TM2000B / TM2500B

PTP and NTP Time Server
GPS Time Sourced

Installation and Operation Manual
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1 Introduction

The Time Machines PTP Network Time Server is a simple to use GPS sourced time server that will supply accurate time for all computers and time keeping devices on the network. By placing a time server on the local network, PTP and NTP time packets are provided without requiring systems to go to the Internet to get a Stratum 1 time synchronization. The system uses an active GPS antenna to maintain the current time as broadcast by United States GPS satellites. With this device installed on your local network, there is no longer the worry that if the Internet connection goes down, time synchronization is lost across the network. In addition, the TM2000B includes a high precision internal clock based on an OCXO (Oven controller oscillator) that allows the unit to serve accurate time beyond loss of the GPS antenna signal.

The TM2500B differs from the TM2000B in that is has a BNC output to allow for 1PPS or a 10MHz reference signal to be output from the device.

The unit is small and can be placed anywhere within the network layout. The built in high sensitivity GPS receiver is able to lock multiple satellites from within many buildings or from a window location, removing the requirement that outdoor antennas be installed.

Setup and use of this time server is straightforward. Simply connect both the included power supply and the GPS antenna to the base unit and then connect the base unit to the local network. Go to a computer on the network and browse to the device at its default address to enter the software setup within the control box. Set parameters to match your network and the system will start to send out time packets to any device on the system that asks for an update from it. Two servers can be setup to provide redundancy and more capacity.

When paired with our digital Power Over Ethernet (PoE) or WiFi clocks, synchronized time is assured no matter the state of your network, or the state of the internet time server the clocks are pointed to. Accuracy is also improved because the network delay of the internet is highly variable, while the local LAN connection is likely sub-millisecond delay.

TimeMachine GPS based time servers are suited to any application where coordination of events at multiple locations is required. Without coordinated network time, searching for problems across multiple system logs becomes much more difficult. Education, industrial facilities, military installations, public safety command rooms, government, broadcasting, and hospitals are all candidates for synchronized time systems.
2 Installation

2.1 Location
To receive GPS signals the Time Server's antenna must be located in a location where it can “see” the sky. The GPS module itself is highly sensitive and able to “see” the GPS satellite signals from within many structures. Multi-Story or metal structures may block the GPS signals such that the antenna must be located elsewhere. In these cases, the GPS antenna may be located in a window. The Time Server box can be located anywhere on the network. All that is required is power and a wired network connection. In the worst case, an outdoor antenna may be required.

2.2 Connections

2.2.1 Antenna
The GPS antenna is connected through the circular female SMA connector on the rear of the Time Server. By default, the GPS antenna connection provides 5.0V to power the LNA in the GPS antenna. This is correct for the supplied GPS patch antenna with the magnetic base. This voltage can be changed with a jumper on the inside of the Time Server. The Time Server has to be opened up and a jumper moved.

Jumper J8
A: 3.3V  B: 5.0V (default)

The only time this jumper would changed would be to allow use of a different antenna that requires +3.3V max for the LNA in the antenna.

2.2.2 Power
A +12V power supply is supplied with the unit. Connect to your local power outlet and the barrel connector to the rear of the Time Server. The time server will begin trying to find the GPS satellites. On power-up, synchronization to the GPS satellites will take several minutes. No battery backup of position is provided to allow for a warm start so the Time Server is always starting from scratch in determining its location to achieve GPS lock.

2.2.3 Network
Connect the 10/100 RJ45 port on the back of the Time Server to a network connection. Verify that the network settings are correct for your system. See the configuration section of this manual for more information on doing this.

2.2.4 Front Panel Indications
The front panel of the Time Server is very basic in its appearance. Three LEDs show the current status of the unit. The “POW” LED indicates that the unit is receiving power through its wall power supply. To serve time, an accurate GPS lock is required beyond just location information. The GPS lock process proceeds through several steps and can be followed by watching the two front Yellow LEDs, LOCK and SEC. Initially, when no lock is present, the Yellow LEDs will be OFF. When a 2D lock is
achieved, the LOCK LED will begin to BLINK. This is the first stage of GPS lock process. When the LOCK LED goes to a solid ON state, the GPS now has a 3D lock. The last stage of the GPS lock is the timing lock. This signifies that the GPS has the most accurate time base available for use in serving time. To achieve the greatest PTP accuracy, this is required. Once the timing lock has occurred, the SEC LED will begin to blink once per second.

It is also possible for the LOCK LED to turn off, or blink, after a GPS timing lock has occurred and the SEC LED continues to blink. This signifies that the TM2000B has an accurate internal time and is serving time, but is trying to re-establish the timing lock because it was lost for some reason.

3 Configuration

3.1 Web Page – Default username/password is “admin/tmachine”

3.2 Default IP address is 192.168.1.20

All Time Server parameters are accessed on the configuration web page. The page can be accessed by pointing any web browser at the IP address of the Time Server. The initial IP address is 192.168.1.20 from the factory.

3.3 Settings Page
3.3.1 **TM2000 Name**
This is a generic entry that has no effect on the TM2000B operation other than to allow the user to enter a name for the device to help recognize it when parameter updates are required.

3.3.2 **IP Address**
The IP address of the unit set to by entering a standard IPv4 dotted quad in this field. 192.168.1.20 or 10.10.0.96 are examples of acceptable formats for this field. Clicking the Submit button will set the entered IP parameters.

3.3.3 **Broadcast**
The Broadcast entry is used to control the propagation of network broadcast packets on the network and to what level they will propagate from the device. This is frequently opposite of the Netmask setting. This is used by the PTP functions to advertise the presence of the server. Clicking the Submit button will set the entered IP parameters. **THIS IS NOT the address to point NTP and PTP clients at, they should given the IP Address.**
3.3.4 **Netmask**
The Netmask entry determines what addresses are on the local network and what addresses are reached through the Gateway. Typical Netmasks are 255.255.0.0 or 255.255.255.0. Consult the network administrator for more information on how this entry should be set. Clicking the Submit button will set the entered IP parameters.

3.3.5 **Gateway**
The Gateway IP address is used when a destination address is determined to not be on the local network. Consult the network administrator for this setting. Clicking the Submit button will set the entered IP parameters.

3.3.6 **DNS1 and DNS2**
Enter the IP addresses for the DNS servers on your network.

3.3.7 **Disable Web Interface**
This is a security option. Once the device is configured and operating as expected, it is possible to check this box, save the setting, and then reboot that device. From that point forward, the web server is disabled. To recover from this mode, the device must be reset to factory parameters by holding the front button for about 5 seconds. The IP address will be reset and the web page will be active again. This allows for a physical security measure to be used to protect settings of the device.

3.3.8 **BNC Output (TM2500 only)**
On the TM2500B, there is a BNC connector on the back panel. This can be used to output the 1PPS from the GPS, or generated by hardware during holdover, or it can output a 10MHz reference output. Only one output can occur at a time and is selected on this page.

3.3.9 **Serial Port Output**
The output to the serial port is selectable between status information or NMEA strings from the GPS module. The serial port is a USB-Mini connection that will enumerate on most Windows and Linux computers as a serial device. It is set to 115200,n81 communications rate.

3.3.10 **Password**
The Password of the unit can be changed in this field. The existing password is not displayed for security purposes. Enter the new password and click the “Change Password” button to update. The TM2000B will then prompt for the new password to be entered to continue access to the web pages.

* Default Username/Password is “admin”/“tmachine”.
The status page is an information only page. It shows the various pieces of information about the current working state of the device.

### 3.4.1 Time Source
This field displays the current source of time. It can be GPS, Peer Time Server, or Manually set.

### 3.4.2 Location
Location shows the latitude and longitude of the device itself based on the GPS receiver. Paste this set of coordinates into Google Maps to see your location.

### 3.4.3 Date/Time
The Date/Time entry shows the current UTC date and time of the device. This is not updated realtime. Refreshing the page will update this time. Note that it is the clients responsibility to adjust for timezone and daylight savings adjustments.
3.4.4 **Satellites Used**
This shows the current number of satellites that are in view and locked by the GPS receiver.

3.4.5 **GPS Fix**
This displays the level of the current GPS lock.
No GPS Fix – Check cable connections. If connected correctly, likely the antenna needs a better view of the sky. Obstructions, building materials, window tinting can all cause possible signal issues.
2D - GPS satellites found.
3D – Required for serving time.

3.4.6 **NTP Lookups**
This field updates on a page reload and shows how many NTP time requests have been requested from client devices.

3.4.7 **Holdover Time**
When the GPS lock is lost and time is being served by the internal OCXO, this will show the amount of time in minutes that the holdover state has been active.

3.4.8 **MAC**
This is an information only field and displays the MAC address of the Time Server.

3.4.9 **Uptime**
Time elapsed since last boot up.

3.4.10 **OCXO Correction**
This field shows the frequency correction being applied to correct the OCXO back on to its root frequency. This value can be saved or reset from this web page. The purpose of saving this value, after the device has run for a period of a couple hours with 3D lock, is to give a more accurate starting point for the correction algorithm to begin on power up. If for some reason the value seems wrong or not working, a Reset is allowed that will, after a reboot, start the algorithm from default and restart the correction process.

If using the TM2X00B for manual NTP time generation, having the device on the GPS for a period of time to determine the correction, then saving it, will dramatically improve drift of the TM2X00B when operated without GPS reception.

3.4.11 **Version**
Displays current software version running on device.

3.4.12 **Satellites**
This table shows the current list of locked satellites, their signal strengths (SNR), as well as their current location over the planet. Refreshing the web page updates the table to their current values.
3.4.13  NTP Peers

If time is being updated from a Peer time server, then this table shows the current list of Peer servers that are being checked to maintain the time in the TM2000B. Several Fields are displayed for each time server.

- **Peer IP** – The Peer IP address is the first field displayed.
- **Offset** – This is the offset of the peer time servers' time when compared to the internal clock of the TM2000B.
- **Delay** – The round trip delay to the peer time server
- **Stratum** – This field shows the stratum level being reported by the peer time server
- **RootD** – This is the root delay value of the peer time server. This is the time servers reported delay from its location to the root of the NTP time setup. A stratum 1 server is considered to be at the root of an NTP setup/design.
- **Reach** – This is a bit field that shows the result of the last 8 lookup attempts of the peer time server. A value of 0xff signifies that the last 8 attempts have been answered by the time server. A successful lookup causes a 1 to be shifted in to the LSB of the byte and all other bits to be shifted 1 bit to the left. A non 0xff value signifies that either the server has just started or that some lookup requests are not getting answered.
- **Next Time** – This is the time that the next request for time from the peer time server will occur. The NTP client of the TM2000B will start out with a check every 30 seconds or so and then expand out if time is tracking well to a couple of minutes. The TM2000B doesn't allow the time sync to extend beyond a few minutes to maintain accurate internal time.

3.4.14  Clients

This area is used to show the current PTP clients. This will display entries only if the TM2000B is in Unicast PTP mode. In multicast mode, the TM2000B isn't aware of all clients getting time from it.
3.5 Update Page

The update page is used to update firmware of the unit. The firmware updates will be archived and available for download from the timemachinescorp.com website. Save the file to the local computers drives. Most likely the file will need to be unzipped. The file type that is used for the update is a .img file. Browse to it using the Choose File button on the Update Page. Once the file is found the update can begin. This process takes 20 to 25 minutes and power should not be removed during the process or the device may be unrecoverable. There are periods of time where there may be little or no indication of the update process occurring, so its important to give it plenty of time. Once completed, the unit will reset and resume operation. Login to the device with a web browser to confirm the version update.

3.5.1 Update Notes:

Some unzip software, Apple MAC computers being one, will extract the files further than they should be. The .IMG file that is contained in the downloaded .ZIP file is actually a file system archive itself, however extraction beyond the .IMG file should not be done as the TM2X000B will do the extraction during the update. The picture below shows the unzip of the downloaded file contents which is all that should be extracted and uploaded for the update.
3.6 SNMP Setup

3.6.1 MIB File-Download TMI-COMMON-SHI.txt
At the top of the page, is the option to download the MIB file for the TM2000B. This is useful in many monitoring systems. It will download to the browser's default download directory.

There are currently 4 supported trap notifications: GPS Lock change alarm, PeerSync Lost alarm, HoldOver expired alarm, and Stratum Change alarm. 14 different web page values are also made available through the SNMPGet system.

3.6.2 Enable
This will enable the SNMP application to startup after bootup.

3.6.3 SNMP Trap Version
This sets the version to SNMPv2 or SNMPv3. It affects format of the trap/inform messages in the next option. If set to V2, then the trap/inform message will only identify itself with the community name with no other security features. The V3 mode supports a username/password combination to be used where the password is hashed with MD5. Full encryption of the SNMP packet is not supported.

3.6.4 Notification Method
This sets the notification method to either Trap or Inform. A Trap messages is an un-acknowledged status packet, while the Inform message is acknowledged by the receiver. The Inform message creates a higher reliability that the receiver received the packet and can act on it. The Trap method is also widely used. Version 2 of these messages is a simpler format and setup, but without the username/password authentication. Version 3 will require the username and password to be setup on the SNMP web page, as well as using the Engine ID setting to synchronize the encryption when using.
Trap messages. Trap/Inform messages are status checked one time per minute.

3.6.5 Trap Receiver IP Address
Enter the IP Address of the device being used to receive the trap/inform packets.

3.6.6 SNMP V2 Community Name
The SNMP community name is used as a simple authentication for Version 2 SNMP packets.

3.6.7 SNMP V3 R/W User Name
Enter the desired SNMPv3 username.

3.6.8 SNMP V3 R/W Password
Enter the SNMPv3 password associated with the username.

3.6.9 SNMP V3 Engine ID
When using SNMPv3 Trap messages, the engine ID needs to match between the trap receiver and the TM2000B as the sender. This entry specifically allows setting of the SNMP engineID. This is handled in this way because the bulk of the file system for the TM2000B is not R/W and parameters that are updated by the SNMP daemon are stored in RAM and lost on a power cycle/reboot. A reboot may be required when setting up Trap messages. Inform messages are a simpler implementation and may be simpler to setup for V3 SNMP.
3.7 NTP Settings Page

The NTP Settings page is used to control the function of the NTP client and server options of the TM2000B.

3.7.1 Start / Stop NTP Server

The NTP daemon can be started and stopped from this page. By default, NTP support is enabled once 3D lock is achieved. Click the desired option and then click the Submit button. Once a time source is available, GPS, Peer, or Manually Set, the TM2000B will enable the NTP server service and NTP requests will be allowed.
3.7.2 Allow 2D Fix for NTP
This checkbox will allow the TM2000B to start serving time once a 2D lock is achieved by the GPS receiver. It is generally better to get a 3D lock as timing accuracy is improved and more stable. The GPS module maker doesn't guarantee accuracy until a 3D lock is achieved, but this option exists if needed. If the TM2000B is capable of getting a 3D lock, then this option should generally be unchecked.

3.7.3 Disable Holdover Limit
When checked, this option allows the holdover limit of the device to extend forever. The TM2000B requires a GPS lock to initially set its time, but by checking this option, it can then be run without a GPS lock. The time WILL drift off of standard at a rate that is dependent on the accuracy of the OCXO of the device, but this option is included for cases where exact accuracy isn't required, just synchronization of devices withing a closed system. Drift has been measured as high as 0.1 seconds per week. This setting also governs the holdover behavior of the PTP modes.

3.7.4 NTP Holdover Time (Minutes)
This setting is used to set how long holdover is allowed GPS lock is lost. The device will change to Stratum 16 when the set holdover time is expired and GPS lock is not achieved.

3.7.5 Remote NTP Servers Enable
Enabling this option, and setting a list of remote NTP servers will allow the TM2000B to get its time from another NTP server using the NTP protocol. When operating in this mode, the TM2000B can begin serving time shortly after it has booted up because it doesn't have to wait for the GPS to lock. It will also allow the TM2000B to operate without a GPS at all if desired. If at some point after boot up, GPS lock is obtained, then the GPS becomes the time source and Peer NTP lookups are stopped. Once the TM2000B has obtained a lock, if it is lost it will not return to the Peer NTP servers for time maintenance, even after the holdover period has expired.

3.7.6 Remote NTP Servers List
The NTP Servers list allows setting of up to three different time sources. The TM2000B runs a version of the Linux NTP daemon that will select the “best” source for setting its time, but will also keep tabs on all of the time sources. If authentication is being used, a key values, 1-65535 can be entered into the key field on the same line as the server.

3.7.7 Serve Time Only With Authentication
Checking this option will set the server into an authenticated client only mode. Normally, if a ntp.keys file has been uploaded, and the client sends authentication credentials, the TM2000B will check and respond with authentication. If a client does not send an NTP request with authentication information, then the TM2000B will respond with a non-authenticated packet. However, if this mode is selected, the TM2000B will only respond to clients that have valid authentication included in the NTP request.

3.7.8 Authentication-Upload Key List
Starting is version 0.3.4, the NTP server of the TM2000B supports authentication. Both MD5 and SHA1 are supported. While these are not considered cryptographically secure in this modern age of
computing, subsequent standards for NTP authentication remain in flux and these are the most common requirements. They maintain the compatibility required of most NTP clients requiring authentication.

A standard ntp.keys file can be uploaded through this page. Simply choose the file to upload from your local computer and allow the upload to complete. This is a one way transaction, there is no way to pull the ntp.keys file from the TM2000B back to the local browser.

The allowed formats for the key file are as follows (this is the default key file in the device):

```
# ntp.keys file
#
#Two types of keys supported, MD5 and SHA1
#Line Format:  Key # <space> Key Type <space> Key
#Key# is a positive integer number greater than 0
#Key Type is either (M)D5 or SHA(1)
#Key:  For MD5 is a character string 1-32 character ASCII String, or for SHA a 40 character hex string
1 M tmachine
3 SHA1 D5C9F80F7B1220D9710049AE41FB5BB5B18D148E
```

A matching copy of the ntp.keys file will need to be entered on the client device, or remote server if the Peer Time Server mode is being used.

If setting up a NTPD implementation, the ntp.conf file on the server will need to include directives to load the key file and authorize them. There are many tutorials on the Internet that discuss setting up authentication on the NTPD implementation. The minimum extra commands that get added to the ntp.conf file are: keys, trustedkey, and the updates to the individual server lines. Other clients supporting authentication will have other instructions to follow.

### 3.7.9 Set TM2000B time manually

This set of fields allows the TM2000B to have its time set manually from the web page. Entering the UTC time of day, 24 hour mode, and clicking the Set Time button below the fields will set the time of the TM2000B accordingly and enable the NTP server software to responds to requests from clients. Holdover settings have no effect when the time has been set manually. If at any point GPS or Peer NTP settings start getting time, then the manual mode will be ended.
3.8 PTP Settings Page

3.8.1 PTP Update Method One/Two Step

This setting controls the Sync packet generation mode of the TM2000B. Default normal operation is to use 1 Step. In this mode, a single Sync packet is generated at the requested/setup rate and HW time stamping is applied to the packet just before it goes onto the Ethernet wire. In the two step mode, two Sync packets are generated, without hardware time stamping, to allow the receiver to determine the accuracy. If at all possible, One Step mode is preferred as it is simply more accurate. Two step is the lower accuracy option, but it included as a setup option now to allow flexibility of use.
3.8.2 Domain Number
Use this entry to set the Domain number to be included in the PTP packets. The domain number is a method to allow multiple PTP servers on the same network, but to separate their traffic between client devices.

3.8.3 Priority 1 & Priority 2
Allows setting the Priority 1 value in the packets

3.8.4 PTP Transmission Method
The PTP transmission method can be set to either Multicast or Unicast. Select the desired mode of operation and click the Submit button.

3.8.5 PTP Post-Holdover Behavior
There are two options here: Update Clock Class to 52 which in the PTP protocol means: “A clock of clock Class 52 shall not be a slave to another clock in the domain.” If set to Faulty, it will report as Faulty and should not be synced to by a client. Holdover time limits for the TM2000B are set in the NTP settings page.

3.8.6 Multicast Configuration – Log Announce Interval
Set the announce message interval. The rate of sync packets is $2^{(-\text{value})}$. The default setting of 1, sets the interval at $2^{(-1)} = 0.5$ packets per second, or every 2 seconds.

3.8.7 Multicast Configuration – Log Sync Interval
Sets the requested Sync Message Interval. The rate of sync packets is $2^{(\text{value})}$. The default of -7, therefore makes the default rate $2^{-7} = 128$ packets per second.

3.8.8 Multicast Configuration – Log Min Delay Request Interval
The minimum permitted mean time interval between Delay_Req messages. A shorter interval makes the TM2000B react faster to the changes in the path delay. It's specified as a power of two in seconds. Generally, this setting doesn't need adjustment on the TM2000B.

3.8.9 Multicast Configuration – Log min Peer Delay Request Interval
The minimum permitted mean time interval between Pdelay_Req messages. It's specified as a power of two in seconds. Generally, this setting doesn't need adjustment on the TM2000B.
3.9 About Page

The About Page shows contact information and software version of the device as well a couple of diagnostic buttons.

3.9.1 Download Log Files

Clicking the Download button will cause the TM2000B to create a binary format log file and initiate an HTTP download. The binary log can be used by TimeMachines as an aid in troubleshooting.

3.9.2 Reboot System

Clicking the Reboot button will cause the TM2000B to do a software based reset. This is a full kernel reset of the unit and takes 20-30 seconds to complete.
4 Troubleshooting

4.1 GPS Lock

Getting GPS lock on the Time Server is required for it to function. Most GPS lock issues come down to issues with Antenna location, or cabling. If there are problems getting GPS lock (i.e. the Lock LED doesn't turn on and the 1 PPS LED doesn't flash each second) trying moving the antenna outside and see if that resolves the issue. If it does, try a window and see if lock is maintained. If that works, move the antenna back to its original location and see if lock is lost. This will help determine where lock can be received and where it cannot. If no lock is achieved outdoors, then something is either wrong with the cabling or the Time Server itself. Contact TimeMachines for help.

4.2 Resetting to Factory Defaults

Front Panel Button - Push and hold the front panel button with a small object for 5 seconds. This will cause the TM2000B to reset to factory default settings.

The front panel button, accessible with a paperclip or other small object, accessible from the front panel of the TM2000B is used to reset the units software settings to factory original. This is useful when a password is forgotten or the IP address cannot be determined. To do this, insert a paperclip or ball point pen end through the hole in the front of the unit until you feel the button depress. Hold this button down for a few seconds and release the button by extracting the paperclip/pen. It should now have the factory default password and IP address information.
5 Locator Data Query

Starting in version 0.3.3, the Locator service employed by TimeMachines clock products is also included in the TM2000B. This makes it easier to manage and monitor a time system on a local network using the TM-Manger software. See the TM-Manager documentation for more information on this feature.

Locator Data Format

The Locator Data Service is a simple UDP/IP protocol that can be used by other network applications to extract status and location information from the TM1000A.

Requesting information from the TM2000B is done by sending a 3 byte message to the TM2000B, using UDP/IP, to port 7372. The three bytes, in hexadecimal, are: 0xA1 0x04 0xB2 The TM2000B will also respond to a broadcast to the same port.

The response packet is 80 bytes and will be formatted as follows:

<table>
<thead>
<tr>
<th>Bytes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>TM2000B response value = 0x05</td>
</tr>
<tr>
<td>1 to 4</td>
<td>client IP address</td>
</tr>
<tr>
<td>5 to 10</td>
<td>MAC address</td>
</tr>
<tr>
<td>11 and 12</td>
<td>firmware version Major:Minor</td>
</tr>
<tr>
<td>13</td>
<td>Lock status 0=No Lock, 1=2D Lock, or 2=3D Lock</td>
</tr>
<tr>
<td>14 to 17</td>
<td>NTP Sync count, 32 bits, MSB to LSB</td>
</tr>
<tr>
<td>18 to 20</td>
<td>Current Time, H:M:S, UTC</td>
</tr>
<tr>
<td>21 to 45</td>
<td>Location of unit 25 bytes, Latitude, Longitude, null terminated</td>
</tr>
<tr>
<td>46 to 80</td>
<td>Name of Time Server, null terminated</td>
</tr>
</tbody>
</table>

TM-Manager uses this protocol to find a monitor TM2000B's on the network. A Wireshark capture of that software can be used to see an example of the data transfer. TM-Manager support of the TM2000B started in version 1.04.
6 Specifications

6.1 Time Server Features and Specifications

- Receive time information from GPS satellites anywhere on the surface of the earth
- RFC1119/1305 NTP Protocol to serve time (Network Time Protocol)
- RFC1769/2030/4330 SNTP Protocol (Simple Network Time Protocol)
- IEEE 1588:2008 Version 2 PTP protocol
- Server Time Level: Stratum 1
- NTP Server Time Precision: better than 1mS + network jitter.
- PTP Server Time Precision: better than 3uS + network jitter.
- All networked computing platforms support time synchronization either natively or with add on drivers including: Windows, Macintosh, and Linux. Many other devices can access the device as well including VoIP phones and digital clocks.
- 10M/100M adaptive network interface
- Unit is capable of serving 750+ NTP synchronizations per second. That provides support for over 600,000+ devices updating every 15 minutes on the network.
- Active Patch GPS antenna included. Magnetic base.
- Compliant with FCC Part 15B, and CE marked for radiated emissions and is a lead free product.
- Power Requirements: 5W at startup and 2.5W continuous at 12V DC
- Environmental Requirements: Commercial temperature range, 0-70C, 95% humidity non-condensing. Altitude -304m to 18,000m.
- Indications: Power, GPS Signal Lock, and 1PPS indications
- Rear Connections: Power, Cat5 Ethernet, Serial (status information only, 115200,n81), and GPS antenna via SMA connection. Supports +3.3V and 5V active GPS antennas with internal jumper setting. TM2500B has BNC output connection.
- Serial port outputs data every two seconds, including the following items:
  - IP, Time, GPS fix, Time known, ptpClockClass, ptpClockAccuracy, ntpStratum.
- Mechanical Dimensions: 5 in. x 4.2 in. x 1.3in.

6.2 GPS Module Specifications

- Based on MediaTek MT3339 Chipset
- 22 channel low power receiver module
- Sensitivity: -165dBm
• GPS Time Precision: +/- 10ns RMS jitter.
• Antenna Connection: 1575.42MHz (L1 Band)
• TTFF (Time To First Fix)
• Cold start @-125dBm typically 33 seconds
• Re-acquisition (<10s obstruction) typically 1 second

6.3 Antenna Specifications
• Active patch antenna with magnetic base.
• Size: 1.57 in. x 1.89 in. x 0.51 in thick, 43 grams.
• Amplifier: LNA +28dB  Noise: 1.5dB  VSWR: 2.0 Voltage: 2.7-6.0V.
• Cable: RG174, 5m length, SMA male.
• Environmental: -40 to +85C
• Waterproof to IpX6

6.4 TM2500B OCXO Timing Information / Specifications
• 1 PPS / 10MHz output is 3.3V TTL signal
• Standard BNC connection
• Best stability of the OCXO and 10Mhz reference in holdover is achieved:
  ◦ 8 hours of operation required if TM2X00B off for 24 hours
  ◦ 24 hours of operation required if TM2X00B off for 1 week
  ◦ 48 hours of operation required if TM2X00B off for 1 month
  ◦ Stable temperature conditions

(Specifications are subject to change without notice)