NTP s5000 Series
Network Time Protocol Server

Installation Manual

Models Covered:
NTP s5000 MSF & DCF-77
NTP s5100 GPS
NTP s5500 Dual GPS \ MSF \ DCF-77

Date: **30 Mar 2007**
Version: **1.0.004**

Table of Contents

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE: For PLUGGABLE EQUIPMENT, the socket outlet shall be installed near the equipment and shall be easily accessible.

Introduction

Network Time Protocol (NTP) can be used to synchronize the time on network clients, across an IP network, to the correct time of an NTP time server. TimeTools NTP s5000 NTP Server provides a stratum 1 NTP Time Server for ensuring the time is correct across an entire network.

The NTP s5000 Network Time Server acquires time from the MSF or DCF-77 Radio Signals or GPS satellite constellation and distributes time across a network using the TCP/IP Network Time Protocol (NTP).

Network managers appreciate the fact that the NTP s5000 is a complete time server housed in a self-contained rack-mountable unit.

Cost savings are achieved by the simple configuration and installation compared to configuring a conventional workstation as a time-server. Savings continue with the elimination of software upgrade costs and network synchronization management.

Key Features

Stand-alone dedicated Stratum 1 NTP Time Server.
Robust 1U high, rack-mountable enclosure.
Linux based, fully static design, **no unreliable hard hard disk-drives.**
Convenient front panel display, detailing time, and signal integrity.
10/100 Base-T Ethernet connectivity.
Can accurately synchronise the time on any NTP or SNTP compatible client including: Windows 95,98, ME, NT, 2000, XP, Novell 5 & 6, UNIX and CISCO Routers and Hubs.
Web, Telnet, FTP and RS232 remote configuration.

Key Benefits

- Highly reliable and secure source of time for your Network.
- Easy to install, configure and maintain.
- Accurately synchronize mission critical network operations and applications across thousands of network clients.
- Secure source of time inside your firewall.

NTP s5000 Hardware

The NTP s5000 is complete NTP time server housed in a 1U high rack-mountable enclosure. It has a 20 character by 2 line backlit LCD display for status and configuration information. The rear of the unit has 4 connections: RJ45 network, antenna, console and power.

Power

Integrated Universal 85-264 VAC, 47-440 Hz CE/UL/CSA Approved PSU
Standard IEC inlet.
Power consumption: approx 12W

Console

RS232 9-Way ‘D’ Type connection for status and configuration via dumb terminal emulator (Windows Hyper-terminal).
Terminal settings: 9600 Bits/Sec, No Parity, 8 Data Bits, 1 Stop Bit.

Antenna Connection

NTP s5000: MSF-60 Radio Antenna. RS232 9 Way ‘D’ type connection.

NTP s5100: GPS Antenna, TNC connection.

Ethernet Network

10/100 BaseT RJ45 Auto sensing

MSF Radio Antenna Installation – NTP s5000

The NTP s5000 is supplied with the TimeTools MPS Professional MSF radio antenna.

The MPS Professional MSF Antenna is an advanced antenna, specifically designed to provide good radio signal reception in poor signal conditions. The antenna can be wall mounted, indoors or outdoors, up to 100m from the host computer.

- Guarantees signal reception in most areas.
- Weather-proof IP66 Antenna, can be wall mounted, outdoors, if required.
- 100 meters maximum cable length (5 meters supplied).
- Can utilise CAT 3/4/5 point to point structured cabling. Cable length easily increased using UTP/STP patch cables.
- No batteries or external power supply required.

MSF Antenna Location

The MSF time signal is transmitted from Rugby in the East Midlands, UK.

The MSF radio antenna is a directional antenna which ideally needs to be mounted horizontally, perpendicular to the source of the radio transmission. Holding the antenna in an upright position with the cable exiting the bottom of the antenna, point the face of the antenna in the general direction of Rugby.

The antenna needs to be mounted above ground away from any sources of electrical interference. Metal structures can act as a Faraday cage blocking signal penetration. Therefore, the antenna must be located externally of any metal structures.

Removing the lid of the antenna reveals a LED. When powered, the LED will light green. When the antenna has a lock on the time signal, it will flash red / green. The antenna should be re-located or rotated until a regular 1 second pulse is obtained on the LED. If the LED flickers irregularly or does not flash, the antenna must be repositioned.

When configured the NTP s5000 privides a signal strength indicator on the LCD display. This should read a steady 100%, any less indicates loss of timing information. Also displayed is the last decoded time reception.

GPS Antenna Installation - NTP s5100

The NTP s5100 has an integrated GPS receiver. An external antenna provides synchronisation with the global positioning system. GPS solutions can be utilised anywhere in the world.

Two types of antenna can be provided, either a patch type GPS antenna supplied with the s5100 (S51-GNP) or jam-resistant pole-mounting GPS antenna (S51-GNT).

For correct operation, the GPS antenna needs to have an un-obscured view of the sky. As a rule of thumb, the better the view of the sky, the more chance of a good consistent signal lock. Ideally, the antenna should be roof mounted with a 360-degree view of the sky. However, satisfactory operation can often be achieved by sitting the antenna on the side of a building or on a widow sill.

Maximum Cable Length (models s5100 to serial number 511024, s5500 to serial number 611008)

Cable Type	Patch Antenna (S51-GNP)	Pole Antenna (S51-GNT)
TimeTools Standard Coax	23m	30m
TimeTools Low-Loss Coax	30m	50m
TimeTools Ultra-Low-Loss Coax	50m	100m

Maximum Cable Length (models s5100 from serial number 511025, s5500 from serial number 611009)

Cable Type	Patch Antenna (S51-GNP)	Pole Antenna (S51-GNT)
TimeTools Standard Coax	42m	50m
TimeTools Low-Loss Coax	60m	80m
TimeTools Ultra-Low-Loss Coax	150m	175m

GPS Amplifier

Single or multiple GPS in line amplifiers may be installed to significantly increase cable runs, if required (product code: T-AD200-8). GPS amplifiers should be placed in-line on the coax cable at the mid-point between the GPS antenna and receiver.

Surge Suppressors

Externally mounted GPS antennas can be prone to lightning strikes and other electrical surges. TimeTools recommends fitting surge suppressors (product code: SPP-GPS) to all externally mounted GPS antennas. The suppressor should be fitted where the GPS coax cable from the antenna enters the building. The surge suppressor requires a connection to a low-impedance ground. For more information about installing surge suppressors please vist the PolyPhaser web site at: www.polyphaser.com.

GPS Time Acquisition

On power-up the GPS receiver will “search the sky” in order to collect satellite orbital information. This process is fully automatic and, under normal circumstances, will take 3-4 minutes to achieve a signal lock. However, it can take as long as 12 minutes.

NTP s5000 Configuration

The NTP s5000 can be configured in a number of ways:

- Web page via network.
- Via RS232 Console Port to host computer.
- Telnet session via network.

Default Configuration

Security

Console, Telnet, FTP username	admin
Console, Telnet, FTP password	admin
HTTP Web Password	admin

Network Configuration

Host Name	NTP001
Domain Name	-
Name Server 1	-
Name Server 2	-
Syslog Server	-
Network Services	Telnet: Enabled FTP: Enabled HTTP: Enabled
DHCP	Enabled
IP Address	-
Network Mask	-
Default Gateway	-

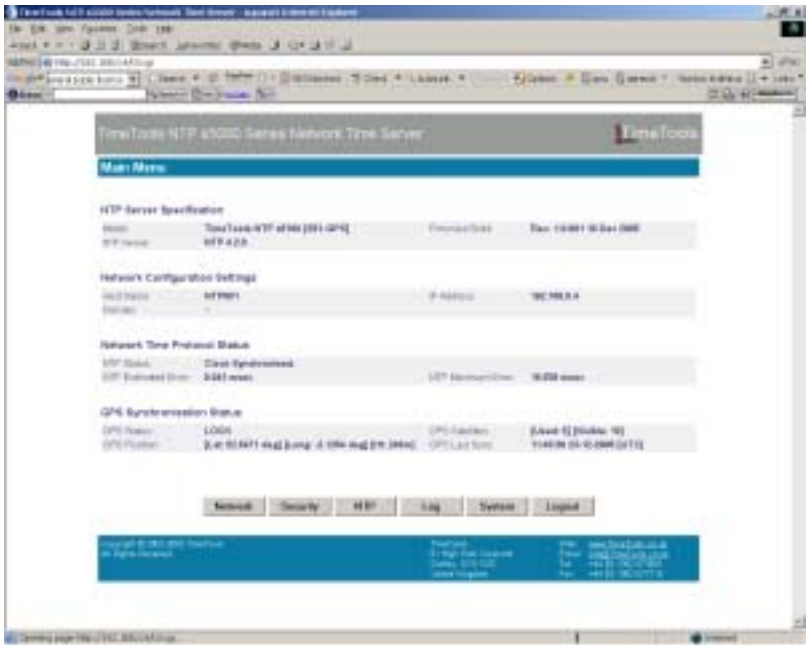
NTP Configuration

External NTP Server Address 1	-
Key	-
External NTP Server Address 2	-
Key	-
External NTP Server Address 3	-
Key	-
NTP Broadcast Address	-
Key	-
Local System Clock Stratum	16
Trusted Keys	-
NTP Keys	-

Web Interface

The web interface can be initiated by entering the IP address of the time server into a web browser, such as Internet Explorer, eg http://192.168.0.4. The user will then be greeted by the login screen.

Configuration Menu



Model	This is the model type of the NTP s5000.
Build	Describes the firmware build revision number and firmware build date.
NTP Version	Network Time Protocol version number currently installed.
Hostname	Hostname of time server.
Domain	Network domain name
IP Address	Network IP address of time server.
NTP Status	Clock Synchronised / Clock Not Synchronised
NTP Estimated Error	Estimated kernel time error
NTP Maximum Error	Maximum kernel time error

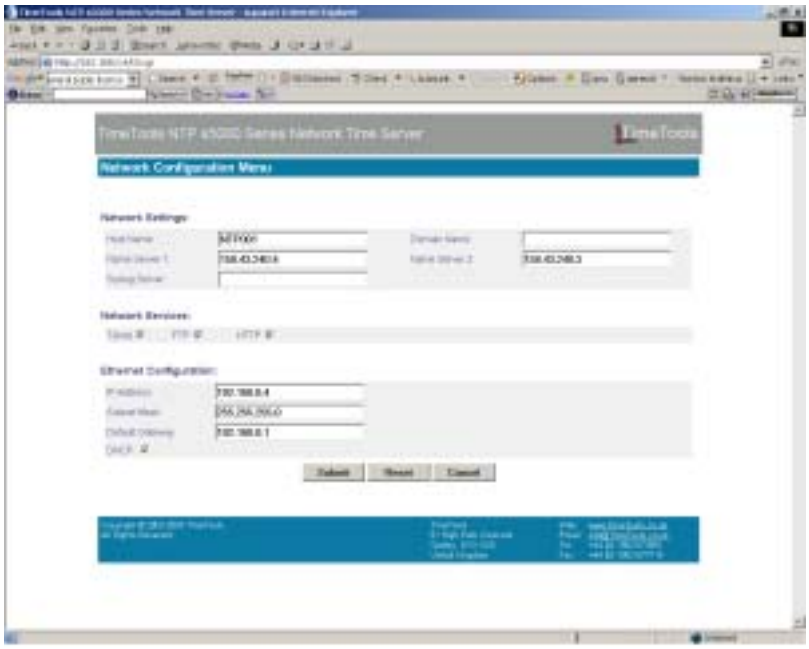
NTP s5000 MSF & DCF-77 Units only

Signal Status	0%-100% Signal strength indication. For good signal reception and decoding a consistant 100% signal strength is required of an extended period of time. NOSIG Indicates either no radio antenna detected, antenna fault or complete lack of signal reception
Last Sync	Last Sync Shows the last successfully decoded time from the radio antenna. A radio time stamp is broadcast once every minute.

NTP s5100 GPS Units Only

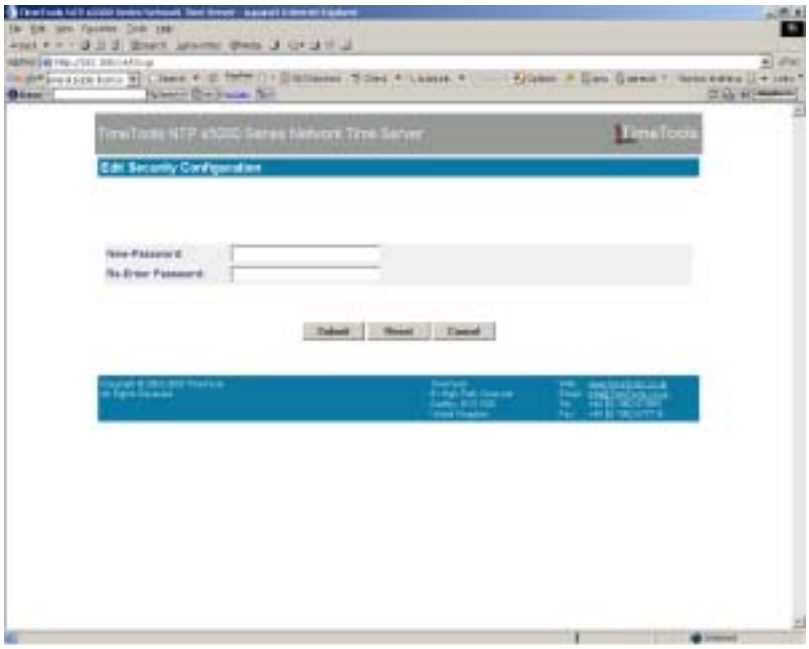
GPS Status	Lock GPS satellite lock has been achieved and receiver operation OK. No Lock GPS satellite lock not acheived or lost. This may be due to poor antenna location. No Comm Indicates no communication with GPS receiver, probable receiver fault
GPS Postion	GPS positioning information, location and height
GPS Satellites	Satellites used in last timing calculation and visible satellites

Network Configuration Menu



Hostname	Hostname of time server.
Domain	Network domain name
Name Server 1	IP address of DNS name server 1.
Name Server 2	IP address of DNS name server 2.
Syslog Server 1	Optional IP address for remote system log (syslog) messages
Network Services	Shows which network services are currently enabled. For added security any or all network services can be disabled
IP Address	Network IP Address of the time server
Subnet Mask	Network mask
Default Gateway	Network default gateway
DHCP	Enable Dynamic Host Configuration Protocol

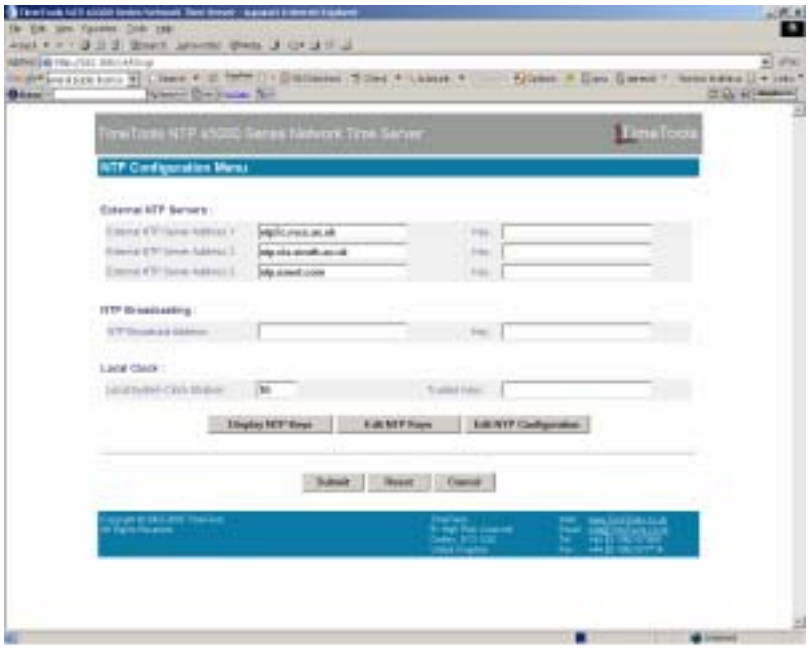
Security Configuration



Change Password Change ‘admin’ password for console and telnet connection.

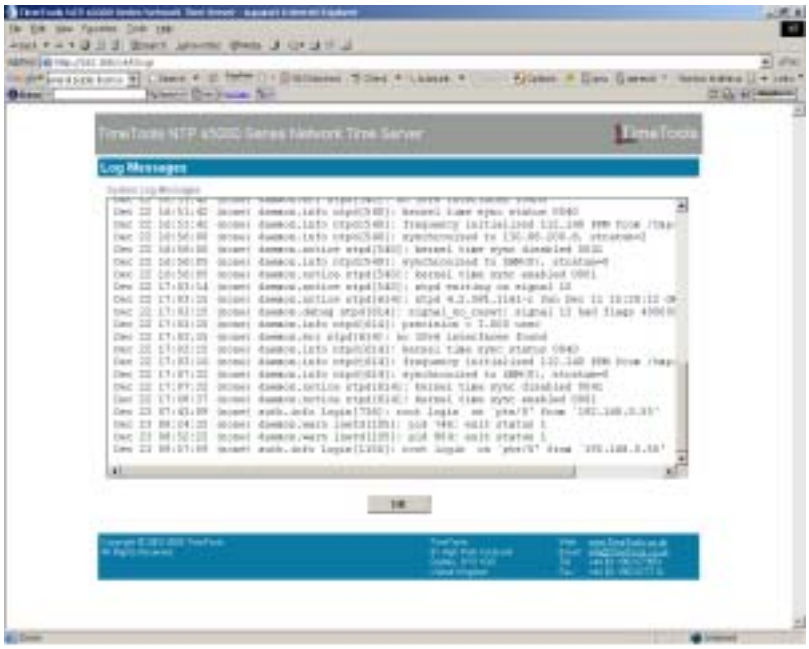
A separate password exists for http (web interface) sessions. The http (web interface) password can only be changed from the web interface.

NTP Configuration Menu



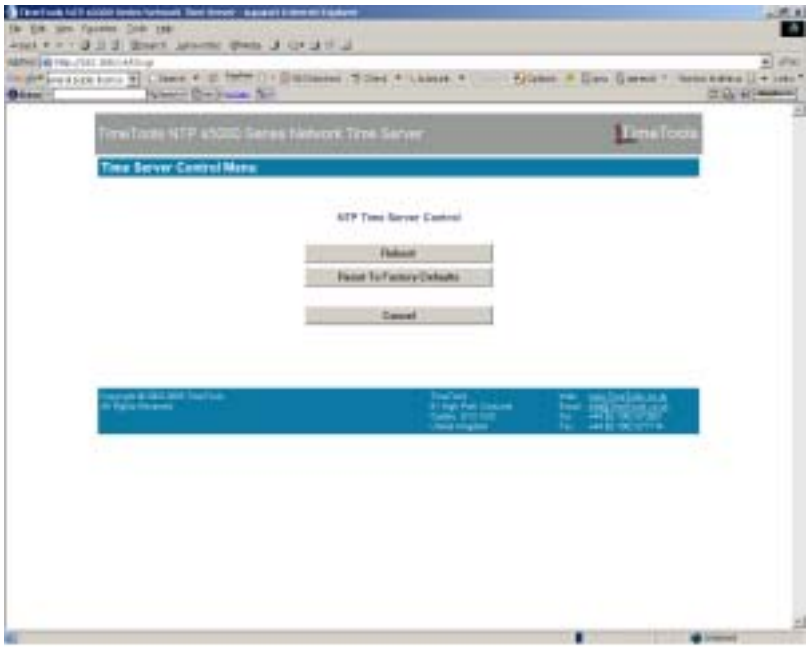
External NTP Servers	Upto three external NTP servers can be peered with the time server to provide backup in the event of primary time source loss or failure. In this mode the local clock can be synchronized to the remote peer or the remote peer can be synchronized to the local clock. This is useful in a network of servers where, depending on various failure scenarios, either the local or remote peer may be the better source of time.
NTP Broadcasting	In broadcast mode the local server sends periodic broadcast messages to a client population at the *address* specified, which is usually the broadcast address on (one of) the local network(s) or a multicast address assigned to NTP. The IANA has assigned the multicast group address IPv4 224.0.1.1 and IPv6 ff05::101 (site local) exclusively to NTP, but other nonconflicting addresses can be used to contain the messages within administrative boundaries. Ordinarily, this specification applies only to the local server operating as a sender; for operation as a broadcast client
Local System Clock Stratum	The local system clock stratum specifies the stratum level of the local system clock that is used as backup in the event of reference clock loss or failure.
Trusted Keys	Specifies the key identifiers which are trusted for the purposes of authenticating peers with symmetric key cryptography, as well as keys used by the `ntpq` and `ntpdc` programs. The authentication procedures require that both the local and remote servers share the same key and key identifier for this purpose, although different keys can be used with different servers. The *key* arguments are 32-bit unsigned integers with values from 1 to 65,534.
NTP Keys	Contains key identifiers and keys controlling authentication of Network Time Protocol (NTP) transactions.

Log Messages



The log messages window displays the current contents of the system log. This includes all NTP information and error messages.

Time Server Control Menu



Reboot	The reboot option restarts the time server. It is used to make any network configuration changes active.
Factory Defaults	The factory defaults menu option reverts all settings back to the factory defaults. However, the console and telnet 'admin' passwords are not changed.

Console Configuration

RS232 Console Configuration

Use the console configuration cable provided to connect the ‘console’ port of the NTP s5000 to a serial port of a computer.

A dumb terminal emulator, such as Hyper Terminal, can then be used on the computer to access the configuration menu of the NTP s5000.

Dumb Terminal Configuration Settings

Connect Using:	Direct to COMx	(where x is the com port number)
Bits per second:	9600	
Data bits:	8	
Parity:	None	
Stop bits:	1	
Flow control:	None	
Terminal Emulation:	ANSI	

Once the dumb terminal has been configured and the console cable connected to the correct COM port, the login prompt will appear by pressing ‘ENTER’.

Telnet Session via Remote Host

The time server can be configured remotely using a telnet session. From a host computer type:

```
telnet xxx.xxx.xxx.xxx
```

where xxx.xxx.xxx.xxx is the IP address of the time server. On successful connection, the login prompt will appear.

Logging On

The default username and password is ‘admin’.

```
Linux 2.4.31 (NTP001) (0)

NTP001 login: admin
Password:
```

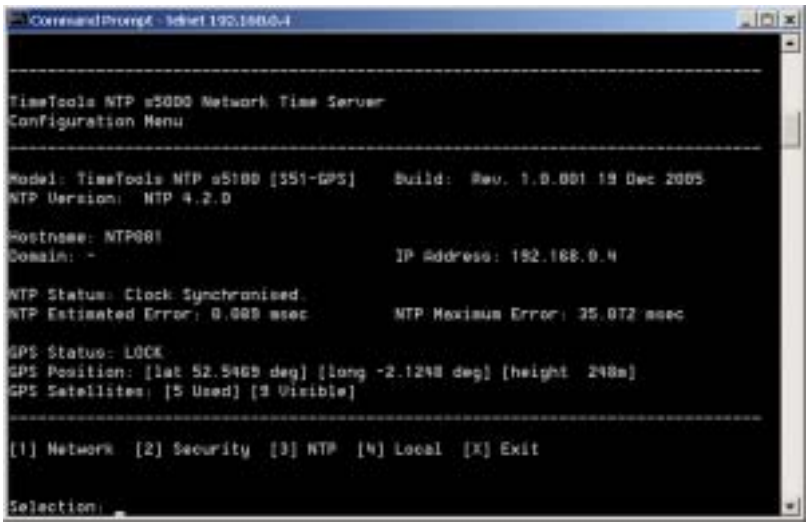
The console configuration menu can be entered by typing ‘console’ at the prompt:

```
/tmp/admin $console
```

The console application provides an easy to use configuration and status tool that is similar in format to the web interface menus.

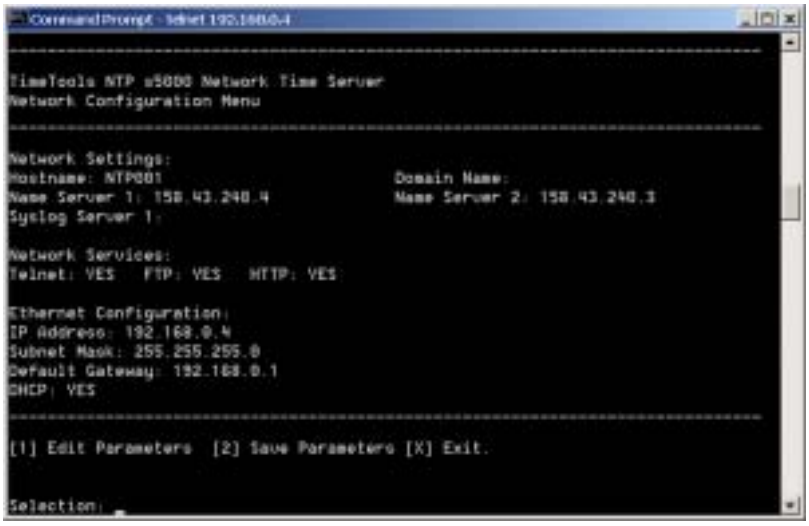
If the NTP s5000 detects no key-presses over a period of 5 minutes, then the console configuration menu will automatically exit.

Configuration Menu



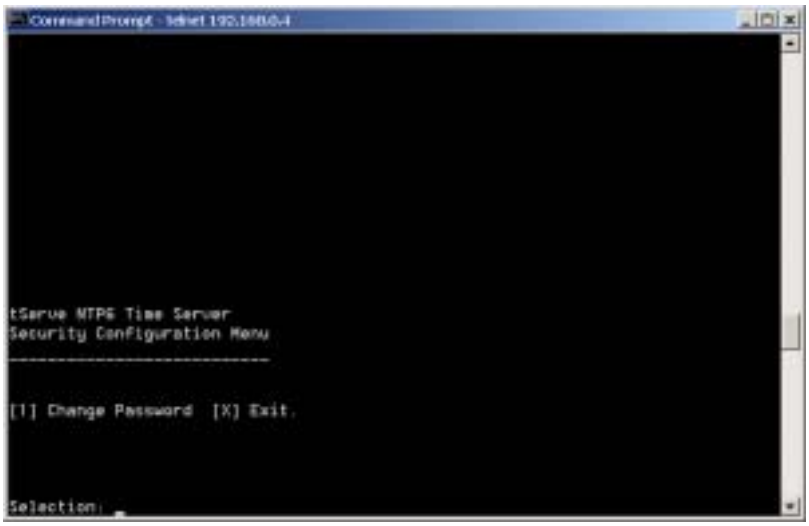
The configuration menu provides network, NTP and reference clock status information.

Network Configuration Menu



The network configuration menu displays the time server network configuration and allows settings to be modified. In order for any network changes to take effect, the time server should be rebooted.

Security Configuration Menu



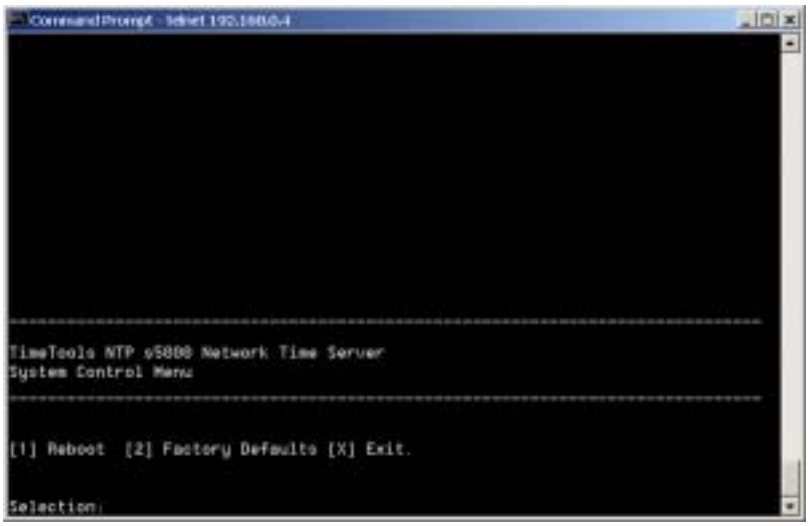
Change Password - Change 'admin' password for console and telnet connection.

A separate password exists for http (web interface) sessions. The http (web interface) password can only be changed from the web interface.

NTP Configuration

Display and edit NTP configuration parameters.

System Control Menu



Allow time server to be rebooted and revert to factory settings.

In order for any network changes to take effect, the time-server should be rebooted.

Reverting to factory defaults does not affect the ‘console’ password. However the http web password reverts to ‘admin’.

NTP Authentication

Symmetric Key Cryptography

The original RFC-1305 specification allows any one of possibly 65,534 keys, each distinguished by a 32-bit key identifier, to authenticate an association. The servers and clients involved must agree on the key and key identifier to authenticate NTP packets.

Keys and related information are specified in a key file. Besides the keys used for ordinary NTP associations, additional keys can be used as passwords for the `ntpq` and `ntpdc` utility programs.

When `ntpd` is first started, it reads the key file and installs the keys in the key cache. However, individual keys must be activated with the `trusted keys` command before use. This allows, for instance, the installation of possibly several batches of keys and then activating or deactivating each batch remotely using `ntpdc`. This also provides a revocation capability that can be used if a key becomes compromised.

NTP Keys

NTP Keys are entered in the following format:

KeyNumber **M** Key

where,

KeyNumber	A positive integer (1 to 65,534)
M	Specifies that Key is a 1-to-8 character ASCII string, using the MD5 authentication scheme.
Key	The key itself.

Trusted Keys

The trusted keys specifies the key identifiers which are trusted for the purposes of authenticating peers with symmetric key cryptography, as well as keys used by the ntpq and ntpdc programs. The authentication procedures require that both the local and remote servers share the same key and key identifier for this purpose, although different keys can be used with different servers. The *key* arguments are 32-bit unsigned integers with values from 1 to 65,534.

NTP s5000 Operation

On power-up the NTP s5000 LCD display will remain blank for approximately 20 seconds, while the unit performs a self-test.

```
(C) 2005 TimeTools
IP: 192.168.0.200
```

LCD Display – Normal Operation (s5000 Radio Versions)

Under normal operating conditions radio versions of the time server display status information on the LCD display on the front panel. NTP time and date, the time stamp of the last radio signal that was decoded and the current radio signal strength are clearly shown.

```
11:09:25  23.12.2005
MSF:11:09   SIG:100%
```

LCD Display – Normal Operation (s5100 GPS Versions)

Under normal operating conditions GPS versions of the time server display status information on the LCD display on the front panel. NTP time and date, the GPS signal status and the number of satellites used in the last timing calculation and the number of visible satellites.

```
11:09:25  23.12.2005
GPS:LOCK    SAT:9/12
```

LCD Display – Normal Operation (s5500 Dual GPS \ Radio Versions)

Under normal operating conditions dual GPS \ Radio versions of the time server display status information on the LCD display on the front panel. NTP time and date, the GPS signal status and the number of satellites used in the last timing calculation, the number of visible satellites and the current radio signal strength are clearly shown.

The GPS signal status is a two character code, encoded as follows:

Ok GPS operating correctly with satellite signal lock.
Es GPS receiver operating correctly but no current satellite signal lock.
Er GPS receiver communications error. This denotes a receiver fault.

```
11:09:25  23.12.2005
GPS:Ok9/12  MSF:100%
```

NTP s5000 System Logs

System Log

```
File Location: /tmp/admin/messages
View using: ‘cat /tmp/admin/messages’ from console or use FTP or Web interface


Dec 28 11:12:13 (none) syslog.info syslogd started: BusyBox v1.00 (2005.06.29-14:57+0000)
Dec 28 11:12:13 (none) daemon.info inetd[76]: Online and ready (2 sockets)
Dec 28 11:12:14 (none) daemon.info LCD[84]: Starting LCD display handler daemon. LCD Handler 1.1.000
Dec 28 11:12:14 (none) daemon.notice ntpd[89]: ntpd 4.2.0@1.1161-r Sun Dec 11 15:28:12 GMT 2005 (3)
Dec 28 11:12:14 (none) daemon.debug ntpd[89]: signal_no_reset: signal 13 had flags 4000000
Dec 28 11:12:14 (none) daemon.info ntpd[89]: precision = 2.000 usec
Dec 28 11:12:14 (none) daemon.info ntpd[89]: kernel time sync status 0040
Dec 28 11:12:14 (none) daemon.info ntpd[89]: frequency initialized 8 PPM from /tmp/config/ntp.drift
Dec 28 11:16:33 (none) daemon.info ntpd[89]: synchronized to SHM(0), stratum=0
Dec 28 11:16:33 (none) daemon.notice ntpd[89]: kernel time sync disabled 0041
Dec 28 11:17:39 (none) daemon.notice ntpd[89]: kernel time sync enabled 0001
```

NTP LoopStats

File Location: /tmp/admin/loopstats
View using: 'cat /tmp/admin/loopstats' from console or use FTP or Web interface
Days Kept: 3 days, stored as /tmp/admin/loopstats.yyyymmdd
Description: Records loop filter statistics information. Each update of the local clock outputs a line of the following form to the file generation set named `loopstats`:

```
50935 75440.031 0.000006019 13.778190 0.000351733 0.0133806
```

The first two fields show the date (Modified Julian Day) and time (seconds and fraction past UTC midnight). The next five fields show time offset (seconds), frequency offset (parts per million - PPM), RMS jitter (seconds), Allan deviation (PPM) and clock discipline time constant.

NTP ClockStats

File Location: /tmp/admin/clocklog
View using: 'cat /tmp/admin/clocklog' from console or use FTP
Days Kept: 1 day
Description: Records reference clock statistics information. Each update of the local clock outputs a line of the following form to the file generation set named `clocklog`:

```
29.12.2005-16:20:29) GPS Time Received: 16:20:30 29-12-2005 [UTC]
```

The first field records the time and date the reference clock time stamp was received followed by the received time stamp.

Appendix A: Specifications

Firmware

Linux:	2.4.31
Supported Protocols	NTP 4.2.0, SNTP, TCP/IP, Telnet, FTP, HTTP, RS232 Console

Hardware

Ethernet:	10/100 BaseT RJ45 Auto sensing
Enclosure:	1U High 19" Rackmount
Construction:	1.8mm Aluminium
Dimensions:	483 x 158 x 44 mm
Weight:	2.2Kg
Operating Temperature:	-20C ~ +60C
Power Supply	Universal 85-264 VAC 47-440 Hz CE/UL/CSA Approved PSU
Power Consumption:	12W approx.
Heat Output	41 Btu/Hr

NTP s5100 GPS units

GPS Receiver Type:	12 Channel Fast Acquisition GPS Receiver
GPS Timing Accuracy	100 nanoseconds (0.0000001 sec)
GPS Antenna Connector Type:	TNC

Appendix B: MPS Radio Antenna Dimensions And Fixings

The IP66 Professional Antenna is a weatherproof radio antenna that may be located indoors or outdoors. Removing the lid reveals holes for wall mounting the unit, if required. Cable exit is from the bottom of the antenna, as shown below.

All dimensions (mm)

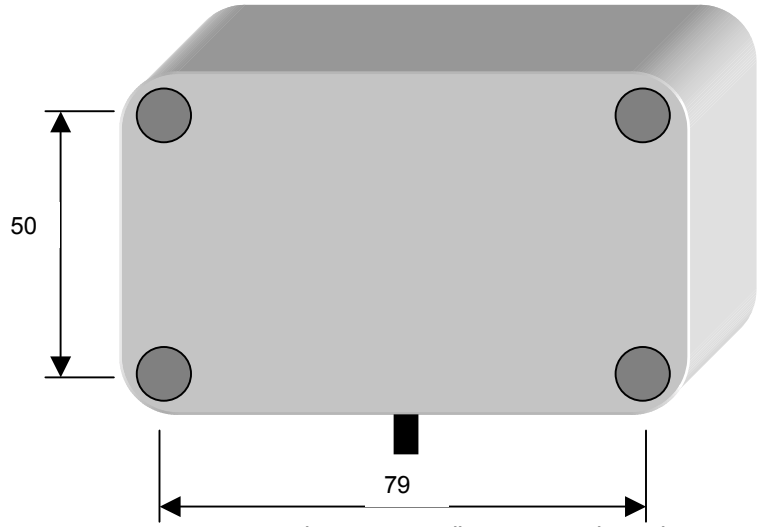
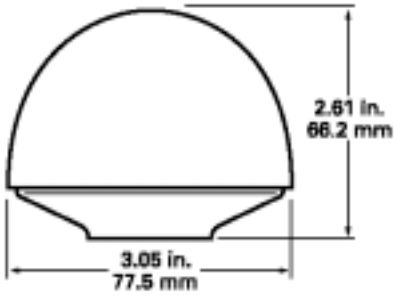


Fig 1. MSF Radio Antenna Dimensions

Dimensions and Specifications

Antenna Type:	Ferrite Active Antenna
Frequency:	60KHz (MSF model) 77.5 KHz (DCF-77 Model)
Mounting:	Wall Mounting
Construction:	Polycarbonate
Antenna Dimensions:	90 x 64 x 56 mm
Weight:	120g
Enclosure:	Fully Weatherproof
Operating Temperature:	-30C ~ +85C
Supplied Cable Length:	5 meters
Maximum Cable Length:	100 meters with CAT3,4 or 5 UTP/STP cable
Connector Type:	RJ45

Appendix C: NTP s5100 (S51-GNT) Pole Mounting Jam-Resistant GPS Antenna



Antenna Type:	Jam Resistant Active GPS Antenna
Mounting:	Pole-Mounting "1-14" straight thread or a standard 3/4" pipe thread
Construction:	Polycarbonate radome / metal base
Antenna Dimensions:	77.5 x 66.2 mm
Weight:	170g
Enclosure:	Water-proof, immersion to 1m
Operating Temperature:	-40C ~ +85C
Supplied Cable Length:	5 meters
Maximum Cable Length:	100 meters with TimeTools ultra-low-loss coax cable (TCX-100)
Connector Type:	TNC

Maximum Cable Length:

Cable Type	Maximum Cable Length
TimeTools Standard Coax	30m
TimeTools Low-Loss Coax	50m
TimeTools Ultra-Low-Loss Coax	100m

Appendix D: NTP s5100 (S51-GNP) Mini Patch Antenna

Antenna Type:	Miniature Patch Antenna
Mounting:	Magnetic\Screw Mount
Construction:	Polycarbonate / metal base
Antenna Dimensions:	25 x 30 x 10 mm
Weight:	30g
Enclosure:	Fully Weatherproof
Operating Temperature:	-30C ~ +85C
Relative Humidity:	95% non-condensing
Supplied Cable Length:	3 meters
Maximum Cable Length:	23 meters with TimeTools 20m coax cable extension (TCX-020)
Connector Type:	BNC

Cable Type	Maximum Cable Length
TimeTools Standard Coax	23m
TimeTools Low-Loss Coax	30m
TimeTools Ultra-Low-Loss Coax	50m

Appendix E: GPS Surge Suppressors

- Industries best RF performance
- Low throughput energy
- Multi-strike capability

Technical Specifications:

Current:	4Adc
Insertion Loss:	≤ 0.1dB
Freq. Range:	800-2500MHz
Mounting:	Bulkhead Flange
Operating Voltage:	+ / -6 Volts
Polarity:	+/-
Protected Side Connector:	N Female 50Ω
RF Power:	0.25 Watts
Surge Side Connector:	N Female 50Ω
Throughput Energy:	≤ 175µJ for 3kA @ 8/20µs Waveform
Turn-On Voltage:	7 Volts
Unit Impedance:	50Ω
Voltage Standing Wave Ratio:	1.1 : 1
Weatherised:	Bellcore #TA-NWT-000487 Procedure 4.11, Wind Driven (120 mph) Rain Intrusion.
UL Approved and Listed	UL497B

Appindix F: Copyright and Permission Notices

Network Time Protocol (NTP) 4.2

```
*********************************************************************
*                                                                   *
* Copyright (c) David L. Mills 1992-2005                            *
*                                                                   *
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