



Optical Cards



Note

The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This chapter describes the Cisco ONS 15454 SDH optical, transponder, and muxponder card features and functions. It includes descriptions, hardware specifications, and block diagrams for each card. For installation and card turn-up procedures, refer to the *Cisco ONS 15454 SDH Procedure Guide*.

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4.1 Optical Card Overview

The optical card overview section summarizes card functions, power consumption, and temperature ranges. For compatibility, see the [“Software and Hardware Compatibility”](#) section on page 1-20.

The cards for the ONS 15454 SDH include FMEC cards, common control cards, electrical cards, optical cards, Ethernet cards, and DWDM cards. Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 SDH shelf assembly. The cards are then installed into slots displaying the same symbols. See the [“Cards and Slots”](#) section on page 1-17 for a list of slots and symbols.

4.1.1 Optical Cards

Table 4-1 lists the ONS 15454 SDH optical cards.

Table 4-1 Optical Cards for the ONS 15454 SDH

Card	Description	For Additional Information...
OC3 IR 4/STM1 SH 1310	The OC3 IR 4/STM1 SH 1310 card provides four intermediate or short-range STM-1 ports and operates at 1310 nm.	See the “OC3 IR 4/STM1 SH 1310 Card” section on page 4-6.
OC3IR/STM1 SH 1310-8	The OC3IR/STM1SH 1310-8 card provides eight intermediate or short-range STM-1 ports and operates at 1310 nm. It operates in Slots 1 to 4 and 14 to 17.	See the “OC3 IR/STM1 SH 1310-8 Card” section on page 4-9.
OC12 IR/STM4 SH 1310	The OC12 IR/STM4 SH 1310 card provides one intermediate or short-range STM-4 port and operates at 1310 nm.	See the “OC12 IR/STM4 SH 1310 Card” section on page 4-13.
OC12 LR/STM4 LH 1310	The OC12 LR/STM4 LH 1310 card provides one long-range STM-4 port and operates at 1310 nm.	See the “OC12 LR/STM4 LH 1310 Card” section on page 4-16.
OC12 LR/STM4 LH 1550	The OC12 LR/STM4 LH 1550 card provides one long-range STM-4 port and operates at 1550 nm.	See the “OC12 LR/STM4 LH 1550 Card” section on page 4-20.
OC12 IR/STM4 SH 1310-4	The OC12 IR/STM4 SH 1310-4 card provides four intermediate or short-range STM-4 ports and operates at 1310 nm.	See the “OC12 IR/STM4 SH 1310-4 Card” section on page 4-24.
OC48 IR/STM16 SH AS 1310	The OC48 IR/STM16 SH AS 1310 card provides one intermediate or short-range STM-16 port at 1310 nm and operates in Slots 1 to 6 and 12 to 17.	See the “OC48 IR/STM16 SH AS 1310 Card” section on page 4-28.
OC48 LR/STM16 LH AS 1550	The OC48 LR/STM16 LH AS 1550 card provides one long-range STM-16 port at 1550 nm and operates in Slots 1 to 6 and 12 to 17.	See the “OC48 LR/STM16 LH AS 1550 Card” section on page 4-32.
OC48 ELR/STM16 EH 100 GHz	The OC48 ELR/STM16 EH 100 GHz card provides one long-range (enhanced) STM-16 port and operates in Slots 5, 6, 12, or 13. This card is available in 18 different wavelengths (9 in the blue band and 9 in the red band) in the 1550 nm range, every second wavelength in the ITU grid for 100-GHz spacing dense wavelength division multiplexing (DWDM).	See the “OC48 ELR/STM16 EH 100 GHz Cards” section on page 4-36.

Table 4-1 Optical Cards for the ONS 15454 SDH (continued)

Card	Description	For Additional Information...
OC192 SR/STM64 IO 1310	The OC192 SR/STM64 IO 1310 card provides one intra-office-haul STM-64 port at 1310 nm and operates in Slots 5, 6, 12, or 13 with the 10 Gb cross-connect (XC10G) card.	See the “OC192 SR/STM64 IO 1310 Card” section on page 4-41.
OC192 IR/STM64 SH 1550	The OC192 IR/STM64 SH 1550 card provides one intermediate-range STM-64 port at 1550 nm and operates in Slots 5, 6, 12, or 13 with the XC10G card.	See the “OC192 IR/STM64 SH 1550 Card” section on page 4-45.
OC192 LR/STM64 LH 1550	The OC192 LR/STM64 LH 1550 card provides one long-range STM-64 port at 1550 nm and operates in Slots 5, 6, 12, or 13 with the XC10G card.	See the “OC192 LR/STM64 LH 1550 Card” section on page 4-49.
OC192 LR/STM64 LH ITU 15xx.xx	The OC192 LR/STM64 LH ITU 15xx.xx card provides one extended long-range STM-64 port and operates in Slots 5, 6, 12, or 13 with the XC10G card. This card is available in multiple wavelengths in the 1550 nm range of the ITU grid for 100-GHz-spaced DWDM.	See the “OC192 LR/STM64 LH ITU 15xx.xx Card” section on page 4-53.
TXP_MR_10G	The TXP_MR_10G (10-Gbps Transponder–100 GHz–Tunable xx.xx-xx.xx) card provides one extended long-range OC-192 port (trunk side) and one short-range STM-64 port (client side). It can process one standard STM-64 interface for use in a 100-GHz DWDM system. On the trunk side, it can provide forward error correction (FEC). The card operates in Slots 1 to 6 and 12 to 17. The card is tunable over two neighboring wavelengths in the 1550 nm, ITU 100-GHz range. It is available in four different versions, covering eight different wavelengths in the 1550 nm range. For the individual card, “xx.xx” is replaced with the wavelength intended to be used. Note The trunk side is also known as the span side.	See the “TXP_MR_10G Card” section on page 4-58.
MXP_2.5G_10G	The MXP_2.5G_10G (2.5-Gbps–10-Gbps Muxponder–100 GHz–Tunable xx.xx-xx.xx) card provides one extended long-range STM-64 port (trunk side) and four short-range STM-16 ports (client side). It can multiplex four standard STM-16 interfaces into one STM-64 interface for use in a 100-GHz DWDM system. On the trunk side, it can provide FEC. The card operates in Slots 1 to 6 and 12 to 17. The card is tunable over two neighboring wavelengths in the 1550 nm, ITU 100-GHz range. It is available in four different versions, covering eight different wavelengths in the 1550 nm range. For the individual card, “xx.xx” is replaced with the wavelength intended to be used.	See the “MXP_2.5G_10G Card” section on page 4-63.

Table 4-1 Optical Cards for the ONS 15454 SDH (continued)

Card	Description	For Additional Information...
TXP_MR_2.5G	The TXP_MR_2.5G (2.5-Gbps Multirate Transponder–100-GHz–tunable xx.xx-xx.xx) card provides one long-range OC-48 port (trunk side) and one client side interface ranging from 8-Mbps to 2.488-Gbps. It can process one standard OC-48 interface for use in a 100-GHz DWDM system. On the trunk side, it can provide forward error correction (FEC). The card operates in Slots 1 to 6 and 12 to 17. The card is tunable over four wavelengths in the 1550 nm, ITU 100-GHz range. It is available in eight different versions, covering 32 different wavelengths in the 1550 nm range. For the individual card, “xx.xx” is replaced with the wavelengths intended to be used.	See the “TXP_MR_2.5G and TXPP_MR_2.5G Cards” section on page 4-69.
TXPP_MR_2.5G	The TXPP_MR_2.5G (2.5-Gbps Multirate Transponder–100-GHz–tunable xx.xx-xx.xx) card provides two long-range OC-48 ports (trunk side) and one client side interface ranging from 8-Mbps to 2.488-Gbps. It can process one standard OC-48 interface for use in a 100-GHz DWDM system. On the trunk side, it can provide forward error correction (FEC). The card operates in Slots 1 to 6 and 12 to 17. The card is tunable over four wavelengths in the 1550 nm, ITU 100-GHz range. It is available in eight different versions, covering 32 different wavelengths in the 1550 nm range. For the individual card, “xx.xx” is replaced with the wavelengths intended to be used.	See the “TXP_MR_2.5G and TXPP_MR_2.5G Cards” section on page 4-69.

**Note**

The Cisco OC3 IR/STM1 SH, OC12 IR/STM4 SH, and OC48 IR/STM16 SH interface optics, all working on 1310 nm, are optimized for the most widely used SMF-28 fiber, available from many suppliers.

Corning MetroCor fiber is optimized for optical interfaces that transmit at 1550 nm or in the C and L DWDM windows, and targets interfaces with higher dispersion tolerances than those found in OC3 IR/STM1 SH, OC12 IR/STM4 SH, and OC48 IR/STM16 SH interface optics. If you are using Corning MetroCor fiber, OC3 IR/STM1 SH, OC12 IR/STM4 SH, and OC48 IR/STM16 SH interface optics become dispersion limited before they become attenuation limited. In this case, consider using OC3 LR/STM1 LH, OC12 LR/STM4 LH, and OC48 LR/STM16 LH cards instead of OC3 IR/STM1 SH, OC12 IR/STM4 SH, and OC48 IR/STM16 SH cards.

With all fiber types, network planners/engineers should review the relative fiber type and optics specifications to determine attenuation, dispersion, and other characteristics to ensure appropriate deployment.

4.1.2 Card Power Consumption

Table 4-2 shows power consumption per card.

Table 4-2 Card Power Consumption for the ONS 15454 SDH

Card	Watts	Amps at -48 V	Amps at -40.5 V	BTU/hr
OC3 IR 4/STM1 SH 1310	19.20	0.40	0.47	65.6
OC3IR/STM1SH 1310-8	23.00	0.48	0.57	78.5
OC12 IR/STM4 SH 1310	9.28	0.19	0.23	31.7
OC12 LR/STM4 LH 1310	9.28	0.19	0.23	31.7
OC12 LR/STM4 LH 1550	9.28	0.19	0.23	31.7
OC12 LR/STM4 LH 1310-4	35.60	0.74	0.88	121.6
OC48 IR/STM16 SH AS 1310	37.20	0.78	0.92	127.0
OC48 LR/STM16 LH AS 1550	37.20	0.78	0.92	127.0
OC48 ELR/STM16 EH 100 GHz	31.20	0.65	0.77	106.5
OC192 SR/STM64 IO 1310	42.00	0.88	1.04	143.4
OC192 IR/STM64 SH 1550	44.00	0.92	1.09	150.2
OC192 LR/STM64 LH 1550	72.20	1.50	1.78	246.5
OC192 LR/STM64 LH ITU 15xx.xx	46.00	0.96	1.14	157.1
TXP_MR_10G	35.00	0.73	0.86	119.5
MXP_2.5G_10G	50.00	1.04	1.23	170.7
TXP_MR_2.5G				
TXPP_MR_2.5G				



Note

The ONS 15454 SDH is a flexible metro optical transport system supporting a wide variety of applications. The power consumption of the shelf assembly varies depending upon shelf configuration. Design your power distribution network based on your maximum ONS 15454 SDH system power draw, or the ONS 15454 SDH's maximum rated shelf power draw.

If you select to design your power plant to your maximum planned ONS 15454 SDH system configuration, the *Cisco ONS 15454 SDH Reference Manual* lists the power consumption for each card that can be used to determine your maximum ONS 15454 SDH system power draw. The general guideline for fuse selection is 20 percent above the maximum calculated system power draw.

If you design your power system to the ONS 15454 SDH's maximum rated shelf power draw, Cisco recommends that you select a power distribution system supporting a minimum capacity of 30 A for each A and B power feeder on each ONS 15454 SDH shelf assembly. Feeder lines should be fused at 30 A. This recommendation is based on the shelf assembly's current rated maximum power draw of 30 A at -48 VDC. The maximum power draw configuration on the ONS 15454 SDH, based on the hardware available with Release 4.0, requires 30 A at -48 VDC.

4.2 OC3 IR 4/STM1 SH 1310 Card



Warning

Class 1 laser product.



Warning

Invisible laser radiation present.



Warning

Use of controls, adjustments, or performing procedures other than those specified may result in hazardous radiation exposure.

The OC3 IR 4/STM1 SH 1310 card provides four intermediate or short range SDH STM-1 ports compliant with ITU-T G.707 and ITU-T G.957. Each port operates at 155.52 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at the STM-1 signal level. [Figure 4-1](#) shows the OC3 IR 4/STM1 SH 1310 faceplate.

Figure 4-1 OC3 IR 4/STM1 SH 1310 Faceplate

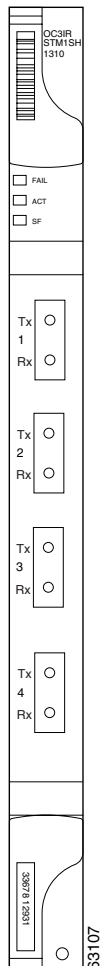
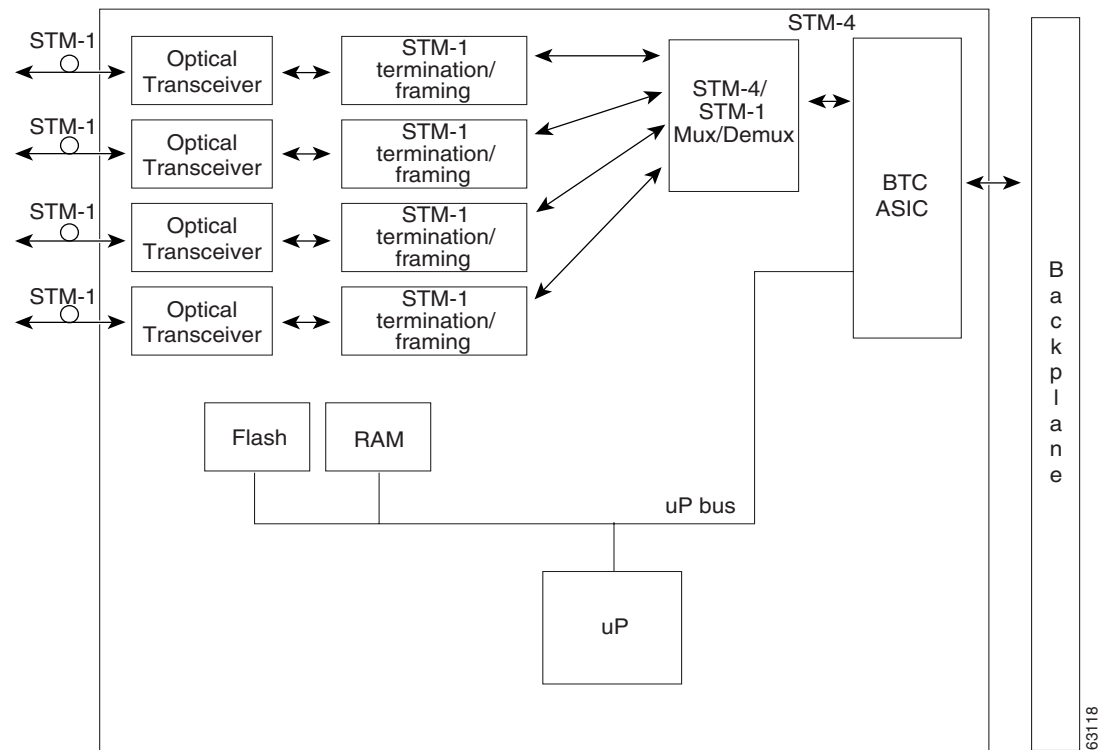


Figure 4-2 shows a block diagram of the four-port OC-3 card.

Figure 4-2 OC3 IR 4/STM1 SH 1310 Block Diagram



You can install the OC3 IR 4/STM1 SH 1310 card in Slots 1 to 6 and 12 to 17. The card can be provisioned as part of an SNCP or in a linear add/drop multiplexer/terminal monitor (ADM/TM) configuration. Each interface features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors.

The OC3 IR 4/STM1 SH 1310 card supports 1+1 unidirectional and bidirectional protection switching. You can provision protection on a per port basis.

The OC3 IR 4/STM1 SH 1310 card detects loss of signal (LOS), loss of frame (LOF), loss of pointer (LOP), multiplex section alarm indication signal (MS-AIS), and multiplex section far-end receive failure (MS-FERF) conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line bit interleaved parity (BIP) errors.

To enable multiplex section protection (MSP), the OC3 IR 4/STM1 SH 1310 card extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The data communication channel/generic communication channel (DCC/GCC) bytes are forwarded to the TCC2 card, which terminates the DCC/GCC.

4.2.1 OC3 IR 4/STM1 SH 1310 Card-Level Indicators

Table 4-3 describes the OC3 IR 4/STM1 SH 1310 card's three card-level LED indicators.

Table 4-3 OC3 IR 4/STM1 SH 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BER on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the links are working, the light turns off.

4.2.2 OC3 IR 4/STM1 SH 1310 Port-Level Indicators

Eight bi-color LEDs show the status per port. The LEDs shows green if the port is available to carry traffic, is provisioned as in-service, and is part of a protection group, in the active mode. You can find the status of the four card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.2.3 OC3 IR 4/STM1 SH 1310 Card Specifications

The OC3 IR 4/STM1 SH 1310 card has the following specifications:

- Line
 - Bit rate: 155.52 Mbps
 - Code: Scrambled non-return to zero (NRZ)
 - Fiber: 1310 nm single-mode
 - Loopback modes: Terminal and facility
 - Connector: SC
 - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: –8 dBm
 - Minimum transmitter output power: –15 dBm
 - Center wavelength: 1261 to 1360 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: Fabry Perot laser
 - Extinction Ratio: 8.2 dB

- Dispersion Ratio: 96 ps/nm
- Receiver
 - Maximum receiver level: –8 dBm at BER $1 * 10^{exp - 12}$
 - Minimum receiver level: –28 dBm at BER $1 * 10^{exp - 12}$
 - Receiver: InGaAs/InP photodetector
 - Link loss budget: 13 dB
 - Receiver input wavelength range: 1261 to 1360 nm
 - Jitter Tolerance: GR-253/G.823 Compliant
- Environmental
 - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 19.20 W, 0.40 A at –48 V, 65.56 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.4 kg (1.0 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.3 OC3 IR/STM1 SH 1310-8 Card



Warning

Class 1 laser product.



Warning

Invisible laser radiation present.



Warning

Use of controls, adjustments, or performing procedures other than those specified may result in hazardous radiation exposure.

The OC3 IR/STM1 SH 1310-8 card provides eight intermediate or short range SDH STM-1 ports compliant with ITU-T G.707, and ITU-T G.957. Each port operates at 155.52 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at the STM-1 signal level. [Figure 4-3 on page 4-10](#) shows the card faceplate.

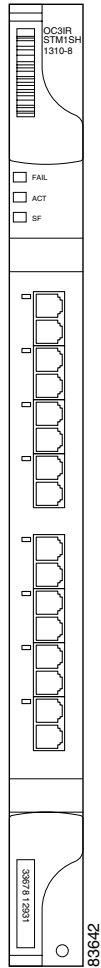
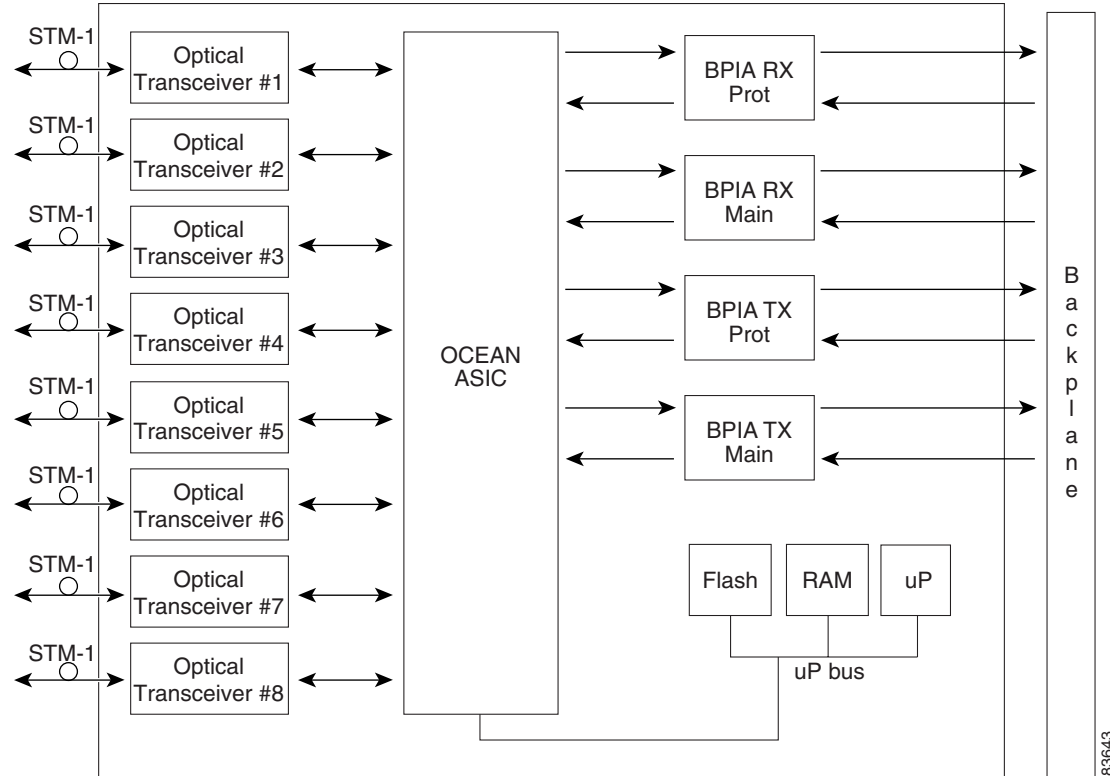
Figure 4-3 OC3 IR/STM1 SH 1310-8 Faceplate

Figure 4-4 on page 4-11 shows a block diagram of the OC3 IR/STM1 SH 1310-8 card.

Figure 4-4 OC3 IR/STM1 SH 1310-8 Block Diagram



You can install the OC3IR/STM1SH 1310-8 card in Slots 1 to 4 and 14 to 17 (multispeed slots). The card can be provisioned as part of an SNCP or in an add/drop multiplexer/terminal monitor (ADM/TM) configuration. Each interface features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses LC connectors on the faceplate, angled downward 12.5 degrees.

The OC3IR/STM1SH 1310-8 card supports 1+1 unidirectional and bidirectional protection switching. You can provision protection on a per port basis.

The OC3IR/STM1SH 1310-8 card detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable MSP, the OC3IR/STM1SH 1310-8 card extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The OC3IR/STM1SH 1310-8 card supports full DCC/GCC connectivity for remote network management.

4.3.1 OC3 IR/STM1 SH 1310-8 Card-Level Indicators

Table 4-4 describes the three card-level LED indicators for the OC3IR/STM1SH 1310-8 card.

Table 4-4 OC3IR/STM1SH 1310-8 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS or high BER on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the links are working, the light turns off.

4.3.2 OC3 IR/STM1 SH 1310-8 Port-Level Indicators

Eight bi-color LEDs show the status per port. The LEDs shows green if the port is available to carry traffic, is provisioned as in-service, and is part of a protection group, in the active mode. You can also find the status of the eight card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.3.3 OC3 IR/STM1 SH 1310-8 Card Specifications

The OC3IR/STM1SH 1310-8 card has the following specifications:

- Line
 - Bit rate: 155.52 Mbps
 - Code: Scrambled NRZ
 - Fiber: 1310 nm single-mode
 - Loopback modes: Terminal and facility
 - Connector: LC
 - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: –8 dBm
 - Minimum transmitter output power: –15 dBm
 - Center wavelength: 1293 to 1334 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: Fabry Perot laser
 - Extinction ratio: 8.2 dB

- Dispersion tolerance: 96 ps/nm
- Receiver
 - Maximum receiver level: -8 dBm at BER $1 * 10 \text{ exp} - 12$
 - Minimum receiver level: -28 dBm at BER $1 * 10 \text{ exp} - 12$
 - Receiver: InGaAs/InP photodetector
 - Link loss budget: 13 dB
 - Receiver input wavelength range: 1274 to 1356 nm
 - Jitter tolerance: GR-253/G.823 Compliant
- Environmental
 - Operating temperature: -5 to $+45$ degrees Celsius ($+23$ to $+113$ degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 23.00 W, 0.48 A at -48 V , 78.5 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.4 kg (1.0 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.4 OC12 IR/STM4 SH 1310 Card



Warning

Class 1 laser product.



Warning

Invisible laser radiation present.

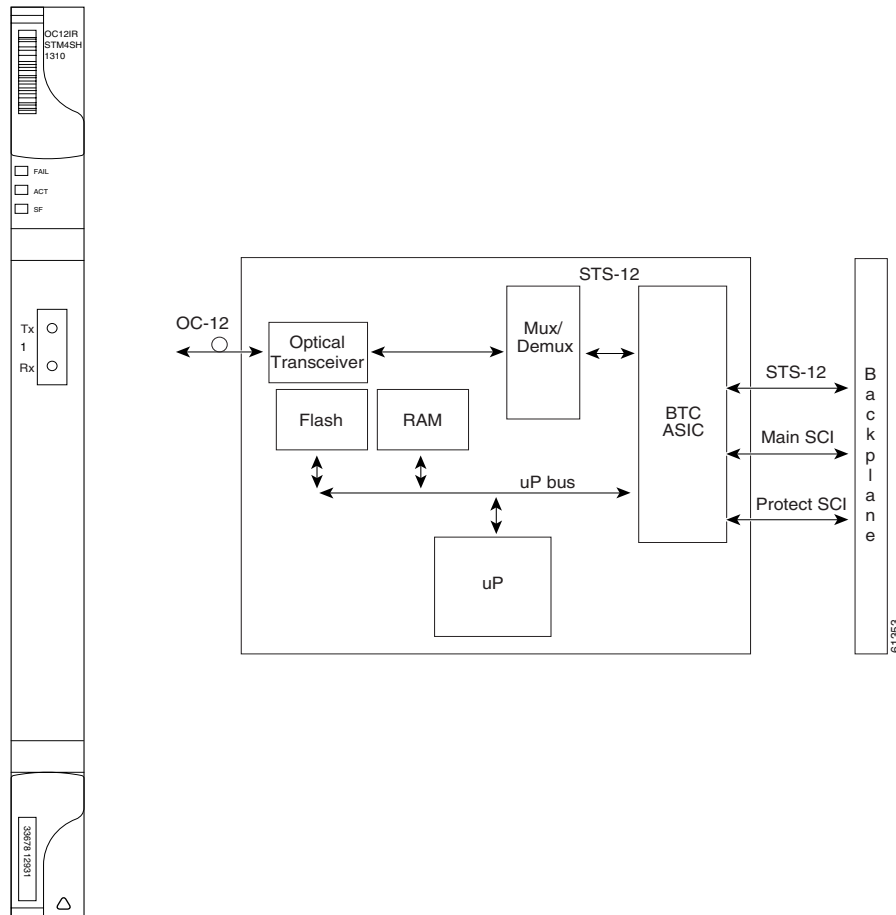


Warning

Use of controls, adjustments, or performing procedures other than those specified may result in hazardous radiation exposure.

The OC12 IR/STM4 SH 1310 card provides one intermediate or short range SDH STM-4 port compliant with ITU-T G.707, and ITU-T G.957. The port operates at 622.08 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at STM-1 and STM-4 signal levels. Figure 4-5 shows the OC12 IR/STM4 SH 1310 faceplate and a block diagram of the card.

Figure 4-5 OC12 IR/STM4 SH 1310 Faceplate and Block Diagram



You can install the OC12 IR/STM4 SH 1310 card in Slots 1 to 6 and 12 to 17 and provision the card as part of an MSP or subnetwork connection (SNC) ring. In ADM/TM configurations, you can provision the card as either an access tributary or a transport span (trunk) side interface.

The OC12 IR/STM4 SH 1310 card interface features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The OC12 IR/STM4 SH 1310 card uses SC optical connections and supports 1+1 unidirectional and bidirectional protection.

The OC12 IR/STM4 SH 1310 detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable MSP, the OC12 IR/STM4 SH 1310 extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The DCC/GCC bytes are forwarded to the TCC2 card, which terminates the DCC/GCC.

4.4.1 OC12 IR/STM4 SH 1310 Card-Level Indicators

Table 4-5 describes the three card-level LED indicators on the OC12 IR/STM4 SH 1310 card.

Table 4-5 OC12 IR/STM4 SH 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is operational and is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.4.2 OC12 IR/STM4 SH 1310 Port-Level Indicators

You can find the status of the OC12 IR/STM4 SH 1310 card port using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.4.3 OC12 IR/STM4 SH 1310 Card Specifications

The OC12 IR/STM/4 SDH 1310 card has the following specifications:

- Line
 - Bit rate: 622.08 Mbps
 - Code: Scrambled NRZ
 - Fiber: 1310 nm single-mode
 - Loopback modes: Terminal and facility
 - Connectors: SC
 - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: -8 dBm
 - Minimum transmitter output power: -15 dBm
 - Center wavelength: 1274 to 1356 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: Fabry Perot laser
 - Extinction ratio: 8.2 dB
 - Dispersion tolerance: 96 ps/nm

- Receiver
 - Maximum receiver level: -8 dBm at BER $1 * 10 \text{ exp} - 12$
 - Minimum receiver level: -28 dBm at BER $1 * 10 \text{ exp} - 12$
 - Receiver: InGaAs/InP photodetector
 - Link loss budget: 13 dB
 - Receiver input wavelength range: 1274 to 1356 nm
 - Jitter tolerance: GR-253/G.823 Compliant
- Environmental
 - Operating temperature: -5 to $+55$ degrees Celsius ($+23$ to $+131$ degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 10.90 W, 0.23 A at -48 V, 37.2 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.6 kg (1.4 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.5 OC12 LR/STM4 LH 1310 Card



Warning

Class 1 laser product.



Warning

Invisible laser radiation present.



Warning

Use of controls, adjustments, or performing procedures other than those specified may result in hazardous radiation exposure.

The OC12 LR/STM4 LH 1310 card provides one long-range SDH STM-4 port per card compliant with ITU-T G.707, and ITU-T G.957. The port operates at 622.08 Mbps over a single-mode fiber span. The card supports VC-4 and nonconcatenated or concatenated payloads at STM-1 and STM-4 signal levels. [Figure 4-6 on page 4-17](#) shows the OC12 LR/STM4 LH 1310 faceplate.

Figure 4-6 OC12 LR/STM4 LH 1310 Faceplate

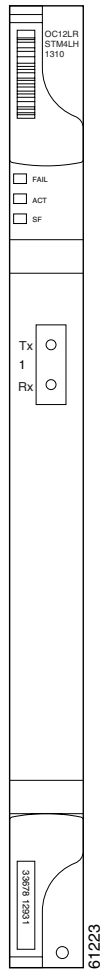
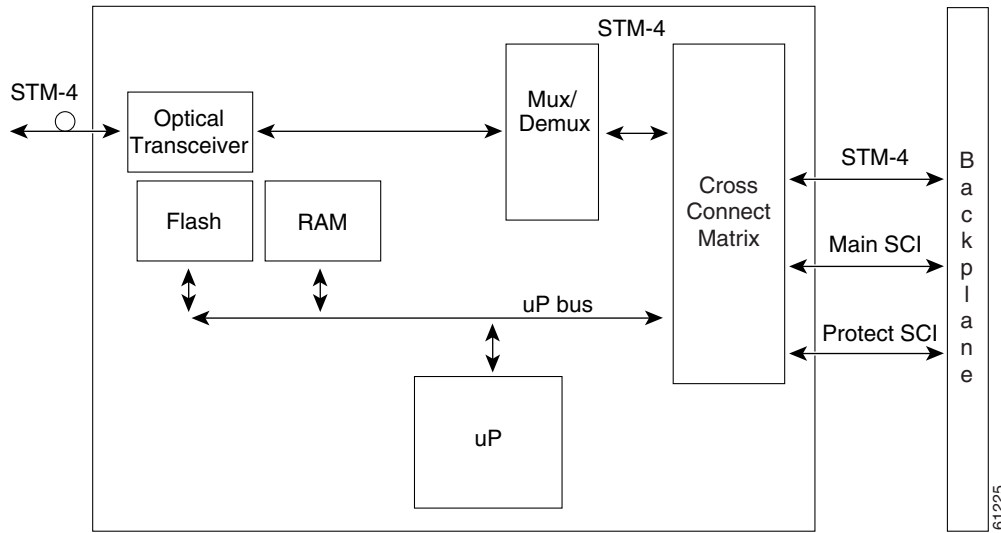


Figure 4-7 on page 4-18 shows a block diagram of the card.

Figure 4-7 OC12 LR/STM4 LH 1310 Block Diagram



You can install the OC12 LR/STM4 LH 1310 card in Slots 1 to 6 and 12 to 17 and provision the card as part of an MSP or SNC ring. In ADM/TM configurations, you can provision the card as either an access tributary or a transport span-side interface.

The OC12 LR/STM4 LH 1310 card interface features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC optical connections and supports 1+1 unidirectional and bidirectional protection.

The OC12 LR/STM4 LH 1310 detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable MSP, the OC12 LR/STM4 LH 1310 extracts the K1 and K2 bytes from the SDH overhead to perform appropriate protection switches. The DCC/GCC bytes are forwarded to the TCC2 card, which terminates the DCC/GCC.

4.5.1 OC12 LR/STM4 LH 1310 Card-Level Indicators

Table 4-6 describes the three card-level LED indicators on the OC12 LR/STM4 LH 1310 card.

Table 4-6 OC12 LR/STM4 LH 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.

Table 4-6 OC12 LR/STM4 LH 1310 Card-Level Indicators (continued)

Card-Level LED	Description
Green ACT LED	The green ACT LED indicates that the card is operational and is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.5.2 OC12 LR/STM4 LH 1310 Port-Level Indicators

You can find the status of the OC12 LR/STM4 LH 1310 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.5.3 OC12 LR/STM4 LH 1310 Card Specifications

The OC12 LR STM4 LH 1310 card has the following specifications:

- Line
 - Bit rate: 622.08 Mbits/s (Mbps)
 - Code: Scrambled NRZ
 - Fiber: 1310 nm single-mode
 - Loopback modes: Terminal and facility
 - Connectors: SC
 - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: +2 dBm
 - Minimum transmitter output power: -3 dBm
 - Center wavelength: 1280 to 1335 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: Distributed feedback (DFB) laser
- Receiver
 - Maximum receiver level: -8 dBm at BER 1×10^{-12}
 - Minimum receiver level: -28 dBm at BER 1×10^{-12}
 - Receiver: InGaAs/InP photodetector
 - Link loss budget: 25 dB
 - Receiver input wavelength range: 1280 to 1335 nm

- Environmental
 - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 9.28 W, 0.19 A at –48 V, 31.7 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.6 kg (1.4 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.6 OC12 LR/STM4 LH 1550 Card

The OC12 LR/STM4 LH 1550 card provides one long-range, ITU-T G.707- and G.957-compliant, SDH STM-4 port per card. The interface operates at 622.08 Mbits/s (Mbps) over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads on a per VC-4 basis. [Figure 4-8 on page 4-21](#) shows the OC12 LR/STM4 LH 1550 faceplate.



Warning

Class 1 laser product.

Figure 4-8 OC12 LR/STM4 LH 1550 Faceplate

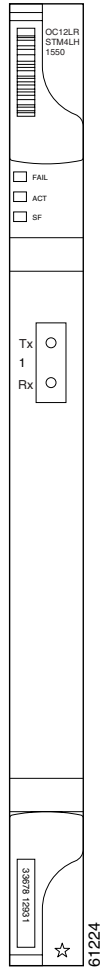
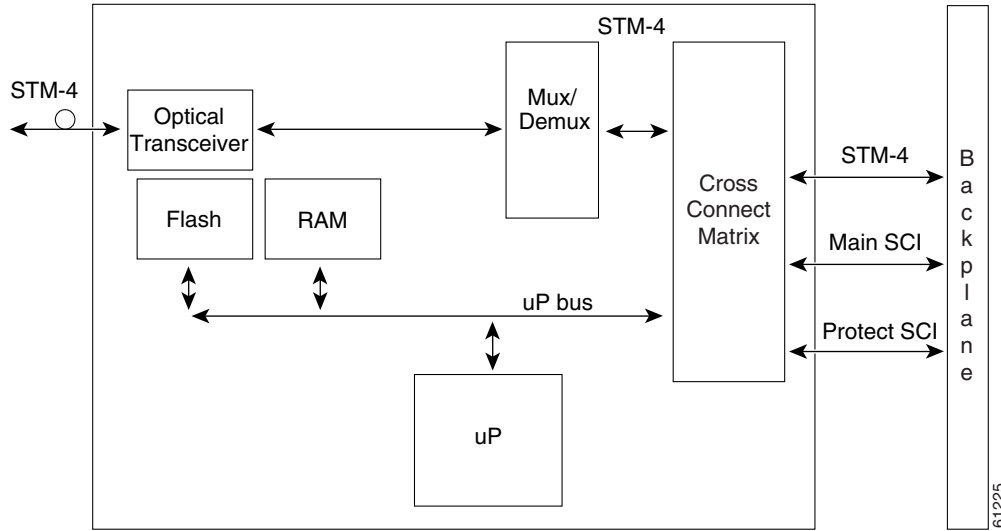


Figure 4-9 on page 4-22 shows a block diagram of the card.

Figure 4-9 OC12 LR/STM4 LH 1550 Block Diagram

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

You can install the OC12 LR/STM4 LH 1550 card in Slots 1 to 6 or 12 to 17. You can provision the card as part of an MSP or SNC ring. In ADM/TM configurations, you can provision the card as either an access tributary or a transport span-side interface.

The OC12 LR/STM4 LH 1550 card uses long-reach optics centered at 1550 nm and contains a transmit and receive connector (labeled) on the card faceplate. The OC12 LR/STM4 LH 1550 card uses SC optical connections and supports 1+1 bidirectional or unidirectional protection switching.

The OC12 LR/STM4 LH 1550 card detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

To enable MSP, the OC12 LR/STM4 LH 1550 extracts the K1 and K2 bytes from the SDH overhead and processes them to switch accordingly. The DCC/GCC bytes are forwarded to the TCC2 card, which terminates the DCC/GCC.

4.6.1 OC12 LR/STM4 LH 1550 Card-Level Indicators

Table 4-7 describes the three card-level LED indicators on the OC12 LR/STM4 LH 1550 card.

Table 4-7 OC12 LR/STM4 LH 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.

Table 4-7 OC12 LR/STM4 LH 1550 Card-Level Indicators (continued)

Card-Level LED	Description
Green ACT LED	The green ACT LED indicates that the card is operational and ready to carry traffic.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.6.2 OC12 LR/STM4 LH 1550 Port-Level Indicators

You can find the status of the OC12 LR/STM4 LH 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.6.3 OC12 LR/STM4 LH 1550 Card Specifications

The OC12 LR/STM4 LH 1550 card has the following specifications:

- Line
 - Bit rate: 622.08 Mbits/s (Mbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Loopback modes: Terminal and facility
 - Connectors: SC
 - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: +2 dBm
 - Minimum transmitter output power: -3 dBm
 - Center wavelength: 1480 to 1580 nm
 - Nominal wavelength: 1550 nm
 - Transmitter: DFB laser
- Receiver
 - Maximum receiver level: -8 dBm at BER 1×10^{-12}
 - Minimum receiver level: -28 dBm at BER 1×10^{-12}
 - Receiver: InGaAs/InP photodetector
 - Link loss budget: 25 dB
 - Receiver input wavelength range: 1480 to 1580 nm

- Environmental
 - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 9.28 W, 0.19 A at –48 V, 31.7 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.6 kg (1.4 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.7 OC12 IR/STM4 SH 1310-4 Card

The OC12 IR/STM4 SH 1310-4 card provides four intermediate or short range SDH STM-4 ports compliant with ITU-T G.707, and ITU-T G.957. Each port operates at 622.08 Mbits/s (Mbps) over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads on a per VC-4 basis. [Figure 4-10 on page 4-25](#) shows the OC12 IR/STM4 SH 1310-4 faceplate.



Warning

Class 1 laser product.

Figure 4-10 OC12 IR/STM4 SH 1310-4 Faceplate

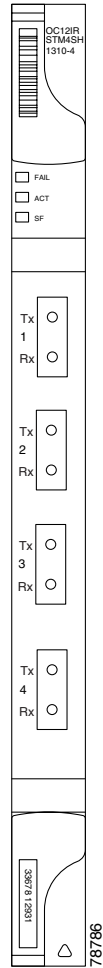
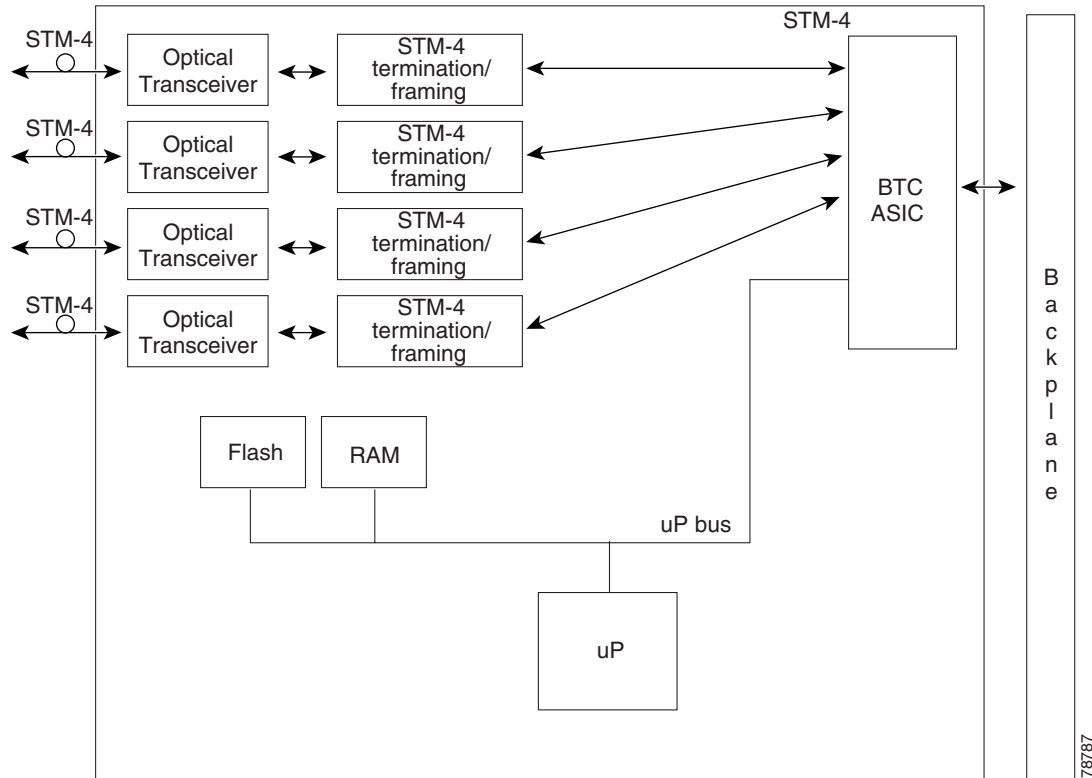


Figure 4-11 on page 4-26 shows a block diagram of the card.

Figure 4-11 OC12 IR/STM4 SH 1310-4 Block Diagram

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

You can install the OC12 IR/STM4 SH 1310-4 card in Slots 1 to 4 and 14 to 17. The card can be provisioned as part of an SNCP, part of an MS-SPRing, or in an ADM/TM configuration. Each interface features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors.

The OC12 IR/STM4 SH 1310-4 card supports 1+1 unidirectional and bidirectional protection switching. You can provision protection on a per port basis.

The OC12 IR/STM4 SH 1310-4 card detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Reference Manual* for a description of these conditions. The card also counts section and line BIP errors.

Each port is configurable to support all ONS 15454 SDH configurations and can be provisioned as part of an MS-SPRing, SNCP, or MSP configuration.

To enable MSP, the OC12 IR/STM4 SH 1310-4 card extracts the K1 and K2 bytes from the SDH overhead and processes them to switch accordingly. The DCC/GCC bytes are forwarded to the TCC2 card, which terminates the DCC/GCC.

**Note**

If you ever expect to upgrade an OC-12/STM-4 ring to a higher bit rate, you should not put an OC12 IR/STM4 SH 1310-4 card in that ring. The four-port card is not upgradable to a single-port card. The reason is that four different spans, possibly going to four different nodes, cannot be merged to a single span.

4.7.1 OC12 IR/STM4 SH 1310-4 Card-Level Indicators

Table 4-8 describes the three card-level LED indicators on the OC12 IR/STM4 SH 1310-4 card.

Table 4-8 OC12 IR/STM4 SH 1310-4 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BER on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the links are working, the light turns off.

4.7.2 OC12 IR/STM4 SH 1310-4 Port-Level Indicators

You can find the status of the four card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Procedure Guide* for a complete description of the alarm messages.

4.7.3 OC12 IR/STM4 SH 1310-4 Card Specifications

The OC12 IR/STM4 SH 1310-4 card has the following specifications:

- Line
 - Bit rate: 622.08 MBits/s (Mbps)
 - Code: Scrambled NRZ
 - Fiber: 1310 nm single-mode
 - Chromatic dispersion allowance: 74 ps/nm for the spectral range of 1274 to 1356 nm; 46 ps/nm for the spectral range of 1293 to 1334 nm
 - Loopback modes: Terminal and facility
 - Connector: SC
 - Compliance: Telcordia GR-253-CORE IR-1, Telcordia GR-2918-CORE, ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: –8 dBm
 - Minimum transmitter output power: –15 dBm
 - Center wavelength: 1293 to 1334 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: Fabry Perot laser

- Receiver
 - Maximum receiver level: -8 dBm at BER $1 * 10 \text{ exp} - 10$
 - Minimum receiver level: -30 dBm at BER $1 * 10 \text{ exp} - 10$
 - Receiver: InGaAs/InP photodetector
 - Link loss budget: 15 dB
 - Receiver input wavelength range: 1274 to 1356 nm
- Environmental
 - Operating temperature: -5 to $+45$ degrees Celsius ($+23$ to $+113$ degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 28 W, 0.58 A at -48 V, 95.6 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.4 kg (1.0 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.8 OC48 IR/STM16 SH AS 1310 Card

The OC48 IR/STM16 SH AS 1310 card provides one intermediate-range, ITU-T G.707- and G.957-compliant, SDH STM-16 port per card. The interface operates at 2.488 GBits/s (Gbps) over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads at STM-1, STM-4, or STM-16 signal levels on a per VC-4 basis. [Figure 4-12 on page 4-29](#) shows the OC48 IR/STM16 SH AS 1310 faceplate.



Warning

Class 1 laser product.

Figure 4-12 OC48 IR/STM16 SH AS 1310 Faceplate

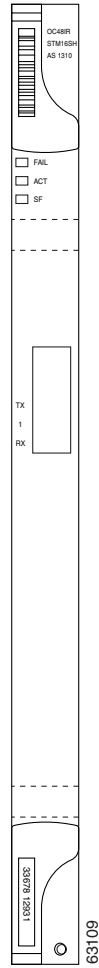
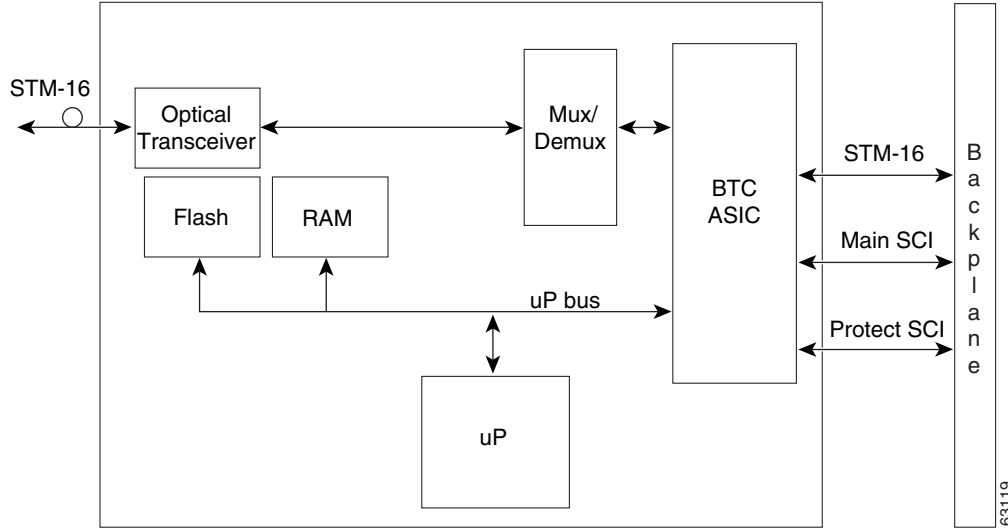


Figure 4-13 on page 4-30 shows a block diagram of the card.

Figure 4-13 OC48 IR/STM16 SH AS 1310 Block Diagram

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

You can install the OC48 IR/STM16 SH AS 1310 card in Slots 1 to 6 and 12 to 17. You can provision the card as part of a MS-SPRing or SNCP. In an ADM/TM configuration, you can provision the card as either an access tributary or a transport span interface.

The STM-16 port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The OC48 IR/STM16 SH AS 1310 card uses SC connectors. The card supports 1+1 unidirectional protection and provisionable bidirectional switching.

The OC48 IR/STM16 SH AS 1310 card detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

4.8.1 OC48 IR/STM16 SH AS 1310 Card-Level Indicators

Table 4-9 describes the three card-level LED indicators on the OC48 IR/STM16 SH AS 1310 card.

Table 4-9 OC48 IR/STM16 SH AS 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.

Table 4-9 OC48 IR/STM16 SH AS 1310 Card-Level Indicators (continued)

Card-Level LED	Description
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, MS-AIS, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.8.2 OC48 IR/STM16 SH AS 1310 Port-Level Indicators

You can find the status of the OC48 IR/STM16 SH AS 1310 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.8.3 OC48 IR/STM16 SH AS 1310 Card Specifications

The OC48 IR/STM16 SH AS 1310 card has the following specifications:

- Line
 - Bit rate: 2488.320 Mbits/s (Mbps)
 - Code: Scrambled NRZ
 - Fiber: 1310 nm single-mode
 - Loopback modes: Terminal and facility
 - Connectors: SC
 - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: 0 dBm
 - Minimum transmitter output power: -5 dBm
 - Center wavelength: 1280 to 1350 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: DFB laser
- Receiver
 - Maximum receiver level: 0 dBm at BER 1×10^{-10}
 - Minimum receiver level: -18 dBm at BER 1×10^{-10}
 - Receiver: InGaAs InP photodetector
 - Link loss budget: 13 dB minimum
 - Receiver input wavelength range: 1280 to 1350 nm

- Environmental
 - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 37.20 W, 0.78 A at –48 V, 127.0 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.9 kg (2.2 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.9 OC48 LR/STM16 LH AS 1550 Card

The OC48 LR/STM16 LH AS 1550 card provides one long-range, ITU-T G.707- and G.957-compliant, SDH STM-16 port per card. The interface operates at 2.488 GBits/s (Gbps) over a single-mode fiber span. The card supports concatenated or nonconcatenated payloads at STM-1, STM-4, or STM-16 signal levels on a per VC-4 basis. [Figure 4-14 on page 4-33](#) shows the OC48 LR/STM16 LH AS 1550 faceplate.



Warning

Class 1 laser product.

Figure 4-14 OC48 LR/STM16 LH AS 1550 Faceplate

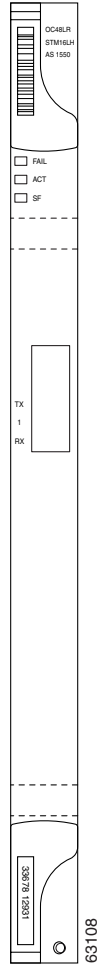
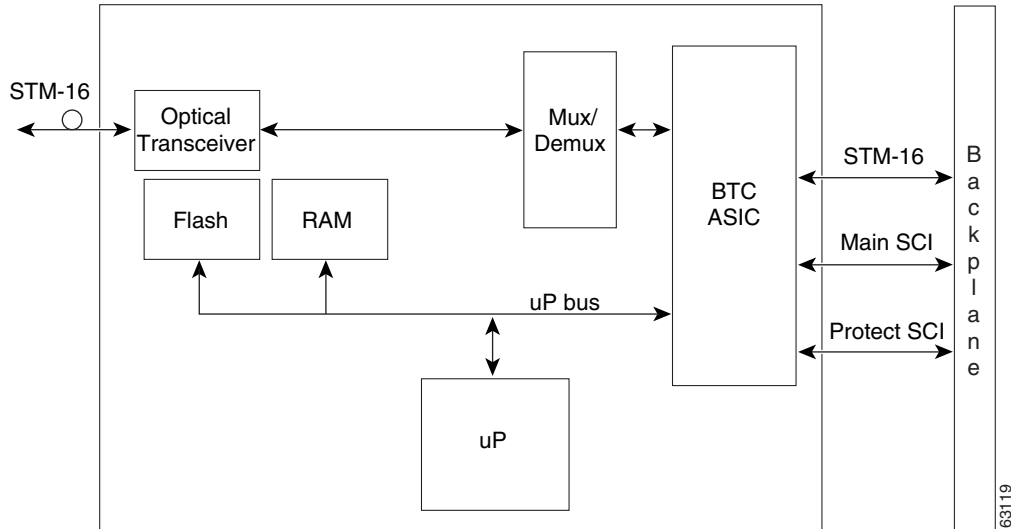


Figure 4-15 on page 4-34 shows a block diagram of the card.

Figure 4-15 OC48 LR/STM16 LH AS 1550 Block Diagram

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

You can install OC48 LR/STM16 LH AS 1550 cards in Slots 1 to 6 or 12 to 17. You can provision this card as part of a MS-SPRing or SNCP. In an ADM/TM configuration, you can provision the card as either an access tributary or a transport span interface.

The OC48 LR/STM16 LH AS 1550 port features a 1550 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors, and it supports 1+1 unidirectional protection and provisionable bidirectional and unidirectional switching.

The OC48 LR/STM16 LH AS 1550 detects LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors.

4.9.1 OC48 LR/STM16 LH AS 1550 Card-Level Indicators

Table 4-10 describes the three card-level LED indicators on the OC48 LR/STM16 LH AS 1550 card.

Table 4-10 OC48 LR/STM16 LH AS 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.

Table 4-10 OC48 LR/STM16 LH AS 1550 Card-Level Indicators (continued)

Card-Level LED	Description
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.9.2 OC48 LR/STM16 LH AS 1550 Port-Level Indicators

You can find the status of the OC48 LR/STM16 LH AS 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.9.3 OC48 LR/STM16 LH AS 1550 Card Specifications

The OC48 LR/STM16 LH AS 1550 card has the following specifications:

- Line
 - Bit rate: 2488.320 Mbits/s (Mbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Loopback modes: Terminal and facility
 - Connectors: SC
 - Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: +3 dBm
 - Minimum transmitter output power: -2 dBm
 - Center wavelength: 1520 to 1580 nm
 - Nominal wavelength: 1550 nm
 - Transmitter: DFB laser
- Receiver
 - Maximum receiver level: -8 dBm at BER 1×10^{-10}
 - Minimum receiver level: -28 dBm at BER 1×10^{-10}
 - Receiver: InGaAs avalanche photo diode (APD) photodetector
 - Link loss budget: 26 dB minimum, with 1 dB dispersion penalty
 - Receiver input wavelength range: 1520 to 1580 nm
- Environmental
 - Eye safety compliance: Class 1 (EN60825)

- Operating temperature: -5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
- Operating humidity: 5 to 95%, noncondensing
- Power consumption: 37.20 W, 0.78 A at -48 V, 127.0 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 0.9 kg (2.2 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product

4.10 OC48 ELR/STM16 EH 100 GHz Cards

Eighteen distinct STM-16 ITU 100-GHz DWDM cards comprise the ONS 15454 SDH DWDM channel plan. This plan contains every second wavelength in the ITU grid for 100-GHz-spaced DWDM. Though the ONS 15454 SDH only uses 200-GHz spacing, the cards work in 100-GHz-spaced nodes, as well.

Each OC48 ELR/STM16 EH 100 GHz card provides one SDH STM-16 port compliant with ITU-T G.692, ITU-T G.707, ITU-T G.957, and ITU-T G.958. The interface operates at 2.488 GBits/s (Gbps) over a single-mode fiber span. Each card supports concatenated or nonconcatenated payloads at STM-1, STM-4, or STM-16 signal levels on a per VC-4 basis. [Figure 4-16 on page 4-37](#) shows the OC48 ELR/STM16 EH 100 GHz faceplate.



Warning

Class 1 laser product.

Figure 4-16 OC48 ELR/STM16 EH 100 GHz Faceplate

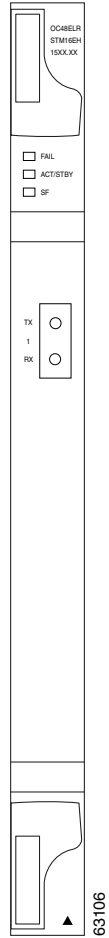
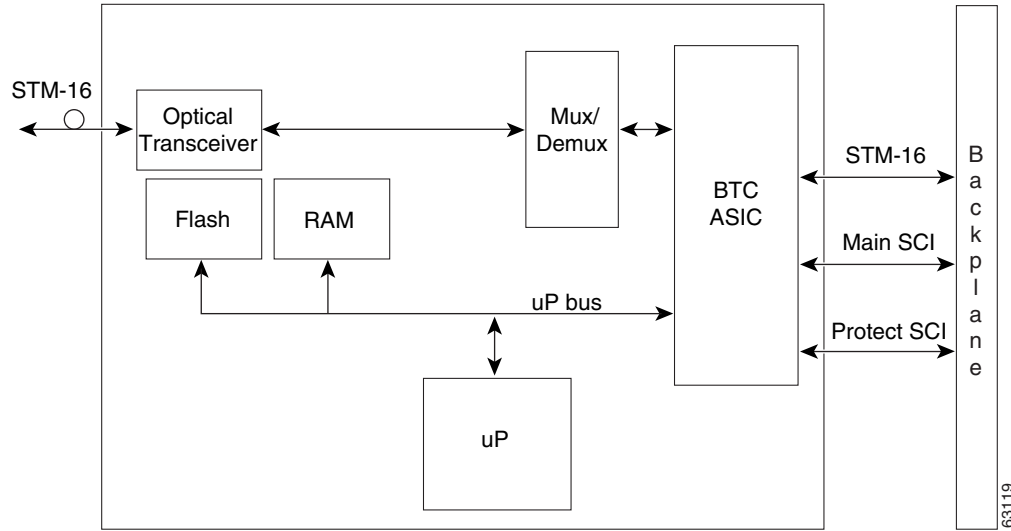


Figure 4-17 on page 4-38 shows a block diagram of the card.

Figure 4-17 OC48 ELR/STM16 EH 100 GHz Block Diagram

**Warning**

Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

Nine of the cards operate in the blue band with a spacing of $2 * 100$ GHz in the ITU grid (1530.33 nm, 1531.90 nm, 1533.47 nm, 1535.04 nm, 1536.61 nm, 1538.19 nm, 1539.77 nm, 1541.35 nm, and 1542.94 nm). The other nine cards operate in the red band with a spacing of $2 * 100$ GHz in the ITU grid (1547.72 nm, 1549.32 nm, 1550.92 nm, 1552.52 nm, 1554.13 nm, 1555.75 nm, 1557.36 nm, 1558.98 nm, and 1560.61 nm).

You can install the OC48 ELR/STM16 EH 100 GHz cards in Slot 5, 6, 12, or 13. You can provision this card as part of a MS-SPRing or SNCP. In an ADM/TM configuration, you can provision the card as either an access tributary or a transport span interface.

Each OC48 ELR/STM16 EH 100 GHz card uses extended long-reach optics operating individually within the ITU 100-GHz grid. The OC48 ELR/STM16 EH 100 GHz cards are intended to be used in applications with long unregenerated spans of up to 200 km (with mid-span amplification). These transmission distances are achieved through the use of inexpensive optical amplifiers (flat gain amplifiers) such as erbium-doped fiber amplifiers (EDFAs). Using collocated amplification, distances up to 200 km can be achieved for a single channel (160 km for 8 channels).

Maximum system reach in filterless applications is 24 dB, or approximately 80 km, without the use of optical amplifiers or regenerators. However, system reach also depends on the condition of the facilities, number of splices and connectors, and other performance-affecting factors. The OC48 ELR/STM16 EH 100 GHz cards feature wavelength stability of ± 0.25 nm. Each port contains a transmitter and a receiver.

The OC48 ELR/STM16 EH 100 GHz cards are the first in a family of cards meant to support extended long-reach applications in conjunction with optical amplification. Using DFB laser technology, the OC48 ELR/STM16 EH 100 GHz cards provide a solution at the lower extended long-reach distances.

The OC48 ELR/STM16 EH 100 GHz port features a 1550 nm range laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses SC connectors and supports 1+1 unidirectional and bidirectional protection switching.

The OC48 ELR/STM16 EH 100 GHz cards detect LOS, LOF, LOP, MS-AIS, and MS-FERF conditions. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The cards also count section and line BIP errors.

To enable MSP, the OC48 ELR/STM16 EH 100 GHz cards extract the K1 and K2 bytes from the SDH overhead. The DCC/GCC bytes are forwarded to the TCC2 card; the TCC2 terminates the DCC/GCC.

4.10.1 OC48 ELR/STM16 EH 100 GHz Card-Level Indicators

Table 4-11 describes the three card-level LED indicators on the OC48 ELR/STM16 EH 100 GHz cards.

Table 4-11 OC48 ELR Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the card is carrying traffic or is traffic-ready.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.10.2 OC48 ELR/STM16 EH 100 GHz Port-Level Indicators

You can find the status of the OC48 ELR/STM16 EH 100 GHz card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.10.3 OC48 ELR/STM16 EH 100 GHz Card Specifications

The OC48 ELR/STM16 EH 100 GHz cards have the following specifications:

- Line
 - Bit rate: 2488.320 Mbits/s (Mbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Loopback modes: Terminal and facility
 - Connectors: SC
 - Compliance: ITU-T G.692, ITU-T G.707, ITU-T G.957, ITU-T G.958
- Transmitter
 - Maximum transmitter output power: 0 dBm
 - Minimum transmitter output power: -2 dBm

- Center wavelength: ± 0.25 nm
- Transmitter: DFB laser
- Receiver
 - Maximum receiver level: -8 dBm at BER 1×10^{-10}
 - Minimum receiver level: -28 dBm at BER 1×10^{-10}
 - Receiver: InGaAs APD photodetector
 - Link loss budget: 26 dB minimum, with 1 dB dispersion penalty
 - Receiver input wavelength range: 1520 to 1580 nm
- Environmental
 - Operating temperature: -5 to $+45$ degrees Celsius ($+23$ to $+113$ degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 31.20 W, 0.65 A at -48 V, 106.5 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 1.1 kg (2.4 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 laser product
- Currently available wavelengths and versions of OC48 ELR/STM16 EH 100 GHz:

2 * 100 GHz spacing ITU grid blue band:

 - 1530.33 ± 0.25 nm, STM-16HS-LH 1530.33 (DWDM)
 - 1531.90 ± 0.25 nm, STM-16HS-LH 1531.90 (DWDM)
 - 1533.47 ± 0.25 nm, STM-16HS-LH 1533.47 (DWDM)
 - 1535.04 ± 0.25 nm, STM-16HS-LH 1535.04 (DWDM)
 - 1536.61 ± 0.25 nm, STM-16HS-LH 1536.61 (DWDM)
 - 1538.19 ± 0.25 nm, STM-16HS-LH 1538.19 (DWDM)
 - 1539.77 ± 0.25 nm, STM-16HS-LH 1539.77 (DWDM)
 - 1541.35 ± 0.25 nm, STM-16HS-LH 1541.35 (DWDM)
 - 1542.94 ± 0.25 nm, STM-16HS-LH 1542.94 (DWDM)

2 * 100 GHz spacing ITU grid red band:

 - 1547.72 ± 0.25 nm, STM-16HS-LH 1547.72 (DWDM)
 - 1549.32 ± 0.25 nm, STM-16HS-LH 1549.32 (DWDM)
 - 1550.92 ± 0.25 nm, STM-16HS-LH 1550.92 (DWDM)

- 1552.52 +/- 0.25 nm, STM-16HS-LH 1552.52 (DWDM)
- 1554.13 +/- 0.25 nm, STM-16HS-LH 1554.13 (DWDM)
- 1555.75 +/- 0.25 nm, STM-16HS-LH 1555.75 (DWDM)
- 1557.36 +/- 0.25 nm, STM-16HS-LH 1557.36 (DWDM)
- 1558.98 +/- 0.25 nm, STM-16HS-LH 1558.98 (DWDM)
- 1560.61 +/- 0.25 nm, STM-16HS-LH 1560.61 (DWDM)

4.11 OC192 SR/STM64 IO 1310 Card



Warning

Class 1 (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products. Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments, or performance of procedures other than those specified may result in hazardous radiation exposure.

The OC192 SR/STM64 IO 1310 card provides one intra-office haul, ITU-T G.707- and G.957-compliant, SDH STM-64 port per card in the 1310 nm wavelength range. The port operates at 9.95328 GBits/s (Gbps) over unamplified distances up to 2 km. The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads. [Figure 4-18 on page 4-42](#) shows the OC192 SR/STM64 IO 1310 faceplate.

Figure 4-18 OC192 SR/STM64 IO 1310 Faceplate

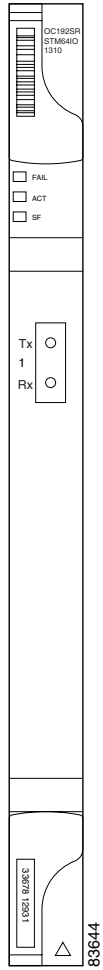
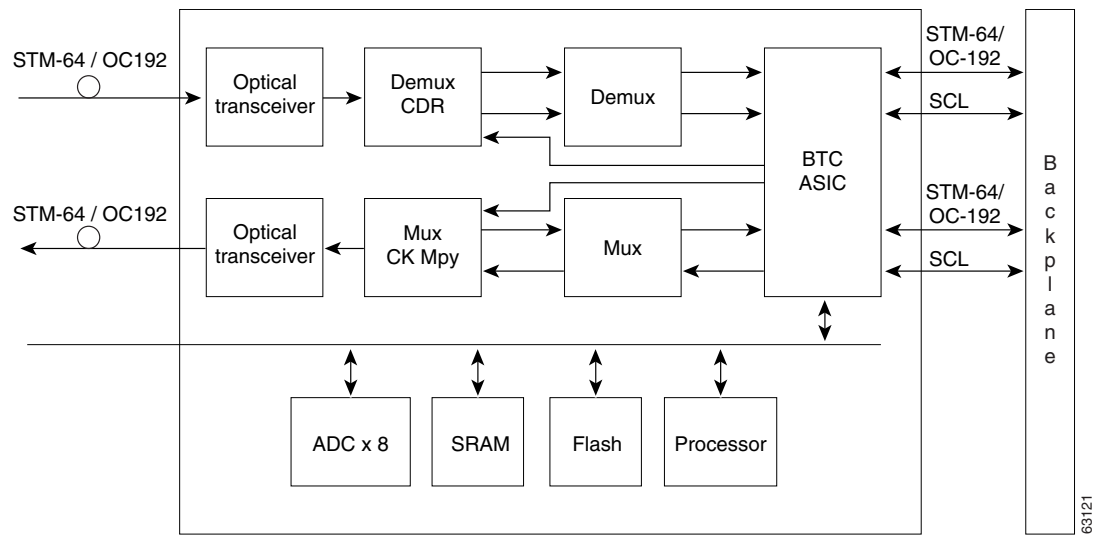


Figure 4-19 on page 4-43 shows a block diagram of the card.

Figure 4-19 OC192 SR/STM64 IO 1310 Block Diagram



You can install OC192 SR/STM64 IO 1310 cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, a SNCP, a linear configuration, or as a regenerator for longer span reaches.

The OC192 SR/STM64 IO 1310 port features a 1310 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports 1:1 protection in four-fiber bidirectional line switched ring applications where both span switching and ring switching might occur.

The OC192 SR/STM64 IO 1310 card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.11.1 OC192 SR/STM64 IO 1310 Card-Level Indicators

Table 4-12 describes the three card-level LED indicators on the OC192 SR/STM64 IO 1310 card.

Table 4-12 OC192 SR/STM64 IO 1310 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACTV/STBY LED is green, the card is operational and ready to carry traffic. If the ACTV/STBY LED is amber, the card is operational and in standby (protect) mode.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.11.2 OC192 SR/STM64 IO 1310 Port-Level Indicators

You can find the status of the OC192 SR/STM64 IO 1310 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.11.3 OC192 SR/STM64 IO 1310 Card Specifications

The OC 192 SR/STM64 IO 1310 card has the following specifications:

- Line
 - Bit rate: 9.95328 GBits/s (Gbps)
 - Code: Scrambled NRZ
 - Fiber: 1310 nm single-mode
 - Maximum chromatic dispersion allowance: 6.6 ps/nm
 - Loopback modes: Terminal and facility
 - Connectors: SC
 - Compliance: ITU-T G.707, ITU-T G.957, ITU-T G.691
- Transmitter
 - Maximum transmitter output power: –1 dBm
 - Minimum transmitter output power: –6 dBm
 - Center wavelength: 1290 to 1330 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: Directly modulated laser
- Receiver
 - Maximum receiver level: –1 dBm at BER $1 * 10^{exp - 12}$
 - Minimum receiver level: –11 dBm at BER $1 * 10^{exp - 12}$
 - Receiver: PIN diode
 - Link loss budget: 5 dB minimum, plus 1 dB dispersion penalty at BER = $1 * 10^{exp - 12}$ including dispersion
 - Receiver input wavelength range: 1290 to 1330 nm
- Environmental
 - Operating temperature: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 47.00 W, 0.98 A at –48 V, 160.5 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)

- Depth with backplane connector: 235 mm (9.250 in.)
- Weight not including clam shell: 1.3 kg (3.1 lb)
- Compliance
 - ONS 15454 SDH optical cards, when installed in a system, comply with these standards:
 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1M (IEC 60825-1 2001.01) and Class 1 (21 CFR 1040.10 and 1040.11) laser product

4.12 OC192 IR/STM64 SH 1550 Card



Warning

Class 1 (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products. Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments, or performance of procedures other than those specified may result in hazardous radiation exposure.

The OC192 IR/STM64 SH 1550 card provides one short-range, ITU-T G.707- and G.957-compliant, SDH STM-64 port per card. The port operates at 9.95328 GBits/s (Gbps) over unamplified distances up to 40 km with SMF-28 fiber limited by loss and/or dispersion. The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads. [Figure 4-20 on page 4-46](#) shows the OC192 IR/STM64 SH 1550 faceplate.

Figure 4-20 OC192 IR/STM64 SH 1550 Faceplate

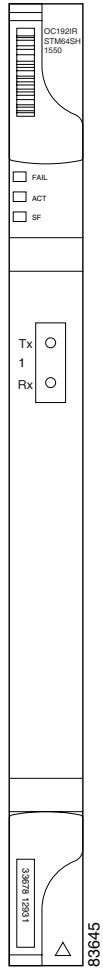
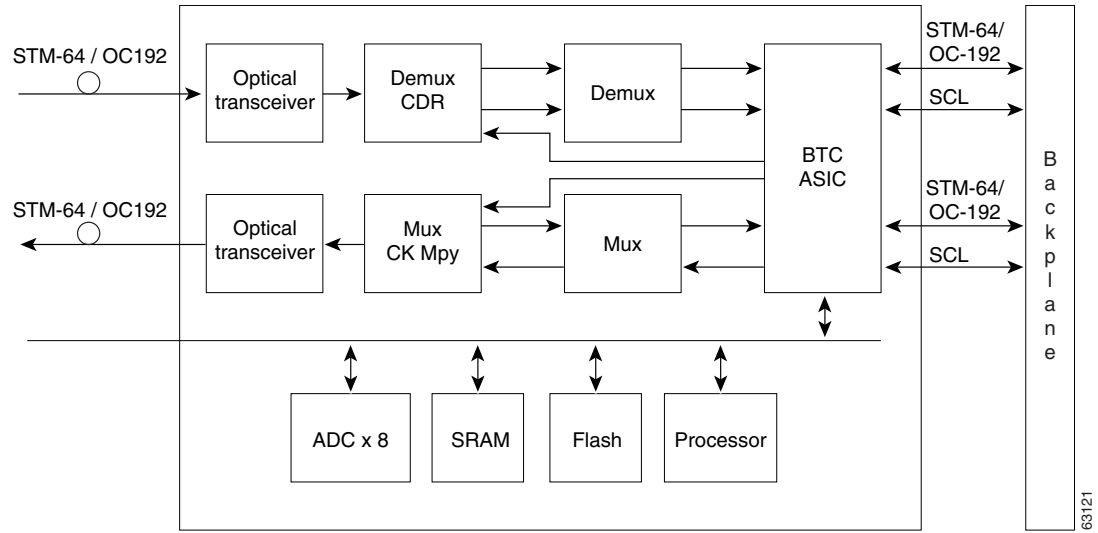


Figure 4-21 on page 4-47 shows a block diagram of the card.

Figure 4-21 OC192 IR/STM64 SH 1550 Block Diagram

**Note**

You must use a 3 to 15 dB fiber attenuator (5 dB recommended) when working with the OC192 IR/STM64 SH 1550 card in a loopback. Do not use fiber loopbacks with the OC192 IR/STM64 SH 1550 card. Using fiber loopbacks can cause irreparable damage to the OC192 IR/STM64 SH 1550 card.

You can install OC192 IR/STM64 SH 1550 cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, SNCP, or linear configuration, or as a regenerator for longer span reaches.

The OC192 IR/STM64 SH 1550 port features a 1550 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports 1:1 protection in four-fiber bidirectional line switched ring applications where both span switching and ring switching might occur.

The OC192 IR/STM64 SH 1550 card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.12.1 OC192 IR/STM64 SH 1550 Card-Level Indicators

Table 4-13 describes the three card-level LED indicators on the OC192 IR/STM64 SH 1550 card.

Table 4-13 OC192 IR/STM64 SH 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) amber (Standby)	If the ACTV/STBY LED is green, the card is operational and ready to carry traffic. If the ACTV/STBY LED is amber, the card is operational and in standby (protect) mode.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.12.2 OC192 IR/STM64 SH 1550 Port-Level Indicators

You can find the status of the OC192 IR/STM64 SH 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.12.3 OC192 IR/STM64 SH 1550 Card Specifications

The OC192 IR/STM64 SH 1550 card has the following specifications:

- Line
 - Bit rate: 9.95328 GBits/s (Gbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Maximum chromatic dispersion allowance: 800 ps/nm
 - Loopback modes: Terminal and facility



Note You must use a 3 to 15 dB fiber attenuator (5 dB recommended) when working with the OC192 IR/STM64 SH 1550 card in a loopback. Do not use fiber loopbacks with the OC192 IR/STM64 SH 1550 card. Using fiber loopbacks can cause irreparable damage to the OC192 IR/STM64 SH 1550 card.

- Connectors: SC
- Compliance: ITU-T G.707, ITU-T G.957

- Transmitter
 - Maximum transmitter output power: +2 dBm
 - Minimum transmitter output power: -1 dBm
 - Center wavelength: 1530 to 1565 nm
 - Nominal wavelength: 1550 nm
 - Transmitter: Cooled EA modulated laser
- Receiver
 - Maximum receiver level: -1 dBm at BER $1 * 10^{exp - 12}$
 - Minimum receiver level: -14 dBm at BER $1 * 10^{exp - 12}$
 - Receiver: PIN diode
 - Link loss budget: 13 dB minimum, plus 2 dB dispersion penalty at BER = $1 * 10^{exp - 12}$ including dispersion
 - Receiver input wavelength range: 1530 to 1565 nm
- Environmental
 - Operating temperature: -5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 50.00 W, 1.04 A at -48 V, 170.7 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 1.3 kg (3.1 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1M (IEC 60825-1 2001.01) and Class 1 (21 CFR 1040.10 and 1040.11) laser product

4.13 OC192 LR/STM64 LH 1550 Card



Warning

Class 1 (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products. Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments, or performance of procedures other than those specified may result in hazardous radiation exposure.

The OC192 LR/STM64 LH 1550 card provides one long-range SDH STM-64 port per card, compliant with ITU-T G.707- and G.957, and Telcordia GR-253-CORE (except minimum and maximum transmit power, and minimum receive power). Also, the port is compliant to ITU-T G.691 (prepublished unedited version 10/2000) L-64.2, except for optical output power and receiver sensitivity (see Note on page 4-53). The port operates at 9.95328 GBits/s (Gbps) over unamplified distances up to 80 km with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion. The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads. Figure 4-22 shows the OC192 LR/STM64 LH 1550 faceplate.

Figure 4-22 OC192 LR/STM64 LH 1550 Faceplate

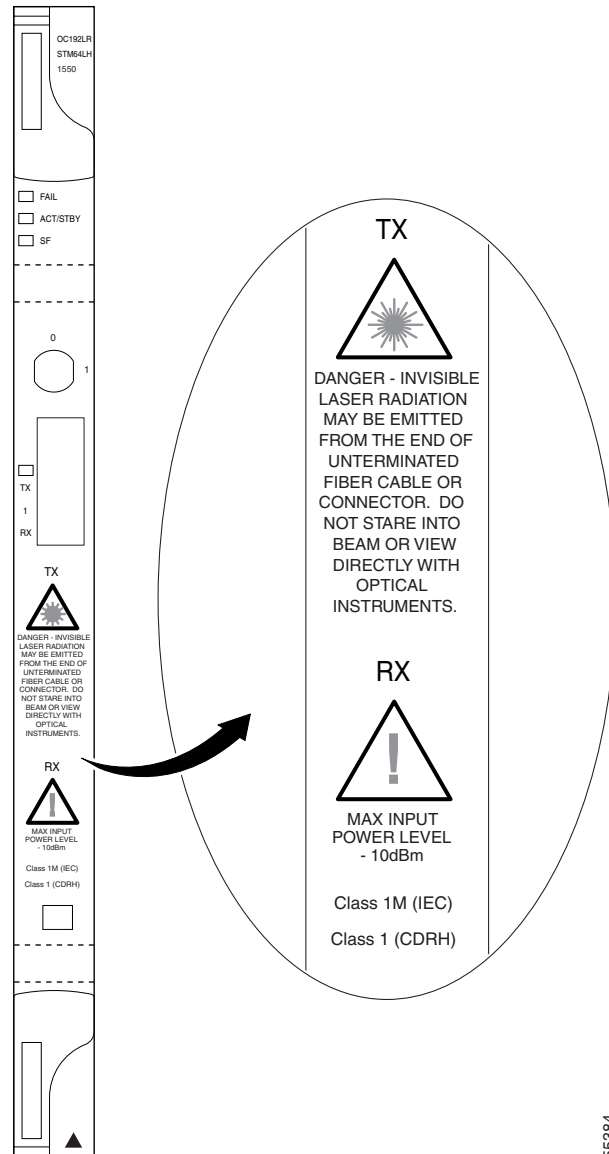
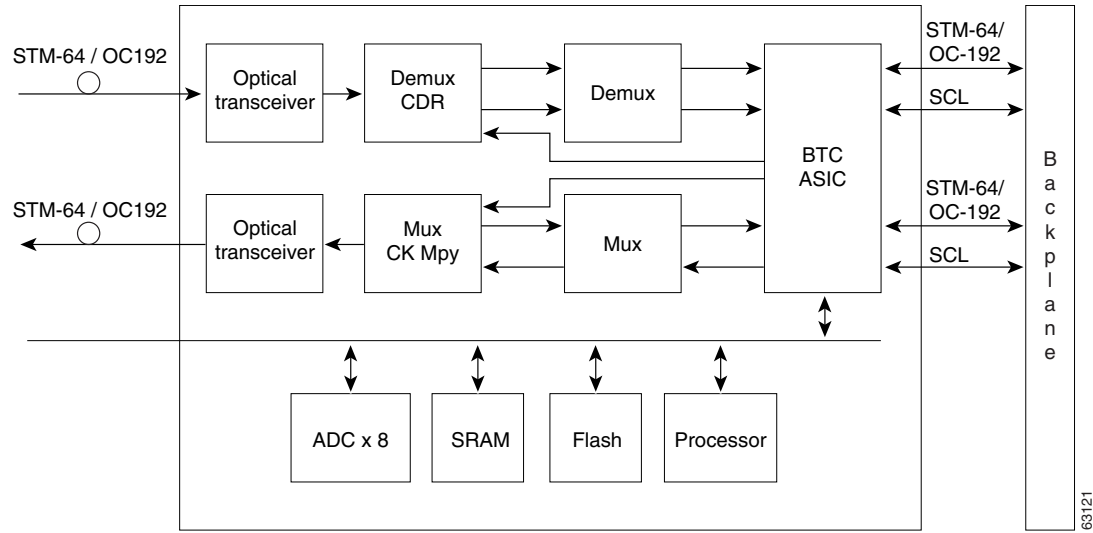


Figure 4-23 on page 4-51 shows a block diagram of the card.

Figure 4-23 OC192 LR/STM64 LH 1550 Block Diagram

**Note**

You must use a 20-dB fiber attenuator (19 to 24 dB) when working with the OC192 LR/STM64 LH 1550 card in a loopback. Do not use fiber loopbacks with the OC192 LR/STM64 LH 1550 card. Using fiber loopbacks causes irreparable damage to the OC192 LR/STM64 LH 1550 card.

You can install OC192 LR/STM64 LH 1550 cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, SNCP, or linear configuration, or also as a regenerator for longer span reaches.

The OC192 LR/STM64 LH 1550 port features a 1550 nm laser and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports 1:1 protection in four-fiber bidirectional line switched ring applications where both span switching and ring switching might occur.

The OC192 LR/STM64 LH 1550 card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.13.1 OC192 LR/STM64 LH 1550 Card-Level Indicators

Table 4-14 describes the three card-level LED indicators on the OC192 LR/STM64 LH 1550 card.

Table 4-14 OC192 LR/STM64 LH 1550 Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.

Table 4-14 OC192 LR/STM64 LH 1550 Card-Level Indicators (continued)

Card-Level LED	Description
ACT/STBY LED Green (Active) amber (Standby)	If the ACTV/STBY LED is green, the card is operational and ready to carry traffic. If the ACTV/STBY LED is amber, the card is operational and in standby (protect) mode.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.13.2 OC192 LR/STM64 LH 1550 Port-Level Indicators

You can find the status of the OC192 LR/STM64 LH 1550 card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.13.3 OC192 LR/STM64 LH 1550 Card Specifications

The OC192 LR/STM64 card has the following specifications:

- Line
 - Bit rate: 9.95328 GBits/s (Gbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Maximum chromatic dispersion allowance: 1360 ps/nm



Caution

You must use a 20 dB fiber attenuator (19 to 24 dB) when working with the OC192 LR/STM64 LH 1550 card in a loopback. Do not use fiber loopbacks with these cards.

- Loopback modes: Terminal and facility
- Connectors: SC
- Compliance: ITU-T G.707, ITU-T G.957
- Transmitter
 - Maximum transmitter output power: +10 dBm (see Note on page 4-53)
 - Minimum transmitter output power: +7 dBm (see Note on page 4-53)
 - Center wavelength: 1545 to 1555 nm
 - Nominal wavelength: 1550 nm
 - Transmitter: LN (Lithium Niobate) external modulator transmitter
- Receiver
 - Maximum receiver level: -9 dBm at BER $1 * 10^{exp - 12}$ (see Note on page 4-53)

- Minimum receiver level: -21 dBm at BER $1 * 10 \text{ exp} - 12$ (see Note on page 4-53)
- Receiver: APD/TIA
- Link loss budget: 24 dB minimum, with no dispersion or 22 dB optical path loss at BER = $1 * 10 \text{ exp} - 12$ including dispersion
- Receiver input wavelength range: 1545 to 1555 nm
- Environmental
 - Operating temperature: -5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 72.20 W, 1.50 A at -48 V, 246.5 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 1.3 kg (3.1 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1M (IEC 60825-1 2001.01) and Class 1 (21 CFR 1040.10 and 1040.11) laser product

**Note**

The optical output power of the OC192 LR/STM64 LH 1550 (+7 dBm to +10 dBm) is 3 dB lower than in L-64.2b of the 10/2000 republished unedited version of ITU-T G.691 (+10 dBm to +13 dBm). However, the total attenuation range of the optical path, 22 to 16 dB, is maintained by the optical receiver sensitivity range of the OC192 LR/STM64 LH 1550 (-9 dBm to -17 dBm). This sensitivity range outperforms the specification in L-64.2b of the 10/2000 republished unedited version of ITU-T G.691 (-14 dBm to -3 dBm).

4.14 OC192 LR/STM64 LH ITU 15xx.xx Card

**Warning**

Class 1 (21 CFR 1040.10, 1040.11 and IEC 60825-1 2001-01) laser products. Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments, or performance of procedures other than those specified may result in hazardous radiation exposure.

Sixteen distinct STM-64 ITU 100 GHz DWDM cards comprise the ONS 15454 SDH DWDM channel plan. The OC192 LR/STM64 LH ITU 15xx.xx card provides one long-range SDH STM-64 port per card, compliant with ITU-T G.707 and G.957, Telcordia GR-253-CORE (except minimum and maximum

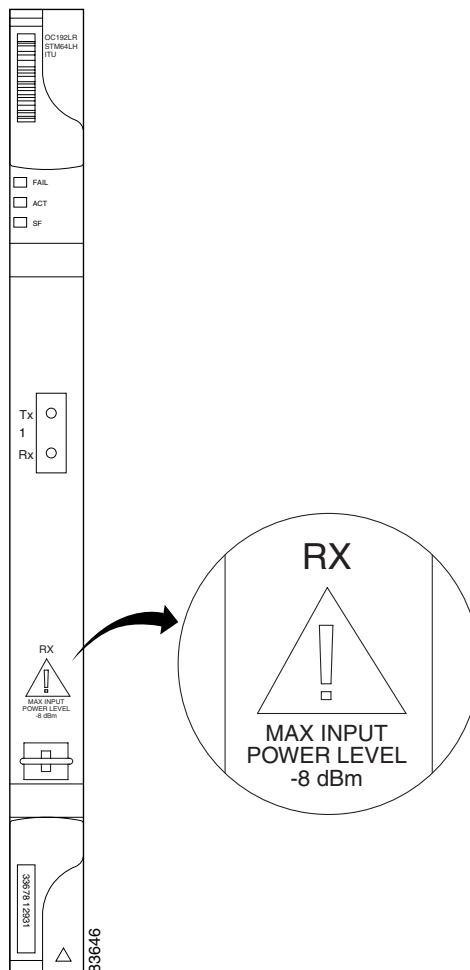
transmit power, and minimum receive power). The port operates at 9.95328 Gbits/s (Gbps) over unamplified distances up to 60 km with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion.

**Note**

Longer distances are possible in an amplified system using dispersion compensation.

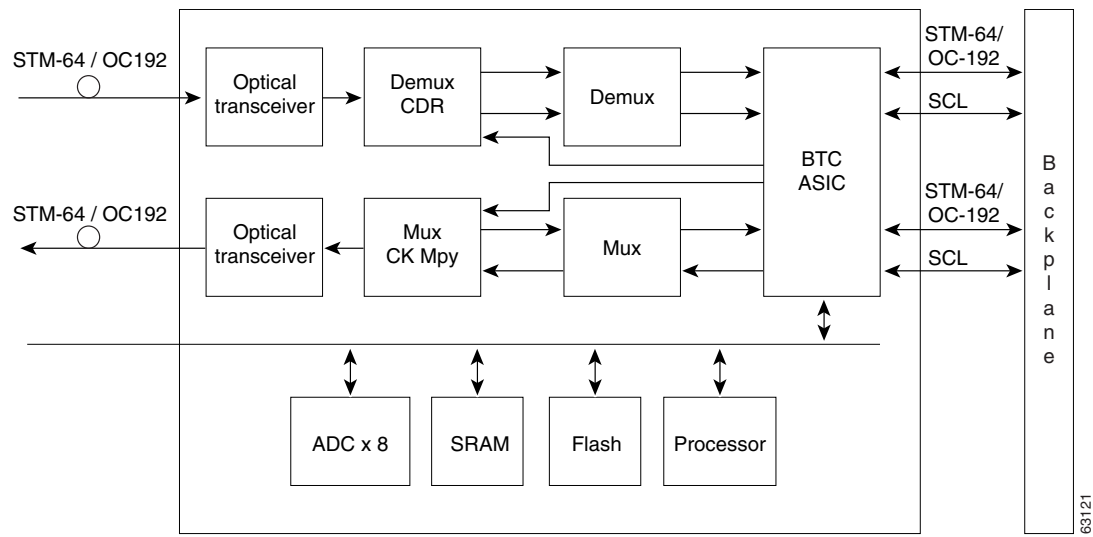
The card supports concatenated or nonconcatenated payloads on a VC-4 basis, as well as VC-4, VC-3, and VC-12 payloads. [Figure 4-24](#) shows the OC192 LR/STM64 LH ITU 15xx.xx faceplate.

Figure 4-24 OC192 LR/STM64 LH ITU 15xx.xx Faceplate



[Figure 4-25 on page 4-55](#) shows a block diagram of the card.

Figure 4-25 OC192 LR/STM64 LH ITU 15xx.xx Block Diagram

**Note**

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the OC192 LR/STM64 LH 15xx.xx card in a loopback. Do not use fiber loopbacks with the OC192 LR/STM64 LH 15xx.xx card. Using fiber loopbacks causes irreparable damage to this card.

Eight of the cards operate in the blue band with a spacing of 100 GHz in the ITU grid (1534.25 nm, 1535.04 nm, 1535.82 nm, 1536.61 nm, 1538.19 nm, 1538.98 nm, 1539.77 nm, and 1540.56 nm). The other eight cards operate in the red band with a spacing of 100 GHz in the ITU grid (1550.12 nm, 1550.92 nm, 1551.72 nm, 1552.52 nm, 1554.13 nm, 1554.94 nm, 1555.75 nm, and 1556.55 nm).

You can install OC192 LR/STM64 LH ITU 15xx.xx cards in Slot 5, 6, 12, or 13. You can provision this card as part of an MS-SPRing, SNCP, or linear configuration, or as a regenerator for longer span reaches.

The OC192 LR/STM64 LH ITU 15xx.xx port features a laser on a specific wavelength in the 1550 nm range and contains a transmit and receive connector (labeled) on the card faceplate. The card uses a dual SC connector for optical cable termination. The card supports 1+1 unidirectional and bidirectional facility protection. It also supports 1:1 protection in four-fiber bidirectional line switched ring applications where both span switching and ring switching might occur.

The OC192 LR/STM64 LH ITU 15xx.xx card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.14.1 OC192 LR/STM64 LH ITU 15xx.xx Card-Level Indicators

Table 4-15 describes the three card-level LED indicators on the OC192 LR/STM64 LH ITU 15xx.xx card.

Table 4-15 OC192 LR/STM64 LH ITU 15xx.xx Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) amber (Standby)	If the ACTV/STBY LED is green, the card is operational and ready to carry traffic. If the ACTV/STBY LED is amber, the card is operational and in standby (protect) mode.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.14.2 OC192 LR/STM64 LH ITU 15xx.xx Port-Level Indicators

You can find the status of the OC192 LR/STM64 LH ITU 15xx.xx card ports using the LCD screen on the ONS 15454 SDH fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a complete description of the alarm messages.

4.14.3 OC192 LR/STM64 LH ITU 15xx.xx Card Specifications

The OC192 LR/STM64 LH ITU 15xx.xx card has the following specifications:

- Line
 - Bit rate: 9.95328 GBits/s (Gbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Maximum chromatic dispersion allowance:
 - in deployments with DCU: +/- 1000 ps/nm, with ONSR of 19 dB (0.5 nm RBW)
 - in deployments without DCU: +/- 1200 ps/nm, with ONSR of 23 dB (0.5 nm RBW)
 - Loopback modes: Terminal and facility



Note

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the OC192 LR/STM64 LH 15xx.xx card in a loopback. Do not use fiber loopbacks with the OC192 LR/STM64 LH 15xx.xx card. Using fiber loopbacks causes irreparable damage to this card.

- Connectors: SC
- Compliance: ITU-T G.707, ITU-T G.957, GR-253

- Transmitter
 - Maximum transmitter output power: +6 dBm
 - Minimum transmitter output power: +3 dBm
 - Center wavelength: See wavelength plan
 - Center wavelength accuracy: +/- 0.040 nm
 - Transmitter: LN external modulator transmitter
- Receiver
 - Maximum receiver level: -9 dBm at BER $1 * 10 \text{ exp} - 12$
 - Minimum receiver level: -22 dBm at BER $1 * 10 \text{ exp} - 12$
 - Receiver: APD
 - Link loss budget: 25 dB minimum, plus 2 dB dispersion penalty at BER = $1 * 10 \text{ exp} - 12$ including dispersion
 - Receiver input wavelength range: 1529 to 1565 nm
- Environmental
 - Operating temperature: -5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 52.00 W, 1.08 A at -48 V, 177.6 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 1.3 kg (3.1 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1 (IEC 60825-1 2001.01, 21 CFR 1040.10 and 1040.11) laser product
- Currently available wavelengths and versions of OC192 LR/STM64 LH ITU 15xx.xx card:
ITU grid blue band:
 - 1534.25 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1534.25
 - 1535.04 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1535.04
 - 1535.82 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1535.82
 - 1536.61 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1536.61
 - 1538.19 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1538.19
 - 1538.98 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1538.98
 - 1539.77 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1539.77
 - 1540.56 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1540.56

ITU grid red band:

- 1550.12 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1550.12
- 1550.92 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1550.92
- 1551.72 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1551.72
- 1552.52 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1552.52
- 1554.13 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1554.13
- 1554.94 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1554.94
- 1555.75 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1555.75
- 1556.55 +/- 0.040 nm, OC192 LR/STM64 LH ITU 1556.55

4.15 TXP_MR_10G Card



Warning

Class 1 (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products. Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments, or performance of procedures other than those specified may result in hazardous radiation exposure.

The TXP_MR_10G card (Transponder Multirate 10G) processes one 10-GBits/s (Gbps) signal (client side) into one 10-GBits/s (Gbps), 100-GHz DWDM signal (trunk side). It provides one extended long-range, ITU-T G.707- and G.957-compliant, SDH STM-64 port per card.

The TXP_MR_10G card is tunable over two neighboring wavelengths in the 1550 nm, ITU 100-GHz range. It is available in four different versions, covering eight different wavelengths in the 1550 nm range.



Note

ITU-T G.709 specifies a form of FEC that uses a “wrapper” approach. The digital wrapper lets you transparently take in a signal on the client side, wrap a frame around it, and restore it to its original form. FEC enables longer fiber links because errors caused by the optical signal degrading with distance are corrected.

The port operates at 9.95328 GBits/s (Gbps) (or 10.70923 GBits/s [Gbps] with ITU-T G.709 Digital Wrapper/FEC) over unamplified distances up to 80 km with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion.



Caution

Since the software has no capability to look into the payload and detect circuits for a TXP_MR_10G card, the card does not display circuits under card view.

For the TXP_MR_10G card, protection is done using Y-cable protection. Two TXP_MR_10G cards can be joined in a Y-cable protection group. In Y-cable protection, the client ports of the two cards are joined by Y-cables. A single receive (Rx) client signal is injected into the Rx Y-cable and is split between the two TXP_MR_10G cards in the protection group. The transmit (Tx) client signals from the two protection group TXP_MR_10G cards are summed in the Tx Y-cable with only the active card signal passing through as the single Tx client signal.



Note

If you create a GCC on either card of the protect group, the trunk port stays permanently active, regardless of the switch state. When you provision a GCC you are provisioning unprotected overhead bytes. The GCC is not protected by the protect group.

Figure 4-26 shows the TXP_MR_10G faceplate.

Figure 4-26 TXP_MR_10G Faceplate

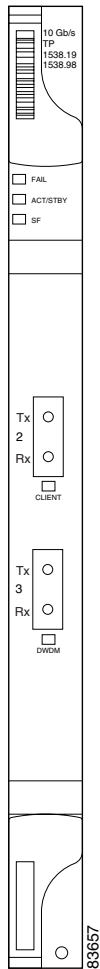
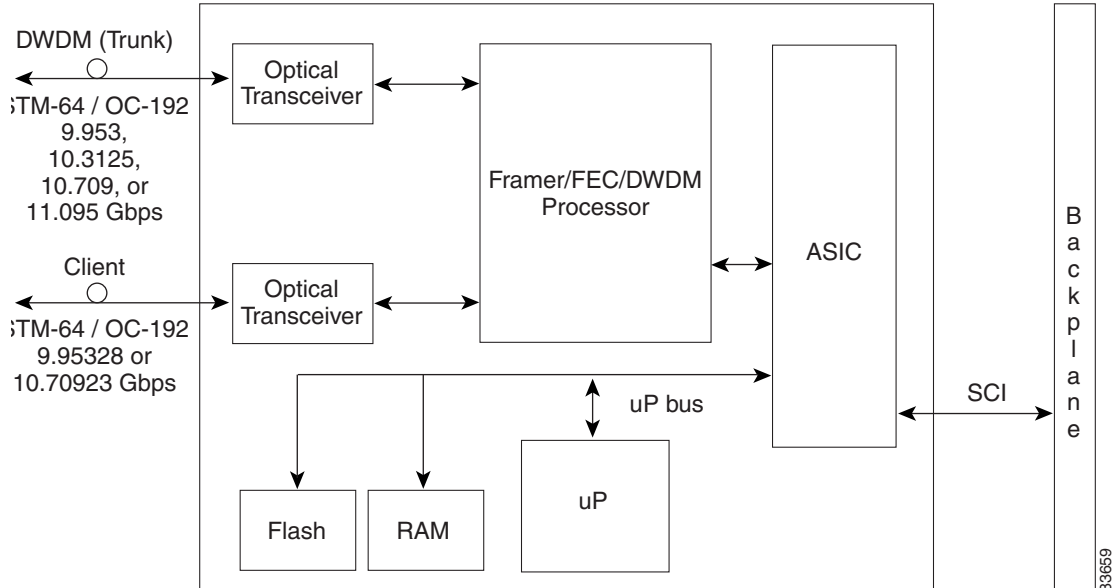


Figure 4-27 shows a block diagram of the card.

Figure 4-27 TXP_MR_10G Block Diagram

**Caution**

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the TXP_MR_10G card in a loopback on the trunk port. Do not use direct fiber loopbacks with the TXP_MR_10G card. Using direct fiber loopbacks causes irreparable damage to the TXP_MR_10G card.

You can install TXP_MR_10G cards in Slots 1 to 6 and 12 to 17. You can provision this card in a linear configuration. TXP_MR_10G cards cannot be provisioned as MS-SPRing, SNCP, or as a regenerator. They can be used in the middle of MS-SPRing or SNCP spans.

The TXP_MR_10G port features a 1550 nm laser for the trunk port and a 1310 nm laser for the client port and contains two transmit and receive connector pairs (labeled) on the card faceplate. The card uses dual LC connectors for optical cable termination.

The TXP_MR_10G card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.15.1 TXP_MR_10G Card-Level Indicators

Table 4-16 describes the three card-level LED indicators on the TXP_MR_10G card.

Table 4-16 TXP_MR_10G Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACTV/STBY LED is green, the card is operational (one or both ports active) and ready to carry traffic. If the ACTV/STBY LED is amber, the card is operational and in standby (protect) mode.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.15.2 TXP_MR_10G Port-Level Indicators

Table 4-17 describes the four port-level LED indicators on the TXP_MR_10G card.

Table 4-17 TXP_MR_10G Port-Level Indicators

Port-Level LED	Description
Green Client LED	The green Client LED indicates that the client port is in service and that it is receiving a recognized signal.
Green DWDM LED	The green DWDM LED indicates that the DWDM port is in service and that it is receiving a recognized signal.
Green Wavelength 1 LED	Each port supports two wavelengths on the DWDM side. Each wavelength LED matches one of the wavelengths. This LED indicates that the board is configured for wavelength 1.
Green Wavelength 2 LED	Each port supports two wavelengths on the DWDM side. Each wavelength LED matches one of the wavelengths. This LED indicates that the board is configured for wavelength 2.

4.15.3 TXP_MR_10G Card Specifications

The TXP_MR_10G card has the following specifications:

- Line (trunk side)
 - Bit rate: 9.95328 GBits/s (Gbps) for OC-192/STM-64 or 10.70923 GBits/s (Gbps) with ITU-T G.709 Digital Wrapper/FEC
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Maximum chromatic dispersion allowance: 6000 ps/nm

**Caution**

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the TXP_MR_10G card in a loopback on the trunk port. Do not use direct fiber loopbacks with the TXP_MR_10G card. Using direct fiber loopbacks causes irreparable damage to the TXP_MR_10G card.

- Loopback modes: Terminal and facility
- Connectors: LC
- Compliance: ITU-T G.707, ITU-T G.957
- Transmitter (trunk side)
 - Maximum transmitter output power: +3 dBm
 - Minimum transmitter output power: -16 dBm
(The optical output power on the trunk side is configurable from -16 to +3 dBm with an accuracy of +/-0.5 dB.)
 - Transmitter: LN external modulator transmitter
- Currently available wavelengths and versions of TXP_MR_10G:
 - ITU grid blue band:
 - 1538.19 to 1538.98 nm, 10T-L1-38.1
 - 1539.77 to 1540.56 nm, 10T-L1-39.7
 - ITU grid red band:
 - 1554.13 to 1554.94 nm, 10T-L1-54.1
 - 1555.75 to 1556.55 nm, 10T-L1-55.7
- Receiver (trunk side)
 - Receiver input power (no FEC, unamplified, BER $1 * 10 \text{ exp} - 12$): -8 to -24 dBm
 - Receiver input power (FEC, unamplified, BER $1 * 10 \text{ exp} - 6$): -8 to -26 dBm
 - Receiver input power (no FEC, amplified, BER $1 * 10 \text{ exp} - 12$): -8 to -22 dBm
 - Receiver input power (FEC, amplified, BER $1 * 10 \text{ exp} - 6$): -8 to -18 dBm
 - Receiver: APD
 - Link loss budget: 24 dB minimum, with no dispersion or 22 dB optical path loss at BER = $1 * 10 \text{ exp} - 12$ including dispersion
 - Receiver input wavelength range: 1290 to 1605 nm
- Line (client side)
 - Bit rate: 9.95328 GBits/s (Gbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Maximum chromatic dispersion allowance: 1600 ps/nm
 - Loopback modes: Terminal and facility
 - Connectors: LC
 - Compliance: ITU-T G.707, ITU-T G.957

- Transmitter (client side)
 - Maximum transmitter output power: –1 dBm
 - Minimum transmitter output power: –6 dBm
 - Center wavelength: 1290 to 1330 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: DFB laser
- Receiver (client side)
 - Maximum receiver level: –1 dBm at BER $1 * 10^{exp - 12}$
 - Minimum receiver level: –14 dBm at BER $1 * 10^{exp - 12}$
 - Receiver: APD
 - Link loss budget: 8 dB minimum, at BER = $1 * 10^{exp - 12}$
 - Receiver input wavelength range: 1290 to 1605 nm
- Environmental
 - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 35.00 W, 0.73 A at –48 V, 119.5 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 1.3 kg (3.1 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1M (IEC 60825-1 2001.01) and Class 1 (21 CFR 1040.10 and 1040.11) laser product

4.16 MXP_2.5G_10G Card



Warning

Class 1 (21 CFR 1040.10 and 1040.11) and Class 1M (IEC 60825-1 2001-01) laser products. Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not stare into the beam or view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard. Use of controls or adjustments, or performance of procedures other than those specified may result in hazardous radiation exposure.

The MXP_2.5G_10G card (Muxponder 2.5G/10G) multiplexes/demultiplexes four 2.5-GBits/s (Gbps) signals (client side) into one 10-GBits/s (Gbps), 100-GHz DWDM signal (trunk side). It provides one extended long-range, ITU-T G.707- and G.957-compliant, SDH STM-64 port per card on the trunk side

and four intermediate or short-range SDH STM-16 ports per card (client side). The port operates at 9.95328 GBits/s (Gbps) over unamplified distances up to 80 km with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion.

The MXP_2.5G_10G card is tunable over two neighboring wavelengths in the 1550 nm, ITU 100-GHz range. It is available in four different versions, covering eight different wavelengths in the 1550 nm range.

**Note**

ITU-T G.709 specifies a form of FEC that uses a “wrapper” approach. The digital wrapper lets you transparently take in a signal on the client side, wrap a frame around it, and restore it to its original form. FEC enables longer fiber links because errors caused by the optical signal degrading with distance are corrected.

The port can also operate at 10.70923 GBits/s (Gbps) in ITU-T G.709 Digital Wrapper/FEC mode.

**Caution**

Since the software has no capability to look into the payload and detect circuits, an MXP_2.5G_10G card does not display circuits under card view.

For the MXP_2.5G_10G card, protection is done using Y-cable protection. Two MXP_2.5G_10G cards can be joined in a Y-cable protection group. In Y-cable protection, the client ports of the two cards are joined by Y-cables. A single receive (RX) client signal is injected into the RX Y-cable and is split between the two MXP_2.5G_10G cards in the protection group. The transmit (TX) client signals from the two protection group MXP_2.5G_10G cards are summed in the TX Y-cable with only the active card signal passing through as the single TX client signal.

**Note**

If you create a GCC on either card of the protect group, the trunk port stays permanently active, regardless of the switch state. When you provision a GCC you are provisioning unprotected overhead bytes. The GCC is not protected by the protect group.

Figure 4-28 shows the MXP_2.5G_10G faceplate.

Figure 4-28 MXP_2.5G_10G Faceplate

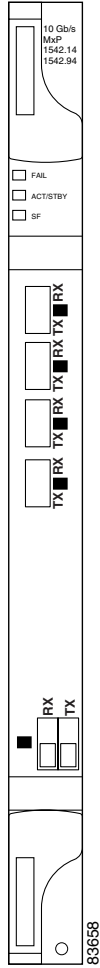
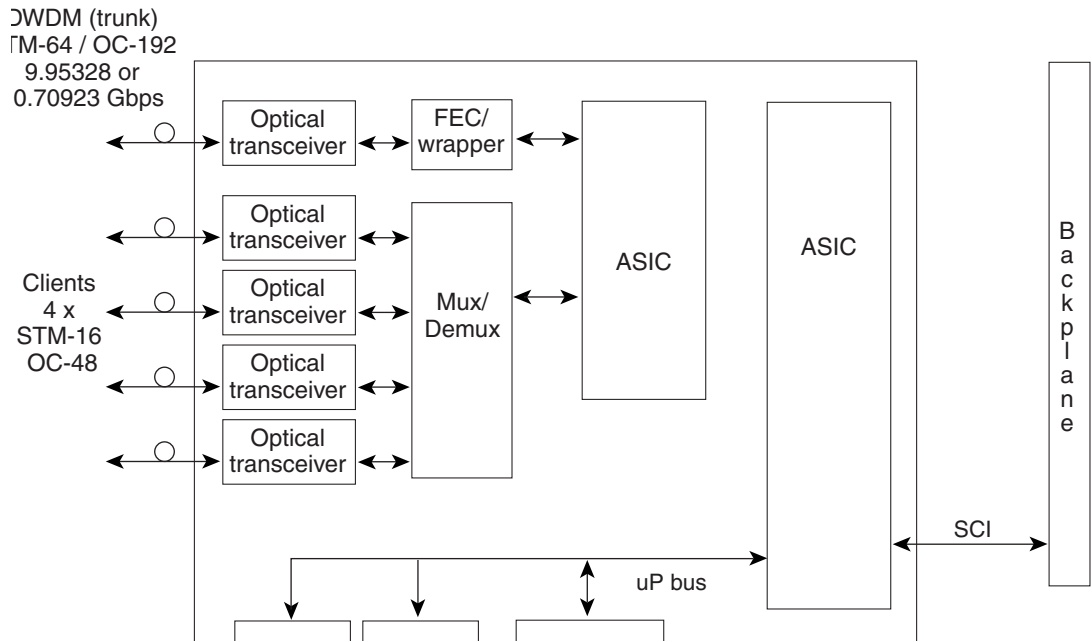


Figure 4-29 shows a block diagram of the card.

Figure 4-29 MXP_2.5G_10G Block Diagram

**Caution**

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the MXP_2.5G_10G card in a loopback on the trunk port. Do not use direct fiber loopbacks with the MXP_2.5G_10G card. Using direct fiber loopbacks causes irreparable damage to the MXP_2.5G_10G card.

You can install MXP_2.5G_10G cards in Slots 1 to 6 and 12 to 17. You can provision this card in a linear configuration. MXP_2.5G_10G cards cannot be provisioned as an MS-SPRing, SNCP, or regenerator. They can be used in the middle of MS-SPRing or SNCP spans.

The MXP_2.5G_10G port features a 1550 nm laser on the trunk port and four 1310 nm lasers on the client ports. It contains five transmit and receive connector pairs (labeled) on the card faceplate. The card uses a dual LC connector on the trunk side and small form factor pluggable (SFP) connectors on the client side for optical cable termination.

The MXP_2.5G_10G card detects SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.16.1 MXP_2.5G_10G Card-Level Indicators

Table 4-18 describes the three card-level LED indicators on the MXP_2.5G_10G card.

Table 4-18 MXP_2.5G_10G Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) amber (Standby)	If the ACTV/STBY LED is green, the card is operational (one or more ports active) and ready to carry traffic. If the ACTV/STBY LED is amber, the card is operational and in standby (protect) mode.
amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.16.2 MXP_2.5G_10G Port-Level Indicators

Table 4-19 describes the seven port-level LED indicators on the MXP_2.5G_10G card.

Table 4-19 MXP_2.5G_10G Port-Level Indicators

Port-Level LED	Description
Green Client LED (four LEDs)	The green Client LED indicates that the client port is in service and that it is receiving a recognized signal. The card has four client ports, with one Client LED for each port.
Green DWDM LED	The green DWDM LED indicates that the DWDM port is in service and that it is receiving a recognized signal.
Green Wavelength 1 LED	Each port supports two wavelengths on the DWDM side. Each wavelength LED matches one of the wavelengths. This LED indicates that the board is configured for wavelength 1.
Green Wavelength 2 LED	Each port supports two wavelengths on the DWDM side. Each wavelength LED matches one of the wavelengths. This LED indicates that the board is configured for wavelength 2.

4.16.3 MXP_2.5G_10G Card Specifications

The MXP_2.5G_10G card has the following specifications:

- Line (trunk side)
 - Bit rate: 9.95328 GBits/s (Gbps) for OC-192/STM-64 or 10.70923 GBits/s (Gbps) with ITU-T G.709 Digital Wrapper/FEC
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode

- Maximum chromatic dispersion allowance: 6000 ps/nm

**Caution**

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the MXP_2.5G_10G card in a loopback on the trunk port. Do not use direct fiber loopbacks with the MXP_2.5G_10G card. Using direct fiber loopbacks causes irreparable damage to the MXP_2.5G_10G card.

- Loopback modes: Terminal and facility
- Connectors: LC
- Compliance: ITU-T G.707, ITU-T G.957
- Transmitter (trunk side)
 - Maximum transmitter output power: +3 dBm
 - Minimum transmitter output power: -16 dBm
(The optical output power on the trunk side is configurable from -16 to +3 dBm with an accuracy of +/-0.5 dB.)
 - Transmitter: LN (Lithium Niobate) external modulator transmitter
- Currently available wavelengths and versions of MXP_2.5G_10G:
 - ITU grid blue band:
 - 1542.14 to 1542.94 nm, 10M-L1-42.1
 - 1543.73 to 1544.53 nm, 10M-L1-43.7
 - ITU grid red band:
 - 1558.17 to 1558.98 nm, 10M-L1-58.1
 - 1559.79 to 1560.61 nm, 10M-L1-59.7
- Receiver (trunk side)
 - Receiver input power (no FEC, unamplified, BER $1 * 10 \text{ exp} - 12$): -8 to -24 dBm
 - Receiver input power (FEC, unamplified, BER $1 * 10 \text{ exp} - 6$): -8 to -26 dBm
 - Receiver input power (no FEC, amplified, BER $1 * 10 \text{ exp} - 12$): -8 to -22 dBm
 - Receiver input power (FEC, amplified, BER $1 * 10 \text{ exp} - 6$): -8 to -18 dBm
 - Receiver: APD
 - Link loss budget: 24 dB minimum, with no dispersion or 22 dB optical path loss at BER = $1 * 10 \text{ exp} - 12$ including dispersion
 - Receiver input wavelength range: 1290 nm to 1605 nm
- Line (client side)
 - Bit rate: 2.48832 GBits/s (Gbps)
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Maximum chromatic dispersion allowance: 1600 ps/nm
 - Loopback modes: Terminal and facility
 - Connectors: SFF
 - Compliance: ITU-T G.707, ITU-T G.957

- Transmitter (client side)
 - Depends on SFP that is used
- Receiver (client side)
 - Depends on SFP that is used
- Environmental
 - Operating temperature: –5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 50.00 W, 1.04 A at –48 V, 170.7 BTU/hr
- Dimensions
 - Height: 321.3 mm (12.650 in.)
 - Width: 18.2 mm (0.716 in.)
 - Depth: 228.6 mm (9.000 in.)
 - Depth with backplane connector: 235 mm (9.250 in.)
 - Weight not including clam shell: 1.3 kg (3.1 lb)
- Compliance

ONS 15454 SDH optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1M (IEC 60825-1 2001.01) and Class 1 (21 CFR 1040.10 and 1040.11) laser product

4.17 TXP_MR_2.5G and TXPP_MR_2.5G Cards



Warning

Class 1 (CDRH) and Class 1M (IEC) laser products.



Warning

Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard.



Warning

Use of controls, adjustments, or performing procedures other than those specified may result in hazardous radiation exposure.



Warning

High-performance devices on this card can get hot during operation. To remove the card, hold it by the faceplate and bottom edge. Allow the card to cool before touching any other part of it or before placing it in an antistatic bag.

**Warning**

Do not reach into a vacant slot or chassis while you install or remove a module or a fan. Exposed circuitry could constitute an energy hazard.

The TXP_MR_2.5G card (2.5G Multirate Transponder) processes one 8-Mbps to 2.488-Gbps signal (client side) into one 8-Mbps to 2.5-Gbps, 100-GHz DWDM signal (trunk side). It provides one long reach STM-16/OC-48 port per card, compliant with ITU-T G.707, ITU-T G.957, and Telcordia GR-253-CORE.

The TXPP_MR_2.5G card (2.5G Multirate Transponder-Protected) processes one 8-Mbps to 2.488-Gbps signal (client side) into two 8-Mbps to 2.5-Gbps, 100-GHz DWDM signals (trunk side). It provides two long reach STM-16/OC-48 ports per card, compliant with ITU-T G.707, ITU-T G.957, and Telcordia GR-253-CORE.

The TXP_MR_2.5G and TXPP_MR_2.5G cards are tunable over four wavelengths in the 1550 nm, ITU 100-GHz range. They are available in eight different versions, covering 32 different wavelengths in the 1550 nm range.

**Note**

ITU-T G.709 specifies a form of FEC that uses a “wrapper” approach. The digital wrapper lets you transparently take in a signal on the client side, wrap a frame around it and restore it to its original form. FEC enables longer fiber links because errors caused by the optical signal degrading with distance are corrected.

The trunk/line port operates at up to 2.488 Gbps (or up to 2.66 Gbps with ITU-T G.709 Digital Wrapper/FEC) over unamplified distances up to 15 km (9.3 miles) with different types of fiber such as C-SMF or dispersion compensated fiber limited by loss and/or dispersion.

**Caution**

Because the software has no capability to look into the payload and detect circuits, a TXP_MR_2.5G or TXPP_MR_2.5G card does not display circuits under card view.

For the TXP_MR_2.5G card, protection is done using Y-cable protection. Two TXP_MR_2.5G cards can be joined in a Y-cable protection group. In Y-cable protection, the client ports of the two cards are joined by Y-cables. A single receive (RX) client signal is injected into the RX Y-cable and is split between the two TXP_MR_2.5G cards in the protection group. The transmit (TX) client signals from the two protection group TXP_MR_2.5G cards are summed in the TX Y-cable with only the active card signal passing through as the single TX client signal.

**Note**

If you create a GCC on either card of the protect group, the trunk (span) port stays permanently active, regardless of the switch state. When you provision a GCC, you are provisioning unprotected overhead bytes. The GCC is not protected by the protect group.

For the TXPP_MR_2.5G card, protection is done using splitter protection. In splitter protection, the single client signal is injected into the client receive (RX) port and is split into two separate signals on the two trunk transmit (TX) ports and are transmitted over diverse paths. The far-end TXPP_MR_2.5G card will choose one of the two trunk receive (RX) port signals and inject it into the transmit (TX) client port. The TXPP_MR_2.5G card will switch the selected trunk receive (RX) port signal in case of failure.

The TXP_MR_2.5G and TXPP_MR_2.5G cards support 2R and 3R+ modes of operation where the client signal is mapped into a G.709 frame. The mapping function is simply done by placing a digital wrapper around the client signal. Only OC-48/STM-16 client signals are fully G.709 compliant, and the output bit rate depends on the input client signal. [Table 4-20](#) shows the possible combinations of client interfaces, input bit rates, 2R and 3R modes, and G.709.

Table 4-20 2R and 3R Mode and G.709 Compliance by Client Interface

Client Interface	Input Bit Rate	3R vs. 2R	G.709
OC-48/STM-16	2.488 Gbps	3R	On or Off
DV-6000	2.38 Gbps	2R	N/A
2 Gigabit Fiber Channel (2G-FC)/FICON	2.125 Gbps	3R	On or Off
High definition television (HDTV)	1.48 Gbps	2R	N/A
Gigabit Ethernet (GE)	1.25 Gbps	3R	On or Off
1 Gigabit Fiber Channel (1G-FC)/FICON	1.06 Gbps	3R	On or Off
OC-12/STM-4	622 Mbps	3R	On or Off
OC-3/STM-1	155 Mbps	3R	On or Off
ESCON	200 Mbps	2R	N/A
SDI/D1 Video	270 Mbps	2R	N/A

The output bit rate is calculated for the trunk bit rate by using the 255/238 ratio as specified in G.709 for OTU1. [Table 4-21](#) lists the calculated trunk bit rates for the client interfaces with G.709 enabled.

Table 4-21 Trunk Bit Rates with G.709 Enabled

Client Interface	G.709 Disabled	G.709 Enabled
OC-48/STM-16	2.488 Gbps	2.66 Gbps
2G-FC	2.125 Gbps	2.27 Gbps
GE	1.25 Gbps	1.34 Gbps
1G-FC	1.06 Gbps	1.14 Gbps
OC-12/STM-4	622 Mbps	666.43 Mbps
OC-3/STM-1	155 Mbps	166.07 Mbps

For 2R operation mode, the TXP_MR_2.5G and TXPP_MR_2.5G cards have the ability to pass data through transparently from client side interfaces to a trunk side interface, which resides on an ITU grid. The data may vary at any bit rate from 200-Mbps up to 2.38-Gbps, including ESCON and video signals. In this pass-through mode, no performance monitoring or digital wrapping of the incoming signal is provided, except for the usual PM outputs from the SFPs. Similarly, the ability to pass data through transparently from the trunk side interfaces to the client side interfaces with bit rates varying from 200-Mbps up to 2.38-Gbps. Again, no performance monitoring or digital wrapping of received signals is available in this pass-through mode.

For 3R+ operation mode, the TXP_MR_2.5G and TXPP_MR_2.5G cards apply a digital wrapper to the incoming client interface signals (OC-n, 1G-FC, 2G-FC, GE). Performance monitoring on these signals is also available except for 2G-FC, and varies depending upon the type of signal. For client inputs other than OC-48/STM-16, a digital wrapper may be applied but the resulting signal will not be G.709 compliant. The card will apply a digital wrapper that is scaled to the frequency of the input signal.

The TXP_MR_2.5G and TXPP_MR_2.5G card has the ability to take digitally wrapped signals in from the trunk interface, remove the digital wrapper, and send the un-wrapped data through to the client interface. Performance monitoring of the G.709 OH, and SONET/SDH OH is implemented.

Figure 4-30 shows the TXP_MR_2.5G and TXPP_MR_2.5G faceplate.

Figure 4-30 TXP_MR_2.5G and TXPP_MR_2.5G Faceplates

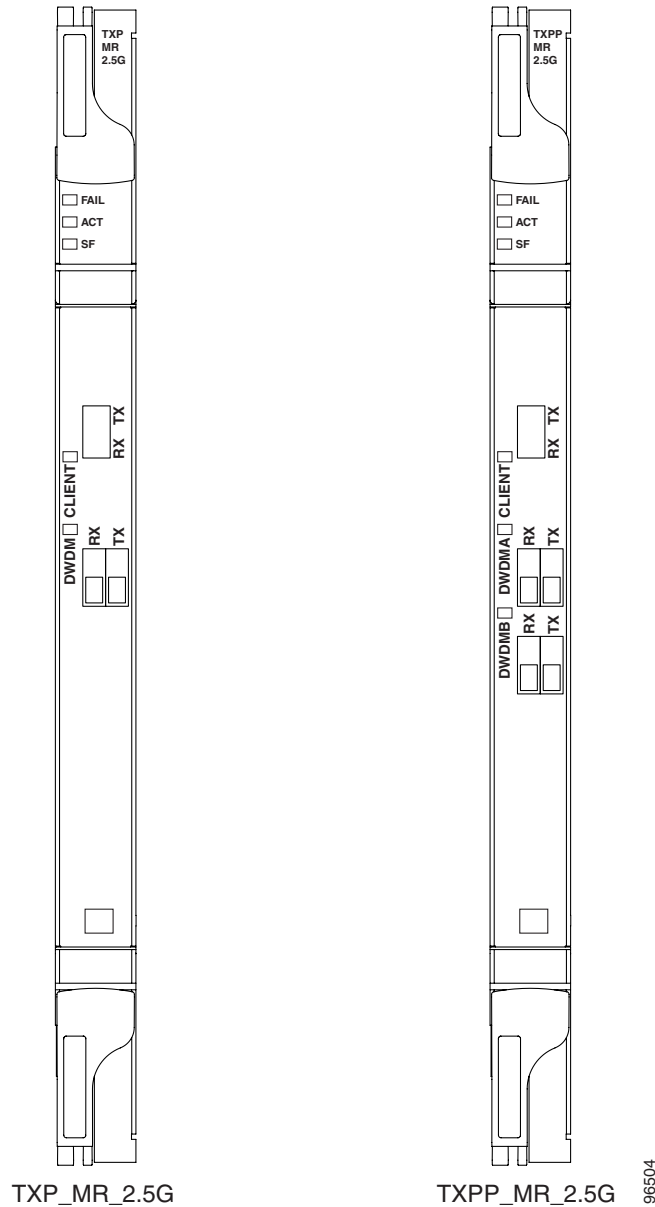
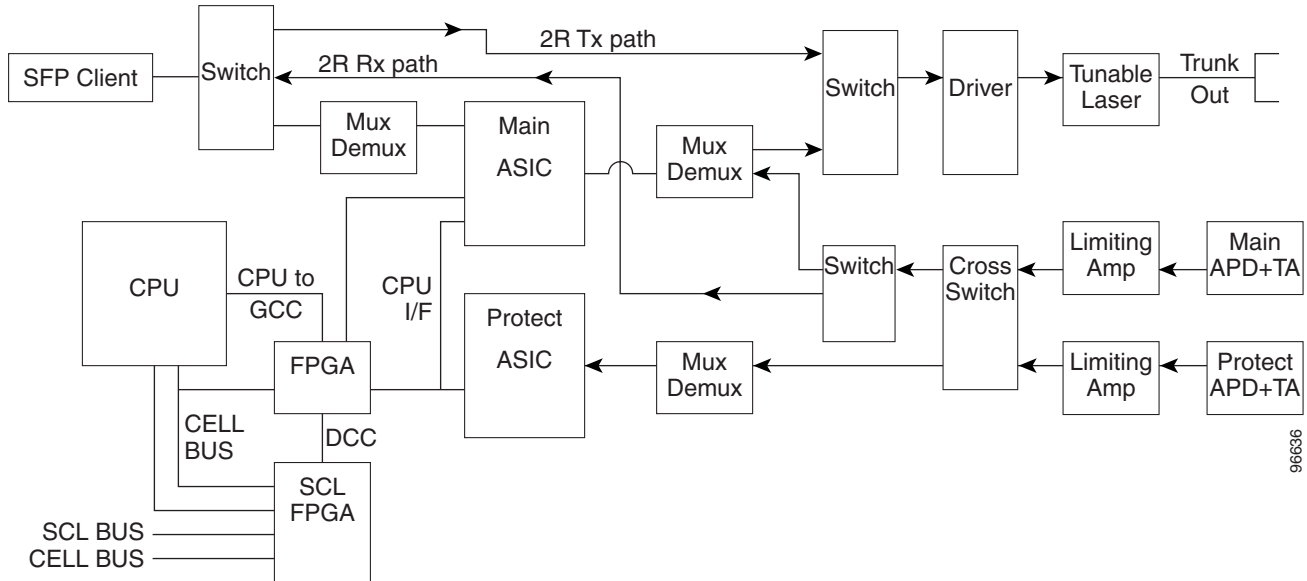


Figure 4-31 shows a block diagram of the TXP_MR_2.5G and TXPP_MR_2.5G cards.

Figure 4-31 TXP_MR_2.5G and TXPP_MR_2.5G Block Diagram



Caution

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the TXP_MR_2.5G and TXPP_MR_2.5G cards in a loopback on the trunk port. Do not use direct fiber loopbacks with the TXP_MR_2.5G and TXPP_MR_2.5G cards. Using direct fiber loopbacks causes irreparable damage to the TXP_MR_2.5G and TXPP_MR_2.5G cards.

You can install TXP_MR_2.5G and TXPP_MR_2.5G cards in Slots 1 to 6 and 12 to 17. You can provision this card in a linear configuration. TXP_MR_10G and TXPP_MR_2.5G cards cannot be provisioned as BLSR, path protection, or as a regenerator. They can be used in the middle of BLSR or 1+1 spans. They can only be used in the middle of BLSR and 1+1 spans when the card is configured for transparent termination mode.

The TXP_MR_2.5G card features a 1550 nm laser for the trunk/line port and a 1310 nm laser for the client port and contains two transmit and receive connector pairs (labeled) on the card faceplate. The card uses dual LC connectors for optical cable termination.

The TXPP_MR_2.5G card features a 1550 nm laser for the trunk/line port and a 1310 nm laser for the client port and contains three transmit and receive connector pairs (labeled) on the card faceplate. The card uses dual LC connectors for optical cable termination.

The TXP_MR_2.5G and TXPP_MR_2.5G cards detect SF, LOS, or LOF conditions on the optical facility. Refer to the *Cisco ONS 15454 SDH Troubleshooting Guide* for a description of these conditions. The card also counts section and line BIP errors from B1 and B2 byte registers in the section and line overhead.

4.17.1 TXP_MR_2.5G and TXPP_MR_2.5G Safety Labels

The TXP_MR_2.5G and TXPP_MR_2.5G cards have several safety labels that provide laser radiation and electrical shock warnings.

Figure 4-32 shows the laser radiation warning hazard level label. The faceplate of these cards are clearly labelled with warnings about the equipment radiation level. Personnel must understand all warning labels before working with these cards. The hazard level label warns the personnel against exposure to laser radiation of Class 1 limits calculated in accordance with IEC60825-1 Ed.1.2.

Figure 4-32 Laser Radiation Warning—Hazard Level Label



Figure 4-33 shows the laser source connector label. This label indicates a laser source at the optical connectors where it has been placed.

Figure 4-33 Laser Radiation Warning—Laser Source Connector Label



Figure 4-34 shows the FDA compliance label. This label shows the statement of compliance to FDA standards and that the hazard level classification is in accordance with IEC60825-1 Am.2 or Ed.1.2.

Figure 4-34 FDA Compliance Statement Label

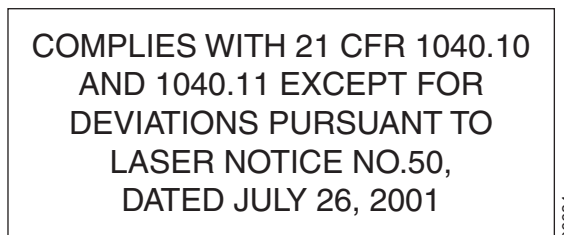
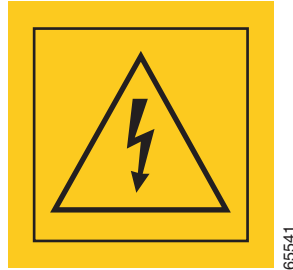


Figure 4-35 on page 4-75 shows the electrical energy hazard label. This label alerts personnel to electrical hazards within the card. The potential of shock hazard exists when adjacent cards are removed during maintenance and touching exposed electrical circuitry on the card itself.

Figure 4-35 Electrical Energy Hazard Label

4.17.2 TXP_MR_2.5G and TXPP_MR_2.5G Card-Level Indicators

Table 4-22 describes the three card-level LED indicators on the TXP_MR_2.5G and TXPP_MR_2.5G cards.

Table 4-22 TXP_MR_10G and TXPP_MR_2.5G Card-Level Indicators

Card-Level LED	Description
Red FAIL LED	The red FAIL LED indicates that the card's processor is not ready. This LED is on during reset. The FAIL LED flashes during the boot process. Replace the card if the red FAIL LED persists.
ACT/STBY LED Green (Active) Amber (Standby)	If the ACTV/STBY LED is green, the card is operational (one or both ports active) and ready to carry traffic. If the ACTV/STBY LED is amber, the card is operational and in standby (protect) mode.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, or high BERs on one or more of the card's ports. The amber SF LED is also on if the transmit and receive fibers are incorrectly connected. If the fibers are properly connected and the link is working, the light turns off.

4.17.3 TXP_MR_2.5G and TXPP_MR_2.5G Port-Level Indicators

Table 4-23 describes the four port-level LED indicators on the TXP_MR_2.5G and TXPP_MR_2.5G cards.

Table 4-23 TXP_MR_10G Port-Level Indicators

Port-Level LED	Description
Green Client LED	The green Client LED indicates that the client port is in service and that it is receiving a recognized signal.
Green DWDM LED	The green DWDM LED indicates that the DWDM port is in service and that it is receiving a recognized signal.

4.17.4 TXP_MR_2.5G and TXPP_MR_2.5G Card Specifications

The TXP_MR_2.5G and TXPP_MR_2.5G cards have the following specifications:

- Line (trunk side)
 - Bit rate: 2.488 Gbps for OC-48/STM-16 or 2.66 Gbps with ITU-T G.709 Digital Wrapper/FEC
 - Code: Scrambled NRZ
 - Fiber: 1550 nm single-mode
 - Maximum chromatic dispersion allowance: 6000 ps/nm
 - Loopback modes: Terminal and facility



Caution

You must use a 20-dB fiber attenuator (15 to 25 dB) when working with the TXP_MR_2.5G and TXPP_MR_2.5G cards in a loopback on the trunk port. Do not use direct fiber loopbacks with the TXP_MR_2.5G and TXPP_MR_2.5G cards. Using direct fiber loopbacks causes irreparable damage to the TXP_MR_2.5G and TXPP_MR_2.5G cards.

- Connectors: LC
- Compliance Telcordia GR-253-CORE, ITU-T G.707, ITU-T G.957
- Transmitter (trunk side)
 - Maximum transmitter output power: +3 dBm
 - Minimum transmitter output power: –16 dBm
(The optical output power on the trunk side is configurable from –16 to +3 dBm with an accuracy of +/-0.5 dB.)
 - Transmitter: Lithium niobate (LN) external modulator transmitter
- Currently available wavelengths of TXP_MR_2.5G and TXPP_MR_2.5G:
 - ITU grid blue band:
 - 1530.334 to 1544.526 nm
 - ITU grid red band:
 - 1546.119 to 1560.606 nm
- Receiver (trunk side)
 - Receiver input power (no FEC, unamplified, BER $1 * 10 \text{ exp} - 12$): –8 to –24 dBm
 - Receiver input power (FEC, unamplified, BER $1 * 10 \text{ exp} - 6$): –8 to –26 dBm
 - Receiver input power (no FEC, amplified, BER $1 * 10 \text{ exp} - 12$): –8 to –22 dBm
 - Receiver input power (FEC, amplified, BER $1 * 10 \text{ exp} - 6$): –8 to –18 dBm
 - Receiver: APD
 - Link loss budget: 24 dB minimum, with no dispersion or 22 dB optical path loss at BER = $1 * 10 \text{ exp} - 12$ including dispersion
 - Receiver input wavelength range: 1290 to 1605 nm
- Line (client side)
 - Bit rate: 8 Mbps to 2.488 Gbps

- Code: Scrambled NRZ
- Fiber: 1310 nm single-mode
- Maximum chromatic dispersion allowance: 1600 ps/nm
- Loopback modes: Terminal and facility
- Connectors: SC
- Compliance: Telcordia GR-253-CORE, ITU-T G.707, ITU-T G.957
- Transmitter (client side)
 - Maximum transmitter output power: -1 dBm
 - Minimum transmitter output power: -6 dBm
 - Center wavelength: 1290 to 1330 nm
 - Nominal wavelength: 1310 nm
 - Transmitter: DFB laser
- Receiver (client side)
 - Maximum receiver level: -1 dBm at BER $1 * 10 \text{ exp} - 12$
 - Minimum receiver level: -14 dBm at BER $1 * 10 \text{ exp} - 12$
 - Receiver: APD
 - Link loss budget: 8 dB minimum, at BER = $1 * 10 \text{ exp} - 12$
 - Receiver input wavelength range: 1290 to 1605 nm
- Environmental
 - Operating temperature: -5 to +45 degrees Celsius (+23 to +113 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
 - Power consumption: 35.00 W, 0.73 A at -48 V, 119.5 BTU/hr
- Dimensions
 - Height: 12.650 in. (321.3 mm)
 - Width: 0.716 in. (18.2 mm)
 - Depth: 9.000 in. (228.6 mm)
 - Depth with backplane connector: 9.250 in. (235 mm)
 - Weight not including clam shell: 3.1 lb (1.3 kg)
- Compliance

ONS 15454 optical cards, when installed in a system, comply with these standards:

 - Safety: IEC 60950, EN 60950, UL 60950, CSA C22.2 No. 60950, TS 001, AS/NZS 3260, IEC 60825-1, IEC 60825-2, 21 CFR 1040-10, and 21 CFR 1040.11
 - Class 1M (IEC 60825-1 2001.01) and Class 1 (21 CFR 1040.10 and 1040.11) laser product. Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.

