
Meridian 1

Trunk cards

Description

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- *QPC71 E&M/DX Signaling and Paging Trunk Card description* (553-2001-187)
- *Recorded Telephone Dictation Trunk Cards description* (553-2001-188)
- *QPC237 4-Wire E&M/DX Trunk Card description* (553-2001-190)
- *CO/FX/WATS Trunk Cards description* (553-2201-185)
- *QPC449 Loop Signaling Trunk Cards description* (553-2201-186)
- *QPC74 Recorded Announcement Trunk Card description* (553-2201-194)
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- *NT8D15 E&M Trunk Card description* (553-3001-172)

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About this document

This document outlines the functions, specifications, applications, and operation of the various Meridian 1 trunk cards. This information is intended to be used as a guide when connecting the trunk cards to customer-provided equipment and central office trunk facilities.

References

See the Meridian 1 system planning and engineering guides for

- *Meridian 1 system engineering* (553-3001-151)
- *Spares planning* (553-3001-153)
- *Meridian 1 equipment identification* (553-3001-154)
- *Summary of transmission parameters* (553-2201-182)

See the Meridian 1 system installation and maintenance guides for

- *Meridian 1 system installation procedures* (553-3001-210)
- *Circuit card installation and testing* (553-3001-211)
- *Meridian 1 general maintenance information* (553-3001-500)
- *Meridian 1 fault clearing* (553-3001-510)
- *Meridian 1 hardware replacement* (553-3001-520)

See the X11 software guides for an overview of software architecture, procedures for software installation and management, and a detailed description of all X11 features and services. This information is contained in two documents:

- *X11 software management (553-3001-300)*
- *X11 features and services*

See the *X11 input/output guide* for a description of all administration and maintenance programs, and *X11 system messages guide* for information about system messages.

Description

Overview

This document describes the various trunk cards that are used with the Meridian 1 switch. It describes the Meridian 1 architecture, the trunk cards themselves, and how the cards fit into the Meridian 1 architecture. It also shows how the cards are used at the customer site, and how they are installed and programmed. It also provides detailed technical specifications on each of the cards.

The following nine trunk cards are described in this document:

- NT8D14 Universal Trunk Card
- NT8D15 E&M Trunk Card
- QPC71 E&M/DX and Paging Trunk Card
- QPC74 Recorded Announcement Trunk Card
- QPC237 4-Wire E&M/DX Trunk Card
- QPC239 Recorded Telephone Dictation Trunk Card with DCK feature
- QPC250 Release Link Trunk Card
- QPC449 Loop Signaling Trunk Card
- QPC450 CO/FX/WATS Trunk Card

Meridian 1 architecture

A Meridian 1 switch is a digital telephone system that provides both voice and data transmission. The internal hardware is divided into the following functional areas (see [Figure 1](#)).

Common equipment

Common equipment circuit cards provide processor control, software execution, and memory functions to the system. Meridian 1 processor functions are executed by the system software in the CPU module (sometimes called a Core module). This module is normally located at the bottom of the Meridian 1 column. The CPU manages the telephone switching functions by responding to interrupt requests from the network and peripheral equipment. It also performs the following housekeeping functions:

- controls call origination, call termination, and feature operation for switched voice and data calls
- executes system administration and configuration functions
- coordinates system diagnostic activities
- controls system utility functions such as software loading, initialization, data dumping, traffic logging, and system auditing

Network equipment

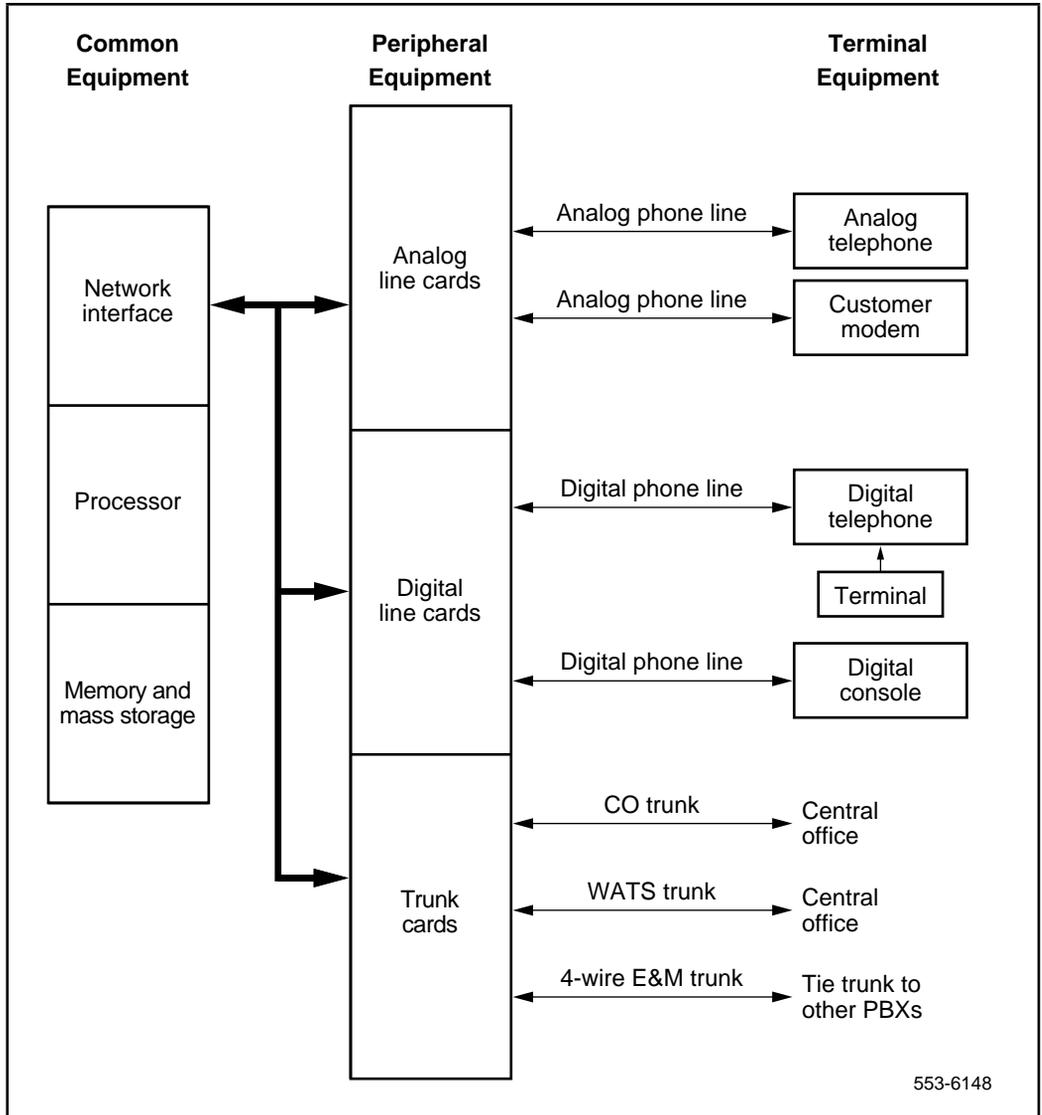
Network interface circuit cards perform data and control switching functions between the processor and peripheral equipment cards.

Note: As shown in [Figure 1](#), the network interface function is generally considered a subset of the common equipment functions.

Some of the functions that network equipment performs include:

- hardware initialization and self-test upon power-up
- establishing call connections between stations connected to remote IPE line cards and stations local to the Meridian 1
- establishing call connections to trunks for long distance trunk calls over public or private networks
- providing local and remote loopback testing and fault isolation functions

Figure 1
Trunk cards in the Meridian 1 architecture



Peripheral equipment

Peripheral equipment circuit cards provide the interface between the network and connected devices, including trunks and terminal equipment. Functions performed by peripheral equipment include:

- performing initialization and self-tests upon power-up
- managing timeslots to line and trunk cards to establish call connections
- providing Card-LAN management information by reporting card and port status
- controlling local station dialing and ringing functions
- providing local and remote loopback testing and fault isolation functions

Trunk cards are peripheral equipment circuit cards that are used to connect the Meridian 1 switch to line facilities and special services. These facilities include:

- Central office trunks
 - Central office trunks (CO)
 - Wide Area Telephone Service trunks (WATS)
 - Direct inward dial trunks (DID)
 - Foreign Exchange trunks (FX)
 - Central Automatic Message Accounting trunks (CAMA)
 - Common Control Switching Arrangement trunks (CCSA)
- PBX—PBX tie trunks
 - Tie trunks (TIE)
 - Release trunks (RLT)
- Special services
 - Recorded Announcement trunks (RAN)
 - Music trunks (MUS)
 - Paging trunks (PAG)
 - Dictation trunks (DIC)

Terminal equipment

Terminal equipment includes telephones and attendant consoles. It may include equipment such as data terminals, printers, and modems.

Complete details on the architecture of the Meridian 1 switch are given in *Meridian 1 system overview* (553-3001-100).

Selecting a trunk card

Each of the trunk cards was designed to fit a specific system need. [Table 1](#) will help you select the trunk card that will best meet your needs.

Intelligent peripheral equipment (IPE) trunk cards

The following trunk cards are designed using the intelligent peripheral equipment (IPE) architecture, and are recommended for use in all new system designs.

NT8D14 Universal Trunk Card

The NT8D14 Universal Trunk Card is an intelligent four-channel trunk card that is designed to be used in a variety of applications. It supports the following five trunk types:

- Central office (CO), Foreign Exchange (FX), and Wide Area Telephone Service (WATS) trunks
- Direct inward dial (DID) trunks
- Tie trunks: two-way loop dial repeating (LDR) and two-way loop outgoing automatic incoming dial (OAID)
- Recorded Announcement (RAN) trunks
- Paging (PAG) trunks

The universal trunk card also supports Music, Automatic Wake Up, and Direct Inward System Access (DISA) features.

Table 1
Trunk card characteristics

Part Number	Description	Trunks	Trunk Types	Architecture
NT8D14	Universal Trunk Card	8	CO/FX/WATS trunks*, direct inward dial trunks, tie trunks, Loop Dial Repeating trunks Recorded Announcement trunks, Paging trunks	IPE
NT8D15	E&M Trunk Card	4	2-wire E&M trunks, 4-wire E&M trunks, 4-wire DX trunks, Paging trunks	IPE
QPC71	E&M/DX Signaling and Paging Trunk Card	2	2-wire E&M trunks, 2-wire DX trunks, 4-wire DX trunks, Paging trunks	IPE
QPC74	Recorded Announcement Trunk Card	4	Recorded Announcement trunks	PE
QPC237	4-wire E&M/DX Trunk Card	2	4-wire E&M trunks, 4-wire DX trunks	PE
QPC239	Recorded Telephone Dictation Trunk Card	2	Recorded Telephone Dictation trunk	PE
QPC250	Release Link Trunk Card	2	Release Link trunks	PE
QPC449	Loop Signaling Trunk Card	4	Direct inward dial trunks, direct outward dial trunks, loop dial repeating trunks	PE
QPC450	CO/FX/WATS Trunk Card	4	CO/FX/WATS trunks	PE
* Central office (CO), Foreign Exchange (FX), and Wide Area Telephone Service (WATS) trunks.				

NT8D15 E&M Trunk Card

The NT8D15 E&M Trunk Card is an intelligent four-channel trunk card that is designed to be used when connecting to the following types of trunks:

- 2-wire E&M Type I signaling trunks
- 4-wire E&M trunks with:
 - Type I or Type II signaling
 - Duplex (DX) signaling
- paging (PAG) trunks

The trunk type and function can be configured on a per port basis. Dialing outpulsing is provided on the card. Make and break ratios are defined in software and downloaded by software commands.

Peripheral equipment (PE) trunk cards

The following trunk cards are designed using the older peripheral equipment (SL-1) architecture. They are available to upgrade an existing system, but should not be used in new system designs.

QPC71 E&M/DX Trunk Card

The QPC71 E&M/DX Trunk Card is a two-channel trunk card that is designed to be used when connecting to the following types of trunks:

- E&M signaling, 2-way dial repeating trunks
- 2-wire DX signaling, 2-way dial repeating trunks where signaling and transmission are via hybrid transformer
- 4-wire DX signaling, 2-way dial repeating trunks where signaling is via the A1 and B1 leads to a 24V4 repeater mounted externally to the Meridian 1, and transmission is via a hybrid transformer to the terminating set of the 24V4 that converts the trunk from 2-wire to 4-wire
- paging (PAG) trunks, dial access or attendant access via the press-to-talk key

The QPC71 can offer either 600 Ω or 900 Ω balanced terminating impedance (selected at the cross connect terminal). It also includes a 2-dB pad to control the gain between line-to-trunk and trunk-to-trunk connections on non-VNL connections, and gain control and echo protection on VNL through balance and terminal balance connections.

QPC74 Recorded Announcement Trunk Card

The QPC74 Recorded Announcement Trunk Card is a four-channel trunk card that is designed to be connected to a variety of recorded announcement machines. Up to five different intercept conditions can be defined that will result in a connection to a recorded announcement machine. Some examples of these conditions are:

- access denied: “You are not allowed access to the number you have dialed. Please dial 0 for assistance.”
- call to a vacant number: “The number you have dialed is not in service. Please check your directory and call again.”

The QPC74 allows selectable termination of the tip and ring impedance using 300 Ω distributing resistors. This allows bridging of up to ten trunks to a single low-impedance (2 Ω or 4 Ω) recorded announcement channel. It also supports both continuous and start/stop modes of operation.

QPC237 4-Wire E&M/DX Trunk Card

The QPC237 is a two-channel, 4-wire E&M/DX trunk card that provides 4-wire voice transmission with E&M or DX signaling without the necessity of going through external 2- to 4-wire conversion. It allows connection to 4-wire trunks that use both Type I and Type II signaling.

QPC239 Recorded Telephone Dictation Trunk Card

The QPC239 Recorded Telephone Dictation Trunk (RTDT) card is a two-channel card that directly interfaces with a variety of customer-provided recorded announcement equipment to allow the user to record an announcement. The RTDT card can be selected to allow either transmission or no transmission during dialing (switch setting). It also has a software switchable 4-dB pad that allows gain control between line-to-trunk and trunk-to-trunk connections.

QPC250 Release Link Trunk Card

The QPC250 Release Link Trunk (RLT) Card is a two-channel trunk card that is used at a remote site to allow access to the main site Centralized Attendant Service (CAS) attendant. An RLT circuit consists of a trunk circuit at a remote private branch exchange (site) to be served by a CAS attendant, and an interfacing trunk circuit at the main site where the CAS attendant is located.

QPC449 Loop Signaling Trunk Card

The QPC449 Loop Signaling Trunk Card is a four-channel trunk card that can interface with any of the following trunk types:

- direct inward dial (DID) and direct outward dial (DOD) trunks
- loop dial repeating (LDR) tie trunks
- two-way dial outgoing automatic incoming dial (OAID) tie trunks
- outgoing automatic number identification (OANI)

The QPC449 can offer either 600 Ω or 900 Ω balanced terminating impedance (selected at the cross connect terminal). It also includes a 4-dB pad to control the gain between line-to-trunk and trunk-to-trunk connections (on the receive or digital-to-analog side).

QPC450 CO/FX/WATS Trunk Card

The QPC450 CO/FX/WATS Trunk Card is a four-channel trunk card that connects to central office (CO), Foreign Exchange (FX) and Wide Area Telephone Service (WATS) trunks. The QPC450 can offer either 600 Ω or 900 Ω balanced terminating impedance (selected at the cross connect terminal).

Installation

This section provides a high-level description of how to install and test trunk cards. For specific installation instructions, see *Circuit card installation and testing* (553-3001-211).

Intelligent peripheral equipment (IPE) trunk cards can be installed in any IPE slot of either the NT8D11 Common/Peripheral Equipment (CE/PE) Module or the NT8D37 Intelligent Peripheral Equipment (IPE) Module. [Figure 2](#) shows where an IPE trunk card can be installed in an NT8D11 CE/PE module, and [Figure 3](#) shows where an IPE trunk card can be installed in an NT8D37 IPE Module.

Peripheral equipment (PE) trunk cards can be installed in any PE slot of the NT8D13 Peripheral Equipment Module. This is shown in [Figure 4](#).

Figure 2
IPE trunk cards installed in an NT8D11 CE/PE Module

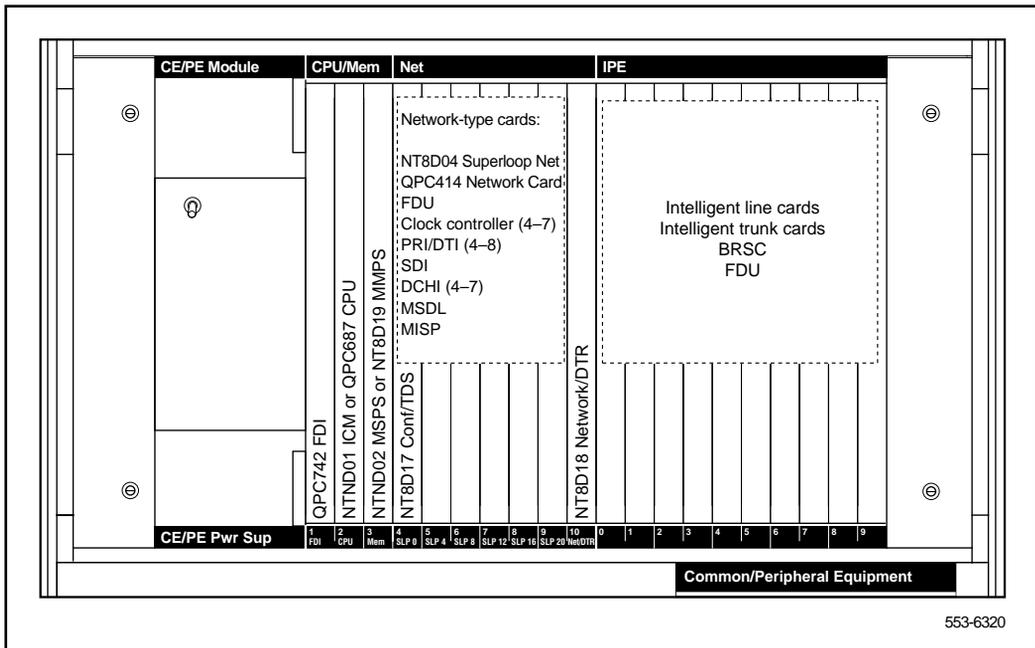
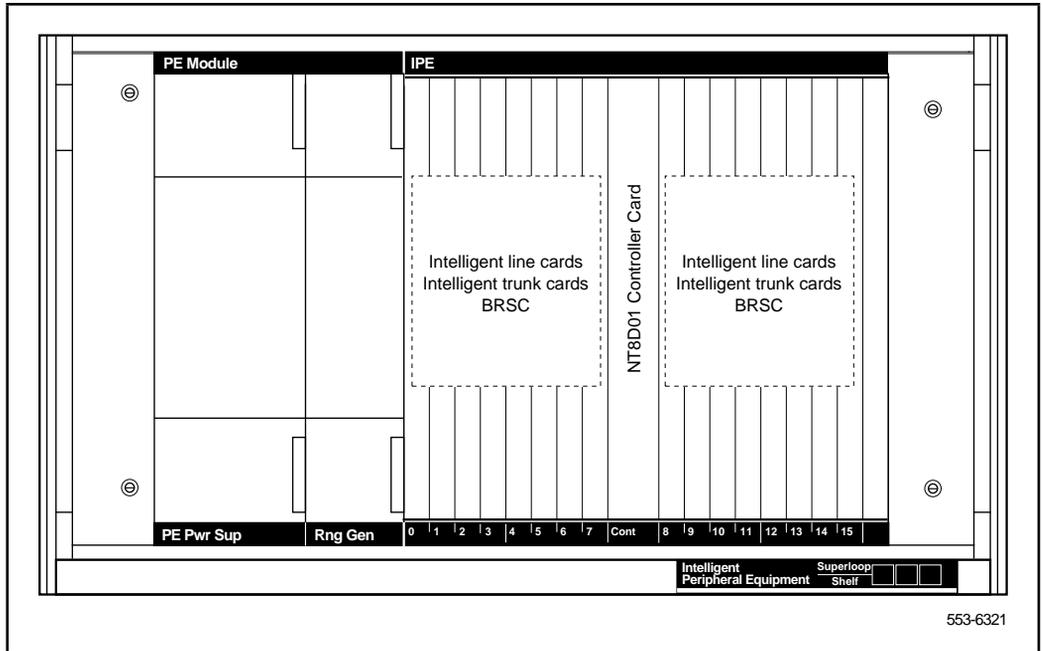


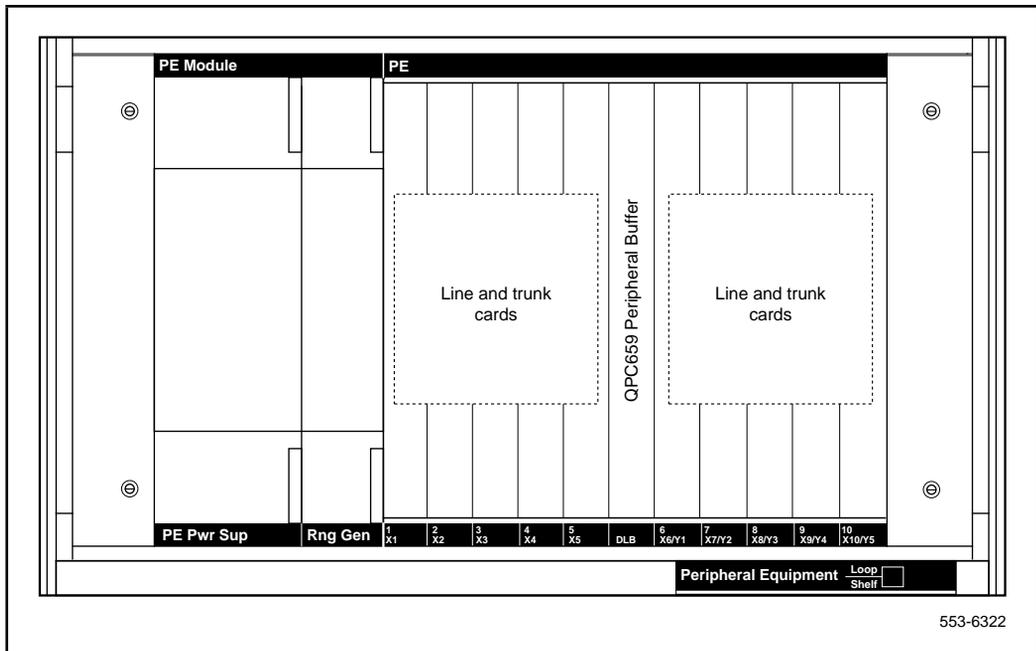
Figure 3
IPE trunk cards installed in an NT8D37 IPE Module



When installing trunk cards, these general procedures should be used:

- 1 Configure the jumpers and switches on the trunk card (if any) to meet your system needs.
- 2 Install the trunk card into the slot that you have selected.
- 3 Install the cable that connects the backplane connector on the PE or IPE module to the module I/O panel.
- 4 Connect a 25-pair cable from the module I/O panel connector to the main distribution frame (MDF).

Figure 4
PE trunk cards installed in an NT8D13 PE Module



- 5 Connect the trunk card output to the selected terminal equipment at the MDF.
- 6 Configure the individual trunk interface unit using the Trunk Administration program (LD 14) and the Trunk Route Administration program (LD 16).

Once these steps have been completed, the trunk card is ready for use.

Operation

This section describes how trunk cards fit into the Meridian 1 architecture, the buses that carry signals to and from the trunk cards, and how they connect to terminal equipment. To fully understand the operation of these cards, you must understand the differences between peripheral equipment (PE) and intelligent peripheral equipment (IPE). See [Table 2](#).

Host interface bus

The original (SL-1 architecture) switches that Northern Telecom produced used a bus standard for line and trunk cards called the peripheral equipment (PE) bus. Newer switches (Meridian 1 architecture) use an improved version of this bus: the intelligent peripheral equipment (IPE) bus. Meridian 1 based switches are designed to be able to interface with the older PE based cards. This allows existing SL-1 switches to be upgraded to the Meridian 1 architecture without the expense of throwing away the existing wiring, PE modules, and line and trunk cards.

Cards based on the IPE bus have a built-in microcontroller; cards based on the PE bus do not. The IPE microcontroller is used to perform local diagnostics (self-test), configure the card according to instructions issued by the Meridian 1 system processor, and report back to the Meridian 1 system processor information such as card identification (type, vintage, and serial number), firmware version, and programmed configuration status.

Note: IPE cards and modules should be used in all new designs. PE equipment should only be specified when upgrading an existing system.

Intelligent peripheral equipment

Intelligent peripheral equipment (IPE) trunk cards all have a similar architecture. [Figure 6](#) shows a typical IPE trunk card architecture. The various trunk cards differ only in the number and types of trunk interface units.

Table 2
Differences between PE and IPE modules

Parameter	Peripheral Equipment	Intelligent Peripheral Equipment
Card Dimensions	31.75 x 25.4 x 3.6 cm. (12.5 x10.0 x 1.4 in.)	31.75 x 25.4 x 2.2 cm. (12.5 x10.0 x 0.875 in.)
Network Interface	SL-1 Network Loops	DS-30X Loops
Communications Interface	via the SL-1 Network Loop	card LAN Link
Microcontroller	None	8031
Peripheral Interface Card	QPC659 Dual-loop Peripheral Buffer Card	NT8D01 Controller Card
Network Interface Card	QPC414 Network Card	NT8D04 Superloop Network Card
Modules	NT8D13 PE Module	NT8D37 IPE Module NT8D11 CE/PE Module

Figure 5
Network connections to PE/IPE modules

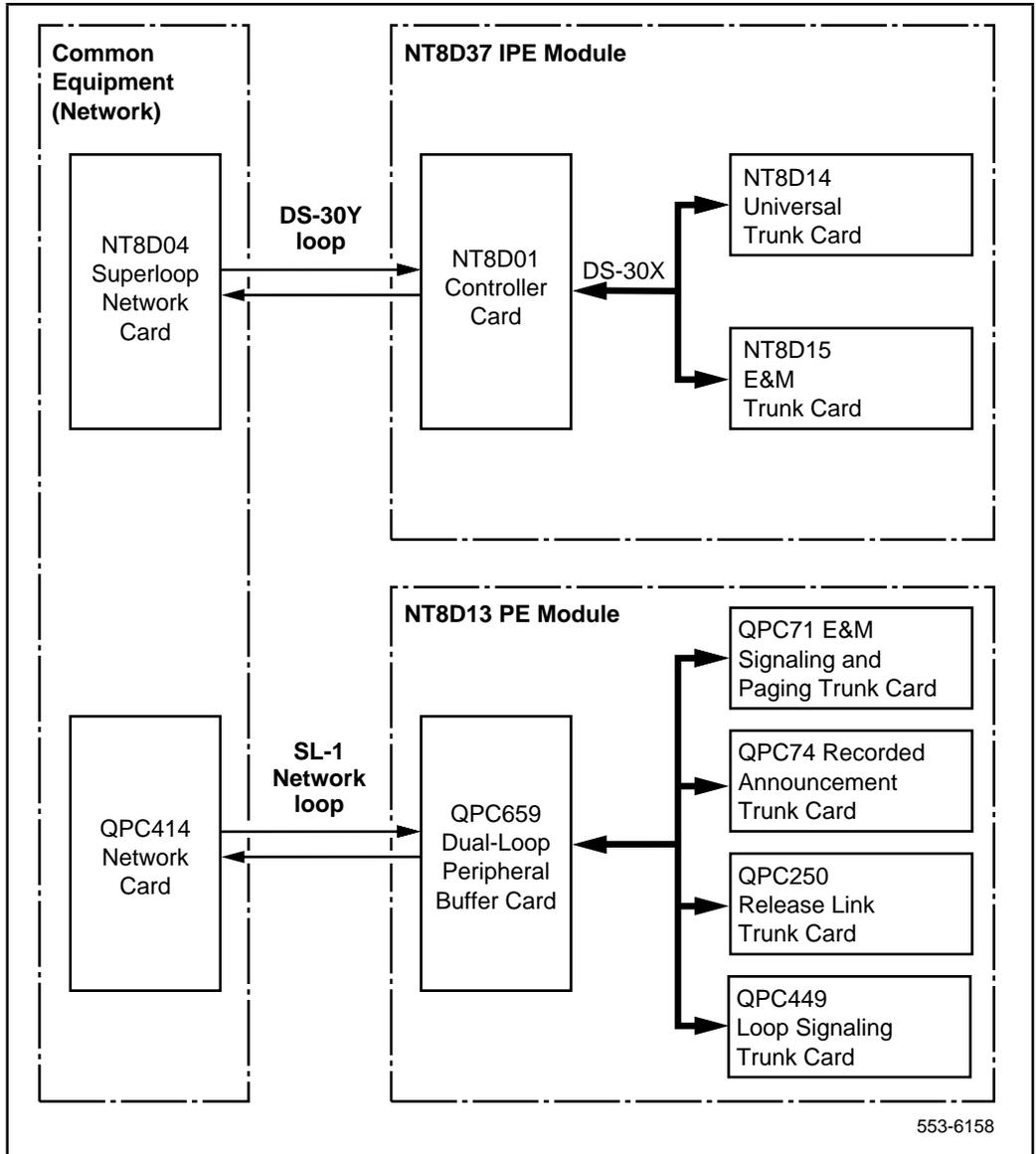
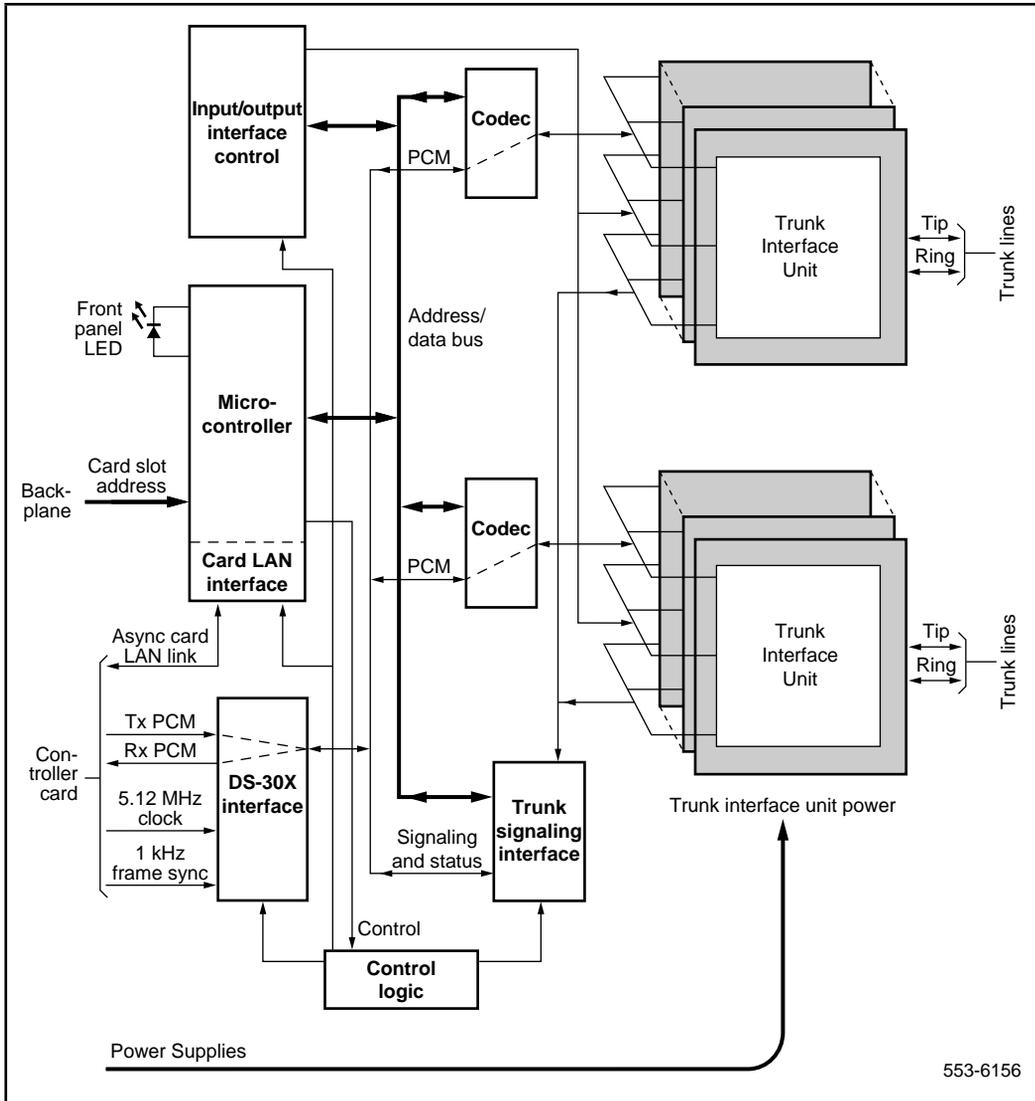


Figure 6
Typical IPE trunk card architecture



The Meridian 1 switch communicates with IPE modules over two separate interfaces. Voice and signaling data are sent and received over DS-30X loops and maintenance data is sent over a separate asynchronous communications link called the card LAN link.

Signaling data is information directly related to the operation of the telephone line. Signaling commands include, but are not limited to:

- off hook/on hook
- ringing signal on/off
- message waiting lamp on/off

Maintenance data is data relating to the setup and operation of the IPE card, and is carried on the card LAN link. Maintenance data includes, but is not limited to:

- polling
- reporting of self-test status
- CPU initiated card reset
- reporting of card ID (card type and hardware vintage)
- reporting of firmware version
- downloading trunk interface unit configuration
- reporting of trunk interface unit configuration
- enabling/disabling of the DS-30X network loop bus
- reporting of card status

DS-30X loops The interfaces provided by the line and trunk cards connect to conventional 2-wire (tip and ring) line facilities. IPE analog line and trunk cards convert the incoming analog voice and signaling information to digital form and route it to the Meridian 1 common equipment (CE) CPU over DS-30X network loops. Conversely, digital voice and signaling information from the CPU is sent over DS-30X network loops to the analog line and trunk cards where it is converted to analog form and applied to the line or trunk facility.

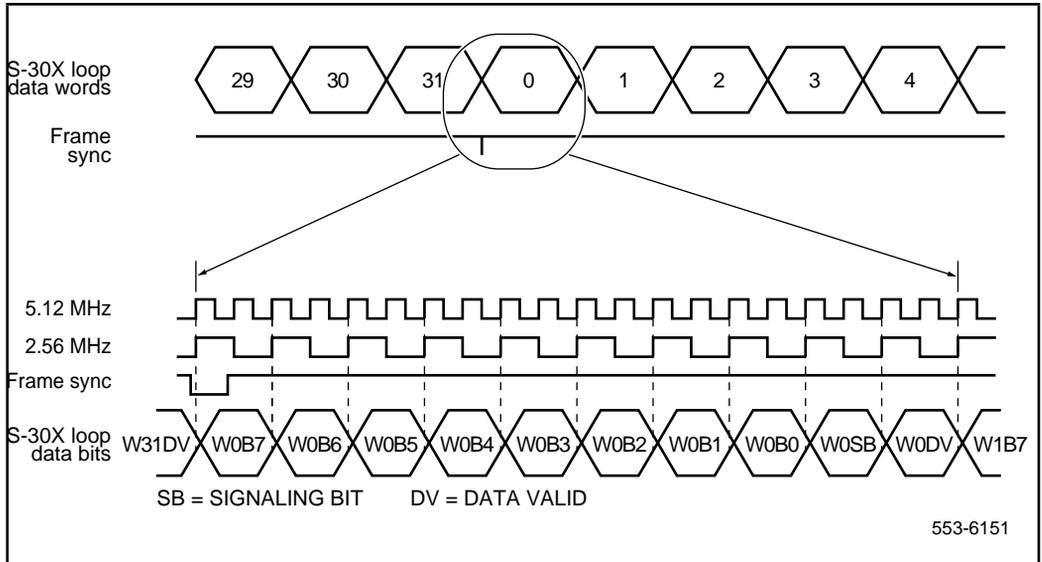
IPE digital line cards receive the data from the digital phone terminal as 512 kHz time compressed multiplexed (TCM) data. The digital line card converts that data to a format compatible with the DS-30X loop, and transmits it in the next available timeslot. When a word is received from the DS-30X loop, the digital line card converts it to the TCM format and transmits it to the digital phone terminal over the digital line facility.

A separate dedicated DS-30X network loop is extended between each IPE line/trunk card and the controller cards within an IPE module (or the controller circuits on a network/DTR card in a CE/PE module). A DS-30X network loop is composed of two synchronous serial data buses. One bus transports in the transmit (Tx) direction toward the line facility and the other in the receive (Rx) direction toward the Meridian 1 common equipment.

Each bus has 32 channels for pulse code modulated (PCM) voice data. Each channel consists of a 10-bit word (see [Figure 7](#)). Eight of the 10 bits are for PCM data, one bit is the call signaling bit, and the last bit is a data valid bit. The 8-bit PCM portion of a channel is called a *timeslot*. The DS-30X loop is clocked at 2.56 Mbps (one-half the 5.12 MHz clock frequency supplied by the controller card). Thus, the timeslot repetition rate for a single channel is 8 kHz. The controller card also supplies a locally generated 1 kHz frame sync signal for channel synchronization.

Signaling data is transmitted to and from the line cards using the call signaling bit within the 10-bit channel. When the line card detects a condition that the Meridian 1 switch needs to know about, it creates a 24-bit signaling word. This word is shifted out on the signaling bit for the associated channel one bit at a time during 24 successive DS-30X frames. Conversely, when the Meridian 1 switch sends signaling data to the line card, it is sent as a 24-bit word divided among 24 successive DS-30X frames.

Figure 7
DS-30X loop data format



DS-30Y network loops extend between controller cards and superloop network cards in the common equipment, and function in a manner similar to DS-30X loops (see [Figure 5](#)). Essentially, a DS-30Y loop carries the PCM timeslot traffic of a DS-30X loop. Four DS-30Y network loops form a *superloop* with a capacity of 128 channels (120 usable timeslots). See *Meridian 1 system engineering* (553-3001-151) for more information on superloops.

Card LAN link Maintenance communications is the exchange of control and status data between IPE line or trunk cards and the CE CPU by way of the NT8D01 Controller Card. Maintenance data is transported via the *card LAN* link. This link is composed of two asynchronous serial buses (called the Async card LAN link in [Figure 6](#)). The output bus is used by the Meridian 1 controller for output of control data to the trunk card. The input bus is used by the Meridian 1 controller for input of trunk card status data.

A card LAN link bus is common to all of the line/trunk card slots within an IPE module (or IPE section of a CE/PE module). This bus is arranged in a master/slave configuration where the controller card is the master and all other cards are slaves. The module backplane provides each line/trunk card slot with a unique hardwired slot address. This slot address enables a slave card to respond when addressed by the controller card. The controller card communicates with only one slave at a time.

In normal operation, the controller card continually scans (polls) all of the slave cards connected to the card LAN to monitor their presence and operational status. The slave card sends replies to the controller on the input bus along with its card slot address for identification. In this reply, the slave informs the controller if any change in card status has taken place. The controller can then prompt the slave for specific information. Slaves only respond when prompted by the controller; they do not initiate exchange of control or status data on their own.

When an IPE line or trunk card is first plugged into the backplane, it runs a self-test. When the self test is completed, a properly functioning card responds to the next controller card poll with the self-test status. The controller then queries for card identification and other status information. The controller then downloads all applicable configuration data to the line/trunk card, initializes it, and puts it into an operational mode.

Peripheral equipment

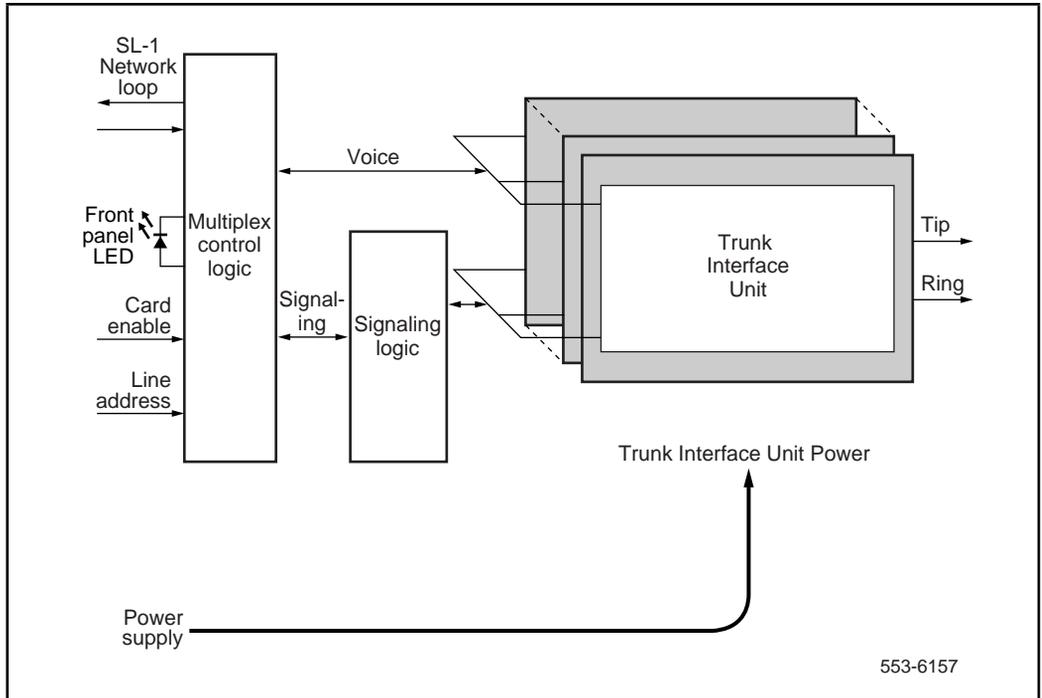
Peripheral equipment (PE) trunk cards all have a similar architecture.

[Figure 8](#) shows a typical PE trunk card architecture. The various trunk cards differ only in the number and types of trunk interface units.

Peripheral equipment (PE) trunk cards are not intelligent cards, but rather must work in conjunction with a QPC659 Dual-Loop Peripheral Buffer Card (see [Figure 5](#) on page 17). The peripheral buffer card generates two sets of “card select” signals. A separate Card enable signal is generated for each card slot in the PE backplane. A 4-bit encoded Line address is used to select an individual trunk interface unit on that card.

The peripheral buffer card maintains a table of which trunk card and line unit address is assigned to a particular timeslot in the SL-1 network loop. It uses that information to generate the Card enable and Line address signals at the proper time.

Figure 8
Typical PE trunk card architecture



A trunk unit is enabled by the simultaneous occurrence of a Card enable signal for the card that it resides on and a Line address that corresponds to the address of the line unit appearing on the Line address bus. When these conditions occur, the data that is present on the SL-1 Network loop at that time is written to and read from the line unit codec.

SL-1 Network loops The line interfaces provided by the line cards connect to conventional 2-wire (tip and ring) line facilities. Peripheral equipment (PE) analog line cards convert the incoming analog voice and signaling information to digital form and route it to the Meridian 1 common equipment (CE) CPU over SL-1 network loops. Conversely, digital voice and signaling information from the CPU is sent over SL-1 Network loops to the analog line cards where it is converted to analog form and applied to the line facility.

PE digital line cards receive the data from the digital phone terminal as 512 kHz time compressed multiplexed (TCM) data. The digital line card converts that data to a format compatible with the SL-1 Network loop, and transmits it in the next available timeslot. When a word is received from the SL-1 Network loop, the digital line card converts it to the TCM format and transmits it to the digital line facility.

Each loop has 32 timeslots for pulse code modulated (PCM) data. Each of the 32 channels is carried at 64 kbps (the standard rate for a digitized voice channel). The total data rate is therefore 2.048 Mbps.

Data on the loop is “bit-interleaved” instead of byte-interleaved as it is on the DS-30X loop. Instead of having a byte of data occupy eight successive timeslots on the loop, the SL-1 Network loop has the first 32 successive timeslots occupied (in order) by the sign bit from each channel. The next 32 successive timeslots are occupied by the most significant bit (MSB), and so on, until eight “subframes” of 32 timeslots each have been completed (see [Figure 9](#)).

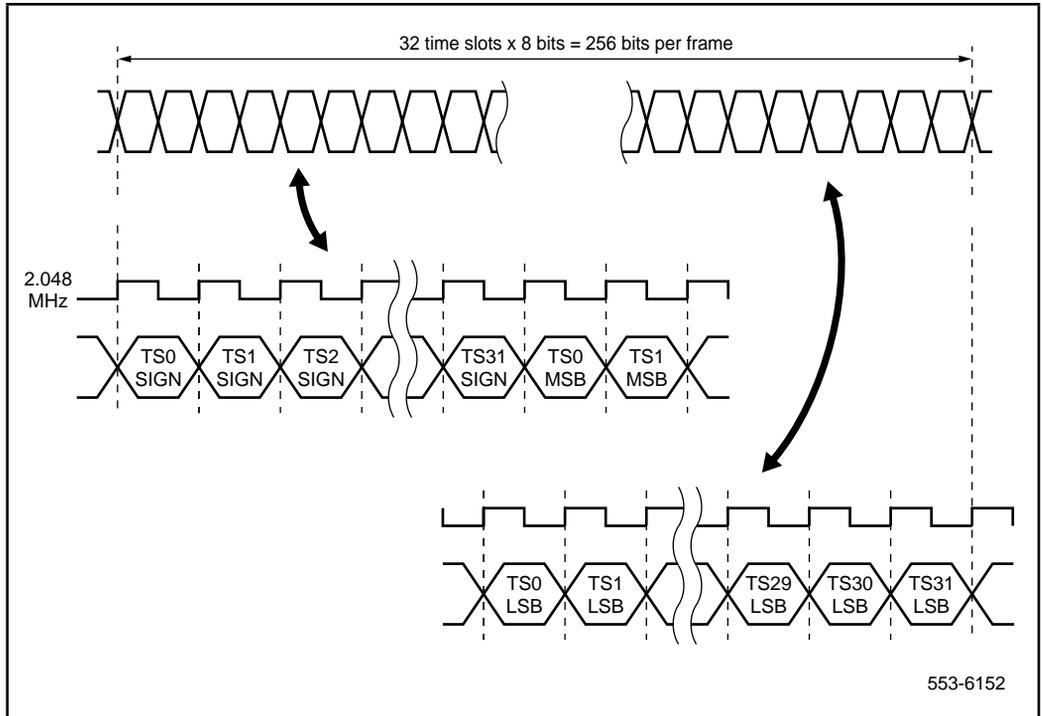
An SL-1 Network loop is composed of two synchronous serial data buses. One bus transports in the transmit (Tx) direction toward the line facility and the other in the receive (Rx) direction toward the Meridian 1 common equipment. When a terminal is enabled during a timeslot, its codec transmits one bit of PCM data toward the Meridian 1 CE and at the same time receives one bit of data from the Meridian 1 CE.

The timeslots are numbered 0 through 31. Timeslot 0 is reserved for signaling information. Timeslot 1 is not used. Timeslots 2 through 31 are used for voice data, giving a total of 30 usable timeslots for voice.

SL-1 Network loop signaling SL-1 Network loop signaling is used to send messages to and receive messages from the peripheral equipment cards. A typical message to the PE card directs the card to enable the front panel fault LED or enable signaling for a particular trunk. A typical message from the PE card tells the system processor that a trunk has gone off hook.

Messages are sent and received during timeslot 0. An enable signal TS0 (timeslot 0 enable) is generated during each timeslot 0. When the network card has a message for a particular peripheral card, it asserts the card enable signal for that card along with the TS0 signal. This continues on successive TS0s until a complete message has been sent. (See [Figure 9](#).)

Figure 9
SL-1 Network loop data format

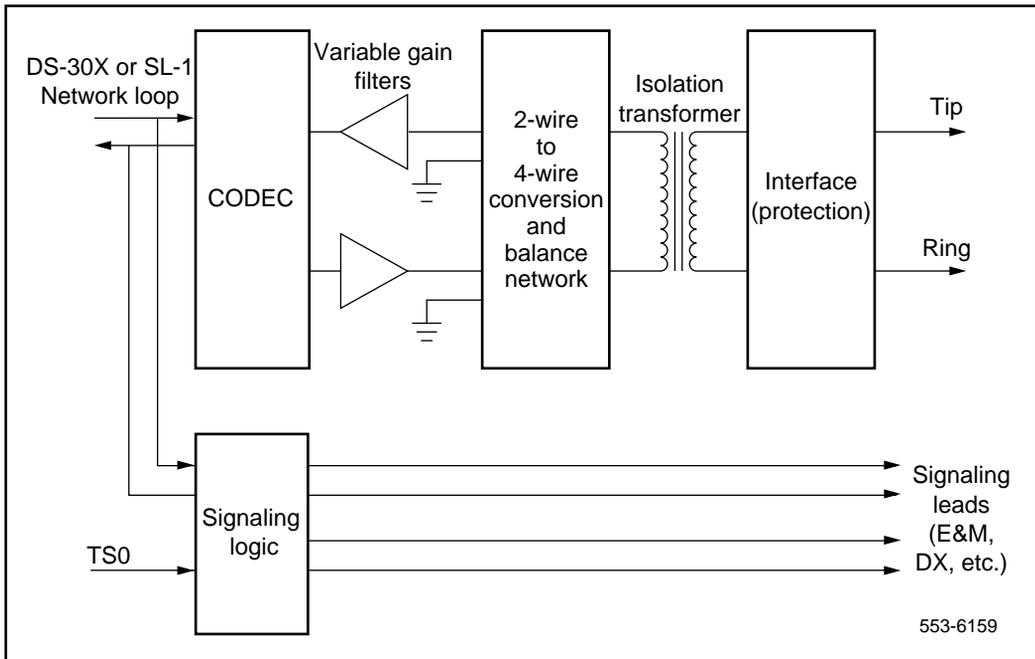


The network card regularly polls the PE cards during TS0 to see if any of them has a message to be sent. When a PE card has a message waiting it responds to the poll by sending a series of 1s during the next five successive timeslot 0s. The network card responds by sending a “message send enable” message (all 1s). The PE card replies by sending 1, 1, 1, 0, and then the message in successive timeslot 0s.

Trunk interface unit

Once the 8-bit digital voice signal has been received by the trunk card, it must be converted back into an analog signal, filtered, and driven onto the analog trunk line through an impedance matching and balance network. The trunk interface also includes the logic necessary to place outgoing call signaling onto the trunk, or the logic to connect to special services such as recorded announcement and paging equipment. [Figure 10](#) shows a typical example of the logic that performs these functions. Each part of the trunk interface unit is discussed in the following section.

Figure 10
Typical trunk interface unit block diagram



Coder/Decoder circuit The Coder/Decoder (codec) performs analog to digital (A/D) and digital to analog (D/A) conversion of the line analog voiceband signal to and from a digital PCM signal. This signal can be coded and decoded using either the A-Law or the μ -Law companding algorithm. On some trunk cards the decoding algorithm depends of the type of codec installed when the board is built. On others, it is an option selected using a software overlay.

Variable gain filters Audio signals received from the analog phone trunk are passed through a low-pass analog to digital (A/D) monolithic filter that limits the frequency spread of the input signal to a nominal 200–3400 Hz bandwidth. The audio signal is then applied to the input of the codec. Audio signals coming from the codec are passed through a low-pass A/D monolithic filter that integrates the amplitude modulated pulses coming from the codec, and then filters and amplifies the result. On some of the trunk cards, the gain of these filters can be programmed by the system controller. This allows the system to make up for line losses according to the loss plan.

Balancing network Depending on the card type, the balancing network is capable of providing either a 600 Ω or a 900 Ω (or both) impedance matching network. It also converts the 2-wire transmission path (tip and ring) to a 4-wire transmission path (Rx/ground and Tx/ground). The balancing network is a transformer/analog (hybrid) circuit combination.

Signaling circuits Signaling circuits are relays that place outgoing call signaling onto the trunk. Signal detection circuits monitor the incoming call signaling.

Control signals Control signals and logic are provided when the trunk is going to be connected to special services such as recorded announcement and paging equipment.

NT8D14 Universal Trunk Card

Introduction

The NT8D14 Universal trunk Card is an Intelligent Peripheral Equipment (IPE) device that can be installed in either the NT8D37 IPE Module or the NT8D11 CE/PE Module. The Universal Trunk card interfaces eight analog trunk lines to the Meridian 1 switch. Each trunk interface is independently configurable by software control using the Trunk Administration program (LD 14).

The universal trunk card supports the following trunk types:

- Centralized Automatic Message Accounting (CAMA) trunks
- Central office (CO), Foreign Exchange (FX), and Wide Area Telephone Service (WATS) trunks
- Direct inward dial (DID) trunks
- Tie trunks: two-way loop dial repeating (LDR) and two-way loop outgoing automatic incoming dial (OAID)
- Recorded Announcement (RAN) trunks
- Paging trunks

The universal trunk card also supports Music, Automatic Wake Up, and Direct Inward System Access (DISA) features.

[Table 3](#) is a matrix of the signaling and trunk types supported by the universal trunk card.

Table 3
Trunk and signaling matrix

Signaling type	Trunk types					
	CO/FX/ WATS	DID	Tie	RAN	Paging	CAMA
Loop start	Yes	No (see note)	No	N/A	N/A	Yes
Ground start	Yes	No	No	N/A	N/A	No
Loop DR	No	Yes	Yes	N/A	N/A	No
Loop OAID	No	No	Yes	N/A	N/A	No
Continuous operation mode	No	No	No	Yes	N/A	No
Start modes (pulse and level)	No	No	No	Yes	N/A	No

Note: For incoming and outgoing service, DID trunks must be programmed as loop dial repeating.

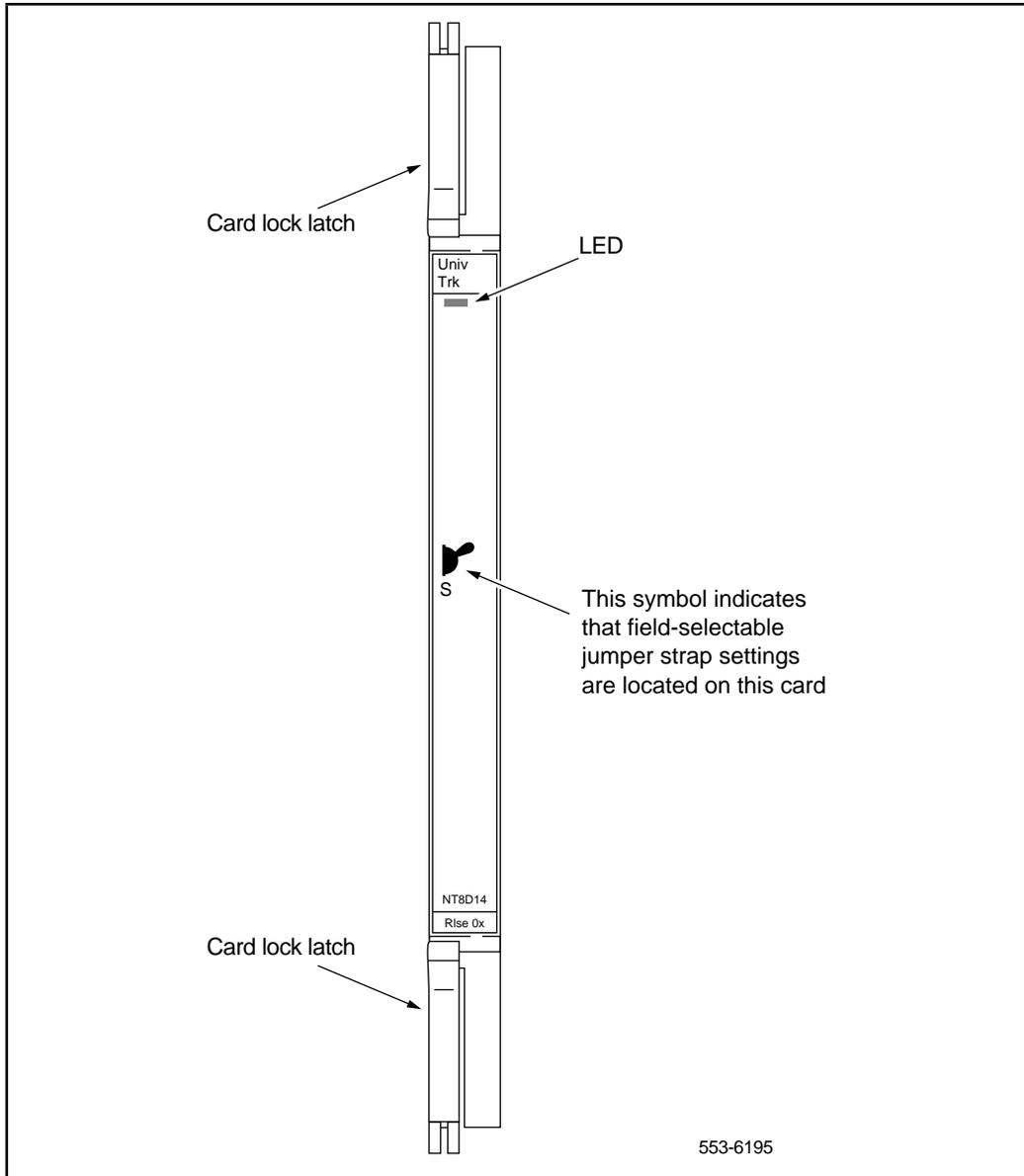
Physical description

The universal trunk card mounts in any IPE slot. The trunk and common multiplexing circuitry is mounted on a 31.75 cm by 25.40 cm (12.5 in. by 10 in.) printed circuit board.

The universal trunk card connects to the backplane through a 160-pin connector shroud. The backplane is cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pair cables. External equipment, such as recorded announcement machines, paging equipment, and central office facilities, connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross-connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 11](#)). When a universal trunk card is installed, the LED remains lit for 2 to 5 seconds while the self-test runs. If the self-test completes successfully, the LED flashes three times and remains lit until the card is configured and enabled in software, then the LED goes out. If the LED does not follow this pattern or operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

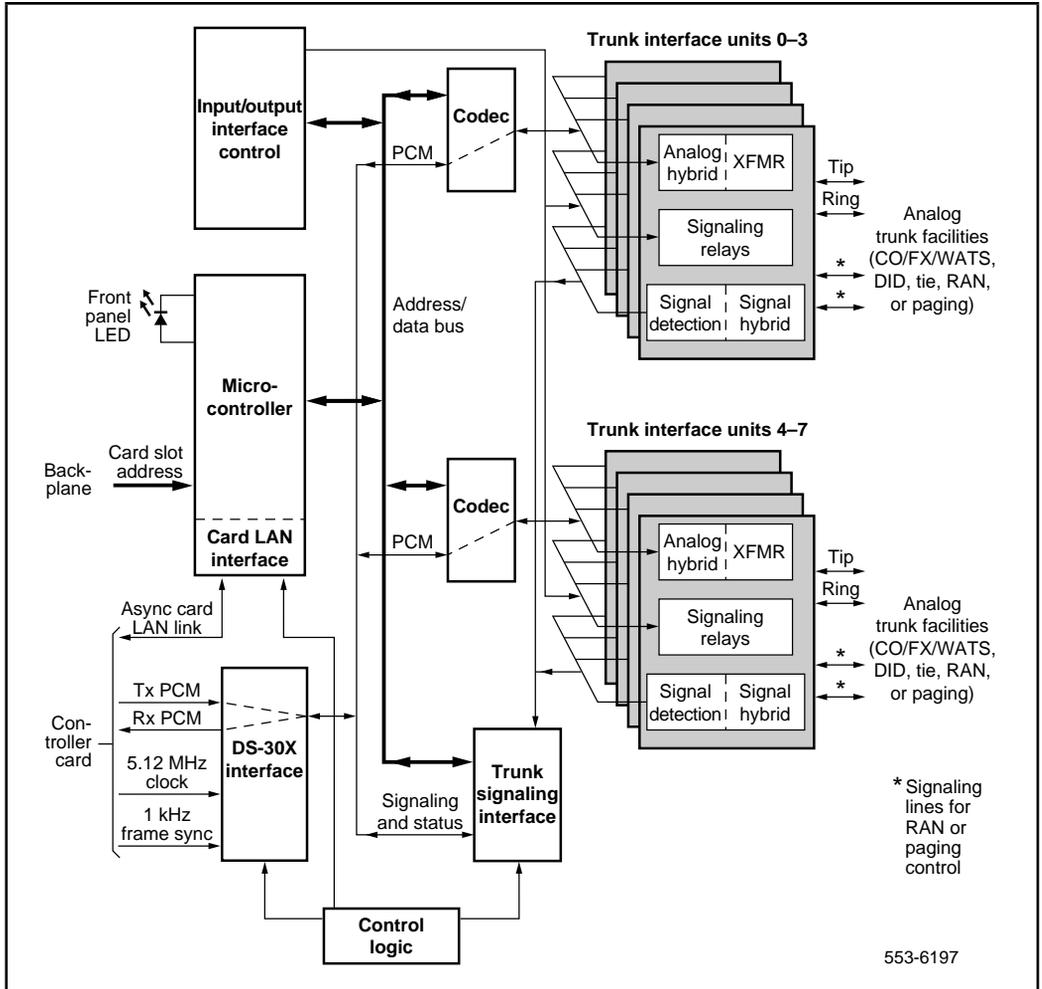
Figure 11
Universal trunk card—faceplate



Functional description

Figure 12 shows a block diagram of the major functions contained on the universal trunk card. Each of these functions are described on the following pages.

Figure 12
Universal trunk card—block diagram



Card interfaces

The universal trunk card passes voice and signaling data over DS-30X loops, and maintenance data over the card LAN link. These interfaces are discussed in detail in “Intelligent peripheral equipment” on page 15.

Trunk interface units

The universal trunk card contains eight identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Also provided are relays for placing outgoing call signaling onto the trunk. Signal detection circuits monitor incoming call signaling. Two codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports four trunk interface units. The following features are common to all units on the card:

- trunk type configurable on a per unit basis
- terminating impedance (600 or 900 ohm) selectable on a per unit basis (minimum vintage BA)
- balance impedance (600 or 900 ohm or complex impedance network) selectable on a per unit basis (minimum vintage BA)
- control signals provided for RAN and paging equipment
- loopback of PCM signals received from trunk facility over DS-30X network loop for diagnostic purposes
- switchable pads for transmission loss control

Card control functions

Control functions are provided by a microcontroller, a card LAN interface, and signaling and control circuits on the universal trunk card.

Microcontroller

The universal trunk card contains a microcontroller that controls the internal operation of the card and the serial card LAN link to the controller card. The microcontroller controls the following:

- reporting to the CE CPU via the card LAN link:
 - card identification (card type, vintage, and serial number)
 - firmware version
 - self-test status
 - programmed configuration status
- receipt and implementation of card configuration via the card LAN link:
 - programming of the codecs
 - enabling/disabling of individual units or entire card
 - programming of input/output interface control circuits for administration of trunk interface unit operation
 - maintenance diagnostics
 - transmission pad settings

Card LAN interface

Maintenance data is exchanged with the common equipment CPU over a dedicated asynchronous serial network called the Card LAN link. The card LAN link is described in “Intelligent peripheral equipment” on page 15.

Signaling and control

The signaling and control portion of the card provides circuits that establish, supervise, and take down call connections. These circuits work with the system CPU to operate trunk interface circuits during calls. The circuits receive outgoing call signaling messages from the CPU and return incoming call status information over the DS-30X network loop.

Operation

The optional applications, features, and signaling arrangements for each unit on the universal trunk card are assigned through the Trunk Administration (LD 14) and Trunk Route Administration (LD 16) programs and/or jumper strap settings on the card. See the *X11 input/output guide* for detailed information on assigning features and services to trunks.

Loop start operation

Loop start operation is configured in software and is implemented in the card through software download messages. When the universal trunk card is idle, it provides a high impedance toward the CO for isolation and AC (ringing) detection.

Incoming calls

The alerting signal into the Meridian 1 is 20 Hz (nominal) ringing sent by the CO. When an incoming call is answered, ringing is tripped when the Meridian 1 places a low-resistance DC loop across the tip and ring leads toward the CO (see [Figures 13](#) and [14](#)).

Outgoing calls

For outgoing calls from the Meridian 1, software sends an outgoing seizure message to place a low-resistance loop across the tip and ring leads toward the CO (see [Figures 15](#) and [16](#)). When the CO detects the low-resistance loop, it prepares to receive digits. When the CO is ready to receive digits, it returns dial tone. Outward address signaling is then applied from the Meridian 1 in the form of loop (interrupting) dial pulses or DTMF tones.

Polarity-sensitive/-insensitive packs feature The Meridian 1 software provides the polarity-sensitive/-insensitive packs (PSP and PIP) feature for the accurate recording of outgoing call duration for loop start and ground start operation. On trunks equipped with far-end answer supervision, the PSP class of service is enabled in software and causes call-duration recording in CDR records to begin only upon receipt of answer supervision from the far end. For trunks not equipped with answer supervision, the PIP class of service is enabled and call-duration recording begins immediately upon near-end trunk seizure. The PSP and PIP classes of service are enabled in the Trunk Administration program (LD 14).

Figure 13
Loop start call states—incoming call from CO/FX/WATS

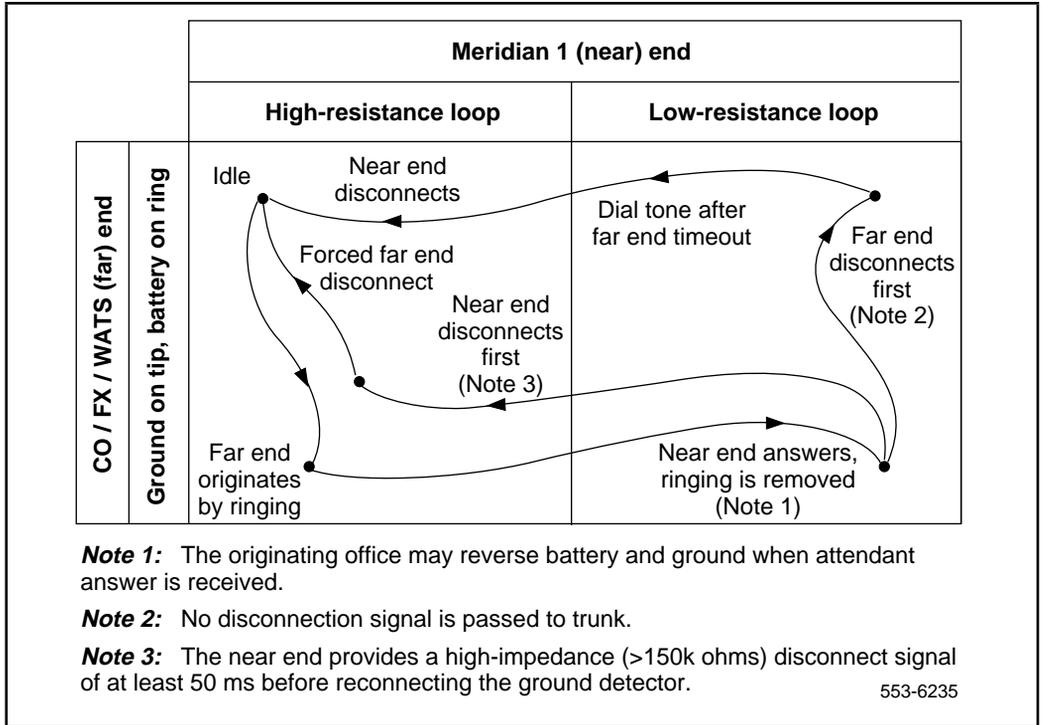


Figure 14
Loop start call connection sequence—incoming call from CO/FX/WATS

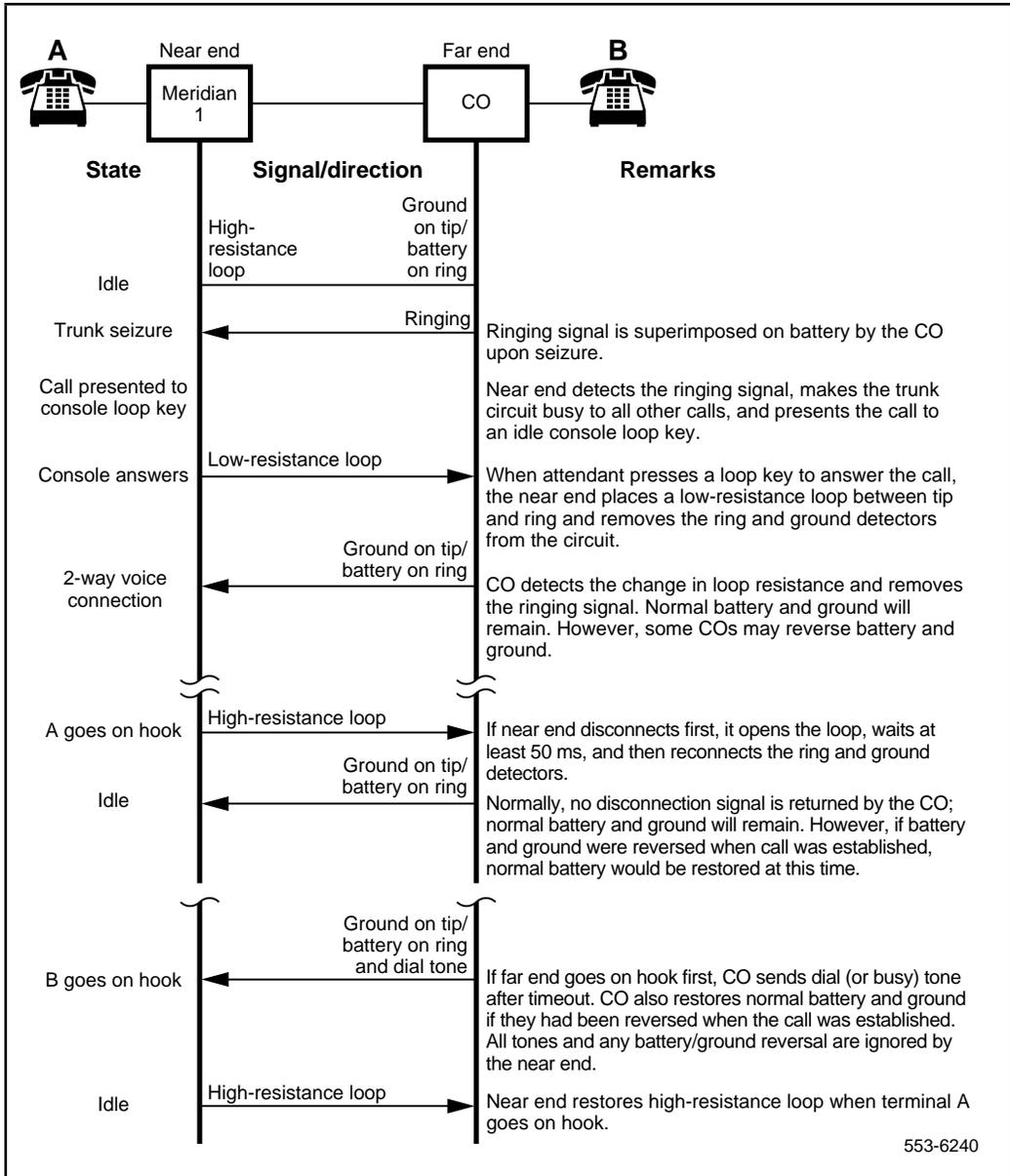


Figure 15
Loop start call states—outgoing call to CO/FX/WATS

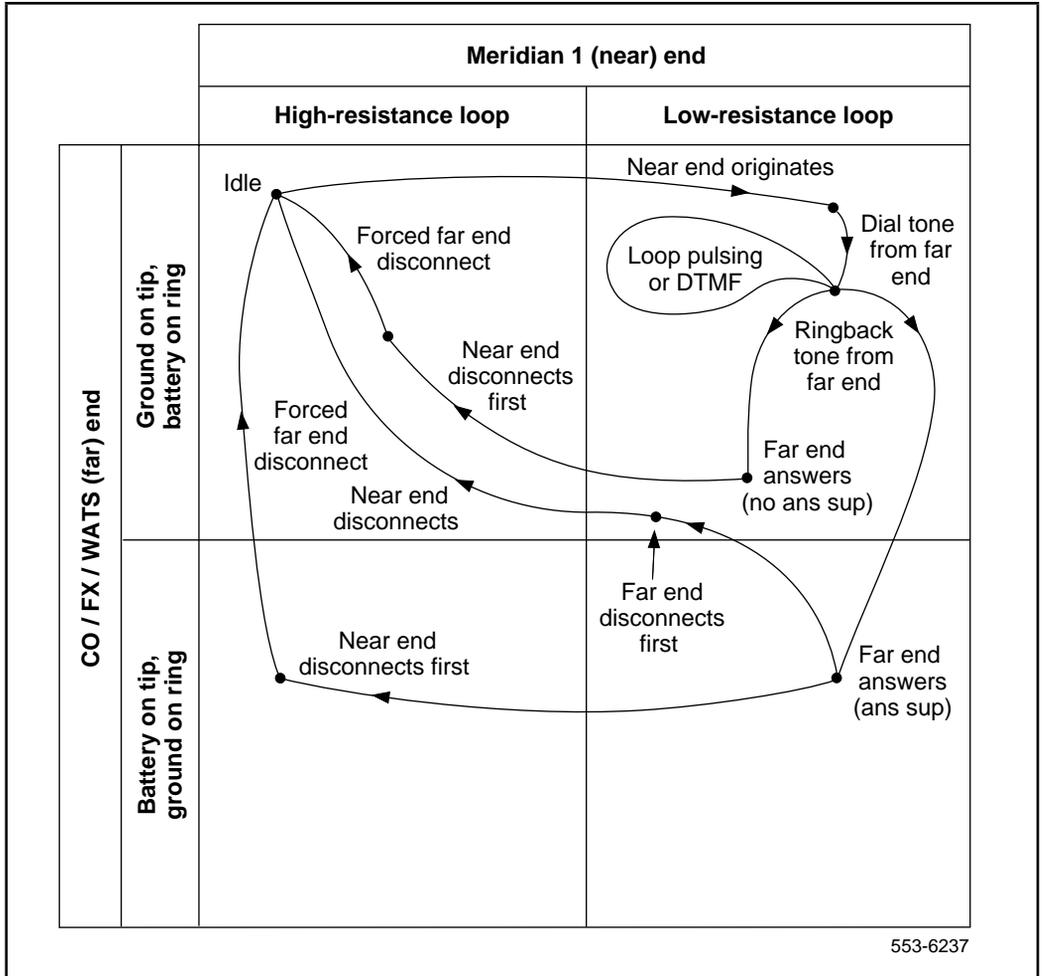
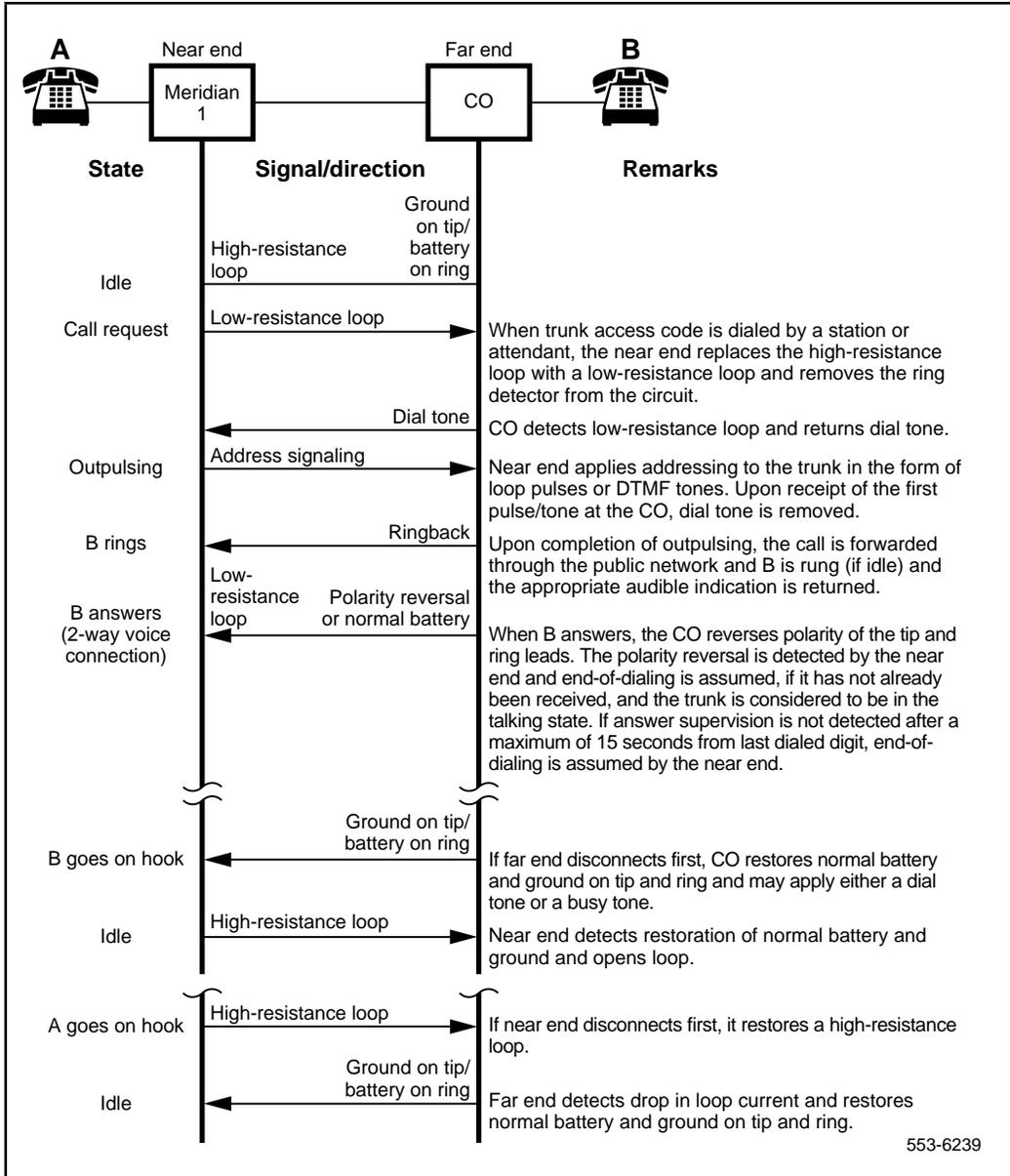


Figure 16
Loop start call connection sequence—outgoing call to CO/FX/WATS



Ground start operation

Ground start operation is configured in software and implemented through software download messages. In the idle state, the tip conductor from the CO is open and a high-resistance negative battery is present on the ring lead.

Incoming calls

In an incoming call, after ground is detected on the tip, the universal trunk card scans for a ringing detection signal before presenting the call to an attendant and tripping the ringing. When the attendant answers, a low resistance is placed across the tip and ring conductors, which trips CO ringing and establishes a speech path (see [Figures 17](#) and [18](#)).

Reverse-wiring compensation The Meridian 1 software includes a feature for detecting reverse wiring (connection of near-end tip and ring leads to far-end ring and tip leads, respectively) on ground start trunks with far-end answer supervision.

Ordinarily, an incoming call on a reverse-wired trunk without reverse-wiring compensation will present ringing on the tip lead rather than on the ring lead. Since software expects to see a ground on the tip lead, it will interpret the end of the first ringing signal as a switchhook flash. But since the interval between ringing signals exceeds the switchhook flash time of 512 milliseconds, software assumes far-end disconnect. This causes the call to be presented to a console loop key and then immediately removed.

The reverse-wiring compensation feature operates as follows. If an apparent disconnect takes place immediately after the first ringing signal, the software will time stamp the event and temporarily remove the call from the console loop key. If another such ringing/disconnect event occurs during the no ringing detector (NRD) time, the trunk will be considered “*possibly* reverse wired” and a threshold counter will be incremented. Calls on trunks identified as possibly reverse wired will be presented to the attendant during the initial ring, removed, and then continuously presented after the second ring. If a call on a possibly reverse-wired trunk is abandoned before the attendant answers, it will be disconnected after the NRD timer expires.

Figure 17
Ground start call states—incoming call from CO/FX/WATS

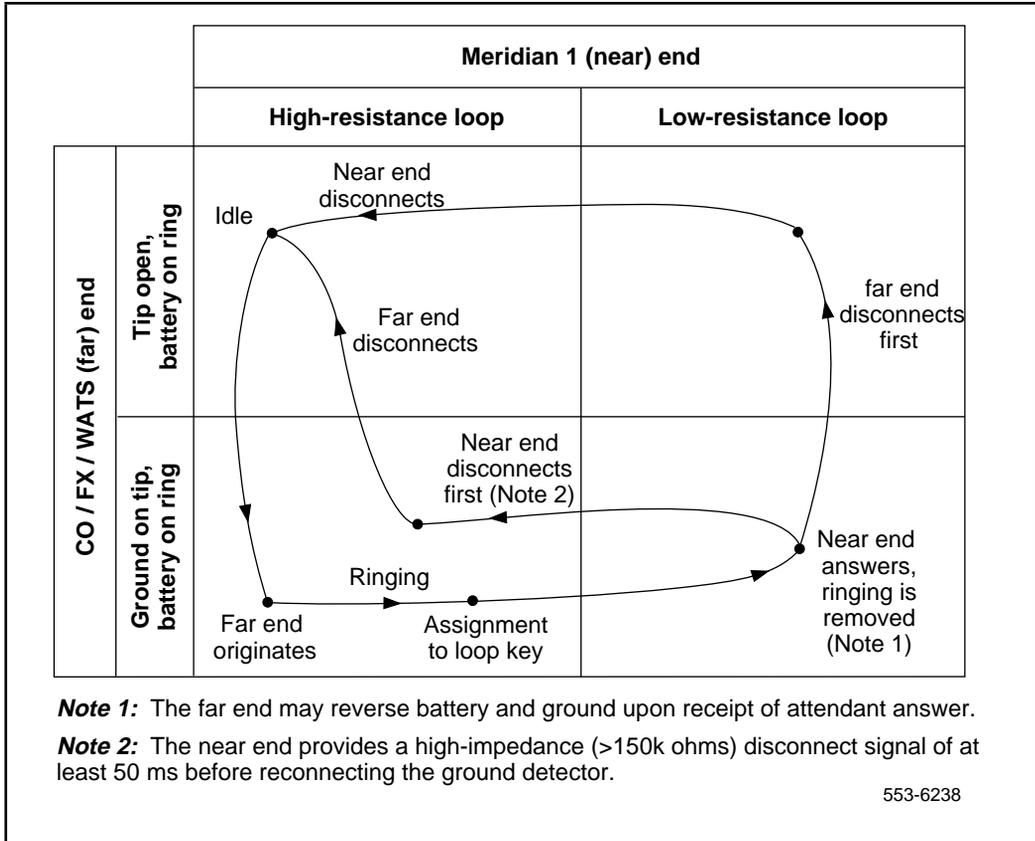
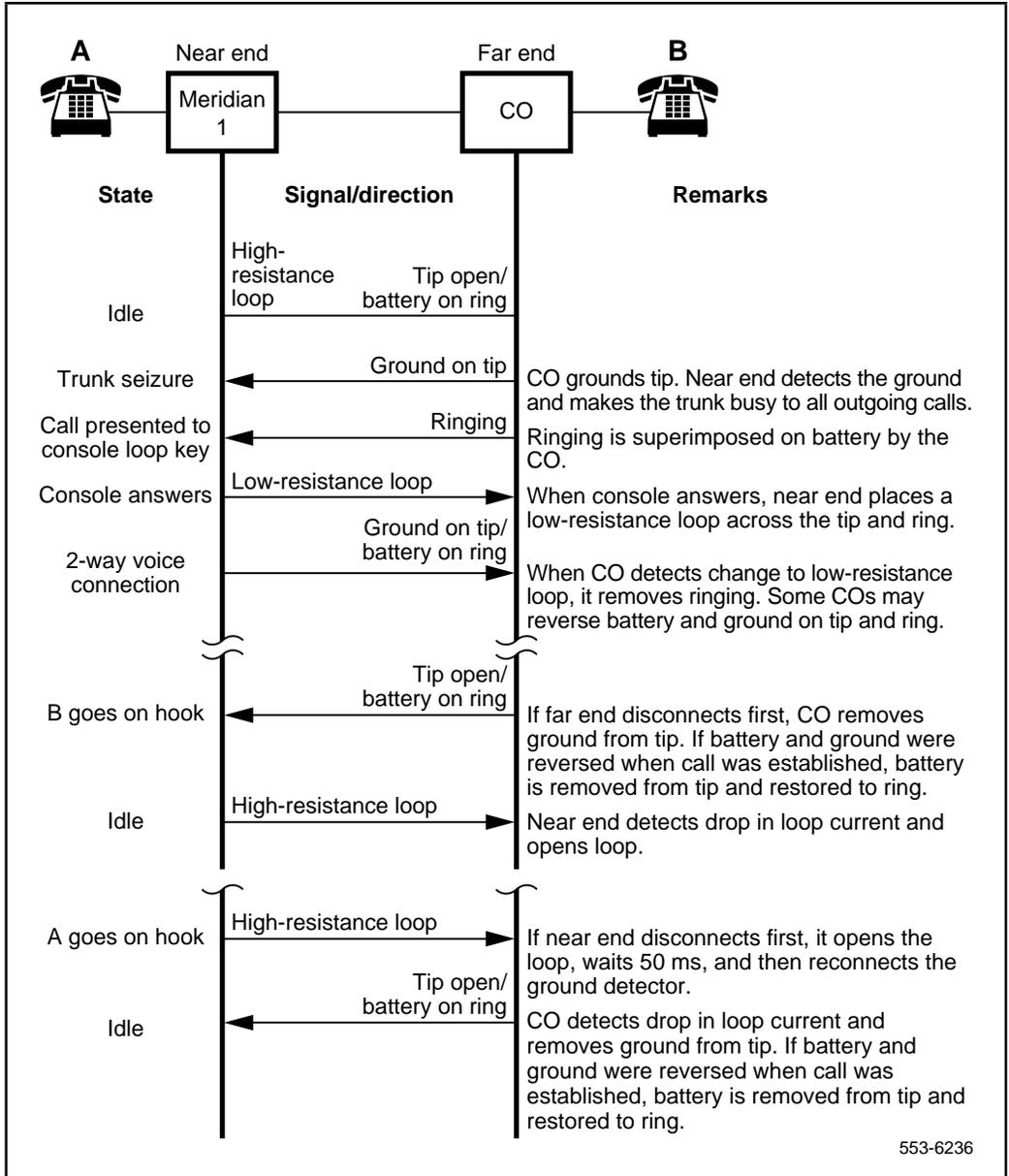


Figure 18
Ground start call connection sequence—incoming call from CO/FX/WATS



Trunks identified as possibly reverse wired will be switched by software to loop start processing after the second ring. This switching takes place on a call-by-call basis. Thus, if a previously correctly wired trunk becomes reverse wired, the next incoming call will be marked as possibly reverse wired and the threshold count will begin.

If the threshold count exceeds its limit, an error message is printed and the trunk is registered as “*positively* reverse wired.” Once identified as positively reverse wired, the call will be presented continuously from the first ring. When a reverse-wired trunk becomes correctly wired, the first subsequent call will clear the threshold counter and normal ground start processing will be implemented.

Outgoing calls

For outgoing calls, the trunk provides ground to the ring lead. The CO responds by grounding the tip and returning dial tone. After the tip ground is detected by the card, a low-resistance path is placed between the tip and ring leads and the ground is removed from the ring. Addressing is then applied from the Meridian 1 in the form of loop (interrupting) dial pulses or DTMF tones (see [Figures 19](#) and [20](#)).

The polarity-sensitive/-insensitive packs (PSP and PIP) feature must be set to provide for proper outgoing call-duration recording with ground start operation. Refer to the description of loop start operation in this section for a more complete discussion of PSP and PIP.

Figure 19
Ground start call states—outgoing call to CO/FX/WATS

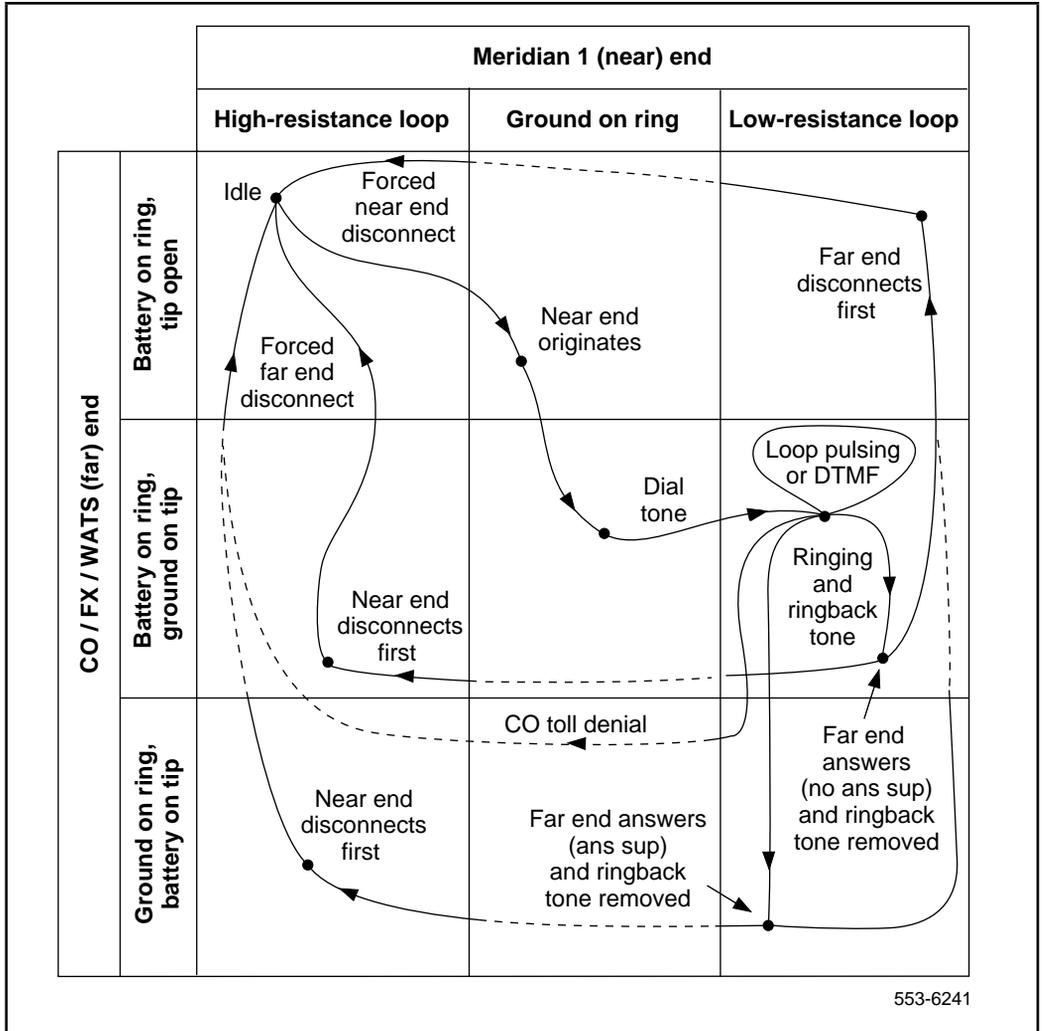
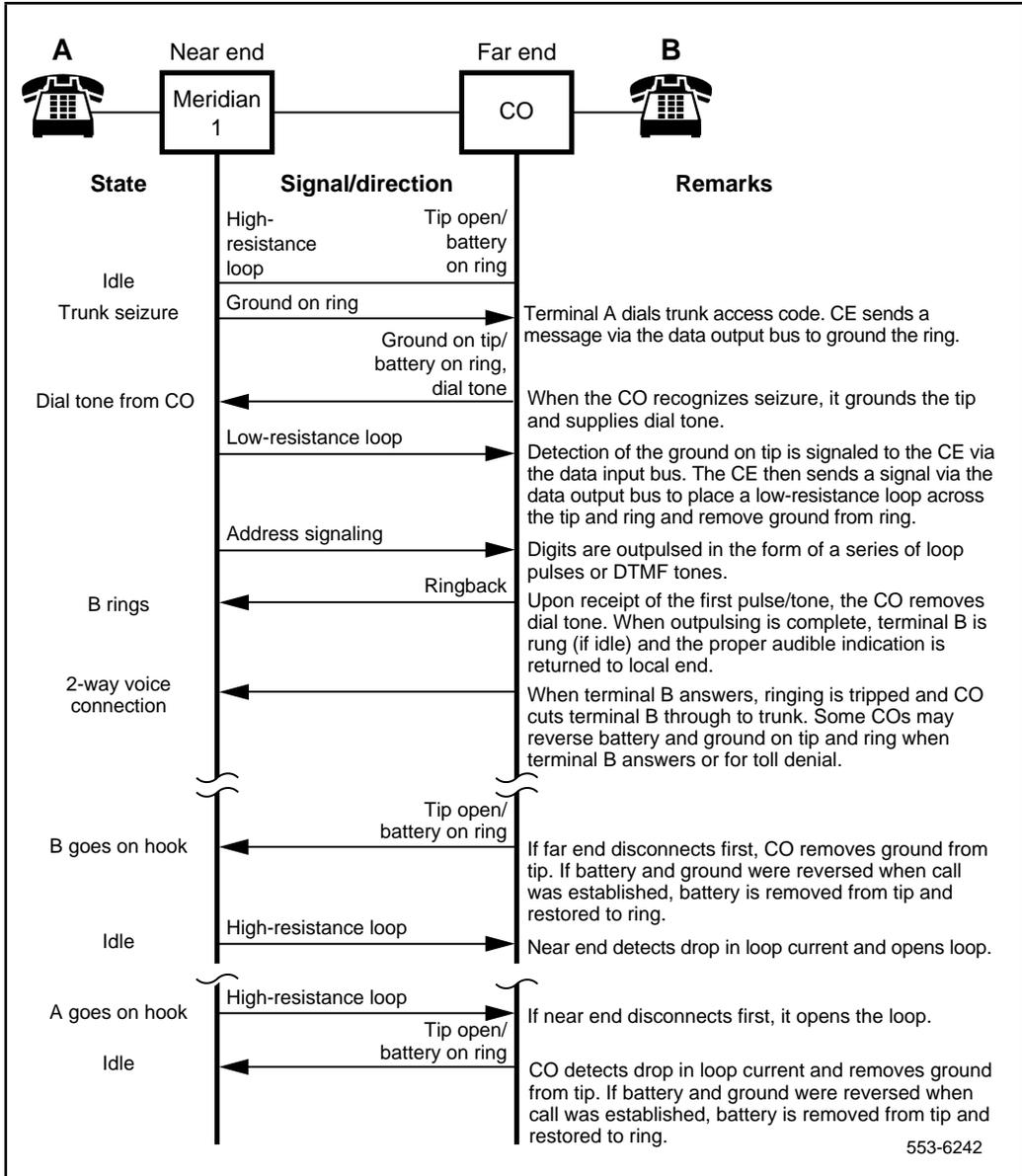


Figure 20
Ground start call connection sequence—outgoing call to CO/FX/WATS



Direct inward dial operation

Incoming calls

An incoming call from the CO places a low-resistance loop across the tip and ring leads (see [Figures 21](#) and [22](#)). Dial pulses or DTMF tones are then presented from the CO. When the called party answers, the universal trunk card reverses battery and ground on the tip and ring leads to the CO. The trunk is arranged for first party release. The CO releases the trunk by removing the low-resistance loop, at which time normal battery and ground are restored at the near end. The operation represented in [Figures 21](#) and [22](#) also applies to incoming tie trunk calls from a far-end PBX.

Two-way, loop dial repeating, tie trunk operation

Incoming calls

In an incoming call configuration, the far end initiates a call by placing a low-resistance loop across the tip and ring leads (see [Figures 23](#) and [24](#)). This causes a current to flow through the battery feed resistors in the trunk circuit. Address signaling is then applied by the far end in the form of DTMF tones or dial pulses. When the called party answers, an answer supervision signal is sent by software, causing the Meridian 1 to reverse battery and ground on tip and ring to the far end. Far-end disconnect is initiated by opening the loop while near-end disconnect is initiated by restoring normal battery and ground. The operation represented in [Figures 23](#) and [24](#) also applies to incoming DID trunk calls from a CO.

Outgoing calls

In an outgoing call configuration, the universal trunk card is connected to another PBX by a tie trunk (see [Figures 25](#) and [26](#)). An outgoing call from the near end seizes the trunk facility by placing a low-resistance loop across the tip and ring leads. Outward addressing is then applied from the Meridian 1 in the form of DTMF tones or dial pulses. If answer supervision is provided by the far end, reverse battery and ground on tip and ring is returned. The operation represented in [Figures 25](#) and [26](#) also applies to outgoing calls on a DID trunk.

Figure 21
 DID trunk, loop DR call states—incoming call from CO

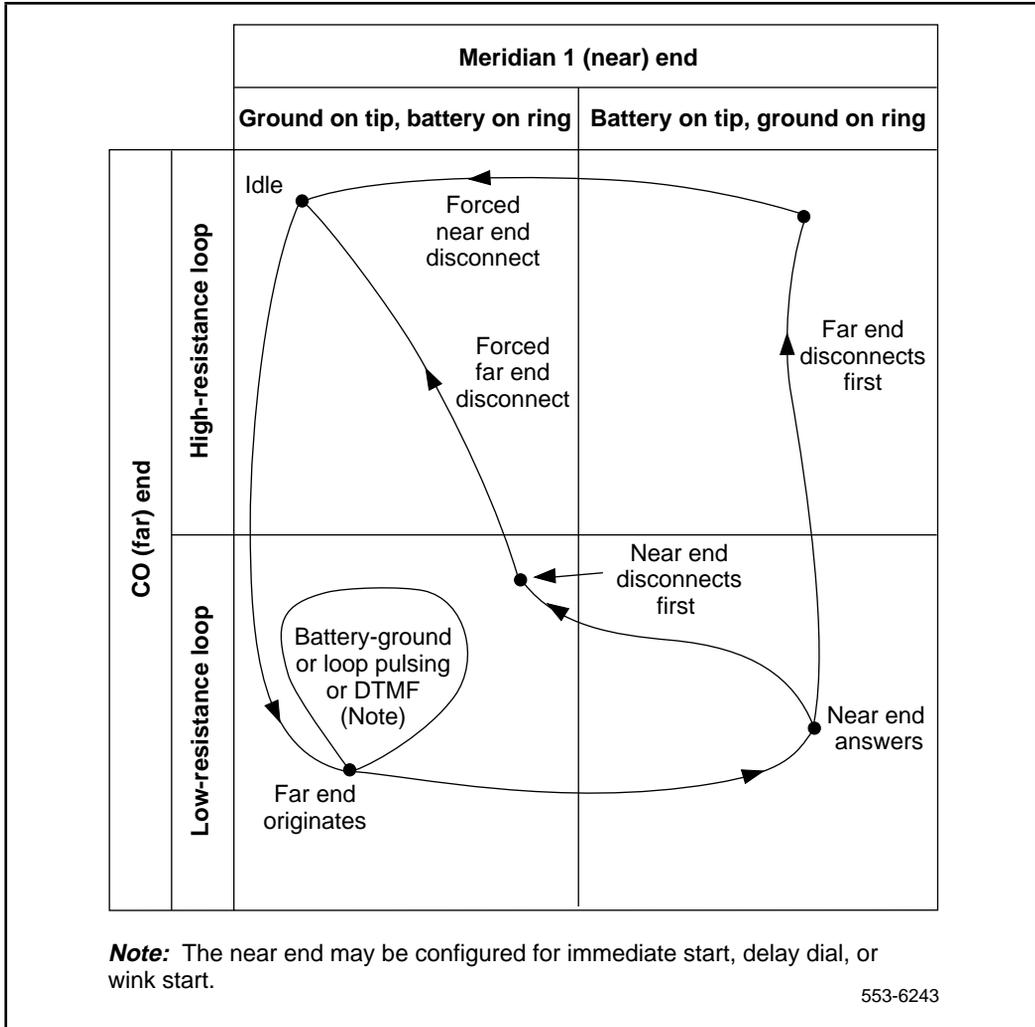


Figure 22
DID trunk, loop DR call connection sequence—incoming call from CO

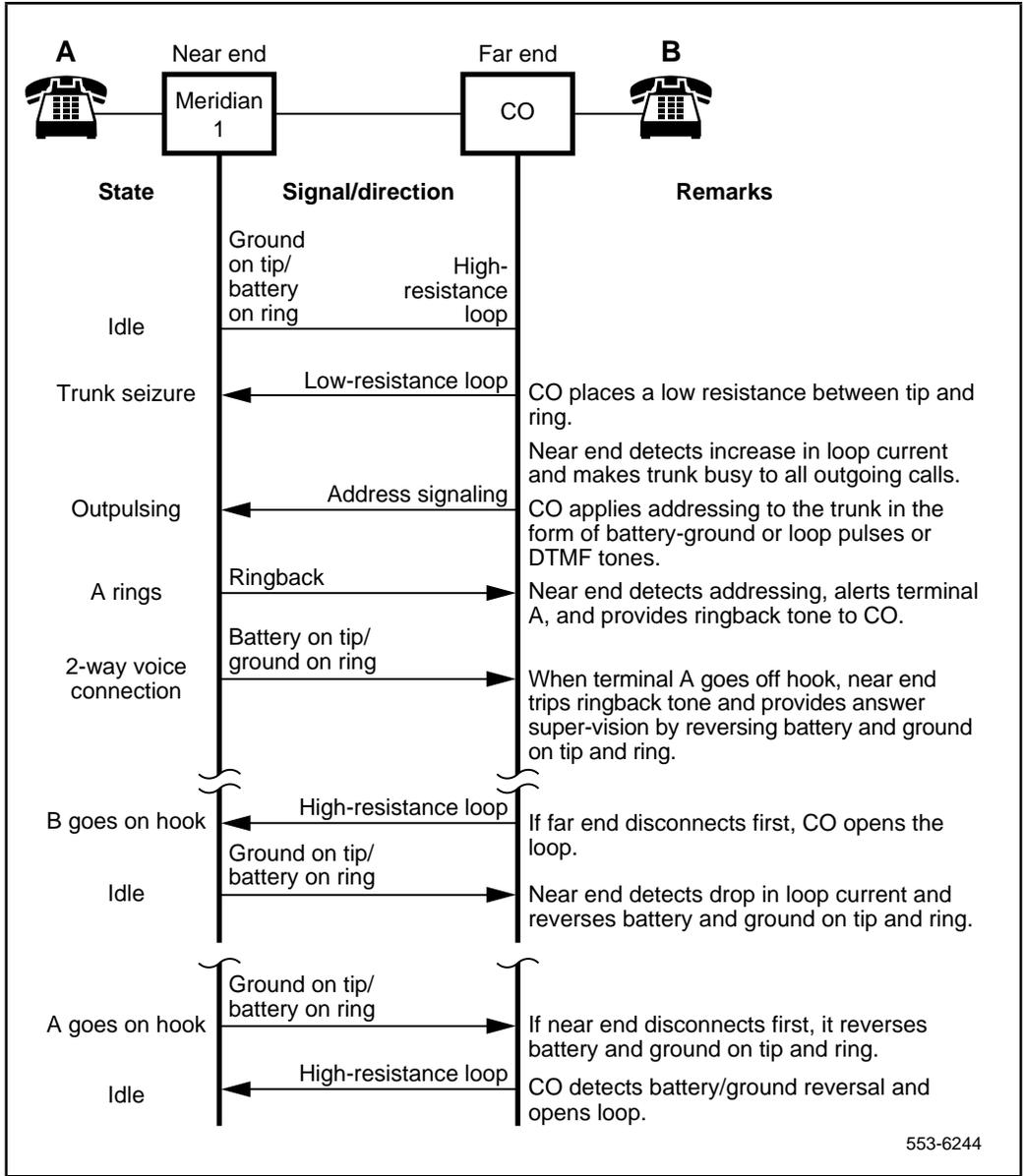


Figure 23
Two-way, loop DR, tie trunk call states—incoming call from far-end PBX

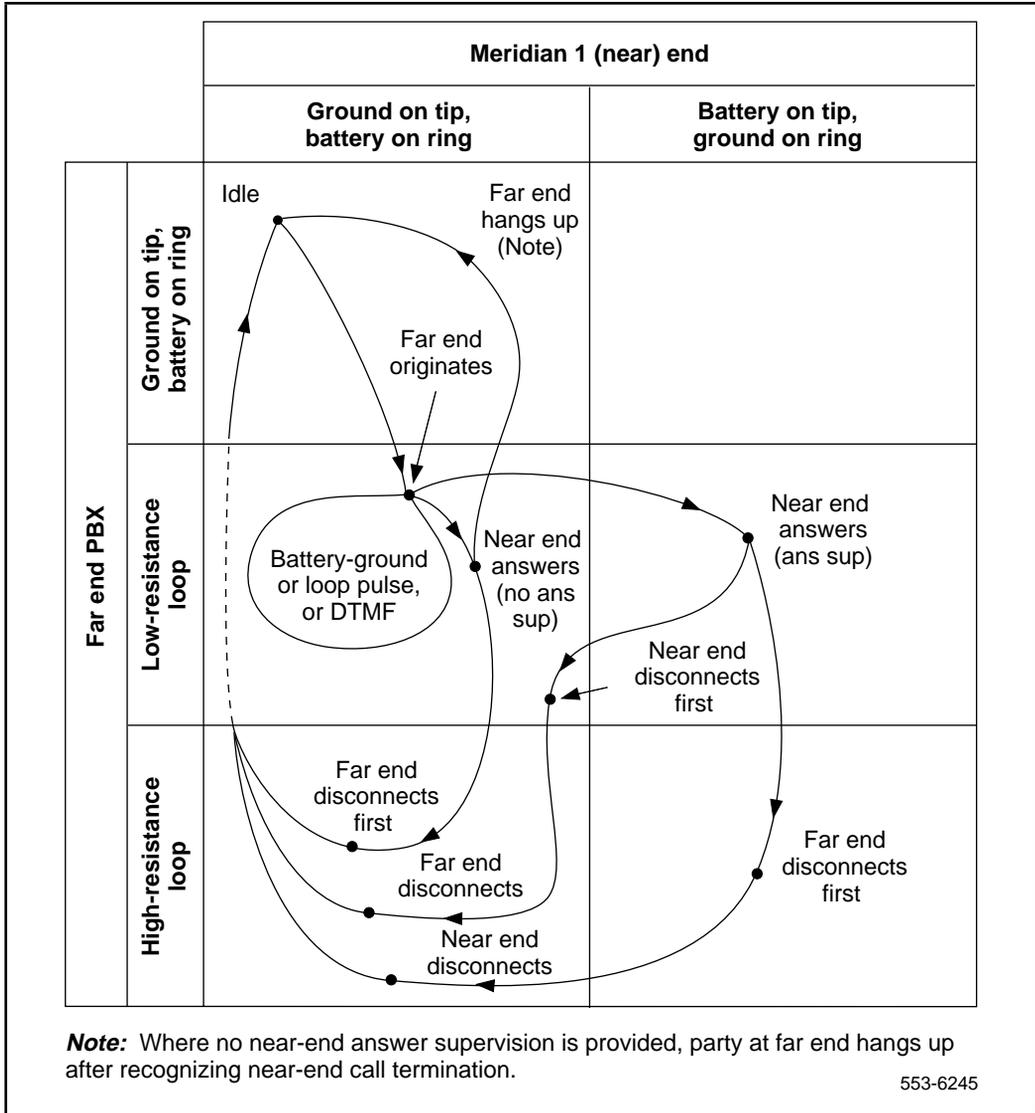


Figure 24
Two-way, loop DR, tie trunk call connection sequence—incoming call from far-end PBX

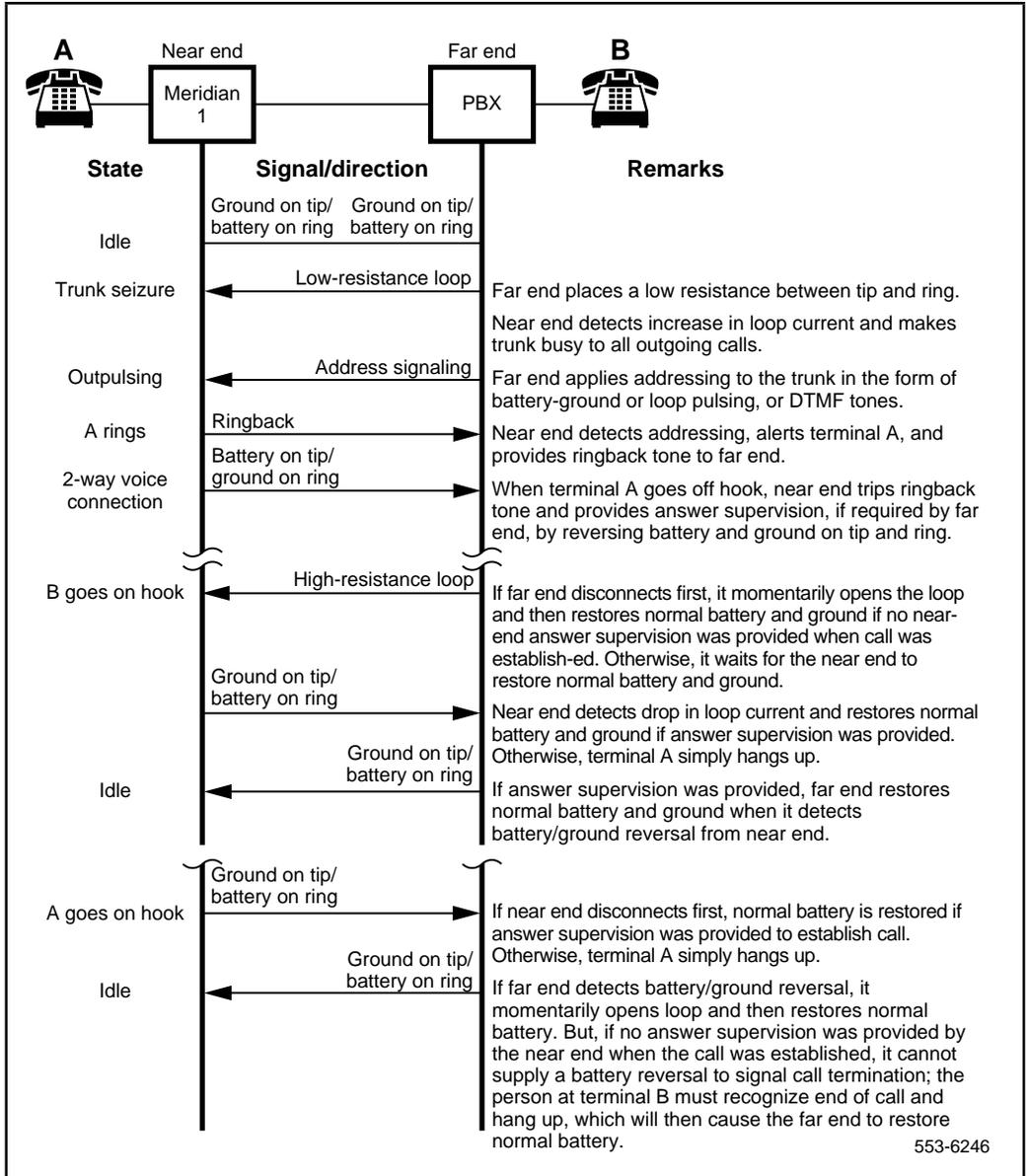


Figure 25
Two-way, loop DR, tie trunk call states—outgoing call to far-end PBX

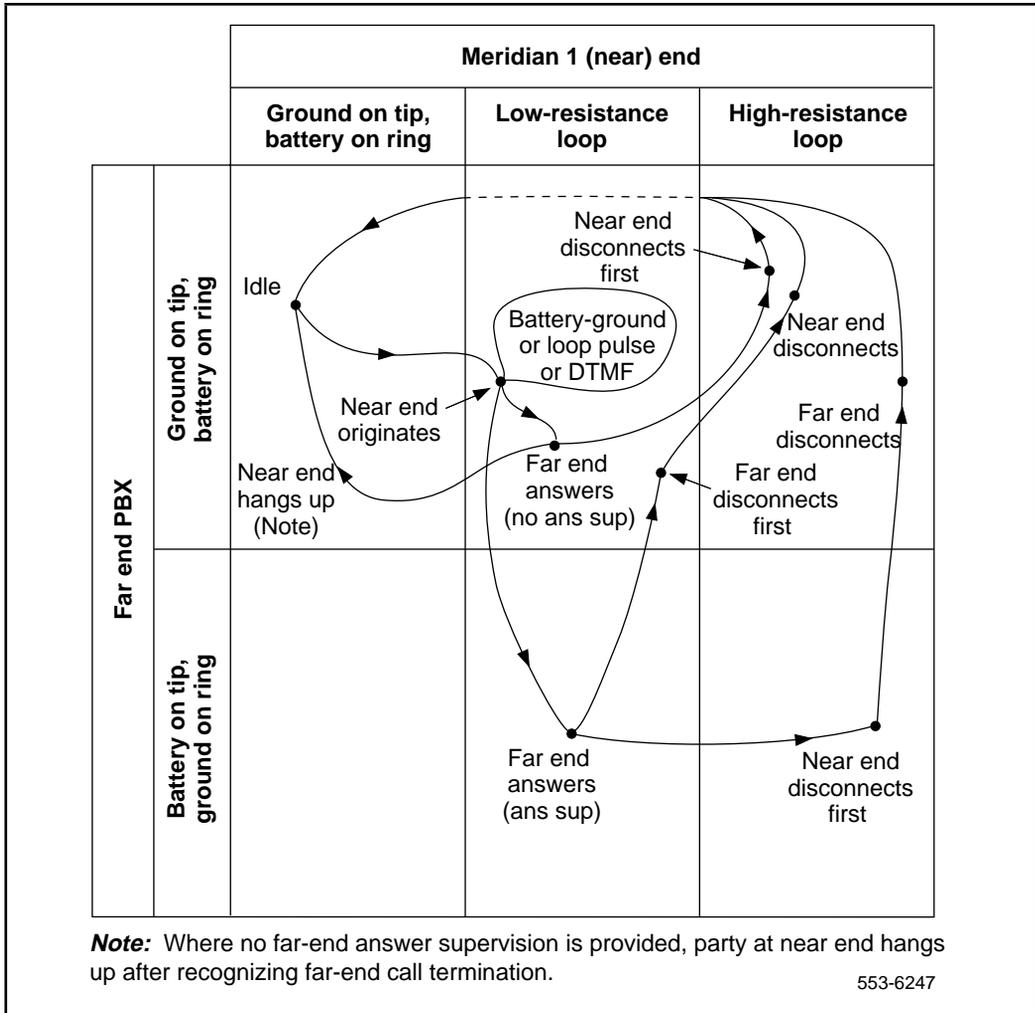
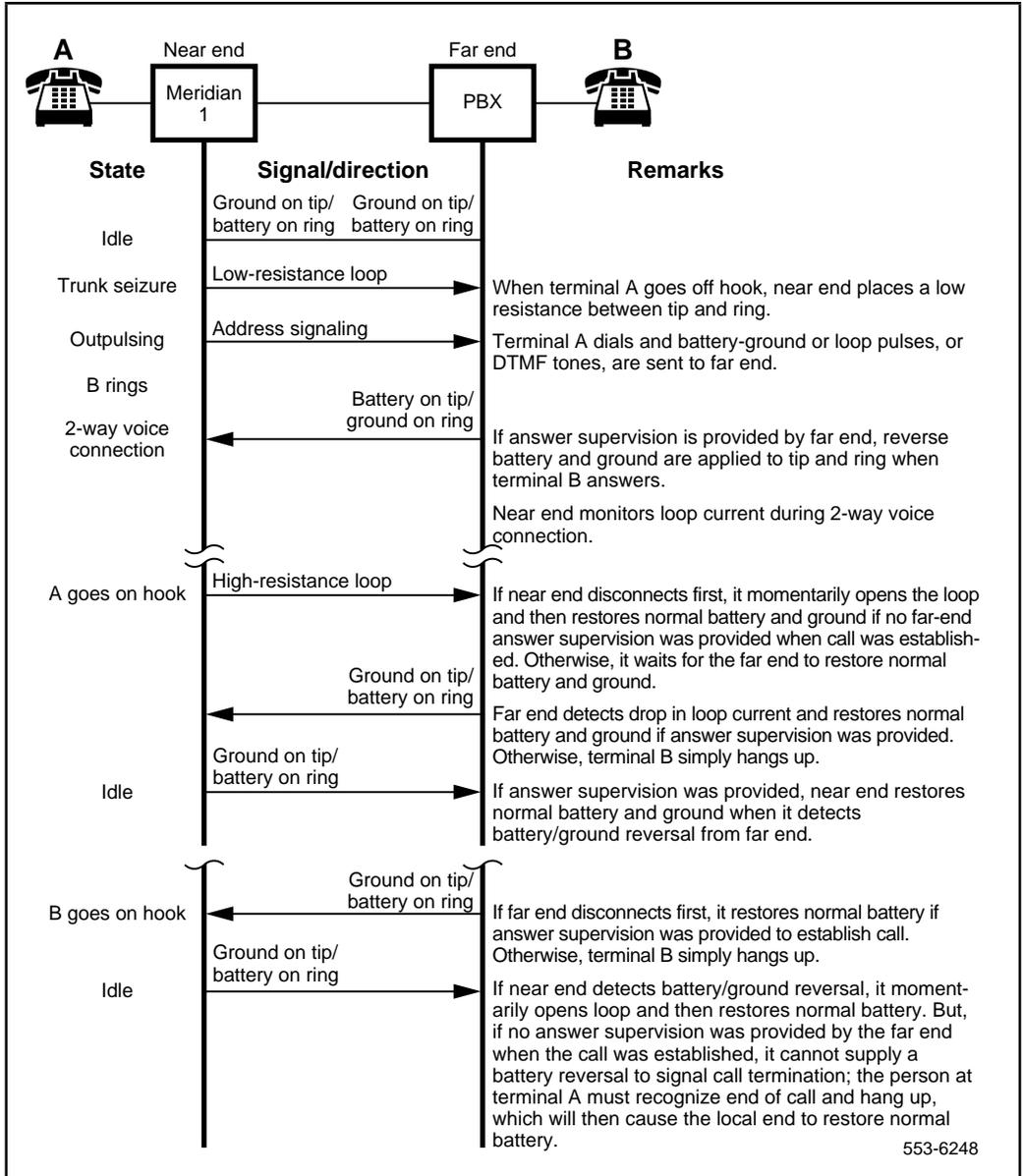


Figure 26
Two-way, loop DR, tie trunk call connection sequence—outgoing call to far-end PBX



Senderized operation for DID and two-way loop DR trunks

Incoming calls

If the far end is senderized, the near end can be operated in any mode: immediate start (IMM), delay dial (DDL) or wink (WNK) start, as assigned at the STRI prompt in the Trunk Administration program (LD 14) (see [Figure 27](#)).

For immediate start, following the seizure signal, the far end may start pulsing after the standard delay (normally 65 ms, minimum).

For delay dial or wink start modes, stop/go signaling (off hook/on hook or battery/ground reversal) is returned by the Meridian 1 after receipt of the seizure signal. The delay dial (stop) signal begins immediately upon seizure and ends (go signal) 384 ms later. The wink start (stop) signal begins 384 ms after seizure and ends (go signal) 256 ms later. The far end detecting the go signal may start pulsing after the standard delay (normally 55 ms, minimum). Stop/go signaling, in addition to the signaling function, serves as an integrity check to help identify a malfunctioning trunk.

If required, the near end can be configured to provide pseudo-answer supervision at expiration of the end-of-dial timer. End-of-dial timer settings are made at the EOD (non-DTMF) or ODT (DTMF) prompts in the Trunk Route Administration program (LD 16).

The operation represented in [Figure 27](#) also applies to incoming calls on a DID trunk from a CO.

Outgoing calls

When DDL or WNK mode is used, outgoing calls require a stop/go signal from the far end so that the near end cannot outpulse until the far end is ready to receive digits (see [Figure 28](#)).

Figure 27

Two-way, loop DR, tie trunk call states—incoming call through senderized, tandem PBX from a CO/FX/WATS trunk

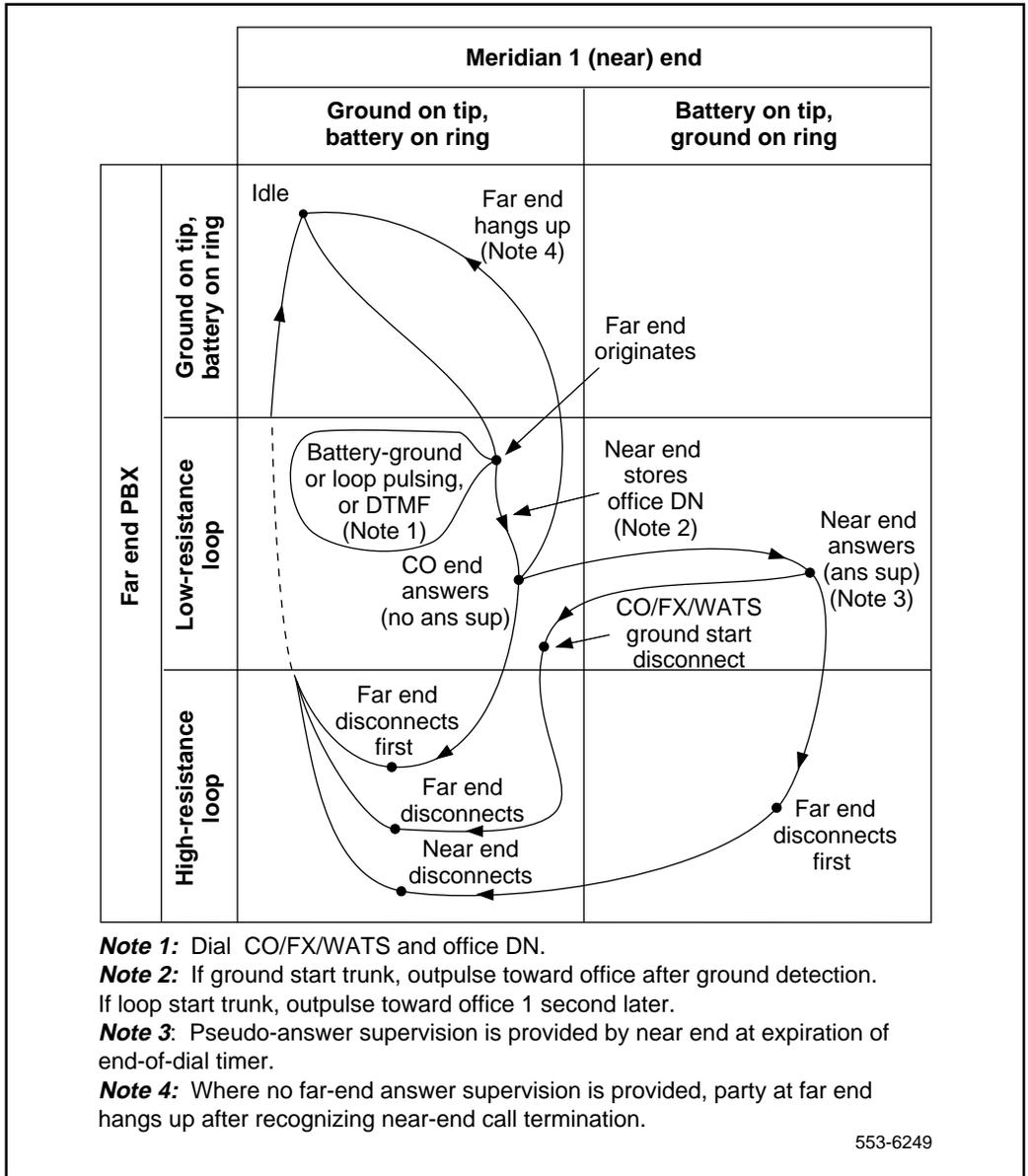
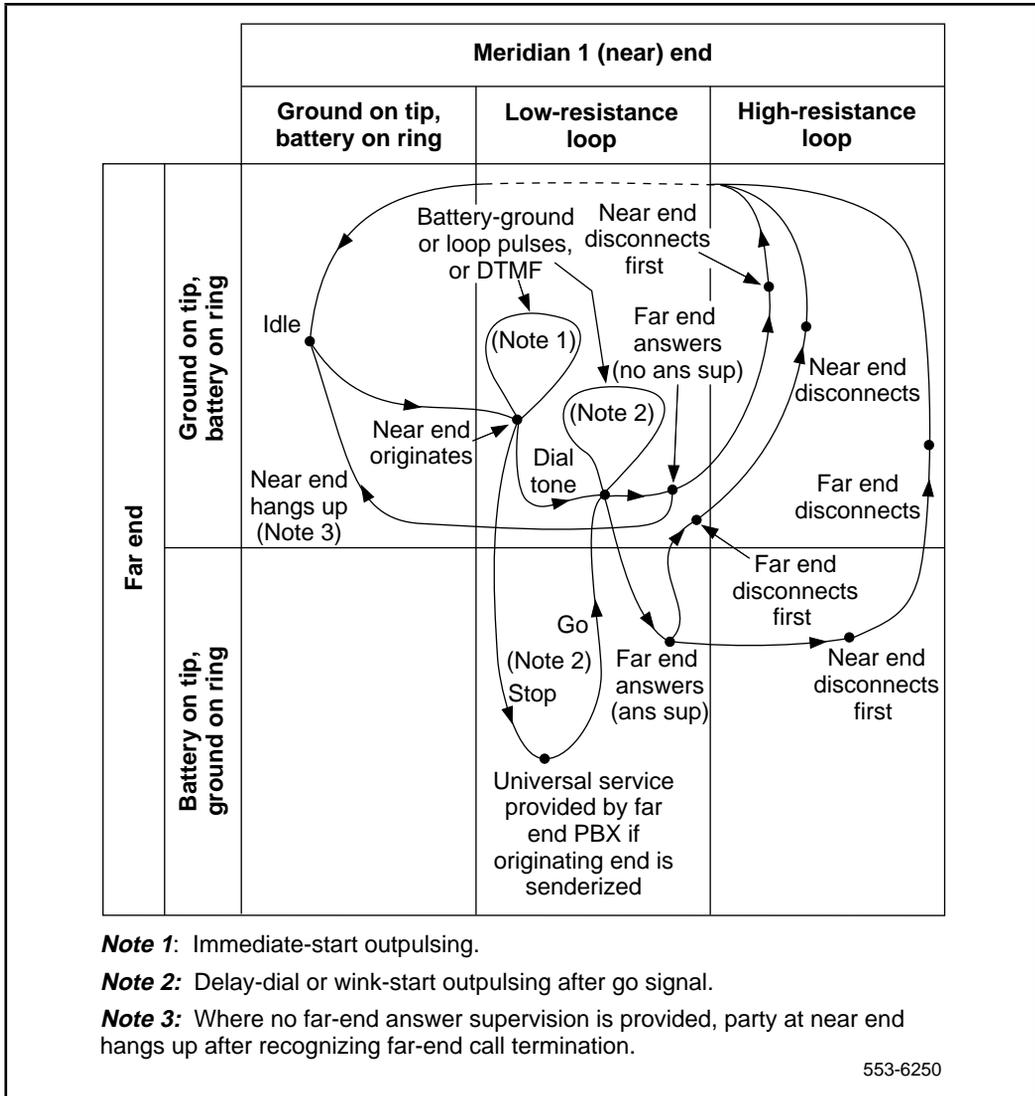


Figure 28
Two-way, loop DR, tie trunk call states—outgoing call through far-end PBX to CO/FX/WATS



Outgoing automatic, incoming dial operation

Incoming calls

When the universal trunk card is seized by the far end on an incoming call, a low-resistance loop is placed across the tip and ring leads. Addressing is then sent by the far end in the form of battery-ground or loop pulses, or DTMF tones. The trunk is released at the far end when the loop is opened. When the near end detects an open loop, it returns to a normal state. See [Figures 29](#) and [30](#).

Outgoing calls

When seized as a dial-selected outgoing trunk, the near end places battery on the tip and ground on the ring. This alerts the far end of the seizure. The far end responds with a low resistance across the tip and ring leads. See [Figures 31](#) and [32](#).

Figure 29
Two-way, loop OAID, tie trunk call states—incoming call from far-end PBX

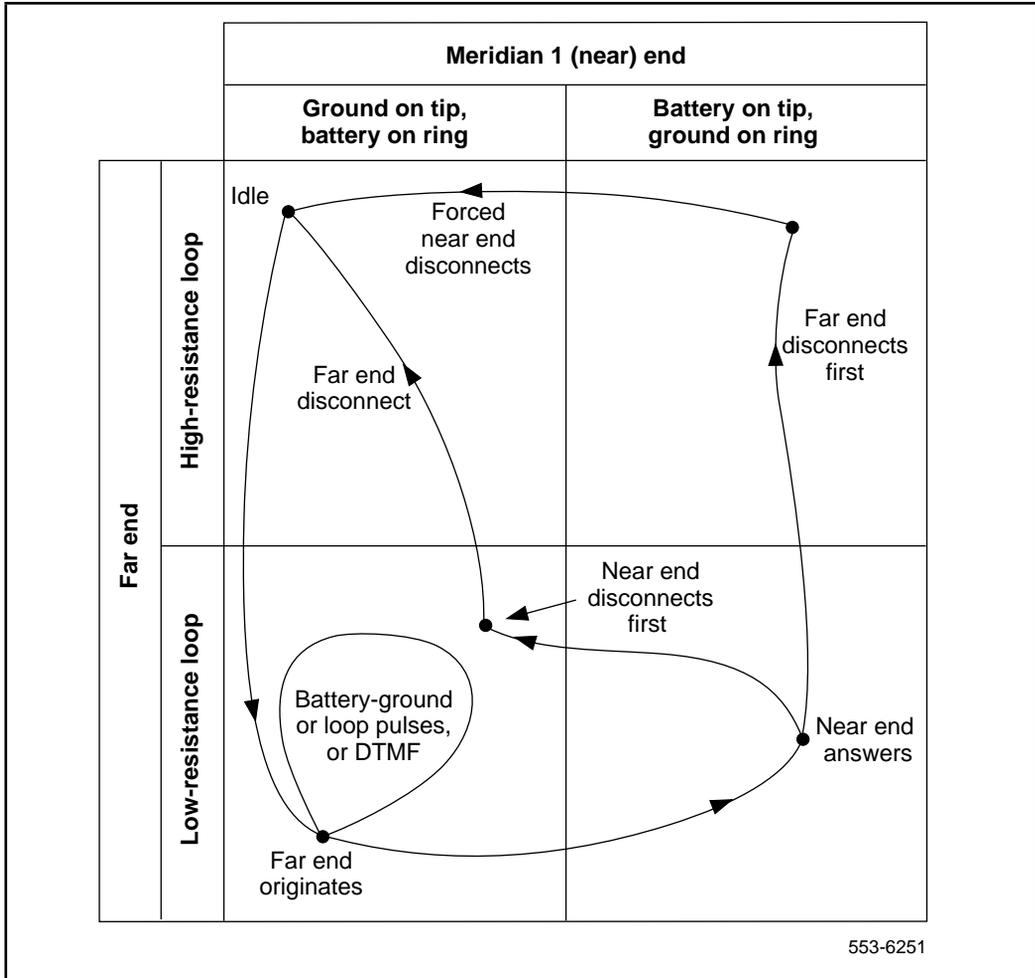


Figure 30
Two-way, loop OAID, tie trunk call connection sequence—incoming call from far-end PBX

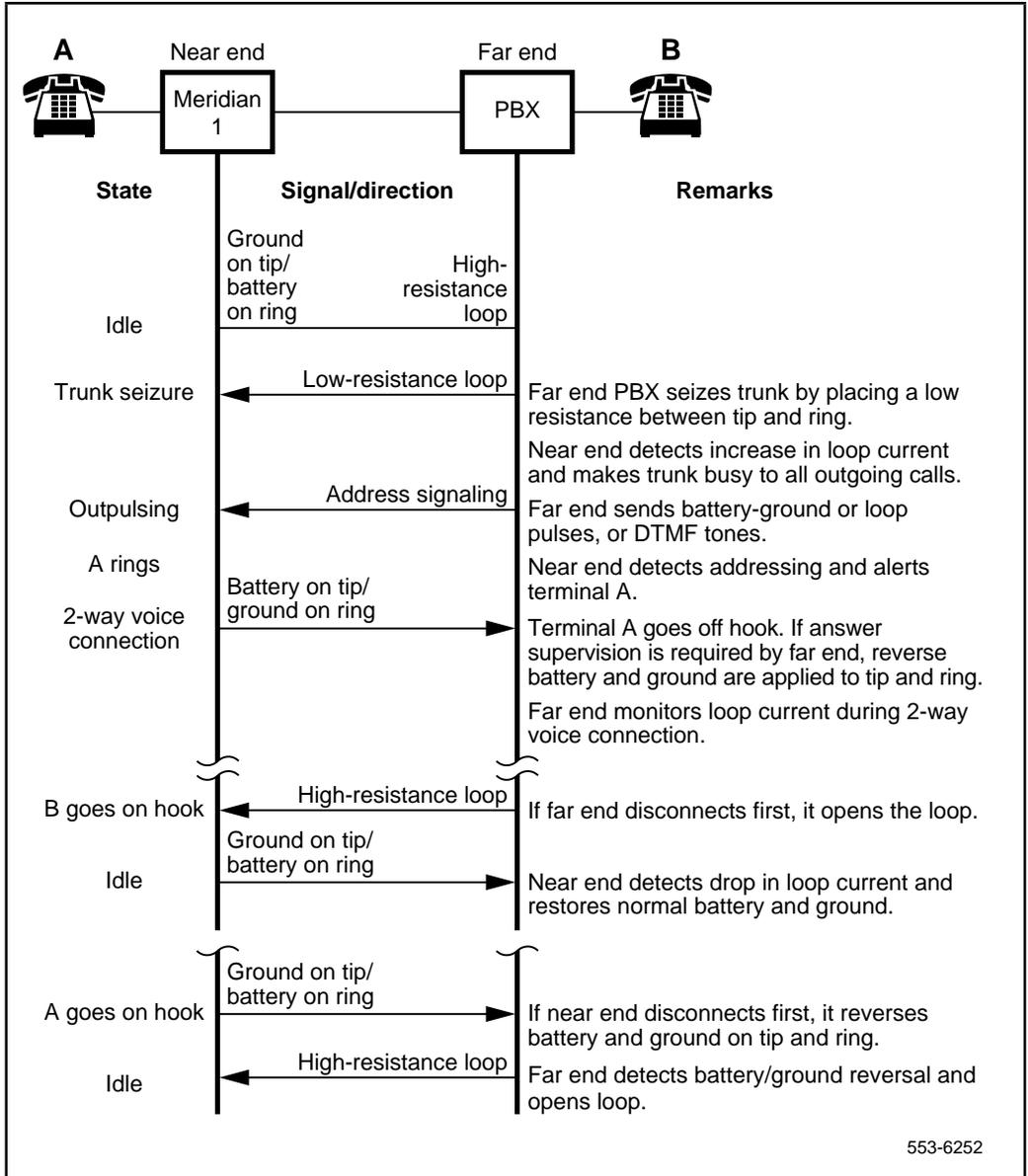


Figure 31
Two-way, loop OAID, tie trunk call states—outgoing call to far-end PBX

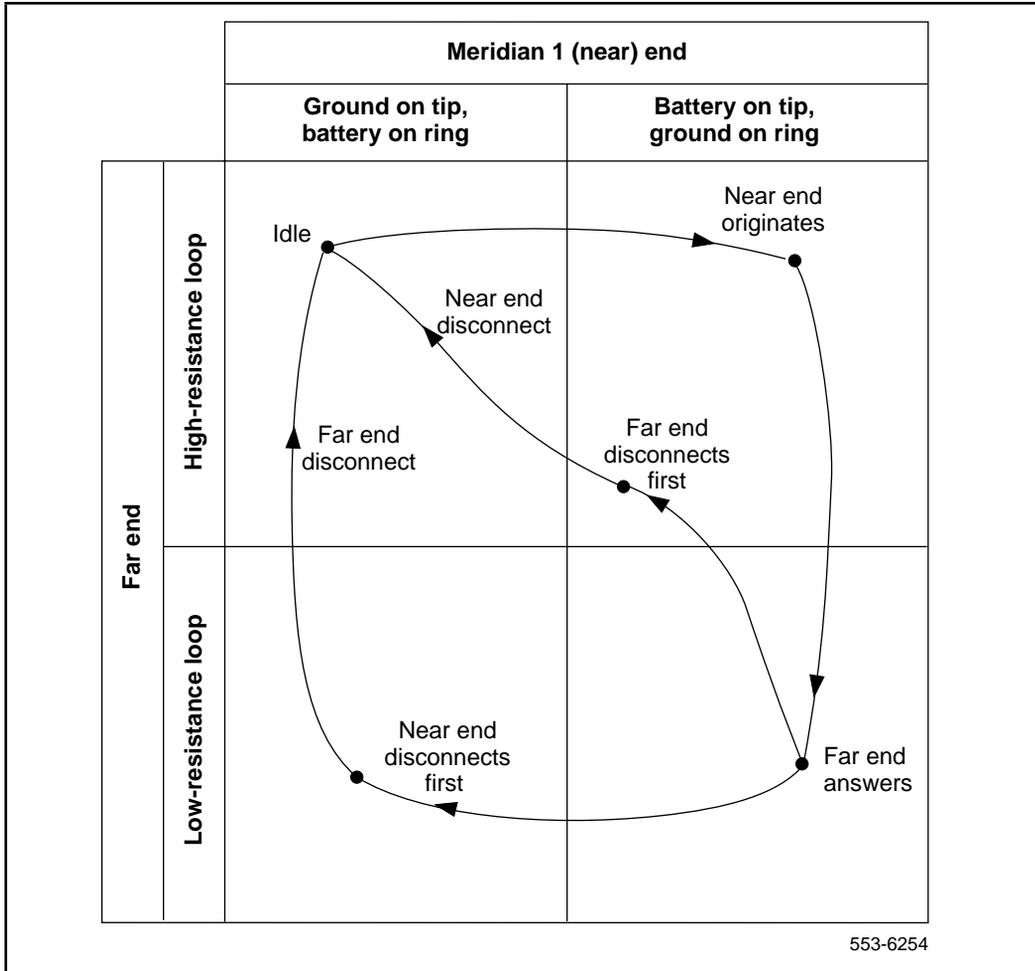
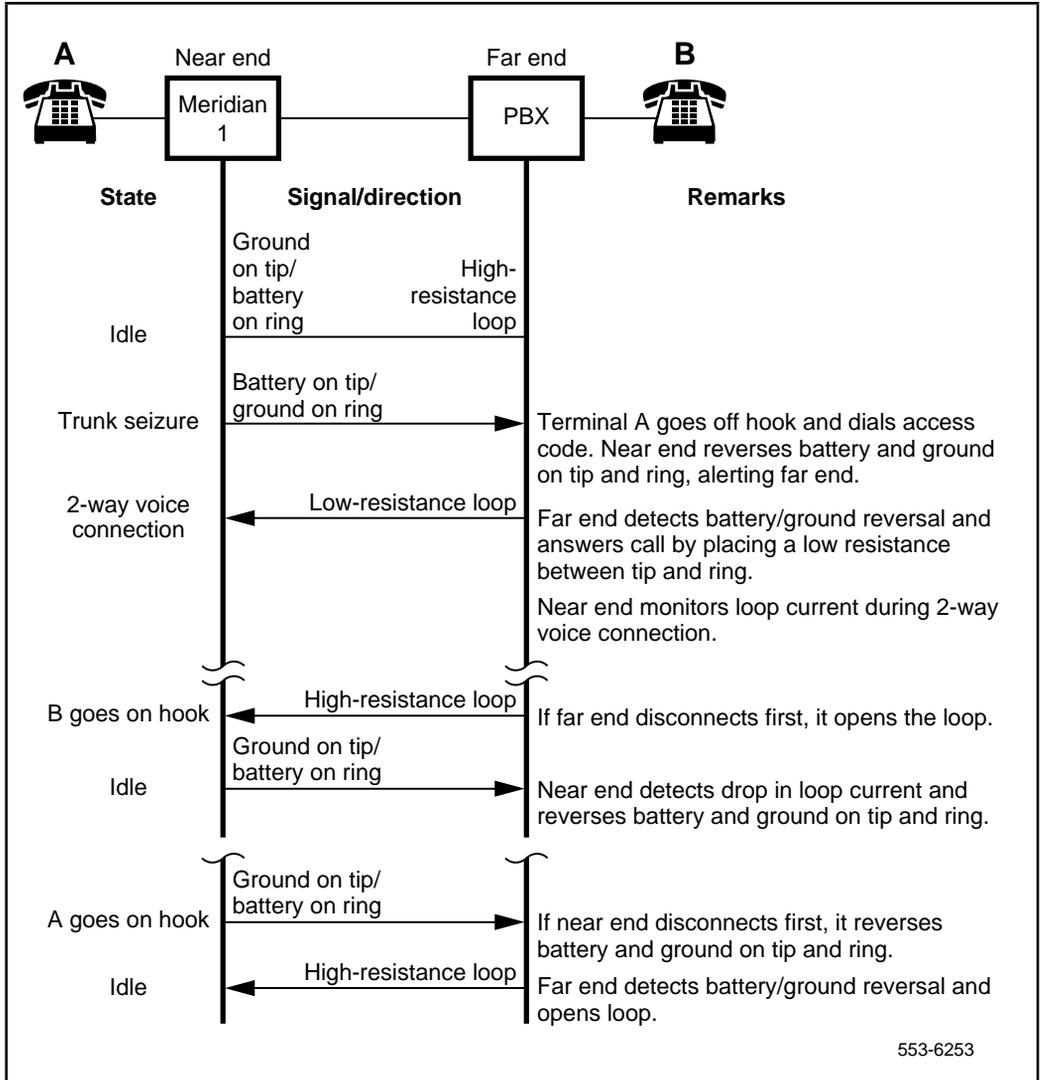


Figure 32
Two-way, loop OAID, tie trunk call connection sequence—outgoing call to far-end PBX



Recorded announcement trunk operation

Note: Refer to “Multi-Channel RAN modes” on page 65 for information on Multi-Channel RAN modes, which are not linked to a RAN machine or a given trunk.

When configured for recorded announcement (RAN) operation, a trunk unit is connected to a customer-provided-recorded announcement machine. Announcement machines must be compatible with Meridian 1 RAN trunks and should be set up according to the manufacturer’s instructions.

Each trunk unit provides the following for operation with RAN equipment:

- pulse start, level start, or continuous operation modes
- selectable termination of tip and ring leads into 600 or 900 ohms for interface with a low-impedance (2- or 4-ohm) source
- connection of up to 24 trunk units to a single announcement machine channel

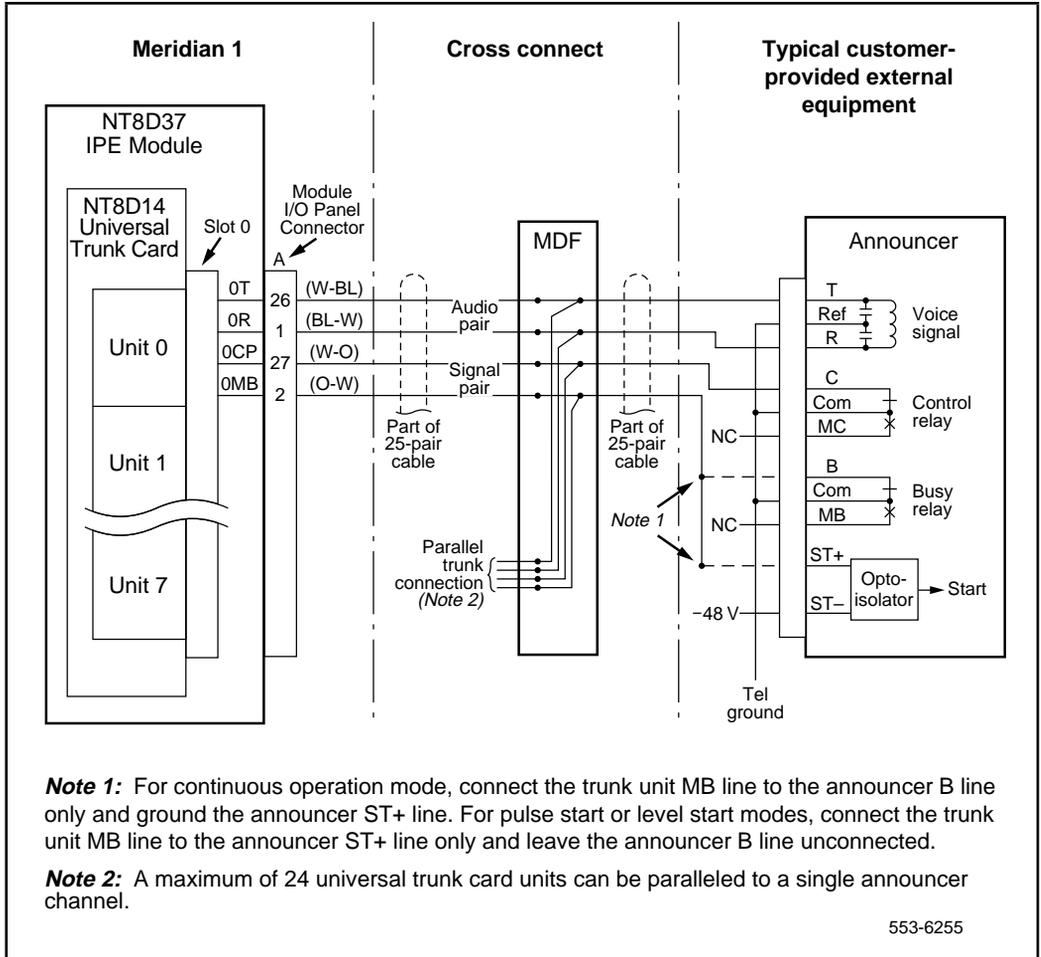
Recorded announcement machines

Recorded announcement machines store prerecorded voice messages that are played back to the trunk units to which they are connected. Most commercially available announcement machines store recordings digitally, although some drum and tape units are still in service.

An announcement machine may provide one or more channels and each channel may be prerecorded with a different message. Some announcement machines also provide a special information tone (SIT) capability. These tones are inserted at the beginning of intercept messages (such as “Your call cannot be completed as dialed. Please check the number and try again.”).

Figure 33 shows a typical connection from a single announcement machine channel to unit 0 on a universal trunk card installed in slot 0 in an NT8D37 IPE Module. See *Meridian 1 system installation procedures* (553-3001-210) for complete trunk wiring information.

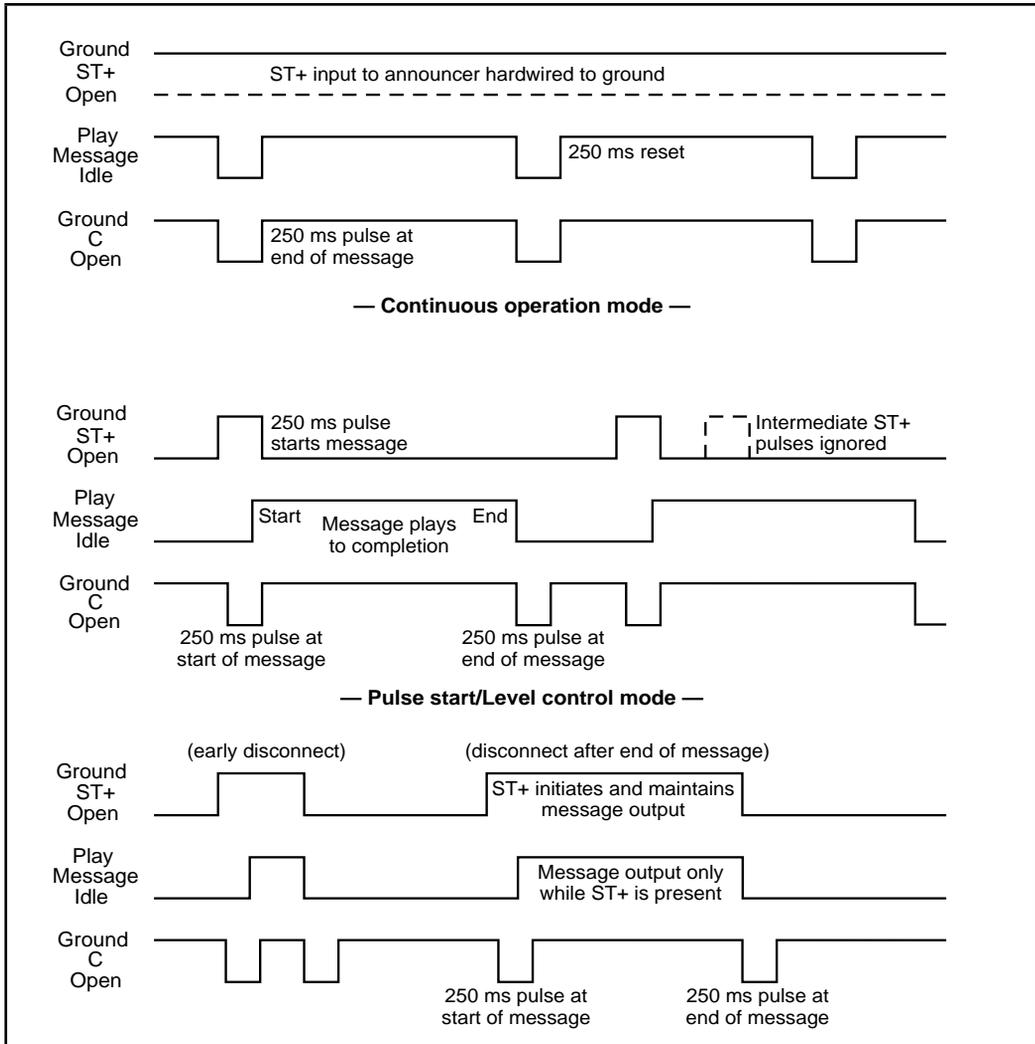
Figure 33
Connecting RAN equipment to the NT8D14 Universal Trunk Card (typical)



RAN modes of operation

Figure 34 shows the relationship of control signals to message playback for the operating modes available in announcement machines. The signal names shown in the figure are typical.

Figure 34
RAN control signals (Control GRD = IDLE)



Multi-Channel RAN modes

In Multi-Channel RAN, multiple RAN channels can be configured within one RAN trunk route. In a Multi-Channel RAN route, each trunk has its own dedicated RAN channel on a physical RAN machine. Multi-Channel RAN routes do not support the cross connecting (daisy chains) of multiple trunk ports together so that several callers hear the same RAN message.

The new multi-channel machine types - Continuous Mode Multi-Channel (MCON), Pulse Start/Stop Multi-Channel (MPUL) and Level Start/Stop Multi-Channel (MLVL) - are not linked to a RAN machine or a given trunk. All trunks belonging to the RAN route are considered independent. RAN trunks and RAN machine channels are connected one to one. Accordingly, if one RAN trunk is detected as faulty, then all other trunks are not impacted.

For these new RAN machine types, the maximum length of the recorded announcement is two hours. The meaning of a ground signal received from the RAN machine (play or idle) is configured in LD 16.

Multi-Channel Level Start/Control Mode (minimum vintage BA)

Introduced in X11 Release 21.41 and later software, a new RAN mode of operation is available called "Multi-Channel Level Start/Control Mode." This mode allows provisioning of multiple RAN channels for a RAN route (playing the same message independently on demand) cross-connected one-for-one to each RAN trunk in a multi-channel level start RAN route. RAN trunks should not be bridged in a multi-channel RAN route.

The Route Data Block overlay (LD 16) is used to configure a RAN route in Multi-Channel Level Start/Control mode, using the following response: (RTYP = MLSS).

Trunk members are provisioned in the Trunk Data Block (LD 14).

Refer to "Programming RAN trunks" on page 67 and to the *X11 input/output guide* for complete instructions on service change programs.

Continuous operation mode In the continuous operation mode (sometimes called the *Audichron* mode), a message is constantly played, over and over again. Callers “bargue in” on a playing message or are provided with a ringing tone until the message begins its next playing. The start line (ST+) is hardwired to always be active (see [Figure 34](#)). At the end of each message, a pulse is issued on the “C” line that is used by the trunk unit to cut through to the waiting call.

Note: The “B” (busy) signal line shown in [Figure 33](#) (not represented in [Figure 34](#)) is used to indicate availability of an announcement machine message to the trunk unit when configured for the continuous operation mode. This signal is made active (ground) by the announcement machine if the channel contains a recorded message and is in an online condition. The “B” line is not connected to a trunk unit when configured for start mode operation.

Start modes (minimum vintage BA) In a start mode (sometimes called the *Code-a-Phone* or *start-stop* mode), playback of a message does not begin until a start pulse is received by the announcement machine. Two subcategories of the start mode exist: pulse start and level start.

In the pulse start mode, a start pulse activates playback of a message that continues until completion (see [Figure 34](#)). The announcement machine ignores all other start pulses that might occur until the message is complete.

In the level start mode, the start signal is a “level” rather than a pulse. The leading edge of the start signal initiates message playback that continues until either the trailing edge of the start signal occurs or the end of the message is reached. A message that is terminated by the trailing edge of a level start signal is immediately reset and again made available for playback.

Call routing to RAN trunks

Software programs in the Meridian 1 control recorded announcement machines. These programs detect the calls to be intercepted, determine the type of intercept treatment required (overflow, attendant, announcement, etc.), queue the intercept, and provide ringback tone to the calling party. At the proper time, an intercepted call is connected to the appropriate RAN trunk.

Programming RAN trunks

The type of intercept and the RAN trunk parameters are defined in the Trunk Administration (LD 14), Customer Data Block (LD 15), and Trunk Route Administration (LD 16) programs.

The Trunk Administration and Route Administration programs specify the RAN trunk, the type of announcement machine, the number of repetitions of announcements before a forced disconnect (all calls) or an attendant intercept is initiated (CCSA/DID calls only), and the point at which the trunk may be connected to the announcement.

The Customer Data Block program defines the type of intercept and the trunk route to which the intercept is to be connected.

Refer to the *X11 input/output guide* for complete instructions on service change programs.

Electrical specifications

[Table 4](#) gives the electrical characteristics of the universal trunk card.

Table 4
Universal trunk card—trunk interface electrical characteristics

Characteristic	CO/FX/WATS trunks	DID or tie trunks	RAN trunks	Paging trunks
Terminal impedance	600 or 900 ohms (Note 1)		600/900 ohms (Note 1)	600 ohms
Balance impedance	600 or 900 ohms (Note 1), 3COM, or 3CM2 (Note 2)		N/A	N/A
Supervision type	Ground or loop start (Note 3)	Loop start (with ans sup) (Note 3)	Continuous, level, or pulse	N/A
DC signaling loop length (max)	1700-ohm loop with near-end battery of -42.75 V	2450-ohm loop with near-end battery of -44 V	600/900-ohm loop	600 ohm loop
Far-end battery	-42 to -52.5 V (Note 4)	-42 to -52.5 V	-42 to -52 V	N/A
Minimum detected loop current	20 mA	10 mA	10 mA	N/A
Ground potential difference	±3 V		±1 V	±1 V
Low DC loop resistance during outpulsing	<300 ohms	N/A	N/A	N/A
High DC loop resistance	Ground start ≥ 30k ohms; loop start ≥ 5M ohms	N/A	N/A	N/A
Ring detection	17 to 33 Hz 40 to 120 V rms	N/A	N/A	N/A
Line leakage	≥ 30k ohms, tip-to-ring, tip-to-ground, ring-to-ground		N/A	N/A
AC induction rejection	10 V rms, tip-to-ring, tip-to-ground, ring-to-ground		N/A	N/A

Note 1: Selected in software.

Note 2: Selected by jumper strap settings on card. Refer to [Tables 8, 9, and 10](#) for details.

Note 3: Loop start answer supervision introduced with vintage BA cards and release 19 software.

Note 4: For loop extender application, the maximum voltage applied between tip and ring is -105 V ±5%. The minimum DC loop resistance for this type of application is 1800 ohms.

Power requirements

Power to the universal trunk card is provided by the module power supply (AC or DC). [Table 5](#) lists the power requirements for the universal trunk card.

Table 5
Power requirements

Voltage	Tolerance	Current (max.)
+15.0 V dc	±5%	306 mA
-15.0 V dc	±5%	306 mA
+5.0 V dc	±5%	750 mA
+8.5 V dc	±2%	450 mA
-48.0 V dc	±5%	415 mA

Foreign and surge voltage protection

The universal trunk card meets UL-1489 and CS03 over-voltage (power cross) specifications and FCC Part 68 requirements.

Environmental specifications

[Table 6](#) lists the environmental specifications for the universal trunk card.

Table 6
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40° to +70° C (-40° to +158° F)

Connector pin assignments

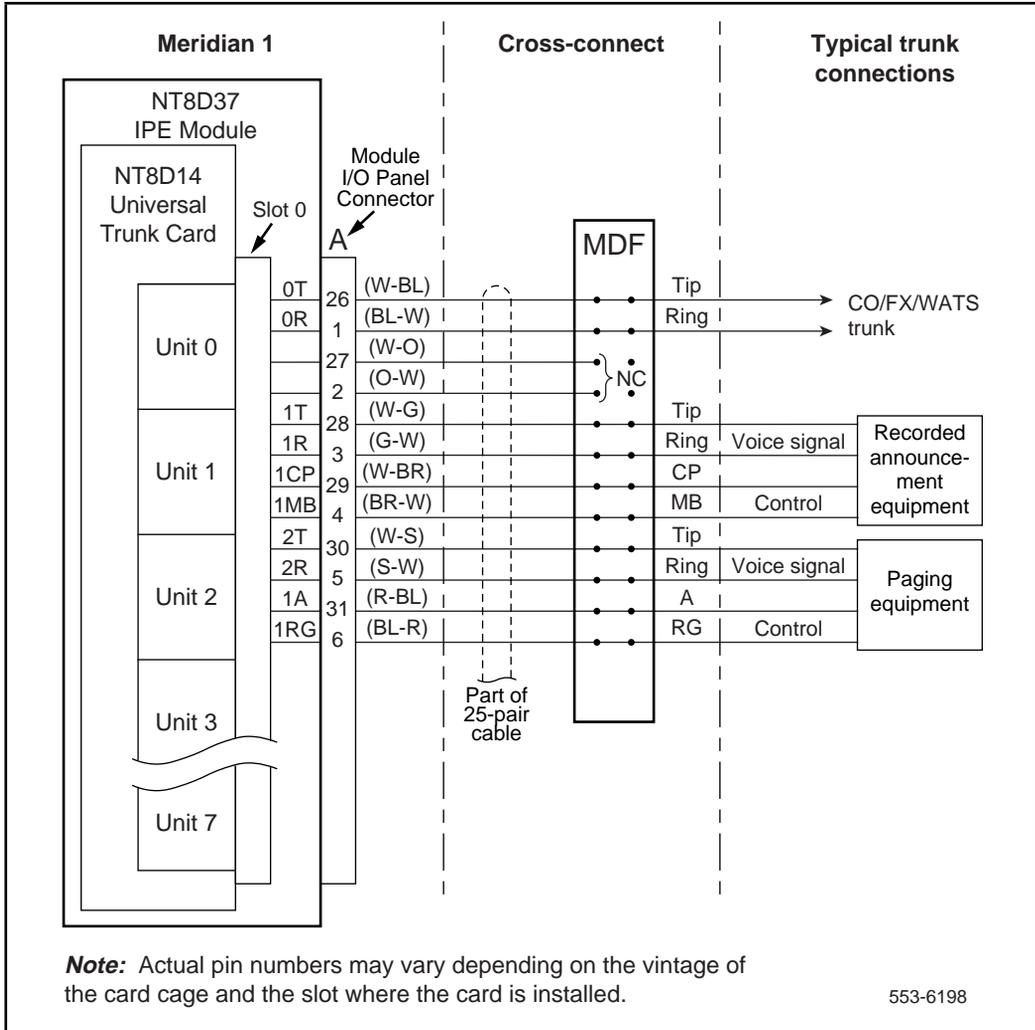
The universal trunk card brings the eight analog trunks to the IPE backplane through a 160-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the universal trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 35](#), and a list of the connections to the universal trunk card is shown in [Table 7](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Table 7
Universal trunk card—backplane pinouts

Trunk Number	Back-plane Pin	Signal			Back-plane Pin	RAN mode	Signal		
		RAN mode	Paging mode	Other modes			Paging mode	Other modes	
0	12A	Tip	Tip	Tip	12B	Ring	Ring	Ring	
	13A	CP	A	N/A	13B	MB	RG	N/A	
1	14A	Tip	Tip	Tip	14B	Ring	Ring	Ring	
	15A	CP	A	N/A	15B	MB	RG	N/A	
2	16A	Tip	Tip	Tip	16B	Ring	Ring	Ring	
	17A	CP	A	N/A	17B	MB	RG	N/A	
3	18A	Tip	Tip	Tip	18B	Ring	Ring	Ring	
	19A	CP	A	N/A	19B	MB	RG	N/A	
4	62A	Tip	Tip	Tip	62B	Ring	Ring	Ring	
	63A	CP	A	N/A	63B	MB	RG	N/A	
5	64A	Tip	Tip	Tip	64B	Ring	Ring	Ring	
	65A	CP	A	N/A	65B	MB	RG	N/A	
6	66A	Tip	Tip	Tip	66B	Ring	Ring	Ring	
	67A	CP	A	N/A	67B	MB	RG	N/A	
7	68A	Tip	Tip	Tip	68B	Ring	Ring	Ring	
	69A	CP	A	N/A	69B	MB	RG	N/A	

Figure 35
Universal trunk card—typical cross connect example



Configuration

The trunk type for each unit on the card as well as its terminating impedance and balance network configuration is selected by software service change entries at the system terminal and by jumper strap settings on the card.

NT8D14BB (Rel 10 and higher) has a reduced jumper strap setting on the card. There are only three jumpers, J1.X, J2.X, and J3.X per channel. [Tables 8, 9, and 10](#) show the functionality of these 3 jumpers.

Jumper strap settings

For most applications, the jumper strap settings remain set to the standard configuration as shipped from the factory (see [Table 8](#)).

For CO/FX/WATS or tie trunk loops exceeding 1524 meters (5000 ft.), DID trunks exceeding a loop resistance of 600 ohms, or RAN trunks operating in pulse start or level start modes, the jumper strap settings must be changed as shown in [Table 9](#). [Figure 37](#) shows jumper locations on the universal trunk card (vintage BA).

Note: Refer to *Circuit card installation and testing* (553-3001-211) for vintage AA jumper strap settings.

Service change entries

The trunk type, terminating impedance, and balance network are selected by making service change entries in the Trunk Administration program (LD 14). Refer to [Table 10](#) to select the proper values for the trunk type and loop length being employed. Refer to the *Meridian 1 X11 input/output guide* for LD 14 service change instructions.

Before the appropriate balance network can be selected, the loop length between the near end (Meridian 1) and the far end (a central office, for example) must be known. To assist in determining loop length, some typical resistance and loss values for the most common cable lengths are given in [Table 11](#) for comparison with values obtained from actual measurements.

Table 8
Jumper strap settings—factory standard (NT8D14BA, NT8D14BB)

Trunk types	Loop length	Jumper strap settings (Note 1)			
		J1.X	J2.X	J3.X	J4.X (Note 2)
CO/FX/WATS	0–1524 m (5000 ft.)	Off	Off	1–2	1–2
2-way tie (LDR)					
2-way tie (OAID)					
DID	0–600 ohms	Off	Off	1–2	1–2
RAN: continuous operation mode	Not applicable: RAN and paging trunks should not leave the building.	Off	Off	1–2	1–2
Paging					

Note 1: Jumper strap settings J1.X, J2.X, J3.X, and J4.X apply to all eight units; “X” indicates the unit number, 0–7. “Off” indicates that no jumper strap is installed on a jumper block. Store unused straps on the universal trunk card by installing them on a single jumper pin as shown below.

Note 2: For the NT8D14BB (Release 10 and higher) card, J4.X is not provided on the card. The J4.X jumper setting specified in [Table 8](#) does not apply.

The diagram illustrates the installation of a jumper strap. It shows a rectangular jumper block with two vertical pins. A jumper strap, which is a small rectangular component with a notch, is being placed over the pins. One end of the strap is shown resting on the top surface of the block, while the other end is shown resting on the top of one of the pins. Labels with leader lines identify the 'Jumper pin', 'Jumper block', and 'Jumper strap'.

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Table 9
Jumper strap settings—extended range (NT8D14BA, NT8D14BB,
NT8D14BB Release 10 and up)

Trunk types	Loop length	Jumper strap settings (Note 1)			
		J1.X	J2.X	J3.X	J4.X (Note 2)
CO/FX/WATS	> 1524 m (5000 ft)	Off	Off	1–2	2–3
2-way tie (LDR)					
2-way tie (OAID)					
DID	> 600 ohms	On	On	1–2	2–3
RAN: pulse start or level start modes	Not applicable: RAN trunks should not leave the building.	Off	Off	2–3	1–2
<p>Note 1: Jumper strap settings J1.X, J2.X, J3.X, and J4.X apply to all eight units; “X” indicates the unit number, 0–7. “Off” indicates that no jumper strap is installed on a jumper block.</p> <p>Note 2: For the NT8D14BB Release 10 or later card, J4.X is not provided on the board. The J4.X jumper setting specified in Table 9 does not apply.</p>					

Figure 36
Universal trunk card—jumper locations (for NT8D14BB release 10 and higher)

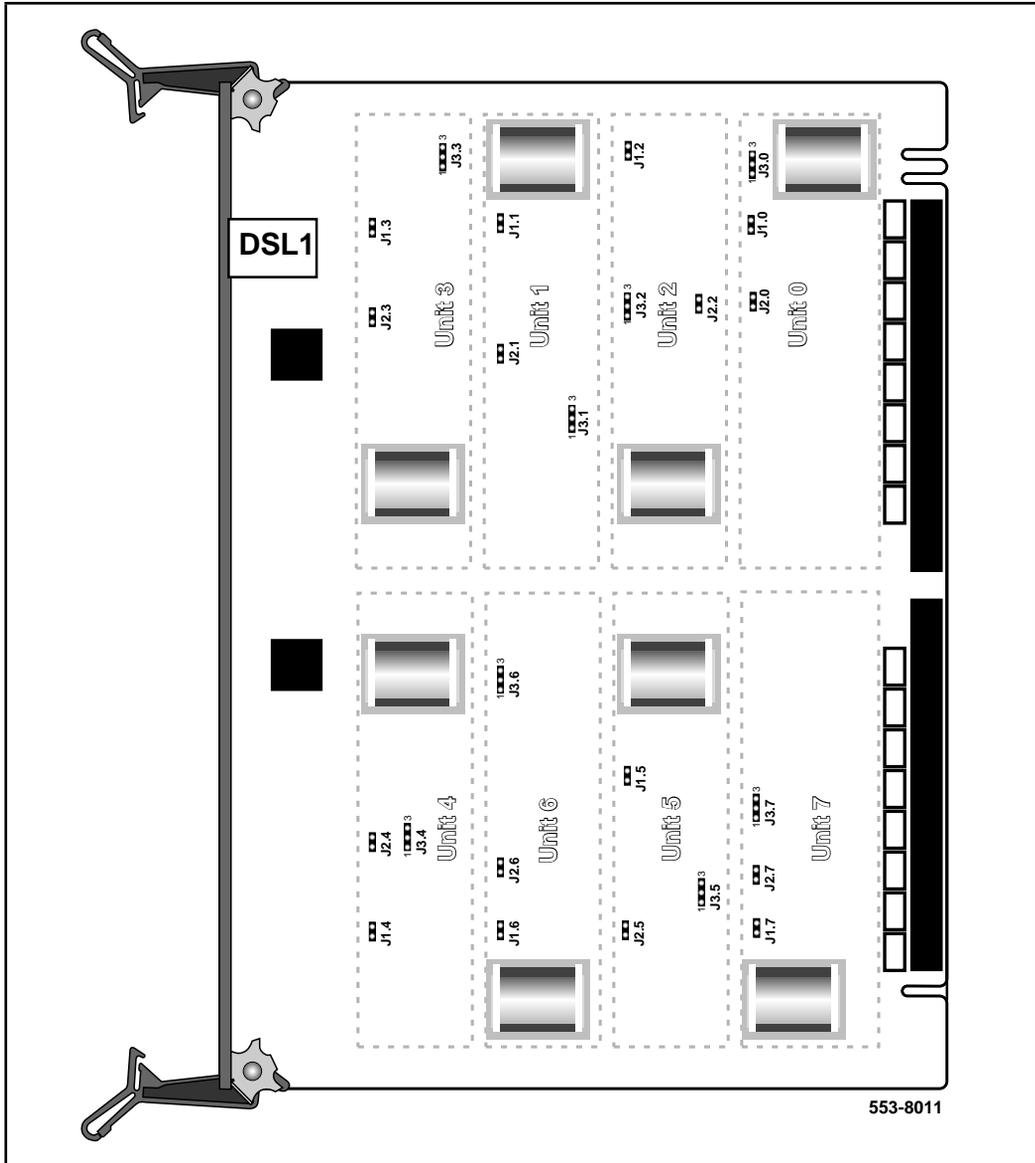


Figure 37
Universal trunk card—jumper locations (for NT8D14BA, NT8D14BB release 9 and below)

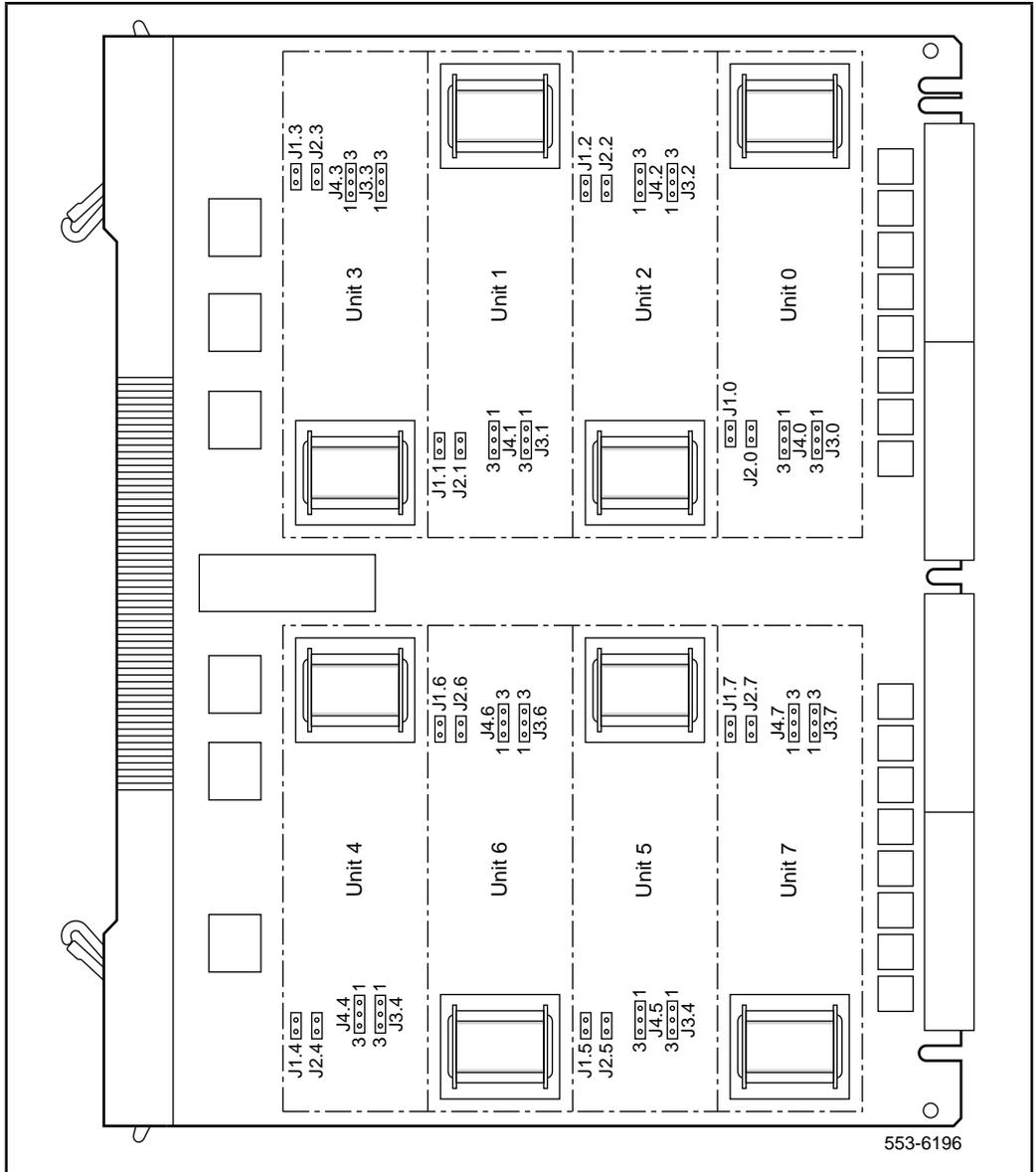


Table 10
Trunk types—termination impedance and balance network (NT8D14BA, NT8D14BB)

Trunk types	Terminating impedance (Note 1)	Balance network for loop lengths (Note 2)		
		0–915 m (0–3000 ft)	915–1524 m (3000–5000 ft)	> 1524 m (> 5000 ft)
CO/FX/WATS	600 or 900 ohms	600 ohms	3COM	3CM2
2-way tie (LDR)	600 or 900 ohms	600 ohms	3COM	3CM2
2-way tie (OAID)	600 or 900 ohms	600 ohms	3COM	3CM2
DID (loop length < 600 ohms)	600 or 900 ohms	600 ohms	3COM	3CM2
DID (loop length ≥ 600 ohms)	600 or 900 ohms	600 ohms	N/A	3CM2
RAN: continuous operation mode	600 or 900 ohms	600 or 900 ohms	N/A	N/A
Paging	600 ohms	600 ohms	N/A	N/A

Note 1: The terminating impedance of each trunk unit is software selectable in LD 14 and should match the nominal impedance of the connecting equipment.

Note 2: The balance network of each trunk unit is software selectable between resistive 600 or 900 ohms or 3COM and jumper selectable between 3COM and 3CM2. Jumper selection for 3COM/3CM2 restriction does not apply to NT8D14BB (Release 10 and later).

Table 11
Cable loop resistance and loss

Cable length	Cable loop resistance (ohms)			Cable loop loss (dB) (nonloaded at 1kHz)		
	22 AWG	24 AWG	26 AWG	22 AWG	24 AWG	26 AWG
915 m (3000 ft)	97	155	251	0.9	1.2	1.5
1524 m (5000 ft)	162	260	417	1.6	2.0	2.5
2225 m (7300 ft)	236	378	609	2.3	3.0	3.7
3566 m (11700 ft)	379	607	977	3.7	4.8	6.0
5639 m (18500 ft)	600	960	1544	5.9	7.6	9.4

Port-to-port loss configuration

Loss parameters are selected on the Universal trunk card by a switchable pad controlled by codec emulation software. For convenience in this discussion, the pads settings are called “in” and “out.” Pad settings are determined by the two factors listed below: the first is under direct user control; the second is controlled indirectly.

- Class of service is assigned in LD 14
- Port-to-port connection loss is automatically set by software on the basis of the port type selected in LD 16; only the port type is set by the user.

The transmission properties of each trunk are characterized by the class of service assigned in LD 14. Transmission properties can be via net loss (VNL) or not via net loss (non VNL).

The VNL class of service is assigned at the prompt CLS with the response VNL. The non-VNL class of service is assigned at prompt CLS by selecting either the TRC (transmission compensated) or NTC (non-transmission compensated) response.

Non-VNL trunks are assigned a TRC or NTC class of service to ensure stability and minimize echo when connecting to long-haul trunks, such as tie trunks. The class of service determines the operation of the switchable pads contained in each unit. They are assigned as follows:

- TRC for a 2-wire non-VNL trunk facility with a loss of greater than 2 dB, or for which impedance compensation is provided, or for a 4-wire non-VNL facility
- NTC for a 2-wire, non-VNL trunk facility with a loss of less than 2 dB, or when impedance compensation is not provided

See [Table 12](#) for the pad switching control for the various through connections and the actual port-to-port loss introduced for connections between the Universal trunk card and any other IPE or PE port designated as Port B.

Table 12
Pad switching algorithm

Port B	Port B pads		Universal Trunk Pads		Port-to-port loss (dB)	
	Transmit D to A	Receive A to D	Transmit D to A	Receive A to D	Port B to Universal trunk card	Universal trunk card to Port B
IPE line	N/A	N/A	Out	Out	0.5	0.5
Universal trunk (TRC)	In	Out	In	Out	1	1
IPE tie (VNL)	In	In	Out	Out	0	0
PE line	N/A	N/A	Out	Out	1	1
PE CO/FX/WATS (TRC)	Out	Out	In	In	1	1
PE tie	Out	Out	In	In	0.5	0.5

Note 1: Transmit and receive designations are from and to the Meridian 1. Transmit is from the Meridian 1 to the external facility (digital-to-analog direction in the Universal trunk card). Receive is to the Meridian 1 from the external facility (analog-to-digital direction in the Universal

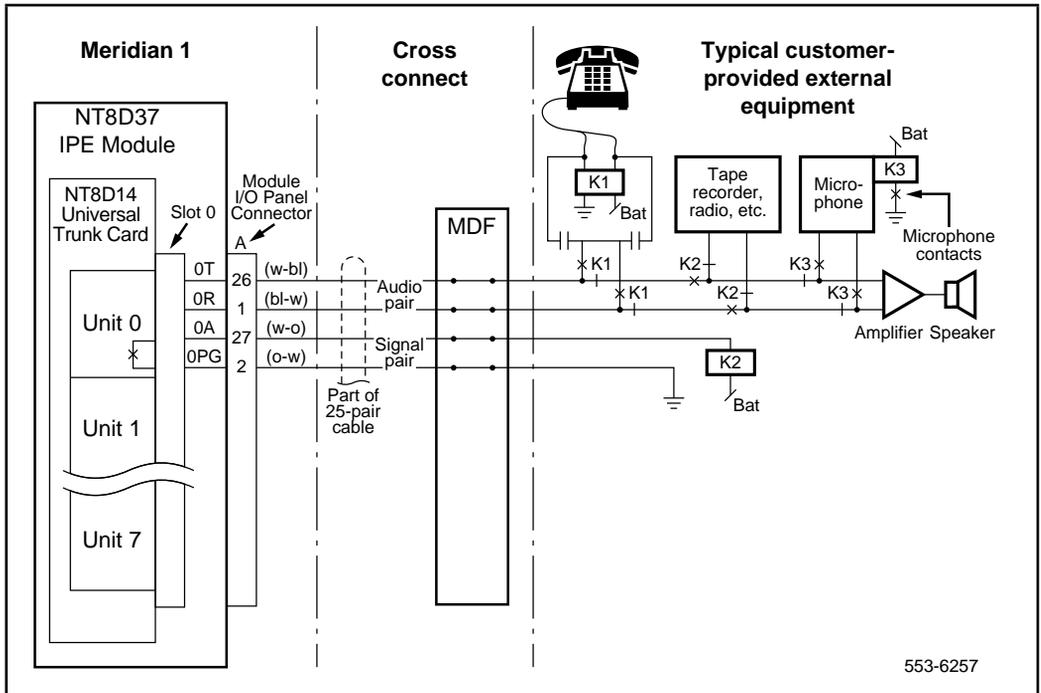
Note 2: When Port B is the call originating port. If the Universal trunk card is the originating port, the UTC pads are out, the Port B (PE CO/FX/WATS) pads are in.

Applications

Paging trunk operation

A universal trunk card unit can be configured as a paging trunk. Configure units as paging trunks in the Trunk Administration program (LD 14) and assign routes in the Route Administration program (LD 16). [Figure 38](#) shows a typical connection from customer-provided equipment to unit 0 on a universal trunk card that is installed in slot 0 in an NT8D37 IPE Module. See *Meridian 1 system installation procedures* (553-3001-210) for complete trunk wiring information.

Figure 38
Connecting paging equipment to the NT8D14 Universal Trunk Card (typical)



Music operation

A trunk unit can be connected to a music source. The audio source should provide an adjustable power output at 600 ohms. Configure units for music at the MUS or AWR prompts in the Trunk Administration program (LD 14) and assign routes at the MRT prompt in the Trunk Route Administration program (LD 16).

Music operation is similar to that of RAN in the continuous operation mode. Connect the unit tip and ring leads to the audio source and ground the CP line at the MDF (see [Figure 33](#)). If the music source is equipped with contacts that close when music is online, use these contacts to provide a ground to the MB line; otherwise, ground the MB line at the MDF.

NT8D15 E&M Trunk Card

Introduction

The NT8D15 E&M Trunk Card is an intelligent peripheral equipment (IPE) device that can be installed in either the NT8D37 IPE Module or the NT8D11 CE/PE Module. The E&M trunk card interfaces four analog telephone trunks to the Meridian 1 switch. Each trunk interface connects to a trunk facility using tip and ring leads that carry voice, ringing, and tone signaling, and to signaling interfaces by E&M leads. Each unit can be configured independently by software control in the Trunk Administration program (LD 14).

The E&M trunk card supports the following types of trunks:

- 2-wire E&M Type I signaling trunks
- 4-wire E&M trunks:
 - Type I or Type II signaling
 - duplex (DX) signaling
- paging (PAG) trunks

Type I signaling utilizes two signaling wires plus ground. Type II and DX signaling utilizes two pairs of signaling wires. Most electronic switching systems use Type II signaling.

[Table 13](#) is a matrix of the signaling and trunk types supported by the E&M trunk card.

Table 13
Trunk and signaling matrix

Signaling	Trunk types			
	RLM/RLR	Tie	PAG	CSA/CAA/CAM
2-wire E&M	Yes	Yes	Yes	Yes
4-wire E&M	Yes	Yes	No	Yes
Legend: RLM Release Link Main RLR Release Link Remote CSA Common Control Switching Arrangement CAA Common Control Switching Arrangement with Automatic Number Identification (ANI) CAM Centralized Automatic Message Accounting (CAMA) trunk				

Physical description

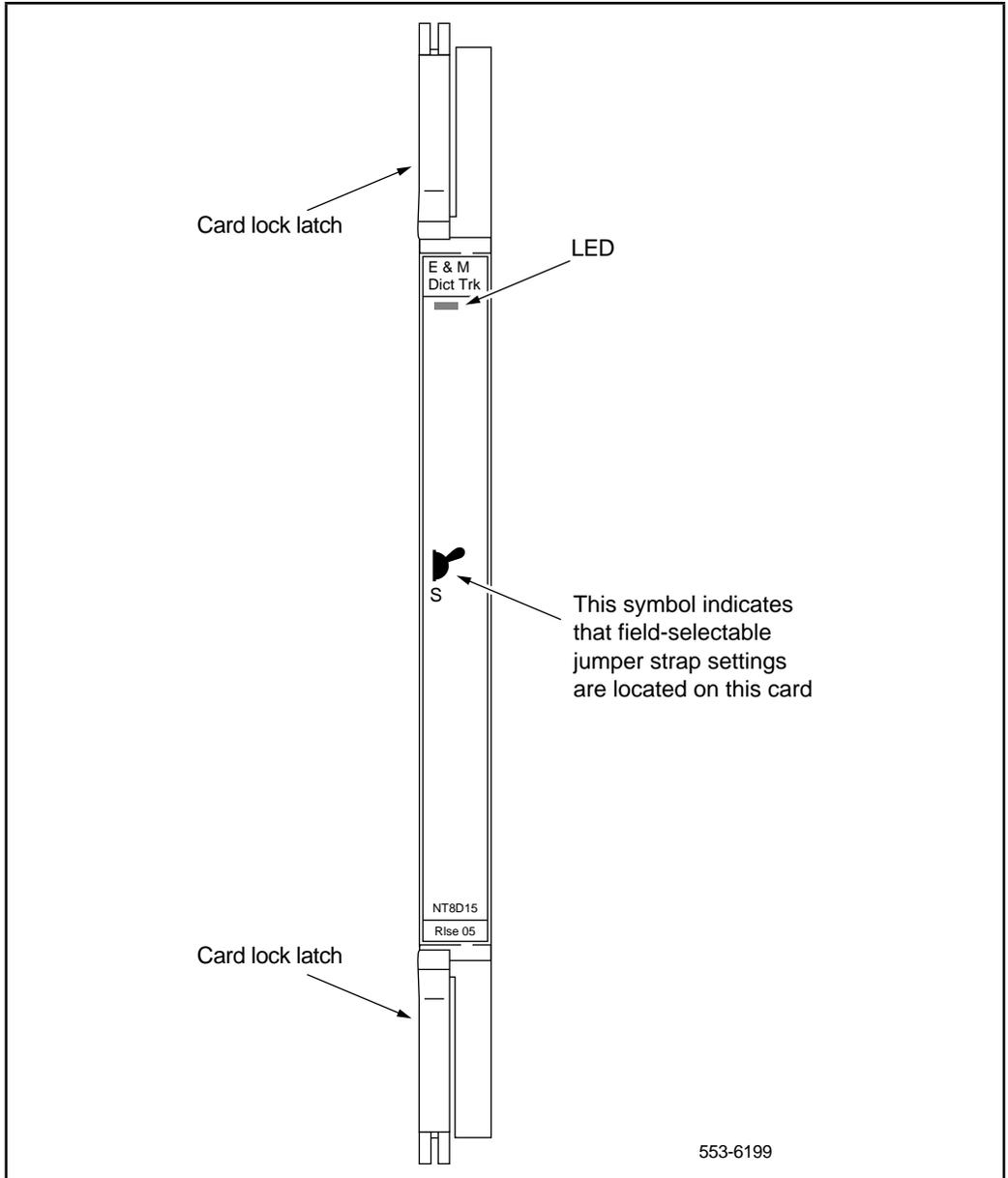
The E&M trunk card mounts in any IPE slot. The line interface and common multiplexing circuitry is mounted on a 31.75 cm by 25.40 cm (12.5 in. by 10 in.) printed circuit board.

The E&M trunk card connects to the IPE backplane through a 160-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables. Telephone lines from station equipment cross connect to the OPS analog line card at the MDF using a wiring plan similar to that used for line cards. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

Refer to [Figure 39](#) for an illustration of the faceplate on the E&M trunk card. The words “Dict Trk” appear on the faceplate label because earlier versions of this card provided dictation trunk connections for third-party equipment.

The faceplate of the card is equipped with a red light emitting diode (LED). When an E&M trunk card is installed, the LED remains lit for 2 to 5 seconds while the self-test runs. If the self-test completes successfully, the LED flashes (off/on) three times and remains lit until the card is configured and enabled in software, then the LED goes out. If the LED does not follow this pattern or operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

Figure 39
E&M trunk card—faceplate

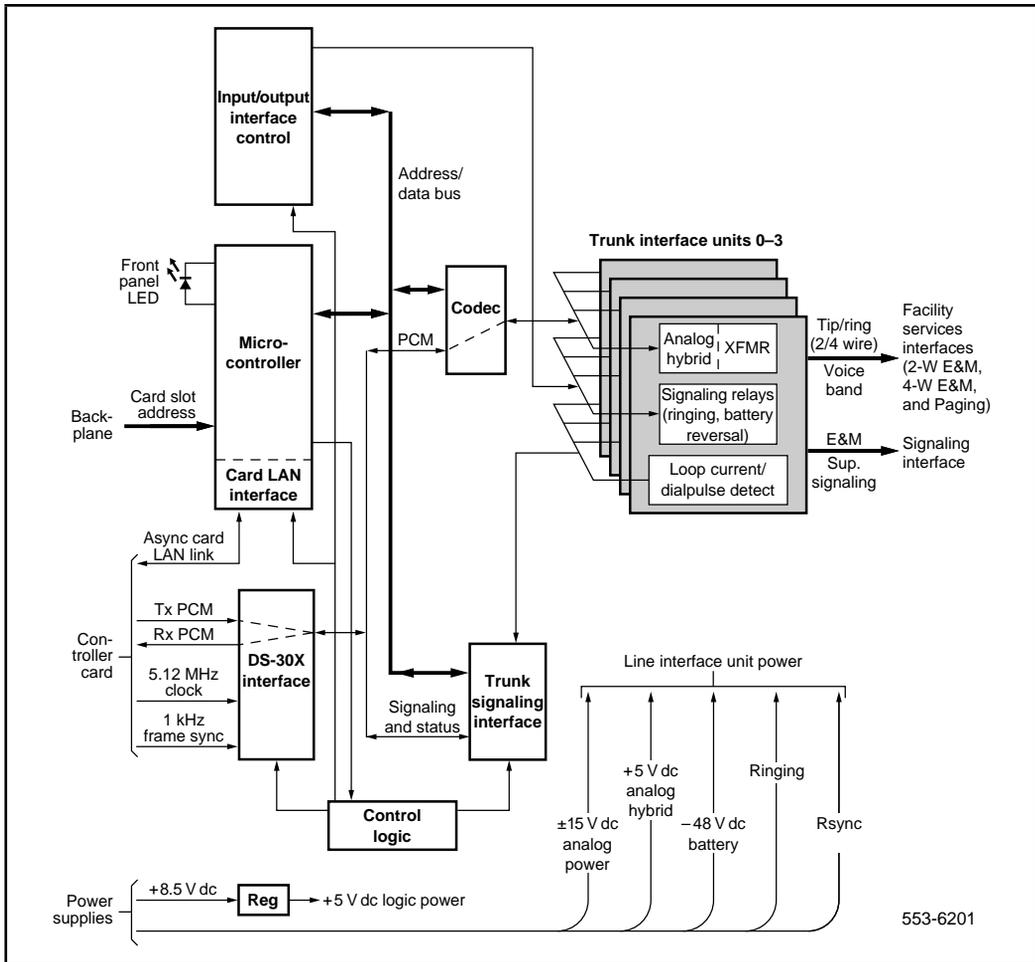


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Functional description

Figure 40 shows a block diagram of the major functions contained on the E&M trunk card. Each of these functions is discussed on the following pages.

Figure 40
E&M trunk card—block diagram



Card interfaces

The E&M trunk card passes voice and signaling data over DS-30X loops, and maintenance data over the card LAN link. These interfaces are discussed in detail in “Intelligent peripheral equipment” on page 15.

Trunk interface units

The E&M trunk card contains four identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Also provided are relays for placing outgoing call signaling onto the trunk. Signal detection circuits monitor incoming call signaling. A codec performs A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals.

The four units on the card can operate in the A-Law or the μ -Law companding mode. The mode is selected by making service change entries. Each unit can be independently configured for 2-wire E&M, 4-wire E&M, and paging trunk types. The trunk type is selected by service change entries and jumper strap settings. All units on the card can perform the following features:

- convert transmission signals from analog-to-digital and digital-to-analog
- provide outpulsing on the card: make/break ratios are defined in software and downloaded at power-up and by software command
- provide 600-ohm balance and termination impedance (2-wire configuration)
- provide 600-ohm termination impedance (4-wire configuration)
- provide pad control for 2-wire and 4-wire facility connections
- allow trunk type and function to be configured on a per port basis in software
- provide isolation of foreign potentials from transmission and signaling circuit
- provide software control of A-Law and μ -Law modes
- support loopback of pulse code modulation (PCM) signals to DS-30X for diagnostic purposes

Trunk unit functions

The functions provided by each unit on the E&M trunk card include 2-wire signaling, 4-wire signaling, and paging operation as follows:

- 2-wire, E&M Type I signaling (see [Figure 41](#)) with:
 - near-end seizure and outpulsing with M lead
 - ground detection with E lead
 - voice transmission through tip and ring for transmit and receive
- 4-wire, E&M Type I and II signaling (see [Figure 42](#)), 2-way dial repeating with:
 - echo suppression for Type I signaling
 - switchable 7 dB and 16 dB pads for carrier interface
 - voice transmission and reception through two separate paths
 - Type I signaling through E&M leads
 - Type II signaling with near-end seizure by SB/M leads and far-end detection by E/SG leads
- 4-wire, DX signaling (see [Figure 43](#))
- paging trunk operation (see [Figure 44](#)) with:
 - support access by low-resistance path at the PG/A1 leads
 - paging end-to-end signaling not supported

Figure 41
E&M Type I signaling

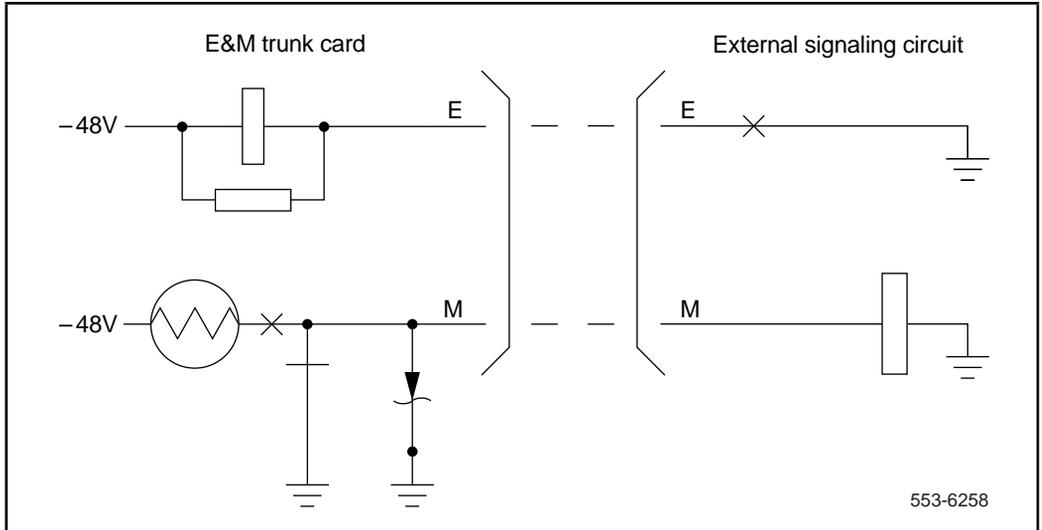


Figure 42
E&M Type II signaling

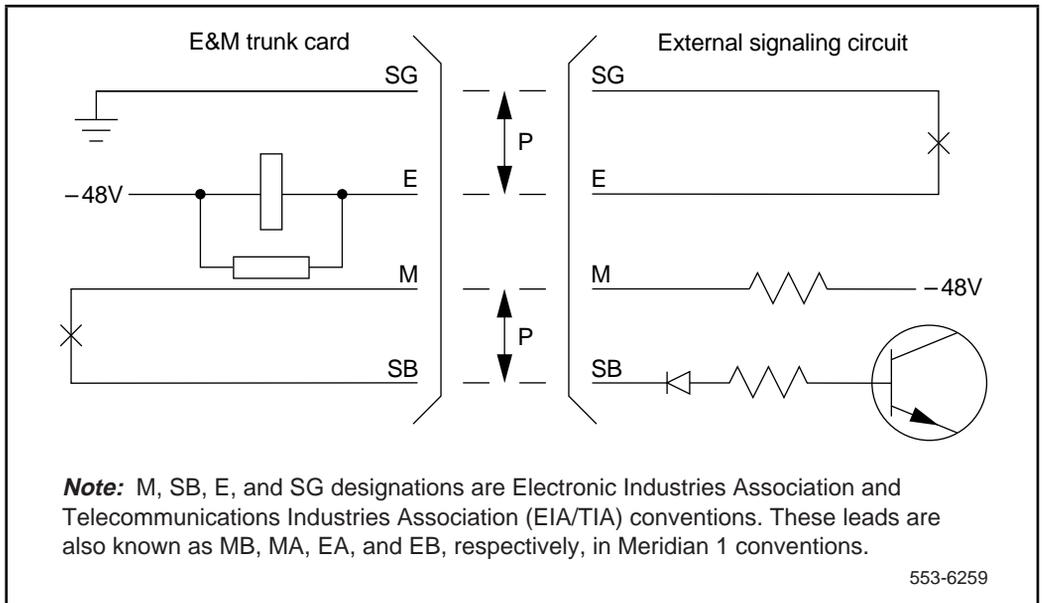
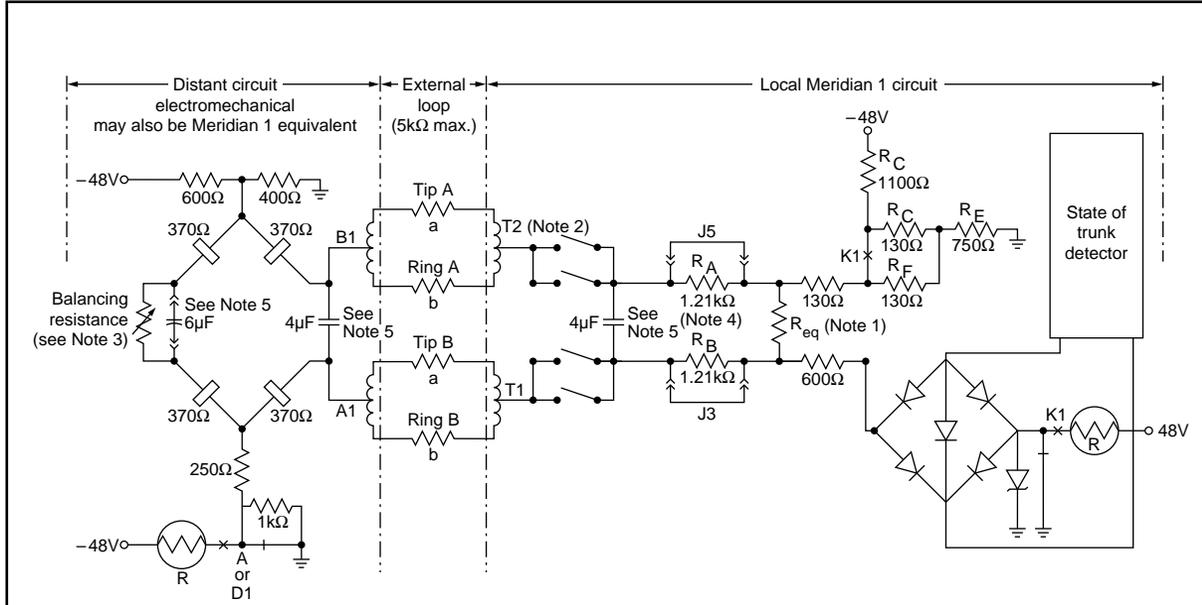
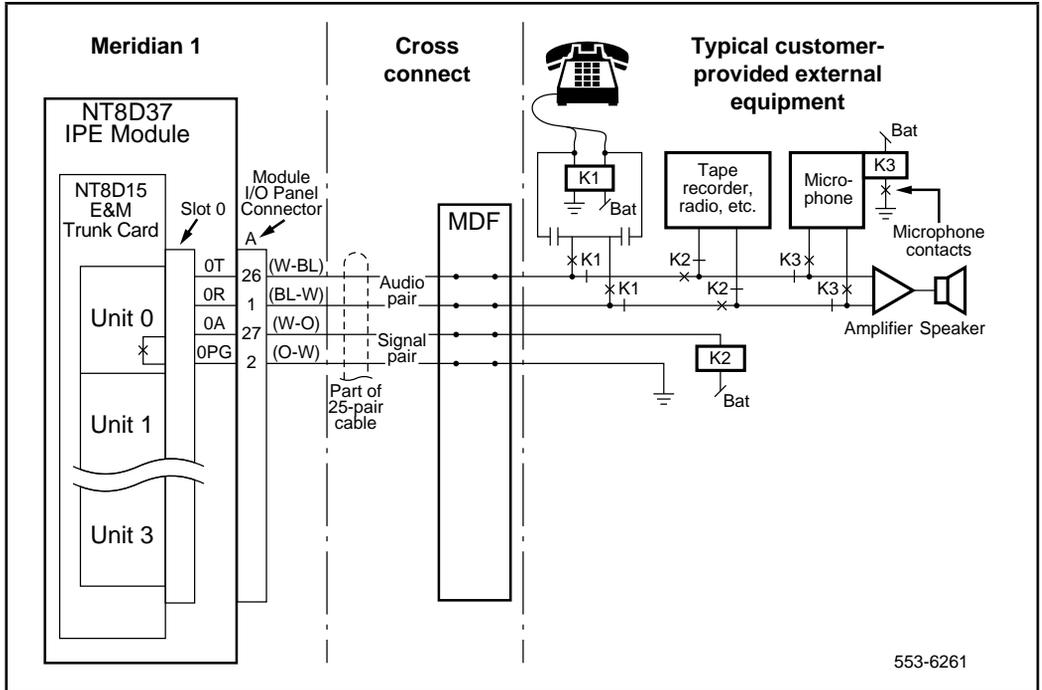


Figure 43
4-wire DX signaling



- Note 1:** The equivalent bridge circuit resistance as seen from distant trunk during the signaling is 1250 ± 125 Ohms.
- Note 2:** T1 and T2 resistance is 47 Ohms for 600 Ohm termination option.
- Note 3:** Compute total balancing resistance as follows (note that in some new DX circuits, a 1260 Ohm resistor is permanently wired in series with the selectable resistance). Total balancing $R = \text{external loop resistance} + 0.5 \times T1 \text{ resistance} + 0.5 \times T2 \text{ resistance} + [(R_A + R_D) \text{ if not shorted out}] + R_{eq}$. Resistance of transformers at electromechanical end is low and can be ignored. "External loop resistance" is defined as 1/2 the loop resistance of one cable pair.
- Note 4:** If the external loop is >2500 Ohms, the loop adjustment resistors R_A and R_B are shorted out. If the external loop resistance is <2500 Ohms, the loop adjustment resistors must be shorted in one machine. If the external loop is >2500 Ohms, the loop adjustment resistors must be shorted out in both machines.
- Note 5:** When the Meridian 1 is connected to an electromechanical trunk using 4-wire operation, a $4\mu F$ capacitor must be connected from the A1 to B1 lead at each end of the trunk. (These may already be installed.) It is also recommended that a $6\mu F$ capacitor be connected in series with the balancing resistance.

Figure 44
Paging trunk operation



Card control functions

Control functions are provided by a microcontroller, a card LAN, and signaling and control circuits on the E&M trunk card.

Microcontroller

The E&M trunk card contains a microcontroller that controls the internal operation of the card and the serial communication link to the NT8D01 Controller Card. The microcontroller provides the following functions:

- card-identification
- self-test
- control of card operation
- status report to the controller
- maintenance diagnostics

Card LAN

The card LAN provides a serial communication link for transferring maintenance data and control signals between the trunk card and the NT8D01 Controller Card. The card LAN controls the microcontroller. The following functions are supported:

- providing card ID/RLS
- reporting self-test status
- polling from the controller card
- enabling/disabling of the DS-30X link

Signaling and control

The signaling and control portion of the E&M trunk card works with the system CPU to operate the card hardware. The card receives messages from the CPU over a signaling channel in the DS-30X loop and returns status information to the CPU over the same channel. The signaling and control portion of the card provides analog loop terminations that establish, supervise, and take down call connections.

Configuration information for the E&M trunk card is downloaded from the CPU at power-up and by command from maintenance programs. Seven configuration messages are sent. One message is sent to each of the four units to configure trunk and signaling type. The remaining three messages are sent per card to select the make/break ratio and the A-Law and μ -Law modes.

The signaling and control circuits on the card perform the following functions:

- provide interface between the card and the system CPU
 - transmit PCM signals from each of the four units to one DS-30X timeslot in A10 format (ready to send/clear to send—flow control, handshake format)
 - transmit and receive signaling messages over a DS-30X signaling channel in A10 format
- decode received messages to set configuration and activate/deactivate interface relays for PCM loopback diagnostic purposes
- decode outpulsing messages (one per digit) from the CPU to drive outpulsing relays at 20 pps, 10 pps1 (primary), or 10 pps2 (secondary)
- monitor signals from the trunk interface and generate a message when required for each state change
- control disabling and enabling of unit or card
- control of A-Law and μ -Law operation modes
- control of transmission pad settings

Maintenance features

The following features are provided for maintenance of the E&M trunk:

- indication of card status from self-test
- software enable and disable capability for individual units or entire card
- loopback of PCM signals to DS-30X for diagnostic purposes
- card ID for autoconfiguration and to determine the serial number and firmware level of the card

Operation

The optional applications, features, and signaling arrangements for each unit on the E&M trunk card are assigned through the Trunk Administration (LD 14) and Trunk Route (LD 16) programs. See the *X11 input/output guide* for detailed information on assigning features and services to trunks.

Signaling and call control

The information in this section describes the signaling and call control of E&M Type I and II trunks. The call is terminated and the trunk released by a disconnect message sent to the associated unit. [Figure 45](#) shows the E&M trunk signaling orientation for a tandem connection between E&M and CO trunks.

E&M Type I signaling

[Figure 46](#) shows E&M Type I signaling patterns for incoming and outgoing calls. [Figure 47](#) shows Type I signaling patterns on a tandem connection where the originating end is senderized and the route is over a CO/FX/WATS trunk (not applicable to CCSA).

Idle state For E&M signaling, in the idle state the M lead is ground and the E lead is an open circuit.

Outgoing calls Outgoing calls are processed as follows:

- The M lead changes from ground to battery.
 - If answer supervision is provided by the far end, there is a change from open to ground on the E lead (ground detection).

Figure 45
Signaling orientation for tandem connection between E&M and CO trunks

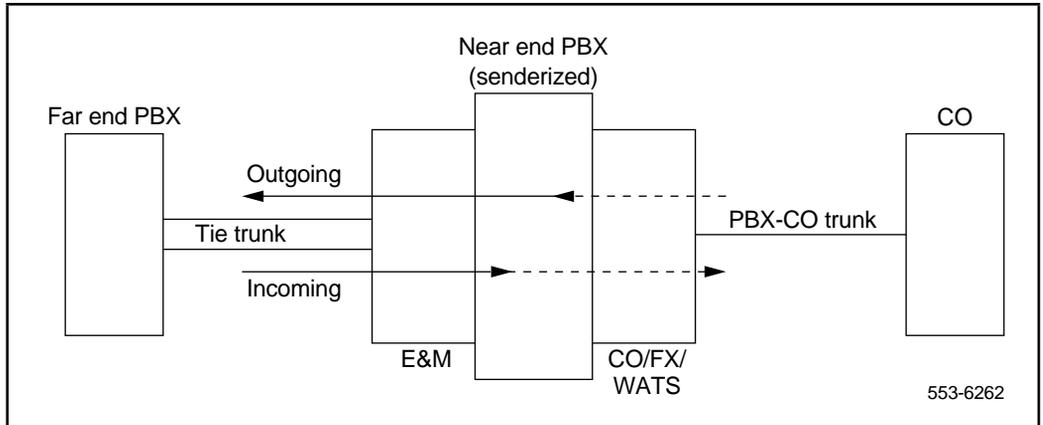
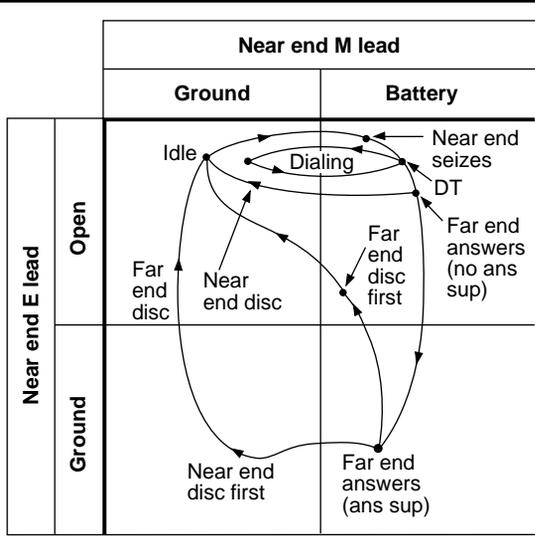
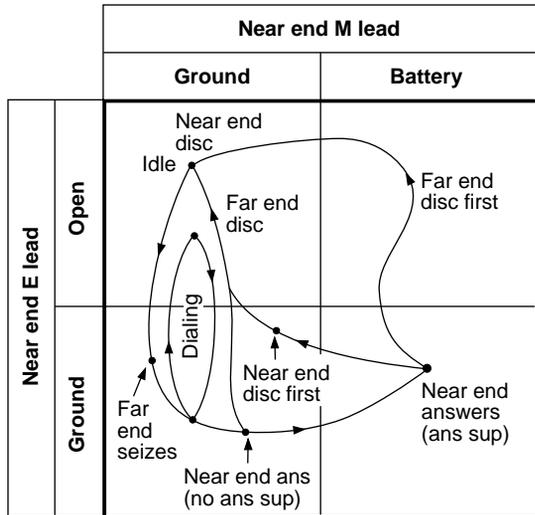


Figure 46
E&M Type I signaling patterns—originating party release



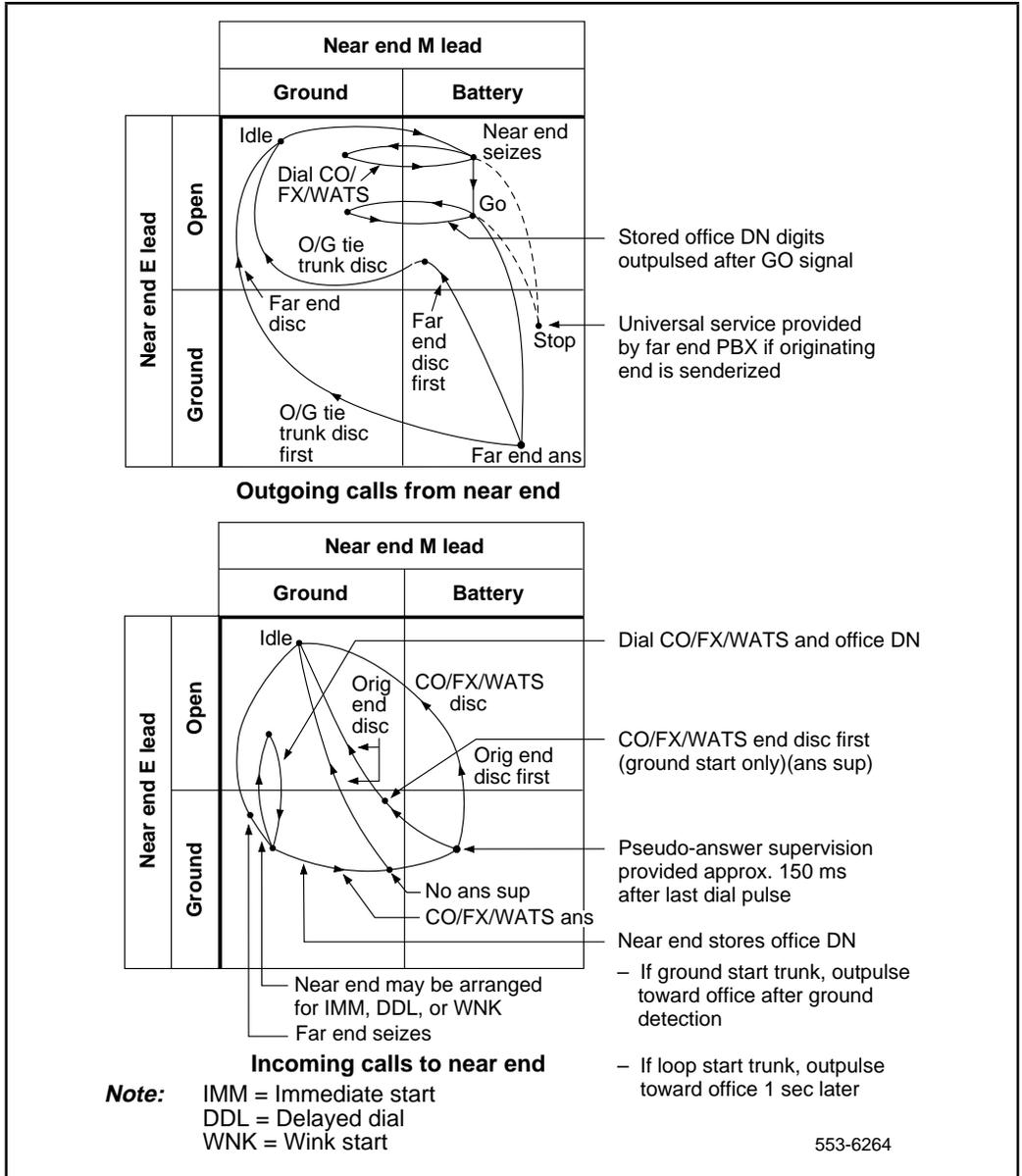
Outgoing calls from near end



Incoming calls to near end

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Figure 47
E&M Type I signaling patterns—originating party release on a tandem connection



Incoming calls The far end initiates calls as follows:

- Ground is placed on the E lead in E&M signaling.
- Dial pulses are subsequently applied from the far end as ground open on the E lead.
- If the far end is equipped for sending, the system may be operated in any mode (immediate start, delay dial, or wink start), as assigned on a start arrangement basis (see [Table 14](#)).
 - In immediate start mode, there is no start signal from the called office. The seizure signal (off hook supervisory state) from the far end should be at least 150 ms. At the end of the seizure signal, the far end may start pulsing after the standard delay (normally 70 ms minimum).
 - In delay dial mode, a 256–384 ms off hook/on hook signal is returned to the far end immediately after receipt of the seizure signal. When the far end detects the on hook state of the signal (start signal), the far end may start pulsing after the standard delay (normally 70 ms minimum).
 - In wink start mode, within a 128–256 ms period after receipt of the seizure signal from the far end, the called office transmits a 250 ms, wink start, off hook/on hook signal to the calling office.

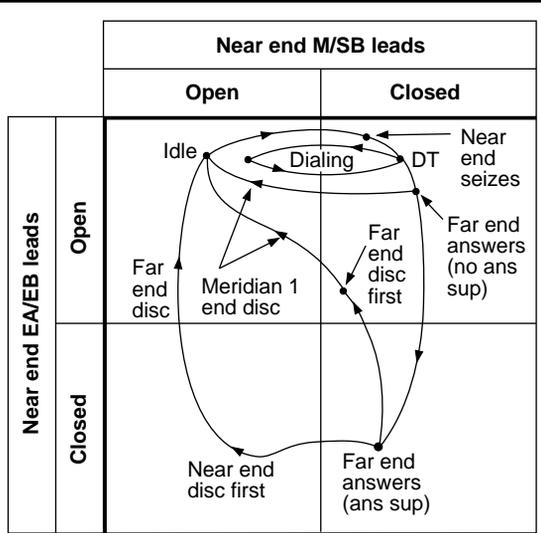
Table 14
Operation mode

Operation mode	Start arrangement
Immediate start	IMM
Delay dial	DDL
Wink start	WNK

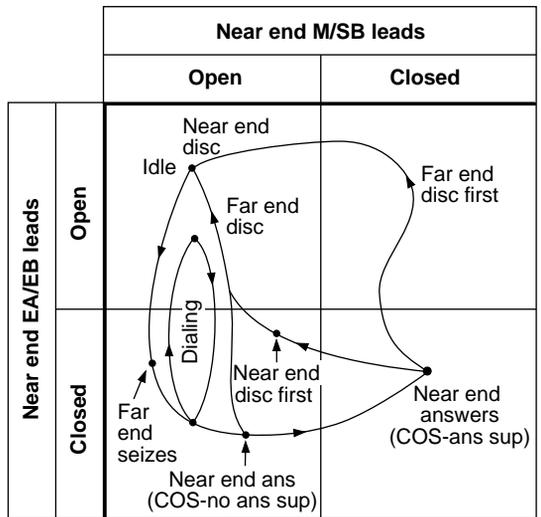
E&M Type II signaling

[Figure 48](#) shows E&M Type II signaling patterns for incoming and outgoing calls. [Figure 49](#) shows Type II signaling patterns for a tandem connection where the originating end is senderized and the route is over a CO/FX/WATS trunk (not applicable to CCSA).

Figure 48
E&M Type II signaling patterns—originating party release



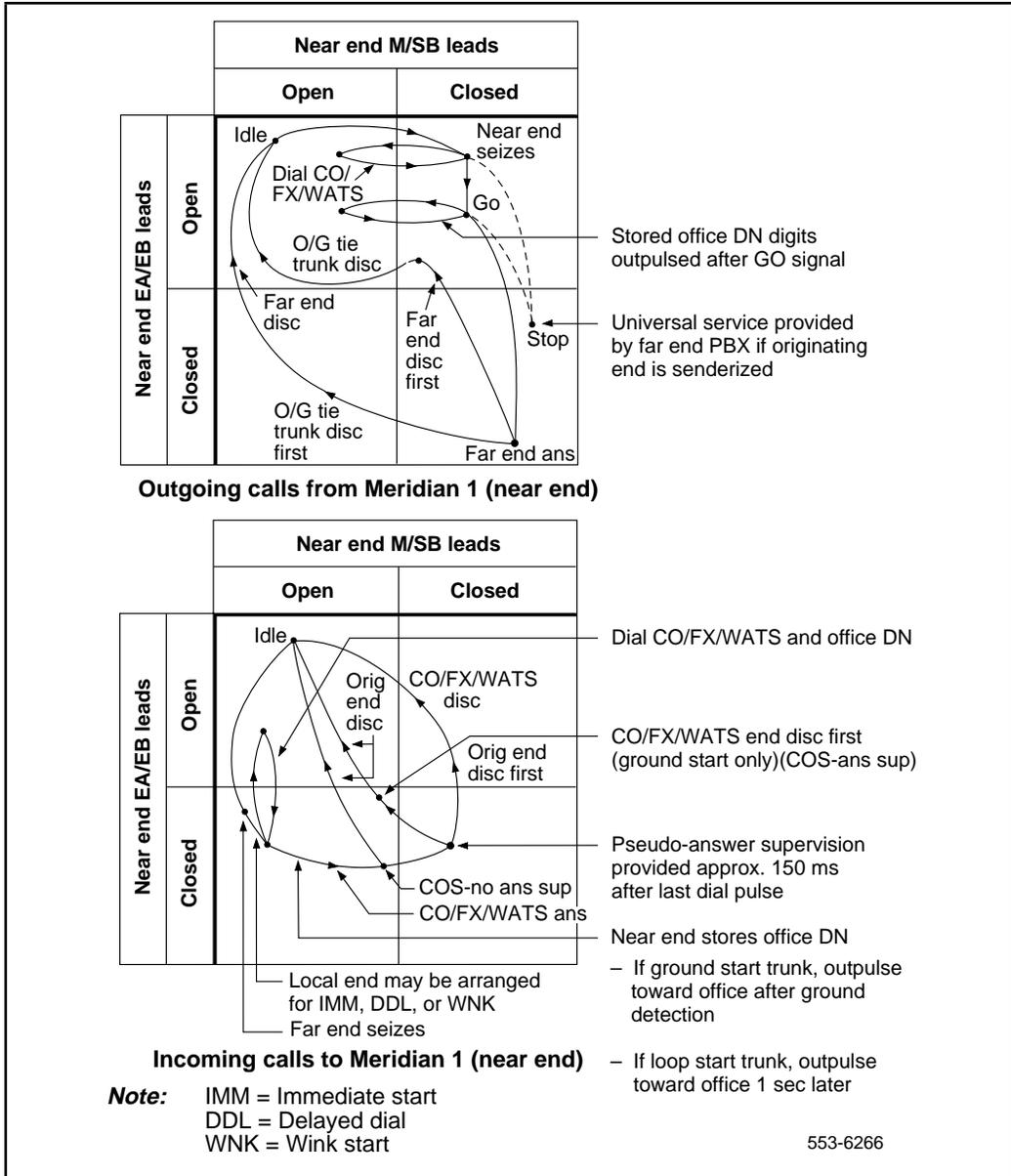
Outgoing calls from Meridian 1 (near end)



Incoming calls to Meridian 1 (near end)

553-6265

Figure 49
E&M Type II signaling patterns—originating party release on a tandem connection



Type II signaling uses four leads: M, SB, E, and SG. Instead of changes of state between battery and ground (M signals) or open and ground (E signals), the trunk signals by closing the contacts between the lead pairs M and SB. Signals are received by detecting current flow between lead pairs E and SG.

On incoming calls, the far end seizes the trunk by shorting the E and SG leads together. This transmits the ground from the SG lead to the E lead (in Type I signaling the ground to the E lead comes from the far end). Dialing is done by opening and closing the E/SG contacts. Since the SB and M leads are also used as the ESCG and ESC leads, respectively, for echo suppression, echo suppressor control cannot be used with Type II signaling.

Note: M, SB, E, and SG designations are Electronic Industries Association and Telecommunications Industries Association (EIA/TIA) conventions. These leads are also known as MB, MA, EA, and EB, respectively, in Meridian 1 conventions.

Release control

Release control of a call made over a trunk is specified in LD 16. Disconnect supervision is specified for each trunk group independently. The two options available are EITHER or ORIGINATING party control. These can be specified for the Meridian 1 end (near end), or for the CO or other PBX end (far end). Joint party control can also be specified for the far end.

Duplex (DX) signaling

DX signaling makes use of the voice transmission leads for signaling as well as for voice transmission (see Figure 6). For purposes of describing the signaling, the lead pair Tip B/Ring B is designated the signaling pair, whereas the other pair Tip A/Ring A conducts current in the opposite direction to balance the overall current flow between the near and far ends. During signaling, current flows through both Tip B and Ring B leads in the same direction.

[Tables 15](#) and [16](#) show call-connection and take-down sequencing for DX signaling. [Tables 17](#) and [18](#) show sequencing where the E&M trunk card is used in a tandem PBX.

Table 15
DX signaling—outgoing calls with originating party release

Condition	Current in signaling lead	State of trunk detector
Idle	No current flow	High
Seizure (dial tone from far end: far end ready for digits)	Current flow	High
Digits	Current flow interrupted for each pulse	High
Far end answers	No current flow	Low
Far end on hook first	Current flow	High
Network taken down and trunk idled when near end goes on hook	No current flow	High
Near end on hook first, network taken down	Current flow	Low
Far end on hook, trunk idled	No current flow	High

Table 16
DX signaling—incoming calls with originating party release

Condition	Current in signaling lead	State of trunk detector
Idle	No current flow	High
Seizure (dial tone to far end: near end ready for digits)	Current flow	Low
Digits	Current flow interrupted for each pulse	Low-high-low for each pulse
Near end answers	No current flow	Low
Far end on hook first	Current flow	High
Network taken down and trunk idled	No current flow	High
Near end on hook first, network taken down	Current flow	Low
Far end on hook, trunk idled	No current flow	High

Table 17
DX signaling—outgoing calls with originating party release on tandem connections

Condition	Current in signaling lead	State of trunk detector
Idle	No current flow	High
Seizure (far end ready for digits)	Current flow	High
Dial CO/FX/WATS	Current flow interrupted for each pulse	High
Stop sender	No current flow	Low
Go sender (universal service provided by far-end PBX if originating end is senderized)	Current flow	High
CO/FX/WATS offices ready for digits		
Stored Office DN digits	Current flow interrupted for each pulse	High
Outpulsed	No current flow	Low
Far end answers	No current flow	Low
Far end on hook first	Current flow	High
Near end on hook, network taken down, trunk idled	No current flow	High
Near end on hook first, network taken down	Current flow	Low
Far end on hook, trunk idled	No current flow	High

Table 18
DX signaling—incoming calls with originating party release on tandem connections

Condition	Current in signaling lead	State of trunk detector
Idle	No current flow	High
Seizure (Meridian 1 may be arranged for IS, DD, or WS)	Current flow	Low
(near end ready for digits)		
Dial CO/FX/WATS and office DN	Current flow interrupted for each pulse	Low-high-low for each pulse
Stored digits outpulsed on CO/FX/WATS trunk after ground detection if ground start, but after 3 s if loop start		
If answer supervision: pseudo-answer supervision is sent approximately 13 s after last dial pulse received	No current flow	Low
If no answer supervision: CO end disconnects (CO ground start—trunk idled and network taken down, but incoming tie trunk held under control of originating end)	Current flow	Low
Originating end disconnects—network taken down and trunk idled	No current flow	High

Electrical specifications

This section lists the electrical specifications for the E&M trunk card.

Trunk interface electrical characteristics

[Table 19](#) lists the electrical characteristics of the trunk interface on the E&M trunk card.

Table 19
Electrical characteristics

Characteristic	4-wire trunk	2-wire trunk
Signaling range	Type I 150Ω Type II 300Ω loop	Type I 150Ω
Signaling type	Type I, Type II	Type I
Far-end battery	-42 to -52.5 V dc	-42 to -52.5 V dc
Near-end battery	-42.75 to -52.5 V dc	-42.75 to -52.5 V dc
Ground potential difference	±10 V dc	±10 V dc
Line leakage between E lead and ground	≥20KΩ	≥20KΩ
Effective loss	See pad table (Table 25)	See pad table (Table 25)
Terminating impedance	600Ω	600Ω
Balance impedance	N/A	600Ω

Power requirements

[Table 20](#) lists the power requirements for the E&M trunk card.

Table 20
Power requirements

Voltage	Tolerance	Max current
+15.0 V dc	±5%	200 mA
-15.0 V dc	±5%	200 mA
+8.5 V dc	±2%	200 mA
-48.0 V dc	±5 %	415 mA

Environmental specifications

[Table 21](#) provides the environmental specifications for the E&M trunk card.

Table 21
Environmental specifications

Parameter	Specifications
Operating temperature	0 to +60 degrees C (32 to +140 degrees F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40 to +70 degrees C (-40 to +158 degrees F)

Foreign and surge voltage protection

The E&M trunk card meets CS03 over-voltage (power cross) specifications and FCC Part 68 requirements.

Connector pin assignments

The E&M trunk card brings the four analog trunks to the IPE backplane through a 160-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the E&M trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 50](#), a list of the connections to the E&M trunk card in the various 2-wire modes is shown in [Table 22](#), and a list of the connections to the E&M trunk card in the various 4-wire modes is shown in [Table 23](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

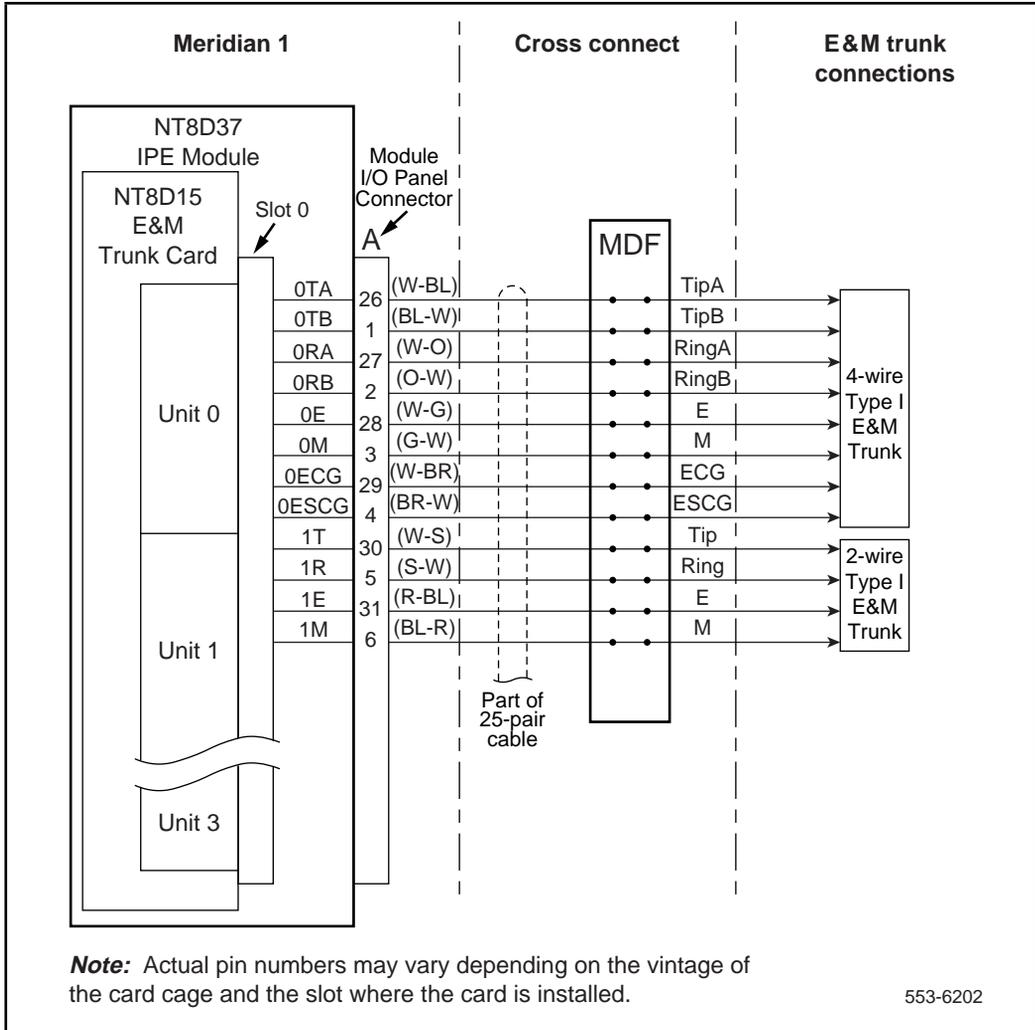
Table 22
E&M trunk card—backplane pinouts for 2-wire modes

Trunk Number	2-wire Paging Mode				2-wire Type I Mode			
	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
0	12B	Tip	12A	Ring	12B	Tip	12A	Ring
	15B	A	15A	PG	14B	E	14A	M
1	16B	Tip	16A	Ring	16B	Tip	16A	Ring
	19B	A	19A	PG	18B	E	18A	M
2	62B	Tip	62A	Ring	62B	Tip	62A	Ring
	65B	A	65A	PG	64B	E	64A	M
3	66B	Tip	66A	Ring	66B	Tip	66A	Ring
	69B	A	69A	PG	48B	E	68A	M

Table 23
E&M trunk card—backplane pinouts for 4-wire modes

Trunk Number	4-wire Type I Mode				4-wire Type II Mode			
	Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
0	12B	TA	12A	TB	12B	TA	12A	TB
	13B	RA	13A	RB	13B	RA	13A	RB
	14B	E	14A	M	14B	EA	14A	EB
	15B	ECG	15A	ESCG	15B	MA	15A	MB
1	16B	TA	16A	TB	16B	TA	16A	TB
	17B	RA	17A	RB	17B	RA	17A	RB
	18B	E	18A	M	18B	EA	18A	EB
	19B	ECG	19A	ESCG	19B	MA	19A	MB
2	62B	TA	62A	TB	62B	TA	62A	TB
	63B	RA	63A	RB	63B	RA	63A	RB
	64B	E	64A	M	64B	EA	64A	EB
	65B	ECG	65A	ESCG	65B	MA	65A	MB
3	66B	TA	66A	TB	66B	TA	66A	TB
	67B	RA	67A	RB	67B	RA	67A	RB
	68B	E	68A	M	68B	EA	68A	EB
	69B	ECG	69A	ESCG	69B	MA	69A	MB

Figure 50
E&M trunk card—typical cross connection example



Configuration

Each of the four trunk circuits on the E&M trunk card can be individually configured for trunk type, companding mode, and port-to-port loss compensation. Configuring the card requires both jumper changes and configuration software service entries. The locations of the jumpers are shown in [Figure 51](#).

Jumper settings

The NT8D15 E&M Trunk Card serves various transmission requirements. The four units on the card can operate in A-Law or μ -Law companding modes, which are selected by service change entries. Each unit can be independently configured for 2-wire E&M, 4-wire E&M, and paging trunk types. The trunk type is selected by service change entries and jumper strap settings (see [Table 24](#) and [Figure 51](#)).

Software service entries

The trunk type is selected by making service change entries in the Trunk Route Administration Program (LD 16). The companding mode is selected by making service change entries in the Trunk Administration Program (LD 14). Refer to [Table 24](#) to select the proper values for the trunk type being employed. Refer to the Meridian 1 *X11 input/output guide* for LD 14 and LD 16 service change instructions.

Figure 51
E&M trunk card—jumper locations

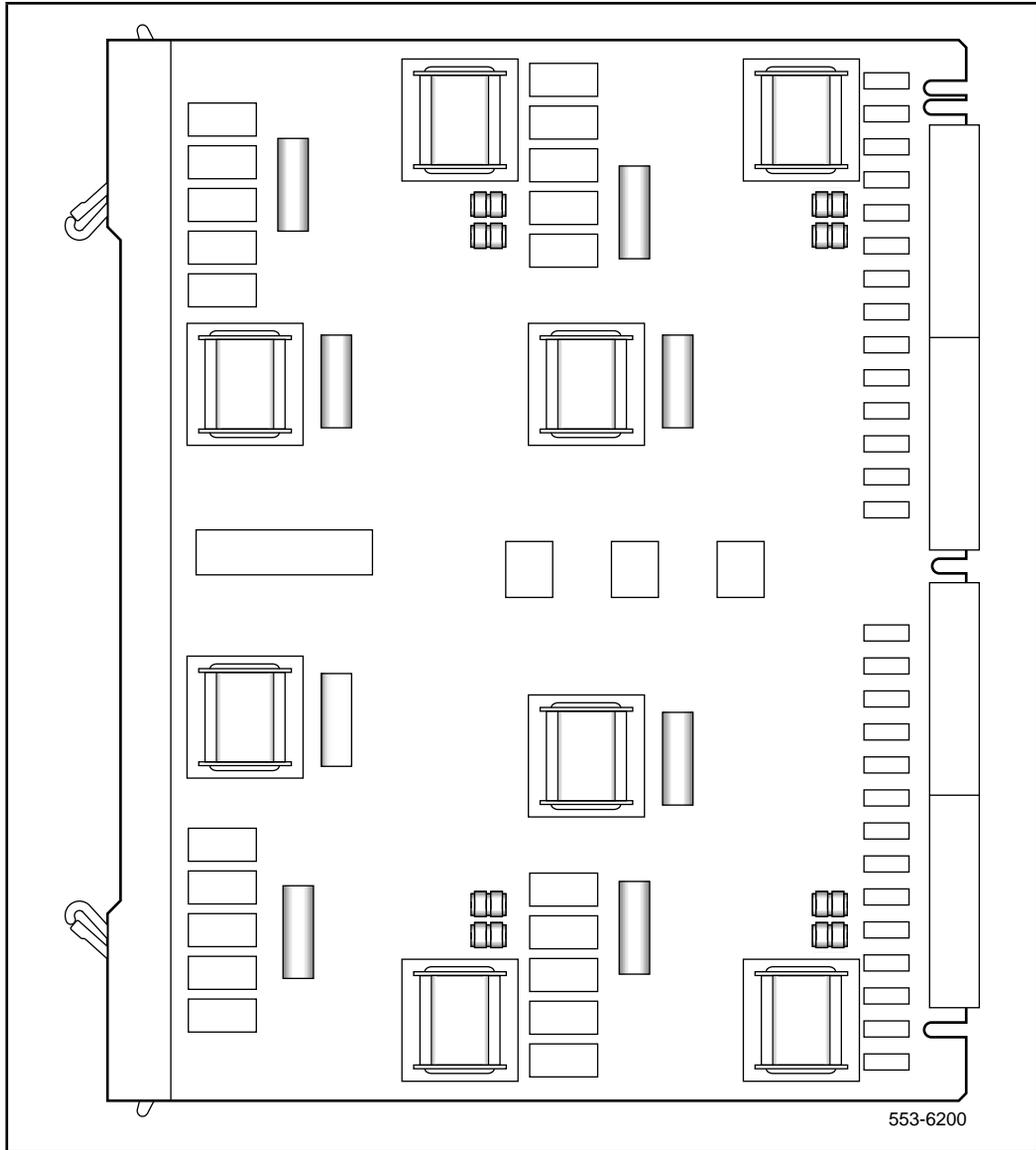


Table 24
E&M trunk card—jumper strap settings

Jumper (Note 1)	Mode of operation (Note 2)					
	2-wire trunk		4-wire trunk			
	Type I	Paging	Type I	Type II	DX tip & ring pair	
					M—rcv E—xmt	E—rcv M—xmt
J1.X	Off	Off	Off	Off	Pins 1–2	Pins 2–3
J2.X	On	On (Note 3)	On	On	Off	Off
J3.X	Off	Off	Off	Off	(Note 4)	(Note 4)
J4.X	Off	Off	Off	Off	Pins 2–3	Pins 1–2
J5.X	Off	Off	Off	Off	(Note 4)	(Note 4)
J6.X	Off	Off	Off	Off	On	On
J7.X	Off	Off	Off	Off	On	On
J8.X	Off	Off	Off	Off	On	On
J9.X	Pins 2–3	Pins 2–3	Pins 2–3	Pins 2–3	Pins 1–2	Pins 1–2

Note 1: Jumper strap settings J1.X through J9.X apply to all four units; “X” indicates the unit number, 0–3.
Note 2: “Off” indicates that no jumper strap is installed on a jumper block.
Note 3: Paging trunk mode is not zone selectable.
Note 4: Jumper strap installed in this location only if external loop resistance is greater than 2500 ohms.

Port-to-port loss configuration

Loss parameters are selected on the E&M trunk card by a switchable pad controlled by codec emulation software. For convenience in this discussion, the pads settings are called “in” and “out.” Pad settings are determined by the three factors listed below: the first two are under direct user control; the third is controlled indirectly.

- Class of service is assigned in LD 14.
- Facility termination is selected (2-wire or 4-wire) in LD 14 (the 2-wire setting provides 0.5 dB more loss in each direction of transmission for echo control).

Note: Facilities associated with the Northern Telecom Electronic Switched Network (ESN) are recommended to be 4-wire for optimum transmission; thus, the 4-wire setting is generally referred to as the ESN setting. However, the 4-wire setting is not restricted to networks using the ESN feature. Conversely, the 2-wire setting, often called non-ESN, can be used on certain trunks in an ESN environment.

- Port-to-port connection loss is automatically set by software on the basis of the port type selected in LD 16; only the port type is set by the user.

The transmission properties of each trunk are characterized by the class of service assigned in LD 14. Transmission properties can be via net loss (VNL) or not via net loss (non-VNL).

The VNL class of service is assigned at the prompt CLS with the response VNL. The non-VNL class of service is assigned at prompt CLS by selecting either the TRC (transmission compensated) or NTC (non-transmission compensated) response.

Non-VNL trunks are assigned a TRC or NTC class of service to ensure stability and minimize echo when connecting to long-haul trunks, such as tie trunks. The class of service determines the operation of the switchable pads contained in each unit. They are assigned as follows:

- TRC for a 2-wire non-VNL trunk facility with a loss of greater than 2 dB, or for which impedance compensation is provided, or for a 4-wire non-VNL facility
- NTC for a 2-wire, non-VNL trunk facility with a loss of less than 2 dB, or when impedance compensation is not provided

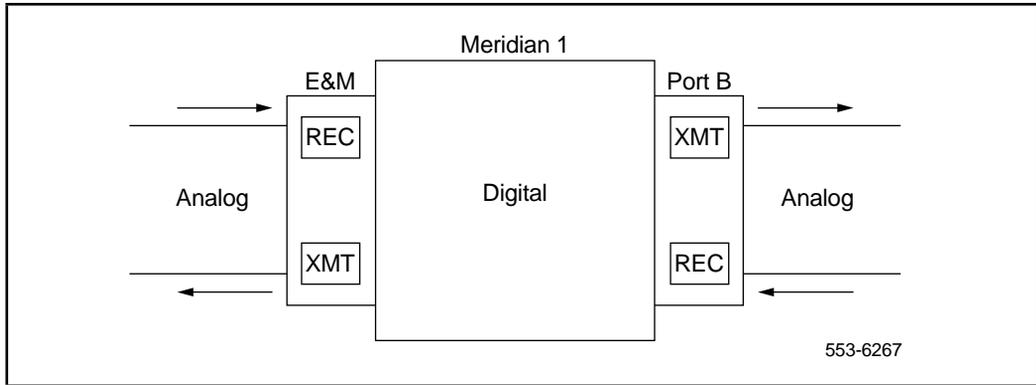
See [Table 25](#) for the pad switching control for the various through connections and the actual port-to-port loss introduced for connections between the E&M trunk card and any other IPE or PE port designated as Port B. [Figure 52](#) shows the pad switching orientation.

Table 25
Pad switching algorithm

Port B	Port B pads		E&M Trunk Pads		Port-to-port loss (dB)	
	Transmit D to A	Receive A to D	Transmit D to A	Receive A to D	Port B to E&M	E&M to Port B
IPE line	N/A	N/A	Out	In	2.5	3.5
Universal trunk (TRC)	Out	Out	In	In	0	0
IPE tie (VNL)	In	Out	In	Out	0	0
PE line	N/A	N/A	Out	In	3.0	4.0
PE CO/FX/WATS (TRC)	Out	Out	In	In	0	0
PE tie	Out	Out	In	In	0	0

Note: Transmit and receive designations are from and to the Meridian 1. Transmit is from the Meridian 1 to the external facility (digital-to-analog direction in the E&M trunk card). Receive is to the Meridian 1 from the external facility (analog-to-digital direction in the E&M trunk card).

Figure 52
Pad orientation

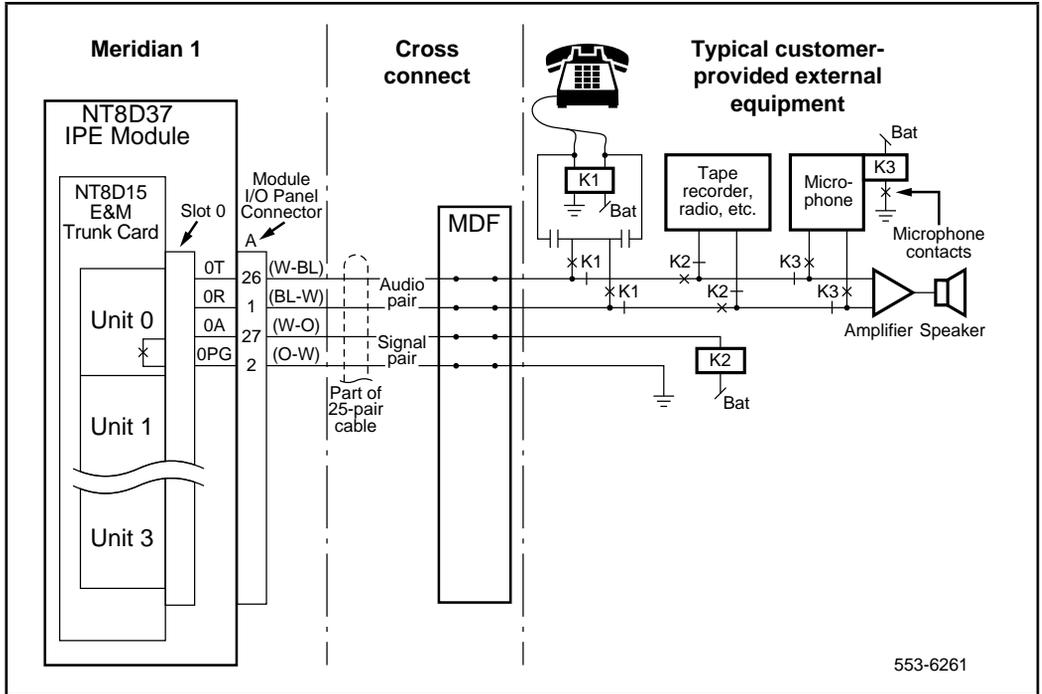


Applications

Paging trunk operation

When used in the paging mode, a trunk is connected to a customer-provided paging amplifier system (not zone selectable). When the trunk is accessed by dial-up or attendant-key operation, it provides a loop closure across control leads PG and A1 (see [Figure 53](#)). In a typical application, this transfers the input of the paging amplifier system to the transmission path of the trunk.

Figure 53
Paging trunk operation



QPC71 E&M/DX and Paging Trunk Card

Introduction

The QPC71 E&M/DX and Paging Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The E&M/DX and paging trunk card interfaces two analog trunk lines to the Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration Program (LD 14).

The E&M/DX and paging trunk card supports these trunk types:

- E&M signaling, 2-way dial repeating trunk
- 2-wire DX signaling, 2-way dial repeating trunk
- 4-wire DX signaling, 2-way dial repeating trunk
- Paging trunk, dial access or attendant access via the press-to-talk key

Physical description

The E&M/DX and paging trunk card mounts in any PE slot. The two trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The E&M/DX and paging trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel that is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 54](#)). The LED should only be lit when the board is defective. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

Functional description

[Figure 55](#) shows a block diagram of the major functions contained on the E&M/DX and paging trunk card. Each of these functions is described on the following pages.

Card interfaces

The E&M/DX and paging trunk card passes both voice and signaling data over the network loop. SL-1 network loops are discussed in detail in “Peripheral equipment” on page 22.

Trunk interface units

The E&M/DX and paging trunk card contains two identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Also provided are relays for placing outgoing call signaling onto the trunk. Signal detection circuits monitor incoming call signaling.

Two codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports one trunk interface unit. The following features are common to all units on the card:

- trunk type configurable for each unit
- balanced terminating impedance (600 or 900 ohm, selectable at the MDF) on a per unit basis
- E&M signaling
- DX signaling bridge for 2-wire or 4-wire mode of operation (bridge balancing is not required; however, conductor loop range compensation is made via the eight-switch option pad)
- supervision of far-end off hook and dial pulsing

Figure 54
E&M/DX and paging trunk card—faceplate

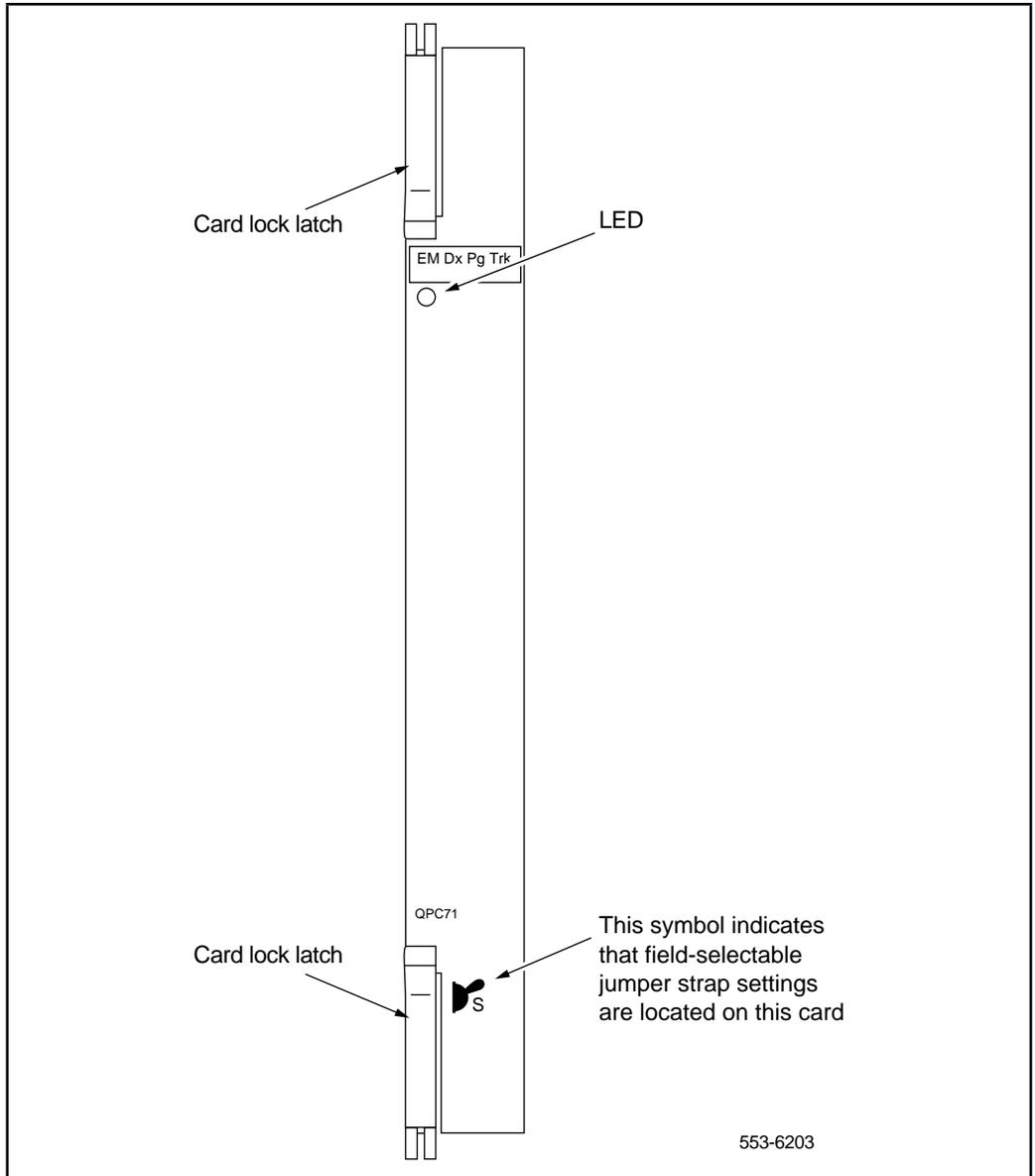
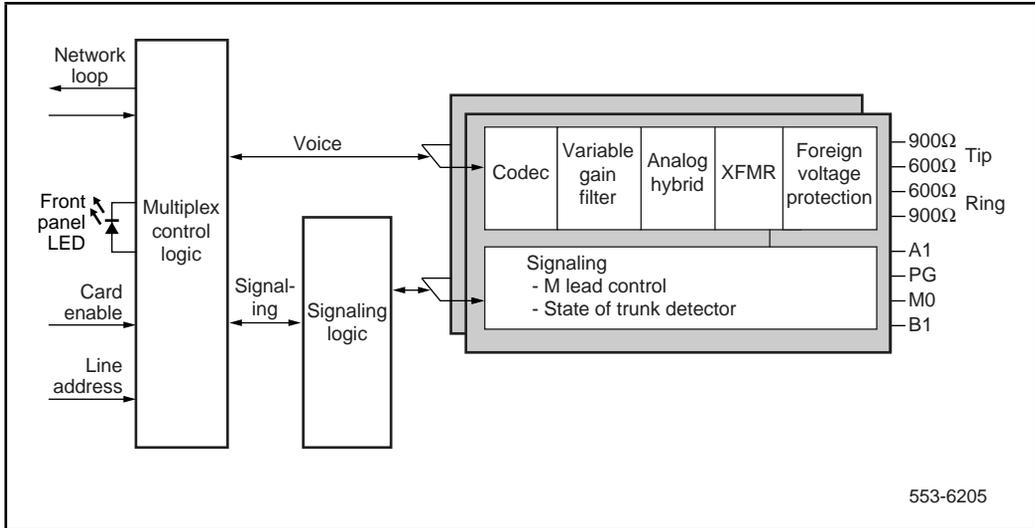


Figure 55
E&M/DX and paging trunk card—block diagram



- near-end seizure and outpulsing via the M lead when in E&M mode, and via the A1 lead when in DX mode
- isolation of foreign potentials on the loop from portions of the transmission and signaling circuit
- external 2-wire to internal 4-wire conversion of the transmission path via hybrid transformer
- controlled false detection compensation on outpulsing
- switchable 2-dB pad for controlling gain between line-to-trunk and trunk-to-trunk on normal non-VNL connections, and gain and echo protection on VNL through balance and terminal balance connections

Multiplex control

The multiplex control logic is common to both channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected time slots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Operation

The optional applications, features, and signaling arrangements for each unit on the E&M/DX and paging trunk card are assigned through the Trunk Administration (LD 14) and Trunk Route Administration (LD 16) programs and/or jumper strap settings on the card. See the *X11 input/output guide* for detailed information on assigning features and services to trunks.

The two release control options available are: EITHER or ORIGINATING party control. These can be specified for the Meridian 1 system end (near end), or for the CO or other PBX end (far end). Joint party control can also be specified for the far end.

Idle circuit states

Trunk is idle

No current flow in signaling lead for DX. State of trunk detector is high. For E&M signaling, M lead is ground and E lead is open circuit.

Trunk cards are scanned periodically by the common equipment (CE). A trunk circuit receives its card enable in time slot 0. The signaling logic responds with a signal on the data input bus.

Outgoing calls

Origination of call

A Meridian 1 switch seizes a trunk facility by sending a message to the trunk circuit signaling logic causing K1 relay to operate. The M lead changes from ground to battery in E&M; or from no current flow to current flow in A1 lead for DX signaling.

The signaling logic responds to the enable with a signal on the data input bus. The scan stops and the card receives further enables. The signaling logic also receives signals on the data output bus and, on receipt, will output contents of the input register onto the data input bus, thus reporting change of state. The scan cycle will then continue.

When ready for outpulsing, a trunk outpulsing enable is sent in an assigned timeslot (not timeslot 0 or timeslot 1) and a message is sent to the signaling logic to set up the trunk logic such that K1 is now controlled by the signal level of the data output bus in the assigned timeslot.

The common equipment (CE), by sending the appropriate data in the selected timeslot, causes K1 to outpulse the required digits. (See [Tables 26, 27, and 28](#) for DX signaling, and [Figures 56 and 57](#) for E&M.)

At the completion of outpulsing, another message is sent to the signaling logic that restores control of K1 to the signaling logic, and the enable in the assigned timeslot is removed.

If answer supervision is provided by the far end, there will be a change from open to ground on the E lead (ground detection) for E&M signaling, or from current flow to no current in the A1 lead (bridge unbalance detection) DX. The signaling logic will subsequently report change of state to the CE.

Disconnection

Disconnection is caused by near end control trunk release.

See [Tables 26 through 28](#) for DX signaling and [Figures 56 and 57](#) for E&M signaling.

Table 26
DX signaling for outgoing calls, originating party release

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (dial tone from far end; far end ready for digits)	current flow	high
Digits	current flow interrupted for each pulse	high
Far end answers	no current flow	low
Far end on hook first	current flow	high
Network taken down and trunk idled when near end goes on hook;	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high

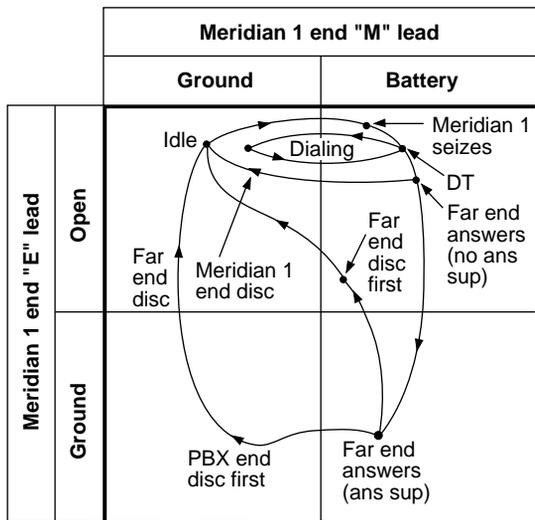
Table 27
DX signaling for incoming calls, originating party release

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (dial tone to far end; near end ready for digits)	current flow	low
Digits	current flow interrupted for each pulse	low-high-low for each pulse
Near end answers	no current flow	low
Far end on hook first	current flow	high
Network taken down and trunk idled	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high

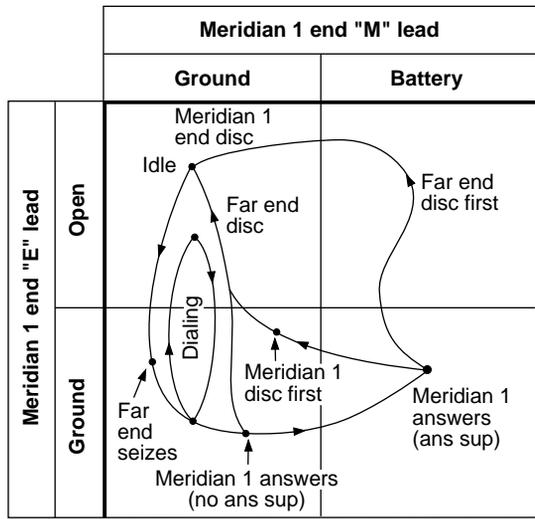
Table 28
DX signaling, originating party release on tandem connections, outgoing calls

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (far end ready for digits)	current flow	high
Dial CO/FX/WATS	current flow interrupted for each pulse	high
Stop sender	no current flow	low
Go sender (universal service provided by far end PBX if originating end is senderized) (CO/FX/WATS offices ready for digits)	current flow	high
Stored office DN digits	current flow interrupted for each pulse	high
Outpulsed	no current flow	low
Far end answers	no current flow	low
Far end on hook first	current flow	high
Near end on hook, network taken down, trunk idled	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high

Figure 56
E&M lead signaling patterns, originating party release



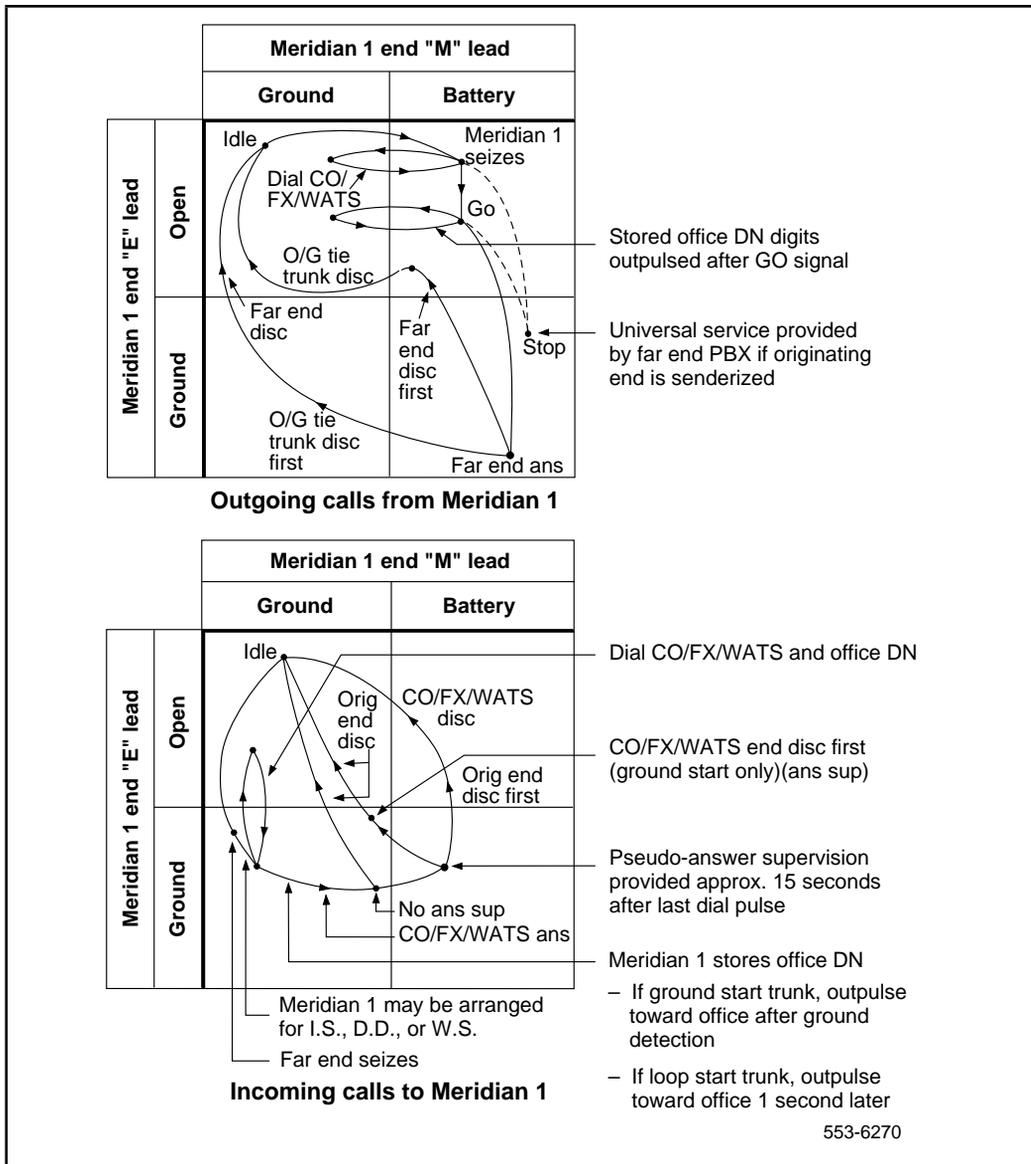
Outgoing calls from Meridian 1



Incoming calls from Meridian 1

553-6269

Figure 57
E&M lead signaling patterns, originating party release on tandem connections



Incoming calls

Origination of call

The far end initiates the call.

During a change of state, ground is placed on the E lead in E&M signaling, or current flow in A1 lead for DX. The appropriate signaling logic input is changed from high to low. A card enable response on the data input bus stops the scan until a change of state is reported to CE.

Dial pulses are subsequently applied from the far end in the form of ground-open on the E lead, or current flow/no current flow in the A1 lead (interruptions). These are detected as changes of state at the signaling logic input.

When the call is completed and the terminating party answers, relay K1 is operated as a result of a message from the CE to the signaling logic, causing the appropriate signal on the M or A1 leads.

If the far end is senderized, the Meridian 1 may be operated in any mode; immediate start, delay dial, or wink start, as assigned on a class of service basis. The class of service modes are shown in [Table 29](#).

Table 29
Class of service modes

Operation	Class of Service
Immediate start	IMM
Delay dial "A"	IMM
Delay dial "B"	DDL
Wink start	WNK

For immediate start class of service (COS), following the seizure signal the far end can start pulsing after the distant end controlled standard delay (normally 70 ms minimum). For stop/go signaling, following the seizure signal, almost immediately an off hook/on hook (320 ± 64 ms for delay dial, 256 ± 64 ms for wink start) signal will be returned to the distant end to satisfy delay dial or wink start mode.

The distant end detecting this signal may start pulsing after the distant end controlled standard delay (normally 70 ms minimum).

When delay dial “B” or wink start COS is used, outgoing calls require stop/go signal from the far end, otherwise the trunk cannot outpulse.

Disconnection

The trunk is released by a disconnect message to the signaling logic that causes K1 to release.

Transmission

Talking connection

Audio signals received from the card tip and ring terminals are passed via the hybrid transformer to the low-pass filter hybrid analog-to-digital filter, then through the PCM codec to the CE for switching. The codec encodes the analog input to produce a digital signal on the data input bus.

Signals received from the common multiplexing circuitry on the data output bus into the codec are decoded to produce the codec analog output. The analog signal from the codec is connected to the input of the low-pass digital-to-analog filter. This circuit integrates the amplitude modulated pulses from the codec, filters the result, and amplifies the analog signals for connection to the hybrid transformer, and through the transformer to the ring and tip leads.

Paging

When used in a paging application, the circuit is connected to a customer-provided paging amplifier system. Connection of the E&M/DX and Paging card to a paging amplifier system is discussed in [“Applications” on page 144](#).

When accessed via dialing or the attendant press-to-talk key, a message is sent to the signaling logic on the circuit causing K1 to be operated. This action causes a loop closure across control leads A1 and PG via a K2 make-contact to operate a customer-provided system. A typical use of this circuit is cutting off music and switching over the paging trunk transmission path to the input of the paging amplifier. The attendant’s paging key has a Preempt feature; that is, by the use of this key, the attendant can access a busy trunk and usurp the current user.

To release the trunk a disconnect message is sent to the signaling logic. This causes K1 to release.

Trunk signaling conditions

Figure 56 on page 128 shows the various states that the trunk card interface goes through under E&M signaling conditions during originating party release when the route does not involve a CO/FX/WATS trunk. Figure 57 on page 129 shows the states that the trunk card interface goes through under E&M signaling conditions during originating party release on tandem connections. These conditions apply when the originating end is senderized and the route is via a CO/FX/WATS trunk. It is not applicable to CCSA lines.

[Table 26, “DX signaling for outgoing calls, originating party release,” on page 125](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release for an outgoing call. [Table 27, “DX signaling for incoming calls, originating party release,” on page 126](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release for an incoming call. [Table 28, “DX signaling, originating party release on tandem connections, outgoing calls,” on page 127](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release on tandem connections for an outgoing call. [Table 30](#) shows the various states that the trunk card interface goes through under DX signaling conditions during originating party release on tandem connections for an incoming call.

Table 30
DX signaling, originating party release on tandem connections, incoming calls

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (Meridian 1 may be arranged for IS, DD, or WS) (near end ready for digits)	current flow	low
Dial CO/FX/WATS & office DN Stored digits outputted on CO/FX/WATS trunk after ground detection if ground start, but after 3 seconds if loop start	current flow interrupted for each pulse	low-high-low for each pulse
If ANS SUP, pseudo-answer supervision is sent approximately 13 seconds after last dial pulse received	no current flow	low
If NO ANS SUP	current flow	low
CO end disconnects (CO ground start—trunk idled and network taken down, but incoming tie trunk held under control of originating end)	current flow	low
Originating end disconnects—network taken down and trunk idled	no current flow	high

Electrical specifications

This section gives the electrical specifications for the E&M/DX and paging trunk card.

Trunk interface electrical characteristics

[Table 31](#) gives the electrical characteristics for the trunk interface units on the E&M/DX and paging trunk card.

Table 31
Trunk interface electrical characteristics

Characteristic	Specification
Circuits per card	2
Nominal impedance	600 or 900 ohms
Signaling	E&M or DX (2- or 4-wire)
DX loop resistance	less than or greater than 2500 ohms
Paging equipment interface	optional
Line leakage	>30 k Ω
DX loop range	5 k Ω with ± 20 V ground potential difference; far-end battery -42.75 V through -52.5 V

Overload level

Signal levels exceeding +5 dBm applied to the tip and ring will cause distortion in the signal.

Power requirements

[Table 32](#) lists the power requirements for the E&M/DX and paging trunk card.

Table 32
Power requirements

Voltage	Tolerance	Current (max.)
+10.0 V dc	±5 %	30 mA.
-10.0 V dc	±5 %	30 mA.
+6.0 V dc	±1 %	80 mA.
-6.0 V dc	±1 %	80 mA.
-48 V dc	±12 %	350 mA.

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 33](#) lists the environmental specifications for the E&M/DX and paging trunk card.

Table 33
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40° to +70° C (-40° to +158° F)

Connector pin assignments

The E&M/DX and paging trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the E&M/DX and paging trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 58](#), and a list of the connections to the E&M/DX and paging trunk card is shown in [Table 34](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Figure 58
E&M/DX and paging trunk card—typical cross connection example

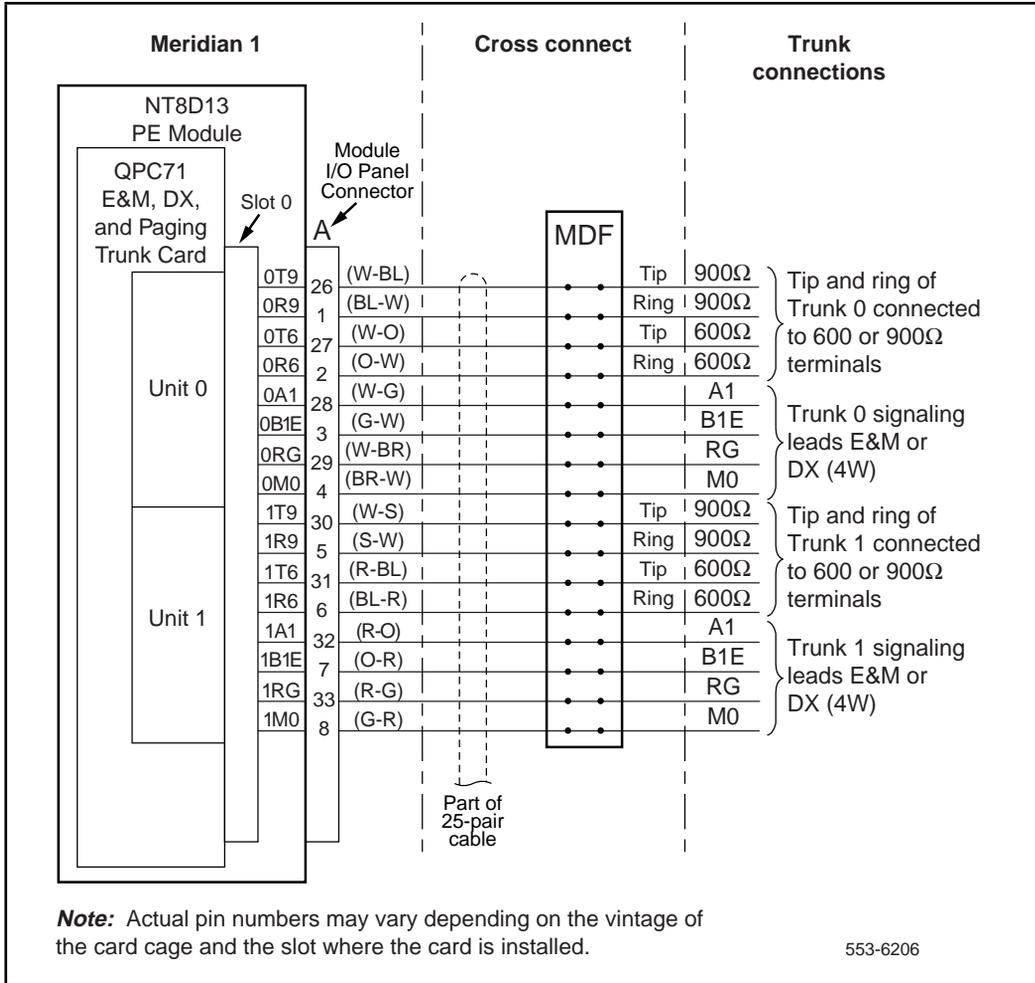


Table 34
E&M/DX and paging trunk card—backplane pinouts

Connector Pin	Signal	Unit
36A	Tip, 900Ω	0
37A	Ring, 900Ω	
38A	Tip, 600Ω	
39A	Ring, 600Ω	
29A	Signaling Lead A1	
30A	Signaling Lead B1E	
32A	Signaling Lead M	
2A	Tip, 900Ω	1
3A	Ring, 900Ω	
4A	Tip, 600Ω	
5A	Ring, 600Ω	
9A	Signaling Lead A1	
10A	Signaling Lead B1E	
12A	Signaling Lead M	

Configuration

The trunk type for each unit on the card as well as its terminating impedance and balance network configuration is selected by software service change entries at the system terminal and by switch settings on the card. The locations of these switches are shown in [Figure 59](#).

Switch settings

The option switches for each trunk line must be set to select the trunk type. If the trunk type is set to DX, then the conductor loop resistance must also be set. The switch settings are shown in [Table 35](#).

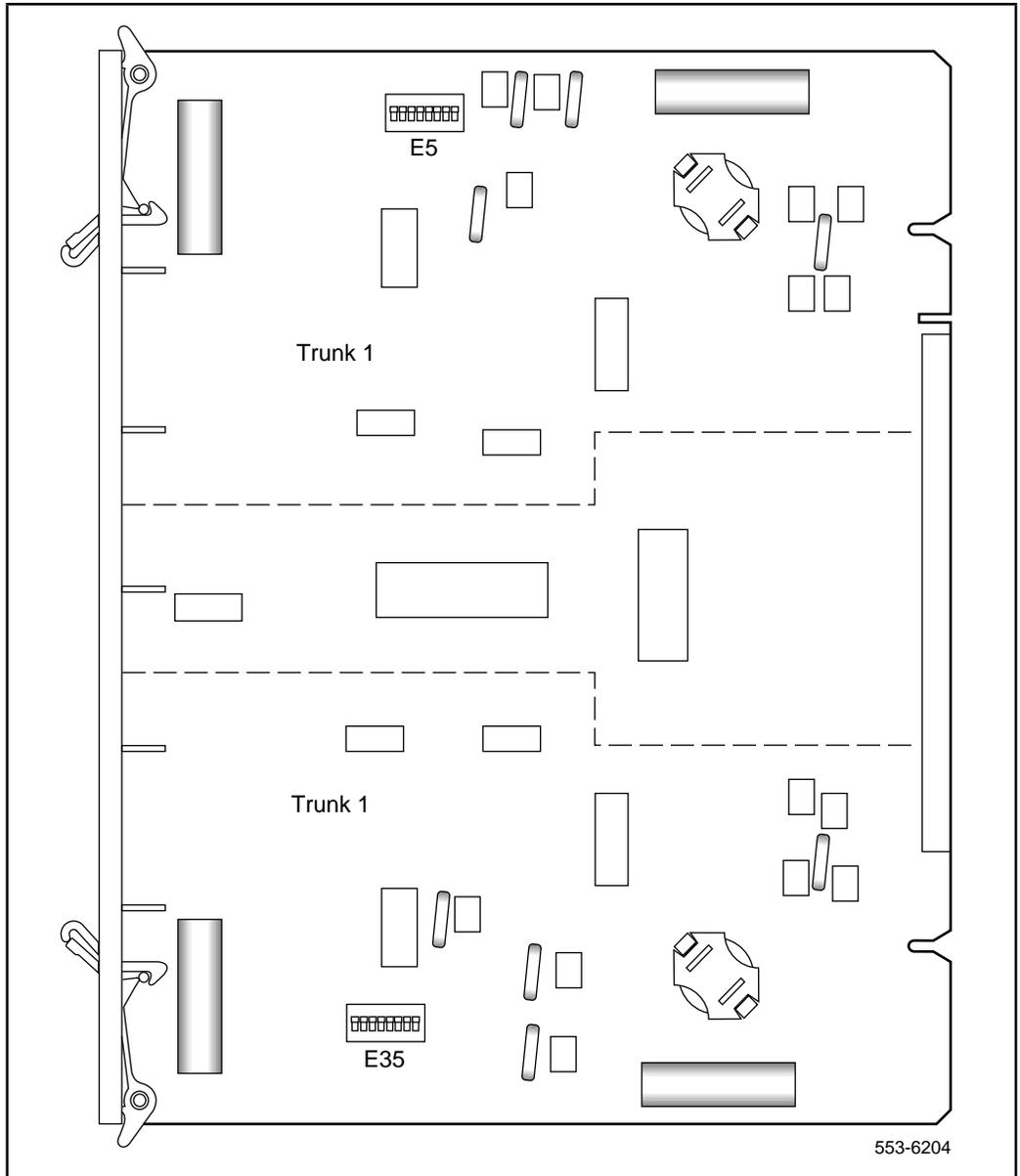
Table 35
E&M/paging trunk card—option switch settings

Trunk 0 and 1 options	Switches							
	1	2	3	4	5	6	7	8
E&M	on	on	on	off	on	on	off	on
DX 2-wire (conductor loop resistance <2.5 kΩ)	off	off	on	on	on	off	on	off
DX 2-wire (conductor loop resistance >2.5 kΩ)	off	off	off	off	on	off	on	off
DX 4-wire (conductor loop resistance <2.5 kΩ)	on	on	on	on	off	off	on	off
DX 4-wire (conductor loop resistance >2.5 kΩ)	on	on	off	off	off	off	on	off
Paging	on	on	on	on	on	on	on	on

Note: DX trunks will not work properly unless they are balanced at the far end.
 e.g., If the conductor loop <2.5 kΩ, the far end balancing resistor is standard.
 If the conductor loop >2.5 kΩ, the far end balancing resistor is standard plus 2.5 kΩ.
 However, when connecting an SL-1 to an SL-1, the option switches should be set for <2.5 kΩ at one end and >2.5 kΩ at the other end. Also use a similar treatment when connecting to a pulse J69 trunk.

Switch E35 is used to select the trunk type for Trunk 0, and switch E5 is used to select the trunk type for Trunk 1.

Figure 59
E&M/DX and paging trunk card—switch locations



Service change entries

The trunk type, features, signaling arrangement, and insertion loss for each trunk are selected by making service change entries in the Trunk Administration program (LD 14). Refer to the Meridian 1 *X11 input/output guide* for LD 14 service change instructions.

Note: When assigning this card in LD 14, both trunk interface units on the card must have an identical entry for the prompt SIGL, regardless of the application (tie, PAG, etc.). When used as a paging circuit, SIGL should be assigned as one of eam, dx2, or dx4.

Insertion loss

The transmission properties of each trunk are characterized by class of service (COS) assignments included in the trunk data block. The assignments can be either:

- Via Net Loss (VNL)
- non-VNL, either transmission compensated (TRC) or non-transmission compensated (NTC)

To ensure stability and minimize echo on long-haul connections, 4-wire tie and CCSA are assigned either COS (a) or (b). Similarly 2-wire, tie, CO, FX, WATS, CCSA, and 4-wire non-VNL facilities are assigned with one of the options in (b).

The TRC and NTC class options given in (b) determine the operation of the switchable pads contained in the trunk circuit cards. They are assigned as follows:

- TRC: for a 2-wire non-VNL trunk facility with a loss of greater than 2 dB or for which impedance compensation is provided; or for a 4-wire non-VNL facility
- NTC: for a 2-wire, non-VNL trunk facility with a loss of less than 2 dB or when impedance compensation is not provided

The control pad switching for the various through connections and the actual loss introduced is given in [Figure 60](#).

Figure 60
Pad switching algorithm

Through connection			Terminal balance		Through balance
To From			Non-VNL		VNL
			Station lines Attendant lines	Non-transmission compensated (2 wire facility loss <2 dB or not impedance compensated)	Transmission compensated (2-wire facility loss >2 dB or impedance compensated or 4-wire facility)
Legend					
IN	Pad switched IN				
OUT	Pad switched OUT				
NA	Not applicable				
Station lines Attendant lines			NA	OUT	OUT
			(5)	(1)	(1)
			NA	NA	NA
			(3)		
Terminal balance	Non-VNL	Non-transmission compensated (2 wire facility loss <2 dB or not impedance compensated)	NA	IN	IN
		Transmission compensated (2 wire facility loss <2 dB or impedance compensated or 4-wire facility)	(1)	(1)	(1)
			OUT	IN	IN
			(1)	(1)	(1)
Through balance	VNL	4-wire Tie CCSA	NA	IN	IN
			(3)	(1)	(1)
			IN	IN	IN
			(1)	(1)	(1)
			IN	NA	NA
			(1)		

Note 1: Actual loss (dB) for each connection is given in parentheses.

Note 2: All trunks have an effective gain of 1.5 dB and contain 4 dB switchable pads except for the QPC71 which has 2 dB switchable pads.

Note 3: The Meridian 1 controls the overall connection to connection gain.

553-6273

Applications

Signaling interface

To assist you in connecting the E&M/DX and paging card to different trunk types, [Figure 61](#) shows a simplified schematic diagram of the DX bridge (2-wire/4-wire) signaling, E&M signaling, and paging interface circuit.

[Figure 62](#) shows a simplified schematic of a complete DX signaling circuit.

Figure 61
Simplified schematic of DX bridge signaling/E&M signaling and paging interface

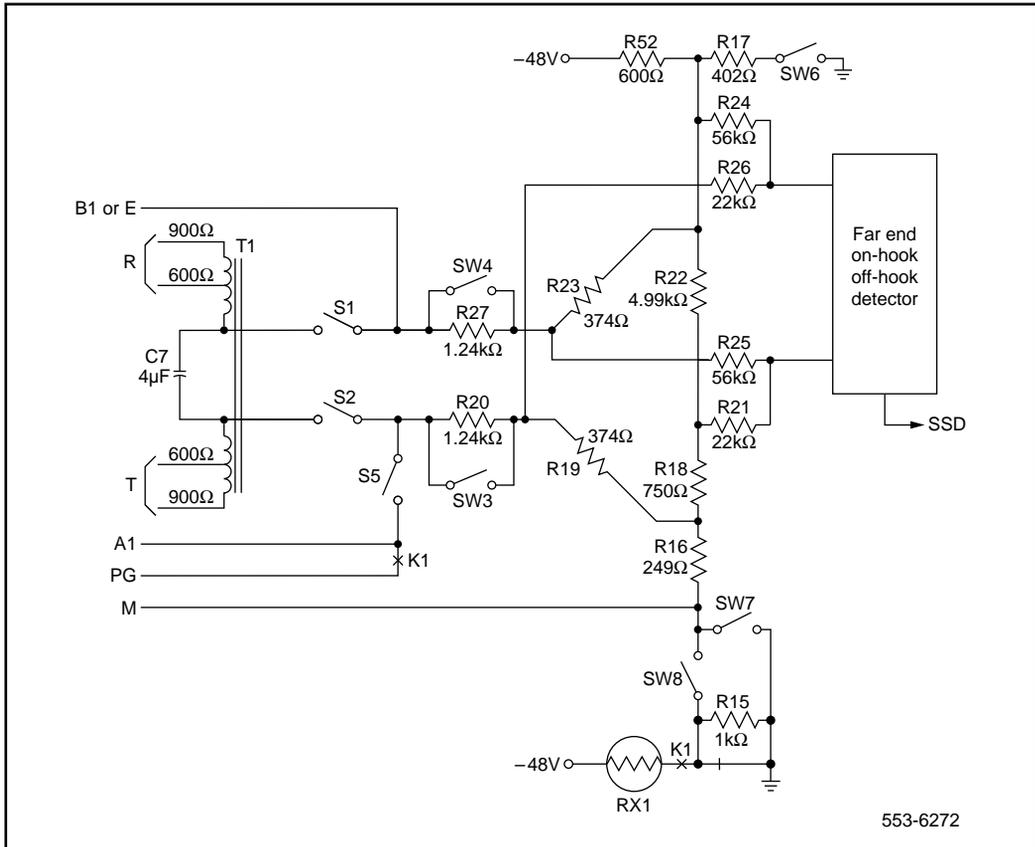
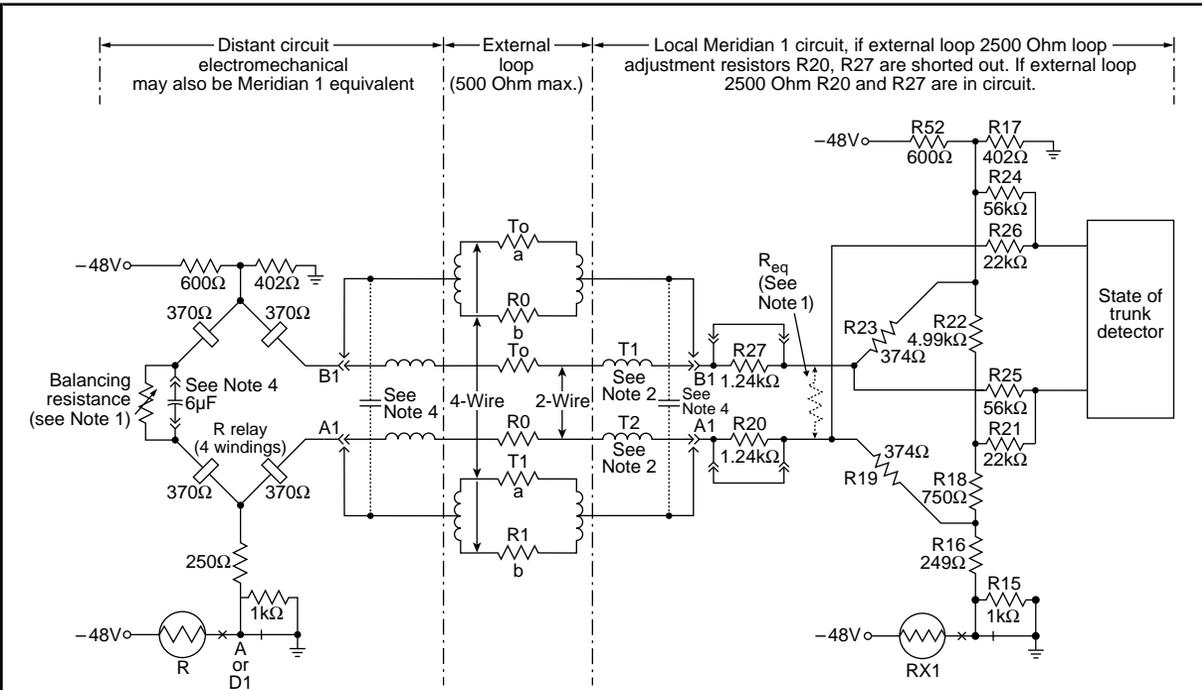


Figure 62
Simplified schematic of DX bridge signaling circuit



- Note 1:** The equivalent bridge circuit resistance as seen from distant trunk during the signaling is 1250 ± 125 Ohms.
- Note 2:** T1 resistance is 36 Ohms for 900 Ohm termination option, 26 Ohms for 600 Ohm termination option.
- Note 3:** Compute total balancing resistance as follows (note that in some new DX circuits, a 1260 Ohm resistor is permanently wired in series with the selectable resistance).

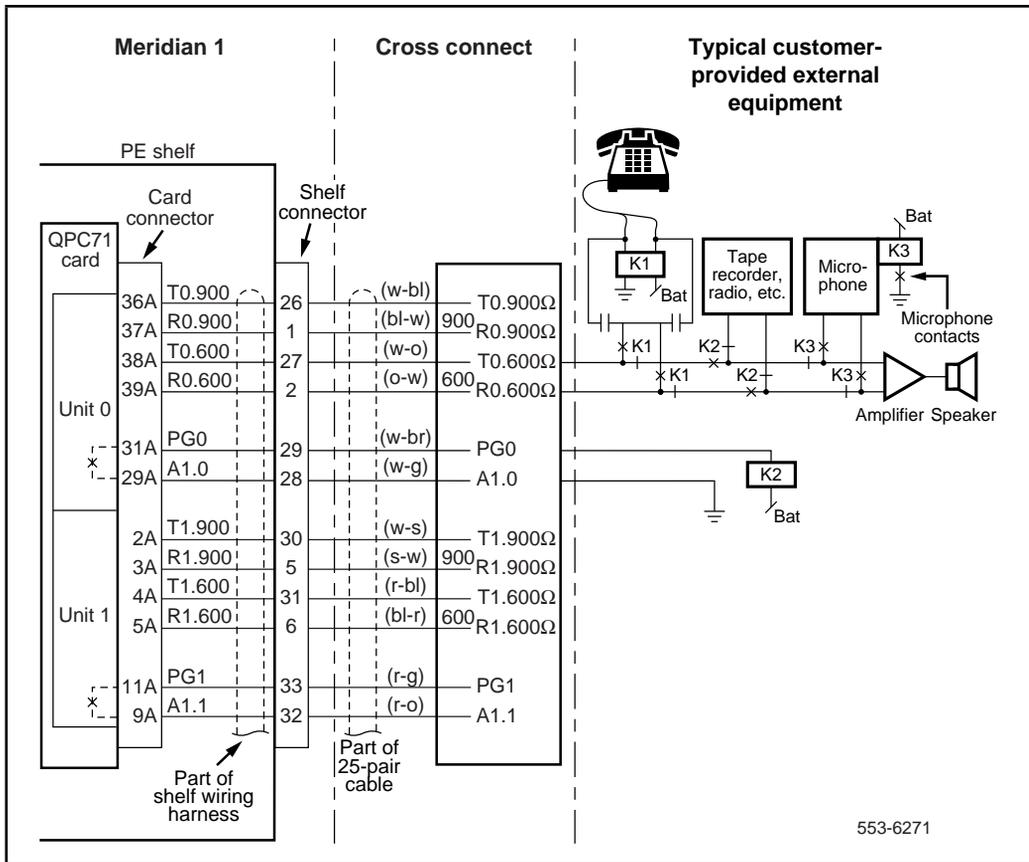
$$\text{Total balancing } R = \text{external loop resistance} + 2 \times T1 \text{ resistance (for 2-wire operation only)} + [(R27 + R20) \text{ if not shorted out}] + R_{eq}$$
 Resistance of transformers at electromechanical end is low and can be ignored.
- Note 4:** When the Meridian 1 is connected to an electromechanical trunk using a 4 microfarad capacitor must be connected from the A1 to B1 lead at each end of the trunk (one of these capacitors may already be installed at the electromechanical end) so it is recommended that a 6 microfarad capacitor be connected in series with the balancing resistance.
- Note 5:** When the Meridian 1 is connected to Meridian 1 or pulse and external loop resistance is 2500 Ohms, the loop adjustment resistors must be shorted out in one machine. If 2500 Ohms, the loop adjustment resistors must be shorted out in both machines.

Paging operation

The circuit shown in [Figure 63](#) should be used when connecting the E&M/DX and paging card to a paging system. When accessed via dialing or the attendant press-to-talk key, a message is sent to the signaling logic on the circuit that causes K1 to be operated. This action causes a contact on relay K2 to close the loop across control leads A1 and PG. In a customer-provided system, this is used to cut off the music and switch the paging trunk transmission path to the input of the paging amplifier. The attendant's paging key has a Preempt feature. By the use of this key, the attendant can access a busy trunk and usurp the current user.

The Meridian system releases the trunk by sending a disconnect message to the signaling logic that causes K1 to release.

Figure 63
Schematic showing paging system connections



QPC74 Recorded Announcement Trunk Card

Introduction

The QPC74 Recorded Announcement Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The recorded announcement trunk card interfaces four recorded announcement trunk lines to a Meridian 1 switch. It supports both continuous and start/stop modes of operation. Each trunk is independently configurable using the Trunk Administration Program (LD 14) and the Trunk Route Administration Program (LD 16).

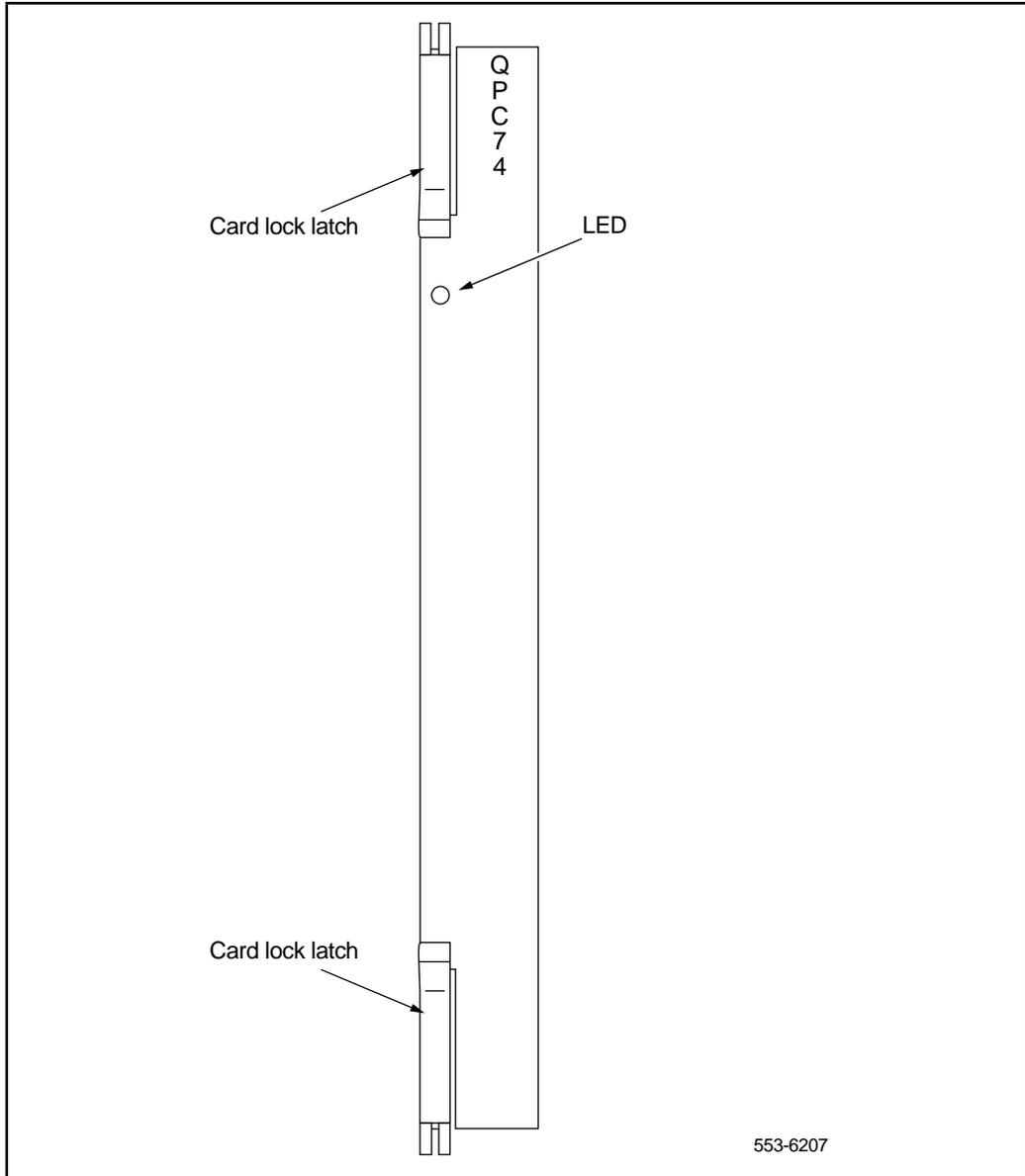
Physical description

The recorded announcement trunk card mounts in any PE slot. The four trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The recorded announcement trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 64](#)). This LED should only be lit when there is a problem with the card. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

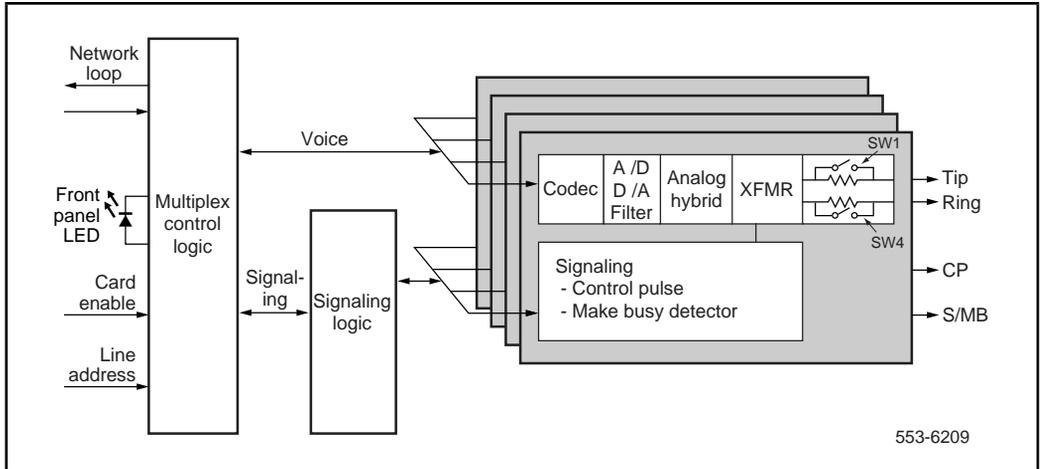
Figure 64
Recorded announcement trunk card—faceplate



Functional description

Figure 65 shows a block diagram of the major functions contained on the recorded announcement trunk card. Each of these functions is described on the following pages.

Figure 65
Recorded announcement trunk card—block diagram



Card interfaces

The recorded announcement trunk card passes both voice and signaling data over the network loop. Network loops are discussed in detail in “Peripheral equipment” on page 22.

Trunk interface units

The recorded announcement trunk card contains four identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. The impedance matching and a balance network allow selectable termination of tip and ring impedance (up to 600 Ω) by providing jumper-selectable 300 Ω distributing resistors in each leg. This allows up to ten trunks to be bridged to a single low-impedance (2 Ω or 4 Ω) source. A 600 Ω impedance can also be selected for interface with a 600 Ω impedance source.

Four codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports one trunk interface unit.

Clamping diodes protect the input filter and hybrid from over-voltages and provide AC coupling. Audio signals received from the circuit card tip and ring terminals (T and R) are passed through the transformer to the low-pass A/D filter in the hybrid circuit. The A/D filter limits the frequency spread of the input to a nominal 200 Hz through 3400 Hz bandwidth, and amplifies the signal for application to the analog input of the hybrid codec. A resistor in the hybrid limits the codec input current. The hybrid codec encodes the analog signal into a digital signal that is applied to the common multiplexing circuitry.

Multiplex control

The multiplex control logic is common to all four channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected time slots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Operation

The optional applications, features, and signaling arrangements for each unit on the recorded announcement trunk card are assigned through the Trunk Administration (LD 14) and Trunk Route Administration (LD 16) programs and/or jumper strap settings on the card. See the *X11 input/output guide* for detailed information on assigning features and services to trunks.

The Recorded Announcement (RAN) feature allows the customer to:

- define the type of call intercept
- allow the connection of a customer-provided recorded announcement machine to the Meridian 1 system
- specify the language RAN route to be used for a Multi-Language Wake-Up call

A customer can specify up to five different intercept conditions that result in a connection to the recorded announcement machine. Each intercept condition has a different announcement. An example of an announcement for each intercept treatment is listed below:

- Access denied: “You are not allowed access to the number you have dialed. Please dial 0 for assistance.”
- Call to a vacant number: “The number you have dialed is not in service. Please check your directory and call again.”
- Maintenance busy number: “The number you have dialed is temporarily out of service. Please check the number and dial again. If you are calling from outside, please stay on the line and an operator will help you.”
- Code or toll restricted call by a TLD station or a tie trunk: “You are not allowed access to the number you have dialed. Please dial 0 for assistance.”
- Calls to a Listed Directory Number (LDN): “The call cannot be completed as dialed. Please check the number and try again.”

[Table 36](#) lists the intercept treatments.

Table 36
Intercept treatment and associated types of announcements

Intercept Situation	Station	Attendant Extended Calls	Calling Party	
			Tie Trunk	CCSA/DID Trunk
Access Denied	C (O)	C (O)	C (O)	C (A)
Call to a vacant number	C (O)	C (O)	C (O)	C (A)
Maintenance busy number or RPE failure	C (O)	C (O)	C (O)	C (A)
Code/toll restricted call by a toll denied (TLD) station or a tie trunk	C (O)	C (O)	C (O)	N/A
Calls to Listed Directory Number (LDN)	C (O)	C (O)	C (O)	N/A
Legend:				
C = Choice of overflow tone, intercept to attendant, or recorded announcement (default in brackets)				
O = Overflow tone (ovf)				
A = Intercept to the attendant (att)				
N/A = Not applicable				

Recorded announcement modes of operation

Each trunk unit can be configured to operate in one of these modes of operation:

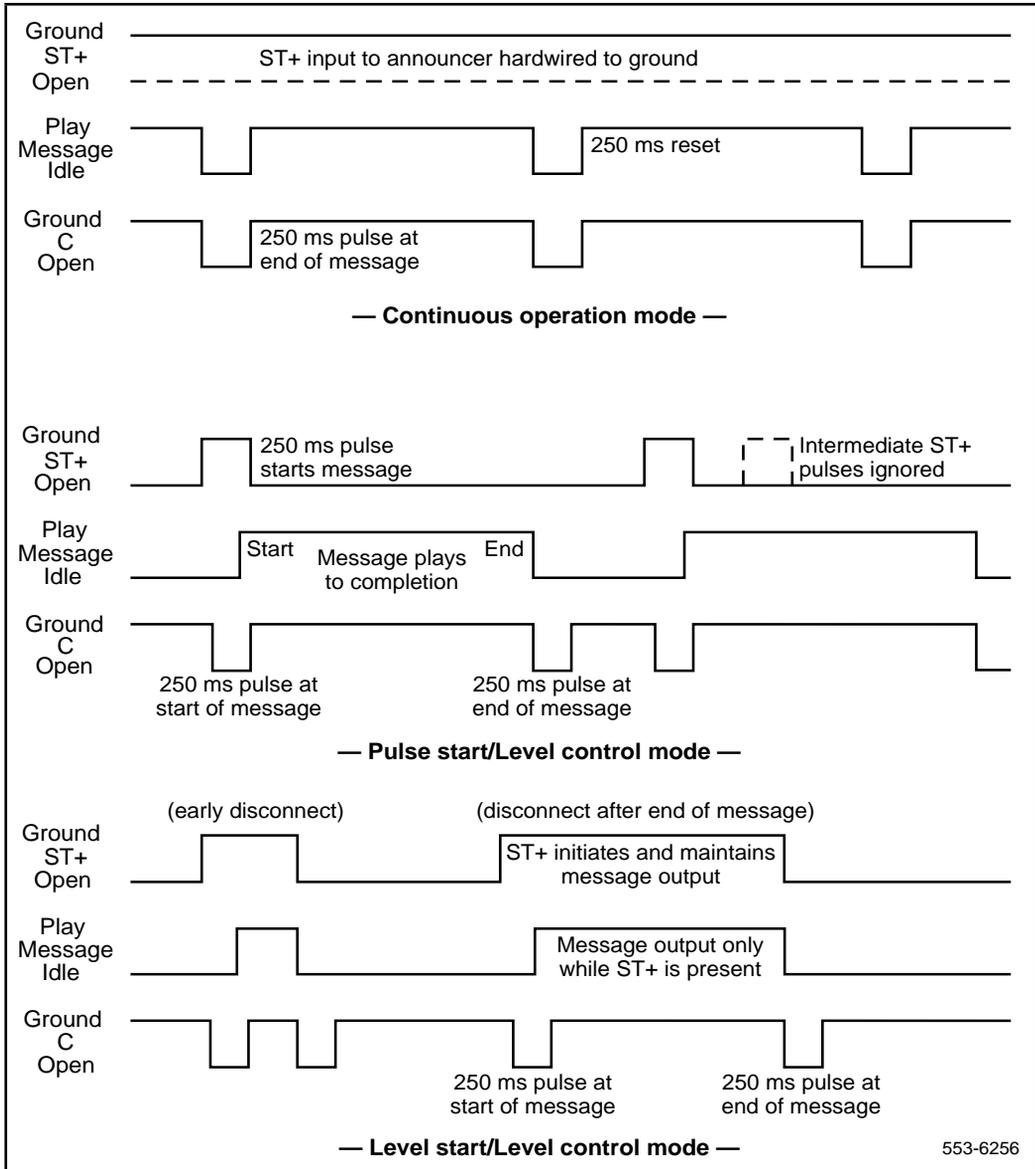
- continuous operation
- pulse start mode
- level start mode

[Figure 66](#) shows the relationship of control signals to message playback for the operating modes available in announcement machines. The signal names shown in the figure are typical of Northern Telecom digital announcement machines and are used here for comparison to other manufacturer's equipment that might be used.

Continuous operation mode In the continuous operation mode (sometimes called the *Audichron* mode), a message is constantly played, over and over again. Callers “barge in” on a playing message or are provided with a ringback tone until the message begins its next playing. The start line (ST+) on the announcement machine is hardwired to always be active. At the end of each message, a pulse is issued on the “CP” line that is used by the trunk unit to cut through to the waiting call.

Note: The “SMB” (busy) signal line is used to indicate availability of an announcement machine message to the trunk unit when configured for the continuous operation mode. This signal is made active (ground) by the announcement machine if the channel contains a recorded message and is in an on-line condition. The “SMB” line is not connected to a trunk unit when configured for start mode operation.

Figure 66
RAN control signals



Start modes In a start mode (sometimes called the *Code-a-Phone* or *start-stop* mode), playback of a message does not begin until a start pulse is received by the announcement machine. Two subcategories of the start mode exist pulse start and level start.

In the pulse start mode, a start pulse activates playback of a message that continues until completion (see [Figure 66](#)). The announcement machine ignores all other start pulses that might occur until the message is complete.

In the level start mode, the start signal is a “level” rather than a pulse. The leading edge of the start signal initiates message playback that continues until either the trailing edge of the start signal occurs or the end of the message is reached. A message that is terminated by the trailing edge of a level start signal is immediately reset and again made available for playback.

Electrical specifications

This section lists the electrical specifications of the recorded announcement trunk card.

Trunk interface electrical characteristics

[Table 37](#) gives the electrical characteristics for the recorded announcement trunk interface units on the card.

Table 37
Trunk interface electrical characteristics

Characteristic	Specification
Circuits per card	4
Card options	Selectable input source impedance: <ul style="list-style-type: none">— Use with a low-impedance source to allow bridging of many trunks to the same channel— Use with a 600 Ω impedance source on a one-to-one basis
Transformer Impedance	600 Ω
Line Leakage	30,000 Ω
Effective Loss	2.5 dB

Power requirements

[Table 38](#) lists the power requirements for the recorded announcement trunk card.

Table 38
Recorded announcement trunk card—power requirements

Voltage	Tolerance	Current (typical)
+10.0 V dc	±5 %	30 mA.
−10.0 V dc	±5 %	30 mA.
+6.0 V dc	±1 %	80 mA.
−6.0 V dc	±1 %	80 mA.
−48 V dc	±12 %	350 mA.

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 39](#) lists the environmental specifications for the recorded announcement trunk card.

Table 39
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	−40° to +70° C (−40° to +158° F)

Connector pin assignments

The recorded announcement trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Recorded announcement trunks connect to the recorded announcement trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 67](#), and a list of the connections to the recorded announcement trunk card is shown in [Table 40](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Figure 67
Recorded announcement trunk card—typical cross connection example

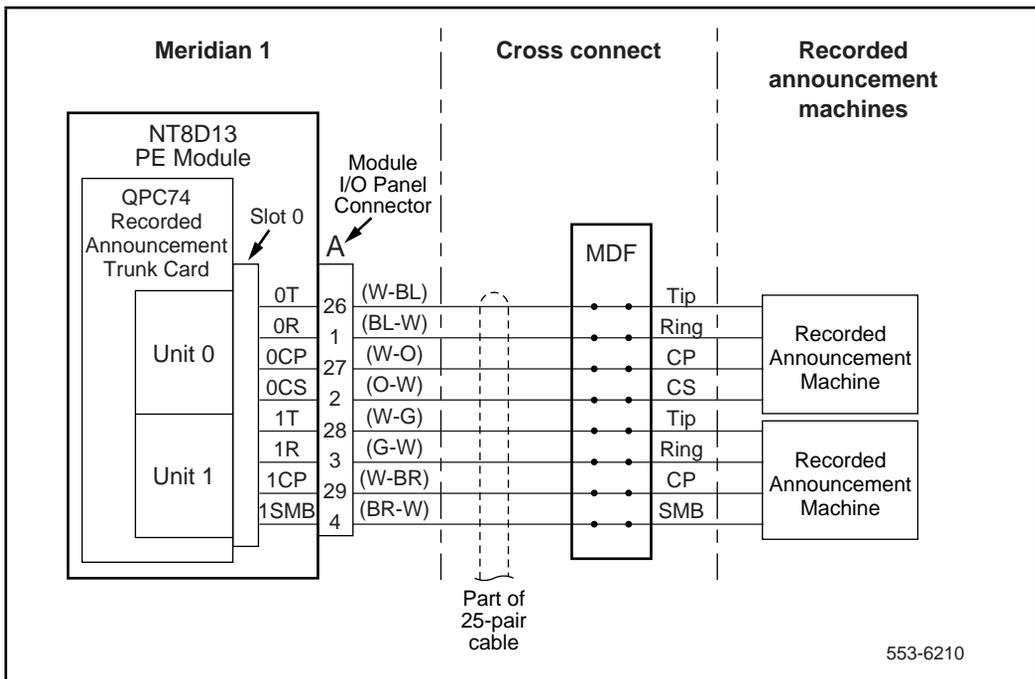


Table 40
Recorded announcement trunk card—backplane pinouts

Connector Pin	Signal	Unit	Termination
36A	Tip		
37A	Ring	0	To recorded announcement machine (see owners manual)
38A	CP		
39A	CS (SMB)		
29A	Tip		
30A	Ring	1	To another recorded announcement machine (or bridged)
31A	CP		
32A	CS (SMB)		
2A	Tip		
3A	Ring	2	To another recorded announcement machine (or bridged)
4A	CP		
5A	CS (SMB)		
9A	Tip		
10A	Ring	3	To another recorded announcement machine (or bridged)
11A	CP		
12A	CS (SMB)		

Configuration

The mode of operation for each unit on the card must be selected using switch settings on the card and by making service change entries in the Trunk Administration program (LD 14) and the Trunk Route Administration program (LD 16). See the *X11 input/output guide* for detailed information on assigning features and services to trunks. [Figure 68](#) shows the location of the switches.

Switch settings

The option switches for each recorded announcement trunk must be set to select the trunk interface impedance and type. The switch settings are shown in [Tables 41](#) and [42](#).

Software service changes

The trunk type, features, and signaling arrangement for each trunk are selected by making service change entries in the Trunk Administration program (LD 14). Refer to the Meridian 1 *X11 input/output guide* for LD 14 service change instructions.

Figure 68
Recorded announcement trunk card—switch and jumper locations

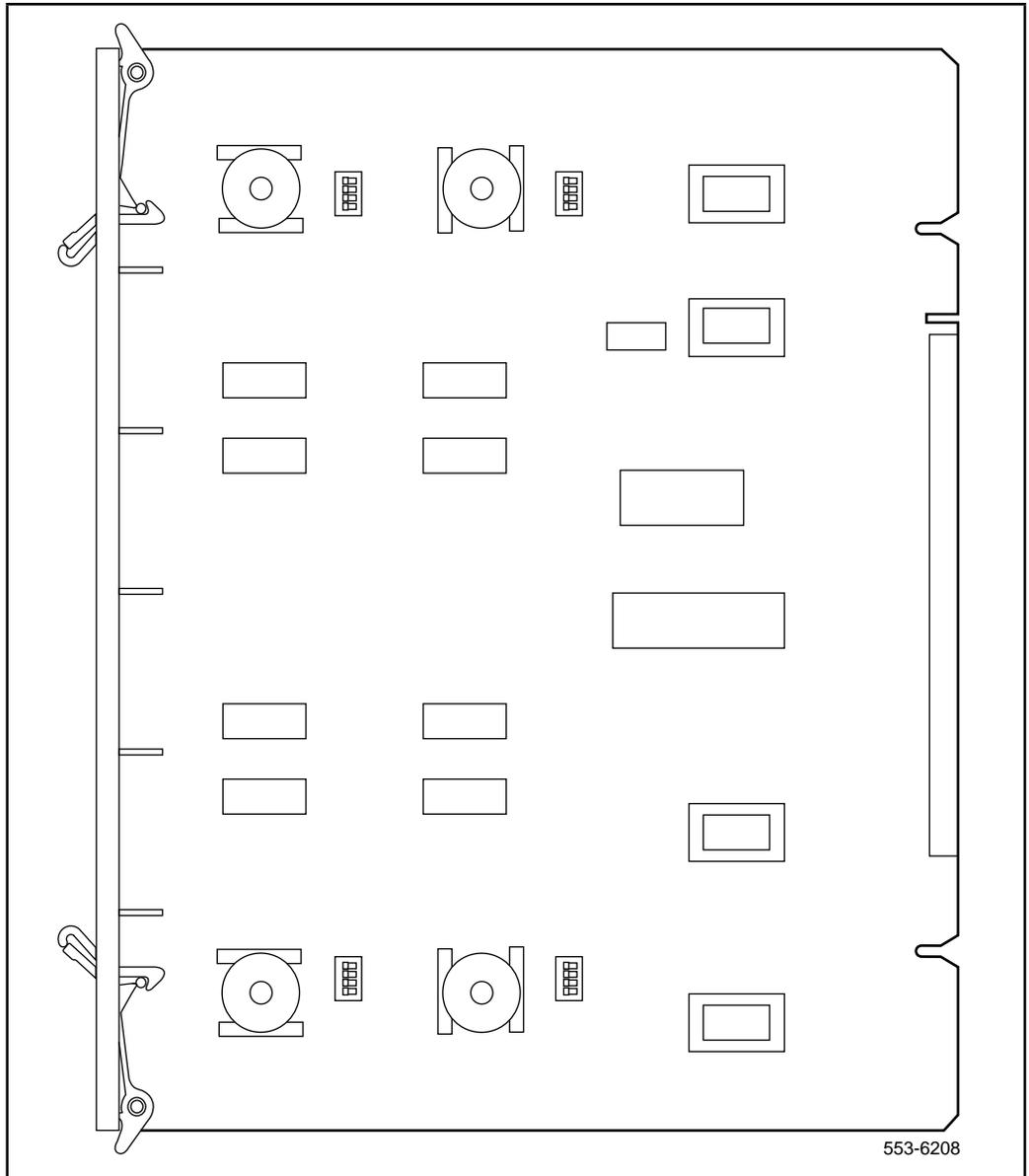


Table 41
Recorded announcement trunk card—switch settings for units 0 and 1

Application	Unit 0—Switch C35				Unit 1—Switch F35			
	1	2	3	4	1	2	3	4
Audichron (continuous mode)	off	off	on	off	off	off	on	off
Code-A-Phone (start–stop mode)	off	on	off	off	off	on	off	off
Cook Digital Announcer (continuous mode)	off	off	on	off	off	off	on	off
Cook Digital Announcer (start–stop mode)	off	on	off	off	off	on	off	off
Test or Music (600 Ω source impedance)	on	off	off	on	on	off	off	on

Table 42
Recorded announcement trunk card—switch settings for units 2 and 3

Application	Unit 2—Switch C5				Unit 3—Switch F5			
	1	2	3	4	1	2	3	4
Audichron (continuous mode)	off	off	on	off	off	off	on	off
Code-A-Phone (start–stop mode)	off	on	off	off	off	on	off	off
Cook Digital Announcer (continuous mode)	off	off	on	off	off	off	on	off
Cook Digital Announcer (start–stop mode)	off	on	off	off	off	on	off	off
Test or Music (600 Ω source impedance)	on	off	off	on	on	off	off	on

Applications

The Recorded Announcement (RAN) feature allows a customer to:

- define the type of call intercept
- allow the connection of a customer-provided recorded announcement machine to the system by means of QPC74 cards
- specify the language RAN route to be used for a Multi-Language Wake-Up call

A customer can specify up to five different intercept conditions resulting in connection to the recorded announcement machine. Each intercept condition has a different announcement. [Table 36, “Intercept treatment and associated types of announcements,” on page 154](#) lists intercept treatments.

For information on configuring recorded announcement features in software, see “Recorded Announcement” in *X11 features and services*.

Message recording

Messages are recorded in three different ways, depending on the noise environment of the recorded announcement machine.

- Quiet machine environment: Record the message at the machine site by using a handset.
- Noisy environment: Record a message on a remote cassette recorder away from the machine site. Connect the cassette recorder to the machine record input, and play the message into the recorder.
- Prerecorded announcement: Place the prerecorded tape directly into the machine. Machine-compatible prerecorded tapes can be obtained from Pastel or other manufacturers.

Recommendations

If announcement start is set for delay dial (DDL), intercept is connected to the announcement at the start of the recording.

- Keep the announcement recording to less than 12 seconds. Announcements of approximately 12 seconds apply one or two ringback tones to the calling party if the announcement is in progress when intercept is initiated.

If announcement start is set for immediate start (IMM), intercept is connected to the announcement the moment intercept is detected.

- The announcement should make sense to the calling party when connected at any point.
- Define the rate as two or more so the calling party receives the complete announcement.

Multi-language wake-up

As an enhancement to the Automatic Wake-Up (AWU) feature (X11 release 10), Multi-Language Wake-Up is an X11 release 16 feature that allows a customer to choose a language for a wake-up call. If AWU is enabled, up to six language-specific RAN route pairs (both a.m. and p.m. for each language) can be configured in the service change.

The languages, 0–5, correspond to RAN routes RAN1/RAN2 (for Language 0), LA11/LA12 (for Language 1)—all the way to LA51/LA52 (for Language 5) in the Customer Data Block (LD 15). The only requirement is that Language 0 (the default language routes RAN1 and RAN2) must be defined. If a specific language RAN is not accessible at wake-up time, the corresponding primary or secondary default language routes (RAN1 and RAN2) will be used.

For music RAN, RAN1 and RAN2 must be unique. However, the same RAN route can be shared among the five additional language RANs. If the same RAN route is shared, there must be as many RAN trunks defined for that route as the number of AWU RANs in the service change program to which it is assigned. For example, if RAN route 76 is assigned to LA11, LA21, LA41, and LA52, at least four RAN trunks should be defined. Since the order of trunk seizure is random, the announcement on shared RAN trunks should be identical.

When an AWU call is presented to a room and answered by the guest, the RAN route corresponding to the room phone's language will be used to announce the wake-up message.

For more information on AWU, Multi-Language Wake-Up, or other hospitality features, refer to *X11 features and services*. For information on service change programs, refer to *X11 input/output guide*.

512-second RAN

This development provides longer message times to accommodate newer digital announcers. This feature is implemented in Trunk Route Administration (LD 16) in response to the RAN type (RTYP) prompt:

- The DGT response provides message lengths up to 256 seconds in continuous mode.
- The CON response provides message lengths up to 608 seconds in continuous mode.
- The CAP response allows message lengths of 608 seconds in start-stop operation.

To operate in continuous mode:

- Program the RAN route type for Audichron format.
- Set switch 3 on the QPC74 card to ON for each unit programmed for continuous mode (see [Tables 41](#) and [42](#)).

On NT7M and 213300 series machines, set switches on the recorded announcement machines as follows:

- Set Control Processor switch S6-7 ON (all others OFF).
- Set Line Expansion Chassis switch S2 and S3 OFF.

Start-stop mode allows for multiple messages; however, multiple messages are shorter than the continuous mode by a divisor of the maximum message length. That is, each of four messages are only one quarter of 512 seconds, equaling 128 seconds. For start-stop mode:

- Program the RAN route for Code-A-Phone format.
- Set switch 2 on the QPC74 card to ON for each unit programmed for continuous mode (see [Tables 41](#) and [42](#) on [page 164](#)).

Note: For more information on option switch settings, see [“Configuration” on page 162](#).

Recorded announcement machines

Customer-provided recorded announcement machines must be compatible with the RAN trunk. This section lists several recorded announcement machines that have been tested for compatibility with the recorded announcement trunk card.

Cook Electric digital announcers

The Cook Electric digital announcers store messages in solid-state message chips using digital coding. These machines are available in one, two, four, six, or eight channels. The Cook Electric digital announcers provide the following optional features:

- 1- to 8-minute recording
- up to 200 lines per trunk
- trunk-based SIT tones
- battery back-up
- remote record
- line or trunk configurations
- continuous run mode
- peg counts
- four different start options

The various models of recorded announcement machines that are compatible with the RAN trunk are listed below:

Cook Electric NT5M series The Cook Electric NT5M series provides:

- two-, four-, six-, or eight-channel configuration
- 1-minute standard recording time
- seven firmware options
- an audio input jack
- switch-selectable options
- 32- or 64-kbps sampling rate
- automatic gain control

Cook Electric NT7M50AA series The Cook Electric NT7M50AA provides:

- two independent variable-length announcements
- two audio outputs

Note: This model is listed for reference only. It is no longer available from the manufacturer.

Cook Electric model NT7M25AA The Cook Electric NT7M25AA provides:

- four independent variable-length announcements or a single message of longer duration, depending on selected firmware
- four audio outputs
- four-channel, four-port synchronous messaging
- four-port demand phase, four-channel fixed message length

Note: This model is listed for reference only. It is no longer available from the manufacturer.

Cook Electric model 21330 The Cook Electric Model 21330 provides:

- single channel (trunk route)
- variable-length announcement

Note: This model is listed for reference only. It is no longer available from the manufacturer.

Cook Electric model 213400 The Cook Electric Model 213400 provides:

- four independent variable-length announcement channels (trunk routes)
- total announcement duration of 2 to 192 seconds (divided among the four channels)

Note: This model is listed for reference only. It is no longer available from the manufacturer.

Audichron HQ-1 112 or Cook Electric 212

The Audichron HQ-1 112 or Cook Electric 212 provides:

- continuous mode operation
- 12 independent channels (trunk routes) per machine
- maximum of five independent announcement channels per customer
- several RAN trunks can be bridged to each channel as required
- announcement duration of 6.5 or 13.5 seconds
- multiple-customer usage of announcement machine

Code-A-Phone 210DC

The Code-A-Phone 210DC provides:

- start-stop machine
- single channel (trunk route)
- single announcement
- announcement duration of up to 3 minutes
- rewind time 1/6 of the announcement time
- single-customer usage of announcement machine
- several RAN trunks can be bridged to each machine

Note: This model is listed for reference only. It is no longer available from the manufacturer.

QAY1 Announcer

The QAY1 Announcer provides:

- start-stop machine
- 12 independent channels (trunk routes) per machine
- maximum of five independent announcement channels per customer
- several RAN trunks can be bridged to each channel as required
- announcement duration of 14 or 28 seconds
- multiple-customer usage of announcement machine

Note: For more complete information on these product options, consult the product specifications.

QPC237 4-Wire E&M/DX Trunk Card

Introduction

The QPC237 4-Wire E&M/DX Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The 4-wire E&M/DX trunk card interfaces two 4-wire E&M/DX trunk lines to a Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration program (LD 14).

The 4-wire E&M/DX trunk provides 4-wire voice transmission with E&M or DX signaling without the necessity of going through external 2- to 4-wire conversion. Two types of E&M signaling are provided:

- Type I (as on the 2-wire E&M trunk) signaling that uses two signaling wires plus ground
- Type II signaling that uses two pairs of signaling wires and is used by most electronic switching systems

The 4-wire trunks can be equipped with software control of an external echo suppressor, which can be used when echo becomes a problem.

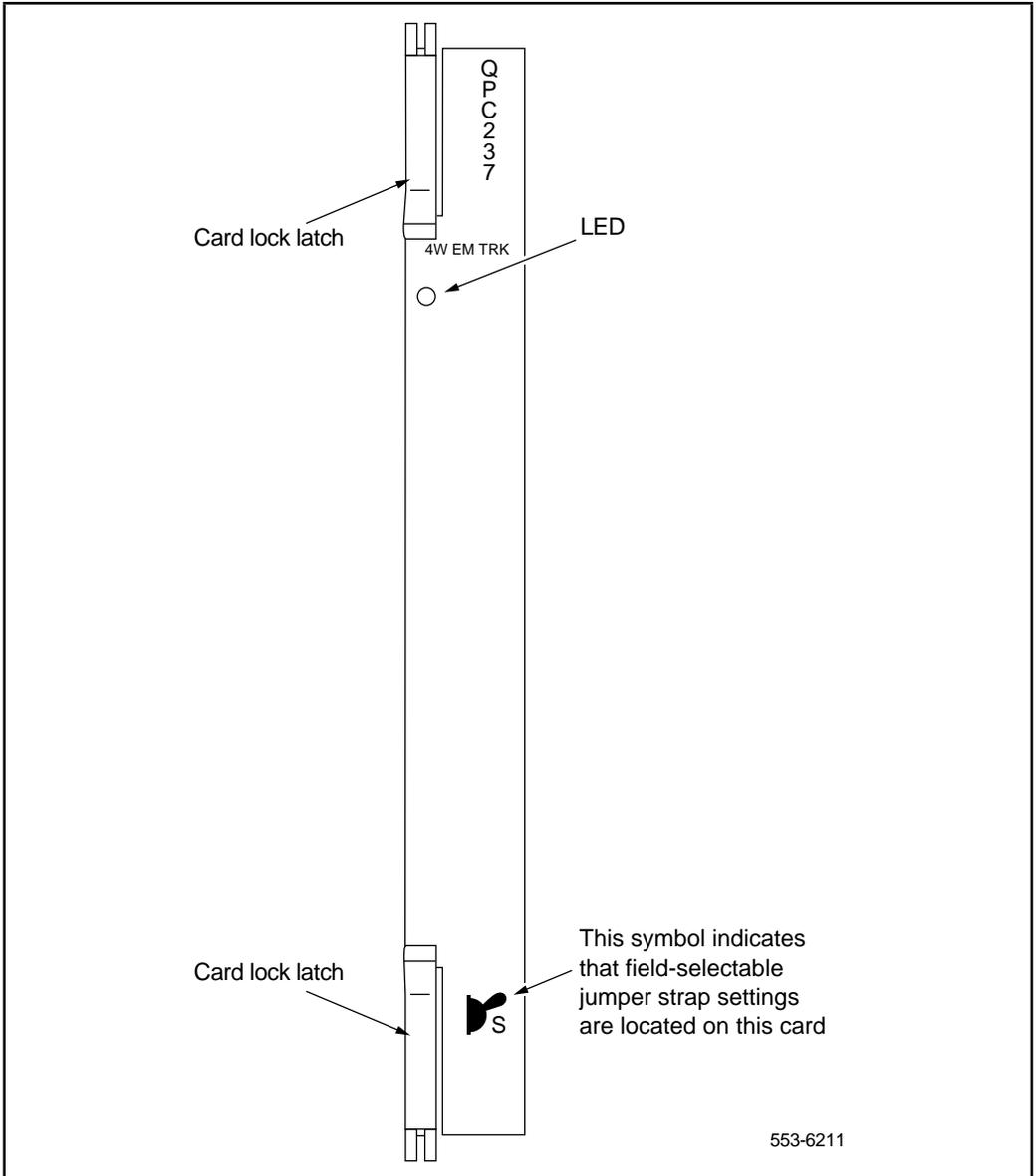
Physical description

The 4-wire E&M/DX trunk card mounts in any PE slot. The two trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The 4-wire E&M/DX trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 69](#)). The LED should only be lit if there is a problem with the card. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

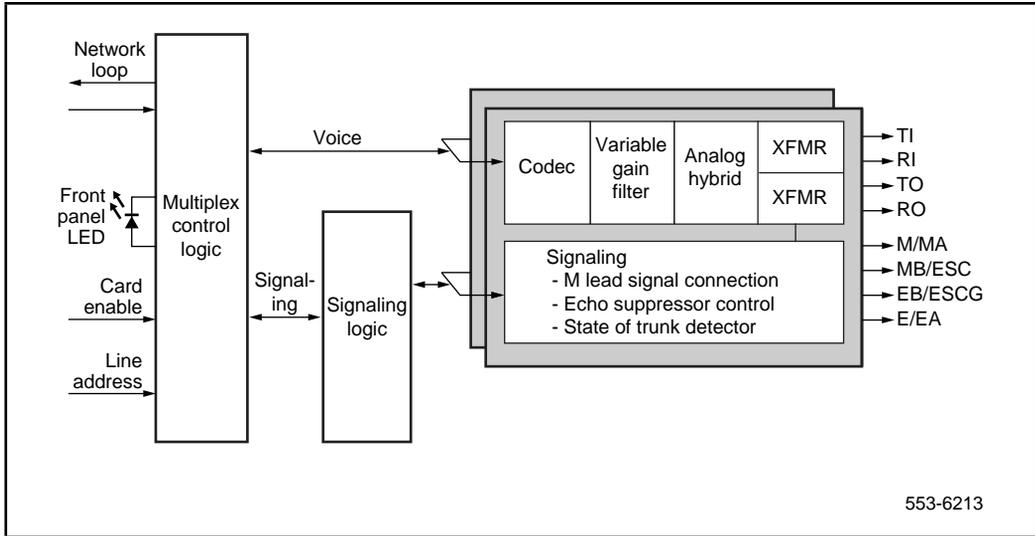
Figure 69
4-wire E&M/DX card—faceplate



Functional description

Figure 70 shows a block diagram of the major functions contained on the 4-wire E&M/DX trunk card. Each of these functions is described on the following pages.

Figure 70
4-wire E&M/DX trunk card block diagram



Card interfaces

The 4-wire E&M/DX trunk card passes both voice and signaling data over the network loop. Network loops are discussed in detail in “Peripheral equipment” on page 22.

Trunk interface units

Two 4-Wire E&M/DX signaling trunk circuits are located on each QPC237 type circuit card. Each trunk circuit can be used as a two-way, dial-repeating trunk in one of the following modes of operation to interface with appropriate types of trunk facilities.

- E&M signaling, Type I interface ([Figure 71](#))
- E&M signaling, Type II interface ([Figure 72](#))
- Back-to-back trunk circuit connection ([Figure 73](#))
- E&M signaling, Type I with M lead connections for the British Post Office (QPC237C only) ([Figure 74](#))

The 4-wire trunk circuit has the following capabilities:

- E&M/DX signaling
- Digitone sending and receiving without any modifications
- supervision of far-end off hook and dial-pulsing
- isolation of foreign potentials on the loop from portions of the transmission and signaling circuit
- controlled false detection compensation on outpulsing
- switchable 2-dB pad for controlling gain between line-to-trunk and trunk-to-trunk on normal non-VNL connections, and gain and echo protection on VNL through balance and terminal balance connections; choice of internal pad switching or control of an external echo suppressor (Type I interface only)
- switchable 7- and 16-dB pads for attenuation to accommodate carrier facilities
- 0 dB insertion loss for ESN applications (such as BARS, NARS, CDP): QPC237C/D circuit cards

The trunk circuit uses four leads to communicate voice signals: TO and RO for output and TI and RI for input. E&M signaling is accomplished using the E lead and the M lead for Type I signaling and the EA & EB and MA & MB leads for Type II signaling. DX signaling is done over the transmission lines TO–RO and TI–RI. For Type I E&M signaling, the leads ESC and ESCG are used to control the (optional) external echo suppressor.

Multiplex control

The multiplex control logic is common to both channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected time slots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Figure 71
Type I interface

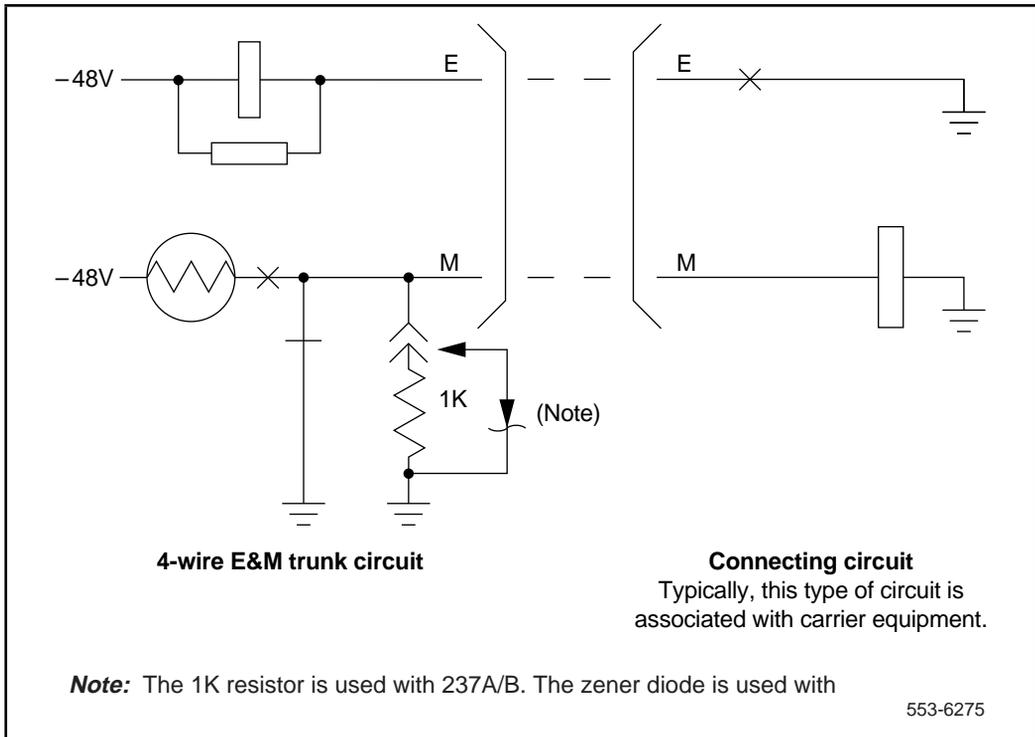


Figure 72
Type II interface

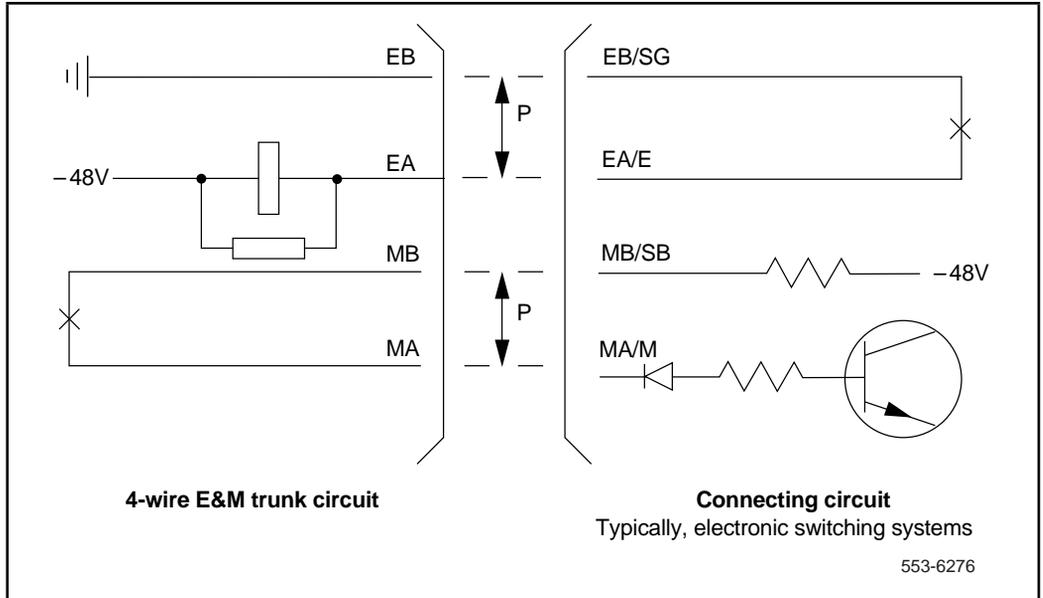


Figure 73
Back-to-back circuit connection

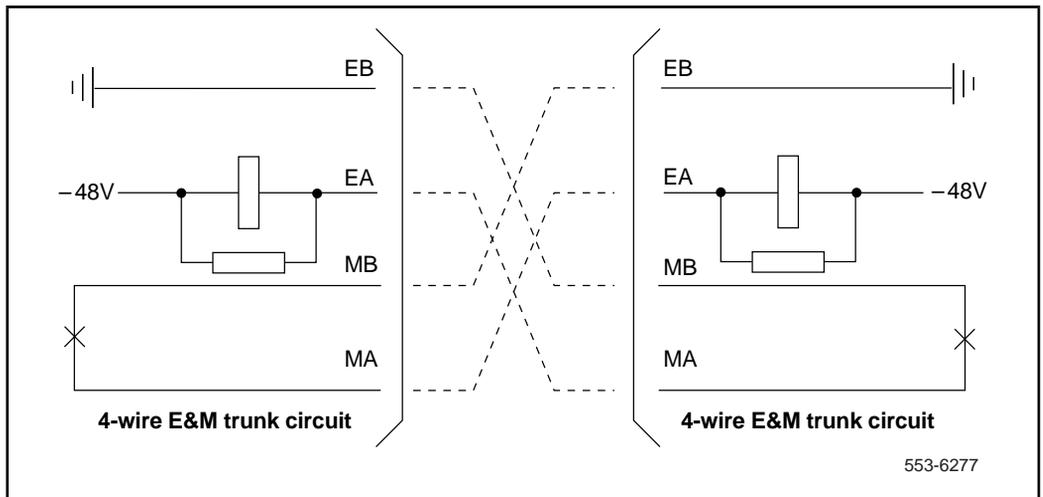
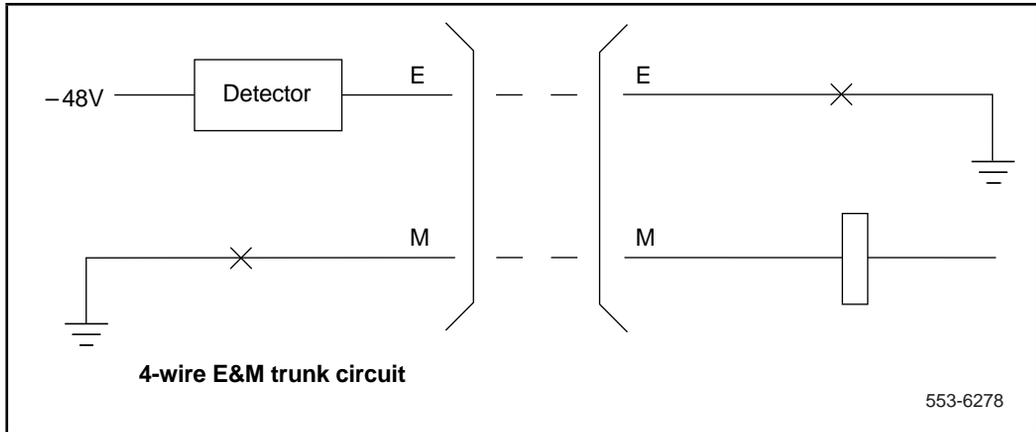


Figure 74
Type I (British Post Office) interface



Operation

E&M, Type I signaling

Release control of a call is specified in the system memory by means of the Trunk Data Block (see *X11 input/output guide*). The two options available are EITHER or ORIGINATING party control. These can be specified for the Meridian 1 system end (near end), or for the CO or other PBX end (far end). Joint party control can also be specified for the far end.

Idle circuit states

Under idle states:

- There is no current flow in the signaling lead for DX. The state of the trunk detector is high. For E&M signaling, the M lead is ground and the E lead is open circuit.
- Trunk cards are scanned periodically by the common equipment (CE). For example, the trunk circuit receives a card enable in timeslot 0. The signaling logic responds with a signal on the data input bus.

Outgoing calls

Outgoing calls are processed as follows:

- 1 The Meridian 1 machine seizes the trunk facility by sending a message to the trunk circuit signaling logic that causes relay K1 to operate. The M lead changes from ground to battery in E&M; or from no current flow to current flow in the A1 lead for DX signaling.
- 2 The signaling logic responds to the enable with a signal on the data input bus. The scan stops and the card receives further enables. The signaling logic also receives signals on the data output bus and, on receipt, outputs the contents of the input register onto the data input bus, thus reporting a change of state. The scan cycle then continues.
- 3 When ready for outpulsing, a trunk outpulsing enable is sent in an assigned timeslot (not timeslot 0 or 1), and a message is sent to the signaling logic to set up the trunk logic so that relay K1 is now controlled by the signal level of the data output bus in the assigned timeslot.
- 4 The CE, by sending the appropriate data in the selected timeslot, causes relay K1 to outpulse the required digits. (See [Tables 44, 45, and 46](#), starting on [page 192](#), for DX signaling, and [Figures 75 and 76](#), starting on [page 185](#), for E&M signaling.)

- 5 At the completion of outpulsing another message is sent to the signaling logic that restores control of K1 to the signaling logic, and the enable in the assigned timeslot is removed.
- 6 If answer supervision is provided by the far end, there is a change from open to ground on the E lead (ground detection) for E&M signaling, or from current flow to no current flow in the A1 lead (bridge unbalance detection) for DX signaling. The Scan and Signal Distributor subsequently reports a change of state to the CE.
- 7 The near end control trunk releases. See [Tables 44, 45, and 46](#) for DX signaling and [Figures 75 and 76](#) for E&M signaling.

Incoming call origination

The far end initiates calls as follows:

- 1 A ground is placed on the E lead in E&M signaling, or current flow is started in the A1 lead for DX signaling. The appropriate signaling logic input is changed from high to low. A card enable response on the data input bus stops the scan until a change of state is reported to CE.
- 2 Dial pulses are subsequently applied from the far end in the form of ground-open on the E lead, or current flow/no current flow in the A1 lead (interruptions). These are detected as changes of state at the signaling logic input.
- 3 When the call has been completed and the terminating party answers, relay K1 is operated as a result of a message from the CE to the signaling logic, causing the appropriate signal on the M leads or A1 leads.
- 4 If the far end is equipped for sending, the Meridian 1 can be operated in any mode: immediate start, delay dial, or wink start (see [Table 43](#)).
- 5 For immediate start, following the seizure signal the far end may start pulsing after the distant end controlled standard delay (normally 70 ms minimum). For wink start, following the seizure signal, within 128–256 ms the incoming trunk gives an off hook/on hook for 250 ms. On DDL a 256–384 ms off hook/on hook signal is returned to the distant end immediately.

Table 43
Start modes

Operation	Class of service
Immediate Start	IMM
Delay Dial A	IMM
Delay Dial B	DDL
Wink Start	WNK

- 6 The distant end, upon detecting this signal, may start pulsing after the distant end controlled standard delay (normally 70 ms minimum).
- 7 The trunk is released by a disconnect message to the signaling logic that causes K1 to release.

E&M, Type II signaling

Type II signaling uses four leads: EA, EB, MA, and MB. Instead of changes of state between battery and ground or open and ground, the trunk signals by making contact closures between the lead pairs MA and MB. Signals are received by detecting current flow between lead pairs EA and EB.

On outgoing calls, the Meridian 1 seizes the far end trunk by shorting the MA leads and MB leads together (instead of putting battery on the M lead as in Type I signaling). Dialing is done by opening and closing the MA/MB contact. See [Figures 77](#) and [78](#).

During incoming calls the far end seizes the trunk by shorting the EA and EB leads together. This transmits the ground from the EB lead to the EA lead (in Type I signaling the ground to the E lead comes from the far end). Dialing is done by opening and closing the EA/EB contacts. See [Figures 77](#) and [78](#).

Since the EB and MB leads also serve as the ESCG and ESC leads, respectively, echo suppressor control cannot be used with Type II signaling.

Duplex (DX) signaling

[Figures 79](#) and [80](#) show a simplified schematic diagram of a DX signaling circuit. DX signaling makes use of the voice transmission leads for signaling as well as for voice transmission. For purposes of describing the signaling, the lead pair T1/R1 is designated the signaling pair, whereas the other pair, T0/R0, conducts current in the opposite direction to balance the overall current flow between the near end and far ends.

During signaling, current flows through both T1 and R1 leads in the same direction.

Transmission

Talking connection

Audio signals received from the card tip and ring input (T1 and R1) are passed through the T1 transformer to the low-pass filter hybrid analog-to-digital filter, then through the PCM codec to the CE for switching.

Carrier facilities

Switchable 7-dB and 16-dB pads are included in each trunk circuit to accommodate the input and output levels required for operation with carrier facilities ([Figure 80](#)). The 7-dB pad attenuates the input to the trunk (T1 and R1) and the 16-dB pad attenuates the outputs from the trunk (T0 and R0).

Figure 75
E&M lead Type I signaling patterns—originating party release
(when route does not involve a CO/FX/WATS trunk)

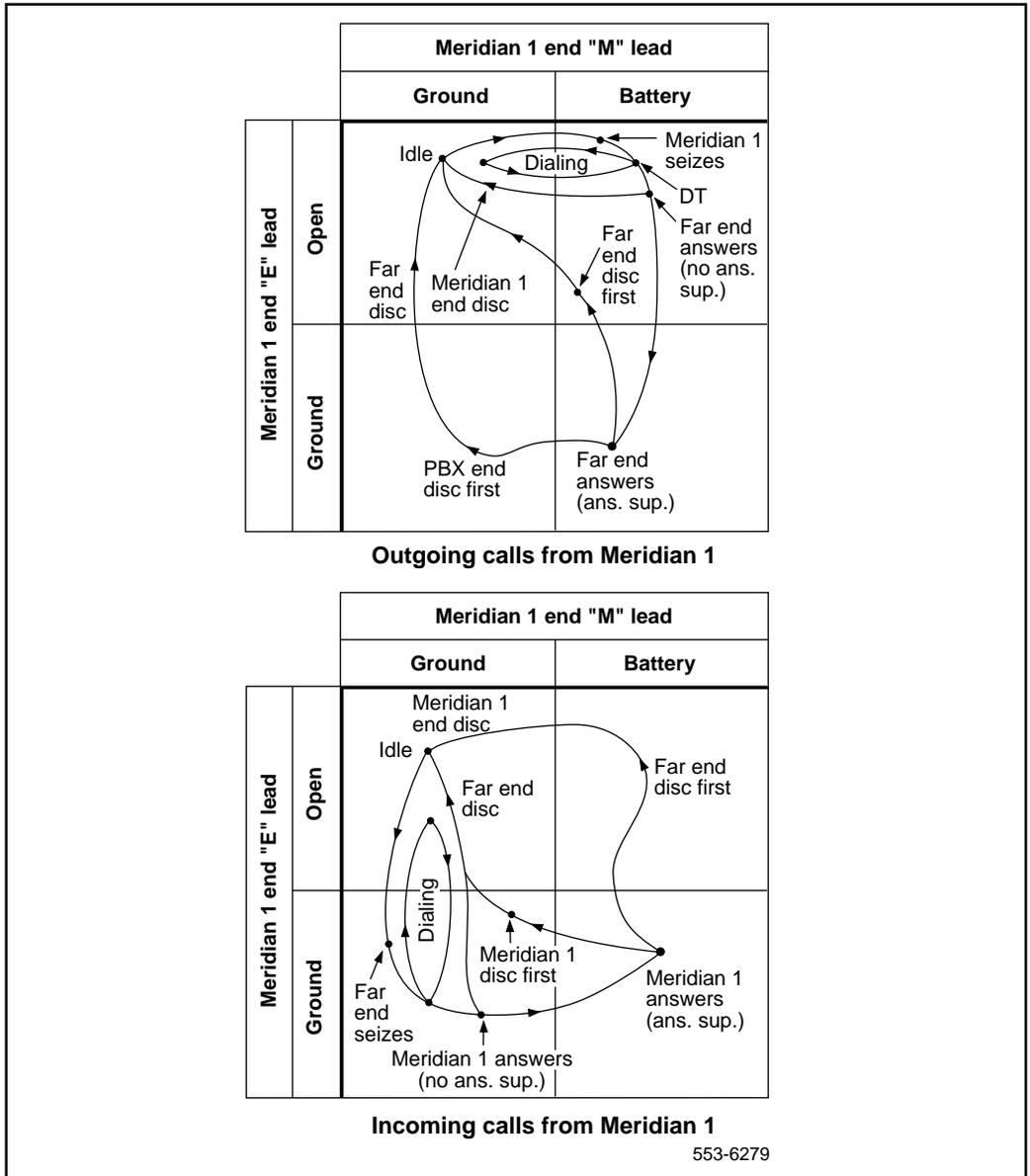


Figure 76
E&M lead Type I signaling patterns—originating party release on tandem connections when originating end is sendedrized and route is through a CO/FX/WATS trunk (not applicable to CCSA lines)

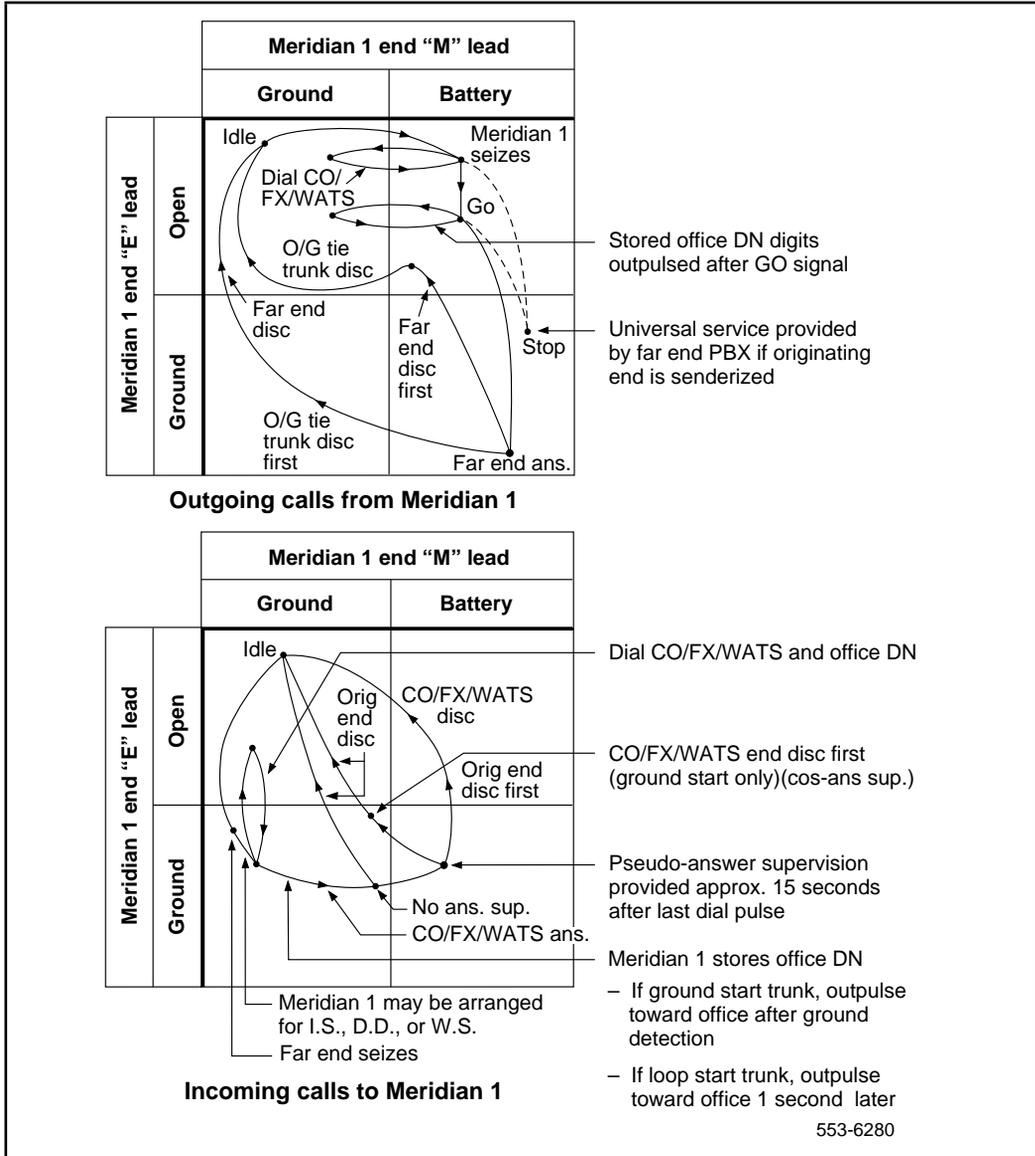
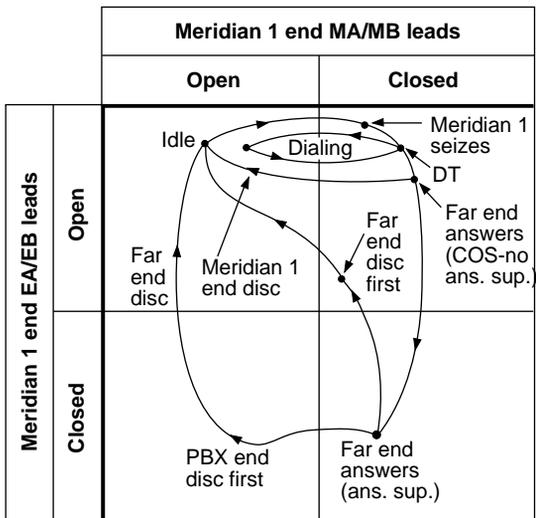
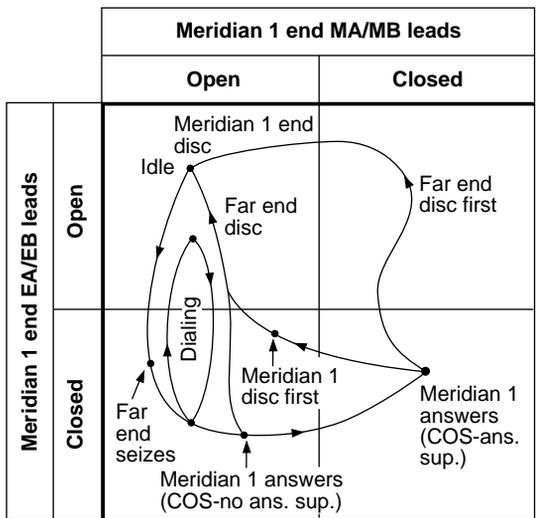


Figure 77
E&M lead Type II signaling patterns—originating party release
(when route does not involve a CO/FX/WATS trunk)



Outgoing calls from Meridian 1 (near end)



Incoming calls to Meridian 1 (near end)

553-6281

Figure 78
E&M lead Type II signaling patterns—originating party release on tandem connections when originating end is sendedrized and route is through a CO/FX/WATS trunk (not applicable to CCSA lines)

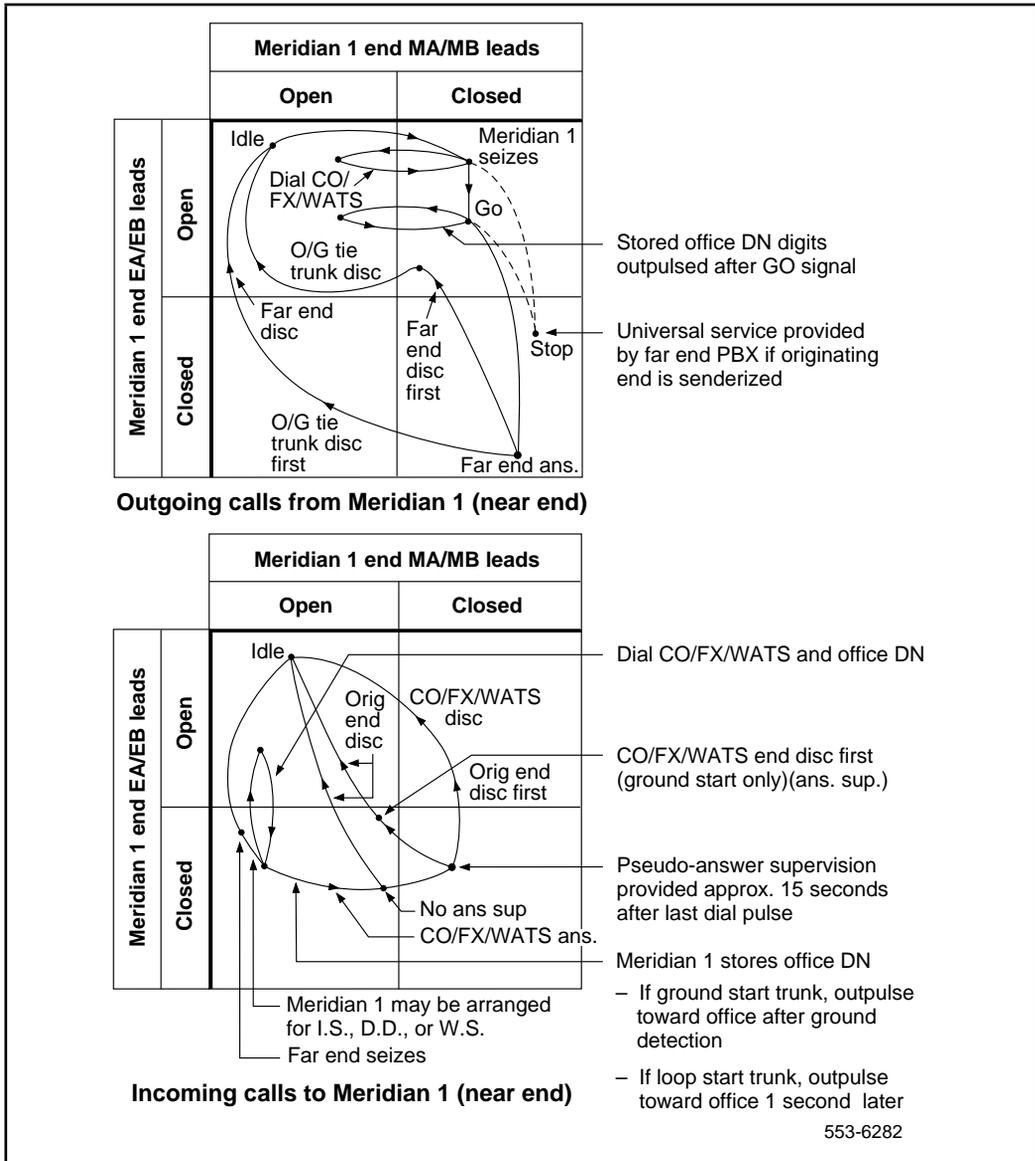


Figure 79
Simplified schematic diagram of a DX signaling (4-wire) circuit for the QPC237A/B

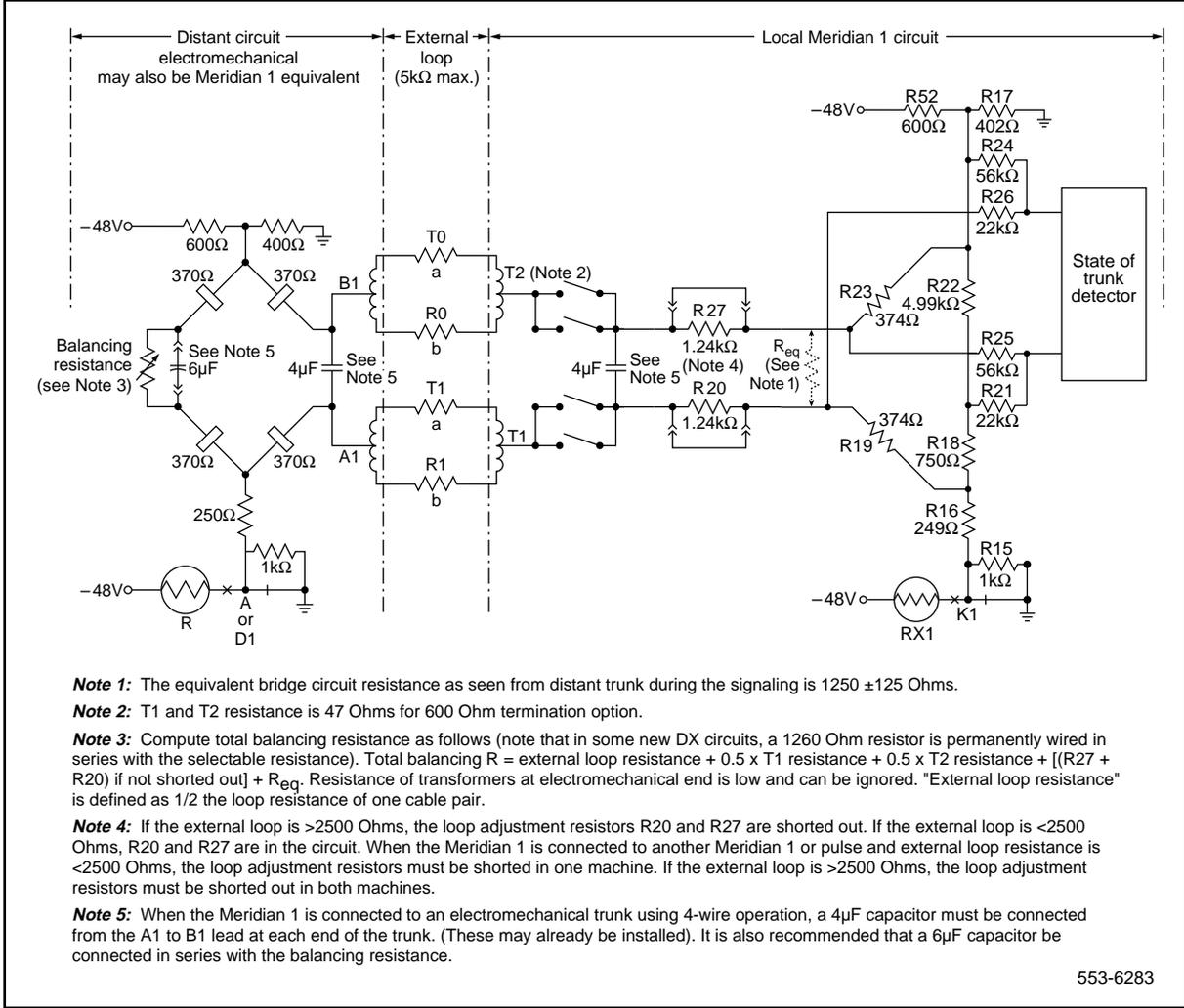
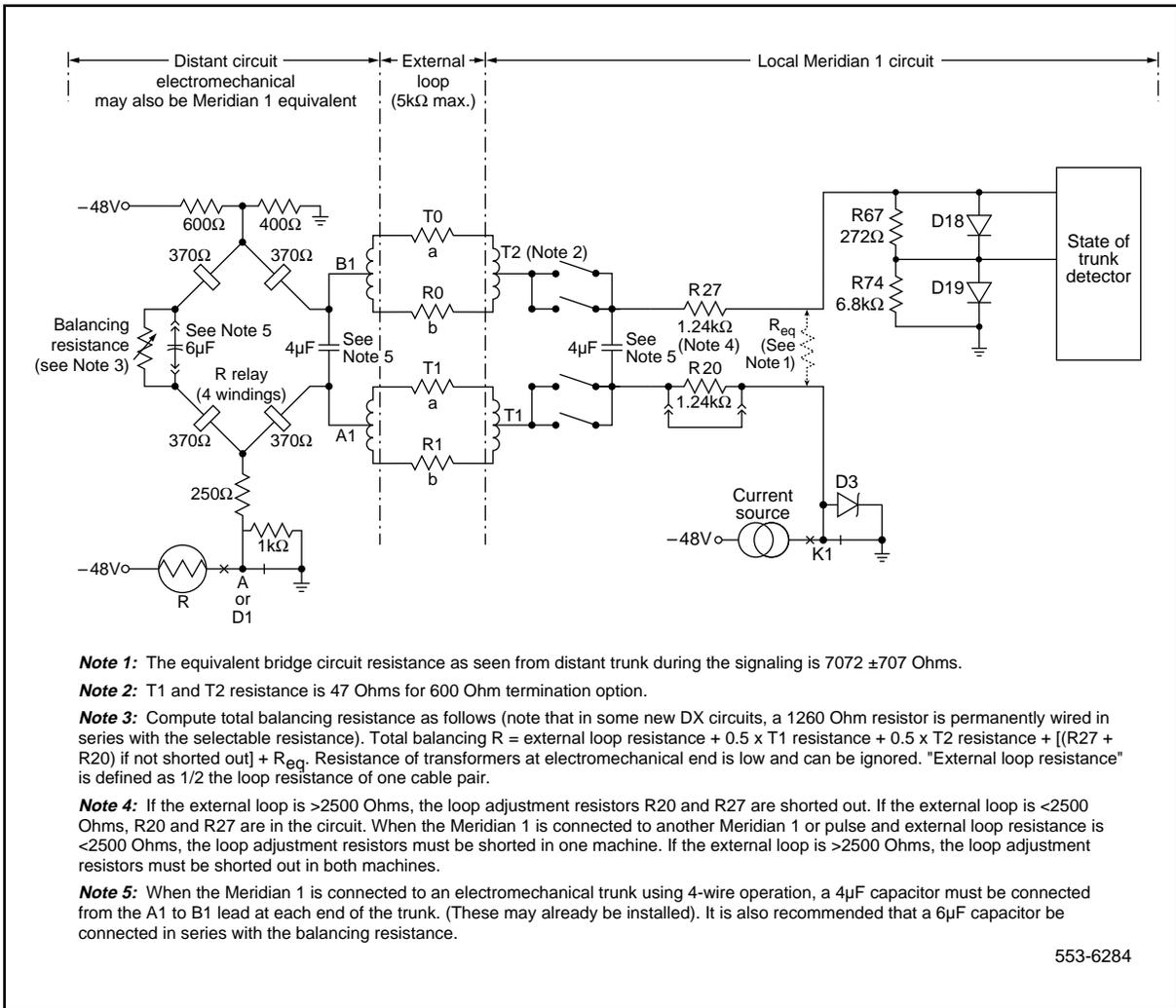
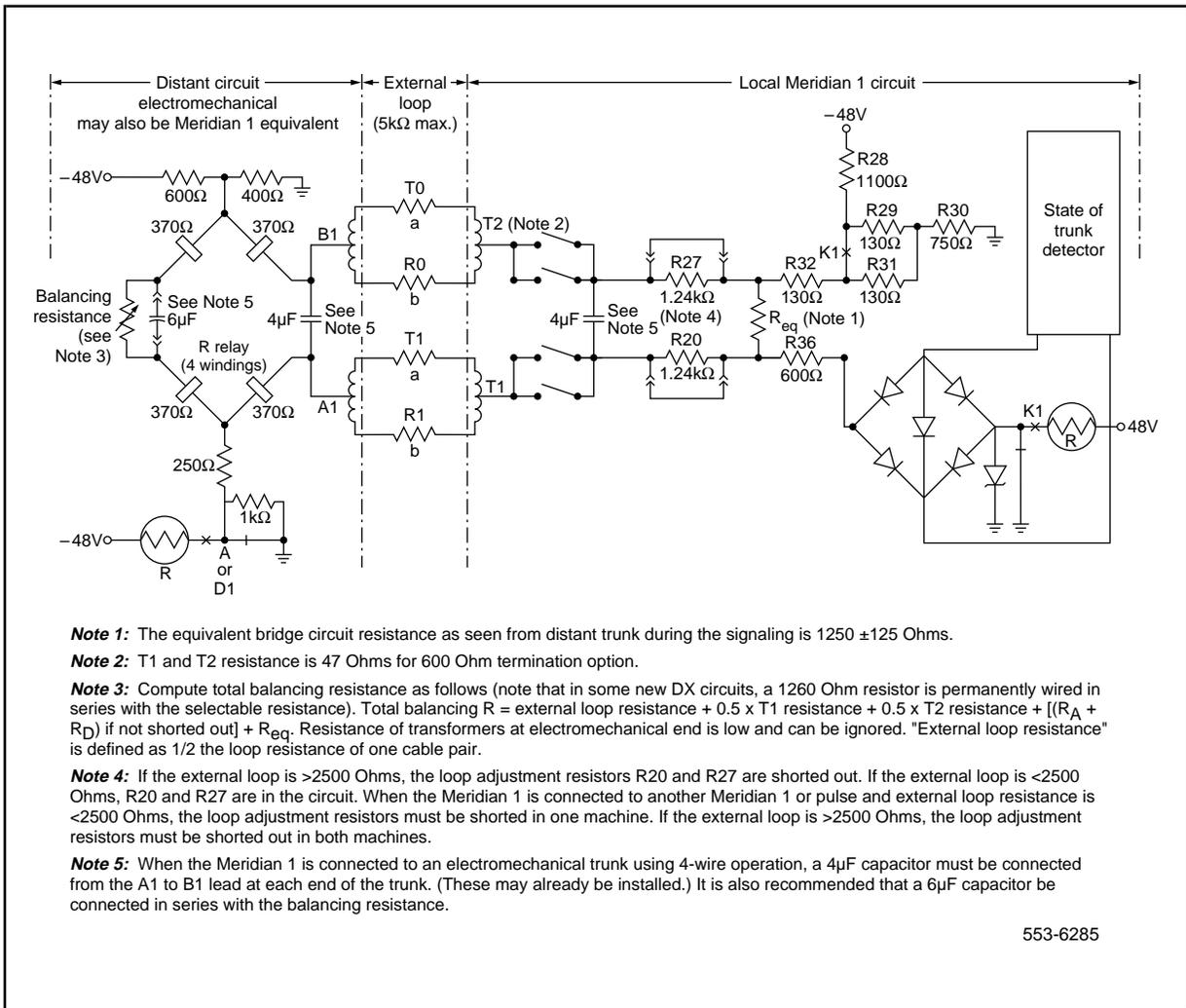


Figure 80
Simplified schematic diagram of a DX signaling (4-wire) circuit for the QPC237C



- Note 1:** The equivalent bridge circuit resistance as seen from distant trunk during the signaling is 7072 ± 707 Ohms.
- Note 2:** T1 and T2 resistance is 47 Ohms for 600 Ohm termination option.
- Note 3:** Compute total balancing resistance as follows (note that in some new DX circuits, a 1260 Ohm resistor is permanently wired in series with the selectable resistance). Total balancing $R = \text{external loop resistance} + 0.5 \times T1 \text{ resistance} + 0.5 \times T2 \text{ resistance} + [(R27 + R20) \text{ if not shorted out}] + R_{eq}$. Resistance of transformers at electromechanical end is low and can be ignored. "External loop resistance" is defined as 1/2 the loop resistance of one cable pair.
- Note 4:** If the external loop is >2500 Ohms, the loop adjustment resistors R20 and R27 are shorted out. If the external loop is <2500 Ohms, R20 and R27 are in the circuit. When the Meridian 1 is connected to another Meridian 1 or pulse and external loop resistance is <2500 Ohms, the loop adjustment resistors must be shorted in one machine. If the external loop is >2500 Ohms, the loop adjustment resistors must be shorted out in both machines.
- Note 5:** When the Meridian 1 is connected to an electromechanical trunk using 4-wire operation, a $4\mu\text{F}$ capacitor must be connected from the A1 to B1 lead at each end of the trunk. (These may already be installed). It is also recommended that a $6\mu\text{F}$ capacitor be connected in series with the balancing resistance.

Figure 81
Simplified schematic diagram of a DX signaling (4-wire) circuit for the QPC237D



553-6285

Table 44
DX signaling—originating party release

Condition	Current in signaling lead	State of trunk detector
OUTGOING CALLS		
Idle	no current flow	high
Seizure (dial tone from far end: far end ready for digits)	current flow	high
Digits	current flow interrupted for each pulse	high
Far end answers	no current flow	low
Far end on hook first	current flow	high
Network taken down and trunk idled when near end goes on hook	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high
INCOMING CALLS		
Idle	no current flow	high
Seizure (dial tone to far end: near end ready for digits)	current flow	low
Digits	current flow interrupted for each pulse	low-high-low for each pulse
Near end answers	no current flow	low
Far end on hook first	current flow	high
Network taken down and trunk idled	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook trunk idled	no current flow	high

Table 45
DX signaling—originating party release on tandem connections for outgoing calls

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (far end ready for digits)	current flow	high
Dial CO/FX/WATS	current flow interrupted for each pulse	high
Stop sender	no current flow	low
Go sender (universal service provided by far end PBX if originating end is senderized)	current flow	high
CO/FX/WATS offices ready for digits		
Stored Office DN digits	current flow interrupted for each pulse	high
Outpulsed	no current flow	low
Far end answers	no current flow	low
Far end on hook first	current flow	high
Near end on hook, network taken down, trunk idled	no current flow	high
Near end on hook first, network taken down	current flow	low
Far end on hook idled	no current flow	high

Table 46
DX signaling—originating party release on tandem connections for incoming calls

Condition	Current in signaling lead	State of trunk detector input to signaling logic
Idle	no current flow	high
Seizure (Meridian 1 may be arranged for IS, DD, or WS)	current flow	low
(near end ready for digits)	current flow	low
Dial CO/FX/WATS and office DN Stored digits outpulsed on CO/FX/WATS trunk after ground detection if ground start, but after 3 seconds if loop start	current flow interrupted for each pulse	low-high-low for each pulse
If ANS SUP, pseudo-answer supervision is sent approximately 13 seconds after last dial pulse received	no current flow	low
If NO ANS SUP	current flow	low
CO end disconnects (CO ground start—trunk idled and network taken down, but incoming tie trunk held under control of originating end)	current flow	low
Originating end disconnects—network taken down and trunk idled	no current flow	high

Electrical specifications

This section lists the electrical specifications for the 4-wire E&M/DX trunk card.

Trunk interface electrical characteristics

[Table 47](#) shows the electrical characteristics of the 4-wire E&M/DX trunk interface units.

Table 47
Electrical characteristics

Characteristics	Comment
Circuits per card	2
Options	
(1) Signaling	DX or E&M Type I or II
(2) DX loop resistance	Switchable, 0 to 2500 Ω or 2500 to 5000 Ω
DX signaling	
External circuit resistance allowed	5 k Ω maximum
Insulation resistance required	100 k Ω minimum
Ground potential difference allowed	± 10 V maximum
E&M signaling	
Feed resistance	M lead, 100 Ω minimum
Contact bounce	M lead, 3 ms maximum
Operating range	Type I 100–150 Ω
	Type II 100–300 Ω
Dial pulse operation	Sending: 10 pps, 58 to 64% break
	Receiving: 10 pps, recognize 10–150 ms as break/make
Terminating impedance	600 Ω

Power requirements

[Table 48](#) shows the typical current that the 4-wire E&M/DX trunk card requires from each power supply.

Table 48
Power requirements

Voltage	Tolerance	Current (typical)
+10 V dc	± 5%	30 mA
-10 V dc	± 5%	30 mA
+6 V	± 1%	8 mA
-6 V	± 1%	8 mA
-48 V dc	± 12%	100 mA

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 49](#) lists the environmental specifications for the 4-Wire E&M/DX trunk card.

Table 49
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40° to +70° C (-40° to +158° F)

Connector pin assignments

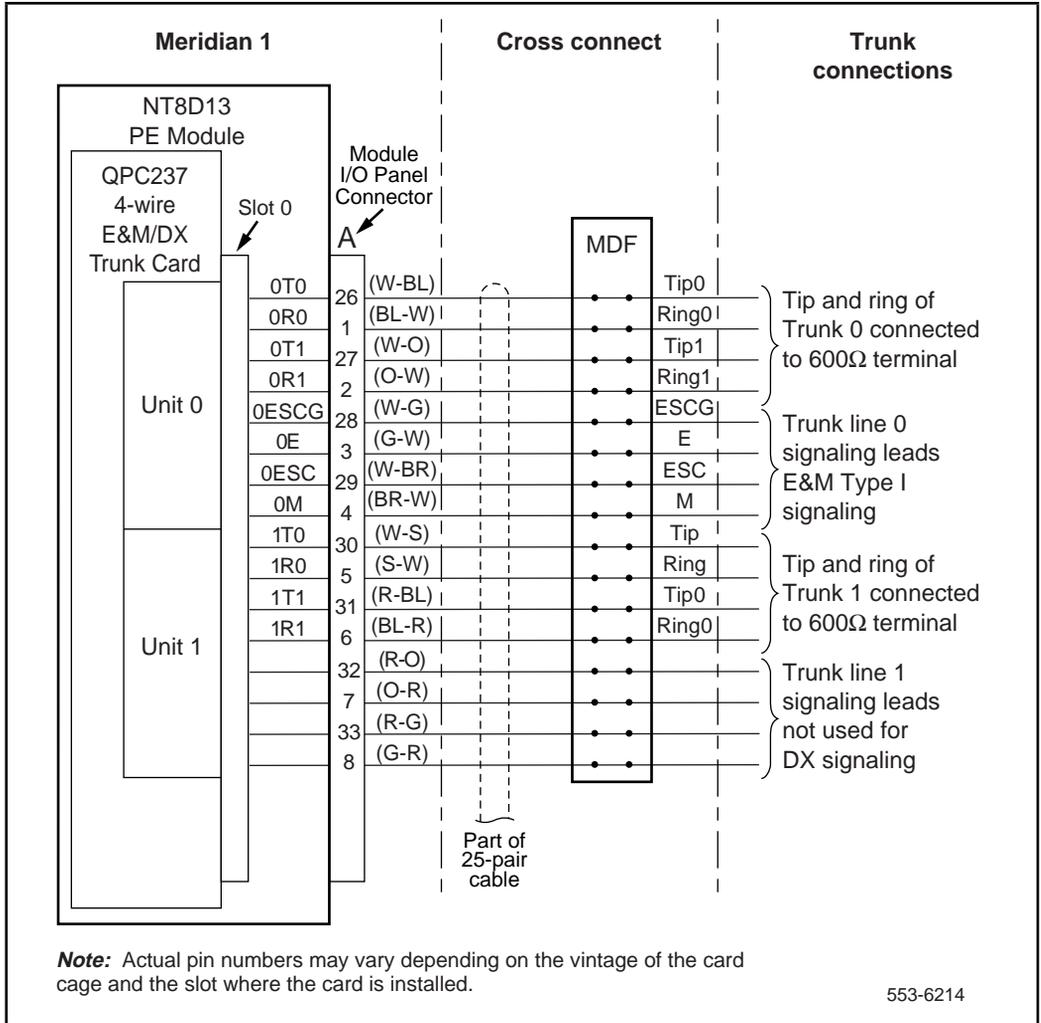
The 4-wire E&M/DX trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

The 4-wire E&M/DX trunks connect to the trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 82](#), and a list of the connections to the 4-wire E&M/DX trunk card is shown in [Table 50](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Table 50
4-wire E&M/DX trunk card—connections

Connector Pin	Lead Designation			Unit
	E&M Type I	E&M Type II	DX	
36A	Tip 0	Tip 0	Tip 0	0
37A	Ring 0	Ring 0	Ring 0	
38A	Tip 1	Tip 1	Tip 1	
39A	Ring 1	Ring 1	Ring 1	
29A	ESCG	EB	N/A	
30A	E	EA	N/A	
31A	ESC	MB	N/A	
32A	M	MA	N/A	
2A	Tip 0	Tip 0	Tip 0	1
3A	Ring 0	Ring 0	Ring 0	
4A	Tip 1	Tip 1	Tip 1	
5A	Ring 1	Ring 1	Ring 1	
9A	ESCG	EB	N/A	
10A	E	EA	N/A	
11A	ESC	MB	N/A	
12A	M	MA	N/A	

Figure 82
4-wire E&M/DX trunk card—typical cross connection example



Configuration

The optional application, features, and signaling arrangement for each trunk are assigned through unique trunk data blocks contained in the system memory. Trunk options for the QPC237D are selected manually by setting option pads. The locations of these switches are shown in [Figure 83](#).

Switch settings

Trunk options for the QPC237A/B are selected manually by setting six option pads. There are three pads per circuit and each pad contains either four or six switches. See *Circuit card installation and testing* (553-3001-211).

Trunk options for the QPC237C are selected manually by setting eight option pads. There are four pads per circuit and each pad contains either four or six switches. See *Circuit card installation and testing* (553-3001-211).

Trunk options for the QPC237D are selected manually by setting option pads. There are three pads per circuit and each pad contains either 6 or 10 switches. The switch settings are shown in [Tables 51](#) and [52](#).

Service change entries

The optional application, features, and signaling arrangement for each trunk are assigned through unique trunk data blocks contained in the system memory. The type of assignments in question are tie, CCSA, E&M, DX, start arrangement, transmission, and compensation.

Figure 83
4-wire E&M trunk card—switch locations

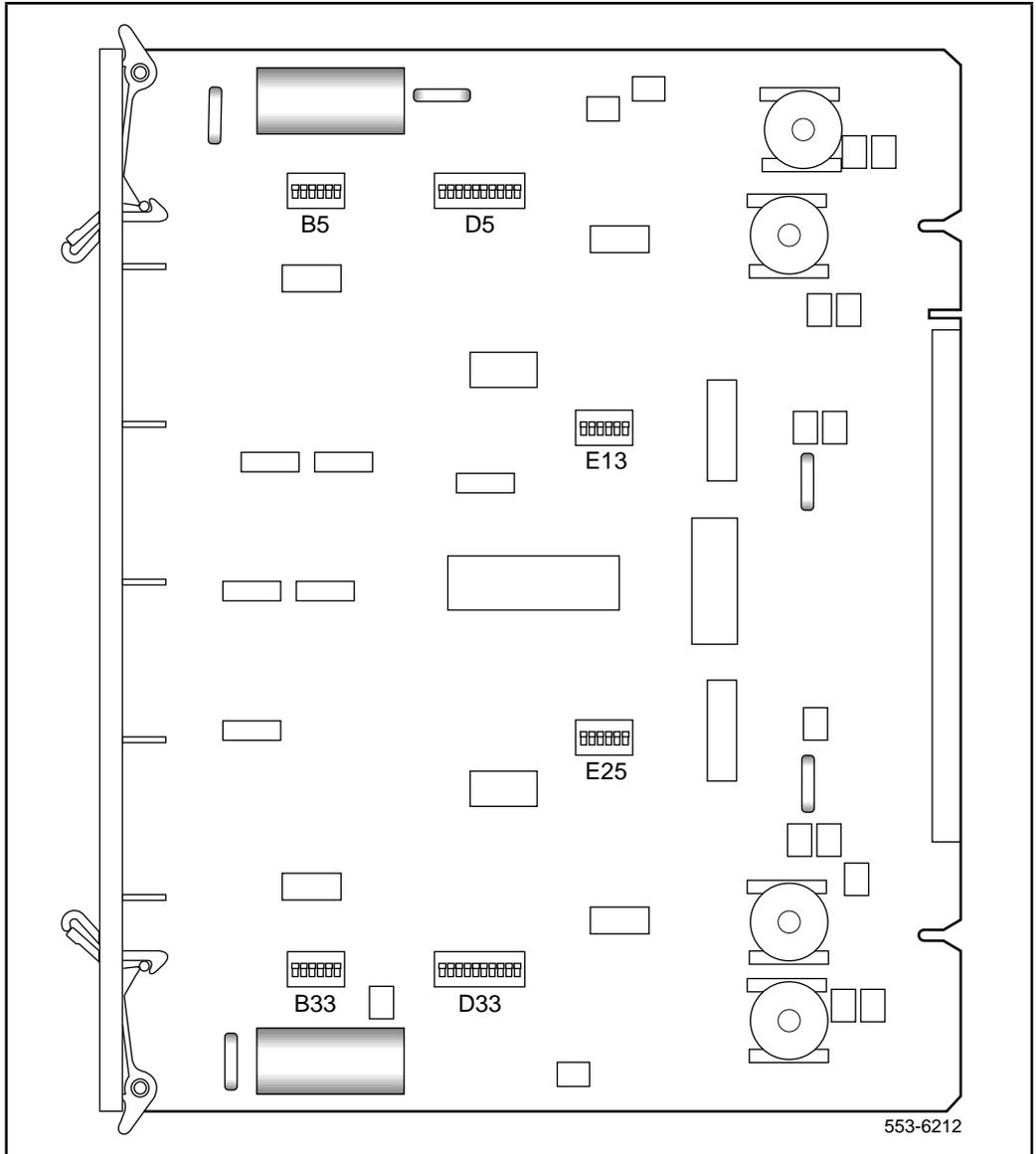


Table 51
4-wire E&M trunk card—S1 and S2 switch settings

Application	Unit 0: Unit 1:		S1 (D33) S2 (D5)								
	1	2	3	4	5	6	7	8	9	10	
E&M Type I	off	off	off	off	off	off	off	off	off	on	off
E&M Type II	off	off	off	off	off	off	off	off	off	on	off
British Telecom	off	off	off	off	off	off	off	off	off	on	off
DX 4-Wire lead M to T1, E to E2	off	on	off	on				on	on	off	on
DX 4-Wire lead M to T2, E to E1	on	off	on	off				on	on	off	on
Conductor loop > 2.5 KΩ					on	on					
Conductor loop < 2.5 KΩ					off	off					

Table 52
4-wire E&M trunk card—S3, S4, S5, and S6 switch settings

Unit 0: Unit 1: Application	S3 (E25) S5 (E13)						S4 (B33) S6 (B5)					
	1	2	3	4	5	6	1	2	3	4	5	6
E&M Type I		on		on	on	on	off	off	on	on	off	off
E&M Type II		on		on	on	off	off	on	off	off	on	off
British Telecom		on		on	on	off	on	off	off	off	off	off
DX 4-Wire lead, M to T1, E to E2		on		on	off	on	off	off	on	on	off	off
DX 4-Wire lead, M to T2, E to E1		on		on	off	on	off	off	on	on	off	off
Interface												
— Carrier network	on		on									
— Public network		off		off								

QPC239 Recorded Telephone Dictation Trunk Card with DCK feature

Introduction

The QPC239 Recorded Telephone Dictation Trunk (RTDT) Card with DCK feature is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The recorded telephone dictation trunk card interfaces two telephone dictation trunk lines to a Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration program (LD 14).

The QPC239 RTDT Card has the following characteristics:

- two units per card
- 600 ohms (balanced) tip and ring impedance
- transmission or no transmission during dialing, selected with option switch settings
- out-of-service control lead
- direct interfacing to recording machine (DCK feature)
- switchable 4-dB pad allows control of gain between line-to-trunk and trunk-to-trunk connections (switching is done under software control)

The out-of-service (OS) control lead serves both “busy” and “out-of-service” functions. It makes the trunk appear busy to the CPU when the recording machine indicates “out of service,” and on disconnect it keeps the trunk busy until the idle signal is received from the recording machine.

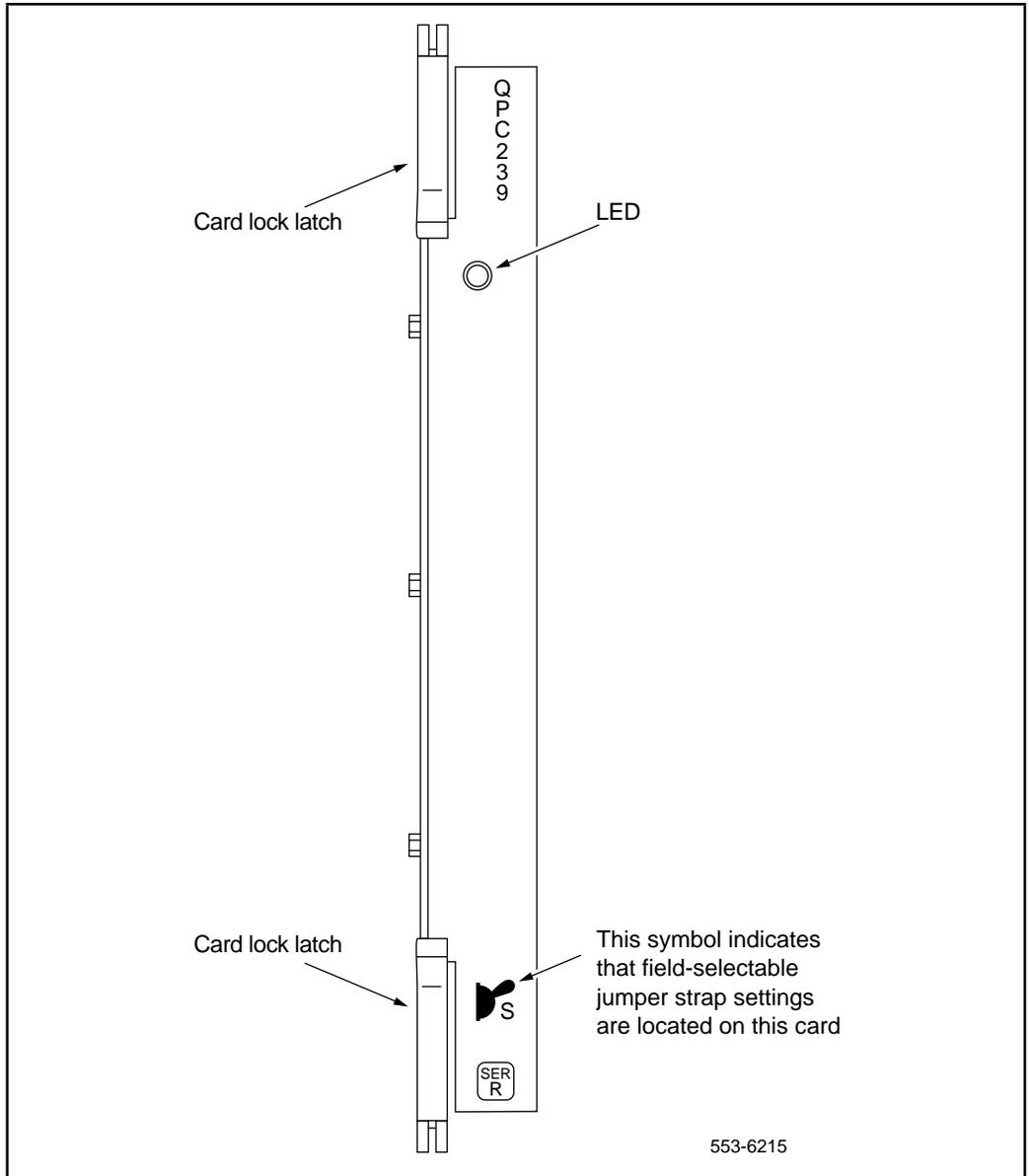
Physical description

The recorded telephone dictation trunk card mounts in any PE slot. The two trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The recorded telephone dictation trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pin cables. The telephone dictation equipment connects to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 84](#)). This LED should only be lit if there is a problem with the card. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

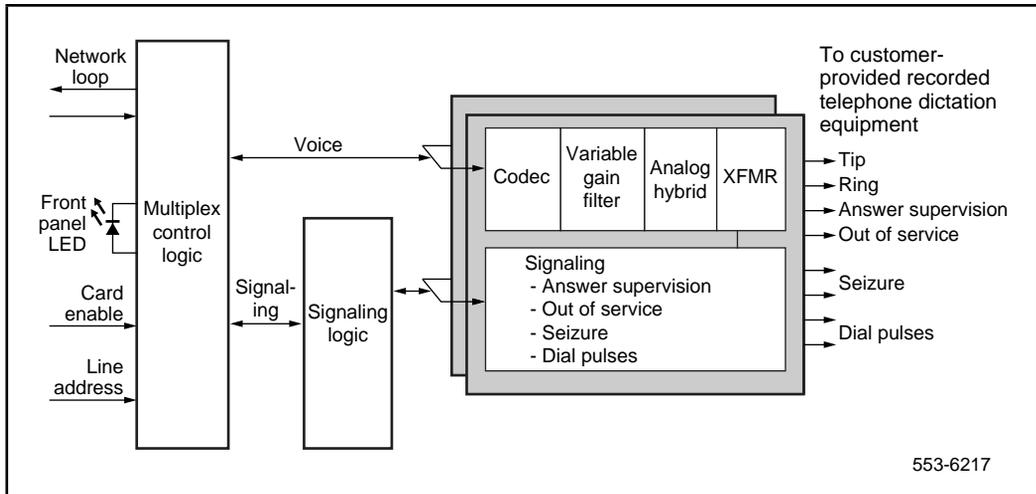
Figure 84
Recorded telephone dictation trunk card—faceplate



Functional description

Figure 85 shows a block diagram of the major functions contained on the recorded telephone dictation trunk card. Each of these functions is described on the following pages.

Figure 85
Recorded telephone dictation trunk card—block diagram



Card interfaces

The recorded telephone dictation trunk card passes both voice and signaling data over the network loop. Network loops are discussed in detail “Peripheral equipment” on page 22.

Trunk interface units

Two recorded telephone dictation trunk units are located on each QPC239 card. Each of these units interfaces directly to a customer-provided recording machine. Each trunk interface has these features:

- termination of the loop tip and ring conductors with a balanced 600-ohm terminating impedance when active or idle
- termination of an out-of-service control lead:
 - to make the trunk appear busy to the CPU when the recording machine indicates out of service
 - on disconnect to keep the trunk busy until the idle information is received from the recording machine
- an option switch to allow or disallow transmission during dialing
- the ability to connect to most recording machines without extra interfacing
- a switchable 4-dB pad for controlling gain between line-to-trunk and trunk-to-trunk connections

The recorded telephone dictation trunk card connects to a recording machine through eight leads. These connections are shown in [Table 53](#).

The out-of-service (OS) control lead serves both “busy” and “out-of-service” functions. It makes the trunk appear busy to the CPU when the recording machine indicates “out of service,” and on disconnect it keeps the trunk busy until the idle signal is received from the recording machine.

Table 53
Connections to recording machines

Lead	Function
Tip and ring	voice connection
OS	lack of ground detection from recording machine on this lead is interpreted as being out of service or busy
CS	a ground returned from the recording machine is interpreted as answer supervision (but CPU takes no action)
CS1 and CS2	seizure relay contact; closed when the card is accessed
CDP1 and CDP2	outpulse relay contacts; send dial pulses to the recording machine
<p>Note: A ground is required from the cross connect field for the recording machine.</p>	

Multiplex control

The multiplex control logic is common to both channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected timeslots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Operation

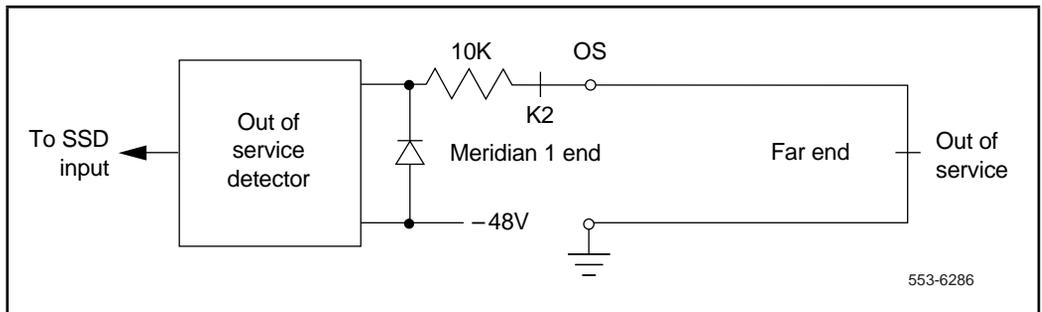
Trunk idle

Since the OS lead (Figure 86) is connected to ground, the state of the out-of-service detector is high to the Out of Service detector. Trunk cards are scanned periodically by the CE. When the card receives a card enable in timeslot 0, the signaling logic responds with a signal on the data input bus.

Trunk busy

An out-of-service condition is initiated when the recording machine removes the ground from the OS lead. When the ground is removed from the out-of-service detector, the appropriate Out of Service detector input is changed from high to low. The Out of Service detector responds with a different signal on the data input bus when scanned.

Figure 86
Out-of-service lead circuit

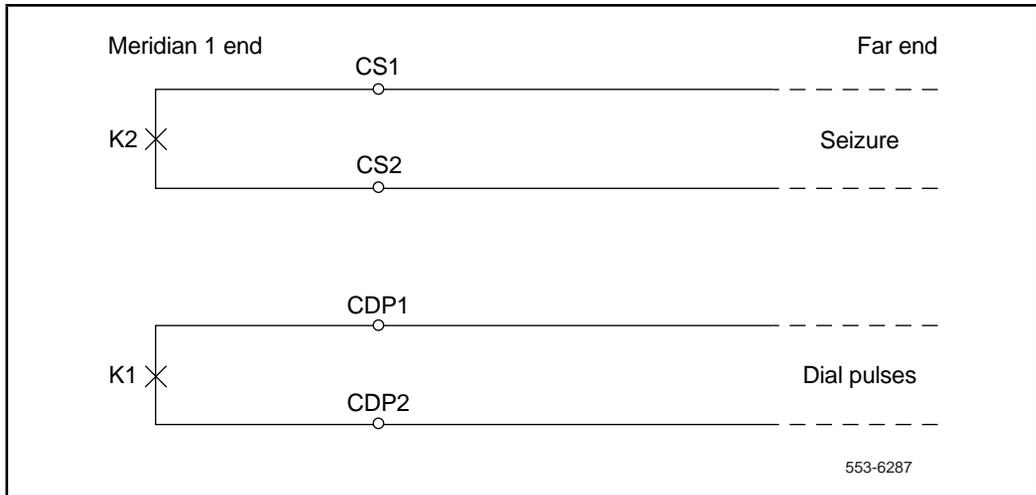


Trunk seizure

When the dial access code is dialed and the card is idle, a message is sent to the signaling logic of the card, causing the K1 relay to operate. The operation of K1 closes the dial-pulsing contact (CDP1, CDP2) and operates the K2 relay to close the seizure contact (CS1, CS2) ([Figure 87](#)).

The signaling logic responds to the enable with a signal on the data input bus. The scan stops and the card receives further enables. The signaling logic also receives signals on the data output bus and, on receipt of these, outputs the contents of the input register onto the data input bus, thus reporting the change of state. The scan cycle then continues.

Figure 87
K1 and K2 relay operation



Outpulsing

A tone and digit switch is assigned to the card throughout the seizure-to-disconnect sequence.

With Digitone class of service, 8-bit PCM word digital signals from the tone and digit switch are applied by means of the data output bus in a selected timeslot to the codec, which decodes and transmits the appropriate tone signals.

With dial pulse class of service, when ready for outpulsing, a trunk outpulsing enable is sent in an assigned timeslot (other than 0 or 1), and a message is sent to the signaling logic to set up the trunk logic so K1 is controlled by the signal level of the data output bus in the assigned timeslot.

The CE then causes K1 to outpulse the required digits by sending the appropriate data from the tone and digit switch in the selected timeslot. The RC network of resistor R47 and capacitor C15 prevents K2 from releasing during the outpulsing of digits by K1 ([Figure 88](#)).

No transmission is obtained during outpulsing by placing switch SW1 in the “on” position. During outpulsing, K3 operates, placing a 620-ohm resistor across the recording machine and disconnecting transformer T1 from leads CT and CR ([Figure 89](#)).

At the completion of outpulsing, another message is sent to the signaling logic. This message returns control of K1 to the signaling logic and the enable in the assigned timeslot is removed.

Note 1: Line cards for 2500 telephones and incoming trunks with Digitone class of service are denied access to RTDT with dial pulse class of service; however, they are allowed if RTDT has Digitone class of service. After the Digitone receiver assigned to the line card times out, the TDS is also freed. The recording machine is controlled through the assigned voice path timeslots.

Note 2: Some recording machines provide answer supervision ([Figure 90](#)). The trunk provides an answer supervision detector, but no action is taken by the system CPU.

Figure 88
Seizure and dial pulsing

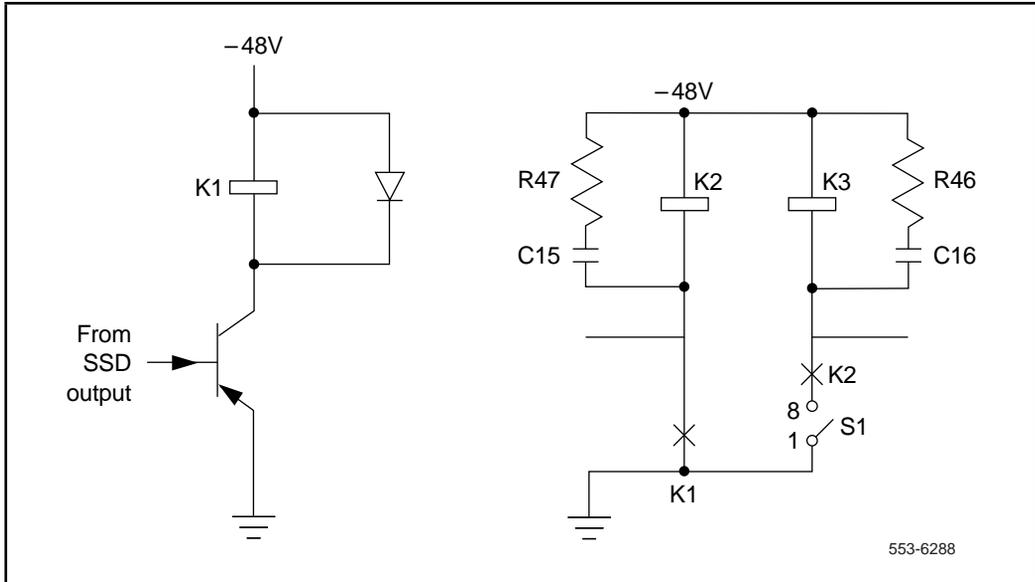


Figure 89
Talking connection

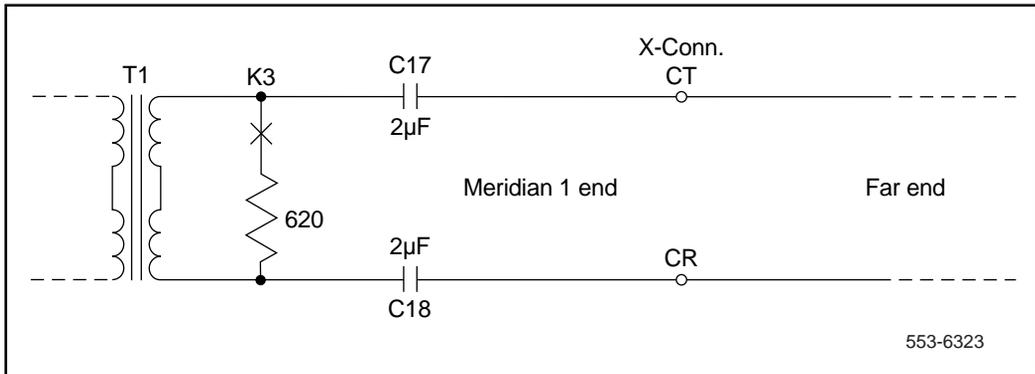
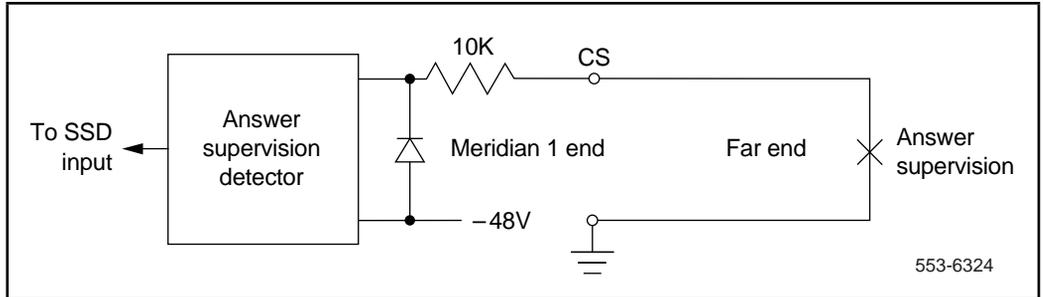


Figure 90
Answer supervision



Disconnection

The near end controls the trunk release by a message to the signaling logic to release K1. However, the trunk is not idled until the OS lead is grounded.

The hybrid codec encodes the analog input to produce a digital signal at DI that is applied through R11 or R13 and Q1 to the common multiplexing circuit.

Q2, controlled by messages to the signaling logic, is used to switch the gain of the digital-analog filter (DAF), to suit the connection loss requirement for various transmission paths.

Signals received from the common multiplexing circuit as DAT 0 into the hybrid codec are decoded in conjunction with signals SYN2 and LEN to produce the codec analog output.

The analog signal from the codec is connected to the input of low pass filter hybrids DAF. This circuit integrates the amplitude modulated pulses from the codec, filters the result, and amplifies the analog signal for connection through R40 and C14 to transformer T1.

Clamping diodes CR7, CR8, CR12, and CR13 protect the ADF and DAF from overvoltages. Resistors R26, R40, and the internal input termination of the ADF hybrid provide the proper termination for transformer T1 to prevent transmission of analog signals from the output of hybrid ADF to the input of hybrid DAF. Q3, controlled by messages to the signaling logic, is used to switch the gain of DAF to suit the connection loss requirement.

C17 and C18 are used to provide an AC-only connection to the recording machine through CT and CR leads ([Figure 89](#)).

Electrical specifications

This section lists the electrical specifications for the recorded telephone dictation trunk card.

Trunk interface electrical characteristics

[Table 54](#) shows the electrical characteristics of the recorded telephone dictation trunk interface unit.

Table 54
Trunk interface electrical characteristics

Characteristic	Specification
Circuits per card	2
Nominal impedance	600 Ω balanced
Gain control pad	4 dB
Options	Dial tone during transmission
	No dial tone during transmission

Overload level

Signal levels exceeding +3 dBm applied to the tip and ring will cause distortion in the trunk.

Power requirements

[Table 55](#) lists the typical power requirements for the recorded telephone dictation trunk card.

Table 55
Power requirements

Voltage	Tolerance	Current (typical)
+10 V dc	± 5%	42 mA
-10 V dc	± 5%	42 mA
+6 V dc	± 1%	17 mA
-6 V dc	± 1%	17 mA
-48 V dc	± 12%	10 mA

Foreign and surge voltage protections

When telephone lines connected to the card are exposed to foreign voltages by direct contact or induction (such as power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 56](#) lists the environmental specifications for the recorded telephone dictation trunk card.

Table 56
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40° to +70° C (-40° to +158° F)

Connector pin assignments

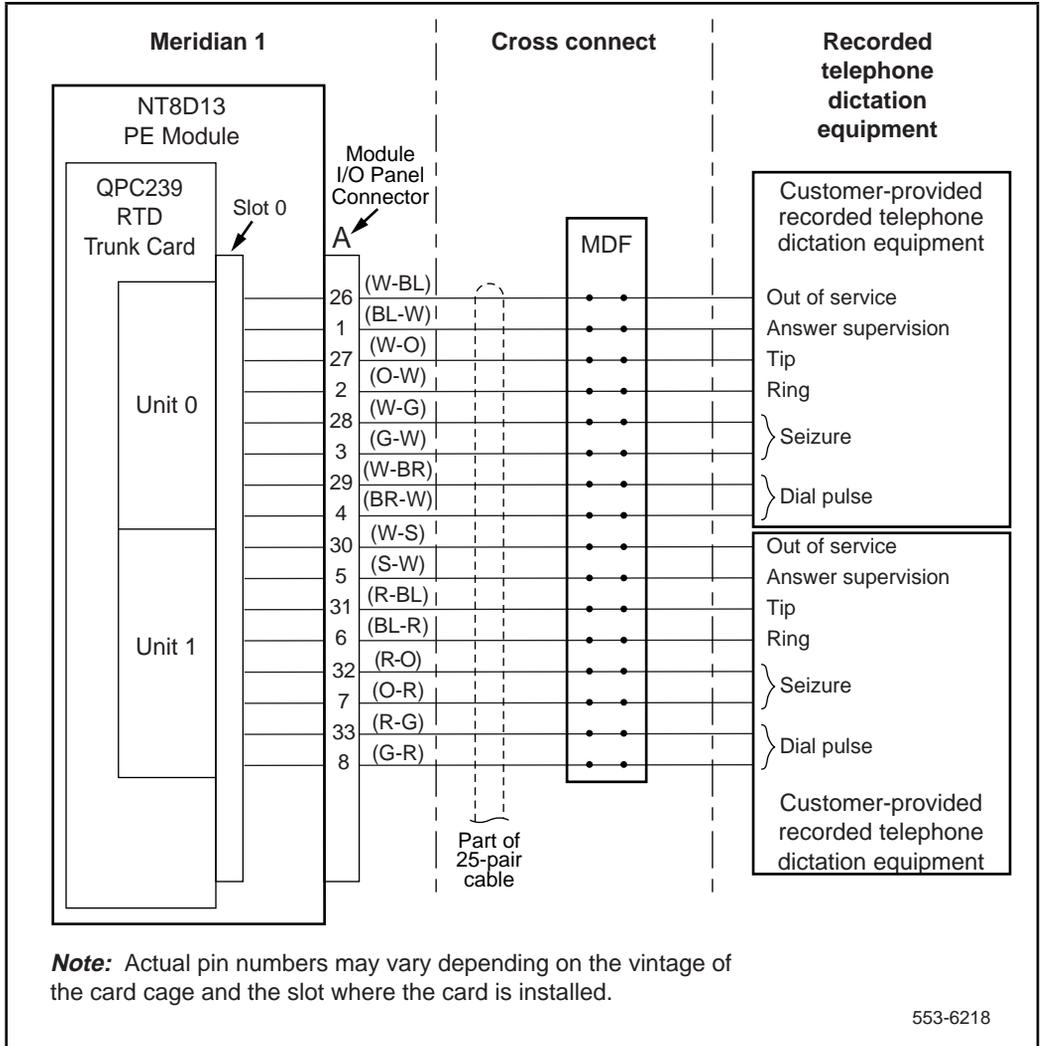
The recorded telephone dictation trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

User-provided telephone dictation equipment connects to the trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 91](#), and a list of the connections to the recorded telephone dictation trunk card is shown in [Table 57](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Table 57
Recorded telephone dictation trunk card—connections

Connector Pin	Signal Name	Function	Unit
36A	OS	Out of Service	0
37A	CS	Answer Supervision	
38A	T	Tip	
39A	R	Ring	
29A	CS1	Seizure	
30A	CS2	Seizure	
31A	CDP1	Dial Pulses	
32A	CDP2	Dial Pulses	
2A	OS	Out of Service	1
3A	CS	Answer Supervision	
4A	T	Tip	
5A	R	Ring	
9A	CS1	Seizure	
10A	CS2	Seizure	
11A	CDP1	Dial Pulses	
12A	CDP2	Dial Pulses	

Figure 91
Recorded telephone dictation trunk card—typical interconnections



Configuration

The trunk is enabled and the insertion loss is set by making software service change entries at the system terminal. The option to have transmission during dialing is enabled for each port by setting a switch on the recorded telephone dictation trunk card. The location of the configuration switches is shown in [Figure 92](#).

Switch settings

The option to have transmission during dialing is enabled for each port by setting a switch on the recorded telephone dictation trunk card. [Table 58](#) shows the settings for these switches.

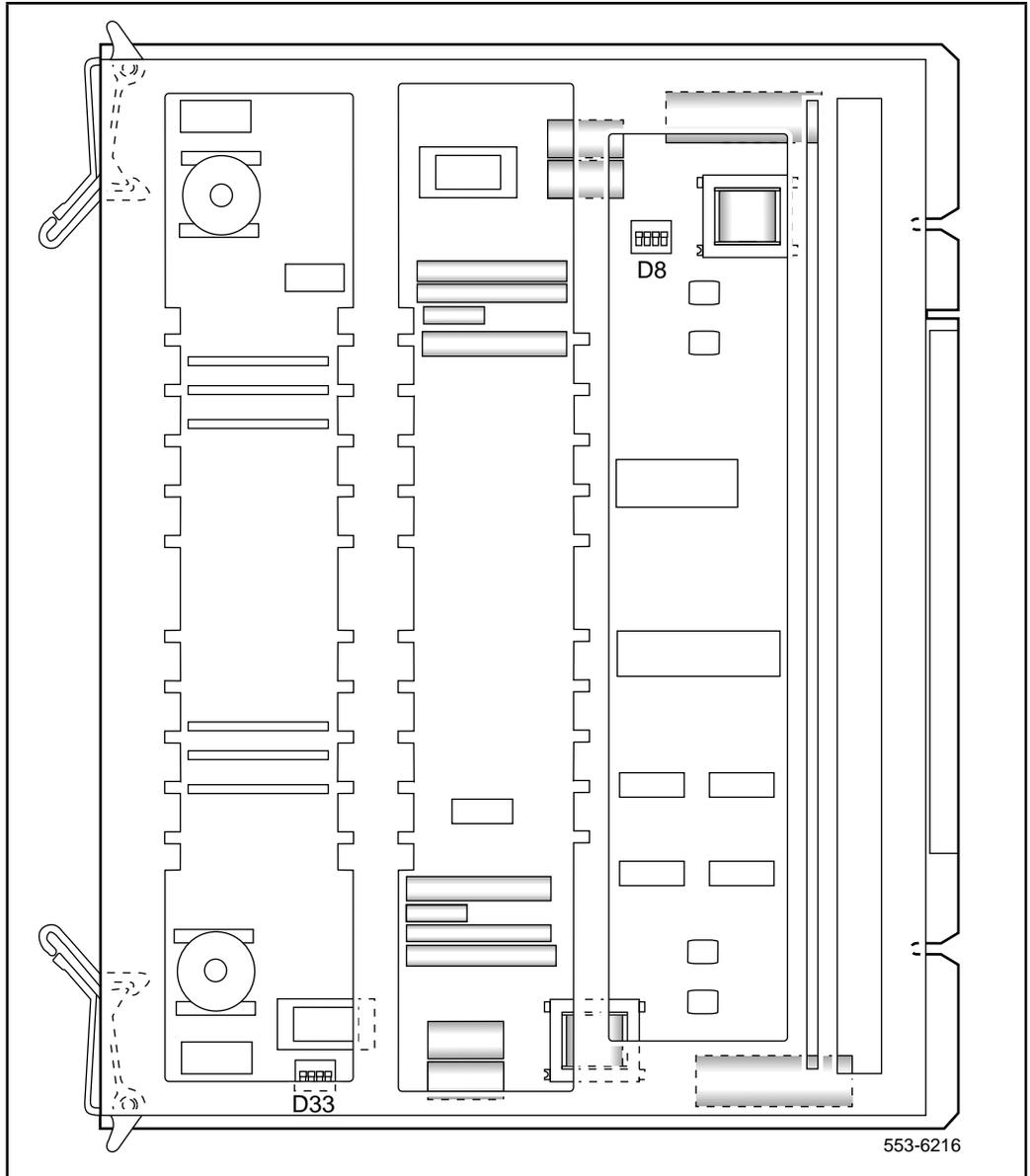
Table 58
Recorded telephone dictation trunk card—switch settings

Transmission during dialing	Unit 0 Switch D33				Unit 1 Switch D8			
	1	2	3	4	1	2	3	4
Yes	off	off	off	off	off	off	off	off
No	on	off	off	off	on	off	off	off

Service change entries

The trunk type, features, signaling arrangement, and insertion loss for each trunk are set by making software service change entries in the Trunk Administration program (LD 14). Refer to the *Meridian 1 X11 input/output guide* for LD 14 service change instructions.

Figure 92
Recorded telephone dictation trunk card—switch locations



QPC250 Release Link Trunk Card

Introduction

The QPC250 Release Link Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The release link trunk card interfaces two analog trunk lines to the Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration program (LD 14).

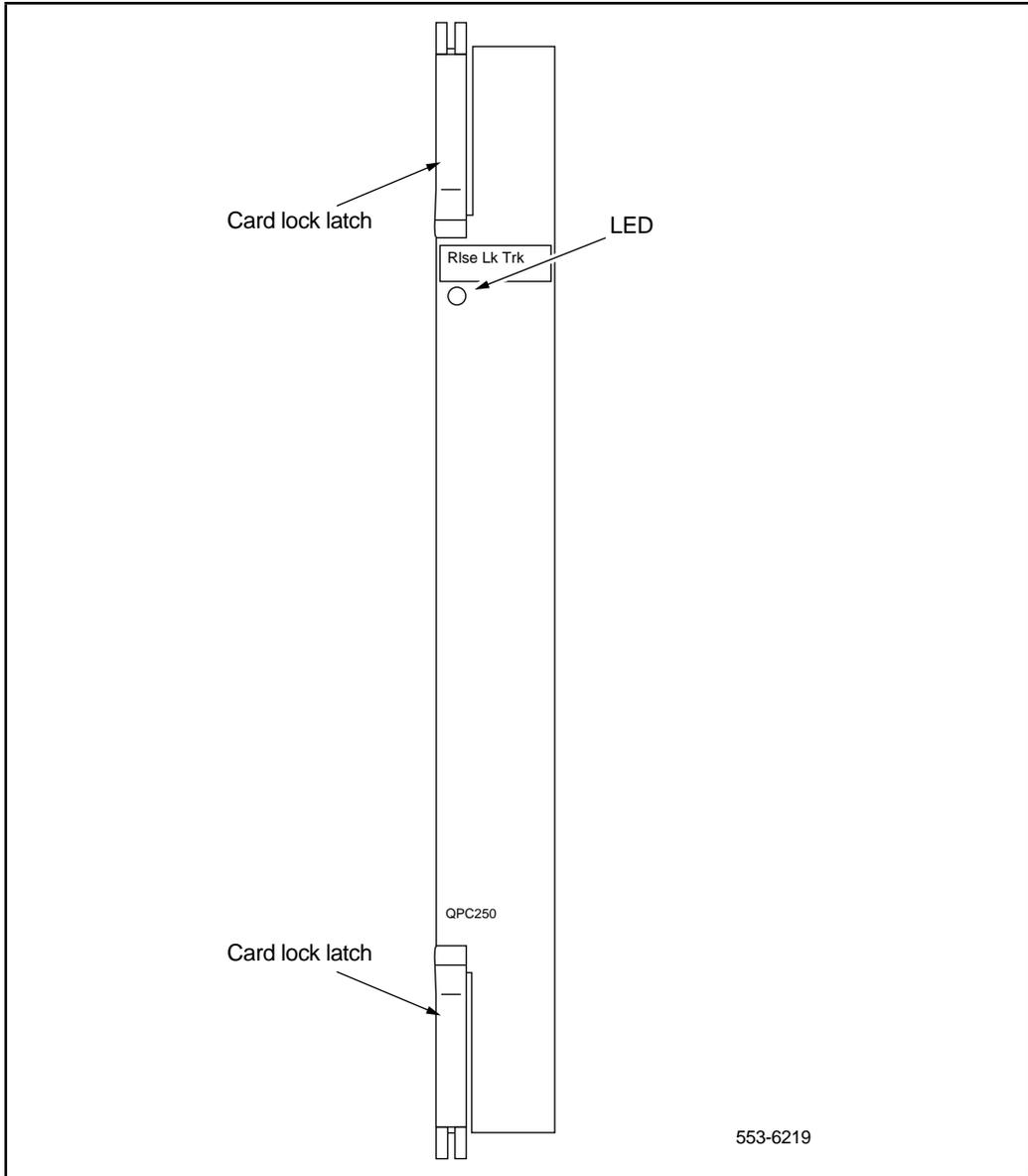
Physical description

The release link trunk card mounts in any PE slot. The two trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The release link trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 93](#)). The LED should only be lit if there is a problem with the card. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

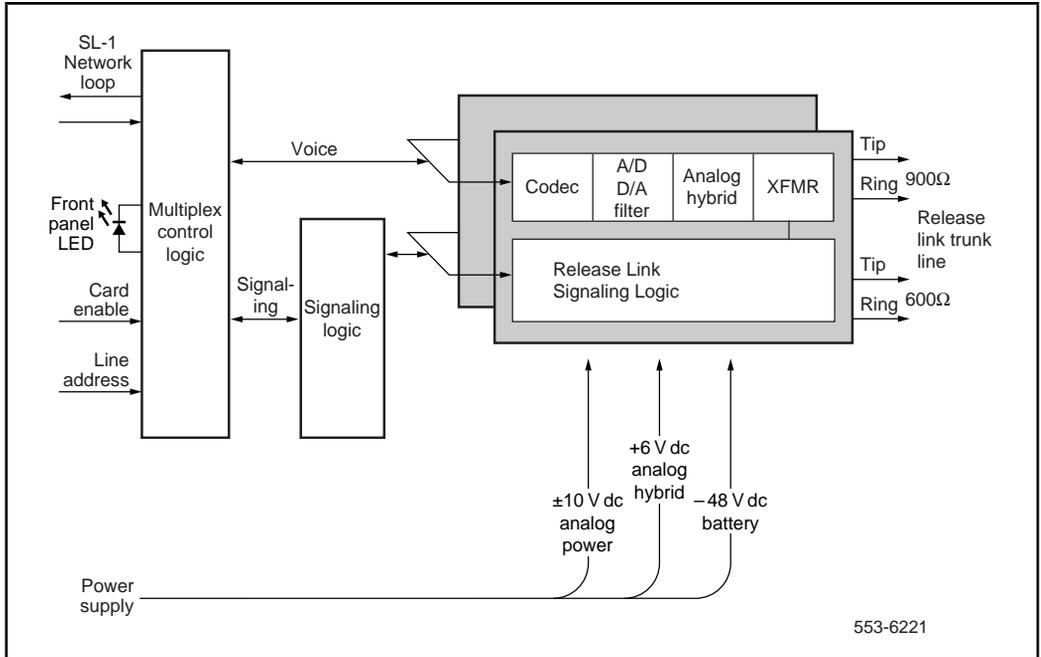
Figure 93
Release link trunk card—faceplate



Functional description

Figure 94 shows a block diagram of the major functions contained on the release link trunk card. Each of these functions are described on the following pages.

Figure 94
Release link trunk card—block diagram



Card interfaces

A release link trunk card is used to interface a remote site to the main site when the Centralized Attendant Service (CAS) feature is required. The remote location is equipped with a QPC250 RLT Card that interfaces with a QPC70 CO Trunk Card, QPC450 CO/FX/WATS Trunk Card, or NT8D14 Universal Trunk Card at the main location. This application is limited to a maximum loop resistance of 1400 ohms.

A release link trunk circuit consists of a trunk circuit at a remote private branch exchange (site) to be served by a CAS attendant, and an interfacing trunk circuit at the main site where the CAS attendant is located. The type of circuit pack that can be used at either the remote site or main site depends on the distance between the remote site and the main site.

The QPC250 RLT Card contains two identical trunk circuits and common circuitry mounted on a printed circuit board. The card can be inserted into any peripheral equipment (PE) shelf slot. Each circuit on a QPC250 RLT Card at a remote site interfaces with a CO trunk circuit at the main site to allow access to the CAS attendant.

Trunk interface units

The release link trunk contains two identical trunk units (also called circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid unit.

Two codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports one trunk interface unit.

Multiplex control

The multiplex control logic is common to both channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected timeslots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Operation

Operation at the remote site

Idle state

The release link trunk (RLT) at the remote site is connected to a central office (CO) trunk circuit at the main site by tip and ring leads. The RLT circuit provides open tip and ring leads during the idle state.

Outgoing seizure

Upon seizure of the RLT by the remote site, the RLT provides ground on the tip lead and battery on the ring lead, and waits 256 ms.

If the DC resistance across the tip and ring leads is greater than 20 K ohms, the site provides steady ringing superimposed with -48 V battery through up to 220 ohms of resistance on the ring lead. If the DC resistance across the tip and ring leads is less than 1300 ohms, then the CO trunk at the main site has not released from a previous call, and the RLT is locked out until the main site removes the loop. A trunk error message (TRK 241) is printed and another RLT circuit is used.

The ringing supply at the remote site should generate AC ringing voltage between 75- and 100-V rms at a frequency of 20 Hz (± 3 Hz).

Detecting answer supervision

The RLT detects a decrease in DC resistance across the tip and ring leads from at least 20 K ohms to 1300 ohms or less, as an off hook signal from the main site equipment. If the off hook signal persists for at least 256 ms, the signal is an answer supervision. The RLT trips ringing within 100 ms when it detects the answer signal. Ringing can be tripped during both the silent and ringing intervals.

Talking state

After answer, and until disconnect, the RLT provides ground through up to 425 ohms of resistance on the tip lead, and -48 V battery through up to 425 ohms of resistance on the ring lead.

Flash signal

The CAS attendant at the main site controls the RLT by the console signal remote (SIG REM) key or release destination (RLS DEST) key. The operation of this key sends a timed flash signal to the RLT. The RLT functions controlled by flashing are a request for a Digitone receiver for the calling party and cancellation of a prior attendant request (release destination).

The RLT recognizes an increase in the DC resistance across the tip and ring leads from <1300 ohms to 20 K ohms or more as an on-hook signal. The on hook signal should be timed for 200 ms to 1.0 second. If the conductor loop resistance changes back to low resistance (off hook) in this interval, the RLT interprets that as a flash signal from the CAS attendant.

The RLT is seized for an incoming CO call, a dial "0", an intercept call, or a hold recall after the CAS attendant has talked to the calling party. The detection of the first flash signal after the RLT has been seized prompts the connection of a Digitone receiver to the RLT, and splits the calling party away from the RLT.

A dial tone is sent to the CAS attendant when the Digitone receiver is available to receive address signals. Dial tone is removed within 50 ms of the start of dialing the first address character. If the RLT detects a subsequent flash signal while connected to a receiver (i.e., attendant flash to clear the receiver), it disconnects the receiver and returns to its initial state (i.e., connected to the calling party). When the receiver has translated the dialed address characters, different confirmation tones are sent to the CAS attendant, depending on the status of the called telephone.

Disconnect

The RLT recognizes and times an increase in the DC resistance across the tip and ring leads from <1300 ohms to 20 K ohms or more as an on-hook from the CAS attendant. If the on hook lasts longer than the flash timer, the RLT interprets the change as a disconnect.

After interpreting disconnect from the attendant, the RLT opens the tip and ring leads to the interfacing CO trunk at the main site, sending a disconnect signal to the main site. To prevent the RLT from being seized from a new call before the CO trunk at the main site has released, the RLT provides a busy guard timer.

Operation at the main site

Idle state

There is a resistance of >20 K ohms across the tip and ring leads at the CO trunk interface during the idle state.

Incoming seizure

The CO trunk at the main site detects seizure by an RLT at a remote site when the RLT provides simultaneously:

- a ground through 1.2 K ohms of resistance or less on the tip lead
- ringing with superimposed –48 V battery on the ring lead through a resistance of 1.2 K ohms or less

The maximum delay of ringing must be less than 5 seconds after ground and battery detection, and the ringing must last more than 640 ms. If any one of the above conditions is not satisfied, the call is not presented to the CAS attendant.

Disconnect before the attendant answers

Before the attendant answers the call, tone ringing should be 2 seconds on and 4 seconds off. If there is no ringing for longer than a value programmed into a programmable timer, the call is withdrawn from presentation to the attendant.

CAS attendant answers

When the CAS attendant answers, a resistance of 800 ohms or less is applied across the tip and ring conductors at the CO trunk. A two-way transmission path between the RLT and the CAS attendant is established within 160 ms to avoid clipping initial speech. The circuit maintains the low resistance across the tip and ring leads until the RLT is flashed or disconnected by the attendant.

Flash signal

When the CAS attendant presses the signal remote (SIG REM) key on the console, a timed flash (on hook) signal is sent to the remote site. The flash signal changes the resistance across the tip and ring leads from low (off-hook) to high (on hook resistance for a timed interval. The flash signal should be 600 ms (± 200 ms) with the preferred signal being 512 ms.

After the CAS attendant has pressed the SIG REM key, a Digitone receiver at the remote end is connected to the RLT and dial tone is sent to the attendant as confirmation that an idle receiver has been connected. Digits dialed after receiving dial tone are outpulsed as soon as an outpulser is available.

When the CAS attendant wishes to release from a prior request (i.e., a call extended to a busy telephone), the release destination (RLS DEST) key on the console is pressed. Operation of this key sends a timed flash to the remote site, and connects the attendant to the original calling party.

Disconnect

The CO trunk at the main site interprets removal of ground from the tip lead and -48 V battery from the ring lead that persists for more than 1 second as a disconnect signal from the RLT. After interpreting disconnect from the remote site, the CO trunk disconnects from the CAS attendant, and removes the loop across the tip and ring leads that acts as a disconnect supervision.

When the CAS attendant disconnects, the resistance of 800 ohms or less applied to the tip and ring leads at the CO trunk changes to 20 K ohms or more. This is interpreted as an on hook signal to the RLT at the remote site.

Electrical specifications

This section gives the electrical specifications for the release link trunk card.

Trunk interface electrical characteristics

[Table 59](#) gives the electrical characteristics for the trunk interface units on the release link trunk card.

Table 59
Electrical specifications

Characteristic	Specification
Impedance	900 ohms
Loop limit	1400 ohms at nominal -48 V
Leakage resistance	30,000 ohms
Ring trip	During silent or ringing intervals
Ringing voltage	85-V rms, 20 Hz superimposed on -48 V dc
Signaling	Ground start
Supervision	Normal battery conditions are applied (-48 V to ring, ground to tip) when the interfacing CO trunk circuit is to be seized
Power input from shelf	± 10 V dc, ± 6 V dc, -48 V dc 85-V rms, 20 Hz, superimposed on -48 V dc
Effective loss	0.5 dB at 1020 Hz (pads in), -1.5 dB (pads out)
Insertion loss	1 dB
Answer supervision	Does not reverse battery when the terminating end answers
Disconnect supervision	Does not momentarily open-circuit the tip and ring leads on disconnect

Power requirements

[Table 60](#) lists the typical power requirements for the release link trunk card.

Table 60
Power requirements

Voltage	Tolerance	Current (typical)
+10 V dc	± 5%	30 mA
+10 V dc	± 5%	30 mA
±6 V dc	± 1%	8 mA
±6 V dc	± 1%	8 mA
-48 V dc	± 12%	100 mA

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 61](#) lists the environmental specifications for the release link trunk card.

Table 61
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40° to +70° C (-40° to +158° F)

Connector pin assignments

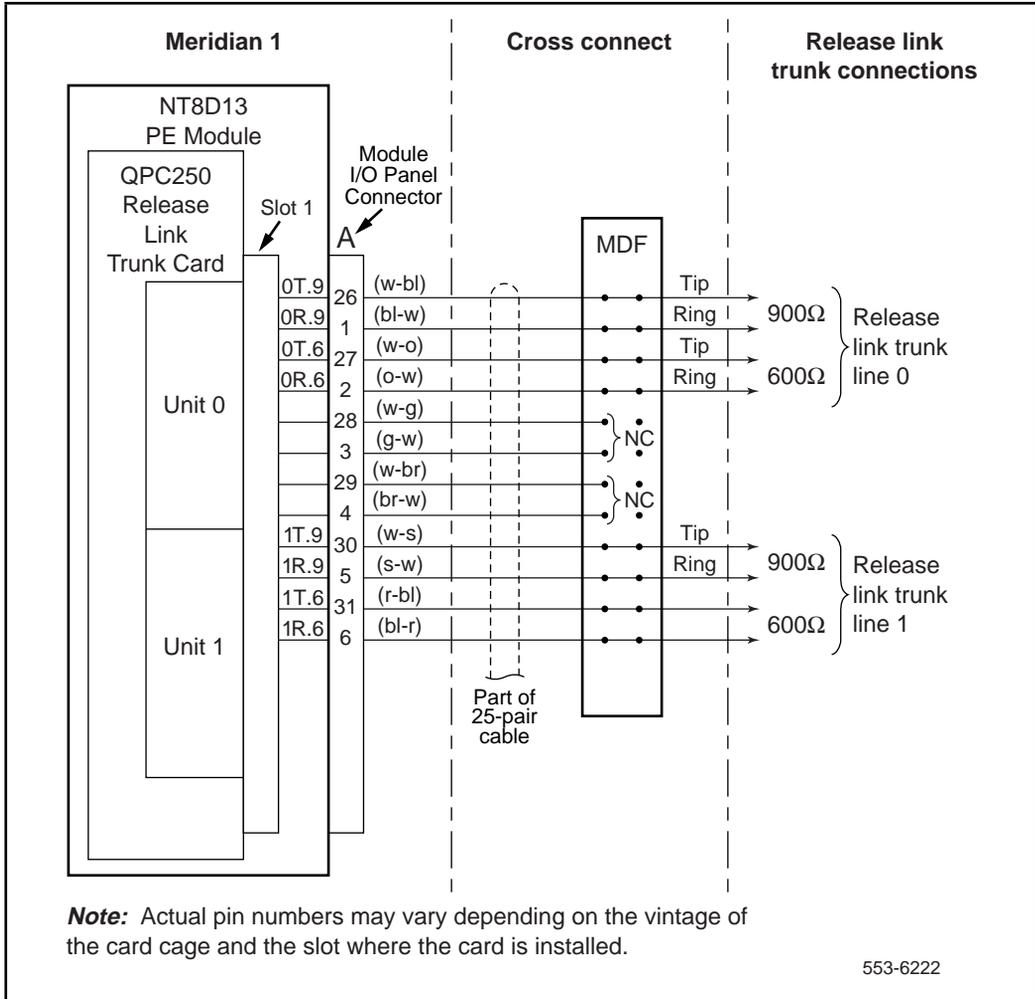
The release link trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the release link trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 95](#) and a list of the connections to the release link trunk card is shown in [Table 62](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair

Table 62
Release link trunk card—backplane pinouts

Connector Pin	Signal	Unit
36A	Tip, 900 Ω	0
37A	Ring, 900 Ω	
38A	Tip, 600 Ω	
39A	Ring, 600 Ω	
2A	Tip, 900 Ω	1
3A	Ring, 900 Ω	
4A	Tip, 600 Ω	
5A	Ring, 600 Ω	

Figure 95
Release link trunk card—typical cross connection example



Configuration

This section gives information on configuring the release link trunk card.

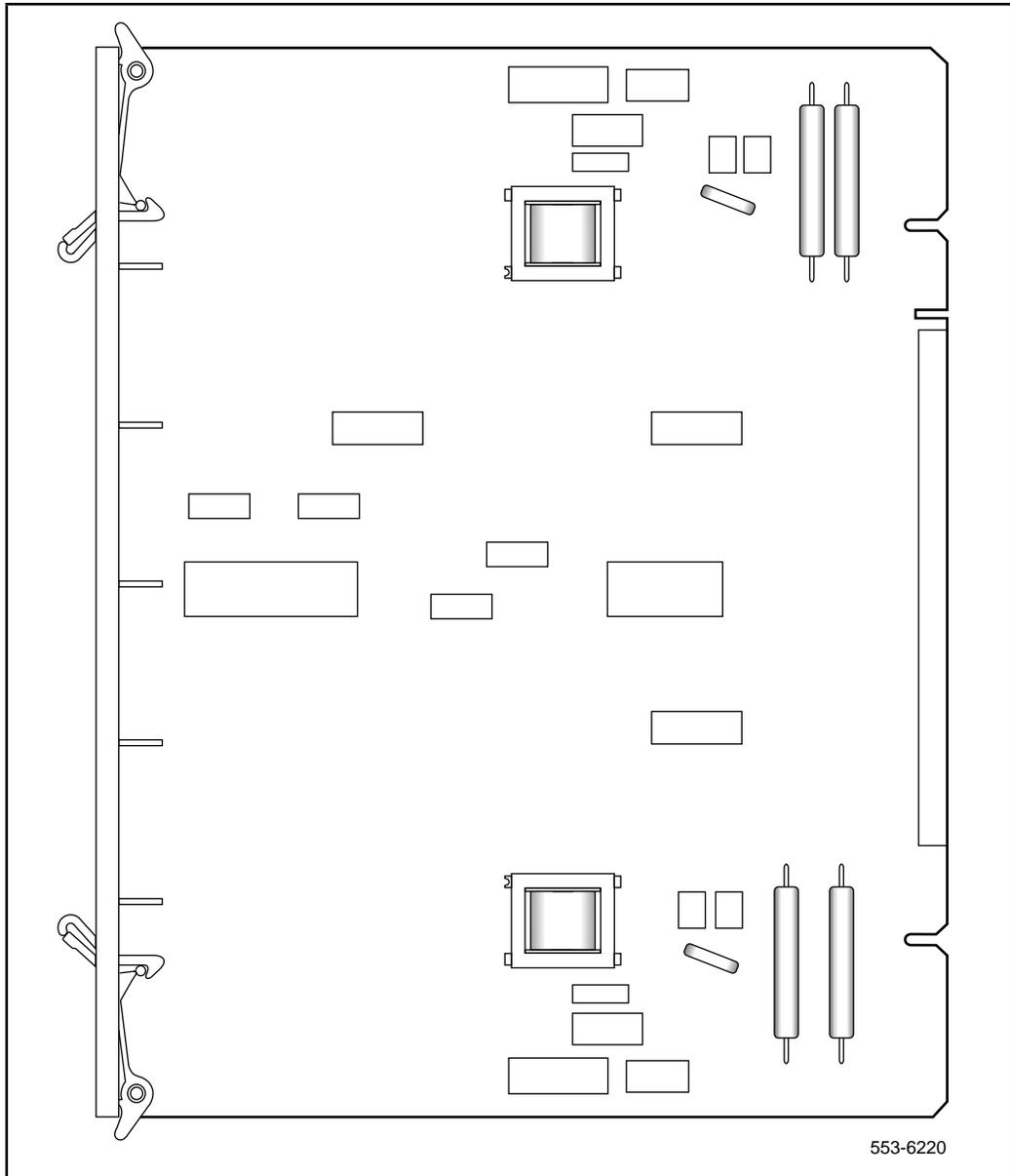
Switch and jumper settings

The trunk type for each unit on the card is selected by software service change entries at the system terminal. There are no switches or jumpers on the release link trunk card. An outline of the card is shown in [Figure 96](#).

Service change entries

The trunk type, features, and signaling arrangement for each trunk are selected by making service change entries in the Trunk Administration program (LD 14). The Centralized Attendant Service is enabled using the Customer Data Block program (LD 15). A CAS trunk is added or changed using the Trunk Route Administration program (LD 16). Refer to the *Meridian 1 X11 input/output guide* for LD 14, LD 15, and LD 16 service change instructions. Refer to *Centralized Attendant Service description and engineering* (553-2681-100) for more information on the Centralized Attendant Service.

Figure 96
Release link trunk card—switch and jumper settings



QPC449 Loop Signaling Trunk Card

Introduction

The QPC449 Loop Signaling Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The loop signaling trunk card interfaces four analog trunk lines to the Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration program (LD 14).

The loop signaling trunk card complies with Electronic Industries Association (EIA) transmission standards except for its terminating impedance and balancing network. Each of the four trunk interface units can interface with any of the following trunk types:

- Direct Inward Dial (DID) and Direct Outward Dial (DOD)
- Loop Dial Repeating (LDR) tie trunk
- Two-way Outgoing Automatic Incoming Dial (OAID) tie trunk
- Outgoing Automatic Number Identification (OANI)

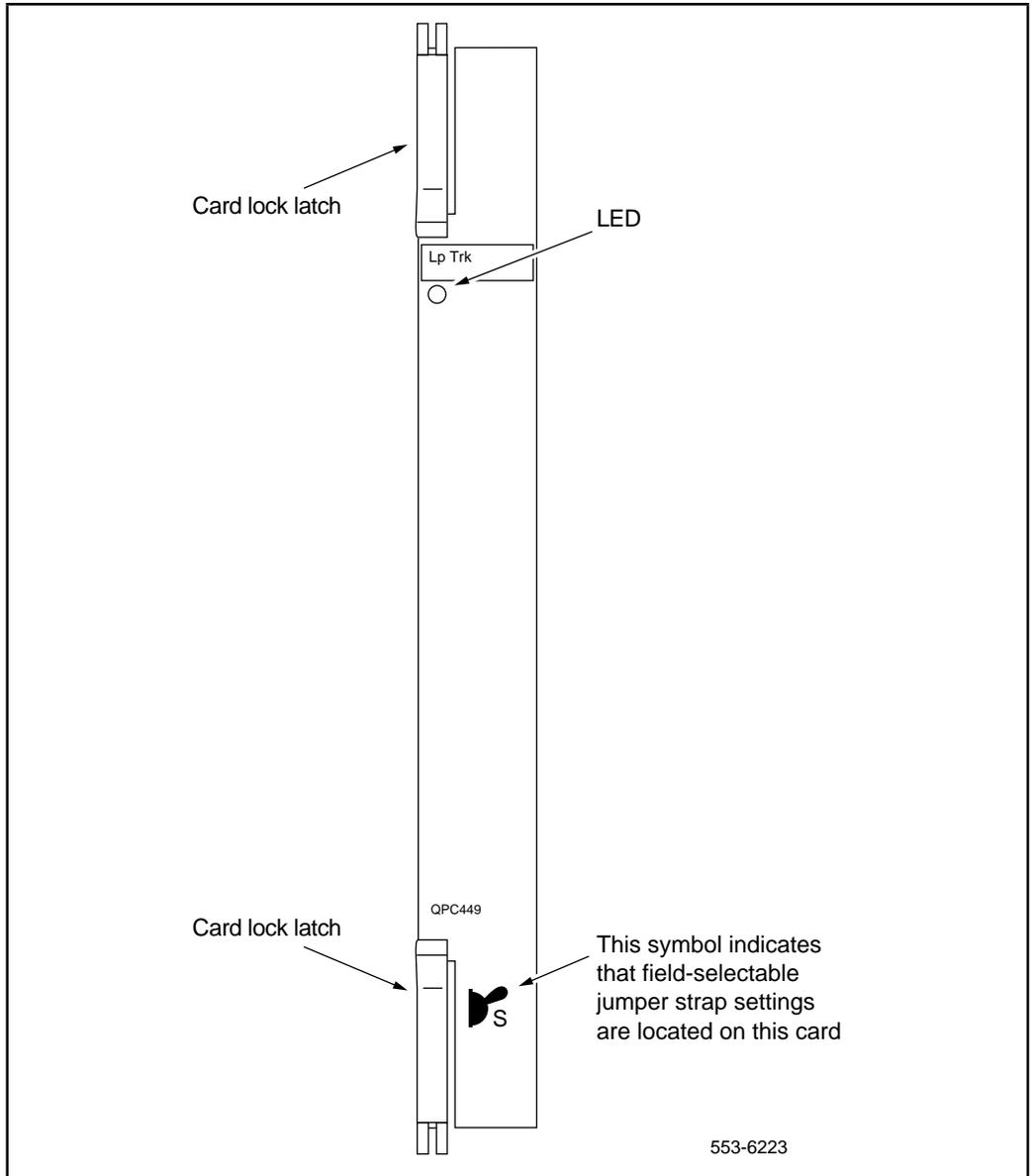
Physical description

The loop signaling trunk card mounts in any PE slot. The four trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The loop signaling trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 97](#)). The LED should only be lit if there is a problem with the card. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

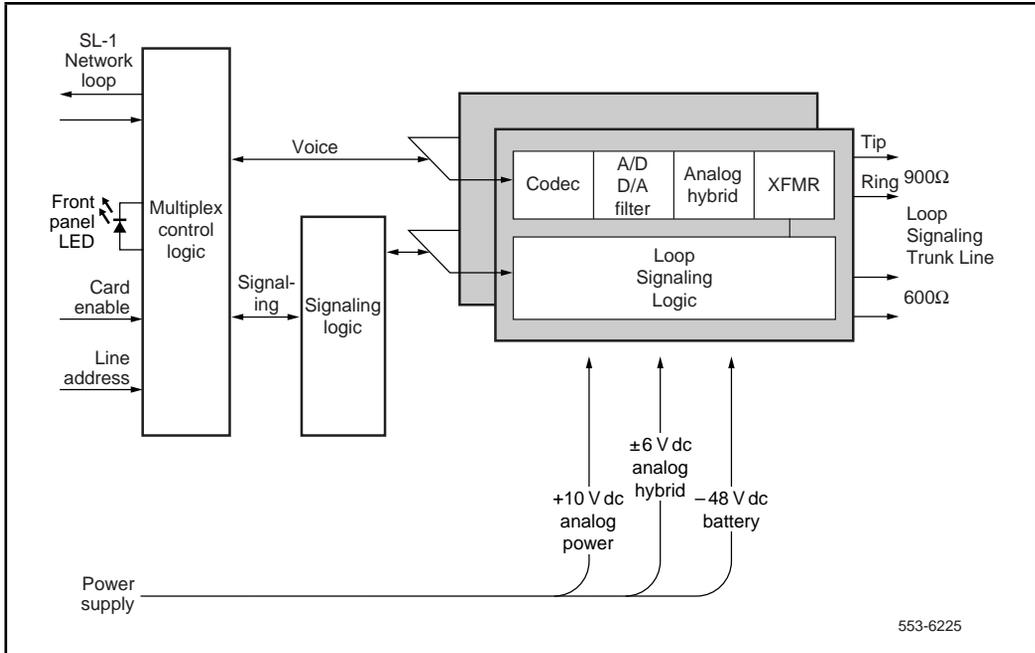
Figure 97
Loop signaling trunk card—faceplate



Functional description

Figure 98 shows a block diagram of the major functions contained on the loop signaling trunk card. Each of these functions is described on the following pages.

Figure 98
Loop signaling trunk card—block diagram



Card interfaces

The loop signaling trunk card passes both voice and signaling data over the network loop. Network loops are discussed in detail in “Peripheral equipment” on page 22.

Trunk interface units

The loop signaling trunk card contains four identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Also provided are relays for placing outgoing call signaling onto the trunk. Signal detection circuits monitor incoming call signaling.

Four codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports one trunk interface unit.

Audio signals received from the tip and ring leads are fed to the analog-to-digital filter through the hybrid transformer. The receiver filter with some external components forms a 26 dB, 60 Hz rejection filter.

The filter limits the frequency range to a nominal 200 to 3400 Hz bandwidth and amplifies the signal for application to the codec. The codec encodes the analog signal to produce a digital signal that is applied to the common multiplexing circuit.

Digital signals from the multiplexing circuit are fed to the codec and decoded to produce an analog output. This is fed to the transmit filter, which amplifies and filters the resulting signal. This signal is then fed to the tip and ring leads through the hybrid transformer.

Multiplex control

The multiplex control logic is common to both channels. This logic interfaces the individual line circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected time slots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Operation

The QPC449 Loop Signaling Trunk Card interface units are compatible with the equipment listed in [Table 63](#). Optional applications (such as class of service, signaling, and start arrangements) for each trunk are assigned in the Trunk Administration program (LD 14).

Battery and ground pulsing is provided for DID/DOD trunks and LDR tie trunks with a loop resistance of 445 to 1225 ohms in each conductor. For DID/DOD trunks, a loop range of 1600 ohms ensures a minimum loop current of 16.2 mA. For two-way OAID tie trunks, a loop range of 1000 ohms ensures a minimum loop current of 23 mA.

Table 63
Application and compatibilities

Application	Loop range (see note)	Compatible with
DID trunk	1600 Ω	Step-by-step CO interconnect; No. 5 crossbar outgoing trunk; sender trunk
DID/DOD trunk	1600 Ω	two-way tie trunk
LDR tie trunk		Pulse QPJ76 circuit; back-to-back with another signaling trunk
Two-way OAID tie trunk	1000 Ω	two-way tie trunk
OANI trunk		Centralized Automatic Message Accounting (CAMA) trunks
Note: The quoted loop range assumes a near end, far end battery of -42.75 V to -52.5 V and a ground potential difference of ± 10 V.		

DID trunk

Release control of a call is specified in the system memory by the Trunk Route Administration program (LD 16). The two options available are EITHER or ORIGINATING party control. These can be specified for the Meridian 1 end (near end), or for the CO or other PBX end (far end). Joint party control can be specified for the far end.

The following description of signaling and supervision applies specifically to an EITHER party release arrangement for a call along a DID trunk and an ORIGINATING party arrangement along a tie trunk. This is the default condition if no options are specified in LD 16.

Origination at CO

- 1 A low resistance is placed at the CO between tip and ring.
- 2 The CPU in the Meridian 1 common equipment (CE) scans the signaling logic and receives a message that the trunk is off hook.
- 3 The CO applies battery-ground or loop pulsing dial pulses to the trunk.
- 4 The dial pulses are detected by the CE, which alerts the terminating station; a ringback tone is returned to the CO subscriber.
- 5 The terminating station lifts the receiver. A ringback tone is tripped.
- 6 Control message from CE operates relays K1, K2, and K3 (see [Figure 98](#)).
- 7 Reversed battery and ground are sent to the CO.

Termination from CO

- 1 The CO removes the low-resistance loop.
- 2 The CE detects changes and generates a signal to restore relays K1, K2, and K3.

Termination from near end

- 1 The station goes on hook.
- 2 The CE restores relays K1, K2, and K3.
- 3 The CO removes the low-resistance loop from the circuit.

Loop Dial Repeating tie trunk

Outgoing call

Origination of outgoing call

- 1 The station or console dials the trunk access code.
- 2 The CE seizes the trunk by sending a message to the signaling logic to open relays K1 and K2 (see Figure 98 on page 242).
- 3 A low resistance is applied between tip and ring.
- 4 When the trunk is ready for outpulsing, the CE operates K3 and digits are outpulsed by K2 under control of the signals on the data output bus.
- 5 At the end of outpulsing, K3 is released and control of K1 and K2 is returned to the signaling logic.
- 6 If answer supervision is provided by the far end, a reverse battery is applied between tip and ring when the far end answers.
- 7 The reverse battery is detected and monitored by the reverse battery detector network.

Termination of call

- 1 Trunk is arranged for outgoing party control.
- 2 The near end goes on hook with no answer supervision from the far end; K1 and K2 release together.

or

The near end goes on hook with answer supervision from the far end; K2 releases but K1 stays operated for 60 s if answer supervision is still being provided by the far end. Otherwise, K1 will release as soon as answer supervision ceases.

Incoming call**Origination of call**

- 1 The far end initiates a call by placing low resistance between tip and ring, causing battery current to flow.
- 2 Loop current flow causes a signal on the data input bus to the CE.
- 3 Dial pulses are applied from the far end in the form of battery/ground or loop current.
- 4 CE detects dial pulses as changes in state on the data input bus.
- 5 The terminating party answers, operating K1, K2, and K3.
- 6 Reverse battery and ground are sent to the far end.

Termination of call

- 1 The far end releases.
- 2 The far end removes low-resistance loop.
- 3 CE detects a change in resistance and releases K1, K2, and K3, restoring normal battery and ground.

OAID tie trunk**Outgoing call****Origination of call**

- 1 The originating party dials the access code.
- 2 CE seizes the trunk by operating relays K1, K2, and K3 (see [Figure 98](#)).
- 3 The battery is placed on tip and ground on ring, alerting the far end.
- 4 The far end answers the call, causing a low resistance to be placed between tip and ring.
- 5 The loop current detector at the near end monitors loop current flow.

Termination of call

- 1 The trunk is arranged for originating party (near end) control.
- 2 If the near end releases, CE releases K1, K2, and K3, restoring normal battery.

If the far end releases, the low-resistance loop is removed from tip and ring.
- 3 Current detector informs CE of zero loop current flow.
- 4 CE releases K1, K2, and K3, restoring normal battery and ground.

Incoming call

Origination of call

- 1 The far end places low-resistance loop between tip and ring.
- 2 The loop current detector at the near end detects loop current and signals the CE.
- 3 The far end sends dial pulses by interrupting loop current.
- 4 The near end answers the call, completing the circuit. If answer supervision is required, reverse battery is sent on tip and ring.

Termination of call

- 1 The trunk is arranged for originating party (far end) control.
- 2 The far end removes low-resistance loop.
- 3 The current detector informs CE of zero current flow.
- 4 CE restores normal battery and ground.

Senderized operation for DID and LDR trunks

If the far end is senderized, the Meridian 1 can be operated in any mode: immediate start (IMM), delay dial (DDL), or wink (WNK) start, as assigned on a class of service basis.

For immediate start, following the seizure signal, the far end may start pulsing after the standard delay (normally 70 ms minimum) controlled by the distant end. For stop/go signaling, following the seizure signal, an off hook/on hook (320 ± 64 ms for DDL, 256 ms for WNK) signal will be returned almost immediately to the distant end to satisfy DDL or WNK mode. The distant end detecting this signal may start pulsing after the standard delay (normally 70 ms minimum) controlled by the distant end.

When DDL or WNK class of service is used, outgoing calls require a stop/go signal from the far end so that the trunk cannot outpulse.

Electrical specifications

This section gives the electrical specifications for the loop signaling trunk card.

Trunk interface electrical characteristics

[Table 64](#) gives the electrical characteristics for the trunk interface units on the loop signaling trunk card.

Table 64
Electrical characteristics

Characteristics	Description
Circuits per card	4
Options	600 or 900 Ω nominal impedance, selected at main distribution frame (MDF)
Loop termination	270 Ω
Effective gain	1.0 dB line-to-trunk
	1.0 dB trunk-to-trunk
Line leakage	>30 k Ω
Power feed	165/165 Ω balanced, 48 V nominal
External resistance	2000 Ω max (for 16.2 mA)
Ground potential difference	± 10 V dc max
Far-end battery limits	-42.75 to -52.5 V dc
Card options	600/900 Ω nominal impedance; ANI or non-ANI; loop or battery/ground pulsing on ANI

Overload level

Signals exceeding +7 dBm applied to the tip and ring terminals will cause distortion in the signal.

Power requirements

[Table 65](#) lists the power requirements for the loop signaling trunk card.

Table 65
Power requirements

Voltage	Tolerance	Worst case current
+6.0 V dc	± 5 %	80 mA
-6.0 V dc	± 5 %	80 mA
+10.0 V dc	± 2%	10 mA
-48 V dc	± 10%	300 mA
-52 V dc	± 10%	160 mA
+2.5 V Ref	± 0.5%	< 0.1 mA

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 66](#) lists the environmental specifications for the loop signaling trunk card.

Table 66
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +60° C (+32 to +140° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40° to +70° C (-40° to +158° F)

Connector pin assignments

The loop signaling trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the loop signaling trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 99](#), and a list of the connections to the loop signaling trunk card is shown in [Table 67](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Figure 99
Loop signaling trunk card—typical cross connection example

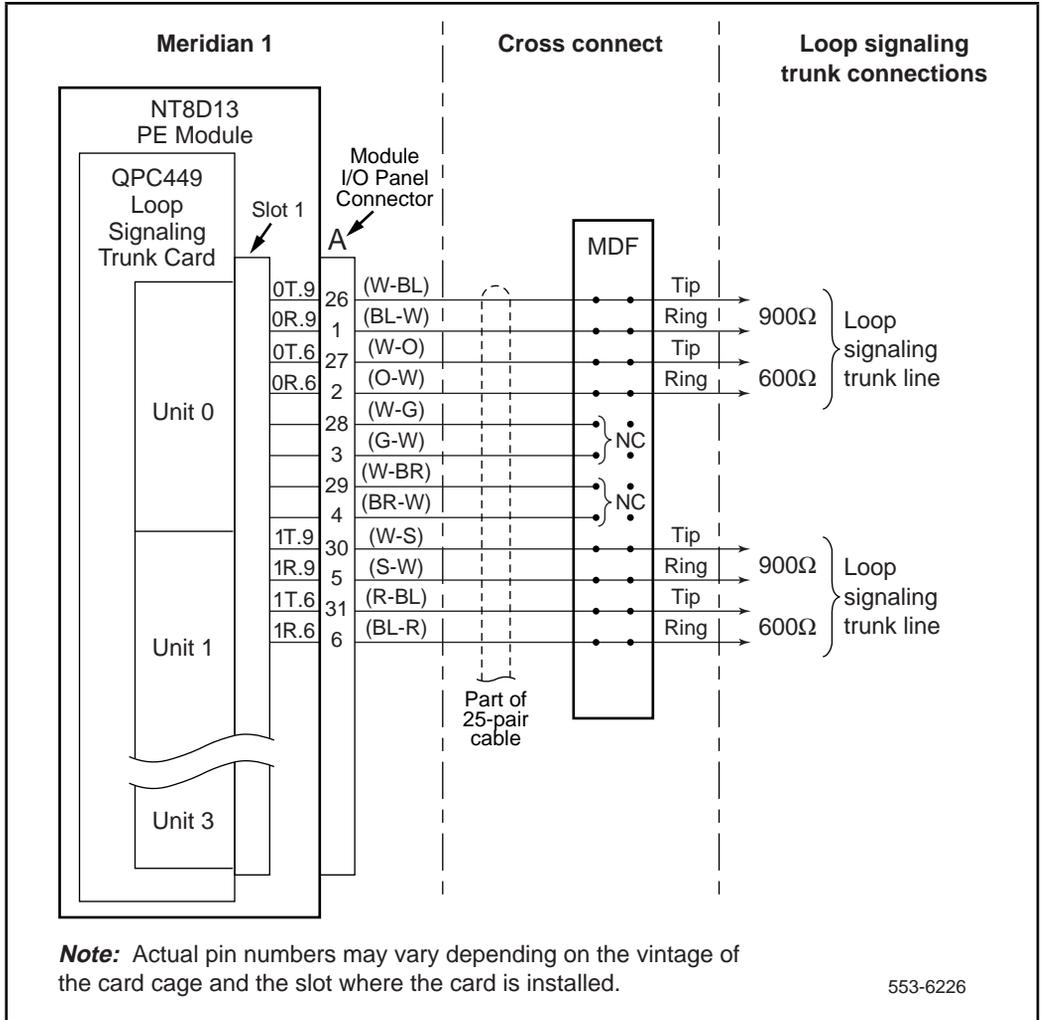


Table 67
Loop signaling trunk card—backplane pinouts

Connector Pin	Signal	Unit
36A	Tip, 900Ω	0
37A	Ring, 900Ω	
38A	Tip, 600Ω	
39A	Ring, 600Ω	
29A	Tip, 900Ω	1
30A	Ring, 900Ω	
31A	Tip, 600Ω	
32A	Ring, 600Ω	
2A	Tip, 900Ω	2
3A	Ring, 900Ω	
4A	Tip, 600Ω	
5A	Ring, 600Ω	
9A	Tip, 900Ω	3
10A	Ring, 900Ω	
11A	Tip, 600Ω	
12A	Ring, 600Ω	

Configuration

This section gives information on configuring the loop signaling trunk card.

Switch and jumper settings

The trunk type for each unit on the card is selected by software service change entries at the system terminal. There are no switches or jumpers on the loop signaling trunk card. An outline of the card is shown in [Figure 100](#).

Service change entries

The trunk type, features, signaling arrangement, and transmission properties for each trunk are selected by making service change entries in the Trunk Administration program (LD 14). Refer to the Meridian 1 *X11 input/output guide* for LD 14 service change instructions.

Insertion loss

The transmission properties of each trunk are characterized by class of service (COS) assignments in the Trunk Administration program (LD 14). The assignments can be either:

- Via Net Loss (VNL)
- non-VNL, either transmission compensated (TRC) or Non-Transmission Compensated (NTC)

To ensure stability and minimize echo when connecting to long-haul VNL class of service trunks, these non-VNL trunks are assigned either TRC or NTC class of service. TRC and NTC determine the operation of the switchable pads contained in the trunk cards. They are assigned as follows:

- TRC: for a 2-wire non-VNL trunk facility with a loss of greater than 2 dB or for which impedance compensation is provided; or for a 4-wire non-VNL facility
- NTC: for a 2-wire, non-VNL trunk facility with a loss of less than 2 dB or when impedance compensation is not provided

The control pad switching for the various through connections and the actual loss introduced are given in [Figure 101](#). The pad switching algorithms are used to provide proper insertion loss and echo protection when required.

Figure 100
Loop signaling trunk card—switches and jumpers

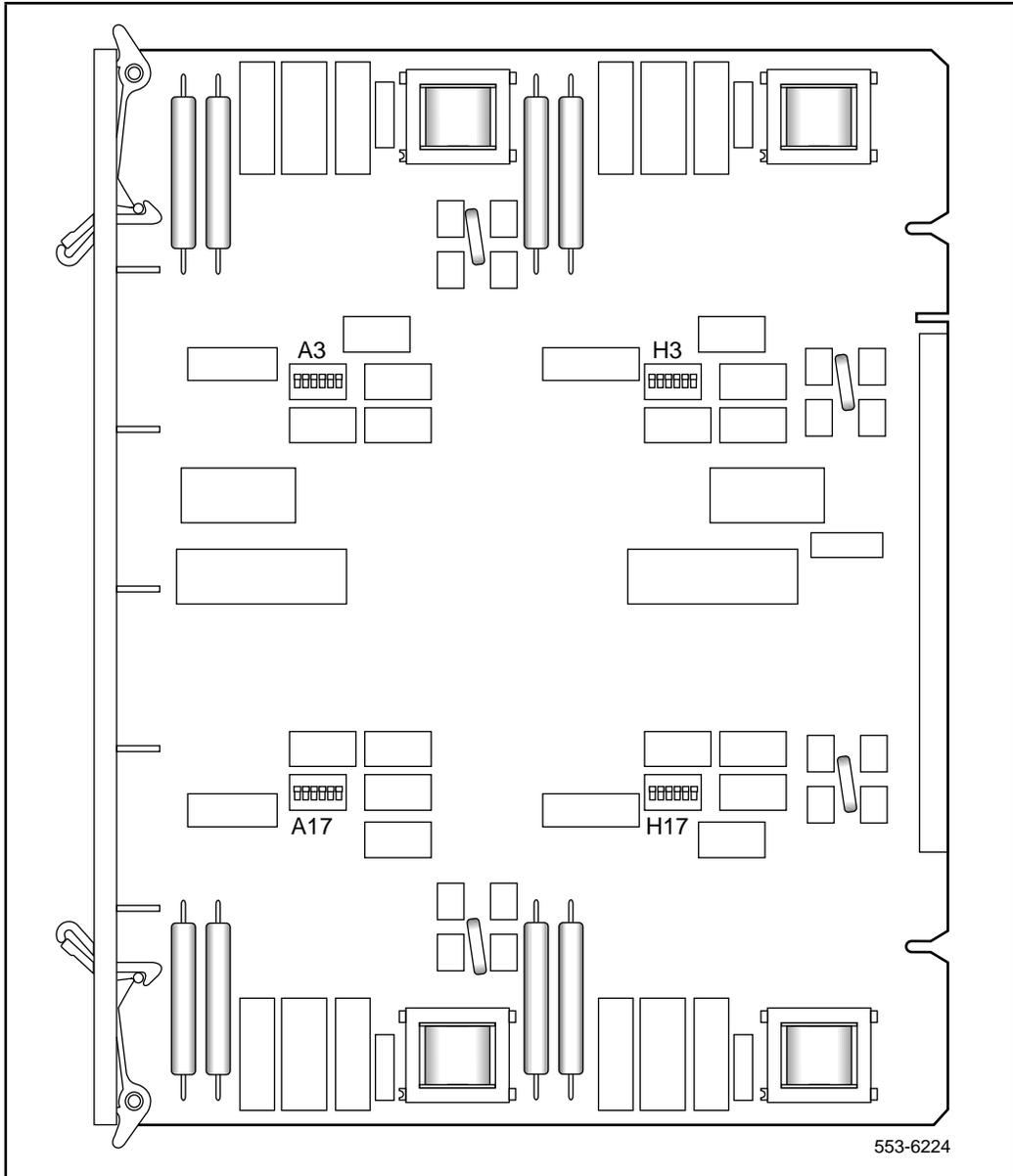


Figure 101
Pad switching algorithms

Through connection			Terminal balance						Through balance	
To	From	Legend IN Pad switched IN OUT Pad switched OUT NA Not applicable	Station lines	Non-VNL				VNL		
				Non-transmission compensated (2 wire facility loss <2 dB or not impedance compensated)		Transmission compensated (2-wire facility loss >2 dB or impedance compensated or 4-wire facility)		Tie CCSA 4-wire		
				Tie	CO/FX/WATS & CCSA	Tie	CO/FX/WATS & CCSA		QPC71 or equivalent	
Station lines Attendant lines			NA	OUT	OUT	OUT	OUT	IN		
			(5)	(1)	(1)	(1)	(1)	(3)		
			NA	NA	NA	NA	NA	NA		
Terminal balance	Non-VNL	Non-transmission compensated (2 wire facility loss <2 dB or not impedance compensated)	CO/FX/WATS & CCSA	NA	OUT	IN	OUT	IN	IN	
			Tie	(1)	(1)	(1)	(1)	(1)	(3)	
		Transmission compensated (2 wire facility loss <2 dB or impedance compensated or 4-wire facility)	CO/FX/WATS & CCSA	OUT	IN	OUT	IN	OUT	IN	IN
			Tie	(1)	(1)	(1)	(1)	(1)	(1)	
Through balance	VNL	4-wire Tie CCSA	CO/FX/WATS & CCSA	NA	OUT	IN	OUT	IN	OUT	
			Tie	(1)	(1)	(1)	(1)	(1)	(1)	
			QPC71 or equivalent	NA	IN	IN	IN	IN		
				(3)	(1)	(3)	(1)	(1)		
				IN	IN	IN	OUT	IN		

Note 1: Actual loss (dB) for each connection is given in parentheses.
Note 2: All trunks have an effective gain of 1.5 dB and contain 4 dB switchable pads.
Note 3: The Meridian 1 controls the overall connection to connection gain.

553-6308

QPC450 CO/FX/WATS Trunk Card

Introduction

The QPC450 CO/FX/WATS Trunk Card is a peripheral equipment (PE) device that can be installed in any peripheral shelf or NT8D13 Peripheral Equipment (PE) Module. The CO/FX/WATS trunk card interfaces four analog trunk lines to the Meridian 1 switch. Each trunk is independently configurable using the Trunk Administration program (LD 14).

The CO/FX/WATS trunk card is used in μ -Law trunk applications. It complies with Electronic Industries Association (EIA) transmission standards except for its terminating impedance and balancing network, which are matched against 600 ohm in series with 2.16 μ F and 900 ohm in series with 2.16 μ F.

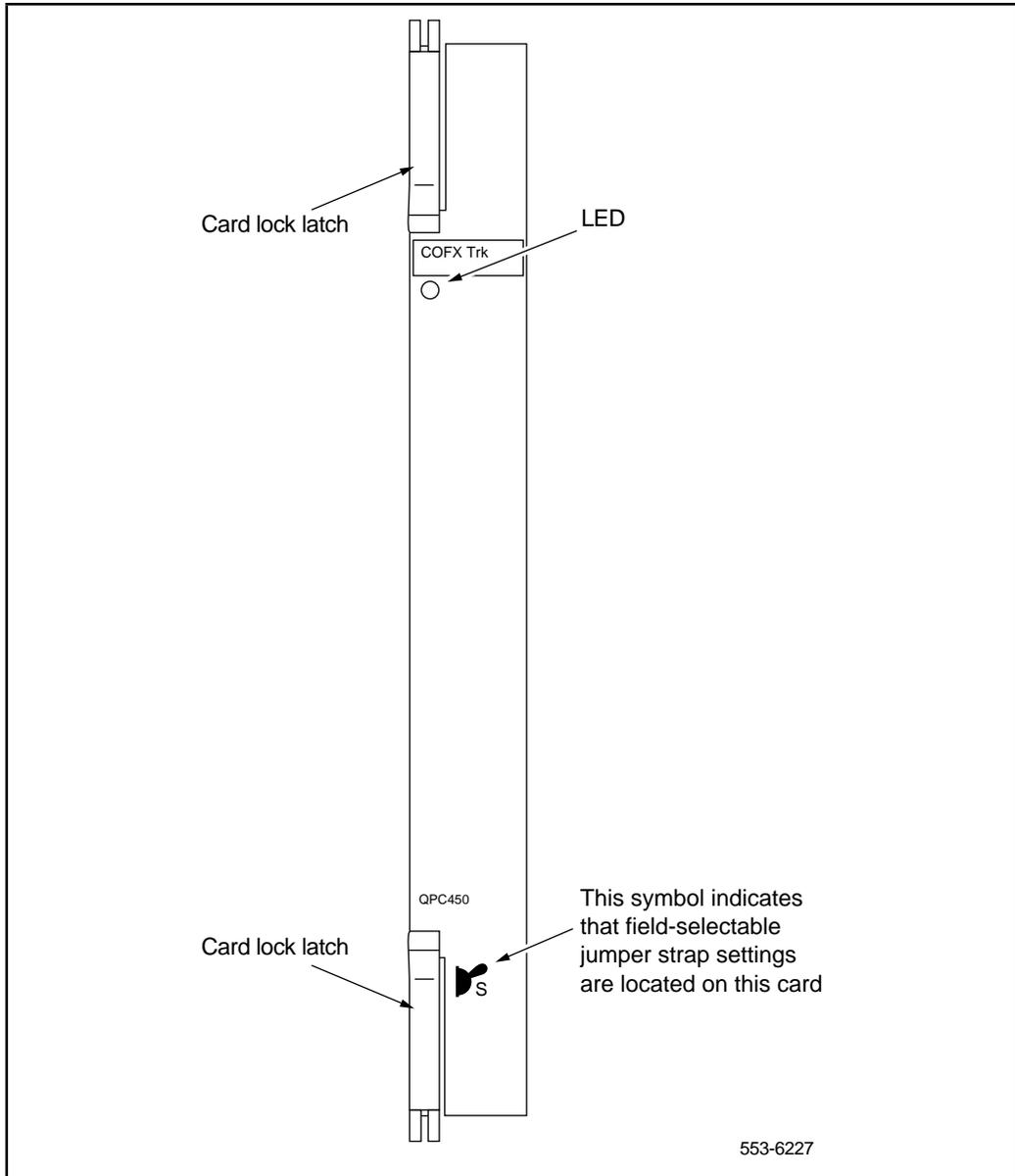
Physical description

The CO/FX/WATS trunk card mounts in any PE slot. The four trunk circuits and common multiplexing circuitry are mounted on a 31.74 cm by 25.4 cm (12.5 in. by 10 in.) printed circuit board.

The CO/FX/WATS trunk card connects to the backplane through an 80-pin connector shroud. The backplane is then cabled to the input/output (I/O) panel, which is cabled to the main distribution frame (MDF) by 25-pin cables. Trunk lines connect to the card at the MDF. See *Meridian 1 system installation procedures* (553-3001-210) for termination and cross connect information.

The faceplate of the card is equipped with a red light emitting diode (LED) (see [Figure 102](#)). This LED is only lit when there is a problem with the board. If the LED operates in any other manner, such as continually flashing or remaining weakly lit, the card should be replaced.

Figure 102
CO/FX/WATS trunk card—faceplate

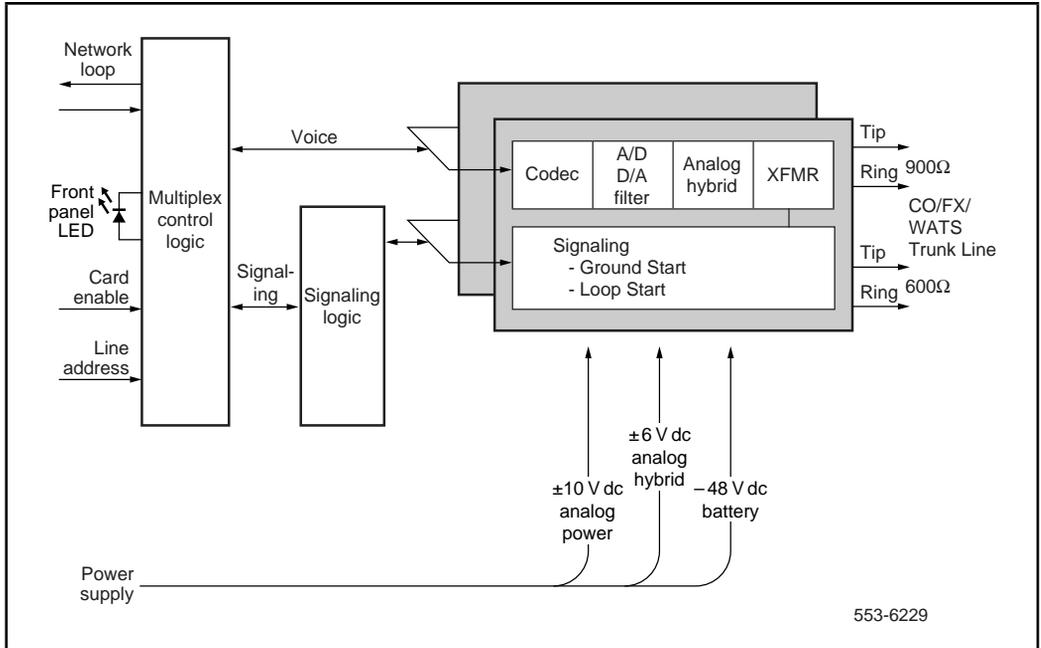


553-6227

Functional description

Figure 103 shows a block diagram of the major functions contained on the CO/FX/WATS trunk card. Each of these functions is described on the following pages.

Figure 103
CO/FX/WATS trunk card—block diagram



Card interfaces

The CO/FX/WATS trunk card passes both voice and signaling data over the network loop. Network loops are discussed in detail in “Peripheral equipment” on page 22.

Trunk interface units

The CO/FX/WATS trunk card contains four identical and independently configurable trunk interface units (also referred to as circuits). Each unit provides impedance matching and a balance network in a signal transformer/analog hybrid circuit. Also provided are relays for placing outgoing call signaling onto the trunk. Signal detection circuits monitor incoming call signaling.

Four codecs are provided for performing A/D and D/A conversion of trunk analog voiceband signals to digital PCM signals. Each codec supports one trunk interface unit. The following features are common to all units on the card:

- 2- to 4-wire conversion of the transmission path
- analog-to-digital and digital-to-analog conversion of transmission signals
- ground start and loop start signaling modes (selected by option switches on the card)
- -48 or -24 V CO battery options accommodated automatically
- ground detection on the tip lead
- loop current supervision
- ringing detection (also on positive battery)
- polarity detection of the loop

Two control circuits (each controlling two trunk units) each provide the interface with connections to the peripheral signaling bus, retime the digital signals, decode the unit addresses to enable the codecs at the correct timeslot, and control the signaling relays. Sensing circuitry is provided to detect second-pair signaling, third-wire battery signaling, and third-wire ground signaling.

Audio signals received from the tip and ring of the circuit card are fed to the analog-to-digital filter through the hybrid transformer. The analog-to-digital filter and external components form a 26 dB, 60 Hz rejection filter.

The filter limits the frequency range to a nominal 200 to 3400 Hz bandwidth and amplifies the signal for application to the codec. The codec encodes the analog signal, producing a digital signal, which is applied to the common multiplexing circuit.

Digital signals from the multiplexing circuit and the data output bus are fed to the codec and decoded to produce an analog output. The analog output of the codec is fed to the filter. This amplifies and filters the resulting signal, which is fed to the tip and ring of the circuit through the hybrid transformer.

Each unit on the card connects to a trunk facility through tip and ring leads that carry voice, ringing, tone signaling, and battery. All CO/FX/WATS trunks have an optional 600 or 900 ohm balanced terminating impedance. One pair of leads for each option is run to the cross connect terminal, where the cross connection is made to the desired tip/ring pair.

Each unit has option switches for selecting loop or ground start mode and 600 or 900 ohm terminating impedance.

Card functions

Multiplex control

The multiplex control logic is common to all four channels. This logic interfaces the individual trunk circuits to the peripheral bus signaling channel. Circuits are provided in the multiplex control logic to retime the digital signals received from the peripheral bus. Other circuits decode the address information contained on the peripheral bus to enable the individual trunk circuits during their selected timeslots. Logic is also provided to enable or disable the front panel LED to indicate the service state of the card. The multiplex control logic is discussed in detail in “Peripheral equipment” on page 22.

Operation

Optional applications, features, and signaling arrangements for each trunk are assigned through the Trunk Route Administration (LD 16) and the Trunk Administration (LD 14) overlay programs.

Release control

Release control of a call over a trunk is specified in the Route Data Block. Disconnect supervision is specified independently for each trunk group.

Only incoming trunks in idle ground start configuration can provide disconnect supervision. For a list of prompts, responses, and default conditions, see LD 14 and LD 16.

Reverse battery application of metering

When the CO returns reverse battery as a pulse signal, only one pulse is received for each CO call. This pulse is passed directly to the software meter for storage. The call charge may be provided on CDR if equipped. If the call is flagged by the attendant as metered, on termination of the call the total charge or pulse count for the call is shown on the console display.

Periodic metering pulse application of metering

With this method, more than one pulse may be returned for each call. The CO sends signals over the tip and ring lead of the trunk. The number of signals sent depends on the duration and, in some cases, the distance of a call. In most cases the signal sent is one of the following types:

- 50 Hz signals
- 16 kHz signals
- 12 kHz signals

Signals from the CO are converted to pulses by a receiver unit. The receiver unit passes the pulses in an 8-bit counter. Once the counter has stored 256 pulses, it generates a CPU interrupt signal, which increments the temporary meter assigned to the call by 256, and the counter resets to 0. When a call is terminated, or when call modification occurs (for example, a call is transferred), the counter increments the temporary meter by the number of pulses stored at that moment, and the counter resets to 0.

Pulse detector

The pulse detector (MR/PPM) circuitry on the trunk is provided with switches to accommodate the various signaling arrangements as follows:

- third wire, battery signaling
- third wire, ground signaling
- second pair

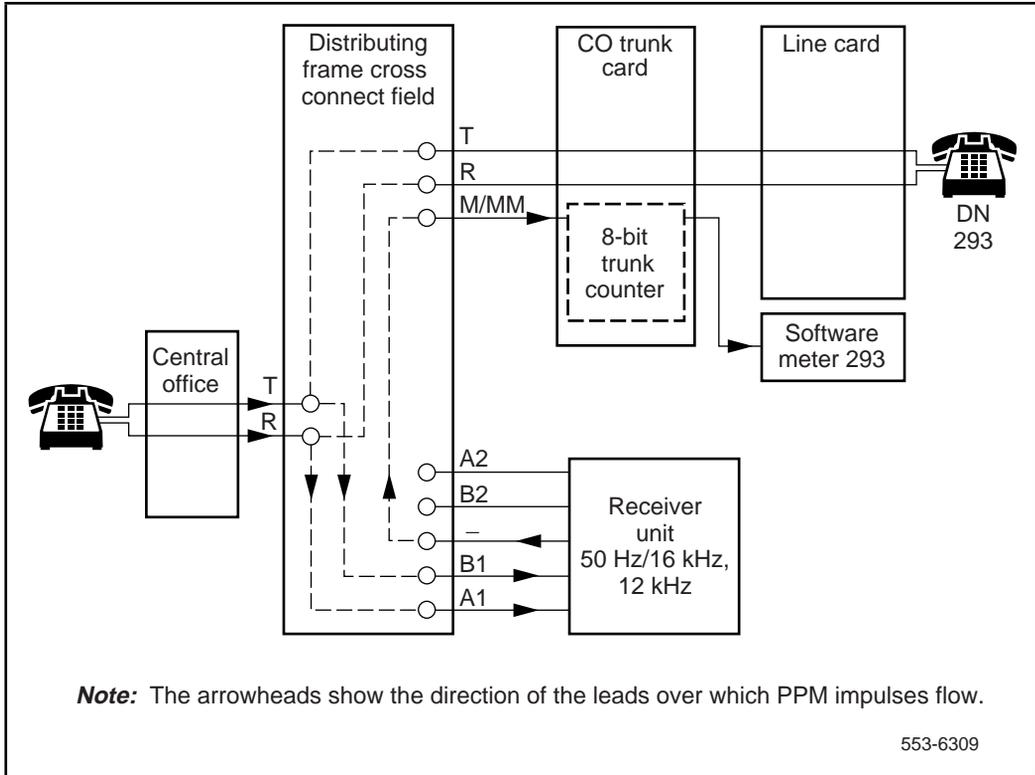
The trunk cards generate two interrupt signals for each pulse received from the CO.

PPM interface circuit application

CO trunks used for PPM must connect to an interface circuit. The receiver unit converts 50 Hz, 12 kHz, or 16 kHz signals from the CO into logic signals for storage in the trunk counter.

Connection to interface circuits is required for storage when the CO returns signals other than reverse battery. The interface circuits (receiver units) extract the signals (50 Hz/16 kHz/12 kHz) from the tip and ring leads of the trunk and send a logic signal to the trunk on the third wire. One receiver unit is required for each trunk. [Figure 104](#) shows how this circuit interfaces with the Meridian 1.

Figure 104
Metering pulse operation



Line operation

Idle state

During idle state:

- tip is open
- CO battery (–48 or –24 V) is applied to the ring
- during each timeslot 0, the CE scans each trunk to detect any change on the data input bus

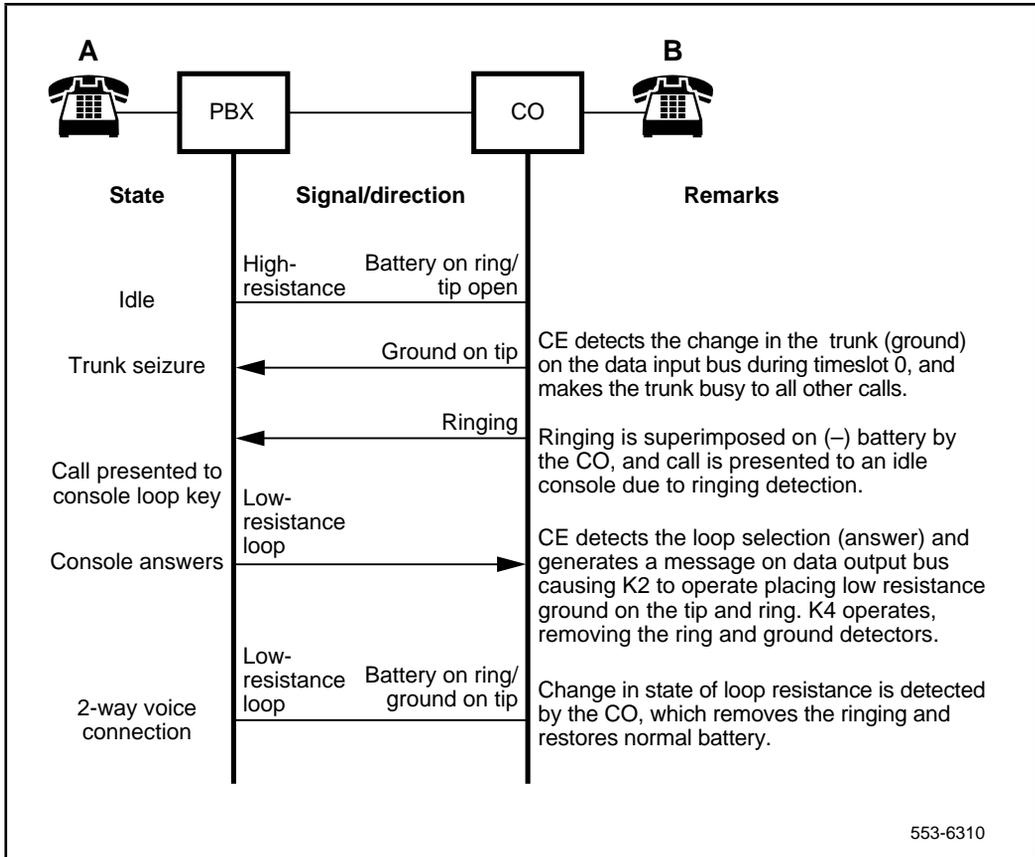
Ground start trunk

The operational sequences and signaling patterns for a ground start trunk operation are provided in [Figures 105](#) to [108](#).

Loop start trunks

The operational sequences and signaling patterns for a loop start trunk operation are provided in [Figures 109](#) and [110](#).

Figure 105
Ground start trunk incoming call connection sequence



553-6310

Figure 106
Ground start trunk outgoing call connection sequence

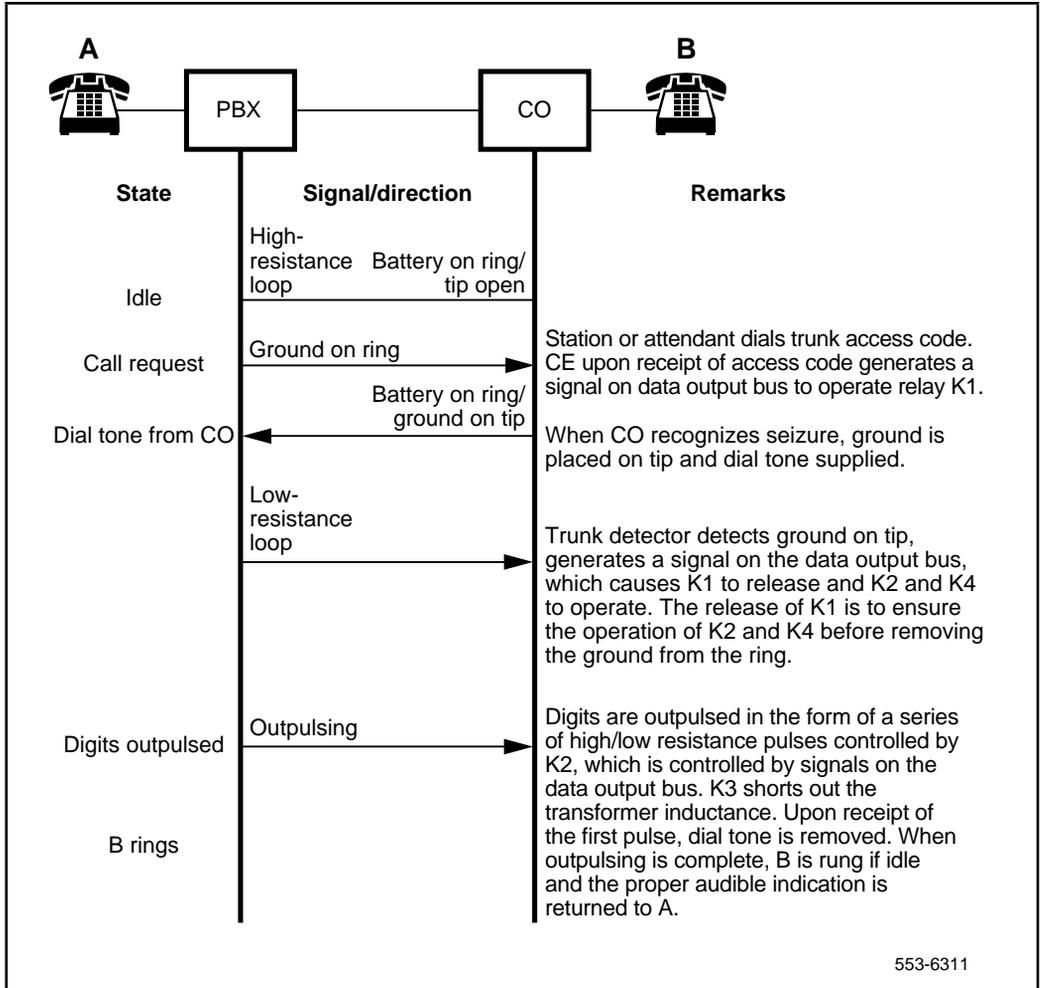


Figure 107
Near end (Meridian 1) disconnects first

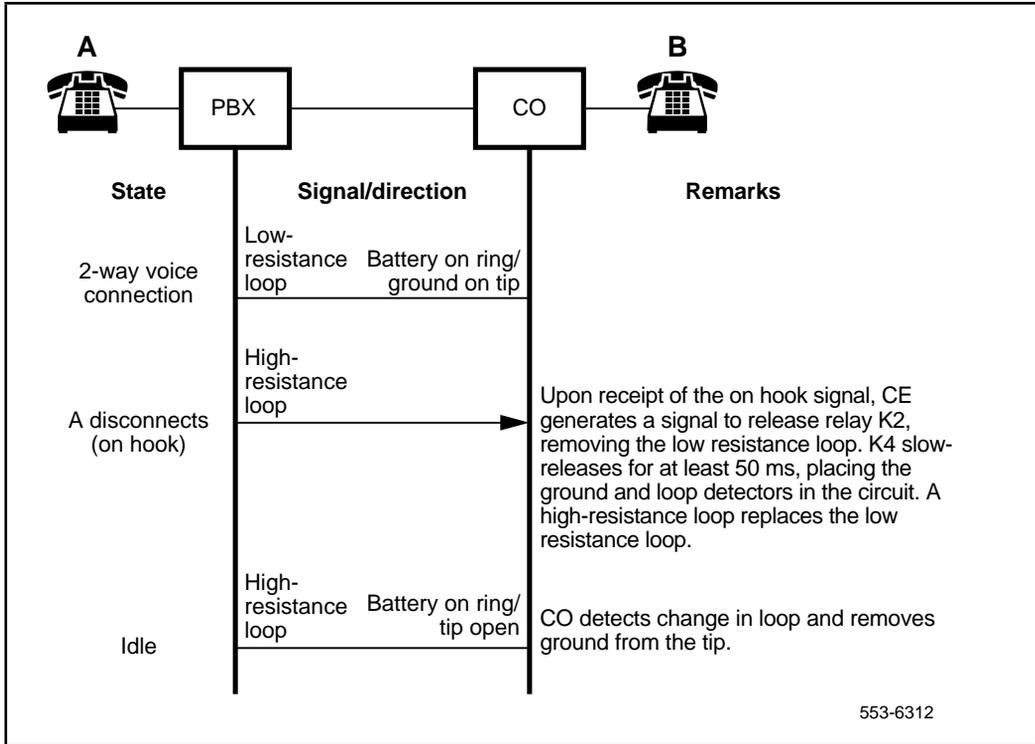


Figure 108
Far end (CO) disconnects first

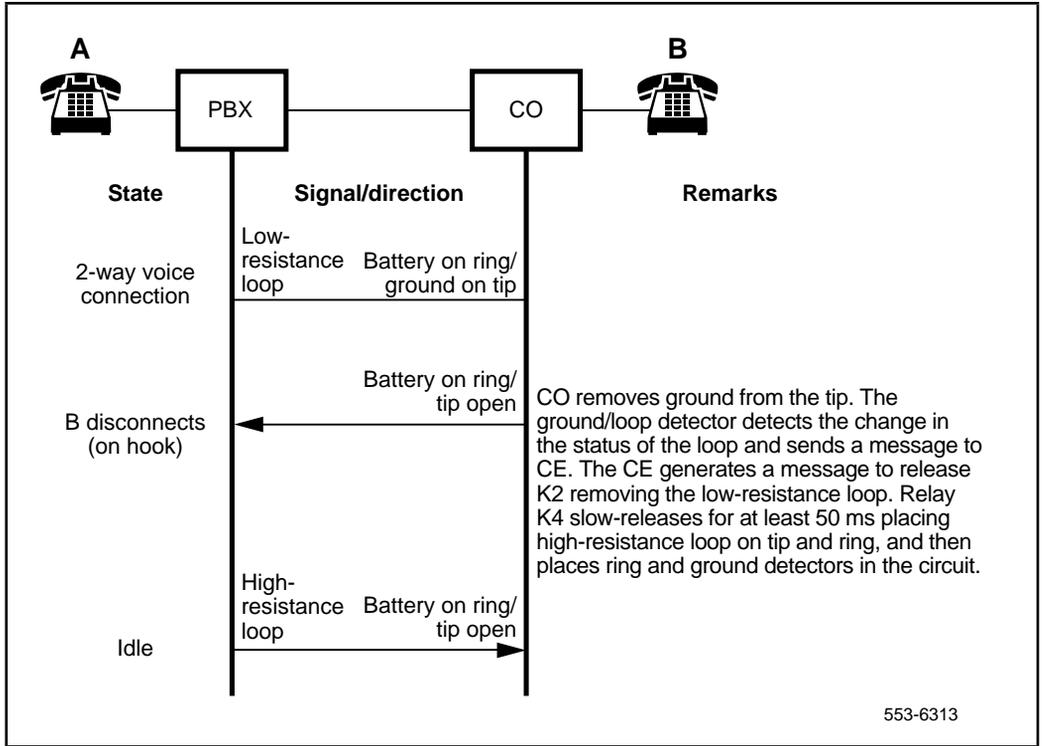


Figure 109
Loop start trunk incoming call connection sequence

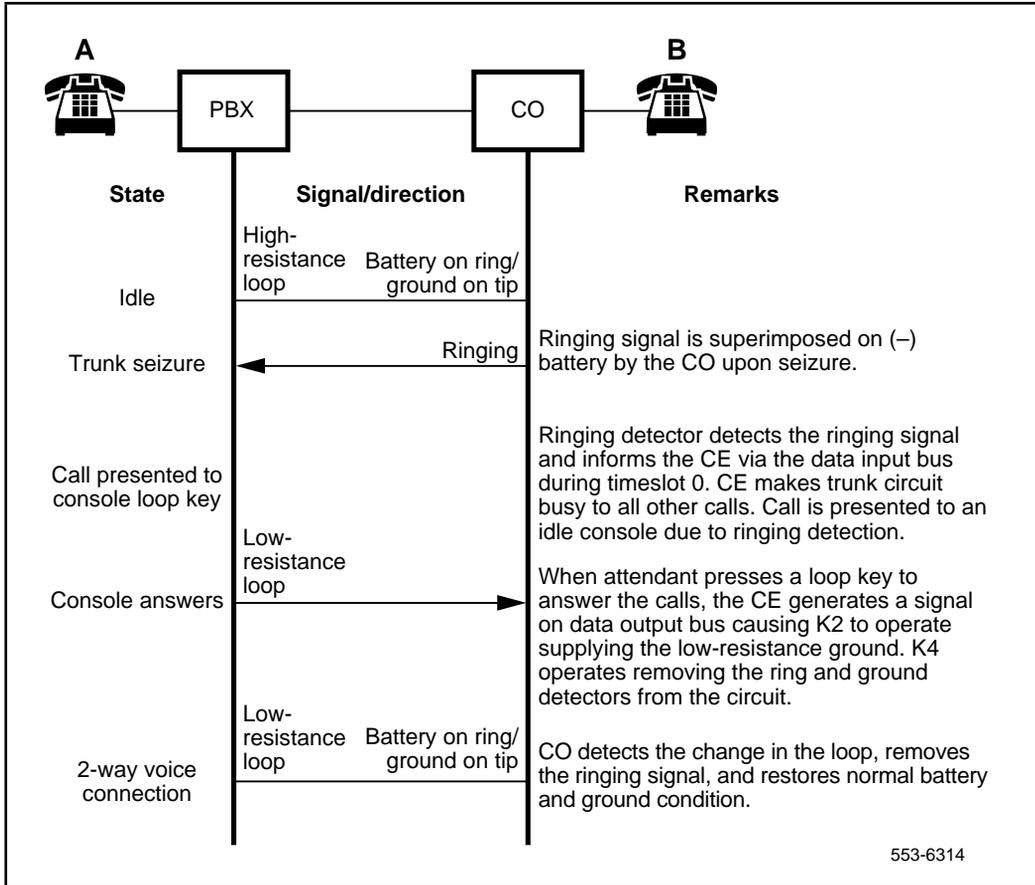
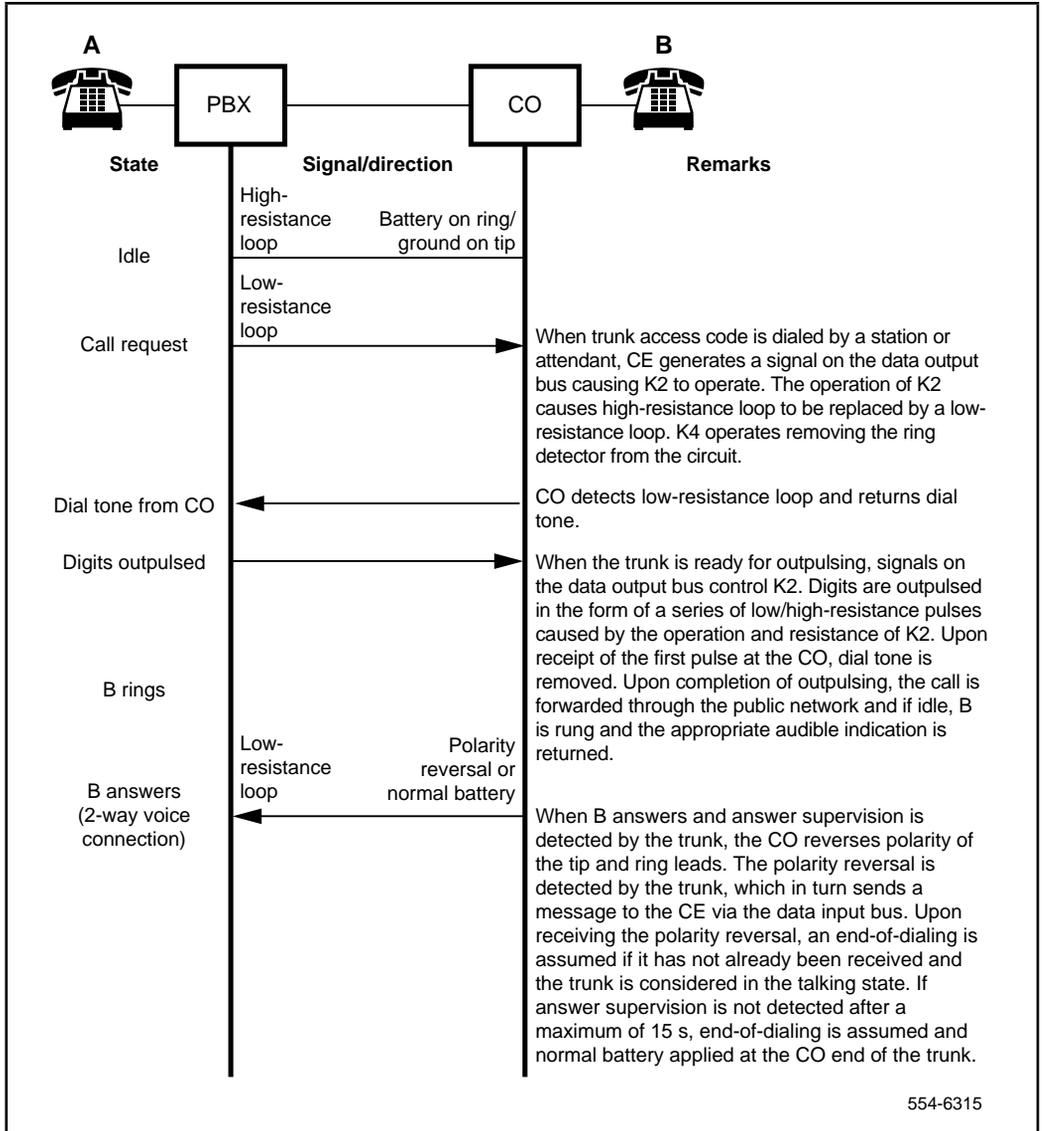


Figure 110
Loop start trunk outgoing call connection sequence



Electrical specifications

This section gives the electrical specifications for the CO/FX/WATS trunk card.

Trunk interface electrical characteristics

[Table 68](#) gives the electrical characteristics for the trunk interface units on the CO/FX/WATS trunk card.

Table 68
Trunk characteristics

Characteristic	Specification
Nominal impedance	600 to 900 Ω , selected with option switches and at cross connect terminal
Signaling range	1700 Ω
Signaling type	Ground or loop start
Far-end battery	-42 to -52.5 V
Near-end battery	-42.75 to -52.5 V
Minimum Loop Current	20 mA
Ground potential difference	± 10 V
Low DC loop resistance during outpulsing	300 Ω
High DC loop resistance	Ground start ≥ 20 k Ω , Loop start ≥ 150 k Ω
Line leakage	30 k Ω (tip to ring, tip to ground, ring to ground)
Effective loss	1.0 dB line-to-trunk 1.0 dB trunk-to-trunk

Overload level

Signal levels exceeding +3 dBm applied to the tip and ring cause distortion in speech transmission (line-to-trunk connection).

Power requirements

[Table 69](#) lists the power requirements for CO/FX/WATS trunk the card.

Table 69
Power requirements

Voltage	Tolerance
+6 V dc	±1%
-6 V dc	±1%
+10 V dc	±5%
-10 V dc	±5%
-48 V dc	±5%
-52 V dc	±5%
+2.5 V dc	±5%

Foreign and surge voltage protections

When telephone lines connected to the trunk circuit are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protection devices must be installed on the customer's premises. These devices must be capable of providing a path to ground from tip and ring for foreign voltages that exceed 600 V peak.

Environmental specifications

[Table 70](#) lists the environmental specs. for the CO/FX/WATS trunk card.

Table 70
Environmental specifications

Parameter	Specifications
Operating temperature	0° to +50° C (+32 to +122° F), ambient
Operating humidity	5 to 95% RH (noncondensing)
Storage temperature	-40° to +70° C (-40° to +158° F)

Connector pin assignments

The CO/FX/WATS trunk card brings the analog trunks to the PE backplane through an 80-pin connector shroud. The backplane is cabled to the input/output (I/O) panel on the rear of the module, which is then connected to the main distribution frame (MDF) by 25-pair cables.

Telephone trunks connect to the CO/FX/WATS trunk card at the MDF using a wiring plan similar to that used for line cards. A typical connection example is shown in [Figure 111](#), and a list of the connections to the CO/FX/WATS trunk card is shown in [Table 71](#). See *Meridian 1 system installation procedures* (553-3001-210) for complete I/O panel connector information and wire assignments for each tip/ring pair.

Figure 111
CO/FX/WATS trunk card—typical cross connection example

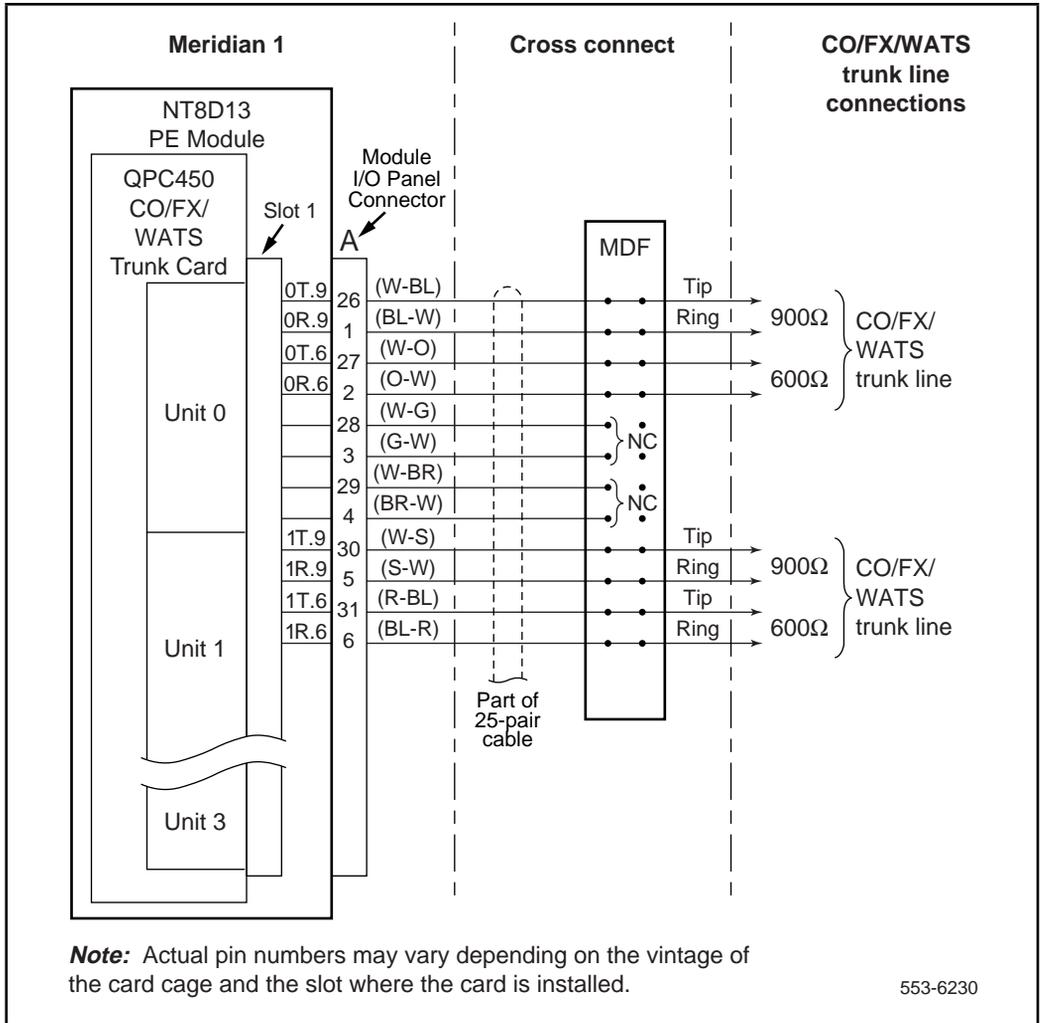


Table 71
CO/FX/WATS trunk card—backplane pinouts

Connector Pin	Signal	Unit
36A	Tip, 900Ω	0
37A	Ring, 900Ω	
38A	Tip, 600Ω	
39A	Ring, 600Ω	
29A	Tip, 900Ω	1
30A	Ring, 900Ω	
31A	Tip, 600Ω	
32A	Ring, 600Ω	
2A	Tip, 900Ω	2
3A	Ring, 900Ω	
4A	Tip, 600Ω	
5A	Ring, 600Ω	
9A	Tip, 900Ω	3
10A	Ring, 900Ω	
11A	Tip, 600Ω	
12A	Ring, 600Ω	

Configuration

The trunk type for each unit on the card as well as its terminating impedance and balance network configuration is selected by software service change entries at the system terminal and by switch and jumper settings on the card. The locations of these switches are shown in [Figure 112](#).

Switch and jumper settings

[Tables 72](#) through [76](#) list the switch and jumper settings for the CO/FX/WATS trunk cards. There is one table for each revision (vintage) of the card.

Figure 112
CO/FX/WATS trunk card—switch and jumper settings

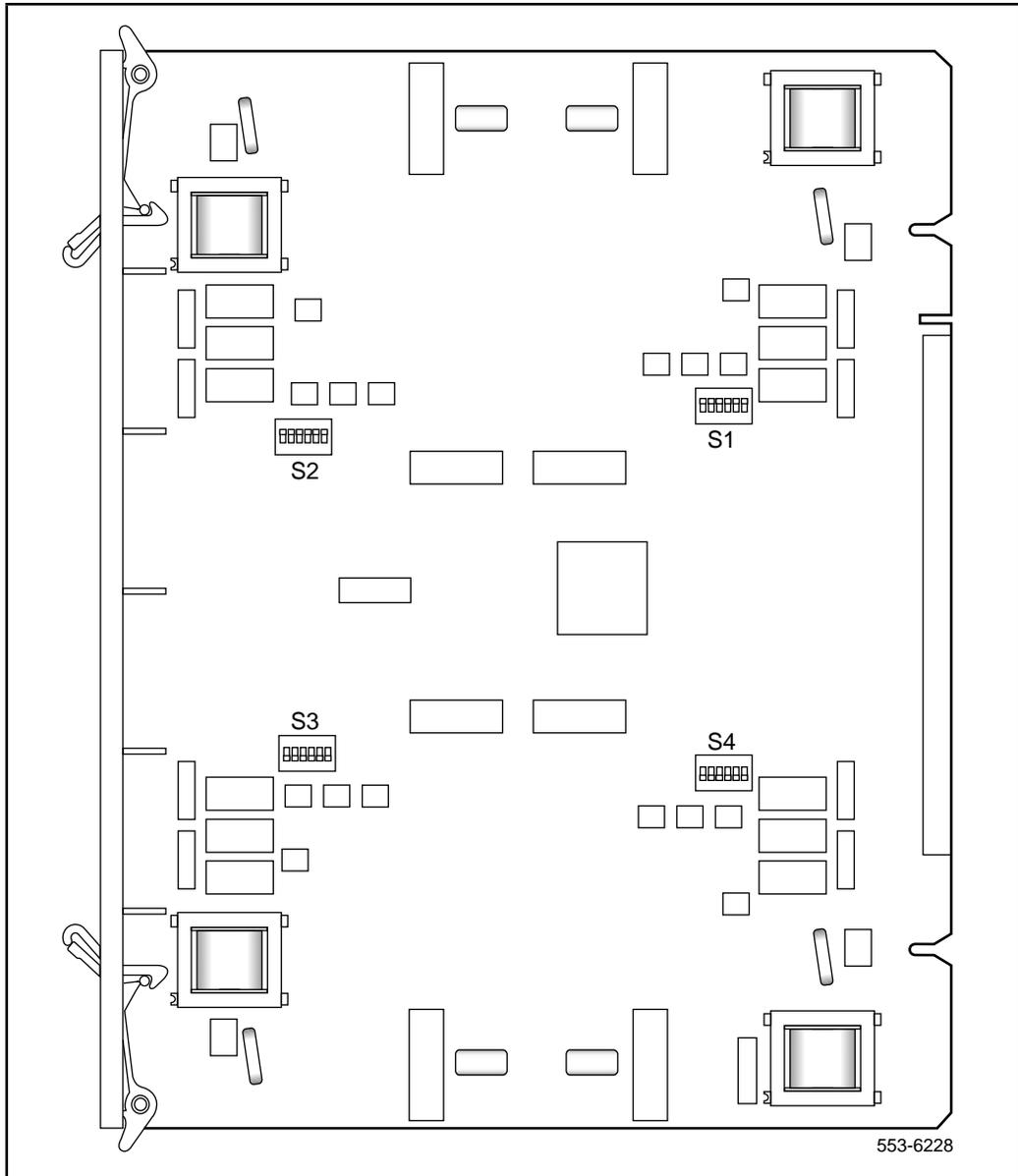


Table 72
QPC450A&B vintage CO/FX/WATS trunk card—switch and jumper settings

Switch Settings										
Switch Position:	Switch S1 (Location A23)									
	1	2	3	4	5	6	7	8		
	On	Off	On	Off	On	Off	On	Off		
Switch Position:	Unit 0: Switch S2 (Location E29) Unit 1: Switch S3 (Location E9) Unit 2: Switch S4 (Location E28) Unit 3: Switch S5 (Location E10)									
	1	2	3	4	5	6	7	8	9	10
Trunk type:										
Loop Start	Off	On	Off	Off	On	Off			Off	Off
Ground Start	Off	On	On	On	On	Off			Off	Off
Metering:										
Second Pair (M,MM) or								Off	Off	
Third wire, battery on M or								Off	On	
Third wire, ground on M								On	Off	
Jumper Settings										
Jumper:	Unit 0 jumper: Location E27 Unit 1 jumper: Location E11 Unit 2 jumper: Location D29 Unit 3 jumper: Location D9									
	Unit 0 Jumper	Unit 1 Jumper	Unit 2 Jumper	Unit 3 Jumper						
600 Ω resistive impedance	Pin 1 to 2	Pin 1 to 2	Pin 1 to 2	Pin 1 to 2						
three-component complex impedance	Pin 2 to 3	Pin 2 to 3	Pin 2 to 3	Pin 2 to 3						

Table 73
QPC450C CO/FX/WATS trunk card—switch settings

Switch Settings								
Switch Position:	Unit 0: Switch S2 (Location E29) Unit 1: Switch S3 (Location E9) Unit 2: Switch S4 (Location E28) Unit 3: Switch S5 (Location E10)							
	1	2	3	4	5	6	7	8
Trunk type:								
Loop Start	Off	On	Off	Off	On			Off
Ground Start	Off	On	On	On	On			Off
Metering:								
Second Pair (M,MM) or						Off	Off	
Third wire, battery on M or						Off	On	
Third wire, ground on M						On	Off	

Table 74
QPC450C1 & D CO/FX/WATS trunk card—switch settings

Switch Settings								
	Unit 0: Switch S4 (Location F28) Unit 1: Switch S3 (Location F10) Unit 2: Switch S1 (Location C27) Unit 3: Switch S2 (Location B10)							
Switch Position:	1	2	3	4	5	6	7	8
Trunk type:								
Loop Start	Off	On	Off			Off	Off	On
Ground Start	Off	On	On			On	Off	On
Metering:								
Second Pair (M,MM) or				Off	Off			
Third wire, battery on M or				Off	On			
Third wire, ground on M				On	Off			

Table 75
QPC450 E&F trunk cards—switch settings

Switch Settings				
Switch Position:	Unit 0: Switch S4 (Location F25) Unit 1: Switch S3 (Location F11) Unit 2: Switch S1 (Location B25) Unit 3: Switch S2 (Location B13)			
	1	2	3	4
Trunk type:				
Loop Start	Off	Off		
Ground Start	On	On		
Metering:				
Second Pair (M,MM) or			Off	Off
Third wire, battery on M or			Off	On
Third wire, ground on M			On	On

Table 76
QPC450G CO/FX/WATS trunk card—switch settings

Switch Settings						
	Unit 0: Switch S4 (Location F25) Unit 1: Switch S3 (Location F11) Unit 2: Switch S1 (Location B25) Unit 3: Switch S2 (Location B13)					
Switch Position:	1	2	3	4	5	6
Trunk type:						
Loop Start	Off	Off				
Ground Start	On	On				
Loop Length:						
— Short loops (600 Ω compromise impedance network)					On	Off
— Long loop (EIA-recommended impedance network)					Off	On

Service change entries

The trunk type, features, signaling arrangement, and insertion loss for each trunk are selected by making service change entries in the Trunk Administration program (LD 14). Refer to the Meridian 1 *X11 input/output guide* for LD 14 service change instructions.

Pad switching

The transmission properties of each trunk are characterized by the class of service assigned in LD 14. Transmission properties can be via net loss (VNL) or non via net loss (non-VNL).

The VNL class of service is assigned at the prompt CLS with the response VNL. The non-VNL class of service is assigned at prompt CLS by selecting either the TRC (transmission compensated) or NTC (non-transmission compensated) response.

Non-VNL trunks are assigned a TRC or NTC class of service to ensure stability and minimize echo when connecting to long-haul trunks, such as tie trunks. The class of service determines the operation of the switchable pads contained in each unit. They are assigned as follows:

- TRC for a 2-wire non-VNL trunk facility with a loss of greater than 2 dB, or for which impedance compensation is provided, or for a 4-wire non-VNL facility
- NTC for a 2-wire, non-VNL trunk facility with a loss of less than 2 dB, or when impedance compensation is not provided

Pad switching provides proper insertion loss and echo protection, when required. The control of pad switching for the various through connections and the actual loss introduced is given in [Figure 113](#).

Meridian 1
Trunk cards
Description

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