Symmetricom

XL-750 GPS Time Source
User Manual

997-00750-01, Revision C
August 2005

TABLE OF CONTENTS

1 Introduction

The XL-750 GPS Time Source produces precision time code signals, serial strings, and pulses for use in synchronizing industrial control and SCADA equipment.

They are ideally suited to providing time synchronization simultaneously to many different devices, such as Remote Terminal Units (RTUs), Protection Relays and other Intelligent Electronic Devices (IEDs), which are typically deployed in electrical sub-stations and industrial control installations.

The XL-750 is fitted with one fixed AM modulated IRIG-B output, three programmable *independent* outputs (which may be configured to output either a pulse of precise duration and offset, or one of a number of standard time codes) and a serial port which is user-configurable to output serial strings and report events for units fitted with Event Time Tagging capability.

Two programmable outputs provide the pulses or time code via TTL signals. Optional signal levels of fiber optic, RS422 or high voltage MOSFET switch are available. BNC connectors are provided as standard. ST fiber optic connectors are provided with the fiber optic signaling option. A two-pin connector is provided for the P2/P3 High Voltage Switch option.

The standard XL-750 supports three power supply voltage ranges. The XL-750 functionality can be expanded with the Network Time Server (NTS) and the Event Time Tagging option. Network protocols supported by the NTS option include SNTP, UDP, ARP, with status monitoring and reporting via SNMP.

All XL-750 units feature a front panel display, giving both installation teams and users visual feedback about the time data being generated on the outputs. LED indicators provide “at a glance” status information.

Figure 1. XL-750 Front Panel

The optimized Receiver/Antenna system employed in the XL-750 provides time information from the GPS satellite constellation. Dynamic T-RAIM processing is used to eliminate any aberrant satellite signals from the timing solution. The result is timing precision on all outputs with accuracy similar to that normally seen only in laboratory instruments.

Unlike laboratory instruments, however, the XL-750 is ideally suited for service in hostile electromagnetic environments, such as sub-stations and electrical switchyards. The internal electronics are isolated from the outside world.

Each output of the XL-750 is isolated from every other output, so that attached wiring can feed out to operating areas in different ground potential zones without compromising the overall site grounding security. Transient suppression networks on each I/O point mean that the unit is protected from both longitudinal and transverse

high voltage events.
The XL-750 unit occupies less than half the width of a 1U rack space. It is supplied complete with all hardware and software required for installation, including rack-mount kit, connectors, L1 GPS antenna, mounting kit with 50 feet (15 m) of Belden 9104 coaxial cable.

2 Installation

2.1 Packing List

Each XL-750 kit is shipped with the following:

- XL-750 GPS Time Source
- User manual (Symmetricom XL-750) – this document
- L1 GPS antenna with mounting kit
- 50 feet (15 m) of Belden 9104 coaxial cable with SMA to BNC adaptor
- 19 inch rack mounting plate and fasteners
- Plug-in connector set (3 x 2 way, 1 x 3 way miniature)
- RS232 interface cable (9 pin male “D” connectors at both ends)
- Configuration software

2.2 Mounting

The clock is designed to be mounted in a 19 inch rack, but may be used on a bench. The unit is attached to the rack mount plate via the four screws shipped installed in the four corners of the front panel.

GPS antenna: Detailed antenna mounting instructions are contained in Appendix A on page 25. 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 ground-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 ground-bonded structure. The GPS antenna mount itself should also be securely bonded directly to the building protection ground – and *not* connected via any other grounded structures.

A lightning arrestors are available for installation in the antenna lead-in cable for additional protection of the equipment. (See Section 5.4 p16 for details.)

☛ *All* XL-750 antenna installations should follow the guidelines above.

2.3 Output Signals

Each XL-750 unit ships with a default signal configuration as shown below:

Plug 2: 1 PPS (100 ms)
Plug 3: Unmodulated IRIG-B output
Plug 4: **(pin 1 and 5)** 1PPS (10 ms) – RS232 level pulses

Plug 4: **(pins 2, 3 and 5)** RS232 level communications Tx and Rx
Plug 5: Amplitude modulated IRIG-B signal
Plug 6: General purpose input (for options such as Event Time Tagging)
Plug 7: Sync relay output (Change-Over contacts)

The default configuration can be field-modified using the configuration software shipped with the clock. (See Section 6 p17 for details of the configuration software).

2.4 Connections

All connections to the unit are via the rear panel.

Figure 2. Rear Panel of the XL-750, Rev D, with BNC and NTS Output Options

P1 Power is applied to the unit via this plug. Despite the markings on P1, the polarity of the power connection is *not* important and the unit is fully isolated internally from the power source. A mating connector is supplied with the unit, suitable for wiring sized up to 1 mm^2.

Connecting the Power Supply

Warning: Ensure that a disconnect device, such as a switch, with the appropriate voltage/current rating is provided when operating/installing the XL-750.

Warning: Prior to installing the power, make sure the unit is grounded using the ground terminal on the back of the unit. The ground should only be removed after all power is removed from the unit.

Warning: Prior to servicing the interior of a unit, remove all power connections.

Connect the Power Supply to a power source. The blinking green "GPS" LED on the front panel indicates that the XL-750 is receiving power.

Notes for DC power supplies:

- Use a 2 amp DC circuit breaker in series with the DC power source.
- Do not connect directly to a DC power source without the breaker.
- 14 gauge wire is the minimum recommended for DC power source hookup.
- The XL-750 with a DC Power Supply rated above 48Vdc/4A is only to be used in a restricted access area.
- The screw torque range on the Power Terminal Block is 5 to 7 inch pounds.
- When connecting to a DC power source, first connect the positive power cable to "+" on the power supply, then connect the negative power supply cable to "−".
- The Unit Chassis must be grounded for proper safety.
- For FCC and CE EMC Radiated Emissions Compliance a Ferrite EMI Suppressor (Fair Rite P/N 0444164951 or equivalent) may need to be placed on the unit end of the cables attached to P2 and P3.

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

Ant The antenna cable adapter (SMA to BNC) connects to the "Ant" connector located above P1. Care should be taken to ensure that the connector is not cross-threaded when attaching the antenna lead-in cable. *Avoid over tightening the connector adaptor to the "Ant" connector.*

P2/P3 Programmable outputs. There are four output signal options available on these two outputs

- TTL 0-5V, 150 mA (standard)
- RS-422, ±6 V, 60 Ω (option)
- High Voltage switch, MOSFET 300 V, 1A (option, see Section 5.1)
- ST Fiber Transmitter (option, see Section 5.5)

Connector options are BNC or ST fiber optic.
A two-pin connector is provided for the P2/P3 High Voltage Switch option.

P4 This output is a DB9 male connector providing a "DCE" serial port on pins 2, 3 and 5, plus a programmable output line on pin 1 (shares pin 5 for return). Do ***not*** over-tighten the securing screws for the RS232 connector.

P5 This output is a BNC connector providing amplitude modulated IRIG-B signal (B12x).

P6 This input plug is used for the Event Time Tagging option. See Appendix B, page 27 for a full description.

P7 Sync status relay contacts. When the clock is in sync, the "NO" and "C" terminals are connected. A mating plug is supplied (wiring to 1 mm^2.)

P8 RJ45 Ethernet port. Provides NTP, SNTP, ARP, BOOTP, DHCP and UDP protocols on a 10baseT link (see Section 5.3, page 15 for full details).

3 Operation

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

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

The time required to achieve tracking and synchronization (given a good "view" of the sky) will vary from just a few seconds to around 45 minutes in the worst case – such as reactivating a unit that was previously synchronized 1000's of km away from the present position.

3.1 LCD 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 (see Figure 3 [a]). The display then automatically changes to the operating default (see Figure 3 [b]). The top line of screen [b] shows the UTC offset in hours and minutes and the local date. The local 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. The definitions of the status characters can be found on the following page.

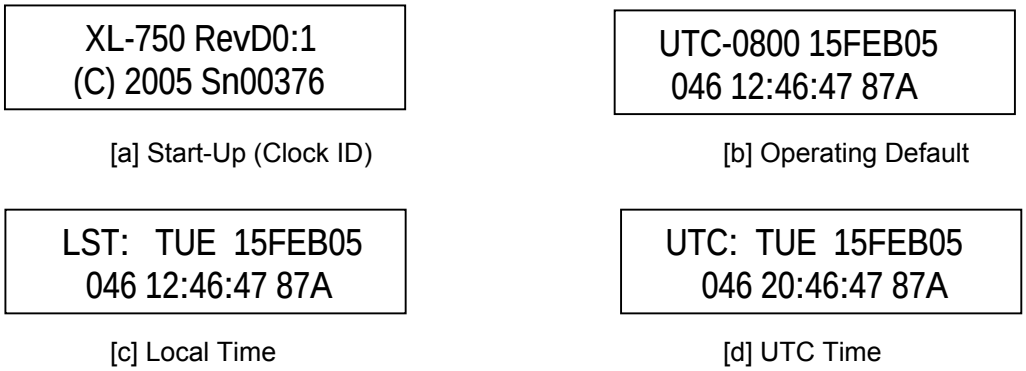


Figure 3. LCD Display Screens

Screens [c] and [d] above are alternate displays accessible by pushing the recessed pushbutton, located on the front panel between the LED indicators. All four of the above screens can be accessed sequentially in this way.

"UTC" denotes UTC time (similar to GMT). "LST" denotes Local Standard Time. If daylight saving time is active, "LST" shown on screen [c] changes to "LDT", denoting Local Daylight Time.

Screen [b] displays Coordinated Universal Time (UTC) minus the **L**ocal **S**tandard **T**ime (LST) offset. In this example, the clock is displaying a LST offset of –8 hours relative to UTC. The LST date is 15th February 2005, and the LST time is 12:46:47.

Screen [c] displays **L**ocal **S**tandard **T**ime (LST).

Screen [d] displays Coordinated Universal Time (UTC).

The display examples above all denote the same instant in time.

Satellite Tracking Status

Display screens Figure 3: [b], [c] and [d] all show a three-character status field at the bottom right-hand side of the display. (The example shows values 8 7 A.) The three-character field provides visual feedback on the most important parameters affecting the operation of the GPS receiver. The meaning of each character is as follows:

1st character: (A hexadecimal digit: range 0-D, meaning 0-13)

Shows the total number of satellites currently present in the sky according to the GPS almanac. (The Hexadecimal Number System represents numbers in the decimal range of 00-15 by using a single character; i.e., the numerals 0-9, with letters A-F added to denote the numeric values 10-15 respectively). Typically, this value will lie in the range 4 through C (12).

A value of zero means that XL-750's GPS receiver has "lost" its knowledge of the GPS satellites' orbit geometries (the "almanac"). 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. If this condition occurs, the XL-750 will begin randomly searching the sky for satellites. The time taken to obtain synch under these conditions will be much longer than usual after switch-on – up to several hours. Once a satellite is found and locked on, the XL-750 automatically begins updating the almanac from data received from the satellite – a task that typically takes about 20 minutes to complete. The status digit will then "come right". The display example in Figure 3 indicates that eight satellites are presently visible overhead.

2nd character: (value in range 0-C denoting 0-12)

Indicates 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 6.1, page 18) the clock will go to "Warning State 2" described below. The display examples in Figure 3 show that the signals from seven satellites are in use to form the time solution.

3rd character:
Possible values are:

A XL-750 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. Position calculation accuracy is degraded under these circumstances, but the XL-750 will still sync.

2 A 2-dimensional position solution is in use. (No height calculation.) This condition may occur within 4 hours of first "switch-on" (before Position Hold mode has been reached) if only three satellites are tracked and geometry is OK. Time synchronization is not compromised.

3 A 3-dimensional position solution is in use, which includes a height calculation. Four or more satellites are being tracked. As the XL-750 automatically begins a site survey process if it has four or more satellites available, this condition will rarely be seen.

S Site Survey in progress – see "OK Status 1", on the following page.

P Position hold mode – the normal steady-state mode achieved on completion of Site Survey – see description of "OK Status 2" on the following page.

3.2 Front Panel LEDs

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

☞ By default, all outputs 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 satellite.

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 correct for syncing purposes! The **GPS** LED shows warning states as follows:

Warning Status 1: — — —
GPS LED flashing rapidly (at about 4 flashes per 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.

Warning Status 2: — — —
GPS LED flashing with a two flash pattern, repeating each second. The unit is searching the sky for satellites to begin the sync process.

OK Status Conditions – (SYN LED illuminated continuously)

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. There are two normal operating states:

OK Status 1:
The **GPS** LED flashes with a single flash each second, with the "ON" period much longer than the "OFF" period. The clock shows this status after first obtaining satellite sync. The long "ON' cadence shows that satellite tracking is operating. (The 2nd status character on the LCD display shows the number of satellites being tracked.) Accuracy on all outputs is typically within 1 μS of UTC in this state. As soon as four or more satellites are being tracked, the unit starts a site survey. The survey determines the precise position of the antenna (latitude, longitude and altitude) by taking the average result of 10,000 position solutions based on data from four or more tracked satellites. A new position solution is calculated each second, so under "clear sky view" circumstances (at least 4 satellites tracked almost immediately from switch-on) the site survey will take about 3 hours. On completion of the survey, XL-750 "freezes" the position and proceeds to the most accurate operating state – OK state 2 below.

OK Status 2:
The **GPS** LED flashes a one-second "heart-beat" as above, but with a shorter "ON" period than "OFF". The 3rd status character on the LCD display shows **P**. In this mode, the embedded GPS receiver operates in "Position-Hold" mode and devotes all resources to resolving the most accurate time solution. Using T-RAIM processing, this mode yields the best steady-state timing accuracy that the clock is capable of, such as leading edge of output signals to within 100 nanoseconds of UTC time. (Provided that the antenna feed delay is compensated correctly.)

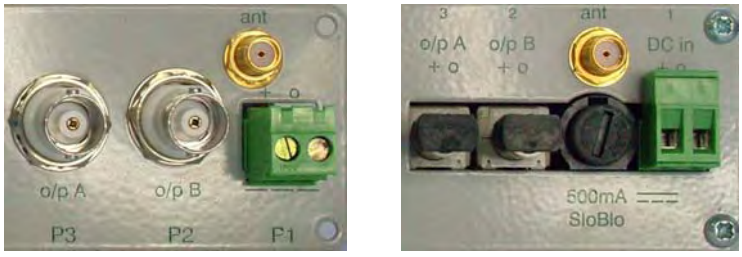
4 Specifications

4.1 Input/Output – Electrical/Physical

P2, P3: Outputs (Figure 4)

[a] CMOS/TTL (5V) logic level driver output ports rated at 150 mA sink and source implemented via BNC connectors. Each port is fully floating and features independent electrical isolation to 2.5 kV. As a factory option, either or both of these outputs can be fitted internally with RS-232 or a Power MOSFET Switch, allowing switching of up to 300 VA (1A max). See Section 5.1, page 14 for suggested wiring configurations for use with Power MOSFET switching.

[b] XL-750 with fiber transmitters fitted: ST fiber transmitters, compatible with ST-terminated 62.5 μm fiber diameter, 125 μm jacket diameter multi-mode fiber optic cabling. The maximum length of fiber recommended is 700 meters.



[a] BNC connectors **[b] ST fiber connectors**

Figure 4. Power Input, Antenna Jack (SMA), Digital Outputs P3 (o/p A)& P2 (o/p B)

Antenna input "Ant": (SMA jack)

The antenna input provides an interface for an external active antenna. To power an active antenna, 5V DC is supplied (maximum current of 50 mA). 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 22 dB.

The XL-750 clock is normally supplied complete with 50 ft (15 m) of lead-in cable and an SMA to BNC adapter. This combination provides an overall gain near the optimum of 22 dB. (See Appendix A, page 25.)

If required, extended cable length options are available providing solutions for lengths of 150 feet (45.7 m), 300 feet (91.4 m), and lengths greater than 300 feet (>91.4 m).

A Lightning Protection device may be inserted into the antenna cable. A suitable device complete with additional cable connectors, a connector crimping tool and mounting hardware is available as an option (see Section 5.4, page 16). Introduction of the Lightning protector does not degrade the performance of the antenna system.

P4: RS232 I/O (Serial port plus programmable output)

A RS232 port (±9V signal levels) is implemented via a 9-way "D" male connector with signal lines: **pin 2** (serial data OUT from XL-750), **pin 3** (serial data IN to XL-750) and **pin 5** (signal ground) together with a programmable signal output on **pin 1**. The programmable output shares **pin 5** (signal ground).

Figure 5. P4 - RS232 Port and Ground Stud

XL-750 is shipped as a DCE configuration. A "straight-wired" Socket-to-Socket 9-way data cable can be used to connect directly to a standard PC serial port. (A suitable 6-foot (2 m.) cable is included with each XL-750.) The CTS and DSR functions are permanently asserted, so the serial port does not support hardware handshake control.

The RS232 signal lines are not HV-isolated from each other, but the port as a whole is isolated to a level of 2.5 kV from all other ports.

Ground stud

A M4 bolt (to chassis) is provided for grounding of cable shields.

P5: BNC output

This output is capable of driving either twisted pair or coaxial cable. It is independently isolated (transformer-coupled) to a minimum of 2.5 kV. The output provides an amplitude-modulated 1 kHz sine wave at a maximum level of 8 Vp-p, 100Ω output impedance.

P6

Two input channels with common return that may be driven by TTL logic levels. This port is implemented via a 2-pin plug-able connector. Wiring size is up to 1.0 mm^2.
The input is isolated to 2.5 kV.

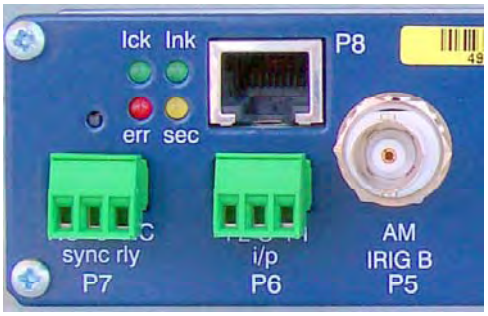


Figure 6. Layout of P5, P6, P7 & P8 (with NTS option)

P7

A set of isolated changeover relay output via 3-pin pluggable connector – capable of switching up to 2A of AC/DC external load (230V AC). Wiring size is 1.0 mm^2. Isolation is 2.5 kV minimum.

NTS

XL-750 units, fitted with the NTS option, feature an RJ45 connector supporting a 10 Mbps Ethernet port (10baseT). The NTS option also includes four indicator LED's and a recessed push-button. (See Section 5.3, page 15 for NTS option details.)

4.2 Input/Output — Functions & Applications

Programmable outputs (P2, P3, P4-pin1)

The outputs P2, P3, and P4-pin1 are each independently programmable to provide one of the following options:

i) DCF-77 pulse simulation
ii) Unmodulated (i.e., DC level-shift) IRIG-B (B00x)
iii) Modified Manchester Modulated IRIG-B (B22x)
iv) Programmed pulse sequence

In the case of option iv above, separate settings are provided so that a different programmed pulse sequence can be specified for each of the three outputs. Each of the three programmable outputs can also be inverted in its operation. Full details on configuring the programmable outputs are contained in Section 6.3, page 20.

A common application for the programmable output on P4-pin1 (RS232 level) is to provide an independent drive to an RS232-fiber converter unit for use in transporting the code signals to a distant location. In such cases, **pin 1** should be "broken out" of the normal 9-way cable optionally used to connect to an external PC, and used in conjunction with **pin 5** (signal return).

Serial Port (P4 –pins 2,3 and 5)

The serial port can be configured to output any one of a number of different serial time messages on a broadcast basis. The serial port runs at a fixed baud-rate of 9600 baud. Message formats operate at 8-bit no parity, no flow control, and are transmitted once per second, unless otherwise noted below.

Alternative message strings, data formats, and protocols currently available for output on this port include:

NGTS protocol
IRIG J-17
String A
String B
String C
String D
String E
GPS Binary

(See Appendix D, page 36 for details of each of the message string formats.)

☞ **Please contact your Symmetricom Sales Representative additional strings are required.**

P5: (AM modulated IRIG-B)

The BNC output provides an amplitude-modulated IRIG-B signal (B12x). The mark/space amplitude modulation ratio is 10:3, and pp o/p level is 8 volts (maximum), 100Ω impedance. The output is fully floating, and is transformer-isolated to a minimum of 2.5 kV.

This output is *not* programmable for other types of signal, and the IRIG-B code is present whenever the unit is powered. The particular IRIG-B data content is as specified by the configuration program (see Section 6.3, page 21).

☞ **Application Hint –** Most devices with amplitude-modulated IRIG-B time sync inputs have an input impedance of between 4 kΩ and 20 kΩ, and maximum allowable peak-to-peak level of approximately 6V. The **P5** output on the XL-750 is designed to drive many of these devices **all in parallel,** with a terminating resistor (typically 100-180 ohms) fitted at the far end of the coax line feeding all of the attached loads. In this way, **P5** can drive at least 20, and typically 30 or more devices without any external amplification required. The terminating resistor is essential to ensure good noise immunity.

P6: General Purpose Inputs

These are two inputs, electrically isolated from the clock circuitry, and sharing a common ground. Currently they are used for the Event Time Tagging option on XL-750 units so equipped. The specifications and protocol for this option is described in Appendix B, page 27.

The connections i1, i2 are 5V TTL inputs, with ‘o’ as a common ground.

P7: Relay Output ("Sync" relay)

A set of changeover contacts is provided via a three-pin pluggable connector. This relay is active ("C" and "NO" connected) whenever the XL-750 has established stable time sync from the GPS satellites. The active relay output indicates that all of the other output signals are operating within specification. The smaller connector shown in Figure 6 (page 10) accommodates 1 mm^2 cabling. The sync relay can be configured to remain active (indicating "in sync") 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).

P8: Network Time Server (NTS) – RJ45 Ethernet connector

Figure 6 (page 10) shows the RJ45 connector associated with The Network Time Server function. This option provides SNTP protocol, together with ARP, BOOTP, DHCP and UDP protocols on a 10baseT (10 MHz) link (see Section 5.3, page 15 for full details).

4.3 Indicators & Display Unit

XL-750 features two LED indicators on the front panel, together with a 2-line by 16-character LCD display. The clock is a lightweight device, normally mounted at eye level or higher in an equipment bay. The display is optimized for viewing straight on, or from below.

SYN: This LED operates in parallel with the Sync Relay, and is active at all times when the unit is operating with time code outputs within specification (i.e., time accurately tracking the GPS time signals).

GPS: Flashing cadences are used on this indicator to indicate the status of the GPS receiver (see Section 3.2, page 7 for details).

LCD Display: The display unit updates every second, displaying day, date, time, and time offset from UTC. It also provides more information on the GPS receiver operation. A recessed push-button located on the front panel between the two indicator LED's is used to switch between display pages (see Section 3.1, page 5 for operating display details).

4.4 Power Requirements

P1: Power Input

The XL-750 is available with three power supply ranges:12-36, 20-60, and 90-350 Volts DC. (see Section 5.2, page 15 for full details on power supply options).

Maximum power consumption is 7W. Connection is via the 2-pin plug connector **P1** on rear panel. **The power input is *not* polarity-sensitive**, despite the markings. The casing is isolated from the power supply inputs so that either (or neither) power supply polarity can be grounded to station ground. All power supply options have surge protection.

4.5 Isolation & Protection

All inputs and outputs feature 2.5 kV isolation from each other. In addition, the logic level outputs (**P2** and **P3**) are each protected against damage from transverse voltage events via a three-stage network of varistor, auto-resetting fuse, and transient suppressor diode.

☞ **Fuse and varistor protection is *removed* when the switching MOSFET factory option is fitted. The user *must* provide an external power supply and suitable fusing to use the MOSFET output option.** (See Section 5.1, page 14 for further information on the MOSFET output option.)

Varistor protection and current limiting (nominally 5 mA) are employed for protection on the general-purpose input.

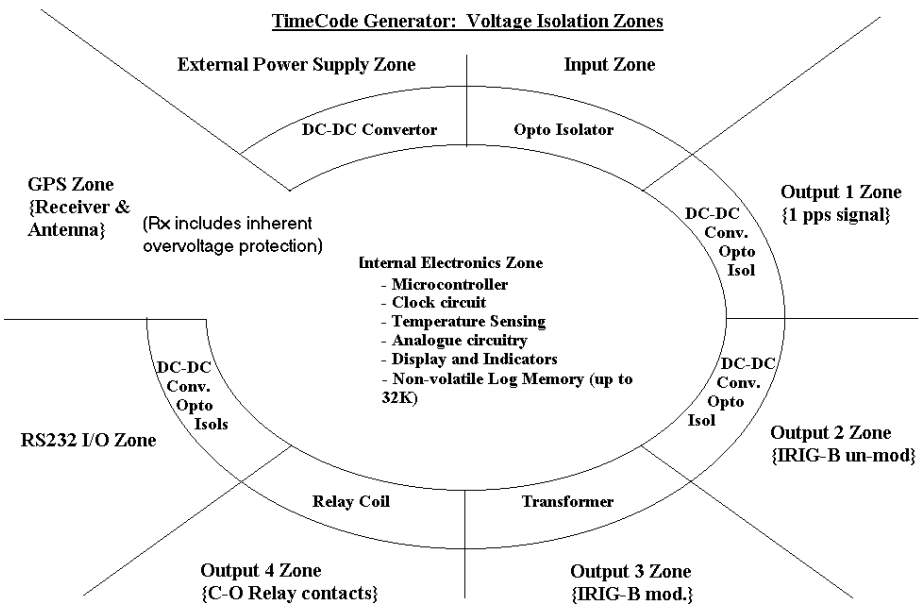


Figure 7. XL-750 Isolation

Transformer isolation, via a DC-DC converter, is used for the main power supply and for power to each of the logic output-drive circuits. The serial communications interface is also separately powered via an isolating DC-DC converter. High-speed, fixed delay opto-isolators are used in each of the time-sensitive signaling paths. The isolation does not degrade the time accuracy of the output signals, as the fixed delays of the isolating components (together with the delay associated with the antenna lead-in) are all internally compensated.

4.6 Dimensions

Width:	6.3 inches (160 mm)
Depth:	6.1 inches (155 mm)
Height:	1.6 inches (40 mm) (1U)
Weight:	1.8 lb (0.8 kg)

Each XL-750 unit is normally supplied complete with antenna, antenna mount, antenna cable and 1U 19-inch rack-mount hardware. Shipping weight of the complete XL-750 kit is approximately 10 lb (4.5 kg)

4.7 Identification

Each XL-750 unit is shipped with an identification label on the base. The label provides details of the particular options fitted to the unit, the power supply requirement, and the serial number.

5 Factory Hardware Options

5.1 XL-750 High Voltage Output Option (P2,P3)

XL-750 may be ordered with either or both of the **P2** and **P3** outputs configured with a high voltage FET switching transistor instead of the standard 5V logic output. When so fitted, each output can switch an external load of up to 300 VA, with a maximum "on" current rating of 1A, and a maximum rated voltage of 300 VDC.

External wiring should be arranged so that the external high voltage supply line (up to 300 VDC maximum) is connected, via a fuse, to the load. The return connection from the load is then wired to one terminal of the **P2(P3)** output, and the other terminal of the **P2(P3)** output is then wired to complete the circuit back to the other side of the power supply. Do not connect the high voltage supply to P2 or P3 unless the high voltage option is fitted – check the label on the base of the XL-750 unit.

☛ Important! It is the user's responsibility to provide adequate protection in the form of an external fuse to protect the external power supply, XL-750 output switch, and load. Note: At all times, the polarity of the P2 (P3) connections should be such that conventional current flow is into the "+" terminal and out of the "o" terminal – i.e., "+" is at higher positive potential than "o".

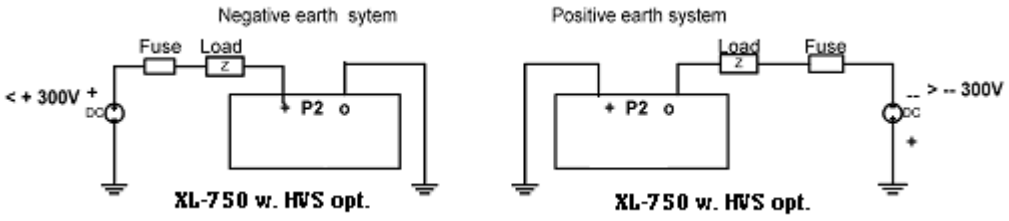


Figure 8. High Voltage MOSFET Output Switch Option: Suggested Wiring

Output isolation (from chassis and other I/O) is still maintained when the HV option is fitted. This simplifies the external load/supply arrangements, particularly when operating with positive-ground systems – as in many utility facilities.

☛ **Caution!** With operation of the XL-750 High Voltage Output Option (P2,P3), High Voltage may be present on the P2/P3 connectors. Remove the P2/P3 connectors prior to servicing.

☛ **Important!** Wiring to the High Voltage Output Option must be in accordance with the NEC/CNEC and all local codes. Be sure to take into account the routing and accessibility to the wiring. Exposed wiring must be Double-Insulated for the working voltage applied (if greater than 60 VDC).

5.2 Power Supply Options

The XL-750 standard product is available with three power supply configurations. Use the following numbers to order a standard XL-750 with the power supply indicated:

- 1540-100: Standard XL-750, Nominal 24 VDC (12–36 VDC)
- 1540-200: Standard XL-750, Nominal 48 VDC (20-60 VDC)
- 1540-300: Standard XL-750, Nominal 110/250 VDC (90-350 VDC) See note below.

Note: The above 110/250 Vdc Power Supply specification reflects the overall Power Supply ratings. For CE Safety compliance the Power Supply must only be operated at 90-300 Vdc.

5.3 Network Time Server (NTS) Option

The network time-server option (where fitted) features an RJ45 UTP connector on the rear panel that functions as a 10 Mbps Ethernet port (10baseT). A standard (i.e., non-crossover) drop cable should be used to connect the XL-750 to a convenient port on a local network hub or switch.

☞ **The RJ45 UTP port is *not* HV-isolated from the XL-750 chassis, but complies with the standard balanced nature of a UTP connection for an office network.**

Protocols supported by the XL-750 NTS option are: ARP, UDP, TCP, ICMP, Telnet, TFTP, DHCP, SNMP and BOOTP. A XL-750 unit equipped with the NTS option provides a complete Stratum-1 time-server function, while still retaining all other output services. Specific time-sync client protocols supported are NTP and SNTP. SNMP trap support allows for status monitoring and NTS alarm reporting to 3rd party network management packages. Status reporting can be integrated with existing network management software to provide a complete package. Provision is made for up to five different IP addresses to be specified for SNMP trap destinations, as well as two “Syslog” IP addresses. Accuracy of the NTS time stamps produced is to within 1 mS of UTC.

Appendix C, page 31 contains detail about how to install and configure the network time server option.

5.4 Lightning Protection Kit Option

A lightning arrestor is available for fitting into the antenna lead-in cable. Full instructions relating to the installation and maintenance of the lightning protector are included with the kit, together with guidelines as to how best position the antenna and protector unit to minimize the possibility of lightning-induced damage to the XL-750 base unit.

☞ **While the LP kit provides a high degree of protection, there is no guarantee of protection against a direct lightning strike to the antenna. Careful antenna positioning is strongly advised.**

5.5 P2 & P3 Output Connector Options

The standard connector for outputs P2 and/or P3 is a BNC connector. An optional ST fiber optic Tx connector is available with the fiber optic option. Refer to Section 4.1, page 8 for a full description of the outputs. A two-pin connector is provided for the P2/P3 High Voltage Switch option.

5.6 Event Time Tagging Option

Independent 2-channel Event Time Tagging is available. See Appendix B, page 27 for more information.

6 Configuration Software

A proprietary software configuration program ships with all XL-750 units. It provides the user access to all of XL-750's programmable system operating parameters, as well as the programmable output options. 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 the window brings up the help cursor. Moving the help-cursor over an option and clicking activates on-line help for that parameter. Pressing **F1** while over a parameter also activates on-line help.

6.1 Getting Started

The configuration tool requires a Windows PC (95, 98, 2000, ME, XP, NT are all supported) with a spare 9-pin serial port. The serial port of the XL-750 must be connected to this PC with a straight-through DB9-DB9 plug, supplied with the XL-750.

The configuration tool can also be run without a clock attached. In this case, it can be used to view or alter a pre-saved configuration *file*.

When first loaded, the configuration tool will bring up a small status window and scan through available serial ports to find a XL-750-compatible clock. If a XL-750 is discovered, a snapshot of the current clock settings will be shown in the "Clock Setup" and "Output Config" tabs, and a live time preview will be shown. The "GPS Setup" Page will also show the status of satellites. If this is not true, check the connections and retry using the "Refresh Data" button. Any changes now made can be updated to the XL-750 by pressing the "Write to XL-750" button in the lower right corner.

6.2 Clock Setup Page

This tab contains XL-750's time and operational settings.

Local Time Settings

Local Standard Time and Local Daylight Time Offsets
The time offsets 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*. For UTC operation, both values should be set to zero.

Local Time
When a XL-750 is connected, this clock-face will be active, and is a preview of the current time according to the current daylight saving and local time rules shown in the configuration tool.

Choose City
The "Choose City" button provides a convenient way of selecting time offset and daylight saving parameters using a PC's time-zone database.

Set Daylight Time Using

This allows configuration of the XL-750's automatic Daylight Saving changes based either on a fixed date or a fixed rule for calculating a date that will be different depending on what year it is. Accurate information, specifying the date and time that daylight saving "Starts" and "Ends", are required for correct observance.

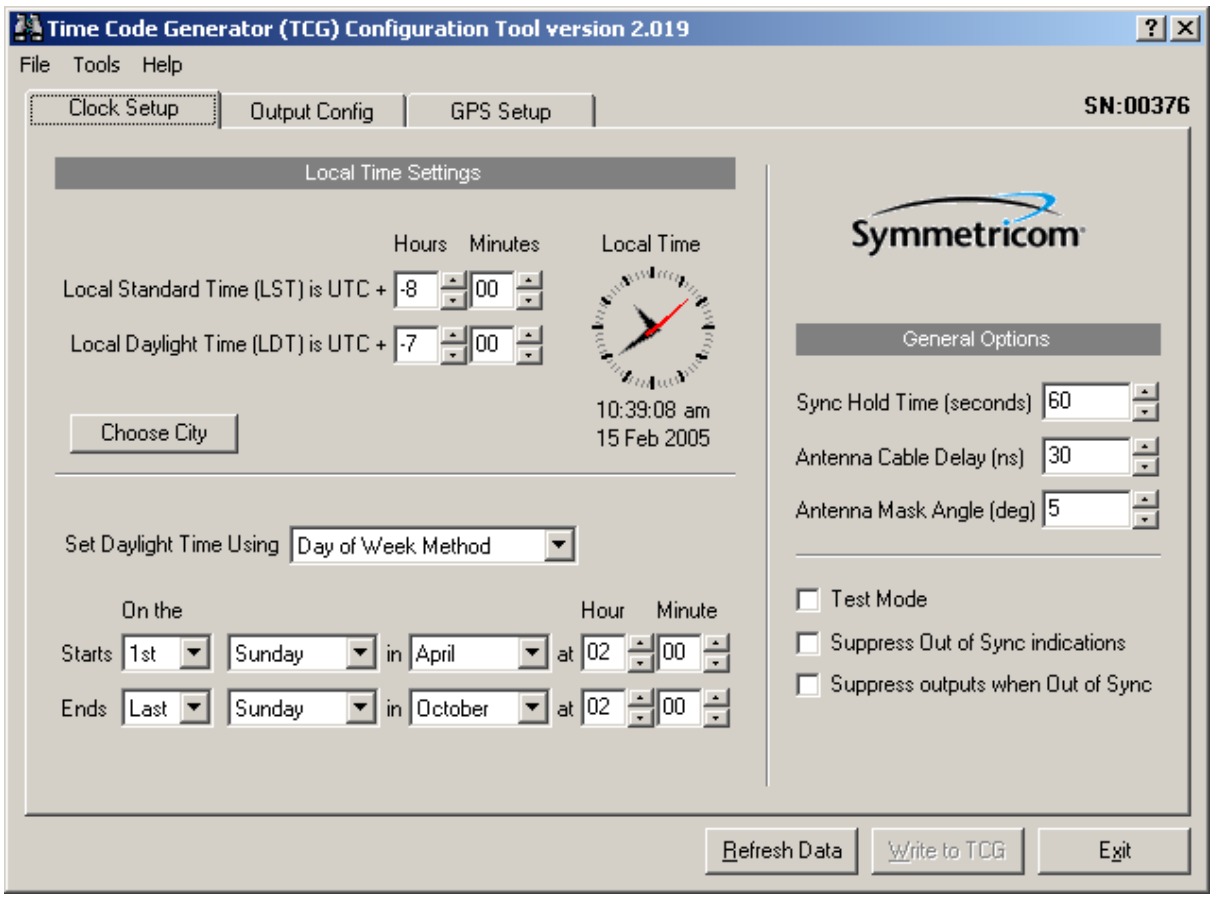


Figure 9. "Clock Setup" Page

General Options

Sync Hold Time

The "Sync Hold" parameter is used to control the time duration, with no satellites visible, that will be tolerated before XL-750 will release the "sync" relay and show loss of sync. The XL-750's antenna should be sited with a good view of the sky so that the unit normally tracks four or more satellites. In areas with poor GPS coverage, there may be occasions where tracking is momentarily lost. The accuracy of the XL-750's outputs, even when there is a complete satellite "blackout", is maintained to within a few micro-seconds over time periods of around a minute, and to within 200 µS for up to 40 minutes. The presence of just one satellite signal is sufficient to reset output accuracy to within 1 µS and, therefore, reset the Sync Hold timeout. The factory default setting is 60 (1 minute delay).

☛ In typical SCADA operations, time syncing to within 0.5 mS is considered adequate, 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, XL-750 performance is more than adequate. This may be a worthwhile strategy to minimize unnecessary "loss of sync" (relay drop-out) alarms when the sky view is very obstructed, or in extremely hostile electromagnetic environments.

Antenna Cable Delay Compensation
This parameter is measured in nanoseconds (nS). All antenna systems introduce delay due to the characteristics of the antenna cable. The XL-750 compensates for this delay to optimize the precision of the output signals. The standard 50ft (15 m) cable, supplied with the XL-750, introduces 60 nS of delay so, for this cable, ensure the antenna cable delay is set as “60”.

Mask Angle
This is the elevation above the horizon below which specific satellite signals will not be used in time and position calculations. The 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.

Test Mode
Test Mode forces the XL-750 to provide all outputs as if it is in sync at all times, even if there is no antenna attached. The sync relay will be on at all times, regardless of the true sync state. During test mode, the XL-750 display will flash a warning.

☛ This is a test-only mode and should not be used during normal operation.

Suppress Out of Sync Indications
This option makes the XL-750 operate as if it is in sync at all times, even if there is no antenna attached. The sync relay operation is unaffected by this option and will still indicate the true sync state of the XL-750.

Suppress Outputs When Out of Sync
This option suppresses the XL-750’s output signals on P2, P3, P4, P5 and the Time Server when the clock goes out of sync. The sync relay operation is unaffected by this option and will still indicate the true sync state of the XL-750.

6.3 Output Configuration Page

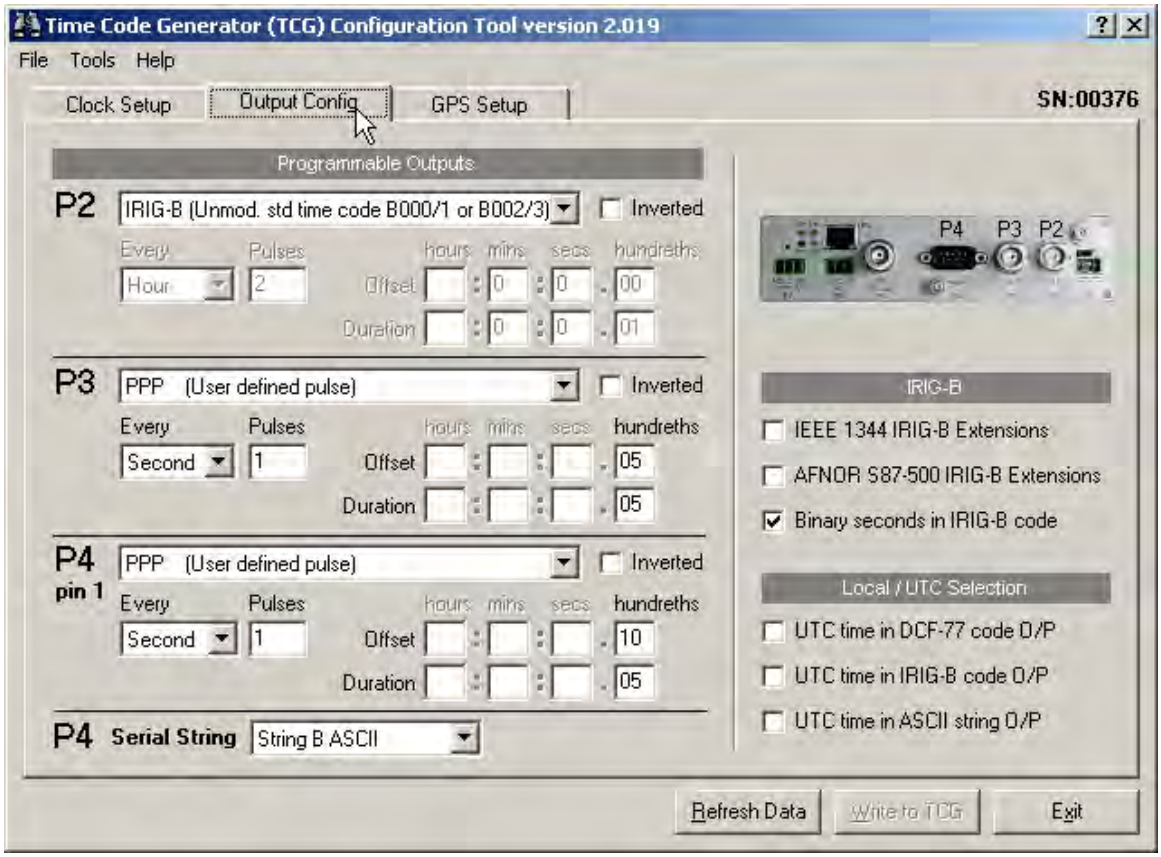


Figure 10. "Output Config" Page

Programmable Outputs

P2 / P3 / P4-pin 1
Each of the three outputs (**P2**, **P3** and **P4-pin 1**) can be programmed to give one of four different output waveforms. Selection between the four options is done via a drop-down menu.

The options available ***independently*** for each output are:

- DCF-77 output pulse simulation
- IRIG-B NRZI (B000/B001 or B002/B003)
- IRIG-B Modified Manchester Encoded (B220/B223 or B221/B222)
- User-defined Pulse Sequence (separate definition stored for each output)

When the User-defined pulse option is selected for any outputs, further parameters are entered to define the pulse sequence. A separate set of parameters is defined for each output specified to use a user-defined pulse sequence. The parameters are as follows:

a) A drop-down menu allows the user to choose to have pulses output "Every" "second", "minute", "hour", or "day".
b) The "Pulses" field defines the number of pulses that will be produced in the selected time interval. Selection is automatically constrained to even divisors of the time interval. For example, if the time interval selected is per minute or

per hour, then the “Pulses” parameter is limited in values to 1, 2, 3, 4, 5, 6, 10, 12, 15, 20 or 30. For more information, position the mouse pointer over the “Pulses” field or “Every” dropdown and press the F1 key.

c) The “Offset” data entry boxes specify how much time elapses into the defined time interval before pulsing starts. Data validation rules ensure that only sensible entries can be made.

d) The “Duration” data entry boxes specify the length of individual pulses.

Figure 11 (page 22) shows the settings for a user-defined pulse on the P4-pin1 output. The values shown will result in a single pulse per minute. The offset specification shows that the pulse does not begin until 59.99 seconds into the minute. The duration spec shows that it lasts for just 1/100th of a second, or 10 mS. These settings of the pulse output on P4-pin1 are normally used, in conjunction with the “NTGS ASCII” Serial String on P4, to give an NTGS synchronization protocol (see Appendix D, page 36).

P4 Serial String

The serial port output **P4** normally operates at the fixed data rate of 9600 baud, no matter what output string option is specified. There is no flow control of any kind provided. Unless specified otherwise, all serial string options are sent in 8-bit, no parity format. The standard XL-750 does not offer any polled message options, but rather, has a selection of broadcast messages that are sent at regular intervals. The broadcast repetition rate of each particular serial option is inherent in the option specification (mostly one message per second). For a complete list of all output strings, consult Appendix D p36 or select the appropriate output string and press F1 for an online description.

IRIG-B Options

Binary Seconds in IRIG-B

The “Binary Seconds” field is an option specified by IRIG standard 200-98. If this option is checked, all of the outputs programmed for IRIG-B code, including the amplitude-modulated output, will include the “Binary Seconds of Day” data.

IRIG-B Extensions

IRIG Standard 200-98 specifies a 27-bit control field in the IRIG-B time codes, but does not define the content. There are now two standards defined for the use of these control bits, IEEE 1344 and AFNOR NF S87-500.

IEEE1344 Extensions (US origin)

The IEEE 1344 IRIG-B extensions define data for:

- year
- impending leap second info
- local time offset info
- impending daylight saving change info
- time-quality figure

AFNOR S87-500 Extensions (European origin)

The AFNOR NF S87-500 extensions define data for:

- day of year
- day of week
- year
- month
- day of month

If either option is checked, *all* of the outputs programmed for IRIG-B code, including the amplitude-modulated output, will include the extension data in the control field.

Local/UTC Selection

UTC Time In DCF-77, IRIG-B, ASCII String O/P
When checked, UTC time will be output in this time code. When not checked, local time, using the XL-750's current Local Standard Time and Daylight Saving Time settings, will be output.

6.4 NTS Setup Page

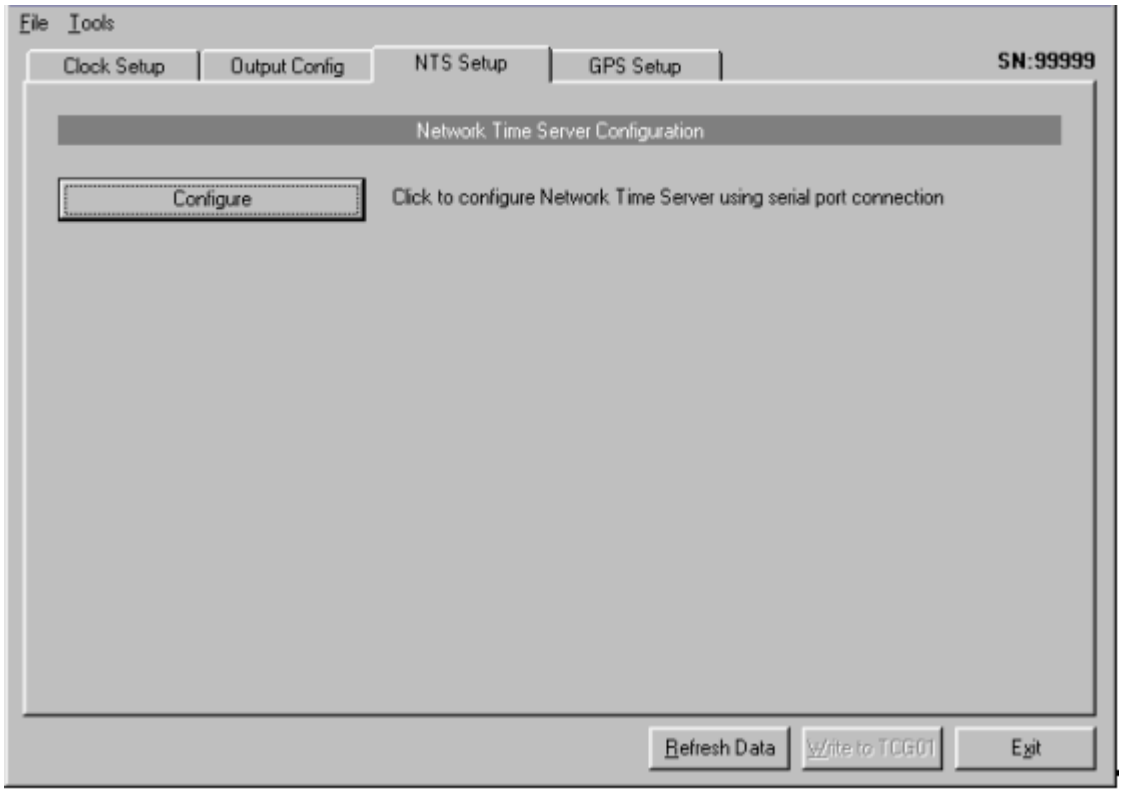


Figure 11. "NTS Setup" Page

The NTS Setup Page is displayed only if a XL-750 unit has a Network Time Server (NTS) fitted. Appendix C p31 contains detail about how to install and configure the network time server option.

6.5 GPS Setup Page

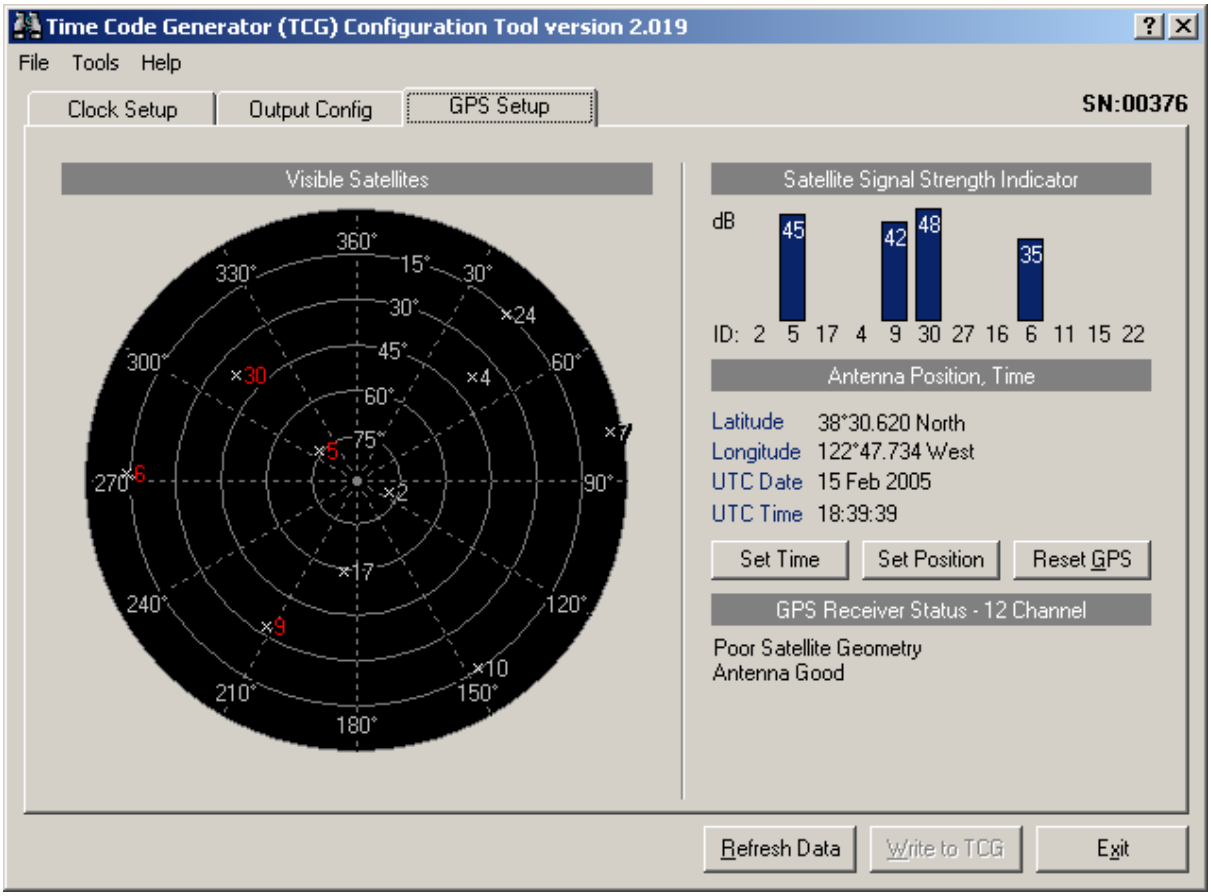


Figure 12. GPS Setup Page with Trails and Minimum Elevations Turned On

The GPS Setup Page provides information about the GPS system. It allows also some commands to be sent to the GPS.

Visible Satellites
Visible satellites are shown on a polar-display where the rings are 'elevation' markers and the sectors mark 'azimuth'. The center of the display is where all the azimuth lines converge, and represents directly overhead, or looking straight up, and the elevation = 90° at this point. The edge of the display, elevation = 0°, represents the horizon. The 'azimuth' is a compass direction where 0° represents true north, 90° is east, 180° is south. Satellites are represented by x's. If a satellite is being tracked for time, it will have a red number next to it.

Right clicking over the Visible Satellites area brings up a menu where satellite trails (green lines) and a minimum elevation plot (the blue lines) can be turned on. Over time, the blue line will show the horizon line, as well as areas where there is poor GPS constellation coverage.

☞ **GPS satellite orbits are inclined 55° to the equator. For the best GPS visibility in higher latitudes (closer to the poles), position the GPS antenna with a clear view of the equatorial sky. For example, in Alaska, position the antenna with a clear view of the southern sky. In Australia, position the antenna with a view of the northern sky.**

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.

Antenna Position/Time
This function shows the current position and time. Time and position can only be set if the XL-750 has not tracked satellites since being powered up. One way to achieve this is to remove the antenna and cycle unit power. Another way is to use the "Reset GPS" button, although in this case the GPS will then lose all its satellite positioning information, past satellite history and time calculations. It will take time (normally half an hour) to recover.

☛ **A full reset of the GPS in XL-750 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 XL-750 can be used as a convenient signal source for testing the ability of externally attached equipment to correctly process received time codes through particularly critical time transitions, such as the 28/29 February rollover during leap years. It also allows the correct operation over daylight saving 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.

Appendix A – Antenna Details

A.1 Antenna Cable Specification

The XL-750 unit's standard shipping configuration includes 50 feet (~15 m) of Belden 9104 (type 59) coax with BNC(m) and TNC(m) connectors. A BNC(f) to SMA(m) adapter is included that mates the cable to the SMA connector on the XL-750 rear panel.

Cable Description:

- 20 AWG solid .032" bare copper-covered steel conductor
- gas-injected foam polyethylene insulation
- Duobond® II and a 67% aluminum braid shield
- PVC jacket.

☛ **While the cable shielding is sufficient, 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 30 cm may be used as a guideline.**

The GPS receiver embedded in the XL-750 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 XL-750.

A.2 Antenna Specification

Antenna description:

- Frequency: 1575 +/- 2MHz
- Polarization: Right Hand Circular
- Axial Ratio: 3 db max
- Impedance: 50 Ohms
- VSWR: <=1.5:1
- Gain: 00,12dB,26dB,36dB
- Voltage: 00,05,RG
- Connector: TNCF,BNCF
- Magnet: NM(No)
- Finish: Weatherable Polymer
- Color: W,S,O
- Weight: 8 oz

A.3 Antenna Assembly

The Antenna Assembly consists of the following items:

- L1 GPS Antenna
- PVC Pipe Antenna Mount
- Belden 9104 cable
- SMA adapter

- Two hose clamps

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 XL-750 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 which method will be used to mount the antenna. For example, strapping the PVC pipe to a frame on the edge of the building. Note that the base of the pipe needs to be accessible for the cable entry. If this is not practical, a hole or slot can be made in the side of the pipe.

3. Unscrew the PVC pipe from the GPS antenna.

4. Pass the TNC end of the Belden 9104 cable through the PVC pipe - from the unthreaded end of the pipe to the threaded end.

5. Firmly hand tighten the TNC connector to the GPS antenna.

6. Firmly hand tighten the threaded end of the PVC pipe into the GPS antenna.

7. Mount the PVC pipe to the building structure using the method determined in step 2.

Appendix B – Event Time-Tagging Option

B.1 Introduction

General Description & Specification

The XL-750's Event Time-Tagging Option provides for the recording of events on two independent input channels. Each channel accepts TTL-level inputs and has a drive burden of between 5 and 10 mA. The two channels share a common signal return line, but are fully isolated from the XL-750 chassis.

Event time is deemed to be the rising edge of a pulse. The minimum pulse duration is 1 μS, and the maximum rate of time tag recording is 100 tags per second (aggregated over both inputs). In the event of pulses occurring simultaneously on both inputs, both events are captured and recorded independently with the same time data.

Tag Data

Time Tags use UTC time, and each tag includes the year, day of year, hour, minute and second, as well as fraction of second to a resolution and accuracy of 100 nS. The XL-750 measures time internally in 40 nS intervals, rounding to the nearest 100 nS for time tag storage purposes, thus allowing accuracy to equate to resolution. Each tag record includes the input channel number, as well as the clock sync status as at the tag time.

Tag Storage

The XL-750 stores Time Tags in a data queue designed as a circular buffer. The maximum number of time tags that may be stored is 512. If further events occur when the buffer is full, the XL-750 sets an overflow status and continues storing tags, overwriting the oldest data first.

Tag Retrieval

The user can retrieve time tags from the buffer using a request/response protocol operating over the XL-750's serial interface. Tags are retrieved from the buffer with the oldest data first.

The XL-750 can be configured to broadcast either status or serial time strings over the serial port. Most users of the time tag option will want to suppress all broadcast outputs to simplify the task of time tag data collection. However, if output strings *are* programmed, then the XL-750 will still output time tag information when requested, timing the responses to avoid interference with the other traffic on the port.

B.2 XL-750 Command / Response Message Structure

All command and response messages used by XL-750 have the same structure:

Prefix:	2 bytes (ASCII "@" characters)
Type:	2 bytes (ASCII alphabetic characters - case matters!)
Data:	n* bytes (may be ASCII or binary data)
Checksum:	1 byte, Binary XOR over all bytes in the "Type" and "Data" fields
Suffix:	2 bytes (ASCII <CR><LF>)

* The length of the “Data” field is determined by “Type”. Command/Response pairs share the same “Type”, but the length of the Command “Data” field may differ from the Response “Data” field.

XL-750 units have a large command-response set, but most are used by the proprietary configuration software only and are not detailed here. Units equipped with the Time-Tagging option provide four command/response message pairs that specifically support Time Tag management and retrieval.

B.3 XL-750 Commands Related to Event Time Tagging

These commands (and their responses) contain ASCII characters only. The configuration utility shipped with each XL-750 includes a basic ASCII terminal function (under the “tools” menu) that provides a convenient way to explore the Time-Tagging command/retrieval functions manually. Note that the XL-750 native serial protocol does *not* include station addressing. In a network-connected system, the address of the Serial to Ethernet interface device can serve as the station address. Symmetricom can supply such devices if required.

Ps command: Get Status

Invokes a **Ps** response that contains the clock status – which includes the number of tags currently in the time-tag event buffer.

Ps Command: Transmitted format: @@**Ps#**<**CR**><**LF**> 7 bytes, numbered 0-6

Ps Response: Rcvd format: @@**Ps**{26 data bytes}{cs}<**CR**><**LF**> 33 bytes, numbered 0-32

Byte # Description (Data bytes only, bytes 4-29 in received message)

4	Antenna feed fault–[A] only if antenna line is short or open circuit*
5	No GPS Solutions–[T] only if no satellites are available for time calculations*
6	S/N level low – [S] only if S/N level is abnormally low for more than an hour*
7	Oscillator Error High – [X] only if Oscillator Control value is extreme*
8	Oscillator DAC out of range – [H] or [L] only if Oscillator Control tending towards extreme*
9	GPS Fail – [B] only if internal GPS receiver sub-system not operating properly*
10	Not implemented – ASCII [space] always
11	Tracking Satellites – [0-9] = # of satellites in time solution (see note 1 below)
12	Receiver Operating Mode – [0-5] see note 2 below
13 – 15	Time Tag Queue Indicator – [000-512, 999] # of tags in queue (999=overflow)
16 – 18	Outage Indicator – [000-999] Hours since receiver was last locked to GPS signals. Becomes non-zero one hour after loss of lock. Resets to zero when lock is reacquired.
19 – 20	Outage Indicator – [00-59] Minutes since receiver was last locked to GPS signals. Becomes non-zero one minute after loss of lock. Resets to zero when lock is reacquired.

21 Oscillator Correction. Most significant 4 bits of 16-bit D/A converter used for oscillator control. Range is ASCII [@] to [O] (hex 40 to hex 4F)
22 Oscillator Correction. More significant 6 bits of 16-bit D/A converter used for oscillator control. Range is ASCII [@] to [del] (hex 40 to hex 7F)
23 Oscillator Correction. Least significant 6 bits of 16-bit D/A converter used for oscillator control. Range is ASCII [@] to [del] (hex 40 to hex 7F)
23 Frequency Error. Local Oscillator frequency offset as compared with GPS received signal. In ASCII, ±00000-99999 referenced to 1E-12

Notes concerning the **Ps** command:

* An ASCII [space] is transmitted if there is no alarm condition present.

1. XL-750 can track up to 12 satellites simultaneously. The message limitation of 9 is to retain compatibility with older equipment using this message format.

2. mode=0: GPS searching for satellites
mode=1: GPS Poor Satellite Geometry
mode=2: GPS fix 2D (3 satellites)
mode=3: GPS fix 3D (4 or more satellites)
mode=4: GPS Automatic site survey
mode=5: GPS position hold (most accurate time)

Pc command: Clear Time-Tag Buffer

Invokes a **Pc** response that returns the number of time-tags that were in XL-750's event buffer when the **Pc** command was received. The event buffer is then cleared.

Pc Command: Transmitted format: @@**Pc3**<**CR**><**LF**> 7 bytes, numbered 0-6

Pc Response: Rcvd format: @@**Pc**{3 data bytes}{cs}<**CR**><**LF**> 10 bytes, numbered 0-9

Byte # Description (Data bytes only, bytes 4-6 in received message)
4 – 6 ASCII [000-512, 999] Number of time-tag entries in XL-750 queue before reset.

Pt command: Get next Time-Tag

Invokes a **Pt** response that contains a single time-tag record – the oldest one in the data queue. Successive "Pt" commands will result in successive time tag data being retrieved. If the queue is empty, the **Pt** response is a null time tag. (ASCII [0] characters in all fields except delimiters).

Pt Command: Transmitted format: @@**Pt$**<**CR**><**LF**> 7 bytes, numbered 0-6

Pt Response: Rcvd format: @@**Pt**{26 data bytes}{cs}<**CR**><**LF**> 33 bytes, numbered 0-32

Byte # Description (Data bytes only, bytes 4-29 in received message)
4 Day of Year in ASCII, 001 to 366
7 Delimiter, ASCII [:] (hex 3A)
8 – 9 Hour of Day in ASCII, 00-23
10 Delimiter, ASCII [:] (hex 3A)
11 –12 Minute of Hour in ASCII, 00-59
13 Delimiter, ASCII [:] (hex 3A)

14 – 15 Second of Minute in ASCII, 00-60

16 Delimiter, ASCII [.] (hex 2E)

17 – 23 Fraction of Second in ASCII (100's of nanoseconds), 0000000-9999999

24 Quality Indicator. Codes are
ASCII [space] (hex 20) if receiver locked, sub-100 nS Output accuracy
ASCII [?] (hex 3F) if receiver unlocked for more than 1 minute
ASCII [*] (hex 2A) if receiver in alarm mode – antenna fail

25– 27 Outage Indicator – [000-999] Hours since receiver was last locked to GPS signals. Becomes non-zero one hour after loss of lock. Resets to zero when lock is reacquired.

28 Delimiter, ASCII [#] (hex 23)

29 Number of Time-Tag Channel in ASCII, 1-2

Pr command: Repeat last Tag Sent

Invokes a Pr response that contains a single time-tag record – the same data that was sent in response to the last Pt command.

Pr Command: Transmitted format: @@**Pr"<CR><LF>** 7 bytes, numbered 0-6

Pr Response: Rcvd format: @@**Pr**{26 data bytes}{cs}<**CR**><**LF**> 33 bytes, numbered 0-32

Data format is identical to **Pt** data format above.

Appendix C - Network Time Server Set-Up

C.1 Configuration Requirements

Configuration of the NTS involves setting the unit's TCP/IP networking parameters (IP Address, Net-Mask and Gateway IP Address settings), the number of tracked satellites required to initiate the Server function, and optionally, the IP addressing data needed for SNMP status reporting. Although not strictly necessary, it is usual to assign a fixed IP address to the NTS module, even in network environments operating with a DHCP Server. This allows NTP client software on all workstations to be permanently programmed to poll to the fixed address of the NTP Server.

☛ It is beyond the scope of this document to discuss TCP/IP addressing concepts in detail. The configuration instructions below assume some familiarity with the TCP/IP networking environment and Network Operating System utilities such as "Ping", "Telnet" and "Arp".

The following TCP/IP information is required to configure the NTS properly:

- The fixed local network address (IP address) to be assigned to the NTS.
- The number of bits in the Netmask that the local network assigns to hosts. The default setting of "0" results in automatic allocation.
- The IP address of the gateway router (only necessary if the NTS is required to service clients on multiple sub-nets) The default is all null – no subnets.
- The IP address(es) to which SNMP status information should be sent (should be set to null if no SNMP status reporting is required – the default setting.)
- The name of the SNMP community to which the NTS is to belong (should be set to null if no SNMP status reporting is required – the default setting.)

C.2 Methods for Accessing "Set-Up Mode"

There are two ways to access the timeserver's configurable options:

a) **Using Configuration Software:** By connecting the XL-750 to a Windows PC using the supplied serial-serial cable, and using the "Configure NTS" button in the "NTS Setup" tab of the configuration program. See the section on page 24 for details on configuration program operation.

   This method has the advantage of being *always* available. There is no need to know the network address of the unit beforehand, and there is no password protection using this configuration method.

b) **Using Telnet:** Network Port Login using a "Telnet" connection to communicate directly with the NTS module over the network.

   This method has the advantage of not requiring the operator to be present at the installed location. However, the existing IP address of the NTS must be known before a Telnet connection can be made. The following information describes how to achieve this connection.

Both methods access the same options and menus. A complete description of the NTS "Set-Up Mode" configuration menus and options starts on p31.

C.3 Using Telnet to Access "Set-Up Mode"

Provided that the NTS IP address is already configured and known, then the time server can be configured using a Telnet Session to port 9999 on the known NTS IP address.

If the NTS IP address is *not* configured, an address must be temporarily assigned before network access can be gained. A temporary IP address can be assigned in one of two ways:

a) DHCP addressing:

Networks that include a DHCP server offer automatic address allocation via **D**ynamic **H**ost **C**onfiguration **P**rotocol. (DHCP). The XL-750 NTS will automatically operate within a DHCP environment to fetch a dynamic address if it does not already have a fixed address configured. Each Symmetricom NTS unit has a unique system name that will show up on the DHCP Server's active lease list within a few seconds of the DHCP Server granting an address to the NTS. Examination of the list will reveal the allocated address. The naming convention used by the NTS is a "C" followed by the last six characters of the NTS device's permanent MAC address. Each XL-750 unit equipped with the NTS server function carries an additional label on its base that shows the permanent MAC address of the unit.

For example: If the XL-750 unit has a base label MAC Address of 00-20-4A-72-08-B7, then the DHCP name of the NTS is: C7208B7.

b) ARP addressing:

The ARP method is available under UNIX and Windows-based systems and can be used in systems where no DHCP server is present. The XL-750 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 (found on the label on the base of XL-750).

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 port 1 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.

C.4 NTS Set-Up Mode Menu

The NTS Set-Up mode menu displays first a summary of the current configuration of the Symmetricom NTS sub-system, followed by a menu offering several options. The set-up mode menu display is similar for both serial and network access.

```
Hardware: Ethernet Autodetect
IP addr – 0.0.0.0/DHCP/BOOTP/AutoIP, no gateway set
DHCP device name : not set
******* Symmetricom NTS parameters *******
SNTP Ref.Identifier : “GPS” Encryption is disabled
Visible Satellites : 1
******* Symmetricom NTS parameters *******
Community Name : public
Enter 1. Trap destination IP Address : --- not set ---
Enter 2. Trap destination IP Address : --- not set ---
Enter 3. Trap destination IP Address : --- not set ---
Enter 4. Trap destination IP Address : --- not set ---
Enter 5. Trap destination IP Address : --- not set ---
Syslog IP addr : --- not set --- --- not set ---
Syslog facility code: 0

Change Setup :
0 Basic parameters
1 NTS configuration
7 Factory defaults
8 Exit without save
9 Save and exit
Your choice ?
```

Figure 13. NTS Set-Up Mode - Main Menu

0 - Basic Parameters

This menu option allows permanent values to be assigned to the basic address parameters of the NTS module. As a minimum, the primary IP Address should be set. The other parameters that can be specified under this menu are:

- Gateway IP Address
- Number of bits in Netmask

If the primary IP address is not changed from the default null value, then this menu will also included an option for setting the DHCP name. When operating with a DHCP-assigned address, the Symmetricom NTS has a permanently assigned DHCP name of Cxxxxxx where xxxxxx is the last 6 digits of the MAC address of the unit (shown on the label on base of the XL-750 unit.) Despite appearances, the DHCP name is *not* changeable under this menu option.

1 - NTS configuration

Selecting this option brings up prompts to set up the parameters required to operate the NTS 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 XL-750 NTS option supports fully encrypted requests from up to 6 clients simultaneously. 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**".

No. of 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 XL-750's true 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 Symmetricom NTP server provides status monitoring to Network Management systems through the use of SNMP trap messages. The parameters that can be set 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 NTS.

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 unit. 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.

Once configuration is complete, the set-up session may be terminated via option **9 Exit and Save.** The NTS will then reset and begin normal operation. (Note that the "HyperTerm" response on the PC may well go "strange" as soon as the NTS resets. This simply indicates that XL-750 has reverted to normal operation on the serial port, transmitting whatever output options are programmed via the XL-750 configuration program.)

C.5 Time Server Operation

The time-server's operation is completely automatic once it is correctly configured for the network. Time-server configuration info is retained indefinitely when the unit is not powered (like all other XL-750 configuration data). The time-server responds to time requests from multiple clients using either SNTP or NTP protocol. If the option is selected, the server will also broadcast time messages on a regular basis. The most common protocol in use is SNTP. A sample SNTP client (freeware) for use on Windows-based PC's (prior to Windows XP) is included with each XL-750 equipped with the NTS option. Windows XP contains an NTP client as part of the operating system.

Correct operation of the Network Time Server can be verified by installing an SNTP client on any Windows-based PC attached to the network. An effective client, "SymmTime" is included on the XL-750 product CD-ROM. The most current version of SymmTime is also available as a free download from the following URL:
http://www.ntp-systems.com/symmtime.asp.

All that is required to use "SymmTime" is, after the program is installed on the PC, add the IP address of the XL-750 NTS to the list of Time Servers, and select it. "SymmTime" will then use this address to fetch time information and sync the PC clock. "SymmTime" installs complete with a list of internet time server addresses. To avoid any confusion, it is suggested that the user remove all of these addresses, leaving only the local NTS address.

The green **lnk** LED indicator on XL-750 lights when a network cable (UTP drop cable) is correctly connected between the XL-750 RJ45 port and the local network hub/switch. The other green LED, the **lck** indicator, lights up steadily when the NTS is correctly synchronized with UTC time. Provided that XL-750 is already synced to UTC time from the GPS satellite constellation (Front Panel **SYN** led on), the **lck** indicator should stabilize and remain on. If the **lck** indicator does *not* stabilize "on", even though XL-750 is in sync with the GPS time, the most likely problem is that the NTS "satellites" parameter (see page 34) is set at too high a value.

The two lower indicators **err** and **sec** should remain off during normal operation. These indicators may flash for a few seconds immediately following power-on, but after the unit has initialized and has a valid network address, they should go off and stay off. They will flash continually when the NTS module is in set-up mode.

Appendix D – Serial Output Strings

D.1 NGTS Time Code O/P on P4

This serial time code option is an ASCII time string transmitted once per minute. The string is sent during the last quarter of the last second before the minute rollover to which the data in the string refers. It is normally used in conjunction with a 10mS pulse programmed for output on P4-pin1 and generated once per minute, finishing precisely on the minute. (See Section 6.3 p20 for details on programming pulses.)

The NGTS time code string content is:

character no.	meaning	value / value range
1	"T" ASCII T	$54
2	tens year	$30-39
3	unit year	$30-39
4	tens month	$30-31
5	unit month	$30-39
6	tens day	$30-33
7	unit day	$30-39
8	day of the week	$31-37 (Monday=1)
9	tens hours	$30-32
10	unit hours	$30-39
11	tens minutes	$30-35
12	unit minutes	$30-39
13	status (0=local, 1=UTC)	$30-31
14	CR (carriage return)	$0D
15	LF (line feed)	$0A

Example: T020422112340<CR><LF>
Reads: Monday 22 April 2002 – 12:34 local time

D.2 IRIG J-17 Time Code O/P on P4

This serial time code option is fully specified in IRIG Standard 212-00. The string is transmitted once every second, with the leading edge of the "start" bit of the first character (<SOH>) exactly on the second mark to which the message data refers. The message data is thus transmitted immediately after the event. The accuracy of the positioning of the message start is limited by the latency of the serial port transmission hardware to within 150 μS of the Second mark. For many applications, this accuracy is sufficient for this message to be used for synching purposes as well as providing the time data.

The data format is specified to be 9600, 7-bit ASCII, odd parity.

The IRIG J-17 string content is:

character no.	meaning	value / value range
1	SOH (start of header)	$01
2	day of year: hundreds	$30-$33
3	day of year: tens	$30-$39
4	day of year: units	$30-$39
5	":" ASCII colon	$3A
6	hour: tens	$30-$32
7	hour: units	$30-$39
8	":" ASCII colon	$3A
9	minute: tens	$30-$35
10	minute: units	$30-$39
11	":" ASCII colon	$3A
12	second: tens	$30-$36
13	second: units	$30-$39
14	CR (carriage return)	$0D
15	LF (line feed)	$0A

Example: <SOH>112:12:34:36<CR><LF>
Reads: day 112, time 12:34:36

D.3 String A Time Code O/P on P4

This code is very similar in data content to the IRIG J-17 code (see above), but adds a two-character data field containing the year data, and uses 8-bit ASCII, no parity data format. The string is transmitted once every second, with the leading edge of the "start" bit of the first character (<SOH>) exactly on the second mark. The accuracy of the positioning of the message start is limited by the latency of the serial port transmission hardware to within 150 μS of the Second mark.

The String A string content is:

character no.	Meaning	value / value range
1	SOH (start of header)	$01
2	day of year: hundreds	$30-$33
3	day of year: tens	$30-$39
4	day of year: units	$30-$39
5	":" ASCII colon	$3A
6	hour: tens	$30-$32
7	hour: units	$30-$39
8	":" ASCII colon	$3A
9	minute: tens	$30-$35
10	minutes: units	$30-$39
11	":" ASCII colon	$3A
12	second: tens	$30-$36
13	second: units	$30-$39
14	":" ASCII colon	$3A
15	year: tens	$30-$39
16	year: units	$30-$39
17	CR (carriage return)	$0D
18	LF (line feed)	$0A

Example: <SOH>112:12:34:36:02 <CR><LF>
Reads: day 112 of year 2002, time: 12:34:36

D.4 String B Time Code O/P on P4

This code substitutes a “Quality” indicator byte for the year field, but otherwise is identical in form, function and timing to String A described above. The string is transmitted once every second, with the leading edge of the “start” bit of the first character (<SOH>) exactly on the second mark. The accuracy of the positioning of the message start is limited by the latency of the serial port transmission hardware to within 150 μS of the Second mark.

String B string content is:

character no.	Meaning	value / value range	“Quality” values
1	SOH (start of header)	$01	
2	day of year: hundreds	$30-$33	$20 (space) = in sync
3	day of year: tens	$30-$39	
4	day of year: units	$30-$39	$2E (.) = < 1uS
5	“:” ASCII colon	$3A	
6	hour: tens	$30-$32	$2A (*) = < 10uS
7	hour: units	$30-$39	
8	“:” ASCII colon	$3A	$23 (#) = < 100uS
9	minute: tens	$30-$35	
10	minute: units	$30-$39	
11	“:” ASCII colon	$3A	$3F (?) = > 100uS
12	second: tens	$30-$36	
13	second: units	$30-$39	
14	“Quality” character	see column	
15	CR (carriage return)	$0D	
16	LF (line feed)	$0A	

Example: <SOH>112:12:34:36?<CR><LF>
Reads: day 112, time: 12:34:36, >100uS sync error

D.5 String C Time Code O/P on P4

This code is effectively a combination of String A and String B, and provides both year information and a sync indicator field. It uses 8-bit ASCII, no parity data format. The string is transmitted once every second, with the leading edge of the "start" bit of the first character (<CR>) exactly on the second mark. The accuracy of the positioning of the message start is limited by the latency of the serial port transmission hardware to within 150 μS of the Second mark.

String C string content is:

character no.:	**Meaning**	**value / value range**
1	CR (carriage return	$0D
2	LF (line feed)	$0A
3	Quality	space = in-sync, "?" = out-of-sync
4	" " ASCII space	$20
5	year: tens	$30-$39
6	year: units	$30-$39
7	" " ASCII space	$20
8	day-of-year: hundreds	$30-$33
9	day-of-year: tens	$30-$39
10	day-of-year: units	$30-$39
11	" " ASCII space	$20
12	hour: tens	$30-$32
13	hour: units	$30-$39
14	":" ASCII colon	$3A
15	minute: tens	$30-$35
16	minute: units	$30-$39
17	":" ASCII colon	$3A
18	second: tens	$30-$36
19	second: units	$30-$39
20	"." ASCII period	$2E
21	"0" ASCII zero	$30
22	"0" ASCII zero	$30
23	"0" ASCII zero	$30
24	" " ASCII space	$20
25	" " ASCII space	$20
26	" " ASCII space	$20

Example: <CR><LF>?_02_112_12:34:36.000_ _ _ ("_" denotes a space)
Reads: day 112 of year (20)02, time: 12:34:36, out-of-sync

D.6 String D Time Code O/P on P4

String D is similar in content to String B, but the second mark is at the leading edge of the start-bit of the (<CR>). The accuracy of the positioning of the message start is limited by the latency of the serial port transmission hardware to within 150 μS of the Second mark.

D.7 String E Time Code O/P on P4.

8--bit ASCII, no parity data format. The string is transmitted once every second, with the leading edge of the "start" bit of the carriage return (<CR>) exactly on the second mark. The accuracy of the positioning of the message start is limited by the latency of the serial port transmission hardware to within 150 μS of the Second mark.

The String E string content is:

character no.	Meaning	value / value range	"Quality" values
1	SOH (start of header)	$01	
2	year: hundreds	$30-$39	
3	year: tens	$30-$39	
4	year: units	$30-$39	
5	":" ASCII colon	$3A	
6	day of year: hundreds	$30-$33	$20 (space) = in sync
7	day of year: tens	$30-$39	
8	day of year: units	$30-$39	$2E (.) = <1uS
9	":" ASCII colon	$3A	
10	hour: tens	$30-$32	$2A (*) = <10uS
11	hour: units	$30-$39	
12	":" ASCII colon	$3A	$23 (#) = < 100uS
13	minute: tens	$30-$35	
14	minute: units	$30-$39	
15	":" ASCII colon	$3A	$3F (?) = < 100uS
16	second: tens	$30-$36	
17	second: units	$30-$39	
18	"Quality" character	See column	
19	CR (carriage return)	$0D	
20	LF (line feed)	$0A	

Example: <SOH>004:112:12:34:36?<CR><LF>
reads: year (2)004, day 112, time: 12:34:36, >100uS sync error

Certificate of Volatility

This product does not have a certificate of volatility.

Statement of Calibration

This product does not require calibration.

FCC Certificate

See the following page.

CE Certificate

See the following page.

Warranty Statement

Symmetricom, Inc. (Symmetricom) warrants for a period of TWO 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 Symmetricom 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 Symmetricom, freight prepaid. Symmetricom, 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.

Symmetricom 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.

There are no understandings, agreements, representations or warranties, express or implied, including warranties of merchantability or fitness for a particular purpose, other than those specifically set out above or by any existing contract between the parties. Any such contract states the entire obligation of Symmetricom. The contents of this document shall not become part of or modify any prior or existing agreement, commitment or relationship.

The information, recommendation, description and safety notations in this or other documents supplied by Symmetricom are based on general industry experience and judgment with respect to such hardware and software. THIS INFORMATION SHOULD NOT BE CONSIDERED TO BE ALL INCLUSIVE OR COVERING ALL CONTINGENCIES. NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS, DESCRIPTIONS AND SAFETY NOTATIONS CONTAINED HEREBYAND IN HARDWARE AND SOFTWARE SPECIFICATION DOCUMENTATION, OR INSTRUCTIONS SUPPLIED BY Symmetricom. In no event will Symmetricom be responsible to the user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss of equipment, plant or power system, cost of capital, loss of profits or revenues, cost of replacement power, additional expenses in the use of existing software, hardware, equipment or facilities, or claims against the user by its employees or customers resulting from the use of the information, recommendations, descriptions and safety notations supplied by Symmetricom. Symmetricom liability is limited (at its election) to (1) refund of buyer's purchase price for such affected products (without interest); (2) repair of such products, or (3) replacement of such products, provided however, that the buyer follows the procedures set forth herein.

Warranty claims must be received by Symmetricom within the applicable warranty period. A replaced product, or part thereof, shall become the property of Symmetricom and shall be returned to Symmetricom at the Purchaser's expense.
A return material authorization number issued by Symmetricom must accompany all return material.

NOTES

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

Ethernet is a trademark of XEROX Corporation. UNIX is a registered trademark of The Open Group. Windows 95, Windows 98, Windows 2000, Windows NT and HyperTerminal are trademarks of Microsoft Corp. WinOncore12 and Oncore are trademarks of Motorola Inc.

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.

Customer Assistance Centers

For technical support, please contact Symmetricom's Timing, Test and Measurement Division (TTM) using contact methods described below, or go to http://www.symmetricom.com/ and click "Support" for more information.

Symmetricom's Customer Assistance Centers are a centralized resource to handle all of your customer needs.

Customer Assistance Center Telephone Numbers:
Worldwide (Main Number): 1-408-428-7907
USA, Canada, Latin America including Caribbean, Pacific Rim including Asia, Australia and
New Zealand: 1-408-428-7907
USA toll-free: 1-888-367-7966 (1-888-FOR-SYMM)
Europe, Middle East & Africa: 49 700 32886435

Technical Support can be obtained either through the Online Support area of Symmetricom web site, or by calling one of the above Customer Assistance Center numbers. When calling the worldwide, or USA-based number, select Option 1 at the first prompt. Telecom Solutions Division customers should then select Option 1; Timing, Test and Measurement Division customers should then select Option 3. How do I know which division to call about my product?

Technical Support personnel are available by phone 24 hours a day, 7 days a week through the Main Customer Assistance Center number above and from 8 am to 5 pm Central European Time, weekdays, at the Europe, Middle East and Africa number.

Customers who have purchased Technical Support Contracts may e-mail support requests to:
mailto:support@symmetricom.com (Americas, Asia, Pacific Rim)
mailto:emeasupport@symmetricom.com (Europe, Middle East, Africa)

Customer Service
For quotations, order placement, order scheduling or status, to schedule services or to reach your account manager or customer service representative call one of the above Customer Assistance Center numbers. When calling the worldwide, or USA-based number, select Option 2 at the first prompt. Timing, Test and Measurement Division customers should then select Option 2.

Customer Service personnel are available by phone 7 a.m. to 5 p.m. Pacific Time (USA) weekdays through the Main Customer Assistance Center number above and 8 am to 5 pm Central European Time, weekdays, at the Europe, Middle East and Africa number.

Repairs
If you're fairly experienced with our product and are sure you need a unit repaired, you can Request a Repair from this site or by downloading the form offered at the link and sending it to the e-mail address in the form. If you're not certain about the problem, we suggest you try phoning Technical Support first to troubleshoot the issue and be certain a repair is necessary.

If you need status, repair pricing, expected turnaround time or other information about your repair, call one of the above Customer Assistance Center numbers. When calling the worldwide, or USA-based number, select Option 3 at the first

prompt. Timing, Test and Measurement Division customers should then select Option 2.

Repair Administration personnel are available by phone 8 a.m. to 5 p.m. Pacific Time (USA) weekdays through the Main Customer Assistance Center number above and 8 am to 5 pm Central European Time, weekdays, at the Europe, Middle East and Africa number. For more information about repairs, advance replacements and warranty coverage, click here.

Other kinds of Service

Do you need training, installation, on-site maintenance, advance replacement support, planning, design or other services related to your Symmetricom products? Our Global Services division offers services to help you lower costs, ensure quality and save time. Our team of dedicated specialists includes many former customers and we provide all-inclusive statements of work that guarantee the price we quote won't change. Whatever the need, we're willing to help. Call us at one of the Customer Assistance Center numbers above. Whatever the need, we're here to help with a dedicated team of experienced professionals.

Comments, complaints and suggestions are always gladly accepted.
mailto:customer_relations@symmetricom.com