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DMS-10 Family

600-Series Generics

General Maintenance Information

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Contents

Section 1: Introduction

Scope and purpose of this publication

This Nortel technical publication (NTP) is an introduction to the maintenance activities DMS-10 switch. It provides general information on maintenance precautions, maintenance interfaces, diagnostic programs, line- and trunk-test features, the alarm system, and maintenance-related controls and indicators.

Organization

The NTP comprises the following sections:

- Section 1 Introduction
- Section 2 Maintenance tools and precautions
- Section 3 Alarms
- Section 4 Maintenance controls and visual indicators
- Section 5 Maintenance interfaces
- Section 6 Integrated line and trunk test features
- Section 7 Line and trunk test equipment interfaces
- Section 8 Outside Plant Module and Outside Plant Access Cabinet Battery Operations
- Section 9 Bit Error Rate Testing
- Section 10 Advanced Intelligent Network maintenance
- Section 11 Preventive Maintenance and System Surveillance
- Section 12 Index

References

The NTPs and other associated documents listed below contain more detailed maintenance-related information and, when necessary, are cited in this NTP.

- The NTP entitled *Input/Output System* (297-3501-300) contains a general description of the input/output equipment associated with DMS-10 switch operation, as well as basic instructions on the use of data terminals, terminal classifications and passwords, log-in/log-out procedures, and manipulation of overlay programs.
- The NTP entitled *DIP Switch Setting*s *for Printed Circuit Packs* (297-3501-316) provides the detailed information necessary for correctly setting the dual-inline package (DIP) switches on printed circuit packs. The switch setting specifications for each pack include a drawing that identifies each DIP switch and its approximate location on the pack. Also included are one or more tables indicating the switch-selectable options and the necessary settings for the selection of each option.
- The NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506) is the reference manual for both free-running and interactive maintenance diagnostic programs. These programs include resident commands as well as overlay programs. The NTP briefly describes each overlay program and lists the format for input commands and system responses. Resident commands are listed, and the function of each command is described.
- The NTP entitled *Maintenance and Test Manual* (297-3501-511) contains procedures used to locate and repair system faults. This NTP contains trouble-clearing procedures (TPs) that provide a response to trouble messages indicated on the maintenance terminal. This NTP also contains emergency trouble clearing procedures (EPs), general procedures (GPs) for frequently performed tasks, routine procedures (RPs) for periodic activities such as cleaning the fan filters, and maintenance procedures (MPs) for software and hardware maintenance and for test procedures.

  A fault in one piece of equipment may affect associated equipment, resulting in multiple trouble messages. When more than one trouble message is printed at approximately the same time, the most significant message should be analyzed first. If the first TP does not clear the fault, the user should follow the TP for the next most significant trouble message.

- *Output Message Manual.* This document, which is supplied with, and keyed to, a specific software-generic issue, lists all messages output by the system to inform or alert operating-company personnel about the operational status of the switch. Each message is identified by a six- or seven-character alphanumeric identifier and is accompanied by a brief explanation of its meaning and the location (within the program listing) of the line of code that generated the message. Messages requiring a procedure to clear an indicated fault reference the procedure, which is found in the NTP entitled *Maintenance and Test Manual* (297-3501-511).

System reliability

Because the DMS-10 switch is intended for use in an unattended office, it is designed for high reliability. For detailed information on system redundancy and system reliability, see the NTPs entitled *General Description* (297-3501-100) and *System Performance Specifications* (297-3501-180).

In addition, the system has automatic fault-detection and isolation capabilities. Automatic self-diagnostic programs decide how best to recover from a fault, and the system reports the results of the fault analysis to an attended location in order to alert maintenance personnel to any condition requiring manual intervention.

Automatic fault detection

The high reliability of the DMS-10 switch is achieved through equipment redundancy, multiple signal-routing arrangements, and automatic fault detection and isolation. The reliability provided by this architecture is enhanced by the use of diagnostic overlay programs for early fault detection. These overlay programs test the control and network equipment continuously and the line and trunk equipment on a scheduled basis, usually once per day. The programs automatically test most system functions, determine whether or not the system is operating correctly, and switch in redundant components when a fault is detected. The cause of any detected fault is reported on-site and, if desired, to a remote location.

Manual and preventive maintenance

Manual maintenance of the DMS-10 switching system consists almost entirely of corrective intervention. Preventive maintenance is limited to the maintenance terminals, environmental-control equipment, and tape drives. Maintenance of this equipment can be performed when operating-company personnel are visiting the office.

Standby subscriber line circuits

Standby subscriber line circuits are distributed through the peripheral equipment (PE). If a fault is detected in a line circuit by the Digital Equipment Diagnostic (DED) or Peripheral Equipment Diagnostic (PED), alarms are generated. A standby circuit may be switched in by using the maintenance (metallic) access bus and appropriate terminal commands. A faulty line circuit in one PE shelf can only be replaced by a line circuit in a different PE shelf. When a standby line circuit is switched in, some restrictions occur on test facilities that use the maintenance access bus.

Note: *Standby lines are not available with Line Concentrating Equipment (LCE) or with Subscriber Carrier Equipment (SCE).*

Section 2: Maintenance tools and precautions

Introduction

This section begins with a list of the tools required for maintenance of the DMS-10 switch. The rest of the section discusses the general precautions that must be taken during any maintenance-related activity in order to avoid causing service degradation and/or damage to the equipment.

Maintenance tools

Because the DMS-10 switch is composed primarily of fully connectorized modules and cables, only a few nonspecialized tools are required for testing and apparatus replacement. These tools are described in Table 2-A.

Table 2-A:
Maintenance tools

Tool	Use
Handset (QSE-4, NT-1011Q1, or equivalent)	Making test calls
Digital voltmeter (Fluke Model 8300 or equivalent)	General checking for presence of power
Extra-long nut driver (Excelite 3B205 or equivalent): length is 6 in (15.2 cm); socket width is 5/16 in (0.79 cm)	Removing and replacing apparatus and shelves
Blade screwdriver (Vaco 73166 or equivalent): working length is 6.5 in (16.5 cm); overall length is 9.5 in (24.1 cm); blade width is 3/16 in (0.48 cm)	Removing and replacing apparatus and shelves
Jeweler's screwdriver	Adjusting potentiometers on system-level reference-trunk pack (NT2T20BB)

Electrostatic discharge precautions

Maintenance personnel and tools must be grounded before making contact with any electronic components or equipment (including circuit pack faceplates) in the DMS-10 switch. Failure to observe this precaution may result in equipment damage or temporary service degradation caused by electrostatic discharge (ESD). Tools or personnel may be grounded simply by making contact with the equipment framework of the DMS-10 switch, which must already be grounded to the Entrance Ground Bar by way of the ac Distribution Panel.

Work environment

Every effort should be made to ensure that the work environment is as static free as possible. All conductive materials in the work area must be grounded, and the area must be kept free of nonconductive materials, including:

- nonconductive plastics, such as tool handles, food wrappers, bubble wrap, and shrink wrap
- foam plastics, including drinking cups and foam-lined cardboard
- wood
- paper, except the documentation required for the job

So that personnel will be grounded when they enter the work area, NTI recommends the use of metal entrance doors with ground jumpers that cross the door hinges and are connected to the Entrance Ground Bar. A metal door handle that is attached directly to the door with no insulating material or paint between the handle and the door should be used. Alternatively, a wooden door may be used if it is equipped with a metal plate that is at least 17.7 in. (45 cm) wide and spans the width of the door, with its center approximately 46.3 in. (117.5 cm) from the floor. The metal plate must be jumpered across the hinges and connected to the Entrance Ground Bar.

Warning signs that indicate ESD hazards should be posted on the entrance door and near the DMS-10 switch and work benches. If an extreme ESD hazard exists, NTI recommends the use of an ionized air precipitator and conductive floor tile.

Normal operating humidity requirements are 20% through 55%; however, the minimum humidity should be increased to 35% for increased protection against ESD.

Shoes and clothing

Only leather-soled shoes should be worn in the office. Rubber- or composition-soled shoes will not provide effective grounding on conductive tile or antistatic mats.

Maintenance personnel should avoid wearing clothing made of wool, silk, and/or synthetic fabrics. Coveralls or smocks made of 100% cotton fabric are recommended.

Wrist straps

The most effective protection against ESD is provided by the use of wrist straps (NTI Tool 9908) grounded to the bottom of a PE or ME bay. Wrist straps should be worn while inserting or removing circuit packs or while performing other maintenance tasks without making contact with antistatic floor mats or other grounded surfaces (for example, removing circuit packs while standing on a wooden ladder).

The wrist strap cord has a yellow two conductor "banana plug" terminator at the end opposite the wrist strap. This terminator should be securely plugged into its grounding socket located on the power and cooling module of the Control Equipment bay.

Before using a wrist strap, operating company personnel must use a multimeter to verify that a solid ground exists at the socket, and, after inserting the jack, that a solid ground exists at the end of the cord where the wrist strap is attached. Wrist straps must be equipped with a 1-MΩ resistor. To ensure that the strap does not become a safety hazard, the resistance must be checked monthly. Procedure RP 0541 in NTP 297-3501-511, *Maintenance and Test Manual* contains instructions for inspecting and testing wrist strap grounding cords.

Antistatic mats and conductive tile

Antistatic mats or conductive tile grounded to earth potential through the system ground should be used on the floor in front of the switch. Similarly grounded antistatic mats should be used on work benches used for adjusting switches in printed circuit packs.

The effectiveness of antistatic floor mats or conductive tile is severely limited if the user wears rubber- or composition-soled shoes. These types of shoe sole inhibit the discharge of electrostatic potential to the mats or tile.

Electrical outlets and switches

All ac outlets and switches must be equipped with metal faceplates to provide additional locations for discharging static electricity.

Test equipment requiring ac power that is used in conjunction with the switching system must be powered from the ac outlets provided on the system framework.

Any electrical tools and custodial equipment must use the wall-mounted electrical outlets in the exchange. Such outlets must be properly grounded with a "green-wire" ground.

Circuit pack precautions

The paragraphs that follow describe the precautions that must be taken when handling, installing, removing, and storing printed circuit packs.

Circuit pack handling

Circuit packs must be handled by their faceplates and edges only. Circuit packs must not be handled by the contacts or components.

Circuit packs contain components that are sensitive to ESD. They require the following handling precautions:

- Packs must be transported in a conductive bag or box.
- Packs must not come into contact with clothing.
- Packs must not be placed on any surface other than the protective antistatic bag supplied in the shipping carton.
- Packs must not be unpacked or handled near electrical apparatus such as motors or transformers.

Circuit pack installation and removal

Circuit packs must be inserted only into their proper locations. For information on the installed locations of circuit packs, see the NTP entitled *Equipment Identification* (297-3501-150). For specific instructions on the correct insertion and removal procedures for circuit packs, refer to procedure MP 1250 in the NTP entitled *Maintenance and Test Manual* (297-3501-511).

All circuit packs (except 5/12 V Power Converter packs) can be installed and removed while the system is powered up. The -48 V dc input to Power Converter packs must be switched off (by operating the appropriate circuit breaker).

Line and trunk circuit packs must be man-made-busy through the maintenance terminal before removal. Similarly, they must be returned to service through the maintenance terminal after insertion.

Circuit packs should not be removed or inserted unnecessarily. The contacts deteriorate from excessive wear. Any dust or dirt on circuit pack or shelf connectors may cause new faults due to poor connections after a pack has been inserted.

If a circuit pack is found with the LED on, no maintenance terminal printout or trouble report exists, and the Enable switch (if equipped) is in the upper position, use the appropriate diagnostic overlay program to test the pack. If no fault is indicated, enable the pack through the maintenance terminal to extinguish the LED. If a fault is found, refer to the *Output Message Manual* for an explanation of the fault and to the trouble-clearing procedure (TP) in the NTP entitled *Maintenance and Test Manual* (297-3501-511).

Circuit pack storage

Circuit packs should be kept in a dust-free area. Unused circuit packs must be stored in a bay storage shelf that is properly grounded or in their antistatic protective packing. The packing materials in which the circuit pack was received should also be stored for use in returning defective circuit packs to a Nortel repair center.

Circuit packs must not be stored in an area of high humidity because high humidity may warp the printed circuit boards. See “Work environment” in this section.

Circuit pack repair

Before touching a circuit pack or backplane with any type of test equipment or probe, the equipment must be grounded. Repair of circuit packs must not be attempted in the field. A defective pack should be replaced with a pack that is known to be good. The defective pack should be returned, in its original packing materials, to a Nortel repair center.

Magnetic tape precautions

The paragraphs that follow describe the precautions that should be taken when using, handling, storing, or shipping the magnetic tape reels used for the storage of Automatic Message Accounting (AMA) billing data.

Magnetic tape environment

The normal operating environment of the magnetic tape should be within the following ranges:

- temperature: 0° C through 40° C
- humidity: 20% through 55% (noncondensing)

Under these conditions, the operating life of the tape can exceed 3,000 passes.

Short-term violations of the environmental requirements (72 hours per occurrence, maximum of 15 days per year) are permitted up to the following limits:

- temperature: 0° C through +50° C
- humidity: 20% through 80% (noncondensing)

Operation of the magnetic tape outside its normal environment causes greatly increased tape wear and may considerably reduce the tape's operating life.

Tape storage

Tapes should be stored:

- in upright position
- in the same environment in which they are to be used
- in an enclosure such as a plastic bag or box for protection from dust

- no nearer than 3.9 in. (10 cm) from sources of magnetic fields (for example, transformers, power supplies, fan inverters, electric typewriters, printers, loudspeakers, and cooling units)

Tape shipping

Tapes should be shipped in a sturdy package (cardboard is sufficient) with a minimum of 10 cm of packing material on each side. The tape reel should be enclosed in a plastic bag during the shipping for protection from dust.

When possible, tapes should be permitted to stabilize for one day in their operating environment before they are used. This is particularly true for those that have been subjected to temperature extremes during shipping. During shipping, temperatures may range between -30° C and +60° C. When these temperature extremes are experienced during shipping, the temperature of the shipping parcel should be permitted to stabilize at the ambient operating temperature before it is opened. This will prevent the accumulation of frost or dew on the tape.

Tape handling

The tape reel:

- should not be dropped
- should not be placed within 3.9 in. (10 cm) of a source of a magnetic field

In addition, the magnetic tape surface must not be touched.

Tape maintenance

The tape read and write head and rubber drive puck must not be touched with the fingers and must be cleaned regularly. For the cleaning procedure, refer to the NTP entitled *Maintenance and Test Manual* (297-3501-511).

Magneto-optical mini-disk unit precautions

Mini-disk unit environment

The ambient operating environment for the Magneto-Optical Mini-Disk Unit (NT4T32BA) should be within the following ranges:

- temperature:
  - operating temperature: 5° C through 40° C
  - short-term temperature: -5° C to 50° C
  - maximum rate of temperature change: 30° C per hour
- humidity:
  - operating humidity: 5% to 85%
  - short-term humidity: 5% to 90% but not to exceed 0.024 pounds of water per pound of dry air

Note 1: Ambient refers to conditions 1.5 m above the floor at a location 40 cm in front of the equipment.

Note 2: Short-term is defined as not more than 96 consecutive hours or 15 days in 1 yr, or a total of 300 hr in a given year but no more than 15 occurrences during a 1-year period.

Under these conditions, the mean time between failures can reach 120,000 hours.

The following environmental criteria apply to the shipping and storage of the magneto-optical mini-disk unit:

- temperature:
  - -40° C through 60° C
  - maximum rate of temperature change: 30° C per hour
- humidity:
  - 5% to 95% but not to exceed 0.024 pounds of water per pound of dry air

Mini-disk unit maintenance

The head on the magneto-optical mini-disk unit, as well as the media cartridge (optical disk) itself, should be cleaned routinely using a media head cleaning kit and a media cartridge cleaning kit. Refer to the routine procedures (RPs) in the *Maintenance and Test Manual*, NTP 297-3461-511, for instructions on performing these maintenance tasks.

It is recommended that each office keep at least one media head cleaning kit and one media cartridge cleaning kit in supply, and Nortel's head cleaning kit (CPC A0734395) and disk cleaning kit (CPC A0734396) can be used. Kits can be ordered from Nortel as needed.

Section 3: Alarms

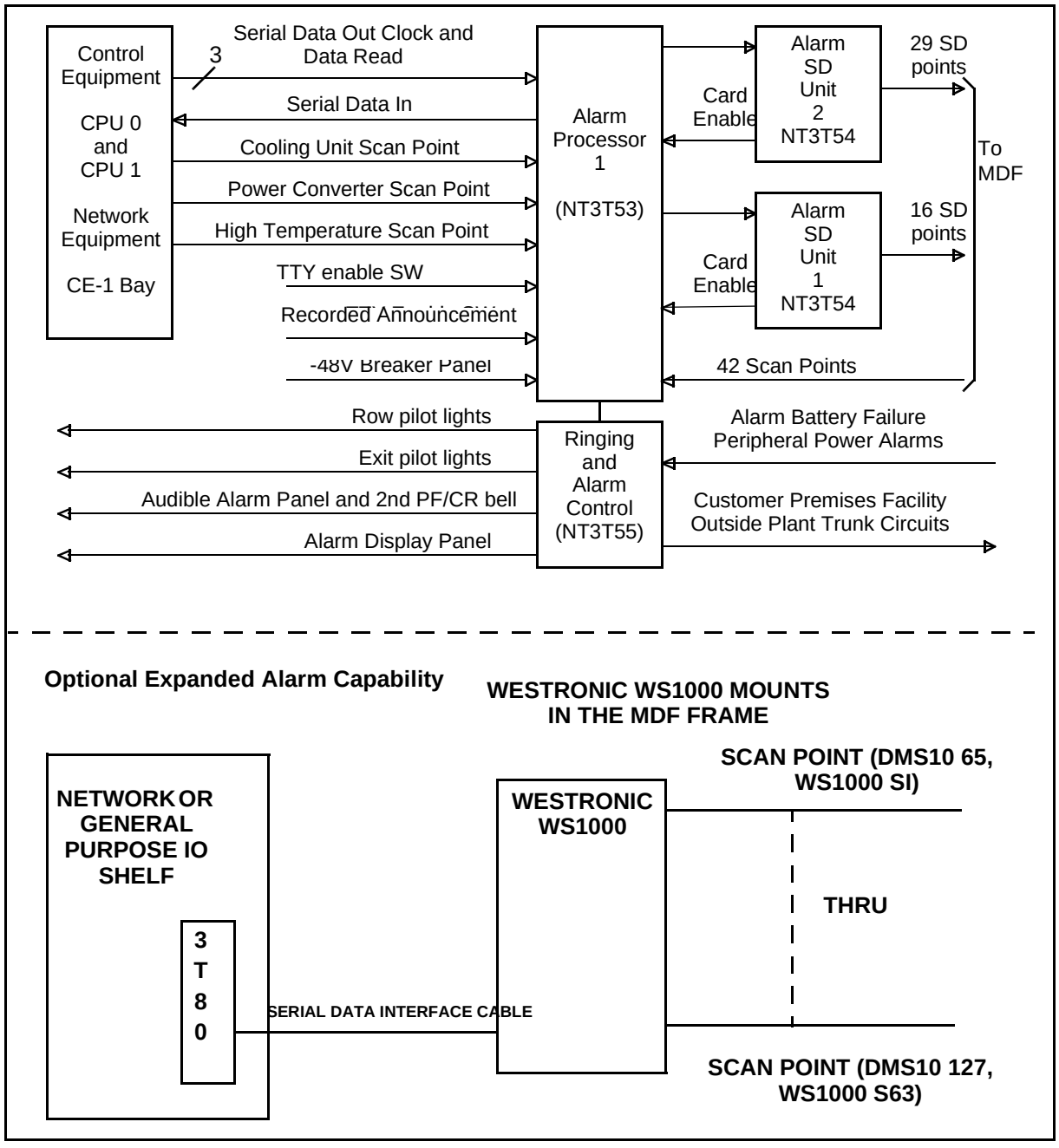
Introduction

This section describes the basic alarm system that alerts maintenance personnel to troubles in the central office. In most cases, the alarm indications allow personnel to perform a preliminary fault diagnosis and begin corrective intervention. Many of the alarm indications in the DMS-10 switch are indicated on the Alarm Display Panel of the Alarm and Ringing Module. For an explanation of the Alarm Display Panel, refer to the “Maintenance controls and visual indicators” section in this NTP.

Alarm detection

Alarm conditions are detected either by diagnostic overlay programs in the system software or, as illustrated in Figure 3-1, by hardware-monitoring circuits.

Figure 3-1: Alarm system with DMS-10 expanded alarm points block diagram



Software-detected alarms

Software-detected alarms are generated by resident programs or diagnostic overlay programs. Resident programs, which are present in system memory at all times, continuously monitor system performance. Diagnostic overlays can run manually or can be scheduled to run automatically.

Reports of software-detected alarms are printed locally on a maintenance terminal. Software-detected alarms also cause an LED indication on the Alarm and Ringing Module through a serial data link between that shelf and the CPU. In addition, an audible alarm indication may be generated. These maintenance terminal, visual (LED), and audible alarm indications may also be provided at remote locations.

Hardware-detected alarms

Hardware-detected alarms are raised by the Alarm Processor pack (NT3T53) and the Ringing and Alarm Control pack (NT3T55) in the Alarm and Ringing Module. Hardware-detected alarms are reported to the CPU by way of the Alarm Processor pack. The CPU then processes them in a manner similar to that for processing software-detected alarms.

The Alarm Processor pack and the Ringing and Alarm Control pack monitor the status of the following equipment:

- power plant
- power distribution
- recorded announcement equipment
- Power and Cooling Module, control equipment
- Alarm Battery Supply
- tape-unit fusing
- ringing distribution
- Peripheral Equipment (PE), Line Concentrating Equipment (LCE), and Subscriber Carrier Equipment (SCE) rows

Alarm classification

Each possible alarm condition in the system is assigned to one of the three following alarm classifications (listed in decreasing order of severity):

- *catastrophic*, which indicates complete loss of service in some critical part of the system. For example, failure of both of the billing systems' magnetic tape units or memory faults in both memory systems.
- *major*, which indicates failure of one member of a redundant hardware pair. For example, one CPU fails, a memory page is spared, or a Network shelf fails.

- *minor*, which indicates a condition that requires attention but that is not system affecting. For example, a line circuit card fails, an MLI or DS-30A multiplex loop fails, or a Network clock fails.

Dead System Alarm

A special alarm, called the Dead System Alarm, is activated when a fault condition occurs that severely impacts call processing. This alarm is generated in any of the following conditions:

- both CPUs fail (detected when the Ringing and Alarm Control pack fails to receive a timer-reset signal for a switch-selectable period of either 2 or 4 min)
- repetitive Initializations occur
- repetitive System Software Reloads (SYSLOADs) occur

When generated, the Dead System Alarm:

- activates the catastrophic audible and visual alarm indicators
- seizes one of two permanently wired operator trunks and applies a tone (no digits are outpulsed)

All of these functions are controlled by hard-wired logic. The trunks must be E&M circuits, since no outpulsing is possible when both processors are down.

The Dead System Alarm is disabled during a SYSLOAD for a period of 8 min, or until Initialization occurs. This time limit may be extended to 12 min by setting a DIP switch on the Ringing and Alarm Control pack.

Alarm reporting

Alarm conditions are reported to maintenance personnel by audible indicators, visual indicators, and messages displayed on a maintenance terminal or on the hexadecimal display on the CPU. Alarms are activated on-site and may be reported to a remote location through an alarm-sending unit and/or maintenance terminal.

Audible indicators

The standard audible alarm indicator is an electronic alerting device located on the Ringing and Alarm Control pack (NT3T55). An optional Audible Alarm Panel (ED0T03-11 G6) is available and provides the alarms listed in Table 3-A.

Table 3-A:
Audible alarms

Alarm	Indicator
Catastrophic (Dead System)	Extra loud tone
Major	Loud tone

Table 3-A: **Audible alarms**	
Alarm	Indicator
Minor	Loud ringing subset
Alarm Battery Supply	Loud ringing subset
Power (see **Note**)	Loud bell

Note: *A separate power bell may be installed with or without the Audible Alarm Panel in locations away from the DMS-10 switch.*

Audible alarm indicators may be silenced with the Silence switch (used for audible silence and audible reset) on the Manual Control section of the Alarm Display Panel or by clearing the alarm through a maintenance-terminal command. The audible alarms will not sound if the Disable switch (used to transfer alarms to a remote location) is enabled. Use of the Silence and Disable switches is described in the "Maintenance controls and visual indicators" section of this NTP. Use of the maintenance terminal in responding to alarm indications is described in Overlay ALO in the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506).

Visual indicators

The primary source of visual alarm information is the maintenance terminal (see "Maintenance-terminal messages" in this section). In addition, several lights and LEDs located on the equipment and in the central office provide visual alarm indications. Table 3-B summarizes the visual alarm indicators (excluding those provided through the maintenance terminal).

Maintenance terminal messages

Alarm messages for all alarms detected by diagnostic overlay programs or by call-processing software are printed at the maintenance terminal. The alarms can be printed at any maintenance terminal (on-site or remote) that is connected to the particular switching system. The maintenance-terminal messages generated by locally detected alarms identify the type of equipment failure (for example, no response), whereas those generated by diagnostic overlays normally identify a faulty component and its physical location in the equipment framework.

Table 3-B: **Visual alarm indicators**			
Alarm Class	**LED Color**	**Alarm Location**	**Source**
Catastrophic (Dead System)	Red	Alarm Display Panel	Hardware or software
Major	Amber	Alarm Display Panel	Hardware or software
Minor	Green	Alarm Display Panel	Hardware or software
Alarm Battery Supply	Amber	Alarm Display Panel	Failure of Alarm Battery Supply

Table 3-B: (Continued) Visual alarm indicators			
Alarm Class	**LED Color**	**Alarm Location**	**Source**
Power	Amber	Alarm Display Panel	Power-plant failure
Row Pilot	Red	Ends of each equipment row	Local-power failure
Exit Pilot	Yellow	At each exit from office	Any alarm in office
Fuse	Red	Fuse panels and Power and Cooling Module	Failure of any fuse panel
CE Bay	Red	Power and Cooling Module	Failure of any fuse in fuse panel or in Power and Cooling Module
PE Bay	Red	Top right of each bay	Power, fuse, or fan failure in bay
Ringing Generator	Red	Front panel of each Ringing Generator Pack (NT3T59)	Ringing Generator failure
Power Converter	Red	Front panel of each 5/12 V Power Converter Pack (NT3T19)	Power Converter failure

For PE ringing generation only. Ringing generator alarms for LCE and SCE are indicated only through the frame LED on the affected frame and alarm messages printed at the maintenance terminal.

Each alarm message consists of a three-character alphabetic mnemonic (for example, ALO) that identifies the diagnostic overlay program that detected the alarm, followed by a three- or four-digit number (for example, 112) unique to the alarm condition. For information on specific alarm messages, refer to the *Output Message Manual*, which provides a list of the alarm messages in alphanumeric order, the alarm-class indicator, a brief description of the meaning of the message, and a cross-reference to the trouble-clearing procedures contained in the NTP entitled *Maintenance and Test Manual* (297-3501-511).

In addition to messages triggered by specific faults and other events, the DMS-10 switch also prints trouble-status reports at the maintenance terminal(s) as a reminder of all current troubles in the central office. The reports contain a listing of all common equipment that is faulty or man-made busy. When multiple alarms have been asserted in a subsystem, only the highest class of alarm is reported. The reports print either on the hour or on the quarter hour. The alarm reporting schedule is established in Overlay CNFG (see NTP 297-3501-311, entitled *Data Modification Manual*).

Another source of alarm messages is the PED Alarm Reporting feature. This feature audits lines and PE trunks for system-made-busy (SMB) status and, when a threshold for the maximum number of lines and trunks that may be SMB is either met or exceeded, raises either a minor or major PED alarm. More information about this feature is found in section 6 of NTP 297-3501-105, *Features and Services Description*.

Each maintenance terminal message carries a sequence number to indicate the actual sequence of events pertaining to a fault. The sequence numbers start at 000, progress to 999, and are then reset to 000. When a SYSLOAD or Initialization occurs, this counter is reset to 000.

Alarm sending

The alarm-sending feature of the DMS-10 switch allows personnel at a remote location to be informed that an alarm condition has been detected by the switching system. The alarm-sending facility may be activated or canceled through terminal commands, which are described in Overlay ALO in the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506). If activated, alarm sending is engaged by the following alarm conditions:

- if no alarms exist, any alarm condition
- if an alarm exists, an alarm of higher class or, as configured through Data Modification Orders (DMOs), an alarm of the same or a higher class

When engaged, alarm sending seizes a dedicated alarm-sending trunk or a regular one-way trunk (no digits are outpulsed) and applies an alarm tone to the trunk. One of the following tones, specified using Overlay CNFG (ALRM) in the NTP entitled *Data Modification Manual* (297-3501-311), may be applied:

- BUSY - busy
- COSH - class of service high
- COSL - class of service low
- CRGB - continuous ringback
- HIGH - high
- LOW - low
- OVFL - overflow

The tone continues until the alarm condition clears or, as configured through Overlay CNFG (COTM), until the alarm-checking number is dialed (within a specified time). The following timeouts are provided:

- If the alarm-sending trunk is not answered within a specified time (maximum 155 s), the trunk connection is released and a different trunk is seized.
- If the alarm-checking number is not dialed within a specified time after answering the alarm-sending trunk (maximum 155 s), another alarm-sending trunk is seized.

Alarm Sending enhancement

The Alarm Sending feature has been modified to enable operating company personnel to restrict the types of alarm, minor, major, or catastrophic, that are reported by the Alarm Sending feature and to arrange for a delay of up to 60 minutes before being notified of alarms by the Alarm Sending feature. The enhancement is configured through Overlay CNFG (ALRM). For a procedure to set up the Alarm Sending feature, refer to the Index in the NTP entitled *Data Modification Manual* (297-3501-311).

Alarm Checking

The Alarm Checking feature provides a directory number that, when dialed on an incoming line or trunk, connects the caller to a tone indicating the highest class of alarm presently activated in the system. A different tone can be assigned to each of the following alarm classes through Overlay ROUT (the indicated tones are recommended):

- catastrophic alarm-no tone
- major alarm-busy (60 ipm busy) tone
- minor alarm-RGBK (Code 1 ringback) tone
- no alarm-RBK2 (Code 2 ringback) tone

The tones may be reassigned to any alarm condition. Once the alarm checking number is dialed and a connection is established, alarm sending, if engaged, may be released or, optionally, the alarm condition may have to be cleared before alarm sending is released.

Access to alarm checking is restricted to the operator signaled by alarm sending (see "Alarm sending" in this section), or to lines designated by a special classmark. All other calls to the alarm-checking number are routed to intercept.

Alarm scan points

The DMS-10 switch alarm system is equipped with 64 alarm scan points (ALPT), or alarm source identification points. Some of these alarm points have fixed assignments, while others can be assigned by the operating company. ALPT numbers 1 through 21 and 64 have fixed assignments, as described in Table 3-C; thus, there are 40 customer-assignable alarm scan points, which correspond to ALPT numbers 22 through 63. In offices equipped with telemetry for the Switching Control Center System (SCCS), ALPT numbers 60 through 63 also have fixed assignments; thus, in this configuration, there are only 36 customer-assignable alarm scan points.

Customer-assignable alarm points are assigned using Overlay ALRM in the NTP entitled *Data Modification Manual* (297-3501-311). Complete information about the points that may be assigned, the information required for an assignment, and options that can be applied are described in the Overlay ALRM section.

Table 3-C:
Alarm scan point assignments

ALPT	Assigned Conditions
1	Major Power Plant Alarm
2	Power Distribution Panel Alarm
3	Alarm Transfer Status (for Remoting)
4	Catastrophic Ringing Generator Alarm
5	Alarm Battery Fuse Alarm
6	Local Power Alarm (Fuse Alarm)
7	Ringing and Alarm Control Pack Enable/Disable or Presence Status
8	Ringing Generator On-Line Status
9	Minor Power Plant Alarm
10	Major Ringing Generator Alarm
11	Ringing Supply Fuse Alarm (Input or Output)
12	Tape Unit Fuse Alarm
13	Recorded Announcement Unit Alarm
14	Audible Reset Request
15	Utility Interrupt Request for TTY Enable
16	CE01 Bay Cooling Unit Alarm
17	CE03 Bay Cooling Unit Alarm
18	CE01 Converter Alarm
19	CE03 Converter Alarm
20	CE02 Bay Cooling Unit Alarm
21	CE02 Bay Converter Alarm
22-53	Customer assignable (see Table 3-D).
54	CE04 Bay Cooling Unit Alarm.
55	CE04 Bay Converter Alarm
56-63	Customer Assignable (see Table 3-D)
64	Signal Distribution Message Acknowledge

Table 3-D summarizes the alarm scan point input connections for a DMS-10 switch not equipped for SCCS telemetry. These connections are wired to the MDF during installation. It should be noted that a contact closure across the input connections for a scan point represents an active alarm condition.

Table 3-D:
Customer-assignable alarm inputs

Designation	ALPT	CE-3 Bay Shelf 5		To Horizontal Terminating Block on MDF	
		Connector	Terminal	Row	Pin
IP01	22	A	1	1	1
IPG01		A	2	1	2
IP02	23	A	3	1	3
IPG02		A	4	1	4
IP03	24	A	5	1	5
IPG03		A	6	1	6
IP04	25	A	7	1	7
IPG04		A	8	1	8
IP05	26	A	9	2	1
IPG05		A	10	2	2
IP06	27	A	11	2	3
IPG06		A	12	2	4
IP07	28	A	13	2	5
IPG07		A	14	2	6
IP08	29	A	15	2	7
IPG08		A	16	2	8
IP09	30	A	17	3	1
IPG09		A	18	3	2
IP10	31	A	19	3	3
IPG10		A	20	3	4
IP11	32	A	21	3	5
IPG11		A	22	3	6
IP12	33	A	23	3	7
IPG12		A	24	3	8
IP13	34	A	25	4	1
IPG13		A	26	4	2
IP14	35	A	27	4	3
IPG14		A	28	4	4
IP15	36	A	29	4	5

Table 3-D: (Continued)
Customer-assignable alarm inputs

Designation	ALPT	CE-3 Bay Shelf 5		To Horizontal Terminating Block on MDF	
		Connector	Terminal	Row	Pin
IPG15		A	30	4	6
IP16	37	A	31	4	7
IPG16		A	32	4	8
IP17	38	A	33	5	1
IPG17		A	34	5	2
IP18	39	A	35	5	3
IPG18		A	36	5	4
IP19	40	A	37	5	5
IPG19		A	38	5	6
IP20	41	A	39	5	7
IPG20		A	40	5	8
IP21	42	A	41	6	1
IPG21		A	42	6	2
IP22	43	A	43	6	3
IPG22		A	44	6	4
IP23	44	A	45	6	5
IPG23		A	46	6	6
IP24	45	A	47	6	7
IPG24		A	48	6	8
IP25	46	A	49	7	1
IPG25		A	50	7	2
IP26	47	A	51	7	3
IPG26		A	52	7	4
IP27	48	A	53	7	5
IPG27		A	54	7	6
IP28	49	A	55	7	7
IPG28		A	56	7	8
IP29	50	A	57	8	1
IPG29		A	58	8	2
IP30	51	A	59	8	3
IPG30		A	60	8	4
IP31	52	A	61	8	5
IPG31		A	62	8	6
IP32	53	A	63	8	7

Table 3-D: (Continued) **Customer-assignable alarm inputs**					
Designation	**ALPT**	**CE-3 Bay Shelf 5**		**To Horizontal Terminating Block on MDF**	
		Connector	**Terminal**	**Row**	**Pin**
IPG32		A	64	8	8
IP33	54	A	65	9	1
IPG33		A	66	9	2
IP34	55	A	67	9	3
IPG34		A	68	9	4
IP35	56	A	69	9	5
IPG35		A	70	9	6
IP36	57	A	71	9	7
IPG36		A	72	9	8
IP37	58	C	1	10	1
IPG37		C	2	10	2
IP38	59	C	3	10	3
IPG38		C	4	10	4
IP39	60	C	5	10	5
IPG39		C	6	10	6
IP40	61	C	7	10	7
IPG40		C	8	10	8
IP41	62	C	9	11	1
IPG41		C	10	11	2
IP42	63	C	11	11	3
IPG42		C	12	11	4

Expanded alarm scan points

The introduction of the expanded alarm points increases the DMS-10 base alarm points from 64 to 127. The expansion is accomplished through the use of the Westronic WS1000 TBOS Remote discrete alarm scan product. This product provides an additional 64 alarm scan points for use in the DMS-10 central office. The product will interface to the DMS-10 through an RS232 connection terminating on a 3T80 port. Communication with the WS1000 will use the Telemetry Byte Oriented Serial (TBOS) protocol. The WS1000 alarm scan point 64 will be reserved for testing the interface to the DMS-10. Table 3-E equates the WS1000 alarm scan points to the DMS-10 customer assignable alarm points.

Table 3-E:
Expanded alarm scan points

DMS-10 ALPT	WS1000 Destination	WS1000 Column	WS1000 Row
65	S1	1	A
66	S2	1	B
67	S3	1	C
68	S4	1	D
69	S5	1	E
70	S6	1	F
71	S7	1	G
72	S8	1	H
73	S9	1	J
74	S10	1	K
75	S11	3	A
76	S12	3	B
77	S13	3	C
78	S14	3	D
79	S15	3	E
80	S16	3	F
81	S17	3	G
82	S18	3	H
83	S19	3	J
84	S20	3	K
85	S21	4	A
86	S22	4	B
87	S23	4	C
88	S24	4	D
89	S25	4	E

Table 3-E: (Continued) **Expanded alarm scan points**			
DMS-10 ALPT	**WS1000 Destination**	**WS1000 Column**	**WS1000 Row**
90	S26	4	F
91	S27	4	G
92	S28	4	H
93	S29	4	J
94	S30	4	K
95	S31	6	A
96	S32	6	B
97	S33	6	C
98	S34	6	D
99	S35	6	E
100	S36	6	F
101	S37	6	G
102	S38	6	H
103	S39	6	J
104	S40	6	K
105	S41	7	A
106	S42	7	B
107	S43	7	C
108	S44	7	D
109	S45	7	E
110	S46	7	F
111	S47	7	G
112	S48	7	H
113	S49	7	J
114	S50	7	K
115	S51	9	A
116	S52	9	B
117	S53	9	C
118	S54	9	D
119	S55	9	E
120	S56	9	F
121	S57	9	G
122	S58	9	H
123	S59	9	J
124	S60	9	K

Table 3-E: (Continued) Expanded alarm scan points			
DMS-10 ALPT	**WS1000 Destination**	**WS1000 Column**	**WS1000 Row**
125	S61	10	A
126	S62	10	B
127	S63	10	C

Signal distribution points

The signal distribution point (SDPT) feature provides up to 64 signal distribution points (SDPT) through relay contacts on the Alarm Signal Distribution packs (NT3T54). As is shown in Table 3-F, some of these signal distribution points are fixed, while others may be assigned by the operating company. In a central office equipped with one Alarm Signal Distribution pack, SDPT numbers 9 through 23 have fixed assignments and are activated only by the system; in a central office equipped with two Alarm Signal Distribution packs, SDPT numbers 9 through 23, 32, 33, 41, 53, 54, 55, 59, and 64 have fixed assignments and are also activated only by the system. In offices equipped with telemetry for the Switching Control Center System (SCCS), a CE-02 bay, a CE-04 bay or Ethernet Switches, two Alarm Signal Distribution packs must be used because these configurations utilize signal distribution points on the second pack.

Customer-assignable signal distribution points are assigned using Overlay ALRM in the NTP entitled *Data Modification Manual* (297-3501-311). Complete information about the points that may be assigned, the information required for an assignment, and options that can be applied are described in the Overlay ALRM section.

Table 3-F: Signal distribution point assignment	
SDPT	**Assigned Signal Distribution Point Outputs**
1-8	Customer Assignable (see Table 3-G)
9	Alarm Processor (Transmit) Enable/Disable
10	Alarm Transfer (Remoting) Enable
11	Major Alarm Audible and Visual Indicator Control
12	Minor Alarm Audible and Visual Indicator Control
13	Minor Power Plant Alarm Audible and Visual Indicator Control
14	CE01 Common Equipment Bay LED Alarm Indicator
15	Dead System Timer Reset
16	Major Power Plant Alarm Audible and Visual Indicator Control
17	PE bay Power Distribution Alarm
18	Catastrophic Alarm Audible and Visual Indicator Control

Table 3-F: (Continued) **Signal distribution point assignment**	
SDPT	**Assigned Signal Distribution Point Outputs**
19	Dead System Timer SYSLOAD Timeout Extension Control
20	Ringing Generator Transfer Control
21	Audible Alarm Silence Control
22	Ringing Alarm Reset
23	CE03 Common Equipment Bay LED Alarm Indicator
24-31	Customer Assignable (see Table 3-G) (see Note 3:)
32	Signal Distribution/Scan Loop Test Control for One Alarm Signal Distribution Pack
33	Dead System Timer Reset
34-40	Customer Assignable (see Table 3-G)
41	Alarm Processor (Transmit) Enable/Disable
42-52	Customer Assignable (see Table 3-G) (see Note 3:)
53	CE-4 Common Equipment Bay LED Alarm Indicator.
54	CE-2 Common Equipment Bay LED Alarm Indicator.
55	Major 1600-bpi AMA Alarm
56-58	Customer Assignable (see Table 3-G) (see Note 4:)
59	System-assigned Distribution Point
60-63	Customer Assignable (see Table 3-G) (see Note 4:)
64	Signal Distribution/Scan Loop Test Control for Second Alarm Signal Distribution Pack

Note 3: In offices equipped with Ethernet Switches, SDPT 31 and 52 have fixed assignments.

Note 4: In offices configured with SCCS, SDPT 56 - 58, and 63, have fixed assignments.

Most of the signal distribution points having fixed assignments are used for internal system control and test functions. Five of them are extended to the MDF, by way of the Ringing and Alarm Control pack (NT3T55), for connection to a customer's monitoring or sending facility. The five signal distribution points extended to the MDF are:

- catastrophic alarm active
- major alarm active
- minor alarm active
- alarm battery supply alarm active
- major power alarm active

Signal distribution points can be assigned to any relay-controlled devices. For example, signal distribution points could be assigned to a cooling fan and a customer-supplied audible alarm. These two signal distribution points could be associated with a scan point monitoring overheat conditions. By assigning these signal distribution points, corrective action (turning on the cooling fan in response to an overheat condition) and alerting of maintenance personnel is automated. If the alarm receiving circuitry in the interfacing equipment is located and powered outside of the DMS-10 isolated ground zone, then an isolation relay, provided in the ED0T81-01 Alarm Isolation and Transfer Panel (described in NTP 297-3501-150, *Equipment Identification*), must be used so that the interfacing equipment receives the alarm signal as referenced to its own local ground through the contacts of the isolation relay. Any customer-assignable signal distribution point(s) may be activated by any active alarm scan point through overlay ALRM in the NTP 297-3501-311, *Data Modification Manual*.

Table 3-G summarizes the output connections for signal distribution points. The connections are wired to the MDF during installation. As indicated in the table, all signal distribution points offer a contact closure when activated. In addition, some of the signal distribution points offer the option of a contact opening when activated.

Any customer-assignable signal distribution point may be controlled through maintenance-terminal command using overlays ALO and ALT in the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506). The output relay may be closed, opened, or pulsed from an open state for 250 ms.

Table 3-G:
Customer-assignable alarm outputs

Designation	Normal State		SDPT	CE-3 Bay Shelf 5		To Horizontal Terminating Block on MDF	
	Open	Closed		Connector	Terminal	Row	Pin
OP01M	X		1	E	8	14	1
OP02M	X		2	E	9	14	2
OP03M	X		3	E	10	14	3
OP04M	X		4	E	11	14	4
OP05M	X		5	E	20	14	5
OP06M	X		6	E	21	14	6
OP07M	X		7	E	22	14	7
OP08M	X		8	E	23	14	8
OP09B		X	24	E	32	15	1
OP09M	X		24	E	33	15	2
OP10B		X	25	E	34	15	3
OP10M	X		25	E	35	15	4

Table 3-G: (Continued)
Customer-assignable alarm outputs

Designation	Normal State		SDPT	CE-3 Bay Shelf 5		To Horizontal Terminating Block on MDF	
	Open	Closed		Connector	Terminal	Row	Pin
OP11B		X	26	E	44	15	5
OP11M	X		26	E	45	15	6
OP12B		X	27	E	46	15	7
OP12M	X		27	E	47	15	8
OP13B		X	28	E	56	16	1
OP13M	X		28	E	57	16	2
OP14B		X	29	E	58	16	3
OP14M	X		29	E	59	16	4
OP15B		X	30	E	68	16	5
OP15M	X		30	E	69	16	6
OP16B		X	31	E	70	16	7
OP16M	X		31	E	71	16	8
OP17M	X		34	F	1	17	1
OP18M	X		35	F	2	17	2
OP19M	X		36	F	3	17	3
OP20M	X		37	F	4	17	4
OP21M	X		38	F	5	17	5
OP22M	X		39	F	6	17	6
OP23M	X		40	F	7	17	7
OP24M	X		42	F	8	17	8
OP25M	X		43	F	9	18	1
OP26M	X		44	F	10	18	2
OP27M	X		45	F	11	18	3
OP28M	X		46	F	12	18	4
OP29M	X		47	F	13	18	5
OP30M	X		48	F	14	18	6
OP31M	X		49	F	15	18	7
OP32M	X		50	F	16	18	8
OP33M	X		51	F	17	19	1
OP34B		X	52	F	25	20	1
OP34M	X		52	F	26	20	2
OP35B		X	53	F	27	20	3
OP35M	X		53	F	28	20	4

Table 3-G: (Continued)
Customer-assignable alarm outputs

Designation	Normal State		SDPT	CE-3 Bay Shelf 5		To Horizontal Terminating Block on MDF	
	Open	Closed		Connector	Terminal	Row	Pin
OP36B		X	54	F	29	20	5
OP36M	X		54	F	30	20	6
OP38B		X	56	F	33	21	1
OP38M	X		56	F	34	21	2
OP39B		X	57	F	35	21	3
OP39M	X		57	F	36	21	4
OP40B		X	58	F	37	21	5
OP40M	X		58	F	38	21	6
OP42B		X	60	F	41	22	1
OP42M	X		60	F	42	22	2
OP43B		X	61	F	43	22	3
OP43M	X		61	F	44	22	4
OP44B		X	62	F	45	22	5
OP44M	X		62	F	46	22	6
OP45B		X	63	F	47	22	7
OP45M	X		63	F	48	22	8

Alarm query

All alarm points (fixed and customer-assignable) and all customer-assignable signal distribution points may be queried from a local or remote maintenance terminal. When the alarm points are queried, all active alarms in the central office are listed; the resulting message includes information on the alarm class, source, status, and any associated signal distribution point. When the signal distribution points are queried, all active customer-assignable signal distribution points are listed in an output message that includes the signal distribution point identifier and the associated alarm point.

AMA system alarms

Alarm scan points 56-59 are pre-assigned for monitoring conditions in the 1600-bpi Automatic Message Accounting (AMA) bay and are not available for customer assignment when the 1600-bpi system is configured. The assignments are:

- 59 - fan fuse failure
- 58 - Converter A Power Failure
- 57 - Converter B Power Failure
- 56 - 1600-bpi Tape Drive Inverter Failure

Remote Equipment Module alarms

This section describes the remote equipment alarms, which are part of the Remote Equipment Module (REM) installation. REM alarms are generated by:

- Office Carrier Modules (OCMs) located at the base site
- Remote Carrier Modules (RCMs) located at the remote site
- Peripheral Equipment (PE) located at the remote site

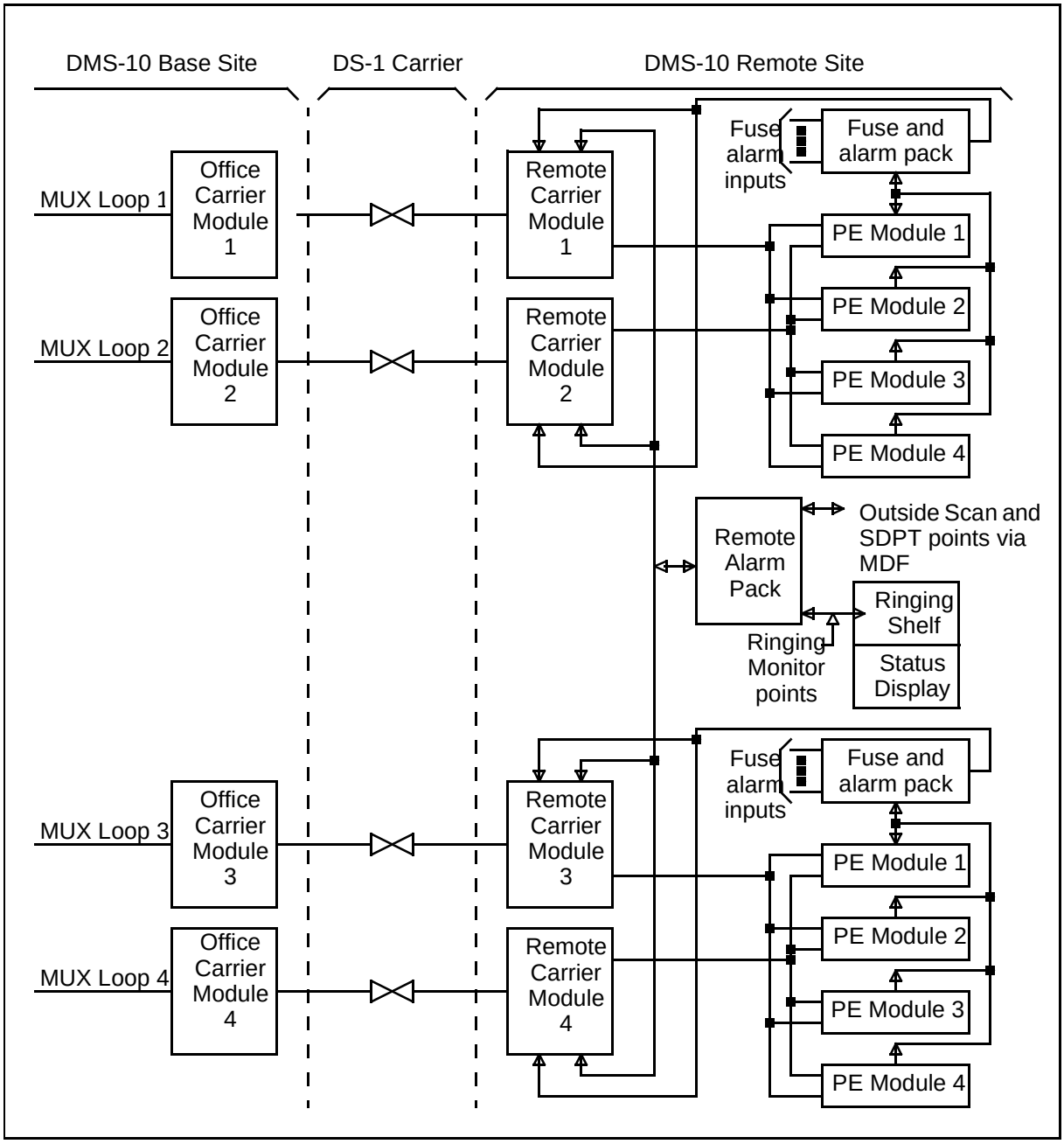
Figure 3-2 illustrates REM alarm distribution. Remote alarms input to the base site are processed by the base-site alarm system, as described below.

Software-detected alarms

The OCM/RCM is monitored for loss of frame synchronization, bipolar violations, and OCM/RCM power failure. The OCM/RCM is removed from service, error messages are printed out, and alarms are raised if a power failure occurs or maintenance thresholds are exceeded.

The only type of RCM alarm that generates individual error messages at the base site is the detection of bipolar violations occurring in each RCM. PE alarms are processed through each multiplex loop as if the remote site were co-located with the base site.

Figure 3-2: REM alarm distribution



Hardware-detected alarms

Hardware-detected alarms are generated by the following equipment:

- ringing-circuit packs
- ringing distribution
- PE bay fuses
- Peripheral Control pack failures
- 5/12 V Converter pack failures

PE fuse alarms, circuit breaker, or peripheral control pack failures are input directly to the base-site alarm system by way of the RCM associated with the failed circuit.

Ringing system failures and fuse alarms are detected by monitoring circuits on the Ringing shelf, which reports the alarm to the remote alarm circuit on the REM shelf. The remote alarm circuit inputs the alarm to the base-site alarm system by way of the associated RCM.

Alarm indicators

When an alarm-generating event occurs, alarms are indicated at the base site and at the remote site. At the base site, appropriate audible and visual signals are enabled; alarm messages are printed out at the maintenance terminal(s); and alarms are classified as catastrophic, major, or minor. At the remote site, appropriate visual indicators (LEDs) are lit, and catastrophic, major, and/or minor LEDs are lit under control of the base site.

The catastrophic alarm LED is also lit by remote-site hardware when all RCMs on a shelf lose power or frame synchronization. Provisioning can also be made to extend catastrophic, major, minor, and customer-assignable alarms to the MDF for connection to the operating company's alarm systems (see the description below under the heading “Extension of Alarms to Operating Company Alarm Systems”).

Visual indicators

Hardware-detected alarms light associated LEDs at the RCM site. LEDs to indicate catastrophic, major, and/or minor alarms are lit by the base-site alarm system.

Visual alarm indicators include:

- three LEDs located on the Alarm Status Display Panel to indicate catastrophic, major, and minor office alarm conditions
- six LEDs located on the Alarm Status Display Panel to indicate ringing generator and ringing distribution faults
- a red LED at the top of each PE bay to indicate a failure within the bay
- a red LED on each fuse panel to indicate blown fuse(s) in the panel

- a red LED on the Peripheral Shelf Converter (NT2T42) faceplate to indicate a power failure
- a red LED on each RCM's Remote Message pack (NT2T38) faceplate to indicate that the RCM system is out-of-service or has lost carrier frame synchronization
- an unlabeled LED on most circuit pack faceplates to indicate that the circuit pack has been disabled by a Control Equipment Diagnostic (CED) command and may be faulty

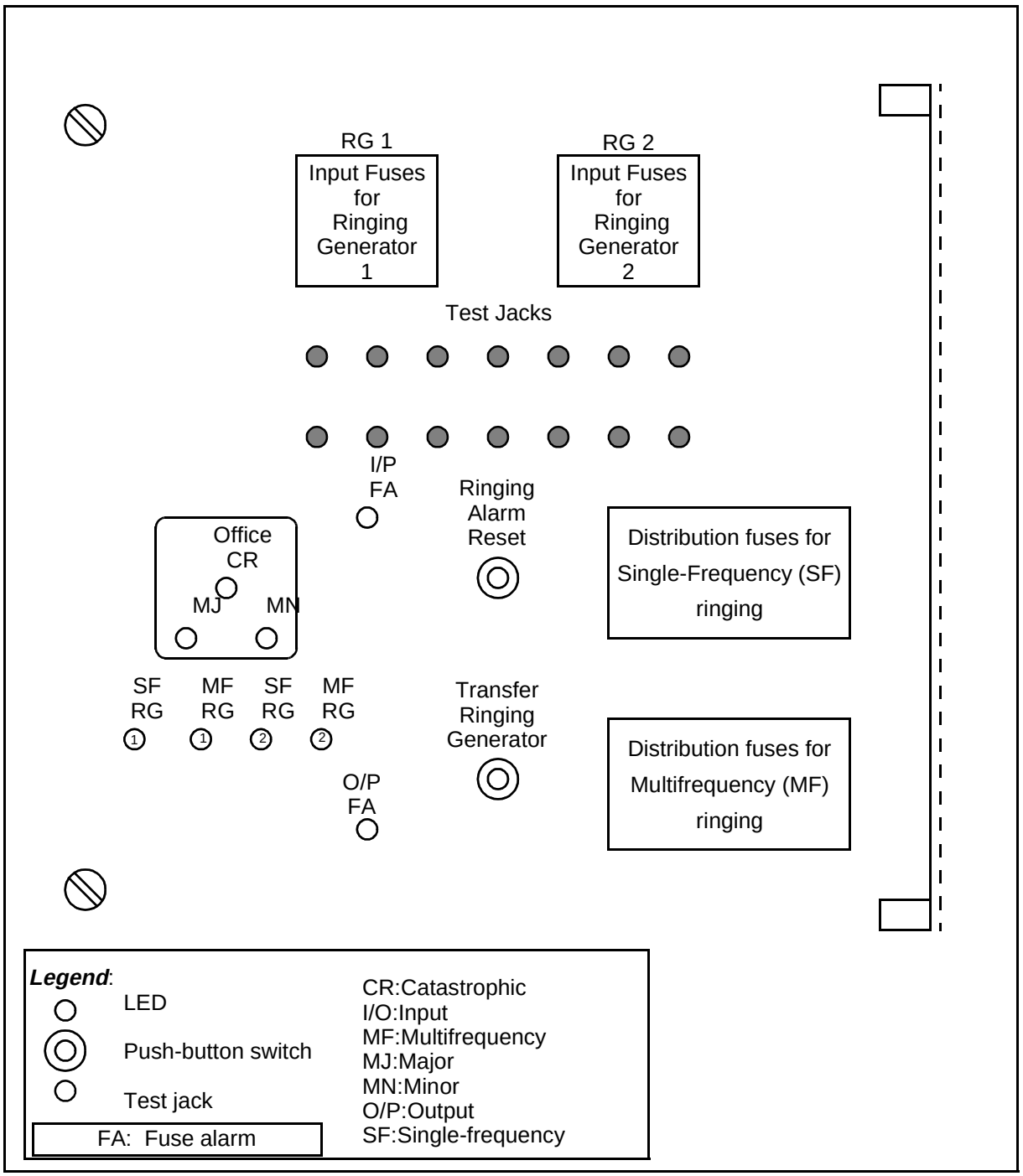
Figure 3-3 depicts the REM Alarm Status Display Panel. The Alarm Status Display Panel indicates catastrophic, major, and minor alarms, input/output fuse failures, and single-frequency and multifrequency ringing supply failures. It also transfers the ringing indicators (via relays) to the active standby ringing system during failures and indicates alarm conditions by the operation of internal relays.

Table 3-H list the LEDs found on the Alarm Status Display Panel and indicates the alarm-reset buttons.

Table 3-H:
Alarm Status Display Panel controls (remote alarm system)

Label	Device	Explanation
CR	LED (Red)	Catastrophic alarm indication.
MJ	LED (Amber)	Major alarm indication.
MN	LED (Green)	Minor alarm indication.
SF RG1	LED (Red)	Single-frequency Ringing Generator 1 failed.
MF RG2	LED (Red)	Multi-frequency Ringing Generator 2 failed.
I/P FA	LED (Red)	Input fuse alarm input fuse(s) for Ringing Generator 1 or Ringing Generator 2 blown.
O/P FA	LED (Red)	One or more ringing distribution fuses blown.
RINGING ALARM RESET	Pushbutton	Clears ringing alarm indications on the Alarm Status Display Panel (if the ringing fault has been corrected).
TRANSFER RING GEN	Pushbutton	Enables a momentary transfer from Ringing Generator 2 to Ringing Generator 1 for test purposes only.

Figure 3-3: REM Alarm Status Display Panel (NT3T42)



Customer-assignable REM alarm points

Customer-assignable alarm points for REM are assigned using overlay ALRM in the NTP entitled *Data Modification Manual* (297-3501-311). Complete information about the points that may be assigned, the information required for an assignment, and options that can be applied are described in the Overlay ALRM section. Customer-assignable alarm points require a loop closure to activate the scanning point and are connected as indicated in Table 3-I.

Table 3-I:
Customer-assignable alarm point connections

Alarm Point Number	REM Remote Shelf, Connector A, Pin Number	MDF Terminal Block	
		Row	Pin
1	49	11	1
	50	11	2
2	61	11	3
	62	11	4

Extension of alarms to operating company alarm systems

Catastrophic, major, and minor alarm indications are extended to the MDF, where they can be connected to an external, operating-company alarm system. Relay contacts in the Remote Alarm pack extend the leads to the MDF and are connected as indicated in Table 3-K.

Table 3-J:
Connections for Remote Alarm pack relay contacts

Lead Designation	REM Shelf Connector A Pin Number	MDF Terminal Block	
		Row	Pin
MCA0	3	11	5
MCA1	4	11	6
MCA1	13	10	3
MMJA0	14	10	4
MMJA0	1	10	1
MMJA0	2	10	2

Subscriber Carrier Module alarms

Alarm conditions arising from the Subscriber Carrier Module (SCM) shelf in the DMS-10 office are processed either by the SCM software maintenance module (for example, transmission line failures) or by the main DMS-10 switch alarm system (for example, power failure). Alarms are indicated by audible office alarms, by messages printed at the maintenance terminal, and/or by indicators on the DMS-10 switch Alarm Display Panel.

During normal operation, the SCM checks itself for such things as data table inconsistencies and buffer overflows. Should any such errors be detected, the SCM initiates fault recovery procedures and informs the DMS-10 switch. The DMS-10 switch checks the response time to commands that require a positive response from the SCM. If the correct response is not forthcoming within a specified time, the DMS-10 switch assumes that the SCM is at fault and initiates recovery procedures, even if the fault is in the multiplex loop or the DMS-10 switch network.

In addition to checks during normal operation, both SCM and DMS-10 switch perform periodic tests for faults, as well as testing the fault detection circuitry. The SCM performs the following types of tests: routine scanning in the active system processor, routine audits in the active system processor, hardware fault detection, and routine tests in the inactive processor set.

Alarm indicators

At the remote site, alarm conditions are indicated by the lighting of one or more of the 18 LEDs on the QPP420A ALM REM circuit pack, as well as by audible alarms, if such audible alarms have been installed by the operating company. Table 3-K lists the alarm points on the Remote Concentrating Terminal (RCT). Of these, the TEMP (14) and DOOR (15) alarm points are integrated into the regular DMS-10 switch TEMP and DOOR alarms. Both TBFA (18) and RFA (19) are indicated at the Remote Concentrator (RCT) by the FUSE LED, but result in separate alarm messages at the DMS-10 switch.

Alarm processing

Each RCT contains 24 alarm points. Nine of these are processed by the SCM maintenance software, the rest by the normal DMS-10 switch alarm system. RCT alarms are controlled by the DMS-10 switch maintenance system in the same way as regular DMS-10 switch alarms.

Table 3-K lists the alarm points for the RCT. Points 0 through 5, 7, 16, and 17 are integrated into the SCM maintenance software. These alarm conditions result in automatic SCM fault-locating routines and/or testing by the SCM diagnostic overlay program. Any faults, including these alarm conditions, are indicated as SCM error messages, along with a minor, major, or catastrophic alarm indication, as appropriate. The remaining alarm points are handled by the normal DMS-10 switch alarm system and result in alarm messages (ALO*nnn*, ALT*nnn*).

Four minor, major, or catastrophic alarms on the RCT can be assigned by the operating company through DMO. For details, see Overlay ALRM in NTP 297-3501-311, *Data Modification Manual*.

Cluster alarms

There are two DMS-10 cluster configurations, the Large Cluster Controller/Satellite Switching Office (LCC/SSO) configuration and the Host Switching Office/Satellite Switching Office (HSO/SSO) configuration. Each of these hosts (LCC and HSO) has central maintenance facilities for monitoring and operating on the SSOs in its configuration.

Alarm conditions for an SSO are detected and processed at the SSO, but are reported at the host on the designated maintenance terminal(s). Alarm processing follows alarm scan point and signal distribution point specifications. Alarm information includes alarm type, alarm classification and location of alarm condition.

Table 3-K:
RCT alarm point assignments

ALPT	Designation	Processed by		Description
		SCM	DMS-10	
0	DGA	X		Digroup A, loss of synchronization
1	DGB	X		Digroup B, loss of synchronization
2	LFA	X		Line A sync loss or bipolar violation
3	LFB	X		Line B sync loss or bipolar violation
4	LFP	X		Protection-line failure
5	BYPASS	X		Bypass function activated
6	unused			
7	LPB	X		Loop-back activated
8	LPF		X	Line-shelf power failure
9	RMJ		X	Double ringing-supply failure
10	RMN		X	Single ringing-supply failure
11	CPF		X	Common Equipment power failure
12	AC		X	ac power failure
13	BAT		X	-48 V power failure
14	TEMP		X	High temperature
15	DOOR		X	Door open
16	PSWA	X		Protection switch A
17	PSWB	X		Protection switch B
18	TBFA		X	Talk-battery fuse failure
19	RFA		X	Ringing-card fuse failure
20	CA1		X	Customer- assignable

Table 3-K: (Continued) **RCT alarm point assignments**				
ALPT	**Designation**	**Processed by**		**Description**
		SCM	**DMS-10**	
21	CA2		X	Customer-assignable
22	CA3		X	Customer-assignable
23	CA4		X	Customer-assignable

Data Link Controller cluster alarms

In addition to the DMS-10 switch alarms detected on an SSO, failures in simplex or duplex data links between an SSO and its host are reported to the host. If duplex data links are employed, a major DLC alarm is raised when one of the data links is system made busy (SMB). A catastrophic DLC alarm is raised when the mate link also becomes SMB or unassigned. If one of the disabled duplex links is returned to service or MMB, the catastrophic DLC alarm is cleared and a major DLC alarm is raised. Once the mate duplex link is also returned to service or MMB, the major DLC alarm is cleared.

In systems using simplex data links, a different data link alarm system is employed. If the simplex link is SMB, a catastrophic DLC alarm is raised. When the link is returned to service, the catastrophic DLC alarm is cleared.

LCC dial-up alarm monitoring

An LCC reports cluster alarm conditions at its maintenance terminal and at the LCC's Alarm and Ringing Module. However, remotely monitoring an LCC requires the use of an auto-dialing alarm monitoring system. Operating companies requiring remote LCC maintenance capabilities (alarm sending and checking and dead system alarm) should select an alarm monitoring system from a reputable vendor. The alarm system should have the following features and capabilities:

- externally assignable alarm circuits - to allow relay interface with the LCC's signal distribution points or environmental monitoring equipment
- programmable, automatic condition reporting - to automatically alert maintenance personnel of alarm conditions, providing descriptive information of those conditions
- call-in status check - to allow maintenance personnel to obtain status information by calling in
- battery back-up - to provide power for itself in case of an ac failure

Consult the alarm monitoring system manufacturer's specifications to properly interface the LCC's alarm and ringing module with the alarm monitoring system.

Remote Line Concentrating Equipment alarms

Remote Line Concentrating Modules (RLCM), Outside Plant Modules (OPM), Outside Plant Access Cabinets (OPAC), and Remote Switching Centers (RSC-S) are remote facilities for serving LCE lines. The RLCM is an LCE bay containing a Line Concentrating Array (LCA), Host Interface Equipment (HIE), a Remote Maintenance Module (RMM), and a Frame Supervisory Panel (FSP). The OPM and OPAC are enclosed, outdoor RLCM installations, designed to withstand harsh environmental conditions and extended power interruptions. OPMs and OPACs have battery back-up equipment, battery maintenance facilities, and enclosure environment controls. OPACs also have a Modular Supervisory Panel instead of an FSP and additional space for customer-supplied equipment. The RSC-S is a remote switching system comprised of a family of DMS-100 remote peripherals, based on Common Peripheral Module (CPM) architecture. Alarm conditions occurring in RLCMs, OPMs, and OPACs are detected by the Remote Maintenance Module (RMM) shelf. The RMM consists of diagnostic and hardware access equipment for maintaining remote line concentrating equipment from the base site.

Alarm indicators

Alarms are indicated by audible base site office alarms (if such alarms have been installed by the operating company), by descriptive messages printed at the base site DMS-10 switch maintenance terminal, and, in some cases, by LED indicators on affected packs in the RLCM, OPM, OPAC, or RSC-S.

Alarm processing

Alarm conditions are detected by alarm scan points on the Miscellaneous Scan Detection pack (NT0X10) on the RMM. When an alarm condition arises, the RMM sends a signal to the base site indicating which device is affected and what its status is. Upon receipt of this signal, the CPU at the base site DMS-10 switch determines which alarm to raise (major, minor, or catastrophic), what alarm message to output, what type of terminals should receive the message, and what action, if any, should be initiated by the system through signal distribution points.

The Miscellaneous Signal Distribution pack (NT2X57) provides signal distribution points which allow system access to assigned hardware components. Each signal distribution point is a software-assigned relay switch which activates relay-controlled equipment.

This equipment can range from environmental control equipment, such as fans, to customer-supplied alarm hardware. For example, if customer-assigned distribution points have been associated with the alarm condition, a signal is sent to the associated device, such as an LED or environmental control device.

Each RMM is configured with one to four NT0X10 packs and one to four NT2X57 packs. Each pack provides 14 alarm points or alarm signal distribution points, respectively, such that up to 61 alarm scan points and signal distribution points are available on an RMM-supported RLCM, OPM, or OPAC. Up to 56 alarm scan points and signal distribution points are available on an RMM-supported RSC-S. If one RMM supports 4 co-located RLCMs, 14 scan points are available for each RLCM. For information on assigning alarm scan points and signal distribution points, see overlay ALRM (ALPT and SDPT prompting sequences) in the NTP entitled *Data Modification Manual* (297-3501-311). Table 3-L summarizes the input connections for the alarm scan points when an RMM is provisioned with two NT0X10 packs in an RLCM. Table 3-M summarizes the output connections for the signal distribution points when an RMM is provisioned with two NT2X57 packs in an RLCM. These connections are wired to the MDF during installation.

Table 3-L:
Customer-assignable alarm inputs

Designation	ALPT	Pin Number for Packs in Positions 3 through 16 of an RMM	To Horizontal Terminating Block on MDF	
			Row	Pin
SC100(IP)	1	2A	13	1
SC200(G)		3A	13	2
SC101(IP)	2	4A	13	3
SC201(G)		5A	13	4
SC102(IP)	3	6A	13	5
SC202(G)		7A	13	6
SC103(IP)	4	8A	13	7
SC203(G)		9A	13	8
SC104(IP)	5	10A	14	1
SC204(G)		11A	14	2
SC105(IP)	6	17A	14	3
SC205(G)		18A	14	4
SC106(IP)	7	19A	14	5
SC206(G)		20A	14	6
SC110(IP)	8	21A	14	7
SC210(G)		22A	14	8
SC111(IP)	9	23A	15	1
SC211(G)		24A	15	2
SC112(IP)	10	25A	15	3
SC212(G)		26A	15	4
SC113(IP)	11	27A	15	5
SC213(G)		28A	15	6

Table 3-L: (Continued)
Customer-assignable alarm inputs

Designation	ALPT	Pin Number for Packs in Positions 3 through 16 of an RMM	To Horizontal Terminating Block on MDF	
			Row	Pin
SC114(IP)	12	29A	15	7
SC214(G)		30A	15	8
SC115(IP)	13	31A	16	1
SC215(G)		32A	16	2
SC116(IP)	14	33A	16	3
SC216(G)		34A	16	4
SC100(IP)	15	2A	21	1
SC200(G)		3A	21	2
SC101(IP)	16	4A	21	3
SC201(G)		5A	21	4
SC102(IP)	17	6A	21	5
SC202(G)		7A	21	6
SC103(IP)	18	8A	21	7
SC203(G)		9A	21	8
SC104(IP)	19	10A	22	1
SC204(G)		11A	22	2
SC105(IP)	20	17A	22	3
SC205(G)		18A	22	4
SC106(IP)	21	19A	22	5
SC206(G)		20A	22	6
SC110(IP)	22	21A	22	7
SC210(G)		22A	22	8
SC111(IP)	23	23A	23	1
SC211(G)		24A	23	2
SC112(IP)	24	25A	23	3
SC212(G)		26A	23	4
SC113(IP)	25	27A	23	5
SC213(G)		28A	23	6
SC114(IP)	26	29A	23	7
SC214(G)		30A	23	8
SC115(IP)	27	31A	24	1
SC215(G)		32A	24	2
SC116(IP)	28	33A	24	3
SC216(G)		34A	24	4

Note: *The alarm device should provide a loop closure between the associated IP and G leads or a ground or battery applied to the IP lead. The ground provided on the G lead is removed during the looparound test routine in order to clear all scan points. If a separate ground is provided by the operating company, the presence of a ground on the IP lead during the looparound test will result in a test error message.*

Table 3-M:
Customer-assignable alarm outputs

Designation	SDPT	Pin Number for Packs in Positions 3 - 16 of an RMM	To Horizontal Terminating Block on MDF	
			Row	Pin
SD100(G)	1	2A	17	1
SD200(OP)		3A	17	2
SD101(G)	2	4A	17	3
SD201(OP)		5A	17	4
SD102(G)	3	6A	17	5
SD202(OP)		7A	17	6
SD103(G)	4	8A	17	7
SD203(OP)		9A	17	8
SD104(G)	5	10A	18	1
SD204(OP)		11A	18	2
SD105(G)	6	17A	18	3
SD205(OP)		18A	18	4
SD106(G)	7	19A	18	5
SD206(OP)		20A	18	6
SD110(G)	8	21A	18	7
SD210(OP)		22A	18	8
SD111(G)	9	23A	19	1
SD211(OP)		24A	19	2
SD112(G)	10	25A	19	3
SD212(OP)		26A	19	4
SD113(G)	11	27A	19	5
SD213(OP)		28A	19	6
SD114(G)	12	29A	19	7
SD214(OP)		30A	19	8
SD115(G)	13	31A	20	1
SD215(OP)		32A	20	2
SD116(G)	14	33A	20	3

Table 3-M: (Continued)
Customer-assignable alarm outputs

Designation	SDPT	Pin Number for Packs in Positions 3 - 16 of an RMM	To Horizontal Terminating Block on MDF	
			Row	Pin
SD216(OP)		34A	20	4
SD100(G)	15	2A	25	1
SD200(OP)		3A	25	2
SD101(G)	16	4A	25	3
SD201(OP)		5A	25	4
SD102(G)	17	6A	25	5
SD202(OP)		7A	25	6
SD103(G)	18	8A	25	7
SD203(OP)		9A	25	8
SD104(G)	19	10A	26	1
SD204(OP)		11A	26	2
SD105(G)	20	17A	26	3
SD205(OP)		18A	26	4
SD106(G)	21	19A	26	5
SD206(OP)		20A	26	6
SD110(G)	22	21A	26	7
SD210(OP)		22A	26	8
SD111(G)	23	23A	27	1
SD211(OP)		24A	27	2
SD112(G)	24	25A	27	3
SD212(OP)		26A	27	4
SD113(G)	25	27A	27	5
SD213(OP)		28A	27	6
SD114(G)	26	29A	27	7
SD214(OP)		30A	27	8
SD115(G)	27	31A	28	1
SD215(OP)		32A	28	2
SD116(G)	28	33A	28	3
SD216(OP)		34A	28	4

OPM and OPAC alarms

Fourteen alarm scan points in the OPM or OPAC are pre-assigned to monitor the battery system and enclosure environment conditions. These pre-assigned scan points are listed in Table 3-N. The remaining available alarm scan points are customer-assignable. All scan detector external input leads are cabled to the distribution frame where they are accessible for on-site monitoring.

Table 3-N:
OPM and OPAC alarm point assignment

ALPT	Mnemonic	Alarm Class	Description
1	HTMP	Major	High Ambient Temperature
2	LTMP	Minor	Low Ambient Temperature
3	BCF0	Major	BCC 0 Fuse Failure
4	BCF1	Major	BCC 1 Fuse Failure
5	RCF0	Major	Rectifier 0 Failure
6	RCF1	Major	Rectifier 1 Failure
7	Unused	NA	Reserved for Future Implementation of Low Voltage Alarm
8	FDR	Major	Enclosure Front Door Ajar (OPM); Enclosure Front Door or Back Door Ajar (OPAC)
9	SDR	Minor	Enclosure Side Door Ajar (OPM); Not used for OPAC
10	FSP	Major	FSP Alarm Reported
11	Unused	NA	not used
12	RCL0	Major	Rectifier 0 Current Limit Reached
13	RCL1	Major	Rectifier 1 Current Limit Reached
14	FALM	Major	Fan alarm

OPM and OPAC customer-assignable alarms

ALPTs 15 through 56 may be assigned by the customer, depending upon Miscellaneous Scan Detection packs (NT0X10) provisioned on the Remote Maintenance Module (RMM) shelf. The OPM RMM Alarm Enhancement enables customers to assign ALPTs 57 through 61, but only to an NT0X10 pack provisioned in RMM shelf position 7. In an OPAC there is also one additional alarm on a second NT0X10 pack which must be defined for an optional third rectifier. For additional information about the customer-assignable OPM and OPAC alarm scan points see the overlay ALRM (ALPT) and CPK (RMPK) prompting sequences in NTP 297-3501-311, *Data Modification Manual*.

OPM and OPAC power alarms

Loss of OPM or OPAC ac power is a critical failure that cannot be detected with scan points. A system of timed rectifier monitoring is used to detect an ac failure. If a single rectifier fails, a rectifier failure alarm is raised and a two-second timer is started. If the second rectifier fails within that two seconds, a second rectifier failure alarm is raised and an ac failure condition is indicated, outputting a power interruption message. If the interruption lasts longer than 30 seconds, a major ac failure alarm will be raised. This system prevents nuisance alarms from being raised due to brownouts and other intermittent power losses.

Switching Control Center System

The Switching Control Center System (SCCS) telemetry feature provides the Switching Control Center (SCC) with remote control and monitoring of the status and performance of the DMS-10 switch. Remote control and monitoring are performed by observing the alarm- and status-indicator panels and using the system-recovery control switches, when necessary.

The DMS-10 switch alarms and controls located in the Alarm and Ringing Module (as well as the status indicators on various software-controlled, DMS-10 switch components) interface, through cables, with a Digital Alarm Scanner (DAS) unit located in the DMS-10 office.

Digital Alarm Scanner (DAS)

The DAS unit provides an interface between the DMS-10 switch and the controls and status indicators at the remote SCC.

The interface between the DMS-10 switch and the DAS unit simultaneously utilizes two modes:

- discrete interface-alarm indications are transmitted by way of a contact closure for each indicator
- serial data link interface-alarm information is transmitted by way of a serial data link

The DAS unit is equipped with minor-alarm leads that are used to report failures in the DAS unit. Should a DAS failure occur, the DAS unit is removed from service, and these leads will trigger audible and visual minor-alarm indications in the DMS-10 office and will also cause the following alarm message to be transmitted over the local and remote maintenance channels:

* ALM021 MIN <site>

where

<site> represents the site mnemonic of the DMS-10 office.

When the fault/failure is remedied, the following message is printed both locally and at the SCC to indicate that the alarm has cleared:

ALM021 MIN CLR <site> DASF

Additionally, all of the remote status indicators are automatically retired by the DMS-10 switch when the fault condition has been cleared.

Alarm status indicators

All remote alarm status indicators (catastrophic, major, and minor) are automatically retired by the DMS-10 switch after a period of 5 s.

Alarm inhibiting

Through DMOs, the operating company can specify whether one of the dedicated building alarm scan points is inhibitable or un-inhibitable. Inhibiting an alarm point silences the audible warning associated with the scan point that triggered the alarm, extinguishes the building/power indicator (unless it was activated by a power or fire alarm), and activates the building-inhibit indicator. (The status of the alarm indicator in the DMS-10 switch is unchanged.)

The operating company defines an alarm point as inhibitable using overlay ALRM in the NTP entitled *Data Modification Manual* (297-3501-311). Maintenance-terminal commands are entered to inhibit an alarm defined as inhibitable. These commands are found in overlays ALO and ALT in the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506). Power alarms, fire alarms, and fire-circuit alarms are un-inhibitable. One or all building alarms can be defined as inhibitable; miscellaneous customer-assignable alarm points are also classified as building alarms for the purpose of alarm inhibiting.

The following conditions apply to alarm inhibiting:

- An inhibited alarm scan point cannot be subsequently set as long as the building inhibit remains active.

- If an inhibitable alarm is inhibited, followed by another inhibited alarm, the building/power indicator lights. This indicator will be extinguished only after the building alarm is inhibited.
- If an attempt is made to inhibit an un-inhibitable alarm, the building/power indicator remains lit, the building-inhibit indicator does not light, and a maintenance-terminal message is printed out indicating that the alarm is un-inhibitable.

In a DMS-10 switch configured with the SCCS feature, a total of 38 alarm points (ALPT numbers 22 through 59) and a total of 16 distribution points (SDPT numbers 1 through 8 and 24 through 31), in offices equipped with one Alarm Signal Distribution pack (NT3T54), or a total of 42 distribution points (SDPT numbers 1 through 8, 24 through 31, 34 through 55, and 59 through 62), in offices equipped with two NT3T54s, are available for assignment.

Indicators and controls

Depending on classification, a particular indicator will appear on either a Critical Indicator Panel or on a Control Console. Controls and their associated control indicators are located on the Control Console. The Critical Indicator Panel and the Control Console are located at the remote SCCS.

Critical Indicator Panel

The critical indicators that appear on the Critical Indicator Panel are listed and explained in Table 3-O.

Table 3-O:
SCCS critical indicators

Indicator	Explanation
Critical	Critical Alarm
Major	Major Alarm
Minor	Minor Alarm
System Emergency	Significant loss of call processing due to one or more of the following conditions: SYSLOAD is in progress. Initialization is in progress Dead system alarm condition exists. Dial tone delay condition exists (external to the DMS-10 switch).
CPU/Memory	One or more of the following conditions exist: CPU 0 or CPU 1 is out of service. One or more Memory packs are out of service. One CPU control bus is out of service. One or more bus extenders are out of service, (that is, one CPU is unable to communicate with a Network shelf)

Table 3-O: (Continued)
SCCS critical indicators

Indicator	Explanation
Traffic	An excessive traffic condition is encountered. The CPU occupancy (real-time measurement) for the last 5 min has exceeded 93 percent.
Network	Network trouble, which involves one or more of the following: Network shelf Network loop Network pack
Peripheral	One or more of the following items are out-of-service or have a service trouble: PE Shelf Controller Digital Carrier Module Digital Signal Interface Office Carrier Module Subscriber Carrier Module
Remote	One or more of the following items are out-of-service or have a service trouble: Remote Equipment Module Remote Concentrator Terminal Remote pair gain system connected to DMS-10 switch
Miscellaneous	One or more of the following items are out-of-service or have a service trouble: One or both ringing generator Magneto-optical drive or hard disk One or more I/O controllers One or more recorded announcement channels One or both network synchronization clocks One or more Tone and Digit Senders One or more Data Link Controller data links
Building Power	Failure of one or more of the following: Major power Minor power Alarm battery supply cut off (ABSF) (This is in addition to the ABSF alarm scan point, which indicates that an alarm battery supply fuse has opened.) Commercial ac power Miscellaneous scan points reserved for operating-company alarm conditions
Building Inhibit	One or more building alarms have been inhibited at the DMS-10 switch.
AMA	One or both Automatic Message Accounting units (800-bpi, 1600-bpi, or BMC) are system-made-busy or man-made-busy, or one or both of the Time-of-Day clocks are disabled.
System Normal	None of the above failures are present.

Control Console

The controls listed and explained in Table 3-P allow SCC personnel to take corrective action or to reconfigure the DMS-10 switch. The controls are extensions of controls located on the DMS-10 switch Alarm Display Panel.

Note: *On the DMS-10 switch Alarm Display Panel, SYSLOAD is labeled RELOAD, and there is no control labeled INITIALIZE.*

The indicators listed in Table 3-Q are located on the SCCS Control Console.

Table 3-P:
Controls located on the SCCS control console

Control	Explanation
Enable	Operates as a security switch to prevent accidental operation of the CPU changeover and reload functions - must be operated with the Reload and Changeover switches.
Reload	Operation of this key causes the DMS-10 switch to reload. The Enable switch must be operated simultaneously with this switch for SYSLOAD to start.
CPU Changeover	Operation of this key causes the DMS-10 switch to switch CPU activity in the following sequence: CPU 0 active, CPU 1 active, CPU 0 active in one-bus mode, CPU 1 active and in one-bus mode; repeat. The Enable switch must be operated simultaneously with this switch for the changeover to take place.
Initialize	Operation of this key causes the DMS-10 switch to initialize.
Ringing Generator Reset	Operation of this key causes the DMS-10 switch to reset a ringing generator and/or switch from one dual ringing generator to the other.
Utility Interrupt	Causes an interrupt to enable all I/O Serial Data Interface (SDI) packs.
Audible Silence	Retires the DMS-10 switch audible alarm automatically after 5 seconds and activates the Alarm Silence indicators in the SCCS and in the DMS-10 switch.

Table 3-Q:
SCCS control console indicators

Indicator	Explanation
Enable	The Enable key has been operated.
Reload	SYSLOAD has been requested manually from the SCC.
CPU Changeover	CPU Changeover key has been operated.
Initialize	Initialization is in progress.
Ringing Generator Reset	Ringing-generator reset key has been operated.
Audible Silence	Audible Silence Control in the SCC is operated.
Utility Interrupt	Utility Interrupt key has been activated.
Major Power	The Major Power alarm is activated.

Table 3-Q: (Continued)
SCCS control console indicators

Indicator	Explanation
Minor Power	The Minor Power alarm is activated.
Alarm Battery Supply	Alarm Battery Supply trouble.
Dead System Alarm	The Dead System Alarm is activated.
CPU 0 Active	CPU 0 is on-line and processing.
CPU 1 Active	CPU 1 is on-line and processing.
One Bus	The DMS-10 switch is in the one-bus mode.
Telco A	Customer-assignable Alarm A is activated.
Telco B	Customer-assignable Alarm B is activated.
Telco C	Customer-assignable Alarm C is activated.
SYSLOAD in Progress	A SYSLOAD is in progress (invoked manually or by software). In addition to this indicator, the software progress marks are printed out on the SCC maintenance terminal.
Audible Silence	The Audible Silence key has been operated at the DMS-10 switch or at the SCC.
DAS Disable	The Digital Alarm Scanner unit is out-of-service.
CPU 0 Standby	CPU 0 is off-line and on standby. CPU 1 active and CPU 1 out-of-service indicators are off.
CPU 0 OOS	CPU 0 is out-of-service.
CPU 1 Standby	CPU 1 is off-line and on standby. CPU 1 Active and CPU 1 out-of-service indicators are off.
CPU 1 OOS	CPU 1 is out-of-service.
Bus Extender	One or more bus extenders are out-of-service.
Memory	One or more Memory packs are out-of-service.
Traffic Overload	An excessive traffic condition. The CPU occupancy (real time measurement) for the last 5 min exceeded 93 percent.
PE Controller	An analog PE shelf is out-of-service.
DCM	One or more Digital Carrier Modules are out-of-service.
DSI	One or more Digital Signal Interface modules are out-of-service.
OCM	One or more Office Carrier Modules are out-of-service or in trouble.
SCM	One or more Subscriber Carrier Modules are out-of-service or in trouble.
Primary Tape	Primary tape unit or IOI device is out-of-service.
Secondary Tape	Secondary tape unit or IOI device is out-of-service.
I/O Controller	One or more I/O controllers (Serial Data Interfaces) are out-of-service.
Recorded Announcement	One or more recorded announcement channels are out-of-service.
Simplex Ringing Generator	One ringing generator is out-of-service.

Table 3-Q: (Continued) **SCCS control console indicators**	
Indicator	**Explanation**
Duplex Ringing Generator	Both ringing generators are out-of-service.
Simplex AMA	One AMA unit is out-of-service (man-made-busy or system-made-busy) or one Time-of-Day clock is disabled.
Duplex AMA	Both AMA units are out-of-service (man-made-busy or system-made-busy) or both Time-of-Day clocks are disabled.
Tone/Digit Sender	The number of Tone and Digit Sender errors has reached the maintenance limit.
Sync Clock	One or both clock packs are out-of-service or out-of-sync.
Commercial Power	Loss of commercial power.
Building	At least one of the following customer-assignable scan points is activated: DOORPRESHUMD TEMPFIREPUMP and/or any custom-made, four-character mnemonic.
Simplex DLC	One Data Link Controller data link in a duplex configuration is system-made-busy or man-made-busy.
Duplex DLC	Both Data Link Controller data links in a duplex configuration are system-made-busy or man-made-busy, or the single link in a simplex configuration is system-made-busy or man-made-busy.

Remote Subscriber Line Equipment (RSLE) alarms

Each Remote Subscriber Line Equipment (RSLE) bay requires two Remote Maintenance (RMP) packs (NT9Y13). These two packs are located on either the same RSLE Control shelf or, if the RSLE bay has two RSLE Control shelves, on separate Control shelves. Each pack supports eight alarm scan points (ALPTs) and five signal distribution points (SDPTs).

Two of the eight ALPTs on each RMP pack are connected to catastrophic and major alarm functions; the remaining six ALPTs on each pack are customer-assignable. Each RSLE site may be configured with 32 different RSLE bays and up to 64 different ALPTs. Table 3-R lists the RSLE ALPTs.

Two of the five SDPTs on each RMP pack are fixed: one for major (MAJ) and one for catastrophic (CAT) alarms. The remaining three SDPTs are customer-assignable. Consequently, in an RSLE bay with one RSLE Control shelf, which contains two RMP packs, a total of six SDPTs per bay are customer-assignable. However, in an RSLE bay with two RSLE Control shelves, each of which contains only one RMP pack, two of the three previously customer-assignable SDPTs on each pack are used to link the metallic test access bus from one shelf to the other, leaving a total of only two customer-assignable SDPTs per bay.

Power Alarms for RSLE

In generics that do not also have the Power Alarms for RSLE feature installed, DC power alarms and software-detected link and controller alarms were reported together through scan point 0. Thus, it was difficult to distinguish between the two alarm types. With the Power Alarms for RSLE feature configured in the switch, only DC power alarms can be reported through scan point 0. The alarm point, source mnemonic, and class set by scan point 0 are customer-assignable. Feature installation requires an NT9Y13DB RMP pack, changes to the J9Y76 Frame Supervisory Panel, and definition of scan point 0 (see the ALRM (ALPT) prompting sequence in NTP 297-3501-311, *Data Modification Manual*).

Remote Subscriber Line Module (RSLM) and Outside Plant Subscriber Module (OPSM) alarms

Each Remote Subscriber Line Module (RSLM) shelf can be configured with one Remote Maintenance (RMP) pack (NT9Y13). Each pack supports eight alarm scan points (ALPTs) and five signal distribution points (SDPTs).

Two of the eight ALPTs on each RMP pack are connected to catastrophic and major alarm functions; the remaining six ALPTs are customer-assignable. However, these six must be assigned only according to their fixed designation within the Outside Plant Subscriber Module (OPSM) environment, as listed in Table 3-R. Each RSLM site may be configured with 32 different RSLM shelves and up to 64 different ALPTs.

Two of the five SDPTs on each RMP pack are fixed: one for major (MAJ) and one for catastrophic (CAT) alarms. The remaining three SDPTs are customer-assignable. Consequently, in an RSLM bay with one RSLM shelf, or in an OPSM, three SDPTs are customer-assignable. In an RSLM bay with two RSLM Type B shelves, a total of six SDPTs are customer-assignable.

The OPSM uses all eight ALPTs available within the RSLM shelf. Table 3-S lists the OPSM alarms.

Power alarms for OPSM and RSLM

In generics that do not also have the Power Alarms for RSLE feature installed, DC power alarms and software-detected link and controller alarms were reported together through scan point 0. Thus, it was difficult to distinguish between the two alarm types. With the Power Alarms for RSLE feature (which also applies to OPSMs and RSLMs) configured in the switch, only DC power alarms can be reported through scan point 0; both alarm types, however, are still reported as MAJ DED alarms. The alarm point, source mnemonic, and class set by scan point 0 are customer-assignable. Feature installation requires an NT9Y13DB RMP pack, changes to the J9Y76 Frame Supervisory Panel, and definition of scan point 0 (see the ALRM (ALPT) prompting sequence in NTP 297-3501-311, *Data Modification Manual*).

Table 3-R:
RSLE, RSLM, and OPSM alarm scan point (ALPT) allocation

RMP Pack	ALPT	Allocation	RSLE	RSLM	OPSM	RSLM/ OPSM Mnemonic
0	0	Major alarm	Fixed	Fixed	Fixed	MAJ; Customer-assignable with the Power Alarms for RSLE feature installed in the switch.
0	1	Single rectifier failure alarm	Unfixed	Unfixed	Fixed	LAC
0	2	Both rectifiers failed alarm	Unfixed	Unfixed	Fixed	NAC
0	3	Door open alarm	Unfixed	Unfixed	Fixed	DOOR
0	4	Fan alarm	Unfixed	Unfixed	Fixed	FAN
0	5	Over-temperature alarm	Unfixed	Unfixed	Fixed	TECE
0	6	Battery alarm	Unfixed	Unfixed	Fixed	BATF / BATD
0	-	Catastrophic alarm	Fixed	Fixed	Fixed	CAT
1	-	Major alarm	Fixed	Fixed	N/A	N/A
1	1/7	Customer assignable	Unfixed	Unfixed	N/A	N/A
1	2/8	Customer assignable	Unfixed	Unfixed	N/A	N/A
1	3/9	Customer assignable	Unfixed	Unfixed	N/A	N/A
1	4/10	Customer assignable	Unfixed	Unfixed	N/A	N/A
1	5/11	Customer assignable	Unfixed	Unfixed	N/A	N/A
1	6/12	Customer assignable	Unfixed	Unfixed	N/A	N/A
1	-	Catastrophic alarm	Fixed	Fixed	N/A	N/A

The ALPT number is the response to the MISC prompt in the ALRM overlay.

In the OPSM, this is also the cabinet Controller alarm. This alarm is also set if any of the following occur: a) microprocessor of temperature controller/battery monitor (9Y00) loses sanity; b) the battery fails either the 2-week test or self test; c) the heater test fails; d) the NT9Y00 malfunctions (A/D failure or temperature sensor out of limit); e) the NT9Y00AA cabinet controller is not seated fully (microswitch mounted on B/P is not properly aligned). Thus, a site visit is required to determine the exact cause of the failure.

ALPTs 7-12 are applicable to RMP1 ia an RSLM bay and to RMP1 in an RSLE bay if RMP1 is on Shelf 3. If RMP1 is an RSLE bay on Shelf 1, then its six ALPTs are also numbered 1-6.

Not applicable.

Table 3-S:
OPSM alarms

Alarm Name	Conditions Causing Alarm	Action Taken
Single rectifier fails	One rectifier “Fail Alarm” sets	Reports to base DMS-10 switch
Both rectifiers fail	Two rectifiers “Fail Alarm” set	Reports to base DMS-10 switch
Cabinet alarm	2	Reports to base DMS-10 switch
Under temperature	Temperature falls below 12° F (-10° C)	Reports to base DMS-10 switch
Fans	Air flow is too weak	Reports to base DMS-10 switch
Over temperature	Temperature rises above 132° F (+55° C)	Reports to base DMS-10 switch
Emergency shut-down	Temperature exceeds +150° F (+65° C)	Disconnects ac; disconnects dc to electronic circuits; activates RSLM catastrophic alarm
Open door	One of the doors to the OPSM opens	Reports to base DMS-10 switch

Generated by the Lorain rectifier; caused by any one of several failure conditions, such as failure of ac input, high dc voltage shutdown, output breaker opening, low output current or rectifier incapable of delivering power.

This alarm is generated when any battery string fails the test (as specified above); the heater malfunctions; various controller malfunctions, such as analog-to-digital converter failure or temperature sensor out of limit: or the microprocessor of the temperature controller/battery monitor is not sane (the microprocessor will be considered not sane if it did not reset the sanity timer within a telco-modifiable number of milliseconds).

This condition generates a "Cabinet" alarm at the base DMS-10 switch. At the OPSM site, the NT9Y00 Cabinet Controller status LED will be red and, when the status push-button switch is pressed, the "Under temperature" indicator "J" will appear in the status LED display. All NT9Y00 LED display codes are listed, beside the faceplate illustration, in Section 4 of the NTP.

Star Remote system

The Star Remote system provides a remote line concentrating system that supports up to 1152 lines, using standard DMS line cards. The Star Remote system comprises two products - the Star Hub, and the Star Module. The Star Hub is available with the DMS-10 switch. The alarm system for the Star Hub is described below.

Star Hub alarms

The Star Hub is configured with two Universal Maintenance Packs (NTTR73). Each Universal Maintenance Pack provides 12 user-defined alarm scan points and 8 user-defined signal distribution points for the Star Hub. The Remote Controller pack (NTTR77) provides 3 hard-coded signal distribution points and 5 hard-coded alarm scan points that activate critical, major, and minor lamps on the Frame Supervisory Panel, and detect major/critical failures, alarm pack (NTTR74) removal, blown fuses, or talk battery failures.

Table 3-T lists the alarm scan points supported in the Star Hub. Table 3-U lists the signal distribution points supported in the Star Hub.

Table 3-T:
Star Hub Alarm Scan Points

Scan Point	Definition	Location
0	Major alarm	NTTR77
1	Fuse failure, power below 41 V, or absence of ABS voltage	NTTR77
2	Catastrophic alarm	NTTR77
3	At least one of the talk battery breakers is off	NTTR77
4	Missing alarm card (NTTR74)	NTTR77
5	User-defined	NTTR73
6	User-defined	NTTR73
7	User-defined	NTTR73
8	User-defined	NTTR73
9	User-defined	NTTR73
10	User-defined	NTTR73
11	User-defined	NTTR73
12	User-defined	NTTR73
13	User-defined	NTTR73
14	User-defined	NTTR73
15	User-defined	NTTR73
16	User-defined	NTTR73

Table 3-U: -
Star Hub Signal Distribution Points

Scan Point	Definition	Location
0	Catastrophic lamp and main distribution frame	NTTR77
1	Major lamp and main distribution frame	NTTR77
2	Minor lamp	NTTR77
3	User-defined	NTTR73

Table 3-U: - (Continued) **Star Hub Signal Distribution Points**		
Scan Point	**Definition**	**Location**
4	User-defined	NTTR73
5	User-defined	NTTR73
6	User-defined	NTTR73
7	User-defined	NTTR73
8	User-defined	NTTR73
9	User-defined	NTTR73
10	User-defined	NTTR73

Common Channel Signaling system alarms

CCS7 alarms are raised when CCS7-related equipment fails, network access is lost, and by the following conditions (not due to manual intervention):

- a destination point code (DPC) is unavailable (Major alarm)
- a link is out of service (Minor alarm)
- all links configured in the DMS-10 switch are out of service (Major alarm)
- a link set is out of service (Major alarm)
- standby Level 3 functionality is lost (Minor alarm)
- both active and standby Level 3 functionality is lost (Major alarm)

A Catastrophic alarm is raised if the alarm is configured in Overlay CNFG (CCS7) and when any combined link set (CLKS) is unavailable, not due to manual intervention. A CLKS is a pair of link sets that have equal priority access to at least one destination point code (DPC). A CLKS normally terminates to a Signal Transfer Point (STP) pair either from a Service Switching Point (SSP) or from another STP pair. The catastrophic alarm (set up through the CAT prompt in Overlay CFNG (CCS7)) indicates that access to any STP pair that grants the DMS-10 switch access to the external CCS7 network has been lost.

Note 5: A Catastrophic alarm at a DMS-10 STP is not raised if access to one of its subtending nodes is lost.

Note 6: If a single (non-mated) SRP is used to concentrate links, then a Catastrophic alarm is not generated at the subtending SSPs even though the external CCS7 is unavailable.

Section 4: Maintenance controls and visual indicators

Introduction

This section describes all controls (except environmental controls) and visual indicators that aid in the maintenance of the DMS-10 switch.

Alarm and Ringing Module (J0T72B-1)

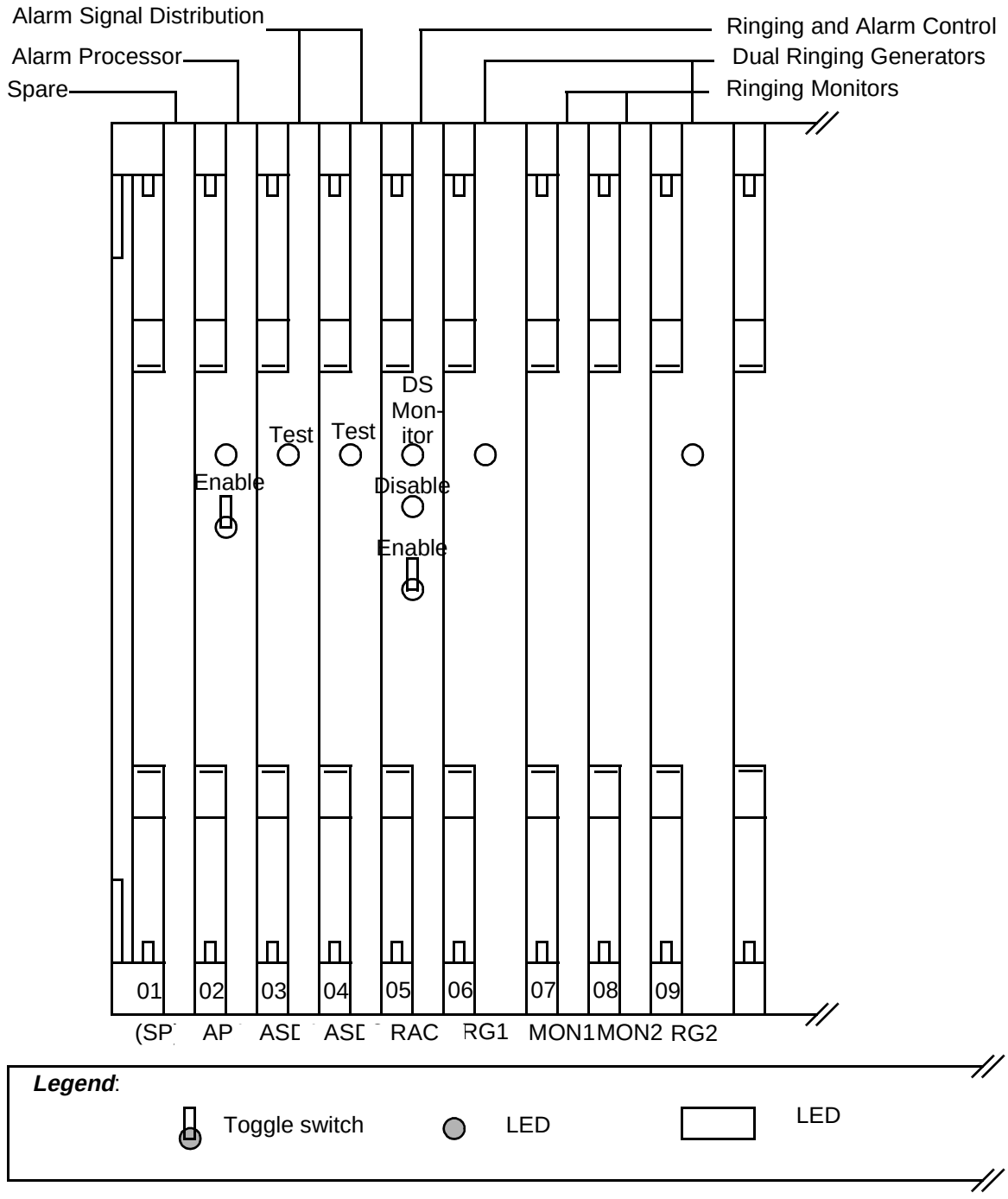
The Alarm and Ringing Module (J0T72B-1) accommodates circuit packs that provide visual alarms when a failure occurs, alarm-status-indicator lamps, and switches that allow operating company personnel to perform the following operations:

- Silence/reset audible alarm indicators
- Enable/disable remote alarm indicators
- Reset ringing generator
- Manual test of alarm- /status-indicator lamps
- Utility interrupt
- CPU changeover
- System Software Reload (SYSLOAD)

The Alarm and Ringing Module is illustrated in Figure 4-1. The switches and indicator lamps are located on a portion of the Alarm and Ringing Module that is called the Alarm Display Panel (refer to “Alarm Display Panel ” in this section).

The Alarm and Ringing Module, which is located on Shelf 5 of the CE-3 bay, houses the circuit packs shown in Table 4-A. The functions, features, and locations of these packs are detailed in the NTP entitled *Equipment Identification* (297-3501-150). For information on those pack faceplates with visual indicators, refer to “Circuit packs” in this section.

Figure 4-1: Overview of fully equipped Alarm and Ringing Module (J0T72B-1)



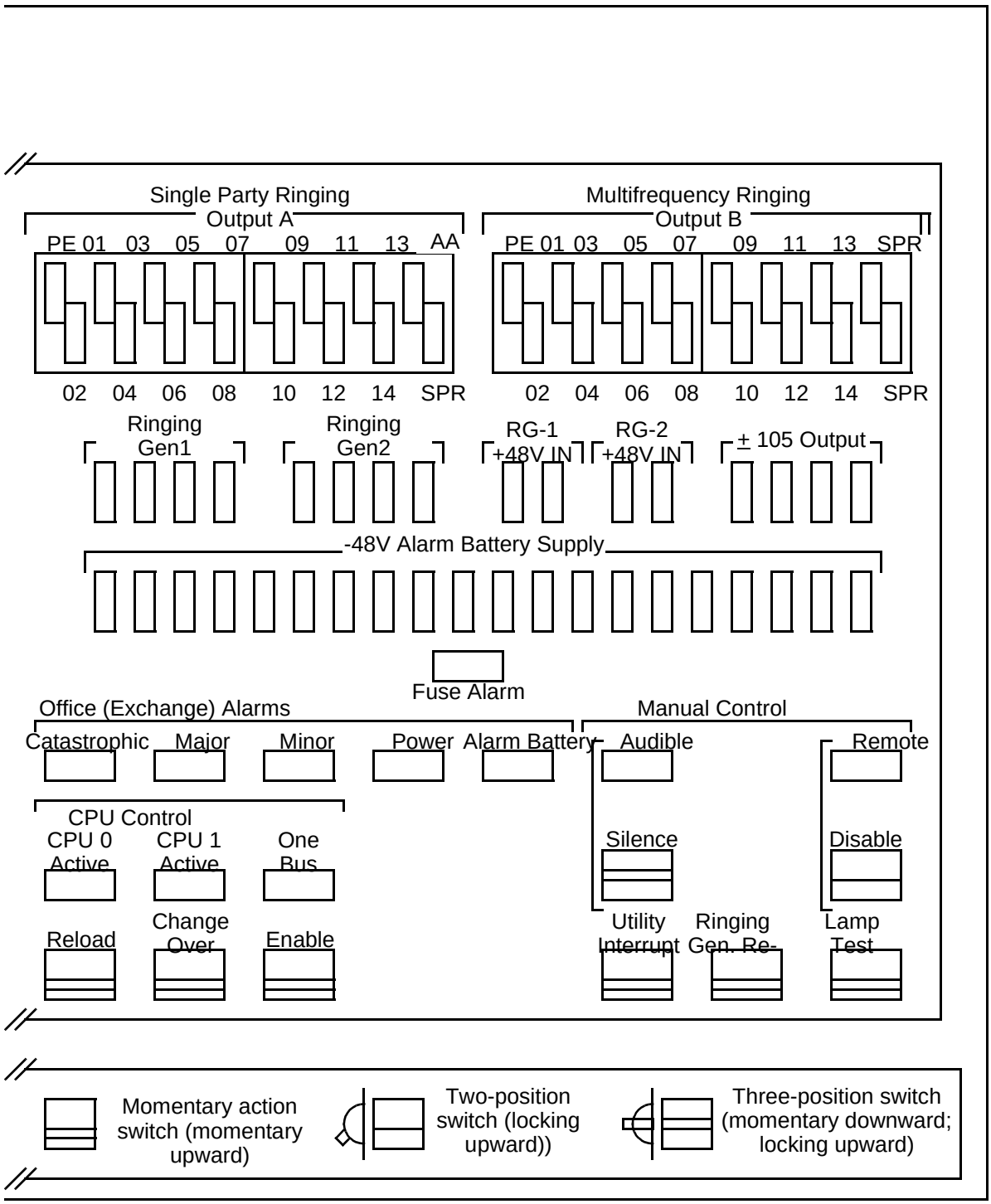

Single Party Ringing
Output A
PE 01 03 05 07 09 11 13 AA
02 04 06 08 10 12 14 SPR
Multifrequency Ringing
Output B
PE 01 03 05 07 09 11 13 SPR
02 04 06 08 10 12 14 SPR
Ringing Gen1
Ringing Gen2
RG-1 +48V IN
RG-2 +48V IN
± 105 Output
-48V Alarm Battery Supply
Fuse Alarm
Office (Exchange) Alarms
Catastrophic
Major
Minor
Power
Alarm Battery
Manual Control
Audible
Remote
CPU Control
CPU 0 Active
CPU 1 Active
One Bus
Silence
Disable
Reload
Change Over
Enable
Utility Interrupt
Ringing Gen. Re-
Lamp Test
Momentary action switch (momentary upward)
Two-position switch (locking upward))
Three-position switch (momentary downward; locking upward)

Table 4-A: **Alarm and Ringing Module-circuit packs**	
Pack Number	**Pack Name**
NT3T27	Ringing Monitor
NT3T30	Fuse Alarm
NT3T53	Alarm Processor
NT3T54	Alarm Signal Distribution
NT3T55	Ringing and Alarm Control
NT3T59	Dual Ringing Generator

Alarm Display Panel

The Alarm Display Panel is located in the lowest third of the panel on the right-hand portion of the Alarm and Ringing Module (J0T72B-1). The Alarm Display Panel houses the visual indicators, audible-indicator devices, and manual controls necessary for performing various maintenance tasks. The panel is shown in Figure 4-1 with the Alarm and Ringing Module, and Tables 4-B through 4-F provide detailed descriptions of the LEDs and manually controlled switches.

Table 4-B: **Alarm Display Panel-alarm class LEDs**				
Alarm Class	**LED Color**	**Activated By**	**Source / Cause**	**Associated Activity**
Cata-strophic	Red	Signal distribution point relay assigned to catastrophic office alarm class or Dead System Alarm relay located on Ringing and Alarm Control pack	System detection of a catastrophic alarm (for example, failure of both PE Ringing Generator packs) Failure of dead system timer to receive reset pulse from signal distribution point relays controlled by software	Ringing and Alarm Control pack: - Activates the pack-mounted alarm - Activates the PF Bell on the audible alarm panel (if provided-customer option) - Lights the appropriate exit pilot lamp(s) - Provides a loop closure between CR1 and CR2 leads to the MDF for making alarms remote

Table 4-B: (Continued)
Alarm Display Panel-alarm class LEDs

Alarm Class	LED Color	Activated By	Source / Cause	Associated Activity
Major	Amber	Signal distribution point relay assigned to the major office alarm class or Signal distribution point relay assigned to a major power alarm (See Power)	System detection of a major alarm (for example, failure of a single Ringing Generator pack)	Ringing and Alarm Control pack: - Activates the pack-mounted audible alarm - Activates the major tone bar on the audible alarm panel (if provided) - Lights the appropriate exit pilot lamp(s) - Provides a loop closure between MJ1 and MJ2 leads to the F for making alarms remote
Minor	Green	Signal distribution point relay assigned to the minor office alarm class or Signal Distribution point relay assigned to a minor power alarm (See Power)	System detection of a minor alarm	Ringing and Alarm Control pack: - Activates the pack-mounted audible alarm - Activates the minor subset on the audible alarm panel (if provided) - Lights the appropriate exitpilot lamp(s) - Provides a loop closure between MN1 and MN2 to MDF for making alarms remote
Power	Amber	Signal distribution point relays assigned to major and minor power alarms	System detection of a power plant alarm by way of scan points on the Alarm Processor pack	Ringing and Alarm Control pack: - Activates the pack-mounted audible alarm - Activates the PF Bell (major power alarm) or the minor subset (minor power alarm) on the audible alarm panel (if provided)

Table 4-B: (Continued)
Alarm Display Panel-alarm class LEDs

Alarm Class	LED Color	Activated By	Source / Cause	Associated Activity
Alarm Battery	Amber	Alarm detection relay on the Ringing and Alarm Control pack	Failure of the alarm battery supply from the exchange power plant or Failure of a fuse on the Alarm Battery Supply fuse channel located in the Alarm and Ringing Module	Ringing and Alarm Control pack: - Activates the pack-mounted audible alarm - Activates the Alarm Battery Supply subset on the audible alarm panel (if provided) - Lights the appropriate exitpilot lamp(s) - Provides a loop closure between ABS1, ABS2 leads to the MDF for making alarms remote, when provisioned

Table 4-C:
Alarm Display Panel-alarm-function status LEDs

Function Label	LED Color	Activated By	Source / Cause	Associated Activity	Comments
Remote Disable	Amber	Making alarms remote (or transfer) disabled relays on the Ringing and Alarm Control pack	Signal distribution point relay operation of the Remote Disable switch plus, if provided, remote disable switch operation on the remote maintenance panel	See "Comments" for Audible Silence Provides a loop closure between ATLR and RGRDR leads to MDF for making alarms remote.	When on, indicates that the function to make alarms remote has been disabled No alarm conditions are transmitted to the remote alarm monitoring location. (Note that alarm sending over operator trunks is not affected).

Table 4-C: (Continued)
Alarm Display Panel-alarm-function status LEDs

Function Label	LED Color	Activated By	Source / Cause	Associated Activity	Comments
Audible Silence	Amber	Audible control relays on the Ringing and Alarm Control pack	Manual operation of the Audible Silence (locking) switch or Software controlled signal distribution point relay operation initiated by a maintenance terminal input message or by system detection of a momentary manual operation of the Audible Reset switch	All audible alarm indicators are silenced	If switch S3 (1-4) on the Ringing and Alarm Control pack is operated (customer option), the local audible indicators are silenced and the Audible Silence visual is turned on whenever alarm remoting is activated (the Remote Disable indicator is off). Not made remote

Table 4-D:
Alarm Display Panel-CPU status LEDs

Indicator Label	LED Color	Activated By	Source / Cause	Associated Activity
CPU 0 Active	Amber	CPU	Normally set by the system but can be changed by operating the Changeover and Enable switches.	Provides a contact closure between the CPUOLEDR and RGRDR leads to the MDF.
CPU 1 Active	Amber	CPU	Normally set by the system but can be changed by operating the Changeover and Enable switches.	Provides a contact closure between the CPU1LEDR and RGRDR leads to the MDF.
One Bus	Red	CPU	Normally set by the system but can be changed by operating the Changeover and Enable switches.	Provides a contact closure between the OBLEDR and RGRDR leads to the MDF.

Table 4-E:
Alarm Display Panel-alarm and ringing manual controls

Control Label	Type of Control Operation	Function	Software Activity Associated with Function	Interface for Remote Control
Lamp Test	Momentary	Lights all Alarm Display Panel LEDs to test for indicator failure.	None	Not remotable.
Ringing Gen. Reset	Momentary	Enables control circuits and relays on the Ringing and Alarm Control pack to reset a Ringing Generator pack alarm once the fault has been cleared and/or transfers the source of the ringing supply being distributed from one Dual Ringing Generator pack to the other.	Alternatively-a signal distribution point relay may be operated momentarily by a maintenance terminal input message to perform the same functions as the manual switch. The state of a scan point on the Alarm Processor pack is changed, thus causing a maintenance terminal printout confirming the action.	A loop closure is to be provided between RARR and RGRDR leads at the MDF to control.
Remote Disable	Locking	Operates relays on the Ringing and Alarm Control pack which opens the leads providing the transfer of alarm indications to a remote location by way of the Main Distributing Frame.	Signal distribution point relay must be operated by a maintenance terminal input command to enable (by providing the necessary ground potential) the relays on the Ringing and Alarm Control pack.	With wiring strap removed between pins 70 and 71 of connector F, a loop closure is to be provided between ATSDR1 and ATSDR leads at the MDF. (Remote Disable function requires signal distribution point relay operation, Alarm Display Panel switch operation and the above loop closure.)

Table 4-E: (Continued)
Alarm Display Panel-alarm and ringing manual controls

Control Label	Type of Control Operation	Function	Software Activity Associated with Function	Interface for Remote Control
Audible-Silence	Locking	Operates and holds the audible inhibit relays on the Ringing and Alarm Control pack which silence all audible signal devices on the Ringing and Alarm Control pack or, if provided, on the audible alarm panel	None	Not remotable.
Audible-Reset	Momentary	Sets a scan point on the Alarm Processor pack which the system interprets as a request to silence alarms	The system operates a signal distribution point relay which operates the audible inhibit relays on the Ringing and Alarm Control pack. The system releases the signal distribution point relay upon detection of another alarm condition and re-enables all active alarm audibles.	Not remotable.

Table 4-F:
Alarm Display Panel-central processing unit manual controls

Control Label	Type of Control Operation	Function	Software Activity Associated with Function	Interface for Remote Control
Utility Interrupt	Momentary	Generates a utility interrupt request.	The system detects this request through a scan point on the Alarm Processor pack.	A momentary loop closure is to be provided between the TTYENR and RGRDR leads at the MDF.

Table 4-F: (Continued)
Alarm Display Panel-central processing unit manual controls

Control Label	Type of Control Operation	Function	Software Activity Associated with Function	Interface for Remote Control
Enable	Momentary	Operates as a security switch to prevent accidental operation of the reload and change-over functions - must be operated with the Reload and Change Over switches.	None.	A momentary loop closure is to be provided between the MCER and RGRDR leads at the MDF.
Change Over	Momentary	The function of this switch depends on the current state of the CPU. Each operation of the Change Over switch with the Enable switch operated changes the activity mode of the CPU from its current state to the next state in the following sequence: (1) CPU 0 Active (2) CPU 1 Active (3) CPU 0 Active and in One-Bus mode (4) CPU 1 Active and in One-Bus mode (5) SYSLOAD (See Caution) For example, if CPU 0 is active and the switch is in One-Bus mode (state 3), operating the Change Over switch causes CPU 1 to be active and in One-Bus mode (state 4).	Causes a system Initialization. **CAUTION:** A system initialization interrupts subscriber service for 3 to 5 minutes.	A momentary loop closure is to be provided between the CPUCOR and RGRDR leads at the MDF.
Reload	Momentary	With Enable switch operated-causes the system to reloaded (SYSLOAD).	Causes the SYSLOAD program to be executed.	A momentary loop closure is to be provided between the CPURELR and RGRDR leads at the MDF.

Sleek Door bay external visual alarm indicators

Sleek Door bays support two types of visual indicators. Row Alarm Lamps, at the end of each equipment row, indicate local failures. Frame Fail Lamps on the Sleek Door panels provide alarm condition notification for each specific bay. The frame fail conditions for each bay are listed in Table 4-G.

Table 4-G:
Sleek Door Frame Fail alarm indicators

Bay Location	LED Color	Alarm Source
CE Bay	Red	Cooling fan air displacement failure
	Red	5/12 V power converter pack (NT3T19) failure
	Red	Power converter pack (NT3T89) failure
PE Bay	Red	Bay supervisory panel (J1T60) failure
	Red	Peripheral shelf controller pack (NT2T41) failure ***Note:*** Applies to NT2T41 with a manually disabled "ENABLE" switch.
	Red	Peripheral shelf converter pack (NT2T42) failure
PE-01 Bay Only	Red	Power distribution panel (J0T75) circuit breaker tripped, or breaker not normally "ON" or "OFF"
LCE Bay	Red	Any panel fuse failure
	Red	Any circuit breaker trip or "OFF" failure
1600 BPI AMA Bay	Red	Power converter pack (NT3T89) failure
	Red	Cooling fan air displacement failure
	Red	Inverter (if equipped) failure
ME Bay	Red	Bay supervisory panel (J1T67) failure
	Red	ED0T81-01 relay (if equipped) alarm failure

Circuit packs

Circuit pack faceplates with multiple LED indicators and/or controls are illustrated in figures arranged in alphanumerical order in this section. The function of each LED or control is described in each illustration. Circuit packs with only one LED and/or a switch are listed in Table 4-J, which follows the pack faceplate illustrations. Each entry in the table includes the pack's number and name, and the function of the LED and/or switch. Information about the function, features, and location of all of these packs can be found in the NTP entitled *Equipment Identification* (297-3501-150).

Figure 4-2: Peripheral Control 1 pack faceplate (NT2T12)

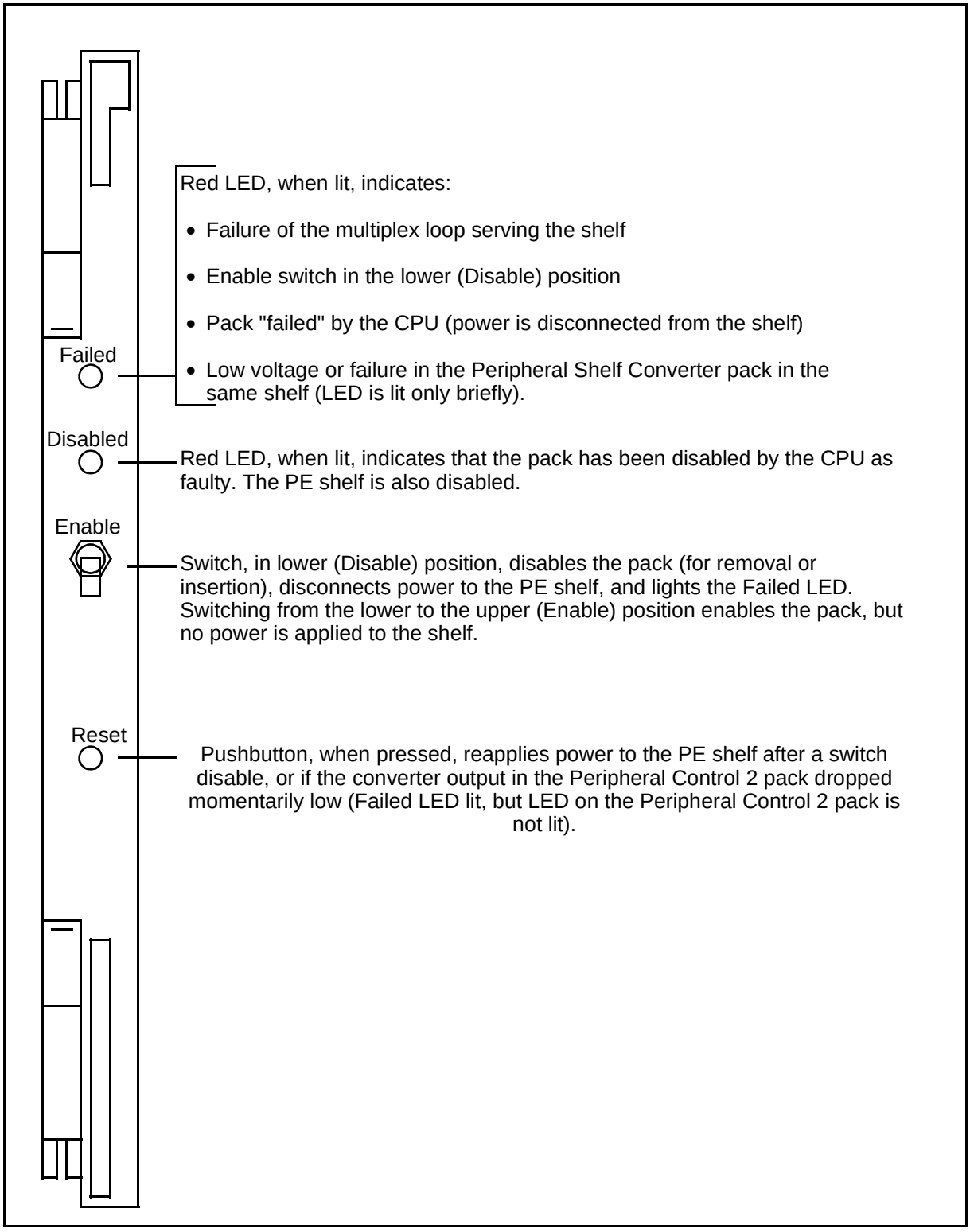


Figure 4-3: Peripheral Maintenance Access pack faceplate (NT2T14)

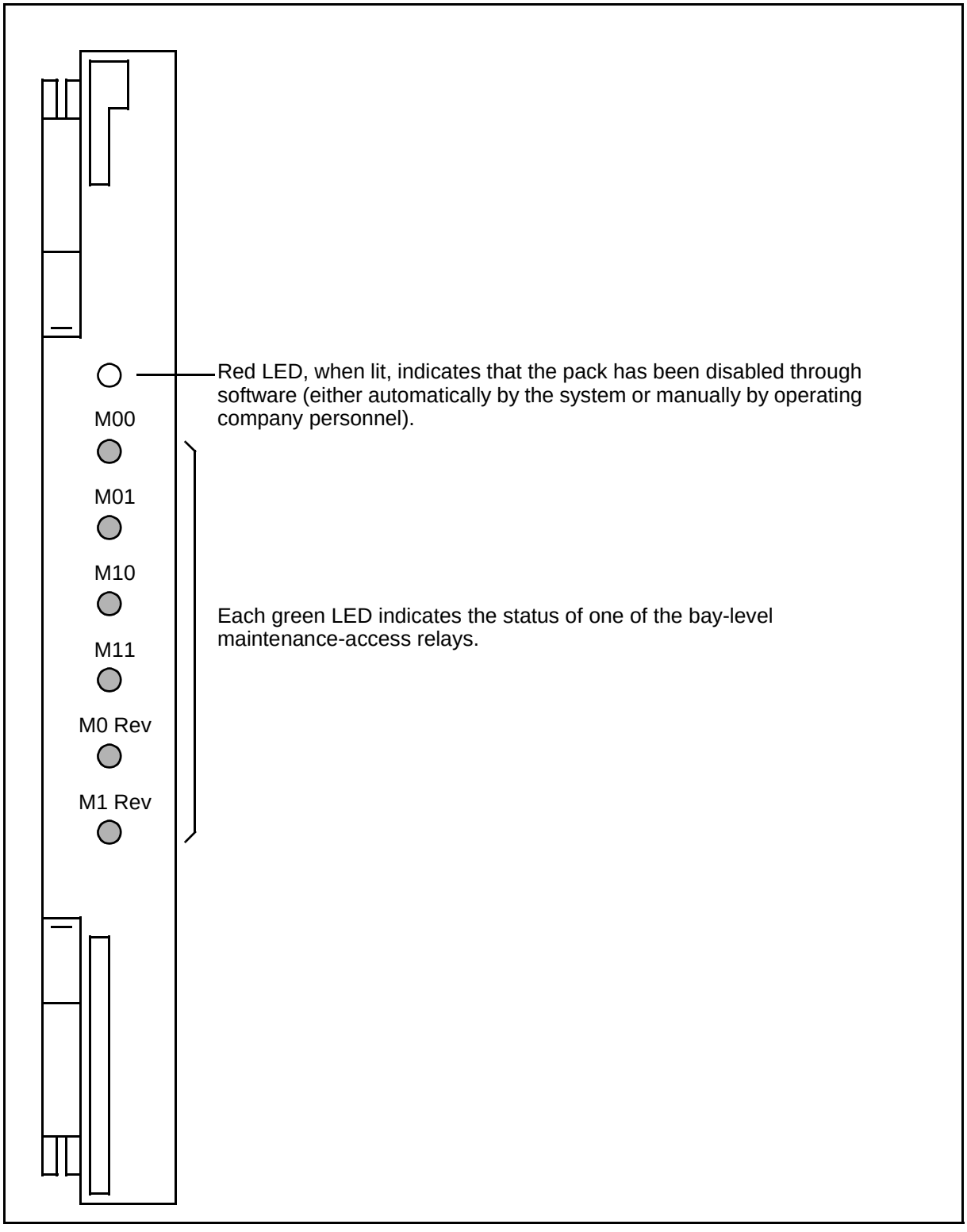


Figure 4-4: Faceplate of packs listed in Table 4-J

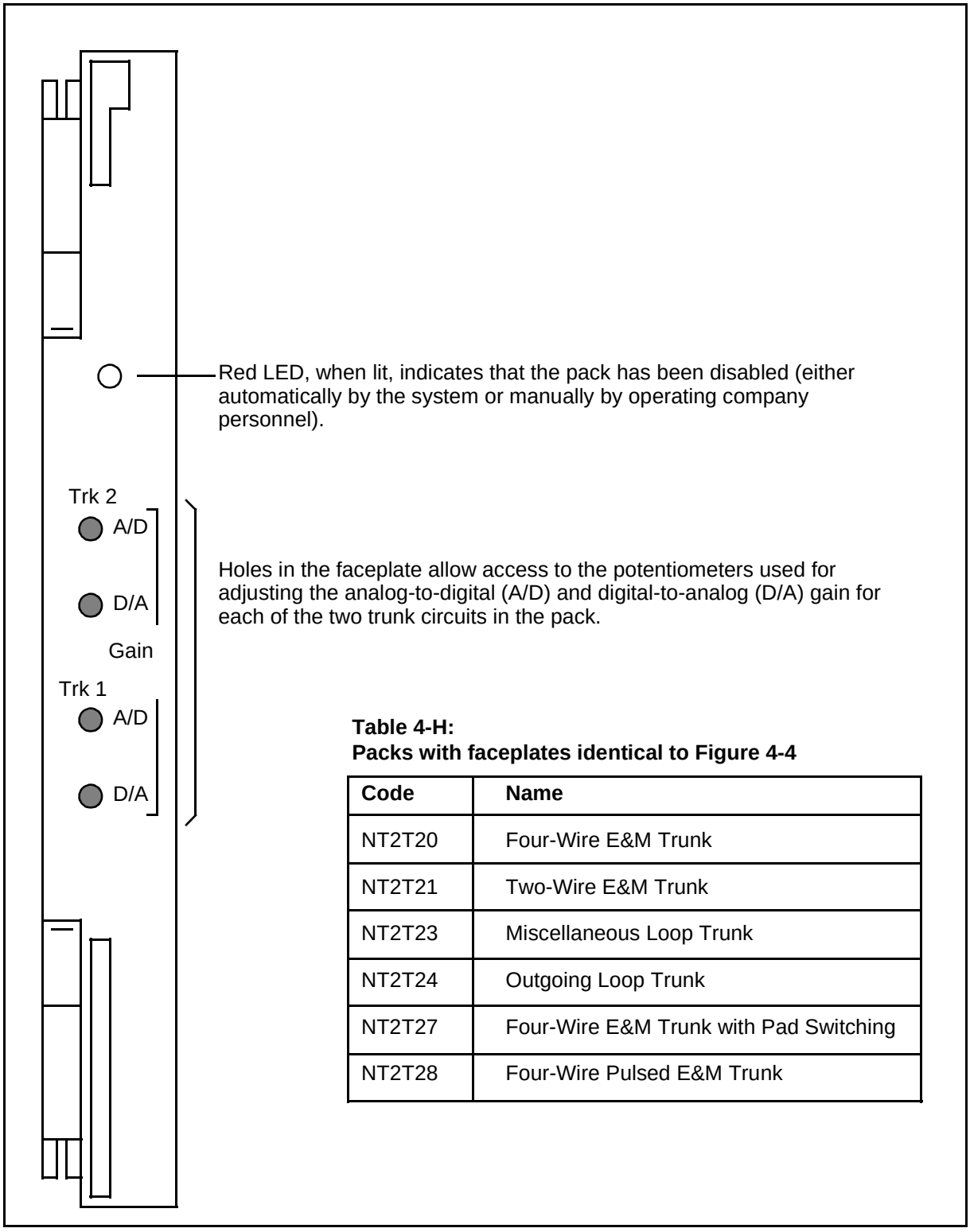


Table 4-H:
Packs with faceplates identical to Figure 4-4

Code	Name
NT2T20	Four-Wire E&M Trunk
NT2T21	Two-Wire E&M Trunk
NT2T23	Miscellaneous Loop Trunk
NT2T24	Outgoing Loop Trunk
NT2T27	Four-Wire E&M Trunk with Pad Switching
NT2T28	Four-Wire Pulsed E&M Trunk

Figure 4-5: Circuit Breaker pack faceplate (NT2T26)

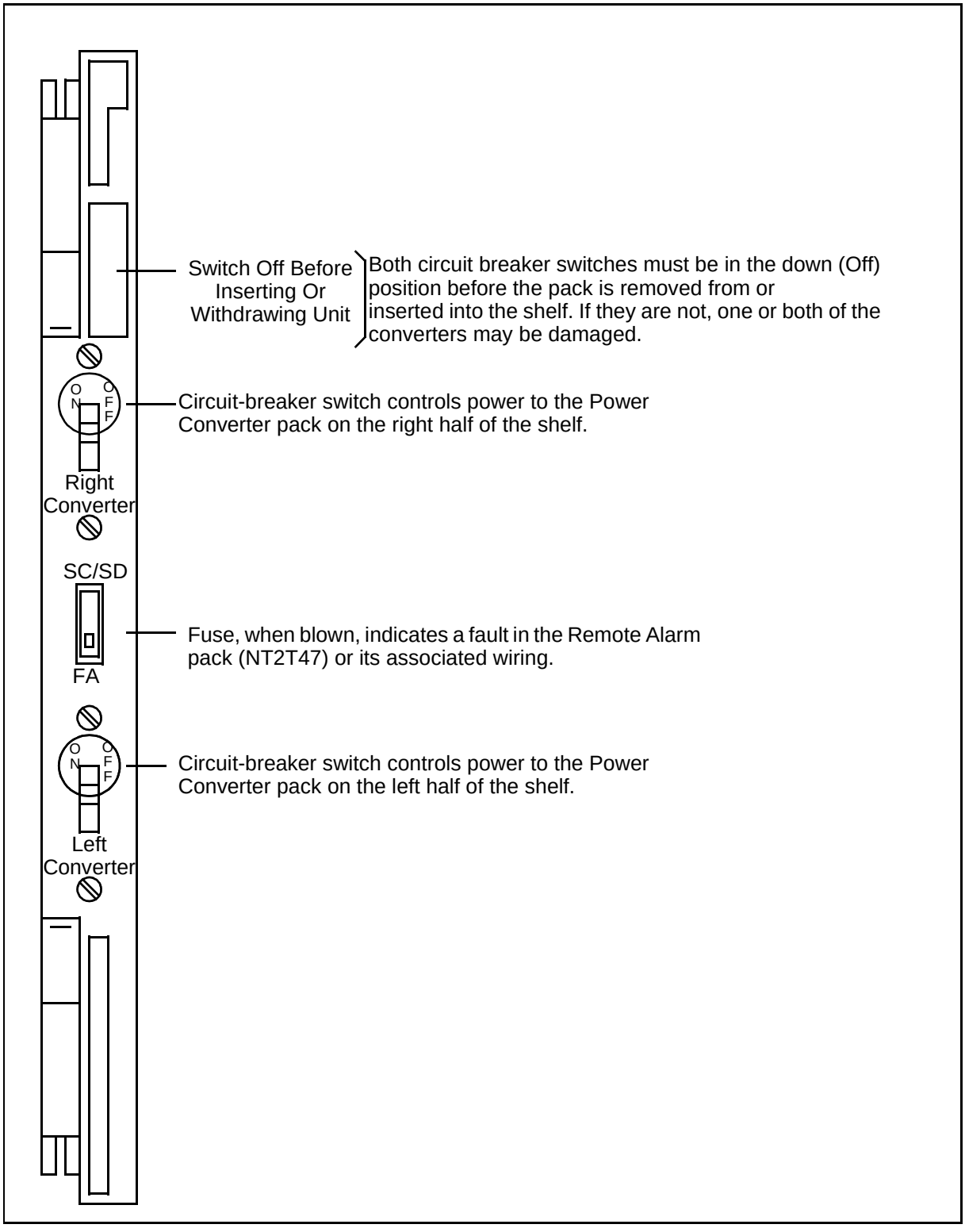


Figure 4-6: Peripheral Shelf Controller pack faceplate (NT2T41)

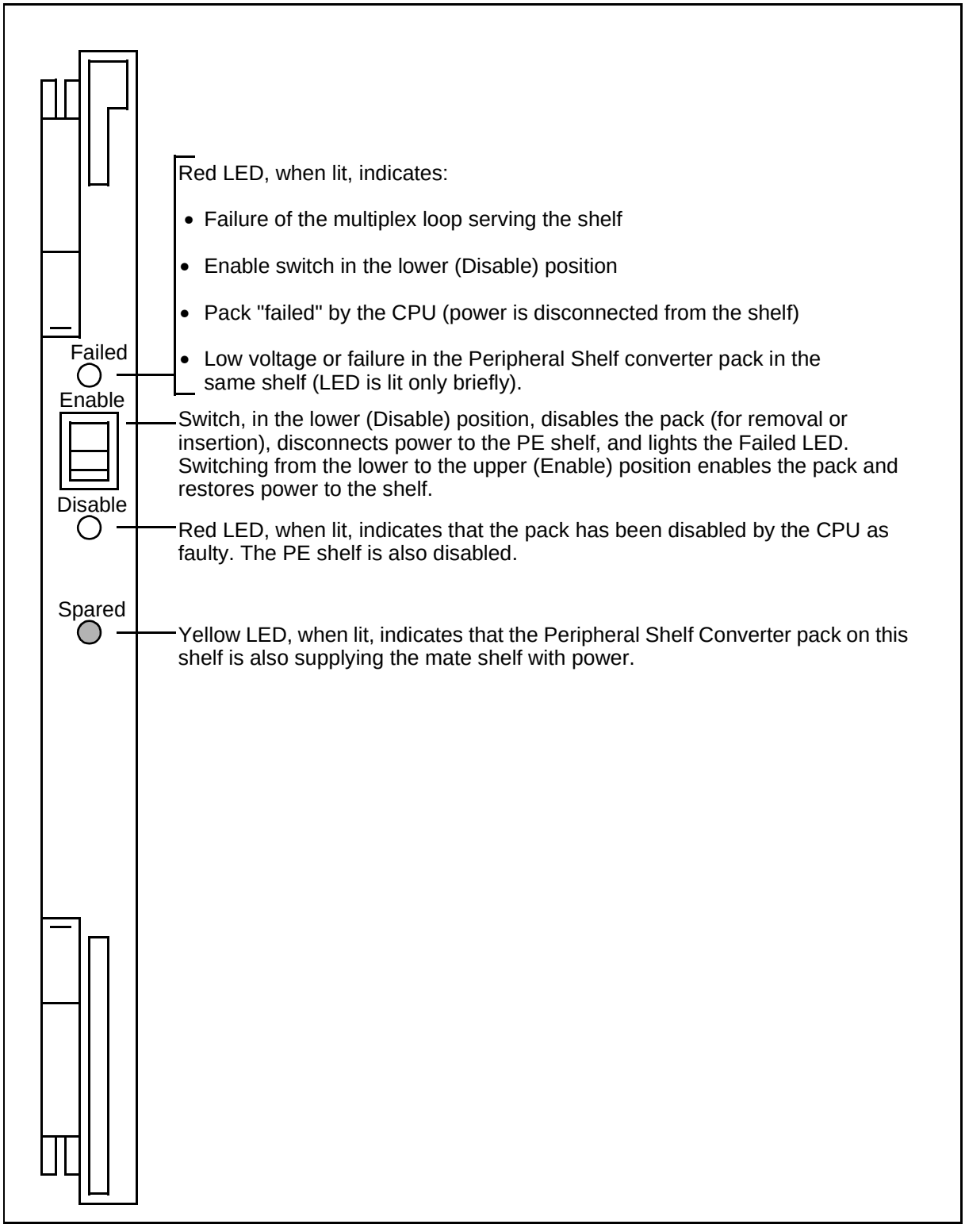


Figure 4-7: Peripheral Shelf Converter pack faceplate (NT2T42)

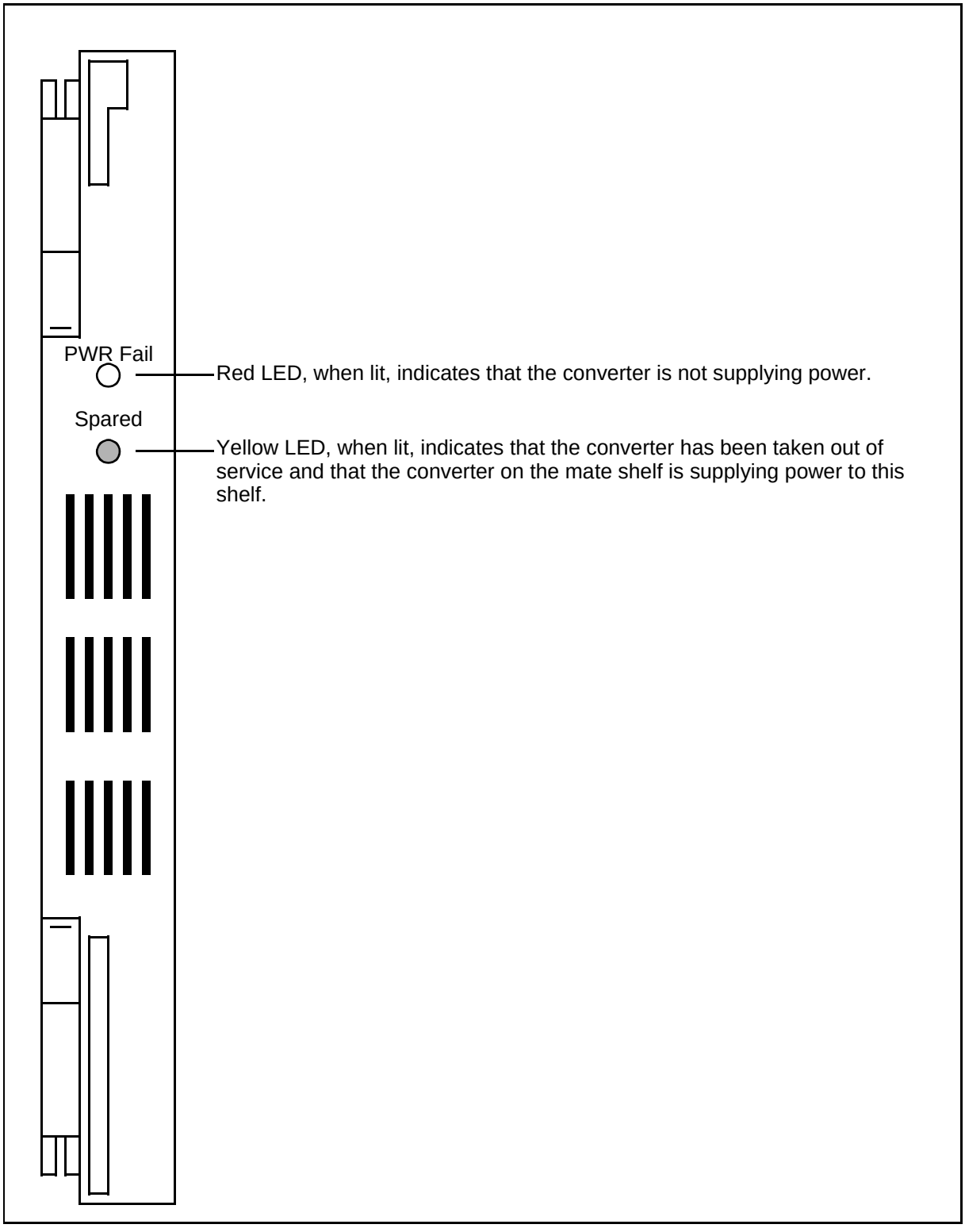


Figure 4-8: CAMA Position Signaling pack faceplate (NT2T48)

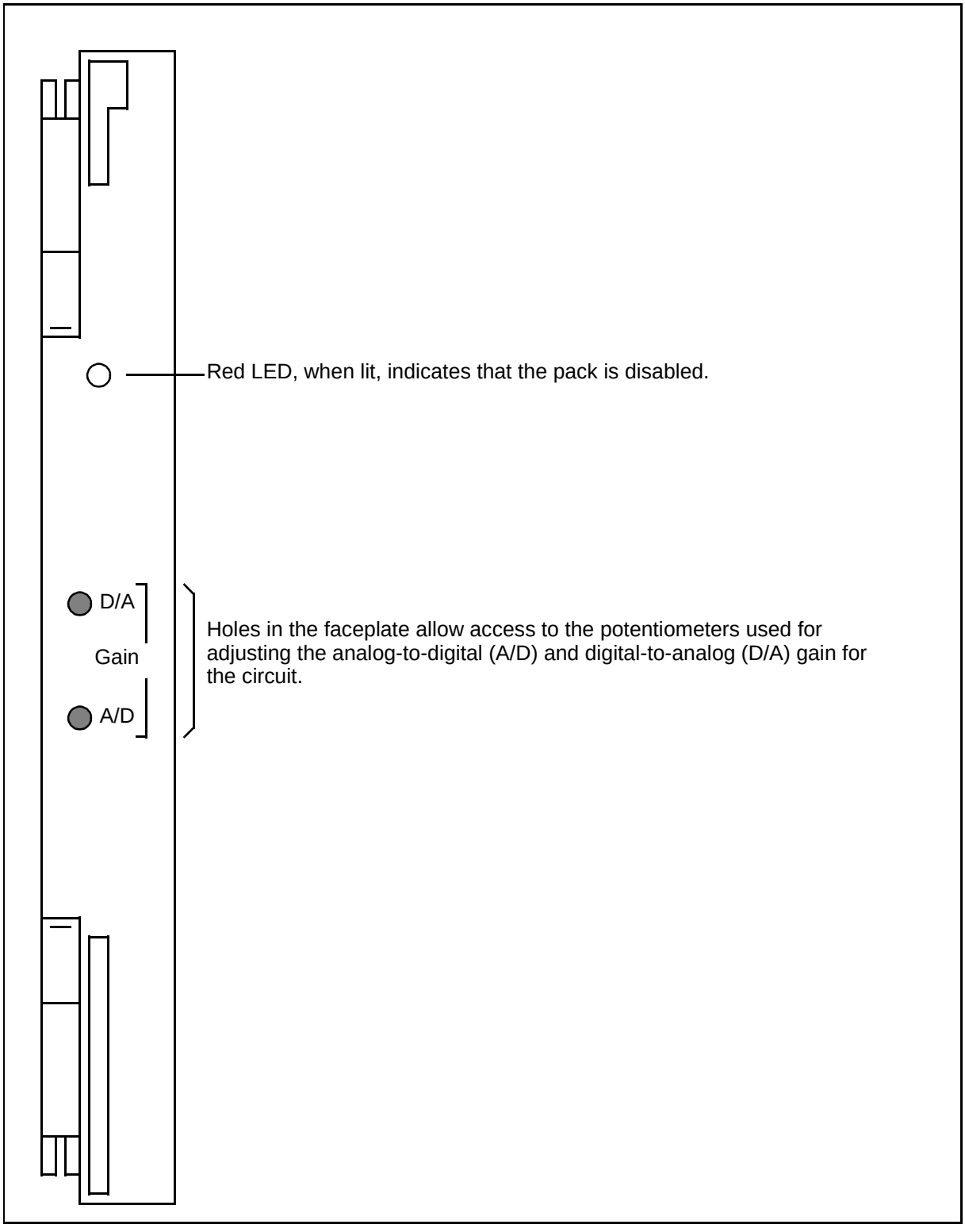


Figure 4-9: Facility Test pack faceplate (NT2T72)

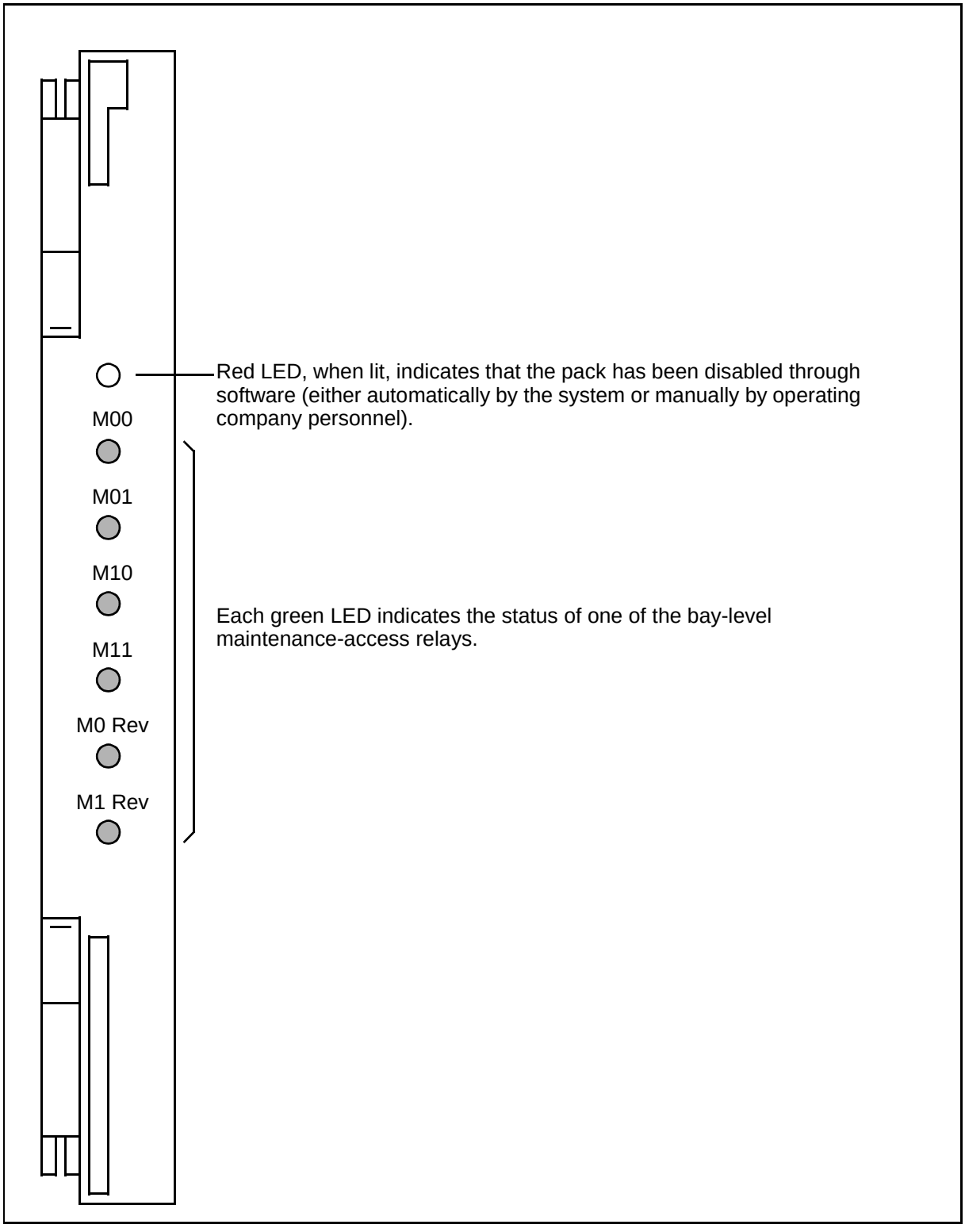


Figure 4-10: Digital Recorded Announcement pack faceplate (NT2T85)

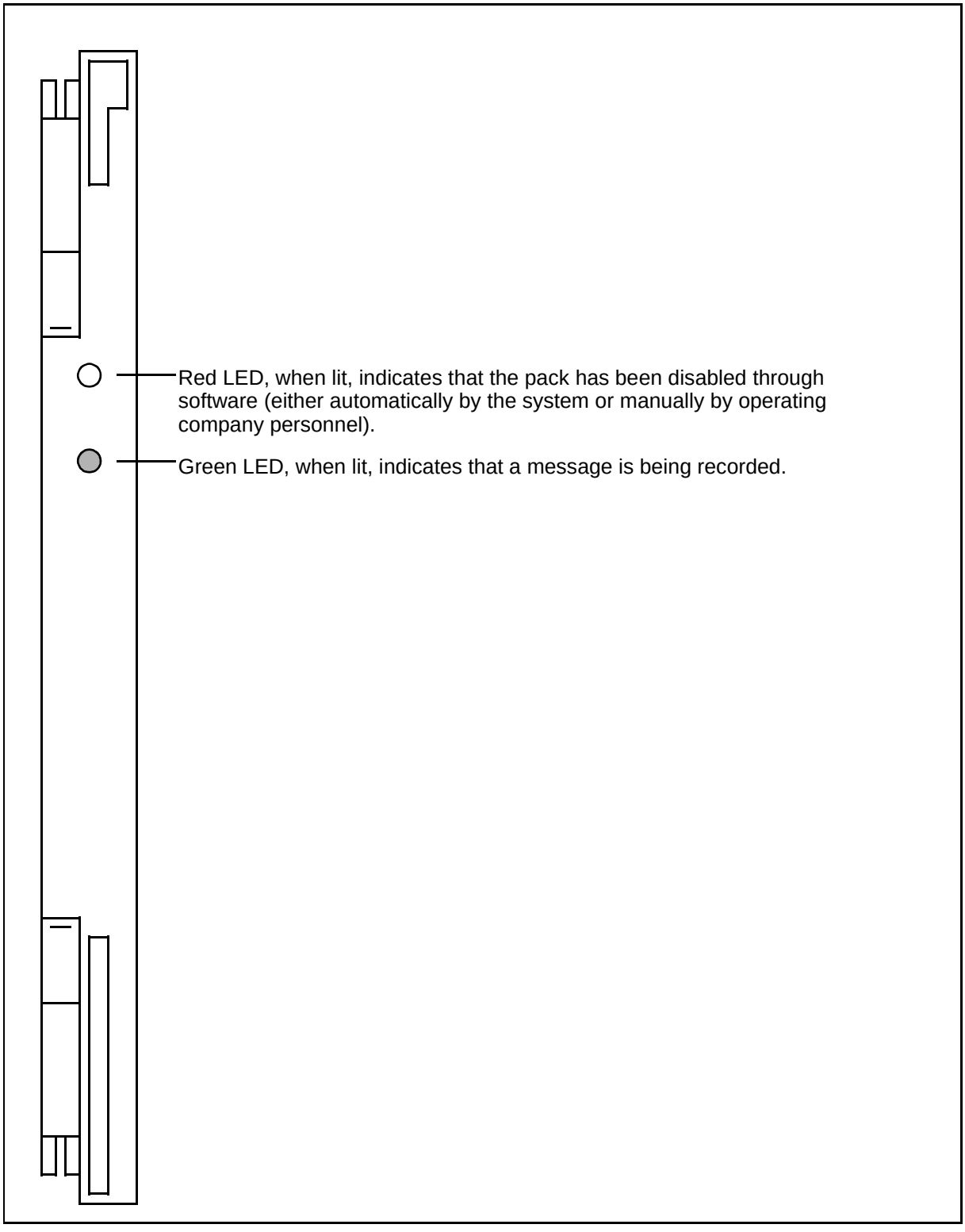


Figure 4-11: Common Feature Power Converter pack faceplate (NT2X06)

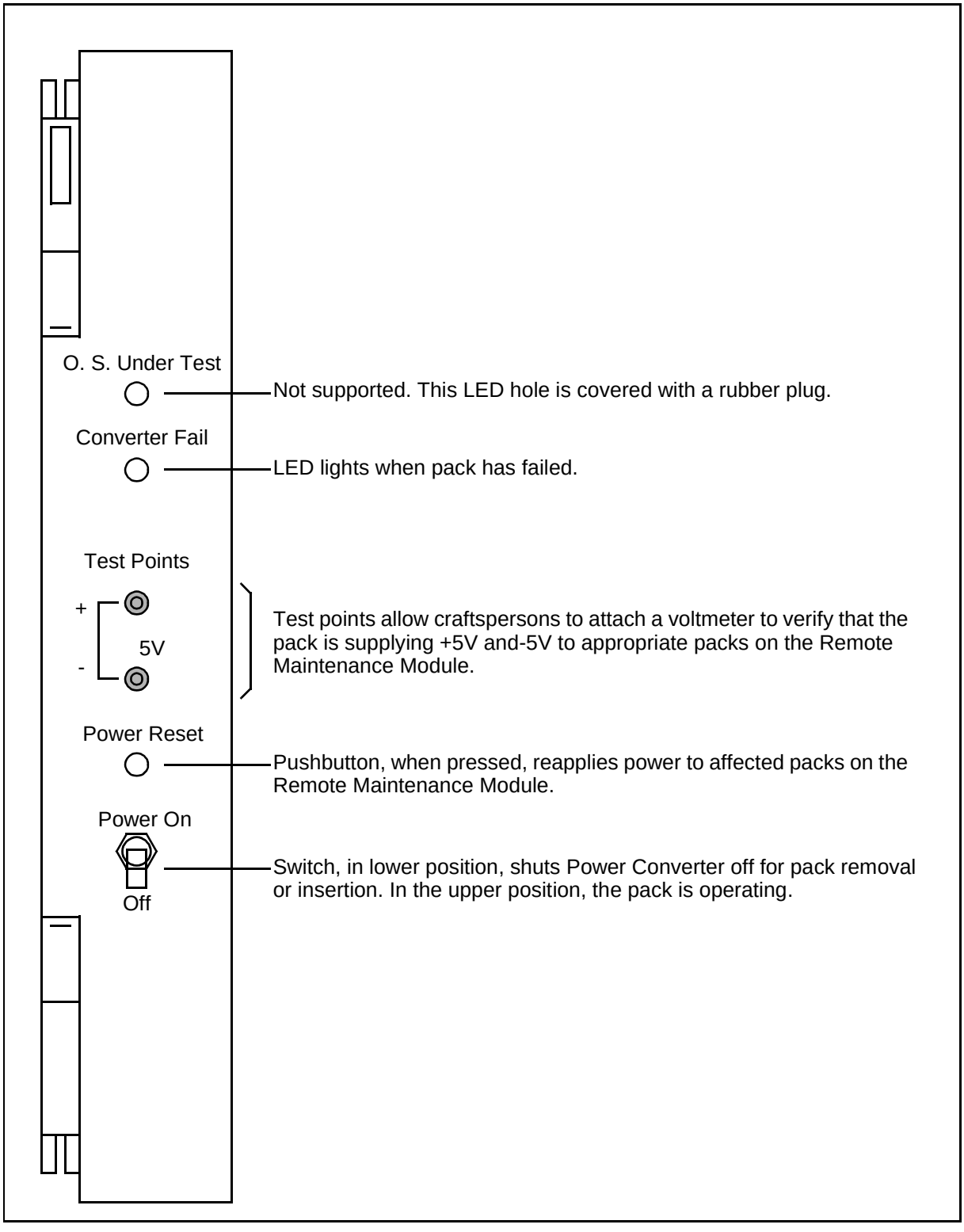


Figure 4-12: Multi-Output Power Converter pack faceplate (NT2X09)

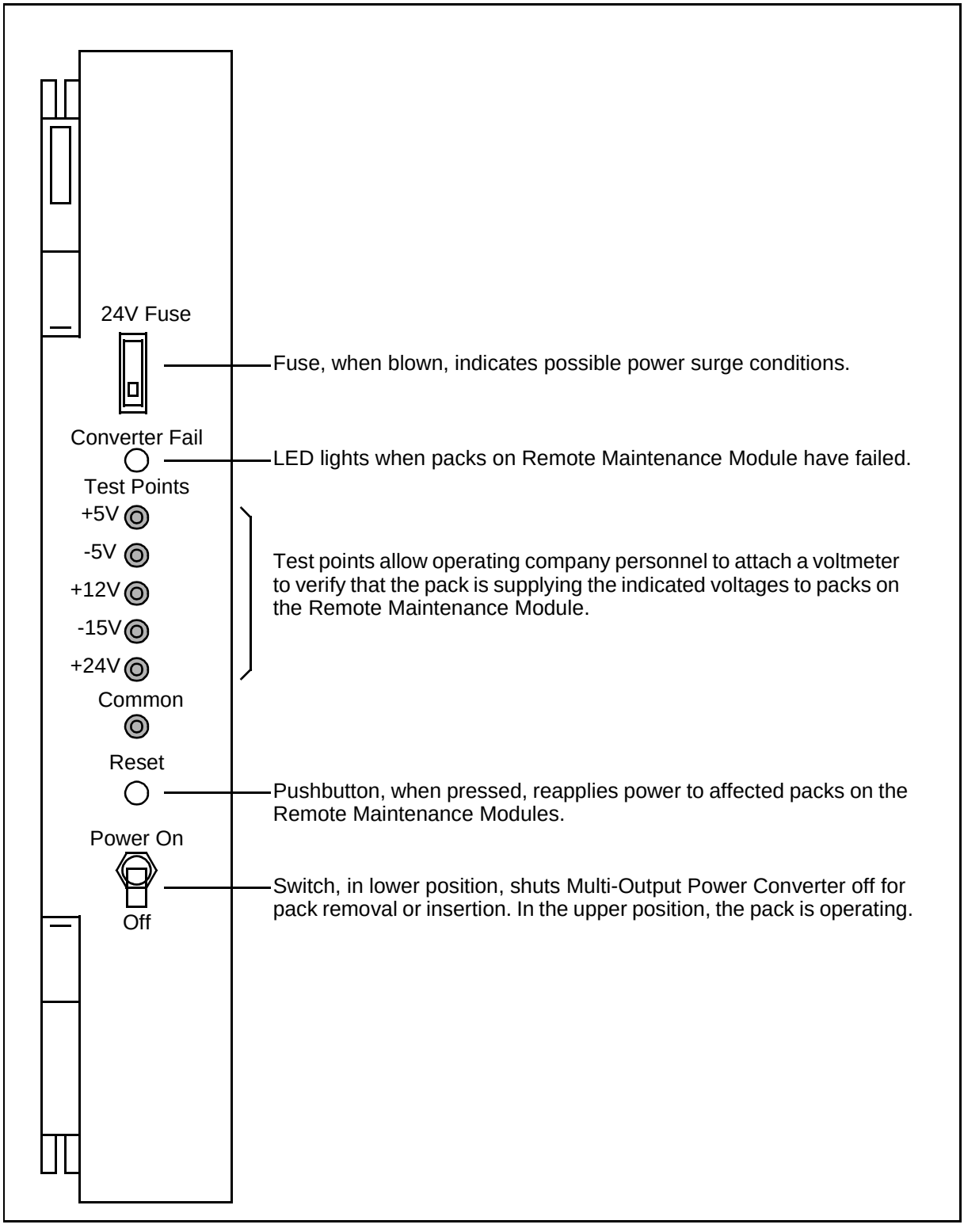


Figure 4-13: Line Test Unit-Analog pack faceplate (NT2X10)

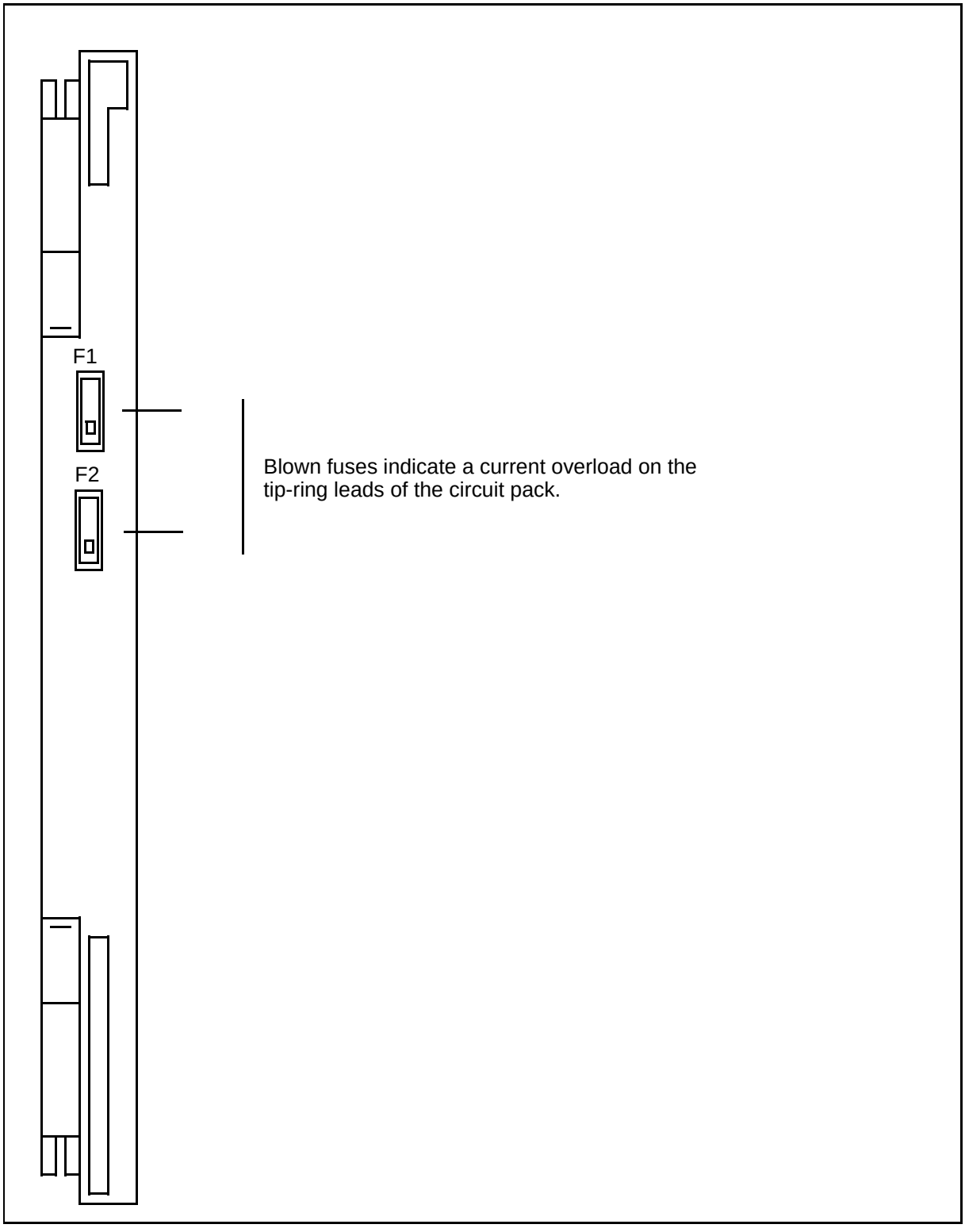


Figure 4-14: Power Converter pack faceplate (NT2X70)

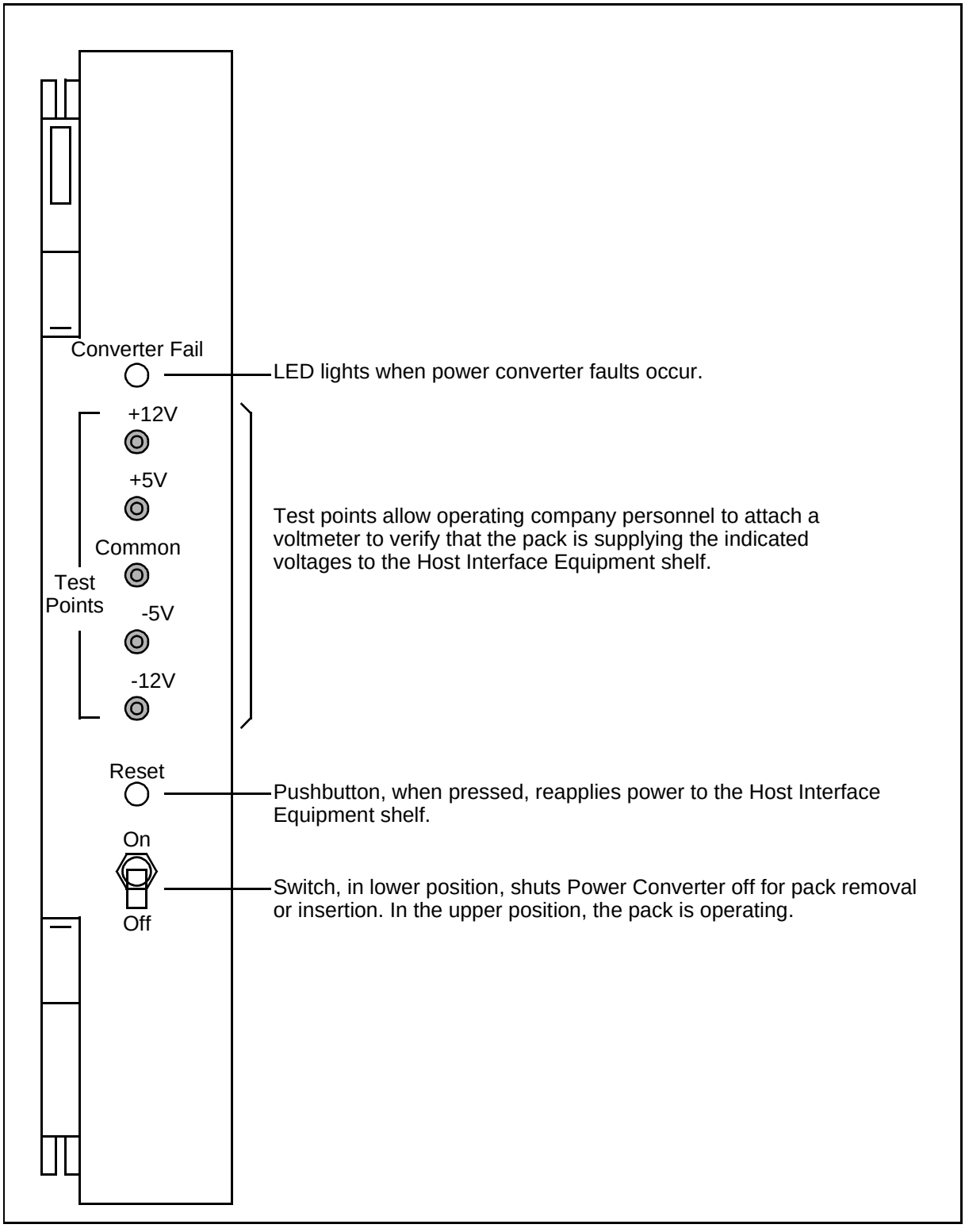


Figure 4-15: Power Converter pack faceplate (NT2X70AE)

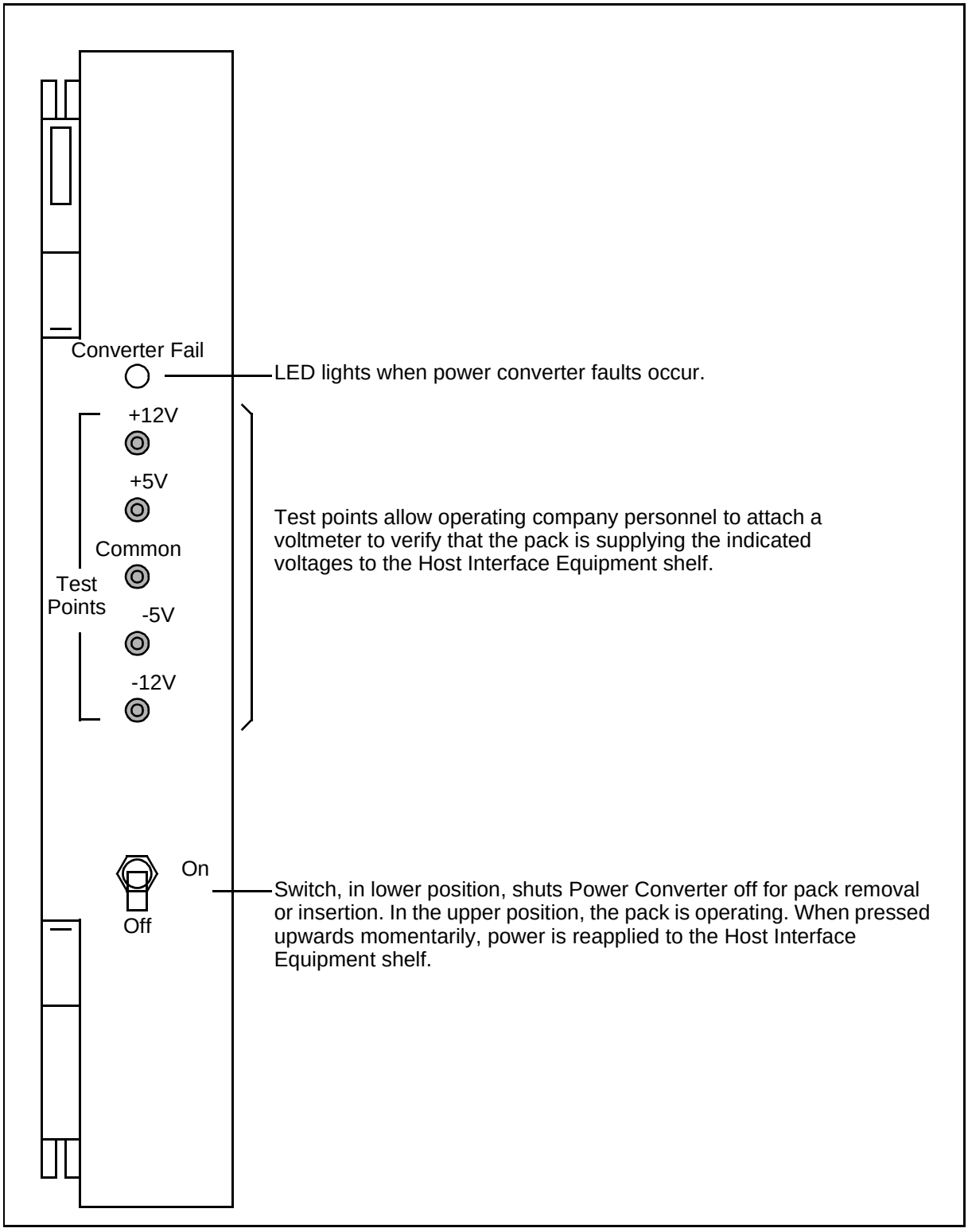


Figure 4-16: Serial Data Interface pack faceplate (NT3T09)

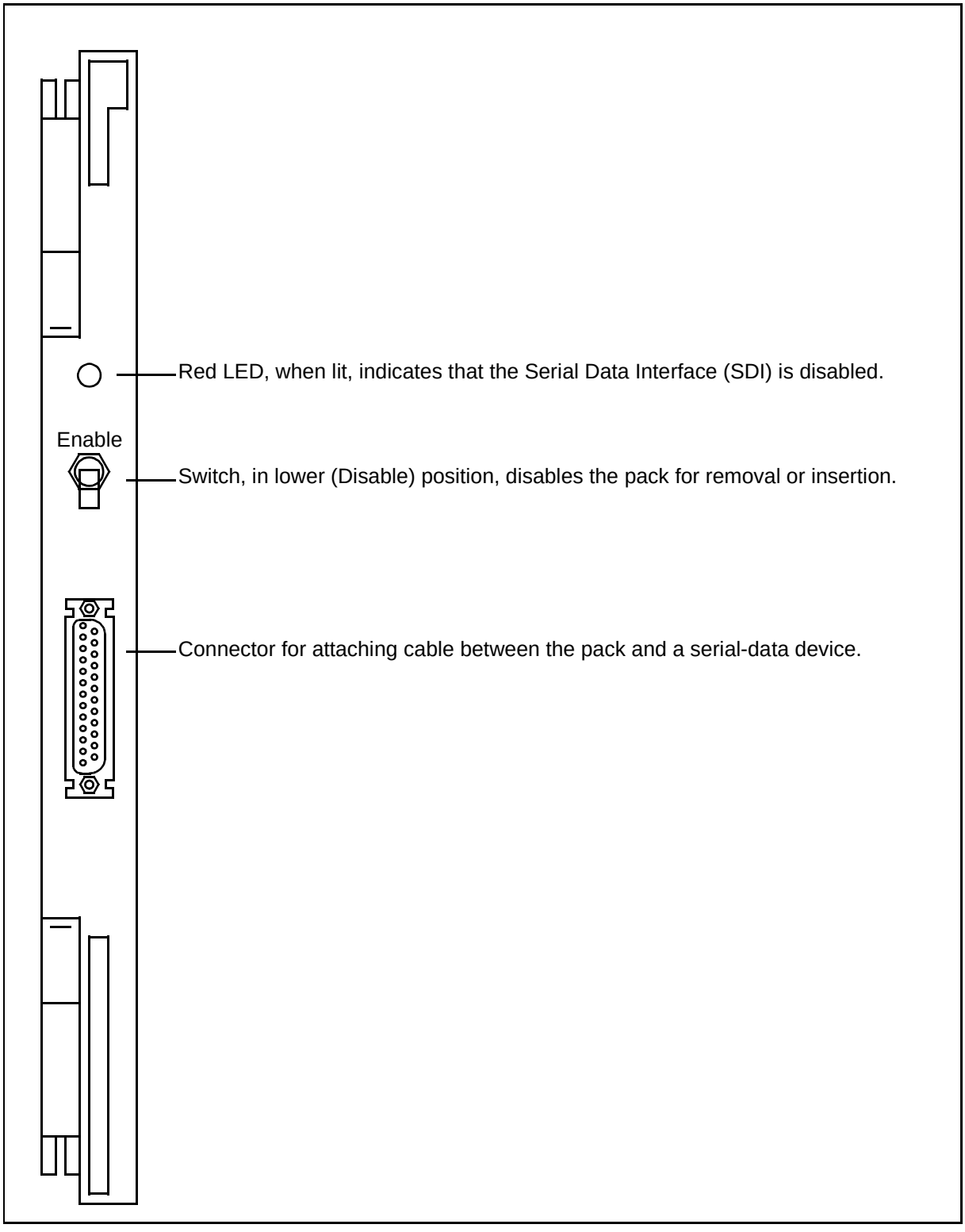


Figure 4-17: Power Converter pack faceplate (NT3T19AE and later)

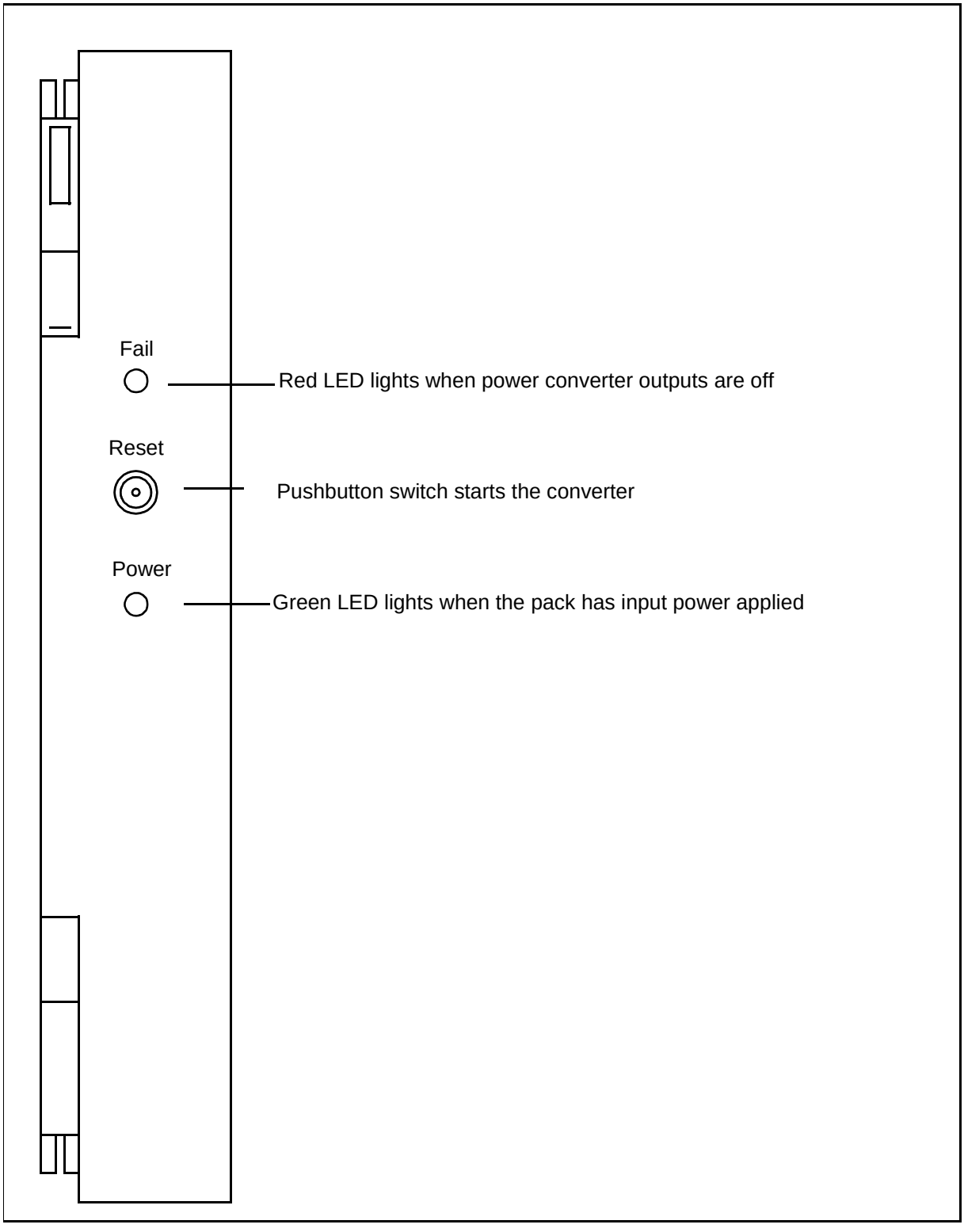
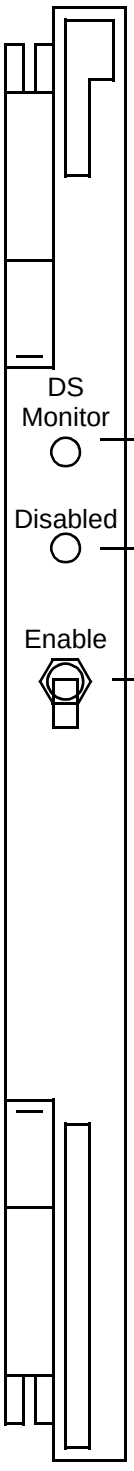


Figure 4-18: Ringing and Alarm Control pack faceplate (NT3T55)



Red LED, when lit while the Enable switch is in the lower (Disable) position, indicates an active Dead System alarm.

Red LED, when lit, indicates that the pack has been disabled though the operation of the switch to the lower position or through software (either automatically by the system or manually by operating company personnel).

Switch, in the lower (Disable) position, disables the pack for removal from or insertion into the shelf.

Note: When inserting the Ringing and Alarm Control pack into the Alarm and Ringing Module, the Dead System Monitor LED will be illuminated briefly. Wait until the LED is extinguished before moving the toggle switch to the upper (Enable) position; this will prevent the generation of a spurious catastrophic alarm.

Figure 4-19: System Bus Controller pack faceplate (NT3T70BA)

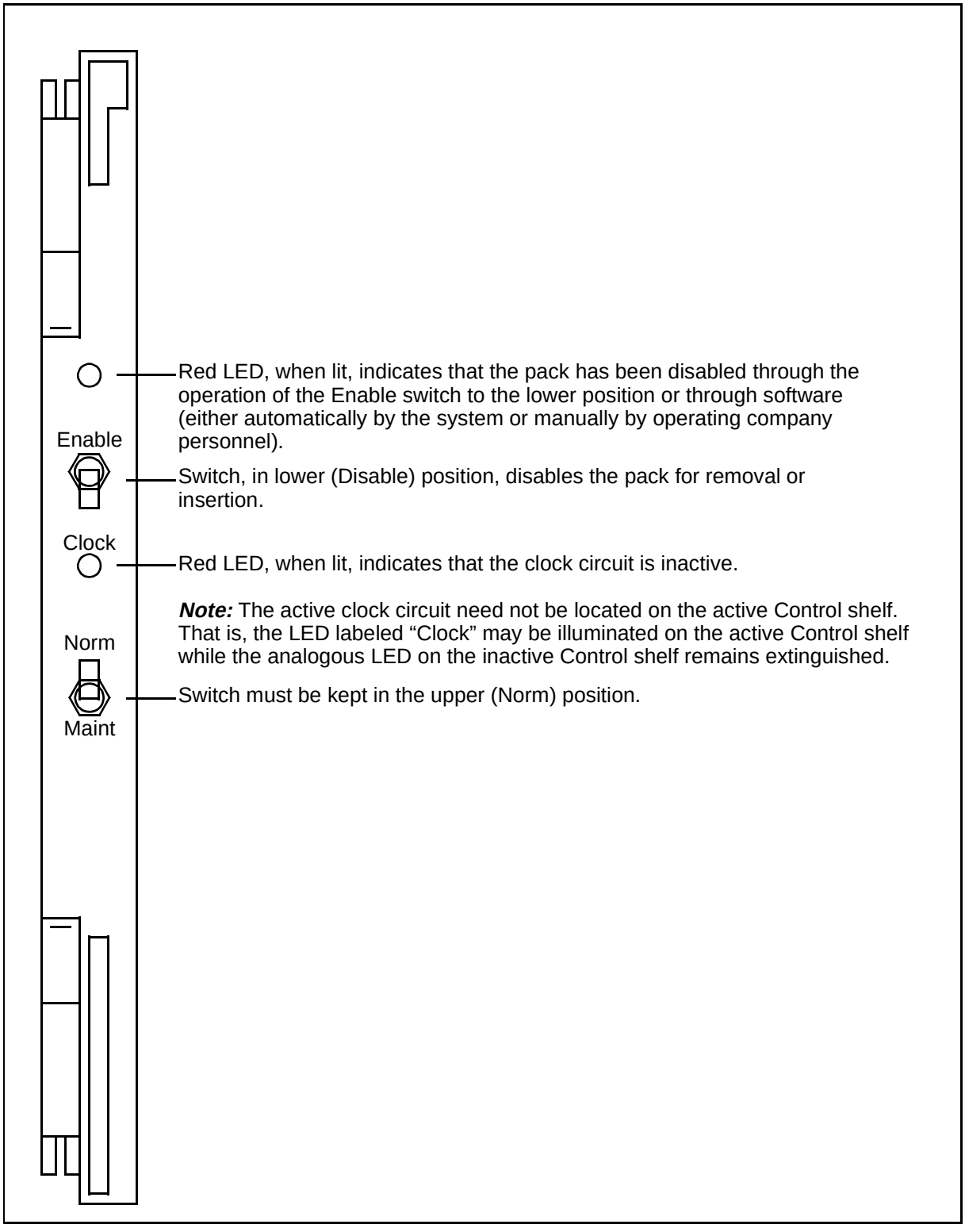


Figure 4-20: System Bus Controller pack faceplate (NT3T70BC)

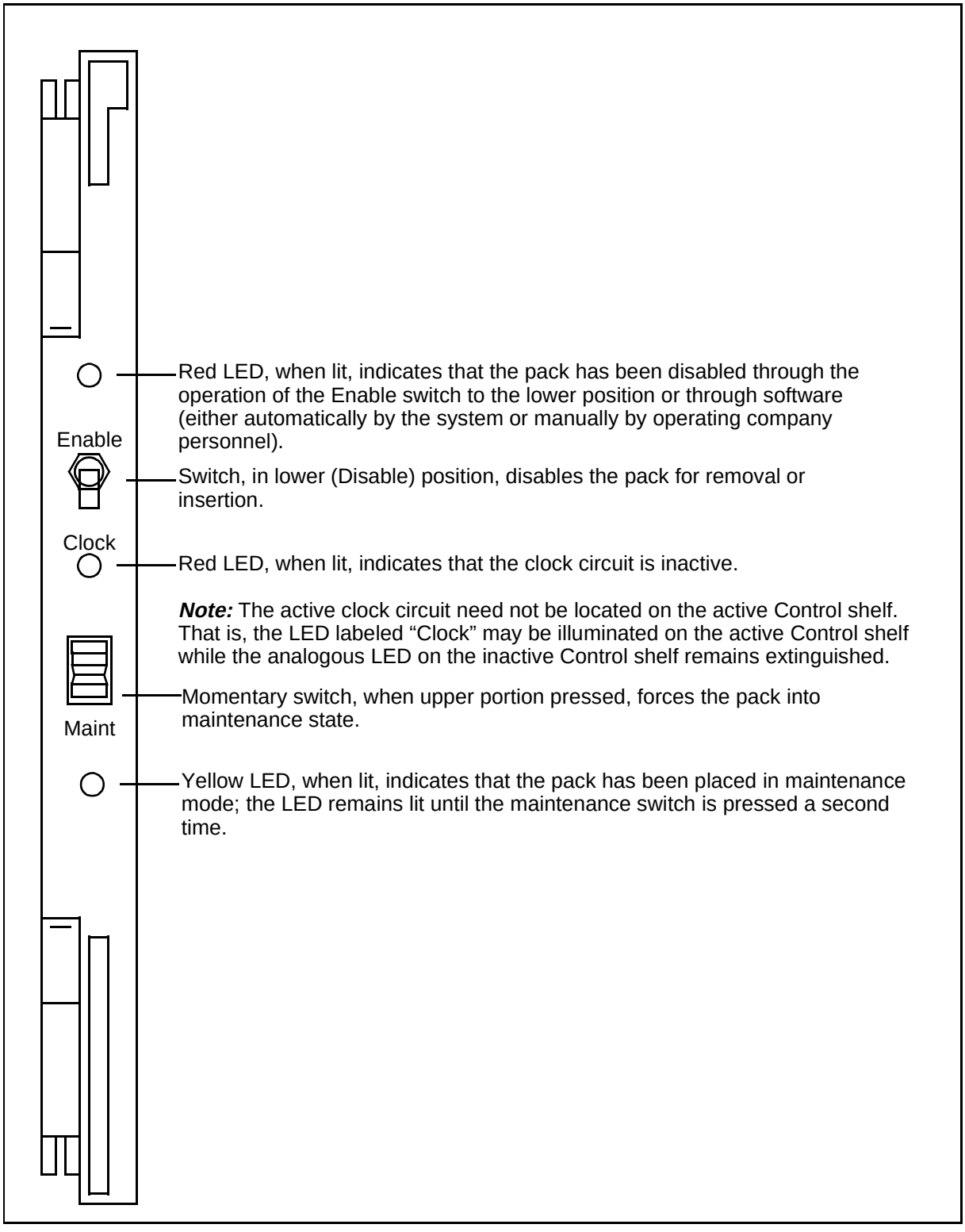


Figure 4-21: System Bus Controller pack (NT3T70BD) faceplate

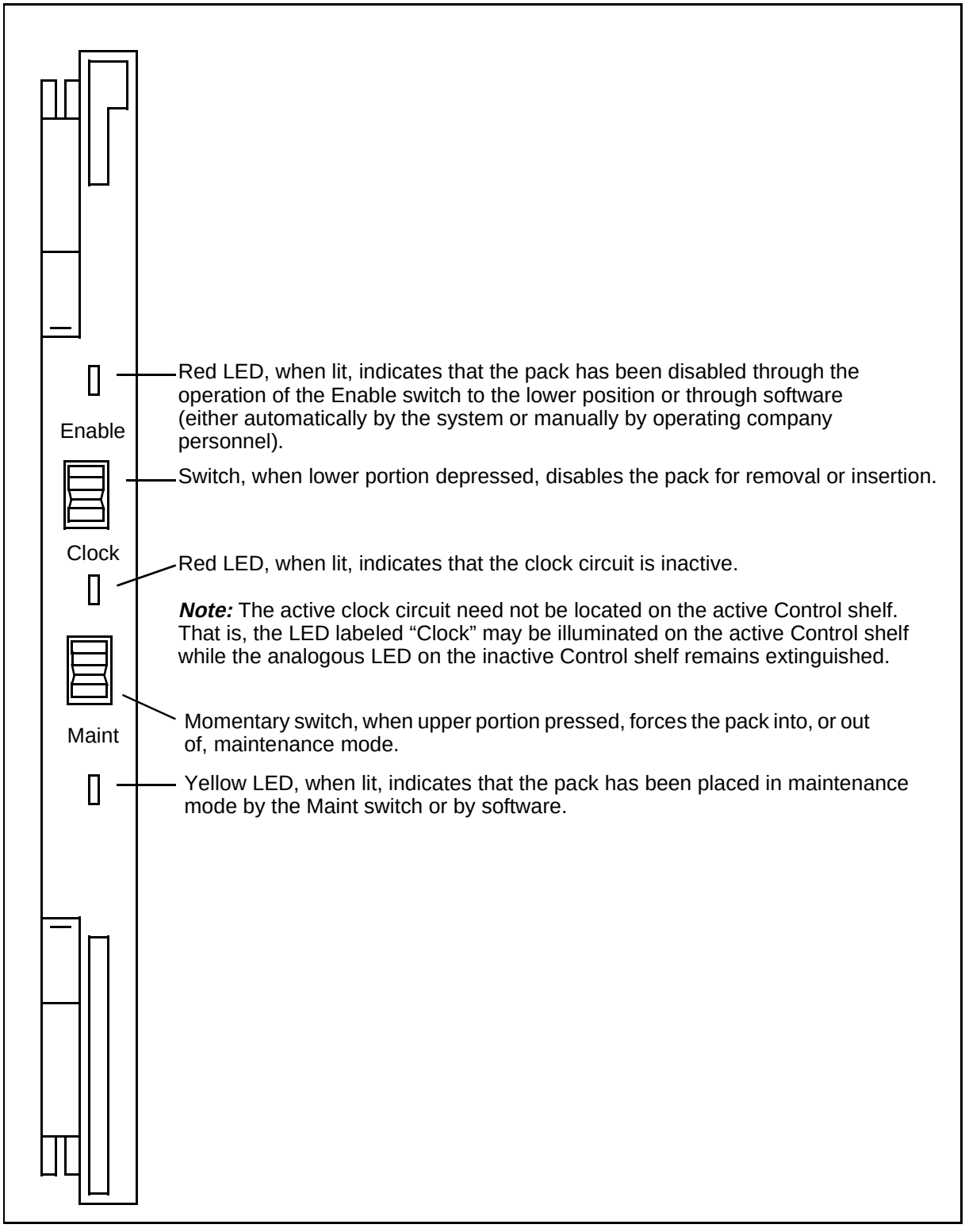


Figure 4-22: Maintenance Interface pack faceplate (NT3T71)

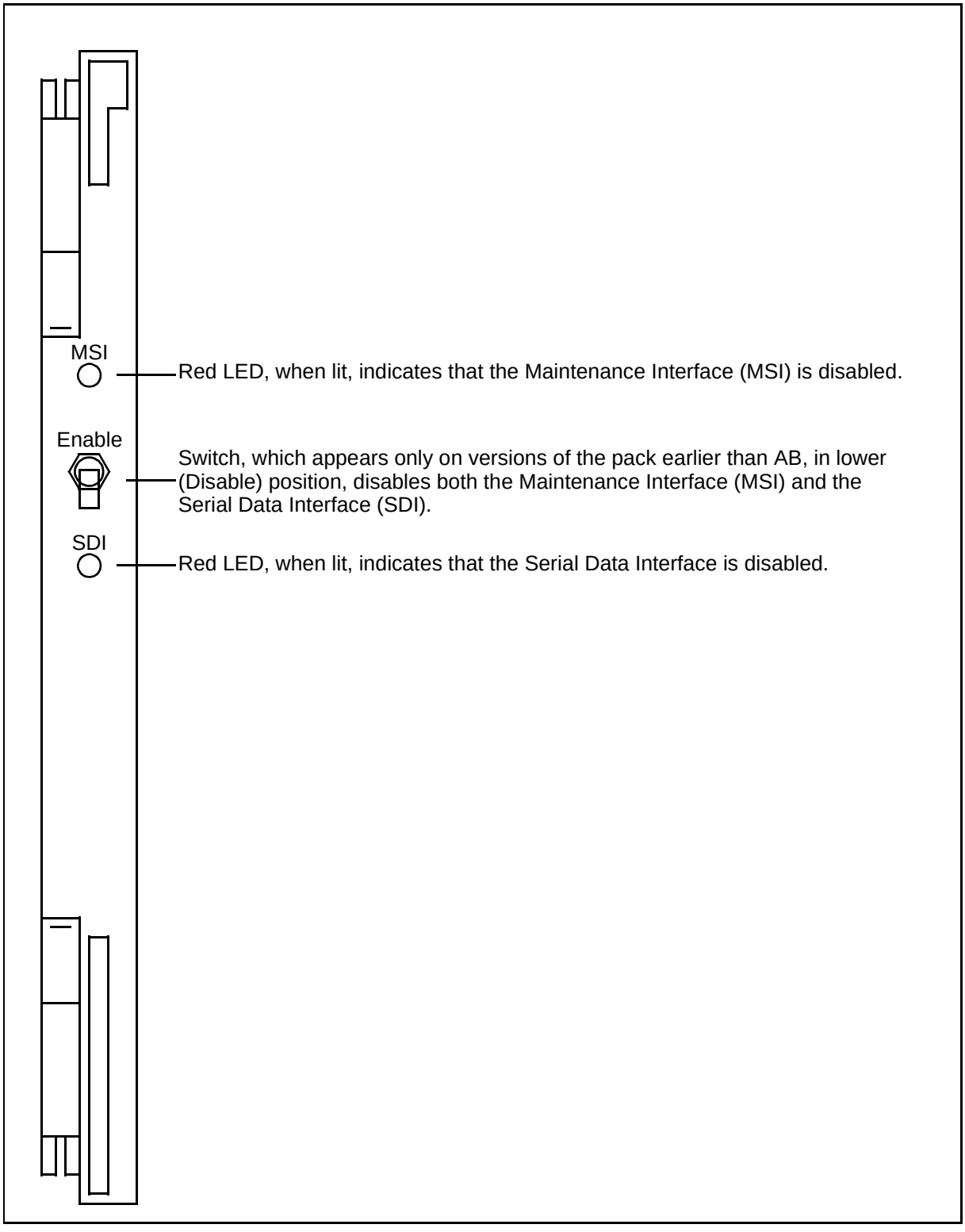


Figure 4-23: Dual Serial Data Interface pack faceplate (NT3T80BA)

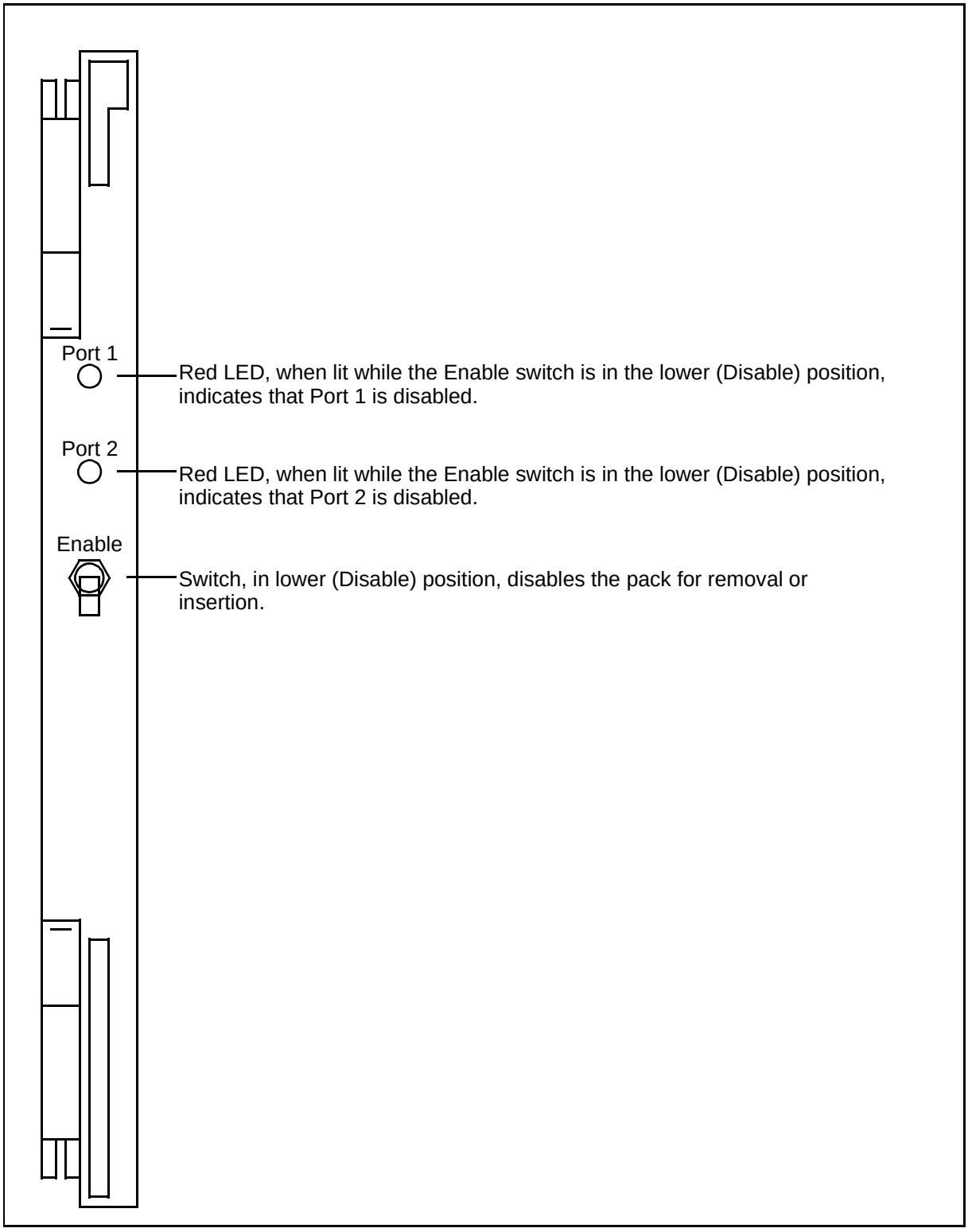


Figure 4-24: Dual Serial Data Interface pack faceplate (NT3T80BB)

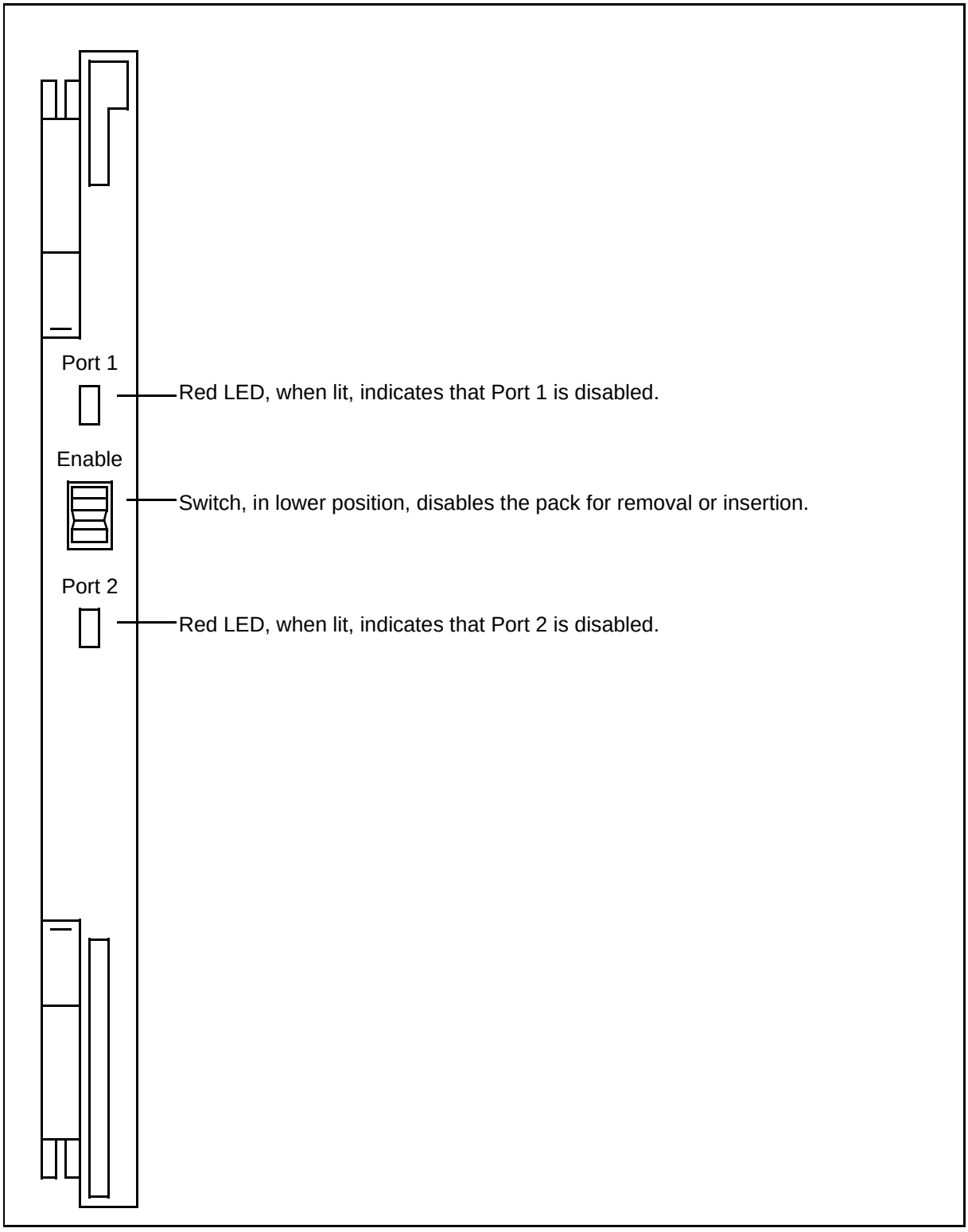


Figure 4-25: Dual Integrated Modem pack faceplate (NT3T93)

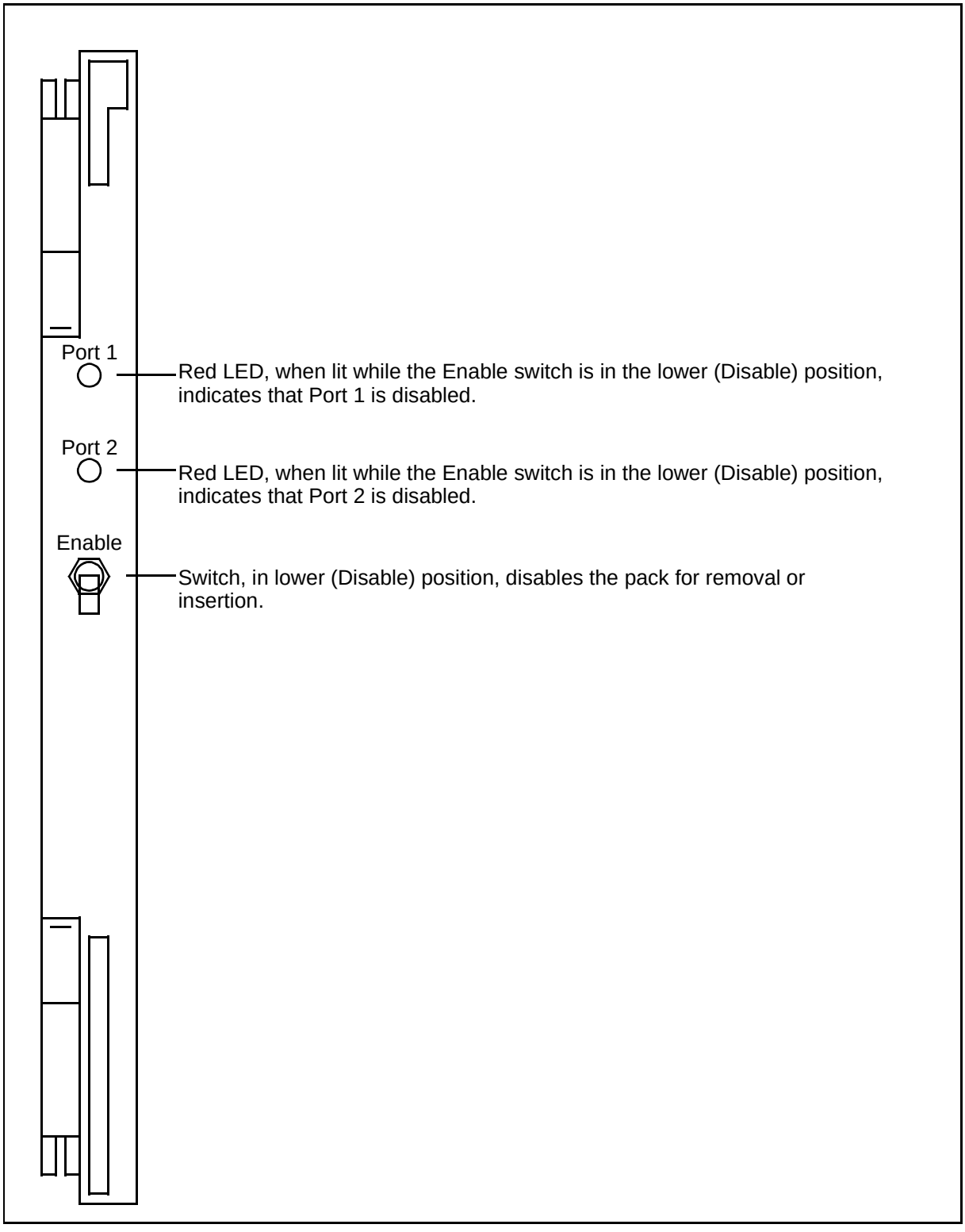


Figure 4-26: System Processor pack (NT3T98)

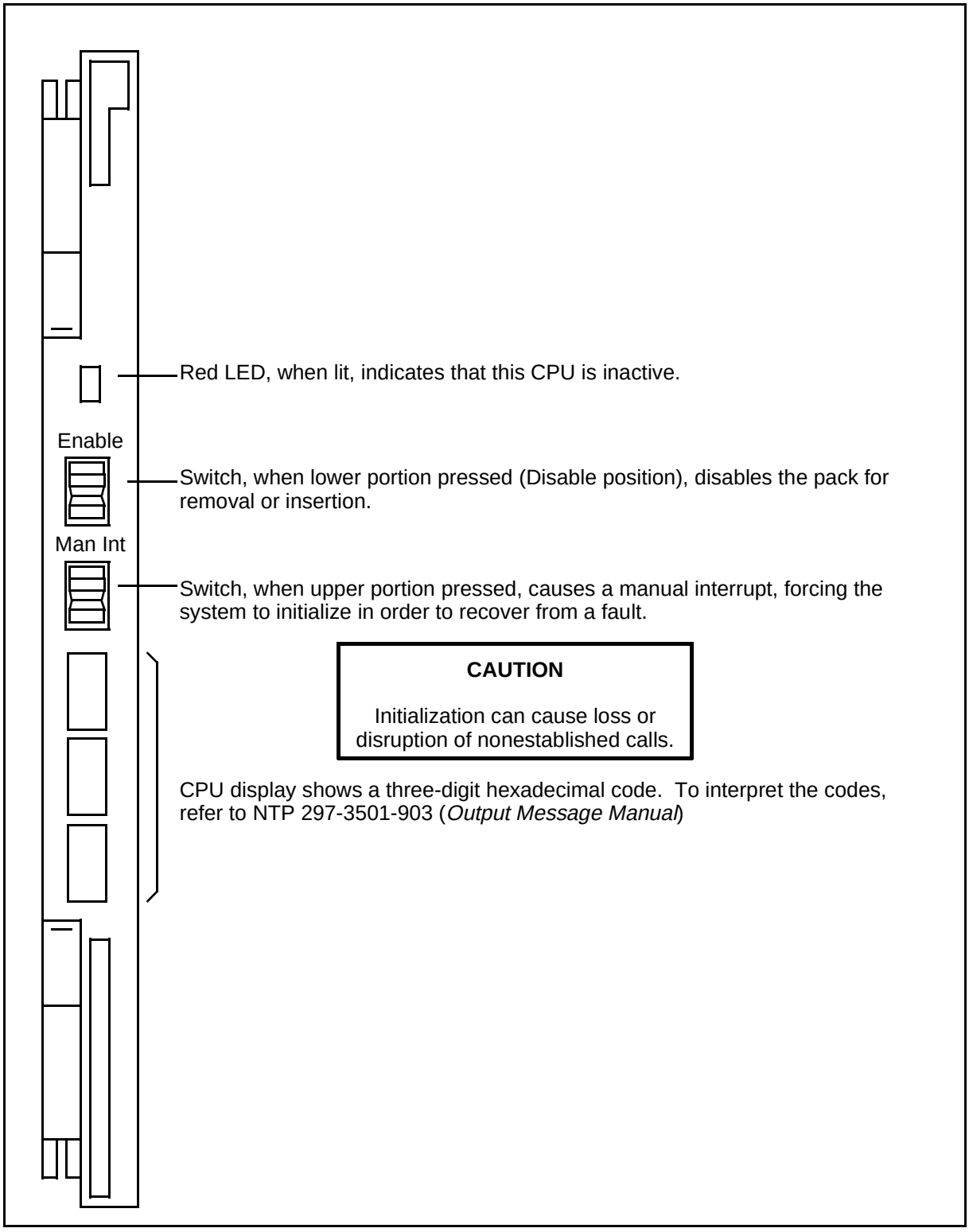


Figure 4-27: Hard Disk Drive faceplate (NT4T31AA)

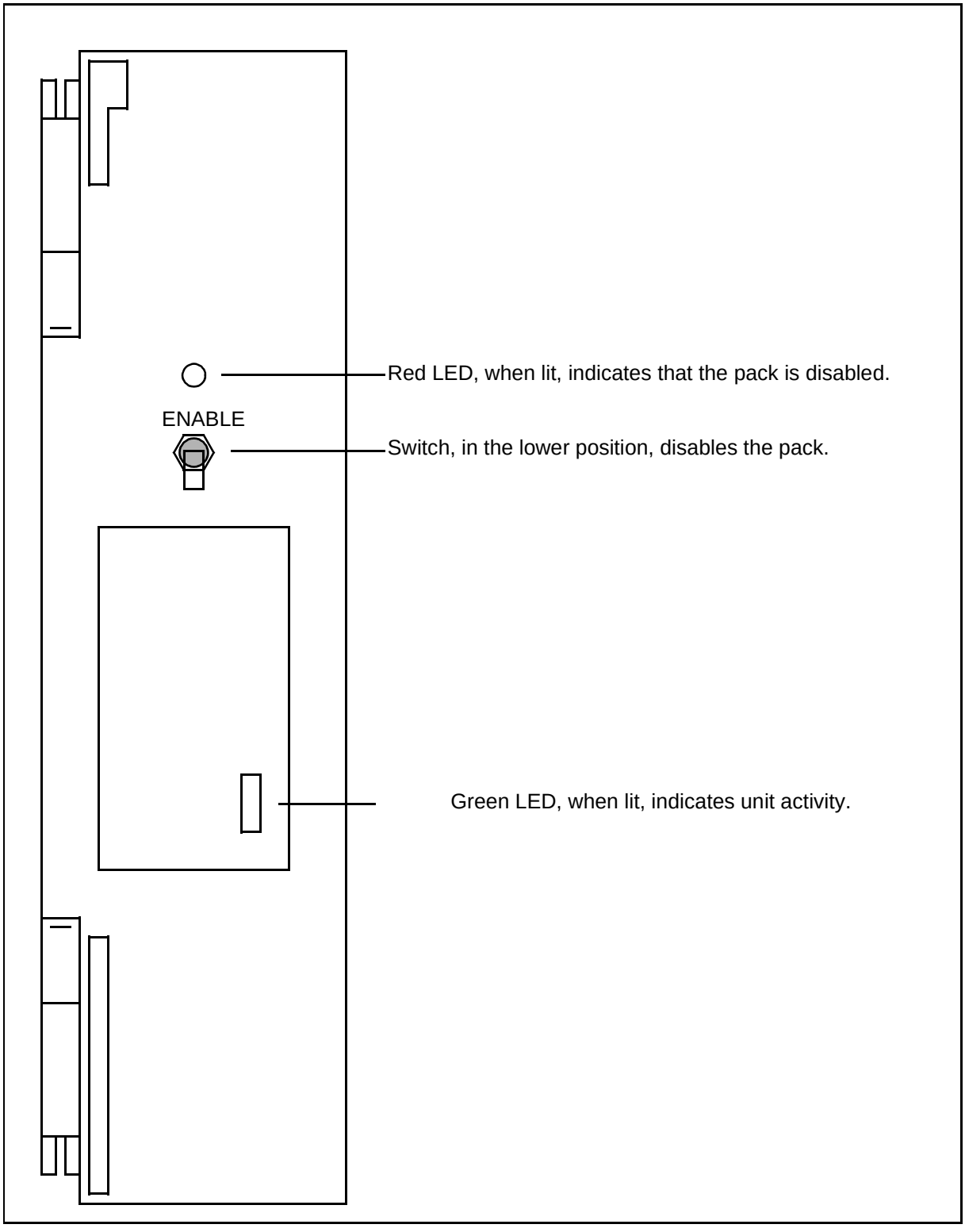


Figure 4-28: Hard Disk Drive faceplate (NT4T31BA)

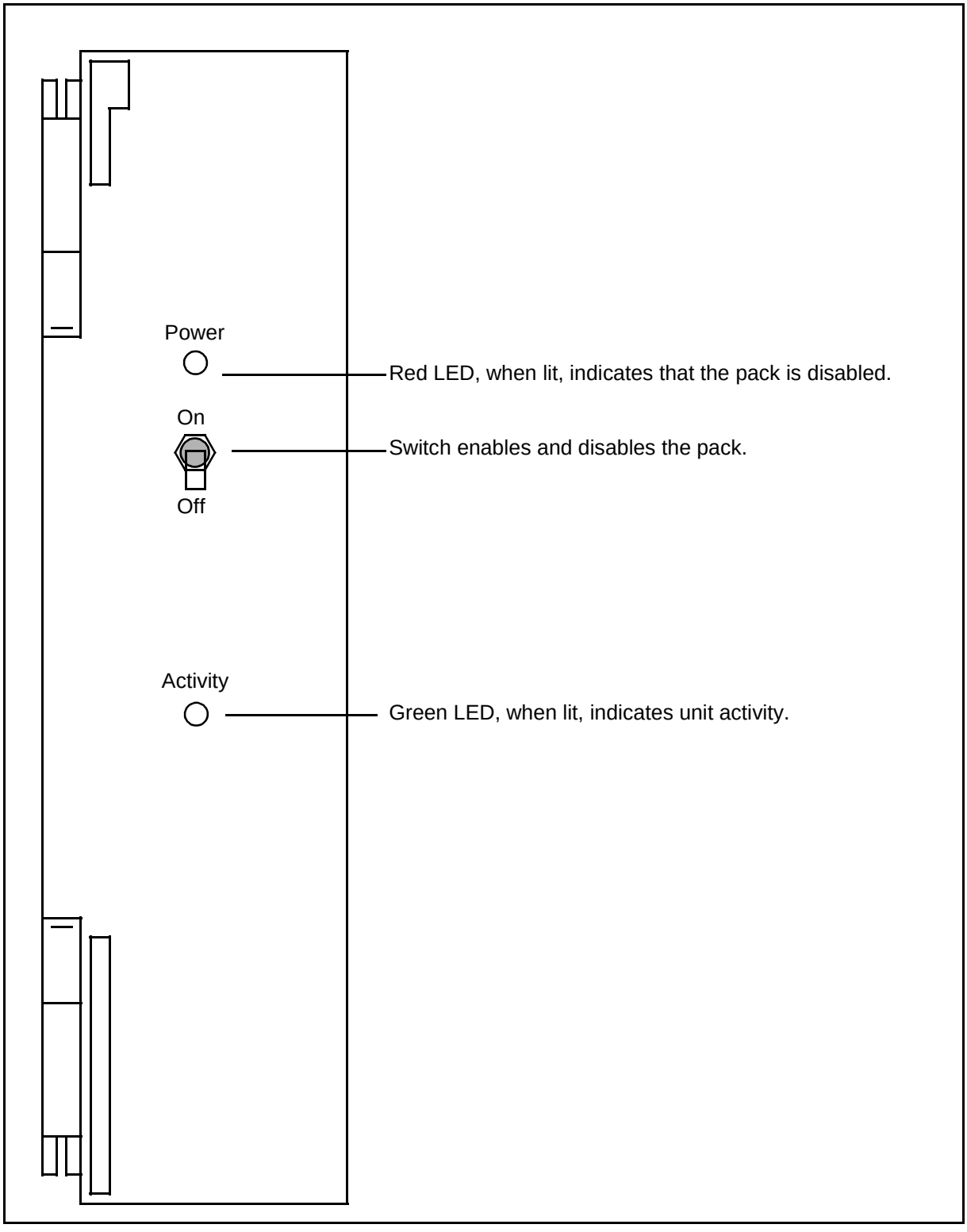


Figure 4-29: Magneto-Optical Mini-Disk Unit pack (NT4T32BA) faceplate

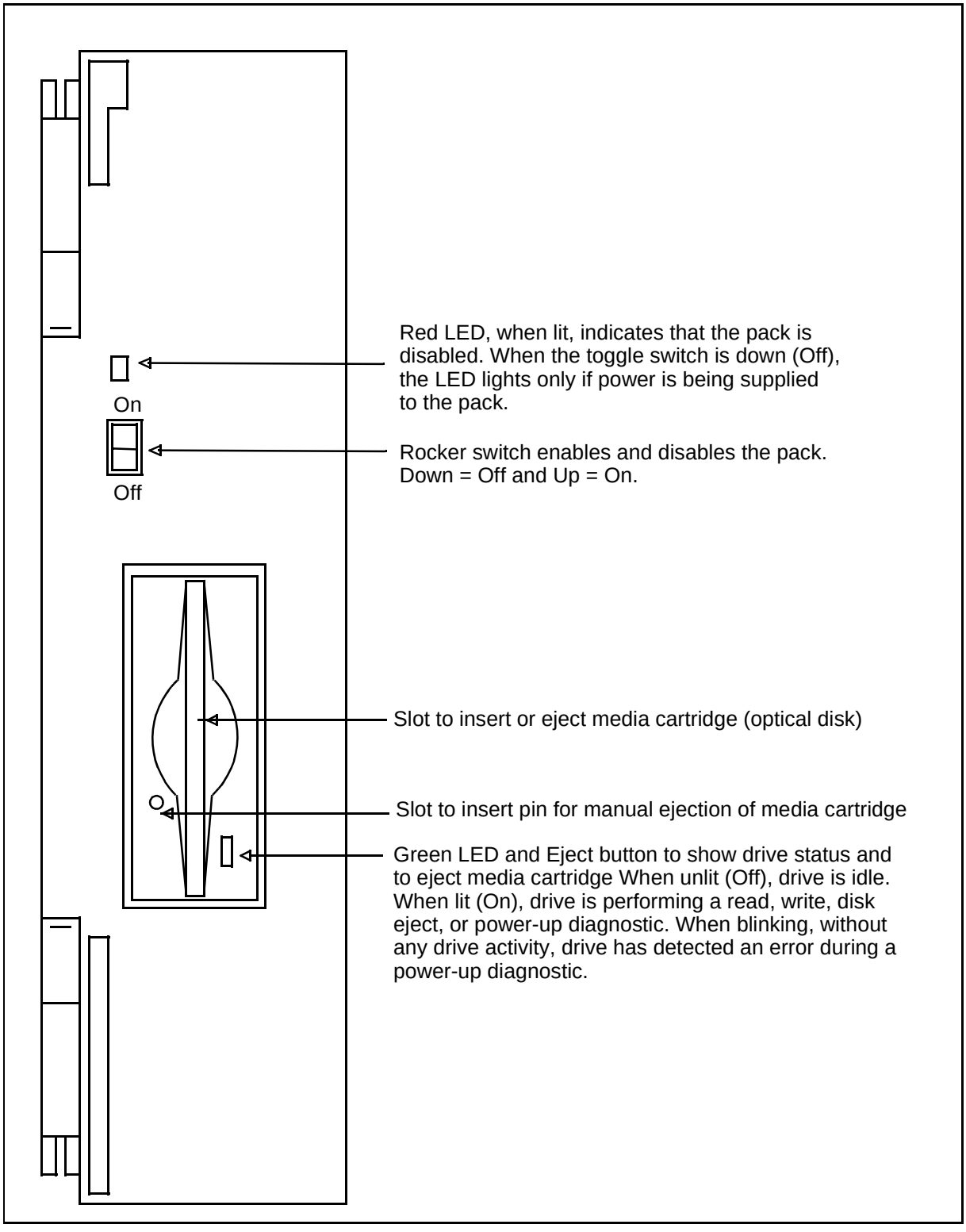


Figure 4-30: LCM Processor pack faceplate (NT6X51AC)

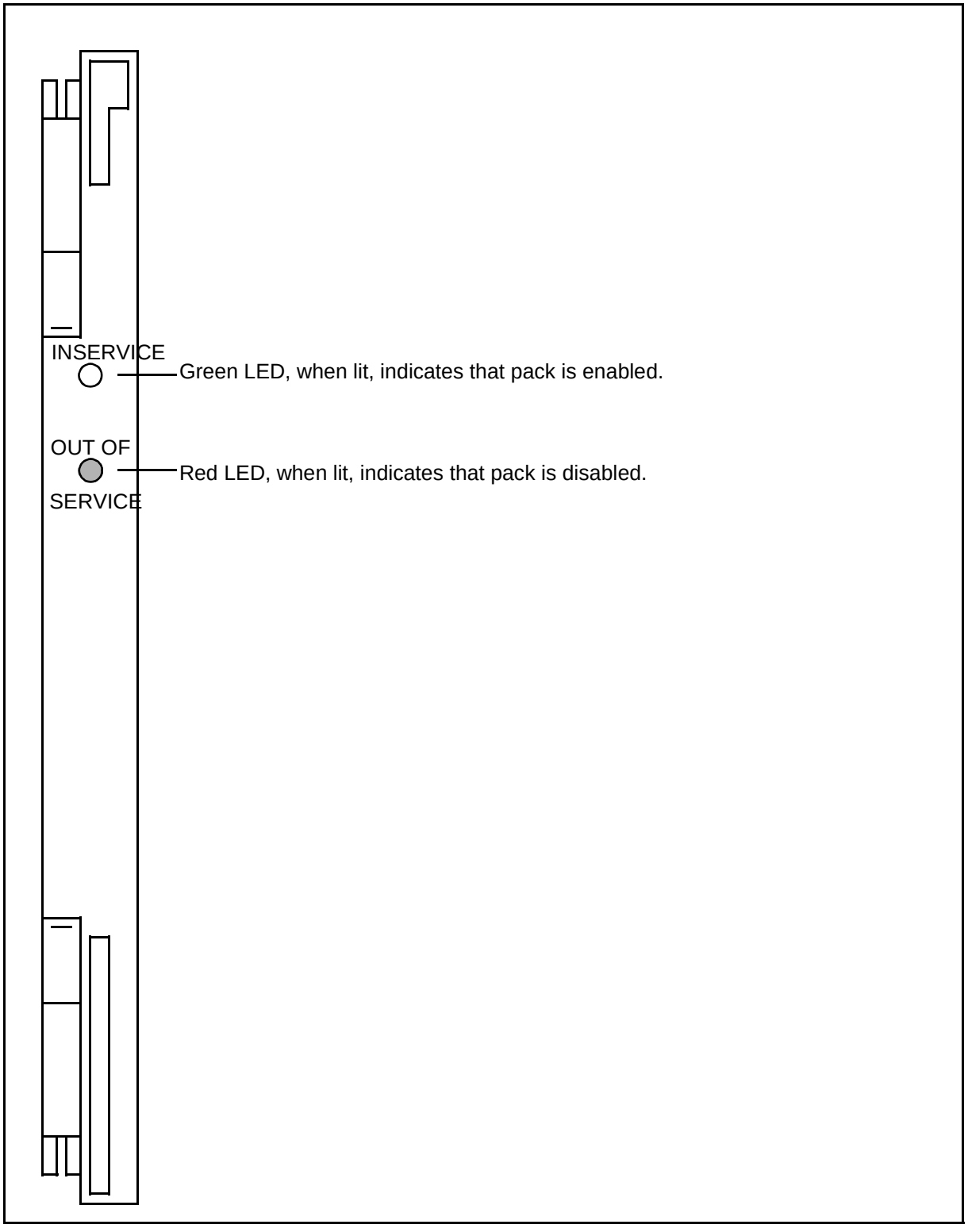


Figure 4-31: LCM Power Converter pack faceplate (NT6X53)

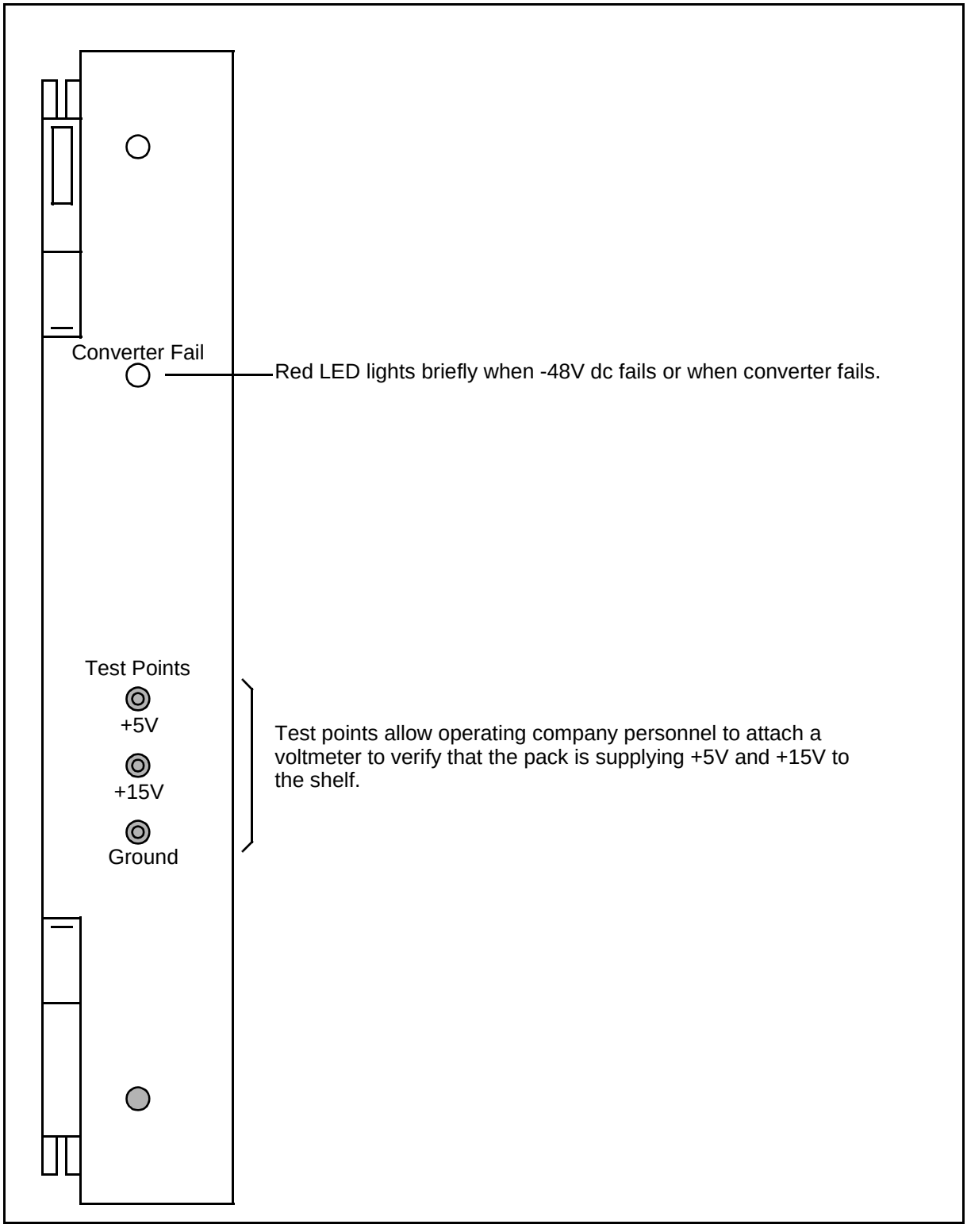


Figure 4-32: ISDN Drawer Controller pack faceplate (NT6X54DA)

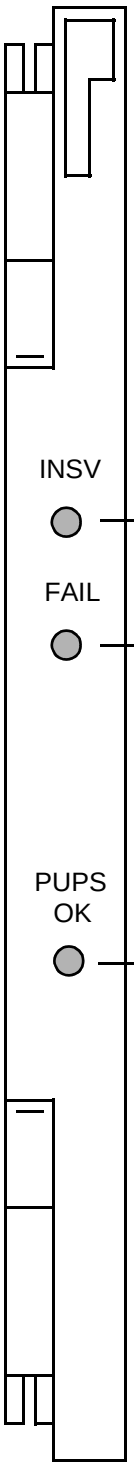


Table 4-I: -
NT6X54DA LED Indicators

	INSV	Fail	Explanation
State 1	on	off	IDC is active, do not remove
State 2	on	on	Lamp test, appears briefly after power-up
State 3	off	on	IDC can be removed
State 4	off	off	Unknown condition, testing is required

Figure 4-33: Network pack faceplate (NT8T06AA)

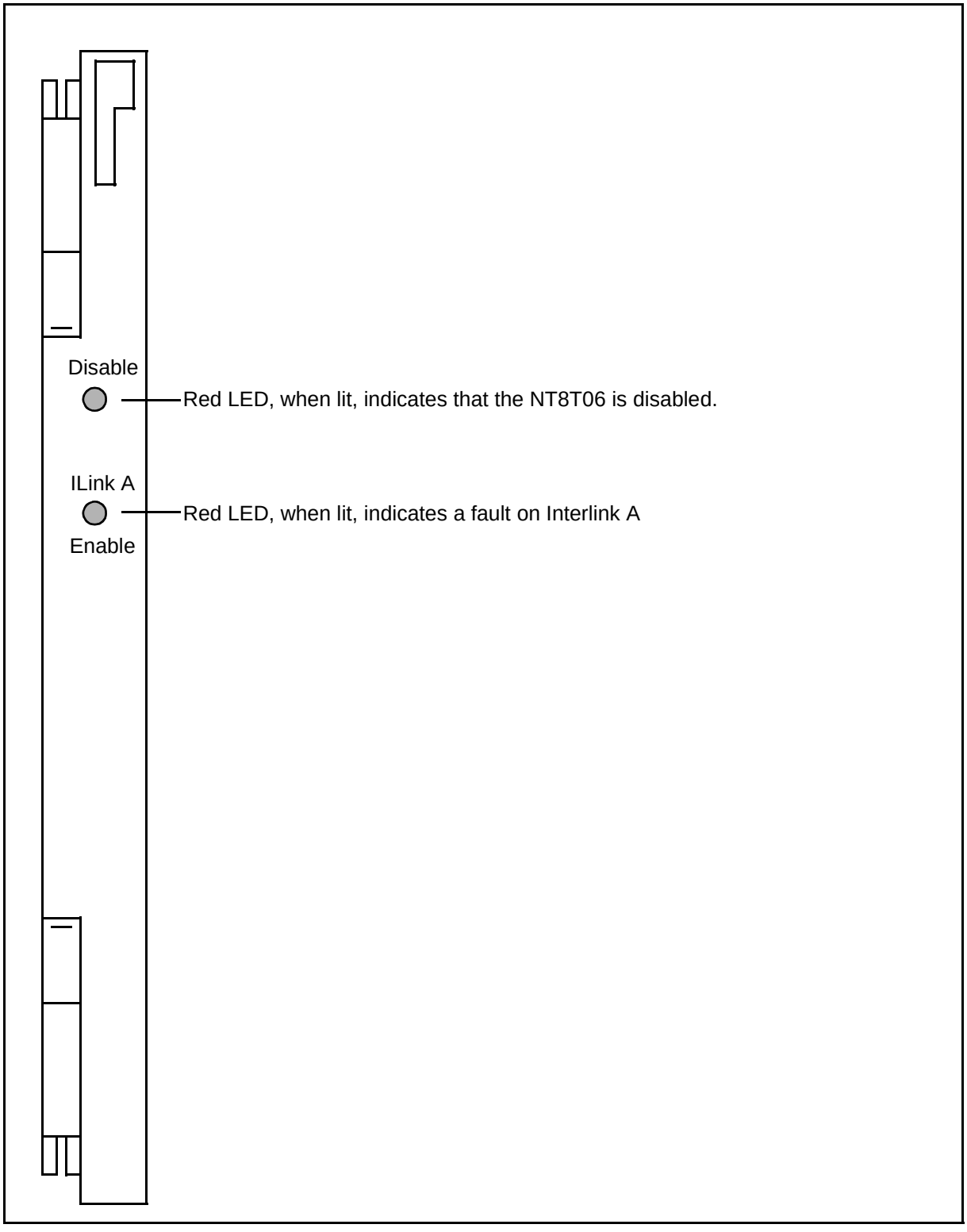


Figure 4-34: Network pack faceplate (NT8T06BA)

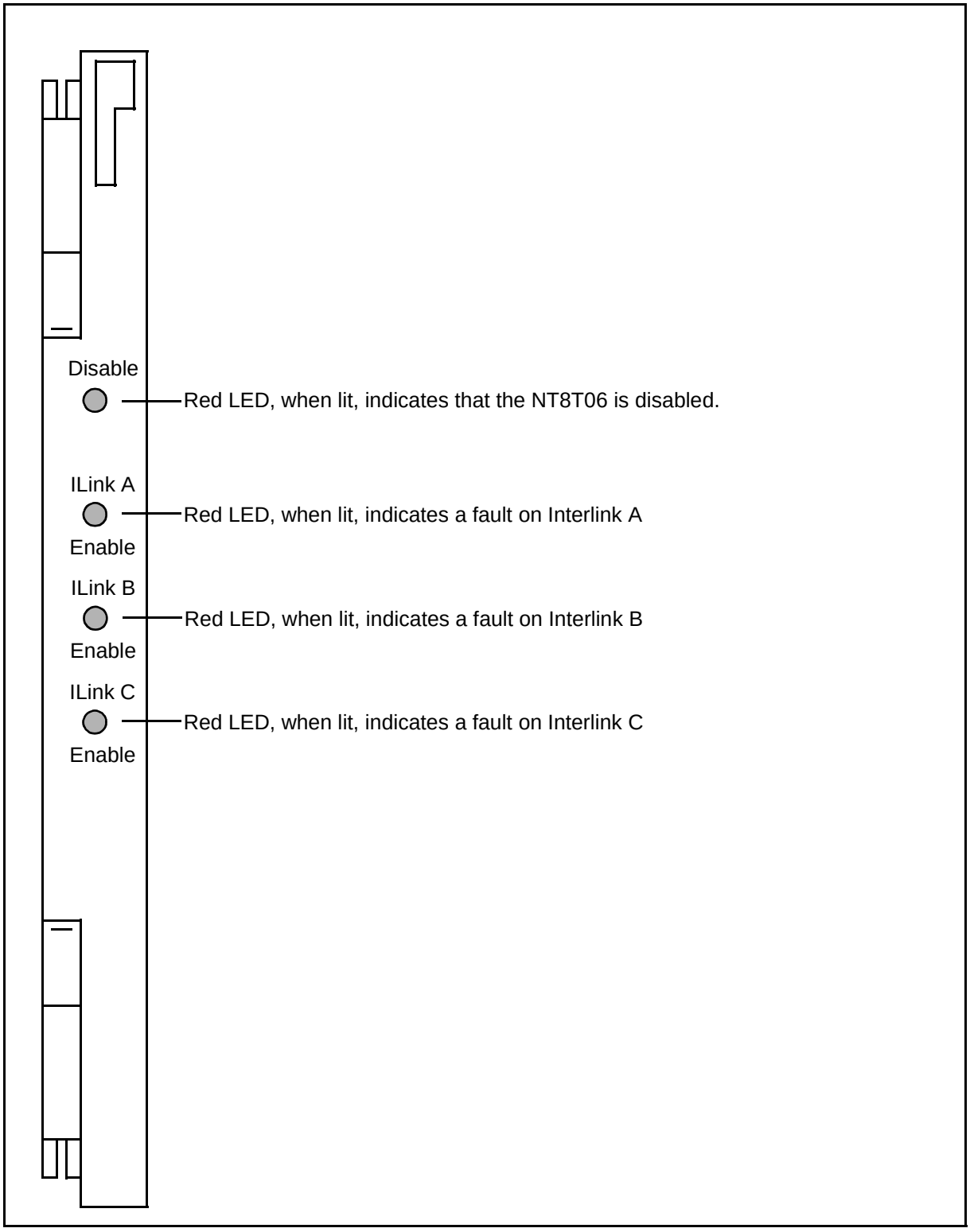


Figure 4-35: SCSI Bus I/O and Disk Drive pack faceplate (NT8T90)

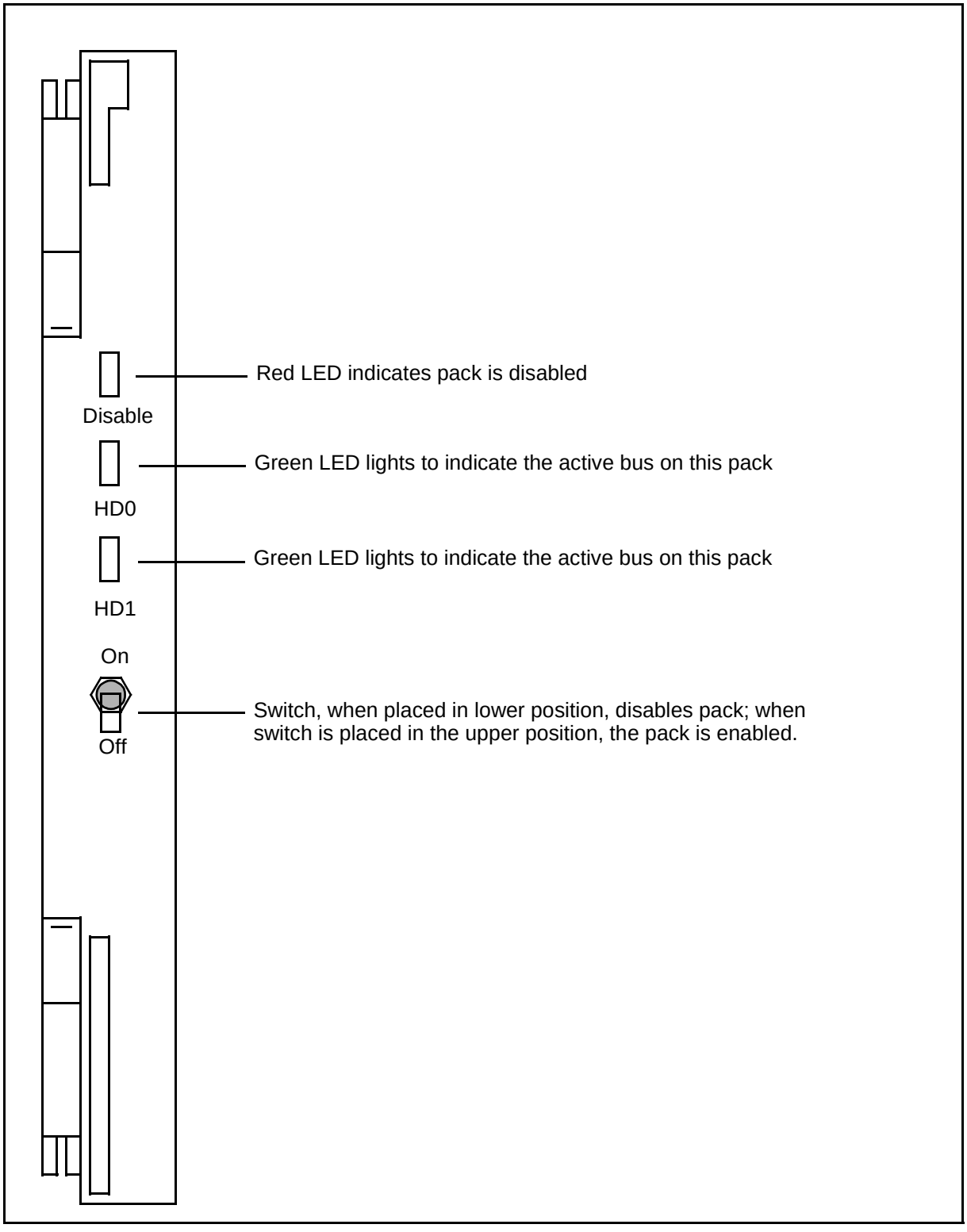


Figure 4-36: Battery Charge Controller pack faceplate (NT8X02)

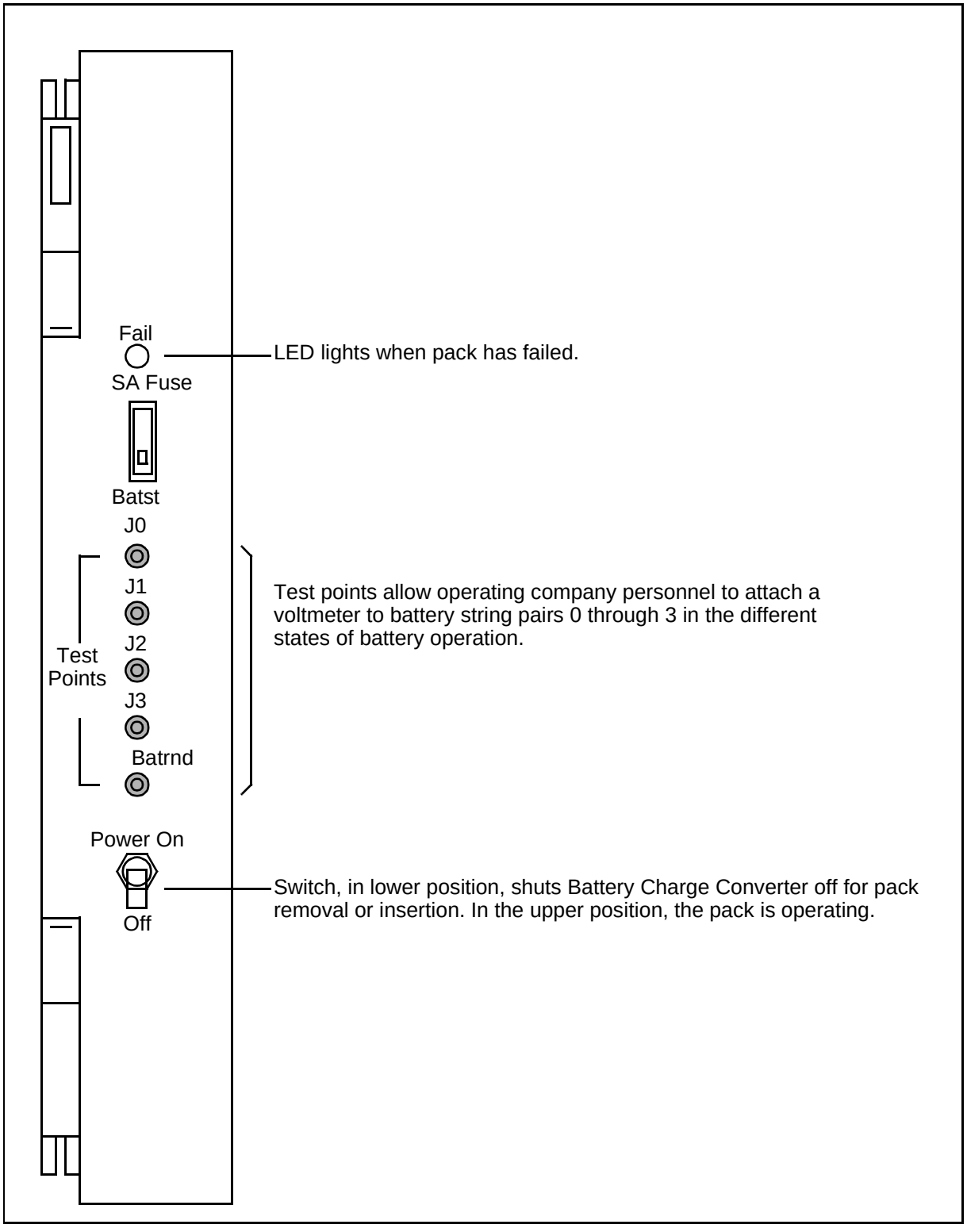


Figure 4-37: OPSM Cabinet Controller pack faceplate (NT9Y00)

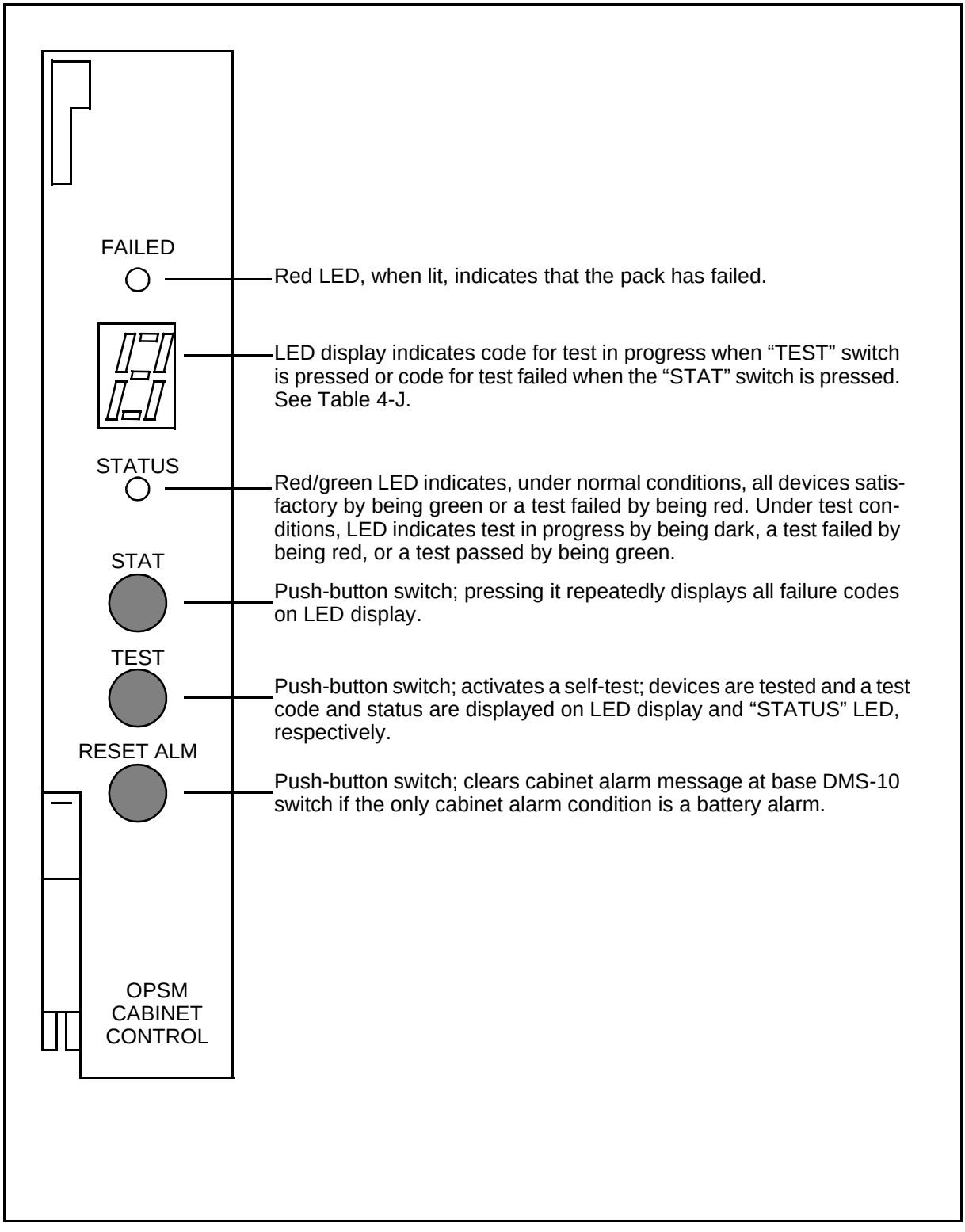


Figure 4-38: Switching Matrix pack faceplate (NT9Y12)

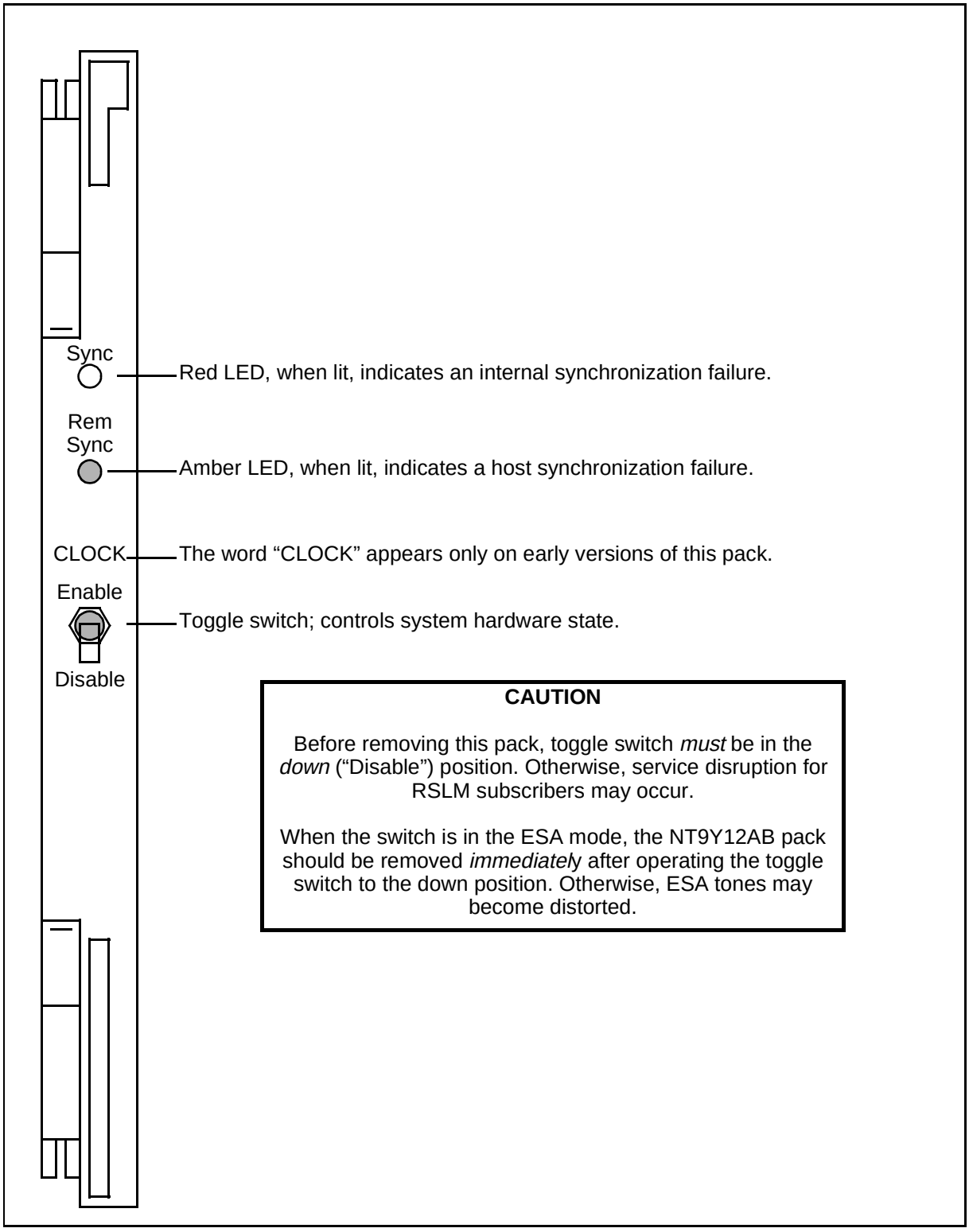


Figure 4-39: Remote Maintenance pack faceplate (NT9Y13)

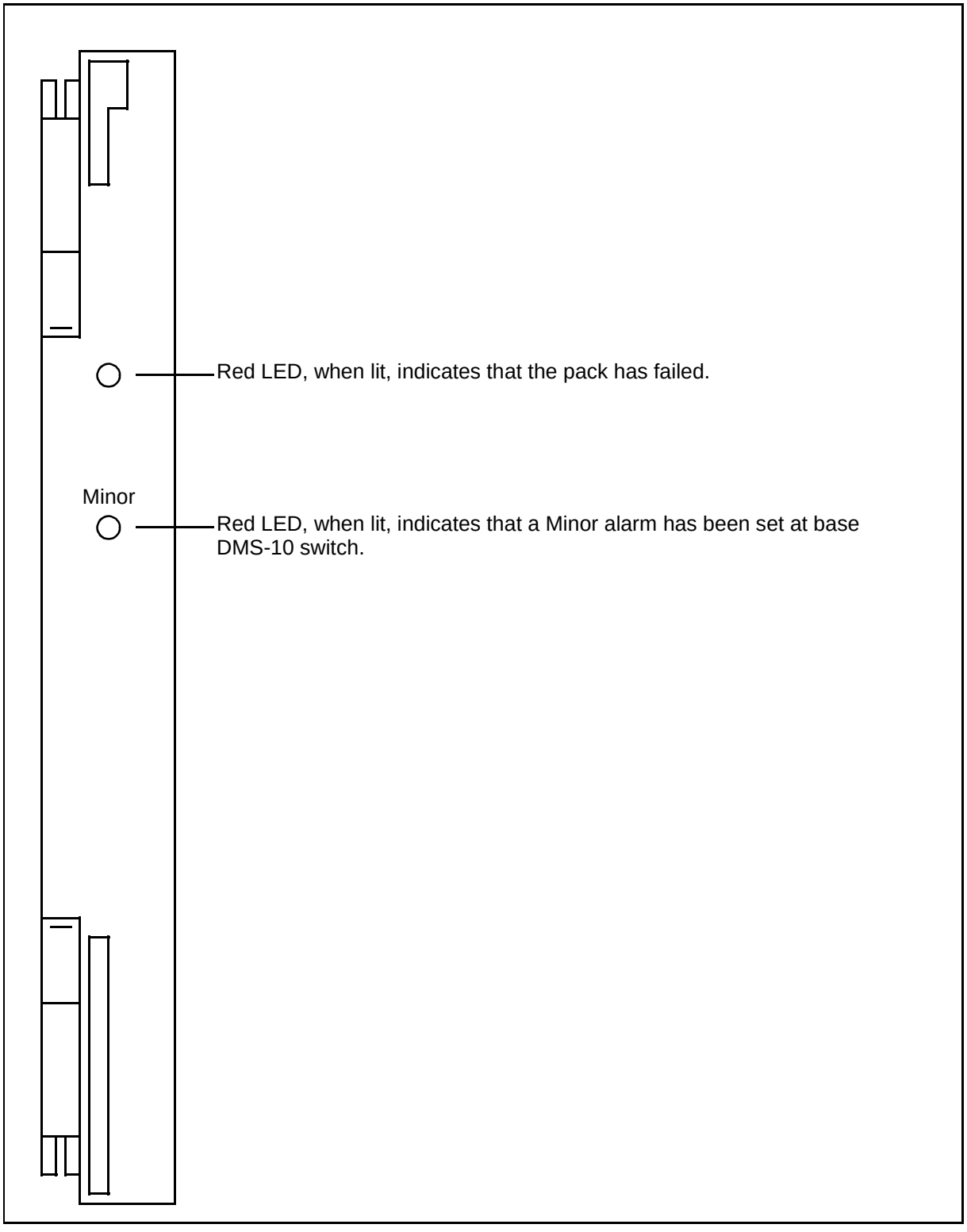


Figure 4-40: RSLM ESA pack faceplate (NT9Y15)

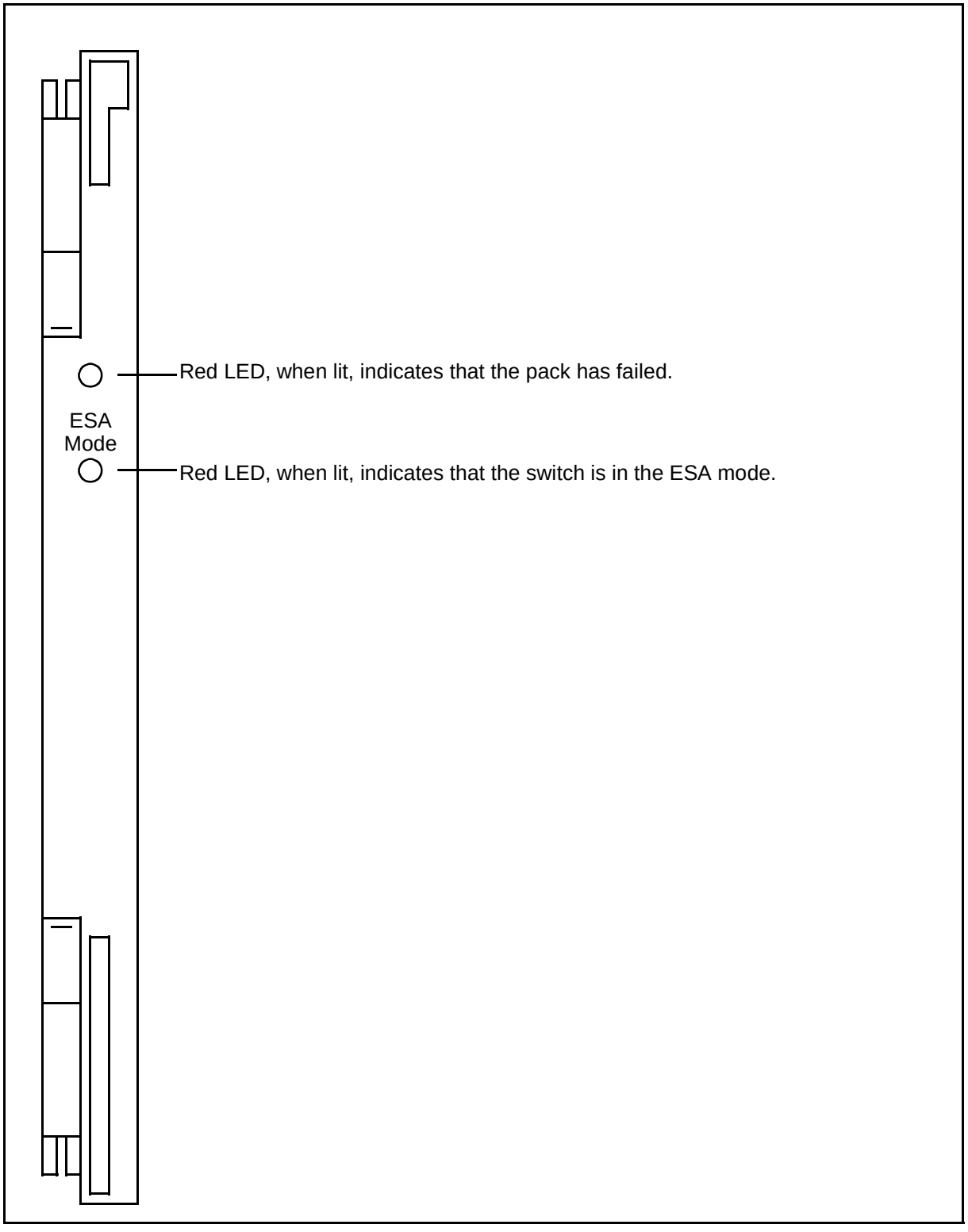


Figure 4-41: RSLE Dual Host Interface and Clock pack faceplate (NT9Y17)

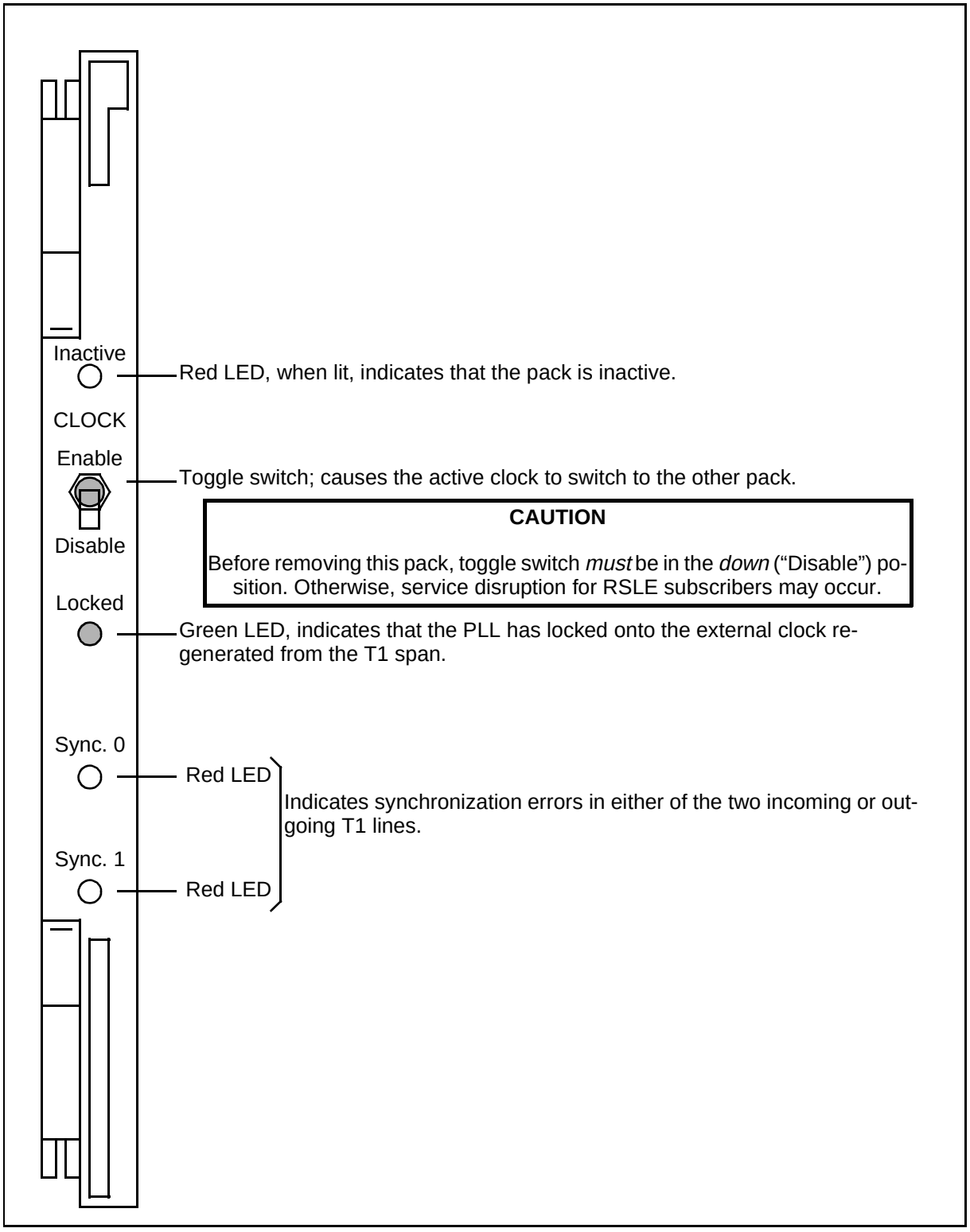


Figure 4-42: RSLE ESA pack faceplate (NT9Y19)

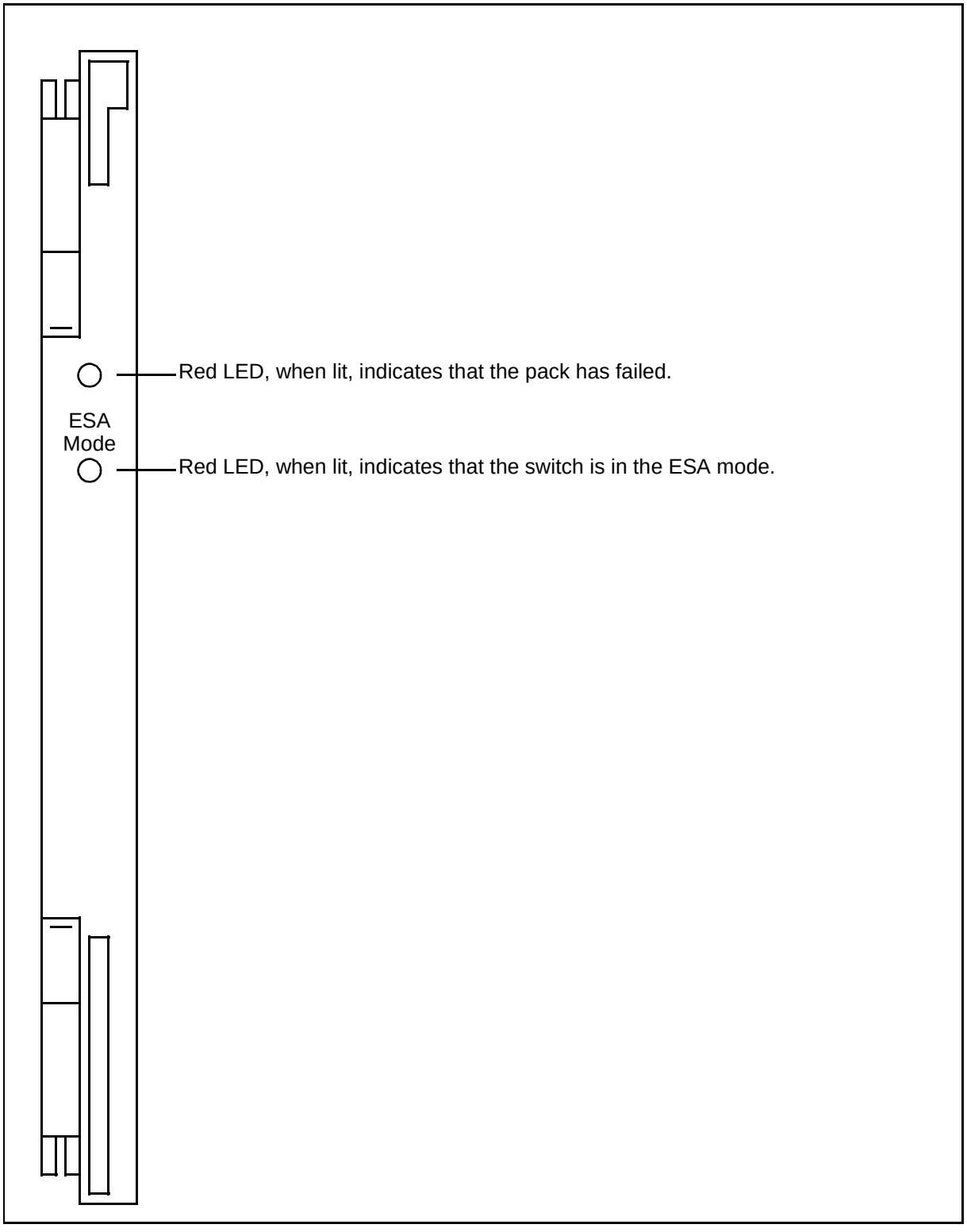


Figure 4-43: RSLE Dual Host Interface pack faceplate (NT9Y20)

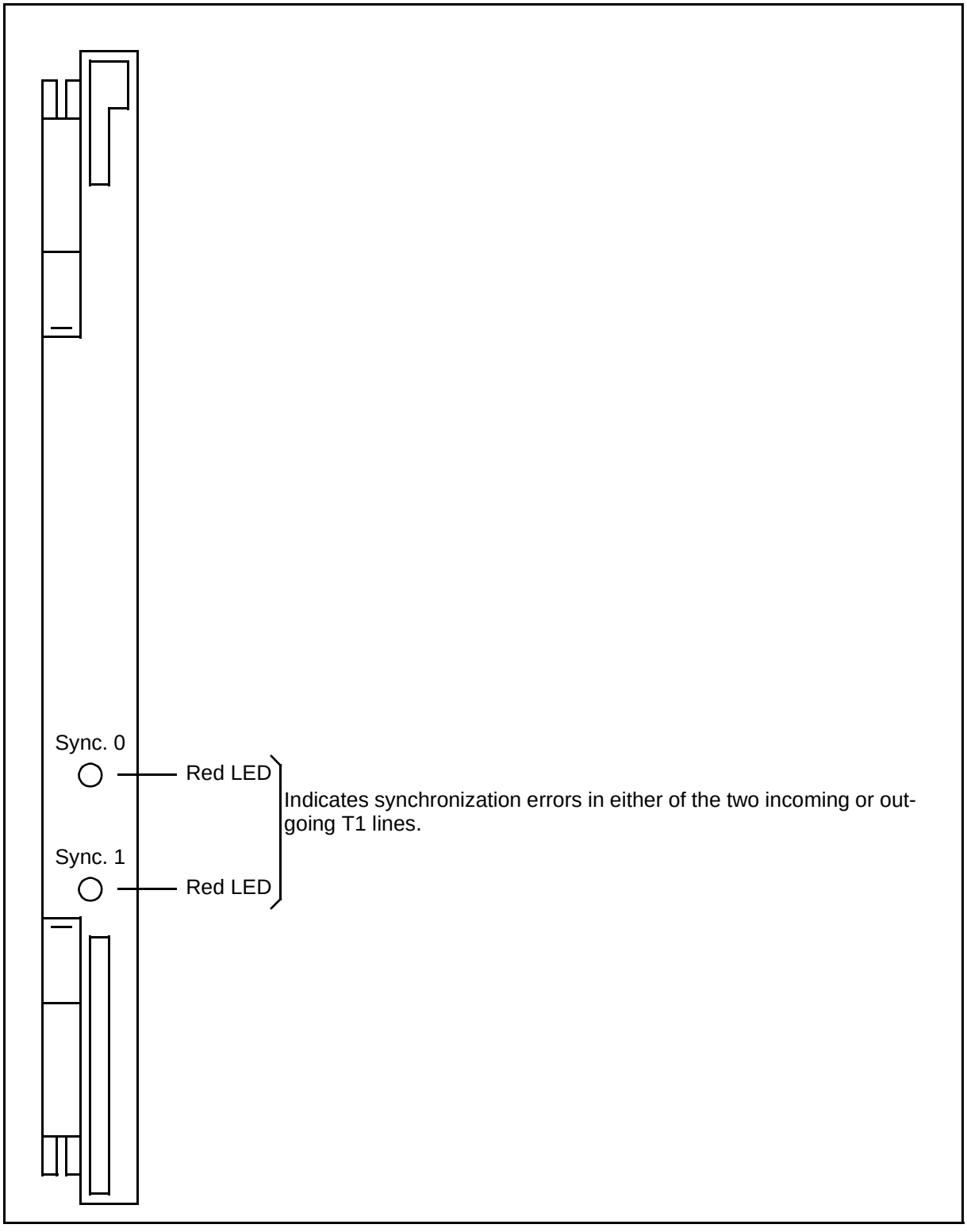


Figure 4-44: Cellular Application Processor pack faceplate (NTAX74)

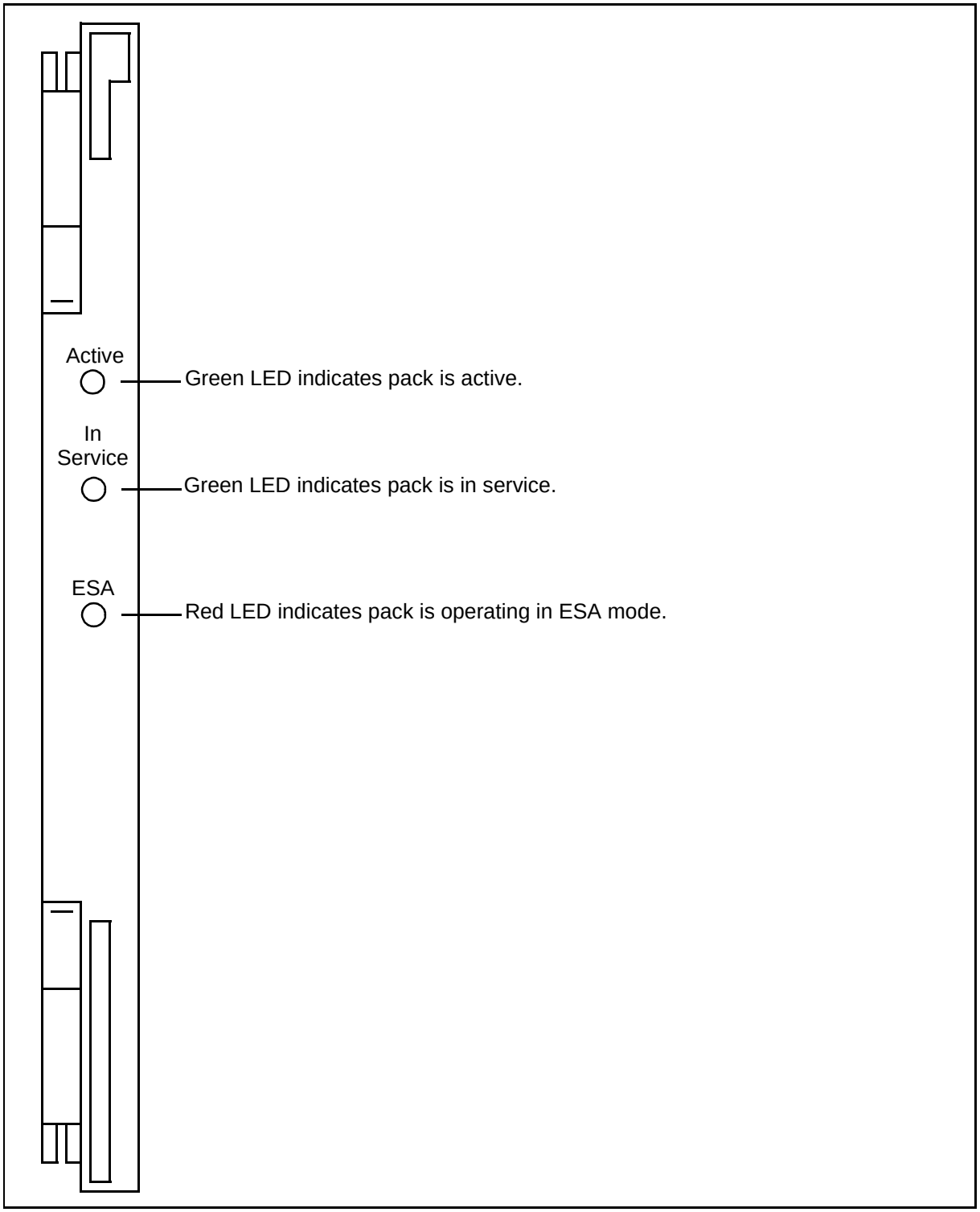


Figure 4-45: Power Converter pack faceplate (NTMX72)

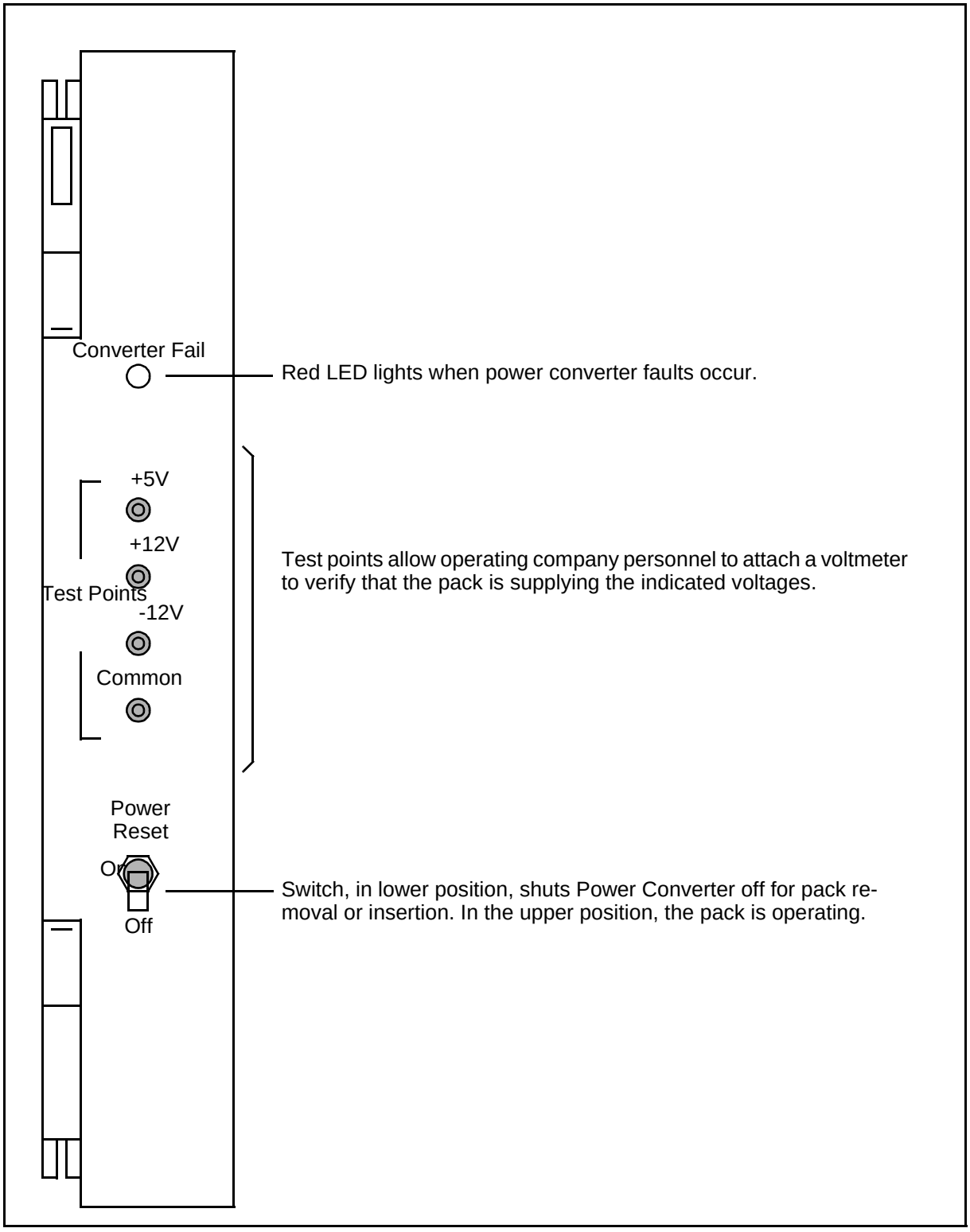


Figure 4-46: Unified Processor pack faceplate (NTMX77)

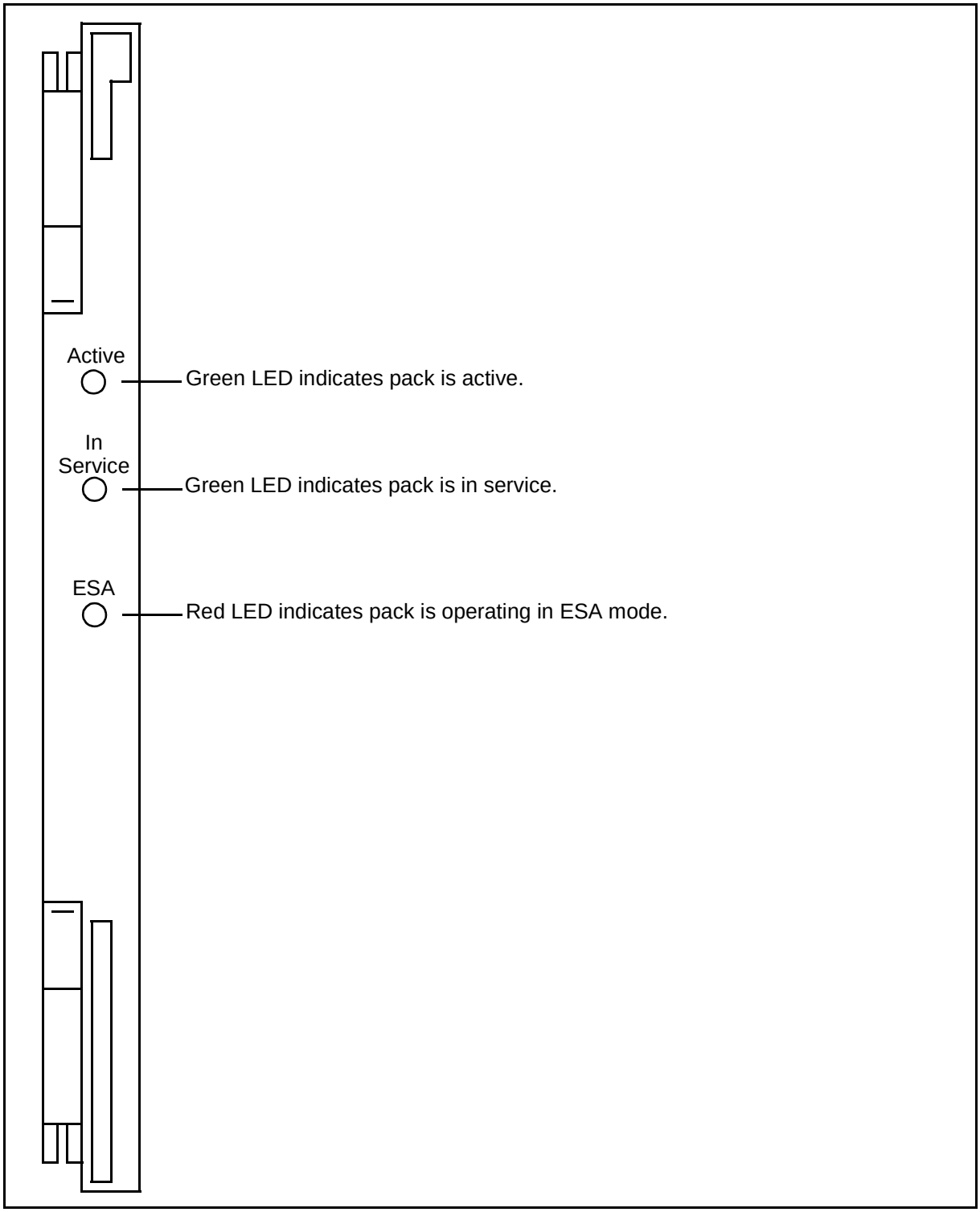


Figure 4-47: DS-60 Extension pack faceplate (NTMX79)

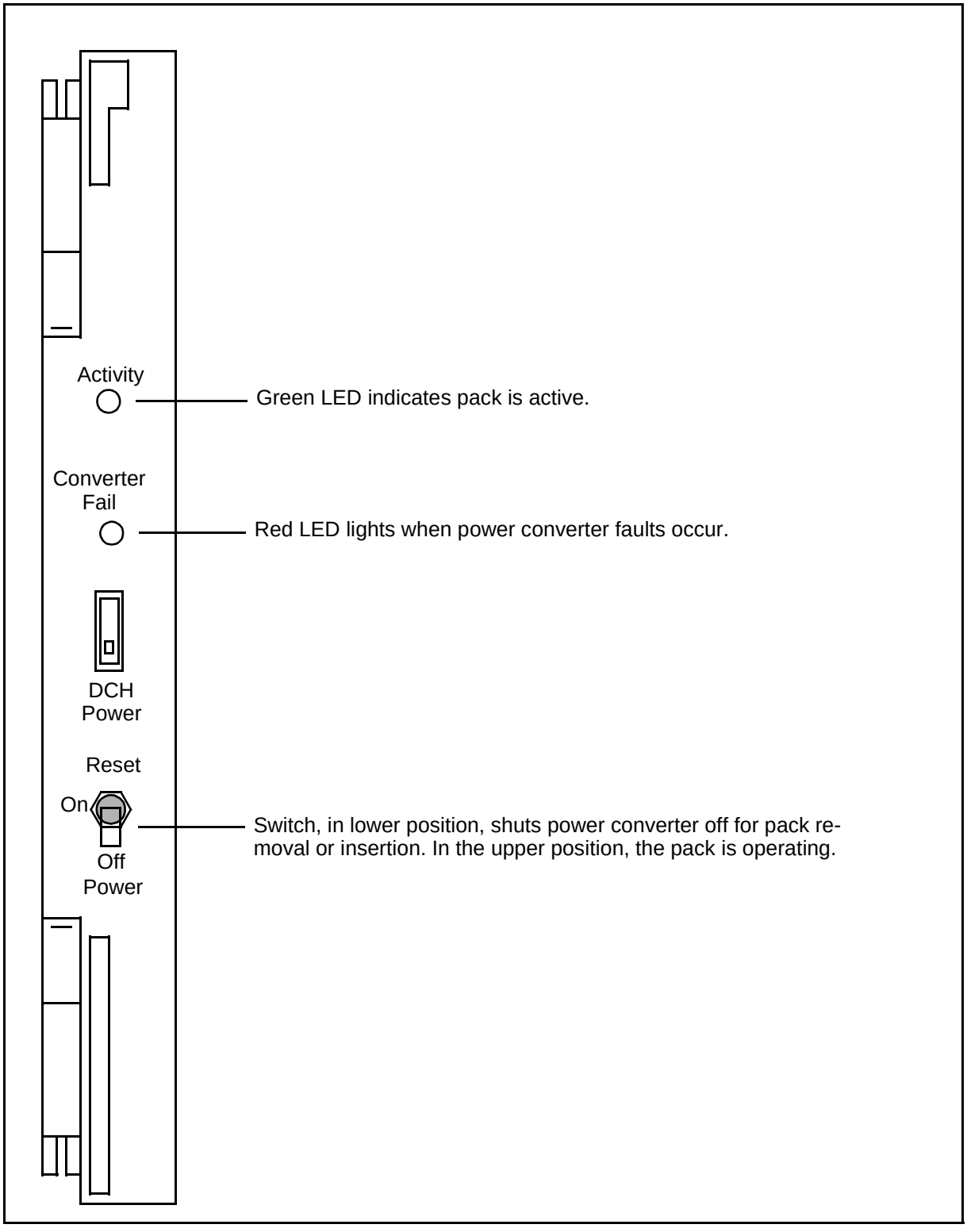


Figure 4-48: Remote Controller pack faceplate (NTTR77)

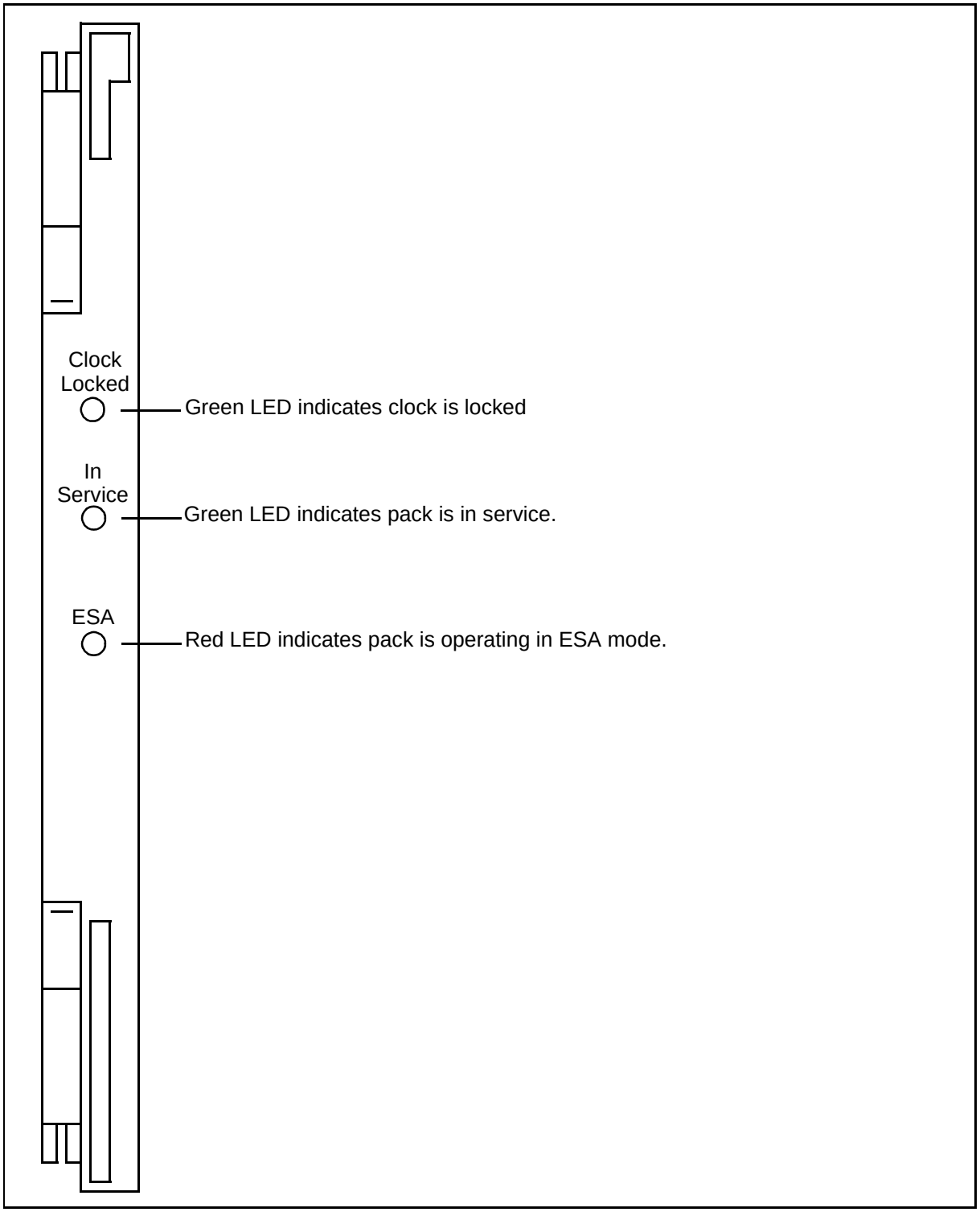


Figure 4-49: Fault Locate Order Wire pack faceplate (QPP519)

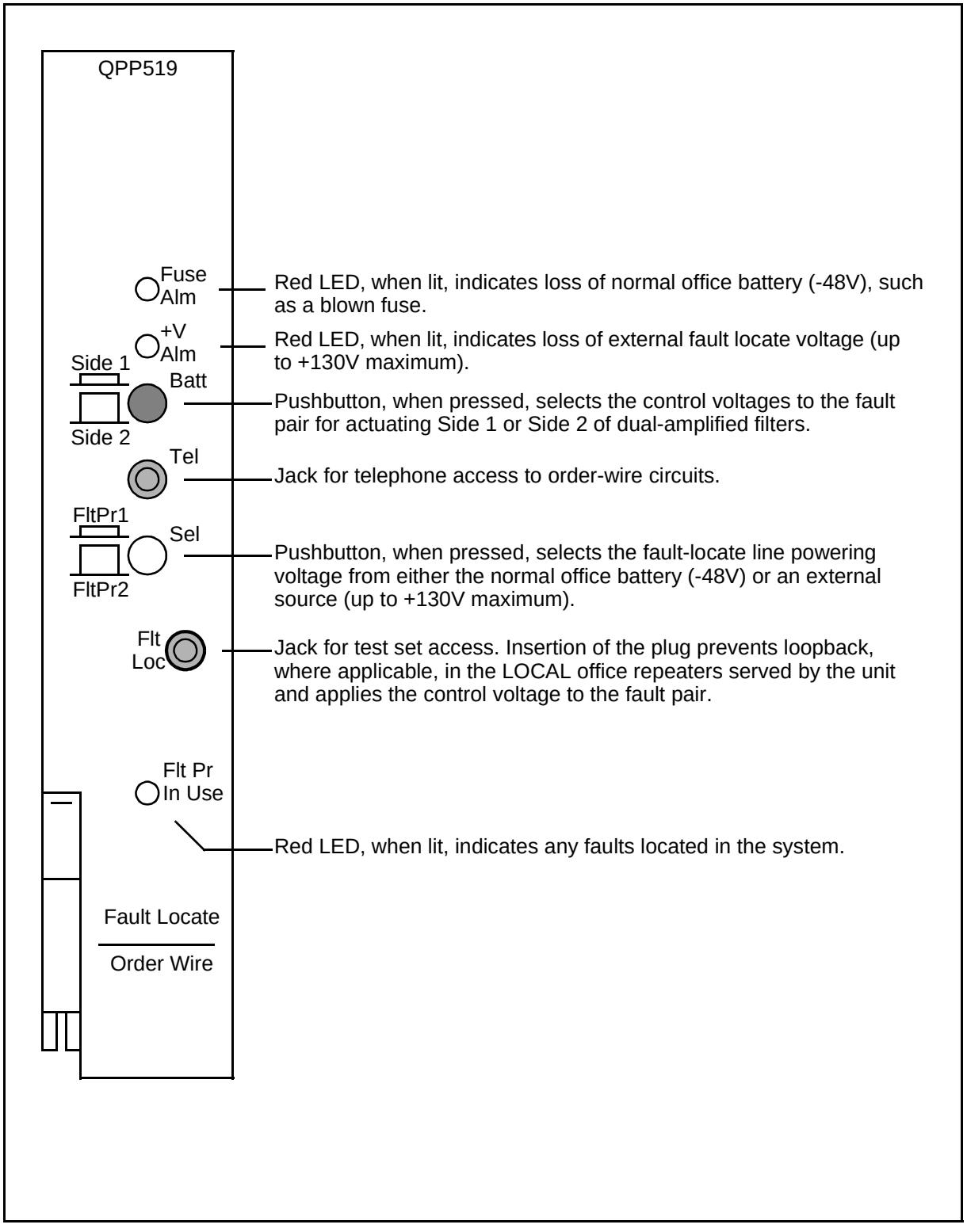


Figure 4-50: Office Repeater pack faceplate (QRY18)

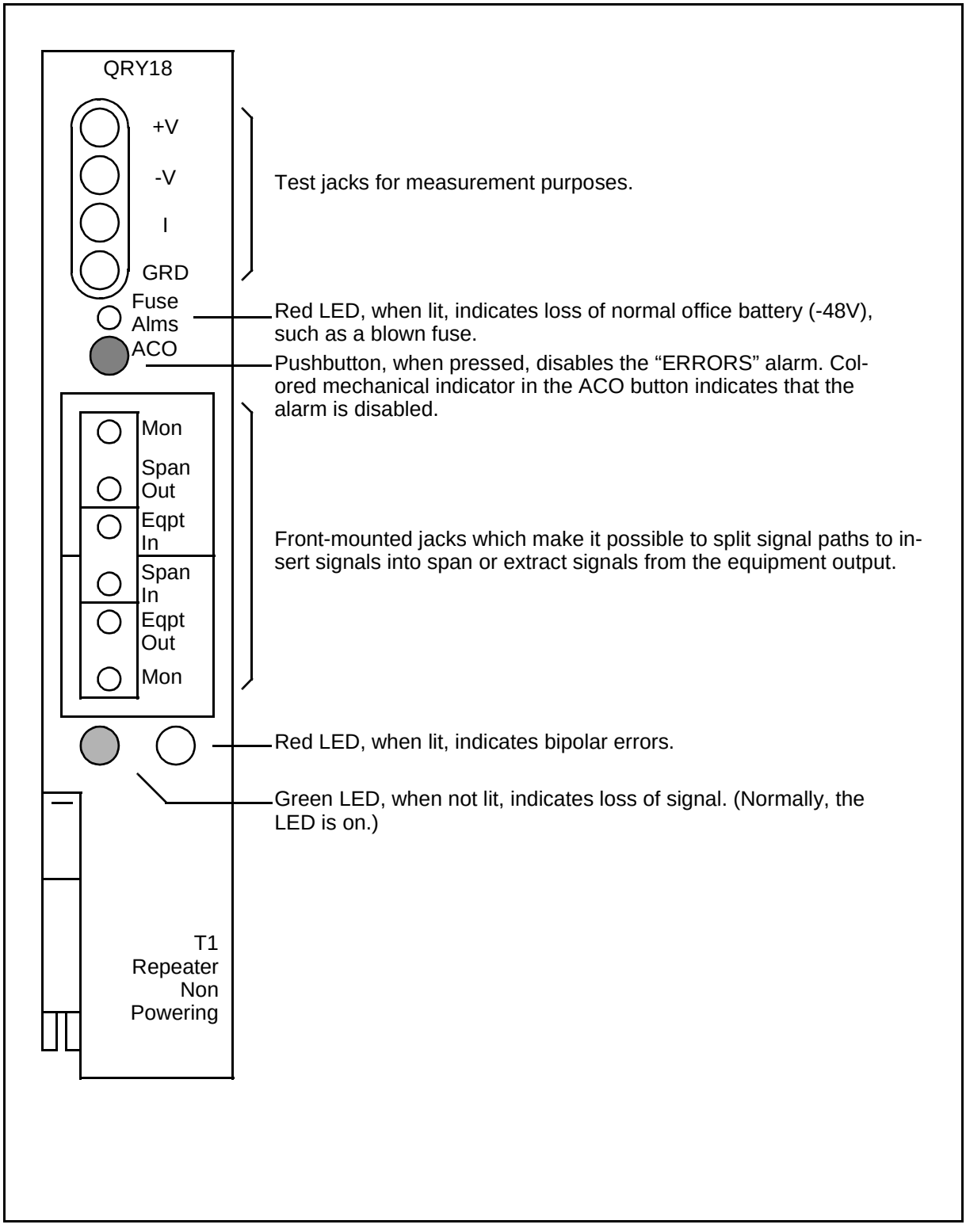


Table 4-J:
Circuit pack faceplates with one LED and / or switch

Pack Number	Pack Name	LED / Switch
NT2T00	Single-Party Line	Red LED lights when pack is disabled.
NT2T01	Two-Party Line	Red LED lights when pack is disabled.
NT2T03	Miscellaneous Line	Red LED lights when pack is disabled.
NT2T08	Extended Range Two-Party Line	Red LED lights when pack is disabled.
NT2T10	Multifrequency Receiver	Red LED lights when pack is disabled.
NT2T11	Digitone Receiver	Red LED lights when pack is disabled.
NT2T13	Peripheral Control 2	Red LED lights either when pack is disabled or when converter output voltages are low; Switch disables pack.
NT2T16	Incoming Test Trunk	Red LED lights when pack is disabled.
NT2T17	Noller Test Trunk	Red LED lights when pack is disabled.
NT2T19	Line and Trunk Test	Red LED lights when pack is disabled.
NT2T40	Auxiliary Ringing and Tone	Red LED lights when pack is disabled.
NT2T51	System Processor	Red LED lights when pack is inactive.
NT2T70	Peripheral Maintenance Processor	Red LED lights when pack is disabled.
NT2T71	Peripheral Circuit Test	Red LED lights when pack is disabled; Switch disables pack.
NT2T73	Signaling Processor	Red LED lights when pack is disabled.
NT2T74	Control Processor	Red LED lights when pack is disabled.
NT3T10	Magnetic Tape Controller	Red LED lights when pack is disabled; Switch disables pack.
NT3T19AC	5/12 V Converter	Red LED lights when the converter self-disables; note on faceplate applies to circuit breaker supplying -48 V dc to the converter.
NT3T19BA	5/12 V Converter	Red LED lights either when the converter input power is applied before reset, or when the converter self-disables; pushbutton switch starts the converter; note on faceplate applies to circuit breaker supplying -48 V dc to the converter.
NT3T47	Synchronous Clock	Red LED lights when pack is disabled; Switch disables pack.
NT3T50	Data Link Controller	Red LED lights when pack is disabled; Switch disables pack.
NT3T51	Disk Drive	Green LED lights when activity occurs.
NT3T53	Alarm Processor	Red LED lights when pack is disabled; Switch disables pack.
NT3T54	Alarm Signal Distribution	Green LED lights when alarm system is in Test mode.
NT3T59	Dual Ringing Generator	Red LED lights either when pack fails or is disabled.
NT3T72	I/O Bus Extender	Red LED lights when pack is disabled; Switch disables pack.

Table 4-J: (Continued)
Circuit pack faceplates with one LED and / or switch

Pack Number	Pack Name	LED / Switch
NT3T80	Dual Serial Data Interface	Red LED lights when pack is disabled; Switch disables pack.
NT3T89	Power Converter	Red LED lights either when Converter is disabled or when converter fails; faceplate switch enables/resets/disables pack.
NT3T90	I/O Interface	Red LED lights when pack is disabled.
NT4T01	Tone and Digit Sender	Red LED lights when pack is disabled.
NT4T02	Universal Tone Receiver	Red LED lights when pack is disabled.
NT4T03	Conference	Red LED lights when pack is disabled.
NT4T04	DS-30A Interface	Red LED lights when pack is disabled.
NT4T05	Multiplex Loop Interface	Red LED lights when pack is disabled.
NT4T06	Network	Red LED lights when pack is disabled.
NT4T16	LAN/CPU Interface	Red LED lights when pack is disabled.
NT4T18	LAN Shelf Controller	Red LED lights when pack is disabled.
NT4T20	LAN Application Controller	Red LED lights when pack is disabled.
NT4T24	Span Interface Controller	Red LED lights in the following conditions: – when the DSI module is used as a remote interface and the BUSY SRI command is issued - either when the BUSY DSI command is issued or when the last assigned DSI link on the pack has been made busy with the BUSY DSLK command
NT4T50	CALEA DDE Interface	Red LED lights when either the BUSY DSI command is issued or when the last assigned DSI link on the pack has been made busy with the BUSY DSLK command.
NT6X60	Ringing Generator	Red LED lights when pack fails.
NT8T04	Network Interface	Red LED lights when pack is disabled.
NT8T44	Terminating I/O Bus paddleboard	Green LED lights when pack power is enabled.
NT8T79	Non-terminating I/O Bus paddleboard	Green LED lights when pack power is enabled.
NT9Y14BA	RSLM Processor	Red LED lights when pack is disabled.
NT9Y22	RSLE Processor	Red LED lights when pack is disabled.
NTMX73	PCM Signaling	Green LED indicates that the clock source is locked to the C side.
NTMX74	DS-30A Interface	Green LED indicates that the pack is active.
NTTR60	6X60 Ringing Generator	Red LED lights when pack fails.

Table 4-J: (Continued)
Circuit pack faceplates with one LED and / or switch

Pack Number	Pack Name	LED / Switch
NTTR73	Universal Maintenance Pack	Green LED indicates that the pack is active.

Section 5: Maintenance interfaces

Introduction

This section describes the man/machine and test-equipment/system interfaces provided as part of the DMS-10 switching system. These interfaces are used in performing routine testing and maintenance, as well as in performing emergency troubleshooting.

Diagnostic programs

Free-running programs and interactive programs are the two major types of diagnostic programs used in the DMS-10 system. Some diagnostics can be both free-running and interactive, yet serve different purposes in either diagnostic mode.

Free-running diagnostic programs

These programs generate messages on the maintenance terminal and initiate corrective actions to reduce or eliminate the effects of equipment failures. No intervention by office personnel is required. The two classes of free-running diagnostic programs are:

- resident programs, which are continuously running
- overlay programs, which are automatically loaded into the overlay area in system memory

Free-running resident programs.

With few exceptions, the following programs rapidly check system performance to detect and correct control faults without disrupting call processing (only the control recovery and overload programs cause a 3- to 7-minute disruption):

- control recovery programs, including Trap, SYSLOAD, and Initialization, which check CPU operation and memory status
- overload, which monitors the messages sent from the network equipment to the CPU
- resident commands, which perform the function necessary for communication with the system by way of the maintenance terminal

- overlay loader (OVL), which controls the loading and aborting of programs traveling through the overlay area. This program also prints out messages to show the status of the overlay area and any problems encountered. Overlay Loader is only free-running when under system control.

Free-running overlay programs.

These programs are free-running only when automatically loaded:

- Software Audit (AUD), which repairs some simple faults in Call Store data structures and also ensures that the network connection memory is sane
- Control Equipment Diagnostic (CED), which tests and automatically disables any faulty standby control equipment and, if necessary, switches CPUs; tests communications to the Ethernet Switches through the console port
- Digital Equipment Diagnostic (DED), which tests all digital interfaces between the DMS-10 switch and the peripheral equipment
- Input/Output Device Diagnostic (IOD), which performs a simplified test sequence that enables all defined maintenance terminals and tests the primary magneto-optical drive or disk unit and associated electronics. IOD will not test secondary drives when in this free-running mode.
- Line Insulation Testing (LIT), marketed as Automatic Line Insulation Testing (ALIT), which is used to detect faults in subscriber loops
- Magnetic Tape Diagnostic (MTD), which tests for all enabled AMA, utility magnetic tape units, Magnetic Tape Controller (MTC) packs, magnetic tape unit interface circuit boards, and cables connecting the previous two pieces of equipment
- Network Equipment Diagnostic (NED), which tests network equipment, the multiplexed loops, and the digital interface logic in the peripheral equipment without affecting established calls or calls being processed by the DMS-10 switch
- Peripheral Equipment Diagnostic (PED), which controls the operation of a Line and Trunk Tester pack (NT2T19)
- Remote Battery Control Diagnostic (RBCD), which scans the OPM or OPAC Battery Control Unit (BCU) and Battery Charge Control (BCC) packs for faults and controls battery string pair rotation
- Subscriber Carrier Module Diagnostic (SCM), which tests the SCM shelf, DS-1 lines, Remote Concentrator Terminal (RCT) common equipment in a DMS-10 system, and is an interface to the DMS-1
- Service Equipment Diagnostic (SED), which tests all Tone and Digit Senders and MF and Digitone receivers in the system

Interactive diagnostic programs

These programs operate in a step-by-step conversational mode and must be called for by maintenance personnel. These diagnostic programs, which are all overlay programs, are used to verify both existing faults and the correction of those faults. interactive diagnostic programs include the following:

- Alarm Overlay (ALO), which lists alarm conditions that exist in the DMS-10 switch and manipulates alarm functions within the system. For further information, see “Alarms” later in this section.
- Alarm Test Diagnostic (ALT), which tests the DMS-10 alarm packs. For further information, see “Alarms” later in this section.
- Software Audit (AUD), which repairs some simple faults in Call Store data structures and also ensures that the network connection memory is sane
- Custom Calling Tape Backup (CCTB), which protects custom calling data through a planned system reload by dumping the data onto a magneto-optical drive or disk drive prior to the reload
- Control Equipment Diagnostic (CED), which tests the standby CPU, the CPU bus extender circuit packs and cables, the backup memory packs, the various equipment changeover mechanisms, and real-time clock circuit packs; Ethernet Switch maintenance
- Circuit Status (CKT), which provides the capability to obtain additional data and status information that cannot be obtained from other overlays
- Digital Equipment Diagnostic (DED), which tests all digital interfaces between the DMS-10 switch and the line and trunk equipment
- Manual Download Overlay (DNLD), which provides the facility to transfer software from the file system to the Peripheral Processor pack (NT2T46)
- Input/Output Device Diagnostic (IOD), which tests the maintenance terminals and associated electronics, the magneto-optical drive, the tape units, the hard disk units, and the Data Link Controller packs
- LAN Equipment Diagnostic (LED), which tests the hardware components of local area network (LAN) equipment
- Line Insulation Testing (LIT), marketed as Automatic Line Insulation Testing (ALIT), which is used to detect faults in subscriber loops
- Microprocessor Download Overlay (MPD), which transfers software from the file system to the ACT (ac tester) or PMS (Peripheral Maintenance System)
- Magnetic Tape Diagnostic (MTD), which thoroughly tests an AMA or utility magnetic tape unit

- Network Equipment Diagnostic (NED), which busies and returns to service Network Equipment, tests Network Equipment and the digital portions of peripheral shelves, and determines status of network and line and trunk equipment
- Peripheral Equipment Diagnostic (PED), which controls the operation of the Line and Trunk Tester pack (NT2T19) and the Line Card Tester (LCT) card (NT2T80)
- Remote Battery Control Diagnostic (RBCD), which is used to manipulate the BCU, BCC packs, and battery string pairs
- Subscriber Carrier Module Diagnostic (SCM), which tests the Subscriber Carrier Module (SCM) shelf, DS-1 lines, and Remote Concentrator Terminal (RCT) common equipment in a DMS-10 system.
- Service Equipment Diagnostic (SED), which tests all Tone and Digit Senders and MF and Digitone Receivers in the system
- Signaling Network Diagnostic (SND), which tests the logical components of the DMS-10 switch's interface to the CCS7 signaling network
- Standby and 0-dB Line Overlay (STBL), which switches and restores standby lines
- Trunk and Loop Tester (TLT) Overlay, which provides outside plant testing capability to the DMS-10 switch. For further information, see “Test Lines” later in this section

Maintenance terminal

The maintenance terminal is the primary man/machine communication channel for maintenance and administration. Faults detected by the system hardware or by diagnostic overlay programs generate maintenance messages, which are displayed at the maintenance terminal(s). These messages alert maintenance personnel to a fault, specify the type of fault, and, when appropriate, specify the physical location of the faulty equipment.

The maintenance terminal is also used to manually enter diagnostic commands into the DMS-10 switch. During the performance of maintenance tasks, commands may be used to:

- obtain a printout of alarms presently existing in the system
- obtain a printout of faults found by resident programs
- load interactive programs into the overlay area of memory
- perform maintenance tests using the interactive diagnostic overlay programs, to verify not only that a fault exists, but also that the fault has been cleared after corrective maintenance

- return the switching system to its original configuration, if automatic reconfiguration has taken place and the cause has been found and cleared
- abort diagnostic overlay programs
- communicate with other maintenance-terminal users
- request a printout of a maintenance-related operational measurement (OPM) block

The interface between the system and a co-located maintenance terminal uses a serial data interface. The interface between the system and a maintenance terminal at a remote location uses both the serial data interface and modems.

Interactive maintenance priority

Terminals are classified according to their use and require the appropriate user password for login. The classes of terminal users (such as MTC, TRAF, ADMN, DMO) and the separate LOGIN passwords for each class are defined using overlay CNFG in the NTP entitled *Data Modification Manual* (297-3501-311).

The Multiple Overlay Access System (MOAS) allows multiple compatible administrative overlays and one maintenance overlay to run concurrently. When a request is made to run an overlay incompatible with an overlay already in use, the request is denied.

The overlay classes (in descending order of priority) are:

1) maintenance-interactive diagnostic overlays

2) traffic change-Operational Measurement Control (OMC)

3) Data Modification Order (DMO) overlays

4) background-free-running Diagnostic overlays

If a user tries to access an overlay and the request is denied, the IMED command option can be input to force pre-emption. The system allows pre-emption only if the pre-empting user is attempting to load a program of higher priority than the currently active incompatible overlay.

The NTP entitled *Input/Output System* (297-3501-300) contains more detailed information on terminal use and overlay programs.

Switching Control Center System (SCCS)

The Switching Control Center System (SCCS) is used to monitor and control the status and performance of a DMS-10 switch from a remote location by interfacing a remote maintenance terminal (MTTY) at the Switching Control Center (SCC) to the DMS-10 switch.

SCCS maintenance terminal interface

The SCCS maintenance terminal interface allows the operating company to centralize DMS-10 switch surveillance and maintenance operations at the SCC.

When the SCCS is used in conjunction with the Cluster configuration, the Host Switching Office (HSO) is interfaced to the SCCS by way of the remote MTTY, and the Satellite Switching Offices (SSOs) are interfaced to the HSO or by way of Data Link Controller (DLC) data links. In this arrangement, the SSOs are not directly linked to the SCCS; consequently, the number of teletypes required to provide SSO information to the SCC is kept to a minimum.

The Cluster configuration can be expanded using the Large Cluster Controller (LCC). The LCC serves as the host message processor for the Cluster.

In the Cluster configuration, as with the standalone DMS-10 switch, input messages and system responses from a local MTTY are echoed at all of the local MTTYs as well as at the remote MTTY. Additionally, messages and responses at the remote MTTY are echoed at the local MTTYs. All alarm and maintenance output messages are directed to both the local and remote MTTYs.

The operating company can specify the format of messages to any maintenance terminal as either *DMS* or *SCCS*. During a SYSLOAD, however, the reload-progress marks will be printed in the SCCS format only at the maintenance terminal connected to Port 7.

Refer to the NTP entitled *Input/Output System* (297-3501-300) for specific information about SCCS messaging and monitoring functions.

SCCS telemetry interface

SCCS telemetry allows the alarm and status indicator panels and system recovery control switches located at the SCC to be used to remotely monitor and control the status and performance of the DMS-10 switch. The alarms and controls located in the Alarm and Ringing Module of the DMS-10 switch, as well as status indicators on various components, interface (by way of cables) to a Digital Alarm Scanner (DAS) In turn, the DAS, which is collocated with the DMS-10 switch, acts as the telemetry interface between the DMS-10 switch and the status indicators and control switches located at the SCC.

All alarms registered at the SCC are classified as either *critical* or *status* alarms. Other selected conditions, such as central office battery discharging and carrier group failures, are also monitored by the DMS-10 switch and reported to the SCC. For a complete listing of critical indicators, see Section 3 of this NTP.

Data between the DMS-10 switch and the DAS are exchanged through both a discrete interface (alarm indications transmitted by way of a contact closure for each indicator) and a serial data interface (alarm information transmitted by way of an RS-232C data link). Data between the DAS and the SCC is exchanged through a modem-connected telemetry link.

In the Cluster configuration, telemetry capabilities are centralized in one DMS-10 switch, the HSO. When the SCC is used with the Cluster, outside plant requirements are substantially reduced, because only one telemetry link is needed from the HSO to the SCC. That is, the SCCS is interfaced through a single physical port to the HSO. Telemetry and MTTY data links, however, are needed to interface the SSOs to the HSO.

In the Cluster configuration, two methods exist for implementing the physical links for the telemetry and the MTTY channels: analog links and digital links.

When analog data links are implemented, the telemetry data and the cluster data are transmitted across analog facilities. Telemetry data are routed to a 1200-baud modem, then to the SCC. The 1200-baud modems used are RS-232C compatible inputs, and transmission lines must be voice-grade telephone lines conforming to Bell Standard 3002. The data links consist of a pair of 2400-, 4800-, or 9600-baud data links. The modems for these links are also RS-232C compatible and conform to Bell Standard 208A.

MTTY information is transmitted from the HSO to the SCC by way of a single 1200-baud dedicated four-wire link to the Data Mounting Unit (DMU), which provides a dialup backup link for input. DMU output is run through a 1200-baud modem, converted to RS-232C format, and transmitted to the DMS-10 switch by way of a Serial Data Interface (SDI) port. MTTY data to/from the HSO to/from the SSO is received and routed by way of the DLC in the respective office.

Implementation of digital data links is functionally equivalent to that of analog links with modems. However, the digital link uses one channel of a DS-1 link to transmit both the telemetry and the Cluster data between the HSOs and the SSOs, with a second DS-1 link serving as a backup. The DCM to DAS telemetry link emulates the signaling and protocol between the DAS and a modem (1200-baud, RS-232C compatible). When a DSI is used in place of a DCM conversion from RS-232 to RS-449 is required, since the DSI uses RS-449 ports for data transmission.

Power and Cooling Module with Test Panel

The Power and Cooling Module with Test Panel (J0T98A-1) contains circuit breakers, fuses, alarm LEDs, cooling fans, and two jack fields. The larger jack field, located on the far right of the module, contains twenty pairs of jacks. Some of these jacks are used to connect external test equipment to the four system-level maintenance buses. These buses are used to perform transmission and other testing on line and trunk circuits. Other jacks provide connections to the two- and four-wire test trunks, test line, and spare links to the main distributing frame. The even-numbered pairs of jacks are labeled (that is, 2, 4, 6, etc.). The upper jack of each numbered pair is a 309-type jack, and the lower jack of each pair is a 310-type jack. This pairing enables operating company personnel to use the type of jack that matches the available patch cords and jacks. The connections provided by each of the numbered jack pairs are listed in Table 5-A. The smaller jack field, located just to the right of the alarm LEDs, contains four jacks, numbered 21 through 24 and labeled "TEST BAT." Each of these 310-type jacks can be used for measurement of the -48 V dc nominal exchange battery supply or as a power source for test equipment powered by -48 V dc nominal current.

Table 5-A:
Power and Cooling Module with Test Panel - jack connections

Jack-Pair Numbers	Connection Provided
1 and 2	To the Four-Wire Test Trunk by way of the Main Distributing Frame.
3	To the first Two-Wire Test Trunk by way of the Main Distributing Frame.
4	To the second Two-Wire Test Trunk by way of the Main Distributing Frame.
5	To the third Two-Wire Test Trunk by way of the Main Distributing Frame.
6	To the Test Line Circuit by way of the Main Distributing Frame.
7 through 10	To the system-level maintenance access bus.
11 through 14	No connection.
15 through 20	Spare jacks to the Main Distributing Frame.

Section 6: Integrated line and trunk test features

Introduction

Integrated line testing is supported in the DMS-10 switch to provide basic measurements of subscriber loop voltage, resistance, and capacitance. In addition, tests of subscriber set outpulsing, dial tone, ringing, line balance and noise, and other parameters are supported.

Overlays provide software control of integrated line and trunk testing, while hardware components provide logical and metallic access to the loops under test. The overlays and hardware used in integrated line and trunk testing are described in this section.

Line testing can also be performed with external testing systems. For information on these systems and the interfaces provided to support them, refer to Section 7 in this NTP, “Line and trunk test equipment interfaces.”

Overlay programs for line and trunk testing

Overlays (DMS-10 switch software programs) provide control of integrated line and trunk testing by accepting test commands and outputting results at the designated maintenance terminals. Overlays PED, CKT, and DED provide pass/fail functional testing for lines and trunks. Overlays LIT and TLT measure specific signal carrying properties of lines and trunks. For detailed information on overlays that control integrated line and trunk testing, see the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506).

Line Insulation Test (LIT)

The LIT feature utilizes a maintenance diagnostic overlay program (overlay LIT), which controls the Peripheral Maintenance System (PMS) hardware residing in a Peripheral Equipment (PE) bay. LIT and the PMS hardware test subscriber loops for foreign ground and foreign capacitance. Remote line equipment (Remote Line Concentrating Modules, Outside Plant Modules, Subscriber Carrier Modules, SLC-96s, and SCM-10Us) must have access to PMS hardware to allow for LIT testing. See “Peripheral Maintenance System” in this section for more information about the PMS.

Foreign ground is a condition of resistance less than or equal to a user-specified value as measured between tip and ground, ring and ground, or tip and ring. Foreign capacitance is defined as a condition of capacitance less than or equal to a user-specified value as measured between tip and ground, ring and ground, or tip and ring. Tolerances for defining foreign ground and foreign capacitance may be changed using the LIT prompting sequence in Overlay CNFG, described in the NTP entitled *Data Modification Manual* (297-3501-311).

Designated LIT-class terminals have access to the LIT overlay and the resident system command "ALIT" for printing results to the terminal. Other messages, such as alarms and maintenance messages, are not printed on designated LIT-class terminals.

Overlay LIT may be scheduled to run automatically. The tests normally progress in sequential directory number (DN) order from first to last DN in the central office. If LIT is aborted in progress by another overlay, the last DN tested is marked, and testing continues with the next DN in the sequence when LIT runs again. If LIT is aborted, a message is printed indicating the last DN tested.

Subscriber's loop testing can be prevented by adding the NLIT (No Line Insulation Test) station option to the line. A count of lines with this option is available to operating company personnel while LIT is running.

Fault information generated by LIT is saved in a buffer area whose size is specified by operating company personnel. When this fault-save area becomes full, LIT stops running and a message is output on all maintenance and LIT-class terminals indicating the condition. The fault-save area is cleared each time operating company personnel schedule LIT to run.

Operating company personnel can also manually test a line by loading overlay LIT, issuing a test command, and specifying the DN to test. For manual testing, the LIT parameters set in overlay CNFG may be temporarily changed with an overlay LIT command. The default values return when overlay LIT is aborted.

Trunk and loop testing (TLT)

Integrated trunk and loop testing is a system that uses a maintenance diagnostic program (Overlay TLT), which controls the Peripheral Maintenance System (PMS) and ac Tester hardware residing in a Peripheral Equipment (PE) bay. In the case of Subscriber Carrier Module (SCM) loop testing, the Remote Line Test pack is used instead of the PMS. In the case of Remote Line Concentrating Module (RLCM), Outside Plant Access Cabinet (OPAC), and Outside Plant Module (OPM) testing, the Line Test Unit (LTU) is used. Other limitations apply for testing remote line equipment. See the description of TLT in the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506) for a discussion of these limitations. Overlay TLT performs voltage, resistance, capacitance, and transmission (loss and noise) tests on trunks and subscriber lines. The system uses the maintenance terminal for test command input and for system response.

Integrated trunk and loop testing runs on specified loops or trunks on a per device basis. Fault information can be determined by comparing the measurements with known good values. There are no facilities for automating TLT fault analysis or for managing TLT fault records.

Diagnostic overlays

Overlay CKT performs circuit status reporting for various packs, including line cards and trunk packs.

Overlay DED provides interactive or scheduled diagnostic capabilities for digital hardware, including LCE, PE, Remote Equipment Modules (REMs), SCMs, SLC-96 equipment, DMS-1U equipment, and digital trunks. All of this digital equipment can be busied, status queried, tested and returned to service.

Overlay PED provides interactive or scheduled diagnostic capabilities for peripheral equipment, including line cards, SLC-96 subscriber lines, and DMS-1U subscriber lines. Lines can be busied, status queried, tested and returned to service.

For line and trunk testing, Overlays CKT, DED, and PED check only the functional status of equipment. LIT and TLT are the best integrated measuring tools for making detailed line and trunk performance evaluations.

LCE Line Card Monitor

The LCE Line Card Monitor feature is designed to prevent NT6X17 and NT6X18 line cards from overheating due to damaging currents flowing into the cards from a subscriber's loop as the result of an abnormal condition. With this feature enabled, a “line hazard test” is performed on lines entering either lockout or overload condition, using the Peripheral Maintenance System (PMS), the Line Test Unit (LTU), and Remote Maintenance Packs (RMP), to determine whether the line's tip-to-ring, tip-to-ground, and ring-to-ground AC voltage, resistance, and DC voltage are within prescribed limits. Background line hazard testing can be configured to run automatically every 15 minutes. A line hazard test can also be run on demand, in Overlay LIT.

When line hazard testing is configured to run automatically, in overlay CNFG (SITE), and a line goes into lockout condition, the line is made SMB (System Made Busy) and is added to the line hazard testing queue. If subsequent line hazard testing determines the line to be hazardous, a minor alarm is raised and the line's CO relay is operated to isolate the associated line card from the outside plant; the line is then queued for additional hazard testing. In contrast, when a line goes into overload condition, its CO relay is operated before any line hazard testing is performed on the line. If subsequent testing determines that the line is hazardous, a minor alarm is raised; the line is then queued for additional hazard testing. A line remains queued for hazard testing until the testing determines that it is no longer hazardous; it is then placed in idle state, removed from the line hazard test queue, and its CO relay is released.

When, in contrast, the line hazard test is run on demand, in overlay LIT, no automatic action is taken to raise an alarm or operate the CO relay if a line is determined to be hazardous. In addition, the line is not queued for additional testing.

Integrated line and trunk testing hardware

Integrated line and trunk testing requires hardware to provide metallic access to loops and direct access to trunks. Some remote configurations require specific pieces of hardware. These configurations and their required hardware are described in Table 6-A.

Table 6-A:
Hardware requirements for integrated trunk and loop testing

Line Equipment	Required Hardware
Line Concentrating Equipment	Peripheral Maintenance System, ac Tester
Peripheral Equipment	Peripheral Maintenance System, ac Tester
Remote Equipment Module	Peripheral Maintenance System located at the REM, ac Tester located at the REM
DMS-1	Peripheral Maintenance System located at the remote site and ac Tester located at the base site, or metallic path from base site and ac Tester located at the base site
SLC-96	Peripheral Maintenance System located at the base site, ac Tester located at the base site, metallic path from base site
DMS-1U	Peripheral Maintenance System located at the base site, ac Tester located at the base site, metallic path from base site, and LTA card configured in the RCU
Remote Line Concentrating Equipment (OPM, OPAC, RLCM)	Remote Maintenance Module located at the remote (includes LTU and MTA packs)
Remote Subscriber Line Equipment (RSLE, RSLM)	Remote Maintenance Pack (RMP) located at the remote

Maintenance bus

The Maintenance bus allows metallic access to all line and trunk circuits in the DMS-10 switch and to all subscriber loops and trunks connected to the DMS-10 switch office. Relays in the PMA circuit packs, PC1/PC2 packs, PSC1/PSC2 packs, and the line or trunk packs establish the connections under CPU control. Figures 6-1 through 6-4 illustrate the Maintenance buses for PE, LCE, RLCM, OPAC, and OPM configurations. For information on DMS-1, SLC-96, and DMS-1U maintenance access, see the documentation supplied with those units.

Figure 6-1: Maintenance bus for peripheral equipment

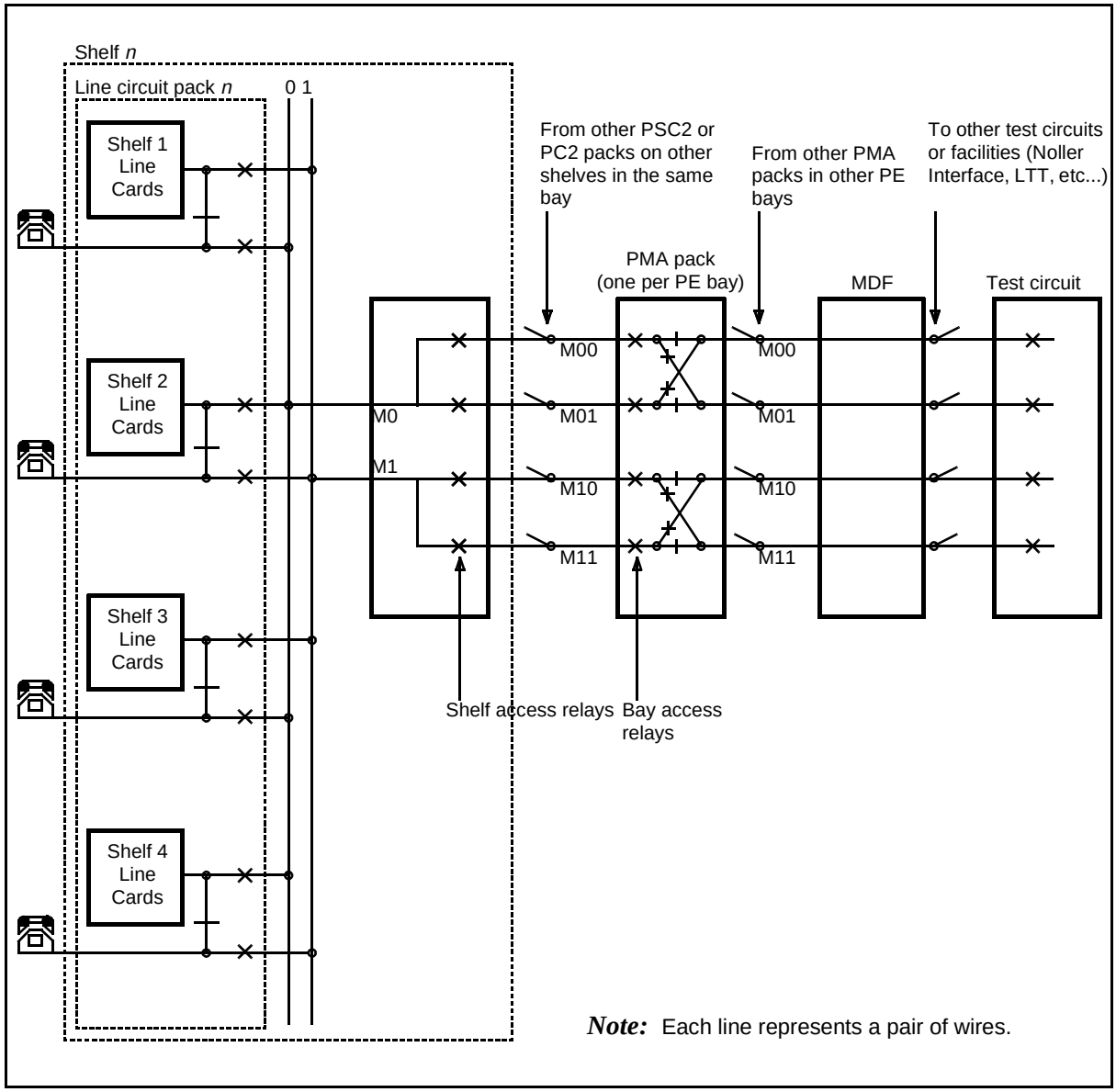


Figure 6-2: Maintenance bus for line concentrating equipment

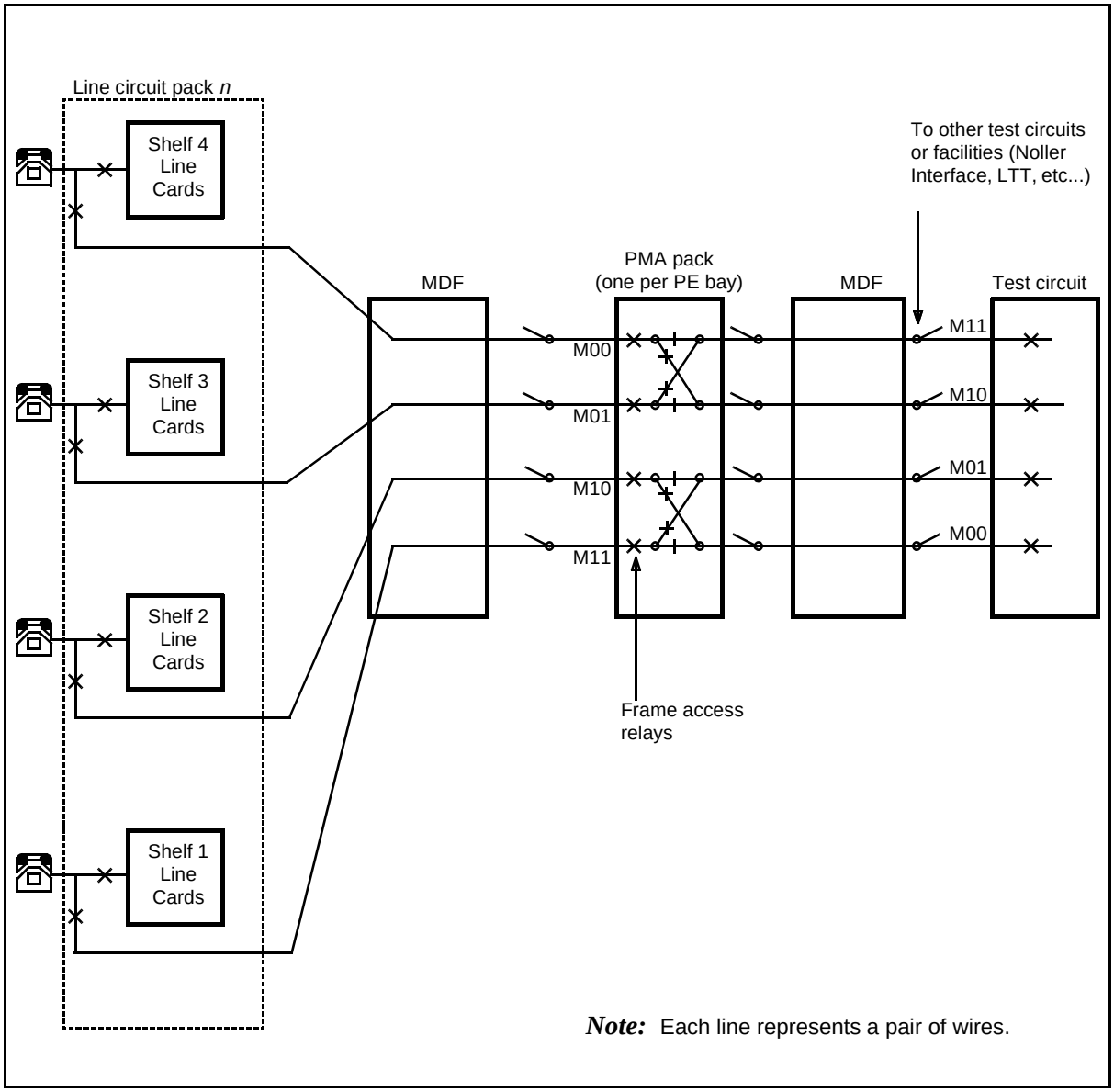


Figure 6-3: Metallic line access for Remote Line Concentrating Modules

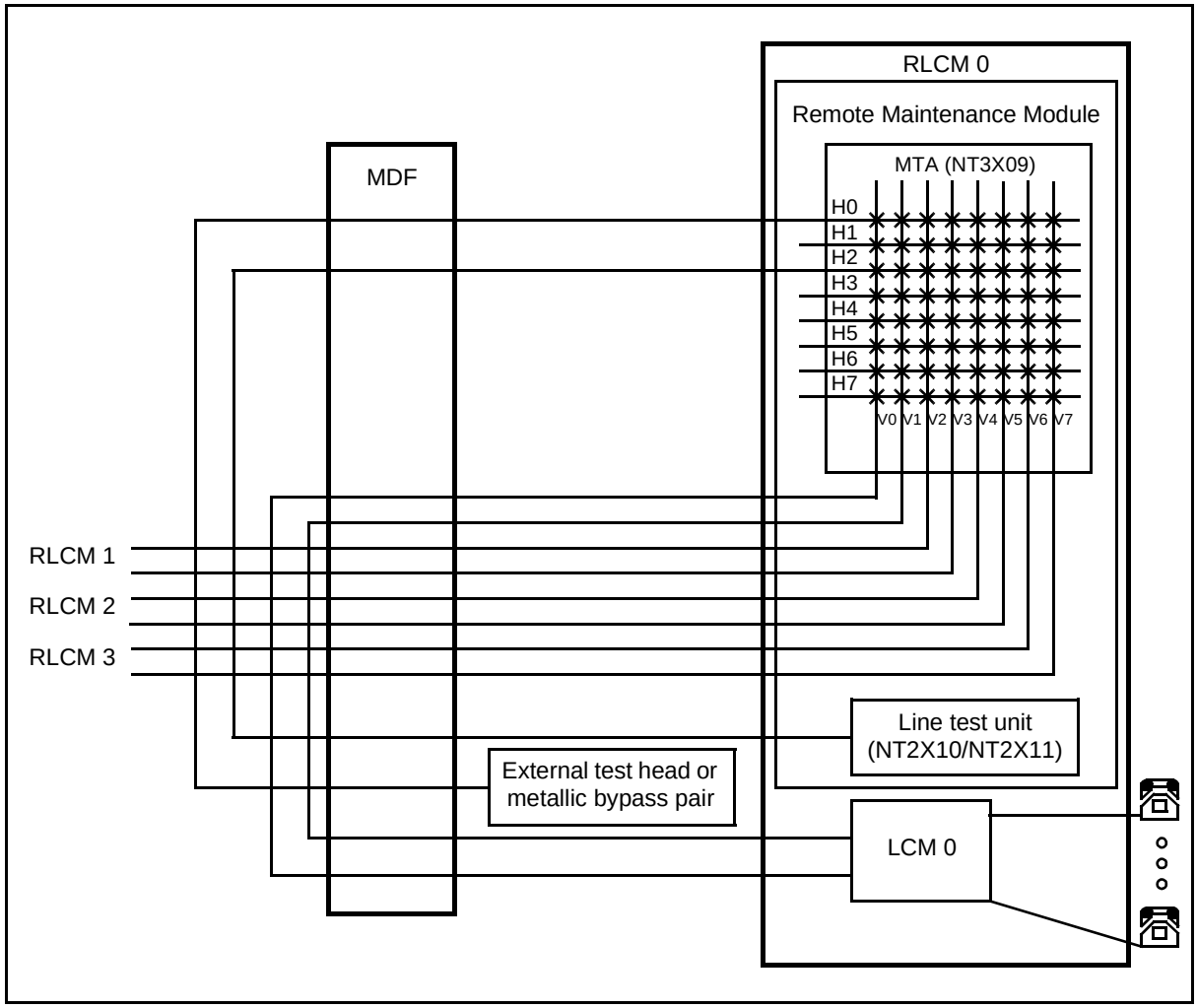
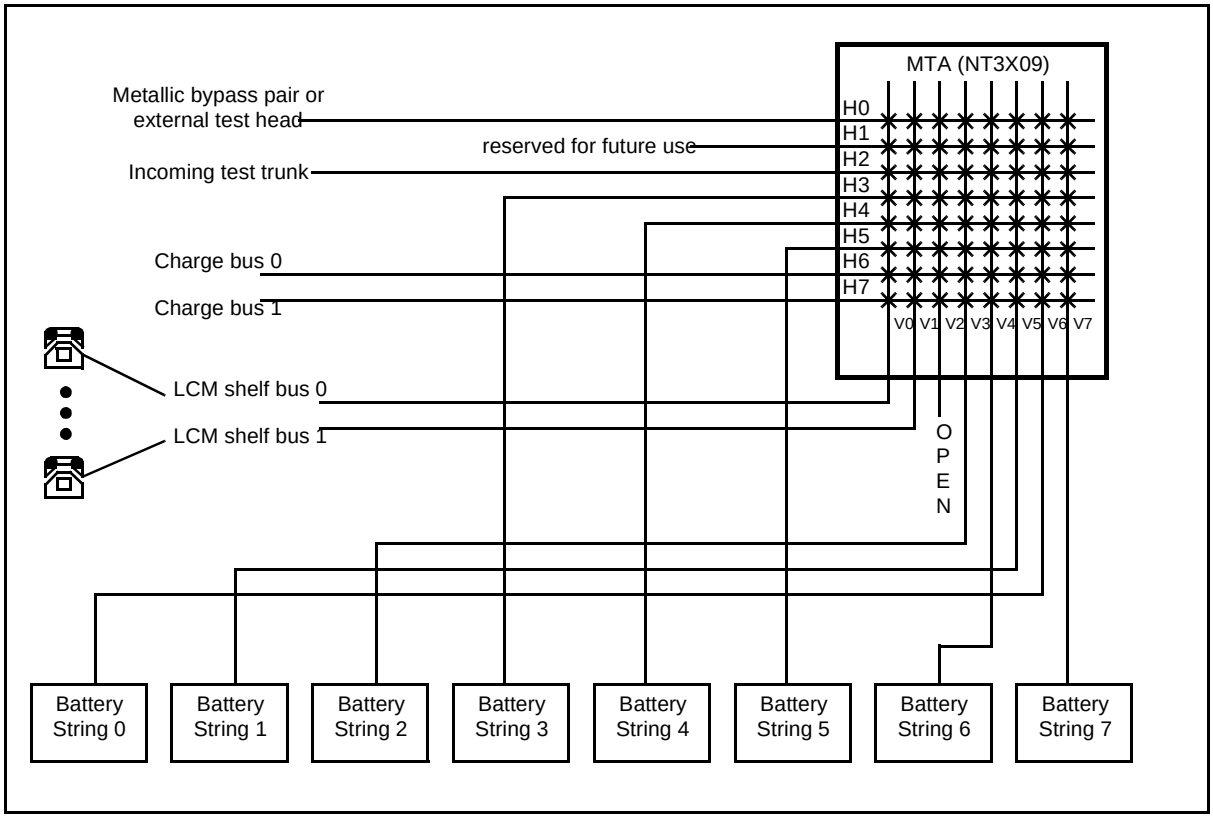


Figure 6-4: Metallic test access for Outside Plant Modules



Circuit testing by way of the Maintenance bus is done automatically by the DMS-10 switch every 24 hours, if so scheduled in the Configuration Record (overlay CNFG). Tests on circuits can also be performed by loading the Peripheral Equipment Diagnostic (PED) program. Tests on subscriber loops can be performed using a test desk (local or remote) or a Noller test set (remote). This test equipment has access to the loops through the Maintenance bus, test circuit packs, and cross-connections on the Main Distributing Frame (MDF). See Section 7 in this NTP, "Line and Trunk Test Equipment Interfaces" for information on using external test equipment on DMS-10 switch line equipment.

Trunk tests can be performed using jacks on the Power and Cooling Module, which accesses trunks through the Maintenance bus.

ac Tester

The ac Tester (ACT) is a microprocessor-controlled transmission measuring system that accesses peripheral devices through the digital network. The ACT consists of the following three circuit packs:

- Peripheral Circuit Test (NT2T71)-This pack provides the reference voltages required by the ACT.

- Signal Processor (NT2T73)-This pack provides digital tone, programmable filters, power meters, and time switches.
- Control Processor (NT2T74)-This pack contains the microprocessor control circuitry and provides the signaling interface to the DMS-10 switch.

Peripheral Maintenance System

The Peripheral Maintenance System (PMS) is a microprocessor-controlled volt-ohmmeter measuring system consisting of the following three circuit packs:

- Peripheral Maintenance Processor (NT2T70)-This pack contains the microprocessor control circuitry and signaling interface to the DMS-10 switch.
- Peripheral Circuit Test (NT2T71)-This pack provides the operating voltages required by the PMS and provides meter access to the Maintenance bus.
- Facility Test (NT2T72)-This pack replaces the PMA pack in the PE bay that houses the PMS. It provides metallic access to the device under test and contains the test head.

The PMS makes four basic tests to the outside facility by way of the Maintenance bus. The test measurements include ac voltage, dc voltage, resistance, and capacitance. A four-wire MDF shoe is provided to permit testing circuits not equipped in the DMS-10 switch.

Both PMS and ACT interface with the Trunk and Loop Test (TLT) diagnostic overlay program.

Line and Trunk Test pack

The Line and Trunk Test pack (NT2T19), under the control of the Peripheral Equipment Diagnostic (PED) program, tests both the basic functions of the line and trunk circuit packs and performs a self-test. Only one pack is required for each DMS-10 switch. The pack, a double-width pack occupying two slots, can be located in any PE shelf.

The Line and Trunk Test pack accesses the pack under test by using the Maintenance bus and the digital switching network. The PED program (free-running) is automatically loaded once every scheduled interval, to test all lines and trunks. Maintenance personnel can request an interactive version of this program to test a particular line or trunk circuit pack for repair purposes.

The tests performed by the Line and Trunk Test pack are:

- Transmission-This tests performance of the circuit in send or receive direction. Test tones are generated (digital and analog) and the power content is measured. A return-loss test is also performed.
- dc measurements-This tests presence of talk battery, coin control signals, and reverse battery as applicable.
- off-hook detection-This test simulates possible loop conditions on eight different terminations.
- ring trip-This test checks that ringing is present, places a termination on the line, and checks for removal of ringing.
- self test-This test checks its own operation and reports failures on the maintenance terminal.

Test lines

The DMS-10 switch may be configured with the following test lines, which are accessed by dialing a directory number from a subscriber loop or from another office by way of a trunk. Looparound trunk tests are performed from another office by using trunk access codes.

- 100-type-This test line provides a termination for balance and noise testing. It can be accessed from lines or trunks. When the test line is seized, off-hook supervision is sent to the calling end. After test line seizure, a 1004-Hz tone at 1 milliwatt is transmitted for 5 s followed by a silent termination. The interval between seizure and tone is normally less than 300 ms; however, this depends upon the degree of blocking in the system at the time.
- 101-type-This test line provides a communication and test line accessible from any line or trunk incoming to the DMS-10 switch. The line is accessible through a jack in the Power and Cooling Module.
- 102-type-This test line provides a tone for one-way transmission measurements. It can be accessed from lines and trunks. When the test line is seized, off-hook supervision is sent to the calling end. After test line seizure, a 1004-Hz tone at 1 milliwatt is transmitted for 9 s followed by a 1 s silent termination. (In this 1 s interval, on-hook supervision is sent to the calling end.) The sequence is repeated until the calling end releases.
- 103-type-This test line provides a connection to a supervisory and signaling test circuit for overall testing on intertoll trunks equipped with ring forward (rering) features. These trunks can only be reached by an automatic trunk test frame or by manual dialing. The test trunk returns an off-hook signal upon seizure and an on-hook signal upon receipt of a rering signal. A 120 ipm flash is returned upon receipt of a second rering.

- 105-type-This test line provides access to a responder at the far end and permits automatic two-way transmission loss and noise measurements to be made on trunks from the near-end office. The near-end office must be equipped with a suitable test frame and an ATMS director. The integrated trunk and loop testing system provides this capability.
- 108-type-This test line provides loopback connections for evaluation of transmission paths from the customer site as well as between any two nodes of class 4 and class 5 offices in the switching network. For additional information about the 108-type test line see NTP 297-3501-105, *Features and Services Description*.

Trunk tests

Trunks in the DMS-10 switch may be tested as follows.

Loop-around transmission

This facility is used for two-way transmission testing on trunks. Maintenance personnel at another office access a trunk incoming to the DMS-10 switch office and dial an access code or DN. When a tone is received (in the pattern, 9s on-1s silence), they access another trunk incoming to the DMS-10 switch and dial another code or DN. By accessing the second test line while the first is being held, a looparound connection between the two trunks is established. For a procedure used to set up this facility, see SOP 0105 in NTP 297-3501-311.

Testing of outgoing trunks

A set of jacks in the Power and Cooling Module is permanently wired to calibrated two- and four-wire test trunks in the DMS-10 switch central office. A connection can be called up on the maintenance terminal between either test trunk and any outgoing trunk from the DMS-10 switch and transmission tests may be performed using portable test equipment plugged into the jacks. Receipt of answer supervision is indicated by LEDs at the four test-trunk jacks.

Calibration of trunk circuits

The two test-trunk circuits provided in the office can also be used for calibration of other trunk circuits. The test-trunk circuits are connected to jacks in the Power and Cooling Module and can be connected to other trunk circuits using the digital network. The analog side of the trunk circuit under test is connected to test jacks by way of the maintenance access bus. The trunk is then set up using external test equipment connected by way of the jacks.

0-db line tests

The Peripheral Processor pack (NT2T46) is a microprocessor-based service circuit that is used with 0-dB lines. The pack is used to measure:

- transhybrid loss in the 0-dB Line packs in the on-hook state
- singing margin in the 0-dB Line packs in the off-hook state

The Peripheral Processor pack monitors loop transmission stability. If the transhybrid loss and singing margin measurements are outside the predetermined limits, the pack informs the CPU, which then compensates for the losses.

The Peripheral Processor pack generates and measures PCM-encoded signals. These signals are used either to analyze the frequency signatures of the line return losses (transhybrid losses) or to measure the reflected tone and calculate the singing margin. All signal transmission occurs by way of the CPU and over the Peripheral Bus of the DMS-10 switch. Functional intelligence is provided by the microprocessor (part of the Peripheral Processor) and controlled by the software downloaded from the DMS-10 switch.

On-hook test

The 0-dB lines are tested periodically. One test, conducted when the loop is on-hook, is invoked either automatically or manually through the Peripheral Equipment Diagnostics (PED) overlay. All 0-dB lines are tested on an individual circuit basis.

During this test, the CPU switches the nonloaded network and the 2-dB pad out of the circuit under test. The CPU also establishes the speech connections between the Peripheral Processor pack and the line under test (LUT) and sends a message to the Peripheral Processor pack to start the test.

Note: *If a subscriber goes off-hook during the test, the test is aborted and the gain/balance is restored.*

Six tones in the voice-frequency bands are generated in the Peripheral Processor pack and are PCM-encoded. They are then stored in the memory of the pack. When the test is started, each tone is applied to the LUT for 32 ms. The tone is then reflected and received by the Peripheral Processor pack. The service pack measures the power of the reflected tone and calculates the transhybrid loss of each tone applied. By signature analysis of the six test tones (transhybrid loss of each tone), the service pack determines whether the line is loaded or nonloaded. The determination represents the test result, which is sent to the CPU. The CPU then switches the appropriate balancing network in the circuit

Off-hook test

The off-hook test is performed by the Peripheral Processor pack on the 0-dB line when the subscriber goes off-hook. This test may be performed on an originating party after dialing or on answer when the line is the destination party. Because a small number of Peripheral Processor packs are provisioned, the line going off-hook therefore competes for an idle Peripheral Processor pack.

The CPU switches normal gain/balance on the 0-dB line pack. The CPU also establishes the speech connection between LUT and the Peripheral Processor pack. It then sends the message to the Peripheral Processor pack to start the test.

A test tone of 3200 Hz at the -6 dBm level is PCM-encoded and stored digitally in the memory of the Peripheral Processor pack. This test tone is applied to the LUT for 6 ms. The reflection of the tone is received by the Peripheral Processor pack and return loss (singing margin) is calculated. The result of the singing margin is split into different thresholds, which are then communicated to the CPU. If instability is detected, the CPU switches a 2-dB pad in the circuit.

Subscriber station tests

The DMS-10 switch has internal facilities for testing a subscriber's loop and telephone set (either Dial Pulse or Digitone) from the subscriber's premises. These tests are performed under software control and require no special hardware. Tests are accessed by dialing a code number from the subscriber's set. Refer to the indicated NTPs for specific test procedures.

- Station Ringer Test-This test verifies that the ringer is working and the office data and outside plant facilities are properly assigned. Refer to MP 1505 in the NTP entitled *Maintenance and Test Manual* (297-3501-511).
- Digitone Dial Test-This test verifies that the dial is producing the correct tones. Refer to MP 1520 in the NTP entitled *Maintenance and Test Manual* (297-3501-511).
- Dial Speed Test-This test verifies that the rotary dial is within the range of 8 to 12 pps. Refer to MP 1515 in the NTP entitled *Maintenance and Test Manual* (297-3501-511).

The Stuck-Coin Test, First-Trial Failure (CFTF) facilitates preventive maintenance on coin stations by collecting information on stuck-coin test, first trial failures. The CFTF operational measurement block includes a peg count of failures and the directory number and the line-circuit identification number (physical location) of each failing station. A maintenance message is printed on the maintenance terminal after second-trial failures. Refer to the CFTF measurement block in the NTP entitled *Operational Measurements* (297-3501-456).

Section 7: Line and trunk test equipment interfaces

Introduction

This section contains descriptions of the interfaces provided on the DMS-10 switch for external (that is, not supplied with the DMS-10) line and trunk test equipment. The DMS-10 switch supports interfaces with a variety of line and test trunk equipment to provide compatibility with an operating company's existing test system. Older test equipment (for example, Noller/Badger Remote Test Systems, No. 14 LTD, and No. 3 LTC) was developed before the advent of commercial digital switching systems. The DMS-10 switch interface for these systems was developed by Nortel Networks and complete descriptions of these interfaces are provided in this section. The interfaces for more recently available test systems (for example, RTEC/LORDEL MITS-70, AT&T LMOS, Teradyne 4-TEL, Nortel Networks LRS and CALRS) have been developed by each system's manufacturers. Brief descriptions of the interfaces to these systems are also provided in this section. Complete DMS-10 switch interface descriptions are available through each system's manufacturer.

Noller NP612 / Badger NP612A remote test systems

The Noller NP612 Remote Test System and Badger NP612A Remote Test System require different connections to the DMS-10 switch. Once wired subscriber loop testing using the Noller NP612 or Badger NP612A is functionally identical.

The Noller NP612 or Badger NP612A consists of:

- a master station (operator's console), normally located at the test center
- a remote station, co-located with the DMS-10 switch

The master station contains code and dial-through transmitter and analog receiver circuits, as well as keys and controls for the test functions. It performs the following three basic functions:

- controls the test or communication lines
- controls the selection of test measurements
- controls the conditioning of the loop

The remote station contains an analog transmitter and code, and dial-through receiver and measurement circuits. It performs two basic functions:

- makes remotely-controlled test measurements of dc and ac voltage, resistance, and capacitance
- operates loop and related office equipment conditioning controls to isolate central office troubles from subscriber line troubles

Interface

The DMS-10 switch interface for the Noller NP612 or Badger NP612A consists of the following three circuit packs:

- Noller Test Trunk (NT2T17) - This pack contains digital-to-analog (D/A) and analog-to-digital (A/D) conversion circuitry. It provides the access to the Maintenance bus of the DMS-10 switch through the Main Distributing Frame (MDF) cross-connections to interface a Noller NP612 master station (at a central test location) with a Noller NP612 remote station (in the DMS-10 switch office) and the subscriber loops served by the DMS-10 switch.
- Miscellaneous Line (NT2T03) - This pack provides the three-wire terminating line necessary to access the test equipment from the distant Noller master station. The third wire (S-lead) is used to seize the test equipment.
- Auxiliary Ringing and Tone (NT2T40) - This pack demultiplexes the DMS-10 switch multifrequency ringing supply to obtain four individual ringing frequencies. In addition, it supplies a +10 dBm busy tone.

  Note: The Auxiliary Ringing and Tone pack is not required if the office has external equipment and uses only one ringing frequency, such as fully selective or semi-selective superimposed ringing.

Refer to Figures 7-1 through 7-5 for specific diagrams on the interface between the DMS-10 switch and the Noller NP612 Test System (Figures 7-1 and 7-2) or Badger NP612A Test System (Figures 7-3 through 7-5).

Noller connections

Connections between the Noller remote station and the three circuit packs that provide the interface are shown in Figure 7-1. In addition, connections between the Noller Test Trunk pack and the Maintenance bus are shown as connections to any Peripheral Maintenance Access pack that brings the bus to the MDF.

Figure 7-1: Interconnection between the DMS-10 switch and Noller NP612

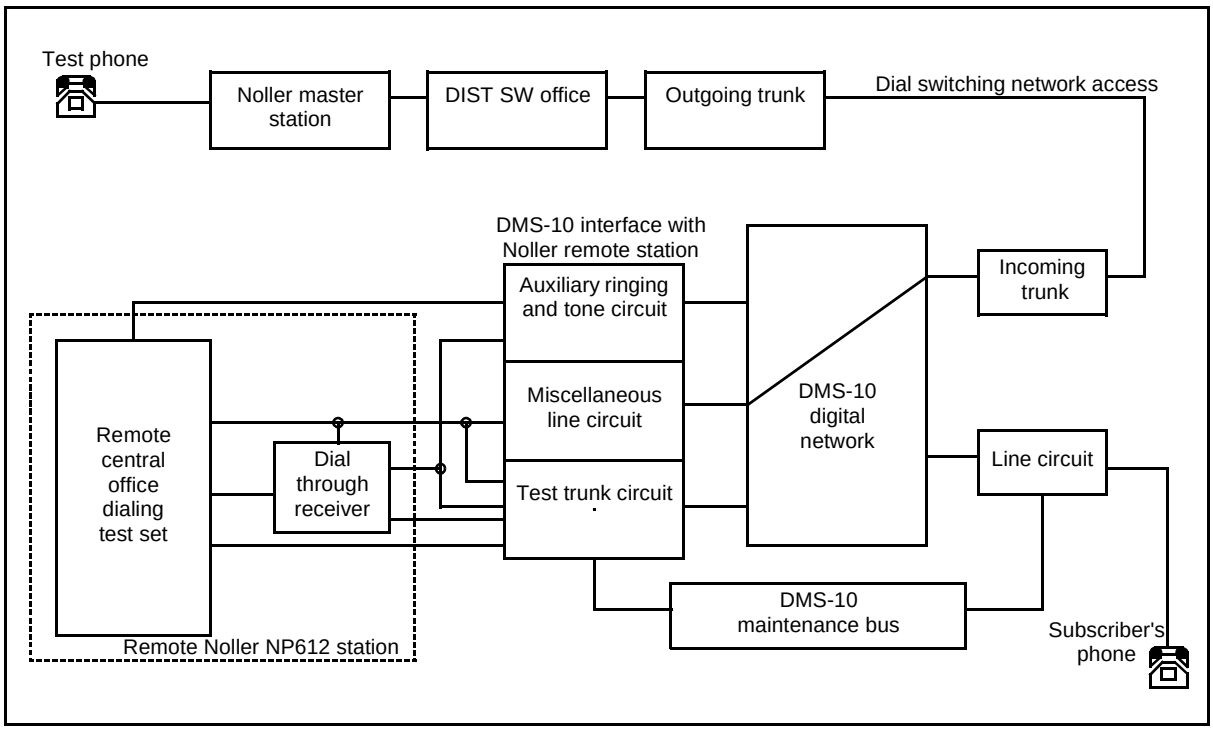
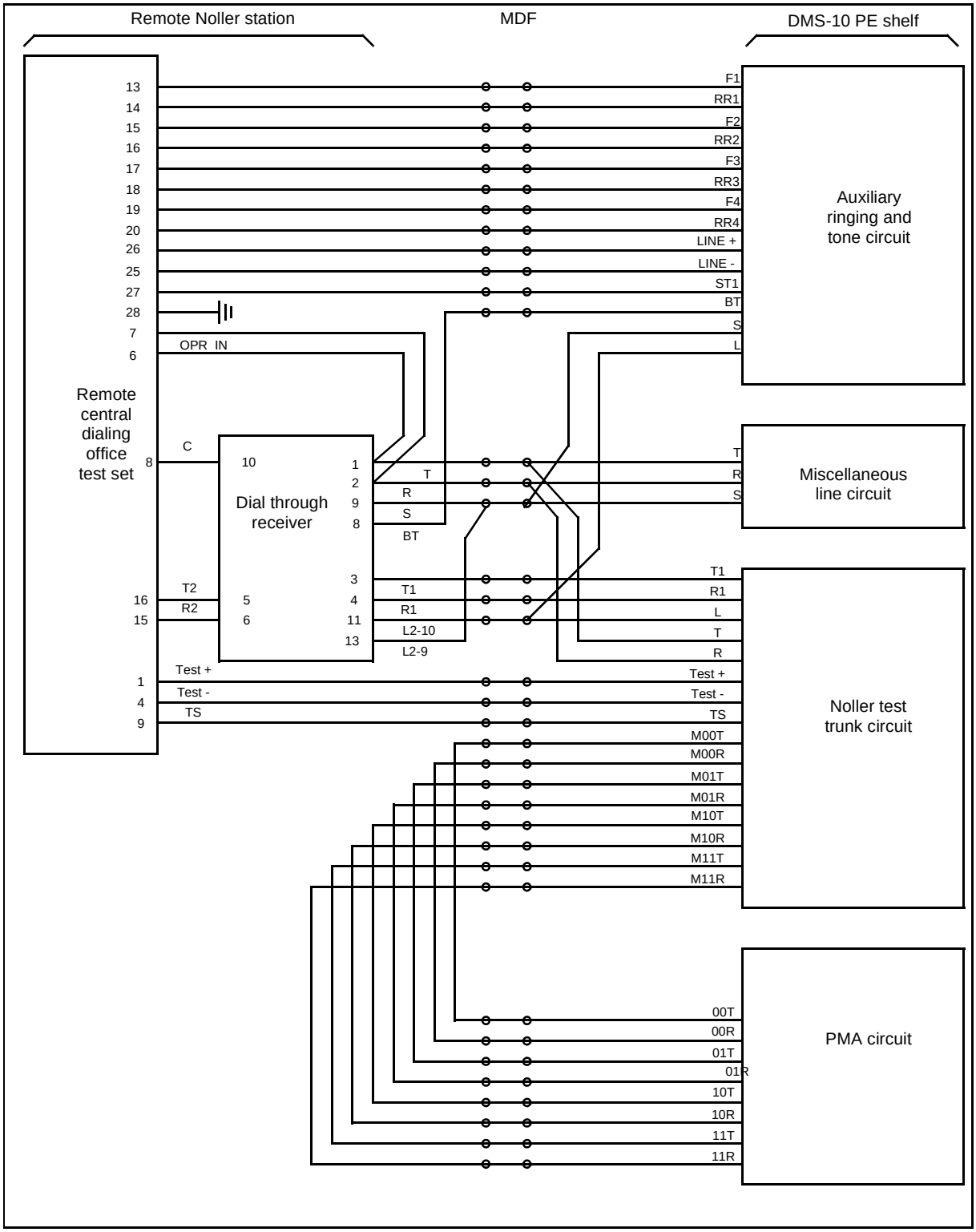


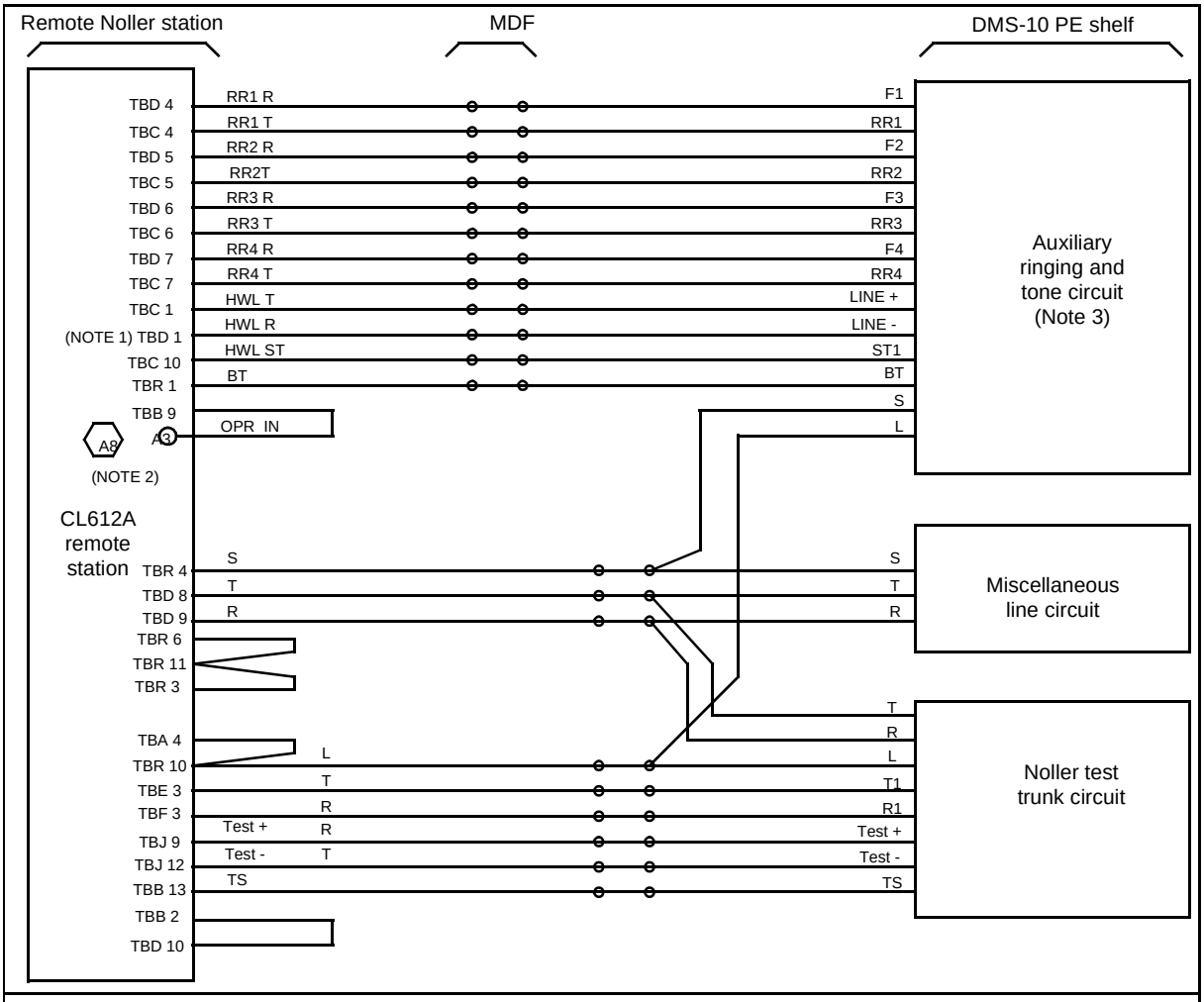
Figure 7-2: Noller to DMS-10 interface connections



Badger connections

The connections between the three circuit packs that form the interface and the required modifications are shown in Figure 7-3. Figure 7-4 shows the wiring for an office that is equipped exclusively with single-party lines or for an office that provides fully selective or semi-selective superimposed ringing. Figure 7-5 shows the connections for a DMS-10 switch equipped with a Remote Equipment Module (REM).

Figure 7-3: Badger to DMS-10 switch interface connection



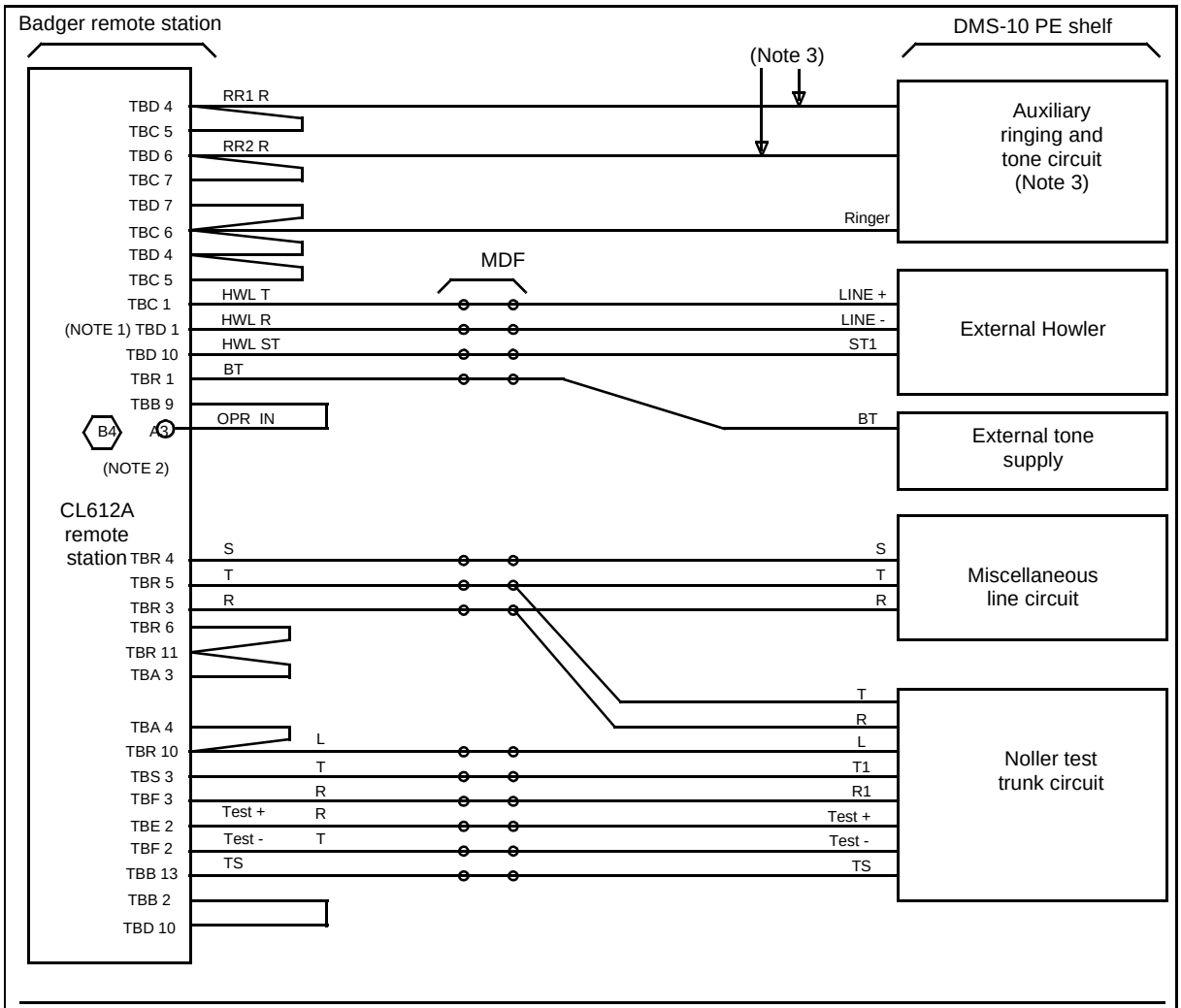
Notes:

1. The lead "HWL ST" should have solid ground (instead of 47 kΩ ground) when relay HL is operated. It is suggested to short circuit the 47 kΩ resistor in the CL612A remote station.

2. Gold pin "A3" is on the rear of CL612A remote station. The symbol A8 refers to printed circuit board position No. 8 on the lower shelf A of the remote station.

3. The auxiliary ringing and tone circuit (NT2T40) is optional, depending on the switching office ringing and tone requirements. Other commercial ringing and tone plants may be used.

Figure 7-4: Badger to DMS-10 switch interface connections for single frequency or superimposed ringing



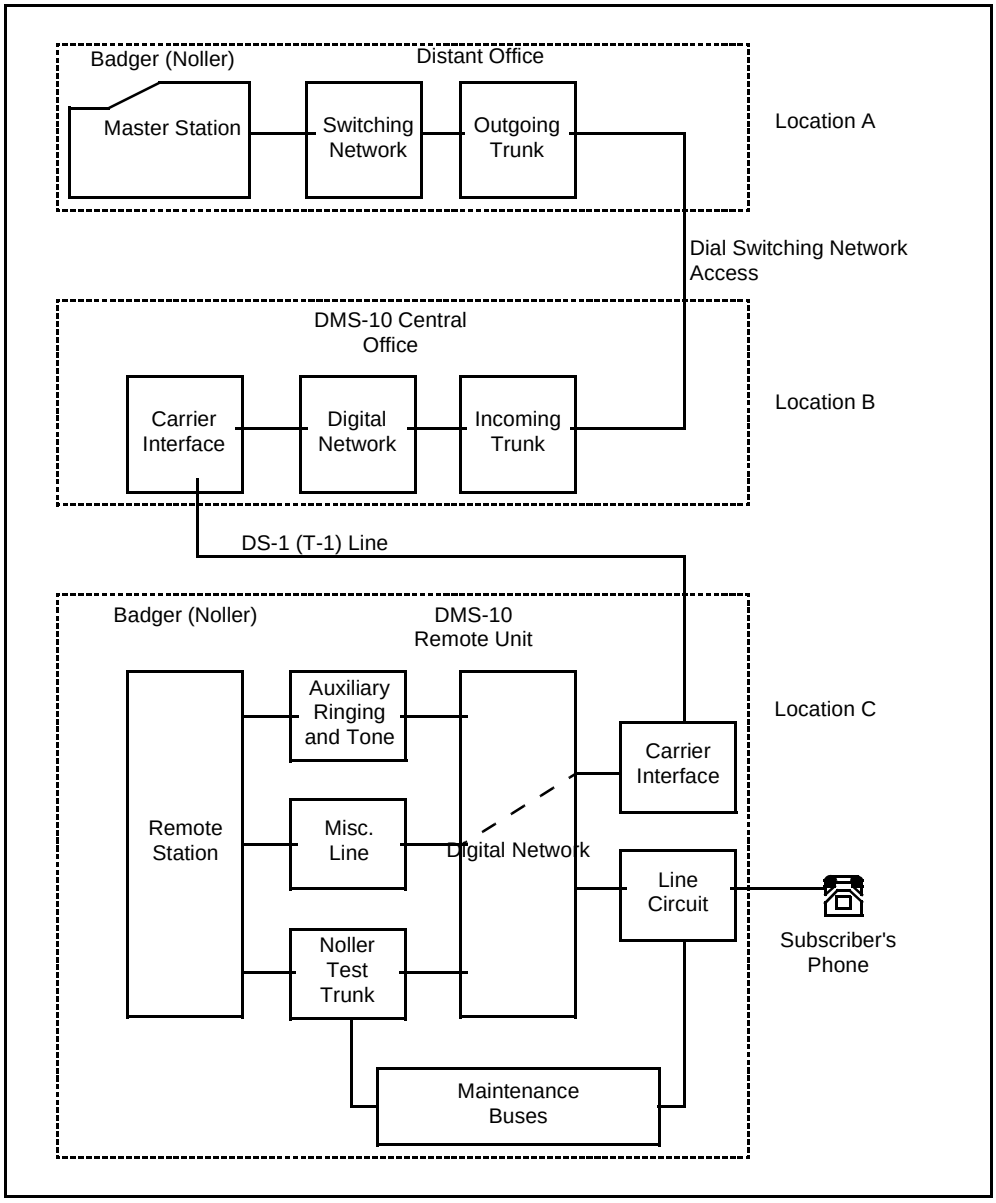
Notes:

1. The lead "HWL ST" should have solid ground (instead of 47 kΩ ground) when relay HL is operated. It is suggested to short circuit the 47 kΩ resistor in the CL612A remote station.

2. Gold pin "A3" is on the rear of CL612A remote station. The symbol B4 refers to printed circuit board position No. 4 on the lower shelf B of the remote station.

3. The RR1 R and RR2 R leads are connected to F32 and F64, respectively. (F32 and F64 are spare fuses that supply the single-party ringing frequency superimposed on +48 V dc and -48 V dc.)

Figure 7-5: Badger to DMS-10 REM interface connections



No. 14 Local Test Desk

The No. 14 Local Test Desk (LTD) is desk-mounted test equipment used for testing subscriber lines. The principal features of the No. 14 LTD are:

- regular telephone terminations and dedicated talking circuits
- test trunks
- digital voltmeter to determine line leakage, foreign potential, line current, and even a reasonable check of line balance and capacity
- miscellaneous test features to apply receiver off-hook (ROH) tone and breakdown voltages to the line under test
- tests for subscriber set dials, Digitone, station sets, transmitters, coin relays, ringers, high-resistance leaks and foreign potentials

Interface

The DMS-10 switch interfaces with the No. 14 LTD Test Trunk by way of the Incoming Test Trunk (ITTK) pack (NT2T16). The ITTK pack contains D/A and A/D conversion circuitry, and it provides access to the maintenance bus of the DMS-10 switch through MDF cross-connections. A busy indication (central office ground on the IN-USE lead) is provided for other equipment (such as DMS-1), which may require an indication when the ITTK is in use.

Connections

The connections between the LTD Test Trunk, the ITTK pack, and the Peripheral Maintenance Access (PMA) pack (NT2T14) are shown in Figure 7-6.

Line idle

If the line being tested by the local test desk is found to be idle upon release of the DIAL or KP key:

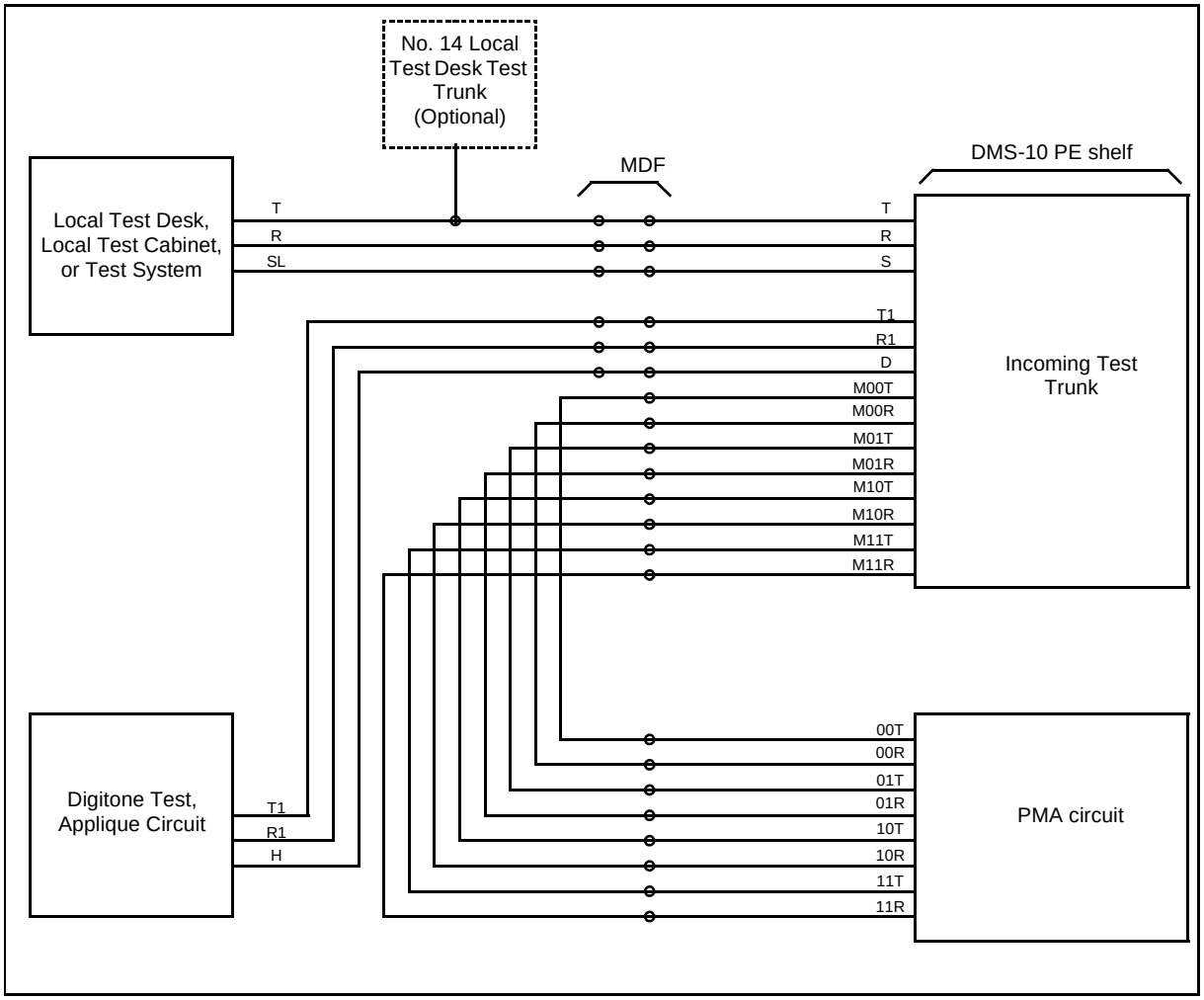
- The tester has immediate dc access to the subscriber line for testing purposes.
- Operation of the 3WO key is not required to obtain the line identification record. Line identification is recorded automatically upon idle line cut-through.

Line busy

The monitoring of busy lines is performed at the operating company's discretion. To determine if monitoring is allowed for a particular DMS-10 switch, the office Configuration Record should be queried using the MTCE prompting sequence of Overlay CNFG. The response to prompt IMON will be YES if monitoring is allowed or NO if it is not.

CAUTION: Do not apply high dc potentials to a unit under test.

Figure 7-6: No. 14 LTD, no. 3 LTC, and CALRS connections



No.3 Local Test Cabinet

The No. 3 Local Test Cabinet (LTC) is used in maintaining the subscriber lines of central offices. The principle features of the test cabinet are:

- a digital voltmeter for detecting shorts, crosses, grounds, resistance and capacitance measurements, current-flow measurements, and, in certain cases, dial-speed trouble
- insulation-breakdown test, transmission test, coin-relay test, ringer test, dial test, receiver off-hook tone test
- a jack panel (ED91465-31) to provide talking and test-trunk channels in addition to those available in the cabinet alone

Interface

The DMS-10 switch interfaces with the No. 3 LTC Test Trunk (SD96229) by way of the Incoming Test Trunk pack (NT2T16).

Connections

Connections for the Incoming Test Trunk pack to the No. 3 LTC Test Trunk and the Digitone Test pack are shown in Figure 7-6.

Model 3703 Local Test Cabinet

The Model 3703 Local Test Cabinet (LTC) provides a full complement of test functions for analyzing the condition of subscriber lines. These test functions include:

- ac voltage, dc voltage, resistance, and capacitance measurements between all combinations of tip, ring, and ground
- ringer presence testing, line length measurement, and fault analysis
- off-hook supervision on subscriber lines (loop-start or ground-start)
- subscriber dialed digits check (dial pulse, multifrequency, or dual tone multifrequency)
- talking and monitoring on accessed lines
- analysis of DP and DTMF digits sent by subscriber's dial
- automatic ringing frequency generation
- variable loop condition specification
- coin-collect / -return pay-station function emulation
- howler tone application
- automatic activation/deactivation of metallic bypass facility
- external line termination access
- self test capability

Interface

Each Model 3703 LTC can access one MDF-type and up to three dial-type test trunks. The MDF-type trunk terminates at the MDF jackbox, while the dial-type trunks are connected by way of the DF to incoming test-trunk circuits of the same or different central office(s).

Total loop-resistance limits for Model 3703 test trunks are:

- 1500Ω when terminating at a central office test-trunk circuit (dial-type only)
- 2000Ω when terminating at a subscriber station (both MDF- and dial-types)

A specific central office test trunk circuit can be dedicated to one LTC dial-type trunk or, alternatively, can be multipled to up to 12 LTC dial-type trunks. The latter arrangement provides access to the switching office from different LTC positions with one central office test trunk circuit.

The DMS-10 switch interfaces with the Model 3703 LTC by way of an Incoming Test Trunk (ITTK) pack (NT2T16). A block schematic diagram of the connection between the Model 3703 LTC and the DMS-10 switch is shown in Figure 7-7.

Automated test systems

The Nortel Networks Loop Reporting System (LRS) and Computer Automated Loop Reporting System (CALRS), the AT&T Loop Maintenance Operation System (LMOS), the RTEC/LORDEL MITS-70 system, and the Teradyne 4-TEL system are mechanized subscriber loop testing and administration systems. These systems are computer-based, employing a database subsystem, a control terminal, test controllers, and test heads located on line equipment. The DMS-10 switch supports subscriber loop testing with any of these systems. A typical configuration is illustrated in Figure 7-8. The following subsection describes the main features of the LRS and CALRS systems. See the manufacturer's documentation for descriptions of LMOS, 4-TEL and RTEC/LORDEL MITS-70 systems.

LRS and CALRS

LRS and CALRS (LRS-1, LRS-10, LRS-100) test features include:

- basic measurements of ac volts between tip and ring, tip and ground, and ring and ground, dc volts, resistance, and capacitance
- various functional tests otherwise performed by a Local Test Desk (LTD) or a Local Test Cabinet (LTC)

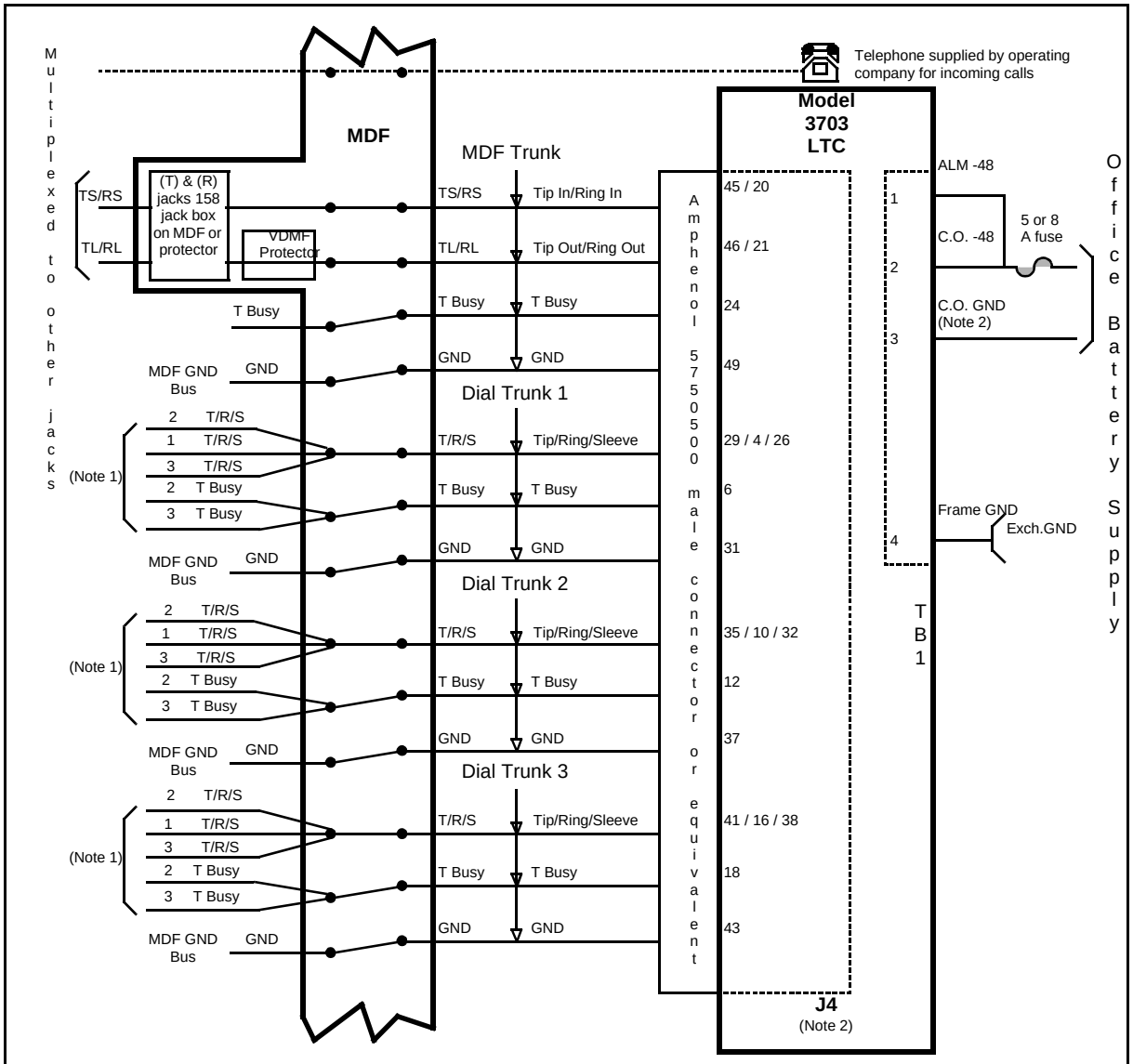
Interface

The CALRS and LRS are interfaced to the DMS-10 switch by way of a single circuit pack, the Incoming Test Trunk (ITTK) pack (NT2T16). A Peripheral Maintenance Access (PMA) pack (NT2T14) provides maintenance relays for line access.

Connections

Connections between the ITTK and the CALRS and LRS test trunks are shown in Figure 7-7. The basic configuration of a DMS-10 switch with remotes and LRS loop testing equipment is depicted in Figure 7-8.

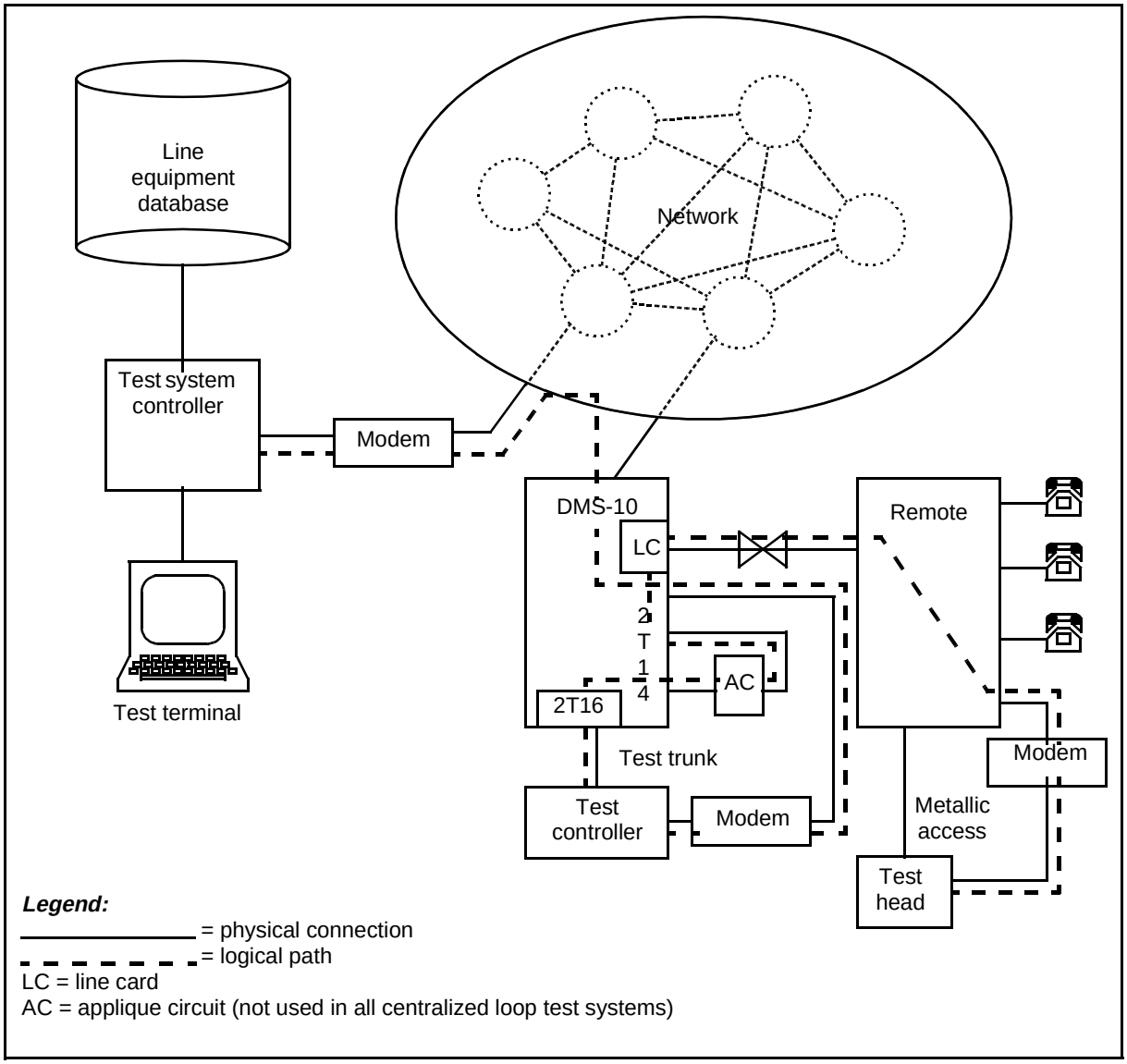
Figure 7-7: Connection between model 3703 local test cabinet and DMS-10



Note 1: The following legend defines the meaning of the numbers associated with each connection: 1 = connection to central office incoming test trunk (NT2T16); 2 = cross-connection to preceding central office test trunk appearance at MDF; 3 = cross-connection to succeeding central office test trunk appearance at MDF. If access to the central office test-trunk circuit is on a “dedicated” basis, the LTC dial trunk shall be extended per 1. If access to the central office test-trunk circuit is on a “shared” basis, the LTC dial trunk shall be extended per 1 and 3 for the first appearance, 2 and 3 for intermediate appearances, and 2 for the last appearance.

Note 2: There must be solid ground from one of the various pins on connector J4 to pin 3 on connector TB1.

Figure 7-8: Typical DMS-10/remote centralized loop test configuration



Incoming test trunk

The Incoming Test Trunk (ITTK) pack (NT2T16) provides the interface between the DMS-10 switch and a Loop Reporting System (LRS-1, LRS-10, LRS-100), a Centralized Automatic Loop Reporting System (CALRS), a Lordel T-9/15 Automatic Line Insulation Test (ALIT) set, or a Mechanized Loop Testing (MLT) system. The ITTK pack allows testing of all DMS-10 switch subscriber loops through the maintenance access bus (metallic access).

After the test trunk has been accessed, the particular line to be tested may be selected either by its seven-digit directory number, by its location, or by its line number. When the line is accessed by line number, the system automatically converts the line number to the correct location of the associated line card at the site served by the test trunk. Table 7-A summarizes the three methods that may be used to access a line for testing.

Note: *Access to a loop is denied when the directory number dialed through an incoming test trunk is a MADN (Multiple Appearance Directory Number). In order to access a loop that is assigned a MADN, either physical location or sequential line dialing may be used.*

Table 7-A:
Loop test access

Access Method	**Dialed Digits**
Directory Number	*n*xx *xxxx*
Location	TBSLLPP, where: T is the access type, routine (1) or demand (0); the NLIT (No Line Insulation Testing) station option is overridden by the demand (0) access type B is the Bay number S is the Shelf number LL is the Line Subgroup number PP is the Line Card number
Line Number	T00XXXX, where: T is the access type, routine (1) or demand (0); the NLIT (No Line Insulation Testing) station option is overridden by the demand (0) access type 00 (digit zero) XXXXis a sequential Line number (0-9999) associated with a line card; 0 represents the first line card in the first line subgroup on the first shelf in the first bay at the site accessed by the trunk

Metallic bypass pair testing

The metallic bypass pair method of accessing subscriber lines for line testing employs a metallic cable test path from the central office to the subscriber pair at the remote site.

The metallic bypass pair test configuration consists of:

- manual or automatic test equipment
- Incoming Test Trunk (ITTK) pack (NT2T16)
- Peripheral Maintenance Access (PMA) pack (NT2T14)
- metallic path from the base site DMS-10 switch to the remote site

The metallic bypass pair test operation works in the following sequence:

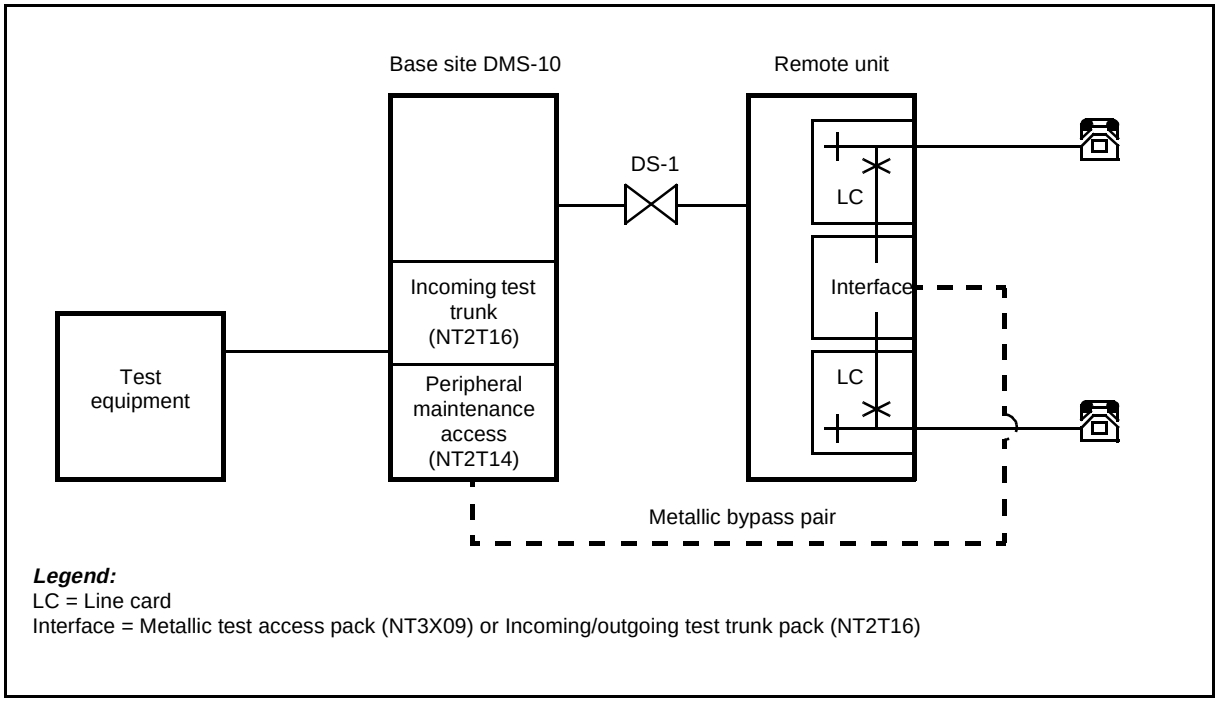
- The test equipment receives a request to test a subscriber loop.
- A connection is set up between the appropriate ITTK pack and PMA pack. The PMA pack provides access to the system maintenance bus.
- The direction of test access (bridged or out) is controlled by the sleeve lead.
- The test equipment performs loop measurements and according to user's requests, returns the results to the controlling location where they are displayed to the user.

Although the metallic bypass pair test configuration works well in some applications, the configuration has the following limitations:

- impedance between the base DMS-10 switch and the subscriber telephone must be less than 1900 Ω
- metallic cable must be used in the bypass pair between the base DMS-10 switch and the remote terminal, which excludes the use of fiber-optic cable.
- In some applications, test units must be calibrated to compensate for the effects of the metallic bypass pair.

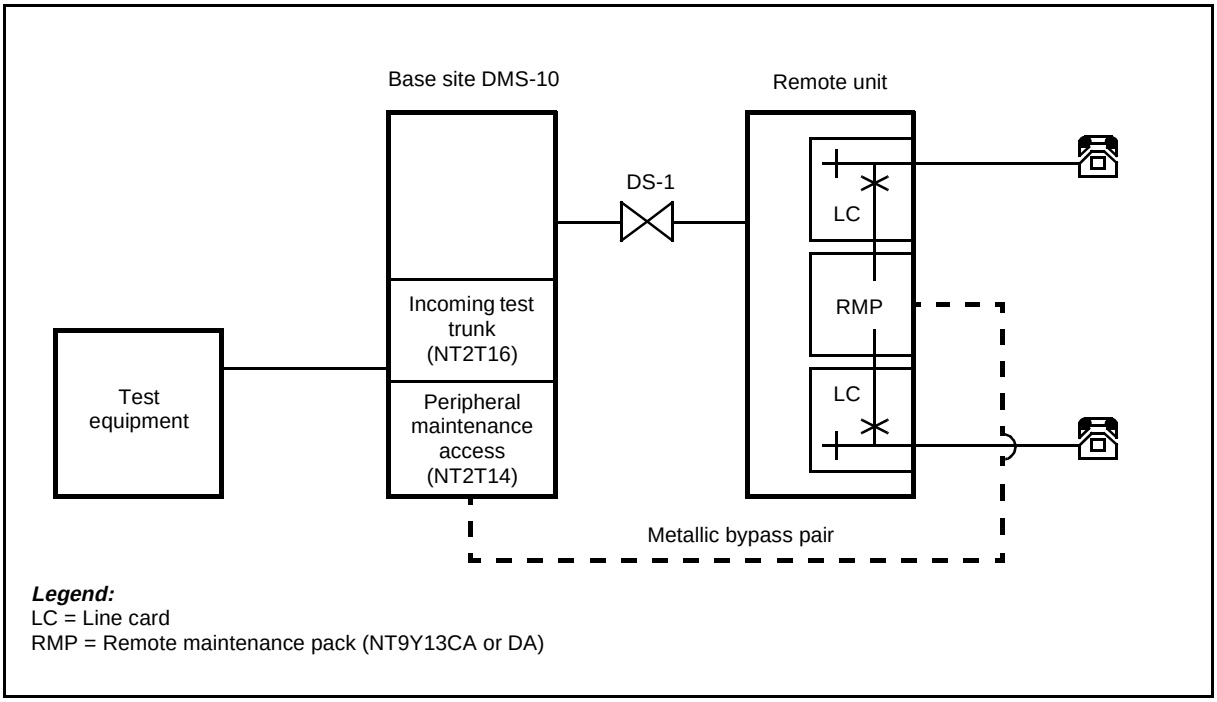
Figures 7-9 through 7-15 illustrate various metallic bypass pair testing configurations.

Figure 7-9: Metallic bypass pair test configuration for RLCM/OPM/OPAC



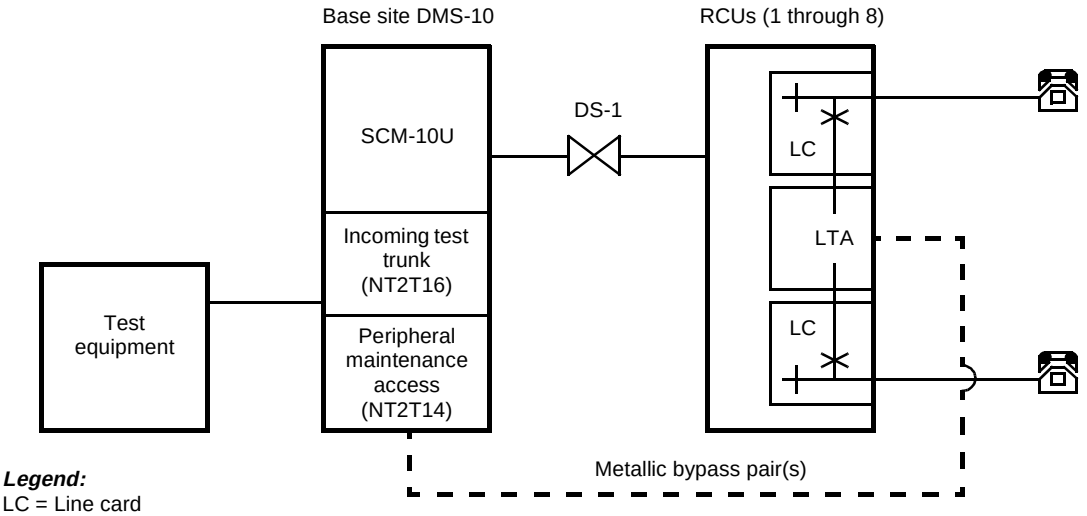
Legend:
LC = Line card
Interface = Metallic test access pack (NT3X09) or Incoming/outgoing test trunk pack (NT2T16)

Figure 7-10: Metallic bypass pair test configuration for RSLE/RSLM/OPSM



Legend:
LC = Line card
RMP = Remote maintenance pack (NT9Y13CA or DA)

Figure 7-11: Metallic bypass pair test configuration for RCU



Legend:
LC = Line card
LTA = Line test access pack (NT 3A59)
RCU = Remote carrier urban

Note: Up to four individual bypass pairs can be assigned for an RCU, when prompt 2T14 in Overlay CNFG (MTCE) (see NTP 297-3501-311, *Data Modification Manual*) is set to YES.

Figure 7-12: Test configuration for RLCM and OPM as RSC-S remotes - Metallic access from DMS-10 host

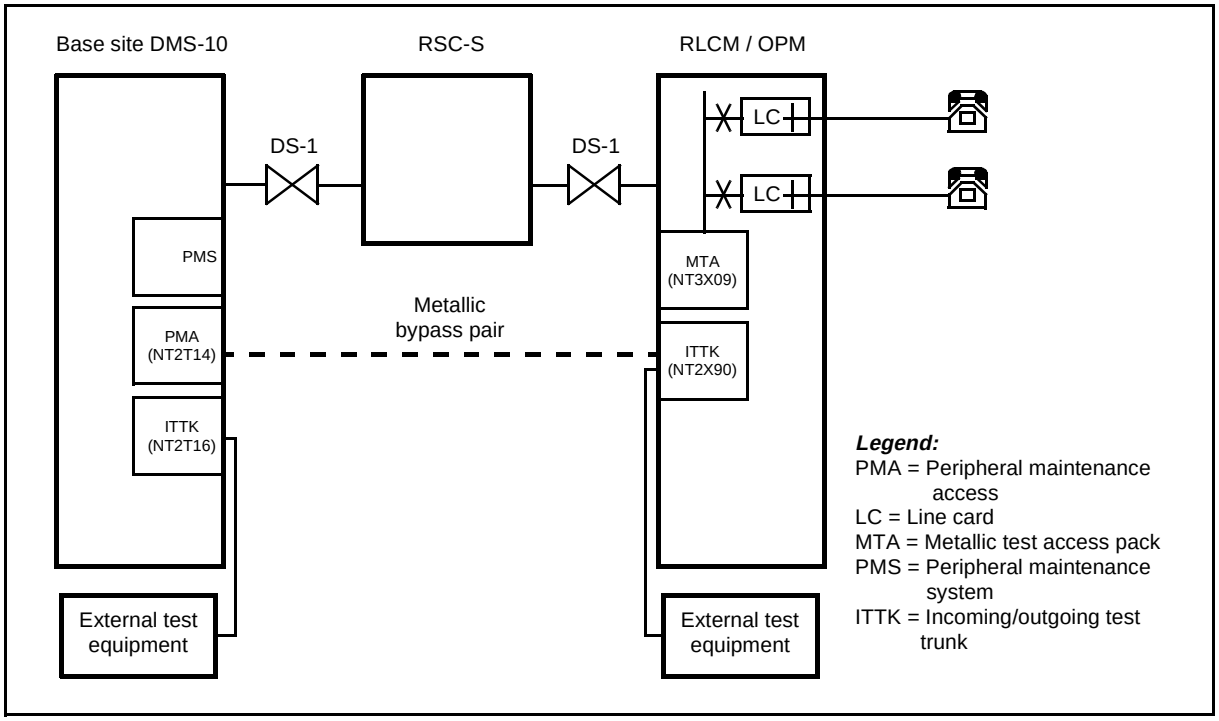


Figure 7-13: Test configuration for RSLM and RSLE as RSC-S remotes - Metallic access from DMS-10 host

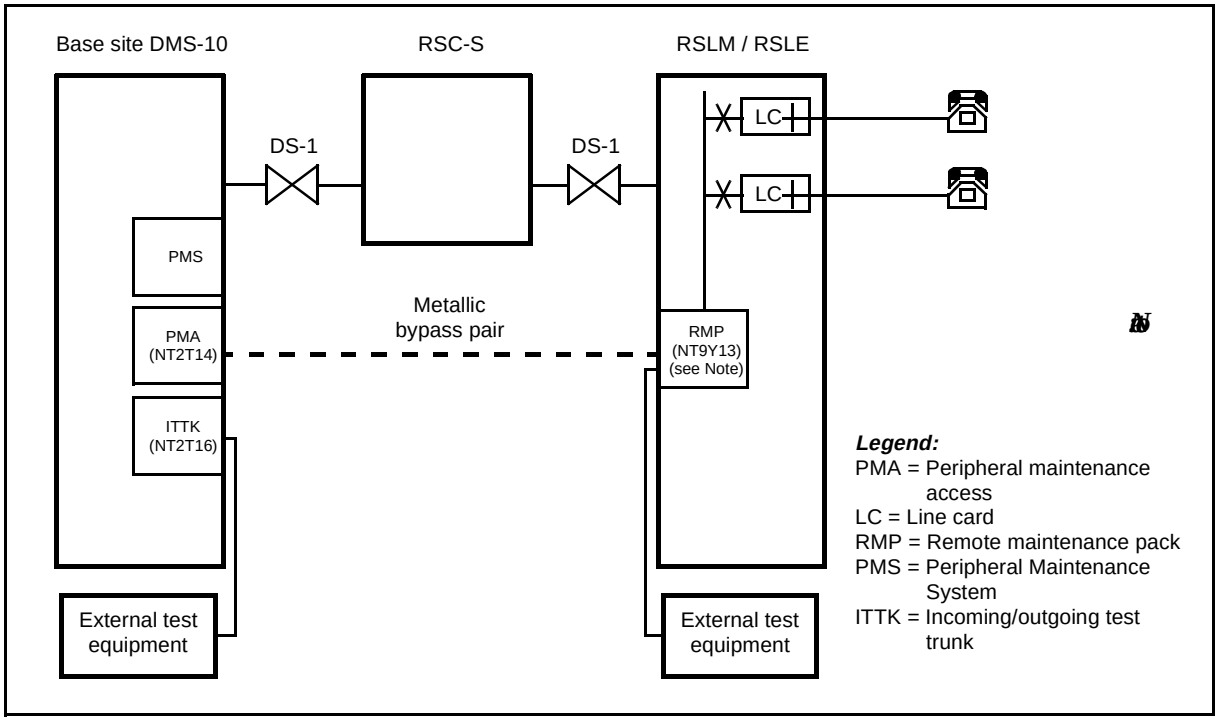


Figure 7-14: Test configuration for SLC-96 as RSC-S remote - Metallic access from DMS-10 host

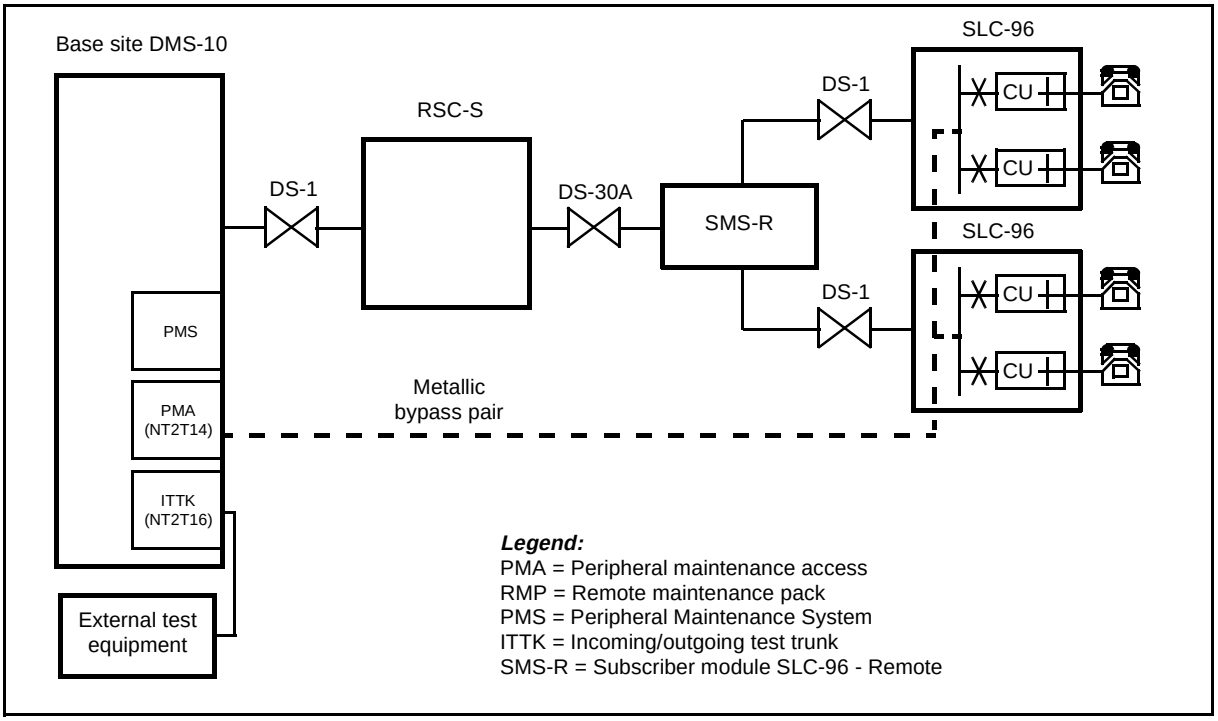
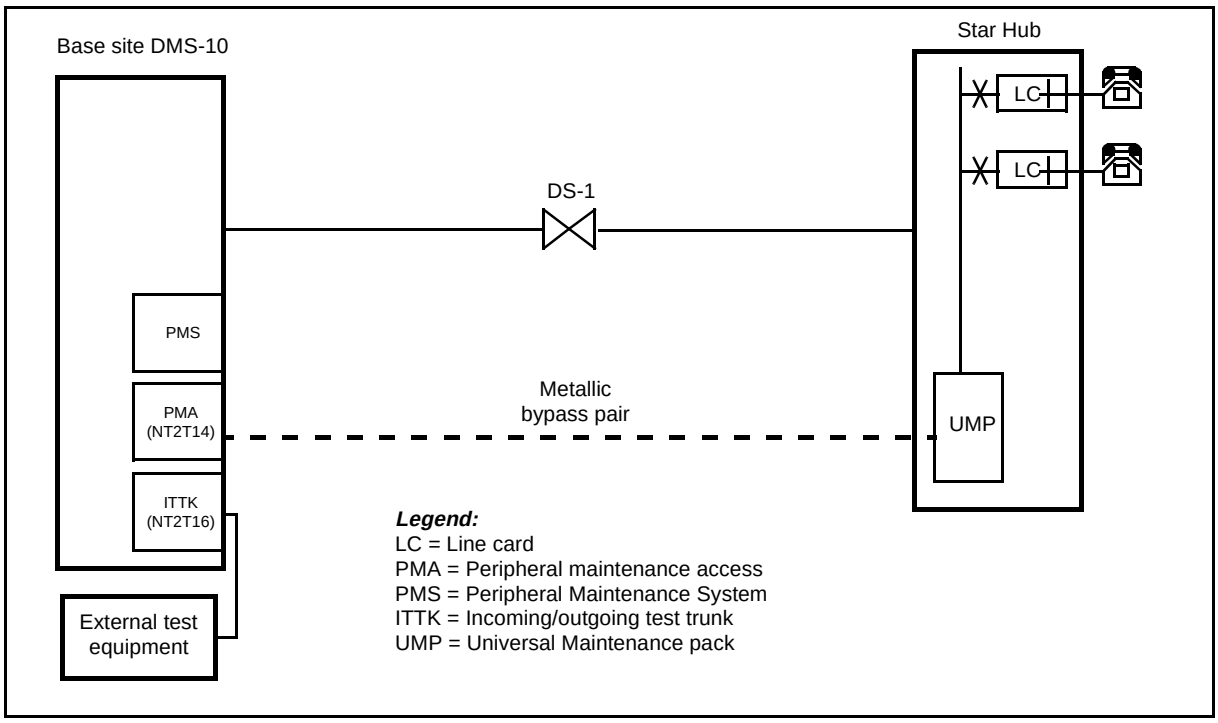


Figure 7-15: Test configuration for Star Hub - Metallic access from DMS-10 host



Digital Remote Test Unit testing

The 3704 Series Digital Remote Test Unit (DRTU) is a measurement device located at the remote site and controlled by a Nortel Networks Loop Reporting System (LRS) or 3703 Local Test Cabinet (LTC). Signal and measurement data between the DMS-10 switch and remote are transmitted over a DS-1 span line. Because a metallic bypass pair is not involved in this test configuration, the DRTU method does not have the limitations of the metallic bypass pair method (that is, distance limitation, metallic-pair requirement, calibration error). Using the extra-fast meter (XFM) measurement technology of the LRS/LTC, the DRTU provides comparable test functions. Refer to "Model 3703 Local Test Cabinet" in this section for a list of these test functions.

The DRTU test configuration consists of the following equipment:

- 3703 LTC
- Incoming Test Trunk (ITTK) pack (NT2T16)
- Peripheral Maintenance Access (PMA) pack (NT2T14)
- Bypass Signature Offhook Routing Card (NT3J00BE)
- base site DMS-10 switch line card assigned the Automatic Line Access (AUT) station option
- RLCM line card connected to the DRTU's dial-in port
- 3704 DRTU

Figure 7-16 illustrates the digital remote test unit method testing configuration for an RLCM, RSLE, RSLM, OPM, OPAC, and OPSM. Figure 7-17 illustrates the digital remote test unit method testing configuration for a SLC-9, RCU, and S/DMS AccessNode.

The DRTU test operation works in the following sequence:

- An operator sends a request to the LTC to test a subscriber loop.
- A connection is set up between the appropriate ITTK pack, PMA pack, and Signature card. The PMA pack provides access to the system maintenance bus.
- The Signature card presents a 75-kΩ delta signature back to the LTC to identify an RLCM loop.
- The LTC sends a bypass initiate signal (+130 V tip to ground) to the Signature card.
- The Signature card detects the bypass initiate signal and applies offhook to the host line card assigned the AUT station option, setting up a modem connection from the LTC to the DRTU's dial-in port.

- The DRTU's maintenance port connects to the RLCM's MTA, which establishes a metallic connection between the tip/ring pair serving the subscriber and the DRTU.
- The optional dial-out port on the DRTU is connected to an RLCM line card. The port sets up a talking path between the loop under test and the 3703.
- The DRTU performs loop measurements and according to user's requests, returns the results to the controlling location where they are displayed to the user.
- The Signature card holds the metallic connection to the DRTU's dial-in port until a remote-off signal (-130 V tip to ground) is placed on the Signature card. If the remote-off signal is not received within 10 min of the bypass initiate signal, the Signature card automatically drops the DRTU dial-in connection.

Figure 7-16: DRTU test configuration for RLCM/RSLE/RSLM/OPM/OPAC/OPSM

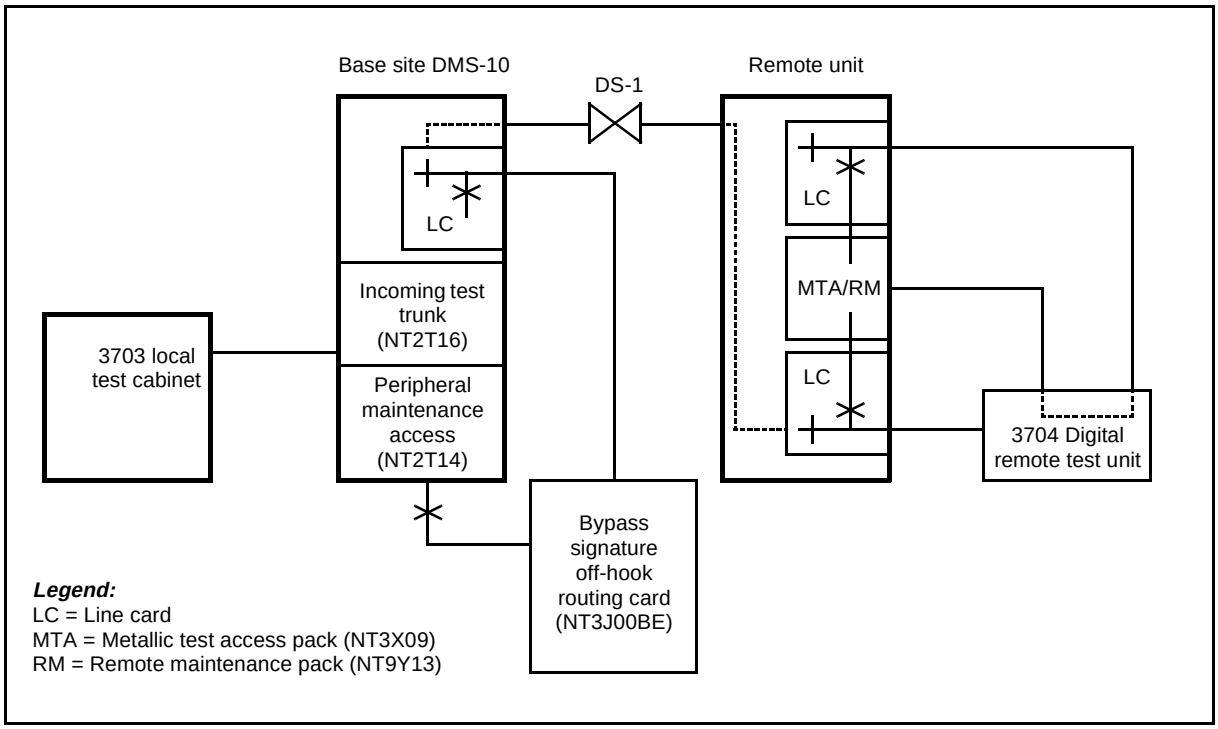
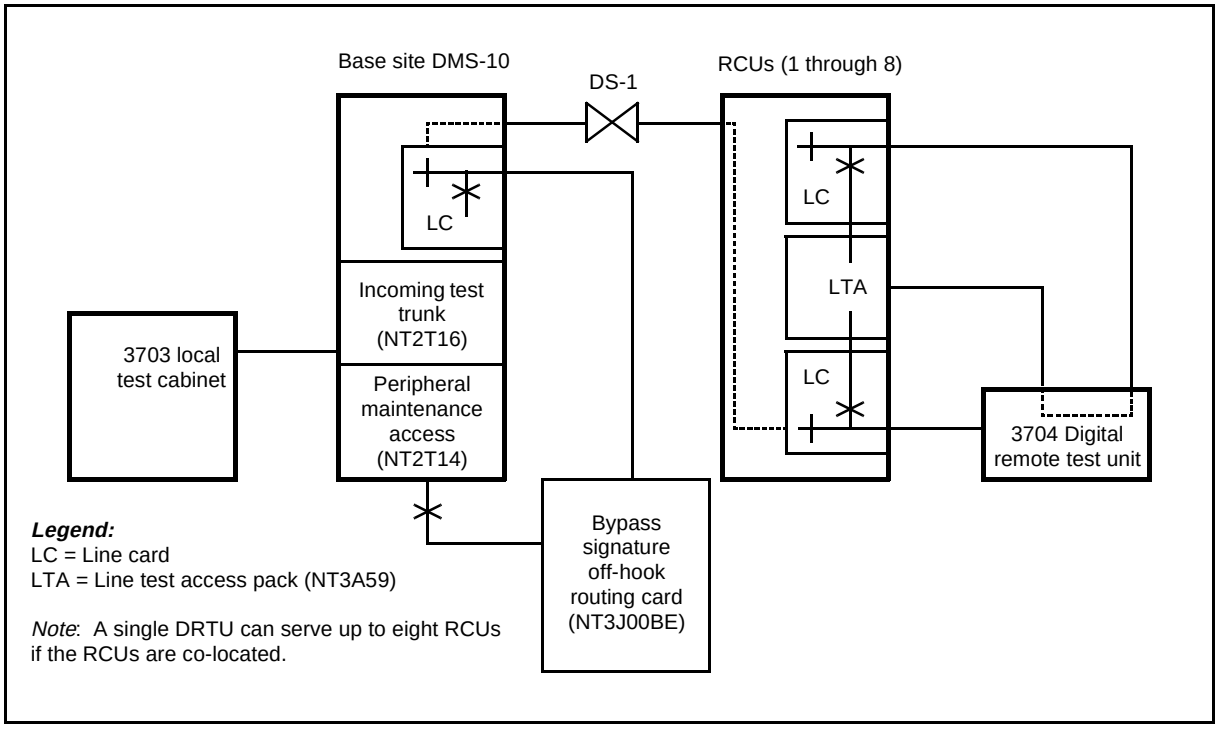


Figure 7-17: DRTU test configuration for RCU, SLC-96, and S/DMS AccessNode



Remote Maintenance Module

The Remote Maintenance Module (RMM) provides maintenance support, including line testing capabilities, for one to four RLCMs, one OPM or OPAC, or an RSC-S. In addition to line testing, craftspersons can monitor and assign alarm scan points and signal distribution points, test lines, trunks, and alarm circuits, and in the case of the OPM or OPAC, perform battery back-up testing and maintenance. The RMM communicates with its associated RLCMs or OPM/OPAC through one of two available DS-30A links.

The RMM packs used to test lines and trunks are:

- Line Test Unit Analog pack (NT2X10) - This pack is used to measure analog subscriber loops and line circuit packs.
- Line Test Unit Digital pack (NT2X11) - This pack is used to measure digital subscriber loops and line circuit packs. It provides a digital interface for the LTU analog pack.
- Incoming/Outgoing Test Trunk pack (NT2X90) - This pack provides the 4-wire interface between the RMM and external test equipment. It emulates an Incoming Test Trunk pack (NT2T16) and should be identified to external testing systems as an NT2T16.
- Metallic Test Access pack (NT3X09) - This pack provides a metallic connection between RMM service circuits and subscriber lines or OPM or OPAC battery strings.

Figure 7-18 illustrates subscriber loop testing using an RMM configuration.

Monitoring and maintaining RMM-equipped remote equipment is similar to that for central office equipment. Overlay programs are used to obtain equipment status, and to operate on and test remote equipment. See the NTP entitled *Equipment Identification Manual* (297-3501-150) for a complete description of the packs available and required for the RMM.

Remote Switching Center (RSC-S) subscriber loop testing using the RMM

The RMM also provides maintenance support, including line testing capabilities, for LCMs connected to the RSC-S. Figure 7-19 illustrates LCM loop testing using an RMM configuration. The RMM also provides maintenance support for remotes connected to the RSC-S including RLCMs, OPMs, RSLMs, OPSMs, and RSLEs, as illustrated in Figures 7-20 and 7-21.

To provide metallic access to the maximum number RSC-S remotes possible, the RMM provisioned in the RSC-S may contain up to three Metallic Test Access packs (MTA) (NT3X09). This provides access to the RSC-S LCMs as well as RSC-S remotes. The horizontals H0 and H2 of all MTA packs are interconnected making it possible to connect Line Test Unit (LTU) (NT2X10/2X11) and Incoming/Outgoing Test Trunk (ITTK) (NT3X09) packs to any vertical of any MTA pack.

RLCM/OPM/OPAC subscriber loop testing using the RMM

The RMM allows all PE and LCE line circuit testing to be performed on RLCM/ OPM/OPAC line circuits, using Overlays LIT and TLT as described in the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506). Section 6 of this NTP, "Integrated Line and Trunk Test Features," contains descriptions of the capabilities of these overlays.

Figure 7-18: RMM test configuration

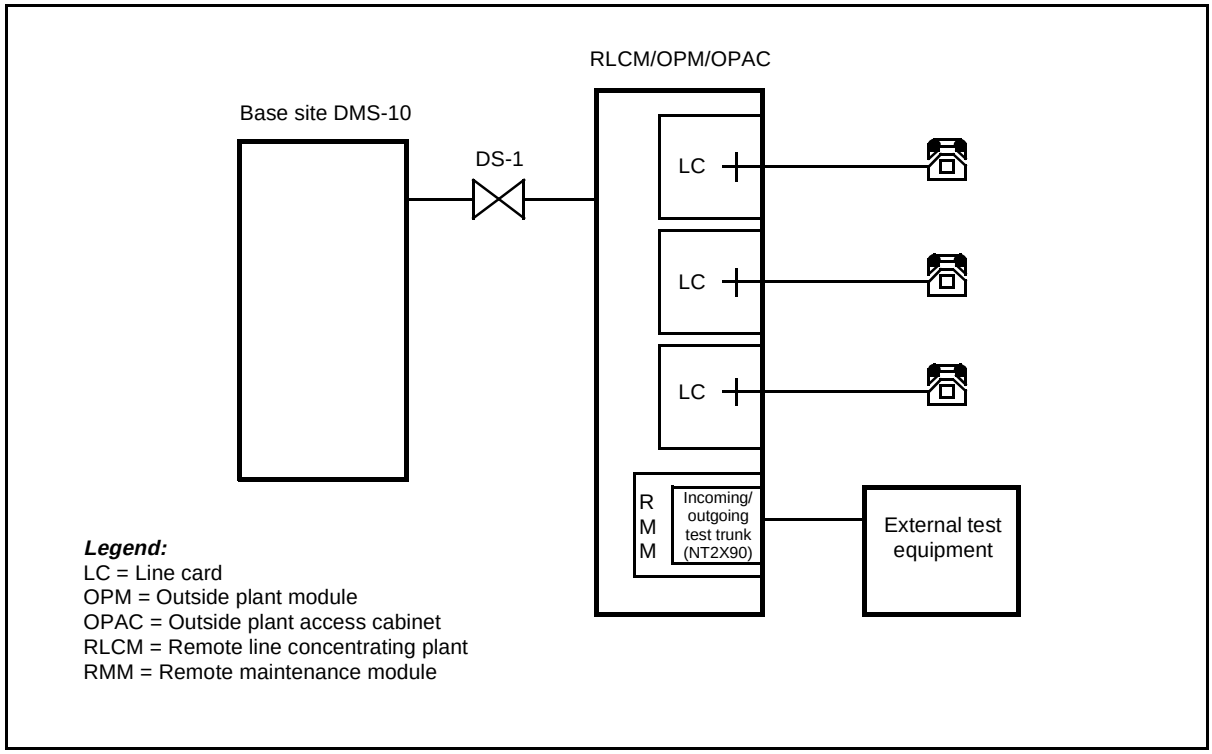


Figure 7-19: RMM test configuration for RSC-S

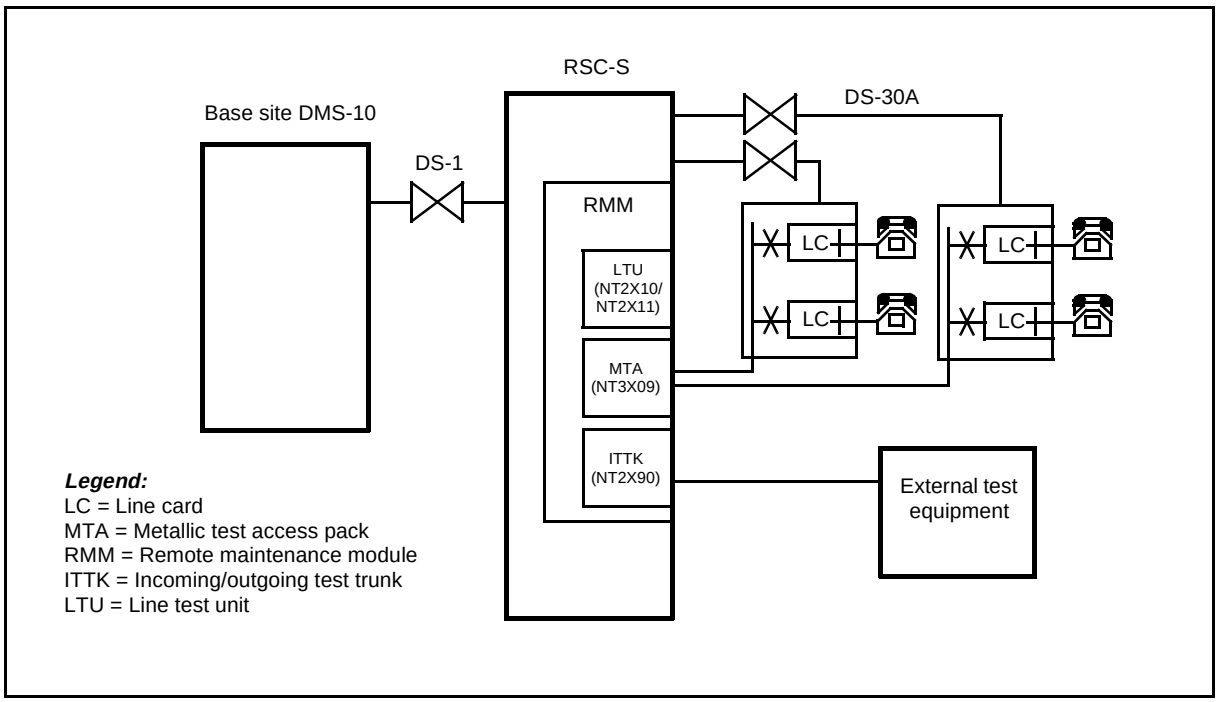


Figure 7-20: Test configuration for RLCM and OPM as RSC-S remotes - Metallic access from RSC-S

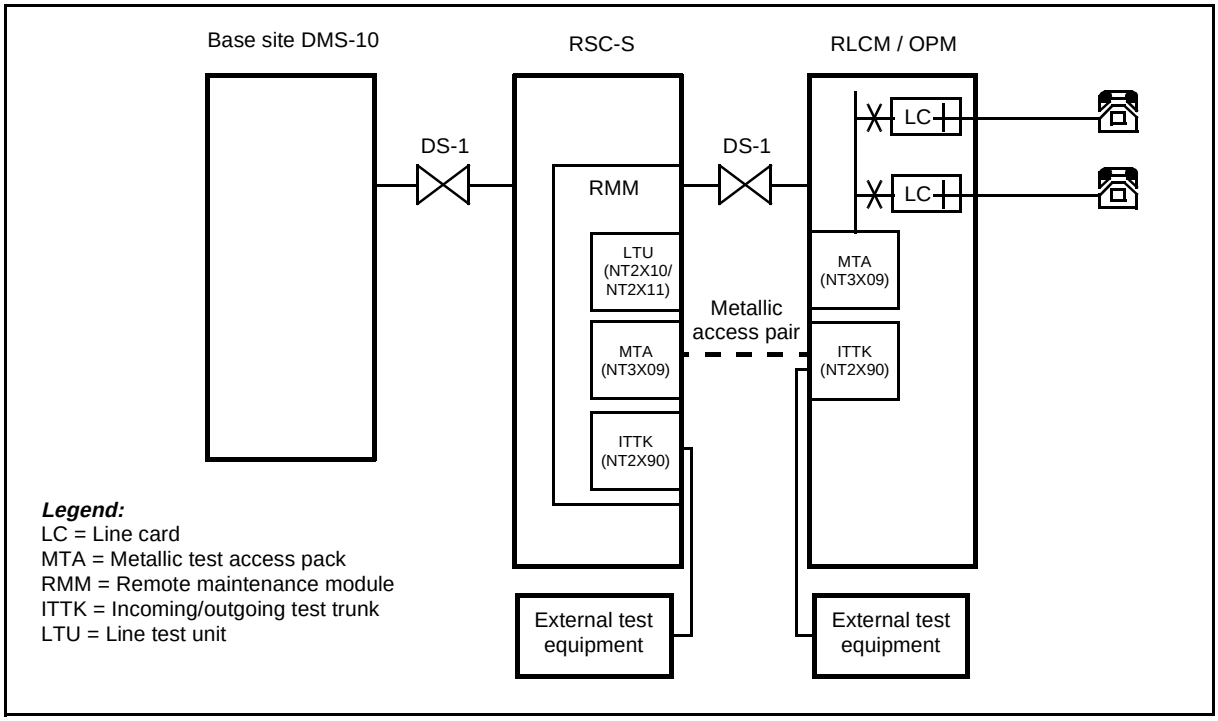
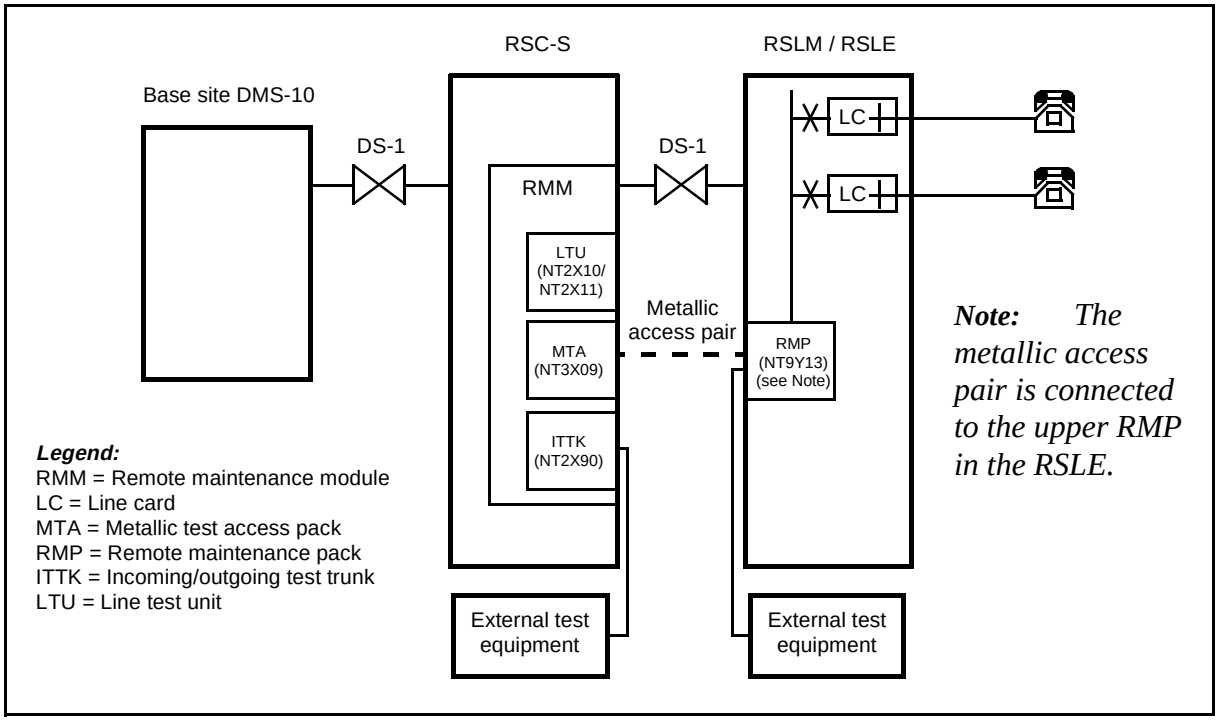


Figure 7-21: Test configuration for RSLM and RSLE as RSC-S remotes - Metallic access from RSC-S



Digital Test Access (DTA) testing

Digital Test Access provides the capability to monitor channels from an ISDN BRI loop. Two digital data streams are derived from the monitored channels: downstream - data flowing toward the subscriber, away from the switch, and upstream - data flowing toward the switch, away from the subscriber. Digital Test Access is performed by duplicating a stream of data using a broadcast connection and then accessing the duplicated stream of data through an external protocol analyzer at the ISDN line card.

DTA testing is supported as part of the RDT line testing package.

DMS-10 Remote equipment test access

Each configuration of DMS-10 switch line equipment provides an interface for external test equipment.

Remote Line Concentrating Equipment test equipment access

The REM, RLCM, RSLE, RSLM, OPM, OPAC, OPSM, and RSC-S provide access to external test equipment for testing subscriber loops by way of the incoming test trunk equipment (NT2T16, NT2X90, NT9Y13). Table 7-B lists specific parameters for subscriber loop access for available line equipment. Table 7-C provides information on DMS-10 switch to remote line concentrating equipment busy access capabilities.

RCT test equipment access

The Remote Concentrator Terminal (RCT) provides line concentrating functions for DMS-1 subscriber lines. The RCT interfaces with a Subscriber Carrier Module located at the DMS-10 switch. Subscriber loop access for test equipment is provided at the RCT. A metallic access bus is provided for test desk access to subscriber loops. Consult the DMS-1 Rural NTP entitled *Line Test Access Feature Description, Installation and Maintenance* (362-2011-108) and DMS-1 Rural NTP entitled *Subscriber Line Test Extension Feature* (362-2011-109) for a description of DMS-1 subscriber loop testing access. Table 7-C provides information on DMS-10 switch to DMS-1 busy access capabilities.

SLC-96 test equipment access

SLC-96 lines are connected to the DMS-10 switch through the SCM-10S interface. Subscriber loop access for test equipment is provided at the SLC-96. Consult the appropriate AT&T documentation for a description of the SLC-96 and its subscriber loop metallic interface. Table 7-C provides information on DMS-10 switch to SLC-96 busy access capabilities.

RCU test equipment access

Remote Carrier Urban (RCU) lines are connected to the DMS-10 switch through the SCM-10U interface. The RCU is configured with a metallic access bypass pair that makes possible a full range of subscriber loop tests. One metallic bypass pair can serve from 1 through 8 RCUs. An optional Line Test Access (LTA) circuit pack must be provisioned in the RCU, and the host office must be configured with ACT (ac Tester), to enable external test systems such as a Mechanized Loop Tester (MLT) or Line Test Desk (LTD) to be used. Consult the appropriate NTPs provided with the DMS-1U for complete descriptions of the RCU, the LTA circuit pack, and the RCU subscriber loop metallic interface. Consult section 6 of this NTP for information about ACT.

Star Remote test equipment access

The Star Remote system provides a remote line concentrating system that supports up to 1152 lines, using standard DMS line cards. The Star Remote system comprises two products - the Star Module and the Star Hub. The Star Hub is available with the DMS-10 switch.

Star Hub test access

In the Star Hub, the Universal Maintenance pack (NTTR73) supports four metallic bus connections. A maximum of 320 lines can be connected to a test access point.

The NTTR73 pack can test only one line card at a time. Since the Star Hub is equipped with two NTTR73 packs, two metallic bus tests can be performed simultaneously, with one NTTR73 operating in ITTK mode and the second through Overlay PED, or with both NTTR73s operating in ITTK mode.

Table 7-B:
Subscriber loop access for available line equipment

Line Units	Subscriber Loop Access Parameters				
	In	Out	Bridged	External test access	Units per test head
OPM	No	Yes	Yes	Host test trunk and metallic access	1
OPAC	No	Yes	Yes	Host test trunk and metallic access	1
OPSM	No	Yes	Yes	Host test trunk and metallic access / Remote test trunk	1
RCU	No	Yes	No	Host test trunk and metallic access	1
REM	Yes	Yes	Yes	Remote test trunk	1
RLCM	No	Yes	Yes	Host test trunk and metallic access / Remote test trunk	4
RSLE	No	Yes	Yes	Host test trunk and metallic access / Remote test trunk	1
RSLM	No	Yes	Yes	Host test trunk and metallic access / Remote test trunk	1
SLC-96	No	Yes	No	Host test trunk and metallic access	1
Star Hub	No	Yes	Yes	Host test trunk and metallic access / Remote test trunk	1

Table 7-C:
Busy access capabilities from a test trunk for available line equipment

Line Equipment	Busy Access Capability	Requirements
DMS-1	Conditional	Metallic path
OPM	Conditional	Test trunk at OPM or metallic path
OPAC	Conditional	Test trunk at OPAC or metallic path

Table 7-C: (Continued)
Busy access capabilities from a test trunk for available line equipment

Line Equipment	Busy Access Capability	Requirements
OPSM	Conditional	Test trunk at OPSM or metallic path
RCU	No	
REM	Yes	None
RLCM	Conditional	Test trunk at RLCM or metallic path
RSLE	Conditional	Test trunk at RSLE or metallic path
RSLM	Conditional	Test trunk at RSLM or metallic path
SLC-96	No	
Star Hub	Conditional	Test trunk at Hub or metallic path

RDT subscriber loop testing

TR-303 is a generic interface that allows telephone exchanges and remote line equipment of different vendors to be connected together. The SCM-10A feature is the interfacing hardware/software that supports the TR-303 interface between the DMS-10 switch and TR-303 compliant access vehicles called “remote digital terminals” (RDT).

Remote Digital Terminal (RDT) is a name applied generically to any vendor remote digital terminal equipment that complies with Bellcore TR-303 specifications. The RDT is the access vehicle that connects terminal devices capable of transmitting either voice or data to the DMS-10 switch. The RDT can provide support for up to 2048 subscriber lines from various types of terminal devices.

The Integrated Digital Terminal (IDT) is a logical entity consisting of the switching resources dedicated to a single RDT. The IDT serves as the DMS-10 switch interface to an RDT.

The maintenance and testing that DMS-10 switch supports for RDT lines includes:

- line maintenance
- channel testing
- line signaling testing
- metallic loop testing
- incoming/outgoing test trunk (ITTK) interface testing
- digital remote test unit (DRTU) testing
- bit error rate testing (BERT)
- digital test access (DTA) testing

Testing may be performed either through the DMS-10 switch or through external test systems.

Line maintenance

Subscriber line maintenance and testing includes:

- testing a line
- determining the location of a fault
- retesting the line and returning it to service

Channel testing

Channel testing is divided into two parts: end-to-end transmission testing, and line signaling testing. End-to-end testing is performed in order to verify the integrity of the PCM path between an IDT and its associated RDT in both directions. Line signaling testing is performed in order to verify the line cards' ability to detect and act in response to coin-control signals sent by the DMS-10 maintenance subsystem. Together, both tests detect any failures in the RDT line cards and in the transmission path between the DMS-10 switch and the RDT line cards.

When testing is initiated, an interface is set up between the DMS-10 switch and the embedded operations channel (EOC) subsystem and the call processing subsystem to enable channel testing using a test response circuit (TRC). The transmission/signaling tests performed include:

- carrier channel loss test
- echo return loss test
- idle channel noise test
- line card signaling test

Carrier channel loss test

This test measures round-trip channel loss. The measurement is made while the RDT line unit is terminated in a reflective manner, that is, terminated with an impedance that maximizes the reflection of the incoming AC signal from the IDT.

Echo return loss test

Echo return loss is measured while the RDT line unit is terminated in an absorptive manner, that is, terminated with an ac impedance that minimizes the reflection of the incoming ac signal from the IDT.

Idle channel noise test

Idle channel noise is determined by measuring the received signal at the IDT/DMS-10 while idle code is transmitted to the RDT line unit terminated in a reflective manner.

Line signaling testing

Line signaling tests verify the ability of line cards to detect hook state transitions and the ability of coin lines to detect and act on coin-control signals applied by the DMS-10 maintenance subsystem. The signaling tests are performed using a TRC. The following capabilities are verified by the tests:

- ability to monitor on-hook and off-hook transitions from a line card
- ability to monitor tip-party ground (off-hook) from multiparty lines and Automatic Number Identification (ANI) for two-party lines
- ability to apply coin-control signals for an RDT coin line card
- ability to apply single-party ringing to an RDT line card (POTS, coin, and multi-party)
- ability to apply positive/negative coded ringing on tip or ring lead for multiparty line cards

Ringing test

This test checks the ability of an RDT line card to produce the correct ringing signal in response to a signaling pattern sent by the DMS-10 switch. The DMS-10 switch must transmit the signaling pattern to the RDT for at least 230 milliseconds in order for the test to be performed.

Off-hook detection test

The DMS-10 switch verifies the ability of a line card to detect an off-hook by transmitting a signaling pattern, for 230 milliseconds, that causes the RDT to apply a 900-ohm termination for the line card. To determine the results of the test, the DMS-10 switch sends the idle (negative loop mode for coin line card) signaling pattern to the RDT. The RDT line card replies with the off-hook signaling pattern if the line card is working properly.

Multiparty line testing

The DMS-10 switch checks the ability of a superimposed ringing multiparty line card to detect a tip party ground by sending to the RDT a signaling pattern that causes the reflect/NTPG termination to be applied and by then sending the tip-party test signaling pattern.

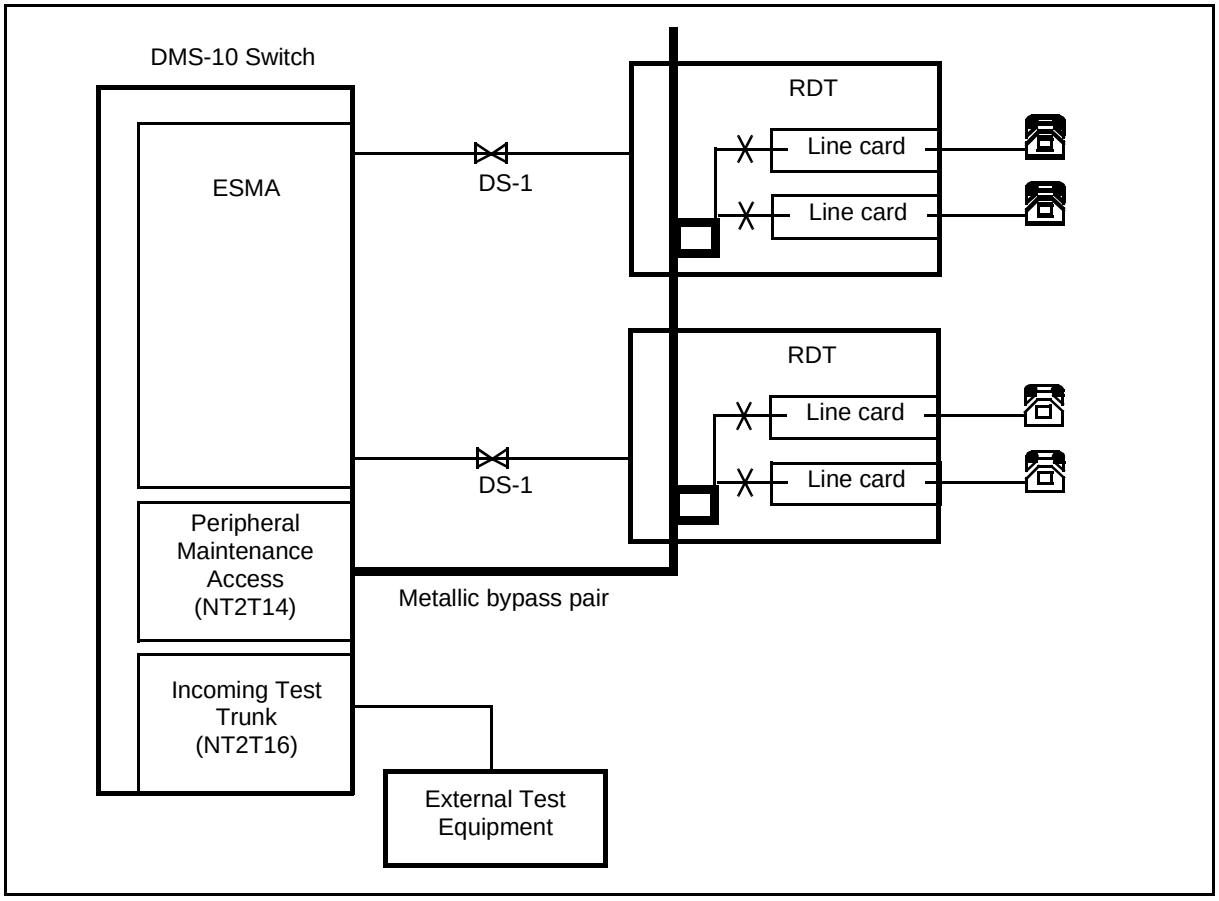
Coin telephone control signaling tests

The DMS-10 switch checks the ability of an RDT coin line card to reproduce all of the coin control states and to detect all of the possible states of a coin telephone by causing appropriate terminations to be applied to the RDT.

Metallic loop testing

Metallic loop testing, illustrated in Figure 7-22, employs a metallic cable test path from the central office to the subscriber pair at the remote site.

Figure 7-22: RDT line testing - metallic access from the host switch



The testing process consists of the following steps:

1) The subscriber loop is disconnected from the RDT line card and is connected to the bypass pair.

2) The test bypass pair is connected to the test equipment.

3) The test equipment measures the resistance, capacitance and ac/dc voltages that may be present from tip to ground and from ring to ground. Resistance and capacitance from tip to ring on the loop is also measured.

The DMS-10 switch also supports testing subscriber loops for subscriber premises facility faults. This testing, which is performed at the subscriber's premises, enables operating company personnel to identify any faults on the subscriber's loop and to determine whether the subscriber's telephone set is operating properly.

Incoming/outgoing test trunk interface testing

The Incoming Test Trunk (ITTK) pack (NT2T16) enables testing of all DMS-10 switch subscriber loops to be performed through the maintenance access bus (metallic access), as shown in Figure 7-23.

The tests that can performed using the ITTK include:

- measuring voltage, resistance, and capacitance between tip, ring, and ground (tip and ring, tip and ground, or ring and ground)
- measuring loop length
- allowing talk/monitor on a subscriber line
- drawing dial tone and dial on a subscriber line
- ringing a subscriber line

The testing process consists of the following steps:

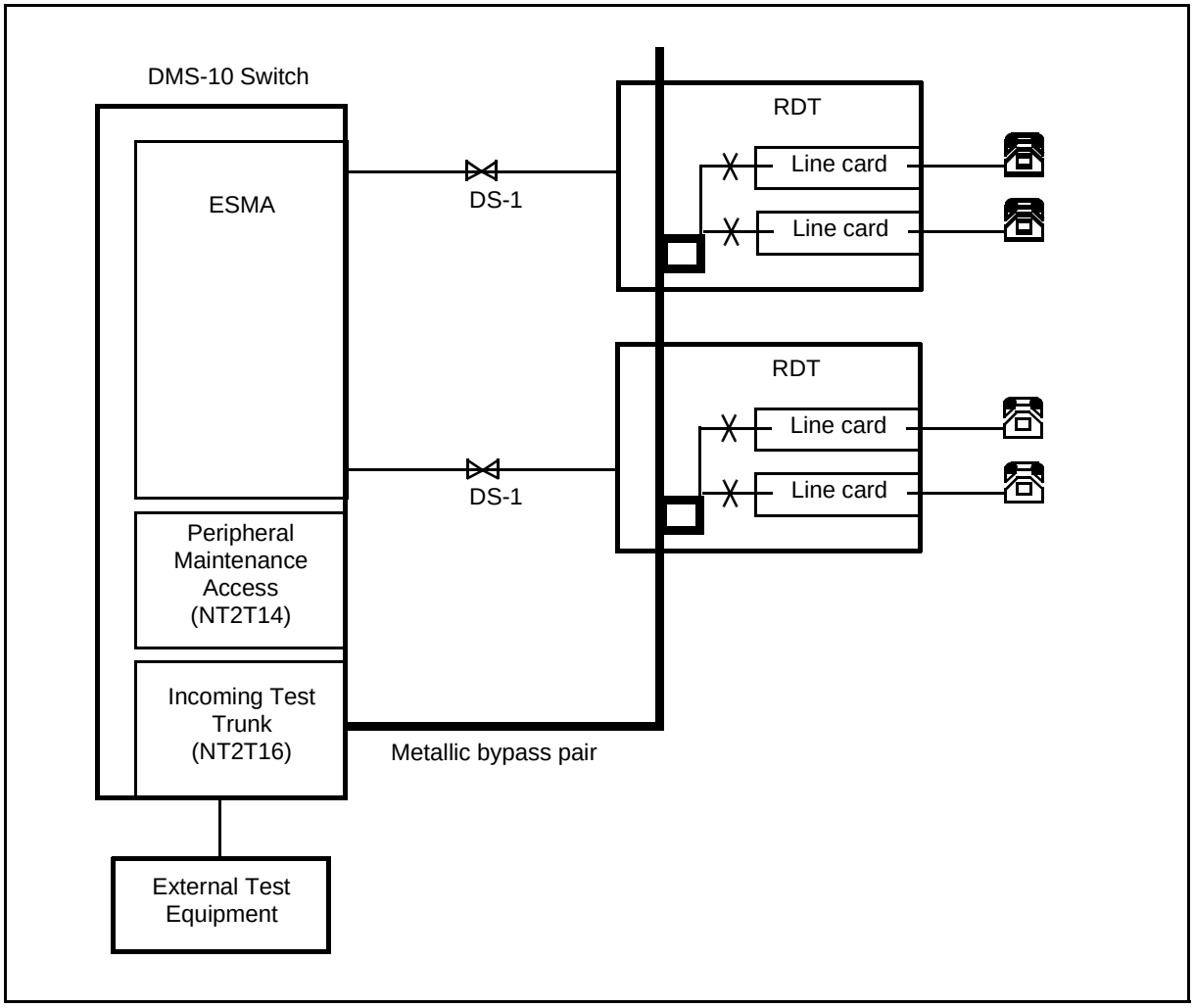
1) The test system dials the directory number of the subscriber line to be tested.

2) The DMS-10 switch responds by applying a dc signature circuit to the tip and ring of the test trunk to indicate that the line being accessed resides on an RDT.

3) The test system applies a “bypass initiate test” signal between the ITTK tip lead and ground. The ring lead is left open for single-party and multiparty lines, but is placed at ground for coin lines.

4) The DMS-10 switch checks the status of the line and of the bypass pair, and if the bypass pair cannot be connected to the subscriber line or is in use, applies a 500-1000 ohm leak to ground, interrupted at 120IPM on the tip lead of the ITTK, to indicate the trouble condition. If there is a major alarm affecting service to the line being accessed, then the 500-1000 leak to ground, interrupted at 60IPM is applied to the tip lead. If the bypass pair can be connected, the DMS-10 switch grounds the inhibit lead, if provided, connects the bypass pair to the RDT subscriber loop, and provides a channel to be used for end-to-end transmission and signaling tests.

Figure 7-23: RDT line testing - metallic access from the host switch using the Incoming Test Trunk (ITTK)

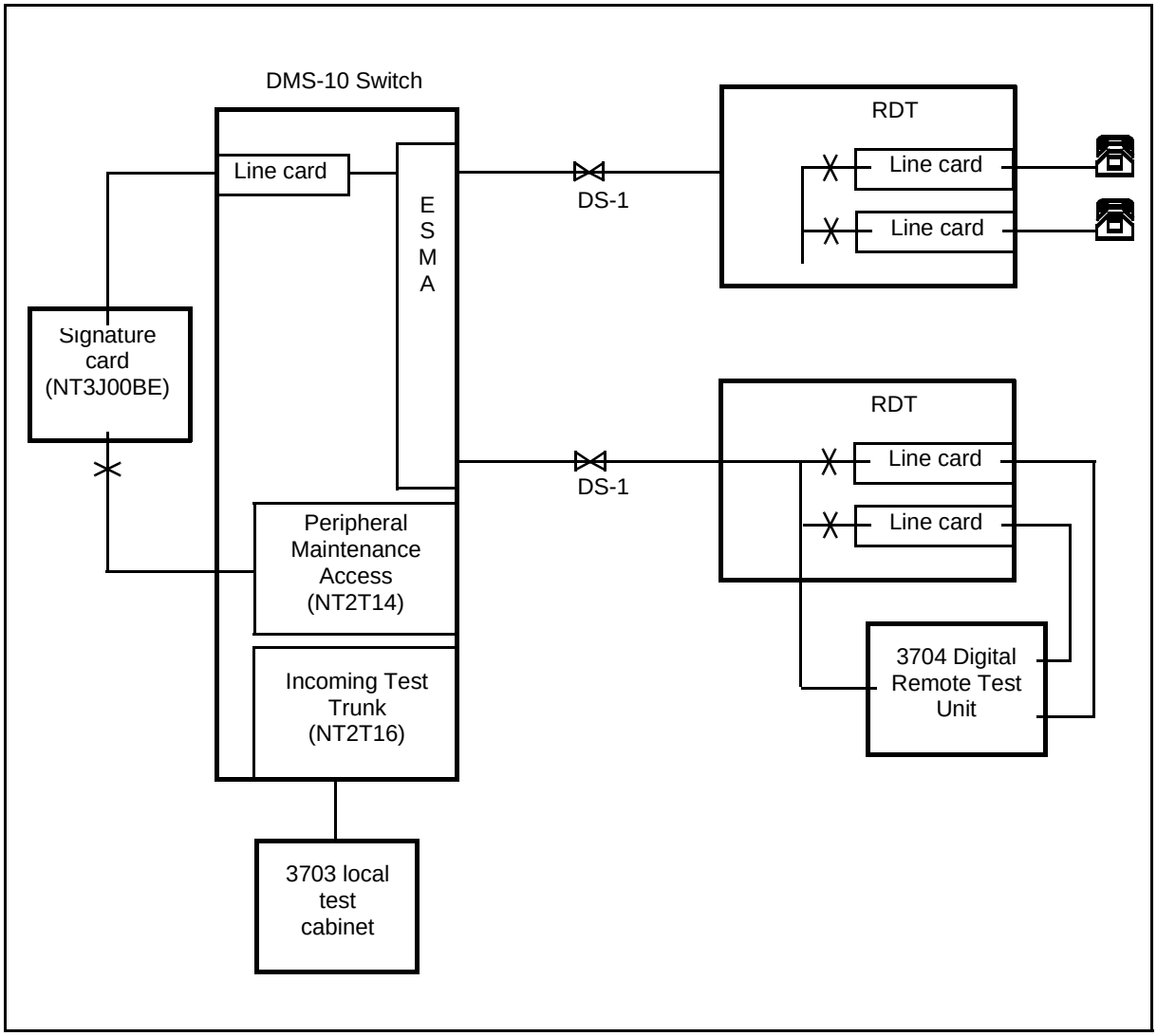


Digital Remote Test Unit testing

The 3704 Series Digital Remote Test Unit (DRTU) is a measurement device located at the remote site and controlled by a Nortel Networks 3703 Local Test Cabinet (LTC). Signal and measurement data between the DMS-10 switch and remote are transmitted over a DS-1 span line. Because a metallic bypass pair is not involved in this test configuration, the DRTU method does not have the limitations of the metallic bypass pair method (that is, distance limitation, metallic-pair requirement, calibration error). Using the extra-fast meter (XFM) measurement technology of the LTC, the DRTU provides comparable test functions.

In this test configuration, shown in Figure 7-24, the DRTU is connected to a dedicated line in the RDT. The 3703 LTC is connected through the Incoming Test Trunk (ITTK) and Peripheral Maintenance Access packs to the dedicated RDT line card. The 3703 LTC controls the DRTU through a dial-up path between the two dedicated line cards. A signature card (NT3J00BE) provides a dc signature to the 3703 LTC to indicate that the line card under test resides on a remote access vehicle.

Figure 7-24: RDT line testing - DRTU access



Bit Error Rate Testing (BERT)

BERT is accomplished by performing separate bit error rate tests. In a bit error rate test, an IBERT pack (NT6X99) is connected to a designated end loopback point in a data path and a specified bit pattern is transmitted over that path. The bit pattern is reflected back to the IBERT pack and it is then compared with the original transmission. The number of mismatches logged as a result of the comparison indicates whether the data transmission performance is at the level expected. By looping back these test data transmissions at different points and measuring the transmission quality at each point, any faults on the path can be isolated. The information in the test summary provides sufficient information to enable the operating company to perform any error correction required. BERT can only be performed on RDT ISDN line cards. For complete information about performing BERT, see Section 9, “Bit Error Rate Testing,” in this NTP.

Digital Test Access (DTA) testing

Digital Test Access testing is supported as part of the RDT line testing package.

Section 8: Outside Plant Module and Outside Plant Access Cabinet battery operations

Introduction

This section contains detailed descriptions of the operations and maintenance of the back-up batteries in the Outside Plant Module (OPM) and in the Outside Plant Access Cabinet (OPAC). Specific commands used to test and perform maintenance on the battery back-up system are available with overlay RBCD, described in the NTP entitled *Maintenance Diagnostic Input Manual* (297-3501-506).

Outside Plant Module

The Outside Plant Module (OPM) is a Remote Line Concentrating Module in an environmentally controlled enclosure. The OPM provides reliable service in hostile environments and during prolonged ac power interruptions. The battery system is normally self-maintaining, testing the batteries every 24 hours, providing continuous float charging of the batteries to an acceptable voltage, and providing back-up power in the event of an ac power interruption or failure. However, craftspersons are advised to become familiar with the operation of the battery back-up system to maintain and manually test the battery system.

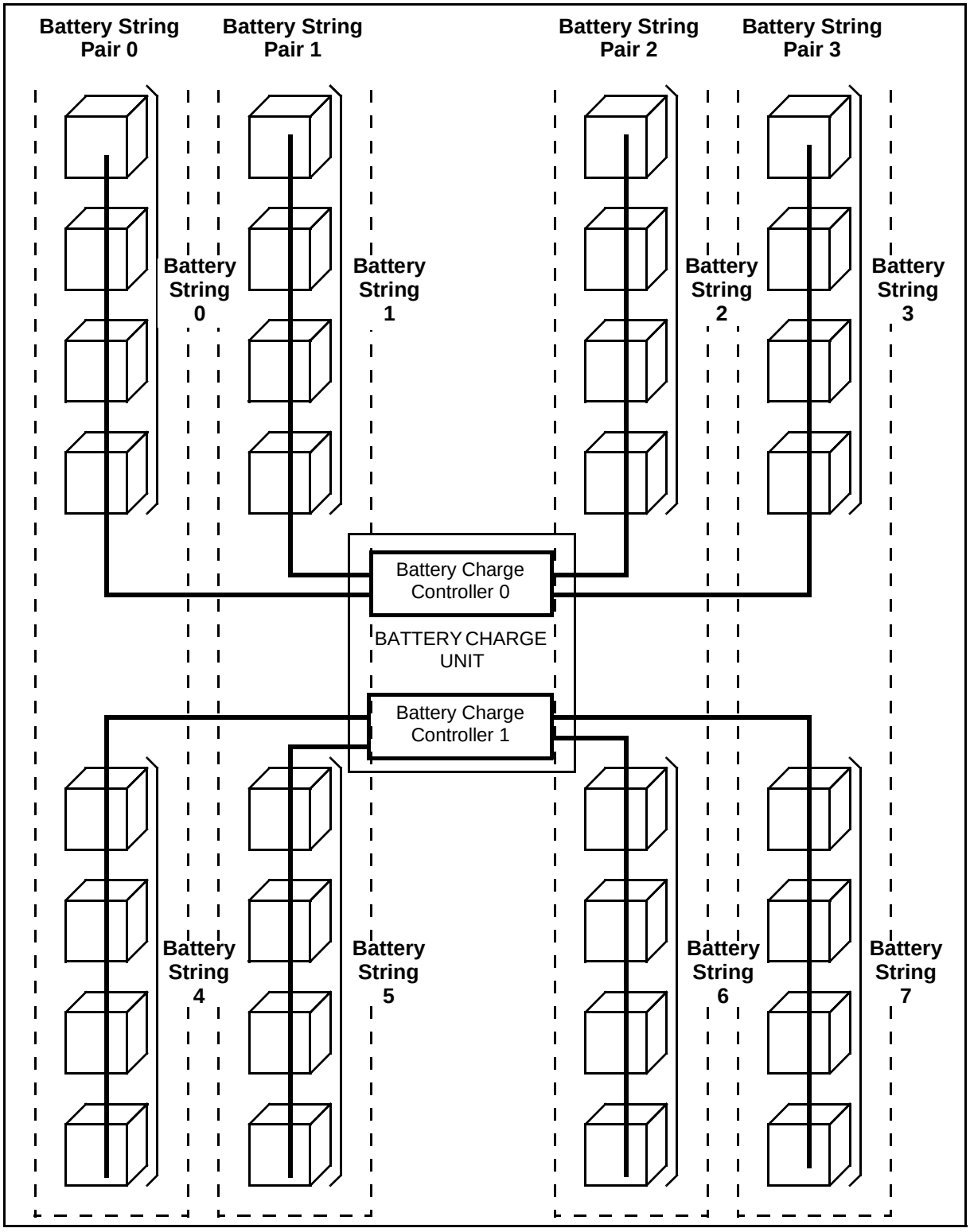
OPM battery functions

The OPM can be equipped with up to four battery string pairs for 2 hours of operation per equipped battery string pair during an ac power failure. The RMM provides battery maintenance capabilities to perform diagnostic and operational functions.

Each battery string in a battery string pair is controlled by one of two Battery Charge Controller (BCC) packs (NT8X02) as illustrated in Figure 8-1. The BCCs manipulate the battery string pairs to independently place them on any one of the three available locations: the charge bus, the load bus, and the open circuit condition. The charge bus may be used manually by operating company personnel to aid in diagnosing suspected battery problems or to quickly charge a newly-installed battery string pair. The load bus takes power from the batteries to power the OPM. It also provides a continuous slow float charge to the batteries. The open circuit condition, when a battery string is not connected to either bus, provides access to measure battery voltages.

To prevent a drop in voltage on the charge bus, the voltage of each battery string is measured in the open circuit condition before it is moved to the charge bus. The voltage on the charge bus is also measured for a safe voltage range before the battery string is moved onto the charge bus. To insure that the battery strings are sufficiently charged, the voltage of each battery string is measured in the open circuit condition before it is moved to the load bus.

Figure 8-1: OPM battery backup system configuration



Outside Plant Access Cabinet

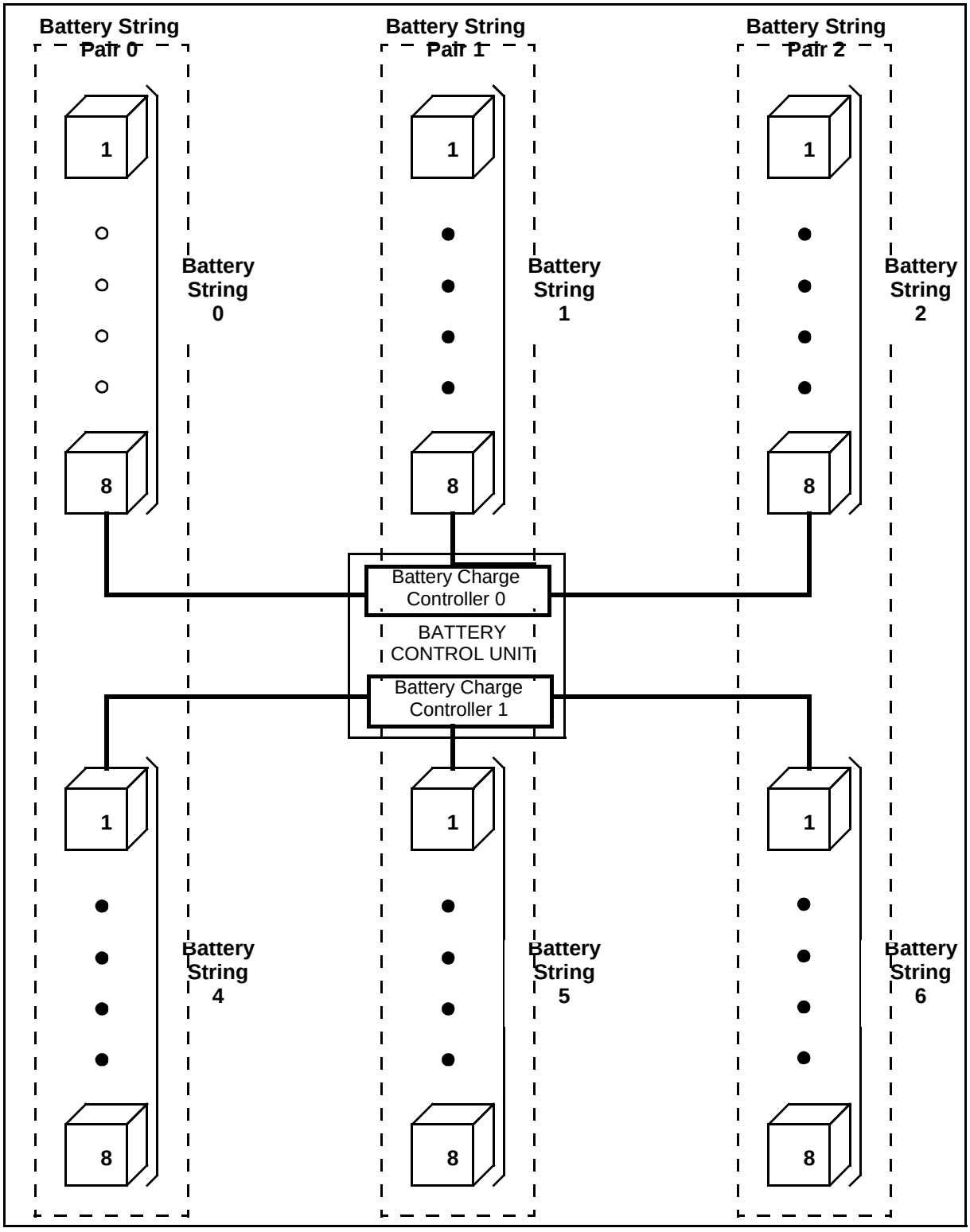
The Outside Plant Access Cabinet (OPAC) is an insulated, weatherproofed structure that, like the OPM, provides a controlled environment for RLCM equipment located at a remote site. The OPAC also provides additional space for transmission or operating company-provided equipment. The OPAC battery system is normally self-maintaining, providing continuous charging of the batteries to an acceptable voltage, and providing back-up power in the event of an ac power interruption or failure.

OPAC battery functions

The OPAC can be equipped with up to six strings of Eagle-Picher 6 V batteries. Each string comprises eight batteries. As illustrated in Figure 8-2, the battery strings are connected, in pairs, to the OPAC load or charge bus through the two Battery Charge Controllers (BCC) in the Battery Control Unit (BCU). Battery string pairs are normally connected to the load bus, but may also be connected to the charge bus, or none of these (open circuit). Moves from the load to charge bus or charge to load bus must be made through the open-circuit state.

The OPAC uses an *intermittent* charging scheme that is implemented by battery rotation and testing audit. In this scheme, the voltage of batteries on the load bus is maintained at a level just above the battery open circuit voltage, -50 Vdc. This voltage is sufficient to maintain the batteries in a fully charged state and to recharge the batteries to between 90% and 100% after a discharge. This voltage is not sufficient, however, to prevent sulfate deposits from accumulating on the battery plates. Thus, periodically the batteries are moved from the load bus to the charge bus for a short period of time. Charge bus voltage is sufficient to ensure the batteries are charged to full capacity and forces any sulfates that have accumulated on the battery plates back into the battery solution.

Figure 8-2: OPAC battery backup system configuration



Modes of operation for OPM and OPAC batteries

The OPM or OPAC may be in one of three modes: normal-battery, ac-failure, or post-ac-failure mode.

Normal-battery mode

In normal-battery mode, all battery string pairs are connected to the load bus. Overlay RBCD runs automatically twice per day, at 6AM and 11PM, to test each of the battery string pairs and to perform automatic battery charging. The OPM and OPAC normally float charge the batteries at 52.5 volts when they are connected to the LOAD bus. If a Telco desires to turn on the automatic charge rotation capability (see prompt AUTO in the RMM prompting sequence of overlay CPK, in NTP 297-3501-311, *Data Modification Manual*), which is recommended for YUASA and Eagle Picher batteries, the batteries will be cycled to the CHRG bus for seven hours per day, once per week, according to the following schedule:

Sunday	11pm	BSPR 0 will be moved to the CHRG bus
Monday	6am	BSPR 0 will be moved to the OPEN bus
Monday	11pm	BSPR 0 will be moved to the LOAD bus
Monday	11pm	BSPR 1 (if equipped) will be moved to the CHRG bus
Tuesday	6am	BSPR 1 (if equipped) will be moved to the OPEN bus
Tuesday	11pm	BSPR 1 (if equipped) will be moved to the LOAD bus
Tuesday	11pm	BSPR 2 (if equipped) will be moved to the CHRG bus
Wednesday	6am	BSPR 2 (if equipped) will be moved to the OPEN bus
Wednesday	11pm	BSPR 2 (if equipped) will be moved to the LOAD bus
Wednesday	11pm	BSPR 3 (if equipped) will be moved to the CHRG bus
Thursday	6am	BSPR 3 (if equipped) will be moved to the OPEN bus
Thursday	11pm	BSPR 3 (if equipped) will be moved to the LOAD bus

ac failure mode

During ac-failure mode, the battery string pairs are placed on the load bus and remain on that bus until all failures have been cleared. The ac-failure mode will be caused by one or more of the following faults: one of the two rectifiers cannot detect its output or the rectifier current limit is reached, either BCC fuse fails, commercial ac power failure is indicated (both rectifiers fail within 2 seconds of each other), or an extremely high temperature alarm occurs. If neither rectifier returns to service within 30 seconds, a major ac failure alarm is raised. During ac-failure mode, overlay RBCD checks to see if the faults have been cleared and if so, sets the BCU to the post-ac-failure mode.

If an ac failure occurs when all four battery strings are fully charged, it takes about 8 hours for a fully configured BCU to drain to the -42 V threshold during ac-failure mode. When the load bus voltage drops to -42 V, the batteries are removed from the load bus. This prevents the batteries from becoming unrecoverable due to discharge to excessively low voltages.

When the battery voltage drops to -42 V and the batteries are removed from the load bus, the lines served by the OPM or OPAC are out of service and a major alarm is raised, indicating a complete link communication failure between the base site DMS-10 switch and the OPM or OPAC. Until the ac failure condition is cleared, no battery can be manually placed on the charge bus.

Post-ac failure mode

When the ac supply is reapplied after an ac failure, or at 6AM and 11PM, overlay RBCD is scheduled to run. Overlay RBCD measures the battery voltage on each battery string; if any voltage less than -48 V is found, the OPM or OPAC enters post-ac-failure mode. In this mode, the battery strings remain on the load bus where they are "pre-charged" to a minimum safe voltage (-48 V). This prevents the failure of a BCU that would occur if drained batteries were placed on the charge bus. Note that the nominal charge bus voltage is -57 V. After the voltage is at the minimum level (-48 V), the battery strings enter normal-battery mode and are then charged to the voltage of the load bus (-52.5 V).

Section 9: Bit Error Rate Testing

Introduction

Bit Error Rate Testing (BERT) enables operating companies to ensure high quality data transfer performance in the DMS-10 switch by assessing data path quality, isolating data path problems, and then correcting any data path equipment problems that are discovered. BERT differs from external test methods in that it provides a detailed testing summary of all of the paths involved in the testing, whereas the external test set can determine only that errors have occurred.

Bit Error Rate Testing

The error level for data-grade transmission is determined by measuring the bit error rate performance for the DMS-10 switch. The bit error rate is the number of bits in error in a given transmission stream. The bit error rate is expressed as an absolute ratio such as 1×10^{-9}, or, one bit error in one billion transmitted bits. But rather than performing test calls consisting of one billion bits, BERT can be used instead to measure the number of error-free seconds in a test call of at least ten minutes duration. The percentage of error-free test time, the distribution of errored seconds during the test call, and the number of error-free calls together provide the operating company with an indication of the grade of service in the switching network. The industry objective for bit error rate performance for switching components is 1×10^{-9}. With proper testing, grooming, and maintenance, the DMS-10 switch can provide this grade of service.

BERT is accomplished by performing separate bit error rate tests. In a bit error rate test, an IBERT pack (NT6X99) is connected to a designated end loopback point in a data path and a specified bit pattern is transmitted over that path. The bit pattern is reflected back to the IBERT pack and it is then compared with the original transmission. The number of mismatches logged as a result of the comparison indicates whether the data transmission performance is at the level expected. By looping back these test data transmissions at different points and measuring the transmission quality at each point, any faults on the path can be isolated. The information in the test summary provides sufficient information to enable the operating company to perform any error correction required.

BERT can be run either on demand or automatically at scheduled times as background testing. Other diagnostic programs can be run concurrently with BERT testing. The BERT overlay is used to establish test paths, test start times, test durations, and test report print instructions. For detailed information about the BERT overlay, see the NTP entitled *Data Modification Manual* (297-3501-311).

BERT capabilities

The available BERT capability is determined in overlay CNFG (FEAT), prompt BERT (see NTP 297-3501-311, *Data Modification Manual*). The two types of BERT capability available are:

- inherent BERT capability (available when prompt BERT in Overlay CNFG (FEAT) is set to NO)
- full BERT capability (available when prompt BERT in Overlay CNFG (FEAT) is set to YES)

These capabilities are described below.

Inherent BERT capability

The inherent BERT capability tests the major elements of the DMS-10 network, as well as the specific digital line cards deployed as part of the Datapath option. The inherent BERT testing capability is limited to a single IBERT (NT6X99) test pack. DMS-10 offices without Line Concentrating Equipment in the host site cannot be tested with BERT.

Full BERT capability

The full BERT capability includes the inherent capabilities described above, plus the ability to execute more complete peripheral testing and fault isolation within the host and remote Line Concentrating Equipment. In addition, full BERT capability adds:

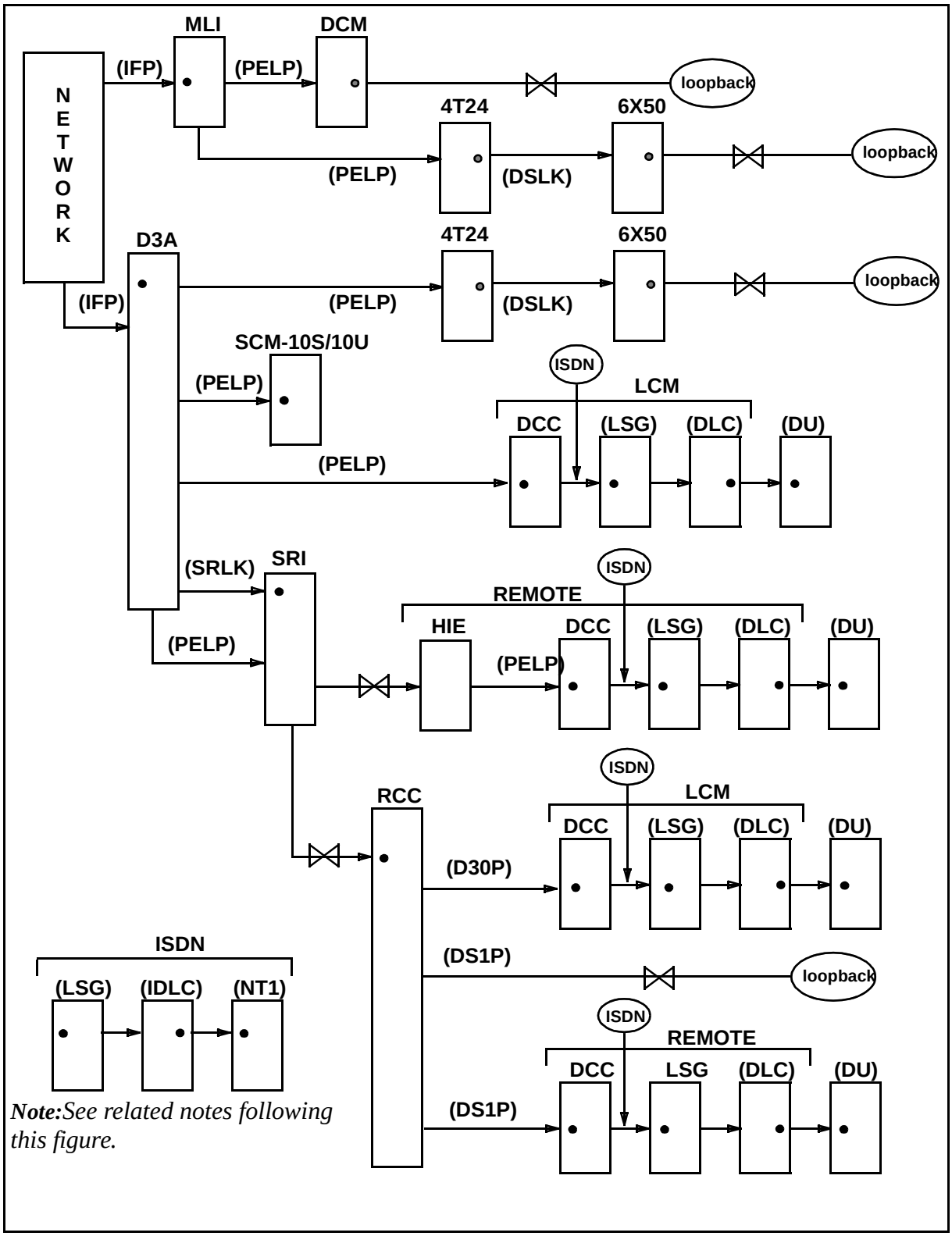
- concurrent testing with multiple IBERT packs, to reduce test time and improve test coverage in larger systems
- multiple loop-arounds at an individual NT4T04 DS-30A Interface pack
- testing LCMs at the line subgroup level, using the NT6X54 Buffer Interface Controller (BIC) to isolate errors occurring within the LCE
- loop around at the NT4T09AB Small Remote Interface (SRI), to help isolate errors in remote paths by eliminating the DS-1 span as a variable.
- testing LCMs at the line subgroup level at RSLEs, RSLMs, and OPSMs
- loop around at NT6X71 Data Line Cards (DLC) and Data Units (DU) configured at an RSC-S

Configuration requirements In the DMS-10 Classic Network configuration, the full BERT capability requires the messaging and loop-around capability available in the AL vintage of the NT4T04 pack. All NT4T04 packs within an office must be this vintage (AL) or later in order for this capability to be operational.

BERT paths

The paths that can be tested are illustrated in Figures 9-1 through 9-14. Figure 9-1 shows all of the path types and associated loopback points that may be selected. Figure 9-2 shows the test path from an IBERT pack to the Network pack(s); each IBERT pack has a specified path to the network equipment which may be tested before any other path types to determine whether the path can be used for BERT. This pack, and path, is then used for all other BERTs selected. Figures 9-3 through 9-14 show the data paths and loopback points for specified types of equipment.

Figure 9-1: BERT testing paths - Path types



Note:*See related notes following this figure.*

Note 1: (IFP), (PELP), (LSG), (DLC), (SRLK), (DU), (LSG), (IDLC), (NT1), (DSI), (D30P) and (DS1P) denote BERT path types that may be selected. The dots mark loopback points associated with the path types.

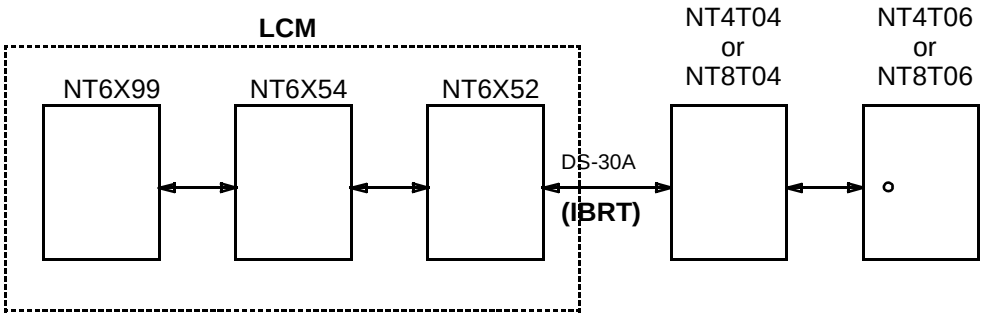
Note 2: Shading in the illustration indicates that that loopback point is not available for BERT testing either without an "AL," or later, version of the NT4T04 (DS-30A Interface) pack provisioned in the switch (LSG loopback), or the loopback point is not available for testing without an "AL," or later, version of the NT4T04 pack provisioned in the switch. This only applies in the DMS-10 Classic Network configuration; in the DMS-10EN network configuration the NT8T04 Network Interface pack replaces the NT4T04 pack and the NT8T06 Network Pack replaces the NT4T06 pack.

Note 3: The LSG loopback point is available for BERT testing for RLCMs, OPMs, or OPACs, but not for RSLMs, RSLEs or OPSMs.

Note 4: The SRI can be either a single NT4T09 or a NT4T24/NT6X50 DSI pack combination. When used as either a digital trunk interface, or as an SRI to a remote, the DSI loopback paths are PELP going to the NT4T24 and DSLK going to the NT6X50.

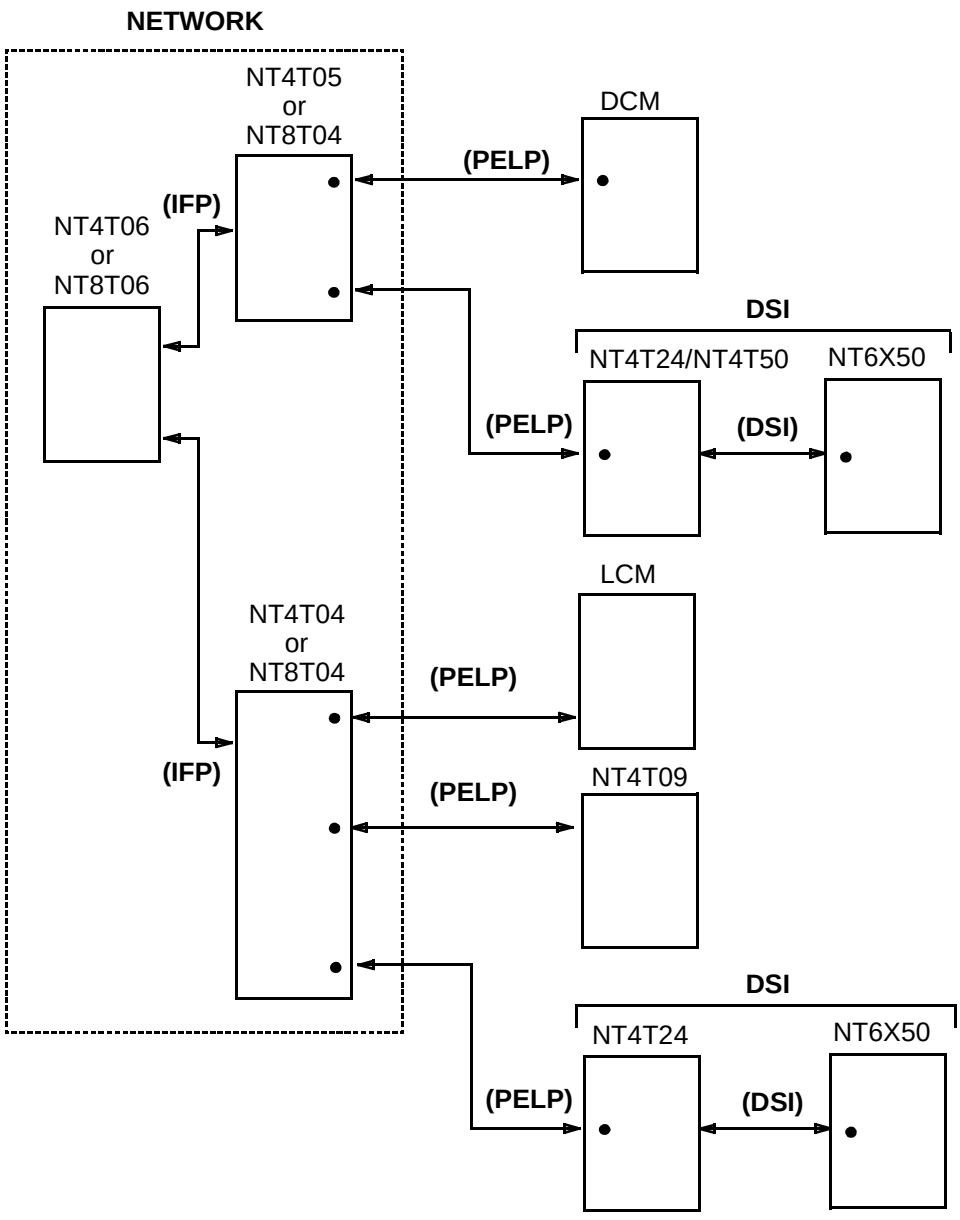
Note 5: Three ISDN paths (LSG, IDLC and NT1) are represented in Figure 9-1. For presentation purposes, an unconnected ISDN BERT path is pictured in the lower left corner of Figure 9-1. ISDN options are available for all DMS-10 supported LCMs and remotes. The connections are represented by a circled ISDN followed by an arrow pointing to the possible ISDN drawer locations.

Figure 9-2: BERT paths - IBERT pack to Network pack test path



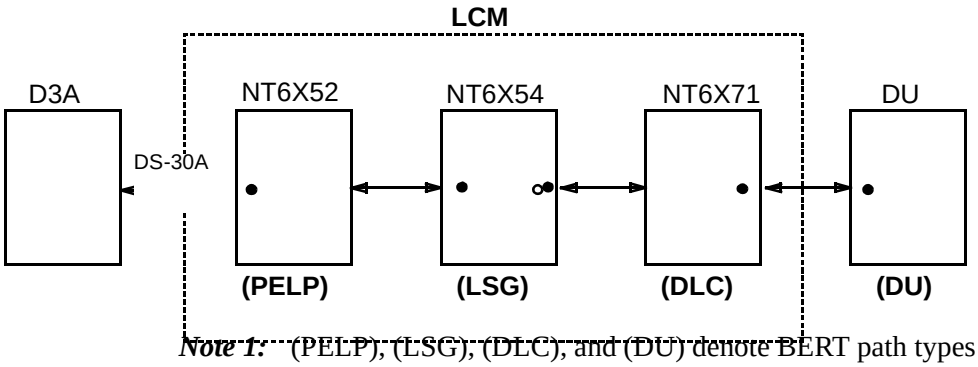
Note: *(IBRT) denotes the BERT path type that is selected for this test. The dot marks the loopback point associated with the path type.*

Figure 9-3: BERT testing paths - Network equipment



Note: *(IFP), (PELP) and (DSI) denote BERT path types that may be selected. The dots mark loopback points associated with the path types.*

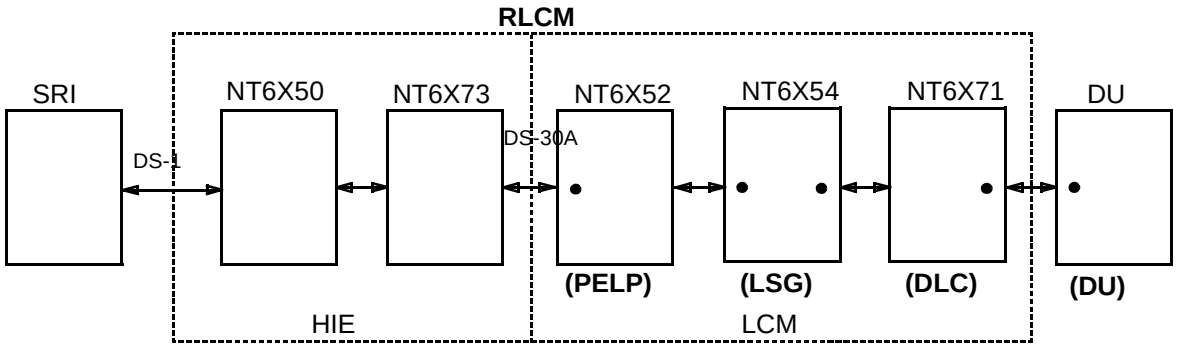
Figure 9-4: BERT paths - LCM data path



Note 1: (PELP), (LSG), (DLC), and (DU) denote BERT path types that may be selected.
The dots mark loopback points associated with the path types.

Note 2: Shading in the illustration indicates that that loopback point is available for BERT only if an "AL," or later, version of the NT4T04 (DS30A Interface) pack is provisioned in the switch, in DMS-10 Classic Network configurations.

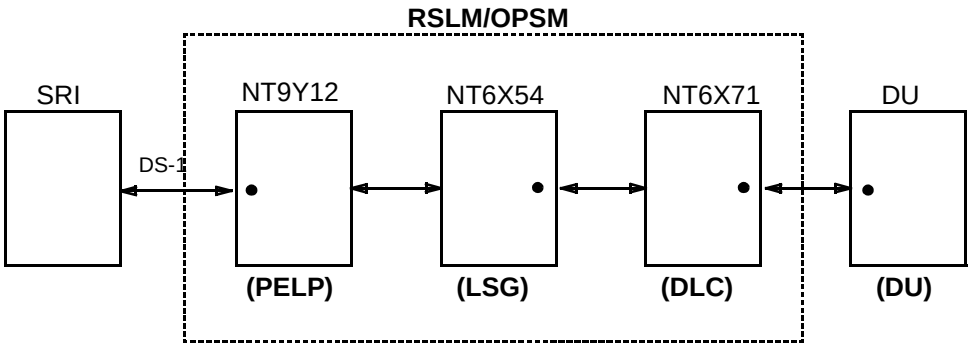
Figure 9-5: BERT paths - RLCM data path



Note 1: (PELP), (LSG), (DLC), and (DU) denote BERT path types that may be selected.
The dots mark loopback points associated with the path types.

Note 2: Shading in the illustration indicates that that loopback point is available for BERT only if an "AL," or later, version of the NT4T04 (DS30A Interface) pack is provisioned in the switch, in DMS-10 Classic Network configurations.

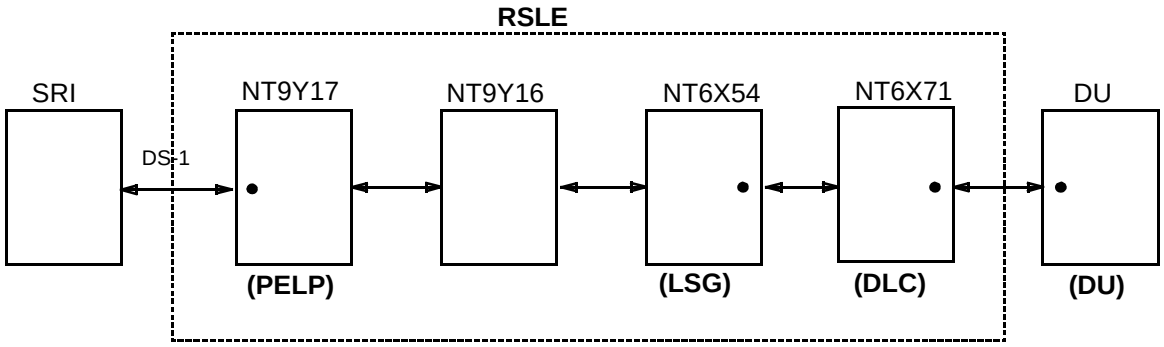
Figure 9-6: BERT paths - RSLM/OPSM data path



Note 1: (PELP), (LSG), (DLC), and (DU) denote BERT path types that may be selected.
The dots mark loopback points associated with the path types.

Note 2: Shading in the illustration indicates that that loopback point is available for BERT only if an "AL," or later, version of the NT4T04 (DS30A Interface) pack is provisioned in the switch, in DMS-10 Classic Network configurations.

Figure 9-7: BERT paths - RSLE data path



Note 1: (PELP), (LSG), (DLC), and (DU) denote BERT path types that may be selected.
The dots mark loopback points associated with the path types.

Note 2: Shading in the illustration indicates that that loopback point is available for BERT only if an "AL," or later, version of the NT4T04 (DS30A Interface) pack is provisioned in the switch, in DMS-10 Classic Network configurations.

Figure 9-8: BERT testing paths - RCC data path

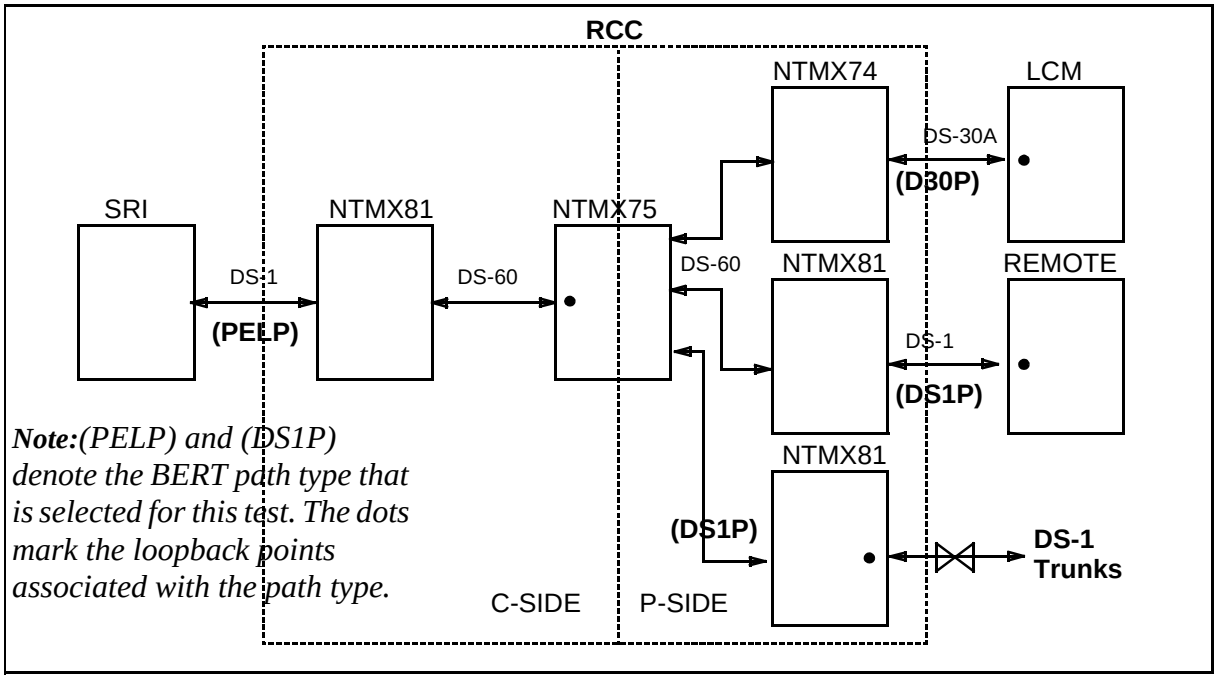
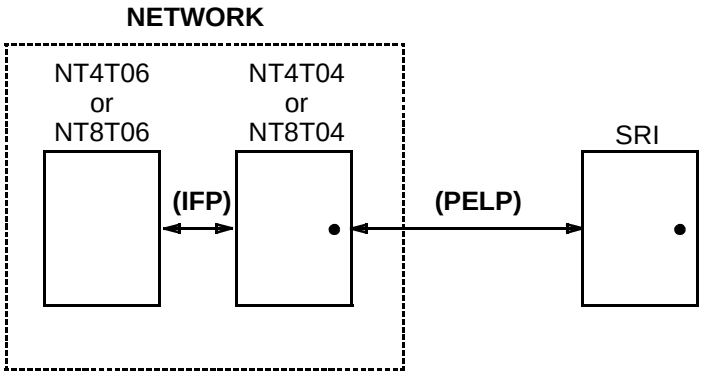


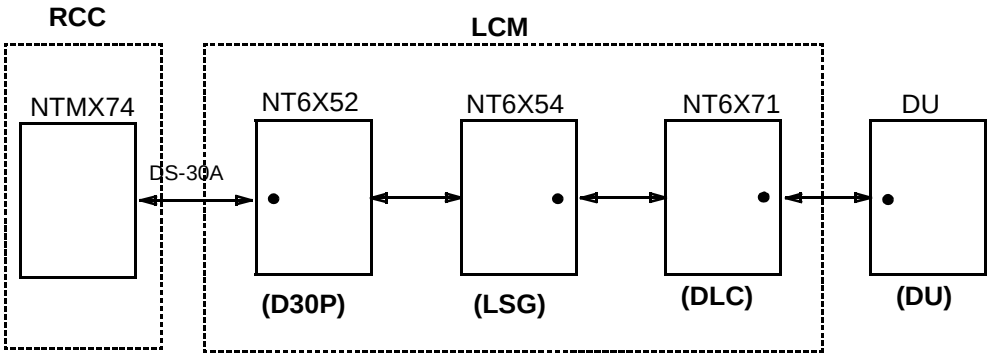
Figure 9-9: BERT testing paths - SRI equipment



Note 1: (IFP) and (PELP) denote BERT path types that may be selected. The dots mark loopback points associated with the path types.

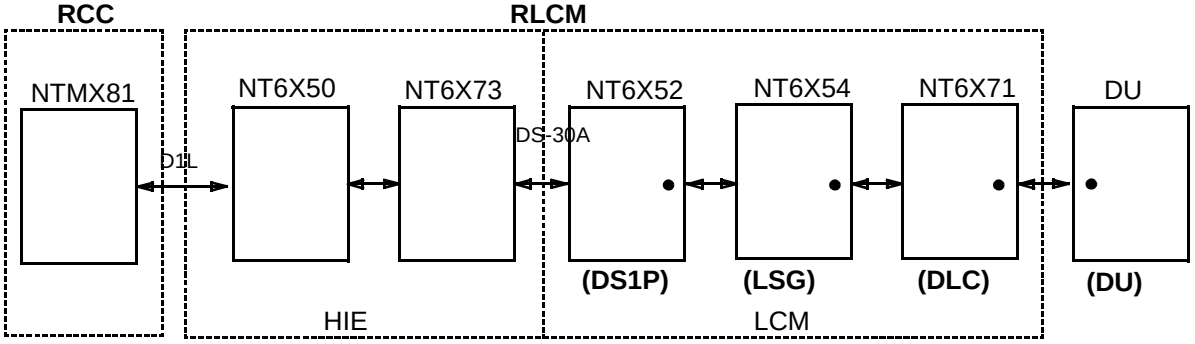
Note 2: Shading in the illustration indicates that that loopback point is not available for BERT testing without an "AL," or later, version of the NT4T04 (DS30A Interface) pack provisioned in the switch, in DMS-10 Classic Network configurations.

Figure 9-10: BERT testing paths - RCC to LCM



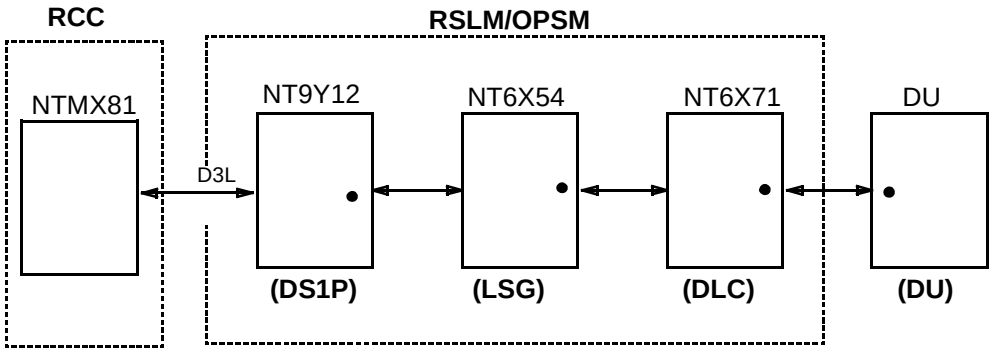
Note: *(DLC), (DS1P) and (DU) denote BERT path types that may be selected. The dots mark loopback points associated with the path types.*

Figure 9-11: BERT testing paths - RCC to RLCM



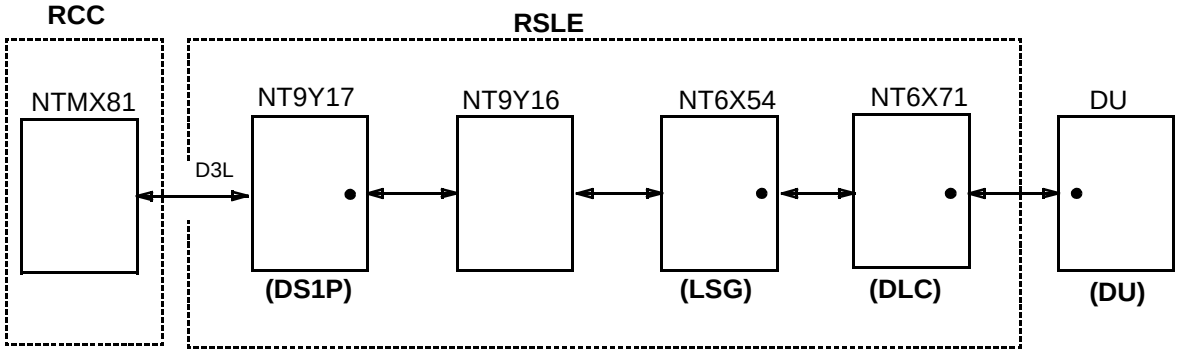
Note: *(DLC), (DS1P) and (DU) denote BERT path types that may be selected. The dots mark loopback points associated with the path types.*

Figure 9-12: BERT testing paths - RCC to RSLM/OPSM



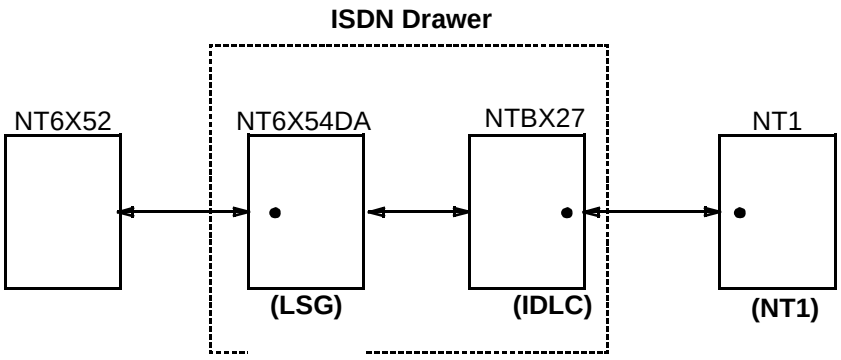
Note: *(DLC), (DS1P) and (DU) denote BERT path types that may be selected. The dots mark loopback points associated with the path types.*

Figure 9-13: BERT testing paths - RCC to RSLE



Note: *(DLC), (DS1P) and (DU) denote BERT path types that may be selected. The dots mark loopback points associated with the path types.*

Figure 9-14: BERT testing paths - ISDN equipment



Note: *(LSG), (IDLC) and (NT1) denote BERT path types that may be selected. The dots mark loopback points associated with the path types. Although shown separately, an ISDN drawer can be located in any DMS-10 supported LCM and remote.*

Automatic background BERT

BERT can be scheduled to run automatically as background testing. Test parameters are defined using the BERT overlay and include the testing time window, BERT report items to print, and the paths to be tested.

Before any automatic background BERTs are executed an IBERT pack self test is performed. If the self test fails, the pack is made busy and is not used for testing. During background testing, the path from the IBERT pack to the Network pack is tested. If this test fails, the IBERT pack is not used for testing. If this test passes, testing continues with the next waiting path. If any equipment associated with the test is taken out of service during testing, the test is terminated and testing continues with the next waiting path until either the scheduled testing ending time or all tests have completed. If testing has not completed within the allotted time, the testing is resumed from where it stopped when the next testing cycle begins.

After the completion of each path test, the test statistics are collected, analyzed, and stored. A report summarizing test results is then available for output.

Manual BERT process

Manual BERT provides additional test controls, including the selection of paths to test and output of the summary report. Either single or multiple path tests can be run. Tests can be requested based on location, on path type, or on previous path test status. The manual BERT parameters are set up through the BERT overlay.

Before testing begins, a self test is performed on each in-service IBERT pack. Any faulty IBERT packs are made busy and are not used for testing; all available IBERT packs are used during testing. The tests, which may be monitored, then run either until all selected paths have been tested or until stopped by operating company personnel. When all of the selected paths have been tested, a summary report is output if requested.

System recovery impact on BERT

If a SYSLOAD occurs while background testing is being performed, all path testing stops and is not restarted regardless of time left in the allotted testing time interval. If manual testing is being performed, it is terminated and not restarted. All report information collected up to that point during a test is lost.

BERT calls are dropped during initialization. Any test information collected before the initialization is lost.

Re-switching equipment carrying BERT transmissions results in test interruption. On the second unsuccessful attempt to restart a test on an affected path, the path test is marked as having not been tested and any test results collected for the interrupted test are lost. If re-switching affects an IBERT pack-to-network connection, a new IBERT connection is established and the IBERT pack continues testing other paths.

Interactions

The following conditions apply to BERT:

- Call processing cannot occur during testing of Data Line Card packs and Data Units (associated with the Switched 56 kbps Services feature).
- Overlay DED and NED activity suspend path tests when contention occurs for loopback points. The suspended tests are restarted when time and resources are available.
- Path continuity does not interrupt a path test.
- PELPs serving DCMs and SRIs cannot be tested in background if they are in service because these devices do not have the ability to loop around a single channel for testing.

BERT results report

The BERT results report comprises a testing summary, the status of all paths selected for testing, optional test counters, and an optional equipment list for each path. Three reports are produced: the *summary report*, the *path report*, and the *equipment list*. The reports are held in protected call store and can be manually printed any time that BERT is not running.

Summary report

The *summary report* is always created and appears in the following format:

BRT400 DATE 05 03 TIME 10:51

BERT PATHS TESTED 047
FAILED BIT ERRORS 000 FAILED ERRORED SECOND 000
TOTAL SECONDS 00002477 EFS 00002477 ERS 00000000
TOTAL BLOCKS 0000068508 BIT ERRORS 0000000000 BLK SIZE 2047

The report contains the number of paths tested, the number of paths that failed, the number of paths that have failed due to bit errors, the number of paths that have failed due to errored seconds, the total test duration in seconds, the total of error-free seconds, the total of errored seconds, the total number of blocks sent, the total of bit errors, and the block size used for testing. Interrupted test time is not included in total test time. The bit error rate can be computed by dividing the total number of bit errors by the total number of bits transmitted, as shown in following formula:

Bit Error Rate = BIT ERRORS / (TOTAL BLOCKS x BLK SIZE)

Path report

The *path report* is output by path type with the status and location of the path, and appears in the following format:

IBRT CAPU LCE 01 4 11 01 PASS DATE 05 15 TIME 09:38
TOTAL SECONDS 000022
SYNC SEC 000022 SYNC LOSS 000000
EFS 000022 ERS 000000
BLOCK SIZE 511 BLOCKS 00002037 BIT ERRORS 000000

6X99 CAPU LCE 01 4 11 01
6X54 CAPU LCE 01 4 11
6X52 CAPU LCE 01 4 2
4T04 CAPU CE 3 3 18 04
4T06 CAPU CE 3 3 20 09

Note: This sample report shows DMS-10 Classic Network DS-30A Interface (NT4T04) and Network (NT4T06) packs. In a DMS-10EN network configuration, Network Interface (NT8T04) and Network (NT8T06) packs would be shown in this report, instead.

The report is always created for background testing but must be requested with the print command for manual testing. The optional counts for a path include the number of test blocks transmitted, bit size of the blocks, bit errors detected, the test time, and the number of errored seconds. The path report provides the information to identify transmission paths that are responsible for causing transmission problems.

The status of the requested BERT is shown on the first line of the report immediately following the loopback location: “PASS” indicates that the test was performed; “NR RC *nn*” indicates that the test was not run for reason *nn*, where *nn* is a code defined in output message BRT317.

Equipment list

The *equipment list* provides information needed by operating company personnel to correct problem paths and includes the equipment type and location of all packs used for the test connection. The packs are listed from the loopback point to the network pack. The IBERT pack used for testing is the last item listed. The report (shown highlighted in the following path report examples) appears after each path tested during the IBERT test, in the following formats:

IFP CAPU CE 3 2 19 04 PASS DATE 05 15 TIME 09:58
TOTAL SECONDS 000293
SYNC SEC 000293 SYNC LOSS 000000
EFS 000293 ERS 000000
BLOCK SIZE 511 BLOCKS 00036224 BIT ERRORS 000000

LOOP BACK
4T05 CAPU CE 3 2 19 04
4T06 CAPU CE 3 3 20 05
6X99 CAPU LCE 01 2 13 07

PELP CAPU CE 3 2 18 02 PASS DATE 05 15 TIME 09:48
TOTAL SECONDS 000287
SYNC SEC 000287 SYNC LOSS 000000
EFS 000287 ERS 000000
BLOCK SIZE 511 BLOCKS 00035464 BIT ERRORS 000000

LOOP BACK
6X52 CAPU LCE 01 1
4T04 CAPU CE 3 2 18 02
4T06 CAPU CE 3 2 20 09
6X99 CAPU LCE 01 3 01 10

SRLK CAPH PE 02 1 14 1 PASS DATE 05 03 TIME 11:32
TOTAL SECONDS 000053
SYNC SEC 000053 SYNC LOSS 000000
EFS 000053 ERS 000000
BLOCK SIZE 2047 BLOCKS 00001330 BIT ERRORS 000000

LOOP BACK
4T09 CAPH PE 02 1 14 1
4T04 CAPH CE 1 5 17 06
4T06 CAPH CE 1 5 19 10
6X99 CAPH LCE 01 1 00 10

LSG CAPU LCE 01 3 05 PASS DATE 05 15 TIME 10:23
TOTAL SECONDS 000593
SYNC SEC 000593 SYNC LOSS 000000
EFS 000593 ERS 000000
BLOCK SIZE 511 BLOCKS 00073800 BIT ERRORS 000000

LOOP BACK
6X54 CAPU LCE 01 3 05

6X52 CAPU LCE 01 4 2
4T04 CAPU CE 3 3 18 03
4T06 CAPU CE 3 3 20 09
6X99 CAPU LCE 01 4 11 01

DLC CAPU LCE 01 4 13 01 PASS DATE 05 15 TIME 10:24
TOTAL SECONDS 000053
SYNC SEC 000053 SYNC LOSS 000000
EFS 000053 ERS 000000
BLOCK SIZE 511 BLOCKS 00006168 BIT ERRORS 000000

LOOP BACK
6X71 CAPU LCE 01 4 13 01
6X54 CAPU LCE 01 4 13
6X52 CAPU LCE 01 4 2
4T04 CAPU CE 3 3 18 03
4T06 CAPU CE 3 3 20 09
6X99 CAPU LCE 01 1 03 03

DU CAPU LCE 01 4 13 01 NR RC 02 DATE 05 15 TIME 10:24
TOTAL SECONDS 000000
SYNC SEC 000000 SYNC LOSS 000000
EFS 000000 ERS 000000
BLOCK SIZE 511 BLOCKS 0000000 BIT ERRORS 000000

Note: *These sample reports show DMS-10 Classic Network DS-30A Interface (NT4T04) and Network (NT4T06) packs. In a DMS-10EN network configuration, Network Interface (NT8T04) and Network (NT8T06) packs would be shown in these reports, instead.*

BERT strategy

BERT can be best described as a snap-shot taken of system performance. By examining many of these snap-shots taken over a long period of time, a profile of system performance can be assembled.

When BERT should be run

In order to assemble enough data to create a system performance profile, BERT should be performed frequently, at approximately the same time of day, and over a long time interval.

BERT setup

Setting up BERT to run entails setting default values for errored seconds, bit error default test times, and test block bit counts. Setting the errored seconds and bit errors values to “1" ensures that any test paths experiencing bit errors will be marked as “failed” in the test results. Setting the background testing interval to 4.5 hours allows sampling of approximately 10^9 bits. Within this 4.5-hour test time window, with one IBERT card being used for testing, one bit error can be expected.

Since bit error rate tests run for at least ten minutes, it is suggested that loopback points that might affect service to subscribers not be tested in background.

Interpreting test results

To determine error conditions that require additional testing and maintenance action, operating company personnel should examine BERT results daily. If the summary report shows any BIT ERRORS, the individual path test reports for BERT should be examined. If a path test results show bit errors, a manual test of the path type should then be run. If the results from the manual test show bit errors, then a system problem may be indicated.

Through a process of elimination, the point in a path at which errors are occurring can be determined. For example, if only one path report shows an error, the first pack in the equipment list associated with that test might be faulty. If many path reports show errors, a pack common to all of the paths may be faulty. For example, if all of the Data Link Controller path reports show errors, the Bus Interface Circuit (NT6X54) card may be faulty.

When a probable faulty pack can be determined, the pack should be replaced, and the path test should be run again. If the bit errors are still present, the pack that was replaced should be re-installed, the next pack in the equipment list should be replaced, and the path test should be run again. This process should be followed until the bit errors no longer appear.

It is possible that bit errors may appear intermittently on BERT reports. In this event, it is necessary to carefully log the occurrences of the bit errors, noting the results of manual follow-up path tests run and packs replaced. By using Figures 9-1 through 9-14 to determine loopback points to select for testing and by following a methodical testing strategy, the faulty equipment responsible for producing the bit errors can finally be isolated.

After bit errors have been eliminated, and before circuit packs are returned for repair, the BERT summary reports should continue to be examined for several days to ensure that the maintenance action has corrected the problem.

Section 10: Advanced Intelligent Network Maintenance

Introduction

This section describes the requirements for Advanced Intelligent Network (AIN) maintenance. AIN maintenance entails verifying and tracing AIN or LNP-related messages and events that enable maintenance personnel to maintain DMS-10 switch performance at levels acceptable to the operating company.

CCS7 Maintenance

CCS7 equipment is tested using the LAN equipment diagnostics overlay (LED). CCS7 link maintenance is performed by level 2 firmware, according to CCS7 protocol. Operating company personnel also uses the signaling network diagnostic overlay (SND) to test and manage the CCS7 signaling network configuration.

AIN Test Query

The AIN test query capability enables operating company personnel to generate an AIN TCAP query from a maintenance terminal and send the query to the SCP. Operating company personnel can then verify the response from the SCP and measure the response time.

Operating company personnel populate an AIN test query command by entering AIN test query parameters using the SND overlay. The AIN test query command includes the AIN trigger type, TCAP parameters, and an entry number for the service logic host route (SLHR) table used for addressing the SCP. The SLHR table contains destination point codes of the primary and secondary STP nodes which handle global title translations (GTT), translation type information used by the primary and secondary STP nodes to obtain SCCP routing information, and a global title source code that identifies the source of the global title information used by the STP to route the message to an SCP application.

Although the test query cannot be distinguished from a normal TCAP query, the test query is exempt from network management and automatic code gapping (ACG) controls. Also, the DMS-10 switch does not create any billing records for the SCP response to a test query.

Test query for call-related messages

Operating company personnel create an AIN query by specifying values for TCAP parameters. Although the parameters required depend on the type of message to be sent, all messages contain the AIN trigger type, SLHR, and user ID parameters.

The following TCAP messages can be created:

- origination attempt (off-hook immediate trigger)
- information collected (off-hook delay trigger or shared interoffice trunk trigger)
- information analyzed (PODP feature code trigger, customized dialing plan trigger, PODP 3 through 10-digit trigger, PODP N11 trigger, and LNP trigger)
- termination attempt (termination attempt trigger)

Tables 10-A through 10-D show TCAP parameters required for each query type. In each table, the parameter, the command (in parentheses) used to enter the parameter, and input required are shown; the command syntax used for entering parameter information is described fully in the SND overlay description in NTP 297-3501-506, *Maintenance Diagnostic Input Manual*. As indicated in each table, operating company personnel are required only to set the parameters denoted by input.

Table 10-A:
AIN Test Query TCAP Parameters for Origination Attempt TCAP Message

Parameter	**Originating Facility Type**			
	Non-ISDN	**ISDN**	**EAMF TG**	**ISUP TG**
bearer capability	default: 1			
SLHR (SET AIN)	input: table number (1 through 15)			
trigger criteria type (SET AIN)	input: 16			
user ID (SET AIN USID)	input: DN = 10 digits	input: TSP = 10 digits + 3 through 20 character SPID	input: MF = 0 through 4 digits	input: ISUP = 0 through 4 digits
LATA	default: value entered in response to prompt LATA in Overlay CNFG (SYS) (see NTP 297-3501-311, *Data Modification Manual*)			
LATA sub-parameters	fixed: nature of number = 0; numbering plan = 0			
calling party ID	default: user ID			
calling party ID sub-parameters	default: PRI = 1; screening indicator = 1 fixed: nature of number = 3; numbering plan = 1			
charge number	default: user ID			

Table 10-A: (Continued)
AIN Test Query TCAP Parameters for Origination Attempt TCAP Message

Parameter	Originating Facility Type			
	Non-ISDN	**ISDN**	**EAMF TG**	**ISUP TG**
charge number sub-parameters	default: nature of number = 3 fixed: numbering plan = 1			
primary carrier (SET AIN)	input: 4 digits			
primary carrier sub-parameters	default: carrier selection = 1			

Table 10-B:
AIN Test Query TCAP Parameters for Information Collected TCAP Message

Parameter	Originating Facility Type			
	Non-ISDN	**ISDN**	**EAMF TG**	**ISUP TG**
bearer capability	default: 1			
SLHR (SET AIN)	input: table number (1 through 15)			
trigger criteria type (SET AIN)	input: 17 or 14			
user ID (SET AIN USID)	input: DN = 10 digits (valid if trigger = 17)	input: TSP = 10 digits + 3 through 20 character SPID (valid if trigger = 17)	input: MF = 1 through 4 digits (valid if trigger = 14)	input: ISUP = 1 through 4 digits (valid if trigger = 14)
primary carrier (SET AIN)	input: 4 digits			
primary carrier sub-parameters	default: carrier selection = 1			
calling party ID	default: user ID		not applicable	input: 3, 6, 10 digits (SET AIN)
calling party ID sub-parameters	default: PRI = 1; screening indicator = 1 fixed: nature of number = 3; numbering plan = 1		not applicable	same as ISDN and non-ISDN
charge number	default: user ID		not applicable	input: 3, 6, 10 digits
charge number sub-parameters	default: nature of number = 3 fixed: numbering plan = 1		not applicable	same as ISDN and non-ISDN
collected address info (SET AIN)	input: 0 through 15 digits			
collected address info sub-parameters	default: nature of number = 3 fixed: numbering plan = 1			

Table 10-B: (Continued)
AIN Test Query TCAP Parameters for Information Collected TCAP Message

Parameter	Originating Facility Type			
	Non-ISDN	**ISDN**	**EAMF TG**	**ISUP TG**
collected digits (SET AIN)	input: 0 through 32 digits			
collected digits sub-parameters	fixed: nature of number = 0; numbering plan = 0			
LATA	default: value entered in response to prompt LATA in Overlay CNFG (SYS) (see NTP 297-3501-311, *Data Modification Manual*)			
LATA sub-parameters	fixed: nature of number = 0; numbering plan = 0			
access code (SET AIN)	input: 1 through 5 digits		not applicable	
access code sub-parameters	fixed: nature of number = 0; numbering plan = 0		not applicable	
vertical service code (SET AIN)	input: up to 5 characters		not applicable	
vertical service code sub-parameters	fixed: nature of number = 0; numbering plan = 0		not applicable	

Table 10-C:
AIN Test Query TCAP Parameters for Information Analyzed TCAP Message

Parameter	Originating Facility Type			
	Non-ISDN	**ISDN**	**EAMF TG**	**ISUP TG**
bearer capability	default: 1			
SLHR (SET AIN)	input: table number (1 through 15)			
trigger criteria type (SET AIN)	input: 1 through 5, 8, 12, 19 through 23		input: 4, 5, 8, 12, 19 through 23	
user ID (SET AIN USID)	input: DN = 10 digits	input: TSP = 10 digits + 3 through 20 character SPID	input: MF = 1 through 4 digits	input: ISUP = 1 through 4 digits
called party (SET AIN)	input: 0 through 15 digits (required for trigger: 4, 5, 8, 12, 19 through 23)			
called party sub-parameters	defaults: nature of number = 3 fixed: numbering plan = 1			
LATA	default: value entered in response to prompt LATA in Overlay CNFG (SYS) (see NTP 297-3501-311, *Data Modification Manual*)		not applicable	

Table 10-C: (Continued)
AIN Test Query TCAP Parameters for Information Analyzed TCAP Message

Parameter	Originating Facility Type			
	Non-ISDN	**ISDN**	**EAMF TG**	**ISUP TG**
LATA sub-parameters	fixed: nature of number = 0; numbering plan = 0		not applicable	
calling party ID	default: user ID		not applicable	input: 3, 6, 10 digits (SET AIN)
calling party ID sub-parameters	default: PRI = 1; screening indicator = 1 fixed: nature of number = 3; numbering plan = 1		not applicable	same as ISDN and Non-ISDN
charge number	default: user ID		not applicable	input: 3, 6, 10 digits (SET AIN)
charge number sub-parameters	default: nature of number = 3 fixed: numbering plan = 1		not applicable	same as ISDN and non-ISDN
access code (SET AIN)	input: 1 through 5 digits (required if trigger = 2)		not applicable	
access code sub-parameters	fixed: nature of number = 0; numbering plan = 0		not applicable	
primary carrier (SET AIN)	input: 4 digits			
primary carrier sub-parameters	default: carrier selection = 1			
collected address info (SET AIN)	input: 0 through 15 digits (required if trigger = 3)		not applicable	
collected address info sub-parameters	fixed: nature of number = 0; numbering plan = 3		not applicable	
vertical service code (SET AIN)	input: up to 5 characters (required if trigger = 1)		not applicable	
vertical service code sub-parameters	fixed: nature of number = 0; numbering plan = 0		not applicable	
collected digits (SET AIN)	input: 0 through 32 digits		not applicable	
collected digits sub-parameters	fixed: nature of number = 0; numbering plan = 0			

Table 10-D:
AIN Test Query TCAP Parameters for Termination Attempt TCAP Message

Parameter	Originating Facility Type			
	Non-ISDN	**ISDN**	**EAMF TG**	**ISUP TG**
bearer capability	default: 1			
SLHR (SET AIN)	input: table number (1 through 15)			
trigger criteria type (SET AIN)	input: 15			
user ID (SET AIN USID)	input: DN = 10 digits	input: TSP = 10 digits + 3 through 20 character SPID	input: MF = 0 through 4 digits	input: ISUP = 0 through 4 digits
called party ID (SET AIN)	input: 0 through 15 digits			
called party ID sub-parameters	defaults: nature of number = 3 fixed: numbering plan = 1			
LATA	default: value entered in response to prompt LATA in Overlay CNFG (SYS) (see NTP 297-3501-311, *Data Modification Manual*)			
LATA sub-parameters	fixed: nature of number = 0; numbering plan = 0			
calling party ID	input: 3, 6, 10 digits (SET AIN)		not applicable	input: 3, 6, 10 digits (SET AIN)
calling party ID sub-parameters	default: PRI = 1; screening indicator = 1 fixed: nature of number = 3; numbering plan = 1		not applicable	same as ISDN and Non-ISDN
charge number (SET AIN)	input: 3, 6 10 digits		not applicable	input: 3, 6, 10 digits
charge number sub-parameters	default: nature of number = 3 fixed: numbering plan = 1		not applicable	same as ISDN and non-ISDN

Table 10-E shows the possible responses for AIN test queries. The response sent by the SCP displays on the maintenance terminal and includes:

- text string indicating the SCP response message type
- text string of each parameter received and the data associated with each parameter
- a generic error message when an error was received
- the response time in milliseconds if a valid message was received

If the response is not received within a specified time period, an error message indicating a timeout displays. If in response to the test query, the SCP requests further action or information (for example, playing an announcement and collecting digits), the message exchange is terminated by sending the required information to the SCP.

Table 10-E:
SCP Responses to Test Queries

SCP Response	TCAP Query Messages			
	Origination Attempt	Information Collected	Information Analyzed	Termination Attempt
Analyze Route	X	X	X	
Authorized Termination				X
Continue			X	
Disconnect	X	X	X	X
Forward Call				X
Send to Resource	X	X	X	X

AIN System Monitoring

AIN trigger status

The activation status of off-hook immediate, off-hook delay, and termination attempt triggers is provided by the ODQ overlay in NTP 297-3501-311, *Data Modification Manual*.

Routing determination check

Routing determination checks are performed using the translation verification function defined in the TRVR prompting sequence of overlay QTRN, described in NTP 297-3501-311, *Data Modification Manual*.

Software audits

Software audits (overlay AUD, NTP 297-3501-506, *Maintenance Diagnostic Input Manual*) repairs simple faults in call store data structures. The TCAP transaction buffers are audited in the same manner as other DMS-10 buffers.

Line insulation testing

Overlay LIT, in NTP 297-3501-506, *Maintenance Diagnostic Input Manual*, enables operating company personnel to test for faults in subscriber loops. The overlay lists the station options assigned to the specified DN being tested, including any AIN triggers to which the station subscribes.

Recorded Announcement Equipment Maintenance

Recorded announcement equipment used for AIN-related call processing interfaces with the DMS-10 switch through standard analog or digital trunks. Announcement-related information is passed to the announcement unit by outpulsed MF signals.

Trunk interface maintenance

Trunks used for recorded announcements are tested using trunk diagnostic commands in overlays PED, DED, or TLT in NTP 297-3501-506, *Maintenance Diagnostic Input Manual*. Recorded announcements can be tested using overlay TLT: announcements may be listened to by maintenance personnel over a telephone selected during test setup.

Recorded announcement equipment maintenance

Since recorded announcement equipment is provided by the operating company, maintenance information should be sought from the manufacturer.

Local Number Portability (LNP) Verification

Using the AIN test query capability described above, LNP verification comprises the following:

- verifying translations for calls originating from lines, trunks, and line-trunks that terminate to both ported-in and ported-out DNs
- verifying LNP translations originating from MF and ISUP trunks that tandem through the exchange
- building and sending LNP queries to the SCP for a DN that exists in a portable NPA-NXX
- verifying translations using the data supplied in an SCP response (which includes verifying LNP routing tables)

Section 11: Preventive Maintenance and System Surveillance

Introduction

The DMS-10 switch is designed for high reliability as an unattended end office. Switch hardware redundancy helps maintain continuous service of the switch. Alarms, trouble messages, operational measurements (OPMs), and diagnostic overlay programs help to identify potential faults before they become service-affecting. But performing preventive maintenance on the DMS-10 switch, which entails performing routine procedures and monitoring system performance on a regular basis, is crucial for ensuring the reliable operation of the switch and keeping customer-originated trouble reports to a minimum. This section describes a recommended plan for regular DMS-10 switch preventive maintenance.

Routine Maintenance

A list of routine maintenance activities and a recommended schedule for performing these activities is found in Section 4 of the *Maintenance and Test Manual* (NTP 297-3501-511). These tasks, such as cleaning filters or checking batteries, need to be performed on a regular basis. Operating company personnel should examine this list to determine what maintenance tasks are appropriate for their DMS-10 configuration. Since many DMS-10 sites are remote and unattended, operating company personnel should also determine how appropriate tasks can best be performed within a minimum number of office visits for these sites.

Daily Checks

Certain activities should be performed each day to determine the status of the switch and to identify any potential or existing problems that must be addressed. These activities include:

- checking the maintenance display on the NT3T98 pack for any maintenance codes which require action and inspecting the switch for LEDs in an incorrect state
- entering the resident command, LIST TRB <CR> to obtain a list of known faults and man-made-busy and out-of-service devices in the system.

- entering the Overlay CKT command, LIST ALL FALT <CR> to list all faulty circuits, and then entering LIST ALL MMB <CR> to list all circuits in the man-made-busy condition
- entering the Overlay ALO command, LIST ALM <CR>, to list active alarm conditions in the system

The resident command, LIST TRB will generally indicate faults at a component level while the LIST ALL FALT/MMB command in Overlay CKT will list faults and man-made-busy devices at the circuit level. The information obtained by using these commands should be logged, as necessary, and the appropriate action taken to correct the fault situation. When faults are cleared, the alarms should then be cleared by using the CLR CAT/MAJ/MIN ALL command in Overlay ALO.

Switch Grooming

Bit Error Rate Testing (BERT) enables operating companies to ensure high quality data communications within the DMS-10 switch by assessing data path quality, isolating data path problems, and then correcting any data path equipment problems that are discovered. BERT differs from external test methods in that it provides a detailed testing summary of all of the paths involved in the testing, whereas the external test set can determine only that errors have occurred. Making BERT a routine part of switch preventive maintenance provides quantifiable measurements of switch performance, the ability to groom out marginal hardware, and an early warning of any change in system integrity. DMS-10 BERT is available only in systems with host LCE positions available for the Integrated Bit Error Rate Tester (NT6X99AA) pack. For complete information about BERT, see Section 9 of this NTP.

Alarms and trouble messages

The most obvious indication of trouble in the DMS-10 is a visual or audible alarm condition originating from the Alarm and Ringing Module. Alarm conditions are detected by hardware-monitoring circuits or diagnostic overlay programs in the system software. When an alarm condition is detected by the system, a message is displayed on the maintenance terminal and the appropriate LED on the Alarm and Ringing module is lit. In some cases, an audible alarm is also activated depending upon the type or level of fault encountered. Alarm conditions in the DMS-10 switch are classified by their level of severity. A full description of alarm classification and associated level of priority can be found in NTP 297-3501-019, *Service Priority Classification*.

When received, alarms or trouble messages should be investigated immediately and corrective action should be taken as soon as service requirements allow. In some cases, it may be advisable to schedule troubleshooting for low traffic periods if the trouble is not yet affecting subscriber service. Failure to respond to alarms and trouble messages in a timely manner could result in the system disabling components associated with the fault condition or by the system attempting to clear the fault through an initialization or system software reload (SYSLOAD).

The time required to system alarms and troubles is dependent upon the preparedness of the office to deal with such problems By ensuring that operating company have the appropriate tools and training, costly delays in making repairs to the system and system downtime can be held to a minimum. In addition, each office should have a clearly defined escalation procedure for system problems. Management should determine the length of time various trouble situations should be allowed to exist before additional aid from the next level of technical support or management is requested. A list of these support personnel names, telephone numbers, and alternates should be posted conspicuously in each office. Support personnel should also have a clear understanding of the escalation procedure and when it should be invoked.

It is also recommended that each office be equipped with an on-site TTY for interfacing with the switch. In a cluster configuration, some offices may have only one means of accessing the switch, through data links originating from the host office. If there is a problem with the data links, or if the host office should experience a major outage, the satellite office could be isolated from control. Data links could also be adversely affected by certain types of System Processor problems within the office. It is recommended that foreign exchange trunks be used as a backup to the data links. A modem should be on-site at each office, as well. If technical assistance is required from a remote location, the dial-up modem may be used to communicate with the switch through a foreign exchange trunk. For security, a callback type of modem may be used.

Logs

Logs should be kept to record alarms, trouble conditions, calls placed to DMS-10 technical assistance (TAS), and other maintenance activities. These logs provide a history of system performance which can be beneficial when troubleshooting problems in the switching system.

DMS-10 alarm log

A log that records alarms received can be useful when diagnosing problems in the switch that may be of an intermittent nature. Alarm logs may also help to identify areas that require more routine testing and surveillance. An alarm log should record the following information:

- the date that the alarm occurred
- the time that the alarm occurred
- indication of the type of alarm (catastrophic, major, minor)
- a brief summary of the fault condition
- the specific problem and the solution found, or the department/personnel that the problem was referred to

A recommended alarm log format is shown in Figure 11-1.

Figure 11-1: DMS-10 Alarm Log format

Office:_____						
		Alarm level				
Date	Time	Min	Maj	Cat	Description	Trouble found

DMS-10 trouble log

The entries in the trouble log may be related to entries in the office alarm log and should record the following information:

- the maintenance ticket number assigned by the operating company for monitoring a trouble condition
- terminal number or hardware address of the indicated faulty device
- the trouble message from the TTY printout
- a summary of the fault condition and the action taken to correct it
- the time at which the problem was resolved

A recommended trouble log format is shown in Figure 11-2.

Figure 11-2: DMS-10 Trouble Log format

Office:_____						
Date	Time	Maintenance Ticket Number	Terminal Number (TN)	Trouble Message	Result	Time Closed

Customer trouble log

A customer trouble log records customer complaints. Customer complaints can usually be attributed to failures in station apparatus or the local loop, but can also be indicative of other system failures when trouble reports are received in large quantities. By comparing the hardware addresses and telephone numbers in multiple customer trouble reports, a common point of failure may be identified. A customer trouble log should contain the following information:

- number assigned by operating company to track the customer trouble report
- the directory number of the customer's line card
- the hardware address of the customer's line card
- the date and time the trouble is received and the time it is closed

- the trouble as it was reported (symptoms), the cause of the trouble, and the action taken to clear the trouble

A sample customer trouble log is shown in Figure 11-3.

Figure 11-3: Customer Trouble Log format

Office:_____							
Ticket Number	**Telephone Number**	**Terminal Number (TN)**	**Report Time**			**Trouble**	
			Date	**Time rec'd**	**Time closed**	**Reported**	**Action taken**

Technical assistance referral log

When the DMS-10 technical assistance (TAS) center is called to assist with the resolution of a problem, the pertinent data related to that trouble call should be recorded in a technical assistance log. This record of calls for assistance may provide valuable information when similar system problems occur. The technical assistance log should contain the following information:

- reference number from the DMS-10 trouble log or the customer trouble log
- a brief summary of the fault condition
- information about the call for technical assistance, including priority (that is, E1, E2, S1) and the date and time of the call made for technical assistance
- information about the fault resolution, including the action taken and the date and time that the fault was cleared

A recommended technical assistance referral log format is shown in Figure 11-4.

Figure 11-4: Technical Assistance Referral Log format

Office:_____							
Ticket Number	**Trouble Description**	**TAS/ETAS Referral**			**Trouble Clearance**		
		Priority	**Date**	**Time**	**Action Taken**	**Date**	**Time**

Circuit pack failure and replacement log

A circuit pack failure and replacement log can be used to track central office troubles, spare packs inventory, and replacement pack turnaround time. The circuit pack failure and replacement log should contain the following information:

- the reference number assigned to the trouble in either the DMS-10 trouble log or the customer trouble log (to be used as a reference number when cross-referencing information from one of the other logs)
- the date that the pack was determined to be faulty
- identifying numbers of the failed pack, including the pack code and serial number
- the slot location that the circuit pack occupies in the switch
- TTY output messages, illuminated LEDs, customer trouble reports or other indications of faults
- the date that the circuit pack was shipped for repair
- the date that the replacement pack arrived from the repair center

A recommended circuit pack failure and replacement log format is shown in Figure 11-5.

Figure 11-5: Circuit Pack Failure and Replacement Log format

Office:_____							
Maintenance ticket	**Date failed**	**Failed pack**		**Pack address (TN)**	**Trouble indication**	**Date sent for repair**	**Date replace-ment recd**
		Code	**Serial #**				

Spare circuit pack test log

Circuit packs in the spare packs inventory should be tested periodically to ensure that the packs are in good operating condition. Introducing a faulty spare pack into the switch while troubleshooting is being performed can increase the time required for restoring the faulty equipment. Thus, it is important to maintain a spare circuit pack test log which should include the following information:

- the pack code of the pack tested such as NT2T41
- the serial number of the pack
- the date that the pack was tested
- any additional pertinent information, such as whether the pack has ever been in-service before or whether it has been repaired and returned previously

A recommended spare circuit pack test log format is shown in Figure 11-6.

Figure 11-6: Spare Circuit Pack Test Log format

Office:_____			
Pack Code	**Serial #**	**Date**	**Remarks**

System Processor down time log

A System Processor down time log provides a record of System Processor outages. The log should be used to record any instances in which the System Processor was unable to process calls due to faults or planned maintenance activities. The System Processor down time log should include the following information:

- the date and time that the System Processor ceased processing calls
- indication as to whether the System Processor outage is a result of a manual System Processor shutdown or a system fault
- the duration in minutes of the System Processor downtime
- any additional pertinent information related to the outage

A recommended System Processor down time log format is shown in Figure 11-7.

Figure 11-7: System Processor Down Time Log format

Office:_____					
Stopped Call Processing		**System Processor Outage Type**		**Down Time (Minutes)**	**Remarks**
Date	**Time**	**Planned**	**Fault**		

SYSLOAD log

A SYSLOAD log tracks all occurrences of system reloads, whether initiated automatically by the system or manually by operating company personnel. The information in the log should include the following:

- date of the SYSLOAD
- time that the SYSLOAD began
- indication as to whether the SYSLOAD was initiated manually or by the system
- any related information about the SYSLOAD, including the reason for the SYSLOAD and trouble messages received

A recommended SYSLOAD log format is shown in Figure 11-8.

Figure 11-8: SYSLOAD Log format

Office:_____				
Date	**Time**	**Type**		**Remarks**
		Manual	**System**	

Patch control log

A patch control log can be used to monitor the application of patches. Information in this log can be used for any follow-up activity if patches are not applied in a timely manner or if other problems arise as a result of patching. The patch control log should contain the following information:

- identification number of the patch
- date of the download and date when the patch was activated
- name, organization, and telephone number of the individual administering the patch
- any additional pertinent information related to patch activity

A recommended patch control log format is shown in Figure 11-9.

Figure 11-9: Patch Control Log format

Office:_____						
Patch ID	**Date**		**Application**			**Remarks**
	Down loaded	**Applied**	**Name**	**Org.**	**Call-back #**	

Operational measurement logs

In addition to providing information for facilities planning, for traffic studies, and for hardware provisioning, operational measurements (OPMs) also provide useful information for monitoring DMS-10 switch performance.

When OPM data is accumulated and recorded systematically in logs, the data can be quickly examined to identify trouble areas or components in the switch that require maintenance. The recommended OPM logs described below are designed to address basic maintenance concerns that do not require in-depth analysis for the following major components of the DMS-10 switch:

- incoming and outgoing trunks
- service circuits
- network devices
- System Processor
- peripheral devices
- span lines

Although OPM data can be printed at different intervals, it is recommended that the log reports below be updated daily in order to provide a reliable, up-to-date record of system performance and health.

Note: *Some operating companies may use the Engineering and Administration Data Acquisition System (EADAS) to generate custom reports and logs. In that case, an equivalent log or report from the EADAS printouts can be used to track switch performance instead of the OPM logs presented in this section.*

Outgoing trunk group log

This log records the data taken from the outgoing trunk group portion of OPM004 (TRK). The values in each heading are cumulative values collected for each trunk group. The recommended log format, shown in Figure 11-10, includes the following information:

- the number assigned to the trunk group
- the number of calls that are routed to this trunk group (PEG)
- the number of attempts to select a trunk in this trunk group that fail due to no trunk being available (OVFL)
- a usage measurement in hundred-call-seconds (CCS) for all trunks in this trunk group (USE)
- the amount of time trunks are out-of-service, man-made-busy, system-made-busy, or faulty for the indicated trunk group (MTCE)

Figure 11-10: Outgoing Trunk Group Log (OPM004) format

Office:_____			Date:_____	
Trunk group	**PEG**	**OVFL**	**USE**	**MTCE**

Incoming trunk group log

This log records data taken from the incoming trunk group portion of OPM004 (TRK). The values in each heading are cumulative values collected for each trunk group. The recommended log format, shown in Figure 11-11, includes the following information:

- the number assigned to the trunk group
- the number of calls that are routed to this trunk group (PEG)
- a usage measurement in hundred-call-seconds (CCS) for all trunks in this trunk group (USE)
- the amount of time trunks are out-of-service, man-made-busy, system-made-busy, or faulty for the indicated trunk group (MTCE)

Figure 11-11: Incoming Trunk Group Log (OPM004) format

Office:_____			Date:_____
Trunk group	**PEG**	**USE**	**MTCE**

Service circuits performance log

This log, to be used for DMS-10 Classic Network configurations, records the data taken from OPM005 (SVCE). It provides information about the performance of Digitone Receiver, Multifrequency Receiver, Tone and Digit Sender, and Universal Tone Receiver circuits. The recommended log format, shown in Figure 11-12, includes the following information:

- a count of requests to connect Digitone receiver circuits necessary for providing Digitone service (REQ)
- a count of Digitone connections that have been completed (PEG). Ideally, the REQ and PEG should be equal.
- a measurement, in CCSs, of all Digitone receivers (USE). Usage starts when a receiver is obtained and ends when it is released.
- a count of requests to connect to Digitone receivers that cannot be satisfied in the first attempt, because all Digitone receivers are busy (OVFL)
- the amount of time the device is out-of-service, man-made-busy, system-made-busy, or faulty (MTCE)

Figure 11-12: Service Circuits Performance Log (OPM005)

Office:_____				**Date:**_____	
Device	**REQ**	**PEG**	**USE**	**OVFL**	**MTCE**

Network performance log

This log, to be used for DMS-10 Classic Network configurations, records the data from OPM006 (NTWK). This information is related to the network interface packs and associated peripheral loops. The recommended log format, shown in Figure 11-13, contains the following information:

- the hardware component measured
- the bay, shelf and pack location of the device
- the number of attempts to obtain a connection with this device that have failed due to not finding an idle timeslot (BLK)
- the amount of time (in CCSs) that the device is out-of-service, man-made-busy, system-made-busy, or faulty (MTCE)

Figure 11-13: Network Performance Log (OPM006)

Office:_____			**Date:**_____
Device	**Address**	**BLK**	**MTCE**

Maintenance Log

The maintenance log provides a means for monitoring equipment unavailability due either to faults or to maintenance activities being performed. The recommended log format, shown in Figure 11-14, contains a count of times that a device is unavailable (P) and the amount of time that the device is unavailable (U). For additional information about the application of these measurements to a particular device, see the description of OPM008 in NTP 297-3501-456, *Operational Measurements*.

Figure 11-14: Maintenance Log (OPM008)

Office:_____	**P = PEG**				**U = USE**							
Device	**Date:** _____		**Date:** _____		**Date:** _____		**Date:** _____		**Date:** _____		**Date:** _____	
	P	U	P	U	P	U	P	U	P	U	P	U

DS-1 span line log

This log is used to record the data taken from OPM018. This measurement block contains information pertaining to the performance of the DS-1 span lines used for connection to various remote units. The measurements contained within OPM018 provide performance data for each DS-1 Interface pack (NT6X85) and each Subscriber Remote Interface (NT4T09) configured in the system. Each pack is identified by the hardware address that it occupies in the switch. The recommended format for this log, shown in Figure 11-15, contains the following information:

- D1LK (DS-1 Link to SLC-96)
- PEG: the number of origination attempts from the shelf groups served by this span line
- BLK: the number of attempted channel assignments for mode II that could not be performed
- USE: usage measurement for all channels on this span line
- MTCE: the amount of time that this span line is placed in a maintenance state (faulty, man-made-busy, system-made-busy, or indirectly out-of-service)
- SRLK (Subscriber Remote Interface Link)
- PEG: the number of attempts to obtain a timeslot on the designated span line, both successful and unsuccessful. When multiple attempts are made to obtain a timeslot, only the first attempt is pegged.
- OVFL: the number of attempts to obtain a timeslot on the designated span line that fail because an idle timeslot is not found
- USE: a usage measurement for all channels on the designated span line. Use begins when the software reserves a timeslot on the designated span line and ends when the timeslot is returned to the idle state.
- MTCE: the amount of time that the designated span line is placed in a maintenance state (faulty, man-made-busy, system-made-busy, indirectly out-of-service)

Figure 11-15: DS-1 Span Line Log

Office:_____				**Date:**_____	
Device	**Address**	**PEG**	**BLK/OVFL**	**USE**	**MTCE**

DMS-10 office evaluation

A DMS-10 office evaluation is used to assess the preparedness of the office to perform maintenance functions. The office evaluation can help identify weak areas in the maintenance program such as under-utilization of logs, routine procedures, operational measurements, and maintenance tools. The information collected for the office evaluation can also be used for planning and inventory management. And, when necessary, office evaluations can be used to measure improvement in the maintenance program, over time. It is recommended that an office evaluation be performed once per year.

DMS-10 office evaluation checklist

The following DMS-10 office evaluation checklist shows what kind of information should be included in an office evaluation report:

Office data

- Office name - the common language location identifier (CLLI) code, or other appropriate name for the office
- Software generic - the current version of software running on the switch

Trunks

- Analog trunks - the quantity of trunks terminating on peripheral equipment
- Hybrid trunks - the quantity of trunks terminating on DCMs which have analog facilities or terminate on a far-end analog switch
- Digital trunks - the quantity of trunks terminating on DCMs or DSIs which have only digital carrier facilities or terminate on a digital switch
- Total trunks - the total number of trunks, including miscellaneous trunks
- DS-1 carrier - the total number of DS-1 carrier systems terminating on the host switch for all applications

Lines

- Flat rate - the quantity of flat rate lines
- Coin - the quantity of coin lines
- MDC - the quantity of Meridian Digital Centrex lines
- Other - the quantity of other lines in the office
- Total line cards - the total number of lines in office

Business day call volumes

- Bus/day line originations - the number of line originations for a typical 24-hour day (Monday through Friday)
- Line abandons - the total number of line abandons divided by 1000 (for a typical business day, as above)

- Bus/day trunk incoming calls - the total number of incoming trunk calls (for a typical business day, as above)
- Trunk abandons - the total number of trunk abandons (for a typical business day, as above)
- Total bus/day calls - the total number of business day calls calculated using the above data as follows:
  - +Bus/day line origination
  - +Bus/day trunk incoming call
  - -Line abandon
  - -Trunk abandons
  - -Algebraic total

Common equipment

- Network shelves - the number of network shelves provisioned in the switch
- I/O device configuration - the number of devices and locations of the devices
- Magnetic tape units (MTU) - the number of magnetic tape units
- TTYs - the number of teletypes and maintenance terminals
- Printers - the number of printers used for DMOs, maintenance, and operational measurements
- Dial-up ports - the number of dial-up ports and application of each
- Dial-up answer type - type of answer or control on all dial-up ports to prevent unauthorized access

Staff

- Office personnel - the total number of staff members working on days, evenings and nights
- SCC staff - the total number of staff members in the Switch Control Center (or equivalent) and people working on days, evenings, and nights
- ESAC staff - the total number of staff members working on days, evenings, and nights
- Office manager - the name of the first level manager of the office
- Telephone - the telephone number for the office manager
- Evaluator - the name of the person performing the office evaluation

Office control logs

Refer to the descriptions of the logs under the headings, “Logs” and “Operational Measurements” for information about the following:

- System Processor down time log
- SYSLOAD log
- Patch control log
- Circuit pack failure and replacement log
- Spare circuit pack test log
- Customer trouble log
- DMS-10 trouble log
- DMS-10 alarm log
- Technical assistance referral log
- Operational measurements logs or EADAS printouts

Office administration and maintenance

- On-site tape storage - Verify that tapes are stored in a protected environment away from electro-magnetic fields, humidity and so on.
- Off-site storage - an extra precautionary measure to protect against the loss of all tapes at a site due to a fire, vandalism or other catastrophe.
- AMA tape ID - Verify that AMA tapes are properly identified.
- Log-in control - Verify that password classes are understood. Change password every three months or when changes to the staff occur.
- Dial-up control - Verify logging and control of dial-up access ports.
- Documentation - Verify that the office has the following documentation and that it is up to date:
  - Nortel Technical Publications (NTPs)
  - Maintenance advisories
  - Cabling assignment
  - Office records
  - Vendor documentation
  - Operating company documents
- Tools and test sets - Verify that the office has the following test equipment:
  - Digital multimeter (Fluke 806A or equivalent)
  - Dual channel oscilloscope (Hewlett-Packard HP1740A or equivalent)

- Transmission test set (Hewlett-Packard HP3551A or equivalent)
- Signaling test set (Northeast electronics or equivalent)
- Bit error rate tester for T-1 testing (Fireberd 2000 or equivalent)

• Environment - Check the status of the following environmental items:

- Work/storage area - Verify that adequate work space has been provided in the maintenance area. There should be room for documentation, tools and test sets, spare circuit packs, and room to analyze data printouts.
- Administration area - Verify that sufficient space is provided for TTYs and printers.
- Equipment layout - Verify that equipment is efficiently grouped from the central control complex and work area to the peripherals. Check for overhead water pipes and cold air outlets above System Processor and network equipment.
- Floor condition - Ensure that the floor is free from dust, paper, and small parts
- Loose equipment cabling - Check for loose hardware, circuit packs and cabling in and around the equipment.
- Equipment lighting - Verify that isles, bays, and work areas have adequate lighting.
- Equipment designations - Ensure that the equipment designations agree with the office specification and circuit pack assignments.
- Spare pack storage - Verify that circuit packs are properly installed in a grounded cabinet or in anti-static containers.
- Tarpaulins - Verify that waterproof tarpaulins are available to cover equipment in case of water leaks or construction around the equipment.
- Fire extinguishers - Ensure that carbon dioxide or Halon gas (preferred) fire extinguishers are available throughout the office in locations that are clearly marked. Liquid or powder extinguishers should not be present in the equipment rooms.
- Humidity alarms - Specify whether the office is equipped with high and low humidity alarms.
- Smoke detectors - Specify whether the office is equipped with fire and smoke alarms.
- High-water alarms - Specify whether the office is equipped with a high-water alarm when the office is located on the first floor or basement, if flooding may be a problem.
- Combustible material - Verify that combustible material is not stored in the office.

  - Grounded mats and wrist straps - Verify that grounded wrist straps are readily available throughout the office. All maintenance operations such as operating toggle switches and replacing circuit packs require the use of wrist straps. Ensure that a grounded mat is placed in front of the System Processor and that the grounding wire is secure.
  - Switchroom restrictions - Verify that access to the switchroom is restricted in such a way that maintenance personnel will be aware of anyone gaining access.
  - Building security - Verify that the office doors are locked when the office is unattended.
  - Open door alarm - Verify that the building or equipment room is equipped with an open door alarm monitored by a surveillance center.
  - Visitor procedure - Verify that a visitor's log is available and used in accordance with company instructions.

- Routine procedures - Verify that routine maintenance procedures are performed at the recommended intervals.
- Emergency procedures - Verify that emergency procedures that apply to 24-hour, 7-days per week operation have been developed for the site and that maintenance personnel names and telephone numbers are readily available.
- Escalation procedures - Verify that procedures exist for escalation of troubles which clearly define time frames to be met and personnel to be contacted.
- Trunk tests and records - Review circuit order transmission records and verify the following tests:
  - Net loss
  - Noise tests
  - ERC/SP results
  - Operation tests
  - Talk tests
  - Slips on DS-1 carrier
- Automatic line tests - Verify the use of the ALIT program to automatically perform line insulation tests.

Section 12: Index

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DMS-10 Family

600-Series Generics

General Maintenance Information

NTP number: NTP 297-3601-500
Release: 07.01
For Generic 602.20
Status: Standard
Date: August 2006