TOTAL CONTROL™

# Network Management Card

## HARDWARE INSTALL GUIDE

# *Table of Contents*

# About this Guide

The purpose of this guide is to cover the hardware configuration and installation of the Network Management Card and its possible interface cards. For software configuration information, see the NMC Reference Manual—part of the Total Control Reference Library. Contact your Sales Representative.

The following topics are covered in this guide:

- NMC NIC / NAC Overview—a brief functional description of the components.
- NIC and NAC sections—physical descriptions of the cards, switch settings, and cabling instructions.
- Installation section—descriptions of NIC and NAC installation.
- NMC quick test and diagnostic troubleshooting
- Technical Specifications

## 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.

By voice mail: (847) 933-5200

Email: sysdocs@usr.com

# Overview

## NMC Network Interface Card (NMC NIC)

The NMC NIC provides the physical link between the NMC processor and other devices, including connections for the computer running the management software.

Throughout this document, the NMC NIC is used as a generic name for the network management interface. The NMC NIC is available in either Token Ring or Ethernet format.

Each NIC has the following characteristics:

- Complies with FCC Part 15 Class A, FCC Part 68, UL-listed, CSA-approved, and IC-certified.
- Provides the interface to the local network (Ethernet or Token Ring).
- Provides an EIA RS-232 port (CH1) that can be used to configure and manage the NMC.

## Network Management Card (NMC)

The Network Management Card (NMC) has the ability to manage all of the devices in the Total Control chassis under direction of the PC running the console software (referred to as the Management Station). Two protocols are involved to implement these management functions: one between the NMC and the Management Station, and a second between the NMC and the managed devices.

- The NMC communicates to the Management Station (MS) by way of the Simple Network Management Protocol (SNMP).

  Since the individual Network Application Cards (NACs) in the chassis are not necessarily running SNMP agent software directly, the NMC performs as a proxy agent.

This means that the NMC receives requests from the MS, articulated by MIBs (Management Information Bases) defined for each device in the chassis. The NMC then carries out the requests and obtains results using a proprietary U.S. Robotics protocol, and returns the results to the MS using SNMP.

- The NMC communicates to the installed devices using the proprietary Management Bus Protocol (MBP).

  The NMC provides configuration management for each of the NACs in the chassis, setting each of the parameters for a NAC to desired values.

  Automatic parameter configuration to predetermined values is also supported. The NMC can also query the current value of the parameters for each NAC, and download software to the NACs for upgrades.

Event management is an important function performed by the NMC. Standard SNMP traps can be enabled to send a trap message, or event notification, to one or more Management Stations. The Management Station uses these traps to provide logging and alarms.

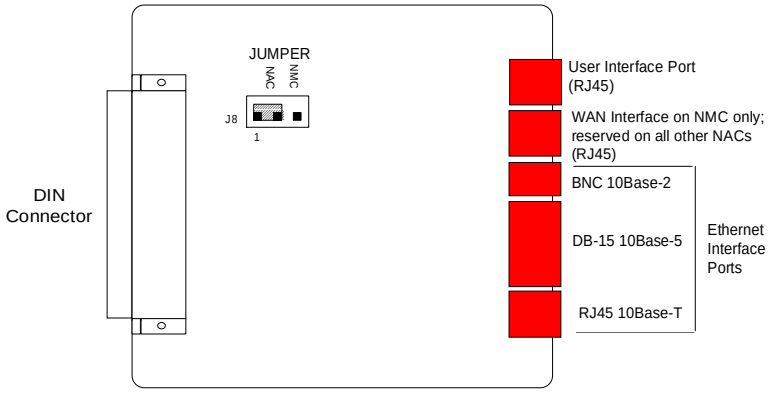
## Note on Shipping

NACs and NICs are shipped in one of two ways, depending on the ordering specification:

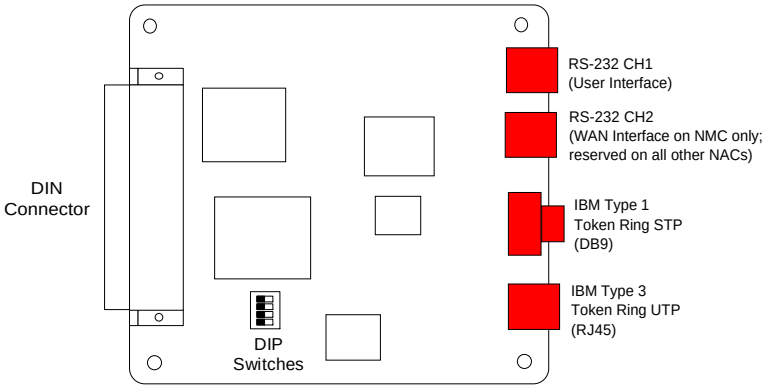
- As a *separate component* that you'll install in a Total Control chassis, or in an upgraded chassis.
- As part of a *pre-assembled rack*—a Total Control chassis with all of its cards factory-installed.

# Network Interface Cards

Depending upon your network requirements, you will have one of two NICs:




*Ethernet Network Interface Card*



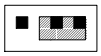

*Token Ring Network Interface Card*

## Ethernet NIC Configuration

The Ethernet NIC has a three-pronged jumper that you must verify before installation. This jumper is at position J8. The following example shows the correct jumper setting for the NMC.

NAC Setting 

Use the shunt to connect pins 1 ans 2 when theNIC is installed behind a NAC other than an NMC. This allows the NMC to reset the NIC via Management Bus Reset.

NMC Setting 

Use the shunt to connect pins 2 and 3 when the NIC is installed behind an NMC.

## Token Ring Configuration

The Token Ring NIC requires that you set the DIP switches to indicate what cable (media) you are using, the line speed of the cable, and whether the Token Ring NIC is installed with a NAC or an NMC.

*TR NIC DIP Switches*

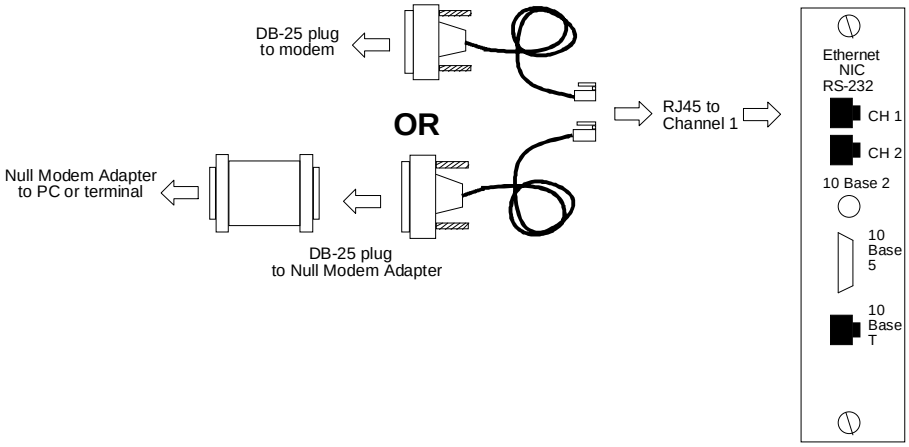
| Switch | Factory Setting | Setting | Function |
|---|---|---|---|
| 1 | OFF | ON | Selects the Shielded Twisted Pair (STP) media option for the Token Ring interface port |
| | | OFF | Selects the Unshielded Twisted Pair (UTP) media option for the Token Ring interface port |
| 2 | OFF | ON | Selects a ring speed of 16 Mbps for the Token Ring connection |
| | | OFF | Selects a ring speed of 4 Mbps for the Token Ring connection |
| 3 | OFF | ON | Sets the TR NIC to operate with the API Card (any NAC other than the NMC)—installed in slots 1–16 |
| | | OFF | Sets the TR NIC to operate with a Network Management Card—installed in slot 17 only |
| 4 | OFF | — | Reserved |

# *NIC EIA RS-232 Rear Panel Interfaces*

## CH1—Console Port

This is also referred to as the User Interface Port. CH1 consists of an 8-position, RJ45 modular jack, and is a standard EIA RS-232 DTE port. You can use the supplied 12-foot EIA RS-232 cable to connect this port directly to modem. To connect to a terminal or PC, add the provided null modem adapter to connect the PC or terminal port to the supplied EIA RS-232 cable.

The Console Port's default speed is 9600 bps and is configurable to 57.6K bps by setting DIP switches on the NMC.




This port can be used for the following purposes:

- *Remote access:* Attach the RJ45 end of the EIA RS-232 cable to CH1 and the DB-25 end to a modem. If the modem does not support a 25-pin connector, you will need to use an adapter. Dial in to the modem from the remote site.
- *Local access:* Attach the RJ45 end of the cable to CH1 and the DB-25 end to the provided null modem adapter. Then attach the null modem adapter to the PC / terminal's EIA RS-232 interface. If the PC / terminal does not support a 25-pin connector, you must use an adapter.
- *Software download:* Attach the EIA RS-232 cable to CH1 and the PC as if you were setting up for local access. Then follow the directions in the SDL guide that accompanies the NMC to perform a software download operation.

### CH2—WAN Interface Port (Out-of-Band-Management)

The second port from the top is also a standard EIA RS-232 DTE port. When the NIC is installed behind an NMC, this port is used for a SLIP connection to a PC running *Total Control Manager/SNMP* (the Management Station). It can also be used for connection to a modem in the event that the Management Station is located at a remote site.

Currently, this port is reserved when the NIC is installed behind a NAC other than the NMC.

## *NIC Network Interfaces*

### Ethernet Interfaces

The three lower ports on the ENET NIC rear panel are designed to connect to an Ethernet LAN. Only one of these ports may be active at any time. Use the port appropriate for the cable type used in your installation. The NIC automatically detects the cable type used and configures itself accordingly.

- **10Base-2** The top port is for a 10Base-2 cable (also called thinnet or cheapernet).
- **10Base-5** The middle port is for a 10Base-5 cable (also called thicknet or AUI).
- **10Base-T** The bottom port is for a 10Base-T cable (also called unshielded twisted pair Ethernet).

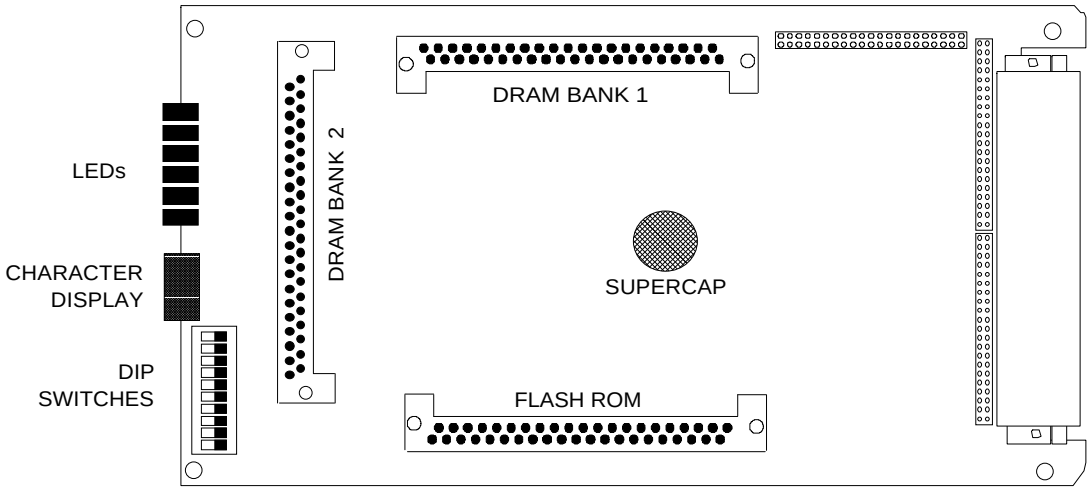
### Token Ring NIC Interfaces

The two lower ports on the TR NIC rear panel are designed for connection to a Token Ring LAN. Use whichever port is appropriate for the type of media used in your installation, and be sure that DIP switch 1 is set accordingly.

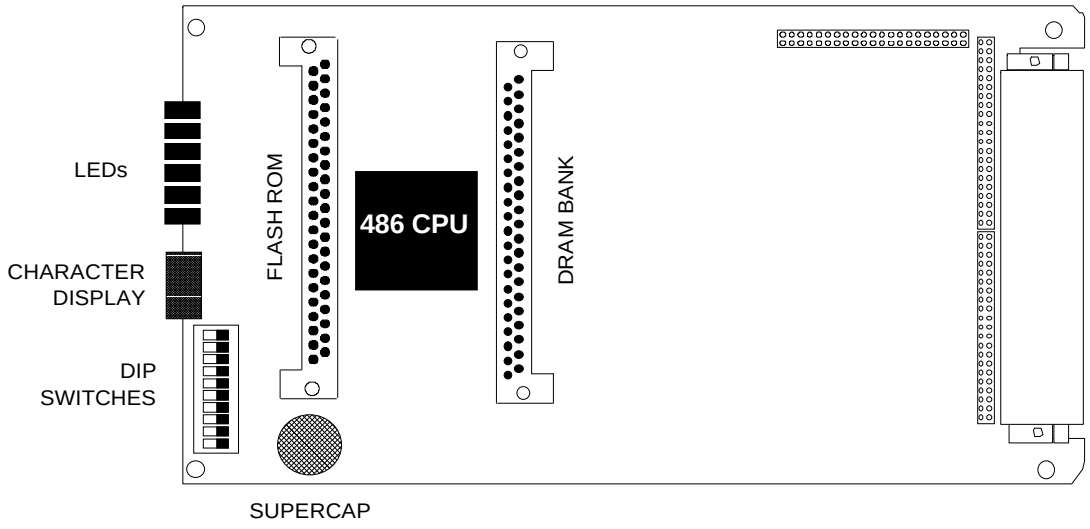
- **STP** The top port is labeled for use with STP (Shielded Twisted Pair, also referred to as IBM Type 1) cable.
- **UTP** The lower port is labeled for use with UTP (Unshielded Twisted Pair, also referred to as IBM Type 3) cable.

# Network Management Card

**NOTE:** The NMC contains VLSI CMOS devices, and is sensitive to static and electric shock. We recommend that you wear a grounded anti-static strap when handling the NMC.




*Network Management Card (386 Model)*




*Network Management Card (486 Model)*

## DIP Switches

There are ten DIP switches located on the NMC board (see Figure 4). The DIP switches are numbered from one to ten, top to bottom and are marked to indicate the ON / OFF positions. All switches are factory set to the OFF position.

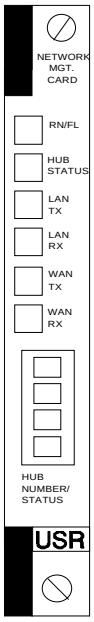
*DIP Switches*

| Switch | Factory Setting | Function | | |
|---|---|---|---|---|
| 1,2 | OFF, OFF | NMC NIC User Interface Port Rate | | |
| | | **DIP 1** | **DIP 2** | **Selects** |
| | | OFF | OFF | 9600 bps |
| | | OFF | ON | 19200 bps |
| | | ON | OFF | 38400 bps |
| | | ON | ON | 57600 bps |
| 3,4 | OFF, OFF | NMC NIC Out-of-Band Management (WAN) Port Rate | | |
| | | **DIP 3** | **DIP 4** | **Selects** |
| | | OFF | OFF | 9600 bps |
| | | OFF | ON | 19200 bps |
| | | ON | OFF | 38400 bps |
| | | ON | ON | 57600 bps |
| 5 | OFF | In the default OFF position, the NMC reads the chassis configuration from NVRAM on power-up. When set ON, the NMC boots from factory defaults. | | |
| * 6–10 | OFF | Reserved | | |

* Do not change the setting of these switches.

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

## *Front Panel LEDs*




*Front Panel LEDs*

*Front Panel LED Definitions*

| LED | Status | Meaning |
|---|---|---|
| Run/Fail (RN/FL) | Solid Green<br>Solid Red<br>Flashing Red/Green<br>Flashing Green | Normal<br>Critical Failure<br>Non-Critical Failure or Initial Power-Up<br>Testing or Software Download (required or in progress) |
| Hub Status | Solid Green<br>Solid Red<br>Flashing Red | Chassis Normal<br>Chassis Critical Failure<br>Management Bus Failure with card in chassis |
| LAN TX | Green<br>Off | NMC Transmitting Data on LAN Port<br>No Data Being Transmitted on LAN Port |
| LAN RX | Green<br>Off | NMC Receiving data on LAN Port<br>No data being received on LAN Port |
| WAN | Green<br>Off | NMC Transmitting Data on WAN Port<br>No Data Being Transmitted on WAN Port |
| WN RX | Green<br>Off | NMC Receiving data on WAN Port<br>No data being received on WAN Port |

## *Hub Number/Status*

The front panel also contains a four-character alphanumeric display. This display can be used to designate a name or number for a rack, or a particular status. When the NMC is first powered on, the word WAIT appears in this display while the NMC performs its initialization tasks. After the NMC completes this initialization phase, and until you substitute another designator, the display shows the word USR.

The Hub Number / Status display is set by sending the NMC a command from the management software.

# Installation

**CAUTION:** The Network Management Card contains VLSI CMOS devices, and is sensitive to static and electric shock. We recommend that you wear a *grounded anti-static strap* when handling the NMC.

It does not matter whether the Total Control chassis is powered on or off during installation. If you have a pre-assembled chassis, skip to *Diagnostics*, later in this section.

1. **1** If the NIC was not part of a pre-assembled rack, use the U.S. Robotics screwdriver supplied with the chassis to unscrew and remove the safety panel covering the slot farthest to the left on the rear of the rack (slot 17), behind the Network Management Card. Store the safety panel and screws for future use.

   **NOTE:** Depending on the configuration of the system, safety panels may cover one or several slots on the rear of the chassis.

1. **2** Insert the NIC in the upper and lower plastic card guides of the slot, DIN connector first. Slide the board inward until its connector is firmly plugged into the midplane and its rear panel is flush with the rack.

2. **3** Tighten the captive screws that are attached to the board's rear panel until the NIC is secure.

3. **4** Power on the rack if it isn't already on.

4. **5** Make sure all DIP switches on the NAC are set to your specifications.

5. **6** Unscrew and remove the safety panel covering slot 17. Keep the screws and save the safety panel in case you need them in the future.

6. **7** With the high density connector facing the rear of the chassis and the LEDs facing the front, insert the NMC in the upper and lower plastic card guides of the slot. Slide the board inward until its connector is firmly plugged into the midplane. The front panel with the LEDs should be flush with the front face of the chassis.

7. Once the connector is plugged in and the NMC has power, it begins running some self-diagnostic tests. See the next section for more information.

8. **8** Use the captive screws on the card's front panel to screw the board in place. 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 NMC 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 NMC 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.

> **NOTE:** keep in mind that installing a NIC behind a powered-up NMC will cause the NMC 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 NAC reboots. A failure is considered critical if it affects execution. Any critical failure is likely to be a hardware problem. If one occurs, follow the Debug Procedure below.

## Debug Procedure

Take these steps in the event of a critical failure.

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

## Performing a Ping Operation

Once the NMC is installed properly, one of the first operations you will want to perform is to assure that you are communicating with the NMC.

Installation of the software places the file PING.EXE in C:\NMS\BIN\NET. Type the following command from the DOS prompt at that directory:

**PING [IP ADDRESS]**

The factory default IP addresses for the LAN and WAN ports on the NIC are 192.77.203.193 and 192.77.203.65, respectively.

You may also use the command line switch "-nX", where X indicates the number of times you want to repeat the operation. The following example pings the NMC at IP address 192.77.203.65 five times:

**PING -n5 192.77.203.65**

## Troubleshooting with the LEDs

If you do not receive a satisfactory response from the Ping operation, observe the LEDs on the NMC front panel. With a SLIP connection, you will need to observe the WAN RX and WAN TX LEDs; LAN connections will be reflected in the LAN RX and LAN TX LEDs.

### No LEDs

- There may be a bad physical connection. Check the cabling, and assure that the correct port is being used on the NMC (CH2 for SLIP, or a LAN port for Ethernet or Token Ring).
- The wrong PC COM port may be addressed physically, or specified incorrectly within the NET.CFG file. Check both the Port and the Interrupt specified in this file.
- If a network adapter card is being used, there may be a problem with the PC COM port addressing.

### Only the RX LED Lights

- The ping may be reaching the NMC, but the wrong IP address is being used. Check that the IP address that you are typing is the one that is set within the NMC User Interface.
- The baud rate may be incompatible. Assure that the baud rate specified in your NET.CFG file is the same as the rate set with the NMC DIP switches.

- 

| Switch | Factory Setting | Function | | |
|---|---|---|---|---|
| 3,4 | OFF, OFF | NMC NIC Out-of-Band Management (WAN) Port Rate | | |
| | | **DIP 3** | **DIP 4** | **Selects** |
| | | OFF | OFF | 9600 bps |
| | | OFF | ON | 19200 bps |
| | | ON | OFF | 38400 bps |
| | | ON | ON | 57600 bps |

- You may be trying to use a baud rate above 19.2K bps with a PC COM port that uses an 8250 UART. We recommend a 16550 UART for higher speed connections.

# Serial Ports (EIA RS-232 CH1 and EIA RS-232 CH2)

## Serial Port (DTE)

| 8-Position Modular Jack | Circuit | Function | Direction |
|---|---|---|---|
| 1 | CC | Data Set Ready | Inbound |
| 2 | CF | Carrier Detect | Inbound |
| 3 | CD | Data Terminal Ready | Outbound |
| 4 | AB | Signal Ground | — |
| 5 | BB | Receive Data | Inbound |
| 6 | BA | Transmit Data | Outbound |
| 7 | CB | Clear to Send | Inbound |
| 8 | CA | Request to Send | Outbound |

## Serial Port Cable (DCE)

One null modem adapter (DB-25-to-DB-25) is supplied for NMC NIC cabling. The table indicates the pin-outs for cable and adapters.

| 8-Position Modular Jack | (Using Adapter*) DB-25M | DB-25F | Function at NIC |
|---|---|---|---|
| 6 | 2 | 3 | Transmit Data |
| 5 | 3 | 2 | Receive Data |
| 8 | 4 | 5 | Request to Send |
| 7 | 5 | 4 | Clear to Send |
| 1 | 6 | 20 | Data Set Ready |
| 4 | 7 | 7 | Signal Ground |
| 2 | 8 | 20 | Carrier Detect |
| 3 | 20 | 6, 8 | Data Terminal Ready |
| Not connected | — | Not connected | Ring Indicate |

***** DB-25-to-DB-25 null modem adapter

# Ethernet Ports

## 10Base-T (RJ45)

| Pin Number | IEEE Name | Function |
|---|---|---|
| 1 | TD + | Transmit Data + |
| 2 | TD – | Transmit Data – |
| 3 | RD + | Receive Data + |
| 4 | Not Used | |
| 5 | Not used | |
| 6 | RD – | Receive Data – |
| 7 | Not used | |
| 8 | Not used | |

## 10Base-5 (DB-15)

| Pin Number | IEEE Name | Function |
|---|---|---|
| 1 | CI-S | GND |
| 2 | CI-A | Collision Detect + |
| 3 | DO-A | Transmit Data + |
| 4 | DI-S | GND |
| 5 | DI-A | Receive Data + |
| 6 | VC | GND |
| 7 | CO-A | Not used |
| 8 | CO-S | GND |
| 9 | CI-B | Collision Detect – |
| 10 | DO-B | Transmit Data – |
| 11 | DO-S | GND |
| 12 | DI-B | Receive Data – |
| 13 | VP | +12V |
| 14 | VS | GND |
| 15 | CO-B | Not Used |
| Shell | PG | Protective GND |

## 10Base-2 (BNC)

| Pin | Function |
|---|---|
| Center | Signal |
| Shield | Isolated GND |

# Token Ring Connectors

**NOTE:** The cables specified here are intended to attach the Token Ring connectors on the Network Interface Card to a wire concentrator or MAU.

## STP Connector

| DB-9M | DB-9M | Pin Designation | Function |
|---|---|---|---|
| 1 | 1 | R | Receive Common |
| 5 | 5 | B | Transmit Data |
| 6 | 6 | G | Receive Data |
| 9 | 9 | O | Transmit Common |

## UTP Connector

| 8-Position Modular Jack | 8-Position Modular Jack | Pin Designation | Function |
|---|---|---|---|
| 3 | 3 | B | Transmit Data |
| 4 | 4 | R | Receive Common |
| 5 | 5 | G | Receive Data |
| 6 | 6 | O | Transmit Data |

# *Technical Specifications*

## Network Management Card

### Certification

Complies with FCC Part 15, UL-listed, CSA-approved

### Processor

80386DX at 25 Mhz
80486SX at 33 Mhz
80486DX4 at 75 / 100 Mhz

### Operational Memory— DRAM (Dynamic Random Access Memory)

4 Mbytes

### Flash ROM

2 Mbytes

### Data Retention Method

Clock, CMOS and chassis configuration values retained

| | |
|---|---|
| *Type:* | Supercap 5.5V 1 Farad |
| *Retention:* | 3 days |
| *Service life:* | MTBF of 100,000 hours |

### Measurement Accuracy

| | Range | Tolerance |
|---|---|---|
| +5.2VDC | 4.5 to 5.5VDC | ±40mv |
| -5VDC | -1.0 to -6.0VDC | ±40mv |
| +12.2VDC | 6.0 to 13.4VDC | ±40mv |
| -12.2VDC | -6.0 to -13.4VDC | ±40mv |
| Temperature | +5 ° F to +300 ° F,<br>-15 ° C to +148.5 ° C | ±4 ° F,<br>±2.5 ° C |

## Midplane Connector

180-position, 4-row, high-density connector

## NAC Management Bus

512 KHz (Data Clock)

## NIC Management Bus

9600 bps

## ISA Bus

8 MHz

## NMC Mechanical

| | | |
|---|---|---|
| *Length:* | 12.95" | 32.89 cm |
| *Width:* | .79" | 2.0 cm |
| *Height:* | 6.9" | 17.53 cm |

## Environment

### Shipping and Storage

| | |
|---|---|
| *Temperature:* | -25 ° to +75 ° Celsius, -13 ° to +167 ° Fahrenheit |
| *Relative Humidity:* | 0 to 100% non-condensing |

### Operating

| | |
|---|---|
| *Temperature:* | 0 ° to +40 ° Celsius, 32 ° to +104 ° Fahrenheit |
| *Relative Humidity:* | 0 to 95% non-condensing |

## NMC Power Requirements

| | Typical | Maximum |
|---|---|---|
| +5VDC | 2.8 A | 3.5 A |
| -5VDC | 8 mA | 20 mA |
| +12VDC | 29 mA | 50 mA |
| -12VDC | 16 mA | 50 mA |

# Network Interface Cards (Ethernet and Token Ring)

## Certification

Complies with FCC Part 15 Class A, FCC Part 68, UL-listed, CSA-approved, and DOC-certified

## Midplane Connector

135-pin DIN connector

## Serial Ports (applies to both EIA RS-232 CH1 and CH2)

*Electrical specification:* EIA RS-232, 8-position modular jack

*Connectors:*

*modular jack:* Stewart 88-360808 or equivalent

*DB-25:* Amp 748677-1 or equivalent

*Configuration:* DTE

*Transmission method:* Unbalanced EIA RS-232

*Transmission rate:* 57.6 Kbps maximum

### Cable Specifications

*Wire type:* Belden 9538 or equivalent, 8 conductor, shielded

*Max cable distance:* 50 feet, 15 meters

*Cabling:* 8-position modular jack to DB-25 (IBM AT pin-out)

*Nominal direct current resistance:*

*Center conductor:* 24 gage (7 strands 32 gage); .61 millimeter diameter; 23.7 ohms / 1000 feet; 77.8 ohms / kilometer

*Shield:* 15.5 ohms / 1000 feet; 50.9 ohms / kilometer

*Outside diameter:* .265 inch; 6.73 millimeters

*Capacitance between conductors:* 30 picofarads / ft; 98 picofarads / meter

## Mechanical

| | | |
|---|---|---|
| *Length:* | 5.3" | 13.46 cm |
| *Width:* | .79" | 2.0 cm |
| *Height:* | 6.90" | 17.53 cm |

## Environment

### Shipping and Storage

| | |
|---|---|
| *Temperature:* | -25° to +75° Celsius, -13° to +167° Fahrenheit |
| *Relative Humidity:* | 0 to 100% non-condensing |

### Operating

| | |
|---|---|
| *Temperature:* | 0° to +40° Celsius, +32° to +104° Fahrenheit |
| *Relative Humidity:* | 0 to 95% non-condensing |

# Ethernet Network Interface Card (ENET NIC)

## *Ethernet 10Base-T*

| | |
|---|---|
| *Data Transfer Rate:* | 10 Mbps |
| *Accessing Scheme:* | CSMA / CD (Carrier Sense Multiple Access with Collision Detection) |
| *Topology:* | Star Wired Hub (using multiport repeater) |
| *Maximum Nodes:* | Limited only by repeater used |
| *Transmission Medium:* | Unshielded Twisted Pair |
| *Network Lobe Distance:* | 100 meters (328 ft.) suggested max. Longer cabling can be used at the expense of reduced receiver squelch levels. |
| *Connector:* | 8-position modular jack, Stewart 88-360808 or equivalent |

### Cable Specifications

| | |
|---|---|
| *Wire Type:* | .5mm or 24 AWG twisted pairs |
| *Max Cable Distance:* | 100 meters (328 ft.) with standard receiver squelch levels |
| *Cable Loss:* | Must be ≤ 11.5 dB / 100 m for frequency range of 5-10 MHz |
| *Characteristic Impedance:* | 85-111 Ohms for frequency range of 5-10 MHz |
| *Propagation Delay:* | ≤ 5.7 nanoseconds / meter |
| *Cabling:* | RJ45 plug to RJ45 plug straight through for multiport repeater applications (Transmit to Receive crossover cable for two-node network) |

## *Ethernet 10Base-5*

| | |
|---|---|
| *Data Transfer Rate:* | 10 Mbps |
| *Accessing Scheme:* | CSMA / CD (Carrier Sense Multiple Access with Collision Detection) |
| *Topology:* | Bus |
| *Maximum Nodes:* | 100 |
| *Transmission Medium:* | Coaxial trunk cable, twisted pair AUI |
| *Network Lobe Distance:* | Minimum separation of 2.5 meters |
| *Connector:* | DB-15, AMP 747845-4 or equivalent |

### Cable Specifications—AUI Cable

| | |
|---|---|
| *Wire Type:* | Shielded twisted pairs |
| *Max Cable Distance:* | Not specified, must meet following specifications |
| *Nominal DC Resistance:* | ≤ 1.75 Ohms per conductor |
| *Pair-to-pair Crosstalk:* | ≥ 40 dB attenuation for frequency range of 5-10 MHz |
| *Characteristic Impedance:* | 78 ±5 Ohms at 10 MHz |
| *Attenuation:* | ≤ 3 dB per pair for frequency range of 5-10 MHz |
| *Propagation Delay:* | ≤ 257 nanoseconds |
| *Cabling:* | DB-15M to DB-15F |

### Cable Specifications—Trunk Cable

| | |
|---|---|
| *Wire Type:* | Coaxial; center conductor—2.17 ±.013 mm (.0855 ±.0005 in.) diameter solid copper<br><br>Shield—6.15 mm (.242 in) inner diameter; 8.28 ±.178 mm (.326 ±.007 in) outer diameter<br><br>dielectric—any material that meets other cable specs<br><br>jacket—polyvinyl chloride with outer diameter of 10.287 ±.178 mm (.405 ±.007 in)<br><br>OR<br><br>fluoropolymer with outer diameter of 9.525 ±.254 mm (.375 ±.010 in) |
| *Maximum Cable Distance:* | 500 m |
| *DC Loop Resistance:* | ≤ 10 milliohms / meter |
| *Velocity of Propagation:* | .77c |
| *Characteristic Impedance:* | 50 ±2 Ohms at 10 MHz |
| *Attenuation:* | ≤ 8.5 dB for 10 MHz sine wave<br>≤ 6.0 dB for 5 MHz sine wave |
| *Cabling:* | Type N plug or coaxial “tap” |

## 10Base-2

| | |
|---|---|
| *Data Transfer Rate:* | 10 Mbps |
| *Accessing Scheme:* | CSMA / CD (Carrier Sense Multiple Access with Collision Detection) |
| *Topology:* | Bus |
| *Maximum Nodes:* | 30 |
| *Transmission Medium:* | Coaxial cable |
| *Network Lobe Distance:* | Minimum separation of .5 meters |
| *Connector:* | Type BNC “T” |

### Cable Specifications

| | |
|---|---|
| *Wire Type:* | Coaxial; center conductor—.89 ±.05 mm diameter stranded, tinned copper<br><br>Shield—2.95 ±.15 mm inside diameter<br><br>dielectric—solid preferred; any other material that meets other cable specs<br><br>jacket—polyvinyl chloride with outer diameter of 4.9 ±.3 mm<br><br>OR<br><br>fluoropolymer with outer diameter of 4.8 ±.3 mm |
| *Maximum Cable Distance:* | 185 m |
| *DC Loop Resistance:* | ≤ 50 milliohms / meter |
| *Velocity of Propagation:* | .65c |
| *Characteristic Impedance:* | 50 ±2 Ohms |
| *Attenuation:* | ≤ 8.5 dB for 10 MHz sine wave<br>≤ 6.0 dB for 5 MHz sine wave |
| *Cabling:* | BNC "T" (plug, receptacle, plug adapter) |

## ENET NIC Power Requirements

| | Typical | Maximum |
|---|---|---|
| +5VDC | 1.2 A | 1.5 A |
| +12VDC | 3 mA | 50 mA |
| -12VDC | 11 mA | 50 mA |

# Token Ring Network Interface Card (TR NIC)

## Token Ring—STP Connector

*Data Transfer Rate:* 4 or 16 Mbps (megabits per second)

*Accessing Scheme:* Token Passing

*Topology:* Star Wired Ring

*Maximum Nodes for Physical Network:* 250

*Transmission Medium:* Type 1—Individual Shielded Pair

*Network Lobe Distance:* 100 meters (328 ft.) suggested maximum

*Connector:* DB-9, AMP 747844-3 or equivalent

### Cable Specifications

*Wire type:* Belden 96888 or equivalent, 4 conductors in 2 individually shielded pairs, copper braid shield overall

*Maximum cable distance:* 328 feet, 100 meters

*Nominal direct current resistance:* 22 gage solid copper; .0255 inches diameter; 16 ohms / 1000 feet; 52.5 ohms / kilometer

*Nominal outside diameter:* .310 inch x .455 inch

*Nominal impedance:* 150 ohms

*Nominal velocity of propagation:* 78%

*Nominal capacitance between conductors:* 8.5 picofarads / foot; 27.9 picofarads / meter

*Cabling:* DB-9M to DB-9M

## Token Ring—UTP Connector

*Data Transfer Rate:* 4 or 16 Mbps (megabits per second)

*Accessing Scheme:* Token Passing

*Topology:* Star Wired Ring

*Maximum Nodes for Physical Network:* 72

*Transmission Medium:* Type 3—Unshielded Twisted Pair

*Network Lobe Distance:* 100 meters (328 ft.) suggested maximum, Level 4

*Connector:* 8-position modular jack, Stewart 88-360808 or equivalent

### Cable Specifications

*Wire type:* Belden 1154A or equivalent, 8 conductors in 4 twisted pairs

*Maximum cable distance:* 328 feet, 100 meters

*Nominal direct current resistance:* 24 gage solid copper; .020 inches diameter; 25.7 ohms / 1000 feet; 84.3 ohms / kilometer

*Nominal outside diameter:* .185 inches

*Nominal impedance:* 105 ohms

*Nominal velocity of propagation:* 60%

*Nominal capacitance between conductors:* 15.0 picofarads / foot; 49.2 picofarads / meter

*Cabling:* 8-position modular plug to 8-position modular plug

## TR NIC Power Requirements

| | Typical | Maximum |
|---|---|---|
| +5VDC | 1.2 A | 1.5 A |
| +12VDC | 3 mA | 50 mA |
| -12VDC | 11 mA | 50 mA |