TOTAL CONTROL™

# Single/Dual T1 Card

# Version 3.0

## REFERENCE MANUAL

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# What's New in this Release

Release 3.0 of the Single / Dual T1 Card supports DTMF (Dual-Tone Multi-Frequency) signaling for both dial-in and dial-out calls. Implementing DTMF with the Total Control product line gives you the flexibility to adapt to services offered by your local telephone company, and makes it possible for the Total Control chassis to perform new operations. You should consult the chapter titled *DTMF Signaling* for details if you have a need for the following features in your installation:

- T1 Ground Start / Loop Start trunk type signaling
- Direct Inward Dialing

These features require support by the Quad V.34 Analog / Digital Modem (at least version 1.3). To implement these features from a Management Station, the Network Management Card and *Total Control Manager/SNMP* software should also be at compatible release levels (at least version 2.2).

# Ordering a T1 Line

The following are some features you should keep in mind when ordering a T1 line from the telephone company (TELCO).

## T1 Service Type

You must order a switched (channelized) T1 service. With a switched service, each DS0 of the T1 span line carries the digital representation of an analog phone line.

## Trunk Types / Start Supervision

Loop Start, Ground Start, and E&M trunk types are supported. Loop Start and Ground Start trunk types use the Dial Tone start method, and use only DTMF signaling.

E&M trunks use either Wink Start or Immediate Start methods, and can use either MF (Multi-Frequency) or DTMF (Dual Tone Multi-Frequency) signaling.

The following table indicates the T1 line provisioning options that are currently supported.

*Supported Trunk Type/Start/Signaling*

| Trunk Type | Start Method | Tone Signaling |
|---|---|---|
| E&M | Wink or Immediate | MF or DTMF |
| Loop Start | Dial Tone | DTMF |
| Ground Start | Dial Tone | DTMF |

Because Loop Start and Ground Start trunks require DTMF signaling, they do not support receiving any address information (DNIS or ANI) that may be sent by the telephone

company Central Office on dial-in calls. To remedy this, additional parameters must be set for the modem.

### E&M Type II Signaling

E&M (Ear and Mouth) is the traditional type of TELCO call signaling for an analog call. It specifies the wires that provide the signaling paths between the TELCO and the customer's equipment. E&M Type II signaling defines how the TELCO modulates the A&B signaling bits to convey call set-up and tear-down information.

### Wink Start / Immediate Start

A wink is the transition from on hook to off hook, and then back to the on hook state. The use of Wink Start Supervision avoids *glare*. Glare occurs when there is a simultaneous seizure on both ends of a two-way trunk.

With Immediate Start trunks, no wink is returned in response to trunk seizure. This leads to slightly faster call setup. However, since no trunk integrity checking is performed, Immediate Start is recommended only when the Customer Premises Equipment (CPE) does not support Wink Start.

### Loop Start

Loop Start was originally developed on analog lines, then converted to digital lines. It is the most common line type available, and is used in most residential lines to provide supervisory and start signals. In an analog Loop Start trunk, there are two conductors: tip and ring. All signaling involves current flow through these two conductors, which forms a current loop with the network. Once the network detects current flow in the loop, it sends a dial tone as a start signal.

Loop Start is translated to the digital T1 carrier by using the A and B signaling bits. The transmitted bits tell the network whether the loop is open or closed.

**NOTE:** Loop Start lines are very susceptible to glare. They should only be used as one-way lines (either dial-in or dial-out).

## Ground Start

Ground Start is a little more robust than Loop Start. It was also originally developed for analog lines and converted to digital. Ground Start trunks have the most complex signaling protocol of the trunks supported. The A and B signaling bits on the T1 line are used to mimic the tip and ground connectors in the analog world. Ground Start trunks are often preferred to Loop Start trunks because the network provides additional signals for alerting, starting and ringing.

Like a Loop Start line, Ground Start lines use both a ring and a tip conductor. However, the network can not only detect current flow through the ring and the tip, but also detect whether the tip or the ring has been grounded. This configuration allows Ground Start lines to convey more signaling information over the line. It also makes Ground Start supervision somewhat of a complex protocol.

Total Control performs Ground Start in the digital world by mimicking analog signals. The T1 Card uses the A and B signaling bits to send a busy-out pattern (0,0) to the TELCO. We believe that this busy-out signaling pattern is appropriate for the majority of cases. However, not all Regional Bell Operating Company switches treat this pattern in the same manner. If your installation experiences any difficulty with this feature, contact U.S. Robotics Technical Support at (800) 231-8770, and we will work with you to find an appropriate solution.

**NOTE**: USR Ground Start and Loop Start support Station signaling only, not Office signaling.

## Tone Signaling (Dialed Digits)

The T1 Card supports DNIS digits sent using standard Multi-Frequency (MF) tones. The T1 Card also supports Dual-Tone Multi-Frequency (DTMF) tones when operating with a properly configured compatible modem.

## DTMF Signaling

DTMF signaling is the same as Touch Tone; it uses 12 distinct signals transmitted over the voice path to provide addressing information (0–9, *, #). This addressing method is slightly

more limited than is possible with MF (Multi-Frequency) signaling, which provides 15 two-frequency combinations. MF signaling supports KP (Key Pulse) and ST (Stop) control signals, which facilitate the transmission of ANI and DNIS digits by indicating when the transmission of an ANI or DNIS number begins and ends. The modem decodes the MF tones and then acts on any ANI or DNIS embedded in the signaling.

**NOTE**: Modem support is required for DTMF signaling.

## Answer Supervision

On receipt of the M-Lead Wink from the T1 Card, the TELCO begins sending *Multi-Frequency (MF) Tones*, which represent the dialed phone number. Once the T1 Card receives the MF Tones, it answers the call by going off hook (*M-Lead Off hook*).

## Frame Type

The Super Frame (SF) format, also known as D4 framing, has 12 DS1 frames, each with 193 bit positions. The first bit is the frame overhead-bit position, which is used for frame and signaling phase alignment.

The Extended Super Frame (ESF) format has 24 DS1 frames: the ESF alignment signal and a Cyclic Redundancy Check (CRC) share the frame overhead-bit position.

## Line Coding

A line coding scheme ensures a sufficient density of 1's in the bit stream, required by the T1 standard for clock synchronization. The T1 software supports Alternate Mark Inversion (AMI), Zero Code Suppression (ZCS), or Binary 8 Zero Substitution (B8ZS).

## Feature Group B DNIS Support

The T1 Card can make use of the Feature Group B (FGB) DNIS (Dialed Number Identification Service) feature, which is offered

by most TELCOs. The FGB DNIS requires a telephone number exchange of 950; the other four digits in the number can be linked with configuration information for a modem. At the beginning of an incoming call, if DNIS is enabled, the TELCO provides the phone number that was dialed. The Quad Modem cards can use this information to provide a specific configuration, or to route the call to a specific Gateway card. If your dial-up application could benefit from the use of DNIS numbers, order this service from the TELCO and select DNIS for the Dial-In Address parameter.

## *Feature Group D ANI and DNIS Support*

Feature Group D (FGD) supports an expanded DNIS feature, in which all seven digits of a phone number (or ten, including the area code) can be linked with configuration information. It also supports ANI (Automatic Number Identification), which identifies the calling number and uses it in a similar way. With FGD, you can select either DNIS, ANI, or ANI-DNIS for the Dial-In Address parameter.

## *CSU Interface*

The T1 NIC's CSU interface supports a DS1 signal. This interface can recover T1 signals through a 6000 foot cable.

**RECOMMENDED:** Connect the T1 NIC's interface directly to the TELCO's Smart Jack interface.

## *Direct Inward Dialing (DID)*

Direct Inward Dialing allows direct access to a PBX line from a line outside of the PBX. It requires the telephone company Central Office to transmit the address of the station being dialed (usually four digits).

On PBXs, when a DID call comes in it is routed to a PBX station corresponding to the number dialed. The T1 Card always routes the dial-in call to the Quad Modem assigned to the DS0 the call came in on. A user can assign any DS0 to any Quad Modem.

Most DID trunks are E&M trunk types, and use Wink Start with DTMF signaling. The Quad Modems support DTMF tones to enable this feature, and E&M and Wink Start can be selected as Call Parameter Configuration parameters for the T1 Card.

# Chapter 1
# T1 Overview

The Total Control Enterprise Network Hub uses the Single or Dual T1 application and interface cards to terminate T1 span lines and process incoming DS0s. The Single T1 handles one T1 span line and up to 24 DS0s; the Dual T1 handles two span lines and up to 48 DS0s.

Together, the T1 application and interface cards perform the same functions as external CSUs and channel banks.

## T1 Network Interface Card (NIC)

The T1 NIC performs all the critical functions of a CSU.

- Responds to TELCO alarms and loopbacks for diagnostic purposes
- Includes Bantam Monitor jacks on the NIC for monitoring line performance
- Conforms to CSA, UL, and FCC Part 68 for protecting operator's equipment from lightning and power cross
- Provides keep alive signal when the T1 NAC is removed

## T1 Network Application Card (NAC)

The T1 NAC performs DSU and PBX functions. It demultiplexes the DS0s from the T1 line and distributes them to the Quad Modem cards by way of the TDM bus. The T1 NAC has the following features:

- Supports Feature Groups B and D. Assists in fast transaction processing and call routing into a network.
- Provides automatic timing source selection and fallback. If the primary timing source fails, a specified alternate source is engaged automatically.

- Provides software download into on-board Flash ROM. The operator can easily add features and software upgrades.
- Provides a full array of front panel LEDs. Indicates the status of the T1 NAC and T1 span lines.
- Provides the following individual trunk control features: busy out, disconnect, ignore call, restore DS0s, and set Dial-In Address type for DNIS, ANI (or both) on a DS1 basis.
- Supports DS0 configuration: Configuration State (Normal, Busy Out, Transparent and Unused); and Time Slot Assignment (slots 0–64 on the TDM Bus.
- Supports an asynchronous management port, which enables local status monitoring and configuration with a PC, VT100 terminal, or remote modem.

## Managing the T1 Card

The T1 Card can be managed by two different methods: the RS-232 Operator Interface and SNMP management through *Total Control Manager/SNMP* software.

- The T1 RS-232 Operator Interface requires the T1 NIC to be connected to a dumb terminal or PC with the RS-232 cable provided. Details of the interface menu system are in Appendix A (Single T1) and Appendix B (Dual T1).
- *Total Control Manager/SNMP* is an SNMP-based, Windows-compatible application. It runs on a PC that is connected to the Network Management Card NIC by RS-232, LAN connection, or from a remote site by modem. This software permits you to perform SNMP GET and SET operations on the T1 Card. See the *NMC Reference Manual* and the *Total Control Manager/SNMP Software Guide* for more information.

## Signaling Overview

### *E&M Signaling*

E&M signaling is the traditional type of call signaling from the TELCO for an analog call, and specifies the wires that provide

the signaling paths between the customer's equipment and the TELCO. The E stands for Ear (receive signaling) and the M stands for Mouth (transmit signaling). With typical Plain-Old-Telephone-Service (POTS), the TELCO uses the E-Lead to transmit signals to the Customer Premises Equipment (CPE) and uses the M-Lead to receive signals from the CPE.

The E- and M-Leads each provide two signaling states, on hook and off hook. When the analog phone line between the CPE and the TELCO's equipment is idle, the E- and M-Leads are in the on-hook state. The TELCO initiates a call to the CPE with a trunk seizure that persists until the end of the call. The CPE acknowledges the trunk seizure with an M-Lead off-hook signal, which is detected by the TELCO's equipment. To terminate the call, the TELCO transmits an E-Lead on-hook signal to the CPE.

For wink start, the CPE responds to the TELCO's seizure (E-Lead off-hook) with an M-Lead off-hook and then on-hook (wink). Then, when the TELCO sends state information, the CPE will answer with a constant M-Lead off-hook.

## A&B Signaling

T1 equipment does not use separate signaling leads to handle call signaling. Instead, it performs inband signaling using A&B signaling bits. The A&B signaling bits occur at the 6th and 12th frames of every T1 superframe (SF) and occupy the Least Significant Bit (LSB) position of each frame on all 24 DS0 channels. The TELCO inband signaling overwrites or replaces the LSB of the DS0 channel data. This method of inband signaling is referred to as *Robbed Bit* signaling. The A&B signaling bits indicate the signaling state of each DS0 channel.

**NOTE:** A&B signaling bits translate directly to the E&M leads.

The T1 Network Application Card (NAC) monitors and detects changes in signaling states of the A&B bits using framer chips. This gives the T1 Card the ability to detect incoming calls from TELCO switching equipment. The framers also enable the T1 NAC to transmit A&B signaling bit information for all 24 DS0 channels to the TELCO. This allows the T1 Card to respond to trunk seizures, to answer calls, and to initiate disconnects.

# Chapter 2
# T1 RS-232 Operator Interface

This chapter describes how to connect a dumb terminal or PC to the T1 RS-232 interface in order to configure the T1 NAC. A detailed description of the menu structure that appears when this connection is made can be found in Appendix A for the Single T1 Card, and Appendix B for the Dual T1 Card.

**NOTE:** A PC, and not a dumb terminal, must be used to perform a software download.

If you wish, you can have a dedicated PC connected to the RS-232 port at all times to perform both configuration and software download tasks. When performing configuration tasks, simply run a terminal emulation program to make your PC act like a terminal. Windows offers a Terminal option, and many communications software programs allow you to establish a TTY connection.

## Connecting to the RS-232 Port

The following are provided with your T1 package:

- An RS-232 cable
- A DB-25 female to DB-25 female adapter

If you intend to configure the T1 Card from a remote site, a modem can be connected to the T1 RS-232 interface with the RS-232 cable provided. If you intend to connect a terminal or PC to the T1 RS-232 port, use both the RS-232 cable and the DB-25 female-to-female adapter.

**NOTE:** You must supply your own interface adapter if your hardware uses something other than a DB-25 connector.

## RS-232 Serial Port Settings

The default serial port rate at the T1 RS-232 port is set at 38400 bps. The rate can be changed by adjusting the settings of DIP switches 1 and 2 on the T1 NAC, as shown below.

| DIP 1 | DIP 2 | Selects |
|---|---|---|
| OFF | OFF | 2400 bps |
| OFF | ON | 9600 bps |
| ON | OFF | 19200 bps |
| ON | ON | 38400 bps |

The data format is 8 data bits, no parity, and 1 stop bit.

**NOTE:** When performing a software download, we recommend that hardware flow control be enabled at the port. This requires that DIP switch 3 of the T1 NAC should be set ON (default setting).

# Chapter 3
# Multi-Frequency (MF) Signaling

## Dial-In Call Sequence

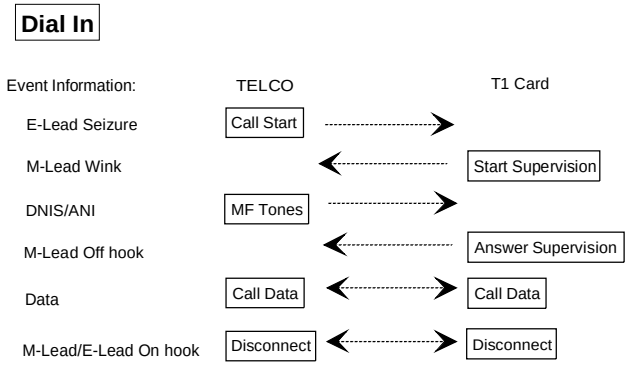



**Figure 3-1. Signaling Between TELCO and T1 Card for a Dial-In Call**

Figure 3-1 illustrates the dial-in process from the TELCO to the T1 Card for a Feature Group B call. A signal-by-signal description of the dial-in process follows.

### Call Start

The Dial-In process begins with a *Call Start* signal sent from the TELCO. The *Call Start* signal is sent in the form of an *E-Lead Seizure,* which is an off-hook signal transmitted on a previously idle trunk. When the T1 Card detects a seizure, it indicates to the modem that there is an incoming call.

### Start Supervision

When the T1 Card receives the *Call Start* signal, it responds by sending a *Start Supervision* signal in the form of an *M-Lead Wink.* A wink is the transition from the on-hook to the off-hook state and then back to the on-hook state. This is the T1 Card's response to the TELCO's trunk seizure.

**Wink Start Supervision.** The use of Wink Start Supervision avoids *Glare*. Glare occurs when there is a simultaneous seizure on both ends of a two-way trunk. If this occurs, each end of the trunk receives a prolonged off-hook signal. With Wink Start, though, the T1 Card foregoes the outgoing call and accepts the incoming one, therefore avoiding glare.

**Immediate Start.** With Immediate Start trunks, no wink is returned in response to trunk seizure. This leads to slightly faster call setup. However, since no trunk integrity checking is performed, Immediate Start is recommended only when the Customer Premises Equipment (CPE) does not support Wink Start.

## MF Tones—Address Information (DNIS and ANI)

Upon receipt of the M-Lead Wink from the T1 Card, the TELCO begins sending *Multifrequency (MF) Tones*. MF Tones carry the address information. Dialed Number Identification Service (DNIS) and Automatic Number Indication (ANI) provide Event Information for MF Tones. This technique enables the T1 Card to recognize the dialed phone number (DNIS) or the calling number (ANI) and to use that information for special configurations and call routing. This helps to reduce the length of the connection process.

The T1 Card can be configured to use DNIS, ANI, ANI-DNIS, or No Address. This can be set through the Dial-in Address Call Configuration Parameter of the RS-232 interface, or with *Total Control Manager/SNMP*. See Appendix A (Single T1) or Appendix B (Dual T1) of this manual, or the *Total Control Manager Software Guide*, for more information.

## Answer Supervision

Once the T1 Card receives the MF Tones, it answers the call by going off hook (*M-Lead Off hook*).

## Call Data

The T1 Card and the TELCO are now connected, and data transmission is possible.

### Disconnect

When the call is finished, the TELCO can disconnect by sending an E-Lead on-hook signal, or the T1 Card can disconnect by sending an M-Lead on-hook signal.

## Dial-Out Call Sequence

Figure 3-2 shows how signals are sent to and from the TELCO for a dial-out call. (This is the reverse of Figure 3-1.)

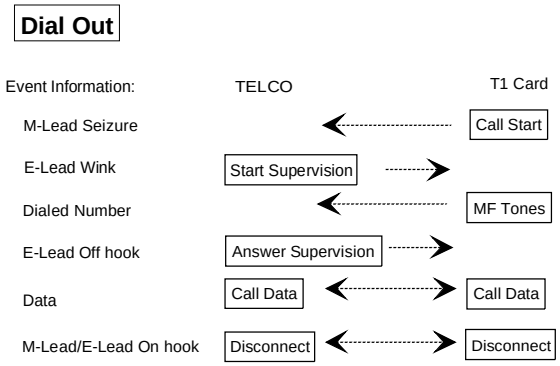



**Figure 3-2. Signaling Between TELCO and T1 Card for a Dial-Out Call**

## Dial-In/Dial-Out Timing

The following sections provide a detailed description of the complete process and signaling details of both incoming (Feature Groups B and D) and outgoing calls, from setup and connection to disconnection. Included in the explanations is important timing information. Figures 3-3, 3-4 and 3-5 present this information graphically.

### *Dialing In*

**NOTE:** The timing values cited in this section are based on general reference specifications. Actual equipment response times may vary.

## Call Setup Sequence—Feature Group B

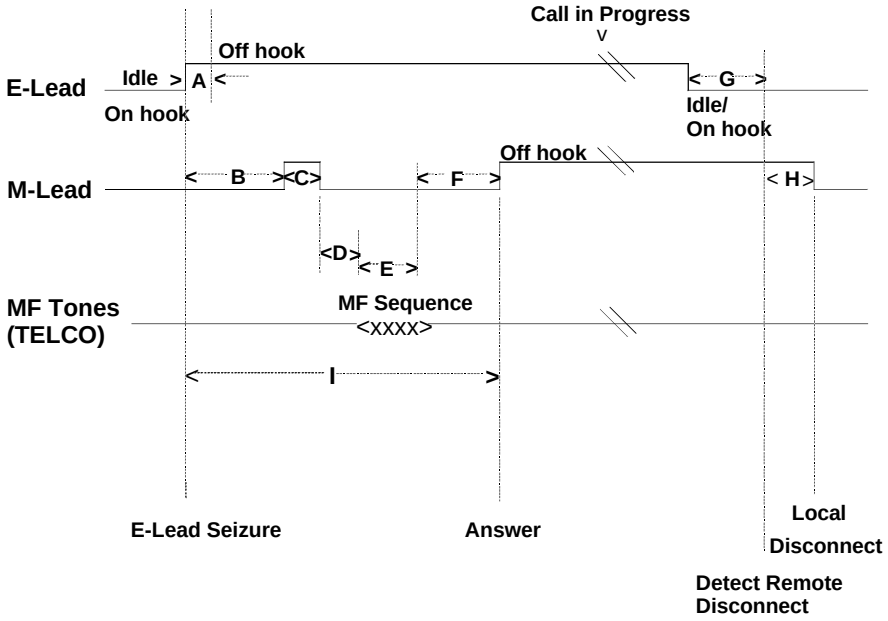
1. The sequence begins when the TELCO initiates a trunk seizure by transmitting an E-Lead off-hook signal. The T1 framers detect the off-hook state of the E-lead, and the T1 Card debounces and verifies the trunk seizure within 40 milliseconds (ms) of receipt by the T1 CPU.
2. The T1 CPU validates the E-Lead seizure and notifies the modem assigned to that trunk. This is the equivalent of ringing in an analog modem. At this point, the modem is not yet connected to the TELCO trunk and is not receiving or transmitting data to the TELCO.
3. The T1 CPU expects a Call Start Acknowledge Pattern from the modem. The T1 CPU requires approximately 16 ms to detect and verify any modem pattern.
4. When the T1 CPU has detected and verified the Call Start Acknowledge Pattern from the modem, it connects the modem's receive data to the incoming TELCO trunk. The modem's transmit data is not connected to the TELCO trunk at this time. The modem's receive data connection is made in preparation for the receipt of the MF tone sequence from the TELCO. Before the wink is sent to the TELCO, 210 ms must elapse from the E-Lead seizure. The T1 CPU then sends the M-Lead wink pulse, which goes to the off-hook state for 200 ms, then back on hook.
5. If no Acknowledge Pattern is received from the modem after five seconds, the T1 CPU records the event but does not respond to the TELCO. If a timeout occurs, the T1 CPU transmit an Idle / Disconnect Pattern to the modem. At this time, no connection between the TELCO and the modem exists and the modem should return to the Idle condition, transmitting the Idle / Disconnect Pattern to the T1 Card.
6. The TELCO begins transmitting the MF sequence 70 ms after it detects the M-Lead wink. The modem receives the MF sequence in approximately 1.32 seconds. Immediately after the modem detects and verifies the entire MF sequence, it transmits the MF Complete Pattern to the T1 Card.
7. The T1 CPU detects the MF Complete Pattern in approximately 16 ms, and programs the Time / Space

Switch to send the MF Complete Acknowledge Pattern (*e*) to the modem. The T1 CPU transmits this pattern for 20 ms and then completes the connection of the modem. The connection between the modem and the TELCO is now complete and the modem begins to look for incoming carrier from the calling modem.

8. If for any reason the modem cannot verify the MF sequence, the T1 CPU does not respond to the TELCO, but maintains the M-Lead on-hook state and logs the event. The TELCO times out if it does not receive the answer signal on the M-Lead from the T1 Card, and also logs the event. The TELCO returns the trunk to the idle state and is ready to assign another call.
9. After the connection of the TELCO to the modem is complete, the T1 Card must respond with an answer signal (M-Lead off hook). This indicates that the TELCO should complete the call connection. However, there must be a 100 ms delay between the time the ST(art) tone is received by the modem and the time the answer signal is transmitted to the TELCO. Once the signal delay connection is satisfied, the T1 CPU programs the T1 framer to transmit the M-Lead off hook answer signal to the TELCO. The M-Lead off hook answer signal persists for the duration of the call connection.

At this point, the call connection is complete and the calling modem and quad modem begin communicating.

Based on the information shown in Figure 3-3, a nominal connect time from trunk seizure to modem connection with the TELCO, assuming one DNIS address digit is received, is 0.910 seconds. The maximum time for this connection is 2.37 seconds.



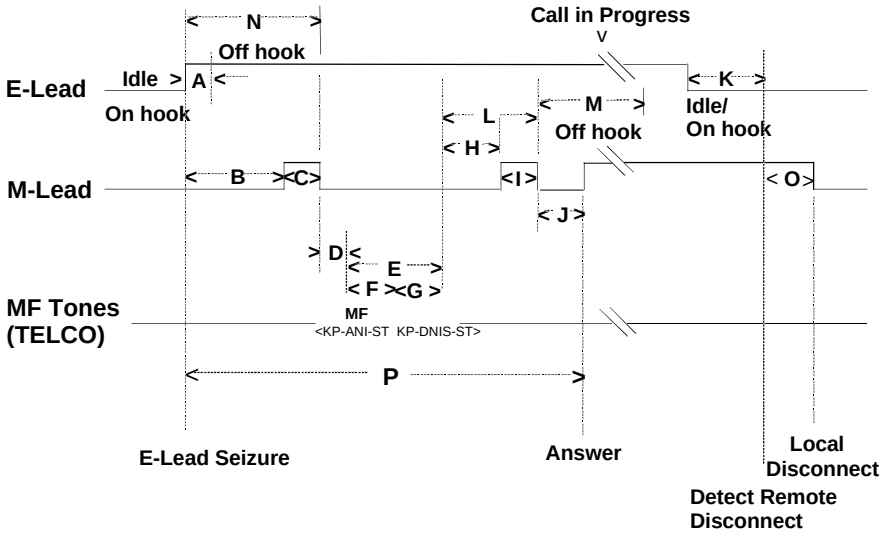

| Symbol | Description | min | typ | max | units |
|---|---|---|---|---|---|
| A | E-Lead Seizure Debounce | 40 | 45 | 50 | ms |
| B | Seizure to Wink Delay | 210 | 220 | 230 | ms |
| C | Off hook Wink Duration | 140 | 200 | 210 | ms |
| D | Wink to Multifrequency Delay | 70 | 100 | | ms |
| E | MF Sequence Duration | 0.26 | 0.47 | 1.4 | sec |
| F | ST Tone to Call Answer Supervision Delay | 100 | 110 | 120 | ms |
| G | E-Lead On hook Call Disconnect Delay | 300 | 315 | 320 | ms |
| H | E-Lead On hook to M-Lead On-hook Delay | | 20 | 50 | ms |
| I | Trunk Seizure to Answer Supervision | 0.78 | 1.1 | 4.0 | sec |

**Figure 3-3. FGB Incoming Call Process and Signaling**

## Call Setup Sequence—Feature Group D

The Dial-in protocol (TELCO to T1 Card) is different for Feature Group D (FGD) in that both DNIS and ANI address information may be sent from the TELCO. The Dial-in Address Call Configuration Parameter should be set to ANI-DNIS for FGD with address information.

The T1 NAC must send an acknowledgment wink after receiving this address information. No acknowledgment wink was required in FGB. Figure 3-4 is a call signaling diagram that shows how the acknowledgment wink is incorporated.




| Symbol | Description | min | typ | max | units |
|---|---|---|---|---|---|
| A | E-Lead Seizure Debounce | 40 | 45 | 50 | ms |
| B | Seizure to Wink Delay | 210 | 220 | 230 | ms |
| C | Off hook Wink Duration | 140 | 200 | 290 | ms |
| D | Wink to Multifrequency Delay | 70 | 100 | | ms |
| E | MF Sequence Duration | 3.0 | | 3.9 | sec |
| F | ANI (MF) Sequence Duration. Assume ANI Sequence is KP00XXXXXXXXXST | 1.6 | | 2.1 | sec |
| G | DNIS (MF) Sequence Duration. Assume DNIS sequence is KPXXXXXXXXXST | 1.4 | | 1.8 | sec |
| H | DNIS ST Tone to Ack Wink Delay | .200 | | 3.5 | sec |
| I | Off-hook Wink Duration (Ack Wink) | 140 | 200 | 290 | ms |
| J | Ack Wink to Answer Delay | 250 | | | ms |
| K | E-Lead On-hook Call Disconnect Delay | 300 | 315 | 320 | ms |
| L | Ack Wink Time Out | | | 4.0 | sec |
| M | Channel Cut Through (Telco will connect talk path within this time) | | | 1.2 | sec |
| N | E-Lead Seizure Wink Time Out | | | 4.0 | sec |
| O | E-Lead On-hook to M-Lead On-hook Delay | | 20 | 50 | ms |
| P | Trunk Seizure to Answer Supervision<br>**NOTE:** The minimum would be 2.32 sec. if no ANI is sent KP+ST only. | 4.1<br>OR<br>2.32 | 4.2 | 5.3 | sec |

**Figure 3-4. FGD Incoming Call Process and Signaling**

## *Dialing Out*

1. Dial-out calls begin with the TELCO, T1 Card, and modem in the idle state.
2. The T1 card sends the M-Lead off-hook signal to the TELCO. The TELCO winks back with the E-Lead; the T1 Card then creates the data path from the modem's transmitter to the TELCO.
3. When the data path is complete, the T1 Card instructs the modem to send the MF tones to dial the phone number.
4. After the MF tones are sent and the TELCO begins to dial, the modem sends the MF Complete Pattern to the T1 Card. This tells the T1 Card to connect the modem's receive data path to the TELCO. At this time, the TELCO may send call progress information such as audible rings, busy, or reorder messages.
5. When the call is completed, the TELCO sends an E-Lead off hook: *answer supervision*. The T1 Card temporarily breaks the data path to the modem and sends the MF Complete Acknowledge Pattern to inform the modem that the call has been answered. The T1 Card then reconnects the modem's receiver to the TELCO so that full duplex call data transfer can take place.

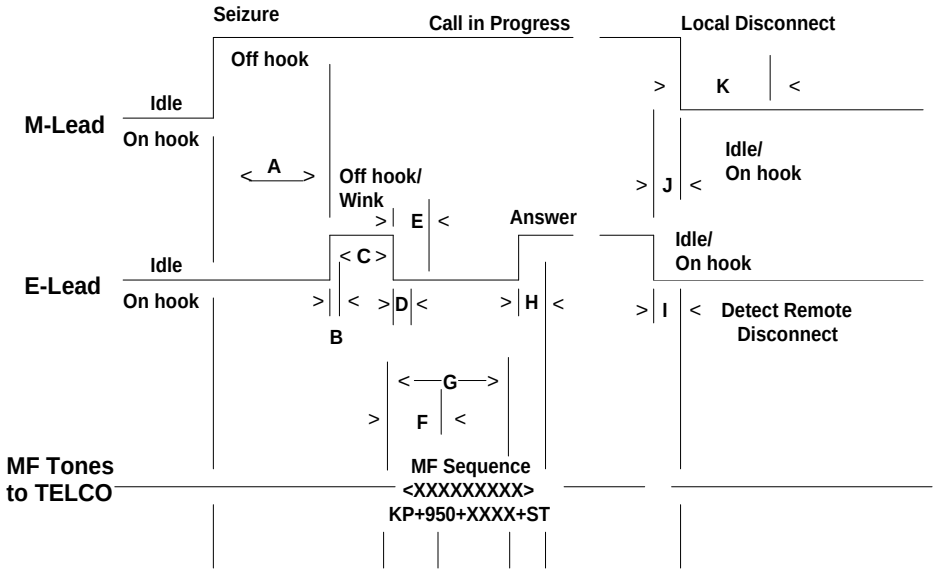
The actual time to make a call depends on several factors, including TELCO response times and the number of digits / speed of the dialed telephone numbers.

Although the TELCO goes on hook to disconnect the call at time *I* in Figure 3-5, the billing clock is not stopped until one of two things occurs:

- The T1 Card goes on hook for 250 ms (time *K*).
- A time-out period of up to 20 seconds elapses.

**NOTE:** If the called Customer-Premise Equipment (CPE) returns the trunk to an off-hook condition before either of the above occurs, the call does not disconnect.

In-band tones such as audible ringing, busy and reorder may be present from the TELCO after the address digits have been received by the TELCO. These in-band signals can be used by the modem to reorder, or to hang up the call if it is busy.




| Symbol | Description | min | typ | max | units |
|---|---|---|---|---|---|
| A | E-Lead Seizure to Wink | 210 | 220 | 5000 | ms |
| B | E-Lead Start of Wink Debounce | 40 | 45 | 50 | ms |
| C | Off hook Wink Duration | 70 | 200 | 290 | ms |
| D | M-Lead End Wink Debounce | 40 | 45 | 50 | ms |
| E | Wink to Multifrequency Delay | 70 | xx | xx | ms |
| F | Wink to First MF Digit | 0 | xx | 5 | sec |
| G | Wink to Last MF Digit | 0 | xx | 15 | sec |
| H | E-Lead Answer Debounce | 40 | 45 | 50 | ms |
| I | E-Lead Disconnect Debounce | 40 | 45 | 50 | ms |
| J | E-Lead Disconnect to M-Lead Disconnect | 300 | xx | xx | ms |
| K | M-Lead On Hook Call Disconnect Delay | 250 | xx | xx | ms |

**Figure 3-5. Outgoing Call Process and Signaling**

# Chapter 4
# DTMF Signaling

The DTMF signaling method uses 12 distinct signals transmitted over the voice transmission path to provide addressing information (0–9, *, #). This addressing method is slightly more limited than is possible with MF (Multi-Frequency) signaling, which provides 15 two-frequency combinations. MF signaling (incorporated in the first release of the T1 Card) supports KP (Key Pulse) and ST (Stop) control signals, which facilitate the transmission of ANI and DNIS digits by indicating when the transmission of an ANI or DNIS number begins and ends. The modem decodes the MF tones and then acts on any ANI or DNIS embedded in the signaling.

## Trunk Types / Start Supervision

Prior to Release 3.0, the T1 Card supported only an E&M (Ear and Mouth) T1 trunk type. E&M trunks use either Wink Start or Immediate Start methods, and can use either MF (Multi-Frequency) or DTMF (Dual Tone Multi-Frequency) signaling.

As of Release 3.0, the T1 Card supports Loop Start and Ground Start trunk types, in addition to E&M. Both new trunk types use the Dial Tone start method, and use only DTMF signaling.

The following table indicates the T1 line provisioning options that are currently supported.

| Trunk Type | Start Method | Tone Signaling |
|---|---|---|
| E&M | Wink or Immediate | MF or DTMF |
| Loop Start | Dial Tone | DTMF |
| Ground Start | Dial Tone | DTMF |

*Table 4-1. Supported Trunk Type/Start/Signaling*

Loop Start and Ground Start trunks require DTMF signaling. They do not support any address information (DNIS or ANI). For DTMF and E&M, additional parameters must be set for the

modem. To indicate how much addressing information is being sent with the transmission, the number of addressing digits (0–12) can be set with S62 (ANI) or S63 (DNIS).

## Loop Start

**NOTE:** Loop Start lines are very susceptible to glare. For this reason, they should only be configured as one-way lines (either dial-in or dial-out).

Loop Start was originally developed on analog lines, then converted to digital lines. It is the most common line type available, and is used in most residential lines to provide supervisory and start signals. In an analog Loop Start trunk, there are two conductors: tip and ring. All signaling involves current flow through these two conductors, which forms a current loop with the network. Once the network detects current flow in the loop, it sends a dial tone as a start signal.

Loop Start is translated to the digital T1 carrier by using the A and B signaling bits. The transmitted signaling bits tell the network whether the loop is open or closed.

## Ground Start

Ground Start is a little more robust than Loop Start. It was also originally developed for analog lines and converted to digital. Ground Start trunks have the most complex signaling protocol of the trunks supported. The A and B signaling bits on the T1 line are used to mimic the tip and ground connectors in the analog world. Ground Start trunks are often preferred to Loop Start trunks because the network provides additional signals for alerting, starting and ringing.

Like a Loop Start line, Ground Start lines use both a ring and a tip conductor. However, the network can not only detect current flow through the ring and the tip, but also detect whether the tip or the ring has been grounded. This configuration allows Ground Start lines to convey more signaling information over the line. It also makes Ground Start supervision somewhat of a complex protocol.

### Ground Start vs. Loop Start

Ground Start lines are more reliable than Loop Start lines in that they provide two signals for alerting and disconnecting. While alerting, the AC ring can be difficult to detect, so the Ground Start lines also ground the tip conductor, which is a more reliable detection of ring. Also, during a disconnect, Ground Start lines remove the loop current. This removal allows a fast indication of disconnect. Overall, these features give Ground Start lines faster response times than Loop Start lines.

The T1 Card has more control over a connection using Ground Start than Loop Start. In a Ground Start line, the T1 Card is able to tear down a connection as well as set up a connection. The Quad Modem is not responsible for maintaining the connection as in Loop Start lines. In addition, the Ground Start line is tolerant to modem failure.

### Busy-out with Ground Start Lines

Total Control performs Ground Start in the digital world by mimicking analog signals. The T1 Card uses the A and B signaling bits to send a busy-out pattern (0,0) to the TELCO. We believe that this busy-out signaling pattern is appropriate for the majority of cases. However, not all Regional Bell Operating Company switches treat this pattern in the same manner. If your installation experiences any difficulty with this feature, contact U.S. Robotics Technical Support and we will work with you to find an appropriate solution.

## *Direct Inward Dialing (DID)*

Direct Inward Dialing allows direct access to a PBX line from a line outside of the PBX. It requires the telephone company Central Office to transmit the address of the station being dialed (usually four digits).

On PBXs, when a DID call comes in it is routed to a PBX station corresponding to the number dialed. The T1 Card always routes the dial-in call to the Quad Modem assigned to the DS0 the call came in on. See Chapter 5 for information on DS0 allocation.

Most DID trunks are E&M trunk types, and use Wink Start with DTMF signaling. The Quad Modems now support DTMF tones to enable this feature, and E&M and Wink Start can be selected as Call Parameter Configuration parameters for the T1 Card.

# Loop Start

## *Loop Start Signaling on a T1 Trunk*

From the point of view of the customer premise equipment (CPE), the transmitted A and B signaling bits tell the network whether the loop is open or closed. The received signaling bits tell the CPE whether a ringing signal is being sent from the network or not. Tables 4-2 and 4-3 show how the A and B signaling bits are interpreted, both in the transmitted and received state.

| Transmitted Signaling | A | B |
|---|---|---|
| Loop Open (off hook) | 0 | 1 |
| Loop Closed (on-hook) | 1 | 1 |
| Sending Address Info | 1 (DTMF tones) | 1 |

*Table 4-2. Meaning of Transmitted Signaling Bits*

| Received Signaling State | A | B |
|---|---|---|
| Ringing* | 0 | 0 |
| Not Ringing | 0 | 1 |

*The received signaling state is ignored when the loop is closed.

*Table 4-3. Meaning of Received Signaling Bits*

### Loop Start Call Processing: Dial-out

Table 4-4 shows the transmitted and received signaling bits (from the T1 Card's point of view) for the various stages in completing a dial-out call.

| | Transmit Signaling | | Receive Signaling | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Idle State | 0 | 1 | 0 | 1 |
| T1 Closes Loop | 1 | 1 | 0 | 1 |
| Send Address Info | 1 | 1 | 0 | 1 |
| Completion of Dialing | 1 | 1 | 0 | 1 |

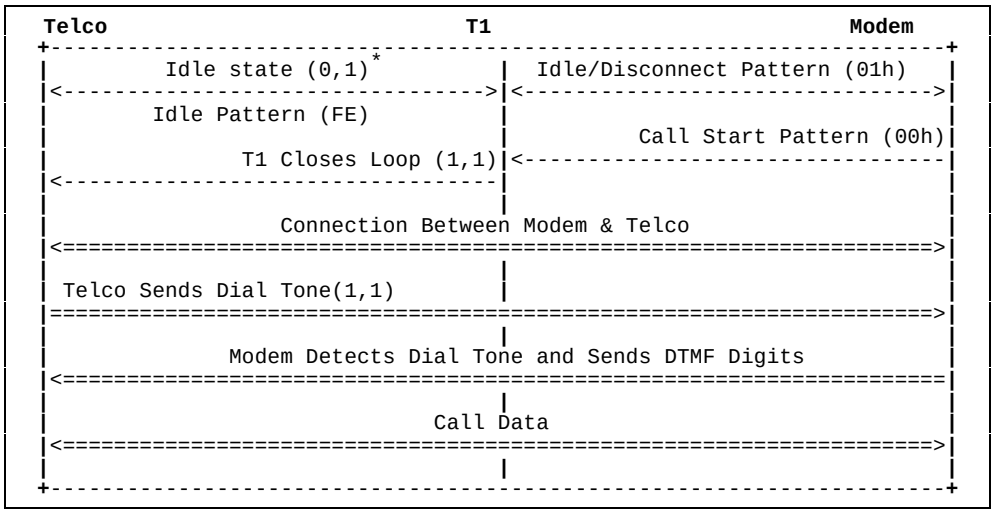
*Table 4-4. Signaling States of a Loop Start Dial-out Call*

**Idle State.** Initially, an idle connection consists of the T1 Card sending the A / B pattern (0,1) to the TELCO. In response, the TELCO should send the same (0,1) pattern back to the T1 Card. Also, the T1 Card sends the Quad Modem the Idle / Disconnect pattern (01h). In response, the T1 Card should receive the same Idle / Disconnect pattern (01h).

**T1 Closes Loop.** To initiate a call, the modem sends the Call Start pattern (00h) to the T1 Card. The T1 Card then closes the loop (goes off-hook) to the TELCO by setting the transmit A bit high (1,1). At this point, the T1 Card connects the modem to the TELCO in a full duplex connection. The TELCO has 3 seconds to respond to the off-hook with a dial tone. The modem must detect and respond to the dial tone.

**Send Address Information.** Seventy milliseconds (70 ms) after the start of the dial tone, the Quad Modem can start transmitting dual-tone multifrequency (DTMF) digits of the called number.

**Complete Dialing.** From this point on, the modem can negotiate the connection like a normal call. Figure 4 represents this call setup process.




*The format for A and B signaling bits is given as (A,B).

*Figure 4-5. Diagram of a Loop Start Dial-out Call*

## Loop Start Call Processing: Dial-in

This section describes how an incoming call from the TELCO is connected to the Quad Modem via Loop Start supervision. Table 4-5 shows the transmitted and received signaling bits (from the T1 Card's point of view) for the various stages in completing a dial-in call.

| | Transmit Signaling | | Receive Signaling | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Idle State | 0 | 1 | 0 | 1 |
| TELCO Applies Ringing* | 0 | 1 | 0 | 0 |
| Interval between Ringing | 0 | 1 | 0 | 1 |
| T1 Answers Call | 1 | 1 | 0 | X |
| Normal Talking State | 1 | 1 | 0 | X |

X=Don't Care

*The received B bit will toggle while ringing signal is presented.

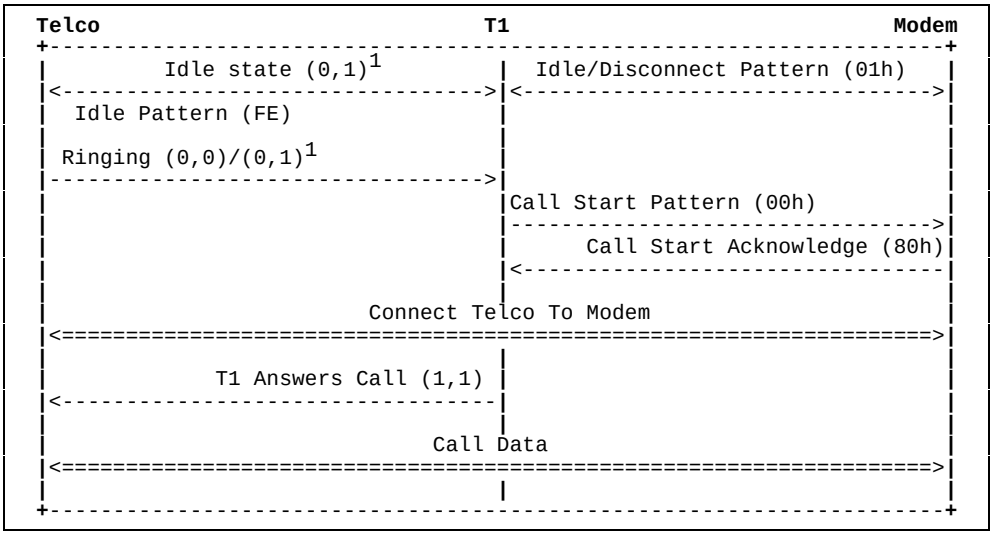
*Table 4-5. Signaling States of a Loop Start Dial-in Call*

**Idle State.** The dial-in call starts the same as the dial-out call. The T1 Card transmits the Idle / Disconnect pattern to the modem. In addition, the T1 Card sends the (A,B) signaling pattern (0,1) to the TELCO.

**TELCO Applies Ringing / Interval Between Ringing.** To initiate a call, the TELCO alerts the T1 Card by toggling the received B bit. The B bit goes low during the actual ring, and then high during the silent interval. A typical ring cycle is a ring for two seconds (B low) and then silence for four seconds (B high).

**T1 Answers Call.** As soon as the T1 Card detects that the received B bit is low, it sends the Call Start pattern (00h) to the modem. The modem responds to the Call Start pattern with a Call Start Acknowledge (80h). To answer the call, the T1 Card sends the (A,B) bit pattern (1,1) to the TELCO. The TELCO starts sending data within 160 ms after the answer signal.

**Normal Talking State.** Once this connection is established, the data can flow normally. Figure 4-6 represents this call setup process.




[1]Ringing signal indicated by toggling the B bit: 2 seconds low, 4 seconds high.

*Figure 4-6. Diagram of a Loop Start Dial-in Call*

**NOTE:** Loop Start is *not* provisioned to carry DNIS or ANI information. Unlike E&M type II signaling, the modems cannot rely upon DNIS data to train quickly. Loop Start connections are neither very fast nor versatile.

## Loop Start Call Processing: Modem Disconnect

This section describes a modem-initiated disconnect procedure. Table 4-6 shows the states of the A and B signaling bits in each stage of the disconnect.

| | Transmit Signaling | | Receive Signaling | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Talking State | 1 | 1 | 0 | X |
| T1 Card Opens Loop | 0 | 1 | 0 | X |
| Idle State* | 0 | 1 | 0 | 1 |

X=Don't Care

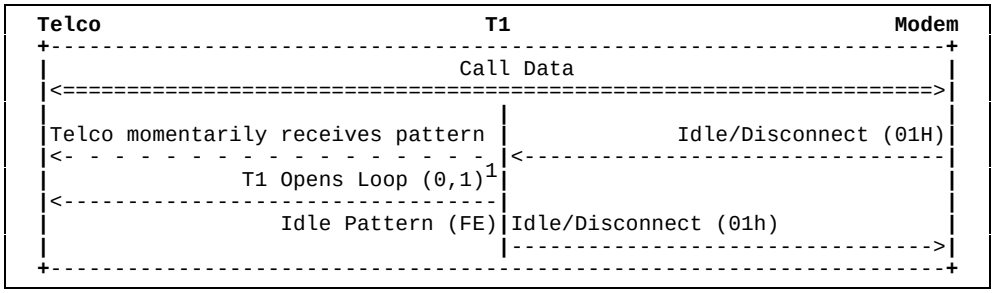
*The T1 Card must return to the idle state 850 ms after opening the loop to accept a new call or present a new call.

*Table 4-6. Signaling States of a Loop Start Modem-Initiated Disconnect*

**Talking State.** To disconnect a call, the modem first sends an Idle / Disconnect pattern (01h) to the T1 Card.

**T1 Card Opens Loop.** The T1 Card opens the loop to the TELCO by setting its transmitted A bit to 0.

**Idle State.** The T1 Card then responds to the modem by returning the Idle / Disconnect pattern (01h). Since there is no way to detect that the TELCO received the change in the transmitted A bit, the T1 Card must assume that the TELCO will be ready for another call 850 ms after loop closure. Figure 4-7 represents this call tear-down process.



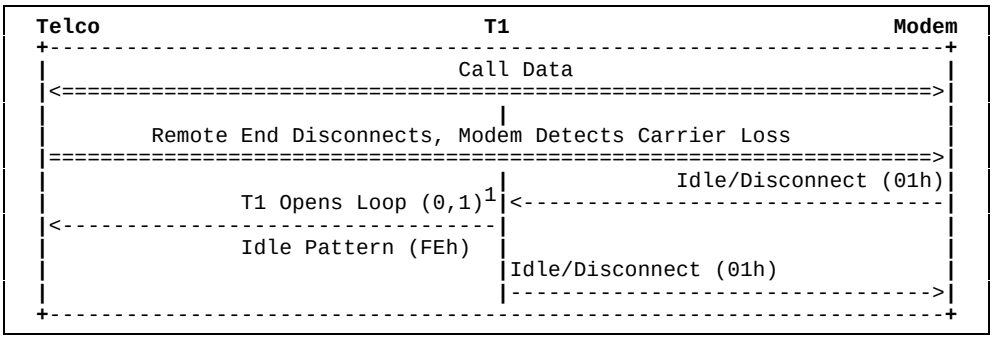

[1]After T1 opens loop, TELCO will be ready to send / receive another call in 850 ms.

*Figure 4-7. Diagram of Loop Start Modem-Initiated Disconnect*

## Loop Start Call Processing: Remote Disconnect

This section describes the procedure for a remote disconnect over a Loop Start trunk. Basically, the TELCO cannot perform this function via the T1 signaling bits. The Quad Modem must detect loss of carrier on the remote end, tell the T1 Card to send a disconnect pattern to the TELCO, and then go on-hook.

Figure 4-8 shows the remote disconnect process. If for some reason the remote end disconnects and the Quad Modem does not detect carrier loss, the T1 Card continues to hold the line and the TELCO eventually returns a dial tone.




1After T1 opens loop, TELCO will be ready to send / receive another call in 850 ms.

*Figure 4-8. Diagram of Loop Start Remote-Initiated Disconnect*

## Loop Start Call Processing: TELCO Abandons Incoming Call

This section describes the process by which the TELCO hangs up a connection while ringing the T1 Card. If the T1 Card creates the connection after the TELCO disconnected, the modem detects a dial tone. The modem recognizes that this is an incoming call, not an outgoing one. Therefore, a dial tone means the modem should hang up the connection. The modem sends an Idle / Disconnect pattern to the T1 Card, which then reopens the loop. Once again, the T1 Card must rely upon the modem for a disconnect signal. Like a typical disconnect procedure, the modem should not try to place another call for 850 ms after the connection has been terminated.

# Ground Start

## Description

In the idle (or on-hook) state, the customer premise equipment (CPE) presents the network with a high resistance between the ring and tip conductors, as well as between ring and ground. No current flows through the loop made between the ring, tip, and the network.

The CPE initiates a call by locally grounding the ring conductor (from which comes the name Ground Start). This allows current to flow through the ring conductor. The network detects this current flow and responds by applying a DC voltage between the tip and ring and applying a dial tone. After 210 ms from the start of the dial tone, the network removes ground from the tip conductor. The CPE needs to close the loop in this 210 ms interval: failure to do so may disconnect the call. After 70 ms of dial tone, the CPE can start sending DTMF digits, as well as the call and transfer data.

To alert the CPE, the network provides an AC ringing signal in conjunction with grounding the tip conductor. This tip ground can also be used to indicate ringing (in fact, in most cases the tip ground is preferred over using AC ringing as an alert signal). When the CPE detects alerting, it responds with a loop closure. The call is then ready to exchange data.

To disconnect a call, the CPE goes on-hook (opens the loop). Within 50 ms, the network responds by grounding the tip conductor. To idle the line, the network removes the tip ground and the voltage between tip and ring. If the network initiates disconnect, it grounds the tip connector. The CPE responds by opening the loop. The network then removes the tip ground and loop voltage.

## Ground Start on a T1 Carrier

Ground Start is translated to the digital T1 carrier by use of the A and B signaling bits. From the point of view of the customer premise equipment (CPE), the transmitted A signaling bit tells the network whether the loop is open or closed. The transmitted B signaling bit tells the network if the CPE has

grounded the ring conductor. The received signaling A bit tells the CPE whether the tip conductor has been grounded. The received B bit tells the CPE whether a ringing signal is being sent from the network or not.

## Ground Start Call Processing: Dial-out

This section describes the call processing and signaling details of an outgoing call from the Quad Modem through the T1 Card and out to the TELCO. Table 4-7 shows the transmitted and received signaling bits (from the T1 Card's point of view) for the various stages in completing a dial-out call.

| | **Transmit Signaling** | | **Receive Signaling** | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Idle State | 0 | 1 | 1 | X |
| T1 Grounds Ring (waiting for dial tone) | 0 | 0 | 1 | X |
| TELCO Grounds Tip (dial tone applied) | 0 | 0 | 0 | X |
| T1 Removes Ring Ground | 0 | 1 | 0 | X |
| T1 Closes Loop | 1 | 1 | 0 | X |
| Dial Pulsing | 1 | 1 (DTMF) | 0 | X |
| Talking State | 1 | 1 | 0 | X |

X = Don't Care

*Table 4-7. Signaling States of a Ground Start Dial-out Call*

**Idle State.** Initially, both the T1 Card and the TELCO are in the idle state. The T1 Card sends the (A,B) signaling pattern of (0,1) to the TELCO. The TELCO responds with its own idle signal of (1,X). (X is a don't care condition.) Also during this time, the T1 Card exchanges the Idle / Disconnect pattern with the Quad Modem and sends an idle pattern to the TELCO.

**T1 Card Grounds Ring.** To initiate a call, the Quad Modem sends the Call Start pattern (00h) to the T1 Card. The T1 Card responds to the Call Start pattern by initiating a connection to the TELCO. The T1 Card grounds the ring by setting the transmitted B bit low (0,0).

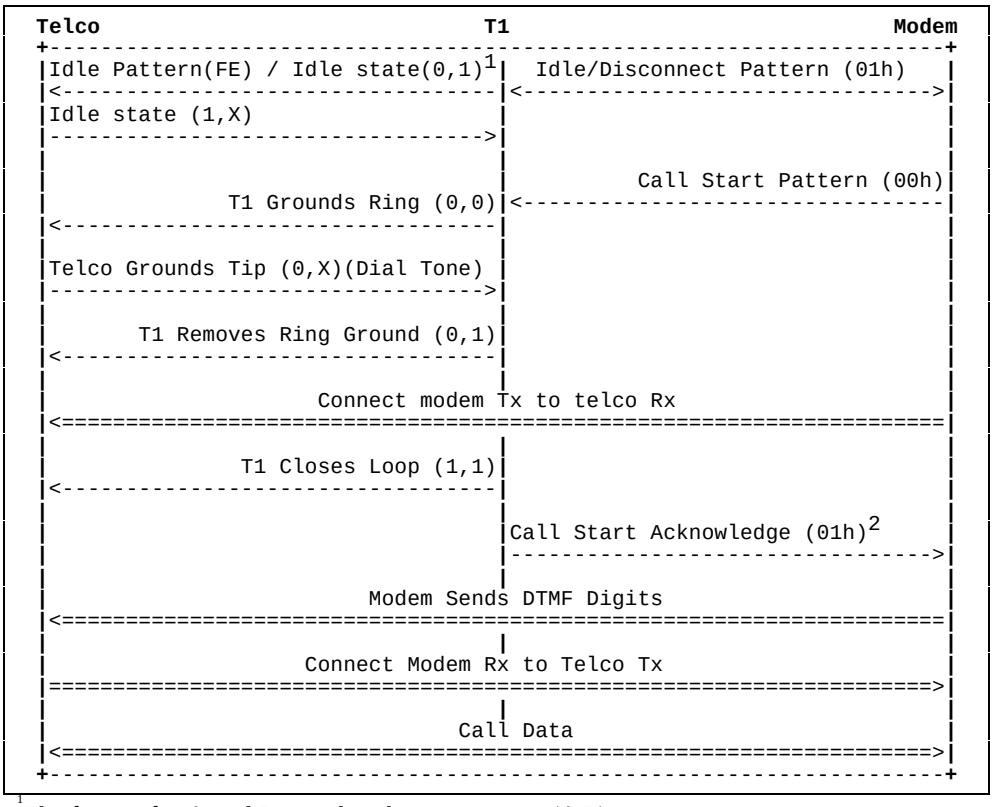
**TELCO Grounds Tip.** The TELCO responds to this in two ways: first, it sends a dial tone via the pulse-code modulated (PCM) data. Second, the TELCO grounds the tip conductor by setting the received A bit low (0,X).

**T1 Removes Ring Ground.** The T1 Card has 50 ms to respond to this tip ground by removing its ring ground by setting the transmitted B bit high (0,1). Before the T1 Card closes the loop to set up a connection, the T1 Card must first connect the modem's transmit line to the TELCO's receive line in preparation for sending DTMF digits.

**T1 Closes Loop.** After this connection is made, the T1 Card closes the loop by setting both of its signaling bits high (1,1). Next, it sends the Call Start Acknowledge pattern (80h) to the modem.

**Dial Pulsing.** The modem responds to the Call Start Acknowledge by sending the DTMF digits (address of called number) 20 ms after receiving the Call Start Acknowledge pattern.

**Talking State.** Forty milliseconds (40 ms) after the T1 Card transmits the Call Start Acknowledge to the modem, it will connect the TELCO's transmit line to the modem's receive line and let the call data ensue. Figure 4-9 represents this call setup process.




[1] The format for A and B signaling bits is given as (A,B).
[2] 40 ms after T1 Card sends Call Start Acknowledge, it connects TELCO Tx to modem Rx.

*Figure 4-9. Diagram of a Ground Start Dial-out Call*

Note that in this case, the T1 Card (and consequently the Quad Modem) can completely ignore the dial tone as a start signal and use the fact that the received A bit has gone low as a start signal. This is one reason why Ground Start connections are quicker and more stable than Loop Start connections, which rely upon the dial tone as a start signal.

## Ground Start Call Processing: Dial-in

This section describes how an incoming call from the TELCO is connected to the Quad Modem via Ground Start supervision. Table 4-8 shows the transmitted and received signaling bits (from the T1 Card's point of view) for the various stages in completing a dial-in call.

| | Transmit Signaling | | Receive Signaling | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Idle State | 0 | 1 | 1 | X |
| TELCO Grounds Tip (interval between ringing)* | 0 | 1 | 0 | 1 |
| Ringing Application | 0 | 1 | 0 | 0 |
| T1 Presents Call | 0 | 1 | 0 | 1 |
| T1 Answers Call | 1 | 1 | 0 | X |
| Talking State | 1 | 1 | 0 | X |

X = Don't Care

*The received B bit will toggle while ringing signal is presented.

*Table 4-8. Signaling States of a Ground Start Dial-in Call*

**Idle State.** The dial-in call starts the same way as the dial-out call. The T1 Card transmits the Idle / Disconnect pattern to the modem. In addition, the T1 Card sends the (A,B) signaling pattern (0,1) to the TELCO. The TELCO sends its own idle pattern of (1,X) to the T1 Card, where X is a don't care condition.

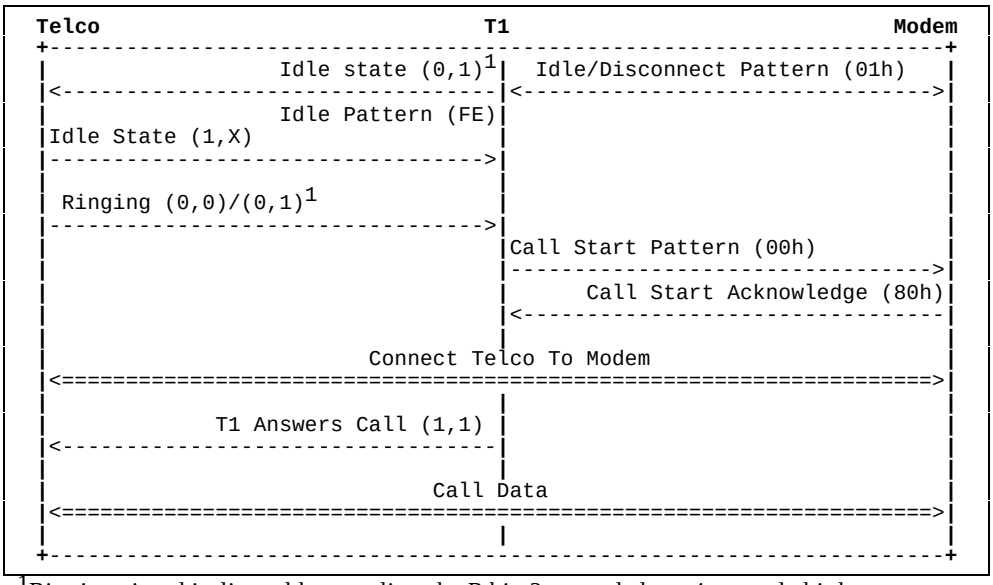
**TELCO Grounds Tip.** To initiate a call, the TELCO alerts the T1 Card by setting the received A bit low and toggling the received B bit.

**Ringing Application.** The B bit goes low during the actual ring, and then goes high during the silent interval. A typical ring cycle is a ring for two seconds (B low) and then silence for four seconds (B high).

**T1 Presents Call.** As soon as the T1 Card detects that the received A bit is low, it sends the Call Start pattern (00h) to the modem. The modem responds to the Call Start pattern with a Call Start Acknowledge (80h).

**T1 Answers Call.** Once the Call Start Acknowledge pattern is received, the T1 Card has 160 ms to set up a data path between the TELCO and the modem. To answer the call, the T1 Card sends the (A,B) bit pattern (1,1) to the TELCO.

**Talking State.** Once this connection is established, the data flows normally. Figure 4-10 represents this call setup process.




[1]Ringing signal indicated by toggling the B bit: 2 seconds low, 4 seconds high.

*Figure 4-10. Diagram of a Ground Start Dial-in Call*

While Loop Start depends upon the AC ringing signal for alerting (or in the T1 case, the PCM encoded ring in the data path), Ground Start simply looks at the received A signaling bit for an indication of a ring. Hence, the connection is a bit quicker (a Loop Start line's connect delay can be 0.5 to 3.0 seconds, whereas a Ground Start line connect delay ranges from 0.3 to 0.7 seconds). However, like Loop Start, Ground Start lines are *not* provisioned to carry either DNIS or ANI information.

## Ground Start Call Processing: Modem Disconnect

This section describes a modem initiated disconnect procedure. Table 4-9 shows the A and B signaling bits in each stage of the disconnect process.

| | Transmit Signaling | | Receive Signaling | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Talking State | 1 | 1 | 0 | X |
| T1 Card Opens Loop | 0 | 1 | 0 | X |
| TELCO Removes Tip Ground* | 0 | 1 | 1 | X |

X = Don't Care

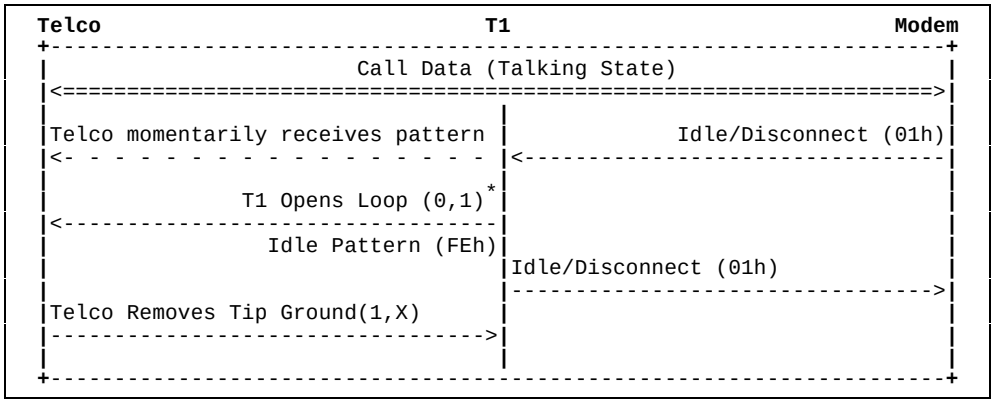
*The modem cannot initiate new call until TELCO has removed the tip ground.

*Table 4-9. Signaling States of a Ground Start Modem-Initiated Disconnect*

**Talking State.** To disconnect a call, the modem first sends an Idle / Disconnect pattern (01h) to the T1 Card.

**T1 Card Opens Loop.** The T1 Card opens the loop to the TELCO by setting its transmitted A bit to 0. At this time, the T1 Card also acknowledges the modem's Idle / Disconnect pattern by returning the same pattern to the modem. Unlike Loop Start supervision, the T1 Card is aware when the modem can place a new call.

**TELCO Removes Tip Ground.** The TELCO has to remove tip ground by sending a (1,X) and return to the idle state before any calls can be placed by the modem. Figure 4-11 represents this call tear down process.




X = Don't Care

*The modem must not present a new outgoing call until the TELCO has removed tip ground.

*Figure 4-11. Diagram of Ground Start Modem-Initiated Disconnect*

The T1 Card will not allow the modem to place a new call between the Idle / Disconnect and removal of the tip ground. The modem keeps track of time to prevent this situation. However, if a Call Start pattern were received in this interval, the T1 Card would ignore the command.

## Ground Start Call Processing: TELCO Disconnect

This section describes the procedure for TELCO disconnect over a Ground Start line. Table 4-10 shows the states of the A and B signaling bits in each stage of the disconnect procedure.

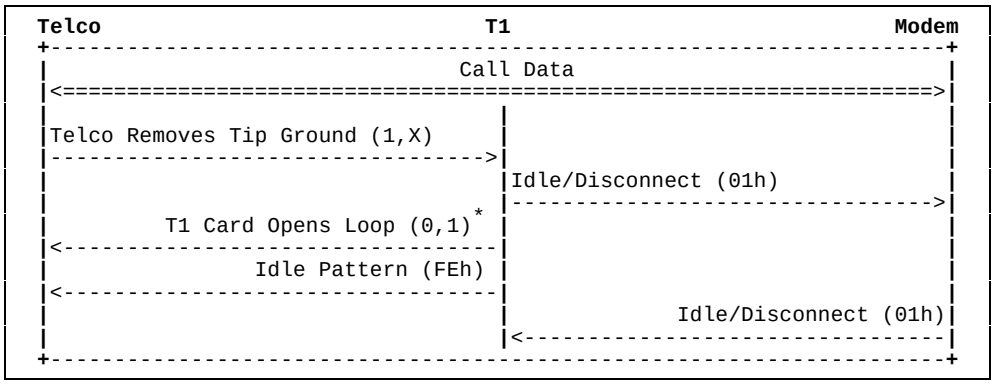
| | Transmit Signaling | | Receive Signaling | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Talking State | 1 | 1 | 0 | X |
| TELCO Removes Tip Ground (far end party hangs up)* | 1 | 1 | 1 | X |
| T1 Card Opens Loop (idle state) | 0 | 1 | 1 | X |

X = Don't Care
*This state is valid for brief transitions only.

*Table 4-10. Signaling States of a Ground Start TELCO-Initiated Disconnect*

**TELCO Removes Tip Ground.** When the TELCO initiates disconnect, it first removes tip ground by setting the (A,B) signaling bits to (1,X), where X is a don't care condition. Once the T1 Card receives this disconnect signal from the TELCO, it sends the Idle / Disconnect pattern (01h) to the modem.

**T1 Card Opens Loop.** Since the response to the TELCO's disconnect signal must be quick, the T1 Card then opens the loop by sending the (A,B) signaling pattern (0,1) to the TELCO. The T1 Card must open the loop quickly, because the TELCO may present a new incoming call at any time after the tip is removed. Leaving the loop open is treated as an answer. The T1 Card also sends the Idle pattern (FEh) to the TELCO. Once the loop is open, the T1 Card sees the idle / disconnect pattern from the modem. Figure 4-12 shows the TELCO disconnect process.




*The T1 Card must send this (0,1) signal as soon as possible because the TELCO can present a new call as soon as it removes tip ground.

*Figure 4-12. Diagram of a Ground Start TELCO-Initiated Disconnect*

## Ground Start Call Processing: Special Cases

This section describes the process by which the T1 Card hangs up a connection during ringing. If the modem decides to abandon a call, it sends the Idle / Disconnect pattern to the T1 Card. The T1 Card then closes the loop. To avoid further confusion for the TELCO, the T1 Card must wait 600 ms before it tries to dial out on that line.

If a modem fails while in a connection, the remote end recognizes the loss of carrier. The TELCO then initiates a disconnect procedure to tear down the connection by signaling the T1 Card. In this way, Ground Start lines are more robust that Loop Start lines.

# Chapter 5
# DS0 Configuration

DS0 configuration can be performed through the local operator interface or the *Total Control Manager/SNMP* management software. Instructions for setting up the local operator interface are in Chapter 2, and descriptions of the menus and screens are in Appendix A (Single T1 Card) and Appendix B (Dual T1 Card). The software is covered in the *Total Control Manager/ SNMP Software Guide*. This chapter discusses the underlying concepts of DS0 configuration.

The individual DS0 channels on each T1 span line can be configured in the following ways:

- Configuration State
- Time Slot Assignment

These configurations are all stored in the T1 Card's NVRAM.

## Configuration State

A request to place a DS0 in a configuration state always takes effect immediately. There are four configuration states:

**Normal**. This is the default configuration, and is the typical DS0-TDM connection. The software looks at the signaling information to maintain the connection for call setup / tear down. This is the only configuration state that can be overridden by a command.

**Busy-out**. This is equivalent to the Hard Busy-out command, but as a configuration state can be saved to NVRAM and used as a power-up setting.

**Transparent**. The channel has been set up so robbed bit signaling will not be used in call set up and tear down. No in-band signaling is used, and signals and data are in separate paths. The Transparent state provides clear DS0 channels to pass data between the T1 Card and modems. Modems must be set up so that they process call information via the Packet Bus and ignore in-band signaling on the TDM Bus.

**Frac-Unused**. Placing the DS0 in this state disconnects the DS0 from the TDM Bus (assigns it a time slot of 0) and sends a stuffed byte to the TELCO. This is applicable when a user has purchased fractional T1 service from the TELCO, in which only a portion of the 24 DS0s available have been subscribed for. All DS0s not used should be placed in the Frac-Unused state.

## Time Slot Assignment

The T1 Card can populate any slot from 1–16. Time slot assignment provides the ability to manage individual DS0s to fit a desired application. A DS0 can be assigned to a time slot on the TDM Bus, ignored entirely, or temporarily disconnected.

### *Configuration Rules*

1. A single DS0 on a given span line cannot be connected to multiple time slots on the TDM Bus.
2. Multiple DS0s on a given span line cannot be connected to a single time slot on the TDM Bus.
3. Assigning a DS0 a time slot of 0 places it into one of two states:
   - If the Configuration State of the DS0 is Fractional T1, the DS0 is configured for a fractional T1 application.
   - If the Configuration State is anything else besides Fractional T1, the DS0 is temporarily disconnected from the TDM Bus and is available for other connections.
4. Based on rules 1, 2 and 3, valid time slot assignments are:
   - Assigning individual DS0s on a span line to time slots on the TDM Bus (Modem Assignment).

- Ignoring individual DS0s on a span line (Fractional T1 Application).
- Disconnecting DS0s temporarily from a TDM or Fractional T1 connection and allowing them to be used in other time slot assignments (Unused State).

5. Time slot assignment configuration is executed in the order received, so that any DS0s associated with the current connection are first disconnected before a new DS0 connection takes effect. Any call in progress associated with DS0s involved in the current and new connection will be disconnected.
6. Time slot assignments override any DS0 state that is issued by command, as opposed to configuration states. For example, if a DS0 has been placed in a Call Ignore state by command and then is configured for Fractional T1, the DS0 is placed in a Fractional-Unused state, which cannot be overridden by any other DS0 command.

## *Modem Assignment Application*

Although a DS0 channel can be assigned to any slot on the TDM Bus, modems are assigned to a fixed time slot based on the slot in which they are installed.

Modem slot/channel numbering is based on time slot number on the TDM Bus, as follows:

| Slot # | Channel # | TDM Time Slot # |
|---|---|---|
| 1 | 1–4 | 61–64 |
| 2 | 1–4 | 1–4 |
| 3 | 1–4 | 5–8 |
| 4 | 1–4 | 9–12 |
| 5 | 1–4 | 13–16 |
| 6 | 1–4 | 17–20 |
| 7 | 1–4 | 21–24 |
| 8 | 1–4 | 25–28 |
| 9 | 1–4 | 29–32 |
| 10 | 1–4 | 33–36 |
| 11 | 1–4 | 37–40 |
| 12 | 1–4 | 41–44 |
| 13 | 1–4 | 45–48 |
| 14 | 1–4 | 49–52 |
| 15 | 1–4 | 53–56 |
| 16 | 1–4 | 57–60 |

Configuring a DS0 for a modem assignment application disrupts any call in progress associated with the DS0. After the new connection is made, modems that were previously assigned to the DS0s that are now disconnected and left unassigned become unused and available for other connections/applications. The unassigned DS0s are left in an Unused state.

# Appendix A
# Single T1 Card Operator Interface

Connecting a dumb terminal, or a PC using a terminal emulation program, to the RS-232 operator interface port on the T1 NIC allows an operator to configure and manage the T1 NAC via menu-driven screens. Once connected, press Return to display the following menu.

**NOTE:** A remote operator can dial in to a modem connected to the RS-232 interface and configure the T1 NAC. Once the modems have connected, press Return to display the following menu on the remote terminal's screen.

```
     U.S. ROBOTICS

     Single T1 Application Card Revision 3.0.2
     Boot Code Linked Date: Fri Dec 13 08:22:17 1994
     Operational Code Linked Date: Fri Dec 13 15:15:23 1994

Main Menu

1) Status
2) Command
3) T1 Card Configuration
4) DS0 Configuration
5) T1 Span Line 1 Configuration
6) T1 Span Line 1 Call Parameter Configuration

Enter menu selection and press Return.

Menu Selection (1-6):_
```

Type the number of the selection you desire and press Return. At any point in the menu structure, pressing Esc returns you to the previous menu.

# Status

When you select Status from the Main Menu, the following menu appears.

```
Status

1) Power-up Self-test Status
2) T1 Card Status
3) T1 Span Line 1 DS0/Modem Status
4) T1 Span Line 1 Alarm/Event Status

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-4):_
```

These options report various status conditions on the T1 NAC, T1 span line, and the quad modems, as well as any alarms or events taking place. The displayed status is a snapshot of the events and/or conditions at the time the operator requests the status report.

## Power-up Self-test Status

Upon power-up, the T1 software performs various tests to ensure proper operation of the T1 hardware. Select option 1 from the Status menu to display the results of those tests.

```
Power-up Self-test Status

RAM: Passed
Flash ROM: Passed
Non-maskable Interrupt: Passed
Watch Dog: Passed
EEPROM: Passed
Management UART: Passed
User Interface UART: Passed
Time/space Switch: Passed
Framer 1: Passed
Line Interface Unit 1: Passed
Internal Clock (INT): Passed
TDM Bus Clock (BUS): Not Present
```

### Possible Power-up Self-test Status

**RAM**. This test fills the SRAM of the NAC with a pattern sequence and then performs a comparison check. The failure level for this test is Critical.

**Flash ROM**. This test performs a CRC check on the Flash ROM. The failure level for this test is Critical.

**Non-maskable Interrupt**. This is a write-to-ROM test, which should result in a non-maskable interrupt (NMI). Any attempt to write to ROM should cause the NMI test code to run. The failure level for this test is Non-critical.

**Watch Dog**. This test verifies the watch-dog circuitry on the T1 NAC. The failure level for this test is Non-critical.

**EEPROM**. This test performs a CRC check as well as a check for a unique string stored in EEPROM. The failure level for this test is Non-critical.

**Management UART**. This is a simple loopback test to verify the UART that communicates with the Management Bus. The failure level for this test is Non-critical.

**User Interface UART**. This is a simple loopback test to verify the UART that communicates with the user interface port. The failure level for this test is Non-critical.

**Time/space Switch**. The T1 software runs two built-in self-tests of the Time Space Interchange (TSI), as well as a write/read test of the TSI registers. The failure level for this test is Non-critical.

**Framer 1**. The T1 software performs various diagnostic exercises to test the framer chip. The failure level for this test is Non-critical.

**Line Interface Unit 1**. The power-up code first checks if the T1 NIC is present, and then configures the CSU on the NIC to local loopback mode. The failure level for this test is Non-critical.

**Internal Clock (INT)**. The test code selects the internal clock as a timing source and then checks to see if the UART's counter is running. The failure level for this test is Non-critical.

**TDM Bus Clock (BUS)**. The test code selects the TDM Bus as a timing source and then checks to see if the UART's counter is running. The failure level for this test is Non-critical.

**NOTE:** The TDM Bus is not currently available as a timing source.

## T1 Card Status

Select Status menu option 2 to view the current timing source, the type of NIC installed with the T1 Card, and the slot in which the T1 NAC is installed.

```
T1 Card Status

Current Timing Source: T1A
NIC Type             : Single T1
T1 NAC Slot Number   : 01
```

## DS0/Modem Status

Select Status menu option 3 to view a snapshot of DS0/Modem status.

```
T1 Span Line 1 DS0/Modem Status

DS0   DS0         Modem      Slot/  DS0  DS0        Modem       Slot/
      Status      Status     Chan        Status     Status      Chan

1   BUSY-OUT    IDLE         2/1   13  CONNECT-OUT CONNECT-OUT 5/1
2   CONNECT-IN  CONNECT-IN   2/2   14  BUSY-OUT    BUSY-OUT    5/2
3   CALL-IGNORE UNAVAIL      2/3   15  IDLE        IDLE        5/3
4   TRANSPTEST  TRANSPTEST   2/3   16  TRANSPTEST  TRANSPTEST  5/4
5   •           •                  17              •
6   •           •                  18              •
7   •           •                  19              •
8   •           •                  20              •
9   •           •                  21              •
10  •           •                  22              •
11  •           •                  23              •
12  •           •                  24              •

Press Return to update status or press Esc to exit.
```

### Possible DS0 Status

**Alarm**. An alarm condition was detected on the DS0, or the DS1 associated with the DS0 trunk. An Out of Frame (OOF) or Loss of Signal (LOS) DS1 condition places associated DS0 trunks into an Alarm state.

**Busy-Out**. The DS0 has been issued a DS0 command of Busy-Out and is not available for use. If a call goes to the DS0, a busy signal is returned.

**Call-Ignore**. A command has been issued from the modem or the T1 operator to ignore all calls on the specified DS0(s).

**CBusy-Out**. The DS0 has been assigned a configuration state of Busy-Out. This setting may be saved to and restored from NVRAM.

**Connect-In**. The DS0 line is in use with a call originating from a remote device through the TELCO.

**Connect-Out**. The DS0 line is in use with a call originating from a modem in the chassis.

**Dialing-In**. A call is originating from the TELCO and is being answered by the T1/modem. Call setup is in progress.

**Dialing-Out**. A call is originating from a chassis modem.

**Frac-Unused**. The DS0 has been assigned a time slot of 0 (disconnected from the TDM Bus) and a configuration state of Frac-Unused, for a Fractional T1 application.

**Idle**. The DS0 line is available and waiting for a call.

**Test**. A test is taking place on the DS0.

**Transparent**. The DS0 has been placed in a transparent mode with a properly configured compatible modem. When in this state, all DS0 commands are ignored. An Alarm state overrides the Transparent state, but returns the DS0 to Transparent when the Alarm clears.

**Transptest**. The DS0 has been placed in a transparent test mode in order for the modem to carry out a tone test on the channel. When in this state, all DS0 commands are ignored except for the Restore DS0 command, which returns the DS0 to the idle state.

**Unavailable**. No T1 span line connected to the NIC. All DS0s also display *unavailable* if no T1 span line is attached.

**Unused**. The DS0 has been assigned a time slot of 0 (disconnected from the TDM Bus) and a configuration state of Normal, Busy Out or Transparent.

### Possible Modem Status

**Busy-Out**. The modem is not available for use. If a call goes to the modem, a busy signal is returned.

**Connect-In**. A modem is in use with a call originating from a remote device through the TELCO.

**Connect-Out**. A modem is originating a call.

**Dialing-In**. A call is originating from the TELCO and is being answered by the modem. Call setup is in progress.

**Dialing-Out**. A call is originating from a modem in the chassis.

**Idle**. The modem is available and waiting for an incoming or outgoing call request.

**Transparent**. The modem has been placed in a transparent test mode with a properly configured DS0 channel.

**Transptest**. The modem is performing a transparent tone test on the DS0 channel.

**Unavailable**. The modem has failed or is not installed.

**Unused**. The modem is not currently connected to a DS0.

## Alarm/Event Status

Select Status menu option 4 to view a snapshot of Alarm/Event status taken when the operator requests the status report.

```
T1 Span Line 1 Alarm/Event Status

Receiver Gain: 0 dB

Errored Seconds: xxxxx seconds
Severely Errored Seconds: xxxxx seconds
Failed Seconds: xxxxx seconds
Bursty Errored Seconds (ESF Only): xxxxx seconds

Bipolar Violations: xxxxx
Framing Bit Errors: xxx
CRC Errors (ESF Only): xxxxx

Change in Frame Alignment: xxx
Remote Frame Alarm: y/n
Alarm Indication Signal: y/n
Frame Slips: xxx
Out of Frame: y/n
Loss of Signal: y/n
Excessive CRC Error (ESF Only): xxx

Press Return to update status, press Ctrl-R to reset counters or
press Esc to exit.
```

The following describes the status conditions reported.

**Receiver Gain**. This is a function of the Line Interface Units and indicates T1 span line signal attenuation in 7.5 dB increments: 0 dB, 7.5 dB, 15 dB and 22.5 dB.

**Errored Seconds**. Depending on framing format, this indicates OOF conditions, frame slip conditions or error events. For SF, it reports the number of seconds during which the frame was in either OOF or slip condition. For ESF, it reports error events in seconds.

**Severely Errored Seconds**. This reports error events or frame slip conditions in seconds.

**Failed Seconds**. This indicates the number of seconds spent in a failed state. A failed state is defined as 10 consecutive seconds during which severely errored seconds occur.

**Bursty Errored Seconds**. This occurs in ESF format only. It reports CRC error conditions in seconds.

**Bipolar Violations**. This indicates bipolar violations (BPV) in the line format being used. When no line coding or ZCS line coding is used, this parameter indicates any BPVs. When B8ZS line coding is used, it indicates any invalid BPVs. The count of the BPVs detected from the T1 span line is reported.

A BPV occurs whenever two consecutive non-zero elements of the same polarity occur in an Alternate Mark Inversion (AMI) signal.

**Framing Bit Errors**. This indicates an error in the framing bit used to determine frame alignment. The count of framing bit errors is reported.

**Excessive CRC Errors**. This occurs when a CRC bit is in error. The count of CRC errors is reported. This is only for ESF mode.

**Change in Frame Alignment (CFA)**. This indicates that a receiver has reframed on a new framing pattern — it has synchronized at a new frame alignment due to an Out of Frame (OOF) condition. The status report indicates whether or not a CFA has occurred.

A counter records the number of times this has occurred since the last counter reset.

**Remote Frame Alarm (RFA)**. This indicates that an OOF condition has occurred at the remote end. It is also known as a yellow alarm. The status report indicates whether or not RFA is present.

**Alarm Indication Signal (AIS)**. This indicates to the remote end a loss of the received signal. It is also known as a blue alarm. AIS occurs when a stream of 1's is received. The status report indicates the presence of an AIS condition.

**Frame Slips**. These can be caused by frames that are repeated due to buffer overflow (BOF) or frames that are deleted because of buffer underflow (BUF). The status report indicates if either a BOF or BUF condition has occurred.

A counter records the number of times this has occurred since the last counter reset.

**Out of Frame (OOF)**. This indicates that a framing pattern for a T1 line has been lost and data cannot be extracted properly. In SF and ESF, OOF occurs when any two of four consecutive frame synchronization bits are in error. The status indicates whether or not OOF conditions are present.

**Loss of Signal (LOS)**. This occurs when 175 consecutive 0's are detected in the NIC. The signal is recovered if the density of 1's reaches 12.5%, that is, four 1's are received within a 32-bit period. The status report indicates the presence of an LOS condition.

**Excessive CRC Error Indication (ECRCEI)**. This is reported only in ESF format, when 32 of any 33 consecutive CRCs are in error. The status report indicates if this has occurred, and a counter records the number of times this has occurred since the last counter reset.

**Reset Counter**. The reset command function is executed by pressing Ctrl-R. The operator can clear counters for Errored Seconds, Bursty Errored Seconds, Severely Errored Seconds, Failed Seconds, CRC Errors, Bipolar Violations and Framing Bit Errors, without changing device configuration. An operator can verify that the counters are cleared by selecting this status screen again to display the new count.

## Command

Select Command from the Main Menu. The following menu appears.

```
Command

1) Reset to Highest Priority Timing Source
2) Reset T1 NAC
3) Soft Busy Out DS0(s) on T1 Span Line 1
4) Hard Busy Out DS0(s) on T1 Span Line 1
5) Restore DS0(s) on T1 Span Line 1
6) Disconnect Call on T1 Span Line 1 DS0(s)
7) Ignore Calls on T1 Span Line 1 DS0(s)
8) Force Receiver Reframe on T1 Span Line 1
9) Set DS0(s) for Transparent Test on Span Line 1

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-9):_
```

This menu provides command options to perform specific functions on the individual T1 span lines and DS0 channels.

**Reset to Highest Priority Timing Source**. This resets the T1 NAC's timing source to the next highest priority source.

**NOTE:** The TDM Bus is not currently available as a timing source.

```
Timing source has been set to T1 Span Line 1.
                              <Internal Clock.>
                              <TDM Bus.>

Press Esc to exit.
```

**Reset T1 NAC**. This resets the T1 NAC and restores the factory configuration. This action takes place immediately and does not prompt for confirmation.

**Soft Busy Out DS0(s) on T1 Span Line 1**. This allows an operator to perform a soft busy out on individual DS0 channel(s). The channels that are manually busied out remain in that state until they are manually restored.

If the line is in use when a soft busy out is executed, the busy out takes place after the call is disconnected. This is a good way to take a T1 span line out of service without disrupting any calls.

```
Soft Busy Out DS0(s) on T1 Span Line 1

Enter DS0(s) to be busied out and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Hard Busy Out DS0(s) on T1 Span Line 1.** This allows an operator to perform a hard busy out on individual DS0 channel(s). The channels that are manually busied out remain in that state until they are manually restored.

Hard busy out can also be used to seize the M-Lead, which is sometimes useful when diagnosing T1 span lines.

**WARNING:** If the line is in use when a hard busy out is executed, the connection is immediately terminated.

```
Hard Busy Out DS0(s) on T1 Span Line 1

Enter DS0(s) to be busied out and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Restore DS0(s) on T1 Span Line 1**. This allows an operator to manually restore individual DS0 channel(s).

```
Restore DS0(s) on T1 Span Line 1

Enter DS0(s) to be restored and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Disconnect Call on T1 Span Line 1 DS0(s)**. This allows an operator to disconnect a call on one or more DS0 channels.

```
Disconnect Call on T1 Span Line 1 DS0(s)

Enter DS0(s) to be disconnected and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Ignore Calls on T1 Span Line 1 DS0(s).** This sets the card to ignore all incoming calls on the T1 span line.

```
Ignore Call on T1 Span Line 1 DS0(s)

Enter DS0(s) to be ignored and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Force Receiver Reframe on T1 Span Line 1**. This forces the T1 framer for T1 span line 1 to reframe. Causes data errors and call disconnects.

```
Force Receiver Reframe on T1 Span Line 1 Successful.
                                              <Unsuccessful.>

Press Esc to exit.
```

**Set DS0(s) for Transparent Test on T1 Span Line 1**. This allows an operator to perform a transparent test on DS0 channel(s).

```
Set DS0(s) for Transparent Test on Span Line 1

Enter DS0(s) to be in transparent test mode and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

# T1 Card Configuration

When you select T1 Card Configuration from the Main Menu, the following menu appears. These options pertain to the T1 NAC as a whole. To return to the T1 Card Configuration menu from one of these submenus, press Esc.

```
T1 Card Configuration                              Current Setting

 1)  Save Current Configuration to NVRAM
 2)  Restore NVRAM Configuration
 3)  Restore Default Configuration
 4)  Timing Source Priority Assignment  T1-1=1   INT=0  BUS=0

  (NOTE: Changing configuration parameters may affect calls
  in progress.)

Enter menu selection and press Return or press Esc to exit the
Menu Selection (1-4):_
```

**Save Current Configuration to NVRAM**. If you made changes to the default configuration of the T1 NAC, and you wish to retain these changes, select this option to save the new configuration to NVRAM. You are prompted to confirm the operation.

```
Saving Current Configuration Settings

1 Save Current Configuration

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Restore NVRAM Configuration**. If you made changes to the NVRAM settings, and you wish to reset the T1 NAC to its previous settings, select this option. You are prompted to confirm the operation.

**REMEMBER:** If you made changes to the NVRAM settings and selected the *Save Current...* option, you can't restore the previous NVRAM configuration.

```
Restore of Config from EEPROM

1 Restore Configuration from EEPROM

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Restore Default Configuration**. Use this option to reload all factory defaults. You are prompted to confirm the operation.

```
Restoring Default Configuration Settings

1 Restore Default Configuration

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Current Timing Source Priority**. A number from 1 (highest priority) to 4 is assigned to the timing sources. The timing source with the highest priority clocks data on the T1 span line and drives the TDM bus. Any timing source can be disabled by assigning a priority of 0. If not disabled, two or more timing sources cannot be assigned the same priority. Priority assignment of timing sources allows switching to the next highest timing source if the current source fails.

```
Current Timing Source Priority

T1 Span Line 1 (T1-1): 1
Internal Clock (INT): 0
TDM Bus (BUS): 0

Enter the desired priority (0-4) beneath each timing source
and press Return or press Esc to exit.

0 = Disabled,  1 = Highest Priority, 4 = Lowest Priority

Timing Source Priority Assignment

          Timing Source:     T1-1  INT  BUS
Timing Source Priority:_
```

The timing source does not switch unless a failure is detected on the current choice. For example, if the primary timing source fails, the secondary timing source takes over. The secondary source remains active as long as it does not fail, even if the primary source returns.

From the Command Menu, select *Reset to Highest Priority Timing Source.* The primary timing source once again becomes active. See a full description earlier in this appendix.

The following table summarizes the options and defaults for timing source priority.

*Table A-1. Timing Source Priority*

| Parameter | Options | Default |
|---|---|---|
| T1 Span Line 1 Timing Source Priority | 0 (Disabled)<br>1 (Highest priority)<br>2<br>3<br>4 (Lowest priority) | 1 |
| Internal Oscillator Timing Source Priority | 0 (Disabled)<br>1 (Highest priority)<br>2<br>3<br>4 (Lowest priority) | 0 (Disabled) |
| TDM Bus Timing Source Priority<br>(Not currently available) | 0 (Disabled)<br>1 (Highest priority)<br>2<br>3<br>4 (Lowest priority) | 0 (Disabled) |

## DS0 Configuration

When you select DS0 Configuration from the Main Menu, the following menu appears. To return to the DS0 Configuration menu from one of these submenus, press Esc.

```
DS0 Configuration

  1  Modem Assignment (Span DS0s to TDM Bus' Time Slots)
  2  Fractional T1 (Span's DS0s Ignored)
  3  Disconnect (Put DS0(s) in 'UNUSED' State)
  4  Configuration Status of DS0 1 to 24 (T1 Span Line 1)

  (NOTE: Changing configuration parameters may affect calls
in progress.)

  Enter menu selection and press Return or press Esc to exit.

  Menu Selection (1-4):
```

**Modem Assignment**. Use this screen to connect a DS0 to a specific TDM Bus time slot using a certain type of signaling (normal signaling, transparent signaling or busy out). This screen can also be used to configure the signaling for one or more DS0s. The following syntax rules apply:

- The command is not case-sensitive.
- 'D', 'T', '-', 'to' and ',' are called tokens, each of which can be separated by zero or more blank spaces.
- Valid numbers for 'D' are 1 to 24 for the Single T1 Card.
- Valid numbers for 'T' are 1 to 64.
- For range assignment, the number preceding '-' must be equal to or less than the number following '-', e.g., 3-1 is invalid.
- For range assignment of connections using the keyword 'to', the range of numbers before and after the keyword must be equal, e.g., 1-2 to 27-31 is incorrect.
- For a modem assignment application, the numbers before the word 'to' refer to the DS0 number, and the numbers after the word 'to' refer to the TDM time slot.
- Any combination of formats must be separated by a comma.

```
Modem Assignment (Span's DS0s to TDM Bus' Time Slots)

 Enter a signaling assignment option followed by DS0 to TDM
Assignments.
 Use the following format"
     'S: D (,D,D-D) to T (,T,T-T)'
 Where S = Signaling Option (can be one of the following):
            N = Normal Signaling on Specified DS0(s)
            T = Transparent Signaling on Specified DS0(s)
            B = Busy Out Specified DS0(s)
       D = DS0 number 1-24:
            DS0  1-24 = span 1
       T = TDM Bus time slot number 1-64:
            time slot  1-60 = rack slots #2 - 16
            time slot 61-64 = rack slot #1

 Separate all entries with a comma (,), where each entry can
 either be a single item (D or T) or a range of items (D-D or
 T-T).

 Example: 'N: 1,2-4 to 1,2,3,4' connects DS0s 1 through 4
 to TDMs 1 through 4 respectively using normal signaling.

 >:
```

**Fractional T1**. Use this screen to configure one or more DS0s with a TDM Bus time slot of 0 and a configuration state of Frac-Unused (fractional T1 application).

```
 Fractional T1 (Span's DS0s Ignored)

 Enter DS0(s) to be configured for Fractional T1 call ignore
and press Return.

 The format for Fractional T1 call ignore configuration
entries is as follows:
     Use 'D' for an individual DS0 assignment
 or
     Use 'D-D' for a range of DS0 assignments
where
     D = DS0 number 1-24:
         DS0  1-24 = span 1

 Separate all entries with a comma (,), where each entry can be
either one of the above formats.

>:
```

**Disconnect**. Use this screen to configure one or more DS0s with a TDM Bus time slot of 0 and a configuration state of Unused.

```
 Disconnect (Put DS0(s) in 'UNUSED' State)
 Enter DS0(s) to be disconnected and press Return.


 Separate all entries with a comma (,), where each entry can
 either be an individual DS0 (1-24) or a range of DS0s
 separated by a dash.

>:
```

**Configuration Status**. This screen shows the current status of all DS0s on the span line. It shows whether the DS0 is connected to the TDM Bus or another span line, the number of the connected time slot or DS0, and the configuration state.

**NOTE:** A DS0 may only be connected to a TDM Bus time slot, not to a DS0 on another span line.

```
 Configuration Status of DS0 1 to 24 (T1 Span Line 1)

 DS0 Conn.To DS0/TS Cfg.State   DS0 Conn.To DS0/TS Cfg.State
 1     TDM     25   Busy-Out    13    TDM     37   Normal
 2     TDM      6   Busy-Out    14    TDM     18   Normal
 3     TDM     None Busy-Out    15    TDM     None Normal
 4     TDM      4   Busy-Out    16
 5     TDM     None Busy-Out    17
 6                              18
 7                              19
 8                              20
 9                              21
10                              22
11                              23
12                              24

Press Esc to Exit.
```

## T1 Span Line 1 Configuration

When you select T1 Span Line 1 Configuration from the Main Menu, the following menu appears. To return to the T1 Span Line 1 Configuration menu from one of these submenus, press Esc.

```
T1 Span Line 1 Configuration                        Current Setting

 1)  Framing Mode                                   SF
 2)  Line Coding                                    AMI
 3)  Remotely Initiated Loopback                    Ignore
 4)  Jitter Attenuation                             Transmitter
 5)  Transmit Line Build Out                        0.0 dB
 6)  Automatic Busy-out                             Disabled
 7)  Fractional T1 Byte Sent to TELCO               FE Hex.

Enter menu selection and press Return or press Esc to exit
Menu Selection (1-6):_
```

Table A-2 summarizes the options and defaults for parameters configurable per T1 span line.

*Table A-2. Parameters Configurable per T1 Span Line*

| Parameter | Options | Default |
|---|---|---|
| Framing Mode | Superframe (SF) \|Extended Superframe (ESF) | Superframe |
| Line Coding | Alternate Mark Inversion (AMI)<br>Zero Code Suppression (ZCS)<br>Binary 8 Zero Substitution (B8ZS) | AMI |
| Line Loopback | Ignore<br>Respond | Ignore |
| Jitter Attenuation | Receiver<br>Transmitter | Transmitter |
| Transmit Line Build Out | 0.0 dB<br>7.5 dB<br>15.0 dB<br>22.5 dB | 0.0 dB |
| Automatic Busy Out | Enabled<br>Disabled | Disabled |
| Fractional T1 Byte | Hexadecimal value | FE |

**Framing Mode**. Allows an operator to specify which framing format to use, superframe (SF) or extended superframe (ESF), for T1 span line 1.

The SF format has 12 DS1 frames, each with 193 bit positions. The ESF format has 24 DS1 frames and the ESF alignment signal, a Cyclic Redundancy Check (CRC), and a data link share the frame overhead-bit position.

In ESF mode, the T1 card reports yellow alarms on the Facilities Data Link. However, it does not provide performance monitoring or respond to diagnostic commands.

```
T1 Span Line 1 Framing Mode

1) Extended Superframe (ESF)
2) Superframe (SF)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Line Coding**. Allows an operator to select a line coding scheme, or Alternate Mark Inversion (AMI), for T1 span line 1. A line coding scheme ensures a sufficient density of 1's in the bit stream, required by the T1 standard for clock synchronization. In selecting AMI (no line coding), you risk losing data.

**IMPORTANT:** Usually the TELCO specifies the type of Framing Mode and Line Coding the T1 line has. Make sure the above options are set in accordance with the type of T1 line purchased.

```
T1 Span Line 1 Line Coding

1) Alternate Mark Inversion (AMI)
2) Zero Code Suppression (ZCS)
3) Binary 8 Zero Substitution (B8ZS)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-3):_
```

**Line Loopback (LLB)**. Allows an operator to enable or disable LLB mode for T1 span line 1. This parameter allows the T1 NAC to respond to a repeating pattern from the TELCO. When enabled, the T1 NAC enters LLB mode upon receipt of the pattern *00001* for 5 seconds, and exits LLB mode upon receipt of the pattern *001* for 5 seconds. In LLB mode, the T1 NAC loops back the received signal to the T1 line; the system side goes to an idle condition.

While in loopback mode, the LPBK LED for the appropriate T1 line is green.

```
T1 Span Line 1 Remotely Initiated Loopback

1) Ignore
2) Response

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Jitter Attenuation**. The T1 NIC hardware provides a 193-bit frame buffer to compensate for low frequency jitter with the synchronization to the T1 network. This buffer can be placed in either the receive or transmit data path.

The default setting is the transmitter. The transmitter is recommended when the T1 Card is using internal timing instead of timing from the span line.

```
T1 Span Line 1 Jitter Attenuation

1) Attenuate Jitter on Receiver
2) Attenuate Jitter on Transmitter

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Transmit Line Build Out**. This is a function of the LIUs and can be selected for 0 dB, 7.5 dB, 15 dB or 22.5 dB, individually for each LIU.

Transmit Line Build Out is used to eliminate crosstalk problems when the transmitter energy causes errors on the low amplitude receive line.

```
T1 Span Line 1 Transmit Line Build Out

1)  0.0 dB
2)  7.5 dB
3) 15.0 dB
4) 22.5 dB

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-4):_
```

**Automatic Busy Out**. This can be set to enable or disable automatic mode to busy out and restore T1 span line 1 based on the availability of the corresponding modem channel.

```
T1 Span Line 1 Automatic Busy-Out

1) Disabled
2) Enabled

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**WARNING:** Busy Out is accomplished by setting the DS0 to an off hook condition. Some TELCOs may react to this as an error condition and remove the DS0 trunk from service. If this is the case, disable Automatic Busy Out.

**Fractional T1**. T1 equipment requires a sufficient number of 1's in the bit stream to derive clock synchronization. For a fractional T1 application, this parameter can be set to send a "stuffed byte" to the TELCO on inactive DS0s to satisfy this requirement. The parameter is configurable so that it can be adjusted to satisfy the 1's density required by the TELCO; the default is FE (Hex).

```
T1 Span Line 1 Fractional T1 Pattern to TELCO

For Fractional T1, a "stuffed byte" pattern must be sent out on
the unused/ignored DS0s toward TELCO to satisfy 1's density
requirement.

Enter a byte in hexadecimal ranges from 00 to FF (default = FE
Hex) and press Enter, or press Esc to exit.

>:_
```

## T1 Span Line 1 Call Parameter Configuration

From the Main Menu, select **Configuration**, then **T1 Call Parameter Configuration**. The T1 Call Parameter Configuration screen is displayed. These options permit the operator to customize the call parameters as needed.

```
T1 Span Line 1 <2> Call Parameter Configuration

1) Set to Feature Group B Defaults
2) Set to Feature Group D Defaults
3) Set to Loop-Start Defaults
4) Set to Ground-Start Defaults
                                                  Current Setting
5) Dial-in/Dial-out Trunk Type                    E&M Type II
6) Dial-in/Dial-out Trunk Start                   Wink
7) Dial-in Address                                DNIS
8) Dial-in Address Acknowledge Wink               Disable
9) Dial-out Address Delay                         70 MS

(NOTE: Changing configuration parameters may affect calls
in progress).

Enter menu selection and press Return or press Esc to exit
Menu Selection (1-9):_
```

**Feature Group Defaults**. The first two options on the menu permit the operator to set the call parameters for the span line to the default values for either Feature Group B or D.

```
Setting Span 1 to Feature Group B <D> Default

1 Set to Feature Group B<D> Defaults

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Loop-Start/Ground-Start Defaults.** Options 3 and 4 automatically configure options 5 and 6 (trunk type and trunk start) to match your choice. Options 7 through 9 do not apply when you select one of these settings. See the descriptions that follow for the default settings.

```
Setting Span 1 Loop-start <Ground-start> Default

1 Set to Loop-start <Ground-start> Defaults

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Dial-in/Dial-out Trunk Type**. Set this parameter to specify whether E&M Type II, Loop Start or Ground Start should be used. E&M Type II is required for Feature Groups B and D. If you choose this trunk type, the start signal type is automatically set to Wink Start, and you may only change it to Immediate Start; Dial Tone is not possible. If you select Loop Start or Ground Start, the start signal type is automatically set to Dial Tone, and the settings on the T1 Call Parameter Configuration menu related to E&M Type II (Dial-in Address, Dial-in Address Acknowledge Wink, and Dial-out Address Delay) will have no significance.

```
T1 Span Line 1 Dial-in/Dial-out Trunk Type

1) E&M Type II (Used for Feature Group B and D and DID)
2) Loop Start
3) Ground Start

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-3):_
```

**Dial-in/Dial-out Trunk Start**. Set this parameter to specify whether Wink Start, Immediate Start or Dial-Tone should be used. Wink Start is required for Feature Groups B and D. Immediate Start is similar to Feature Group B signaling, except a wink start is not returned in response to a trunk seizure. Immediate Start does provide a slightly faster call setup, but provides no trunk integrity checking.

```
T1 Span Line 1 Dial-in/Dial-out Trunk Start

1) Wink (Used for Feature Group B and D)
2) Immediate
3) Dial-tone (Used for Ground Start and Loop Start)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-3):_
```

**Dial-in Address**. Set this parameter to specify what type of Feature Group addressing will be used on a dial-in call. The choice here depends on the type of T1 service purchased from the TELCO. You may select between No Address, DNIS only, both DNIS and ANI, or ANI only.

```
T1 Span Line 1 Dial-in Address

1) No Address (Optional for Feature Groups B and D)
2) DNIS (Used for Feature Group B)
3) ANI-DNIS (Used for Feature Group D)
4) ANI

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-4):_
```

**Dial-in Address Acknowledge Wink**. Set this parameter to enable / disable an acknowledge wink for a dial-in call. This is used with Feature Group D and will be enabled if you have selected Feature Group D defaults.

```
T1 Span Line 1 Dial-in Address Acknowledge Wink

1) Disable
2) Enable (Used for Feature Group D)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Dial-out Address Delay**. Set this parameter to change the delay that controls how quickly the T1 NAC will outpulse the address information on a dial-out call. This delay can be adjusted to allow the T1 NAC to connect with equipment that may not meet the FGB, FGD and Immediate Start delay specification of 70 ms.

```
T1 Span Line 1 Dial-out Address Delay

Enter address delay in milliseconds ranging from 70 ms (default)
to 3000 ms (3 seconds) and press Return or press Esc to exit.

>:_
```

# Appendix B
# Dual T1 Card Operator Interface

Connecting a dumb terminal, or a PC using a terminal emulation program, to the RS-232 operator interface port on the T1 NIC allows an operator to configure and manage the T1 NAC via menu-driven screens. Once connected, press Return to display the following menu.

**NOTE:** A remote operator can dial in to a modem connected to the RS-232 interface and configure the T1 NAC. Once the modems have connected, press Return to display the following menu on the remote terminal's screen.

```
     U.S. ROBOTICS

     Dual T1 Application Card Revision 3.0.2
     Boot Code Linked Date: Fri Dec 13 08:22:17 1994
     Operational Code Linked Date: Fri Dec 13 15:15:23 1994

Main Menu

1) Status
2) Command
3) T1 Card Configuration
4) DS0 Configuration
5) T1 Span Line 1 Configuration
6) T1 Span Line 1 Call Parameter Configuration
7) T1 Span Line 2 Configuration
8) T1 Span Line 2 Call Parameter Configuration

Enter menu selection and press Return.

Menu Selection (1-8):_
```

Type the number of the selection you desire and press Return. At any point in the menu structure, pressing Esc returns you to the previous menu.

# Status

When you select Status from the Main Menu, the following menu appears.

```
Status

1) Power-up Self-test Status
2) T1 Card Status
3) T1 Span Line 1 DS0/Modem Status
4) T1 Span Line 1 Alarm/Event Status
5) T1 Span Line 2 DS0/Modem Status
6) T1 Span Line 2 Alarm/Event Status

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-6):_
```

These options report various status conditions on the T1 NAC, T1 span line(s), and the quad modems, as well as any alarms or events taking place. The displayed status is a snapshot of the events and / or conditions at the time the operator requests the status report.

## Power-up Self-test Status

Upon power-up, the T1 software performs various tests to ensure proper operation of the T1 hardware. Select option 1 from the Status menu to display the results of those tests.

```
Power-up Self-test Status

RAM: Passed
Flash ROM: Passed
Non-maskable Interrupt: Passed
Watch Dog: Passed
EEPROM: Passed
Management UART: Passed
User Interface UART: Passed
Time/space Switch: Passed
Framer 1: Passed
Framer 2: Passed
Line Interface Unit 1: Passed
Line interface Unit 2: Passed
Internal Clock (INT): Passed
TDM Bus Clock (BUS): Not Present
```

### Possible Power-up Self-test Status

**RAM**. This test fills the SRAM of the NAC with a pattern sequence and then performs a comparison check. The failure level for this test is Critical.

**Flash ROM**. This test performs a CRC check on the Flash ROM. The failure level for this test is Critical.

**Non-maskable Interrupt**. This is a write-to-ROM test, which should result in a non-maskable interrupt (NMI). Any attempt to write to ROM should cause the NMI test code to run. The failure level for this test is Non-critical.

**Watch Dog**. This test verifies the watch-dog circuitry on the T1 NAC. The failure level for this test is Non-critical.

**EEPROM**. This test performs a CRC check as well as a check for a unique string stored in EEPROM. The failure level for this test is Non-critical.

**Management UART**. This is a simple loopback test to verify the UART that communicates with the Management Bus. The failure level for this test is Non-critical.

**User Interface UART**. This is a simple loopback test to verify the UART that communicates with the user interface port. The failure level for this test is Non-critical.

**Time/space Switch**. The T1 software runs two built-in self-tests of the Time Space Interchange (TSI), as well as a write/read test of the TSI registers. The failure level for this test is Non-critical.

**Framer 1/2**. The T1 software performs various diagnostic exercises to test the framer chips. The failure level for this test is Non-critical.

**Line Interface Unit 1/2**. The power-up code first checks if the T1 NIC is present, and then configures the CSU on the NIC to local loopback mode. The failure level for this test is Non-critical.

**Internal Clock (INT)**. The test code selects the internal clock as a timing source and then checks to see if the UART's counter is running. The failure level for this test is Non-critical.

**TDM Bus Clock (BUS)**. The test code selects the TDM Bus as a timing source and then checks to see if the UART's

counter is running. The failure level for this test is Non-critical.

**NOTE:** The TDM Bus is not currently available as a timing source.

## T1 Card Status

Select Status menu option 2 to view the current timing source, the type of NIC installed with the T1 Card, and the slot in which the T1 NAC is installed.

```
T1 Card Status

Current Timing Source: T1A
NIC Type:              Dual T1
T1 NAC Slot Number   : 01
```

## DS0/Modem Status

Select Status menu option 3 or 5 to view a snapshot of DS0/Modem status.

```
T1 Span Line 1<2> DS0/Modem Status

DS0   DS0         Modem      Slot/  DS0  DS0        Modem       Slot/
     Status       Status     Chan       Status     Status       Chan

1   BUSY-OUT     IDLE       2/1    13  CONNECT-OUT CONNECT-OUT 5/1
2   CONNECT-IN   CONNECT-IN 2/2    14  BUSY-OUT    IDLE        5/2
3   CBUSY-OUT    UNAVAIL    2/3    15  IDLE        IDLE        5/3
4   TRANSPTEST   TRANSPTEST 2/4    16  FRAC-UNUSED UNUSED      5/4
5   •            •                  17              •
6   •            •                  18              •
7   •            •                  19              •
8   •            •                  20              •
9   •            •                  21              •
10  •            •                  22              •
11  •            •                  23              •
12  •            •                  24              •

Press Return to update status or press Esc to exit.
```

### Possible DS0 Status

**Alarm**. An alarm was detected on the DS0, or the DS1 associated with the DS0. An Out of Frame (OOF) or Loss of Signal (LOS) condition places associated DS0s into Alarm.

**Busy-Out**. The DS0 is not available for use. If a call goes to the DS0, a busy signal is returned.

**Call-Ignore**. A command has been issued from the modem or the T1 operator to ignore all calls on the specified DS0(s).

**CBusy-Out**. The DS0 has been assigned a configuration state of Busy-Out. This setting may be saved to and restored from NVRAM.

**Connect-In**. The DS0 line is in use with a call originating from a remote device through the TELCO.

**Connect-Out**. The DS0 line is in use with a call originating from a modem in the chassis.

**Dialing-In**. A call is originating from the TELCO and is being answered by the T1/modem. Call setup is in progress.

**Dialing-Out**. A call is originating from a chassis modem.

**Frac-Unused**. The DS0 has been assigned a time slot of 0 (disconnected from the TDM Bus) and a configuration state of Frac-Unused, for a Fractional T1 application.

**Idle**. The DS0 line is available and waiting for a call.

**Test**. A test is taking place on the DS0.

**Transparent**. The DS0 has been placed in a transparent mode in order to perform Signaling System 7 (SS7) with a properly configured compatible modem. When in this state, all DS0 commands are ignored. An Alarm state overrides the Transparent state, but returns the DS0 to Transparent when the Alarm clears.

**Transptest**. The DS0 has been placed in a transparent test mode in order for the modem to carry out a tone test on the channel. When in this state, all DS0 commands are ignored except for the Restore DS0 command, which returns the DS0 to the idle state.

**Unavailable**. No T1 span line connected to the NIC. All DS0s also display *unavailable* if no T1 span line is attached.

**Unused**. The DS0 has been assigned a time slot of 0 (disconnected from the TDM Bus) and a configuration state of Normal, Busy Out or Transparent.

### Possible Modem Status

**Busy-Out**. The modem is not available for use. If a call goes to the modem, a busy signal is returned.

**Connect-In**. A modem is in use with a call originating from a remote device through the TELCO.

**Connect-Out**. A modem is originating a call.

**Dialing-In**. A call is originating from the TELCO and is being answered by the modem. Call setup is in progress.

**Dialing-Out**. A call is originating from a chassis modem.

**Idle**. The modem is available and waiting for an incoming or outgoing call request.

**Transparent**. The modem has been placed in a transparent test mode in order to perform Signaling System 7 (SS7) with a properly configured DS0 channel.

**Transptest**. The modem is performing a transparent tone test on the DS0 channel.

**Unavailable**. The modem has failed or is not installed.

**Unused**. The modem is not currently connected to a DS0.

## Alarm/Event Status

Select Status menu option 4 or 6 to view a snapshot of Alarm / Event status.

```
T1 Span Line 1<2> Alarm/Event Status

Receiver Gain: 0 dB

Errored Seconds: xxxxx seconds
Severely Errored Seconds: xxxxx seconds
Failed Seconds: xxxxx seconds
Bursty Errored Seconds (ESF Only): xxxxx seconds

Bipolar Violations: xxxxx
Framing Bit Errors: xxx
CRC Errors (ESF Only): xxxxx

Change in Frame Alignment: xxx
Remote Frame Alarm: y/n
Alarm Indication Signal: y/n
Frame Slips: xxx
Out of Frame: y/n
Excessive CRC Error: xxx
Loss of Signal: y/n
Excessive CRC Error (ESF Only): xxx

Press return to update status, press Ctrl-R to reset counters or
press Esc to exit.
```

The following describes the status conditions reported.

**Receiver Gain**. This is a function of the Line Interface Units and indicates T1 span line signal attenuation in 7.5 dB increments: 0 dB, 7.5 dB, 15 dB and 22.5 dB.

**Errored Seconds**. Depending on framing format, this indicates OOF conditions, frame slip conditions or error events. For SF, it reports the number of seconds during which the frame was in either OOF or slip condition. For ESF, it reports error events in seconds.

**Severely Errored Seconds**. This reports error events or frame slip conditions in seconds.

**Failed Seconds**. This indicates the number of seconds spent in a failed state. A failed state is defined as 10 consecutive seconds during which severely errored seconds occur.

**Bursty Errored Seconds**. This occurs in ESF format only. It reports CRC error conditions in seconds.

**Bipolar Violations**. This indicates bipolar violations (BPV) in the line format being used. When no line coding or ZCS line coding is used, this parameter indicates any BPVs. When B8ZS line coding is used, it indicates any invalid BPVs. The count of the BPVs detected from both T1 span lines is reported.

A BPV occurs whenever two consecutive non-zero elements of the same polarity occur in an Alternate Mark Inversion (AMI) signal.

**Framing Bit Errors**. This indicates an error in the framing bit used to determine frame alignment. The count of framing bit errors is reported.

**Excessive CRC Errors**. This occurs when a CRC bit is in error. The count of CRC errors is reported. This is only for ESF mode.

**Change in Frame Alignment (CFA)**. This indicates that a receiver has reframed on a new framing pattern, and has synchronized at a new frame alignment due to an Out of Frame (OOF) condition. The status report indicates whether or not a CFA has occurred, and a counter records the number of times this has occurred since the last counter reset.

**Remote Frame Alarm (RFA)**. This indicates that an OOF condition has occurred at the remote end. It is also known as a yellow alarm. The status report indicates whether or not RFA is present.

**Alarm Indication Signal (AIS)**. This indicates to the remote end a loss of the received signal. It is also known as a blue alarm. AIS occurs when a stream of 1's is received. The status report indicates the presence of an AIS condition.

**Frame Slips**. These can be caused by frames that are repeated due to buffer overflow (BOF) or frames that are deleted because of buffer underflow (BUF). The status report indicates if either a BOF or BUF condition has occurred. A counter records the number of times this has occurred since the last counter reset.

**Out of Frame (OOF)**. This indicates that a framing pattern for a T1 line has been lost and data cannot be extracted properly. In SF and ESF, OOF occurs when any two of four consecutive frame synchronization bits are in error. The status indicates whether or not OOF conditions are present.

**Loss of Signal (LOS)**. This occurs when 175 consecutive 0's are detected in the NIC. The signal is recovered if the density of 1's reaches 12.5%, that is, four 1's are received within a 32-bit period. The status report indicates the presence of an LOS condition.

**Excessive CRC Error Indication (ECRCEI)**. This is reported only in ESF format, when 32 of any 33 consecutive CRCs are in error. The status report indicates if this has occurred, and a counter records the number of times this has occurred since the last counter reset.

**Reset Counter**. The reset command function is executed by pressing Ctrl-R. The operator can clear counters for Errored Seconds, Bursty Errored Seconds, Severely Errored Seconds, Failed Seconds, CRC Errors, Bipolar Violations and Framing Bit Errors, without changing device configuration. After the reset command function has been executed by pressing Ctrl-R, an operator can verify that the counters are cleared by selecting this function to display the new count.

## Command

Select Command from the Main Menu.

```
Command

 1)  Reset to Highest Priority Timing Source
 2)  Reset T1 NAC
 3)  Soft Busy Out DS0(s) on T1 Span Line 1
 4)  Hard Busy Out DS0(s) on T1 Span Line 1
 5)  Restore DS0(s) on T1 Span Line 1
 6)  Disconnect Call on T1 Span Line 1 DS0(s)
 7)  Ignore Calls on T1 Span Line 1 DS0(s)
 8)  Force Receiver Reframe on T1 Span Line 1
 9)  Set DS0(s) for Transparent Test on Span Line 1
10)  Soft Busy Out DS0(s) on T1 Span Line 2
11)  Hard Busy Out DS0(s) on T1 Span Line 2
12)  Restore DS0(s) on T1 Span Line 2
13)  Disconnect Call on T1 Span Line 2 DS0(s)
14)  Ignore Calls on T1 Span Line 2 DS0(s)
15)  Force Receiver Reframe on T1 Span Line 2
16)  Set DS0(s) for Transparent Test on Span Line 2

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-16):_
```

This menu provides command options to perform specific functions on the individual T1 span lines and DS0 channels.

**Reset to Highest Priority Timing Source**. This resets the T1 NAC's timing source to the next highest priority source.

**NOTE:** TDM Bus is not available as a timing source.

```
Timing source has been set to T1 Span Line 1.
                              <T1 Span Line 2.>
                              <Internal Clock.>
                              <TDM Bus.>

Press Esc to exit.
```

**Reset T1 NAC**. This resets the T1 NAC and restores the factory configuration. This action takes place immediately and does not prompt for confirmation.

**Soft Busy Out DS0(s) on T1 Span Line 1/2**. This allows an operator to perform a soft busy out on individual DS0 channel(s). The channels that are manually busied out remain in that state until they are manually restored.

If the line is in use when a soft busy out is executed, the busy out takes place after the call is disconnected. This is a good way to take a T1 span line out of service without disrupting any calls.

```
Soft Busy Out DS0(s) on T1 Span Line 1<2>

Enter DS0(s) to be busied out and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Hard Busy Out DS0(s) on T1 Span Line 1/2.** This allows an operator to perform a hard busy out on individual DS0 channel(s). The channels that are manually busied out remain in that state until they are manually restored.

Hard busy out can also be used to seize the M-Lead, which is sometimes useful when diagnosing T1 span lines.

**WARNING:** If the line is in use when a hard busy out is executed, the connection is immediately terminated.

```
Hard Busy Out DS0(s) on T1 Span Line 1<2>

Enter DS0(s) to be busied out and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Restore DS0(s) on T1 Span Line 1/2**. This allows an operator to manually restore individual DS0 channel(s).

```
Restore DS0(s) on T1 Span Line 1<2>

Enter DS0(s) to be restored and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Disconnect Call on T1 Span Line 1/2 DS0(s)**. This allows an operator to disconnect a call on one or more DS0 channels.

```
Disconnect Call on T1 Span Line 1<2> DS0(s)

Enter DS0(s) to be disconnected and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Ignore Calls on T1 Span Line 1/2 DS0(s).** All incoming calls are ignored on the specified T1 span line.

```
Ignore Call on T1 Span Line 1<2> DS0(s)

Enter DS0(s) to be ignored and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

**Force Receiver Reframe on T1 Span Line 1/2**. This forces the T1 framer for either T1 span line 1 or 2 to reframe. Causes data errors and call disconnects.

```
Force Receiver Reframe on T1 Span Line 1<2> Successful.
                                            <Unsuccessful.>

Press Esc to exit.
```

**Set DS0(s) for Transparent Test on T1 Span Line 1/2**. This allows an operator to perform a transparent test on DS0 channel(s).

```
Set DS0(s) for Transparent Test on Span Line 1 <2>

Enter DS0(s) to be in transparent test mode and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual DS0 (1 to 24) or a range of DS0(s)
separated by a dash (-).

>:_
```

# T1 Card Configuration

When you select T1 Card Configuration from the Main Menu, the following menu appears. These options pertain to the T1 NAC as a whole. To return to the T1 Card Configuration menu from one of these submenus, press Esc.

```
T1 Card Configuration                              Current Setting

 1)  Save Current Configuration to NVRAM
 2)  Restore NVRAM Configuration
 3)  Restore Default Configuration
 4)  Timing Source Priority Assignment T1-1=1 T1-2=2 INT=0 BUS=0

  (NOTE: Changing configuration parameters may affect calls
  in progress.)

Enter menu selection and press Return or press Esc to exit the
Menu Selection (1-4):_
```

**Save Current Configuration to NVRAM**. If you made changes to the default configuration of the T1 NAC, and you wish to retain these changes, select this option to save the new configuration to NVRAM. You are prompted to confirm the operation.

```
Saving Current Configuration Settings

1 Save Current Configuration

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Restore NVRAM Configuration**. If you made changes to the NVRAM settings, and you wish to reset the T1 NAC to its previous settings, select this option. You are prompted to confirm the operation.

**REMEMBER:** If you made changes to the NVRAM settings and selected the *Save Current...* option, you can't restore the previous NVRAM configuration.

```
Restore of Config from EEPROM

1 Restore Configuration from EEPROM

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Restore Default Configuration**. Use this option to reload all factory defaults. You are prompted to confirm the operation.

```
Restoring Default Configuration Settings

1 Restore Default Configuration

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Current Timing Source Priority**. A number from 1 (highest priority) to 4 is assigned to the timing sources. The timing source with the highest priority clocks data on the T1 span line(s) and drives the TDM bus. Any timing source can be disabled by assigning a priority of 0. If not disabled, two or more timing sources cannot be assigned the same priority. Priority assignment of timing sources allows switching to the next highest timing source if the current source fails.

```
Current Timing Source Priority

T1 Span Line 1 (T1-1): 1
T1 Span Line 2 (T1-2): 2
Internal Clock (INT): 0
TDM Bus (BUS): 0

Enter the desired priority (0-4) beneath each timing source
and press Return or press Esc to exit.

0 = Disabled,  1 = Highest Priority, 4 = Lowest Priority

Timing Source Priority Assignment

          Timing Source:     T1-1  T1-2  INT  BUS
Timing Source Priority:_
```

The timing source does not switch unless a failure is detected on the current choice. For example, if the primary timing source fails, the secondary timing source takes over.

The secondary source remains active as long as it does not fail, even if the primary source returns.

From the Command Menu, select *Reset to Highest Priority Timing Source.* The primary timing source once again becomes active. See a full description earlier in this appendix.

The following table summarizes the options and defaults for timing source priority.

*Table B-1. Timing Source Priority*

| Parameter | Options | Default |
|---|---|---|
| T1 Span Line 1 Timing Source Priority | 0 (Disabled)<br>1 (Highest priority)<br>2<br>3<br>4 (Lowest priority) | 1 |
| T1 Span Line 2 Timing Source Priority | 0 (Disabled)<br>1 (Highest priority)<br>2<br>3<br>4 (Lowest priority) | 2 |
| Internal Oscillator Timing Source Priority | 0 (Disabled)<br>1 (Highest priority)<br>2<br>3<br>4 (Lowest priority) | 0 (Disabled) |
| TDM Bus Timing Source Priority<br>(Not currently available) | 0 (Disabled)<br>1 (Highest priority)<br>2<br>3<br>4 (Lowest priority) | 0 (Disabled) |

## DS0 Configuration

When you select DS0 Configuration from the Main Menu, the following menu appears. To return to the DS0 Configuration menu from one of these submenus, press Esc.

```
DS0 Configuration

  1  Modem Assignment (Span DS0s to TDM Bus' Time Slots)
  2  Fractional T1 (Span's DS0s Ignored)
  3  Disconnect (Put DS0(s) in 'UNUSED' State)
  4  Configuration Status of DS0 1 to 24  (T1 Span Line 1)
  5  Configuration Status of DS0 25 to 48 (T1 Span Line 2)

  (NOTE: Changing configuration parameters may affect calls
in progress.)

  Enter menu selection and press Return or press Esc to exit.

  Menu Selection (1-4):
```

**Modem Assignment**. Use this screen to connect a DS0 to a specific TDM Bus time slot using a certain type of signaling (normal signaling, transparent signaling or busy out). This screen can also be used to configure the signaling for one or more DS0s. The following syntax rules apply:

- The command is not case-sensitive.
- 'D', 'T', '-', 'to' and ',' are called tokens, each of which can be separated by zero or more blank spaces.
- Valid numbers for 'D' are 1 to 24 for the Single T1 Card, and include 25 to 48 for the Dual T1 Card.
- Valid numbers for 'T' are 1 to 64.
- For range assignment, the number preceding '-' must be equal to or less than the number following '-', e.g., 3-1 is invalid.
- For range assignment of connections using the keyword 'to', the range of numbers before and after the keyword must be equal, e.g., 1-2 to 27-31 is incorrect.
- For a modem assignment application, the numbers before the word 'to' refer to the DS0 number, and the numbers after the word 'to' refer to the TDM time slot.

- Any combination of formats must be separated by a comma.

```
Modem Assignment (Span's DS0s to TDM Bus' Time Slots)

 Enter a signaling assignment option followed by DS0 to TDM
Assignments.
 Use the following format"
     'S: D (,D,D-D) to T (,T,T-T)'
 Where S = Signaling Option (can be one of the following):
           N = Normal Signaling on Specified DS0(s)
           T = Transparent Signaling on Specified DS0(s)
           B = Busy Out Specified DS0(s)
       D = DS0 number 1-48:
           DS0  1-24 = span 1
           DS0 25-48 = span 2
       T = TDM Bus time slot number 1-64:
           time slot  1-60 = rack slots #2 - 16
           time slot 61-64 = rack slot #1

 Separate all entries with a comma (,), where each entry can
 either be a single item (D or T) or a range of items (D-D or
 T-T).

 Example: 'N: 1,2-4 to 1,2,3,4' connects DS0s 1 through 4
 to TDMs 1 through 4 respectively using normal signaling.

 >:
```

**Fractional T1**. Use this screen to configure one or more DS0s with a TDM Bus time slot of 0 and a configuration state of Frac-Unused (fractional T1 application).

```
 Fractional T1 (Span's DS0s Ignored)

 Enter DS0(s) to be configured for Fractional T1 call ignore
and press Return.

 The format for Fractional T1 call ignore configuration
entries is as follows:
     Use 'D' for an individual DS0 assignment
 or
     Use 'D-D' for a range of DS0 assignments
where
     D = DS0 number 1-24:
         DS0  1-24 = span 1

 Separate all entries with a comma (,), where each entry can be
either one of the above formats.

>:
```

**Disconnect**. Use this screen to configure one or more DS0s with a TDM Bus time slot of 0 and a configuration state of Unused.

```
 Disconnect (Put DS0(s) in 'UNUSED' State)
 Enter DS0(s) to be disconnected and press Return.


 Separate all entries with a comma (,), where each entry can
 either be an individual DS0 (1-48) or a range of DS0s
 separated by a dash.

>:
```

**Configuration Status**. This screen shows the current status of all DS0s on the span line. It shows whether the DS0 is connected to the TDM Bus or another span line, the number of the connected time slot or DS0, and the configuration state.

**NOTE:** A DS0 may only be connected to a TDM Bus time slot, not to a DS0 on another span line.

The sample screen below is displayed by selecting option 4 from the DS0 Configuration menu, and shows status for DS0s on T1 Span Line 1. A screen with an identical layout is displayed for Span Line 2 by selecting option 5 from the DS0 Configuration menu.

```
 Configuration Status of DS0 1 to 24 (T1 Span Line 1)

 DS0 Conn.To DS0/TS Cfg.State   DS0 Conn.To DS0/TS Cfg.State
 1     TDM     25   Busy-Out    13    TDM     37   Normal
 2     TDM      6   Busy-Out    14    TDM     18   Normal
 3     TDM     None Busy-Out    15    TDM     None Normal
 4     TDM      4   Busy-Out    16
 5     TDM     None Busy-Out    17
 6                              18
 7                              19
 8                              20
 9                              21
10                              22
11                              23
12                              24

Press Esc to Exit.
```

# T1 Span Line 1/2 Configuration

When you select T1 Span Line 1/2 Configuration from the Main Menu, the following menu appears. To return to the T1 Span Line 1/2 Configuration menu from one of these submenus, press Esc.

```
T1 Span Line 1 <2> Configuration                  Current Setting

 1)  Framing Mode                                 SF
 2)  Line Coding                                  AMI
 3)  Remotely Initiated Loopback                  Ignore
 4)  Jitter Attenuation                           Transmitter
 5)  Transmit Line Build Out                      0.0 dB
 6)  Automatic Busy-out                           Disabled
 7)  Fractional T1 Byte Sent to TELCO             FE Hex.

Enter menu selection and press Return or press Esc to exit
Menu Selection (1-7):_
```

The following table summarizes the options and defaults for parameters configurable per T1 span line.

*Table B-2. Parameters Configurable per T1 Span Line*

| Parameter | Options | Default |
|---|---|---|
| Framing Mode | Superframe (SF) \|Extended Superframe (ESF) | Superframe |
| Line Coding | Alternate Mark Inversion (AMI)<br>Zero Code Suppression (ZCS)<br>Binary 8 Zero Substitution (B8ZS) | AMI |
| Line Loopback | Ignore<br>Respond | Ignore |
| Jitter Attenuation | Receiver<br>Transmitter | Transmitter |
| Transmit Line Build Out | 0.0 dB<br>7.5 dB<br>15.0 dB<br>22.5 dB | 0.0 dB |
| Automatic Busy Out | Enabled<br>Disabled | Disabled |
| Fractional T1 Byte | Hexadecimal value | FE |

**Framing Mode**. Allows an operator to specify which framing format to use, superframe (SF) or extended superframe (ESF), for T1 span line 1/2.

The SF format has 12 DS1 frames, each with 193 bit positions. The ESF format has 24 DS1 frames and the ESF alignment signal, a Cyclic Redundancy Check (CRC), and a data link share the frame overhead-bit position.

In ESF mode, the T1 card reports yellow alarms on the Facilities Data Link. However, it does not provide performance monitoring or respond to diagnostic commands.

```
T1 Span Line 1 <2> Framing Mode

1) Extended Superframe (ESF)
2) Superframe (SF)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Line Coding**. Allows an operator to select a line coding scheme, or Alternate Mark Inversion (AMI), for T1 span line 1/2. A line coding scheme ensures a sufficient density of 1's in the bit stream, required by the T1 standard for clock synchronization. In selecting AMI (no line coding), you risk losing data.

**IMPORTANT:** Usually the TELCO specifies the type of Framing Mode and Line Coding the T1 line has. Make sure the above options are set in accordance with the type of T1 line purchased.

```
T1 Span Line 1<2> Line Coding

1) Alternate Mark Inversion (AMI)
2) Zero Code Suppression (ZCS)
3) Binary 8 Zero Substitution (B8ZS)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-3):_
```

**Line Loopback (LLB)**. Allows an operator to enable or disable LLB mode for T1 span line 1/2. This parameter allows the T1 NAC to respond to a repeating pattern from the TELCO. When enabled, the T1 NAC enters LLB mode upon receipt of the pattern *00001* for 5 seconds, and exits LLB mode upon receipt of the pattern *001* for 5 seconds. In LLB mode, the T1 NAC loops back the received signal to the T1 line; the system side goes to an idle condition. While

in loopback mode, the LPBK LED for the appropriate T1 line is green.

```
T1 Span Line 1<2> Remotely Initiated Loopback

1) Ignore
2) Response

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Jitter Attenuation**. The T1 NIC hardware provides a 193-bit frame buffer to compensate for low frequency jitter with the synchronization to the T1 network. This buffer can be placed in either the receive or transmit data path.

The default setting is the transmitter. The transmitter is recommended when the T1 Card is using internal timing instead of timing from the span line.

```
T1 Span Line 1<2> Jitter Attenuation

1) Attenuate Jitter on Receiver
2) Attenuate Jitter on Transmitter

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Transmit Line Build Out**. This is a function of the LIUs and can be selected for 0 dB, 7.5 dB, 15 dB or 22.5 dB, individually for each LIU.

Transmit Line Build Out is used to eliminate crosstalk problems when the transmitter energy causes errors on the low amplitude receive line.

```
T1 Span Line 1<2> Transmit Line Build Out

1)  0.0 dB
2)  7.5 dB
3) 15.0 dB
4) 22.5 dB

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-4):_
```

**Automatic Busy Out**. This can be set to enable or disable automatic mode to busy out and restore T1 span line 1/2 based on the availability of the corresponding modem channel.

```
T1 Span Line 1<2> Automatic Busy-Out

1) Disabled
2) Enabled

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**WARNING:** Busy Out is accomplished by setting the DS0 to an off hook condition. Some TELCOs may react to this as an error condition and remove the DS0 trunk from service. If this is the case, disable Automatic Busy Out.

**Fractional T1**. T1 equipment requires a sufficient number of 1's in the bit stream to derive clock synchronization. For a fractional T1 application, this parameter can be set to send a "stuffed byte" to the TELCO on inactive DS0s to satisfy this requirement. The parameter is configurable so that it can be adjusted to satisfy the 1's density required by the TELCO; the default is FE (hex.).

```
T1 Span Line 1<2> Fractional T1 Pattern to TELCO

For Fractional T1, a "stuffed byte" pattern must be sent out on
the unused/ignored DS0s toward TELCO to satisfy 1's density
requirement.

Enter a byte in hexadecimal ranges from 00 to FF (default = FE
Hex.) and press Enter, or press Esc to exit.

>:_
```

# T1 Span Line 1/2 Call Parameter Configuration

From the Main Menu, select **Configuration**, then **T1 Call Parameter Configuration**. The T1 Call Parameter Configuration screen is displayed. These options permit the operator to customize the call parameters as needed.

```
T1 Span Line 1 <2> Call Parameter Configuration

 1) Set to Feature Group B Defaults
 2) Set to Feature Group D Defaults
 3) Set to Loop-Start Defaults
 4) Set to Ground-Start Defaults
                                                Current Setting
 5) Dial-in/Dial-out Trunk Type                 E&M Type II
 6) Dial-in/Dial-out Trunk Start                Wink
 7) Dial-in Expected Address                    DNIS
 8) Dial-in Address Acknowledge Address         Disable
 9) Dial-out Address Delay                      70 ms

 (NOTE: Changing configuration parameters may affect calls
 in progress.)

 Enter menu selection and press Return or press Esc to exit.
 Menu Selection (1-9):_
```

**Feature Group Defaults**. The first two options permit the operator to set the call parameters for the span line(s) to the default values for either Feature Group B or D.

```
Setting Span 1<2> to Feature Group B <D> Default

1 Set to Feature Group B<D> Defaults

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Loop-start/Ground-start Defaults.** Options 3 and 4 automatically configure options 5 and 6 (trunk type and trunk start) to match your choice. Options 7 through 9 do not apply when you select one of these settings. See the descriptions that follow for the default settings.

```
Setting Span 1<2> Loop-start <Ground-start> Default

1 Set to Loop-start <Ground-start> Defaults

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

**Dial-in/Dial-out Trunk Type**. Set this parameter to specify whether E&M Type II, Loop Start or Ground Start should be used. E&M Type II is required for Feature Groups B and D. If you choose this trunk type, the start signal type is automatically set to Wink Start, and you may only change it to Immediate Start; Dial Tone is not possible. If you select Loop Start or Ground Start, the start signal type is automatically set to Dial Tone, and the settings on the T1 Call Parameter Configuration menu related to E&M Type II (Dial-in Address, Dial-in Address Acknowledge Wink, and Dial-out Address Delay) will have no significance.

```
T1 Span Line 1<2> Dial-in/Dial-out Trunk Type

1) E&M Type II (Used for Feature Group B and D and DID)
2) Loop Start
3) Ground Start

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-3):_
```

**Dial-in/Dial-out Trunk Start**. Set this parameter to specify whether Wink Start, Immediate Start or Dial-Tone should be used. Wink Start is required for Feature Groups B and D. Immediate Start is similar to Feature Group B signaling, except a wink is not returned in response to a trunk seizure. Immediate Start does provide a slightly faster call setup, but provides no trunk integrity checking. Dial Tone is required for Ground Start and Loop Start trunks.

```
T1 Span Line 1<2> Dial-in/Dial-out Trunk Start

1) Wink (Used for Feature Group B and D)
2) Immediate
3) Dial-tone (Used for Ground Start and Loop Start)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-3):_
```

**Dial-in Address**. Set this parameter to specify what type of Feature Group addressing will be used on a dial-in call. The choice here depends on the type of T1 service purchased from the TELCO. You may select between No Address, DNIS only, both DNIS and ANI, or ANI only.

```
T1 Span Line 1<2> Dial-in Address

1) No Address (Optional for Feature Groups B and D)
2) DNIS (Used for Feature Group B)
3) ANI-DNIS (Used for Feature Group D)
4) ANI

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-4):_
```

**Dial-in Address Acknowledge Wink**. Set this parameter to enable / disable an acknowledge wink for a dial-in call. This is used with Feature Group D and will be enabled if you have selected Feature Group D defaults.

```
T1 Span Line 1<2> Dial-in Address Acknowledge Wink

1) Disable
2) Enable (Used for Feature Group D)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

**Dial-out Address Delay**. Set this parameter to change the delay implemented between the T1 Card sending a trunk seizure signal to the TELCO and the T1 Card sending a Call Start Acknowledge pattern to the modem.

```
T1 Span Line 1<2> Dial-out Address Delay

Enter address delay in milliseconds ranging from 70 ms (default)
to 3000 ms (3 seconds) and press Return or press Esc to exit.

>:_
```

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