TOTAL CONTROL™

Single/Dual T1 Card

HARDWARE INSTALL GUIDE

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About this Guide

The purpose of this Guide is to cover the hardware aspects of the Single / Dual T1 Network Application Card (NAC) and the Single / Dual T1 Network Interface Card (NIC). For software configuration information, please refer to the *T1 Card Reference Manual*—part of the Total Control Reference Library. Contact your Sales Representative.

These topics are covered in this Guide:

- Ordering a T1 Line—some considerations to take into account when ordering a T1 line from the TELCO
- T1 NIC / NAC Overview—a brief functional description of the components
- T1 NIC / NAC sections—a description of how to configure hardware switches on the cards
- Installation—instructions for installation and cabling
- Technical Specifications—details about the interfaces and mechanicals of the cards

We Welcome Your Suggestions

Every effort has been made to provide useful, accurate information. If you have any comments or suggestions, please let us know.

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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. The DTMF signaling method is the same as Touch Tone; it 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 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.

T1 NIC/NAC 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 lightening 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 DS0s from the T1 line and distributes them to the Quad Modem cards via 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), which allows the T1 Card to be used in Fractional T1 applications.
- Supports an asynchronous management port, enabling local status monitoring / 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 EIA RS-232 cable and null modem adapter provided. See the *T1 Card Reference Manual* for information on this menu system.
- *Total Control Manager* is an SNMP-based, Windows-compatible application. It runs on a PC that is connected to the Network Management Card NIC by EIA 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*, the *SNMP MIB Reference Manual*, and the *Total Control Manager/SNMP Software Guide* for more information.

Note on Shipping

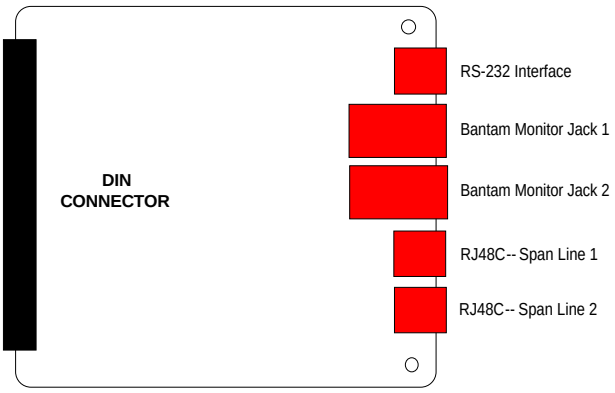
T1 NACs and NICs are shipped in one of three ways, depending on the ordering specification.

- As a separate component that you install in the Total Control chassis
- As part of a set (one NAC and one NIC)
- As part of a *pre-assembled system* — a Total Control chassis with all of its cards factory-installed

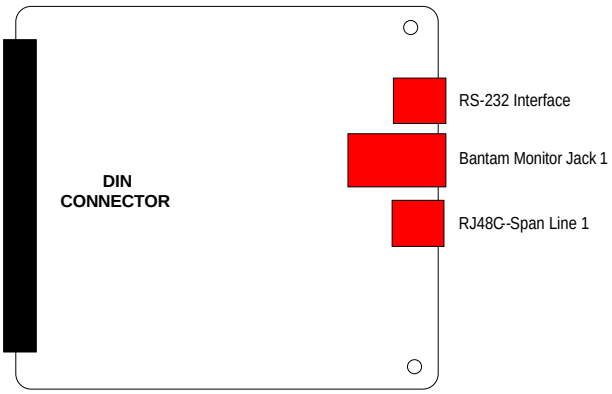
T1 Network Interface Card (NIC)

The T1 Network Interface Card (NIC) provides an EIA RS-232 serial port, Bantam Monitor Jacks, and RJ48C connectors. The RJ48C connectors provide a Channel Service Unit (CSU) interface, which recovers clock and data from incoming T1 signals.

The recovered data from the T1 NIC passes to the T1 NAC through the midplane connector. The midplane connector also allows the T1 NAC's CPU to manage the T1 NIC.



Dual T1 Network Interface Card



Single T1 Network Interface Card

Function

The T1 NIC provides the line interface circuitry between the T1 span line(s) and the T1/CEPT framers on the T1 NAC. The NIC has an LIU to provide the interface to each T1 span line.

Line Interface Unit (LIU)

The LIU contains automatic gain control (AGC), auto-equalization and data recovery. It also recovers the T1 1.544 MHz network clock, which is used by the T1 NAC to clock the data to the T1 framers. Depending on the configuration, the network clock may be used by the Total Control chassis as a timing source.

NIC Managed by NAC

The NIC has the drivers and receivers for the EIA RS-232 serial interface in order to perform a software download. However, there is no software-driven component on the T1 NIC. It is managed completely by the T1 NAC.

Channel Service Unit (CSU)

The NIC provides a DS1 signal that is capable of driving and receiving signals from distances up to 6000 feet. If connecting to an external CSU, make sure that it can accept a DS1 signal.

NOTE: Most CSUs work with a DS1 signal. However, if problems exist, contact U.S. Robotics Systems Products Support for information on obtaining a CSU that supports the DSX template.

When the NIC's CSU is in the default state (that is, when the T1 NAC is removed), it sends a non-framed, all 1's pattern to the TELCO. This is a standard alarm sequence that signals the TELCO that the equipment is down.

If the NAC is removed for extended periods of time, the TELCO may elect to make the span lines inactive. Also, while sending out all 1's, the NIC responds to network loopbacks. This is useful when diagnosing span line problems.

Span Power

Although it does not use it as a power source, the NIC terminates span power. This lets the TELCO know that a CSU is attached to the span line.

T1 Interfaces

Rear Panel Connectors

The Dual T1 NIC has two RJ48C connectors and two Bantam jacks, and the Single T1 NIC has one of each. The RJ48C connectors are dedicated to span lines coming into the chassis. Each T1 span line contains twenty-four 64 Kbps DS0 channels that are multiplexed into the 1.544 Mbps DS1 rate.

The following table lists the supported functions and pin assignments for the RJ48C interface of the T1 span lines.

Table 2. RJ48C Pin Assignments

Pin	Function	T1 NIC ↔ TELCO
1	Receive Ring	←
2	Receive Tip	←
3	None	—
4	Transmit Ring	→
5	Transmit Tip	→
6–8	None	—

Bantam jacks are provided for monitoring equipment. These jacks (TX and RX) are passively coupled so that the monitoring equipment can be installed while the NIC is powered on, without causing errors.

NOTE: Make sure the monitoring equipment to be connected to the Bantam jacks is in monitoring (non-intrusive) mode. Because of the passive coupling, the received signal from the monitoring jack will be attenuated, and some test equipment may not be able to recover the signal.

RS-232 Operator Interface

The T1 NIC's RS-232 Operator Interface is an 8-pin connector configured as a DTE. Use the EIA RS-232 cable to connect to the following devices:

- a modem for remote configuration or software download
- a terminal for local configuration
- a PC for local configuration or software download

When connecting a PC to the EIA RS-232 operator interface, use the DB-25 female-to-male adapter provided. You must supply your own

interface adapter if your application uses something other than a DB-25 connector.

The following table lists the supported functions and pin assignments of the EIA RS-232 interface.

EIA RS-232 Pin Assignments

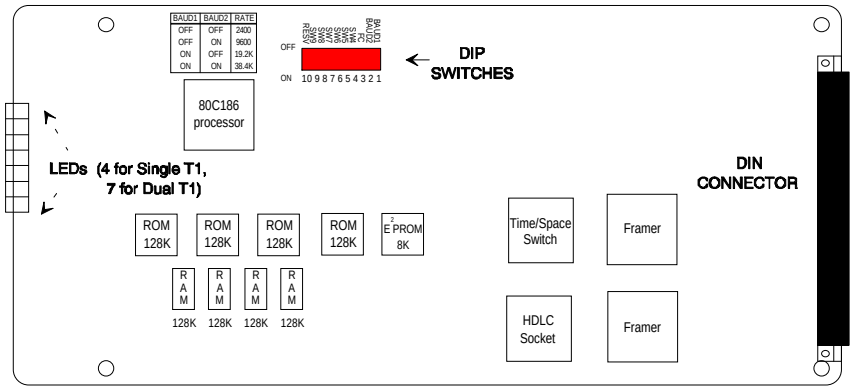
Pin	Function	NIC ↔ Device
1	Data Set Ready	←
2	Data Carrier Detect	←
3	Data Terminal Ready	→
4	Signal Ground	↔
5	Received Data	←
6	Transmitted Data	→
7	Clear to Send	←
8	Request to Send	→

Network Management Bus

The Network Management Bus is the primary communications path between the T1 NIC/T1 NAC and the Network Management Card (NMC). Through this bus, the NMC maintains constant communications with these cards and performs all management functions. For more information on these functions, see the *NMC Reference Manual* and the *Total Control Manager/SNMP Software Guide*.

T1 Network Application Card (NAC)

NOTE: This section only discusses configuration prior to installation. Further configuration is possible after installation through the EIA RS-232 interface or using management software. See the *T1 Card Reference Manual* or the *Total Control Manager/SNMP Software Guide* for more information.



T1 Network Application Card

DIP Switches

There are ten DIP switches located on the upper middle portion of the T1 NAC. Of these, only DIP switches 1, 2 and 3 are functional at this time. DIP switches 1 and 2 are used to set the serial port rate of the EIA RS-232 interface. DIP switch 3 is used to enable or disable hardware flow control.

NOTE: The DIP switches are numbered from ten on the left to one on the right. To set a DIP switch ON, put it in the down position.

DIP Switches

Switch	Factory Setting	Function
1, 2	ON, ON	EIA RS-232 Serial Port Rate Select **DIP 1** **DIP 2** **Selects** OFF OFF 2400 bps OFF ON 9600 bps ON OFF 19200 bps ON ON 38400 bps
3	ON	Hardware Flow Control OFF Disabled ON Enabled
* 4–10	OFF	Reserved

* Do *not* change settings of reserved DIP switches unless directed by U.S. Robotics Systems Products Support.

Make sure to set the DIP switches to your required specifications before installing the T1 NAC.

The EIA RS-232 serial port is used to configure the T1 NAC and to view DS0 and modem status. This requires that you attach either a dumb terminal or PC to the EIA RS-232 serial port. It is also used to perform software download, which requires a PC. Check your terminal or PC documentation to determine the maximum serial port rate your equipment supports. Do this before installing the card so that you can make the proper DIP switch settings.

Front Panel LEDs

The Dual T1 NAC has seven LEDs: Run/Fail, Carrier (2, one for each T1 line), Alarm (2), and Loopback (2). The Single T1 NAC has four LEDs, since it only needs to reflect status for one T1 span line. In addition to monitoring the LEDs from the front panel, they can be viewed from within the *Total Control Manager* software. The LEDs provide the following status information.

Front Panel LEDs

LED	Status	Meaning
Run/Fail (RN/FL)	Solid Green Solid Red Flashing Red/Green Flashing Green	Normal Critical Failure Non-Critical Failure Power-Up Self-Test, or Software Download in Process, or EEPROM is re-initializing
Carrier (CAR 1 & 2)	Solid Green Solid Red Off	Present Unframed Signal Not Present
Alarm (ALM 1 & 2)	Off Solid Red	No Alarm Alarm Condition
Loopback (LPBK 1 & 2)	Off Green	No Loopback Loopback Mode

Run/Fail indicates whether the T1 NAC is in normal operation or critical failure mode due to a hardware and / or software failure.

Carrier indicates carrier presence on a T1 span line. An Unframed Signal occurs with an Out of Frame (OOF) condition. The signal is present but not usable. Carrier is assumed not present when a Loss of Signal (LOS) condition occurs. The signal is reported as not present.

Alarm indicates an alarm condition on a T1 span line. The alarm LED is active when at least one of the following conditions exists: Line Format Violation, Frame Alignment Error, Change of Frame Alignment, Remote Frame Alarm, Alarm Indication Signal, Frame Slip, Out of Frame, or Excessive CRC Error.

For more information on the alarm conditions, see the *T1 Card Reference Manual.*

Loopback indicates whether a remote loopback test, initiated by the TELCO, is in progress.

Installation

Network Interface Card

1. Remove the safety panel for slot 1 (or whichever slot you intend to use for the card) at the back of the chassis by unscrewing the top and bottom screws of the panel.

2. With the T1 and EIA RS-232 interfaces facing out, slide the T1 NIC into the slot's upper and lower card guides until the DIN connector is firmly seated in the midplane.

3. Tighten the screws that are attached to the T1 NIC. Pay careful attention to the alignment of the screws before tightening them. Problems could arise if the screws are not threaded properly.

4. Attach the serial port and span line cables.

Network Application Card

5. Make sure all DIP switches are set to your specifications.

6. Remove the plexiglass door from the front of the chassis.

7. Unscrew and remove the safety panel covering the slot in which you intend to install the NAC (corresponding to the slot in which you installed the NIC). Keep the screws and the safety panel in case you need them in the future.

8. With the DIN connector facing the rear of the chassis and the LEDs facing the front, insert the T1 NAC in the upper and lower card guides of the slot. (Make sure the DIP switches are on the right side of the card as you insert it.) Slide the board towards the rear until its DIN connector is firmly plugged into the midplane.

   Once the DIN connector is plugged in and the T1 Card has power, it begins running some self-diagnostic tests. See the next section for more information on these tests.

9. Tighten the captive screws on the T1 Card front panel. Pay careful attention to the alignment of the screws before tightening them. Problems could arise if the screws are not threaded properly.

Diagnostics

Once the T1 card is installed in a powered-on chassis, the BIOS code performs various initializations and power-on self-tests specific to the chipset. The Extended BIOS then validates and loads operational code from Flash ROM to RAM. If operational code is corrupt, it executes a software download routine.

If the T1 card does not detect a NIC installed in the slot behind it during power-up, the RN/FL LED will flash red and green until a NIC is installed. Keep in mind, however, that installing a NIC behind a powered-up T1 will cause the card to reset.

No Failures

Once all tests are performed, if no failures are found, the Run/Fail LED turns solid green.

Critical Failures

If a critical failure is detected, the Run/Fail LED turns solid red and the card reboots. A failure is considered critical if it affects execution. Any critical failure is likely to be a hardware problem. If one occurs, contact Technical Support.

Debug Procedure

Take these steps in the event of a critical failure.

1. Pull the card forward to unplug it from the midplane, and then reseat it. This may resolve the problem.
2. If reseating the card in the midplane doesn't resolve the critical failure, contact U.S. Robotics Systems Product Support.

Technical Specifications

T1 Interface

- Dual T1 Interface supports up to 48 DS0s; Single T1 supports up to 24 DS0s
- D4 or ESF frame formats
- AMI, B8ZS, ZCS line coding
- Integral CSU
  - – Line Rate: T1 (1.544 Mbps)
  - – Input Signal: DS1 to -34dB typical per AT&T Publication 64211
  - – Output Signal: DS1 with LBO 0, -7.5, -15, -22.5dB (selectable)
  - – Configuration: Stored in NVRAM
- Loop timing source from either span line
- Automatic fallback to alternate timing sources
- E&M type II signaling
- Wink Start and Answer Supervision
- Immediate Start / Ground Start / Loop Start
- Address signaling (DNIS / ANI)

Total Control Chassis Interfaces

- Supports Quad Modem Cards
- Dynamic modem configuration based on DNIS / ANI information

Management

- *Total Control Manager*, SNMP-based, Windows-compatible software for configuration management, status reporting, operator commands and software download
- TTY RS-232 Operator Interface for direct connection interface to perform the features of the Management Station
- Software upgradeable using on-board Flash memory
- Automatic / Manual DS0 Busy-Out
- Supports TELCO-initiated Line Loopbacks per AT&T Publication 54016

Monitoring

- Data Storage: Information accessible through user interface
- DS0/Modem Status: Alarm, Available, Busy-Out, Call-Ignore, Connect-In, Connect-Out, Dialing-In, Dialing-Out, Idle, Test, TranspTest (transparent tone test), Unavailable
- Alarm/Event Status: Alarm Indication Signal, Bipolar Violations, Bursty Errored Seconds, Change in Frame Alignment, Current Timing Source, CRC Errors, Errored Seconds, Excessive CRC Error Indication, Failed Seconds, Frame Slips, Framing Bit Errors, Loss of Signal, Out of Frame, Receiver Gain, Remote Frame Alarm, Reset Counter, Severely Errored Seconds

LEDs

- Run/Fail
- Carrier (2 for Dual T1 Card)
- Loopback (2 for Dual T1 Card)
- Alarm (2 for Dual T1 Card)

Interfaces

- To terminate T1 span lines, 2 RJ48C connectors for Dual T1 NIC, 1 RJ48C connector for Single T1 NIC
- For monitoring network signals, 2 Bantam Monitor jacks for Dual T1 NIC, 1 Bantam Monitor jack for Single T1 NIC
- EIA RS-232D modular 8 connector for configuration and software download with a PC, terminal, or modem
- Menu-driven operator interface via the EIA RS-232 port

Mechanicals

Dimensions

T1 NAC 12.45" x 6.4"

T1 NIC 4.85" x 6.4"

Power

5 watts

Heat

17 BTUs

Mean Time Between Failure

75,000 hours

Operating Environment

Temperature 0–40° C, 32–104° F

Relative humidity 0–95% non-condensing