

NTS 03-E

USER MANUAL



TEKRON

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1. Introduction

The NTS 03-E Network Time Server provides a precision time reference for synchronizing Ethernet networks. It features multiple independently-addressed Ethernet Ports each supporting Network and Precision Time Protocols (NTP & PTP). Up to six Ethernet Ports can be accommodated in a single NTS 03-E 1U rack. Each base unit has a built-in GPS-synchronized master clock which provides the source reference time used by all of the Ethernet ports. All NTS 03-E Ethernet ports function as Stratum 1 (NTP) and GrandMaster (PTP) sources.

With true dual /redundant power supply options (not just dual power input connectors), the NTS 03-E product is ideally suited for use in industrial environments and can provide NTP & PTP server functions to multiple independent Ethernet networks.

All NTS 03-E units feature a front panel display (See figure 1) giving visual feedback about the time data being generated on the outputs. LED indicators provide “at a glance” status information.



Figure 1 – NTS 03-E chassis and front panel

The NTS 03-E features an administrative 10/100 Mb Ethernet port through which the unit's inputs and outputs can be configured. When the IEEE 1588 v2 option is enabled, the unit can operate as a PTP Grand Master, an ordinary PTP clock, or a Slave-Only Clock.

It comes complete with Ethernet cables to allow for customization and easy setup from the Windows™ Configuration software which is available to download from www.tekron.com. Optional accessories include antenna, low loss antenna cable, antenna pipe mounting components and lightning protection kit.

2. Front Panel

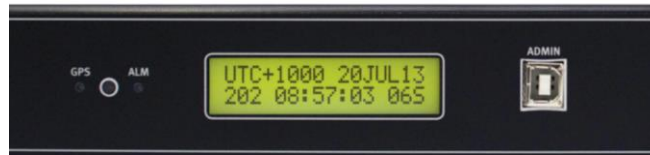


Figure 2 – NTS 03-E front panel

NTS 03-E features two LED indicators on the front panel (See figure 2), together with a 2-line by 16-character backlit LCD display.

SYN LED: This LED shows the status of the current sync source

ALM LED: This LED shows the alarm status of the NTS 03-E.

ADMIN (USB) Port: This port may be used to configure the clock using the Tekron Configuration Tool available for download on the Tekron website.

LCD Display

On initial power-up, the LCD display shows a copyright message, along with the serial number and revision level of the unit (See figure 3a). Approximately 10 seconds after power-up, if the NTS 03-E is operating in its default mode (GPS-synchronized), then the display changes automatically to indicate that it is waiting for satellites (See figure 3b). Once one or more satellites have been discovered, it transitions to the operating default display (See figure 3c). Figures 3d and 3e show alternative time displays that the user can access by pushing the button on the front panel between the LED indicators. Successive button-pushes can be used to cycle through all the display screens in turn. The screen display examples below all show the same instant in time.

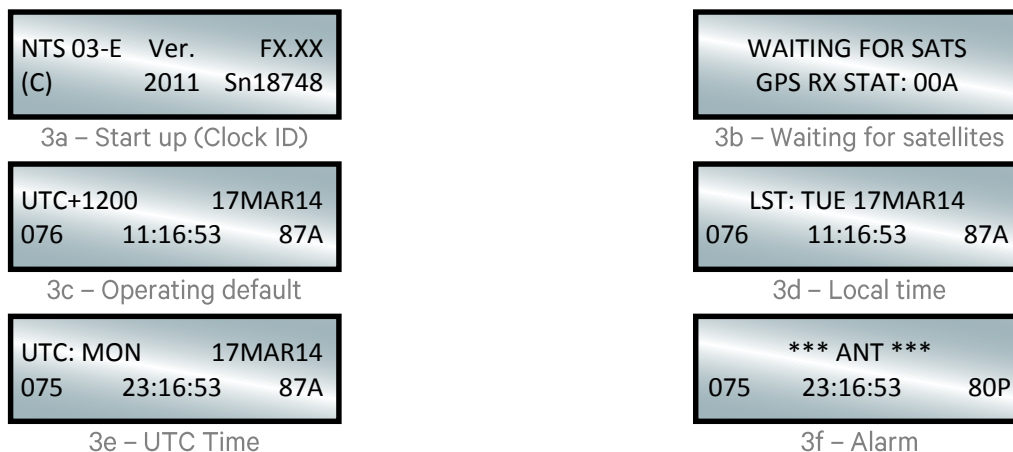


Figure 3 – LCD display screens (examples)

“UTC” denotes Universal Time Coordinated (approximately equivalent to GMT). The top line of screen 3c shows the clock’s current local time offset from UTC (hours & minutes), together with local date. The local time day-of-year and time-of-day are on the bottom line.

Screen 3c shows that the clock is operating with a local time offset of 12 hours ahead of UTC. The local date is 17th March 2013, and the local time is 11:16:53 in the morning.

Screen 3d shows the same time and date, but also indicates that the time displayed is Local Standard Time, and that the day is Tuesday. “LST” denotes Local Standard Time. If daylight savings time is active, the “LST” in screen 3d changes to “LDT”, denoting Local Daylight Time.

Screen 3e shows the UTC time and date which is 11:16:53 on the evening of Monday 17th March 2013.

All screens displayed after the initial start-up screen show a three-character status field at the bottom right-hand side of the display. When the NTS 03-E is operating in its default mode (GPS-synchronized), this field provides further details about the GPS function as shown in Figure 4 – Status field (GPS sync source) and table 1a below.

When the NTS 03-E is sync’d from a source other than GPS, this field directly indicates the sync source.). Table 1b shows the alternate sync sources supported by the NTS 03-E.

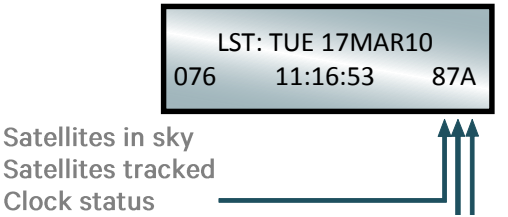


Figure 4 – Status field (GPS sync source)

Table 1a – Sync Status Field (GPS sync source)

| Character | Values | Description |
|-----------------------|---|--|
| Satellites in the sky | “O - 9”=0 - 9 “A - E”=10-14 “F”>=14 | Represents the total number of satellites currently present in the sky according to the GPS almanac. “O” in this position means that NTS 03-E has lost its knowledge of the GPS satellites’ orbit geometries. This occurs if the unit has been in storage for an extended period, or if the GPS receiver has been reset. It may take up to two hours for the NTS 03-E to operate normally again. |
| Satellites tracked | “O - 9”=0 - 9 “A - E”=10 - 14 “F”>=14 | This digit represents the number of satellites currently being used to compute the time solution. A “O” value means that no updated time solution is available, (“out of lock” condition). If this condition persists for the “Sync Hold” time, the clock will indicate the “out of sync” condition described under Table 1b below. |
| GPS Receiver Mode | “A” | NTS 03-E in Acquisition mode - attempting to get satellite fixes. |
| | “G” | “Poor satellite geometry”: Satellites are positioned in almost a straight line so best accuracy cannot be obtained, but the unit will still sync to UTC. |
| | “S” | Site Survey in progress. NTS 03-E is calculating an accurate position; once complete the mode will change to Position hold. |
| | “P” | “Position hold”: Position is known accurately, and the GPS is providing its most accurate time, typically better than 40 ns to UTC. |

Table 1b – Sync Status field (Alternative Sync Sources)

| Status field | | Description |
|--------------------------|-------|---|
| Alternative Clock Status | “PTP” | Clock is synchronized to a PTP Grandmaster |
| | “NTP” | Clock is synchronized to a NTP server |
| | “SLC” | Clock is synchronized to an IRIG-B source on P2 input “Slave:Cu” |
| | “SLF” | Clock is synchronized to an IRIG-B source on the Fiber input “Slave:Fiber” |
| | “SL?” | Clock is not synchronized to a slave source. The GPS has been disabled |
| | “TST” | Clock is operating with manually set time. Please refer to configuration tool “Set Time” function for further details |

LED Indicators

The **SYN LED** shows the status of the sync source. The various states are shown as follows:-

Off: The NTS 03-E has no power.

On: The NTS 03-E is synchronized to the source indicated by the LCD display

Slow Flash (1 flash per second): The NTS 03-E is operating in the “hold-over” state (Sync Hold timer running)

Fast Flash (5 flashes per second): The NTS 03-E is not synchronized. “Out of Sync” condition

The **ALM LED** indicates the internal alarm status of the NTS 03-E. It has only two operating states:-

Off: The NTS 03-E is operating normally. i.e., there are no alarms

Fast Flash (5 flashes per second): Alarms are active. In this case, the actual alarm state is shown on the top line of the LCD display, replacing the normal date information (see example in fig 3f above).

Alarm Definitions Table 1c

| Alarm State | Definition |
|-------------|--|
| *PwrA* | Power A: Power is not present on the Power A (P1A) input |
| *PwrB* | Power B: Power is not present on the Power B (P1B) input |
| *Hold* | Holdover: The clock has lost sync, but the outputs are still turned ON |
| *Sync* | Lost sync: The clocks has lost sync, the holdover time has expired and the outputs are turned OFF |
| *AntL* | Antenna Low: An under-current state has been detected on the antenna input (antenna disconnected) |
| *AntH* | Antenna High: An over-current state has been detected on the antenna input (antenna short circuit) |
| *Sats* | Satellites Low: The number of satellites have fallen below the user configured threshold |
| *IRIG* | Bad IRIG-B: An IRIG-B source is present, but cannot be decoded correctly |

Admin (USB) Port

An Admin port (USB type B) is provided to support local configuration/administration. The configuration software supplied with the NTS 03-E supports both USB and Ethernet configuration.

3. Back Panel

Examples of NTS 03-E back panels are shown (See figure 5 & 6). Their appearance may vary, as different connector types can be fitted at the factory to suit your requirements.



Figure 5 – Rear panel of NTS 03-E, 3 Port Option



Figure 6 – Rear panel of NTS 03-E, 6 Port Option

P1A/B: Power Input



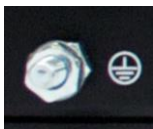
Power is applied to the unit via P1A and/or P1B (when fitted). The NTS 03-E can be ordered with high voltage AC input supplies and / or high medium and low voltage DC supplies, or a combination. IEC-320 power connectors (shown to the left) are used for high voltage AC, and 5.08 mm 2-pin connectors for low, medium or high voltage DC inputs. The polarity of DC power sources is not important as both the unit and case are isolated from the supply inputs. This enables the use of positive earth, negative earth or fully floating DC power sources. . If either of the power supplies fails the clock will remain operational provided that each power supply is powered from a different source.

The input voltage range is marked below the P1A/B connectors. Refer to section 6.1 for a list of orderable ranges.



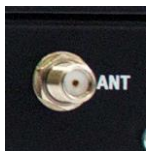
Check the label on the unit base for power supply voltage ratings before powering the unit. If IEC connectors are not used, then an external fuse should be fitted to the non-earthed power supply line.

Earth Studs (M4 Nut)



Two M4 bolts (to chassis) are provided for earthing of cable shields.

Ant: Antenna Connector (SMA Connector)



The “ant” antenna input provides an interface for an external active antenna to be installed. The antenna should be connected using a high quality, low-loss 50 Ω coaxial cable. The center conductor supplies 5 V DC (100 mA max) to power an active antenna. The GPS receiver inside the NTS 03-E is a high-sensitivity unit that supports a wide range of antenna and lead-in cable combinations. The overall gain of the installed antenna system (antenna gain less the combined losses in cable, connectors and any amplifiers/splitters/protection devices included) must fall in the range of 0 dB to 40 dB, with 5 dB to 35 dB preferred.

Antenna Cable Considerations

Tekron offers a timing-optimized, narrow-band antenna (nominal gain 38 dB) for use with the NTS 03E. When installed with a 30 m (100ft) lead-in cable (CNT-240) and a lightning protection device, the overall antenna system gain is around 23 dB, comfortably within the preferred range. For lead-in lengths longer than about 60 m (200ft), amplification and/or lower loss cable should be considered and can be supplied to order.

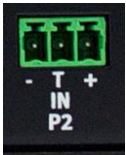
| | |
|-----------|--|
| CNT-240 – | 33 dB/100 m. Plus 1 dB/connector Preferred Length: 6 m to 70 m (20ft – 230 ft) Maximum Length: 100 m (330 ft) |
| CNT-400 – | 17 dB/100 m. Plus 1 dB/connector Preferred Length: 12 m to 138 m (40 ft – 450 ft) Maximum Length: 190 m (625 ft) |

Note: The examples shown above are based on an average GPS signal strength of -130 dBm at sea-level and assume that the antenna is positioned with a clear view of the sky, with a lightning protection device fitted in the lead-in cable. It is highly recommended that such a device be installed. A suitable lightning protection device complete with additional cable connectors, connector crimping tool, and mounting hardware is available as an optional kit. The lightning protection device inserts a further 2.5dB of loss into the antenna system (largely due to the loss in the additional connectors). This is equivalent to 8 m (25 ft) of CNT-240 cable, or 4 m (13 ft) of CNT-400 cable.



Care should be taken to ensure that the connector is not cross-threaded when attaching the antenna lead-in cable. The connector should be tightened firmly by hand or by a SMA torque wrench only. Do not over tighten.

P2: IRIG-B Input (3-pin 3.81 mm Connector)



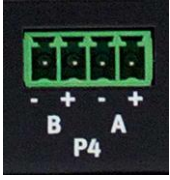
This port accepts an RS422 format un-modulated IRIG-B signal (B004 + IEEE1344 extensions). When configured appropriately, the NTS 03-E can synchronize to this source rather than the internal GPS receiver, thus operating as a slaved device from another NTS 03-E Master source. Connection of the incoming RS422 line (120 Ω twisted pair recommended) is to pins “+” and “-” of the mating connector. An RS422 termination load is provided on pin “T”, and can be activated by linking pins “T” and “-” in the mating connector.

P3: IRIG-B Output (3-pin 3.81 mm Connector)



This port transmits an un-modulated IRIG-B signal (B004 + IEEE1344 extensions) in RS422 format on pins “+” and “-” of the pluggable connector. It can be used as the Master Source signal to drive the P2 inputs of one or many Slave NTS02/03-E units on the IRIG-B timing pulses (both leading and trailing edges) from this port is typically to within 100 ns of UTC. A TTL-compatible output signal (single-ended, 0V referenced) can be obtained by connecting the signal cable to “+” and “0V” instead of to “+” and “-”.

P4: Sync Alarm Relay (4-pin 3.81 mm Connector)



The port provides two alarm output channels. The alarm outputs are type “A” (normally-open) dry contact types. Note: the “Normally-Open” descriptor refers to the de-energized state of the relay. The NTS 03-E operates with the alarm relays energized during normal operation, and de-energized in the alarm state. It follows that, in the event of all power to the clock being lost, both of the alarm relays default to the “alarm” state (open contact). The “+” and “-” symbols are included for reference purposes only, as the alarm contacts are not polarized.

P4 A is a GPS signal fail (antenna disconnected or antenna short (over-current)) alarm. Activation of the alarm (opening of the contact) is delayed by 10 seconds from the onset of the triggering condition.

P4 B is a synchronization fail alarm. This alarm is active (contact open) when the unit is initially powered on, and remains active until synchronization is achieved. The contact then closes, deactivating the alarm. If a loss of synchronization later occurs, then the NTS 03-E will operate in “Sync Hold” mode for a period defined by the “Sync Hold time”. At the expiry of the “Sync Hold time”, the alarm condition is again activated (contact open). Note that the “Sync Hold Time” is configurable up to a maximum of 2400 minutes. The default setting is 1 minute.

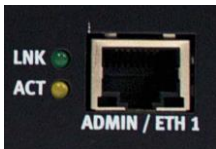
P5: Power Alarm Relay (4-pin 3.81 mm Connector)



The plug-able connector provides two alarm output channels. Wiring size is up to 1.00 mm². The alarm outputs are type A (normally-open) dry contact types. Note: the “Normally-Open” descriptor refers to the de-energized state of the solid state relay. The convention used in the NTS 03-E is to have the alarm relays energized during normal operation, and de-energized in the alarm state. In the case that all power to the clock is lost, all of the alarm relays then default to the “alarm” state (open contact). The “+” and “-” symbols are included for reference purposes only, as the alarm contacts are not polarized.

P5 A is a power A fail alarm and P5 B is a Power B fail alarm. Alarm signaling is delayed by 10 seconds. That is, if power supply A fails, the Power A alarm contact will open 10 seconds later.

ADMIN/ETH 1: Ethernet Administration Port (RJ45)



The Ethernet administration port (ETH1), features an RJ45 connector and supports 10/100 Mbps, Auto MDiX & Auto Negotiate. The LEDs convey Link (LNK) and Activity (ACT) status for the port. This port is used to configure the clock via the Tekron Configuration Tool, which is available for download from the Tekron website.

ETH 2 – 6: Ethernet Communication Ports (RJ45/ST Fibre Connector)



The Ethernet communication ports (ETH2 – 6), feature an RJ45 (10/100 Mbps, Auto MDiX & Auto Negotiate) or ST Fibre (100 Mbps) connectors (orderable option). The LEDs convey Link (LNK) and Activity (ACT) status for the port.

NOTE:

The NTS 03-E features absolute security between all ports, so that no Ethernet paths exist between any of the Ethernet ports. For this reason, the NTS 03-E does not support hub, switch or router functions.

4. Factory Hardware Options

Power Supply Options

This table shows the two different power supply connection inputs that may be ordered with NTS 03-E. The NTS 03-E supports dual power supplies, which are independently configurable during manufacture.

| Designator | Input Range |
|------------------------|--------------|
| IEC320 Inlet | 85 - 265 Vac |
| High Voltage (2 pin) | 90 - 300 Vdc |
| Medium Voltage (2 pin) | 20 – 75 Vdc |
| Low Voltage (2 pin) | 14 – 36 Vdc |

Expansion Board Options

This table shows additional Expansion board configuration that may be ordered with NTS 03-E.

| Expansion | Description |
|-------------|---|
| 3x Ethernet | Additional 3 Ethernet ports (RJ45 or Fibre) |

Slave Only Option (Fiber input)

NTS 03-E can be ordered as a slave-only device in which case, the SMA Antenna Jack is removed, and an ST Fiber receiver port (multi-mode) is fitted instead. The unit will then synchronize to an incoming IRIG-B signal on either P2 (RS422 format signal required) or on the Fiber input

5. Appendix

NTS 03-E Specifications

| Physical Specifications | | | | |
|--|----------------|-----------------------------|--------------------------|--|
| Dimensions | Width | 430 mm | | |
| | Depth | 270 mm | | |
| | Height | 45 mm | | |
| Weight | | 2.0 kg | | |
| Operating Temperature Range | | -10 ~ + 65 °C | | |
| Storage Temperature Range | | -40 ~ + 85°C | | |
| Operating Humidity | | 10 ~ 95 % non-condensing | | |
| Electrical Specifications | | | | |
| Power Supply | Low Voltage | 14 ~ 36 Vdc | | |
| | Medium Voltage | 20 ~ 75 Vdc | | |
| | High Voltage | 90 ~ 300 Vdc / 85 ~ 265 Vac | | |
| Power drain | | 7.5 W max | | |
| Isolation | | 3.0 kV | | |
| Input & Output Specifications | | | | |
| Ethernet Port (Administrator) | | RJ45 | 10/100 Mbps | |
| | | Isolation | 1.5 kV | |
| Ethernet Ports (2 - 6) | | Type | RJ45 | |
| | | Isolation | 1.5 kV | |
| | | Type | ST Fibre | |
| USB Port | | Type B | | |
| P2 Input | | Voltage level | RS422 | Sensitivity 200 mV |
| | | Input resistance | 150 kΩ (typical) | |
| P3 Output | | Voltage level | RS422 | Capable of driving 50 unit loads (1 V out @ 80 ma) |
| P4 & P5 Relay | | Isolation | 3.5 kV | |
| | | Max contact rating | 300V @ 100 mA (AC or DC) | |
| GPS Receiver | | | | |
| L1 (1575.42 MHz) Frequency, C/A Code, 14 Channel, parallel-tracking receiver | | | | |
| Position Accuracy | Horizontal | <9 m (90%) | | |
| | Altitude | <18 m (90%) | | |
| Timing Accuracy | | <15 ns to UTC | | |
| Acquisition | Reacquisition | <2 s (90%) | | |
| | Hot Start | <18 s (90%) | | |
| | Cold Start | <50 s (90%) | | |
| Sensitivity | Acquisition | -160 dBm | | |
| | Tracking | -155 dBm | | |
| Antenna output voltage | | 5 V | | |
| Antenna output current | | 100 mA (max) | | |

6. 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 Authorization (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 unauthorized 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 authorization number issued by Tekron must accompany all return material.

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.

Notes

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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