

**TENET
Ethernet Local Area
Network Board****V1.0****2nd April 1996**

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INTRODUCTION

This document provides the specification for the TENET Ethernet card for the PC/104 bus.

The card is based on the National Semiconductor Atlantic Ethernet controller chip, the DP83905. This chip is compatible with the Novell NE2000+ card, so the TENET is also NE2000+ compatible.

Key features include:

- NE2000+ compatible
- A range of driver software (provided by National Semiconductor) is provided.
- All three standard interfaces are provided. The TENET supports twisted pair (10BaseT), thin Ethernet (10base2) and AUI (10Base5) interfaces.
- Standard connectors are provided for each interface. These are RJ45 (twisted pair), BNC (thin Ethernet) and 15-way D-type (thick Ethernet).
- A socket for an optional boot ROM is provided.
- An on-board EEPROM contains all configuration information, including Ethernet node address, board I/O address and interrupt level. A utility program is provided to allow these parameters to be changed.
- The Ethernet functions use the 16-bit PC/104 interface and are I/O mapped at one of 7 addresses (software selectable). The boot ROM socket uses the 8-bit PC/104 and is memory mapped at one of 15 addresses (software selectable). One of eight interrupts is selected (software selectable). DMA is not required, and nor is memory space, unless the boot ROM is used.
- 16k bytes of buffer RAM provided.
- A connector allows connection to five status LEDs.
- Low power, +5V only operation (+12V is required to power an AUI node).
- Option for powering off the Ethernet core functions and memory, for very low power suspend mode.
- Complies with PC/104 specification Revision 2.2.

The TENET is available as a fully featured board, with all three cable interfaces. Other variants, each with only one cable interface implemented, are available subject to a minimum order quantity.

PC/104 INTERFACE

The National Semiconductor Atlantic (DP83905) Ethernet controller chip, which is used on the TENET, is software compatible with Novell NE2000+ Ethernet cards.

The NE2000+ Ethernet functions use the 16-bit PC/104 interface and are I/O mapped at one of 7 addresses (software selectable). The optional boot ROM socket uses an 8-bit PC/104 interface and is memory mapped at one of 15 addresses (software selectable). One of eight interrupts is selected (software selectable). DMA is not required, and nor is memory space, unless the boot ROM is used.

The I/O addresses, memory addresses (if a boot ROM is used) and interrupt are all selected from pre-defined tables. Each option is controlled by registers within the DP83905. These configuration registers are automatically loaded following a hardware reset. The required parameters are stored in a small non-volatile memory device (a serial EEPROM) on the TENET. The EEPROM can be programmed using a utility program provided with the TENET.

The fact that the memory and I/O addresses, and the interrupt level, are stored in an EEPROM device means that there are no jumpers to configure on the TENET.

The TENET occupies 32 bytes (20H) of the PC/104 I/O space. Seven address ranges are available, and can be selected using a software configuration program:

Available Address Ranges
240h - 24Fh
280h - 28Fh
2C0h - 2CFh
300h - 30Fh
320h - 32Fh
340h - 34Fh
360h - 36Fh

The optional boot ROM uses 8k, 32k or 64k bytes of memory space selected using the AUTOSET8 software configuration program:

Memory Map	Memory space
No boot EPROM	
C0000h - C1FFFh	8K
C4000h - C5FFFh	8K
C8000h - C9FFFh	8K
CC000h - CDFFFh	8K
D0000h - D1FFFh	8K
D4000h - D5FFFh	8K
D8000h - D9FFFh	8K
DC000h - DDFFFh	8K
C0000h - C7FFFh	32K
C8000h - CFFFFh	32K
D0000h - D7FFFh	32K
D8000h - DFFFFh	32K
C0000h - CFFFFh	64K
D0000H - DFFFFH	64K

The interrupt can be selected from one of the following:

Available Interrupts
IRQ3
IRQ4
IRQ5
IRQ9 (IRQ2)
IRQ10
IRQ11
IRQ12
IRQ15

The TENET can operate as an 8-bit or as a 16-bit peripheral. It is normally configured as a 16-bit peripheral, with two 8-bit SRAM buffers and a solder link at link area LK1. It can be operated as an 8-bit peripheral, either to operate with a processor which has only an 8-bit I/O space, or to save cost (by omitting one of the two SRAMS). In 8-bit mode LK1 is omitted.

Users should check the other boards in their PC/104 system and select address and interrupt options which do not conflict with other boards. Section 4 below describes how to configure the TENET board.

3 NETWORK CABLE OPTIONS

The Ethernet local area network system operates at a 10Mbps (10 million bits per second) data rate. It is a CSMA/CD system. CSMA/CD stands for carrier sense multiple access with collision detect. Basically, this means that any node on the network may transmit when it has data ready, provided that it determines that no other node is currently transmitting. Of course, it is possible that two nodes may initiate transmission at the same time, and thus their transmissions may collide. The Ethernet system provides circuitry to detect collisions in these circumstances, and both nodes will then stop their transmissions, and back-off for a random length of time before trying again.

There are three common types of Ethernet cabling. These are called Thick Ethernet, also known as 10Base5, Thin Ethernet, also known as 10Base2 and Twisted Pair, also known as 10BaseT. The TENET can drive all three of these cable types. They are described in detail below:

3.1 THICK ETHERNET (10BASE5)

This was the first Ethernet cable scheme. It requires a high quality 50 ohm coaxial cable plus a number of network transceivers. Typically the coaxial cable runs along a wall and the transceivers are on the cable. The TENET Ethernet card connects to the wall-mounted transceiver through its AUI interface and a AUI cable. The AUI interface consists of a 15-way D-type connector plus a cable assembly carrying four pairs of wires - a transmit twisted pair, a receive twisted pair, a collision detect twisted pair and a pair of wires which provide a +1 2V power supply to the transceiver.

The AUI interface on the TENET uses the 15-way female D-type connector, J4. The power supply required by AUI transceivers is +12V, which is routed to the 15-way D-type connector from the PC/104 J1 connector. The +12V supply is not used by any circuitry on the TENET, and this is the only instance where power supplies other than +5V are required.

3.2 THIN ETHERNET (10BASE2)

Thin Ethernet was introduced to provide a lower cost coax solution. It involves a lower specification coax cable, with the functions of the AUJ transceiver moved back to the TENET card. The network coaxial cable is brought directly to the TENET card, and a module on the TENET card provides an isolation of the signals and an isolated DC-DC power supply to power the cable interface.

The cable is typically type RG58. It has a 50 ohm characteristic impedance, and requires 50 ohm termination networks at each end of the network cable. Connections along the length of the network cable are either made by routing the coax cable into and out of the TENET card with T-piece BNC connectors, or by routing a dual coax cable to the TENET from a junction box on the wall.

The thin Ethernet interface on the TENET is provided through BNC coax connector, J5.

3.3 TWISTED PAIR (10BASET)

Twisted pair Ethernet is an even cheaper option, since the twisted pair cabling tends to be lower cost, and an isolated DC-DC power supply is not required. Twisted pair networks require a central hub, into which nodes connect in a star topology. Two twisted pairs are required - one each for transmit and receive.

Twisted pair connection is through an 8-pin RJ45 connector and twisted pair cable. Although only two pairs are required by the TENET, cables are usually supplied with three or four pairs. Twisted pair cable is available in a variety of grades, with Category 5 unshielded twisted pair cable often considered the best.

The twisted pair interface on the TENET is through the RJ45 connector, J3.

4 CONFIGURATION

Most of the configuration options for the TENET are determined by a serial EEPROM, which is pre-programmed at the factory and which can be re-programmed by the user. There are also two solder link options.

4.1 SERIAL EEPROM CONFIGURATION OPTIONS

A configuration program called AUTOSSET8 is available on the TENET Utility Disk. This program allows the TENET card to be configured through software.

The parameters which can be changed by this program are: I/O address, interrupt level, boot PROM size and address, and interface cable type.

The default settings of the TENET, when shipped, are:

Default Settings	
I/O Address	280h
Interrupt	IRQ5
Interface	Thin Ethernet
Boot PROM	Disabled

To change these settings run the AUTOSET8 program, select the "Display/Change Adapter Configuration" option and follow instructions to cycle through and select the options. When you are happy with the selection, execute the "Save Configuration" command, which will save the configuration to the serial EEPROM and to a file on disk.

Note that this program attempts to identify resources which are already in use, and will not offer these as options. For example, if you use a VGA adapter with a VGA BIOS at memory address C0000H, you will not be able to address the boot ROM at C0000H.

4.2 SOLDER LINK OPTIONS

There are two solder links on the TENET, neither of which will normally need to be changed by the user.

Solder link LK1 is present for a 16-bit PC/104 interface. If you are operating with an 8-bit PC/104 bus you will need to remove the LK1 link.

Solder link LK2 is always present if the power-down circuitry is omitted, and always omitted if the power-down circuitry is present. See section 6 for a discussion of the power-down option.

5 STATUS LEDES

Up to five status light emitting diodes can be directly driven by the TENET. These provide status information about the network and the node card. The LEDs can be connected between pins on connector J6 and SWVCC (+5V). Current limiting resistors are present on the TENET card, so the only external components required are the LEDs.

The status LED signals are:

Status LED	Glowes when...
TX	The TENET transmits data
RX	The TENET receives data
CO	A collision occurs
GDLINK	In twisted pair mode and a good link is established
PO	The twisted pair cable is in wrong polarity

6 POWER DOWN OPTION

The TENET is intrinsically a low power board. However, some systems might-benefit from an even lower-power standby mode of operation, and so circuitry has been designed to allow for the majority of the TENET to be powered down. NOTE THAT THIS CIRCUITRY IS OMITTED IN THE STANDARD VERSION OF THE TENET. It can be added as an option, subject to a minimum order quantity.

If the circuitry is present, then it operates as follows. If the PD pin on the J6 connector is driven to a logic 0 by an external signal (perhaps an unused digital output pin such as a printer control output signal) then much of the TENET card will be placed into a low power mode. It is normally pulled high by a 1M ohm pull-up resistor fitted on the TENET card.

Most of the TENET circuitry is powered down. The exception is the PC/104 bus interface logic.

Note that the Atlantic chip's internal registers will have lost their contents when the power is restored, and so the user must ensure that software re-initialises the Atlantic chip when power is restored.

A boot ROM cannot be used if the power-down mode is used.

APPENDIX A - PIN ASSIGNMENTS

There are five connectors on the TENET. Connectors J1 and J2 are defined by the PC/104 specification, and are in effect the PC/AT bus signals. Connectors J3, J4 and J5 are the Ethernet interfaces, and carry Ethernet signals to one of the three types of Ethernet cable. Connector J6 provides connection to the status LEDs and power-down pins. This Appendix gives the pin assignments of these connectors.

A.1 PC Bus Connector (J1)

The PC bus connector is, for the most part the signals found on PC bus expansion cards.

The PC bus connector is labeled J1 - it is the 64-way connector on the TENET. It is defined by the PC/104 V2.2 specification. The connector has two parts - male and female - so that the TENET can be stacked in a PC/104 board stack. The PC bus connector is used as the main set of signals between the TENET and additional I/O boards, as well as being part of the mechanical system which secures the TENET processor to other PC/104 boards.

PC bus cards have 62 pins - rows a and b, and pins 1 to 31. The PC/104 boards have most of these signals present on the connector marked J1, as well as two extra pins. The two extra pins (32a and 32b) are two additional GND pins (the OV power supply signal).

Table A1 lists the pin assignments of the PC bus connector, J1:

Pin	Signal	Pin	Signal
1a	/IOCHCHK *	1b	0V (Gnd)
2a	SD7	2b	RESETDRV
3a	SD6	3b	+5V (VCC)
4a	SD5	4b	IRQ2/9
5a	SD4	5b	-5V *
6a	SD3	6b	DRQ2 *
7a	SD2	7b	-12V
8a	SD1	8b	/ENDXFR *
9a	SD0	9b	+12V
10a	IOCHRDY	10b	(KEY)
11a	AEN	11b	/SMEMW
12a	SA19	12b	/SMEMR
13a	SA18	13b	/IOW
14a	SA17	14b	/IOR
15a	SA16	15b	/DACK3 *
16a	SA15	16b	DRQ3 *
17a	SA14	17b	/DACK1 *
18a	SA13	18b	DRQ1 *
19a	SA12	19b	/REFRESH *
20a	SA11	20b	CLK
21a	SA10	21b	IRQ7 *
22a	SA9	22b	IRQ6 *
23a	SA8	23b	IRQ5
24a	SA7	24b	IRQ4
25a	SA6	25b	IRQ3
26a	SA5	26b	/DACK2 *
27a	SA4	27b	TC *
28a	SA3	28b	BALE
29a	SA2	29b	+5V (VCC)
30a	SA1	30b	OSC *
31a	SA0	31b	0V (Gnd)
32a	0V (Gnd)	32b	0V (Gnd)

Table A1: TENET PC Bus Connector (J1) Pin Assignments

* These signals are not used on TENET

A.2 AT BUS EXTENSION CONNECTOR (J2)

The J2 connector is defined by the PC/104 bus specification. It carries the signals required for 16-bit bus cycles, as used on AT expansion boards.

The connector has two parts, - male and female - so that the TENET can be stacked in a PC/104 board stack. The AT bus connector is used to provide 16-bit data transfers, as well as being part of the mechanical system which secures the TENET processor to other PC/104 boards.

PC bus cards have 36 pins rows c and d, and pins 1 to 18. The PC/104 boards have most of these signals present on the connector marked J2, as well as four extra pins. Three of the extra pins (0c, 0d and 19d) are additional GND pins (the 0V power supply signal). The other extra pin (19c) is a key position.

The pin assignments of J2 follow:

Pin	Signal	Pin	Signal
0c	0V (Gnd)	0d	0V (Gnd)
1c	/SBHE	1d	/MEMCS16
2c	LA23	2d	/IOCS16
3c	LA22	3d	IRQ10
4c	LA21	4d	IRQ11
5c	LA20	5d	IRQ12
6c	LA19	6d	IRQ13
7c	LA18	7d	IRQ14 *
8c	LA17	8d	/DACK0 *
9c	/MEMR	9d	DRQ0 *
10c	/MEMW	10d	/DACK5 *
11c	SD8	11d	DRQ5 *
12c	SD9	12d	/DACK6 *
13c	SD10	13d	DRQ6 *
14c	SD11	14d	/DACK7 *
15c	SD12	15d	DRQ7 *
16c	SD13	16d	+5V (Vcc)
17c	SD14	17d	/MASTER *
18c	SD15	18d	0V (Gnd)
19c	(KEY)	19d	0V (Gnd)

Table A2: TENET AT bUS Connector (J2) Pin Assignments

* These signals are not used on the TENET

A.3 Twisted Pair (10BaseT) Connector (J3)

This is the RJ45 connector used for the 10BaseT twisted pair cable.

Pin	Signal
1	TD+
2	TD
3	RD+
4	N/C
5	N/C
6	RD
7	N/C
8	N/C

Table A3

A-4 Thick Ethernet (10Base5) Connector (J4)

This is the 15-way D-type connector used for the interface to the AUI transceiver, which connects to the thick Ethernet cable.

Pin	Signal
1	GND
2	CD+
3	TX+
4	GND
5	RX+
6	GND
7	N/C
8	GND
9	CD-
10	TX-
11	GND
12	RX-
13	+12V
14	GND
15	N/C

Table A4

A-5 Thin Ethernet Connector (J5)

This connector provides a BNC connector for thin Ethernet connections.

A.6 Status and Control Connector (J5)

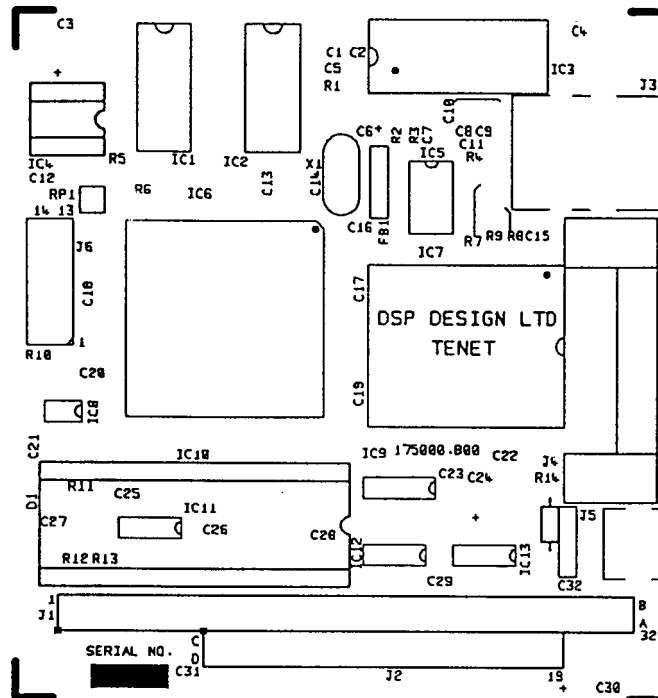
This connector provides optional connection for remote status LEDs, for placing the TENET in its very low power mode and for programming the serial EEPROM in the manufacturing process (after manufacturing, the serial EEPROM is programmed by software).

Pin	Signal	Function	Pin	Signal	Function
1	TXLED	Transmit LED	2	SWVCC	+5V for LED
3	RXLED	Receive LED	4	SWVCC	+5V for LED
5	COLED	Collision LED	6	SWVCC	+5V for LED
7	GDLINK	Good Link LED	8	POLED	Polarity LED
9	PD	Power Down	10	GND	Ground
11	MSD0	Serial EEPROM	12	MSD1	Serial EEPROM
13	MSD2	Serial EEPROM	14	CS	Serial EEPROM

Table A5: TENET Status Connector (J6) Pin assignments

APPENDIX B - COMPONENT PLACEMENT DIAGRAM

This Appendix includes a component placement diagram for the TENET.



APPENDIX C - NETWORK SOFTWARE

The TENET-UTILS disk includes the AUTOSET8 configuration program that is required to reconfigure the TENET card. See the README.DOC file on the TENET-UTILS disk for more up to date information on the TENET-UTILS disk.

APPENDIX D - ORDERING INFORMATION

The DSP Design part numbers for the TENET and related products are given below. Note that the standard product is the TENET, and the other variants, which could cost less than the full featured product, are available subject to a minimum order quantity.

ORDERING CODES DESCRIPTION

TENET	PC/104 Ethernet Board. All interfaces.
TENET-AUI	PC/104 Ethernet Board. AUI interface only.
TENET-TP	PC/104 Ethernet Board. Twisted pair only.
TENET-THIN	PC/104 Ethernet Board. Thin Ethernet only.
TENET-UTILS	Software Utility Disk for TENET.
TRM-TENET	This Manual.

DSP Design manufacture a range of PC/104 processor boards, I/O boards and development systems. Contact your supplier for latest details.

APPENDIX E - SPECIFICATION

Product:	TENET
Description:	PC/104 Ethernet Board
PC/104 interface:	I/O mapped, 8-bit or 16-bit data bus. I/O addresses, memory addresses, interrupt and cable connection mode can be configured with a utility program.
Interrupts:	RQ3, IRQ4, IRQ5, IRQ9, IRQL 0, IRQL 1, IRQL 2, IRQL 5, software selectable.
Connectors:	PC/104 J1 (64-pin) and J2 (40-pin) stack-through connectors. J3: 8-way RJ45 for twisted pair cable. J4: 15-way female D-type for AUI cable. J5: BNC connector for thin Ethernet cable. J6: 14-way (2 x 7) right angle pin header for status LEDs etc.
Dimensions:	90mm x 96mm (PCB) (3.55" x 3.775")
Weight:	100g approx.
Temperature:	0 - 70 degrees C operating.
Humidity:	10% - 90% non-condensing.
Power Supplies:	+5V / 55mA typical (twisted pair or AUI), 120mA (Thin Ethernet). +12V required only by AUI transceiver (no +12V current required by TENET).

APPENDIX F: FAULT REPORTING

DSP Design makes every effort to ship products and documentation which are completely free from faults, design errors and inconsistencies. Sometimes, however, problems do show up in the field. To help us put these right as quickly and efficiently as possible, we need as much information as possible from you, the user.

For this reason we have included here a "Product Fault Report" form. If you ever have cause to return a board for repair, or if you detect an error in the documentation, we would appreciate it if you could fill in the form on the next page, or a copy of it, and return the form to your supplier.

Prior to returning a faulty product, please check the following:

- 1 The board has been correctly configured for the intended application (see earlier appendix for board installation details).
2. The power supplies are providing correct voltage levels.
3. Cabling to the board is sound and connected correctly.
4. Other cards in the system are known to be correctly configured and functioning.
5. **PLEASE RETURN THE BOARD TO US IN EXACTLY THE SAME CONFIGURATION AS IT FAILED IN.**

Your help with this will enable us to sort out your problem more quickly. Thank you.

PRODUCT FAULT REPORT

CUSTOMER INFORMATION

COMPANY NAME:

INDIVIDUAL CONTACT:

PHONE NO:

PRODUCT INFORMATION

PRODUCT/DOCUMENT:

SERIAL NO:

DATE OF RETURN:

SYMPTOMS OBSERVED /DOCUMENTATION ERRORS (as applicable):

IN WHAT CONFIGURATION IS THE BOARD USUALLY USED? (WHAT OTHER BOARDS, WHAT SOFTWARE ETC)?

FOR DSP DESIGN USE ONLY:

PRODUCT TEST REPORT:

DATE OF RECEIPT:

REPAIRED BY:

CHARGES TO BE INVOICED: E

DATE OF RETURN:

RETURNED BY: