



---

# MX960 5G Universal Routing Platform Hardware Guide



Modified: 2019-05-16

Juniper Networks, Inc.  
1133 Innovation Way  
Sunnyvale, California 94089  
USA  
408-745-2000  
www.juniper.net

Juniper Networks, the Juniper Networks logo, Juniper, and Junos are registered trademarks of Juniper Networks, Inc. in the United States and other countries. All other trademarks, service marks, registered marks, or registered service marks are the property of their respective owners.

Juniper Networks assumes no responsibility for any inaccuracies in this document. Juniper Networks reserves the right to change, modify, transfer, or otherwise revise this publication without notice.

*MX960 5G Universal Routing Platform Hardware Guide*  
Copyright © 2019 Juniper Networks, Inc. All rights reserved.

The information in this document is current as of the date on the title page.

#### YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

#### END USER LICENSE AGREEMENT

The Juniper Networks product that is the subject of this technical documentation consists of (or is intended for use with) Juniper Networks software. Use of such software is subject to the terms and conditions of the End User License Agreement ("EULA") posted at <https://support.juniper.net/support/eula/>. By downloading, installing or using such software, you agree to the terms and conditions of that EULA.

# Table of Contents

	About the Documentation . . . . .	xxv
	Documentation and Release Notes . . . . .	xxv
	Using the Examples in This Manual . . . . .	xxv
	Merging a Full Example . . . . .	xxvi
	Merging a Snippet . . . . .	xxvi
	Documentation Conventions . . . . .	xxvii
	Documentation Feedback . . . . .	xxix
	Requesting Technical Support . . . . .	xxix
	Self-Help Online Tools and Resources . . . . .	xxx
	Creating a Service Request with JTAC . . . . .	xxx
<b>Part 1</b>	<b>Overview</b>	
<b>Chapter 1</b>	<b>System Overview . . . . .</b>	<b>3</b>
	MX960 Router Overview . . . . .	3
<b>Chapter 2</b>	<b>Chassis Components and Descriptions . . . . .</b>	<b>7</b>
	MX960 Chassis Description . . . . .	7
	MX960 Component Redundancy . . . . .	10
	MX960 Router Hardware and CLI Terminology Mapping . . . . .	10
	MX960 Midplane Description . . . . .	12
	MX960 Rack-Mounting Hardware . . . . .	13
	MX960 Craft Interface Overview . . . . .	14
	MX960 Alarm Relay Contacts on the Craft Interface . . . . .	14
	MX960 Alarm LEDs and Alarm Cutoff/Lamp Test Button . . . . .	15
	MX960 Component LEDs on the Craft Interface . . . . .	16
	MX960 Host Subsystem LEDs on the Craft Interface . . . . .	16
	MX960 Power Supply LEDs on the Craft Interface . . . . .	16
	MX960 DPC and MPC LEDs on the Craft Interface . . . . .	16
	MX960 FPC LEDs on the Craft Interface . . . . .	17
	MX960 SCB LEDs on the Craft Interface . . . . .	17
	MX960 Fan LEDs on the Craft Interface . . . . .	18
	MX960 Cable Manager Description . . . . .	18
<b>Chapter 3</b>	<b>Cooling System Components and Descriptions . . . . .</b>	<b>21</b>
	MX960 Cooling System Description . . . . .	21
	MX960 Fan LED . . . . .	23

<b>Chapter 4</b>	<b>Host Subsystem Components and Descriptions</b>	<b>25</b>
	MX960 Host Subsystem Description	25
	MX960 Host Subsystem LEDs	26
	MX960 Routing Engine Description	26
	Supported Routing Engines	26
	Routing Engine Function	27
	Routing Engine Slots	27
	Routing Engine Interface Ports	27
	MX Routing Engine LEDs	28
	Routing Engine Specifications	28
<b>Chapter 5</b>	<b>Line Card Components and Descriptions</b>	<b>35</b>
	Interface Modules—DPCs	35
	MX960 Dense Port Concentrator Description	35
	DPC Components	37
	MX960 Dense Port Concentrator LEDs	38
	DPCs Supported on MX240, MX480, and MX960 Routers	38
	MX960 DPC Port and Interface Numbering	40
	Interface Modules—FPCs and PICs	44
	MX960 Flexible PIC Concentrator Description	44
	FPC Components	46
	MX960 Flexible PIC Concentrator (FPC) LEDs	47
	FPCs Supported by MX240, MX480, and MX960 Routers	47
	MX960 PIC Description	48
	MX960 PIC LEDs	48
	MX960 PIC Port and Interface Numbering	48
	PICs Supported by MX240, MX480, and MX960 Routers	50
	Interface Modules—MPCs and MICs	51
	MX960 Application Services Modular Line Card Description	51
	MX960 AS MLC Function	52
	AS MLC Components	53
	MX960 SCB, Power Supply, and Cooling System Requirements for AS MLC	54
	MX960 Application Services Modular Storage Card Description	54
	MX960 Application Services Modular Processing Card Description	55
	MX960 AS MSC LEDs	56
	MX960 AS MXC LEDs	57
	MIC/MPC Compatibility	57
	MX960 Modular Interface Card Description	65
	MX960 Modular Interface Card (MIC) LEDs	65
	MICs Supported by MX Series Routers	65
	MX960 MIC Port and Interface Numbering	73
	MX960 Modular Port Concentrator Description	76
	MPC Components	78
	MX960 Modular Port Concentrator LEDs	79
	MPCs Supported by MX Series Routers	79

<b>Chapter 6</b>	<b>Power System Components and Descriptions</b>	<b>85</b>
	MX960 Power System Overview	85
	MX960 AC Power Supply Description	86
	Normal-Capacity AC Power Supplies	88
	High-Capacity AC Power Supplies	88
	Understanding Input Mode Switch (DIP Switch) Settings	89
	MX960 AC Power Supply LEDs	91
	MX960 DC Power Supply	92
	MX960 DC Power Supply LEDs	93
<b>Chapter 7</b>	<b>Switch Control Board Components and Descriptions</b>	<b>95</b>
	MX-Series Switch Control Board (SCB) Overview	95
	CLI Identification	97
	SCBE3-MX Description	98
	SCBE3-MX Components and Features	99
	SCBE3-MX Fabric Bandwidth Performance and Redundancy	100
	SCBE3-MX Maximum Power Consumption Per Ambient Temperature and CB slot	102
	SCBE3-MX Interoperability with Existing Hardware	102
	SCBE3-MX Unsupported Functions and Capabilities from Legacy SCBs	104
	SCBE2-MX Description	104
	SCBE2-MX Interoperability with Existing Hardware	107
	SCBE2-MX LEDs	108
	SCBE-MX Description	109
	Routing Engines and MPCs for the SCBE-MX	110
	SCBE-MX LEDs	111
	SCB-MX Description	112
	SCB-MX LEDs	114
	SCB-MX Fabric Plane Scale and Redundancy	115
	Supported Routing Engines	115
<b>Part 2</b>	<b>Site Planning, Preparation, and Specifications</b>	
<b>Chapter 8</b>	<b>Preparation Overview</b>	<b>119</b>
	MX960 Router Physical Specifications	119
	MX960 Router Environmental Specifications	122
	MX960 Site Preparation Checklist	122
	MX960 Rack Requirements	123
	Rack Size and Strength	124
	Spacing of Mounting Bracket Holes	125
	Connection to the Building Structure	126
	Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router	126
	MX960 Cabinet Size and Clearance Requirements	128
	MX960 Cabinet Airflow Requirements	128

<b>Chapter 9</b>	<b>Transceiver and Cable Specifications . . . . .</b>	<b>131</b>
	Calculating Power Budget and Power Margin for Fiber-Optic Cables . . . . .	131
	Calculating Power Budget for Fiber-Optic Cable . . . . .	131
	Calculating Power Margin for Fiber-Optic Cable . . . . .	132
	Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion . . . .	133
	Signal Loss in Multimode and Single-Mode Fiber-Optic Cable . . . . .	133
	Attenuation and Dispersion in Fiber-Optic Cable . . . . .	133
	Routing Engine Interface Cable and Wire Specifications for MX Series Routers . . . . .	134
<b>Chapter 10</b>	<b>Pinout Specifications . . . . .</b>	<b>137</b>
	MX960 Router Grounding Specifications . . . . .	137
	MX960 Chassis Grounding Points Specifications . . . . .	137
	MX960 Router Grounding Cable Lug Specifications . . . . .	139
	MX960 Router Grounding Cable Specifications . . . . .	140
	RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port . . .	140
	RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports . . . . .	141
<b>Chapter 11</b>	<b>AC Power Requirements, Specifications, and Guidelines . . . . .</b>	<b>143</b>
	Electrical Specifications for the MX960 AC Power Supply . . . . .	143
	Power Requirements for an MX960 Router . . . . .	144
	Calculating Power Requirements for MX960 Routers . . . . .	152
	AC Power Circuit Breaker Requirements for the MX960 Router . . . . .	156
	AC Power Cord Specifications for the MX960 Router . . . . .	156
<b>Chapter 12</b>	<b>DC Power Requirements, Specifications, and Guidelines . . . . .</b>	<b>159</b>
	Electrical Specifications for the MX960 DC Power Supply . . . . .	159
	Power Requirements for an MX960 Router . . . . .	161
	Calculating Power Requirements for MX960 Routers . . . . .	169
	DC Power Circuit Breaker Requirements for the MX960 Router . . . . .	173
	DC Power Source Cabling for the MX960 Router . . . . .	173
	DC Power Cable Specifications for the MX960 Router . . . . .	175
<b>Part 3</b>	<b>Initial Installation and Configuration</b>	
<b>Chapter 13</b>	<b>Unpacking the MX960 Router . . . . .</b>	<b>179</b>
	Tools and Parts Required to Unpack the MX960 Router . . . . .	179
	Unpacking the MX960 Router . . . . .	179
	Verifying the MX960 Parts Received . . . . .	181
<b>Chapter 14</b>	<b>Installing the Mounting Hardware . . . . .</b>	<b>185</b>
	Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet . . . .	185
	Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack . . . . .	187
	Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack . . . . .	189

<b>Chapter 15</b>	<b>Installing the MX960 Router</b>	<b>193</b>
	Installing an MX960 Router Overview	193
	Removing Components from the MX960 Router Chassis Before Installing It with a Lift	194
	Removing the Power Supplies Before Installing an MX960 Router with a Lift	195
	Removing the Standard Cable Manager Before Installing an MX960 Router with a Lift	196
	Removing the Fan Trays Before Installing an MX960 Router with a Lift	197
	Removing the SCBs Before Installing an MX960 Router with a Lift	199
	Removing the DPCs Before Installing an MX960 Router with a Lift	200
	Removing the FPCs Before Installing the MX960 Router with a Lift	202
	Tools Required to Install the MX960 Router with a Mechanical Lift	203
	Installing the MX960 Router Using a Mechanical Lift	204
	Reinstalling Components in the MX960 Chassis After Installing It with a Lift	206
	Reinstalling the Power Supplies After Installing the MX960 Router with a Lift	206
	Reinstalling the Fan Trays After Installing the MX960 Router with a Lift	207
	Reinstalling the SCBs After Installing the MX960 Router with a Lift	209
	Reinstalling the DPCs After Installing the MX960 Router with a Lift	210
	Reinstalling the FPCs After Installing the MX960 Router with a Lift	212
	Reinstalling the Standard Cable Manager After Installing an MX960 Router with a Lift	213
<b>Chapter 16</b>	<b>Connecting the MX960 Router to Power</b>	<b>215</b>
	Tools and Parts Required for MX960 Router Grounding and Power Connections	215
	Grounding the MX960 Router	216
	Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies	217
	Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies	219
	Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies	222
	Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies	223
	Connecting Power to a DC-Powered MX960 Router with High-Capacity Power Supplies	226
	Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies	230
	Powering Off the MX960 Router	232
	Connecting an MX960 AC Power Supply Cord	233
	Connecting an MX960 DC Power Supply Cable	234

<b>Chapter 17</b>	<b>Connecting the MX960 Router to the Network . . . . .</b>	<b>237</b>
	Tools and Parts Required for MX960 Router Connections . . . . .	237
	Connecting the MX960 Router to Management and Alarm Devices . . . . .	237
	Connecting the MX960 Router to a Network for Out-of-Band Management . . . . .	238
	Connecting the MX960 Router to a Management Console or Auxiliary Device . . . . .	238
	Connecting an MX960 Router to an External Alarm-Reporting Device . . . . .	240
	Connecting the MX960 Router to a Network for Out-of-Band Management . . . . .	241
	Connecting the MX960 Router to a Management Console or Auxiliary Device . . . . .	242
	Connecting an MX960 Router to an External Alarm-Reporting Device . . . . .	243
	Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router . . . . .	244
	Connecting the Alarm Relay Wires to the MX960 Craft Interface . . . . .	245
<b>Chapter 18</b>	<b>Initially Configuring the MX960 Router . . . . .</b>	<b>247</b>
	Initially Configuring the MX960 Router . . . . .	247
<b>Part 4</b>	<b>Installing and Replacing Components</b>	
<b>Chapter 19</b>	<b>Overview of Installing and Replacing Components . . . . .</b>	<b>255</b>
	MX960 Field-Replaceable Units . . . . .	255
	Tools and Parts Required for MX960 Router Connections . . . . .	256
<b>Chapter 20</b>	<b>Installing Components . . . . .</b>	<b>257</b>
	Installing the MX960 Craft Interface . . . . .	257
	Installing the MX960 Air Filter . . . . .	258
	Installing an MX960 Fan Tray . . . . .	259
	Installing an MX960 Routing Engine . . . . .	261
	Installing an MX960 Switch Control Board . . . . .	263
	Installing an MX960 DPC . . . . .	265
	Installing an MX960 FPC . . . . .	269
	Installing an MX960 MIC . . . . .	272
	Installing an MX960 Dual-Wide MIC . . . . .	275
	Installing an MX960 MPC . . . . .	278
	Installing an MX960 PIC . . . . .	280
	Installing a Cable on an MX960 DPC, MPC, MIC, or PIC . . . . .	283
	Installing an MX960 AC Power Supply . . . . .	284
	Installing an MX960 DC Power Supply . . . . .	287
	Installing an MX960 AS MLC . . . . .	291
	Installing an MX960 AS MSC . . . . .	293
	Installing an MX960 AS MXC . . . . .	295
	Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC . . . . .	296
	Replacing a CFP2 Transceiver . . . . .	297
	Removing a CFP2 Transceiver . . . . .	298
	Installing a CFP2 Transceiver . . . . .	299
	Replacing a CFP Transceiver . . . . .	300
	Removing a CFP Transceiver . . . . .	300
	Installing a CFP Transceiver . . . . .	301



<b>Chapter 21</b>	<b>Replacing Chassis Components</b>	<b>303</b>
	Replacing the MX960 Craft Interface	303
	Disconnecting the Alarm Relay Wires from the MX960 Craft Interface	303
	Removing the MX960 Craft Interface	304
	Installing the MX960 Craft Interface	305
	Connecting the Alarm Relay Wires to the MX960 Craft Interface	306
	Replacing the MX960 Cable Manager	307
	Replacing the Console or Auxiliary Cable on an MX960 Router	308
	Replacing the Management Ethernet Cable on an MX Series Router	309
	Replacing an MX960 AS MLC	309
	Removing an MX960 AS MLC	309
	Installing an MX960 AS MLC	312
	Replacing an MX960 AS MSC	314
	Removing an MX960 AS MSC	314
	Installing an MX960 AS MSC	315
	Replacing an MX960 AS MXC	317
	Removing an MX960 AS MXC	317
	Installing an MX960 AS MXC	318
<b>Chapter 22</b>	<b>Replacing Cooling System Component</b>	<b>321</b>
	Replacing the MX960 Air Filter	321
	Removing the Normal-Capacity MX960 Air Filter	321
	Installing the MX960 Air Filter	323
	Replacing an MX960 Fan Tray	323
	Removing an MX960 Fan Tray	324
	Installing an MX960 Fan Tray	326
<b>Chapter 23</b>	<b>Replacing Host Subsystem Components</b>	<b>329</b>
	Replacing an MX960 Routing Engine	329
	Removing an MX960 Routing Engine	329
	Installing an MX960 Routing Engine	331
	Replacing an SSD Drive on an RE-S-1800	334
	Replacing an SSD Drive on an RE-S-X6-64G	335
	Replacing Connections to MX960 Routing Engine Interface Ports	340
	Replacing the Management Ethernet Cable on an MX Series Router	341
	Replacing the Console or Auxiliary Cable on an MX960 Router	341
	Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem	342
	Removing the Routing Engine	343
	Installing the Routing Engine RE-S-X6-64G	345
	Verifying and Configuring the Upgraded Routing Engine as the Master	348
	Verifying and Configuring the Upgraded Routing Engine as the Backup	348
	Upgrading to the RE-S-X6-64G Routing Engine in a Nonredundant Host Subsystem	348
	Removing the Routing Engine	349
	Installing the Routing Engine RE-S-X6-64G	350

<b>Chapter 24</b>	<b>Replacing Line Card Components</b> . . . . .	<b>351</b>
	Replacing an MX960 DPC . . . . .	351
	Removing an MX960 DPC . . . . .	351
	Installing an MX960 DPC . . . . .	354
	Replacing an MX960 FPC . . . . .	358
	Removing an MX960 FPC . . . . .	358
	Installing an MX960 FPC . . . . .	361
	Replacing an MX960 MIC . . . . .	364
	Removing an MX960 MIC . . . . .	364
	Installing an MX960 MIC . . . . .	368
	Installing an MX960 Dual-Wide MIC . . . . .	371
	Replacing an MX960 MPC . . . . .	374
	Removing an MX960 MPC . . . . .	374
	Installing an MX960 MPC . . . . .	377
	Replacing an MX960 PIC . . . . .	380
	Removing an MX960 PIC . . . . .	380
	Installing an MX960 PIC . . . . .	382
	Replacing a Cable on an MX960 DPC, MPC, MIC, or PIC . . . . .	384
	Removing a Cable on an MX960 DPC, MPC, MIC, or PIC . . . . .	384
	Installing a Cable on an MX960 DPC, MPC, MIC, or PIC . . . . .	386
	Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC . . . . .	388
	Removing an SFP or XFP Transceiver from an MX960 DPC, MPC, MIC, or PIC . . . . .	388
	Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC . . . . .	389
	Replacing a CFP2 Transceiver . . . . .	390
	Removing a CFP2 Transceiver . . . . .	391
	Installing a CFP2 Transceiver . . . . .	392
	Replacing a CFP Transceiver . . . . .	393
	Removing a CFP Transceiver . . . . .	393
	Installing a CFP Transceiver . . . . .	394
<b>Chapter 25</b>	<b>Replacing Power System Components</b> . . . . .	<b>397</b>
	Replacing an MX960 AC Power Supply . . . . .	397
	Removing a Normal Capacity MX960 AC Power Supply . . . . .	397
	Installing an MX960 AC Power Supply . . . . .	400
	Replacing an MX960 DC Power Supply . . . . .	402
	Removing an MX960 DC Power Supply . . . . .	402
	Installing an MX960 DC Power Supply . . . . .	405
	Replacing an MX960 AC Power Supply Cord . . . . .	409
	Disconnecting an MX960 AC Power Supply Cord . . . . .	410
	Connecting an MX960 AC Power Supply Cord . . . . .	410
	Replacing an MX960 DC Power Supply Cable . . . . .	411
	Disconnecting an MX960 DC Power Supply Cable . . . . .	411
	Connecting an MX960 DC Power Supply Cable . . . . .	412

<b>Chapter 26</b>	<b>Replacing and Upgrading Switch Control Boards</b> . . . . .	<b>415</b>
	Replacing an MX960 SCB . . . . .	415
	Removing an MX960 SCB . . . . .	416
	Installing an MX960 Switch Control Board . . . . .	417
	Upgrading an MX960 to Use the SCBE-MX . . . . .	419
	Prepare for the Upgrade . . . . .	420
	Upgrade the SCB-MX in the Spare Slot 2 (SCB 2) . . . . .	421
	Upgrade the SCB-MX in the Backup Routing Engine Slot 1 (SCB 1) . . . . .	422
	Upgrade the SCB-MX in the Master Routing Engine Slot 0 (SCB 0) . . . . .	424
	Complete the SCBE-MX Upgrade . . . . .	427
	Upgrading an MX960 to Use the SCBE2-MX . . . . .	430
	Prepare the MX960 Router for SCBE2-MX Upgrade . . . . .	431
	Power Off the MX960 Router . . . . .	431
	Remove the MX960 Routing Engine . . . . .	432
	Install the MX960 Routing Engine into the SCBE2-MX . . . . .	432
	Power On the MX960 Router . . . . .	433
	Complete the SCBE2-MX Upgrade . . . . .	434
	Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX . . . . .	435
	Upgrade the Routing Engine . . . . .	435
	Install the Routing Engine into the SCBE3-MX . . . . .	436
	Install the SCBE3-MX into the Router Chassis . . . . .	436
	Complete the SCBE3-MX Upgrade . . . . .	436
<b>Part 5</b>	<b>Maintaining the Chassis and Components</b>	
<b>Chapter 27</b>	<b>Routine Maintenance Procedures</b> . . . . .	<b>441</b>
	Routine Maintenance Procedures for the MX960 Router . . . . .	441
<b>Chapter 28</b>	<b>Maintaining Components</b> . . . . .	<b>443</b>
	Tools and Parts Required to Maintain the MX960 Router . . . . .	443
	Maintaining the MX960 Air Filter . . . . .	444
	Maintaining the MX960 Fan Trays . . . . .	444
	Maintaining the MX960 Host Subsystem . . . . .	446
	Maintaining MX960 DPCs . . . . .	448
	Holding an MX960 DPC . . . . .	450
	Storing an MX960 DPC . . . . .	452
	Maintaining MX960 FPCs . . . . .	453
	Holding an MX960 FPC . . . . .	455
	Storing an MX960 FPC . . . . .	459
	Maintaining MX960 MICs . . . . .	460
	Maintaining MX960 MPCs . . . . .	461
	Maintaining MX960 PICs . . . . .	464
	Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs . . . . .	465
	Maintaining the MX960 Power Supplies . . . . .	466
	Verifying the Version of the MX960 Cable Manager . . . . .	467
<b>Chapter 29</b>	<b>Converting to a Different Type of Power Supply</b> . . . . .	<b>471</b>
	Converting from AC to DC Power Supplies on an MX960 Router . . . . .	471
	Converting from DC to AC Power Supplies on an MX960 Router . . . . .	476

<b>Part 6</b>	<b>Troubleshooting Hardware</b>	
<b>Chapter 30</b>	<b>Troubleshooting Components</b>	<b>485</b>
	Troubleshooting Resources for MX960 Routers	485
	Command-Line Interface	485
	Chassis and Interface Alarm Messages	486
	Alarm Relay Contacts	486
	Craft Interface LEDs	486
	Component LEDs	487
	Juniper Networks Technical Assistance Center	487
	Troubleshooting the MX960 Cooling System	488
	Troubleshooting the MX960 DPCs	488
	Troubleshooting the MX960 FPCs	490
	Troubleshooting the MX960 PICs	492
	Troubleshooting the MX960 MICs	493
	Troubleshooting the MX960 MPCs	494
	Troubleshooting the MX960 Power System	496
<b>Part 7</b>	<b>Contacting Customer Support and Returning the Chassis or Components</b>	
<b>Chapter 31</b>	<b>Contacting Customer Support</b>	<b>503</b>
	Contacting Customer Support	503
<b>Chapter 32</b>	<b>Locating Component Serial Numbers</b>	<b>505</b>
	Displaying MX960 Router Components and Serial Numbers	505
	MX960 Routing Engine Serial Number Label	507
	MX960 Chassis Serial Number Label	508
	MX960 Craft Interface Serial Number Label	509
	MX960 Fan Tray Serial Number Label	510
	MX960 Power Supply Serial Number Labels	510
	MX960 MIC Serial Number Label	512
	MX960 MPC Serial Number Label	513
	MX960 PIC Serial Number Label	514
	MX960 FPC Serial Number Label	515
	MX960 DPC Serial Number Label	516
	MX960 SCB Serial Number Label	517
	Contacting Customer Support	518
<b>Chapter 33</b>	<b>Packing and Returning Components</b>	<b>521</b>
	Contacting Customer Support to Obtain Return Material Authorization	521
	Guidelines for Packing Hardware Components for Shipment	522
	Packing the MX960 Router for Shipment	522
	Returning a Hardware Component to Juniper Networks, Inc.	523
<b>Chapter 34</b>	<b>Safety and Compliance Information</b>	<b>525</b>
	General Safety Guidelines and Warnings	525
	General Safety Guidelines and Warnings	525
	Definitions of Safety Warning Levels	526
	Qualified Personnel Warning	528

Fire Safety Requirements . . . . .	528
Fire Suppression . . . . .	529
Fire Suppression Equipment . . . . .	529
Warning Statement for Norway and Sweden . . . . .	529
Installation and Maintenance Safety Guidelines and Warnings . . . . .	530
Installation Instructions Warning . . . . .	530
Chassis and Component Lifting Guidelines . . . . .	530
Ramp Warning . . . . .	531
Rack-Mounting and Cabinet-Mounting Warnings . . . . .	531
Grounded Equipment Warning . . . . .	535
Radiation and Laser Warnings . . . . .	535
Laser and LED Safety Guidelines and Warnings . . . . .	536
General Laser Safety Guidelines . . . . .	536
Class 1 Laser Product Warning . . . . .	536
Class 1 LED Product Warning . . . . .	537
Laser Beam Warning . . . . .	537
Radiation from Open Port Apertures Warning . . . . .	538
Maintenance and Operational Safety Guidelines and Warnings . . . . .	539
Maintenance and Operational Safety Guidelines and Warnings . . . . .	539
Battery Handling Warning . . . . .	539
Jewelry Removal Warning . . . . .	540
Lightning Activity Warning . . . . .	541
Operating Temperature Warning . . . . .	542
Product Disposal Warning . . . . .	543
Electrical Safety Guidelines and Warnings . . . . .	544
General Electrical Safety Guidelines and Warnings . . . . .	544
Prevention of Electrostatic Discharge Damage . . . . .	545
AC Power Electrical Safety Guidelines . . . . .	546
AC Power Disconnection Warning . . . . .	547
DC Power Copper Conductors Warning . . . . .	548
DC Power Disconnection Warning . . . . .	548
DC Power Grounding Requirements and Warning . . . . .	550
DC Power Wiring Sequence Warning . . . . .	550
DC Power Wiring Terminations Warning . . . . .	552
Midplane Energy Hazard Warning . . . . .	553
Multiple Power Supplies Disconnection Warning . . . . .	553
Action to Take After an Electrical Accident . . . . .	554
Agency Approvals and Compliance Statements . . . . .	554
Agency Approvals for MX960 Routers . . . . .	554
Compliance Statements for NEBS for the MX960 Router . . . . .	555
Compliance Statements for EMC Requirements for the MX960 Router . . . . .	556
Canada . . . . .	556
European Community . . . . .	556
Israel . . . . .	556
Japan . . . . .	556
United States . . . . .	557
Compliance Statements for Environmental Requirements . . . . .	557
Compliance Statements for Acoustic Noise for the MX960 Router . . . . .	557
Statements of Volatility for Juniper Network Devices . . . . .	557



# List of Figures

<b>Part 1</b>	<b>Overview</b>	
<b>Chapter 2</b>	<b>Chassis Components and Descriptions</b>	<b>7</b>
	Figure 1: Front View of a Fully Configured MX960 Router Chassis	8
	Figure 2: Rear View of a Fully Configured AC-Powered MX960 Router Chassis	9
	Figure 3: Rear View of a Fully Configured DC-Powered MX960 Router Chassis	9
	Figure 4: Midplane	13
	Figure 5: Front Panel of the Craft Interface	14
	Figure 6: Alarm Relay Contacts	15
	Figure 7: Standard Cable Manager	18
	Figure 8: Extended Cable Manager	19
	Figure 9: Extended Cable Manager Cover	19
<b>Chapter 3</b>	<b>Cooling System Components and Descriptions</b>	<b>21</b>
	Figure 10: Airflow Through the Chassis	22
	Figure 11: Normal Fan Tray	22
	Figure 12: Air Filter	22
	Figure 13: Normal Air Filter Tray	22
	Figure 14: High-Capacity Fan Tray	23
	Figure 15: High-Capacity Filter Tray with Air Filter	23
<b>Chapter 5</b>	<b>Line Card Components and Descriptions</b>	<b>35</b>
	Figure 16: Typical DPCs Supported by the Router	36
	Figure 17: DPCs Installed Vertically in the MX960 Router	37
	Figure 18: MX960 DPC Interface Port Mapping	42
	Figure 19: FPC Installed in the MX960 Router Chassis	45
	Figure 20: Typical FPCs Supported on the MX960 Router	46
	Figure 21: MX960 PIC Interface Port Mapping	49
	Figure 22: Application Services Modular Line Card (AS MLC)	52
	Figure 23: AS MLC Installed in the MX960 Router Chassis	53
	Figure 24: Application Services Modular Storage Card	55
	Figure 25: Application Services Modular Processing Card (AS MXC)	56
	Figure 26: Port Mapping for the 20-Port Gigabit Ethernet MIC with SFP Installed in the MX960	75
	Figure 27: Typical MPC Supported on the MX960 Router	77
	Figure 28: MPC Installed Vertically in the MX960 Router	78
<b>Chapter 6</b>	<b>Power System Components and Descriptions</b>	<b>85</b>
	Figure 29: MX960 Normal-Capacity AC Power Supply	87
	Figure 30: MX960 with High-Capacity AC Power Supplies Installed	87

	Figure 31: Setting the Input Mode Switch (DIP Switch) . . . . .	89
	Figure 32: DC Power Supply . . . . .	92
	Figure 33: High-Capacity DC Power Supply . . . . .	93
<b>Chapter 7</b>	<b>Switch Control Board Components and Descriptions . . . . .</b>	<b>95</b>
	Figure 34: SCBE3-MX . . . . .	98
	Figure 35: SCBE2-MX . . . . .	105
	Figure 36: SCBE-MX . . . . .	110
	Figure 37: SCB-MX . . . . .	112
<b>Part 2</b>	<b>Site Planning, Preparation, and Specifications</b>	
<b>Chapter 8</b>	<b>Preparation Overview . . . . .</b>	<b>119</b>
	Figure 38: Typical Open-Frame Rack . . . . .	124
	Figure 39: Chassis Dimensions and Clearance Requirements for the MX960 Router with the Normal-Capacity Power Supplies . . . . .	127
	Figure 40: Chassis Dimensions and Clearance Requirements for the MX960 Router with the Standard Cable Manager and High-Capacity DC Power Supplies . . . . .	127
	Figure 41: Airflow Through the Chassis . . . . .	129
<b>Chapter 10</b>	<b>Pinout Specifications . . . . .</b>	<b>137</b>
	Figure 42: Connecting AC Power to the Router . . . . .	138
	Figure 43: Connecting DC Power to the Router . . . . .	139
	Figure 44: Grounding Cable Lug . . . . .	140
<b>Chapter 11</b>	<b>AC Power Requirements, Specifications, and Guidelines . . . . .</b>	<b>143</b>
	Figure 45: AC Plug Types . . . . .	157
<b>Chapter 12</b>	<b>DC Power Requirements, Specifications, and Guidelines . . . . .</b>	<b>159</b>
	Figure 46: Typical DC Source Cabling to the Router . . . . .	174
	Figure 47: DC Power Cable Lug . . . . .	175
<b>Part 3</b>	<b>Initial Installation and Configuration</b>	
<b>Chapter 13</b>	<b>Unpacking the MX960 Router . . . . .</b>	<b>179</b>
	Figure 48: Contents of the Shipping Crate . . . . .	180
<b>Chapter 14</b>	<b>Installing the Mounting Hardware . . . . .</b>	<b>185</b>
	Figure 49: Installing the Mounting Hardware for a Four-Post Rack or Cabinet . . . . .	187
	Figure 50: Installing the Mounting Hardware for Front-Mounting in an Open-Frame Rack . . . . .	189
	Figure 51: Installing the Mounting Hardware for Center-Mounting in an Open-Frame Rack . . . . .	191
<b>Chapter 15</b>	<b>Installing the MX960 Router . . . . .</b>	<b>193</b>
	Figure 52: Removing a Power Supply Before Installing the MX960 Router . . . . .	196
	Figure 53: Removing the Standard Cable Manager . . . . .	197
	Figure 54: Removing an Upper Fan Tray . . . . .	198
	Figure 55: Removing a Lower Fan Tray . . . . .	199
	Figure 56: Removing an SCB . . . . .	200
	Figure 57: Removing a DPC . . . . .	201



	Figure 58: Removing an FPC . . . . .	203
	Figure 59: Installing the MX960 Router in the Rack . . . . .	205
	Figure 60: Reinstalling a Power Supply . . . . .	207
	Figure 61: Installing an Upper Fan Tray . . . . .	208
	Figure 62: Installing a Lower Rear Fan Tray . . . . .	209
	Figure 63: Reinstalling an SCB . . . . .	210
	Figure 64: Installing a DPC . . . . .	211
	Figure 65: Reinstalling an FPC . . . . .	213
	Figure 66: Reinstalling the Cable Manager . . . . .	214
<b>Chapter 16</b>	<b>Connecting the MX960 Router to Power . . . . .</b>	<b>215</b>
	Figure 67: Connecting AC Power to the MX960 Router . . . . .	218
	Figure 68: MX960 with High-Capacity AC Power Supplies Installed . . . . .	219
	Figure 69: MX960 AC Power Input Mode Switch . . . . .	220
	Figure 70: Connecting DC Power to the MX960 Router . . . . .	226
	Figure 71: MX960 with High-Capacity DC Power Supplies Installed . . . . .	227
	Figure 72: MX960 DC High-Capacity Power Supply Front View . . . . .	230
	Figure 73: Connecting Power Cables to the DC Power Supply . . . . .	235
<b>Chapter 17</b>	<b>Connecting the MX960 Router to the Network . . . . .</b>	<b>237</b>
	Figure 74: Ethernet Port . . . . .	238
	Figure 75: Routing Engine Ethernet Cable Connector . . . . .	238
	Figure 76: Auxiliary and Console Ports . . . . .	239
	Figure 77: Routing Engine Console and Auxiliary Cable Connector . . . . .	239
	Figure 78: Alarm Relay Contacts . . . . .	240
	Figure 79: Ethernet Port . . . . .	241
	Figure 80: Routing Engine Ethernet Cable Connector . . . . .	241
	Figure 81: Auxiliary and Console Ports . . . . .	242
	Figure 82: Routing Engine Console and Auxiliary Cable Connector . . . . .	242
	Figure 83: Alarm Relay Contacts . . . . .	243
	Figure 84: Attaching a Cable to a DPC . . . . .	245
	Figure 85: Attaching a Cable to a MIC . . . . .	245
	Figure 86: Alarm Relay Contacts . . . . .	246
<b>Part 4</b>	<b>Installing and Replacing Components</b>	
<b>Chapter 20</b>	<b>Installing Components . . . . .</b>	<b>257</b>
	Figure 87: Installing the Craft Interface . . . . .	258
	Figure 88: Installing the Air Filter . . . . .	259
	Figure 89: Installing an Upper Fan Tray . . . . .	260
	Figure 90: Installing a Lower Fan Tray . . . . .	261
	Figure 91: Installing a MX960 Routing Engine . . . . .	263
	Figure 92: Installing a Switch Control Board in the MX480 . . . . .	264
	Figure 93: Installing a DPC . . . . .	267
	Figure 94: Attaching a Cable to a DPC . . . . .	268
	Figure 95: Installing an FPC . . . . .	271
	Figure 96: Installing the Septum . . . . .	272
	Figure 97: Installing a MIC . . . . .	274
	Figure 98: Removing the Septum . . . . .	275
	Figure 99: Installing a Dual-Wide MIC . . . . .	277

	Figure 100: Installing an MPC . . . . .	280
	Figure 101: Installing a PIC . . . . .	282
	Figure 102: Installing an AC Power Supply . . . . .	286
	Figure 103: Installing a DC Power Supply . . . . .	290
	Figure 104: Connecting DC Power to the MX960 Router . . . . .	291
	Figure 105: Installing an AS MLC . . . . .	293
	Figure 106: Installing an AS MSC . . . . .	294
	Figure 107: Installing an AS MXC . . . . .	296
	Figure 108: Form-Factor Pluggable (CFP2) . . . . .	298
<b>Chapter 21</b>	<b>Replacing Chassis Components . . . . .</b>	<b>303</b>
	Figure 109: Alarm Relay Contacts . . . . .	304
	Figure 110: Removing the Craft Interface . . . . .	304
	Figure 111: Installing the Craft Interface . . . . .	305
	Figure 112: Alarm Relay Contacts . . . . .	306
	Figure 113: Removing the Standard Cable Manager . . . . .	307
	Figure 114: Auxiliary and Console Ports . . . . .	308
	Figure 115: Cable Connector . . . . .	309
	Figure 116: Ethernet Port . . . . .	309
	Figure 117: Removing an AS MLC . . . . .	311
	Figure 118: Installing an AS MLC . . . . .	313
	Figure 119: Removing an AS MSC . . . . .	315
	Figure 120: Installing an AS MSC . . . . .	316
	Figure 121: Removing an AS MXC . . . . .	318
	Figure 122: Installing an AS MXC . . . . .	319
<b>Chapter 22</b>	<b>Replacing Cooling System Component . . . . .</b>	<b>321</b>
	Figure 123: Removing the Normal-Capacity Air Filter Tray from the Chassis . . . . .	322
	Figure 124: Installing the Air Filter . . . . .	323
	Figure 125: Removing an Upper Fan Tray . . . . .	325
	Figure 126: Removing a Lower Fan Tray . . . . .	326
	Figure 127: Installing an Upper Fan Tray . . . . .	327
	Figure 128: Installing a Lower Fan Tray . . . . .	328
<b>Chapter 23</b>	<b>Replacing Host Subsystem Components . . . . .</b>	<b>329</b>
	Figure 129: Removing a Routing Engine . . . . .	331
	Figure 130: Installing a MX960 Routing Engine . . . . .	333
	Figure 131: RE-S-1800 Storage Drive Slots . . . . .	334
	Figure 132: RE-S-X6-64G Storage Drive Slots . . . . .	336
	Figure 133: Removing an SSD in the Routing Engine RE-S-X6-64G . . . . .	337
	Figure 134: Installing an SSD in the Routing Engine RE-S-X6-64G . . . . .	339
	Figure 135: Cable Connector . . . . .	341
	Figure 136: Ethernet Port . . . . .	341
	Figure 137: Auxiliary and Console Ports . . . . .	342
	Figure 138: Removing a Routing Engine from an MX240 Router . . . . .	344
	Figure 139: Removing a Routing Engine from an MX480 Router . . . . .	344
	Figure 140: Removing a Routing Engine from an MX960 Router . . . . .	345
	Figure 141: Installing a Routing Engine in an MX240 Router . . . . .	346
	Figure 142: Installing a Routing Engine in an MX480 Router . . . . .	347
	Figure 143: Installing a Routing Engine in an MX960 Router . . . . .	347

<b>Chapter 24</b>	<b>Replacing Line Card Components</b> . . . . .	<b>351</b>
	Figure 144: Removing a DPC . . . . .	353
	Figure 145: Installing a DPC . . . . .	356
	Figure 146: Attaching a Cable to a DPC . . . . .	357
	Figure 147: Removing an FPC . . . . .	360
	Figure 148: Installing an FPC . . . . .	363
	Figure 149: Removing a MIC . . . . .	366
	Figure 150: Removing a Dual-Wide MIC . . . . .	367
	Figure 151: Installing the Septum . . . . .	368
	Figure 152: Installing a MIC . . . . .	370
	Figure 153: Removing the Septum . . . . .	371
	Figure 154: Installing a Dual-Wide MIC . . . . .	373
	Figure 155: Removing an MPC . . . . .	376
	Figure 156: Installing an MPC . . . . .	379
	Figure 157: Removing a PIC . . . . .	381
	Figure 158: Installing a PIC . . . . .	383
	Figure 159: Removing SFPs or XFPs . . . . .	389
	Figure 160: Form-Factor Pluggable (CFP2) . . . . .	391
<b>Chapter 25</b>	<b>Replacing Power System Components</b> . . . . .	<b>397</b>
	Figure 161: Removing an AC Power Supply . . . . .	399
	Figure 162: Top of the Power Supply Showing Midplane Connector . . . . .	399
	Figure 163: Installing an AC Power Supply . . . . .	401
	Figure 164: Removing a DC Power Supply from the MX960 Router . . . . .	404
	Figure 165: Top of the Power Supply Showing Midplane Connector . . . . .	404
	Figure 166: Installing a DC Power Supply . . . . .	408
	Figure 167: Connecting DC Power to the MX960 Router . . . . .	409
	Figure 168: Connecting Power Cables to the DC Power Supply . . . . .	413
<b>Chapter 26</b>	<b>Replacing and Upgrading Switch Control Boards</b> . . . . .	<b>415</b>
	Figure 169: Removing a MX960 SCB . . . . .	417
	Figure 170: Installing a Switch Control Board in the MX480 . . . . .	418
<b>Part 5</b>	<b>Maintaining the Chassis and Components</b>	
<b>Chapter 28</b>	<b>Maintaining Components</b> . . . . .	<b>443</b>
	Figure 171: Do Not Grasp the Connector Edge . . . . .	451
	Figure 172: Do Not Rest the DPC on an Edge . . . . .	452
	Figure 173: Do Not Grasp the Connector Edge . . . . .	456
	Figure 174: Do Not Carry an FPC with Only One Hand . . . . .	457
	Figure 175: Do Not Rest the FPC on an Edge . . . . .	458
	Figure 176: Holding an FPC Vertically . . . . .	459
	Figure 177: Do Not Stack FPCs . . . . .	460
	Figure 178: Standard Cable Manager . . . . .	465
	Figure 179: Extended Cable Manager . . . . .	465
<b>Chapter 29</b>	<b>Converting to a Different Type of Power Supply</b> . . . . .	<b>471</b>
	Figure 180: Removing an MX960 AC Power Supply . . . . .	472
	Figure 181: MX960 with High-Capacity DC Power Supplies Installed . . . . .	473
	Figure 182: MX960 DC High-Capacity Power Supply Front View . . . . .	476

	Figure 183: Removing a DC Power Supply from the MX960 Router . . . . .	478
	Figure 184: MX960 with High-Capacity AC Power Supplies Installed . . . . .	479
	Figure 185: MX960 AC Power Input Mode Switch . . . . .	480
<b>Part 6</b>	<b>Troubleshooting Hardware</b>	
<b>Chapter 30</b>	<b>Troubleshooting Components . . . . .</b>	<b>485</b>
	Figure 186: MX960 AC Power Input Mode Switch . . . . .	499
<b>Part 7</b>	<b>Contacting Customer Support and Returning the Chassis or Components</b>	
<b>Chapter 32</b>	<b>Locating Component Serial Numbers . . . . .</b>	<b>505</b>
	Figure 187: Serial Number ID Label . . . . .	507
	Figure 188: Routing Engine Serial Number Label . . . . .	507
	Figure 189: RE-S-X6-64G Routing Engine Serial Number Label . . . . .	508
	Figure 190: MX960 Chassis Serial Number Label . . . . .	509
	Figure 191: Craft Interface Serial Number Label . . . . .	510
	Figure 192: MX960 Fan Tray Serial Number Label . . . . .	510
	Figure 193: AC Power Supply Serial Number Label . . . . .	511
	Figure 194: DC Power Supply Serial Number Label . . . . .	511
	Figure 195: 2-Port MIC Serial Number Label . . . . .	512
	Figure 196: 4-Port MIC Serial Number Label . . . . .	512
	Figure 197: 20-Port MIC Serial Number Label . . . . .	513
	Figure 198: 40-Port MIC Serial Number Label . . . . .	513
	Figure 199: MPC Serial Number Label . . . . .	514
	Figure 200: PIC Serial Number Label . . . . .	515
	Figure 201: FPC Serial Number Label . . . . .	516
	Figure 202: DPC Serial Number Label . . . . .	517
	Figure 203: SCB Serial Number Label . . . . .	518
<b>Chapter 34</b>	<b>Safety and Compliance Information . . . . .</b>	<b>525</b>
	Figure 204: Placing a Component into an Antistatic Bag . . . . .	546

# List of Tables

	<b>About the Documentation</b> . . . . .	<b>xxv</b>
	Table 1: Notice Icons . . . . .	xxvii
	Table 2: Text and Syntax Conventions . . . . .	xxviii
<b>Part 1</b>	<b>Overview</b>	
<b>Chapter 1</b>	<b>System Overview</b> . . . . .	<b>3</b>
	Table 3: MX960 Router Capacity . . . . .	3
	Table 4: Switch Control Board Capacities for MX Series 5G Universal Routing Platforms (Full-Duplex) . . . . .	4
<b>Chapter 2</b>	<b>Chassis Components and Descriptions</b> . . . . .	<b>7</b>
	Table 5: MX960 Router Hardware Components and CLI Terminology . . . . .	10
	Table 6: Alarm LEDs and Alarm Cutoff/Lamp Test Button . . . . .	15
	Table 7: Host Subsystem LEDs on the Craft Interface . . . . .	16
	Table 8: Power Supply LEDs on the Craft Interface . . . . .	16
	Table 9: DPC and MPC LEDs on the Craft Interface . . . . .	17
	Table 10: FPC LEDs on the Craft Interface . . . . .	17
	Table 11: SCB LEDs on the Craft Interface . . . . .	17
	Table 12: Fan LEDs on the Craft Interface . . . . .	18
<b>Chapter 4</b>	<b>Host Subsystem Components and Descriptions</b> . . . . .	<b>25</b>
	Table 13: Routing Engine LEDs . . . . .	28
	Table 14: Routing Engine Specifications . . . . .	28
	Table 15: Hardware Specifications of the RE-MX-X6, RE-MX-X8, RE-PTX-X8, RCBPTX, RE-QFX10002-60C, and RE-PTX10002-60C Routing Engines . . . . .	32
	Table 16: End-of-Life Routing Engine Specifications . . . . .	33
<b>Chapter 5</b>	<b>Line Card Components and Descriptions</b> . . . . .	<b>35</b>
	Table 17: DPCs Supported in MX240, MX480, and MX960 Routers . . . . .	38
	Table 18: FPCs Supported by MX Series Routers . . . . .	47
	Table 19: PICs Supported by MX240, MX480, and MX960 Routers . . . . .	50
	Table 20: AS MSC LEDs . . . . .	56
	Table 21: AS MXC LEDs . . . . .	57
	Table 22: MIC/MPC1 Compatibility . . . . .	57
	Table 23: MIC/MPC2 Compatibility . . . . .	59
	Table 24: MIC/MPC3 Compatibility . . . . .	61
	Table 25: MIC/MPC6 Compatibility . . . . .	63
	Table 26: MIC/MPC8 Compatibility . . . . .	64
	Table 27: MIC/MPC9 Compatibility . . . . .	64
	Table 28: MIC/MPC10003 Compatibility . . . . .	64
	Table 29: MICs Supported by MX240, MX480, MX960 and MX2008 Routers . . . . .	66

	Table 30: MICs Supported by MX2010 and MX2020 Routers . . . . .	68
	Table 31: MICs Supported by MX5, MX10, and MX40 Routers . . . . .	70
	Table 32: MICs Supported by MX80 and MX104 Routers . . . . .	71
	Table 33: MICs Supported by MX10003 Router . . . . .	73
	Table 34: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers . . . . .	80
<b>Chapter 6</b>	<b>Power System Components and Descriptions . . . . .</b>	<b>85</b>
	Table 35: Minimum Number of Power Supplies Required for the MX960 . . . . .	87
	Table 36: Zoning for High-Capacity Power Supplies in an MX960 . . . . .	89
	Table 37: AC Power Supply LEDs . . . . .	91
	Table 38: Minimum Required Number of DC Power Supplies . . . . .	92
	Table 39: DC Power Supply LEDs . . . . .	94
<b>Chapter 7</b>	<b>Switch Control Board Components and Descriptions . . . . .</b>	<b>95</b>
	Table 40: Switch Control Board Capacities for MX Series 5G Universal Routing Platforms (Full-Duplex) . . . . .	96
	Table 41: Supported Routing Engines for MX Series 5G Universal Routing Platforms Switch Control Boards . . . . .	96
	Table 42: SCBE3 Interoperability with MPCs and Routing Engines . . . . .	102
	Table 43: SCBE2-MX LEDs . . . . .	108
	Table 44: SCBE-MX Specifications . . . . .	110
	Table 45: Supported Routing Engines and MPCs for the SCBE-MX . . . . .	111
	Table 46: SCBE-MX LEDs . . . . .	111
	Table 47: SCB-MX LED Descriptions . . . . .	114
	Table 48: SCB-MX Fabric Plane Scale and Redundancy Assuming Four PFEs per FPC . . . . .	115
<b>Part 2</b>	<b>Site Planning, Preparation, and Specifications</b>	
<b>Chapter 8</b>	<b>Preparation Overview . . . . .</b>	<b>119</b>
	Table 49: Physical Specifications . . . . .	119
	Table 50: Router Environmental Specifications . . . . .	122
	Table 51: MX960 Site Preparation Checklist . . . . .	122
	Table 52: Clearance Requirements for High-Capacity Power Supplies . . . . .	126
<b>Chapter 9</b>	<b>Transceiver and Cable Specifications . . . . .</b>	<b>131</b>
	Table 53: Estimated Values for Factors Causing Link Loss . . . . .	132
	Table 54: Cable and Wire Specifications for Routing Engine and RCB Management and Alarm Interfaces . . . . .	134
<b>Chapter 10</b>	<b>Pinout Specifications . . . . .</b>	<b>137</b>
	Table 55: RJ-45 Connector Pinout for the Routing Engine ETHERNET Port . . . . .	140
	Table 56: RJ-45 Connector Pinout for the AUX and CONSOLE Ports . . . . .	141
<b>Chapter 11</b>	<b>AC Power Requirements, Specifications, and Guidelines . . . . .</b>	<b>143</b>
	Table 57: AC Power Supply Electrical Specifications . . . . .	143
	Table 58: AC Power System Specifications . . . . .	144
	Table 59: MX960 Common Component Power Requirements . . . . .	145
	Table 60: FRU Power Requirements . . . . .	145
	Table 61: MX960 Zoning . . . . .	153

	Table 62: Sample Power Requirements for an MX960 Router . . . . .	154
	Table 63: Calculating Power Budget . . . . .	154
	Table 64: Calculating Input Power . . . . .	155
	Table 65: Calculating Thermal Output . . . . .	156
	Table 66: AC Power Cord Specifications . . . . .	157
<b>Chapter 12</b>	<b>DC Power Requirements, Specifications, and Guidelines . . . . .</b>	<b>159</b>
	Table 67: Power Supply Electrical Specifications . . . . .	159
	Table 68: Power System Electrical Specifications . . . . .	160
	Table 69: MX960 Common Component Power Requirements . . . . .	161
	Table 70: FRU Power Requirements . . . . .	161
	Table 71: MX960 Zoning . . . . .	170
	Table 72: Sample Power Requirements for an MX960 Router . . . . .	171
	Table 73: Calculating Power Budget . . . . .	171
	Table 74: Calculating Input Power . . . . .	172
	Table 75: Calculating Thermal Output . . . . .	173
	Table 76: DC Power Cable Specifications . . . . .	175
<b>Part 3</b>	<b>Initial Installation and Configuration</b>	
<b>Chapter 13</b>	<b>Unpacking the MX960 Router . . . . .</b>	<b>179</b>
	Table 77: Parts List for a Fully Configured MX960 Router . . . . .	181
	Table 78: Accessory Box Parts List . . . . .	182
<b>Chapter 14</b>	<b>Installing the Mounting Hardware . . . . .</b>	<b>185</b>
	Table 79: Four-Post Rack or Cabinet Mounting Hole Locations . . . . .	185
	Table 80: Mounting Hardware Hole Locations for Front-Mounting in an Open-Frame Rack . . . . .	188
	Table 81: Mounting Hardware Hole Locations for Center-Mounting in an Open-Frame Rack . . . . .	190
<b>Chapter 16</b>	<b>Connecting the MX960 Router to Power . . . . .</b>	<b>215</b>
	Table 82: MX960 High-Capacity AC Power Supply LEDs . . . . .	221
	Table 83: MX960 High-Capacity DC Power Supply LEDs . . . . .	229
<b>Part 4</b>	<b>Installing and Replacing Components</b>	
<b>Chapter 19</b>	<b>Overview of Installing and Replacing Components . . . . .</b>	<b>255</b>
	Table 84: Field-Replaceable Units . . . . .	256
<b>Part 5</b>	<b>Maintaining the Chassis and Components</b>	
<b>Chapter 29</b>	<b>Converting to a Different Type of Power Supply . . . . .</b>	<b>471</b>
	Table 85: MX960 High-Capacity DC Power Supply LEDs . . . . .	475
	Table 86: MX960 High-Capacity AC Power Supply LEDs . . . . .	481





# About the Documentation

- [Documentation and Release Notes on page xxv](#)
- [Using the Examples in This Manual on page xxv](#)
- [Documentation Conventions on page xxvii](#)
- [Documentation Feedback on page xxix](#)
- [Requesting Technical Support on page xxix](#)

## Documentation and Release Notes

---

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at <https://www.juniper.net/documentation/>.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at <https://www.juniper.net/books>.

## Using the Examples in This Manual

---

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

## Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

```
system {
  scripts {
    commit {
      file ex-script.xsl;
    }
  }
}
interfaces {
  fxp0 {
    disable;
    unit 0 {
      family inet {
        address 10.0.0.1/24;
      }
    }
  }
}
```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

```
[edit]
user@host# load merge /var/tmp/ex-script.conf
load complete
```

## Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

```
commit {
  file ex-script-snippet.xsl; }
```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

```
[edit system scripts]
user@host# load merge relative /var/tmp/ex-script-snippet.conf
load complete
```

For more information about the **load** command, see [CLI Explorer](#).

## Documentation Conventions

Table 1 on page xxvii defines notice icons used in this guide.

Table 1: Notice Icons







Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xxviii defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
<b>Bold text like this</b>	Represents text that you type.	To enter configuration mode, type the <b>configure</b> command:  user@host> <b>configure</b>
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> <b>show chassis alarms</b>  No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> <li>Introduces or emphasizes important new terms.</li> <li>Identifies guide names.</li> <li>Identifies RFC and Internet draft titles.</li> </ul>	<ul style="list-style-type: none"> <li>A policy <i>term</i> is a named structure that defines match conditions and actions.</li> <li><i>Junos OS CLI User Guide</i></li> <li>RFC 1997, <i>BGP Communities Attribute</i></li> </ul>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name:  [edit] root@# <b>set system domain-name</b> <i>domain-name</i>
<b>Text like this</b>	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> <li>To configure a stub area, include the <b>stub</b> statement at the [edit protocols ospf area area-id] hierarchy level.</li> <li>The console port is labeled <b>CONSOLE</b>.</li> </ul>
< > (angle brackets)	Encloses optional keywords or variables.	<b>stub &lt;default-metric metric&gt;;</b>
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	<b>broadcast   multicast</b>  <i>(string1   string2   string3)</i>
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	<b>rsvp { # Required for dynamic MPLS only</b>
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	<b>community name members [ community-ids ]</b>
Indentation and braces ( { } )	Identifies a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	}

---

## GUI Conventions

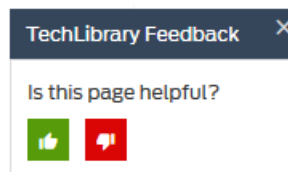
Table 2: Text and Syntax Conventions (continued)

Convention	Description	Examples
<b>Bold text like this</b>	Represents graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> <li>In the Logical Interfaces box, select <b>All Interfaces</b>.</li> <li>To cancel the configuration, click <b>Cancel</b>.</li> </ul>
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select <b>Protocols&gt;Ospf</b> .

## Documentation Feedback

We encourage you to provide feedback so that we can improve our documentation. You can use either of the following methods:

- Online feedback system—Click TechLibrary Feedback, on the lower right of any page on the [Juniper Networks TechLibrary](#) site, and do one of the following:



- Click the thumbs-up icon if the information on the page was helpful to you.
- Click the thumbs-down icon if the information on the page was not helpful to you or if you have suggestions for improvement, and use the pop-up form to provide feedback.
- E-mail—Send your comments to [techpubs-comments@juniper.net](mailto:techpubs-comments@juniper.net). Include the document or topic name, URL or page number, and software version (if applicable).

## Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active Juniper Care or Partner Support Services support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at <https://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.
- Product warranties—For product warranty information, visit <https://www.juniper.net/support/warranty/>.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

## Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: <https://www.juniper.net/customers/support/>
- Search for known bugs: <https://prsearch.juniper.net/>
- Find product documentation: <https://www.juniper.net/documentation/>
- Find solutions and answer questions using our Knowledge Base: <https://kb.juniper.net/>
- Download the latest versions of software and review release notes: <https://www.juniper.net/customers/csc/software/>
- Search technical bulletins for relevant hardware and software notifications: <https://kb.juniper.net/InfoCenter/>
- Join and participate in the Juniper Networks Community Forum: <https://www.juniper.net/company/communities/>
- Create a service request online: <https://myjuniper.juniper.net>

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: <https://entitlementsearch.juniper.net/entitlementsearch/>

## Creating a Service Request with JTAC

You can create a service request with JTAC on the Web or by telephone.

- Visit <https://myjuniper.juniper.net>.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see <https://support.juniper.net/support/requesting-support/>.

## PART 1

# Overview

- [System Overview on page 3](#)
- [Chassis Components and Descriptions on page 7](#)
- [Cooling System Components and Descriptions on page 21](#)
- [Host Subsystem Components and Descriptions on page 25](#)
- [Line Card Components and Descriptions on page 35](#)
- [Power System Components and Descriptions on page 85](#)
- [Switch Control Board Components and Descriptions on page 95](#)





## CHAPTER 1

# System Overview

- [MX960 Router Overview on page 3](#)

## MX960 Router Overview

---

The MX960 5G Universal Routing Platform is an Ethernet-optimized edge router that provides both switching and carrier-class Ethernet routing. The MX960 router enables a wide range of business and residential applications and services, including high-speed transport and VPN services, next-generation broadband multiplay services, high-speed Internet and data center internetworking.

The MX960 chassis provides redundancy and resiliency. The hardware system is fully redundant, including power supplies, fan trays, Routing Engines, and Switch Control Boards.

The MX960 router is 16 rack units (U) tall. Three routers can be stacked in a single floor-to-ceiling rack, for increased port density per unit of floor space. The router provides 14 slots that can be populated with 11 or 12 Dense Port Concentrators (DPCs) or Modular Port Concentrators (MPCs), six Flexible PIC Concentrators (FPCs), and two Switch Control Boards (SCBs) in nonredundant fabric configurations.

Fully populated, the MX960 router provides an aggregate switch fabric capacity of up to 10.56 Tbps, with line-rate throughput on 264 10-Gigabit Ethernet ports, 22 100-Gigabit Ethernet and 44 10-Gigabit Ethernet ports and 66 40-Gigabit Ethernet ports.

[Table 3 on page 3](#) lists the MX960 router capacity.

**Table 3: MX960 Router Capacity**

Description	Capacity
System capacity	10.56 Tbps half duplex
Switch fabric capacity per slot	480 Gbps
MPCs and DPCs per chassis	11 or 12 (depending on protection scheme)
Chassis per rack	3

Several types of DPCs are available. Each DPC includes either two or four Packet Forwarding Engines (PFE). Each PFE enables a throughput of 10 Gbps.

Up to two PICs can be installed in each FPC. Fully populated, the MX960 supports up to 12 PICs.

Up to two Modular Interface Cards (MICs) can be installed in each MPC. Fully populated, the MX960 supports up to 24 MICs.

MPCs support fixed interfaces or up to two Modular Interface Cards (MICs) that can be installed in each MPC. Fully populated, the MX960 supports up to 22 MICs.

For a list of the supported DPCs, FPCs, MPCs, MICs, PICs, and SCBs, see the [MX Series Interface Module Reference](#).

Table 4 on page 4 compares the switch fabric bandwidth capacities.

**Table 4: Switch Control Board Capacities for MX Series 5G Universal Routing Platforms (Full-Duplex)**

Description	Fabric Bandwidth Per Slot	MX240 Fabric Bandwidth	MX480 Fabric Bandwidth	MX960 Fabric Bandwidth
Enhanced MX Switch Control Board (model SCBE3-MX)	Up to 1.5 Tbps (non-redundant fabric configuration with MPC10E line cards); 1 Tbps (redundant fabric configuration with MPC10E line cards)	Up to 6 Tbps	Up to 18 Tbps	Up to 33 Tbps
Enhanced MX Switch Control Board (SCBE2-MX)	Up to 480 Gbps (non-redundant fabric configuration); 340 Gbps (redundant fabric configuration)	Up to 1.92 Tbps	Up to 5.76 Tbps	Up to 10.56 Tbps
Enhanced MX Switch Control Board (SCBE-MX)	Up to 240 Gbps (non-redundant fabric configuration); 160 Gbps (redundant fabric configuration)	Up to 930 Gbps	Up to 2.79 Tbps	Up to 5.25 Tbps
Switch Control Board (SCB-MX)	Up to 240 Gbps (non-redundant fabric configuration); 120 Gbps (redundant fabric configuration)	Up to 465 Gbps	Up to 1.39 Tbps	Up to 2.6 Tbps

The connections between interface cards and SCBs are organized in three groups:

- Switch fabric—Connects the interface cards and provides for packet transport between DPCs, FPCs, and MPCs. Two SCBs provide one non-redundant fabric. Three SCBs are required for a redundant fabric configuration.
- Control Plane—Gigabit Ethernet links between the combined SCBs/Routing Engines and each DPC, FPC, or MPC. All board-to-board information is passed over Ethernet except for low-level status and commands.
- Management signals—Provide low-level status diagnostic support.

**Related Documentation**

- [MX960 Component Redundancy on page 10](#)

- [MX960 Router Physical Specifications on page 119](#)
- [MX960 Chassis Description on page 7](#)
- [MX960 Host Subsystem Description on page 25](#)
- [MX960 Craft Interface Overview on page 14](#)
- [MX960 Power System Overview on page 85](#)
- [MX960 Cooling System Description on page 21](#)



## CHAPTER 2

# Chassis Components and Descriptions

- [MX960 Chassis Description on page 7](#)
- [MX960 Component Redundancy on page 10](#)
- [MX960 Router Hardware and CLI Terminology Mapping on page 10](#)
- [MX960 Midplane Description on page 12](#)
- [MX960 Rack-Mounting Hardware on page 13](#)
- [MX960 Craft Interface Overview on page 14](#)
- [MX960 Alarm Relay Contacts on the Craft Interface on page 14](#)
- [MX960 Alarm LEDs and Alarm Cutoff/Lamp Test Button on page 15](#)
- [MX960 Component LEDs on the Craft Interface on page 16](#)
- [MX960 Cable Manager Description on page 18](#)

## MX960 Chassis Description

---

The router chassis is a rigid sheet metal structure that houses all the other router components (see [Figure 1 on page 8](#), [Figure 2 on page 9](#), and [Figure 3 on page 9](#)). The chassis installs in many types of racks, including 800-mm deep (or larger) enclosed cabinets, standard 19-in. equipment racks, or telco open-frame racks. Two types of chassis are available for the MX960 router:

- The standard chassis measures 27.75 in. (70.49 cm) high, 17.37 in. (44.11 cm) wide (excluding the mounting flanges and brackets), and 23.0 in. (58.42 cm) deep (from the front-mounting flanges to the rear of the chassis). The standard cable manager extends the depth to 28.0 in. (71.1 cm). Up to three routers can be installed in a 48-U rack if the rack can handle their combined weight, which can be greater than 1,050 lb (476.3 kg).



**NOTE:** The chassis depth with the high-capacity AC power supply is 30.6" and the depth with high-capacity DC power supply is 32.8".

- The chassis with the extended cable manager installed measures 36.5 in. (92.7 cm) high, 17.37 in. (44.11 cm) wide, and approximately 29.00 in. (73.7 cm) deep (from the front-mounting flanges to the rear of the extended cable manager). Up to two routers

with the extended cable manager can be installed in a 48-U rack if the rack can handle their combined weight, which can be greater than 748 lb (339.28 kg).

Mounting hardware includes front-mounting flanges on the front of the chassis, and two center-mounting brackets attached to the center of the chassis.

**Figure 1: Front View of a Fully Configured MX960 Router Chassis**

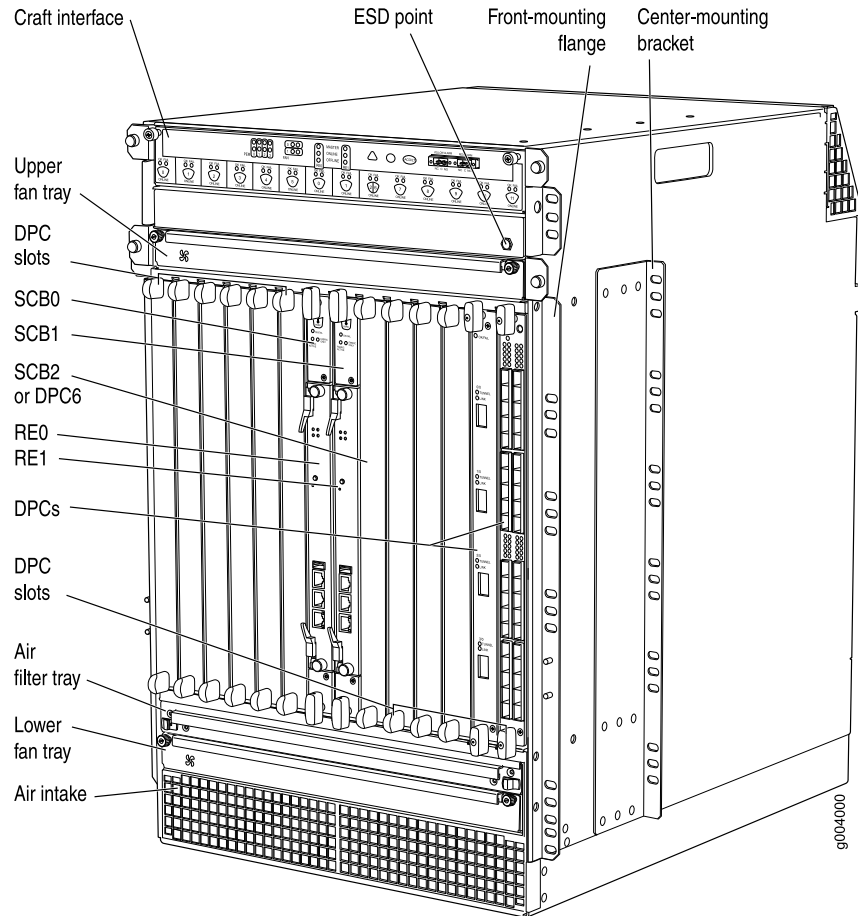


Figure 2: Rear View of a Fully Configured AC-Powered MX960 Router Chassis

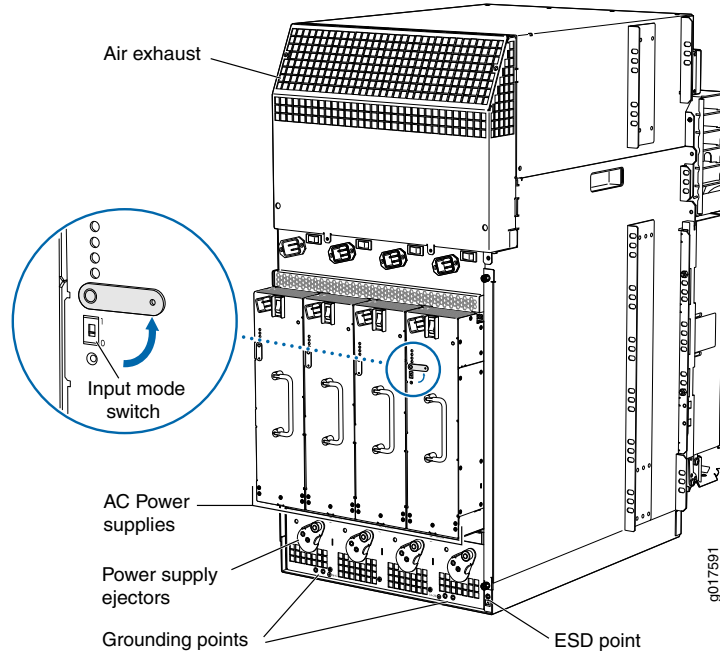
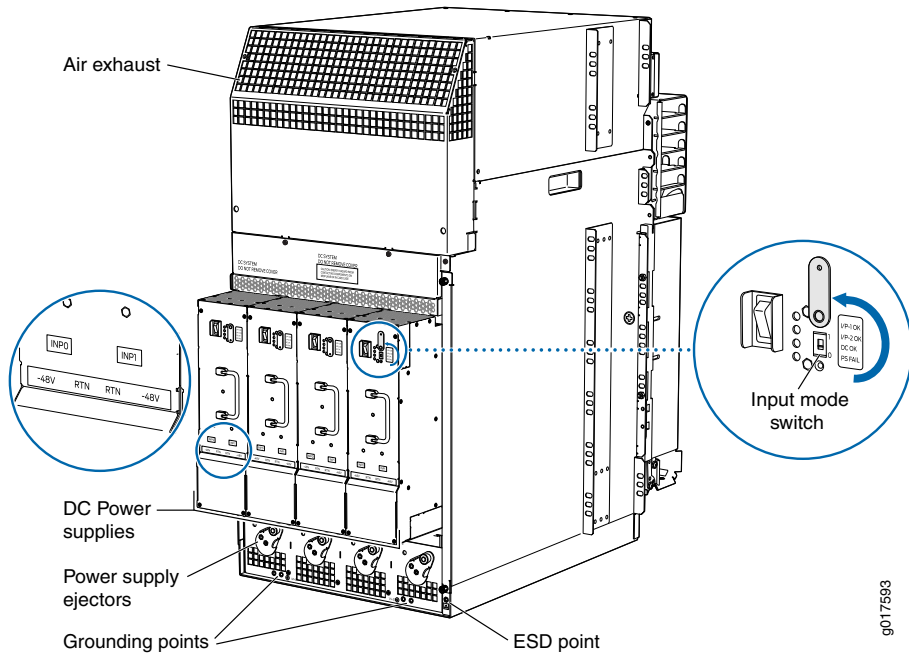


Figure 3: Rear View of a Fully Configured DC-Powered MX960 Router Chassis



**Related Documentation**

- [MX960 Router Physical Specifications on page 119](#)
- [Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet on page 185](#)
- [MX960 Router Grounding Specifications on page 137](#)

## MX960 Component Redundancy

A fully configured router is designed so that no single point of failure can cause the entire system to fail. Only a fully configured router provides complete redundancy. All other configurations provide partial redundancy. The following major hardware components are redundant:

- **Host subsystem**—The host subsystem consists of a Routing Engine and an SCB. The router can have one or two host subsystems. If two host subsystems are installed, one functions as the master and the other functions as the backup. If the master host subsystem (or either of its components) fails, the backup can take over as the master. To operate, each host subsystem requires a Routing Engine installed directly into in an SCB.
- **Power supplies**—In the AC configuration with normal capacity AC power supplies, a minimum of three power supplies is required to supply power to a fully configured router. All AC power supplies share the load evenly. The addition of a fourth power supply provides full power redundancy. If one power supply fails in a redundant configuration, the three remaining power supplies provide full power. In the DC configuration and the AC configuration with high capacity power supplies, two power supplies are required to supply power to a fully configured router. One power supply supports approximately half of the components in the router, and the other power supply supports the remaining components. The addition of two power supplies provides full power redundancy. If one or two power supplies fail, the remaining power supplies can provide full power to the router.
- **Cooling system**—The cooling system has redundant components, which are controlled by the host subsystem. If one of the fans fails, the host subsystem increases the speed of the remaining fans to provide sufficient cooling for the router indefinitely.

### Related Documentation

- [MX960 Router Overview on page 3](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)

## MX960 Router Hardware and CLI Terminology Mapping

The MX960 router supports the components in [Table 5 on page 10](#).

*Table 5: MX960 Router Hardware Components and CLI Terminology*

Component	Hardware Model Number	CLI Name	Description
Chassis	MX960BASE-AC	<b>MX960</b>	"MX960 Router Physical Specifications" on page 119
	MX960BASE-DC		"MX960 Chassis Description" on page 7



Table 5: MX960 Router Hardware Components and CLI Terminology (continued)

Component	Hardware Model Number	CLI Name	Description
Craft Interface Panel	CRAFT-MX960-S	Front Panel Display	"MX960 Craft Interface Overview" on page 14
<b>Cooling System</b>			
Fan tray	FFANTRAY-MX960	Fan Tray	"MX960 Cooling System Description" on page 21
Filter tray	FFILTER-MX960	N/A	
	FFILTER-MX960-HC	N/A	
Filter kit	FLTR-KIT-MX960	N/A	
<b>Host Subsystem</b>			"MX960 Host Subsystem Description" on page 25
Routing Engine	See <i>Supported Routing Engines by Router</i> .		"MX960 Routing Engine Description" on page 26
SCB	MX960-SCB-S	MX SCB	"SCB-MX Description" on page 112
<b>Interface Modules</b>			
DPC	See "DPCs Supported on MX240, MX480, and MX960 Routers" on page 38 in the <i>MX Series Interface Module Reference</i> .		"MX960 Dense Port Concentrator Description" on page 35
DPC or SCB blank panel	DPC-SCB-BLANK	N/A	
FPC	MX-FPC2	MX FPC Type 2	"MX960 Flexible PIC Concentrator Description" on page 44
	MX-FPC3	MX FPC Type 3	
MIC	See "MICs Supported by MX Series Routers" on page 65 in the <i>MX Series Interface Module Reference</i> .		"MX960 Modular Interface Card Description" on page 65
MIC blank panel	MIC-BLANK	N/A	
MPC	See "MPCs Supported by MX Series Routers" on page 79 in the <i>MX Series Interface Module Reference</i> .		"MX960 Modular Port Concentrator Description" on page 76
PIC	See "PICs Supported by MX240, MX480, and MX960 Routers" on page 50 in the <i>MX Series Interface Module Reference</i> .		"MX960 PIC Description" on page 48
	SCBE-MX960-S	Enhanced MX SCB	
Transceiver	See <i>MX Series Interface Module Reference</i> .	Xcvr	"Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC" on page 296

Table 5: MX960 Router Hardware Components and CLI Terminology (continued)

Component	Hardware Model Number	CLI Name	Description
Power System			"MX960 Power System Overview" on page 85
Power distribution module (PDM)	Power Distribution Module	<b>Power Distribution Module</b>	"MX960 Power System Overview" on page 85
AC power supply	PWR-MX960-AC	<b>AC Power Entry Module</b>	"MX960 AC Power Supply Description" on page 86
	PWR-MX960-4100-AC	<b>AC 4.1kW Power Entry Module</b>	
DC power supply	PWR-MX960-DC	<b>DC Power Entry Module</b>	"MX960 DC Power Supply" on page 92
	PWR-MX960-4100-DC	<b>DC 4.1kW Power Entry Module</b>	
Power supply blank panel	PWR-BLANK-MX960	N/A	"MX960 Power System Overview" on page 85

**Related Documentation**

- [MX960 Router Overview on page 3](#)
- [MX960 DPC Port and Interface Numbering on page 40](#)
- [MX960 MIC Port and Interface Numbering on page 73](#)
- [MX960 PIC Port and Interface Numbering on page 48](#)
- [MX Series Router Interface Names](#)

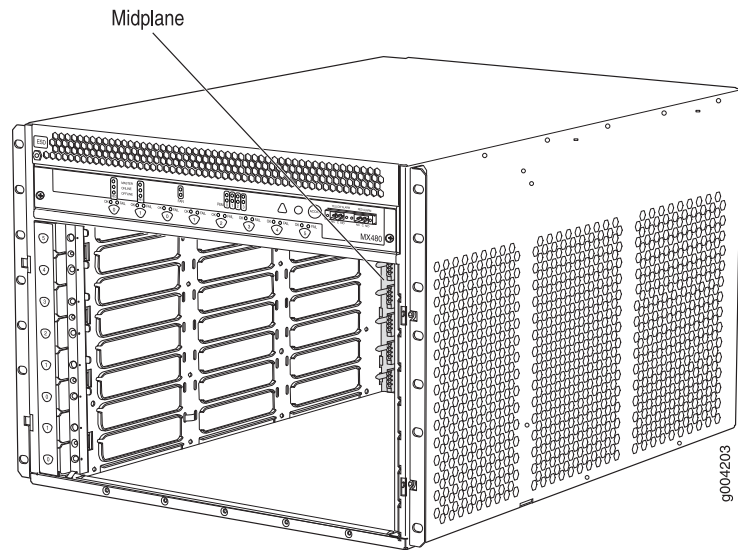
## MX960 Midplane Description

The midplane is located toward the rear of the chassis and forms the rear of the card cage (see [Figure 4 on page 13](#)). The line cards and SCBs install into the midplane from the front of the chassis, and the power supplies install into the midplane from the rear of the chassis. The cooling system components also connect to the midplane.

The midplane performs the following major functions:

- **Data path**—Data packets are transferred across the midplane between the line cards through the fabric ASICs on the SCBs.
- **Power distribution**—The router power supplies connect to the midplane, which distributes power to all the router components.
- **Signal path**—The midplane provides the signal path to the line cards, SCBs, Routing Engines, and other system components for monitoring and control of the system.

Figure 4: Midplane



**Related  
Documentation**

- [MX960 Router Overview on page 3](#)
- [MX960 Chassis Description on page 7](#)
- [MX960 Dense Port Concentrator Description on page 35](#)
- [MX960 Modular Port Concentrator Description on page 76](#)
- [SCB-MX Description on page 112](#)
- [MX960 Routing Engine Description on page 26](#)
- [MX960 Flexible PIC Concentrator Description on page 44](#)
- [MX960 Power System Overview on page 85](#)

## MX960 Rack-Mounting Hardware

The rack-mounting hardware for the MX960 router includes:

- The large mounting shelf for mounting in four-post racks, cabinets, and open-frame racks
- The small mounting shelf for front-mounting in a four-post rack or cabinet
- Front-mounting flanges on the front of the chassis for front-mounting in a four-post rack or cabinet
- Two center-mounting brackets attached to the center of the chassis for center-mounting in an open-frame rack. For an open-frame rack, center-mounting is preferable because of the more even distribution of weight.

**Related  
Documentation**

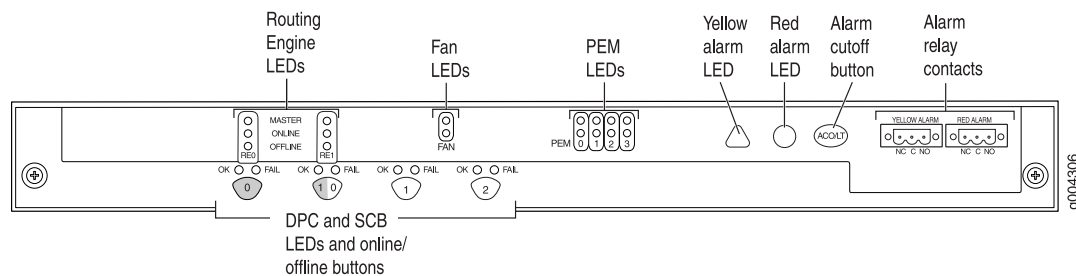
- [MX960 Chassis Description on page 7](#)

- [MX960 Midplane Description on page 12](#)
- [Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack on page 189](#)
- [Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack on page 187](#)
- [Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet on page 185](#)

## MX960 Craft Interface Overview

The craft interface allows you to view status and troubleshooting information at a glance and to perform many system control functions. It is hot-insertable and hot-removable. The craft interface is located on the front of the router above the card cage and contains LEDs for the router components, the alarm relay contacts, and alarm cutoff button. See [Figure 5 on page 14](#).

**Figure 5: Front Panel of the Craft Interface**



**NOTE:** At least one SCB must be installed in the router for the craft interface to obtain power.

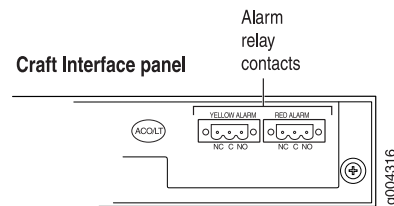
### Related Documentation

- [Replacing the MX960 Craft Interface on page 303](#)
- [MX960 Craft Interface Serial Number Label on page 509](#)

## MX960 Alarm Relay Contacts on the Craft Interface

The craft interface has two alarm relay contacts for connecting the router to external alarm devices (see [Figure 6 on page 15](#)). Whenever a system condition triggers either the red or yellow alarm on the craft interface, the alarm relay contacts are also activated. The alarm relay contacts are located on the upper right of the craft interface.

Figure 6: Alarm Relay Contacts



- Related Documentation**
- [Disconnecting the Alarm Relay Wires from the MX960 Craft Interface on page 303](#)
  - [Connecting the Alarm Relay Wires to the MX960 Craft Interface on page 245](#)

## MX960 Alarm LEDs and Alarm Cutoff/Lamp Test Button




Two large alarm LEDs are located at the upper right of the craft interface. The circular red LED lights to indicate a critical condition that can result in a system shutdown. The triangular yellow LED lights to indicate a less severe condition that requires monitoring or maintenance. Both LEDs can be lit simultaneously.

A condition that causes an LED to light also activates the corresponding alarm relay contact on the craft interface.

To deactivate red and yellow alarms, press the button labeled **ACO/LT** (for “alarm cutoff/lamp test”), which is located to the right of the alarm LEDs. Deactivating an alarm turns off both LEDs and deactivates the device attached to the corresponding alarm relay contact on the craft interface.

[Table 6 on page 15](#) describes the alarm LEDs and alarm cutoff button in more detail.

**Table 6: Alarm LEDs and Alarm Cutoff/Lamp Test Button**

Shape	Color	State	Description
	Red	On steadily	Critical alarm LED—Indicates a critical condition that can cause the router to stop functioning. Possible causes include component removal, failure, or overheating.
	Yellow	On steadily	Warning alarm LED—Indicates a serious but nonfatal error condition, such as a maintenance alert or a significant increase in component temperature.
	—	—	Alarm cutoff/lamp test button—Deactivates red and yellow alarms. Causes all LEDs on the craft interface to light (for testing) when pressed and held.

- Related Documentation**
- [MX960 Craft Interface Overview on page 14](#)
  - [MX960 Alarm Relay Contacts on the Craft Interface on page 14](#)
  - [MX960 Router Overview on page 3](#)

## MX960 Component LEDs on the Craft Interface

- [MX960 Host Subsystem LEDs on the Craft Interface on page 16](#)
- [MX960 Power Supply LEDs on the Craft Interface on page 16](#)
- [MX960 DPC and MPC LEDs on the Craft Interface on page 16](#)
- [MX960 FPC LEDs on the Craft Interface on page 17](#)
- [MX960 SCB LEDs on the Craft Interface on page 17](#)
- [MX960 Fan LEDs on the Craft Interface on page 18](#)

### MX960 Host Subsystem LEDs on the Craft Interface

Each host subsystem has three LEDs, located in the middle of the craft interface, that indicate its status. The LEDs labeled **RE0** show the status of the Routing Engine in slot **0** and the SCB in slot **0**. The LEDs labeled **RE1** show the status of the Routing Engine and SCB in slot **1**. [Table 7 on page 16](#) describes the functions of the host subsystem LEDs.

*Table 7: Host Subsystem LEDs on the Craft Interface*

Label	Color	State	Description
<b>MASTER</b>	Green	On steadily	Host is functioning as the master.
<b>ONLINE</b>	Green	On steadily	Host is online and is functioning normally.
<b>OFFLINE</b>	Red	On steadily	Host is installed but the Routing Engine is offline.
	–	Off	Host is not installed.

### MX960 Power Supply LEDs on the Craft Interface

Each power supply has two LEDs on the craft interface that indicate its status. The LEDs, labeled **0** through **3**, are located on the upper left of the craft interface next to the **PEM** label. [Table 8 on page 16](#) describes the functions of the power supply LEDs on the craft interface.

*Table 8: Power Supply LEDs on the Craft Interface*

Label	Color	State	Description
<b>PEM</b>	Green	On steadily	Power supply is functioning normally.
	Red	On steadily	Power supply has failed or power input has failed.

### MX960 DPC and MPC LEDs on the Craft Interface

Each DPC or MPC has LEDs on the craft interface that indicate its status. The LEDs, labeled **0** through **5**, **2/6**, and **7** through **11**, are located along the bottom of the craft

interface. Slot 2/6 is for an additional DPC, FPC, MPC, or SCB. [Table 9 on page 17](#) describes the functions of the LEDs.

*Table 9: DPC and MPC LEDs on the Craft Interface*

Label	Color	State	Description
OK	Green	On steadily	Card is functioning normally.
		Blinking	Card is transitioning online or offline.
		–	The slot is not online.
FAIL	Red	On steadily	Card has failed.

### MX960 FPC LEDs on the Craft Interface

An FPC takes up two DPC slots when installed in an MX Series router. The LEDs, labeled 0 through 5, 2/6, and 7 through 11, are located along the bottom of the craft interface. Slot 2/6 is for an additional DPC, FPC, MPC, or SCB. The LED corresponds to the lowest DPC slot number in which the FPC is installed. [Table 10 on page 17](#) describes the functions of the FPC LEDs.

*Table 10: FPC LEDs on the Craft Interface*

Label	Color	State	Description
OK	Green	On steadily	FPC is functioning normally.
		Blinking	FPC is transitioning online or offline.
		–	The slot is not online.
FAIL	Red	On steadily	FPC has failed.

### MX960 SCB LEDs on the Craft Interface

Each SCB has two LEDs on the craft interface that indicates its status. The SCB LEDs, labeled 0, 1, and 2/6, are located along the bottom of the craft interface.

[Table 11 on page 17](#) describes the functions of the SCB LEDs.

*Table 11: SCB LEDs on the Craft Interface*

Label	Color	State	Description
OK	Green	On steadily	SCB: Fabric and control board functioning normally.
		Blinking	SCB is transitioning online or offline.
		–	The slot is not online.
FAIL	Red	On steadily	SCB has failed.

## MX960 Fan LEDs on the Craft Interface

The fan LEDs are located on the top left of the craft interface. [Table 12 on page 18](#) describes the functions of the fan LEDs.

*Table 12: Fan LEDs on the Craft Interface*

Label	Color	State	Description
FAN	Green	On steadily	Fan is functioning normally.
	Red	On steadily	Fan has failed.

### Related Documentation

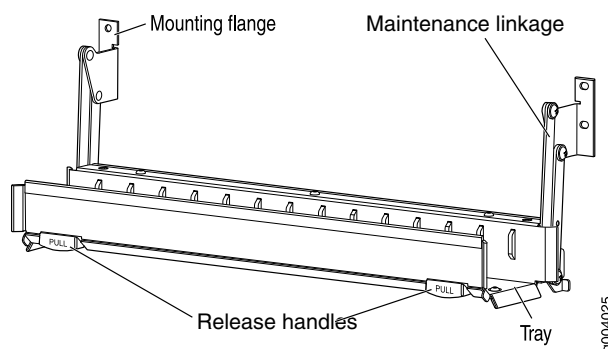
- [MX960 Craft Interface Overview on page 14](#)
- [MX960 Alarm Relay Contacts on the Craft Interface on page 14](#)

## MX960 Cable Manager Description

The standard cable manager (see [Figure 7 on page 18](#)) is a tray located below the line-card cage, which has a row of fourteen dividers for securing the cables for each Dense Port Concentrator (DPC), Modular Port Concentrator (MPC), Modular Interface Card (MIC), or PIC.

You can use cable strips or other ties to gently secure the cables in the standard cable manager. To secure the cables in place, loop the tie through the cable anchor and secure the tie. You can pull the standard cable manager up and outward to lock it into the maintenance position. This allows you to access the lower fan tray and the air filter.

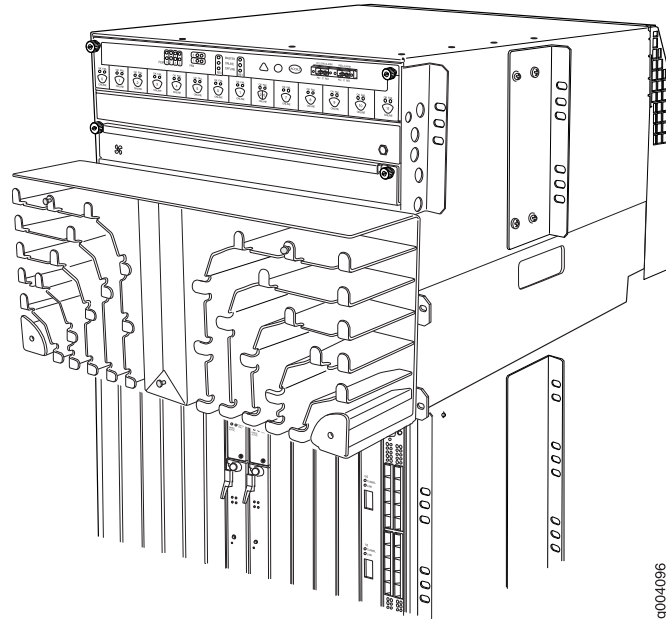
*Figure 7: Standard Cable Manager*



The extended cable manager allows you to route cables away from the front of the DPCs, MPCs, MICs, and PICs, and provides additional access (see [Figure 9 on page 19](#) and [Figure 8 on page 19](#)).

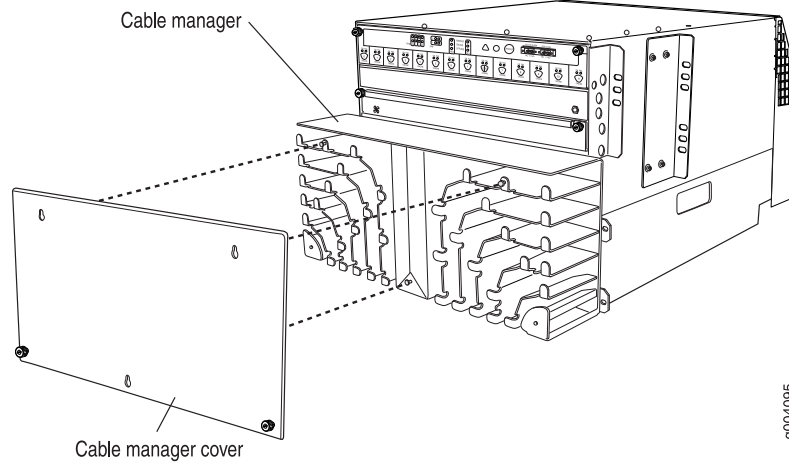


Figure 8: Extended Cable Manager



9004096

Figure 9: Extended Cable Manager Cover



9004095

**Related Documentation**

- [Replacing the MX960 Cable Manager on page 307](#)
- [Verifying the Version of the MX960 Cable Manager on page 467](#)



## CHAPTER 3

# Cooling System Components and Descriptions

- [MX960 Cooling System Description on page 21](#)
- [MX960 Fan LED on page 23](#)

### MX960 Cooling System Description

---

The cooling system consists of the following components:

- Upper front fan tray
- Lower front fan tray
- Front air filter

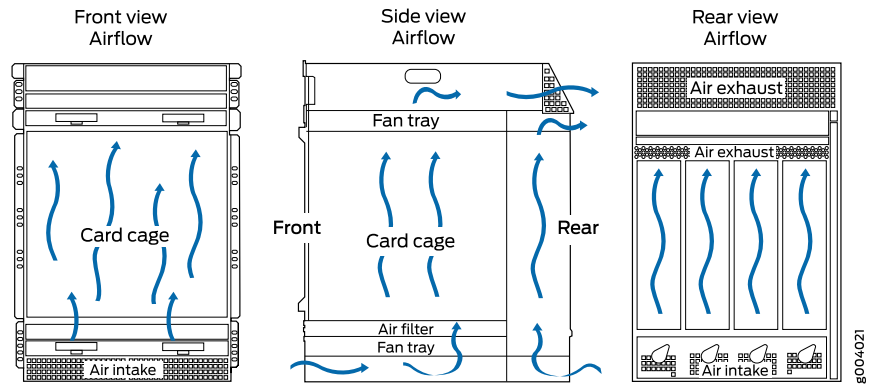
The cooling system components work together to keep all router components within the acceptable temperature range (see [Figure 10 on page 22](#), [Figure 11 on page 22](#), [Figure 12 on page 22](#), and [Figure 13 on page 22](#)). The router has two fan trays located in the front of the router that install horizontally above and below the card cage. Each normal-capacity fan tray contains six fans. High-capacity fan trays that contain twelve fans can be installed in the upper and lower fan tray slots. The fan trays are hot-insertable and hot-removable.

The MX960 requires high-capacity fan trays to satisfy cooling requirements for high-density DPCs and MPCs. When replacing normal-capacity fan trays with high-capacity fan trays, you must replace them in both the upper and lower fan trays. Additionally, you must replace the front normal air filter tray with a high capacity filter tray and air filter.

There is a single air intake in the front of the router. Air is pushed up through the card cage and through the upper fan tray where it is exhausted out the upper rear of the system through the larger air exhaust shown in [Figure 10 on page 22](#).

At the bottom rear of the chassis, there is an air intake for power supply cooling. Air flows over the power supplies and is exhausted out the rear of the chassis through the smaller air exhaust below the main exhaust.

Figure 10: Airflow Through the Chassis



The host subsystem monitors the temperature of the router components. When the router is operating normally, the fans function at lower than full speed. If a fan fails or the ambient temperature rises above a threshold, the speed of the remaining fans is automatically adjusted to keep the temperature within the acceptable range. If the ambient maximum temperature specification is exceeded and the system cannot be adequately cooled, the Routing Engine shuts down the system by disabling output power from each PEM.

Figure 11: Normal Fan Tray

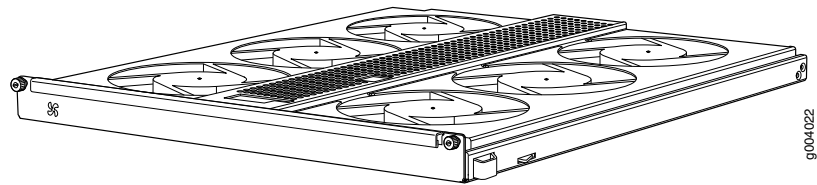


Figure 12: Air Filter

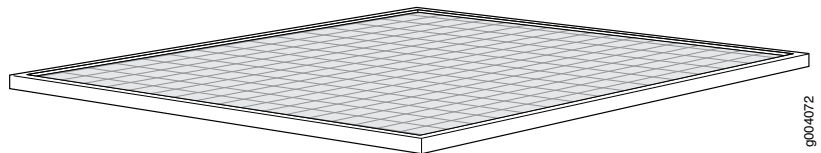


Figure 13: Normal Air Filter Tray

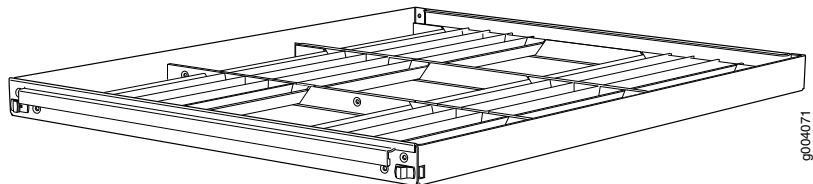


Figure 14: High-Capacity Fan Tray

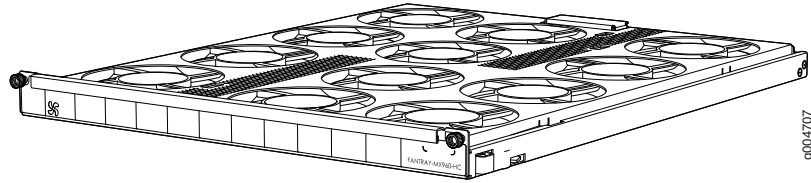
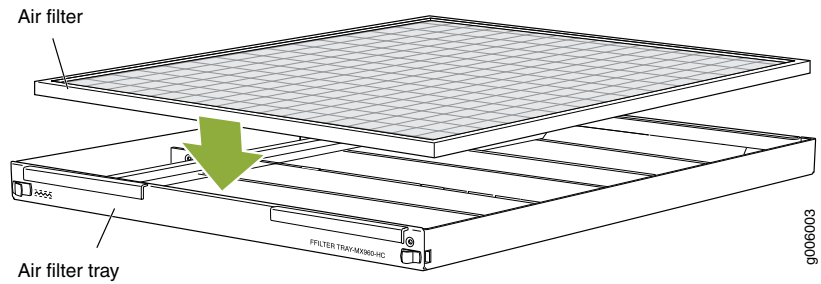


Figure 15: High-Capacity Filter Tray with Air Filter



**Related Documentation**

- [Troubleshooting the MX960 Cooling System on page 488](#)
- [Maintaining the MX960 Air Filter on page 444](#)
- [Maintaining the MX960 Fan Trays on page 444](#)

## MX960 Fan LED

Each fan has an LED that displays its status. The fan LEDs are located on the top left of the craft interface. For more information, see “[MX960 Fan LEDs on the Craft Interface](#)” on page 18.

**Related Documentation**

- [MX960 Cooling System Description on page 21](#)
- [Maintaining the MX960 Fan Trays on page 444](#)
- [Troubleshooting the MX960 Cooling System on page 488](#)



# Host Subsystem Components and Descriptions

- [MX960 Host Subsystem Description on page 25](#)
- [MX960 Host Subsystem LEDs on page 26](#)
- [MX960 Routing Engine Description on page 26](#)
- [MX Routing Engine LEDs on page 28](#)
- [Routing Engine Specifications on page 28](#)

## MX960 Host Subsystem Description

---

The host subsystem provides the routing and system management functions of the router. You can install one or two host subsystems on the router. Each host subsystem functions as a unit; the Routing Engine must be installed directly into the Switch Control Board.



**NOTE:** We recommend that you install two host subsystems for redundant protection. If you install only one host subsystem, we recommend that you install it in slot 0.

Each host subsystem has three LEDs that display its status. The host subsystem LEDs are located in the middle of the craft interface.

### Related Documentation

- [MX960 Host Subsystem LEDs on page 26](#)
- [Maintaining the MX960 Host Subsystem on page 446](#)
- [Taking an MX960 Host Subsystem Offline](#)
- [Effect of Taking the MX960 Host Subsystem Offline](#)
- [Replacing an MX960 Routing Engine on page 329](#)
- [Replacing an MX960 SCB on page 415](#)

## MX960 Host Subsystem LEDs

---

Each host subsystem has three LEDs that display its status. The host subsystem LEDs are located in the middle of the craft interface. For more information, see “MX960 Host Subsystem LEDs on the Craft Interface” on page 16.

- Related Documentation**
- [MX960 Host Subsystem Description on page 25](#)
  - [Maintaining the MX960 Host Subsystem on page 446](#)
  - [Taking an MX960 Host Subsystem Offline](#)

## MX960 Routing Engine Description

---

If the host system is redundant, the backup Routing Engine is hot-removable and hot-insertable, but the master Routing Engine is hot-pluggable. A Routing Engine that is not redundant is hot-pluggable.

- [Supported Routing Engines on page 26](#)
- [Routing Engine Function on page 27](#)
- [Routing Engine Slots on page 27](#)
- [Routing Engine Interface Ports on page 27](#)

## Supported Routing Engines

The MX960 router supports the following Routing Engines:

- RE-S-1300-2048 supported for Junos OS Release 8.2 and later.
- RE-S-2000-4096 supported for Junos OS Release 8.2 and later.
- RE-S-1800x2 supported for Junos OS Release 10.4 and later.
- RE-S-1800x4 supported for Junos OS Release 10.4 and later.
- RE-S-X6-64G supported for Junos OS Release 15.1F4, 16.1 and later.
- RE-S-X6-64G-LT supported for Junos OS Release 17.2R1 and later.



**NOTE:** The Routing Engine is equipped with limited encryption support only.

---



**NOTE:** If two Routing Engines are installed, they must both be the same hardware model.

---



## Routing Engine Function

The Routing Engine runs the Junos OS. Software processes that run on the Routing Engine maintain the routing tables, manage the routing protocols used on the router, control the router interfaces, control some chassis components, and provide the interface for system management and user access to the router.

## Routing Engine Slots

You can install one or two Routing Engines in the router. Each Routing Engine must be installed directly into an SCB. A USB port on the Routing Engine accepts a USB memory device that allows you to load Junos OS. The Routing Engines install into the front of the chassis in vertical slots directly into the SCBs labeled **0** and **1**. If two Routing Engines are installed, one functions as the master and the other acts as the backup. If the master Routing Engine fails or is removed and the backup is configured appropriately, the backup takes over as the master.

On the MX960 router, a Routing Engine installed in SCB slot **2/6** receives no power and supplies no additional routing functions. If no SCB is installed in slot **2/6**, install a blank panel in the slot.

## Routing Engine Interface Ports

Three ports, located on the right side of the routing engine, connect the Routing Engine to one or more external devices on which system administrators can issue Junos OS command-line interface (CLI) commands to manage the router.

The ports with the indicated labels function as follows:

- **AUX**—Connects the Routing Engine to a laptop, modem, or other auxiliary device through a serial cable with an RJ-45 connector.
- **CONSOLE**—Connects the Routing Engine to a system console through a serial cable with an RJ-45 connector.
- **ETHERNET or MGMT**—Connects the Routing Engine through an Ethernet connection to a management LAN (or any other device that plugs into an Ethernet connection) for out-of-band management. The port uses an autosensing RJ-45 connector to support 10-Mbps or 100-Mbps connections. Two small LEDs on the right of the port indicate the connection in use: the LED flashes yellow or green for a 10-Mbps or 100-Mbps connection, and the LED is light green when traffic is passing through the port.

### Related Documentation

- [RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports on page 141](#)
- [RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port on page 140](#)
- [Replacing an MX960 Routing Engine on page 329](#)

## MX Routing Engine LEDs

Each Routing Engine has four LEDs that indicate its status. The LEDs, labeled **MASTER**, **HDD**, **ONLINE**, and **FAIL**, are located directly on the faceplate of the Routing Engine. [Table 13 on page 28](#) describes the functions of the Routing Engine LEDs.

*Table 13: Routing Engine LEDs*

Label	Color	State	Description
<b>MASTER</b>	Blue	On steadily	Routing Engine is the Master.
<b>HDD</b>	Green	Blinking	Indicates activity on the hard disk drive.
<b>ONLINE</b>	Green	Blinking	Routing Engine is transitioning online.
		On steadily	Routing Engine is functioning normally.
<b>FAIL</b>	Red	On steadily	Routing Engine has failed.

### Related Documentation

- [MX960 Routing Engine Description on page 26](#)
- [Replacing an MX960 Routing Engine on page 329](#)

## Routing Engine Specifications

[Table 14 on page 28](#) lists the current specifications for Routing Engines supported on M Series, MX Series, and T Series routers. [Table 15 on page 32](#) lists the hardware specifications of the Routing Engines with VMHost support. [Table 16 on page 33](#) lists the specifications for end-of-life Routing Engines.



**NOTE:** For a list of the routing engines that are supported on the M Series, MX Series, T Series, and PTX routers, see *Supported Routing Engines by Router*.



**NOTE:** For information about PTX Series Routing Engine specifications, see *Routing Engines Supported on PTX Series Routers*.

*Table 14: Routing Engine Specifications*

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-400-768	400-MHz Celeron	768 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	9.0	–

Table 14: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-A-1000-2048	1.0-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1	–
RE-A-2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.1	–
RE-S-1300-2048	1.3-GHz Pentium	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2	SCB, SCBE
RE-S-2000-4096	2.0-GHz Pentium	4096 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	8.2	SCB, SCBE

Table 14: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-C1800	1.8-GHz	8 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	T1600 router in a routing matrix: 9.6R2  Standalone T640 or T1600 router:11.2	CB-T for a standalone router.  CB-LCC for a router in a routing matrix.
	1.8 Ghz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	32-bit Junos OS on a standalone T1600 router: 11.4R2 32-bit Junos OS on a T1600 router in a routing matrix: 11.4R2  64-bit Junos OS on a standalone T1600 router: 11.4R2 64-bit Junos OS on a T1600 router in a routing matrix: 11.4R2	CB-T for a standalone router.  CB-LCC for a router in a routing matrix.
RE-C2600	2.6-GHz	16 GB	Gigabit Ethernet	SSD	4 GB CompactFlash card	TX Matrix Plus router: 9.6R2	–
RE-A-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	–
RE-S-1800x2	1800-MHz	8 GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE, SCBE2, SCBE3

Table 14: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
RE-S-1800x4	1800-MHz	8GB or 16 GB	Gigabit Ethernet	32 GB SSD	4 GB CompactFlash card	10.4	SCB, SCBE, SCBE2, SCBE3
RE-S-MX104	1.8-GHz	4 GB	Gigabit Ethernet	–	8 GB NAND Flash	13.2	–
RE-B-1800x1-4G	1.73-GHz	4 GB	Gigabit Ethernet	64 GB SSD	4 GB CompactFlash card	12.1R2, 11.4R4, and 12.2R1	–
RE-MX2000-1800x4	1.8- GHz	16 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	12.3R2	SCB, SCBE
RE-S-1800X4-32G-S	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4 GB Fixed Internal CompactFlash card	<ul style="list-style-type: none"> <li>• 12.3R4</li> <li>• 13.2R1</li> </ul>	SCB, SCBE, SCBE2, SCBE3
REMX2K-1800-32G-S	1.8- Ghz	32 GB	Gigabit Ethernet	32 GB SSD	4GB Fixed Internal CompactFlash card	<ul style="list-style-type: none"> <li>• 12.3R4</li> <li>• 13.2R1</li> </ul>	–
RE-S-X6-64G, RE-S-X6-64G-LT	2 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	-	15.1F4, 16.1	SCBE2, SCBE3
REMX2K-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	15.1F5-S1, 16.1R2, and 16.2R1	–
REMX2K-X8-64G-LT	2.3 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	17.2R1	–
REMX2008-X8-64G	2.3 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	–	15.1F7	–
RE-S-1600x8	1.6 Ghz	64 GB	Gigabit Ethernet	Two 50-GB SSDs	–	17.3R1	–
REMX2008-X8-64G-LT	2.1 Ghz	64 GB	Gigabit Ethernet	Two 100-GB SSDs	-	17.2R1	-

Table 14: Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	Switch Control Board
REMX2008-X8-128G	2.3 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.2R1	-
RE-S-X6-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.1R1	SCBE2, SCBE3
REMX2K-X8-128G	2.1 Ghz	128 GB	Gigabit Ethernet	Two 200-GB SSDs	-	18.1R1	-
JNP10003-RE1	1.6-GHz	64 GB	Gigabit Ethernet	Two 100 GB SSDs	-	17.3R1	-
JNP10003-RE1-LT	1.6-GHz	64 GB	Gigabit Ethernet	Two 100 GB SSDs	-	18.1R1	-
JNP10K-RE0	2.5 Ghz	32 GB	Gigabit Ethernet	Two 50 GB SSDs	-	17.2R1	-
JNP10K-RE1	2.3 Ghz	64 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.2R1	-
JNP10K-RE1-LT	2.3 Ghz	64 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.3R1	-
JNP10K-RE1-128	2.3 Ghz	128 GB	Gigabit Ethernet	Two 200 GB SSDs	-	18.3R1	-



**NOTE:** Use shielded CAT5e cable for connecting the AUX, CONSOLE, and MGMT ports in RE-S-X6-64G, REMX2K-X8-64G, and REMX2008-X8-64G Routing Engines.

Table 15 on page 32 lists the hardware specifications of the Routing Engines with VMHost support.

Table 15: Hardware Specifications of the RE-MX-X6, RE-MX-X8, RE-PTX-X8, RCBPTX, RE-QFX10002-60C, and RE-PTX10002-60C Routing Engines

Model Number	Supported on Device	Specifications
RE-S-X6-64G	MX240, MX480, and MX960	<ul style="list-style-type: none"> <li>6-core Haswell CPU</li> <li>Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB solid-state drives (SSDs)</li> </ul>

**Table 15: Hardware Specifications of the RE-MX-X6, RE-MX-X8, RE-PTX-X8, RCBPTX, RE-QFX10002-60C, and RE-PTX10002-60C Routing Engines (continued)**

Model Number	Supported on Device	Specifications
REMX2K-X8-64G	MX2020 and MX2010	<ul style="list-style-type: none"> <li>8-core Haswell CPU</li> <li>Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB SSDs</li> </ul>
RE-PTX-X8-64G	PTX5000	<ul style="list-style-type: none"> <li>8-core Haswell CPU</li> <li>Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB SSDs</li> <li>New Control Board CB2-PTX</li> </ul>
RCBPTX	PTX3000	<ul style="list-style-type: none"> <li>Wellsburg PCH-based Routing Engine with 64-GB DRAM and two 64-GB SSDs</li> <li>Multi-core Haswell CPU</li> </ul> <p>RCB combines the functionality of a Routing Engine, Control Board, and Centralized Clock Generator (CCG)</p>
RE-S-1600x8	MX10003	<ul style="list-style-type: none"> <li>High-performance 1.6-GHz Intel 8 Core X86 CPU</li> <li>64-GB DDR4 RAM</li> <li>100-GB SATA SSD</li> </ul>
RE-S-1600x8	MX204	<ul style="list-style-type: none"> <li>High-performance 1.6-GHz Intel 8 Core X86 CPU</li> <li>32-GB DDR4 RAM</li> <li>100-GB SATA SSD</li> </ul>
RE-QFX10002-60C	QFX10002-60C	<ul style="list-style-type: none"> <li>High-performance 1.6-GHz Intel 8 Core X86 CPU</li> <li>32-GB DDR4 RAM</li> <li>Two 50-GB SATA SSD</li> </ul>
RE-PTX10002-60C	PTX10002-60C	<ul style="list-style-type: none"> <li>High-performance 1.6-GHz Intel 8 Core X86 CPU</li> <li>32-GB DDR4 RAM</li> <li>Two 50-GB SATA SSD</li> </ul>
RE-ACX-5448	ACX5448	<ul style="list-style-type: none"> <li>High-performance 1.6-GHz Intel 8 Core X86 CPU</li> <li>32-GB two DIMM DRAM</li> <li>Two 100-GB SATA SSD</li> </ul>

**Table 16: End-of-Life Routing Engine Specifications**

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
RE-333-256	333-MHz Pentium II	256 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.4	<a href="#">PSN-2003-01-063</a>
RE-333-768	333-MHz Pentium II	768 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.4	<a href="#">PSN-2003-01-063</a>

Table 16: End-of-Life Routing Engine Specifications (continued)

Routing Engine	Processor	Memory	Connection to PFEs	Disk	Media	First Junos OS Support	EOL Details
RE-600-512	600-MHz Pentium III	512 MB	Fast Ethernet	30 GB hard disk	256 MB CompactFlash card	5.4	<a href="#">PSN-2004-07-019</a>
RE-600-2048	600-MHz Pentium III	2048 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	5.3	<a href="#">PSN-2008-02-018</a>
RE-850-1536	850-MHz Pentium III	1536 MB	Fast Ethernet	40 GB hard disk	1 GB CompactFlash card	7.2	<a href="#">PSN-2011-04-226</a>
RE-M40	200-MHz Pentium	256 MB	Fast Ethernet	6.4 GB hard disk	80 MB CompactFlash card	3.2	<a href="#">FA-HW-0101-001</a>
<del>RE-M40-333-768</del>	333-MHz Pentium II	768 MB	Fast Ethernet	10 GB hard disk	80 MB CompactFlash card	4.2	<a href="#">PSN-2003-01-063</a>
<del>RE-M40-600-2048</del>	600-MHz Pentium III	2048 MB	Fast Ethernet	30 GB hard disk	128 MB CompactFlash card	5.4	<a href="#">PSN-2004-TI-020</a>
RE-1600-2048	1.6-GHz Pentium M	2048 MB	Gigabit Ethernet	40 GB hard disk	1 GB CompactFlash card	6.2	<a href="#">PSN-2008-02-019</a>



**NOTE:** The memory in [Table 14 on page 28](#) indicates the amount of total memory. To determine the amount of available memory, issue the `show chassis routing-engine` CLI command.

On routers that accept two Routing Engines, you cannot mix Routing Engine types except for a brief period (one minute or so) during an upgrade or downgrade to two Routing Engines of the same type.

#### Related Documentation

- [Supported Routing Engines by Router](#)



## CHAPTER 5

# Line Card Components and Descriptions

- Interface Modules—DPCs on page 35
- Interface Modules—FPCs and PICs on page 44
- Interface Modules—MPCs and MICs on page 51

### Interface Modules—DPCs

---

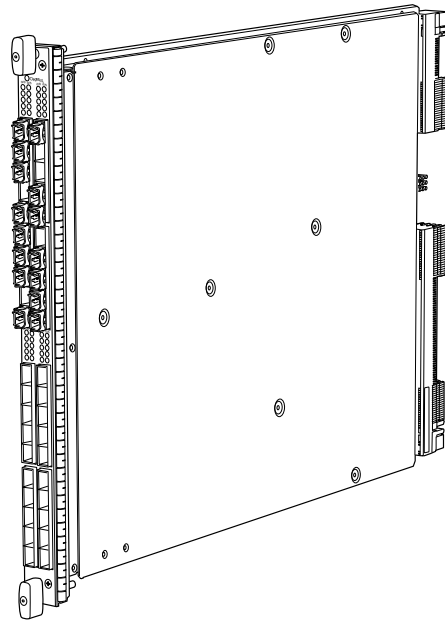
- MX960 Dense Port Concentrator Description on page 35
- MX960 Dense Port Concentrator LEDs on page 38
- DPCs Supported on MX240, MX480, and MX960 Routers on page 38
- MX960 DPC Port and Interface Numbering on page 40

### MX960 Dense Port Concentrator Description

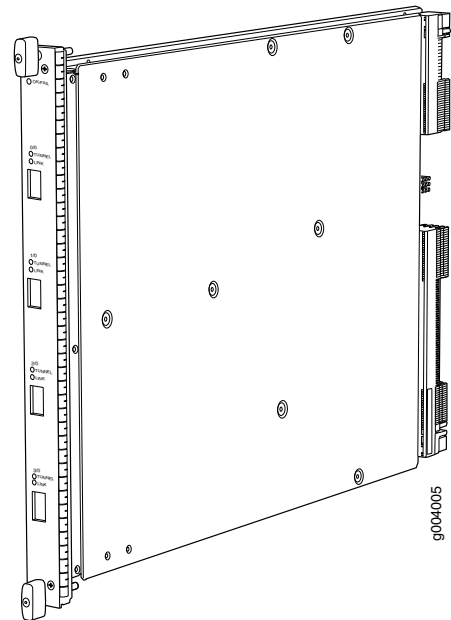
A Dense Port Concentrator (DPC) is optimized for Ethernet density. [Figure 16 on page 36](#) shows two examples of DPCs. For a list of the DPCs supported, see the [MX Series Interface Module Reference](#).

Figure 16: Typical DPCs Supported by the Router

DPC 40x1GE



DPC 4x10GE



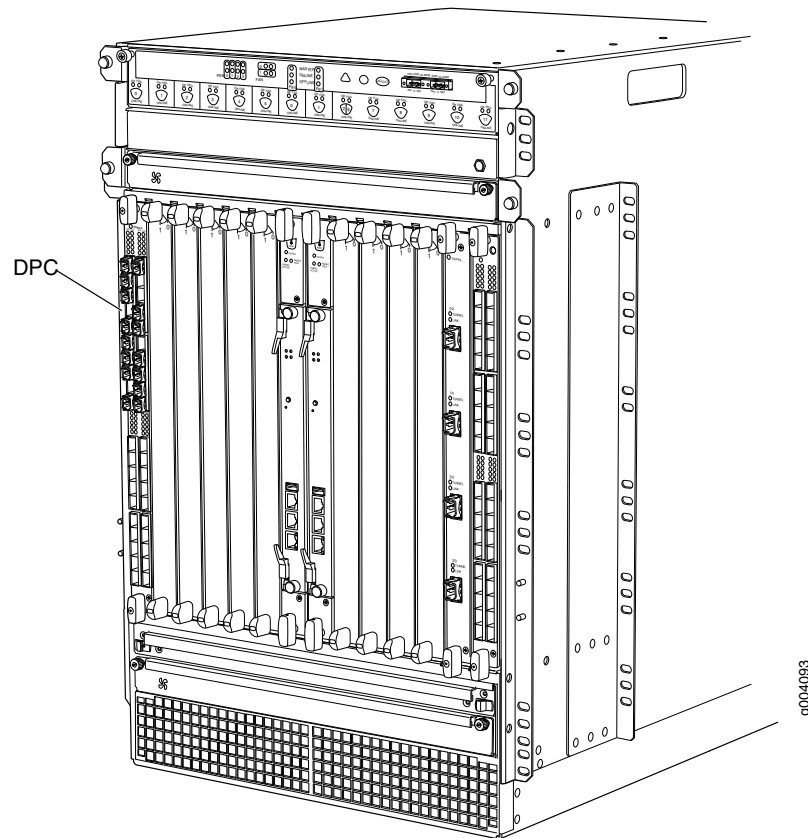
The DPC assembly combines packet forwarding and Ethernet interfaces on a single board, with either two or four 10-Gbps Packet Forwarding Engines. Each Packet Forwarding Engine consists of one I-chip for Layer 3 processing and one Layer 2 network processor. The DPCs interface with the power supplies and Switch Control Boards (CBs).

The router has 11 dedicated DPC slots. DPCs install vertically in the front of the router (see [Figure 17 on page 37](#)). The dedicated DPC slots are numbered 0 through 5, and 7 through 11, left to right. An additional multifunction slot labeled 2/6 supports either an SCB or a DPC. A DPC can be installed in any slot that supports DPCs. You can install any combination of DPC types in the router.

If a slot is not occupied by a DPC, a DPC blank panel must be installed to shield the empty slot and to allow cooling air to circulate properly through the router.

DPCs are hot-removable and hot-insertable. When you install a DPC in an operating router, the Routing Engine downloads the DPC software, the DPC runs its diagnostics, and the Packet Forwarding Engines housed on the DPC are enabled. Forwarding on other DPCs continues uninterrupted during this process.

Figure 17: DPCs Installed Vertically in the MX960 Router



### DPC Components

Each DPC consists of the following components:

- DPC cover, which functions as a ground plane and a stiffener.
- Fabric interfaces.
- Two Gigabit Ethernet interfaces that allow control information, route information, and statistics to be sent between the Routing Engine and the CPU on the DPCs.
- Two interfaces from the SCBs that enable the DPCs to be powered on and controlled.
- Physical DPC connectors.
- Two or four Packet Forwarding Engines.
- Midplane connectors and power circuitry.
- Processor subsystem, which includes a 1.2-GHz CPU, system controller, and 1 GB of SDRAM.
- Online button—Takes the DPC online or offline when pressed.
- LEDs on the DPC faceplate. For more information about LEDs on the DPC faceplate, see the [MX Series Interface Module Reference](#).

Two LEDs, located on the craft interface above the DPC, display the status of the DPC and are labeled **OK** and **FAIL**.

- See Also**
- [MX960 Dense Port Concentrator LEDs on page 38](#)
  - [MX960 Field-Replaceable Units on page 255](#)
  - [Replacing an MX960 DPC on page 351](#)

## MX960 Dense Port Concentrator LEDs

Two LEDs, located on the craft interface above the DPC, display the status of the DPC and are labeled **OK** and **FAIL**. For more information about the DPC LEDs on the craft interface, see “[MX960 DPC and MPC LEDs on the Craft Interface](#)” on page 16.

Each DPC also has LEDs located on the faceplate. For more information about LEDs on the DPC faceplate, see the “LEDs” section for each DPC in the [MX Series Interface Module Reference](#).

- See Also**
- [MX960 Dense Port Concentrator Description on page 35](#)
  - [Maintaining MX960 DPCs on page 448](#)
  - [Replacing an MX960 DPC on page 351](#)

## DPCs Supported on MX240, MX480, and MX960 Routers



**NOTE:** These DPCs have all been announced as End of Life (EOL). The End of Support (EOS) milestone dates for each model are published at [https://www.juniper.net/support/eol/mseries\\_hw.html](https://www.juniper.net/support/eol/mseries_hw.html).

Table 17 on page 38 lists the DPCs supported by the MX240, MX480, and MX960 routers.

Table 17: DPCs Supported in MX240, MX480, and MX960 Routers

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
<b>Gigabit Ethernet</b>				
<i>Gigabit Ethernet DPC with SFP</i>	DPC-R-40GE-SFP EOL (see <a href="#">PSN-2009-06-400</a> )	40	40 Gbps	8.2
<i>Gigabit Ethernet Enhanced DPC with SFP</i>	DPCE-R-40GE-SFP EOL (see <a href="#">PSN-TSB16810</a> )	40	40 Gbps	8.4

Table 17: DPCs Supported in MX240, MX480, and MX960 Routers (continued)

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
<i>Gigabit Ethernet Enhanced Ethernet Services DPC with SFP</i>	DPCE-X-40GE-SFP  EOL (see <a href="#">PSN-TSB16810</a> )	40	40 Gbps	8.4
<i>Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP</i>	DPCE-X-Q-40GE-SFP  EOL (see <a href="#">PSN-2013-02-851</a> )	40	40 Gbps	8.5
<i>Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP</i>	DPCE-R-Q-20GE-SFP  EOL (see <a href="#">PSN-2013-02-851</a> )	20	20 Gbps	9.1
<i>Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP</i>	DPCE-R-Q-40GE-SFP  EOL (see <a href="#">PSN-2011-07-314</a> )	40	40 Gbps	8.5
<i>10-Gigabit Ethernet DPC with XFP</i>	DPC-R-4XGE-XFP  EOL (see <a href="#">PSN-2009-06-400</a> )	4	40 Gbps	8.2
<b>10-Gigabit Ethernet</b>				
<i>10-Gigabit Ethernet Enhanced DPCs with XFP</i>	DPCE-R-2XGE-XFP  EOL (see <a href="#">PSN-2011-02-314</a> )	2	20 Gbps	9.1
<i>10-Gigabit Ethernet Enhanced DPCs with XFP</i>	DPCE-R-4XGE-XFP  EOL (see <a href="#">PSN-TSB16810</a> )	4	40 Gbps	8.4
<i>10-Gigabit Ethernet Enhanced Ethernet Services DPC with XFP</i>	DPCE-X-4XGE-XFP  EOL (see <a href="#">PSN-TSB16810</a> )	4	40 Gbps	8.4
<i>10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP</i>	DPCE-X-Q-4XGE-XFP  EOL (see <a href="#">PSN-2013-02-851</a> )	4	40 Gbps	8.5
<i>10-Gigabit Ethernet Enhanced Queuing IP Services DPC with XFP</i>	DPCE-R-Q-4XGE-XFP  EOL (see <a href="#">PSN-2011-02-314</a> )	4	40 Gbps	8.5

Table 17: DPCs Supported in MX240, MX480, and MX960 Routers (continued)

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
<b>Mult-Rate Ethernet</b>				
<i>Multi-Rate Ethernet Enhanced DPC with SFP and XFP</i>	DPCE-R-20GE-2XGE EOL (see <a href="#">PSN-TSB16810</a> )	22	40 Gbps	9.2
<i>Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP</i>	DPCE-X-20GE-2XGE EOL (see <a href="#">PSN-2011-02-314</a> )	22	40 Gbps	9.2
<i>Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP</i>	DPCE-R-Q-20GE-2XGE EOL (see <a href="#">PSN-TSB16810</a> )	22	40 Gbps	9.3
<b>Tri-Rate Ethernet</b>				
<i>Tri-Rate Enhanced DPC</i>	DPCE-R-40GE-TX EOL (see <a href="#">PSN-2013-02-851</a> )	40	40 Gbps	9.1
<i>Tri-Rate Enhanced Ethernet Services DPC</i>	DPCE-X-40GE-TX EOL (see <a href="#">PSN-2011-07-315</a> .)	40	40 Gbps	9.1
<b>Services</b>				
<i>Multiservices DPC</i>	MS-DPC EOL (see <a href="#">PSN-TSB16812</a> )	2 (Not supported)	–	9.3

- See Also**
- *Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)*
  - *Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)*
  - *Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)*
  - *Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)*
  - *Protocols and Applications Supported by the Multiservices DPC (MS-DPC)*

## MX960 DPC Port and Interface Numbering

Each port on a DPC corresponds to a unique interface name in the CLI.

In the syntax of an interface name, a hyphen (-) separates the media type from the DPC number (represented as an **FPC** in the CLI). The DPC slot number corresponds to the first number in the interface. The second number in the interface corresponds to the logical PIC number. The last number in the interface matches the port number on the DPC. Slashes (/) separate the DPC number from the logical PIC number and port number.

***type-fpc/pic/port***

- *type*—Media type, which identifies the network device. For example:
  - *ge*—Gigabit Ethernet interface
  - *so*—SONET/SDH interface
  - *xe*—10-Gigabit Ethernet interface

For a complete list of media types, see *Interface Naming Overview*.

- *fpc*—Slot in which the DPC is installed. On the MX960 router, the DPCs are represented in the CLI as **FPC 0** through **FPC 11**.
- *pic*—Logical PIC on the DPC. The number of logical PICs varies depending on the type of DPC. For example, a:
  - 20-port Gigabit Ethernet DPC has two logical PICs, numbered 0 through 1.
  - 40-port Gigabit Ethernet DPC has four logical PICs, numbered 0 through 3.
  - 2-port 10-Gigabit Ethernet DPC has two logical PICs, numbered 0 through 1.
  - 4-port 10-Gigabit Ethernet DPC has four logical PICs, numbered 0 through 3.

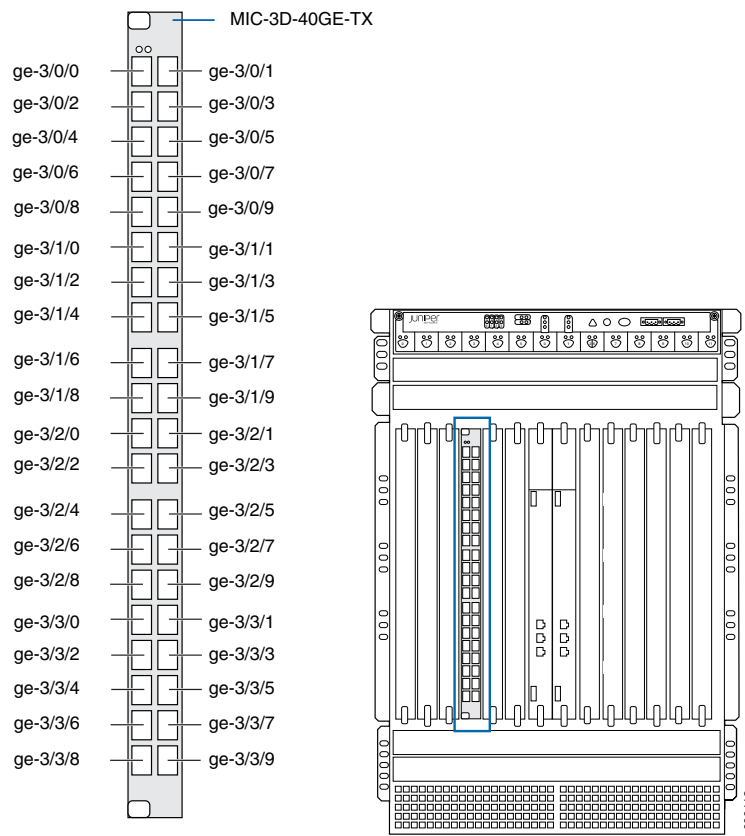
For more information on specific DPCs, see “[DPCs Supported on MX240, MX480, and MX960 Routers](#)” on page 38 in the *MX Series Interface Module Reference*.

- *port*—Port number.

The MX960 router supports up to twelve DPCs that install vertically and are numbered 0 through 11 from left to right.

[Figure 18 on page 42](#) shows a 40-port Gigabit Ethernet DPC with SFP installed in slot **3** on the MX960 router.

Figure 18: MX960 DPC Interface Port Mapping



The DPC contains four logical PICs, numbered **PIC 0** through **PIC 3** in the CLI. Each logical PIC contains 10 ports numbered **0** through **9**.

The **show chassis hardware** command output displays a 40-port Gigabit Ethernet DPC with SFP (**DPCE-R-40GE-SFP**) installed in DPC slot **3**. The DPC is shown as **FPC 3** and the DPC's four logical PICs — **10x 1GE(LAN)** — are shown as **PIC 0** through **PIC 3**.

```
user@host> show chassis hardware
```

```
...
FPC 3          REV 07  750-018122  KB8222          DPCE 40x 1GE R
CPU           REV 06  710-013713  KA9010          DPC PMB
PIC 0
  Xcvr 0      REV 01  740-011782  PCH2NU4        SFP-SX
  Xcvr 1      REV 01  740-011782  PCH2P4R        SFP-SX
  Xcvr 2      REV 01  740-011782  PCH2NYL        SFP-SX
  Xcvr 3      REV 01  740-011782  PCH2UW6        SFP-SX
  Xcvr 4      REV 01  740-011782  PCH2P4N        SFP-SX
  Xcvr 5      REV 01  740-011782  PCH2UME        SFP-SX
  Xcvr 6      REV 01  740-011613  PCE1H5P        SFP-SX
  Xcvr 7      REV 01  740-011782  PCH2UFG        SFP-SX
  Xcvr 8      REV 02  740-011613  AM0947SEYU2    SFP-SX
  Xcvr 9      REV 02  740-011613  AM0947SEYTQ    SFP-SX
PIC 1          BUILTIN  BUILTIN        10x 1GE(LAN)
```



```

Xcvr 0    REV 01  740-011782  PCH2UYF      SFP-SX
Xcvr 1    REV 01  740-011782  PCH2P4L      SFP-SX
Xcvr 2    REV 01  740-011782  PCH2UCL      SFP-SX
Xcvr 3    REV 01  740-011782  PCH2P4X      SFP-SX
Xcvr 4    REV 01  740-011782  PCH2P1E      SFP-SX
Xcvr 5    REV 01  740-011782  PCH2UD2      SFP-SX
Xcvr 6    REV 01  740-011782  PCH2PLC      SFP-SX
Xcvr 7    REV 01  740-011782  PCH2UDJ      SFP-SX
Xcvr 8    REV 02  740-011613  AM0947SEX7S  SFP-SX
PIC 2     BUILTIN  BUILTIN      10x 1GE(LAN)
Xcvr 0    REV 01  740-011782  PCH2NV7      SFP-SX
Xcvr 1    REV 01  740-011782  PCH2P6Q      SFP-SX
Xcvr 2    REV 01  740-011782  PCH2NUG      SFP-SX
Xcvr 3    REV 01  740-011782  PCH2P10      SFP-SX
Xcvr 9    REV 02  740-011613  AM0947SEXBT  SFP-SX
PIC 3     BUILTIN  BUILTIN      10x 1GE(LAN)
Xcvr 0    REV 01  740-011782  PCH2PL4      SFP-SX
Xcvr 1    REV 01  740-011782  PCH2P1K      SFP-SX
Xcvr 2    REV 01  740-011782  PCH2PLM      SFP-SX
Xcvr 3    REV 01  740-011782  PCH2UFF      SFP-SX
Xcvr 8    REV 02  740-011613  AM1003SFV5S  SFP-SX
Xcvr 9    REV 02  740-011613  AM0947SEBX   SFP-SX
...

```

The `show interfaces terse` command output displays the Gigabit Ethernet interfaces that correspond to the 40 ports located on the DPC.

```
user@host> show interfaces terse ge-3*
```

```

Interface           Admin Link Proto  Local           Remote
ge-3/0/0             up    up
ge-3/0/1             up    down
ge-3/0/2             up    up
ge-3/0/3             up    up
ge-3/0/4             up    up
ge-3/0/5             up    up
ge-3/0/6             up    up
ge-3/0/7             up    up
ge-3/0/8             up    up
ge-3/0/9             up    up
ge-3/1/0             up    down
ge-3/1/1             up    down
ge-3/1/2             up    down
ge-3/1/3             up    down
ge-3/1/4             up    up
ge-3/1/5             up    up
ge-3/1/6             up    up
ge-3/1/7             up    up
ge-3/1/8             up    up
ge-3/1/9             up    down
ge-3/2/0             up    down
ge-3/2/1             up    down
ge-3/2/2             up    down
ge-3/2/3             up    down
ge-3/2/4             up    down
ge-3/2/5             up    down
ge-3/2/6             up    down
ge-3/2/7             up    down

```

ge-3/2/8	up	down
ge-3/2/9	up	down
ge-3/3/0	up	down
ge-3/3/1	up	down
ge-3/3/2	up	down
ge-3/3/3	up	down
ge-3/3/4	up	down
ge-3/3/5	up	down
ge-3/3/6	up	down
ge-3/3/7	up	down
ge-3/3/8	up	down
ge-3/3/9	up	down

**See Also** • [MX960 Router Hardware and CLI Terminology Mapping on page 10](#)

## Interface Modules—FPCs and PICs

---

- [MX960 Flexible PIC Concentrator Description on page 44](#)
- [MX960 Flexible PIC Concentrator \(FPC\) LEDs on page 47](#)
- [FPCs Supported by MX240, MX480, and MX960 Routers on page 47](#)
- [MX960 PIC Description on page 48](#)
- [MX960 PIC LEDs on page 48](#)
- [MX960 PIC Port and Interface Numbering on page 48](#)
- [PICs Supported by MX240, MX480, and MX960 Routers on page 50](#)

### MX960 Flexible PIC Concentrator Description

A Flexible PIC Concentrator (FPC) occupies two Dense Port Concentrator (DPC) slots on an MX Series router. The MX960 router has 11 dedicated DPC slots and one multifunction slot that supports either a DPC, FPC, or Switch Control Board (SCB). The dedicated DPC slots are numbered 0 through 5, and 7 through 11, left to right. The multifunction slot is labeled 2/6. Up to six FPCs can be installed vertically in any two slots that support FPCs (see [Figure 19 on page 45](#)). The interface corresponds to the lowest numbered DPC slot for which the FPC is installed.

Figure 19: FPC Installed in the MX960 Router Chassis

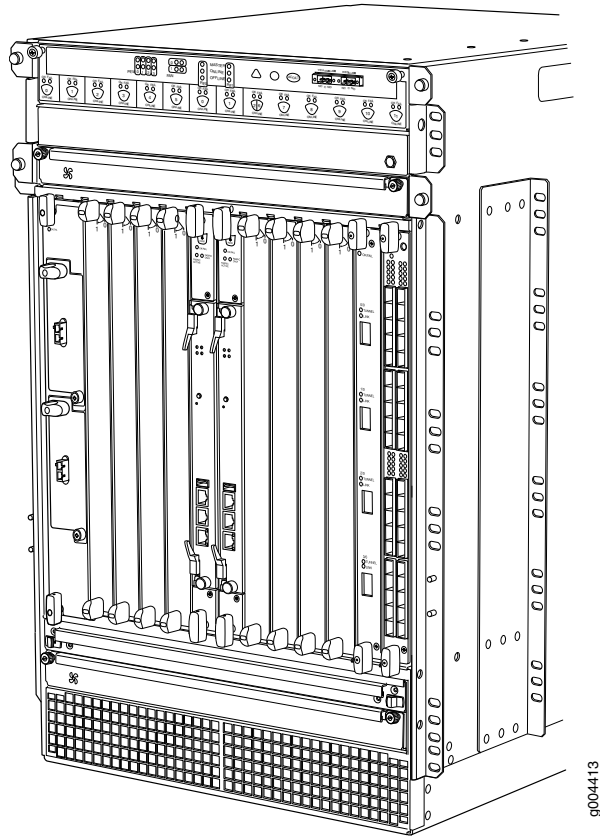
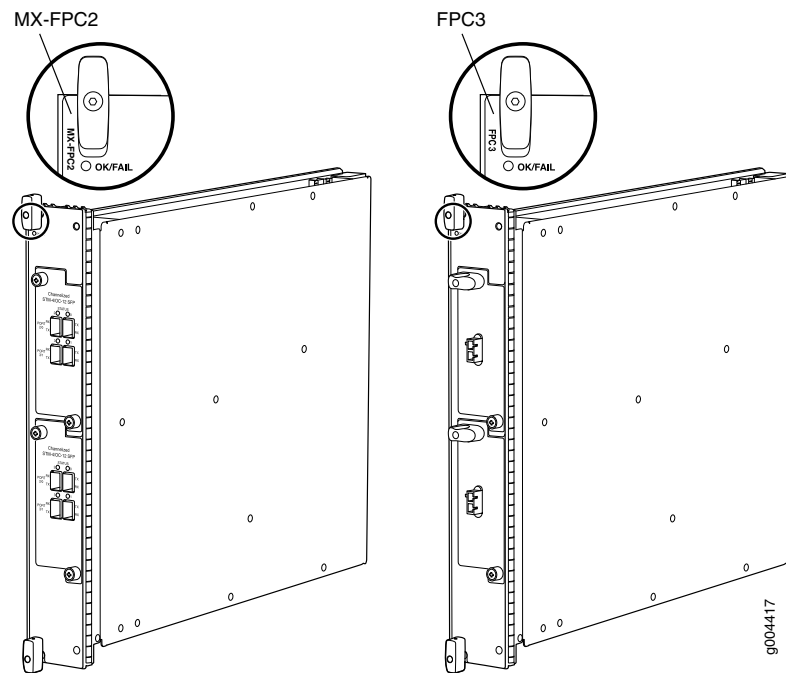


Figure 20 on page 46 shows the typical FPCs supported on the MX960 router.

Figure 20: Typical FPCs Supported on the MX960 Router



If a slot is not occupied by a DPC, an FPC, or an SCB, a blank panel must be installed to shield the empty slot and to allow cooling air to circulate properly through the router.

Each FPC supports up to two PICs. On an FPC2, one Packet Forwarding Engine receives incoming packets from the PICs installed on the FPC and forwards them through the switch planes to the appropriate destination port. On an FPC3, two Packet Forwarding Engines receive incoming packets from the PICs installed on the FPC and forward them through the switch planes to the appropriate destination port. The FPCs interface with the power supplies and SCBs.

FPCs are hot-removable and hot-insertable, as described in [“MX960 Component Redundancy”](#) on page 10. When you install an FPC into a functioning router, the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the PICs, housed on the FPC, are enabled. Forwarding continues uninterrupted during this process. When you remove or install an FPC, packet forwarding between other DPCs or FPCs is not affected.

### FPC Components

Each FPC consists of the following components:

- FPC card carrier, which includes two PIC slots
- Up to two Packet Forwarding Engines, each consisting of one 1-chip for Layer 3 processing and one Layer 2 network processor
- Midplane connectors and power circuitry
- Processor subsystem (PMB), which includes a 1.2-GHz CPU, system controller, 1 GB of SDRAM, and two Gigabit Ethernet interfaces

- Two LEDs, located on the craft interface above the FPC, that display the status of the FPC and are labeled **OK** and **FAIL**
- FPC online/offline button, located on the craft interface above the FPC

- See Also**
- [MX960 Flexible PIC Concentrator \(FPC\) LEDs on page 47](#)
  - [MX960 FPC Terminology](#)
  - [Replacing an MX960 FPC on page 358](#)
  - [Maintaining MX960 FPCs on page 453](#)
  - [Troubleshooting the MX960 FPCs on page 490](#)

### MX960 Flexible PIC Concentrator (FPC) LEDs

Two LEDs, located on the craft interface above the FPC, that display the status of the FPC and are labeled **OK** and **FAIL**. For more information about the FPC LEDs located on the craft interface, see “[MX960 FPC LEDs on the Craft Interface](#)” on page 17.

- See Also**
- [MX960 FPC Terminology](#)
  - [Replacing an MX960 FPC on page 358](#)
  - [Maintaining MX960 FPCs on page 453](#)
  - [Troubleshooting the MX960 FPCs on page 490](#)

### FPCs Supported by MX240, MX480, and MX960 Routers

An FPC occupies two slots when installed in an MX240, MX480, or MX960 router. The maximum number of supported FPCs varies per router:

- MX960 router—6 FPCs
- MX480 router—3 FPCs
- MX240 router—1 FPC

[Table 18 on page 47](#) lists FPCs supported by MX240 routers.

**Table 18: FPCs Supported by MX Series Routers**

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported	Maximum Throughput per FPC (Full-duplex)	First Junos OS Release
3	FPC3	MX-FPC3	2	20 Gbps	9.4
2	FPC2	MX-FPC2	2	10 Gbps	9.5

- See Also**
- [MX Series FPC and PIC Overview](#)

- [PICs Supported by MX240, MX480, and MX960 Routers on page 50](#)
- [High Availability Features](#)

## MX960 PIC Description

PICs provide the physical connection to various network media types, receiving incoming packets from the network and transmitting outgoing packets to the network. During this process, each PIC performs framing and line-speed signaling for its media type. Before transmitting outgoing data packets, the PICs encapsulate the packets received from the FPCs. Each PIC is equipped with an ASIC that performs control functions specific to the media type of that PIC.

PICs are hot-removable and hot-insertable. Up to two PICs can be installed in the slots in each FPC. Up to six FPCs can be installed in an MX960 router. PICs used in an FPC2 have captive screws at their upper and lower corners. PICs used in a Type 3 FPC have an upper ejector handle and a lower captive screw.

- See Also**
- [PICs Supported by MX240, MX480, and MX960 Routers on page 50](#)
  - [MX960 PIC LEDs on page 48](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Maintaining MX960 PICs on page 464](#)
  - [Troubleshooting the MX960 PICs on page 492](#)
  - [MX960 PIC Serial Number Label on page 514](#)

## MX960 PIC LEDs

Each PIC has LEDs located on the faceplate. For more information about LEDs on the PIC faceplate, see the “LEDs” section for each PIC in the [MX Series Interface Module Reference](#).

- See Also**
- [PICs Supported by MX240, MX480, and MX960 Routers on page 50](#)
  - [MX960 PIC Description on page 48](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Maintaining MX960 PICs on page 464](#)

## MX960 PIC Port and Interface Numbering

Each port on a PIC corresponds to a unique interface name in the CLI.

In the syntax of an interface name, a hyphen (-) separates the media type from the FPC slot number (represented as an FPC in the CLI). The FPC slot number corresponds to the first number in the interface. The second number in the interface corresponds to the PIC number. The last number in the interface matches the port number on the PIC. Slashes (/) separate the FPC number from the PIC number and port number:

***type-fpc/pic/port***

- *type*—Media type, which identifies the network device. For example:
  - *ge*—Gigabit Ethernet interface
  - *so*—SONET/SDH interface
  - *xe*—10-Gigabit Ethernet interface

For a complete list of media types, see *Interface Naming Overview*.

- *fpc*—Lowest slot number in which the FPC is installed. On the MX960 router, the FPCs occupy two slots and are represented in the CLI as **FPC 0** through **FPC 10**.
- *pic*—PIC number, 0 or 1 depending on the FPC slot.

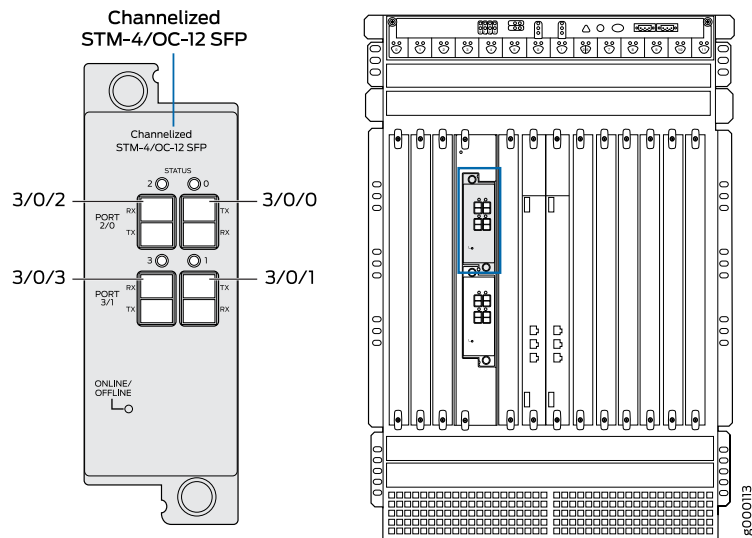
For more information on specific PICs, see “PICs Supported by MX240, MX480, and MX960 Routers” on page 50 in the *MX Series Interface Module Reference*.

- *port*—Port number.

The MX960 supports up to six FPCs that install vertically and are numbered from left to right. Each FPC accepts up to two PICs.

[Figure 21 on page 49](#) shows a Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP installed in PIC slot 0 of an FPC installed in slot 3 and slot 4.

**Figure 21: MX960 PIC Interface Port Mapping**



The **show chassis hardware** command output displays a Channelized OC12/STM4 Enhanced IQ (IQE) PIC (4x CHOC12 IQE SONET) installed in an **MX FPC Type 2**.

```
user@host> show chassis hardware
```

```
...
FPC 3          REV 01  710-024386  JW9571          MX FPC Type 2
```

CPU	REV 03	710-022351	KE2986	DPC PMB
PIC 0	REV 00	750-022630	DS1284	4x CHOC12 IQE SONET
Xcvr 0	REV 01	740-011782	PB821SG	SFP-SX
Xcvr 1	REV 01	740-011782	PB829Q6	SFP-SX
Xcvr 2	REV 01	740-011613	P9F15NQ	SFP-SX
Xcvr 3	REV 01	740-011782	P7N036X	SFP-SX...

The **show interfaces terse** command output displays the channelized SONET OC12 interfaces (**coc12**), that correspond to the four ports located on the PIC.

```
user@host> show interfaces terse coc12*
```

Interface	Admin	Link	Proto	Local	Remote
coc12-3/0/0	up	up			
coc12-3/0/1	up	up			
coc12-3/0/2	up	up			
coc12-3/0/3	up	up			

**See Also** • [MX960 Router Hardware and CLI Terminology Mapping on page 10](#)

## PICs Supported by MX240, MX480, and MX960 Routers

Table 19 on page 50 lists the PICs supported by MX240, MX480, and MX960 routers.

Table 19: PICs Supported by MX240, MX480, and MX960 Routers

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
<b>Channelized IQ PICs</b>				
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	PB-4CHOC12-STM4-IQE-SFP	4	2	9.5
Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP	PB-1CHOC48-STM16-IQE	1	2	9.5
<b>SONET/SDH PICs</b>				
SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	PB-4OC3-1OC12-SON2-SFP	4	2	9.5
SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	PB-4OC3-4OC12-SON-SFP	4	2	9.5
SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP	PC-4OC48-STM16-IQE-SFP	4	3	10.4R2
SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP	PB-1OC48-SON-B-SFP	1	2	9.5
SONET/SDH OC48/STM16 PIC with SFP	PC-4OC48-SON-SFP	4	3	9.4



Table 19: PICs Supported by MX240, MX480, and MX960 Routers (continued)

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
SONET/SDH OC192c/STM64 PIC	PC-1OC192-SON-VSR	1	3	9.4
SONET/SDH OC192c/STM64 PIC with XFP	PC-1OC192-SON-XFP	1	3	9.4

- See Also**
- [MX Series FPC and PIC Overview](#)
  - [FPCs Supported by MX240, MX480, and MX960 Routers on page 47](#)
  - [High Availability Features](#)

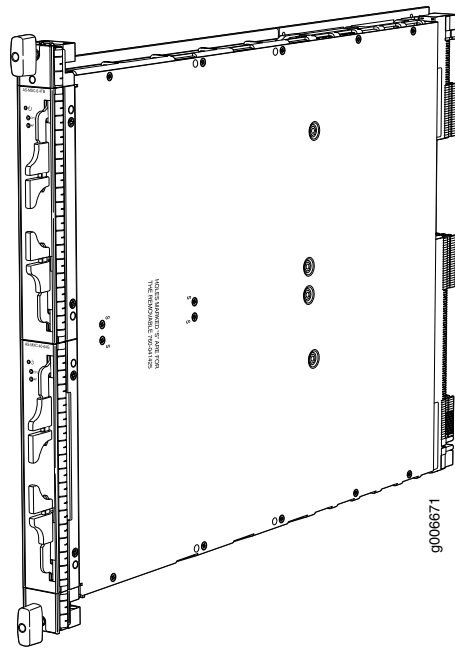
## Interface Modules—MPCs and MICs

- [MX960 Application Services Modular Line Card Description on page 51](#)
- [MX960 Application Services Modular Storage Card Description on page 54](#)
- [MX960 Application Services Modular Processing Card Description on page 55](#)
- [MX960 AS MSC LEDs on page 56](#)
- [MX960 AS MXC LEDs on page 57](#)
- [MIC/MPC Compatibility on page 57](#)
- [MX960 Modular Interface Card Description on page 65](#)
- [MX960 Modular Interface Card \(MIC\) LEDs on page 65](#)
- [MICs Supported by MX Series Routers on page 65](#)
- [MX960 MIC Port and Interface Numbering on page 73](#)
- [MX960 Modular Port Concentrator Description on page 76](#)
- [MX960 Modular Port Concentrator LEDs on page 79](#)
- [MPCs Supported by MX Series Routers on page 79](#)

### MX960 Application Services Modular Line Card Description

The Application Services Modular Line Card (AS MLC) is an X86-based card for MX960, MX480, and MX240 routers to deliver integrated application service solutions. The first application that network operators can take advantage of is the Junos Content Encore system, a high-throughput, solid state storage platform for media rich content delivery. Additionally, the AS MLC can serve as the platform for Juniper Networks JunosV App Engine, powering a host of network applications directly embedded into your MX Series 5G Universal Routing Platforms.

The AS MLC is modular and decouples CPU and storage in individual field-upgradeable units. The AS MLCs are designed to enable application throughput up to 50 Gbps and a storage capacity of 400 gigabytes (GB) of NAND Flash.

*Figure 22: Application Services Modular Line Card (AS MLC)*

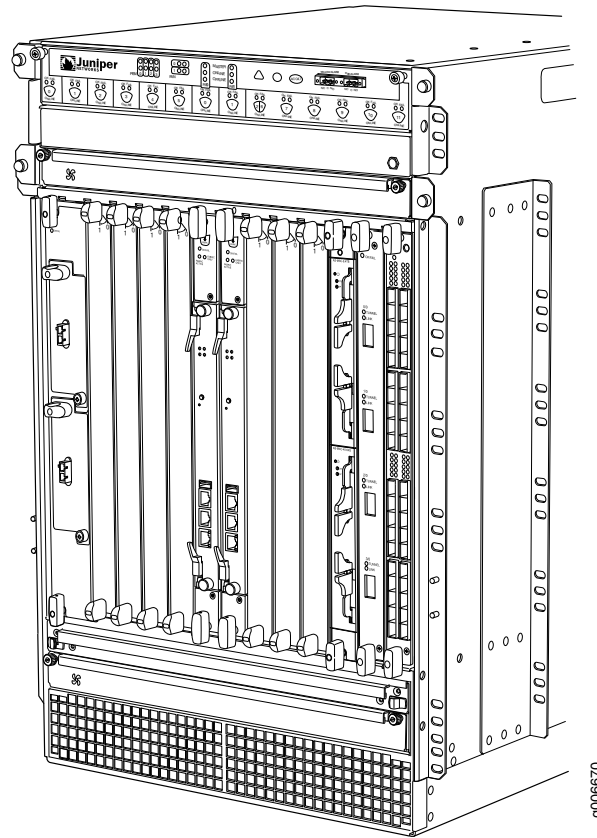
### MX960 AS MLC Function

The AS MLC provides modular processing and modular storage. Installed on the AS MLC, the Junos Content Encore system operates as a caching application, in either HTTP reverse proxy mode or HTTP transparent proxy mode, to manage client requests for content and the distribution of the content to clients from origin servers. In the future, the AS MLC will run other Juniper Networks router services and applications, and serve as a virtualized platform for third-party applications. The AS MLC provides Ethernet switching and high-speed fabric interface to MX routers. Graceful Routing Engine switchover is also supported on the AS MLC.

Integrated with application forwarding on MX Series routers, the AS MLC provides increased service flexibility with reduced power and space requirements for the network infrastructure.

The AS MLC Modular Carrier Card (AS MCC), the carrier card of the AS MLC, fits vertically in the front of the MX960 router (see [Figure 23 on page 53](#)).

Figure 23: AS MLC Installed in the MX960 Router Chassis



### AS MLC Components

Each AS MLC consists of the following components:

- AS MLC Modular Carrier Card (AS MCC), which fits vertically in front of the MX960 router, includes two slots for the Application Services Modular Storage Card (AS MSC) and Application Services Modular Processing Card (AS MXC)
- AS MXC with 64 GB RAM for processing
- AS MSC with 400 GB NAND Flash capacity for modular storage



**NOTE:** The AS MCC, AS MXC, and AS MSC are hot-removable and hot-insertable.

- Switch fabric interfaces to the chassis
- XM ASIC chip, which owns and manages the packet data memory built from external DDR3 memory chips, the fabric queuing system, a portion of the WAN queuing system, and the host queuing system

- LU ASIC chip, which performs all functions relating to header processing including input processing, route lookup, classification, filtering, policing, accounting, encapsulation, and statistics
- Midplane connectors and power circuitry
- Processor Mezzanine Board (PMB), which that contains the host processor and supporting peripherals
- LED on the AS MCC, which displays the status of the AS MLC

### MX960 SCB, Power Supply, and Cooling System Requirements for AS MLC

Each MX960 router requires specific SCB, power supply, and cooling system models to run the AS MLC.

- SCB—Enhanced MX Switch Control Board (SCBE-MX). See [“SCBE-MX Description” on page 109](#) for details.
- Power supply:
  - 4100W AC power supply—Model PWR-MX960-AC
  - 4100W DC power supply—Model PWR-MX960-DC
- Power requirement for AS MLC:
  - AS MCC—191W
  - AS MXC—259W
  - AS MSC—50W
- Cooling system—Required fan and fan tray models:
  - Fans:
    - For AC power supply: PWR-FAN-MX960-AC-HC-U
    - For DC power supply: PWR-FAN-MX960-DC-HC-U
  - Fan tray—FFANTRAY-MX960-HC

- See Also**
- [Replacing an MX960 AS MLC on page 309](#)
  - [Replacing an MX960 AS MSC on page 314](#)
  - [Replacing an MX960 AS MXC on page 317](#)

### MX960 Application Services Modular Storage Card Description

Application Services Modular Storage Card (AS MSC) is a NAND Flash-based card that is inserted into the upper slot of the Application Services Modular Line Card (AS MLC). The AS MSC (see [Figure 24 on page 55](#)) serves as the second tier caching storage for platforms such as the Junos Content Encore system. This card is equivalent to a PIC or

a Modular Interface Card (MIC) and provides a maximum of 3.6 Gbps read and 2 Gbps of write memory.

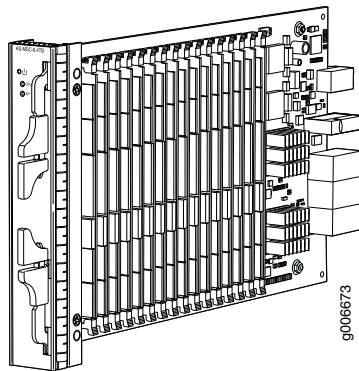
The AS MSC has the following features:

- 400 GB NAND Flash memory
- Up to 10 years of write memory
- Multilevel cell (MLC) NAND memory support
- Best-in-class NAND controller for maximum performance and reliability

AS MSCs are hot-removable and hot-insertable. One AS MSC can be installed in the top slot of each AS MLC. Each AS MSC has these components:

- SATA-3 controller—An eight-ports, 6 Gbps SAS/SATA controller.
- NAND Flash controller— NAND Flash and NAND Flash controller are used in an AS MSC.
- Control plane—Inter-integrated circuit control plane that allows Peripheral Component Interconnect Express (PCIe) control.
- LEDs—Two LEDs display the status of the AS MSC and storage.
- Online/offline button—To power on or power off the AS MSC.

*Figure 24: Application Services Modular Storage Card*



- See Also**
- [MX960 AS MSC LEDs on page 56](#)
  - [Replacing an MX960 AS MSC on page 314](#)

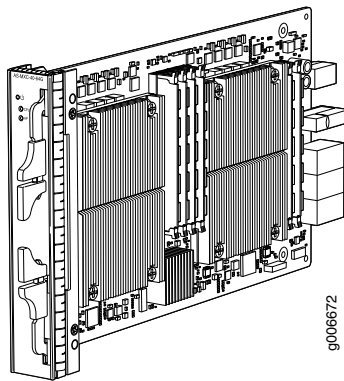
## MX960 Application Services Modular Processing Card Description

The Application Services Modular Processing Card (AS MXC) is a pluggable X86-based card that can be inserted into the lower slot of the Application Services Modular Line Card (AS MLC). The AS MXC serves as the processing card for the Junos Content Encore system and contains the two X86, Intel 8-core processors with interface ability greater than 80 Gbps. The AS MXC (see [Figure 25 on page 56](#)) is equivalent to a PIC or MIC (Modular Interface Card).

AS MXCs are hot-removable and hot-insertable. One MXC can be installed in the lower slot of each AS MLC. Each MXC has these components:

- Two 8-core Intel processors—Contains eight execution cores with Ring Interconnect architecture. Each core supports two threads, up to 16 threads per socket.
- 64 GB DRAM—On DIMM sockets.
- LEDs—Two LEDs on the faceplate display the CPU and application status.

*Figure 25: Application Services Modular Processing Card (AS MXC)*



- See Also**
- [MX960 AS MXC LEDs on page 57](#)
  - [Replacing an MX960 AS MXC on page 317](#)

## MX960 AS MSC LEDs

Two LEDs (**CPU** and **AP**) indicate the status of the AS MSC and are located on the AS MSC. [Table 20 on page 56](#) describes the functions of the AS MSC LEDs.

*Table 20: AS MSC LEDs*

Label	Color	State	Description
CPU	Green	On steadily	AS MSC operates normally.
	Red	On steadily	AS MSC has an error or has failed.
	–	Off	AS MSC is offline.
AP	Green	On steadily	AS MSC storage operation is normal.
	Red	On steadily	AS MSC storage operation has an error.
	–	Off	AS MSC storage operation is not activated.

- See Also**
- [MX960 Application Services Modular Storage Card Description on page 54](#)

- [Replacing an MX960 AS MSC on page 314](#)

## MX960 AS MXC LEDs

Two LEDs (**CPU** and **AP**) indicate the status of the AS MXC and are located on the AS MXC. [Table 21 on page 57](#) describes the functions of the AS MXC LEDs.

*Table 21: AS MXC LEDs*

Label	Color	State	Description
CPU	Green	On steadily	AS MXC operates normally.
	Red	On steadily	AS MXC has an error or has failed.
	–	Off	AS MXC is offline.
AP	Green	On steadily	AS MXC applications operation is normal.
	Red	On steadily	AS MXC applications operation has an error.
	–	Off	AS MXC applications are not activated.

- See Also**
- [MX960 Application Services Modular Processing Card Description on page 55](#)
  - [Replacing an MX960 AS MXC on page 317](#)

## MIC/MPC Compatibility

The following tables provide a compatibility matrix for the MICs currently supported by MPC1, MPC2, MPC3, MPC6, MPC8, and MPC9 on MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 routers. Each table lists the first Junos OS release in which the MPC supports the MIC. For example, Junos OS Release 10.2 is the first release in which the MX-MPC1-3D supports the Gigabit Ethernet MIC with SFP. An en dash indicates that the MIC is not supported.

*Table 22: MIC/MPC1 Compatibility*

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
MIC-3D-80C3-20C12-ATM (ATM MIC with SFP)	–	–	12.1	12.1R4
MIC-3D-20GE-SFP (Gigabit Ethernet MIC with SFP)	10.2	11.2R4	10.2	11.2R4

Table 22: MIC/MPC1 Compatibility (continued)

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
MIC-3D-20GE-SFP-E <i>(Gigabit Ethernet MIC with SFP (E))</i>	13.2R2	13.2R2	13.2R2	13.2R2
MIC-3D-2XGE-XFP <i>(10-Gigabit Ethernet MICs with XFP)</i>	10.2	11.2R4	10.2	11.2R4
MIC-3D-4XGE-XFP <i>(10-Gigabit Ethernet MICs with XFP)</i>	—	—	—	—
MIC-3D-40GE-TX <i>(Tri-Rate MIC)</i>	10.2	11.2R4	10.2	11.2R4
MC-3D-4OC3OC12-1OC48, MC-3D-8OC3OC12-4OC48 <i>(SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP)</i>	11.2	11.2R4	11.2	11.2R4
MC-3D-4COC3-1COC12-CE <i>(Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP)</i>	—	—	12.2	12.2
MIC-3D-1OC192-XFP <i>(SONET/SDH OC192/STM64 MIC with XFP)</i>	12.2	12.2	12.2	12.2
MC-3D-4CHOC3-2CHOC12, MC-3D-8CHOC3-4CHOC12  MIC-4COC3-2COC12-G, MIC-8COC3-4COC12-G <i>(Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP)</i>	—	—	11.4	11.4



Table 22: MIC/MPC1 Compatibility (continued)

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
MIC-3D-16CHE1-T1-CE <i>(Channelized E1/T1 Circuit Emulation MIC)</i>	13.2	13.2	12.3	12.3
	<b>NOTE:</b> Support for Non-Channelized MIC only.	<b>NOTE:</b> Support for Non-Channelized MIC only.		
MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B <i>(DS3/E3 MIC)</i>	11.4	11.4	11.4	11.4
	<b>NOTE:</b> You cannot run Channelized DS3 (MIC-3D-8CHDS3-E3) on non-Q MPCs. Channelized DS3 is supported only on Q and EQ-based MPCs.			
MIC-MACSEC-20GE <i>Gigabit Ethernet MIC with 256b-AES MACSEC</i>	18.3R1	18.3R1	18.3R1	18.3R1
MS-MIC-16G <i>(Multiservices MIC)</i>	13.2	13.2	13.2	13.2

Table 23: MIC/MPC2 Compatibility

MIC Name	MPC2	MPC2E	MPC2E NG	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ	MPC2E P	MPC2E NG Q
MIC-3D-8OC3-2OC12-ATM <i>(ATM MIC with SFP)</i>	—	—	14.1R4, 14.2R3 with Junos Continuity	12.1	12.1R4	12.1	12.1R4	—	14.1R4, 14.2R3 with Junos Continuity
			15.1						15.1
MIC-3D-20GE-SFP <i>(Gigabit Ethernet MIC with SFP)</i>	10.1	11.2R4	14.1R4, 14.2R3 with Junos Continuity	10.1	11.2R4	10.1	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity
			15.1						15.1
MIC-3D-20GE-SFP-E <i>(Gigabit Ethernet MIC with SFP (E))</i>	13.2R2	13.2R2	14.1R4, 14.2R3 with Junos Continuity	13.2R2	13.2R2	13.2R2	13.2R2	13.2R2	14.1R4, 14.2R3 with Junos Continuity
			15.1						15.1

Table 23: MIC/MPC2 Compatibility (continued)

MIC Name	MPC2	MPC2E	MPC2E NG	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ	MPC2E P	MPC2E NG Q
MIC-3D-2XGE-XFP <i>(10-Gigabit Ethernet MIC with XFP)</i>	10.2	11.2R4	14.1R4, 14.2R3 with Junos Continuity  15.1	10.2	11.2R4	10.2	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity  15.1
MIC-3D-4XGE-XFP <i>(10-Gigabit Ethernet MICs with XFP)</i>	10.1	11.2R4	14.1R4, 14.2R3 with Junos Continuity  15.1	10.1	11.2R4	10.1	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity  15.1
MIC-3D-40GE-TX <i>(Tri-Rate MIC)</i>	10.2	11.2R4	14.1R4, 14.2R3 with Junos Continuity  15.1	10.2	11.2R4	10.2	11.2R4	12.2	14.1R4, 14.2R3 with Junos Continuity  15.1
MIC-3D-4OC3OC12-1OC48, MIC-3D-8OC3OC12-4OC48 <i>(SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP)</i>	11.4	11.4	14.1R4, 14.2R3 with Junos Continuity  15.1	11.4	11.4	11.4	11.4	-	14.1R4, 14.2R3 with Junos Continuity  15.1
MIC-3D-4COC3-1COC12-CE <i>(Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP)</i>	—	—	—	12.2	12.2	12.2	12.2	12.2	14.1R4, 14.2R3 with Junos Continuity  15.1
MIC-3D-1OC192-XFP <i>(SONET/SDH OC192/STM64 MIC with XFP)</i>	12.2	12.2	14.1R4, 14.2R3 with Junos Continuity  15.1	12.2	12.2	12.2	12.2	12.2	14.1R4, 14.2R3 with Junos Continuity  15.1
MIC-3D-4CHOC3-2CHOC12, MIC-3D-8CHOC3-4CHOC12  MIC-4COC3-2COC12-G, MIC-8COC3-4COC12-G <i>(Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP)</i>	—	—	15.1 with flexible queuing option	11.4	11.4	11.4	11.4	—	15.1  14.1R4, 14.2R3 with Junos Continuity

Table 23: MIC/MPC2 Compatibility (continued)

MIC Name	MPC2	MPC2E	MPC2E NG	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ	MPC2E P	MPC2E NG Q
MIC-3D-16CHE1-T1-CE <i>(Channelized E1/T1 Circuit Emulation MIC)</i>	13.2		15.1 with flexible queuing option	12.3	12.3	12.3	12.3	—	14.1R4, 14.2R3 with Junos Continuity 15.1
	<b>NOTE:</b> Support for Non-Channelized MIC only.								
MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B <i>(DS3/E3 MIC)</i>	11.4	11.4	14.1R4, 14.2R3 with Junos Continuity 15.1	11.4	11.4	11.4	11.4	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1
	<b>NOTE:</b> You cannot run Channelized DS3 (MIC-3D-8CHDS3-E3) on non-Q MPCs. Channelized DS3 is supported only on Q and EQ-based MPCs.								
MS-MIC-16G <i>(Multiservices MIC)</i>	13.2	13.2	14.1R4, 14.2R3 with Junos Continuity 15.1	13.2	13.2	13.2	13.2	13.2	14.1R4, 14.2R3 with Junos Continuity 15.1
	<b>NOTE:</b> Only one MS-MIC-16G can be installed into any MPC.								
MIC-MACSEC-20GE <i>Gigabit Ethernet MIC with 256b-AES MACSEC</i>	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1	18.3R1

Table 24: MIC/MPC3 Compatibility

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
MIC-3D-8OC3-2OC12-ATM <i>(ATM MIC with SFP)</i>	—	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-20GE-SFP <i>(Gigabit Ethernet MIC with SFP)</i>	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-20GE-SFP-E <i>(Gigabit Ethernet MIC with SFP (E))</i>	13.2R2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1

Table 24: MIC/MPC3 Compatibility (continued)

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
MIC3-3D-1X100GE-CFP (100-Gigabit Ethernet MIC with CFP)	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-2XGE-XFP (10-Gigabit Ethernet MICs with XFP)	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-4XGE-XFP (10-Gigabit Ethernet MICs with XFP)	—	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-10XGE-SFP+ (10-Gigabit Ethernet MIC with SFP+ (10 Ports))	12.3	14.1R4, 14.2 R3 and Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-2X40GE-QSFP+ (40-Gigabit Ethernet MIC with QSFP+)	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-1X100GE-CXP (100-Gigabit Ethernet MIC with CXP)	12.2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-100G-DWDM (100-Gigabit DWDM OTN MIC with CFP2-ACO)	15.1F5 15.1F6 17.1R1	15.1F5 15.1F6 17.1R1	15.1F5 15.1F6 17.1R1
MIC3-3D-4OC3OC12-1OC48 MIC3-3D-8OC3OC12-4OC48 (SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP)	13.3	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-1OC192-XFP (SONET/SDH OC192/STM64 MIC with XFP)	13.3	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-4COC3-1COC12-CE (Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP)	—	—	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC3-3D-16CHE1-T1-CE (Channelized E1/T1 Circuit Emulation MIC)	—	15.1 with flexible queuing option	15.1

Table 24: MIC/MPC3 Compatibility (continued)

MIC Name	MPC3E	MPC3E NG	MPC3E NG Q
MS-MIC-16G <i>(Multiservices MIC)</i>	13.2R2	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
<p><b>NOTE:</b> On MPC3E, the installation of the Multiservices MIC (MS-MIC-16G) with MIC3-3D-2X40GE-QSFPP, MIC3-3D-10XGE-SFPP, or MIC3-3D-1X100GE-CFP does not meet the NEBS criteria.</p> <p><b>NOTE:</b> Only one MS-MIC-16G can be installed into any MPC.</p>			
MIC-3D-40GE-TX <i>Tri-Rate MIC</i>	—	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4OC3OC12-1OC48, MIC-3D-8OC3OC12-4OC48 <i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-4CHOC3-2CHOC12, MIC-3D-8CHOC3-4CHOC12 MIC-4COC3-2COC12-G, MIC-8COC3-4COC12-G <i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	—	15.1 with flexible queuing option	14.1R4, 14.2R3 with Junos Continuity 15.1
MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B <i>DS3/E3 MIC</i>	12.1	14.1R4, 14.2R3 with Junos Continuity 15.1	14.1R4, 14.2R3 with Junos Continuity 15.1
<p><b>NOTE:</b> You cannot run Channelized DS3 (MIC-3D-8CHDS3-E3) on non-Q MPCs. Channelized DS3 is supported only on Q and EQ-based MPCs.</p>			
MIC-MACSEC-20GE <i>Gigabit Ethernet MIC with 256b-AES MACSEC</i>	18.3R1	18.3R1	18.3R1

Table 25: MIC/MPC6 Compatibility

MIC Name	MPC6E
MIC6-10G <i>10-Gigabit Ethernet MIC with SFP+ (24 Ports)</i>	13.3R2
MIC6-10G-OTN <i>10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)</i>	13.3R3

**Table 25: MIC/MPC6 Compatibility (continued)**

MIC Name	MPC6E
MIC6-100G-CXP <i>100-Gigabit Ethernet MIC with CXP (4 Ports)</i>	13.3R2
MIC6-100G-CFP2 <i>100-Gigabit Ethernet MIC with CFP2</i>	13.3R3

**Table 26: MIC/MPC8 Compatibility**

MIC Name	MPC8E
MIC-MRATE <i>MIC MRATE</i>	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1</li> </ul>
MIC-MACSEC-MRATE <i>Multi-Rate Ethernet MIC</i>	17.4

**Table 27: MIC/MPC9 Compatibility**

MIC Name	MPC9E
MIC-MRATE <i>MIC MRATE</i>	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1</li> </ul>
MIC-MACSEC-MRATE <i>Multi-Rate Ethernet MIC</i>	17.4

**Table 28: MIC/MPC10003 Compatibility**

MIC Name	MPC10003
JNP-MIC1 <i>Multi-Rate Ethernet MIC</i>	17.3
JNP-MIC1-MACSEC <i>Multi-Rate Ethernet MIC</i>	17.3R2

- See Also**
- [MICs Supported by MX Series Routers on page 65](#)
  - [Junos Continuity Software User Guide \(Junos OS Release 14.1R4 and Later Releases\)](#)

## MX960 Modular Interface Card Description

Modular Interface Cards (MICs) install into Modular Port Concentrators (MPCs) and provide the physical connections to various network media types. MICs allow different physical interfaces to be supported on a single line card. You can install MICs of different media types on the same MPC as long as the MPC supports those MICs.

MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received.

MICs are hot-removable and hot-insertable. You can install up to two MICs in the slots in each MPC.

- See Also**
- [MICs Supported by MX Series Routers on page 65](#)
  - [MX960 Modular Interface Card \(MIC\) LEDs on page 65](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Troubleshooting the MX960 MICs on page 493](#)
  - [Replacing an MX960 MIC on page 364](#)

## MX960 Modular Interface Card (MIC) LEDs

Each MIC has LEDs located on the faceplate. For more information about LEDs on the MIC faceplate, see the “LEDs” section for each MIC in the *MX Series Interface Module Reference*.

- See Also**
- [MICs Supported by MX Series Routers on page 65](#)
  - [MX960 Modular Interface Card Description on page 65](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Troubleshooting the MX960 MICs on page 493](#)
  - [Replacing an MX960 MIC on page 364](#)

## MICs Supported by MX Series Routers

The following tables list the first supported Junos OS release for the MX Series.

- [Table 29 on page 66](#) lists the first supported Junos OS release for MICs on MX240, MX480, MX960, and MX2008 routers.
- [Table 30 on page 68](#) lists the first supported Junos OS release for MICs on MX2010 and MX2020 routers.
- [Table 31 on page 70](#) list the first supported Junos OS release for MICs on MX5, MX10, and MX40 routers.

- [Table 32 on page 71](#) lists the first supported Junos OS release for MICs on MX80 and MX104 routers.
- [Table 33 on page 73](#) lists the first supported Junos OS release for MICs on MX10003 router.

**Table 29: MICs Supported by MX240, MX480, MX960 and MX2008 Routers**

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
<b>ATM</b>				
<i>ATM MIC with SFP</i>	MIC-3D-8OC3-2OC12-ATM	8	12.1	15.1F7
<b>DS3/E3</b>				
<i>DS3/E3 MIC</i>	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	11.4	15.1F7
<b>Circuit Emulation</b>				
<i>Channelized E1/T1 Circuit Emulation MIC</i>	MIC-3D-16CHE1-T1-CE	16	12.3	15.1F7
<b>Gigabit Ethernet</b>				
<i>Gigabit Ethernet MIC with SFP</i>	MIC-3D-20GE-SFP	20	10.1	15.1F7
<i>Gigabit Ethernet MIC with SFP (E)</i>	MIC-3D-20GE-SFP-E	20	13.3	15.1F7
<i>Gigabit Ethernet MIC with 256b-AES MACSEC</i>	MIC-MACSEC-20GE	20	18.3	-
<b>10-Gigabit Ethernet</b>				
<i>10-Gigabit Ethernet MICs with XFP</i>	MIC-3D-2XGE-XFP	2	10.2	15.1F7
<i>10-Gigabit Ethernet MICs with XFP</i>	MIC-3D-4XGE-XFP	4	10.1	15.1F7
<i>10-Gigabit Ethernet MIC with SFP+ (10 Ports)</i>	MIC3-3D-10XGE-SFPP	10	12.3	15.1F7
<i>10-Gigabit Ethernet MIC with SFP+ (24 Ports)</i>	MIC6-10G	24	-	15.1F7
<i>10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)</i>	MIC6-10G-OTN	24	-	15.1F7
<b>40-Gigabit Ethernet</b>				



Table 29: MICs Supported by MX240, MX480, MX960 and MX2008 Routers (continued)

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
<i>40-Gigabit Ethernet MIC with QSFP+</i>	MIC3-3D-2X40GE-QSFP	2	12.2	15.1F7
<b>100-Gigabit Ethernet</b>				
<i>100-Gigabit Ethernet MIC with CFP</i>	MIC3-3D-1X100GE-CFP	1	12.1	15.1F7
<i>100-Gigabit Ethernet MIC with CXP</i>	MIC3-3D-1X100GE-CXP	1	12.2	15.1F7
<i>100-Gigabit Ethernet MIC with CXP (4 Ports)</i>	MIC6-100G-CXP	4	-	15.1F7
<i>100-Gigabit Ethernet MIC with CFP2</i>	MIC6-100G-CFP2	2	-	15.1F7
<b>100-Gigabit DWDM OTN</b>				
<i>100-Gigabit DWDM OTN MIC with CFP2-ACO</i>	MIC3-100G-DWDM	1	15.1F5 15.1F6 17.1R1	15.1F7
<b>Multi-Rate</b>				
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4OC3OC12-1OC48	4	11.2	15.1F7
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8OC3OC12-4OC48	8	11.2	15.1F7
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4CHOC3-2CHOC12	4	11.4	15.1F7
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8CHOC3-4CHOC12	8	11.4	15.1F7
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP</i>	MIC-3D-4COC3-1COC12-CE	4	12.2	15.1F7
<i>MIC MRATE (12-Port Multi-Rate MIC with QSFP+)</i>	MIC-MRATE	12	-	15.1F7
<i>Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)</i>	MIC-MACSEC-MRATE	12		17.4

Table 29: MICs Supported by MX240, MX480, MX960 and MX2008 Routers (continued)

MIC Name	MIC Model Number	Ports	MX240, MX480, and MX960 Routers	MX2008 Routers
<b>Tri-Rate</b>				
<i>Tri-Rate MIC</i>	MIC-3D-40GE-TX	40	10.2	15.1F7
<b>Services</b>				
<i>Multiservices MIC</i>	MS-MIC-16G	0	13.2	15.1F7
<b>SONET/SDH</b>				
<i>SONET/SDH OC192/STM64 MIC with XFP</i>	MIC-3D-10C192-XFP	1	12.2	15.1F7

Table 30: MICs Supported by MX2010 and MX2020 Routers

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
<b>ATM</b>				
<i>ATM MIC with SFP</i>	MIC-3D-8OC3-2OC12-ATM	8	12.3	12.3
<b>DS3/E3</b>				
<i>DS3/E3 MIC</i>	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	12.3	12.3
<b>Circuit Emulation</b>				
<i>Channelized E1/T1 Circuit Emulation MIC</i>	MIC-3D-16CHE1-T1-CE	16	–	–
<b>Gigabit Ethernet</b>				
<i>Gigabit Ethernet MIC with SFP</i>	MIC-3D-20GE-SFP	20	12.3	12.3
<i>Gigabit Ethernet MIC with SFP (E)</i>	MIC-3D-20GE-SFP-E	20	13.3	13.3
<b>10-Gigabit Ethernet</b>				
<i>10-Gigabit Ethernet MICs with XFP</i>	MIC-3D-2XGE-XFP	2	12.3	12.3
<i>10-Gigabit Ethernet MICs with XFP</i>	MIC-3D-4XGE-XFP	4	12.3	12.3
<i>10-Gigabit Ethernet MIC with SFP+ (10 Ports)</i>	MIC3-3D-10XGE-SFPP	10	12.3	12.3
<i>10-Gigabit Ethernet MIC with SFP+ (24 Ports)</i>	MIC6-10G	24	13.3R2	13.3R2

Table 30: MICs Supported by MX2010 and MX2020 Routers (continued)

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
<i>10-Gigabit Ethernet OTN MIC with SFP+ (24 Ports)</i>	MIC6-10G-OTN	24	13.3R3	13.3R3
<b>40-Gigabit Ethernet</b>				
<i>40-Gigabit Ethernet MIC with QSFP+</i>	MIC3-3D-2X40GE-QSFP	2	12.3	12.3
<b>100-Gigabit Ethernet</b>				
<i>100-Gigabit Ethernet MIC with CFP</i>	MIC3-3D-1X100GE-CFP	1	12.3	12.3
<i>100-Gigabit Ethernet MIC with CXP</i>	MIC3-3D-1X100GE-CXP	1	12.3	12.3
<i>100-Gigabit Ethernet MIC with CXP (4 Ports)</i>	MIC6-100G-CXP	4	13.3R2	13.3R2
<i>100-Gigabit Ethernet MIC with CFP2</i>	MIC6-100G-CFP2	2	13.3R3	13.3R3
<b>100-Gigabit DWDM OTN</b>				
<i>100-Gigabit DWDM OTN MIC with CFP2-ACO</i>	MIC3-100G-DWDM	1	15.1F5 15.1F6 17.1R1	15.1F5 15.1F6 17.1R1
<b>Multi-Rate</b>				
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4OC3OC12-1OC48	4	12.3	12.3
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8OC3OC12-4OC48	8	12.3	12.3
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4CHOC3-2CHOC12	4	12.3	12.3
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8CHOC3-4CHOC12	8	12.3	12.3
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP</i>	MIC-3D-4COC3-1COC12-CE	4	12.3	12.3
<i>MIC MRATE (12-Port Multi-Rate MIC with QSFP+)</i>	MIC-MRATE	12	<ul style="list-style-type: none"> <li>15.1F5 with Junos Continuity</li> <li>16.1R1 and later</li> </ul>	<ul style="list-style-type: none"> <li>15.1F5 with Junos Continuity</li> <li>16.1R1 and later</li> </ul>

Table 30: MICs Supported by MX2010 and MX2020 Routers (continued)

MIC Name	MIC Model Number	Ports	MX2010 Routers	MX2020 Routers
<i>Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)</i>	MIC-MACSEC-MRATE	12	17.4	17.4
<b>Tri-Rate</b>				
<i>Tri-Rate MIC</i>	MIC-3D-40GE-TX	40	12.3	12.3
<b>Services</b>				
<i>Multiservices MIC</i>	MS-MIC-16G	0	13.2	13.2
<b>SONET/SDH</b>				
<i>SONET/SDH OC192/STM64 MIC with XFP</i>	MIC-3D-1OC192-XFP	1	12.3	12.3

Table 31: MICs Supported by MX5, MX10, and MX40 Routers

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
<b>ATM</b>					
<i>ATM MIC with SFP</i>	MIC-3D-8OC3-2OC12-ATM	8	12.1	12.1	12.1
<b>DS3/E3</b>					
<i>DS3/E3 MIC</i>	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	11.4	11.4	11.4
<b>Circuit Emulation</b>					
<i>Channelized E1/T1 Circuit Emulation MIC</i>	MIC-3D-16CHE1-T1-CE	16	13.2R2	13.2R2	13.2R2
<i>Channelized E1/T1 Circuit Emulation MIC (H)</i>	MIC-3D-16CHE1-T1-CE-H	16	–	–	–
<b>Gigabit Ethernet</b>					
<i>Gigabit Ethernet MIC with SFP</i>	MIC-3D-20GE-SFP	20	11.2R4	11.2R4	11.2R4
<i>Gigabit Ethernet MIC with SFP (E)</i>	MIC-3D-20GE-SFP-E	20	13.2R2	13.2R2	13.2R2
<i>Gigabit Ethernet MIC with SFP (EH)</i>	MIC-3D-20GE-SFP-EH	20	–	–	–
<b>10-Gigabit Ethernet</b>					
<i>10-Gigabit Ethernet MICs with XFP</i>	MIC-3D-2XGE-XFP	2	11.2R4	11.2R4	11.2R4

Table 31: MICs Supported by MX5, MX10, and MX40 Routers (continued)

MIC Name	MIC Model Number	Ports	MX5	MX10	MX40
<b>Multi-Rate</b>					
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4OC3OC12-1OC48	4	11.2R4	11.2R4	11.2R4
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8OC3OC12-4OC48	8	11.2R4	11.2R4	11.2R4
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4CHOC3-2CHOC12	4	11.4	11.4	11.4
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8CHOC3-4CHOC12	8	11.4	11.4	11.4
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP</i>	MIC-3D-4COC3-1COC12-CE	4	12.2	12.2	12.2
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (H)</i>	MIC-4COC3-1COC12-CE-H	-	-	-	-
<b>Tri-Rate</b>					
<i>Tri-Rate MIC</i>	MIC-3D-40GE-TX	40	-	11.2R4	11.2R4
<b>Services</b>					
<i>Multiservices MIC</i>	MS-MIC-16G	0	13.2 Rear slot only.	13.2 Rear slot only.	13.2 Rear slot only.
<i>SONET/SDH OC192/STM64 MIC with XFP</i>	MIC-3D-1OC192-XFP	1	12.2	12.2	12.2

Table 32: MICs Supported by MX80 and MX104 Routers

MIC Name	MIC Model Number	Ports	MX80	MX104
<b>ATM</b>				
<i>ATM MIC with SFP</i>	MIC-3D-8OC3-2OC12-ATM	8	12.1	13.3
<b>DS3/E3</b>				
<i>DS3/E3 MIC</i>	MIC-3D-8DS3-E3, MIC-3D-8CHDS3-E3-B	8	11.4	13.3
<b>Circuit Emulation</b>				

Table 32: MICs Supported by MX80 and MX104 Routers (continued)

MIC Name	MIC Model Number	Ports	MX80	MX104
<i>Channelized E1/T1 Circuit Emulation MIC</i>	MIC-3D-16CHE1-T1-CE	16	13.2R2	13.2R2
<i>Channelized E1/T1 Circuit Emulation MIC (H)</i>	MIC-3D-16CHE1-T1-CE-H	16	–	13.2R2
<b>Gigabit Ethernet</b>				
<i>Gigabit Ethernet MIC with SFP</i>	MIC-3D-20GE-SFP	20	10.2	13.2R2
<i>Gigabit Ethernet MIC with SFP (E)</i>	MIC-3D-20GE-SFP-E	20	13.2R2	13.2R2
<i>Gigabit Ethernet MIC with SFP (EH)</i>	MIC-3D-20GE-SFP-EH	20	–	13.2R2
<i>Gigabit Ethernet MIC with 256b-AES MACSEC</i>	MIC-MACSEC-20GE	20	18.3	18.3
<i>10-Gigabit Ethernet MICs with XFP</i>	MIC-3D-2XGE-XFP	2	10.2	13.2R2
<b>Multi-Rate</b>				
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4OC3OC12-1OC48	4	11.2	13.3
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8OC3OC12-4OC48	8	11.2	13.3
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-4CHOC3-2CHOC12	4	11.4	13.3
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	MIC-3D-8CHOC3-4CHOC12	8	11.4	13.3
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP</i>	MIC-3D-4COC3-1COC12-CE	4	12.2	13.2R2
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (H)</i>	MIC-4COC3-1COC12-CE-H	–	–	13.2R2
<b>Tri-Rate</b>				
<i>Tri-Rate MIC</i>	MIC-3D-40GE-TX	40	10.2	13.2R2
<b>Services</b>				

Table 32: MICs Supported by MX80 and MX104 Routers (continued)

MIC Name	MIC Model Number	Ports	MX80	MX104
<i>Multiservices MIC</i>	MS-MIC-16G	0	13.2 Rear slot only. Supported on the modular MX80 and fixed MX80-48T	13.3R2 <b>NOTE:</b> Not supported From Junos OS 13.3R3, 14.1R2, and 14.2R1, MX104 supports only two Multiservices MICs.
<b>SONET/SDH</b>				
<i>SONET/SDH OC192/STM64 MIC with XFP</i>	MIC-3D-1OC192-XFP	1	12.2	13.3

Table 33: MICs Supported by MX10003 Router

MIC Name	MIC Model Number	Ports	MX10003
<b>Multi-Rate</b>			
<i>Multi-Rate Ethernet MIC (12-Port Multi-Rate MIC with QSFP+)</i>	JNP-MIC1	12	17.3
<i>Multi-Rate Ethernet MIC (12-Port Multi-Rate MACsec MIC with QSFP+)</i>	JNP-MIC1-MACSEC	12	17.3R2

- See Also**
- [MX Series MIC Overview](#)
  - [MIC/MPC Compatibility on page 57](#)

## MX960 MIC Port and Interface Numbering

Each port on a MIC corresponds to a unique interface name in the CLI.



**NOTE:** Fixed configuration MPCs, that is, MPCs with built-in MICs follow the port numbering of DPCs.

In the syntax of an interface name, a hyphen (-) separates the media type from the MPC number (represented as an FPC in the CLI). The MPC slot number corresponds to the first number in the interface. The second number in the interface corresponds to the

logical PIC number. The last number in the interface matches the port number on the MIC. Slashes (/) separate the MPC number from the logical PIC number and port number:

***type-fpc/pic/port***

- *type*—Media type, which identifies the network device. For example:
  - *ge*—Gigabit Ethernet interface
  - *so*—SONET/SDH interface
  - *xe*—10-Gigabit Ethernet interface

For a complete list of media types, see *Interface Naming Overview*.

- *fpc*—Slot in which the MPC is installed. On the MX960 router, the MPCs are represented in the CLI as **FPC 0** through **FPC 11**.
- *pic*—Logical PIC on the MIC, numbered 0 or 1 when installed in MIC slot 0 and 2 or 3 when installed in MIC slot 1. The number of logical PICs varies depending on the type of MIC. For example, a:
  - 20-port Gigabit Ethernet MIC has two logical PICs, numbered 0 and 1 when installed in MIC slot 0, or 2 and 3 when installed in MIC slot 1.
  - 4-port 10-Gigabit Ethernet MIC has two logical PICs numbered 0 and 1 when installed in MIC slot 0, or 2 and 3 when installed in MIC slot 1.
  - 100-Gigabit Ethernet MIC with CFP has one logical PIC numbered 0 when installed in MIC slot 0 or 2 when installed in MIC slot 1.

For more information on specific MICs, see “MICs Supported by MX Series Routers” on page 65 in the *MX Series Interface Module Reference*.

- *port*—Port number.



**NOTE:** The MIC number is not included in the interface name.

---

The MX960 supports up to twelve MPCs that install vertically and are numbered from left to right. Each MPC accepts up to two MICs.

[Figure 26 on page 75](#) shows an example of a 20-port Gigabit Ethernet MIC with SFP installed in MIC slot 0 of an MPC in slot 3.

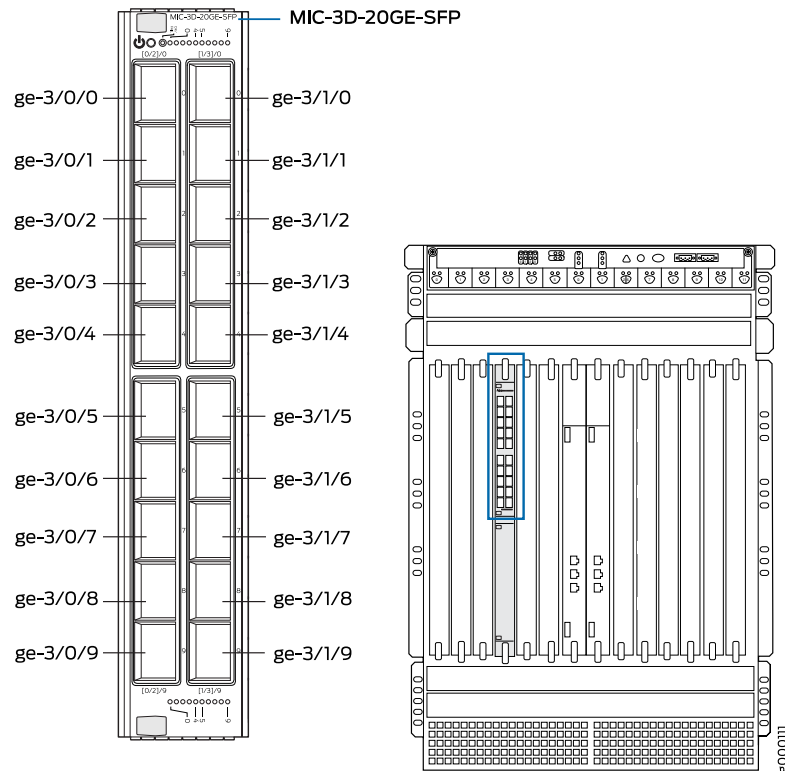


**NOTE:** The 20-port Gigabit Ethernet MIC with SFP-E has a different port numbering. See *Gigabit Ethernet MIC with SFP (E)*

---



Figure 26: Port Mapping for the 20-Port Gigabit Ethernet MIC with SFP Installed in the MX960



The MIC contains two logical PICs, numbered **PIC 0** through **PIC 1** in the CLI. Each logical PIC contains 10 ports numbered **0** through **9**.

The **show chassis hardware** command output displays a 20-port Gigabit Ethernet MIC with SFP — **3D 20x 1GE(LAN) SFP** — installed in MIC slot 0 of an MPC (**MPC Type 2 3D EQ**) in slot 3. The MPC is shown as **FPC 3** and the MIC's two logical PICs — **10x 1GE(LAN) SFP** — are shown as **PIC 0** and **PIC 1**.

```
user@host> show chassis hardware
```

```
...
FPC 3          REV 28   750-031090   YH8181          MPC Type 2 3D EQ
  CPU          REV 06   711-030884   YH9437          MPC PMB 2G
  MIC 0        REV 22   750-028392   YD0439          3D 20x 1GE(LAN) SFP
    PIC 0      BUILTIN  BUILTIN       10x 1GE(LAN) SFP
      Xcvr 0    REV 01   740-011613   PCE14D5        SFP-SX
      Xcvr 1    REV 01   740-011782   P9C280T        SFP-SX
      Xcvr 2    REV 01   740-011782   P9C2512        SFP-SX
      Xcvr 3    REV 02   740-011613   AM0951SFF3Z    SFP-SX
      Xcvr 4    REV 02   740-011613   AM0951SFF33    SFP-SX
      Xcvr 5    REV 02   740-011613   AM0951SFF3Y    SFP-SX
      Xcvr 6    REV 02   740-011613   AM0951SFF4B    SFP-SX
```

Xcvr 7	REV 01	740-011613	E08H01273	SFP-SX
Xcvr 8	REV 02	740-011613	AM0951SFFWK	SFP-SX
PIC 1		BUILTIN	BUILTIN	10x 1GE(LAN) SFP
Xcvr 0	REV 01	740-011613	E08H00516	SFP-SX
Xcvr 1	REV 01	740-011613	E08G03648	SFP-SX
Xcvr 2	REV 01	740-011613	E08H00514	SFP-SX
...				

The **show interfaces terse** command output displays the Gigabit Ethernet interfaces that correspond to the 20 ports located on the MIC.

```
user@host> show interfaces terse ge-3*
```

Interface	Admin	Link	Proto	Local	Remote
ge-3/0/0	up	down			
ge-3/0/1	up	down			
ge-3/0/2	up	down			
ge-3/0/3	up	up			
ge-3/0/4	up	up			
ge-3/0/5	up	up			
ge-3/0/6	up	up			
ge-3/0/7	up	up			
ge-3/0/8	up	up			
ge-3/0/9	up	down			
ge-3/1/0	up	up			
ge-3/1/1	up	up			
ge-3/1/2	up	up			
ge-3/1/3	up	down			
ge-3/1/4	up	down			
ge-3/1/5	up	down			
ge-3/1/6	up	down			
ge-3/1/7	up	down			
ge-3/1/8	up	down			
ge-3/1/9	up	down			

**See Also** • [MX960 Router Hardware and CLI Terminology Mapping on page 10](#)

## MX960 Modular Port Concentrator Description

Modular Port Concentrators (MPCs) provide packet forwarding services. The MPCs are inserted into a slot in a router. Modular Interface Cards (MICs) provide the physical interfaces and install into the MPCs. You can install up to two MICs of different media types on the same MPC as long as the MPC supports those MICs.

A specialized fixed configuration MPC provides higher port density over MICs and combines packet forwarding and Ethernet interfaces onto a single line card. The fixed configuration MPC is inserted into a slot in a router and contains no slots for MICs.

MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received. Each MPC is equipped with up to four Junos Trio chipsets, which perform control functions tailored to the MPC's media type. The

MPCs interface with the power supplies and Switch Control Boards (SCBs). You must install redundant SCBs to support full line rate.

The MX960 router supports up to 12 MPCs. You must install a high-capacity fan tray to use an MPC. For power requirements, see [“Calculating Power Requirements for MX960 Routers” on page 152](#).

The router has 11 dedicated line-card slots for DPCs, MPCs, or FPCs. MPCs install vertically in the front of the router. The dedicated slots are numbered **0** through **5**, and **7** through **11**, left to right. An additional multifunction slot labeled **2/6** supports either an SCB, a DPC, an FPC, or an MPC. An MPC can be installed in any slot that supports MPCs. You can install any combination of MPC types in the router.

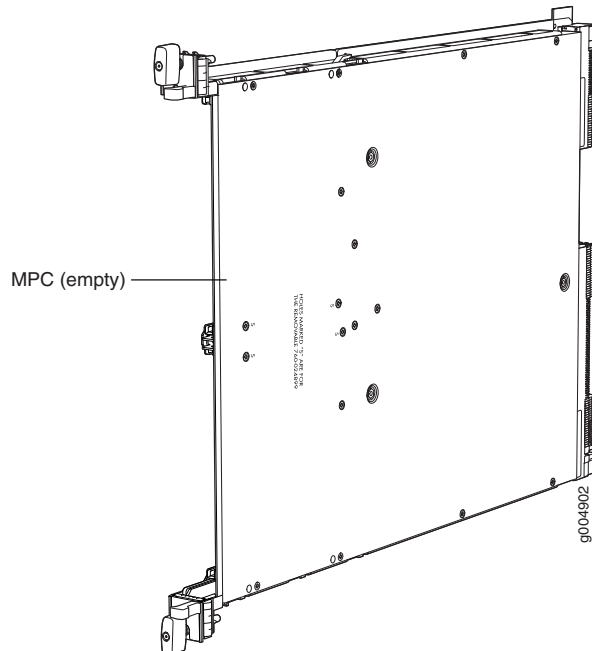
When a slot is not occupied by an MPC or other line card, you must insert a blank DPC panel to fill the empty slot and ensure proper cooling of the system.

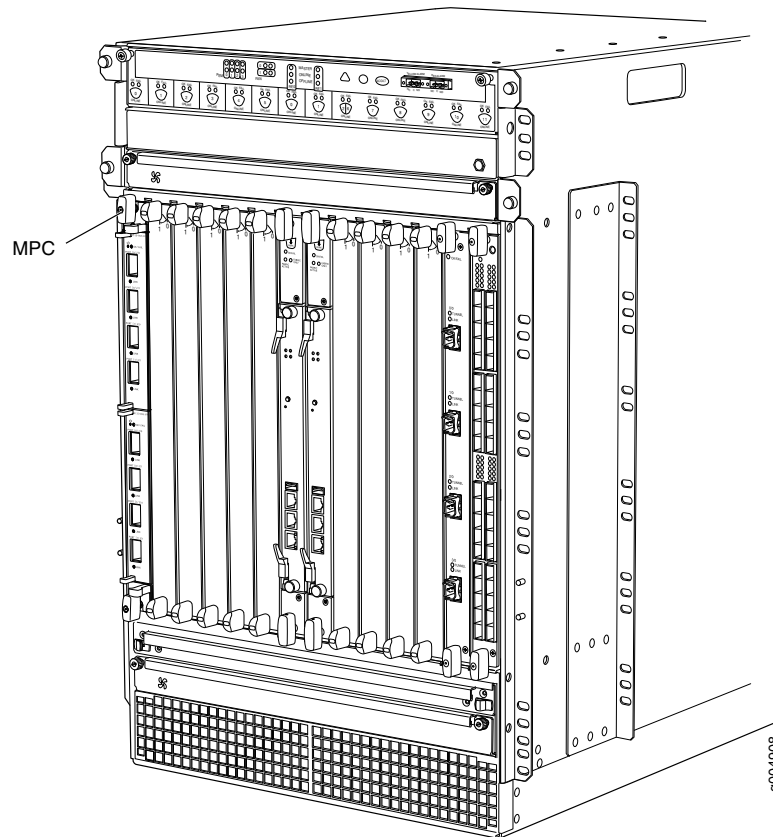
MPCs are hot-removable and hot-insertable. When you install an MPC in an operating router, the Routing Engine downloads the MPC software, the MPC runs its diagnostics, and the Packet Forwarding Engines housed on the MPC are enabled. Forwarding on other MPCs continues uninterrupted during this process.

[Figure 27 on page 77](#) shows a typical MPC supported on the MX960 router.

[Figure 28 on page 78](#) shows an MPC installed vertically in the MX960 router. For more information about MPCs, see the *MX Series Ethernet Services Routers Line Card Guide*.

**Figure 27: Typical MPC Supported on the MX960 Router**



*Figure 28: MPC Installed Vertically in the MX960 Router*

### MPC Components

Each MPC consists of the following components:

- MPC card carrier, which includes two MIC slots (excludes the fixed configuration MPC).
- Fabric interfaces.
- Two Gigabit Ethernet interfaces that allow control information, route information, and statistics to be sent between the Routing Engine and the CPU on the MPCs.
- Two interfaces from the SCBs that enable the MPCs to be powered on and controlled.
- Physical MPC connectors.
- Up to four Junos Trio chipsets, which perform control functions tailored to the MPC's media type.
- Midplane connectors and power circuitry.
- Processor subsystem, which includes a 1.5-GHz CPU, system controller, and 1 GB of SDRAM.

- Online button which takes the MPC online or offline when pressed.
- **OK/Fail** LED on the MPC faceplate. For more information about LEDs on the MPC faceplate, see the [MX Series Interface Module Reference](#).

Two LEDs, located on the craft interface above the MPC, display the status of the line cards and are labeled **OK** and **FAIL**.

- See Also**
- [MPCs Supported by MX Series Routers on page 79](#)
  - [MX960 Modular Port Concentrator LEDs on page 79](#)
  - [MX960 Field-Replaceable Units on page 255](#)
  - [Maintaining MX960 MPCs on page 461](#)
  - [Troubleshooting the MX960 MPCs on page 494](#)
  - [Replacing an MX960 MPC on page 374](#)

### MX960 Modular Port Concentrator LEDs

Two LEDs, located on the craft interface above the MPC, display the status of the line cards and are labeled **OK** and **FAIL**. For more information about the line card LEDs on the craft interface, see “[MX960 DPC and MPC LEDs on the Craft Interface](#)” on page 16.

Each MPC also has LEDs located on the faceplate. For more information about LEDs on the MPC faceplate, see the “LEDs” section for each MPC in the [MX Series Interface Module Reference](#).

- See Also**
- [MX960 Modular Port Concentrator Description on page 76](#)
  - [Maintaining MX960 MPCs on page 461](#)
  - [Troubleshooting the MX960 MPCs on page 494](#)
  - [Replacing an MX960 MPC on page 374](#)

### MPCs Supported by MX Series Routers

[Table 34 on page 80](#) lists the MPCs and their first supported Junos OS release on MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 routers.

Table 34: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	First Junos OS Release on MX10008 Routers
<b>Fixed Configuration MPCs</b>							
<i>16x10GE MPC</i>	MPC-3D-16XGE-SFP	10.0R2	15.1F7	12.3	12.3	–	–
<i>Multiservices MPC</i>	MS-MPC	13.2R4	15.1F7	15.1	15.1	–	–
<i>32x10GE MPC4E</i>	MPC4E-3D-32XGE-SFPP	12.3R2	15.1F7	12.3R2	12.3R2	–	–
<i>2x100GE + 8x10GE MPC4E</i>	MPC4E-3D-2CGE-8XGE	12.3R2	15.1F7	12.3R2	12.3R2	–	–
<i>6x40GE + 24x10GE MPC5E</i>	MPC5E-40G10G	13.3R2	15.1F7	13.3R2	13.3R2	–	–
<i>6x40GE + 24x10GE MPC5EQ</i>	MPC5EQ-40G10G	13.3R2	15.1F7	13.3R2	13.3R2	–	–
<i>2x100GE + 4x10GE MPC5E</i>	MPC5E-100G10G	13.3R3	15.1F7	13.3R3	13.3R3	–	–
<i>2x100GE + 4x10GE MPC5EQ</i>	MPC5EQ-100G10G	13.3R3	15.1F7	13.3R3	13.3R3	–	–
<i>MPC7E (Multi-Rate)</i>	MPC7E-MRATE	<ul style="list-style-type: none"> <li>• 15.1F4 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	15.1F7	<ul style="list-style-type: none"> <li>• 15.1F4 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	<ul style="list-style-type: none"> <li>• 15.1F4 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	–	–
<i>MPC7E 10G</i>	MPC7E-10G	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	15.1F7	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	–	–

**Table 34: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers (continued)**

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	First Junos OS Release on MX10008 Routers
<b>MPCs</b>							
<i>MPC1</i>	MX-MPC1-3D	10.2	15.1F7	12.3	12.3	–	–
<i>MPC1E</i>	MX-MPC1E-3D	11.2R4	15.1F7	12.3	12.3	–	–
<i>MPC1 Q</i>	MX-MPC1-3D-Q	10.2	15.1F7	12.3	12.3	–	–
<i>MPC1E Q</i>	MX-MPC1E-3D-Q	11.2R4	15.1F7	12.3	12.3	–	–
<i>MPC2</i>	MX-MPC2-3D	10.1	15.1F7	12.3	12.3	–	–
<i>MPC2E</i>	MX-MPC2E-3D	11.2R4	15.1F7	12.3	12.3	–	–
<i>MPC2 Q</i>	MX-MPC2-3D-Q	10.1	15.1F7	12.3	12.3	–	–
<i>MPC2E Q</i>	MX-MPC2E-3D-Q	11.2R4	15.1F7	12.3	12.3	–	–
<i>MPC2 EQ</i>	MX-MPC2-3D-EQ	10.1	15.1F7	12.3	12.3	–	–
<i>MPC2E EQ</i>	MX-MPC2E-3D-EQ	11.2R4	15.1F7	12.3	12.3	–	–
<i>MPC2E P</i>	MX-MPC2E-3D-P	12.2	15.1F7	12.3	12.3	–	–
<i>MPC2E NG</i>	MX-MPC2E-3D-NG	14.1R4, 14.2R3 and Junos Continuity  15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity  15.1	14.1R4, 14.2R3 and Junos Continuity  15.1	–	–
<i>MPC2E NG Q</i>	MX-MPC2E-3D-NG-Q	14.1R4, 14.2R3 and Junos Continuity  15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity  15.1	14.1R4, 14.2R3 and Junos Continuity  15.1	–	–
<i>MPC3E</i>	MX-MPC3E-3D	12.1	15.1F7	12.3	12.3	–	–

**Table 34: MPCs Supported by MX240, MX480, MX960, MX2008, MX2010, MX2020, and MX10003 Routers (continued)**

MPC Name	MPC Model Number	First Junos OS Release on MX240, MX480, and MX960 Routers	First Junos OS Release on MX2008 Routers	First Junos OS Release on MX2010 Routers	First Junos OS Release on MX2020 Routers	First Junos OS Release on MX10003 Routers	First Junos OS Release on MX10008 Routers
<i>MPC3E NG</i>	MX-MPC3E-3D-NG	14.1R4, 14.2R3 and Junos Continuity  15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity  15.1	14.1R4, 14.2R3 and Junos Continuity  15.1	–	–
<i>MPC3E NG Q</i>	MX-MPC3E-3D-NG-Q	14.1R4, 14.2R3 and Junos Continuity  15.1	15.1F7	14.1R4, 14.2R3 and Junos Continuity  15.1	14.1R4, 14.2R3 and Junos Continuity  15.1	–	–
<i>MPC6E</i>	MX2K-MPC6E	–	15.1F7	13.3R2	13.3R2	–	–
<i>MPC8E</i>	MX2K-MPC8E	–	15.1F7	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	–	–
<i>MPC9E</i>	MX2K-MPC9E	–	15.1F7	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	<ul style="list-style-type: none"> <li>• 15.1F5 with Junos Continuity</li> <li>• 16.1R1 and later</li> </ul>	–	–
<i>MX10003 MPC (Multi-Rate)</i>	MX10003-LC2103	–	–	–	–	17.3	–
<i>Line card (MX10K-LC2101)</i>	JNP10K-LC2101	–	–	–	–	–	18.2R1

- See Also**
- [MX Series MPC Overview](#)
  - [MIC/MPC Compatibility on page 57](#)
  - [MX Series MIC Overview](#)
  - [MICs Supported by MX Series Routers on page 65](#)



- *Junos Continuity Software Overview*
- [Pathfinder: Hardware Supported by Junos Continuity Software](#)



## CHAPTER 6

# Power System Components and Descriptions

- [MX960 Power System Overview on page 85](#)
- [MX960 AC Power Supply Description on page 86](#)
- [MX960 AC Power Supply LEDs on page 91](#)
- [MX960 DC Power Supply on page 92](#)
- [MX960 DC Power Supply LEDs on page 93](#)

## MX960 Power System Overview

---

The MX960 router uses either AC or DC power supplies. The MX960 router is configurable with three or four normal-capacity AC power supplies, up to four high-capacity DC power supplies, and up to four high-capacity AC power supplies. The power supplies connect to the midplane, which distributes the different output voltages produced by the power supplies to the router components, depending on their voltage requirements.



**CAUTION:** The router cannot be powered from AC and DC power supplies simultaneously. The first type of power supply detected by the router when initially powered on determines the type of power supply allowed by the router. All installed power supplies of the other type are disabled by the router. If you install a power supply of the other type while the router is operating, the router disables the power supply and generates an alarm.

All power supplies are hot-removable and hot-insertable. Each power supply is cooled by its own internal cooling system.

Unlike systems with previous MX960 AC supplies, the systems with MX Series high-capacity power supplies are zoned. No current sharing between power supplies is needed with the upgraded system because the redundancy changes from 3+1 per system to 1+1 per zone. For MX960 AC configurations, two zones are present. Two adjacent power supplies need to be installed in the chassis with two feeds attached.



**NOTE:** Two AC power cables are required when installing the high-capacity AC power supplies.



**NOTE:** Routers configured with DC power supplies are shipped with a blank panel installed over the power distribution modules. Routers configured with AC power supplies have no blank panel.



**NOTE:** When upgrading to enhanced power supplies, always upgrade power supplies in adjacent slots.

**Related  
Documentation**

- [Troubleshooting the MX960 Power System on page 496](#)
- [MX960 AC Power Supply Description on page 86](#)
- [MX960 DC Power Supply on page 92](#)

---

## MX960 AC Power Supply Description

The MX960 requires special power supplies that are not interchangeable with the MX240, MX480, or the MX2000 series routers. Two types of AC power supplies can be used: normal-capacity or high-capacity. Each AC power supply has a corresponding AC appliance inlet located in the MX960 chassis directly above the power supply. Additionally, high-capacity AC power supplies have an AC appliance inlet on the power supply itself. Each inlet requires a dedicated AC power feed and a dedicated 15 A (250 VAC) circuit breaker for the normal-capacity power supply and 38 A (264 VAC) circuit breaker for the high-capacity power supply. One power cord per feed is required. See [“AC Power Cord Specifications for the MX960 Router” on page 156](#) for more details.

Normal-capacity and high-capacity AC power supply configurations are zoned meaning that certain components in the MX960 chassis are powered by specific power supplies. Normal-capacity AC power supply configurations have one overall zone that provides power to all components in the MX960 chassis. High-capacity AC power supply configurations have two zones that provide power to specific components in the MX960 chassis.

[Figure 29 on page 87](#) and [Figure 30 on page 87](#) illustrate normal-capacity and high-capacity AC power supplies for the MX960.

Figure 29: MX960 Normal-Capacity AC Power Supply

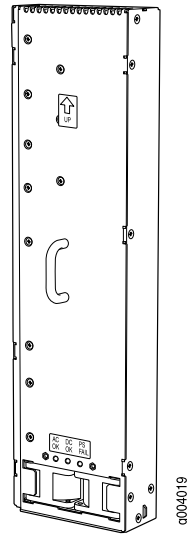
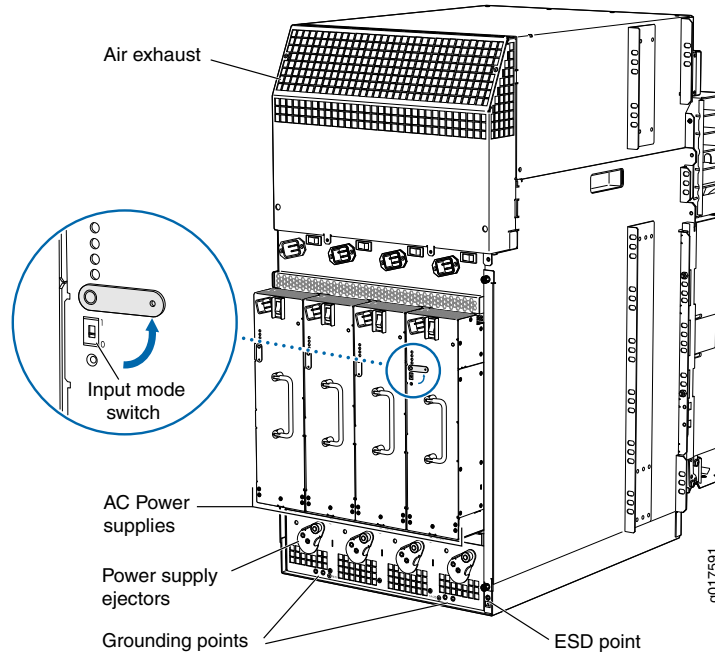


Figure 30: MX960 with High-Capacity AC Power Supplies Installed



The minimum number of power supplies must be present in the router at all times. Refer to [Table 35 on page 87](#).

Table 35: Minimum Number of Power Supplies Required for the MX960

Router Model	Configuration	Minimum Required Number of Power Supplies	Model Number
MX960	High-capacity AC	One per zone x two zones = 2 power supplies	PWR-MX960-4100-AC

Table 35: Minimum Number of Power Supplies Required for the MX960 (continued)

MX960	Normal-capacity AC	2	PWR-MX960-AC
-------	--------------------	---	--------------

- [Normal-Capacity AC Power Supplies on page 88](#)
- [High-Capacity AC Power Supplies on page 88](#)
- [Understanding Input Mode Switch \(DIP Switch\) Settings on page 89](#)

## Normal-Capacity AC Power Supplies

The MX960 can be powered by three normal-capacity AC power supplies (non-redundant configuration) or four normal-capacity AC power supplies (redundant configuration). In a non-redundant configuration, the three AC power supplies share power almost equally within a fully-populated MX960 system. In a redundant configuration there is full power redundancy meaning if one power supply fails or is removed, the remaining power supplies instantly assume the entire electrical load without interruption and provide full power for the maximum configuration for as long as the router is operational.



**NOTE:** Each normal-capacity power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker. Juniper recommends that you use a 15 A (250 VAC) minimum, or as required by local code.

## High-Capacity AC Power Supplies

The MX960 can also be powered by two high-capacity AC power supplies. The high-capacity power supplies must be installed in adjacent slots in the chassis. They can operate in one-feed mode or two-feed mode. The maximum inrush current for a high-capacity AC power supply is 38A per feed at 264VAC.

In one-feed mode, the power supplies output power at a reduced capacity (1700W). In two-feed mode, the power supplies provide power at full capacity (4100W). To operate the MX960 at full capacity, you must use two-feed mode. High-capacity power supplies require one power cord per feed. Therefore, to operate the MX960 at full capacity, you will need four power cords.

Each high-capacity AC power supply accepts two AC feeds in two unique AC receptacles, one receptacle located on the chassis and the other on the power supply.

When using the high-capacity AC power supplies in one-feed mode, plug one end of the power cord into the corresponding AC receptacle directly above the power supply in the chassis and the other end into a AC outlet. When using the high-capacity power supply in two-feed mode, you need two power cords. Plug one power cord into the AC receptacle on the chassis and then plug the other end into a AC outlet. Next, plug the second power cord into the AC receptacle on the AC power supply and plug the other end into a AC outlet.

In high-capacity AC power supply configurations, there are two zones that provide power to specific components in the MX system. No current sharing between power supplies

is needed with the high-capacity system because the redundancy changes from 3+1 per system to 1+1 per zone. [Table 36 on page 89](#) lists the components that receive power for each zone in a high-capacity AC power supply configuration.

**Table 36: Zoning for High-Capacity Power Supplies in an MX960**

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
MX960 AC high-capacity power supplies	Zone 0	PEM 0 or 2	<ul style="list-style-type: none"> <li>Lower fan tray</li> <li>DPC/MPC slots 6 through 11</li> <li>SCB slots 1 through 2</li> </ul>
MX960 AC high-capacity power supplies	Zone 1	PEM 1 or 3	<ul style="list-style-type: none"> <li>Upper fan tray</li> <li>DPC/MPC slots 0 through 5</li> <li>SCB slot 0</li> </ul>

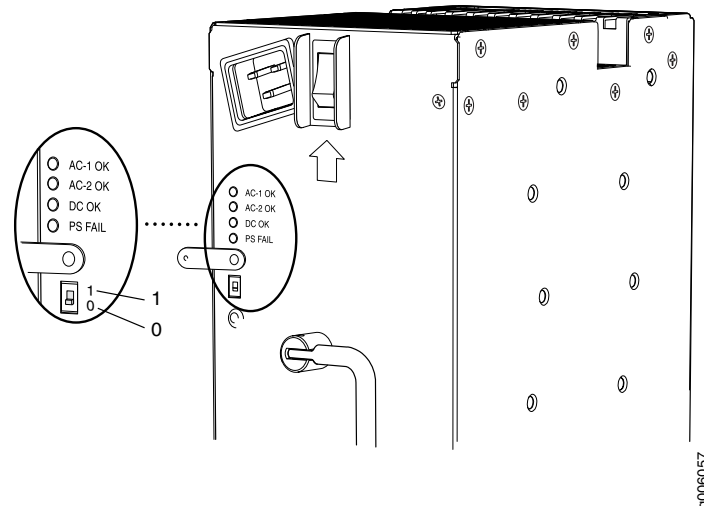
### Understanding Input Mode Switch (DIP Switch) Settings

Each PSM has two input mode switches (DIP switches) on the faceplate. The DIP switches provide critical information to the power management subsystem to help generate alarms in case of a feed failure or a wrong connection. Each PSM has an LED per feed indicating whether the feed is active and whether the feed is properly connected. You must set the DIP switch on each high-capacity AC power supply according to how many feeds are connected. When one feed is connected, the system is running in reduced capacity mode. When two feeds are connected the system is running in full-capacity mode. Use these DIP switch settings:

- **Position-0** indicates one AC feed is present
- **Position-1** indicates two AC feeds are present

Refer to [Figure 31 on page 89](#).

**Figure 31: Setting the Input Mode Switch (DIP Switch)**



Use the **show chassis power** command to verify that the DIP switch settings on the high-capacity AC power supplies are set to the correct position. Here are examples of the command output:

### Example 1: Proper setting of the DIP switch

```
user@host>show chassis power
PEM 0:
  State:      Online
  AC input:   OK (2 feed expected, 2 feed connected)
  Capacity:   4100 W (maximum 4100 W)
  DC output:  855 W (zone 0, 15 A at 57 V, 20% of capacity)

PEM 1:
  State:      Online
  AC input:   OK (1 feed expected, 1 feed connected)
  Capacity:   1700 W (maximum 4100 W)
  DC output:  969 W (zone 1, 17 A at 57 V, 57% of capacity)
```

In Example 1, **PEM 0** is running at full capacity (4100 W) with two AC feeds expected and two AC feeds connected. This indicates that the DIP switch is properly set to **Position 1** since two AC feeds are connected. The example also shows that **PEM 1** is running at reduced capacity (1700W) with one AC feed expected and one AC feed connected. This indicates that the DIP switch is correctly set to **Position 0** since one feed is present.

Example 2 shows the **show chassis power** command output when the DIP switch is set improperly:

### Example 2: Improper Setting of the DIP Switch

```
user@host>show chassis power
PEM 0:
  State:      Online
  AC input:   OK (2 feed expected, 2 feed connected)
  Capacity:   4100 W (maximum 4100 W)
  DC output:  0 W (zone 0, 0 A at 56 V, 0% of capacity)

PEM 1:
  State:      Present
  AC input:   Check (2 feed expected, 1 feed connected)
  Capacity:   1700 W (maximum 4100 W)
```

The **PEM 0** status indicates the system is **Online**, the **AC Input** is **OK**, is running at full capacity (4100 W) with two AC feeds expected and two AC feeds connected. But notice the status for **PEM 1**. The **State** is **Present** and the **AC input** is **Check (2 feed expected, 1 feed connected)**. This indicates there is a mismatch between the DIP switch setting and the number of feeds connected. Therefore, the power supply is running at reduced capacity (1700 W). If PEM 1 should be running at full-capacity, verify that there are two feeds connected to the power supplies and the DIP switch is set to position 1.

**Related Documentation**

- [MX960 Router Grounding Specifications on page 137](#)



- [Electrical Specifications for the MX960 AC Power Supply on page 143](#)
- [Calculating Power Requirements for MX960 Routers on page 152](#)
- [Power Requirements for an MX960 Router on page 144](#)
- [AC Power Circuit Breaker Requirements for the MX960 Router on page 156](#)
- [AC Power Cord Specifications for the MX960 Router on page 156](#)
- [Site Electrical Wiring Guidelines for MX Series Routers](#)
- [Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies on page 217](#)
- [Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies on page 219](#)
- [MX960 Power Supply LEDs on the Craft Interface on page 16](#)

## MX960 AC Power Supply LEDs

Each AC power supply faceplate contains three LEDs that indicate the status of the power supply (see [Table 37 on page 91](#)). The power supply status is also reflected in two LEDs on the craft interface. In addition, a power supply failure triggers the red alarm LED on the craft interface.

*Table 37: AC Power Supply LEDs*

Label	Color	State	Description
AC OK	Green	Off	AC power applied to power supply is not within the normal operating range.
		On	AC power applied to power supply is within the normal operating range.
DC OK	Green	Off	DC power outputs generated by the power supply are not within the normal operating ranges.
		On	DC power outputs generated by the power supply are within the normal operating ranges.
PS FAIL	Red	Off	Power supply is functioning normally.
		On	Power supply is not functioning normally. Check AC OK and DC OK LEDs for more information.

### Related Documentation

- [MX960 Chassis Description on page 7](#)
- [MX960 Power System Overview on page 85](#)
- [MX960 AC Power Supply Description on page 86](#)

## MX960 DC Power Supply

In the DC power configuration, the router contains either two or four DC power supplies (see [Figure 32 on page 92](#)), located at the lower rear of the chassis in slots **PEM0** through **PEM3** (left to right). You can upgrade your DC power system from two to four power supplies. The DC power supplies in slots **PEM0** and **PEM2** provide power to the lower fan tray, DPC slots **6** through **11**, and SCB slots **1** and **2**. The DC power supplies in slots **PEM1** and **PEM3** provide power to the upper fan tray, DPC slots **0** through **5**, and SCB slot **0**.

Four power supplies provide full redundancy. If a DC power supply fails, its redundant power supply takes over without interruption.

For existing power supplies, each DC power supply has a single DC input (–48 VDC and return). For high-capacity power supplies, each DC power supply has two DC inputs (–48 VDC and return).

The minimum number of power supplies must be present in the router at all times. See [Table 38 on page 92](#) for the minimum required number of power supplies.

**Table 38: Minimum Required Number of DC Power Supplies**

Router Model	Configuration	Minimum Required Number of Power Supplies	Model Number
MX960	High-capacity DC	One per zone x two zones = 2 power supplies	PWR-MX960-4100-DC
MX960	Normal-capacity DC	2	PWR-MX960-DC

**Figure 32: DC Power Supply**

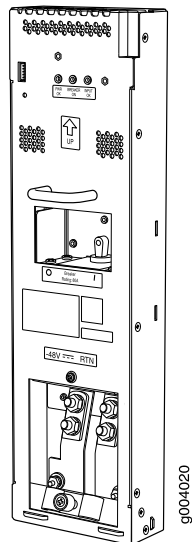
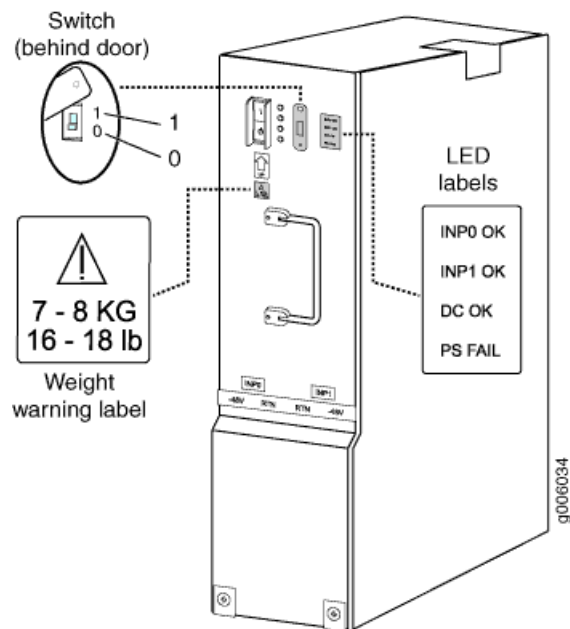


Figure 33: High-Capacity DC Power Supply



Each high-capacity DC power supply supports two DC feeds. You must set the input mode switch according to the number of DC feeds available for the power entry module (PEM). The input mode switch positions **0** and **1** indicate the following:

- **Position 0**—Indicates that only one DC feed is provided.
- **Position 1**—Indicates that two DC feeds are provided.

#### Related Documentation

- [MX960 DC Power Supply LEDs on page 93](#)
- [MX960 Router Grounding Specifications on page 137](#)
- [Calculating Power Requirements for MX960 Routers on page 152](#)
- [DC Power Circuit Breaker Requirements for the MX960 Router on page 173](#)
- [DC Power Source Cabling for the MX960 Router on page 173](#)
- [DC Power Cable Specifications for the MX960 Router on page 175](#)
- [Site Electrical Wiring Guidelines for MX Series Routers](#)

## MX960 DC Power Supply LEDs

Each DC power supply faceplate contains three LEDs that indicate the status of the power supply (see [Table 39 on page 94](#)). The power supply status is also reflected in two LEDs on the craft interface. In addition, a power supply failure triggers the red alarm LED on the craft interface.

Table 39: DC Power Supply LEDs

Label	Color	State	Description
PWR OK	Green	Off	Power supply is not functioning normally. Check the <b>INPUT OK</b> LED for more information.
		On	Power supply is functioning normally.
BREAKER ON	Green	Off	DC power supply circuit breaker is turned off.
		On	DC power supply circuit breaker is turned on.
INPUT OK	Green	Off	DC input to the PEM is not present.
		On	DC input is present and is connected in correct polarity.
	Yellow	On	DC input is present, but connected in reverse polarity.

**Related Documentation**

- [MX960 Power Supply LEDs on the Craft Interface on page 16](#)
- [MX960 Power System Overview on page 85](#)
- [MX960 AC Power Supply Description on page 86](#)
- [MX960 DC Power Supply on page 92](#)
- [Electrical Specifications for the MX960 DC Power Supply on page 159](#)

## CHAPTER 7

# Switch Control Board Components and Descriptions

- [MX-Series Switch Control Board \(SCB\) Overview on page 95](#)
- [SCBE3-MX Description on page 98](#)
- [SCBE2-MX Description on page 104](#)
- [SCBE-MX Description on page 109](#)
- [SCB-MX Description on page 112](#)

## MX-Series Switch Control Board (SCB) Overview

---

At the heart of the MX Series 5G Universal Routing Platform is the Switch and Control Board (SCB). The SCB has three primary functions: switch data between the line cards, control the chassis, and house the Routing Engine. The SCB is a single-slot card and has a carrier for the Routing Engine on the front.

Switch Control Boards control power to MPCs, monitor and control system functions such as fan speed and the system front panel, and manage clocking, resets, and boots.

Depending on the MX chassis and the level of redundancy, the number of SCBs can vary. The MX240 and MX480 require two SCBs for 1+1 redundancy, whereas the MX960 requires three SCBs for 2+1 redundancy.

There are four generations of SCBs for the MX Series 5G Universal Routing Platform: SCB-MX, SCBE-MX, SCBE2-MX, and SCBE3-MX.

- SCB-MX is the first-generation switch control board. The SCB-MX is designed to work with first-generation DPC line cards.
- The SCBE-MX is the second generation switch control board and is designed specifically for use with MPC3E line cards to provide full line-rate performance and redundancy without a loss of bandwidth.
- The SCBE2-MX provides improved fabric performance for high-capacity line cards using the third generation fabric XF2 chip (MPC4E, MPC5E, MPC2/3 NG, and MPC7E).
- The SCBE3-MX Enhanced Switch Control Board provides improved fabric performance and bandwidth capabilities for high-capacity line cards using the ZF-based switch fabric.

Table 4 on page 4 compares the SCB capacities of the MX Series 5G Universal Routing Platforms.

Table 41 on page 96 lists the supported routing engines per SCB.

**Table 40: Switch Control Board Capacities for MX Series 5G Universal Routing Platforms (Full-Duplex)**

Description	Fabric Bandwidth Per Slot	MX240 Fabric Bandwidth	MX480 Fabric Bandwidth	MX960 Fabric Bandwidth
Enhanced MX Switch Control Board (SCBE3-MX)	Up to 1.5 Tbps (non-redundant fabric configuration with MPC10E line cards); 1 Tbps (redundant fabric configuration with MPC10E line cards)	Up to 6 Tbps	Up to 18 Tbps	Up to 33 Tbps
Enhanced MX Switch Control Board (SCBE2-MX)	Up to 480 Gbps (non-redundant fabric configuration); 340 Gbps (redundant fabric configuration)	Up to 1.92 Tbps	Up to 5.76 Tbps	Up to 10.56 Tbps
Enhanced MX Switch Control Board (SCBE-MX)	Up to 240 Gbps (non-redundant fabric configuration); 160 Gbps (redundant fabric configuration)	Up to 930 Gbps	Up to 2.79 Tbps	Up to 5.25 Tbps
Switch Control Board (SCB-MX)	Up to 240 Gbps (non-redundant fabric configuration); 120 Gbps (redundant fabric configuration)	Up to 465 Gbps	Up to 1.39 Tbps	Up to 2.6 Tbps

**Table 41: Supported Routing Engines for MX Series 5G Universal Routing Platforms Switch Control Boards**

Switch Control Board	Supported Routing Engines
SCBE3-MX	RE-S-1800x2
	RE-S-1800x4
	RE-S-X6-64G
	RE-S-X6-128G
	RE-S-X6-64G-LT
SCBE2-MX	RE-S-1300 (EOLed)
	RE-S-2000 (EOLed)
	RE-S-1800*
	RE-S-X6*
SCBE-MX	RE-S-1300 (EOLed)
	RE-S-2000 (EOLed)
	RE-S-1800*

**Table 41: Supported Routing Engines for MX Series 5G Universal Routing Platforms Switch Control Boards (continued)**

Switch Control Board	Supported Routing Engines
SCB-MX	RE-S-1300 (EOLed) RE-S-2000 (EOLed) RE-S-1800

\* All variants

## CLI Identification

The SCBs are identified in the CLI as:

SCB Model	CLI Identification
SCB-MX	MX SCB
SCBE-MX	Enhanced MX SCB
SCBE2-MX	SCBE2-MX-S
SCBE3-MX	SCBE3-MX-S

```
user@host> show chassis hardware | match SCB
```

```
Item  Version  Part Number  Serial Number  Description
CB0   REV 07  710-021523  ABBC8281     MX SCB
CB1   REV 07  710-021523  ABBC8323     MX SCB
CB2   REV 07  710-021523  ABBD1410     MX SCB
```

```
user@host> show chassis hardware models | match SCBE
```

```
Item  Version  Part Number  Serial Number  Description
CB0   REV 02  750-031391  YE8505     Enhanced MX SCB
CB1   REV 07  710-031391  YL6769     Enhanced MX SCB
CB2   REV 07  710-031391  YE8492     Enhanced MX SCB
```

```
user@host> show chassis hardware models | match SCBE2
```

```
Item  Version  Part Number  Serial Number  Description
CB0   REV 01  750-062572  CAGN2123     SCBE2-MX-S
CB1   REV 07  750-062572  CAGN2456     SCBE2-MX-S
CB2   REV 07  750-062572  CAGN2789     SCBE2-MX-S
```

```
user@host> show chassis hardware models | match SCBE3
```

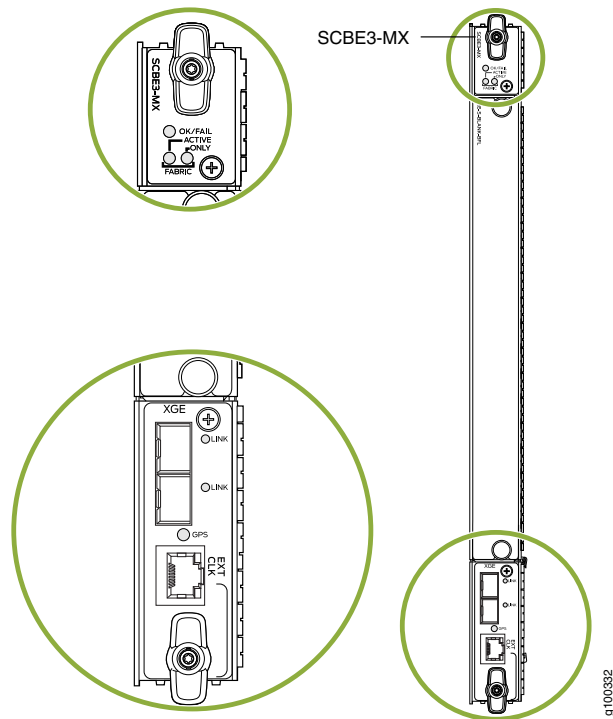
```
Item          Version  Part number  Serial number  FRU model number
```

CB 0	REV 23	750-070866	CALH6007	SCBE3-MX-S
CB 1	REV 23	750-070866	CALH6017	SCBE3-MX-S
CB 2	REV 23	750-070866	CALH6015	SCBE3-MX-S

## SCBE3-MX Description

The SCBE3-MX Enhanced Switch Control Board provides improved fabric performance and bandwidth capabilities for high-capacity line cards using the ZF-based switch fabric. In a redundant configuration, the SCBE3-MX provides fabric bandwidth of up to 1 Tbps per slot. In a non-redundant configuration the SCBE3-MX provides fabric bandwidth of up to 1 Tbps per slot (four fabric planes) and 1.5 Tbps per slot fabric bandwidth when all six fabric planes are used (with MPC10E line cards). The SCBE3-MX is supported on Junos 18.4R1 and later releases. It is installed vertically into the MX960 chassis, and horizontally in the MX480 and MX240 chassis.

Figure 34: SCBE3-MX



Software release	Junos OS Release 18.4R1 and later
	Name in CLI: <b>SCBE3-MX-S</b>



SCBE3 LEDs	<p><b>OK/FAIL</b>—A green LED indicates the board is OK. A red LED indicates the board has failed.</p> <p><b>FABRIC ACTIVE</b>—A green LED indicates the switch fabric on this board is in Active mode.</p> <p><b>FABRIC ONLY</b>—A green LED indicates the switch is in fabric-only mode and on slot 8.</p> <p><b>XGE Port LINK</b>—Indicates the status of the respective SFP+ interface.</p> <p><b>GPS EXT CLK</b>—Indicates the status of the GPS clocking interface. If the LED is green, the link is OK. If the LED is blinking amber, there is activity on the clocking interface.</p>
SCBE3-MX Weights and Dimensions	<p>Physical:</p> <ul style="list-style-type: none"> <li>• Weight: 13.6 lb (6.2 kg)</li> <li>• Width: 15.7 in (39.87 cm)</li> <li>• Depth: 21.2 in (53.85 cm)</li> <li>• Height: 1.2 in (3.05 cm)</li> </ul> <p>Shipping box:</p> <ul style="list-style-type: none"> <li>• Weight: 19.9 lb (9.03 kg)</li> <li>• Width: 24.5 in (62.2 cm)</li> <li>• Depth: 29.5 in (74.93 cm)</li> <li>• Height: 7.5 in (19.05 cm)</li> </ul>
SCBE3-MX Power and Cooling Requirements	<p>For efficient and reliable power and cooling, you must install MX-series high-capacity power supplies and fan trays in the MX chassis. Additionally, for the MX960, you must install a high-capacity filter tray.</p> <p><b>NOTE:</b> If you are using old fan trays and the internal temperature of the chassis exceeds 25° C, the chassis may overheat and a shutdown may occur.</p>

- [SCBE3-MX Components and Features on page 99](#)
- [SCBE3-MX Fabric Bandwidth Performance and Redundancy on page 100](#)
- [SCBE3-MX Maximum Power Consumption Per Ambient Temperature and CB slot on page 102](#)
- [SCBE3-MX Interoperability with Existing Hardware on page 102](#)
- [SCBE3-MX Unsupported Functions and Capabilities from Legacy SCBs on page 104](#)

## SCBE3-MX Components and Features

Component/Feature	Description
XGE ports	Two Ethernet ports provide 10 GE/1 GE SFP+ interfaces. These ports also are connected to the Ethernet control switch which limits the traffic for the 10 GE port and provides security to prevent unwanted access to the control plane via the external ports.
GPS port	One RJ-45 GPS external clock interface port receives GPS and PPS timing from the GPS external interface. A red LED indicates there is no clock present or the clock is not OK. A green LED indicates the clock interface is active and OK. If the LED is off, the clock interface is not enabled.
External clock interface	The external clock interface is on the SCBE3-MX front panel. The clock source interface receives GPS and PPS timing from the GPS external interface.

Component/Feature	Description
Centralized Stratum3E clock module	The clock module performs clock monitoring, filtering, and holdover on the centralized fabric card. This centralized clocking architecture also provides clock cleanup and distribution.
In-system removable Routing Engine	The in-system Routing Engine can support any new Routing Engine that conforms to the standard modular Routing Engine I/O interface and form factor.  <b>NOTE:</b> When a Routing Engine is not installed in the SCBE3-MX, you need to cover the empty slot with a blank panel.
Hot-Swappable	The SCBE3-MX and associated Routing Engine assembly are hot-swappable. The system software provides a mechanism to shut down, or acquiesce the Routing Engine/SCBE3-MX. The system software also provides a method to reset or reboot the Routing Engine/SCBE3-MX. This support is provided via cli commands, and various hardware support circuits.  <b>NOTE:</b> The Routing Engine must be brought offline prior to removal to avoid possible corruption of the hard drive.
System upgrade capabilities	See <a href="#">"Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX" on page 435</a> for details.
Redundancy	With three SCBE3-MX's installed, the MX960 router provides 2 + 1 redundancy. With two SCBE3-MX's installed, the MX240 router and MX480 router provide 1 + 1 redundancy.
DMR	Supports Dynamic Multicast Replication (DMR)
GRES	Supports Graceful Routing Engine Switchover (GRES)
MPC line cards	Supports the MPCs listed in <a href="#">Table 42 on page 102</a> .
Hitless Operation	Allows you to upgrade programmable parts and reboot with "hitless" operation if the redundant SCBE3-MX's are inserted in the system and are operational.
Removable Routing Engine Module	You can remove the Routing Engine module FRU in the existing form factor.

## SCBE3-MX Fabric Bandwidth Performance and Redundancy

### MX960 Routers

- The MX960 system may contain up to three SCBE3-MX's to provide a total of six switch fabric planes for packet forwarding among the MPCs. Two fabric planes per SCBE3-MX's are required. To achieve full fabric bandwidth performance, three SCBE3-MX's must be installed in the MX960 chassis.
- Two chassis slots are provided in the center of the MX960 chassis in slots 6 and 7 (also designated as slot SCB 0 and slot SCB 1) for two SCBE3-MXs, each equipped with a Routing Engine.
- To provide 2 + 1 fabric redundancy for an MX960, a third SCBE3-MX must be installed in slot 8 (also designated as slot SCB 2).

- Slot 8 in the MX960 chassis is a dual-purpose slot, and supports either an SCBE3-MX or an MPC. When the SCBE3-MX/Routing Engine are plugged into slot 8, the Routing Engine is powered down and does not provide any control functionality for the board or the MX960. The fabric-only LED on the card faceplate will be lit when an SCBE3-MX/Routing Engine assembly is plugged into slot 8.
- Once redundancy is configured, the master SCBE3-MX controls the chassis.
- Graceful upgrades can be achieved on a non-master redundant SCBE3-MX.
- In a redundant configuration, the non-master redundant Routing Engine can be removed or installed without affecting the switching plane functionality on the SCBE3-MX in which it resides.
- In a non-redundant configuration, all six fabric planes will be in Active mode for increased fabric bandwidth.
- There is one ZF-based switch fabric per SCBE3-MX and it acts as two virtual planes in MX960.

#### MX480 and MX240 Routers

- You can install either one or two SCBE3-MX's in the MX480 and MX240 router chassis in the slots labeled 0 and 1.
- The SCBE3-MX in slot 0 (SCB 0) provides two fabric planes; the SCBE3-MX in slot 1 (SCB 1) provides four fabric planes. A total of six fabric planes are available in the MX240 and MX480 routers.
- In redundant configuration, two fabric planes on the first SCBE3-MX and two fabric planes on the other SCBE3-MX will be in Active mode.
- There is one ZF-based switch fabric per SCBE3-MX and it acts as four virtual planes in the MX480 and MX240.

Two SCBE3-MX's installed in the MX240 or MX480 are required for 1 + 1 redundancy. To provide 1 + 1 fabric redundancy, there must be an SCBE3-MX installed in slot 1.



#### NOTE:

- If SCB 0 fails, SCB 1 will be automatically configured with four fabric planes active. In this fail over scenario, the SCBE3-MX will support full line rate 100% redundancy.
- If SCB 1 fails, SCB 0 has only two available fabric planes; therefore, in this failover mode, the line rate will drop to 50%.

## SCBE3-MX Maximum Power Consumption Per Ambient Temperature and CB slot



**NOTE:** These power consumption values are for the SCBE3-MX only. They do not include re-allocated power.

MX Model	Ambient Temperature	Maximum Power Consumption	Slot
MX960	55°C	425W	SCB 0, SCB 1, SCB 2
	40°C	400W	
	25°C	385W	
MX480	55°C	295W	SCB 0 (Master)
	40°C	280W	
	25°C	265W	
MX480	55°C	425W	SCB 1 (Backup)
	40°C	400W	
	25°C	385W	
MX240	55°C	275W	SCB 0 (Master)
	40°C	260W	
	25°C	245W	
MX240	55°C	295W	SCB 1 (Backup)
	40°C	280W	
	25°C	265W	

## SCBE3-MX Interoperability with Existing Hardware

Table 42: SCBE3 Interoperability with MPCs and Routing Engines

SCBE3-MX Operating Mode	MX240/480/960	Supported
	DPC/MS-DPC	No

Table 42: SCBE3 Interoperability with MPCs and Routing Engines (continued)

SCBE3-MX Operating Mode	MX240/480/960	Supported
Enhanced IP/Enhanced Ethernet Mode Only	MS-MPC	Yes
	MPC1E	No
	MPC2E	No
	MPC2E-NG	Yes
	MPC3E	Yes
	MPC3E-NG	Yes
	MPC4E	Yes
	16x10GE MPC	No
	MPC5E	Yes
	MPC6E	No
	MPC7E (480 Gbps)	Yes
	MPC8E (960 Gbps)	No
	MPC9E (1.6 Tbps)	No
	MPC10E (1.5 Tbps)	Yes
Supported Routing Engines	RE-S-1300 (EOLed)	no
	RE-S-2000 (EOLed)	no
	RE-S-1800 (all variants)	yes
	RE-S-X6 (all variants)	yes



**NOTE:** Enhanced IP is the default network service on the SCBE3-MX.



**NOTE:** Hyper-mode is the default forwarding mode on the SCBE3-MX. If your deployment does not need hyper-mode, disable hyper-mode using the `set forwarding-options no-hyper-mode` cli command before installing the Routing Engine into the SCBE3-MX.

## SCBE3-MX Unsupported Functions and Capabilities from Legacy SCBs

- The SCBE3-MX does not support the external UTI/DTI interface (front panel LED and daughter card interface).
- The SCBE3-MX does not interoperate with any previous generation SCBs (SCB, SCBE, and SCBE2). Smooth upgrade is not supported.
- The SCBE3-MX does not support the MPC1/2 NEO line card or legacy I-chip based line cards.
- Due to certain limitations in functionality, the MPC7E is not supported in slot 1 when the SCBE3-MX is plugged in to an MX960 PREMIUM3/BASE3 system. If you have an MPC7E in slot 1, move it to a different slot before installing the SCBE3-MX.
- The SCBE3-MX does not support BITS.
- The SCBE3-MX does not support DPCs.
- The SCBE3-MX does not support mixed mode (DPC+MPC).
- The SCBE3-MX does not support the JAM release.
- The SCBE3-MX does not support MACsec.

### Related Documentation

- [Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX on page 435](#)

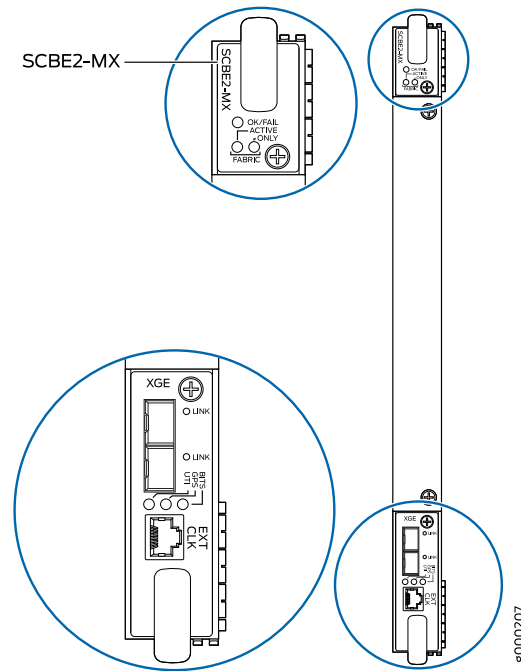
---

## SCBE2-MX Description

The MX Enhanced Switch Control Board (SCBE2-MX) serves the carrier Ethernet services router and carrier Ethernet transport markets that require higher-capacity traffic support, demanding greater interface density (slot and capacity scale) as well as improved services. The SCBE-MX is supported on MX960, MX480, and MX240 routers.

The SCBE2-MX is installed vertically in the MX960 chassis and horizontally in the MX480 and MX240 chassis. The routing engine is installed directly into a slot on the SCBE2-MX (see [Figure 35 on page 105](#)).

Figure 35: SCBE2-MX



- Software release
- Junos OS Release 13.3 R1 and later
  - Name in CLI: **SCBE2**

Requirements For proper cooling, you must install MX-series high-capacity fan trays in the MX chassis. Additionally, for the MX960, you must install a high-capacity filter tray.

- SCBE2-MX Features
- Provides improved fabric performance for high-capacity line cards using the third generation fabric XF2 chip.
  - Provides bandwidth of up to 340 Gbps per slot with redundant fabric support and 480 Gbps per slot without redundant fabric support.
  - Provides a central clocking module and a centralized clocking architecture that supports clock cleanup and distribution. The Stratum 3 clock module performs clock monitoring, filtering, and holdover at a centralized chassis location.
  - Supports dynamic multicast replication.
  - Supports GRES.
  - Supports MPC line cards. Does not support DPCs.
  - Allows you to configure the system such that one SCBE2-MX supports a GPS interface, and the other SCBE2-MX supports a BITS interface.
  - Provides support for cross-coupling of clock input. This requires an enhanced midplane:
    - MX960—CHAS-BP3-MX960-S
    - MX480—CHAS-BP3-MX480-S
    - MX240—CHAS-BP3-MX240-S

- |                     |   |
|---------------------|---|
| SCBE2-MX Components | <ul style="list-style-type: none"> <li>• Control Board and Routing Engine (CB-RE) mastership mechanism.</li> <li>• External clock interface—Allows BITS or GPS clock source input to the centralized timing circuit, or allows centralized timing to be output to BITS or GPS.</li> <li>• Switch fabric—Provides switching functions for MPCs.</li> <li>• 1000Base-T Ethernet controller—Provides a 1Gbps Ethernet link between the Routing Engines.</li> <li>• Power circuits for the Routing Engine and the SCBE2-MX.</li> <li>• LEDs—Provide status of the SCBE2-MX and the clocking interface.</li> </ul> |
|---------------------|---|

- |                |  |
|----------------|--|
| SCBE2-MX Slots | <p>For the MX960:</p> <ul style="list-style-type: none"> <li>• You can install up to three SCBE2-MX's in the MX960 router chassis.</li> <li>• SCBE2-MX's are installed vertically into the front of the MX960 chassis in the slots labeled 0, 1, and 2. If any slots are empty, you must install a blank panel.</li> <li>• The two SCBE2-MX's residing in slot 6 and slot 7 of the MX960 chassis provide both control and switch fabric features, while the third SCBE2-MX residing in slot 8 of the chassis (hybrid slot) will only do fabric functions.</li> </ul> <p>For the MX480 and MX240 routers:</p> <ul style="list-style-type: none"> <li>• You can install either one or two SCBE2-MX's in the MX480 and MX240 router chassis. SCBE2-MX's are installed horizontally into the front of the MX480 and MX240 chassis in the slots labeled 0 and 1. If any slots are empty, you must install a blank panel.</li> </ul> |
|----------------|--|

- |                                       |   |
|---------------------------------------|---|
| SCBE2-MX Fabric Planes and Redundancy | <p>For the MX960:</p> <ul style="list-style-type: none"> <li>• Each SCBE2-MX provides two switch fabric planes for packet forwarding among the MPCs in the MX960.</li> <li>• The MX960 chassis may contain up to three SCBE2-MX's. Therefore, six fabric planes are available.</li> <li>• Three SCBE2-MX's are required for 2 + 1 redundancy.</li> <li>• In redundant fabric mode, four fabric planes from the first two SCBE2-MX's will be in Active mode, and two fabric planes from the third SCBE2-MX will be in Spare mode.</li> <li>• In a non-redundant fabric mode, all six fabric planes will be in Active mode to increase fabric bandwidth.</li> </ul> <p>For the MX240 and MX480 routers:</p> <ul style="list-style-type: none"> <li>• Each SCBE2-MX provides four switch fabric planes for packet forwarding among the MPCs in the MX480 and MX240 chassis.</li> <li>• The MX480 and MX240 routers contain a maximum of two SCBE2-MX's. Therefore, eight logical planes are available.</li> <li>• Two SCBE2-MX's are required for 1 + 1 redundancy.</li> <li>• In redundant fabric mode, four fabric planes from the first SCBE2-MX will be in Active mode, and four fabric planes from the second SCBE2-MX will be in Spare mode.</li> <li>• In a non-redundant fabric mode, all eight fabric planes will be in Active mode to provide increased fabric bandwidth.</li> <li>• Each fabric ASIC is configured in virtual plane mode, where two virtual planes exist on one fabric ASIC.</li> </ul> |
|---------------------------------------|---|

- |                       |   |
|-----------------------|---|
| Weight and Dimensions | <ul style="list-style-type: none"> <li>• Weight: 9.6 lb (4.4 kg) (with Routing Engine installed)</li> <li>• Width: 17 in (43.2 cm)</li> <li>• Depth: 22 in (55.9 cm)</li> <li>• Height: 1.25 in (3.2 cm) height.</li> </ul> |
|-----------------------|---|



Maximum Power Requirements	SCBE2-MX (applies to MX240, MX480, and MX960) 185 W at 55° C 160 W at 40° C 155 W at 25° C
----------------------------	---

- LEDs
- **FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL** LEDs indicate the status of the SCBE2-MX.
  - The **BITS**, **GPS**, and **UTI** LEDs, located next to the **EXT CLK** port, indicate the status of the respective clocking interface.
  - The **LINK** LED located next to the two Ethernet ports, indicate the status of the respective SFP+ interface.

For more information about the SCBE2-MX LEDs, see *SCBE2-MX LEDs*.

### SCBE2-MX Interoperability with Existing Hardware

SCBE2 Operating Mode	MX240/480/960	Supported
Enhanced IP/Enhanced Ethernet Mode Only	DPC/MS-DPC	No
	MS-MPC	Yes
	MPC1	Yes
	MPC2	Yes
	MPC3	Yes
	MPC4	Yes
	MPC2-NG	Yes
	MPC3-NG	Yes
	16x10GE MPC	Yes
	MPC5	Yes
	MPC6	No
	MPC7 (480 Gbps)	Yes
	MPC8 (960 Gbps)	No
	MPC9 (1.6 Tbps)	No

SCBE2 Operating Mode	MX240/480/960	Supported
Routing Engines	RE-S-1300 (EOLed)	yes
	RE-S-2000 (EOLed)	yes
	RE-S-1800 (all variants)	yes
	RE-S-X6 (all variants)	yes

## SCBE2-MX LEDs

**FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL** LEDs indicate the status of the SCBE2-MX. The **BITS**, **GPS**, and **UTI** LEDs, located next to the **EXT CLK** port, indicate the status of the respective clocking interface. The **LINK** LED located next to the two Ethernet ports, indicate the status of the respective SFP+ interface. [Table 43 on page 108](#) describes the functions of the SCBE2-MX LEDs.

*Table 43: SCBE2-MX LEDs*

Label	Color	State	Description
<b>FABRIC ACTIVE</b>	Green	On steadily	Fabric is in active mode.
<b>FABRIC ONLY</b>	Green	On steadily	SCBE2-MX operates in fabric-only mode.
	–	Off	SCBE2-MX operates in fabric or control-board mode.
<b>OK/FAIL</b>	Green	On steadily	SCBE2-MX is online.
	Red	On steadily	SCBE2-MX has failed.
	–	Off	SCBE2-MX is offline.
<b>BITS</b>	Green	On steadily	Building-integrated timing supply (BITS) clocking interface is active.
	Red	On steadily	BITS clocking interface has failed.
	–	Off	BITS clocking interface is offline.
<b>GPS</b>	Green	On steadily	Global positioning system (GPS) clocking interface is active.
	Red	On steadily	GPS clocking interface has failed.
	–	Off	GPS clocking interface is offline.

Table 43: SCBE2-MX LEDs (continued)

Label	Color	State	Description
UTI	Green	On steadily	Universal Timing Interface (UTI) clocking interface is active.
	Red	On steadily	UTI clocking interface has failed.
	–	Off	UTI clocking interface is offline.
LINK	Green	On steadily	Port is enabled and link is established.
	–	Off	Port is disabled or no link is established.

## SCBE-MX Description

The MX Enhanced Switch Control Board (SCBE-MX) for MX960, MX480, and MX240 routers serves the carrier Ethernet services router and carrier Ethernet transport markets that require higher-capacity traffic support, demanding greater interface density (slot and capacity scale), as well as improved services. The SCBE-MX provides:

- 160 Gbps/slot bandwidth with redundant fabric support, and improved fabric performance by using the next-generation fabric (XF) chip
- A central clocking module and a centralized clocking architecture that supports clock cleanup and distribution. The Stratum 3 clock module performs clock monitoring, filtering, and holdover in a centralized chassis location
- Full performance with fabric redundancy for higher capacity line cards such as 16x10GE and MPC3

The Routing Engine installs directly into a slot on the SCBE-MX (see [Figure 36 on page 110](#)).

Figure 36: SCBE-MX

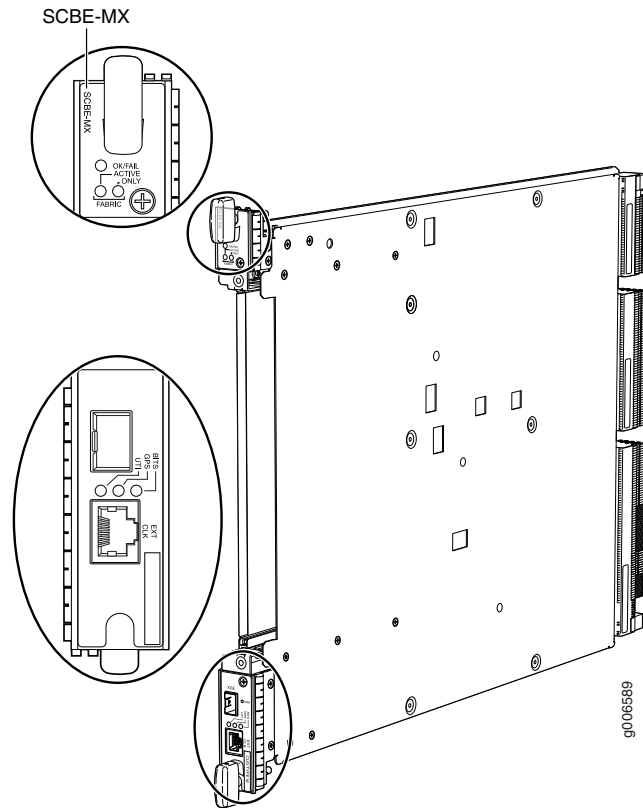


Table 44 on page 110 lists the maximum number of SCBE-MXs you can install in the MX chassis, the corresponding slot labels, and the backup slot used for redundancy. If any slots are empty, you must install a blank panel.

Table 44: SCBE-MX Specifications

Chassis	Maximum SCBE-MXs	Slot Labels	Backup Slot
MX960	3	0, 1, and 2	2
MX480	2	0 and 1	1
MX240	2	0 and 1	1

## Routing Engines and MPCs for the SCBE-MX

The SCBE-MX supports the routing engines and MPCs in Table 45 on page 111.

Table 45: Supported Routing Engines and MPCs for the SCBE-MX

Supported Routing Engines	Supported MPCs
RE-S-1300	MPC3e
RE-S-1800 (all variants)	MPC3e
RE-S-2000	MPC3e

## SCBE-MX LEDs

The **FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL** LEDs indicate the status of the SCBE-MX. The **BITS**, **GPS**, and **UTI** LEDs (next to the **EXT CLK** port) indicate the status of the respective clocking interface. [Table 46 on page 111](#) describes the behavior of the SCBE-MX LEDs.

Table 46: SCBE-MX LEDs

Label	Color	State	Description
<b>FABRIC ACTIVE</b>	Green	On steadily	Fabric is in active mode.
<b>FABRIC ONLY</b>	Green	On steadily	SCBE-MX operates in fabric-only mode.
	–	Off	SCBE-MX operates in fabric/control board mode.
<b>OK/FAIL</b>	Green	On steadily	SCBE-MX is online.
	Red	On steadily	SCBE-MX has failed.
	–	Off	SCBE-MX is offline.
	Red	On steadily	GPS clocking interface has failed.
	–	Off	GPS clocking interface is offline.
<b>NOTE:</b> The LEDs <b>BITS</b> , <b>GPS</b> , and <b>UTI</b> are not currently supported.			
<b>BITS</b>	Green	On steadily	Building-integrated timing supply (BITS) clocking interface is active.
	Red	On steadily	BITS clocking interface has failed.
	–	Off	BITS clocking interface is offline.
<b>GPS</b>	Green	On steadily	Global positioning system (GPS) clocking interface is active.
	Red	On steadily	GPS clocking interface has failed.
	–	Off	GPS clocking interface is offline.

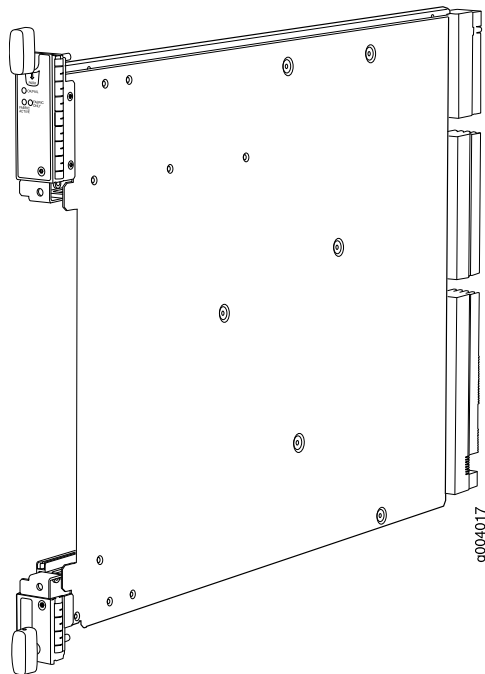
Table 46: SCBE-MX LEDs (continued)

Label	Color	State	Description
UTI	Green	On steadily	Universal Timing Interface (UTI) clocking interface is active.
	Red	On steadily	UTI clocking interface has failed.
	–	Off	UTI clocking interface is offline.

## SCB-MX Description

The MX Switch Control Board (SCB-MX) provides control plane functions, chassis management functions, and switch plane functions for MX960, MX480, and MX240 routers. It is also a carrier for the Routing Engine which installs directly into a slot on the SCB-MX. See [Figure 37 on page 112](#).

Figure 37: SCB-MX



- |                  |   |
|------------------|---|
| Software release | <ul style="list-style-type: none"> <li>• Junos OS Release 12.3 R1 and later</li> <li>• Name in CLI: <b>SCB</b></li> </ul> |
|------------------|---|

SCB-MX Functions	<ul style="list-style-type: none"> <li>• Powers on and powers off DPCs, FPCs, and MPCs.</li> <li>• Controls clocking, system resets, and booting.</li> <li>• Monitors and controls system functions, including fan speed, board power status, power distribution module status and control, and the craft interface</li> <li>• Provides Ethernet connectivity to all processors in the chassis for control plane communications.</li> <li>• Provides bandwidth of up to 160 Gbps per slot with redundant fabric support.</li> <li>• Provides interconnections to all the DPCs, FPCs, and MPCs within the chassis through the switch fabrics integrated into the SCB-MX.</li> </ul>
SCB-MX Components	<ul style="list-style-type: none"> <li>• Control Board and Routing Engine (CB-RE) mastership mechanism.</li> <li>• External clock interface—Allows BITS or GPS clock source input to the centralized timing circuit, or allows centralized timing to be output to BITS or GPS.</li> <li>• Switch fabric—Provides switching functions for MPCs.</li> <li>• 1000Base-T Ethernet controller—Provides a 1 Gbps Ethernet link between the Routing Engines.</li> <li>• Power circuits for the Routing Engine and the SCBE2-MX.</li> <li>• LEDs—Provide status of the SCBE2-MX and the clocking interface.</li> </ul>
SCB-MX Slot Numbers	<p>For the MX960:</p> <ul style="list-style-type: none"> <li>• You can install up to three SCB-MXs in the MX960 chassis for a total of six switch fabrics and six fabric planes. The SCB-MXs install vertically into the front of the MX960 chassis in the slots labeled <b>0</b>, <b>1</b>, and <b>2/6</b>.</li> </ul> <p><b>NOTE:</b> On the MX960, either a SCB-MX or a DPC can be plugged into slot 8. A third SCB-MX is used only for switch fabric redundancy. Therefore, if an application does not require switch fabric redundancy, a DPC can be used in slot 8.</p> <p>For the MX480 and MX240 routers:</p> <ul style="list-style-type: none"> <li>• You can install one or two SCB-MXs in the MX240 and MX480 for a total of four switch fabrics and eight fabric planes. The SCB-MX installs horizontally into the front of the chassis in the slots labeled <b>0</b> and <b>1</b>. If any slots are empty, you must install a blank panel.</li> </ul>
Weight and Dimensions	<ul style="list-style-type: none"> <li>• Weight: 9.6 lb (4.4 kg) (with Routing Engine installed)</li> <li>• Width: 17 in (43.2 cm)</li> <li>• Depth: 22 in (55.9 cm)</li> <li>• Height: 1.25 in (3.2 cm) height.</li> </ul>

## SCB-MX Fabric Planes and Redundancy

For MX960 routers:

- Each SCB-MX provides two switch fabric planes for packet forwarding among the DPCs and MPCs in the MX960.
- The MX960 chassis may contain up to three SCB-MX's. Therefore, six fabric planes are available.
- The MX960 provides 2 + 1 SCB-MX redundancy when used with DPC line cards.
- In redundant fabric mode, four fabric planes from the first two SCB-MX's will be in Active mode, and two fabric planes from the third SCB-MX will be in Spare mode.
- In a non-redundant fabric mode, all six fabric planes will be in Active mode to increase fabric bandwidth.
- SCB-MXs installed in slots 0 and 1 provide non-redundant fabric connections. An SCB-MX installed in slot 2/6, in conjunction with SCB-MXs in slots 0 and 1, provides redundant fabrics, but the Routing Engine installed on it receives no power and provides no additional routing functions. If no SCB-MX is installed in slot 2/6, you must install a blank panel in the slot.

For MX240 and MX480 routers:

- Each fabric ASIC is configured in virtual plane mode, where two virtual planes exist on one fabric ASIC. This means that the MX240 and MX480 require only a single SCB-MX to provide line rate throughput, and an additional SCB-MX to provide 1 + 1 SCB redundancy.
- In redundant fabric mode, four virtual planes from the first SCB-MX will be in Active mode, and four virtual planes from the second SCB-MX will be in Spare mode.
- In a non-redundant fabric mode, all eight virtual planes will be in Active mode to provide the maximum fabric bandwidth.

## Maximum Power Requirements

SCB-MX (applies to MX240, MX480, and MX960)

185 W at 55° C

160 W at 40° C

155 W at 25° C

## SCB-MX LEDs

Three LEDs on the SCB indicate the status of the SCB. The LEDs, labeled **FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL**, are located directly on the SCB. [Table 47 on page 114](#) describes the functions of the SCB LEDs.

*Table 47: SCB-MX LED Descriptions*

Label	Color	State	Description
<b>FABRIC ACTIVE</b>	Green	On steadily	Fabric is in active mode.
<b>FABRIC ONLY</b>	Green	On steadily	SCB-MX operates in fabric-only mode.
	–	Off	SCB-MX operates in fabric/control board mode.
<b>OK/FAIL</b>	Green	On steadily	SCB-MX is online.
	Red	On steadily	SCB-MX has failed.
	–	Off	SCB-MX is offline.



## SCB-MX Fabric Plane Scale and Redundancy

Each of the fabric planes on the SCB-MX is able to process 20 Gbps of bandwidth. The MX240 and MX480 use eight fabric planes across two SCB-MXs, whereas the MX960 uses six fabric planes across three SCB-MX's. Because of the fabric plane virtualization, the aggregate fabric bandwidth between the MX240, MX480, and MX960 is different. Refer to [Table 48 on page 115](#).

**Table 48: SCB-MX Fabric Plane Scale and Redundancy Assuming Four PFEs per FPC**

SCB-MX	MX240	MX480	MX960
PFEs	12	24	48
SCBs	2	2	3
Switch Fabrics	4	4	6
Fabric Planes	8	8	6
Spare Planes	4 (1+1 SCB-MX redundancy)	4 (1+1 SCB-MX redundancy)	2 (2+1 SCB-MX redundancy)
Fabric Bandwidth Per Slot	160 Gbps	160 Gbps	120 Gbps

## Supported Routing Engines

The SCB-MX supports the following routing engines (REs):

- *RE-S-1300 Routing Engine Description*
- *RE-S-2000 Routing Engine Description*
- *RE-S-1800 Routing Engine Description*



## PART 2

# Site Planning, Preparation, and Specifications

- [Preparation Overview on page 119](#)
- [Transceiver and Cable Specifications on page 131](#)
- [Pinout Specifications on page 137](#)
- [AC Power Requirements, Specifications, and Guidelines on page 143](#)
- [DC Power Requirements, Specifications, and Guidelines on page 159](#)



## CHAPTER 8

# Preparation Overview

- [MX960 Router Physical Specifications on page 119](#)
- [MX960 Router Environmental Specifications on page 122](#)
- [MX960 Site Preparation Checklist on page 122](#)
- [MX960 Rack Requirements on page 123](#)
- [Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router on page 126](#)
- [MX960 Cabinet Size and Clearance Requirements on page 128](#)
- [MX960 Cabinet Airflow Requirements on page 128](#)

## MX960 Router Physical Specifications

---

[Table 49 on page 119](#) summarizes the physical specifications for the router chassis.

*Table 49: Physical Specifications*

Description	Weight	Width	Depth	Height
Standard chassis dimensions	Standard chassis with midplane, two fan trays, air filter, and standard cable manager: 150 lb (68.04 kg)  Standard chassis with maximum configuration: 350 lb (158.76 kg)  Standard chassis with components removed: 150 lb (68.04 kg)	17.37 in. (44.11 cm) (excluding the mounting flanges or brackets)	23.0 in. (58.42 cm) (from front-mounting flange to chassis rear)  Total depth (including standard cable manager) 27.75 in. (70.49 cm)	27.75 in. (70.49 cm)

---

Table 49: Physical Specifications (continued)

Description	Weight	Width	Depth	Height
Router with extended cable manager installed	<p>Chassis with midplane, two fan trays, air filter, and extended cable manager: 174 lb (78.93 kg)</p> <p>Chassis with extended cable manager and maximum configuration: 374 lb (169.64 kg)</p> <p>Chassis with components removed: 174 lb (78.93 kg)</p>	17.37 in. (44.11 cm) (excluding the mounting flanges or brackets)	<p>23.0 in. (58.42 cm) (from front-mounting flange to chassis rear)</p> <p>Total depth (including extended cable manager) approximately 29.00 in. (73.7 cm)</p>	36.5 in. (92.7 cm) high
Router with high-capacity power supplies installed	<p>Standard chassis with midplane, two fan trays, air filter, and standard cable manager: 195 lb (88.45 kg)</p> <p>Standard chassis with maximum configuration: 395 lb (179.17 kg)</p> <p>Standard chassis with components removed: 195 lb (88.45 kg)</p>	17.37 in. (44.11 cm) (excluding the mounting flanges or brackets)	<p>Router with high-capacity power supplies installed. Depth with high-capacity AC power supply is 30.65" (77.9 cm); depth with high-capacity DC power supply is 32.85" (83.4 cm).</p>	27.75 in. (70.49 cm)
Craft interface	1.5 lb (0.68 kg)	17 in (43.2 cm)	8.5 in (21.6 cm)	6.25 in (15.9 cm)
DPC	<p>Maximum up to 14.5 lb (6.6 kg)</p> <p>Blank panel in DPC slot: 9 lb</p>	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
FPC	<p>FPC2: 15 lb (6.8 kg)</p> <p>FPC3: 14 lb (6.5 kg)</p>	17 in (43.2 cm)	22 in (55.9 cm)	2.5 in (6.4 cm)
PIC	2 lb (0.9 kg)	7.75 in (28.3 cm)	11.125 in (19.7 cm)	4.125 in (10.5 cm)
MPC weight (fixed configuration)	18.35 lb (8.3 kg)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
MPC (without MICs)	14 lb (6.4 kg)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)

Table 49: Physical Specifications (continued)

Description	Weight	Width	Depth	Height
MIC	Maximum up to 1.2 lb (0.54 kg)	6.25 in (15.9 cm)	6.8 in (17.3 cm)	1.25 in (3.2 cm)
AC power supply	5 lb (2.3 kg) each	14.5 in (36.8 cm)	4 in (10.2 cm)	1.75 in (4.4 cm)
High-capacity AC power supply	11.9 lb (5.4 kg) each	14.5 in (36.8 cm)	6.85 in (12.92 cm)	1.75 in (4.4 cm)
DC power supply	3.8 lb (1.7 kg)	14.5 in (36.8 cm)	4 in (10.2 cm)	1.75 in (4.4 cm)
High-capacity DC power supply	15.8 lb (7.2 kg)	14.5 in (36.8 cm)	9.05 in (22.99 cm)	1.75 in (4.4 cm)
Air filter	1 lb (0.5 kg)	16.7 in (42.4 cm)	19.7 in (50 cm)	0.43 in (1.1 cm)
SCB	9.6 lb (4.4 kg) (with Routing Engine installed)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
SCBE	9.6 lb (4.4 kg) (with Routing Engine installed)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
SCBE2	9.6 lb (4.4 kg) (with Routing Engine installed)	17 in (43.2 cm)	22 in (55.9 cm)	1.25 in (3.2 cm)
Routing Engine	2.4 lb (1.1 kg)	11 in (27.9 cm)	7.75 in (19.7 cm)	1.25 in (3.2 cm)
Routing Engine (RE-S-1800)	2.4 lb (1.1 kg)	11 in (27.9 cm)	7.75 in (19.7 cm)	1.25 in (3.2 cm)
Routing Engine (RE-S-X6-64G)	2.69 lb (1.18 kg)	10.7 in (27.18 cm)	7.47 in (18.97 cm)	1.19 in (3.02 cm)
Upper fan tray	13 lb (5.9 kg)	16.9 in (43 cm)	20.6 in (52.3 cm)	1.4 in (3.6 cm)
Lower fan tray	13 lb (5.9 kg)	16.9 in (43 cm)	20.6 in (52.3 cm)	1.4 in (3.6 cm)
High-capacity fan tray	13 lb (5.9 kg)	16.9 in (43 cm)	20.6 in (52.3 cm)	1.4 in (3.6 cm)
Standard cable manager	4.1 lb (1.9 kg)	18.9 in (43 cm)	5.5 in (14 cm)	6.7 in (17 cm)
Extended cable manager	39 lb (2.3 kg)	24.5 in (62.2 cm)	30 in (78 cm)	24.25 in (61.6 cm)

- Related Documentation**
- [MX960 Router Overview on page 3](#)
  - [MX960 Chassis Description on page 7](#)

## MX960 Router Environmental Specifications

Table 50 on page 122 specifies the environmental specifications required for normal router operation. In addition, the site should be as dust-free as possible.

**Table 50: Router Environmental Specifications**

Description	Value
Altitude	No performance degradation to 10,000 ft (4038 m)
Relative humidity	Normal operation ensured in relative humidity range of 5% to 90%, noncondensing
Temperature	Normal operation ensured in temperature range of 32°F (0°C) to 104°F (40°C)  Nonoperating storage temperature in shipping container: –40°F (–40°C) to 158°F (70°C)
Seismic	Designed to meet Telcordia Technologies Zone 4 earthquake requirements
Maximum thermal output	AC power: 27,007 BTU/hour (7920 W)  DC power: 18,987 BTU/hour (5568 W)



**NOTE:** Install the router only in restricted areas, such as dedicated equipment rooms and equipment closets, in accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code, ANSI/NFPA 70.

### Related Documentation

- [Tools and Parts Required to Maintain the MX960 Router on page 443](#)
- [Definition of Safety Warning Levels](#)

## MX960 Site Preparation Checklist

The checklist in Table 51 on page 122 summarizes the tasks you must perform when preparing a site for router installation.

**Table 51: MX960 Site Preparation Checklist**

Item or Task	For More Information	Performed By	Date
Verify that environmental factors such as temperature and humidity do not exceed router tolerances.	<a href="#">“MX960 Router Environmental Specifications” on page 122</a>		



**Table 51: MX960 Site Preparation Checklist (continued)**

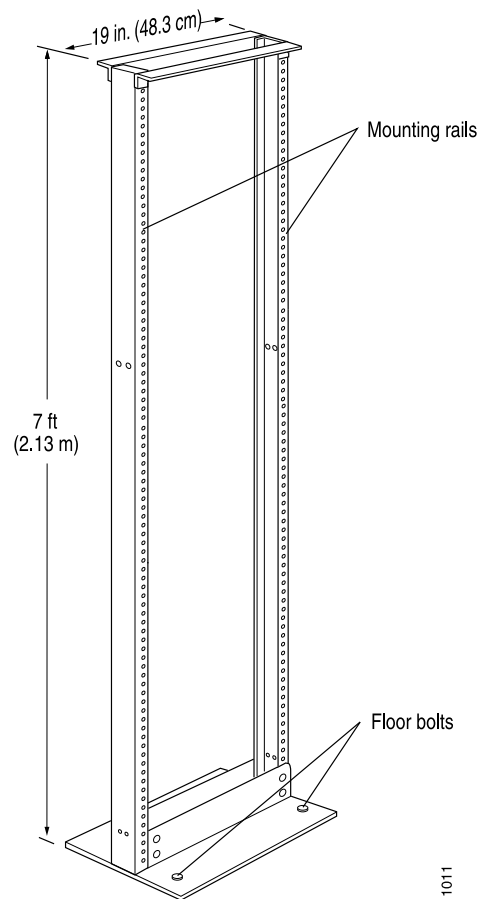
Item or Task	For More Information	Performed By	Date
Select the type of rack or cabinet.	"MX960 Cabinet Size and Clearance Requirements" on page 128, "MX960 Rack Requirements" on page 123		
Plan rack or cabinet location, including required space clearances.	"MX960 Cabinet Size and Clearance Requirements" on page 128, "MX960 Rack Requirements" on page 123, "Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router" on page 126		
If a rack is used, secure rack to floor and building structure.	"MX960 Rack Requirements" on page 123		
Acquire cables and connectors.			
Locate sites for connection of system grounding.	"MX960 Router Grounding Specifications" on page 137		
Measure distance between external power sources and router installation site.			
Calculate the optical power budget and optical power margin.	"Calculating Power Budget and Power Margin for Fiber-Optic Cables" on page 131		

- Related Documentation**
- [Installing an MX960 Router Overview on page 193](#)
  - [Unpacking the MX960 Router on page 179](#)

## MX960 Rack Requirements

The router can be installed in many types of racks, including four-post (telco) racks and open-frame racks. An example of an open-frame rack appears in [Figure 38 on page 124](#).

Figure 38: Typical Open-Frame Rack



- [Rack Size and Strength on page 124](#)
- [Spacing of Mounting Bracket Holes on page 125](#)
- [Connection to the Building Structure on page 126](#)

## Rack Size and Strength

The size, strength, and location of the rack must accommodate the router's weight and external dimensions. The location of the rack must allow for the clearance requirements specified in “[Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router](#)” on page 126.

The chassis is 17.37 in. (44.11 cm) wide. The router is designed for installation in a standard 19-in. rack, as defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronic Components Industry Association (ECIA) (<http://www.ecianow.org>). The spacing of the holes between the left and right front-mounting flanges and center-mounting brackets is 19 in. (48.3 cm) apart. However, the inner edge of the rack rails must allow sufficient space for the width of the chassis.

With the use of adapters or approved wing devices to narrow the opening between the rails, the router can fit into a 600-mm-wide rack, as defined in the four-part *Equipment*

*Engineering (EE); European telecommunications standard for equipment practice* (document numbers ETS 300 119-1 through 119-4) published by the European Telecommunications Standards Institute (<http://www.etsi.org>).

The weight, height, and depth of the router depends on the type of cable manager installed.

With the standard cable manager installed, use these guidelines:

- The rack must have sufficient vertical usable space to accommodate the height of the router: 27.75 in. (70.49 cm) high (approximately 16 U). You can stack three MX960 routers with the standard cable manager in a rack that has at least 48 U (89.3 in. or 2.24 m).



**NOTE:** A U is the standard rack unit defined in *Cabinets, Racks, Panels, and Associated Equipment* (document number EIA-310-D) published by the Electronic Components Industry Association (ECIA) (<http://www.ecianow.org>).

- The location of the rack must provide sufficient space to accommodate the depth of the router. The chassis is 23.0 in. (58.42 cm) deep, but the standard cable manager extends the depth to 28.0 in. (71.1 cm).
- The rack must be strong enough to support the weight of the fully configured router, up to 350 lb (158.76 kg). If you stack three fully configured routers, it must be capable of supporting up to 1,050 lb (476.3 kg).

With the extended cable manager installed, use these guidelines:

- The rack must have sufficient vertical usable space to accommodate the additional height of the extended cable manager: 36.5 in. (92.7 cm) high (approximately 21 U). You can stack two MX960 routers in a rack that has at least 48 U (89.3 in. or 2.24 m).
- The rack must be able to accommodate the additional depth of the extended cable manager. The chassis with the extended cable manager installed is 29.00 in. (73.7 cm) deep.
- The rack must be strong enough to support up to 374 lb (169.64 kg). If you stack two fully configured routers, it must be capable of supporting up to 748 lb (339.28 kg).

## Spacing of Mounting Bracket Holes

The holes within each set are spaced at 1 U (1.75 in. or 4.5 cm). The router can be mounted in any rack that provides holes spaced at those distances.

The router can be mounted in any rack that provides holes or hole patterns spaced at 1U (1.75 in.) increments. The mounting brackets and front-mount flanges used to attach the chassis to a rack are designed to fasten to holes spaced at those distances.

## Connection to the Building Structure

Always secure the rack to the structure of the building. If your geographical area is subject to earthquakes, bolt the rack to the floor. For maximum stability, also secure the rack to ceiling brackets.

### Related Documentation

- [Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router on page 126](#)
- [MX960 Rack-Mounting Hardware on page 13](#)
- [MX960 Cabinet Size and Clearance Requirements on page 128](#)
- [MX960 Cabinet Airflow Requirements on page 128](#)

## Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router

When planning the installation site, you need to allow sufficient clearance around the rack (see [Figure 40 on page 127](#)):

- For the cooling system to function properly, the airflow around the chassis must be unrestricted.
- For service personnel to remove and install hardware components, there must be adequate space at the front and back of the router. At least 24 in. (61 cm) is required both in front of and behind the router. NEBS GR-63 recommends that you allow at least 30 in. (76.2 cm) behind the router.

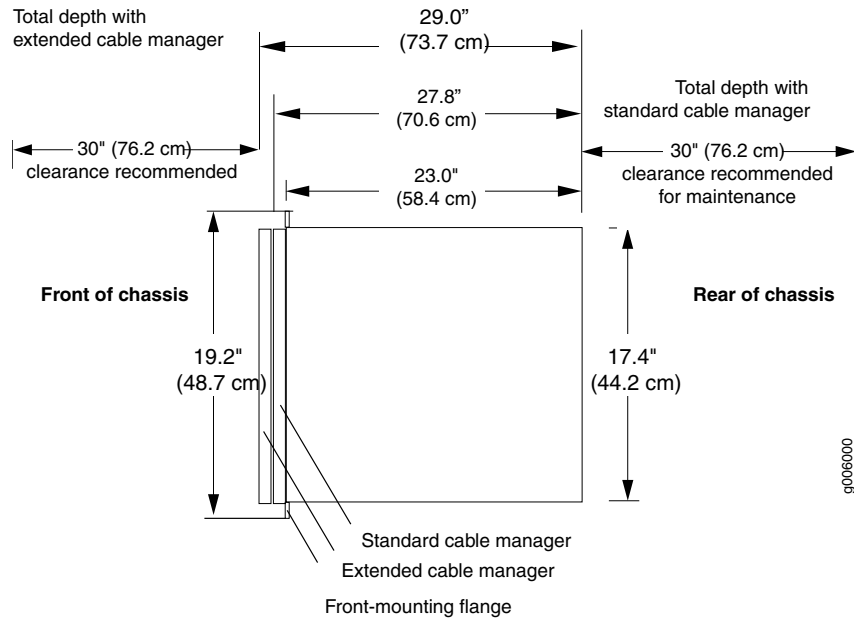
Airflow must always be from front to back with respect to the rack. The device must not interfere with the cooling of other systems in the rack. Fillers must be used as appropriate in the rack to ensure there is no recirculation of heated exhaust air back to the front of the rack. Care must also be taken around cables to ensure that no leakage of air in situations where recirculation may result.

- Additional clearance is required to accommodate the height and depth of the chassis with the extended cable manager:
  - 36.5 in. (92.7 cm) high
  - 29.00 in. (73.7 cm) deep approximately
- Additional clearance is also required to accommodate the depth of the MX960 high-capacity power supplies; they extend beyond the chassis as shown in [Table 52 on page 126](#).

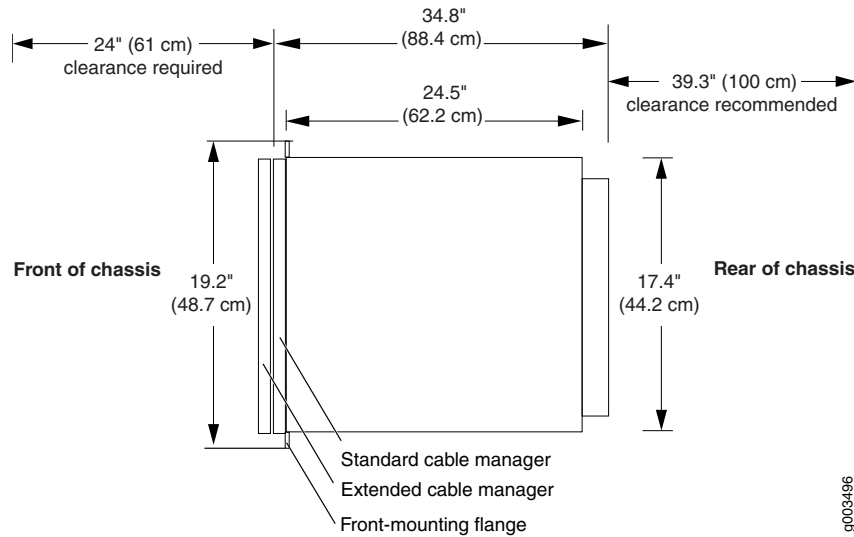
**Table 52: Clearance Requirements for High-Capacity Power Supplies**

Power Supply	Additional depth requirement
MX960 high-capacity AC power supply	2.85" (7.24 cm)
MX960 high-capacity DC power supply	5.05" (12.83 cm)

**Figure 39: Chassis Dimensions and Clearance Requirements for the MX960 Router with the Normal-Capacity Power Supplies**



**Figure 40: Chassis Dimensions and Clearance Requirements for the MX960 Router with the Standard Cable Manager and High-Capacity DC Power Supplies**



**Related Documentation**

- [MX960 Rack Requirements on page 123](#)
- [MX960 Rack-Mounting Hardware on page 13](#)
- [MX960 Cabinet Size and Clearance Requirements on page 128](#)
- [MX960 Cabinet Airflow Requirements on page 128](#)

## MX960 Cabinet Size and Clearance Requirements

---

The minimum size cabinet that can accommodate the router is 600 mm wide and 800 mm deep. A cabinet larger than the minimum requirement provides better airflow and reduces the chance of overheating. To accommodate a single router, the cabinet must be at least 16 U high. If you provide adequate cooling air and airflow clearance in a cabinet that has at least 48 U (89.3 in. or 224 mm) of usable vertical space, you can stack three routers with the standard cable manger installed, or two routers with the extended cable manager installed.

The minimum front and rear clearance requirements depend on the mounting configuration you choose. The minimum total clearance inside the cabinet is 39.4 in or 1000 mm, between the inside of the front door and the inside of the rear door.

### Related Documentation

- [Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router on page 126](#)
- [MX960 Cabinet Airflow Requirements on page 128](#)
- [MX960 Rack-Mounting Hardware on page 13](#)
- [MX960 Rack Requirements on page 123](#)

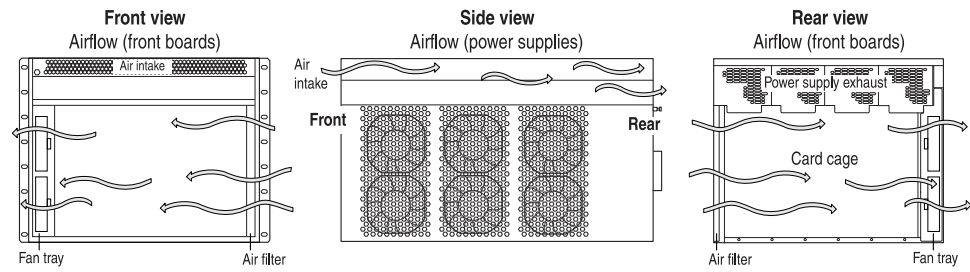
## MX960 Cabinet Airflow Requirements

---

Before you install the router in a cabinet, you must ensure that ventilation through the cabinet is sufficient to prevent overheating. Consider the following requirements to when planning for chassis cooling:

- Ensure that the cool air supply you provide through the cabinet can adequately dissipate the thermal output of the router.
- Ensure that the cabinet allows the chassis hot exhaust air to exit from the cabinet without recirculating into the router. An open cabinet (without a top or doors) that employs hot air exhaust extraction from the top allows the best airflow through the chassis. If the cabinet contains a top or doors, perforations in these elements assist with removing the hot air exhaust. For an illustration of chassis airflow, see [Figure 41 on page 129](#).
- Install the router as close as possible to the front of the cabinet so that the cable management brackets just clear the inside of the front door. This maximizes the clearance in the rear of the cabinet for critical airflow.
- Route and dress all cables to minimize the blockage of airflow to and from the chassis.

Figure 41: Airflow Through the Chassis



g004211

**Related Documentation**

- [Clearance Requirements for Airflow and Hardware Maintenance for the MX960 Router on page 126](#)
- [MX960 Cabinet Size and Clearance Requirements on page 128](#)
- [MX960 Rack Requirements on page 123](#)
- [MX960 Rack-Mounting Hardware on page 13](#)





# Transceiver and Cable Specifications

- [Calculating Power Budget and Power Margin for Fiber-Optic Cables](#) on page 131
- [Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion](#) on page 133
- [Routing Engine Interface Cable and Wire Specifications for MX Series Routers](#) on page 134

## Calculating Power Budget and Power Margin for Fiber-Optic Cables

---

Use the information in this topic and the specifications for your optical interface to calculate the power budget and power margin for fiber-optic cables.



**TIP:** You can use the [Hardware Compatibility Tool](#) to find information about the pluggable transceivers supported on your Juniper Networks device.

To calculate the power budget and power margin, perform the following tasks:

1. [Calculating Power Budget for Fiber-Optic Cable](#) on page 131
2. [Calculating Power Margin for Fiber-Optic Cable](#) on page 132

## Calculating Power Budget for Fiber-Optic Cable

To ensure that fiber-optic connections have sufficient power for correct operation, you need to calculate the link's power budget, which is the maximum amount of power it can transmit. When you calculate the power budget, you use a worst-case analysis to provide a margin of error, even though all the parts of an actual system do not operate at the worst-case levels. To calculate the worst-case estimate of power budget ( $P_B$ ), you assume minimum transmitter power ( $P_T$ ) and minimum receiver sensitivity ( $P_R$ ):

$$P_B = P_T - P_R$$

The following hypothetical power budget equation uses values measured in decibels (dB) and decibels referred to one milliwatt (dBm):

$$P_B = P_T - P_R$$

$$P_B = -15 \text{ dBm} - (-28 \text{ dBm})$$

$$P_B = 13 \text{ dB}$$

## Calculating Power Margin for Fiber-Optic Cable

After calculating a link's power budget, you can calculate the power margin ( $P_M$ ), which represents the amount of power available after subtracting attenuation or link loss (LL) from the power budget ( $P_B$ ). A worst-case estimate of  $P_M$  assumes maximum LL:

$$P_M = P_B - LL$$

$P_M$  greater than zero indicates that the power budget is sufficient to operate the receiver.

Factors that can cause link loss include higher-order mode losses, modal and chromatic dispersion, connectors, splices, and fiber attenuation. [Table 53 on page 132](#) lists an estimated amount of loss for the factors used in the following sample calculations. For information about the actual amount of signal loss caused by equipment and other factors, refer to vendor documentation.

**Table 53: Estimated Values for Factors Causing Link Loss**

Link-Loss Factor	Estimated Link-Loss Value
Higher-order mode losses	Single-mode—None Multimode—0.5 dB
Modal and chromatic dispersion	Single-mode—None Multimode—None, if product of bandwidth and distance is less than 500 MHz-km
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	Single-mode—0.5 dB/km Multimode—1 dB/km

The following sample calculation for a 2-km-long multimode link with a power budget ( $P_B$ ) of 13 dB uses the estimated values from [Table 53 on page 132](#) to calculate link loss (LL) as the sum of fiber attenuation (2 km @ 1 dB/km, or 2 dB) and loss for five connectors (0.5 dB per connector, or 2.5 dB) and two splices (0.5 dB per splice, or 1 dB) as well as higher-order mode losses (0.5 dB). The power margin ( $P_M$ ) is calculated as follows:

$$P_M = P_B - LL$$

$$P_M = 13 \text{ dB} - 2 \text{ km (1 dB/km)} - 5 (0.5 \text{ dB}) - 2 (0.5 \text{ dB}) - 0.5 \text{ dB}$$

$$P_M = 13 \text{ dB} - 2 \text{ dB} - 2.5 \text{ dB} - 1 \text{ dB} - 0.5 \text{ dB}$$

$$P_M = 7 \text{ dB}$$

The following sample calculation for an 8-km-long single-mode link with a power budget ( $P_B$ ) of 13 dB uses the estimated values from [Table 53 on page 132](#) to calculate link loss (LL) as the sum of fiber attenuation (8 km @ 0.5 dB/km, or 4 dB) and loss for seven connectors (0.5 dB per connector, or 3.5 dB). The power margin ( $P_M$ ) is calculated as follows:

$$P_M = P_B - LL$$

$$P_M = 13 \text{ dB} - 8 \text{ km} (0.5 \text{ dB/km}) - 7(0.5 \text{ dB})$$

$$P_M = 13 \text{ dB} - 4 \text{ dB} - 3.5 \text{ dB}$$

$$P_M = 5.5 \text{ dB}$$

In both examples, the calculated power margin is greater than zero, indicating that the link has sufficient power for transmission and does not exceed the maximum receiver input power.

## Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion

This topic describes signal loss, attenuation, and dispersion in fiber-optic cable.

- [Signal Loss in Multimode and Single-Mode Fiber-Optic Cable on page 133](#)
- [Attenuation and Dispersion in Fiber-Optic Cable on page 133](#)

### Signal Loss in Multimode and Single-Mode Fiber-Optic Cable

Multimode fiber is large enough in diameter to allow rays of light to reflect internally (bounce off the walls of the fiber). Interfaces with multimode optics typically use LEDs as light sources. However, LEDs are not coherent sources. They spray varying wavelengths of light into the multimode fiber, which reflects the light at different angles. Light rays travel in jagged lines through a multimode fiber, causing signal dispersion. When light traveling in the fiber core radiates into the fiber cladding, higher-order mode loss results. Together these factors limit the transmission distance of multimode fiber compared with single-mode fiber.

Single-mode fiber is so small in diameter that rays of light can reflect internally through one layer only. Interfaces with single-mode optics use lasers as light sources. Lasers generate a single wavelength of light, which travels in a straight line through the single-mode fiber. Compared with multimode fiber, single-mode fiber has higher bandwidth and can carry signals for longer distances.

Exceeding the maximum transmission distances can result in significant signal loss, which causes unreliable transmission.

### Attenuation and Dispersion in Fiber-Optic Cable

Correct functioning of an optical data link depends on modulated light reaching the receiver with enough power to be demodulated correctly. *Attenuation* is the reduction in power of the light signal as it is transmitted. Attenuation is caused by passive media components, such as cables, cable splices, and connectors. Although attenuation is significantly lower for optical fiber than for other media, it still occurs in both multimode

and single-mode transmission. An efficient optical data link must have enough light available to overcome attenuation.

*Dispersion* is the spreading of the signal over time. The following two types of dispersion can affect an optical data link:

- Chromatic dispersion—Spreading of the signal over time resulting from the different speeds of light rays.
- Modal dispersion—Spreading of the signal over time resulting from the different propagation modes in the fiber.

For multimode transmission, modal dispersion, rather than chromatic dispersion or attenuation, usually limits the maximum bit rate and link length. For single-mode transmission, modal dispersion is not a factor. However, at higher bit rates and over longer distances, chromatic dispersion rather than modal dispersion limits maximum link length.

An efficient optical data link must have enough light to exceed the minimum power that the receiver requires to operate within its specifications. In addition, the total dispersion must be less than the limits specified for the type of link in Telcordia Technologies document GR-253-CORE (Section 4.3) and International Telecommunications Union (ITU) document G.957.

When chromatic dispersion is at the maximum allowed, its effect can be considered as a power penalty in the power budget. The optical power budget must allow for the sum of component attenuation, power penalties (including those from dispersion), and a safety margin for unexpected losses.

## Routing Engine Interface Cable and Wire Specifications for MX Series Routers

Table 54 on page 134 lists the specifications for the cables that connect to management ports and the wires that connect to the alarm relay contacts.



**NOTE:** In routers where the Routing Engine (RE) and Control Board (CB) are integrated into a single board, a CB-RE is known as Routing and Control Board (RCB). The RCB is a single FRU that provides RE and CB functionality.

**Table 54: Cable and Wire Specifications for Routing Engine and RCB Management and Alarm Interfaces**

Port	Cable Specification	Cable/Wire Supplied	Maximum Length	Router Receptacle
Routing Engine console or auxiliary interface	RS-232 (EIA-232) serial cable	1.83-m length with RJ-45/DB-9 connectors	1.83 m	RJ-45 female

*Table 54: Cable and Wire Specifications for Routing Engine and RCB Management and Alarm Interfaces (continued)*

Port	Cable Specification	Cable/Wire Supplied	Maximum Length	Router Receptacle
Routing Engine Ethernet interface	Category 5 cable or equivalent suitable for 100Base-T operation	One 4.57-m length with RJ-45/RJ-45 connectors	100 m	RJ-45 autosensing
Alarm relay contacts	Wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm <sup>2</sup> )	No	None	—

**Related Documentation**

- [MX960 Routing Engine Description on page 26](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
- [Replacing an MX960 Routing Engine on page 329](#)



## CHAPTER 10

# Pinout Specifications

- [MX960 Router Grounding Specifications on page 137](#)
- [RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port on page 140](#)
- [RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports on page 141](#)

## **MX960 Router Grounding Specifications**

---

- [MX960 Chassis Grounding Points Specifications on page 137](#)
- [MX960 Router Grounding Cable Lug Specifications on page 139](#)
- [MX960 Router Grounding Cable Specifications on page 140](#)

## **MX960 Chassis Grounding Points Specifications**

To meet safety and electromagnetic interference (EMI) requirements and to ensure proper operation, the router must be adequately grounded before power is connected. To ground AC-powered and DC-powered routers, you must connect a grounding cable to earth ground and then attach it to the chassis grounding points using the two screws provided. Two threaded inserts (PEM nuts) are provided on the right of the lower rear of the chassis for connecting the router to earth ground (see [Figure 42 on page 138](#) or [Figure 43 on page 139](#)).

Figure 42: Connecting AC Power to the Router

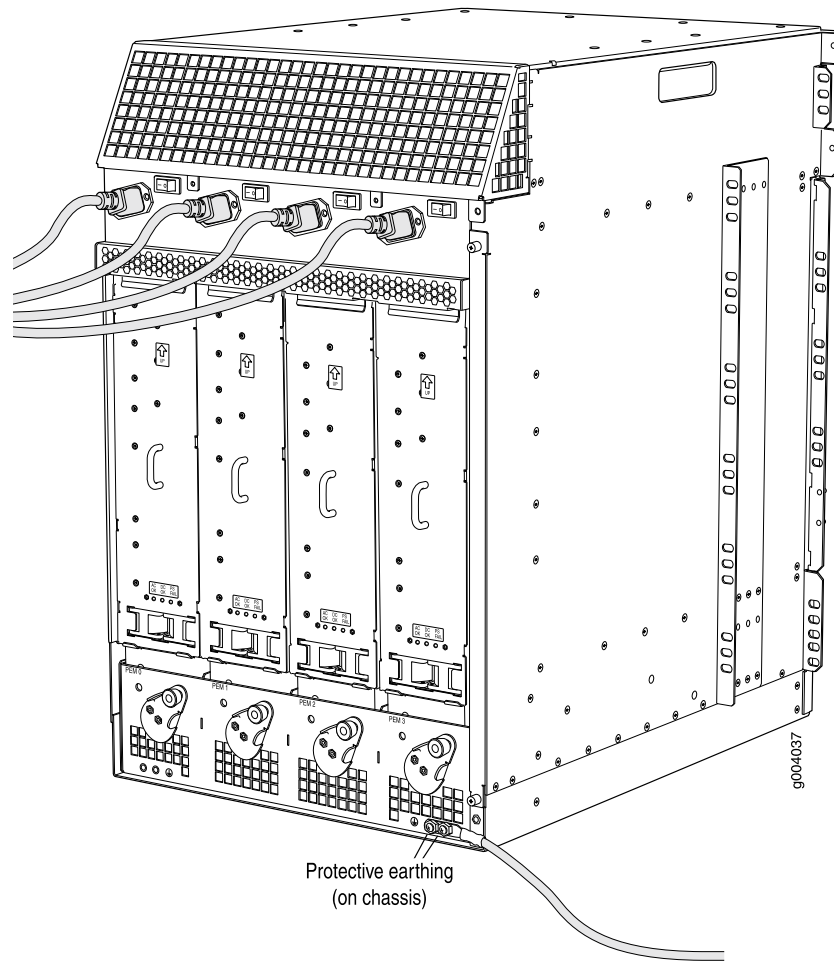
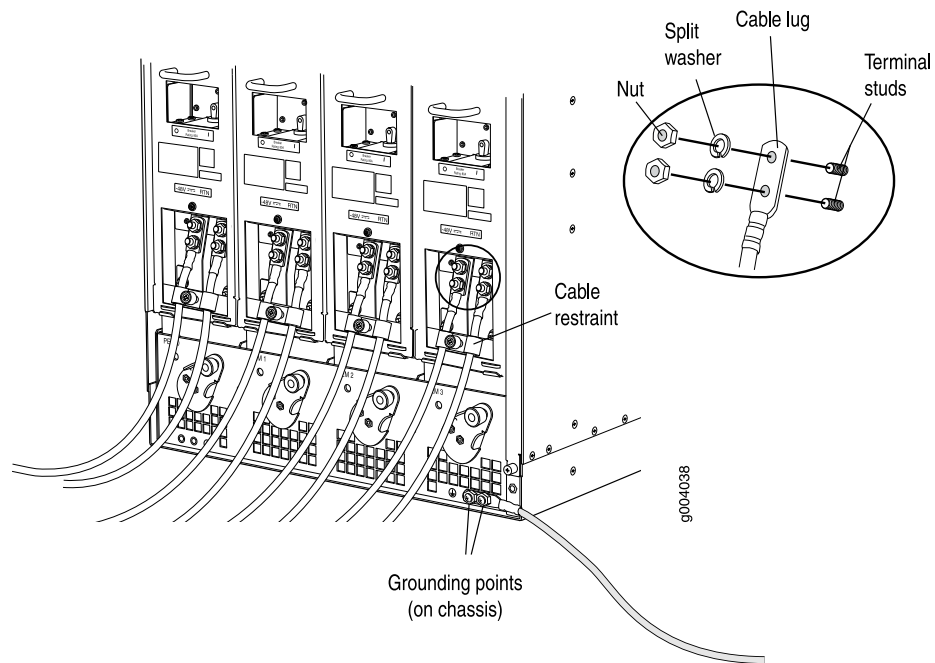




Figure 43: Connecting DC Power to the Router



### MX960 Router Grounding Cable Lug Specifications



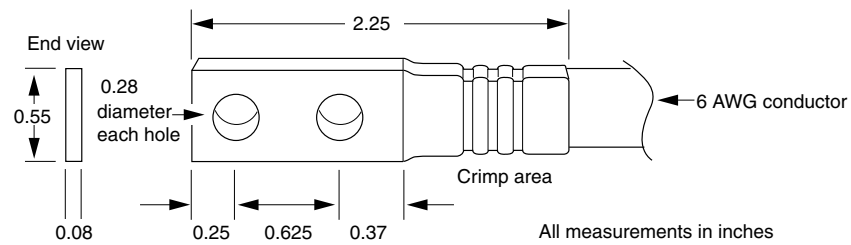
**CAUTION:** Before router installation begins, a licensed electrician must attach a cable lug to the grounding and power cables that you supply. A cable with an incorrectly attached lug can damage the router.

To ground AC-powered and DC-powered routers, connect a grounding cable to earth ground and then attach it to the chassis grounding points using two screws. The left pair of grounding points fits M6 screws (European), and the right pair fits UNC 1/4–20 screws (English). The grounding points are spaced at 0.625-in. (15.86-mm) centers. The accessory box shipped with the router includes the cable lug that attaches to the grounding cable (see [Figure 44 on page 140](#)) and two UNC 1/4–20 screws used to secure the grounding cable to the right pair of grounding points.



**WARNING:** The router is a pluggable type A equipment installed in a restricted access location. It has a separate protective earthing terminal (Metric [–M6] and English [–1/4–20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

Figure 44: Grounding Cable Lug



## MX960 Router Grounding Cable Specifications

The 48 VDC facility must be equipped with a circuit breaker rated 40 A (–48 VDC), or 60 A (–48 VDC), and the grounding cable must be minimum 10 AWG, or as required by the local code.



**NOTE:** Additional grounding is provided to an AC-powered router when you plug its power supplies into grounded AC power receptacles.



**WARNING:** The router is installed in a restricted-access location. It has a separate protective earthing terminal (Metric [–M6] and English [–¼-20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

### Related Documentation

- [Grounding the MX960 Router on page 216](#)
- [Tools and Parts Required for MX960 Router Grounding and Power Connections on page 215](#)

## RJ-45 Connector Pinouts for an MX Series Routing Engine ETHERNET Port

The port on the Routing Engine labeled **ETHERNET** is an autosensing 10/100-Mbps Ethernet RJ-45 receptacle that accepts an Ethernet cable for connecting the Routing Engine to a management LAN (or other device that supports out-of-band management). [Table 55 on page 140](#) describes the RJ-45 connector pinout.

Table 55: RJ-45 Connector Pinout for the Routing Engine ETHERNET Port

Pin	Signal
1	TX+
2	TX–
3	RX+

*Table 55: RJ-45 Connector Pinout for the Routing Engine ETHERNET Port (continued)*

Pin	Signal
4	Termination network
5	Termination network
6	RX-
7	Termination network
8	Termination network

**Related Documentation**

- [MX960 Routing Engine Description on page 26](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
- [Replacing an MX960 Routing Engine on page 329](#)

**RJ-45 Connector Pinouts for MX Series Routing Engine AUX and CONSOLE Ports**

The ports on the Routing Engine labeled **AUX** and **CONSOLE** are asynchronous serial interfaces that accept an RJ-45 connector. The ports connect the Routing Engine to an auxiliary or console management device. [Table 56 on page 141](#) describes the RJ-45 connector pinout.

*Table 56: RJ-45 Connector Pinout for the AUX and CONSOLE Ports*

Pin	Signal	Description
1	RTS	Request to Send
2	DTR	Data Terminal Ready
3	TXD	Transmit Data
4	Ground	Signal Ground
5	Ground	Signal Ground
6	RXD	Receive Data
7	DSR/DCD	Data Set Ready
8	CTS	Clear to Send

**Related Documentation**

- [MX960 Routing Engine Description on page 26](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)

- [Replacing an MX960 Routing Engine on page 329](#)

# AC Power Requirements, Specifications, and Guidelines

- [Electrical Specifications for the MX960 AC Power Supply on page 143](#)
- [Power Requirements for an MX960 Router on page 144](#)
- [Calculating Power Requirements for MX960 Routers on page 152](#)
- [AC Power Circuit Breaker Requirements for the MX960 Router on page 156](#)
- [AC Power Cord Specifications for the MX960 Router on page 156](#)

## Electrical Specifications for the MX960 AC Power Supply

Table 57 on page 143 lists the AC power supply electrical specifications. Table 58 on page 144 lists the AC power system specifications.

*Table 57: AC Power Supply Electrical Specifications*

Item	Specification
<b>Normal-Capacity Power Supply</b>	
Maximum output power	1700 W
AC nominal input voltage	Operating range: 200 to 240 VAC
AC input line frequency	50 to 60 Hz
AC input current rating	11 A @ 240 VAC maximum
Efficiency	88%
<b>NOTE:</b> This value is at full load and nominal voltage.	
<b>High-Capacity Power Supply</b>	
Maximum output power	Two-feed mode
	One-feed mode
	4100 W
	1700 W
AC nominal input voltage	Operating range: 200 to 240 VAC

Table 57: AC Power Supply Electrical Specifications (continued)

Item	Specification	
AC input line frequency	50 to 60 Hz	
AC input current rating	Two-feed mode	One-feed mode
	26 A (13 A per feed)	13 A
Maximum AC inrush current	76 A (38 A per feed at 264 VAC)	38 A per feed at 264 VAC
Efficiency	~88%	

**NOTE:** This value is at full load and nominal voltage.

Table 58: AC Power System Specifications

Item	Normal-Capacity	High-Capacity	
		All PEMs in two-feed mode	All PEMs in one-feed mode
Redundancy	3+1	2+2	2+2
Output power (maximum) per supply	1700 W	4100 W	1700 W
Output power (maximum) per system	5100 W	8200 W	3400 W

- Related Documentation**
- [MX960 AC Power Supply Description on page 86](#)
  - [Replacing an MX960 AC Power Supply on page 397](#)
  - [Installing an MX960 AC Power Supply on page 284](#)
  - [show chassis power](#)

## Power Requirements for an MX960 Router

Table 59 on page 145 lists the MX960 base system and cooling system power requirements. Table 60 on page 145 lists the FRU power requirements for Switch Control Boards (SCB), Routing Engines, Modular Port Concentrators (MPC), Modular Interface Cards (MIC), Dense Port Concentrators (DPC), and Flexible PIC Concentrators (FPC).

Typical power represents power under certain temperatures and normal operating conditions.

**Table 59: MX960 Common Component Power Requirements**

Component	Maximum Power Requirement	Typical Power Requirement
Base system	50 W	50 W
Normal-capacity cooling system	600 W (full speed)	400 W (normal speed)
High-capacity cooling system	640 W (full speed)	450 W (normal speed)

**Table 60: FRU Power Requirements**

Component	Part Number	Maximum Power Requirement
Switch Control Boards (SCB)		
<a href="#">"SCB-MX" on page 112</a>	SCB-MX (applies to MX240, MX480, and MX960)	150 W
<a href="#">"SCBE-MX" on page 109</a>	SCBE-MX (applies to MX240, MX480, and MX960)	160 W at 55° C 130 W at 40° C 120 W at 25° C
<a href="#">"SCBE2-MX" on page 104</a>	SCBE2-MX (applies to MX240, MX480, and MX960)	185 W at 55° C 160 W at 40° C 155 W at 25° C
<a href="#">"SCBE3-MX" on page 98</a>	SCBE3-MX (applies to MX240, MX480, and MX960)	275 W at 55° C 260 W at 40° C 245 W at 25° C
Routing Engines		
Routing Engines	RE-S-1300-2048 RE-S-1800X2-8G RE-S-1800X4-8G RE-S-1800X2-16G RE-S-1800X4-16G RE-S-1800X4-32G RE-S-2000-4096 RE-S-X6-64G	90 W
Fixed Configuration Modular Port Concentrators (MPC)		

Table 60: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
16x10GE MPC	MPC-3D-16XGE-SFPP	440 W at 55° C ambient
	MPC-3D-16XGE-SFPP-R-B	423 W at 25° C ambient
Multiservices MPC	MS-MPC-128G	590 W
32x10GE MPC4E	MPC4E-3D-32XGE-SFPP	610 W
		<b>With optics:</b> 607 W at 55° C, with SFPP ZR optics
		584 W at 40° C, with SFPP ZR optics
		565 W at 25° C, with SFPP ZR optics
2x100GE + 8x10GE MPC4E	MPC4E-3D-2CGE-8XGE	610 W
		<b>With optics:</b> 607 W at 55° C, with SFPP ZR and CFP LR4 optics
		584 W at 40° C, with SFPP ZR and CFP LR4 optics
		565 W at 25° C, with SFPP ZR and CFP LR4 optics
6x40GE + 24x10GE MPC5E	MPC5E-40G10G	<b>With optics:</b> 607 W at 55° C
		541 W at 40° C
		511 W at 25° C
6x40GE + 24x10GE MPC5EQ	MPC5EQ-40G10G	<b>With optics:</b> 607 W at 55° C
		541 W at 40° C
		511 W at 25° C
2x100GE + 4x10GE MPC5E	MPC5E-100G10G	<b>With optics:</b> 607 W at 55° C
		541 W at 40° C
		511 W at 25° C
2x100GE + 4x10GE MPC5EQ	MPC5EQ-100G10G	<b>With optics:</b> 607 W at 55° C
		541 W at 40° C
		511 W at 25° C
MPC7E (Multi-Rate)	MPC7E-MRATE	<b>With optics:</b> 545 W at 55° C
		465 W at 40° C
		440 W at 25° C

---

 Modular Port Concentrators (MPC)
 

---



Table 60: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>MPC1</i>	MX-MPC1-3D	165 W
<i>MPC1E</i>	MX-MPC1E-3D	With MICs and optics: 239 W at 55° C  227 W at 40° C  219 W at 25° C
<i>MPC1 Q</i>	MX-MPC1-3D-Q	175 W
<i>MPC1E Q</i>	MX-MPC1E-3D-Q	With MICs and optics: 249 W at 55° C  237 W at 40° C  228 W at 25° C
<i>MPC2</i>	MX-MPC2-3D	274 W
<i>MPC2E</i>	MX-MPC2E-3D	With MICs and optics: 348 W at 55° C  329 W at 40° C  315 W at 25° C
<i>MPC2 Q</i>	MX-MPC2-3D-Q	294 W
<i>MPC2E Q</i>	MX-MPC2E-3D-Q	With MICs and optics: 368 W at 55° C
<i>MPC2 EQ</i>	MX-MPC2-3D-EQ	347 W at 40° C
<i>MPC2E EQ</i>	MX-MPC2E-3D-EQ	333 W at 25° C
<i>MPC2E P</i>	MX-MPC2E-3D-P	294 W  With MICs and optics: 368 W at 55° C  347 W at 40° C  333 W at 25° C
<i>MPC2E NG</i>	MPC2E-3D-NG	474 W  With MICs and optics: 474 W at 55° C  417 W at 40° C  400 W at 25° C

Table 60: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>MPC2E NG Q</i>	MPC2E-3D-NG-Q	529 W  With MICs and optics: 529 W at 55° C  460 W at 40° C  438 W at 25° C
<i>MPC3E</i>	MX-MPC3E-3D	440W  With MICs and optics: 500 W at 55° C, two 40 W MICs  485 W at 40° C, two CFP MICs with LR4 optics  473 W at 25° C, two CFP MICs with LR4 optics
<i>MPC3E NG</i>	MPC3E-3D-NG	534 W  With MICs and optics: 534 W at 55° C  485 W at 40° C  461 W at 25° C
<i>MPC3E NG Q</i>	MPC3E-3D-NG-Q	583 W  With MICs and optics: 583 W at 55° C  532 W at 40° C  503 W at 25° C
Modular Interface Cards (MIC)		
<i>ATM MIC with SFP</i>	MPC4E-3D-2CGE-8XGE	610 W  With optics: 607 W at 55° C, with SFPP ZR and CFP LR4 optics  584 W at 40° C, with SFPP ZR and CFP LR4 optics  565 W at 25° C, with SFPP ZR and CFP LR4 optics

Table 60: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>Gigabit Ethernet MIC with SFP</i>	MIC-3D-20-GE-SFP	37 W
10-Gigabit Ethernet MIC with XFP	2-Port: MIC-3D-2XGE-XFP	2-Port: 29 W
	4-Port: MIC-3D-4XGE-XFP	4-Port: 37 W
<i>10-Port Gigabit Ethernet MIC with SFPP</i>	MIC3-3D-10XGE-SFPP	24.2 W at 55° C with SR and LR optics
		29.8 W at 55° C with ER optics
		29.8 W at 40° C with ZR optics
<i>40-Gigabit Ethernet MIC with QSFP+</i>	MIC3-3D-2X40GE-QSFPP	18 W
<i>100-Gigabit Ethernet MIC with CFP</i>	MIC3-3D-1X100GE-CFP	40 W
<i>100-Gigabit Ethernet MIC with CFP2</i>	MIC6-100G-CFP2	104 W
<i>100-Gigabit Ethernet MIC with CXP</i>	MIC3-3D-1X100GE-CXP	20 W
<i>100-Gigabit Ethernet MIC with CXP (4 Ports)</i>	MIC6-100G-CXP	57 W
<i>100-Gigabit DWDM OTN MIC with CFP2</i>	MIC3-100G-DWDM	<b>With optics:</b> 91 W at 55° C
		83 W at 25° C
<i>100-Gigabit DWDM OTN MIC with CFP2-ACO</i>	MIC3-100G-DWDM	<b>With optics:</b> 91 W at 55° C
		83 W at 25° C
<i>Multiservices MIC</i>	MS-MIC-16G	60 W

Table 60: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	4-Port: MIC-3D-4OC3OC12-1OC48	4-Port: 24 W at 55° C 22.75 W at 40° C 21.5 W at 25° C
	8-Port: MIC-3D-8OC3OC12-4OC48	8-Port: 29 W at 55° C 27.75 W at 40° C 26.5 W at 25° C
<i>SONET/SDH OC192/STM64 MIC with XFP</i>	MIC-3D-1OC192-XFP	41 W at 55° C 38.5 W at 40° C 36 W at 25° C
<i>Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP</i>	4-Port: MIC-3D-4CHOC3-2CHOC12	4-Port: 41 W at 55° C 40 W at 40° C 39 W at 25° C
	8-Port: MIC-3D-8CHOC3-4CHOC12	8-Port: 52 W at 55° C 50.5 W at 40° C 49 W at 25° C
<i>Tri-Rate MIC</i>	MIC-3D-40GE-TX	41 W
<i>DS3/E3 MIC</i>	MIC-3D-8DS3-E3	36 W at 55° C
	MIC-3D-8CHDS3-E3-B	35 W at 40° C 34 W at 25° C
<i>Channelized E1/T1 Circuit Emulation MIC</i>	MIC-3D-16CHE1-T1-CE	29.08 W at 55° C 27.84 W at 40° C 26.55 W at 25° C

Table 60: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP</i>	MIC-3D-4COC3-1COC12-CE	36.48 W at 55° C
		35.04 W at 40° C
		33.96 W at 25° C
Dense Port Concentrators (DPC)		
<i>Gigabit Ethernet DPC with SFP</i>	DPC-R-40GE-SFP	335 W
<i>Gigabit Ethernet Enhanced DPC with SFP</i>	DPCE-R-40GE-SFP	335 W
	DPCE-X-40GE-SFP	
<i>Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP</i> <i>Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP</i>	DPCE-R-Q-40GE-SFP	365 W
	DPCE-X-Q-40GE-SFP	
<i>Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP</i>	DPCE-R-Q-20GE-SFP	200 W
<i>10-Gigabit Ethernet DPC with XFP</i>	DPC-R-4XGE-XFP	310 W
<i>10-Gigabit Ethernet Enhanced DPC with XFP</i>	DPCE-R-2XGE-XFP	175 W
<i>10-Gigabit Ethernet Enhanced DPCs with XFP</i>	DPCE-R-4XGE-XFP	310 W
	DPCE-X-4XGE-XFP	
<i>10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP</i>	DPCE-R-Q-4XGE-XFP	330 W
	DPCE-X-Q-4XGE-XFP	
<i>Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP</i>	DPCE-R-20GE-2XGE	333 W
	DPCE-X-20GE-2XGE	
<i>Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP</i>	DPCE-R-Q-20GE-2XGE	335 W

Table 60: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>Tri-Rate Enhanced DPCor</i>	DPCE-R-40GE-TX	320 W
<i>Tri-Rate Enhanced Ethernet Services DPC</i>	DPCE-X-40GE-TX	
<i>Multiservices DPC</i>	MS-DPC	265 W
Flexible PIC Concentrators (FPC)		
FPC Type 2	MX-FPC2	190 W (with PICs and optics)
FPC Type 3	MX-FPC3	265 W (with PICs and optics)

**Related Documentation**

- [Electrical Specifications for the MX960 DC Power Supply on page 159](#)
- [Electrical Specifications for the MX960 AC Power Supply on page 143](#)

## Calculating Power Requirements for MX960 Routers

The information in this topic helps you determine which power supplies are suitable for various configurations, as well as which power supplies are not suitable because output power is exceeded. You determine suitability by subtracting the total power draw from the maximum output of the power supplies. Afterward, the required input current is calculated. Finally, you calculate the thermal output. A sample configuration is provided in [Table 36 on page 89](#).

We recommend that you provision power according to the maximum input current listed in the power supply electrical specifications (see [“Electrical Specifications for the MX960 AC Power Supply” on page 143](#) and [“Electrical Specifications for the MX960 DC Power Supply” on page 159](#)).

Use the following procedures to calculate the power requirement:

1. Calculate the power requirement.
2. Evaluate the power budget.
3. Calculate input power.
4. Calculate thermal output (BTUs) for cooling requirements.

Both normal-capacity and high-capacity MX960 chassis with DC power supplies and MX960 chassis with high-capacity AC power supplies are zoned. MX960 chassis with normal-capacity AC power supplies have one overall zone. Zoning means that certain components are powered by specific power supplies (see [Table 36 on page 89](#) for information on zoning). When calculating power requirements, be sure that there is adequate power for each zone.

Three AC power supplies are mandatory for MX960 chassis with normal-capacity AC power supplies.

**Table 61: MX960 Zoning**

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (high-capacity power supplies)	Zone 0	PEM 0 or 2	<ul style="list-style-type: none"> <li>Lower fan tray</li> <li>DPC/MPC slots 6 through 11</li> <li>SCB slots 1 through 2</li> </ul>
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (high-capacity power supplies)	Zone 1	PEM 1 or 3	<ul style="list-style-type: none"> <li>Upper fan tray</li> <li>DPC/MPC slots 0 through 5</li> <li>SCB slot 0</li> </ul>

The following sample configuration shows an MX960 chassis with:

- Four high-capacity AC power supplies (using two feeds for each power supply); two supplies are active, two are redundant
- Six 16 port 10 GbE MPC with SFP+ interfaces (slots 0 through 5)
- Two SCBs with two (redundant) RE-1800x2 routing engines (SCB slot 0 and SCB slot 1)
- SCB (SCB slot 6)
- Five 16 port 10 GbE MPC with SFP+ interfaces (slots 7 through 11)
- High-capacity cooling system (upper and lower fan trays)



**NOTE:** The high-capacity cooling system satisfies cooling requirements of MPCs, and must be used for proper cooling.

1. Calculate the power requirements (usage) using the values in “Power Requirements for an MX960 Router” on page 144 as shown in Table 62 on page 154.

**Table 62: Sample Power Requirements for an MX960 Router**

Chassis Component	Part Number	Power Requirement	Zone
Base system	MX960BASE-AC-HIGH	50 W <sup>1</sup>	—
High-capacity cooling system	FFANTRAY-MX960-HC	320 W * 2 = 640 W	Zone 0 (lower fan tray) and Zone 1 (upper fan tray)
MPC - slots 0 through 5	MPC-3D-16XGE-SFPP	440 W * 6 = 2640 W	Zone 1
MPC - slots 7 through 11	MPC-3D-16XGE-SFPP	440 W * 5 = 2200 W	Zone 0
SCB 0	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 1
SCB 1	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 0
SCB 2 - slot 6	SCBE2-MX	185 W	Zone 0
MX960 normal-capacity AC (not zoned)		6265 W	
Zone 0 total output power		3005 W	
Zone 1 total output power		3260 W	

<sup>1</sup> Divided equally between zone 0 and zone 1.

2. Evaluate the power budget, including the budget for each zone if applicable. In this step, we check the required power against the maximum output power of available power supply options.

Table 63 on page 154 lists the power supplies, their maximum output power, and unused power (or a power deficit).

**Table 63: Calculating Power Budget**

Power Supply	Maximum Output Power of Power Supply	Maximum Output Power for System	Nonzoned Unused Power	Zone 0 Unused Power <sup>1</sup>	Zone 1 Unused Power <sup>2</sup>
MX960 AC normal-capacity	1700 W	5100 W	Power exceeded (non-zoned; 5100 W - 6160 = power exceeded)	—	—



Table 63: Calculating Power Budget (continued)

Power Supply	Maximum Output Power of Power Supply	Maximum Output Power for System	Nonzoned Unused Power	Zone 0 Unused Power <sup>1</sup>	Zone 1 Unused Power <sup>2</sup>
MX960 AC high-capacity	1700 W (one feed)	3400 W (one feed)	–	Power exceeded	Power exceeded
	4100 W (two feeds)	8200 W (two feeds)		1165 W	875 W
MX960 DC normal-capacity	2800 W	5600 W	–	Power exceeded	Power exceeded
MX960 DC high-capacity	1700 W (one feed)	3400 W (one feed)	–	Power exceeded	Power exceeded
	4100 W (two feeds)	8200 W (two feeds)		1165 W	875 W

<sup>1</sup> For this configuration, output power is 2935 W.

<sup>2</sup> For this configuration, output power is 3225 W.

- Calculate input power. In this step, the input power requirements for the example configuration are calculated. To do this, divide the total output requirement by the efficiency of the power supply as shown in [Table 64 on page 155](#).



**NOTE:** MX960 AC and MX960 DC normal-capacity power supplies are not included in the following table, because their power budget was exceeded in the sample configuration.

Table 64: Calculating Input Power

Power Supply	Power Supply Efficiency <sup>1</sup>	Input Power Requirement <sup>2</sup>
MX960 AC high-capacity	~88 %	3335 W <sup>3</sup>
MX960 DC high-capacity	86 %	3413 W <sup>3</sup>

<sup>1</sup> These values are at full load and nominal voltage.

<sup>2</sup> For this configuration, total power for zone 0 is 2935 W. The calculation method for zone 1 is the same as zone 0.

<sup>3</sup> Zone 0 requirement.

- Calculate thermal output (BTUs). To calculate this, multiply the input power requirement (in watts) by 3.41 as shown in [Table 65 on page 156](#).

Table 65: Calculating Thermal Output

Power Supply	Thermal Output (BTUs per hour)
MX960 AC high-capacity	$3335 * 3.41 = 11,372 \text{ BTU/hr}^1$
MX960 DC high-capacity	$3413 * 3.41 = 11,638 \text{ BTU/hr}^1$

<sup>1</sup> Zone 0 output. The calculation method for zone 1 is the same as for zone 0.

#### Related Documentation

- [Power Requirements for an MX960 Router on page 144](#)
- [Electrical Specifications for the MX960 AC Power Supply on page 143](#)
- [Electrical Specifications for the MX960 DC Power Supply on page 159](#)

## AC Power Circuit Breaker Requirements for the MX960 Router

Each AC power supply has a single AC appliance inlet located in the chassis directly above the power supply that requires a dedicated AC power feed. We recommend that you use a dedicated customer site circuit breaker rated for 15 A (250 VAC) minimum for each AC power supply, or as required by local code.

Each high-capacity AC PEM accepts two AC feeds in two unique AC receptacles. We recommend that you use a dedicated customer site circuit breaker rated for 38 A (264 VAC) minimum for each high-capacity AC power supply, or as required by local code.

#### Related Documentation

- [MX960 AC Power Supply Description on page 86](#)
- [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
- [Replacing an MX960 AC Power Supply on page 397](#)

## AC Power Cord Specifications for the MX960 Router

Each normal capacity AC power supply has a single AC appliance inlet located in the chassis directly above the power supply that requires a dedicated AC power feed and each high-capacity AC PEM accepts two AC feeds in two unique AC receptacles. Most sites distribute power through a main conduit that leads to frame-mounted power distribution panels, one of which can be located at the top of the rack that houses the router. An AC power cord connects each power supply to the power distribution panel.

You can order detachable AC power cords, each approximately 8 ft (2.5 m) long that supply AC power to the router. The C19 appliance coupler at the female end of the cord inserts into the AC appliance inlet coupler, type C20 (right angle) as described by International Electrotechnical Commission (IEC) standard 60320. The plug at the male end of the power cord fits into the power source receptacle that is standard for your geographical location. If you want to use two AC feeds, two power cords are needed for

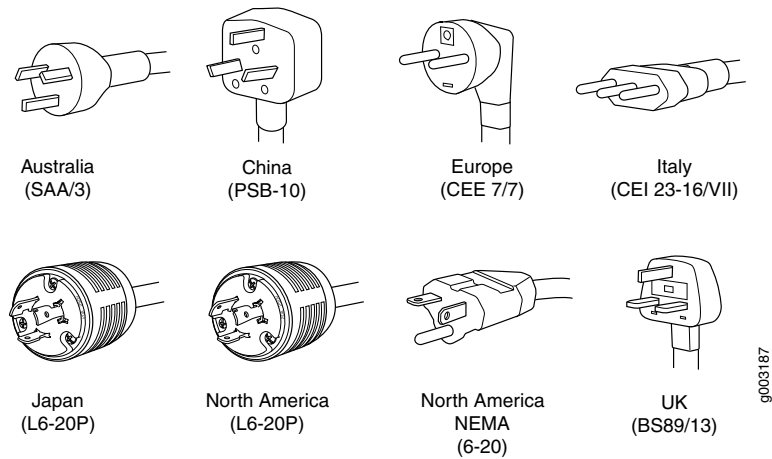
each HC AC power supply. For more information about AC power supplies, see “MX960 AC Power Supply Description” on page 86 .

Table 66 on page 157 provides specifications and Figure 45 on page 157 depicts the plug on the AC power cord provided for each country or region.

*Table 66: AC Power Cord Specifications*

Country	Electrical Specification	Plug Type
Australia	240 VAC, 50 Hz AC	SAA/3
China	220 VAC, 50 Hz AC	PSB-10
Europe (except Denmark, Italy, Switzerland, and United Kingdom)	220 or 230 VAC, 50 Hz AC	CEE 7/7
Italy	230 VAC, 50 Hz AC	CEI 23-16/VII
Japan	220 VAC, 50 or 60 Hz AC	NEMA L6-20P
North America	250 VAC, 60 Hz AC	NEMA L6-20P
United Kingdom	240 VAC, 50 Hz AC	BS89/13

*Figure 45: AC Plug Types*



**WARNING:** The AC power cord for the router is intended for use with the router only and not for any other use.



WARNING:

付属の電源コードセットはこの製品専用です。  
他の電気機器には使用しないでください。

9017253

Translation from Japanese: The attached power cable is only for this product. Do not use the cable for another product.



NOTE: In North America, AC power cords must not exceed 4.5 m (approximately 14.75 ft) in length, to comply with National Electrical Code (NEC) Sections 400-8 (NFPA 75, 5-2.2) and 210-52, and Canadian Electrical Code (CEC) Section 4-010(3). You can order AC power cords that are in compliance.



WARNING: The router is a pluggable type A equipment installed in restricted access location. It has a separate protective earthing terminal (Metric [–M6] and English [–¼-20] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.



CAUTION: Power cords and cables must not block access to device components or drape where people could trip on them.

#### Related Documentation

- [MX960 AC Power Supply Description on page 86](#)
- [Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies on page 217](#)
- [Replacing an MX960 AC Power Supply Cord on page 409](#)

## CHAPTER 12

# DC Power Requirements, Specifications, and Guidelines

- [Electrical Specifications for the MX960 DC Power Supply on page 159](#)
- [Power Requirements for an MX960 Router on page 161](#)
- [Calculating Power Requirements for MX960 Routers on page 169](#)
- [DC Power Circuit Breaker Requirements for the MX960 Router on page 173](#)
- [DC Power Source Cabling for the MX960 Router on page 173](#)
- [DC Power Cable Specifications for the MX960 Router on page 175](#)

### Electrical Specifications for the MX960 DC Power Supply

---

Table 67 on page 159 lists the DC power supply electrical specifications.

*Table 67: Power Supply Electrical Specifications*

Item	Specification
<b>Normal-Capacity Power Supplies</b>	
Maximum output power	2800 W
DC input current rating	58 A @ -48 V nominal operating voltage
Maximum input current	70 A
DC input voltage	Operating range: -40 to -72 VDC Nominal: -48 VDC
Maximum DC inrush current	140.5 A for both feeds at nominal -48V
Internal Circuit Breaker	80 A
Efficiency	99%
<b>NOTE:</b> This value is at full load and nominal voltage.	

Table 67: Power Supply Electrical Specifications (continued)

Item	Specification	
<b>High-Capacity Power Supplies</b>		
Maximum output power	Two-Feed Mode	One-Feed Mode
	4100 W	1700 W
DC input voltage	Nominal: -48 VDC	
	Operating range: -40 to -72 VDC	
DC nominal input current rating @48 VDC	Two-Feed Mode	One-Feed Mode
	104 A for both feeds (54 A and 50 A per feed)	42 A
Maximum input current rating @ 40 VDC input voltage	128 A for both feeds (66 A and 62 A per feed)	52 A
Maximum DC inrush current	140.5 A for both feeds (70 A and 70.5 A per feed)	70 A
Efficiency	86%	

**NOTE:** This value is at full load and nominal voltage.

Table 68: Power System Electrical Specifications

Item	Normal-Capacity	High-Capacity	
Redundancy	2+2	2+2	
Output power (maximum) per supply	2800 W	Two-feed mode	One-feed mode
		4100 W	1700 W
Output power (maximum) per system	5600 W	8200 W	3400 W

- Related Documentation**
- [Calculating Power Requirements for MX960 Routers on page 152](#)
  - [MX960 DC Power Supply on page 92](#)
  - [MX960 DC Power Electrical Safety Guidelines](#)
  - [show chassis power](#)

## Power Requirements for an MX960 Router

Table 59 on page 145 lists the MX960 base system and cooling system power requirements. Table 60 on page 145 lists the FRU power requirements for Switch Control Boards (SCB), Routing Engines, Modular Port Concentrators (MPC), Modular Interface Cards (MIC), Dense Port Concentrators (DPC), and Flexible PIC Concentrators (FPC).

Typical power represents power under certain temperatures and normal operating conditions.

**Table 69: MX960 Common Component Power Requirements**

Component	Maximum Power Requirement	Typical Power Requirement
Base system	50 W	50 W
Normal-capacity cooling system	600 W (full speed)	400 W (normal speed)
High-capacity cooling system	640 W (full speed)	450 W (normal speed)

**Table 70: FRU Power Requirements**

Component	Part Number	Maximum Power Requirement
Switch Control Boards (SCB)		
"SCB-MX" on page 112	SCB-MX (applies to MX240, MX480, and MX960)	150 W
"SCBE-MX" on page 109	SCBE-MX (applies to MX240, MX480, and MX960)	160 W at 55° C 130 W at 40° C 120 W at 25° C
"SCBE2-MX" on page 104	SCBE2-MX (applies to MX240, MX480, and MX960)	185 W at 55° C 160 W at 40° C 155 W at 25° C
"SCBE3-MX" on page 98	SCBE3-MX (applies to MX240, MX480, and MX960)	275 W at 55° C 260 W at 40° C 245 W at 25° C
Routing Engines		

Table 70: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
Routing Engines	RE-S-1300-2048	90 W
	RE-S-1800X2-8G	
	RE-S-1800X4-8G	
	RE-S-1800X2-16G	
	RE-S-1800X4-16G	
	RE-S-1800X4-32G	
	RE-S-2000-4096	
	RE-S-X6-64G	
Fixed Configuration Modular Port Concentrators (MPC)		
16x10GE MPC	MPC-3D-16XGE-SFPP	440 W at 55° C ambient
	MPC-3D-16XGE-SFPP-R-B	423 W at 25° C ambient
Multiservices MPC	MS-MPC-128G	590 W
32x10GE MPC4E	MPC4E-3D-32XGE-SFPP	610 W
		<b>With optics:</b> 607 W at 55° C, with SFPP ZR optics
		584 W at 40° C, with SFPP ZR optics
		565 W at 25° C, with SFPP ZR optics
2x100GE + 8x10GE MPC4E	MPC4E-3D-2CGE-8XGE	610 W
		<b>With optics:</b> 607 W at 55° C, with SFPP ZR and CFP LR4 optics
		584 W at 40° C, with SFPP ZR and CFP LR4 optics
		565 W at 25° C, with SFPP ZR and CFP LR4 optics
6x40GE + 24x10GE MPC5E	MPC5E-40G10G	<b>With optics:</b> 607 W at 55° C
6x40GE + 24x10GE MPC5EQ	MPC5EQ-40G10G	541 W at 40° C
		511 W at 25° C



Table 70: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>2x100GE + 4x10GE MPC5E</i>	MPC5E-100G10G	<b>With optics:</b> 607 W at 55° C
<i>2x100GE + 4x10GE MPC5EQ</i>	MPC5EQ-100G10G	541 W at 40° C 511 W at 25° C
<i>MPC7E (Multi-Rate)</i>	MPC7E-MRATE	<b>With optics:</b> 545 W at 55° C 465 W at 40° C 440 W at 25° C
Modular Port Concentrators (MPC)		
<i>MPC1</i>	MX-MPC1-3D	165 W
<i>MPC1E</i>	MX-MPC1E-3D	<b>With MICs and optics:</b> 239 W at 55° C 227 W at 40° C 219 W at 25° C
<i>MPC1 Q</i>	MX-MPC1-3D-Q	175 W
<i>MPC1E Q</i>	MX-MPC1E-3D-Q	<b>With MICs and optics:</b> 249 W at 55° C 237 W at 40° C 228 W at 25° C
<i>MPC2</i>	MX-MPC2-3D	274 W
<i>MPC2E</i>	MX-MPC2E-3D	<b>With MICs and optics:</b> 348 W at 55° C 329 W at 40° C 315 W at 25° C
<i>MPC2 Q</i>	MX-MPC2-3D-Q	294 W
<i>MPC2E Q</i>	MX-MPC2E-3D-Q	<b>With MICs and optics:</b> 368 W at 55° C
<i>MPC2 EQ</i>	MX-MPC2-3D-EQ	347 W at 40° C
<i>MPC2E EQ</i>	MX-MPC2E-3D-EQ	333 W at 25° C

Table 70: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>MPC2E P</i>	MX-MPC2E-3D-P	294 W  With MICs and optics: 368 W at 55° C  347 W at 40° C  333 W at 25° C
<i>MPC2E NG</i>	MPC2E-3D-NG	474 W  With MICs and optics: 474 W at 55° C  417 W at 40° C  400 W at 25° C
<i>MPC2E NG Q</i>	MPC2E-3D-NG-Q	529 W  With MICs and optics: 529 W at 55° C  460 W at 40° C  438 W at 25° C
<i>MPC3E</i>	MX-MPC3E-3D	440W  With MICs and optics: 500 W at 55° C, two 40 W MICs  485 W at 40° C, two CFP MICs with LR4 optics  473 W at 25° C, two CFP MICs with LR4 optics
<i>MPC3E NG</i>	MPC3E-3D-NG	534 W  With MICs and optics: 534 W at 55° C  485 W at 40° C  461 W at 25° C

Table 70: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>MPC3E NG Q</i>	MPC3E-3D-NG-Q	583 W  With MICs and optics: 583 W at 55° C  532 W at 40° C  503 W at 25° C
Modular Interface Cards (MIC)		
<i>ATM MIC with SFP</i>	MPC4E-3D-2CGE-8XGE	610 W  With optics: 607 W at 55° C, with SFPP ZR and CFP LR4 optics  584 W at 40° C, with SFPP ZR and CFP LR4 optics  565 W at 25° C, with SFPP ZR and CFP LR4 optics
<i>Gigabit Ethernet MIC with SFP</i>	MIC-3D-20-GE-SFP	37 W
<i>10-Gigabit Ethernet MIC with XFP</i>	2-Port: MIC-3D-2XGE-XFP	2-Port: 29 W
	4-Port: MIC-3D-4XGE-XFP	4-Port: 37 W
<i>10-Port Gigabit Ethernet MIC with SFPP</i>	MIC3-3D-10XGE-SFPP	24.2 W at 55° C with SR and LR optics
		29.8 W at 55° C with ER optics
		29.8 W at 40° C with ZR optics
<i>40-Gigabit Ethernet MIC with QSFP+</i>	MIC3-3D-2X40GE-QSFPP	18 W
<i>100-Gigabit Ethernet MIC with CFP</i>	MIC3-3D-1X100GE-CFP	40 W
<i>100-Gigabit Ethernet MIC with CFP2</i>	MIC6-100G-CFP2	104 W
<i>100-Gigabit Ethernet MIC with CXP</i>	MIC3-3D-1X100GE-CXP	20 W

Table 70: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
100-Gigabit Ethernet MIC with CXP (4 Ports)	MIC6-100G-CXP	57 W
100-Gigabit DWDM OTN MIC with CFP2	MIC3-100G-DWDM	With optics: 91 W at 55° C  83 W at 25° C
100-Gigabit DWDM OTN MIC with CFP2-ACO	MIC3-100G-DWDM	With optics: 91 W at 55° C  83 W at 25° C
Multiservices MIC	MS-MIC-16G	60 W
SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4OC3OC12-1OC48	4-Port: 24 W at 55° C 22.75 W at 40° C 21.5 W at 25° C
	8-Port: MIC-3D-8OC3OC12-4OC48	8-Port: 29 W at 55° C 27.75 W at 40° C 26.5 W at 25° C
SONET/SDH OC192/STM64 MIC with XFP	MIC-3D-1OC192-XFP	41 W at 55° C 38.5 W at 40° C 36 W at 25° C
Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP	4-Port: MIC-3D-4CHOC3-2CHOC12	4-Port: 41 W at 55° C 40 W at 40° C 39 W at 25° C
	8-Port: MIC-3D-8CHOC3-4CHOC12	8-Port: 52 W at 55° C 50.5 W at 40° C 49 W at 25° C

Table 70: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>Tri-Rate MIC</i>	MIC-3D-40GE-TX	41 W
<i>DS3/E3 MIC</i>	MIC-3D-8DS3-E3	36 W at 55° C
	MIC-3D-8CHDS3-E3-B	35 W at 40° C
		34 W at 25° C
<i>Channelized E1/T1 Circuit Emulation MIC</i>	MIC-3D-16CHE1-T1-CE	29.08 W at 55° C
		27.84 W at 40° C
		26.55 W at 25° C
<i>Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP</i>	MIC-3D-4COC3-1COC12-CE	36.48 W at 55° C
		35.04 W at 40° C
		33.96 W at 25° C
<b>Dense Port Concentrators (DPC)</b>		
<i>Gigabit Ethernet DPC with SFP</i>	DPC-R-40GE-SFP	335 W
<i>Gigabit Ethernet Enhanced DPC with SFP</i>	DPCE-R-40GE-SFP	335 W
	DPCE-X-40GE-SFP	
<i>Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP</i>	DPCE-R-Q-40GE-SFP	365 W
	DPCE-X-Q-40GE-SFP	
<i>Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP</i>		
<i>Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP</i>	DPCE-R-Q-20GE-SFP	200 W
<i>10-Gigabit Ethernet DPC with XFP</i>	DPC-R-4XGE-XFP	310 W
<i>10-Gigabit Ethernet Enhanced DPC with XFP</i>	DPCE-R-2XGE-XFP	175 W
<i>10-Gigabit Ethernet Enhanced DPCs with XFP</i>	DPCE-R-4XGE-XFP	310 W
	DPCE-X-4XGE-XFP	

Table 70: FRU Power Requirements (continued)

Component	Part Number	Maximum Power Requirement
<i>10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP</i>	DPCE-R-Q-4XGE-XFP	330 W
	DPCE-X-Q-4XGE-XFP	
<i>Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP</i>	DPCE-R-20GE-2XGE	333 W
	DPCE-X-20GE-2XGE	
<i>Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP</i>	DPCE-R-Q-20GE-2XGE	335 W
<i>Tri-Rate Enhanced DPCor Tri-Rate Enhanced Ethernet Services DPC</i>	DPCE-R-40GE-TX	320 W
	DPCE-X-40GE-TX	
<i>Multiservices DPC</i>	MS-DPC	265 W
Flexible PIC Concentrators (FPC)		
FPC Type 2	MX-FPC2	190 W (with PICs and optics)
FPC Type 3	MX-FPC3	265 W (with PICs and optics)

**Related  
Documentation**

- [Electrical Specifications for the MX960 DC Power Supply on page 159](#)
- [Electrical Specifications for the MX960 AC Power Supply on page 143](#)

## Calculating Power Requirements for MX960 Routers

---

The information in this topic helps you determine which power supplies are suitable for various configurations, as well as which power supplies are not suitable because output power is exceeded. You determine suitability by subtracting the total power draw from the maximum output of the power supplies. Afterward, the required input current is calculated. Finally, you calculate the thermal output. A sample configuration is provided in [Table 36 on page 89](#).

We recommend that you provision power according to the maximum input current listed in the power supply electrical specifications (see [“Electrical Specifications for the MX960 AC Power Supply” on page 143](#) and [“Electrical Specifications for the MX960 DC Power Supply” on page 159](#)).

Use the following procedures to calculate the power requirement:

1. Calculate the power requirement.
2. Evaluate the power budget.
3. Calculate input power.
4. Calculate thermal output (BTUs) for cooling requirements.

Both normal-capacity and high-capacity MX960 chassis with DC power supplies and MX960 chassis with high-capacity AC power supplies are zoned. MX960 chassis with normal-capacity AC power supplies have one overall zone. Zoning means that certain components are powered by specific power supplies (see [Table 36 on page 89](#) for information on zoning). When calculating power requirements, be sure that there is adequate power for each zone.

Three AC power supplies are mandatory for MX960 chassis with normal-capacity AC power supplies.

**Table 71: MX960 Zoning**

Chassis Power Configuration	Zone	Power Supply (PEM)	Components Receiving Power
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (high-capacity power supplies)	Zone 0	PEM 0 or 2	<ul style="list-style-type: none"> <li>Lower fan tray</li> <li>DPC/MPC slots 6 through 11</li> <li>SCB slots 1 through 2</li> </ul>
MX960 DC (normal-capacity and high-capacity power supplies); MX960 AC (high-capacity power supplies)	Zone 1	PEM 1 or 3	<ul style="list-style-type: none"> <li>Upper fan tray</li> <li>DPC/MPC slots 0 through 5</li> <li>SCB slot 0</li> </ul>

The following sample configuration shows an MX960 chassis with:

- Four high-capacity AC power supplies (using two feeds for each power supply); two supplies are active, two are redundant
- Six 16 port 10 GbE MPC with SFP+ interfaces (slots 0 through 5)
- Two SCBs with two (redundant) RE-1800x2 routing engines (SCB slot 0 and SCB slot 1)
- SCB (SCB slot 6)
- Five 16 port 10 GbE MPC with SFP+ interfaces (slots 7 through 11)
- High-capacity cooling system (upper and lower fan trays)



**NOTE:** The high-capacity cooling system satisfies cooling requirements of MPCs, and must be used for proper cooling.



1. Calculate the power requirements (usage) using the values in “Power Requirements for an MX960 Router” on page 144 as shown in Table 62 on page 154.

**Table 72: Sample Power Requirements for an MX960 Router**

Chassis Component	Part Number	Power Requirement	Zone
Base system	MX960BASE-AC-HIGH	50 W <sup>1</sup>	—
High-capacity cooling system	FFANTRAY-MX960-HC	320 W * 2 = 640 W	Zone 0 (lower fan tray) and Zone 1 (upper fan tray)
MPC - slots 0 through 5	MPC-3D-16XGE-SFPP	440 W * 6 = 2640 W	Zone 1
MPC - slots 7 through 11	MPC-3D-16XGE-SFPP	440 W * 5 = 2200 W	Zone 0
SCB 0	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 1
SCB 1	SCBE2-MX with RE-S-1800X2-8G	185 W 90 W	Zone 0
SCB 2 - slot 6	SCBE2-MX	185 W	Zone 0
MX960 normal-capacity AC (not zoned)		6265 W	
Zone 0 total output power		3005 W	
Zone 1 total output power		3260 W	

<sup>1</sup> Divided equally between zone 0 and zone 1.

2. Evaluate the power budget, including the budget for each zone if applicable. In this step, we check the required power against the maximum output power of available power supply options.

Table 63 on page 154 lists the power supplies, their maximum output power, and unused power (or a power deficit).

**Table 73: Calculating Power Budget**

Power Supply	Maximum Output Power of Power Supply	Maximum Output Power for System	Nonzoned Unused Power	Zone 0 Unused Power <sup>1</sup>	Zone 1 Unused Power <sup>2</sup>
MX960 AC normal-capacity	1700 W	5100 W	Power exceeded (non-zoned; 5100 W - 6160 = power exceeded)	—	—

Table 73: Calculating Power Budget (continued)

Power Supply	Maximum Output Power of Power Supply	Maximum Output Power for System	Nonzoned Unused Power	Zone 0 Unused Power <sup>1</sup>	Zone 1 Unused Power <sup>2</sup>
MX960 AC high-capacity	1700 W (one feed)	3400 W (one feed)	–	Power exceeded	Power exceeded
	4100 W (two feeds)	8200 W (two feeds)		1165 W	875 W
MX960 DC normal-capacity	2800 W	5600 W	–	Power exceeded	Power exceeded
MX960 DC high-capacity	1700 W (one feed)	3400 W (one feed)	–	Power exceeded	Power exceeded
	4100 W (two feeds)	8200 W (two feeds)		1165 W	875 W

<sup>1</sup> For this configuration, output power is 2935 W.

<sup>2</sup> For this configuration, output power is 3225 W.

- Calculate input power. In this step, the input power requirements for the example configuration are calculated. To do this, divide the total output requirement by the efficiency of the power supply as shown in [Table 64 on page 155](#).



**NOTE:** MX960 AC and MX960 DC normal-capacity power supplies are not included in the following table, because their power budget was exceeded in the sample configuration.

Table 74: Calculating Input Power

Power Supply	Power Supply Efficiency <sup>1</sup>	Input Power Requirement <sup>2</sup>
MX960 AC high-capacity	~88 %	3335 W <sup>3</sup>
MX960 DC high-capacity	86 %	3413 W <sup>3</sup>

<sup>1</sup> These values are at full load and nominal voltage.

<sup>2</sup> For this configuration, total power for zone 0 is 2935 W. The calculation method for zone 1 is the same as zone 0.

<sup>3</sup> Zone 0 requirement.

- Calculate thermal output (BTUs). To calculate this, multiply the input power requirement (in watts) by 3.41 as shown in [Table 65 on page 156](#).

Table 75: Calculating Thermal Output

Power Supply	Thermal Output (BTUs per hour)
MX960 AC high-capacity	$3335 * 3.41 = 11,372 \text{ BTU/hr}^1$
MX960 DC high-capacity	$3413 * 3.41 = 11,638 \text{ BTU/hr}^1$

<sup>1</sup> Zone 0 output. The calculation method for zone 1 is the same as for zone 0.

**Related Documentation**

- [Power Requirements for an MX960 Router on page 144](#)
- [Electrical Specifications for the MX960 AC Power Supply on page 143](#)
- [Electrical Specifications for the MX960 DC Power Supply on page 159](#)

## DC Power Circuit Breaker Requirements for the MX960 Router

If you plan to operate a maximally configured DC-powered router with normal capacity power supplies, we recommend that you provision at least 116 A (58 A per feed) @ –48 VDC (nominal) for the system. Use a customer site circuit breaker rated according to respective National Electrical Code and customer site internal standards to maintain proper level of protection for the current specified above.

If you plan to operate a maximally configured DC-powered router with high-capacity power supplies, we recommend that you provision at least 208 A (104 A per supply) @ –48 VDC (nominal) for the system. This is maximum current draw at –48 VDC when two power supplies are providing the power to the system and the redundant power supplies are not supplying power or not present. Use a customer site circuit breaker rated according to respective National Electrical Code and customer site internal standards to maintain proper level of protection for the current specified above.

If you plan to operate a DC-powered router at less than the maximum configuration, we recommend that you provision a circuit breaker according to respective National Electrical Code and customer site internal standards to maintain proper level of protection for the current specified above or each DC power supply rated for at least 125% of the continuous current that the system draws at –48 VDC.

**Related Documentation**

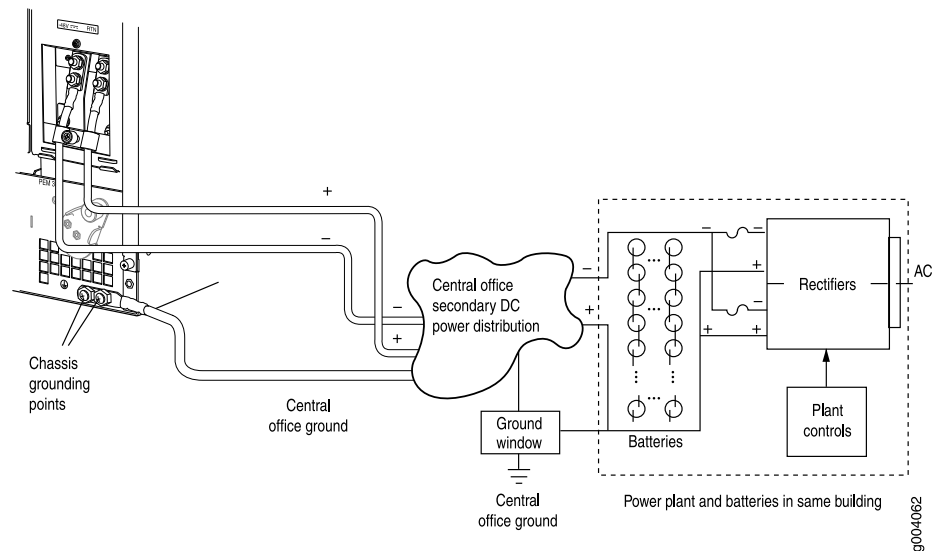
- [MX960 DC Power Supply on page 92](#)
- [MX960 DC Power Electrical Safety Guidelines](#)
- [Electrical Specifications for the MX960 DC Power Supply on page 159](#)

## DC Power Source Cabling for the MX960 Router

Figure 46 on page 174 shows a typical DC source cabling arrangement.

Figure 46: Typical DC Source Cabling to the Router

## DC power supply on MX960



The DC power supplies in slots **PEM0** and **PEM1** must be powered by dedicated power feeds derived from feed **A**, and the DC power supplies in slots **PEM2** and **PEM3** must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed **A/B** feed redundancy for the system.



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.



**WARNING:** For field-wiring connections, use copper conductors only.



**CAUTION:** Power cords and cables must not block access to device components or drape where people could trip on them.

#### Related Documentation

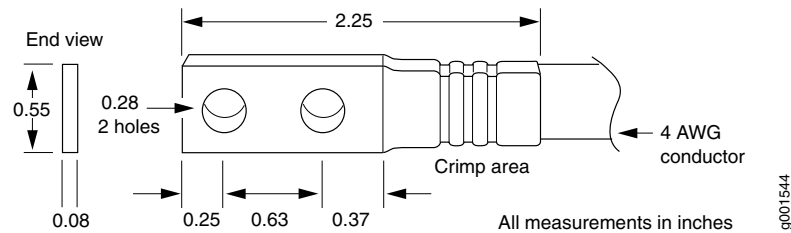
- [General Electrical Safety Guidelines and Electrical Codes for Juniper Networks Devices](#)
- [MX960 DC Power Supply on page 92](#)
- [Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies on page 223](#)
- [Replacing an MX960 DC Power Supply Cable on page 411](#)

- [Connecting an MX960 DC Power Supply Cable on page 234](#)
- [DC Power Cable Specifications for the MX960 Router on page 175](#)

## DC Power Cable Specifications for the MX960 Router

The accessory box shipped with the router includes the cable lugs that attach to the terminal studs of each power supply (see [Figure 47 on page 175](#)).

**Figure 47: DC Power Cable Lug**



**CAUTION:** Before router installation begins, a licensed electrician must attach a cable lug to the grounding and power cables that you supply. A cable with an incorrectly attached lug can damage the router.



**WARNING:** The Router is a pluggable type A equipment installed in restricted access location. It has a separate protective earthing terminal (Metric [ $-M6$ ] and English [ $-\frac{1}{4}-20$ ] screw ground lugs) provided on the chassis in addition to the grounding pin of the power supply cord. This separate protective earth terminal must be permanently connected to earth.

[Table 76 on page 175](#) summarizes the specifications for the power cables, which you must supply.

**Table 76: DC Power Cable Specifications**

Cable Type	Quantity and Specification
Power	Eight 4-AWG (13.3 mm <sup>2</sup> ), minimum 60°C wire, or as required by the local code



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.

**Related  
Documentation**

- [MX960 DC Power Supply on page 92](#)
- [MX960 DC Power Electrical Safety Guidelines](#)
- [DC Power Source Cabling for the MX960 Router on page 173](#)
- [Connecting an MX960 DC Power Supply Cable on page 234](#)

## PART 3

# Initial Installation and Configuration

- [Unpacking the MX960 Router on page 179](#)
- [Installing the Mounting Hardware on page 185](#)
- [Installing the MX960 Router on page 193](#)
- [Connecting the MX960 Router to Power on page 215](#)
- [Connecting the MX960 Router to the Network on page 237](#)
- [Initially Configuring the MX960 Router on page 247](#)





# Unpacking the MX960 Router

- [Tools and Parts Required to Unpack the MX960 Router on page 179](#)
- [Unpacking the MX960 Router on page 179](#)
- [Verifying the MX960 Parts Received on page 181](#)

## Tools and Parts Required to Unpack the MX960 Router

---

To unpack the router and prepare for installation, you need the following tools:

- Phillips (+) screwdriver, number 2
- 1/2-in. or 13-mm open-end or socket wrench to remove bracket bolts from the shipping pallet
- Blank panels to cover any slots not occupied by a component

### Related Documentation

- [Unpacking the MX960 Router on page 179](#)
- [Verifying the MX960 Parts Received on page 181](#)
- [MX960 Router Overview on page 3](#)

## Unpacking the MX960 Router

---

The router is shipped in a wooden crate. A wooden pallet forms the base of the crate. The router chassis is bolted to this pallet. Quick Start installation instructions and a cardboard accessory box are also included in the shipping crate.

The shipping container measures 21 in. (53.3 cm) high, 23.5 in. (60.0 cm) wide, and 32.5 in. (82.5 cm) deep. The total weight of the container containing the router and accessories can range from 93 lb (42.2 kg) to 169 lb (76.7 kg).



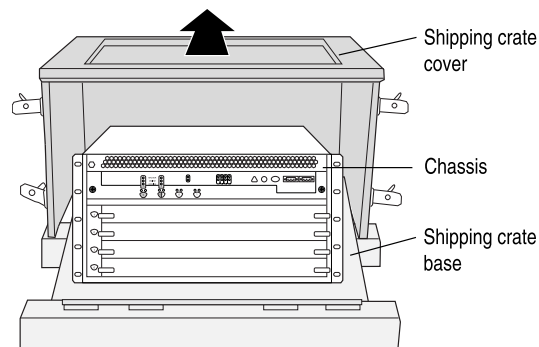
**NOTE:** The router is maximally protected inside the shipping crate. Do not unpack it until you are ready to begin installation.

---

To unpack the router (see [Figure 48 on page 180](#)):

1. Move the shipping crate to a staging area as close to the installation site as possible, where you have enough room to remove the components from the chassis. While the chassis is bolted to the pallet, you can use a forklift or pallet jack to move it.
2. Position the shipping crate with the arrows pointing up.
3. Open all the latches on the shipping crate.
4. Remove the front door of the shipping crate cover and set it aside.
5. Slide the remainder of the shipping crate cover off the pallet.
6. Remove the foam covering the top of the router.
7. Remove the accessory box and the Quick Start installation instructions.
8. Verify the parts received against the lists.
9. Remove the vapor corrosion inhibitor (VCI) packs attached to the pallet, being careful not to break the VCI packs open.
10. To remove the brackets holding the chassis on the pallet, use a 1/2-in. socket wrench and a number 2 Phillips screwdriver to remove the bolts and screws from the brackets.
11. Store the brackets and bolts inside the accessory box.
12. Save the shipping crate cover, pallet, and packing materials in case you need to move or ship the router at a later time.

**Figure 48: Contents of the Shipping Crate**



- Related Documentation**
- [Tools and Parts Required to Unpack the MX960 Router on page 179](#)
  - [Verifying the MX960 Parts Received on page 181](#)
  - [Installing the MX960 Router Using a Mechanical Lift on page 204](#)

## Verifying the MX960 Parts Received

A packing list is included in each shipment. Check the parts in the shipment against the items on the packing list. The packing list specifies the part numbers and descriptions of each part in your order.

If any part is missing, contact a customer service representative.

A fully configured router contains the router chassis with installed components, listed in [Table 77 on page 181](#), and an accessory box, which contains the parts listed in [Table 78 on page 182](#). The parts shipped with your router can vary depending on the configuration you ordered.

*Table 77: Parts List for a Fully Configured MX960 Router*

Component	Quantity
Chassis, including midplane, craft interface, front-mounting flanges, and center-mounting brackets	1
DPCs	Up to 12
FPCs	Up to 6
MPCs	Up to 12
MICs	Up to 24
PICs	Up to 12
Routing Engines	1 or 2
SCBs	Up to 3
Power supplies	Up to 4
Fan trays	2
Air filter	1
Air filter tray	1
Quick start installation instructions	1
Large mounting shelf	1

**Table 77: Parts List for a Fully Configured MX960 Router (continued)**

Component	Quantity
Small mounting shelf	1
Blank panels for slots without components installed	One blank panel for each slot not occupied by a component

**Table 78: Accessory Box Parts List**

Part	Quantity
Screws to mount chassis	14
DC power terminal Lugs, 4-AWG	8
RJ-45 cable, with RJ-45 Jack to Female DB-9, to connect the router through the serial port	1
Terminal block plug, 3 pole, 5.08 mm spacing, 12A, to connect the router alarms	2
Label, accessories contents, MX960	1
USB flash drive with Junos	1
Read me first document	1
Affidavit for T1 connection	1
Juniper Networks Product Warranty	1
End User License Agreement	1
Document sleeve	1
3" x 5" pink bag	2
9" x 12" pink bag, ESD	2
Accessory Box, 19 x 12 x 3"	1
Ethernet cable, RJ-45/RJ-45, 4-pair stranded UTP, Category 5E, 15'	1
ESD wrist strap with cable	1

**Related Documentation**

- [Tools and Parts Required to Unpack the MX960 Router on page 179](#)
- [Unpacking the MX960 Router on page 179](#)

- [MX960 Router Overview on page 3](#)



# Installing the Mounting Hardware

- Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet on page 185
- Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack on page 187
- Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack on page 189

## Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet

Before installing the router in a four-post rack or cabinet, install the large mounting shelf, followed by the small mounting shelf. You must also remove the mounting brackets from the chassis.

Table 79 on page 185 specifies the holes in which you insert cage nuts, if needed, and screws to install the mounting hardware required in a four-post or cabinet rack (an X indicates a mounting hole location). The hole distances are relative to one of the standard U divisions on the rack. The bottom of all mounting shelves is at 0.04 in. (0.02 U) above a U division.

*Table 79: Four-Post Rack or Cabinet Mounting Hole Locations*

Hole	Distance Above U Division		Large Shelf	Small Shelf
3	1.51 in. (3.8 cm)	0.86 U		X
2	0.88 in. (2.2 cm)	0.50 U	X	X
1	0.25 in. (0.6 cm)	0.14 U		X

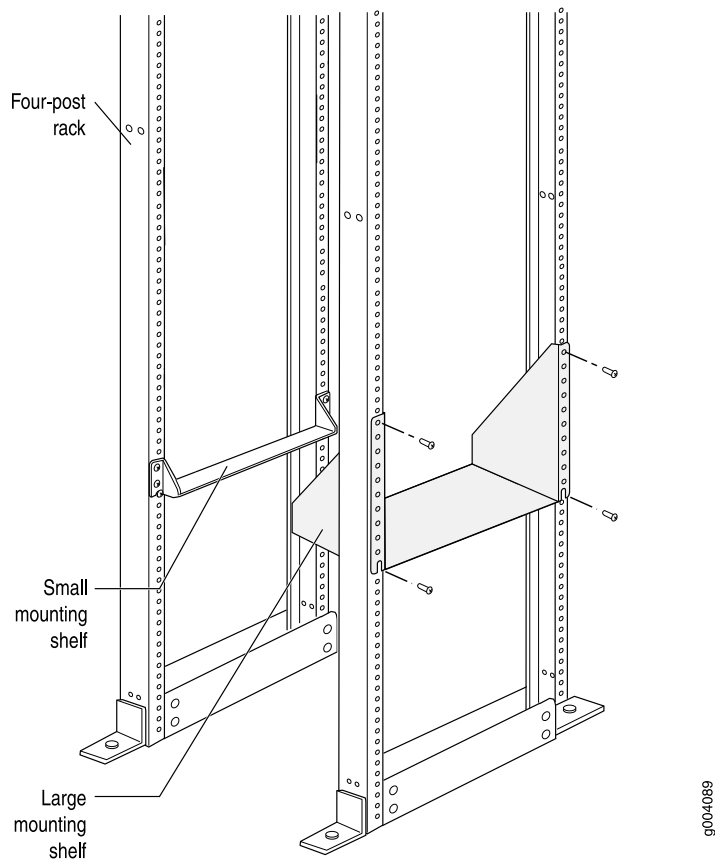
To install the mounting shelves (see Figure 49 on page 187):

1. On the front rack rails, install cage nuts, if needed, in the holes specified in Table 79 on page 185 for the large shelf and the spacer bars.
2. On the front of each front rack rail, partially insert a mounting screw into the hole containing the lowest cage nut.

3. Install the large shelf on the front rack rails. Rest the bottom slot of each flange of the large shelf on a mounting screw.
4. Partially insert a mounting screw into the top hole in each flange of the large shelf.
5. Tighten all the screws completely.
6. On the rear rack rails, install cage nuts, if needed, in the holes specified in [Table 79 on page 185](#) for the small shelf.
7. On the back of each rear rack rail, partially insert a mounting screw into the hole containing the lowest cage nut.
8. Install the small shelf on the back rack rails. Rest the bottom slot of each flange of the small shelf on a mounting screw. The small shelf installs on the back of the rear rails, extending toward the center of the rack. The bottom of the small shelf should align with the bottom of the large shelf.
9. Partially insert screws into the open holes in the flanges of the small shelf.
10. Tighten all the screws completely.



Figure 49: Installing the Mounting Hardware for a Four-Post Rack or Cabinet



After the mounting hardware is installed, proceed to “Installing the MX960 Router Using a Mechanical Lift” on page 204.

#### Related Documentation

- [Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack on page 189](#)
- [Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack on page 187](#)
- [MX960 Rack-Mounting Hardware on page 13](#)

## Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack

Before front-mounting the router in an open-frame rack, install the large mounting shelf on the rack, and remove the mounting brackets from the chassis. The small mounting shelf is not needed.

[Table 80 on page 188](#) specifies the holes in which you insert screws to install the mounting hardware in an open-frame rack (an X indicates a mounting hole location). The hole distances are relative to one of the standard U divisions on the rack. For reference, the bottom of all mounting shelves is at 0.04 in. (0.02 U) above a U division.

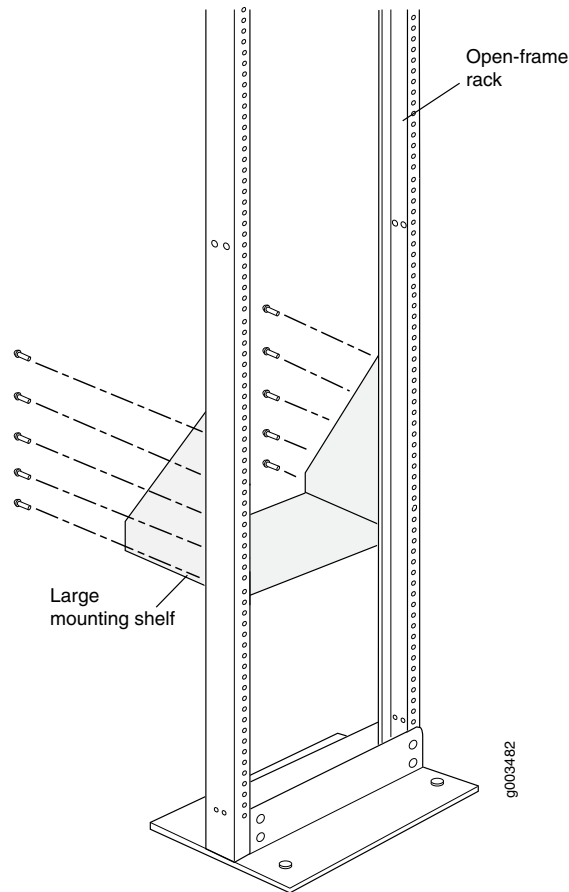
**Table 80: Mounting Hardware Hole Locations for Front-Mounting in an Open-Frame Rack**

Hole	Distance Above U Division		Large Shelf
30	17.26 in. (43.8 cm)	9.86 U	X
27	15.51 in. (39.4 cm)	8.86 U	X
24	13.76 in. (34.9 cm)	7.86 U	X
21	12.01 in. (30.5 cm)	6.86 U	X
18	10.26 in. (26.0 cm)	5.86 U	X
15	8.51 in. (21.6 cm)	4.86 U	X
12	6.76 in. (17.1 cm)	3.86 U	X
9	5.01 in. (12.7 cm)	2.86 U	X
6	3.26 in. (8.3 cm)	1.86 U	X
3	1.51 in. (3.8 cm)	0.86 U	X
2	0.88 in. (2.2 cm)	0.50 U	X
1	0.25 in. (0.6 cm)	0.14 U	

To install the large mounting shelf (see [Figure 50 on page 189](#)):

1. On the rear of each rack rail, install cage nuts, if needed, in the holes specified in [Table 80 on page 188](#) for the large shelf.
2. Partially insert a mounting screw into the highest hole specified in [Table 80 on page 188](#).
3. Hang the shelf over the mounting screws using the keyhole slots located near the top of the large shelf flanges.
4. Partially insert screws into the open holes in the flanges of the large shelf.
5. Tighten all the screws completely.

Figure 50: Installing the Mounting Hardware for Front-Mounting in an Open-Frame Rack



After the mounting hardware is installed, proceed to “[Installing the MX960 Router Using a Mechanical Lift](#)” on page 204.

**Related Documentation**

- [Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet](#) on page 185
- [Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack](#) on page 189
- [MX960 Rack-Mounting Hardware](#) on page 13

## Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack

Before center-mounting the router in an open-frame rack, you must install the large mounting shelf on the rack. The small mounting shelf is not needed.

[Table 81](#) on page 190 specifies the holes in which you insert screws to install the mounting hardware in an open-frame rack (an X indicates a mounting hole location). The hole distances are relative to one of the standard U divisions on the rack. For reference, the bottom of all mounting shelves is at 0.04 in. (0.02 U) above a U division.

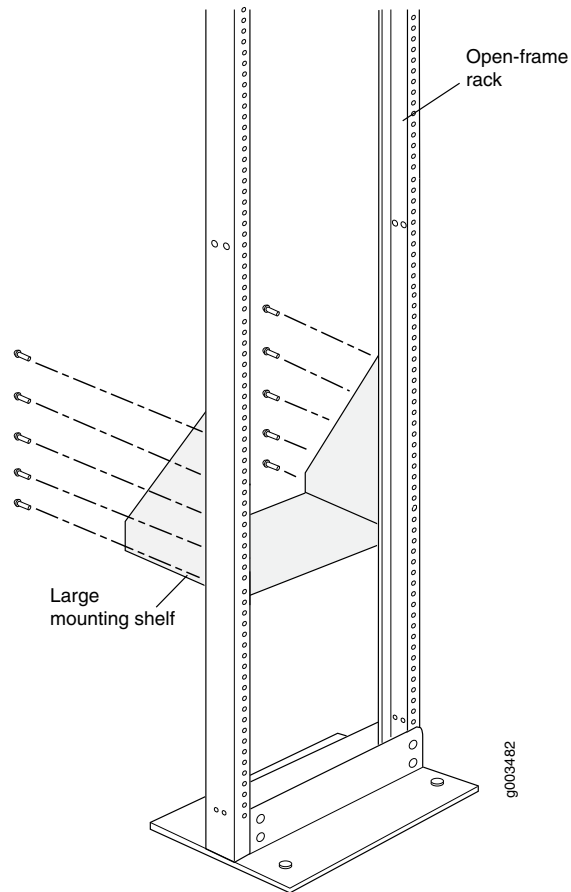
**Table 81: Mounting Hardware Hole Locations for Center-Mounting in an Open-Frame Rack**

Hole	Distance Above U Division		Large Shelf
30	17.26 in. (43.8 cm)	9.86 U	X
27	15.51 in. (39.4 cm)	8.86 U	X
24	13.76 in. (34.9 cm)	7.86 U	X
21	12.01 in. (30.5 cm)	6.86 U	X
18	10.26 in. (26.0 cm)	5.86 U	X
15	8.51 in. (21.6 cm)	4.86 U	X
12	6.76 in. (17.1 cm)	3.86 U	X
9	5.01 in. (12.7 cm)	2.86 U	X
6	3.26 in. (8.3 cm)	1.86 U	X
3	1.51 in. (3.8 cm)	0.86 U	X
2	0.88 in. (2.2 cm)	0.50 U	X
1	0.25 in. (0.6 cm)	0.14 U	

To install the large mounting shelf (see [Figure 51 on page 191](#)):

1. On the rear of each rack rail, partially insert a mounting screw into the highest hole specified in [Table 81 on page 190](#) for the large shelf.
2. Install the large shelf on the rack. Hang the shelf over the mounting screws using the keyhole slots located near the top of the large shelf flanges.
3. Partially insert screws into the open holes in the flanges of the large shelf.
4. Tighten all the screws completely.

Figure 51: Installing the Mounting Hardware for Center-Mounting in an Open-Frame Rack



After the mounting hardware is installed, proceed to [“Installing the MX960 Router Using a Mechanical Lift”](#) on page 204.

**Related Documentation**

- [Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet](#) on page 185
- [Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack](#) on page 187
- [MX960 Rack-Mounting Hardware](#) on page 13



## CHAPTER 15

# Installing the MX960 Router

- [Installing an MX960 Router Overview on page 193](#)
- [Removing Components from the MX960 Router Chassis Before Installing It with a Lift on page 194](#)
- [Tools Required to Install the MX960 Router with a Mechanical Lift on page 203](#)
- [Installing the MX960 Router Using a Mechanical Lift on page 204](#)
- [Reinstalling Components in the MX960 Chassis After Installing It with a Lift on page 206](#)

## Installing an MX960 Router Overview

---

To install the MX960 router:

1. Prepare your installation site.
  - See [“MX960 Site Preparation Checklist” on page 122](#).
2. Review the safety guidelines.
  - [General Safety Guidelines for Juniper Networks Devices](#)
  - [General Safety Warnings for Juniper Networks Devices](#)
3. Unpack the router and verify the parts.
  - a. [Unpacking the MX960 Router on page 179](#)
  - b. [Verifying the MX960 Parts Received on page 181](#)
4. Install the mounting hardware.
  - [Installing the MX960 Mounting Hardware for a Four-Post Rack or Cabinet on page 185](#)
  - [Installing the MX960 Mounting Hardware for Front-Mounting in an Open-Frame Rack on page 187](#)
  - [Installing the MX960 Mounting Hardware for Center-Mounting in an Open-Frame Rack on page 189](#)
5. Lift the router on to the rack. Because of the weight of the router, we recommend that you use a mechanical lift.

See [“Installing the MX960 Router Using a Mechanical Lift”](#) on page 204.

6. Connect cables to the network and external devices.

See [“Connecting the MX960 Router to Management and Alarm Devices”](#) on page 237.

7. Connect the grounding cable

See [“Grounding the MX960 Router”](#) on page 216.

8. Connect the AC power cord or DC power cables:

- [Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies](#) on page 217
- [Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies](#) on page 223

9. Power on the router:

- [Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies](#) on page 222
- [Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies](#) on page 230

10. Perform the initial system configuration.

See [“Initially Configuring the MX960 Router”](#) on page 247.

**Related  
Documentation**

- [MX960 Chassis Description](#) on page 7
- [Routine Maintenance Procedures for the MX960 Router](#) on page 441
- [Troubleshooting Resources for MX960 Routers](#) on page 485

## **Removing Components from the MX960 Router Chassis Before Installing It with a Lift**

Before installing the router with a lift, you must first remove components from the chassis, and reinstall the components the router is installed in the rack. With components removed, the chassis weighs approximately 150 lb (68.04 kg).

1. [Removing the Power Supplies Before Installing an MX960 Router with a Lift](#) on page 195
2. [Removing the Standard Cable Manager Before Installing an MX960 Router with a Lift](#) on page 196
3. [Removing the Fan Trays Before Installing an MX960 Router with a Lift](#) on page 197
4. [Removing the SCBs Before Installing an MX960 Router with a Lift](#) on page 199
5. [Removing the DPCs Before Installing an MX960 Router with a Lift](#) on page 200
6. [Removing the FPCs Before Installing the MX960 Router with a Lift](#) on page 202



## Removing the Power Supplies Before Installing an MX960 Router with a Lift

Remove the leftmost power supply first and then work your way to the right. To remove the AC or DC power supplies for each power supply (see [Figure 52 on page 196](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. On an AC-powered router, move the AC input switch in the chassis above each power supply to the off (O) position. On a DC-powered router, move the DC circuit breaker on each power supply faceplate to the off (O) position.

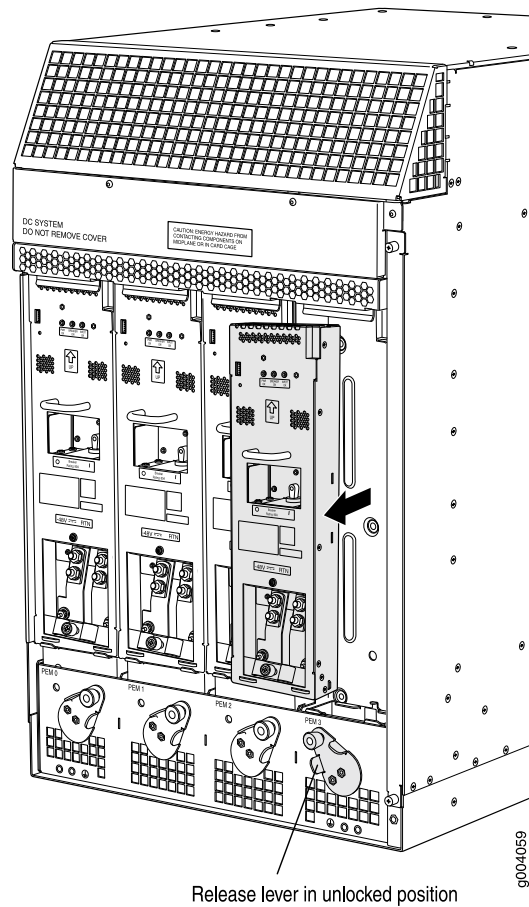
We recommend this even though the power supplies are not connected to power sources.

3. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.
4. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
5. Pull the power supply straight out of the chassis.



**WARNING:** Do not touch the power connector on the top of the power supply. It can contain dangerous voltages.

Figure 52: Removing a Power Supply Before Installing the MX960 Router

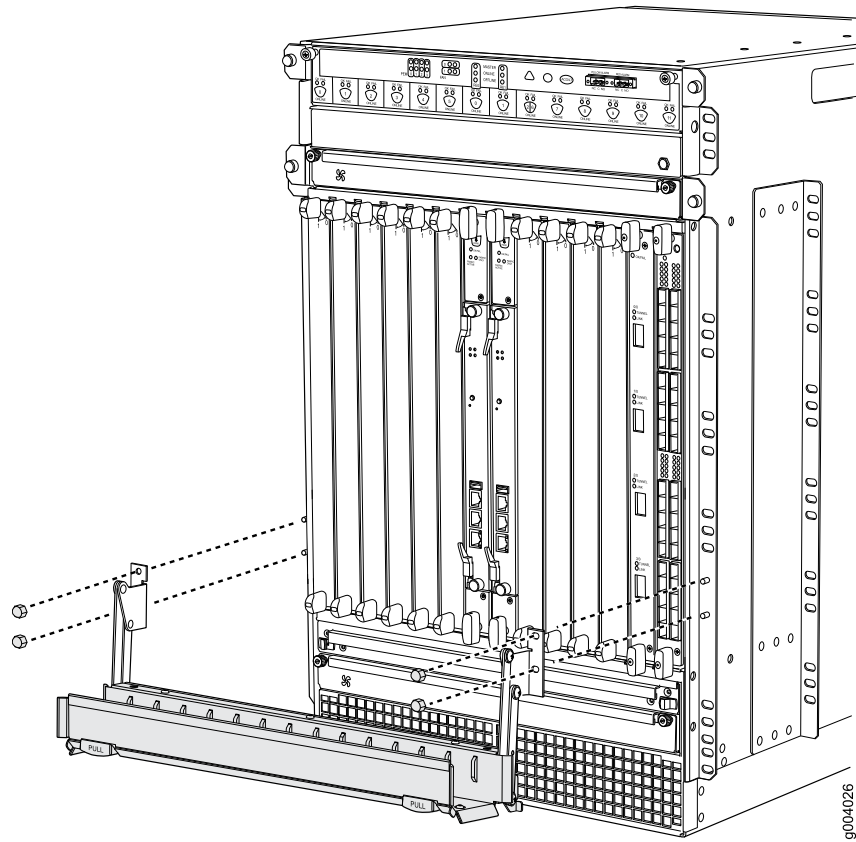


## Removing the Standard Cable Manager Before Installing an MX960 Router with a Lift

To remove the standard cable manager (see [Figure 53 on page 197](#)):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Using a 7/16-in. (11 mm) nut driver, unscrew the nuts on the corners of the standard cable manager.
3. Grasp the bottom of the standard cable manager, and pull it straight out from the studs on the front of the chassis.

Figure 53: Removing the Standard Cable Manager

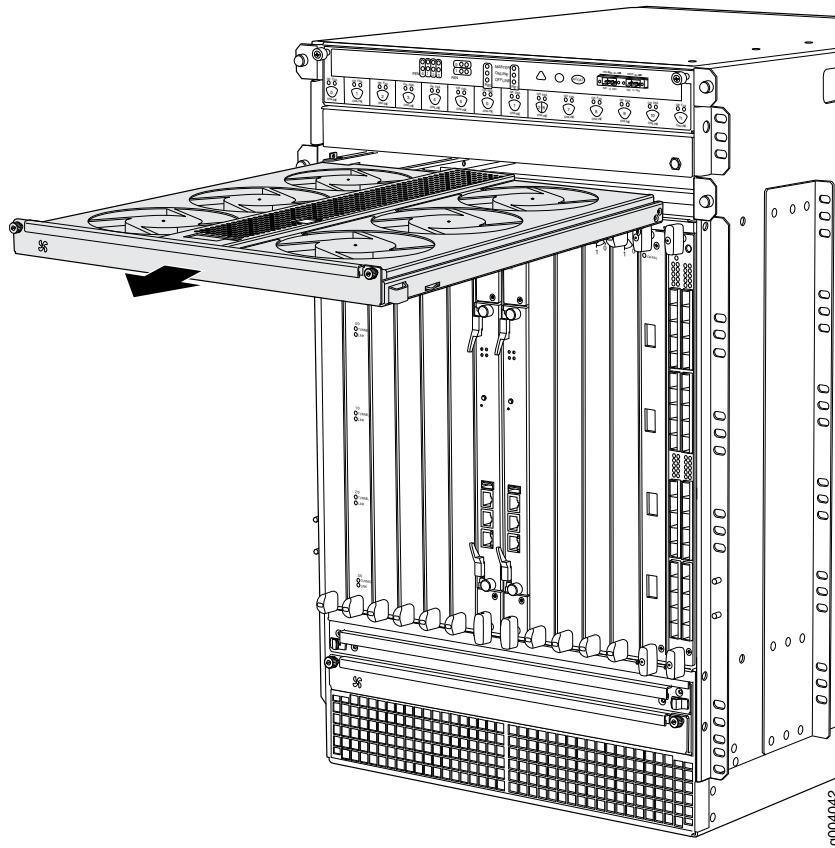


### Removing the Fan Trays Before Installing an MX960 Router with a Lift

To remove the upper or lower fan tray (see [Figure 54 on page 198](#) and [Figure 55 on page 199](#), which illustrate the upper and lower fan trays):

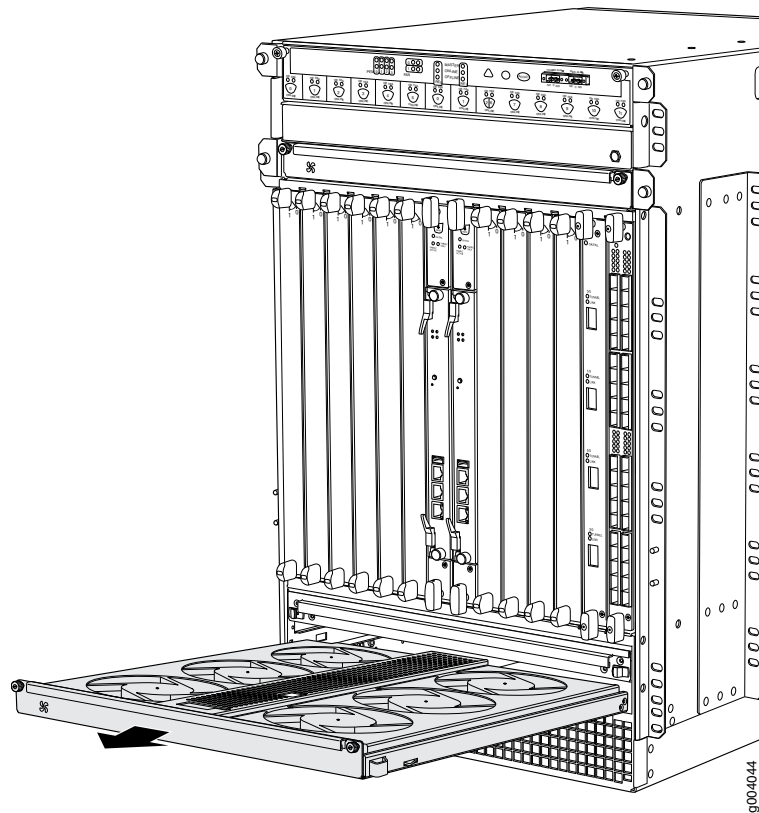
1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
2. Loosen the captive screw on each side of the fan tray faceplate.
3. Grasp both sides of the fan tray, and pull it out approximately 1 to 3 inches.
4. Press on the two latches located on the inside of the fan tray to release the fan tray from the chassis.
5. Place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

Figure 54: Removing an Upper Fan Tray



9004042

Figure 55: Removing a Lower Fan Tray



### Removing the SCBs Before Installing an MX960 Router with a Lift

To remove the SCBs (see Figure 56 on page 200):

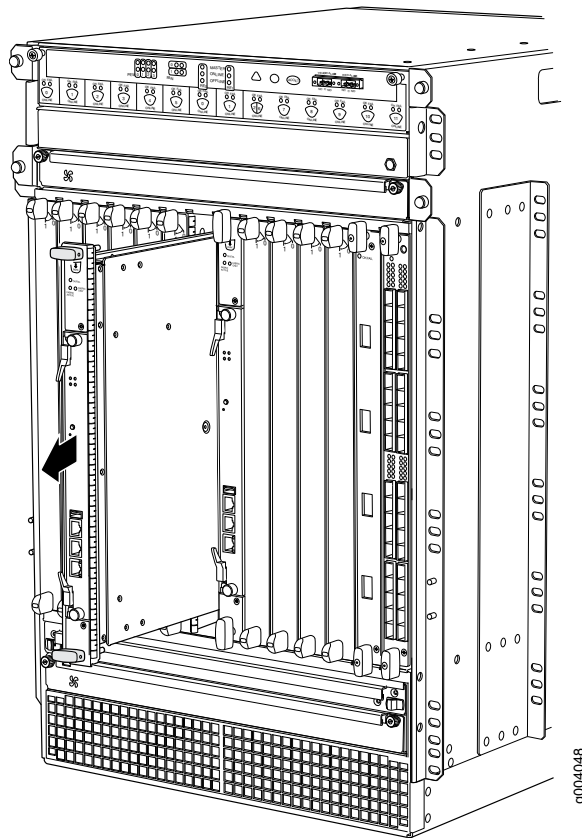
1. Place an electrostatic bag or antistatic mat on a flat, stable surface.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
3. Rotate the ejector handles simultaneously counterclockwise to unseat the SCB.
4. Grasp the ejector handles, and slide the SCB about halfway out of the chassis.
5. Place one hand underneath the SCB to support it, and slide it completely out of the chassis. Place it on the antistatic mat.



**CAUTION:** Do not stack hardware components on one another after you remove them. Place each component on an antistatic mat resting on a stable, flat surface.

6. Repeat the procedure for each SCB.

*Figure 56: Removing an SCB*



## Removing the DPCs Before Installing an MX960 Router with a Lift

To remove a DPC (see [Figure 57 on page 201](#)):

1. Have ready an antistatic mat for the DPC. Also have ready rubber safety caps for each DPC using an optical interface on the DPC that you are removing.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
3. Simultaneously turn both the ejector handles counterclockwise to unseat the DPC.

4. Grasp the handles, and slide the DPC straight out of the card cage halfway.
5. Place one hand around the front of the DPC and the other hand under it to support it. Slide the DPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.

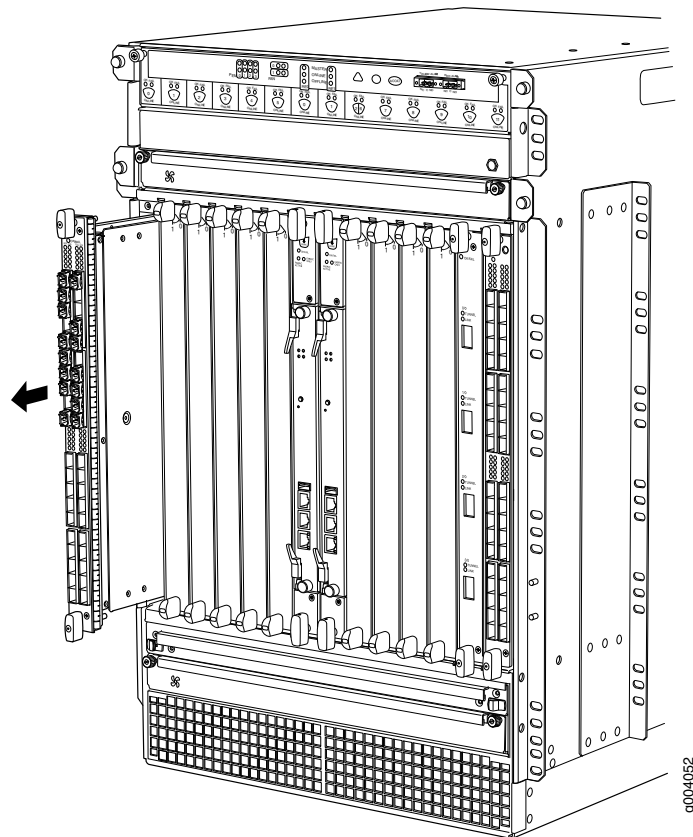


**CAUTION:** The weight of the DPC is concentrated in the back end. Be prepared to accept the full weight—up to 13.1 lb (5.9 kg)—as you slide the DPC out of the chassis.

When the DPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

Do not stack DPC on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

*Figure 57: Removing a DPC*



## Removing the FPCs Before Installing the MX960 Router with a Lift

To remove an FPC (see [Figure 58 on page 203](#)):

1. Have ready an antistatic mat for the FPC. Also have ready rubber safety caps for each PIC using an optical interface on the PIC that you are removing.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
3. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
4. Grasp the handles, and slide the FPC straight out of the card cage halfway.
5. Place one hand around the front of the FPC and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



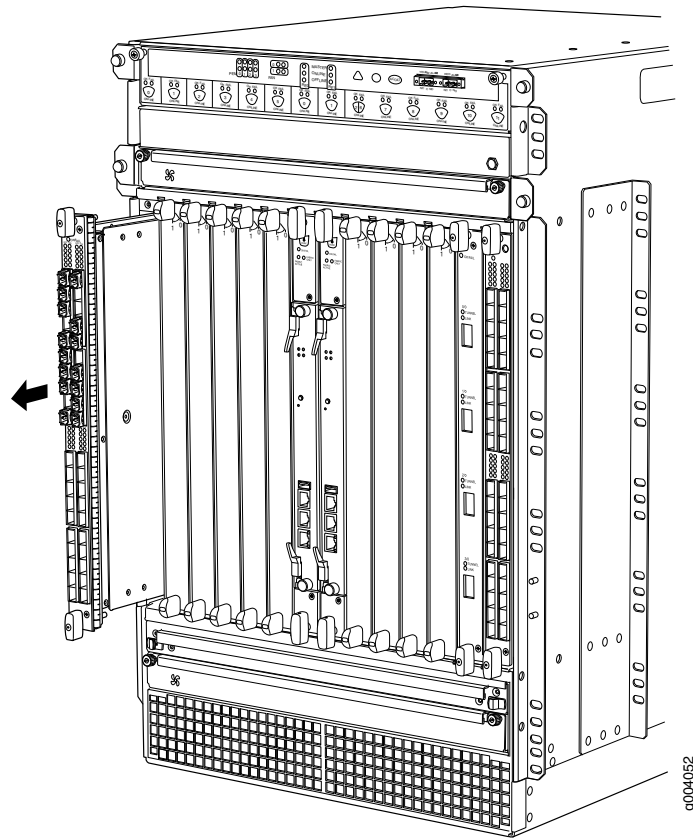
**CAUTION:** The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 18 lb (8.2 kg)—as you slide the FPC out of the chassis.

When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

---



Figure 58: Removing an FPC



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [MX960 Site Preparation Checklist on page 122](#)
- [Tools Required to Install the MX960 Router with a Mechanical Lift on page 203](#)
- [Installing the MX960 Router Using a Mechanical Lift on page 204](#)
- [Reinstalling Components in the MX960 Chassis After Installing It with a Lift on page 206](#)

## Tools Required to Install the MX960 Router with a Mechanical Lift

To install the router, you need the following tools:

- Mechanical lift
- Phillips (+) screwdriver, number 2
- 7/16-in. (11 mm) nut driver
- ESD grounding wrist strap

**Related Documentation**

- [MX960 Site Preparation Checklist on page 122](#)

- [Removing Components from the MX960 Router Chassis Before Installing It with a Lift on page 194](#)
- [Installing the MX960 Router Using a Mechanical Lift on page 204](#)
- [Reinstalling Components in the MX960 Chassis After Installing It with a Lift on page 206](#)

## Installing the MX960 Router Using a Mechanical Lift

---

Because of the router's size and weight—up to 350 lb (158.8 kg) depending on the configuration—you must use mechanical lift to install the router.

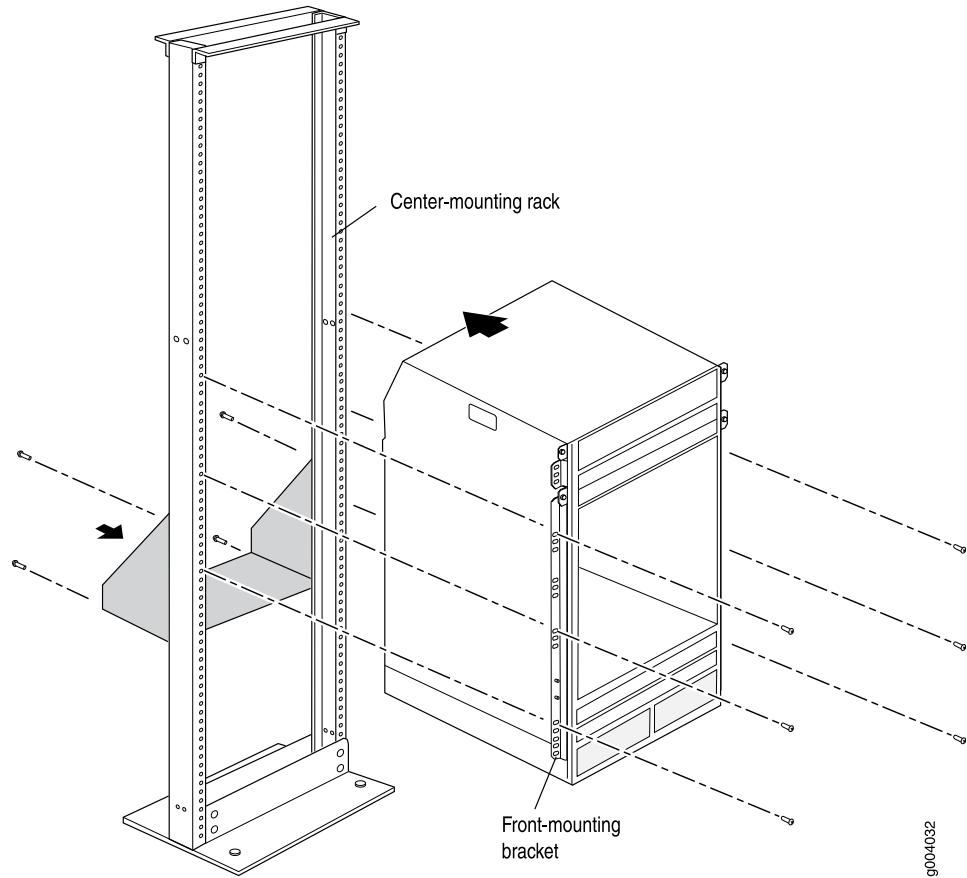


**CAUTION:** Before front mounting the router in a rack, have a qualified technician verify that the rack is strong enough to support the router's weight and is adequately supported at the installation site.

To install the router using a lift (see [Figure 59 on page 205](#)):

1. Ensure that the rack is in its permanent location and is secured to the building. Ensure that the installation site allows adequate clearance for both airflow and maintenance.
2. Load the router onto the lift, making sure it rests securely on the lift platform.
3. Using the lift, position the router in front of the rack or cabinet, centering it in front of the mounting shelf.
4. Lift the chassis approximately 0.75 in. above the surface of the mounting shelf and position it as close as possible to the shelf.
5. Carefully slide the router onto the mounting shelf so that the bottom of the chassis and the mounting shelf overlap by approximately two inches.
6. Slide the router onto the mounting shelves until the mounting brackets or front-mounting flanges contact the rack rails. The shelves ensure that the holes in the mounting brackets and the front-mounting flanges of the chassis align with the holes in the rack rails.
7. Move the lift away from the rack.
8. To install the router in an open-frame rack, install a mounting screw into each of the open mounting holes aligned with the rack, starting from the bottom.
9. Visually inspect the alignment of the router. To verify that the router is installed properly in the rack, verify that all the mounting screws on one side of the rack are aligned with the mounting screws on the opposite side and the router is level.

Figure 59: Installing the MX960 Router in the Rack



**NOTE:** This illustration depicts the router being installed in an open-frame rack.

#### Related Documentation

- [MX960 Site Preparation Checklist on page 122](#)
- [Tools Required to Install the MX960 Router with a Mechanical Lift on page 203](#)
- [Removing Components from the MX960 Router Chassis Before Installing It with a Lift on page 194](#)
- [Reinstalling Components in the MX960 Chassis After Installing It with a Lift on page 206](#)

## Reinstalling Components in the MX960 Chassis After Installing It with a Lift

---

After the router is installed in the rack, reinstall the removed components before booting and configuring the router. You reinstall components first in the rear of the chassis, and then in the front:

1. [Reinstalling the Power Supplies After Installing the MX960 Router with a Lift on page 206](#)
2. [Reinstalling the Fan Trays After Installing the MX960 Router with a Lift on page 207](#)
3. [Reinstalling the SCBs After Installing the MX960 Router with a Lift on page 209](#)
4. [Reinstalling the DPCs After Installing the MX960 Router with a Lift on page 210](#)
5. [Reinstalling the FPCs After Installing the MX960 Router with a Lift on page 212](#)
6. [Reinstalling the Standard Cable Manager After Installing an MX960 Router with a Lift on page 213](#)

### Reinstalling the Power Supplies After Installing the MX960 Router with a Lift

Reinstall the rightmost power supply first and then work your way to the left. To reinstall the AC or DC power supplies, follow this procedure for each power supply (see [Figure 60 on page 207](#), which shows the installation of the DC power supplies):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. For an AC-powered router, move the AC input switch in the chassis above the power supply slot to the off (O) position. For a DC-powered router, move the DC circuit breaker on the power supply to the off (O) position.

We recommend this even though the power supplies are not connected to power sources.

3. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see [Figure 60 on page 207](#)).

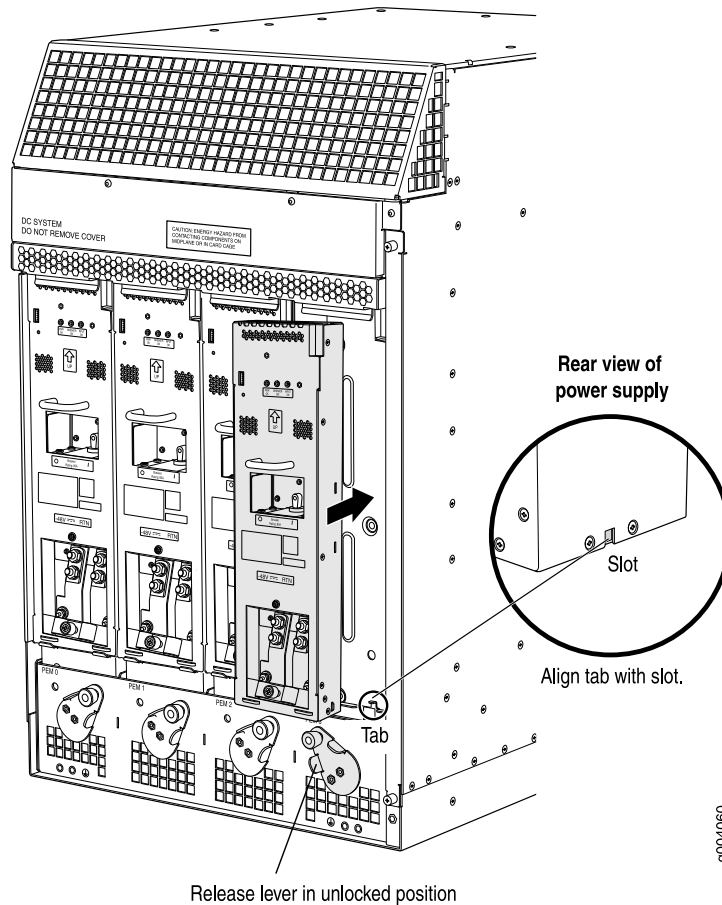
If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

4. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplates.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply. This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

Figure 60: Reinstalling a Power Supply



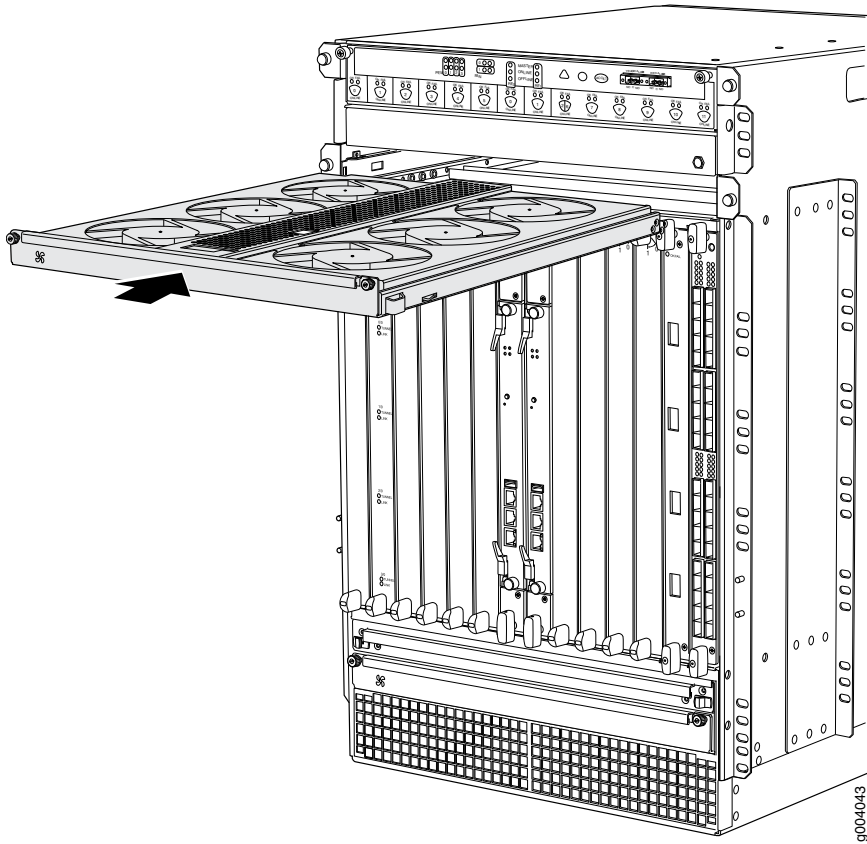
## Reinstalling the Fan Trays After Installing the MX960 Router with a Lift

To reinstall the fan trays (see [Figure 61 on page 208](#) and [Figure 62 on page 209](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Grasp the fan tray on each side, and insert it straight into the chassis. Note the correct orientation by the "this side up" label on the top surface of the fan tray.

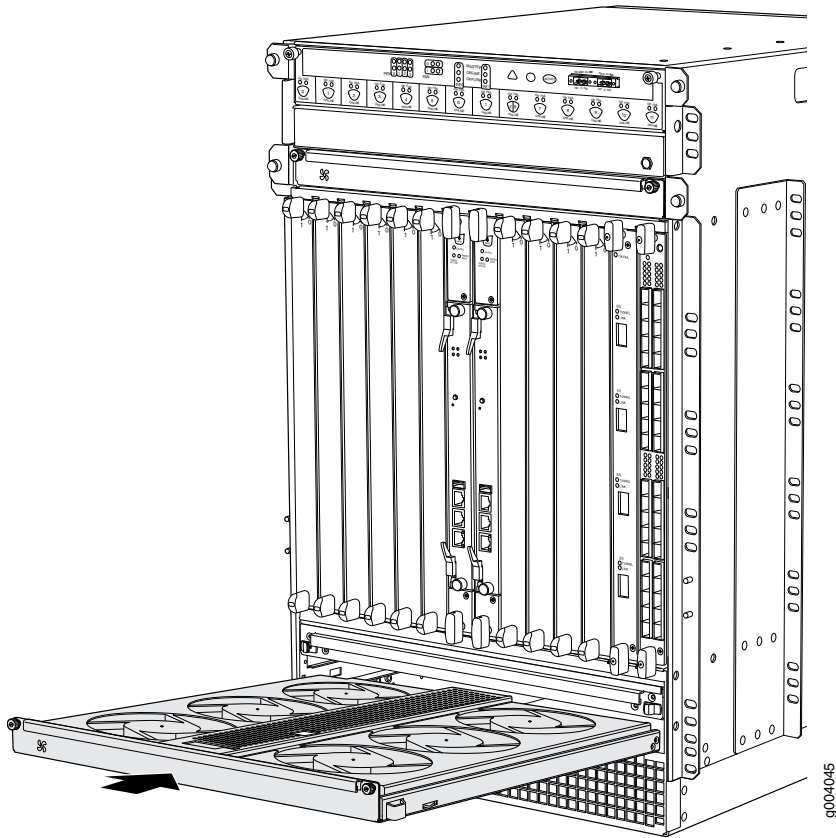
3. Tighten the captive screws on each side of the fan tray faceplate to secure it in the chassis.
4. Lower the standard cable manager back into position, if necessary.

Figure 61: Installing an Upper Fan Tray



g004043

Figure 62: Installing a Lower Rear Fan Tray



### Reinstalling the SCBs After Installing the MX960 Router with a Lift

To reinstall an SCB (see [Figure 63 on page 210](#)):

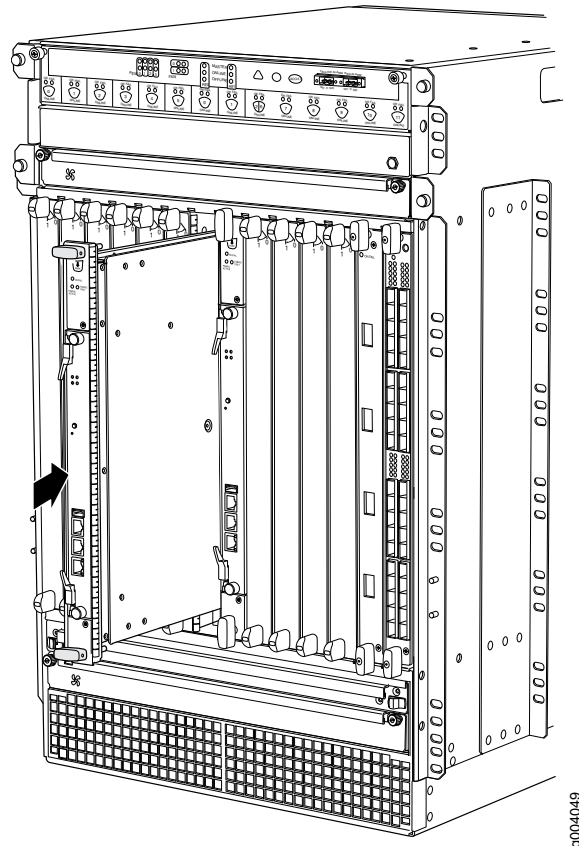


**CAUTION:** Before removing or replacing an SCB, ensure that the ejector handles are stored horizontally and pressed toward the center of the SCB.

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Carefully align the sides of the SCB with the guides inside the chassis.
3. Slide the SCB into the chassis until you feel resistance, carefully ensuring that it is correctly aligned.

4. Grasp both ejector handles, and rotate them simultaneously clockwise until the SCB is fully seated.
5. Place the ejector handles in their proper position, vertically and toward the center of the board. To avoid blocking the visibility of the LEDs position the ejectors over the PARK icon.

Figure 63: Reinstalling an SCB



9004049

## Reinstalling the DPCs After Installing the MX960 Router with a Lift

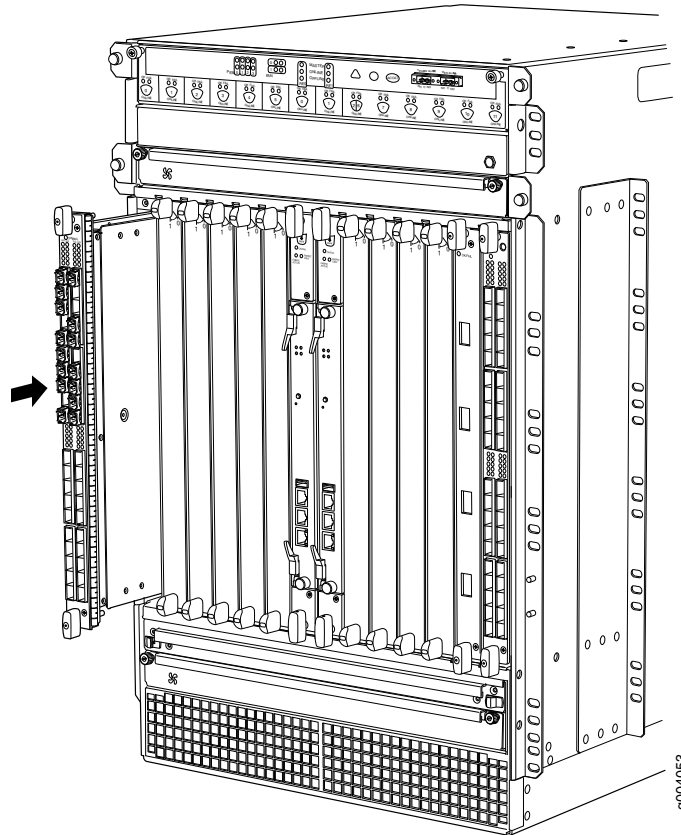
To reinstall a DPC (see [Figure 64 on page 211](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Take each DPC to be installed out of its electrostatic bag, and identify the slot on the DPC where it will be connected.
3. Verify that each fiber-optic DPC has a rubber safety cap covering the transceiver. If it does not, cover the transceiver with a safety cap.



4. Locate the slot in the DPC card cage in which you plan to install the DPC.
5. Ensure that the DPC is right-side up, with the text on the faceplate of the DPC facing upward.
6. Lift the DPC into place, and carefully align first the bottom, then the top of the DPC with the guides inside the card cage.
7. Slide the DPC all the way into the card cage until you feel resistance.
8. Grasp both ejector handles, and rotate them simultaneously clockwise until the DPC is fully seated.

*Figure 64: Installing a DPC*

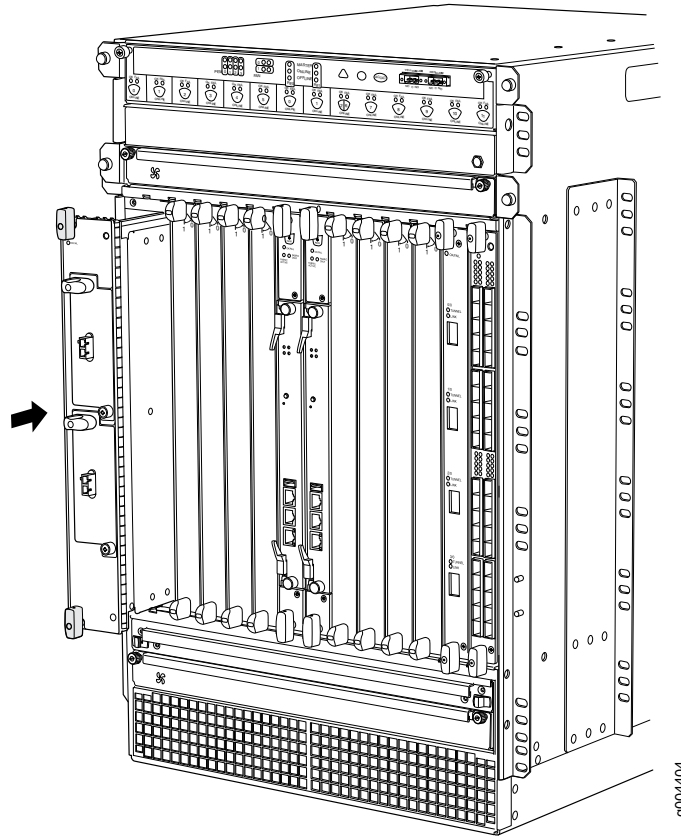


## Reinstalling the FPCs After Installing the MX960 Router with a Lift

To reinstall an FPC (see [Figure 65 on page 213](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the FPC on an antistatic mat, or remove it from its electrostatic bag.
3. Identify the two DPC slots on the router where the FPC will be installed.
4. Verify that each fiber-optic transceiver on the PIC is covered by a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the FPC so that the faceplate faces you.
6. Lift the FPC into place, and carefully align the sides of the FPC with the guides inside the card cage.
7. Slide the FPC all the way into the card cage until you feel resistance.
8. Grasp both ejector handles, and rotate them clockwise simultaneously until the FPC is fully seated.

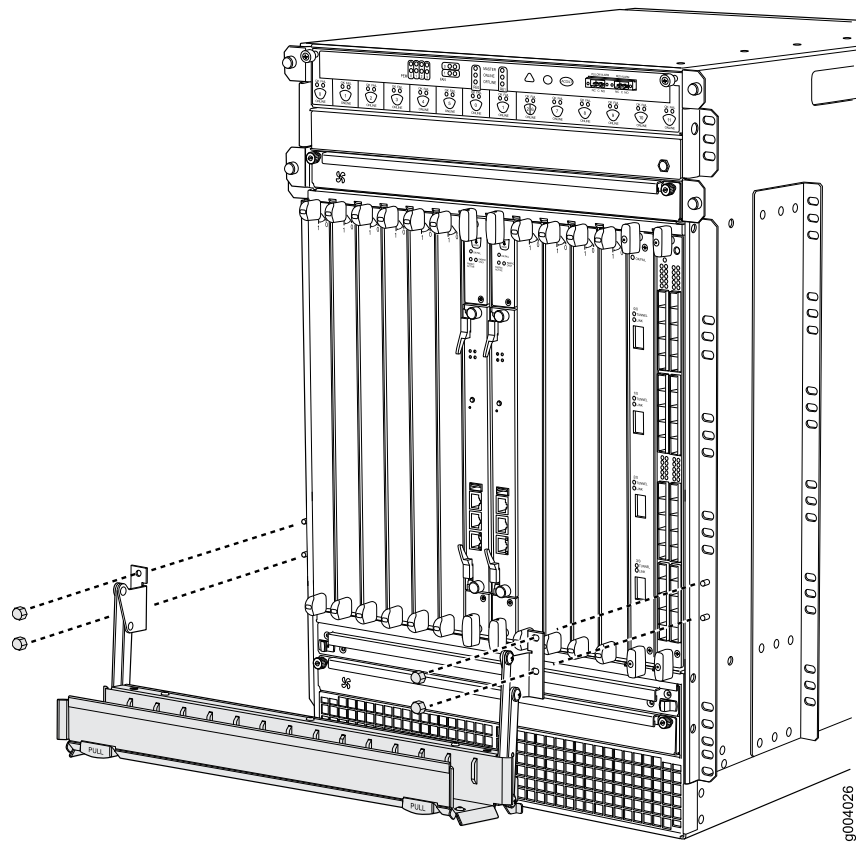
Figure 65: Reinstalling an FPC



### Reinstalling the Standard Cable Manager After Installing an MX960 Router with a Lift

To reinstall the standard cable manager (see [Figure 66](#) on page 214):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Position the cable manager on the studs on the lower front of the chassis.
3. Insert the nuts on the corners in the cable manager onto the studs on the chassis.
4. Using a 7/16-in. (11 mm) nut driver, tighten the nuts securely.

*Figure 66: Reinstalling the Cable Manager***Related Documentation**

- [MX960 Site Preparation Checklist on page 122](#)
- [Tools Required to Install the MX960 Router with a Mechanical Lift on page 203](#)
- [Removing Components from the MX960 Router Chassis Before Installing It with a Lift on page 194](#)
- [Installing the MX960 Router Using a Mechanical Lift on page 204](#)

# Connecting the MX960 Router to Power

- Tools and Parts Required for MX960 Router Grounding and Power Connections on page 215
- Grounding the MX960 Router on page 216
- Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies on page 217
- Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies on page 219
- Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies on page 222
- Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies on page 223
- Connecting Power to a DC-Powered MX960 Router with High-Capacity Power Supplies on page 226
- Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies on page 230
- Powering Off the MX960 Router on page 232
- Connecting an MX960 AC Power Supply Cord on page 233
- Connecting an MX960 DC Power Supply Cable on page 234

## Tools and Parts Required for MX960 Router Grounding and Power Connections

---

To ground and provide power to the router, you need the following tools and parts:

- Phillips (+) screwdrivers, numbers 1 and 2
- 2.5-mm flat-blade (–) screwdriver
- 7/16-in. (11 mm) hexagonal-head external drive socket wrench, or nut driver, with a torque range between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) tightening torque, for tightening nuts to terminal studs on each power supply on a DC-powered router.
- Wire cutters
- Electrostatic discharge (ESD) grounding wrist strap



**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs. Use an appropriately-sized driver or socket wrench. Ensure that the driver is undamaged and properly calibrated and that you have been trained in its use. You may wish to use a driver that is designed to prevent overtorque when the preset torque level is achieved.

---

**Related Documentation**

- [Grounding the MX960 Router on page 216](#)
- [MX960 Router Grounding Specifications on page 137](#)
- [Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies on page 217](#)
- [Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies on page 223](#)

## Grounding the MX960 Router

---

You ground the router by connecting a grounding cable to earth ground and then attaching it to the chassis grounding points using two screws. You must provide the grounding cables (the cable lugs are supplied with the router).

1. Verify that a licensed electrician has attached the cable lug provided with the router to the grounding cable.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an approved site ESD grounding point. See the instructions for your site.
3. Ensure that all grounding surfaces are clean and brought to a bright finish before grounding connections are made.
4. Connect the grounding cable to a proper earth ground.
5. Detach the ESD grounding strap from the site ESD grounding point.
6. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
7. Place the grounding cable lug over the grounding points on the rear of the chassis. The left pair is sized for M6 screws, and the right pair is sized for UNC 1/4-20 screws.

8. Secure the grounding cable lug to the grounding points, first with the washers, then with the screws.
9. Dress the grounding cable and verify that it does not touch or block access to router components, and that it does not drape where people could trip on it.

**Related Documentation**

- [MX960 Router Grounding Specifications on page 137](#)
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies on page 217](#)
- [Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies on page 223](#)

## Connecting Power to an AC-Powered MX960 Router with Normal-Capacity Power Supplies



**CAUTION:** Do not mix AC and DC power supply modules within the same router. Damage to the router might occur.

The AC appliance inlets are located in the chassis directly above the power supplies.

To connect the AC power cords to the router (see [Figure 67 on page 218](#)):

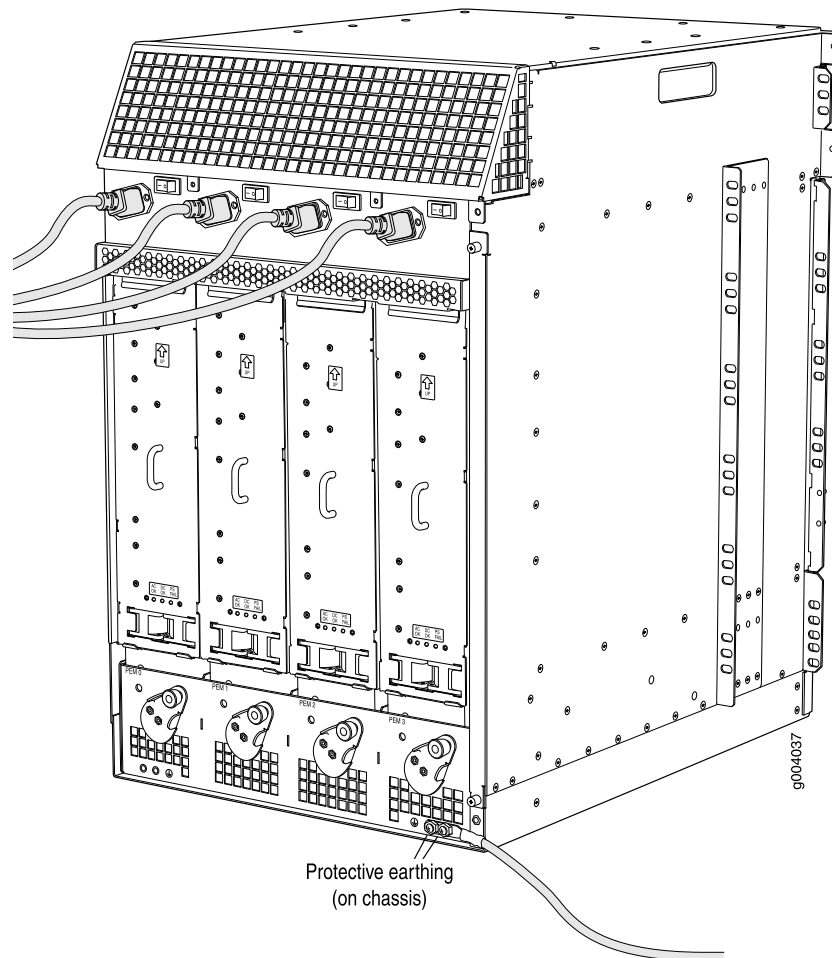
1. Locate the power cords shipped with the router, which should have a plug appropriate for your geographical location.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Move the AC input switch, which is to the right of the appliance inlet on the chassis, to the off (O) position.
4. Connect the power cord into the appliance inlet located in the chassis directly above the AC power supply.
5. Insert the power cord plug into an external AC power source receptacle.



**NOTE:** Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker. We recommend that you use a 15 A (250 VAC) minimum, or as required by local code.

6. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, or drape where people could trip on it.
7. Repeat Step 3 through Step 6 for the remaining power supplies.

Figure 67: Connecting AC Power to the MX960 Router



**Related Documentation**

- [Grounding the MX960 Router on page 216](#)
- [AC Power Cord Specifications for the MX960 Router on page 156](#)
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies on page 222](#)
- [Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies on page 219](#)



## Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies

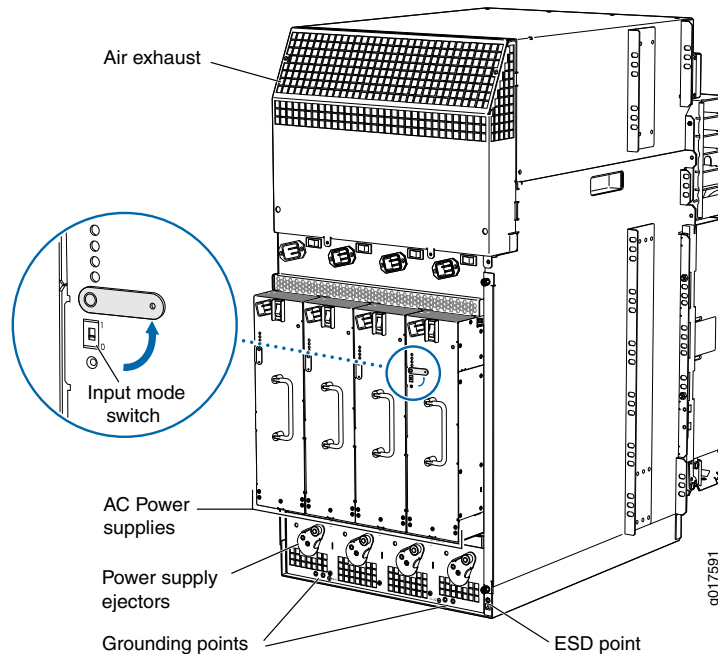


**NOTE:** A minimum of two AC nominal 220 VAC 20 amp power cords are required for this procedure.

To install an MX960 high-capacity AC power supply, use the following procedure (see [Figure 68 on page 219](#)).

1. Verify that the power switch on the power supply is in the off (O) position.
2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see [Figure 68 on page 219](#)).

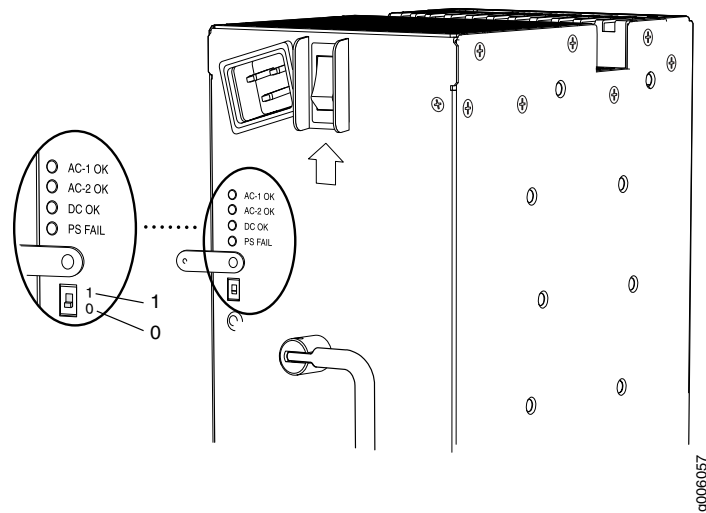
*Figure 68: MX960 with High-Capacity AC Power Supplies Installed*



If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.
4. Move the input mode switch to position 0 for one feed or position 1 for two feeds (see [Figure 69 on page 220](#)).

Figure 69: MX960 AC Power Input Mode Switch



**CAUTION:** Do not use a pencil, because fragments can break off and cause damage to the power supply.

- Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate will protrude beyond the chassis.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see [Figure 69 on page 220](#)). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

- While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
- Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
- Locate a power cord with the type of plug appropriate for your geographical location (see [“AC Power Cord Specifications for the MX960 Router” on page 156](#)).
- Plug the power cord into the corresponding appliance inlet located in the chassis directly above the power supply. This is the recommend receptacle when using the power supply in one-feed mode. If using the power supply in two-feed mode, plug the second power cord into the receptacle on the power supply.



**NOTE:** Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker.



**NOTE:** To use HC-PSs with full capacity you have to switch them to two feed mode and use two power corders per HC-PS.

10. Dress the power cords appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.
11. Move the AC input switch above the power supply to the on (—) position. This is the only switch you have to turn on if you are using the power supply in one feed mode. If using the power supply in two-feed mode, move the power switch on the power supply to the on position. Remember to turn on both switches when operating the power supply in two-feed mode.
12. If the power supply is correctly installed and functioning normally, the **AC1 OK**, **AC2 OK** (two-feed mode only) **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit. See [Table 82 on page 221](#).

**Table 82: MX960 High-Capacity AC Power Supply LEDs**

Connected Inputs	DIP Switch Position	LEDs			
		AC-1 OK	AC-2 OK	DC OK	PS FAIL
PDM connected, power supply disconnected	0 (1 input)	Green	Off	Green	Off
PDM disconnected, power supply connected	0 (1 input)	Off	Green	Green	Off
PDM connected, power supply connected	0 (1 input)	Green	Green	Green	Off
PDM connected, power supply disconnected	1 (2 inputs)	Green	Off	Off	Red
PDM disconnected, power supply connected	1 (2 inputs)	Off	Green	Off	Red

Table 82: MX960 High-Capacity AC Power Supply LEDs (continued)

Connected Inputs	DIP Switch Position	LEDs			
		AC-1 OK	AC-2 OK	DC OK	PS FAIL
PDM connected, power supply connected	1 (2 inputs)	Green	Green	Green	Off

**Note:** The corresponding appliance inlet located in the chassis directly above the power supply is the recommend receptacle when using the power supply in one feed mode. If using the power supply in two-feed mode, plug the second power cord into the receptacle on the power supply

**Note:** PDM in the above table stands for Power Distribution Module.

- Repeat steps 1-12 for installing power supplies in slots 1, 2, and 3, where required.

## Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies

To power on an AC-powered router:

- Verify that the power supplies are fully inserted in the chassis.
- Verify that each AC power cord is securely inserted into its appliance inlet.
- Verify that an external management device is connected to one of the Routing Engine ports (**AUX**, **CONSOLE**, or **ETHERNET**).
- Turn on the power to the external management device.
- Switch on the dedicated customer site circuit breakers. Follow the ESD and safety instructions for your site.
- Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
- Switch the AC switch in the chassis above each power supply to the on (—) position.
- Check that the AC power supply is correctly installed and functioning normally. Verify that the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.



**NOTE:** After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the status LEDs on the power supply and the show chassis command display—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

9. On the external management device connected to the Routing Engine, monitor the startup process to verify that the system has booted properly.



**NOTE:** If the system is completely powered off when you power on the power supply, the Routing Engine boots as the power supply completes its startup sequence. Normally, the router boots from the Junos OS on the CompactFlash card.

After powering on a power supply, wait at least 60 seconds before turning it off.

#### Related Documentation

- [Connecting Power to an AC-Powered MX960 Router with High-Capacity Power Supplies on page 219](#)
- [Connecting the MX960 Router to Management and Alarm Devices on page 237](#)
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Replacing an MX960 AC Power Supply on page 397](#)
- [Powering Off the MX960 Router on page 232](#)

## Connecting Power to a DC-Powered MX960 Router with Normal-Capacity Power Supplies



**CAUTION:** Do not mix AC and DC power supply modules within the same router. Damage to the router might occur.



**WARNING:** Before performing DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.

You connect DC power to the router by attaching power cables from the external DC power sources to the terminal studs on the power supply faceplates. You must provide the power cables (the cable lugs are supplied with the router).

To connect the DC source power cables to the router:

1. Switch off the dedicated customer site circuit breakers. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Move the DC circuit breaker on the power supply faceplate to the off (O) position.
4. Remove the clear plastic cover protecting the terminal studs on the faceplate.
5. Verify that the DC power cables are correctly labeled before making connections to the power supply. In a typical power distribution scheme where the return is connected to chassis ground at the battery plant, you can use a multimeter to verify the resistance of the **-48V** and **RTN** DC cables to chassis ground:
  - The cable with very large resistance (indicating an open circuit) to chassis ground is **-48V**.
  - The cable with very low resistance (indicating a closed circuit) to chassis ground is **RTN**.



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (-) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.

6. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11 mm] nut driver or socket wrench.)
7. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut (see [Figure 70 on page 226](#)). Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut. Do not overtighten the nut. (Use a 7/16-in. [11 mm] torque-controlled driver or socket wrench.)
  - a. Secure each positive (+) DC source power cable lug to the **RTN** (return) terminal.
  - b. Secure each negative (-) DC source power cable lug to the **-48V** (input) terminal.



**CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin

freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.



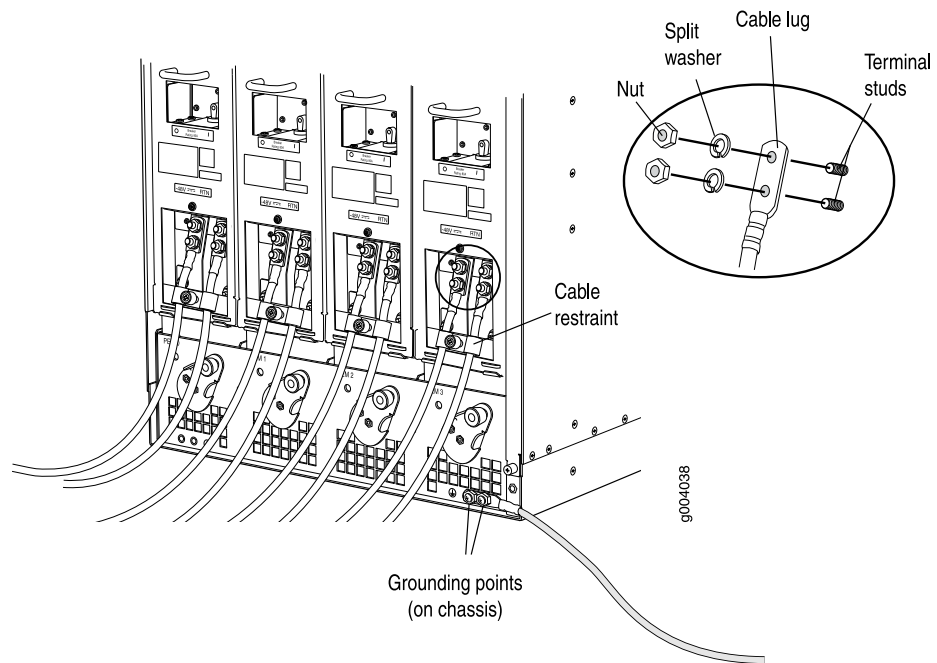
**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.



**NOTE:** The DC power supplies in slots PEM0 and PEM1 must be powered by dedicated power feeds derived from feed A, and the DC power supplies in slots PEM2 and PEM3 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.

8. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.
9. Route the positive and negative DC power cables through the left and right sides of the cable restraint.
10. Tighten the cable restraint captive screw to hold the power cables in place.
11. Replace the clear plastic cover over the terminal studs on the faceplate.
12. Verify that the power cables are connected correctly, that they are not touching or blocking access to router components, and that they do not drape where people could trip on them.
13. Repeat Steps 3 through 12 for the remaining power supplies.

Figure 70: Connecting DC Power to the MX960 Router



#### Related Documentation

- [DC Power Cable Specifications for the MX960 Router on page 175](#)
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies on page 230](#)

## Connecting Power to a DC-Powered MX960 Router with High-Capacity Power Supplies

To install an MX960 DC high-capacity DC power supply:

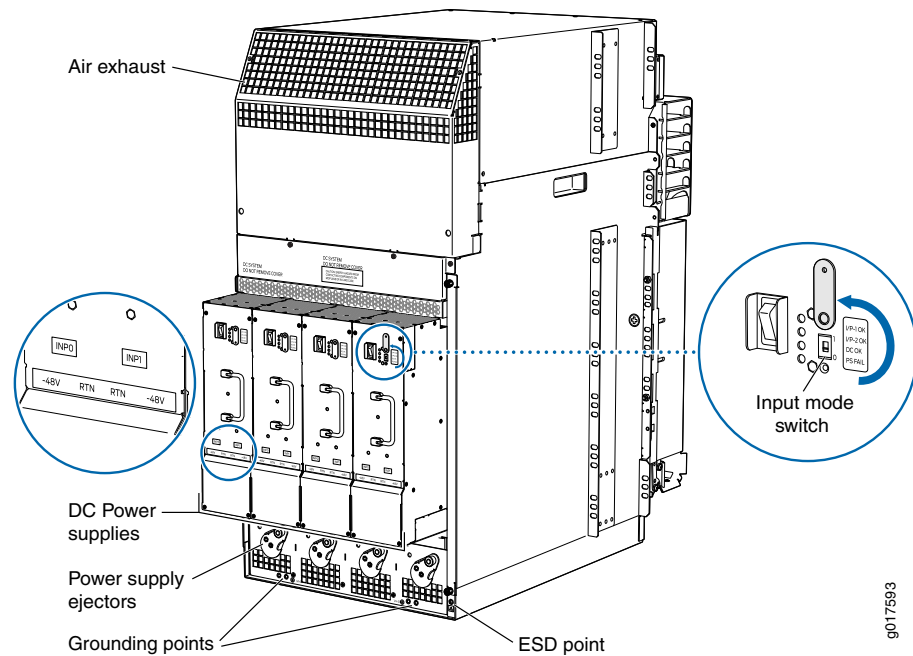
1. Verify that the power switch on the power supply is in the off (O) position.
2. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.
3. Move the input mode switch to position 0 for one feed or position 1 for two feeds (see [Figure 71 on page 227](#)).



**NOTE:** For a fully redundant configuration in two-feed mode, eight feeds are required. For a non-redundant configuration, four feeds are required.



Figure 71: MX960 with High-Capacity DC Power Supplies Installed



**CAUTION:** Do not use a pencil, because fragments can break off and cause damage to the power supply.

4. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.

5. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position.

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

6. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply. This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

7. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

8. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
9. Remove the cover protecting the terminal studs on the faceplate.
10. Remove the nut and washer from each of the terminal studs.
11. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 in-lb. (2.6 Nm) and 25 in-lb. (2.8 Nm) of torque to each nut. Do not overtighten the nut. (Use a 7/16-in. [11-mm] torque-controlled driver or socket wrench.)
  - a. On **INPUT 0**, attach the positive (+) DC source power cable lug to the **RTN** (return) terminal as shown in [Figure 71 on page 227](#). Repeat this step for **INPUT 1** if using two feeds.
  - b. On **INPUT 0** attach the negative (–) DC source power cable lug to the **–48V** (input) terminal. Repeat this step for **INPUT 1** if using two feeds.



**CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.



**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 36 in-lb. (4.0 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.



**NOTE:** The DC power supplies in slots PEM0 and PEM1 must be powered by dedicated power feeds derived from feed A, and the DC power supplies in PEM2 and PEM3 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system. For information about connecting to DC power sources, see [“Electrical Specifications for the MX960 DC Power Supply” on page 159](#).

12. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.
13. Replace the clear plastic cover over the terminal studs on the faceplate.

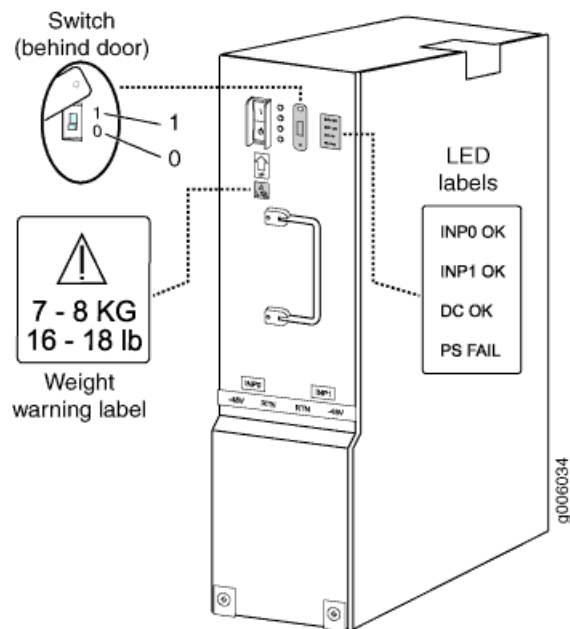
14. Switch on the dedicated customer site circuit breaker.
15. Verify that the **INPUT 0 OK** or **INPUT 1 OK** LEDs on the power supply are lit green steadily. If using two feeds, verify that both **INPUT 0 OK** and **INPUT 1 OK** LEDs on the power supply are lit steadily. The **INPUT OK** will be lit amber if that input's voltage is in reverse polarity. Check the polarity of the power cables to fix the condition (see [Figure 72 on page 230](#) and [Table 83 on page 229](#)).
16. Move the switch to the on (I) position.
17. Verify that the **DC OK** LED is lit green steadily. See [Table 83 on page 229](#) for information on MX960 high-capacity DC LEDs.

**Table 83: MX960 High-Capacity DC Power Supply LEDs**

Connected Inputs	DIP Switch Position	LEDs			
		INP-0 OK	INP-1 OK	DC OK	PS FAIL
INP0 connected, INP1 disconnected	0 (1 input)	Green	Off	Green	Off
INP0 disconnected, INP1 connected		Off	Green	Green	Off
INP0 connected, INP1 connected		Green	Green	Green	Off
INP0 connected, INP1 disconnected	1 (2 inputs)	Green	Off	Off	Red
INP0 disconnected, INP1 connected		Off	Green	Off	Red
INP0 connected, INP1 connected		Green	Green	Green	Off

18. Repeat steps 1-17 for installing power supplies in slots 1, 2, and 3, where required.

Figure 72: MX960 DC High-Capacity Power Supply Front View



19. Install a blank panel over the power distribution modules, if available.

## Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies

1. Verify that an external management device is connected to one of the Routing Engine ports (**AUX**, **CONSOLE**, or **ETHERNET**).
2. Turn on the power to the external management device.
3. Verify that the power supplies are fully inserted in the chassis.
4. Verify that the source power cables are connected to the appropriate terminal: the positive (+) source cable to the return terminal (labeled **RTN**) and the negative (-) source cable to the input terminal (labeled **-48V**).
5. Switch on the dedicated customer site circuit breakers to provide power to the DC power cables. Follow your site's procedures.
6. Check that the **INPUT OK** LED is lit steadily green to verify that power is present.

7. If power is not present:
  - Verify that the fuse is installed correctly, and turn on the breaker at the battery distribution fuse board or fuse bay.
  - Check the voltage with a meter at the terminals of the power supply for correct voltage level and polarity.
8. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
9. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (I) position.



**NOTE:** The circuit breaker may bounce back to the off (O) position if you move the breaker too quickly.

10. Verify that the **BREAKER ON** LED is lit green steadily.
11. Verify that the **PWROK** LED is lit green steadily, indicating the power supply is correctly installed and functioning normally.



**NOTE:** After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the status LEDs on the power supply and the show chassis command display—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

12. On the external management device connected to the Routing Engine, monitor the startup process to verify that the system has booted properly.



**NOTE:** If the system is completely powered off when you power on the power supply, the Routing Engine boots as the power supply completes its startup sequence. Normally, the router boots from the Junos OS on the CompactFlash card.

After powering on a power supply, wait at least 60 seconds before turning it off. To power off the system after the Routing Engine finishes booting, see [“Powering Off the MX960 Router” on page 232](#).

- Related Documentation**
- [Connecting Power to a DC-Powered MX960 Router with High-Capacity Power Supplies on page 226](#)
  - [Connecting the MX960 Router to Management and Alarm Devices on page 237](#)
  - [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing an MX960 DC Power Supply on page 402](#)

## Powering Off the MX960 Router

---



**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

---

To power off the router:

1. On the external management device connected to the Routing Engine, issue the **request system halt both-routing-engines** operational mode command. The command shuts down the Routing Engines cleanly, so their state information is preserved. (If the router contains only one Routing Engine, issue the **request system halt** command.)

```
user@host> request system halt both-routing-engines
```

2. Wait until a message appears on the console confirming that the operating system has halted. For more information about the command, see the [CLI Explorer](#).
3. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Move the AC input switch on the chassis above the AC power supply or the DC circuit breaker on each DC power supply faceplate to the off (O) position.

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Grounding the MX960 Router on page 216](#)
  - [Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies on page 222](#)
  - [Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies on page 230](#)

## Connecting an MX960 AC Power Supply Cord

---

To connect the AC power cord:

1. Locate a replacement power cord with the type of plug appropriate for your geographical location (see “AC Power Cord Specifications for the MX960 Router” on page 156).
2. Plug the replacement power cord into the corresponding appliance inlet located in the chassis directly above the power supply.
3. Insert the power cord plug into an external AC power source receptacle.



**NOTE:** Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker. We recommend that you use a 15 A (250 VAC) minimum, or as required by local code.

4. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, or drape where people could trip on it.
5. Move the AC input switch in the chassis above the power supply to the on (—) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

### Related Documentation

- [MX960 AC Power Supply Description on page 86](#)
- [Disconnecting an MX960 AC Power Supply Cord on page 410](#)
- [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
- [Replacing an MX960 AC Power Supply on page 397](#)

## Connecting an MX960 DC Power Supply Cable



**WARNING:** Before performing DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.

To connect a power cable for a DC power supply:

1. Locate a replacement power cable that meets the specifications defined in “[Electrical Specifications for the MX960 DC Power Supply](#)” on page 159.
2. Verify that a licensed electrician has attached a cable lug to the replacement power cable.
3. Verify that the **INPUT OK** LED is off.
4. Secure the power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut (see [Figure 73 on page 235](#)). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)



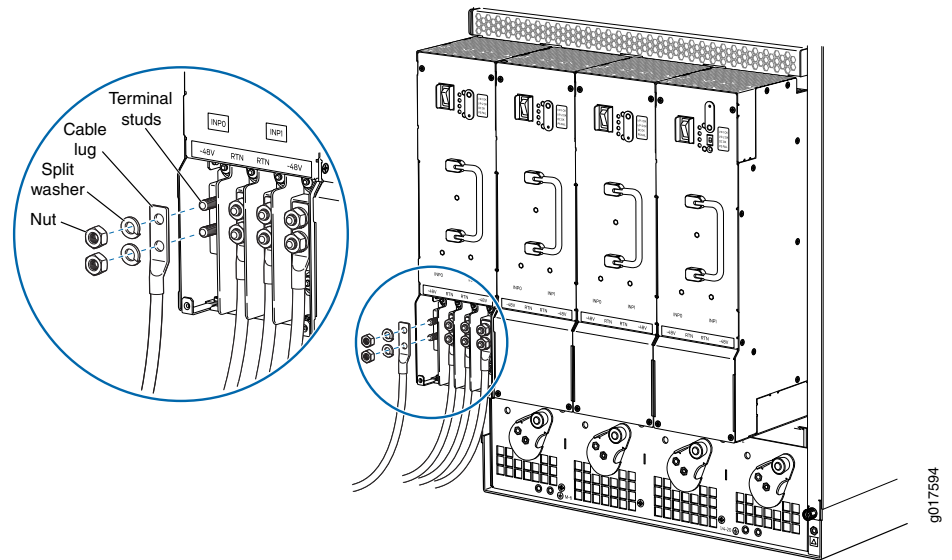
**CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.



**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.



Figure 73: Connecting Power Cables to the DC Power Supply



5. Route the power cable through the cable restraint. Make sure that the cable does not touch or obstruct any router components.
6. Tighten the cable restraint captive screw to hold the power cables in place.
7. Verify that the DC power cable is connected correctly, that it does not touch or block access to router components, and that it does not drape where people could trip on it.
8. Replace the clear plastic cover over the terminal studs on the faceplate.
9. Attach the power cable to the DC power source.
10. Turn on the dedicated customer site circuit breaker to the power supply.
11. Verify that the **INPUT OK** LED on the power supply is lit steadily.
12. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (I) position.



**NOTE:** The circuit breaker may bounce back to the off (O) position if you move the breaker too quickly.

Observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **PWR OK**, **BRKR ON**, and **INPUT OK** LEDs light green steadily.

**Related  
Documentation**

- [DC Power Cable Specifications for the MX960 Router on page 175](#)
- [Disconnecting an MX960 DC Power Supply Cable on page 411](#)
- [MX960 DC Power Supply on page 92](#)
- [MX960 DC Power Electrical Safety Guidelines](#)

# Connecting the MX960 Router to the Network

- [Tools and Parts Required for MX960 Router Connections on page 237](#)
- [Connecting the MX960 Router to Management and Alarm Devices on page 237](#)
- [Connecting the MX960 Router to a Network for Out-of-Band Management on page 241](#)
- [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 242](#)
- [Connecting an MX960 Router to an External Alarm-Reporting Device on page 243](#)
- [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
- [Connecting the Alarm Relay Wires to the MX960 Craft Interface on page 245](#)

## Tools and Parts Required for MX960 Router Connections

---

To connect the router to management devices and line cards, you need the following tools and parts:

- Phillips (+) screwdrivers, numbers 1 and 2
- 2.5-mm flat-blade (–) screwdriver
- 2.5-mm Phillips (+) screwdriver
- Wire cutters
- Electrostatic discharge (ESD) grounding wrist strap

### Related Documentation

- [Connecting the MX960 Router to a Network for Out-of-Band Management on page 238](#)
- [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 238](#)
- [Connecting an MX960 Router to an External Alarm-Reporting Device on page 240](#)

## Connecting the MX960 Router to Management and Alarm Devices

---

- [Connecting the MX960 Router to a Network for Out-of-Band Management on page 238](#)
- [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 238](#)
- [Connecting an MX960 Router to an External Alarm-Reporting Device on page 240](#)

## Connecting the MX960 Router to a Network for Out-of-Band Management

To connect the Routing Engine to a network for out-of-band management, connect an Ethernet cable with RJ-45 connectors to the **ETHERNET** port on the Routing Engine. One Ethernet cable is provided with the router. To connect to the **ETHERNET** port on the Routing Engine:

1. Turn off the power to the management device.
2. Plug one end of the Ethernet cable (Figure 75 on page 238 shows the connector) into the **ETHERNET** port on the Routing Engine. Figure 74 on page 238 shows the port.
3. Plug the other end of the cable into the network device.

Figure 74: Ethernet Port

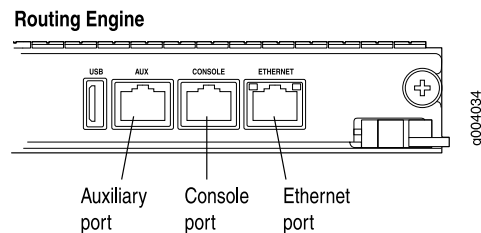
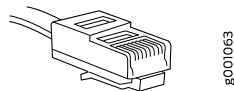


Figure 75: Routing Engine Ethernet Cable Connector



- See Also**
- [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
  - [Tools and Parts Required for MX960 Router Connections on page 237](#)
  - [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
  - [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
  - [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 238](#)
  - [Connecting an MX960 Router to an External Alarm-Reporting Device on page 240](#)

## Connecting the MX960 Router to a Management Console or Auxiliary Device

To use a system console to configure and manage the Routing Engine, connect it to the appropriate **CONSOLE** port on the Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One serial cable with an RJ-45 connector and a DB-9 connector is provided with the router. To connect a device to the **CONSOLE** port and another device to the **AUX** port, you must supply an additional cable.

To connect a management console or auxiliary device:

1. Turn off the power to the console or auxiliary device.
2. Plug the RJ-45 end of the serial cable ([Figure 77 on page 239](#) shows the connector) into the **AUX** port or **CONSOLE** port on the Routing Engine. [Figure 76 on page 239](#) shows the ports.
3. Plug the female DB-9 end into the device's serial port.

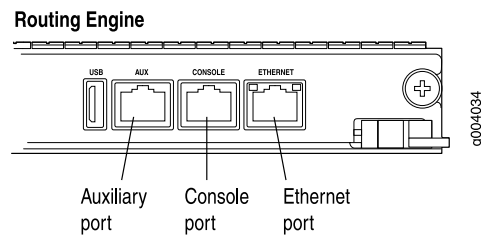


**NOTE:**

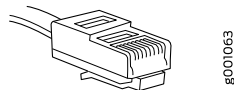
For console devices, configure the serial port to the following values:

- Baud rate—9600
- Parity—N
- Data bits—8
- Stop bits—1
- Flow control—none

*Figure 76: Auxiliary and Console Ports*



*Figure 77: Routing Engine Console and Auxiliary Cable Connector*



- See Also**
- [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
  - [Tools and Parts Required for MX960 Router Connections on page 237](#)
  - [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
  - [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
  - [Connecting an MX960 Router to an External Alarm-Reporting Device on page 240](#)

## Connecting an MX960 Router to an External Alarm-Reporting Device

To connect the router to external alarm-reporting devices, attach wires to the **RED** and **YELLOW** relay contacts on the craft interface. (See [Figure 78 on page 240](#).) A system condition that triggers the red or yellow alarm LED on the craft interface also activates the corresponding alarm relay contact.

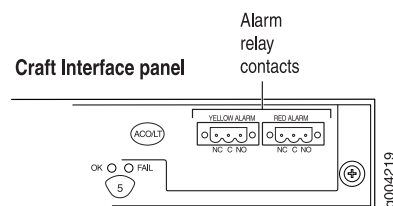
The terminal blocks that plug into the alarm relay contacts are supplied with the router. They accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

To connect an external device to an alarm relay contact (see [Figure 78 on page 240](#)):

1. Prepare the required length of wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).
2. While the terminal block is not plugged into the relay contact, use a 2.5-mm flat-blade screwdriver to loosen the small screws on its side. With the small screws on its side facing left, insert wires into the slots in the front of the block based on the wiring for the external device. Tighten the screws to secure the wire.
3. Plug the terminal block into the relay contact, and use a 2.5-mm flat-blade screwdriver to tighten the screws on the face of the block.
4. Attach the other end of the wires to the external device.

To attach a reporting device for the other kind of alarm, repeat the procedure.

*Figure 78: Alarm Relay Contacts*



- See Also**
- [Tools and Parts Required for MX960 Router Connections on page 237](#)
  - [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
  - [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
  - [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 238](#)
  - [Connecting the MX960 Router to a Network for Out-of-Band Management on page 238](#)

**Related Documentation**

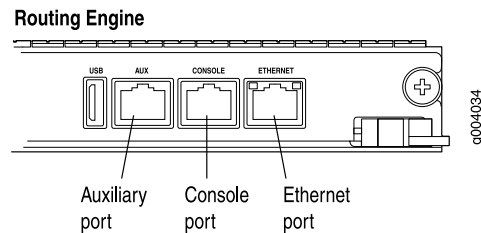
- [Tools and Parts Required for MX960 Router Connections on page 237](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
- [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
- [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)

## Connecting the MX960 Router to a Network for Out-of-Band Management

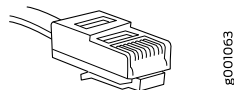
To connect the Routing Engine to a network for out-of-band management, connect an Ethernet cable with RJ-45 connectors to the **ETHERNET** port on the Routing Engine. One Ethernet cable is provided with the router. To connect to the **ETHERNET** port on the Routing Engine:

1. Turn off the power to the management device.
2. Plug one end of the Ethernet cable (Figure 75 on page 238 shows the connector) into the **ETHERNET** port on the Routing Engine. Figure 74 on page 238 shows the port.
3. Plug the other end of the cable into the network device.

*Figure 79: Ethernet Port*



*Figure 80: Routing Engine Ethernet Cable Connector*

**Related Documentation**

- [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
- [Tools and Parts Required for MX960 Router Connections on page 237](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
- [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
- [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 238](#)
- [Connecting an MX960 Router to an External Alarm-Reporting Device on page 240](#)

## Connecting the MX960 Router to a Management Console or Auxiliary Device

To use a system console to configure and manage the Routing Engine, connect it to the appropriate **CONSOLE** port on the Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One serial cable with an RJ-45 connector and a DB-9 connector is provided with the router. To connect a device to the **CONSOLE** port and another device to the **AUX** port, you must supply an additional cable.

To connect a management console or auxiliary device:

1. Turn off the power to the console or auxiliary device.
2. Plug the RJ-45 end of the serial cable (Figure 77 on page 239 shows the connector) into the **AUX** port or **CONSOLE** port on the Routing Engine. Figure 76 on page 239 shows the ports.
3. Plug the female DB-9 end into the device's serial port.



### NOTE:

For console devices, configure the serial port to the following values:

- Baud rate—9600
- Parity—N
- Data bits—8
- Stop bits—1
- Flow control—none

Figure 81: Auxiliary and Console Ports

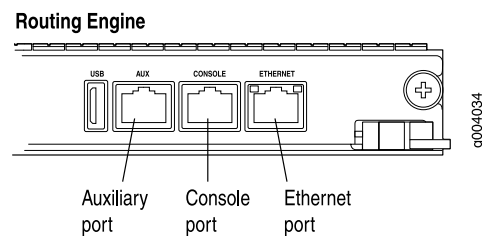
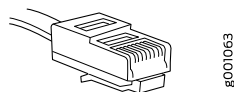


Figure 82: Routing Engine Console and Auxiliary Cable Connector





- Related Documentation**
- [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
  - [Tools and Parts Required for MX960 Router Connections on page 237](#)
  - [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
  - [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
  - [Connecting an MX960 Router to an External Alarm-Reporting Device on page 240](#)

## Connecting an MX960 Router to an External Alarm-Reporting Device

To connect the router to external alarm-reporting devices, attach wires to the **RED** and **YELLOW** relay contacts on the craft interface. (See [Figure 78 on page 240](#).) A system condition that triggers the red or yellow alarm LED on the craft interface also activates the corresponding alarm relay contact.

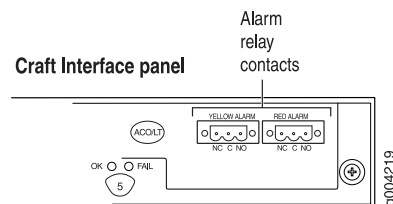
The terminal blocks that plug into the alarm relay contacts are supplied with the router. They accept wire of any gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>), which is not provided. Use the gauge of wire appropriate for the external device you are connecting.

To connect an external device to an alarm relay contact (see [Figure 78 on page 240](#)):

1. Prepare the required length of wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).
2. While the terminal block is not plugged into the relay contact, use a 2.5-mm flat-blade screwdriver to loosen the small screws on its side. With the small screws on its side facing left, insert wires into the slots in the front of the block based on the wiring for the external device. Tighten the screws to secure the wire.
3. Plug the terminal block into the relay contact, and use a 2.5-mm flat-blade screwdriver to tighten the screws on the face of the block.
4. Attach the other end of the wires to the external device.

To attach a reporting device for the other kind of alarm, repeat the procedure.

*Figure 83: Alarm Relay Contacts*



**Related Documentation**

- [Tools and Parts Required for MX960 Router Connections on page 237](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
- [Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router on page 244](#)
- [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 238](#)
- [Connecting the MX960 Router to a Network for Out-of-Band Management on page 238](#)

## Connecting DPC, MPC, MIC, or PIC Cables to the MX960 Router

To connect the DPCs, MPCs, MICs, or PICs to the network (see [Figure 84 on page 245](#) and [Figure 85 on page 245](#)):

1. Have ready a length of the type of cable used by the component. For cable specifications, see the [MX Series Interface Module Reference](#).
2. Remove the rubber safety plug from the cable connector port.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

3. Insert the cable connector into the cable connector port on the faceplate.



**NOTE:** The XFP cages and optics on the components are industry standard parts that have limited tactile feedback for insertion of optics and fiber. You need to insert the optics and fiber firmly until the latch is securely in place.

4. Arrange the cable to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.

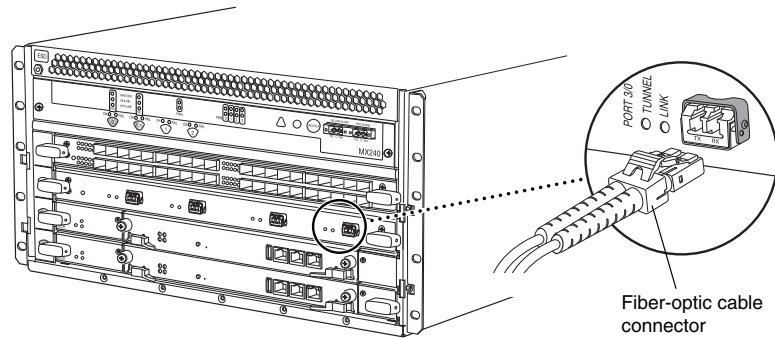


**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.



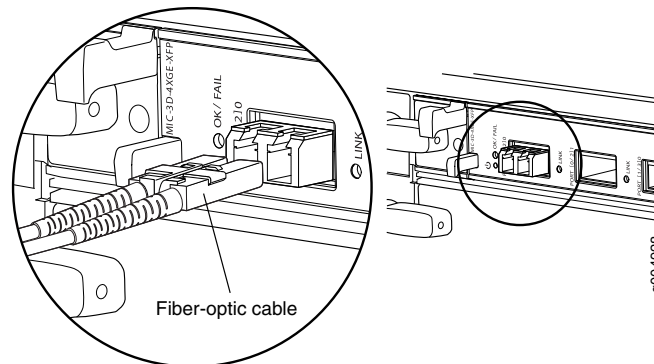
**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

Figure 84: Attaching a Cable to a DPC



g004317

Figure 85: Attaching a Cable to a MIC



g004928

#### Related Documentation

- [Connecting the MX960 Router to Management and Alarm Devices on page 237](#)
- [Tools and Parts Required for MX960 Router Connections on page 237](#)
- [Grounding the MX960 Router on page 216](#)

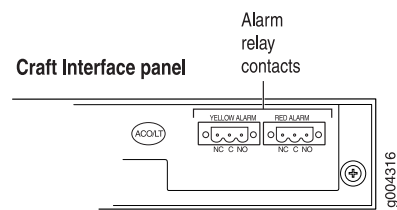
## Connecting the Alarm Relay Wires to the MX960 Craft Interface

To connect the alarm relay wires between a router and an alarm-reporting device (see [Figure 86 on page 246](#)):

1. Prepare the required length of replacement wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).
2. Insert the replacement wires into the slots in the front of the block. Use a 2.5-mm flat-blade screwdriver to tighten the screws and secure the wire.

3. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Plug the terminal block into the relay contact, and use a 2.5-mm flat-blade screwdriver to tighten the screws on the face of the block.
5. Attach the other end of the wires to the external device.

**Figure 86: Alarm Relay Contacts**



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Disconnecting the Alarm Relay Wires from the MX960 Craft Interface on page 303](#)
- [Removing the MX960 Craft Interface on page 304](#)
- [Installing the MX960 Craft Interface on page 257](#)
- [MX960 Craft Interface Overview on page 14](#)

# Initially Configuring the MX960 Router

- [Initially Configuring the MX960 Router on page 247](#)

## Initially Configuring the MX960 Router

---

The MX240 router is shipped with Junos OS preinstalled and ready to be configured when the MX240 router is powered on. There are three copies of the software: one on a CompactFlash card in the Routing Engine, one on a rotating hard disk in the Routing Engine, and one on a USB flash drive that can be inserted into the slot in the Routing Engine faceplate.

When the router boots, it first attempts to start the image on the USB flash drive. If a USB flash drive is not inserted into the Routing Engine or the attempt otherwise fails, the router next tries the CompactFlash card (if installed), and finally the hard disk.

You configure the router by issuing Junos OS command-line interface (CLI) commands, either on a console device attached to the **CONSOLE** port on the Routing Engine, or over a telnet connection to a network connected to the **ETHERNET** port on the Routing Engine.

Gather the following information before configuring the router:

- Name the router will use on the network
- Domain name the router will use
- IP address and prefix length information for the Ethernet interface
- IP address of a default router
- IP address of a DNS server
- Password for the root user

This procedure connects the router to the network but does not enable it to forward traffic. For complete information about enabling the router to forward traffic, including examples, see the Junos OS configuration guides.

To configure the software:

1. Verify that the router is powered on.
2. Log in as the “root” user. There is no password.

3. Start the CLI.

```
root# cli
root@>
```

4. Enter configuration mode.

```
cli> configure
[edit]
root@#
```

5. Configure the name of the router. If the name includes spaces, enclose the name in quotation marks (" ").

```
[edit]
root@# set system host-name host-name
```

6. Create a management console user account.

```
[edit]
root@# set system login user user-name authentication plain-text-password
New password: password
Retype new password: password
```

7. Set the user account class to super-user.

```
[edit]
root@# set system login user user-name class super-user
```

8. Configure the router's domain name.

```
[edit]
root@# set system domain-name domain-name
```

9. Configure the IP address and prefix length for the router's Ethernet interface.

```
[edit]
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

10. Configure the IP address of a backup router, which is used only while the routing protocol is not running.

```
[edit]
root@# set system backup-router address
```

11. Configure the IP address of a DNS server.

```
[edit]
root@# set system name-server address
```

12. Set the root authentication password by entering either a clear-text password, an encrypted password, or an SSH public key string (DSA or RSA).

```
[edit]
root@# set system root-authentication plain-text-password
New password: password
Retype new password: password
```

or

```
[edit]
root@# set system root-authentication encrypted-password encrypted-password
```

or

```
[edit]
root@# set system root-authentication ssh-dsa public-key
```

or

```
[edit]
root@# set system root-authentication ssh-rsa public-key
```

13. (Optional) Configure the static routes to remote subnets with access to the management port. Access to the management port is limited to the local subnet. To access the management port from a remote subnet, you need to add a static route to that subnet within the routing table. For more information about static routes, see the *Junos OS Administration Library*.

```
[edit]
root@# set routing-options static route remote-subnet next-hop destination-IP retain
no-readvertise
```

14. Configure the telnet service at the [edit system services] hierarchy level.

```
[edit]
root@# set system services telnet
```

15. (Optional) Display the configuration to verify that it is correct.

```
[edit]
root@# show
system {
  host-name host-name;
  domain-name domain-name;
  backup-router address;
```

```

root-authentication {
  authentication-method (password | public-key);
}
name-server {
  address;
}
}
interfaces {
  fxp0 {
    unit 0 {
      family inet {
        address address/prefix-length;
      }
    }
  }
}
}
}

```

16. Commit the configuration to activate it on the router.

```

[edit]
root@# commit

```

17. (Optional) Configure additional properties by adding the necessary configuration statements. Then commit the changes to activate them on the router.

```

[edit]
root@host# commit

```

18. When you have finished configuring the router, exit configuration mode.

```

[edit]
root@host# exit
root@host>

```



**NOTE:** To reinstall Junos OS, you boot the router from the removable media. Do not insert the removable media during normal operations. The router does not operate normally when it is booted from the removable media.

When the router boots from the storage media (removable media, CompactFlash card, or hard disk) it expands its search in the `/config` directory of the routing platform for the following files in the following order: `juniper.conf` (the main configuration file), `rescue.conf` (the rescue configuration file), and `juniper.conf.1` (the first rollback configuration file). When the search finds the first configuration file that can be loaded properly, the file loads and the search ends. If none of the file can be loaded properly, the routing platform does not function properly. If the router boots from an alternate boot device, Junos OS displays a message indication this when you log in to the router.



**Related  
Documentation**

- [Powering On an AC-Powered MX960 Router with Normal Capacity Power Supplies on page 222](#)
- [Powering On a DC-Powered MX960 Router with Normal Capacity Power Supplies on page 230](#)
- [Grounding the MX960 Router on page 216](#)
- [Routine Maintenance Procedures for the MX960 Router on page 441](#)



## PART 4

# Installing and Replacing Components

- [Overview of Installing and Replacing Components on page 255](#)
- [Installing Components on page 257](#)
- [Replacing Chassis Components on page 303](#)
- [Replacing Cooling System Component on page 321](#)
- [Replacing Host Subsystem Components on page 329](#)
- [Replacing Line Card Components on page 351](#)
- [Replacing Power System Components on page 397](#)
- [Replacing and Upgrading Switch Control Boards on page 415](#)



# Overview of Installing and Replacing Components

- [MX960 Field-Replaceable Units on page 255](#)
- [Tools and Parts Required for MX960 Router Connections on page 256](#)

## MX960 Field-Replaceable Units

---

Field-replaceable units (FRUs) are router components that can be replaced at the customer site. Replacing most FRUs requires minimal router downtime. The router uses the following types of FRUs:

- Hot-removable and hot-insertable FRUs—You can remove and replace these components without powering off the router or disrupting the routing functions.
- Hot-pluggable FRUs—You can remove and replace these components without powering off the router, but the routing functions of the system are interrupted when the component is removed.

[Table 84 on page 256](#) lists the FRUs for the MX960 router. Before you replace an SCB or a Routing Engine, you must take the host subsystem offline.

Table 84: Field-Replaceable Units

Hot-Removable and Hot-Insertable FRUs	Hot-Pluggable FRUs
<ul style="list-style-type: none"> <li>• Air filter</li> <li>• Craft interface</li> <li>• Backup Switch Control Board (SCB) (if redundant)</li> <li>• Master Switch Control Board (SCB) (if nonstop active routing is configured)</li> <li>• Backup Routing Engine (if redundant)</li> <li>• Master Routing Engine (if nonstop active routing is configured)</li> <li>• Dense Port Concentrators (DPCs)</li> <li>• Flexible PIC Concentrators (FPCs)</li> <li>• Modular Port Concentrators (MPCs)</li> <li>• Modular Interface Cards (MICs)</li> <li>• PICs</li> <li>• AC and DC power supplies (if redundant)</li> <li>• Fan tray</li> </ul>	<ul style="list-style-type: none"> <li>• Master Switch Control Board (SCB) (if nonstop active routing is not configured)</li> <li>• Master Routing Engine (if nonstop active routing is not configured)</li> <li>• Switch Control Board (SCB) (nonredundant)</li> <li>• Routing Engine (nonredundant)</li> <li>• Solid-state drives (SSDs) of Routing Engines</li> </ul>

**Related Documentation**

- [Taking an MX960 Host Subsystem Offline](#)
- [Tools and Parts Required to Replace MX960 Hardware Components](#)
- [Replacing the MX960 Craft Interface on page 303](#)
- [Replacing an MX960 Fan Tray on page 323](#)
- [Replacing the MX960 Air Filter on page 321](#)

## Tools and Parts Required for MX960 Router Connections

To connect the router to management devices and line cards, you need the following tools and parts:

- Phillips (+) screwdrivers, numbers 1 and 2
- 2.5-mm flat-blade (–) screwdriver
- 2.5-mm Phillips (+) screwdriver
- Wire cutters
- Electrostatic discharge (ESD) grounding wrist strap

**Related Documentation**

- [Connecting the MX960 Router to a Network for Out-of-Band Management on page 238](#)
- [Connecting the MX960 Router to a Management Console or Auxiliary Device on page 238](#)
- [Connecting an MX960 Router to an External Alarm-Reporting Device on page 240](#)

## CHAPTER 20

# Installing Components

- Installing the MX960 Craft Interface on page 257
- Installing the MX960 Air Filter on page 258
- Installing an MX960 Fan Tray on page 259
- Installing an MX960 Routing Engine on page 261
- Installing an MX960 Switch Control Board on page 263
- Installing an MX960 DPC on page 265
- Installing an MX960 FPC on page 269
- Installing an MX960 MIC on page 272
- Installing an MX960 Dual-Wide MIC on page 275
- Installing an MX960 MPC on page 278
- Installing an MX960 PIC on page 280
- Installing a Cable on an MX960 DPC, MPC, MIC, or PIC on page 283
- Installing an MX960 AC Power Supply on page 284
- Installing an MX960 DC Power Supply on page 287
- Installing an MX960 AS MLC on page 291
- Installing an MX960 AS MSC on page 293
- Installing an MX960 AS MXC on page 295
- Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC on page 296
- Replacing a CFP2 Transceiver on page 297
- Replacing a CFP Transceiver on page 300

## Installing the MX960 Craft Interface

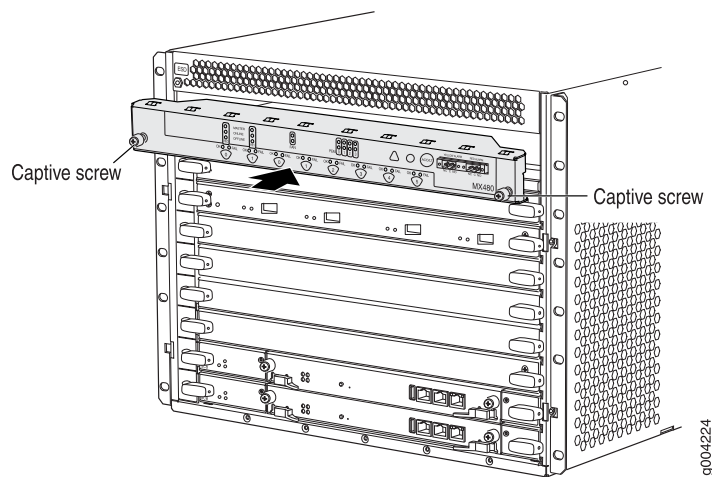
---

To install the craft interface (see [Figure 87 on page 258](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Grasp the craft interface with one hand, and hold the bottom edge of the craft interface with the other hand to support its weight.

3. Orient the ribbon cable so that it plugs into the connector socket. The connector is keyed and can be inserted only one way.
4. Align the bottom of the craft interface with the sheet metal above the card cage and press it into place.
5. Tighten the screws on the left and right corners of the craft interface faceplate.
6. Reattach any external devices connected to the craft interface.

*Figure 87: Installing the Craft Interface*



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Disconnecting the Alarm Relay Wires from the MX960 Craft Interface on page 303](#)
- [Removing the MX960 Craft Interface on page 304](#)
- [Connecting the Alarm Relay Wires to the MX960 Craft Interface on page 245](#)
- [MX960 Craft Interface Overview on page 14](#)

## Installing the MX960 Air Filter

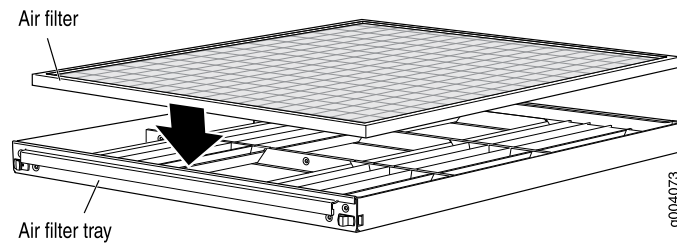
To install the air filter (see [Figure 88 on page 259](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Ensure that the air filter is right side up.
3. Place the air filter into the air filter tray.



4. Insert the air filter tray into the chassis by sliding it straight into the chassis until it stops.
5. Lower the cable manager back into position.
6. Rearrange the cables in the cable manager.

**Figure 88: Installing the Air Filter**



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Removing the Normal-Capacity MX960 Air Filter on page 321](#)
- [Maintaining the MX960 Air Filter on page 444](#)

## Installing an MX960 Fan Tray

To install a fan tray (see [Figure 89 on page 260](#) and [Figure 90 on page 261](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Grasp the fan tray on each side, and insert it straight into the chassis. Note the correct orientation by the "this side up" label on the top surface of the fan tray.
3. Tighten the captive screws on each side of the fan tray faceplate to secure it in the chassis.
4. Lower the cable manager back into position, if necessary.

Figure 89: Installing an Upper Fan Tray

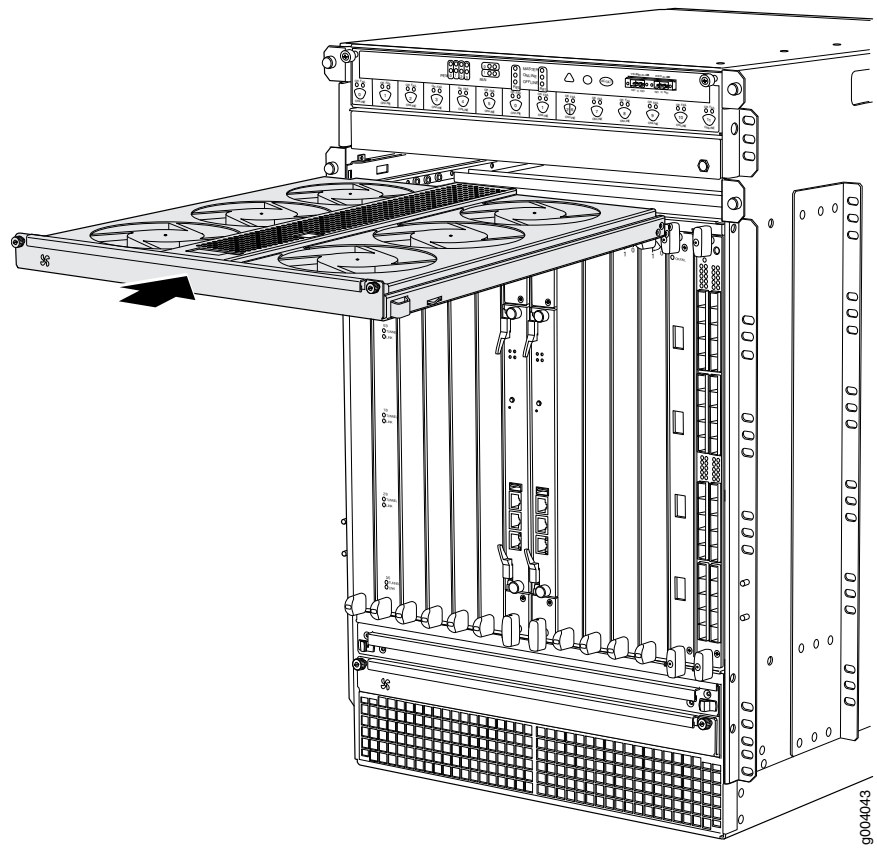
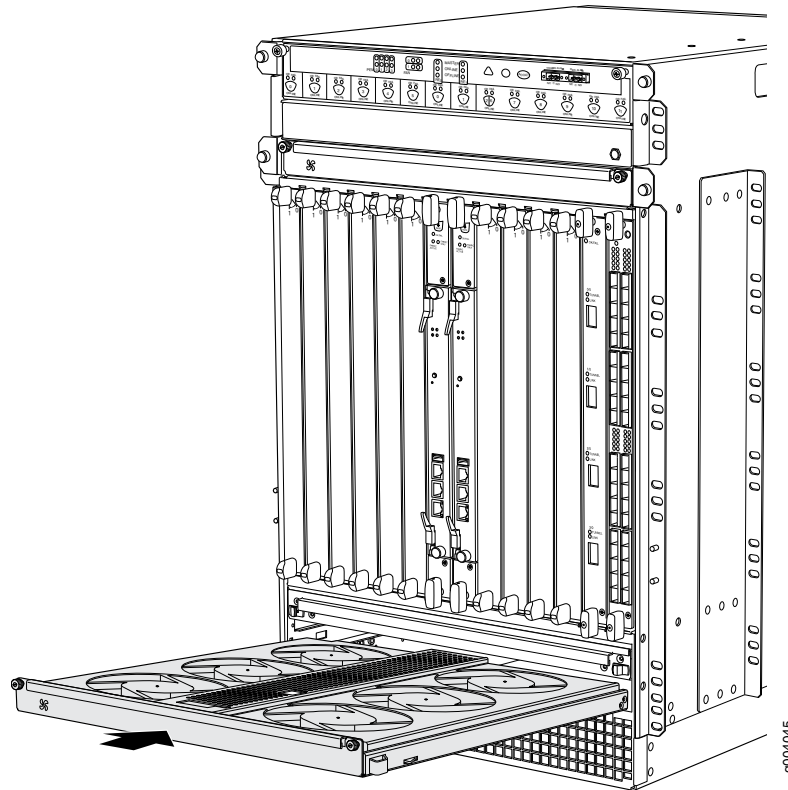


Figure 90: Installing a Lower Fan Tray



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Removing an MX960 Fan Tray on page 324](#)
- [Maintaining the MX960 Fan Trays on page 444](#)

## Installing an MX960 Routing Engine

To install a Routing Engine into an SCB (Figure 91 on page 263):

1. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.
2. Place one hand underneath the Routing Engine to support it.
3. Carefully align the sides of the Routing Engine with the guides inside the opening on the SCB.
4. Slide the Routing Engine into the SCB until you feel resistance, and then press the Routing Engine's faceplate until it engages the connectors.



**CAUTION:** Align the Routing Engine correctly to avoid damaging it.

5. Press both of the ejector handles inward to seat the Routing Engine.
6. Tighten the captive screws on the top and bottom of the Routing Engine.
7. Connect the management device cables to the Routing Engine.

The Routing Engine might require several minutes to boot.

After the Routing Engine boots, verify that it is installed correctly by checking the **FAIL**, **RE0**, and **RE1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED lights steadily. If the red **FAIL** LED lights steadily instead, remove and install the Routing Engine again. If the red **FAIL** LED still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

To check the status of the Routing Engine, use the CLI command:

```
user@host> show chassis routing-engine
```

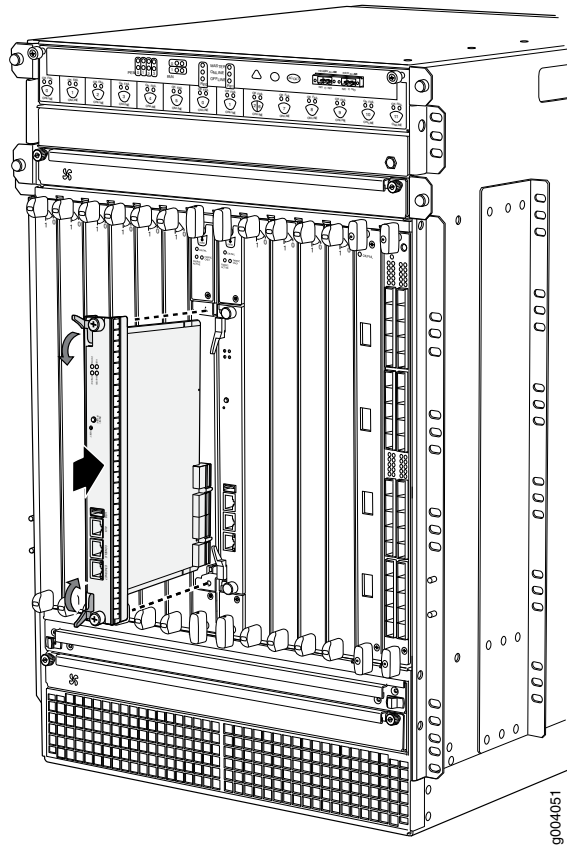
```
Routing Engine status:      Slot 0:      Current state      Master ...
```

For more information about using the CLI, see the Junos OS documentation.



**NOTE:** If enhanced IP network services is configured on the chassis, all routing engines must be rebooted after synchronizing the routing engines. For more information on synchronizing the routing engines, see *Synchronizing Routing Engines*.

Figure 91: Installing a MX960 Routing Engine



#### Related Documentation

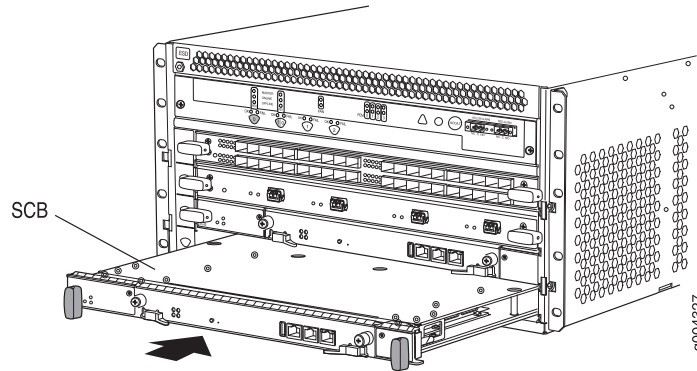
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
- [Removing an MX960 Routing Engine on page 329](#)
- [MX960 Routing Engine Description on page 26](#)

### Installing an MX960 Switch Control Board

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Carefully align the sides of the Switch Control Board with the guides inside the chassis.
3. Slide the Switch Control Board into the chassis until you feel resistance, carefully ensuring that it is correctly aligned.
4. Grasp both ejector handles, and rotate them simultaneously clockwise until the Switch Control Board is fully seated.

- Place the ejector handles in the proper position, horizontally and toward the center of the board.

Figure 92: Installing a Switch Control Board in the MX480



- Check the LEDs on the Switch Control Board faceplate to verify that it is functioning normally.
  - The green **OK/FAIL** LED should light steadily a few minutes after the Switch Control Board is installed.
  - If the **OK/FAIL** LED is red, remove and install the Switch Control Board again. If the **OK/FAIL** LED still lights steadily, the Switch Control Board is not functioning properly. Contact your customer support representative.
- Check the status of the Switch Control Board using the **show chassis environment cb** command:

```
user@host> show chassis environment cb
```

```
CB 0 status:
State                Online Master
Temperature          25 degrees C / 77 degrees F
Power 1
 1.2 V                1198 mV
 1.5 V                1508 mV
 1.8 V                1830 mV
 2.5 V                5059 mV
 3.3 V                6593 mV
 5.0 V                5111 mV
12.0 V                12181 mV
 1.25 V              1250 mV
 3.3 V SM3           6587 mV
 5 V RE              5078 mV
12 V RE              12026 mV
Power 2
11.3 V bias PEM      11253 mV
 4.6 V bias MidPlane 4827 mV
11.3 V bias FPD      11408 mV
11.3 V bias POE 0    11446 mV
11.3 V bias POE 1    11408 mV
Bus Revision         6
FPGA Revision        0
CB 1 status:
```

State	Online Standby
Temperature	26 degrees C / 78 degrees F
Power 1	
1.2 V	1211 mV
1.5 V	1517 mV
1.8 V	1817 mV
2.5 V	2507 mV
3.3 V	3312 mV
5.0 V	5136 mV
12.0 V	12142 mV
1.25 V	1260 mV
3.3 V SM3	3306 mV
5 V RE	5085 mV
12 V RE	11968 mV
Power 2	
11.3 V bias PEM	11369 mV
4.6 V bias MidPlane	4814 mV
11.3 V bias FPD	11427 mV
11.3 V bias POE 0	11350 mV
11.3 V bias POE 1	11330 mV
Bus Revision	39
FPGA Revision	1

- Related Documentation**
- *Preventing Electrostatic Discharge Damage to an MX960 Router*
  - *Operating and Positioning the MX960 SCB Ejectors*

## Installing an MX960 DPC

A DPC weighs up to 14.5 lb (6.6 kg). Be prepared to accept its full weight.

To install a DPC (see [Figure 93 on page 267](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the DPC on an antistatic mat, or remove it from its electrostatic bag.
3. Identify the slot on the router where it will be installed.
4. Verify that each fiber-optic transceiver is covered with a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the DPC so that the faceplate faces you vertically.
6. Lift the DPC into place, and carefully align the sides of the DPC with the guides inside the card cage.
7. Slide the DPC all the way into the card cage until you feel resistance.

8. Grasp both ejector handles, and rotate them clockwise simultaneously until the DPC is fully seated.
9. Remove the rubber safety cap from each fiber-optic transceiver and cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

10. Insert the cables into the cable connector ports on each DPC (see [Figure 94 on page 268](#)).
11. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

12. Use one of the following methods to bring the DPC online:
  - Press and hold the corresponding DPC online button on the craft interface until the green **OK** LED next to the button lights steadily, in about 5 seconds.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

For more information about the command, see the [CLI Explorer](#).

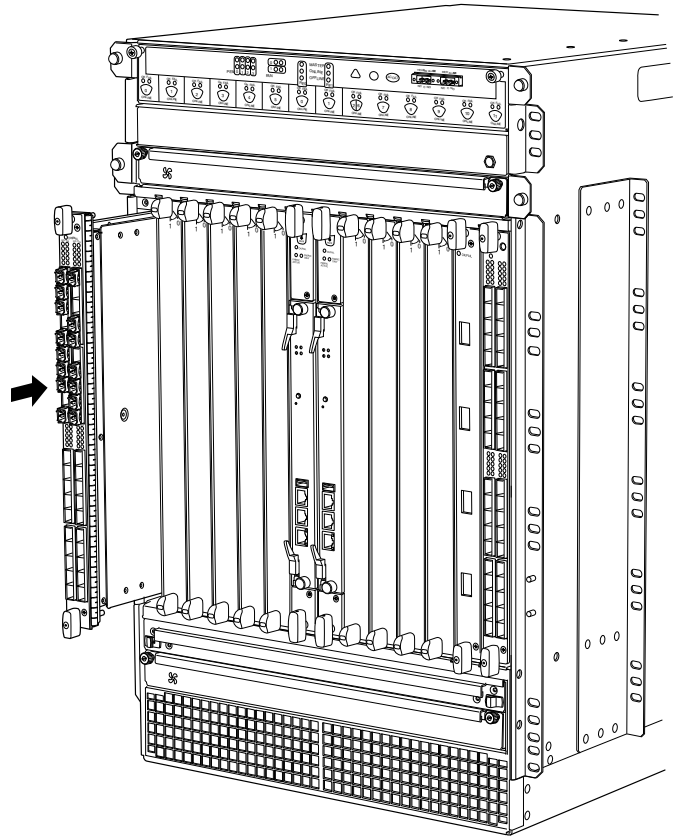


**CAUTION:** After the OK LED turns green, wait at least 30 seconds before removing the DPC again, removing a DPC from a different slot, or inserting a DPC in a different slot.

You can also verify that the DPC is functioning correctly by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands.

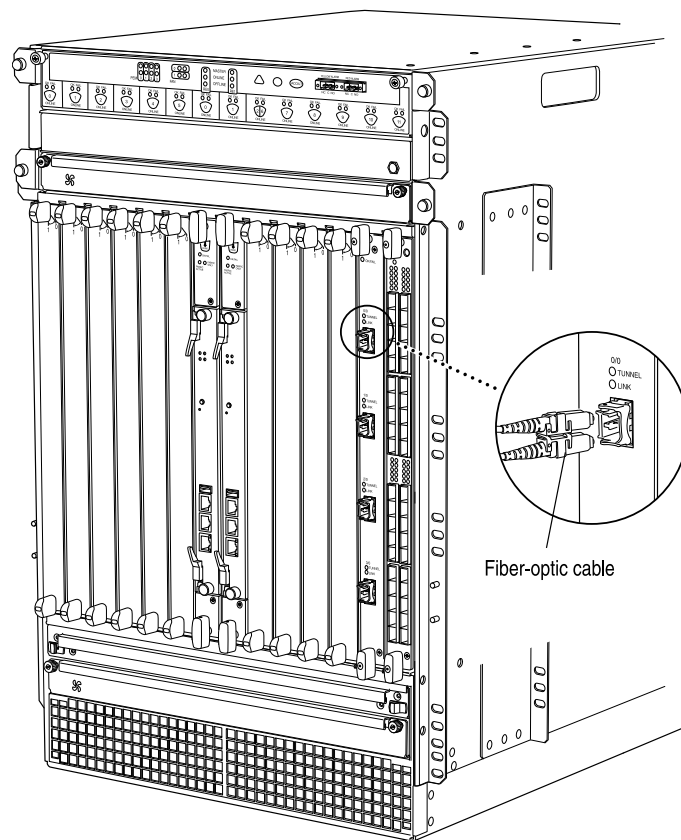


Figure 93: Installing a DPC



9004053

Figure 94: Attaching a Cable to a DPC

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Holding an MX960 DPC on page 450](#)
- [Storing an MX960 DPC on page 452](#)
- [MX960 DPC Terminology](#)
- [Removing an MX960 DPC on page 351](#)
- [Maintaining MX960 DPCs on page 448](#)
- [Troubleshooting the MX960 DPCs on page 488](#)

## Installing an MX960 FPC

An FPC takes up two DPC slots on the MX960 router. Up to six FPCs can be installed vertically in the front of the router. The FPCs are hot-insertable and hot-removable. An empty FPC3 weighs 14 lb (6.5 kg). A fully configured FPC can weigh up to 18 lb (8.2 kg). Be prepared to accept its full weight.

To install an FPC (see [Figure 95 on page 271](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the FPC on an antistatic mat.
3. Take each PIC to be installed in the replacement FPC out of its electrostatic bag, and identify the slot on the FPC where it will be connected.
4. Verify that each fiber-optic PIC has a rubber safety cap covering the PIC transceiver. If it does not, cover the transceiver with a safety cap.
5. Install each PIC into the appropriate slot on the FPC.
6. Locate the two slots in the card cage in which you plan to install the FPC.
7. Orient the FPC so that the faceplate faces you.
8. Lift the FPC into place, and carefully align the sides of the FPC with the guides inside the card cage.



**CAUTION:** When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

9. Slide the FPC all the way into the card cage until you feel resistance.
10. Grasp both ejector handles, and rotate them clockwise simultaneously until the FPC is fully seated.
11. If any of the PICs on the FPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

12. Insert the appropriate cable into the cable connector ports on each PIC on the FPC.
13. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

14. Use one of the following methods to bring the FPC online:
  - Press and hold the FPC online/offline button until the green OK LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

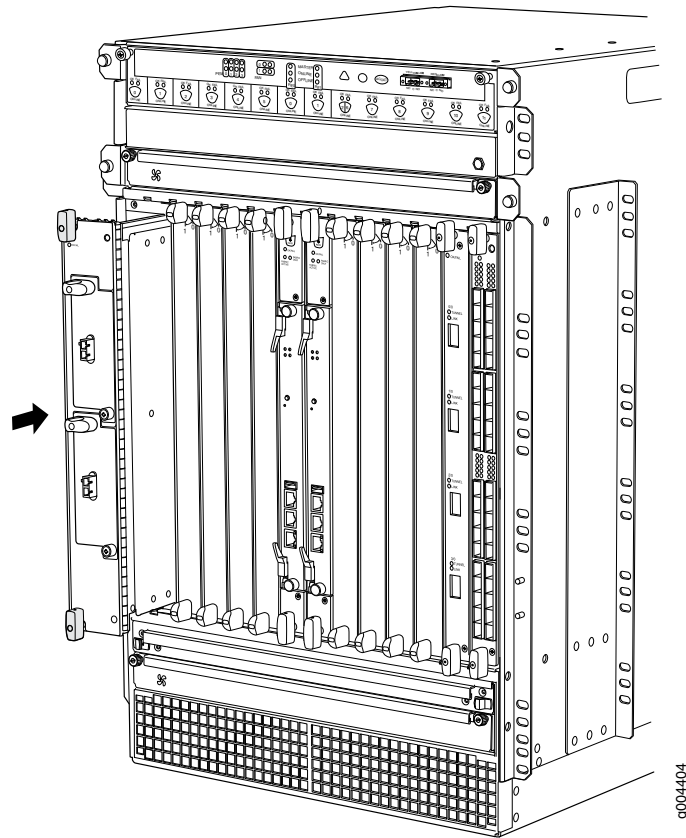
For more information about the command, see the [CLI Explorer](#).



**CAUTION:** After the OK LED lights steadily, wait at least 30 seconds before removing the FPC again, removing an FPC from a different slot, or inserting an FPC in a different slot.

You can also verify correct FPC and PIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands described in “[Maintaining MX960 FPCs](#)” on page 453 and “[Maintaining MX960 PICs](#)” on page 464.

Figure 95: Installing an FPC



g004404

**Related Documentation**

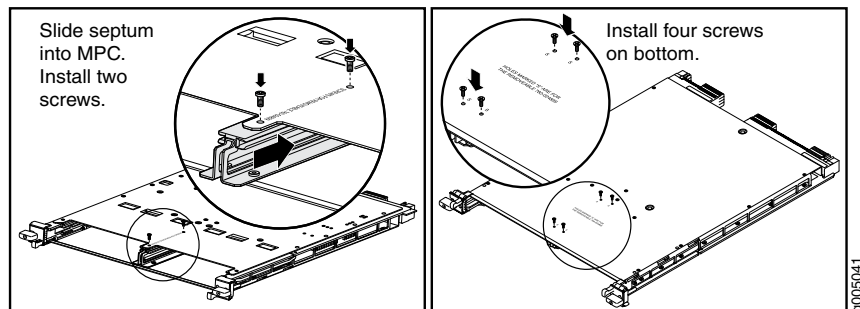
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Installing an MX960 PIC on page 280](#)
- [Removing an MX960 FPC on page 358](#)
- [Maintaining MX960 FPCs on page 453](#)
- [Holding an MX960 FPC on page 455](#)
- [Storing an MX960 FPC on page 459](#)

## Installing an MX960 MIC

To install a MIC (see [Figure 97 on page 274](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. If you have used a dual-wide MIC and are now replacing it with two “single” MICs, install the septum (see [Figure 96 on page 272](#)):
  - a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in [“Removing an MX960 MPC” on page 374](#)).
  - b. Position the septum in the center of the MPC so that it lines up with holes labeled **S** on the top of the MPC.
  - c. Insert a screw into each of the two holes labeled **S**, and then tighten completely.
  - d. On the bottom of the MPC, insert a screw into each of the four holes labeled **S**, and then tighten completely.
  - e. Install the MPC as described in [“Installing an MX960 MPC” on page 278](#).

*Figure 96: Installing the Septum*



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.
4. On the MPC, pull the ejector lever that is adjacent to the MIC you are installing away from the MPC faceplate.
5. Align the rear of the MIC with the guides located at the corners of the MIC slot.
6. Slide the MIC into the MPC until it is firmly seated in the MPC.



**CAUTION:** Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector lever is engaged by pushing it towards the MPC faceplate.
8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

9. Insert the appropriate cables into the cable connectors on the MIC.
10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

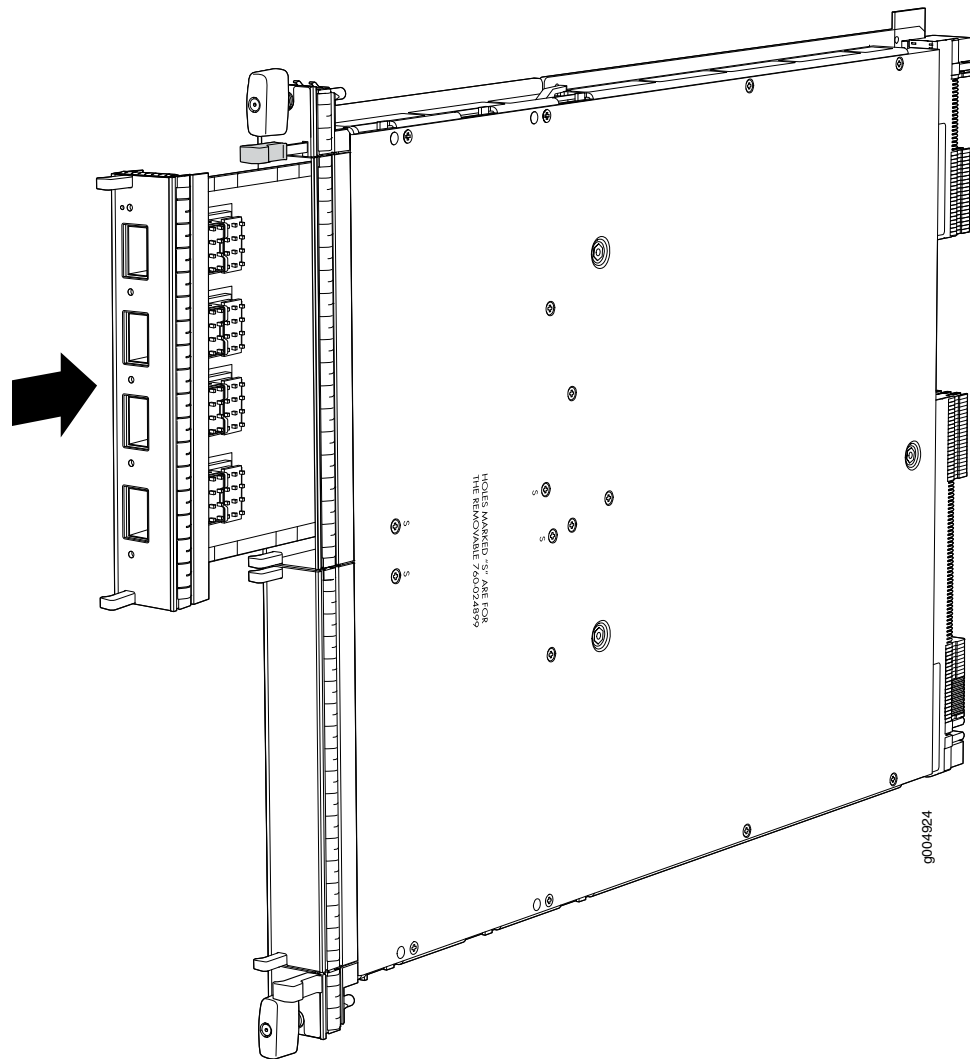
11. Use one of the following methods to bring the MIC online:
  - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
  - Issue the following CLI command:

```
user@host> request chassis mic fpc-slot mpc-slot mic-slot mic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the `show chassis fpc pic-status` command described in “Maintaining MX960 MICs” on page 460.

Figure 97: Installing a MIC



**Related Documentation**

- [MX960 Modular Interface Card Description on page 65](#)
- [Maintaining MX960 MICs on page 460](#)
- [Troubleshooting the MX960 MICs on page 493](#)
- [Removing an MX960 MPC on page 374](#)
- [Removing an MX960 MIC on page 364](#)
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

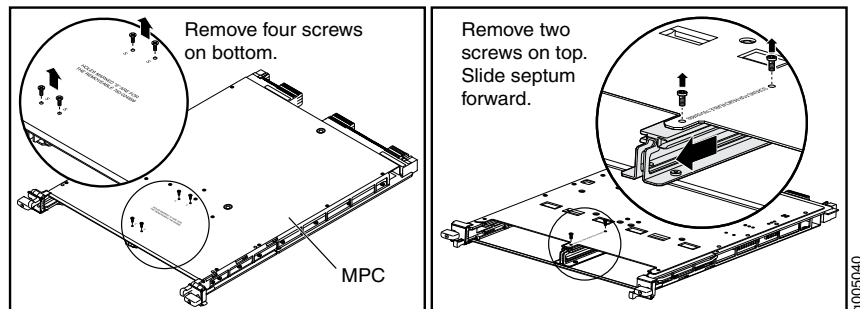


## Installing an MX960 Dual-Wide MIC

To install a dual-wide MIC (see [Figure 99 on page 277](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Remove the septum, if necessary (see [Figure 98 on page 275](#)):
  - a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in [“Removing an MX960 MPC” on page 374](#)).
  - b. Remove the four screws labeled **S** on the bottom of the MPC.
  - c. Remove the two screws labeled **S** on the top of the MPC.
  - d. Slide the septum towards you and out of the MPC.
  - e. Store the septum and screws for later use.
  - f. Install the MPC as described in [“Installing an MX960 MPC” on page 278](#).

*Figure 98: Removing the Septum*



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.
4. Pull the ejector lever above both MIC slots away from the router.
5. Align the rear of the MIC with the guides located at the corners of the MIC slot.
6. Slide the MIC into the MIC slot until it is firmly seated in the chassis.



**CAUTION:** Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector levers are engaged by pushing them toward the router.
8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

9. Insert the appropriate cables into the cable connectors on the MIC.
10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



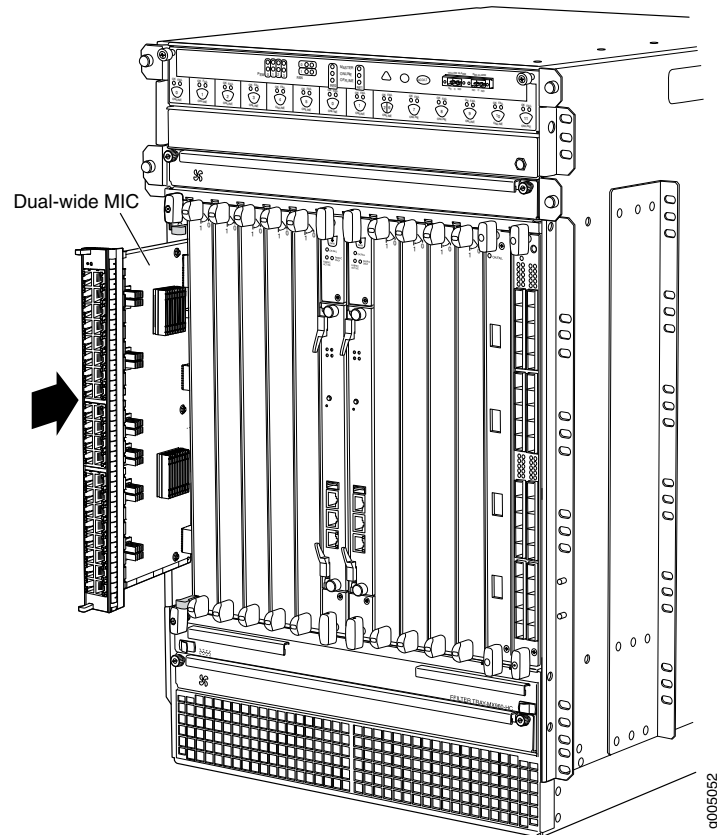
**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

11. Use one of the following methods to bring the MIC online:
  - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
  - Issue the following CLI command:

```
user@host> request chassis mic fpc-slot mpc-slot mic-slot mic-slot online
```

The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the `show chassis fpc pic-status` command described in “Maintaining MX960 MICs” on page 460.

Figure 99: Installing a Dual-Wide MIC



**Related Documentation**

- [MX960 Modular Interface Card Description on page 65](#)
- [Maintaining MX960 MICs on page 460](#)
- [Troubleshooting the MX960 MICs on page 493](#)
- [Removing an MX960 MPC on page 374](#)
- [Removing an MX960 MIC on page 364](#)
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

## Installing an MX960 MPC

An MPC installs vertically in the front of the router. The MPCs are hot-insertable and hot-removable. A fully configured MPC can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

To install an MPC (see [Figure 100 on page 280](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the MPC on an antistatic mat.
3. Take each MIC to be installed in the replacement MPC out of its electrostatic bag, and identify the slot on the MPC where it will be connected.
4. Verify that each fiber-optic MIC has a rubber safety cap covering the MIC transceiver. If it does not, cover the transceiver with a safety cap.
5. Install each MIC into the appropriate slot on the MPC.
6. Locate the slot in the card cage in which you plan to install the MPC.
7. Orient the MPC so that the faceplate faces you.
8. Lift the MPC into place, and carefully align the sides of the MPC with the guides inside the card cage.



**CAUTION:** When the MPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

9. Slide the MPC all the way into the card cage until you feel resistance.
10. Grasp both ejector handles, and rotate them clockwise simultaneously until the MPC is fully seated.
11. If any of the MICs on the MPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

12. Insert the appropriate cable into the cable connector ports on each MIC on the MPC. Secure the cables so that they are not supporting their own weight. Place excess cable out of the way in a neatly coiled loop, using the cable management system. Placing fasteners on a loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

13. Use one of the following methods to bring the MPC online:

- Press and hold the corresponding MPC online button on the craft interface until the green OK/FAIL LED next to the button lights steadily, in about 5 seconds.
- Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

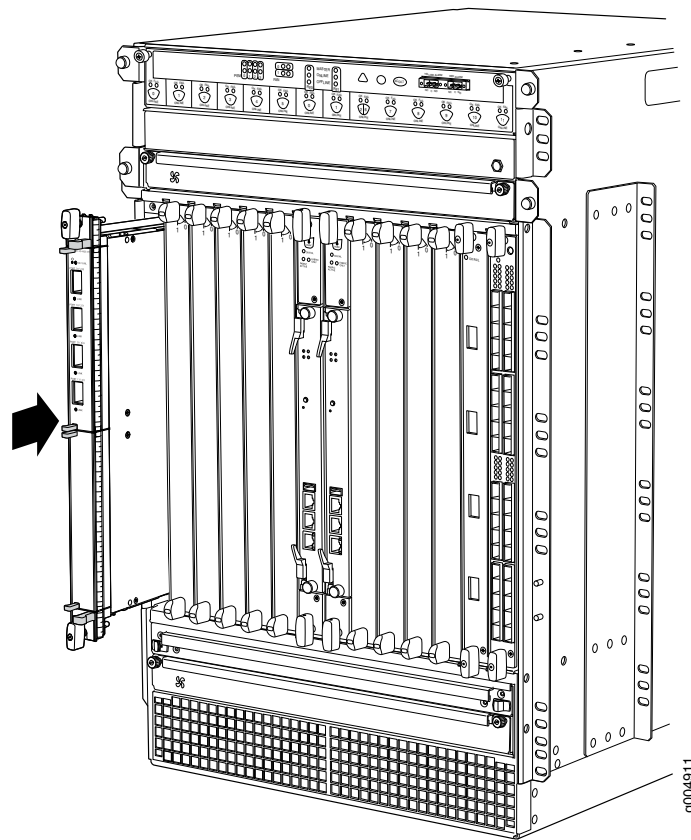
For more information about the command, see the [CLI Explorer](#).



**CAUTION:** After the OK/FAIL LED lights steadily, wait at least 30 seconds before removing the MPC again, removing an MPC from a different slot, or inserting an MPC in a different slot.

You can also verify correct MPC and MIC functioning by issuing the `show chassis fpc` and `show chassis fpc pic-status` commands described in “[Maintaining MX960 MPCs](#)” on page 461 and “[Maintaining MX960 MICs](#)” on page 460.

Figure 100: Installing an MPC

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [MX960 Modular Port Concentrator Description on page 76](#)
- [Removing an MX960 MPC on page 374](#)
- [Installing an MX960 MIC on page 272.](#)
- [Maintaining MX960 MPCs on page 461](#)
- [Troubleshooting the MX960 MPCs on page 494](#)

## Installing an MX960 PIC

To install a PIC (see [Figure 101 on page 282](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. If the PIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.

3. Align the notches in the connector at the rear of the PIC with the notches in the PIC slot in the FPC and then slide the PIC in until it lodges firmly in the FPC.



**CAUTION:** Slide the PIC straight into the slot to avoid damaging the components on the bottom of the PIC.

4. For an FPC3 PIC, turn the ejector handle at the top of the PIC faceplate clockwise, then tighten the captive screw at the bottom of the faceplate to secure the PIC in the FPC.

5. If the PIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Insert the appropriate cables into the cable connectors on the PIC.
7. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

8. Use one of the following methods to bring the PIC online:
  - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.

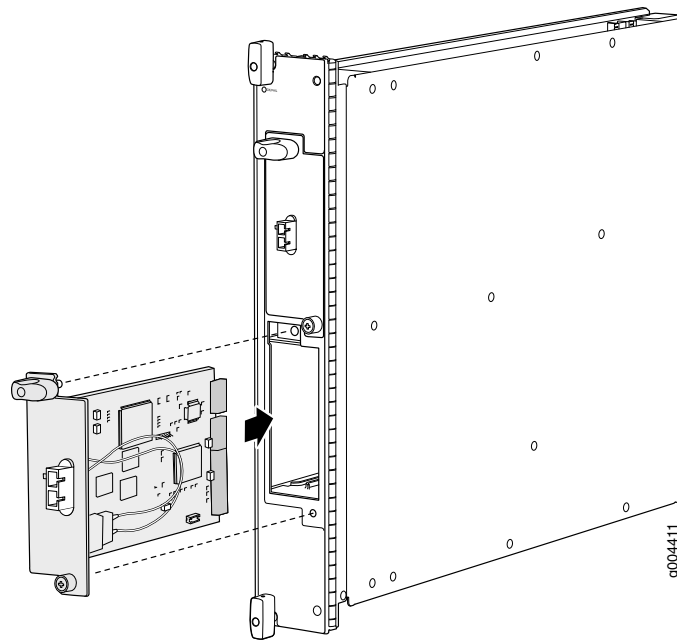
- Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the PIC is online. You can also verify correct PIC functioning by issuing the **show chassis fpc pic-status** command described in “[Maintaining MX960 PICs](#)” on page 464.

*Figure 101: Installing a PIC*



#### Related Documentation

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Removing an MX960 PIC on page 380](#)
- [Troubleshooting the MX960 PICs on page 492](#)
- [Maintaining MX960 PICs on page 464](#)
- [MX960 PIC Serial Number Label on page 514](#)
- [MX960 PIC Description on page 48](#)



## Installing a Cable on an MX960 DPC, MPC, MIC, or PIC

To install a cable:

1. Have ready a length of the type of cable used by the component. For cable specifications, see the *MX Series Interface Module Reference*.

2. If the cable connector port is covered by a rubber safety cap, remove the cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

3. Insert the cable connector into the cable connector port on the component faceplate.

4. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

5. Insert the other end of the cable into the destination port.

6. Repeat the previous steps for any additional cables.

7. If the component is offline (its failure indicator LED is lit), use one of the following methods to bring it online.

- To bring a DPC or MPC online:

- Press and hold the corresponding online button on the craft interface until the green **OK** LED next to the button lights steadily, in about 5 seconds.
- Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

For more information about the command, see the [CLI Explorer](#).

- To bring a PIC online:
  - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
  - Issue the following CLI command:

```
user@host>request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

- To bring a MIC online:
  - Press the MIC offline/online button until the MIC LED lights green.
  - Issue the following CLI command:

```
user@host>request chassis mic fpc-slot mpc-slot pic-slot mic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning indicator LED confirms that the component is online. You can also verify correct DPC or MPC functioning by issuing the **show chassis fpc** command or the correct PIC or MIC functioning by issuing the **show chassis fpc pic-status** command.

#### Related Documentation

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Removing a Cable on an MX960 DPC, MPC, MIC, or PIC on page 384](#)
- [Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs on page 465](#)

---

## Installing an MX960 AC Power Supply

To install an AC power supply (see [Figure 102 on page 286](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Move the AC input switch in the chassis above the empty power supply slot to the off (O) position.

3. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see [Figure 102 on page 286](#)).

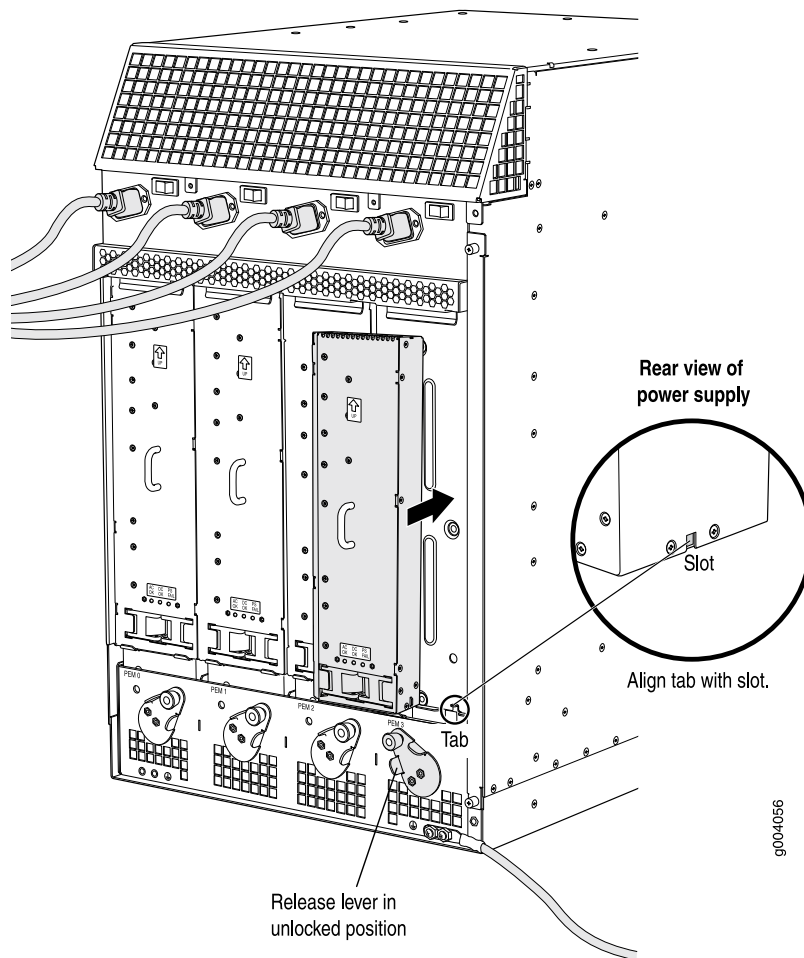
If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

4. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplates.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see [Figure 102 on page 286](#)). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
7. Move the AC input switch in the chassis above the power supply to the on (—) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

Figure 102: Installing an AC Power Supply

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [MX960 AC Power Supply Description on page 86](#)
- [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
- [Removing a Normal Capacity MX960 AC Power Supply on page 397](#)
- [Connecting an MX960 AC Power Supply Cord on page 233](#)
- [Disconnecting an MX960 AC Power Supply Cord on page 410](#)

## Installing an MX960 DC Power Supply



**WARNING:** Before performing DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.

To install a DC power supply (see [Figure 103 on page 290](#)):

1. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Move the DC circuit breaker on the power supply faceplate to the off (O) position.
4. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see [Figure 103 on page 290](#)).

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

5. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplates.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see [Figure 103 on page 290](#)). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
8. Remove the clear plastic cover protecting the terminal studs on the faceplate.
9. Remove the nut and washer from each of the terminal studs.

10. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut (see [Figure 104 on page 291](#)). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)
  - a. Attach the positive (+) DC source power cable lug to the **RTN** (return) terminal.
  - b. Attach the negative (–) DC source power cable lug to the **–48V** (input) terminal.



**CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.



**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.



**NOTE:** The DC power supplies in slots PEM0 and PEM1 must be powered by dedicated power feeds derived from feed A, and the DC power supplies in PEM2 and PEM3 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system. For information about connecting to DC power sources, see [“Electrical Specifications for the MX960 DC Power Supply” on page 159](#).

11. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.
12. Route the positive and negative DC power cables through the left and right sides of the cable restraint.

13. Tighten the cable restraint captive screw to hold the power cables in place.



**WARNING:** Once the DC power supply is connected, the cable will be blocking the PEM slot label. Make sure and note or mark the PEM slot once the power supply is connected.

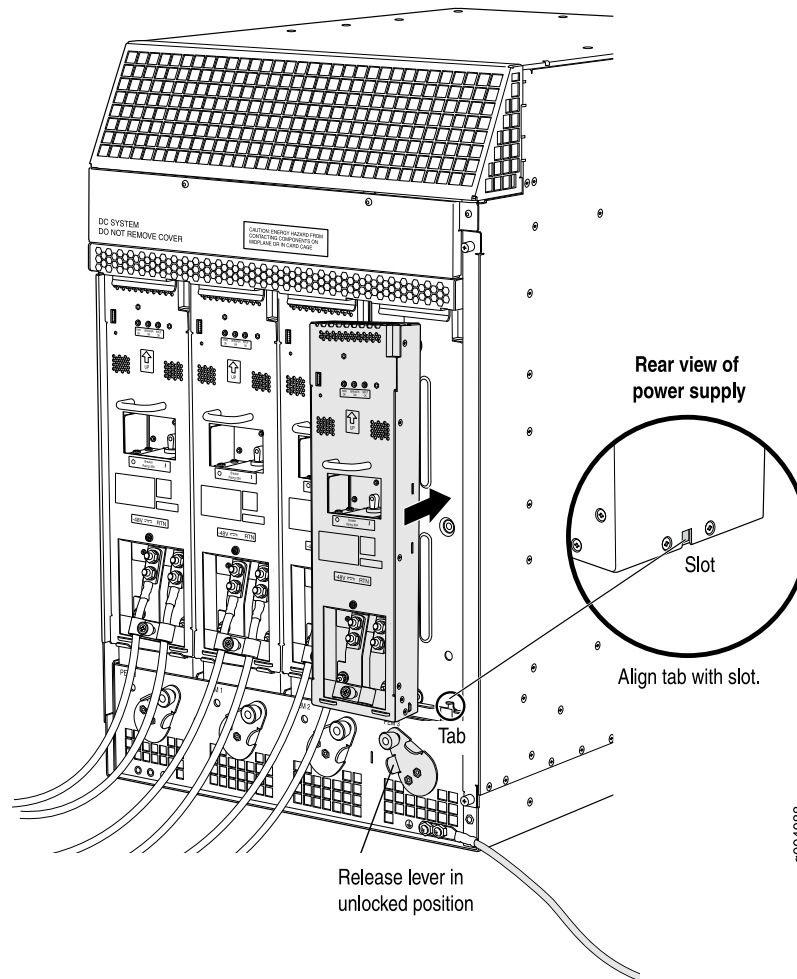
14. Replace the clear plastic cover over the terminal studs on the faceplate.
15. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.
16. Switch on the dedicated customer site circuit breaker.
17. Verify that the **INPUT OK** LED on the power supply is lit steadily.
18. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (I) position.



**NOTE:** The circuit breaker may bounce back to the off (O) position if you move the breaker too quickly.

19. Verify that the **BREAKER ON** LED is lit steadily.
20. Verify that the **PWR OK** LED is lit steadily.

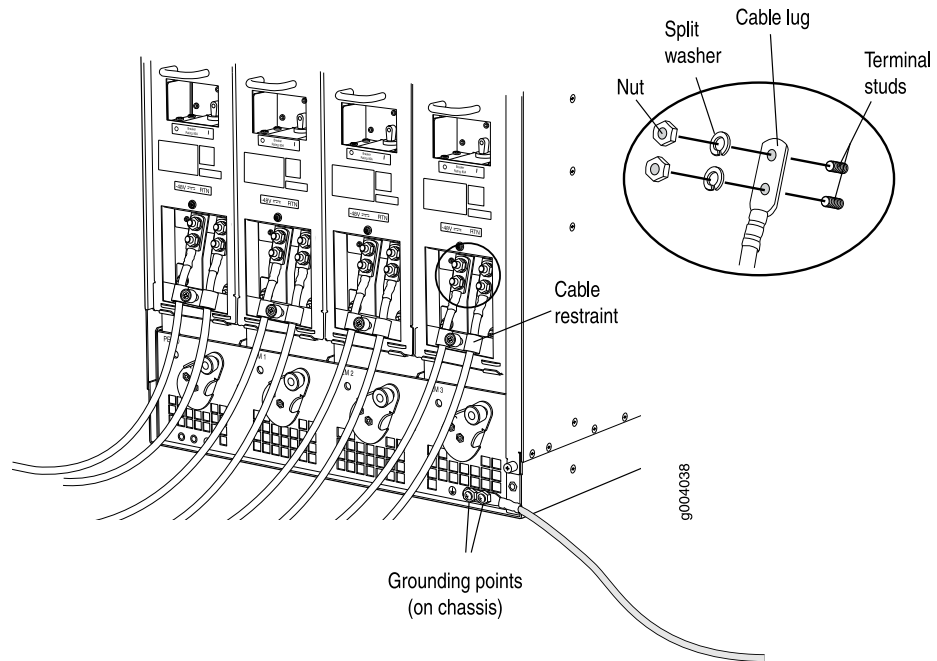
Figure 103: Installing a DC Power Supply



9004088



Figure 104: Connecting DC Power to the MX960 Router



#### Related Documentation

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [MX960 DC Power Supply on page 92](#)
- [MX960 DC Power Electrical Safety Guidelines](#)
- [Removing an MX960 DC Power Supply on page 402](#)
- [Connecting an MX960 DC Power Supply Cable on page 234](#)
- [Disconnecting an MX960 DC Power Supply Cable on page 411](#)

## Installing an MX960 AS MLC

You can install up to eight Application Services Modular Line Cards (AS MLCs) vertically in the front of the MX960 router. The AS MLCs are hot-insertable and hot-removable. An empty AS MLC weighs 10.5 lb (4.76 kg). A fully configured AS MLC can weigh up to 15.27 lb (6.93 kg). Be prepared to accept its full weight.

To install an AS MLC (see [Figure 105 on page 293](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the AS MLC on an antistatic mat.

3. Take the AS MSC and AS MXC (the modular cards) to be installed in the AS MLC out of its electrostatic bag. The AS MSC must be inserted in the top slot and the AS MXC in the bottom slot.
4. Install the AS MSC and AS MXC into the appropriate slot on the AS MLC.
5. Locate the slots in the card cage in which you plan to install the AS MLC.
6. Orient the AS MLC so that the faceplate faces you.
7. Lift the AS MLC into place, and carefully align the sides of the AS MLC with the guides inside the card cage.



**CAUTION:** When the AS MLC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

8. Slide the AS MLC all the way into the card cage until you feel resistance.
9. Grasp both ejector handles, and rotate them clockwise simultaneously until the AS MLC is fully seated.
10. Use one of the following methods to bring the AS MLC online:
  - Press and hold the AS MLC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each AS MLC are located directly above it on the craft interface.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

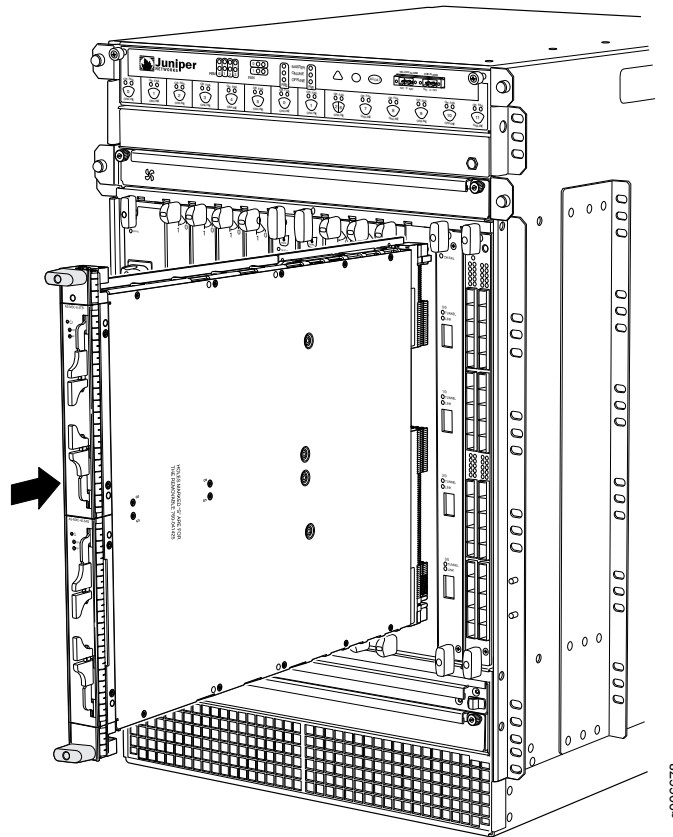
For more information about the command, see the [CLI Explorer](#).



**CAUTION:** After the OK LED lights steadily, wait at least 30 seconds before removing the AS MLC again, removing an AS MLC from a different slot, or inserting an AS MLC in a different slot.

You can also verify correct AS MLC and AS MSC or AS MXC functioning by issuing the `show chassis fpc` and `show chassis fpc pic-status`.

Figure 105: Installing an AS MLC



**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Installing an MX960 AS MSC on page 293](#)
- [Installing an MX960 AS MXC on page 295](#)
- [Removing an MX960 AS MLC on page 309](#)

## Installing an MX960 AS MSC

To install an AS MSC (see [Figure 106 on page 294](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Align the notches in the connector at the rear of the AS MSC with the notches in the AS MSC slot (slot 0—the top slot in the AS MLC ), and then slide the AS MSC in until it lodges firmly in the AS MLC.



**CAUTION:** Slide the AS MSC straight into the slot to avoid damaging the components on the bottom of the AS MSC.

3. Use one of the following methods to bring the AS MSC online:

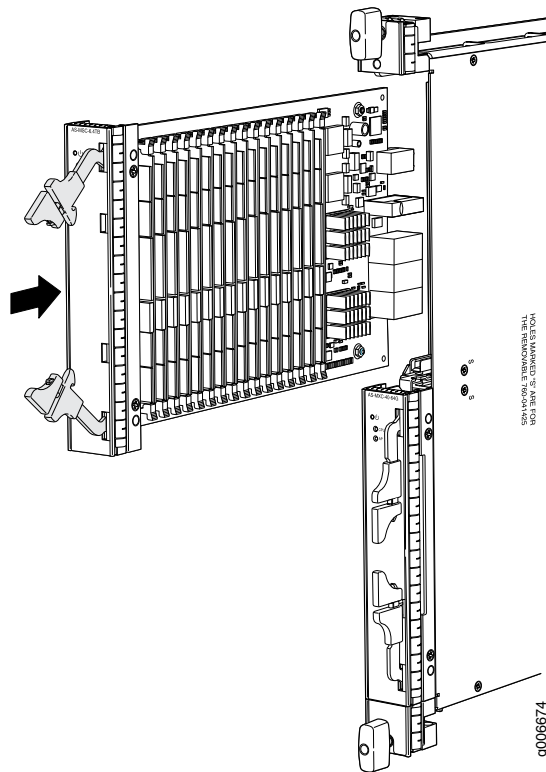
- Press the AS MSC offline/online button until the LED light turns green.
- Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the AS MSC is online. You can also verify correct AS MSC functioning by issuing the `show chassis fpc pic-status` command..

*Figure 106: Installing an AS MSC*



**Related Documentation**

- [MX960 Application Services Modular Storage Card Description on page 54](#)
- [Removing an MX960 AS MSC on page 314](#)

---

## Installing an MX960 AS MXC

---

To install an AS MXC (see [Figure 107 on page 296](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Align the notches in the connector at the rear of the AS MXC with the notches in the AS MXC slot (slot 1—the bottom slot in the AS MLC), and then slide the AS MXC in until it lodges firmly in the AS MLC.



**CAUTION:** Slide the AS MXC straight into the slot to avoid damaging the components on the bottom of the AS MXC.

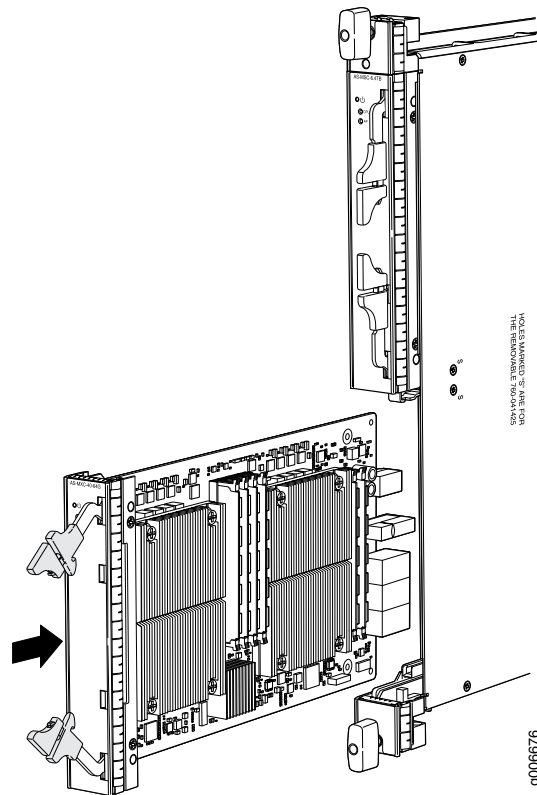
3. Use one of the following methods to bring the AS MXC online:
  - Press the AS MXC offline/online button until the LED light turns green.
  - Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the AS MXC is online. You can also verify correct AS MXC functioning by issuing the **show chassis fpc pic-status** command.

Figure 107: Installing an AS MXC



#### Related Documentation

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [MX960 Application Services Modular Processing Card Description on page 55](#)
- [Removing an MX960 AS MXC on page 317](#)

## Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC

To install an SFP or XFP:

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Take each transceiver to be installed out of its electrostatic bag, and identify the slot on the component where it will be installed.
3. Verify that each transceiver is covered by a rubber safety cap. If it is not, cover the transceiver with a safety cap.
4. Carefully align the transceiver with the slots in the component. The connectors should face the component.

5. Slide the transceiver until the connector is seated in the component slot. If you are unable to fully insert the transceiver, make sure the connector is facing the right way.
6. Close the ejector handle of the transceiver.
7. Remove the rubber safety cap from the transceiver and the end of the cable. Insert the cable into the transceiver.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

8. Verify that the status LEDs on the component faceplate indicate that the SFP or XFP is functioning correctly. For more information about the component LEDs, see the [MX Series Interface Module Reference](#).

**Related  
Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Removing an SFP or XFP Transceiver from an MX960 DPC, MPC, MIC, or PIC on page 388](#)
- [Replacing an MX960 PIC on page 380](#)
- [Replacing an MX960 DPC on page 351](#)

## Replacing a CFP2 Transceiver

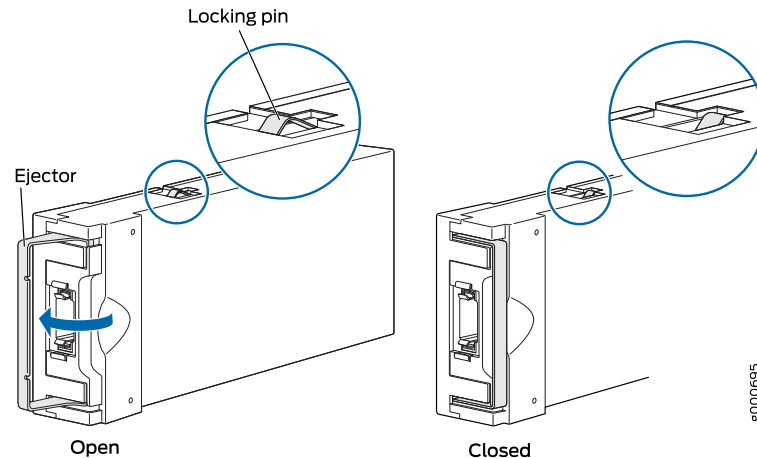
---

- [Removing a CFP2 Transceiver on page 298](#)
- [Installing a CFP2 Transceiver on page 299](#)

## Removing a CFP2 Transceiver

C form-factor pluggables (CFPs) are transceivers that can be removed from a PIC. CFP2 transceivers are hot-insertable and hot-removable. Removing a CFP2 transceiver does not interrupt PIC functioning, but the removed CFP2 transceiver no longer receives or transmits data.

*Figure 108: Form-Factor Pluggable (CFP2)*



To remove a CFP2 transceiver (see [Figure 108 on page 298](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP2 transceiver and the cable.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Label the cable connected to the CFP2 transceiver so that you can later reconnect it to the correct CFP2 transceiver.
4. Disconnect the cable from the CFP2 transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



5. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. Pull the ejector latch to the extreme end away from the CFP2 transceiver faceplate to unseat the CFP2 transceiver from the PIC. Pull the CFP2 transceiver out of the PIC and place it on the antistatic mat or in the electrostatic bag.



**NOTE:** You cannot remove the transceiver until you move the ejector latch to the extreme end.

## Installing a CFP2 Transceiver

To install a replacement CFP2:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.
3. Orient the CFP2 over the port in the PIC so that the connector end will enter the slot first and the CFP2 connector faces the appropriate direction.
4. Slide the CFP2 into the slot. If there is resistance, remove the CFP2 and flip it so that the connector faces the other direction.
5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Arrange the cable in the cable management system to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. Verify that the status LEDs on the PIC faceplate indicate that the CFP2 is functioning correctly. You can also verify PIC functioning by issuing the **show chassis fpc pic-status** command.

## Replacing a CFP Transceiver

---

C form-factor pluggable (CFP) transceivers are hot-insertable and hot-removable. Removing a transceiver does not interrupt line card functioning, but the removed transceiver no longer receives or transmits data.

You can use the [Hardware Compatibility Tool](#) to find information about the pluggable transceivers supported on your Juniper Networks device.

- [Removing a CFP Transceiver on page 300](#)
- [Installing a CFP Transceiver on page 301](#)

## Removing a CFP Transceiver

To remove a CFP transceiver:

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP transceiver and the cable.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.
3. Label the cable connected to the CFP transceiver so that you can later reconnect it to the correct CFP transceiver.
4. Disconnect the cable from the CFP transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

5. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. Unscrew the screws from the CFP transceiver faceplate to unseat the CFP transceiver from the line card. Pull the CFP transceiver out of the line card and place it on the antistatic mat or in the electrostatic bag.

## Installing a CFP Transceiver

To install a replacement CFP transceiver:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.
2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.
3. Orient the CFP over the port in the line card so that the connector end will enter the slot first and the CFP connector faces the appropriate direction.
4. Slide the CFP into the slot. If there is resistance, remove the CFP and flip it so that the connector faces the other direction.
5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



.....

**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

.....

6. Arrange the cable in the cable management system to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.



.....

**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

.....



.....

**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

.....

7. Verify that any status LEDs on the line card faceplate indicate that the CFP is functioning correctly. For more information about the line card LEDs, see the *MX Series 5G Universal Routing Platform Interface Module Reference*. You can also verify line card functioning by issuing the **show chassis fpc pic-status** command.

**Related  
Documentation**

- [MICs Supported by MX Series Routers on page 65](#)
- [MPCs Supported by MX Series Routers on page 79](#)

# Replacing Chassis Components

- [Replacing the MX960 Craft Interface on page 303](#)
- [Replacing the MX960 Cable Manager on page 307](#)
- [Replacing the Console or Auxiliary Cable on an MX960 Router on page 308](#)
- [Replacing the Management Ethernet Cable on an MX Series Router on page 309](#)
- [Replacing an MX960 AS MLC on page 309](#)
- [Replacing an MX960 AS MSC on page 314](#)
- [Replacing an MX960 AS MXC on page 317](#)

## Replacing the MX960 Craft Interface

---

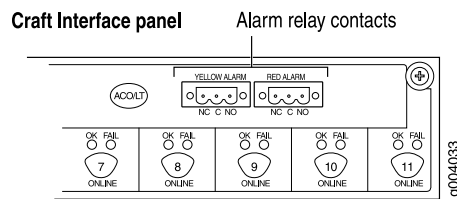
1. [Disconnecting the Alarm Relay Wires from the MX960 Craft Interface on page 303](#)
2. [Removing the MX960 Craft Interface on page 304](#)
3. [Installing the MX960 Craft Interface on page 305](#)
4. [Connecting the Alarm Relay Wires to the MX960 Craft Interface on page 306](#)

## Disconnecting the Alarm Relay Wires from the MX960 Craft Interface

To disconnect the alarm relay wires from the router and an alarm-reporting device (see [Figure 109 on page 304](#)):

1. Disconnect the existing wire at the external device.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Using a 2.5-mm flat-blade screwdriver, loosen the small screws on the face of the terminal block and remove the block from the relay contact.
4. Using the 2.5-mm flat-blade screwdriver, loosen the small screws on the side of the terminal block. Remove existing wires from the slots in the front of the block.

Figure 109: Alarm Relay Contacts



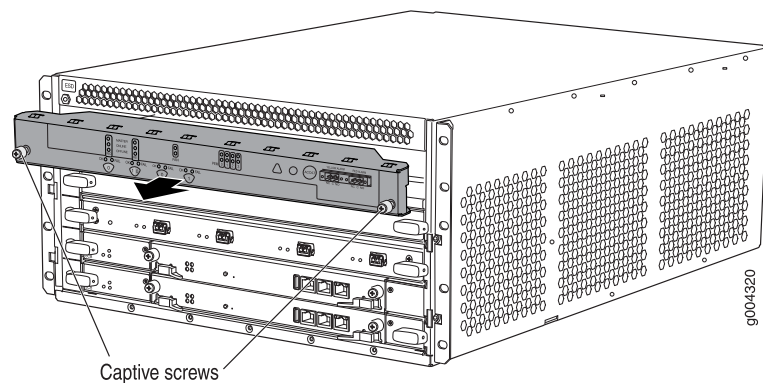
- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Removing the MX960 Craft Interface on page 304](#)
  - [Installing the MX960 Craft Interface on page 257](#)
  - [Connecting the Alarm Relay Wires to the MX960 Craft Interface on page 245](#)

## Removing the MX960 Craft Interface

To remove the craft interface (see [Figure 110 on page 304](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Detach any external devices connected to the craft interface.
3. Loosen the captive screws at the left and right corners of the craft interface faceplate.
4. Grasp the craft interface faceplate and carefully tilt it toward you until it is horizontal.
5. Disconnect the ribbon cable from the back of the faceplate by gently pressing on both sides of the latch with your thumb and forefinger. Remove the craft interface from the chassis.

Figure 110: Removing the Craft Interface



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

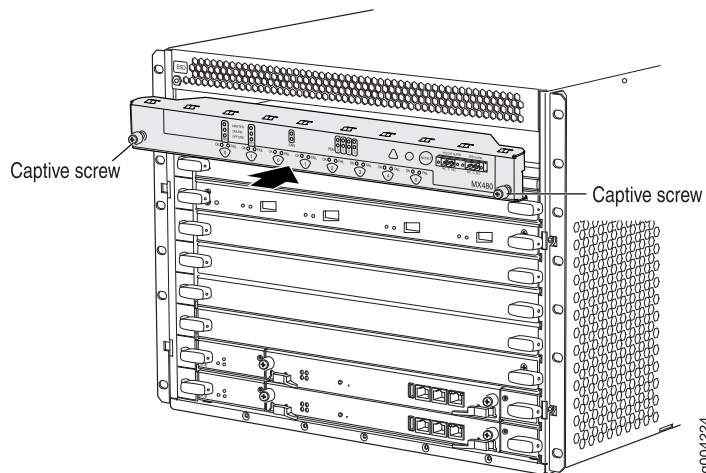
- [Disconnecting the Alarm Relay Wires from the MX960 Craft Interface on page 303](#)
- [Installing the MX960 Craft Interface on page 257](#)
- [Connecting the Alarm Relay Wires to the MX960 Craft Interface on page 245](#)
- [MX960 Craft Interface Overview on page 14](#)

## Installing the MX960 Craft Interface

To install the craft interface (see [Figure 87 on page 258](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Grasp the craft interface with one hand, and hold the bottom edge of the craft interface with the other hand to support its weight.
3. Orient the ribbon cable so that it plugs into the connector socket. The connector is keyed and can be inserted only one way.
4. Align the bottom of the craft interface with the sheet metal above the card cage and press it into place.
5. Tighten the screws on the left and right corners of the craft interface faceplate.
6. Reattach any external devices connected to the craft interface.

*Figure 111: Installing the Craft Interface*



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Disconnecting the Alarm Relay Wires from the MX960 Craft Interface on page 303](#)

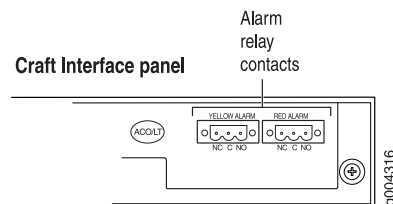
- [Removing the MX960 Craft Interface on page 304](#)
- [Connecting the Alarm Relay Wires to the MX960 Craft Interface on page 245](#)
- [MX960 Craft Interface Overview on page 14](#)

## Connecting the Alarm Relay Wires to the MX960 Craft Interface

To connect the alarm relay wires between a router and an alarm-reporting device (see [Figure 86 on page 246](#)):

1. Prepare the required length of replacement wire with gauge between 28-AWG and 14-AWG (0.08 and 2.08 mm<sup>2</sup>).
2. Insert the replacement wires into the slots in the front of the block. Use a 2.5-mm flat-blade screwdriver to tighten the screws and secure the wire.
3. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Plug the terminal block into the relay contact, and use a 2.5-mm flat-blade screwdriver to tighten the screws on the face of the block.
5. Attach the other end of the wires to the external device.

*Figure 112: Alarm Relay Contacts*



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Disconnecting the Alarm Relay Wires from the MX960 Craft Interface on page 303](#)
  - [Removing the MX960 Craft Interface on page 304](#)
  - [Installing the MX960 Craft Interface on page 257](#)
  - [MX960 Craft Interface Overview on page 14](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 Craft Interface Overview on page 14](#)
  - [MX960 Craft Interface Serial Number Label on page 509](#)

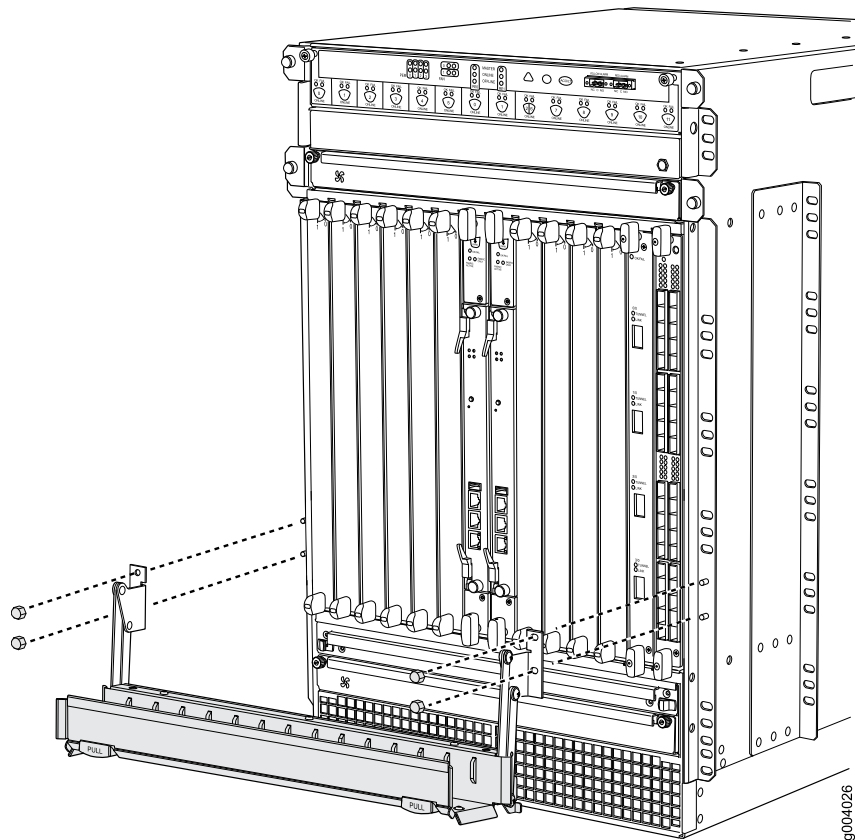


## Replacing the MX960 Cable Manager

To remove the standard cable manager (see [Figure 113 on page 307](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Using a 7/16-in. (11 mm) nut driver, unscrew the nuts on the corners of the standard cable manager.
3. Grasp the bottom of the standard cable manager, and pull it straight out from the studs on the front of the chassis.

*Figure 113: Removing the Standard Cable Manager*



To install the standard cable manager (see [Figure 113 on page 307](#)):

1. Position the standard cable manager on the studs on the lower front of the chassis.
2. Insert the nuts on the corners in the standard cable manager onto the studs on the chassis.

- Using a 7/16-in. (11 mm) nut driver, tighten the nuts securely.

#### Related Documentation

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [MX960 Cable Manager Description on page 18](#)
- [Verifying the Version of the MX960 Cable Manager on page 467](#)

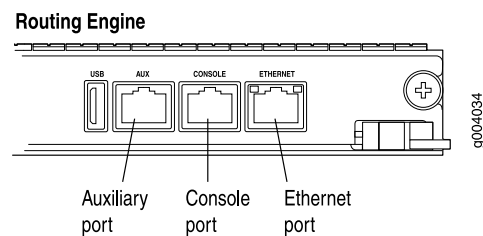
## Replacing the Console or Auxiliary Cable on an MX960 Router

To use a system console to configure and manage the Routing Engine, connect it to the **CONSOLE** port on the Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One RJ-45/DB-9 cable is provided with the router. If you want to connect a device to both ports, you must supply another cable.

To replace a cable connected to a management console or auxiliary device:

- Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
- Press the tab on the connector, and pull the connector straight out of the port.
- Disconnect the cable from the console or auxiliary device.
- Plug the RJ-45 end of the replacement serial cable into the **CONSOLE** or **AUX** port. [Figure 114 on page 308](#) shows the external device ports on the Routing Engine.
- Plug the female DB-9 end into the console or auxiliary device's serial port.

**Figure 114: Auxiliary and Console Ports**



#### Related Documentation

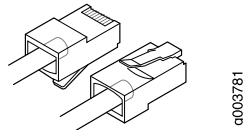
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Replacing the Management Ethernet Cable on an MX Series Router on page 309](#)
- [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
- [Replacing an MX960 Routing Engine on page 329](#)

## Replacing the Management Ethernet Cable on an MX Series Router

One Ethernet cable with RJ-45 connectors is provided with the router. To replace the cable connected to the **ETHERNET** port:

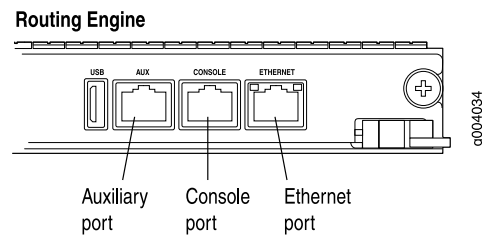
1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Press the tab on the connector, and pull the connector straight out of the port.  
[Figure 115 on page 309](#) shows the connector.
3. Disconnect the cable from the network device.
4. Plug one end of the replacement cable into the **ETHERNET** port. [Figure 116 on page 309](#) shows the port.
5. Plug the other end of the cable into the network device.

*Figure 115: Cable Connector*



g003781

*Figure 116: Ethernet Port*



g004034

**Related Documentation** • [Replacing an MX960 Routing Engine on page 329](#)

## Replacing an MX960 AS MLC

1. [Removing an MX960 AS MLC on page 309](#)
2. [Installing an MX960 AS MLC on page 312](#)

## Removing an MX960 AS MLC

When you remove an Application Services Modular Line Card (AS MLC), the router continues to function, although the modular cards (AS MXC and AS MSC) installed on the AS MLC being removed no longer function.

Up to eight AS MLCs can be installed vertically in the front of the MX960 router. The AS MLCs are hot-insertable and hot-removable. An empty AS MLC weighs 10.5 lb (4.76 kg). A fully configured AS MLC can weigh up to 15.27 lb (6.93 kg). Be prepared to accept its full weight.

To remove an AS MLC (See [Figure 117 on page 311](#)):

1. Have ready a replacement AS MLC or an AS MLC blank panel and an antistatic mat for the AS MLC.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Use one of the following methods to take the AS MLC offline:
  - Press and hold the AS MLC online/offline button. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes out. The online/offline button for each AS MLC is located directly above it on the craft interface.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number offline
```

For more information about the command, see the [CLI Explorer](#).



**NOTE:** The slot number corresponds to the lowest numbered slot for which the AS MLC is installed.

4. Simultaneously turn both the ejector handles counterclockwise to unseat the AS MLC.
5. Grasp the handles, and slide the AS MLC straight out of the card cage halfway.
6. Place one hand around the front of the AS MLC (the modular card housing) and the other hand under it to support it. Slide the AS MLC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



**CAUTION:** The weight of the AS MLC is concentrated in the back end. Be prepared to accept the full weight—up to 15.27 lb (6.93 kg)—as you slide the AS MLC out of the chassis.

When the AS MLC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

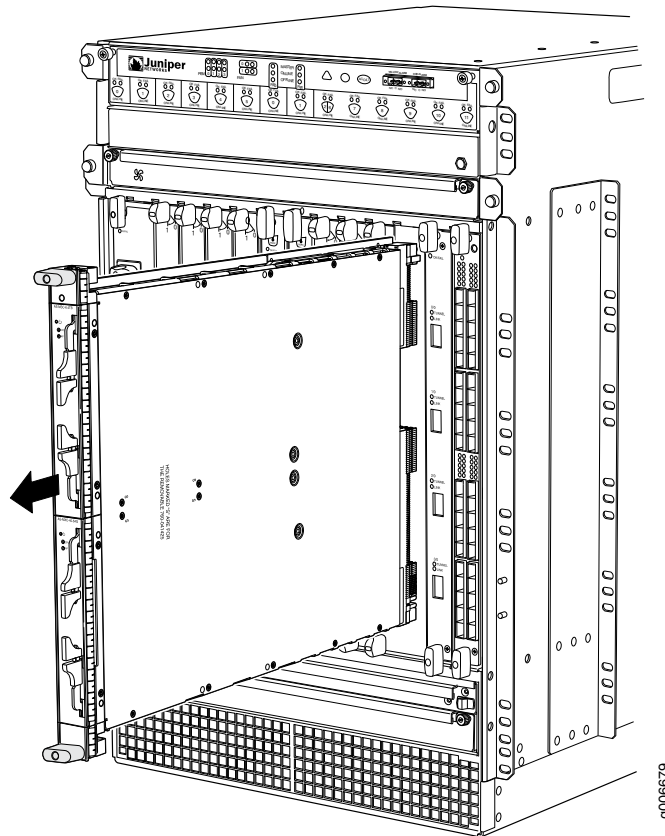
Do not stack AS MLCs on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

7. If necessary, remove each installed AS MSC and AS MXC from the AS MLC.
8. After you remove each modular card, immediately place it on an antistatic mat or in an electrostatic bag.
9. If you are not reinstalling an AS MLC into the emptied slots within a short time, install a blank AS MLC panel over each slot to maintain proper airflow in the card cage.



**CAUTION:** After removing an AS MLC from the chassis, wait at least 30 seconds before reinserting it or inserting an AS MLC into a different slot.

Figure 117: Removing an AS MLC



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Removing an MX960 AS MSC on page 314](#)
  - [Removing an MX960 AS MXC on page 317](#)
  - [Installing an MX960 AS MLC on page 291](#)

## Installing an MX960 AS MLC

You can install up to eight Application Services Modular Line Cards (AS MLCs) vertically in the front of the MX960 router. The AS MLCs are hot-insertable and hot-removable. An empty AS MLC weighs 10.5 lb (4.76 kg). A fully configured AS MLC can weigh up to 15.27 lb (6.93 kg). Be prepared to accept its full weight.

To install an AS MLC (see [Figure 105 on page 293](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the AS MLC on an antistatic mat.
3. Take the AS MSC and AS MXC (the modular cards) to be installed in the AS MLC out of its electrostatic bag. The AS MSC must be inserted in the top slot and the AS MXC in the bottom slot.
4. Install the AS MSC and AS MXC into the appropriate slot on the AS MLC.
5. Locate the slots in the card cage in which you plan to install the AS MLC.
6. Orient the AS MLC so that the faceplate faces you.
7. Lift the AS MLC into place, and carefully align the sides of the AS MLC with the guides inside the card cage.



**CAUTION:** When the AS MLC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

8. Slide the AS MLC all the way into the card cage until you feel resistance.
9. Grasp both ejector handles, and rotate them clockwise simultaneously until the AS MLC is fully seated.
10. Use one of the following methods to bring the AS MLC online:
  - Press and hold the AS MLC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each AS MLC are located directly above it on the craft interface.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot s1ot-number online
```

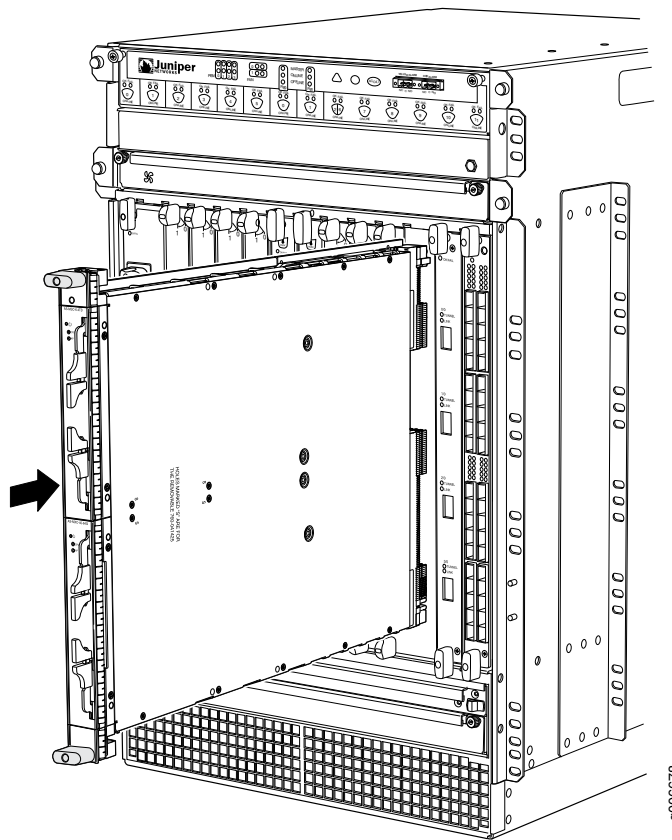
For more information about the command, see the [CLI Explorer](#).



**CAUTION:** After the OK LED lights steadily, wait at least 30 seconds before removing the AS MLC again, removing an AS MLC from a different slot, or inserting an AS MLC in a different slot.

You can also verify correct AS MLC and AS MSC or AS MXC functioning by issuing the `show chassis fpc` and `show chassis fpc pic-status`.

*Figure 118: Installing an AS MLC*



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing an MX960 AS MSC on page 293](#)
  - [Installing an MX960 AS MXC on page 295](#)
  - [Removing an MX960 AS MLC on page 309](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

- [Replacing an MX960 AS MSC on page 314](#)
- [Replacing an MX960 AS MXC on page 317](#)

## Replacing an MX960 AS MSC

---

1. [Removing an MX960 AS MSC on page 314](#)
2. [Installing an MX960 AS MSC on page 315](#)

### Removing an MX960 AS MSC

AS MSCs are hot-insertable and hot-removable. When you remove an AS MSC, the router continues to function.

The AS MSCs are located in the AS MLCs installed in the front of the router. An AS MSC weighs 1.4 lb (0.6 kg).

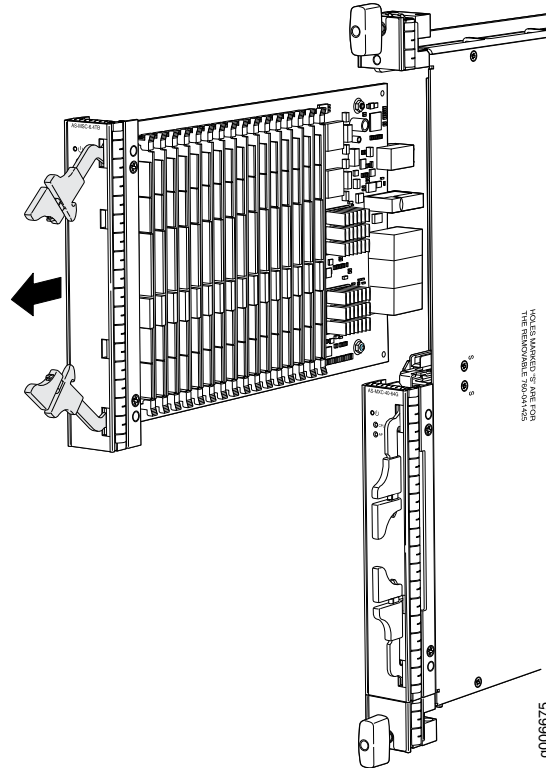
To remove an AS MSC (see [Figure 119 on page 315](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the AS MSC.
  2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
  3. Use one of the following methods to take the AS MSC offline:
    - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the AS MSC LED goes out (about 5 seconds).
    - Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot offline
```
- For more information about the command, see the [CLI Explorer](#).
4. Slide the AS MSC out of the AS MLC card carrier by pulling the handles, and place it in the electrostatic bag or on the antistatic mat.
  5. If you are not reinstalling an AS MSC into the emptied AS MSC slot within a short time, install a blank AS MSC panel over the slot to maintain proper airflow in the AS MLC card cage.



Figure 119: Removing an AS MSC



- See Also**
- [MX960 Application Services Modular Storage Card Description on page 54](#)
  - [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing an MX960 AS MSC on page 293](#)

### Installing an MX960 AS MSC

To install an AS MSC (see [Figure 106 on page 294](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Align the notches in the connector at the rear of the AS MSC with the notches in the AS MSC slot (slot 0—the top slot in the AS MLC ), and then slide the AS MSC in until it lodges firmly in the AS MLC.



**CAUTION:** Slide the AS MSC straight into the slot to avoid damaging the components on the bottom of the AS MSC.

3. Use one of the following methods to bring the AS MSC online:

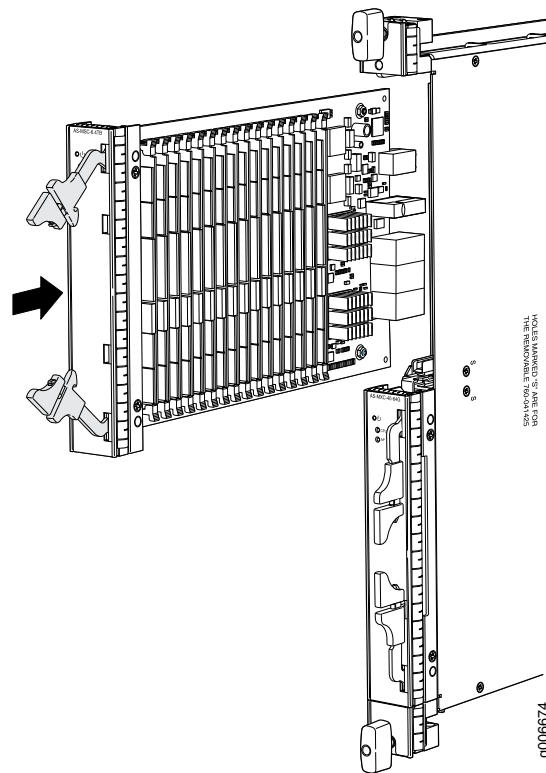
- Press the AS MSC offline/online button until the LED light turns green.
- Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the AS MSC is online. You can also verify correct AS MSC functioning by issuing the **show chassis fpc pic-status** command.

Figure 120: Installing an AS MSC



- See Also**
- [MX960 Application Services Modular Storage Card Description on page 54](#)
  - [Removing an MX960 AS MSC on page 314](#)

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Replacing an MX960 AS MLC on page 309](#)
- [MX960 Application Services Modular Storage Card Description on page 54](#)

---

## Replacing an MX960 AS MXC

---

1. [Removing an MX960 AS MXC on page 317](#)
2. [Installing an MX960 AS MXC on page 318](#)

### Removing an MX960 AS MXC

AS MXCs are hot-insertable and hot-removable. When you remove an AS MXC, the router continues to function.

The AS MXCs are located in the AS MLCs installed in the front of the router. An AS MXC weighs less than 2 lb (0.9 kg).

To remove an AS MXC (see [Figure 121 on page 318](#)):

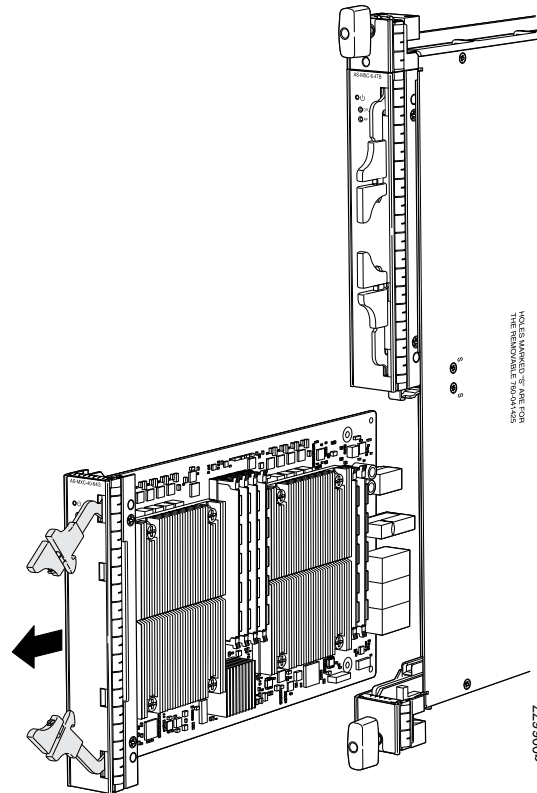
1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the AS MXC.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Use one of the following methods to take the AS MXC offline:
  - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the AS MXC LED goes out (about 5 seconds).
  - Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot offline
```

For more information about the command, see the [CLI Explorer](#).

5. Slide the AS MXC out of the AS MLC card carrier by pulling the handles, and place it in the electrostatic bag or on the antistatic mat.
6. If you are not reinstalling an AS MXC into the emptied AS MXC slot within a short time, install a blank AS MXC panel over the slot to maintain proper airflow in the AS MLC card cage.

Figure 121: Removing an AS MXC



- See Also**
- [MX960 Application Services Modular Processing Card Description on page 55](#)
  - [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing an MX960 AS MXC on page 295](#)

## Installing an MX960 AS MXC

To install an AS MXC (see [Figure 107 on page 296](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Align the notches in the connector at the rear of the AS MXC with the notches in the AS MXC slot (slot 1—the bottom slot in the AS MLC), and then slide the AS MXC in until it lodges firmly in the AS MLC.



**CAUTION:** Slide the AS MXC straight into the slot to avoid damaging the components on the bottom of the AS MXC.

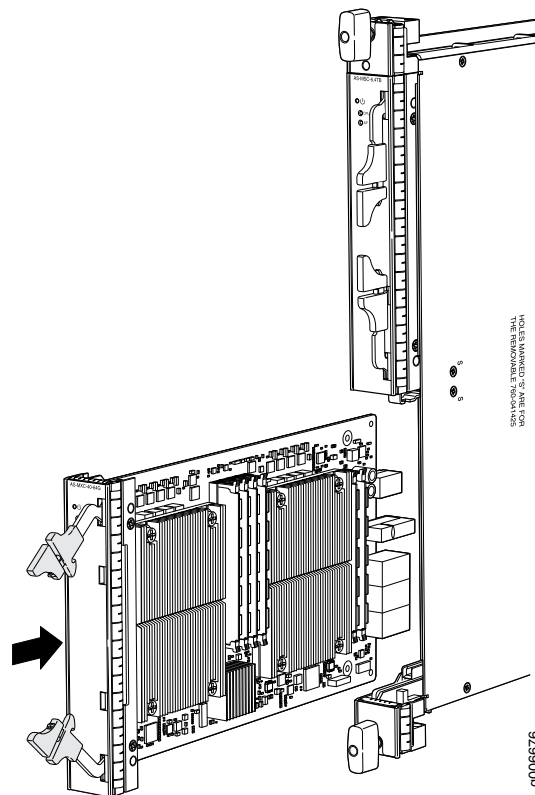
3. Use one of the following methods to bring the AS MXC online:
  - Press the AS MXC offline/online button until the LED light turns green.
  - Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the AS MXC is online. You can also verify correct AS MXC functioning by issuing the `show chassis fpc pic-status` command.

*Figure 122: Installing an AS MXC*



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 Application Services Modular Processing Card Description on page 55](#)
  - [Removing an MX960 AS MXC on page 317](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing an MX960 AS MLC on page 309](#)
  - [MX960 Application Services Modular Processing Card Description on page 55](#)



# Replacing Cooling System Component

- Replacing the MX960 Air Filter on page 321
- Replacing an MX960 Fan Tray on page 323

## Replacing the MX960 Air Filter

---

1. Removing the Normal-Capacity MX960 Air Filter on page 321
2. Installing the MX960 Air Filter on page 323

### Removing the Normal-Capacity MX960 Air Filter



**CAUTION:** Do not run the router for more than a few minutes without the air filter in place.



**CAUTION:** Always keep the air filter in place while the router is operating, except during replacement. Because the fans are very powerful, they could pull small bits of wire or other materials into the router through the unfiltered air intake. This could damage the router components.

To remove the normal-capacity air filter tray, use the following procedure.

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Unwrap any cables on the standard cable manager and remove the cables from the tray. Arrange the cables so that they do not block the front of the cable manager and tray, and secure them with temporary fasteners so that they are not supporting their own weight as they hang from the connector.



**NOTE:** Removing the cables from the extended cable manager is not necessary to access the air filter.



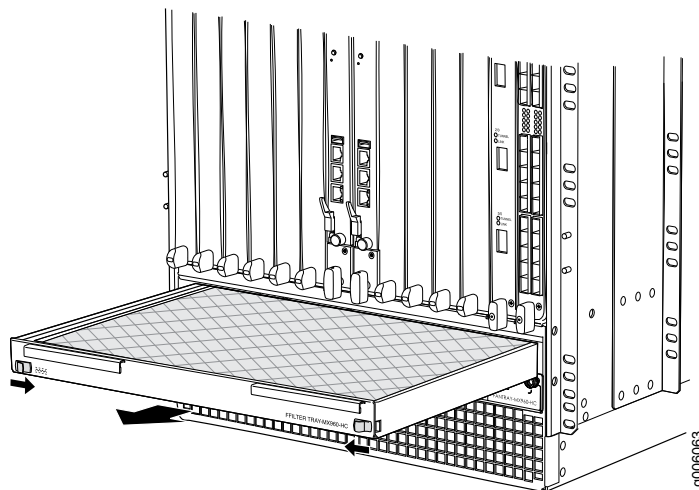
**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Do not run the router for more than two minutes without the air filter in place.

3. Simultaneously pull the two releases labeled **PULL** on the standard cable manager. Lift it up and outward to lock it in place to access the air filter.
4. Pull the filter tray release on both sides of the filter tray.
5. Slide the air filter tray out of the chassis as shown in [Figure 123 on page 322](#).

*Figure 123: Removing the Normal-Capacity Air Filter Tray from the Chassis*



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing the MX960 Air Filter on page 258](#)
  - [Maintaining the MX960 Air Filter on page 444](#)

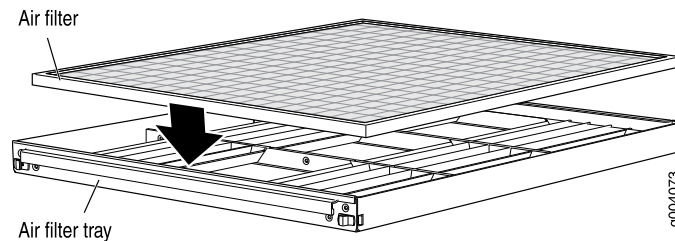


## Installing the MX960 Air Filter

To install the air filter (see [Figure 88 on page 259](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Ensure that the air filter is right side up.
3. Place the air filter into the air filter tray.
4. Insert the air filter tray into the chassis by sliding it straight into the chassis until it stops.
5. Lower the cable manager back into position.
6. Rearrange the cables in the cable manager.

*Figure 124: Installing the Air Filter*



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Removing the Normal-Capacity MX960 Air Filter on page 321](#)
  - [Maintaining the MX960 Air Filter on page 444](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Maintaining the MX960 Air Filter on page 444](#)

## Replacing an MX960 Fan Tray

1. [Removing an MX960 Fan Tray on page 324](#)
2. [Installing an MX960 Fan Tray on page 326](#)

## Removing an MX960 Fan Tray



**NOTE:** To prevent overheating, install the replacement fan tray immediately after removing the existing fan tray.

To remove the upper or lower fan tray (see [Figure 125 on page 325](#) and [Figure 126 on page 326](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Reposition the standard cable manager before removing the lower front fan tray:



**NOTE:** This step is not required for the extended cable manager.

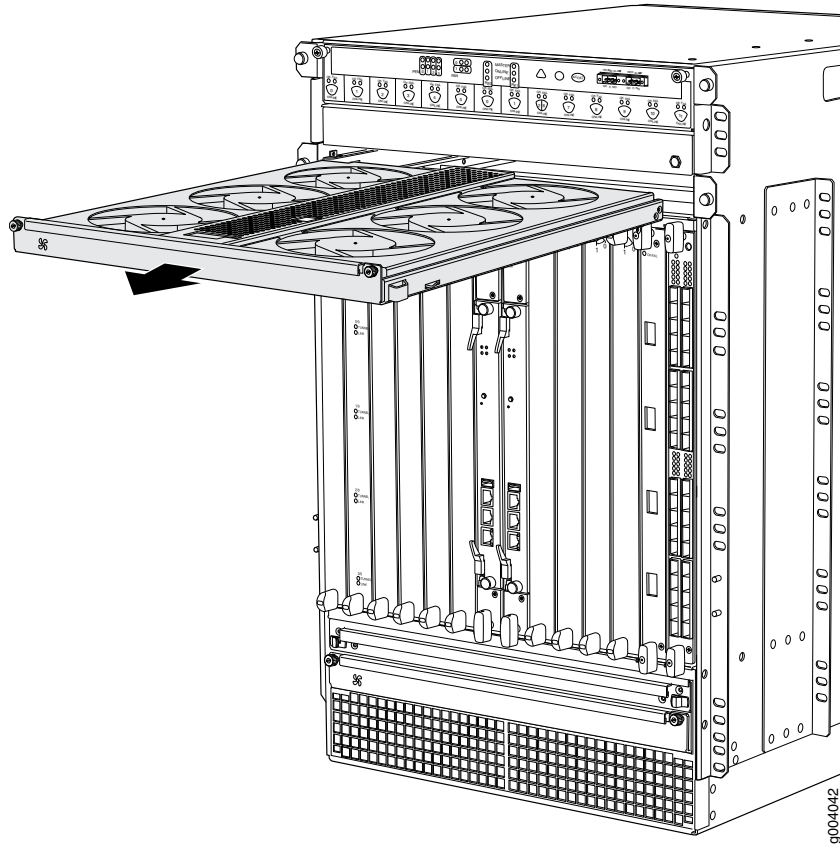
- a. Unwrap any cables on the standard cable manager and remove the cables from the tray. Arrange the cables so that they do not block the front of the cable manager and tray, and secure them with temporary fasteners so that they are not supporting their own weight as they hang from the connector.
  - b. Simultaneously pull the two releases labelled PULL on the cable manager. Lift it up and outward to lock it in place.
3. Loosen the captive screw on each side of the fan tray faceplate.
  4. Grasp both sides of the fan tray, and pull it out approximately 1 to 3 inches.

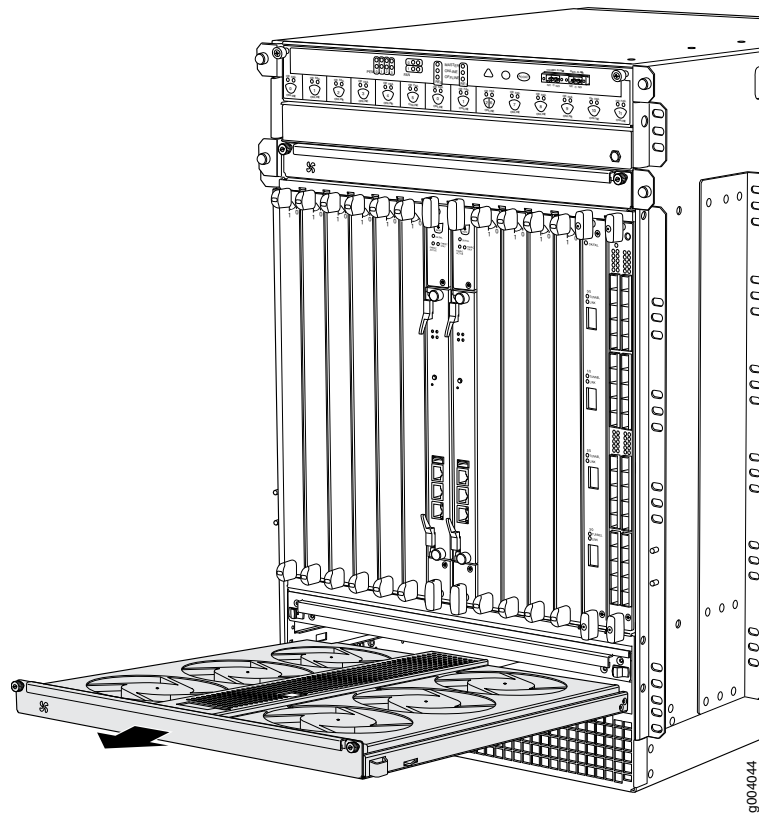


**WARNING:** To avoid injury, keep tools and your fingers away from the fans as you slide the fan module out of the chassis. The fans might still be spinning.

5. Pause for approximately 15 seconds to allow the fans to stop spinning.
6. When the fans stop spinning, press on the two latches located on the inside of the fan tray.
7. Place one hand under the fan tray to support it, and pull the fan tray completely out of the chassis.

Figure 125: Removing an Upper Fan Tray



*Figure 126: Removing a Lower Fan Tray*

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing an MX960 Fan Tray on page 259](#)
  - [Maintaining the MX960 Fan Trays on page 444](#)

## Installing an MX960 Fan Tray

To install a fan tray (see [Figure 89 on page 260](#) and [Figure 90 on page 261](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Grasp the fan tray on each side, and insert it straight into the chassis. Note the correct orientation by the "this side up" label on the top surface of the fan tray.
3. Tighten the captive screws on each side of the fan tray faceplate to secure it in the chassis.
4. Lower the cable manager back into position, if necessary.

Figure 127: Installing an Upper Fan Tray

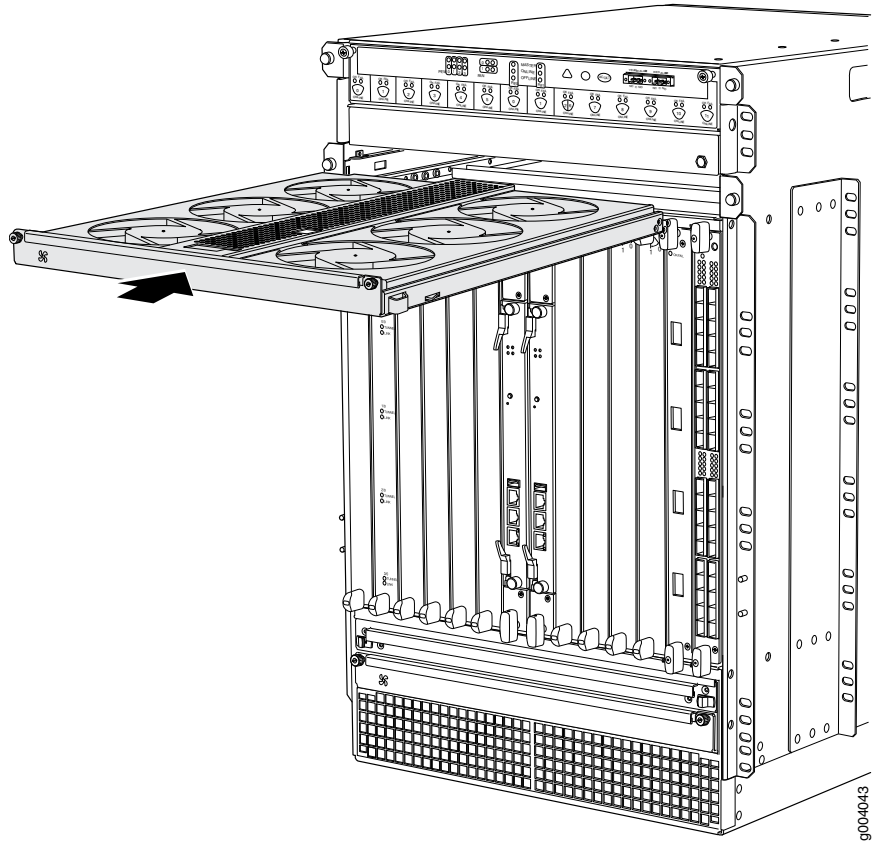
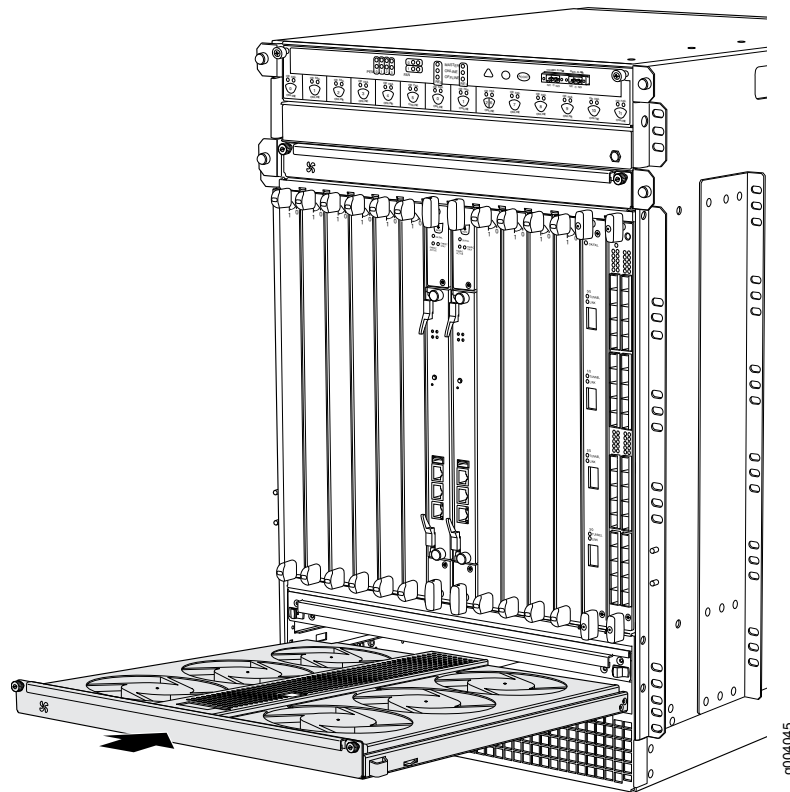


Figure 128: Installing a Lower Fan Tray



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Removing an MX960 Fan Tray on page 324](#)
  - [Maintaining the MX960 Fan Trays on page 444](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Maintaining the MX960 Fan Trays on page 444](#)

# Replacing Host Subsystem Components

- Replacing an MX960 Routing Engine on page 329
- Replacing an SSD Drive on an RE-S-1800 on page 334
- Replacing an SSD Drive on an RE-S-X6-64G on page 335
- Replacing Connections to MX960 Routing Engine Interface Ports on page 340
- Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem on page 342
- Upgrading to the RE-S-X6-64G Routing Engine in a Nonredundant Host Subsystem on page 348

## Replacing an MX960 Routing Engine

---

1. Removing an MX960 Routing Engine on page 329
2. Installing an MX960 Routing Engine on page 331

## Removing an MX960 Routing Engine

Before you remove a Routing Engine, remove the cables that connect to it.



**CAUTION:** Before you replace a Routing Engine, you must take the host subsystem offline. If there is only one host subsystem, taking the host subsystem offline shuts down the router.



**CAUTION:** If the Routing Engine to be replaced is currently functioning as the master Routing engine, switch it to be the backup before removing it.

To remove a Routing Engine from an SCB (see [Figure 129 on page 331](#)):

1. Take the Routing Engine offline gracefully.
2. Place an electrostatic bag or antistatic mat on a flat, stable surface.

3. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Verify that the Routing Engine LEDs are off.
5. Loosen the captive screws on the top and bottom of the Routing Engine.
6. Flip the ejector handles outward to unseat the Routing Engine.
7. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.
8. Place one hand underneath the Routing Engine to support it, and slide it completely out of the chassis.
9. Place the Routing Engine on the antistatic mat.



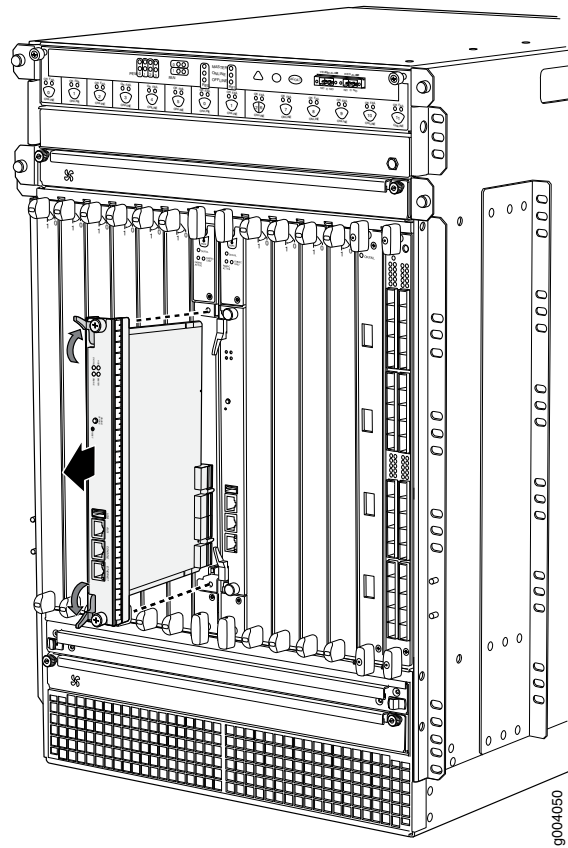
.....

**NOTE:** To maintain proper airflow through the chassis, do not leave an SCB installed in the chassis without a Routing Engine for extended periods of time. If a Routing Engine is removed, a replacement Routing Engine should be installed as soon as possible.

.....



Figure 129: Removing a Routing Engine



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 Routing Engine Description on page 26](#)
  - [Installing an MX960 Routing Engine on page 261](#)
  - [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
  - [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)

## Installing an MX960 Routing Engine

To install a Routing Engine into an SCB (Figure 91 on page 263):

1. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.
2. Place one hand underneath the Routing Engine to support it.
3. Carefully align the sides of the Routing Engine with the guides inside the opening on the SCB.

4. Slide the Routing Engine into the SCB until you feel resistance, and then press the Routing Engine's faceplate until it engages the connectors.



**CAUTION:** Align the Routing Engine correctly to avoid damaging it.

5. Press both of the ejector handles inward to seat the Routing Engine.
6. Tighten the captive screws on the top and bottom of the Routing Engine.
7. Connect the management device cables to the Routing Engine.

The Routing Engine might require several minutes to boot.

After the Routing Engine boots, verify that it is installed correctly by checking the **FAIL**, **RE0**, and **RE1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED lights steadily. If the red **FAIL** LED lights steadily instead, remove and install the Routing Engine again. If the red **FAIL** LED still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

To check the status of the Routing Engine, use the CLI command:

```
user@host> show chassis routing-engine
```

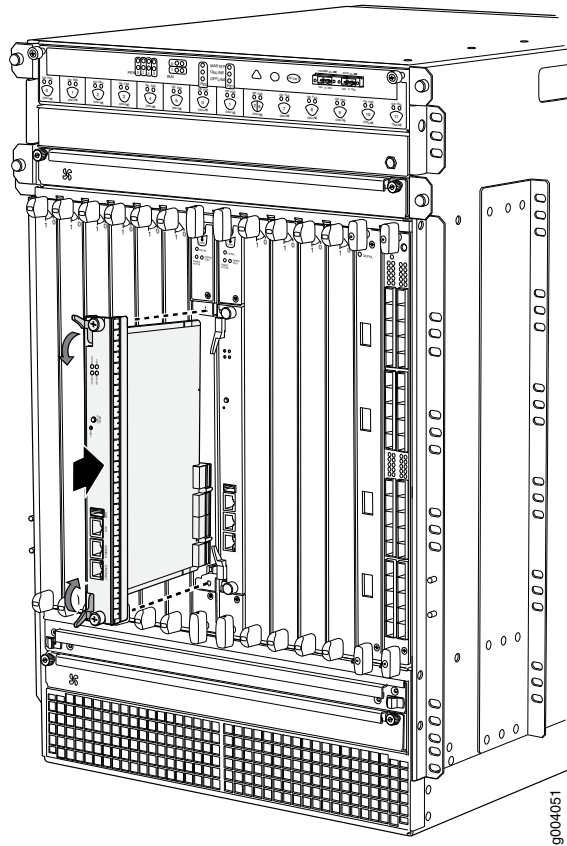
Routing Engine status:	Slot 0:	Current state	Master ...

For more information about using the CLI, see the Junos OS documentation.



**NOTE:** If enhanced IP network services is configured on the chassis, all routing engines must be rebooted after synchronizing the routing engines. For more information on synchronizing the routing engines, see *Synchronizing Routing Engines*.

Figure 130: Installing a MX960 Routing Engine



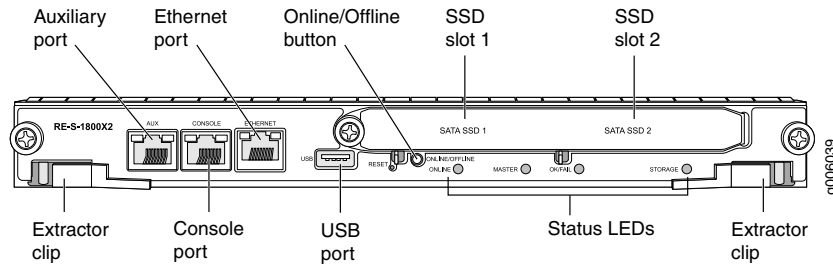
- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
  - [Removing an MX960 Routing Engine on page 329](#)
  - [MX960 Routing Engine Description on page 26](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)
  - [MX960 Routing Engine Description on page 26](#)
  - [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
  - [Synchronizing Routing Engines](#)

## Replacing an SSD Drive on an RE-S-1800

Each RE-S-1800 Routing Engine supports two solid-state drives (SSD) specified by Juniper Networks. The RE-S-1800 ships with one SSD installed in the slot labeled **SATA SSD1**. The spare SSD is Juniper part number SSD-32G-RE-S. [Figure 131 on page 334](#) shows the arrangement of storage drive slots on a RE-S-1800 Routing Engine.

*Figure 131: RE-S-1800 Storage Drive Slots*



The following drive has been verified to work in the RE-S-1800 Routing Engine:

- SSD-32G-RE-S

To replace a storage drive:

1. Disable and deactivate the storage drive.

2. Remove the storage drive.
  - a. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to an ESD point on the appliance.

For more information about ESD, see *Preventing Electrostatic Discharge Damage* in the hardware guide for your router.
  - b. Unfasten the thumbscrew that secures the access door in front of the storage drive slots, and open the door.
  - c. Slide the lock on the ejector to the unlocked position.
  - d. Carefully slide the drive out of the slot.
3. Reinstall a storage drive.
  - a. Carefully align the sides of the drive with the guides in the slot.
  - b. Slide the drive into the slot until you feel resistance, carefully ensuring that it is correctly aligned.
  - c. Close the access door and tighten the thumbscrew to secure the door.

**Related  
Documentation**

- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)

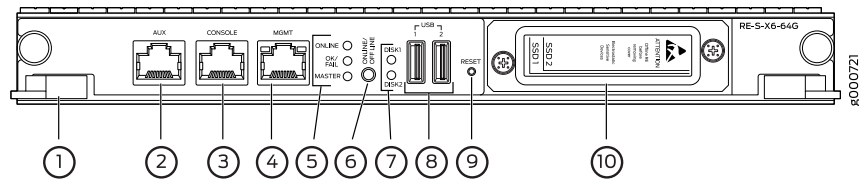
## Replacing an SSD Drive on an RE-S-X6-64G

Each RE-S-X6-64G Routing Engine supports two solid-state drives (SSD) specified by Juniper Networks. The RE-S-X6-64G ships with two SSDs installed in the slot labeled **DISK1** and **DISK2**. [Figure 132 on page 336](#) shows the arrangement of storage drive slots on a RE-S-X6-64G Routing Engine.

Replacing an SSD drive in a RE-S-X6-64G Routing Engine consists of the following two stages:

1. Replacing the SSD Drive in the Routing Engine.
2. Copying vmhost and Junos OS to the replaced SSD.

Figure 132: RE-S-X6-64G Storage Drive Slots



The following drive has been verified to work in the RE-S-X6-64G Routing Engine:

- 64GB slim SATA SSD

#### Replacing the SSDs:

1. To replace an SSD in the slot labeled **Disk2**:

- a. Make sure that there is no **VMHost %d Boot from alternate disk** alarm in the output:

```
user@host>show chassis alarm
```

- To replace an SSD in the slot labeled **Disk1**:

- a. Make sure that the router is booted up and running from an image from disk1.

Back up the currently running vmhost and Junos OS on disk1 to ensure that both disk1 and disk2 have the same version of vmhost and Junos OS:

```
user@host> request vmhost snapshot [partition]
```



**NOTE:** Partitioning the target media is optional.

- b. Reboot the router from disk2:

```
user@host> request vmhost reboot disk2
```

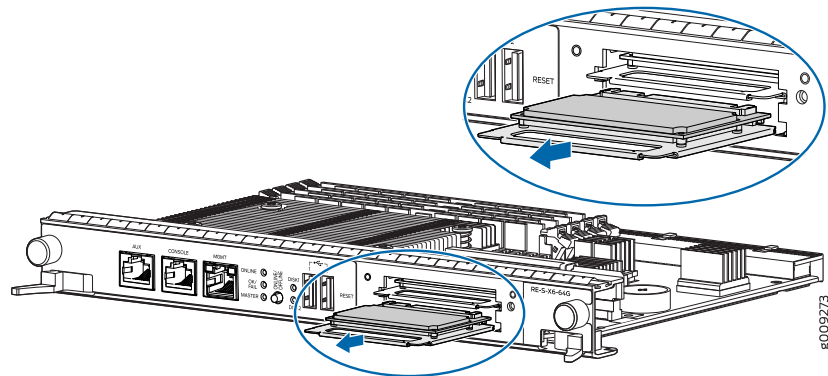
- c. Check for the presence of the **VMHost %d Boot from alternate disk** alarm in the output:

```
user@host>show chassis alarm
```

2. Offline the Routing Engine by pressing the **ONLINE/OFFLINE** button.

3. Remove the SSD.
  - a. Attach an ESD grounding strap to your bare wrist, and connect the strap to an ESD point on the appliance.  
For more information about ESD, see *Preventing Electrostatic Discharge Damage* in the hardware guide for your router.
  - b. Unfasten the thumbscrew that secures the access door in front of the storage drive slots, and open the door.
  - c. Slide the lock on the ejector to the unlocked position.
  - d. Carefully slide the drive out of the slot.

Figure 133: Removing an SSD in the Routing Engine RE-S-X6-64G



4. Reinstall an SSD:
  - a. Carefully align the sides of the drive with the guides in the slot.
  - b. Slide the drive into the slot until you feel resistance, carefully ensuring that it is correctly aligned.
  - c. Close the access door and tighten the thumbscrew to secure the door.

1. Copy Junos OS to the newly replaced SSD:

If both the SSDs are replaced together:

- a. Install using an USB disk:

1. Insert the USB disk in the **USB** slot on the Routing Engine.
2. After the Routing Engine boots from the USB, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N?** on the console.
3. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.



**NOTE:** To prepare a bootable USB disk, see *Creating an Emergency Boot Device for Routing Engines with VM Host Support*.

- b. Install vmhost using the PXEBoot method:

1. Set up the PXEBoot server. See *Copying VM Host Installation Package to the PXE Boot Server*.
2. Bring the Routing Engine online by pressing the ONLINE/OFFLINE button
3. During the boot, when you see the message **Press Esc for boot options** press **Esc** key to enter into the BIOS menu boot options.  
After the **Esc** key is pressed, **Esc is pressed. Go to boot options.** is displayed on the screen.
4. Using **Up** or **Down** arrow keys, navigate to **Boot Manager** and press the **Enter** key.
5. Using **Up** or **Down** arrow keys, navigate through the EFI boot devices listed and select **EFI Network 0 for IPv4** to boot from the PXEboot server and press the **Enter** key.
6. **Booting `net boot console** is displayed and PXEBoot continues.



**NOTE:** The booting process may take several minutes.

7. After the Routing Engine boots, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N?** on the console.
8. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.

If only disk2 is replaced:

- a. Bring the Routing Engine online by pressing the ONLINE/OFFLINE button.
- b. The router boots from disk1. To be able to boot from disk2:



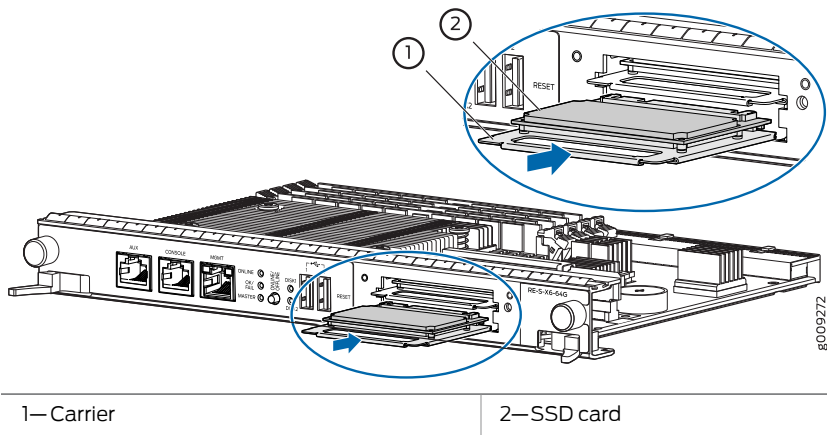
```
user@host> request vmhost snapshot partition
```

If only disk1 is replaced:

- a. Bring the Routing Engine online by pressing the ONLINE/OFFLINE button.
- b. The router boots from disk2 . To be able to boot from disk1:

```
user@host> request vmhost snapshot partition
```

Figure 134: Installing an SSD in the Routing Engine RE-S-X6-64G



Copying vmhost and Junos OS from an USB disk when both the SSDs are replaced together:



**NOTE:** To prepare a bootable USB disk, see [Creating an Emergency Boot Device for RE-MX-X6, RE-MX-X8 and RE-PTX-X8 Routing Engines](#).

1. Insert the USB disk in the **USB** slot on the Routing Engine.
2. After the Routing Engine boots from the USB, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N]?** on the console.
3. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.

Copying vmhost and Junos OS to the SSDs from the PXEBoot server:

1. Set up the PXEBoot server. See [Copying VM Host Installation Package to the PXE Boot Server](#).
2. Bring the Routing Engine online by pressing the **ONLINE/OFFLINE** button.

3. During the boot, when you see the message **Press Esc for boot options** press **Esc** key to enter into the BIOS menu boot options.  
  
After the **Esc** key is pressed, **Esc is pressed. Go to boot options.** is displayed on the screen.
4. Using **Up** or **Down** arrow keys, navigate to **Boot Manager** and press the **Enter** key.
5. Using **Up** or **Down** arrow keys, navigate through the EFI boot devices listed and select **EFI Network 0 for IPv4** to boot from the PXEboot server and press the **Enter** key.
6. **Booting `net boot console** is displayed and PXEBoot continues.



**NOTE:** The booting process may take several minutes.

7. After the Routing Engine boots, press **y** when you are prompted to confirm **Install vmhost and Junos software on Primary and Secondary disk [y/N]?** on the console.
8. After the installation is completed, press **y** when prompted to confirm **Reboot now? [y/N]?** to reboot from the SSD disk.

**Copying vmhost and Junos OS when only one disk is replaced:**

- a. Bring the Routing Engine online by pressing the **ONLINE/OFFLINE** button.
- b. The router boots from disk1 if disk2 is replaced. To be able to boot from disk2:

```
user@host> request vmhost snapshot partition
```

The router boots from disk2 if disk1 is replaced. To be able to boot from disk1:

```
user@host> request vmhost snapshot recovery partition
```

**Related Documentation**

- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Upgrading the SSD Firmware on Routing Engines with VM Host Support](#)

---

## Replacing Connections to MX960 Routing Engine Interface Ports

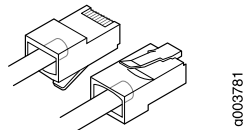
- [Replacing the Management Ethernet Cable on an MX Series Router on page 341](#)
- [Replacing the Console or Auxiliary Cable on an MX960 Router on page 341](#)

## Replacing the Management Ethernet Cable on an MX Series Router

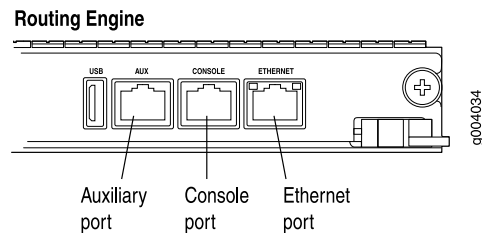
One Ethernet cable with RJ-45 connectors is provided with the router. To replace the cable connected to the **ETHERNET** port:

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Press the tab on the connector, and pull the connector straight out of the port.  
[Figure 115 on page 309](#) shows the connector.
3. Disconnect the cable from the network device.
4. Plug one end of the replacement cable into the **ETHERNET** port. [Figure 116 on page 309](#) shows the port.
5. Plug the other end of the cable into the network device.

*Figure 135: Cable Connector*



*Figure 136: Ethernet Port*



**See Also** • [Replacing an MX960 Routing Engine on page 329](#)

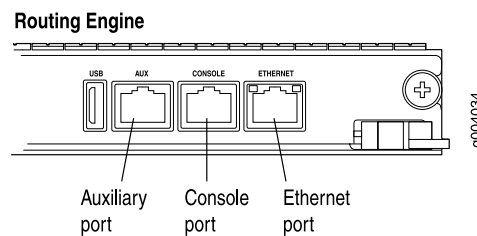
## Replacing the Console or Auxiliary Cable on an MX960 Router

To use a system console to configure and manage the Routing Engine, connect it to the **CONSOLE** port on the Routing Engine. To use a laptop, modem, or other auxiliary device, connect it to the **AUX** port on the Routing Engine. Both ports accept a cable with an RJ-45 connector. One RJ-45/DB-9 cable is provided with the router. If you want to connect a device to both ports, you must supply another cable.

To replace a cable connected to a management console or auxiliary device:

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Press the tab on the connector, and pull the connector straight out of the port.
3. Disconnect the cable from the console or auxiliary device.
4. Plug the RJ-45 end of the replacement serial cable into the **CONSOLE** or **AUX** port. [Figure 114 on page 308](#) shows the external device ports on the Routing Engine.
5. Plug the female DB-9 end into the console or auxiliary device's serial port.

*Figure 137: Auxiliary and Console Ports*



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing the Management Ethernet Cable on an MX Series Router on page 309](#)
  - [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
  - [Replacing an MX960 Routing Engine on page 329](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Routing Engine Interface Cable and Wire Specifications for MX Series Routers on page 134](#)
  - [Replacing an MX960 Routing Engine on page 329](#)

## Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem

A redundant host subsystem consists of a master Routing Engine (RE0) and a backup Routing Engine (RE1). To upgrade the host subsystem to use the RE-S-X6-64G Routing Engine, you must first uninstall the backup Routing Engine and install the RE-S-X6-64G Routing Engine, which then becomes the backup Routing Engine. You then switch over this backup Routing Engine to make it the master Routing Engine. Replace the other Routing Engine and configure it as the backup Routing Engine.

Ensure that the Switch Control Board in the chassis is SCBE2 because the RE-S-X6-64G Routing Engine is not compatible with the Switch Control Boards SCB or SCBE. To upgrade the Switch Control Board to SCBE2, see *Upgrading an MX240 to Use the SCBE2-MX*, *Upgrading an MX480 to Use the SCBE2-MX* or “[Upgrading an MX960 to Use the SCBE2-MX](#)” on page 430, depending on the chassis on which the Routing Engine is being upgraded.



**NOTE:** Save the router configuration before proceeding with the Routing Engine upgrade.



**NOTE:** Nonstop active routing (NSR) and graceful Routing Engine switchover (GRES) are not supported during the upgrade and they must be temporarily disabled. Disable NSR by removing the `nonstop-routing` statement from the `[edit routing-options]` hierarchy level and by removing the `graceful-switchover` statement from the `[edit chassis redundancy]` hierarchy level .

1. [Removing the Routing Engine on page 343](#)
2. [Installing the Routing Engine RE-S-X6-64G on page 345](#)
3. [Verifying and Configuring the Upgraded Routing Engine as the Master on page 348](#)
4. [Verifying and Configuring the Upgraded Routing Engine as the Backup on page 348](#)

## Removing the Routing Engine

To remove the backup Routing Engine from the chassis (see [Figure 138 on page 344](#), [Figure 139 on page 344](#), and [Figure 140 on page 345](#)):

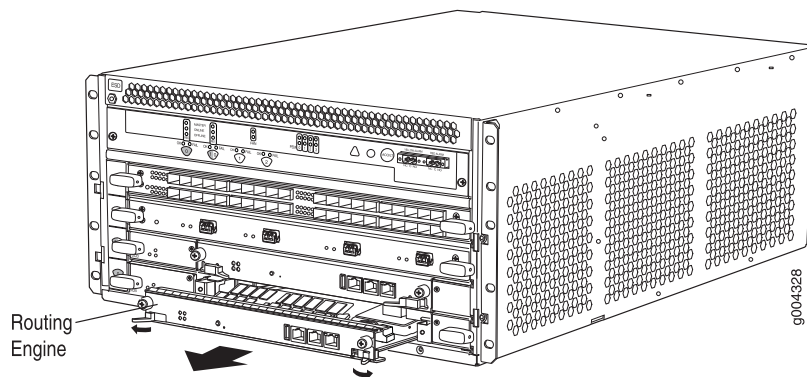
1. On the external management device connected to the Routing Engine, shut down the host subsystem by using the `request system power-off` command.
2. Wait until a message appears on the console confirming that the operating system has halted.
3. Remove the cables connected to the Routing Engine.
4. Place an electrostatic bag or antistatic mat on a flat, stable surface. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
5. Verify that the Routing Engine LEDs are off. Loosen the captive screws on the top and bottom of the Routing Engine.

6. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.
7. Place one hand underneath the Routing Engine to support it, and slide it completely out of the chassis. Place the Routing Engine on the antistatic mat.



**NOTE:** To maintain proper airflow through the chassis, do not leave an SCB installed in the chassis without a Routing Engine for extended periods of time. If a Routing Engine is removed, a replacement Routing Engine should be installed as soon as possible.

*Figure 138: Removing a Routing Engine from an MX240 Router*



*Figure 139: Removing a Routing Engine from an MX480 Router*

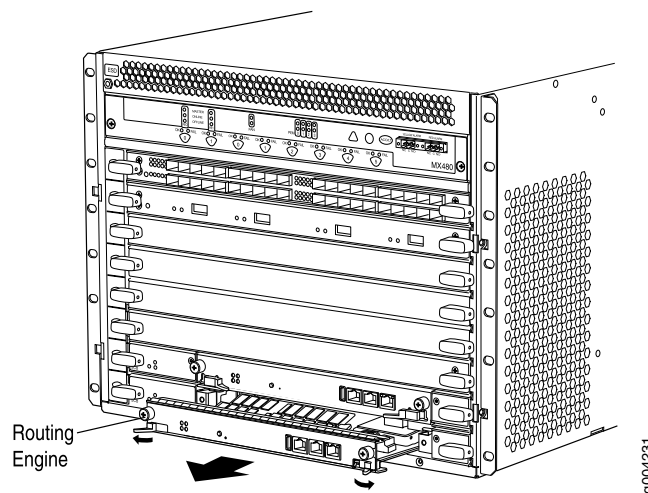
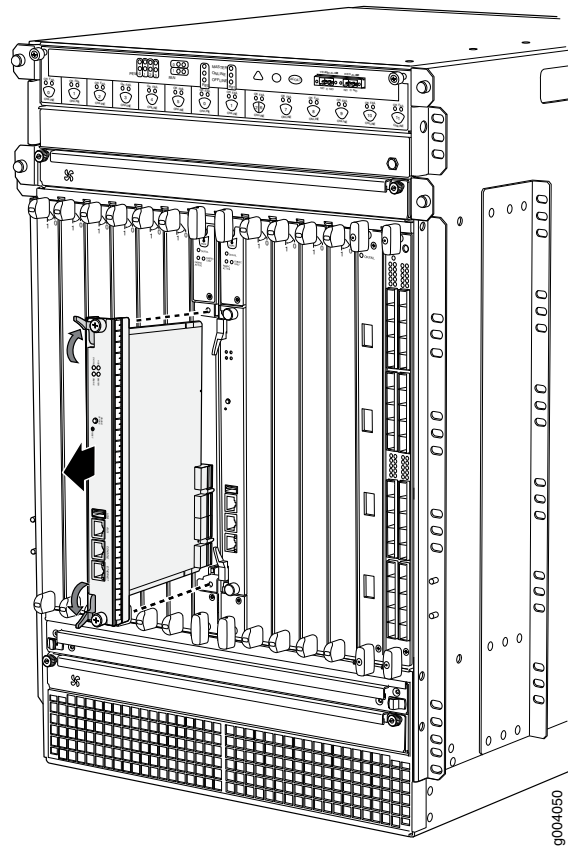


Figure 140: Removing a Routing Engine from an MX960 Router



### Installing the Routing Engine RE-S-X6-64G

To install the Routing Engine RE-S-X6-64G:

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.
3. Place one hand underneath the Routing Engine to support it and carefully align the sides of the Routing Engine with the guides inside the opening on the Switch Control Board SCBE2.



**NOTE:** The Routing Engine RE-S-X6-64G is supported only on the SCBE2. RE-S-X6-64G is not compatible with the SCB or the SCBE.

4. Slide the Routing Engine into the SCBE2 until you feel resistance, and then press the Routing Engine's faceplate until it engages the connectors.

5. Press both of the ejector handles inward to seat the Routing Engine. Tighten the captive screws on the top and bottom of the Routing Engine.
6. Connect the management device cables to the Routing Engine. After the Routing Engine is installed, the **ONLINE** LED starts blinking green slowly.
7. Replace the former master Routing Engine, RE0, with the Routing Engine RE-S-X6-64G.



**NOTE:** The Routing Engine RE-S-X6-64G is supported only on the SCBE2. RE-S-X6-64G is not compatible with the SCB or the SCBE.

The Routing Engine might require several minutes to boot. After the Routing Engine boots, verify that it is installed correctly by checking the **FAIL**, **RE0**, and **RE1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED on the Routing Engine lights steadily. If the red **FAIL** LED on the Routing Engine lights steadily instead, remove and install the Routing Engine again. If the red **FAIL** LED still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

*Figure 141: Installing a Routing Engine in an MX240 Router*

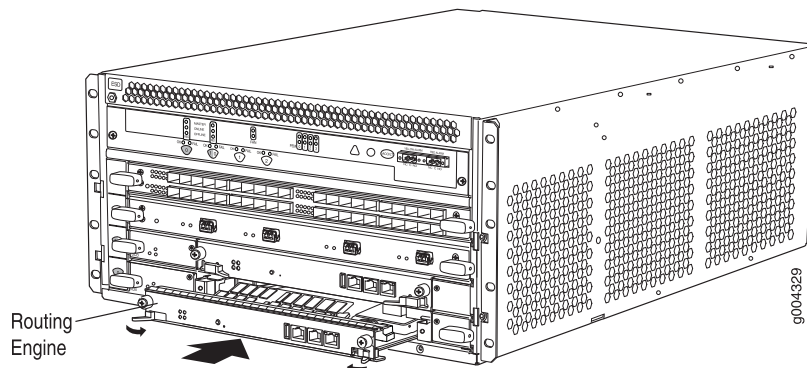




Figure 142: Installing a Routing Engine in an MX480 Router

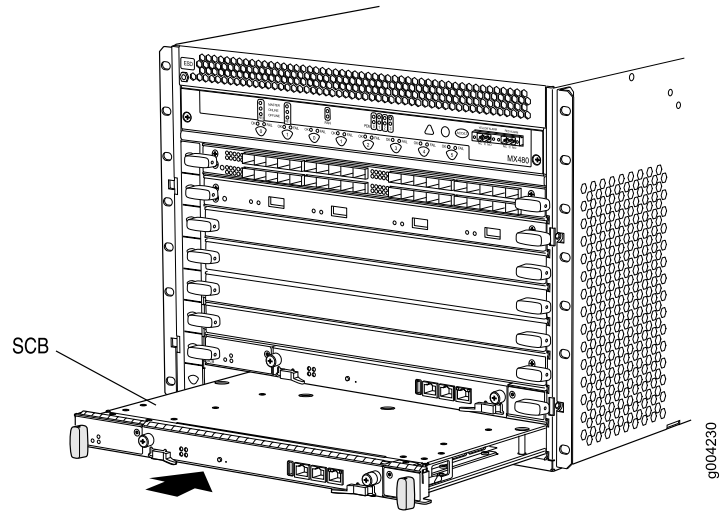
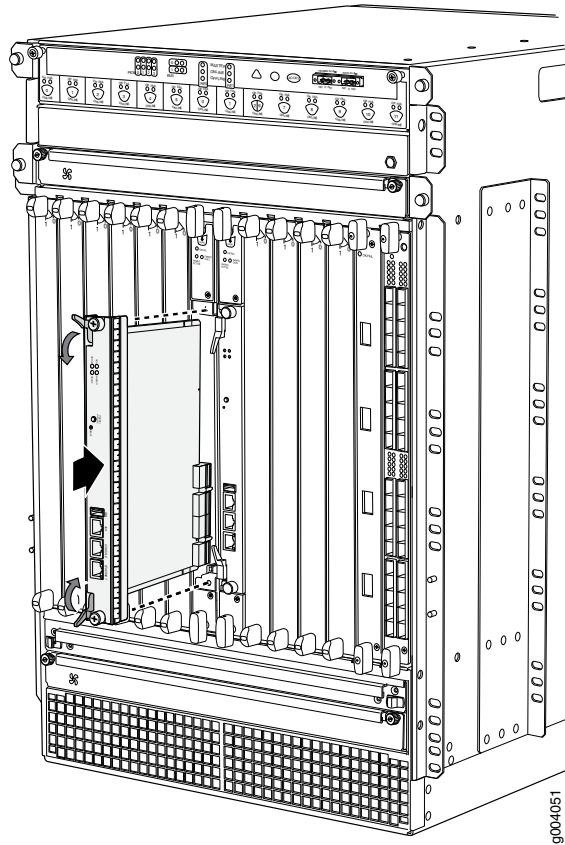


Figure 143: Installing a Routing Engine in an MX960 Router



## Verifying and Configuring the Upgraded Routing Engine as the Master

After replacing the backup Routing Engine with the RE-S-X6-64G Routing Engine, perform the following steps:

1. Verify that the SCBE2 and RE-S-X6-64G Routing Engine are online by issuing the **show chassis hardware** command.
2. After you install the RE-S-X6-64G Routing Engine into the SCBE2, the Routing Engine gets automatically powered on and comes up in *amnesiac* mode as it is loaded with factory defaults. After the Routing Engine comes up in *amnesiac* mode, load the base configuration and commit.
3. Configure the backup Routing Engine by using the **commit synchronize** command to copy the configuration to the backup Routing Engine.
4. Use the **request chassis routing-engine master switch** command to make the Routing Engine RE-S-X6-64G (RE1) the master Routing Engine. All FPCs reboot after this step.

## Verifying and Configuring the Upgraded Routing Engine as the Backup

1. Use the **request chassis routing-engine master switch** command to make newly installed RE-S-X6-64G (RE0) the backup Routing Engine.
2. Use the **commit synchronize** command to copy the active configuration from the master Routing Engine to the backup Routing Engine.

**Related Documentation**

- [RE-S-X6-64G Routing Engine Description](#)

## Upgrading to the RE-S-X6-64G Routing Engine in a Nonredundant Host Subsystem

In a nonredundant host subsystem, only one Routing Engine and one Switch Control Board are present in the chassis. When you are upgrading the Routing Engine, taking the host subsystem offline shuts down the router. To upgrade the host subsystem with the RE-S-X6-64G Routing Engine, you must uninstall the existing Routing Engine and install the RE-S-X6-64G Routing Engine. Ensure that the Switch Control Board in the chassis is SCBE2 because the RE-S-X6-64G Routing Engine is not compatible with the Switch Control Boards SCB or SCBE. To upgrade the Switch Control Board to SCBE2, see [Upgrading an MX240 to Use the SCBE2-MX](#), [Upgrading an MX480 to Use the SCBE2-MX](#) or [“Upgrading an MX960 to Use the SCBE2-MX” on page 430](#), depending on the chassis on which the Routing Engine is being upgraded. .



**NOTE:** Save the router configuration before proceeding with the Routing Engine upgrade.

1. [Removing the Routing Engine on page 349](#)
2. [Installing the Routing Engine RE-S-X6-64G on page 350](#)

## Removing the Routing Engine

To remove the Routing Engine from the chassis:

1. On the external management device connected to the Routing Engine, shut down the host subsystem by using the **request system power-off** command.
2. Wait until a message appears on the console confirming that the operating system has halted.
3. Remove the cables connected to the Routing Engine.
4. Place an electrostatic bag or antistatic mat on a flat, stable surface. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
5. Verify that the Routing Engine LEDs are off. Loosen the captive screws on the top and bottom of the Routing Engine.
6. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.
7. Place one hand underneath the Routing Engine to support it, and slide it completely out of the chassis. Place the Routing Engine on the antistatic mat.



**NOTE:** To maintain proper airflow through the chassis, do not leave an SCB installed in the chassis without a Routing Engine for extended periods of time. If a Routing Engine is removed, a replacement Routing Engine should be installed as soon as possible.

## Installing the Routing Engine RE-S-X6-64G

To install the new Routing Engine (RE-S-X6-64G):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.
3. Place one hand underneath the Routing Engine to support it and carefully align the sides of the Routing Engine with the guides inside the opening on the SCBE2.



**NOTE:** The Routing Engine RE-S-X6-64G is supported only on the SCBE2. RE-S-X6-64G is not compatible with the SCB or the SCBE.

4. Slide the Routing Engine into the SCBE2 until you feel resistance, and then press the Routing Engine's faceplate until it engages the connectors.
5. Press both of the ejector handles inward to seat the Routing Engine. Tighten the captive screws on the top and bottom of the Routing Engine.
6. Connect the management device cables to the Routing Engine. After the Routing Engine is installed, the **ONLINE** LED starts blinking green slowly.
7. Verify that the SCBE2 and RE-S-X6-64G Routing Engine are online by issuing the **show chassis hardware** command.
8. After you install the RE-S-X6-64G Routing Engine into the SCBE2, the Routing Engine gets automatically powered on and comes up in *amnesiac* mode as it is loaded with factory defaults. After the Routing Engine comes up in *amnesiac* mode, load the base configuration and commit.

The Routing Engine might require several minutes to boot. After the Routing Engine boots, verify that it is installed correctly by checking the **FAIL**, **RE0**, and **RE1** LEDs on the craft interface. If the router is operational and the Routing Engine is functioning properly, the green **ONLINE** LED on the Routing Engine lights steadily. If the red **FAIL** LED lights steadily instead, remove the Routing Engine and reinstall it. If the red **FAIL** LED on the Routing Engine still lights steadily, the Routing Engine is not functioning properly. Contact your customer support representative.

### Related Documentation

- [RE-S-X6-64G Routing Engine Description](#)
- [Upgrading to the RE-S-X6-64G Routing Engine in a Redundant Host Subsystem on page 342](#)

# Replacing Line Card Components

- Replacing an MX960 DPC on page 351
- Replacing an MX960 FPC on page 358
- Replacing an MX960 MIC on page 364
- Replacing an MX960 MPC on page 374
- Replacing an MX960 PIC on page 380
- Replacing a Cable on an MX960 DPC, MPC, MIC, or PIC on page 384
- Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC on page 388
- Replacing a CFP2 Transceiver on page 390
- Replacing a CFP Transceiver on page 393

## Replacing an MX960 DPC

---

1. Removing an MX960 DPC on page 351
2. Installing an MX960 DPC on page 354

### Removing an MX960 DPC

A DPC weighs up to 13.1 lb (5.9 kg). Be prepared to accept its full weight.

To remove a DPC (see [Figure 144 on page 353](#)):

1. Have ready a replacement DPC or DPC blank panel and an antistatic mat for the DPC. Also have ready rubber safety caps for each DPC you are removing that uses an optical interface.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Label the cables connected to each port on the DPC so that you can later reconnect the cables to the correct ports.
4. Use one of the following methods to take the DPC offline:

- Press and hold the corresponding DPC online button on the craft interface. The green OK LED next to the button begins to blink. Hold the button down until the LED goes off.
- Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number offline
```

For more information about the command, see the [CLI Explorer](#).

5. Disconnect the cables from the DPC.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. Immediately cover each optical transceiver and the end of each fiber-optic cable with a rubber safety cap.
7. Arrange the disconnected cables in the standard or extended cable manager to prevent the cables from developing stress points.
8. Simultaneously turn both of the ejector handles counterclockwise to unseat the DPC.
9. Grasp the handles, and slide the DPC straight out of the card cage halfway.
10. Place one hand around the front of the DPC and the other hand under it to support it. Slide the DPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



**CAUTION:** The weight of the DPC is concentrated in the back end. Be prepared to accept the full weight—up to 13.1 lb (5.9 kg)—as you slide the DPC out of the chassis.

When the DPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

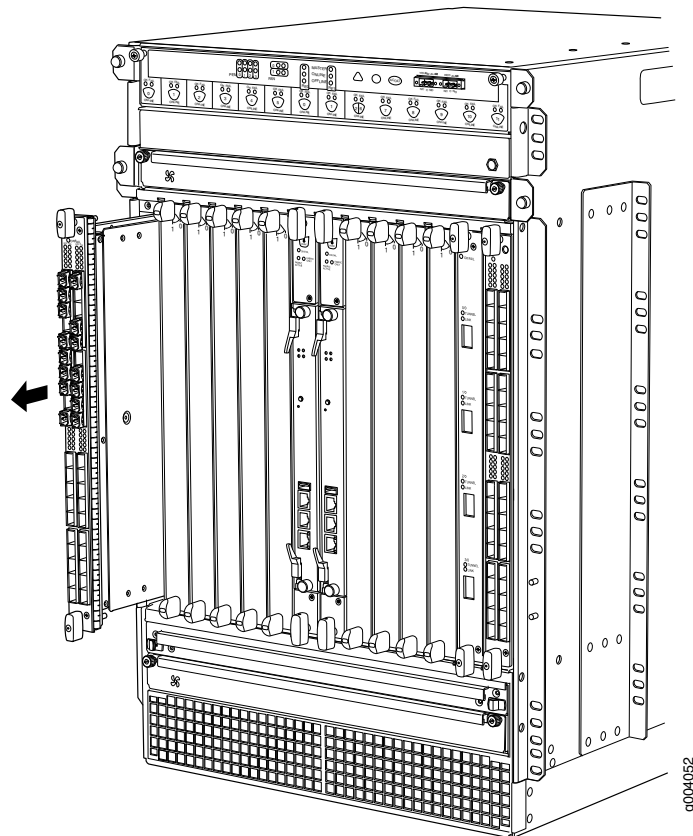
Do not stack DPCs on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

11. If you are not reinstalling a DPC into the emptied DPC slot within a short time, install a blank DPC panel over the slot to maintain proper airflow in the DPC card cage.



**CAUTION:** After removing a DPC from the chassis, wait at least 30 seconds before reinserting it, removing a DPC from a different slot, or inserting a DPC into a different slot.

Figure 144: Removing a DPC



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Holding an MX960 DPC on page 450](#)

- [Storing an MX960 DPC on page 452](#)
- [MX960 DPC Terminology](#)
- [Installing an MX960 DPC on page 265](#)
- [Maintaining MX960 DPCs on page 448](#)
- [Troubleshooting the MX960 DPCs on page 488](#)

## Installing an MX960 DPC

A DPC weighs up to 14.5 lb (6.6 kg). Be prepared to accept its full weight.

To install a DPC (see [Figure 93 on page 267](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the DPC on an antistatic mat, or remove it from its electrostatic bag.
3. Identify the slot on the router where it will be installed.
4. Verify that each fiber-optic transceiver is covered with a rubber safety cap. If it does not, cover the transceiver with a safety cap.
5. Orient the DPC so that the faceplate faces you vertically.
6. Lift the DPC into place, and carefully align the sides of the DPC with the guides inside the card cage.
7. Slide the DPC all the way into the card cage until you feel resistance.
8. Grasp both ejector handles, and rotate them clockwise simultaneously until the DPC is fully seated.
9. Remove the rubber safety cap from each fiber-optic transceiver and cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

10. Insert the cables into the cable connector ports on each DPC (see [Figure 94 on page 268](#)).



11. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

12. Use one of the following methods to bring the DPC online:

- Press and hold the corresponding DPC online button on the craft interface until the green OK LED next to the button lights steadily, in about 5 seconds.
- Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

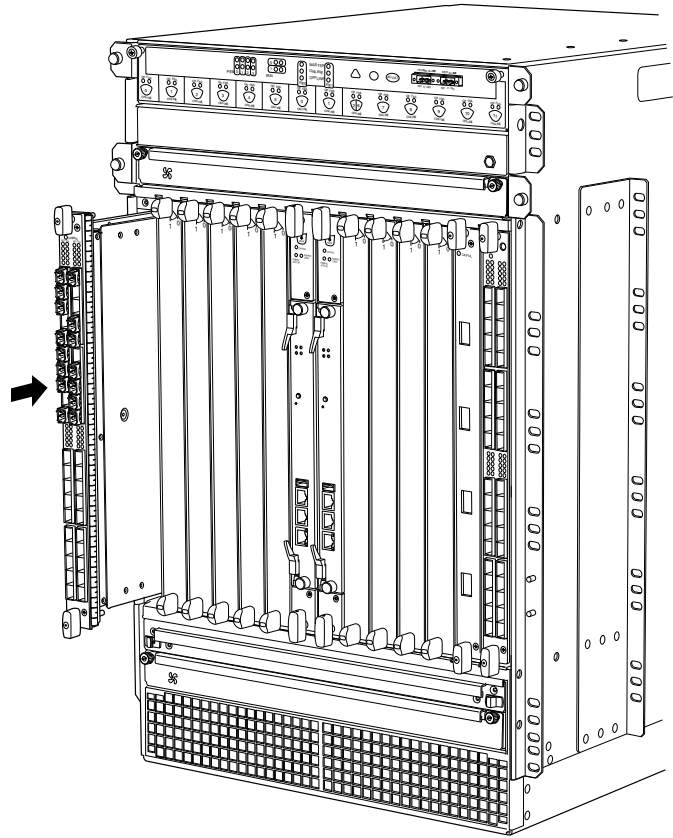
For more information about the command, see the [CLI Explorer](#).



**CAUTION:** After the OK LED turns green, wait at least 30 seconds before removing the DPC again, removing a DPC from a different slot, or inserting a DPC in a different slot.

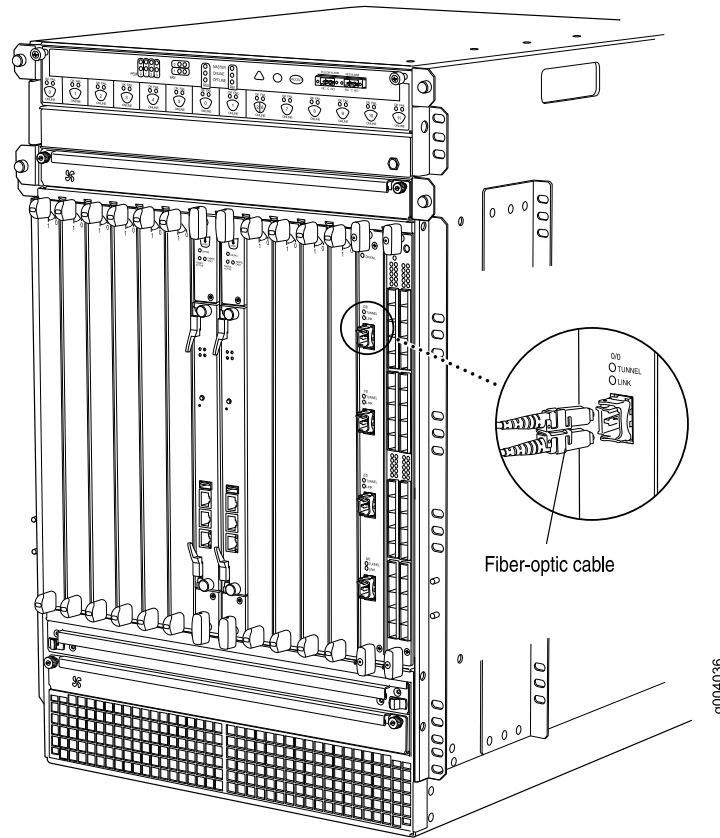
You can also verify that the DPC is functioning correctly by issuing the `show chassis fpc` and `show chassis fpc pic-status` commands.

Figure 145: Installing a DPC



9004053

Figure 146: Attaching a Cable to a DPC



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Holding an MX960 DPC on page 450](#)
  - [Storing an MX960 DPC on page 452](#)
  - [MX960 DPC Terminology](#)
  - [Removing an MX960 DPC on page 351](#)
  - [Maintaining MX960 DPCs on page 448](#)
  - [Troubleshooting the MX960 DPCs on page 488](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Holding an MX960 DPC on page 450](#)
  - [Storing an MX960 DPC on page 452](#)
  - [MX960 DPC Terminology](#)
  - [Maintaining MX960 DPCs on page 448](#)
  - [Troubleshooting the MX960 DPCs on page 488](#)

## Replacing an MX960 FPC

- [Removing an MX960 FPC on page 358](#)
- [Installing an MX960 FPC on page 361](#)

### Removing an MX960 FPC

When you remove an FPC, the router continues to function, although the PIC interfaces installed on the FPC being removed no longer function.

An FPC takes up two DPC slots on the MX960 router. Up to six FPCs can be installed vertically in the front of the MX960 router. The FPCs are hot-insertable and hot-removable. An empty FPC3 weighs 14 lb (6.5 kg). A fully configured FPC can weigh up to 18 lb (8.2 kg). Be prepared to accept its full weight.

To remove an FPC (see [Figure 147 on page 360](#)):

1. Have ready a replacement FPC or FPC blank panel and an antistatic mat for the FPC. Also have ready rubber safety caps for each PIC using an optical interface on the FPC that you are removing.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Label the cables connected to each PIC on the FPC so that you can later reconnect the cables to the correct PICs.
4. Use one of the following methods to take the FPC offline:
  - Press and hold the FPC online/offline button. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes out. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number offline
```

For more information about the command, see the [CLI Explorer](#).



**NOTE:** The slot number corresponds to the lowest numbered slot for which the FPC is installed.

5. Disconnect the cables from the PICs installed in the FPC.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. If a PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap. Arrange the disconnected cables in the cable manager to prevent the cables from developing stress points.
7. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
8. Grasp the handles, and slide the FPC straight out of the card cage halfway.
9. Place one hand around the front of the FPC (the PIC housing) and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



**CAUTION:** The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 18 lb (8.2 kg)—as you slide the FPC out of the chassis.

When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

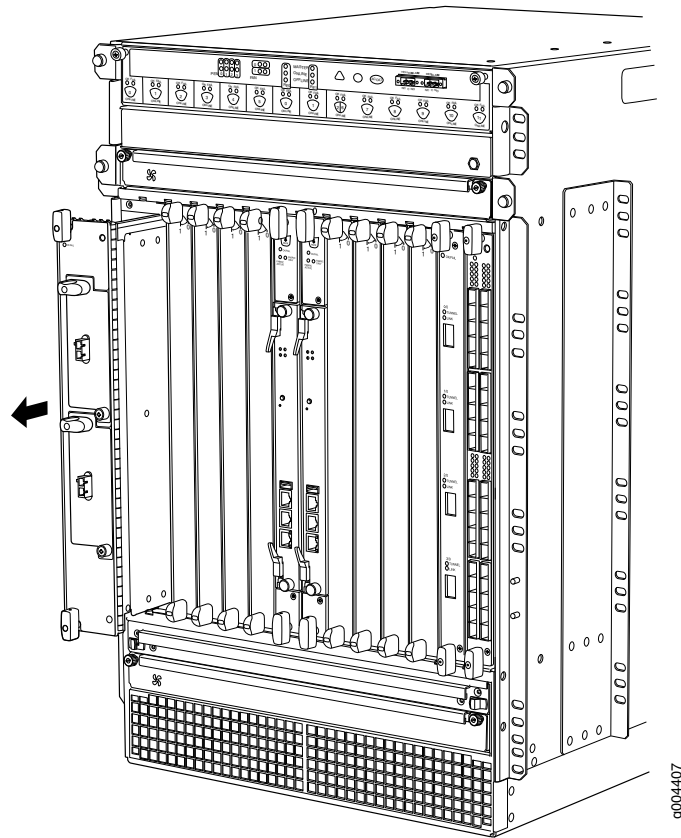
Do not stack FPCs on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

10. If necessary, remove each installed PIC from the FPC.
11. After you remove each PIC, immediately place it on an antistatic mat or in an electrostatic bag.
12. If you are not reinstalling an FPC into the emptied DPC slots within a short time, install a blank DPC panel over each slot to maintain proper airflow in the card cage.



**CAUTION:** After removing an FPC from the chassis, wait at least 30 seconds before reinserting it or inserting an FPC into a different slot.

Figure 147: Removing an FPC



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Removing an MX960 PIC on page 380](#)
  - [Maintaining MX960 FPCs on page 453](#)
  - [Installing an MX960 FPC on page 269](#)
  - [Holding an MX960 FPC on page 455](#)
  - [Storing an MX960 FPC on page 459](#)

## Installing an MX960 FPC

An FPC takes up two DPC slots on the MX960 router. Up to six FPCs can be installed vertically in the front of the router. The FPCs are hot-insertable and hot-removable. An empty FPC3 weighs 14 lb (6.5 kg). A fully configured FPC can weigh up to 18 lb (8.2 kg). Be prepared to accept its full weight.

To install an FPC (see [Figure 95 on page 271](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the FPC on an antistatic mat.
3. Take each PIC to be installed in the replacement FPC out of its electrostatic bag, and identify the slot on the FPC where it will be connected.
4. Verify that each fiber-optic PIC has a rubber safety cap covering the PIC transceiver. If it does not, cover the transceiver with a safety cap.
5. Install each PIC into the appropriate slot on the FPC.
6. Locate the two slots in the card cage in which you plan to install the FPC.
7. Orient the FPC so that the faceplate faces you.
8. Lift the FPC into place, and carefully align the sides of the FPC with the guides inside the card cage.



**CAUTION:** When the FPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

9. Slide the FPC all the way into the card cage until you feel resistance.
10. Grasp both ejector handles, and rotate them clockwise simultaneously until the FPC is fully seated.
11. If any of the PICs on the FPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

12. Insert the appropriate cable into the cable connector ports on each PIC on the FPC.
13. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

14. Use one of the following methods to bring the FPC online:
  - Press and hold the FPC online/offline button until the green **OK** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

For more information about the command, see the [CLI Explorer](#).

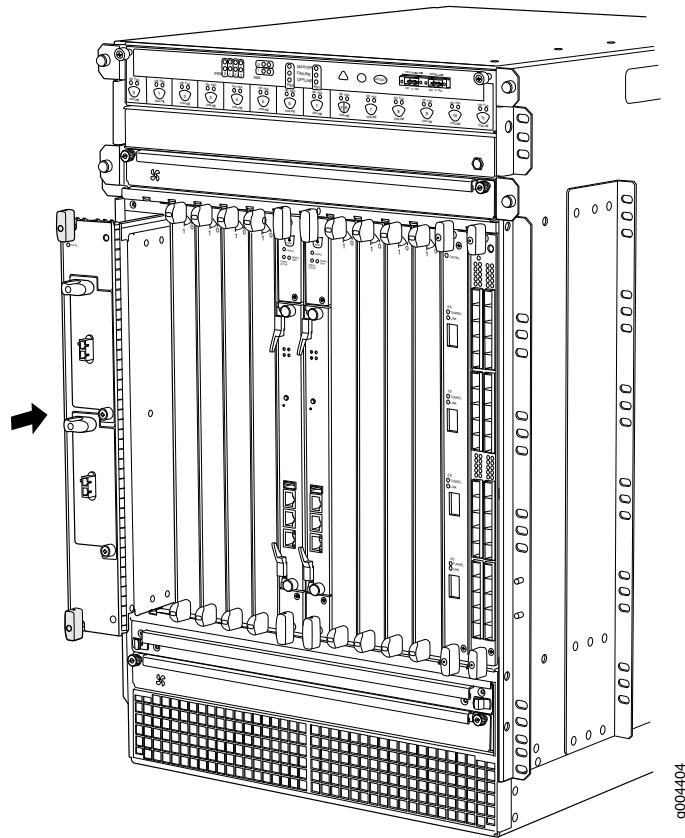


**CAUTION:** After the OK LED lights steadily, wait at least 30 seconds before removing the FPC again, removing an FPC from a different slot, or inserting an FPC in a different slot.

You can also verify correct FPC and PIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands described in “[Maintaining MX960 FPCs](#)” on page 453 and “[Maintaining MX960 PICs](#)” on page 464.



Figure 148: Installing an FPC



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing an MX960 PIC on page 280](#)
  - [Removing an MX960 FPC on page 358](#)
  - [Maintaining MX960 FPCs on page 453](#)
  - [Holding an MX960 FPC on page 455](#)
  - [Storing an MX960 FPC on page 459](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Maintaining MX960 FPCs on page 453](#)
  - [Holding an MX960 FPC on page 455](#)
  - [Storing an MX960 FPC on page 459](#)

## Replacing an MX960 MIC

1. [Removing an MX960 MIC on page 364](#)
2. [Installing an MX960 MIC on page 368](#)
3. [Installing an MX960 Dual-Wide MIC on page 371](#)

## Removing an MX960 MIC

MICs are hot-insertable and hot-removable. When you remove a MIC, the router continues to function, although the MIC interfaces being removed no longer function.

The MICs are located in the MPCs installed in the front of the router. A MIC weighs less than 2 lb (0.9 kg).

To remove a MIC (see [Figure 149 on page 366](#) and [Figure 150 on page 367](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the MIC. If the MIC connects to fiber-optic cable, have ready a rubber safety cap for each transceiver and cable.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Use one of the following methods to take the MIC offline:
  - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC OK/FAIL LED goes off.
  - Issue the following CLI command:

```
user@host> request chassis mic fpc-slot mpc-slot mic-slot mic-slot offline
```
4. Label the cables connected to the MIC so that you can later reconnect each cable to the correct MIC.
5. Disconnect the cables from the MIC. If the MIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Arrange the cable to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. On the MPC, pull the ejector lever that is adjacent to the MIC you are removing away from the MPC faceplate. This disconnects the MIC from the MPC.



**NOTE:** To remove a dual-wide MIC that takes up both MIC slots, you must pull both ejector levers away from the MPC faceplate.

8. Grasp the handles on the MIC faceplate, and slide the MIC out of the MPC card carrier. Place it in the electrostatic bag or on the antistatic mat.
9. If you are not reinstalling a MIC into the emptied MIC slot within a short time, install a blank MIC panel over the slot to maintain proper airflow in the MPC card cage.

Figure 149: Removing a MIC

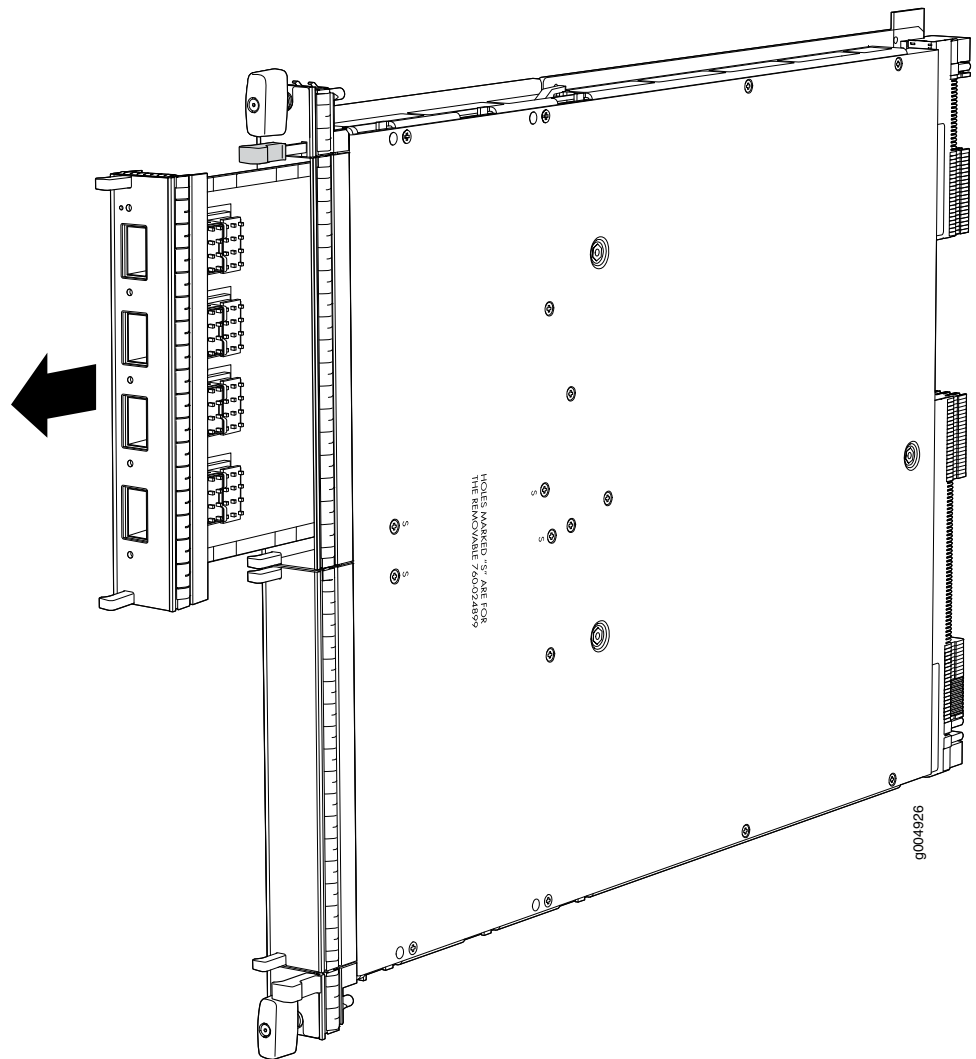
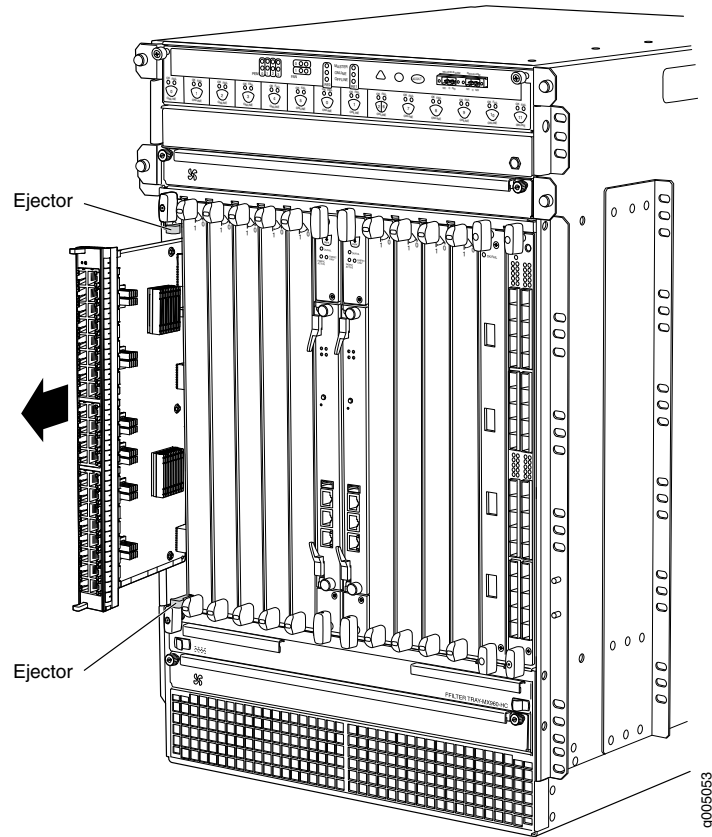


Figure 150: Removing a Dual-Wide MIC



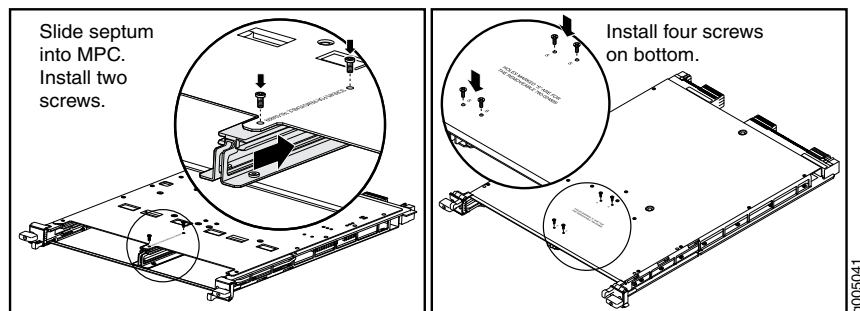
- See Also**
- [MX960 Modular Interface Card Description on page 65](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Troubleshooting the MX960 MICs on page 493](#)
  - [Removing an MX960 MPC on page 374](#)
  - [Installing an MX960 MIC on page 272](#)
  - [Installing an MX960 Dual-Wide MIC on page 275](#)
  - [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

## Installing an MX960 MIC

To install a MIC (see [Figure 97 on page 274](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. If you have used a dual-wide MIC and are now replacing it with two “single” MICs, install the septum (see [Figure 96 on page 272](#)):
  - a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in [“Removing an MX960 MPC” on page 374](#)).
  - b. Position the septum in the center of the MPC so that it lines up with holes labeled **S** on the top of the MPC.
  - c. Insert a screw into each of the two holes labeled **S**, and then tighten completely.
  - d. On the bottom of the MPC, insert a screw into each of the four holes labeled **S**, and then tighten completely.
  - e. Install the MPC as described in [“Installing an MX960 MPC” on page 278](#).

*Figure 151: Installing the Septum*



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.
4. On the MPC, pull the ejector lever that is adjacent to the MIC you are installing away from the MPC faceplate.
5. Align the rear of the MIC with the guides located at the corners of the MIC slot.
6. Slide the MIC into the MPC until it is firmly seated in the MPC.



**CAUTION:** Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector lever is engaged by pushing it towards the MPC faceplate.
8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

9. Insert the appropriate cables into the cable connectors on the MIC.
10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

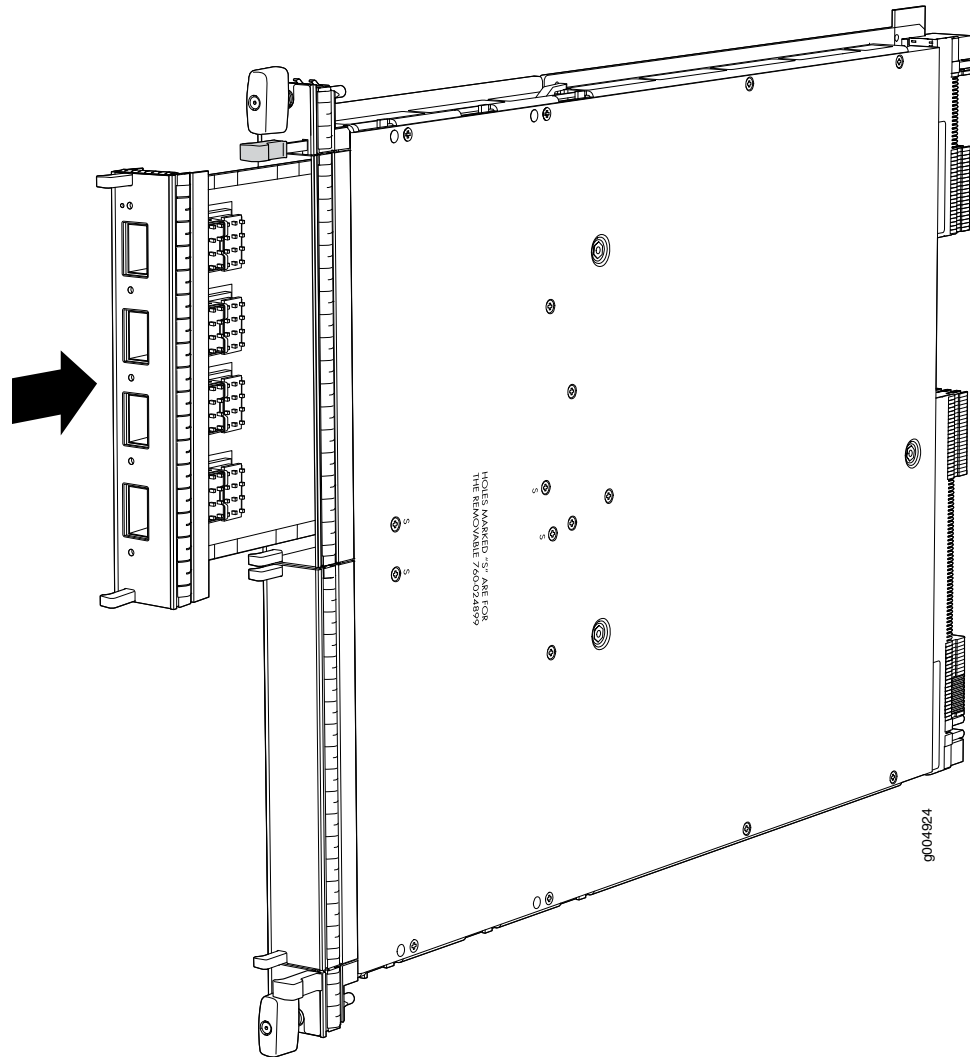
11. Use one of the following methods to bring the MIC online:
  - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
  - Issue the following CLI command:

```
user@host> request chassis mic fpc-slot mpc-slot mic-slot mic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the `show chassis fpc pic-status` command described in “Maintaining MX960 MICs” on page 460.

Figure 152: Installing a MIC



- See Also**
- [MX960 Modular Interface Card Description on page 65](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Troubleshooting the MX960 MICs on page 493](#)
  - [Removing an MX960 MPC on page 374](#)
  - [Removing an MX960 MIC on page 364](#)
  - [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

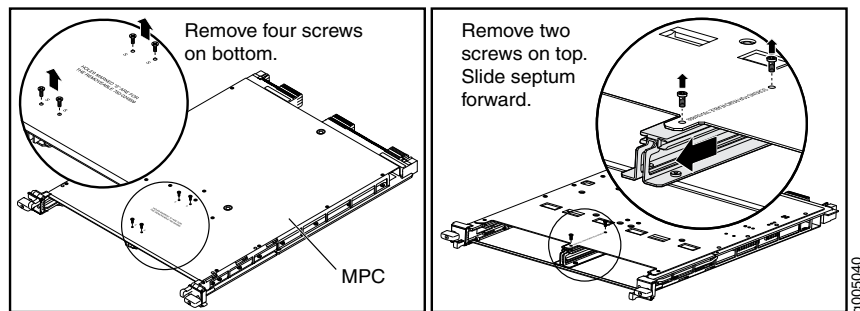


## Installing an MX960 Dual-Wide MIC

To install a dual-wide MIC (see [Figure 99 on page 277](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Remove the septum, if necessary (see [Figure 98 on page 275](#)):
  - a. Place the MPC on a flat surface (if necessary, remove the MPC from the router as described in [“Removing an MX960 MPC” on page 374](#)).
  - b. Remove the four screws labeled **S** on the bottom of the MPC.
  - c. Remove the two screws labeled **S** on the top of the MPC.
  - d. Slide the septum towards you and out of the MPC.
  - e. Store the septum and screws for later use.
  - f. Install the MPC as described in [“Installing an MX960 MPC” on page 278](#).

*Figure 153: Removing the Septum*



3. If the MIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.
4. Pull the ejector lever above both MIC slots away from the router.
5. Align the rear of the MIC with the guides located at the corners of the MIC slot.
6. Slide the MIC into the MIC slot until it is firmly seated in the chassis.



**CAUTION:** Slide the MIC straight into the slot to avoid damaging the components on the MIC.

7. Verify that the ejector levers are engaged by pushing them toward the router.
8. If the MIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

9. Insert the appropriate cables into the cable connectors on the MIC.
10. Arrange each cable to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



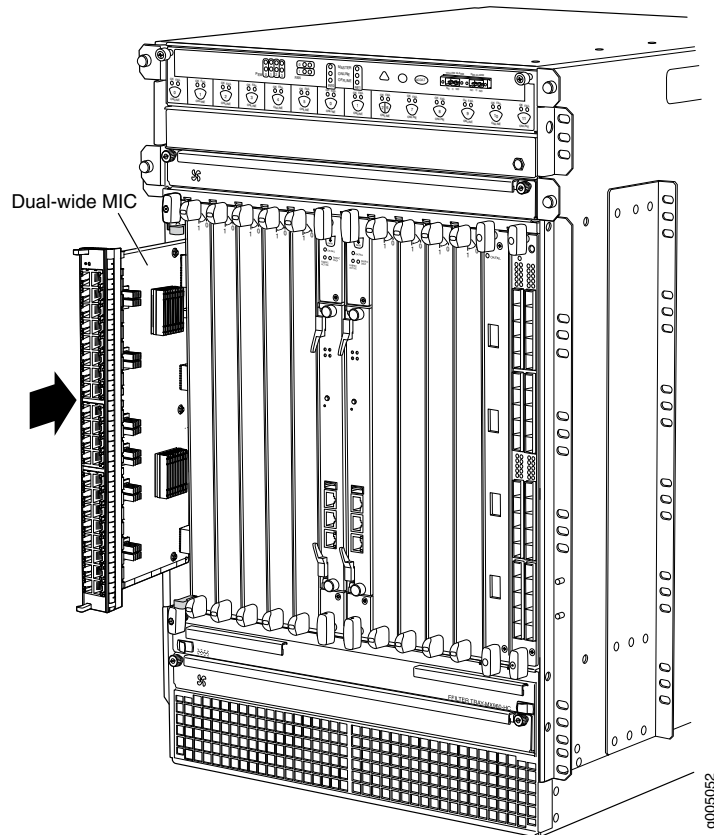
**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

11. Use one of the following methods to bring the MIC online:
  - Press its online/offline button. Use a narrow-ended tool that fits inside the opening that leads to the button. Press the button until the MIC **OK/FAIL** LED lights green.
  - Issue the following CLI command:

```
user@host> request chassis mic fpc-slot mpc-slot mic-slot mic-slot online
```

The normal functioning status LED confirms that the MIC is online. You can also verify correct MIC functioning by issuing the `show chassis fpc pic-status` command described in “Maintaining MX960 MICs” on page 460.

Figure 154: Installing a Dual-Wide MIC



- See Also**
- [MX960 Modular Interface Card Description on page 65](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Troubleshooting the MX960 MICs on page 493](#)
  - [Removing an MX960 MPC on page 374](#)
  - [Removing an MX960 MIC on page 364](#)
  - [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

- Related Documentation**
- [MX960 Modular Interface Card Description on page 65](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Troubleshooting the MX960 MICs on page 493](#)
  - [Removing an MX960 MPC on page 374](#)

- *Preventing Electrostatic Discharge Damage to an MX960 Router*

## Replacing an MX960 MPC

---

1. [Removing an MX960 MPC on page 374](#)
2. [Installing an MX960 MPC on page 377](#)

### Removing an MX960 MPC

When you remove an MPC, the router continues to function, although the MIC interfaces installed on the MPC being removed no longer function.

An MPC installs vertically in the front of the router. The MPCs are hot-insertable and hot-removable. A fully configured MPC can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

To remove an MPC (see [Figure 155 on page 376](#)):

1. Have ready a replacement MPC or DPC blank panel and an antistatic mat for the MPC. Also have ready rubber safety caps for each MIC using an optical interface on the MPC that you are removing.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Label the cables connected to each MIC on the MPC so that you can later reconnect the cables to the correct MICs.
4. Use one of the following methods to take the MPC offline:
  - Press and hold the corresponding online button on the craft interface. The green **OK/FAIL** LED next to the button begins to blink. Hold the button down until the LED goes off.
  - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number offline
```

For more information about the command, see the [CLI Explorer](#).
5. Disconnect the cables from the MICs installed in the MPC.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

---



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing a cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. If a MIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.
7. Arrange the disconnected cables in the cable manager to prevent the cables from developing stress points.
8. Simultaneously turn both the ejector handles counterclockwise to unseat the MPC.
9. Grasp the handles, and slide the MPC straight out of the card cage halfway.
10. Place one hand around the front of the MPC (the MIC housing) and the other hand under it to support it. Slide the MPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



**CAUTION:** The weight of the MPC is concentrated in the back end. Be prepared to accept the full weight—up to 18.35 lb (8.3 kg)—as you slide the MPC out of the chassis.

When the MPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

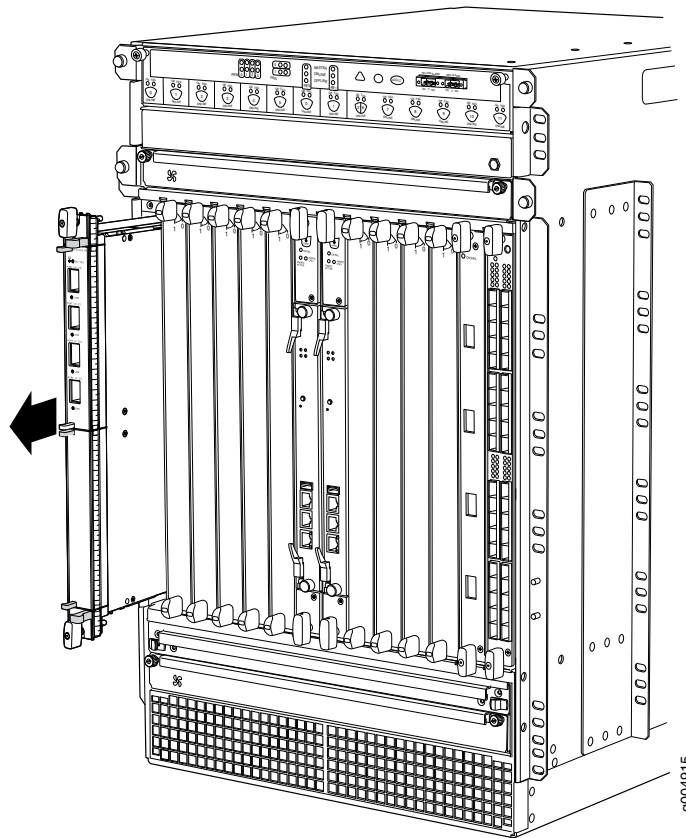
Do not stack MPCs on top of one another after removal. Place each one individually in an electrostatic bag or on its own antistatic mat on a flat, stable surface.

11. If necessary, remove each installed MIC from the MPC.
12. After you remove each MIC, immediately place it on an antistatic mat or in an electrostatic bag.
13. If you are not reinstalling an MPC into the emptied line card slots within a short time, install a blank DPC panel over each slot to maintain proper airflow in the card cage.



**CAUTION:** After removing an MPC from the chassis, wait at least 30 seconds before reinserting it or inserting an MPC into a different slot.

Figure 155: Removing an MPC



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 Modular Port Concentrator Description on page 76](#)
  - [Installing an MX960 MPC on page 278](#)
  - [Removing an MX960 MIC on page 364.](#)
  - [Maintaining MX960 MPCs on page 461](#)
  - [Troubleshooting the MX960 MPCs on page 494](#)

## Installing an MX960 MPC

An MPC installs vertically in the front of the router. The MPCs are hot-insertable and hot-removable. A fully configured MPC can weigh up to 18.35 lb (8.3 kg). Be prepared to accept its full weight.

To install an MPC (see [Figure 100 on page 280](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the MPC on an antistatic mat.
3. Take each MIC to be installed in the replacement MPC out of its electrostatic bag, and identify the slot on the MPC where it will be connected.
4. Verify that each fiber-optic MIC has a rubber safety cap covering the MIC transceiver. If it does not, cover the transceiver with a safety cap.
5. Install each MIC into the appropriate slot on the MPC.
6. Locate the slot in the card cage in which you plan to install the MPC.
7. Orient the MPC so that the faceplate faces you.
8. Lift the MPC into place, and carefully align the sides of the MPC with the guides inside the card cage.



**CAUTION:** When the MPC is out of the chassis, do not hold it by the ejector handles, bus bars, or edge connectors. They cannot support its weight.

9. Slide the MPC all the way into the card cage until you feel resistance.
10. Grasp both ejector handles, and rotate them clockwise simultaneously until the MPC is fully seated.
11. If any of the MICs on the MPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

12. Insert the appropriate cable into the cable connector ports on each MIC on the MPC. Secure the cables so that they are not supporting their own weight. Place excess cable out of the way in a neatly coiled loop, using the cable management system. Placing fasteners on a loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

13. Use one of the following methods to bring the MPC online:

- Press and hold the corresponding MPC online button on the craft interface until the green **OK/FAIL** LED next to the button lights steadily, in about 5 seconds.
- Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

For more information about the command, see the [CLI Explorer](#).

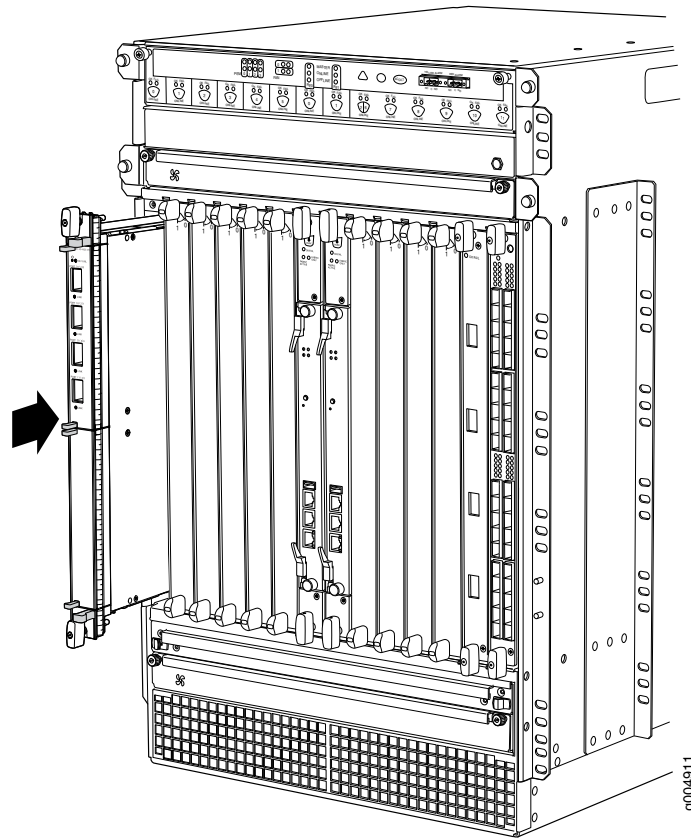


**CAUTION:** After the **OK/FAIL** LED lights steadily, wait at least 30 seconds before removing the MPC again, removing an MPC from a different slot, or inserting an MPC in a different slot.

You can also verify correct MPC and MIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** commands described in “[Maintaining MX960 MPCs](#)” on page 461 and “[Maintaining MX960 MICs](#)” on page 460.



Figure 156: Installing an MPC



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 Modular Port Concentrator Description on page 76](#)
  - [Removing an MX960 MPC on page 374](#)
  - [Installing an MX960 MIC on page 272.](#)
  - [Maintaining MX960 MPCs on page 461](#)
  - [Troubleshooting the MX960 MPCs on page 494](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 Modular Port Concentrator Description on page 76](#)
  - [Replacing an MX960 MIC on page 364.](#)
  - [Maintaining MX960 MPCs on page 461](#)
  - [Troubleshooting the MX960 MPCs on page 494](#)

## Replacing an MX960 PIC

- [Removing an MX960 PIC on page 380](#)
- [Installing an MX960 PIC on page 382](#)

### Removing an MX960 PIC

PICs are hot-insertable and hot-removable. When you remove a PIC, the router continues to function, although the PIC interfaces being removed no longer function.

The PICs are located in the FPCs installed in the front of the router. A PIC weighs less than 2 lb (0.9 kg).

To remove a PIC (see [Figure 157 on page 381](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the PIC. If the PIC connects to fiber-optic cable, have ready a rubber safety cap for each transceiver and cable.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Use one of the following methods to take the PIC offline:
  - Press its online/offline button. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the PIC LED goes out (about 5 seconds).
  - Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot offline
```

For more information about the command, see the [CLI Explorer](#).
4. Label the cables connected to the PIC so that you can later reconnect each cable to the correct PIC.
5. Disconnect the cables from the PIC. If the PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

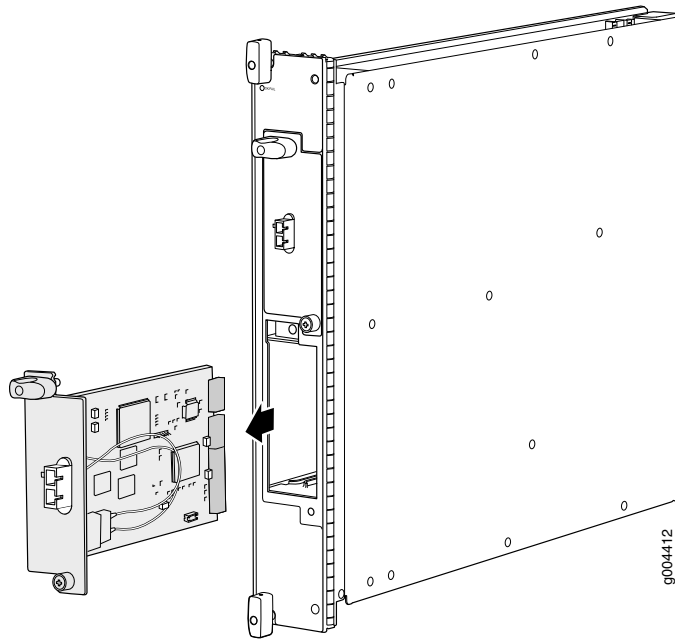
6. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. For an FPC3 PIC, loosen the captive screw at the bottom of the PIC faceplate, then twist the ejector handle at the top of the faceplate counterclockwise to unseat the PIC.
8. Slide the PIC out of the FPC card carrier and place it in the electrostatic bag or on the antistatic mat.
9. If you are not reinstalling a PIC into the emptied PIC slot within a short time, install a blank PIC panel over the slot to maintain proper airflow in the FPC card cage.

*Figure 157: Removing a PIC*



- See Also**
- [MX960 PIC Description on page 48](#)
  - [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing an MX960 PIC on page 280](#)
  - [Troubleshooting the MX960 PICs on page 492](#)

- [Maintaining MX960 PICs on page 464](#)
- [MX960 PIC Serial Number Label on page 514](#)

## Installing an MX960 PIC

To install a PIC (see [Figure 101 on page 282](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. If the PIC uses fiber-optic cable, verify that a rubber safety cap is over each transceiver on the faceplate. Install a cap if necessary.
3. Align the notches in the connector at the rear of the PIC with the notches in the PIC slot in the FPC and then slide the PIC in until it lodges firmly in the FPC.



**CAUTION:** Slide the PIC straight into the slot to avoid damaging the components on the bottom of the PIC.

4. For an FPC3 PIC, turn the ejector handle at the top of the PIC faceplate clockwise, then tighten the captive screw at the bottom of the faceplate to secure the PIC in the FPC.
5. If the PIC uses fiber-optic cable, remove the rubber safety cap from each transceiver and the end of each cable.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Insert the appropriate cables into the cable connectors on the PIC.
7. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

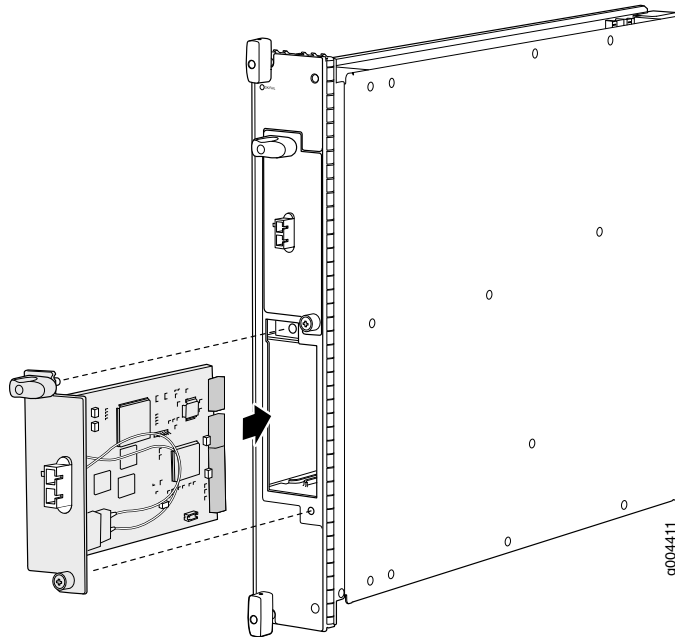
8. Use one of the following methods to bring the PIC online:
  - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
  - Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning status LED confirms that the PIC is online. You can also verify correct PIC functioning by issuing the `show chassis fpc pic-status` command described in “[Maintaining MX960 PICs](#)” on page 464.

*Figure 158: Installing a PIC*



**See Also** • [Preventing Electrostatic Discharge Damage to an MX960 Router](#)

- [Removing an MX960 PIC on page 380](#)
- [Troubleshooting the MX960 PICs on page 492](#)
- [Maintaining MX960 PICs on page 464](#)
- [MX960 PIC Serial Number Label on page 514](#)
- [MX960 PIC Description on page 48](#)

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Replacing an MX960 FPC on page 358](#)
- [Troubleshooting the MX960 PICs on page 492](#)
- [Maintaining MX960 PICs on page 464](#)
- [MX960 PIC Serial Number Label on page 514](#)
- [MX960 PIC Description on page 48](#)

---

## Replacing a Cable on an MX960 DPC, MPC, MIC, or PIC

---

- [Removing a Cable on an MX960 DPC, MPC, MIC, or PIC on page 384](#)
- [Installing a Cable on an MX960 DPC, MPC, MIC, or PIC on page 386](#)

## Removing a Cable on an MX960 DPC, MPC, MIC, or PIC

Removing and installing cables on a DPC, MPC, MIC, or PIC does not affect router function, except that the component does not receive or transmit data while its cable is disconnected.

To remove a fiber-optic cable:

1. If the component connects to fiber-optic cable, have ready a rubber safety cap for each cable and transceiver.
2. If removing all cables connected to the component, use one of the following methods to take the component offline:
  - To take a DPC or an MPC offline:
    - Press and hold the corresponding online button on the craft interface. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes off.
    - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number offline
```

For more information about the command, see the [CLI Explorer](#).

- To take a PIC offline:

- Press the online/offline button on the PIC. For a PIC installed in an FPC3, use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the PIC LED goes out (about 5 seconds).
- Issue the following CLI command:

```
user@host> request chassis pic fpc-slot fpc-slot pic-slot pic-slot offline
```

For more information about the command, see the [CLI Explorer](#).

- To take a MIC offline:
  - Press the online/offline button on the MIC. Use a narrow-ended tool that fits inside the opening that leads to the button. Press and hold the button until the MIC LED goes off (about 5 seconds).
  - Issue the following CLI command:

```
user@host> request chassis mic fpc-slot mpc-slot pic-slot mic-slot offline
```

For more information about the command, see the [CLI Explorer](#).

3. Unplug the cable from the cable connector port. If the PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

4. Remove the cable from the cable manager and detach it from the destination port.

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing a Cable on an MX960 DPC, MPC, MIC, or PIC on page 283](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC on page 388](#)

## Installing a Cable on an MX960 DPC, MPC, MIC, or PIC

To install a cable:

1. Have ready a length of the type of cable used by the component. For cable specifications, see the *MX Series Interface Module Reference*.
2. If the cable connector port is covered by a rubber safety cap, remove the cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when you are inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

3. Insert the cable connector into the cable connector port on the component faceplate.
4. Arrange the cable in the standard or extended cable manager to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Avoid bending a fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.



**CAUTION:** Do not let fiber-optic cables hang free from the connector. Do not allow the fastened loops of a cable to dangle, which stresses the cable at the fastening point.

5. Insert the other end of the cable into the destination port.
6. Repeat the previous steps for any additional cables.
7. If the component is offline (its failure indicator LED is lit), use one of the following methods to bring it online.
  - To bring a DPC or MPC online:



- Press and hold the corresponding online button on the craft interface until the green **OK** LED next to the button lights steadily, in about 5 seconds.
- Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

For more information about the command, see the [CLI Explorer](#).

- To bring a PIC online:
  - Press the PIC offline/online button until the PIC LED lights green. For a PIC installed in FPC3, use a narrow-ended tool that fits inside the opening that leads to the button.
  - Issue the following CLI command:

```
user@host>request chassis pic fpc-slot fpc-slot pic-slot pic-slot online
```

For more information about the command, see the [CLI Explorer](#).

- To bring a MIC online:
  - Press the MIC offline/online button until the MIC LED lights green.
  - Issue the following CLI command:

```
user@host>request chassis mic fpc-slot mpc-slot pic-slot mic-slot online
```

For more information about the command, see the [CLI Explorer](#).

The normal functioning indicator LED confirms that the component is online. You can also verify correct DPC or MPC functioning by issuing the **show chassis fpc** command or the correct PIC or MIC functioning by issuing the **show chassis fpc pic-status** command.

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Removing a Cable on an MX960 DPC, MPC, MIC, or PIC on page 384](#)
  - [Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs on page 465](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Replacing an MX960 DPC on page 351](#)
  - [Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC on page 388](#)

## Replacing an SFP or XFP Transceiver on an MX960 DPC, MPC, MIC, or PIC

Small form-factor pluggable (SFPs) and XFPs are optical transceivers that are installed in a DPC or PIC. SFPs and XFPs are hot-insertable and hot-removable.

1. [Removing an SFP or XFP Transceiver from an MX960 DPC, MPC, MIC, or PIC on page 388](#)
2. [Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC on page 389](#)

### Removing an SFP or XFP Transceiver from an MX960 DPC, MPC, MIC, or PIC

Removing an SFP or XFP does not interrupt DPC, MPC, MIC, or PIC functioning, but the removed SFP or XFP no longer receives or transmits data.

To remove an SFP or XFP transceiver (see [Figure 159 on page 389](#)):

1. Have ready a replacement transceiver or a transceiver slot plug, an antistatic mat, and a rubber safety cap for the transceiver.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Label the cables connected to the transceiver so that you can reconnect them correctly later.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

4. Remove the cable connector from the transceiver.
5. Pull the ejector handle out from the transceiver to unlock the transceiver.

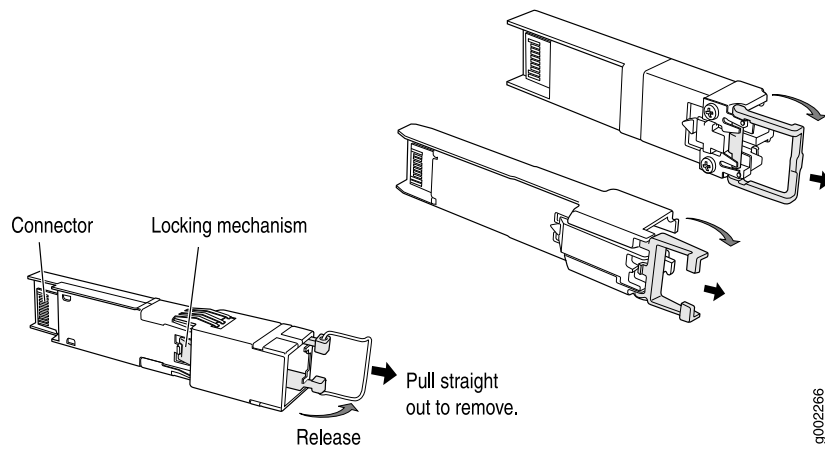


**CAUTION:** Make sure that you open the ejector handle completely until you hear it click. This prevents damage to the transceiver.

Use needlenose pliers to pull the ejector handle out from the transceiver.

6. Grasp the transceiver ejector handle, and pull the transceiver approximately 0.5 in. (1.3 cm) out of the DPC, MPC, MIC, or PIC.
7. Using your fingers, grasp the body of the transceiver, and pull it the rest of the way out of the DPC, MPC, MIC, or PIC.

Figure 159: Removing SFPs or XFPs



8. Place a rubber safety cap over the transceiver.
9. Place the removed transceiver on an antistatic mat or in an electrostatic bag.



**CAUTION:** After removing a transceiver from the chassis, wait at least 30 seconds before reinserting it or inserting a transceiver into a different slot.

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC on page 296](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Replacing an MX960 DPC on page 351](#)

### Installing an SFP or XFP Transceiver into an MX960 DPC, MPC, MIC, or PIC

To install an SFP or XFP:

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Take each transceiver to be installed out of its electrostatic bag, and identify the slot on the component where it will be installed.
3. Verify that each transceiver is covered by a rubber safety cap. If it is not, cover the transceiver with a safety cap.
4. Carefully align the transceiver with the slots in the component. The connectors should face the component.

5. Slide the transceiver until the connector is seated in the component slot. If you are unable to fully insert the transceiver, make sure the connector is facing the right way.
6. Close the ejector handle of the transceiver.
7. Remove the rubber safety cap from the transceiver and the end of the cable. Insert the cable into the transceiver.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cables connected to a transceiver emit laser light that can damage your eyes.

8. Verify that the status LEDs on the component faceplate indicate that the SFP or XFP is functioning correctly. For more information about the component LEDs, see the [MX Series Interface Module Reference](#).

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Removing an SFP or XFP Transceiver from an MX960 DPC, MPC, MIC, or PIC on page 388](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Replacing an MX960 DPC on page 351](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Replacing an MX960 DPC on page 351](#)

---

## Replacing a CFP2 Transceiver

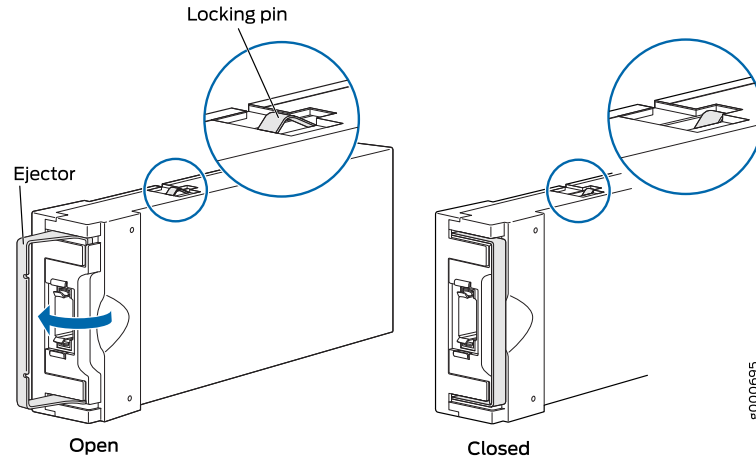
---

- [Removing a CFP2 Transceiver on page 391](#)
- [Installing a CFP2 Transceiver on page 392](#)

## Removing a CFP2 Transceiver

C form-factor pluggables (CFPs) are transceivers that can be removed from a PIC. CFP2 transceivers are hot-insertable and hot-removable. Removing a CFP2 transceiver does not interrupt PIC functioning, but the removed CFP2 transceiver no longer receives or transmits data.

*Figure 160: Form-Factor Pluggable (CFP2)*



To remove a CFP2 transceiver (see [Figure 108 on page 298](#)):

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP2 transceiver and the cable.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
3. Label the cable connected to the CFP2 transceiver so that you can later reconnect it to the correct CFP2 transceiver.
4. Disconnect the cable from the CFP2 transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

5. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. Pull the ejector latch to the extreme end away from the CFP2 transceiver faceplate to unseat the CFP2 transceiver from the PIC. Pull the CFP2 transceiver out of the PIC and place it on the antistatic mat or in the electrostatic bag.



**NOTE:** You cannot remove the transceiver until you move the ejector latch to the extreme end.

## Installing a CFP2 Transceiver

To install a replacement CFP2:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.
3. Orient the CFP2 over the port in the PIC so that the connector end will enter the slot first and the CFP2 connector faces the appropriate direction.
4. Slide the CFP2 into the slot. If there is resistance, remove the CFP2 and flip it so that the connector faces the other direction.
5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

6. Arrange the cable in the cable management system to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor. Place excess cable out of the way in a neatly coiled loop in the cable management system. Placing fasteners on the loop helps to maintain its shape.



**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

7. Verify that the status LEDs on the PIC faceplate indicate that the CFP2 is functioning correctly. You can also verify PIC functioning by issuing the **show chassis fpc pic-status** command.

## Replacing a CFP Transceiver

C form-factor pluggable (CFP) transceivers are hot-insertable and hot-removable. Removing a transceiver does not interrupt line card functioning, but the removed transceiver no longer receives or transmits data.

You can use the [Hardware Compatibility Tool](#) to find information about the pluggable transceivers supported on your Juniper Networks device.

- [Removing a CFP Transceiver on page 393](#)
- [Installing a CFP Transceiver on page 394](#)

## Removing a CFP Transceiver

To remove a CFP transceiver:

1. Place an electrostatic bag or antistatic mat on a flat, stable surface to receive the CFP transceiver. Have ready a rubber safety cap for the CFP transceiver and the cable.
2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.
3. Label the cable connected to the CFP transceiver so that you can later reconnect it to the correct CFP transceiver.
4. Disconnect the cable from the CFP transceiver. Immediately cover the transceiver and the end of the cable with a rubber safety cap.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

5. Arrange the cable in the cable management system to prevent it from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.



**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. Unscrew the screws from the CFP transceiver faceplate to unseat the CFP transceiver from the line card. Pull the CFP transceiver out of the line card and place it on the antistatic mat or in the electrostatic bag.

## Installing a CFP Transceiver

To install a replacement CFP transceiver:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to the ESD point on the chassis.
2. Verify that a rubber safety cap covers the CFP transceiver, installing one if necessary.
3. Orient the CFP over the port in the line card so that the connector end will enter the slot first and the CFP connector faces the appropriate direction.
4. Slide the CFP into the slot. If there is resistance, remove the CFP and flip it so that the connector faces the other direction.
5. Remove the rubber safety cap from the transceiver and the end of the cable, and insert the cable into the transceiver.



**WARNING:** Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.





.....

**CAUTION:** Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

.....

6. Arrange the cable in the cable management system to prevent the cable from dislodging or developing stress points. Secure the cable so that it is not supporting its own weight as it hangs to the floor.



.....

**CAUTION:** Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

.....



.....

**CAUTION:** Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

.....

7. Verify that any status LEDs on the line card faceplate indicate that the CFP is functioning correctly. For more information about the line card LEDs, see the *MX Series 5G Universal Routing Platform Interface Module Reference*. You can also verify line card functioning by issuing the **show chassis fpc pic-status** command.

**Related  
Documentation**

- [MICs Supported by MX Series Routers on page 65](#)
- [MPCs Supported by MX Series Routers on page 79](#)



# Replacing Power System Components

- Replacing an MX960 AC Power Supply on page 397
- Replacing an MX960 DC Power Supply on page 402
- Replacing an MX960 AC Power Supply Cord on page 409
- Replacing an MX960 DC Power Supply Cable on page 411

## Replacing an MX960 AC Power Supply

---

1. Removing a Normal Capacity MX960 AC Power Supply on page 397
2. Installing an MX960 AC Power Supply on page 400

## Removing a Normal Capacity MX960 AC Power Supply

Before you remove a power supply, be aware of the following:



NOTE: The minimum number of power supplies must be present in the router at all times.



CAUTION: To maintain proper cooling and prevent thermal shutdown of the operating power supply unit, each power supply slot must contain either a power supply or a blank panel. If you remove a power supply, you must install a replacement power supply or a blank panel shortly after the removal.



NOTE: After powering off a power supply, wait at least 60 seconds before turning it back on.

To remove an AC power supply (see [Figure 161 on page 399](#)):

1. Switch off the dedicated customer site circuit breaker for the power supply, and remove the power cord from the AC power source. Follow the ESD and disconnection instructions for your site.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Move the AC input switch in the chassis above the power supply to the off (O) position.
4. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.
5. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
6. Pull the power supply straight out of the chassis.



.....  
**WARNING:** Do not touch the power connector on the top of the power supply (see [Figure 162 on page 399](#)). It can contain dangerous voltages.  
.....

Figure 161: Removing an AC Power Supply

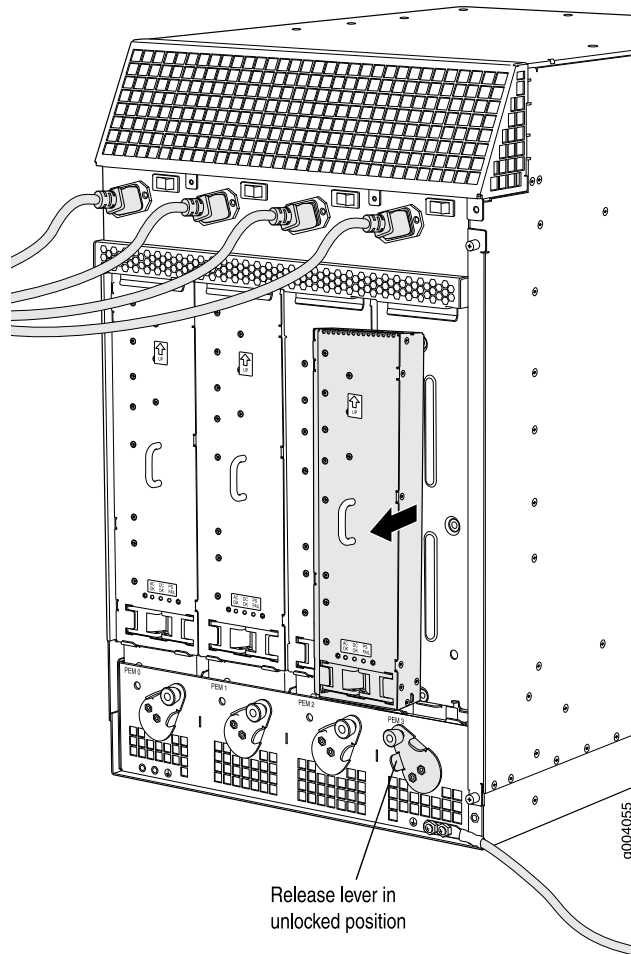
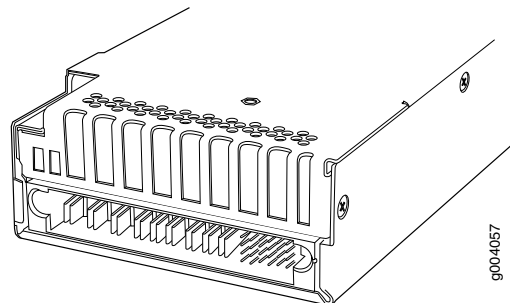


Figure 162: Top of the Power Supply Showing Midplane Connector



Connector end of AC or DC power supply

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Connecting an MX960 AC Power Supply Cord on page 233](#)
  - [Disconnecting an MX960 AC Power Supply Cord on page 410](#)

- [Installing an MX960 AC Power Supply on page 284](#)
- [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
- [MX960 AC Power Supply Description on page 86](#)

## Installing an MX960 AC Power Supply

To install an AC power supply (see [Figure 102 on page 286](#)):

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Move the AC input switch in the chassis above the empty power supply slot to the off (O) position.
3. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see [Figure 102 on page 286](#)).

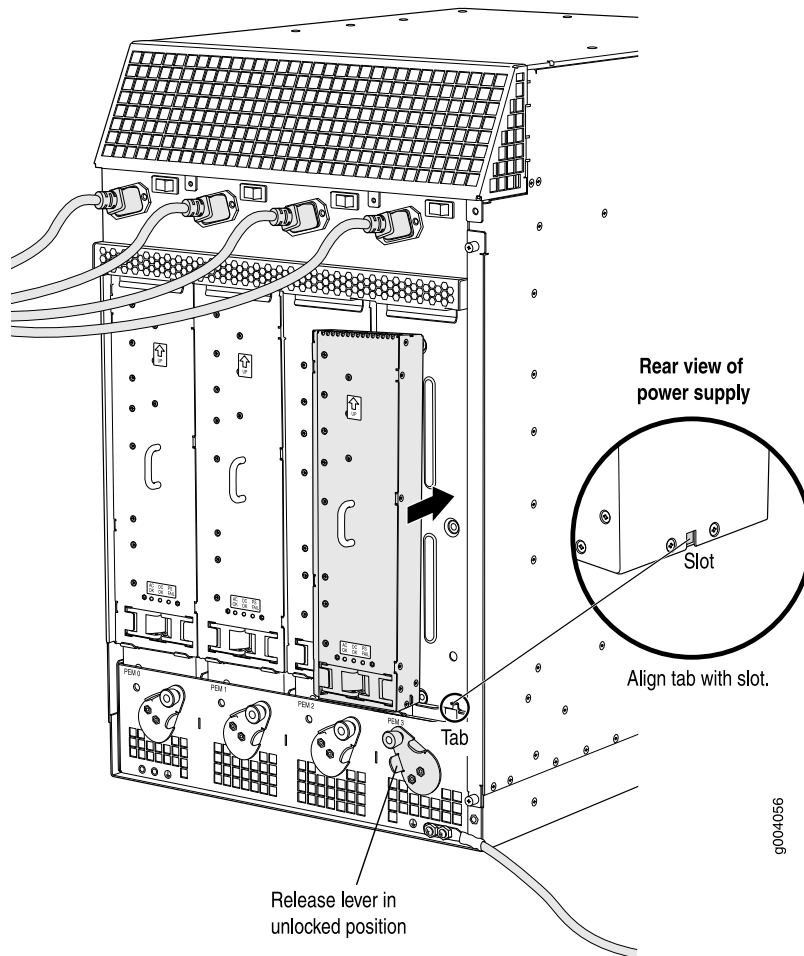
If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

4. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplates.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see [Figure 102 on page 286](#)). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

5. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
6. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
7. Move the AC input switch in the chassis above the power supply to the on (—) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

Figure 163: Installing an AC Power Supply



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 AC Power Supply Description on page 86](#)
  - [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
  - [Removing a Normal Capacity MX960 AC Power Supply on page 397](#)
  - [Connecting an MX960 AC Power Supply Cord on page 233](#)
  - [Disconnecting an MX960 AC Power Supply Cord on page 410](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Connecting an MX960 AC Power Supply Cord on page 233](#)
  - [Disconnecting an MX960 AC Power Supply Cord on page 410](#)
  - [MX960 AC Power Supply Description on page 86](#)
  - [MX960 AC Power Electrical Safety Guidelines and Warnings](#)

## Replacing an MX960 DC Power Supply

1. Removing an MX960 DC Power Supply on page 402
2. Installing an MX960 DC Power Supply on page 405

### Removing an MX960 DC Power Supply

Before you remove a power supply, be aware of the following:



**NOTE:** The minimum number of power supplies must be present in the router at all times.



**WARNING:** Before performing DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.



**CAUTION:** To maintain proper cooling and prevent thermal shutdown of the operating power supply unit, each power supply slot must contain either a power supply or a blank panel. If you remove a power supply, you must install a replacement power supply or a blank panel shortly after the removal.



**NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

To remove a DC power supply (see [Figure 164 on page 404](#)):

1. Switch off the dedicated customer site circuit breaker for the power supply being removed. Follow your site's procedures for ESD.
2. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.
3. Verify that the **INPUT OK** LEDs on the power supply to be removed are not lit.
4. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
5. Move the DC circuit breaker on the power supply faceplate to the off (O) position.



6. Remove the clear plastic cover protecting the terminal studs on the faceplate.
7. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11 mm] nut driver or socket wrench.)
8. Remove the cable lugs from the terminal studs.
9. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.
10. Carefully move the power cables out of the way.
11. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.
12. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
13. Pull the power supply straight out of the chassis.



**WARNING:** Do not touch the power connector on the top of the power supply (see [Figure 165 on page 404](#)). It can contain dangerous voltages.

Figure 164: Removing a DC Power Supply from the MX960 Router

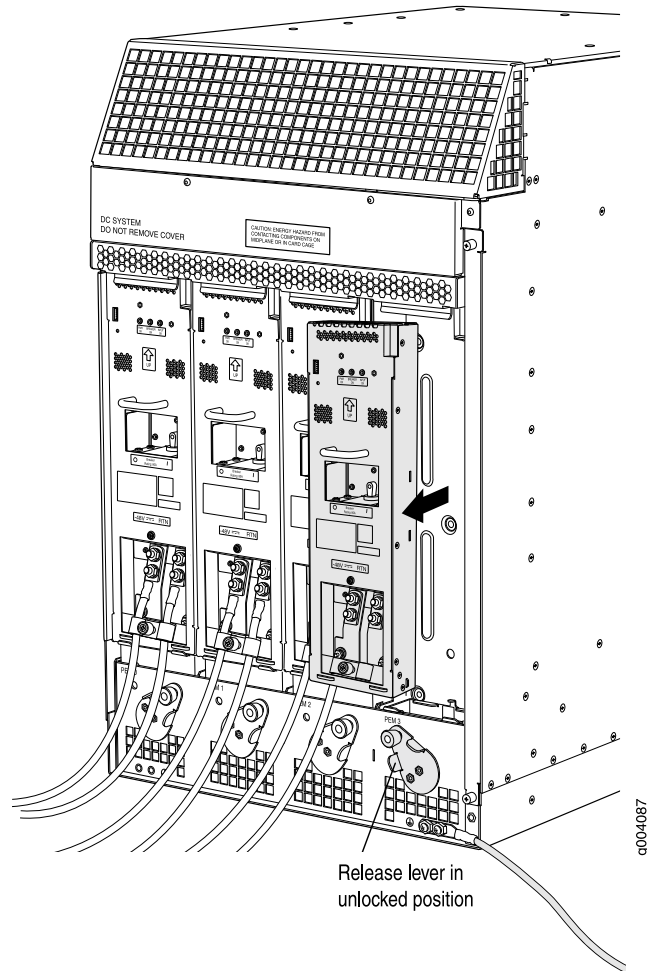
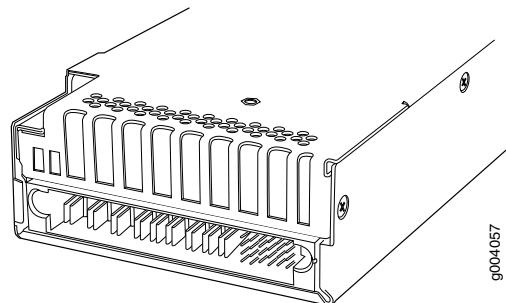


Figure 165: Top of the Power Supply Showing Midplane Connector



Connector end of AC or DC power supply

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 DC Power Supply on page 92](#)
  - [MX960 DC Power Electrical Safety Guidelines](#)

- [Installing an MX960 DC Power Supply on page 287](#)
- [Connecting an MX960 DC Power Supply Cable on page 234](#)
- [Disconnecting an MX960 DC Power Supply Cable on page 411](#)

## Installing an MX960 DC Power Supply



**WARNING:** Before performing DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.

To install a DC power supply (see [Figure 103 on page 290](#)):

1. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
2. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Move the DC circuit breaker on the power supply faceplate to the off (O) position.
4. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see [Figure 103 on page 290](#)).

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

5. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplates.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see [Figure 103 on page 290](#)). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

8. Remove the clear plastic cover protecting the terminal studs on the faceplate.
9. Remove the nut and washer from each of the terminal studs.
10. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut (see [Figure 104 on page 291](#)). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)
  - a. Attach the positive (+) DC source power cable lug to the RTN (return) terminal.
  - b. Attach the negative (–) DC source power cable lug to the –48V (input) terminal.



**CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.



**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.



**CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.



**NOTE:** The DC power supplies in slots PEM0 and PEM1 must be powered by dedicated power feeds derived from feed A, and the DC power supplies in PEM2 and PEM3 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system. For information about connecting to DC power sources, see [“Electrical Specifications for the MX960 DC Power Supply” on page 159](#).

11. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

12. Route the positive and negative DC power cables through the left and right sides of the cable restraint.
13. Tighten the cable restraint captive screw to hold the power cables in place.



**WARNING:** Once the DC power supply is connected, the cable will be blocking the PEM slot label. Make sure and note or mark the PEM slot once the power supply is connected.

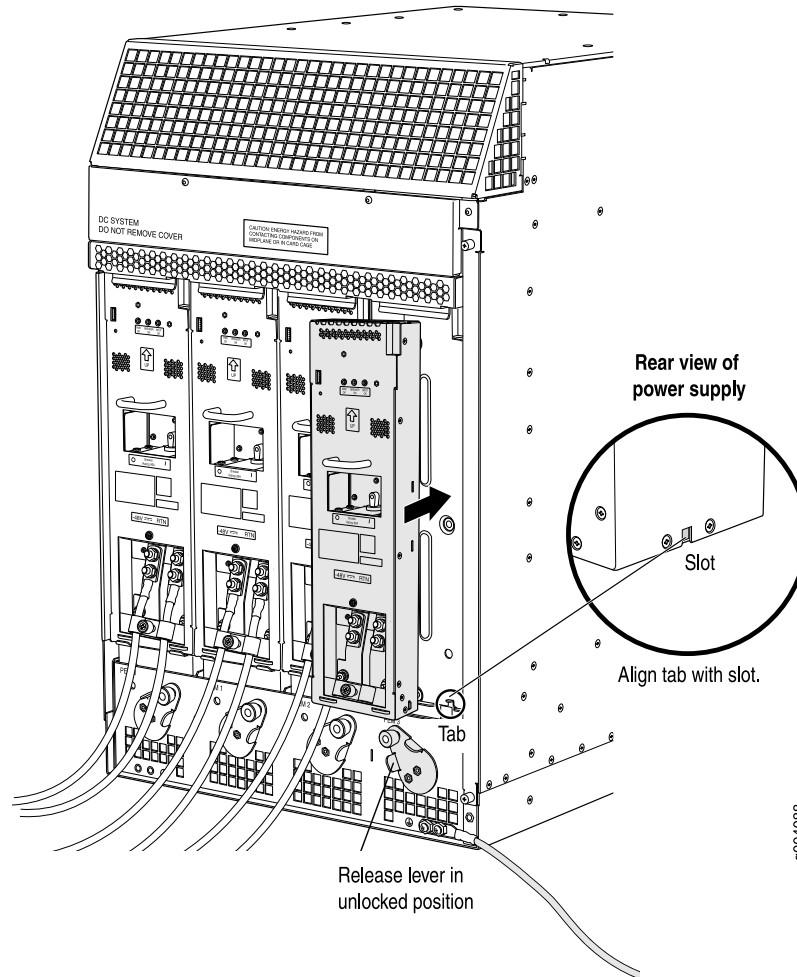
14. Replace the clear plastic cover over the terminal studs on the faceplate.
15. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.
16. Switch on the dedicated customer site circuit breaker.
17. Verify that the **INPUT OK** LED on the power supply is lit steadily.
18. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (I) position.



**NOTE:** The circuit breaker may bounce back to the off (O) position if you move the breaker too quickly.

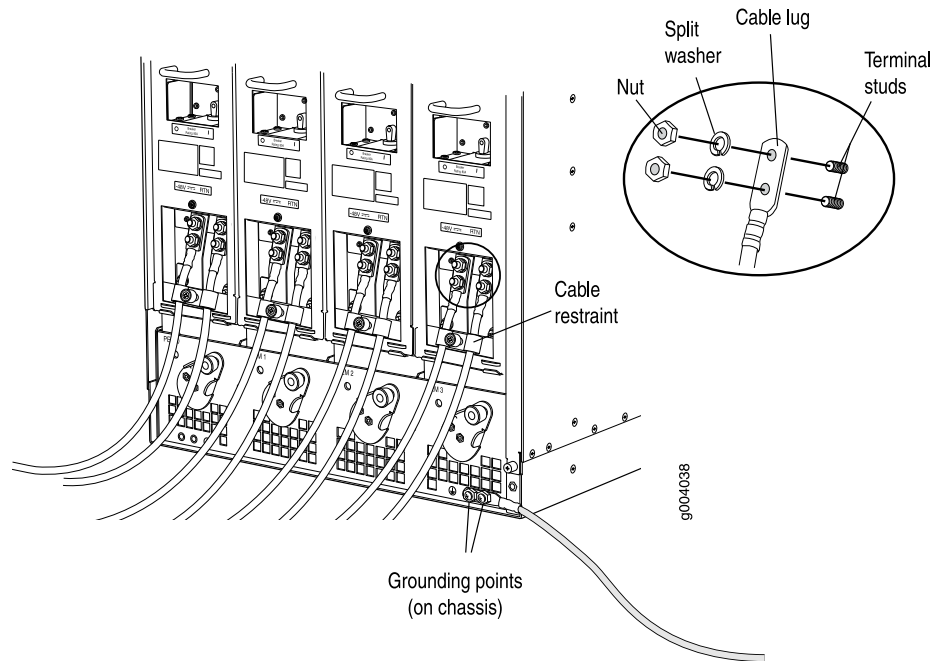
19. Verify that the **BREAKER ON** LED is lit steadily.
20. Verify that the **PWR OK** LED is lit steadily.

Figure 166: Installing a DC Power Supply



9004088

Figure 167: Connecting DC Power to the MX960 Router



- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [MX960 DC Power Supply on page 92](#)
  - [MX960 DC Power Electrical Safety Guidelines](#)
  - [Removing an MX960 DC Power Supply on page 402](#)
  - [Connecting an MX960 DC Power Supply Cable on page 234](#)
  - [Disconnecting an MX960 DC Power Supply Cable on page 411](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [Electrical Specifications for the MX960 DC Power Supply on page 159](#)
  - [MX960 DC Power Supply on page 92](#)
  - [MX960 DC Power Electrical Safety Guidelines](#)
  - [Connecting an MX960 DC Power Supply Cable on page 234](#)
  - [Disconnecting an MX960 DC Power Supply Cable on page 411](#)

## Replacing an MX960 AC Power Supply Cord

1. [Disconnecting an MX960 AC Power Supply Cord on page 410](#)
2. [Connecting an MX960 AC Power Supply Cord on page 410](#)

## Disconnecting an MX960 AC Power Supply Cord

To disconnect the AC power cord:

1. Move the AC input switch, which is to the right of the appliance inlet on the chassis, to the off (O) position.
2. Unplug the power cord from the power source receptacle.
3. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Unplug the power cord from the appliance inlet on the power supply.

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [AC Power Cord Specifications for the MX960 Router on page 156](#)
  - [MX960 AC Power Supply Description on page 86](#)
  - [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
  - [Connecting an MX960 AC Power Supply Cord on page 233](#)
  - [Replacing an MX960 AC Power Supply on page 397](#)

## Connecting an MX960 AC Power Supply Cord

To connect the AC power cord:

1. Locate a replacement power cord with the type of plug appropriate for your geographical location (see [“AC Power Cord Specifications for the MX960 Router” on page 156](#)).
2. Plug the replacement power cord into the corresponding appliance inlet located in the chassis directly above the power supply.
3. Insert the power cord plug into an external AC power source receptacle.



**NOTE:** Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker. We recommend that you use a 15 A (250 VAC) minimum, or as required by local code.

---



4. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, or drape where people could trip on it.
5. Move the AC input switch in the chassis above the power supply to the on (—) position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.

- See Also**
- [MX960 AC Power Supply Description on page 86](#)
  - [Disconnecting an MX960 AC Power Supply Cord on page 410](#)
  - [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
  - [Replacing an MX960 AC Power Supply on page 397](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [AC Power Cord Specifications for the MX960 Router on page 156](#)
  - [MX960 AC Power Supply Description on page 86](#)
  - [MX960 AC Power Electrical Safety Guidelines and Warnings](#)
  - [Replacing an MX960 AC Power Supply on page 397](#)

## Replacing an MX960 DC Power Supply Cable

---

1. [Disconnecting an MX960 DC Power Supply Cable on page 411](#)
2. [Connecting an MX960 DC Power Supply Cable on page 412](#)

### Disconnecting an MX960 DC Power Supply Cable



**WARNING:** Before performing DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.

To disconnect a power cable for a DC power supply:

1. Switch off the dedicated customer site circuit breaker for the power supply being removed. Follow your site's procedures for ESD.
2. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.
3. Verify that the **INPUT OK** LED on the power supply is not lit.

4. Remove the power cable from the external DC power source.
5. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
6. Move the DC circuit breaker on the power supply faceplate to the off (O) position.
7. Remove the clear plastic cover protecting the terminal studs on the faceplate.
8. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11 mm] nut driver or socket wrench.)
9. Remove the cable lug from the terminal studs.
10. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.
11. Carefully move the power cable out of the way.

- See Also**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [DC Power Cable Specifications for the MX960 Router on page 175](#)
  - [Connecting an MX960 DC Power Supply Cable on page 234](#)
  - [MX960 DC Power Supply on page 92](#)
  - [MX960 DC Power Electrical Safety Guidelines](#)

## Connecting an MX960 DC Power Supply Cable

---



**WARNING:** Before performing DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the off position, and tape the switch handle of the circuit breaker in the off position.

---

To connect a power cable for a DC power supply:

1. Locate a replacement power cable that meets the specifications defined in [“Electrical Specifications for the MX960 DC Power Supply” on page 159](#).
2. Verify that a licensed electrician has attached a cable lug to the replacement power cable.

3. Verify that the **INPUT OK** LED is off.
4. Secure the power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut (see [Figure 73 on page 235](#)). Do not overtighten the nut. (Use a 7/16-in. (11 mm) torque-controlled driver or socket wrench.)

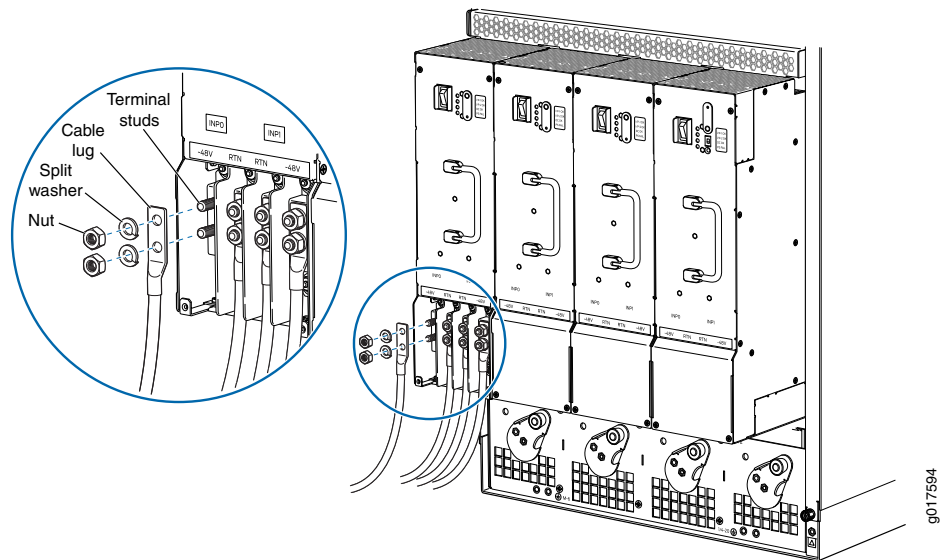


**CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.



**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 58 lb-in. (6.5 Nm). The terminal studs may be damaged if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.

*Figure 168: Connecting Power Cables to the DC Power Supply*



5. Route the power cable through the cable restraint. Make sure that the cable does not touch or obstruct any router components.
6. Tighten the cable restraint captive screw to hold the power cables in place.

7. Verify that the DC power cable is connected correctly, that it does not touch or block access to router components, and that it does not drape where people could trip on it.
8. Replace the clear plastic cover over the terminal studs on the faceplate.
9. Attach the power cable to the DC power source.
10. Turn on the dedicated customer site circuit breaker to the power supply.
11. Verify that the **INPUT OK** LED on the power supply is lit steadily.
12. On each of the DC power supplies, switch the DC circuit breaker to the center position before moving it to the on (I) position.



**NOTE:** The circuit breaker may bounce back to the off (O) position if you move the breaker too quickly.

Observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **PWR OK**, **BRKR ON**, and **INPUT OK** LEDs light green steadily.

- See Also**
- [DC Power Cable Specifications for the MX960 Router on page 175](#)
  - [Disconnecting an MX960 DC Power Supply Cable on page 411](#)
  - [MX960 DC Power Supply on page 92](#)
  - [MX960 DC Power Electrical Safety Guidelines](#)

- Related Documentation**
- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
  - [DC Power Cable Specifications for the MX960 Router on page 175](#)
  - [MX960 DC Power Supply on page 92](#)
  - [MX960 DC Power Electrical Safety Guidelines](#)

## CHAPTER 26

# Replacing and Upgrading Switch Control Boards

- [Replacing an MX960 SCB on page 415](#)
- [Upgrading an MX960 to Use the SCBE-MX on page 419](#)
- [Upgrading an MX960 to Use the SCBE2-MX on page 430](#)
- [Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX on page 435](#)

## Replacing an MX960 SCB

---

Before replacing an SCB, read the guidelines in *Operating and Positioning the MX960 SCB Ejectors*.

1. [Removing an MX960 SCB on page 416](#)
2. [Installing an MX960 Switch Control Board on page 417](#)

## Removing an MX960 SCB

To remove an SCB (see [Figure 169 on page 417](#)):



**NOTE:** You can remove the SCB and Routing Engine as a unit, or remove the Routing Engine separately.



**CAUTION:** Before removing an SCB, ensure that you know how to operate the ejector handles properly to avoid damage to the equipment.



**NOTE:** You do not need to offline the host subsystem in the following scenarios:

- You are replacing an SCB installed in slot 2/6.
- You are replacing an SCB that functions as a third SCB and no Routing Engine is installed.

1. Take the host subsystem offline.



**NOTE:** If there is only one host subsystem, taking the host subsystem offline shuts down the router and you are not required to offline the SCB.

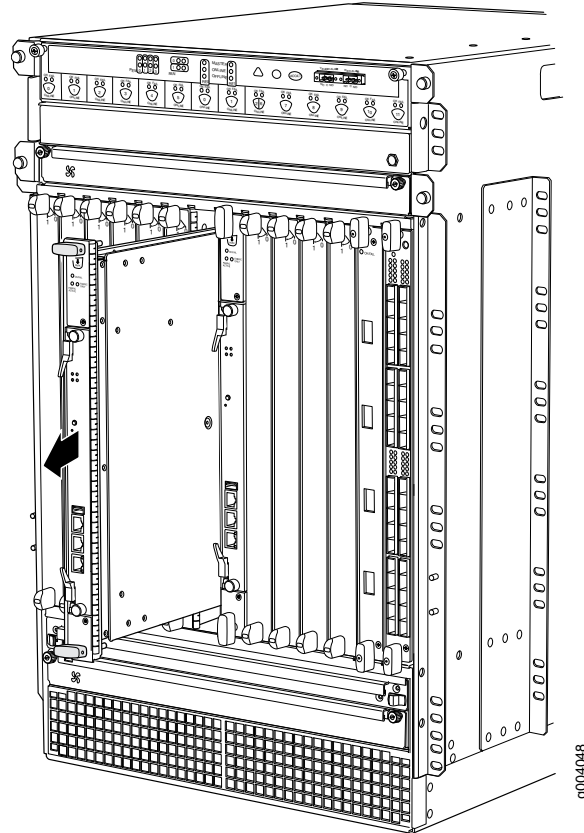
2. Take the SCB offline by issuing the following CLI command:

```
user@host>request chassis cb slot slot-number offline
```

3. Place an electrostatic bag or antistatic mat on a flat, stable surface.
4. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
5. Rotate the ejector handles simultaneously counterclockwise to unseat the SCB.
6. Grasp the ejector handles, and slide the SCB about halfway out of the chassis.
7. Place one hand underneath the SCB to support it, and slide it completely out of the chassis.

8. Place the SCB on the antistatic mat.
9. If you are not replacing the SCB now, install a blank panel over the empty slot.

**Figure 169: Removing a MX960 SCB**



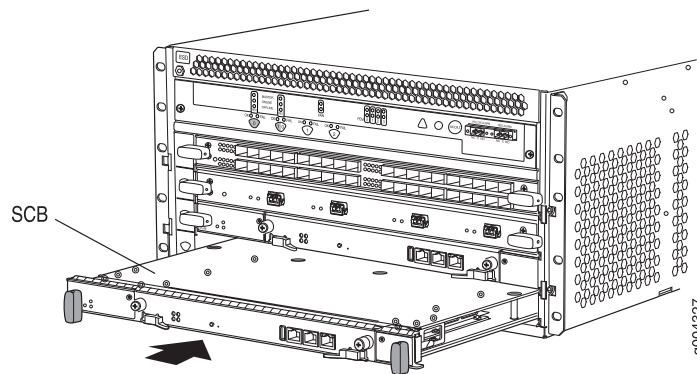
- See Also**
- *Preventing Electrostatic Discharge Damage to an MX960 Router*
  - *Operating and Positioning the MX960 SCB Ejectors*
  - *Effect of Taking the MX960 Host Subsystem Offline*
  - *Taking an MX960 Host Subsystem Offline*
  - [Installing an MX960 Switch Control Board on page 263](#)

### Installing an MX960 Switch Control Board

1. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Carefully align the sides of the Switch Control Board with the guides inside the chassis.

3. Slide the Switch Control Board into the chassis until you feel resistance, carefully ensuring that it is correctly aligned.
4. Grasp both ejector handles, and rotate them simultaneously clockwise until the Switch Control Board is fully seated.
5. Place the ejector handles in the proper position, horizontally and toward the center of the board.

*Figure 170: Installing a Switch Control Board in the MX480*



6. Check the LEDs on the Switch Control Board faceplate to verify that it is functioning normally.
  - The green **OK/FAIL** LED should light steadily a few minutes after the Switch Control Board is installed.
  - If the **OK/FAIL** LED is red, remove and install the Switch Control Board again. If the **OK/FAIL** LED still lights steadily, the Switch Control Board is not functioning properly. Contact your customer support representative.
7. Check the status of the Switch Control Board using the **show chassis environment cb** command:

```
user@host> show chassis environment cb
```

```
CB 0 status:
State                Online Master
Temperature          25 degrees C / 77 degrees F
Power 1
  1.2 V              1198 mV
  1.5 V              1508 mV
  1.8 V              1830 mV
  2.5 V              5059 mV
  3.3 V              6593 mV
  5.0 V              5111 mV
  12.0 V             12181 mV
  1.25 V             1250 mV
  3.3 V SM3          6587 mV
  5 V RE              5078 mV
  12 V RE            12026 mV
Power 2
```



```

11.3 V bias PEM          11253 mV
4.6 V bias MidPlane     4827 mV
11.3 V bias FPD         11408 mV
11.3 V bias POE 0       11446 mV
11.3 V bias POE 1       11408 mV
Bus Revision             6
FPGA Revision            0
CB 1 status:
State                    Online Standby
Temperature              26 degrees C / 78 degrees F
Power 1
1.2 V                    1211 mV
1.5 V                    1517 mV
1.8 V                    1817 mV
2.5 V                    2507 mV
3.3 V                    3312 mV
5.0 V                    5136 mV
12.0 V                   12142 mV
1.25 V                   1260 mV
3.3 V SM3                3306 mV
5 V RE                   5085 mV
12 V RE                  11968 mV
Power 2
11.3 V bias PEM          11369 mV
4.6 V bias MidPlane     4814 mV
11.3 V bias FPD         11427 mV
11.3 V bias POE 0       11350 mV
11.3 V bias POE 1       11330 mV
Bus Revision             39
FPGA Revision            1

```

- See Also**
- *Preventing Electrostatic Discharge Damage to an MX960 Router*
  - *Operating and Positioning the MX960 SCB Ejectors*

## Upgrading an MX960 to Use the SCBE-MX

This topic describes how to upgrade your MX960, MX480, or MX240 router to use the SCBE-MX without taking the router offline. This “in-service” upgrade only works for MX routers with DPC, MS-DPC, MPC1, MPC2, or MPC3 line cards. If your MX router has another type of line card, you’ll need to take the router offline before you do the upgrade.



**NOTE:** Junos OS does not support in-service upgrades to the SCBE-MX on routers with an MX-MPC3E-3D or MX-MPC3-3D MPC. If your MX router has these MPCs, you’ll need to shutdown the system before you do the upgrade. An in-service upgrade can result in service disruption.

Before you do the upgrade, open a telnet session to the master Routing Engine CLI operational mode and issue the **configure exclusive** command. This command locks the configuration to prevent accidental changes during the upgrade process. Lock the current configuration there are no changes to the CLI during the upgrade process.



**TIP:** To prevent traffic loss during the upgrade process, we recommend that you operate the line cards at 50% line rate. This 50% limit must be maintained per PFE on each line card.

1. [Prepare for the Upgrade on page 420](#)
2. [Upgrade the SCB-MX in the Spare Slot 2 \(SCB 2\) on page 421](#)
3. [Upgrade the SCB-MX in the Backup Routing Engine Slot 1 \(SCB 1\) on page 422](#)
4. [Upgrade the SCB-MX in the Master Routing Engine Slot 0 \(SCB 0\) on page 424](#)
5. [Complete the SCBE-MX Upgrade on page 427](#)

## Prepare for the Upgrade

Prior to upgrading to the SCBE-MX:

1. Verify that the system runs Junos OS Release 11.4 or later by issuing the **show version** command on the master router. Here's an example for the MX960:

```
user@host> show version
Model: mx960
Junos Base OS Software Suite [11.4-20110530];
```



**NOTE:** The SCBE-MX is supported only in Junos OS Release 11.4 or later.

The latest software ensures a healthy system—that is, Routing Engines, control boards, and FPCs—before the upgrade.

2. Verify that SCB-MX boards are installed:

```
user@host> show chassis hardware
Item  Version  Part Number  Serial Number  Description
CB0   REV 07  710-021523  ABBC8281     MX SCB
CB1   REV 07  710-021523  ABBC8323     MX SCB
CB2   REV 07  710-021523  ABBD1410     MX SCB
```

SCB-MX details are displayed as above, along with other hardware components.

3. Establish console connections to both Routing Engines. You can use a telnet session to connect to the router console by issuing the **<router name>-con** command. For example, if the router name is juniper, you can connect to RE0 and RE1 consoles by issuing the **telnet juniper-con** and **telnet juniper1-con** commands.
4. Ensure that graceful switchover (GRES), commit synchronize (required for nonstop routing), and nonstop routing (NSR) are enabled or configured by running the **set chassis redundancy graceful-switchover**, **set system commit synchronize**, **set routing-options nonstop-routing** commands.



**NOTE:** These commands are mandatory for this upgrade and may be removed, if desired, after the upgrade.

5. Set the upgrade flag on and start the SCB-MX upgrade by issuing the **set chassis state cb-upgrade on** command.

```
user@host# configure
user@host# set chassis state cb-upgrade on
user@host# commit
```

6. Determine the order to replace the existing SCB-MXs with upgraded ones. SCB 0, SCB 1, and SCB 2 are available for the MX960. SCB 0 is associated with RE0, SCB 1 is associated with RE1, and SCB 2 is the spare SCB. The SCB upgrade order for the MX960 is:

- Upgrade the SCB in the Spare Slot 2 (SCB 2)
- Upgrade the SCB in the Backup Routing Engine Slot 1 (SCB 1)
- Upgrade the SCB in the Master Routing Engine Slot 0 (SCB 0)



**NOTE:** Do not add or remove any router hardware during the upgrade procedure.

## Upgrade the SCB-MX in the Spare Slot 2 (SCB 2)

1. Take the fabric plane offline by issuing the **request chassis fabric plane 4 offline** command.
2. Verify that fabric plane 4 is offline by issuing the **show chassis fabric summary** command.

```
user@host> show chassis fabric summary
```

```
Plane State Uptime
 4 Offline
 5 Online 1 hour, 15 minutes, 35 seconds
```

3. Take the next fabric plane offline by issuing the **request chassis fabric plane 5 offline** command, and then verify that the fabric plane is offline by issuing the command given in Step 2.
4. Take the SCB-MX in slot 2 offline by issuing the **request chassis cb offline slot 2** command.

- Verify that the control board is offline by issuing the **show chassis environment cb 2** command:

```
user@host> show chassis environment cb 2
```

```
CB 2 status:
State Offline
Power 1 Disabled
Power 2 Disabled
```

- Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
- Remove and replace the SCB-MX in slot 2 on the router (SCB 2) with the SCBE. Use the procedure described in [“Replacing an MX960 SCB” on page 415](#).
- Verify that the installation is successful and the SCBE is online:

```
user@host> show chassis environment cb 2
```

```
CB 2 status
State Online
Temperature 30 degrees C / 86 degrees F
```

- Verify that the fabric planes come online correctly by issuing the **show chassis fabric summary** command:

```
user@host> show chassis fabric summary
```

```
Plane State Uptime
4 Online 2 minutes, 25 seconds
5 Online 2 minutes, 15 seconds
```

- Verify the alarms:

```
user@host> show chassis alarms
```

```
Alarm Time Class Description
2011-06-01 13:26:56 EDT Major CB fabrics are of mixed types
2011-06-01 12:10:41 EDT Major Require a fan tray upgrade
```

Because only one SCB-MX has been upgraded, the alarm indicates that the SCBs are of mixed type. This alarm is cleared after all the control boards are upgraded.

## Upgrade the SCB-MX in the Backup Routing Engine Slot 1 (SCB 1)

- Power down the backup Routing Engine from the master Routing Engine by issuing the **request system power-off other-routing-engine** command.
- Ensure that the Routing Engine is powered down by issuing the **show chassis routing-engine 1** command. The slot of the Routing Engine may be 0 or 1, and is shown as 1 in this example:

```
user@host> show chassis routing-engine 1
```

```
Routing Engine Status:  
Slot 1:  
Current State Present
```

Verify that the Current State is Present, which indicates that the Routing Engine is offline.

3. Take the first fabric plane of the backup Routing Engine offline by issuing the **request chassis fabric plane 3 offline** command.
4. Verify that the fabric plane is offline by issuing the **show chassis fabric summary** command.

```
user@host> show chassis fabric summary
```

```
Plane State Uptime  
2 Online 3 minutes, 45 seconds  
3 Offline
```

Check if the state of plane 4 is Offline.

5. Take the next fabric plane offline by issuing the **request chassis fabric plane 2 offline** command and verify that the fabric plane is offline by issuing the command in Step 4.
6. Take the SCB-MX in slot 1 offline by issuing the **request chassis cb offline slot 1** command.
7. Verify that the SCB-MX is offline by issuing the **show chassis environment cb 1** command:

```
user@host> show chassis environment cb 1
```

```
CB 1 status:  
State Offline  
Power 1 Disabled  
Power 2 Disabled
```

8. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
9. Remove and replace the offline SCB-MX on the router with the SCBE.
10. Verify that the installation is successful and the SCB is online by issuing the **show chassis environment cb 1** command:

```
user@host> show chassis environment cb 1
```

```
CB 1 status
State Online
Temperature 30 degrees C / 86 degrees F
```

Other details, such as power, are also displayed along with the state.

- Verify that the fabric planes 2 and 3 come online correctly by issuing the **show chassis fabric summary** command:

```
user@host> show chassis fabric summary

Plane State Uptime
2 Online 2 minutes, 5 seconds
3 Online 1 minutes, 55 seconds
```

- Verify that the backup routing engine is back online by issuing the **show chassis routing-engine 1** command:

```
user@host> show chassis routing-engine 1

Routing Engine Status:
Slot 1:
Current State Backup
```

## Upgrade the SCB-MX in the Master Routing Engine Slot 0 (SCB 0)

To upgrade the SCB-MX in the master Routing Engine slot:

- Ensure a Graceful RE Switchover (GRES) to gracefully switch between the master and backup Routing Engines, so that the backup RE becomes the master RE, by issuing the **request chassis routing-engine master switch** command.
- Log in to the new master Routing Engine after the switchover.
- Switch the configuration mode to ensure that you are still in configure exclusive mode by issuing the **exit** command and then the **configure exclusive** command, from the old master Routing Engine.
- Log in to the current master Routing Engine again and issue the **configure exclusive** command.
- Power down the backup Routing Engine from the master Routing Engine by issuing the **request system power-off other-routing-engine** command.
- Ensure that the Routing Engine is powered down by issuing the **show chassis routing-engine 0** command. The slot of the Routing Engine may be 0 or 1, and is shown as 1 in this example:

```
user@host> show chassis routing-engine 1
```

```
Routing Engine Status:
Slot 0:
Current State Present
```

Verify that the Current State is Present, which indicates that the Routing Engine is offline or powered down.

7. Take the first fabric plane of the backup Routing Engine offline by issuing the **request chassis fabric plane offline 1** command.
8. Verify that the fabric plane is offline by issuing the **show chassis fabric summary** command.

```
user@host> show chassis fabric summary
```

```
Plane State Uptime
1 Offline
2 Online 3 minutes, 25 seconds
```

Verify that the state of plane 1 is Offline.

9. Take the next fabric plane offline by issuing the **request chassis fabric plane offline 0** command and verify that the fabric plane is offline by issuing the command given in Step 2.
10. Take the SCB-MX in slot 0 offline by issuing the **request chassis cb offline slot 0** command.
11. Verify that the control board is offline by issuing the **show chassis environment cb 0** command:

```
user@host> show chassis environment cb 0
```

```
CB 0 status:
State Offline
Power 1 Disabled
Power 2 Disabled
```

12. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
13. Remove and replace the offline SCB-MX on the router with the SCBE. Use the procedure described in [“Replacing an MX960 SCB” on page 415](#).
14. Verify that the installation is successful and the SCBE is online by issuing the **show chassis environment cb 0** command:

```
user@host> show chassis environment cb 0
```

```
CB 0 status
State Online
Temperature 30 degrees C / 86 degrees F
```

15. Verify that the fabric planes 0 and 1 come online correctly by issuing the **show chassis fabric summary** command:

```
user@host> show chassis fabric summary

Plane State Uptime
0 Online 2 minutes, 9 seconds
1 Online 2 minutes, 2 seconds
```

16. Verify that the backup Routing Engine is back online by issuing the **show chassis routing-engine 0** command:

```
user@host> show chassis routing-engine 0

Routing Engine Status:
Slot 0:
Current State Backup
```

17. Verify the alarms by issuing the **show chassis alarms** command:

```
user@host> show chassis alarms

Alarm Time   Class Description
2011-06-01 13:26:56 EDT Major CB fabric links require upgrade/training
2011-06-01 12:10:41 EDT Major Require a fan tray upgrade
```

The major alarm has changed from **CB fabrics are of mixed types** to **CB fabric links require upgrade/training**, as a SCB-MX requires training to change the link speed from 3G to 6G for the SCBE-MX. This alarm is displayed until the 3G to 6G link transition is completed.



## Complete the SCBE-MX Upgrade

1. Verify if there are any MPCs running at 3G instead of 6G:

```
user@host> request chassis fabric upgrade-bandwidth info
Slot State
0 Upgrade not supported
1 Upgraded
2 Empty
3 Empty
4 Empty
5 Empty
6 Empty
7 Empty
```

In this example, the results indicate that slot 0 does not support the upgrade and slot 1 needs upgrade.



**NOTE:** The SCBE line card supports only DPC, MS-DPC, MPC1, MPC2, and MPC3 line cards for the `upgrade-bandwidth`. If line cards that do not support the command option are present in the chassis during the SCB-MX to SCBE-MX upgrade, the `request chassis fabric upgrade-bandwidth` commands will return `Upgrade not supported` for the slot(s) that contain the unsupported line card(s).

2. Upgrade the bandwidth of all MPCs by issuing the `request chassis fabric upgrade-bandwidth fpc all` command. If you want to control the MPC line card upgrade, go to Step 3.



**CAUTION:** Use this command only if you are not concerned with the slot upgrade order or if only one old MPC is present in the chassis. Running this command may result in a loss of traffic across that MPC. Using this method may increase that loss, as it does not consider any redundancy or graceful switchover strategies that you may have configured on the system.

3. Issue the `request chassis fabric upgrade-bandwidth fpc slot 1` command to upgrade the MPC in slot 1.
4. Verify that the MPC is upgraded:

```
user@host> request chassis fabric upgrade-bandwidth info
Slot State
0 Upgrade not supported
1 Upgraded
2 Empty
```

5. Verify the fabric plane state for all MPCs:

```
user@host> show chassis fabric summary
```

```
Plane State Uptime
0 Spare 21 seconds
1 Spare 12 seconds
2 Online 12 minutes
3 Online 12 minutes
4 Online 30 minutes
5 Online 30 minutes
```

6. Verify the state of MPCs:

```
user@host> show chassis fabric fpcs
```

```
FPC 1
PFE #0
Plane 0: Links ok
Plane 1: Links ok
Plane 2: Plane enabled
Plane 3: Plane enabled
Plane 4: Plane enabled
Plane 5: Plane enabled
PFE #1
Plane 0: Links ok
Plane 1: Links ok
Plane 2: Plane enabled
Plane 3: Plane enabled
Plane 4: Plane enabled
Plane 5: Plane enabled
PFE #2
Plane 0: Links ok
Plane 1: Links ok
Plane 2: Plane enabled
Plane 3: Plane enabled
Plane 4: Plane enabled
Plane 5: Plane enabled
PFE #3
Plane 0: Links ok
Plane 1: Links ok
Plane 2: Plane enabled
Plane 3: Plane enabled
Plane 4: Plane enabled
Plane 5: Plane enabled
```

Fabric plane details of all MPCs are similarly displayed.

7. Verify if the **show chassis fabric summary** command output shows fabric planes in the 'check' state. This indicates that the fabric plane has an error. You can try to recover the fabric plane to normal operation by issuing the **request chassis fabric plane <#> offline** command, followed by the **request chassis fabric plane <#> online** command, where <#> equals the fabric plane in error.



**NOTE:** After you issue the `request chassis fabric plane <#> offline` and `request chassis fabric plane <#> online` commands, issue the `show chassis fabric summary` command to verify that the fabric plane errors are rectified and to verify the current state of the fabric planes.

8. Verify if there are any major alarms:

```
user@host> show chassis alarms
```

```
Alarm Time   Class Description
2011-06-01 13:37:43 EDT Minor Require a fan tray upgrade
2011-06-01 13:37:26 EDT Minor Backup RE Active
```

In this example, the major alarms are no longer displayed, and the upgrade is successfully completed.

9. Disable the upgrade configuration by issuing the `set chassis state cb-upgrade off` command and then the `commit` command.
10. Disable the upgrade configuration by issuing the `set chassis state cb-upgrade off` command.
11. You can delete the upgrade configuration by issuing the `delete chassis state cb-upgrade` command and then the `commit` command.



**WARNING:** Deleting the chassis state `cb-upgrade` on configuration before disabling the SCB-MX upgrade using the `set chassis state cb-upgrade off` command can cause unexpected errors in the fabric.

12. Verify the SCBE-MXs are installed by issuing the `show chassis hardware` command:

```
user@host> show chassis hardware
```

```
Item  Version  Part Number  Serial Number  Description
CB0   REV 02  750-031391  YE8505  Enhanced MX SCB
CB1   REV 07  710-031391  YL6769  Enhanced MX SCB
CB2   REV 07  710-031391  YE8492  Enhanced MX SCB
```

As shown in the example, the MX960 now has MX SCBEs.

**See Also** • [SCBE-MX Description on page 109](#)

## Upgrading an MX960 to Use the SCBE2-MX

Consider the following scenarios when upgrading an MX960 SCB-MX or SCBE-MX to use the SCBE2-MX:

Scenario 1: SCBE2-MX; Routing Engine with Junos OS Release 13.3R1 or later installed.

- Replace the SCBs. Ensure you replace the Routing Engines at the same time.
- Ensure that Enhanced IP or Enhanced Ethernet Network Services mode is configured before you power on the router.

Scenario 2: SCB-MX or SCBE-MX; existing Routing Engine with a Junos OS Release 13.3R1 or earlier installed.

- Upgrade the Routing Engine (**RE0** and **RE1**) software to Junos OS Release 13.3 or later.
- Configure Enhanced IP or Enhanced Ethernet Network Services mode.
- Replace the SCBs. Ensure that you replace the SCBs at the same time.

Scenario 3: Failed SCB-MX or SCBE-MX; Routing Engine with a Junos OS Release 13.3R1 or earlier installed.

- Upgrade the software on the Routing Engine hosting the failed SCB-MX or SCBE-MX with Junos OS Release 13.3R1 or later.
- Replace the SCBs. Ensure that you replace the SCBs at the same time.
- Upgrade the software on the Routing Engine hosting the SCBE2-MX with Junos OS Release 13.3R1 or later.
- Configure Enhanced IP or Enhanced Ethernet Network Services mode.

To upgrade the SCB-MX or SCBE-MX to SCBE2, perform the following steps:



**NOTE:** You cannot upgrade to SCBE2-MX without powering off the MX960 router.

1. [Prepare the MX960 Router for SCBE2-MX Upgrade on page 431](#)
2. [Power Off the MX960 Router on page 431](#)
3. [Remove the MX960 Routing Engine on page 432](#)
4. [Install the MX960 Routing Engine into the SCBE2-MX on page 432](#)
5. [Power On the MX960 Router on page 433](#)
6. [Complete the SCBE2-MX Upgrade on page 434](#)

## Prepare the MX960 Router for SCBE2-MX Upgrade

1. Verify that the system runs Junos OS Release 13.3 or later by issuing the **show version** command on the master router.

```
user@host> show version
Model: mx960
Junos Base OS Software Suite [13.3-yyyymmdd];
...
```



**NOTE:** The SCBE2-MX is supported only on:

- Junos OS Release 13.3 or later
- Network Services Mode: Enhanced-IP

The latest software ensures a healthy system—that is, a system that comprises Routing Engines, control boards, and FPCs—before the upgrade.

For information about how to verify and upgrade the Junos OS, see the *Junos OS Installation and Upgrade Guide*.

## Power Off the MX960 Router



**NOTE:** After turning off the power supply, wait at least 60 seconds before turning it back on.

1. On the external management device connected to the Routing Engine, issue the **request system halt both-routing-engines** operational mode command. The command shuts down the Routing Engines cleanly, so that their state information is preserved. (If the router contains only one Routing Engine, issue the **request system halt** command.)

```
user@host> request system halt both-routing-engines
```

2. Wait until a message appears on the console confirming that the operating system has halted.
3. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Move the AC input switch on the chassis above the AC power supply or the DC circuit breaker on each DC power supply faceplate to the off (O) position.

## Remove the MX960 Routing Engine

1. Remove the cables connected to the Routing Engine.
2. Place an electrostatic bag or antistatic mat on a flat, stable surface.
3. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
4. Loosen the captive screws on the top and bottom of the Routing Engine.
5. Flip the ejector handles outward to unseat the Routing Engine.
6. Grasp the Routing Engine by the ejector handles, and slide it about halfway out of the chassis.
7. Place one hand underneath the Routing Engine to support it, and slide it completely out of the chassis.
8. Place the Routing Engine on the antistatic mat.

## Install the MX960 Routing Engine into the SCBE2-MX

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist, and connect the strap to one of the ESD points on the chassis.
2. Ensure that the ejector handles are not in the locked position. If necessary, flip the ejector handles outward.
3. Place one hand underneath the Routing Engine to support it.
4. Carefully align the sides of the Routing Engine with the guides inside the opening on the SCBE2-MX.
5. Slide the Routing Engine into the SCBE2-MX until you feel resistance and then press the faceplate of the Routing Engine until it engages the connectors.
6. Press both of the ejector handles inward to seat the Routing Engine.
7. Tighten the captive screws on the top and bottom of the Routing Engine.
8. Connect the management device cables to the Routing Engine.

## Power On the MX960 Router

1. Verify that the power supplies are fully inserted in the chassis.
2. Verify that each AC power cord is securely inserted into its appliance inlet.
3. Verify that an external management device is connected to one of the Routing Engine ports (**AUX**, **CONSOLE**, or **ETHERNET**).
4. Turn on the power to the external management device.
5. Switch on the dedicated customer-site circuit breakers. Follow the ESD and safety instructions for your site.
6. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
7. Move the AC input switch on the chassis above the AC power supply or the DC circuit breaker on each DC power-supply faceplate to the off (—) position.
8. Check that the AC or the DC power supply is correctly installed and functioning normally. Verify that the **AC OK** and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit.



**NOTE:** After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the status LEDs on the power supply and the **show chassis** command display—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

If any of the status LEDs indicates that the power supply is not functioning normally, repeat the installation and cabling procedures.

9. On the external management device connected to the Routing Engine, monitor the startup process to verify that the system has booted properly.



**NOTE:** If the system is completely powered off when you power on the power supply, the Routing Engine boots as the power supply completes its startup sequence. Normally, the router boots from the Junos OS on the CompactFlash card.

After turning on a power supply, wait at least 60 seconds before turning it off.

## Complete the SCBE2-MX Upgrade

1. Verify that the installation is successful and the SCBE2-MX is online by issuing the **show chassis environment cb** command:

```
user@host> show chassis environment cb 0
CB 0 status
State Online
Temperature 30 degrees C / 86 degrees F
...
```

```
user@host> show chassis environment cb 1
CB 1 status
State Online
Temperature 30 degrees C / 86 degrees F
...
```

Other details, such as, temperature, power, etc are also displayed along with the state.

2. Verify that the fabric planes come online correctly by issuing the **show chassis fabric summary** command:

```
user@host> show chassis fabric summary
Plane  State  Uptime
0      Online 2 days, 19 hours, 10 minutes, 9 seconds
1      Online 2 days, 19 hours, 10 minutes, 9 seconds
...
```

3. Verify that the backup Routing Engine is back online by issuing the **show chassis routing-engine 1** command:

```
user@host> show chassis routing-engine 1
Routing Engine Status:
Slot 1:
Current State Backup
...
```

4. Verify the SCBE2-MXs before you finish by issuing the **show chassis hardware** command:

```
user@host> show chassis hardware
Hardware inventory:
Item          Version  Part number  Serial number  Description
CB 0          REV 08   750-048307   CABC9829      Enhanced MX SCB 2
CB 1          REV 08   750-048307   CABC9828      Enhanced MX SCB 2
...
```

As shown in the example, the MX960 now has SCBE2-MXs.



- Related Documentation**
- [SCBE2-MX Description on page 104](#)
  - [Removing an MX960 SCB on page 416](#)
  - [Installing an MX960 Switch Control Board on page 263](#)

## Upgrading an MX240, MX480, or MX960 Router to Use the SCBE3-MX



**NOTE:** Due to certain limitations in functionality, the MPC7E is not supported in slot 1 when the SCBE3-MX is plugged into an MX960 PREMIUM3/BASE3 system. If you have an MPC7E in slot 1, move it to a different slot before installing the SCBE3-MX.

1. [Upgrade the Routing Engine on page 435](#)
2. [Install the Routing Engine into the SCBE3-MX on page 436](#)
3. [Install the SCBE3-MX into the Router Chassis on page 436](#)
4. [Complete the SCBE3-MX Upgrade on page 436](#)

### Upgrade the Routing Engine

If you are upgrading to the SCBE3-MX from an SCBE2-MX or older SCB, the Routing Engine must be upgraded to the first supported Junos release for the SCBE3-MX (18.4R1) before you install it in the SCBE3-MX. Also, we recommend that you update the recovery snapshot with the 18.4R1 or later image before you begin the upgrade. If the Routing Engine fails to boot from the primary image, it will attempt to boot from the recovery image. Since the older recovery image does not support the SCBE3-MX, the Routing Engine will crash if it attempts to boot from the old recovery image.



**CAUTION:** If you plug the Routing Engine into the SCBE3-MX without first upgrading Junos to 18.4R1 or later, Junos might crash and go to a db prompt. Should this occur, you'll need to recover the router by copying the Junos software image for the 18.4R1 or later release and then booting from the USB drive to install 18.4R1 Junos on the SCBE3-MX. The USB install will wipe out the router configuration and all user files on the Routing Engine.

To upgrade the Routing Engine while it's plugged into an SCBE2-MX or older SCB:

1. Download the software related to your MX Series Routing Engine.
2. If you have not already done so, connect to the console port on the switch from your management device, and log in to the Junos OS CLI.
3. (Optional) Back up the current software configuration to a second storage option. See the [Junos OS Installation and Upgrade Guide](#) for instructions on performing this task.

4. Install the new software.
5. Reboot the Routing Engine and wait for it to boot with the new Routing Engine image.
6. Install the SCBE3-MX into the Router Chassis. See:
  - Installing an MX240 Switch Control Board*
  - Installing an MX480 Switch Control Board*
  - [Installing an MX960 Switch Control Board on page 263](#)

### Install the Routing Engine into the SCBE3-MX

Refer to the Routing Engine installation procedure for your MX model:

*Installing an MX240 Routing Engine*

*Installing an MX480 Routing Engine*

[“Installing an MX960 Routing Engine” on page 261](#)

### Install the SCBE3-MX into the Router Chassis

Refer to the Switch Control Board installation procedure for your MX model:

*Installing an MX240 Switch Control Board*

*Installing an MX480 Switch Control Board*

[“Installing an MX960 Switch Control Board” on page 263](#)

### Complete the SCBE3-MX Upgrade

1. Verify that the installation is successful and the SCBE3-MX is online:

```
user@host> show chassis environment cb 0
```

```
CB 0 status
State Online
Temperature 30 degrees C / 86 degrees F
...
```

```
user@host> show chassis environment cb 1
```

```
CB 1 status
State Online
Temperature 30 degrees C / 86 degrees F
...
```

Other details, such as, temperature, power, etc are also displayed along with the state.

2. Verify that the fabric planes come online correctly:

```
user@host> show chassis fabric summary
```

```

Plane   State   Uptime
0       Online 2 days, 19 hours, 10 minutes, 9 seconds
1       Online 2 days, 19 hours, 10 minutes, 9 seconds
...

```

3. Verify that the backup Routing Engine is back online:

```
user@host> show chassis routing-engine 1
```

```

Routing Engine Status:
Slot 1:
Current State  Backup
...

```

4. Verify the SCBE3-MXs are installed:

```
user@host> show chassis hardware
```

```

Hardware inventory:
Item          Version  Part number  Serial number  Description
CB 0          REV 29   750-070866   CAKP0543       Enhanced MX SCB 3
CB 1          REV 29   750-070866   CAKP0541       Enhanced MX SCB 3
...

```

**Related Documentation**

- [SCBE3-MX Description on page 98](#)



## PART 5

# Maintaining the Chassis and Components

- [Routine Maintenance Procedures on page 441](#)
- [Maintaining Components on page 443](#)
- [Converting to a Different Type of Power Supply on page 471](#)



## CHAPTER 27

# Routine Maintenance Procedures

- [Routine Maintenance Procedures for the MX960 Router on page 441](#)

## Routine Maintenance Procedures for the MX960 Router

---

**Purpose** For optimum router performance, perform preventive maintenance procedures.

- Action**
- Inspect the installation site for moisture, loose wires or cables, and excessive dust. Make sure that airflow is unobstructed around the router and into the air intake vents.
  - Check the status-reporting devices on the craft interface—System alarms and LEDs.
  - Inspect the air filter at the left rear of the router, replacing it every 6 months for optimum cooling system performance. Do not run the router for more than a few minutes without the air filter in place.

- Related Documentation**
- [Tools and Parts Required to Maintain the MX960 Router on page 443](#)
  - [Maintaining the MX960 Air Filter on page 444](#)
  - [Maintaining the MX960 Fan Trays on page 444](#)





## CHAPTER 28

# Maintaining Components

- [Tools and Parts Required to Maintain the MX960 Router on page 443](#)
- [Maintaining the MX960 Air Filter on page 444](#)
- [Maintaining the MX960 Fan Trays on page 444](#)
- [Maintaining the MX960 Host Subsystem on page 446](#)
- [Maintaining MX960 DPCs on page 448](#)
- [Holding an MX960 DPC on page 450](#)
- [Storing an MX960 DPC on page 452](#)
- [Maintaining MX960 FPCs on page 453](#)
- [Holding an MX960 FPC on page 455](#)
- [Storing an MX960 FPC on page 459](#)
- [Maintaining MX960 MICs on page 460](#)
- [Maintaining MX960 MPCs on page 461](#)
- [Maintaining MX960 PICs on page 464](#)
- [Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs on page 465](#)
- [Maintaining the MX960 Power Supplies on page 466](#)
- [Verifying the Version of the MX960 Cable Manager on page 467](#)

## Tools and Parts Required to Maintain the MX960 Router

---

To maintain hardware components, you need the following tools and parts:

- ESD grounding wrist strap
- Flat-blade (–) screwdriver
- Phillips (+) screwdriver, number 1
- Phillips (+) screwdriver, number 2

### Related Documentation

- [Routine Maintenance Procedures for the MX960 Router on page 441](#)
- [Maintaining the MX960 Host Subsystem on page 446](#)
- [Maintaining the MX960 Power Supplies on page 466](#)

## Maintaining the MX960 Air Filter

**Purpose** For optimum cooling, verify the condition of the air filters.

- Action**
- Regularly inspect the air filter. A dirty air filter restricts airflow in the unit, producing a negative effect on the ventilation of the chassis. The filter degrades over time. You must replace the filter every 6 months.



**CAUTION:** Always keep the air filter in place while the device is operating. Because the fans are very powerful, they could pull small bits of wire or other materials into the through the unfiltered air intake. This could damage the components.

- The shelf life of polyurethane filter varies from two years to five years depending on the storage conditions. Store in a cool, dry, and dark environment. Wrap the media in plastic and store in an environment with relative humidity between 40%- 80% and temperature between 40° F (4° C) to 90° F (32° C). Note that if the material flakes, or becomes brittle when rubbed or deformed, it is no longer usable.

- Related Documentation**
- [Tools and Parts Required to Maintain the MX960 Router on page 443](#)
  - [Replacing the MX960 Air Filter on page 321](#)
  - [Installing the MX960 Air Filter on page 258](#)

## Maintaining the MX960 Fan Trays

**Purpose** For optimum cooling, verify the condition of the fans.

- Action**
- Monitor the status of the fans. A fan tray contains multiple fans that work in unison to cool the router components. If one fan fails, the host subsystem adjusts the speed of the remaining fans to maintain proper cooling. A red alarm is triggered when a fan fails, and a yellow alarm and red alarm is triggered when a fan tray is removed.
  - To display the status of the cooling system, issue the **show chassis environment** command. The output is similar to the following:

```
user@host> show chassis environment
```

Class	Item	Status	Measurement
Temp	PEM 0	OK	40 degrees C / 104 degrees F
	PEM 1	Absent	
	PEM 2	Absent	
	PEM 3	OK	40 degrees C / 104 degrees F
	Routing Engine 0	OK	39 degrees C / 102 degrees F
	Routing Engine 1	OK	42 degrees C / 107 degrees F

CB 0 Intake	OK	26 degrees C / 78 degrees F
CB 0 Exhaust A	OK	27 degrees C / 80 degrees F
CB 0 Exhaust B	OK	27 degrees C / 80 degrees F
CB 0 ACBC	OK	26 degrees C / 78 degrees F
CB 0 SF A	OK	37 degrees C / 98 degrees F
CB 0 SF B	OK	35 degrees C / 95 degrees F
CB 1 Intake	OK	27 degrees C / 80 degrees F
CB 1 Exhaust A	OK	30 degrees C / 86 degrees F
CB 1 Exhaust B	OK	28 degrees C / 82 degrees F
CB 1 ACBC	OK	27 degrees C / 80 degrees F
CB 1 SF A	OK	36 degrees C / 96 degrees F
CB 1 SF B	OK	36 degrees C / 96 degrees F
CB 2 Intake	Absent	
CB 2 Exhaust A	Absent	
CB 2 Exhaust B	Absent	
CB 2 ACBC	Absent	
CB 2 SF A	Absent	
CB 2 SF B	Absent	
FPC 2 Intake	OK	22 degrees C / 71 degrees F
FPC 2 Exhaust A	OK	27 degrees C / 80 degrees F
FPC 2 Exhaust B	OK	33 degrees C / 91 degrees F
FPC 2 I3 0 TSensor	OK	33 degrees C / 91 degrees F
FPC 2 I3 0 Chip	OK	35 degrees C / 95 degrees F
FPC 2 I3 1 TSensor	OK	33 degrees C / 91 degrees F
FPC 2 I3 1 Chip	OK	33 degrees C / 91 degrees F
FPC 2 I3 2 TSensor	OK	33 degrees C / 91 degrees F
FPC 2 I3 2 Chip	OK	30 degrees C / 86 degrees F
FPC 2 I3 3 TSensor	OK	30 degrees C / 86 degrees F
FPC 2 I3 3 Chip	OK	30 degrees C / 86 degrees F
FPC 2 IA 0 TSensor	OK	33 degrees C / 91 degrees F
FPC 2 IA 0 Chip	OK	36 degrees C / 96 degrees F
FPC 2 IA 1 TSensor	OK	30 degrees C / 86 degrees F
FPC 2 IA 1 Chip	OK	35 degrees C / 95 degrees F
FPC 4 Intake	OK	22 degrees C / 71 degrees F
FPC 4 Exhaust A	OK	28 degrees C / 82 degrees F
FPC 4 Exhaust B	OK	31 degrees C / 87 degrees F
FPC 4 I3 0 TSensor	OK	31 degrees C / 87 degrees F
FPC 4 I3 0 Chip	OK	34 degrees C / 93 degrees F
FPC 4 I3 1 TSensor	OK	31 degrees C / 87 degrees F
FPC 4 I3 1 Chip	OK	33 degrees C / 91 degrees F
FPC 4 I3 2 TSensor	OK	31 degrees C / 87 degrees F
FPC 4 I3 2 Chip	OK	29 degrees C / 84 degrees F
FPC 4 I3 3 TSensor	OK	29 degrees C / 84 degrees F
FPC 4 I3 3 Chip	OK	29 degrees C / 84 degrees F
FPC 4 IA 0 TSensor	OK	35 degrees C / 95 degrees F
FPC 4 IA 0 Chip	OK	37 degrees C / 98 degrees F
FPC 4 IA 1 TSensor	OK	31 degrees C / 87 degrees F
FPC 4 IA 1 Chip	OK	35 degrees C / 95 degrees F
FPC 7 Intake	OK	20 degrees C / 68 degrees F
FPC 7 Exhaust A	OK	21 degrees C / 69 degrees F
FPC 7 Exhaust B	OK	21 degrees C / 69 degrees F
FPC 7 I3 0 TSensor	OK	31 degrees C / 87 degrees F
FPC 7 I3 0 Chip	OK	36 degrees C / 96 degrees F
FPC 7 I3 1 TSensor	OK	32 degrees C / 89 degrees F
FPC 7 I3 1 Chip	OK	35 degrees C / 95 degrees F
FPC 7 I3 2 TSensor	OK	32 degrees C / 89 degrees F
FPC 7 I3 2 Chip	OK	30 degrees C / 86 degrees F
FPC 7 I3 3 TSensor	OK	30 degrees C / 86 degrees F
FPC 7 I3 3 Chip	OK	31 degrees C / 87 degrees F
FPC 7 IA 0 TSensor	OK	34 degrees C / 93 degrees F

	FPC 7 IA 0 Chip	OK	37 degrees C / 98 degrees F
	FPC 7 IA 1 TSensor	OK	31 degrees C / 87 degrees F
	FPC 7 IA 1 Chip	OK	35 degrees C / 95 degrees F
Fans	Top Fan Tray Temp	OK	27 degrees C / 80 degrees F
	Top Tray Fan 1	OK	Spinning at high speed
	Top Tray Fan 2	OK	Spinning at high speed
	Top Tray Fan 3	OK	Spinning at high speed
	Top Tray Fan 4	OK	Spinning at high speed
	Top Tray Fan 5	OK	Spinning at high speed
	Top Tray Fan 6	OK	Spinning at high speed
	Bottom Fan Tray Temp	OK	28 degrees C / 82 degrees F
	Bottom Tray Fan 1	OK	Spinning at high speed
	Bottom Tray Fan 2	OK	Spinning at high speed
	Bottom Tray Fan 3	OK	Spinning at high speed
	Bottom Tray Fan 4	OK	Spinning at high speed
	Bottom Tray Fan 5	OK	Spinning at high speed
	Bottom Tray Fan 6	OK	Spinning at high speed



**NOTE:** The fan numbers are stamped into the fan tray sheet metal next to each fan.

- Related Documentation**
- [Tools and Parts Required to Maintain the MX960 Router on page 443](#)
  - [Replacing an MX960 Fan Tray on page 323](#)

## Maintaining the MX960 Host Subsystem

**Purpose** For optimum router performance, verify the condition of the host subsystem. The host subsystem includes an SCB and a Routing Engine installed into a slot in the SCB.

**Action** On a regular basis:

- Check the LEDs on the craft interface to view information about the status of the Routing Engines.
- Check the LEDs on the SCB faceplate (see Table 9 in “SCB-MX Description” on page 112).
- Check the LEDs on the Routing Engine faceplate (see Table 10 in “MX960 Routing Engine Description” on page 26).
- To check the status of the Routing Engines, issue the **show chassis routing-engine** command. The output is similar to the following:

```
user@host> show chassis routing-engine
```

```
Routing Engine status:
Slot 0:
  Current state           Master
  Election priority       Master (default)
```

```

Temperature          39 degrees C / 102 degrees F
CPU temperature      47 degrees C / 116 degrees F
DRAM                3584 MB
Memory utilization   10 percent
CPU utilization:
  User              0 percent
  Background        0 percent
  Kernel            6 percent
  Interrupt         0 percent
  Idle              94 percent
Model               RE-S-2000
Serial ID           1000639065
Start time          2006-11-07 11:42:58 PST
Uptime              53 minutes, 35 seconds
Load averages:     1 minute 5 minute 15 minute
                   0.06      0.07      0.02

Routing Engine status:
Slot 1:
  Current state     Backup
  Election priority Backup (default)
  Temperature       42 degrees C / 107 degrees F
  CPU temperature   50 degrees C / 122 degrees F
  DRAM              3584 MB
  Memory utilization 9 percent
  CPU utilization:
    User            0 percent
    Background      0 percent
    Kernel          0 percent
    Interrupt       0 percent
    Idle            100 percent
  Model            RE-S-2000
  Serial ID        1000664335
  Start time       2006-11-02 18:35:01 PST
  Uptime           4 days, 18 hours, 1 minute, 28 seconds

```

- To check the status of the SCBs, issue the **show chassis environment cb** command. The output is similar to the following:

```
user@host> show chassis environment cb
```

```

CB 0 status:
State          Online Master
Temperature    26 degrees C / 78 degrees F
Power 1
  1.2 V        1202 mV
  1.5 V        1508 mV
  1.8 V        1830 mV
  2.5 V        5053 mV
  3.3 V        6593 mV
  5.0 V        5111 mV
  12.0 V       12181 mV
  1.25 V       1263 mV
  3.3 V SM3    6593 mV
  5 V RE       5078 mV
  12 V RE      12007 mV
Power 2
  11.3 V bias PEM 11253 mV

```

```

    4.6 V bias MidPlane      4827 mV
    11.3 V bias FPD         11408 mV
    11.3 V bias POE 0       11446 mV
    11.3 V bias POE 1       11408 mV
    Bus Revision             6
    FPGA Revision            0
CB 1 status:
    State                    Online Standby
    Temperature              27 degrees C / 80 degrees F
    Power 1
    1.2 V                   1214 mV
    1.5 V                   1517 mV
    1.8 V                   1814 mV
    2.5 V                   2507 mV
    3.3 V                   3312 mV
    5.0 V                   5136 mV
    12.0 V                  12142 mV
    1.25 V                  1256 mV
    3.3 V SM3               3306 mV
    5 V RE                   5085 mV
    12 V RE                 11949 mV
    Power 2
    11.3 V bias PEM         11369 mV
    4.6 V bias MidPlane     4814 mV
    11.3 V bias FPD         11427 mV
    11.3 V bias POE 0       11350 mV
    11.3 V bias POE 1       11330 mV
    Bus Revision            39
    FPGA Revision           1

```

To check the status of a specific SCB, issue the **show chassis environment cb** command and include the slot number of the SCB—for example, **show chassis environment cb 0**.

For more information about using the CLI, see the Junos OS manuals.

- Related Documentation**
- [MX960 Craft Interface Overview on page 14](#)
  - [MX960 Host Subsystem Description on page 25](#)
  - *Taking an MX960 Host Subsystem Offline*
  - *Effect of Taking the MX960 Host Subsystem Offline*

## Maintaining MX960 DPCs

- Purpose** The router can have up to 12 Dense Port Concentrators (DPCs) mounted vertically in the DPC card cage at the front of the chassis. For optimum router performance, verify the condition of the DPCs.

**Action** On a regular basis:

- Check the LEDs on the craft interface directly above each DPC slot. The green LED labeled **OK** lights steadily when a DPC is functioning normally.
- Check the **OK/FAIL** LED on the DPC. For more information, see [MX Series Interface Module Reference](#). If the DPC detects a failure, the DPC sends an alarm message to the Routing Engine.
- Check the status of installed DPCs by issuing the CLI **show chassis fpc** command to check the status of installed DPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the DPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%) Total	Utilization (%) Interrupt	Memory (MB) DRAM	Utilization (%) Heap	Buffer
0	Empty						
1	Empty						
2	Online	22	40	0	1024	15	57
3	Empty						
4	Online	22	24	0	1024	15	57
5	Empty						
6	Empty						
7	Offline	---Offlined by cli command---					
8	Empty						
9	Empty						
10	Empty						
11	Empty						

For more detailed output, add the **detail** option. The following example does not specify a slot number, which is optional:

```
user@host> show chassis fpc detail
```

```
Slot 2 information:
  State                Online
  Temperature          22 degrees C / 71 degrees F
  Total CPU DRAM       1024 MB
  Total SRAM           256 MB
  Total SDRAM          0 MB
  Start time           2006-11-03 07:35:40 PST
  Uptime               2 hours, 27 minutes, 1 second

Slot 4 information:
  State                Online
  Temperature          22 degrees C / 71 degrees F
  Total CPU DRAM       1024 MB
  Total SRAM           256 MB
  Total SDRAM          0 MB
  Start time           2006-11-03 07:35:48 PST
  Uptime               2 hours, 26 minutes, 53 seconds

Slot 7 information:
  State                Online
  Temperature          24 degrees C / 75 degrees F
  Total CPU DRAM       1024 MB
  Total SRAM           256 MB
  Total SDRAM          0 MB
  Start time           2006-11-03 07:35:53 PST
  Uptime               2 hours, 26 minutes, 48 seconds
```

- Issue the CLI **show chassis fpc pic-status** command. The DPC slots are numbered from 0 through 5, 2/6, 7 through 11, left to right:

```
user@host> show chassis fpc pic-status
Slot 2  Online      MX960 40GE DPC
PIC 0  Online      10x 1GE
PIC 1  Online      10x 1GE
PIC 2  Online      10x 1GE
PIC 3  Online      10x 1GE
Slot 4  Online      MX960 4 XGE DPC
PIC 0  Online      1x 10GE(LAN/WAN)
PIC 1  Online      1x 10GE(LAN/WAN)
PIC 2  Online      1x 10GE(LAN/WAN)
PIC 3  Online      1x 10GE(LAN/WAN)
Slot 7  Offline     MX960 4 XGE DPC
```

For further description of the output from the command, see the [CLI Explorer](#).

#### Related Documentation

- [MX960 Chassis Description on page 7](#)
- [MX960 Dense Port Concentrator Description on page 35](#)
- [MX960 DPC and MPC LEDs on the Craft Interface on page 16](#)
- [Troubleshooting the MX960 DPCs on page 488](#)
- [Replacing an MX960 DPC on page 351](#)

## Holding an MX960 DPC

When carrying a DPC, you can hold it either vertically or horizontally.



**NOTE:** A DPC weighs 14.5 lb (6.6 kg). Be prepared to accept the full weight of the DPC as you lift it.

To hold a DPC vertically:

1. Orient the DPC so that the faceplate faces you. To verify orientation, confirm that the text on the DPC is right-side up and the electromagnetic interference (EMI) strip is on the right-hand side.
2. Place one hand around the DPC faceplate about a quarter of the way down from the top edge. To avoid deforming the EMI shielding strip, do not press hard on it.
3. Place your other hand at the bottom edge of the DPC.

If the DPC is horizontal before you grasp it, place your left hand around the faceplate and your right hand along the bottom edge.



To hold a DPC horizontally:

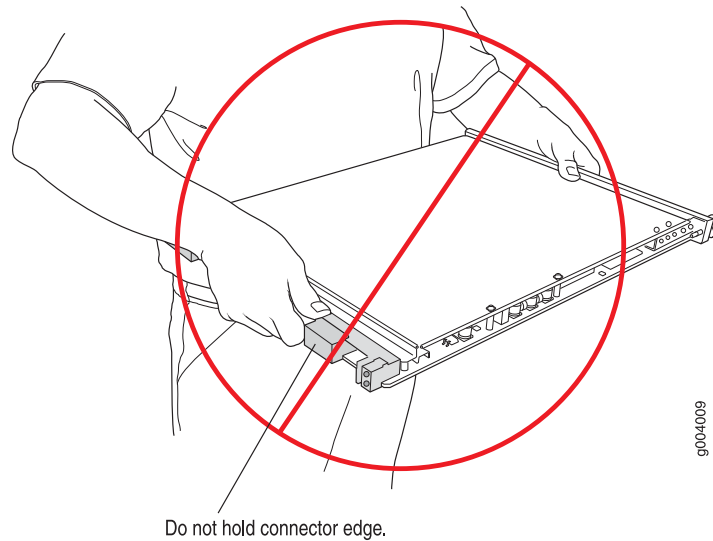
1. Orient the DPC so that the faceplate faces you.
2. Grasp the top edge with your left hand and the bottom edge with your right hand.

You can rest the faceplate of the DPC against your body as you carry it.

As you carry the DPC, do not bump it against anything. DPC components are fragile.

Never hold or grasp the DPC anywhere except places that this document indicates. In particular, never grasp the connector edge, especially at the power connector in the corner where the connector and bottom edges meet. See [Figure 171 on page 451](#).

**Figure 171: Do Not Grasp the Connector Edge**

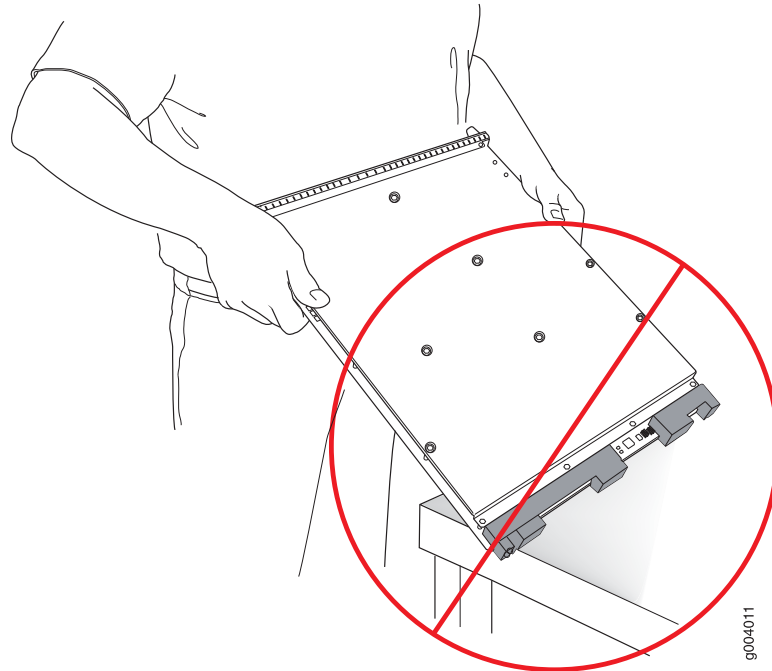


Never carry the DPC by the faceplate with only one hand.

Do not rest any edge of a DPC directly against a hard surface (see [Figure 172 on page 452](#)).

Do not stack DPCs.

*Figure 172: Do Not Rest the DPC on an Edge*



Do not rest connectors on any surface.

If you must rest the DPC temporarily on an edge while changing its orientation between vertical and horizontal, use your hand as a cushion between the edge and the surface.

**Related Documentation**

- [MX960 DPC Terminology](#)
- [Storing an MX960 DPC on page 452](#)
- [Troubleshooting the MX960 DPCs on page 488](#)
- [Replacing an MX960 DPC on page 351](#)

## Storing an MX960 DPC

You must store a DPC as follows:

- In the router
- In the container in which a spare DPC is shipped
- Horizontally and sheet metal side down

When you store a DPC on a horizontal surface or in the shipping container, always place it inside an antistatic bag. Because the DPC is heavy, and because antistatic bags are fragile, inserting the DPC into the bag is easier with two people. To do this, one person holds the DPC in the horizontal position with the faceplate facing the body, and the other person slides the opening of the bag over the DPC connector edge.

If you must insert the DPC into a bag by yourself, first lay the DPC horizontally on a flat, stable surface, sheet metal side down. Orient the DPC with the faceplate facing you. Carefully insert the DPC connector edge into the opening of the bag, and pull the bag toward you to cover the DPC.

Never stack a DPC under or on top of any other component.

#### Related Documentation

- [MX960 DPC Terminology](#)
- [Holding an MX960 DPC on page 450](#)
- [Maintaining MX960 DPCs on page 448](#)
- [Replacing an MX960 DPC on page 351](#)
- [Troubleshooting the MX960 DPCs on page 488](#)

## Maintaining MX960 FPCs

**Purpose** The router can have one Flexible PIC Concentrator (FPC) installed vertically in two DPC slots at the front of the chassis. For optimum router performance, verify the condition of the FPC.

**Action** On a regular basis:

- Check the LEDs on the craft interface directly above the FPC. The green LED labeled **OK** lights steadily when an FPC is functioning normally.
- Check the **OK/FAIL** LED on the FPC. If the FPC detects a failure, the FPC sends an alarm message to the Routing Engine.
- Issue the CLI **show chassis fpc** command to check the status of the installed FPC. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the FPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%)	Memory Utilization (%)	DRAM (MB)	Heap	Buffer
0	Online	24	3	0	1024	13	21
1	Empty						
2	Online	41	9	0	1024	15	57
3	Online	43	5	0	1024	16	57
4	Online	43	11	0	1024	16	57
5	Online	41	9	0	1024	15	57
6	Online	43	5	0	1024	16	57
7	Empty						
8	Empty						
9	Empty						
10	Online	24	3	0	1024	13	21
11	Empty						

For more detailed output, add the **detail** option. The following example does not specify a slot number, which is optional:

```

user@host> show chassis fpc detail

Slot 0 information:
  State                Online
  Temperature          24 degrees C / 75 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         128 MB
  Total DDR DRAM       2048 MB
  Start time:         2008-12-11 16:53:24 PST
  Uptime:              15 hours, 2 minutes, 47 seconds

Slot 2 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:         2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds

Slot 3 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:         2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds

Slot 4 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:         2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds

Slot 5 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:         2008-12-11 16:53:22 PST
  Uptime:              15 hours, 2 minutes, 49 seconds

Slot 6 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:         2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds

Slot 10 information:
  State                Online
  Temperature          24 degrees C / 75 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         128 MB
  Total DDR DRAM       2048 MB
  Start time:         2008-12-11 16:53:24 PST
  Uptime:              15 hours, 2 minutes, 47 seconds

```

- Issue the CLI **show chassis fpc pic-status** command. The following example shows an FPC installed in DPC slots 1 and 2:

```
user@host> show chassis fpc pic-status
```

```
Slot 0  Online      DPC 40x 1GE R
PIC 0  Online      10x 1GE(LAN)
PIC 1  Online      10x 1GE(LAN)
PIC 2  Online      10x 1GE(LAN)
PIC 3  Online      10x 1GE(LAN)
Slot 1  Online      MX FPC Type 3
PIC 0  Online      1x OC-192 SONET
PIC 1  Online      1x OC-192 SONET
```



**NOTE:** An FPC takes up two DPC slots when installed on an MX Series router. The slot number corresponds to the lowest numbered DPC slot.

For further description of the output from the command, see the [CLI Explorer](#).

#### Related Documentation

- [MX960 Flexible PIC Concentrator \(FPC\) LEDs on page 47](#)
- [Troubleshooting the MX960 FPCs on page 490](#)
- [Replacing an MX960 FPC on page 358](#)
- [Holding an MX960 FPC on page 455](#)
- [Storing an MX960 FPC on page 459](#)

## Holding an MX960 FPC



**CAUTION:** Many components on the FPC are fragile. Failure to handle FPCs as specified in this document can cause irreparable damage.



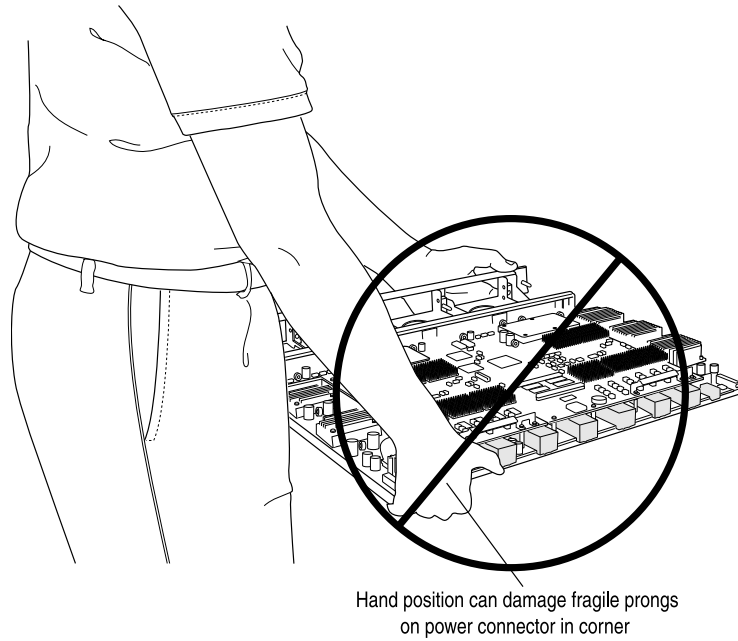
**NOTE:** An FPC configured with PICs installed can weigh as much as 18 lb (8.2 kg). Be prepared to accept the full weight of the FPC as you lift it.



**CAUTION:** To prevent damage when handling or carrying FPCs:

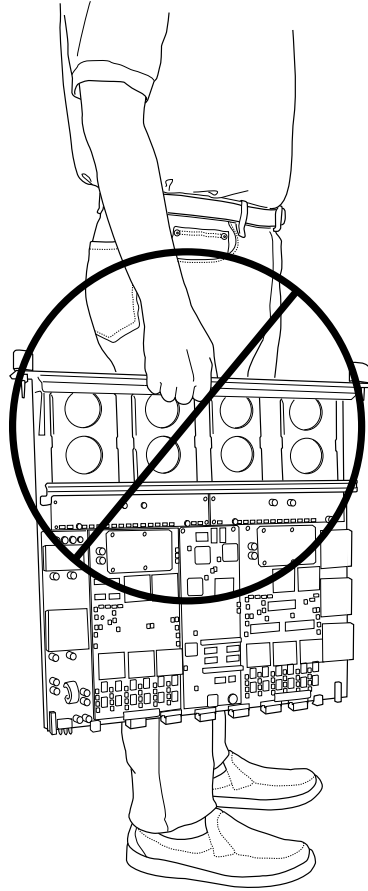
- As you carry the FPC, do not bump it against anything. FPC components are fragile.
- Do not grasp the FPC anywhere except places that this document indicates. In particular, never grasp the connector edge, especially at the power connector in the corner where the connector and bottom edges meet (see [Figure 173 on page 456](#)).

*Figure 173: Do Not Grasp the Connector Edge*



- Do not carry the FPC by the faceplate with only one hand (see [Figure 174 on page 457](#)).

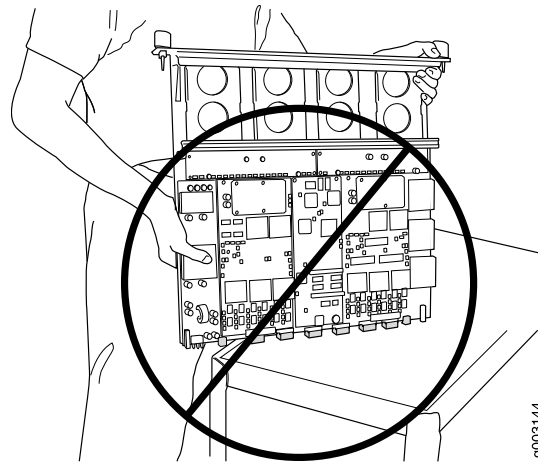
Figure 174: Do Not Carry an FPC with Only One Hand



9003143

- Do not rest any edge of an FPC directly against a hard surface (see [Figure 175 on page 458](#)). If you must rest the FPC temporarily on an edge while changing its orientation between vertical and horizontal, use your hand as a cushion between the edge and the surface.

*Figure 175: Do Not Rest the FPC on an Edge*

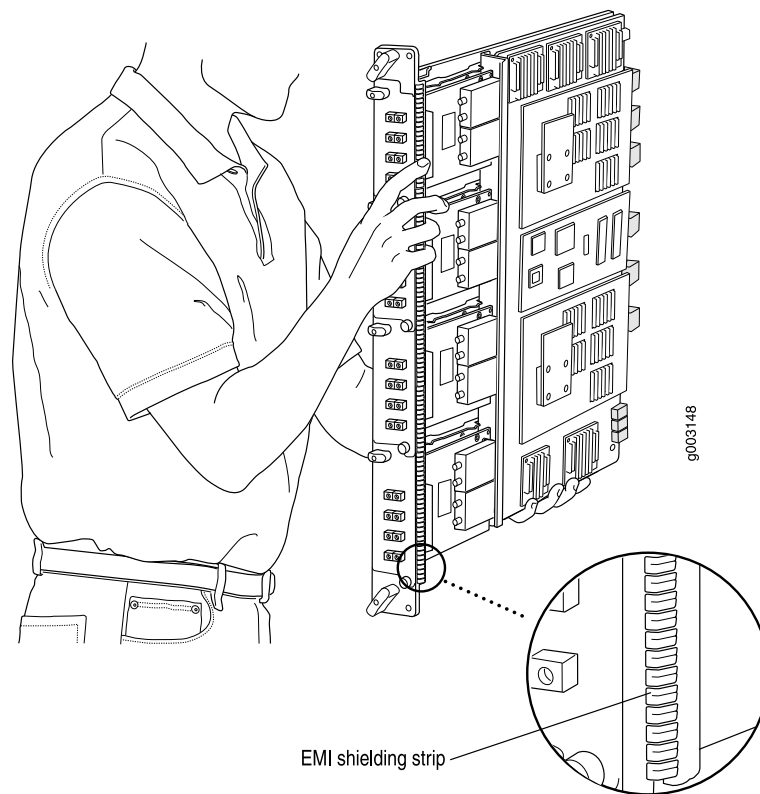


You hold an FPC vertically when installing it into the chassis or an equipment rack. To hold an FPC vertically (see [Figure 176 on page 459](#)):

1. Orient the FPC so that the faceplate faces you.
2. Place one hand around the FPC faceplate about a quarter of the way down from the top edge. To avoid deforming the electromagnetic interference (EMI) shielding strip, do not press hard on it.
3. Place your other hand at the bottom edge of the FPC. If the FPC has heat sinks about midway between the faceplate and connector edge, place your other hand against the heat sinks.



Figure 176: Holding an FPC Vertically



- Related Documentation**
- [MX960 Flexible PIC Concentrator Description on page 44](#)
  - [MX960 FPC Terminology](#)
  - [Storing an MX960 FPC on page 459](#)

## Storing an MX960 FPC

When not installed in the routing platforms, FPCs must be either stored in the container in which a spare FPC is shipped or stored horizontally with the component-side up on a flat, stable surface. When you store an FPC on a horizontal surface or in the shipping container, always place it inside an antistatic bag. Because the FPC is heavy and because antistatic bags are fragile, inserting the FPC into the bag is easier with two people. The storage guidelines are as follows:

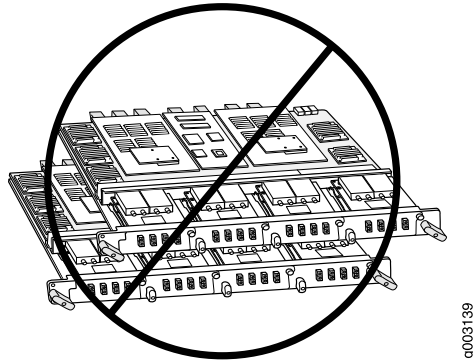
- When storing an FPC with two people, one person holds the FPC in the horizontal position with the faceplate facing their body, the other person slides the opening of the bag over the FPC connector edge.
- When storing an FPC with one person, you must insert the FPC into a bag by yourself. First lay the FPC horizontally on a flat, stable surface, component-side up. Orient the FPC with the faceplate facing you. Carefully insert the FPC connector edge into the opening of the bag, and pull the bag toward you to cover the FPC.



**CAUTION:** To prevent damage when storing FPCs:

- Never lay an FPC component-side down.

Figure 177: Do Not Stack FPCs



- Never stack an FPC under or on top of any other component (see [Figure 177 on page 460](#)).

#### Related Documentation

- [MX960 Flexible PIC Concentrator Description on page 44](#)
- [MX960 FPC Terminology](#)
- [Holding an MX960 FPC on page 455](#)

## Maintaining MX960 MICs

**Purpose** For optimum router performance, verify the condition of the Modular Interface Cards (MICs).

**Action** On a regular basis:

- Check the LEDs on MIC faceplates. The meaning of the LED states differs for various MICs. For more information, see the [MX Series Interface Module Reference](#). If the MPC that houses the MIC detects a MIC failure, the MPC generates an alarm message to be sent to the Routing Engine.
- Issue the CLI `show chassis fpc pic-status` command. The MIC slots in an MPC are numbered `PIC 0/1` and `PIC 2/3`, top to bottom:

```
user@host> show chassis fpc pic-status
Slot 0  Online      DPCE 4x 10GE R EQ
PIC 0   Online      1x 10GE(LAN/WAN) EQ
PIC 1   Online      1x 10GE(LAN/WAN) EQ
PIC 2   Online      1x 10GE(LAN/WAN) EQ
PIC 3   Online      1x 10GE(LAN/WAN) EQ
Slot 1  Online      DPCE 40x 1GE R EQ
PIC 0   Online      10x 1GE(LAN) EQ
```

```

PIC 1 Online      10x 1GE(LAN) EQ
PIC 2 Online      10x 1GE(LAN) EQ
PIC 3 Online      10x 1GE(LAN) EQ
Slot 2 Online     MS-DPC
PIC 0 Online      MS-DPC PIC
PIC 1 Online      MS-DPC PIC
Slot 3 Online     MPC Type 2 3D EQ
PIC 0 Online      1x 10GE XFP
PIC 1 Online      1x 10GE XFP
Slot 4 Online     MPC 3D 16x 10GE
PIC 0 Online      4x 10GE(LAN) SFP+
PIC 1 Online      4x 10GE(LAN) SFP+
PIC 2 Online      4x 10GE(LAN) SFP+
PIC 3 Online      4x 10GE(LAN) SFP+
Slot 6 Online     MX960 40GE DPC
PIC 0 Online      10x 1GE
PIC 1 Online      10x 1GE
PIC 2 Online      10x 1GE
PIC 3 Online      10x 1GE
Slot 10 Online    MPC 3D 16x 10GE
PIC 0 Online      4x 10GE(LAN) SFP+
PIC 1 Online      4x 10GE(LAN) SFP+
PIC 2 Online      4x 10GE(LAN) SFP+
PIC 3 Online      4x 10GE(LAN) SFP+

```

For further description of the output from the command, see the [CLI Explorer](#).

- Related Documentation**
- [MX960 Modular Interface Card Description on page 65](#)
  - [MX960 Modular Interface Card \(MIC\) LEDs on page 65](#)
  - [Troubleshooting the MX960 MICs on page 493](#)
  - [Replacing an MX960 MIC on page 364](#)

## Maintaining MX960 MPCs

**Purpose** The router can have up to 12 Modular Port Concentrators (MPCs) mounted vertically in the card cage at the front of the chassis. For optimum router performance, verify the condition of the MPCs.

**Action** On a regular basis:

- Check the LEDs on the craft interface directly above each MPC slot. The green LED labeled **OK** lights steadily when an MPC is functioning normally.
- Check the **OK/FAIL** LED on the MPC. If the MPC detects a failure, the MPC sends an alarm message to the Routing Engine.
- Issue the CLI **show chassis fpc** command to check the status of installed MPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the MPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp	CPU Utilization (%)		Memory		Utilization (%)
		(C)	Total	Interrupt	DRAM (MB)	Heap	Buffer
0	Online	36	3	0	2048	14	13
1	Online	40	5	0	2048	26	13
2	Online	41	6	0	1024	7	43
3	Online	43	5	0	1024	16	57
4	Online	24	3	0	1024	13	21
5	Empty						
6	Online	43	5	0	1024	16	57
7	Empty						
8	Empty						
9	Empty						
10	Online	24	3	0	1024	13	21
11	Empty						

For more detailed output, add the **detail** option. The following example does not specify a slot number, which is optional:

```
user@host> show chassis fpc detail
```

```
Slot 0 information:
  State                Online
  Temperature          33 degrees C / 91 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:          2009-12-22 12:26:54 PST
  Uptime:              6 days, 3 hours, 8 minutes, 51 seconds

  Max Power Consumption 330 Watts

Slot 1 information:
  State                Online
  Temperature          32 degrees C / 89 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:          2009-12-22 12:26:54 PST
  Uptime:              6 days, 3 hours, 8 minutes, 51 seconds

  Max Power Consumption 365 Watts

Slot 2 information:
  State                Online
  Temperature          41 degrees C / 105 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         128 MB
  Total DDR DRAM       2048 MB
  Start time:          2009-12-22 12:26:46 PST
  Uptime:              6 days, 3 hours, 8 minutes, 59 seconds

  Max Power Consumption 265 Watts

Slot 3 information:
  State                Online
  Temperature          36 degrees C / 96 degrees F
  Total CPU DRAM       2048 MB
  Total RLDRAM         806 MB
  Total DDR DRAM       2632 MB
  Start time:          2009-12-22 12:27:04 PST
  Uptime:              6 days, 3 hours, 8 minutes, 41 seconds
```

```

Max Power Consumption          450 Watts
Slot 4 information:
State                          Online
Temperature                    40 degrees C / 104 degrees F
Total CPU DRAM                 2048 MB
Total RLDRAM                   1324 MB
Total DDR DRAM                 5120 MB
Start time:                    2009-12-22 12:27:02 PST
Uptime:                        6 days, 3 hours, 8 minutes, 43 seconds

Max Power Consumption          440 Watts
Slot 6 information:
State                          Online
Temperature                    29 degrees C / 84 degrees F
Total CPU DRAM                 1024 MB
Total RLDRAM                   256 MB
Total DDR DRAM                 4096 MB
Start time:                    2008-12-11 16:53:18 PST
Uptime:                        15 hours, 2 minutes, 53 seconds
Max Power Consumption          365 Watts
Slot 10 information:
State                          Online
Temperature                    24 degrees C / 75 degrees F
Total CPU DRAM                 1024 MB
Total RLDRAM                   128 MB
Total DDR DRAM                 2048 MB
Start time:                    2008-12-11 16:53:24 PST
Uptime:                        15 hours, 2 minutes, 47 seconds
Max Power Consumption          440 Watts

```

- Issue the CLI `show chassis fpc pic-status` command. The MPC slots are numbered 0 through 5, bottom to top:

```

user@host> show chassis fpc pic-status

Slot 0  Online      DPCE 4x 10GE R EQ
PIC 0   Online      1x 10GE(LAN/WAN) EQ
PIC 1   Online      1x 10GE(LAN/WAN) EQ
PIC 2   Online      1x 10GE(LAN/WAN) EQ
PIC 3   Online      1x 10GE(LAN/WAN) EQ
Slot 1  Online      DPCE 40x 1GE R EQ
PIC 0   Online      10x 1GE(LAN) EQ
PIC 1   Online      10x 1GE(LAN) EQ
PIC 2   Online      10x 1GE(LAN) EQ
PIC 3   Online      10x 1GE(LAN) EQ
Slot 2  Online      MS-DPC
PIC 0   Online      MS-DPC PIC
PIC 1   Online      MS-DPC PIC
Slot 3  Online      MPC Type 2 3D EQ
PIC 0   Online      1x 10GE XFP
PIC 1   Online      1x 10GE XFP
Slot 4  Online      MPC 3D 16x 10GE
PIC 0   Online      4x 10GE(LAN) SFP+
PIC 1   Online      4x 10GE(LAN) SFP+
PIC 2   Online      4x 10GE(LAN) SFP+
PIC 3   Online      4x 10GE(LAN) SFP+
Slot 6  Online      MX960 40GE DPC
PIC 0   Online      10x 1GE
PIC 1   Online      10x 1GE

```

```

PIC 2 Online      10x 1GE
PIC 3 Online      10x 1GE
Slot 10 Online    MPC 3D 16x 10GE
PIC 0 Online      4x 10GE(LAN) SFP+
PIC 1 Online      4x 10GE(LAN) SFP+
PIC 2 Online      4x 10GE(LAN) SFP+
PIC 3 Online      4x 10GE(LAN) SFP+

```

For further description of the output from the command, see the [CLI Explorer](#).

- Related Documentation**
- [MX960 Modular Port Concentrator Description on page 76](#)
  - [MX960 Modular Port Concentrator LEDs on page 79](#)
  - [Troubleshooting the MX960 MPCs on page 494](#)
  - [Replacing an MX960 MPC on page 374](#)

## Maintaining MX960 PICs

**Purpose** For optimum router performance, verify the condition of the PICs.

**Action** On a regular basis:

- Check the LEDs on PIC faceplates. The meaning of the LED states differs for various PICs. For more information, see the [MX Series Interface Module Reference](#). If the FPC that houses the PIC detects a PIC failure, the FPC generates an alarm message to be sent to the Routing Engine.
- Issue the CLI **show chassis fpc pic-status** command. The PIC slots in an FPC are numbered from 0 through 1, top to bottom:

```
user@host> show chassis fpc pic-status
```

```

Slot 0 Online      DPC 40x 1GE R
PIC 0 Online      10x 1GE(LAN)
PIC 1 Online      10x 1GE(LAN)
PIC 2 Online      10x 1GE(LAN)
PIC 3 Online      10x 1GE(LAN)
Slot 1 Online      MX FPC Type 3
PIC 0 Online      1x 0C-192 SONET
PIC 1 Online      1x 0C-192 SONET

```

For further description of the output from the command, see the [CLI Explorer](#).

- Related Documentation**
- [MX960 PIC Description on page 48](#)
  - [Replacing an MX960 PIC on page 380](#)
  - [Troubleshooting the MX960 PICs on page 492](#)
  - [MX960 PIC Serial Number Label on page 514](#)

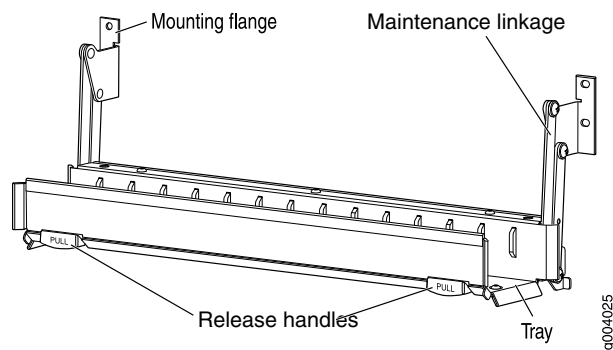
## Maintaining Cables That Connect to MX960 DPCs, MPCs, MICs, or PICs

**Purpose** For optimum router performance, verify the condition of the cables that connect to the DPCs, MPCs, MICs, or PICs.

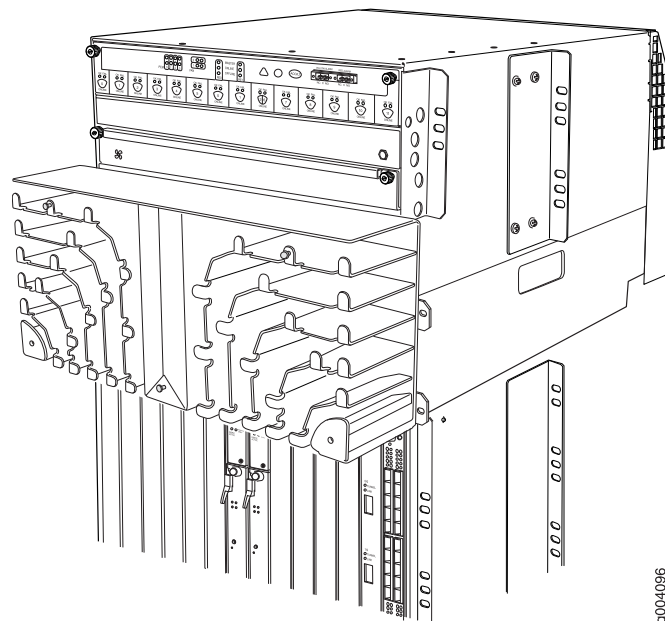
**Action** On a regular basis:

- Use a standard cable manager or extended cable manager (shown in [Figure 178 on page 465](#) and [Figure 179 on page 465](#)) to support cables and prevent cables from dislodging or developing stress points.

*Figure 178: Standard Cable Manager*



*Figure 179: Extended Cable Manager*



- Place excess cable out of the way in the standard or extended cable manager. Do not allow fastened loops of cable to dangle from the connector or cable manager because this stresses the cable at the fastening point. Putting fasteners on the loops helps to maintain their shape.

- Keep the cable connections clean and free of dust and other particles, which can cause drops in the received power level. Always inspect cables and clean them if necessary before connecting an interface.
- Label both ends of the cables to identify them.

The following guidelines apply specifically to fiber-optic cables:

- When you unplug a fiber-optic cable, always place a rubber safety plug over the transceiver on the faceplate and on the end of the cable.
- Anchor fiber-optic cables to avoid stress on the connectors. Be sure to secure fiber-optic cables so that they do not support their own weight as they hang to the floor. Never let fiber-optic cable hang free from the connector.
- Avoid bending fiber-optic cable beyond its bend radius. An arc smaller than a few inches can damage the cable and cause problems that are difficult to diagnose.
- Frequent plugging and unplugging of fiber-optic cable into and out of optical instruments can cause damage to the instruments that is expensive to repair. Instead, attach a short fiber extension to the optical equipment. Any wear and tear due to frequent plugging and unplugging is then absorbed by the short fiber extension, which is easy and inexpensive to replace.
- Keep fiber-optic cable connections clean. Small microdeposits of oil and dust in the canal of the transceiver or cable connector could cause loss of light, reducing signal power and possibly causing intermittent problems with the optical connection.

To clean the transceivers, use an appropriate fiber-cleaning device, such as RIFOCS Fiber Optic Adaptor Cleaning Wands (part number 946). Follow the directions for the cleaning kit you use.

After you clean an optical transceiver, make sure that the connector tip of the fiber-optic cable is clean. Use only an approved alcohol-free fiber-optic cable cleaning kit, such as the Optex Cletop-S Fiber Cleaner. Follow the directions for the cleaning kit you use.

- Related Documentation**
- [Maintaining MX960 DPCs on page 448](#)
  - [Maintaining MX960 MPCs on page 461](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Maintaining MX960 PICs on page 464](#)

---

## Maintaining the MX960 Power Supplies

---

**Purpose** For optimum router performance, verify the condition of the power supplies.

**Action** On a regular basis:

- Check the status of the power supplies by issuing the **show chassis environment pem** command. The output is similar to the following:



```
user@host> show chassis environment pem
```

```
PEM 0 status:
  State           Online
  Temperature     OK
  DC output       OK
PEM 1 status:
  State           Online
  Temperature     OK
  DC output       OK
```

- Make sure that the power and grounding cables are arranged so that they do not obstruct access to other router components.
- Routinely check the status LEDs on the power supply faceplates and the craft interface to determine if the power supplies are functioning normally.
- Check the red and yellow alarm LEDs on the craft interface. Power supply failure or removal triggers an alarm that causes one or both of the LEDs to light. You can display the associated error messages by issuing the following command:

```
user@host> show chassis alarms
```

- Periodically inspect the site to ensure that the grounding and power cables connected to the router are securely in place and that there is no moisture accumulating near the router.

#### Related Documentation

- [MX960 Power Supply LEDs on the Craft Interface on page 16](#)
- [MX960 AC Power Supply Description on page 86](#)
- [MX960 DC Power Supply on page 92](#)
- [Troubleshooting Resources for MX960 Routers on page 485](#)
- [MX960 Site Preparation Checklist on page 122](#)

## Verifying the Version of the MX960 Cable Manager

**Purpose** To verify the version of the cable manager—standard or extended.

**Action** Issue the **show chassis hardware** command. In the following output, *Extended Cable Manager* in the **Description** field indicates that the MX960 router has an extended cable manager installed.

```
user@host> show chassis hardware
```

```
Hardware inventory:
Item           Version  Part number  Serial number  Description
Chassis                                     JN10BA496AFA  MX960
Midplane       REV 03   710-013698   TR0193         MX960 Backplane
Fan Extender   REV 02   710-018051   JY5226         Extended Cable
Manager
FPM Board      REV 03   710-014974   JZ6867         MX960 Front
```

Panel Display				
PDM	Rev 03	740-013110	QCS11035022	Power
Distribution Module				
PEM 0 Module	Rev 03	740-013683	QCS1104706T	DC Power Entry
PEM 1 Module	Rev 03	740-013683	QCS11047071	DC Power Entry
PEM 2 Module	Rev 03	740-013683	QCS1110700A	DC Power Entry
PEM 3 Module	Rev 03	740-013683	QCS11107006	DC Power Entry
Routing Engine 0	REV 06	740-013063	1000690747	RE-S-2000
Routing Engine 1	REV 06	740-013063	1000690717	RE-S-2000
CB 0	REV 07	710-013385	KA3976	MX SCB
CB 1	REV 07	710-013385	KA2127	MX SCB
CB 2	REV 07	710-013385	KA2122	MX SCB
FPC 0	REV 06	710-013699	JZ8103	DPCE 40x 1GE X
CPU	REV 06	710-013713	JZ7349	DPC PMB
PIC 0		BUILTIN	BUILTIN	10x 1GE(LAN)
Xcvr 0	REV 01	740-011783	PB93302	SFP-LX
Xcvr 1	REV 01	740-011613	AM0703S02F5	SFP-SX
Xcvr 2	REV 01	740-011613	AM0703S02EV	SFP-SX
Xcvr 3	REV 01	740-011613	AM0703S02EN	SFP-SX
Xcvr 4	REV 01	740-011613	AM0703S02FD	SFP-SX
Xcvr 5	REV 01	740-011783	PB93RLK	SFP-LX
Xcvr 6	REV 01	740-011783	PB9292T	SFP-LX
Xcvr 7	REV 01	740-011613	AM0703S02EC	SFP-SX
Xcvr 8	REV 01	740-011783	PB9296B	SFP-LX
Xcvr 9	REV 01	740-011783	PB9294X	SFP-LX
PIC 1		BUILTIN	BUILTIN	10x 1GE(LAN)
Xcvr 0	REV 01	740-011783	PB9330R	SFP-LX
Xcvr 1	REV 01	740-011613	PB349PQ	SFP-SX
Xcvr 2	REV 01	740-011613	AM0703S02F1	SFP-SX
Xcvr 3	REV 01	740-011613	PB3494J	SFP-SX
Xcvr 4	REV 01	740-011613	AM0703S02EY	SFP-SX
Xcvr 5	REV 01	740-011613	AM0703S02F3	SFP-SX
Xcvr 6	REV 01	740-011613	AM0703S02EX	SFP-SX
Xcvr 7	REV 01	740-011613	AM0703S02EZ	SFP-SX
Xcvr 8	REV 01	740-011613	AM0703S02ET	SFP-SX
Xcvr 9	REV 01	740-011613	AM0703S02G8	SFP-SX
PIC 2		BUILTIN	BUILTIN	10x 1GE(LAN)
Xcvr 0	REV 01	740-011783	PB92938	SFP-LX
Xcvr 1	REV 01	740-011613	AM0703S02E0	SFP-SX
Xcvr 2	REV 01	740-011613	AM0703S02F6	SFP-SX
Xcvr 3	REV 01	740-011613	AM0703S02FB	SFP-SX
Xcvr 4	REV 01	740-011613	AM0703S02FA	SFP-SX
Xcvr 5	REV 01	740-011613	AM0703S02ED	SFP-SX
Xcvr 6	REV 01	740-011783	PB9338R	SFP-LX
Xcvr 7	REV 01	740-011613	AM0703S02E1	SFP-SX
Xcvr 8	REV 01	740-011783	PB929AU	SFP-LX
Xcvr 9	REV 01	740-011783	PB929AV	SFP-LX
PIC 3		BUILTIN	BUILTIN	10x 1GE(LAN)
Xcvr 0	REV 01	740-011783	PB9330Q	SFP-LX
Xcvr 1	REV 01	740-011613	AM0703S02E8	SFP-SX
Xcvr 2	REV 01	740-011613	PB34FPU	SFP-SX
Xcvr 3	REV 01	740-011613	PB34FZ4	SFP-SX
Xcvr 4	REV 01	740-011613	PB34N3Q	SFP-SX
Xcvr 5	REV 01	740-011613	AM0703S02EL	SFP-SX
Xcvr 6	REV 01	740-011613	AM0703S02EG	SFP-SX
Xcvr 7	REV 01	740-011613	AM0703S02EJ	SFP-SX

Xcvr 8	REV 01	740-011783	PB9292Y	SFP-LX
Xcvr 9	REV 01	740-011783	PB9296A	SFP-LX
FPC 3	REV 08	710-014219	KA1048	DPCE 4x 10GE X
CPU	REV 06	710-013713	JZ7177	DPC PMB
PIC 0		BUILTIN	BUILTIN	1x
10GE(LAN/WAN)				
Xcvr 0	REV 01	740-014279	6Z3019A00247	XFP-10G-LR
PIC 1		BUILTIN	BUILTIN	1x
10GE(LAN/WAN)				
Xcvr 0	REV 01	740-014279	723019A00434	XFP-10G-LR
PIC 2		BUILTIN	BUILTIN	1x
10GE(LAN/WAN)				
Xcvr 0	REV 01	740-014289	C712XU005	XFP-10G-SR
PIC 3		BUILTIN	BUILTIN	1x
10GE(LAN/WAN)				
Xcvr 0	REV 01	740-014279	6Z3019A00216	XFP-10G-LR
Fan Tray 0	REV 03	740-014971	TP0730	Fan Tray
Fan Tray 1	REV 03	740-014971	TP0451	Fan Tray

- Related Documentation**
- [MX960 Cable Manager Description on page 18](#)
  - [Replacing the MX960 Cable Manager on page 307](#)



# Converting to a Different Type of Power Supply

- [Converting from AC to DC Power Supplies on an MX960 Router on page 471](#)
- [Converting from DC to AC Power Supplies on an MX960 Router on page 476](#)

## Converting from AC to DC Power Supplies on an MX960 Router

---

The conversion of an MX960 router from AC to DC or DC to AC should be performed with the system completely powered off. A system cannot operate with a mix of AC and DC power supplies. This procedure assumes conversion from normal-capacity power supplies to high-capacity power supplies.

Remove MX960 normal-capacity AC power supplies for power supplies in slots 0, 1, 2, 3 where present. All power supplies should be removed before proceeding with the installation of the DC power supplies. To convert from AC to DC, use the following procedures.

Use the following procedures to install the MX960 high capacity DC power supplies for power supply in slots 0, 1, 2, 3 where present.

To remove a normal-capacity AC power supply (see [Figure 161 on page 399](#)):

1. Move the AC input switch in the chassis above the power supply in slot 0 to the off (O) position.
2. Remove the power cord from the AC power source. Follow the ESD and disconnection instructions for your site.
3. Remove the power cord from the power supply.
4. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.
5. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

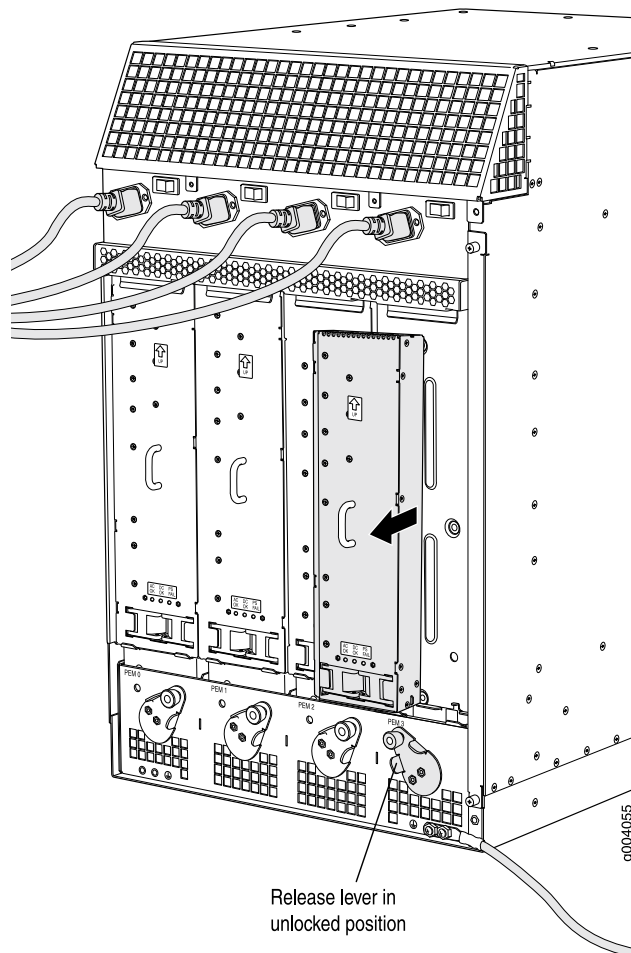
- Pull the power supply straight out of the chassis as shown in [Figure 161 on page 399](#).



**WARNING:** Do not touch the power connector on the top of the power supply. It can contain dangerous voltages.

- Repeat steps 1-6 for power supplies in slot 1, 2, 3 where present.

*Figure 180: Removing an MX960 AC Power Supply*



Use the following procedures to install the MX960 high-capacity DC power supplies for power supply in slots 0, 1, 2, and 3, where present.

To install an MX960 DC high-capacity DC power supply:

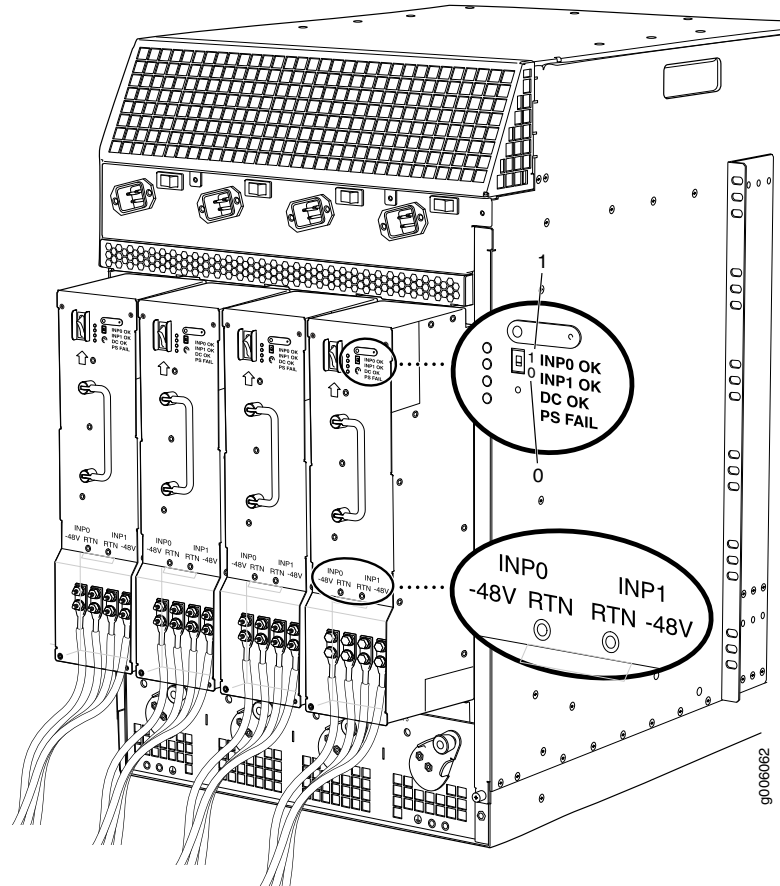
- Verify that the power switch on the power supply is in the off (O) position.
- On the power supply, rotate the metal cover away from the input mode switch to expose the switch.

3. Move the input mode switch to position 0 for one feed or position 1 for two feeds (see Figure 71 on page 227).



**NOTE:** For a fully redundant configuration in two-feed mode, eight feeds are required. For a nonredundant configuration, four feeds are required.

Figure 181: MX960 with High-Capacity DC Power Supplies Installed



**CAUTION:** Do not use a pencil, because fragments can break off and cause damage to the power supply.

4. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.
5. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position.

If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

6. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply. This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

7. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
8. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
9. Remove the cover protecting the terminal studs on the faceplate.
10. Remove the nut and washer from each of the terminal studs.
11. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut. Do not overtighten the nut. (Use a 7/16-in. [11-mm] torque-controlled driver or socket wrench.)
  - a. On **INPUT 0**, attach the positive (+) DC source power cable lug to the **RTN** (return) terminal as shown in [Figure 71 on page 227](#). Repeat this step for **INPUT 1** if using two feeds.
  - b. On **INPUT 0** attach the negative (–) DC source power cable lug to the **-48V** (input) terminal. Repeat this step for **INPUT 1** if using two feeds.



**CAUTION:** Ensure that each power cable lug seats flush against the surface of the terminal block as you are tightening the nuts. Ensure that each nut is properly threaded onto the terminal stud. The nut should be able to spin freely with your fingers when it is first placed onto the terminal stud. Applying installation torque to the nut when improperly threaded may result in damage to the terminal stud.

---



**CAUTION:** The maximum torque rating of the terminal studs on the DC power supply is 36 lb-in. (4.0 Nm). The terminal studs may be damaged



if excessive torque is applied. Use only a torque-controlled driver or socket wrench to tighten nuts on the DC power supply terminal studs.



**NOTE:** The DC power supplies in slots PEM0 and PEM1 must be powered by dedicated power feeds derived from feed A, and the DC power supplies in PEM2 and PEM3 must be powered by dedicated power feeds derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system. For information about connecting to DC power sources, see [“Electrical Specifications for the MX960 DC Power Supply” on page 159](#).

12. Verify that the power cabling is correct, that the cables are not touching, and that they do not block access to router components or drape where people could trip on them.
13. Replace the clear plastic cover over the terminal studs on the faceplate.
14. Switch on the dedicated customer site circuit breaker.
15. Verify that the **INPUT 0 OK** or **INPUT 1 OK** LEDs on the power supply are lit green steadily. If using two feeds, verify that both **INPUT 0 OK** and **INPUT 1 OK** LEDs on the power supply are lit steadily. The **INPUT OK** will be lit amber if that input's voltage is in reverse polarity. Check the polarity of the power cables to fix the condition (see [Figure 72 on page 230](#) and [Table 83 on page 229](#)).
16. Move the switch to the on (I) position.
17. Verify that the **DC OK** LED is lit green steadily. See [Table 83 on page 229](#) for information on MX960 high-capacity DC LEDs.

**Table 85: MX960 High-Capacity DC Power Supply LEDs**

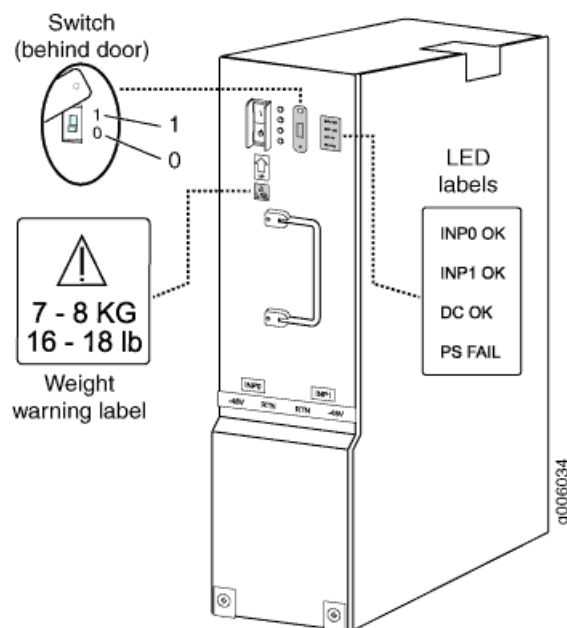
Connected Inputs	DIP Switch Position	LEDs			
		INP-0 OK	INP-1 OK	DC OK	PS FAIL
INP0 connected, INP1 disconnected	0 (1 input)	Green	Off	Green	Off
INP0 disconnected, INP1 connected		Off	Green	Green	Off
INP0 connected, INP1 connected		Green	Green	Green	Off

Table 85: MX960 High-Capacity DC Power Supply LEDs (continued)

Connected Inputs	DIP Switch Position	LEDs			
		INP-0 OK	INP-1 OK	DC OK	PS FAIL
INP0 connected, INP1 disconnected	1 (2 inputs)	Green	Off	Off	Red
INP0 disconnected, INP1 connected		Off	Green	Off	Red
INP0 connected, INP1 connected		Green	Green	Green	Off

18. Repeat steps 1-17 for installing power supplies in slots 1, 2, and 3, where present.

Figure 182: MX960 DC High-Capacity Power Supply Front View



19. Install a blank panel over the power distribution modules, if available.

- Related Documentation**
- [MX960 Power System Overview on page 85](#)
  - [Troubleshooting the MX960 Power System on page 496](#)

## Converting from DC to AC Power Supplies on an MX960 Router

The conversion of an MX960 router from AC to DC or DC to AC should be performed with the system completely powered off. A system cannot operate with a mix of AC and DC power supplies. This procedure assumes conversion from normal-capacity power supplies to high-capacity power supplies.

Remove MX960 normal-capacity DC power supplies for power supply in slots 0, 1, 2, 3 where present. All power supplies should be removed proceeding with the installation of the AC power supplies. To convert from DC to AC, use the following procedures.

To remove a normal-capacity DC power supply (see [Figure 164 on page 404](#)):

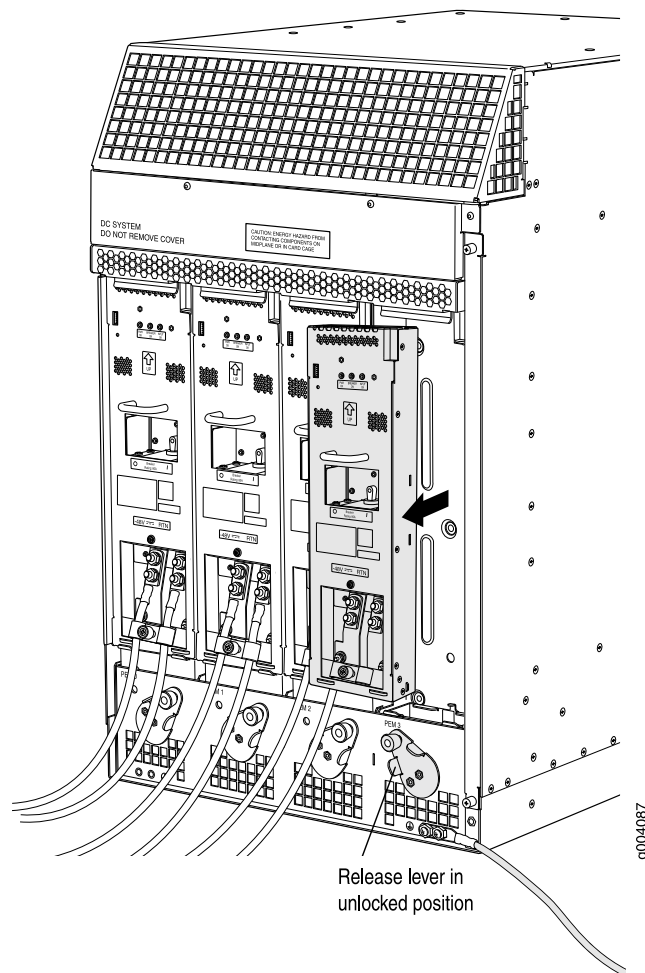
1. Switch off the dedicated customer site circuit breaker for the power supply being removed. Follow your site's procedures for electrostatic discharge (ESD).
2. Move the DC circuit breaker on the power supply faceplate to the off (O) position.
3. Verify that the **INPUT OK** LEDs on the power supply to be removed are not lit. Also verify that the **BREAKER ON** LED is not lit.
4. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.
5. Remove the clear plastic cover protecting the terminal studs on the faceplate from the power supply in slot 0.
6. Remove the nut and washer from each of the terminal studs. (Use a 7/16-in. [11-mm] nut driver or socket wrench.)
7. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.
8. Remove the cable lugs from the terminal studs.
9. Carefully move the power cables out of the way.
10. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops.
11. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
12. Pull the power supply straight out of the chassis (see [Figure 164 on page 404](#)).



**WARNING:** Do not touch the power connector on the top of the power supply. It can contain dangerous voltages.

13. Repeat steps 1-12 for power supplies in slot 1, 2, and 3, where present.

Figure 183: Removing a DC Power Supply from the MX960 Router



Use the following procedures to install the MX960 high-capacity AC power supplies for power supply in slots 0, 1, 2, and 3, where present.

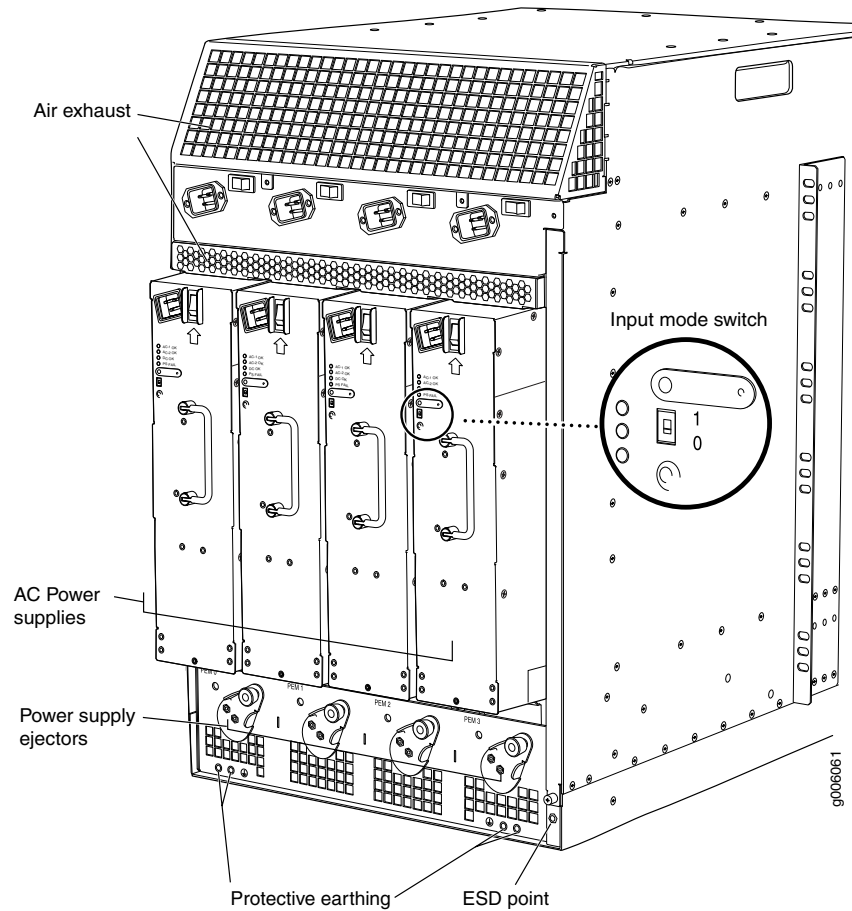


**NOTE:** During the upgrade process, you can simultaneously run normal-capacity and high-capacity power supplies. However, it is recommended to upgrade all power supplies to high-capacity power supplies.

To install an MX960 high-capacity AC power supply, use the following procedure (see [Figure 68 on page 219](#)).

1. Verify that the power switch on the power supply is in the off (O) position.
2. Ensure that the release lever below the empty power supply slot is locked in the counterclockwise position (see [Figure 68 on page 219](#)).

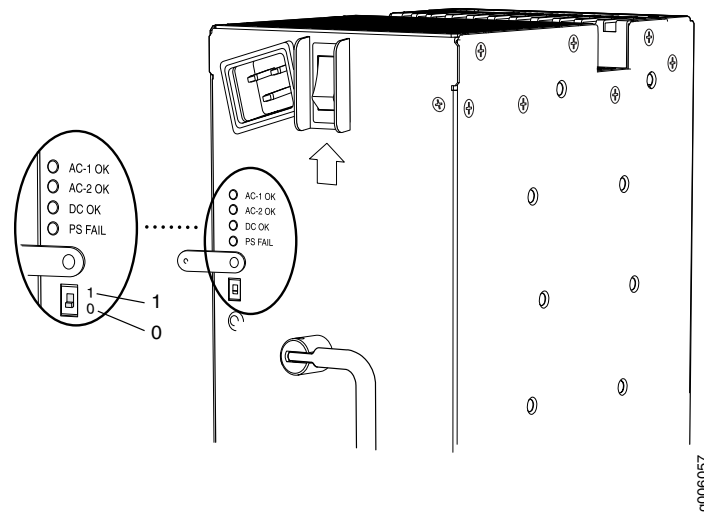
Figure 184: MX960 with High-Capacity AC Power Supplies Installed



If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

3. On the power supply, rotate the metal cover away from the input mode switch to expose the switch.
4. Move the input mode switch to position 0 for one feed or position 1 for two feeds (see [Figure 69 on page 220](#)).

Figure 185: MX960 AC Power Input Mode Switch



**CAUTION:** Do not use a pencil, because fragments can break off and cause damage to the power supply.

- Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate will protrude beyond the chassis.

The small tab on the metal housing that is controlled by the release lever must be inside of the corresponding slot at the bottom of the power supply (see [Figure 69 on page 220](#)). This tab is used to pull the power supply down in the chassis slot, prior to removing the power supply.

- While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.
- Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.
- Locate a power cord with the type of plug appropriate for your geographical location (see [“AC Power Cord Specifications for the MX960 Router” on page 156](#)).
- Plug the power cord into the corresponding appliance inlet located in the chassis directly above the power supply. This is the recommend receptacle when using the power supply in one feed mode. If using the power supply in two-feed mode, plug the second power cord into the receptacle on the power supply.



**NOTE:** Each power supply must be connected to a dedicated AC power feed and a dedicated customer site circuit breaker.

10. Dress the power cord appropriately. Verify that the power cord does not block the air exhaust and access to router components, and that they do not drape where people could trip on them.
11. Move the AC input switch above the power supply to the on (—) position. This is the only switch you have to turn on if you are using the power supply in one feed mode. If using the power supply in two-feed mode, move the power switch on the power supply to the on position. Remember to turn on both switches when operating the power supply in two-feed mode.
12. If the power supply is correctly installed and functioning normally, the **AC1 OK**, **AC2 OK** (two-feed mode only), and **DC OK** LEDs light steadily, and the **PS FAIL** LED is not lit. See [Table 82 on page 221](#).
13. Repeat steps 1-12 for installing power supplies in slots 1, 2, and 3, where present

**Table 86: MX960 High-Capacity AC Power Supply LEDs**

Connected Inputs	DIP Switch Position	LEDs			
		AC-1 OK	AC-2 OK	DC OK	PS FAIL
PDM connected, power supply disconnected	0 (1 input)	Green	Off	Green	Off
PDM disconnected, power supply connected	0 (1 input)	Off	Green	Green	Off
PDM connected, PS connected	0 (1 input)	Green	Green	Green	Off
PDM connected, PS disconnected	1 (2 inputs)	Green	Off	Off	Red
PDM disconnected, PS connected	1 (2 inputs)	Off	Green	Off	Red
PDM connected, PS connected	1 (2 inputs)	Green	Green	Green	Off

**NOTE:** PDM in the above table stands for Power Distribution Module.

- Related Documentation**
- [MX960 Power System Overview on page 85](#)
  - [Troubleshooting the MX960 Power System on page 496](#)



PART 6

# Troubleshooting Hardware

- [Troubleshooting Components on page 485](#)



## CHAPTER 30

# Troubleshooting Components

- [Troubleshooting Resources for MX960 Routers on page 485](#)
- [Troubleshooting the MX960 Cooling System on page 488](#)
- [Troubleshooting the MX960 DPCs on page 488](#)
- [Troubleshooting the MX960 FPCs on page 490](#)
- [Troubleshooting the MX960 PICs on page 492](#)
- [Troubleshooting the MX960 MICs on page 493](#)
- [Troubleshooting the MX960 MPCs on page 494](#)
- [Troubleshooting the MX960 Power System on page 496](#)

## Troubleshooting Resources for MX960 Routers

---

- [Command-Line Interface on page 485](#)
- [Chassis and Interface Alarm Messages on page 486](#)
- [Alarm Relay Contacts on page 486](#)
- [Craft Interface LEDs on page 486](#)
- [Component LEDs on page 487](#)
- [Juniper Networks Technical Assistance Center on page 487](#)

## Command-Line Interface

The Junos OS command-line interface (CLI) is the primary tool for controlling and troubleshooting router hardware, the Junos OS, routing protocols, and network connectivity. CLI commands display information from routing tables, information specific to routing protocols, and information about network connectivity derived from the **ping** and **traceroute** utilities.

You enter CLI commands on one or more external management devices connected to ports on the Routing Engine.

For information about using the CLI to troubleshoot the Junos OS, see the appropriate Junos OS configuration guide.

## Chassis and Interface Alarm Messages

When the Routing Engine detects an alarm condition, it lights the red or yellow alarm LED on the craft interface as appropriate. To view a more detailed description of the alarm cause, issue the **show chassis alarms** command:

```
user@host> show chassis alarms
```

There are two classes of alarm messages:

- Chassis alarms—Indicate a problem with a chassis component such as the cooling system or power supplies.
- Interface alarms—Indicate a problem with a specific network interface.

## Alarm Relay Contacts

The craft interface has two alarm relay contacts for connecting the router to external alarm devices. Whenever a system condition triggers either the red or yellow alarm on the craft interface, the alarm relay contacts are also activated. The alarm relay contacts are located on the upper right of the craft interface.

## Craft Interface LEDs

The craft interface is the panel on the front of the router located above the DPC cards that contains LEDs and buttons that allow you to troubleshoot the router.

LEDs on the craft interface include the following:

- Alarm LEDs—One large red circular LED and one large yellow triangular LED, located on the upper right of the craft interface, indicate two levels of alarm conditions. The circular red LED lights to indicate a critical condition that can result in a system shutdown. The triangular yellow LED lights to indicate a less severe condition that requires monitoring or maintenance. Both LEDs can be lit simultaneously. A condition that causes an alarm LED to light also activates the corresponding alarm relay contact on the craft interface.
- Host subsystem LEDs—Three LEDs, **MASTER**, **ONLINE**, and **OFFLINE**, indicate the status of the host subsystem. A green **MASTER** LED indicates that the host is functioning as the master. The **ONLINE** LED indicates that the host is online. The **OFFLINE** LED indicates that the host is installed but the routing engine is offline. The host subsystem LEDs are located on the left of the craft interface and are labeled **RE0** and **RE1**.
- Power supply LEDs—Two LEDs (**PEM**) indicate the status of each power supply. Green indicates that the power supply is functioning normally. Red indicates that the power supply is not functioning normally. The power supply LEDs are located in the center craft interface, and are labeled **0** through **3**.
- Line card LEDs—Two LEDs, **OK** and **FAIL**, indicate the status of each DPC, FPC, or MPC. Green indicates OK and red indicates a failure. The line card LEDs are located along the bottom of the craft interface.

- SCB LEDs—Two LEDs, **OK** and **FAIL**, indicate the status of each SCB. Green indicates OK and red indicates a failure. The SCB LEDs are located on the left of the craft interface along the bottom.
- Fan LEDs—Two LEDs indicate the status of the fans. Green indicates the fans are functioning normally and red indicates a fan has failed. The fan LEDs are located on the upper left of the craft interface.

## Component LEDs

The following LEDs are located on various router components and display the status of those components:

- DPC LED—One LED labeled **OK/FAIL** on each DPC faceplate indicates the DPC's status. For more information, see the [MX Series Interface Module Reference](#).
- FPC LED—One LED labeled **OK/FAIL** on each FPC faceplate indicates the FPC's status.
- MPC LED—One LED labeled **OK/FAIL** on each FPC faceplate indicates the FPC's status.
- MIC LED—One LED labeled **OK/FAIL** on each MIC faceplate indicates the MIC's status. For more information, see the [MX Series Interface Module Reference](#).
- PIC LED—One LED labeled **OK/FAIL** on each PIC faceplate indicates the PIC's status. For more information, see the [MX Series Interface Module Reference](#).
- SCB LEDs—Three LEDs, labeled **FABRIC ACTIVE**, **FABRIC ONLY**, and **OK/FAIL**, on each SCB faceplate indicate the status of the SCB. If no LEDs are lit, the master RE might still be booting or the SCB is not receiving power.
- Routing Engine LEDs—Four LEDs, labeled **MASTER**, **HDD**, **ONLINE**, and **FAIL** on each Routing Engine faceplate indicate the status of the Routing Engine and hard disk drive.
- Power supply LEDs—Two LEDs on each power supply faceplate indicate the status of that power supply.

## Juniper Networks Technical Assistance Center

If you need assistance during troubleshooting, you can contact the Juniper Networks Technical Assistance Center (JTAC) by using the Web or by telephone.

### Related Documentation

- [Troubleshooting the MX960 Cooling System on page 488](#)
- [Troubleshooting the MX960 DPCs on page 488](#)
- [Troubleshooting the MX960 FPCs on page 490](#)
- [Troubleshooting the MX960 PICs on page 492](#)
- [Troubleshooting the MX960 MPCs on page 494](#)
- [Troubleshooting the MX960 MICs on page 493](#)
- [Troubleshooting the MX960 Power System on page 496](#)

## Troubleshooting the MX960 Cooling System

---

**Problem**    **Description:** The fans in a fan tray are not functioning normally.

**Solution**    Follow these guidelines to troubleshoot the fans:

- Check the fan LEDs and alarm LEDs on the craft interface.
- If the red alarm LED on the craft interface lights, use the CLI to get information about the source of an alarm condition: `user@host> show chassis alarms`.  
  
If the CLI output lists only one fan failure, and the other fans are functioning normally, the fan is most likely faulty and you must replace the fan tray.
- Place your hand near the exhaust vents at the side of the chassis to determine whether the fans are pushing air out of the chassis.
- If a fan tray is removed, a yellow alarm and a red alarm occur.
- The following conditions automatically cause the fans to run at full speed and also trigger the indicated alarm:
  - A fan fails (red alarm).
  - The router temperature exceeds the “temperature warm” threshold (yellow alarm).
  - The temperature of the router exceeds the maximum (“temperature hot”) threshold (red alarm and automatic shutdown of the power supplies).

**Related  
Documentation**

- [MX960 Alarm LEDs and Alarm Cutoff/Lamp Test Button on page 15](#)
- [Replacing an MX960 Fan Tray on page 323](#)
- [Maintaining the MX960 Air Filter on page 444](#)
- [Maintaining the MX960 Fan Trays on page 444](#)

## Troubleshooting the MX960 DPCs

---

**Problem**    **Description:** The DPCs are not functioning normally.

- Solution**
- Monitor the green LED labeled **OK** above the DPC on the craft interface as soon as a DPC is seated in an operating router.

The Routing Engine downloads the DPC software to it under two conditions: the DPC is present when the Routing Engine boots Junos OS, and the DPC is installed and requested online through the CLI or push button on the front panel. The DPC then runs diagnostics, during which the **OK** LED blinks. When the DPC is online and functioning normally, the **OK** LED lights green steadily.

- Make sure the DPC is properly seated in the midplane. Check that each ejector handle has been turned clockwise and is tight.
- Check the **OK/FAIL** LED on the DPC and **OK** and **FAIL** DPC LEDs on the craft interface. When the DPC is online and functioning normally, the **OK** LED lights green steadily.
- Issue the **show chassis fpc** command to check the status of installed DPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the DPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%)		Memory Utilization (%)		
			Total	Interrupt	DRAM (MB)	Heap	Buffer
0	Online	41	9	0	1024	15	57
1	Online	43	5	0	1024	16	57
2	Online	43	11	0	1024	16	57
3	Empty						
4	Empty						
5	Online	42	6	0	1024	16	57



**NOTE:** The **show chassis fpc** command displays the status of the DPCs.

For more detailed output, add the **detail** option. The following example does not specify a slot number, which is optional:

```
user@host> show chassis fpc detail
```

```
Slot 2 information:
  State                Online
  Temperature          22 degrees C / 71 degrees F
  Total CPU DRAM       1024 MB
  Total SRAM           256 MB
  Total SDRAM          0 MB
  Start time           2006-11-03 07:35:40 PST
  Uptime                2 hours, 27 minutes, 1 second

Slot 4 information:
  State                Online
  Temperature          22 degrees C / 71 degrees F
  Total CPU DRAM       1024 MB
  Total SRAM           256 MB
  Total SDRAM          0 MB
  Start time           2006-11-03 07:35:48 PST
  Uptime                2 hours, 26 minutes, 53 seconds

Slot 7 information:
```

```

State                               Online
Temperature                          24 degrees C / 75 degrees F
Total CPU DRAM                       1024 MB
Total SRAM                           256 MB
Total SDRAM                           0 MB
Start time                            2006-11-03 07:35:53 PST
Uptime                                2 hours, 26 minutes, 48 seconds

```

For further description of the output from the commands, see the *Junos OS Administration Library*.

- Related Documentation**
- [MX960 Dense Port Concentrator Description on page 35](#)
  - [Installing an MX960 DPC on page 265](#)
  - [Maintaining MX960 DPCs on page 448](#)

## Troubleshooting the MX960 FPCs

**Problem Description:** The FPCs are not functioning normally.

- Solution**
- Monitor the green LED labeled **OK** above the FPC on the craft interface as soon as an FPC is seated in an operating router.

The Routing Engine downloads the FPC software to it under two conditions: the FPC is present when the Routing Engine boots Junos OS, and the FPC is installed and requested online through the CLI or push button on the front panel. The FPC then runs diagnostics, during which the **OK** LED blinks. When the FPC is online and functioning normally, the **OK** LED lights green steadily.

- Make sure the FPC is properly seated in the midplane. Check that each ejector handle has been turned clockwise and is tight.
- Check the **OK/FAIL** LED on the FPC and **OK** and **FAIL** FPC LEDs on the craft interface. When the FPC is online and functioning normally, the **OK** LED lights green steadily.
- Issue the **show chassis fpc** command to check the status of installed FPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the FPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%)	Memory Utilization (%)
			Total	DRAM (MB) Heap
0	Online	24	3	0 1024 13 21
1	Empty			
2	Online	41	9	0 1024 15 57
3	Online	43	5	0 1024 16 57
4	Online	43	11	0 1024 16 57
5	Online	41	9	0 1024 15 57
6	Online	43	5	0 1024 16 57
7	Empty			
8	Empty			



```

9 Empty
10 Online 24 3 0 1024 13 21
11 Empty

```



**NOTE:** The `show chassis fpc` command displays the status of the FPCs.

For more detailed output, add the `detail` option. The following example does not specify a slot number, which is optional:

```
user@host> show chassis fpc detail
```

```

Slot 0 information:
  State                Online
  Temperature          24 degrees C / 75 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         128 MB
  Total DDR DRAM       2048 MB
  Start time:          2008-12-11 16:53:24 PST
  Uptime:              15 hours, 2 minutes, 47 seconds
Slot 2 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:          2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds
Slot 3 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:          2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds
Slot 4 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:          2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds
Slot 5 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         256 MB
  Total DDR DRAM       4096 MB
  Start time:          2008-12-11 16:53:22 PST
  Uptime:              15 hours, 2 minutes, 49 seconds
Slot 6 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM       1024 MB

```

```

Total RLDRAM          256 MB
Total DDR DRAM        4096 MB
Start time:           2008-12-11 16:53:18 PST
Uptime:               15 hours, 2 minutes, 53 seconds
Slot 10 information:
State                 Online
Temperature           24 degrees C / 75 degrees F
Total CPU DRAM        1024 MB
Total RLDRAM          128 MB
Total DDR DRAM        2048 MB
Start time:           2008-12-11 16:53:24 PST
Uptime:               15 hours, 2 minutes, 47 seconds

```

For further description of the output from the commands, see the *Junos OS Administration Library*.

#### Related Documentation

- [Maintaining MX960 FPCs on page 453](#)
- [Replacing an MX960 FPC on page 358](#)
- [MX960 Flexible PIC Concentrator \(FPC\) LEDs on page 47](#)
- [Holding an MX960 FPC on page 455](#)
- [Storing an MX960 FPC on page 459](#)

## Troubleshooting the MX960 PICs

**Problem** **Description:** The PICs are not functioning normally.

- Solution**
- Check the status of each port on a PIC by looking at the LED located on the PIC faceplate. For information about the meaning of LED states on different PICs, see the [MX Series Interface Module Reference](#).
  - Check the status of a PIC by issuing the **show chassis fpc pic-status** CLI command. The PIC slots in the FPC are numbered from **0** through **1**, top to bottom:

```

user@host> show chassis fpc pic-status
Slot 0  Online      DPC 40x 1GE R
PIC 0   Online      10x 1GE(LAN)
PIC 1   Online      10x 1GE(LAN)
PIC 2   Online      10x 1GE(LAN)
PIC 3   Online      10x 1GE(LAN)
Slot 1  Online      MX FPC Type 3
PIC 0   Online      1x 0C-192 SONET
PIC 1   Online      1x 0C-192 SONET

```

For further description of the output from the command, see the [CLI Explorer](#).

#### Related Documentation

- [MX960 PIC Description on page 48](#)

- [Replacing an MX960 PIC on page 380](#)
- [Maintaining MX960 PICs on page 464](#)
- [MX960 PIC Serial Number Label on page 514](#)

## Troubleshooting the MX960 MICs

**Problem**    **Description:** The MICs are not functioning normally.

- Solution**
- Check the status of each port on a MIC by looking at the LED located on the MIC faceplate. For information about the meaning of LED states on different MICs, see the *MX Series Ethernet Services Routers Line Card Guide*.
  - Check the status of a MIC by issuing the **show chassis fpc pic-status** CLI command. The MIC slots in the MPC are labeled **PIC 0/1** and **PIC 2/3**, top to bottom:

```
user@host> show chassis fpc pic-status
Slot 0  Online      DPCE 4x 10GE R EQ
  PIC 0  Online      1x 10GE(LAN/WAN) EQ
  PIC 1  Online      1x 10GE(LAN/WAN) EQ
  PIC 2  Online      1x 10GE(LAN/WAN) EQ
  PIC 3  Online      1x 10GE(LAN/WAN) EQ
Slot 1  Online      DPCE 40x 1GE R EQ
  PIC 0  Online      10x 1GE(LAN) EQ
  PIC 1  Online      10x 1GE(LAN) EQ
  PIC 2  Online      10x 1GE(LAN) EQ
  PIC 3  Online      10x 1GE(LAN) EQ
Slot 2  Online      MS-DPC
  PIC 0  Online      MS-DPC PIC
  PIC 1  Online      MS-DPC PIC
Slot 3  Online      MPC Type 2 3D EQ
  PIC 0  Online      1x 10GE XFP
  PIC 1  Online      1x 10GE XFP
Slot 4  Online      MPC 3D 16x 10GE
  PIC 0  Online      4x 10GE(LAN) SFP+
  PIC 1  Online      4x 10GE(LAN) SFP+
  PIC 2  Online      4x 10GE(LAN) SFP+
  PIC 3  Online      4x 10GE(LAN) SFP+
Slot 6  Online      MX960 40GE DPC
  PIC 0  Online      10x 1GE
  PIC 1  Online      10x 1GE
  PIC 2  Online      10x 1GE
  PIC 3  Online      10x 1GE
Slot 10 Online      MPC 3D 16x 10GE
  PIC 0  Online      4x 10GE(LAN) SFP+
  PIC 1  Online      4x 10GE(LAN) SFP+
  PIC 2  Online      4x 10GE(LAN) SFP+
  PIC 3  Online      4x 10GE(LAN) SFP+
```

For further description of the output from the command, see the [CLI Explorer](#).

- Related Documentation**
- [MX960 Modular Interface Card Description on page 65](#)
  - [Maintaining MX960 MICs on page 460](#)
  - [Replacing an MX960 MIC on page 364](#)

## Troubleshooting the MX960 MPCs

**Problem**    **Description:** The MPCs are not functioning normally.

**Solution**    • Monitor the green LED labeled **OK** above the MPC on the craft interface as soon as an MPC is seated in an operating router.

The Routing Engine downloads the MPC software to it under two conditions: The MPC is present when the Routing Engine boots Junos OS, and the MPC is installed and requested online through the CLI or push button on the front panel. The MPC then runs diagnostics, during which the **OK** LED blinks. When the MPC is online and functioning normally, the **OK** LED lights green steadily.

- Make sure the MPC is properly seated in the midplane. Check that each ejector handle has been turned clockwise and is tight.
- Check the **OK/FAIL** LED on the MPC and **OK** and **FAIL** line card LEDs on the craft interface. When the MPC is online and functioning normally, the **OK** LED lights green steadily.
- Issue the **show chassis fpc** command to check the status of installed MPCs. As shown in the sample output, the value **Online** in the column labeled **State** indicates that the MPC is functioning normally:

```
user@host> show chassis fpc
```

Slot	State	Temp (C)	CPU Utilization (%)		Memory DRAM (MB)	Utilization (%)	
			Total	Interrupt		Heap	Buffer
0	Online	36	3	0	2048	14	13
1	Online	40	5	0	2048	26	13
2	Online	41	6	0	1024	7	43
3	Online	43	5	0	1024	16	57
4	Online	24	3	0	1024	13	21
5	Empty						
6	Online	43	5	0	1024	16	57
7	Empty						
8	Empty						
9	Empty						
10	Online	24	3	0	1024	13	21
11	Empty						



**NOTE:** The **show chassis fpc** command displays the status of the MPCs.

For more detailed output, add the **detail** option. The following example does not specify a slot number, which is optional:

```
user@host> show chassis fpc detail
```

```
Slot 0 information:
  State                Online
  Temperature          33 degrees C / 91 degrees F
  Total CPU DRAM      1024 MB
  Total RLDRAM        256 MB
  Total DDR DRAM      4096 MB
  Start time:         2009-12-22 12:26:54 PST
  Uptime:              6 days, 3 hours, 8 minutes, 51 seconds

  Max Power Consumption 330 Watts

Slot 1 information:
  State                Online
  Temperature          32 degrees C / 89 degrees F
  Total CPU DRAM      1024 MB
  Total RLDRAM        256 MB
  Total DDR DRAM      4096 MB
  Start time:         2009-12-22 12:26:54 PST
  Uptime:              6 days, 3 hours, 8 minutes, 51 seconds

  Max Power Consumption 365 Watts

Slot 2 information:
  State                Online
  Temperature          41 degrees C / 105 degrees F
  Total CPU DRAM      1024 MB
  Total RLDRAM        128 MB
  Total DDR DRAM      2048 MB
  Start time:         2009-12-22 12:26:46 PST
  Uptime:              6 days, 3 hours, 8 minutes, 59 seconds

  Max Power Consumption 265 Watts

Slot 3 information:
  State                Online
  Temperature          36 degrees C / 96 degrees F
  Total CPU DRAM      2048 MB
  Total RLDRAM        806 MB
  Total DDR DRAM      2632 MB
  Start time:         2009-12-22 12:27:04 PST
  Uptime:              6 days, 3 hours, 8 minutes, 41 seconds

  Max Power Consumption 450 Watts

Slot 4 information:
  State                Online
  Temperature          40 degrees C / 104 degrees F
  Total CPU DRAM      2048 MB
  Total RLDRAM        1324 MB
  Total DDR DRAM      5120 MB
  Start time:         2009-12-22 12:27:02 PST
  Uptime:              6 days, 3 hours, 8 minutes, 43 seconds

  Max Power Consumption 440 Watts

Slot 6 information:
  State                Online
  Temperature          29 degrees C / 84 degrees F
  Total CPU DRAM      1024 MB
  Total RLDRAM        256 MB
  Total DDR DRAM      4096 MB
  Start time:         2008-12-11 16:53:18 PST
  Uptime:              15 hours, 2 minutes, 53 seconds
  Max Power Consumption 365 Watts
```

```

Slot 10 information:
  State                Online
  Temperature          24 degrees C / 75 degrees F
  Total CPU DRAM       1024 MB
  Total RLDRAM         128 MB
  Total DDR DRAM       2048 MB
  Start time:          2008-12-11 16:53:24 PST
  Uptime:              15 hours, 2 minutes, 47 seconds
  Max Power Consumption 440 Watts

```

For further description of the output from the commands, see the *Junos OS Administration Library*.

- Related Documentation**
- [MX960 Modular Port Concentrator Description on page 76](#)
  - [Maintaining MX960 MPCs on page 461](#)
  - [Replacing an MX960 MPC on page 374](#)

## Troubleshooting the MX960 Power System

**Problem Description:** The power system is not functioning normally.

- Solution**
- Check the LEDs on each power supply faceplate.
    - If an AC power supply is correctly installed and functioning normally, the **AC OK** and **DC OK** LED's light steadily, and the **PS FAIL** LED is not lit.
    - If a DC power supply is correctly installed and functioning normally, the **PWR\_OK**, **INPUT OK**, and **BREAKER ON** LED's light steadily.
  - Issue the CLI **show chassis environment pem** command to check the status of installed power supply modules. As shown in the sample output, the value **Online** in the rows labeled **State** indicates that each power supply is functioning normally:

```

user@host> show chassis environment pem
PEM 0 status:
  State                Online
  Temperature          OK
  DC output            OK
PEM 1 status:
  State                Online
  Temperature          OK
  DC output            OK

```

If a power supply is not functioning normally, perform the following steps to diagnose and correct the problem:

- If a red alarm condition occurs, issue the **show chassis alarms** command to determine the source of the problem.
- Check that the AC input switch (—) or DC circuit breaker (I) is in the on position and that the power supply is receiving power.
- Verify that the source circuit breaker has the proper current rating. Each power supply must be connected to a separate source circuit breaker.
- Verify that the AC power cord or DC power cables from the power source to the router are not damaged. If the insulation is cracked or broken, immediately replace the cord or cable.
- Connect the power supply to a different power source with a new power cord or power cables. If the power supply status LEDs indicate that the power supply is not operating normally, the power supply is the source of the problem. Replace the power supply with a spare.
- If all power supplies have failed, the system temperature might have exceeded the threshold, causing the system to shut down.



**NOTE:** If the system temperature exceeds the threshold, the Junos OS shuts down all power supplies so that no status is displayed.

The Junos OS also can shut down one of the power supplies for other reasons. In this case, the remaining power supplies provide power to the router, and you can still view the system status through the CLI or display.

To restart a high-capacity AC power supply after a shut down due to an over-temperature situation:

1. Move the power switch on the power supply to the off (o) position.
2. Turn off power to where the AC line goes into the power distribution module (PDM) area.
3. Wait for the power supply LEDs to fade out and for the fans inside the power supply to shutdown. This can take up to 10 seconds.



**CAUTION:** Do not attempt to power-on the power supply if the LED is still lit and the fan is still running. If you do, the router will not reboot.

4. Turn on power to where the AC line goes into the power distribution module (PDM) area.

5. Move the power switch on the power supply to the on (I) position.
6. Verify that the LEDs on the power supply faceplate are properly lit.
7. Issue the CLI **show chassis environment pem** command and verify the State is **ONLINE** and the Temperature is **OK**.

To restart a high-capacity DC power supply after a shut down due to an over-temperature situation:

1. Switch off the circuit breaker(s) on the DC distribution panel to remove power to the chassis and power supplies.
2. Switch on the circuit breaker(s) on the distribution panel to power up the chassis and power supplies.



**NOTE:** The power switch on the power supplies is not part of the outer or inner DC circuits and therefore does not need to be switched off when restarting the chassis.

---



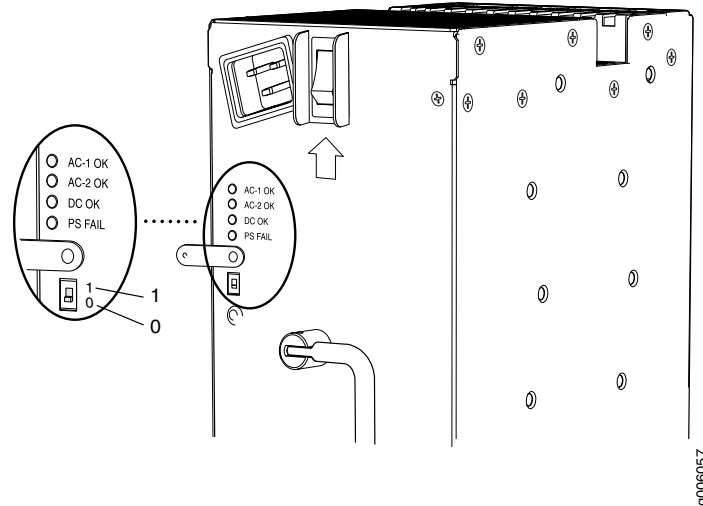
**NOTE:** If output power is not load-balancing correctly in the same zone on an MX960 with a high-capacity AC or DC power supply module, connect two feeds and change the DIP switch to 1 to boost the voltage on the power supply module.

---



Each High Capacity AC or DC power supply accepts two AC or DC feeds in two unique AC or DC receptacles. It is possible to operate with one feed, but there is a reduction in the power supply output. The DIP switch must be set according to the number of AC or DC feeds that are present for the power supply.

Figure 186: MX960 AC Power Input Mode Switch



- Position – 0 indicates that only one AC or DC feed is provided.
- Position – 1 indicates that two AC or DC feeds are provided.

To check the DIP switch position:

1. Issue the **show chassis power** command and check to see how many feeds are connected. The following example shows there are two AC input feeds connected for PEM 0 and one AC input feed connected for PEM 1. This indicates that the DIP switch for PEM 0 is in position 1 and the DIP switch for PEM 1 is in position 0. These are the proper settings.

**# run show chassis power**

```

PEM 0:
State: Online
AC input: OK (2 feed expected, 2 feed connected)
Capacity: 4100 W (maximum 4100 W)
DC output: 855 W (zone 0, 15 A at 57 V, 20% of capacity)

PEM 1:
State: Online
AC input: OK (1 feed expected, 1 feed connected)
Capacity: 1700 W (maximum 4100 W)
DC output: 969 W (zone 1, 17 A at 57 V, 57% of capacity)

```

2. Issue the **show chassis alarms** command to see if there are any active alarms on the DIP switch:

**> show chassis alarms**

```
4 alarms currently active
Alarm time Class Description 2013-01-11 14:48:26 UTC Minor PEM 0 Dipswitch 0
Feed Connection 2
```

3. If the **show chassis alarms** output shows an alarm on **Dipswitch**, issue the **show chassis power** command to check the DIP switch position.

```
# run show chassis power
```

```
PEM 0:
State: OnLine
AC input: OK (1 feed expected, 2 feed connected)
Capacity: 4100 W (maximum 4100 W)
DC output: 855 W (zone 0, 15 A at 57 V, 20% of capacity)
```

In this example, the DIP switch is in the wrong position since there is one AC feed expected but two AC feeds are connected. Change the DIP switch to position 1. This should clear the alarm.



**NOTE:** Changing the DIP switch position does not impact traffic. However, it is always recommended to do so in a maintenance window.

#### Related Documentation

- [MX960 AC Power Supply Description on page 86](#)
- [MX960 DC Power Supply on page 92](#)
- [Replacing an MX960 AC Power Supply on page 397](#)
- [Replacing an MX960 DC Power Supply on page 402](#)
- [Troubleshooting Resources for MX960 Routers on page 485](#)

## PART 7

# Contacting Customer Support and Returning the Chassis or Components

- [Contacting Customer Support on page 503](#)
- [Locating Component Serial Numbers on page 505](#)
- [Packing and Returning Components on page 521](#)
- [Safety and Compliance Information on page 525](#)



# Contacting Customer Support

- [Contacting Customer Support on page 503](#)

## Contacting Customer Support

---

You can contact Juniper Networks Technical Assistance Center (JTAC) 24 hours a day, 7 days a week in one of the following ways:

- On the Web, using the Service Request Manager link at:

<https://support.juniper.net/support/>

- By telephone:
  - From the US and Canada: 1-888-314-JTAC
  - From all other locations: 1-408-745-9500



**NOTE:** If contacting JTAC by telephone, enter your 12-digit service request number followed by the pound (#) key if this is an existing case, or press the star (\*) key to be routed to the next available support engineer.

When requesting support from JTAC by telephone, be prepared to provide the following information:

- Your existing service request number, if you have one
- Details of the failure or problem
- Type of activity being performed on the device when the problem occurred
- Configuration data displayed by one or more **show** commands
- Your name, organization name, telephone number, fax number, and shipping address

The support representative validates your request and issues an RMA number for return of the component.



# Locating Component Serial Numbers

- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [MX960 Routing Engine Serial Number Label on page 507](#)
- [MX960 Chassis Serial Number Label on page 508](#)
- [MX960 Craft Interface Serial Number Label on page 509](#)
- [MX960 Fan Tray Serial Number Label on page 510](#)
- [MX960 Power Supply Serial Number Labels on page 510](#)
- [MX960 MIC Serial Number Label on page 512](#)
- [MX960 MPC Serial Number Label on page 513](#)
- [MX960 PIC Serial Number Label on page 514](#)
- [MX960 FPC Serial Number Label on page 515](#)
- [MX960 DPC Serial Number Label on page 516](#)
- [MX960 SCB Serial Number Label on page 517](#)
- [Contacting Customer Support on page 518](#)

## Displaying MX960 Router Components and Serial Numbers

---

Before contacting Juniper Networks, Inc. to request a Return Materials Authorization (RMA), you must find the serial number on the router or component. To display all of the router components and their serial numbers, enter the following command-line interface (CLI) command:

```
user@host> show chassis hardware
```

```
Hardware inventory:
Item          Version  Part number  Serial number  Description
Chassis                               JN107FC5DAFA  MX960
Midplane     REV 02   710-013698  CC6220        MX960 Midplane
FPM Board    REV 01   710-014974  JS4208        MX960 Front Panel Display
PIM          Rev 02   740-013110  QCS10375009  Power Inlet Module
PEM 0       Rev 01   740-013682  QCS10374009  PS 1.7kW; 200-240VAC in
PEM 1       Rev 01   740-013682  QCS10374029  PS 1.7kW; 200-240VAC in
Routing Engine 0 REV 02   740-013063  1000639065   RE-S-2000
Routing Engine 1 REV 04   740-013063  1000664335   RE-S-2000
CB 0        REV 02.6 710-013385  JM7908       MX960 SCB
CB 1        REV 03   710-013385  JS9412       MX960 SCB
```

FPC 2	REV 03	710-013699	JS4284	MX960 40GE DPC
CPU	REV 04	710-013713	JS9401	MX960 DPC PMB
PIC 0		BUILTIN	BUILTIN	10x 1GE
Xcvr 0	REV 01	740-011613	P9F1ANQ	SFP-SX
Xcvr 1	REV 01	740-011613	P9F1ANB	SFP-SX
Xcvr 2	REV 01	740-011613	P9F18GT	SFP-SX
Xcvr 3	REV 01	740-011613	P9F1AP1	SFP-SX
Xcvr 4	REV 01	740-011613	P9F1ANF	SFP-SX
Xcvr 5	REV 01	740-011613	P9F1ANK	SFP-SX
Xcvr 6	REV 01	740-011613	P9F1AP2	SFP-SX
Xcvr 7	REV 01	740-011613	P9F1ALL	SFP-SX
Xcvr 8	REV 01	740-011613	P9F1ANM	SFP-SX
Xcvr 9	REV 01	740-011613	P9F1ANU	SFP-SX
PIC 1		BUILTIN	BUILTIN	10x 1GE
Xcvr 0	REV 01	740-011613	P9F18HA	SFP-SX
Xcvr 1	REV 01	740-011613	P9F18GY	SFP-SX
Xcvr 2	REV 01	740-011613	P9F18GL	SFP-SX
Xcvr 3	REV 01	740-011613	P9F18H3	SFP-SX
Xcvr 4	REV 01	740-011613	P9F18GQ	SFP-SX
Xcvr 5	REV 01	740-011613	P9F18GX	SFP-SX
Xcvr 6	REV 01	740-011613	P9F18GK	SFP-SX
Xcvr 7	REV 01	740-011613	P9F18H7	SFP-SX
Xcvr 8	REV 01	740-011613	P9F13JV	SFP-SX
Xcvr 9	REV 01	740-011613	P9F18GF	SFP-SX
PIC 2		BUILTIN	BUILTIN	10x 1GE
Xcvr 0		NON-JNPR	P5A08SR	SFP-T
Xcvr 1	REV 01	740-007327	435040B00332	SFP-LX
Xcvr 2	REV 01	740-011782	P8J1SZ4	SFP-SX
Xcvr 3	REV 01	740-011782	P8J1SYH	SFP-SX
Xcvr 4	REV 01	740-011613	P9F18HB	SFP-SX
Xcvr 5	REV 01	740-011613	P9F1AN9	SFP-SX
PIC 3		BUILTIN	BUILTIN	10x 1GE
Xcvr 0	REV 01	740-011613	P9F18GE	SFP-SX
Xcvr 1	REV 01	740-011613	P9F18GW	SFP-SX
Xcvr 2	REV 01	740-011613	P9F18H0	SFP-SX
Xcvr 3	REV 01	740-011613	P9F18GC	SFP-SX
Xcvr 4	REV 01	740-011613	P9F18GD	SFP-SX
Xcvr 5	REV 01	740-013111	60882058	SFP-T
Xcvr 6	REV 01	740-011613	P9F18GN	SFP-SX
Xcvr 8	REV 01	740-011613	P9F18GV	SFP-SX
Xcvr 9	REV 01	740-011613	P9F18H5	SFP-SX
FPC 4	REV 04	710-014219	JS4980	MX960 4 XGE DPC
CPU	REV 03	710-013713	JS4164	MX960 DPC PMB
PIC 0		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0		NON-JNPR	K9J02RS	XFP-10G-LR
PIC 1		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0		NON-JNPR	K9J03CY	XFP-10G-LR
PIC 2		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0	REV 01	740-014279	62E204N00004	XFP-10G-LR
PIC 3		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
FPC 7	REV 04	710-014219	JW7120	MX960 4 XGE DPC
CPU	REV 04	710-013713	JS4236	MX960 DPC PMB
PIC 0		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0		NON-JNPR	K9J02T3	XFP-10G-LR
PIC 1		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0		NON-JNPR	K9J03BQ	XFP-10G-LR
PIC 2		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0		NON-JNPR	K9J03DA	XFP-10G-LR
PIC 3		BUILTIN	BUILTIN	1x 10GE (LAN/WAN)
Xcvr 0		NON-JNPR	K9J02Q0	XFP-10G-LR



Fan Tray 0	REV 01	740-014971	FT0655	MX960 Fan Tray
Fan Tray 1	REV 01	740-014971	FT0653	MX960 Fan Tray

Most components also have a small rectangular serial number ID label (see [Figure 187 on page 507](#)) attached to the component body.

*Figure 187: Serial Number ID Label*



**Related Documentation**

- [MX960 Chassis Serial Number Label on page 508](#)
- [MX960 Craft Interface Serial Number Label on page 509](#)
- [MX960 DPC Serial Number Label on page 516](#)
- [MX960 FPC Serial Number Label on page 515](#)
- [MX960 PIC Serial Number Label on page 514](#)
- [MX960 MPC Serial Number Label on page 513](#)
- [MX960 MIC Serial Number Label on page 512](#)
- [MX960 Power Supply Serial Number Labels on page 510](#)
- [MX960 Routing Engine Serial Number Label on page 507](#)
- [MX960 SCB Serial Number Label on page 517](#)

## MX960 Routing Engine Serial Number Label

The serial number label is located on the left side of the top of the Routing Engine (see [Figure 188 on page 507](#) and [Figure 189 on page 508](#)).

*Figure 188: Routing Engine Serial Number Label*

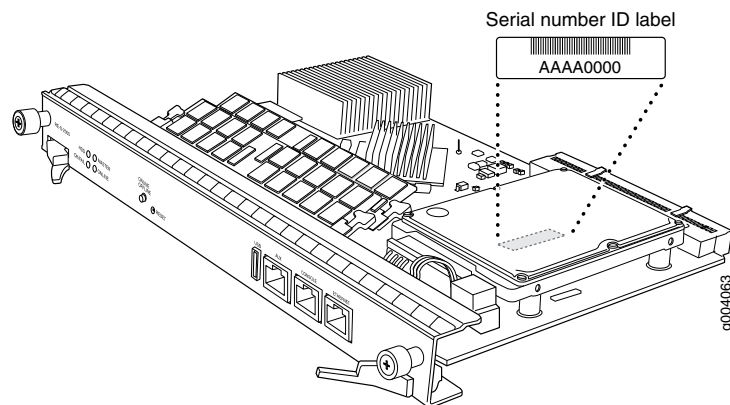
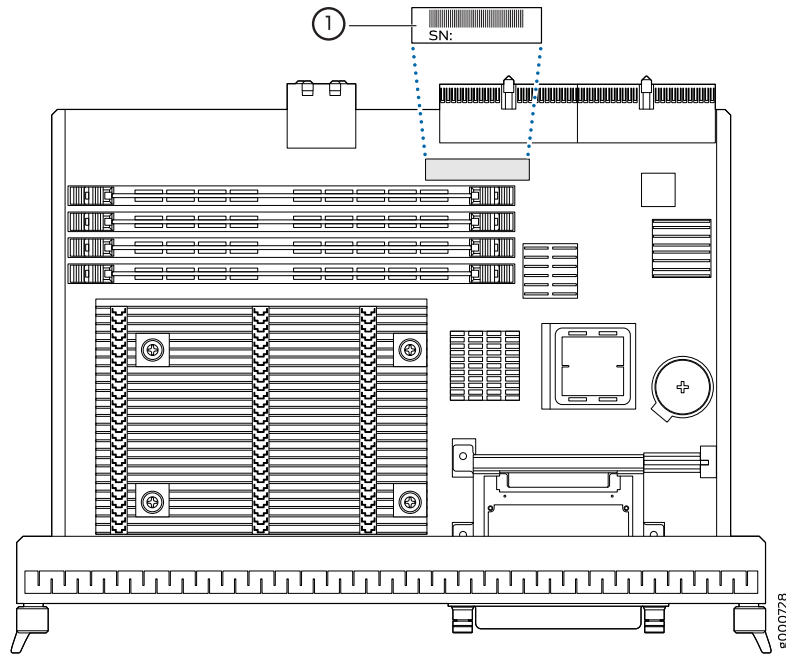


Figure 189: RE-S-X6-64G Routing Engine Serial Number Label



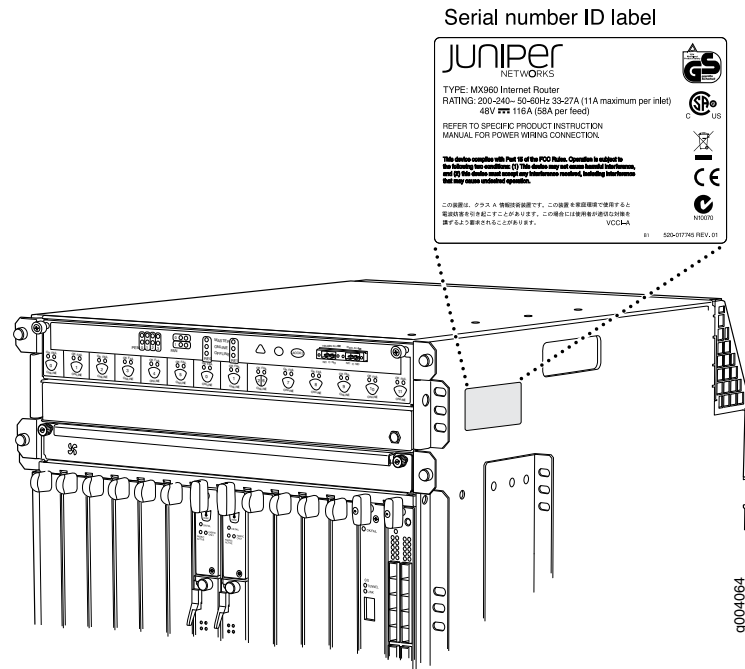
**Related Documentation**

- [Replacing an MX960 Routing Engine on page 329](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

## MX960 Chassis Serial Number Label

The chassis serial number is located on the side of the chassis (see [Figure 190 on page 509](#)).

Figure 190: MX960 Chassis Serial Number Label

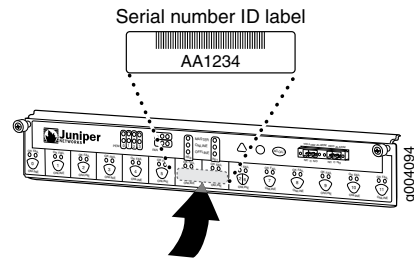


#### Related Documentation

- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [MX960 Craft Interface Serial Number Label on page 509](#)
- [MX960 DPC Serial Number Label on page 516](#)
- [MX960 FPC Serial Number Label on page 515](#)
- [MX960 PIC Serial Number Label on page 514](#)
- [MX960 MPC Serial Number Label on page 513](#)
- [MX960 MIC Serial Number Label on page 512](#)
- [MX960 Power Supply Serial Number Labels on page 510](#)
- [MX960 Routing Engine Serial Number Label on page 507](#)
- [MX960 SCB Serial Number Label on page 517](#)

### MX960 Craft Interface Serial Number Label

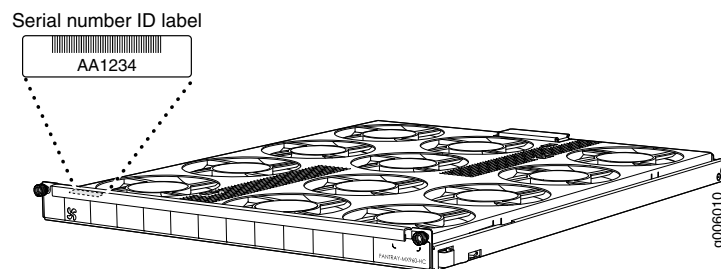
The serial number is located on the back of the craft interface panel (see Figure 191 on page 510).

*Figure 191: Craft Interface Serial Number Label***Related Documentation**

- [Replacing the MX960 Craft Interface on page 303](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

**MX960 Fan Tray Serial Number Label**

The serial number is located on the top left-hand corner of the fan tray, near the captive thumbscrew (see [Figure 192 on page 510](#)).

*Figure 192: MX960 Fan Tray Serial Number Label***Related Documentation**

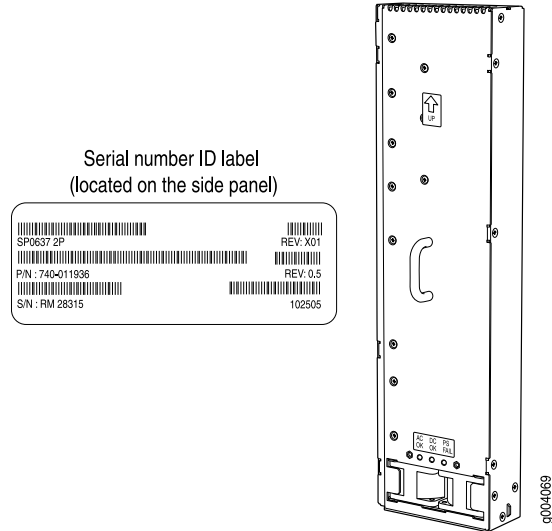
- [Replacing the MX960 Craft Interface on page 303](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

**MX960 Power Supply Serial Number Labels**

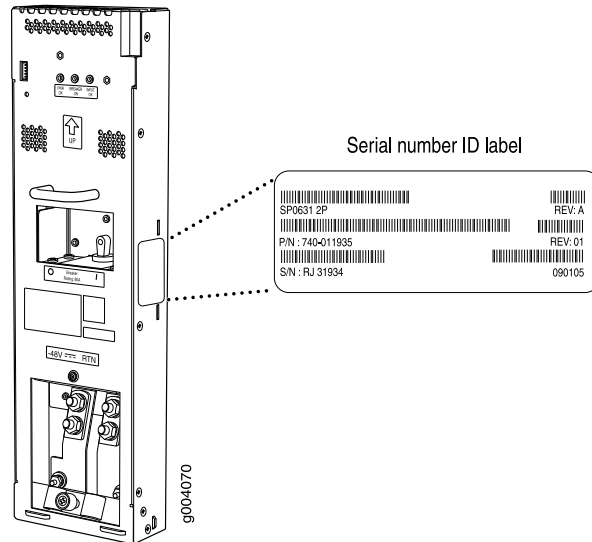
The serial number label is located on the AC power supply faceplate under the on/off switch (see [Figure 193 on page 511](#)).

The serial number label is located on the DC power supply faceplate under the circuit breaker switch (see [Figure 194 on page 511](#)).

**Figure 193: AC Power Supply Serial Number Label**



**Figure 194: DC Power Supply Serial Number Label**



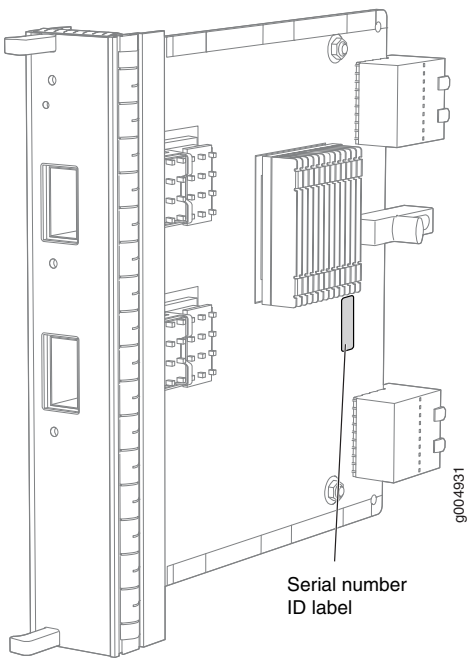
**Related Documentation**

- [Replacing an MX960 AC Power Supply on page 397](#)
- [Replacing an MX960 DC Power Supply on page 402](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

## MX960 MIC Serial Number Label

The serial number label location varies per MIC (see [Figure 196 on page 512](#) and [Figure 197 on page 513](#)). The exact location may be slightly different on different MICs, depending on the placement of components on the MIC board (see [Figure 195 on page 512](#), [Figure 196 on page 512](#), [Figure 197 on page 513](#), and [Figure 198 on page 513](#)).

**Figure 195: 2-Port MIC Serial Number Label**



**Figure 196: 4-Port MIC Serial Number Label**

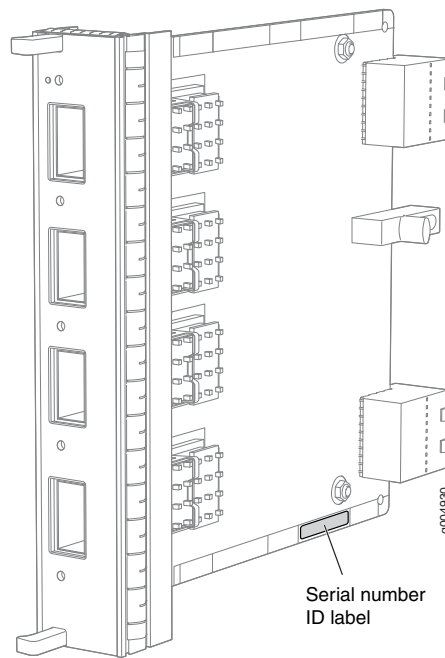


Figure 197: 20-Port MIC Serial Number Label

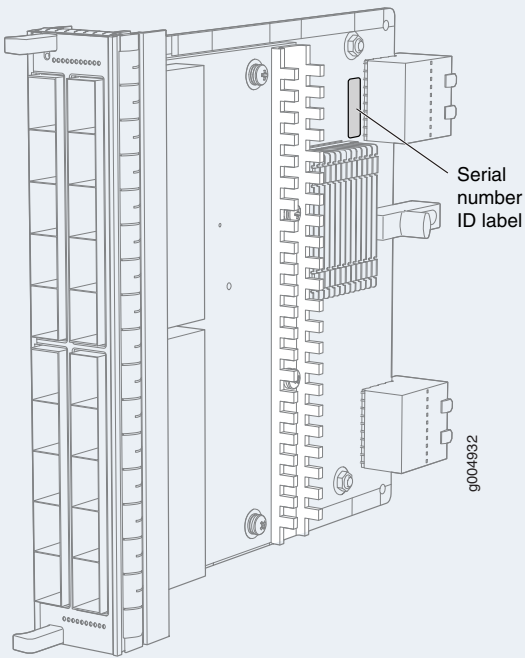
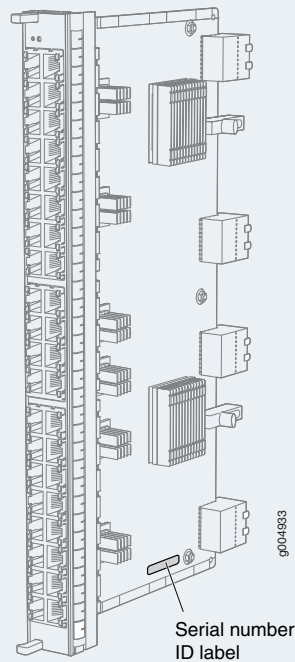


Figure 198: 40-Port MIC Serial Number Label



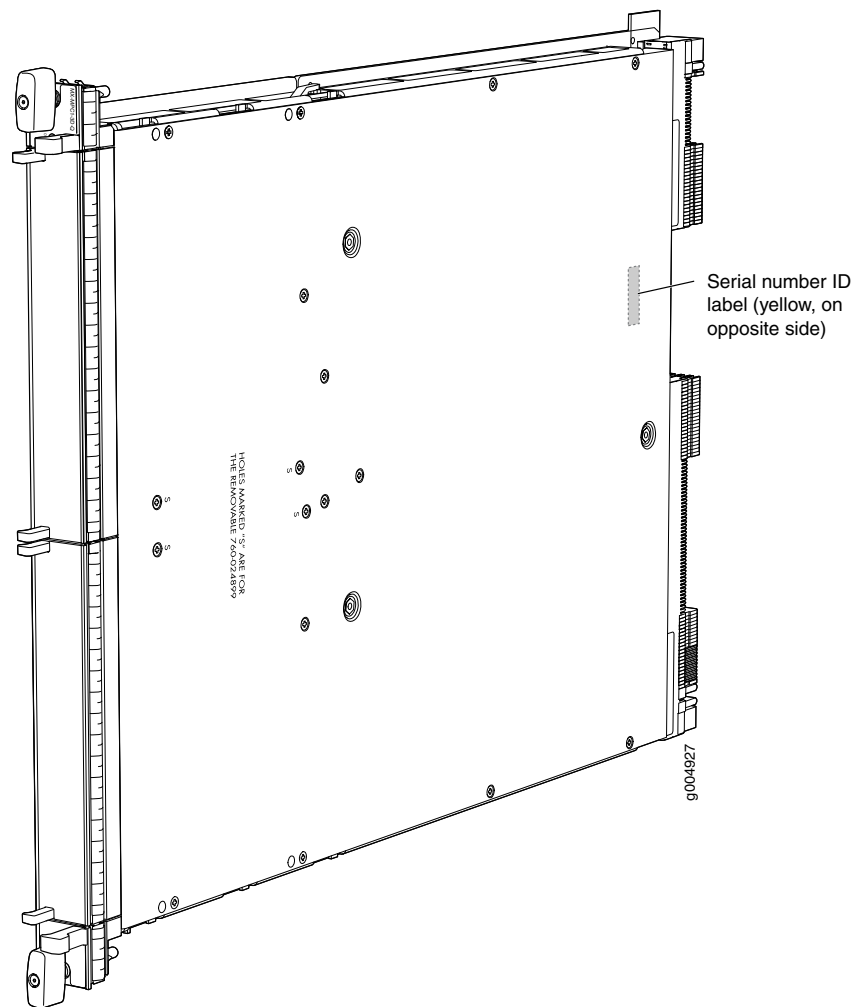
**Related Documentation**

- [Replacing an MX960 MIC on page 364](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

## MX960 MPC Serial Number Label

The serial number label is near the connectors located on the left side of the MPC when it is oriented vertically (see [Figure 199 on page 514](#)).

Figure 199: MPC Serial Number Label

**Related Documentation**

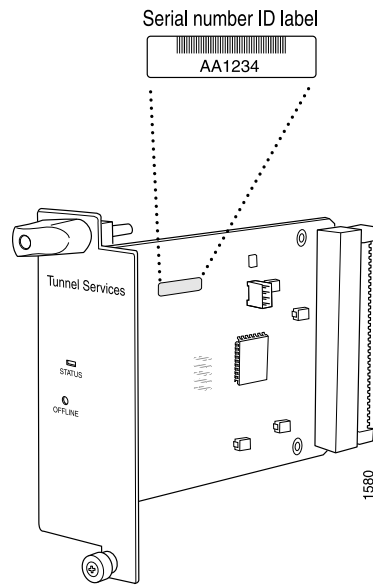
- [Replacing an MX960 MPC on page 374](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

## MX960 PIC Serial Number Label

The serial number label is located on the right side of the PIC (see [Figure 200 on page 515](#)), when the PIC is vertically oriented (as it would be installed in the router). The exact location may be slightly different on different PICs, depending on the placement of components on the PIC board.



Figure 200: PIC Serial Number Label

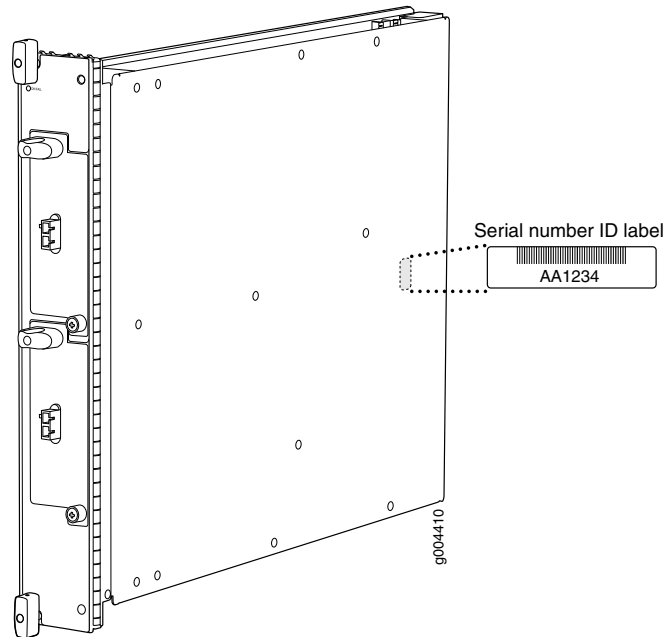


**Related Documentation**

- [Replacing an MX960 PIC on page 380](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

## MX960 FPC Serial Number Label

The serial number label is located on the center of the right side of the FPC (see [Figure 201 on page 516](#)).

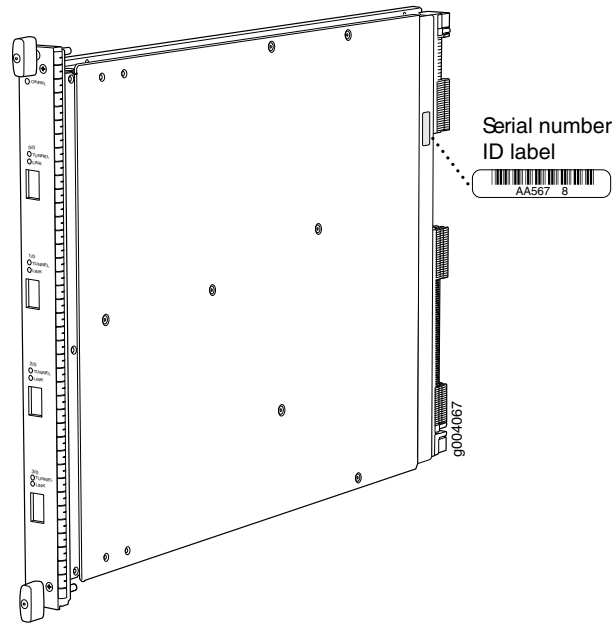
*Figure 201: FPC Serial Number Label***Related Documentation**

- [Replacing an MX960 FPC on page 358](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

## MX960 DPC Serial Number Label

The serial number label is located on the center of the right side of the DPC (see [Figure 202 on page 517](#)).

Figure 202: DPC Serial Number Label

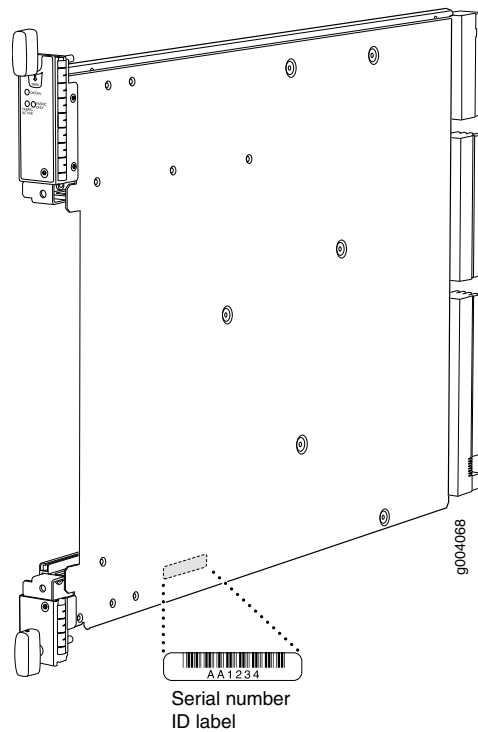


#### Related Documentation

- [Replacing an MX960 DPC on page 351](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

### MX960 SCB Serial Number Label

The serial number is located on the right side of the top of the SCB (see [Figure 203 on page 518](#)).

*Figure 203: SCB Serial Number Label***Related Documentation**

- [Replacing an MX960 SCB on page 415](#)
- [Displaying MX960 Router Components and Serial Numbers on page 505](#)
- [Contacting Customer Support on page 503](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)

## Contacting Customer Support

You can contact Juniper Networks Technical Assistance Center (JTAC) 24 hours a day, 7 days a week in one of the following ways:

- On the Web, using the Service Request Manager link at:  
<https://support.juniper.net/support/>
- By telephone:
  - From the US and Canada: 1-888-314-JTAC
  - From all other locations: 1-408-745-9500



**NOTE:** If contacting JTAC by telephone, enter your 12-digit service request number followed by the pound (#) key if this is an existing case, or press the star (\*) key to be routed to the next available support engineer.

When requesting support from JTAC by telephone, be prepared to provide the following information:

- Your existing service request number, if you have one
- Details of the failure or problem
- Type of activity being performed on the device when the problem occurred
- Configuration data displayed by one or more **show** commands
- Your name, organization name, telephone number, fax number, and shipping address

The support representative validates your request and issues an RMA number for return of the component.



# Packing and Returning Components

- [Contacting Customer Support to Obtain Return Material Authorization on page 521](#)
- [Guidelines for Packing Hardware Components for Shipment on page 522](#)
- [Packing the MX960 Router for Shipment on page 522](#)
- [Returning a Hardware Component to Juniper Networks, Inc. on page 523](#)

## Contacting Customer Support to Obtain Return Material Authorization

---

If you are returning a device or hardware component to Juniper Networks for repair or replacement, obtain a Return Material Authorization (RMA) number from Juniper Networks Technical Assistance Center (JTAC).

After locating the serial number of the device or hardware component you want to return, open a service request with Juniper Networks Technical Assistance Center (JTAC) on the Web or by telephone.

Before you request an RMA number from JTAC, be prepared to provide the following information:

- Your existing service request number, if you have one
- Serial number of the component
- Your name, organization name, telephone number, fax number, and shipping address
- Details of the failure or problem
- Type of activity being performed on the device when the problem occurred
- Configuration data displayed by one or more **show** commands

You can contact JTAC 24 hours a day, seven days a week on the Web or by telephone:

- Service Request Manager: <https://support.juniper.net/support>
- Telephone: +1-888-314-JTAC (+1-888-314-5822), toll free in U.S., Canada, and Mexico



**NOTE:** For international or direct-dial options in countries without toll free numbers, see <https://support.juniper.net/support/>.

If you are contacting JTAC by telephone, enter your 12-digit service request number followed by the pound (#) key for an existing case, or press the star (\*) key to be routed to the next available support engineer.

The support representative validates your request and issues an RMA number for return of the component.

## Guidelines for Packing Hardware Components for Shipment

---

To pack and ship individual components:

- When you return components, make sure that they are adequately protected with packing materials and packed so that the pieces are prevented from moving around inside the carton.
- Use the original shipping materials if they are available.
- Place individual components in antistatic bags.
- Write the RMA number on the exterior of the box to ensure proper tracking.



.....  
**CAUTION:** Do not stack any of the hardware components.  
.....

## Packing the MX960 Router for Shipment

---

To pack the router for shipment:

1. Retrieve the shipping crate and packing materials in which the router was originally shipped. If you do not have these materials, contact your Juniper Networks representative about approved packaging materials.
2. On the console or other management device connected to the master Routing Engine, enter CLI operational mode and issue the following command to shut down the router software. (If two Routing Engines are installed, also issue the command on the backup Routing Engine.)

```
user@host> request system halt
```

Wait until a message appears on the console confirming that the operating system has halted.

For more information about the command, see *request system halt*.

3. Attach an ESD grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
4. Shut down power to the router by pressing the AC input switch or DC circuit breaker for all power supplies to the off (O) position.



5. Disconnect power from the router.
6. Remove the cables that connect to all external devices.
7. Remove all field replaceable units (FRUs) from the router.
8. Remove the router from the rack:
  - If you are using a mechanical lift, place the lift platform under the router, unscrew and remove the mounting screws from the rack, and move the router to the shipping crate.
  - If you are not using a mechanical lift and the router weight is fully supported by a shelf or another router, unscrew and remove the mounting screws from the rack. Three people can then lift the router and move it to the shipping crate.
  - If you are not using a mechanical lift and the router weight is not fully supported by a shelf or another router, three people should grasp the router while a fourth person unscrews and removes the mounting screws from the rack. The three lifters can then move the router to the shipping container.
9. Place the router in the shipping crate or onto the pallet. If on a pallet, bolt the router to the pallet.
10. Cover the router with an ESD bag and place the packing foam on top of and around the router.
11. Replace the accessory box on top of the packing foam.
12. Securely tape the box closed or place the crate cover over the router.
13. Write the RMA number on the exterior of the box to ensure proper tracking.

**Related Documentation**

- [Preventing Electrostatic Discharge Damage to an MX960 Router](#)
- [Powering Off the MX960 Router on page 232](#)
- [Disconnecting an MX960 AC Power Supply Cord on page 410](#)
- [Disconnecting an MX960 DC Power Supply Cable on page 411](#)
- [Replacing Connections to MX960 Routing Engine Interface Ports on page 340](#)

---

**Returning a Hardware Component to Juniper Networks, Inc.**

---

If a hardware component fails, please contact Juniper Networks, Inc. to obtain a Return Material Authorization (RMA) number. This number is used to track the returned material at the factory and to return repaired or new components to the customer as needed.



**NOTE:** Do not return any component to Juniper Networks, Inc. unless you have first obtained an RMA number. Juniper Networks, Inc. reserves the right to refuse shipments that do not have an RMA. Refused shipments are returned to the customer by collect freight.

For more information about return and repair policies, see the customer support webpage at <https://support.juniper.net/support/>.

For product problems or technical support issues, contact the Juniper Networks Technical Assistance Center (JTAC) by using the Service Request Manager link at <https://support.juniper.net/support/> or at 1-888-314-JTAC (within the United States) or 1-408-745-9500 (from outside the United States).

To return a defective hardware component:

1. Determine the part number and serial number of the defective component.
2. Obtain an RMA number from the Juniper Networks Technical Assistance Center (JTAC). You can send e-mail or telephone as described above.
3. Provide the following information in your e-mail message or during the telephone call:
  - Part number and serial number of component
  - Your name, organization name, telephone number, and fax number
  - Description of the failure
4. The support representative validates your request and issues an RMA number for return of the component.
5. Pack the component for shipment.

## CHAPTER 34

# Safety and Compliance Information

- General Safety Guidelines and Warnings on page 525
- Installation and Maintenance Safety Guidelines and Warnings on page 530
- Radiation and Laser Warnings on page 535
- Maintenance and Operational Safety Guidelines and Warnings on page 539
- Electrical Safety Guidelines and Warnings on page 544
- Agency Approvals and Compliance Statements on page 554

### General Safety Guidelines and Warnings

---

- General Safety Guidelines and Warnings on page 525
- Definitions of Safety Warning Levels on page 526
- Qualified Personnel Warning on page 528
- Fire Safety Requirements on page 528
- Warning Statement for Norway and Sweden on page 529

### General Safety Guidelines and Warnings

The following guidelines help ensure your safety and protect the device from damage. The list of guidelines might not address all potentially hazardous situations in your working environment, so be alert and exercise good judgment at all times.

- Perform only the procedures explicitly described in the hardware documentation for this device. Make sure that only authorized service personnel perform other system services.
- Keep the area around the device clear and free from dust before, during, and after installation.
- Keep tools away from areas where people could trip over them while walking.
- Do not wear loose clothing or jewelry, such as rings, bracelets, or chains, which could become caught in the device.
- Wear safety glasses if you are working under any conditions that could be hazardous to your eyes.

- Do not perform any actions that create a potential hazard to people or make the equipment unsafe.
- Never attempt to lift an object that is too heavy for one person to handle.
- Never install or manipulate wiring during electrical storms.
- Never install electrical jacks in wet locations unless the jacks are specifically designed for wet environments.
- Operate the device only when it is properly grounded.
- Ensure that the separate protective earthing terminal provided on this device is permanently connected to earth.
- Replace fuses only with fuses of the same type and rating.
- Do not open or remove chassis covers or sheet-metal parts unless instructions are provided in the hardware documentation for this device. Such an action could cause severe electrical shock.
- Do not push or force any objects through any opening in the chassis frame. Such an action could result in electrical shock or fire.
- Avoid spilling liquid onto the chassis or onto any device component. Such an action could cause electrical shock or damage the device.
- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.
- Some parts of the chassis, including AC and DC power supply surfaces, power supply unit handles, SFB card handles, and fan tray handles might become hot. The following label provides the warning of the hot surfaces on the chassis:



- Always ensure that all modules, power supplies, and cover panels are fully inserted and that the installation screws are fully tightened.

## Definitions of Safety Warning Levels

The documentation uses the following levels of safety warnings (there are two *Warning* formats):



**NOTE:** You might find this information helpful in a particular situation, or you might overlook this important information if it was not highlighted in a Note.



**CAUTION:** You need to observe the specified guidelines to prevent minor injury or discomfort to you or severe damage to the device.



**WARNING:** This symbol alerts you to the risk of personal injury from a laser.



**WARNING:** This symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

**Waarschuwing** Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen.

**Varoitus** Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista.

**Attention** Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents.

**Warnung** Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt.

**Avvertenza** Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti.

**Advarsel** Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskaade. Før du utfører arbeid på utstyr, må du være oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker.

**Aviso** Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes.

**¡Atención!** Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos

que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes.

**Varning!** Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador.

---

## Qualified Personnel Warning

---



**WARNING:** Only trained and qualified personnel should install or replace the device.

**Waarschuwing** Installatie en reparaties mogen uitsluitend door getraind en bevoegd personeel uitgevoerd worden.

**Varoitus** Ainoastaan koulutettu ja pätevä henkilökunta saa asentaa tai vaihtaa tämän laitteen.

**Attention** Tout installation ou remplacement de l'appareil doit être réalisé par du personnel qualifié et compétent.

**Warnung** Gerät nur von geschultem, qualifiziertem Personal installieren oder auswechseln lassen.

**Avvertenza** Solo personale addestrato e qualificato deve essere autorizzato ad installare o sostituire questo apparecchio.

**Advarsel** Kun kvalifisert personell med riktig opplæring bør montere eller bytte ut dette utstyret.

**Aviso** Este equipamento deverá ser instalado ou substituído apenas por pessoal devidamente treinado e qualificado.

**¡Atención!** Estos equipos deben ser instalados y reemplazados exclusivamente por personal técnico adecuadamente preparado y capacitado.

**Varning!** Denna utrustning ska endast installeras och bytas ut av utbildad och kvalificerad personal.

---

## Fire Safety Requirements

In the event of a fire emergency, the safety of people is the primary concern. You should establish procedures for protecting people in the event of a fire emergency, provide safety training, and properly provision fire-control equipment and fire extinguishers.

In addition, you should establish procedures to protect your equipment in the event of a fire emergency. Juniper Networks products should be installed in an environment suitable for electronic equipment. We recommend that fire suppression equipment be available

in the event of a fire in the vicinity of the equipment and that all local fire, safety, and electrical codes and ordinances be observed when you install and operate your equipment.

### Fire Suppression

In the event of an electrical hazard or an electrical fire, you should first turn power off to the equipment at the source. Then use a Type C fire extinguisher, which uses noncorrosive fire retardants, to extinguish the fire.

### Fire Suppression Equipment

Type C fire extinguishers, which use noncorrosive fire retardants such as carbon dioxide and Halotron™, are most effective for suppressing electrical fires. Type C fire extinguishers displace oxygen from the point of combustion to eliminate the fire. For extinguishing fire on or around equipment that draws air from the environment for cooling, you should use this type of inert oxygen displacement extinguisher instead of an extinguisher that leaves residues on equipment.

Do not use multipurpose Type ABC chemical fire extinguishers (dry chemical fire extinguishers). The primary ingredient in these fire extinguishers is monoammonium phosphate, which is very sticky and difficult to clean. In addition, in the presence of minute amounts of moisture, monoammonium phosphate can become highly corrosive and corrodes most metals.

Any equipment in a room in which a chemical fire extinguisher has been discharged is subject to premature failure and unreliable operation. The equipment is considered to be irreparably damaged.



**NOTE:** To keep warranties effective, do not use a dry chemical fire extinguisher to control a fire at or near a Juniper Networks device. If a dry chemical fire extinguisher is used, the unit is no longer eligible for coverage under a service agreement.

We recommend that you dispose of any irreparably damaged equipment in an environmentally responsible manner.

### Warning Statement for Norway and Sweden



**WARNING:** The equipment must be connected to an earthed mains socket-outlet.

**Advarsel** Apparatet skal kobles til en jordet stikkontakt.

**Varning!** Apparaten skall anslutas till jordat nätuttag.

## Installation and Maintenance Safety Guidelines and Warnings

---

- Installation Instructions Warning on page 530
- Chassis and Component Lifting Guidelines on page 530
- Ramp Warning on page 531
- Rack-Mounting and Cabinet-Mounting Warnings on page 531
- Grounded Equipment Warning on page 535

### Installation Instructions Warning



**WARNING:** Read the installation instructions before you connect the device to a power source.

**Waarschuwing** Raadpleeg de installatie-aanwijzingen voordat u het systeem met de voeding verbindt.

**Varoitus** Lue asennusohjeet ennen järjestelmän yhdistämistä virtalähteeseen.

**Attention** Avant de brancher le système sur la source d'alimentation, consulter les directives d'installation.

**Warnung** Lesen Sie die Installationsanweisungen, bevor Sie das System an die Stromquelle anschließen.

**Avvertenza** Consultare le istruzioni di installazione prima di collegare il sistema all'alimentatore.

**Advarsel** Les installasjonsinstruksjonene før systemet kobles til strømkilden.

**Aviso** Leia as instruções de instalação antes de ligar o sistema à sua fonte de energia.

**¡Atención!** Ver las instrucciones de instalación antes de conectar el sistema a la red de alimentación.

**Varning!** Läs installationsanvisningarna innan du kopplar systemet till dess strömförsörjningsenhet.

---

### Chassis and Component Lifting Guidelines

- Before moving the device to a site, ensure that the site meets the power, environmental, and clearance requirements.
- Before lifting or moving the device, disconnect all external cables and wires.
- As when lifting any heavy object, ensure that most of the weight is borne by your legs rather than your back. Keep your knees bent and your back relatively straight. Do not twist your body as you lift. Balance the load evenly and be sure that your footing is firm.
- Use the following lifting guidelines to lift devices and components:



- Up to 39.7 lb (18 kg): One person.
- 39.7 lb (18 kg) to 70.5 lb (32 kg): Two or more people.
- 70.5 lb (32 kg) to 121.2 lb (55 kg): Three or more people.
- Above 121.2 lbs (55 kg): Material handling systems (such as levers, slings, lifts and so on) must be used. When this is not practical, specially trained persons or systems must be used (riggers or movers).

## Ramp Warning



**WARNING:** When installing the device, do not use a ramp inclined at more than 10 degrees.

**Waarschuwing** Gebruik een oprijplaat niet onder een hoek van meer dan 10 graden.

**Varoitus** Älä käytä sellaista kaltevaa pintaa, jonka kaltevuus ylittää 10 astetta.

**Attention** Ne pas utiliser une rampe dont l'inclinaison est supérieure à 10 degrés.

**Warnung** Keine Rampen mit einer Neigung von mehr als 10 Grad verwenden.

**Avvertenza** Non usare una rampa con pendenza superiore a 10 gradi.

**Advarsel** Bruk aldri en rampe som heller mer enn 10 grader.

**Aviso** Não utilize uma rampa com uma inclinação superior a 10 graus.

**¡Atención!** No usar una rampa inclinada más de 10 grados

**Varning!** Använd inte ramp med en lutning på mer än 10 grader.

## Rack-Mounting and Cabinet-Mounting Warnings

Ensure that the rack or cabinet in which the device is installed is evenly and securely supported. Uneven mechanical loading could lead to a hazardous condition.



**WARNING:** To prevent bodily injury when mounting or servicing the device in a rack, take the following precautions to ensure that the system remains stable. The following directives help maintain your safety:

- The device must be installed in a rack that is secured to the building structure.
- The device should be mounted at the bottom of the rack if it is the only unit in the rack.

- When mounting the device on a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing equipment, install the stabilizers before mounting or servicing the device in the rack.

**Waarschuwing** Om lichamelijk letsel te voorkomen wanneer u dit toestel in een rek monteert of het daar een servicebeurt geeft, moet u speciale voorzorgsmaatregelen nemen om ervoor te zorgen dat het toestel stabiel blijft. De onderstaande richtlijnen worden verstrekt om uw veiligheid te verzekeren:

- De Juniper Networks switch moet in een stellage worden geïnstalleerd die aan een bouwsel is verankerd.
- Dit toestel dient onderaan in het rek gemonteerd te worden als het toestel het enige in het rek is.
- Wanneer u dit toestel in een gedeeltelijk gevuld rek monteert, dient u het rek van onderen naar boven te laden met het zwaarste onderdeel onderaan in het rek.
- Als het rek voorzien is van stabiliseringshulpmiddelen, dient u de stabilisatoren te monteren voordat u het toestel in het rek monteert of het daar een servicebeurt geeft.

**Varoitus** Kun laite asetetaan telineeseen tai huolletaan sen ollessa telineessä, on noudatettava erityisiä varotoimia järjestelmän vakavuuden säilyttämiseksi, jotta vältetään loukkaantumiselta. Noudata seuraavia turvallisuusohjeita:

- Juniper Networks switch on asennettava telineeseen, joka on kiinnitetty rakennukseen.
- Jos telineessä ei ole muita laitteita, aseta laite telineen alaosaan.
- Jos laite asetetaan osaksi täytettyyn telineeseen, aloita kuormittaminen sen alaosasta kaikkein raskaimmalla esineellä ja siirry sitten sen yläosaan.
- Jos telinettä varten on vakaimet, asenna ne ennen laitteen asettamista telineeseen tai sen huoltamista siinä.

**Attention** Pour éviter toute blessure corporelle pendant les opérations de montage ou de réparation de cette unité en casier, il convient de prendre des précautions spéciales afin de maintenir la stabilité du système. Les directives ci-dessous sont destinées à assurer la protection du personnel:

- Le rack sur lequel est monté le Juniper Networks switch doit être fixé à la structure du bâtiment.
- Si cette unité constitue la seule unité montée en casier, elle doit être placée dans le bas.

- Si cette unité est montée dans un casier partiellement rempli, charger le casier de bas en haut en plaçant l'élément le plus lourd dans le bas.
- Si le casier est équipé de dispositifs stabilisateurs, installer les stabilisateurs avant de monter ou de réparer l'unité en casier.

**Warnung** Zur Vermeidung von Körperverletzung beim Anbringen oder Warten dieser Einheit in einem Gestell müssen Sie besondere Vorkehrungen treffen, um sicherzustellen, daß das System stabil bleibt. Die folgenden Richtlinien sollen zur Gewährleistung Ihrer Sicherheit dienen:

- Der Juniper Networks switch muß in einem Gestell installiert werden, das in der Gebäudestruktur verankert ist.
- Wenn diese Einheit die einzige im Gestell ist, sollte sie unten im Gestell angebracht werden.
- Bei Anbringung dieser Einheit in einem zum Teil gefüllten Gestell ist das Gestell von unten nach oben zu laden, wobei das schwerste Bauteil unten im Gestell anzubringen ist.
- Wird das Gestell mit Stabilisierungszubehör geliefert, sind zuerst die Stabilisatoren zu installieren, bevor Sie die Einheit im Gestell anbringen oder sie warten.

**Avvertenza** Per evitare infortuni fisici durante il montaggio o la manutenzione di questa unità in un supporto, occorre osservare speciali precauzioni per garantire che il sistema rimanga stabile. Le seguenti direttive vengono fornite per garantire la sicurezza personale:

- Il Juniper Networks switch deve essere installato in un telaio, il quale deve essere fissato alla struttura dell'edificio.
- Questa unità deve venire montata sul fondo del supporto, se si tratta dell'unica unità da montare nel supporto.
- Quando questa unità viene montata in un supporto parzialmente pieno, caricare il supporto dal basso all'alto, con il componente più pesante sistemato sul fondo del supporto.
- Se il supporto è dotato di dispositivi stabilizzanti, installare tali dispositivi prima di montare o di procedere alla manutenzione dell'unità nel supporto.

**Advarsel** Unngå fysiske skader under montering eller reparasjonsarbeid på denne enheten når den befinner seg i et kabinett. Vær nøye med at systemet er stabilt. Følgende retningslinjer er gitt for å verne om sikkerheten:

- Juniper Networks switch må installeres i et stativ som er forankret til bygningsstrukturen.
- Denne enheten bør monteres nederst i kabinettet hvis dette er den eneste enheten i kabinettet.

- Ved montering av denne enheten i et kabinett som er delvis fylt, skal kabinettet lastes fra bunnen og opp med den tyngste komponenten nederst i kabinettet.
- Hvis kabinettet er utstyrt med stabiliseringsutstyr, skal stabilisatorene installeres før montering eller utføring av reparasjonsarbeid på enheten i kabinettet.

**Aviso** Para se prevenir contra danos corporais ao montar ou reparar esta unidade numa estante, deverá tomar precauções especiais para se certificar de que o sistema possui um suporte estável. As seguintes directrizes ajudá-lo-ão a efectuar o seu trabalho com segurança:

- O Juniper Networks switch deverá ser instalado numa prateleira fixa à estrutura do edifício.
- Esta unidade deverá ser montada na parte inferior da estante, caso seja esta a única unidade a ser montada.
- Ao montar esta unidade numa estante parcialmente ocupada, coloque os itens mais pesados na parte inferior da estante, arrumando-os de baixo para cima.
- Se a estante possuir um dispositivo de estabilização, instale-o antes de montar ou reparar a unidade.

**¡Atención!** Para evitar lesiones durante el montaje de este equipo sobre un bastidor, oerriormente durante su mantenimiento, se debe poner mucho cuidado en que el sistema quede bien estable. Para garantizar su seguridad, proceda según las siguientes instrucciones:

- El Juniper Networks switch debe instalarse en un bastidor fijado a la estructura del edificio.
- Colocar el equipo en la parte inferior del bastidor, cuando sea la única unidad en el mismo.
- Cuando este equipo se vaya a instalar en un bastidor parcialmente ocupado, comenzar la instalación desde la parte inferior hacia la superior colocando el equipo más pesado en la parte inferior.
- Si el bastidor dispone de dispositivos estabilizadores, instalar éstos antes de montar o proceder al mantenimiento del equipo instalado en el bastidor.

**Varning!** För att undvika kroppsskada när du installerar eller utför underhållsarbete på denna enhet på en ställning måste du vidta särskilda försiktighetsåtgärder för att försäkra dig om att systemet står stadigt. Följande riktlinjer ges för att trygga din säkerhet:

- Juniper Networks switch måste installeras i en ställning som är förankrad i byggnadens struktur.
- Om denna enhet är den enda enheten på ställningen skall den installeras längst ned på ställningen.
- Om denna enhet installeras på en delvis fylld ställning skall ställningen fyllas nedifrån och upp, med de tyngsta enheterna längst ned på ställningen.
- Om ställningen är försedd med stabiliseringsdon skall dessa monteras fast innan enheten installeras eller underhålls på ställningen.

## Grounded Equipment Warning



**WARNING:** The device is intended to be grounded. During normal use, ensure that you have connected earth ground to the chassis.

**Waarschuwing** Deze apparatuur hoort geaard te worden Zorg dat de host-computer tijdens normaal gebruik met aarde is verbonden.

**Varoitus** Tämä laitteisto on tarkoitettu maadoitettavaksi. Varmista, että isäntälaitte on yhdistetty maahan normaalikäytön aikana.

**Attention** Cet équipement doit être relié à la terre. S'assurer que l'appareil hôte est relié à la terre lors de l'utilisation normale.

**Warnung** Dieses Gerät muß geerdet werden. Stellen Sie sicher, daß das Host-Gerät während des normalen Betriebs an Erde gelegt ist.

**Avvertenza** Questa apparecchiatura deve essere collegata a massa. Accertarsi che il dispositivo host sia collegato alla massa di terra durante il normale utilizzo.

**Advarsel** Dette utstyret skal jordes. Forviss deg om vertsterminalen er jordet ved normalt bruk.

**Aviso** Este equipamento deverá estar ligado à terra. Certifique-se que o host se encontra ligado à terra durante a sua utilização normal.

**¡Atención!** Este equipo debe conectarse a tierra. Asegurarse de que el equipo principal esté conectado a tierra durante el uso normal.

**Varning!** Denna utrustning är avsedd att jordas. Se till att värdenheten är jordad vid normal användning.

## Radiation and Laser Warnings

- [Laser and LED Safety Guidelines and Warnings on page 536](#)
- [Radiation from Open Port Apertures Warning on page 538](#)

## Laser and LED Safety Guidelines and Warnings

Juniper Networks devices are equipped with laser transmitters, which are considered a Class 1 Laser Product by the U.S. Food and Drug Administration and are evaluated as a Class 1 Laser Product per EN 60825-1 requirements.

Observe the following guidelines and warnings:

- [General Laser Safety Guidelines on page 536](#)
- [Class 1 Laser Product Warning on page 536](#)
- [Class 1 LED Product Warning on page 537](#)
- [Laser Beam Warning on page 537](#)

### General Laser Safety Guidelines

When working around ports that support optical transceivers, observe the following safety guidelines to prevent eye injury:

- Do not look into unterminated ports or at fibers that connect to unknown sources.
- Do not examine unterminated optical ports with optical instruments.
- Avoid direct exposure to the beam.



**WARNING:** Unterminated optical connectors can emit invisible laser radiation. The lens in the human eye focuses all the laser power on the retina, so focusing the eye directly on a laser source—even a low-power laser—could permanently damage the eye.

### Class 1 Laser Product Warning



**WARNING:** Class 1 laser product.

**Waarschuwing Klasse-1 laser produkt.**

**Varoitus Luokan 1 lasertuote.**

**Attention Produit laser de classe I.**

**Warnung Laserprodukt der Klasse 1.**

**Avvertenza Prodotto laser di Classe 1.**

**Advarsel Laserprodukt av klasse 1.**

**Aviso Produto laser de classe 1.**

**¡Atención! Producto láser Clase I.**

**Varning! Laserprodukt av klass 1.**

### Class 1 LED Product Warning

---



**WARNING:** Class 1 LED product.

**Waarschuwing** Klasse 1 LED-product.

**Varoitus** Luokan 1 valodiodituote.

**Attention** Alarme de produit LED Class I.

**Warnung** Class 1 LED-Produktwarnung.

**Avvertenza** Avvertenza prodotto LED di Classe 1.

**Advarsel** LED-produkt i klasse 1.

**Aviso** Produto de classe 1 com LED.

**¡Atención!** Aviso sobre producto LED de Clase 1.

**Varning!** Lysdiodprodukt av klass 1.

---

### Laser Beam Warning

---



**WARNING:** Do not stare into the laser beam or view it directly with optical instruments.

**Waarschuwing** Niet in de straal staren of hem rechtstreeks bekijken met optische instrumenten.

**Varoitus** Älä katso säteeseen äläkä tarkastele sitä suoraan optisen laitteen avulla.

**Attention** Ne pas fixer le faisceau des yeux, ni l'observer directement à l'aide d'instruments optiques.

**Warnung** Nicht direkt in den Strahl blicken und ihn nicht direkt mit optischen Geräten prüfen.

**Avvertenza** Non fissare il raggio con gli occhi né usare strumenti ottici per osservarlo direttamente.

**Advarsel** Stirr eller se ikke direkte p strlen med optiske instrumenter.

**Aviso** Não olhe fixamente para o raio, nem olhe para ele directamente com instrumentos ópticos.

**¡Atención!** No mirar fijamente el haz ni observarlo directamente con instrumentos ópticos.

**Varning!** Rikta inte blicken in mot strålen och titta inte direkt på den genom optiska instrument.

---

## Radiation from Open Port Apertures Warning

---



**WARNING:** Because invisible radiation might be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.

**Waarschuwing** Aangezien onzichtbare straling vanuit de opening van de poort kan komen als er geen fiberkabel aangesloten is, dient blootstelling aan straling en het kijken in open openingen vermeden te worden.

**Varoitus** Koska portin aukosta voi emittoitua näkymätöntä säteilyä, kun kuitukaapelia ei ole kytkettynä, vältä säteilylle altistumista äläkä katso avoimiin aukkoihin.

**Attention** Des radiations invisibles à l'il nu pouvant traverser l'ouverture du port lorsqu'aucun câble en fibre optique n'y est connecté, il est recommandé de ne pas regarder fixement l'intérieur de ces ouvertures.

**Warnung** Aus der Port-Öffnung können unsichtbare Strahlen emittieren, wenn kein Glasfaserkabel angeschlossen ist. Vermeiden Sie es, sich den Strahlungen auszusetzen, und starren Sie nicht in die Öffnungen!

**Avvertenza** Quando i cavi in fibra non sono inseriti, radiazioni invisibili possono essere emesse attraverso l'apertura della porta. Evitate di esporvi alle radiazioni e non guardate direttamente nelle aperture.

**Advarsel** Unngå utsettelse for stråling, og stirr ikke inn i åpninger som er åpne, fordi usynlig stråling kan emitteres fra portens åpning når det ikke er tilkoblet en fiberkabel.

**Aviso** Dada a possibilidade de emissão de radiação invisível através do orifício da via de acesso, quando esta não tiver nenhum cabo de fibra conectado, deverá evitar a exposição à radiação e não deverá olhar fixamente para orifícios que se encontrarem a descoberto.

**¡Atención!** Debido a que la apertura del puerto puede emitir radiación invisible cuando no existe un cable de fibra conectado, evite mirar directamente a las aperturas para no exponerse a la radiación.

**Varning!** Osynlig strålning kan avges från en portöppning utan ansluten fiberkabel och du bör därför undvika att bli utsatt för strålning genom att inte stirra in i oskyddade öppningar.

---



## Maintenance and Operational Safety Guidelines and Warnings

- [Maintenance and Operational Safety Guidelines and Warnings on page 539](#)

### Maintenance and Operational Safety Guidelines and Warnings

While performing the maintenance activities for devices, observe the following guidelines and warnings:

- [Battery Handling Warning on page 539](#)
- [Jewelry Removal Warning on page 540](#)
- [Lightning Activity Warning on page 541](#)
- [Operating Temperature Warning on page 542](#)
- [Product Disposal Warning on page 543](#)

#### Battery Handling Warning



**WARNING:** Replacing a battery incorrectly might result in an explosion.

Replace a battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

**Waarschuwing** Er is ontploffingsgevaar als de batterij verkeerd vervangen wordt. Vervang de batterij slechts met hetzelfde of een equivalent type dat door de fabrikant aanbevolen is. Gebruikte batterijen dienen overeenkomstig fabrieksvoorschriften weggeworpen te worden.

**Varoitus** Räjähdyksen vaara, jos akku on vaihdettu väärään akkuun. Käytä vaihtamiseen ainoastaan saman- tai vastaavantyyppistä akkua, joka on valmistajan suosittama. Hävitä käytetyt akut valmistajan ohjeiden mukaan.

**Attention** Danger d'explosion si la pile n'est pas remplacée correctement. Ne la remplacer que par une pile de type semblable ou équivalent, recommandée par le fabricant. Jeter les piles usagées conformément aux instructions du fabricant.

**Warnung** Bei Einsetzen einer falschen Batterie besteht Explosionsgefahr. Ersetzen Sie die Batterie nur durch den gleichen oder vom Hersteller empfohlenen Batterietyp. Entsorgen Sie die benutzten Batterien nach den Anweisungen des Herstellers.

**Advarsel** Det kan være fare for eksplosjon hvis batteriet skiftes på feil måte. Skift kun med samme eller tilsvarende type som er anbefalt av produsenten. Kasser brukte batterier i henhold til produsentens instruksjoner.

**Avvertenza** Pericolo di esplosione se la batteria non è installata correttamente. Sostituire solo con una di tipo uguale o equivalente, consigliata dal produttore. Eliminare le batterie usate secondo le istruzioni del produttore.

**Aviso** Existe perigo de explosão se a bateria for substituída incorrectamente. Substitua a bateria por uma bateria igual ou de um tipo equivalente recomendado pelo fabricante. Destrua as baterias usadas conforme as instruções do fabricante.

**¡Atención!** Existe peligro de explosión si la batería se reemplaza de manera incorrecta. Reemplazar la batería exclusivamente con el mismo tipo o el equivalente recomendado por el fabricante. Desechar las baterías gastadas según las instrucciones del fabricante.

**Varning!** Explosionsfara vid felaktigt batteribyte. Ersätt endast batteriet med samma batterityp som rekommenderas av tillverkaren eller motsvarande. Följ tillverkarens anvisningar vid kassering av använda batterier.

---

### Jewelry Removal Warning

---



**WARNING:** Before working on equipment that is connected to power lines, remove jewelry, including rings, necklaces, and watches. Metal objects heat up when connected to power and ground and can cause serious burns or can be welded to the terminals.

**Waarschuwing** Alvorens aan apparatuur te werken die met elektrische leidingen is verbonden, sieraden (inclusief ringen, kettingen en horloges) verwijderen. Metalen voorwerpen worden warm wanneer ze met stroom en aarde zijn verbonden, en kunnen ernstige brandwonden veroorzaken of het metalen voorwerp aan de aansluitklemmen lassen.

**Varoitus** Ennen kuin työskentelet voimavirtajohtoihin kytkettyjen laitteiden parissa, ota pois kaikki korut (sormukset, kaulakorut ja kellot mukaan lukien). Metalliesineet kuumenevat, kun ne ovat yhteydessä sähkövirran ja maan kanssa, ja ne voivat aiheuttaa vakavia palovammoja tai hitsata metalliesineet kiinni liitäntänapoihin.

**Attention** Avant d'accéder à cet équipement connecté aux lignes électriques, ôter tout bijou (anneaux, colliers et montres compris). Lorsqu'ils sont branchés à l'alimentation et reliés à la terre, les objets métalliques chauffent, ce qui peut provoquer des blessures graves ou souder l'objet métallique aux bornes.

**Warnung** Vor der Arbeit an Geräten, die an das Netz angeschlossen sind, jeglichen Schmuck (einschließlich Ringe, Ketten und Uhren) abnehmen. Metallgegenstände erhitzen sich, wenn sie an das Netz und die Erde angeschlossen werden, und können schwere Verbrennungen verursachen oder an die Anschlußklemmen angeschweißt werden.

**Avvertenza** Prima di intervenire su apparecchiature collegate alle linee di alimentazione, togliersi qualsiasi monile (inclusi anelli, collane, braccialetti ed orologi). Gli oggetti metallici si riscaldano quando sono collegati tra punti

di alimentazione e massa: possono causare ustioni gravi oppure il metallo può saldarsi ai terminali.

**Advarsel** Fjern alle smykker (inkludert ringer, halskjeder og klokker) før du skal arbeide på utstyr som er koblet til kraftledninger. Metallgjenstander som er koblet til kraftledninger og jord blir svært varme og kan forårsake alvorlige brannskader eller smelte fast til polene.

**Aviso** Antes de trabalhar em equipamento que esteja ligado a linhas de corrente, retire todas as jóias que estiver a usar (incluindo anéis, fios e relógios). Os objectos metálicos aquecerão em contacto com a corrente e em contacto com a ligação à terra, podendo causar queimaduras graves ou ficarem soldados aos terminais.

**¡Atención!** Antes de operar sobre equipos conectados a líneas de alimentación, quitarse las joyas (incluidos anillos, collares y relojes). Los objetos de metal se calientan cuando se conectan a la alimentación y a tierra, lo que puede ocasionar quemaduras graves o que los objetos metálicos queden soldados a los bornes.

**Varning!** Tag av alla smycken (inklusive ringar, halsband och armbandsur) innan du arbetar på utrustning som är kopplad till kraftledningar. Metallobjekt hettas upp när de kopplas ihop med ström och jord och kan förorsaka allvarliga brännskador; metallobjekt kan också sammansvetsas med kontakterna.

---

### Lightning Activity Warning

---



**WARNING:** Do not work on the system or connect or disconnect cables during periods of lightning activity.

**Waarschuwing** Tijdens onweer dat gepaard gaat met bliksem, dient u niet aan het systeem te werken of kabels aan te sluiten of te ontkoppelen.

**Varoitus** Älä työskentele järjestelmän parissa äläkä yhdistä tai irrota kaapeleita ukkosilmalla.

**Attention** Ne pas travailler sur le système ni brancher ou débrancher les câbles pendant un orage.

**Warnung** Arbeiten Sie nicht am System und schließen Sie keine Kabel an bzw. trennen Sie keine ab, wenn es gewittert.

**Avvertenza** Non lavorare sul sistema o collegare oppure scollegare i cavi durante un temporale con fulmini.

**Advarsel** Utfør aldri arbeid på systemet, eller koble kabler til eller fra systemet når det tordner eller lyner.

Aviso Não trabalhe no sistema ou ligue e desligue cabos durante períodos de mau tempo (trovoada).

**¡Atención!** No operar el sistema ni conectar o desconectar cables durante el transcurso de descargas eléctricas en la atmósfera.

**Varning!** Vid åska skall du aldrig utföra arbete på systemet eller ansluta eller koppla loss kablar.

---

### Operating Temperature Warning

---



**WARNING:** To prevent the device from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature. To prevent airflow restriction, allow at least 6 in. (15.2 cm) of clearance around the ventilation openings.

**Waarschuwing** Om te voorkomen dat welke switch van de Juniper Networks router dan ook oververhit raakt, dient u deze niet te bedienen op een plaats waar de maximale aanbevolen omgevingstemperatuur van 40° C wordt overschreden. Om te voorkomen dat de luchtstroom wordt beperkt, dient er minstens 15,2 cm speling rond de ventilatie-openingen te zijn.

**Varoitus** Ettei Juniper Networks switch-sarjan reititin ylikuumentuusi, sitä ei saa käyttää tilassa, jonka lämpötila ylittää korkeimman suositellun ympäristölämpötilan 40° C. Ettei ilmanvaihto estyisi, tuuletusaukkojen ympärille on jätettävä ainakin 15,2 cm tilaa.

**Attention** Pour éviter toute surchauffe des routeurs de la gamme Juniper Networks switch, ne l'utilisez pas dans une zone où la température ambiante est supérieure à 40° C. Pour permettre un flot d'air constant, dégagez un espace d'au moins 15,2 cm autour des ouvertures de ventilations.

**Warnung** Um einen Router der switch vor Überhitzung zu schützen, darf dieser nicht in einer Gegend betrieben werden, in der die Umgebungstemperatur das empfohlene Maximum von 40° C überschreitet. Um Lüftungsverschluß zu verhindern, achten Sie darauf, daß mindestens 15,2 cm lichter Raum um die Lüftungsöffnungen herum frei bleibt.

**Avvertenza** Per evitare il surriscaldamento dei switch, non adoperateli in un locale che ecceda la temperatura ambientale massima di 40° C. Per evitare che la circolazione dell'aria sia impedita, lasciate uno spazio di almeno 15.2 cm di fronte alle aperture delle ventole.

**Advarsel** Unngå overoppheting av eventuelle rutere i Juniper Networks switch Disse skal ikke brukes på steder der den anbefalte maksimale omgivelsestemperaturen overstiger 40° C (104° F). Sørg for at klaringen rundt lufteåpningene er minst 15,2 cm (6 tommer) for å forhindre nedsatt luftsirkulasjon.

**Aviso** Para evitar o sobreaquecimento do encaminhador Juniper Networks switch, não utilize este equipamento numa área que exceda a temperatura máxima recomendada de 40° C. Para evitar a restrição à circulação de ar, deixe pelo menos um espaço de 15,2 cm à volta das aberturas de ventilação.

**iAtención!** Para impedir que un encaminhador de la serie Juniper Networks switch se recaliente, no lo haga funcionar en un área en la que se supere la temperatura ambiente máxima recomendada de 40° C. Para impedir la restricción de la entrada de aire, deje un espacio mínimo de 15,2 cm alrededor de las aperturas para ventilación.

**Varning!** Förhindra att en Juniper Networks switch överhettas genom att inte använda den i ett område där den maximalt rekommenderade omgivningstemperaturen på 40° C överskrids. Förhindra att luftcirkulationen inskränks genom att se till att det finns fritt utrymme på minst 15,2 cm omkring ventilationsöppningarna.

---

### Product Disposal Warning

---



**WARNING:** Disposal of this device must be handled according to all national laws and regulations.

**Waarschuwing** Dit produkt dient volgens alle landelijke wetten en voorschriften te worden afgedankt.

**Varoitus** Tämän tuotteen lopullisesta hävittämisestä tulee huolehtia kaikkia valtakunnallisia lakeja ja säännöksiä noudattaen.

**Attention** La mise au rebut définitive de ce produit doit être effectuée conformément à toutes les lois et réglementations en vigueur.

**Warnung** Dieses Produkt muß den geltenden Gesetzen und Vorschriften entsprechend entsorgt werden.

**Avvertenza** L'eliminazione finale di questo prodotto deve essere eseguita osservando le normative italiane vigenti in materia

**Advarsel** Endelig disponering av dette produktet må skje i henhold til nasjonale lover og forskrifter.

**Aviso** A descartagem final deste produto deverá ser efectuada de acordo com os regulamentos e a legislação nacional.

**iAtención!** El desecho final de este producto debe realizarse según todas las leyes y regulaciones nacionales

**Varning!** Slutlig kassering av denna produkt bör skötas i enlighet med landets alla lagar och föreskrifter.

---

## Electrical Safety Guidelines and Warnings

---

- General Electrical Safety Guidelines and Warnings on page 544
- Prevention of Electrostatic Discharge Damage on page 545
- AC Power Electrical Safety Guidelines on page 546
- AC Power Disconnection Warning on page 547
- DC Power Copper Conductors Warning on page 548
- DC Power Disconnection Warning on page 548
- DC Power Grounding Requirements and Warning on page 550
- DC Power Wiring Sequence Warning on page 550
- DC Power Wiring Terminations Warning on page 552
- Midplane Energy Hazard Warning on page 553
- Multiple Power Supplies Disconnection Warning on page 553
- Action to Take After an Electrical Accident on page 554

### General Electrical Safety Guidelines and Warnings

---



**WARNING:** Certain ports on the device are designed for use as intrabuilding (within-the-building) interfaces only (Type 2 or Type 4 ports as described in *GR-1089-CORE*) and require isolation from the exposed outside plant (OSP) cabling. To comply with NEBS requirements and protect against lightning surges and commercial power disturbances, the intrabuilding ports *must not* be metallically connected to interfaces that connect to the OSP or its wiring. The intrabuilding ports on the device are suitable for connection to intrabuilding or unexposed wiring or cabling only. The addition of primary protectors is not sufficient protection for connecting these interfaces metallically to OSP wiring.

---



**CAUTION:** Before removing or installing components of a device, connect an electrostatic discharge (ESD) grounding strap to an ESD point and wrap and fasten the other end of the strap around your bare wrist. Failure to use an ESD grounding strap could result in damage to the device.

---

- Install the device in compliance with the following local, national, and international electrical codes:
  - United States—National Fire Protection Association (NFPA 70), United States National Electrical Code.
  - Other countries—International Electromechanical Commission (IEC) 60364, Part 1 through Part 7.

- Evaluated to the TN power system.
- Canada—Canadian Electrical Code, Part 1, CSA C22.1.
- Locate the emergency power-off switch for the room in which you are working so that if an electrical accident occurs, you can quickly turn off the power.
- Make sure that grounding surfaces are cleaned and brought to a bright finish before grounding connections are made.
- Do not work alone if potentially hazardous conditions exist anywhere in your workspace.
- Never assume that power is disconnected from a circuit. Always check the circuit before starting to work.
- Carefully look for possible hazards in your work area, such as moist floors, ungrounded power extension cords, and missing safety grounds.
- Operate the device within marked electrical ratings and product usage instructions.
- To ensure that the device and peripheral equipment function safely and correctly, use the cables and connectors specified for the attached peripheral equipment, and make certain they are in good condition.

You can remove and replace many device components without powering off or disconnecting power to the device, as detailed elsewhere in the hardware documentation for this device. Never install equipment that appears to be damaged.

## Prevention of Electrostatic Discharge Damage

Device components that are shipped in antistatic bags are sensitive to damage from static electricity. Some components can be impaired by voltages as low as 30 V. You can easily generate potentially damaging static voltages whenever you handle plastic or foam packing material or if you move components across plastic or carpets. Observe the following guidelines to minimize the potential for electrostatic discharge (ESD) damage, which can cause intermittent or complete component failures:

- Always use an ESD wrist strap when you are handling components that are subject to ESD damage, and make sure that it is in direct contact with your skin.

If a grounding strap is not available, hold the component in its antistatic bag (see [Figure 204 on page 546](#)) in one hand and touch the exposed, bare metal of the device with the other hand immediately before inserting the component into the device.



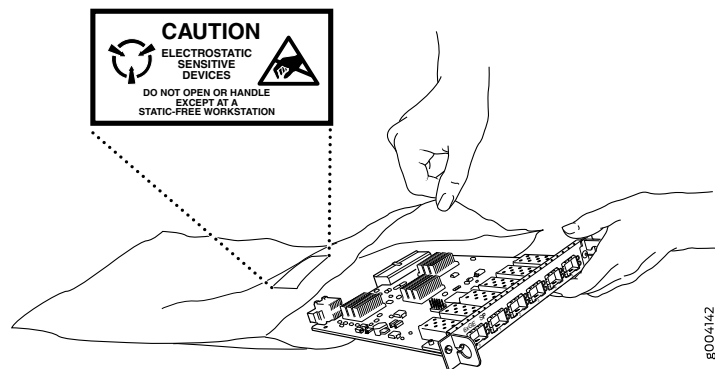
**WARNING:** For safety, periodically check the resistance value of the ESD grounding strap. The measurement must be in the range 1 through 10 Mohms.

- When handling any component that is subject to ESD damage and that is removed from the device, make sure the equipment end of your ESD wrist strap is attached to the ESD point on the chassis.

If no grounding strap is available, touch the exposed, bare metal of the device to ground yourself before handling the component.

- Avoid contact between the component that is subject to ESD damage and your clothing. ESD voltages emitted from clothing can damage components.
- When removing or installing a component that is subject to ESD damage, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an antistatic bag (see [Figure 204 on page 546](#)). If you are returning a component, place it in an antistatic bag before packing it.

*Figure 204: Placing a Component into an Antistatic Bag*



**CAUTION:** ANSI/TIA/EIA-568 cables such as Category 5e and Category 6 can get electrostatically charged. To dissipate this charge, always ground the cables to a suitable and safe earth ground before connecting them to the system.

## AC Power Electrical Safety Guidelines



**CAUTION:** For devices with AC power supplies, an external surge protective device (SPD) must be used at the AC power source.

The following electrical safety guidelines apply to AC-powered devices:

- Note the following warnings printed on the device:
  - “**CAUTION:** THIS UNIT HAS MORE THAN ONE POWER SUPPLY CORD. DISCONNECT ALL POWER SUPPLY CORDS BEFORE SERVICING TO AVOID ELECTRIC SHOCK.”
  - “**ATTENTION:** CET APPAREIL COMPORTE PLUS D'UN CORDON D'ALIMENTATION. AFIN DE PRÉVENIR LES CHOCS ÉLECTRIQUES, DÉBRANCHER TOUT CORDON D'ALIMENTATION AVANT DE FAIRE LE DÉPANNAGE.”
- AC-powered devices are shipped with a three-wire electrical cord with a grounding-type plug that fits only a grounding-type power outlet. Do not circumvent this safety feature. Equipment grounding must comply with local and national electrical codes.



- You must provide an external certified circuit breaker (2-pole circuit breaker or 4-pole circuit breaker based on your device) rated minimum 20 A in the building installation.
- The power cord serves as the main disconnecting device for the AC-powered device. The socket outlet must be near the AC-powered device and be easily accessible.
- For devices that have more than one power supply connection, you must ensure that all power connections are fully disconnected so that power to the device is completely removed to prevent electric shock. To disconnect power, unplug all power cords (one for each power supply).

#### Power Cable Warning (Japanese)

**WARNING:** The attached power cable is only for this product. Do not use the cable for another product.

## 注意

附属の電源コードセットはこの製品専用です。  
他の電気機器には使用しないでください。

9017253

#### AC Power Disconnection Warning



**WARNING:** Before working on the device or near power supplies, unplug all the power cords from an AC-powered device.

**Waarschuwing** Voordat u aan een frame of in de nabijheid van voedingen werkt, dient u bij wisselstroom toestellen de stekker van het netsnoer uit het stopcontact te halen.

**Varoitus** Kytke irti vaihtovirtalaitteiden virtajohto, ennen kuin teet mitään asennuspohjalle tai työskentelet virtalähteiden läheisyydessä.

**Attention** Avant de travailler sur un châssis ou à proximité d'une alimentation électrique, débrancher le cordon d'alimentation des unités en courant alternatif.

**Warnung** Bevor Sie an einem Chassis oder in der Nähe von Netzgeräten arbeiten, ziehen Sie bei Wechselstromeinheiten das Netzkabel ab bzw.

**Avvertenza** Prima di lavorare su un telaio o intorno ad alimentatori, scollegare il cavo di alimentazione sulle unità CA.

**Advarsel** Før det utføres arbeid på kabinettet eller det arbeides i nærheten av strømforsyningsenheter, skal strømledningen trekkes ut på vekselstrømsenheter.

Aviso Antes de trabalhar num chassis, ou antes de trabalhar perto de unidades de fornecimento de energia, desligue o cabo de alimentação nas unidades de corrente alternada.

**¡Atención!** Antes de manipular el chasis de un equipo o trabajar cerca de una fuente de alimentación, desenchufar el cable de alimentación en los equipos de corriente alterna (CA).

**Varning!** Innan du arbetar med ett chassi eller nära strömförsörjningsenheter skall du för växelströmsenheter dra ur nätsladden.

---

### DC Power Copper Conductors Warning

---



**WARNING:** Use copper conductors only.

**Waarschuwing** Gebruik alleen koperen geleiders.

**Varoitus** Käytä vain kuparijohtimia.

**Attention** Utilisez uniquement des conducteurs en cuivre.

**Warnung** Verwenden Sie ausschließlich Kupferleiter.

**Avvertenza** Usate unicamente dei conduttori di rame.

**Advarsel** Bruk bare kobberledninger.

**Aviso** Utilize apenas fios condutores de cobre.

**¡Atención!** Emplee sólo conductores de cobre.

**Varning!** Använd endast ledare av koppar.

---

### DC Power Disconnection Warning

---



**WARNING:** Before performing any of the DC power procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the device handle of the circuit breaker in the OFF position.

**Waarschuwing** Voordat u een van de onderstaande procedures uitvoert, dient u te controleren of de stroom naar het gelijkstroom circuit uitgeschakeld is. Om u ervan te verzekeren dat alle stroom UIT is geschakeld, kiest u op het schakelbord de stroomverbreker die het gelijkstroom circuit bedient, draait de stroomverbreker naar de UIT positie en plakt de schakelaarhandel van de stroomverbreker met plakband in de UIT positie vast.

**Varoitus** Varmista, että tasavirtapiirissä ei ole virtaa ennen seuraavien toimenpiteiden suorittamista. Varmistaaksesi, että virta on KATKAISTU täysin, paikanna tasavirrasta huolehtivassa kojetaulussa sijaitseva suojakytkin, käännä suojakytkin KATKAISTU-asentoon ja teippaa suojakytkimen varsi niin, että se pysyy KATKAISTU-asennossa.

**Attention** Avant de pratiquer l'une quelconque des procédures ci-dessous, vérifiez que le circuit en courant continu n'est plus sous tension. Pour en être sûr, localiser le disjoncteur situé sur le panneau de service du circuit en courant continu, placer le disjoncteur en position fermée (OFF) et, à l'aide d'un ruban adhésif, bloquer la poignée du disjoncteur en position OFF.

**Warnung** Vor Ausführung der folgenden Vorgänge ist sicherzustellen, daß die Gleichstromschaltung keinen Strom erhält. Um sicherzustellen, daß sämtlicher Strom abgestellt ist, machen Sie auf der Schalttafel den Unterbrecher für die Gleichstromschaltung ausfindig, stellen Sie den Unterbrecher auf AUS, und kleben Sie den Schaltergriff des Unterbrechers mit Klebeband in der AUS-Stellung fest.

**Avvertenza** Prima di svolgere una qualsiasi delle procedure seguenti, verificare che il circuito CC non sia alimentato. Per verificare che tutta l'alimentazione sia scollegata (OFF), individuare l'interruttore automatico sul quadro strumenti che alimenta il circuito CC, mettere l'interruttore in posizione OFF e fissarlo con nastro adesivo in tale posizione.

**Advarsel** Før noen av disse prosedyrene utføres, kontroller at strømmen er frakoblet likestrømkretsen. Sørg for at all strøm er slått AV. Dette gjøres ved å lokalisere strømbryteren på brytertavlen som betjener likestrømkretsen, slå strømbryteren AV og teipe bryterhåndtaket på strømbryteren i AV-stilling.

**Aviso** Antes de executar um dos seguintes procedimentos, certifique-se que desligou a fonte de alimentação de energia do circuito de corrente contínua. Para se assegurar que toda a corrente foi DESLIGADA, localize o disjuntor no painel que serve o circuito de corrente contínua e coloque-o na posição OFF (Desligado), segurando nessa posição a manivela do interruptor do disjuntor com fita isoladora.

**¡Atención!** Antes de proceder con los siguientes pasos, comprobar que la alimentación del circuito de corriente continua (CC) esté cortada (OFF). Para asegurarse de que toda la alimentación esté cortada (OFF), localizar el interruptor automático en el panel que alimenta al circuito de corriente continua, cambiar el interruptor automático a la posición de Apagado (OFF), y sujetar con cinta la palanca del interruptor automático en posición de Apagado (OFF).

**Varning!** Innan du utför någon av följande procedurer måste du kontrollera att strömförsörjningen till likströmskretsen är bruten. Kontrollera att all strömförsörjning är BRUTEN genom att slå AV det överspänningsskydd som skyddar likströmskretsen och tejpa fast överspänningsskyddets omkopplare i FRÅN-läget.

.....

## DC Power Grounding Requirements and Warning

An insulated grounding conductor that is identical in size to the grounded and ungrounded branch circuit supply conductors but is identifiable by green and yellow stripes is installed as part of the branch circuit that supplies the device. The grounding conductor is a separately derived system at the supply transformer or motor generator set.



**WARNING:** When you install the device, the ground connection must always be made first and disconnected last.

**Waarschuwing** Bij de installatie van het toestel moet de aardverbinding altijd het eerste worden gemaakt en het laatste worden losgemaakt.

**Varoitus** Laitetta asennettaessa on maahan yhdistäminen aina tehtävä ensiksi ja maadoituksen irti kytkeminen viimeiseksi.

**Attention** Lors de l'installation de l'appareil, la mise à la terre doit toujours être connectée en premier et déconnectée en dernier.

**Warnung** Der Erdanschluß muß bei der Installation der Einheit immer zuerst hergestellt und zuletzt abgetrennt werden.

**Avvertenza** In fase di installazione dell'unità, eseguire sempre per primo il collegamento a massa e disconnetterlo per ultimo.

**Advarsel** Når enheten installeres, må jordledningen alltid tilkobles først og frakobles sist.

**Aviso** Ao instalar a unidade, a ligação à terra deverá ser sempre a primeira a ser ligada, e a última a ser desligada.

**¡Atención!** Al instalar el equipo, conectar la tierra la primera y desconectarla la última.

**Varning!** Vid installation av enheten måste jordledningen alltid anslutas först och kopplas bort sist.

## DC Power Wiring Sequence Warning



**WARNING:** Wire the DC power supply using the appropriate lugs. When connecting power, the proper wiring sequence is ground to ground, +RTN to +RTN, then -48 V to -48 V. When disconnecting power, the proper wiring sequence is -48 V to -48 V, +RTN to +RTN, then ground to ground. Note that the ground wire must always be connected first and disconnected last.

**Waarschuwing** De juiste bedradingsvolgorde verbonden is aarde naar aarde, +RTN naar +RTN, en -48 V naar -48 V. De juiste bedradingsvolgorde losgemaakt is en -48 naar -48 V, +RTN naar +RTN, aarde naar aarde.

**Varoitus** Oikea yhdistettävä kytkentäjäjestys on maajohto maajohtoon, +RTN varten +RTN, –48 V varten – 48 V. Oikea irrotettava kytkentäjäjestys on –48 V varten – 48 V, +RTN varten +RTN, maajohto maajohtoon.

**Attention** Câblez l'alimentation d'alimentation CC En utilisant les crochets appropriés à l'extrémité de câblage. En reliant la puissance, l'ordre approprié de câblage est rectifié pour rectifier, +RTN à +RTN, puis –48 V à –48 V. En débranchant la puissance, l'ordre approprié de câblage est –48 V à –48 V, +RTN à +RTN, a alors rectifié pour rectifier. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois.

**Warnung** Die Stromzufuhr ist nur mit geeigneten Ringösen an das DC Netzteil anzuschliessen. Die richtige Anschlusssequenz ist: Erdanschluss zu Erdanschluss, +RTN zu +RTN und dann -48V zu -48V. Die richtige Sequenz zum Abtrennen der Stromversorgung ist -48V zu -48V, +RTN zu +RTN und dann Erdanschluss zu Erdanschluss. Es ist zu beachten dass der Erdanschluss immer zuerst angeschlossen und als letztes abgetrennt wird.

**Avvertenza** Mostra la morsettiera dell'alimentatore CC. Cablare l'alimentatore CC usando i connettori adatti all'estremità del cablaggio, come illustrato. La corretta sequenza di cablaggio è da massa a massa, da positivo a positivo (da linea ad L) e da negativo a negativo (da neutro a N). Tenere presente che il filo di massa deve sempre venire collegato per primo e scollegato per ultimo.

**Advarsel** Riktig tilkoples tilkoplingssekvens er jord til jord, +RTN til +RTN, –48 V til – 48 V. Riktig frakoples tilkoplingssekvens er –48 V til – 48 V, +RTN til +RTN, jord til jord.

**Aviso** Ate con alambre la fuente de potencia cc Usando los terminales apropiados en el extremo del cableado. Al conectar potencia, la secuencia apropiada del cableado se muele para moler, +RTN a +RTN, entonces –48 V a –48 V. Al desconectar potencia, la secuencia apropiada del cableado es –48 V a –48 V, +RTN a +RTN, entonces molió para moler. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último.

**Atenção!** Wire a fonte de alimentação de DC Usando os talões apropriados na extremidade da fiação. Ao conectar a potência, a seqüência apropriada da fiação é moída para moer, +RTN a +RTN, então –48 V a –48 V. Ao desconectar a potência, a seqüência apropriada da fiação é –48 V a –48 V, +RTN a +RTN, moeu então para moer. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último.

**Varning!** Korrekt kopplingssekvens ar jord till jord, +RTN till +RTN, –48 V till –48 V. Korrekt kopplas kopplingssekvens ar –48 V till –48 V, +RTN till +RTN, jord till jord.

## DC Power Wiring Terminations Warning



**WARNING:** When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations must be the appropriate size for the wires and must clamp both the insulation and conductor.

**Waarschuwing** Wanneer geslagen bedrading vereist is, dient u bedrading te gebruiken die voorzien is van goedgekeurde aansluitingspunten, zoals het gesloten-lus type of het grijperschop type waarbij de aansluitpunten omhoog wijzen. Deze aansluitpunten dienen de juiste maat voor de draden te hebben en dienen zowel de isolatie als de geleider vast te klemmen.

**Varoitus** Jos säikeellinen johdin on tarpeen, käytä hyväksyttyä johdinliitäntää, esimerkiksi suljettua silmukkaa tai kourumaista liitäntää, jossa on ylöspäin käännetyt kiinnityskorvat. Tällaisten liitäntöjen tulee olla kooltaan johtimiin sopivia ja niiden tulee puristaa yhteen sekä eristeen että johdinosan.

**Attention** Quand des fils torsadés sont nécessaires, utiliser des douilles terminales homologuées telles que celles à circuit fermé ou du type à plage ouverte avec cosses rebroussées. Ces douilles terminales doivent être de la taille qui convient aux fils et doivent être refermées sur la gaine isolante et sur le conducteur.

**Warnung** Wenn Litzenverdrahtung erforderlich ist, sind zugelassene Verdrahtungsabschlüsse, z.B. für einen geschlossenen Regelkreis oder gabelförmig, mit nach oben gerichteten Kabelschuhen zu verwenden. Diese Abschlüsse sollten die angemessene Größe für die Drähte haben und sowohl die Isolierung als auch den Leiter festklemmen.

**Avvertenza** Quando occorre usare trecce, usare connettori omologati, come quelli a occhiello o a forcilla con linguette rivolte verso l'alto. I connettori devono avere la misura adatta per il cablaggio e devono serrare sia l'isolante che il conduttore.

**Advarsel** Hvis det er nødvendig med flertrådede ledninger, brukes godkjente ledningsavslutninger, som for eksempel lukket sløyfe eller spadetype med oppoverbøyde kabelsko. Disse avslutningene skal ha riktig størrelse i forhold til ledningene, og skal klemme sammen både isolasjonen og ledningen.

**Aviso** Quando forem requeridas montagens de instalação eléctrica de cabo torcido, use terminações de cabo aprovadas, tais como, terminações de cabo em circuito fechado e planas com terminais de orelha voltados para cima. Estas terminações de cabo deverão ser do tamanho apropriado para os respectivos cabos, e deverão prender simultaneamente o isolamento e o fio condutor.

**¡Atención!** Cuando se necesite hilo trenzado, utilizar terminales para cables homologados, tales como las de tipo "bucle cerrado" o "espada", con las

lengüetas de conexión vueltas hacia arriba. Estos terminales deberán ser del tamaño apropiado para los cables que se utilicen, y tendrán que sujetar tanto el aislante como el conductor.

**Warning!** När flertrådiga ledningar krävs måste godkända ledningskontakter användas, t.ex. kabelsko av sluten eller öppen typ med uppåtvänd tapp. Storleken på dessa kontakter måste vara avpassad till ledningarna och måste kunna hålla både isoleringen och ledaren fastklämda.

### Midplane Energy Hazard Warning



**WARNING:** High levels of electrical energy are distributed across the midplane. Be careful not to contact the midplane connectors, or any component connected to the midplane, with any metallic object while servicing components.

### Multiple Power Supplies Disconnection Warning



**WARNING:** The network device has more than one power supply connection. All connections must be removed completely to remove power from the unit completely.

**Waarschuwing** Deze eenheid heeft meer dan één stroomtoevoerverbinding; alle verbindingen moeten volledig worden verwijderd om de stroom van deze eenheid volledig te verwijderen.

**Varoitus** Tässä laitteessa on useampia virtalähdekytkentöjä. Kaikki kytkennät on irrotettava kokonaan, jotta virta poistettaisiin täysin laitteesta.

**Attention** Cette unité est équipée de plusieurs raccordements d'alimentation. Pour supprimer tout courant électrique de l'unité, tous les cordons d'alimentation doivent être débranchés.

**Warnung** Diese Einheit verfügt über mehr als einen Stromanschluß; um Strom gänzlich von der Einheit fernzuhalten, müssen alle Stromzufuhren abgetrennt sein.

**Avvertenza** Questa unità ha più di una connessione per alimentatore elettrico; tutte le connessioni devono essere completamente rimosse per togliere l'elettricità dall'unità.

**Advarsel** Denne enheten har mer enn én strømtilkobling. Alle tilkoblinger må kobles helt fra for å eliminere strøm fra enheten.

**Aviso** Este dispositivo possui mais do que uma conexão de fonte de alimentação de energia; para poder remover a fonte de alimentação de energia, deverão ser desconectadas todas as conexões existentes.

**¡Atención!** Esta unidad tiene más de una conexión de suministros de alimentación; para eliminar la alimentación por completo, deben desconectarse completamente todas las conexiones.

**Varning!** Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.

---

## Action to Take After an Electrical Accident

If an electrical accident results in an injury, take the following actions in this order:

1. Use caution. Be aware of potentially hazardous conditions that could cause further injury.
2. Disconnect power from the device.
3. If possible, send another person to get medical aid. Otherwise, assess the condition of the victim, then call for help.

## Agency Approvals and Compliance Statements

---

- [Agency Approvals for MX960 Routers on page 554](#)
- [Compliance Statements for NEBS for the MX960 Router on page 555](#)
- [Compliance Statements for EMC Requirements for the MX960 Router on page 556](#)
- [Compliance Statements for Environmental Requirements on page 557](#)
- [Compliance Statements for Acoustic Noise for the MX960 Router on page 557](#)
- [Statements of Volatility for Juniper Network Devices on page 557](#)

## Agency Approvals for MX960 Routers

The routers comply with the following standards:

- Safety
  - EN 60825-1 Safety of Laser Products – Part 1: Equipment Classification, Requirements and User's Guide
  - CSA 60950-1 Safety of Information Technology Equipment
  - UL 60950-1 Safety of Information Technology Equipment
  - EN 60950-1 Safety of Information Technology Equipment
  - IEC 60950-1 Safety of Information Technology Equipment (with country deviations)
- EMC/EMI/ETSI



- AS/NZS CISPR22 (Australia/New Zealand)
- EN55022 Class A European Radiated Emissions
- FCC Part 15 Class A USA Radiated Emissions
- VCCI Class A Japanese Radiated Emissions
- ETSI EN-300386 V1.3.3 Telecommunication Network Equipment. Electromagnetic Compatibility Requirements
- Immunity
  - EN 55024 +A1+A2 Information Technology Equipment Immunity Characteristics
  - EN-61000-3-2 Power Line Harmonics
  - EN-61000-3-3 +A1 +A2 +A3 Power Line Voltage Fluctuations and Flicker
  - EN-61000-4-2 +A1 +A2 Electrostatic Discharge
  - EN-61000-4-3 +A1+A2 Radiated Immunity
  - EN-61000-4-4 Electrical Fast Transients
  - EN-61000-4-5 Surge
  - EN-61000-4-6 Immunity to Conducted Disturbances
  - EN-61000-4-11 Voltage Dips and Sags

The router is designed to comply with the following standards:

- NEBS
  - GR-1089-Core: EMC and Electrical Safety for Network Telecommunications Equipment
  - SR-3580 NEBS Criteria Levels (Level 3 Compliance)
  - GR-63-Core: NEBS, Physical Protection

- See Also**
- [Compliance Statements for NEBS for the MX960 Router on page 555](#)
  - [Compliance Statements for EMC Requirements for the MX960 Router on page 556](#)
  - [Compliance Statements for Environmental Requirements on page 557](#)
  - [Compliance Statements for Acoustic Noise for the MX960 Router on page 557](#)

### Compliance Statements for NEBS for the MX960 Router

- The equipment is suitable for installation as part of the Common Bonding Network (CBN).
- The equipment is suitable for installation in locations where the National Electrical Code (NEC) applies.

- The battery return connection is to be treated as an isolated DC return (that is, DC-I), as defined in GR-1089-CORE.
- You must provision a readily accessible device outside of the equipment to disconnect power. The device must also be rated based on local electrical code practice.

- See Also**
- [Agency Approvals for MX960 Routers on page 554](#)
  - [Compliance Statements for EMC Requirements for the MX960 Router on page 556](#)
  - [Compliance Statements for Environmental Requirements on page 557](#)
  - [Compliance Statements for Acoustic Noise for the MX960 Router on page 557](#)

## Compliance Statements for EMC Requirements for the MX960 Router

- [Canada on page 556](#)
- [European Community on page 556](#)
- [Israel on page 556](#)
- [Japan on page 556](#)
- [United States on page 557](#)

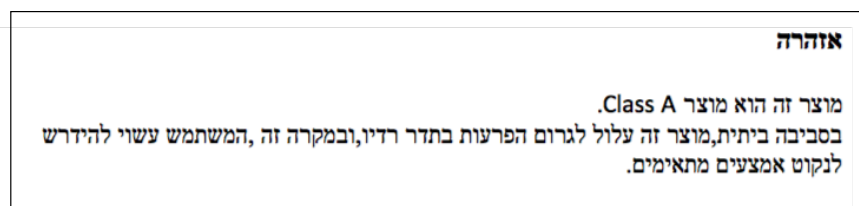
### Canada

CAN ICES-3 (A)/NMB-3(A)

### European Community

This is a Class A product. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

### Israel



Translation from Hebrew—Warning: This product is Class A. In residential environments, the product might cause radio interference, and in such a situation, the user might be required to take adequate measures.

### Japan

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI-A

The preceding translates as follows:

This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this product is used near a radio or television receiver in a domestic environment, it might cause radio interference. Install and use the equipment according to the instruction manual. VCCI-A.

### United States

The hardware equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**See Also** • [Grounded Equipment Warning on page 535](#)

## Compliance Statements for Environmental Requirements

Batteries in this product are not based on mercury, lead, or cadmium substances. The batteries used in this product are in compliance with EU Directives 91/157/EEC, 93/86/EEC, and 98/101/EEC. The product documentation includes instructional information about the proper method of reclamation and recycling.

## Compliance Statements for Acoustic Noise for the MX960 Router

The router complies with NEBS Level 3 requirements:

- GR-63-CORE: NEBS, Physical Protection
- GR-1089-CORE: EMC and Electrical Safety for Network Telecommunications Equipment

**See Also** • [Agency Approvals for MX960 Routers on page 554](#)  
• [Compliance Statements for NEBS for the MX960 Router on page 555](#)  
• [Compliance Statements for EMC Requirements for the MX960 Router on page 556](#)  
• [Compliance Statements for Environmental Requirements on page 557](#)

## Statements of Volatility for Juniper Network Devices

*A statement of volatility*—sometimes known as *letter of volatility*—identifies the volatile and non-volatile storage components in Juniper Networks devices, and describes how to remove non-volatile storage components from the device.



**NOTE:** Statements of volatility are not available for all Juniper Networks devices.

---

CTP Series:

- CTP2000

EX Series:

- EX2200 and EX2200-C
- EX2300-24P, EX2300-24T, and EX2300-24T-DC
- EX2300-48P and EX2300-48T
- EX2300-C
- EX3300
- EX3400-24P, EX3400-24T, EX3400-24T-DC
- EX3400-48P, EX3400-48T, EX3400-48T-AFI
- EX4200
- EX4300
- EX4300-48MP
- EX4500
- EX4550
- EX4600
- EX8200
- XRE200 External Routing Engine

LN Series:

- LN1000-CC

MX Series:

- M7i
- M7i Compact Forwarding Engine Board (CFEB)
- M40e and M10i
- M320
- MX5, MX10, MX40, and MX80
- MX240, MX480, and MX960
- RE-A-2000 Route Engine
- RE-S-X6-64G Routing Engine

## QFX Series:

- QFX3008-I
- QFX3100
- QFX3500
- QFX3600
- QFX5100-24Q
- QFX5100-48S
- QFX5100-48T
- QFX5110-32Q
- QFX5110-48S
- QFX5200
- QFX5200-32C
- QFX10008 and QFX10016

## SRX Series:

- SRX100
- SRX110
- SRX210B
- SRX210H-POE
- SRX210H-P-MGW
- SRX220
- SRX240H
- SRX240H-POE
- SRX300
- SRX320
- SRX340 and SRX345
- SRX550
- SRX650
- SRX1400
- SRX1500
- SRX3400 and SRX3600
- SRX5400, SRX5600, and SRX5800

- [SRX-MP-1SERIAL](#)
- [SSG-520M](#)

T Series:

- [RE-A-2000 Route Engine](#)