

Precise Time and Frequency, LLC

Ptf 5000 Series PTP Servers

Operation Manual



PTF 5100 Series - PTP EMBEDDED DEVICE MANUAL



ptf 5103A



ptf 5102A



ptf 5101A

Certificate of Conformance

This certificate confirms that the following equipment:

Unit type: ptf 5000A Series TymeMaster PTP Server

Serial Number: _____

has successfully passed a FINAL ACCEPTANCE TEST and conforms in all respects of form, fit, and function to current specifications, including regulatory requirements and certifications.

This part is RoHS 2 (DIRECTIVE 2011/65/EU) / RoHS 3 (DIRECTIVE EU 2015/863) compliant with no exemptions.

This part is REACH compliant (EC/NO 1907/2006) per ECHA SVHC list 209, June 25, 2020

Inspected and verified by:

Date:

For Precise Time and Frequency, LLC

Declaration of Conformity

This certificate confirms that the following equipment:

Unit type: **ptf 5000A** Series PTP Server

is in conformity with the relevant provisions of the following standard(s)
or other normative document(s):

EU EMC Directive 2014/30/EU:

Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements

EN 55022:2006

Information technology equipment — Radio disturbance characteristics - Limits and methods of measurement

EN 61000-4-2: 2001

Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques -
Electrostatic discharge immunity test

EN 61000-4-3:2006

Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques -
Radiated, radiofrequency, electromagnetic field immunity test

EN 61000-4-4:2004

Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques -
Electrical fast transient/burst immunity test

EN 61000-4-5:2006

Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Surge
immunity test

EN 61000-4-6:2005

Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques -
Electrical fast transient/burst immunity test

EN 61000-4-11:2004

Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques — Voltage
Dips and Short Interruptions immunity test

ISO 7637-2:2004

Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical
transient conduction along supply lines only

EN 61000-3-2:2006 +A1:2009 +A2:2009

Electromagnetic compatibility (EMC) - Part 32: Limits - Limits for harmonic and current emissions (equipment input current ≤ 16 A per phase)

EN 61000-3-3:1995

Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

EN 55016-1-1:2007

Specification for radio disturbance and immunity measuring apparatus and methods — Part 1-1: Radio disturbance and immunity measuring apparatus — Measuring apparatus Amendment1 (2007)

CISPR16-1-2:2003

Specification for radio disturbance and immunity measuring apparatus and methods — Part 1-2: Radio disturbance and immunity measuring apparatus — Ancillary equipment — Conducted disturbances 5

Amendment1 (2004)

Amendment 2 (2006)

EN 55016-1-4:2007

Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Radiated disturbances

EN 55016-2-3:2004

Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity — Radiated disturbance measurements Amendment 1 (2005)

EN 55016-4-2:2003

Specification for radio disturbance and immunity measuring apparatus and methods — Part 4-2: Uncertainties, statistics and limit modeling — Measurement instrumentation uncertainty

EU Low Voltage Directive 2014/35/EU

2014/35/EU Safety of Information Technology Equipment,
including electrical business equipment

IEC 60950-1:2005/AMD2:2013 +A2 Safety of Information technology equipment

EU ROHS directive compliance according to Directive 2015/863



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1. Purpose

PTF 5000 Series time servers use time acquired from UTC (either via satellite directly or via Precision Time Protocol provided over the ethernet connection) to provide Precision Time Protocol information to downstream devices and generate precision digital outputs. The device can operate without, but it is generally recommended to connect an Antenna source or External RF source to the back connector of the PTF Device. The end user can log in to the embedded server after powering the device via the AC connection in the back of the device. The methods of controlling the device are over the telnet protocol with an ethernet connection to the monitor & control rj45 port or via a serial connection to the device via the console USB port. The end user can log in to the device via [user:pwd] after connecting via telnet or serial.

A. Use Cases for Device:

The 5100 Series devices are designed to supply a network with precise time thru NTP or PTP protocols. The precise time is accurately acquired by a front end GNSS receiver built into the device.

B. Required Components, Connections, and electrical Safety

A power cable, the unit is rated for: 90 to 265 VAC / 10W

An external antenna: 5V DC

OR

Alternatively, the unit is operable with a 1pps or 10MHz input following:

10MHz : RF sine wave, 13dBm

1PPS 5V CMOS signal with repetition rate of once per second

2. Set Up Instructions for GNSS Referenced NTP/PTP:

Connect an antenna cable to 5100 Series device TNC antenna connection and ensure that the cable is connected to a proper patch or full antenna assembly with good, unmasked, visibility of the sky.

Or

Connect 10MHz 13dBm RF sine connection to rear BNC connection of 5100 Series device which will discipline (phase lock) the oscillator. The unit will produce timecodes based off manually input times.

Connect 1PPS 5V CMOS sine connection to rear BNC connection of 5100 Series device which will discipline (phase lock) the oscillator. The unit will produce timecodes based off manually input times.

Connect to the 5th RJ45 port on the front panel of a 5103a or connect to the M&C RJ45 port of a 5102a or connect to the M&C RJ45 port of a 5101a. When the unit locks, provided DHCP is still enabled, the device should appear on the network and be acting as a NTP server on this port. Additionally, depending on the configuration, PTP data will appear on the other ports the device has.

3. Description of Software Packages Utilized on the Device

- a. **Ptp4l:** Ptp4l is a Unix/Linux package used for implementing the Precision Time Protocol (PTP), which allows devices to synchronize their clocks with high accuracy. Ptp4l provides functionality for both PTP master and slave devices, facilitating precise time synchronization in embedded systems. Its inclusion in the embedded device manual ensures that the device can maintain accurate time synchronization within a network.
- b. **Chrony:** Chrony is a time synchronization tool for Unix/Linux systems that provides accurate timekeeping, especially in scenarios with intermittent network connectivity or high network delays. It combines the functionality of a client and server, allowing the device to synchronize its clock with reliable time sources on the network. The embedded device manual incorporates Chrony to ensure consistent and accurate time synchronization, even in challenging network environments.
- c. **DHCP:** DHCP (Dynamic Host Configuration Protocol) is a network protocol that dynamically assigns IP addresses to devices on a network. It eliminates the need for manual configuration and

enables efficient management of IP addresses within the network. The embedded device utilizes DHCP to automate the IP address assignment process, simplifying network setup and administration. The manual explains how the device leverages DHCP to obtain its IP address automatically.

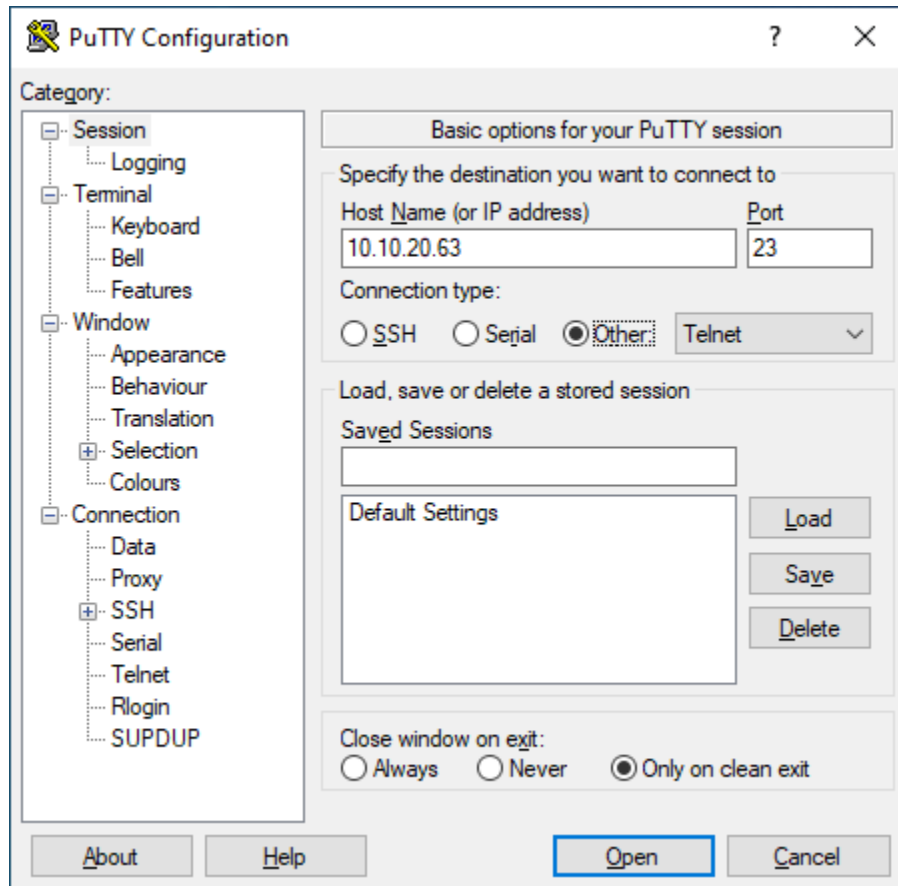
- d. **dhclient:** Dhclient is a DHCP client program that communicates with a DHCP server to request and manage IP address allocation for a device. It is commonly used in Unix/Linux systems to obtain IP addresses, network configuration parameters, and other network-related information from a DHCP server. The embedded device manual highlights the usage of dhclient, emphasizing how the device interacts with the DHCP server to obtain the necessary network settings.
- e. **IP:** The "ip" command-line tool in Unix/Linux systems is a versatile utility for managing various aspects of networking, including IP addresses, routing tables, network interfaces, and more. It provides a wide range of functionalities such as assigning IP addresses, configuring network interfaces, setting up routing rules, and managing network tunnels. The embedded device manual showcases the usage of the "ip" command-line tool to enable administrators to configure and manage network settings efficiently.
- f. **NTP:** NTP (Network Time Protocol) is a networking protocol used to synchronize the clocks of devices in a network. It ensures accurate timekeeping by utilizing a hierarchical system of time servers that provide time information to clients. The embedded device incorporates NTP to synchronize its clock with reliable time sources, ensuring precise timekeeping for various applications. The manual describes how NTP is employed to maintain accurate time synchronization and how administrators can configure it for optimal performance.
- g. **gpsd:** gpsd is a Unix/Linux package that provides access to GPS (Global Positioning System) receivers connected to the device. It offers a standardized interface for obtaining location, time, and other data from GPS devices. By incorporating gpsd into the embedded device manual, users can understand how to interact with GPS receivers and utilize the acquired data for various location-based applications.
- h. **cgps:** cgps is a command-line utility that works in conjunction with gpsd to provide a visual representation of GPS data. It displays real-time information such as latitude, longitude, speed, and satellite information in a user-friendly format. The embedded device manual includes cgps to demonstrate how users can monitor and interpret GPS data in a convenient graphical manner.
- i. **top:** top is a Unix/Linux command-line tool used for monitoring system processes and resource usage. It provides real-time information about CPU usage, memory utilization, and running processes. Including top in the embedded device manual enables users to effectively monitor system performance, identify resource-intensive processes, and troubleshoot potential performance issues.

- j. **netstat:** netstat is a command-line utility that displays network connections, routing tables, and network interface statistics. It provides information about active network connections, listening ports, and network traffic statistics. The embedded device manual incorporates netstat to help users analyze network connectivity, diagnose network-related problems, and manage network resources efficiently.
- k. **ps:** ps is a command-line tool used to display information about active processes running on a Unix/Linux system. It provides details such as process IDs, CPU and memory usage, and execution status. By including ps in the embedded device manual, users can learn how to view and manage processes, identify resource-intensive tasks, and troubleshoot issues related to system processes.
- l. **free:** free is a command-line utility that provides information about the system's memory usage, including total, used, and available memory. It also displays details about swap space utilization. The embedded device manual highlights the usage of free to enable users to monitor and optimize memory usage, ensuring efficient operation of the device and preventing memory-related performance problems.

4. Connection Help

The 5100 Series devices have SSH &/ Telnet &/ Console connection capabilities. The 5103 & 5102 have front facing USB connections that allow a Windows PC to utilize a program like putty to open connection to the device. Additionally, a program like putty or HyperTerminal would allow someone to remotely access the device via protocols like ssh or telnet. The default end user account is PTF-MC and it's password is ptf123. Refer to your individual customer material for specific user accounts, or if it is applicable to your device use the default technician "debian" && "temppwd" for username and password. Warning, usage of the debian account can cause damage to the device. Such damage is not covered under any warranties and will likely result in RMA surcharging.

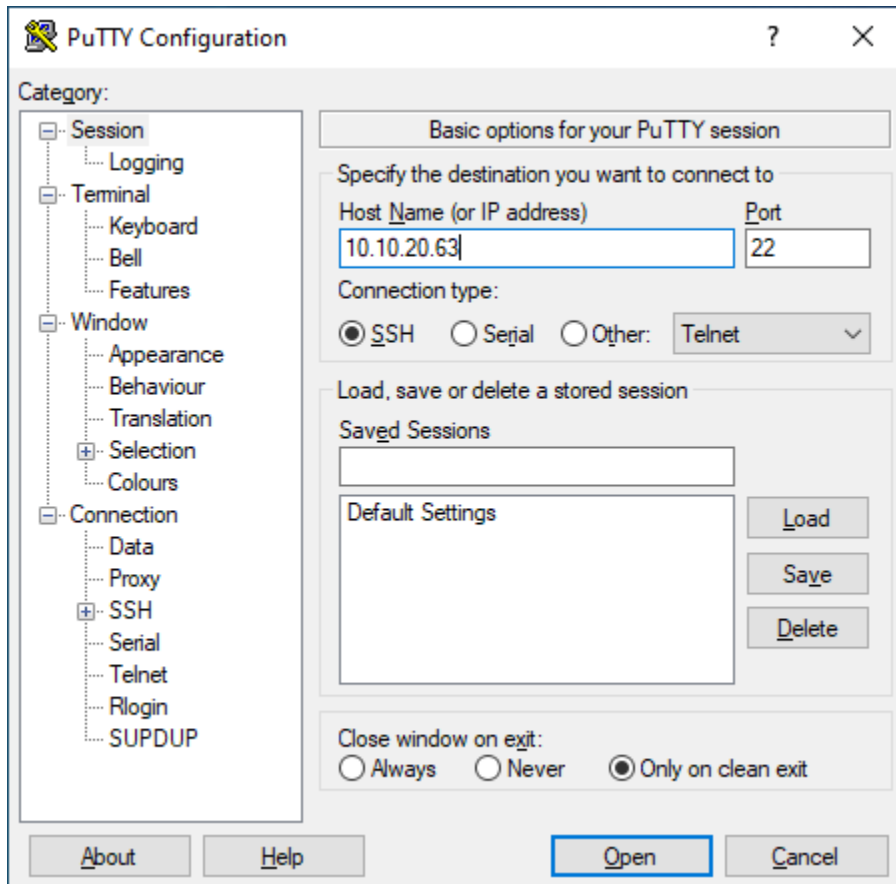
Example Telnet connection with Putty:



*Telnet uses port23

**Telnet is not considered a secure protocol and the below method is recommended

Example SSh Connection with PuTTY:



The Rear panel of the 5102 and 5103 have an additional USB connection along with an RS232 or DB9 connector. These connections are for configuration purposes only, if your account has a qualified technician who is trained to use these connections; they allow for configuration and field upgrades to the firmware of the modules within the device. These are generally used during device creation, configuration, and setup. They can be used to repurpose certain devices into other devices.

5. End Customer Command List

a. General Commands

- i. Command: “?” will display the command list to the user, the list is of all available commands, and may include commands which might not be relevant to your device.
- ii. Command: “commands” will give you a command overview for your device and will accept optional input, like the following two examples:
- iii. Command: “commands P” which will display the help message of all the PXY (where x & y are numerical values) commands on your device.
- iv. Command: “commands ?” will display the same as “?” but with all help messages included
- v. Command: “help P01” will display the help message of command P01, similar PXY will display the help message of the command which corresponds to the numerical values put in for X and Y
- vi. Command: “exit” will logout the device and close the session

b. PXY

“PXY” commands relate to the device’s time protocol configurations and can change the output of the embedded time server.

- i. P00 -> P20 are set/reserved for launching PTP profiles.
- ii. P21 -> P30 are set/reserved for NTP profiles and settings.
- iii. P31 -> P40 are set/reserved for chrony settings; this can cause hiccups in the time protocol behavior.

c. NXY

“NXY” commands relate to the devices device configurations and can change module behavior and settings.

- i. N00 -> D10 are set/reserved for network/dhcp/ip profiles.

d. SXY

“SXY” commands contain status queries that will dump information out to the telnet/serial session

- i. S00 -> S10 are reserved for querying and dumping the device status into the user session.

e. DXY

CAUTION: “DXY” commands relate to the device’s GNSS module and can alter module behavior and device operation.

- i. D00 -> D10 are set/reserved for GPSD settings and configurations.

f. Hidden Commands

There are additional hidden commands for the device.

- i. “X99” is a double prompted yes then no; to restart the device’s software interface.
- ii. “all clients” which is a combination of the following two commands:
- iii. “ntp clients” provides information about ntp subscribers
- iv. “ptp_clients” provides information about downstream ptp clients
- v. “gnss_restart” which restarts gnss service

6. Command List Explained

- a. P00 – reserved.
- b. P01 – Launches default ptp, invoke with “P01”, no parameters needed or optional.
- c. P02 – Launches g ptp, invoke with “P02”, no parameters needed or optional.
- d. P03 – Launches g 8275 2 ptp, invoke with “P03”, no parameters needed or optional.
- e. P05 – Launches g 8265 1 ptp, invoke with “P05”, no parameters needed or optional.
- f. P06 – Launches automotive ptp, invoke with “P06”, no parameters needed or optional.
- g. P07 –
- h. P08 –
- i. P09
- j. P10
- k. D00
- l. D01
- m. D02
- n. D03
- o. D04
- p. D05

- q. **N01 ethernet interface 0 properties and configuration script.** When called without parameters, “N01” will return eth0 interface properties. When given three IP address type strings after the “N01”, ie “N01 10.10.20.50 10.10.20.51 10.10.20.52” it will attempt to set the ip addr, gateway, and netmask as those values.
- r. **N02 ethernet interface 1 properties and configuration script.** It invokes with “N02” and operates the same as N01 except for the eth1 interface
- s. **N03 Dhcp on.** Refer to the section above on how DHCP and dhclient operate. “N03” will turn Dhcp on for eth1 and eth0. If you are operating a 5103, then only eth1 will change as your eth0 will be static for communication with the internal components. You will need to utilize additional scripts to ensure that the switch module of a 5103 has corresponding network configurations
- t. **N04 Dhcp off.** Refer to the section above on how DHCP and dhclient operate. “N04” will turn Dhcp off for eth1 and eth0. If you are operating a 5103, then only eth1 will change as your eth0 will be static for communication with the internal components. You will need to utilize additional scripts to ensure that the switch module of a 5103 has corresponding network configurations
- u. **N05 Purge telnet/ssh;** this script will close all open telnet and ssh sessions on the device. Warning, this will boot you off the device if you are not in a serial session.
- v. **S00 – Reserved**
- w. **S01 - Device Health Check:** Invoke with “S01”

Description: This script checks the health and status of the device. It provides an overview of various system metrics, such as CPU utilization, memory usage, disk space, and network utilization

- x. **S02 - CPU Temperature:** Invoke with “S02”

Description: This script displays the current temperature of the CPU

- y. **S03 - Memory Usage:** Invoke with “S03”

Description: This script shows the current memory usage of the device, represented as a percentage of the total available memory

- z. **S04 - Network Utilization:** Invoke with “S04”

Description: This script provides information about the network utilization, including the total number of incoming and outgoing network connections

- aa. **S05 - Disk Space:** Invoke with “S05”

Description: This script displays the available disk space on the device, providing information about the usage and capacity of each mounted filesystem

bb. S06 - System Uptime: Invoke with "S06"

Description: This script shows the system's uptime, indicating how long the device has been running since the last boot.

cc. S07 - Active Network Connections: Invoke with "S07"

Description: This script lists all the currently active network connections, including listening ports, established connections, and associated program names or process IDs.

dd. S08 - Load Average: Invoke with "S08"

Description: This script provides the load average of the system for the past 1 minute, 5 minutes, and 15 minutes. It indicates the average number of processes waiting to be executed

ee. S09 - Process Count: Invoke with "S09"

Description: This script displays the total number of running processes on the device.

ff. S10 - System Information: Invoke with "S10"

Description: This script provides general information about the device, including the operating system, kernel version, system architecture, and other relevant details

*You can invoke these scripts by typing the corresponding command in your terminal, such as S01, S02, etc., to retrieve the desired information

7. PTP Profiles Described

- a. **Default PTP Profile:** The default PTP profile refers to the standard Precision Time Protocol implementation without any specific industry or application requirements. It provides basic time synchronization capabilities for general purposes.
- b. **gPTP (Generalized PTP) Profile:** The gPTP profile extends the capabilities of the PTP protocol to meet the needs of industrial automation and control systems. It includes enhancements such as additional message types, synchronization accuracy improvements, and fault tolerance mechanisms to ensure precise and reliable time synchronization in industrial environments.
- c. **g8275-2 Profile:** The g8275-2 profile is a specific implementation of PTP tailored for power utility substation automation. It incorporates the requirements specified in the IEC 61850-9-3

standard and focuses on achieving high-accuracy time synchronization for substation automation systems, including protection, control, and monitoring devices.

- d. **g8275-1 Profile:** The g8275-1 profile is another implementation of PTP designed for power utility applications. It follows the requirements outlined in the IEEE C37.238 standard and emphasizes time synchronization for power system protection and control devices. This profile addresses the unique challenges of the power grid environment, such as network latency, jitter, and fault tolerance.
- e. **g8265-1 Profile:** The g8265-1 profile is a PTP implementation specifically tailored for mobile backhaul networks. It conforms to the ITU-T G.8265.1 recommendation and focuses on delivering accurate and reliable time synchronization for mobile network infrastructure. This profile ensures that base stations, radio access networks, and other elements in mobile networks are tightly synchronized to maintain seamless operation.
- f. **Automotive PTP Profile:** The automotive PTP profile addresses the time synchronization requirements in the automotive industry. It caters to applications such as advanced driver-assistance systems (ADAS), autonomous vehicles, and in-vehicle networks. This profile takes into account the unique challenges of the automotive environment, including high vibration, temperature variations, and stringent timing requirements.

8. Additional Information For Configuration and Testing Purposes

The default user name and password is 'debian' and 'temppwd'.

The user has access to limited shell abilities as the Debian user. The user has access to scripts located in /home/Debian

To connect to the device, power the device on and connect to it via the front panel usb console connection with a windows PC. The windows PC should open a com port. You can use a program like PuTTY to remote into the device.

Alternatively, connect to the device over ethernet. Plug into the last RJ45 port of the device and ssh/telnet into the device with the IP address. You may retrieve the IP address from the display or from the usb console connection.

Rear DB9 connection can dump information from the internal FPGA to inform of device issues. Data mapping unavailable.

Rear USB connection can reconfigure gnss module and can be used for customer requests to ignore satellite constellations

9. Service and Support Information

These devices are highly sophisticated electronic equipment which can be damaged if not handled properly. All service should be performed at the Precise Time and Frequency, LLC facility or an authorized representative.

a. Contact Information

- i. Address:
Precise Time and Frequency, LLC
50L Audubon Road
Wakefield, MA 01880
USA
- ii. Telephone:
+1 (781)245-9090
- iii. Email:
support@ptf-llc.com
- iv. Website:
www.ptf-llc.com
- v. Hours:
8:30 a.m. to 4:30 p.m. Monday to Friday