



NTS 01



NETWORK TIME SERVER User Manual

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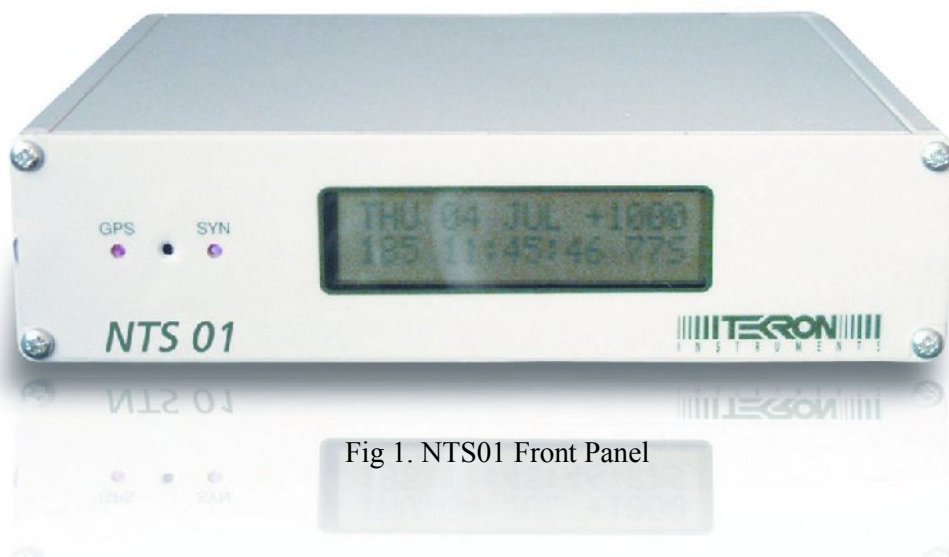
1 Introduction – NTS01 Features

NTS01 Network Time Servers provide precision time references for synchronising Ethernet networks. The NTS01 features multiple independently-addressed Time Server Ports each supporting NTP protocol. Up to five Time Server Ports can be accommodated in a single NTS01 1U Rack. Each NTS01 base unit has a built-in GPS-synchronised master clock which provides the source reference time used by all of the Time Server ports. It follows, therefore, in terms of Network Time Protocol (NTP) definitions, that the NTS01 Time Server Ports are Stratum 1 NTP sources.

The NTS01 product is ideally suited for use in industrial environments and can provide NTP server functions to multiple independent Ethernet networks. Each Time Server Port is independently configurable, and provides status reporting over Ethernet using SNMP.

Each NTS01 1U rack includes a sync status relay to allow integration with other station alarm monitoring functions via RTU. Each unit also includes an expansion facility (both input and output ports for IRIG-B code) enabling multiple racks of NTS01 units to all share a single GPS antenna. When connected in this way, the total number of NTP Stratum 1 Ethernet Time Server Ports that can be realised from a single GPS antenna is limited only by the rack-space available, with each successive 5-port unit occupying a further 1U space.

All NTS01 base units feature a front panel display, giving users visual feedback of time and date, with LED indicators providing “at a glance” status information.



The optimised Receiver / Antenna system employed in NTS01 derives time information from up to 12 GPS satellites simultaneously. The result is sub-millisecond timing precision on all Ethernet Time Server outputs, and sub-microsecond precision on the IRIG-B output.

It is supplied complete with all hardware and software required for installation, including rack-mount kit, connectors, 30m lead-in antenna cable, and antenna.

2 Installation

2.1 Packing list

Each NTS 01 kit is shipped with the following:

- NTS 01 Network Time Server unit (optionally with NTS01E or Multiport module)
- 19” Rack mounting Plate & fasteners
- User Manual (TEKRON NTS01) – this document
- Pipe Mount GPS Antenna (optimised for stationary applications)
- 30m of antenna lead-in cable (fitted with matching connectors)
- 2M USB cable for configuration via PC
- Configuration Software
- 2M UTP Ethernet drop-leads leads (one for each network port fitted)

2.2 Mounting

The NTS01 is designed to be mounted in a 19” rack, but may be used on a bench. The unit attaches to the supplied rack-mount front plate via the four screws shipped installed in the four corners of the front panel. If ordered with an expansion module, (either the NTS01E, or the Multiport) then the unit is supplied already fitted into the 19” rack-mounting front plate together with the expansion module.

2.3 GPS Antenna Mounting

Detailed antenna mounting instructions are contained in [Appendix A.2](#) p28. The antenna should be located in a position with as clear a view of the sky as possible, over as wide an angle as possible. *The antenna should also be mounted in a “lightning-protected zone” as far as is possible.* In practice, this means ensuring that there is at least one other earth-bonded structure located in the same rooftop area (e.g. another antenna, or a lightning rod) that reaches significantly higher than the top of the GPS antenna. The GPS Antenna should be mounted so that it lies within a 45-degree angle “skirt” from the top of the other earth-bonded structure. The GPS antenna mount itself should also be securely bonded directly to the building protection earth – and *not* connected via any of the other earthed structures.

A lightning protection kit is available for installation in the antenna lead-in cable for additional protection of the equipment. (See [section 7.4](#) p25 for details.)

 **All NTS 01 antenna installations should follow the guidelines above.**

3 Specifications & Connections

3.1 Plugs – Inputs & Outputs

All connections to the NTS01 are made via the rear panel.



Fig 2. Rear Panel – NTS 01 base unit

P1/P2 Power is applied to the unit via either or both of these plugs. Maximum power consumption is 6 watts. Despite the markings on P1 and P2, the polarity of the power connection is *not* important and the unit is fully isolated internally from the power source. Mating connectors are supplied with the unit, suitable for wiring sized up to 1.5mm². The provision of two power inputs allows the NTS01 to be used in environments operating with redundant power supplies. NTS01 has several power supply options covering the range of 12Vdc through 300Vdc/230Vac. All options include surge protection. (See [Section 7.2](#) p25 for full details on power supply options)

⚠ *Check the option label on the unit base for power supply voltage ratings!!*

Ant The antenna input, (SMA jack located above P1) provides an interface for an external active antenna via low-loss coaxial cable of 50Ω impedance. 3V DC is supplied (Imax=100mA) to power the high-gain active GPS antenna supplied with the NTS01 kit.

⚠ *Care should be taken to ensure that the connector is not cross-threaded when attaching the antenna lead-in cable.*

The total combined gain of the antenna system (antenna plus cable and connectors) should fall in the range of 10 to 35 dB, the optimum being 22dB. The antenna and 30M cable supplied with the kit provides a near-optimum combination, but if necessary, the lead-in cable can be reduced to 15m or extended to 60m using the same type of cable without the need for any additional amplification. For lead-in lengths longer than 60m, either amplification and/or larger diameter, lower loss cable can be supplied to order.

A Lightning Protection device may be inserted into the antenna lead. A suitable device complete with additional cable connectors, a connector crimping tool and mounting hardware is available as an option (see [section 7.4](#) p25). Introduction of the Lightning protector does not degrade the performance of the antenna system.

P3 Configuration input. This is a USB port. The configuration software supplied with the NTS01 runs on a Windows-based PC which connects to the NTS01 via this port. A matching USB cable is included with each NTS01 kit to facilitate configuration of the unit. See [Section 5](#) p14 for details of the configuration procedure.

P4 IRIG-B input port. This port is an RS422 receiver, and accepts an unmodulated IRIG-B time signal (B002/B003 + IEEE1344 extensions). If the NTS01 is configured appropriately, it can obtain synchronised time from this source rather than the internal GPS receiver, thus operating as a slaved device from another NTS 01 Master source. Connection of the incoming RS422 line (ideally a 120ohm impedance twisted pair) is to pins “+” and “-“ of the pluggable connector. Pin “T” provides a standard RS422 terminator load, and is activated by linking pins “T” and “-“ together in the mating connector. Maximum wire size in mating connector is 1mm².

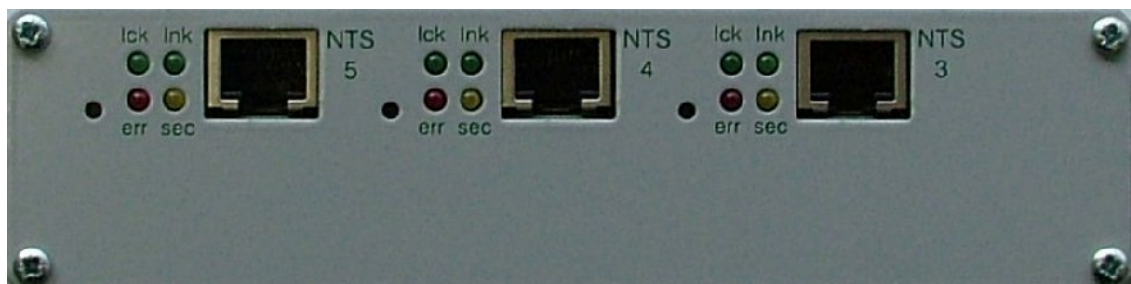
P5 IRIG-B output port. This port provides an unmodulated IRIG-B output signal in 5V RS422 format on pins “+” and “-“ of the pluggable connector. It can be used as the Master Source signal to drive the P4 input of one or more Slave NTS01 units. Pin “0V” provides an earth for the shield of a 120ohm impedance twisted pair data cable. Maximum wire size for mating connector is 1mm². The precision on the IRIG-B timing pulses (both leading and trailing edges) from this port is typically to within 100nS of UTC. Note that a TTL format signal (earth-referenced) can be obtained if required by connecting between “+” and “0V” instead of between “+” and “-“.

P6 Sync status relay contacts in Type “C” form. The contacts are capable of switching up to 2A at 230VAC or 1A at 280VDC. A mating connector is supplied which will accept wire size to 1mm². Minimum isolation of the relay contacts to earth or internal electronics is 2.5kV.

If the Time Server is not powered, or not operating in synch, then the “NC” and “C” pins are connected. If the Time Server is synchronised, (either via GPS or via the P4 input) the “NO” and “C” pins are connected. The sync relay can be configured to remain active (indicating “in synch”) for a period following the loss of satellite signals. The default period is one minute, but this can be altered up to a maximum period of 42:30 (2550 seconds).

NTS 1, NTS 2 These Time Server Port Ethernet interfaces each consist of an RJ45 standard connector, 4 status LED’s and a recessed reset button. Protocols supported independently on each interface are NTP, ARP, UDP, TCP, ICMP, Telnet, TFTP, DHCP, SNMP and BOOTP. See [section 4.4](#) p13 for further details.

NTS 3, NTS 4, NTS 5 These Time Server Port Ethernet interfaces are identical in form and function to NTS1 and NTS2 above. They are located on the NTS01E expansion option that fits in the same 1U rack as the NTS01 base unit. (See [Factory Options - 7.1](#) p25 and fig 3 below)



P11 Part of the Multiport option (See Fig 4 below), this output provides a fixed 1PPS TTL level output, rated to sink and source 75mA. The Multiport Option fits alongside the NTS01 base unit in the same 1U rack space. As the Multiport Option and the NTS01E Extension option occupy the same space, one or the other can be specified, but not both.

P12-P15 Part of the Multiport option (See Fig 4 below), these outputs feature IRIG-B code, and are individually switchable between unmodulated (B002) and AM Modulated (B120) forms of IRIG-B. In Unmodulated mode, each output will source and sink 20mA.

In AM mode, the output is 120ohm, 9v p-p.

When operating these outputs in AM mode, the signal lines must be correctly terminated at the distant end for reliable operation. A 150 ohm resistor should be connected across the line to form the termination.



Fig 4 Multiport Option (See [Section 7.5](#) pError! Bookmark not defined.)

The Multiport unit is an option on a number of different Tekron products. When installed as an option in an NTS01 rack, Plugs P9 and P10 on the Multiport unit have no function.

3.2 Dimensions

NTS01 module: Width: 160mm, Depth: 155mm, Height: 40mm , Weight: 0.8Kg.

NTS01E module: as above.

Rack mount: 19” face plate with cut-out for NTS01 display, 1U high.

Each NTS01 unit is normally supplied complete with antenna, antenna mount, antenna cable and 1U 19” rack-mount hardware. Shipping weight of the complete NTS01 kit is 4.8Kg. If the NTS01E extension unit is included, shipping weight is 5.6Kg, and the unit is shipped already assembled in the rack mount.

3.3 Identification

Each NTS01 unit is shipped with an identification label on the base. The label provides details of the particular options fitted to the unit, including the power supply specifications and the unit serial number.

4 Operation

Connect the antenna lead and the antenna (with a good view of the sky). Then connect the power source to **P1** and/or **P2**

☛ *Check the option label on the base for voltage requirements before switching on!*

The time needed to attain tracking and synchronisation (given a good “view” of the sky) will vary from just a few seconds to several hours in the worst case – such as reactivating a unit that was recently synchronised 1000’s of km away from the present position.

4.1 Time Display

The LCD display shows a copyright message, along with the serial number and revision level of the unit for approximately 10 seconds following power-up, (Fig.5 [a]). The display then automatically changes to the operating default, (Fig.5 [b]). The top line of screen [b] announces that the time standard is UTC (formerly known as GMT) and includes the current date. The day-of-year and time-of-day are displayed on the bottom line. The three-character field at the right of the bottom line is a status field. See [4.2](#) following for the definition of each character in this field.

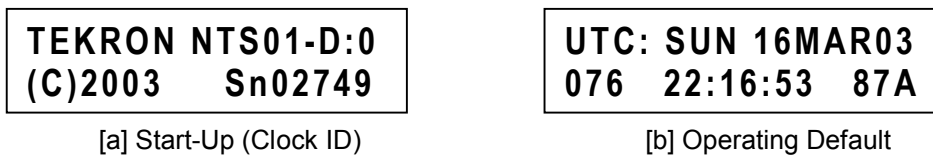


Fig 5a, b LCD display screens

Following the start-up period, Screens [a] and [b] can be accessed alternately by pushing the recessed pushbutton located on the front panel between the LED indicators.

☛ **The standard NTS01 does not offer local time either on its display or on the IRIG-B output port. Local time display (and IRIG-B output), complete with automatic daylight savings operation is available as a factory option, but the NTS outputs *always* use UTC time.**

If the NTS01 is equipped with the “Local Time Display” option, ([See 7.3](#) p25) then the following two displays are also available by pushing the recessed pushbutton located on the front panel between the LED indicators.

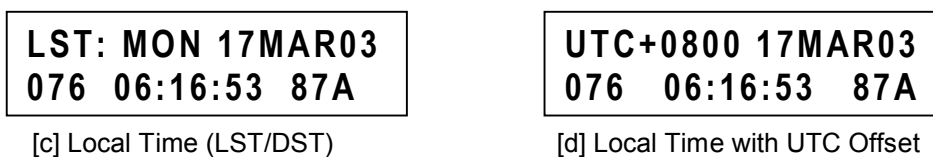


Fig 5c, d LST = Local Standard time, DST = Local Daylight Time

The NTS outputs *always* operate with UTC time.

4.2 GPS / Satellite Tracking Status

Display screens [fig 5](#): [b,c,d] all show a three-character status field at the bottom right-hand side of the display. (The examples shows values 8 7 A.) The three-character field provides visual feedback on the most important parameters affecting the operation of the internal GPS receiver. The meaning of each character is as follows:

1st character: (Hexadecimal¹ number: range of values is 0-D, or decimal value range 0-13)

This shows the total number of satellites that are possibly able to be “seen” at this physical location, based on the internal GPS receiver’s knowledge of the orbit parameters of each GPS satellite (the GPS “Almanac”). A value of zero means that NTS01’s GPS receiver has no stored almanac data. This condition can occur if the unit has been in storage for an extended period, or as a result of the embedded GPS receiver being reset. Under these circumstances, the NTS01 starts searching the sky randomly to find satellites, and the time required to obtain synchronisation can be much longer than usual – up to several hours in the worst case. As soon as a satellite is detected, the NTS01 begins updating its almanac record from data down-loaded from the satellite. This task typically takes about 20 minutes, after which the status digit changes to a non-zero value to show that the stored almanac is now valid. The display example in [fig5 b](#) indicates that 8 satellites are present in the hemisphere of sky overhead.

2nd character: (Hexadecimal¹ number: range of values is 0-C, or decimal range 0-12)

This shows the number of satellites currently being used to compute the time solution. “0” indicates that no updated time solution is available – the “out of lock” condition. If this condition persists for the “Sync Hold” time, (See [section 5.3](#) p15) the clock will go to “Warning State 2” described below. The display examples in [fig 5](#) show that the signals from 7 satellites are currently in use to form the time solution.

3rd character:

Possible values are:

- A** NTS01 in Acquisition mode - attempting to get satellite fixes
- G** Poor satellite geometry – can occur when multiple satellites are tracked, but are positioned in almost a straight line, degrading the ability of the unit to calculate accurate time. If the unit has achieved a 3-dimensional (see “3” below) fix at some point in the past, synchronisation will be maintained under this condition
- 2** A 2-dimensional position solution is in use. (No height calculation). If the unit has achieved a 3-dimensional (see “3” below) fix at some point in the past, synchronisation will be maintained under this condition.
- 3** A 3-dimensional position solution is in use, which includes a height calculation. 4 or more satellites are being tracked. This condition is *required* before the NTS01 first enters a synchronised state after switch on.
- ✖ The NTS01 unit is configured to operate in Slave mode, where a precision time signal is expected on the IRIG-B input P4. (RS422 signal IRIG-B with IEEE1344 extensions).

¹ A Number system with 16 characters instead of 10, with “A”-“F” having decimal values 10-15.

4.3 Front Panel LEDs:

The **GPS** LED shows the status of the internal GPS receiver, while the **SYN** LED shows the status of the time synchronisation to UTC reference time derived from the GPS satellites.

- **By default, all outputs (NTP and IRIG-B) become active within a few seconds of initial power-up even when the unit is not synced to GPS satellite time! Output time data is not precise until the unit is synced to the GPS satellites (or to incoming IRIG-B signal when operating in “Slave” mode).**

Warning Status Indications – (SYN LED not illuminated)

The sync relay is deactivated (“C” connected to NC”). The accuracy of the clock outputs is not guaranteed to be correct for syncing purposes! The **GPS** LED shows warning states as follows:-.

Warning Status 1: 

GPS LED flashing with a four-flash “burst” pattern, repeating each second: Either the antenna is not connected, or it is short or open-circuited. When the antenna is operating correctly, this sequence will not be seen. When the NTS01 is configured to operate in Slave mode (synchronising to IRIG-B input signal on P4) this flash pattern indicates that the IRIG-B signal is not present, or is unreadable.

Warning Status 2: 

GPS LED flashing with a two-flash “burst” pattern, repeating each second: The unit is searching the sky for satellites to begin the sync process. In Slave mode (synchronising to IRIG-B input signal on P4) this flash pattern indicates that the incoming signal has been recognised, but that the unit has not yet synchronised to it. In practice, the NTS01 slave sync algorithm is extremely rapid, so that this status signal will rarely be seen when operating in Slave mode.

OK Status indications – (SYN LED is illuminated continuously)



The **GPS** LED flashes with a single flash each second, with the “ON” period much longer than the “OFF” period. The sync relay output is activated, giving both visual and electrical indications that the system is operating normally. All of the output time data is then accurate and usable for sync purposes.

The Time Server first shows this status after obtaining satellite sync (with 4 or more satellites being tracked) and maintains this status indefinitely for as long as at least one satellite is being tracked successfully. (The 2nd status character on the LCD display shows the number of satellites actually being tracked at any given time.) In Slave mode (synchronising to IRIG-B input signal on P4) this flash pattern indicates that the unit is synced to the IRIG-B signal, and that all outputs are operating correctly.

4.4 Time Server Ports: NTS1-NTS5

General

The following section applies to each Time Server Port equipped on the NTS01. Each Time-server Port has its own IP address and operates independently of any other port. Operation is completely automatic once the port is correctly configured for the network. Section 5 gives details on configuring Time Server Ports using the supplied Configuration utility, while Section 6 covers methods of configuring the Time Server Ports via Ethernet using Telnet. Telnet access is controlled by password, but can be inhibited completely if more stringent security is required.

Individual Time-server Port configuration info is retained indefinitely when the NTS01 is not powered (as is all other NTS01 configuration data). Each Time-Server Port responds to time requests from multiple clients using either SNTP or NTP protocol. If the appropriate option is configured for a particular port, then the server will also broadcast time messages on a regular basis. The most common protocol in use is SNTP.

SNTP Client Software

Correct operation of a Network Time Server Port can be verified by installing an SNTP client on any Windows-based PC attached to the network. Windows XP contains an NTP client as part of the operating system. Alternatively, and for earlier Windows Versions, a very simple and effective client, “Dimension 4” is included with the NTS01 package (3 licenses are provided. Additional licenses may be purchased from Thinking Man Software www.thinkman.com)

After installing “Dimension 4” on the PC to be synched, add the IP address of the Time Server Port to “Dimension 4”’s list of Time Servers, and select it. “Dimension 4” will then use this address to fetch time information and sync the PC’s internal clock. “Dimension 4” installs complete with a large list of internet time server addresses. To avoid any confusion, it is suggested that the user remove all of these pre-installed addresses, leaving only the local Time Server Port IP address(es) in the list.

Time Server Port LED Indications

Along with an RJ45 Connector, each Time Server Port features a group of four LED indicators.

The green **lnk** LED indicator lights steadily when a network cable (UTP drop lead) is correctly connected between the RJ45 Connector and the local network hub/switch.

The other green LED, the **lck** indicator, lights up steadily when the NTS Port is correctly synchronised with UTC time. Provided that NTS01’s front panel **SYN** Led is on, then the **lck** indicator should stabilise and remain on. If the **lck** indicator does *not* stabilise “on”, even though the NTS01 is synchronised, then the most likely problem is that the “[Visible Satellites](#)” parameter for the Time Server Port (see p.20) is set at too high a value.

The two lower LED indicators **err** and **sec** may flash for up to 30 seconds immediately following power-on. They also flash while the Time Server Port is being accessed by the configuration utility software. At all other times, the **err** and **sec** LED indicators remain off.

5 NTS01 Configuration Software

5.1 General

A proprietary software configuration program ships with all NTS01 units. It provides the user access to all of NTS01's programmable system operating parameters. If preferred, parameter set-up can be carried out ex factory to customer specification. In addition to the descriptions below, the various configurable parameters are also described within the program's on-line help. Clicking on the “?” icon in the top RH corner of any window activates the help cursor. Moving the help-cursor over an option and clicking activates on-line help for that parameter. The on-line help can also be activated by pressing **F1** while holding the mouse over a parameter.

5.2 Installation

The configuration utility requires a Windows PC (2000, NT and XP are supported) with a USB port available. The program has the required USB drivers built-in. Installation procedure is as follows:

- a) Create directory (e.g. C:\Tekron) and copy the files “NTS.exe” and “NTS.hlp” to it.
- b) Optionally, create a shortcut to “NTS.exe” and place the shortcut where convenient.
- c) Connect the NTS01 unit using the supplied USB cable. (NTS01 must be powered)
- d) Run the configuration utility by clicking on NTS.exe (or the shortcut)

When an NTS01 unit is first connected via a USB port, Windows will identify the NTS01 as new hardware. Provided that the program is installed as indicated above, Windows will, automatically make the NTS01 hardware ready for use. However, because the Tekron Software has not been registered with Microsoft, Windows will open warning screens during the installation process. This may occur several times. Each time this happens, please choose to “continue anyway.”

The configuration utility can be run without an NTS01 connected for training purposes.

On starting, the utility opens on the “Clock Setup” screen. At the base of this window, a bar shows that a port scanning process is taking place to “discover” any NTS01 connected via a USB port. When an NTS01 is found, the screen updates to show the current parameter values, together with a live time display. If the scan reports that no NTS01 is present, check the cable connections and try the operation again by pressing the “Refresh Data” button in the lower left hand part of the screen.

The configuration utility has several pages of data, accessed via click-tabs at the top of the screen.

5.3 Clock Setup Page

This tab contains General Options and parameters relating to time format. (See [fig 6](#))

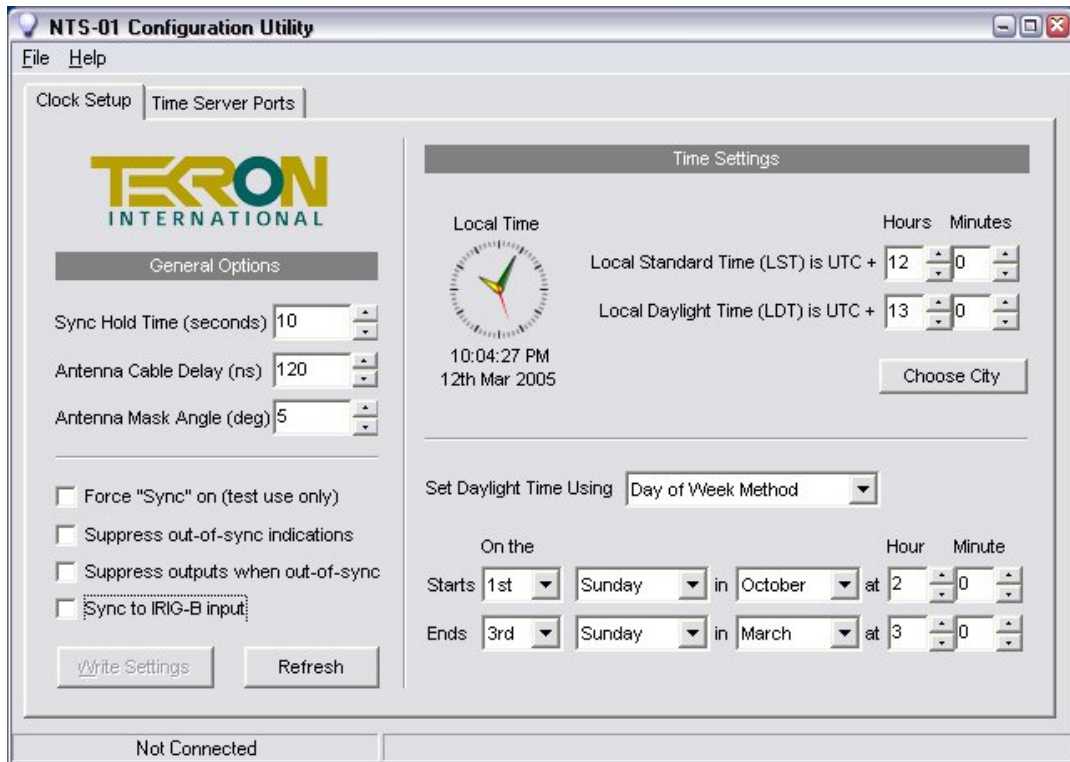


Fig 6. Config. Utility: Clock Setup Page

General Options

Sync Hold Time

The time with no satellites visible (or – in the case of syncing via IRIG-B input – the time with no signal) that will pass before the NTS01 releases the “sync” relay, and indicates loss of sync. In areas with poor GPS coverage there may be rare times when no satellites can be tracked. The Sync Hold feature allows the NTS01 to maintain its outputs under these conditions. Accuracy is maintained to within a few micro-seconds for black-out periods of around a minute, and to within 200uS for periods up to the maximum settable time of 42.5 minutes.



In typical Network Time Synchronisation situations using NTP, time syncing to better than 0.5mS is not practical due to network constraints, so setting the Sync Hold number to the maximum tolerance (representing 42.5 minutes) would be quite in order, as even in this worst case, NTS01 performance is more than adequate.

Antenna Cable Delay Compensation

Measured in nanoseconds. All antenna systems introduce delay due to the characteristics of the antenna cable. NTS01 compensates for this delay to optimise the precision of the output signals. The standard 30m cable supplied with NTS01 introduces 120nS of delay, so for this cable, the Antenna cable delay is set as “120”. In most practical situations, external factors such as network topology will have much greater effect on the precision of overall system synchronisation, so that precise setting of this parameter becomes irrelevant. When the NTS01 is operating in Slave mode (synced to incoming IRIG-B on P4), this parameter has no meaning, and is shown greyed out.

Mask Angle

The elevation above the horizon below which specific satellite signals will not be used in time and position calculations. Factory default value is 5 degrees. Range: 0-90.degrees.

Where the antenna view of the sky is severely restricted, in rare circumstances, altering this value may give some fine improvement in stability of the time signal. Increasing the angle reduces the likelihood of errors being introduced by multi-path signals from low elevation satellites (typically caused by reflections off land-based obstacles), but narrows the overall field of view. When the NTS01 is operating in Slave mode (synced to incoming IRIG-B on P4), this parameter has no meaning, and is shown greyed out.

Test Mode

Test Mode forces NTS01 to provide all outputs as if it is in sync at all times, even if there is no antenna attached, or no sync source on P4. The sync relay will be on at all times, regardless of the true sync state. During test mode the NTS01 display will flash a warning.



This mode should NOT be used during normal operation.

Suppress Out of Sync Indications

A similar mode to “Test” mode, but if this option is selected, the Sync Relay will still indicate the true sync state of the NTS01 unit. All other outputs will operate as if the unit is synchronised at all times.

Suppress Outputs When Out of Sync

The Network Time Server Ports (NTS) and the code output on P5 are normally active at all times, even when the NTS01 unit is not synchronised. Selecting this option will cause all of the outputs to be suppressed. NTP clients polling the Time Servers will still receive responses, but the responses will contain null time stamps, and the “sync” status flag in the responses will not be asserted.

Sync to IRIG-B Input

If an IRIG-B signal (with IEEE1344 extensions active) is input on P4, (RS422 signalling protocol required!) then the NTS01 will synchronise to it if this option is selected. The usual source of such a signal would be from the P5 output of another NTS01 unit.

Time Settings

Time Display

When an NTS01 is connected, this clock-face will be active, and is a preview of the current time as kept by the NTS01. The standard NTS01 unit operates in UTC time exclusively. In these units, the clock-face on this page shows UTC time, while in units with “Local Time Functions” firmware option, the clock-face shows Local Time.

The local Time Settings described below will all be shown “greyed out” unless the NTS01 unit has the “Local Time Functions” firmware option installed. (See [Section 7.3](#) p25)

Local Standard Time (LST) is UTC +

Local Daylight Time (LDT) is UTC +

The time offsets settable here define the number of hours (and, in rare cases, minutes) that the local time differs from UTC time. A positive offset means that the local time is *ahead* of UTC. *If automatic Daylight Saving Time operation is not required, both of the offsets should be set to the same value.* The time that results is the time that is used in the LCD display

Choose City

The “Choose City” button provides a convenient way of selecting time offset and daylight savings parameters using a the host PC's time-zone database.

Set Daylight Time Using

This allows configuration of Automatic Daylight savings time changes based either on a fixed date, or a fixed rule for calculating a date that will differ from year to year. Accurate information specifying the date and time that daylight savings “Starts” and “Ends” are required for correct observance.



In the absence of specific instructions at the time of order of NTS01's with the “Local Time Functions” firmware option, then the factory default settings for UTC offsets and Daylight Savings Calculations will match the published time conventions of the shipping destination

5.4 Time Servers Page

General

On entry into the “Time Servers” page via the program tab, the utility displays a summary of the IP address information for each of NTS01’s Time Server Ports (NTSs), together with the Firmware Version installed and the MAC Address of the Port’s Ethernet Interface. Five panels are shown – one for each of the five NTS’s supported by the NTS01. (NTS’s 3-5 are found on the NTS01E expansion unit). The current Network Addressing information for each NTS is shown together with the installed firmware version and date. Non-equipped NTS panels are labelled accordingly.

- It is beyond the scope of this document to discuss TCP/IP addressing concepts in detail. The configuration information that follows assumes that the reader has a working knowledge of TCP/IP, IP addressing, and associated protocols and utilities such as DHCP (Server and Client)

Configuration of the Time Server Ports involves setting each NTS’s basic TCP/IP networking parameters (IP Address, NetMask and Gateway IP Address) along with a set of parameters that customise the Time Server function for each port.

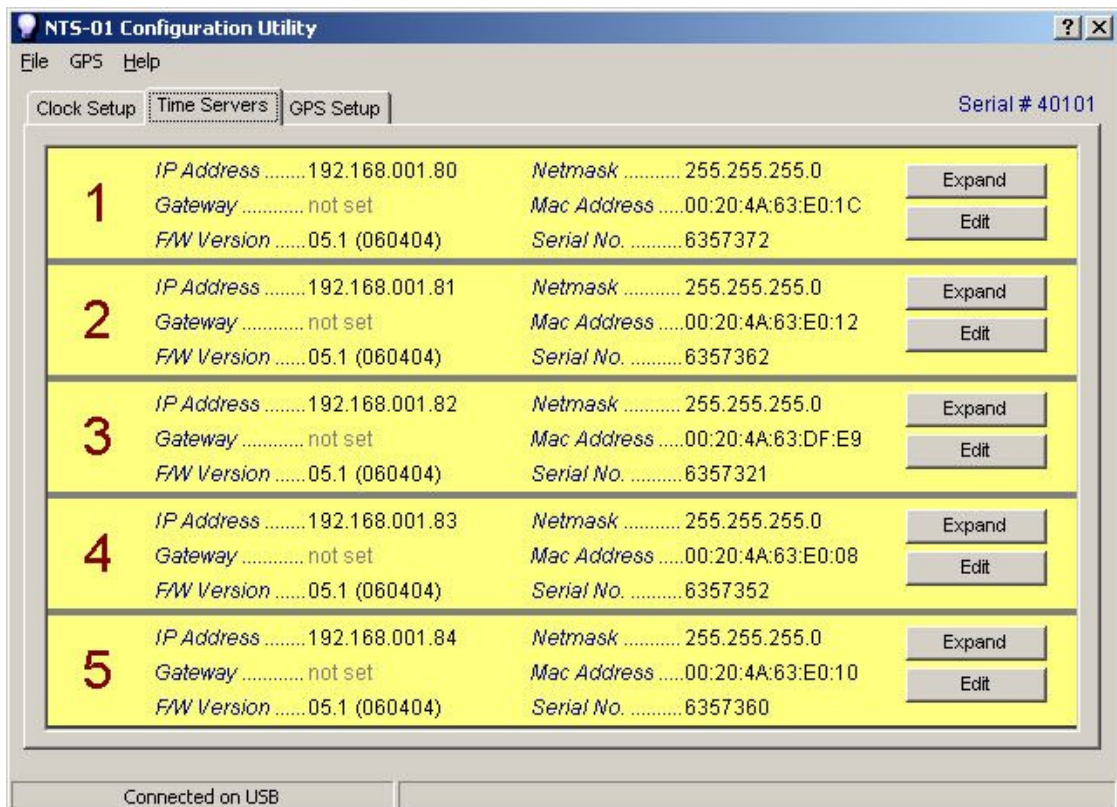


Fig 7 Configuration Utility – Time Servers Screen

Each NTS Panel has two action buttons on the right-hand side. Clicking on the “Expand” button expands the associated panel to show all of the current parameter settings for that port. Clicking on the “Edit” button opens the Setup screen for that NTS.

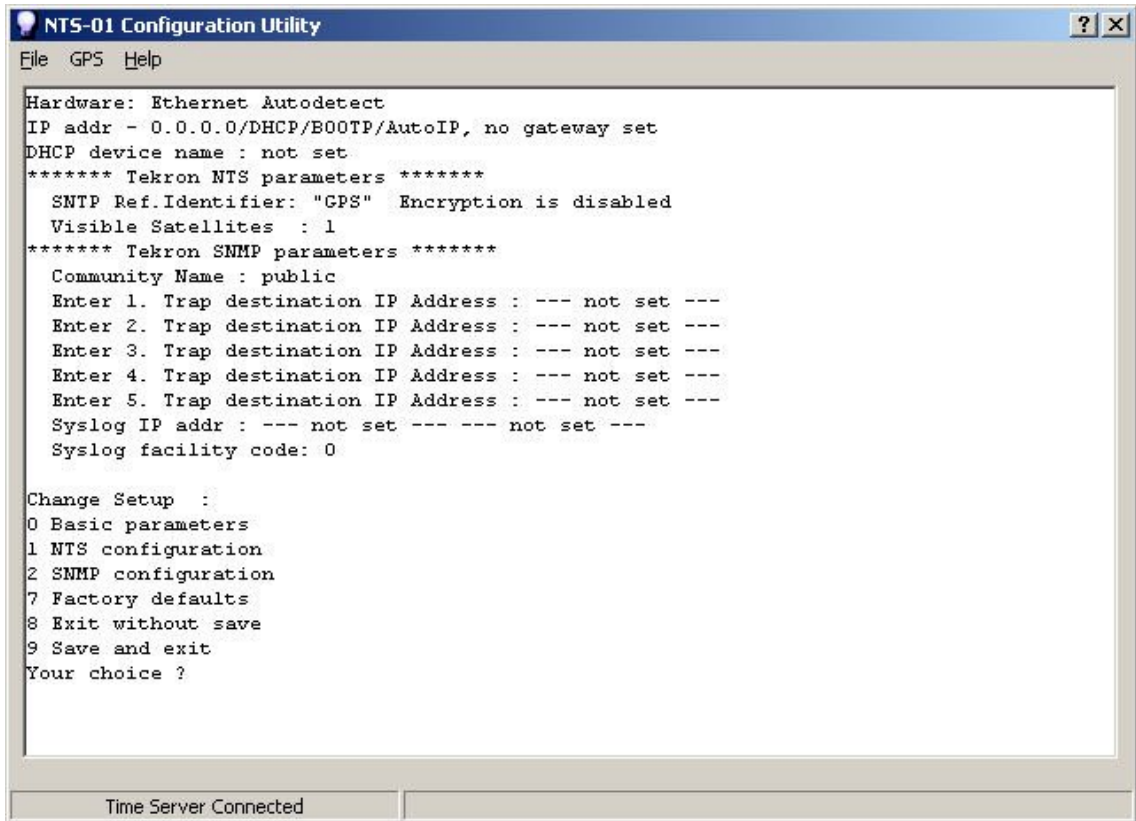


Fig 8: NTS Edit Mode - Main Menu

The NTS Edit Mode menu displays the current configuration summary followed by a list menu and a User Prompt, as shown in Fig .

0 - Basic Parameters

This option allows permanent values to be assigned to the basic address parameters of the NTS. The parameters that can be edited under this menu are described below

IP Address: The IP address is set by keying four 3-digit values representing the 4 octets of the IP address. Range of each value is 0-254. If the IP address is set to 0 in all four octets (the factory default) then the NTS will automatically operate in DHCP/BOOTP/AutoIP mode. In this mode the NTS will search the network for a DHCP Server so that it can obtain an IP address automatically. Tekron recommends that the user sets a specific IP address for each NTS rather than allowing automatic address allocation via DHCP. The address should match the network address definition (usually the first 3 octets) with the unique address of the NTS occupying the last octet.

Gateway IP Address: If the Time Server is required to operate over more than one Ethernet sub-net, then a Gateway IP Address must be specified. The Gateway Address is the IP Address of the network router or bridging device that connects the subnets together. When using DHCP, the network's DHCP Server will automatically provide the Gateway Address if required.

Netmask: The Netmask tells the Time Server the number of bits (counting back from the end of the IP address) that are allocated for addressing individual host devices on the network. As the NTS01 is normally used on small closed networks, the default value is 8, meaning that the last octet of the IP address is used to address individual hosts. When using DHCP, the DHCP Server automatically provides the correct Netmask.

Telnet Access Password: A four-character password may be set to hinder unauthorised access to the Time Server Port's Setup screen over the network. Default is no password.

- **The simple password provides only basic security. If absolute security is required, Telnet Access should be disabled. Access is disabled if the password is set to ****.**

Change DHCP Device Name: This option only appears if DHCP operation has been selected (by setting the IP address value to all 000). The default DHCP host name for an NTS01 Time Server Port is Cxxxxxx where xxxxxx denotes the first six digits of the NTS's MAC address. For example, a NTS with MAC address:- 00:20:4A:72:DB:2B will appear on DHCP Server lease listings as host: C72DB2B.

- **Tekron strongly recommends that, if DHCP addressing is to be used, then the NTS Name should NOT be changed from the default.**

1 - NTS configuration

Selecting this option brings up prompts to set up the parameters required to operate the Time Server function. For most applications, the default settings will be appropriate. The parameters that can be set are as follows:-

Broadcast Mode: Defaults to "N". If "Y" is selected, the unit prompts for a poll interval. The unit will then broadcast time packets at the interval specified. Note that, while in broadcast mode, the unit will still respond to NTP/SNTP client requests in the usual manner. In most applications, Broadcast Mode is not used, so the default is the appropriate setting.

Encryption: Defaults to "N". Most users will not use encryption. The NTS01 supports fully encrypted requests from up to 6 clients simultaneously on each Time Server Port. If the answer "Y" is selected here, the unit then prompts for six encryption MAC strings. A good rule is – if you do not already know what MAC data to use – don't attempt to use encryption at all, and leave the option at "N".

Visible Satellites: Defaults to "1". Range 0-8. If there are not this many GPS satellites being tracked for time, a SNMP message "low satellites" is generated. As the NTS01's clock accuracy when tracking just a single satellite is at least two orders of magnitude better than what can be practically handled on the network, the default value of "1" is sufficient for detection of this condition.

2 - SNMP configuration

The NTS01 Network Time Server Ports each provide status monitoring to Network Management systems through the use of SNMP trap messages. The parameters that can be set for each port are as follows:-

Community: The default value is “public”. This may be changed to suit the specific SNMP architecture on the network if required. If SNMP is not implemented for other purposes on the network, then the “public” setting allows the use of a simple SNMP trap display utility running on a remote monitoring PC to display the status messages sent from the Time Server.

SNMP Trap IP Address: This parameter allows for up to five destination IP addresses to be entered. Machines on any or all of these IP addresses can then receive the status messages from the NTS. Even if there is no formal SNMP system running on the network, the messages can be received and displayed on the destination machines running “Windows NT” or higher using the freeware utility “SNMPTRAP.EXE” which is on the CD supplied with the kit.

Syslog IP Addr: One or two IP addresses may be entered to define destination machines running system logs. These parameters are really only useful in networks running full SNMP network management systems. Similarly, the following **Syslog facility code** parameter is only useful on full SNMP network systems.

7 - Factory Defaults

This option initialises critical Time Server Port memory areas, resets all SNMP parameters to null and sets the “Visible Satellites” parameter to “1”. All other parameters, including the Telnet password are not changed.

The Time Server Port Edit process may be terminated either by option

8 - Exit without save


or

9 - Save and exit.

The Time Server Port will then reset and begin normal operation

5.5 GPS Set-Up Page

The GPS Set-Up Page shows the current status of the GPS receiver in NTS01. It is also possible to alter some of the GPS receiver's operating parameters from this page.

- 
 The GPS receiver operation in NTS01 is automatic, so that there is no need to change any of these parameters under normal circumstances. In practice, if the GPS receiver is tracking satellites and the time is synchronised to satellite time, then receiver will ignore attempts to change position or time parameters. It will also ignore changes if it has not been powered down since it was last synced to satellite time.

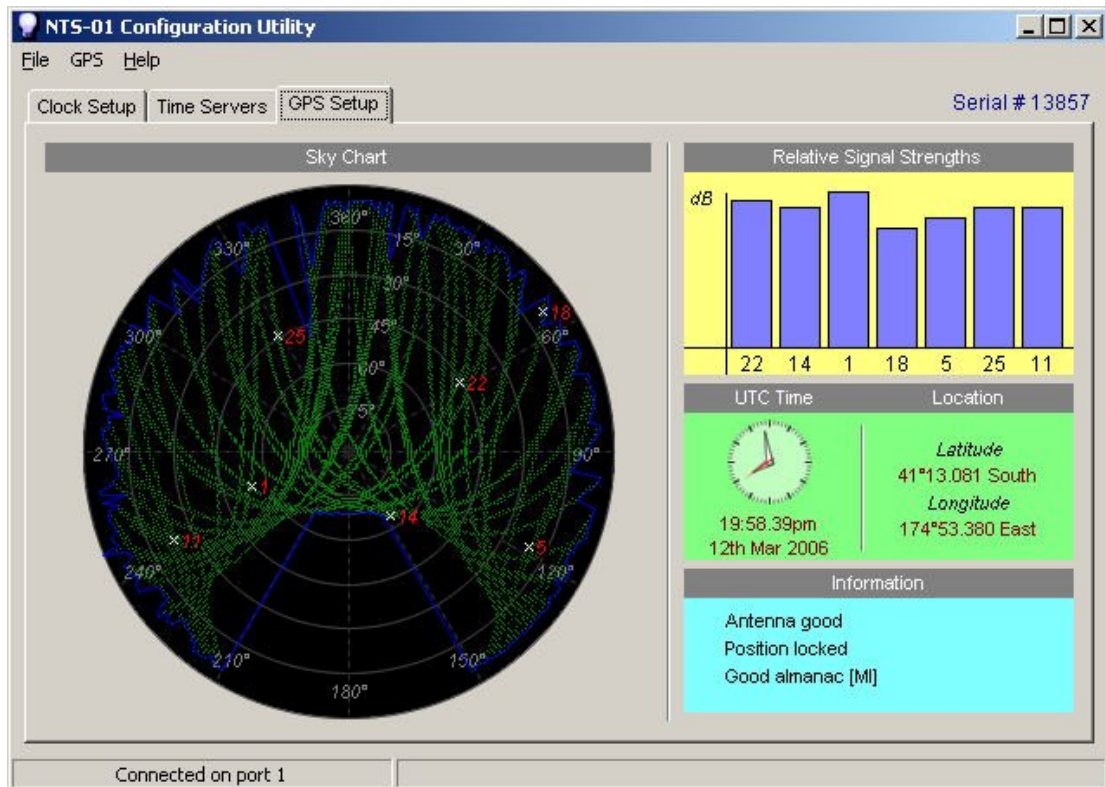


Fig 9 GPS Setup Page with trails and minimum elevations turned on

Sky Chart

Visible satellites are shown on a Sky Chart (see fig above) where the rings are 'elevation' markers and the sectors mark 'azimuth'. The centre of the display, where the azimuth lines converge, represents the sky directly overhead of the antenna. The elevation above the horizon is 90° at this point. The outer edge of the display, or elevation of 0°, represents the horizon. The 'azimuth' is a compass bearing where 0° represents True North, 90° is East. Satellites are represented by x's. Satellites that are in use by NTS01 for calculating time have red ID numbers.

Satellite Trails (green lines), and a Minimum Elevation plot (blue lines) can be turned on and off from the “GPS” menu option on this page. Over time, the blue line will show the horizon line, as well as areas where there is poor GPS constellation coverage. The example in fig is from Wellington, New Zealand and clearly shows that there is poor satellite coverage in southern latitudes.

- It is important, when operating NTS01 in extreme southern latitudes, to ensure that the antenna is positioned with a clear view of the sky to the north if reliable performance is to be guaranteed. The opposite situation occurs when operating in extreme northern latitudes, where a clear view of the sky to the south is desirable.

Satellite Signal Strength Indicator

The received signal strength of satellites being used for time calculations are shown here. The white numbers are a cross reference to the satellite number on the Visible Satellites display.

Location and UTC Time

This panel shows the current position and UTC time data held in NTS01’s GPS receiver. Once the Receiver has successfully tracked satellites and computed time and position, these parameters can no longer be changed externally. However, it IS possible to set time and position if the Receiver has not achieved a satellite fix since power on, or if the Receiver has had all existing data cleared before attempting to set time and position. The Menu Selection “GPS/Advanced” gives the user access to these functions. Note that if the advanced GPS menu option “Clear Location Time and Almanac” is used, then the GPS Receiver may take some time (up to half an hour or more) to recover unless the user is able to assist by entering a known position and an approximate time.

- The “Clear Location Time and Almanac” option in NTS01 should **ONLY** be executed by experienced technical personnel under controlled circumstances, such as to facilitate laboratory testing of external equipment as described below.

The ability to force any time and date into the instrument means that NTS01 can be used as a convenient signal source for testing the ability of externally attached equipment to correctly process received time messages through particularly critical time transitions, (such as the 28/29 Feb rollover during leap years). In units fitted with the Local Time Display Firmware Option, It also allows the correct operation over daylight savings transitions to be conveniently checked, by setting the time to just a short period prior to the expected transition time then waiting for the transition to tick by.

6 Time Server Port (NTS) Configuration over Ethernet

The recommended method of configuring the Time Server Ports of NTS01 is by using the supplied configuration software running on a PC connected to the NTS01 unit via the supplied USB cable. However, provided that the NTS IP address is already configured and known, and **provided that Telnet access is enabled for that NTS** then the NTS can be fully configured using a Telnet Session to TCP port 9999 on the known IP address. The menu presented in the Telnet session is identical to that described in Section 5.4. If the NTS IP address is *not* configured, an IP Address must be assigned to the NTS before any network access is possible. There are two ways to assign an IP address to an NTS.

a) DHCP addressing:

An NTS01 NTS will automatically operate within a DHCP environment to fetch a dynamic address if it does not already have a fixed address configured. Most DHCP Servers also provide facilities to pre-allocate specific IP addresses to named host devices. As Each NTS01 NTS has a unique DHCP name defined by the last 6 digits of it's MAC address, this facility can be used to give the NTS a specific address rather than just the next address available from the DHCP Server's list.

The default DHCP name for an NTS01 NTS is Cxxxxxx where xxxxxx denotes the first six digits of the Port's MAC address. For example, an NTS with Ethernet MAC address:- 00:20:4A:72:DB:2B will appear on DHCP Server lease listings as device: C72DB2B.

b) ARP addressing:

The ARP method is available under UNIX and Windows systems and can be used when there is no DHCP server. . An NTS will set its address from the first directed TCP/IP packet it receives.

On a Unix host, create an entry in the host's ARP table using the intended IP address and the hardware MAC address of the NTS. The UNIX command (for example addresses IP: 192.168.1.56 and MAC: 00-20-4A-72-08-B7) is:

```
arp -s 192.168.1.56 00:20:4A:72:08:B7
```


In order for the ARP command to work correctly in Windows, the ARP table on the PC must have at least IP address defined other than its own. If the command **ARP -A** typed from the DOS prompt results in only the local IP address being shown, then "ping" any other known IP address on the network to establish a non-local entry. Once another entry is established, use the same command as above to ARP an IP address to the NTS.

Next, open a Telnet connection to TCP port 1 on the NTS with command:-

```
telnet 192.168.1.56 1
```

This Telnet connection will quickly fail (3 seconds) but the NTS will change its IP address to the one specified. Finally, open a new Telnet connection to port 9999 with command:

```
telnet 192.168.1.56 9999
```

 The IP address set above will revert to the default null address if the NTS is powered down or reset unless the full Set-Up procedure is completed and all of the changes stored permanently using option 9 on the Set-Up menu.

7 Factory Hardware / Firmware Options

7.1 Opt. 1 – NTS01E Extension unit.

This unit (where fitted) provides up to three further Network Time Server Ethernet ports, (NTS3, NTS4 and NTS5) each with the same function and feature set as ports NTS1 and NTS2. If this option is specified, the Multiport option (Opt 5) can *not* be included.

7.2 Opt. 2L, Opt. 2M, Opt. 2H - Power Supply Options

There are three different power supply configurations that may be ordered with TCG 01.

- a) Order **Opt.2L Nominal 24Vdc**
This supply operates with DC input in the range 12 –36Vdc,
or with AC input in the range 16-24Vac
- b) Order **Opt.2M Nominal 48Vdc**
This supply operates with DC input in the range 20-72Vdc,
or with AC input in the range 24-48Vac
- c) Order **Opt .2H Nominal 110/250Vdc**
This supply operates with DC input in the range 90-350Vdc,
or with AC input in the range 80-240Vac

7.3 Opt. 3 - Local Time Display / Output

This factory firmware option provides for display of local time on the front panel of NTS01 and also allows local time to be output on the P5 (IRIG-B) output for use in synchronising other vendors' equipment if required. See NTS01 configuration – Section .. for details on setting the local time and daylight savings parameters. Note: Other NTS01 units configured for Slave operation that use the P5 signal for synching purposes, will *always* correctly interpret this signal, regardless of the local time setting.

7.4 Opt. 4 - Lightning Protection Kit

A lightning Protection kit is available for fitting into the antenna lead-in cable. The kit contains a protection device, two coaxial cable connectors, a connector crimp tool, and mounting hardware for the protection device. Full instructions relating to the installation and maintenance of the lightning protector are included with the kit, together with some guidelines as to best positioning of the antenna and protector unit to minimize the possibility of lightning-induced damage to the TCG 01 base unit.

8 Certification & Testing

Tekron products are CE certified and comply with the following international standards:

- **IEC 61000-4-2:1995** Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques
Section 2: Electromagnetic discharge immunity test
- **IEC 61000-4-3:2002** Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques
Section 3: Radiated, radio frequency, electromagnetic field immunity test
- **IEC 61000-4-4:1995** Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques
Section 4: Electrical fast transient burst immunity test.
- **IEC 61000-4-5:1995** Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques
Section 5: Surge immunity test.
- **IEC 61000-4-6:2003** Electromagnetic Compatibility (EMC) Part 4: Testing and measurement techniques
Section 6: Immunity to conducted disturbances, induced by radio frequency fields.
- **IEC 61010-1:2001** Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1 General Requirements.
- **IEC 61326:2002** Electrical equipment for measurement, control and laboratory use - EMC requirements.
- **CISPR 22:2003** Information technology equipment - Radio disturbance characteristics - limits and methods of measurement.
- **FCC 47 Part 15:2002** RF emission requirements of the Federal Communications Commission

Appendix A – Antenna Details

A.1 Antenna Cable Specification

The NTS01 unit's standard shipping configuration includes 30 metres of cable factory-fitted with an SMA male connector at one end to mate with the connector on the NTS01 rear panel. This connector is only fractionally larger in diameter than the cable itself. This facilitates installation in conduit and through small apertures. The other end of the cable is fitted with a connector to match the antenna supplied with the unit.

The supplied cable has the following characteristics:

Centre conductor:	1.42mm diameter Solid bare copper
Dielectric:	3.81mm diameter Low loss, closed polyethylene foam (Cellular PE)
Shield:	3.94mm diameter Aluminium Laminated Tape bonded to the Dielectric, with a Tinned Copper Overbraid – 4.52mm diameter
Jacket:	6.10mm Black Polyethylene
Bending Radius:	40mm (maintaining less than 1 ohm impedance change at bend).
Weight:	0.051 kg/metre
Temperature Range:	-40°C to +85°C
Impedance:	50 ohms
Velocity:	84%
Capacitance	79.4pf/metre
DC Resistance:-	
Centre conductor:	10.5 ohms per 1000 metre
Shield:	2.8 ohms per 1000 metre
Attenuation:	0.33dB per metre @ 1575.42MHz (L1)
Shielding:	> 90dB
Phase Stability:	+/- 10ppm/degree C

This is a high performance RF cable, and care should be taken during installation to ensure that the minimum bending radius limit noted above is scrupulously maintained.

Optional cable lengths of 15m or 60m are also available.

■ While the cable shielding is excellent, the cable should not be routed in close proximity to power cables or other RF cables carrying transmitter signals – in particular, parallel runs are to be avoided if possible. If such runs are absolutely unavoidable, a minimum separation of 30cm may be used as a guideline.

The GPS receiver embedded in NTS01 has excellent OOB rejection characteristics, as does the antenna itself. However, sound engineering practice should not rely on these factors alone to guarantee performance. Careful installation will enhance the long-term reliability and on-going stability of the Network Time Server.

A.2 Antenna Assembly

Mounting Assembly - description

The supplied antenna includes an antenna mount is designed to fit over the top of a user-supplied pipe like a capping. The mount is designed to be placed over the top of a user-supplied pipe, through which the antenna cable runs. For maximum durability, the pipe should have walls of at least 2mm thickness, and be treated to resist corrosion. The top end of the pipe should be cut flat, so that the rubber gasket inside the antenna mount sits flush against it, forming an effective weather seal. The mount is fixed to the pipe with a stainless steel hexagon- socket setscrew (supplied).

The metal base of the antenna is affixed to the top of the mount. The antenna cable is passed up through the pipe from the bottom end, and connects directly to the connector on the base of the antenna.

Suggested Assembly order

1. Select a suitable location where the antenna has a good view of the sky. Avoid close proximity to antennas from other services where possible. The antenna has excellent rejection characteristics to out-of-band signals, as does the TCG 01 GPS receiver, but high-powered RF signals in close proximity to the antenna may still swamp the very low-level signals from the GPS satellites.
2. Establish the mounting method for the pipe, such as strapping to a frame on the edge of the building, or to an air conditioning exhaust or similar. Note that the base of the pipe needs to be accessible for the cable entry. If this is not practical, then a hole or slot can be made in the side of the pipe to allow the cable to enter and be passed up to the top of the pipe.
3. Position the antenna cable inside the pipe, protruding from the top.
4. Pass the antenna mount over the top of the protruding cable, so that the cable passes through the mount.
5. Connect the antenna to the cable, ensuring that the connector is not cross-threaded, and tighten the connector. Do *not* over-tighten!
6. Position the antenna (connected to the cable) on top of the mount, and secure it firmly, taking care *not* to rotate the antenna and cable (which could result in twisting the cable or loosening the connector).
7. Place the antenna and mount assembly, complete with the cable attached, squarely over the top of the mounting pipe, allowing excess cable to fall back through the pipe. Secure the antenna mount with the setscrew, ensuring that the antenna assembly remains firmly pressed against the end of the pipe, thus providing the exterior weather seal. Secure the now complete antenna assembly and pipe to the previously prepared mounting structure.

Warranty Statement

Tekron International Ltd (Tekron) warrants for a period of TEN years from the date of shipment that each Product supplied shall be free of defects in material and workmanship. During this period, if the customer experiences difficulty with a product and is unable to resolve the problem by phone with Tekron Technical Support, a Return Material Authorisation (RMA) will be issued. Following receipt of an RMA number, the customer is responsible for returning the product to Tekron, freight prepaid. Tekron, upon verification of warranty will, at its option, repair or replace the product in question and return it to the customer, freight prepaid. No services are handled at the customer's site under this warranty.

Tekron shall have no obligation to make repairs, or to cause replacement required through normal wear and tear or necessitated in whole or in part by catastrophe, fault or negligence of the user, improper or unauthorised use of the Product, or use of the Product in such a manner for which it was not designed, or by causes external to the Product, such as, but not limited to, power or failure of building services.

A product will not be warranted if it is an accessory not carrying the Tekron brand name. In this case, warranties are limited to the warranty provided by the original manufacturer of the accessory. Examples of such products and accessories are antennas, cables, etc.

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Warranty claims must be received by Tekron within the applicable warranty period. A replaced product, or part thereof, shall become the property of Tekron and shall be returned to Tekron at the Purchaser's expense.

A return material authorisation number issued by Tekron must accompany all return material.

ENDNOTES

The information in this manual may change without notice. The manufacturer assumes no responsibility for any errors that may appear in this manual.

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WARNING

This product has been designed to comply with the limits for a Class A digital device pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against such interference when operating in a commercial environment.