

User Guide

Portable Timing Unit

Model PTU

P/N 001-5XXX

Revision E

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Table of Contents

1	Introduction.....	5
2	Specifications	6
3	Rear Panel Connections.....	8
4	Getting Started.....	9
4.1	Powering up the PTU	9
4.2	Setting the Network Address	9
4.2.1	Discovering the IP Address.....	9
4.2.2	GPS Operation.....	9
4.2.3	HaveQuick Input.....	10
4.2.4	IRIG B Input	10
4.2.5	1PPS	10
4.2.6	Output Timing Signals.....	10
4.2.7	Front Panel Indications.....	10
4.2.8	Battery Charge/Discharge operation.....	11
5	Web Interface.....	11
5.1	Accessing the web-based interface	11
5.2	Accessing Functions on the PTU.....	12
5.3	Viewing the Current Status of the PTU system	13
5.3.1	Viewing the current list of alarms	15
5.3.2	View the current GPS status.....	16
5.3.3	Viewing the Current Phase Lock Status	17
5.3.4	Viewing the Battery Status	18
5.4	Changing the Settings on the PTU.....	19
5.4.1	Selecting a Reference.....	19
5.4.2	Setting the GPS Mode.....	20
5.4.3	Adjusting the Output Settings	22
5.4.4	Changing the IP Address.....	24
5.4.5	Changing SNMP Settings.....	25
5.4.6	Changing The Location Setting	26
5.4.7	Changing The Display Brightness.....	27
5.4.8	Changing The Access Password	28
6	Troubleshooting Guide	29
6.1	Unit does not power up.....	29
6.2	PTU does not acquire satellites.....	29
6.3	Time Valid does not illuminate, but the PTU is tracking satellites	29
6.4	Battery does not hold charge	29
6.5	Red Fault light is on	29
7	Support Information.....	30
8	Front Panel.....	31
9	Rear Panel	32

Table of Figures

Figure 1 - Portable Timing Unit.....	9
Figure 2 - PTU Management Web Page.....	12
Figure 3 - PTU Main Menu	12
Figure 4 - PTU Status Page.....	13
Figure 5 - Alarm List	15
Figure 6 - Current GPS Status	16
Figure 7 - PTU Phase Status Page.....	17
Figure 8 - PTU Battery Status	18
Figure 9 - Available Reference Sources	19
Figure 10 - PTU Reference Settings.....	19
Figure 11 - Available GPS Modes.....	20
Figure 12 - GPS Settings Menu	20
Figure 13 - PTU Output Options	22
Figure 14 - PTU Output Settings.....	22
Figure 15 - 1PPS Signal, showing normal and inverted.....	23
Figure 16 - PTU IP Address Settings	24
Figure 17 - SNMP Settings.....	25
Figure 18 - Location Setting.....	26
Figure 19 - Brightness Controls.....	27
Figure 20 - Password Settings.....	28
Figure 21 - PTU Front Panel	31
Figure 22 - PTU Rear Panel.....	32

Table of Tables

Table 1 - Specifications.....	6
Table 2 - Rear Panel Connections.....	8

1 Introduction

The Portable Timing Unit (PTU) is low cost, battery operated, transportable timing system that is designed to provide precise time of day at point of use. The PTU may be automatically synchronized by means of either GPS signals, or an serial time code such as IRIG B or Have Quick.

Operation of the unit can be monitored via an Ethernet interface, or by means of front panel indicators and displays. Outputs are 1PPS, Have Quick, IRIG B Time Code and Network Time Protocol (NTP).

The unit is mounted in a rugged, weather proof case that may be easily transported to the point of use. When AC power is available, the PTU's built-in power supply will automatically charge the internal batteries.

Reference Input Sources

The PTU is extremely flexible in its ability to synchronize to a variety of timing sources. Available references are:

- 16 channel GPS SPS receiver (standard)
- 12 channel GB-GRAM SAASM GPS receiver (optional)
- IRIG B Time Code (standard)
- HaveQuick/1PPS from external GPS receiver (standard)

Once synchronized to the selected reference, the PTU will use the reference to continuously calibrate its internal oscillator so that accurate time can be maintained in the absence the reference. Front panel LEDs indicate the reference type in use, and whether time is valid. The PTU can be configured to always use a particular reference source, or automatically select whatever source is available.

Time Keeping

The internal time of the PTU is maintained by a high precision oscillator. Selection of the oscillator type will determine the accuracy of the PTU when its reference, (such as GPS) is not available. Available internal oscillator options are

- Temperature Compensated Crystal Oscillator (TCXO) -option
- Oven Controlled Crystal Oscillator (OCXO) standard
- Atomic Rubidium Oscillator – option

Network Interface

The PTU incorporates an Ethernet connection that provides a convenient means of monitoring status of the instrument via a computer and simple web browser. This interface is also used to provide NTP synchronization, firmware updates and Browser based setup features.

Output Signals

The PTU provides a variety of timing signal outputs, giving maximum application flexibility

- 1PPS 1 Pulse Per Second Signal Time Mark
- Have Quick Time Code
- IRIG B Time Code
- NTP

Internal Battery Backup

The PTU contains an internal 7Ah battery that will operate the system in the event prime power is lost. The battery charge is monitored and maintained whenever prime power is applied to the PTU. Status is indicated by front panel LED's. Battery life is dependent upon the oscillator configuration selected and the ambient temperature, but 5 hours is typical for the OCXO version.

Time Display

An 11 digit display indicates Years, Days, Hours, Minutes and Seconds. Illumination of the display is controlled by a front panel switch to conserve battery life.

Weatherproof Enclosure

The PTU is housed in a sturdy weatherproof enclosure that is suitable for outdoor use in all weather conditions.

2 Specifications

Table 1 - Specifications

Satellite Signal	GPS L ₁ 1575.42 MHz
Satellite Code	C/A 1.023 MHz
Receiver Type	Parallel 16 Channel. All-in-view satellites tracked continuously and simultaneously
Warm Start	<10 sec (Open Sky)
Autonomous Start	<60 Seconds Cold Start (Open Sky)
Cold Start Requirement	Automatic: No input of time of position required
Position Accuracy	2.4 m horizontal, 5 m altitude with respect to WGS84 after 24 hour position averaging
Timing Accuracy (tracking satellites)	± 50 ns. Absolute UTC . Std Deviation 15ns (OCXO)
Timing Accuracy (holdover mode, ± 5°C)	< 20ms/day (TCXO) < 50 µsec/day (OCXO) < 5 µsec / day (Rb)
1PPS Output Connector Level On Time	BNC 0-5V or 0-10V into 50Ω link selectable by user Rising Edge
Network Interface Interface Type Protocols	10/100BaseT TCP/IP, UDP, NTPv3, HTTP, SNMP v1, DHCP
Serial Interface Type Baud Rate Content	RS232 9600, N,8,1 User configurable, broadcast 1/sec

IRIG Time Code Output Connector Code Type Control Functions Level	BNC IRIG B125, A135, E115, G145, standard via menu selection. IEEE 1344 – IRIG B125 only. 3 V p-p into 600 ohm
Have Quick Output Connector Code Type Levels	BNC Have Quick II per ICD-GPS-060A 0-5V
Alarm Status	Voltage free relay changeover contacts
Status Indicator LED's	Power, GPS Locked, Time Valid, IRIG, Have Quick, Fault, Battery Charge, Battery Low
1PPS Input Connector Level Impedance	BNC 2.5V to 5V 50Ω
Have Quick Input Connector Code Type	BNC Have Quick II per ICD-GPS-060
IRIG Time Code Input Connector Code Type Control Functions Impedance Level	BNC B120, B122, B123, B125 IEEE 1344 supported 600 ohm 1-6Vp-p
Battery Life at 25 ± 15°C	24 Hours (TCXO) 5 Hours (OCXO) 3 Hours (Rb)
Battery Charging Temperature	-20°C to 50°C
Environmental Temperature Humidity Sealing Power	Instrument: -40 to +60 °C Rb1 Option: -10 to +50 °C RB2 Option: -20 to +60 °C 95% IP54, NEMA 3 85-265VAC 50/60Hz 12VDC
Dimensions	6" W, 8" H, 12" D
Weight	11 lb. typical
EMC Emission	EN55022 FCC Chapter 15 Part B
EMC Immunity	EN55024

3 Rear Panel Connections

Table 2 - Rear Panel Connections

CONNECTOR REFERENCE	CONNECTOR TYPE	CONNECTOR PIN	SIGNAL
J1	BNC	CENTER	GPS Input
GPS Receiver Input		SHIELD	GND
J2	BNC	CENTER	GPS Output
GPS Antenna		SHIELD	GND
J3 Trigger / Alarm	DB-9 MALE	1	STATUS A IN
		2	RX
		3	TX
		4	ALM OUT NC
		5	GND
		6	ALM OUT NO
		7	STATUS B IN
		8	GND
		9	ALM OUT COMMON
J4	BNC	CENTER	Have Quick Output
Have Quick Out		SHIELD	GND
J5	BNC	CENTER	Have Quick Input
Have Quick IN		SHIELD	GND
J6	BNC	CENTER	IRIG A/B/G Out
IRIG A/B/G Out		SHIELD	GND
J7	BNC	CENTER	IRIG B Input
IRIG B IN		SHIELD	GND
J8	BNC	CENTER	1PPS Outputs
1PPS Out		SHIELD	GND
J9	BNC	CENTER	1PPS Inputs
1PPS IN		SHIELD	GND
ETHERNET, J10	RJ-45	1	TX+
		2	TX-
		3	RX+
		4	-
		5	-
		6	RX-
		7	-
		8	-
J11 Power AC		A	LINE
		E	GND
		D	NEUTRAL
J11 Power DC		C	12VDC
		B	GND
F101	FUSE		

4 Getting Started



Figure 1 - Portable Timing Unit

4.1 Powering up the PTU

The PTU can be powered from 110Vac via the AC power cable, or from external 12Vdc via the DC power cable. Both cables plug into J11, a 5-pin power connector on the rear of the unit. The PTU must be turned on for battery charging to commence. (See Figure 22 - PTU Rear Panel)

A front panel power switch is used to turn the unit on.

4.2 Setting the Network Address

Connect the unit to an Ethernet switch via J10, the Ethernet connector. The PTU uses a 10BaseT Ethernet interface without Auto-MDIX, so if a connection is to be made directly to a laptop, a cross-over Ethernet cable must be used.

4.2.1 Discovering the IP Address.

Power the PTU off, and then power it back on. Press and hold the display switch. The Unit IP address will be shown after approximately 30 seconds.

4.2.2 GPS Operation

When GPS is selected as reference, ensure that a GPS antenna is connected to the unit. The chassis mounted antenna can be used by simply connecting J1 to J2 with a short coax cable (provided.) Alternatively, an external antenna can be used by connecting it directly to J1, the GPS receiver input.

It typically takes approximately five to six minutes for the PTU to complete its Rubidium warm-up cycle, acquire satellites and start displaying valid time. Until it does, the PTU will display a simple count value starting from 0. In a cold start

scenario, where the unit has been powered down for longer than 24 hours or has been moved more than 60 miles since last use, it may take as long as 15 minutes to acquire satellites and start displaying valid time.

A number of GPS parameters can be tracked on the Status page of the web-browser interface. Select the Status tab at the top of the browser. The number of satellites tracked as well as the position data from the GPS can be viewed.

As soon as 4 satellites are tracked, the front panel LED labeled “GPS Locked” will light up.

4.2.3 HaveQuick Input

The HaveQuick reference requires both a standard HaveQuick II and a 1PPS input signal, both conforming to ICD-GPS-060A. Connect the HaveQuick source to J5 and the 1PPS source to J9. Ensure that HaveQuick is selected as reference on the web-browser Setup page.

4.2.4 IRIG B Input

Connect a standard 1kHz modulated IRIG-B signal to the BNC connector at J7, and ensure that IRIG-B is selected as reference input on the Setup page of the web-browser.

4.2.5 1PPS

Connect a standard ICD-GPS-060 1PPS (1 pulse-per-second) signal to the J9 connector on the rear of the unit and ensure that “Ext 1PPS” is selected as reference input on the Setup page of the web-browser.

Enter the date and time manually in the dialog boxes on the same web page and click “submit” to allow the PTU to read those values.

4.2.6 Output Timing Signals

Regardless of the input reference selected, the PTU will always provide the following output signals:

- HaveQuick Out (J4)
- Time-code Out (J6). IRIG B125 is the default settings.
- 1PPS Out (J8)

4.2.7 Front Panel Indications

The front panel shows a date/time display in years, days, hours, minutes and seconds. The date and time displayed is derived from the currently selected reference input, namely GPS, IRIG-B, HaveQuick or 1PPS. The display is also used to display the IP address of the unit on power-up.

The front panel 7-segment time/ date display is turned off by default, to allow the maximum battery life during the discharge cycle. To view the 7-segment display, push and hold the “Display” button on the right-hand-side of the front panel.

LEDs are used to indicate whether the device is set to HaveQuick or IRIG as input reference. If neither the HaveQuick or IRIG In LEDs are lit, the unit is set for GPS operation.

A fault LED will illuminate if any internal fault is detected. These faults include output signal levels, internal communication errors and oscillator problems.

If the unit is in GPS reference mode and is tracking at least 4 satellites, the GPS locked LED will light up.

The Time Valid LED will illuminate when the selected reference is being decoded without error. In addition, for GPS reference, the Time Valid LED will stay on for 8 hours after the unit has stopped tracking satellites.

4.2.8 Battery Charge/Discharge operation

The Charge LED turns solid yellow when external power is present and the battery is charging. When external power is removed and the battery starts discharging, the Charge LED will start flashing slowly.

The Battery Low red LED will flash when the battery voltage level drops below 11V. When the level drops below 10.5V, the LED will turn solid red. The unit will turn off automatically when the battery voltage drops below 10V.

If the battery level reaches a critically low point, a speaker in the unit will start beeping to alert the user to the low battery. When the battery charge level reaches a very critically low point, it will emit a continuous tone until it automatically powers down.

To charge the battery, reconnect external AC or DC power, and turn the front panel power switch on.

5 Web Interface

5.1 Accessing the web-based interface

When the unit is powered up, the display will show its IP address as part of the startup sequence. Enter this IP Address into the address bar of your web browser. This will bring up the PTU's main information page. (See Figure 2 - PTU Management Web Page)

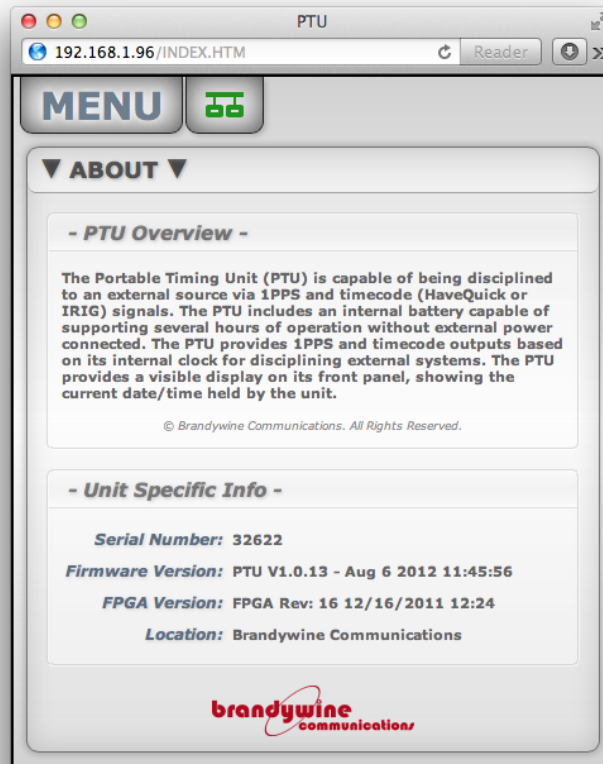


Figure 2 - PTU Management Web Page

5.2 Accessing Functions on the PTU

To access different functions of the PTU management web page, select the button labeled "MENU" in the top left hand corner of the web page.

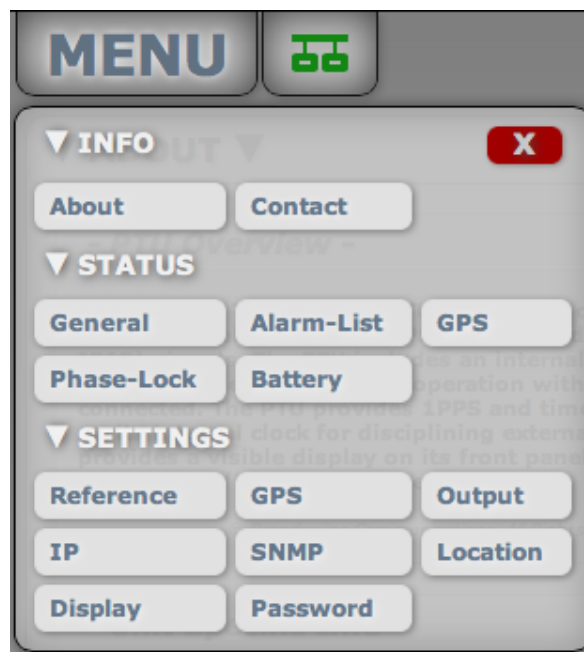


Figure 3 - PTU Main Menu

5.3 Viewing the Current Status of the PTU system

From the “MENU” button, select “General” from the status menu. This shows information such as the current output time, UTC time, up time, the current input reference, the current output format, current system state, alarm status, battery status, and current internal temperature.

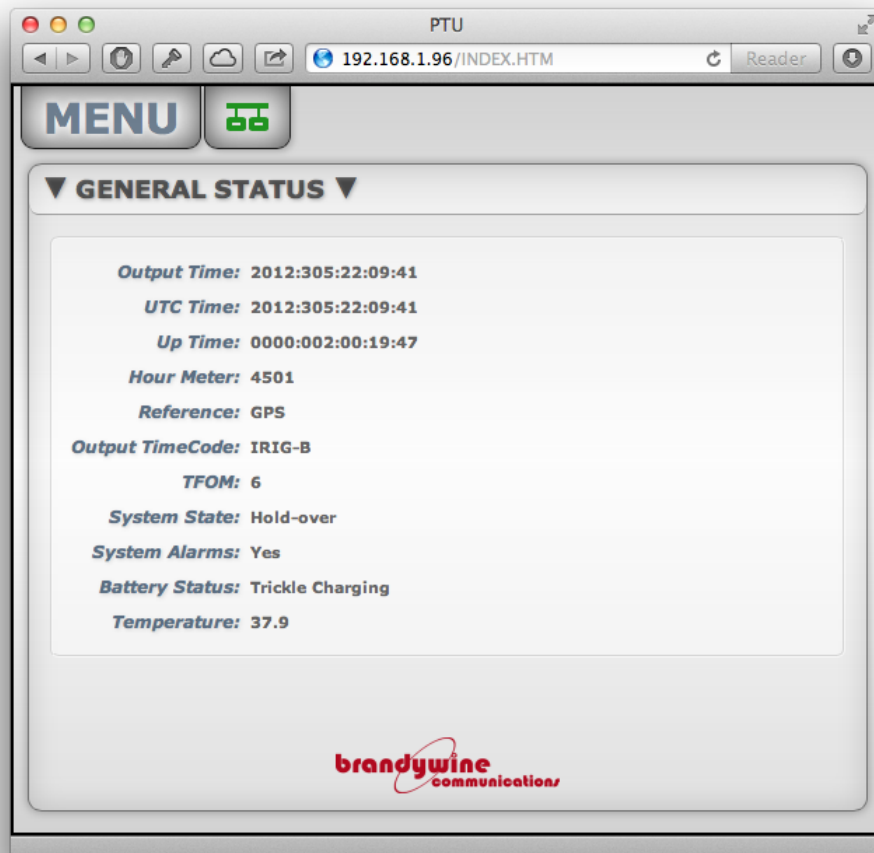


Figure 4 - PTU Status Page

Output Time: The current time of day being displayed or being output by the PTU

UTC Time: The current time of day from the GPS constellation in Universal Time Coordinate (UTC)

Up Time: The amount of time that the PTU has been powered on

Hour Meter: This is the number of hours since the PTU was first built.

Reference: The current reference input being used by the PTU

Output TimeCode: The current timecode format in use by the PTU’s outputs

TFOM: Time Figure Of Merit – the difference between the unit’s time and the reference input. A 1 means the unit is accurate to within 1ns, a 2 means the unit is accurate to within 10ns, a 3 means 100ns, etc

System state: The current mode of the PTU’s internal clock

Possible Modes:

Holdover: The system is using the internal oscillator as a reference, and is counting from the last time it synchronized to an external reference

Time Valid: The system is locked to an external reference source such as GPS or IRIG, and is displaying or outputting that time.

System Alarms: If the system is currently displaying any alarms

Battery Status: The Current status of the battery

Temperature: The internal temperature of the unit.

5.3.1 Viewing the current list of alarms

Select "Alarm-List" from the status menu, this will display a list of the current system alarms



Figure 5 - Alarm List

The possible alarms that the PTU can have are as follows:

- "No internal 1PPS generated from the FPGA"
- "Serial FLASH failed"
- "Serial EEPROM memory failed"
- "FPGA failed to initialize or load"
- "Oscillator (rubidium) is showing unlocked"
- "Battery under voltage fault"
- "Battery over voltage fault"
- "Reference has a fault."

5.3.2 View the current GPS status

If the unit is connected to a GPS antenna, and is using a GPS reference as an input source, select “GPS” from the status section of the main menu. This will display a webpage showing the current GPS status, including Latitude, Longitude, Altitude, Heading and Speed. This page also displays an interactive 3D map of the current GPS constellation visible to the connected GPS antenna. (See Figure 6 - Current GPS Status)

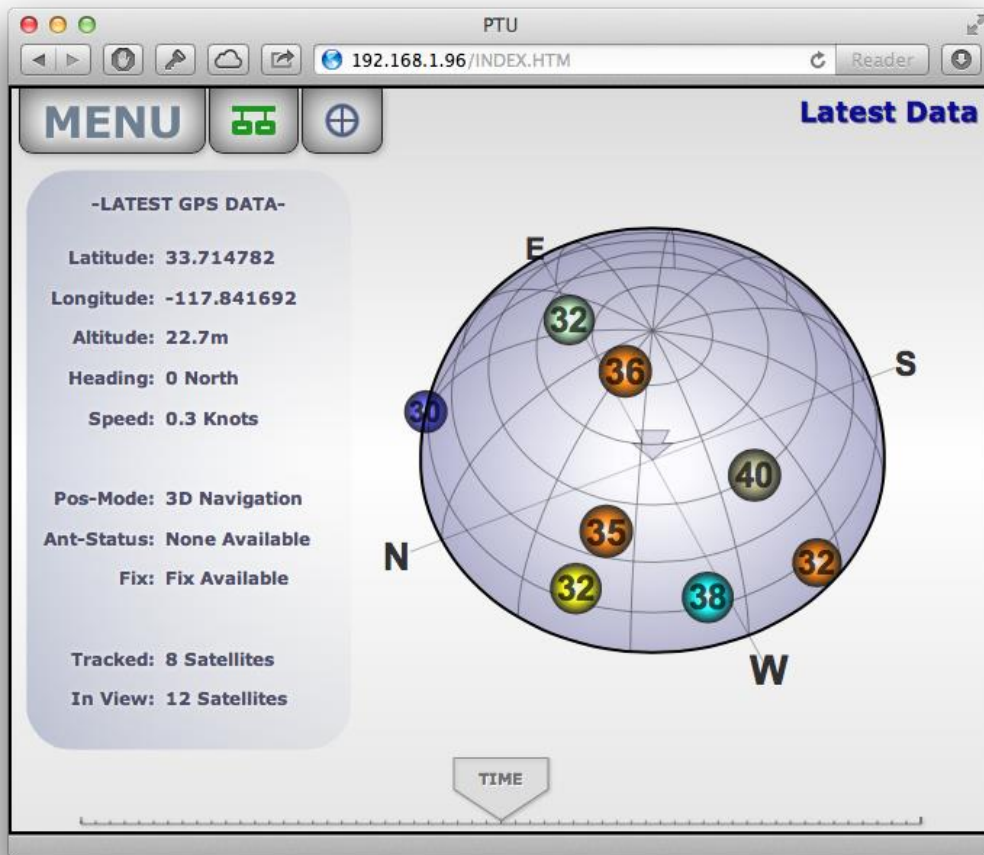


Figure 6 - Current GPS Status

5.3.2.1 Navigating the interactive GPS status page

To navigate the interactive map of the GPS constellation, click and drag the map to reposition the map hemisphere, using the left and right motion of your pointer to adjust the orientation of the map, and the up and down motion of your pointer to adjust the angle of the map.

5.3.3 Viewing the Current Phase Lock Status

From the “MENU” button, select “Phase-Lock” from the status section, this will display an interactive graph showing the current Tuning Value and both Raw Phase and Filtered Phase.

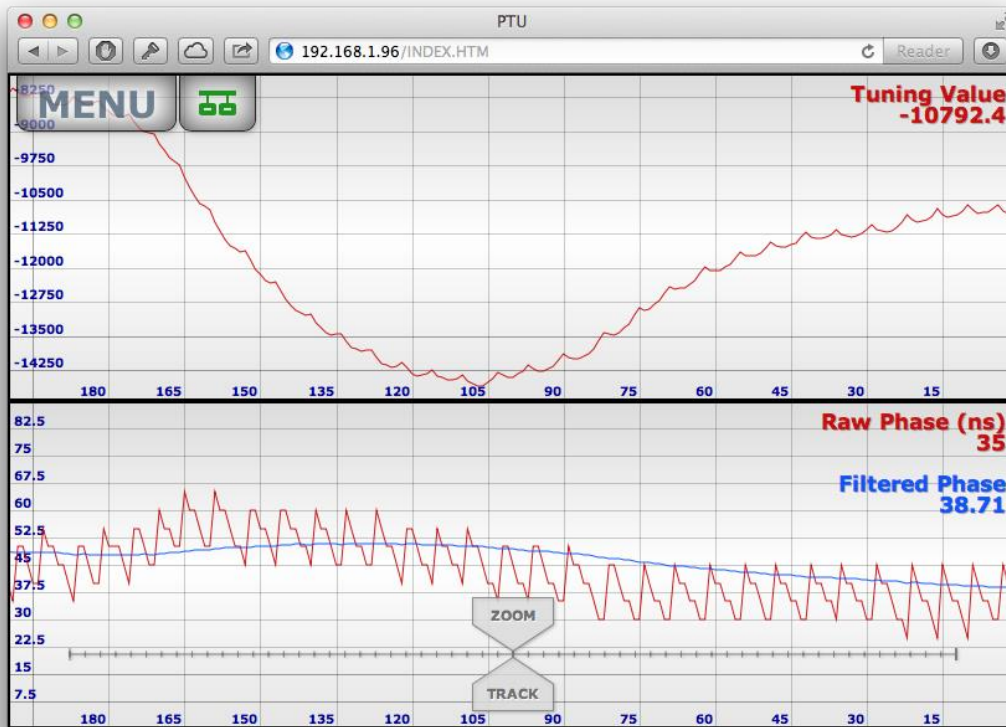


Figure 7 - PTU Phase Status Page

The Raw Phase shows the difference between the reference and the PTU timing. The filtered phase shows the value of the phase after passing through a software filtering algorithm to remove the pulse-to-pulse jitter typically found in a GPS receiver, the tuning value shows the control input to the PTU Oscillator.

5.3.4 Viewing the Battery Status

Under the status heading of the main menu, select “Battery” to view a graph showing the current Battery voltage, and a graph showing the charging and discharging amperage.

5.3.4.1 How the battery charges

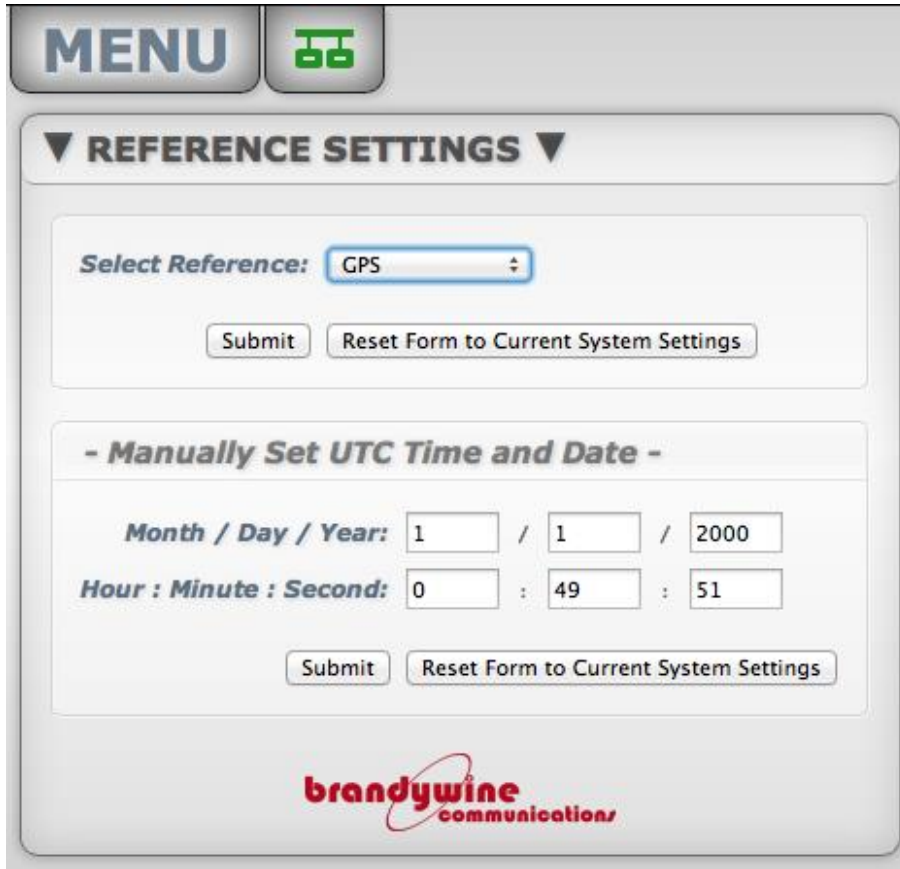
The PTU has a battery life of approximately eight hours at 25°C, and takes about 12 hours to charge. The charger is a constant current charger until the battery voltage reaches 14.3V, at which point it changes to a constant voltage. Once the battery drops below 100ma, the charge voltage switches to a ‘trickle charge’ mode at 13.8V.



5.4 Changing the Settings on the PTU

5.4.1 Selecting a Reference

From the menu, select “Reference” from the settings submenu. From the “Select Reference” dropdown menu, select your input source. For 1PPS-based reference sources, the time and date will have to be entered manually. See Figure 9 - Available Reference Sources for a list of the available reference sources that the PTU can use.



The screenshot shows the PTU Reference Settings interface. At the top, there is a 'MENU' button and a green icon representing a reference source. Below this is a section titled 'REFERENCE SETTINGS' with a downward arrow. The main section contains a 'Select Reference:' dropdown menu currently set to 'GPS'. Below the dropdown are two buttons: 'Submit' and 'Reset Form to Current System Settings'. A second section is titled '- Manually Set UTC Time and Date -'. It contains two rows of input fields: 'Month / Day / Year:' with values '1 / 1 / 2000' and 'Hour : Minute : Second:' with values '0 : 49 : 51'. Below these fields are two buttons: 'Submit' and 'Reset Form to Current System Settings'. The Brandywine Communications logo is at the bottom of the interface.

Figure 10 - PTU Reference Settings

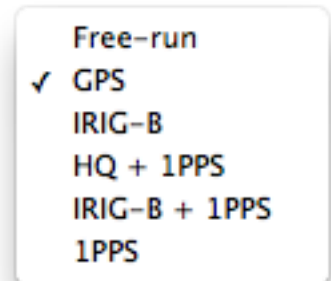
- 
- Free-run
 - ✓ GPS
 - IRIG-B
 - HQ + 1PPS
 - IRIG-B + 1PPS
 - 1PPS

Figure 9 - Available Reference Sources

5.4.2 Setting the GPS Mode

From the menu, select “GPS” from the settings submenu. From here, you can select your GPS Mode (see Figure 11 - Available GPS Modes), set your GPS position manually, or force a cold start of the GPS system.

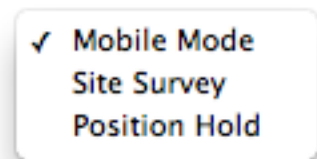
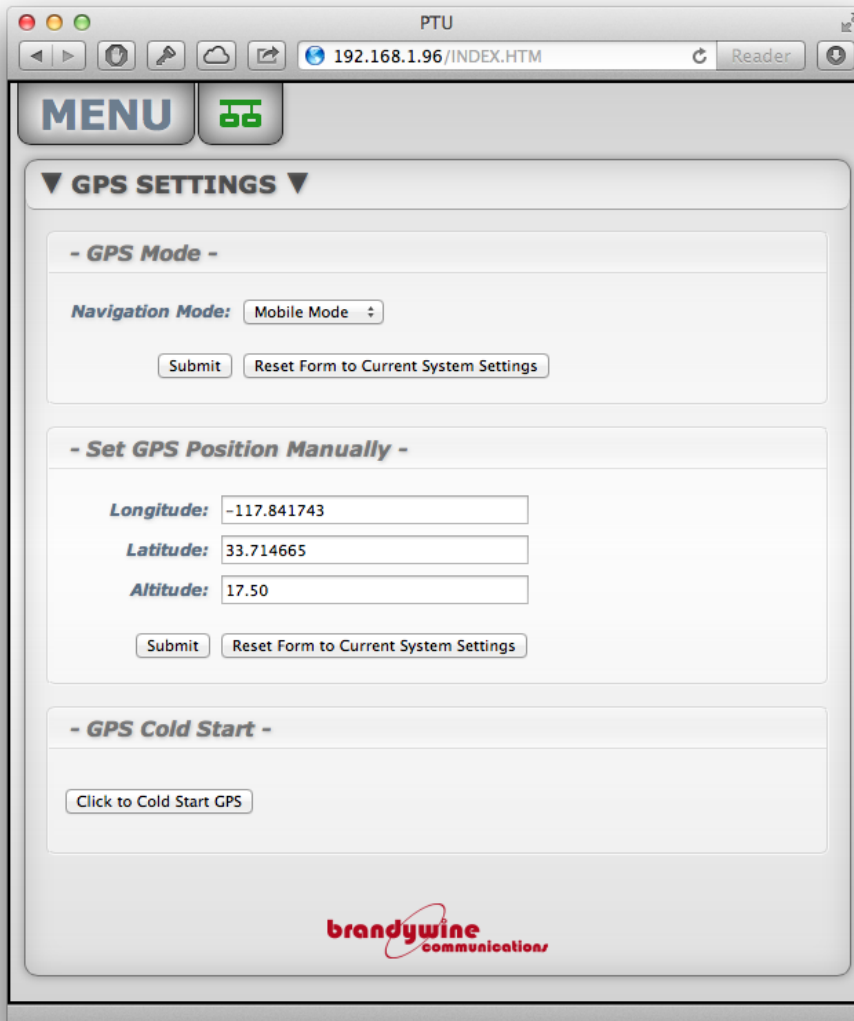


Figure 11 - Available GPS Modes

Figure 12 - GPS Settings Menu

5.4.2.1 GPS Modes

Mobile Mode: The unit will continuously update its recorded position in accordance to the GPS constellation, the internal GPS receiver will navigate and

continuously compute both position and time from all satellites in view. This mode requires a minimum of four tracked satellites at all times.

This mode **MUST** be used for portable applications.

Site Survey: The GPS receiver is in the position fix mode while it averages a specified number of sample positions. A minimum number of four satellites must be tracked during this time. Once the averaged value is determined, the receiver enters into position hold mode.

During the position hold mode, only one tracked satellite is needed.

Only use this mode for **FIXED** antenna locations such as a rooftop antenna.

Position Hold: In this mode, the PTU does not navigate and is programmed to a known position and thus stops calculating new positions, only deriving time from the satellite constellation. Erroneous satellite tracking data can be detected and removed from the over-determined timing solution using the receiver's built in Receiver Autonomous Integrity Monitoring (RAIM) function.

In locations where the satellite visibility is poor, the PTU can operate with as few as one tracked satellite in this mode.

This mode gives the best results with a **FIXED** antenna.

5.4.2.2 Cold Start GPS

Forcing a cold start on the GPS deletes all the current GPS almanac and real-time clock data in the GPS receiver, and forces the GPS receiver to perform a sky-search to acquire GPS satellite signals. Completion of a cold start can take up to 60 minutes.

5.4.3 Adjusting the Output Settings

From the main menu, select “Output” from the settings submenu. This lets you change the Output timecode format, 1PPS settings, and change the time zone and daylight savings settings.

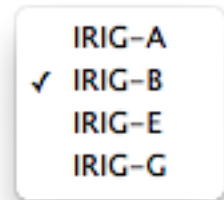
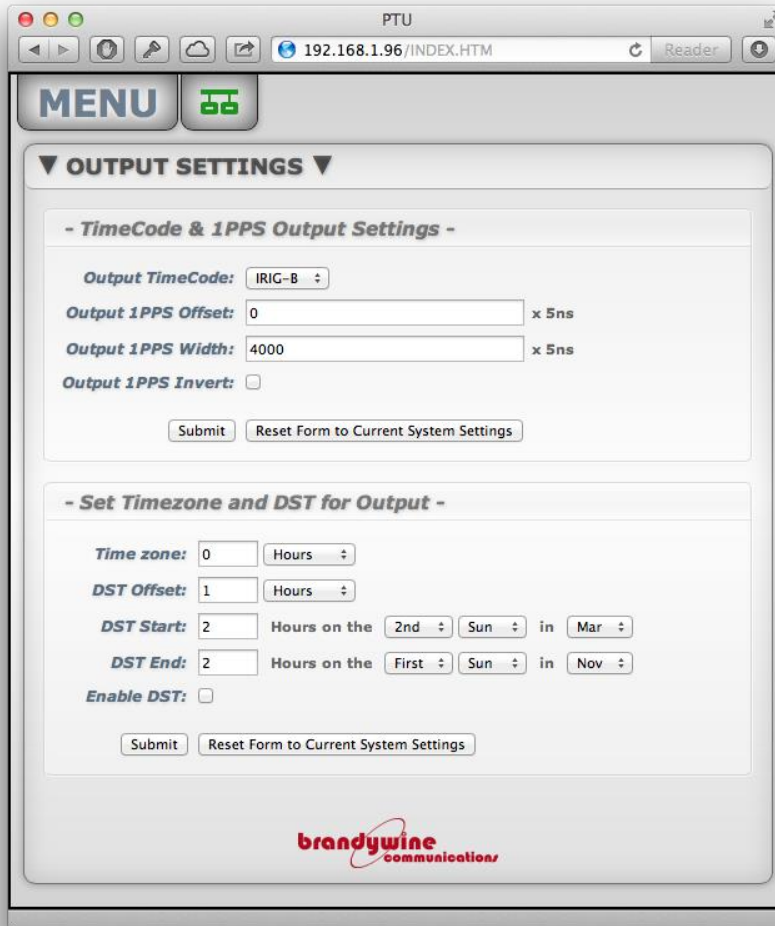


Figure 13 - PTU Output Options

Figure 14 - PTU Output Settings

5.4.3.1 Adjusting the Time Zone Offset

To adjust the Time zone offset, enter the number of hours EAST of UTC as a positive value, and the number of hours WEST of UTC as a negative value.

5.4.3.2 Adjusting 1PPS Output settings

The PTU's 1PPS output is adjustable in both width and phase.

The PTU incorporates a unique feature that allows the 1PPS outputs to be offset from the main internal time base (which is synchronized to the reference). This feature may be used to compensate for propagation delay in the cables between the PTU and the point of use.

A negative delay will ADVANCE the 1PPS relative to the reference.

A positive delay will RETARD the 1PPS relative to the reference.

Each individual 1PPS output can be delayed over a full second range (± 0.5 seconds) in 1ns steps, independent of the settings of the other outputs.

The Pulse width may be varied over the range of 10ns to 650 μ s in increments of 5ns. Enter the desired pulse width (in nanoseconds) in the box labeled Output 1PPS Width and click Submit. The pulse width setting applies to all 1PPS outputs.

Select the checkbox labeled "Output 1PPS Invert" to invert the 1PPS Output. Under normal settings, the 1PPS output provides 0V and increases to 5V for each pulse. Inverting it changes the 1PPS output to 5V and drops to 0V for the duration of the pulse.

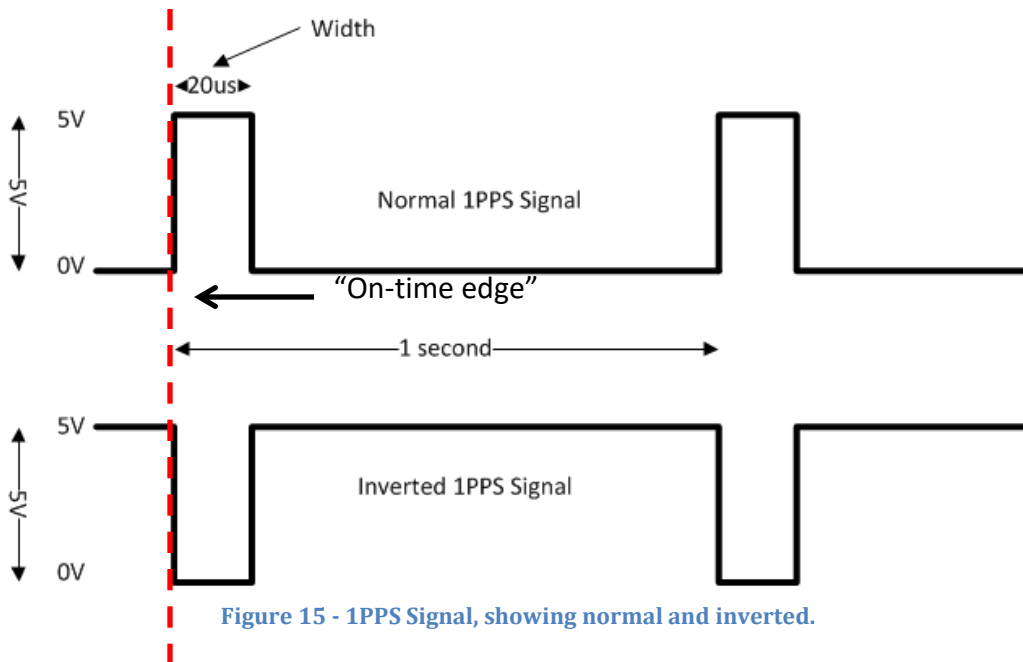


Figure 15 - 1PPS Signal, showing normal and inverted.

5.4.4 Changing the IP Address

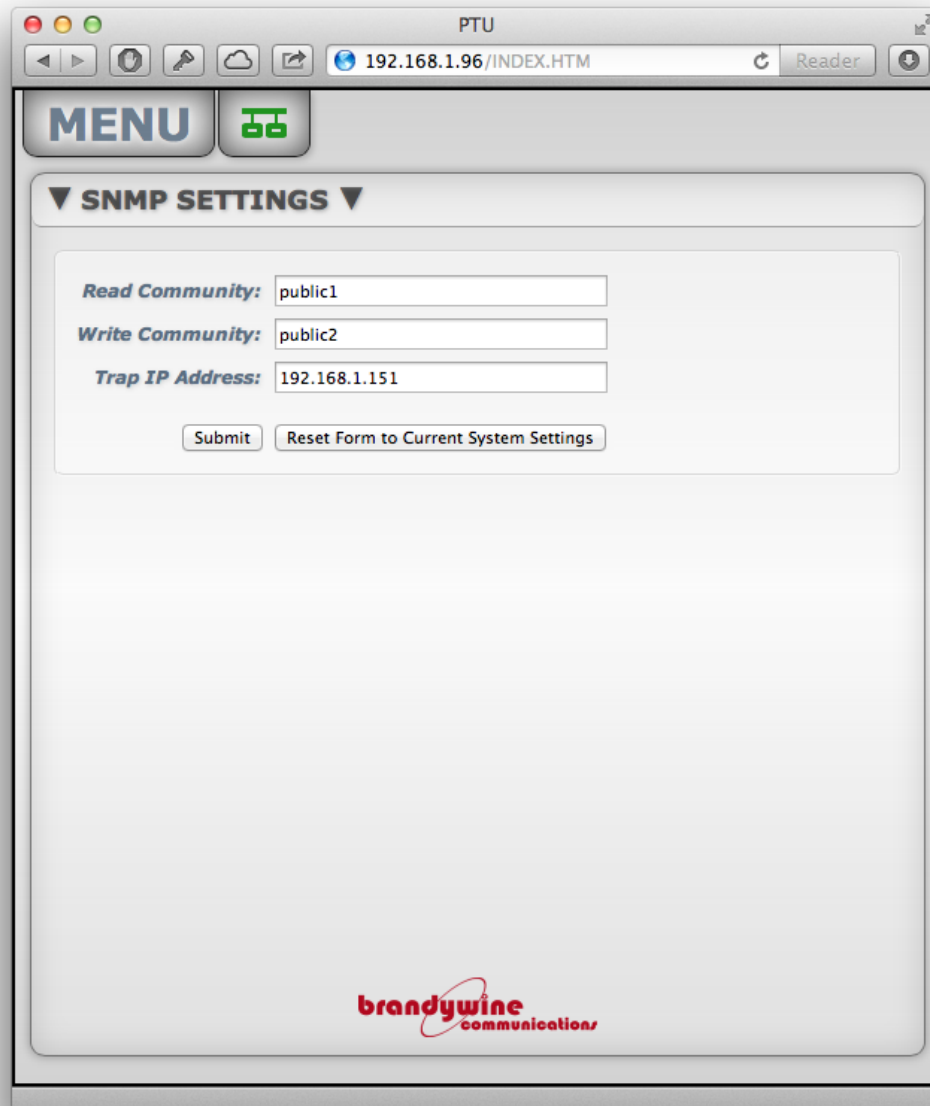
From the main menu, select “IP” from the settings submenu. From here you can change the IP Address, Subnet Mask, and Gateway address of the unit. From here you can also enable DHCP, however this action is not recommended.



Figure 16 - PTU IP Address Settings

5.4.5 Changing SNMP Settings

From the main menu, select “SNMP” from the settings submenu. From here you can set the Read Community, Write Community, and Trap IP Address.



The screenshot shows a web browser window titled "PTU" with the address bar displaying "192.168.1.96/INDEX.HTM". The page features a "MENU" button and a "SNMP SETTINGS" section. The settings are as follows:

Field	Value
Read Community:	public1
Write Community:	public2
Trap IP Address:	192.168.1.151

Buttons: Submit, Reset Form to Current System Settings

Figure 17 - SNMP Settings

5.4.5.1 Monitoring the PTU using SNMP

To monitor the PTU via Simple Network Management Protocol (SNMP), you will need to download an MIB file from the Support Downloads section of the Brandywine Communications website.

(<http://www.brandywinecomm.com/product-support/downloads>)

5.4.6 Changing The Location Setting

From the main menu, select “Location” from the settings submenu. This setting tells the user where the unit is physically located within a facility. (e.g. Room 102)

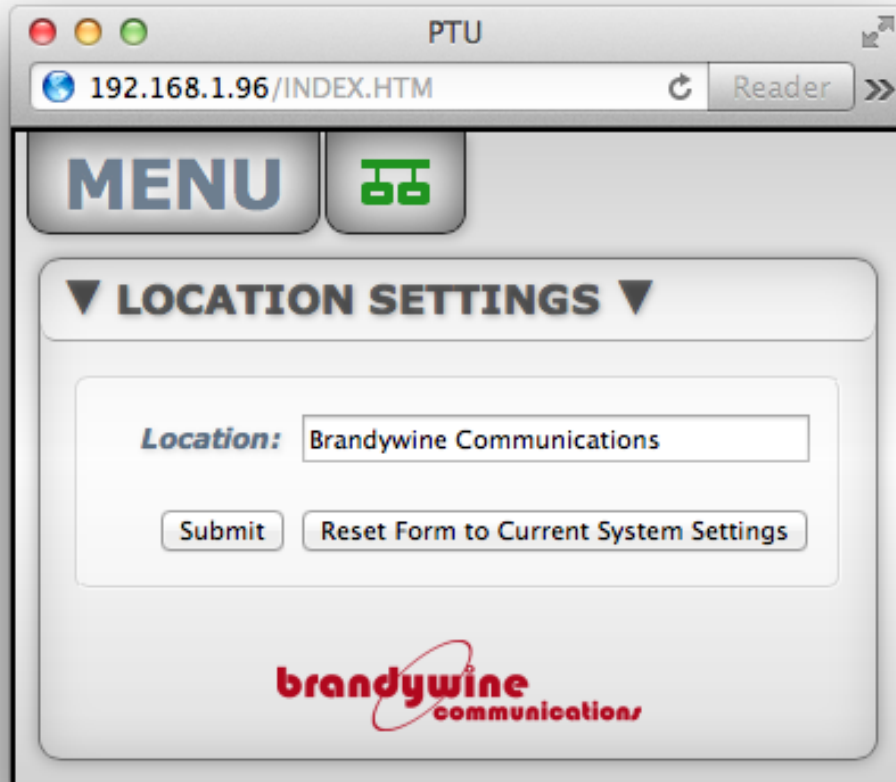


Figure 18 - Location Setting

5.4.7 Changing The Display Brightness

From the main menu, select “Display” from the settings submenu. This dropdown setting allows you to change the brightness of the front panel display, with 0 being the least bright, and 15 being the brightest.

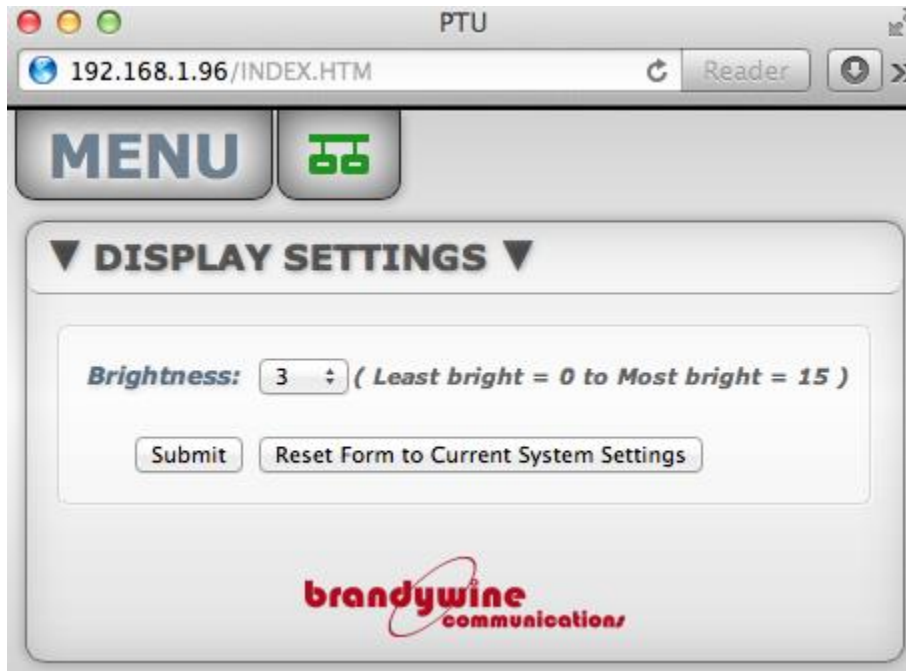


Figure 19 - Brightness Controls

5.4.8 Changing The Access Password

From the main menu, select “Password” from the settings submenu. From here you can change the access password for the unit to prevent other users from changing settings. You must have the current Username and Password in order to reset the existing username and password.

The factory default login credentials are:

Username: BRANDYWINE

Password: BRANDYWINE



The screenshot shows a web browser window titled "PTU" with the address bar displaying "192.168.1.96/INDEX.HTM". The page features a "MENU" button and a settings icon. The "PASSWORD SETTINGS" section is expanded, showing five input fields: "Current Username:", "Current Password:", "New Username:", "New Password:", and "Confirm New Password:". A "Submit" button is located below the input fields. The Brandywine Communications logo is visible at the bottom of the page.

Figure 20 - Password Settings

6 Troubleshooting Guide

6.1 Unit does not power up.

Ensure that the unit is plugged in and the switch is in the upwards (ON) position. Check to make sure that the green power light is illuminated. Please note that the display will only show the current time while the DISPLAY button is depressed.

6.2 PTU does not acquire satellites

Ensure that an antenna is fully connected and that the antenna has a clear view of the sky. In order to acquire satellites, the PTU must have an unobstructed view of the sky with at least 270° of clear sky horizontally, and no large obstructions more than 30° above the horizon.

If using the built-in antenna, ensure that the short coaxial link cable between J1 and J2 is installed.

6.3 Time Valid does not illuminate, but the PTU is tracking satellites

Check that the PTU has finished its warmup cycle. During power-up, the PTU needs at least five satellites to establish a GPS lock, and only 1 satellite to be visible at all times after that first lock. If the PTU is not in its warmup cycle, check the GPS status page to see how many satellites it's tracking. Using the PTU in mobile mode requires that at least five satellites be visible at all times.

6.4 Battery does not hold charge

Charge the PTU for 5 hours from the AC power connector, and then run it from the battery, if the unit cannot last more than 1 hour, contact Brandywine to request a replacement battery.

6.5 Red Fault light is on

Check that the GPS antenna is able to see satellites and is not obstructed. If the PTU is able to see satellites, check the alarm list from your web browser. (See 5.3.1 for how to access the list of alarms and for a list of alarms)



7 Support Information

All Brandywine Communications products come with a one-year warranty.

If your unit is still exhibiting problems not covered by the above troubleshooting guide, please contact us for technical support at support@brandywinecomm.com or call us at 714-755-1050.

If it becomes necessary to return your unit to the factory for repairs, please call us at 714-755-1050 extension 113 to arrange an RMA.

8 Front Panel

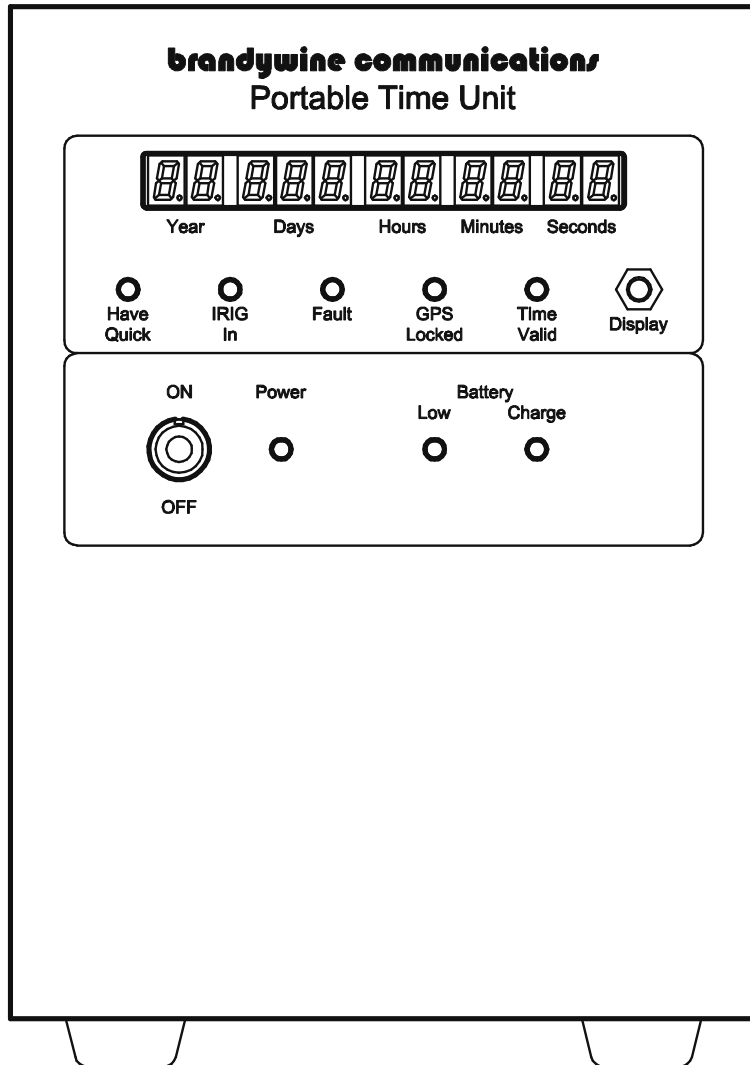


Figure 21 - PTU Front Panel

9 Rear Panel

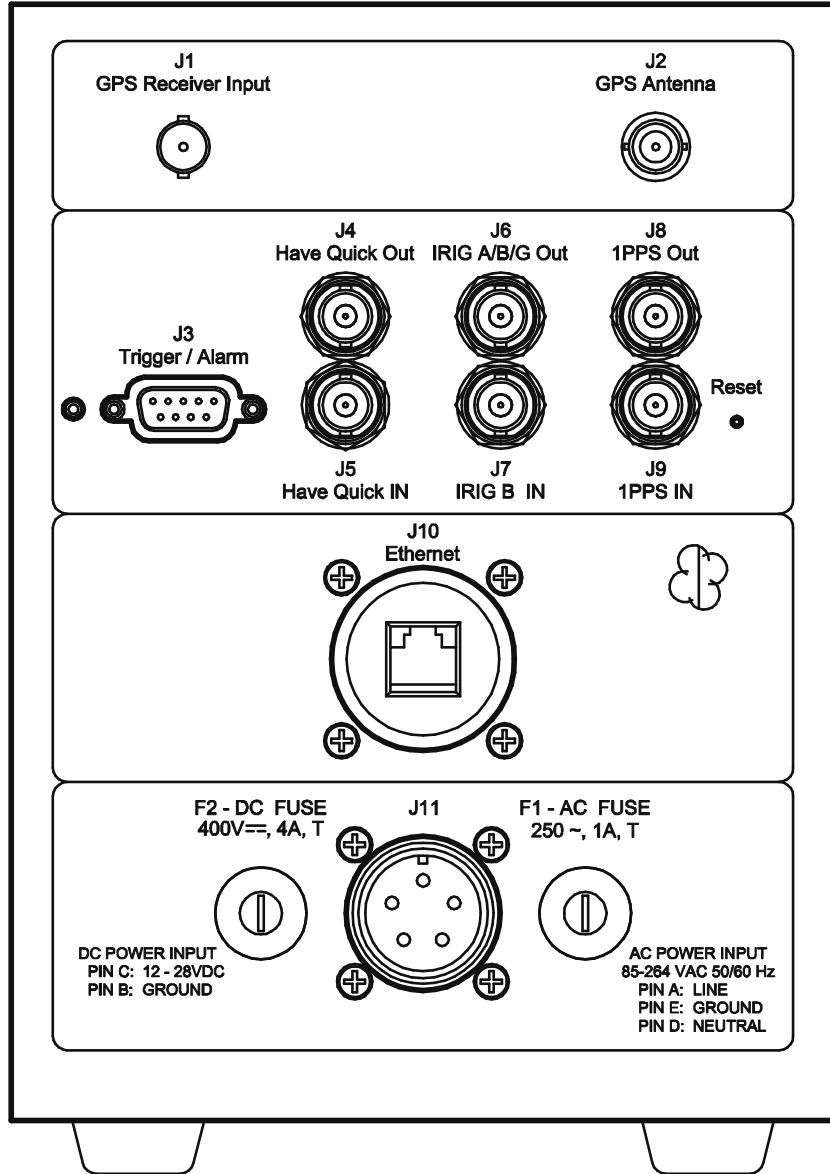


Figure 22 - PTU Rear Panel