Network Time Server
NTS–100i–GPS

Model NIC-315

Addendum for Network Time Servers

Rack Mount Instructions

To securely mount a TrueTime Network Time Server (NTS) in any EIA standard 19 inch rack system*, use the equipment supplied in TrueTime's Rack Mount Kit and follow the steps outlined below.

The Rack Mount Kit contains:

- 2 mounting brackets (part number 206-015)
- 4 flat-head, Phillips screws (part number 241-008-005, 8-32 x 5/8)

To rack mount the NTS:

1. Remove the two factory-installed flat head (Phillips) screws from the front end of the NTS side panel.
2. Place a rack mount bracket on the side panel, so that the countersunk screw holes in the bracket line up with the screw holes in the panel.
3. Place two of the rack mount screws through the holes in the bracket and into the NTS.
4. Tighten the screws to the following specifications:
   Use a #2 size Phillips bit with an inch ounce torque setting of 4 ¼ to 4 ¾ (high).
5. Repeat steps 1-4 to install the other rack mount bracket on the unit's other side panel.
6. Place the NTS in a 1 ¾ inch opening in any EIA Standard 19 inch rack system, and position the unit so that the rack holes line up with the holes in the bracket.
7. Use the appropriate screws to secure the brackets to the rack.
8. Ensure that the operating ambient temperature does not exceed +50 °C (keep ventilation openings clear).

* Installation requires the use of standard rack mount hardware.

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Addendum for TrueTime NTS-100i Network Time Servers

NIC-315   NIC-215   NIC-415

Correction to Section 2-2.2 on page 10. The "Apply Power" step should be step #2, not step #5. Apply power after connecting to the synchronization source. Do not wait until the end of this

2-2.2   NTP Port/NET Port Network Parameter Configuration

An overview of the network parameter configuration steps are:

1. Make the synchronization connection.

2. Apply power to the NTS.

3. Use serial function 36 (see page"xx") to enter the IP address, Subnet Mask, and Default Gateway.

   Configure the NTP port and the NET port separately using a serial device that is connected to the available RS-232 port at **9600 8N1**. Use serial Function F36 to configure the NTP port, and serial Function F100 to configure the NET port. F36 and F100 use the same parameters; the only difference is the function number.

   Note: The configuration examples below use one line for all parameters and use letters in the data fields instead of numbers, to prevent confusion. During your installation, use the numbers assigned by your System Administrator. You may use a separate line to enter each parameter.

   Configure NTP Port network parameters with serial F36, as shown below:

       F36 IP:iii.iii.iii.iii   SM:sss.sss.sss.sss   G:ggg.ggg.ggg.ggg<Enter>

   Configure NET Port network parameters with serial F100, as shown below:

       F100 IP:jjj.jjj.jjj.jjj   SM:lll.lll.lll.lll   G:ppp.ppp.ppp.ppp<Enter>

   The normal response to the above commands is "OK," followed by a line terminator. If any other response is received, check the input and re-enter the command.

4. Verify the configuration parameters you entered.

   To verify the NTP port network parameters, send the following serial command:

       F36<Enter>

   Check the returned settings against the ones previously entered. Make any necessary corrections using the F36 command.

   In a similar way, to verify the NET port settings, send the following serial command:

       F100 IC<Enter>

   Once the addresses are configured, connect the cables (see the next section for details), then supply power to the NTS.

5. Connect to the ethernet.

Addendum for TrueTime NTS-100i Network Time Servers

NIC-215   NIC-315   NIC-415

Corrections to Table 1-1 in Section 1-12.3 and Table 3-1 in Section 3-5.

On Table 1-1, RXNIC should read RXD and TXNIC should read TXD.

Table 1-1: RS-232 Interface Pin Assignments

Pin	Assignment
1	NC
2	RXD
3	TXD
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC

On Table 3-1, RXNIC should read RXD and TXNIC should read TXD; also, the TXD line in the NTS column should say OUT (instead of IN) and the direction of the arrow in the adapter cable column should be reversed.

Table 3-1: RS-232 Pinouts and Signal Types

NTS	9- to 25-PIN ADAPTER CABLE 9-pin	25-pin	RS-232 Computer Interface
OPEN	1	8	DCD, CARRIER DETECT
IN RXD	2– – – – – –<– – – – – –3		TRANSMITTED DATA
OUT TXD	3– – – – – ->– – – – – –2		RECEIVED DATA
OPEN	4	20	DTR, DATA TERMINAL READY
GND	5– – – – – –<>– – – – – 7		SC, SIGNAL GROUND
OPEN	6	6	DSR, DATA SET READY
OPEN	7	4	RTS, REQUEST TO SEND
OPEN	8	5	CTS, CLEAR TO SEND

Settings of NTS Ethernet Ports

Record NTS-100i network configuration for the NTP and NET ports below, for quick reference.

NET port network setup instructions are detailed in the Quick Start Guide, starting on page 9.

NTP Port Ethernet Address: _____

NTP Port IP Address: _____

NTP Port Subnet Mask: _____

NTP Port Default Gateway: _____

NET Port Ethernet Address: _____

NET Port IP Address: _____

NET Port Subnet Mask: _____

NET Port Default Gateway: _____

NTS–100i–GPS
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APPENDICES

1

General Information

1-1   INTRODUCTION

This manual provides you with all of the information necessary to properly install and operate the NTS–100i–GPS Network Time Server (hereafter referred to as the NTS). The information in this manual includes any normal maintenance and adjustment data that may be required to facilitate field repairs.

1-1.1   Conventions

The conventions used in this manual are:

Note	=	Tips and clarifications.
Caution	=	Actions to prevent equipment damage.
< >	**=**	Keyboard entries. For example, <Enter> means press the Enter key for a line terminator; <SP> means press the spacebar to enter a space.

1-1.2   Overview of Internet Access (Telnet and HTTP)

The NTS provides Internet Protocol (IP) network time synchronization over Ethernet connected networks via the Network Time Protocol (NTP) developed by Dr. David Mills at the University of Delaware. In providing this synchronization, the NTS operates as a "server". The NTS currently supports versions 2 and 3.0 of the NTP, RFC-1305, as well as the Simple Network Time Protocol (SNTP), RFC-1361. In addition, the NTS responds to TIME protocol requests, RFC-868. For details about these protocols, refer to Appendix A and Appendix B in this manual). You can obtain these protocols at web sites listed in Appendix E (Section E-1).

The NTS also provides Internet access to control functions through use of either the Telnet protocol or the Hypertext Transfer Protocol (HTTP). Telnet is a session-based terminal/remote host protocol developed for the Internet. Telnet control of an NTS uses the same function strings that are employed when using the unit's front panel keypad. Telnet applications are available on every Windows NT, 95, or 98 system and is also widely available on UNIX systems. See Section 3-4, starting on page 17.   HTTP is the protocol used on the web. It presents a user-friendly graphical user interface and provides access via any web browser. See Section 3-3, starting on page 15.

An NTS has two RJ-45 Ethernet connectors. The NTP port connector provides NTP access. The NET port provides Internet/LAN access.

A 9-pin D serial connector is also provided for user access, however the serial timestamps are not available.

The NTS obtains timing information from the global positioning system (GPS).

In addition to performing the functions of an NTP Server, the NTS provides optional 1 PPS and IRIG-B timing and frequency outputs.

1-2 LIMITED WARRANTY

Each new product manufactured by TrueTime is warranted for defects in material or workmanship for a period of one year from date of shipment ("Limited Warranty"). Defects in material or workmanship found within that period will be replaced or repaired, at TrueTime's option, without charge for material or labor, provided the customer returns the equipment, freight prepaid, to the TrueTime factory under this limited warranty. TrueTime will return the repaired equipment, freight prepaid, to the customer's facility. This one year Limited Warranty does not apply to any software or to any product not manufactured by TrueTime.

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By purchasing any product from TrueTime, the Buyer consents to and agrees that the Buyer's sole and exclusive remedy for any damages or losses incurred by the Buyer, as a result of TrueTime's breach of its one-year Limited Warranty for defects in materials and workmanship or otherwise in connection with any claim respecting the product, shall be limited to the repair or replacement of the product or a refund of the sales price of the product.

In no event shall the Buyer be entitled to recover consequential damages or any other damages of any kind or description whatsoever.

1-4 PROPRIETARY NOTICE

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1-5   PHYSICAL SPECIFICATIONS

For rack mounting, the NTS requires a 19" enclosure. Physical specifications of the NTS are:

NTS Chassis	
Size:	1.75 in. x 17.00 in. x 10.38 in. (4.45 cm. x 43.18 cm. x 26.40 cm.)
Weight:	4.21 lb. max. (1.91 Kg).
Standard Antenna	
Size:	2.625 in. dia. x 1.5 in. (6.67 cm. dia. x 3.81 cm.)
Weight:	.55 lb. (.250 Kg) (including mounting nipple)
Power Regulated:	±5 VDC @ <25 mA
Frequency (L1):	1575.42 MHz Coarse Acquisition (C/A) Code
Optional Down Converter	
Antenna Size:	4.4 in. dia. x 2.1 in. (11.17 cm. dia. x 6.85 cm.)
Antenna Weight :	0.60 lb (.272 Kg) (including mounting nipple)
Power Regulated:	±5 VDC @ <25 mA
Antenna Cable (for Standard Antenna)	
Type:	RG-59 Attenuation at 1.575 G should be no more than 10.5 dB per 100 feet (Belden 9104 or equivalent)
Length:	50 ft. (available in lengths up to 200 ft.)
Weight:	1.2 lb (.545 Kg)
Antenna Cable (for Down Converter Antenna)	
Type:	RG-58
Length:	50 ft. (available in lengths 150 to 1500 ft.)
Weight:	2.7 lb (1.23 Kg) per 100 ft.

Note: For non-standard antenna types, contact TrueTime for assistance.

1-6   ENVIRONMENTAL SPECIFICATIONS

Environmental specifications of the NTS are:

Operating Temperature	
NTS Module:	0 to +50 °C (+32 to +122 °F)
Antenna:	–40 to +70 °C (–40 to +158 °F)
Storage Temperature	
NTS Module:	–40 to +85 °C (–40 to +185 °F)
Antenna:	–55 to +85 °C (–67 to +185 °F)
Humidity	
NTS Module:	95%, non-condensing
Antenna:	100%, condensing

1-7 POWER INPUT SPECIFICATIONS

Power input specifications of the NTS are:

Power Input	
Voltage:	95-260 Vac
Frequency:	47-440 Hz
Power Consumption:	<15W

1-8 INTERNAL TIMING PERFORMANCE SPECIFICATIONS

The absolute time and frequency characteristics of the NTS are essentially those of the input synchronization source. The relative synchronization characteristics given here reflect the capabilities of the NTS to preserve the time and frequency characteristics of its synchronization source. Refer to Sections 3-8 on page 26 and 3-9 on page 28 for details concerning the time and frequency characteristics of the NTS.

The NTS output signal timing and frequency specifications relative to the input synchronization source are:

> 1 PPS Output Accuracy: ±5 µs
>
> Amplitude Modulated IRIG-B Output Accuracy: ±10 µs

During a synchronization input outage, following initial synchronization of the NTS to the input synchronization source, the timing and frequency outputs from the unit diverge from the input at the rate of approximately 6 parts in 10^{-6}, if the ambient temperature is maintained within ±3°C.

Note: In order to obtain the specified timing accuracy, the unit should be operated with the cover in place.

1-9 PROTOCOLS

The NTS supports the following protocols:

Telnet	RFC-854	SNMP	RFC-1157
DATETIME	RFC-867	MIB	RFC-1212
TIME	RFC-868	MIB II	RFC-1213
FTP	RFC-959	DHCP	RFC-2132
SMI	RFC-1155*	NTP ver. 3.0	RFC-1305**
		SNTP	RFC-1361***

* SMI = Structure of Management Information

** The NTS does not implement the "authenticator field" of the NTP packet as described in Appendix C of RFC-1305.

***The NTS does not support Broadcast Mode.

Note: TIME and DATETIME are available in both TCP and UDP protocols.

Refer to Appendix A and Appendix B in this manual for details about NTP and SNTP protocols, and Appendix E regarding SNMP and MIB protocols and references to RFC documents.

1-10 NETWORK TIME PROTOCOL SYNCHRONIZATION SPECIFICATIONS

The NTS hardware is designed specifically to implement the NTP server function. As such it was carefully designed to operate with the TrueTime real time operating system to minimize the unknown latencies in timestamping the received and transmitted NTP packets.

The NTP Packet timestamp accuracy specifications are:

Received Timestamp Accuracy:	±10 µs, relative to synchronization source
Transmitted Timestamp Accuracy:	±10 µs, relative to synchronization source

At these levels of accuracy, the realizable NTP synchronization accuracy of any client is determined by the repeatability of the network and client delays, *not* by the NTP timestamp uncertainty.

Note: Time accuracy, distributed via NTP, is ultimately determined by client software, as well as network topology.

1-11 FRONT PANEL INTERFACE

This section provides a general description of the NTS front panel input devices. For details about how to enter commands and interpret display readouts, see Section 3-11, starting on page 30.

The NTS front panel is the primary system interface. Input is through the three front panel push-buttons and a 16-key keypad. Output is through the two-line, 32-character alphanumeric display (see Figure 1-1 below).
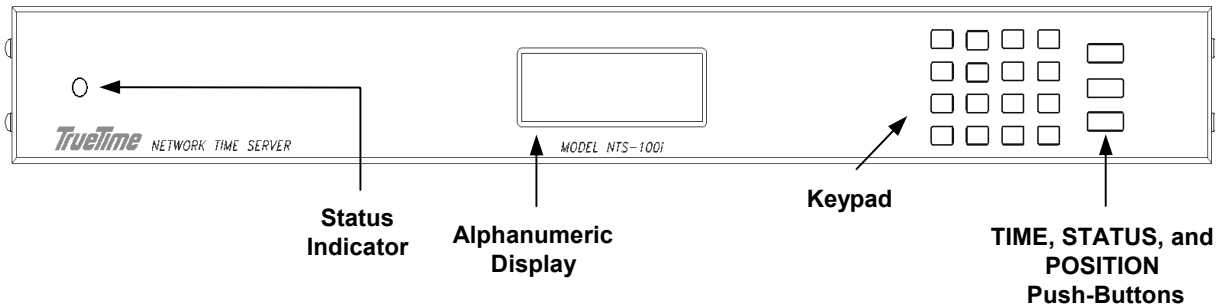
Figure 1-1: NTS Back Panel

1-11.1   Input: The Keypad and the Push-Buttons

The keypad consists of numeric keys "0" through "9", arrow keys "up", "down", "right", and "left", a clear key "CLR" and the function/enter key, "FUNC/ENTR". Use the keypad to issue function commands and to navigate TrueTime menus. The up- and down-arrow keys scroll through the list of menu items and FUNC/ENTR actuates the selected menu option (see Section 3-11, starting on page 30, for details).

Pressing the TIME push-button places the equivalent time-of-year and the date on the alphanumeric display. The format of the date is day-of-week, month, day-of-month, year.

Pressing the STATUS push-button displays information indicating whether or not the unit is locked or unlocked to its synchronization input source. Another use of the STATUS push-button is to abort any keypad function currently in progress. For example, if you enter an incorrect function, or if the display shows something unexpected, pressing the STATUS push-button aborts the function, with no action taken by the function.

Pressing the POSITION push-button repeatedly toggles between the latitude, longitude, altitude and PDOP (Position Dilution of Precision) of the GPS antenna, based on the last position fix. The values are the same as those displayed when requesting information through Function 50 (Position Entry/Request).

Note: PDOP represents the degree to which the satellite geometry increases possible errors in a position fix.

1-11.2   Output: The Display

The front panel display shows current clock status and the system's response to commands you enter through the keypad. When the display is not being used for keypad function, you can set it to show (in real time) the current clock mode, or the current time with calendar day and year.

1-12   INTERFACE SPECIFICATIONS

1-12.1   NTP Ethernet Interface

Type:	10Base-T
Frame Format:	DIX Ethernet (Ethernet II) or IEEE 802.3

1-12.2   Network Interface Card (NIC) Ethernet Interface

Type:	10/100Base-T
Frame Format:	DIX Ethernet (Ethernet II) or IEEE 802.3

Note: The factory-shipped frame format supports the majority of Ethernet-based networks. Check with your System Administrator for more information.

1-12.3   Utility RS-232 I/O Interface

Note: Serial timestamps are *not* available from an NTS.

Data:	Serial or Telnet functions (see Chapter 4, starting on page 53)
Data Rates:	**9600**
Data Bits:	**8**
Parity:	**None**
Stop Bits:	**1**
Connector:	Male 9-pin D subminiature, wired as DTE

Note: Serial I/O settings are factory set and cannot be changed. For cabling information and a back panel illustration, see page 11.

The following table shows the RS-232 Interface Pin Assignments:

Table 1-1: RS-232 Interface Pin Assignments

Pin	Assignment
1	NC
2	RXNIC
3	TXNIC
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC

1-13   LED STATUS INDICATOR

A front panel mounted, tri-color LED reflects the status of the NTS:

Solid Red:	Major Alarm Fault
Solid Orange:	Minor Alarm Fault
Blinking Green:	Fully Operational State, no enabled faults are detected

When the NTS is in either alarm condition, the open collector alarm will be in a high impedance state. The non-alarm condition corresponds with the open collector alarm output low impedance.

Major Alarm Faults can be caused by antenna loss, GPS receiver failure, or non-volatile RAM data failure.

Minor Alarm Faults can be caused by reaching the time error threshold, loss of tracking, or reaching the oscillator tuning voltage limit. When the unit is in initial acquisition mode, the LED also displays solid orange.

1-13.1   Alarm Output

The purpose of the alarm output BNC is to provide an indication of an out-of-service condition caused by initial power-up, an extended period without synchronization input, or hardware failure. The Leap Indicator bits of the NTP packet sent by the NTS are set to 3, based solely on the time error minor fault. The time error threshold is sent in the NTP packet as the root dispersion.

1-14   TIME/FREQUENCY OUTPUT SIGNALS

A combination of two output signals are available from the NTS via panel mounted, female BNC connectors. The available output signals are:

1-14.1   IRIG-B Time Code:

Format:	IRIG-B 122
Carrier:	1 KHz
Amplitude:	5.0 Vp-p high, 1.5 Vp-p low, no load
Output Z:	600 ohms
Connector:	Female BNC, J1

1-14.2   1 PPS Output:

Amplitude:	ACMOS Levels
Output Z:	22 ohms
Connector:	Female BNC, J2

1-15   SYNC INPUT CHARACTERISTICS

Format:	GPS
Input Characteristics:	Antenna

2

Installation

2-1   INTRODUCTION

You must provide the NTS with a source of power, a GPS antenna connection, two Ethernet network connections, setup parameters, and any optional output connections (see Appendix F for any optional output connections your device may be equipped with). Once configured, the NTS is capable of basic operation without an RS-232 connection, and retains all configuration data in non-volatile memory when power is removed.

Of the two Ethernet connections, one is for NTP output (the NTP port), and the other is for the Internet/LAN connection (NET port). The NET port is used to control the NTS from a remote location. The network connections are made via the Ethernet RJ-45 connectors that plug in to the outlets labeled NET port and NTP port.

See Section 2-2.3 on page 11 for an illustration of cable connections.

2-2   QUICK START GUIDE

This quick start guide is designed for both novice and experienced users, and provides the minimum set of instructions required for basic NTS setup.

2-2.1   Site Preparation

To install and use the NTS, you must have access to the following:

- An Ethernet LAN that has two ports available at the NTS location
- Two sets of network address parameters, one set for the NTP port that delivers NTP time, the other set for the NET port that is used to remotely control the unit

Each address set consists of the following:

- IP Address
- Subnet Mask
- Default Gateway
- A serial interface device, either PC or dumb terminal, capable of 9600 8N1
- RS-232 cable and null modem connector for the serial connection
- Two Ethernet cables with RJ-45 connectors, one for the NTP port and one for the NET port

Note: The NET port may optionally be configured to use DHCP to obtain its IP Address. The System Administrator will know whether to manually assign the IP Address, or enable DHCP.

> **Caution:** To ensure proper functioning, perform the installation steps in the order presented below. Configure the NTP and NET ports' IP Address, Subnet Mask, and Default Gateway *before* connecting their respective cables.

2-2.2   NTP Port/NET Port Network Parameter Configuration

An overview of the network parameter configuration steps are:

1. Make the synchronization connection by attaching the GPS antenna.
2. Use serial function 36 (see page 62) to enter the IP address, Subnet Mask, and Default Gateway.

   Configure the NTP port and the NET port separately using a serial device that is connected to the available RS-232 port at **9600 8N1**. Use serial Function F36 to configure the NTP port, and serial Function F100 to configure the NET port. F36 and F100 use the same parameters; the only difference is the function number.

   > **Note:** The configuration examples below use one line for all parameters and use letters in the data fields instead of numbers, to prevent confusion. During your installation, use the numbers assigned by your System Administrator. You may use a separate line to enter each parameter.

   Configure NTP Port network parameters with serial F36, as shown below:

   > F36 IP:iii.iii.iii.iii   SM:sss.sss.sss.sss   G:ggg.ggg.ggg.ggg<Enter>

   Configure NET Port network parameters with serial F100, as shown below:

   > F100 IP:jjj.jjj.jjj.jjj   SM:lll.lll.lll.lll   G:ppp.ppp.ppp.ppp<Enter>

   The normal response to the above commands is "OK," followed by a line terminator. If any other response is received, check the input and re-enter the command.

3. Verify the configuration parameters you entered.

   To verify the NTP port network parameters, send the following serial command:

   > F36<Enter>

   Check the returned settings against the ones previously entered. Make any necessary corrections using the F36 command.

   In a similar way, to verify the NET port settings, send the following serial command:

   > F100 IC<Enter>

   Once the addresses are configured, connect the cables (see the next section for details), then supply power to the NTS.

4. Connect to the ethernet.
5. Apply power to the NTS.

2-2.3   Cabling

Refer to Figure 2-1 (NTS Back Panel) for connector locations. The numbers in the drawing refer to that connector's position in Table 2-1 (NTS Cabling).

Note: It is important to connect the cables in the order listed in Table 2-1.
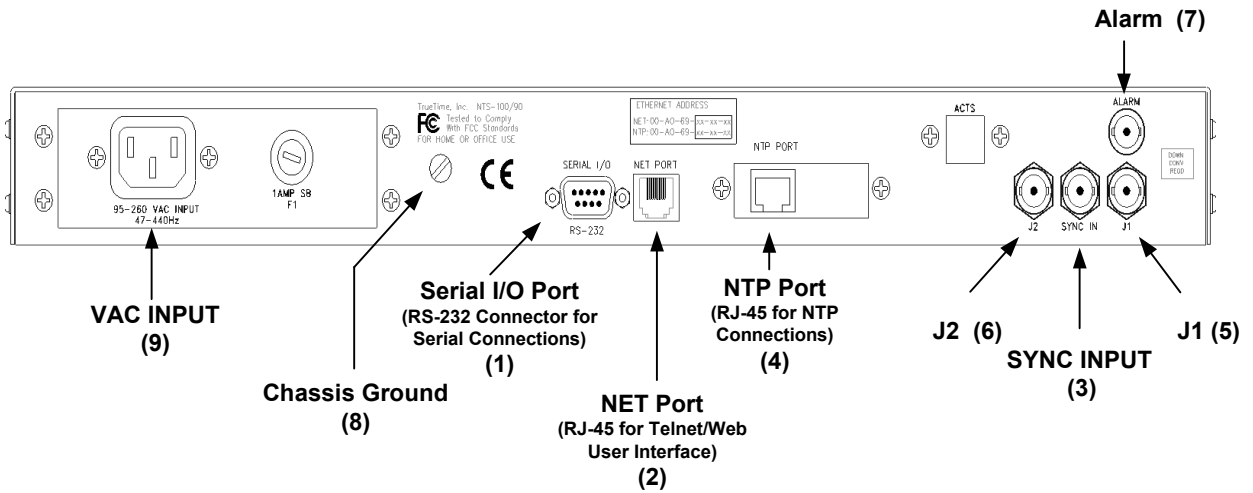
Figure 2-1: NTS Back Panel

Table 2-1: NTS Cabling

Connection Order	Cable Name	Required or Optional	Description	Type	Label
1	Serial Interface	Required	Utility port adjacent to the NET Port	9-pin D	SERIAL I/O
2	Net Interface	Required	NET Port - for Telnet/Web control of unit	RJ-45	NET PORT
3	Sync In	Required	GPS Antenna	BNC	SYNC IN
4	NTP Interface	Required	NTP Port - for NTP output	RJ-45	NTP PORT
5	IRIG-B	Optional	IRIG-B output	BNC	J1
6	1 PPS	Optional	One pulse per second output	BNC	J2
7	Alarm	Optional	Alarm contact	BNC	ALARM
8	Chassis Ground	Optional	Ground screw	-	(Symbol)
9	Power	Required	Power socket	-	VAC INPUT

2-2.4   Antenna Placement

2-2.4.1   General Information

The GPS Synchronized Receiver operates on the L1 (1575.42 MHz) signal and the C/A code (1.023 MHz bit rate) with a minimum signal level of –162.0 dBW and a maximum signal level of –137.0 dBW. The system supplied is designed to provide the proper signal levels to the receiver with the cable length supplied.

2-2.4.2   Lead-In Cable

The L1 GPS Antenna is designed to operate with up to 200 feet of RG-59 coax cable. The optional Down Converter is designed to operate with up to 1,500 feet of RG-58 coax cable. For details, see the specifications, starting on page 3.

2-2.4.3   Antenna Installation and Location

When selecting a site for the antenna, find an outdoor location that provides full 360-degree visibility of the horizon. In most cases, this means locating the antenna as high as possible. Any obstruction will degrade unit performance by blocking the satellite signal or causing a reflection that cancels some of the signal. Blocked signals can <u>significantly</u> increase the time for satellite acquisition, or prevent acquisition altogether.

Figure 2-2

Basic Antenna Components

Mounting brackets are provided to mount the antenna to a pole or the peak of a building. One of the easiest ways to mount the antenna is with a pipe that has an inside diameter greater than one inch. Pass the coaxial cable through the pipe, connect the antenna, then fasten the pipe to a convenient part of the building.

2-2.4.4   Mast Mounting

Mast top mounting is the preferred mounting method. The antenna mounting mast should be 2-inch threaded water pipe or conduit. The pipe must be rigid and able to withstand high winds without flexing. Guy wires may be used to stabilize a pipe longer than 10 feet.

Multipath cancellation is caused by reflected signals that arrive at the antenna out of phase with the direct signal. Reflective interference is most pronounced at low elevation angles from 10 to 20 degrees above the horizon. The height of the mast may be extended to prevent multipath cancellation. The antenna should be at least 1.0 m from a reflecting surface. Figure 2-3 shows the recommended mounting of the antenna to the mast.

Antenna

Mast

Figure 2-3

Basic Antenna Components

2-2.5   Verify Functionality

To verify that the unit is running, press the TIME push-button on the front panel, or send the serial F03 command. The time data being generated by the unit is displayed on the front panel, as well as by the serial F03 return. Also, check the front-panel LED status indicator:

- At power-up, the LED is solid red
- While the NTS is acquiring satellites, the LED is solid orange and the Open Collector Alarm Output is in a high impedance state; if you send the serial F03 command during this time, the NTS displays the time data being generated
- Once the NTS achieves stabilization, the LED is blinking green

To verify functionality of the NTP and NET ports:

1. Ping the NTP port IP Address.

2. Ping the NET port IP Address.

3. If either of these actions fails, or if the LED is not functioning as expected, return to Section 2-2.2 on page 10 to check the configuration values assigned to the ports, and correct parameters as necessary.

4. If the NTS is still not operational, verify with your system administrator that the values used are correct. Then re-enter parameters as necessary. If problems persist, contact TrueTime Technical Customer Service.

2-2.6   Wrap-up & Advanced Operation

When the LAN interfaces are operational and time is being reported, the unit has achieved its basic level of functionality.

Once the NTS has stabilized, indicated by the blinking green LED, clear the latched error flags using serial Function 73 (see page 77). This allows you to distinguish between errors that occurred during start-up and functional errors that may occur during normal operation.

For details of unit operation, see Chapters 3 and 4. This manual also describes error recovery procedures in Chapter 5.

Caution: After the NTS is completely configured, you may remove the RS-232 Utility port serial cable at any time. However, to avoid damaging your equipment, power-down the NTS before connecting (or re-connecting) any cable.

3

Remote Operation and Keypad Functions

3-1 INTRODUCTION

TrueTime's NTS is an advanced network time server that provides accurate time over an Ethernet connection to multiple client sites, and can be monitored and controlled over the Internet or LAN.

The most commonly used NTS functions (TIME and STATUS) are assigned to front-panel push-buttons (pressing the POSITION push-button has no effect on the unit). You can access and view all functions in several ways:

Access	Viewing Medium
Front-Panel Keypad	NTS Front-Panel Alphanumeric Display
Serial I/O Interface	PC Terminal
Telnet or Web Interface	PC Terminal or other Monitor

In order to remotely configure or monitor the NTS via the web interface or a Telnet session, you must be able to establish a connection to the NTS using a computer (portable, desktop, or workstation) attached to a TCP/IP-based Ethernet network. If the NTS is located behind a firewall, or in an isolated LAN or subnet, a connection may not be possible. Check with your local LAN administrator or IT manager for assistance with your computer, network connection, or software.

3-2 NETWORK INTERFACE

The NTS supports protocols RFC-868, RFC-1305 and RFC-1361. An NTP or SNTP client, compatible with the computer platform you use, is required for accurate network synchronization. The client must be configured to use the NTS NTP port IP address. In addition, the NTS supports SNMP MIB II and Enterprise MIB. See Appendix E for details on SNMP implementation.

3-3 WEB ACCESS

The main feature of the NTS web interface is its ability to perform setup and control operations from a remote location, using the Internet or TCP/IP LAN. The protocol used for Internet access to an NTS is either Telnet or HTTP. Telnet is a standard Internet communications program that is bundled with Windows 95/98/NT and connects to the NTS through its NET port. HTTP access is provided via any standard Web Browser (such as Microsoft's Internet Explorer or Netscape's Navigator/Communicator).

3-3.1   Starting the Web Browser

To use the web interface, launch any Java-capable and frames-compatible web browser such as Microsoft Internet Explorer (IE version 3.0 or later, available at www.microsoft.com), Netscape Navigator (version 3.0 or later) or Netscape Communicator (any version; Netscape browsers are available at www.netscape.com).

3-3.1.1   Accessing the NTS Web Interface

In the "Location:" field (Netscape), the "Address:" field (Internet Explorer), or the equivalent field in the window of a different web browser, enter the IP address assigned to the NET port of the NTS in the following format:

> http://<ipaddress>

An example of an NTS NET port IP address is: http://192.168.1.1

The available web pages are: Home, Time, GPS, Satellite Status, Network Status, and Controls. When entering from the IP address, your first stop is the Home Page.

3-3.1.2   Home Page

After entering the NET port IP address, TrueTime's home page appears in the browser window. You can access all the other web pages from the home page, so for future quick access, bookmark it (in Netscape) or add it to your browser favorites (in Internet Explorer).

3-3.1.3   Time, GPS, Satellite Status, and Network Status Pages

These pages display status. You can navigate from page to page using the corresponding buttons at the top of the web browser window.

Note: The button for access to the Satellite Status page is located on the GPS Status page.

The values displayed on these pages are static, i.e., they may not reflect changes that occurred following the initial display of the page. An example of this is current Local Instrument Time field on the Time Status page. The time shown is the time read at the instant the web page first displayed, and does not update with the most recent values until you click the **Reload** or **Refresh** button of your web browser.

3-3.1.4   Configuration Control Login Page

Enter the NTS control portion of the site through the control login page. To get there, click the **Controls** button located at the top any of the status pages.

The user name is **operator** and the default password is **mercury**. Enter these values (all lower case and not bold) in the corresponding fields on this page, then click the **Press to Continue** button. The page refreshes and the Status Message window indicates whether or not the login passed (you may have to scroll down to see it). See page 89 for Login/Logout details.

Note: As with all password protection, to ensure security please change the default password as soon as possible using the "F100 P" command (see page 87). Password change can only be made using the serial or Telnet interface.

3-3.1.5   Time and Network Control Pages

The Time, GPS, Satellite, and Network control pages allow for remote control of the NTS. Navigate from page to page using the corresponding buttons located at the top of each page.

The values displayed on these pages are static, i.e., they may not reflect changes that occurred following the initial display of the page. An example of this is the current Local Instrument Time field on the Time Control page. The time shown is the time read at the instant the web page first displayed, and does not update with the most recent values until you click the **Reload** or **Refresh** button of your web browser.

To make a change to a value, either enter the new values, or chose the appropriate values from either the radio buttons or drop-down lists, and click the **Submit Changes** button, located near the bottom of each control page. The changes are submitted to the NTS and the page refreshes, showing the new values. Check the Status Message Window located immediately below the **Submit Changes** button. Occasionally, a change to a parameter fails due to a processing error or transient network problem. If this occurs, simply resubmit the changes. If you encounter repeated failures, use the Telnet or serial interfaces to affect the required changes.

3-3.1.6   Leaving the Control Interface

The control session, activated with a successful login, ends under the following circumstances:

  ▪ Inactivity: no page navigation or submission of changes in the last five minutes
  ▪ Location change: navigation to a status page or the home page

If inadvertently logged out, navigate to the Control Login page (click the Controls button) from the home page or any status page, then follow the guidelines in Section 3-3.1.4 above.

3-3.1.7   Leaving the Web Interface

To terminate the web interface, exit your web browser or enter a new URL.

3-4   TELNET ACCESS

The NTS can perform setup and control operations sent from a remote location through the Internet. The protocol used for Internet access to an NTS is Telnet, a standard Internet communications program, with an ASCII character-based interface, that is bundled with Windows 95/98/NT and connects to the NTS through its NET port. Use Telnet just like Procomm, or any other serial interface program, by entering F-series commands, to which the NTS responds.

Note: Check with your System Administrator for Telnet application information, if you are using an operating system other than Windows (such as Macintosh or UNIX).

Telnet can only send in commands when there is no active session on the Utility port. If a Utility port session is active, either Telnet login will fail or, if already logged in, any Telnet command generates the response:

```
NOTICE: Cannot respond to command because Utility Port session has priority.
```

3-4.1 Starting Telnet and Making a Connection

1.   Press the **Start** button at the lower left of your screen.

2.   Click **Run** and enter "Telnet" in the **Open** field.
      The **Run** dialog box appears:
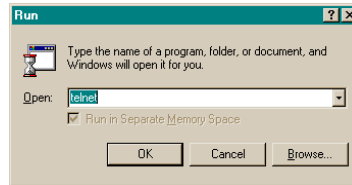
3.   Click **OK**.
      The **Telnet – (None)** window appears:
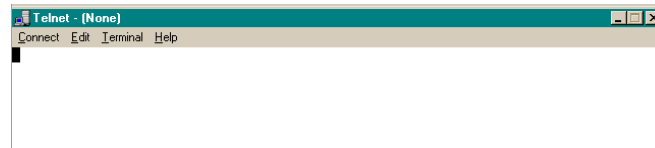
4.   Click **Connect**, the first item on the Telnet menu bar, then select **Remote System**.
      The **Connect** dialog box appears:
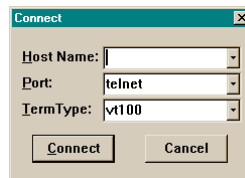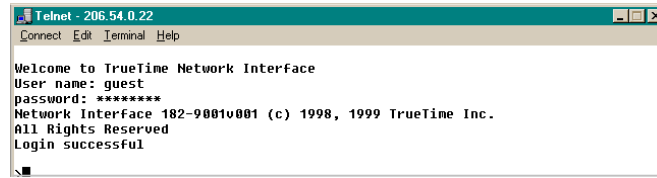
5.   In the **Host Name** field, enter the IP Address of the NTS.
      Do not change the text in the other two fields, which should read "Telnet" and "VT100".

6.   Click **Connect** to start a Telnet connection to the NTS.
      If the connection was successful, a login prompt appears:
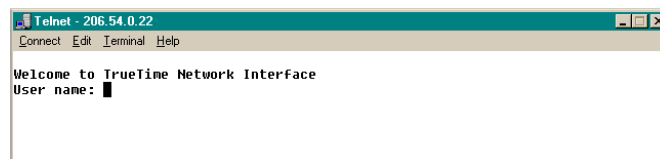
      If an hourglass appears instead, it means the connection was not successful and you should repeat steps 1-5.

7.   Enter the login name "guest".
      A password prompt appears.

8.   Enter the default password "truetime" (one word, all lower case).
      A welcome message appears if the login and password are approved:

```
Telnet - 206.54.0.22                                        _ □ ×
Connect  Edit  Terminal  Help

Welcome to TrueTime Network Interface
User name: guest
password: ********
Network Interface 182-9001v001 (c) 1998, 1999 TrueTime Inc.
All Rights Reserved
Login successful
▄
```

9.   Begin your Telnet session by entering F-series commands.

3-4.2   Ending Telnet

There are two ways to end Telnet:

▪   Close it from your terminal by selecting **Exit** from the **Connect** menu

▪   Let it timeout; if no commands are received for 15 minutes, the NTS automatically terminates the session

3-5   SERIAL ACCESS THROUGH THE UTILITY PORT

With the exception of serial timestamp-related functions (which are not supported on the NTS), this RS-232 connector provides serial access. The RS-232 connector is located to the left of the NET port connector on the back of the NTS (see Figure 2-1 on page 11). This connector is labeled "Serial I/O", and is referred to as the "Utility port."

Note: Serial time output is not available on the Utility port.

The following table describes the Utility port's RS-232 pinouts and signal types, using a null modem cable:

Table 3-1: RS-232 Pinouts and Signal Types

NTS		9- to 25-PIN ADAPTER CABLE 9-pin 25-pin		RS-232 Computer Interface
OPEN		1	8	DCD, CARRIER DETECT
IN	RXNIC	2– – – – – – <– – – – – – –3		TRANSMITTED DATA
IN	TXNIC	3– – – – – – <– – – – – – –2		RECEIVED DATA
OPEN		4	20	DTR, DATA TERMINAL READY
GND		5– – – – – <>– – – – – 7		SC, SIGNAL GROUND
OPEN		6	6	DSR, DATA SET READY
OPEN		7	4	RTS, REQUEST TO SEND
OPEN		8	5	CTS, CLEAR TO SEND
OPEN		9	22	RI, RING INDICATOR

3-5.1   Serial Line Settings

Serial I/O settings are factory set and cannot be changed. The default serial format is:

Data Rate:	**9600 bits/second**
Word Length:	**8 bits**
Parity:	**None**
Stop Bits:	**1**

To connect to a computer's serial port, use a null modem. Any serial access program may be used to connect to the Utility port. All commands are input using conventional TrueTime F-series type commands (see Chapter 4, starting on page 53). For cabling information and a back panel illustration, see page 11.

Note: The following examples use two popular Windows-based serial programs, Procomm and HyperTerminal. These examples apply *only* to systems using Windows 95/98/NT. Check with your System Administrator if you are using another operating system.

The Utility port can be connected to a terminal or a computer. These instructions assume that a terminal is connected.

Note: When using Procomm or HyperTerminal, start the program *before* using the serial cable to connect the computer to the NTS.

3-5.2   Procomm

As with all TrueTime products, connect the serial cable from the computer running Procomm to the NTS Utility port.

3-5.3   HyperTerminal

To use HyperTerminal, follow the steps described in the following sections.

3-5.3.1   Starting HyperTerminal

To start HyperTerminal:

1.   Click the **Start** button on the task bar.

2.   Select **Programs > Accessories > HyperTerminal > HyperTerminal**.
     The **Connection Description** dialog box appears:
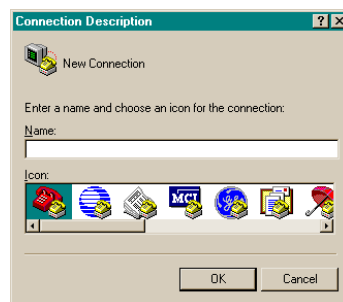
3. Enter a name (such as "NTS") for this connection in the **Name** box and click **OK**.
    The **Connect To** dialog box appears:

4. In the **Connect using** box, use the drop-down menu to select your modem's Com port (COM1 in this example), then click **OK**.
    The **COM1 Properties** dialog box appears, showing the **Port Settings** tab:
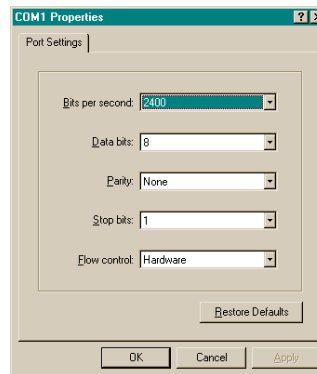
5. Edit the fields in the **Port Settings** dialog box as follows:

Bits per second	**9600**
Data bits	**8**
Parity	**None**
Stop Bits	**1**
Flow control	**None**

6. Click **OK**.
    The **NTS HyperTerminal** window appears, indicating the NTS is now connected through the Utility port:
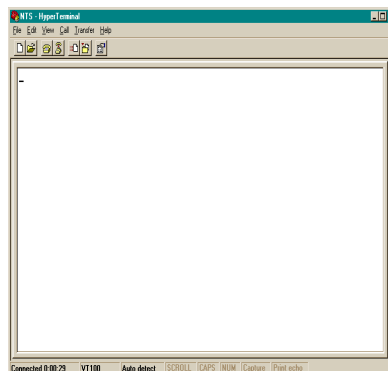
3-5.3.2   Setting Up a HyperTerminal Session

To set up a HyperTerminal session:

1. From the **File** menu in the session window, select **Properties**.
    The **NTS Properties** dialog box appears, showing the **Connect To** tab:
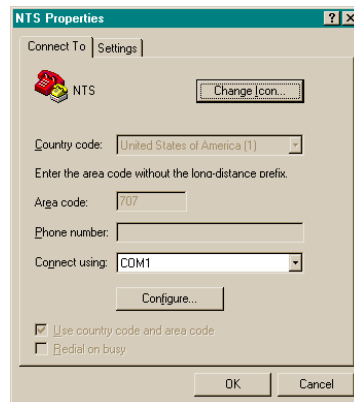
2. Select the **Settings** tab and click the **Terminal keys** radio button.
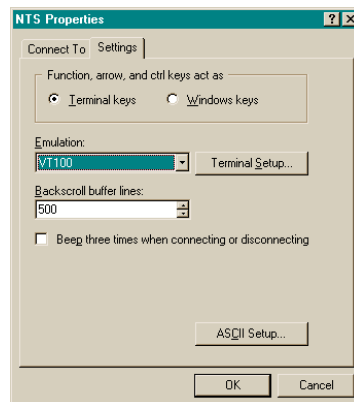
3. In the **Emulation** box, use the drop-down menu to select **VT100** terminal type (do not select the Auto detect option).

4. Click **Terminal Setup** and configure the terminal by selecting the appropriate options in the **Terminal Settings** dialog box (with a VT100 terminal, the recommended settings are pictured below):
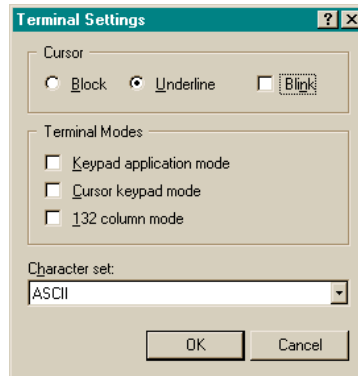
5. Click **ASCII Setup**…
    The **ASCII Setup** dialog box appears:
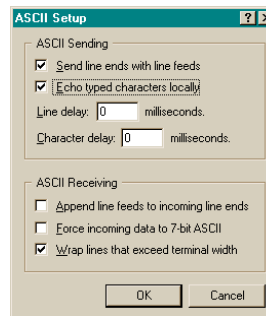
6. Place check marks in the following boxes:

    - Send line end with line feeds
    - Echo typed characters locally
    - Wrap lines that exceed terminal width

7. Click **OK**.
    This returns you to the **NTS Properties** dialog box.

8. Click **OK**.
    This returns you to your HyperTerminal session window, where you can enter "F" sequence commands.

9. When exiting HyperTerminal, click **Yes** when prompted to save the current session:
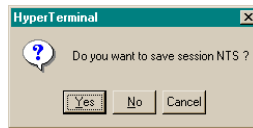
The next time you launch HyperTerminal from the **Start** menu, you can reconnect to the session you just created.

3-5.3.3 To reconnect to your last HyperTerminal session:

1. From the **HyperTerminal** window, select **File > Open**.

2. Double-click your last session:
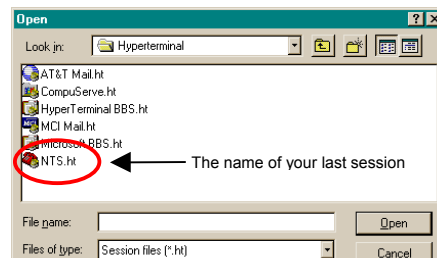
3-6 SESSION TIMERS

There are timers on Utility port and Telnet sessions that terminate them, if there is a lack of activity. Any action you take during a session resets the timer, and it starts all over again. The timers and their interactions are described in the following sections.

3-6.1   Utility Port Session Timer

The Utility port Session Timer starts upon receipt of a character from the Utility port. The timer is reset upon receipt of every character. If no characters are received for fifteen consecutive minutes, the Utility port Watchdog Program terminates the session.

When a Utility port session is in progress, Telnet cannot execute any commands to the NTS. The Utility Port session must end before full Telnet access is possible.

3-6.2   Telnet Session Timer

The Telnet Session Timer starts upon receipt of a command line from Telnet, via the NET port. The timer is reset upon receipt of every command line. If no lines are received for fifteen consecutive minutes, the Telnet port Watchdog Program terminates the session.

Terminating a Telnet session drops the connection to the remote host. You can immediately activate a new session by logging in again.

3-6.3   Web Control Session Timer

The Web Control Session Timer starts upon receipt of an HTTP request from a web browser, via the NET port. The timer is reset upon receipt of every HTTP request. If no HTTP requests are received for five consecutive minutes, the Web Control Watchdog program terminates the session.

Terminating a Web Control session causes the NTS to deny any further requests you make for changes. You can immediately activate a new session by logging in again.

3-7 NTS START-UP

At power-up, the NTS checks its EEPROM for valid configuration data. If configuration data is valid and present, then the NTS attempts to synchronize its internal time to the synchronization source.

Once the NTS has synchronized itself, then it is ready to respond to any requests that it receives over the serial connection. During interruptions of the synchronization input, the NTS estimates the quality of the time it is able to provide to clients and updates the fields of the NTP packet appropriately. In addition, the time quality character of the "worst-case time error," reported by Function 13, is also updated during such interruptions. The NTS provides NTP server operation until the "worst case time error" has exceeded the value of the root dispersion field set in the NTP packet. See Section 3-9 (Time Quality Indication) on page 28, and Appendix A, for details on this behavior. For details about start-up procedures, see the Quick Start Guide, starting on page 9.

Note: An NTS does not, at any time, output continuous elapsed time to the serial port.

Messages on the front panel display indicate which version of software is installed, and how to use the keypad help function.

> The first message is the version of the system software. An example of the response is:

```
TRUETIME MKIII
sys ver 007
```

> After a few seconds, the display shows:

```
Press func, 0, 0
for help.
```

> Then the display shows the version of the clock-specific software:

```
NTS   V1.007
```

> An example of the response is:

```
182-7004v001
```

Note: The text of the version messages varies from model to model and version to version.

After a few seconds, the display shows the STATUS display, which remains until a keypad function is invoked, or the TIME or POSITION push-button is pressed.

3-7.1   Satellite Acquisition

Satellite acquisition begins at power-up and continues until power-down. Time to first satellite acquisition depends on many factors. The following paragraphs describe some of the possible events that affect satellite acquisition times.

Note: Satellite visibility at the receiver antenna site affects time to first satellite acquisition.

The NTS attempts to acquire satellites, not knowing which satellites are visible. Its search continues until a satellite is acquired. If the position of the GPS antenna is already known, time is acquired from the first satellite and the receiver returns to normal operation. This procedure may take from as little as 3 minutes to as long as 15 minutes, depending upon current satellite visibility.

If the current GPS antenna position is unknown, or in error by more than 100 Km (62 miles), acquisition typically requires from 3 to 15 additional minutes to locate current antenna position, reacquire satellite almanac and ephemeris data, and deliver UTC time. Refer to AUTO MODE below for operational details.

If the NTS has saved a good current average position In AUTO or TIME mode, and has saved recent UTC leap second information, it typically locks to GPS in 3 to 5 minutes and delivers UTC time.

3-8 OPERATING MODES

The NTS operates under one of three modes: AUTO, SURVEY and TIME. Each mode is described below.

Use Function 53 (see page 41), or serial Function F53 (see page 68) to change from one mode to another or to determine the current mode.

The out-of-the-box default mode is AUTO. The default on subsequent power-up will be the mode used at the previous power-down, unless the unit is moved more than 1km, in which case it reverts to AUTO mode.

3-8.1   Auto Mode

AUTO mode offers a painless solution to GPS receiver installation, start-up and operation. Under AUTO mode, no user input is required to properly complete an NTS site installation, however a minimum of 4 satellites is required to complete the installation process.

Note: Invoking AUTO mode clears the average position and may disturb the time and frequency outputs. For this reason, do not unnecessarily use AUTO mode.

After unit installation, or whenever you reinstall the NTS, select AUTO MODE using keypad Function 53, or serial or Telnet function 53.

AUTO mode consists of 3 phases:

> Phase 1: Current Position Search
> Phase 2: Current Position Averaging and Refinement
> Phase 3: Invocation of Time Mode

Time and Frequency data and output signals are available throughout this process, however optimal accuracy and stability are not achieved until phase 2 is complete. With good satellite visibility, this occurs after about 24 hours of averaging.

Phase 1: Current Position Search

Immediately after invoking AUTO mode, the NTS clears the average position and the GPS receiver begins a satellite search. The display shows: "STATUS: Looking for satellites".

Right after acquiring the first satellite, the unit attempts data lock and adjusts the satellite doppler compensation (the change in the 1.575 kHz frequency due to the apparent satellite velocity for terrestrial based receivers, typically 0 to +5 KHz) until data can be read from the satellite.

After data lock, GPS time is acquired to the 20 ms level of accuracy, and almanac data loading for the entire constellation begins. At this time the display shows "MODE: AUTO 1 SAT", and the serial F53 command returns "F53 AUTO: 1 SATS".

During the data loading process, the NTS searches for additional satellites. When a second satellite is acquired and data lock is achieved, the position of the NTS may be placed in the proper hemisphere, narrowing the search for possible satellites.

When a third satellite is acquired, a unique position solution exists given an assumed ellipsoid height near 0 meters. At this time, the serial F53 command returns "F53 AUTO: 3 SATS". With this position, the remaining visible satellites are determined based on the almanac and the time, and are acquired rapidly. Once a 3-D position fix has been determined, synchronization to UTC begins and the first stage of AUTO Mode has ended. At this time serial F53 command returns "F53 AUTO: # SATS", where # is the number of satellites being tracked, which may be as many as 6.

Phase 2: Current Position Averaging and Refinement

After completing the first Current Position Search phase of AUTO mode, AUTO mode automatically begins averaging position fixes. The average position is used as a starting position the next time the unit is powered on, enabling it to obtain accurate time even if only one satellite is visible. The average position is improved until 90,000 position fixes have been averaged, which takes approximately 24 hours. At this time, the display shows "MODE: TIME" and the serial F53 command returns "F53 TIME: # SATS" .

Phase 3: Invocation of TIME Mode

After the position average is complete, the AUTO mode switches the time and frequency module to TIME mode and the averaged position is used for all future timing solutions. TIME mode inhibits further surveying. This concludes the auto mode installation process.

The NTS remains in TIME mode and powers-up in TIME mode using the averaged position after a power outage. However, after powering-up in TIME mode, if the computed positions consistently differ from the previously stored average position by more than 1 Km for a significant period of time, the NTS automatically reinitializes itself to AUTO mode and re-establishes the position. Otherwise, operator intervention would be necessary to re-invoke AUTO mode.

3-8.2   Survey Mode

SURVEY mode is appropriate for networks on <u>dynamic</u> or <u>pseudo-static</u> platforms, such as ships or planes. In SURVEY mode, the NTS repeatedly calculates position and time based on the unaveraged position. The position solutions are not averaged. Strictly stationary users should use TIME mode.

SURVEY mode has two sub-mode options: SURVEY STATIC and SURVEY DYNAMIC.

SURVEY STATIC should be used when the mode of operation is pseudo-static, i.e. the unit is periodically transported to a new location and then stationary operation is performed at the new location. In this mode, the GPS core receiver easily maintains lock under the dynamics experienced during ground transport and quickly provides accurate time and frequency once at the new site. This mode also supports operation with a single satellite, once the position at the new site has been determined.

Note: If operation while moving is important and the possibility of satellite obstruction exists, SURVEY STATIC should not be selected as erroneous time and frequency steering data could be used while only a single satellite is visible.

SURVEY DYNAMIC should be used when operation is truly dynamic and might possibly include high acceleration or velocity, such as might be experienced on-board tactical aircraft. In this mode, satellite visibility must be complete. Fall-back to single satellite operation is not supported.

3-8.3   Time Mode

In TIME mode, the NTS disables updating of the reference position average. Timing solutions are based on either current position fixes, the previously averaged position, or a reference position which has been input via serial or Telnet function F56, if too few satellites have been visible to perform a position fix. However, each position fix update is tested against the reference position to detect possible relocation of the receiver and antenna during the last power-off period. If the NTS determines that it has been moved by more than 1 km, it automatically sets itself into AUTO mode.

Up to six satellites are used for timing solutions, enabling significant reduction of the effects of Selective Availability on the stability and accuracy of the timing and frequency outputs and measurement data. The satellites chosen are the best ones currently available.

3-9 TIME QUALITY INDICATION

Whenever the NTS is not tracking satellites, the timing accuracy of the time and frequency module depends on the accuracy and stability of the internal oscillator. Upon loss of GPS synchronization, time error accumulates (determined by the oscillator's stability accuracy characteristics).

When the receiver is tracking satellite signals and is operating from a known position, the worst-case error is ± 5 μs. If lock with all satellite signals is lost, the serial F53 command returns "F53 MODE: 0 SATS", where "MODE" is the current operating mode, i.e. AUTO, SURVEY, TIME.

If the NTS loses its lock on the incoming signal from its synchronization source, the time output and time display gradually begin to drift. Based on the nature of its synchronization source and oscillator characteristics, the NTS internally calculates an estimate of the worst-case time error in real time. If time quality indication is enabled (through the F05 command), the NTS compares this estimate to predetermined threshold levels and sets time quality error flags on the IRIG output if these thresholds have been met or exceeded, using a different time quality character for each of

the four thresholds. These settings only affect the IRIG output and do not affect NTP packets. See Appendix C for more information about IRIG-B time code and worst-case error flags.

As shipped, the time quality indication is enabled and the default thresholds are:

First threshold	10 μs
Second threshold	100 μs
Third threshold	1000 μs
Fourth threshold	10000 μs

3-10   FRONT PANEL INTERFACE

The NTS front panel is the primary user interface. Input is via three front panel push-buttons and a 16-key keypad. Output is via the two-line 32-character alphanumeric LCD. The alphanumeric display shows status and various function displays.

3-10.1   Alphanumeric Display

The alphanumeric display is used either for keypad function operation, or to display (in real time) the current clock mode or current time with calendar day and year.

3-10.2   TIME Push-Button

Pressing the TIME push-button places the equivalent time-of-year and the date on the alphanumeric display. The format of the date is day-of-week, month, day-of-month, year.

3-10.3   STATUS Push-Button

Pressing the STATUS push-button displays the status of the NTS, and indicates whether the unit is locked or unlocked to its synchronization input source.

Additionally, pressing the Status button aborts any keypad function currently in progress. If you entered an incorrect function, or if the alphanumeric display shows something unexpected, press the STATUS push-button to abort the function with no action taken by the function.

3-10.4   POSITION Push-Button

Pressing the POSITION repeatedly toggles between the latitude, longitude, altitude and PDOP of the GPS antenna, based on the last position fix. The values are the same as those displayed when requesting information through Function 50 (Position Entry/Request).

Note: PDOP is Position Dilution of Precision, and represents the degree to which the satellite geometry increases possible errors in a position fix.

3-11   KEYPAD OPERATION

The 16-key front panel-mounted keypad consists of numeric keys "0" through "9", arrow keys "up", "down", "right", and "left", a clear key, "CLR", and the function/enter key, "FUNC/ENTR". Refer to Section 3-12 below before attempting function entries. The following rules are for keypad function entry:

The current status, position or time should be on the alphanumeric display before starting a function. If not, press the STATUS push-button.

It takes several seconds for some functions to appear. If nothing happens after several seconds, press the STATUS push-button, then try again.

When pressing keypad buttons, hold the button for ¼ second to reduce contact bounce and insure the key is recognized. Short "pokes" may result in bad entries.

To enter a specific function, press "FUNC/ENTR" followed by the function number. Be sure to include the leading zeros for function numbers lower than ten. If the function number is currently unassigned or not implemented, the alphanumeric display shows the "Function not implemented" message, then reverts to STATUS.

When entries are complete and the display shows the desired data, press "FUNC/ENTR".

The "CLR" key clears data entered. Example: If you intended to enter an IP Address of 255.255.255.240, but notice just prior to pressing the "FUNC/ENTR" that you inadvertently entered 255.255.255.255, press "CLR". The display reverts to the previous value. Then re-enter 255.255.255.240 and press "FUNC/ENTR".

To verify your entry, press "FUNC/ENTR" and the appropriate function number and the data displays. To leave this function unchanged simply press the STATUS push-button. Your entry remains unchanged and the display reverts back to the STATUS function.

Use the left- or right-arrow keys to move the cursor beneath the character that you wish to edit. Use the up- or down-arrow keys to scroll through the possible choices for that character.

3-12   SELECTING FUNCTIONS AND ENTERING DATA

The various keypad functions are listed in the following table. Some of these functions are optional and may not be included in your unit. If in doubt as to whether your unit includes a particular function, try it. The alphanumeric display shows the message "Function not implemented" if the function is not in your firmware.

Note: All functions must be re-requested to display the most current information.

In some cases, such as in keypad Function 36, sub-menus contain editing choices. Scroll through the sub-menus using the up- and down-arrow keys. Your changes are not applied until you press "FUNC/ENTER" and advance to the next parameter. At any time in the sub-menu editing process, you can press "CLR" to restore the original settings, or the STATUS push-button to exit the Function altogether without saving any modifications.

The commands in the following table are available from the front panel keypad:

Table 3-2: Keypad Function List

Command	Function
F00	Keypad Help Function
F01	Time Zone Entry/Request
F02	12/24 Hour Format Entry/Request
F03	Time and Date Entry/Request
F05	Time Quality Enable/Setup
F06	Keypad Lock Enable
F13	Worst-case Time Error Request
F18	Software Version Request
F36	NTP Port Network Configuration Entry/Request
F50	Position Entry/Request
F51	Antenna Cable Delay Entry/Request
F53	Operating Mode Entry/Request
F55	Altitude Units Entry/Request
F56	Average Position Entry/Request
F60	Satellite List Request
F65	Satellite Select
F66	Daylight Savings Enable
F67	Leap Second Information Request
F68	Year Entry (GPS Epoch Management)
F71	Oscillator Statistics Request
F72	Fault Status
F73	Display/Set Alarm Status/Control
F79	Warm Restart

3-13   KEYPAD FUNCTION DESCRIPTIONS

The following sections describe the NTS keypad function commands.

3-13.1   Keypad Function 00 – Keypad Help Function

Use Function 00 to obtain a short description of all keypad functions available.

> To display this list, press the following keys:

> "FUNC/ENTR" "0" "0"

The NTS responds with:

```
up, down keys
to view list...
```

Press any key to see the next display:

```
Func/enter key
to call function
```

Press any key to see the next display, which is the first entry in the keypad function description list:

```
F01: Sets time zone
```

The list of available keypad functions can now be viewed by pressing the up- or down-arrow keys. Each entry in the list gives the function number and a short description of the function's purpose. If the "FUNC/ENTR" is pressed, the function being displayed will be invoked. When a function so invoked is finished, the display reverts back to the STATUS function.

You can exit the help function without invoking a function by pressing the TIME, or STATUS push-button.

3-13.2   Keypad Function 01 – Time Zone Entry/Request

Use Function 01 to enter or select the time-zone offset. This affects the front panel display, serial or Telnet port time display, command responses to the serial terminal, and IRIG-B output. The time-zone offset is related to the F03 return (see the table below). The time transmitted in the NTP packets is always UTC time, and the initial out-of-the-box default is 00:00. The acceptable range of offsets is +12:00 to –12:00 hours.

> To see current information, press the following keys:

> "FUNC/ENTR" "0" "1"

The NTS responds with:

```
Time zone hr:min
±00:00
```

Press the right- or left-arrow key to position the cursor beneath the character that you wish to change. Press the up- or down-arrow keys to scroll through the possible choices. Alternately, directly enter the numbers using the keypad. The cursor advances to the next digit automatically. When the display shows the desired time-zone offset, press "FUNC/ENTR" to enter your choice.

Commands F01 and F03 are interrelated and always apply to local time. Command results may also affect UTC time, depending on the state of the synchronization source, as shown by the following table:

Table 3-3: Effect of Synchronization Source State on UTC and Local Time

State of the Synchronization Source	F01 Command Success	Result for UTC Time, as displayed by F03	Result for Local Time
Present and locked	Yes	Entry is immediately overwritten by the incoming time from the synchronization source	Entry persists
Lost, still in free-run mode, still in tolerance	Yes	Entry may be overwritten by the incoming signal	Entry persists
Lost, drifted out of tolerance	Yes	Entry persists	Entry persists

3-13.3   Keypad Function 02 – 12/24 Hour Format Request

Use Function 02 to set or request either the 12-hr or 24-hr time display format. The 12/24 Hour Format affects the front panel display, serial or Telnet port time display, command responses to the serial terminal, and IRIG-B output. The time transmitted in the NTP packets is always UTC time, and the initial out-of-the-box power-up default is the 24-hr format. The default upon subsequent power-ups is the value used before power-down.

To display current data, press the following keys:

"FUNC/ENTR" "0" "2"

The NTS responds with:

```
12/24 hr Format    or 12/24 hr Format
24                    12
```

Press the up- or down-arrow keys to toggle between 24 and 12. When the display shows the desired format, press "FUNC/ENTR" to enter your choice.

3-13.4 Keypad Function 03 – Time and Date Entry/Request

Use Function 03 to enter or request time and date. The initial out-of-the-box default is UTC date and time. The time-of-year before power-down is the default upon subsequent power-ups.

Note: If the GPS antenna is installed and tracking satellites, the time you enter using F03 is immediately overwritten by the incoming signal.

To display current data, press the following keys:

"FUNC/ENTR" "0" "3"

The NTS responds with:

```
Date-time    or    Date-time
utc                local
```

Press the up- or down-arrow keys to toggle between "UTC" and "Local".

When the display shows your choice, press "FUNC/ENTR" again and the NTS responds
with:

```
Date-time
MM/DD/YY
```

where MM is the month, DD is the day, and YY is the year.

Note: Year entries less than 10 display as a single digit, preceded by an empty space. Examples
of the response under these conditions are:

```
01/01/ 0  for January 1, 2000
05/12/ 5  for May 12, 2005
```

Press the right- or left-arrow keys to move the cursor beneath the digit that you wish to change.
Press the up- or down-arrow keys to scroll through the possible choices. Alternately, directly
enter the numbers using the keypad. The cursor advances to the next digit automatically.

Note: Although an illegal date entry displays, it is not accepted.

Press "FUNC/ENTR" again and the NTS responds with:

```
Date-time
00:00:00
```

where the zeros represent hours, minutes, and seconds, in that order.

Press the left- or right-arrow keys to position the cursor beneath the digit that you wish to
change. Press the up- or down-arrow keys to scroll through the possible choices. Alternately,
directly enter the numbers using the keypad. The cursor advances to the next digit
automatically.

Note: The 00:00:00 display lets you set the time. It does not mean "zero time." To display time,
press the TIME push-button.

Press "FUNC/ENTR" to enter the data to the NTS (only valid dates are accepted).

3-13.5 Keypad Function 05 – Time Quality Enable/Setup

Use Function 05 to enable or disable time quality indication and to determine time quality thresholds
(see Time Quality Indication on page 28 for more information).   These settings affect the IRIG output,
but do not affect NTP packets. The settings in use at power-down are used as the default for
subsequent power-ups. See Appendix C for more information about IRIG-B time code and worst-case
error flags.

As shipped, the time quality indication is enabled and the default thresholds are:

First threshold	10 μs
Second threshold	100 μs
Third threshold	1000 μs
Fourth threshold	10000 μs

To determine if the indicators are enabled and what the thresholds are, press the following keys:

"FUNC/ENTR" "0" "5"

The NTS responds with:

```
Time quality    or    Time quality
on                    off
```

Press the up- or down-arrow keys to toggle between "on" and "off". When the display shows the desired state, press "FUNC/ENTR".

The NTS responds with:

```
First tq flag:
00000000000ns
```

or with the current value.

Press the right- or left-arrow keys to position the cursor beneath the digit that you wish to change. Press the up- or down-arrow keys to scroll through the possible digit choices. Alternately, directly enter the numbers using the key pad. The cursor advances to the next digit automatically.

When the display shows the value that you desire for the first time quality threshold, press "FUNC/ENTR".

The NTS responds with:

```
Second tq flag:
00000000000ns
```

or with the current value.

Press the right- or left-arrow keys to position the cursor beneath the digit that you wish to change. Press the up- or down-arrow keys to scroll through the possible digit choices. Alternately, directly enter the numbers using the key pad. The cursor advances to the next digit automatically.

When the display shows the value that you desire for the second time quality threshold, press "FUNC/ENTR".

The NTS responds with:

```
Third tq flag:
00000000000ns
```

or with the current value.

Press the right- or left-arrow keys to position the cursor beneath the digit that you wish to change. Press the up- or down-arrow keys to scroll through the possible digit choices. Alternately, directly enter the numbers using the key pad. The cursor advances to the next digit automatically.

When the display shows the value that your desire for the third time quality threshold, press "FUNC/ENTR".

The NTS responds with:

```
Fourth tq flag:
00000000000ns
```

or with the current value.

Press the right- or left-arrow keys to position the cursor beneath the digit that you wish to change. Press the up- or down-arrow keys to scroll through the possible digit choices. Alternately, directly enter the numbers using the key pad. The cursor advances to the next digit automatically.

When the display shows the value that you desire for the fourth time quality threshold, press "FUNC/ENTR" to enter all of the data.

The appropriate threshold values range from: 000010000ns to 40000000000ns.

3-13.6   Keypad Function 06 – Keypad Lock Enable

Use Function 06 to enable or disable the keypad. Once enabled, the keypad lock function prevents unauthorized or accidental entries on the keypad. The initial out-of-the-box default is "off". The default upon subsequent power-ups is the same as it was on the previous power-down.

To display current data, press the following keys:

"FUNC/ENTR" "0" "6"

The NTS responds with:

```
Keypad lock      or      Keypad lock
on                       off
```

Press up- or down-arrow keys to toggle between "on" and "off". When the display shows the desired choice, press "FUNC/ENTR". After the keypad lock is enabled, any attempt to enter a function on the keypad (except keypad function 06) results in the message "Keypad locked" or "Function not implemented."

3-13.7   Keypad Function 13 – Worst-Case Time Error Request

Use Function 13 to request the worst-case time error due to oscillator drift during periods when satellites are not being tracked.

The worst-case time error, while the synchronization source input is present and the NTS is locked to it, depends on the type of synchronization source. If the NTS acquired valid time but subsequently lost lock to the signals, then the time output and time display begin to drift. This drift is dependent on the stability of the internal oscillator, and the accuracy to which it had been set on frequency prior to the outage. The processor calculates and displays in seconds the worst-case time based on the stability of the time base and the time elapsed since loss of synchronization source.

To display current data, press the following keys:

"FUNC/ENTR" "1" "3"

If the unit has not yet acquired valid time, the NTS responds with:

```
Time error
Over range
```

If the unit has acquired valid time, an example of the response is:

```
Time error ±
00.000005000
```

3-13.8 Keypad Function 18 – Software Version Request

Use Function 18 to obtain information about the current version of NTP-specific software installed in the NTS. To obtain the version number of the NET port network interface software that allows Telnet access, use serial or Telnet I/O Function F100 VER (see page 89).

> To display current data, press the following keys:
>> "FUNC/ENTR" "1" "8”

> An example of the response is:
>> ```
>> TRUETIME NTS
>> sys ver 007
>> ```

> Press any of the arrow keys, to change the display to the clock-specific version. An example of the response is:
>> ```
>> NTS    v1.007
>> 182-7004v001
>> ```

Repeated presses of arrow keys will switch back and forth between the two displays.

The two examples shown indicate that the system software is version 007, and the clock-specific software is version 1.007, PART NO. 182-7004v001.

> To return to the STATUS display, press the "FUNC/ENTR", or STATUS push-button.

3-13.9 Keypad Function 36 – NTP Port Network Configuration Entry/Request

Use Function 36 to request or set NTP port network parameters and, if the serial port is unavailable, configure SNMP and maintain MD5 Authentication keys. To request or set information about NET port network configuration, use F100 IC (see page 86).

> To display current data, press the following keys:
>> “FUNC/ENTR” “3” ”6”

> The NTS responds with:
>> ```
>> Display Ethernet
>> Address
>> ```

Use the up- and down-arrow keys to scroll among the major selections for Function 36:
- Ethernet Address
- IP Address
- Subnet Mask
- Default Gateway
- Network Type
- Clock Type
- MD5 Authentication

Pressing "FUNC/ENTR" while a major selection is displayed allows you to view and/or modify the NTP parameters.

At any time a major selection is displayed, the up- and down-arrow keys can be used to move to another major selection. This eliminates the need to view each of the Function 36 parameters, if you only want to change one parameter.

Note: If you change an F36 parameter, you must answer "Yes" to the "Save settings and restart?" prompt that will appear after Clock Type. It requires several seconds to reboot the system. Please wait until the unit has completed re-initialization before issuing further commands.

3-13.9.1   Ethernet Address

The Ethernet address is a six-byte, hexadecimal value specific to the NTS NET port. The first three bytes are registered to TrueTime, Inc; the last three bytes are the hex value identifying the NET port. The ethernet address for the NTS NET port is a fixed address assigned at the factory and cannot be changed.

> Press "FUNC/ENTR" on "Display Ethernet Address" to display the Ethernet Address of the unit. An example of the response is:

```
Company: 00-A0-69
   Unit: 00-00-0F
```

Press "FUNC/ENTR" to move on to the next parameter, or press the STATUS push-button to exit Function 36 without saving any updated settings. The next parameter is IP Address.

3-13.9.2   IP Address

> Press "FUNC/ENTR" on "Display/Setup IP Address" to view and/or change the IP Address of the NTS unit. An example of the response is:

```
IP Address:
 255.054.000.034
```

The left- and right-arrow keys move the cursor beneath the digits of the address. Use the up- and down-arrow keys, or the number keys, to modify the address. Upon completion, use the "FUNC/ENTR" key to enter the address shown and proceed to the next parameter, "CLR" to restore the original setting, or the STATUS push-button to exit Function 36 without saving any updated settings. The next parameter is Subnet Mask.

3-13.9.3   Subnet Mask

> Press "FUNC/ENTR" on "Display/Setup Subnet Mask" to view and/or change the Subnet Mask of the NTS unit. An example of the response is:

```
Subnet Mask:
 255.255.255.240
```

The left- and right-arrow keys move the cursor beneath the digits of the mask. Use the up-and down-arrow keys, or the number keys, to modify the mask. Upon completion, use the "FUNC/ENTR" key to enter the mask shown and proceed to the next parameter, "CLR" to restore the original setting, or the STATUS push-button to exit Function 36 without saving any updated settings. The next parameter is Default Gateway.

3-13.9.4   Default Gateway

> Press "FUNC/ENTR" on "Display/Setup Default Gateway" to view and/or change the Default Gateway of the NTS unit. An example of the response is:

```
Default Gateway:
 255.054.000.033
```

The left- and right-arrow keys move the cursor beneath the digits of the address. Use the up-and down-arrow keys, or the number keys, to modify the address. Upon completion, use the "FUNC/ENTR" key to enter the address shown and proceed to the next parameter, "CLR" to restore the original setting, or the STATUS push-button to exit Function 36 without saving any updated settings. The next parameter is Network Type.

3-13.9.5   Network Type

Press "FUNC/ENTR" on "Display/Setup Network Type" to view and/or change the Network Type of the NTS unit. An example of the response is:

```
Network Type:
 Ethernet II DIX
```

The up- and down-arrow keys toggle the Network Type between "Ethernet II DIX", and "IEEE 802.3". When the required type is shown, use the "FUNC/ENTR" key to enter the Network Type and proceed to the next parameter, "CLR" to restore the original setting, or the STATUS push-button to exit Function 36 without saving any updated settings. The next parameter is Clock Type.

3-13.9.6   Clock Type

The synchronization input option determines the clock type.

Press "FUNC/ENTR" to display the "Clock Type", which is always GPS for this unit. An example of the response is:

```
Clock Type:
        GPS
```

Attempts to set this field will be rejected with a syntax error message. The next parameter is MD5 Authentication, which also lets you configure SNMP.

3-13.9.7   MD5 Authentication

Although you can maintain MD5 Authentication keys and obtain information about, or change, the current SNMP configuration by using keypad Function 36, it is much easier to use the serial interface for this purpose. This is because these parameters are alphanumeric strings and the keypad interface does not allow easy entry of alpha characters.

For details about MD5 key maintenance using the keypad, see Section D-3 in Appendix D. For details about SNMP configuration using the keypad, see Section E-3 in Appendix E.

3-13.10   Keypad Function 50 – Position Entry/Request

Use Function 50 to enter or request the current antenna position. Since Function 50 returns the most recent fix computed by the GPS core receiver, not the long term averaged position (which is calculated during the AUTO mode of operation and reported via either keypad Function 56 or serial or Telnet Function F56), its use is mainly for initializing the approximate position of the GPS core receiver at new installations or after loss of non-volatile RAM back-up power.

Note: In TIME mode, the GPS receiver overwrites position entries.

To display current data, press the following keys:

"FUNC/ENTR" "5" "0"

An example of the response is:

```
Latitude
N 38° 23'53.9"
```

To enter a new position, press the right- or left-arrow keys to position the cursor beneath the character that you wish to change. Press the up- or down-arrow keys to scroll through the possible choices. Alternately, numbers may be directly entered using the keypad. The cursor automatically advances to the next position. When the display shows the desired latitude, press "FUNC/ENTR" for a response.

An example of the response is:

```
Longitude
W 122° 42'53.0"
```

Press the right- or left-arrow keys to position the cursor beneath the character that you wish to change. Press the up- or down-arrow keys to scroll through the possible choices. Alternately, numbers may be directly entered using the keypad. The cursor automatically advances to the next position. When the display shows the desired longitude, press "FUNC/ENTR". An example of the response is:

```
Altitude
±000055 Meters
```

Press the right- or left-arrow keys to position the cursor beneath the character that you wish to change. Press the up- or down-arrow keys to scroll through the possible choices. Alternately, numbers may be directly entered using the keypad. The cursor automatically advances to the next position. When the display shows the desired altitude, press "FUNC/ENTR" and all of the new position data will be entered.

To abort without changing the initial position data, press the STATUS push-button any time before the final "FUNC/ENTR".

If you attempt to enter a value that is out of the acceptable range, the display shows the message:

```
Value error!
re-enter
```

You can then re-enter the correct position value.

3-13.11   Keypad Function 51 – Antenna Cable Delay Entry/Request

Use Function 51 to enter or request the antenna cable delay. Typical delays for RG-58 and RG-59 cables are approximately 1.4 ns/foot, and the default is +70ns. The value is held in non-volatile RAM. The acceptable range of delays is from +001000000ns to –001000000ns.

To display current data, press the following keys:

"FUNC/ENTR" "5" "1"

The NTS responds with:

```
Ant. Cable delay
±000000070 ns
```

Press the right- or left-arrow keys to position the cursor beneath the digit that you wish to change. Press the up- or down-arrow keys to scroll through the possible choices. Alternately, numbers may be directly entered using the keypad. The cursor automatically advances to the next position.

When the display shows the desired delay, press "FUNC/ENTR" to enter the data.

Note: Positive delays entered here advance the NTS timing outputs while negative delays retard them.

3-13.12   Keypad Function 53 – Operating Mode Entry/Request

Use Function 53 to select the operating mode, either AUTO, SURVEY (SURVEY STATIC or SURVEY DYNAMIC), or TIME. For an explanation of these modes, refer to Section 3-8, starting on page 26.

> To display the current mode, press the following keys:
>
> > "FUNC/ENTR" "5" "3"
>
> The NTS responds with:
>
> > ```
> > AUTO / TIME Mode
> > AUTO
> > ```

Press the up- or down-arrow keys to scroll through the possible operating modes.

> When the display shows the desired mode, press "FUNC/ENTR" to enter your choice. If you choose SURVEY mode, the NTS responds with:
>
> > ```
> > Dynamic Mode
> > STATIC
> > ```
>
> Select either the STATIC or DYNAMIC sub-mode.

Press the up- or down-arrow keys to scroll through the possible SURVEY operating sub-modes. When the display shows the desired sub-mode, press "FUNC/ENTR" to enter your choice.

3-13.13   Keypad Function 55 – Altitude Units Entry/Request

Use Function 55 to select the units (either feet or meters) in which to express altitude. The initial out-of-the-box default is meters. The default on subsequent power-ups is the unit of measurement that was set just before the previous power-down.

> To display the units in which altitude is currently expressed, press the following keys:
>
> > "FUNC/ENTR" "5" "5"
>
> The NTS responds with:
>
> > ```
> > Altitude mode   or    Altitude mode
> > Meters                Feet
> > ```

Press the up- or down-arrow keys to toggle between "Meters" and "Feet". When the display shows the desired units of measure, press "FUNC/ENTR" to enter your choice.

3-13.14   Keypad Function 56 – Average Position Entry/Request

Use Function 56 to enter or request the averaged, hence accurate, current antenna position. Its main use is to provide a means of setting an accurate, surveyed position for use in the TIME mode of operation. Positions provided to the NTS via Function 56 should be more accurate than 10 meters, otherwise better results may be obtained via AUTO mode, unless satellite visibility at the site is too poor to provide three dimensional positioning. An averaged position, as returned via function 56, that subsequently becomes in error by more than 1 Km (either due to transport of the receiver and antenna, or due to error in the initial entry), will be cleared and recalculated automatically, once positioning begins at the new site and the error is detected.

Note: The NTS out-of-the-box default is AUTO mode. At start-up, in AUTO mode, the F56 command returns all zeros. In TIME mode, it returns the position at last power-down. The unit must be in TIME mode to enter the accurate position using F56.

To determine or modify the present position, press the following keys:

"FUNC/ENTR" "5" "6"

The NTS responds with:

```
Averager Count      or    Entered Average
   XXXX/90000                 Position
```

This response indicates either that the present average position is based on XXXX position fixes, and that 90000 such fixes will be averaged to complete the accurate position determination, or that the current averaged position was entered.

Press "FUNC/ENTR" again to display:

```
Ave. Latitude
N DD° MM'SS.S"
```

You can change the latitude by pressing a combination of arrow keys and/or direct digit entry. When it is as desired, press "FUNC/ENTR".

An example of the response is:

```
Ave. Longitude
W DDD° MM'SS.S"
```

You can change this longitude by pressing a combination of arrow keys and/or direct digit entry. When it is as desired, press "FUNC/ENTR".

An example of the response is:

```
Ave. Altitude
+XXXXXX Meters
```

You can change the height above the WGS-84 ellipsoid (the Geodetic Survey map of the world, from which the GPS references altitudes) by pressing a combination of arrow keys and/or direct digit entry. When it is as desired, press "FUNC/ENTR".

An example of the response is:

```
Enter average
position? No
```

Note: This choice is only available when the NTS operates in the TIME mode. Use the up- or down-arrow key to toggle to the desired response and press "FUNC/ENTR" to either cancel the entry or complete it.

3-13.15 Keypad Function 60 – Satellite List Request

Use Function 60 to list current, tracked, or bad satellites and to see the relative signal strength of tracked satellites.

Note: The NTS requires 24 hours after power-up to complete the satellite list.

To display current data, press the following keys:

"FUNC/ENTR" "6" "0"

The NTS responds with:

```
List sats:
Tracked
```

Press the up- or down-arrow keys to toggle between "Tracked" and "Bad". Once the type of list has been selected, press "FUNC/ENTR" again.

The NTS responds with:

```
Tracked Sats:    or    Bad Sats:
#14   +13.65           #14
```

depending on which list was requested.

Some other Satellite number may display. When observing Tracked Sats, the number following the satellite number is the relative signal strength of that satellite. Each time "FUNC/ENTR" is pressed the display shows the next tracked or bad satellite number.

When the list is complete, the NTS responds with:

```
Tracked sats:    or  Bad sats:
End of list.         End of list.
```

Press "FUNC/ENTR" again and the display shows the initial display. Press the STATUS push-button to exit Function 60.

Note: Use keypad Function F65 to control which individual satellites the NTS tracks.

3-13.16 Keypad Function 65 – Satellite Select

Use Function 65 to select the satellites you want the NTS to track or to stop tracking. Selections are retained in non-volatile memory.

Caution: If you instruct the NTS to stop tracking *all* visible satellites, the unit will *not* lock to GPS time.

To display current data, press the following keys:

"FUNC/ENTR" "6" "5"

The NTS responds with:

```
Sat# 14          or     Sat# 14
Enabled                 Disabled
```

or some other satellite number.

Press the up- or down-arrow key to toggle between "Enable" (track) and "Disable" (not track) When the display shows the desired choice, press "FUNC/ENTR". Each time "FUNC/ENTR" is pressed, the display shows the next satellite and indicates whether or not it is being tracked. This continues until the NTS displays the status of all satellites for which it has data.

Then the NTS responds with:

```
End. Press
Enter to confirm
```

Press "FUNC/ENTR" to enter your selections. To abort without changing the tracked/not tracked status of the satellites, press the STATUS push-button.

Note: Only those satellites whose numbers appear on the F60 Satellite List respond to F65 commands.

3-13.17   Keypad Function 66 – Daylight Savings Enable

Use Function 66 to enable, disable, or set the entry or exit times for Daylight Savings Time (DST). The initial out-of-the-box default is "Off". The default upon subsequent power-ups is the selection in use just before the previous power-down.

To display the current settings, press the following keys:

"FUNC/ENTR" "6" "6"

The NTS responds with:

```
Daylight Saving      or    Daylight Saving
Off                        Manual
```

Press the up- or down-arrow key to scroll between the choices. When the display shows the desired choice, press "FUNC/ENTR" to enter your choice.

The display, and all other time outputs, indicate UTC without any DST adjustment if a time-zone offset of 00:00 is selected. Regardless of the time-zone offset there will be no DST adjustment if "Off" is selected for the DST function. Some local jurisdictions enter and leave DST at times other than those set by U.S. federal law. Therefore, TrueTime has included a "Manual" choice that allows you to override the times of entry into and exit from DST by selecting your own.

If "Manual" is selected for the DST function, an example of the response is:

```
Enter dst: 02:00
1st Sun in Apr
```

or the unit may respond with some other entry time and date.

The above display means that Daylight Savings Time will start at 2 a.m. local time on the first Sunday in April each year.

Press the right- or left-arrow keys to position the cursor beneath the character that you wish to change. Press the up- or down-arrow keys to scroll through the possible choices. Alternatively, directly enter the numbers using the keypad. The cursor automatically advances to the next position.

DST transitions may be set to occur at any hour of the day (the range is from 0 to 23), any day of the week, any week of the month (the options are "1st", "2nd", "3rd", "4th", or "Last"), or any month of the year, with the following restriction: If either transition is less than 24 hours from the start or end of a year, the transition may not occur at the desired time.

When the display shows the desired entry time and date, press "FUNC/ENTR" again. An example of the response is:

```
Leave dst: 02:00
Last Sun in Oct
```

or some other entry time and date.

Press the right- or left-arrow keys to position the cursor beneath the character that you wish to change. Press the up- or down-arrow keys to scroll through the possible choices. Alternatively, directly enter the numbers using the keypad. The cursor automatically advances to the next position. The ranges are the same as before, but the exit time must be later than the entry time, otherwise DST will never be entered.

When the display shows the desired exit time, press "FUNC/ENTR" to enter the selections. The data entry may be aborted at any time prior to pressing the last "FUNC/ENTR" by pressing either the TIME, STATUS, or POSITION push-button.

Once the entry and exit times are entered, they will be retained in nonvolatile memory if the clock loses power or is turned off. If the nonvolatile memory is corrupted due to battery failure or any other cause, the entry time will default to 2:00 a.m. on the first Sunday in April and the exit time will default to 2:00 a.m. on the last Sunday of October.

The sequence of the count upon entry into DST is:

```
01:59:58
01:59:59
03:00:00
03:00:01
```

assuming the entry time was 2:00 a.m. The sequence upon exit from DST is:

```
01:59:58
01:59:59
01:00:00
01:00:01
```

assuming the exit time was 2:00 a.m.

If the DST function is enabled or disabled when DST is already in effect, the display takes several seconds to respond. Each time zone transitions into and out of Daylight Savings Time independently. This means that if the current time zone just entered DST and the time zone offset is then changed by using keypad Function 01 to a time zone in which the local time of the transition has not yet occurred, the standard time for that zone will be displayed. If the original time zone setting is restored, its time will remain in DST.

3-13.18　Keypad Function 67 – Leap Second Information

Use Function 67 to retrieve information regarding upcoming leap seconds. This is satellite information and can not be changed through the NTS.

Although UTC leap second adjustments may be performed on four occasions annually, in practice they are only performed twice: June 30th and December 31st.

To display current information, press the following keys:

"FUNC/ENTR" "6" "7"

The NTS responds with the GPS to UTC offset and information on pending leap seconds. An example of the response is:

```
Leap seconds: 11
 12/31/95    None
```

The NTS automatically determines the next available date for a leap second. Use the up- and down-arrows to scroll between None, +1, and –1. A setting of "–1" causes a second to be subtracted from the end of June 30, 1996. A setting of "None" does not effect the time. A setting of "+1" causes a second to be added to the end of June 30, 1996. Press the STATUS push-button to exit function 67.

3-13.19　Keypad Function 68 – Year Entry (GPS Epoch Management)

Use Function 68 to manually enter the current year. The reason for doing this is as follows:

The GPS week number, sent from the satellites, has only 10 bits of precision. As a result, 1024 weeks from January 10, 1980 (GPS week 0), the GPS week number count rolls back to 0. To correctly calculate calendar dates after this roll point, firmware keeps track of the current year and constructs an absolute, non-rolling week number since January 10, 1980.

The firmware has the current year embedded in code, and will properly handle dates through the year 2015. In addition, as the clock advances to each new year, the current year is updated and used in future calendar calculations. No user intervention is required as long as the current year saved in non-volatile memory is intact, and so long as the clock runs locked to GPS at least once each 5 years to allow the year to be updated.

After 2015, if the current year saved in non-volatile memory is lost, or if the clock is not locked to GPS within 5 years of the last year saved in non-volatile memory, you can use Function 68 to manually enter the current year. Years prior to 1996 are not accepted, and entering a future year may cause incorrect calendar date calculations.

To request the current year setting, press the following keys:

"FUNC/ENTR" "6" "8"

The NTS responds with:

```
Set current year
     1996
```

The year displayed will be the year saved in non-volatile memory used in the calendar calculations.

To change the year, enter the current year, then press "FUNC/ENTER".

The NTS responds with:

```
Save year?
No
```

To save the year, use the up-arrow key to change "No" to "Yes", then press "FUNC/ENTER".

3-13.20   Keypad Function 71 – Oscillator Statistics Request

Use Function 71 to request the oscillator's phase, frequency offset, drift rate and DAC value. The phase is the instantaneous error in seconds between the oscillator and the control loop zero servo point, as reported by the GPS receiver. The frequency offset is computed using an averaging time that is equal to the effective averaging time of the oscillator controller. The oscillator drift rate is computed using a 24 hour average and is the daily drift rate of the oscillator. The oscillator DAC value is the signed 16 bit integer that controls the DAC output voltage. It ranges from 32767 to –32768.

"Oscillator phase" is the instantaneous error between the NTS timing outputs and GPS.

To display current data, press the following keys:

"FUNC/ENTR" "7" "1"

An example of the response is:

```
Osc Phase
-5.788e-09 s
```

indicating that the NTS timing was most recently reported to be approximately 6 nanoseconds late. This number has the full effects of Selective Availability superimposed upon it. The oscillator control loop drives the mean of this number to zero.

"Oscillator offset" is the frequency offset or error with respect to the GPS frequency.

Press "FUNC/ENTR". An example of the response is:

```
Osc Offset
-2.150e-11
```

indicating that the internal frequency is less than GPS by approximately 2 parts in 10^{11}.

"Oscillator drift" is the change in oscillator frequency per day.

Press "FUNC/ENTR" again. An example of the response is:

```
Osc Drift
3.990e-12/DAY
```

indicating that the internal oscillator frequency is changing positively with respect to GPS by approximately 4 parts in 10^{12} per day.

"Oscillator DAC" is the signed 16 bit DAC control integer that sets the DAC output voltage to control the internal oscillator.

Press "FUNC/ENTR" again. An example of the response is:

```
DAC
 -3177
```

"Response Time" is the approximate step response time of the control loop. It indicates how much "averaging" is performed on the GPS time measurements.

```
Response Time
 2.499  e+01 s
```

3-13.21   Keypad Function 72 – Fault Status

Use Function 72 to display the status of certain fault detectors within the NTS. These are currently limited to the status of the Antenna feed circuit, and GPS lock status. The faults indicated here contribute to the state of the summary alarm open collector output. Whenever an alarm output is detected, these faults should be checked using this command.

To display current data, press the following keys:

"FUNC/ENTR", "7","2"

The NTS responds with:

```
Fault Status
Antenna: XXX
```

where XXX is one of "OK", or "FAULT".

Pressing the up- or down-arrow keys, or "FUNC/ENTR", displays the next status indicator:

```
Fault Status
 GPS:   XXXXXXXX
```

where XXXXXXXX is either "LOCKED" or "UNLOCKED".

3-13.22   Keypad Function 73 – Display/Set Alarm Status/Control

Use Function 73 to monitor and control (enable/disable) those conditions that signal an alarm or fault through the NTS Open Collector Output. The fault condition is sampled on entering each fault display. At any time, you may exit Function 73 without changing the alarm mask settings by pressing TIME, STATUS, or POSITION.

To display current data, press the following keys:

"FUNC/ENTR" "73"

The NTS responds with:

```
Clock Status
 GPS: <locked status>
```

where <locked status> can be "Locked" or "Unlocked", indicating whether the clock is locked to GPS within specifications.

To display position status, press FUNC/ENTR. An example of the response is:

```
Position Status
<ave. status>
```

where <ave. status> summarizes the state of the position averaging process. The options are "Full Accuracy", "Position Approx.", "Position Unknown", or "Pos,Time Unknown".

When the unit is operated in AUTO mode, and has obtained its first 3-D position fix, the position status is "Position Approx". When the position averaging process is completed, the clock switches into TIME mode and the position status display reads "Full Accuracy". "Full Accuracy" is also displayed if the unit has a measured 3-D position and is manually switched into TIME mode, or if you enter an assumed good position while in TIME mode. When the unit operates in the SURVEY mode and has a measured position, the status display reads "Position Approx".

The remaining items are fault conditions that can be individually enabled or disabled. The <en> field is either "En" or "Dis" and can be toggled with the up- and down-arrow keys to Enable or Disable each fault condition. These mask settings will be changed only if requested at the end of all the fault items.

```
Major Alarm:    <en>
 Antenna:       <ant. status>
```

where <ant. status> can be "OK", or "Fault", indicating detection of improper load conditions on the antenna feed.

At this parameter, and at some of those that follow, you may see an asterisk (*) at the end of the second line of the display. This indicates a latch alarm has occurred. Later on, you will be able to clear these latch alarms. This is especially important right after start-up. The next item is major alarm receiver.

```
Major Alarm:    <en>
 Receiver:      <rec. status>
```

where <rec. status> can be "OK", or "Fault".

"Fault" indicates there is some problem with the GPS receiver, such as a failure to communicate with the host processor. The next item is major alarm NVRAM (non-volatile RAM).

```
Major Alarm:    <en>
 NV RAM:        <nvram status>
```

where <nvram status> can be "OK" or "Error".

If any checksum errors were found on recalling any non-volatile memory blocks, or one or more blocks were missing and were created with default values, then this <nvram status> will be "Error". This may occur the first time the unit is powered up, or if some options have just been installed and new non-volatile memory blocks have been created for their use. If <nvram status> is "Error", then the next item displayed is to clear it.

```
Clear NV RAM
fault?  <resp>
```

where <resp> can be toggled between "No" or "Yes" by the up- and down-arrow keys.

If you confirm that all settings are correct, select "Yes" to cancel the error, so that future errors can be caught. The next item is major alarm timeout.

```
Major Alarm:    <en>
 Timeout:       <timeout status>
```

where <timeout status> can be "OK" or "Fault".

"Fault" indicates that the time error has exceeded the time error threshold for more than Timeout seconds. The next item is timeout delay.

```
Timeout delay
 <timeout> s
```

where <timeout> is in seconds between 0 and 86400 (1 day), and sets the delay from when the time error threshold is exceeded and when the Timeout fault occurs.

The next item is minor alarm time error.

```
Minor Alarm:    <en>
Time Error:     <TE status>
```

where <TE status> can be "OK" or "Fault" and indicates that the estimated time error (available through Function 13) exceeds the alarm time error threshold.

When this fault occurs the alarm bits in the NTP packet are set. The next item is time error threshold.

```
Time threshold
 <threshold> ns
```

where <threshold> is in nanoseconds.

This value is placed in the root dispersion field of the NTP packet. The next item is minor alarm tracking.

```
Minor Alarm:    <en>
 Tracking:      <tracking status>
```

where <tracking status> can be "OK" or "Fault".

This generally indicates whether or not the NTS is receiving and decoding satellite information. The next item is minor alarm tuning.

```
Minor Alarm:    <en>
 Tuning:        <tuning status>
```

where <tuning status> can be "OK" or "Fault".

If the oscillator is near the limits of the range in which it can be steered by the DAC, then <tuning status> becomes "Fault" indicating that the oscillator may need to be checked and replaced soon. The next item is minor alarm acquisition.

```
Minor Alarm:    <en>
Acquisition:    <acq.  status>
```

where <acq. status> can be "OK" or "Flt".

"Flt" indicates that the unit is still in the process of acquiring initial lock, and that it has not yet locked since power-up. "OK" indicates that it has locked at least once, regardless of whether it is currently locked.

If you did not change any alarm mask settings, the next item lets you clear latch alarms. Responding "Yes" removes any alarm indicators (*) and is especially useful right after start-up, to distinguish between errors that occurred during start-up and functional errors during normal operation.

```
Clear alarm
Latch? <resp>
```

where <resp> can be toggled with the up- and down-arrow keys between "No" or "Yes".

However, if you changed any alarm mask settings, the next item is:

```
Save Alarm Mask?
<resp>
```

where <resp> can be toggled with the up- and down-arrow keys between "No" or "Yes". If you answer "Yes", and press "FUNC/ENTR", the alarm enable settings, timeout delay, and time error threshold you requested are made the current settings and stored in nonvolatile memory.

The tri-color LED on the front panel also displays status. In general, faults only affect the LED if they are enabled. However, even if there is no enabled major or minor fault, the presence of the time error fault is indicated by a solid green LED. Normal operation within the user-defined time error threshold is indicated by the green LED blinking at a one pulse per second rate.

The LED has the following states:

Off	Power off
Solid Red	Major enabled alarm fault
Solid Orange	Minor enabled alarm fault, time error outside threshold
Blinking Green	No enabled alarm faults, time error within threshold

The NTS Open Collector Alarm Output has the following states:

Off	Power off
Off	Error, major or minor enabled alarm fault
On	Normal, no major or minor enabled alarm faults

If the processor fails, resulting in a failure to trigger the watchdog timer, the watchdog timer resets the processor and attempts to restart the system. During the processor reset, the LED output is red, and the alarm output transistor open collector is off, indicating a fault. If the processor were unable to recover and resume triggering the watchdog timer, you would see a blinking red LED, indicating a succession of watchdog timer timeouts and resets. Depending on whether or not you enabled or disabled this fault, the open collector alarm output transistor either might be off, or might toggle between off and on following the repeated resets, indicating an alarm condition.

Major Alarm Faults can be caused by antenna loss, GPS receiver failure, or non-volatile RAM data failure.

Minor Alarm Faults can be caused by reaching the time error threshold, loss of tracking, or reaching the oscillator tuning voltage limit. When the unit is in initial acquisition mode, the LED also displays solid orange.

When the NTS is in either alarm condition, the open collector alarm will be in a high impedance state. The non-alarm condition corresponds with the open collector alarm output low impedance.

The default alarm mask settings are summarized below:

Major Alarm Default Alarm Mask

Antenna	Enabled
Receiver	Enabled
NV RAM	Enabled
Timeout	Disabled

Minor Alarm Default Alarm Mask

Time Error	Enabled
Tracking	Disabled
Tuning	Disabled
Acquisition	Disabled

3-13.23   Keypad Function 79 – Warm Restart

This function issues a reset command to the GPS receiver. It does not clear stored almanac and ephemeris data. A warm restart may be needed when all other diagnostics have failed to return the NTS to tracking satellites.

> To display current data, press the following keys:
>
> "FUNC/ENTR" "7" "9"

The NTS responds with:

```
Cold start?
No
```

Note: In the context of the GPS receiver, a "cold start" clears satellite tracking data while retaining stored almanac and ephemeris data. It is, in effect, a warm restart of the GPS module.

Press the up- or down-arrow keys to toggle between "No" and "Yes". When the display shows the choice you desire, press "FUNC/ENTR". If you choose "yes" this will initiate a warm restart. To exit this function without performing a warm restart press the STATUS push-button.

4

Serial or Telnet I/O Functions

4-1   I/O FUNCTION

Once the NTS has synchronized itself after power-up, the NTS Utility port is ready to receive commands. The NTS does *not* output serial timestamps, so it is not necessary to stop the timestamps before entering commands.

Table 4-1 on the next page lists all serial/Telnet function commands and their parameters. Commands F01 – F79 are also available from the front panel key pad. The string ######## represents a series of up to 8 digits.

Table 4-1: Serial/Telnet Function Command List

Command	Function	Parameters
F01	Time Zone Entry/Request	± HH:MM
F02	12/24 Hour Format Entry/Request	12 or 24
F03	Time and Date Entry/Request	MM/DD/YY HH:MM:SS
F05	Time Quality Enable/Setup	ON or OFF
F06	Keypad Lock Enable	ON or OFF
F13	Worst-case Time Error Request	–
F15	Exclusive Use Enable/Disable	ON, OFF, SELF or OTHER
F18	Software Version Request	–
F36	NTP Port Network Configuration Entry/Request	EA, IP, SM, G, N, T
F50	Position Entry/Request	N or S ##d##'##.#" W or E ###d##'##.#" ##F or ##M PDOP #.##
F51	Antenna Cable Delay Entry/Request	± ##### (in nanoseconds)
F53	Operating Mode Entry/Request	AUTO, SURVEY STATIC, SURVEY DYNAMIC, or TIME
F55	Altitude Units Entry/Request	FEET or METERS
F56	Average Position Entry/Request	N or S ##d##'##.#" W or E ###d##'##.#" ##F or ##M
F60	Satellite List Request	ALL, CURRENT, TRACKED, or BAD
F65	Satellite Select	SELECT or DESELECT ### or ALL
F66	Daylight Savings Enable	OFF or MANUAL HH WW DD MM HH WW DD MM
F67	Leap Second Information Request	–
F68	Year Entry (GPS Epoch Management)	####
F71	Oscillator Statistics Request	–
F72	Fault Status	–
F73	Display/Set Alarm Status/Control	MASK, THRESHOLD, TIMEOUT, CLEAR
F79	Warm Restart	YES, NO
F100 BASET	10Base-T/100Base-T Control	–
F100 DHCP	DHCP Control	ENABLE/DISABLE
F100 EA	NET Port Ethernet Address	00–A0–69–##–##–##
F100 G	NET Port Gateway	###.###.###.###
F100 IC	NET Port Network Configuration Request	–
F100 IP	NET Port IP Address	###.###.###.###
F100 P	Password	XXXXXXXX
F100 SM	NET Port Subnet Mask	###.###.###.###
F100 ST	Self Test Status	–
F100 VER	Version Request	–

4-2   GENERAL INPUT AND OUTPUT FORMAT

Data may be sent to or requested from the serial or Telnet port by using various function commands and ASCII character strings.

In general, those functions which request status or data fit the form:

      F<FUNC#><Enter>

   where:

F	=	ASCII character F
<FUNC>	=	two-digit function number
<Enter>	=	input line terminator

The format for both data input and data output strings is:

      F<FUNC#>[<SP><FIELD>]<Enter> (input string)
      or
      `F<FUNC#>[<SP><FIELD>]<CR><LF>` (output string)

   where:

F	=	ASCII character F
<FUNC>	=	function number
<SP>	=	space
<FIELD>	=	data entry or request
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator
[]	=	encloses a phrase that is repeated as often as necessary

Output strings from the serial or Telnet port are kept to fixed lengths whenever possible. This means that numeric values often contain many leading blanks. The manual represents output strings in a fixed font. Quantities that can be positive or negative will have a sign even if positive. This is done to simplify the task of programming computer systems that receive the data. The formats of the output strings are designed so that it is possible to request the state of a function and save the response string. Later that string can be sent to the unit to restore the original state of that function.

Input strings sent to the unit may be of variable length. The manual represents them in the same font as body text. The number of separators between fields may be varied. Numeric values may be entered with or without leading zeros. Where a sign is allowed, it may be omitted for positive quantities. String fields (such as "on" or "off") may be entered in upper or lower case, as can the "F" that starts all serial commands. Some fields of some commands are optional, and may be replaced by a semicolon. If a field is so replaced, the corresponding value will be left unchanged. All input strings should be ended by pressing the <Enter> or <Return> key on your terminal keyboard.

Incorrect entry may result in an error message, as described in Section 5-1, starting on page 91.

    The NTS responds to correct entries with:

      `OK<CR><LF>`

4-2.1   Exclusive Use

The unit has the ability to grant "exclusive use" to the serial port. Exclusive Use disables the keypad's ability of other ports to set any control parameter. Neither the front panel keypad nor the NET port can be granted exclusive use. At power-up or when exclusive use is off any port or the front panel has free access.

4-3   I/O FUNCTION DESCRIPTIONS

The following section describes the NTS I/O function commands.

4-3.1   I/O Function F01 – Time Zone Entry/Request

Use Function F01 to enter or select the time-zone offset, which affects only the front panel display, serial or Telnet port time display, command responses to the serial terminal, and IRIG-B output. The time-zone offset is related to the F03 return (see the table below). The time transmitted in the NTP packets is always UTC time, and the initial out-of-the-box default is 00:00. The acceptable range of offsets is +12:00 to –12:00 hours.

> To request the offset, send the following command:

> > F01<Enter>

The NTS responds with:

> > F01<SP><SIGN><HH>:<MM><CR><LF>

where:

F	=	ASCII character F
01	=	function number
<SP>	=	space
<SIGN>	=	either no character or + for positive offsets or – for negative offsets
<HH>	=	one or two digit hours offset from +12 to –12 hours
:	=	ASCII character for a colon
<MM>	=	two-digit minutes offset
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator
Sample entry:		F01<Enter>
The response might be:		F01 –4:30<CR><LF>

> To set the time zone offset, send a command as shown in the examples below:

Sample entry:		F01 – 8:00<Enter>
The response might be:		OK<CR><LF>
Sample entry:		F01<Enter>
The response might be:		F01 8:00<CR><LF>

Commands F01 and F03 are interrelated and always apply to local time. Command results may also affect UTC time, depending on the state of the synchronization source, as shown by the following table.

Table 4-2: Effect of Synchronization Source State on UTC and Local Time

State of the Synchronization Source	F01 Command Success	Result for UTC Time, as displayed by F03	Result for Local Time
Present and locked	Yes	Entry is immediately overwritten by the incoming time from the synchronization source	Entry persists
Lost, still in free-run mode, still in tolerance	Yes	Entry may be overwritten by the incoming signal	Entry persists
Lost, drifted out of tolerance	Yes	Entry persists	Entry persists

4-3.2   I/O Function F02 – 12/24 Hour Format Entry/Request

Use Function F02 to set or request either the 12-hr or 24-hr time display format. The 12/24 Hour Format affects only the front panel display, Serial or Telnet port time display, and IRIG-B output. The time transmitted in the NTP packets is always UTC time, and the initial out-of-the-box power-up default is the 24-hr format. The default upon subsequent power-ups is the value used before power-down.

To determine the format, send the following command:

F02<Enter>

The NTS responds with:

`F02<SP><HH><CR><LF>`

where:

F	=	ASCII character F
02	=	function number
<SP>	=	space
<HH>	=	12 or 24
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator
Sample entry:		F02<Enter>
The response might be:		`F02 12<CR><LF>`

To select 24 hour format, send a command as shown in the example below:

Sample entry:		F02 24<Enter>
The response might be:		`OK<CR><LF>`

4-3.3   I/O Function F03 – Time and Date Entry/Request

Use Function F03 to enter or request time and date. The initial out-of-the-box default is UTC date and time. The time-of-year before power-down is the default upon subsequent power-ups.

Note: If the GPS antenna is installed and tracking satellites, the time you enter using F03 is immediately overwritten by the incoming signal.

To request time and date, send the following command:

F03<Enter>

The NTS responds with:

F03<SP><TYPE><SP><mm>/<dd>/<yy><SP><HH>:<MM>:<SS><CR><LF>

where

F	=	ASCII character F
03	=	function number
<SP>	=	space
<TYPE>	=	either LOCAL or UTC
<mm>	=	one- or two-digit month
/	=	ASCII character slash
<dd>	=	one- or two-digit day
<yy>	=	two-digit year
<HH>	=	one- or two-digit hours
:	=	ASCII character for a colon
<MM>	=	two-digit minutes
<SS>	=	two-digit seconds
;	=	replacement character
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry:	F03<Enter>
The response might be:	F03 UTC 01/07/96 02:48:29<CR><LF>
Sample entry:	F03 LOCAL<Enter>
The response might be:	F03 LOCAL 01/07/96 7:48:29<CR><LF>
Sample entry:	F03 UTC<Enter>
The response might be:	F03 UTC 01/07/96 2:48:29<CR><LF>

To set the time zone offset, send a command to the serial port using the format above. Either the date MM/DD/YY or the time HH:MM:SS may be omitted if they are replaced with a semicolon (;). Only valid dates are acceptable.

The following entry sets the local date and time:

Sample entry:	F03 LOCAL 10/3/96 20:07:04<Enter>
The response might be:	OK<CR><LF>

The following entry uses a semicolon to omit the time type and date fields, thus setting the UTC time, and leaving the date unchanged. Using F03 in this way does not affect the time.

Sample entry:	F03 ; 3:06:48<Enter>
The response might be:	OK<CR><LF>

4-3.4   I/O Function F05 – Time Quality Enable/Setup

Use Function F03 to enable or disable time quality indication and to determine time quality thresholds (see Time Quality Indication on page 28 for more information).   These settings affect the IRIG output, but do not affect NTP packets. The settings in use at power-down are used as the default for subsequent power-ups. See Appendix C for more information about IRIG-B time code and worst-case error flags.

As shipped, the time quality indication is enabled and the default thresholds are:

First threshold	10 µs
Second threshold	100 µs
Third threshold	1000 µs
Fourth threshold	10000 µs

To determine if the indicators are enabled and what the thresholds are, send the following command:

F05<Enter>

The NTS responds with:

```
F05<SEP><STATE><SEP><FLAG><SEP><FLAG><SEP><FLAG><SEP><FLAG>
<CR><LF>
```

where

F	=	ASCII character F
05	=	function number
<SP>	=	space
<STATE>	=	ON or OFF
<FLAG>	=	one error threshold in nanoseconds, 1 to 11 digits with or without leading zeros
<Enter>	=	input line terminator
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator
Sample entry:		F05<Enter>
The response might be:		`F05 ON 00000010000 00000100000`
		`00001000000 00010000000<CR><LF>`

This string appears as a single line on your display.

To enable, disable, or set the thresholds of the time quality indicators, send the following command:

Sample entry:	F05 ON 00000010000 00000100000 00001000000 00020000000<Enter>
The response might be:	`OK<CR><LF>`

The appropriate threshold values range from: 000010000ns to 40000000000ns.

Sample entry:	F05 ON 100000 20000 5000 1000<Enter>
The response might be:	`OK<CR><LF>`

Note: Although leading zeros are not required for data entry they will be included in any data response.

4-3.5   I/O Function F06 – Keypad Lock Enable

Use Function F06 to enable or disable the keypad. Once enabled, the keypad lock function prevents unauthorized or accidental entries on the keypad. The initial out-of-the-box default is "off". The default upon subsequent power-ups will be the same as it was on the previous power-down.

> To determine if the keypad lock is enabled, send the following command:

> F06<Enter>

The NTS responds with:

> `F06<SP><STATE><CR><LF>`

where

F	=	ASCII character F
06	=	function number
<SP>	=	space
<STATE>	=	ON or OFF
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry: F06<Enter>
The response might be: `F06  OFF<CR><LF>`

To enable keypad lock, send the following command:

Sample entry: F06 ON<Enter>
The response might be: `OK<CR><LF>`

4-3.6   I/O Function F13 – Worst-Case Time Error Request

Use Function F13 to request the worst-case time error due to oscillator drift during periods when satellites are not being tracked.

The worst-case time error, while the synchronization source input is present and the NTS is locked to it, depends on the type of synchronization source. If the NTS acquired valid time but subsequently lost lock to the signals, then the time output and time display begin to drift. This drift is dependent on the stability of the internal oscillator, and the accuracy to which it had been set on frequency prior to the outage. The processor calculates and displays in seconds the worst-case time based on the stability of the time base and the time elapsed since loss of synchronization source.

> To report this calculation, send the following command:

> F13<Enter>

The NTS responds with:

> `F13<SP><ERROR><CR><LF>`

where

F	=	ASCII character F
13	=	function number
<SP>	=	space
<ERROR>	=	calculated worst-case error in seconds
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry: F13<Enter>
The response might be: `F13 00.050000000<CR><LF>`

4-3.7   I/O Function F15 – Exclusive Use Enable/Disable

Use Function F15 to allow data entry only through the serial or Telnet interface. This prevents data entry through the front panel keypad, although the front panel display still responds to data requests.

As shipped, the exclusive use function is disabled. On subsequent power-ups, the exclusive use function will be off.

To enable or disable this function, send the following command:

F15<SP><STATE><Enter>

where

F	=	ASCII character F
15	=	function number
<SP>	=	space
<STATE>	=	OFF if no port has exclusive use, OTHER if some other port has exclusive use, SELF if the serial port has exclusive use or ON if enabling the serial port.
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

If the state changes, or if another port has exclusive use, the NTS responds with:

The NTS responds with:

`ERROR: EXCLUSIVE USE<CR><LF>`

Sample entry: F15<Enter> (This asks for the state)
The response might be: `F15 OFF<CR><LF>`

Sample entry: F15 ON<Enter> (This enables exclusive use)
The response might be: `OK<CR><LF>`

Sample entry :   F15<Enter> (This asks for the state)
The response might be :   `F15 SELF<CR><LF>`

4-3.8   I/O Function F18 — Software Version Request

Use Function F18 to obtain information about the current version of NTP-specific software installed in the NTS. Use Serial or Telnet I/O Function F100 VER (see page 87) to obtain the version number of the network interface software that allows Telnet access.

To use F18, send the following command:

F18<Enter>

where

F	=	ASCII character F
18	=	function number
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

The NTS responds with a string no longer than 80 characters, such as:

```
TRUETIME Mk III sys ver 007 NTS V1.007 182-7004v001<CR><LF>
```

This response indicates that the system software is version 007, the Network Time Server-specific software is version 1.007 and the specific EEPROM image is 182-7004, version 001.

4-3.9   I/O Function F36 — NTP Port Network Configuration Entry/Request

Use Function F36 to request or set NTP port network parameters, configure SNMP, and maintain MD5 keys. To request or set information about NET port network configuration, use F100 IC (see page 86).

The F36 options are:

- Ethernet Address
- IP Address
- Subnet Mask
- Default Gateway
- Network Type
- Network Configuration
- Clock Type
- MD5 Authentication

In the following sections, where it is not already stated, <Enter> = input line terminator and <CR><LF> = output line terminator.

Note: When you enter new parameters using an F36 command, the NTS responds "Restarting" and requires several seconds to reboot the system. Please wait until the unit has completed re-initialization before issuing further commands.

4-3.9.1   Ethernet Address

The ethernet address is a six-byte, hexadecimal value specific to the NTS NET port. The first three bytes are registered to TrueTime Inc, and the last three bytes are the hex value identifying the NET port. The ethernet address of the NTS is a fixed address established at the factory and cannot be changed.

To request the ethernet address of the NTS module, send the following command:

    F36 EA<Enter>

The NTS responds with:

    F36 EA:00–A0–69–xx–xx–xx<CR><LF>

where "xx– xx– xx" are the six hex digits of the unit's unique address.

Sample entry: F36 EA<Enter>
The response might be: F36 EA:00-A0-69-00-05-F5<CR><LF>

Attempts to set this field will be rejected with a syntax error message.

4-3.9.2 IP Address

To obtain the IP address of the NTS module, send the following command:

    F36 IP<Enter>

The NTS responds with:

    F36 IP:nnn.nnn.nnn.nnn<CR><LF>

where "nnn.nnn.nnn.nnn" is the dotted decimal address notation.

To set the IP address and restart the NTS, send the following command:

    F36 IP:nnn.nnn.nnn.nnn<Enter>

Sample entry: F36 IP:206.54.0.21<Enter>
The response might be: Restarting<CR><LF>

4-3.9.3 Subnet Mask

To return the subnet mask of the NTS module, send the following command:

    F36 SM<Enter>

The NTS responds with:

    F36 SM:nnn.nnn.nnn.nnn<CR><LF>

To set the subnet mask and restart the NTS, send the following command:

    F36 SM:nnn.nnn.nnn.nnn<Enter>

Sample entry: F36 SM:255.255.255.240<Enter>
The response might be: Restarting<CR><LF>

4-3.9.4 Default Gateway

To obtain the default gateway of the NTS module, send the following command:

    F36 G<Enter>

The NTS responds with:

    F36 G:nnn.nnn.nnn.nnn<CR><LF>

To set the default gateway and restart the NTS, send the following command:

    F36 G:nnn.nnn.nnn.nnn<Enter>

Sample entry: F36 G:206.54.0.17<Enter>
The response might be: Restarting<CR><LF>

4-3.9.5 Network Type

To determine the type of network packets being used, send the following command:

    F36 N<Enter>

The NTS responds with one of two strings:

For IEEE 802.3 networks: F36 N:I<CR><LF>
or
For Ethernet II DIX networks: F36 N:E<CR><LF>

To set the type of network being used, send the appropriate command, as shown below:

For IEEE 802.3 networks: F36 N:I<Enter>
For Ethernet II DIX networks: F36 N:E<Enter>

Note: This setting affects only the packet type that the NTS transmits. The NTS receives packets of either type, regardless of this setting.

4-3.9.6 Complete NTP Network Configuration

To review the entire current network configuration of the NTS, send the following command:

    F36<Enter>

An example of the response is:

    F36 IP:206.54.0.21 SM:255.255.255.240 G:206.54.0.17
    N:E<CR><LF>

This string appears as a single line on your display and indicates the specific IP address, Subnet Mask, Default Gateway, and Network Type of the NTS.

To set all settable network parameters in a single entry, send a command that provides the NET port network interface card with an IP address, Subnet Mask, Default Gateway, and Network Type.

Sample entry: F36 IP:206.54.0.21 SM:255.255.255.240
                            G:206.54.0.17 N:E<Enter>
The response might be: `Restarting<CR><LF>`

Note: Leading zeros may be omitted when entering IP address, Subnet Mask, and Default
Gateway. Any field may be omitted and order is not significant. Blanks are allowed on
either side of a colon.

Note: Any legal command set containing one of the four network parameters causes the
NTS to reboot.

4-3.9.7 Clock Type

The synchronization input determines the clock type, which is always GPS for this unit.

To query the clock type, send the following command:

F36 T<Enter>

The NTS responds with:

`F36 T:GPS<CR><LF>`

Attempts to set this field will be rejected with a syntax error message.

4-3.9.8 MD5 Authentication

It is much easier to use the serial interface, rather than the keypad, to maintain MD5
Authentication keys or obtain information about, or change, the current SNMP configuration.
This is because these parameters are alphanumeric strings and the keypad interface does
not allow easy entry of alpha characters.

For details about MD5 key maintenance using the serial interface, see Section D-4 in
Appendix D. For details about SNMP configuration using the serial interface, see
Section E-4 in Appendix E.

4-3.10 I/O Function F50 – Position Entry/Request

Use Function F50 to enter or request the current antenna position. Since F50 returns the most recent fix computed by the GPS core receiver, not the long term averaged position (which is calculated during the AUTO mode of operation and reported via either keypad function 56 or serial or Telnet function F56), its use is mainly for initializing the approximate position of the GPS core receiver at new installations or after loss of non-volatile RAM back-up power.

Note: In TIME mode, the GPS receiver overwrites position entries.

To determine the present position, send the following command:
   F50<Enter>

The NTS responds with:
```
F50<SP><SIGN><SP><DEG>d<MIN>'<SEC>"<SP><SIGN><SP><DEG>d<MIN>'
<SEC>"<SP><SP><SP><SP><ALT><UNITS><SP>pdop<SP><PDOP><CR><LF>
```

where

F	=	ASCII character F (f or F for the input string)
50	=	function number
<SP>	=	space
<SIGN>	=	N or S for latitude; E or W for longitude; or + or – for longitude, latitude or altitude (–) corresponds to S or W or no character, <SP> for + altitude
<DEG>	=	two-digit degrees for latitude or three-digit degrees for longitude
D	=	ASCII character d (either d or D for the input string, but always d for the output string)
<MIN>	=	two-digit minutes
'	=	ASCII character '(' m or M for the input string, but always ' for the output strings)
<SEC>	=	two-digit seconds
"	=	ASCII character "(" s or S for the input string, but always " for the output string)
<ALT>	=	altitude in feet or meters
<UNITS>	=	unit of altitude, either a M or m for meters or F or f for feet depending on the units selected with keypad function 55 or Serial or Telnet function F55
<PDOP>	=	3 or 4 digit value of the position dilution of precision
;	=	replacement character
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry:	F50<Enter>
The response might be:	F50 N 38d23'51.3" W 122d42'53.2" 58m pdop 2.69<CR><LF>

This response string, and those that follow, appear as a single line on your display.

To enter a position, send a command as shown in the examples below (latitude, longitude or altitude may be omitted in the string, provided they are replaced with a semicolon (;) character. The altitude units may be feet or meters).

Sample entry:	F50 n 38d23'51.3" w 122d42'53.2" 10m<Enter>
Equivalent entry:	F50 + 38D23M51.3S + 122D42M53.2S +10M<Enter>
The response might be:	`OK<CR><LF>`
Sample entry:	F50<Enter> (after sending above string)
The response might be:	`F50 N 38d23'51.3" W 122d42'53.2" 10m pdop 2.69<CR><LF>`
Sample entry:	F50;;40m<Enter> (with values from the example above)
Equivalent entry:	F50 ; ; 40M<Enter> (no change to latitude or longitude - altitude now 0m)
The response might be:	`F50 N 38d23'51.3" W 122d42'53.2" 40m pdop 2.69<CR><LF>`

Note: Altitude must be included in the position entry string. Either a value or a (;) must be
entered or a syntax error will occur (causing the entered string to be ignored).

4-3.11 I/O Function F51 – Antenna Cable Delay Entry/Request

Use Function 51 to enter or request the antenna cable delay. Typical delays for RG-58 and RG-59
cables are approximately 1.4 ns/foot, and the default is +70ns. The value is held in non-volatile
RAM. The acceptable range of delays is from +001000000ns to –001000000ns.

To determine the present value, send the following command:

F51<Enter>

The NTS responds with:

F51<SP><SIGN><DELAY>ns<CR><LF>

where

F	=	ASCII character F (f or F for the input string)
51	=	the function number
<SP>	=	space
<SIGN>	=	either + or –
<DELAY>	=	1 to 9 digit delay from +001000000ns to –001000000ns
ns	=	nanoseconds (ns or NS for the input string)
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry:	F51<Enter>
The response might be:	`F51<SP><SP><SP><SP><SP><SP><SP><SP>+50ns <CR><LF>`

This string appears on your display as a single line.

To enter a 1 millisecond cable delay, send the following command:

Sample entry:	F51<SP>1000000NS<Enter>
The response might be:	`OK<CR><LF>`
Sample entry:	F51<Enter> (using entry from above)
The response might be:	`F51<SP><SP><SP>+1000000ns<CR><LF>`

4-3.12 I/O Function F53 – Operating Mode Entry/Request

Use Function F53 to select the operating mode, either AUTO, SURVEY STATIC (OPTION),
SURVEY DYNAMIC (OPTION) or TIME. For an explanation of these modes, refer to Section 3-8 on
page 26. The power-up default is the mode in use at the previous power-down.

> To request the present mode, send the following command:
> > F53<Enter>

The NTS responds with:
> `F53<SP><MODE>:<SP><#><SP>SATS<CR><LF>`

where

F	=	ASCII character F
53	=	function number
<SP>	=	space
<MODE>	=	AUTO, SURVEY STATIC, SURVEY DYNAMIC or TIME
:	=	ASCII colon
<#>	=	number of satellites being tracked
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry:	F53<Enter>
The response might be:	`F53 SURVEY STATIC: 6 SATS<CR><LF>`

To enter TIME mode, send the following command:

Sample entry:	F53<SP>TIME<Enter>
The response might be:	`OK<CR><LF>`

Sample entry:	F53<Enter>
The response might be:	`F53 TIME: 5 SATS<CR><LF>`

4-3.13 I/O Function F55 – Altitude Units Entry/Request

Use Function F55 to select the units (either feet or meters) in which to express altitude. The initial
out-of-the-box default is meters. The default on subsequent power-ups is the unit of measurement
that was set just before the previous power-down.

> To request the units presently in use, send the following command:
> > F55<Enter>

The NTS responds with:
> `F55<SP><UNITS><CR><LF>`

where

F	=	ASCII character F
55	=	function number
<SP>	=	space
<UNITS>	=	FEET or METERS
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry: F55<Enter>
The response might be: `F55 METERS<CR><LF>`

To select feet, send the following command:

Sample entry: F55<SP>FEET<Enter>
The response might be: `OK<CR><LF>`
Sample entry: F55<Enter>
The response might be: `F55 FEET<CR><LF>`

4-3.14 I/O Function F56 – Average Position Entry/Request

Use Function F56 to enter or request the averaged, hence accurate, current antenna position. Its main use is to provide a means of setting an accurate, surveyed position for use in the TIME mode of operation. Positions provided to the NTS via F56 should be more accurate than 10 meters, otherwise better results may be obtained via AUTO mode, unless satellite visibility at the site is too poor to provide three dimensional positioning. An averaged position, as returned via function F56, that subsequently becomes in error by more than 1 Km, either due to transport of the receiver and antenna or error in the initial entry, will be cleared and recalculated automatically once positioning begins at the new site and the error is detected.

Note: The NTS out-of-the-box default is AUTO mode. At start-up, in AUTO mode, the F56 command returns all zeros. In TIME mode, it returns the position at last power-down. The unit must be in TIME mode to enter the accurate position using F56.

To determine the present position, send the following command:

F56<Enter>

The NTS responds with:

`F56<SP><SIGN><SP><DEG>d<MIN>'<SEC>"<SP><SIGN><SP><DEG>d<MIN>'<SEC>"`
`<SP><SP><SP><SP><ALT><UNITS><SP><SOURCE><CR><LF>`

where

F	=	ASCII character F (f or F for the input string)
56	=	function number
<SP>	=	space
<SIGN>	=	N or S for latitude; E or W for longitude; or + or – for longitude, latitude or altitude (–) corresponds to S or W or no character, <SP> for + altitude
<DEG>	=	two-digit degrees for latitude or three-digit degrees for longitude
d	=	ASCII character d (either d or D for the input string, but always d for the output string)
<MIN>	=	two-digit minutes
'	=	ASCII character ' (either ' m or M for the input string, but always ' for the output string)
<SEC>	=	two-digit seconds
"	=	ASCII character "(" s or S for the input string, but always " for the output string)
<ALT>	=	altitude in feet or meters
<UNITS>	=	unit of altitude, either a M or m for meters or F or f for feet depending on the units selected with keypad function 55 or Serial or Telnet Function F55

<SOURCE>	=	the source of the position in one of two formats: COUNT <NNNNN> / 90000
		where NNNNN is the total number of fixes in the average, and 90000 is the total number of fixes required to complete the position average process,
		and ENTERED Indicates that the current averaged position was obtained via operator entry
;	=	replacement character
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry: F56<Enter>

The response might be: `F56 N 38d23'51.3" W 122d42'53.2" 58m COUNT 49001/90000<CR><LF>`

This response string, and those that follow, appears as a single line on your display.

To enter a position send a command as shown in the examples below. Latitude, longitude or altitude may be omitted in the string provided they are replaced with a semicolon (;) character. The altitude units may be feet or meters.

Note: Altitude must be included in the position entry string. Either a value or a (;) must be entered, or a syntax error occurs and the NTS ignores the entered string.

Sample entry: F56 n 38d23'51.3" w 122d42'53.2" 10m<Enter>

Equivalent entry: F56 + 38D23M51.3S + 122D42M53.2S +10M<Enter>

The response might be: `OK<CR><LF>`

Sample entry   F56<Enter> (after sending above string)

The response might be: `F56 N 38d23'51.3" W 122d42'53.2" 10m ENTERED<CR><LF>`

Sample entry: F56;;40m <Enter> (with values from the example above)

Equivalent entry: F56 ; ; 40M <Enter> (no change to latitude or longitude - altitude now 40m)

The response might be: `F56 N 38d23'51.3" W 122d42'53.2"  40m <CR><LF>`

These response strings appear as a single line on your display.

4-3.15 I/O Function F60 – Satellite List Request

Use Function 60 to list current, tracked, or bad satellites and to see the relative signal strength of those satellites the NTS is tracking.

Note: The NTS requires 24 hours after power-up to complete the satellite list.

To request the list, send the following command:
F60<SP><TYPE><Enter>

where

F	=	ASCII character F
60	=	function number
<SP>	=	space
<TYPE>	=	ALL, CURRENT, TRACKED or BAD
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

The NTS responds with:
```
F60<SP>prn NN good enabled tracked current sig level =
+<LEVEL><CR><LF>
```

where

NN	=	two-digit satellite number
<CR><LF>	=	line terminator
tracked	=	either present or absent
current	=	either present or absent

Sample entry: F60 ALL<Enter>
The response might be:
```
F60  prn  1  good  enabled                     sig level = +0.00
F60  prn  2  good  enabled   tracked current  sig level = +21.37
F60  prn  3  good  enabled                     sig level = +0.00
F60  prn  4  good  enabled                     sig level = +0.00
F60  prn  5  good  enabled                     sig level = +0.00
F60  prn  6  good  enabled                     sig level = +0.00
F60  prn  7  good  enabled   tracked current  sig level = +16.20
F60  prn  9  good  enabled                     sig level = +0.00
F60  prn 13  good  enabled                     sig level = +0.00
F60  prn 14  good  enabled                     sig level = +0.00
F60  prn 15  good  enabled   tracked current  sig level = +4.95
F60  prn 16  good  enabled                     sig level = +0.00
F60  prn 17  good  enabled                     sig level = +0.00
F60  prn 18  good  enabled                     sig level = +0.00
F60  prn 19  good  enabled   tracked current  sig level = +12.20
F60  prn 20  good  enabled                     sig level = +0.00
F60  prn 21  good  enabled                     sig level = +0.00
F60  prn 22  good  enabled                     sig level = +0.00
F60  prn 23  good  enabled                     sig level = +0.00
F60  prn 24  good  enabled                     sig level = +0.00
F60  prn 25  good  enabled                     sig level = +0.00
F60  prn 26  good  enabled   tracked current  sig level = +9.82
F60  prn 27  good  enabled   tracked current  sig level = +17.52
F60  prn 28  good  enabled                     sig level = +0.00
F60  prn 29  good  enabled                     sig level = +0.00
F60  prn 31  good  enabled                     sig level = +0.00
```

Note: Use Function F65 to select individual satellites you want the NTS to track (or stop tracking).

4-3.16 I/O Function F65 – Satellite Select

Use Function 65 to select the satellites you want the NTS to track or to stop tracking.

> **Caution:** If you instruct the NTS to stop tracking *all* visible satellites, the unit will *not* lock to GPS time.

To use F65, send the following command:

    F65<SP><REQUEST>[<SP>NN]<Enter>
    or
    F65<SP><REQUEST>ALL<Enter>

where

F	=	ASCII character F
65	=	function number
<REQUEST>	=	either SELECT or DESELECT
<SP>	=	space
NN	=	two-digit satellite number
ALL	=	ASCII character string ALL
[ ]	=	encloses a phrase that is repeated as often as necessary
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

The NTS responds with:

    OK<CR><LF>

Sample entry: F65 SELECT 02 18 13<Enter>
The response might be: OK<CR><LF>

Sample entry: F65<SP> SELECT ALL<Enter>
The response might be: OK<CR><LF>

Sample entry: F65 DESELECT 01 08<Enter>
The response might be: F65 OK<CR><LF>

Note: Only those satellites whose numbers appear on the F60 Satellite List respond to F65 commands.

4-3.17 I/O Function F66 – Daylight Savings Enable

Use Function F66 to enable, disable, or set the entry or exit times for Daylight Savings Time (DST). The initial out-of-the-box default is "Off". The default upon subsequent power-ups is the selection in use just before the previous power-down.

To request the present status of the daylight savings enable, send the following command:

F66<Enter>

The NTS responds with:

F66<SP><STATE><CR><LF>

where

F	=	ASCII character F
66	=	function number
<SP>	=	space
<STATE>	=	Off or Manual
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

If the DST function is in Manual:

Sample entry: F66<Enter>
The response might be: F66 OFF<CR><LF>

To alter the state of the daylight savings enable, send a command as shown above to the serial port.

Sample entry: F66<SP>Off<Enter>
The response might be: OK<CR><LF>

To place the DST function in Manual and set the DST entry and exit times, send the following command:

F66 MANUAL <IN HOUR><SP><IN WEEK><SP><IN DAY><SP>
<IN MONTH><OUT HOUR><SP><OUT WEEK><SP><OUT DAY><SP>
<OUTMONTH><Enter>

where

<IN HOUR>	=	time to enter DST in 24-hour format
<SP>	=	space
<IN WEEK>	=	which week to enter DST, 1, 2, 3, 4 or 0 (for last)
<IN DAY>	=	day of week to enter DST, 1 through 7 where Sunday is 1
<IN MONTH>	=	month to enter DST, 1 through 12 where 1 is January
<OUT HOUR>	=	hour to exit DST, in 24 hour format
<OUT WEEK>	=	which week to exit DST, 1, 2, 3, 4 or 0 (for last)
<OUT DAY>	=	day in to exit DST, 1 through 7 where Sunday is 1
<OUT MONTH>	=	month to exit DST, 1 through 12 where 1 is January
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

If desired, any item may be replaced with a semicolon, which will leave its value unchanged. If any of the items in an input string are invalid, an error message is returned.

Sample entry:	F66<Enter>
The response might be:	`F66 MANUAL 02 1 1 04 02 0 1 10<CR><LF>`
Meaning:	Manual settings are in effect. The entry time is 02 a.m. on the first Sunday of April and the exit time is 02 a.m. on the last Sunday in October.
Sample Entry:	F66 MANUAL ; 0 ; ; ; ; ; ;<Enter>
The response might be:	`OK<CR><LF>`
Meaning:	DST will now be entered on the last week of the month. All other parameters remain unchanged.
Sample Entry:	F66 MANUAL 4 2 2 3 13 4 6 11<Enter>
The response might be:	`OK<CR><LF>`
Meaning:	DST will now be entered 04 a.m. on the 2nd Monday in March and exit DST at 01 p.m. on the 4th Friday in November.

4-3.18 I/O Function F67 – Leap Second Information

Use Function 67 to retrieve information regarding upcoming leap seconds. This is satellite information and can not be changed through the NTS.

Although UTC leap second adjustments may be performed on four occasions annually, in practice they are only performed twice: June 30th and December 31st.

To return the leap second status, send the following command:

F67<Enter>

where

F	=	ASCII character F
67	=	function number
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

An example of the response might be:

`F67 06/30/96 +1 11<CR><LF>`

This response indicates there is a leap second addition during the last minute of June 30, 1996.

If there was no leap second pending, the response might be:

`F67 none 11<CR><LF>`

4-3.19 I/O Function F68 – Year Entry (GPS Epoch Management)

Use Function F68 to manually enter the current year. The reason for doing this is as follows:

The GPS week number, sent from the satellites, has only 10 bits of precision. As a result, 1024 weeks from January 10, 1980 (GPS week 0), the GPS week number count rolls back to 0. To correctly calculate calendar dates after this roll point, firmware keeps track of the current year and constructs an absolute, non-rolling week number since January 10, 1980.

The firmware has the current year embedded in code, and will properly handle dates through the year 2015. In addition, as the clock advances to each new year, the current year is updated and used in future calendar calculations. No user intervention is required as long as the current year saved in non-volatile memory is intact, and so long as the clock runs locked to GPS at least once each 5 years to allow the year to be updated.

After 2015, if the current year saved in non-volatile memory is lost, or if the clock is not locked to GPS within 5 years of the last year saved in non-volatile memory, you can use Function F68 to manually enter the current year. Years prior to 1996 are not accepted, and entering a future year may cause incorrect calendar date calculations.

To request the current year setting, send the following command:

Sample entry: F68<Enter>
The response might be: `F68 1996<CR><LF>`

where

F	=	ASCII character F
68	=	function number
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

To set the current year, send the following command:

Sample entry: F68 1997<Enter>
The response might be: `OK<CR><LF>`

4-3.20 I/O Function F71 – Oscillator Statistics Request

Use Function F71 to request the internal oscillator's phase, frequency offset, drift rate and DAC value. The phase is the instantaneous error in seconds between the oscillator and the control loop zero servo point, as reported by the core GPS module. The frequency offset is computed using an averaging time that is equal to the effective averaging time of the oscillator controller. The oscillator drift rate is computed using a 24 hour average and is the daily drift rate of the oscillator. The oscillator DAC value is the signed 16 bit integer that controls the DAC output voltage. It ranges from 32767 to –32768.

To request current parameters, send the following command:

F71<Enter>

The NTS responds with:

```
F71<SP>phase=<SIGN><MULT>E<SIGN><EXP><SP>s<SP><SP>
offset=<SIGN><MULT>E<SIGN><EXP><SP><SP>
drift=<SIGN><MULT>E<SIGN><EXP>/DAY<SP><SP>
DAC=<SIGN><INT><CR><LF>
```

where:

F	=	ASCII character F
71	=	function number
<SP>	=	space
<MULT>	=	multiplier, 4 digits with decimal point
E	=	ASCII character E for exponent
s	=	ASCII character s for seconds abbreviation
<SIGN>	=	– for negative or <SP> for positive
<EXP>	=	2 digit exponent
/DAY	=	ASCII characters, units of drift rate
<INT>	=	integer, 5 digits
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Sample entry:	F71<Enter>
The response might be:	`F71 phase=-5.788E-09 s offset-2.150E-11` `drift= 3.990E-12/DAY  DAC= 16368<CR><LF>`

This string appears as a single line on your display.

In this example:

- -5.788E-09 indicates that the NTS timing was most recently reported to be approximately 6 nanoseconds late; this number has the full effects of Selective Availability superimposed upon it; the oscillator control loop drives the mean of this number to zero

- -2.150E-11 indicates that the internal frequency is less than GPS by approximately 2 parts in 10^{11}

- 3.990E-12/DAY indicates that the internal oscillator frequency is changing positively with respect to GPS by approximately 4 parts in 10^{12} per day

- 16368 is the DAC control integer

4-3.21 I/O Function F72 – Fault Status

Use Function F72 to display the status of certain fault detectors within the NTS. These are currently limited to the status of the Antenna feed circuit, and GPS lock status. The faults indicated here contribute to the state of the summary alarm open collector output and should be checked using this command whenever an alarm output is detected.

Send the following command:

F72<Enter>

The NTS responds:

`F72<SP>Antenna: <ANT STATUS> GPS: <GPS STATUS><CR><LF>`

where:

F	=	ASCII character F
72	=	function number
<SP>	=	space
<ANT STATUS>	=	OK, or FAULT
<GPS STATUS>	=	LOCKED, UNLOCKED
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator
Sample entry:		F72<Enter>
The response might be:		`F72 Antenna: OK  GPS: Locked<CR><LF>`

4-3.22 I/O Function F73 – Request/Set Alarm Status/Control

Use Function 73 to monitor and control (enable/disable) those conditions that signal an alarm or fault through the NTS open collector output. You can also monitor the status of individual indicators that may contribute to the summary alarm outputs. The fault condition is sampled on entering each fault display. The fault status flags can be read, regardless of whether the faults are enabled or not.

To read the fault status flags, send the following command:

F73<Enter>

The NTS responds with:

`F73<SP>S12345678<SP>M12345678<SP>m12345678<CR><LF>`

where:

F	=	ASCII character F
7	=	ASCII character 7
3	=	ASCII character 3
<SP>	=	space
S	=	'S' Status delimiter
1	=	'L' Satellite Lock OK
		'U' Unlock Spec Reached
2	=	'A' Position Accurate, Full Accuracy and Stability When Locked
		'B' Position Approximate, Slightly Degraded Accuracy and Stability When Locked
		'C' Position Unknown, Highly Degraded Accuracy and Stability, Not Locked
		'D' Position and Time Unknown, Not Locked

3	=	'A' Auto Mode
		'T' Time Mode
		'S' Survey Mode
		'D' Differential Mode
4	=	'0' through '6' - Number of Current Satellites used in solutions
5	=	'– ' Currently not used
6	=	'– ' Currently not used
7	=	'– ' Currently not used
8	=	'– ' Currently not used
M	=	'M' Major Alarm delimiter
1	=	'– ' Currently not used
2	=	'– ' Antenna OK
		'F' Antenna Fault
3	=	'– ' Receiver OK
		'R' Receiver Fault
4	=	'– ' Non-Volatile RAM Data OK
		'N' Non-Volatile RAM Data Fault
5	=	'– ' The minor alarm, 'Time Error Threshold Reached', has not persisted for Timeout seconds
		'U' The minor alarm, 'Time Error Threshold Reached', has persisted for Timeout seconds
6	=	'– ' Currently not used
7	=	'– ' Currently not used
8	=	'– ' Currently not used
m	=	'm' Minor Alarm delimiter
1	=	'– ' Time Error Threshold Not Reached
		'U' Time Error Threshold Reached
2	=	'– ' Tracking OK
		'T' Not Tracking Satellites
3	=	'– ' Oscillator Tuning Voltage OK
		'X' Oscillator Tuning Voltage Requires Adjustment
4	=	'– ' Currently not used
5	=	'– ' Unit has locked at least once
		'A' Initial Acquisition Mode, unit has not yet locked since power-up
6	=	'– ' Currently not used
7	=	'– ' Currently not used
8	=	'– ' Currently not used
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

You can query or control which faults affect the alarm outputs seen by this command by sending the following commands. When setting the mask, the letter 'E' enables the fault, the letter 'D' disables it, and a '– ' leaves it unchanged.

If you send the following command:

F73<SP>MASK<Enter>

The NTS responds with:

```
F73<SP>MASK<SP>M12345678<SP>m12345678<CR><LF>
```

If you send the following command:

F73<SP>MASK<SP>M12345678<SP>m12345678<Enter>

The NTS sets the alarm mask, where:

M	=	'M' Major Alarm delimiter
1	=	'–' Currently not used
2	=	'E' Antenna Alarm Enabled
		'D' Antenna Alarm Disabled
3	=	'E' Receiver Alarm Enabled
		'D' Receiver Alarm Disabled
4	=	'E' Non-Volatile RAM Data Alarm Enabled
		'D' Non-Volatile RAM Data Alarm Disabled
5	=	'E' The minor alarm, 'Time Error Threshold Reached', has persisted for Timeout seconds, Alarm Enabled
		'D' The minor alarm, 'Time Error Threshold Reached', has persisted for Timeout seconds, Alarm Disabled
6	=	'–' Currently not used
7	=	'–' Currently not used
8	=	'–' Currently not used
m	=	'm' Minor Alarm delimiter
1	=	'E' Time Error Threshold Reached Alarm Enabled
		'D' Time Error Threshold Reached Alarm Disabled
2	=	'E' Tracking Alarm Enabled
		'D' Tracking Alarm Disabled
3	=	'E' Oscillator Tuning Voltage Alarm Enabled
		'D' Oscillator Tuning Voltage Alarm Disabled
4	=	'–' Currently not used
5	=	'E' Initial Acquisition Mode Alarm Enabled
		'D' Initial Acquisition Mode Alarm Disabled
6	=	'–' Currently not used
7	=	'–' Currently not used
8	=	'–' Currently not used
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

The NTS responds with:

```
OK<CR><LF>
```

The time error threshold at which the time error fault is activated can be queried or set by sending the following command:

F73<SP>THRESHOLD<Enter>

The NTS responds with:

    73<SP>THRESHOLD<SP><nanoseconds><SP>ns<CR><LF>

where <nanoseconds> is the time error threshold in nsec.

If you send the command:

    F73<SP>THRESHOLD<SP><nanoseconds><Enter>

The NTS sets the time error threshold and, if successful, responds with:

    OK<CR><LF>

If you send the following command:

    F73<SP>TIMEOUT<Enter>

If you send the following command, the NTS queries or sets the timeout after which a time error fault becomes a timeout fault:

 The NTS responds with:

    F73<SP>TIMEOUT<SP><seconds><SP>s<CR><LF>

where <seconds> is the timeout in seconds, between 0 and 86400.

If you send the command:

    F73<SP>TIMEOUT<SP><seconds><Enter>

The NTS sets the timeout and, if successful, responds with:

    OK<CR><LF>

If any checksum errors were found on recalling any non-volatile memory blocks, or one or more blocks were missing and were created with default values, then this <nvram status> will be "Error". This may occur the first time the unit is powered up, or if some options have just been installed and new non-volatile memory blocks have been created for their use. If <nvram status> is "Error", then the next item displayed is to clear it.

If you send the following command, you can cancel the error, so that future errors can be caught after you confirm that all settings are correct:

    F73<SP>CLEAR<SP>NVRAM<SP>FAULT<Enter>

The NTS clears the fault and responds with:

    OK<CR><LF>

You can distinguish between errors that occurred during start-up and functional errors during normal operation by clearing latch alarm indicators after starting the NTS.

To clear latch alarms, first send the following command to stop serial time output:

    Ctrl-C

To display fault status flags, send the following command:

    F73

An example of the NTS response is:

    F73 SUDT0---- M----U--- mUT—A---

To display latch alarms, send the following command:

    F73 latch

An example of the NTS response is:

    F73 LATCH M-A—I---mUT—A---

To clear the latch alarms, send the following command:

    F73 clearalarmlatch

The NTS responds with:

    OK

To verify the clearing of alarms, send the following command:

    F73 latch

An example of the NTS response showing a clearing of alarms, is:

    F73 LATCH M----U--- mU---A---

The tri-color LED on the front panel also displays status. In general, faults only affect the LED if they are enabled. However, even if there is no enabled major or minor fault, the presence of the time error fault is indicated by a solid green LED. Normal operation within the user-defined time error threshold is indicated by the green LED blinking at a one pulse per second rate.

The LED has the following states:

Off	Power off
Solid Red	Major enabled alarm fault
Solid Orange	Minor enabled alarm fault, time error outside threshold
Blinking Green	No enabled alarm faults, time error within threshold

The NTS Open Collector Alarm Output has the following states:

Off	Power off
Off	Error, major or minor enabled alarm fault
On	Normal, no major or minor enabled alarm faults

If the processor fails, resulting in a failure to trigger the watchdog timer, the watchdog timer resets the processor and attempts to restart the system. During the processor reset, the LED output is red, and the alarm output transistor open collector is off, indicating a fault. If the processor were unable to recover and resume triggering the watchdog timer, you would see a blinking red LED, indicating a succession of watchdog timer timeouts and resets. Depending on whether or not you enabled or disabled this fault, the open collector alarm output transistor either might be off, or might toggle between off and on following the repeated resets, indicating an alarm condition.

Major Alarm Faults can be caused by antenna loss, GPS receiver failure, or non-volatile RAM data failure.

Minor Alarm Faults can be caused by reaching the time error threshold, loss of tracking, or reaching the oscillator tuning voltage limit. When the unit is in initial acquisition mode, the LED also displays solid orange.

When the NTS is in either alarm condition, the open collector alarm will be in a high impedance state. The non-alarm condition corresponds with the open collector alarm output low impedance.

The default alarm mask settings are summarized below:

Major Alarm Default Alarm Mask

Antenna	Enabled
Receiver	Enabled
NV RAM	Enabled
Timeout	Disabled

Minor Alarm Default Alarm Mask

Time Error	Enabled
Tracking	Disabled
Tuning	Disabled
Acquisition	Disabled

4-3.23 I/O Function F79 – Warm Restart

This function issues a reset command to the GPS module. It clears satellite tracking data, while retaining stored almanac and ephemeris data. A warm restart may be needed when all other diagnostics have failed to return the NTS to tracking satellites.

To initiate a warm restart, send the following command:

F79<Enter>

where:

F	=	ASCII character F
79	=	function number
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

The NTS responds by initiating a warm restart.

Sample entry:	F79<Enter>
The response might be:	OK<CR><LF>

4-3.24 Extended F100 Commands

This series of function commands controls the NET port network interface card (NIC) functions and NET port configuration. The parameters specify which specific sub-function should be executed and may also provide command data. In the following sections, where it is not already stated, <Enter> = input line terminator and <CR><LF> = output line terminator.

Note: F100 commands are very similar to F36 commands (see page 62). The difference is that F100 commands affect *only* NIC functions and NET port network configuration.

The NET port network configuration parameters may only be altered when DHCP is disabled.

Note: When you enter new parameters using an F100 command, the NTS responds "Restarting" and requires several seconds to reboot the system. Please wait until the unit has completed re-initialization before issuing further commands.

Use Serial or Telnet I/O Function F100 IC (see page 86) to obtain information about the entire current NET port NIC configuration, or to change the setup with a single entry.

4-3.24.1 F100 BASET – 10BASE-T/100BASE-T Control

With the BASET command, the unit can be set to 10Base-T only, or allow it to negotiate between 10Base-T and 100Base-T. The current Base-T setting can be queried with this command.

To set 100Base-T maximum connection speed to 100Base-T, send the following command:

F100<SP>BASET<SP>100<Enter>

where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
BASET	=	specify Base-T command
100	=	set maximum Base-T speed to 100
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

To set 10Base-T maximum connection speed to 10Base-T, send the following command:

F100<SP>BASET<SP>10<Enter>

where

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
BASET	=	specify Base-T command
10	=	set maximum Base-T speed to 10
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

To query the maximum Base-T speed, send the following command:

F100<SP>BASET<Enter>><CR><LF>

where

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
BASET	=	specify Base-T command
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

An example of the response is:

```
F100 BASET 100T<CR><LF>
```

4-3.24.2 F100 DHCP – DHCP Control

DHCP (Dynamic Host Configuration Protocol) provides the NTS with the capability of auto-configuring its network address. DHCP is a TCP/IP client/server protocol that allows IP addresses to be administered and assigned from a common pool located at the server.

In order to work, the NTS must be installed on an Ethernet LAN that includes a DHCP server. Use F100 DHCP to configure DHCP status.

To enable DHCP, send the following command:

F100<SP>DHCP<SP>ENABLE<Enter>

where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
DHCP	=	specify DHCP command
ENABLE	=	command DHCP to be enabled
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

To disable DHCP, send the following command:

F100<SP>DHCP<SP>DISABLE<Enter>

where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
DHCP	=	specify DHCP command
DISABLE	=	command DHCP to be enabled
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

Note: DHCP status can be queried without rebooting the unit.

To query the status of DHCP send:

F100<SP>DHCP<Enter>

where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
DHCP	=	specify DHCP command
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

4-3.24.3 F100 EA – Ethernet Address

This ethernet address is a six-byte, hexadecimal value specific to the NTS NET port. The first three bytes are registered to TrueTime Inc; the last three bytes are the hex value identifying the NET port. The Ethernet address for the NTS NET port is a fixed address assigned at the factory.

To request the Ethernet address of the NTS NET port, send the following command:

F100 EA<Enter>

The NTS responds with:

```
F100 EA:00-A0-69-xx-xx-xx<CR><LF>
```

where "xx-xx-xx" are the six hex digits of the unit's unique address.

An example of the response is:

```
F100 EA:00-A0-69-00-06-2A<CR><LF>
```

Attempts to set this field will be rejected with a syntax error message.

4-3.24.4 F100 G – Gateway

The Default Gateway Address can only be manually set if DHCP is disabled, and can be queried at any time.

To obtain the Default Gateway of the NTS NET port, send the following command:

F100 G<Enter>

The NTS responds with:

```
F100 G:nnn.nnn.nnn.nnn<CR><LF>
```

An example of the response is:

```
F100 G:206.54.0.1<CR><LF>
```

To set the Default Gateway and restart the NTS, send the following command:

F100 G:nnn.nnn.nnn.nnn<Enter>

Sample entry: F100 G:206.54.0.17<Enter>
The response might be: `Restarting<CR><LF>`

4-3.24.5   F100 IC — NET Port Network Configuration Request

To review the entire network configuration of the NET port NIC, send the following command:

F100<SP>IC<Enter>

An example of the response is:

```
F100 IP:206.54.0.21 SM:255.255.255.240
G:206.54.0.17<CR><LF>
```

This response, which appears as a single line on your display, indicates the specific IP address, Subnet Mask, and Default Gateway of the NTS NET port.

Note: The leading zeros within fields of the dotted decimal addresses are omitted from the IP address, Subnet Mask, and Default Gateway.

To set all settable network parameters in a single entry and reset the NET port NIC, send a command that provides the NET port NIC with an IP address, Subnet Mask, and Default Gateway.

Sample entry:	F100 IP:206.54.0.21 SM:255.255.255.240
	G:206.54.0.17<Enter>
The response might be:	`Restarting<CR><LF>`

Note: The leading zeros may be omitted when entering IP address, Subnet Mask, and Default Gateway. Any field may be omitted and order is not significant. Blanks are allowed on either side of a colon.

Note: Any legal command set containing one of the three network parameters causes the NTS to reboot.

4-3.24.6   F100 IP — IP Address

The IP Address can only be set if DHCP is disabled, and can be queried at any time.

To obtain the IP address of the NTS NET port, send the following command:

F100 IP<Enter>

The NTS responds with:

```
F100 IP:nnn.nnn.nnn.nnn<CR><LF>
```

where "nnn.nnn.nnn.nnn" is the dotted decimal address notation.

An example of the response is:

```
F100 IP:206.54.0.33<CR><LF>
```

To set the IP address and restart the NTS, send the following command:

F100 IP:nnn.nnn.nnn.nnn<Enter>

Sample entry:	F100 IP:206.54.0.21<Enter>
The response might be:	`Restarting<CR><LF>`

4-3.24.7 F100 P — Change User Password

The User Password is only used when initiating a Telnet Session.

The password may be changed from either the Telnet port or the Utility port. It is not necessary to know the old password in order to enter a new password. If you forget the password, just use the Utility port to define a new one.

Maximum password size is ten characters.

> To change the User Password, send the following command:
>
> > F100<SP>P<Enter>
>
> where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
P	=	specify Password command
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

The NTS responds with:

> Enter new user password:

When you enter a new password, the NTS responds with:

> Enter it again:

Enter the same new password again, to confirm the spelling.

> If the same new password has been entered twice, the NTS responds with:
>
> > OK<CR><LF>

In this case, the new password will be used for the next Telnet login.

> However, if the new password is entered differently the second time, the NTS responds with:
>
> > ERROR: Passwords do NOT match. New password rejected.

The old password will be used for the next Telnet login.

4-3.24.8 F100 SM — Subnet Mask

The subnet mask can only be set if DHCP is disabled, and can be queried at any time.

> To return the subnet mask of the NTS NET port, send the following command:
>
> > F100 SM<Enter>

The NTS responds with:

> F100 SM:nnn.nnn.nnn.nnn<CR><LF>

An example of the response is:

> F100 SM:255.255.255.125<CR><LF>

To set the subnet mask and restart the NTS, send the following command:

         F100 SM:nnn.nnn.nnn.nnn<Enter>

Sample entry: F100 SM:255.255.255.240<Enter>
The response might be: `Restarting<CR><LF>`

4-3.24.9   F100 ST – Self Test Status

Query the status of the power-up tests with the ST command. The response contains the PASS/FAIL status of the flash memory checksum test, ram test, serial port test, and version check.

To query the self-test status, send the following command:

         F100<SP>ST<Enter>

where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
ST	=	specify ST command
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

The NTS responds with:

```
F100<SP>ST<SP>FLASH/CRC<SP>:<SP><STATUS>,<SP>RAM<SP>:
<SP><STATUS>,<SP>SERIAL<SP>:<SP><STATUS>,<SP>VER<SP>:
<SP><STATUS><CR><LF>
```

where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
ST	=	specify ST command
FLASH/CRC	=	specify flash checksum result
RAM	=	specify ram test result
SERIAL	=	specify serial port test result
VER	=	specify version test result; this test compares the version of the code against the version recorded in the Non-Volatile memory
<STATUS>	=	is either ASCII PASS or FAIL
,	=	ASCII comma
:	=	ASCII colon
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

An example of the response is:

```
F100 ST flash/CRC : PASS, Ram : PASS, Serial : PASS,
Ver : PASS
```

This string appears as a single line on your display.

4-3.24.10 F100 VER – Version Request

Version Request queries the software version number of the NET port NIC. The version number is set at compile time, and cannot be changed. It may only be queried.

> To query the version number send the following command:
>
>> F100<SP>VER<Enter>

where:

F	=	ASCII character F
100	=	NTS function number
<SP>	=	space
VER	=	specify Version Request command
<Enter>	=	input line terminator
<CR><LF>	=	output line terminator

> An example of the response is:
>
> ```
> F100 VER 182-9001v002
> ```

4-3.25   Login/Logout

Login/Logout allows access to more advanced features. There are two levels of login: "operator" and "guest".

4-3.25.1   Operator Login

Operator is the default level at the RS-232 interface. No "Login" is necessary to access the Operator level via the serial interface.

As shipped, you can access the Operator level with:

- Password: mercury

In order to maintain security, change the Operator password at installation.

Operator may perform most of the defined serial or Telnet functions through the RS-232 interface. The only function that an Operator cannot perform is to change the Guest Password.

4-3.25.2   Guest Login

Guest login is the default level on the Telnet interface.

As shipped, you can access the Guest level with:

- User Name: guest
- Password: truetime

In order to maintain security, the Guest password should be changed at time of installation.

A Guest may perform most of the defined serial or Telnet functions through the RS-232 interface. The only function that a Guest cannot perform is to change the Operator Password.

4-4　OUTPUTS

4-4.1　1 PPS Output

A time-stable ACMOS level 50 ohm 1 PPS output is provided on a rear-panel mounted BNC connector. The rising edge of this pulse coincides with the start of the UTC second. The output has a 50% duty cycle. If no satellites are being tracked, the 1 PPS pulse will be as stable as the internal oscillator of the NTS. This output is valid whenever the NTS has an accurate position and is tracking at least one satellite.

4-4.2　IRIG-B Output

An amplitude modulated 1 KHz carrier IRIG-B output is provided on a rear-panel mounted BNC connector. The primary purpose of the IRIG-B time code output is to drive slave displays manufactured by TrueTime. Refer to Appendix C for a full description.

Note:　This code is not used when driving the TrueTime Models RD-8, RMD-8, SF-DC or 560 Distribution Amplifier. The four bits in the "control functions" portion of the IRIG-B code that encode the time quality indicators are not used by these devices (see Time Quality Indication on page 28).

The modulated 1 KHz sine wave is capable of driving a 600 ohm load. The high level of the code is 2.5 ± 0.25 volts peak-to-peak and the low level is $.75 \pm 0.1$ volts peak-to-peak into 600 ohms. The open circuit levels are twice those into 600 ohms, i.e. the source impedance is 600 ohms.

5

NTS-Generated Messages

5-1   ERROR MESSAGES

The following section describes NTS-generated messages.

5-1.1   ERROR: Access denied.

Meaning:	You have attempted to use a command that is not user accessible.
Recovery Action:	Consult the manual for the correct command and re-enter.

5-1.2   ERROR: Command is NOT supported

Meaning:	You have attempted to use a serial timestamp related command that is NOT supported on an NTS.
Recovery Action:	Do something else. The command cannot be executed on an NTS.

5-1.3   ERROR: Login refused

Meaning:	You have attempted to login from Telnet while another user was changing the User Password from the Utility port.
Recovery Action:	Coordinate activities with whomever is currently working on the Utility port.

5-1.4   ERROR: Undefined Command

Meaning:	You have attempted to use an undefined F100 command string.
Recovery Action:	Retype the command, correcting the typing error.

5-1.5   ERROR: Exclusive Use

Meaning:	Keypad command entry is blocked by the Exclusive Use feature, until the current serial session ends.
Recovery Action:	Wait until the current serial session is over, or ask the serial port user to disable the Exclusive Use feature.

5-1.6   ERROR 01 VALUE OUT OF RANGE

Meaning:	You have entered a valid command, with an invalid parameter value.
Recovery Action:	Retype the command, using a valid parameter.

5-1.7   ERROR 02 SYNTAX

Meaning:	You have entered a valid command with a minor syntax error. The NET port network interface card software has detected the error.
Recovery Action:	Retype the command, using valid syntax.

5-1.8   ERROR 05 No Such Function

Meaning:	You have entered an invalid command.
Recovery Action:	Consult the manual for the correct command and re-enter.

5-2   INFORMATIONAL MESSAGES

Messages in this section inform you of events and do not require any action on your part.

5-2.1   DHCP is enabled

Meaning:	You have just successfully entered the Enable DHCP command.

5-2.2   DHCP is disabled

Meaning:	You have just successfully entered the Disable DHCP command.

5-2.3   Goodbye.

Meaning:	The NTS has just terminated a session.

5-2.4   Rev Level is

Meaning:	Response to F100 V command, requesting NTS NET port software version number.

5-2.5   Restarting

Meaning: A command has just been executed that requires a soft restart of the NTS. The restart happens immediately after this message is sent.

5-3   NOTICE MESSAGES

5-3.1   NOTICE: A new Telnet Session has been started on the InterNet Port.

Meaning: Sent to the Utility port user to inform that someone has logged in to the Telnet port.

5-3.2   NOTICE: Cannot respond to command because Utility Port session has priority

Meaning: The Telnet port user tried to send a command, but was prevented from doing so because there is an active session on the Utility port. The Telnet port user cannot send any commands until the Utility port session ends.

5-3.3   NOTICE: Resource usage conflict. Try again later.

Meaning: Simultaneous attempts to change the User Password are being attempted from the Utility port and the NET port.

5-3.4   NOTICE: There is already a Telnet Session on the InterNet Port

Meaning: You have started a session on the Utility port when the NET port was already active.

5-3.5   NOTICE: Telnet now has full access to Product

Meaning: Sent to the Utility port after its watchdog expired. Inform whoever is working on the Utility port that the Utility port session has terminated and Telnet can now be fully used.

5-3.6   NOTICE: Telnet Port Watchdog expired

Meaning: Sent to the NET port user to inform that the Telnet Session watchdog has expired. The Telnet session will be terminated, by the NTS immediately after this message is displayed.

5-3.7   NOTICE: Telnet Session terminated by timeout

Meaning: Sent to the Utility port, if it is active, to inform the Utility port user that the Telnet Session has timed out.

5-3.8   NOTICE: To take control back from Telnet, send in a command

Meaning: Sent to the Utility port, if it is active, to inform the
                            user that the Utility port timer has expired and that
                            Telnet has full rights. This message reminds the
                            Utility port user that they can take control back by
                            sending in a character.

5-3.9   NOTICE: Utility Monitor Session has relinquished control to this Telnet Session

Meaning: Sent to the Telnet user to inform that they are no
                            longer being inhibited from performing commands
                            because of a Utility port session. The Utility port
                            session has just ended.

5-3.10   NOTICE: Utility Monitor Session has taken priority from this Telnet Session

Meaning: Sent to the Telnet port user to inform that they can
                            no longer enter commands because a session has
                            started on the Utility port. The Utility port has
                            precedence over the Telnet port.

5-3.11   NOTICE: Utility Port Watchdog expired

Meaning: Sent to the Utility port after its timer has expired
                            because from lack of activity.

5-3.12   NOTICE: You have taken control away from the Telnet Session

Meaning: Sent to the Utility port user to inform that a Telnet
                            Session was in progress when they started a session
                            by sending in a character.

5-4   OTHER MESSAGES

5-4.1   OK

Meaning: Command accepted and processed as specified.

5-4.2   User Login Message

Network Interface 182-9001v001 (c) 1998 TrueTime Inc.
All Rights Reserved
Login successful

Meaning: A Telnet port user has just successfully logged in, by
                            sending in the correct login name and password.

5-5 PASSWORD RELATED MESSAGES

5-5.1 Login:

Meaning: Prompt for login name; you must enter a name.

5-5.2 Password:

Meaning: Prompt for login password; you must enter the user password.

5-5.3 Enter new user password:

Meaning: You have entered the Change Password command. This is the first prompt for the new password. You must enter a new password.

5-5.4 Enter it again:

Meaning: You are in the process of changing the User Password and have entered a new password. This message prompts you to enter it again, for confirmation. You must re-enter the new password.

5-5.5 ERROR: Passwords do NOT match. New password rejected.

Meaning: The re-entered password does NOT match the original password. Restart the password sequence.

Appendix A

Network Time Protocol V 3.0 Data Formats

A-1   INTRODUCTION

The following two data formats are described below:

- The NTP V 3.0 per RFC-1305

- The SNTP V 3.0 per RFC-1361

A-2   NTP V 3.0 DATA FORMAT PER RFC-1305

A-2.1   NTP Data Packet

The layout of the NTP data packet information following the UDP header is shown below:

Leap Indicator	Version Number	Mode	Stratum	Poll	Precision
Synchronizing Distance (Root Delay Version 3)					
Synchronizing Dispersion (Root Dispersion Version 3)					
Reference Clock Identifier					
Reference Timestamp					
Originate Timestamp					
Receive Timestamp					
Transmit Timestamp					
Authenticator					

Figure A-1: NTP Data Packet Information Layout

A-2.2 Leap Indicator

The leap indicator is a 2 bit code that signals an impending leap second to be added or subtracted in the last minute of the current day. Leap year codes and their corresponding meanings are shown in Table A-1 below:

Table A-1: Leap Year Codes

Bit 0	Bit 1	Meaning
0	0	Normal Operation
0	1	61 second last minute
1	0	59 second last minute
1	1	Clock not synchronized

The unsynchronized state is indicated by the NTS whenever the estimated synchronization error is greater than the root dispersion. Such conditions typically occur following turn-on, until synchronization with the external source has been achieved, and whenever the external synchronization input has been removed and the extrapolated time error has exceeded the value of the root dispersion.

A-2.3 Version Number

The version number is a three bit integer that specifies the NTP version. The NTS will copy this field from the client requesting packet and return it in this field if it is equal to either 2 or 3. NTP version 1.0 packets are not supported.

A-2.4 Mode

The mode is a three bit integer that determines the functions the NTS module will perform. TrueTime's NTS module operates in mode four or server mode. Mode four operation allows the module to synchronize hosts but will not allow the module to be synchronized by another host.

A-2.5 Stratum

The stratum is an eight bit integer providing the stratum level of the local time source. TrueTime's NTS module operates in stratum 1, denoting a primary reference.

A-2.6 Poll Interval

The poll interval is a signed eight bit integer used as the exponent of two to yield in seconds the minimum interval between consecutive messages. For example, a poll interval value of six implies a minimum interval of 64 seconds. The NTS does not alter the setting of this field.

A-2.7 Precision

The precision is a signed eight bit integer used as the exponent of two to yield in seconds the precision of the local time source and any other hardware affecting the base level "jitter" of the time server. This field is set to approximate the time stamping resolution of the NTS, which is 10 µs. So the precision byte is set to –16, which is equivalent to a precision of 15.26 µs.

A-2.8   Synchronizing Distance (Root Delay Version 3)

The root delay is a signed 32-bit fixed point number representing the predicted roundtrip delay in seconds to the primary synchronizing source. The fraction point is between bits 15 and 16. This value is set to 0 seconds in TrueTime's NTS module.

A-2.9   Synchronizing Dispersion (Root Dispersion Version 3)

The root dispersion is a signed 32-bit fixed point number representing the maximum error in seconds relative to the primary synchronizing source. This value is a function of the precision and the quality of the synchronization input option.

When the synchronization input option is GPS, then the NTS will self determine the accuracy. Once the accuracy has been determined, then the NTS sets the root dispersion equal to ten times the square root of the sum of the squares of the precision and the accuracy, except for the ACTS synchronization option, where the root dispersion is set equal to the accuracy.

A-2.10 Reference Clock Identifier

The reference clock identifier is a 32-bit code identifying the particular type of timing source. Strata 0 and 1 use a four-octet, left justified, zero-padded ASCII string. TrueTime's NTS module operates as Stratum 1 and uses this four-octet string based on the local time source input as shown in Table A-2 below. This setting is determined based on the NTS synchronization input option.

Table A-2: Local Time Source Input

Local Source Input	Reference Identifier String
GPS	"GPS"
IRIG-B	"IRIG"
ACTS	"ACTS"

A-2.11 Reference Timestamp

The reference timestamp is a 64-bit timestamp format representing the local time at the last update. TrueTime's NTS module's reference timestamp is the last time that a valid synchronization source signal was present.

A-2.12 Originate Timestamp

The originate timestamp is a 64-bit timestamp format representing the time that the request left the client.

A-2.13   Receive Timestamp

The receive timestamp is a 64-bit timestamp format representing the time that the request arrived at the service host.

A-2.14   Transmit Timestamp

The transmit timestamp is a 64-bit timestamp format representing the time that the reply left the service host.

A-2.15   Authenticator

This is a 96-bit field containing the authenticator information as described in Appendix C of RFC-1305. This field is not implemented by the NTS.

A-3   SNTP V 3.0 DATA FORMAT PER RFC-1361

When the NTS replies to requests from SNTP clients, the packet format is the same as the NTP packet format described above, with these differences:

A-3.1   Leap Indicator

The NTS will set these 2 bits to either 0 (normal) or 3 (unsynchronized) only

A-3.2   Version Number

The NTS will copy this field from the client request packet and return it in this field.

A-3.3   Reference Timestamp

This field is set to the time that the reply left the NTS server host.

A-3.4   Receive Timestamp

This field is set to the time that the reply left the NTS server host.

A-3.5   Transmit Timestamp

This field is set to the time that the reply left the NTS server host.

A-3.6   Authenticator

This field is not used in SNTP.

Appendix B

Time Protocol per RFC-868

B-1   INTRODUCTION

This protocol provides a site-independent, machine readable date and time. The TIME service sends back to the originating source the UTC time in seconds since midnight on January 1, 1900.

This protocol may be used either above the Transmission Control Protocol (TCP) or above the User Datagram Protocol (UDP). The NTS implements the TIME protocol only above the UDP.

When used via UDP, the TIME service works as follows:

Server:	Listen on port 37 (45 octal).
Client:	Send an empty datagram to port 37.
Server:	Send a datagram containing the UTC time as a 32-bit binary number.
Client:	Receive the TIME datagram.

The server listens for a datagram on port 37. When a datagram arrives, the server returns a datagram containing the 32-bit time value. If the server is unable to determine the time at its site, it should discard the arriving datagram and make no reply.

B-2   THE TIME FORMAT

The time is the number of seconds since 00:00 (midnight) 1 January 1900 UTC, such that the time 1 is 12:00:01 AM on January 1, 1900 UTC; this base will serve until the year 2036.

Appendix C

IRIG-B Time Code

C-1   INTRODUCTION

The document 200-70 "IRIG STANDARD TIME FORMATS" by the Telecommunications Working Group, Inter-range Instrumentation Group, Range Commanders Council describes IRIG-B, IRIG-H and IRIG-E time codes. It is available by writing Secretariat, Range Commanders Council, White Sands Missile Range, New Mexico, 88002.

The standard time formats of IRIG codes were designed for use in missile, satellite and space research programs. Use of these codes facilitates efficient interchange of test data. These formats are suitable for recording on magnetic tape, oscillographs, film and for real-time transmission in both automatic and manual data reduction. IRIG-B from the NTS is suitable for remote display driving, magnetic tape recording, and many other uses. IRIG codes, in the strict sense, encode Universal Coordinated Time (UTC) in 24 hour format and not local time. Nonetheless, this instrument can encode UTC or local time in either 24 or 12 hour formats.

C-2   IRIG-B CODE FORMAT

With reference to Figure C-1 on the next page, the level shifted, pulse-width modulated, serial format of IRIG-B is divided into three segments.

The first segment encodes time-of-year in binary-coded-decimal (BCD) notation. The second segment encodes control functions. This segment is generally available for data of the user's choice. In the IRIG-B code output of the NTS, this segment may encode worst-case time error flags, as explained below in Section C-3. The third segment sometimes encodes time-of-day in straight binary seconds (SBS) notation. This segment is not encoded by the NTS.

These three segments are contained within one "frame". The frame length for IRIG-B is 1 second long and contains 100 "elements" (pulses) each of which start every 10 milliseconds.

An element may represent either a binary zero, a binary one, a reference marker or a position identifier. A zero is 0.2 of the duration of an element, a one is 0.5 of the duration of an element and a position identifier or reference marker is 0.8 of the duration of an element. A reference marker locates the beginning of each frame and a position identifier marks the end of every ten elements. IRIG-B has ten position identifiers per frame.

The elements prior to position identifier P5 comprise the time-of-year segment. The first ten elements encode the seconds, the second ten elements encode the minutes, and so on through days. Each element is a digit in a binary number with a place value sequence 1-2-4-8.
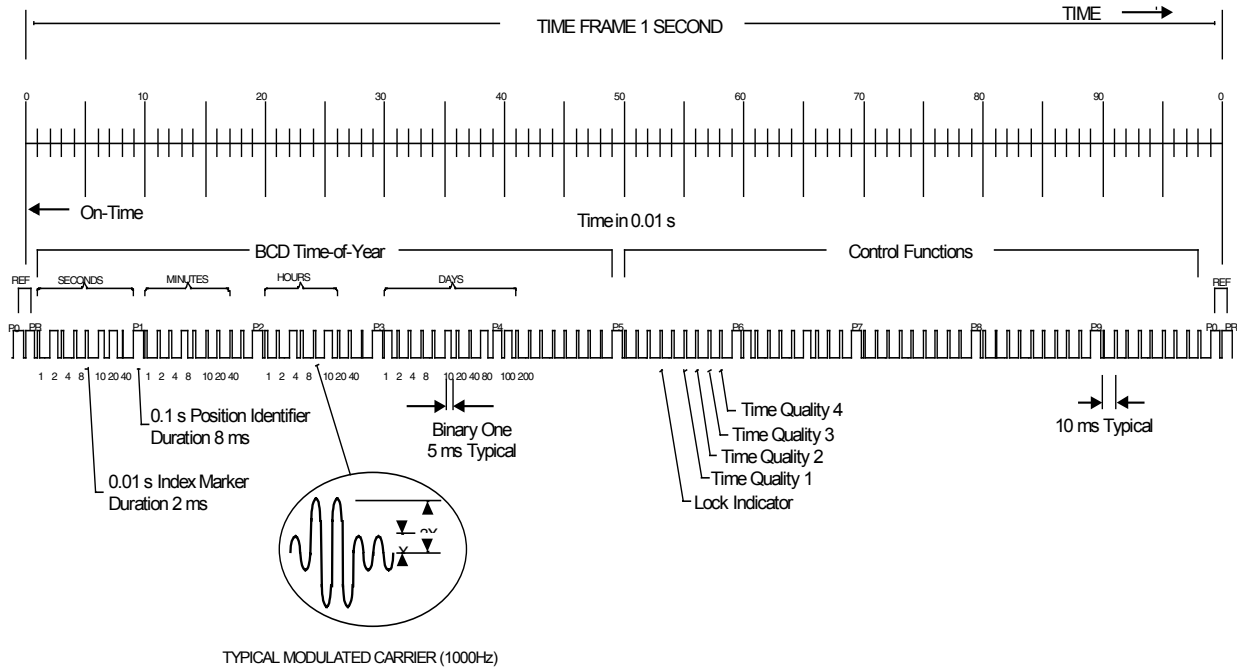
Figure C-1: IRIG-B Time Code Format

C-3   EMBEDDED WORST-CASE TIME ERROR FLAGS

Five flags are encoded in the control function segment of the IRIG-B code. The first flag encoded at element P5+40 ms is the LOCK indicator. It is a binary 1 when the unit has lost contact with satellite signals. The second flag encoded at element P5+60 ms is a binary 1 when the worst-case time error exceeds threshold 1. Element P5+70 ms is a binary 1 when the worst-case time error exceeds threshold 2. Element P5+80 ms encodes a binary 1 when the error exceeds threshold 3 and P5+90 ms when the error exceeds threshold 4.

See Time Quality Indication on page 28 for more information. For details on setting error thresholds with the F05 command, see page 34 (for keypad commands) or page 59 (for serial commands).

Appendix D

MD5 Authentication Protocol for NTP Packets

D-1 INTRODUCTION

MD5 is a security protocol that can be used to authenticate NTP client-server communications. TrueTime's version of MD5 is completely compatible with current versions of NTP client software xntpd 3.XX and ntpdate 3.XX furnished by Dr. David Mills at the University of Delaware. MD5 was drafted into a standard by MIT Laboratory for Computer Science and RSA Data Security, Inc. MD5 authentication means the information within the NTP packet is guaranteed to be unaltered and from a user having privileged access. Unlike other cryptographic ciphers, MD5 does not hide the data within the packet. The MD5 authenticated NTP packet is still readable. This means MD5 is faster to generate than other cryptographic protocols, and as Dr. Mills notes, there is no reason to hide the actual time from anyone. Further, MD5 does not suffer from any export restrictions. Think of MD5 as a very sophisticated NTP data checksum that is extremely difficult to reverse generate.

The MD5 cryptographic key identifier and cryptographic message digest are tacked on to the end of a normal NTP packet and the two pieces of information are referred to together as an MD5 signature. The key identifier is the first field in the signature, and it is a 32-bit integer in the range from 1 to 4294967295 (0xFFFFFFFF). This number specifies an index into a table of many possible MD5 keys.

Note: Zero is an illegal value, and for TrueTime setup purposes, 0 internally means the key identification is unused.

An MD5 key is an ASCII alpha/numeric character string that is from 1 to 31 characters in length. The key is most secure when all 31 characters are filled with numbers and letters chosen at random. The ASCII key string is combined with the NTP packet data and results in a secure message digest.

The MD5 message digest is 16 bytes in length and it follows the key identifier in the signature. A server authenticates the NTP packet from a client by first looking up the key by reference to the key identifier. It then generates the MD5 message digest based on the key and the NTP data and compares the resulting message digest to the client packet's MD5 message digest. If the two compare, a NTP reply packet is generated with a new MD5 signature. If the MD5 message digests do not agree, then the NTP client packet is ignored by the TrueTime server.

For more technical information on MD5, see the MD5 RFC-1321, NTP RFC-1305, and the release notes for NTP client software furnished by Dr. David Mills' web site located at the University of Delaware at:

- http://www.eecis.udel.edu/~ntp
  or
- http://www.eecis.udel.edu/~ntp/software.html

D-2   TRUETIME NTP MD5 OPERATION

A TrueTime NTP time server can handle both unauthenticated and MD5 authenticated packets at the same time. A packet is assumed to be MD5 authenticated if the total UDP data size of the packet is equal to the size of a normal NTP packet plus the exact size of an MD5 signature. A normal unauthenticated NTP packet is one that has no extra bytes beyond the last NTP timestamp.

The procedure used is functionally the one followed by Dr. David Mills' NTP software. Packets without authentication are returned without signatures and packets with authentication are returned with authentication signatures using the key ID specified by the client request. If a packet does not send the correct authentication signature, it is silently dropped.

A TrueTime NTS can contain up to 16 MD5 authentication keys. MD5 keys are entered and maintained through the standard TrueTime keypad and the serial/Telnet interface. Therefore, for security reasons, the TrueTime time server should be physically isolated from unauthorized users (a good practice anyway). MD5 keys should be changed on a regular schedule as a further security measure. Persons privileged to carry and maintain keys should have appropriate clearances and be trained for handling secure information.

Note: Delete any keys that are no longer trusted (those that are potentially compromised) from the TrueTime MD5 key table.

D-3   NTP MD5 KEY MAINTENANCE USING THE KEYPAD INTERFACE

Although you can maintain MD5 Authentication keys from the keypad, it is much easier to use the serial interface for this purpose (see the next section). This is due to the fact that MD5 keys are alphanumeric strings and the keypad interface does not allow easy entry of alpha characters.

To maintain MD5 Authentication keys from the keypad, follow these steps:

1. Press the status function button first, then press "FUNC/ENTR" 36.
   This displays the network configuration menu.

2. Press the up-arrow key until you see the *Display/Set NTP MD5 Auth* prompt.

3. Press "FUNC/ENTR" for the menu titled *MD5* Main *Menu.*
   The menu choices are:

   - Modify MD5 keys
   - Output On/off
   - Back one menu

   Note: "Output On/off" is related to NTP broadcast mode, which the NTS does not currently support. For this reason, the menu generated by the *Output On/off* command is not functional.

   Note: For all TrueTime menus: the up- and down-arrow keys scroll through the list of menu items and "FUNC/ENTR" actuates the selected menu option. The "Back one menu" choice returns to the previous menu.

4. Press "FUNC/ENTR" at the *Modify MD5 keys* option to display the menu where you can edit or view MD5 keys.
   The options are:

```
MD5 Edit Menu:      or     MD5 Edit Menu:
Edit a key                 Back one menu
```

5. Press the up-arrow at the "Edit a key" prompt to cycle through the editing options:

   - Add a key
   - Delete a key
   - Delete all keys
   - Back one menu

6. Press Add *a* key to display the first prompt. An example of the response is:

   ```
   Enter Key ID:
   0000000001
   ```

7. Use the up- or down-arrow keys to toggle through the settings options. The left- and right-arrow keys move the cursor between digits and letters within an address or a string.

8. Press "FUNC/ENTR" to enter the selection and proceed to the next parameter, "CLR" to restore the original setting, or the STATUS push-button to exit Function 36 without saving any updated settings. You may edit the key ID in the range from 1 to 4294967295.

   Note: Entering a key identification that is already in use effectively edits that key to the new value.

9. Pressing "FUNC/ENTR" after configuring a key displays the *MD5 key up to 31 ASCII char* prompt.

10. Press FUNC/ENTR again to enter the actual MD5 key.

11. Press "FUNC/ENTR" when done and you are taken to the prompt. An example of the response is:

    ```
    Add this key?
    No
    ```

12. Press the up- and down-arrows to select *Yes* or *No*, then press "FUNC/ENTR" to activate the command. This returns you to the *MD5 Edit Menu: Edit a Key:* display.

13. Press the up-arrow and scroll to *Back one menu*. Press "FUNC/ENTR" . This returns you to the *MD5 Main Menu: Modify MD5 keys* display.

To leave MD5 key maintenance, press the up-arrow and scroll to the *Back one menu* display, then press "FUNC/ENTR". An example of the response is:

```
Display/Set
 NTP MD5 Auth
```

From here you can configure SNMP. In Appendix E, see Section E-3 for keyboard commands, or Section E-4 for serial commands.

D-4   NTP MD5 KEY MAINTENANCE USING THE TRUETIME SERIAL OR TELNET INTERFACE

The easiest method to maintain MD5 Authentication keys is through the serial or Telnet interface. This is due to the fact that MD5 keys are alphanumeric strings and the keypad interface does not allow easy entry of alpha characters.

To maintain MD5 Authentication keys from the serial interface, follow these steps:

1. To view a particular NTP MD5 key, send the following command:

        F36 MV:x<Enter>

    where x is the key identification number ranging from 1 to 4294967295.
    The NTS responds with:

        F36 key ID = <MD5KEYID>, key = <MD5KEY><CR><LF>

2. To view the next NTP MD5 Key, send the following command:

        F36 MV<Enter>

    The NTS responds with:

        F36 KEY ID = <MD5KEYID>, key = <MD5KEY><CR><LF>

    where MD5KEYID is the next key identification, in numerical order, from the last command that referenced a key identification. If the previous key viewed was at the end of the key identification list it will wrap back to the first key identification.

    Note: After booting, the key viewed will be the lowest numbered key identification.

3. To add a NTP MD5 key, send the following command:

        F36 MS:x <MD5KEY><Enter>

    where x is the key identification number ranging from 1 to 4294967295 and MD5Key is the MD5 ASCII string key ranging from 1 to 31 characters.

    Note: It is best to limit the string to alpha/numeric characters only. If other characters are desired, then you must consider the restrictions the remote NTP client program places on the string.

    The NTS responds with:

        OK<CR><LF>

4. To delete a NTP MD5 key, send the following command:

        F36 MD:x<Enter>

    where x is the key identification number ranging from 1 to 4294967295.

    The NTS responds with:

        OK<CR><LF>

5. To delete all NTP MD5 Keys, send the following command:

        F36 MD:ALL<Enter>

    The NTS responds with:

        OK<CR><LF>

Appendix E

SNMP – Simple Network Management Protocol

E-1   INTRODUCTION

SNMP management software allows a network user to remotely monitor and configure an IP host that supports a SNMP agent. A SNMP agent is protected from unauthorized use through a security authentication scheme. The TrueTime Network Time Server supports a SNMP version 1 agent with the MIB II and Enterprise MIB databases.

The material in this section assumes you already have an understanding of SNMP. If that is not the case, pick up a copy of "SNMP, SNMPv2 and CMIP" written by William Stallings and published by Addison-Wesley Publishing Company. This book is considered by the Internet community to be the definitive introduction to SNMP. Another good reference is "How To Manage Your Network Using SNMP," by Marshal T. Rose and Keith McClogurie. For more technical references, see RFC-1157 (definition of SNMPv1), RFC-1213 (definition of MIB II) and RFC-1354 (IP Forwarding table addition to MIB II). All RFCs are published with approval of the Internet Activities Board, found on the Internet by running any search engine and typing in the search field "RFC-####". Two such search engines can be found at the following internet addresses:

- http://lycos.com/
- http://www.altavista.com/

Two sites in particular that have basic information on SNMP are:

- The Simple Web: http://snmp.cs.utwente.nl
- Basic SNMP Information: http://www.skyweb.net/~parsons/snmp-links.html

E-2   TRUETIME SNMP CONFIGURATION

SNMP offers a security authentication scheme that is based on a common password shared by the management station and a group of agents. A group of hosts are known as a community. Any management station or agent can be a member of any combination of communities. Typically a manager will need to change the SNMP community information from TrueTime's SNMP agent factory defaults for security purposes. However, the factory default SNMP community settings are chosen to make the TrueTime SNMP immediately useable. TrueTime's SNMP agent recognizes up to five separate SNMP communities. These communities are configured through the serial or Telnet interface using the F36 string, or the front panel keypad where the "menus" referred to in this section appear. Each community has several configurable parameters that are defined in the table on the following page.

Table E-1: SNMP Community Configurable Parameters

Key Word (as seen from the front panel display)	Definition
Community Name	The name of this community. The name is limited to up to 32 ASCII letters, numbers or punctuation letters. This is the name that a management SNMP PDU (packet) specifies. If the community name of an incoming PDU does not match any of the five community names, the packet is ignored and an optional authentication trap message can be generated. See traps below. An empty string field disables the community name.
Trusted IP Address	If the Use Trusted IP flag is set to yes, then this is the table of IP host addresses that this community recognizes as valid SNMP management hosts. Even if the community name of an incoming PDU matches this community, the source IP address must match one of the IP addresses in this table, or the packet is ignored and an optional authentication error trap message is issued. Setting an IP address to all zeros turns off that IP address entry. In addition, this table also serves as the list of hosts that SNMP trap messages are sent to – regardless of the state of the Use Trusted IP flag.
Use Trusted IP	If this flag is set to yes, then the Trusted IP Address table is used in addition to the Community Name for authentication of incoming PDU(s).
R/W Access	For a particular community, the SNMP variables are set to read only, or normal SNMP access. This allows the manager to have a public known community from which anyone may read the SNMP data base and a separate private community that has full normal read and write access to the SNMP database. *Note:* SNMP MIB II does not define all variables to be writeable. SNMP variables defined by RFC-1213 as read-only remain read-only, regardless of the state of this R/W Access flag.
Trap Enable	When this flag is set to yes, trap messages are issued for this community. *Note:* This enables/disables all traps (both coldstart and authentication).
Trap Port	A trap port other than the normal SNMP trap port of 162 maybe specified. *Note:* This address must be chosen carefully, or conflicts with other protocols may occur.
Save settings	When any setting is changed, this becomes visible and answering yes immediately saves the changes to TrueTime's SNMP. Answering No will negate the changes.

The following tables define SNMP configurable parameters that are applied globally to all SNMP communities (this menu appears on the front panel display after the last community menu), and the TrueTime SNMP factory default settings.

Table E-2: SNMP Community Global Parameters

Key Word (as seen from the front panel display)	Definition
SNMP Global Enable Traps	When set to yes, all authentication failure traps are disabled. This flag overrides the Trap Enable flag set for each community and directly sets the value of the SNMP variable snmpEnableAuthenTraps.0. *Note:* The state of this flag has no effect on the issue of coldstart trap messages.
Return To Main Menu	This leads back to the main SNMP function window.
Save settings	When SNMP Global Enable Traps is changed, this becomes visible and answering yes immediately saves the change to TrueTime's SNMP. Answering No will negate the change.

Table E-3: TrueTime SNMP Default Settings

Key Word (as seen from the front panel display)	Definition
Community 1	
Community Name	public
Trusted IP Address	0.0.0.0, 0.0.0.0, 0.0.0.0, 0.0.0.0
Use Trusted IP	no
R/W Access	read/only
Trap Enable	no
Trap Port	162
Community 2	
Community Name	system
Trusted IP Address	0.0.0.0, 0.0.0.0, 0.0.0.0, 0.0.0.0
Use Trusted IP	no
R/W Access	normal
Trap Enable	no
Trap Port	162
Community 3 to 5	
Community Name	
Trusted IP Address	0.0.0.0, 0.0.0.0, 0.0.0.0, 0.0.0.0
Use Trusted IP	no
R/W Access	read/only
Trap Enable	no
Trap Port	162
SNMP Global Enable Traps	yes

The factory default settings are summarized as follows: community one is called *public* and is set to read-only access for the SNMP MIB; community two is named *system* and it has normal access to the SNMP database; all other communities are disabled. All traps are disabled. Many SNMP

management utilities are written with these default assumptions and thus the TrueTime SNMP is immediately useable without configuration.

E-3   KEYPAD CONFIGURATION

Although you can obtain information about, or change, the current SNMP configuration through the keypad, it is much easier to use the serial interface for this purpose. This is because SNMP parameters are alphanumeric strings and the keypad interface does not allow easy entry of alpha characters.

To use the keypad, follow these steps. There are 5 possible communities in this unit. In each of the strings listed below, x represents the community number 1-5.

1. Press the up-arrow on Display/Set MD5 AUTH to begin SNMP by displaying the Display/Set SNMP prompt.

    An example of the response is:

    ```
    Display/Set
     SNMP
    ```

2. Press "FUNC/ENTR" to display the SNMP Community #1 option, then continue pressing the up-arrow to select the community that you want to configure.

    An example of the response is:

    ```
    SNMP
    Community #1
    ```

3. Press "FUNC/ENTR" at the desired SNMP Community menu number to configure its parameters. These are described in Table E-3 in this appendix. To choose the letters for community names, use the up- or down-arrow keys to cycle to the letter of your choice.

4. Use the up- or down-arrow keys to toggle through the settings options.
    The left- and right-arrow keys move the cursor between digits and letters within an address or a string. Press "FUNC/ENTR" to enter the selection and proceed to the next parameter, "CLR" to restore the original setting, or the STATUS push-button to exit Function 36 without saving any updated settings.

5. At the "Save settings:" prompt, use the up- or down-arrows to toggle between Yes and No responses, and press "FUNC/ENTR" to submit your selection.

    Note: You must select a Yes response, or else you lose your community settings. Once saved, changes to SNMP take place immediately and there is no need to reboot the NTS.

6. After configuring SNMP Community parameters, press the up-arrow to display the SNMP Global Enable Traps option.

    An example of the response is:

    ```
    SNMP Global
    Enable Traps
    ```

7. Press "FUNC/ENTR" again.

An example of the response is:

```
Enable Authentic
ation Traps? Yes
```

8. Use the up- or down-arrow keys to toggle between Yes and No responses, then press "FUNC/ENTR" to submit your choice.

    An example of the response is:

```
Return to
Main Menu
```

9. To return to the Display/Set SNMP prompt, press "FUNC/ENTR again.

To exit Function 36 entirely, press the STATUS push-button.

To maintain MD5 Authentication keys, press the up-arrow until you see the NTP MD5 Auth prompt, then press "FUNC/ENTR". An example of the response is:

```
MD5 Main Menu:
Modify MD5 keys
```

E-4   SERIAL OR TELNET CONFIGURATION

It is much easier to use the serial interface, rather than the keypad, to obtain information about, or change, the current SNMP configuration. This is because SNMP parameters are alphanumeric strings and the keypad interface does not allow easy entry of alpha characters.

There are 5 possible communities in this unit. In each of the strings listed below, x represents the community number 1-5.

To read the current settings for an SNMP community, send the following command:

F36 Cx<Enter>

The NTS responds with:

```
F36 Cx: name  UseIP:n  R/W:n  Trp On:n  Trp Prt:n<CR><LF>
```

where n is 0 for off or 1 for on.

Sample entry: F36 C1<Enter>
The response might be: `F36 C1: system  UseIP:0  R/W:1`
                                 `Trp On:1  Trp Port:162<CR><LF>`

In this example the community name is "system". The access mode is read/write. Traps are on and the trap port is 162. This community will not use the trusted IP address list.

To read the current list of trusted IP addresses for an SNMP community, send the following command:

F36 CxIP<Enter>

The NTS responds with:

```
F36 Cx Trusted Ips: n.n.n.n  n.n.n.n  n.n.n.n  n.n.n.n<CR><LF>
```

where n.n.n.n is an IP address.

Sample entry: F36 CxIP<Enter>
The response might be: `F36 C1 Trusted IPs: 206.54.0.50 206.54.0.51`
                                 `206.54.0.52 0.0.0.0<CR><LF>`

This string appears as a single line on your display.

E-4.1   Read SNMP Configuration

Each of the SNMP fields can be read individually. The read commands are listed below:

To read the community name, send the following command:

F36 CxN<Enter>

The NTS responds with:

```
F36 Cx Name:   aaaa<CR><LF>
```

where aaaa is an alphanumeric string up to 32 bytes long.

To read a trusted IP address for a community, send the following command:

F36 CxIPy<Enter>

where `y` is a trusted IP address field 1-4.

The NTS responds with:

```
F36 Cx Trusted Ipy: n.n.n.n<CR><LF>
```

where `n.n.n.n` is an IP address.

To read the use trusted IP addresses (UseIP) setting, send the following command:

F36 CxU<Enter>

The NTS responds with:

```
F36 Cx Use Trusted IP Addresses:n<CR><LF>
```

where `n` is 0 for off or 1 for on.

To read the trap enable (Trp On) setting, send the following command:

F36 CxT<Enter>

The NTS responds with:

```
F36 Cx Trap Enable:n<CR><LF>
```

where `n is` 0 for off or 1 for on.

To read the trap port (Trp Prt) number, send the following command:

F36 CxTP<Enter>

The NTS responds with:

```
F36 Cx Trap Port: nnnnn<CR><LF>
```

where nnnnn is the trap port number.

To read the access mode (R/W) for a community, send the following command:

F36 CxA<Enter>

The NTS responds with:

```
F36 Cx Normal Access:n<CR><LF>
```

where n is 0 for off (read only) or 1 for on (read/write).

E-4.2   Write SNMP Configuration

The commands to change SNMP community settings are listed below:

> To set a community name, send the following command:
> > F36 CxN: aaaa<Enter>

where aaaa is alphanumeric string up to 32 bytes long.

Sample entry: F36 C3N: public<Enter>
The response might be: OK<CR><LF>

For community number 3 this sets the name to 'public'.

> To set a trusted IP address, send the following command:
> > F36 CxIPy: n.n.n.n<Enter>

where y is trusted IP address field 1-4 and n.n.n.n is an IP address.

Sample entry: F36 C2IP4: 206.54.0.50<Enter>
The response might be: OK<CR><LF>

This sets trusted IP address field 4 in community 2 to 206.54.0.50.

> To set the use trusted IP (UseIP) flag, send the following command:
> > F36 CxU: n<Enter>

where x is community number 1-5, and n is 0 for off or 1 for on.

Sample entry: F36 C5U: 0<Enter>
The response might be: OK<CR><LF>

This says that community 5 will not use trusted IP addresses.

> To set the trap enable flag, send the following command:
> > F36 CxT: n<Enter>

where n is 0 for off or 1 for on.

Sample entry: F36 C2T: 1<Enter>
The response might be: OK<CR><LF>

This sets the trap enable flag for community number 2 to on.

> To set the trap port, send the following command:
> > F36 CxTP: nnnnn<Enter>

where nnnnn is the trap port number.

Sample entry: F36 C1TP: 162<Enter>
The response might be: OK<CR><LF>

This sets the trap port for community number 1 to 162.

> To set the read/write access for a community, send the following command:
> > F36 CxA: n

where n is 0 for off (read only) or 1 for on (read/write).

Sample entry: F36 C3A: 0<Enter>
The response might be: OK<CR><LF>

This sets the access for community number 3 to read only.

E-4.3   SNMP Global Enable Traps

The SNMP variable snmpEnableAuthenTraps.0 can be changed via the serial port. This flag overrides the Trap Enable flag set for each community.

To read the state of this flag, send the following command:

F36 ST<Enter>

The NTS responds with:

F36 ST:n<CR><LF>

where n is 0 for off or 1 for on.

To set this variable, send the following command:

F36 ST:n<Enter>

where n is 0 for off or 1 for on.

E-5   TRUETIME SNMP ENTERPRISE MIB

E-5.1   Introduction

A Management Information Base (MIB) is a database of managed objects that have a hierarchical structure. There are common or vendor-specific managed objects. The internet community has over 1,000 objects registered. The objects themselves are representations of real physical network properties or information.

Using a TCP/IP network and TrueTime's SNMP Enterprise MIB, you can remotely obtain information on the health and status of the NTP application and the primary time synchronization source using the SNMP version 1 protocol. The Enterprise MIB database is divided into five variable groups and they are the Trap Message Group, the Network Time Protocol Group, the Network Time Server Control Group, the GPS Group, and the ACTS Group. Presently, the control group is preliminary and it is not implemented in the current version of software.

The trap message group holds the ASCII string data to send whenever an SNMP trap message is transmitted. The NTS agent sends SNMP trap messages to SNMP management hosts notifying them of some critical event at the NTS agent. The NTS issues three types of trap messages. The first type is a cold start trap message indicating when the box boots or reinitializes. The second type of trap message is issued when the NTS estimated time error has exceeded the minimum time accuracy threshold. The third trap message is issued when a packet received by the NTS agent fails SNMP authentication. The second feature notifies a network administrator immediately if the time server lost its ability to tell accurate time.

The NTP Enterprise Group furnishes information on the Network Time Protocol. This group provides packet information for the number of received, rejected, and transmitted NTP packets exchanged between the UDP transport and the NTP application layers. Packets are rejected when they are malformed or the MD5 encryption authentication failed. In addition, time quality can be assessed by looking at the current estimated time error and comparing it with the time accuracy threshold. Finally, all of the NTP control information transmitted by the NTS in an NTP packet is available in this enterprise group. One important variable in this group is ntpSysLeap because it is the clearest indication if the NTS is telling correct time.

When GPS is used as the time synchronization source, the GPS Enterprise MIB Group provides detailed information about the satellites used by the NTS time server. Compete GPS satellite information exists on the number of satellites tracked and used for timing purposes, their signal strengths, the tracking mode, altitude, longitude, and latitude of the GPS antenna. This information allows you to properly set up the GPS antenna and to use the unit for position information as well as time information.

When ACTS is used as the time synchronization source, the ACTS Enterprise MIB Group provides detailed information on the ACTS dial-up modem time service. Complete information on the number and success of the ACTS phone calls as well as a detailed break down of the various possible modem and line failures that can occur. This information allows you to fine tune calling frequency with the desired time accuracy and assess the telephone line quality of the connection to the ACTS service.

Obtaining the enterprise MIB information requires you to have an SNMP management program running on your computer. There are many SNMP programs available and they range from simple command line interfaces to complete GUI interfaces providing a visual map of the managers network. The command line SNMP is the most universal of these programs and it will be used for an example on how to obtain enterprise MIB data.

As an example, lets say you want to find the number of packets that the NTP application has sent down to UDP. The name of this variable is ntpOutPkts. Also, assume you have a simple SNMP command line management program. You would type in at the command prompt:

snmp -c public -h 206.54.0.21 get 1.3.6.1.4.1.1896.2.2.0

The management SNMP program responds with

enterprise.1896.2.2.0 = ######

In this response, ###### equals the number of packets.

Note: The *-c* command sets the community name and *-h* the address of the NTS SNMP agent. The doted number is the OID address of the enterprise MIB variable in question. The first numbers *1.3.6.1.4.1* are standard and they represent the generic SNMP enterprise MIB address and this is often symbolically substituted with the word *enterprise*. Next in the OID address is *1896*, TrueTime's assigned enterprise MIB address. Finally, in the OID address are the numbers *2.2.0* that stand for the NTP group, ntpOutPkts variable, and leaf variable type address, respectively.

As another example, you can obtain the altitude of the timeservers GPS antenna by reading the gpsAltitude variable. To do this, enter:

snmp -c public -h 206.54.0.21 get 1.3.6.1.4.1.1896.4.6.0.

Further, the IP address in this example is the TrueTime public time server and if you are connected to the Internet and your SNMP management software uses this syntax, then you will get a real response and you can compare this to your NTS.

E-5.2   Variable Definitions

This section contains a complete and formal definition of TrueTime's SNMP enterprise MIB group, including all the variables in TrueTime's Enterprise MIB, along with the MIB OID address and data types. The text is in machine readable form. In other words, it is an exact copy of the file that any SNMP management software compiles in order to learn TrueTime's enterprise MIB.

An electronic form of this file was included with this manual. If the disk has been misplaced or corrupted, a copy can be obtained from TrueTime's web site (www.truetime.com). Search under the network products section from the main page. The file's name is "TrueTime.MIB", and should compile for virtually any SNMP management software. It has been verified to work for Sun's Solaris X-SNMP and Hewlett Packard's OpenView management software packages.

TrueTime DEFINITIONS ::= BEGIN

IMPORTS

OBJECT-TYPE   FROM SNMPv2-SMI
Counter   FROM RFC1155-SMI
DisplayString   FROM SNMPv2-TC
TRAP-TYPE   FROM RFC-1215;

--iso   OBJECT IDENTIFIER ::= { 1 }
org   OBJECT IDENTIFIER ::= { iso 3 }
dod   OBJECT IDENTIFIER ::= { org 6 }
internet   OBJECT IDENTIFIER ::= { dod 1 }
private   OBJECT IDENTIFIER ::= { internet 4 }
enterprises   OBJECT IDENTIFIER ::= { private 1 }

trueTimeEnt   OBJECT IDENTIFIER ::= { enterprises 1896 }
trapMsg   OBJECT IDENTIFIER ::= { trueTimeEnt 1 }
ntp   OBJECT IDENTIFIER ::= { trueTimeEnt 2 }
NTSControl   OBJECT IDENTIFIER ::= { trueTimeEnt 3 }
gps   OBJECT IDENTIFIER ::= { trueTimeEnt 4 }
acts   OBJECT IDENTIFIER ::= { trueTimeEnt 5 }

trapMsgColdStart OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..255))
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is an ASCII string sent to UDP port 162 (or user defined) when the
TrueTime time server re-initializes. The message is Cold Start Trap PDU from: ###.###.###.###.
Where ###.###.###.### is the dotted decimal notation of the IP address of the booting unit. ::= {
trapMsg 1 }

trapMsgNtpAlarm OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..255))
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is an ASCII string sent to UDP port 162 (or user defined) when   the
TrueTime time server's Leap Indicator is set to 3 (that is, ntpSysLeap=3). This generally means
the time server has lost primary time synchronization. This could be due to a line breakage in the
timing source, loss of GPS satellites, etc. The message is 'NTP Alarm Trap PDU from:
###.###.###.###'. Where ###.###.###.### is the dotted decimal notation of the IP address of the
time server in the alarm state. See ntpSyncLeap and ntpSysLeap. ::= { trapMsg 2 }

trapMsgSnmpAuthFail OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..255))
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is an ASCII string sent to UDP port 162 (or user defined) when the
TrueTime time server determines the SNMP authentication for a SNMP PDU is in correct. The
message is 'SNMP Authentication Failure Trap PDU from: ###.###.###.###'. Where
###.###.###.### is the dotted decimal notation of the IP address of the unit attempting the invalid
access. ::= { trapMsg 3 }

ntpInPkts OBJECT-TYPE
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION: Total number of NTP packets delivered to the NTP application layer from the transport layer. ::= { ntp 1 }

ntpOutPkts OBJECT-TYPE
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION: Total number of NTP packets passed from the NTP application layer to the transport layer. ::= { ntp 2 }

ntpInErrors OBJECT-TYPE
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION: Total number of NTP packets reject for any reason by NTP application layer.
::= { ntp 3 }

ntpAuthFail OBJECT-TYPE
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION: Total number of authentication failures. This is a subset of ntpInErrors.
::= { ntp 4 }

ntpDesiredAcc OBJECT-TYPE
SYNTAX INTEGER (0..2147483647)
ACCESS read-only
STATUS mandatory
DESCRIPTION: The desired (worst case time) accuracy in microseconds that the time server will attempt to steer to. This variable is related to ntpEstError. Should ntpEstError be greater than ntpDesiredAcc, the NTP alarm condition will be set (ntpSysLeap will be equal to 3). Note: outgoing NTP packets will have their leap indicator field set to ntpSysLeap. ::= { ntp 5 }

ntpEstErr OBJECT-TYPE
SYNTAX INTEGER (0..+2147483647)
ACCESS read-only
STATUS mandatory
DESCRIPTION: The current estimated (time) error in microseconds of the time server. This variable is related to ntpEstError. Usually, this value is small and constant for a given type of time server. However, when primary synchronization is lost, this value will slowly increase with time as the time server's oscillator flywheels away from true time. Should ntpEstError be greater than ntpDesiredAcc, the NTP alarm   condition will be set (ntpSysLeap will be equal to 3). Note: a primary time server's outgoing NTP packets will have its leap indicator field set to tpSysLeap.
::= { ntp 6 }

ntpSysLeap OBJECT-TYPE
SYNTAX INTEGER
{NoLeapWarningAndTimeIsSynchronized   (0),
LastMinuteHas61SecondsAndTimeIsSynchronized   (1),
LastMinuteHas59SecondsAndTimeIsSynchronized   (2),
AlarmConditionAndLossOfTimeSynchronization   (3)}
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is a status code indicating normal operation, a leap second to be inserted in the last minute of the current day, a leap second to be deleted in the last second of the day or an alarm condition indicating the loss of timing synchronization. Note: a primary time server's outgoing NTP packet will have its leap indicator field set to ntpSysLeap. ::= { ntp 7 }

ntpSysHostMode OBJECT-TYPE
SYNTAX INTEGER
{HostModeIsReserved0   (0),
HostModeIsSymmetricActive   (1),
HostModeIsSymmetricPassive   (2),
HostModeIsClient   (3),
HostModeIsServer   (4),
HostModeIsBroadcast   (5),
HostModeIsReserved6   (6),
HostModeIsReserved7   (7)}
ACCESS read-only
STATUS mandatory
DESCRIPTION: The value of this variable indicates the mode that the host is operating in. Note: this is the value of the time server's outgoing NTP packet mode field. ::= { ntp 8 }

ntpSysStratum OBJECT-TYPE
SYNTAX INTEGER (1..255)
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is an integer that ranges from 1 to 255 indicating the stratum level of the local clock. Note: a primary time server sets outgoing NTP packets stratum field and ntpSysStratum to 1. ::= { ntp 9 }

ntpSysPoll OBJECT-TYPE
SYNTAX INTEGER (6..10)
ACCESS read-only
STATUS mandatory
DESCRIPTION: When the time server is in NTP broadcast mode, this is an integer indicating the maximum interval between successive NTP messages, in seconds to the nearest power of two. For example a value of 6 means 2^6 or 64 seconds. Note: a primary time server's outgoing NTP packet will have its poll field set to ntpSysPoll. Note: this field is equal to 0 when not in NTP broadcast mode. Note: unless this is a time server initiated NTP packet the value of the poll equals the value set in the in coming packet::= { ntp 10 }

ntpSysPrecision OBJECT-TYPE
SYNTAX INTEGER (-127..+127)
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is an integer indicating the ultimate precision of the synchronizing clock, in seconds to the nearest power of two. Note: a primary time server's outgoing NTP packet will have its precision field set to ntpSysPrecision. ::= { ntp 11 }

ntpSysRootDelay OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is a raw 32-bit number representing a signed fixed point 32-bit number indicating the total round-trip delay to the primary synchronization clock source in seconds with the fraction point between bits 15 and 16. Note that this variable can take on both positive and negative values, depending on clock precision and skew. Note: a primary time server's outgoing NTP packet will have its root delay field set to ntpSysRootDelay. ::= { ntp 12 }

ntpSysRootDisp OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is a raw 32-bit number representing a signed 32-bit fixed-point number indicating the maximum error relative to the primary reference source, in seconds with fraction point between bits 15 and 16. Only positive values greater than zero are possible. Note: a primary time server's outgoing NTP packet will have its root dispersion field set to ntpSysRootDisp. ::= { ntp 13 }

ntpSysRefClockIdent OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..4))
ACCESS read-only
STATUS mandatory
DESCRIPTION: This is a four byte ASCII string identifying the particular reference clock. In the case of stratum 0 (unspecified) or stratum 1 (primary reference), this is a four-octet, left-justified, zero-padded ASCII string. While not enumerated as part of the NTP specification, the following are suggested ASCII identifiers:

Stratum	Code	Meaning
0	DCN	DCN routing protocol
0	NIST	NIST public modem
0	TSP	TSP time protocol
0	DTS	Digital Time Service
1	ATOM	Atomic clock (calibrated)

Stratum	Code	Meaning
1	VLF	VLF radio (OMEGA, etc.)
1		Call sign Generic radio
1	LORC	LORAN-C radionavigation
1	GOES	GOES UHF environment satellite
1	GPS	GPS UHF satellite positioning
1	ACTS	ACTS telephone modem dial-up
1	IRIG	Inter-Range Instrumentation Group signal

Note: For TrueTime time servers only GPS, ACTS and IRIG are presently used. Further, a primary time server's outgoing NTP packet will have its reference identifier field set to ntpSysRefClockIdent. ::= { ntp 14 }

ntpControlInput OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..255))
ACCESS read-write
STATUS mandatory
DESCRIPTION: This variable emulates TrueTime's serial function command strings. The same commands issued to the serial port can be sent to this string. Use this variable for SNMP sets of functions strings. Note: setting this variable clears ntpControlOutput to the null string. See ntpControlOutput below. ::= { NTSControl 1 }

ntpControlOutput OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..255))
ACCESS read-only
STATUS mandatory
DESCRIPTION: This variable emulates TrueTime's serial function command strings. The same commands issued to the serial port can be sent to this string. This variable holds the output result string from the last setting of the above ntpControlInput variable. Use this variable for SNMP gets of function strings. See ntpControlInput above. ::= { NTSControl 2 }

gpsGroupValid OBJECT-TYPE
SYNTAX INTEGER
{GpsGroupIsInvalid   (0),
GpsGroupIsValid   (1)}
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: A test flag indicating if data contained in this SNMP GPS group is valid or not. This flag equals 1 when GPS is used as the time synchronization source and 0 for all other sources. ::= { gps 1 }

gpsNumTrackSats OBJECT-TYPE
SYNTAX INTEGER (0..8)
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: The number of GPS satellites tracked. ::= { gps 2 }

gpsNumCurrentSats OBJECT-TYPE
SYNTAX INTEGER (0..8)
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: Current number of GPS satellites used in position and time fix calculations. The number of satellites available depends on how long the time server has been up, the time of day and the total amount of clear sky as seen from the GPS antenna. Because of the high frequency of GPS radio signals, GPS antennas must have unobstructed line of sight from the antenna to the satellite to receive data. ::= { gps 3 }

gpsSatTrackMode OBJECT-TYPE
SYNTAX INTEGER
{AutomaticMode   (0),
TimeMode   (1),
SurveyStaticMode   (2),
SurveyDynamicMode   (3)}
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: Mode of operation for satellite tracking. See section 3.20 of the users manual for a complete description of these modes. Generally, modes 0 and 1 are used for time applications. Mode 2 is useful for more accurate position information when the unit is stationary, or slowly moving and mode 3 is for accurate position information when the unit is moving quickly. ::= { gps 4 }

gpsSatMaxSigStrength OBJECT-TYPE
SYNTAX INTEGER (0..30)
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: Strongest signal strength of all tracking satellites seen by the GPS receiver. Generally, this number should be 4 or greater for good reception. ::= { gps 5 }

gpsAltitude OBJECT-TYPE
SYNTAX INTEGER (-2147483647..+2147483647)
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: Altitude of the GPS antenna in centimeters above, or below the WGS-84
reference ellipsoid. The reference ellipsoid is a rotated ellipse that is centered on the Earth's
center of mass. The surface of the ellipsoid is not necessarily the same as sea level. The
ellipsoid surface may be as much as 100 meters different from actual sea level. ::= { gps 6 }

gpsLongitude OBJECT-TYPE
SYNTAX INTEGER (-2147483647..+2147483647)
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: Longitude location of GPS antenna where: +2147483647 is maximum east
longitude, -2147483647 is maximum west longitude and 0 is Greenwich England. To calculate
the longitude in radians use the following formula (gpsLongitude * PI) / ((2^31)-1) = longitude in
radians. For degrees: (gpsLongitude * 180) / ((2^31)-1) = longitude in degrees. Note: longitude
varies from -PI to +PI in radians and -180 to +180 in degrees. ::= { gps 7 }

gpsLatitude OBJECT-TYPE
SYNTAX INTEGER (-2147483647..+2147483647)
ACCESS read-only
STATUS mandatory -- for GPS capable units
DESCRIPTION: Latitude location of GPS antenna where: +2147483647 is the North Pole,
-2147483647 is the South Pole and 0 is the equator. To calculate the latitude in radians use the
following formula (gpsLatitude * PI) / (2*((2^31)-1)) = longitude in radians. For degrees:
(gpsLatitude * 90) / ((2^31)-1) = latitude in degrees. Note: latitude varies from -PI/2 to +PI/2 in
radians and -90 to +90 in degrees. ::= { gps 8 }

actsGroupValid OBJECT-TYPE
SYNTAX INTEGER
{ActsGroupIsInvalid   (0),
ActsGroupIsValid   (1)}
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: A test flag indicating if data contained in this SNMP ACTS group is valid or not.
This flag equals 1 when ACTS is used as the time synchronization source and 0 for all other
sources.   ::= { acts 1 }

actsBaudRate OBJECT-TYPE
SYNTAX INTEGER
{Baud300   (300),
Baud1200   (1200)}
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Indicates the baud rate setting for the ACTS modem. The ACTS dial-up service
accepts 300 or 1200 baud. Note: this is a rare case where faster is not better and 300 baud
yields the best time accuracy. ::= { acts 2 }

actsFailRedial OBJECT-TYPE
SYNTAX INTEGER (0..+9999)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: When the dial-up session fails to connect this is the time in seconds to wait to try
again. ::= { acts 3 }

actsMaxCallPeriod OBJECT-TYPE
SYNTAX INTEGER (0..+999)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: This is the maximum time in hours the ACTS unit will wait between successful calls to the ACTS service. ::= { acts 4 }

actsPhoneNum OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..25))
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: This is the phone number of the ACTS dial-up service, including any prefixes needed to reach an outside line or international dialing. Prefixes are separated by a comma from the main phone number. ::= { acts 5 }

actsNumberOfCalls OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Number of times the time server has called the ACTS dial-up service - whether the call was successful or not. ::= { acts 6 }

actsGoodCalls OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Number of times the time server called the ACTS dial-up service and successfully received the time. ::= { acts 7 }

actsBadCalls OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Number of times the time server called the ACTS dial-up service and something was not right. This variable is the sum total of all other ACTS failure types. ::= { acts 8 }

actsFailedInit OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Time server's internal modem failed to initialize. If this is excessive, it may indicate a time server hardware failure. ::= { acts 9 }

actsNoDialTone OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Time server's internal modem found no dial tone. This may be caused by a broken phone line to the time server. ::= { acts 10 }

actsNoCarrier OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Time server's internal modem found no carrier. No modem was found at the other end and maybe the phone number for ACTS is wrong. ::= { acts 11 }

actsBusyLine OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: Time server's internal modem found ACTS line busy. ::= { acts 12 }

a**ctsNoAnswer** OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: The remote ACTS mode did not answer the call. ::= { acts 13 }

actsBadReply OBJECT-TYPE
SYNTAX Counter (0..4294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: The syntax of the reply from remote modem was incorrect, possibly due to line noise. ::= { acts 14 }

actsNoOnTimeMark OBJECT-TYPE
SYNTAX Counter (0..294967295)
ACCESS read-only
STATUS mandatory -- for ACTS capable units
DESCRIPTION: The reply from remote modem had no on time mark, possibly due to line noise.
::= { acts 15 }

Appendix F

Non-Standard Features

This appendix contains information on optional features that may have been added to your device at the factory. For a standard device, it is normal for this appendix to be empty.

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