Channelized T3 Trunk Card

The Cisco AS5800 universal access server supports a channelized T3 (CT3) ingress interface that provides asynchronous aggregation of channelized interfaces and multiplexing on a single T3 facility. The CT3 trunk card is installed in the Cisco 5814 dial shelf chassis in slots 0 to slot 5. The Cisco AS5800 currently supports as many as two CT3 trunk cards.

This chapter explains how to remove and replace a CT3 trunk card in the Cisco 5814 dial shelf chassis, and also includes steps for verifying and troubleshooting your trunk card installation and configuring your software.

CT3 Trunk Card Overview

The CT3 trunk card contains an onboard M13 multiplexer, which multiplexes 28 separate T1 lines into a single T3 line. Each CT3 trunk card installed in the Cisco 5814 dial shelf contains all necessary functionality to terminate link signaling and incoming digital calls.

Figure 3-1 shows the CT3 trunk card.

Figure 3-1   CT3 Trunk Card
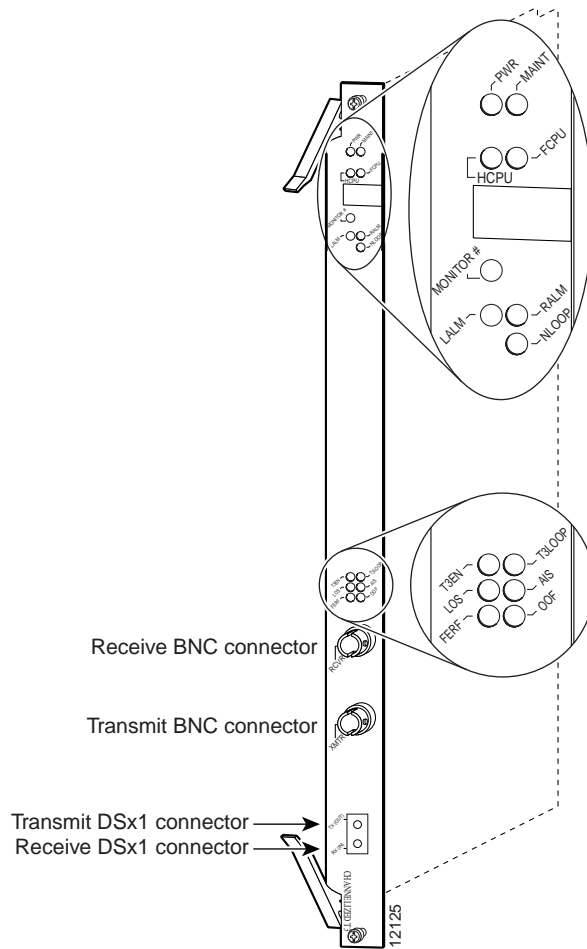
Each CT3 trunk card performs the following functions:

- Provides physical termination for as many as 672 sessions.

- Provides digital termination for as many as 256 DS0 connections (calls) using onboard High-Level Data Link Control (HDLC) controllers. Note that the D-channel of a PRI consumes a single channel of an HDLC controller.

- Removes framing and embedded signaling bits (or inserts them, depending on the direction of the flow), demultiplexing the calls. The framer CPU sends the data stream to onboard time-division multiplexing (TDM) resources, which break out each call and pass each call to an appropriate call termination resource. Digital or ISDN-originated calls are terminated onboard the CT3 trunk card on HDLC controllers.

> **Note**   Each D-channel consumes an HDLC controller.

Analog modem-originated calls are passed over the dial shelf backplane TDM bus to an available modem resource. The system software controls modem and HDLC resource management.

- Responds to time-sensitive signaling. Each CT3 trunk card can supply two clocks from any two of its 28 ports. You can assign priorities to these clocks or accept the default values assigned by the software.

- Processes counting information for performance monitoring.

- Supports online insertion and removal (OIR), a feature that allows you to remove and replace a trunk card in the Cisco 5814 dial shelf while the system is operating without disrupting other cards and their associated calls. If you remove a trunk card while the system is operating, all calls associated with the CT3 lines on that card are dropped. Calls being handled by other trunk or modem cards, however, are not affected. For more information, see the "Online Insertion and Removal" section on page 1-1.

Figure 3-2 shows two trunk cards installed in a fully-configured Cisco 5814 dial shelf chassis.

Figure 3-2   Cisco 5814 Dial Shelf Chassis Fully Configured with Trunk Cards Installed
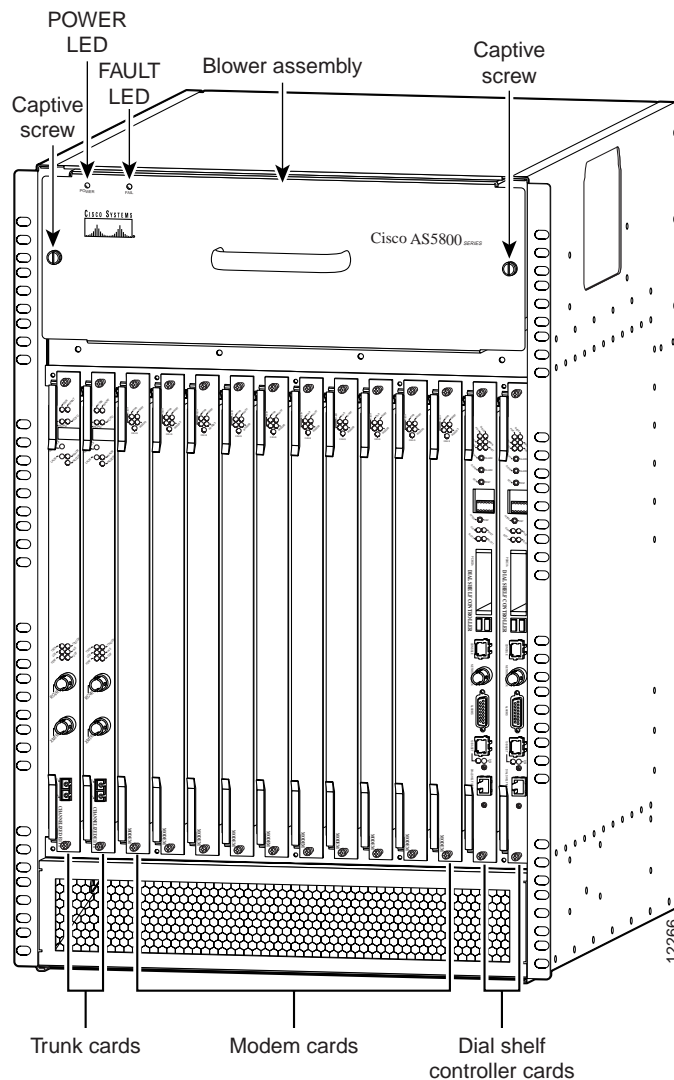
Clocking

All Cisco AS5800 access server trunk cards use the same transmit clock. This clock can originate from the following sources:

- TDM clock source—A priority value from 1 to 50 that is applied to a clock source when multiple clock sources are used

- External clock source—A clock source external to the access server

Clocks are prioritized by slot number (slots 0 to 5). The highest-priority clock is selected from the card in slot 0 and used as the default clock. If this clock fails, the highest-priority clock from the card in slot 1 becomes the default clock, and so forth.

The trunk card then forwards the clocks to the dial shelf controller. The dial shelf controller selects the highest-priority clock as the system primary clock, and the rest of the clocks remain in a prioritized backup queue.

Instead of using the default algorithm for clock selection, you can specify clocks through global configuration and select a maximum of two clocks per trunk card.

If you configure fewer than two clocks on a trunk card and all other configured clocks fail, clock selection resorts to the default algorithm on that card and the second clock will be selected automatically.

CT3 Clocking

CT3 trunk cards are usually attached to an external device, such as a Digital Access and Crossconnect System (DACS) or Add-Drop Multiplexer (ADM). This point-to-point link requires a single clock source to which the CT3 link is timed. You must determine whether you want the CT3 trunk card or an external device to be used as the primary clock source and configure it accordingly during the software configuration process, which is discussed in the "Configuration Commands" section on page 3-12.

CT1 Clocking

The CT3 trunk card has 28 T1 framers that always get their clock from the line. As a result, configuration of T1 clock sources is not allowed.

LED and Alphanumeric Indicators

The CT3 trunk card front panel is designed with LED and alphanumeric displays to provide trunk card status. (See Figure 3-3.)

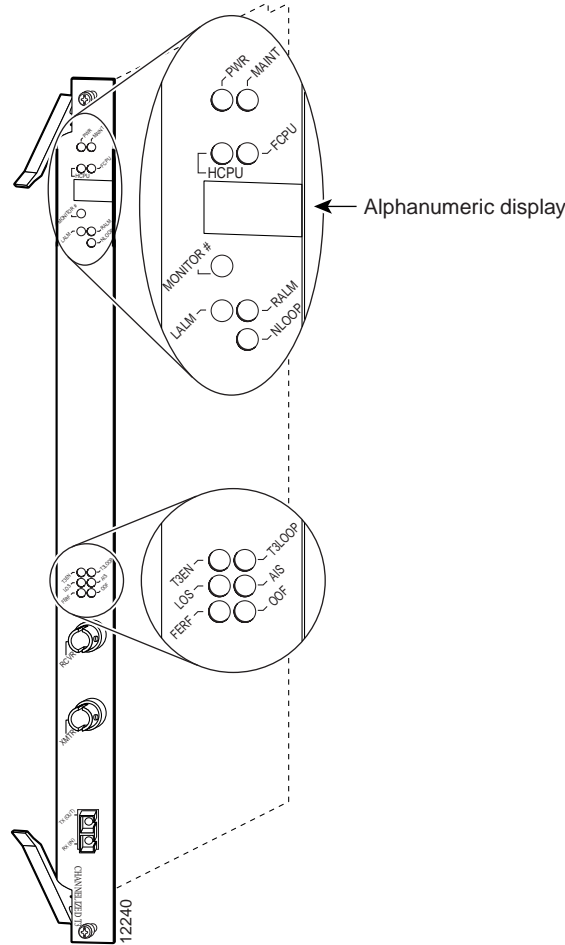*Figure 3-3   CT3 Trunk Card Front Panel LED and Alphanumeric Indicators*

Table 3-1 lists the CT3 trunk card LEDs and their functions.

Table 3-1   CT3 Trunk Card LED Indicators

LED	Color	Description
PWR	Green	Power—Lights when power is ON.
MAINT	Yellow	Maintenance—Lights to indicate that the feature card is ready for OIR.
HCPU	Green	Host CPU—Lights when the associated host CPU is determined to be in good working condition; shuts off when there is an error condition or code is being downloaded.
FCPU	Green	Framing data link—Lights when the associated FDL CPU is determined to be in good working condition; shuts off when there is an error condition or code is being downloaded.
LALM	Yellow	Local alarm—Lights to indicate a T1 alarm condition was encountered by software for a particular port; remains OFF when the operating condition is normal.

*Table 3-1   CT3 Trunk Card LED Indicators (continued)*

LED	Color	Description
RALM	Yellow	Remote alarm—Lights to indicate a T1 alarm condition was encountered by software for a particular port; remains OFF when the operating condition is normal.
NLOOP	Yellow	Network loop—Lights to indicate that at least one T1 is unavailable (status indicator); remains OFF when the operating condition is normal.
T3EN	Green[1]	Enable—Lights to indicate a CT3 card line connection enabling normal operation.
T3LOOP[2]	Yellow[3]	Loopback—Lights to indicate that a loopback condition exists on the CT3 line; software controlled.
LOS	Yellow[3]	Loss-of-signal—Lights to indicate that the CT3 framer is experiencing a loss of signal (175 successive zeros).
AIS	Yellow[3]	Alarm indication signal—Lights to indicate the presence of AIS in the received CT3 line. Lights to indicate that a T3 alarm condition exists; remains OFF when the operating condition is normal.
FERF	Yellow[3]	Far-end receive failure—Lights to indicate a far-end receive failure on the CT3 line.
OOF	Yellow[3]	Out-of-frame—Lights to indicate an out-of-frame condition on the CT3 line.

1. This LED must be lit for proper CT3 operation.

2. When in loopback mode, enables diagnostics to perform local CT3 testing without external support. The CT3 line is not affected by this condition, thus remaining disconnected and open.

3. This LED must remain off for proper CT3 operation.

Trunk Card Connectors

The CT3 front panel is designed with two types of cable connectors (see Figure 3-4). The BNC connectors are used to connect the cables carrying the T3 signals. The bantam jacks are used for local BERT circuit testing to the DS1 level.
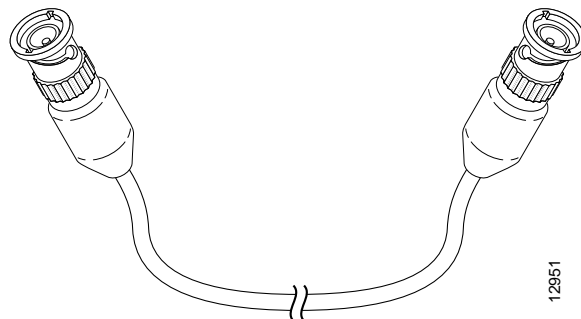
Figure 3-4   CT3 Trunk Card Front Panel Connectors
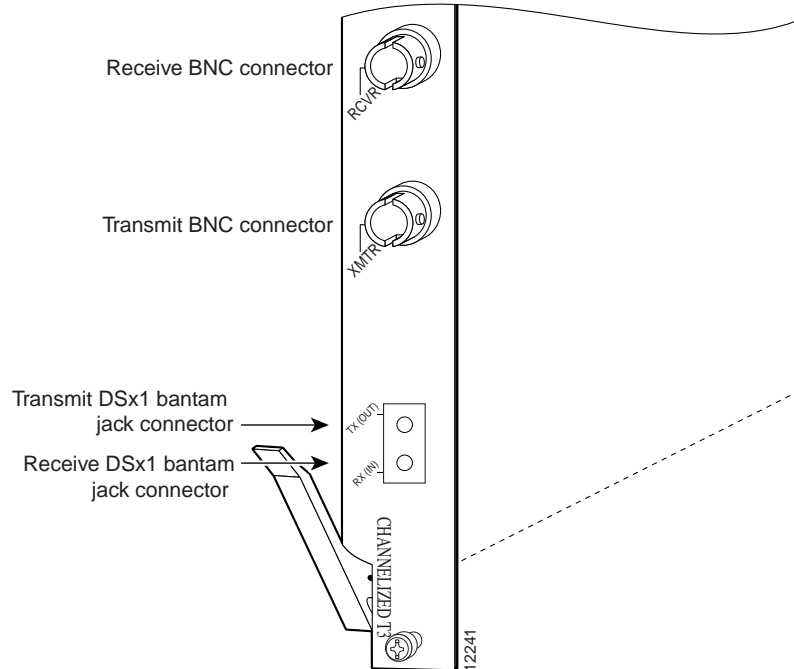
Receive BNC connector

Transmit BNC connector

Transmit DSx1 bantam
jack connector

Receive DSx1 bantam
jack connector

Cables

The CT3 trunk card receives and transmits 45 Mbps signals through a 75-ohm cable, using common BNC coaxial cable connectors (see Figure 3-5). There are two female BNC connectors: one for T3 transmit data and one for T3 receive data.

Figure 3-5   CT3 75-Ohm Coaxial Cable

Using the Test Port

The CT3 trunk card front panel is designed with an alphanumeric display to provide trunk card status and port monitoring information (see Figure 3-3).

Test-port functionality is supported by Cisco IOS Release 12.0(6)T and later releases.

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Trunk Card Bantam Jacks

The test port is a set of bantam jack connectors located at the bottom of the CT3 front panel (see Figure 3-4). The bantam jacks allow the connection of an external test device (for example, a FIREBERD test device) to test any of the 28 individual T1 circuits in drop-and-insert mode or to monitor an individual T1 circuit in monitor mode.

- In drop-and-insert mode, the T1 line is dropped out of service. To prevent accidental use of the push button in drop-and-insert mode, use the **test trunk drop-insert** privileged EXEC command to disable the drop-and-insert mode on the specified T3 controller.

- In monitor mode, you can monitor only the ingress side of the T1 line. The T1 line being monitored is not disrupted, and the line maintains its HDLC and modem connections through TDM.

Drop-and-Insert Mode

The **test trunk drop-insert** privileged EXEC command is used to enable or disable drop-and-insert mode on a T3 controller. When the system initially boots up, the drop-and-insert mode is disabled on all T3 controllers.

To drop a particular T1 line to the test port, follow these steps:

Step 1   Enable drop-and-insert mode by entering the **test trunk drop-insert on** privileged EXEC command as follows:

```
AS5800# test trunk drop-insert on shelf/slot/unit
```

Note   The *shelf/slot/unit* identifies the T1 to the CT3 controller.

Step 2   Push and quickly release the push button below the LED to toggle to the port number. The push button is labeled "MONITOR #" in Figure 3-3.

Note   You must release the push button within 2 seconds to advance through the port numbers (from 1 to 28). After port 28, the display returns to port 1.

Step 3   Push and hold the push button for two or more seconds.

The letter "D" (indicating drop-insert) is displayed in the front panel LED, indicating that the particular T1 line has been dropped to the test port.

Note   To select another port number, press the push button again and hold it for two or more seconds. You can now toggle to another port number.

Step 4   Disable the drop-and-insert mode after testing the T1 lines. We recommend that you disable drop-and-insert mode to prevent accidental use of the push button on the CT3 board.

To disable drop-and-insert mode, enter the **test trunk drop-insert off** privileged EXEC command as follows:

```
AS5800# test trunk drop-insert off shelf/slot/unit
```

Monitor Mode

To monitor a particular T1 line at the test port, follow these steps:

Step 1   Verify that drop-and-insert mode is disabled on the CT3 controller by entering the **show** command, as follows:

```
AS5800# sh controller t3 shelf/slot/unit
```

The following is sample output from the **sh controller t3** command if drop-and-insert mode is disabled:

```
AS5800# show controller t3 1/1/0
T3 1/1/0 is up.
Applique type is Channelized T3
No alarms detected.
FEAC code received: No code is being received
Framing is M23, Line Code B3ZS, Clock Source is Internal
Drop-insert is disabled
Data in current interval (90 seconds elapsed):
 0 Line Code Violations, 0 P-bit Coding Violation
 0 C-bit Coding Violation, 0 P-bit Err Secs
 0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
 0 Unavailable Secs, 0 Line Errored Secs
 0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
AS5800#
```

✎
Note   If the display shows `Drop-insert is enabled`, repeat Step 4 in the "Drop-and-Insert Mode" section on page 3-8.

Step 2   Push and quickly release the push button below the LED to toggle to the port number. The push button is labeled "MONITOR #" in Figure 3-3.

✎
Note   You must release the push button within two seconds to advance through the port numbers (from 1 to 28). After port 28, the display returns to port 1.

Step 3   Push and hold the push button for two or more seconds.

The letter "M" (indicating monitor) is shown in the front panel display, indicating that you can monitor the particular T1 line at the test port.

✎
Note   To select another port number, press the push button again and hold it for two or more seconds. You can now toggle to another port number.

Specifications

Table 3-2 lists the CT3 trunk card specifications.

Table 3-2   CT3 Trunk Card Specifications

Description	Specification
Dimensions H x W x L	15.4 x 0.08 x 18.7 in. (39.12 x 0.203 x 47.5 cm) without the carrier 15.5 x 1.23 x 19 in. (39.37 x 3.12 x 48.26 cm) with the carrier
Weight	8 lb (3.6 kg)
Transmission bit rate	44,736 Mbps
MTBF[1]	Exceeds 50,000 hr
Power requirements	+3.3 VDC, 8A, 5% +5.0 VDC, 15A, 5%
Regulatory compliance	Safety: UL 1950, CSA 22.2 No. 950, EN60950, AUSTEL TS001, AS/NZS 3260, IEC 950
	Emissions: CFR 47 Part 15 Class B(FCC), CISPR22 Class B, EN55022 Class B, AS/NRZ 3548 Class B, ICES003, VCCI Class B
	Immunity: IEC 1000-3-2, IEC 1000-3-3, IEC-1000-4-2, IEC-1000-4-3, IEC-1000-4-4, IEC-1000-4-5, IEC-1000-4-6, IEC-1000-4-11, EN50082-1, EN50082-2
	For additional compliance information, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.

1.   MTBF = Mean time between failures.

Connecting Trunk Card Cables

The CT3 trunk card receives and transmits 45-Mbps signals through a 75-ohm cable, using common female BNC coaxial cable connectors. There are two female BNC connectors: one for T3 transmit data and one for T3 receive data. Use a 75-ohm coaxial cable to connect the T3 lines (see Figure 3-5).

To connect the T3 lines, follow these steps:

Step 1   Attach the end of the T3 cable directly to the BNC receptacle on the trunk card (see Figure 3-6).

Figure 3-6   CT3 Trunk Card BNC Cable Connections
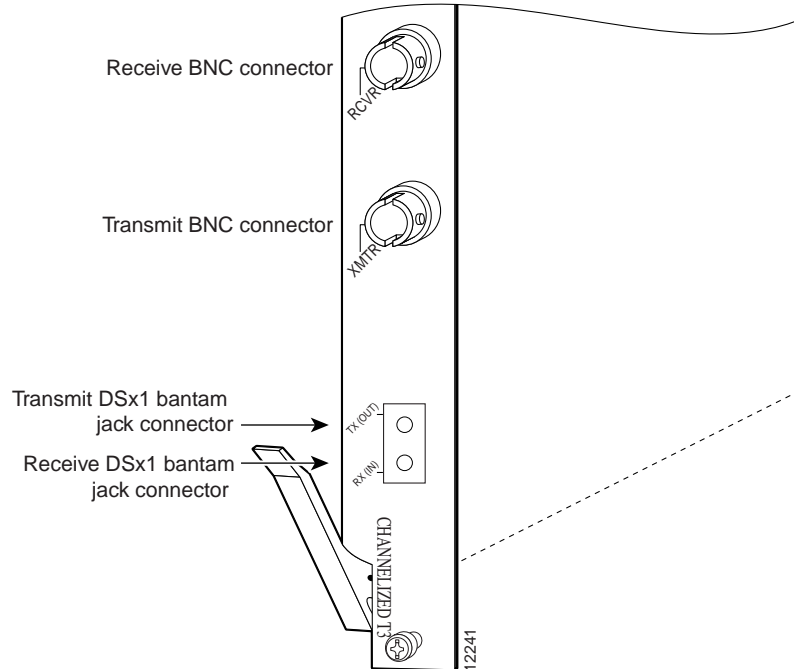
Step 2   Attach the network end of your CT3 cable to your external network.

Configuring Cable Length

When you configure your CT3 trunk cards, you must include the length of the cable connected to the card. To specify this length, use the **cablelength** command and designate the length of the DS3 cable, as shown in Table 3-3. Cable length is a number of feet from 0 to 450.

When you configure your system for CT3 lines, you must also include additional commands to define framing, line code, clock source, signaling, and so forth. For additional software information, refer to the *Cisco AS5800 Universal Access Server Operation, Administration, Maintenance, and Provisioning Guide* that shipped with your system.

This completes the trunk card installation procedure. To verify the installation, proceed to the following section "Verifying and Troubleshooting the Installation."

Verifying and Troubleshooting the Installation

When you first power ON your Cisco AS5800, all LEDs light while the system runs a series of diagnostics. After the system passes initial diagnostics, all LEDs shut off. The LEDs then light again as described in Table 3-1.

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To complete the hardware installation, verify that the trunk card LEDs operate properly by observing the following LED states:

- The power LED is ON.

  If the power LED remains OFF, verify that the card is seated properly.

  If the power LED lights on other trunk cards in the dial shelf, try inserting the trunk card in a different slot. If none of the power LEDs lights, check your dial shelf power connections, power entry modules, and AC-input power supplies (if present).

- The HCPU LED is ON.

  If the HCPU LED is OFF but the power LED is ON, the software image might have failed to load onto the card. The dial shelf controller attempts to reload the software automatically. After a programmed number of attempts to reload the software image fails, the dial shelf controller powers OFF the trunk card and all LEDs are shut off.

  If this happens, assume that the failure is due to defective hardware. Return the card to the factory for replacement. For information on how to contact Cisco, see the "Obtaining Documentation" section on page xiv.

- The FCPU LED is ON.

  If the FCPU LED is OFF while the HCPU LED is ON, either the hardware is defective or the framer processor software has crashed. To determine if the failure is software related, wait while the auto-reload feature on the dial shelf controller card attempts to reload the software image. If the software fails to reload after the programmed number of times, assume that the failure is due to defective hardware. Return the card to the factory for replacement.

Tips For further installation troubleshooting information, refer to the *Cisco AS5800 Universal Access Server Hardware Installation Guide*.

Configuring the CT3 Trunk Card

The Cisco 5814 dial shelf recognizes trunk cards only in dial shelf slots 0 to 5. Therefore, install trunk cards only in the first six slots.

If you are replacing a dial shelf card by installing a new dial shelf card of the same type in the same slot, the system software recognizes the new dial shelf card interfaces and brings them up automatically. No additional configuration is needed.

If you are installing a trunk card in a different slot than the trunk card you just removed, additional configuration is needed. Refer to the *Cisco AS5800 Universal Access Server Operation, Administration, Maintenance, and Provisioning Guide* that shipped with your system.

Configuration Commands

Table 3-3 lists commands to help you configure your CT3 card.

Note The / symbol is used in commands to specify a physical location. Thus 1/0/0 on a T3 port tells you where you can plug something in to the dial shelf. The : symbol is used in commands to specify a TDM channel within a physical port.

Table 3-3   T3 Configuration Commands

	Command	Description
Step 1	`AS5800> `**`enable`** `Password: `*`password`* `AS5800#`	Enter the **enable** command. Enter your password. You are in privileged EXEC mode when the prompt changes to `AS5800#`.

Step 2	`AS5800# `**`configure terminal`**
	`Enter configuration commands, one per`
	`line. End with CNTL/Z.`
	`AS5800(config)#`
		Enter global configuration mode by entering the **configure terminal** command. The example uses the terminal configuration option.
		You are in global configuration mode when the prompt changes to `AS5800(config)#`.

Step 3	`AS5800(config)# `**`interface loopback 0`**
	`%LINEPROTO-5-UPDOWN: Line protocol on`
	`Interface Loopback0, changed state to`
	`up`
		Enter **interface loopback 0** to create interface loopback 0, which is the logical IP subnet containing all dial-in user addresses.
		You are in interface mode when the prompt changes to `AS5800(config-if)#`.

Step 4	`AS5800(config-if)# `**`loopback`** *`local`*	Set the normal data path back to its source (either *local* or *network*).
Step 5	`AS5800(config-if)# `**`no shutdown`**	Enable the interface using the **no shutdown** command.[1]
Step 6	`AS5800(config)# `**`controller t3`** *`shelf/slot`*`/0`	Enter controller configuration mode to configure your T3 controller port. The only legal port value is 0.
Step 7	`AS5800(config-controller)# `**`t3`** **`description`** *`ascii-string`*	Enter an optional text description for the T3 controller.
Step 8	`AS5800(config-controller)# `**`cablelength`** *`200`*	Enter the controller **cablelength** value, from **0** to **450** (feet).
Step 9	`AS5800(config-controller)# `**`framing`** *`c-bit`*	Enter the type of T3 framing used. *C-bit* specifies C-bit parity framing. *M23* (default) specifies M23 multiplexer framing.
Step 10	`AS5800(config-controller)# `**`t1`** *`ds1`* **`controller`**	Create a logical T1 controller from each of the specified T3 line time slots. The entry *ds1* is a time slot within the T3 line with a value from **1** to **28**.
Step 11	`AS5800(config)# `**`controller t1`** *`shelf/slot/port:t1-num`*	Enter controller configuration mode to configure your T3 controller port. *T1-num* is a T1 timeslot within the T3 line with a value from **1** to **28**.
Step 12	`AS5800(config-controller)# `**`clock source`** *`line`*	Configure the clock source as an internal clock (*internal*) or a recovered clock (*line*).

Table 3-3   T3 Configuration Commands (continued)

	Command	Description
Step 13	AS5800(config)# **dial-tdm-clock priority** *{1-50}* *{external | trunk-slot}* *{0-5}* **ds3-port 0 port** *{1-28}*	Configure clock priority, which is a value from **1** to **50**. Select a clocking source by selecting an *external* reference clock or a *trunk card*. If you are using an external reference clock, no other CLI is needed. If you are using a trunk card, select a dial shelf slot from **0** to **5**. Select the T3 port number, which has a value of **0**.
Step 14	AS5800# **copy running-config startup-config**	Save your changes when ready.

1. To deactivate a command functionality, type **no** before the command.

To verify your software configuration, you can enter **show** commands to display clock (`show dial-shelf clock`) and controller (`show controller t3`) settings. To enter **show** commands, you must be in privileged EXEC mode. Some examples:

```
AS5800# show dial-shelf clock
Primary Clock:
--------------
Slot 12:
System primary is 1/1/0:2 of priority 213
TDM Bus Master Clock Generator State = NORMAL

Backup clocks:
Source  Slot  Port  DS3-Port  Priority     Status      State
------------------------------------------------------------
Trunk   0     1     0         206          Bad         Default
Trunk   0     2     0         212          Bad         Default
Trunk   1     4     0         225          Good        Default

Status of trunk clocks:
----------------------

      Ds3           2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1
Slot  Port  Type    8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1
0     0     T3      G G G G G G G G G G G G G G G G G G G G G G G G G G G G
1     0     T3      B B B B B B B B B B B B B B B B B B B G G G G G G G G G
```

```
AS5800# show controller t3
T3 1/0/0 is up.
  Applique type is Channelized T3
  No alarms detected.
  FEAC code received: No code is being received
  Framing is M23, Line Code is B3ZS, Clock Source is Line.
  Data in current interval (751 seconds elapsed):
      0 Line Code Violations, 0 P-bit Coding Violation
      0 C-bit Coding Violation, 0 P-bit Err Secs
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
      0 Unavailable Secs, 0 Line Errored Secs
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  Total Data (last 16 15 minute intervals):
      34989 Line Code Violations, 16414 P-bit Coding Violation,
      49331 C-bit Coding Violation, 0 P-bit Err Secs,
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
      12 Unavailable Secs, 0 Line Errored Secs,
      10 C-bit Errored Secs, 10 C-bit Severely Errored Secs

T3 1/1/0 is up.
  Applique type is Channelized T3
  No alarms detected.
  FEAC code received: No code is being received
  Framing is M23, Line Code is B3ZS, Clock Source is Line.
  Data in current interval (751 seconds elapsed):
      0 Line Code Violations, 0 P-bit Coding Violation
      0 C-bit Coding Violation, 0 P-bit Err Secs
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs
      0 Unavailable Secs, 0 Line Errored Secs
      0 C-bit Errored Secs, 0 C-bit Severely Errored Secs
  Total Data (last 16 15 minute intervals):
      42579 Line Code Violations, 16421 P-bit Coding Violation,
      49208 C-bit Coding Violation, 0 P-bit Err Secs,
      0 P-bit Severely Err Secs, 0 Severely Err Framing Secs,
      2 Unavailable Secs, 0 Line Errored Secs,
      10 C-bit Errored Secs, 10 C-bit Severely Errored Secs
```

A typical T3 controller configuration in a running-configuration file appears as follows:

```
T3 controller configuration:
----------------------------
controller T3 1/0/0
 framing m23
 clock source line
 cablelength 224
 t1 1 controller
 t1 2 controller
 t1 3 controller
 t1 4 controller
 t1 5 controller
 t1 6 controller
 t1 7 controller
 t1 8 controller
 t1 9 controller
 t1 10 controller
 t1 11 controller
 t1 12 controller
 t1 13 controller
 t1 14 controller
 t1 15 controller
 t1 16 controller
 t1 17 controller
 t1 18 controller
 t1 19 controller
 t1 20 controller
 t1 21 controller
 t1 22 controller
 t1 23 controller
 t1 24 controller
 t1 25 controller
 t1 26 controller
 t1 27 controller
 t1 28 controller
```

A typical T1 controller configuration appears as follows:

```
T1 controller configuration:
----------------------------
controller T1 1/0/0:1
framing esf
pri-group timeslots 1-24
controller T1 1/0/0:2
channel-group 0 timeslots 1-24
          .
          .
          .
controller T1 1/1/0:28
cas-group 0 timeslots 1-24
```

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