SL-1

NT7D16 Data Access Card

Description and operation

Revision history

December 20, 1990

This is a new document issued for the NT7D16 Data Access Card.

December 1, 1991

Standard, release 2.0

December 31, 1992

Standard, release 3.0 reissued for technical updates. Changes are noted with revision bars in the margins.

Contents

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About this document

This document outlines the characteristics and operation of the NT7D16 Data Access Card (DAC).

References

The following documents are for reference only, and are not required to use the DAC.

— *QPC723 RS-232 Interface Line Card description, installation and operation* (553-2731-106)

— *QMT21 High Speed Data Module description, installation, operation* (553-2731-107)

— *Meridian data features traffic engineering and configuration* (553-2731-151)

— High Speed Data Module User Guide

See the *X11 input/output guide* (553-3001-400) for a description of all administration programs, maintenance programs, and system messages.

Description

The NT7D16 Data Access Card (DAC) is a data interface card that integrates the functionality of the QPC723A RS-232 4-Port Interface Line Card (RILC) and the QPC430 Asynchronous Interface Line Card (AILC). This combination allows the NT7D16 DAC to work with the RS-232-C interface, the RS-422 interface, or both.

To support the NT7D16 Data Access Card, the system must be equipped with software release 16 or higher, and an Intelligent Peripheral Equipment (IPE) Module.

The DAC supports up to six ports, each capable of operating in RS-232-C or RS-422 mode. Each port supports its own parameters that, once configured and stored in the system database memory, are downloaded to the card.

Features

Light Emitting Diodes (LEDs) indicate the status of the card, the call connection, and the mode (RS-232-C or RS-422) the DAC is operating in. A push-button toggle switch allows you to scan all six ports and monitor the activity on each port.

The DAC supports the following features:

— Asynchronous and full duplex operation

— Keyboard dialing

— Hayes dialing

— Data terminal equipment (DTE)/data communication equipment (DCE) mode selection

— Modem and gateway connectivity in DTE mode

— Terminal and host connectivity in DCE mode

— Forced or normal DTR

— Hotline

— Remote and local loopback testing

— Virtual leased line mode

— Inactivity timeout

— Wire test mode

— Self diagnostics

— Inbound modem pooling with any asynchronous modems

— Outbound modem pooling using "dumb" modems

— Outbound modem pooling using auto dialing modems

Controls and indicators

The LEDs on the DAC faceplate indicate the status mode for each port.
Figure 1 shows the NT7D16 DAC faceplate.

Card status

The LED at the top of the faceplate is unlabeled. This LED is:

— off: if one or more ports are enabled

— on: if all ports are disabled

Electronic Industries Association signal monitors

The six LEDs located below the card status LED are labeled SD, RD, DTR,
DSR, DCD, and RI. They show the dynamic state of the associated Electronic
Industries Association (EIA) control leads for a specific port (as shown by the
display). When in RS-422 mode, only SD and RD are utilized. When in
RS-232-C mode, the LED goes on to indicate that the signal is asserted on, or
off to indicate that the signal is asserted off. When the LED is off, there is no
active voltage on the signal lead.

CONNECT

This lamp lights to indicate that a data call is established for the port displayed. A data call is connected when the data module-to-data module protocol messages are successfully exchanged between the two ends.

Port mode

This lamp lights to indicate that the port indicated is in RS-422 mode. If the lamp is dark, the specified port is in RS-232-C mode.

Port number

The number displayed specifies the port driving the EIA signal LEDs mentioned above. The push-button switch below the display allows you to rotate among the six ports to monitor the activity of any port. This display is also used to monitor several error conditions.

Port select button

This push-button switch below the display is used to select which port is monitored.

Wire test

These switches are used to select the wire test mode for each of the six ports.

Figure 1
NT7D16 Data Access Card faceplate

card status

SD

RD

DTR

DSR

DCD

RI

EIA signal
monitor LEDs

CONNECT

CONNECT

RS-422

Port mode

Port number

2

Port select

UN SEL

WIRE TEST

Wire test

UN0
UN1
UN2
UN3
UN4
UN5

OFF ON

NT7D16AA

553-5018
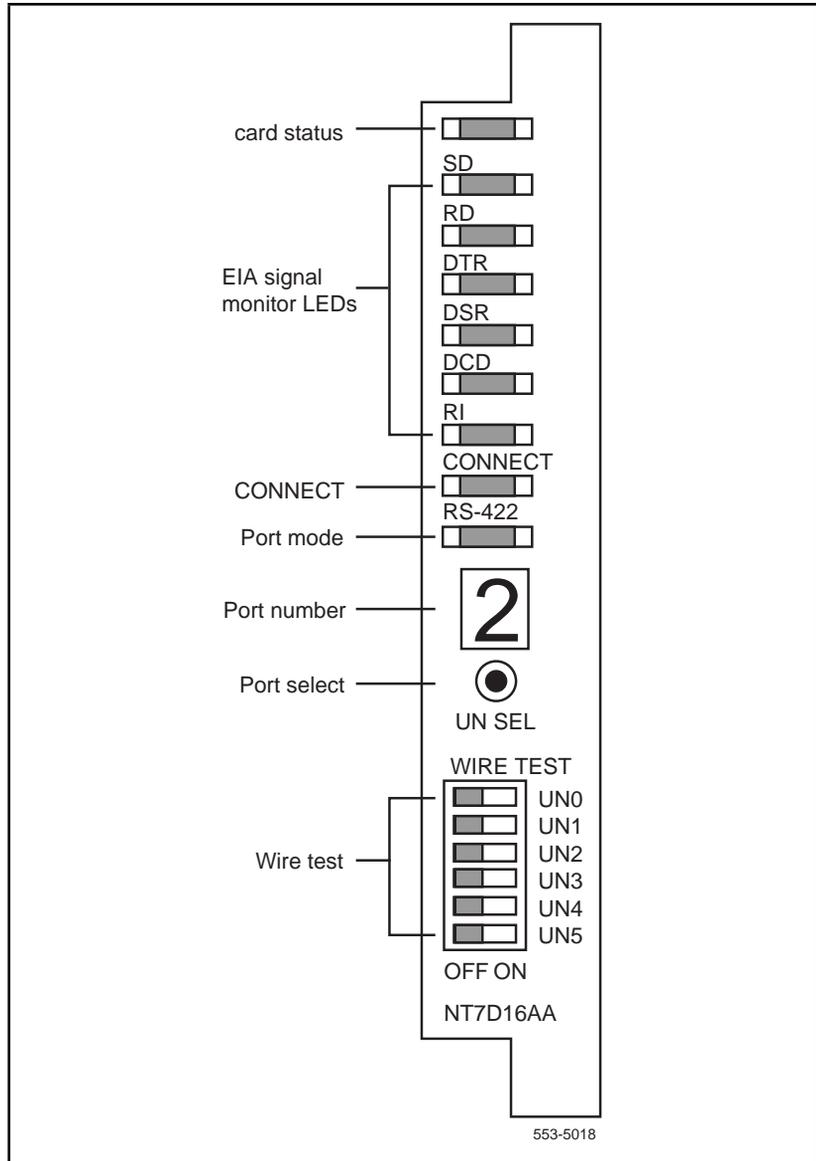
Operation

Dialing operations

The DAC supports both keyboard and Hayes dialing sequences. The following discussion concerns features common to both dialing modes.

Port firmware in idle state

The port firmware is considered idle when it is expecting one of the allowed autobaud characters. The idle state is identified by either of the following conditions:

— The last prompt received was RELEASED (keyboard dialing).

— The last prompt received was OK, NO CARRIER, or ERROR (Hayes dialing).

Call Set-up abort

The user may abandon the call during the dialogue phase using one of the following methods:

— **Terminal off-line** This method is useful for RS-232-C interface only. The equipment drops Data Terminal Ready (DTR) to indicate an idle connection. For example, if the equipment is turned off, the DAC interprets that signal as an idle connection.

— **Long break** The user sends a break (transmit line held in the OFF or SPACE state) for more than 1.2 seconds. The break is not transmitted to the far end. At the end of the long break, the DAC port initiates call disconnect. The AILU converts the dropping of DTR into a long break for the RS-422 interface. The long break feature can be disabled through the Modify menu on the DAC port.

— **Three short breaks** When the user equipment transmits three breaks to the far end, the DAC abandons the call. Note that the breaks must be spaced at least 10 msec apart, and all three must occur within 3 seconds.

Make Port Busy on loss of DTR

This feature is implemented by means of the Make Set Busy (MSB) station feature. When this is activated, any attempt to reach the specified Data DN will result in a busy signal.

This application, which operates only in the RS-232-C mode, requires a non-standard RS-232-C interface. Only two of the possible sixteen RS-232-C modes can be used: Mode 8 (DCE, Host, Normal DTR, Manual dial), and Mode 12 (DCE, Terminal, Normal DTR, Manual dial). This feature is configured in the software, and is downloaded to the DAC.

A DTR timeout period is started whenever the DTR signal lead makes the transition to OFF. If DTR is returned to ON within the set time period (5 seconds), the DAC port operates as if this feature was not activated. If the DTR remains OFF beyond the 5 seconds, the system receives an MSB feature key message. The DAC sends another MSB message when the DTR returns to ON, and the port is able to receive inbound calls.

Note: If this feature is active, and the port is connected to a DTE that holds DTR OFF when idle, the port will be permanently busied out to inbound calls following the DTR timeout period.

Inactivity timeout

Once a successful data call is completed, the user's activity is monitored. If no activity occurs within the amount of time configured in the downloaded parameters, the DAC releases the call. Three minutes before the inactivity timeout takes place, the DAC sends a warning message to the near-end equipment if terminal mode is selected.

Wire test mode

The DAC allows for the EIA signaling leads to be tested to facilitate installation and troubleshooting. This feature can be invoked through the service change downloaded parameters, or by setting the appropriate front panel switch. Wire test mode only operates when the port is idle. The leads are cycled ON and OFF in 0.5 second periods (ON for 0.5 seconds, OFF for 0.5 seconds) for the number of cycles shown in Table 1. The lead status can be monitored by the front panel LEDs. The test will be run indefinitely until the front panel switch is turned off, and the software wire test parameters are disabled.

Note: For the most accurate results, be sure no equipment is connected to the EIA leads.

Table 1
Wire test signal leads cycle counts

Label	EIA Signal Lead description	Pin	Cycle count	
			RS-232-C	**RS-422**
TxD	Transmit	2	1	1
RxD	Receive	3	2	2
CTS	Clear To Send	5	3	—
DSR	Data Set Ready	6	4	—
DCD	Carrier Detect	8	5	—
DTR	Data Terminal Ready	20	6	—
RI	Ring Indicator	22	7	—

Note: The CTS signal is not included in the faceplate LED. Therefore, a 1.5-second delay will occur between the RxD lamp going on, and the DSR lamp going on.

Independent storage of dialing parameters

Two dialing parameters, DCD control, and Answer mode, can be modified by both keyboard and Hayes dialing commands.

The Hayes dialing mode also allows the user to modify the Input echo control, and Prompt/Result codes transmit control. With keyboard dialing, the Input echo control and Prompt/Response codes control are determined by the downloaded parameters. They cannot be altered through dialing commands.

The DAC maintains separate buffers for keyboard and Hayes dialing modes. Changes made to a given parameter in one mode do not affect that parameter in the other mode. When a dialing mode is selected, the DAC copies the corresponding dialing parameters into the active buffer. This buffer controls the call processing.

If the DAC receives an incoming call while idle, the most recent dialing mode is used to answer the call.

User input

User input may include either upper or lower case ASCII characters.

All entries are accumulated in an input record. This record is completed with a Terminator character. For keyboard dialing, this character is always <CR>; for Hayes dialing, it can be user defined (but default to <CR>). The entries are not processed until the Terminator character is received.

The input record is limited to 43 characters, including the Terminator, but excluding any ignored space characters.

The record can be edited by using the backspace and escape characters.

Operating modes

There are sixteen possible RS-232-C operating modes with three basic common modes of operation which correspond to three types of equipment connected to the DAC. The three modes are: modem, terminal, and host. Host mode is a subset of the terminal mode, which only suppresses the prompts at the terminal.

The fourth mode, gateway, is a subset of the modem mode and is not normally used. This mode is useful if the attached modems do not have Ring Indicator lead. The application used is inbound modem pooling.

The different modes enable the DAC to connect to different types of devices such as modems (modes 0, 1, 2, and 3), gateways (modes 4, 5. 6, and 7), hosts (modes 8. 9. 10, and 11), and terminals (modes 12. 13. 14, and 15). After selecting the appropriate group (that is, modem, gateway, host, or terminal), the installer should study the four different modes in that group to make the

proper selection. See Table 2.

Table 2
DAC mode of operation selection (Part 1 of 3)

Service changeable downloadable parameters (LD11)					
Operation mode	Modem/ Gateway/ Host/KBD	Forced DTR*	Hotline	Type of device to be connected	Group selection
DEM	PRM	DTR	HOT		
0 (DTE)	OFF "Host On" (Ring Indicator — RI)	OFF Not Forced	OFF Not Hotline	Modem Pool inbound and outbound (similar to Synchronous / Asynchronous Data Module (SADM) in inbound) MSB by RI	Modes 0, 1, 2, and 3 are for RS232 modem connectivity
1 (DTE)	OFF "Host On" (RI)	OFF Not Forced	ON Hotline	Modem Pool inbound only (Hotline by RI- similar to SADM)	
2 (DTE)	OFF "Host On" (RI)	ON Forced	OFF Not Hotline	Modem Pool inbound and outbound (for Hayes 1200 modem) MSB by RI	
3 (DTE)	OFF "Host On" (RI)	ON Forced	ON Hotline	Modem Pool inbound only (Hotline for Hayes 1200 modem only)	
4 (DTE)	ON "Keyboard Dialing (KBD) On" (No RI)	OFF Not Forced	OFF Not Hotline	Gateway inbound and outbound (DTR is OFF in idle state) MSB by Carrier Detect (DCD)	Modes 4, 5, 6, and 7 are for RS232 Gateway connectivity
5 (DTE)	ON "KBD On" (No RI)	OFF Not Forced	ON Hotline	Gateway inbound only (Hotline by DCD: ON for Hotline OFF for Virtual Leased Line (VLL)	
* Not prompted for Type = R422. Defaults for Type = R422: DEM = DCE and DTR = OFF.					

Table 2
DAC mode of operation selection (Part 2 of 3)

Service changeable downloadable parameters (LD11)					
Operation mode	**Modem/ Gateway/ Host/KBD**	**Forced DTR***	**Hotline**	**Type of device to be connected**	**Group selection**
DEM	**PRM**	**DTR**	**HOT**		
6 (DTE)	ON "KBD On" (No RI)	ON Forced	OFF Not Hotline	Gateway inbound and outbound (DTR is on in idle state) MSB by DCD	
7 (DTE)	ON "KBD On" (No RI)	ON Forced	ON Hotline	Gateway inbound only (Hotline by DCD: ON for Hotline OFF for VLL) (DTR is ON in idle state)	
8 (DCE)	OFF "Host On" (prompts off)	OFF Not Forced	OFF Not Hotline	Outbound to Host (similar to Multi Channel Data System (MCDS)) Prompt PBDO = OFF/ ON	Modes 8 and 9 are for RS422 Host connectivity
9 (DCE)	OFF "Host On" (prompts off)	OFF Not Forced	On Hotline	Host Hotline by DTR	
10 (DCE)	OFF "Host On" (prompts off)	ON Forced	OFF Not Hotline	Host similar to MCDS but does not require DTR to be ON	Modes 8, 9, 10, and 11 are for RS232 Host connectivity
11 (DCE)	OFF "Host On" (prompts off)	ON Forced	On Hotline	Continuous Hotline mode when DTR is ON (VLL)	
* Not prompted for Type = R422. Defaults for Type = R422: DEM = DCE and DTR = OFF.					

Table 2
DAC mode of operation selection (Part 3 of 3)

Service changeable downloadable parameters (LD11)					
Operation mode	Modem/ Gateway/ Host/KBD	Forced DTR*	Hotline	Type of device to be connected	Group selection
DEM	PRM	DTR	HOT		
12 (DCE)	ON "KBD On" (prompts on)	OFF Not Forced	OFF Not Hotline	Terminal similar to Asynchronous/ Synchronous Interface Module (ASIM) when set to Not Forced DTR and Not Hotline Prompt PBDO = OFF/ ON	Modes 12 and 13 are for RS422 Terminal connectivity
13 (DCE)	ON "KBD On" (prompts on)	OFF Not Forced	On Hotline	Terminal similar to ASIM when set to Not Forced DTR and Hotline	
14 (DCE)	ON "KBD On" (prompts on)	ON Forced	OFF Not Hotline	Terminal similar to ASIM when set to forced DTR and Not Hotline	Modes 12, 13, 14, and 15 are for RS232 Terminal connectivity (similar to ASIM)
15 (DCE)	ON "KBD On" (prompts on)	ON Forced	On Hotline	Continuous Hotline when DTR is ON	
* Not prompted for Type = R422. Defaults for Type = R422: DEM = DCE and DTR = OFF.					

Selecting the proper mode for Modem connectivity

Select modes 0, 1, 2, and 3 when the DAC is connected to different types of modems for inbound and outbound modem pooling. In these modes, the DAC operates as a DTE, monitors the DSR, DCD, and RI control leads, and drives the DTR lead. No menus are given and no characters are echoed when DCD is OFF. All prompts and messages are enabled for inbound calls and disabled for outbound calls.

In modes 0 and 1, the DAC drives the DTR lead OFF when in the idle state, and ON when processing an incoming or outgoing call.

In modes 2 and 3, the DAC drives the DTR lead ON except when the call is being disconnected. At disconnect, DTR is dropped for 0.2 seconds and then returns to ON.

In the case of outbound modem pooling, the DAC answers the data call and drives the DTR lead ON (modes 0 and 1). Then the calling data module and the DAC form a transparent link between the calling DTE and the modem. The DTE user may then enter the appropriate commands to the modem for dialing a remote modem. When the call is established, the modem may cause the DAC to disconnect the call by dropping either DSR or DCD.

In the case of inbound modem pooling, the modem must drive the RI lead ON to activate the DAC. Then the DAC responds by driving the DTR lead ON and making the unit busy for outbound calls (modes 0 and 1). The modem is expected to turn DCD to ON within 35 seconds; otherwise, the call will be dropped by the DAC. If the modem turns DCD ON before the 35-second timeout, the DAC validates the incoming call and prepares to accept <CR> from the remote modem for autobaud.

See Figure 2 for more details.

Figure 2
DAC to modem connectivity

553-5215
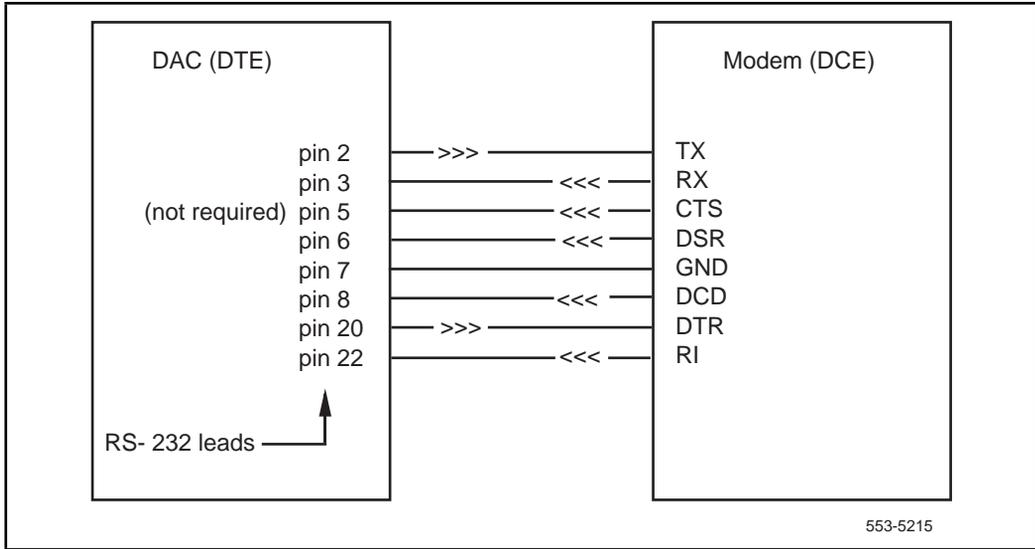
Mode 0

This mode should be selected when the DAC is connected to a modem, except Hayes-1200, for inbound and outbound modem pooling (see modes 2 and 3 for Hayes-1200 modem). The modem used should have the following features:

Auto-answer capability This feature is required when the modem is used for inbound modem pooling. It allows the modem to drive the RI lead ON when ringing is present at its tip and ring. In addition, the modem should auto-answer after the first ringing cycle if the DTR lead is ON (most modems support this feature).

Dynamic control of DCD This feature must be supported by all modems to be connected to the DAC. It allows the modem to drive the DCD lead ON when the carrier is detected and OFF when the carrier is absent (most modems support this feature).

Auto-dial capability This feature is required when the modem is used for outbound modem pooling. It allows the modem to go off-hook and dial the remote number (such as Smartmodem Hayes-2400 or Bizcomp).

Auto-reset capability This feature is required when the modem is used for outbound modem pooling. The modem should execute auto-reset when the DTR lead goes OFF. As a result, the modem must reset all its internal parameters to the default values. This feature prevents the users of the modem pool from modifying the modem's default parameters to inappropriate values.

Configuring modems for mode 0

To configure Hayes modem 2400, enter the following commands:

```
AT&D2&W
ATVl&W
ATQ&W
ATEl&W
ATSO= 1&W
AT&Cl&Sl&W
AT&J&W
ATB1&W
AT&D3&W
```

Since the default parameters are programmable using commands, there is no guarantee that users will not change them.

To configure Bizcomp 1200 modem, set the following parameters in LD11:

DEM   DTE
PRM   OFF
DTR   OFF
HOT   OFF

— To configure MULTI MODEM 224E modem, set the configuration switches as follows:

switches 3 and 8 to DOWN position

— all other switches to UP position. Switch 7 should be UP when using RJ-11 jack.

Programing DAC for mode 0 in service change LD11

When used for inbound or outbound Modem Pool only, the DAC can be configured as R232 in LD11. When used for both inbound and outbound Modem Pool, the DAC must be configured as R232; station hunting for the outbound modem access should be in the opposite direction to the 500/2500 station hunting for the inbound modem access. See Figure 3 for more details.

Note: If Call Detail Recording (CDR) is required, use separate outbound and inbound Modem Pools.

Figure 3
DAC to Modem Pool connectivity
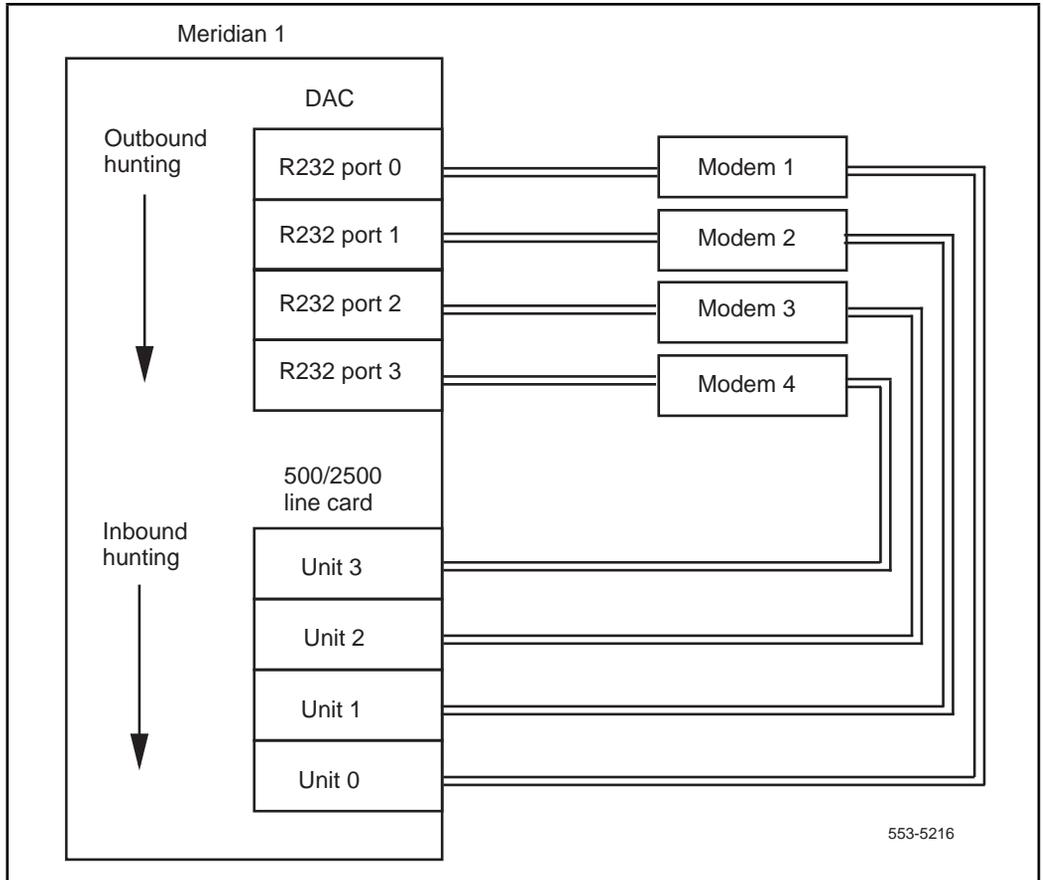
Mode 1

This mode should be selected when the DAC is connected to an auto-answer modem for inbound Hotline operation. In this mode, the DAC automatically executes Hotline operation when RI is driven ON by the modem. The modem used should have the following features:

Auto-answer capability This feature is required when the modem is used for inbound modem pooling. It allows the modem to drive the RI lead ON when ringing is present at its tip and ring. In addition, the modem should auto-answer after the first ringing cycle if the DTR lead is ON (most modems support this feature).

Dynamic control of DCD This feature must be supported by all modems to be connected to the DAC. It allows the modem to drive the DCD lead ON when the carrier is detected and OFF when the carrier is absent (most modems support this feature).

The baud rate of the Hotline call is determined by switches 6 and 8, and the Meridian 1 should be programmed to allow inbound modem calls only.

Configuring modems for mode 1

Most dumb modems can be configured for this mode. The modem must be able to auto-answer and have dynamic control of DCD as described in mode 0. Smart modems can also be used if set to the dumb mode of operation. Hayes 2400, Bizcomp 1200, and MULTI MODEM 224E can be used when set up as follows:

— For Hayes 2400, the dumb-mode-strap should be moved to the dumb-position (see Hayes manual).

— For Bizcomp 1200 modem, set the following parameters in LD11:

DEM   DTE
PRM   OFF
DTR   OFF
HOT   ON

Hayes 1200 cannot be used in this mode when the default parameters are selected (see mode 3).

Programing DAC for mode 1 in service change LD11

The DAC must be configured as R232 (the Autodial feature key is used for this mode). The DAC must not be configured as an Asynchronous Data Module (ADM) trunk.

Mode 2

This mode should be selected when the DAC is connected to a Hayes-1200 modem for inbound and outbound modem pooling. This mode is created specially to resolve some problems that were encountered with this modem, namely, the auto-reset implementation. When this modem is operating in the auto-reset mode, it drives both RI and DCD ON as long as DTR is OFF. This problem was resolved by driving DTR ON in the idle state, and OFF for 0.2 seconds, and then ON when an established call is dropped. The DAC also ignores the status of RI and DCD for approximately 2 seconds after a call is released to avoid false inbound call initiation.

Configuring Hayes 1200 for mode 2

To configure this modem, set the following parameters in LD11:

DEM	DTE
PRM	OFF
DTR	ON
HOT	OFF

To configure this modem, set the configuration switches as follows:

— switches 3, 8, and 10 to DOWN position

— all other switches to UP position. Switch 7 should be UP when using RJ-11 jack.

Programing DAC for mode 2 in service change LD11

When used for inbound or outbound Modem Pool only, the DAC can be configured as R232 in LD11. When used for both inbound and outbound Modem Pool, the DAC must be configured as R232. When the DAC is programmed as station hunting, outbound modem access should be in the opposite direction to the 500/2500 station hunting for the inbound modem access.

Note: If Call Detail Recording (CDR) is required, use separate outbound and inbound Modem Pools.

Mode 3

This mode should be selected when the DAC is connected to a Hayes-1200 modem for inbound Hotline operation. It is recommended that mode 1 be used for inbound Hotline operations if some other modem is available. However, if only Hayes-1200 modems are available, then this mode could be used as a last resort.

Configuring Hayes 1200 for mode 3

For Hayes 1200 modem, set the following parameters in LD11:

DEM	DTE
PRM	OFF
DTR	ON
HOT	ON

To configure this modem, set the configuration switches as follows:

— all switches to UP position, except for switch 4. Switch 7 should be UP when using RJ-11 jack.

Programing DAC for mode 3 in service change LD11

The DAC must be configured as R232 (the Autodial feature is used for this mode). The DAC must not be configured as an ADM trunk.

Selecting the proper mode for Gateway connectivity

Select modes 4, 5, 6, and 7 when the DAC is connected to different types of gateways for inbound and outbound operations. The term gateway refers to any equipment that has the following characteristics:

— The equipment must be a DCE.

— The equipment does not drive RI lead (optional, the DAC ignores this lead).

— The equipment must drive DCD lead dynamically.

— The equipment drives DSR lead (optional).

— The equipment can monitor the DTR lead (optional, depending on the mode selected).

In modes 4, 5, 6, and 7, the DAC:

— operates as a DTE

— monitors the DSR

— monitors DCD control leads

— drives the DTR lead

The RI lead is ignored. No menus or prompts are given when DCD is OFF. All prompts and messages are enabled for inbound calls and disabled for outbound calls. See Figure 4 for more details.

In modes 4 and 5, the DAC drives the DTR lead OFF in the idle state, and ON when processing an incoming or outgoing call.

In modes 6 and 7, the DAC drives the DTR lead ON except when the call is being disconnected. At disconnect, DTR is dropped for 0.2 seconds and then returns to ON.

With outbound gateway access, the DAC answers the data call and drives the DTR lead ON (modes 4 and 5; in modes 6 and 7, DTR is already ON). Then the calling data module and the DAC form a transparent link between the calling Data Module (DM) and the gateway. The DM user may then enter the appropriate commands to the gateway to establish a data call. The DAC expects the gateway to drive DCD ON (modes 4 and 5 only) within 35 seconds. If the gateway fails to do so, the DAC turns DTR OFF and drops the call. When the call is established, the gateway may cause the DAC to disconnect the call by dropping either DSR or DCD.

For inbound gateway access, the gateway must drive the DCD lead ON to activate the DAC. When the DAC receives this signal, it drives the DTR lead ON, makes the unit busy for outbound calls (modes 4 and 5; in modes 6 and 7, DTR is already ON), and prepares to accept <CR> for autobaud. The DAC expects DCD to remain ON for as long as the data call is established.

Figure 4
DAC to Gateway connectivity
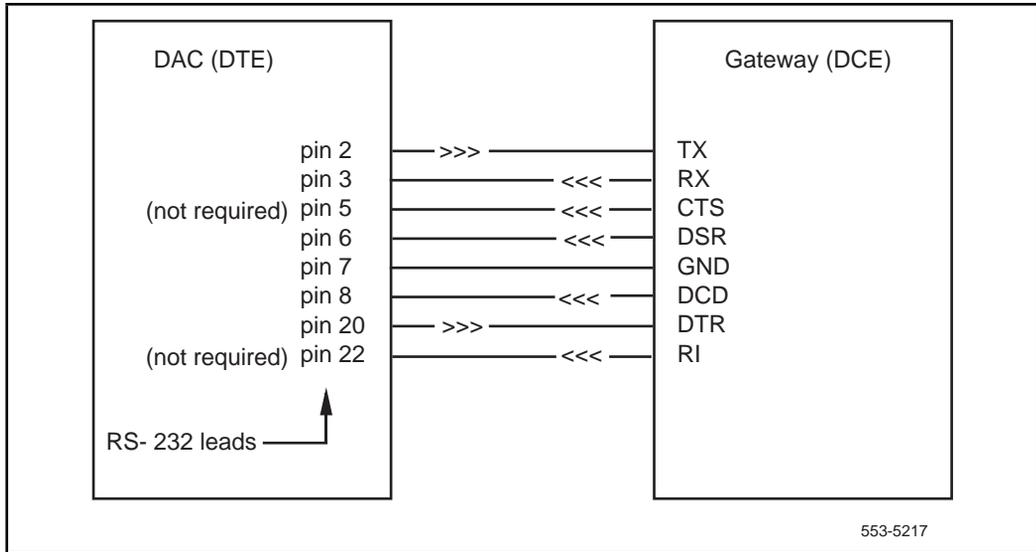
Mode 4

This mode should be selected when the DAC is connected to a gateway for inbound and outbound operation. The characteristics of the gateways to be used with this mode are:

Auto-answer capability This feature is required when the gateway is used for inbound operation. It allows the gateway to drive the DCD lead ON when the inbound data call is pending. In addition, the gateway should auto-answer when the DTR lead is ON.

Dynamic control of DCD This feature must be supported by all gateways to be connected to the DAC. It allows the gateway to drive the DCD lead ON when the data call is established, and OFF when the data call is disconnected.

In the inbound operation, the DAC drives the DTR lead OFF until the gateway drives the DCD lead ON. Then, the DAC drives DTR ON and makes that unit busy for any outbound calls. After that, the user of the gateway may enter the proper commands to establish a local data call to any DM.

In the outbound operation, the DAC drives the DTR lead OFF until another DM calls it for outbound accessing. The DAC answers the data call and drives the DTR lead ON. The calling DM is then transparently connected to the gateway. The DAC requires the gateway to drive the DCD lead to ON within 35 seconds after the outbound call is connected. Call disconnection may be initiated by dropping DCD (or DSR) from ON to OFF.

Programing DAC for mode 4 in service change LD11

When used for inbound or outbound gateway access, the DAC can be configured as R232 in LD11. When used for both inbound and outbound gateway access, the DAC must be configured as R232. When the DAC is programmed as station hunting, outbound gateway access should be in the opposite direction to the hunting for inbound gateway access. See Figure 5 for more details.

Note: If CDR is required, use separate outbound and inbound gateway access.

Figure 5
DAC to Gateway—Inbound/Outbound connectivity
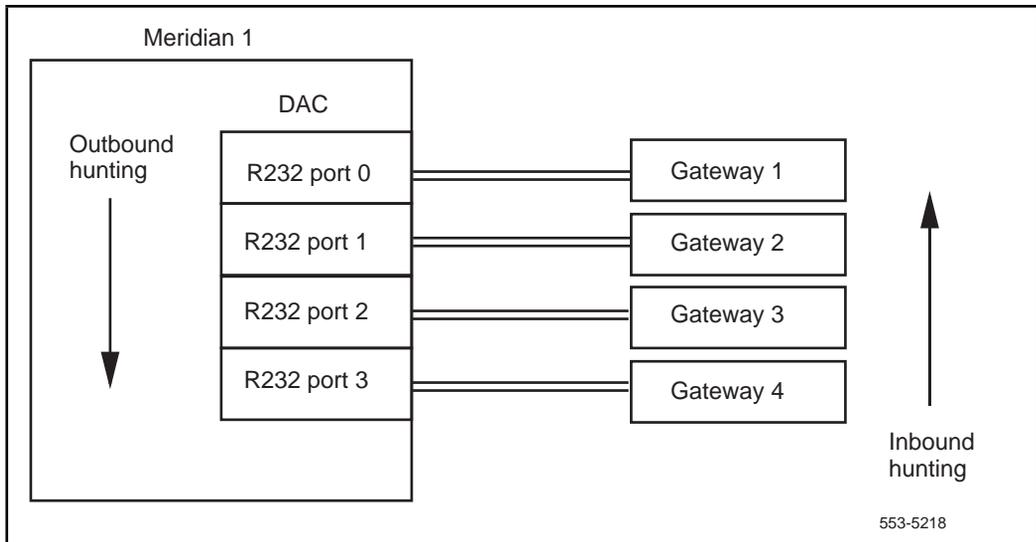
Mode 5

This mode should be selected when the DAC is connected to an auto-answer gateway for inbound Hotline operation. In this mode, the DAC automatically executes Hotline operation when DCD is driven ON by the gateway. If the DM being called by the Hotline operation is busy or not answering, the DAC will place repeated Hotline calls as long as the DCD lead is ON until the called unit answers. The gateway used in this mode should have the following features:

Auto-answer capability This feature is required when the gateway is used for inbound operation. It allows the gateway to drive the DCD lead ON when the inbound data call is pending. In addition, the gateway should auto-answer when the DTR lead is ON.

Dynamic control of DCD This feature must be supported by all gateways to be connected to the DAC. It allows the gateway to drive the DCD lead ON when the data call is established, and OFF when the data call is disconnected.

The baud rate of the Hotline call is determined by the AUTB and BAUD parameters in LD11. The Meridian 1 should be programmed to allow inbound modem calls only.

Programing DAC for mode 5 in service change LD11

The DAC must be configured as R232 (the Autodial feature is used for this mode). The DAC must not be configured as an ADM trunk.

Mode 6

This mode should be selected when the DAC is connected to a gateway that requires DTR to be ON always except during call disconnection. In this mode, the DAC can be used for both inbound and outbound operations. The operation of this mode is similar to mode 4 except for the following:

— The DTR lead is ON in the idle state.

— The DTR lead will be dropped OFF for 0.2 seconds when an established call is disconnected.

Programing DAC for mode 6 in service change LD11

When used for inbound or outbound gateway access, the DAC can be configured as R232 in LD11. When used for both inbound and outbound gateway access, the DAC must be configured as R232. When the DAC is programmed as station hunting, outbound gateway access should be in the opposite direction to the hunting for inbound gateway access. See Figure 5 for more details.

Note: If CDR is required, use separate outbound and inbound gateway access.

Mode 7

This mode should be selected when the DAC is connected to a gateway for inbound Hotline operation. The operation of this mode is similar to mode 5 except for the following:

— The DTR lead is ON in the idle state.

— The DTR lead will be dropped OFF for 0.2 second when an established call is disconnected.

The baud rate of inbound Hotline calls is determined by programmable database. The Meridian 1 should be programmed to allow inbound calls only on the DAC unit.

Programing DAC for mode 7 in service change LD11

The DAC must be configured as R232 (the Autodial feature is used for this mode). The DAC must not be configured as an ADM trunk.

Selecting the proper mode for Host connectivity

Select modes 8, 9, 10, and 11 when the DAC is connected to different types of hosts (DTE). In these modes, the DAC operates as a DCE and drives DSR, DCD, and RI control leads (see Figure 6). CTS, DSR, and DCD are driven OFF in the idle state.

The DAC will not send any menu or prompt to the host, nor will it echo any command sent from the host. The CTS, DSR, and DCD will be driven ON until the call is released. An incoming call to the DAC causes the RI lead to go ON for 2 seconds and then OFF for 4 seconds until the call is answered by the host. When the host turns DTR ON, the DAC answers the call. If DM-to-DM protocol exchange is successful, the DAC drives CTS, DSR, and DCD ON. If DTR was already ON, the DAC does not drive RI ON.

Figure 6
DAC to Host connectivity
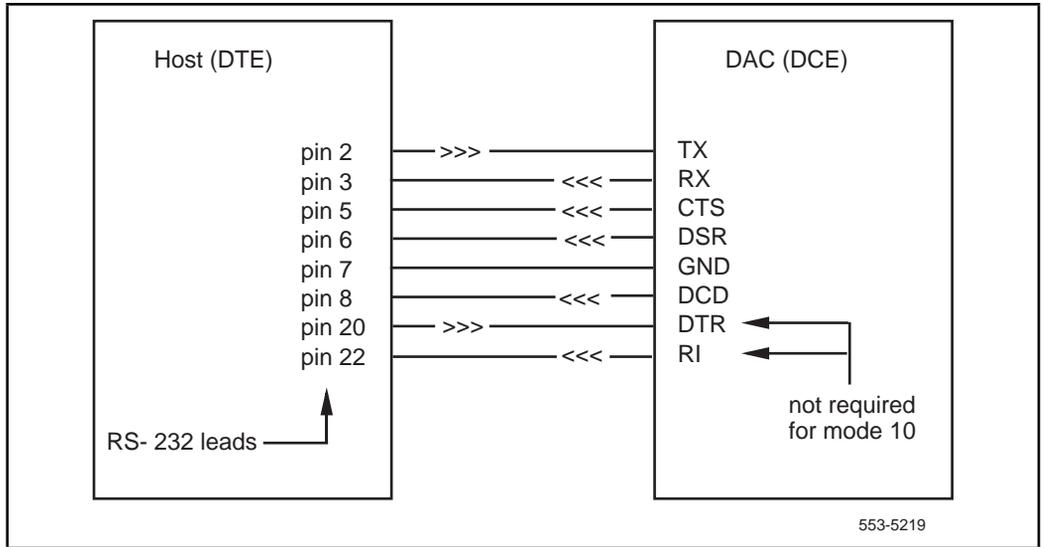
Mode 8

This mode should be selected when the DAC is connected to a host for host accessing. In this mode, the DAC operates in a similar manner to the MCDS. The hosts used with this mode should have the following characteristics:

Auto-answer capability The host should be capable of monitoring the RI lead for detection of incoming calls. When RI is turned ON by the DAC, the host responds by driving DTR ON, which forces the DAC to answer the incoming call. If the host drives the DTR lead ON all the time, incoming calls will always be immediately answered and the RI lead will not be turned ON by the DAC. If DM-to-DM protocol exchange is successful, the DAC drives CTS, DSR, and DCD ON.

Dynamic control of DTR This feature is required only if the host must be capable of releasing an established call. The host should be able to drop an established data call by driving DTR OFF for more than 100 ms.

> *Note:* If the PBDO parameter in LD11 is ON, then Make Set Busy will be activated when DTR is driven OFF for more than five seconds.

In this mode, the DAC will not send any menus or prompts to the host. However, the host can still originate an outgoing call by blind-dialing (sending commands to the DAC without receiving echoes).

Programing DAC for mode 8 in service change LD11

When used for inbound or outbound host access, the DAC can be configured as R232 or R422 in LD11. When used for both inbound and outbound host access, the DAC must be configured as R232 or R422. When the DAC is programmed as station hunting, outbound host access should be in the opposite direction to the hunting for inbound host access.

> *Note:* If CDR is required, use separate outbound and inbound host access.

Mode 9

This mode should be selected when the DAC is connected to a host and Hotline call origination is required. In this mode, the host will be able to Hotline to a specific data unit by simply driving the DTR lead ON. The transition of DTR from OFF to ON causes the DAC to Hotline to the Autodial DN. The hosts used with this mode should have the following characteristics:

Dynamic control of DTR for call origination The host should be capable of driving the DTR lead from OFF to ON to initiate the Hotline call. If the host always drives the DTR lead ON (not capable of dynamic control), mode 11 should be used.

Dynamic control of DTR for releasing established calls This feature is required only if it is required that the host be capable of releasing an established call. The host should be able to drop an established data call by driving DTR OFF for more than 100 ms.

Programing DAC for mode 9 in service change LD11

The DAC must be configured as R232 or R422 (the Autodial feature is used for this mode). The DAC must not be configured as an ADM trunk.

Mode 10

This mode should be selected when the DAC is connected to a host for inbound host accessing. The host in this mode is not required to monitor RI or drive DTR. This mode is similar to mode 8, except for the following:

— The status of DTR lead is assumed to be always ON, even when the actual condition of that lead is OFF (forced-DTR). The DAC always answers an incoming call regardless of the status of DTR.

— The host cannot release an established data call by driving DTR OFF. As a result, the host cannot initiate call release except with a long break or three short breaks.

In this mode, the DAC does not send any menus or prompts to the host. However, the host can still originate an outgoing call by blind-dialing (sending commands to the DAC without receiving echoes).

Programing DAC for mode 10 in service change LD11

When used for inbound or outbound host access, the DAC can be configured as R232 in LD11. When used for both inbound and outbound host access, the DAC must be configured as R232. When the DAC is programmed as station hunting, outbound host access should be in the opposite direction to the hunting for inbound host access.

> *Note:* If CDR is required, use separate outbound and inbound gateway access.

Mode 11

This mode provides a "virtual leased line" and the meaning of the Forced DTR switch is re-defined. The operation is similar to having a leased line feature, where the connection between two extensions is always established. The DAC does not send any menus or prompts to the host. The baud rate of the Hotline call is determined by switches 6, 7, and 8.

This mode should be selected when the DAC is connected to a host and continuous Hotline operation is required. In this mode, the DAC repeatedly tries to Hotline to the Autodial DN as long as DTR is ON. When the DAC tries to Hotline to a busy Data Module, it activates Ring Again and the connection is established as soon as the called unit is free. After establishing the data call, if the called unit releases the call for any reason, the DAC will automatically try to Hotline again to reestablish the call.

If the data unit being called does not answer the Hotline call, the DAC tries to place another Hotline call once every 40 seconds until the called unit answers. This mode is recommended only when a permanent connection between a host and another data unit is required.

Programing DAC for mode 11 in service change LD11

The DAC must be configured as R232 (the Autodial feature is used for this mode). The DAC must not be configured as an ADM trunk.

Selecting the proper mode for Terminal connectivity

Select modes 12, 13, 14,and 15 when the DAC is connected to different types of terminals. In these modes, the DAC operates as a DCE, drives DSR, DCD, and RI control leads, and monitors DTR lead in modes 12, 13, and 15 (see Figure 7). DTR is ignored in mode 14. All the menus and prompts are sent to the terminals and all the commands from the terminals are echoed. CTS, DSR, and DCD are driven OFF during the idle state (data call is not established).

When the call is released, DSR and DCD are turned OFF for 200 ms. The RI lead is controlled only in modes 12, 13, and 15, and is driven OFF in the idle and connect states. An incoming call to the DAC causes the RI lead to go ON for 2 seconds and then OFF for 4 seconds until the call is answered by the terminal. When the terminal turns DTR ON, the DAC answers the call.

Figure 7
DAC to Terminal connectivity
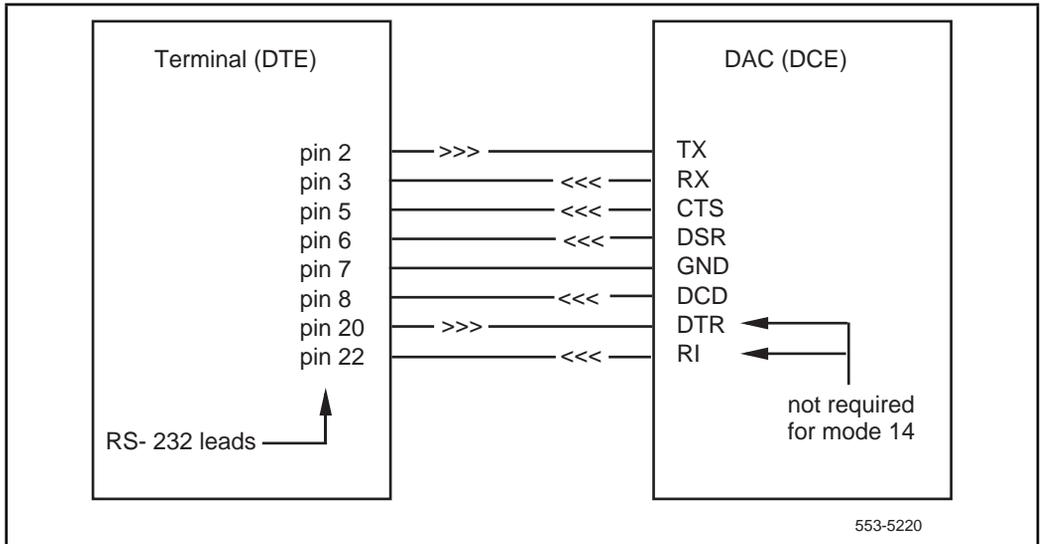
Mode 12

This mode should be selected when the DAC is connected to a terminal (DTE) for inbound and outbound data calls. This mode is similar to the operation of the ASIM when set to not-forced-DTR and not-Hotline. In this mode, call origination and auto-answer will not be executed by the DAC, unless the DTR lead is driven ON by the terminal. Any terminal that drives the DTR lead ON can be used with this mode (such as VT100 or VT102).

The DAC drives CTS, DSR, and DCD ON, except when a call is dropped or when control—Z is entered during the idle state. In this case, the DAC drives those leads OFF for 0.2 seconds and then ON. When the DTR lead is driven OFF by the terminal, the DAC does not execute autobaud, nor will it respond to any command.

> *Note:* If the PBDO parameter in LD11 is ON, then Make Set Busy will be activated when DTR is driven OFF for more than five seconds.

Programing DAC for mode 12 in service change LD11

The DAC must be configured as R232 or R422 since Autodial, Speed Call, and Display commands are likely to be used.

Mode 13

This mode should be selected when the DAC is connected to a terminal (DTE) and Hotline call origination is required. This mode is similar to the operation of the ASIM when set to not-forced-DTR and Hotline. In this mode, the terminal is able to Hotline to a specific data unit by driving the DTR lead ON. The transition of DTR from OFF to ON causes the DAC to Hotline to the Autodial DN. Any terminal that drives DTR lead ON can be used with this mode (such as VT100 or VT102).

The DAC drives CTS, DSR, and DCD ON, except when a call is dropped. In this case, the DAC drives those leads OFF for 0.2 second and then ON. The baud rate of the Hotline call is determined by the AUTB and BAUD parameters in LD11.

Programing DAC for mode 13 in service change LD11

The DAC must be configured as R232 or R422 since Autodial, Speed Call, and Display commands are likely to be used.

Mode 14

This mode should be selected when the DAC is connected to a terminal (DTE) for inbound and outbound data calls. This mode is similar to the operation of the ASIM when set to forced-DTR and not-Hotline. The terminal used with this mode is not required to drive the DTR lead. This mode of operation is similar to mode 12, except for the following:

— The status of DTR lead is assumed to be always ON, even when the actual condition of that lead is OFF (forced-DTR). The DAC always answers an incoming call regardless of the DTR status.

— The terminal cannot release an established data call by driving DTR OFF. As a result, the terminal cannot initiate call release except with a long break or three short breaks.

Programing DAC for mode 14 in service change LD11
The DAC must be configured as R232 since Autodial, Speed Call, and Display commands are likely to be used.

Mode 15

This mode provides a "virtual leased line" and the meaning of the "Forced DTR" switch is re-defined.

This mode should be selected when the DAC is connected to a terminal (DTE) and continuous Hotline call origination is required. In this mode, the DAC repeatedly tries to Hotline to the Autodial DN as long as DTR is ON. This operation is similar to having a leased line feature, where the connection between two extensions is always established. When the DAC tries to Hotline to a busy Data Module, it activates Ring Again and the connection is established as soon as the called unit is free. After establishing the data call, if the called unit releases the call for any reason, the DAC automatically tries to Hotline again to reestablish the call.

If the data unit being called does not answer the Hotline call, the DAC tries to place another Hotline call once every 40 seconds until the called unit answers. This mode is recommended only when a permanent connection between a terminal and another data unit is required. The baud rate of the Hotline call is determined by the AUTB and BAUD parameters in LD11. The status of CTS, DSR, and DCD is controlled in a similar manner as described in mode 13.

Programing DAC for mode 15 in service change LD11

The DAC must be configured as R232 since Autodial, Speed Call, and Display commands are likely to be used.

Mode selection baud rates

The AUTB and BAUD parameters in LD11 provide two functions for calls originated from a DAC:

— Provide a way to select a baud rate of a Hotline call. The DAC starts the Hotline operation without receiving a <CR> for autobaud.

— Set the DAC to operate at a fixed baud rate. The DAC does not return the menu or Hotline unless a <CR> is received at the selected baud rate. Normally the DAC should be selected to operate at autobaud.

Note: If AUTB is set to ON, the BAUD parameter is not prompted. If AUTB is set to OFF, you may select a fixed baud rate in response to the prompt BAUD.

When the DAC receives a call, it adapts to the caller's baud rate.

See Table 3 for connect and disconnect protocol.

Table 3
Connect and disconnect protocol (Part 1 of 9)

Mode of operation	Interface application	Comments
Mode 0	Inbound and Outbound modem pools For inbound modem pools, most dumb modems may be used. For outbound modem pools, only smart modems (auto-dialer) may be used.	**Outbound modem pooling:** 1 Modem sends ring/no ring cycle (2 seconds ON, 4 seconds OFF) to initiate connection. 2 DAC responds by driving DTR ON within the first ring cycle. 3 Modem responds by answering the incoming call and driving DCD ON within 35 seconds. 4 If modem does not drive DCD ON within 35 seconds, the DAC drops DTR and goes idle. 5 Remote DTE sends <CR> to the DAC. The DAC autobauds and sends initial prompt. **Outbound modem pooling:** 1 Local DM user calls to the outbound modem access number. 2 DAC answers the outbound call and drives DTR ON. 3 Modem receives DTR and prepares to receive commands. 4 Local DM user enters the proper commands for calling the remote modem. 5 Remote modem answers; data call established. **Call disconnection (DAC):** 1 DAC drops DTR if the local DM user drops the call. The modem must drop DCD. 2 DAC drops DTR if the remote modem sends a long break or three short breaks. The modem must drop DCD. **Call disconnection (modem):** 1 Modem drops DCD (DCD OFF for 100 ms or more). The DAC drops DTR and disconnects the local call. 2 Modem drops DSR (DSR OFF for 100 ms or more). The DAC drops DTR and disconnects the local call.

Table 3
Connect and disconnect protocol (Part 2 of 9)

Mode of operation	Interface application	Comments
Mode 1	Inbound Hotline modem pools Most dumb modems can be used for this application.	**Inbound Hotline modem pooling:** 1 Modem sends ring/no ring cycle (2 seconds ON, 4 seconds OFF) to initiate connection. 2 DAC responds by trying to establish a Hotline call to a specific Data Module (Autodial). 3 When Data Module answers, then and only then, the DAC turns DTR ON. 4 Modem should answer the incoming call when DTR goes ON and should turn DCD ON within 35 seconds; otherwise the DAC disconnects the call. **Call disconnection:** Disconnection is the same as mode 0.
Mode 2	Inbound and Outbound modem pools (with forced DTR) Use this mode with Hayes 1200 modem.	**Inbound and Outbound modem pooling:** The DAC operation is identical to mode 0 except that DTR is always forced ON (except during disconnect). **Call disconnection:** Disconnection is identical to mode 0 except: — when a call is released, the DAC turns DTR OFF for 0.2 second and then ON. DTR stays ON until the next call release. — The DAC ignores RI and DCD for about 2 seconds after releasing a call. This avoids problems with the Hayes 1200 modem.
Mode 3	Inbound Hotline modem pools (with forced DTR) Use this mode with Hayes 1200 modem.	**Inbound Hotline modem pooling:** The DAC operation is identical to mode 1 except that DTR is always forced ON (except during disconnect). **Call disconnection:** Disconnection is identical to mode 2.

Table 3
Connect and disconnect protocol (Part 3 of 9)

Mode of operation	Interface application	Comments
Mode 4	Inbound and Outbound Gateway access	**Inbound Gateway connection protocol:**
		1 Gateway raises DCD to initiate connection.
		2 DAC responds by driving DTR ON.
		3 Gateway does not have to turn DSR ON. However, toggling DSR or DCD from ON to OFF causes the DAC to disconnect the call.
		4 Gateway user sends <CR> to the DAC.
		5 DAC autobauds and sends the initial prompt to the Gateway.
		Outbound Gateway connection protocol:
		1 Local DM user calls the DAC that is connected to a Gateway.
		2 DAC answers the data call and drives DTR ON.
		3 Gateway receives DTR and prepares to receive commands.
		4 Local DM user is now transparently connected to the Gateway.
		5 Gateway is expected to drive DCD ON within 35 seconds. If the Gateway fails to do so, the DAC drops DTR and the call.
		Call disconnection (DAC):
		1 DAC drops DTR if the local DM user drops the call. The Gateway must drop DCD.
		2 DAC drops DTR if the DAC receives a long break or three short breaks. The Gateway must drop DCD.
		Call disconnection (Gateway):
		1 Gateway drops DCD (DCD OFF for 100 ms or more). The DAC drops DTR and disconnects the local call.
		2 Gateway drops DSR (DSR OFF for 100 ms or more). The DAC drops DTR and disconnects the local call.

Table 3
Connect and disconnect protocol (Part 4 of 9)

Mode of operation	Interface application	Comments
Mode 5	Inbound Hotline Gateway access	**Inbound Hotline Gateway protocol:**
		1 Gateway raises DCD to initiate connection.
		2 DAC responds by trying to establish a Hotline call to a specific Data Module (Autodial).
		3 When Data Module answers, then and only then, the DAC turns DTR ON.
		4 Gateway does not have to turn DSR ON. However, toggling DSR or DCD from ON to OFF causes the DAC to drop the call.
		5 Gateway is not transparently linked to the equipment connection to the DM.
		Call disconnection:
		Disconnection is identical to mode 4.
Mode 6	Inbound and Outbound Gateway access (with forced DTR)	**Inbound and Outbound Gateway protocol:**
		The DAC operation is identical to mode 4 except that DTR is always forced ON (except during disconnect). The establishment of the outbound call does not require DCD to be driven ON by the Gateway.
		Call disconnection:
		Disconnection is identical to mode 4 except that when a call is released, the DAC turns DTR OFF for 0.2 second and then ON. DTR stays ON until the next call release.
Mode 7	Inbound Hotline Gateway access (with forced DTR)	**Inbound Hotline Gateway protocol:**
		The DAC operation is identical to mode 5 except that DTR is always forced ON (except during disconnect).
		Call disconnection:
		Disconnection is identical to mode 6.

Table 3
Connect and disconnect protocol (Part 5 of 9)

Mode of operation	Interface application	Comments
Mode 8	Host access for call origination and answering	**Host answering an incoming data call:** 1 Local DM user dials the access number to initiate the connection. 2 DAC responds by driving RI ON for 2 seconds and OFF for 4 seconds until the Host answers by turning DTR ON. (If the Host always drives DTR ON, the DAC immediately answers the call without driving RI ON.) 3 When Host receives RI ON, it should respond by turning DTR ON. 4 DAC answers when it receives DTR ON. 5 DAC turns DSR, DCD, and CTS ON when the call is completely established. The local DM user is now transparently linked to the Host. **Host originating a data call:** 1 Host turns DTR ON to initiate the connection. 2 DAC prepares to receive <CR> for autobaud. 3 Host sends <CR> followed by other commands for establishing a data call (the DAC does not echo a command, nor does it send any prompt to the Host (blind dialing). 4 When the data call is completely established, the DAC turns DSR, DCD, and CTS ON as long as the call is connected. **Call disconnect ion (DAC):** 1 DAC drops DSR, DCD, and CTS if the local DM user releases the call. The Host should then drop the call. 2 DAC drops DSR, DCD, and CTS if the Host sends a long break or three short breaks. The Host should then drop the call. **Call disconnection (Host):** The Host toggles DTR from ON to OFF (DTR must be OFF for 100 ms or more). The DAC drops DSR, DCD, and CTS and disconnects the local call.

Table 3
Connect and disconnect protocol (Part 6 of 9)

Mode of operation	Interface application	Comments
Mode 9	Hotline call origination	**Hotline originated by Host (Inbound):** 1 Host toggles DTR from OFF to ON to initiate the Hotline call. 2 DAC responds by trying to establish a Hotline call to a specific Data Module (Autodial). 3 When Data Module answers, then and only then, the DAC turns DSR, DCD, and CTS ON (the DAC does not send any prompts to the Host). If the Data Module is busy or not responding, the DAC requires another transition of DTR from OFF to ON to initiate another Hotline call. If the Host keeps DTR ON, the DAC does not try to establish another Hotline call, unless the Host sends a <CR> while DTR is ON. **Call disconnection:** Disconnection is identical to mode 8.
Mode 10	Host access for call origination and answering (with forced DTR)	**Host access for call origination and answering:** The DAC operation is identical to mode 8 except DTR is always considered ON, even when the Host is driving DTR OFF. **Call disconnection:** 1 DAC drops DSR, DCD, and CTS if the local DM user releases the call. The Host should then drop the call. 2 DAC drops DSR, DCD, and CTS if the Host sends a long break or three short breaks. The Host should then drop the call.

Table 3
Connect and disconnect protocol (Part 7 of 9)

Mode of operation	Interface application	Comments
Mode 11	Hotline call origination (Virtual Leased Line)	**Hotline origination by Host (continuous Hotline mode):**
		The DAC operation is similar to mode 9 except the Host initiates the Hotline call by driving DTR ON. However, if the DM is busy or not answering, the DAC will continuously try to originate Hotline calls once every 40 seconds (as long as DTR stays ON) until the called DM answers the call.
		Call disconnection:
		Disconnection is identical to mode 8.
Mode 12	Terminal access for call origination and answering	**Terminal answering an incoming data call:**
		1 DAC drives DSR, DCD, and CTS ON in the idle state.
		2 Local DM user dials the access number to initiate the connection.
		3 DAC responds by driving RI ON for 2 seconds and OFF for 4 seconds, until the terminal answers by turning DTR ON (if the terminal always drive DTR ON, the DAC immediately answers the call without driving RI ON).
		4 When terminal receives RI ON, it should respond by turning DTR ON.
		5 DAC answers when DTR goes ON and the local DM user is now transparently linked to the terminal.
		Terminal originating an outgoing data call:
		1 DAC drives DSR, DCD, and CTS ON in the idle state.
		2 Terminal turns DTR ON to initiate the connection.
		3 DAC prepares to receive <CR> for autobaud.
		4 Terminal sends <CR> followed by other commands for establishing a data call (the DAC echoes all commands).

Table 3
Connect and disconnect protocol (Part 8 of 9)

Mode of operation	Interface application	Comments
		Call disconnection (DAC):
		If the local DM user releases the call, the DAC turns DSR, DCD, and CTS OFF for 0.2 second and then ON.
		Call disconnection (terminal):
		1 Terminal toggles DTR from ON to OFF (DTR must be OFF for 100 ms or more). The DAC turns DSR, DCD, and CTS OFF for 0.2 second and then ON.
		2 Terminal sends a long break or three short breaks. The DAC turns DSR, DCD, and CTS OFF for 0.2 second and then ON.
Mode 13	Hotline call origination	**Hotline originated by terminal:**
		1 DAC drives DSR, DCD, and CTS ON in the idle state.
		2 Terminal toggles DTR from OFF to ON to initiate Hotline call.
		3 DAC responds by trying to establish a Hotline call to a specific DM (Autodial).
		4 If Data Module is busy or not responding, the DAC requires another transition of DTR from OFF to ON to initiate another Hotline call. If the terminal keeps DTR ON, the DAC does not try to establish another Hotline call unless the terminal sends a <CR> while DTR is ON.
		Call disconnection:
		Disconnection is identical to mode 12.
Mode 14	Terminal access for call origination and answering (with forced DTR)	**Terminal access for call origination and answering:**
		The DAC operation is identical to mode 12 except that DTR is considered to be always ON, even when the terminal is driving DTR OFF.

Table 3
Connect and disconnect protocol (Part 9 of 9)

Mode of operation	Interface application	Comments
		Call disconnection (DAC):
		If the local DM user drops the call, the DAC turns DSR, DCD, and CTS OFF for 0.2 second and then ON.
		Call disconnection (terminal):
		The terminal sends a long break or three short breaks. The DAC turns DSR, DCD, and CTS OFF for 0.2 second, and then ON.
Mode 15	Hotline call origination (Virtual Leased Line)	**Hotline call origination by terminal:**
		The DAC operation is similar to mode 13 except the terminal initiates the Hotline call by driving DTR ON. However, if the called DM is busy or not answering, the DAC will continuously try to originate Hotline calls once every 40 seconds (as long as DTR remains ON) until the Data Module answers the call.
		Call disconnection:
		Disconnection is identical to mode 12.

Keyboard dialling

Keyboard dialing is an interactive dialogue mode between the connected equipment and the DAC. This dialogue allows equipment to give dialing commands to the DAC in order to make a data call to another far-end data port. Keyboard dialing supports a modify mode that allows the user to modify certain dialing parameters.

The following keyboard dialing features are supported with the DAC:

— Autobaud from 110 to 19200 bps

— Autoparity to ensure that the keyboard dialing menu is readable on the data terminal during the interactive dialogue mode

— Originating calls to local and remote hosts

— Ring Again

— Speed Call

— Two answer modes for incoming calls: manual and auto

— Digit display

— Dialing by mnemonic

Initiating conditions

In order for the DAC to respond to user commands/entries, the following conditions must be met:

— The DAC must be active (power ON), and have successfully received the downloaded parameters from the system.

— The user equipment must be active, and, if in RS-232-C mode, must assert these control lines

• DCE mode: DTR (unless Forced DTR has been software selected)

• DTE mode: RI has cycled the appropriate number of times

Echo

During call setup (dialogue phase), all user input is echoed back to the user equipment. Once the call is established, the DAC is transparent to data communications. To get echoed characters after a call is established, the far end must provide the echo.

Note: When RS-232-C modes 12-15 (Host modes) are selected, there is no echo during dialogue phase.

Prompts

Call processing prompts are in upper case letters only. Other prompts consist of both upper and lower case characters, and the dialogue session depicts the actual upper/lower case letters used.

All prompts are preceded by the Carriage Return and Line Feed ASCII characters (<CR>, <LF>).

Prompts requesting user input are terminated with the ASCII colon (:).

Prompts requiring a Yes or No answer are terminated by a question mark (?), followed by a list of allowable responses. The default response, if allowed, is bracketed.

Call abort

In addition to the methods mentioned above, which are common to both Hayes and keyboard modes, keyboard dialing supports the following method to abort a call during the dialogue phase.

— Sending the Control Z character (simultaneously pressing the control and Z keys) sends a message to the DAC to immediately abandon the data call setup.

Autobaud

All user dialogue must begin with Autobaud detection. This allows the DAC to determine the user equipment baud rate. During this phase, only <CR> will be recognized by the DAC. All other entries are ignored, and no entries are echoed. Once a valid <CR> is detected, the DAC responds with the New Menu prompt at the baud rate detected. If a fixed rate has been determined by the downloaded parameters, the DAC will look for that rate. If the rates agree, the dialogue phase begins. If not, the following prompt is sent to the user:

Baud Rate xxxx expected

After receiving a number of invalid responses, the DAC reverts to autobaud detection, since the terminal data speed may have changed.

Keyboard Autobaud is allowed after the call is placed in off-line mode.

> *Note:* If the Hayes autobaud characters A or a are sent, the DAC will enter Hayes dialing mode. Autobaud character detection is selected in the software.

Auto parity

The user can override the downloaded parity rate by entering the ASCII period (.) as a command. This period must be the only command sent, followed by <CR>. The period must be sent only when the Primary menu is displayed, and can be sent only once during a call setup session.

Dialing operation

For the purposes of this document, when illustrating the prompt/response sequences, the bold type is what the user enters on the keyboard. All other type represents the DAC output. Likewise, "xxxxxxx," "yyyyyyy," or "zzzzzzz" represents numbers entered by the user, or dialed by the DAC, and in no way indicates the absolute character limit. A maximum of 43 characters is allowed.

When the user enters the autobaud character, <CR>, and the dialing mode is Manual (not Hotline), the DAC sends the following menu:

<CR><LF><CR><LF><LF>ENTER NUMBER OR H (FOR HELP):<SP>

If the user enters <CR>, the DAC presents this prompt again. When a number is entered, the DAC attempts to place the call. Entering H at this point will list the Primary Commands menu:

Primary Commands Menu:

A - Auto Dial   C - Call
D - Display   M - Modify
S - Speed Call
CTRL Z (Abort Keyboard Dialing)
Select: <SP>

Whenever a Primary command is expected, the user may enter the Parity command (period). If Auto Parity has already been done, the Invalid Command menu is presented:

Invalid Command/Entry
Re-Enter: <SP>

The user's port may be set to idle by entering CTRL Z. Any call in progress will be dropped, and any Ring Again placed will be released. Once the Primary Command menu has appeared, the user must enter C to place a call. The DAC will not accept a number in place of a Primary command.

Primary commands

Once the Primary menu has appeared, only primary commands are accepted.

Call (C)

The Call command must be used to place a call once the Primary menu has appeared. The DAC will not accept a number only.

C<CR>

ENTER NUMBER:<SP>

xxxxxxx<CR>

CALLING xxxxxxx
RINGING
ANSWERED
CALL CONNECTED. SESSION STARTS

Autodial (A)

The Autodial command allows the user to dial a predefined number stored within the local system. The DAC will automatically attempt to place a data call to the Autodial number:

A <CR>

CALLING xxxxxxx

RINGING

ANSWERED

CALL CONNECTED. SESSION STARTS

The currently stored Autodial number may be viewed by entering the primary command D (Display), followed by the selection A (Autodial). See the Display discussion later in this document.

> *Note:* If the Autodial feature key is not defined in the software you will be notified by the following: Feature key Autodial not defined.

Speed Call (S)

The Speed Call command allows the user to make a call to a number associated with a 1-, 2-, or 3-digit access code. The user supplies the access code, and the DAC places the call according to the code supplied.

S<CR>

ENTER ACCESS CODE: <SP>

xxx<CR>
CALLING yyyyyy
RINGING
ANSWERED
CALL CONNECTED. SESSION STARTS

If the DAC does not know the access code length, you will be notified by: ENTER ACCESS CODE (all digits) <SP>. Leading zeroes must be entered if the access code is less than the maximum number of digits allowed for the Speed Call list for the associated data DN (DDN).

Note: If the Speed Call feature key is not defined in the software, you will be notified by the following: Feature key Speed Call not defined.

Both the Autodial and Speed Call commands can be changed with the Modify command (M). Additionally, the Speed Call number can be changed in the service change. When this command is entered, the Modify menu appears.

Modify Menu:

A - Auto Number   D - DCD Control
L - Long Break   M - Manual Answer
Q - Quit Modify Menu   R - Remote Loopback
S - Speed Call
CTRL Z (Abort Keyboard Dialing)
Select:<SP>

Any of these choices leads to another series of prompts and responses.

By entering A on the keyboard, you enter the Autodial Modify menu. Respond to the following prompts to change the Autodial number.

A <CR>

Current Autodial number: zzzzzzz

Enter Autodial number: <SP>

xxxxxxx <CR>

New Autodial number: xxxxxxx

By entering S on the keyboard, you enter the Speed Call Modify menu. The Speed Call number can also be changed in the software. Respond to the following prompts to change the Speed Call number.

S<CR>

Enter access code <SP>

Current Speed Call number: zzzzzzz

Enter Speed Call number: <SP>

zzzzzzz<CR>

New Speed Call number: xxxxxxx

By entering R on the keyboard, you enter the Remote Loopback Modify menu. Respond to the following prompts to enable or disable the Remote Loopback feature.

R <CR>

Remote Loopback Disabled (or enabled, indicating current status)
Remote Loopback
 (Y/N): <SP>

Y <CR> or N <CR>

Remote Loopback: Enabled (or Disabled)

By entering M on the keyboard, you enter the Manual Answer Modify menu. Manual Answer indicates that the DAC prompts the user to answer an incoming data call. Auto answer picks up the call after the specified number of rings. Respond to the following prompts to enable or disable the Manual Answer feature.

M <CR>

Current Answer Mode: Manual
                                              Auto - xx Rings

Manual Answer? (Y/N): <SP>

Y <CR>   **N <CR>**

                                                                    Number of rings (1-255 <1>): <SP>

yy

New Answer Mode: Manual New Answer Mode: Auto - yy Rings

By entering D on the keyboard, you enter the DCD Modify menu. Respond to the following prompts to enable DCD as Forced or Dynamic.

D <CR>

DCD Control: Dynamic
                             Forced On

Dynamic DCD? (Y/N): <SP>

Y <CR>   **N <CR>**

DCD Control: Dynamic   DCD Control: Forced On

By entering L on the keyboard, you enter the Long Break Detect Modify menu. Respond to the following prompts to enable or disable the detection of the Long Break as an abandon signal.

L <CR>

Long Break: Detected
                     Ignored

Detect Long Break? (Y/N): <SP>

Y <CR>   **N <CR>**

Long Break: Detected   Long Break: Ignored

To exit the Modify menu, enter Q. This entry returns you to the Primary commands menu. To view the port's parameters, enter D when in the Primary Commands menu. This display shows the Display Options menu.

Display Options Menu:

A - Auto Dial number   D - Date and Time
K - Feature Keys   P - Data Port Parameters
Q - Quit Display   S - Speed Call number(s)
CTRL Z (Abort Keyboard Dialing)
Select: <SP>

Ring Again

When a call is placed to a busy DN, the DAC prompts you to activate Ring Again. The Ring Again feature alerts you as soon as the dialed DN becomes free. Once the Ring Again has been activated, you will return to the Primary Commands menu. The following is the prompt and response sequence enabling the Ring Again feature.

Note: If you hang up the call, or give an abandon command, Ring Again is canceled.

BUSY, RING AGAIN? (Y/N): <SP>

Y <CR>   or   N <CR>

RING AGAIN PLACED

Primary Commands Menu:

A - Auto Dial   C - Call
D - Display   M - Modify
S - Speed Call
CTRL Z (Abort Keyboard Dialing)
Select: <SP>

If a Ring Again request has already been placed, the DAC offers the option of overriding the previous request.

RING AGAIN ACTIVE, REPLACE? (Y/N): <SP>

Y <CR>

RING AGAIN PLACED

Primary Commands Menu:

A - Auto Dial   C - Call
D - Display   M - Modify
S - Speed Call
CTRL Z (Abort Keyboard Dialing)
Select: <SP>

When the called DN becomes available, the system notifies the DAC, which then prompts the user to place the call. If you do not respond to the Ring Again prompt within a software determined time period, Ring Again is canceled, and the Primary Commands Menu appears.

DATA STATION NOW AVAILABLE, PLACE CALL? (Y/N/<Y>): <SP>

Y <CR>

CALLING XXXX
RINGING
ANSWERED
CALL CONNECTED. SESSION STARTS

> *Note 1:* If the Ring Again notice occurs during a parameter change, the prompt only appears after the change has been completed.

> *Note 2:* If the notice occurs during an active call, the Ring Again notice is ignored. When the active call is completed, you will be notified that the Ring Again call was canceled.

You can also cancel the Ring Again request at this time.

DATA STATION NOW AVAILABLE, PLACE CALL? (Y/N/[Y]): <SP>

N <CR>

RING AGAIN CANCELLED

Primary Commands Menu:

A - Auto Dial   S - Speed Call
C - Call   M - Modify
D - Display
CTRL Z (Abort Keyboard Dialing)
Select: <SP>

Not in service

When the DAC attempts a call to a DN that is not supported, it sends you a message. The call is released, and you must reenter the Autobaud character <CR> to initiate keyboard dialing again.

C<CR>

ENTER NUMBER:<SP>

xxxxxxx<CR>

CALLING xxxxxxx

NOT IN SERVICE

RELEASED

No response from the system

Likewise, when the DAC receives no system response from your port after a 30-second timeout period, the DAC sends you a message. The call is abandoned. This means the port is either disabled or unequipped.

C<CR>

ENTER NUMBER:<SP>

xxxxxxx<CR>

NO SYSTEM RESPONSE

RELEASED

Hayes dialing

Like keyboard dialing, Hayes dialing is an interactive dialing mode with the terminating equipment connected to the NT7D16 Data Access Card (DAC). In addition to the common parameters and functions, the Hayes dialing mode offers the following features:

— Data call dialing

— Two modes for answering incoming calls: auto and manual

— Repeat previous command

— Character echo control

— On-hook/off-hook control

— Detect off-line escape sequence

— Return to on-line

— Initiate Remote Digital Loopback

— Terminate Remote Digital Loopback

— Modify S Registers S0 through S12

— Display S Registers S0 through S12

— Support all S Registers except: S6, S7, S9, and S11

The Hayes dialing mode supports the following AT Dialing commands

Initiating conditions

The DAC responds to commands only when the following initial requirements are met:

— the DAC is active

— the DAC has successfully received the downloaded parameters

— the user equipment is active, and, if operating in RS-232-C mode

  • the DCE mode is DTR (unless Forced DTR has been software selected)

  • the DTE mode, and RI has cycled the appropriate number of times and DCD is asserted on by the modem

Note: In Gateway mode, DCD must be asserted on. In modem mode, only RI must be on. The DAC asserts DTR to the modem, and awaits DCD from the modem.

Input requirements

All input must be in the same case (upper or lower).

The Hayes repeat command, A/, is used to immediately execute the last command entered. The terminator character need not be entered. A complete discussion of the Repeat command can be found later in this document.

Where a Dial Number is expected, you may enter the characters 0-9, #, and comma (,). The characters @, P, R, T, and W are accepted, but ignored.

The maximum number of characters is 43. This limit includes the AT prefix, and the record Terminator character, but does not include the ASCII space character.

Echo

Throughout the dialogue phase, the DAC echoes all user input. In RS-232-C modes 0, 1, 2, and 3, no inbound call messages are presented to the modem. Prompts are presented only if the modem user originates the call. In modes 8, 9, 10, and 11, no prompts or characters echo under any circumstances. The echo function can be turned off with a Hayes dialing command.

All prompts and responses issued by the system are displayed to the user unless the display command has been disabled. Like the Repeat command, this is explained later in this document.

Note: If the RS-232-C DAC Host modes (1, 2, 3, 8, 9, 10, 11, or 12) are used, all attempts to enable the echo or display is ignored. Likewise, the Hayes Reset command is also ignored.

Result codes and messages

Each input record generates a result code which is sent to the user. Only one code is sent regardless of the number of commands in the record. The reply is in one of two formats:

— Numeric replies contain a one- or two-number code

— Verbose replies contain one or more words

Table 4 shows the codes for each reply in both formats, and explanations for the codes.

Note 1: Verbose commands are the default and appear in upper case characters only. Numeric commands are sent by issuing the Numeric Results code command (explained later in this document).

Note 2: All verbose codes and messages are preceded and terminated by the user defined Terminator and New Line characters. The default, or reset, characters are the ASCII Carriage Return, and ASCII Line Feed. The Numeric codes are preceded and terminated by the Terminator character only.

> *Note 3:* The Suppress result command (explained later in this document) will disable the sending of these codes. If in RS-232-C DAC Host modes, this command is ignored.

Table 4
Hayes dialing result codes and messages

Verbose code	Numeric code	Description
OK	0	Command(s) executed, no error
CONNECT	1	Data call established, session starts
RING	2	Inbound call presented
NO CARRIER	3	Data call abandoned
ERROR	4	Error in command line
NO DIALTONE	6	System does not allow call to proceed
BUSY	7	Far end is busy
NO ANSWER	8	Far end does not answer
CONNECT 1200	5	Session starts at 1200 baud
CONNECT 2400	10	Session starts at 2400 baud
CONNECT 4800	11	Session starts at 4800 baud
CONNECT 9600	12	Session starts at 9600 baud
CONNECT 19200	14	Session starts at 19200 baud

Baud rate detection

Every command line begins with Baud rate detection. This phase allows the DAC to determine the user equipment baud rate. During this phase, the DAC accepts only the ASCII "A," or "a" characters. Once a valid autobaud character is detected, the DAC echoes the parity bit character at the baud rate detected.

Note: If Hayes dialing is desired, you must enter the character "A" or "a" BEFORE the <CR>. If Carriage Return (<CR>) is entered before this Hayes dialing command, you will be placed in keyboard dialing mode.

Parity detection

Once the baud rate has been determined, the DAC accepts only the ASCII characters "T," "t," or "/." If the Repeat character "/" is entered, the previous command is executed. If "T," or "t" is entered, the DAC uses its parity and the parity of the preceding A (a) to determine the user's parity. This parity is used on the following messages and prompts associated with the command lines.

Note: The parity determined here overrides the parity downloaded from the system. Also, the T (t) must be entered in the same case as the A (a). If you entered uppercase A for the Baud Rate, you must enter upper case T for the parity.

Dialing operation

Like keyboard dialing, the Hayes dialing commands allow the user to initiate a data call, as well as change certain dialing parameters. The commands may be entered in either upper or lower case, but must be the same case throughout the command line. Also the case must match the autobaud case.

Note: Hayes dialing does not allow for the Ring Again feature. If a call is made to a busy number, that call is abandoned.

Table 5 provides a list of the AT dialing commands.

Table 5
AT dialing commands

Command	Description
ATA	Answer (answer incoming data call)
ATDnnnn ATDTnnnn	Dial (n = 0-9, numbers to be dialed)
A/	Repeat last command (no <CR> needed)
ATO	On-line (enter three Escape characters rapidly to go off-line)
ATDPnnnn	Voice call (n = 0-9, numbers to be dialed)
ATF0	Handsfree/mute (toggle Handsfree between mute and normal)
ATF1	Hold (put voice call on hold)
ATF2	Select (take voice call off hold)
ATH0	Hang up data call
ATHP	Hang up voice call
ATQn	Result code (n = 0, 1; if n = 0, result codes are sent)
ATVn	Verbal result (n = 0, 1; if n = 0, numeric codes are sent)
ATXn	Result code selection (n = 0, 1; if n = 1, extended results)
ATSn	Read S register (n = number of S register to read)
ATSn=x	Write S register (n = S register number; x = new value)
ATZ	Soft reset (reset to default parameters)
ATCn	Carrier detect (n = 0, 1; if n = 1, carrier detect is enabled)
ATEn	Echo (n = 0, 1; if n = 1, commands will echo back to terminal)
ATTSP!	Transparent mode
Note 1: To use AT dialing, enter CTRL-z at carriage return (<CR>) when the port is idle.	
Note 2: Follow each command (except A/) by a carriage return (<CR>) to execute it.	

For the purposes of this document, when illustrating the prompt/response sequences, the bold type is what the user enters on the keyboard. All other type represents the DAC output. Likewise, "xxxxxxx," "yyyyyyy," or "zzzzzzz" represents numbers entered by the user, or dialed by the DAC, and in no way indicates the absolute character limit. The number of characters is dependent on the feature activated (Auto Dial, Speed Call, for example). Also, for simplicity purposes, all Result messages are shown in Verbose code. See Table 4 for a complete list of the Verbose and Numeric codes. See *X11 features and services* (553-3001-305) for a complete description of the features operating.

S registers

These commands allow the user to access various dialing parameters. The user can determine the present parameter setting, and alter the parameter. These parameters are grouped into a set referred to as the S registers.

All S registers may be changed with the exception of S1, the Ring count. If an attempt is made to change this parameter, the command is accepted but no action is taken. The Ring count is the number of 6-second intervals that have expired since an inbound call has been received. The current count may be displayed through the Display S register command but cannot be altered After a call is dropped, the Ring counter is set back to 0.

If, when using the display or alter commands, no register or value number is input, the number 0 is used. For example, ATS? is equivalent to ATS0.

Allowable S registers Table 6 shows the supported S registers allowed by the DAC. This table shows the register number, the range accepted (decimal values shown), and a description of the register. Whenever a register value is changed, the DAC checks for validity. If the value entered is not within the allowed range, all processing ceases and no command processing following the invalid entry is accepted. The DAC sends an ERROR result message.

Table 6
Allowable S registers

S register	Range	Range units	Supported	Description
S0	0–255	Rings	Yes	Number of rings to answer a system call (0 = manual answer)
S1	0–255	Rings	Yes	Ring count for the current inbound system call
S2	0–127	ASCII	Yes	Off-line escape sequence character
S3	0–127	ASCII	Yes	Input/output line terminating character
S4	0–127	ASCII	Yes	New line character for the output line
S5	0–32, 127	ASCII	Yes	Backspace character for input/output lines
S6	2–255	Seconds	No	Wait time before blind dialing
S7	1–255	Seconds	Yes	Timeout timer for far end answering
S8	0–30	Seconds	Yes	Duration for the dial pause character
S9	1–255	0.1 second	No	Carrier detect response time
S10	1–255	0.1 second	No	Delay time between loss of carrier and call release
S11	50–255	Milliseconds	No	Touch tone spacing
S12	20–255	20 milliseconds	Yes	Guard time for the escape sequence

You can view any of the S registers by issuing the following display command. Any S register can be specified through the ATS command, and the system will display the current setting for that parameter. More than one S register can be viewed by listing the desired registers on the same command line.

One register	Two registers
ATS8?	**ATS8? S9**
20	002
OK	006
	OK

To change any S register range, except S1, use the following change command. The new parameters remain in effect until another change command is given or the Hayes Reset modem command (Z) is issued. If the DAC is powered up, the parameters are reset to the defaults.

ATS   8 = 15
OK

Reset Hayes parameters

All of the Hayes dialing parameters and S registers remain even after the data call is complete. Similarly, if the dialing mode, keyboard to Hayes or vice versa, are changed, the parameters remain as specified. The following command allows you to reset the parameters and S registers to the defaults. Entering 0 resets to the Hayes default, while entering 1 resets to the downloaded operating parameters.

CAUTION
All previous instructions will be ignored.
This command should only be used to reset all parameters. It should be the last command entered, because all previous commands are ignored.

ATZ   0
           1

OK

Table 7 lists all the parameter and S register default values. These are the values established when the reset command is given.

Table 7
Hayes parameters and S register reset values (Part 1 of 2)

Parameter	Value	Description
C	1 *	DCD control Dynamic (1) Forced ON (0)
E	1 *	Input character echo Enabled (1) Disabled (0)
Q	0	Send Result codes Enabled (1) Disabled (0)
V	1	Result codes sent in Verbose format
X	1	Features selection 0 - 8, 10 - 13
P	—	Dial method (pulse)
S0	0 *?1	Manual Answer (if 0)?Auto answer on 1 ring
S1	0	Ring count 0
S2	43	Escape sequence character Plus sign (+)
* Parameters that are reset to the downloaded operating parameters when 1 is entered at the reset command.		

Table 7
Hayes parameters and S register reset values (Part 2 of 2)

Parameter	Value	Description
S3	13	Terminator character Carriage Return (<CR>)
S4	10	New line character Line Feed (<LF>)
S5	8	Back space character BS (<BS>)
S6	2	Blind dial delay 2 seconds
S7	30	Timeout for outbound call answer 30 seconds
S8	2	Dial pause delay 2 seconds
S9	6	Carrier detect response time 0.6 seconds
S10	14	Call disconnect timer for carrier loss 1.4 seconds
S11	95	Touchtone space 95 milliseconds
S12	50	Escape sequence guard timer 1.00 seconds
* Parameters that are reset to the downloaded operating parameters when 1 is entered at the reset command.		

Outbound calls

The DAC supports two types of outbound data calls:

— point-to-point data calls

— calls sent through a modem without call origination capabilities

Hayes dialing does not provide for any alterations during call processing, Ring Again, or Controlled Call Back Queueing (CCBQ) for example. Consequently, if such variances occur during the call processing, the DAC releases the call and notifies you with a NO CARRIER or BUSY result code. Table 8 lists the command characters allowed for an outbound call.

Table 8
Allowed outbound call command characters

Character	Description
0 - 9	Dial number normal digits
,	Delay dialing the next digit by the value set in S8 register

Inbound calls

The DAC supports auto answer and manual answer capabilities. The following commands give examples of both auto and manual answer dialogues.

This dialogue session describes the sequence when the S0 register is set to three. In this case, the DAC automatically answers the incoming call on the third ring, and the session begins with the CONNECT message.

RING

RING

RING

CONNECT

Issuing the On Hook command while the call is still ringing disconnects the incoming call. The DAC disconnects the call and notifies you with a NO CARRIER message.

RING

RING

ATH   0

NO CARRIER

When the S0 register is set to 0, the DAC is set to manual answer, and an inbound call must be answered with the Answer command. You can also abandon the call with the On Hook message, as in the Autodial sequence.

RING

RING

ATH   0

NO CARRIER

Off Line mode

Off Line mode acts as a sort of Hold mode. Once the call is answered and the session begins, the Off Line command enables you to enter Hayes command modes. The Off Line sequence is transmitted to the far-end, but at the end of the sequence, the command mode is initiated. At this point, any Hayes command except Dial Number can be executed. Once the desired command is completed, you can return to the call through the On Line command.

The Guard Time (S12 register) defines the amount of time for no local input for the Off Line escape sequence to take place. If the S12 register is set to 0, enter the escape character defined in the S2 register. For a complete list of the parameters allowed for each S Register, see Table 7 describing the S Registers.

In the following example, <GT> is the Guard Time and <EC> the Escape
Character defined in the S2 register. The example shows the Off Line escape
sequence, the command to display an S register (Ring Count, in this case),
and the command to go back on line and attend to the answered call.

<GT><EC><EC><EC><GT

OK

ATS   1

005

OK

ATO   0

CONNECT

Specifications

QPC430 and QPC723 interfaces

The NT7D16 Data Access Card provides the same features as the QPC430 four-port Asynchronous Interface Line Card (AILC) and the QPC723 RS-232 Interface Line Card (RILC). The operational mode for each port is determined in LD11.

Download parameters

These parameters are configured in the system through service change operations. They are then downloaded to the DAC. For a complete description of the service change procedures, see the *X11 input/output guide* (553-3001-400).

System parameters

System parameters downloaded by the switch include the type of system, the inactivity timer, and the data DN. These parameters are described below:

— System type: Meridian 1

— Inactivity timeout

- No timeout

- 15 minutes

- 30 minutes

- 60 minutes

— DDN: 1 to 7 digits (0–9)

Operating parameters

There are thirteen parameters configured in the system that are downloaded to the DAC. They are:

— Dialogue parity

- Space (OFF)

- Mark (ON)

- Even

- Odd

— DTR control

- Dynamic (affected by call progress)

- Forced ON

— DCD control

- Dynamic (affected by call progress)

- Forced ON

— Dialing mode

- Manual (user initiates the call with dialogue commands)

- Hotline (call the Autodial number upon connection)

— Wire test

- Disabled (can be invoked only with front panel switch)

- Enabled (start only if the DAC firmware is idle)

— Language

- English

- Quebec French

— Keyboard dialing

- Enabled (allow both keyboard or Hayes dialing modes)

- Disabled (Hayes dialing only)

— Make port busy

- Disabled—On with DTR (normal)
- Enabled—Off with DTR (modes 8 or 12, and no DTR for 5 seconds)

— Auto Baud

- Variable (use auto baud rate)
- Fixed (use baud rate selection only)

— Baud rate

- 110
- 150
- 300
- 600
- 1200
- 2400
- 4800
- 9600
- 19200

— Operating mode

- DCE
- DTE

— Equipment type

- Terminal (send prompts/replies)
- Host (suppress prompts/replies)

— Long Break Detect

In Figures 8 and 9, the rectangles represent the settings of service change parameters in LD11 that affect the desired function. The diamonds represent the logical DAC operating mode decisions.

Figure 8
Operating mode selection—RS422

OPE YES

Operate Mode? — Terminal → PRM = On — Mode 12 and 13

Host

Mode 8 and 9 — PRM = Off

Virtual Leased Line?

No — DTR = Off

Yes — HOT = On / DTR = On

Hotline?

Yes — HOT = On

No — HOT = Off

Allow Autobaud?

No — AUTB = Off / Select BAUD

Yes — AUTB = On / BAUD = 7

Set remaining Operate Parameters as appropriate:

par, aut, DLNG, KBD, WIRE, & PBDO

553-5221

Note: DTR and PBDO are not prompted.
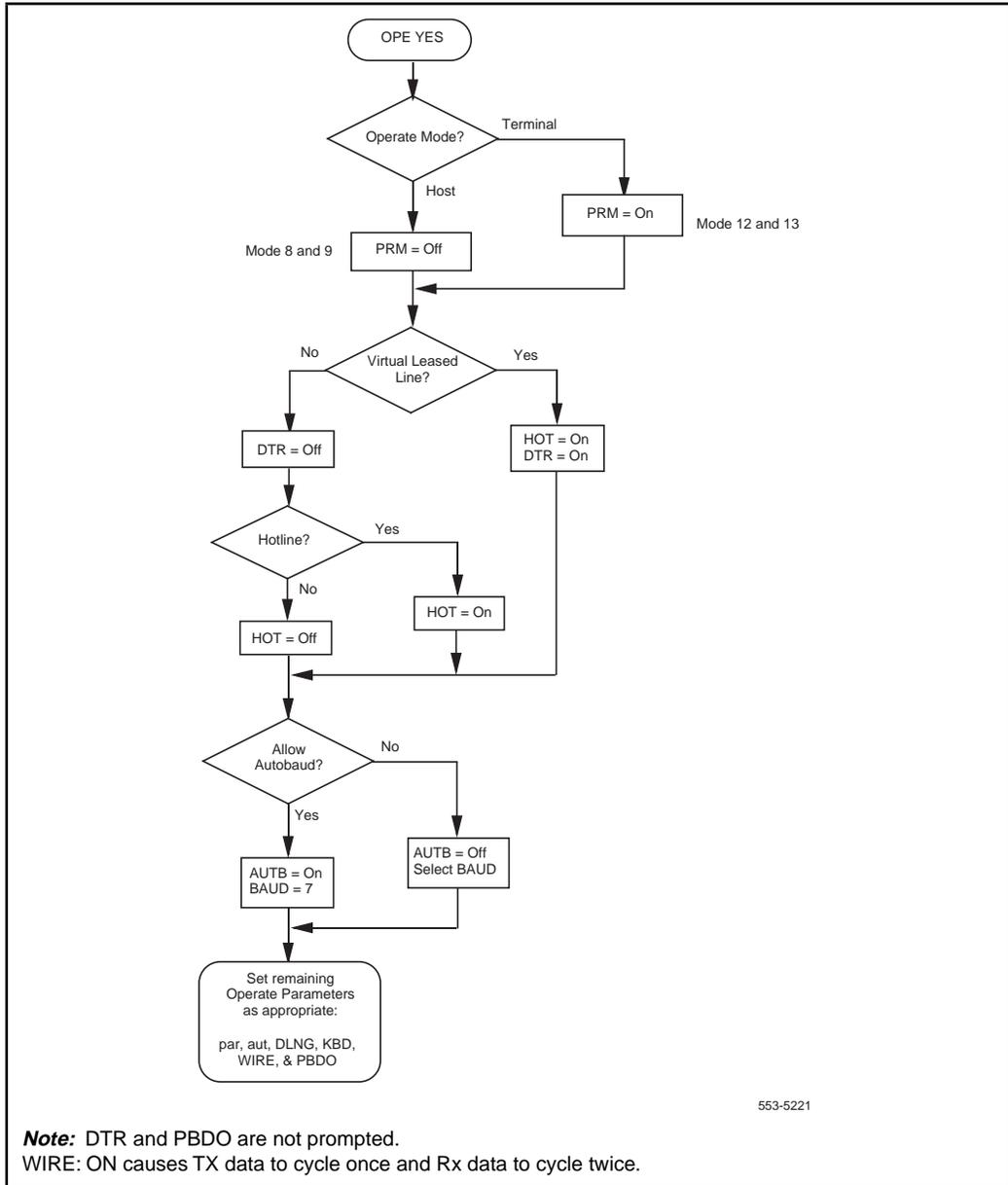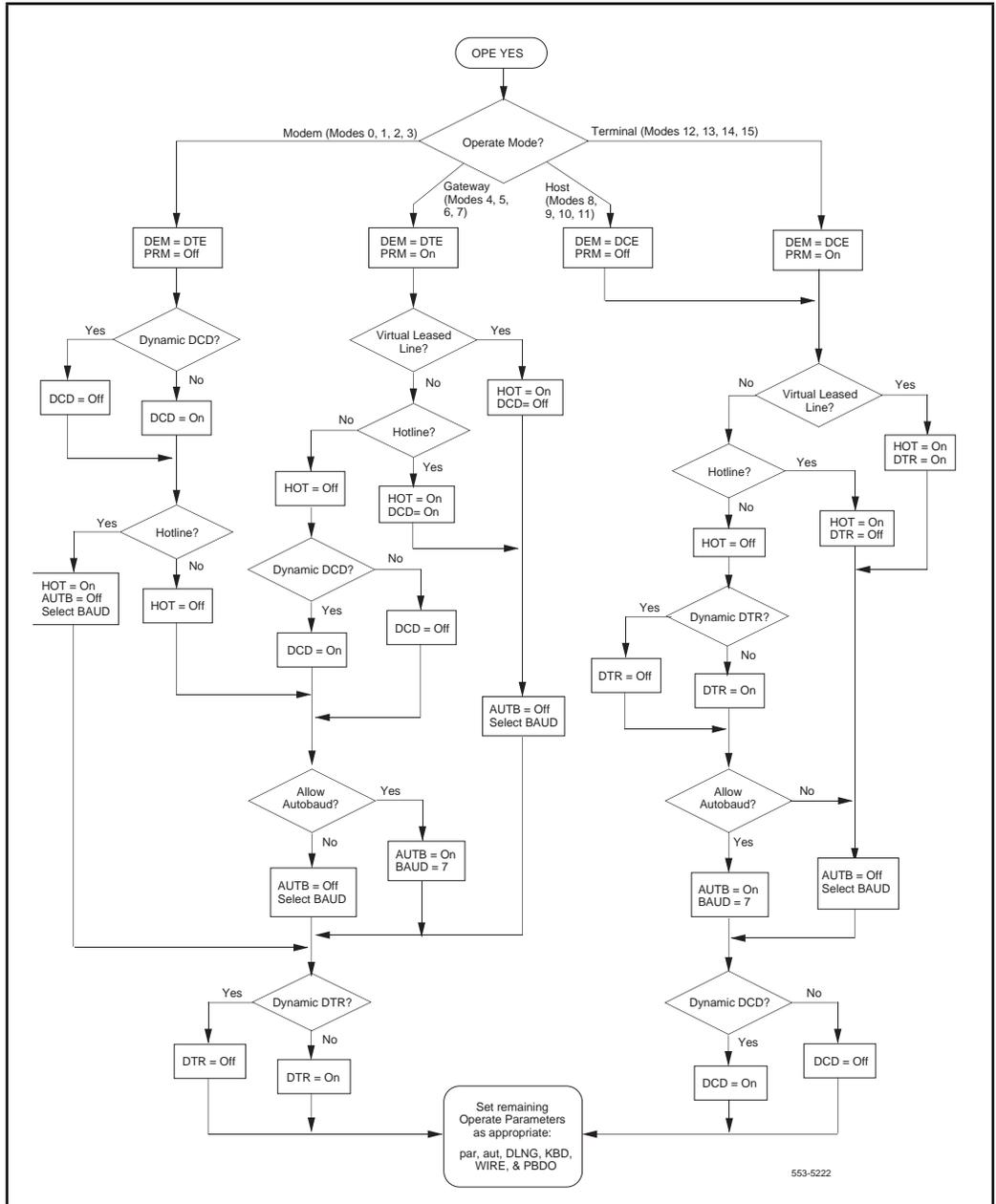WIRE: ON causes TX data to cycle once and Rx data to cycle twice.

Figure 9
Operating mode selection—RS-232-C

553-5222

Upload parameters

The system can, at any time, request information from a DAC port. The uploaded parameters contain information about the individual card (card type, order code, release information), as well as the status of the configured operating parameters. Because the dialogue operations of data calls can affect the operating parameters, this is useful to monitor and confirm port settings. An additional parameter is listed in the uploaded information: port interface mode (RS-232-C/RS-422). The interface is set by the use of jumpers on the DAC, and cannot be altered by the service change.

System database requirements

To ensure proper operation of the DAC keyboard and Hayes dialing, the system requires the following:

— The Data DN must have only one appearance.

— For access to remote hosts, the TNs class of service must allow external calls. The Data TN must have the following in its class of service:

• Call Pickup Denied (PUD)

• Call Forward No Answer Denied (FND)

• Call Forward Busy Denied (FBD)

• Data (DTA)

Note: Warning Tone Denied (WTD) defaults if DTA is entered.

— If the DAC is used to call out through modem pooling, where the modem pool consists of dumb modems connected to QMT8 SADM or QMT12 V.35 SADM, the DAC port should be configured with a secondary DN, which has a single appearance.

— The Virtual keys must be assigned as shown in Table 9.

Table 9
Virtual key assignments

Feature key	Key number		Use
	SL-1	**SL-100**	
Data DN	0	0	Required
Secondary DN	1	1	Required for manual modem pooling
Call Transfer	2	—	Required for manual modem pooling
Auto Dial	3	2	Required for Hotline and VLL
Ring Again	4	6	Optional
Speed Call	5	3	Optional
Display	6	—	Required
Make Set Busy	7	7	Optional

Power supply

Be sure that all power requirements are met before installing the DAC.
Operation may be affected by improper power and environmental conditions.

EIA signals supported

The DAC supports a subset of the standard signals. Only 8 leads can be
brought through the backplane connector for each port, totaling 48 leads for
each card slot. Table 10 lists the EIA signals supported on this card.

Table 10
EIA signals supported (RS-232-C)

EIA	DB-25 Pin	Signal abbreviation	Description	DCE mode	DTE mode
BA	2	TD	Transmitted Data	In	Out
BB	3	RD	Received Data	Out	In
CB	5	CTS	Clear To Send	Out	In
CC	6	DSR	Data Set Ready	Out	In
AB	7	GND	Signal Ground	—	—
CF	8	DCD	Carrier Detect	Out	In
CD	20	DTR	Data Terminal Ready	In	Out
CE	22	RI	Ring Indicator	Out	In
Note: RS-422 leads supported are: Tx (transmit) and Rx (receive).					

Environmental

The DAC functions fully when operating within the following specified conditions:

Specification	Operating	Storage
Ambient temperature	0 to 60 degrees C	40 to 70 degrees C
Humidity	5% to 95%	5% to 95%

Reliability

The DAC has a predicted mean time between failure (MTBF) of 8 years at 45 degrees Celsius. The mean time to repair (MTTR) is 1 hour.

Installation

Installing the Data Access Card in system option 11

The DAC is fully supported in any card slot in either the main or expansion cabinet of system option 11 without any hardware modification. Insert the DAC into any available card slot and secure it in place using the locklatches.

To cable out the DAC on system option 11, run a standard 25-pair cable to the cross connect, or use one of the following breakout cables in conjunction with an Amphenol 50-pin female-to-female gender converter:

— QCAD318A   50-pin Amphenol to 6 female DB25 connectors

— QCAD319A   50-pin Amphenol to 6 male DB25 connectors

For information on the programming of the DAC, see "Configuring the Data Access Card".

> *Note:* For system option 11, the format to be used in response to the "TN" prompt must be one of the following:
> | | | |
> |---|---|---|
> | | CC 00 00 UU | CC - Card Slot |
> | or | CC UU | UU - Unit Number |

Installing the Data Access Card in system options 21, 51, 61, 71, and 81

In most Meridian 1 system options 21, 51, 61, 71, and 81, the DAC is fully supported in IPE modules. These special slots on the DAC have 24-pair cables pre-wired to the Main Distribution Frame (MDF) in card slots 0-15. Any IPE slot will support the first four ports on the DAC if connections are made at the MDF. Most IPE modules can be upgraded to wire 24-pair cables to the MDF for all card slots.

Note: For directions concerning the pinouts for the MDF, refer to *System installation* (553-3001-210).

Before you begin, power down:

— the IPE module only, if it is a DC-powered system

— the entire column, if it is an AC-powered system

It is recommended that you begin the installation from the right hand side (when facing the backplane), starting with slot 0 and moving towards slots on the left side. If you wish to add more than six DACs, and require slots 8 through 15, remove the input/output (I/O) panel. Be aware that a full shelf installation can take up to 3 hours. You need the following equipment to upgrade the cabling:

— A0359946 Amphenol cables

  • These connectors include all the connector and screw apparatus.

  • You need one cable for each DAC.

— cable ties

— wire cutters

— A3/16 nutdriver

System compatibility

To support the 24-pair requirement of the DAC, some cabling may need to be upgraded (Table 11). See "Upgrading systems" for more information.

Ports 0, 1, 2, and 3 of the DAC work in any standard 16-pair IPE slot (connect directly to the MDF).

An upgraded backplane has three shrouds for each card slot. A backplane that cannot be upgraded has only two shrouds for each card slot.

Table 11
System option compatibility with the DAC

System option	Backplane code	Backplane release	Upgrade	Maximum no. of ports/DAC supported
21/21A	NT8D1102	6 and below	No	4
21/21A	NT8D1102	7 and above	Yes	6
51/61/71	NT8D3701	3 and below	No	4
51/61/71	NT8D3701	4 and above	Yes	6

Port configuration

Figure 10 shows the port configurations for both the RS-232-C and RS-422 ports. The software configuration requirements for the DAC are shown at the end of this chapter. Responses to the prompts listed are required. Depending on the configuration, ensure that the option plug is set for RS-232 or RS-422.

Figure 10
NT7D16 Data Access Card port connectors

553-5234

Note: Insert only one option plug per port.
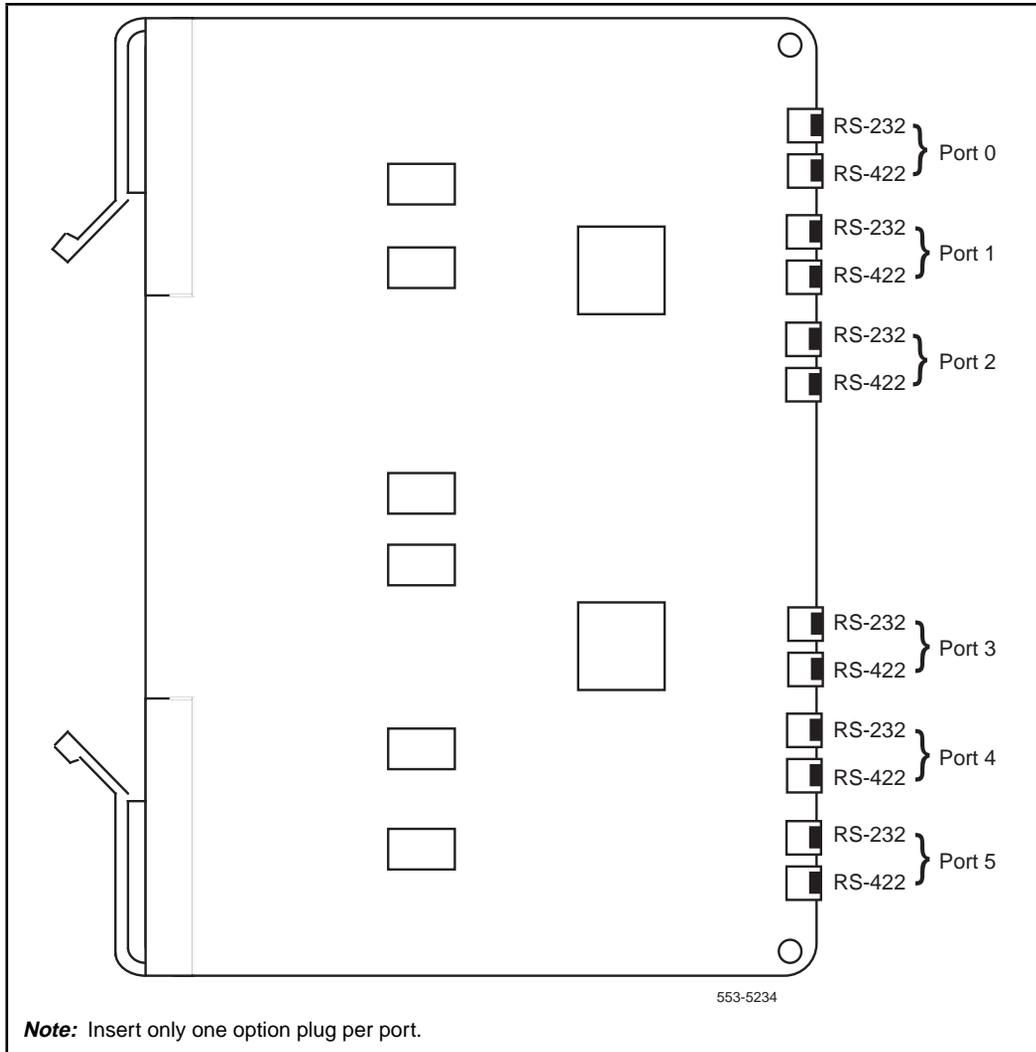
Cabling

Several cabling schemes are possible for both AILC and RILC modes. Typical capacitance for 24- and 26-gauge cables is shown in the Tables 12 and 13. RS-232 and RS-422 transmission distance is limited by the electrical capacitance of the cable. Low-capacitance cable carries a digital signal further than a high-capacitance cable.

Table 12
RS-232-C maximum line capacitance 2,500 μF

Gauge	Capacitance per foot (μF)	Max distance
24	24	104
26	15	166

Table 13
RS-422 maximum line capacitance 60,000 μF

Gauge	Capacitance per foot (μF)	Max distance
24	24	2500
26	15	4000

Figure 11 shows the cabling choices available. It includes cabling with the RS-232-C cable, associated patch panel, the RJ-11, and the octopus cable. Each scheme can be tailored to suit individual needs, and specific alternatives are shown in later figures.

Figure 11
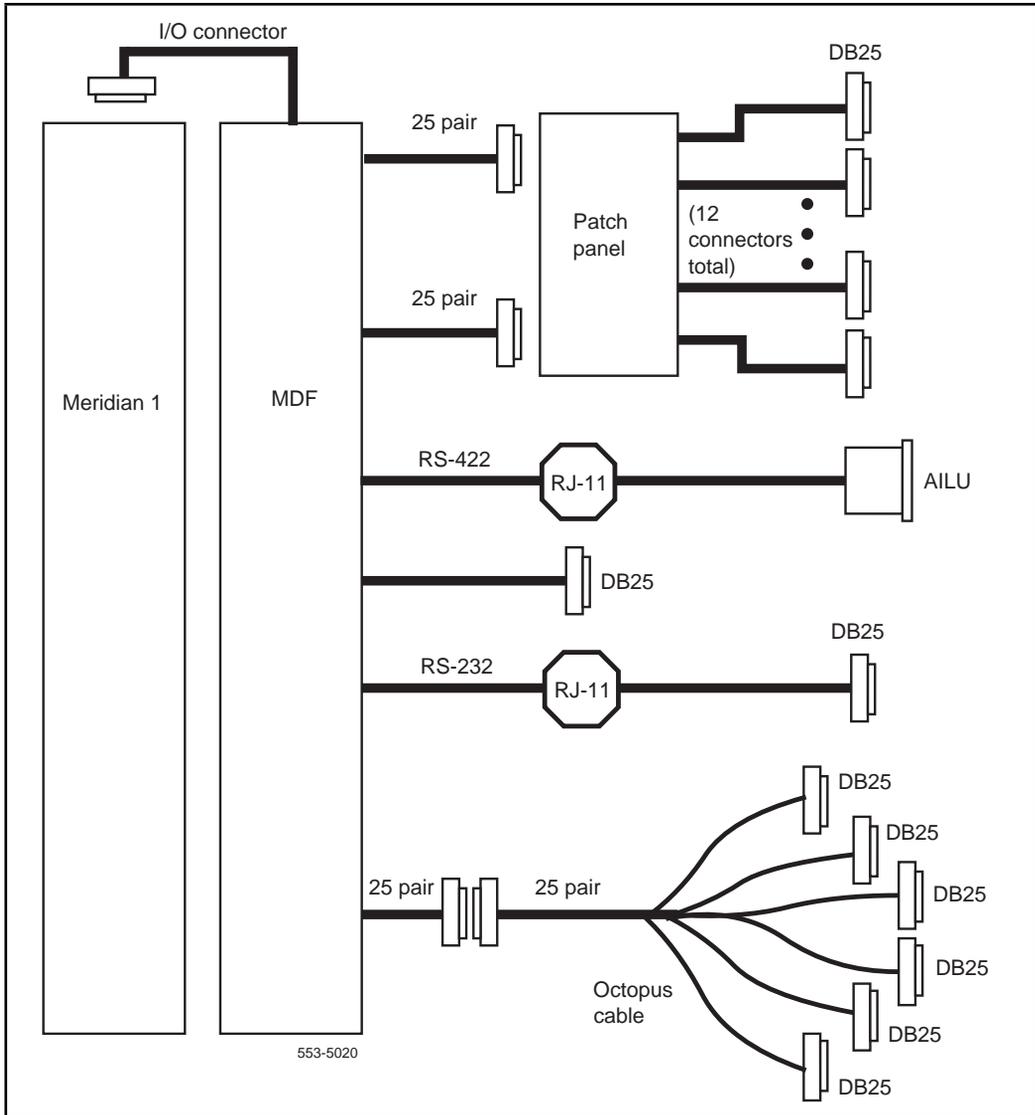**Cabling to the data equipment**

553-5020

Figure 12 shows a connection through an RJ-11 or RJ-45 jack located at the data station. It is recommended that four wires be used similarly to the AIM drop when using the RJ-11 jack. Another cable is required to convert the RJ-11 or RJ-45 into DB25.

> *Note:* It is necessary to turn over Receive Data and Send Data between the DAC and the AILU. This is done on the TN at the MDF.
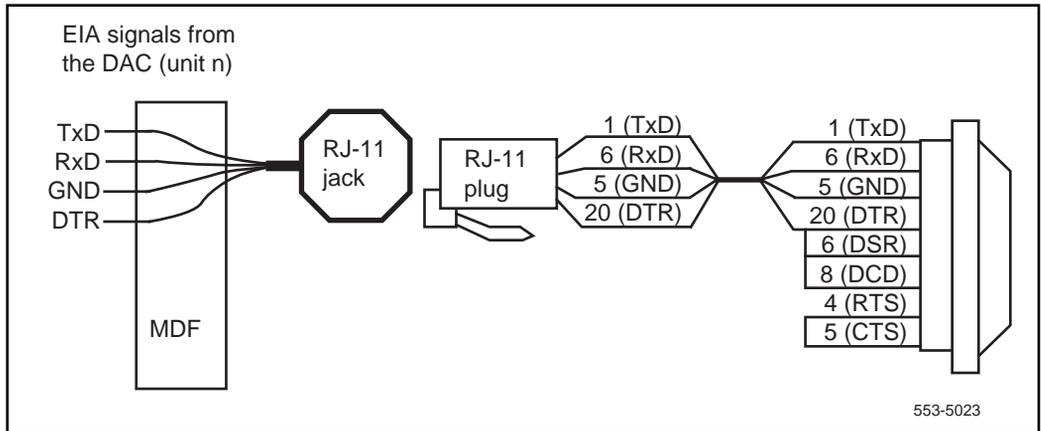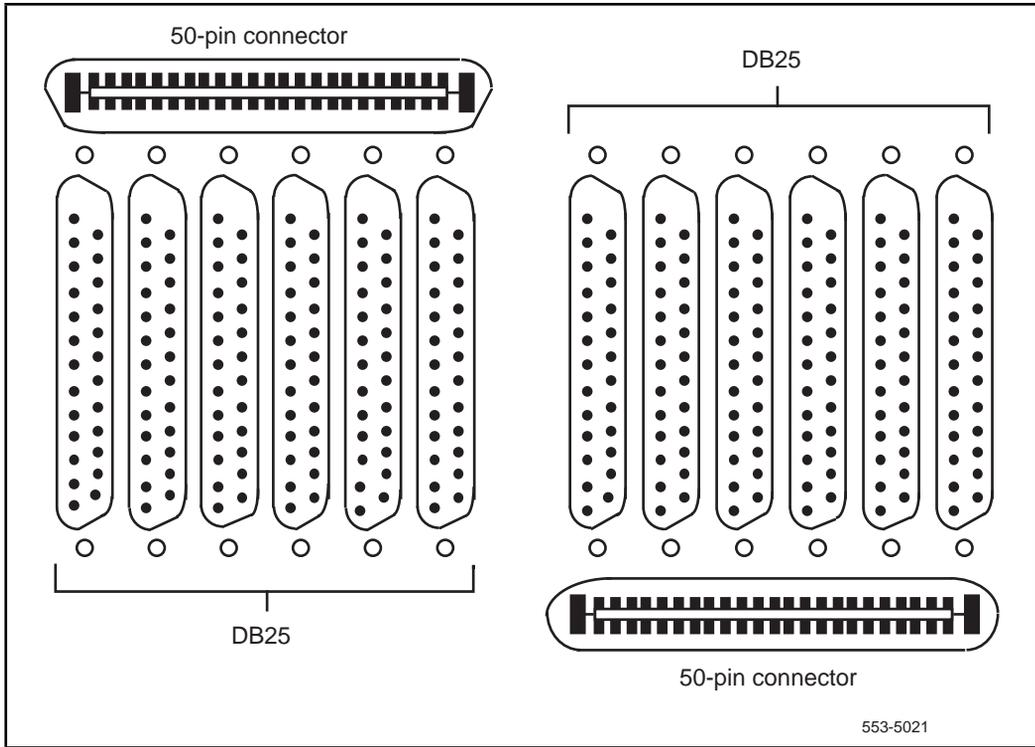
Figure 12
RJ-11 or RJ-45 jacks

Figure 13 illustrates the patch panel. RS-232-C cables are used to connect the data equipment to the patch panel. This particular panel shows two 50-pin connectors into twelve DB25. The signals from the MDF travel on 25-pair cables, terminating at the patch panel.

> *Note:* Use patch panels that follow the pinout of the DAC.

Figure 14 describes an octopus cabling scheme. This cable replaces the combined patch panel and RS-232-C cabling scheme. The 25-pair cable is split into six RS-232-C male or female connectors. This allows direct connections to the data equipment from the Meridian 1 I/O panel. The octopus cable allows for the maximum segregation of the voice signals that might otherwise be present within the same 25-pair cable.

Figure 13
Patch panel layout

Note: Use an octopus cable that follows the pinout of the DAC, such as QCAD318A (female) and QCAD319A (male), in conjunction with a 50-pin female-to-female gender converter.

Figure 14
Octopus cabling
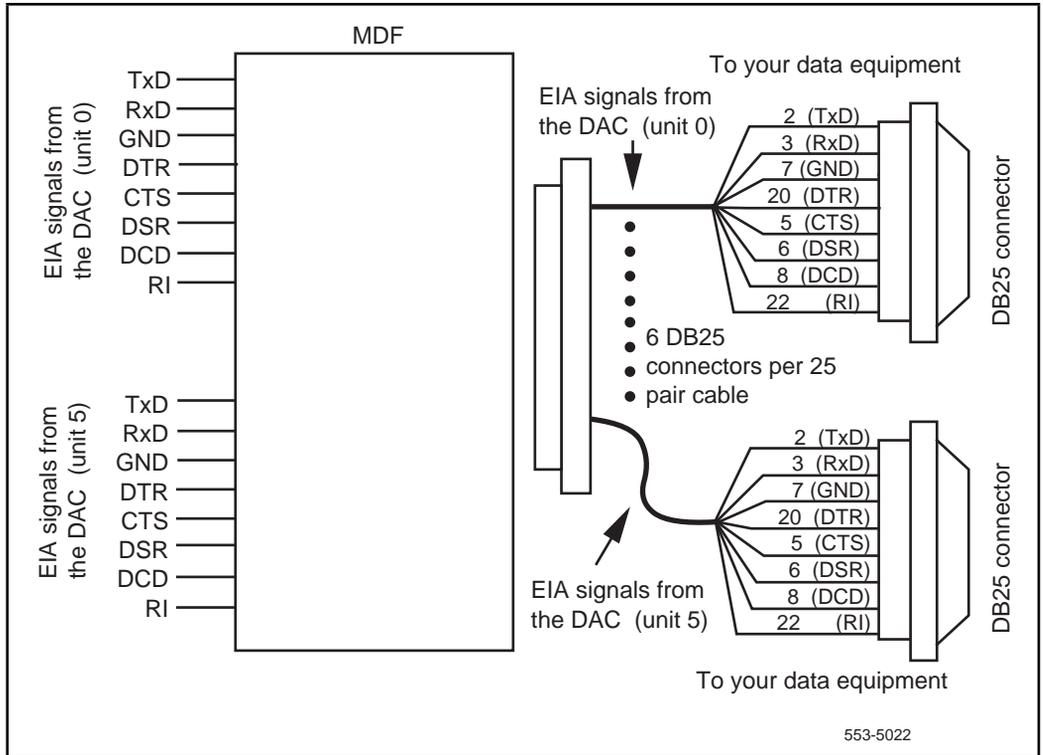
Backplane pinout and signaling

Two 40-pin, and two 20-pin edge connectors connect the card to the backplane. The detailed pinout configurations are listed in Tables 14 and 15.

Table 14
RS-232-C and RS-422 pinouts for first three DAC ports (Part 1 of 2)

I/O cable			Unit no.	RS-232-C		RS-422 Signal	Patch pair or octopus
Pair	Pin	Pair color		Signal	Pin no.		
1T	26	W-BL	UNIT 0	TD0	2	RDA0	
1R	1	BL-W		RD0	3	RDB0	
2T	27	W-O		DTR0	20	SDA0	
2R	2	O-W		GND0	7	SDB0	Connector
3T	28	W-G		DCD0	8		1
3R	3	G-W		DSR0	6		
4T	29	W-BR		RI0	22		
4R	4	BR-W		CTS0	5		
5T	20	W-S	UNIT 1	TD1	2	RDA1	
5R	5	S-W		RD1	3	RDB1	
6T	31	R-BL		DTR1	20	SDA1	
6R	6	BL-R		GND1	7	SDB1	Connector
7T	32	R-O		DCD1	8		2
7R	7	O-R		DSR1	6		

Note 1: The RS-232 pinout follows the standard set by the QPC723 RILC.

Note 2: The RS-422 pinout follows the standard set by the QPC430 AILC (first pair: Receive Data; second pair: Send Data). Receive and Send are designated with reference to the DTE; therefore, they must be turned over in the cross-connect since most DTE have first pair as Send Data and second pair as Receive Data.

Table 14
RS-232-C and RS-422 pinouts for first three DAC ports (Part 2 of 2)

I/O cable			Unit no.	RS-232-C		RS-422 Signal	Patch pair or octopus
Pair	Pin	Pair color		Signal	Pin no.		
8T	33	R-G		RI1	22		
8R	8	G-R		CTS1	5		
9T	34	R-BR	UNIT 2	TD2	2	RDA2	
9R	9	BR-R		RD2	3	RDB2	
10T	35	R-S		DTR2	20	SDA2	
10R	10	S-R		GND2	7	SDB2	Connector
11T	36	BK-BL		DCD2	8		3
11R	11	BL-BK		DSR2	6		
12T	37	BK-O		RI2	22		
12R	12	O-BK		CTS2	5		

Note 1: The RS-232 pinout follows the standard set by the QPC723 RILC.

Note 2: The RS-422 pinout follows the standard set by the QPC430 AILC (first pair: Receive Data; second pair: Send Data). Receive and Send are designated with reference to the DTE; therefore, they must be turned over in the cross-connect since most DTE have first pair as Send Data and second pair as Receive Data.

Table 15
RS-232-C and RS-422 pinouts for last three DAC ports (Part 1 of 2)

I/O cable			Unit no.	RS-232-C		RS-422 Signal	Patch pair or octopus
Pair	Pin	Pair color		Signal	Pin no.		
13T	38	BK-G	UNIT 3	TD3	2	RDA3	
13R	13	G-BK		RD3	3	RDB3	
14T	39	BK-BR		DTR3	20	SDA3	
14R	14	BR-BK		GND3	7	SDB3	Connector
15T	40	BK-S		DCD3	8		1
15R	15	S-BK		DSR3	6		
16T	41	Y-BL		RI3	22		
16R	16	BL-Y		CTS3	5		
17T	42	Y-O	UNIT 4	TD4	2	RDA4	
17R	17	O-Y	(Note)	RD4	3	RDB4	
18T	43	Y-G		DTR4	20	SDA4	
18R	18	G-Y		GND4	7	SDB4	Connector
19T	44	Y-BR		DCD4	8		2
19R	19	BR-Y		DSR4	6		
20T	45	Y-S		RI4	22		
20R	20	S-Y		CTS4	5		
21T	46	V-BL	UNIT 5	TD5	2	RDA5	
21R	21	BL-V	(Note)	RD5	3	RDB5	
22T	47	V-O		DTR5	20	SDA5	

Note: Units 4 and 5 are available when the DAC is installed in a fully wired 24-pair slot.

Table 15
RS-232-C and RS-422 pinouts for last three DAC ports (Part 2 of 2)

I/O cable			Unit no.	RS-232-C		RS-422 Signal	Patch pair or octopus
Pair	**Pin**	**Pair color**		**Signal**	**Pin no.**		
22R	22	O-V		GND5	7	SDB5	Connector
23T	48	V-G		DCD5	8		3
23R	23	G-V		DSR5	6		
24T	49	V-BR		RI5	22		
24R	24	BR-V		CTS5	5		
Note: Units 4 and 5 are available when the DAC is installed in a fully wired 24-pair slot.							

Configuring the Data Access Card

LD11 must be configured to accept the DAC. The commands listed here must be answered. LD20 prints out card information when requested. For a complete list of the service change prompts and responses, see *X11 input/output guide* (553-3001-400).

DAC administration (LD11)

Responding R232 or R422 to the TYPE prompt in LD11 begins the prompt sequence for the DAC configuration. Responses to the following prompts are required. The defaults are bracketed, and may be issued by Carriage Return (<CR>).

Table 16
???—was not numbered or titled in Word file (Part 1 of 3)

Prompt	Response	Comments
REQ	NEW, CHG, MOV, COPY	Add, change, move or copy the unit
TYPE	R232, R422	R232 = the RS-232-C unit R422 = the RS-422 unit
TN	LL S CC U	DAC data TN. The loop (LL) must be a superloop.
RNPG	<CR>	Ringing number pickup group (default to zero)
CLS	 DTA ADD	The class of service allowed for the DAC. These are the required responses. DTA = data allowed ADD = digit display allowed (optional)
TOV	(0), 1, 2, 3	Timeout value 0 = no timeout 1 = 15 minutes 2 = 30 minutes 3 = 60 minutes
OPE	YES, (NO)	Operation parameter change
PAR	(SPAC), ODD, EVEN, MARK	SPAC = space parity ODD = odd parity EVEN = even parity MARK = mark parity
DTR	ON, (OFF)	DTR settings ON = forced DTR OFF = dynamic DTR This prompt appears only if TYPE = R232
HOT	ON, (OFF)	Hotline
If HOT = ON, then AUTB = OFF		

Table 16
???—was not numbered or titled in Word file (Part 2 of 3)

Prompt	Response	Comments
AUT	OFF, (ON)	Automatic answer
AUTB	OFF, (ON)	Autobaud
		Prompt appears only if HOT - OFF
BAUD	0, 1, 2, 3, 4, 5, 6, (7), 8	Baud rate 0 = 110 1 = 150 2 = 300 3 = 600 4 = 1200 5 = 2400 6 = 4800 7 = 9600 8 = 19200
		This prompt appears only if AUTB = OFF.
DCD	OFF, (ON)	DCD settings OFF = forced DCD ON = dynamic DCD
		This prompt appears only if TYPE = R232.
PRM	OFF, (ON)	Prompt mode OFF = no prompt (Host) mode ON = prompt (Terminal) mode
DEM	DTE, (DCE)	Data Equipment mode
		This prompt appears only if TYPE = R232.
DLNG	FRN, (ENG)	Data port language FRN = Quebec French ENG = English
KBD	OFF, (ON)	Keyboard dialing OFF = disabled (Hayes dialing commands will still work) ON = enabled

Table 16
???—was not numbered or titled in Word file (Part 3 of 3)

Prompt	Response	Comments
WIRE	ON, (OFF)	Wire test mode ON = enabled OFF = disabled
PBDO	ON, (OFF)	Port busy upon DTR off ON = enabled (port busy off with DTR) OFF = disabled (port busy on with DTR) This prompt appears only if TYPE = R232 PBDO = OFF for any RS-232-C mode besides 8, or 12 If PBDO = ON, key 7 = MSB
KEY	 0 SCR xxxx 1 SCR xxxx 2 TRN 3 ADL yy xxxx 4 RGA 5 SCC 0-253 6 DSP 7 MSB	Key settings Primary data DN Secondary Data DN Call Transfer Autodial Ring Again Speed Call Controller, list number Display Make Set Busy Primary and secondary data DNs must be single appearance DNs. Feature key assignment must be as shown here.

Printing the card parameters (LD20)

By responding R232, R422, or DAC to the TYPE prompt in LD20, you can print out the configured parameters for each port, or the entire DAC. This is useful to determine if any parameters have been altered during keyboard or Hayes dialing modify procedures.

Table 17
???—was not numbered or titled in Word file

Prompt	Response	Comments
REQ	PRT, LTN, LUU	Print data, TN, or unit information for the unit specified
TYPE	R232, R422, DAC	Print information for the RS-232-C, RS-422 ports, or the whole DAC
TN	LL S CC U	Print information for this TN. Uploaded parameters can only be printed when a specific TN is listed.

The operation parameter printout for an RS-232 or RS-422 port is similar to the following, depending on the configuration.

Table 18
???—was not numbered or titled in Word file

	DBASE R-232 or R-422	UPLOAD R-232 or R-422
PAR	SPAC	SPAC
DTR	ON	ON
HOT	OFF	OFF
AUT	ON	O
AUTB	ON	ON
BAUD	9600	4800
DCD	OFF	OFF
PRM	KBD ON	KBD ON
DEM	DCE	DCE
DLNG	FRN	FRN
KBD	ON	ON
WIRE	OFF	OFF
PBDO	OFF	OFF
Note: The Upload parameters are printed only when a single TN is specified.		

Connecting Apple Macintosh to the DAC

The Apple Macintosh can be connected with twisted pair wire to a port of a NT7D16 Data Access Card (DAC) to allow access to the Meridian 1 switching capability. The Macintosh can then access local or remote terminals, personal computers, hosts, and peripherals.

Figure 15 shows the 9-pin subminiature D (DB9) connection to the Macintosh. Figure 16 shows the mini-8 DIN connection to the Macintosh.
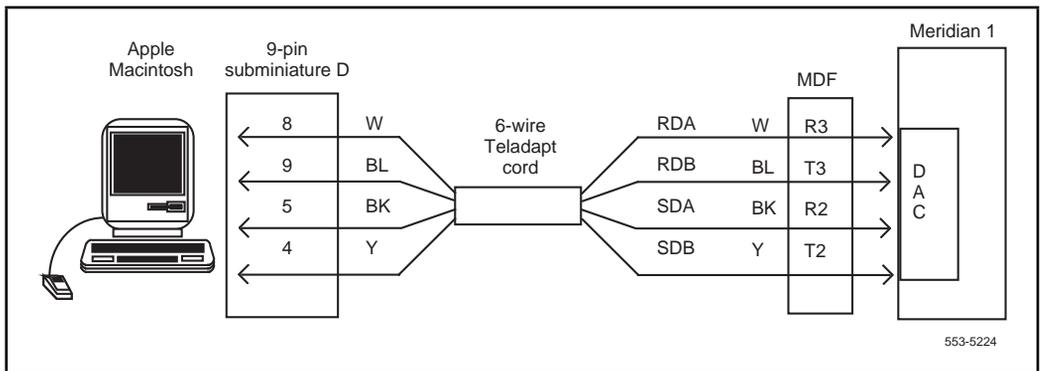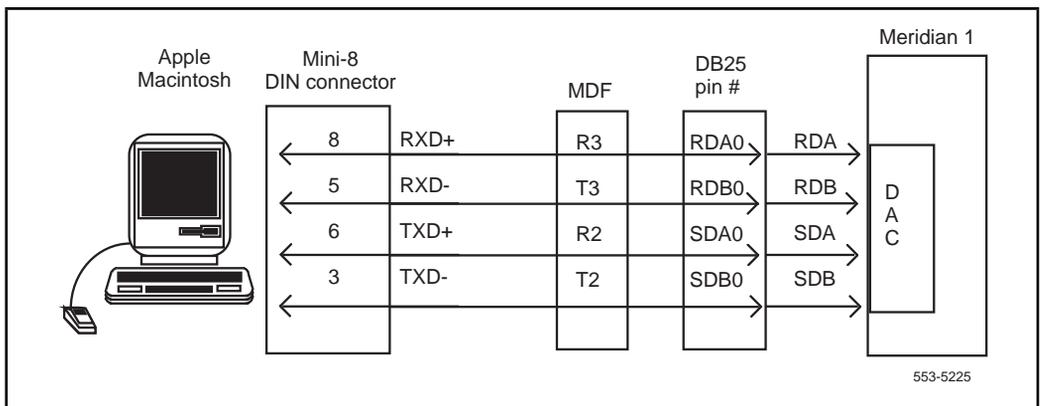
Figure 15
Macintosh to DAC connection—9-pin subminiature D

Figure 16
Macintosh to DAC connection—mini-8 DIN

Upgrading systems

The following explains when and how to upgrade your Meridian 1 system to support the DAC. Ports 0, 1, 2, and 3 of the DAC will work in any standard 16-pair IPE slot (connect directly to the MDF).

System options 21 and 21A upgrade

With release 7 of the NT8D1102 Backplane, the first card slot is fully cabled for the 24 pair to the I/O panel. The DAC can be installed directly into slot 0 with no cabling changes. If another slot is required, the upgrade must be made. Follow this procedure to upgrade the cabling for card slots one through nine.

Note 1: Three new NT8D81AA cable/filter assemblies are required.

Note 2: Cables are designated by the letter of the I/O panel cutout where the 50-pin cable connector is attached. The 20-pin connectors are labeled 1, 2, and 3.

Note 3: The locations for the cable connectors are designated by the slot number (L0-L9), and the shroud row (1, 2, and 3).

1   Remove cable C from the backplane and connect ends C-1, C-2, and C-3 to L2-1, L2-2, and L2-3.

2   Add cable D to the I/O panel by connecting ends D-1, D-2, and D-3 to L3-1, L3-2, and L3-3.

3   Move cable end E-3 to L4-3.

4   Remove cable F from the backplane and connect ends F-1, F-2, and F-3 to L5-1, L5-2, and L5-3.

5   Add cable G to the I/O panel by connecting ends G-1, G-2, and G3 to L6-1, L6-2, and L6-3.

6   Move cable end H-3 to L7-3.

7   Remove cable K from the backplane and connect ends K-1, K-2, and K-3 to L9-1, L9-2, and L9-3.

8   Add cable L to the I/O panel by connecting ends L-1, L-2, and L3 to L9-1, L9-2, and L9-3.

Be sure to re-label the MDF to show that the module has been upgraded to allow for one cable per peripheral equipment (PE slot). The resulting backplane and cable arrangement should look like this:

Backplane slot-connector	I/O panel cable position
L0	A
L1	B
L2	C
L3	D (new cable)
L4	E
L5	F
L6	G (new cable)
L7	H
L8	K
L9	L (new cable)

You can also upgrade the first four PE slots only. This requires only one NT8D81AA cable assembly. Perform the following procedure:

1   Leave cable A as is in slot L0.

2   Move cable end B-3 to L1-3.

3   Remove cable C from the backplane and connect ends C-1, C-2, and C-3 to L2-1, L2-2, and L2-3.

4   Add cable D to the I/O panel by connecting ends D-1, D-2, and D-3 to L3-1, L3-2, and L3-3.

Cables E, F, H, and K remain the same. Cable positions G and L are open for further expansion. Be sure to re-label the MDF to show that the module has been upgraded to provide one cable for each PE slot.

System options 51, 61, 71, and 81 upgrade

With release 4 of the NT8D3701 Backplane, the four slots are fully cabled for the 24 pair to the I/O panel. The DAC can be installed directly into slots 0, 4, 8, and 12 with no cabling changes. If other slots are required, the upgrade must be made. Follow this procedure to upgrade your cabling. You can upgrade the cabling segment-by-segment, or the entire module at one time.

Note 1: Four NT8D81AA cable/filter assemblies are required to upgrade the entire module, one assembly per segment.

Note 2: Cables are designated by the letter of the I/O panel cutout where the 50-pin cable connector is attached. The 20-pin connectors are labeled 1, 2, and 3.

Note 3: The locations for the cable connectors are designated by the slot number (L0-L9), and the shroud row (1, 2, and 3).

Segment 0

1   Leave cable A as is in slot L0.

2   Move cable end B-3 to L1-3.

3   Remove cable C from the backplane and connect ends C-1, C-2, and C-3 to L2-1, L2-2, and L2-3.

4   Add cable D to the I/O panel by connecting ends D-1, D-2, and D-3 to L3-1, L3-2, and L3-3.

Segment 1

1   Leave cable E as is in slot L4.

2   Move cable end F-3 to L5-3.

3   Remove cable G from the backplane and connect ends G-1, G-2, and G-3 to L6-1, L6-2, and L6-3.

4   Add cable H to the I/O panel by connecting ends H-1, H-2, and H-3 to L7-1, L7-2, and L7-3.

Segment 2

1 Leave cable K as is in slot L8.

2 Move cable end L-3 to L9-3.

3 Remove cable M from the backplane and connect ends M-1, M-2, and M-3 to L10-1, L10-2, and L10-3.

4 Add cable N to the I/O panel by connecting ends N-1, N-2, and N-3 to L11-1, L11-2, and L11-3.

Segment 3

1 Leave cable R as is in slot L12.

2 Move cable end S-3 to L13-3.

3 Remove cable T from the backplane and connect ends T-1, T-2, and T-3 to L14-1, L14-2, and L14-3.

4 Add cable U to the I/O panel by connecting ends U-1, U-2, and U-3 to L15-1, L15-2, and L15-3.

Be sure to re-label the MDF to show that the module has been upgraded to provide one cable for each PE slot. The resulting backplane and cable arrangement should look like this:

Backplane slot-connector	I/O panel cable position
L0	A
L1	B
L2	C
L3	D (new cable)
L4	E
L5	F
L6	G
L7	H (new cable)
L8	K
L9	L
L10	M
L11	N (new cable)
L12	R
L13	S
L14	T
L15	U (new cable)

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