



CHAPTER 7

Card Protection

This chapter explains the Cisco ONS 15454 card protection configurations. To provision card protection, refer to the *Cisco ONS 15454 Procedure Guide*.

Chapter topics include:

- [7.1 Electrical Card Protection, page 7-1](#)
- [7.2 Electrical Card Protection and the Backplane, page 7-5](#)
- [7.3 OC-N Card Protection, page 7-13](#)
- [7.4 Unprotected Cards, page 7-14](#)
- [7.5 External Switching Commands, page 7-15](#)

7.1 Electrical Card Protection

The ONS 15454 provides a variety of electrical card protection methods. This section describes the protection options. [Figure 7-1](#) shows a 1:1 protection configuration and [Figure 7-2 on page 7-3](#) shows a 1:N protection configuration.

This section covers the general concept of electrical card protection. Specific electrical card protection schemes depend on the type of electrical card as well as the electrical interface assembly (EIA) type used on the ONS 15454 backplane. [Table 7-4 on page 7-6](#) details the specific electrical card protection schemes.



Note

See [Table 1-1 on page 1-15](#) and [Table 1-2 on page 1-16](#) for the EIA types supported by the 15454-SA-ANSI and 15454-SA-HD (high-density) shelf assemblies.



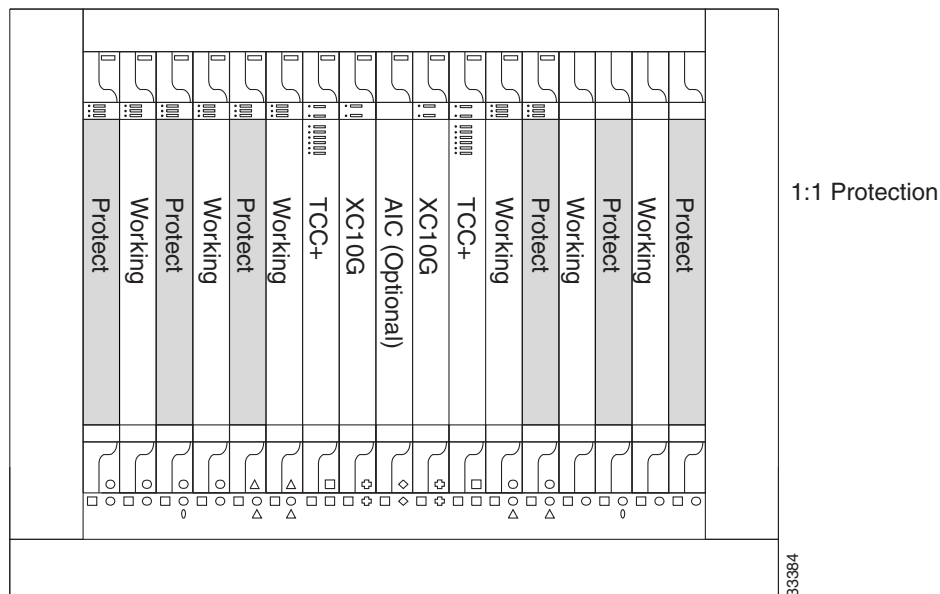
Caution

When a protection switch moves traffic from the working/active electrical card to the protect/standby electrical card, ports on the new active/standby card cannot be placed out of service as long as traffic is switched. Lost traffic can result when a port is taken out of service, even if the standby card no longer carries traffic.

7.1.1 1:1 Protection

In 1:1 protection, a working card is paired with a protect card of the same type. If the working card fails, the traffic from the working card switches to the protect card. You can provision 1:1 to be revertive or nonrevertive. If revertive, traffic automatically reverts to the working card after the failure on the working card is resolved. [Figure 7-1](#) shows an example of the ONS 15454 in a 1:1 protection configuration. Each working card in an even-numbered slot is paired with a protect card in an odd-numbered slot: Slot 1 is protecting Slot 2, Slot 3 is protecting Slot 4, Slot 5 is protecting Slot 6, Slot 17 is protecting Slot 16, Slot 15 is protecting Slot 14, and Slot 13 is protecting Slot 12.

Figure 7-1 Example: ONS 15454 Cards in a 1:1 Protection Configuration (SMB EIA)



[Table 7-1](#) provides supported 1:1 protection by electrical card type.

Table 7-1 Supported 1:1 Protection by Electrical Card

Working Card	Protect Card	Working Slot	Protection Slot
DS1-14 or DS1N-14	DS1-14 or DS1N-14	2	1
DS3-12/DS3-12E or DS3N-12/DS3N-12E	DS3-12 or DS3N-12	4	3
DS3i-N-12	DS3i-N-12	6	5
DS3XM-6 (Transmux)	DS3XM-6 (Transmux)	12	13
DS3XM-12 (Transmux)	DS3XM-12 (Transmux)	14	15
		16	17

7.1.2 1:N Protection

1:N protection allows a single electrical card to protect up to five working cards of the same speed. 1:N cards have added circuitry to act as the protect card in a 1:N protection group. Otherwise, the card is identical to the standard card and can serve as a normal working card.

The physical DS-1 or DS-3 interfaces on the ONS 15454 backplane use the working card until the working card fails. When the node detects this failure, the protect card takes over the physical DS-1 or DS-3 electrical interfaces through the relays and signal bridging on the backplane. Figure 7-2 shows the ONS 15454 in a 1:N protection configuration. Each side of the shelf assembly has only one card protecting all of the cards on that side.

Figure 7-2 Example: ONS 15454 Cards in a 1:N Protection Configuration (SMB EIA)

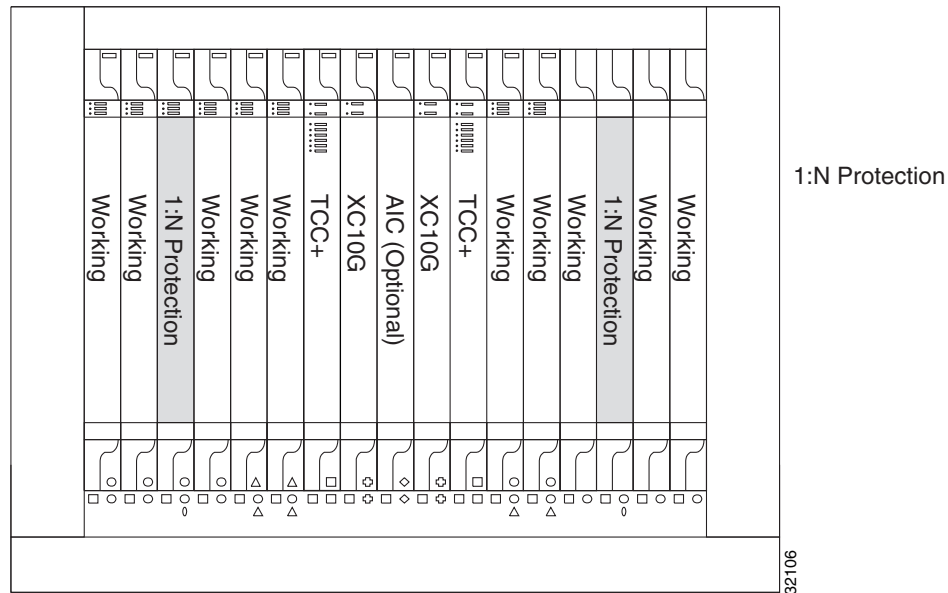


Table 7-2 provides the supported 1:N configurations by electrical card, as well as the card types that can be used for working and protection cards. Additional engineering rules for 1:N card deployments will be covered in the following sections.

Table 7-2 Supported 1:N Protection by Electrical Card

Working Card	Protect Card	Protect Group (Maximum)	Working Slot	Protection Slot
DS1-14 or DS1N-14	DS1N-14	N_5	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15
DS1/E1-56	DS1/E1-56	N_2	1 ¹ , 2 ²	3
			16 ³ , 17 ⁴	15
DS3-12/DS3-12E or DS3N-12/DS3N-12E	DS3N-12/DS3N-12E	N_5	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15
DS3i-N-12	DS3i-N-12	N_5	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15

Table 7-2 Supported 1:N Protection by Electrical Card (continued)

Working Card	Protect Card	Protect Group (Maximum)	Working Slot	Protection Slot
DS3/EC1-48	DS3/EC1-48	N _ 2	1 ⁵ , 2 ⁶	3
			16 ⁷ , 17 ⁸	15
DS3XM-12 (Transmux)	DS3XM-12 (Transmux)	N _ 5	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15
DS3XM-12 (Transmux)	DS3XM-12 (Transmux)	N _ 7 (portless ⁹)	1, 2, 4, 5, 6, 12, 13, 14, 15, 16, 17	3
			1, 2, 3, 4, 5, 6, 12, 13, 14, 16, 17	15

1. A high-density electrical card inserted in Slot 1 restricts the use of Slots 5 and 6 to optical, data, or storage cards.
2. A high-density electrical card inserted in Slot 2 restricts the use of Slots 4 and 6 to optical, data, or storage cards.
3. A high-density electrical card inserted in Slot 16 restricts the use of Slot 14 to optical, data, or storage cards.
4. A high-density electrical card inserted in Slot 17 restricts the use of Slots 12 and 13 to optical, data, or storage cards.
5. A high-density electrical card inserted in Slot 1 restricts the use of Slots 5 and 6 to optical, data, or storage cards.
6. A high-density electrical card inserted in Slot 2 restricts the use of Slots 4 and 6 to optical, data, or storage cards.
7. A high-density electrical card inserted in Slot 16 restricts the use of Slot 14 to optical, data, or storage cards.
8. A high-density electrical card inserted in Slot 17 restricts the use of Slots 12 and 13 to optical, data, or storage cards.
9. Portless DS-3 Transmux operation does not terminate the DS-3 signal on the EIA panel.

7.1.2.1 Revertive Switching

1:N protection supports revertive switching. Revertive switching sends the electrical interfaces (traffic) back to the original working card after the card comes back online. Detecting an active working card triggers the reversion process. There is a variable time period for the lag between detection and reversion, called the revertive delay, which you can set using the ONS 15454 software, Cisco Transport Controller (CTC). To set the revertive delay, refer to the “Turn Up Node” chapter in the *Cisco ONS 15454 Procedure Guide*. All cards in a protection group share the same reversion settings. 1:N protection groups default to automatic reversion.



Caution

A user-initiated switch (external switching command) overrides the revertive delay, that is, clearing the switch clears the timer.

7.1.2.2 1:N Protection Guidelines

There are two types of 1:N protection groups for the ONS 15454: ported and portless. Ported 1:N interfaces are the traditional protection groups for signals electrically terminated on the shelf assembly. Portless 1:N interfaces are signals received through an electrical synchronous transport signal (STS) through the cross-connect card. The DS3XM-12 card supports portless as well as traditional ported deployments. [Table 7-2 on page 7-3](#) outlines the 1:N configurations supported by each electrical card type.

The following rules apply to ported 1:N protection groups in the ONS 15454:

- Working and protect card groups must reside in the same card bank (Side A or Side B).
- The 1:N protect card must reside in Slot 3 for Side A and Slot 15 for Side B.

- Working cards can sit on either or both sides of the protect card.

The following rules apply to portless 1:N protection groups in the ONS 15454:

- Working and protect card groups can reside in the same card bank or different card banks (Side A or Side B).
- The 1:N protect card can be installed in either Slot 3 or Slot 15 and protect working cards in both card banks.
- Working cards can sit on either or both sides of the protect card.

The ONS 15454 supports 1:N equipment protection for all add-drop multiplexer (ADM) configurations (ring, linear, and terminal), as specified by Telcordia GR-253-CORE. For detailed procedures for setting up DS-1 and DS-3 protection groups, refer to the *Cisco ONS 15454 Procedure Guide*.

7.2 Electrical Card Protection and the Backplane

Protection schemes for electrical cards depend on the EIA type used on the ONS 15454 backplane. The difference is due to the varying connector size. For example, because BNC connectors are larger, fewer DS3-12 cards can be supported when using a BNC connector. [Table 7-3](#) shows the number of connectors per side for each EIA type according to low-density and high-density interfaces.

In the tables, high-density (HD) cards include the DS3/EC1-48 and DS1/E1-56 cards. Low-density (LD) cards) include the following:

- DS1-14, DS1N-14
- DS3-12/DS3-12E, DS3N-12/DS3N-12E
- DS3XM-6
- DS3XM-12
- EC1-12



Note

For EIA installation, refer to the “Install the Shelf and Backplane Cable” chapter in the *Cisco ONS 15454 Procedure Guide*.



Caution

When a protection switch moves traffic from the working/active electrical card to the protect/standby electrical card, ports on the new active/standby card cannot be taken out of service as long as traffic is switched. Lost traffic can result when a port is taken out of service even if the standby electrical card no longer carries traffic.

Table 7-3 EIA Connectors Per Side

Interfaces per Side	Standard BNC	High-Density BNC	MiniBNC	SMB	AMP Champ	UBIC-V and UBIC-H (SCSI)
Total physical connectors	48	96	192	168	6	16
Maximum LD DS-1 Interfaces (transmit [Tx] and receive [Rx])	—	—	—	84	84	84
Maximum LD DS-3 interfaces (Tx and Rx)	24	48	72	72	—	72
Maximum HD DS-1 interfaces (Tx and Rx)	—	—	—	—	—	112
Maximum HD DS-3 interfaces (Tx and Rx)	—	—	96	—	—	96

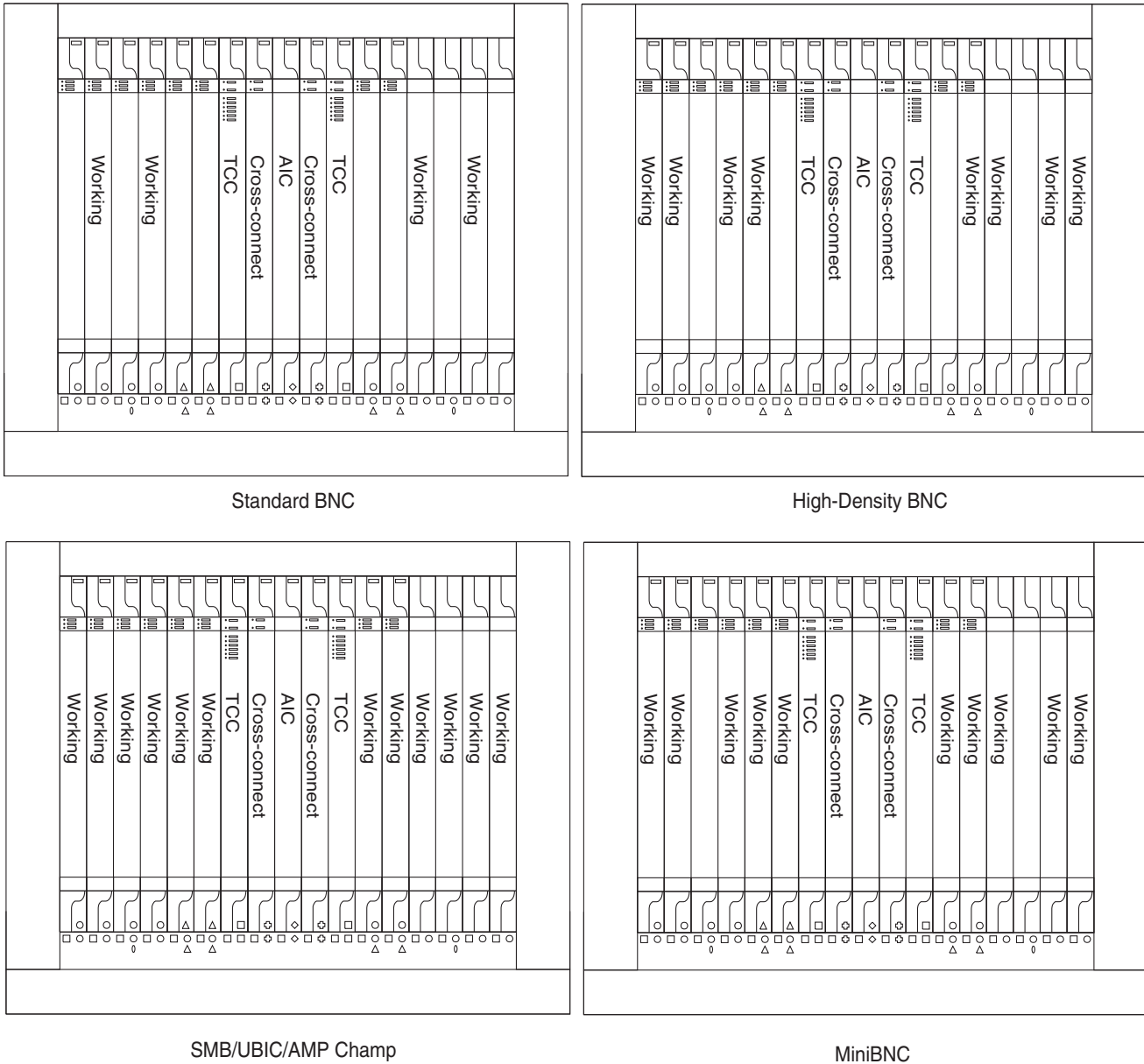
Table 7-4 shows the electrical card protection for each EIA type according to shelf side and slots.

Table 7-4 Electrical Card Protection By EIA Type

Protection Type	Card Type	Side	Standard BNC	High-Density BNC	MiniBNC	SMB	AMP Champ	UBIC-V and UBIC-H (SCSI)
Unprotected	LD, Working	A	2, 4	1, 2, 4, 5	1–6	1–6	1–6	1–6
		B	14, 16	13, 14, 16, 17	12–17	12–17	12–17	12–17
	HD, Working	A	—	—	1, 2	—	—	1, 2
		B	—	—	16, 17	—	—	16, 17
1:1	LD, Working	A	2, 4	2, 4	2, 4, 6	2, 4, 6	2, 4, 6	2, 4, 6
		B	14, 16	14, 16	12, 14, 16	12, 14, 16	12, 14, 16	12, 14, 16
	LD, Protect	A	1, 3	1, 3	1, 3, 5	1, 3, 5	1, 3, 5	1, 3, 5
		B	15, 17	15, 17	13, 15, 17	13, 15, 17	13, 15, 17	13, 15, 17
1:N	LD, Working	A	—	1, 2, 4, 5	1–6	1–6	1–6	1–6
		B	—	13, 14, 16, 17	12–17	12–17	12–17	12–17
	LD, Protect	A	—	3	3	3	3	3
		B	—	15	15	15	15	15
	HD, Working	A	—	—	1, 2	—	—	1, 2
		B	—	—	16, 17	—	—	16, 17
	HD, Protect	A	—	—	3	—	—	3
		B	—	—	15	—	—	15

Figure 7-3 shows unprotected low-density electrical card schemes by EIA type.

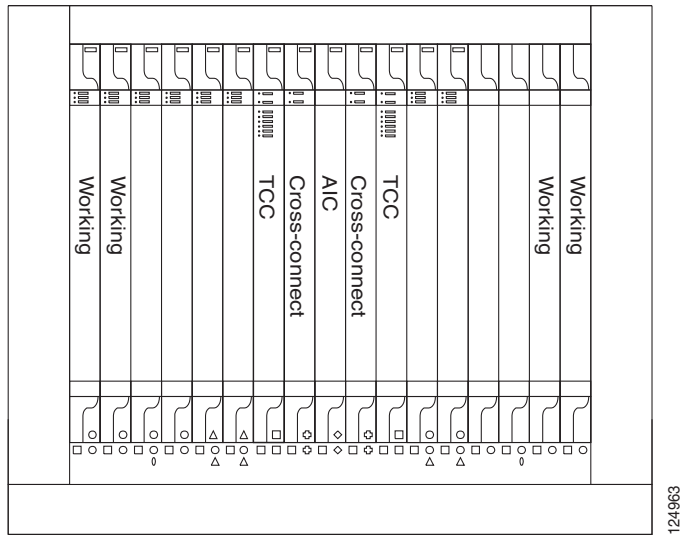
Figure 7-3 Unprotected Low-Density Electrical Card Schemes for EIA Types



124060

Figure 7-4 shows unprotected high-density electrical card schemes by EIA type.

Figure 7-4 Unprotected High-Density Electrical Card Schemes for EIA Types



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UBIC/MiniBNC

Figure 7-5 shows 1:1 low-density card protection by EIA type.

Figure 7-5 1:1 Protection Schemes for Low-Density Electrical Cards with EIA Types

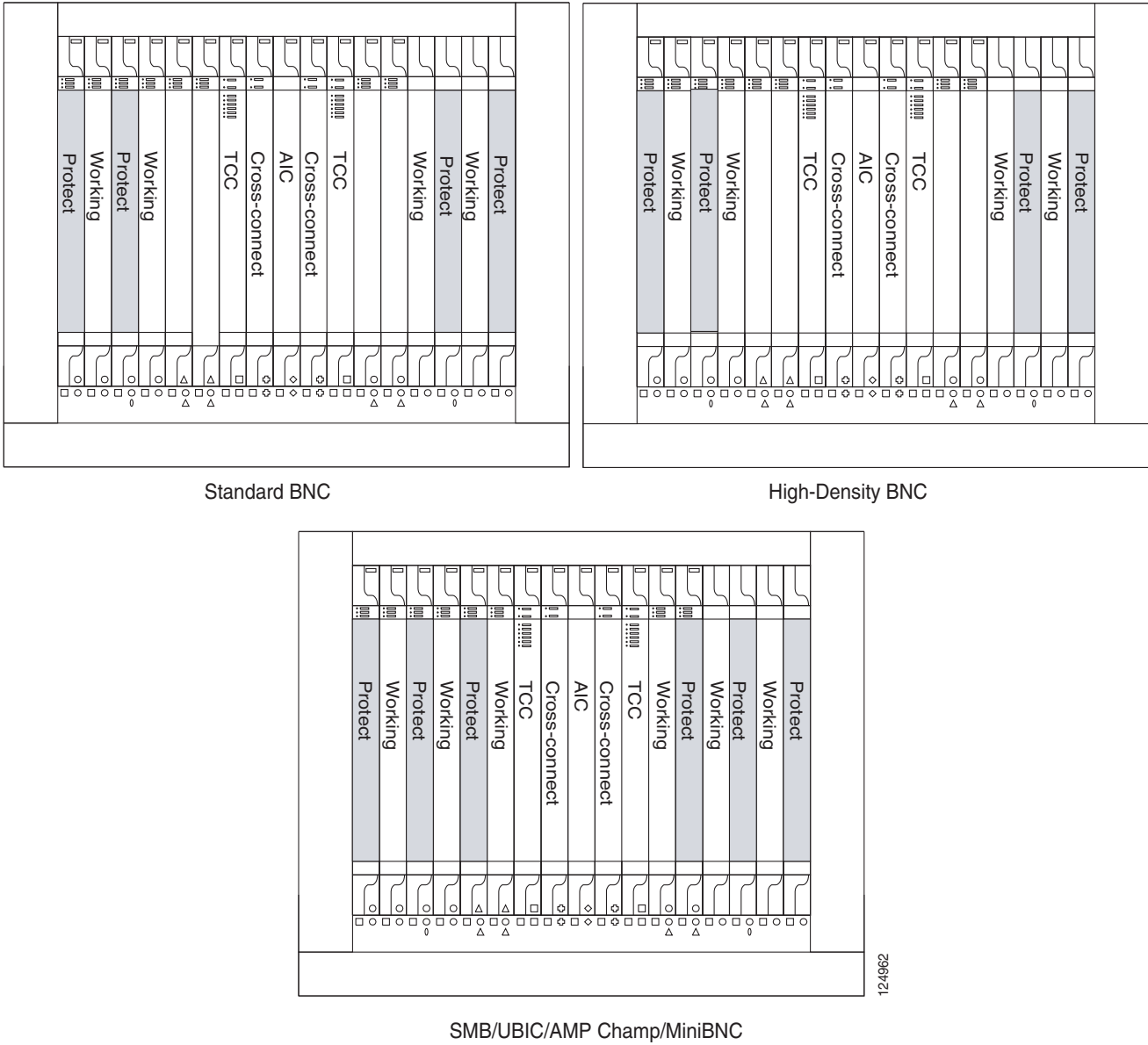
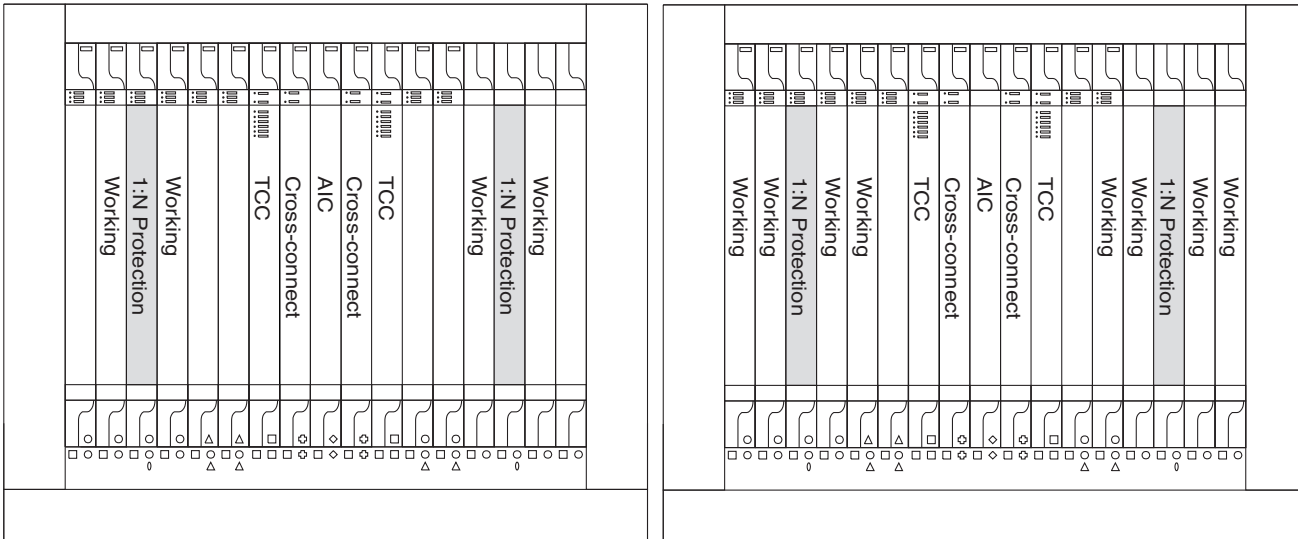


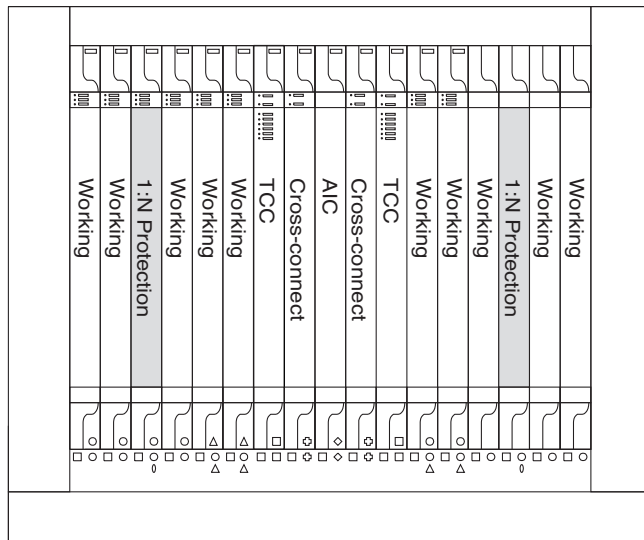
Figure 7-6 shows 1:N protection for low-density electrical cards.

Figure 7-6 1:N Protection Schemes for Low-Density Electrical Cards with EIA Types



Standard BNC

High-Density BNC



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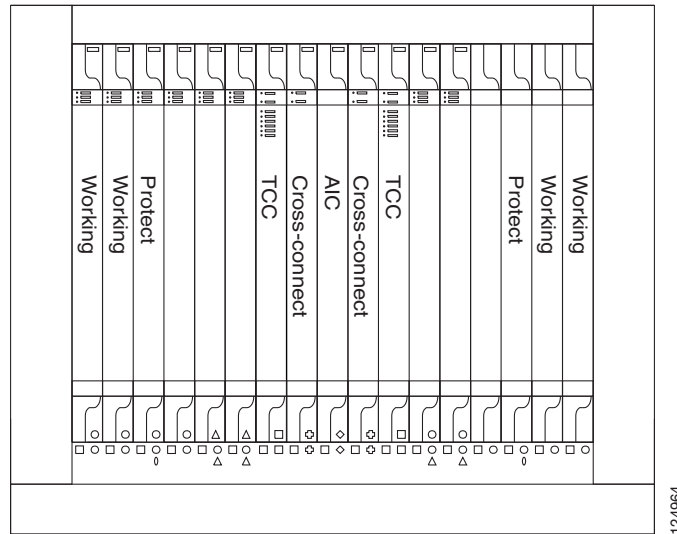
SMB/UBIC/AMP Champ/MiniBNC

**Note**

EC-1 cards do not support 1:N protection.

Figure 7-7 shows 1:1 high-density card protection by EIA type.

Figure 7-7 1:1 Protection Schemes for High-Density Electrical Cards with UBIC or MiniBNC EIA Types



UBIC/MiniBNC

7.2.1 Standard BNC Protection

When used with the standard BNC EIA, the ONS 15454 supports unprotected, 1:1, or 1:N ($N \leq 2$) electrical card protection for DS-3 and EC-1 signals, as outlined in [Table 7-1 on page 7-2](#) and [Table 7-2 on page 7-3](#). The standard BNC EIA panel provides 48 BNC connectors for terminating up to 24 transmit and 24 receive signals per EIA panel, enabling 96 BNC connectors for terminating up to 48 transmit and receive signals per shelf with two standard-BNC panels installed. With an A-Side standard BNC EIA, Slots 2 and 4 can be used for working slots and with a B-Side EIA, Slots 14 and 16 can be used for working slots. Each of these slots is mapped to 24 BNC connectors on the EIA to support up to 12 transmit/receive signals. These slots can be used with or without equipment protection for DS-3 and EC-1 services.

7.2.2 High-Density BNC Protection

When used with the high-density BNC EIA, the ONS 15454 supports unprotected, 1:1, or 1:N ($N \leq 4$) electrical card protection for DS-3 and EC-1 signals, as outlined in [Table 7-1 on page 7-2](#) and [Table 7-2 on page 7-3](#). The high-density BNC EIA panel provides 96 BNC connectors for terminating up to 48 transmit and 24 receive signals per EIA panel, enabling 192 BNC connectors for terminating up to 96 transmit and receive signals per shelf with two high-density BNC panels installed. With an A-Side high-density BNC EIA, Slots 1, 2, 4, and 5 can be used for working slots and with a B-Side EIA,

Slots 13, 14, 16, and 17 can be used for working slots. Each of these slots is mapped to 24 BNC connectors on the EIA to support up to 12 transmit/receive signals. These slots can be used with or without equipment protection for DS-3 and EC-1 services.

7.2.3 MiniBNC Protection

When used with the MiniBNC EIA, the ONS 15454 supports unprotected, 1:1, or 1:N (N ≤ 5) electrical card protection for DS-1, DS-3 and EC-1 signals, as outlined in [Table 7-1 on page 7-2](#) and [Table 7-2 on page 7-3](#). The MiniBNC EIA provides 192 MiniBNC connectors for terminating up to 96 transmit and 96 receive signals per EIA, enabling 384 MiniBNC connectors for terminating up to 192 transmit and receive signals per shelf with two MiniBNC panels installed. With an A-Side MiniBNC EIA, Slots 1, 2, 4, 5, and 6 can be used for working slots and on a B-Side panel, Slots 12, 13, 14, 16, and 17 can be used for working slots. Each of these slots is mapped to 24 MiniBNC connectors on the EIA panel to support up to 12 transmit/receive signals. In addition, working Slots 1, 2, 16 and 17 can be mapped to 96 MiniBNC connectors to support the high-density electrical card. These slots can be used with or without equipment protection for DS-3 and EC-1 services.

7.2.4 SMB Protection

When used with the SMB EIA, the ONS 15454 supports unprotected, 1:1, or 1:N (N ≤ 5) electrical card protection for DS-3 and EC-1 signals, as outlined in [Table 7-1 on page 7-2](#) and [Table 7-2 on page 7-3](#). The SMB EIA provides 168 SMB connectors for terminating up to 84 transmit and 84 receive signals per EIA, enabling 336 SMB connectors for terminating up to 168 transmit and receive signals per shelf with two SMB EIAs installed. With an A-Side SMB EIA, Slots 1, 2, 3, 4, 5, and 6 can be used for working slots and with a B-Side EIA, Slots 12, 13, 14, 15, 16, and 17 can be used for working slots. Each of these slots is mapped to 28 SMB connectors on the EIA to support up to 14 transmit/receive signals. These slots can be used with or without equipment protection for DS-1, DS-3 and EC-1 services. For DS-1 services, an SMB-to-wire-wrap balun is installed on the SMB ports for termination of the 100 ohm signal.

7.2.5 AMP Champ Protection

When used with the AMP Champ EIA, the ONS 15454 supports unprotected, 1:1, or 1:N (N ≤ 5) electrical card protection for DS-1 signals, as outlined in [Table 7-1 on page 7-2](#) and [Table 7-2 on page 7-3](#). The AMP Champ EIA provides 6 AMP Champ connectors for terminating up to 84 transmit and 84 receive signals per EIA, enabling 12 AMP Champ connectors for terminating up to 168 transmit and receive signals per shelf with two AMP Champ EIAs installed. With an A-Side SMB EIA, Slots 1, 2, 3, 4, 5, and 6 can be used for working slots and with a B-Side EIA, Slots 12, 13, 14, 15, 16, and 17 can be used for working slots. Each of these slots is mapped to 1 AMP Champ connector on the EIA to support 14 transmit/receive signals. These slots can be used with or without equipment protection for DS-1 services.

7.2.6 UBIC Protection

When used with the UBIC EIA, the ONS 15454 high-density shelf assembly (15454-HD-SA) supports unprotected, 1:1, or 1:N (N ≤ 5) electrical card protection for DS-1, DS-3 and EC-1 signals, as outlined in [Table 7-1 on page 7-2](#) and [Table 7-2 on page 7-3](#). The UBIC EIA provides 16 SCSI connectors for terminating up to 112 transmit and receive DS-1 signals per EIA, or up to 96 transmit and receive DS-3

connections. With an A-side UBIC EIA, Slots 1, 2, 3, 4, 5, and 6 can be used for working slots and with a B-Side EIA, Slots 12, 13, 14, 15, 16, and 17 can be used for working slots. Each of these slots is mapped to two SCSI connectors on the EIA to support up to 14 transmit/receive signals. In addition, working Slots 1, 2, 16, and 17 can be mapped to 8 SCSI connectors to support the high-density electrical card. These slots can be used with or without equipment protection for DS-1, DS-3, and EC-1 services.

7.3 OC-N Card Protection

The ONS 15454 provides two optical card protection methods, 1+1 protection and optimized 1+1 protection. This section covers the general concept of optical card protection. Specific optical card protection schemes depend on the optical cards in use.

7.3.1 1+1 Protection

Any OC-N card can use 1+1 protection. With 1+1 port-to-port protection, ports on the protect card can be assigned to protect the corresponding ports on the working card. The working and protect cards do not have to be placed side by side in the node. A working card must be paired with a protect card of the same type and number of ports. For example, a single-port OC-12 must be paired with another single-port OC-12, and a four-port OC-12 must be paired with another four-port OC-12. You cannot create a 1+1 protection group if one card is single-port and the other is multiport, even if the OC-N rates are the same. The protection takes place on the port level, and any number of ports on the protect card can be assigned to protect the corresponding ports on the working card.

For example, on a four-port card, you can assign one port as a protection port on the protect card (protecting the corresponding port on the working card) and leave three ports unprotected. Conversely, you can assign three ports as protection ports and leave one port unprotected. In other words, all the ports on the protect card are used in the protection scheme.

1+1 span protection can be either revertive or nonrevertive. With nonrevertive 1+1 protection, when a failure occurs and the signal switches from the working card to the protect card, the signal stays switched to the protect card until it is manually switched back. Revertive 1+1 protection automatically switches the signal back to the working card when the working card comes back online. 1+1 protection is unidirectional and nonrevertive by default; revertive switching is easily provisioned using CTC.

**Note**

When provisioning a line timing reference for the node, you cannot select the protect port of a 1+1 protection group. If a traffic switch occurs on the working port of the 1+1 protection group, the timing reference of the node automatically switches to the protect port of the 1+1 protection group.

7.3.2 Optimized 1+1 Protection

Optimized 1+1 protection is used in networks that mainly use the linear 1+1 bidirectional protection scheme. Optimized 1+1 is a line-level protection scheme using two lines, working and protect. One of the two lines assumes the role of the primary channel, where traffic is selected, and the other line assumes the role of secondary channel, which protects the primary channel. Traffic switches from the primary channel to the secondary channel based on either line conditions or an external switching command performed by the user. After the line condition clears, the traffic remains on the secondary channel. The secondary channel is automatically renamed as the primary channel and the former primary channel is automatically renamed as the secondary channel.

Unlike 1+1 span protection, 1+1 optimized span protection does not use the revertive or nonrevertive feature. Also, 1+1 optimized span protection does not use the Manual switch command. The 1+1 optimized span protection scheme is supported only on the Cisco ONS 15454 SONET using either OC3-4 cards or OC3-8 cards with ports that are provisioned for SDH payloads.

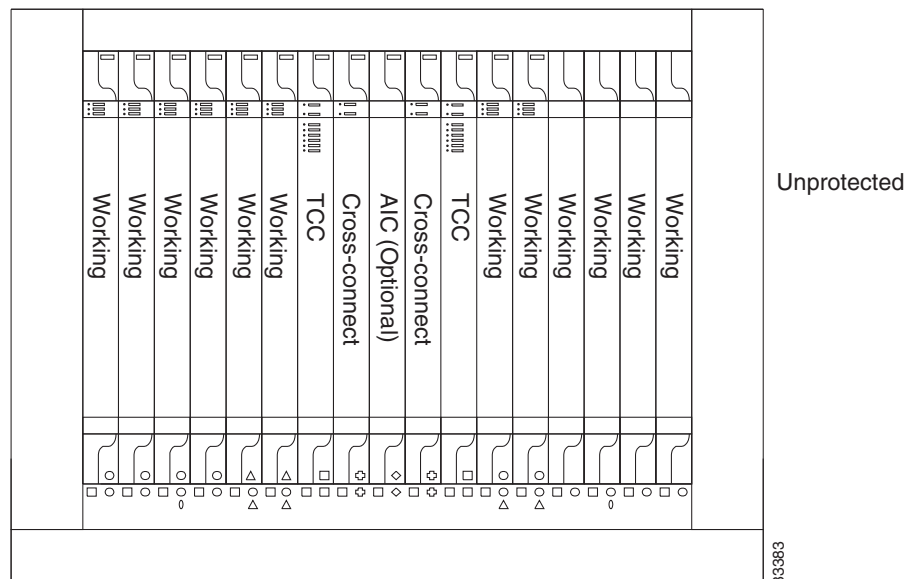
Optimized 1+1 is fully compliant with Nippon Telegraph and Telephone Corporation (NTT) specifications. With optimized 1+1 port-to-port protection, ports on the protect card can be assigned to protect the corresponding ports on the working card. The working and protect cards do not have to be installed side by side in the node. A working card must be paired with a protect card of the same type and number of ports. For example, a four-port OC-3 must be paired with another four-port OC-3, and an eight-port OC-3 must be paired with another eight-port OC-3. You cannot create an optimized 1+1 protection group if the number of ports do not match, even if the OC-N rates are the same.

The protection takes place on the port level, and any number of ports on the protect card can be assigned to protect the corresponding ports on the working card. For example, on a four-port card, you can assign one port as a protection port on the protect card (protecting the corresponding port on the working card) and leave three ports unprotected. Conversely, you can assign three ports as protection ports and leave one port unprotected. With 1:1 or 1:N protection (electrical cards), the protect card must protect an entire slot. In other words, all the ports on the protect card are used in the protection scheme.

7.4 Unprotected Cards

Unprotected cards are not included in a protection scheme; therefore, a card failure or a signal error results in lost data. Because no bandwidth lies in reserve for protection, unprotected schemes maximize the available ONS 15454 bandwidth. [Figure 7-8](#) shows the ONS 15454 in an unprotected configuration. All cards are in a working state.

Figure 7-8 ONS 15454 in an Unprotected Configuration



7.5 External Switching Commands

The external switching commands on the ONS 15454 are Manual, Force, and Lockout. If you choose a Manual switch, the command will switch traffic only if the path has an error rate less than the signal degrade (SD) bit error rate threshold. A Force switch will switch traffic even if the path has SD or signal fail (SF) conditions; however, a Force switch will not override an SF on a 1+1 protection channel.

A Force switch has a higher priority than a Manual switch. Lockouts, which prevent traffic from switching to the protect port under any circumstance, can only be applied to protect cards (in 1+1 configurations). Lockouts have the highest priority. In a 1+1 configuration you can also apply a lock on to the working port. A working port with a lock on applied cannot switch traffic to the protect port in the protection group (pair). In 1:1 protection groups, working or protect ports can have a lock on.

**Note**

Force and Manual switches do not apply to 1:1 protection groups; these ports have a single switch command.
