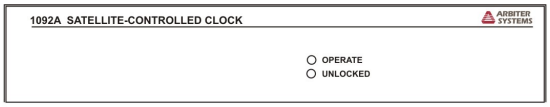
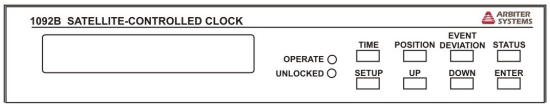
MODEL 1092A/B/C
MODEL 1093A/B/C
SATELLITE-CONTROLLED CLOCK

OPERATION MANUAL

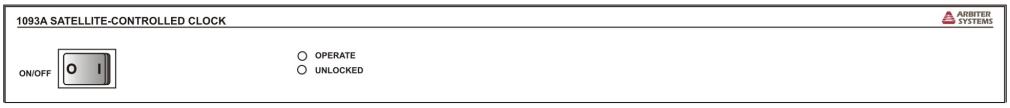


Model 1092A

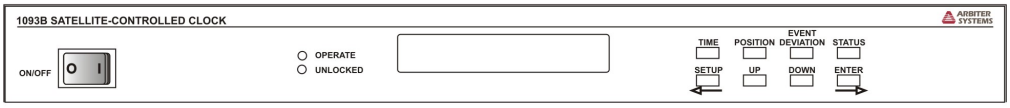


Model 1092B

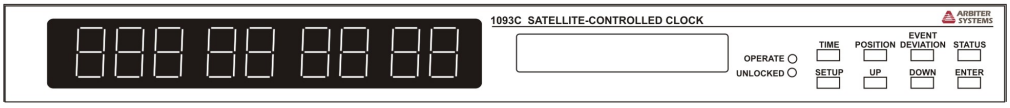
Model 1092C



Model 1093A



Model 1093B



Model 1093C

ARBITER SYSTEMS, INC.
PASO ROBLES, CA 93446
U.S.A.
WWW.ARBITER.COM

Description This manual is issued for reference only, at the convenience of Arbiter Systems. Reasonable effort was made to verify that all contents were accurate as of the time of publication. Check with Arbiter Systems at the address below for any revisions made since the original date of publication.

Contact Information

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What This Manual Covers

This manual describes the set up and operation of the Model 1092A/B/C and Model 1093A/B/C series satellite-controlled clocks.

How to Determine Firmware Version Date

To display the firmware date for your instrument (Models 1092B, 1093B and 1093C only) press and release the SETUP key at power-up and the date should appear briefly on the LCD display. To display the firmware date for Models 1092A, 1092C and 1093A, use the main RS-232 port (see page 10.2.15). To determine the current firmware date for this product, see the Arbiter website under the specific product name.

Firmware Updates – Main Board

Clocks with an main board require a ROM change to update firmware. This version of the manual is written for clocks with a ROM current with the publishing date of this manual (see page v). Where applicable, this update may include new documentation, such as a new version of this manual.

LIMITED WARRANTY Arbiter Systems makes no warranty, expressed or implied, on any product manufactured or sold by Arbiter Systems except for the following limited warranty against defects in materials and workmanship on products manufactured by Arbiter Systems.

Products manufactured by Arbiter Systems are guaranteed against defective materials and workmanship under normal use and service from the date of delivery for the period listed as Limited Lifetime[1]. The responsibility of Arbiter Systems under this warranty is limited to repair or replacement, at Arbiter Systems' option, of any product found to be defective. Arbiter Systems shall have no liability under this warranty unless it receives written notice of any claimed defect.

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This limited warranty does not extend to any product, which has been subject to:

1. Improper use or application, abuse, or operation beyond its rated capacity, or contrary to the instructions in the operation and maintenance manuals (if any);

2. Accident;

3. Repair or maintenance performed by Buyer, except in accordance with the operation and maintenance manuals, if any, and any special instructions of Arbiter Systems;

4. Modification without the prior written authorization of Arbiter Systems (whether by the substitution of non-approved parts or otherwise). The remedies provided herein are Buyer's sole and exclusive remedies. In no event shall Arbiter Systems be liable for direct, indirect, incidental or consequential damages (including loss of profits), whether based on contract, tort, or other legal theory.

FOR THE FASTEST POSSIBLE SERVICE, PLEASE PROCEED AS FOLLOWS:

1. Notify Arbiter Systems, Inc., specifying the instrument model number and serial number and giving full details of the difficulty. Service data or instrument-return authorization will be provided upon receipt of this information.

2. If instrument return is authorized, forward prepaid to the manufacturer. If it is determined that the instrument is not covered by this warranty, an estimate will be made before the repair work begins, if requested.

See Contact Information on page ii.

[1] "Limited Lifetime" means that Arbiter Systems will repair or replace the defective component as long as components are available and for no more than five years after the product has been deemed obsolete.

Model 1092A/B/C
Model 1093A/B/C
Satellite–Controlled Clock
Operation Manual

PD0021000AH

Contents

List of Figures

List of Tables

Chapter 1

Unpacking the Clock

1.1 Introduction

This section will assist you with unpacking the clock from its shipping container; other parts and accessories shipped with the clock include:

- 1093A/B/C GPS Clock (includes internal power supply)
- 1092A/B/C GPS Clock (includes external power supply)
- Antenna Cable, 50 feet with connectors
- GPS Antenna
- Rack-Mount Ears, 2 ea. (1093A/B/C only)
- Instrument Manual

1.2 Precautions

Mechanical Shock Note that the GPS antenna is small and smooth, and can be damaged if dropped. Use care when handling. Remember to store the antenna in a safe place before the final installation.

Static Discharge Note that the Model 1092A/B/C and 1093A/B/C are electronic devices and use static-sensitive components in their operation. Therefore, use care when handling against static discharges. Generally, these components are protected in their normal situation, however some of these are accessible when the cover is removed.

CAUTION Antenna Input Connector - Connect only the antenna cable coming from the antenna into this connector. The antenna input connector on the clock itself leads to the GPS receiver, which could be damaged from high voltage or a static discharge. To protect the GPS clock from electrical discharges during operation, consider the optional surge suppressor (Part no. AS0049000). For more information see Section 4.3.

1.3 Unpacking and Locating Accessories

The Model 1093A/B/C, and included accessories, are packed between two closed-cell foam shells (see Figure 1.1). The Model 1092A/B/C series clocks are packed between layers of molded foam pieces. Carefully pull apart the two shells to extract the clock and accessories. Some of the accessories (i.e. antenna and rack-mount ears) are located in one of these shells for protection. In the diagram below, you can see how the GPS antenna and rack-mount ears are located in the closed-cell foam marked with the label that reads,

ADDITIONAL PARTS INSIDE

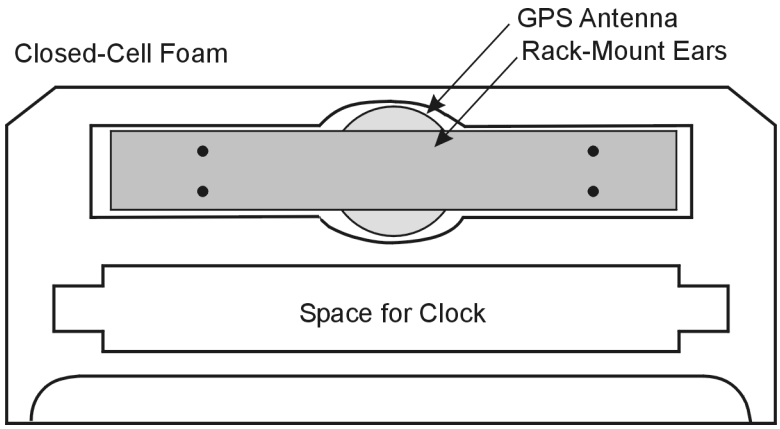


Figure 1.1: Packaging of Accessories

Antenna cable, clock and operation manual are located between the two pieces of closed-cell foam. *The rack-mount ears and antenna are embedded in the packing foam side labeled* ADDITIONAL PARTS INSIDE.

1.4 Attaching Rack-Mount Ears to 1093A/B/C Series Clocks

Each Model 1093A/B/C comes with two rack-mount ears suitable for mounting in a 19-inch system rack. These ears have four mounting holes, two of which are used to attach them to the sides of the clock. Since it is required to remove the M25 x 10 mm screws which attach the cover to the chassis, it may be good to attach the ears after first making any jumper configuration inside the clock. *You will want to return to this section after making these changes.*

1.4.1 Mounting Instructions

1. Using a Torx T25 driver or large slot screwdriver, remove the four M5x10 screws attaching the clock cover to the chassis. Use either a T25 or large slot screwdriver.

2. With the ear facing out from the front panel, match the lower set of holes of the ear to the cover/chassis and remount the M5x10 screws.

3. Repeat this procedure with the other side of the chassis and other ear.

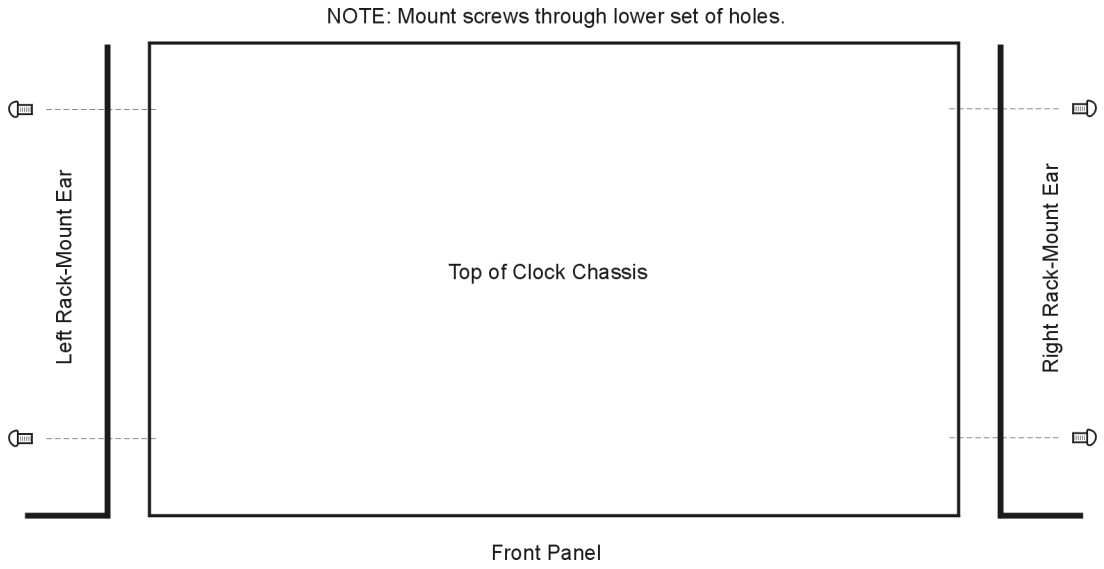


Figure 1.2: Attaching Rack-Mount Ears

NOTE: Before installing the rack-mount ears, you might want to determine if you need to set any internal jumpers. To install the rack-mount ears requires removal of the top cover, which would be a good time to make any changes to jumper settings. See Chapter 5, Setting Internal Jumpers, for information on doing this.

1.4.2 Rack-Mount Ears for Model 1092A/B/C Series Clocks

Rack-mount ears are available for Model 1092A/B/C series clocks by ordering part number AS0044500. These ears are similar to the rack-mount ears for 1093A/B/C, however the ears are wider to accommodate the narrower width of these clocks. Check with Arbiter sales or your local representative to order these items.

Chapter 2

Front and Rear Panels

2.1 Introduction

This section identifies the connectors, controls, and displays found on the front and rear panels of the 1092A/B/C and 1093A/B/C series clocks. Take care to review all of these items prior to connecting cables to and configuring these products.

Figure 2.1: Model 1092A/B/C and 1093A/B/C Front Panel Description

2.2 Front Panel Controls and Indicators

The front panels of the Model 1092A/B/C and 1093A/B/C series clocks are different from one another because of the arrangement of LED indicators, display(s) and keypad. See Figure 2.1 to see the difference between these models. Of the 1092-series clocks, only the Model 1092B has an eight-button keypad. Because of the large LED display, the Model 1092C does not have the two-line by twenty-character LCD. All 1092-series clocks have the two annunciator LED's.

The Model 1093A has two annunciator LED's; the Model 1093B adds to that the two-line by twenty-character LCD and eight-button keypad; the Model 1093C adds to the Model 1093B another nine-character, LED for higher visibility. ON/OFF switch is optional and can be added for a small charge. The upper row of keys are Information keys and the lower row of keys are configuration keys. In the figure below are illustrated the front panels of all of these clocks, illustrating all of the indicators and controls.

Definitions for the annunciator LEDs are found below and definitions for keys in Table 2.1. Each of four upper keys allows you to view specific clock information, such as time and date, geographical position and instrument status. Each of the four lower keys allows you to configure various clock functions. To configure, see Chapter 7, The Setup Menus.

2.2.1 Command Key Definitions

Table 2.1 subdivides all of the functions of the eight keys by name and function. Some of the keys have alternate functions as well.

Key	**Function**	**Alternate Function**
TIME	time and date	N/A
POSITION	latitude, longitude and elevation	N/A
EVENT DEVIATION	Event or Deviation	N/A
STATUS	Clock and Receiver Status	N/A
SETUP	setup mode	move cursor left in data entry mode
UP	select upper value	increase numerical value
DOWN	select lower value	decrease numerical value
ENTER	install selected value	move cursor right in data entry mode

Table 2.1: Command Key Definitions

2.2.2 LED Status Indicators

Two LED's provide information about the operational status of the instrument. The Operate LED is green and the Out-of-Lock LED is red. For normal operation, with the clock locked and accurate, the green LED should be ON and the red LED should be OFF. The following definitions apply to these indicators:

- **OPERATE**: Illuminates green when power is being supplied to the clock.
- **OUT OF LOCK**: Illuminates red when the clock has not yet synchronized, or has lost synchronization, with the GPS.

2.2.3 LCD Display

The Model 1092B and the 1093B/C contain a liquid crystal display (LCD), which provides a 20-character by 2-line readout. The readout displays instrument status, time and event data. The readout is also used to display the current configuration of operation parameters.

2.2.4 Enabling and Disabling the Keypad and Display

The Model 1093A/B/C and 1092A/B/C also have one or more RS-232 ports that provide control over the operation of the keypad and display (lock, enable, blank). Refer to Section 10.2.7, in the Serial Communication and Command Set, for a detailed description of RS-232 commands to control the front panel. The front-panel Pushbutton Keys are described below.

Time

Sets the display to the Time Display Mode. There are four modes of the time display available and repeated pressing of this key will cause the display to scroll through all four modes continuously. Changing the time display has no effect on the time data, which is output from rear-panel timing outputs.

Position

Cycles the display through the longitude, latitude, and elevation data readouts of the antenna location according to the most recent position fix.

Event/Deviation

Selects Event and/or Deviation Data recorded by the specific clock model; up to 400 event records or updated 1-PPS deviation data. Also, see Event Inputs in Chapters 5, 6, 8 and 9.

Status

Toggles the display between four status display modes: Clock, Receiver, DXCO and EEPROM, including the display of GPS satellite acquisition and synchronization.

Setup

Invokes a series of menus used to adjust configurable parameters within the clock. In numeric data entry mode, moves the cursor to the left.

Up

Used in conjunction with the Setup menus to adjust values upward, or to scroll upward through the available menu choices. Also assists in navigating through main Setup menus in normal order.

Down

Used in conjunction with the Setup menus to adjust values downward, or to scroll downward through available menu choices. Also assists in navigating through main Setup menus in reverse.

Enter

Used for confirming changes made within Setup menus. Generally, pressing Enter also advances to the next parameter, or returns to the previous menu level. In numeric data entry mode, moves the cursor to the right.

2.3 Rear Panel Identification and Connectors

This section contains information to assist you in identifying where to connect inlet power, the GPS antenna cable and all of the input and output cables on the Model 1092A/B/C and 1093A/B/C series clocks.

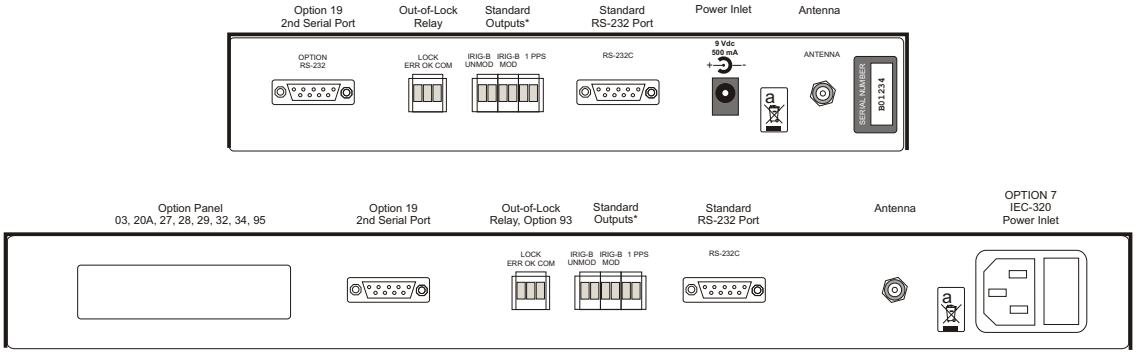


Figure 2.2: Model 1092A/B/C and 1093A/B/C Rear Panel Description*

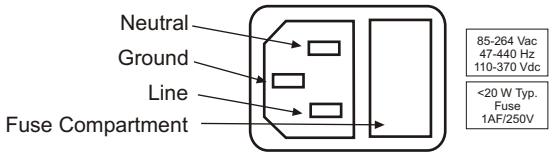
*Note: Optional outputs may be shown.

2.3.1 Power Inlet

To cover all of the possible inlet power conditions, the Model 1093A/B/C has three optional power supplies. The Model 1092A/B/C series clocks have an external power supply that connects to a 3.5 mm mini connector on the rear panel. Carefully examine the paperwork you received to make sure you have correctly identified the inlet connection. The supply types described below apply to the 1093A/B/C only.

Option 07. IEC-320 supply with a range of 85 to 264 VAC, 47 to 440 Hz and 110 to 370 VDC (see Figure 2.3).

Figure 2.3: Option 07 Power Supply Inlet Connector



Option 08. 10 to 60 VDC ONLY, Terminal Power Strip with Surge Withstand Protect Circuitry (SWC) power (see Figure 2.4).

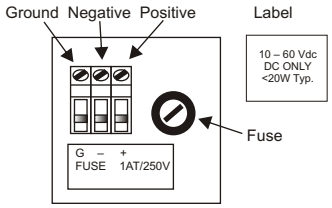


Figure 2.4: Option 08 Power Supply Inlet Connector

Option 10. 110 to 350 VDC and 85 to 250 VAC, 47 to 440 Hz, Terminal Power Strip with Surge Withstand Protect Circuitry (see Figure 2.5).

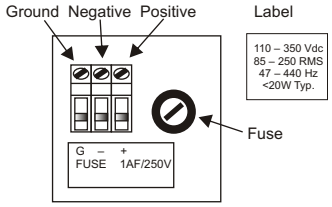


Figure 2.5: Option 10 Power Supply Inlet Connector

2.3.2 Antenna Input

Figure 2.6 illustrates the female type-F, GPS antenna input connector, which also supplies 5 VDC to energize the antenna.

Figure 2.6: GPS Antenna Connector

To check for this 5-volt signal, use a small multimeter and probe from the center pin (+) of the connector to the threads. Voltage range is 4.9 to 5.1 VDC. For further information, see Chapter 4, Antenna and Cable Information.

2.3.3 Event Input

For timing external events based on the GPS-synchronized time, use either of two event input connectors: J4 (Standard I/O) and J6 (RS-232C). See Figure 5.1, which illustrates the location of these two connectors and the jumper location to select either connector.

2.3.4 RS-232 and RS-485 Communication Ports

The Model 1092A/B/C and 1093A/B/C each have one standard and one optional communication port with RS-232 supported. RS-485 is supported only on the standard RS-232 port, not the optional RS-232 port. The RS-232 port does not use flow control and the RS-485 is transmit only (uses Transmit A and Transmit B, no Receive A and Receive B).

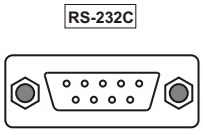


Figure 2.7: Communications Port Connector

2.3.5 Form C, Relay Contacts – Option 93

Optional Form C relay contacts provide contact closure for an out-of-lock condition, or loss of inlet power. Installing Option 93 gives the Model 1092A/B/C and Model 1093A/B/C one set of Form C relay contacts with three contact points labeled ERR (Normally Closed), OK (Normally Open) and COM; "Normally" refers to the clock in the powered OFF state (illustrated in Figure 2.8). The information below gives the contact states for two situations: (1) faulted (including power off) and, (2) not faulted.

1. Faulted, or Power OFF – ERR to COM is shorted, OK to COM is open.
2. Not Faulted and Power On – ERR to COM is open, OK to COM shorted.

Failsafe

Essentially "Failsafe" mode occurs in the event of a power loss, and the Form C relay contacts are faulted.

For additional information on Option 93, including specifications, see Chapter 9, Relay Contacts and Event Inputs and the Options List in Section C.19.

Figure 2.8: Relay Contact Connector

2.3.6 Standard Inputs/Outputs

Figure 2.9 illustrates the timing output connector for three separate timing signals: unmodulated IRIG-B, modulated IRIG-B and 1 Pulse Per Second (PPS). Viewed from the rear panel, they are labeled IRIG-B UNMOD, IRIG-B MOD[1], 1 PPS from left to right. Multiple devices may be connected in parallel from a single output connector. For more information concerning how to connect timing outputsv11, see Chapter 8, Timing, IRIG-B and Pulses.

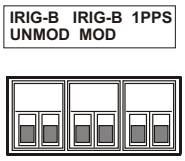


Figure 2.9: Standard Input/Output Connectors

[1]Main board requires Option 92 for modulated IRIG-B.

Chapter 3

Connecting Inlet Power, Input and Output Signals

Model 1092A/B/C Model 1092A/B/C series clocks include an external wall-mount power supply with an output of +9 VDC at 500 mA. The Model 1092A/B/C has an input voltage range from +8 to +15 VDC.

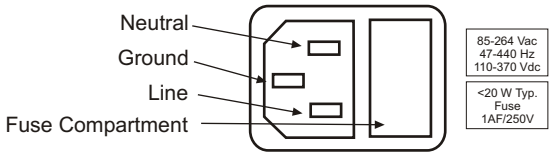
Model 1093A/B/C To provide for a wide range of inlet power sources, the 1093B can be ordered with any one of three different power inlet modules. Each of the power inlet module connectors are illustrated here and also in Chapter 2. Take time to examine the power inlet module connection on your clock to verify that it is correct according to your order. Also, carefully check the voltage range at the inlet connector before connecting power to the clock.

3.1 Option 07, IEC-320 Power Inlet Module

The Option 07, IEC-320 power inlet module, comes with power cord for the required country code. See Figure 3.1 below.

Inlet Specifications: 85 to 264 VAC, 47 to 440 Hz, or 110 to 370 VDC, $<$ 20 Watts

Figure 3.1: Option 07 Power Supply Inlet Description



3.1.1 Cordsets and Plug Styles for Option 07

Make sure that the cordset matches the wall connector for your country. Table 3.1 lists IEC-320 mating cordsets by country and include plug style and specifications.

3.1.2 Option 07, Connecting Power to the 1093B

Connect the IEC-320 plug on the cordset to the IEC-320 connector on the 1093B, and then connect the wall plug on the cordset into the wall socket.

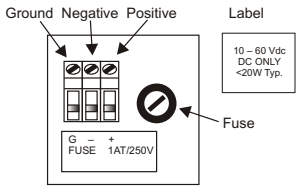
No.	Country	Specification	Rating
P01	Continental Europe	CEE 7/7	220V
P02	Australia, NZ, PRC	AS3112-1981	240V
P03	U.K.	BS 1363	240V
P04	Denmark	Afsnit 107-2-01	240V
P05	India	BS 546	220V
P06	Israel	SI 32	220V
P07	Italy	CEI 23-16/VII 1971	220V
P08	Switzerland	SEV 1011.1959	220V
P09	North America and ROC	NEMA 5-15P CSA C22.2#42	120V
P10	Japan	JIS8303	120V

Table 3.1: Available IEC-320 Cordsets by Country

3.2 Option 08, 10 to 60 VDC Terminal Power Strip

This option replaces the standard power supply with one accepting 10 to 60 VDC (only), < 20 VA typical. Replaces the standard IEC-320 inlet with a 3-pole terminal strip. Provides input surge protection (SWC) for compliance with ANSI C37.90-1 and IEC 801-4. Option 08 operates from common low-voltage battery systems, including 12, 24, and 48 VDC.

Figure 3.2: Option 08 Power Supply Inlet Description



3.2.1 Option 08, Connecting Inlet Power

When wiring station batteries to this power supply, make sure to first connect an earth ground wire to the terminal strip connector labeled “G” (for ground). After connecting a ground wire, connect the positive and negative leads from the station batteries to the corresponding Option 08 terminals. Figure 3.2 illustrates the Option 08 connector with terminals labeled as “+” and “–”.

3.3 Option 10, 110 to 350 VDC Terminal Power Strip

Figure 3.3 illustrates Option 10, which replaces the standard IEC-320 inlet with a 3-pole terminal strip and provides input surge protection for compliance with ANSI C37.90-1 and IEC 801-4. Input voltages are: 85 to 250 VAC, 47 to 440 Hz, or 110 to 350 VDC, < 20 VA typical.

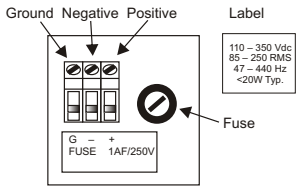


Figure 3.3: Option 10 Power Supply Inlet Description

3.3.1 Option 10, Connecting Inlet Power

When wiring this power supply, make sure to first connect an earth ground wire to the terminal strip connector labeled "G" (for ground). After connecting a ground wire, connect the positive and negative leads from the station batteries to the corresponding Option 10 terminals. Positive and negative terminals are marked on the terminals as "+" and "–".

3.4 Fuse Locations and Types

Use the fusing table below for identifying the correct fuse for your option power supply.

PS Option	Arbiter P/N	Fuse ID	Size, mm
07	FU0001816	F1AL250V	5 x 20
08	FU0001419	T2AL250V	5 x 20
10	FU0001816	F1AL250V	5 x 20

Table 3.2: Fuse Chart

3.4.1 Replacing Fuses

An IEC-320 power inlet connector includes a 1-A, 250-V fast acting fuse. The fuse is contained in a small compartment with a snap-fit latch, which also has a compartment for a spare fuse. Check Table 3.2 for replacement fuse information.

The fuse compartment is located directly adjacent to the input connector socket, and can be opened by pulling both sides directly out away from the chassis, or by gently prying with a small flag-blade screwdriver. To replace the fuse, first disconnect the line cord from the power source and then remove the cord from the rear-panel IEC connector. The in-circuit fuse is the innermost one; inspect it to determine if it is open. As required, replace with fuse in the outer compartment, and replace the spent fuse.

Option 08 and 10 fuses are located in a separate threaded compartment. To check the fuse, use a small flat-bladed screwdriver and turn the cover counter-clockwise. The cover and fuse should pop out. CAUTION: Replace fuse only with another of the same type and rating. See Table 3.2 above for the correct fuse configured for your option.

To replace the fuse, first disconnect inlet power from the clock. Using a small flat-blade screwdriver, turn the fuse cover counter-clockwise (CCW) and it should pop outward. Replace fuse with the same size and type.

3.5 Connecting Output Signals

Output signals may be connected through designated standard or option connector. For standard I/O connectors, see Section 2.3.6. Terminals are Phoenix-type with 5-mm spacing and will accept between 0.25 and 2.5–mm wire diameter. For Options that have terminals for output connectors, see Appendix C for details about those options and connectors. BNC connectors (on installed option boards) are female and require only connecting the (male) connector into it.

To connect wires to any of the terminals, strip the insulation back to expose about 1/4" of bare wire and DO NOT tin the bare end. Insert the stripped wire into the terminal and turn the screw down to secure it in the connector.

3.6 Connecting Input Signals

Input signals may be connected through the designated I/O terminals, the RS-232 connector and through an installed option connector designated as Input. For standard I/O connectors, see Section 2.3.6. Terminals are Phoenix-type with 5-mm spacing and will accept between 0.25 and 2.5–mm wire diameter. Option 95 has four BNC connectors and allows connection of an input signal for event timing besides the three output connectors. See specific option number in Appendix C for details about wiring and connectors. BNC connectors (on installed option boards) are female and require only connecting the (male) connector to it.

To connect wires to any of the terminals, strip the insulation back to expose about 1/4–inch of bare wire and DO NOT tin the bare end. Insert the stripped wire into the terminal and turn the screw down to secure it in the connector.

Chapter 4

GPS Antenna and Cable Information

The Model 1092A/B/C and 1093A/B/C come complete with the necessary hardware to be able to receive GPS signals: 50-feet of RG-6 cable and a GPS antenna. Longer cables are available. The antenna cable is connected between the female F connector on the antenna and the female F connector at the rear panel of the clock.

This section should help you with installing the GPS antenna and antenna cable(s) and accessories. It should also be a source of information if you should need to trouble shoot the antenna cable system.

4.1 GPS Antenna Installation

To properly receive GPS signals, the GPS antenna needs to be mounted clear of buildings and surrounding elements that may block the GPS signals being transmitted by the satellites. For complete coverage, the antenna needs to have a clear view of the sky from 10 degrees above the horizon to directly overhead for all points of the compass. Minimal installations, where the antenna is mounted in a less favorable location, may work however reception may be somewhat limited during certain hours of the day.

4.1.1 Mounting the Antenna

The standard antenna is designed for pole mounting on a 26-mm pole (1.05-in. OD or 3/4-in. ID pipe), with either a standard 1-in. – 14 (approximately M25.4 x 1.81) marine-mount thread or a 3/4-in. NPT pipe thread. The Type F connector on the inside of the antenna is protected from direct exposure to the elements when the antenna is mounted in this way. This will extend the operational life of the antenna-to-cable interface.

To mount the antenna, you will need a short piece of gray, 3/4–in. plastic pipe nipple that can be attached to a solid fixture. The piece of pipe nipple should be threaded up into the antenna receptacle after connecting the antenna cable to the Type F cable adapter. Arbiter Systems sells an antenna mounting kit (P/N AS0044600) that simplifies installation for a variety of locations. Figures 4.1, 4.2 and 4.3 illustrate several components for a suggested mounting method.

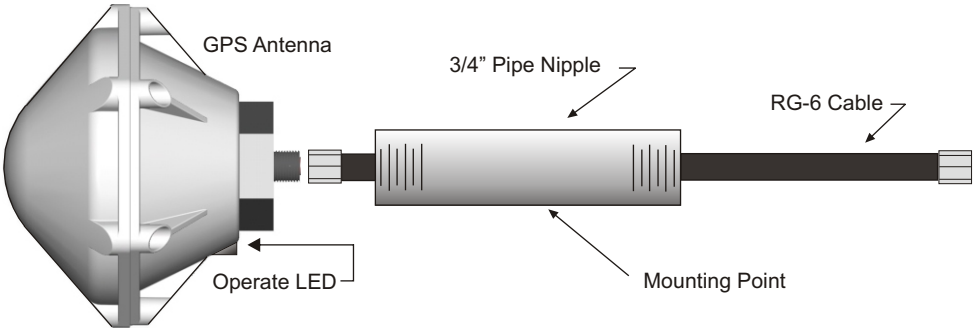


Figure 4.1: Antenna Assembly for Mounting

Antenna mounting procedure:

1. Thread the RG-6 antenna cable through the plastic pipe.
2. Tighten the Type F male connector to the female connector on the antenna. **WARNING! Do not spin the antenna onto cable. Attach and tighten using cable nut.**
3. Thread the plastic pipe into the antenna mounting nut.
4. Mount the plastic pipe and antenna/cable assembly to a fixture.

4.1.2 Optional Antenna Mounting Bracket, Kit P/N AS0044600

The AS0044600 antenna mounting kit is designed specifically for use with antennas shipped with Arbiter Systems GPS-controlled clocks. The hardware included with the bracket allows installation of the antenna on a mast or pipe up to about 2–in. in diameter, and a different clamp may be substituted for use with a larger diameter pipe. Also, the bracket can be mounted to a wall, a roof, or any other flat surface.

For complete details on this product request *Installation Instructions for Arbiter Systems GPS Antenna Mounting Bracket* on document number *PD0024700A*. All metallic hardware is stainless steel.

Qty	Description	ASI P/N
1	GPS antenna mounting bracket	HD0052700
1	U-bolt, 1-1/8–in., with 2 hex nuts	HP0014700
1	3/4 x 4–in. threaded pipe, PVC, schedule 80	HP0014804
1	Hose clamp, worm drive	HP0014900
1	Mounting bracket stabilizer	HD0054200

Table 4.1: Antenna Mounting Bracket Parts List

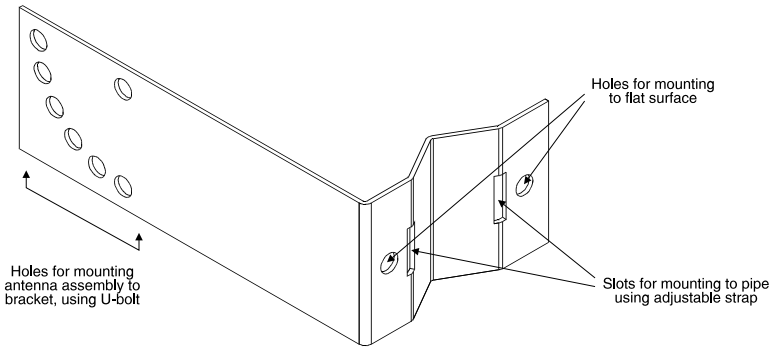


Figure 4.2: Antenna Mounting Bracket

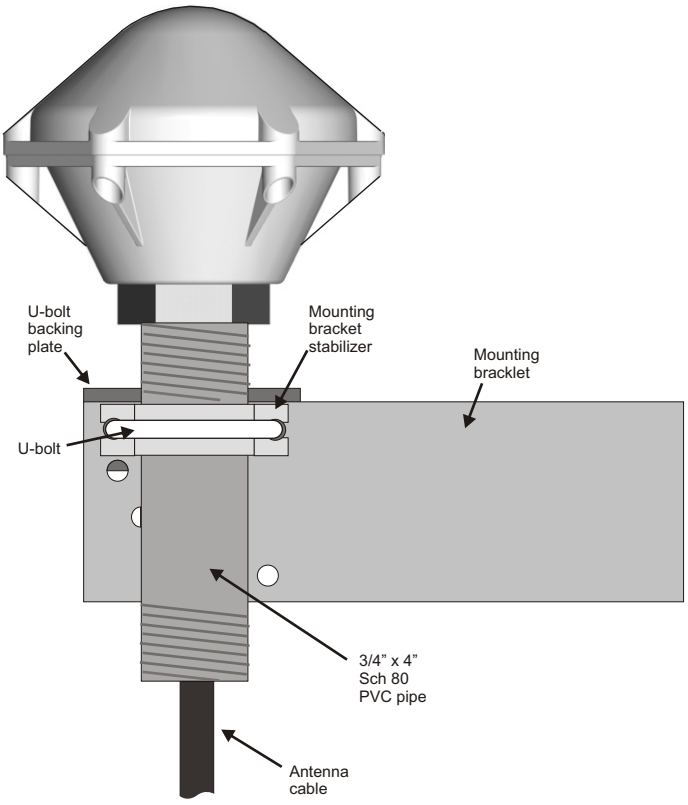


Figure 4.3: Antenna Mounting with AS0044600

4.2 Verifying Antenna and Cable Operation

A two-color operate LED, located at the base of the antenna, indicates proper antenna operation. GREEN indicates proper operation (i.e. the antenna is getting the correct voltage); AMBER indicates improper operation (i.e. the voltage is low).

4.2.1 Checking the Antenna Voltage

The GPS clock provides +5 VDC to the GPS antenna, which is carried through the antenna cable. Nominal antenna current is 29 mA (nominal). Check the voltage at the antenna connector on the rear panel. Without a 5 VDC signal applied to the antenna, the GPS clock will not synchronize with the Global Positioning System and can generate an out-of-lock alarm, if the Out-of-Lock feature is enabled.

4.2.2 Power Supply Check

The Antenna Voltage test (above) actually tests the main power supply voltage for all models of clocks. This signal should be between 4.9 and 5.1 VDC.

4.2.3 Checking the Antenna Resistance

Checking the internal resistance of the Arbiter GPS antenna is not as useful as verifying the antenna current mentioned above. Antenna resistance measures several megohms with meter probes at one polarity and less so if you change the meter probe polarity.

4.3 GPS Surge Arrester

Figure 4.4 illustrates the GPS surge arrester kit (P/N AS0094500), which is mounted in line with the antenna cable. The surge suppressor has two female F connectors, which are bidirectional, and two ground lugs with hardware for connecting to a solid ground. The surge arrester passes power to the GPS antenna, but does not draw power from the clock.

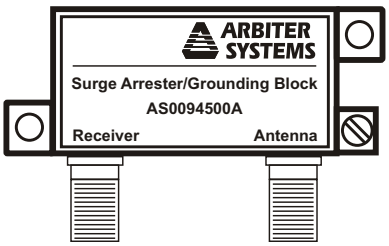


Figure 4.4: GPS Surge Arrester

4.3.1 Using the GPS Surge Arrester

Before installation, review the documentation on this device found in Appendix B. The AS0094500 surge arrester is weatherproof except for the F connectors, which may be sealed with rubber port seals or GE Silicone II compound.

4.4 Technical Details on GPS Antennas and Cables

4.4.1 Antenna Cable

Length and Loss Considerations

Standard Antenna Cable
The standard antenna cable assembly included with the clock is constructed using a 15-meter (50-foot) length of RG-6 type low-loss coaxial cable, terminated with male Type F connectors. Optional lengths of RG-6 coax are separately available for longer runs; see Table 4.2, Cable Data and Accessory Information.

Effects of Cable Parameters

To receive GPS signals and properly operate the clock, the type and length of the cable are important. Due to their effect on specific parameters described in the following paragraphs, any changes to the length and/or type of antenna cable should be made carefully. Damaged cables may also affect performance.

Cable Delay

The velocity factor and the physical length of the cable determine cable delay. During the initial factory calibration of the clock, a value for cable delay (based upon the length and type of cable supplied) is entered into the clock memory. Firmware uses this figure to counteract the effect that the delay has upon GPS timing accuracy. The value entered for a standard 15-meter cable is 60 nanoseconds. For other cable options, the delay is tabulated below. The formula for calculating cable delay is:

$$T = \lambda \frac{1}{CKv} + 1ns \tag{4.1}$$

Where:

T = Cable delay, in nanoseconds;
λ = Cable length, in meters;
C = Speed of light (3×10^8 meters per second);
Kv = Nominal velocity of propagation (0.85).

One nanosecond is added to the calculated value to account for the length and velocity factor of the short connecting cable inside of the clock.

Attenuation

Attenuation depends upon the cable length, and the loss per unit length. The total attenuation must be limited to 21 dB (maximum) at the GPS L1 frequency of 1575.42 MHz. Loss up to 42 dB can be accommodated with the separately available 21-dB in-line preamplifier (P/N AS0044700).

DC Resistance

The cross-sectional area and length of the conductors in the cable determine the dc resistance. Since power to the RF preamplifier in the antenna is supplied via the antenna cable, excessive dc resistance will degrade performance.

Because of the above factors, changes to the length and/or type of antenna cable should be made carefully. Damaged cables may also affect performance.

Available Antenna Cables and Accessories for Longer Runs

Arbiter Systems offers longer antenna cables for use with all models of clocks when the standard 15-meter (50-foot) cable is inadequate. For RG-6 cable runs greater than 250 feet, up to 500 feet, Arbiter offers a 21-dB in-line amplifier, P/N AS0044700. A larger RG-11 style cable is available (P/N WC0004900, 305-m / 1000-ft roll), that can be used for runs to 120 meters (400 feet) without the in-line preamplifier, or 240 meters (800 feet) with the AS0044700 amplifier. See a list of these accessories in Table 4.2.

P/N	Description	Delay, ns	Signal Level, dB
CA0021315	15-m (50-ft) cable, RG-6	60 ns	-5 dB
CA0021330	30-m (100-ft) cable, RG-6	119 ns	-9 dB
CA0021345	45-m (150-ft) cable, RG-6	177 ns	-13 dB
CA0021360	60-m (200-ft) cable, RG-6	236 ns	-17 dB
CA0021375	75-m (250-ft) cable, RG-6	295 ns	-21 dB
WC0004900	305-m (1000-ft) roll RG-11	3.92 ns/m	-17.5 dB/100 m
AS0044800	RG-11 crimp tool and 25 connectors	N/A	N/A
AS0044700	21-dB in-line amplifier	1 ns	+21 dB

Table 4.2: GPS Cable Data and Accessory Information

Physical Protection

When routing the antenna cable, protect it from physical damage, which may result from closing doors, falling objects, foot traffic, etc. Also, when routing around corners, allow for sufficient bend radius to prevent kinks. Extra length should be allowed at both ends of the cable to prevent tension on the connectors, which could cause damage or failure. Extra length is useful as a service loop, in the event that a connector needs replacement.

Do not stretch the cable mid-air over any appreciable distance without support. Cable degradation or failure could result. Always leave a drip loop wherever the cable enters a structure, to prevent water from entering the structure via the cable jacket. The maximum temperature rating for the type of cable provided with the clock is 75°C (167°F). Exercise care when routing the cable near sources of heat to avoid cable damage.

Adjacent Signals

Although the standard RG-6 style cable is triple-shielded and has excellent shielding properties, be cautious when routing near high power RF sources or alongside cables carrying high power RF, such as transmitter cables. In these applications, consider using RG-11 style cable (P/N WC0004900). Its quad-shielded design provides even more isolation.

Antenna Power

The RF preamplifier within the antenna requires 5 VDC at 15 mA nominal for operation. A power supply within the clock generates this voltage, which is applied to the antenna via the two conductors of the coaxial antenna cable. Avoid shorting the center conductor to the shield of the coaxial cable as it may damage the preamplifier. Conversely, a high-resistance connection or open circuit would deprive the preamplifier of power. Either a short-circuit or open-circuit condition in the antenna cable will render the clock inoperable.

Prior to initial operation or if problems are suspected, perform the Antenna/Cable Operational Test Procedure described in Section 4.2.

Connection to Antenna

The male Type F connector on one end of the antenna cable mates with the female Type F connector on the antenna. Avoid placing mechanical stress on the cable attachment to the antenna.

Connection to Clock

The male Type F connector on the opposite end of the antenna cable connects to the female Type F connector on the rear panel of the Substation Clock.

User-Supplied Antenna Cables

Any RF cable meeting the requirements described above for loss ($<$ 21 dB at 1575 MHz) and dc resistance ($<$ 15 ohms total loop resistance) may be used with the clock. However, prior to using a non-standard antenna cable, verify proper installation by performing the Power Supply Test and Antenna Resistance Test above.

For additional technical details concerning the GPS, GPS antennas and antenna cabling see Appendix A, Technical Details and Specifications.

Chapter 5

Setting Internal Jumpers

5.1 Introduction

Jumpers in the the 1092A/B/C and 1093A/B/C series clocks are normally set up at the factory according default settings, or according to the purchase order if requested. If it should be necessary to change any jumpers or to enable an alternate function, follow the instructions in this chapter.

5.2 Cover Removal

To change jumper configurations, the instrument cover must be removed. Remove top cover as follows:

1. On all Models, disconnect the power cord. If equipped with Option 04 (power switch), first turn the power switch to OFF.
2. Using a T-25 driver, remove the four screws securing the cover (and rack-mount ears, if used). Lift the cover off.

5.3 Main Board Version

Figure 5.1 indicates important jumper and test point locations on the main board in the Model 1092A/B/C and 1093A/B/C. Use this drawing to assist you with locating the jumpers you may want to configure. Jumpers are noted on the main board with a "JMP" prefix before the numbered location. For example, jumper 3 would have a label of JMP3 on the main board. Table 5.1 lists all of the current jumpers and their functions.

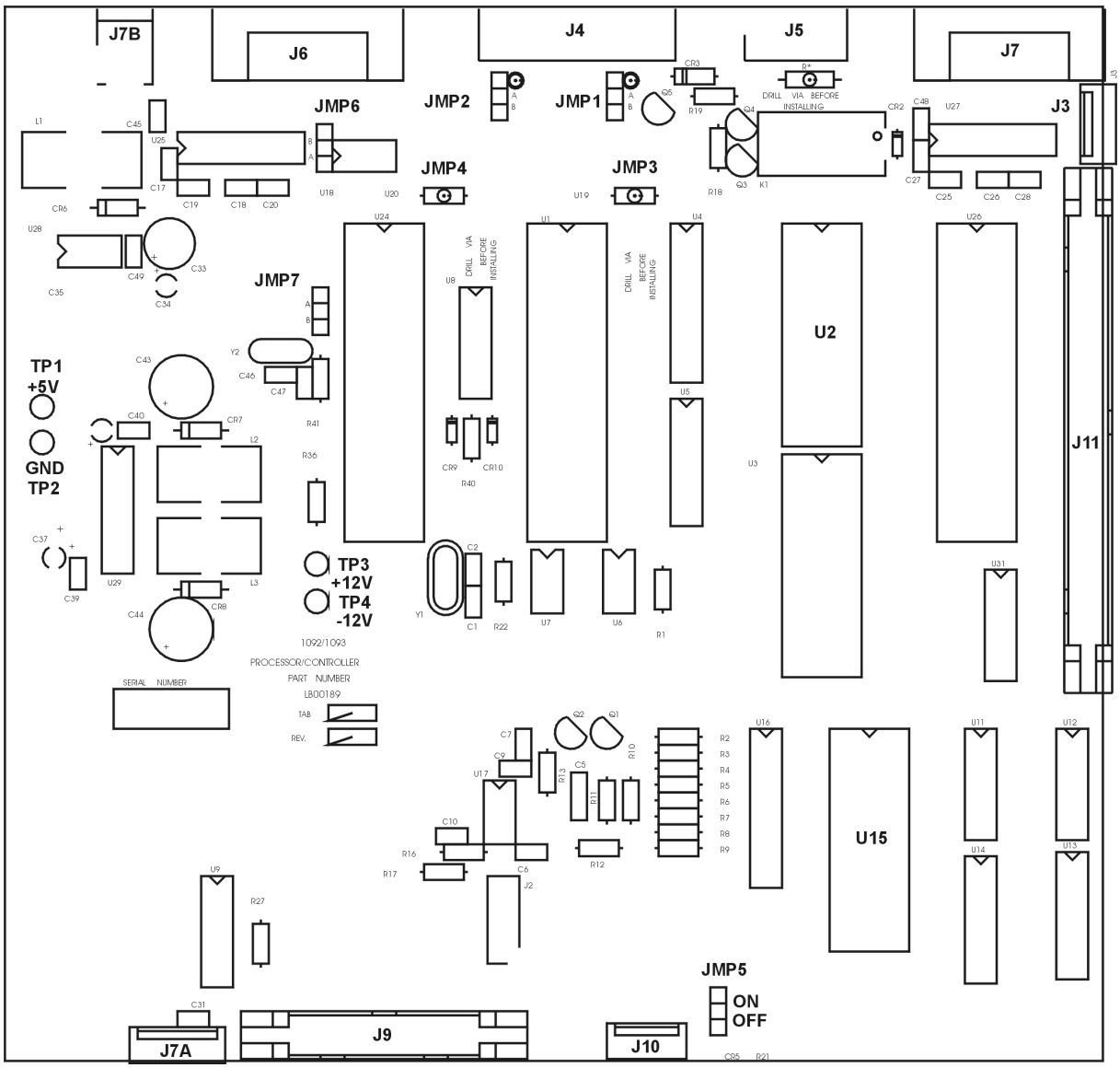


Figure 5.1: Main board and Jumper Locations

5.3.1 Output Signal Type, JMP3 and JMP4

Jumpers JMP3 and JMP4 may be installed to change the output signal type available at I/O connector J4.[1] Before installing either of these jumpers, the drill-out via under the jumper location must be broken, using a small drill in a pin-vise or a sharp blade (such as an X-Acto knife). This disconnects the original signal from the buffer input. **Note:** *Vias are marked by small targets at the Jumper, shown on Figure 5.1.*

[1]Note: do not attempt to change these settings on boards whose serial number begins with the digits 9636 without first contacting the factory.

Jumper	Name	Function	Special Note
1	JMP1	Output Signal Select	if 200 V Open Drain Output Option is Installed[a]
2	JMP2	Output Signal Select	if 200 V Open Drain Output Option is Installed[b]
3	JMP3	Output Signal Type	IRIG-B Unmodulated* or Programmable Pulse
4	JMP4	Output Signal Type	1 PPS* or Programmable Pulse
5	JMP5	Data Backup Battery	Obsolete*
6	JMP6	RS-232 Aux. Output	RS-232 handshake* or Programmable Pulse Output
7	JMP7	Event Select	Set to A for RS-232 Input, B for I/O

[a]Option P/N, 1092optS001 or 1093optS001
[b]Option P/N, 1092optS001 or 1093optS001

Table 5.1: Main Board Jumper Table

5.3.2 Change Unmodulated IRIG-B to Programmable Pulse

To change the output signal at pin 1 of J4 from IRIG-B unmodulated to Programmable Pulse, drill the via at JMP3 and install a zero-ohm jumper or a short piece of wire as shown on the PC board.

5.3.3 Change 1 PPS to Programmable Pulse

To change the output signal at pin 5 of J4 from 1 PPS to Programmable Pulse, drill the via at JMP4 and install a zero-ohm jumper or a short piece of wire as shown on the PC board.

5.3.4 I/O Connector Used as Event Capture Input, JMP7

With modification, the Model 1092A/B/C and 1093A/B/C can accept an Event Capture input through connectors J4 or J6 (I/O and RS-232 respectively). See Figure 5.1. To select the RS-232 input from J6, set jumper JMP7 to the "A" position[2]. To select the I/O connector as the Event Input from J4, set jumper JMP7 to the "B" position. The event capture circuit will, once armed, capture the time of occurrence of the start bit of the next received character (see Section 7.10, entitled "Setting the Event or Deviation Modes").

Selection of one of the I/O connector pins for event capture (in place of the normal output signal) is done by a hardware modification, which is generally performed at the factory at the time of initial order. If this has been done, it will be indicated by the "EVENT INPUT" label above the appropriate pins of J6. Then, setting jumper JMP7 to the "B" position will enable an external 5 V CMOS-level signal to drive the event-capture circuit.

[2]Available on boards with serial numbers beginning with four digits greater than 9636. For boards with serial numbers beginning with 9636, this jumper is not available, and the only event input possible without a board modification is RS-232.

For RS-232C Event Trigger Operation, it is necessary to configure the clock as described in Section 9.2.8, "RS-232C Event Trapping."

5.3.5 Output Signal Select, JMP1 and JMP2

JMP1 and JMP2 (available only if the 200 V open-drain outputs have been installed) select between the standard surge-protected 5 V CMOS drivers (position A) and the 200 V open-drain FET drivers (position B). JMP1 controls the signal at pin 1 (IRIG-B unmodulated, or Programmable Pulse) and JMP2 controls the signal at pin 5 (1 PPS, or Programmable Pulse). The drive of the open-drain FETs has been inverted, so that the signal at this pin (with an external pull-up) will have the same polarity in either mode of operation. Also note that the open-drain outputs do not have any protection against reverse polarity, transient over-voltage, or over-current. It is the responsibility of the user of this function to provide the necessary protection. Maximum recommended operating voltage is 150 VDC (200 V peak) and continuous operating current is 100 mA (power limited).

5.3.6 Data Backup Battery, JMP5 (Option 02) - Obsolete

Jumper JMP5 is no longer used. All new GPS receivers incorporate an manganese-lithium rechargeable data backup battery.

5.3.7 RS-232 AUX Out, JMP6

The function of the AUX OUT line, pin 4 of J6, may be changed from a handshake line (position "A") to Programmable Pulse, at RS-232 levels (position "B"). This may be used to provide a synchronization pulse, which can generate an interrupt in a host computer.

Chapter 6

Startup and Basic Operation

6.1 Initial Startup Sequence

Before powering ON any of these clock models, make sure that the chassis cover is installed and if equipped with a power switch, that inlet power is properly connected to the power inlet connector. If the clock does not have a power switch, then the clock will begin the startup sequence when inlet power is connected to the rear panel. When the clock starts, several things should occur[1] in the sequence listed below:

- The two annunciator LED's initially should flash momentarily, then the OPERATE LED and UNLOCKED LED should light steadily.
- The LCD should display several introductory messages - see below (for 1092B and 1093B/C clocks only).
- The Out-of-Lock Relay (Fault) will be in the out-of-lock (or faulted) position (if equipped with Option 93).
- Eventually, the UNLOCKED LED should extinguish.
- The Out-of-Lock Relay (Fault) should change to Locked (non-faulted) position after a few minutes.
- The LCD should indicate that the clock is Locked (for 1092B and 1093B/C clocks).

[1]Startup behavior is based on Models 1092B and 1093B/C clocks with a display. Startup behavior for the 1092A and 1093A models have no visible display other than two annunciator LEDs. For the 1092A and 1093A, time and position (and other) data may be viewed if monitoring through a RS-232 port. Model 1092C has two annunciator LEDs and nine-digit LED time display. At startup, the 1092C time display will start counting from zero seconds until acquiring satellites, then begin displaying the time with day of year.

6.1.1 Clock Time, Startup Mode – 1092B, 1093B/C

When the clock first starts, it will not indicate the correct time until it is locked to the GPS. Pressing the TIME key before the UNLOCKED LED is extinguished will produce the message:

TIME NOT AVAILABLE

For IRIG-B time, it will begin counting from zero, with the Julian Day also set to zero. This method was chosen so that there would be no mistake in interpreting that the clock was in startup mode. For example, the time could indicate as follows:

000:00:00:01
000:00:00:02
000:00:00:03
.
.
.
265:13:45:21
265:13:45:21 (these values chosen for illustrative purposes only)

During a short period of time (from a few minutes to a few seconds) the displayed clock time may jump and add or lose some seconds as more satellites are acquired. This is normal, until the full set of ephemeris data is received by the GPS receiver from the GPS (satellites), when the time will be accurate. At this time, the Out-of-Lock LED will extinguish and the Out-of-Lock relay will close (if equipped with Option 93).

6.2 Front Panel Indication – 1092B, 1093B/C

6.2.1 Display Indication at Startup

In the startup sequence, the LCD display should indicate clock status as follows:

ARBITER SYSTEMS GPS
SUBSTATION CLOCK

followed by:

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ARBITER SYSTEMS, INC.

followed by:

CLOCK STATUS
STARTUP

followed by:

CLOCK STATUS
UNLOCKED – MIN

followed by:

CLOCK STATUS
NOT STABILIZED

After this, the second line of the status display should change to UNLOCKED, or LOCKED depending on the previous operation, inactivity or if the clock has been moved. During startup, the Unlocked LED should remain extinguished after the GPS receiver begins tracking satellites.

6.2.2 Other Display Indications When Unlocked

Time Display
TIME NOT AVAILABLE
Position Display
POSITION
NOT AVAILABLE
Event Display
PLEASE WAIT!
TIME ADJUSTMENTS
Status Display
GPS RECEIVER STATUS
ACQUIRING SATS

6.2.3 Status Display Indications

There are three indications when successively pressing the STATUS key. These are as follows:

CLOCK STATUS
STARTUP*

*The second line will change between STARTUP, to UNLOCKED (with time),
to NOT STABILIZED, to LOCKED–AUTO SURVEY, to LOCKED–POSITION HOLD.
Press status key:

GPS RECEIVER STATUS
TRACKING: 00*

*The number of tracked satellites can change from 0, 1, . . . , 12.

Press status key:

DCXO STATUS
DEVIATION: ±nn.nn PPM

Press status key:

EEPROM STATUS
CORR. ERRORS = 0

If the number of corrected (CORR.) errors begins to climb, contact the factory about replacing the EEPROM.

6.2.4 Event/Deviation Display

There are separate displays when pressing the EVENT/DEVIATION key, depending on the setting. Successive events appear when repeatedly pressing the EVENT/DEVIATION key, or if configured

for DEVIATION, it will indicate the 1-PPS Deviation (updates once per second) and Sigma. If there are no records, the second line will indicate "NO DATA".

Event Display

Ch A EVENT nnn
ddd:hh:ss.sssssss

Where:

nnn = event number(001 to 400)
ddd = day of year of the event(1 to 366)
hh = hour of the event(00 to 23)
mm = minute of the event(00 to 59)
ss.sssssss = second and fractional seconds of the event

Deviation Display

1 PPS: 0.00 μS
SIGMA: 0.00 μS

6.2.5 IRIG-B Time Data

IRIG-B time is sent out immediately, when the clock is powered ON, from any timing output port configured for IRIG-B as indicated above. Time will not be accurate until the clock is locked to the GPS. See also, check out-of-lock indication in Section 2.2.2 and Section 7.5.

6.3 Clock Status Display Mode

When first applying power to the clock, the display will indicate several startup messages, then will revert to Clock Status mode condition called STARTUP. After a short time, while the GPS receiver begins collecting data from the GPS, it will indicate either UNLOCKED (XX Min), NOT STABILIZED, LOCKED–AUTO SURVEY, or LOCKED–POSITION HOLD. Various faults, if they exist, may be indicated as follows:

- Not Stabilized
- Out Of Lock
- Time Error
- VCXO Tuning Error
- Receiver Failure

For additional information on internal faults, please see Chapter 2, Front and Rear Panels, and Section 10.2.5, System Status command.

6.4 Time Display Modes – 1092B and 1093B/C

After establishing GPS satellite synchronization, date and time information can be displayed on the front panel by pressing the TIME key and scrolling through the four available displays. Press this key to select the time display mode (UTC or Local) time data (Date/Time or Day of Year).

Time Definitions: www = Day of the Week (Sun – Sat); dd = the Day of the Month (1 – 31); ddd = the Day of Year (1 – 366); mmm = the Month (Jan – Dec); yyyy = the Year (e.g. 2007); hh = the Hour (00 – 23); mm = the Minute (00 – 59); ss = the Second (00 – 59)

6.4.1 Date and Time Display, Universal Time Coordinated (UTC)

This mode displays UTC, in the Date and Time format, as maintained by the United States Naval Observatory (USNO), as described below:

UTC DATE/TIME www
dd mmm yyyy hh:mm:ss

This mode displays UTC, Time of Year mode, without the application of daylight saving correction and local offset.

6.4.2 Time of Year Display, UTC

This mode also displays UTC, in Time of Year format, which differs from the previous format as follows:

UTC DATE/TIME www
yyyy ddd:hh:mm:ss

This mode displays UTC, Time of Year mode, without the application of daylight saving correction and local offset. NOTE: Daylight saving and local-offset have no effect on this display.

6.4.3 Date and Time Display, Local Time

This mode displays the date and time after the daylight-saving correction and local offset have been applied, but in the same format as that of the Date and Time, UTC.

LOCAL DATE/TIME www
dd mmm yyyy hh:mm:ss

6.4.4 Time of Year Display, Local Time

This mode displays the time of year after the daylight-saving correction and local offset have been applied, but in the same format as that of the Time of Year, UTC.

LOCAL DATE/TIME www
yyyy ddd:hh:mm:ss

NOTE: Unless the daylight saving and local offset parameters have been set properly, this display may not reflect the correct local time.

6.4.5 Daylight Saving Time/Summer Time (DST)

The Daylight Saving Time/Summer Time (DST) configuration feature allows expanded settings. The addition of AUTO allows the user to customize the DST settings to match the requirements of locations in either Northern or Southern latitudes.

DST configuration may be changed through the serial port or through the front panel keypad.

6.5 Position Display Modes – 1092B, 1093B/C

When the clock is first powered ON and acquiring satellites, the only position information available is the previous position, stored in the clock's EEPROM. This position information reflects the location of the receiver as determined by the last position while locked to at least four satellites. Displayed position will be based on the most recent position fix.

Press the front-panel button named POSITION to access longitude, latitude, and elevation data values. Repeatedly pressing the POSITION key scrolls the readout display continuously through these values. If pressed prior to acquisition of enough satellites to accurately determine and update position data, these numbers will reflect the receiver's power-on defaults, or display the message, POSITION NOT AVAILABLE.

Synchronization to a minimum of four satellites is necessary for precise determination of longitude, latitude, and elevation. When meeting this minimum satellite lock requirement, POSITION values will accurately correspond to the present antenna location.

6.5.1 Longitude Display

ANTENNA LONGITUDE
XXX° XX' XX.XXX" W*

Where:

*W = WEST, or E = EAST

6.5.2 Latitude Display

ANTENNA LATITUDE
XX° XX' XX.XXX" N*

Where:

*N = NORTH, or S = SOUTH

6.5.3 Elevation Display

ANTENNA ELEVATION
XXXXX.XX m WGS-84

Where the elevation is displayed referenced to the WGS-84 datum.

Chapter 7

The Setup Menus

7.1 To Begin Configuring

This section should guide you in configuring the Model 1092A/B/C and 1093A/B/C operation using the setup menus or RS-232 port(s). These menus allow you to configure the operation according to your preferences. Logically, use the setup menus after installing the clock for the first time, or changing any of the main board jumpers as described in Chapter 5.

There are two available methods for configuring the 1092B and 1093B/C: (1) Using the lower row of keys on the front panel, and (2) remotely, using either the main RS-232 port or option RS-232 port. *To configure Models 1092A/C and 1093A, you must use the RS-232 port(s).* Both methods are described in this section. For complete information on configuring all clocks remotely through either serial port, please refer to Chapter 10, Serial Communication and Command Set.

At the end of each setup menu section are references to the corresponding RS-232 commands for configuring these functions. Table 7.1 lists the various menus used to configure the operation of these clock models. Press the setup key to enter the clock configuration menus, starting with the main RS-232 port parameters.

SETUP: Press the setup key repeatedly to scroll through the main menus. Also, after pressing SETUP once, you can press the UP or DOWN keys to scroll the menus. In numeric data entry mode, pressing SETUP moves the cursor to the left.

ENTER: Press the Enter key to confirm changes made within setup menus. Generally, pressing ENTER also advances the next parameter, or returns to the previous menu level. In numeric data entry mode, pressing ENTER moves the cursor to the right.

UP: Press the UP key, within the setup menus, to adjust numerical values upward, or to scroll upward through the available menu choices. The UP key also assists in navigating through main Setup Menus in normal order.

DOWN: Press the DOWN key, within the setup menu, to adjust numerical values downward, or to scroll downward through available menu choices. Also assists in navigating through main Setup menus in reverse order.

7.2 Setup Menus

No.	Setup Menus	Setup Items
1	Set Main RS-232?	Main RS-232 Port Parameters and Broadcast
2	Set Local Hour?	Set Local Offset, Daylight Saving mode
3	Set Out-Of-Lock?	Set Time Interval Before Alarm
4	Set Back Light?	Set to ON, OFF or AUTO
5	Set System Delays?	Set Antenna Cable Delay in Nanoseconds
6	Set Prog. Pulse?	Set Mode, Pulse Width and Time Zone
7	Set IRIG Time Data?	Set IRIG-B Time Zone and IEEE-1344
8	Set Event/Deviation?	Set for Event, or 1–PPS Deviation
9	Set Auto Survey?	Set Survey mode
10	Set Position Hold?	Set ON or OFF
11	Set Option Control?	Set Main board and Aux. board options

Table 7.1: Front-Panel Setup Menus

7.2.1 Default Firmware Settings

When shipped from the factory, and unless specified otherwise, all models will be configured with default settings. Most users elect to modify the clock settings to fit their locale and desired operation. Default settings are listed in Table 7.2.

Menu Item	Default	Menu Item	Default
Main RS-232	9600, 8, N, 1	Local Offset & DST	none, OFF
Out-of-Lock	01 minute	Backlight	Auto
System Delays	60 ns	Prog Pulse	Sec. per Pulse
IRIG-B Time Data	UTC, 1344 OFF	Event/Deviation	1 PPS Deviation
Auto Survey	Power On Survey	Position Hold	ON
Option Control	None	–	–

Table 7.2: Default Firmware Settings

7.2.2 Numeric Data Entry Mode

Numeric data entry mode is activated anytime you enter a menu that requires a change in numerical value and press either the UP or DOWN key to change the digit value. When in this mode, the function of the SETUP and ENTER keys change to give left and right cursor control.

7.2.3 To Exit Setup Menus

To exit any configuration menu without saving, press any of the upper row of keys before pressing ENTER (which installs a new value). To return to the configuration menus, press SETUP again. If you make a configuration error, you can scroll through the menus again and press ENTER when you find the menu you want to change.

7.3 Setting the Main RS-232 Port

Press SETUP key to configure the main RS-232 port, and press the ENTER key to begin setting up the RS-232 port parameters (See Figure 7.1). To set up the broadcast mode, press SETUP and skip to Section 7.3.2 below.

NOTE: port settings may not be changed in the 1092A/C and 1093A series clocks since they do not have a keypad, and there are no port setting commands.

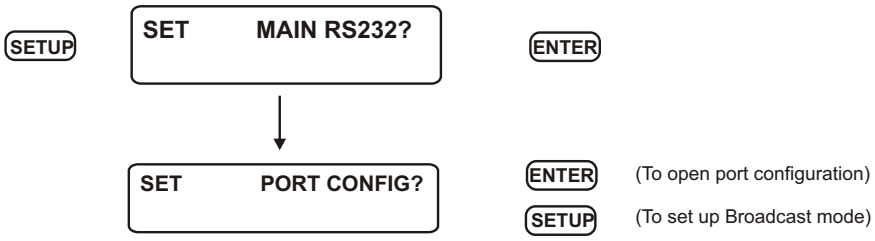


Figure 7.1: Main RS-232 Setup

7.3.1 Setting Port Parameters

The "Set Port Config" menu allows you to configure any of the RS-232 port parameters from the front panel. Use the UP and DOWN keys to adjust the parameter values. *For RS-232 command, Port parameters may not be changed from RS-232C ports. They may only be changed with Models 1092B and 1093B/C from front-panel interface.*

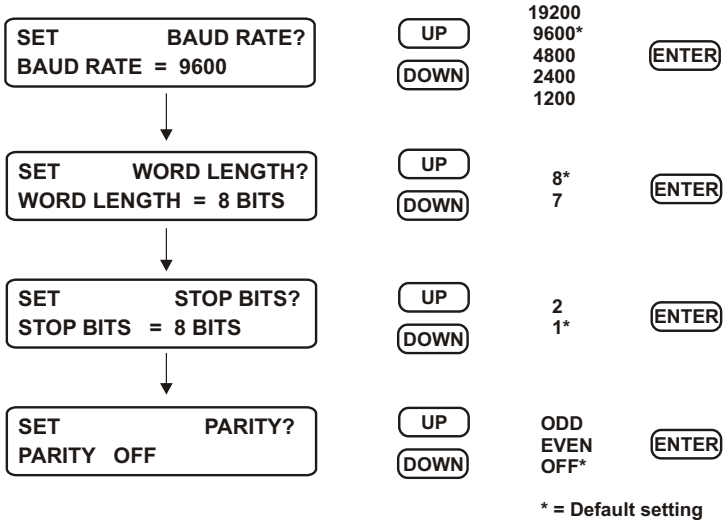


Figure 7.2: Port Parameter Setup

7.3.2 Setting the Broadcast Mode from Main RS-232

The "Set Broadcast Mode" menu allows you to configure any of these clock models to broadcast ASCII time/date-related data from the available RS-232 ports. With the UP/DOWN keys select the desired broadcast mode and press ENTER to immediately start the broadcast. *For RS-232 command, see Section 10.2.3.*

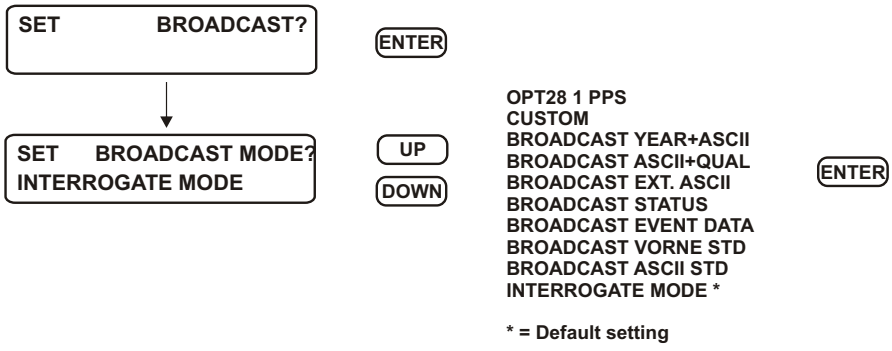


Figure 7.3: Broadcast Setup

7.4 Setting the Local Hour

Use "Set Local Hour" to set the offset in time from UTC to your locale and any Daylight Saving settings if they apply. Offsets may be adjusted in 15-minute increments, up to plus or minus 12 hours. Daylight Saving is adjusted for start and stop times, based on month, week of month, day and time of day. Use this menu to set up basic DST adjustment. *For RS-232 command, see Section 10.2.6.*

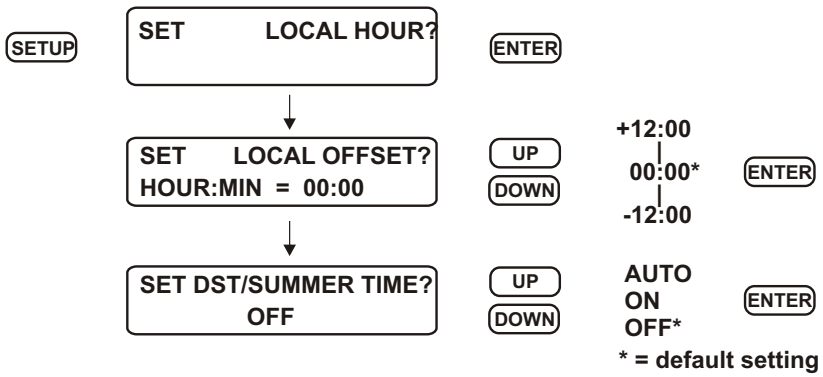


Figure 7.4: Local Hour Setup

7.4.1 Set Daylight Saving Time (DST)

Use the "Set Daylight Saving Time" menu to configure the one-hour offset to "Local Hour" settings. For automatic changeover, use the AUTO setting explained above. Make sure to determine the changeover requirements in your locale before trying to adjust the settings. The default setup is for North America, where DST begins on the second Sunday of March at 2 am and ends on the first Sunday of November at 2 am. Go through each setting and verify that the settings are valid. To adjust and install values, press the UP/DOWN keys to adjust the desired value and ENTER key to install that value and proceed to the next setting. *For RS-232 command, see Section 10.2.6.*

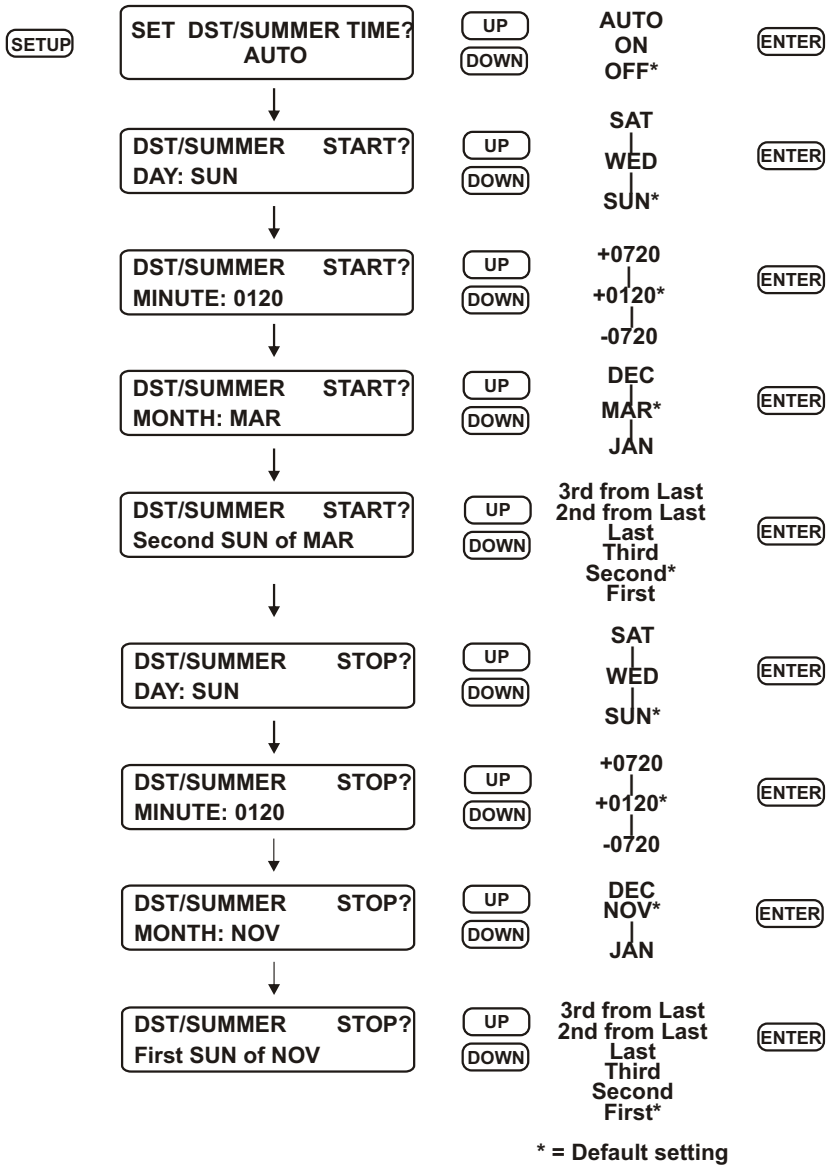


Figure 7.5: Auto Daylight Saving Setup

7.5 Setting Out of Lock

Use the "Set Out of Lock" feature to control how the clock responds to an out-of-lock condition. Out of lock means that the GPS receiver in the clock is no longer tracking any satellites and that the time may drift according to characteristics of the internal clock and environmental conditions. Adjust these settings so that, in the event of an out-of-lock condition, you will be notified in a reasonable amount of time. The default setting is for the clock to alarm after being unlocked for a period of one minute. Unlocked indications include the red unlocked LED being ON, and the optional out-of-lock relay (Option 93) switching to the unlocked, or faulted, condition. *For RS-232 command, see Section 10.2.14.*

"Extend Relay Start" increases the time for the clock to change from an unlocked to a locked indication, thereby increasing clock stability at startup. Normally at startup, the clock waits until the GPS receiver is tracking at least four satellites before it will indicate that the signal is accurate and changes to a Locked" condition. To extend the out-of-lock indication for a few minutes longer, select "Yes" to the selection, "Extend Relay Start."

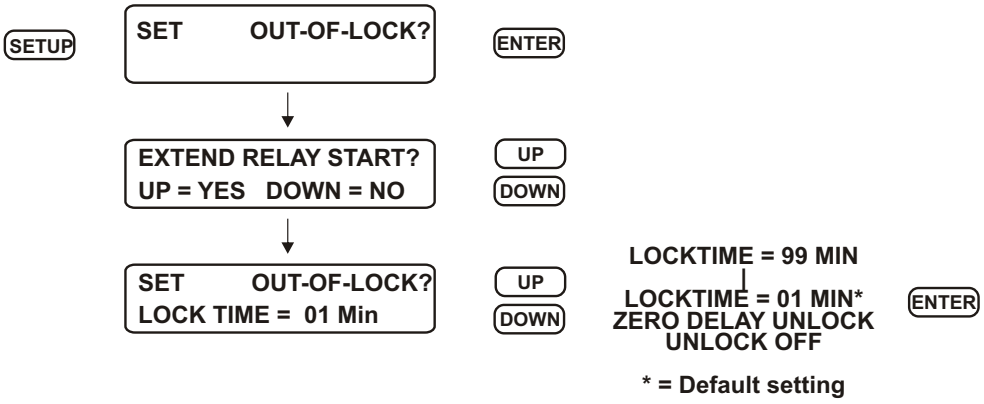


Figure 7.6: Out-of-Lock Setup

7.6 Setting the Back Light

If the optional back light (Option 01) is installed in the clock, use the "Set Back Light" menu to configure how the back light operates. If back light is not installed, then the "Set Back Light" menu will have no effect. Settings are either (1) Back light OFF, (2) Back light ON, or (3) Back light AUTO. In the Auto setting, the back light will operate for approximately 30 seconds before switching OFF. *For RS-232 command, see Section 10.2.7.*

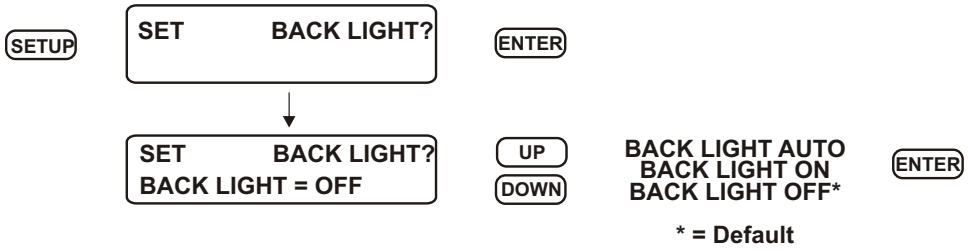


Figure 7.7: Back Light Setup

7.7 Setting System Delays

Use the "Set System Delays" menu to set the delay of the GPS signal received at the GPS antenna until it reaches the GPS receiver. The delay in nanoseconds (10^{-9} seconds) is a product of the length of the cable and the its velocity factor. Without compensating for the cable delay, the time would be slow by this amount. *For RS-232 command, see Section 10.2.13.*

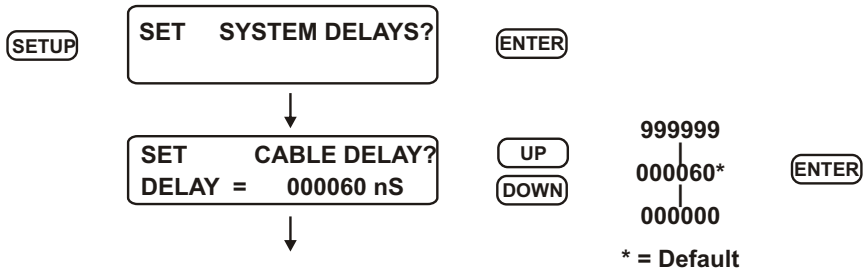


Figure 7.8: System Delay Setup

7.8 Setting Programmable Pulse Mode

Use the "Set Prog. Pulse" menu to set up one of the many pulse modes, in which you can broadcast a pulse over one of the standard outputs (I/O) at a predetermined interval or rate. Also, there is a "pulse-per-day" mode and a "pulse-per-year" mode. Programming includes adjusting the pulse width, from a minimum of 10 milliseconds to 600 seconds, depending on the application, and also allows you to configure the pulse to occur at either UTC or Local time where applicable. *For RS-232 command, see Section 10.2.12.*

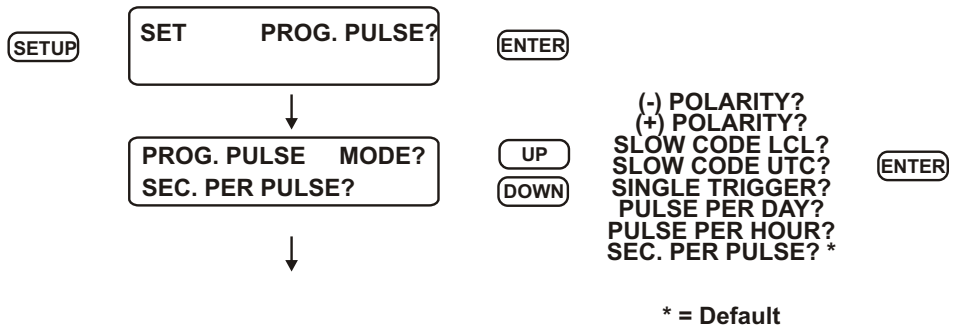


Figure 7.9: Programmable Pulse Setup

7.8.1 Entering Numerical Values

When installing numerical values first use the UP/DOWN keys to change the digits and then SETUP and ENTER to move the cursor left or right. Then, use the UP/DOWN keys as before to change digits. To complete the installation after you have configured the numerical value, keep pressing the ENTER key to move the cursor to the right and exit the menu.

7.8.2 Programmable Pulse – Seconds–Per–Pulse Mode

Use the "Seconds–Per–Pulse" mode to generate a pulse every X number of seconds, from 1 to 60,000 seconds, and a Pulse Width of from 10 milliseconds to 600 seconds. Refer to Section 7.8 above for additional detail on the Programmable Pulse mode. *For RS-232 command, see Section 10.2.12.*

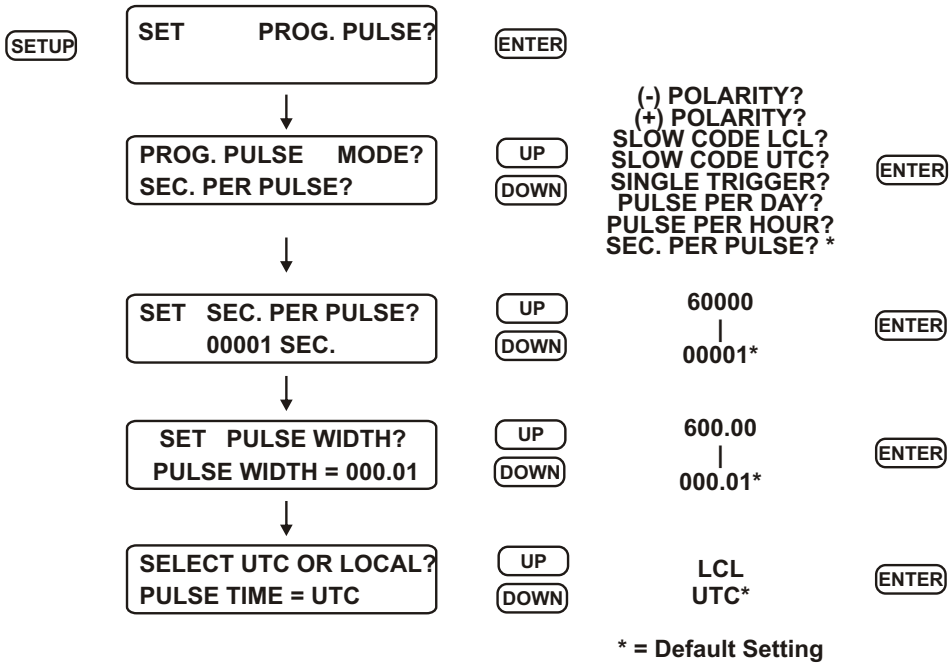


Figure 7.10: Seconds–Per–Pulse Setup

7.8.3 Programmable Pulse – Pulse–Per–Hour Mode

Use the "Pulse–Per–Hour" mode to generate a pulse every hour, at the number of specified seconds (from 0 to 3599 seconds) after the hour. Refer to Section 7.8 above for additional detail on the programmable pulse modes, and entering numerical values. *For RS-232 command, see Section 10.2.12.*

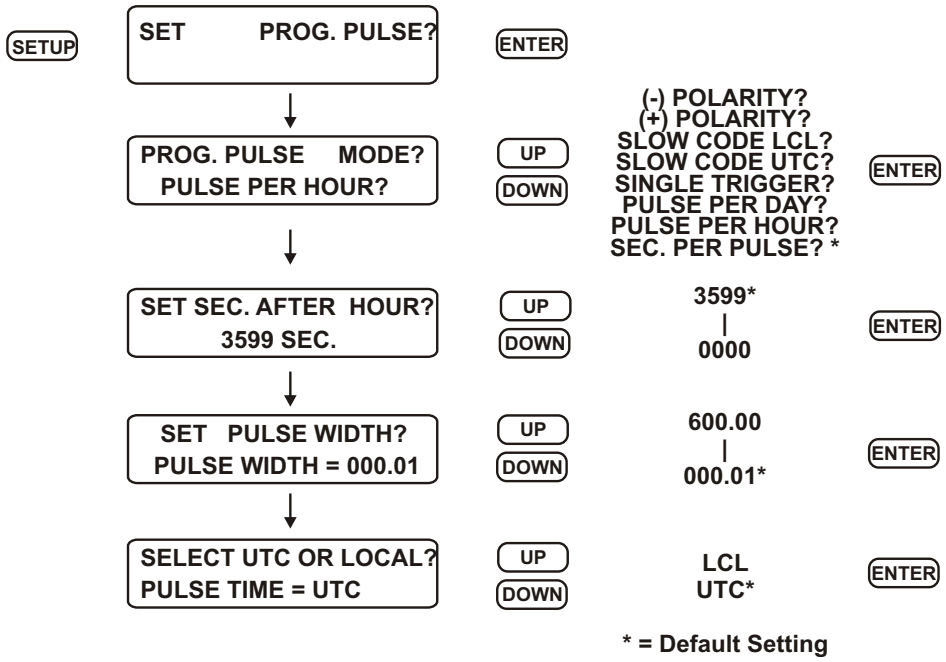


Figure 7.11: Pulse–Per–Hour Setup

7.8.4 Programmable Pulse – Pulse–Per–Day Mode

Use the "Pulse–Per–Day" mode to generate a pulse every day, at the specified hour, minute, second and fractional seconds. Refer to Section 7.8 above for additional detail on the Programmable Pulse mode, and entering numerical values. *For RS-232 command, see Section 10.2.12.*

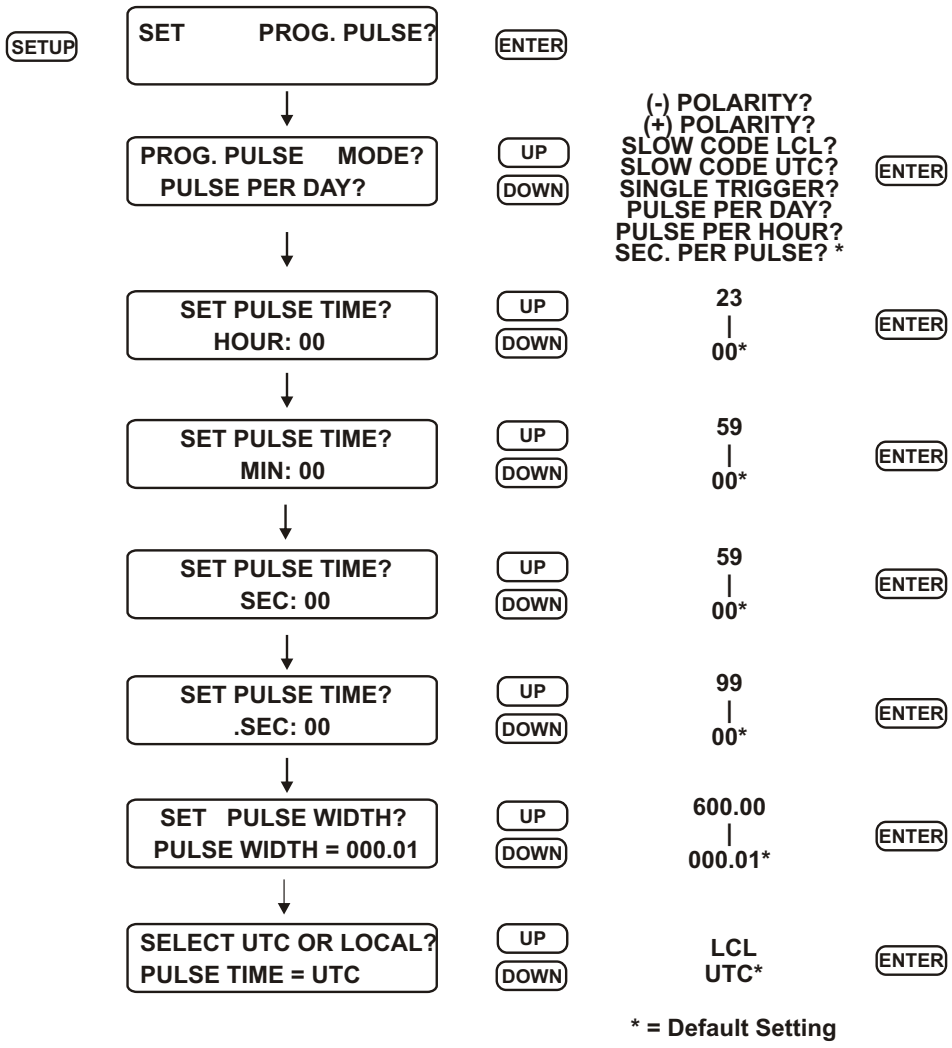


Figure 7.12: Pulse–Per–Day Setup

7.8.5 Programmable Pulse – Single Trigger

Use the "Single Trigger" mode to generate a pulse once per year at the specified Julian Day, hour, minute, second and fractional seconds. For reference, many calendars indicate the Julian Day. Refer to Section 7.8 above for additional detail on the Programmable Pulse mode, and entering numerical values. *For RS-232 command, see Section 10.2.12.*

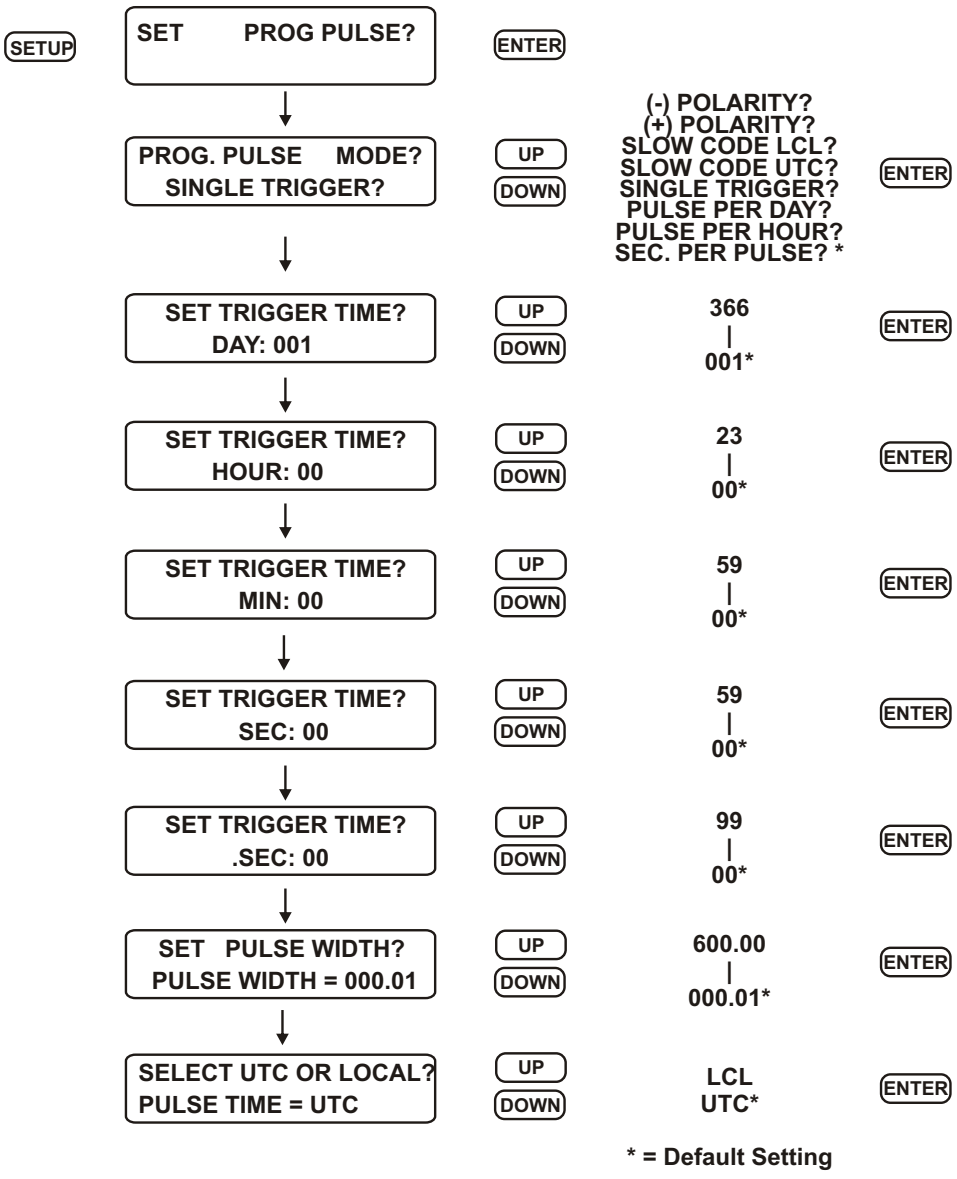


Figure 7.13: Single Trigger Setup

7.8.6 Programmable Pulse – Slow Code

The "Slow Code" mode causes the output voltage to be held high and go low for six seconds on the day, four seconds on the hour and two seconds on the minute. *For RS-232 command, see Section 10.2.12.*

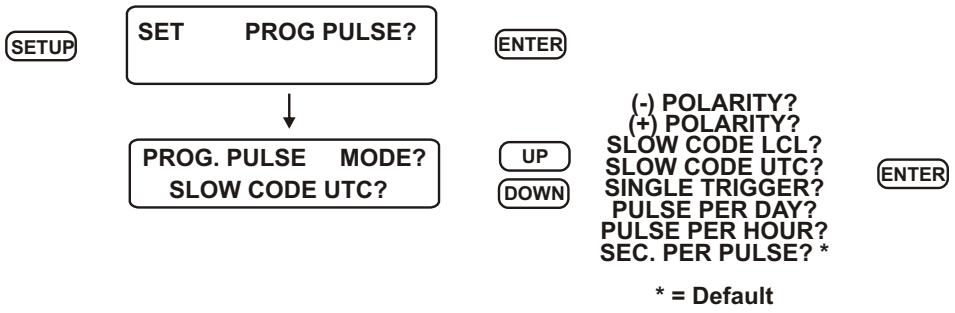


Figure 7.14: Slow Code Setup

7.8.7 Programmable Pulse – Pulse Polarity

Use "Pulse Polarity" to change the pulse's OFF-to-ON behavior as follows:

1. Positive: the voltage is held low (0 VDC) when the pulse is off and transitions high (5 VDC) when on.
2. Negative: the voltage is held high (5 VDC) when the pulse is off and transitions low (0 VDC) when on.

To set up the pulse polarity, first set up the programmable pulse mode (e.g. Single Trigger) and then go back into the Prog Pulse menu and set up the polarity separately. *For RS-232 command, see Section 10.2.12.*

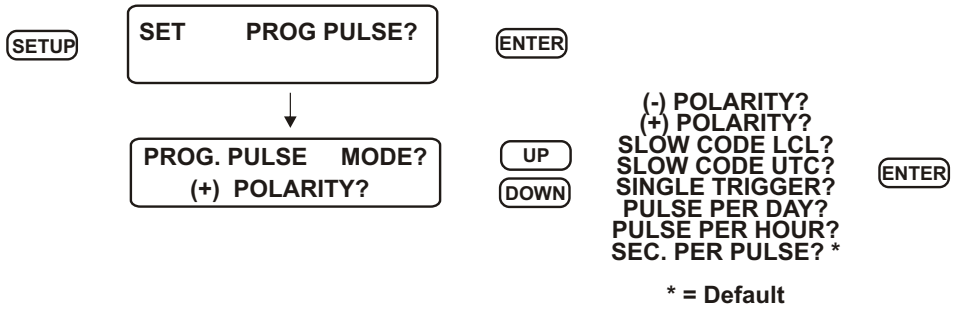


Figure 7.15: Pulse Polarity Setup

7.9 Setting IRIG Time Data

Use the "Set IRIG Time Data" menu to adjust the time for *IRIG-B Time Data* from UTC to Local, and to turn ON or OFF the IEEE-1344 extension. The IEEE-1344 extension controls some additional information contained in the IRIG-B time code (see Section 8.3.3). *For RS-232 command, see Section 10.2.8.*

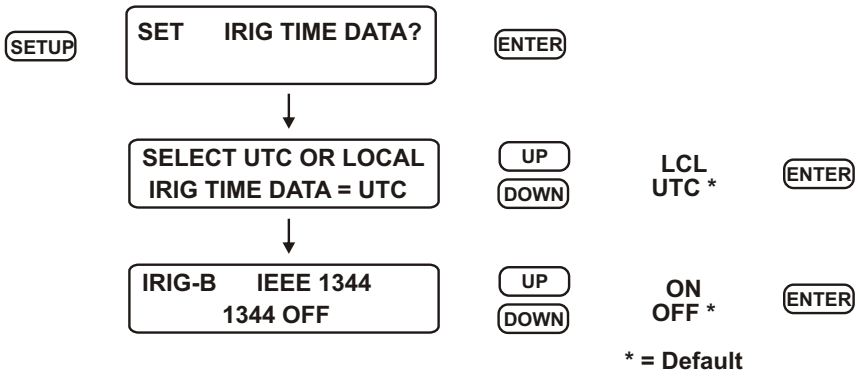


Figure 7.16: IRIG-B Time Data Setup

7.10 Setting the Event or Deviation Modes

Use the "Event/Deviation" mode to capture an event (input signal) at any of the configured ports (see Sections 5.3.4). Configure for either event timing (up to 400 stored events) or one pulse-per-second (1 PPS) deviation, including sigma (see Section 9.2.3 for details on the principle of deviation measurement). *For RS-232 command, see Section 10.2.4.*

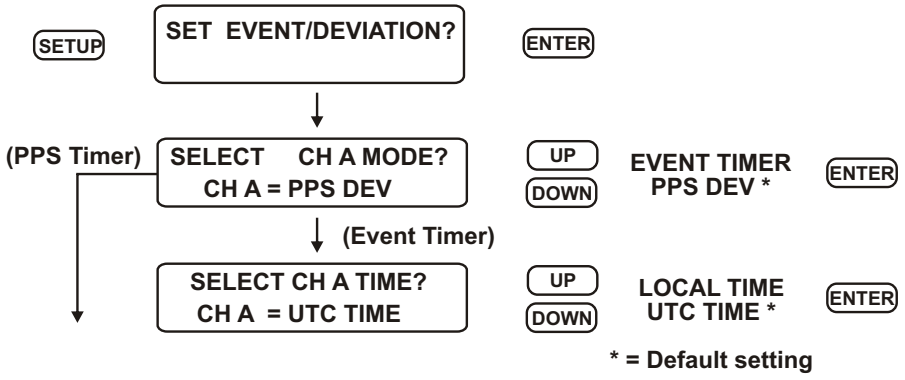


Figure 7.17: Event/Deviation Mode Setup

7.11 Setting the Auto Survey Mode

Use one of the Auto Survey modes to control how and when the clock determines position information. The accuracy of the position (and indirectly, time) is based on averaging the assigned number of position fixes surveyed, either during startup or by a single survey. At the conclusion of a survey, the averaged position is placed into memory and the clock is placed in Position Hold mode. If accurate position information is used, this results in a reduced standard deviation for the time data. *For RS-232 command, see Section 10.2.10.*
There are five Auto Survey modes available:

1. Turn Off Survey – halt the survey in progress
2. Single Survey – initiate a new survey at this time
3. Power-On Survey – initiate a new survey when the clock is powered on
4. Suspend Survey – pause a survey in progress
5. Resume Survey – resume a survey that was paused

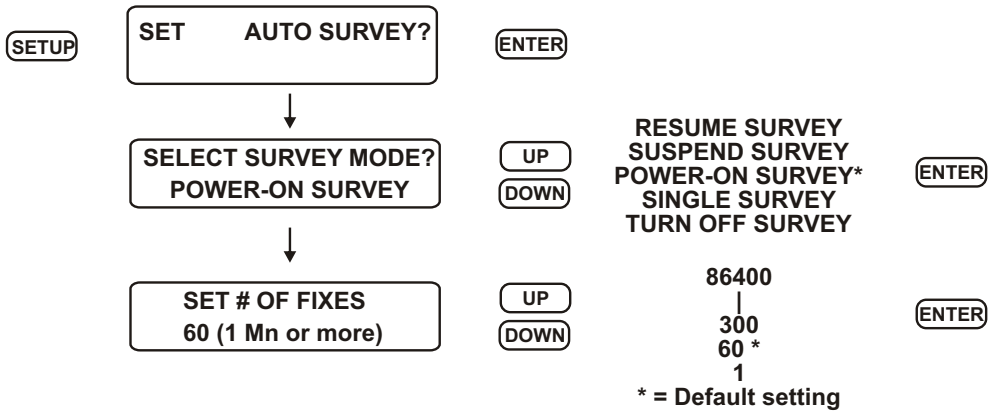


Figure 7.18: Survey Mode Setup

7.11.1 Number of Fixes

Auto Survey configuration presents a list of possible surveys from 1 to 86,400 seconds (approx. 24 hours). Surveys are listed as 1 (single fix), 60 (1 minute or more), 300 (5 minutes or more), 900 (15 minutes or more), 1800 (30 minutes or more), 3600 (1 hour or more), 7200 (2 hours or more), 14400 (4 hours or more), 28800 (8 hours or more), 43200 (12 hours or more), and 86400 (24 hours or more). To complete a survey, the GPS receiver must be tracking at least four satellites. If, during a survey, the number of satellites being tracked drops below four, the survey will pause until the GPS receiver again begins tracking four or more satellites. Then, the survey will resume computing positions until completion.

7.12 Setting Position Hold ON or OFF

With Position Hold turned ON, the surveyed position is placed into memory and used for computing more precise timing solutions. With Position Hold turned OFF, the GPS receiver is placed in the Fix mode, calculating a new position approximately every second as long as the GPS receiver is tracking four or more satellites. *For RS-232 command, see Section 10.2.9.*

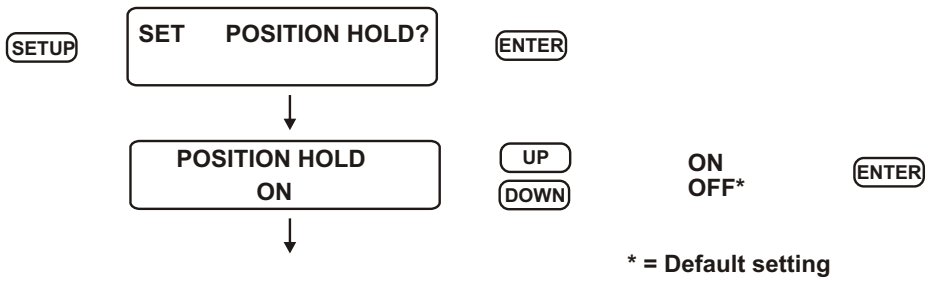


Figure 7.19: Position Hold Mode Setup

7.13 Setting Option Control

Use the "Set Option Control" menu to configure any main board or auxiliary board option mounted in the clock. Some of these options require you to configure additional settings. For information on configuring specific options see the Option List located in Appendix C. *For RS-232 command, see Section 10.2.15.*

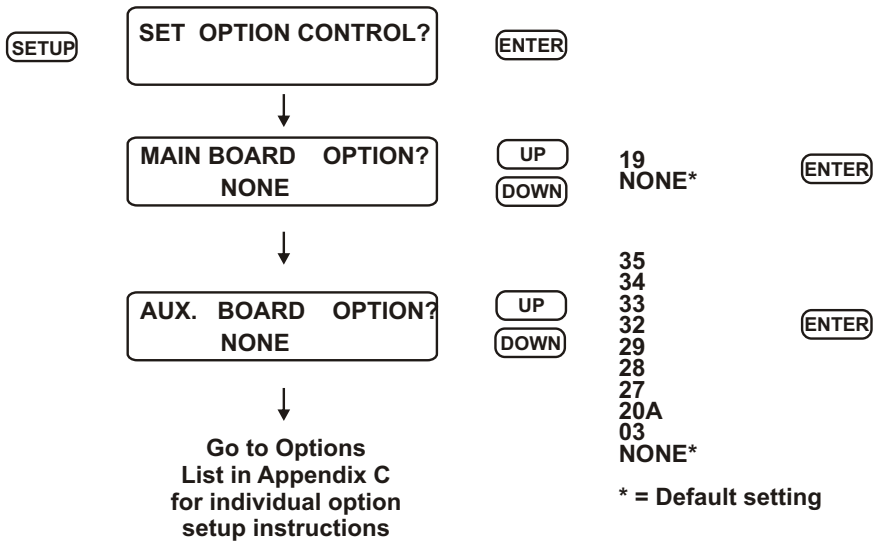


Figure 7.20: Option Control Setup

Chapter 8

Timing, IRIG-B and Pulses

8.1 Introduction

This section covers some basic information about timing signals and how to connect them to your IEDs. Common questions concerning connecting timing signals include:

- What are the different types of IRIG-B, and what are the differences?
- How do you connect multiple devices to one timing output?
- How far can you transmit timing signals?
- What kind of cabling and connectors should I use?

The steps involved in getting your devices synchronized to the GPS are fairly simple and should not take long to complete. To expedite the process, make sure to:

1. determine the type of timing signal each piece of equipment requires, and
2. enable the equipment to receive the timing signal

Various methods are used to configure equipment to receive IRIG-B time codes including setting a physical jumper, or using a setup application. Some equipment can auto detect the timing signal, so that nothing else is required, other than connecting the cable.

8.2 Timing Output Description

When viewing the rear panels of the Model 1092A/B/C and 1093A/B/C, you will see a number of different types of connectors as illustrated in Figure 8.1. Generally, there is a power inlet connector, a GPS antenna connector, two DB-9 serial connectors (one is an optional RS-232 port), one optional SPDT relay connector, one optional and two standard timing outputs. The Model 1093A/B/C series clocks also have an option plate that can be replaced by one of several accessory boards. Whereas the Model 1093A/B/C has an internal power supply, the Model 1092A/B/C clocks have a separate external power supply.

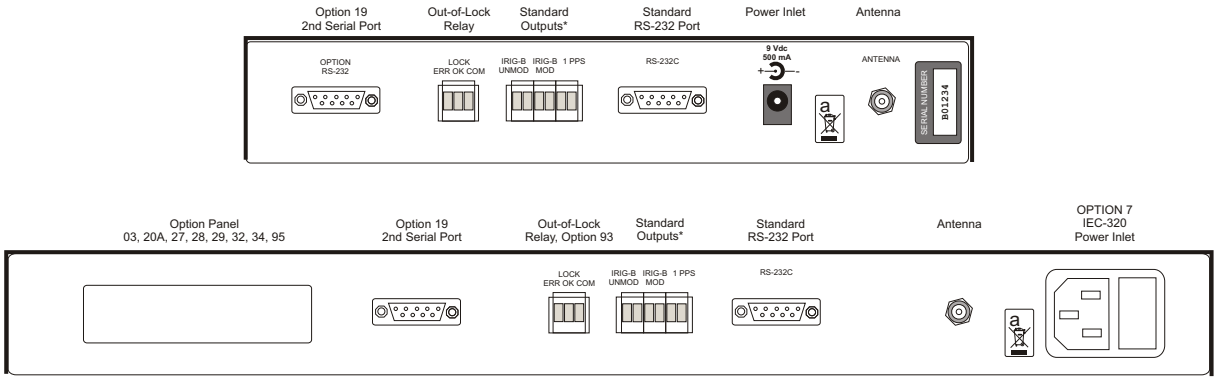


Figure 8.1: Rear Panel Descriptions – optional outputs may be shown

8.2.1 Inputs and Outputs – Port 1, Port 2, Port 3

Three, Phoenix-style, terminal connectors can supply timing signals to external equipment and may also be configured for input. Two of the outputs (Ports 1 & 3) are designed for digital signals and one (Port 2) for analog. Signals supplied to the digital drivers include unmodulated IRIG-B, 1 PPS (pulse per second), and programmable pulse. On main boards Option 92 is required for modulated IRIG-B.

8.2.2 Digital Drivers

Each of the digital outputs is driven by a CMOS 74HCxxx quad driver capable of supplying 75 mA at 5 VDC, which may be fanned out to a number of devices. To determine the number of devices you can supply, calculate the load current required by each connected device. For example, if the IED timing signal input (e.g. IRIG-B003) requires 10 mA, one digital output should be able to support eight identical devices.

8.2.3 Analog Driver

Modulated IRIG-B is available[1] at Port 2 of the standard input/output block, and uses an analog driver exclusively for this purpose. Basically a push-pull audio design, the analog driver supplies 4.5 volts peak-to-peak (Vpp) to a 19.6-ohm source resistor, then to connected equipment. As the load current increases (by adding external loads), more voltage is dropped across the clock source resistor causing the drive voltage to decrease. To assure detection by your equipment, make sure to match the modulated output to within the required voltage range of the receiving equipment. Table 8.1 shows how the actual drive voltage varies with increasing load current. For IED's with a restricted input range, it may be necessary to match the available drive voltage to the IED through a small dropping resistor or amplifier.

[1]For main boards choose Option 92; for new main boards it is standard.

Drive Current, mA	Actual Drive Voltage, Vpp
0	4.5
1	4.48
10	4.3
100	2.54

Table 8.1: Drive Current vs. Voltage

8.3 Output Signal Description

All clock models can provide three different digital signals and one analog signal. Digital signals consist of unmodulated IRIG-B, 1 PPS and Programmable Pulse. Analog consists of modulated IRIG-B. 1 PPS is often used to synchronize another (unsynchronized) timing signal. Programmable pulse modes are similar to 1 PPS only they have an adjustable period and pulse width with the rising edge on time. Programmable pulse modes include, seconds per pulse, pulse per hour, pulse per day, single trigger (once per year) and slow code. Pulse polarity adjustment is also available.

8.3.1 IRIG-B Description

IRIG-B is a complete serial time code that occurs once per second and, depending on the configuration, contains the day of year, hours, minutes, seconds, year and other important information. The Model 1092A/B/C and 1093A/C transmit (IRIG) Format B with four variations as seen in Table 8.2. Note that with the newer IRIG Standard 200-04, two of the designations have changed: the older B000 has become B004 and B120 has become B124.

Designation, New (Old)	Signal Type	Code Components
B004 (B000)	Pulse width code, No carrier	BCD_{TOY}, BCD_{YEAR}, CF, SBS
B003	Pulse width code, No carrier	BCD_{TOY}, SBS
B124 (B120)	Sine wave, amplitude modulated, 1 kHz	BCD_{TOY}, BCD_{YEAR}, CF, SBS
B123	Sine wave, amplitude modulated, 1 kHz	BCD_{TOY}, SBS

Table 8.2: IRIG-B Time Code Types Available

The IRIG-B time code consists of 100 bits produced every second, 74 bits of which contain various time, date, time changes and time quality information of the time signal. Consisting of logic ones, zeros and reference bits, the time code provides a reliable method of transmitting time to synchronize a variety equipment.

Three functional groups of bits in the IRIG-B time code are arranged in the following order: Binary Coded Decimal (BCD), Control Function (CF) and Straight Binary Seconds (SBS). The BCD group, with IEEE 1344 OFF, contains only time information including the seconds, minutes, hours and days, recycling yearly. With IEEE 1344 ON, BCD adds year information. The CF group contains other information including time quality, leap year, pending leap seconds and parity. Reference bits separate the various components of the IRIG-B time code.

8.3.2 Modulated and Unmodulated IRIG-B

Figure 8.2 illustrates the primary differences between modulated and unmodulated IRIG-B. You will notice that the while modulated IRIG-B is distinctive because of the 1 kHz sinewave carrier, it is similar to unmodulated IRIG-B since the peak-to-peak values of the carrier follow the same form as the peaks of the digital waveform, which contain the information.

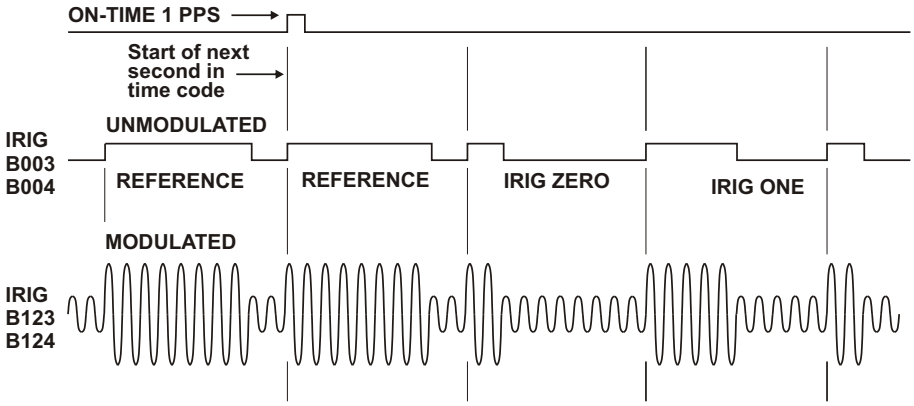


Figure 8.2: IRIG-B Waveforms

8.3.3 IRIG-B IEEE 1344 Extension

As mentioned above, the turning IEEE 1344 ON in the clock enables extra bits of the Control Function (CF) portion of the IRIG-B time code. Within this portion of the time code, bits are designated for additional features, including:

- Calendar Year (old method, now called BCD_{YEAR})
- Leap seconds, and leap seconds pending
- Daylight Saving Time (DST), and DST pending
- Local time offset
- Time quality
- Parity
- Position identifiers

To be able to use these extra bits of information, protective relays, RTU's and other equipment receiving the time code must be able to decode them. Consult your equipment manual to determine if the IEEE 1344 feature should be turned ON in the clock. To view details of the IEEE Std 1344-1995, please check with the IEEE.

NOTE: To download a copy of of the IRIG-B 2004 specification, please go to the Arbiter web site (at www.arbiter.com) and check under Documentation.

8.3.4 1 Pulse-per-Second (1 PPS)

A one pulse-per-second timing signal is very simple in concept. It is a digital bit transmitted every second with a pulse width of 10 milliseconds. A critical part of this signal is that it is "on time" at

the rising edge when compared with the signal from the Global Positioning System (GPS). When configured from any of the TTL/CMOS (5-volt) drivers, it has the same drive power as the IRIG-B and the programmable pulse. See Figure 8.2 for a comparison between unmodulated IRIG-B and 1 PPS.

8.3.5 Programmable Pulse (PROG PULSE)

Models 1092A/B/C and 1093A/B/C have an programmable pulse feature that may require some jumper and firmware configuration. Models 1093B/C and 1092B may be configured from the front panel and 1092A/C and 1093A must be configured through the RS-232 port. There are many available programmable pulse modes from which to choose that include setting the pulse width and time zone. For jumper configuration, please see Section 5.3.1, and for available modes and firmware configuration, please see Section 7.8.

Programmable Pulse Mode	**Configured Feature**
Seconds per pulse	X number of seconds between pulses, 0 – 60,000
Pulse per hour	Number of seconds after each hour, 0 – 3599
Pulse per day	Hour, minute, second, fractional seconds
Single trigger	Day, hour, minute, second, fractional seconds
Slow code	2 seconds on the minute, 4 seconds on the hour, 6 seconds on the day
Pulse polarity	Positive or negative–going pulse

Table 8.3: Programmable Pulse Modes and Features

8.3.6 Programmable Pulse with 200-Volt FET, Setup

For high-level switching on the main board, choose option 1093optS001 or 1092optS001. Clocks can provide high-level switching at either of the two digital outputs (Port 1 or 3). Connect a voltage of up to 200 volts and pull down a signal with the open drain 200-Volt FET. Make sure to connect the FET with suitable protection against overvoltage transients and over current conditions. To set timing output jumpers for programmable pulse with 200-Volt FET, see Section 5.3.5. Next, you will need to configure the type of programmable pulse through the setup menus or serial port. See Sections 7.8 or 10.2.12.

8.3.7 Protecting the 200-Volt FET Connection

Open-drain outputs are not internally protected against overcurrent or overvoltage. Maximum peak ratings are 100 mA and 200 V. External protections (current-limiting resistors, surge suppression diodes, snubbers, etc.) must be provided by the user, if required, to ensure that maximum ratings are not exceeded even momentarily. Also, consult the data sheet of the VN0120N3 FET used in these models.

8.4 Connecting the Outputs

All clocks come equipped with Phoenix-style, screw terminal connectors, which are compatible with twisted pair cabling. To attach, strip the wires bare, DO NOT tin with solder, insert into the correct screw terminal positions and tighten clockwise. To adapt coaxial cabling to the 1092/93 terminal connectors, use a BNC Breakout[2], or other similar adapter.

NOTE: If using a shielded, twisted-pair cable (like Belden 8760), connect the cable shield at the clock. It has become best industry practice to ground time-code outputs from clocks, and use galvanic isolation of time code inputs to IEDs.[3]

8.4.1 Attaching Cables to Screw Terminals

Prepare the twisted pair cable by stripping back at least 1/4" of the insulation and any shielding; DO NOT tin the bare wire with solder. Tighten the screws (clockwise) down on the wire.

8.4.2 How Far Can I Run IRIG-B Cabling?

Before laying cable to transmit IRIG-B over long distances, take time to consider the following factors: (1) resistive losses in cabling, (2) electromagnetic interference, (3) propagation delays, and (4) installation and maintenance costs.

Realize that when cable is laid from point A to point B that two cables are involved: one outgoing and one return. For coaxial cable, the resistance is different for the center conductor than for the outer conductor, or shield. For twisted pair wires, both outgoing and return wires will be the same. As a simple example, to connect an IRIG-B signal to a device 100 feet away from the clock, you must account for resistive losses in 200 feet of wire.

For details on distributing IRIG-B signals over long distances, see application note, AN101, Distributing Timing Signals in a High-EMI Environment. Download file appnote101.pdf at the following link:

http://www.arbiter.com/resources/documentation.php

For important considerations about IRIG-B connections, distribution of signals and accuracy, download the following file from the same link.
IRIG-B_accuracy_and_connection_requirements.pdf at the same link above.

8.4.3 Synchronizing Multiple IED's From One Masterclock Output

In many installations, master clock signals are "fanned out" to a number of devices. This method makes more efficient use of the clock synchronizing capability since the clock drivers are designed to handle multiple loads. The exact number of possible loads must be determined from the input impedance of each connected IED.

[2]Pomona Electrics, www.pomonaelectronics.com, (800) 444-6785, (425) 446-6010, part no. 4969 and 4970

[3]William Dickerson, "Time in the Power Industry: How and Why We Use It," www.arbiter.com, Resources, Documentation

8.4.4 Connecting Unmodulated IRIG-B

To drive multiple loads from one unmodulated IRIG-B output, make sure that the loads are wired in parallel. A common term for this is "Daisy-Chaining", however the idea is to drive all of these loads in parallel from a single output. It is much simpler to connect loads using unmodulated IRIG-B than for modulated, because all of the loads are driven at the same voltage.

To determine load current imposed on one Unmodulated IRIG-B output:

1. Determine the impedance or resistance (R_{dev}) of each IED load (check device manuals).
2. Calculate the load current for each device ($I_{dev} = 5V \div R_{dev}$).
3. To get the total current, sum up all the load currents for all devices connected to the output in question. $I_{devT} = I_{dev1} + I_{dev2} + \ldots + I_{devN}$, where T = Total for N devices.

Unmodulated Example

For example, if the input impedance of the IED is 5 kilohms, determine the device current (I) as seen in Calculation 8.1:

$$I = V \div R_{dev} = 5\ Volts \div 5000\ Ohms = 0.001\ Amps\ (1\ mA) \tag{8.1}$$

If you were to connect ten of the same IED's to the same output, then the total current drawn would be 10 x 0.001 A = 0.01 A (10 mA).

Another method is to determine the lumped impedance of all of the connected IED's in parallel. Then, determine the overall current by dividing the drive voltage (5 V) by the computed lumped impedance value. This current should not exceed 75 mA.

8.4.5 Connecting Modulated IRIG-B

While the modulated driver supplies approximately 4.5 volts peak-to-peak (Vpp) open circuit, it can supply 3 Vpp into 50 ohms. This amounts to about 0.064 A (64 mA) drive current.

Make sure to check the acceptable voltage range for the equipment. Some modulated IRIG-B decoders are fairly sensitive to peak-to-peak voltage levels (3.3 Vpp ± 0.5 Vpp), others are more tolerant (0.1 – 10 Vpp). With added loads, the clock's modulated driver produces more current, which reduces the output voltage at the output terminals. Calculation 8.2 shows how to calculate the available output voltage with a 10 mA drive current.

$$Vpp = 4.5\ Vpp - I \times 19.6\ Ohms \tag{8.2}$$

Therefore, if you had 10 mA of load current (I load) the available voltage (Vpp) would be 4.304 Vpp. If the load current equals 100 mA, then the available voltage would be 2.54 Vpp. So, you can see how the increasing load current (i.e number of loads) affects the available drive voltage at the clock output. See also Table 8.1.

8.4.6 Wire Losses

Another factor affecting the available voltage is the resistive losses through the cabling. Wire has a certain resistivity associated with it that is determined by its metallic composition, and resistance determined by the diameter and length. For example, single-strand, 22 AWG (bare, enamel-coated) copper wire has a resistance of approximately 19.6 ohms per 1000 feet. To compute the loss we must include both wires in the connection, signal and return. For coaxial cabling, the resistance of the center conductor is rated differently than the shield. For a twisted pair, both of them should essentially have the same resistance per cut length. Using 500 feet of 22 AWG shielded twisted pair wire, and including the source resistor, the available voltage would be as calculated in 8.3:

$$Vpp\ available = 4.5 - I \times 19.6\ (R_{source}) - I \times 19.6\ (R_{wire}) = 0.58\ Vpp \tag{8.3}$$

So, you can see that most of the drive voltage is lost with 100 mA of current and 500 feet of 22 AWG twisted pair transmission line; this includes the voltage losses at the source resistor. 0.58 Vpp may not be detected by the decoder in some IED's. *To assure reliable detection, make your cable runs as short as possible, use a larger diameter wire and carefully distribute the loads.*

8.4.7 Voltage Matching for Modulated IRIG-B

With modulated IRIG-B, it was mentioned that certain decoders are very intolerant of drive voltage variation. If the IED specification says that the acceptable voltage range is 3.3 Vpp ± 0.5 volt, and the available voltage is high, then you must reduce the voltage using a dropping resistor (R_{drop}). The value of the dropping resistor is determined by dividing the difference voltage (V_{diff}) by the device current (I_{dev}). For example, suppose that the available voltage is 4.3 Vpp, the (nominal) acceptable voltage is 3.3 Vpp, and the device current is 10 mA. Determine the dropping resistor value.

$$R_{drop} = V_{diff} \div I_{dev} = (4.3 - 3.3) \div 0.01 = 100.4\ Ohms \tag{8.4}$$

The Power dissipation (P) is:

$$P = I^2R = 0.01^2 \times 100.4 = 0.01\ Watts \tag{8.5}$$

In this example, an eighth-watt resistor should work fine.

For a voltage that is too low, then the modulated IRIG-B signal level must be increased by some other means, such as (1) distributing the load differently to reduce the current (raising the available voltage), (2) by reducing the loss through the wiring, or (3) by using an amplifier.

8.4.8 Cable Delays

Electromagnetic waves travel at the speed of light (C) in free space or vacuum and a fraction of that speed through cabling. The speed of an electromagnetic wave in free space is given by Constant 8.6.

$$C \approx 9.82 \times 10^8\ \ feet/second \tag{8.6}$$

Since electromagnetic waves travel slower through any cable, cable manufacturers normally specify cable with a velocity factor (VF), which is a percentage of the speed of light in free space, and characteristic of the specific cable. The Velocity Factor for the RG-6 cabling used by Arbiter Systems for GPS antenna connections, is about 83% of C. Most transmission lines have velocity factors in the range of 65% to 97%. Using these values you can determine the actual time delay in your cable distribution system and compare it to your required accuracy. As an example, 840 feet of RG-6 cable (with a velocity factor of 83%) would delay the timing signal by one microsecond. For IRIG-B timing applications, these delays may not be important, compared to other criteria. Otherwise, you would be forced to compensate for the time delay using another method, such as advancing the timing output or placing another master clock at the remote site.

8.4.9 Solutions

There are many solutions to providing an accurate timing signal to equipment in distant locations. However, the most satisfying solution may not be to string cabling for hundreds of meters. The costs associated with installing and maintaining cabling over a wide area may be unsatisfactory. Since the GPS is so pervasive, it may prove to be less costly to install another clock at a distant location, which would also improve accuracy and provide redundancy. Before installing cabling over a wide area, be sure to first examine all the possibilities.

Chapter 9

Relay Contacts and Event Inputs

9.1 Relay Contacts – Option 93

9.1.1 Introduction

Option 93 provides a single set of SPDT relay contacts when installed the Model 1092A/B/C or 1093A/B/C. Without Option 93 installed, the relay contact connector will be visible, however no contacts or related circuitry will be installed. To retrofit the Option 93, Out-of-Lock relay, you must arrange to return it to the factory for installation. These Form C type contacts have a limited lifetime of approximately 100,000 cycles. See also Section 2.3.5.

9.1.2 Relay Operation

The out-of-lock relay is in the faulted position when the clock is powered OFF (Failsafe operation) or is not locked to the GPS. The faulted indication is as follows; ERR (Normally Closed) is shorted to COM and OK (Normally Open) is open with respect to COM. If the clock loses synchronization with the GPS, the out-of-lock relay will change state (is faulted) based on the "Out-of-Lock" setup. Configure this through the front panel (see Section 7.5) or the RS-232 interface (see Section 10.2.14). Out-of-Lock settings are (1) Unlock OFF, (2) Zero Delay Unlock, and (3) 1 to 99 Minute Delay for unlock.

Figure 9.1: Relay Contact Connector

9.2 Event Inputs

9.2.1 Event Timing Input

When configured for event timing, the 1092A/B/C and 1093A/B/C can provide one input channel with one microsecond resolution. This channel is primarily used for synchronization via the RS-232 port with an external computer or other type of device. It may also be used to time an external 5 V CMOS signal applied to one of the I/O connectors; see Section 5.3.4.

Data for individual recorded events can be recalled using either the Event/Deviation front panel key or via the RS-232C interface (see Section 10.2.4). Data for each event will be retained until it is retrieved using one of these two methods. Thus, if no event data points are retrieved, recording will be suspended when the total number of event buffer is full. As soon as data is retrieved for a recorded event, its address is made available for data corresponding to a new incoming event.

9.2.2 Event Timing Latency

Event data are recorded using a high-speed capture circuit operating with a 4 MHz time-base. Latency is limited by the interrupt processing speed of the clock's microcontroller, which in turn depends on its workload at the time the event is received. Since the workload varies from time to time, latency likewise varies. However, response time will, in general, never be less than a few hundred microseconds nor greater than 10 milliseconds.

9.2.3 Deviation Measurement

The Channel A input can also be configured to display measured event times as 1 pulse-per-second (1 PPS) deviation measurements. The intended purpose of the deviation measurement function is to allow comparison of an external 1–PPS signal to the clock's internal 1–PPS signal. The clock determines the mean time difference between the two signals, which can be displayed on the front panel or read via the RS-232 Interface.

9.2.4 Measurement Principle

The measurement technique employed for 1–PPS Deviation uses the same time determination and recording scheme used for event time measurement (refer to paragraph above), but makes the assumption that the input signal is periodic and continuous. Also, the operation of the circular memory buffer is modified somewhat, in that recording does not stop after the buffer is full; new Event Data is given priority over existing data, and will overwrite it. Since the incoming signal occurs once per second and the circular buffer holds a number of events, each event time record will be overwritten on a regular basis.

Once every second, the processor looks at the most recent group of 16 events. When computing deviation, it uses only the portion of the event data describing fractional seconds (e.g. values between 0.0000000 and 0.9999999 seconds). By normalizing the 16 fractional-second values around 0.0000000, the range of results from the deviation computations will be centered on zero (-0.4999999 to +0.5000000 seconds). Statistical computations are then performed on the 16 values to determine their Mean and Sigma (Standard Deviation) values, which are then displayed on the front panel or output via RS-232.

9.2.5 Event Timer Input Channel Configuration

In order for the Model 1092A/B/C or 1093A/B/C to receive a timing input, adjustments to both the hardware and software configuration may be required. The hardware configuration is described in Section 5.3.4.

9.2.6 Firmware Setup

Reconfiguration of the firmware may also be required to allow measurement and display of Event Time Data and/or 1 PPS Deviation. See Figure 7.17 for detail on configuring the Event/Deviation parameters from the front panel. See Section 10.2.4 for details on using the RS-232 interface.

9.2.7 Displaying Data

Event and deviation data can be accessed from either the front panel or via RS-232 commands. The following paragraphs describe the steps required to access data using the front panel EVENT/DEVIATION key. When pressing the EVENT/DEVIATION key, the display will enter a circular scroll, which begins by showing the data (if any is present) for Channel A, as previously configured for Event Recording in Section 10.2.4. The readout will display one of the event times using the following format:

CH A EVENT #nnn TIME
ddd:hh:mm:ss.sssssss

Where:
nnn = event number (001 to 400)
ddd = day of year of the event (1 to 366)
hh = hour of the event (00 to 23)
mm = minute of the event (00 to 59)
ss.sssssss = second and fractional seconds of the event (e.g. 59.9999999)

Pressing the UP and DOWN keys will scroll the display through all events presently stored in the event time buffer. If the event display mode is exited and then re-entered, the first event data displayed for a given channel will correspond to the same event number as was last displayed for that channel. However, the data itself may be changed if it has been overwritten.

To clear the event buffer, press the EVENT/DEVIATION key again, while viewing event data. This will cause the display to issue the following prompt:

CLEAR EVENT (A)?

NOTE: If the event capture channel is not configured for event time recording, the CLEAR EVENT prompt will not be displayed.

Clocks display the CLEAR EVENT prompt only if the event capture channel was previously configured for event time recording. Press ENTER during this display to delete all of the records in the event buffer, and to allow recording of new event times, starting with event number 001.

If the event capture channel is configured for 1–PPS Deviation (via Event/Deviation Setup Menu), the readout will display the deviation of the 1–PPS input signal. In this case, the readout display will have the format:

A 1 PPS XXXXX.XX ?S
SIGMA: XXXXX.XX ?S

Where: The top number is the mean (average) value of the most recent 16 records in the event buffer, and represents the mean deviation (in microseconds) of the measured 1–PPS signal from

the GPS 1-PPS signal. A negative number means the applied 1–PPS signal is early, i.e. before on-time, and a positive number means it is late, i.e. after on-time.

The bottom number is the standard deviation (sigma) of the values of the 16 samples.

9.2.8 RS-232C Event Trapping

The event capture channel of the Model 1092A/B/C and 1093A/B/C can be configured to capture one or more events via the RS-232C Serial Interface. The time mark for a captured event will correspond to the leading edge of the start bit of the first character in the RS-232C signal. This event mode can be both armed and interrogated for data over the RS-232C interface, allowing automated synchronization of an external computer or system.

To perform event trapping via the RS-232C interface, the circuit must first be ARMED; that is, made ready to receive an event trigger. Only one event may be captured after every arming, but the events are stored sequentially in the event buffer in exactly the same manner as the normal event time mode.

9.2.9 Event Trapping Setup

Configuring the clock to trap events on the RS-232C interface requires making the configuration changes described in Section 5.3.4.

Arm the Event-Trapping circuit from the front panel using the SET RS-232 sub-menu of the SETUP menu. This menu also provides for configuration of communications port parameters (e.g. baud rate, word length, etc.) to match those of the computer or equipment to be interfaced. The following steps are required to arm the Event Trapping circuitry from the front panel:

Press the following keys in order; SETUP > ENTER > SETUP > SETUP. The display should indicate the following:

SET A EVENT?

Press ENTER again and the display should indicate the following:

ARM A EVENT?
PRESS ENTER TO ARM

Press the ENTER button and the Event Input should be armed.

When the event occurs on the RS-232C port (i.e. the start bit of the next received character), the event data can be reviewed in the event mode, exactly as any normally captured event would be. To capture further events, the circuit must be re-armed, either by the front panel or by using the RS-232 Command “AR.”

Note that received commands are viewed as complete when the final character in the command is received. Control characters, such as carriage-return and line-feed, are ignored and may follow the ‘AR’ command, but the start bit of the next character after the ‘R’ (even if a carriage return) may trigger the event timer. For a complete list of RS-232C Event Mode commands, refer to Section 10.2.4.

Chapter 10

Serial Communication and Command Set

10.1 Introduction

Models 1092A/B/C and 1093A/B/C have one main RS-232 port, and one optional RS-232 port. These are labeled **RS-232C** and **Option RS-232**. When viewing the rear panel, the main port is nearest the antenna connector and the optional port is to the left of the Standard I/O connectors. RS-232 combines an RS-485 function in the same connector if Option 94 is installed. *It is important to note that the Option RS-232 port does not support RS-485, neither RS-232 ports use flow control, and the RS-485 port functions in transmit only mode.*

Use the two serial ports interchangeably for separate functions. You may wish to interrogate the clock on one port for basic information (i.e to configure something) and at the same time be able to have the second serial port broadcasting a specific time code to a meter. While most substation IEDs appear to have standardized on the IRIG-B time code, some devices are designed to receive ASCII data through the serial port. Another common serial-port function is to connect a digital wall display to indicate the time.

10.2 Command Set

This section provides information for controlling and communicating with these clocks via the RS-232C serial interface. All off the RS-232 commands are functionally grouped into similar categories. For example, Section 10.2.3 lists all of the commands used to broadcast the date and time in one of the standard formats.

Each command name and syntax is highlighted in bold at the beginning of each definition. Detailed information used to interpret the commands and responses follows each command heading. Sometimes the command is very short, such as the command to return the Local Time: **TL**. Other commands require a prefix or suffix with the letter command to specify them, such as to broadcast: **Bn**, where n = an integer specifying the broadcast. For example, the command to start the ASCII Standard broadcast string at a rate of once per second, on Local time, from the main RS-232 port is **B1**.

When a command requests information from a clock, it returns the most current data available. Numeric data is returned as an ASCII string of numeric characters, with leading sign and embedded

decimal point as required. Strings are normally terminated with carriage return and line feed characters, however not always. Enter any RS-232C command as written in these tables *without* pressing ENTER. Characters are automatically received when typed. If including any of these commands in a programming sequence, do not include any carriage-return or line-feed characters.

In each case, the actual command to do something in the clock follows the word "Command:" and is in bold font. Please read the comments below each command as some commands include one or more commas and in other cases a comma will separate multiple commands.

The following symbols and syntax are used:

↵ = Shorthand for carriage-return, line-feed
U = UTC Time
L = Local Time
soh = An ASCII character (start of header) = Hex 01
bel = An ASCII character = Hex 07
n = integer used for various numerical values
yyyy = four digit year
ddd = Julian day-of-year
mm = month
hh = hour
mm = minute
ss = second
www = Day of Week
_ = Underlines are used for clarity only and graphically represent the location of ASCII spaces.

10.2.1 Custom String Command

Command: @@**A . . . , @@B . . .**

The 1093A/B/C is able to store two custom strings for broadcasting; one (i.e. Custom A) may be broadcast from the main serial port and one (i.e. Custom B) from the option serial port (Option 19 required). Use the @@A . . . command to create a Custom A string, and the @@B . . . command to create a Custom B string. Available characters and controls that may define these strings are listed in Table 10.1, followed by custom string examples.

Start Custom Broadcast

Command: **B9, O9**
B9 activates the Custom A string broadcast from the main serial port; O9 activates the Custom B string broadcast from the option serial port. Use the B0 and O0 commands to stop the broadcast (see Section 10.2.3).

Return Custom String

Command: **UB, UO**
Use the UB command to return the Custom A string definition (Standard RS-232 port), and the UO command to return the Custom B string definition (Option RS-232 port, requires Option 19).

Custom Broadcast Character Set

Character	Meaning
//	/ character
Cssnn	Xor checksum of specified range, where ss = start location (hex value from 00 to FF) and nn = number of bytes (hex value from 00 to FF)
D	Day of month: 01, . . . , 31
d	Day of year: 001, . . . , 366
e	GPS elevation: ±dddddd.dd length = 10
f	Fractional Seconds: 00, . . . , 99
Hxx	Hexadecimal value where xx is a hex value from 00, . . . , FF
h	Hour: 00, . . . , 23
Ln	LCD front panel display buffer, 2 lines, 20 characters: L1 = top line; L2 = bottom line
m	Minute: 00, . . . , 59
M	Month: 01, . . . , 12
O	Local hour offset: ±hh where hh=00, . . . , 12
o	Local minute offset: 0, . . . , 59 minutes
Pi	Latitude: where i = 1, degrees (dd); = 2, Minutes (mm); = 3, Fractional minutes (mmmm); = 4, Seconds (ss); = 5, Fractional seconds (fff); = 6, N (North) or S (South)
pi	Longitude: where i = 1, degrees (ddd); = 2, minutes (mm); = 3, fractional minutes; = 4, seconds (ss); = 5, fractional seconds (fff); = 6, E (East) or W (West)
r	Carriage return and line feed
Sii	String Type where ii: 01 = Status change; 02 = Vorne Opt28; 03 = Opt28 ASCII; 04 = True Time Opt28
s	Seconds: 00, . . . , 59
Txx	On time character where xx is a hex value from 01 to FF (Note: Must be at the start or end of the string!)
U	Unlock time: 00, . . . ,99 minutes
vnn	Option 28 values: 01 = Time Deviation; 02 = Frequency; 03 = Frequency Deviation; 04 = Amplitude; 05 = Phase Angle
W	Day of week: 1, . . . , 7 where 1 = Sunday
w	Day of week: 1, . . . , 7 where 1 = Monday
y	Year: 00, . . . , 99
Y	Year: 2000, . . . , 2xxx
z	Display number

Table 10.1: Characters used with Custom Strings

Table 10.1 Notes. Conditionals can use any of the above, with the exception of Cssnn and Txx, in addition to any string characters. CONDITIONALS CANNOT BE NESTED!

True/False Condition

Command: $/[ii? < t > / :< f > /]$
where:
$< t >$ = True condition
$< f >$ = False condition
ii: 01 = Locked; 02 = Status change; 03 = Locked with max accuracy; 04 = Fault; 05 = Daylight Saving Time change pending; ; 06 = Unlocked LED status (whether Unlocked LED On/Off)

Ordinal Condition

Command: $/\{ii? < 0 > / :, \ldots, < n > /; < e >\}$
where:
$< 0 >, < 1 >, \ldots, < n >$ = ordinal position
$< e >$ = Else condition
ii: 01 = Time Quality (13 possible ordinals); 02 = Time Quality for True Time[1] format (5 possible); 03 = Time Zone Indicator (3 possible, 0=DST active, 1=Not active, 2=UTC)

Binary	Hex	Value (worse case accuracy)
1111	F	Fault-clock failure, time not reliable
1011	B	10 seconds
1010	A	1 second
1001	9	100 milliseconds (time within 0.1s)
1000	8	10 milliseconds (time within 0.01s)
0111	7	1 millisecond (time within 0.001s)
0110	6	100 microseconds (time within 10^{-4}s)
0101	5	10 microseconds (time within 10^{-5}s)
0100	4	1 microsecond (time within 10^{-6}s)
0011	3	100 nanoseconds (time within 10^{-7}s)
0010	2	10 nanoseconds (time within 10^{-8}s)
0001	1	1 nanosecond (time within 10^{-9}s)
0000	0	Normal operation, clock locked

Table 10.2: List of Possible Time Quality Levels, Ordinal 01

Symbol	**ASCII Character**	**Accuracy**
(space)	32	locked, maximum accuracy
.	46	Error $<$ 1 microsecond
*	42	Error $<$ 10 microseconds
#	35	Error $<$ 100 microseconds
?	63	Error $>$ 100 microseconds

Table 10.3: List of True Time Quality Levels, Ordinal 02

[1]For True Time Broadcast Mode, see Page 123

Using Ordinals and Conditionals

An ordinal returns an ASCII character or characters (e.g. 1, 2, 3,...., good, bad, etc.) for a requested value (e.g. clock accuracy). A conditional returns an ASCII character or characters (e.g. 0, 1, locked, unlocked, etc.) based on a true/false request (e.g. Is there a Fault?). Illustrated below are several examples of using ordinals and conditionals when constructing a custom string. You can even construct standard strings to check your work. All the ordinal/conditional examples below use the ASCII Standard broadcast string.

Ordinal 01. This ordinal consists of 13 different accuracy values as listed in Table 10.2. Notice the ordinals (0, 1, 2,...,B,F) are all represented in this example. All need not be used as shown in the second example. This example more closely follows the 1093A/B/C accuracy, not signaling a change until reaching 1 microsecond.

@@A/T01/d:/h:/m:/s/{01?0/:1/:2/:3/:4/:5/:6/:7/:8/:9/:A/:B/:F/}/r

@@A/T01/d:/h:/m:/s/{01?0/:0/:0/:0/:4/:5/:6/:7/:8/:9/;out of lock/}/r

Note that the accuracy values (e.g. 0, 1, 2,...,F) can be replaced with textual values. For example, note that the value "out of lock" in the second example replaced everything after "9" in the first example.

Ordinal 02. This ordinal consists of 5 different accuracy values as listed in Table 10.3.

@@A/T01/d:/h:/m:/s/{02? /:./:∗/:#/:?/}/r

Ordinal 03. This ordinal consists of three different time zone values: DST active (i.e. Daylight Saving Time), DST inactive (i.e. Standard Time) and UTC time.

@@A/T01/d:/h:/m:/s/{03? DST Active/: DST Inactive/: UTC/}/r

Conditional 03. In this condition the clock is queried for a locked condition. It answers true with a space if locked and false with a question mark if unlocked.

@@A/T01/d:/h:/m:/s/[03? /:?/]/r

10.2.2 String Setup Examples and Tutorial

In this section, you will find a number of examples of constructing a custom broadcast string that produces one of the standard broadcasts. By building up a custom string that produces a standard broadcast, you to compare the output your custom string produces with that of the standard broadcast. If the outputs agree, then your custom string must be correct. This should give you some confidence in constructing your own broadcast string.

In each broadcast example that follows the first line will give the broadcast name, the second line will give the desired broadcast output and the third line shows the custom input string code. At the end of each example, you will find some string constructions notes to help you understand how to use the custom string commands in Table 10.1. This includes the use of ordinals and conditionals.

ASCII Standard

Desired Output: <soh>ddd:hh:mm:ss ↵

Input String Code: @@A/T01/d:/h:/m:/s/r

Input String Construction Notes: Note that the ordinary method of starting the ASCII Standard broadcast is using the B1 or O1 command as described on page 69. Custom string entry always begins with the @@A for strings output from the main serial port, or @@B for strings output from the option serial port. Next, the T01 specifies the on-time character as a Hex 01, which is the Start of Header. Notice that these characters are preceded by the "/", which precedes each of the other (Table 10.1) characters. "d" is for Julian Day, "h" if for hours, "m" is for minutes, "s" is for seconds, and "r" is for carriage return, line feed. The ":" subdivides the Julian day, hour, minute and second, and no space between characters. After typing in the Input String Code (as shown above), press the Enter key. The code's acceptance is indicated by a carriage return line feed.

Vorne Standard

Desired Output:
44hhmmss ↵
55ddd ↵
11nn ↵
bel

Input String Code: 44/h/m/s/r55/d/r11/U/r/T07

Input String Construction Notes: Note that the ordinary method of starting the Vorne Standard broadcast is using the B2 or O2 command as described on page 69. This input string code begins with the characters "44"; note that these are printed as that and are not preceded by a "/". "h", "m" and "s" follow and include a "r" for carriage-return, line-feed. "55" immediately follows the "r", then a "d" for Julian day, followed by another "r". "11" immediately follows the "r", followed by a "U" for unlock time and "r" for another carriage-return, line-feed. Lastly, the "T07" specifies the on time character as the Hex 07, which sounds the bel in the machine. Note that the "44", "55" and the "11" are not preceded by a "/" since they are printed as characters.

Status

Desired Output: ddd:hh:mm:ss I=nn:nn X=nn:nn ↵

Input String Code: /[02?/d:/h:/m:/s /S01/r/:/]

Input String Construction Notes: Note that the ordinary method of starting the Status broadcast is using the B4 or O4 command as described on page 70. This string begins with a true/false conditional 02, which is a change of status. Since it is a part of the Table 10.1 character set, it must be preceded by the "/". After the "?", appears the Julian day, hours, minutes and seconds that indicate the day and time that the status changed. After the "s" (seconds) is an intentional space as shown in the input string code. After the space is the intended "/" and "S01", which indicates a status change string type of "01". The "/:" separates the "or" of the "true or false" conditions, only in this case there is no specified false condition.

Extended ASCII (DTSS MSG)

Desired Output: ↵
Q_yy_ddd_hh:mm:ss.000___

Input String Code: /T0D/H0A/[03? /:?/] /y /d:/h:/m:/s.000

Input String Construction Notes: Note that the ordinary method of starting the Ext. ASCII broadcast is using the B5 or O5 command as described on page 70. "T0D" sets the on time mark as a carriage return, and "H0A" is line feed. Immediately following is a "03", which is a "locked with maximum accuracy" conditional. This is followed by a space, which indicates that the clock is locked with maximum accuracy. If the condition is false, then it prints a "?". The "/:" separates the true/false outputs. Outside the conditional statement are the normal values that are broadcast at the chosen rate. "y", "d", "h", "m" and "s" are the two-digit year, Julian day, hours, minutes, seconds, followed by three fractional second digits and three spaces.

ASCII + Quality

Desired Output: <soh>ddd:hh:mm:ssQ↵

Input String Code: /T01/d:/h:/m:/s/{01? /:./:∗/:#/;?/}/r

Input String Constructions Notes: Note that the ordinary method of starting the ASCII + Quality broadcast is using the B6 or O6 command as described on page 71. This string is very similar to the Standard ASCII described earlier appended with a quality indicator, "Q". All of the notes under ASCII Standard apply, except that "Q" is an ordinal. The ordinal will produce all of the necessary time quality values passed on by the clock. The ordinal begins with a "{" and ends with a "}". "01" is the selected (time quality) value governing the output character. Ordinals are a sequence conditional, meaning that you have values separated by a "/:" (OR), and (in this case) at last is a "/;" (ELSE). For ASCII + Qual, there are four OR conditions (specific time quality ranges) followed by one ELSE (worst quality range). The initial ordinal is a space, meaning maximum time quality followed by a ".", a "*", a "#" and finally by the ELSE condition of a "?". A carriage return line feed "r" ends the string.

ASCII + Year

Desired Output: <soh>yyyy:ddd:hh:mm:ssQ↵

Input String Code: /T01/Y:/d:/h:/m:/s/{01? /:./:∗/:#/;?/}/r

Input String Constructions Notes: Note that the ordinary method of starting the ASCII + Year broadcast is using the B8 or O8 command as described on page 71. The ASCII + Year is identical to the ASCII + Qual described above but includes the four-digit year followed by a space that precedes the Julian day. Notice that there are two characters for year: y (0 – 99) and Y (2000 – 2xxx).

Common ASCII Characters

Listed below are a few common ASCII control characters used with the Model 1092/93 series clocks. For a more complete listing of ASCII characters, you will need to consult a additional sources[2].

[2]See Wikipedia, at http://en.wikipedia.org/wiki/ASCII

Other printable characters may be typed in as seen on a keyboard.

Decimal	Hex	Abbreviation	Description
0	00	NUL	Null Character
1	01	SOH	Start of Header
7	07	BEL	Bell (sound)
10	0A	LF	Line Feed
13	0D	CR	Carriage Return

Table 10.4: Short Table of ASCII Characters

10.2.3 Broadcast Mode Commands

Broadcast Mode – INTERROGATE (Broadcast OFF)

Command: **B0, O0**
B0 deactivates the RS-232C broadcast mode (resets to interrogate mode) on the main RS-232 port. O0 deactivates the RS-232C broadcast mode on the option RS-232 port.

Response: ↵

Broadcast Mode – ASCII STD

Command: **B1, O1**
B1 configures the clock to broadcast the time-of-day as ASCII standard data from the main RS-232 port. O1 configures the clock to broadcast ASCII standard data from the option RS-232 port.

Response: <soh>ddd:hh:mm:ss ↵

Broadcast Mode – VORNE STD

Command: **B2, O2**
B2 configures the clock to broadcast data formatted for Vorne large format time displays from the main RS-232 port. O2 configures the clock to broadcast from the option RS-232 port Vorne-formatted data. Refer to Arbiter Systems Application Note 103 for more information on using large format displays with GPS clocks from Arbiter Systems.

Response: 44hhmmss ↵ (UTC/Local Time)
55ddd ↵ (day of year)
11nn ↵ (out-of-lock time)
bel (bel = Hex 07; sounds at the end of the time code)

The number and order of strings returned depend upon options ordered with clock (for example Option 28):

Data is transmitted ahead of time, and the bel character is transmitted on time. When properly configured, the Vorne displays update simultaneously upon receipt of the bel character.

Broadcast Mode – EVENT DATA

Command: **B3, O3**
B3 configures the clock to broadcast from the main RS-232 port any event data at the time it is recorded. O3 configures the clock to broadcast from the option RS-232 port any event data at the time it is recorded.

Response: (Local) mm/dd/yyyy hh:mm:ss.sssssss nnnAL ↵
(UTC) mm/dd/yyyy hh:mm:ss.sssssss nnnAU ↵

Where: nnn = Event-Buffer Read Index Number
U = UTC Time, and L = Local Time

Broadcast Mode – STATUS

Command: **B4, O4**
B4 configures the clock to broadcast any status data from the main RS-232 port when it changes. O4 configures the clock to broadcast any status data from the option RS-232 port when it changes. NOTE: When a valid fault is detected, the specific status fault is broadcast (with Julian day, and time) to the chosen serial port once. When the fault clears, another message is sent describing the cleared fault.

Response: ddd:hh:mm:ss I=nn:nn X=nn:nn ↵ (Updates whenever the status changes.)
Where:

I, Internal clock conditions
X, External clock conditions
nn:nn, Status byte(Hex).

The 2 digits preceding the colon describe the present condition of the instrument. The 2 digits after the colon indicate the parameters, which have changed.

Bit	**Weight**	**Fault**	**Bit**	**Weight**	**Fault**
0	1	Reserved	4	16	Out-of-Lock
1	2	Stabilized (=1)	5	32	Time Error
2	4	Reserved	6	64	VCXO tune Error
3	8	Reserved	7	128	Receiver Failure

Table 10.5: Fault Indications and Definitions

Broadcast Mode – EXT. ASCII

Command: **B5, O5**
B5 configures the clock to broadcast from the main RS-232 port, the time-of-day as ASCII using an extended format prefaced with a time quality indicator (Q). O5 configures the clock to broadcast the same data from the option RS-232 port. The start bit of a carriage-return is transmitted on time. EXT. ASCII (or Extended ASCII) adds a time quality indicator at the start of the Standard ASCII time string (including some spaces).

Response: ↵
Q_yy_ddd_hh:mm:ss.000___

Format: Q = Time quality indicator, and may be represented by:
_ = meaning it is locked with maximum accuracy.
? = (ASCII 63) unlocked, accuracy not guaranteed
_ = (space) used for clarity only and graphically represents the location of an ASCII space.

Broadcast Mode – ASCII + QUAL

Command: **B6, O6**
B6 configures the clock to broadcast from the main RS-232 port the time-of-day as ASCII data appended with a time quality indicator. O6 configures the clock to broadcast from the option RS-232 port. ASCII + QUAL means Standard ASCII plus Time Quality Indicator.

Response: <soh>ddd:hh:mm:ssQ↵

Format: soh = Hex 01 – the start bit of the soh character is transmitted on time.
Q = Time quality indicator. May be represented by:
_ (space) = locked, maximum accuracy
. = (ASCII 46) Error < 1 microsecond
* = (ASCII 42) Error < 10 microseconds
# = (ASCII 35) Error < 100 microseconds
? = (ASCII 63) Error > 100 microseconds

Broadcast Mode – YEAR + ASCII

Command: **B8, O8**
B8 configures the clock to broadcast from the main RS-232 port, the year and time-of-day as ASCII data appended with a time quality indicator. O8 configures the clock to broadcast from the option RS-232 port. YEAR + ASCII is the same as ASCII plus Time Quality Indicator adding the four digit year to the beginning of the string.

Response: <soh>yyyy:ddd:hh:mm:ssQ↵

Format: soh = Hex 01 – the start bit of the soh character is transmitted on time.
Q = Time quality indicator. may be represented by:
space = locked, maximum accuracy
. = (ASCII 46) Error < 1 microsecond
* = (ASCII 42) Error < 10 microseconds
# = (ASCII 35) Error < 100 microseconds
? = (ASCII 63) Error > 100 microseconds

Broadcast Mode – NMEA183GLL

Command: **0,nB**
0,nB configures the clock to broadcast the National Marine Electronics Association Standard (NMEA - 0183) to broadcast from the main RS-232 port, where n = the update rate in seconds, from 1 to 9999.

GLL - Geographic Position, Latitude-Longitude
Latitude and Longitude of present vessel position, time of position fix and status.
Response: $–GLL,llll.llll,a,yyyyy.yyyy,a,hhmmss.sss,A*cs ↵

Where: GLL = Geographic Position, Latitude / Longitude
llll.llll = Latitude of position
a = N or S
yyyyy.yyyy = Longitude of position
a = E or W
hhmmss.sss in UTC
A = status: “A” is Active, “V” is Void
*cs = checksum

Broadcast Mode - NMEA183ZDA

Command: **1,nB**
1,nB configures the clock to broadcast the National Marine Electronics Association Standard (NMEA - 0183) to broadcast ZDA format from the main RS-232 port, where n = the update rate in seconds from 1 to 9999. ZDA, time and date, includes the UTC day, month, year, and local time zone.

Response: $–ZDA,hhmmss.ss,dd,mm,yyyy,±xx,xx,*cs ↵

Where: ZDA = Time and date
hhmmss.ss = Time in UTC
dd = Day, 01 to 31
mm = Month, 01 to 12
yyyy = Year
±xx,xx = Local zone description, 00 to +/- 13 hours and minutes
*cs = checksum

Broadcast Data – ABB_SPA_MSG

Command: **0,nTB**
0,nTB configures the clock to broadcast the ABB SPA format from the main RS-232 port, where n = the time zone; time reported is in UTC format for n = 0, and Local format for n = 1.

The ABB SPA time string is a sequence of 32 ASCII characters starting with the characters >900WD and ending with the carriage return character. The letters printed in italics are replaced by ASCII numbers whereas the other characters are part of the time string.

Response: >900WD:*yy-mm-dd_hh:mm:ss.fff:cc*< *CR* >

yy-mm-dd the current date:
yy = year of century, (00...99)
mm = month, (1...12)
dd = day of month, (01...31)
_ = Space (ASCII 20h)
hh:mm:ss.fff the current time:
hh = hours, (00...23)
mm = minutes, (00...59)
ss = seconds, (00...59, or 60 while leap second)
fff = milliseconds, (000...999)
cc = Check sum*
< *CR* > = Carriage Return (ASCII code 0Dh)

*EXCLUSIVE-OR result of previous characters, displayed as HEX byte (2 ASCII characters 0...9 or A...F)

Broadcast PATEK_PHILIPPE_MSG (CUSTOM 1)

Command: **BA, OA**
BA configures the clock to broadcast the Patek Philippe message (or CUSTOM 1) from the main RS-232 port. OA configures the clock to broadcast the Patek Philippe message from the Option RS-232 port.

Response: T:yy:mm:dd:dw:hh:mm:ss ↵
Where: dw = day of week

Broadcast KISSIMMEE_MSG

Command: **1,nTB**
1,nTB configures the clock to broadcast the Kissimmee message (Telegyr 5700) from the main RS-232 port, where n = the time zone; time reported is in UTC format for n = 0, and Local for n = 1.

Response: ddd:hh:mm:ssQ ↵

Where: Q = quality indicator (with indicators shown below)
_ = locked, maximum accuracy
. = (ASCII 46) Error < 1 microsecond
* = (ASCII 42) Error < 10 microseconds
# = (ASCII 35) Error < 100 microseconds
? = (ASCII 63) Error > 100 microseconds

Pin 6 Serial Port Broadcast Control

Command: **xPM**

xPM activates (x = 1) or deactivates (x = 0) the use of the main serial port, pin 6 controlling (by high or low input) the output from pin 3. When used with a modem, the modem can be programmed to toggle HI and LO to effectively free it from domination from a broadcast output from the clock and restore operation.

Normally, pin 6 is not used to control any communications in the clock. The default setup when shipped from the factory turns OFF this feature. To enable this feature, and halt the transmit output from the UART to the serial port connector (pin 3), send a 1PM. When the broadcast control is enabled and pin 6 is pulled LO, the transmitted output will stop. When broadcast control is enabled and pin 6 is pulled HI, the transmitted output will continue from the serial port.

Response: ↵

10.2.4 Event Mode Commands

Return Specific Event

Command: **nnnA**
nnnA sets the event buffer read index to a specific event number (001 to 400), and returns that event information in either Local or UTC time format depending on how the command, nTA is configured.

Response: LCL mm/dd/yyyy hh:mm:ss.sssssss nnnL ↵
UTC mm/dd/yyyy hh:mm:ss.sssssss nnnU ↵

Format: nnn = Event–Buffer Read Index Number
U = UTC Time
L = Local Time

Set Event Channel Time

Command: **nTA**
nTA sets the time source as either Local or UTC, where n = 0 sets the event time to UTC and n = 1 sets the event time to Local.

Response: ↵

Set Channel – Deviation

Command: **AD**
AD sets channel A to the 1-PPS deviation mode.

Response: ↵

Set Channel – Event

Command: **AE**
AE sets Channel A to the event recording mode.

Response: ↵

Clear Event Buffer

Command: **CA**
CA clears the channel A event buffer and then resets the read and wrote indices to 0.

Response: ↵

Return Deviation for Event Channel

Command: **DA**
DA returns 1-PPS deviation and sigma for the event input.

Response: ± dddd.dd ssss.ss ↵ (Results are in microseconds)

Format: dddd.dd = the deviation from 1-PPS (GPS), averaged over 16 samples
ssss.ss = the standard deviation (sigma) of samples

Arm Event Trigger

Command: **AR**
AR arms the RS-232C event capture circuitry.

Response: ↵

Return Single Event

Command: **EA**
EA returns a single event record from the channel A event buffer. The record number (nnn) increments once for every issuance of this command.

Response: Local Time mm/dd/yyyy hh:mm:ss.sssssss nnAL ↵
UTC time mm/dd/yyyy hh:mm:ss.sssssss nnnAU ↵

Format: A = Channel A
U = UTC time, Channel A
L = Local time, Channel A
NO DATA ↵ (if buffer is empty)

10.2.5 Status Mode Commands

Return Status of Event/Deviation

Command: **SA**
SA returns the event/deviation channel setup information, read index number and write index number.

Response: D(E), R = nnn, S = mmm ↵

Format: D indicates the input channel is in 1–PPS deviation mode
E indicates the input channel is in event mode

nnn Channel read index (001 to 400)
mmm Channel write index (001 to 400)

NOTE: When nnn = mmm, using the EA command to read event data, the event buffer is empty, i.e., all event data which has been recorded has also been read.

Return Clock Status

Command: **SC**
SC returns the current clock status.

Response: L/U, U=xx, S=nn ↵

Format:
L = Clock currently locked to GPS (U for unlocked).
xx = Indicates loss of lock period, up to 99 minutes.
nn = User specified out-of-lock delay, 00 to 99 minutes (refer to Table A-8).
S = Off if the out-of-lock function is deactivated, S = ZDL indicates zero delay.

Return DCXO Status

Command: **SD**
SD returns the DCXO (Digitally Compensated Crystal Oscillator) status, which compares the oscillator with the 1 PPS to track the oscillator drift.

Response: ±pp.pp PPM ↵
Format: pp.pp = Residual, corrected DCXO error, in parts per million

EEPROM Status

Command: **SE**
SE returns the EEPROM status.

Response: T=t CE=ee

Format: t = 0, No Timeout Error; t = 1, Timeout Error
ee = Number of corrected errors in reading EEPROM data

Receiver Status

Command: **SR**
SR returns the current receiver status.

Response: V=vv S=ss T=t P=Off E=0 ↵

Format: vv = number of satellites, visible to the antenna, per almanac.
ss = relative signal strength (range: 0 to 255, nominal value = 15)

t = number of satellites being actively tracked (up to twelve)
P = Off, indicates that the time dilution of precision (TDOP) calculation is not being performed. Returns 1.0 - 99.0, depending on satellite geometry, when TDOP calculation is being performed. A TDOP calculation is NOT performed if less than 3 satellites are visible, OR if Position-Hold is active. E = 0, currently unused.

Survey Status

Command: **SQ**
SQ returns Auto-Survey mode data. For a survey in progress, it returns current status of the survey. For a completed survey, it returns the final results of the survey, i.e. the averaged position.

Response: Sn Pm Fnnnnn #nnnnn Tyyyy:dd:hh:mm:ss Eddd:mm:ss.sss Ndd:mm:ss.sss Hmmmmm.mm ↵
Format: Sn = status of the Auto-Survey mode
Pm = status of the Position-Hold mode
Fnnnnn = current number of fixes
#nnnnn = total number of fixes required
yyyy:ddd:hh:mm:ss = completion time of the most recent average
Eddd:mm:ss.sss = surveyed longitude
Ndd:mm:ss.sss = surveyed latitude
Hmmmmm.mm = surveyed elevation

Table 10.6 columns on the left show the significant three bits of the Auto Survey status byte, weighting and assignments. On the right, columns show the significant three bits of the Position Hold status byte, weighting and assignments.

Bit	Weight	Function	Bit	Weight	Function
0 (LSB)	1	Single Auto Survey	0 (LSB)	1	Position Hold Enabled
1	2	Power-On Survey	1	2	Position Hold Active
2	4	Suspend Survey	2	4	Position Hold ID:*
3–7	N/A	–	3–7	N/A	–

Table 10.6: Survey (Sn) / Position-Hold Status (Pm)
*0=surveyed, 1=User-entered

The remainder of the information is the running position average, including all fixes since the beginning of the Auto Survey cycle. Gives latitude and longitude in degrees, minutes and seconds. Indicates E, W, N, and S respectively as East or West longitude and North or South latitude, and H indicating elevation in meters WGS–84 (World Geodetic Survey, 1984).

System Status

Command: **SS**
SS returns the instrument operation status whenever the status changes. See Table 10.5 for bit assignments of clock conditions.

Response: I=nn:nn X=nn:nn ↵

Format: I = internal clock conditions
X = external clock conditions
nn:nn = hexadecimal representations of the status byte.

The two digits preceding the colon describe present condition of the instrument.
The two digits after the colon indicate the parameters that have changed.

Time Quality

Command: **TQ**
TQ returns a single ASCII character (0, 4–9, A, B, F) indicating estimated worst-case time quality, which follows the IEEE Standard, P1344. Table 10.7 gives the returned value and error category.

Response: h ↵

Value, h	Time Error	Value, h	Time Error
0	Locked, max. Accuracy	8	Unlocked, accuracy < 10 ms
4	Unlocked, < 1 us	9	Unlocked, < 100 ms
5	Unlocked, < 10 us	A	Unlocked, < 1 s
6	Unlocked, < 100 us	B	Unlocked, < 10 s
7	Unlocked, < 1 ms	F	Clock failure

Table 10.7: Unlocked Time Quality

10.2.6 Local / Daylight Saving Time Setup Commands

Return Daylight Saving/Summer Time Settings

Command: **0DT**
0DT returns the current Daylight Saving / Summer Time settings to the connected RS-232 port (Modes: OFF, ON, or AUTO).

Response: Mode :AUTO ↵
START :02:00 Second SUN of MAR ↵
STOP :02:00 First SUN of NOV ↵

Set Daylight Saving/Summer Time Mode

Command: **1,mDT**
1,mDT activates the Daylight Saving mode, where m = 0, 1, 2, with 0 = OFF, 1 = ON, and 2 = AUTO. When OFF this time adjust feature does not add the specified offset to local time display and output. With m = 1 (ON), the Daylight Saving / Summertime feature is always on. With m = 2, the Daylight Saving / Summertime feature will automatically change at the specified dates

and times. To complete the Daylight Saving / Summer Time setup, you must also use the "Set Daylight Saving Auto Start" and "Stop" commands that follow below.

Response: ↵

Set Daylight Saving/Summer Auto Start Time

Command: **2,w,x,y,zDT**
2,w,x,y,zDT sets the starting (Start) date and time for Daylight Saving / Summer Time AUTO setting.

Where: w = Month (0 through 11), with 0 = Jan, 1 = Feb, ... 11 = Dec.
x = WeekOfMonth (0 through 5), with 0 = First, 1 = Second, 2 = Third, 3 = Last, 4 = Second from Last, and 5 = Third from Last.
y = DayOfWeek (0 through 6), with 0 = Sun, 1 = Mon, . . . , 6 = Sat.
z = Minutes after midnight z (0 through 1440).

Response: ↵

Set Daylight Saving/Summer Auto Stop Time

Command: **3,w,x,y,zDT**
3,w,x,y,zDT sets the ending (Stop) date and time for Daylight Saving / Summer Time AUTO setting.

Where: w = Month (0 through 11), with 0 = Jan, 1 = Feb, . . . , 11 = Dec.
x = WeekOfMonth (0 through 5), with 0 = First, 1 = Second, 2 = Third, 3 = Last, 4 = Second from Last, and 5 = Third from Last.
y = DayOfWeek (0 through 6), with 0 = Sun, 1 = Mon, . . . , 6 = Sat.
z = Minutes after midnight z (0 through 1440).

Response: ↵

Local Offset Command

Command: **±hh:[mm]L**
±hh:[mm]L sets the local offset in hours and fifteen-minute increments from -12:00 to +12:00, where hh and mm equals the number of hours and minutes, positive (East) or negative (West).

Response: ↵

10.2.7 Front Panel Control Commands

Disable Control Panel

Command: **FB**
FB disables all control–panel keys and blanks the front panel display – Models 1092B and 1093B/C only.

Response: ↵

Enable Control Panel

Command: **FE**
FE enables all control–panel keys and activates the front panel display – Models 1092B and 1093B/C only.

Response: ↵

Lock Setup Keys

Command: **FL**
FL disables setup control keys and activates the front panel display – Models 1092B and 1093B/C only.

Response: ↵

Set Backlight – OFF

Command: **L0**
L0 disables the backlight operation – Models 1092B and 1093B/C only, with Option 01 installed.

Response: ↵

Set Backlight – ON

Command: **L1**
L1 selects the continuous backlight operation – Models 1092B and 1093B/C only, with Option 01 installed.

Response: ↵

Set Backlight – AUTO

Command: **L2**
L2 enables the automatic backlight operation – Models 1092B and 1093B/C only, with Option 01 installed. It keeps the backlight active for 30 seconds after any key is pressed.

Response: ↵

10.2.8 IRIG-B Data Output Commands

IRIG Data IEEE 1344

Command: **In**
In activates (n=1) or deactivates (n=0) the IEEE 1344 extension, which uses IRIG-B control bits for additional information. Information includes the two-digit year, local offset, time quality and notification of pending non-sequence events such as leap seconds and daylight saving time changeovers.

Response: ↵

IRIG Data – Local

Command: **IL**
IL configures all IRIG time data outputs to local time code reference.

Response: ↵

IRIG Data – UTC

Command: **IU**
IU configures all IRIG time data outputs to UTC time code reference.

Response: ↵

10.2.9 Position Data Commands

Return Elevation

Command: **LH**
LH returns the current antenna elevation. In Position Hold mode, LH returns the current position-hold elevation setting. In Fix mode, LH returns the most recent computed elevation value (calculated each second). Elevation is referenced to the WGS-84 datum.

Response: nnnnn.nn↵ (from -1000.00 to +18000.00 meters WGS-84)

Format: n = -1000.00 to +18000.00 meters.

Return Latitude

Command: **LA**
LA returns the current antenna latitude. In Position Hold mode, LA returns the current position-hold latitude setting. In Fix mode, LA returns the most recent computed latitude value (calculated each second).

Response: Ndd:mm:ss.sss↵

Format: N = North (S for South), dd = degrees, mm = minutes, ss.sss = seconds

Return Longitude

Command: **LO**
LO returns the current antenna longitude. In Position Hold mode, LO returns the current position-hold longitude setting. In Fix mode, LO returns the most recent computed longitude value (calculated each second).

Response: Wddd:mm:ss.sss↵

Format: W = West (E for East), ddd = degrees, mm = minutes, ss.sss = seconds

Position–Hold – OFF

Command: **PH0**
PH0 deactivates the Position–Hold timing mode. The receiver resumes computing time and position solutions approximately each second. This is referred to as the Fix mode.

Response: ↵

Position–Hold – ON

Command: **PH1**
PH1 activates the Position–Hold timing mode. In this mode, the receiver position is held fixed and each channel is used to compute a timing solution. These solutions are averaged together, resulting in reduced timing noise due to to Selective Availability and RF channel noise. To operate properly, the position used by the receiver must be fairly accurate. Due to the risk that previously stored position data may be inaccurate, exercise caution when activating the Position–Hold mode without either performing an Auto Survey or getting the position directly. Failure to observe these precautions may result in serious timing errors.

Set Position Hold – Elevation

Command: **MMMMM.mmH**
Sets the antenna elevation in meters MSL (mean sea level); fractional meters of elevation are optional. Position Hold must be enabled to set position.

Format: M = meters; m = fractional meters

Response: ↵

Set Position Hold – Latitude

Command: **dd:mm:ss.sssN(S)**
Sets the antenna latitude in degrees, minutes and seconds, North (N) or South (S). Position Hold must be enabled to set position.

Format: dd = degrees; mm = minutes; ss.sss = seconds and fractional seconds

Response: ↵

Set Position Hold – Longitude

Command: **ddd:mm:ss.sssE(W)**
Sets the antenna longitude in degrees, minutes and seconds, East (E) or West (W). Position Hold must be enabled to set position.

Format: ddd = degrees; mm = minutes; ss.sss = seconds and fractional seconds

Response: ↵

10.2.10 Survey Mode Commands

Auto Survey Mode Selection

Command: **m:nQ**
m:nQ sets the mode (m) and number of fixes to average (n). Used to automatically determine position data for Position–Hold. Requires Position–Hold mode to be ON to start the survey. See conditions in Table 10.8. Use the SQ command during a survey to obtain the survey status. Activate the Position–Hold mode with the PH1 command.

Response: ↵

m	Condition	n	Condition
0	Survey Off	0	single position fix
1	Initiate single auto survey	1	60 fixes (1 minute)
2	Perform auto survey at power on	2	300 fixes (5 minutes)
3	Temporarily suspend auto survey	3	900 fixes (15 minutes)
4	Resume suspended auto survey	4	1800 fixes (30 minutes)
–	–	5	3600 fixes (1 hour)
–	–	6	7200 fixes (2 hours)
–	–	7	14400 fixes (4 hours)
–	–	8	28800 fixes (8 hours)
–	–	9	43200 fixes (12 hours)
–	–	10	86400 fixes (24 hours)

Table 10.8: Auto Survey Setup Conditions

10.2.11 Date and Time Commands

Set Receiver Time

Command: **yyyy:mm:dd:hh:mmTS**
TS sets the receiver to UTC time *only when not locked to the GPS*. The command is ignored when locked to satellites. When the receiver is initially activated, and has not locked onto satellites, acquisition time may be improved by giving the clock an initial estimate of UTC time, which it can use (with stored position and almanac data) to determine which satellites and Doppler shifts to use in acquisition.

Response: ↵

Format: yyyy = year, mm = month, dd = day, hh = hour, mm = minute

Return Local Date, Return UTC Date

Command: **DL, DU**
DL returns the current date, in the Local time zone. DU returns the current date, in the UTC time zone.

Response: ddmmmyyyy ↵

Return Local Time, Return UTC Time

Command: **TL, TU**

TL returns the current Local time. TU returns current UTC time.

Response: ddd:hh:mm:ss ↵

NOTE: The DL, DU, TL and TU command formats are identified as follows: yyyy = year, hh = hour, mmm = month (JAN - DEC), mm = minute, dd = day of month, ss = second, ddd = day of year.

10.2.12 Programmable Pulse Output Commands

Pulse Width, Seconds-Per-Pulse

Command: **nnn.nnPW**
nnn.nnPW configures the Programmable Pulse output pulse width in seconds (rear panel connector).

Response: ↵
Format: nnn.nn (0.01 to 600 seconds in 10-millisecond increments).
For values greater than 1, use a decimal point and enter trailing zeros as applicable.
Examples:

1 = 0.01 second
10 = 0.10 second
1.00 = 1 second
100 = 1 second

Seconds Per Pulse / Pulse Per Hour

Command: **m,nPS**
m,nPS configures the programmable pulse as "Seconds per Pulse" or "Pulse Per Hour" mode as follows:

Response: ↵
Format: m = 0, seconds–per–pulse mode
m = 1, pulse–per–hour mode
n = 1 – 60000 seconds if seconds–per–pulse mode
n = 0 – 3599 seconds offset from hour if pulse–per–hour mode

For the Seconds–Per–Pulse mode, the first pulse will be on time at the top of the minute. If n is divisible by 60, the first pulse will be on time at the top of the hour.

For the Pulse–Per–Hour mode, the pulse will be on time at the second after the hour described by n. For example, 1,1200ps would cause a pulse at exactly 20 minutes after the hour.

If only one number is present then the number sets the seconds as in seconds–per–pulse mode.

Set Alarm Time Mark

Command: **ddd:hh:mm:ss(.ss)OU(OL)**
OU sets the time at which the clock issues the programmable pulse, in the UTC timezone. OL sets the time at which the clock issues the programmable pulse, in the Local timezone. If ddd is set to 0, the pulse will repeat daily at the specified time. If ddd is set from 001 to 366, the output pulse will be generated at the next occurrence of the specified time and date.

Response: ↵
Format: ddd = day of year (1 through 366)
hh = hour (0 through 23)
mm = minute (0 through 59)
ss = second (0 through 59)
(.ss) = fractional seconds in 0.01 increments (00 through 99)
OU = UTC time (OL for Local time)

Set Pulse Output to Slow Code

Command: **nCM**
nCM configures the pulse output to slow code. Slow Code pulse output is held high and goes low for six seconds on the day, four seconds on the hour and two seconds on the minute.

Response: ↵

Format: n = 0, Slow Code off
n = 1, UTC Slow Code
n = 2, Local Slow Code

Set Pulse Polarity

Command: **nPP**
nPP sets the programmable pulse output polarity (i.e. TTL/CMOS high or low), where n = 0 sets pulse polarity to positive, and n = 1 sets the pulse polarity to negative. Positive means that the output voltage is held low until the beginning of the pulse period, at which time it goes high. Negative means that the output voltage is held high until the beginning of the pulse period, at which time it goes low.

Response: ↵

10.2.13 Antenna System Delay Commands

Set Antenna Delay

Command: **nnnnnnDA**
nnnnnnDA sets antenna system delay compensation value. NOTE: Factory default setting for the standard 15-meter (50-foot) cable is 60 ns. Time range is from 0 to 999999 nanoseconds. The exact syntax for a 60-ns delay is 60DA. See Section 4.4.1 for information on calculating cable delay.

Response: ↵

10.2.14 Out-of-Lock Commands

Set Out-of-Lock Time

Command: **(-)nnK**
(-)nnK configures the amount of delay time (in minutes) following loss of satellite synchronization before an out–of–lock signal is generated and output via rear panel connector (if Option 93 is installed). A negative number turns the out-of-lock function OFF. n = 0 sets the out-of-lock time to zero delay. n = 1 to 99 sets the amount of delay time (in minutes).

Response: ↩

10.2.15 Miscellaneous Commands

Return Firmware Version

Command: **V**
V returns the firmware version date of the installed ROM.

Response: dd mmm yyyy ↩

Return Display Buffer

Command: **Z**
Z returns the contents of Display Buffer.

Response: Echoes current display (40 characters); no line wrap. For display contents, see Chapter 6, Startup and Basic Operation.

Set Option Control

Command: **m,n,k,lXI**
m,n,k,lXI configures the specified option in the clock, where m = 0 for the main board and m = 1 for the auxiliary board.
Where:

m = 0 for Main board option, and m = 1 for Aux board option.
n = option number (see Table 10.9 below)
k = security key; 1092 or 1093
l = *use only if n specifies Option 28.* l = 0 for 60 Hz and l = 1 for 50 Hz.

Response: ↩

Main Board Option, m=0	none	19	–	–	–	–	–	–	–	–
Aux Board Option, m=1	none	03	20A	27	28	29	32	33	34	35
Option Number, n=	0	1	2	3	4	5	6	7	8	9

Table 10.9: Option Control Settings

Option Control Examples

The following two examples show the commands to set up the specific options in a clock using the serial port instead of the front panel.

Example 1 – Model 1093A, Main board Opt. 19, Aux board Opt. 28

0,1,1093XI
1,4,1093,0XI

Note: the 0 before XI in the last command sets the Option 28 frequency to 60 Hz.

Example 2 – Model 1093A, Main board Opt. none, Aux board Opt. 34

0,0,1093XI
1,8,1093XI

Return IP/MAC Address – Development

Command: **IP**
IP returns the IP and MAC addresses of both ports of the Option 34. Dashes are used to show either an unassigned or unconnected port IP address.

Response:

```
NET1:  192.168.000.232 64:73:E2:00:00:23
NET2:  ---.---.---.--- 64:73:E2:00:00:24
```

10.3 Communication Port Information

Table 10.10 gives a list of functions and associated pins for both the RS-232 and RS-485 ports.

Pin No.	Function	Pin No.	Function
1	Not Connected	6	RS-232 Input
2	RS-232, Rx Data	7	Not Connected
3	RS-232, Tx Data	8	RS-422/485, Tx-A
4	RS-232 Output/Prog Pulse	9	RS-422/485, Tx-B
5	Ground	–	–

Table 10.10: Main RS-232 Port Pin Definitions

NOTE: pins 6 – 9 are not connected on the optional RS-232 port.

Appendix A

Technical Specifications and Operating Parameters

A.1 Scope

In this section you will find information relating to the functional and operational characteristics of the standard Model 1092A/B/C and 1093A/B/C Satellite Controlled Clocks. Topics included in this section are Receiver Characteristics, I/O Configuration, System Interface(s), Antenna System, Operator Interface(s), and Physical Specifications.

NOTE: Specifications are subject to change without notice.

A.2 Receiver Characteristics

A.2.1 Input Signal

- GPS L1 C/A code, 1575.42 MHz.

A.2.2 Timing Accuracy

GPS/UTC time ± 500 ηs rms (at 1-PPS output), when receiving 4 or more satellites (one satellite if position is known within 25 meters.)

A.2.3 Position Accuracy (rms)

- 25 meters, SA (USA Department of Defense Selective Availability) OFF, 100 meters, SA ON.

A.2.4 Satellite Tracking

- 12 channels, C/A code (1575.42 MHz)

The receiver simultaneously tracks up to twelve satellites. Results from all tracked satellites are averaged in Position-Hold Mode or, with Position-Hold Off, are determined by least-squares estimation.

A.2.5 Acquisition

- 150 seconds typical, cold start
- 15 minutes, 90% confidence, cold start
- 40 seconds, with almanac less than one month old
- 15 seconds, with ephemeris less than 4 hours old

A.3 I/O Configuration

Any output signal, or the designated input, may be selected on specified connector by means of internal push-on jumpers or special wiring. Each output connector is independently buffered.

A.3.1 I/O Connectors – Main Board

I/O connectors may be configured to any one of the output signals or a specific input function as listed below:

- One as IRIG-B unmodulated or Programmable Pulse
- One as 1 PPS or Programmable Pulse
- One as IRIG-B, Modulated with Option 92
- One as Event Input with special wiring and JMP7 set. Can use IRIG-B modulated connector if unused, or Option 95 with Model 1093A/B/C if Option board slot not used.
- RS-232 port(s) (standard or second), Auxiliary output at pin 4, Programmable Pulse output or Event A input. Secondary RS-232 port available with Option 19.

A.3.2 Standard Output Signals

- IRIG-B: 1 kHz modulated (main board requires Option 92).
- IRIG-B: 5 V CMOS level-shift (unmodulated), 10-Ohm source impedance; ±75-mA drive.
- 1 PPS: 5 V CMOS, 10-Ohm source impedance; ±75-mA drive.
- IRIG-B, Modified Manchester: 5 V CMOS level-shift (unmodulated), 10-Ohm source impedance; ±75-mA drive

A.3.3 Option 03, Four Additional Configurable Outputs

- IRIG-B: 1 kHz modulated, 10 Vpp (Option 9.
- IRIG-B: 5 V CMOS level-shift (unmodulated).
- 1 PPS: 5 V CMOS.
- Out of Lock: 5 V CMOS (HI = Locked, LO = Unlocked).
- Programmable Pulse, user-selectable: 5 V CMOS.
- CMOS outputs are buffer type (74HC126) with 10-Ohm source resistors.

A.3.4 Input Functions

- Event A or 1 PPS Deviation: 5 V TTL/CMOS.

A.3.5 Event Input, Option 98 – Main Board

- This input has a 100-ns timing resolution, and may be configured to record up to 400 sequential events, provided that the events are separated by at least 11 ms. The event log may be read later from the front panel or RS-232 interface. A command is also provided to clear the event log. Event data is stored in battery-backed RAM.
- The Event A input may also be configured to accept an external 1-PPS signal, and measure the deviation from a 1-PPS GPS signal with 100-ns resolution.

A.3.6 Synchronization

- For a received data message, the leading edge of the start bit may be selected to trigger the Event-A input, providing synchronization with 100-ns resolution.

A.4 System Interface

A.4.1 RS-232C Port

For a list of serial port pins and assigned functions, see Table 10.10.

- Connector: 9-pin D-type subminiature:
- RS-422/485 (Option 94): Transmit only.
- Communication Parameters – Selectable 1,200-19,200 baud; 7 or 8 data bits, 1 or 2 stop bits, odd/even/no parity.
- Supports all keyboard functions.

A.4.2 Broadcast Data Formats

For detailed information on all broadcast formats, please see Section 10.2.3.

A.5 Antenna System

The included antenna is directly mounted on a 26-mm pole (1.05-in. OD or 3/4-in. ID pipe), with either a standard 1-in. – 14 (approximately M25.4 x 1.81) marine-mount thread or a 3/4-in. NPT pipe thread. Other mounting configurations are available (contact Arbiter Systems).

- GPS Antenna Assembly, 3/4" Pipe Thread Mount, 35 dB gain; Operates on 5 VDC.
- Optional Antenna Mounting Bracket available to mount on 60-mm (2-in. nominal) pipe (P/N AS0044600, see section 4.1.2).

A.5.1 Antenna Cable

- 15-meter (50-foot) cable included with antenna.
- Other cable styles and lengths available see Table 4.2 under Available Antenna Cables and Accessories for Longer Runs.

A.6 Operator Interface

A.6.1 Setup Methods

- Via RS-232C Interface
- 8 Front-panel keys (Models 1092B and 1093B/C)

A.6.2 Setup Functions

Initial Position	System Delays	Position Hold
RS-232 Parameters	Programmable Pulse	Option Control
Local Hour	IRIG Time Data	–
Out-of-Lock Indication	Event/Deviation	–
Backlight	Auto Survey	–

Table A.1: Setup Functions Listed

A.6.3 Display

- 2-line by 20-character supertwist LCD
- Backlight available (Option 01)
- Model 1092C and 1093C include a large LED time display

A.6.4 Display Functions

- Time: UTC or Local
- 1 PPS (input) Deviation
- Position: Latitude, Longitude and Elevation
- Event Time
- Status: Clock, Receiver, DCXO & EEPROM
- Configuration (1092B and 1093B/C)

A.6.5 Annunciators

- Operate (Green)
- Unlocked (Red)

Model 1093A/B/C:	430-mm W x 44-mm H x 280-mm D (16.9-in. x 1.7-in. x 11.0-in.)
Model 1092A/B/C:	218-mm W x 44-mm H x 260-mm D (8.6-in. x 1.7-in. x 10.5-in)
Antenna:	77-mm diameter x 66-mm height (3.05-in. x 2.61-in.)

Table A.2: Clock and Antenna Dimensions

Model 1092A/B/C	**Model 1093A/B/C**
1.4 kg (3.0 lbs.) net. (Instrument)	1.9 kg (4.3 lbs.) net. (Instrument)
2.0 kg (4.4 lbs.) net. (Antenna and Cable)	2.0 kg (4.4 lbs.) net. (Antenna and Cable)
4.5 kg (10 lbs.) includes antenna, cables and accessories (Shipping)	5.5 kg (12 lbs.) includes antenna, cables, and accessories. (Shipping)

Table A.3: Clock and Shipping Weights

A.7 Physical Specifications

A.7.1 Dimensions

A.7.2 Weight

A.8 Temperature and Humidity

A.9 Power Requirements

Model 1092A/B/C The Model 1092A/B/C comes standard with an external 120 VAC to 9 VDC wall-mount transformer that connects to the rear panel. It will also operate from a battery source from 8 to 15 VDC at 500-mA. Additionally, the antenna receives power through the antenna cable connected to the Type F antenna connector on the rear panel of the Model 1092A/B/C.

Model 1093A/B/C The Model 1093A/B/C comes with one of three user-specified internal power supplies. Additionally, the antenna receives power through the antenna cable connected to the Type F connector on the rear panel of the Model 1093A/B/C.

- Option 07: 85 - 264 VAC, 47 - 440 Hz, or 110 - 350 VDC, $<$ 20 W typical (Standard power supply).
- Option 08: 10 - 60 VDC (DC only), $<$ 20 W typical. Uses a three-position terminal strip in place of the IEC-320 power inlet module; includes Surge-Withstand Capability.
- Option 10: 110 - 350 VDC, $<$ 20 VA or 85 - 264 VAC, 47 - 440 Hz, with three-position Terminal Power Strip and Surge-Withstand Capability.

A.9.1 Power Connector (Model 1093A/B/C)

- Option 7, Standard Power Supply: This includes a fused IEC-320 power inlet module with mating ac cord. Plug type specified as Options P1 through P10 (see Section 3.1.1).
- Options 08 and 10: Using a 3-pole terminal strip power inlet with Surge-Withstand Capability (see Section 3.2 and 3.3).

Temperature	**Operating**	**Storage**
Instrument	0 to 50°C	-40 to 75°C
Antenna	-40 to 85°C	-55 to 100°C
Antenna Cable	-40 to 75°C	-40 to 80°C
Humidity	10 to 90% non-condensing	10 to 90% non-condensing

Table A.4: Temperature and Humidity List

A.9.2 Electro-Magnetic Interference (EMI)

- Conducted Emissions: power supply (Options 07 and 08) complies with FCC 20780, Class A and VDE 0871/6.78, Class A
- Surge Withstand Capability (SWC), power inlet (Options 08 and 10) designed to meet ANSI/IEEE C37.90-1 and IEC 801-4.

Appendix B

Using a Surge Arrester

B.1 Introduction

These instructions cover the installation of the Arbiter Systems Model AS0094500, Surge Arrester, as illustrated in Figure B.1. The AS0094500 performs two basic functions:

1. Provides a solid and reliable grounding point for the antenna system connected to a GPS receiver;
2. Protects connected equipment from the damaging effects of atmospheric static electricity and induced voltage spikes from nearby lightning strikes or other electrical events.

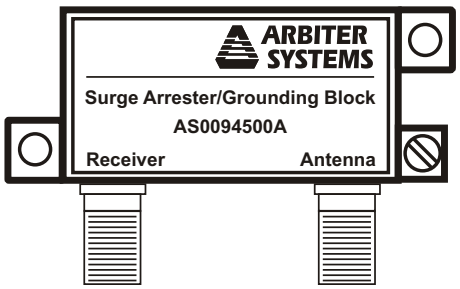


Figure B.1: GPS Surge Arrester

B.2 Description

The AS0094500 is a three-terminal device with two type F connectors and one ground terminal. One of the F connectors connects to the GPS antenna and the other F connector to the GPS receiver in the clock. A screw terminal provides a point to connect an earth ground wire. Being weatherproof, the AS0094500 can be mounted outdoors provided that the cabling and Type F connectors are sealed from the weather. The device will also pass the DC current necessary to energize the GPS antenna.

B.3 Installation

B.3.1 Mounting Location

Location is a key consideration when installing the Model AS0094500. Mount as close as possible to a good earth ground, such as a grounding rod or station ground grid. The shorter the path between the arrester and the earth ground, the more effectively and reliably it will bypass the induced voltages.

B.3.2 Ground Connection

The Model AS0094500 can be grounded in two ways: (1) via the ground-wire screw connection, or (2) by hard-mounting directly to a grounded metal surface.

If grounding via the ground-wire screw connection, use the largest possible gauge wire, with the shortest possible ground path. Hole diameter allows up to 8 AWG wire (0.129 in or 3.26 mm). This wire should be as short as possible, and connected to a good earth ground.

Alternately, the AS0094500 could be mounted directly to a well-grounded plate within the facility.

B.3.3 Antenna and Clock Connections

The AS0094500 is labeled to indicate which terminals should be connected to the GPS receiver and to the GPS antenna. Use only a low-loss, tri-shield or quad-shield 75-ohm coaxial cable – RG-6 or RG-11 are the preferred cable types. RG-59, or other similar types of coaxial cable, should be avoided due to greater signal loss and poorer shielding at the GPS frequency (1.575 GHz).

B.3.4 Weather Sealing the Connections

To protect from weather, use only type F connectors with appropriate sealing features. Typically this includes an o-ring in the male connector that seats against the face of the female connector on the surge arrester. Also, crimped connectors frequently include a silicone gel flooding compound, which enhances the ability of the connection to withstand the rain and humid conditions. To better seal the entire connection, cover the joint with GE Silicone II compound.

Use the proper crimping tool if using crimp-on connectors. Improper tools may not guarantee a strong and sufficiently grounded connector resulting in poor cable performance and GPS reception. Consider purchasing RF cables of various standard and custom lengths manufactured by Arbiter Systems.

B.3.5 Suggested Mounting

Figure B.2 illustrates the recommended mounting of the AS0094500 with the F-connectors facing downward. Install drip loops in the cables to reduce the likelihood of moisture penetrating the device.

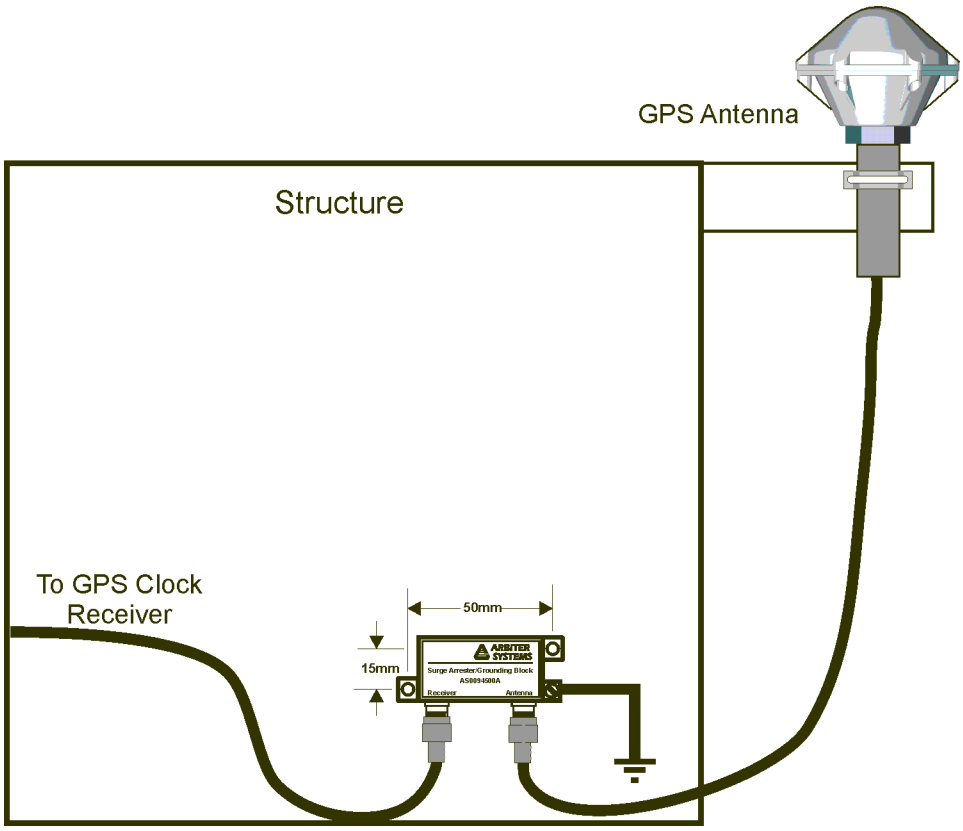


Figure B.2: Suggested Mounting of the AS0094500 Surge Arrester

B.4 Physical Dimensions

Overall:	59mm x 38mm x 18mm (2.32in x 1.49in x 0.71in) LxWxH
Mounting Hole Dim:	50mm x 15mm
Mounting Hole Dia:	4mm (0.157in)
F Connector Dim:	24mm, center to center
Weight:	48.2 g (1.7 oz)

Appendix C

Options List

C.1 Introduction

Each Arbiter Model 1092A/B/C and 1093A/B/C Satellite-Controlled Clock has a number of standard options that may be installed for special purposes. This section is devoted to these options, and provides supplemental and detailed information for operation and configuration of these options. While many of these options apply to other clock models than the Model 1092A/B/C and 1093A/B/C, references to these models will be found throughout this document.

Additionally, there will be references to certain capabilities and specifications that apply only to specific clock models when using these options. For example, with Option 03, there will be a large list of possible signals that can be selected with the option board jumpers. Many of these signals do not apply to the Model 1092A/B/C and 1093A/B/C series clocks because the signals do not originate on the main clock board. The key to usage is to check the basic specification of the clock to determine the option capability.

C.2 Option 01: Backlighted LCD Display

C.2.1 General Description – 1092B & 1093B/C Only

Option 01 for the Arbiter System line of Satellite-Controlled Clocks adds illumination to the front panel display, if so equipped. The standard reflective liquid crystal display (LCD) is replaced with a transflective LCD. An Electro-luminescent (EL) panel located behind the transflective LCD provides backlighting; thereby increasing the readability of the display in subdued lighting conditions. The backlight can be set to remain on indefinitely, or to turn off after a predetermined time following the last keystroke. With the backlight turned off, the display is still readable in ordinary ambient light.

C.2.2 Specifications

- **Initial Luminance:** 30 cd/m^2 minimum
- **Service Life:** 4000 hours (down to 10 cd/m^2)

C.2.3 Configuration

The SETUP menu outlined in the Operation Manual contains a sub-menu, which allows selection of the backlight-operating mode. To set the backlight-operating mode, observe the following steps:

1. With the clock power turned on, press the SETUP key. The display should change to read, "SET MAIN RS-232?".

2. Press the SETUP key repeatedly, until the display reads, "SET BACK LIGHT?". Press the ENTER key to select the backlight sub-menu. The current backlight operating mode will be displayed, from one of the following selections:

   - OFF – Backlight never on.
   - ON – Backlight always on.
   - AUTO – Backlight turns on when a key is pressed, remains on for 30 seconds after the last key is pressed. This is the preferred mode for applications requiring a lighted display, since it will provide the longest EL panel lifespan (see Specifications, above).

3. Pressing the UP and DOWN keys will change the selection. When the desired operating mode is displayed, press the ENTER key to confirm the choice and return to the first level of the SETUP menu.

The backlight operating mode can also be changed via the RS-232C port, using the L0, L1, or L2 commands for OFF, ON, and AUTO, respectively. For details regarding this and other capabilities of the RS-232C port, refer to the Operation Manual, Appendix A.

C.3 Option 02: GPS Battery Backup - *Obsolete*

NOTE: This option has become obsolete because the new GPS receivers incorporate a lithium dioxide data backup battery. See the Model 1092/1093 Operation Manual for further information.

C.3.1 General Description

Option 02 incorporates a nickel-cadmium battery to back up memory circuits, which store data pertaining to GPS system parameters. Circuitry within the clock maintains the charge level of the battery during normal operation, and the battery preserves the data during power outages or when the clock is turned off.

The GPS backup battery supports the following functions and parameters:

Function: Ephemeris Data.

Description: Information pertaining to satellite position or projected position, as a function of time.

Storing the above information will reduce the time needed to re-acquire satellite lock when the unit is turned on, or upon restoration of power after an outage.

NOTES:

1. There is no relationship between the GPS backup battery and the RAM backup battery included in a standard Model 1088A/B clock. The purpose of the standard RAM backup battery is to preserve the configuration settings for the instrument.

2. The standard Models 1083A, 1084A/B/C and 1093A/B/C clocks do not contain a RAM backup battery because an EEPROM has replaced the RAM.

C.3.2 Specifications

Nickel-Cadmium, 3.6 volts, 60 mAh, Memory Retention Time: 2 months (approximate)

C.4 Option 03: Four Additional Outputs – *Obsoleted by Opt36*

C.4.1 General Description

Option 03 adds four rear-panel outputs, which may be configured to an available signals in the 1092A/B/C or 1093A/B/C series clocks. Note that there are many more jumper settings on the Option 03 board than the 1092A/B/C or 1093A/B/C is capable of providing. The configuration of the four outputs can be changed at any time via internal jumper settings.

C.4.2 Specifications

General

Output Connectors: BNC-type RF connectors (4).

Analog Outputs

Output Type	Operational amplifier (LF353) output, with 557-ohm series resistor.
Available Outputs:	Note: All outputs available on clock Models 1088B, 1084A/B/C, 1093A/B/C and other clocks as noted.
IRIG-B, Modulated:	IRIG format B time code, modulated onto 1 kHz 10 Vpp sine wave carrier. Available on clock Model 1093A/B/C when equipped with Option 92, IRIG-B Modulated Output.
Deviation:	±5 volts analog, corresponding to 1-PPS deviation channel A or B (see individual clock Operation Manual). The proportion is 1 V per 10-μs deviation (±50 μs full scale). Model 1088A/B only.

C.4.3 Digital Outputs

Output Type:	High-Speed CMOS (74HC126), 0 to 5 volts, with 47 ohm series resistance.
Available Outputs:	Model 1093A/B/C output signals include unmodulated IRIG-B, 1 PPS, Programmable Pulse, Out-of-Lock.
IRIG-B:	IRIG format B time code (unmodulated). *Also available on clock Models 1088B, 1084A/B/C and 1093A/B/C.*

Changing Output Settings via Internal Settings

Case Removal

To change the configuration of Option 03, the top cover of the instrument must be removed. Turn off the instrument, and disconnect the power cord. Using a T-25 Torx driver, remove the four screws holding the cover (and rack mount ears, if used) in place, and lift the cover off.

WARNING Do not remove the top cover while power is applied. Hazardous voltages are present while the power cord is connected. Always disconnect the unit from the input power source before removal of the top cover.

General Information

Option 03 incorporates an extremely flexible output selection system using jumpers on the Option 03 printed circuit board. Each of the four rear-panel BNC-type I/O connectors, included with Option 03, can be configured to perform any of the available output functions. Figure C.1 shows the locations and functions for all of the jumpers on the Option 03 board.

Function Selection

Jumpers JMP3 through JMP10 determine which output function their respective I/O connectors perform. The dotted lines in Figure C.1 show the relationships between the jumper strips and the connectors. Set the jumper for each connector to the appropriate location for the type of output signal desired. Jumpers JMP4, 6, 8 and 10 refer to Output Function selections 1 and 2. Jumpers JMP3, 5, 7, and 9 refer to Output Function selections 3 through 22. The signals available are listed in the text to the left of the jumpers in Figure C.1.

Mode Selection

In addition to specifying the output signal type for each individual connector, it is necessary to define whether the signal is analog or digital. This is accomplished using jumpers JMP11, JMP12, JMP14, and JMP15. Each of these jumpers corresponds to the output function jumper for one of the output connectors; the relationships are illustrated by the dotted lines in Figure C.1. Table C.1 shows the Function and Mode jumper settings for all of the various output signal types. Only the Modulated IRIG-B and Deviation outputs are analog; all others are digital.

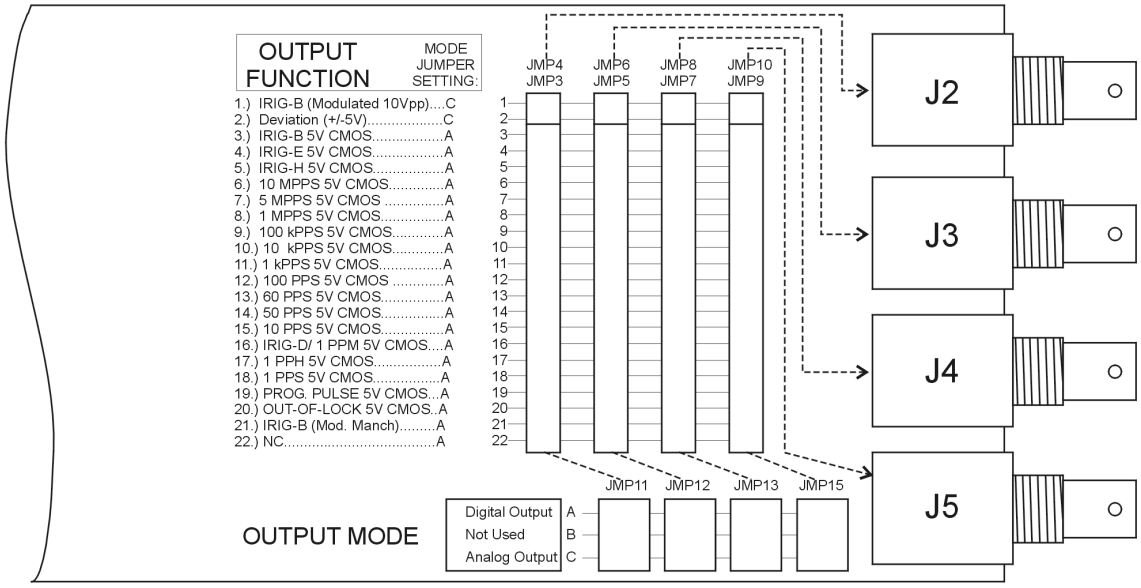


Figure C.1: Option 03 Jumper Configuration

Signal	Description
IRIG-E:	IRIG format E time code.
IRIG-H:	IRIG format H time code.
10 MPPS:	10,000,000 pulse-per-second (PPS) square wave, synchronous to the 1-PPS output.
5 MPPS:	5,000,000-PPS square wave, synchronous to the 1-PPS output.
1 MPPS:	1,000,000-PPS square wave, synchronous to the 1-PPS output.
100 kPPS:	100,000-PPS square wave, synchronous to the 1-PPS output.
10 kPPS:	10,000-PPS square wave, synchronous to the 1-PPS output.
1 kPPS:	1,000-PPS square wave, synchronous to the 1-PPS output.
100 PPS:	100-PPS square wave, synchronous to the 1-PPS output.
60 PPS:	60-PPS square wave, synchronous to the 1-PPS output.
50 PPS:	50-PPS square wave, synchronous to the 1-PPS output.
10 PPS:	10-PPS square wave, synchronous to the 1-PPS output.
IRIG-D/1 PPM:	IRIG format D time code (1 pulse per minute), rising edge on time.
1 PPH:	1 pulse per hour, rising edge on time.
1 PPS:	(10 ms HI), synchronous to 1 PPS/GPS. *Also available on clock Models 1084A/B/C and 1088B.*
Programmable:	Outputs a single pulse at a preprogrammed time, or a continuous pulse train having a period of one day or less. Pulse width is adjustable from 0.01 to 600 seconds. *Also available on clock Model 1093A/B/C.*
Out-of-Lock:	Normally HI after acquisition of satellite signals. Toggles LO nn minutes after loss of satellite signal lock. Range for nn is 00 to 99 minutes, and is set using the SETUP menu or RS-232C (refer to clock Operation Manual). Setting of 00 disables this function (output remains HI). This output follows the standard Out-of-Lock function on the clock.
IRIG-B (Modified Manchester):	IRIG format B time code, Manchester encoded with 1-kPPS carrier, and data transitions on time mark. Also available on clock Models 1088B and 1084A/B/C.

Table C.1: Option 03 Signal Definitions

Output Signal	**Function Select Jumper**	**Mode Select Jumper**
IRIG-B Modulation	1	C
Deviation	2	C
IRIG-B	3	A
IRIG-E	4	A
IRIG-H	5	A
10 MPPS	6	A
5 MPPS	7	A
1 MPPS	8	A
100 kPPS	9	A
10 kPPS	10	A
1 kPPS	11	A
100 PPS	12	A
60 PPS	13	A
50 PPS	14	A
10 PPS	15	A
IRIG-D/1 PPM	16	A
1 PPM	17	A
1 PPS	18	A
Programmable Pulse	19	A
Out of Lock	20	A
IRIG-B Mod. Manch.	21	A
No Connection	22	A

Table C.2: Output Connector Jumper Settings

C.5 Option 04: ON/OFF Switch

Option 04, ON/OFF switch for Satellite-Controlled clocks, can be mounted in Models 1093A/B only.

NOTE: Model 1093C LED uses the full front panel and Option 04 switch cannot be mounted.

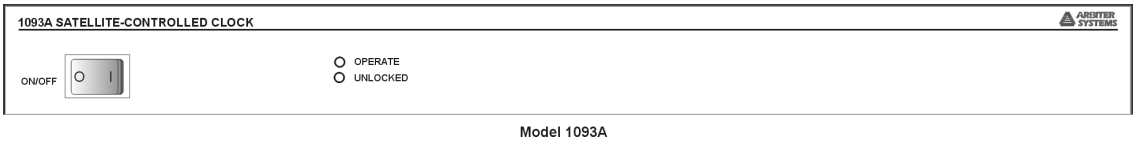


Figure C.2: Model 1093A

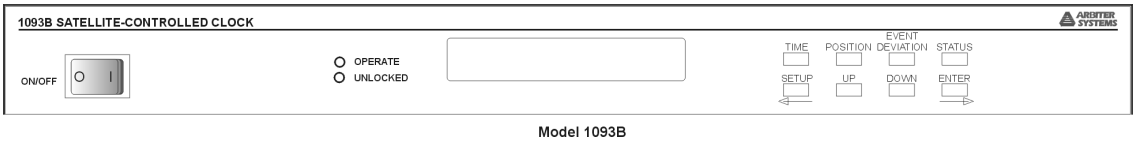


Figure C.3: Model 1093B

C.6 Option 07: Inlet Power Supply Description

C.6.1 85 to 264 VAC, 47 to 440 Hz, 110 to 370 VDC, IEC–320 Connector

Option 07 provides an ac/dc power module, which includes an IEC-320 type inlet and mating ac cord. Input voltages are 85 to 264 VAC, 47 to 440 Hz or 110 to 370 VDC, less than 20 Volt-Amps typical. Various plug styles are available as Options P01 through P10.

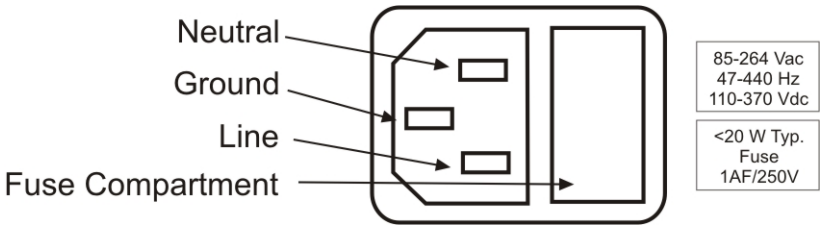


Figure C.4: Option 07 Power Supply Inlet Description

C.6.2 Specifications

Fuse

Type:	Bussman GBD-1A
Current Rating:	1 Ampere, fast-acting
Voltage Rating:	250 Volts
Size:	5 mm x 20 mm

Input Power

AC Voltage Range:	85 to 264 VAC
Frequency Range:	47 to 440 Hz
DC Voltage Range:	110 to 370 VDC
Input Power:	$<$ 20 Watts

C.7 Option 08: Inlet Power Supply Description

C.7.1 10 to 60 VDC ONLY, Terminal Power Strip, SWC

Option 08 replaces the standard IEC-320 power inlet module with a three-position, screw-type terminal block, including Surge Withstand Capability (SWC). With DC ONLY inlet voltages from 10 to 60 VDC, this feature is intended for use in installations where it is necessary or desirable to have the instrument power hard-wired.

WARNING: Do not apply AC voltages to the Option 08 terminals.

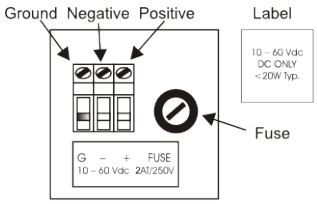


Figure C.5: Option 08 Power Supply Inlet Description

C.7.2 Specifications

Input Power

DC Voltage:	10 to 60 VDC
Input Power:	< 20 Watts, typical

Terminal Strip

Terminal Assignment:	Ground, (−), (+) Left to right, viewed from rear
Block Size:	49 mm W x 15 mm H x 16.5 mm D (1.9” x 0.6” x 0.6”)
Block Material:	Glass-filled thermoplastic
Screw Size:	6–32 x 1/4”
Screw Material:	Cadmium-plated steel
Terminal Spacing:	9 mm (0.35”)
Approvals:	U.L. recognized; C.S.A. approved

Fuse

Type:	Bussman GDC-2A
Current Rating:	2 Ampere, time lag
Voltage Rating:	250 Volts
Size:	5 mm x 20 mm

Surge Withstand Protection (SWC)
Provides input Surge Withstand Capability (SWC) in compliance with both ANSI C37.90 and IEC 801-4.

C.8 Option 10: Inlet Power Supply Description

C.8.1 110 to 350 VDC, 85 to 250 VAC, 47 to 440 Hz Terminal Power Strip, SWC

Option 10 replaces the standard IEC-320 power input module with a three-position, screw-type terminal block, including Surge Withstand Capability (SWC). This feature is intended for use in installations where it is necessary or desirable to have the instrument power hard-wired. See Figure C.6.

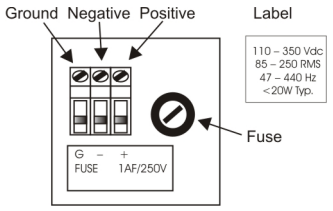


Figure C.6: Option 10 Power Supply Inlet Description

C.8.2 Specifications

Input Power:

AC Voltage Range:	85 to 250 VAC
Frequency Range:	47 to 440 Hz
DC Voltage Range:	110 to 350 VDC
Input Power:	$<$ 20 Watts

Terminal Block:

Terminal Assignment:*	Ground, (−), (+), left to right, viewed from rear
Block Size:	15 mm W x 18 mm H x 30 mm D. (5/8” x 0.75” x 1 3/16”)
Approvals:	U. L. recognized; C.S.A. approved

*For AC operation, input line may be connected between (+) and (−), without regard to polarity; however proper grounding should always be employed

Fuse:

Type:	Bussman GDC-1A
Current Rating:	1 Ampere, fast-acting
Voltage Rating:	250 Volts
Size:	5 mm x 20 mm

Surge Withstand Protection (SWC)

Provides input Surge Withstand Capability (SWC) in compliance with both ANSI C37.90 and IEC 801-4.

Connections

All input power line connections to the rear-panel terminal strip should be made using appropriate power cables which have the insulation removed about 1/4” from the end or as required for tinning. If a DC source is used, connect the positive lead to the positive (+) terminal, connect the negative lead to the negative (−) terminal and a safety ground lead to the “G” terminal when viewing the instrument from the rear (see Figure C.6).

C.9 Option 19: Second RS-232C Interface

C.9.1 General Description

Option 19 for the Model 1092A/B/C and 1093A/B/C adds a second RS-232C port, allowing communications and control via a second 9-pin connector on the rear panel. The second RS-232C port connector is initially installed in units without the option. Option 19 requires the installation of internal components.

C.9.2 Specification

Commands

All commands, which are available for the main RS-232C port on the Model 1093A/B/C, may be used with Option 19. See Chapter 10 for list of RS-232 commands. Note that broadcast commands supporting the main RS-232 port begin with B and broadcast commands supporting the second RS-232 port begin with O. For example, to broadcast ASCII from the main RS-232 port, type B1. To broadcast ASCII from the second RS-232 port, type O1.

RS-232 Connector Pin Locations

The connector pin locations of the RS-232 connector is as follows:

Pin	Pin Definition	Pin	Pin Definition
1	No Connection	6	No Connection
2	Receive Data input (RXD)	7	No Connection
3	Transmit Data output (TXD)	8	No Connection
4	Programmable Pulse Output	9	No Connection
5	Signal Common	–	–

Table C.3: Option 19, Second RS-232 Port Pin Locations

C.10 Option 20A: Four Fiber Optic Outputs

Purpose

When installed into the standard Model 1093A/B/C, 1084A/B/C or 1088B, Option 20A provides four individually selectable fiber-optic outputs with Type ST connectors and 820 nm transmitters compatible with multimode fiber.

Specifications

Each fiber-optic output is jumper-configurable to each of the standard digital (CMOS) signal outputs. *Analog signals, IRIG-B Modulated, and ±5-V Recorder are not selectable.*

Option 20A provides an optical power output of -15 dBm minimum (-12 dBm typical) into 62.5/125-μm fiber.

The optical signal is ON whenever the selected logic signal is HI. Transmitter bandwidth is compatible with all available logic signals.

Option 20A may be installed in Auxiliary Slot of Model 1084A/B/C, in either Slot A or B of the standard Model 1088A/B clock and in Auxiliarry Slot of Model 1093A/B/C clock.

Output Enable (JMP1) – Model 1088B Only

This jumper is used at the factory for setting the output enable for the optical transmitters. For normal operation, set jumper to position A. With two clocks containing Option 18 and configured for redundant operation, this jumper may be set to position B, allowing the optical outputs to be externally paralleled and driven by the on-line clock. Normally, this jumper will be configured as required when delivered from the factory.

Output Jumper Enable (JMP2 JMP5)

The standard digital (CMOS) output signals can be selected for output via one of the fiber-optic output transmitters by setting jumpers JMP2 through JMP5 on the Fiber-Optic Option Board as described in Table C.4 and illustrated in Figure C.7.

The following tables provide a list of jumper to corresponding output transmitter and a list digital signals available for configuration to a fiber-optic output connector. The same signals are available via each jumper (JMP2 – JMP5) and corresponding setting.

Output Transmitter	Jumper	Pin	Signal per Output	Notes
CR1	JMP2	1	IRIG-B	1, 2, 3
CR2	JMP3	2	IRIG-E	2, 3
CR3	JMP4	3	IRIG-H	2, 3
CR4	JMP5	4	10 MPPS	2, 3
–	–	5	5 MPPS	2, 3
–	–	6	1 MPPS	2, 3
–	–	7	100 kPPS	2, 3
–	–	8	10 kPPS	2, 3
–	–	9	1 kPPS	2, 3
–	–	10	100 PPS	2, 3
–	–	11	60 PPS	2
–	–	12	50 PPS	2
–	–	13	10 PPS	2, 3
–	–	14	1 PPM	2, 3
–	–	15	1 PPH	2, 3
–	–	16	1 PPS	1, 2, 3
–	–	17	Prog. Pulse	1, 2, 3
–	–	18	IRIG-B Mod. Manch.	2, 3

Table C.4: Option 20A, Four Fiber Optic Output Configuration

1. Signals available on the Model 1093A/B/C
2. Signals available on the Model 1088A/B
3. Signals available on the Model 1084A/B/C

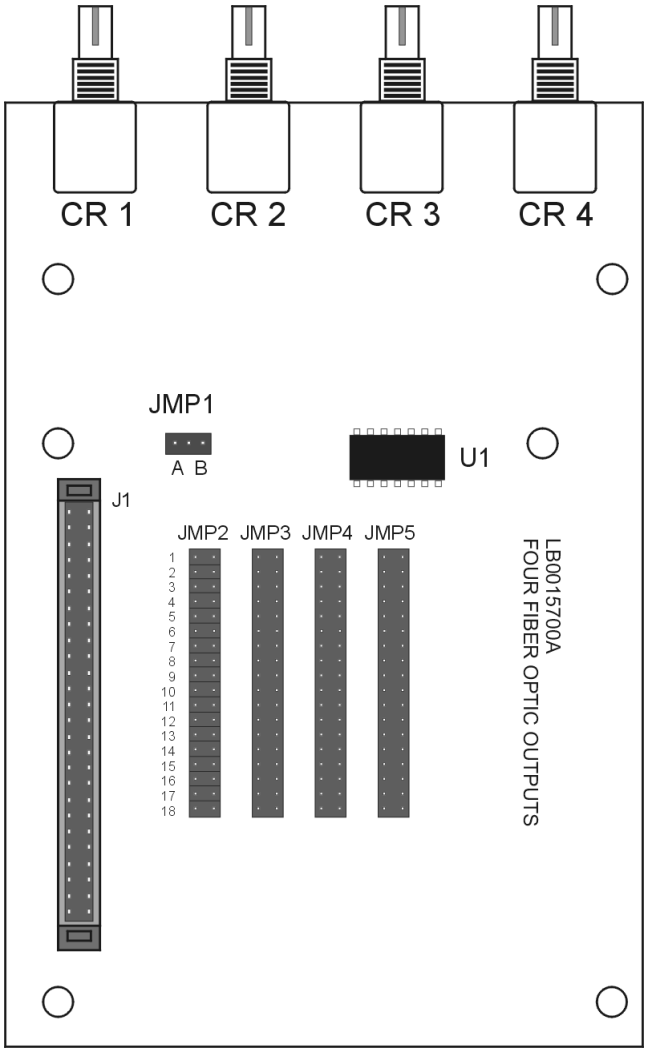


Figure C.7: Option 20A Jumper Locations

C.11 Option 27: 8-Channel High Drive

C.11.1 General Description

Option 27 provides eight independent, IRIG-B buffered outputs, each capable of driving multiple loads. Outputs are short circuit and surge protected. Each output is individually configurable for either modulated or unmodulated IRIG-B signals via jumper settings as illustrated in Figure C.8.

C.11.2 Specifications

Output Selection

Each output is jumper selectable for either a Modulated or Unmodulated signal. See Figure C.8 for jumper locations and configuration settings.

Number of Channels:	Eight (8).
Signal Levels:	
Modulated:	4.5 Vpp with 20-Ohm source impedance; each channel will drive a 50-Ohm load to 3 Vpp minimum; requires Option 92 in Model 1093A/B/C.
Unmodulated:	+5-V open-circuit; +4 V minimum at 250-mA load current each channel will drive 25 Schweitzer SEL-3xx (in parallel) or 50 SEL-2xx (in series/parallel) relays at 10 mA per relay.
Maximum Load (per driver):	
Modulated:	No Limit: will drive a short circuit.
Unmodulated:	250-mA peak current; pulse-by-pulse shutdown if load current exceeds internal limit (self-resetting).

Output Connector

16-position pluggable 5-mm (Phoenix-type) terminal strip with eight 2-position mating connectors.

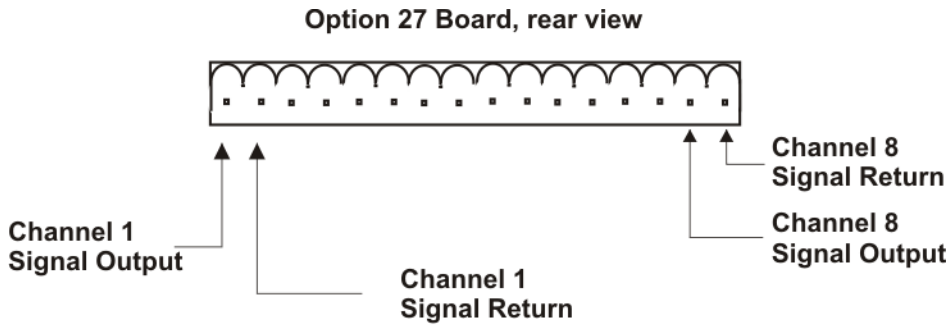
C.11.3 Option Setup

Using Front Panel Keys

To set up Option 27 from the front-panel keys, please follow the guidelines in Section 7.13.

Using RS-232C Port

To set up Option 27 using the RS-232C port, please follow the guidelines in Section 10.2.15.



16-position I/O Connector with eight 2-position mating connectors.

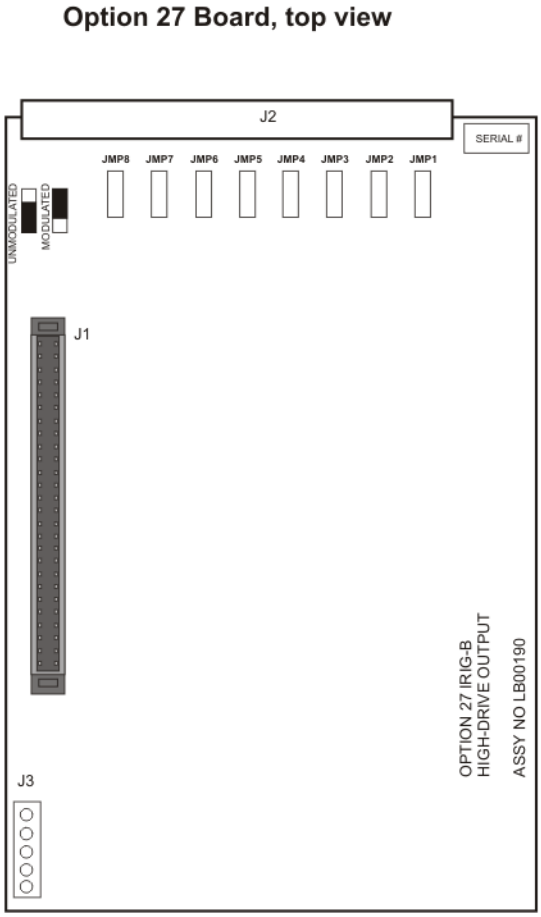


Figure C.8: Option 27 Jumper Locations

C.11.4 Output Load and Loop Example – Unmodulated IRIG-B

When designing circuits for connection to the output bus, several factors must be considered.

1. Loop Resistance
2. Type and quantity of loads connected
3. Maximum loop distance desired

Table C.5 provides a matrix of these factors using the Schweitzer relay(s) as the output load(s). The loop distance figures were obtained using the following types of Belden Wire (cross-referenced to corresponding part number):

	AWG20	AWG18	AWG16	AWG14	AWG12
Shielded	8762	8760	8719	8720	8718
Non-Shielded	8205	8461	8471	8473	8477

Total Loop Resistance	Output Load and Voltage Drop using SEL Relays[1] @0.25 V drop		@0.5 V drop		Loop Length (ft.)				
	I (mA)	# SEL-3xx[2]	I (mA)	# SEL-3xx	AWG20	AWG18	AWG16	AWG14	AWG12
10 Ω	25	2	50	5	500	800	1200	2000	3000
5 Ω	50	5	100	10	250	400	600	1000	1500
2.5 Ω	100	10	200	20	125	200	300	500	750
1 Ω	250	25	500[3]	50	50	80	120	200	300

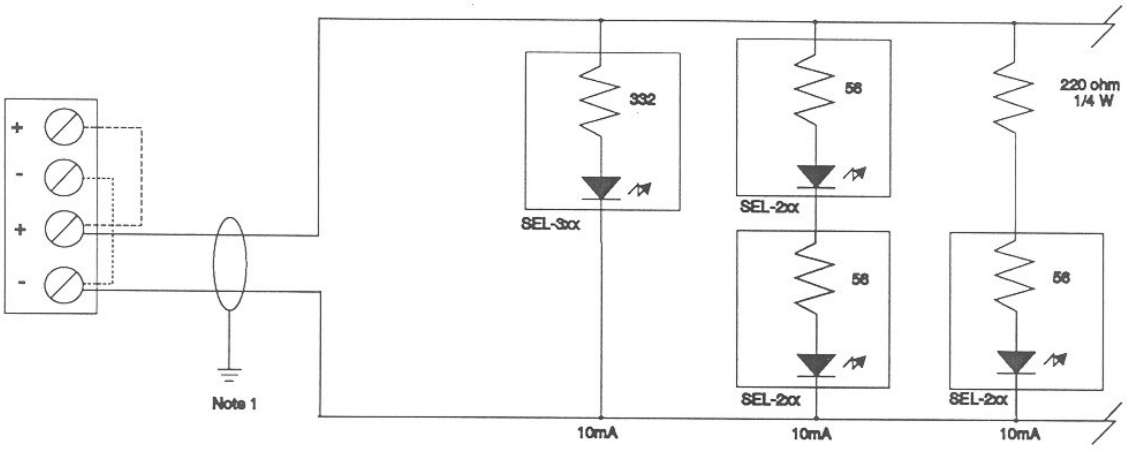
Table C.5: Example, Output Load and Loop Distance Matrix

1. Output Load and Voltage Drop, # SEL-3xx is the number of relays connected as output load.
2. For SEL-2xx, using pairs of relays with inputs of each pair in series, the maximum number of relays is two times that for SEL-3xx.
3. Using 2 drivers in parallel. Parallel connection may be made using AWG22 wire.

C.11.5 Connecting Load(s) to Output Bus

The following example illustrates use of different types of SEL relays connected to the output bus.

Total Load Current: 250 mA (peak) per driver or less.



Note 1:

Shielding is optional. However, if shielding is used, connect drain wire at source end of cable to a local surge ground. Maintain shielding throughout bus by connecting drain wires together at each junction or drop point. Do not connect drain wires at ends of cables. Do not connect drain wires to signal wires. Do not connect shield to ground at more than one location, as this may result in circulating currents.

C.11.6 Output Loading (Modulated IRIG-B)

Driving modulated IRIG-B loads is simpler than for unmodulated IRIG-B loads because input impedances are substantially greater (several kilohms typically); and most modulated IRIG-B loads include some sort of leveling or AGC amplifier, providing tolerance for signal level variations. Consequently, modulated IRIG-B loads may be connected with greater ease; Arbiter Systems recommends that your simply calculate the effective parallel load impedance of the parallel-connected loads. As long as the load impedance is 50 ohms or more per driver, and the loads will accept a 3 Vpp minimum signal level, and the connecting lines are short (5 ohms or less loop resistance), then no further analysis is required.

As with unmodulated signals, two or more drivers may be paralleled if desired. Unlike the current-limited unmodulated IRIG-B drivers, the modulated IRIG-B drivers are impedance-limited and will operate properly into any load impedance, including a short circuit.

If the loop resistance is greater than 5 ohms, then it may be treated as additional source resistance in series with the 20-ohm driver impedance. This source resistance then forms a voltage divider with the load. See calculation for "Output Level at Load" below by using Equation C.1.

For Example (see figure below)

Using Equation C.1 to calculate the Output Level at Load;

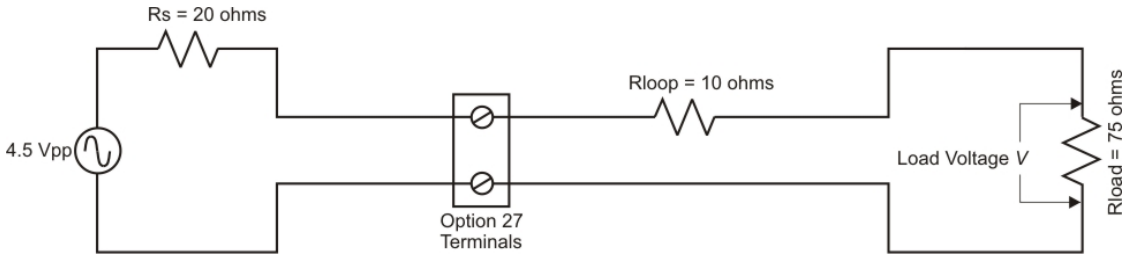
$$V = \frac{R_{load}}{R_S + R_{loop} + R_{load}} \times 4.5 \tag{C.1}$$

Source impedance of driver: 20 ohms

Loop Resistance: 10 ohms

Load Resistance: 75 ohms

Output Level at Load $V = (75 \div 105) \times 4.5 = 3.2Vpp$



C.12 Option 28: Power System Time, Frequency and Phase Monitor

C.12.1 General Description

This document describes Option 28 Power System Time, Frequency, and Phase Monitor, which is used in the Arbiter Systems line of standard Satellite-Controlled Clocks.

C.12.2 Discussion

Option 28 provides the clock with the ability to accept either a 50 Hz or 60 Hz, 30-300 Vrms signal input and measure the instantaneous phase, magnitude and frequency of the fundamental component while rejecting the effects of harmonics, noise and DC offsets. This option also integrates total time deviation, which is system time minus GPS time. Measurement results may be output via the rear-panel RS-232 connector or displayed on the front panel. To determine phase shift across a transmission line, the measured phase angles from two units placed at the ends of the line are subtracted and normalized into the range of 0-360 (or ±180) degrees. By subtracting the two measurements of absolute phase, which are measured using the same (GPS time) reference, the reference cancels leaving the phase angle between the two units: A-B = (A-R) - (B-R).

C.12.3 System Reference Connection

To connect the Option 28 board to the system reference input perform the following steps:

1. Connect System Reference (50 or 60 Hz signal) input to the Option 28 assembly, using the 6 m (20 ft.) length of twin axial cable provided. Strip the unterminated end of this cable and prepare it as required for termination to your System Reference signal. Do not connect the shield of the cable at the reference input end.
2. Attach this cable to the Option 28 System Reference input. Hold the cable connector by its body (not by the rotating locking ring) and rotate it inside the twin-BNC connector until you feel it begin to mate with the twin-BNC input of the Option 28 assembly. Once the connectors begin to mate, then use the locking ring to secure the connectors together.

CAUTION: The twin-BNC connector, unlike a standard BNC connector, will only mate properly in one orientation, and any attempt to force the connector into position with the locking ring when it is improperly oriented (as may be done with standard BNC connectors) will not work and may damage the connector.

NOTE: The supplied cable is terminated at one end with a twin-BNC connector which mates with the system reference input of the Option 28 board.

C.12.4 Firmware Configuration

Apply power and observe front panel display, when CLOCK STATUS STARTUP is displayed, press the SETUP key.

Navigate through the series of menu selections, using either the DOWN, UP or SETUP key, until SET OPTION BOARD? appears. Press ENTER and navigate to AUX. BOARD OPTION.

Press ENTER, and then press the UP key until Option 28 is displayed. Press ENTER. You will be given additional setup choices for Option 28; Set System Time Dev?, Set UTC/Local Time,

Set 50/60 Hz Input, and Return to Main Menu. Select the desired choices. When complete (if this is the first time these options have been activated), turn the clock OFF and back ON again to initialize the Option Boards.

View the deviations on the front panel display as follows:

1. To view Channel C, press the EVENT/DEVIATION key and observe the following display on the front panel (values are representative):

   System Input 114.91 V
   Phase 359.60°

2. Press the EVENT/DEVIATION key again and the following is displayed:

   System Δ F -0.0010 Hz
   Δ T +0.0000 Sec

3. Press the EVENT/DEVIATION key again and the following is displayed:

   System Frq 59.993 Hz
   Time 19:39:25.4327

   NOTE: Selection of Option 28 results in the deactivation of the Event front panel displays. The event displays may be re-enabled if desired, by entering the SET EVENT/DEVIATION menu and following the procedure below. This choice is only available when Option 28 is installed in the unit.

4. Use the SETUP key and access the SET EVENT DEVIATION ? setup menu. Press ENTER. The following is displayed:

   DISPLAY OPT 28 ONLY?
   UP = YES DOWN = NO

5. To view Option 28 only, press the UP key, then press the front panel key EVENT /DEVIATION to display Option 28 measurement information.

6. To enable Event/Deviation A and B displays as well, press the DOWN key and configure the Channel Mode, Time, and Recorder Channel. Then press the front-panel key EVENT/DEVIATION to sequentially display all three channels. For a detailed description, refer to Section 5.3.4.

C.12.5 Calibration

The clock is now configured for operation. Calibration for phase and amplitude may be further performed. Specifically, these calibrations have no effect on system time and frequency measurements, and are unnecessary if only time and frequency are required.

Uncalibrated phase accuracy is usually less than 0.3°, and can be reduced to 0.1° typical and 0.2 degree guaranteed with calibration. Uncalibrated amplitude accuracy is usually less than 1%, which is the typical performance of this measurement. Amplitude accuracy is not guaranteed, and amplitude measurements are provided primarily to verify that the unit is properly connected and receiving the expected signal level.

C.12.6 Phase Calibration

Phase calibration has been performed at the factory, and the calibration factor (which must be entered into the clock non-volatile memory for it to be effective) is supplied with the assembly. Entering this factor into the clock requires connecting the clock to a computer or terminal via the RS-232 interface. For the computer, use a terminal-emulation program such as Procomm, Windows HyperTerminal or Tera Term Pro[1]. Send the character V to the clock to check that connections and port settings are correct. The clock should respond with the firmware dates in the format 01 Jan 1997 Op28 02 Jan 1997.

To send the phase calibration factor to the clock, key in the message:

dd.dd,1084PC, or dd.dd,1088PC, or dd.dd,1093PC

Where dd.dd is the calibration factor in degrees, for example -0.16; and 1084, 1093 or 1088 is the clock model number (a security key to prevent unintentional modification):

-0.16,1084PC

C.12.7 Amplitude Calibration

For amplitude calibration, the format is similar, replacing PC with RV. The calibration factor (supplied with boards having a serial number with prefix greater than 97420) is approximately 1.0, and is multiplied by the measured result to generate the displayed value. If an accurate ac source at 50 or 60 Hz is available (for example, the Arbiter Systems, Inc. Model 1040C Panel Meter Calibrator), the error (for boards with prefix 97420) can be measured and the correction factor entered as described. For example, if 120 Vrms is applied to the Option 28 assembly, and the display indicates 119.1 Vrms, the calibration factor is (120.0 / 119.1) or 1.0076. You would enter 1.0076,1093RV to calibrate the unit (Model 1093A/B/C). The display should then read close to 120.0 Vrms. To clear the calibration factor, you may set the unit to factory defaults or send the command 1,1093RV. Again, use either 1084, 1088 or 1093 to match the clock model number.

C.12.8 Option 28–Specific RS-232 Commands

The following symbols and syntax are used throughout the RS-232 Commands listing and are repeated here for emphasis:

↵	Shorthand for Carriage–Return, Line–Feed.
A	Channel A.
B	Channel B.
U	UTC Time, Channel A (or B).
L	Local Time, Channel A (or B).

Fourteen (14) new RS-232 commands are available with Option 28. The following conventions apply to all RS-232 communications:

- Phase angle, in all messages, is defined as zero (or 360) for the positive-going zero crossing coincident with 1 PPS-GPS, and is scaled between zero and 360 degrees. Phase angle increases

[1]To download Tera Term Pro, see the Arbiter Website and select “Service/Support > Downloads.”

with frequency below nominal (50 or 60 Hz) and decreases with frequency above nominal; in other words, if the zero crossing occurs just after 1 PPS-GPS, the phase angle will be just above zero, and if the zero crossing occurs just prior to 1 PPS-GPS, phase angle will be just under 360°.

- Time deviation decreases (becomes more negative) with frequency below nominal, and increases (becomes more positive) with frequency above nominal.

C.12.9 Option 28 Commands

Return System Frequency

Command: **FS**

FS returns Option 28 system frequency.

Response: SS ff.fff ↵
Where: SS = UTC seconds
ff.fff = frequency, Hz

Return System Frequency Deviation

Command: **FD**
FD returns the system frequency deviation.

Response: SS±f.fff ↵
Where: SS = UTC seconds
f.fff = frequency, Hz

Return System Phase

Command: **PS**
PS returns the system phase.

Response: SS±ppp.pp ↵
Where: SS = UTC seconds
ppp.pp = phase, 0 to 360 degrees

Return System Time Deviation

Command: **TD**

TD returns the system time deviation.

Response: SS±tt.tttt ↵
Where: SS = UTC seconds
tt.tttt = time deviation, seconds

Return System Time

Command: **TS**
TS returns the Option 28 system time.

Response: MM DD YYYY hh:mm:ss.ssss SS ↵
Where: MM = Month
DD = Day of Year
YYYY = Year
hh = hour
mm = minute
ss.ssss = seconds
SS = UTC seconds

Set Option 28 System Time, UTC

Command: **SU**
SU sets the Option 28 to reflect system time in UTC format.

Response: ↵

Set Option 28 System Time, Local

Command: **SL**
SL sets the Option 28 to reflect system time in UTC format.

Response: ↵

Return System Status

Command: **SM**
SM returns the Option 28 system status.

Response: h ↵
Where (h): 0 = System OK
1 = No System Reference
2 = System okay now but reference lost since last request

Start Broadcast Mode–Vorne

Command: **B2**
B2 configures RS-232 broadcast mode to support Vorne large format time displays. Data is transmitted ahead of time, and the <BEL> character is transmitted on time. When properly configured, the Vorne display updates simultaneously upon receipt of the <BEL> character. Refer to Arbiter Systems Application Note 103 for more information.

Response:		
1/second	11nn ↵	Out-Of-Lock Time
	44hhmmss ↵	UTC/Local Time
	22±ff.fff ↵	Frequency Deviation
	33±s.ss ↵	Time Deviation*
	34±sss.sss ↵	Time Deviation*
	66hhmmss ↵	System Time

77nn.nnn ↵	System Frequency
88nnn.nn ↵	System Phase
89nnn.nn ↵	System Magnitude
55ddd ↵	Day of Year
<BEL>	<BEL> = hex 07

The decimal points shown above are not actually transmitted in the data stream, but their position is implied. The displays are configured to show the decimal point in this position.

*Time Deviation is output in two formats in the same data stream: 33±s.ss and 34±sss.sss.

Output for the 33±s.ss format will be +9.bb when the measured value exceeds +9.99 (b = blank). It will be -9.bb when the measured value is less than -9.99.

Output for the 34±sss.sss format will observe the following conventions for out-of-range values and leading blanks. Decimal points are implicit and do not appear in the data stream.

Time Deviation Range	**Format (b=blank)**
Below -999.99	-bbb.bbb
-999.99 to -100.00	-sss.sss
-99.99 to -10.00	-bss.sss
-9.99 to -0.01	-bbs.sss
+0.00 to +9.99	+bbs.sss
+10.00 to +99.99	+bss.sss
+100.00 to +999.99	+sss.sss
Above +999.99	+bbb.bbb

Table C.6: Option 28 B2 Broadcast, Time Deviation Values

Start Broadcast Mode–ASCII

Command: **B7, O7**

B7 configures the *Standard RS-232* broadcast mode to send Time, Frequency, and Phase Deviation, once per second, in ASCII format. O7 configures the *Option RS-232* broadcast mode to send Time, Frequency and Phase Deviation, once per second, in ASCII format.

Response: broadcast mode, UTC:
mm/dd/yyyy hh:mm:ssU ss +f.fff +t.tttt ppp.ppp vvv.vv ↵

broadcast mode, Local:
mm/dd/yyyy hh:mm:ssL ss +f.fff +t.tttt ppp.ppp vvv.vv ↵

Where:
mm/dd/yyyy = Date

hh:mm:ssU	= Time of Day, UTC
(or)	
hh:mm:ssL	= Time of Day, Local
ss	= Status
	first character is Reference Status:
	0 : Locked;
	1 : Unlocked;
	second character is clock status per IEEE P1344
+f.fff	signed Frequency Error in Hz.
+t.tttt	signed Time Deviation in seconds.
ppp.pp	Phase Angle, 0 to 360 degrees.
vvv.vv	Line voltage, rms Volts.

Start Broadcast Mode–True Time

Command: **BT, OT**

BT configures the *Standard RS-232* broadcast mode to send Time, Time Quality and Frequency, once per second, in True Time format. OT configures the *Option RS-232* broadcast mode to send Time, Time Quality and Frequency, once per second, in True Time format.

Response: broadcast mode, UTC:
<SOH>DDD:HH:MM:SSQTsDS.thmFsU.thm ↵

Where:

<SOH>	= ASCII start of header character (01h)
DDD	= Day
:	= ASCII colon (3Ah)
HH	= Two digits of the hour of day
MM	= Two digits of the minute of day
SS	= Two digits of the second of day
Q	= Quality Sentry character (, ".", "*", "#", "?")
	space (20h) error $\leqq$ 1 μs
.	period (2Eh) 1 $\leqq$ error $<$ 10 μs
*	asterisk (2Ah) 10 $\leqq$ error $<$ 100 μs
#	pound sign (23h) 100 $\leqq$ error $<$ 1000 μs
?	question mark (3Fh) error $\geqq$ 1000 μs
T	ASCII T, indicates start of Time Deviation Field
s	Sign character + (2Bh) or - (2Dh)
D	Tens of seconds (Time Deviation
.	Period, decimal point
thm	Tenths, hundredths and thousandths of seconds
F	ASCII F, indicates the start of Frequency Deviation Field
s	Sign character + (2Bh) frequency above nominal or
	- (2Dh) frequency below nominal
U	Units of Hertz (Frequency Deviation)

.	Period, decimal point
thm	Tenths, hundredths and thousandths of Hertz
↵	Carriage-return, line-feed characters (0Dh, 0Ah)

Set Measured System Deviation

Command: **(-)s.fsRD**
(-)s.fsRD sets the system deviation.

Response: ↵
Where: s = 0 to ±2000 seconds
fs = fractional seconds

Set Phase Calibration

Command: **p:kPC**
p:kPC sets the phase calibration offset. Phase offset is stored in protected RAM.

Response: ↵
Where: p = Phase Offset in degrees
k = Security Key (e.g. 1093)

Set Voltage Amplitude Correction

Command: **v:kRV**
v:kRV sets the system voltage amplitude correction.

Response: ↵
Where: v = Voltage correction per unit with 1.000000 equal to no correction.
k = Security Key (e.g. 1093)

Return Time, Frequency, Phase Deviation with UTC Time

Command: **nPD**
nPD returns the System Time, Frequency and Phase Deviation with a UTC time reference, at each issuance of the command.

Response:
(when n = 0) mm/dd/yyyy hh:mm:ssU ss +f.fff +t.tttt ppp.ppp vvv.vv ↵
(when n = 1) mm/dd/yyyy hh:mm:ssL ss +f.fff +t.tttt ppp.ppp vvv.vv ↵

Where:

mm/dd/yyyy	= Date
hh:mm:ssU	= Time of Day, UTC

(or)	
hh:mm:ssL	= Time of Day, Local
ss	= Status (0 = Locked, 1 = Unlocked) (first character is Reference Status:) (second character is clock status per IEEE P1344)
+f.fff	signed Frequency Error in Hz.
+t.tttt	signed Time Deviation in seconds.
ppp.pp	Phase Angle, 0 to 360 degrees.
vvv.vv	Line voltage, rms Volts.

C.13 Option 29: Four Additional Outputs; Dry Contacts; +25/50 VDC

C.13.1 General Description

This document describes Option 29: Four Additional Outputs With Dry Contact and +25/50 VDC; which may be used in the Arbiter Systems Models 1084A/B/C, 1088B, and 1093A/B/C GPS Satellite-Controlled Clocks. Option 29 includes six configurable outputs. Four are standard, 5 V CMOS outputs; two are Aromat AQV210E solid-state relays (SSRs). A +25 or +50 VDC supply is available on-board and may be switched by the SSR outputs.

C.13.2 Specifications

General

Output Connector	16-position, 5 mm Pluggable Terminal Strip. Four 2-position and two 4-position mating connectors provided. The connectors accept wire sizes of 0.25 to 2.5 mm^2 (AWG 12 to 22). See Table C.7 and Figure C.10 for Connector Configuration.

Digital Outputs

Output Quantity	4
Output Type:	5 V CMOS, individually configurable
Output Rating:	+5 V open-circuit, nominal
	75 mA peak current, per channel
	+3.5 V typical at 75 mA peak current
Available Output Signals:	Jumper selectable to any of the digital signals available from the clock mainframe plus on board generation of 1 PPM and 1 PPH for the 1093 clock models. See Figure C.9 for Jumper location and selections.

Solid State Relay Output

Output Quantity:	2
Output Type:	Aromat AQV210E solid-state relays, 130 mA AC or DC at 350 V peak.
Output Rating:	Limited to 100 mA DC, 140 Vrms / 180 V peak by the fuse and surge suppression devices.
Output timing:	Propagation Delay, 90 μs Nominal, to 50%.
	Rise Time, 50 μs Nominal, 20-80%.

Solid State Relay Output, continued

Output Power Supply:	Individually configurable for 0 VDC, +25 VDC, or +50 VDC.
Available Output Signals:	1 PPM, 1 PPH, 1 PPS, Programmable Pulse, Locked and Out of Lock.
Pulse Width:	Individually configurable for a fixed, 50-ms pulse, or the default width of pulse provided by the clock mainframe.
Available Output Configurations:	1. Dry contact closure. 2. Contact closure to ground. 3. +25/50 VDC switched for grounded load 4. +25/50 VDC with contact closure to ground for non-grounded load. See Table C.13.2: Operating Modes of SSR Outputs.

Operating Modes of SSR Outputs

Mode = Dry Contact Closure

1. SSR Output 1 − Connect load to pins 10 & 11 (polarity not important)
2. SSR Output 2 − Connect load to pins 14 & 15 (polarity not important)

Mode = Contact Closure to Ground

1. Short pins 9 & 10, connect load to pin 11
2. Short pins 13 & 14, connect load to pin 15

Mode = +25/50 VDC Switched to Grounded Load

1. Short pins 11 & 12, connect load to pins 9 (-) & 10 (+)
2. Short pins 15 & 16, connect load to pins 13 (-) & 14 (+)

Mode = +25/50 VDC Switched to Floating Load

1. Short pins 9 & 10, connect load to pins 11 (-) & 12 (+)
2. Short pins 13 & 14, connect load to pins 15 (-) & 16 (+)

Pin	Function	Setup Jumpers–Default Settings
1 (Rightmost)	CMOS Output 1	JMP4: Signal Select – Default = 1 PPH
2	Ground	–
3	CMOS Output 2	JMP3: Signal Select – Default = 1 PPM
4	Ground	–
5	CMOS Output 3	JMP2: Signal Select – Default = Prog. Pulse
6	Ground	–
7	CMOS Output 4	JMP1: Signal Select – Default = IRIG-B
8	Ground	–
9	Ground	–
10	SSR Output 1	JMP5: Signal Select – Default = 1 PPM
11	SSR Output 1	JMP7: Standard/50ms – Default = 50 ms
12	+25/50 VDC 1	JMP10: +25/50 VDC – Default = 50 VDC
13	Ground	–
14	SSR Output 2	JMP6: Signal Select – Default = 1 PPM
15	SSR Output 2	JMP8: Standard/50 ms – Default = 50ms
16 (Leftmost)	+25/50 VDC 2	JMP11: +25/50 VDC – Default = 50 VDC

Table C.7: Output Connectors and Setup Jumpers

C.13.3 Firmware Configuration

1. It is necessary to verify the configuration in the Option Setup Menu so Option 29 is recognized.
2. Apply power and observe the front panel display, when CLOCK STATUS STARTUP is displayed, press the SETUP key.
3. Navigate through the series of menu selections, using either the SETUP or UP key, until SET OPTION BOARD? appears.
4. Press ENTER, and then press the UP key until Option 29 is displayed. Press ENTER. Remember that the Option 29 is located in Option Slot B *of the Model 1088B*.
5. Press SETUP to exit from the SET OPTION BOARD configuration.

C.13.4 Output Jumper Setting Changes

1. Set Line Power switch to OFF position (if equipped). Disconnect the power cord from rear-panel.
2. Remove rack-ears (if equipped) and remove top cover using a T-25 Torx driver (4 screws).
3. Locate the appropriate Jumper using Figure C.9 and move the jumper to the desired setting.
4. Replace the top cover and rack-ears (if equipped).
5. Connect the power cord to the rear-panel and set the Line Power switch to ON position (if equipped).

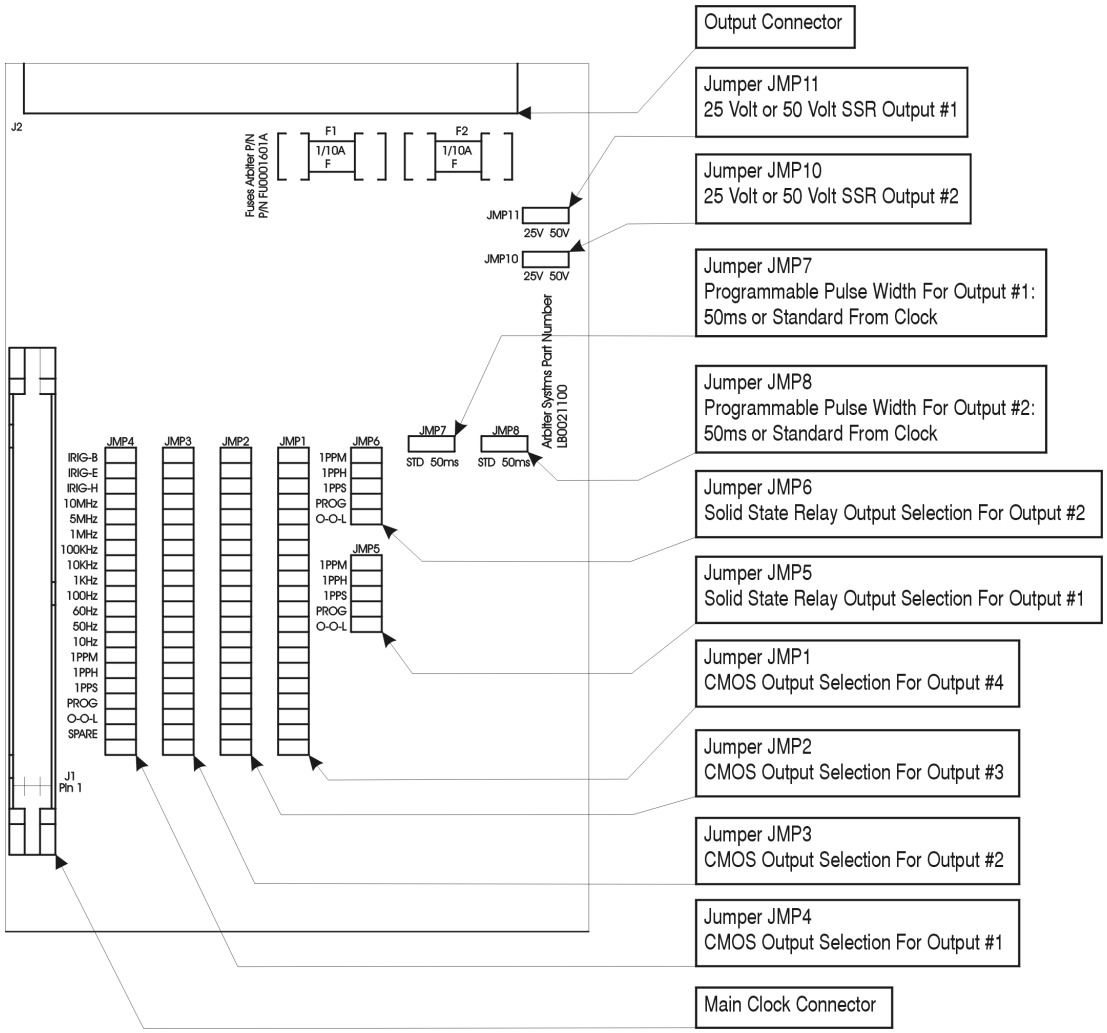


Figure C.9: Option 29 Jumper Locations

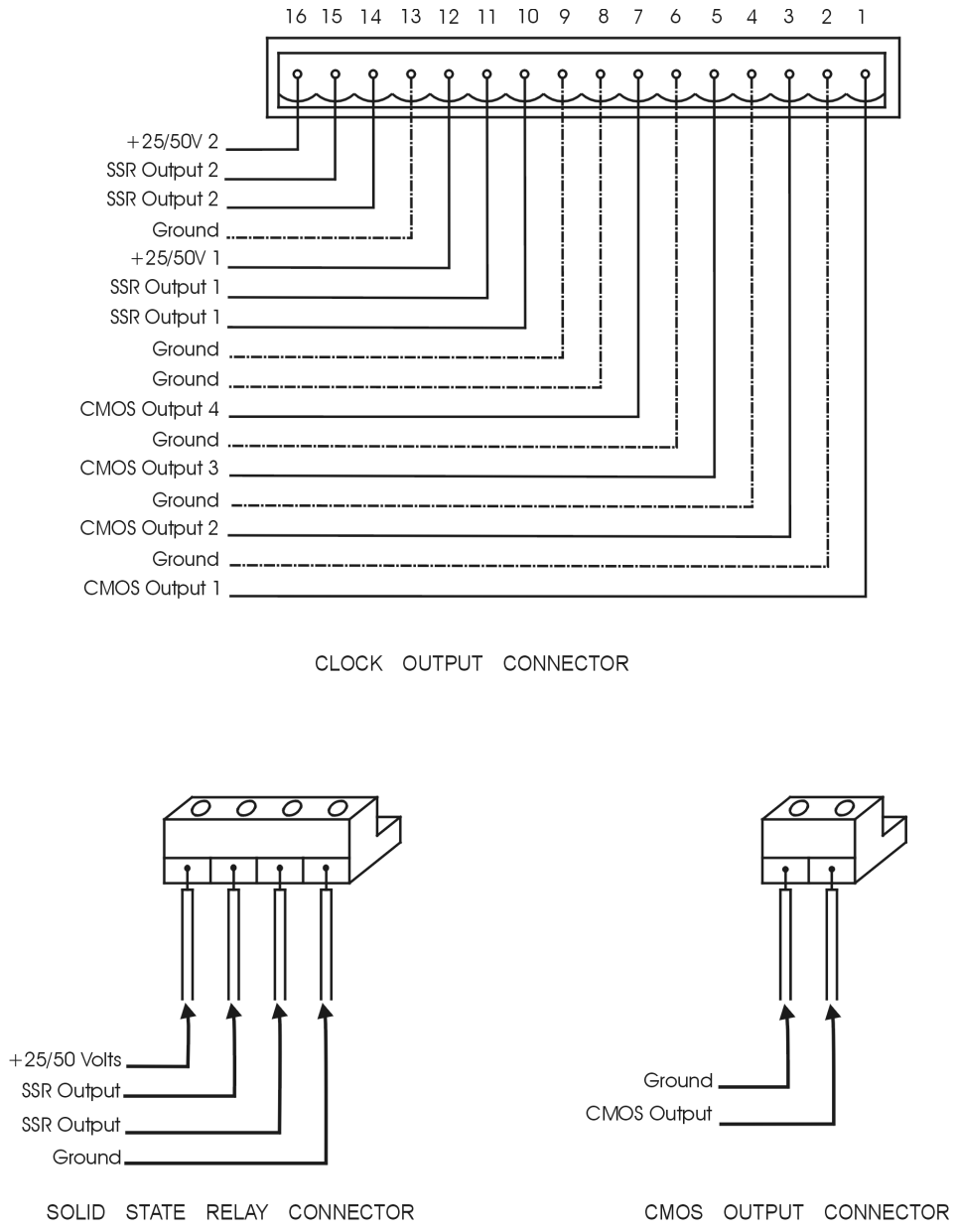


Figure C.10: Option 29 Connector – Signal Locations

C.14 Option 32/33: Internal NTP Server – *Obsoleted by Opt34*

C.14.1 General Description

Option 32 is a single internal Network Time Protocol (NTP) Server (Port 1), and used in the Arbiter Systems line of 19-inch, rack mount Satellite-Controlled Clocks. Option 33 is very similar to Option 32, however it has two identical and independent NTP servers (Port 1 and Port 2). Both options come with a six-foot phone cord and RJ-11 to DB-9F adapter for connecting to the RS-232, or NTP Setup, port. For Model 1093B/C clocks, the NTP Status display should indicate as follows:

NTP1(2): SYNCHRONIZED (may also indicate as ERROR)
NETWORK: GOOD LINK (may also indicate as BAD LINK)

Option 32/33

Option 32/33 allows the clock to act as time server over an Ethernet network using the network time protocol operating in server mode - symmetric operation modes are not supported. Time is distributed over the network interface to computers, controllers and other equipment needing the correct time. Option 32/33 understands NTP Version 1, Version 2, and Version 3 frames, and optionally supports authentication via DES and MD5 cryptographic checksums. If authentication is not used, the controller can typically be used for hundreds of clients without overloading it. Authentication requires typically 40 ms for checking and generating the cryptograms, which is covered and averaged out by the protocol. Option 32/33 supports full SNTP and all NTP functions required for reliable server operation. Functions not required for server operation are not implemented.

Hardware Configuration.

Option 32/33 consists of two building blocks; an OEM NTP module (Option 33 has two) and an interface to the GPS clock. Option 32/33 is connected to the main board via the standard 50 pin option cable, and has three external connectors, an RS-232 (RJ-11) and two 10/100 Base-T (RJ 45). The center RJ-45 connector is not used in the Option 32. In addition to the connectors there are six status LED's on the rear panel. Three LEDs are used in the Option 32 at Port 1, and six LEDs are used in the Option 33. See Figure C.11.

External Connectors

The RS-232 connector can be used to interrogate the clock or to configure the NTP module depending on the jumper settings (see Section C.14.2 Jumper Settings). The port parameters are set to 9600, N, 8, 1. This RS-232 port is not operational during normal use. The Ethernet port is used to distribute time and can also be used to configure the NTP module.

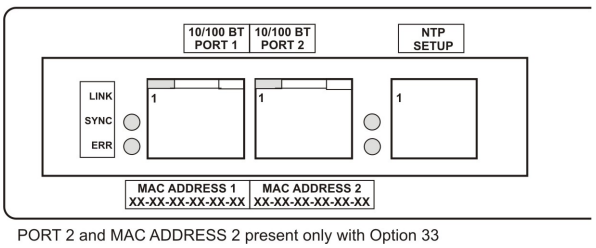


Figure C.11: Option 32/33 Rear Panel

RS-232, NTP Setup

The RS-232 port uses an RJ-11 style connector, which is configured as a DTE device with the following pin out:

GND = Pin 2	TXD = Pin 3	RXD = Pin 4	GND = Pin 5

10/100 Base-T

Option 32/33 uses the standard 10/100 base-T connection for connecting to an Ethernet. Figure C.11 indicates the location of pin 1 (two places for Option 33).

TXD+ = Pin 1	TXD– = Pin 2	RXD+ = Pin 3	RXD– = Pin 6

Status LED's

There are three active status LED's on the rear panel of Option 32; six active LED's on the Option 33. The LED's are Link (green), Synch (green) and Error (red). Option 32/33 will perform an initial self test when powered on. After the initial self-test phase, where all status LEDs should be lit, the LED's indicate the status of the NTP Server.

Link LED

Link (green) LED on: Ethernet 10/100 base-T connection is good.

Synch LED

Synch (green) LED on: synchronized to the time signal, correct reception of time data, requires the satellite controlled clock to be synchronized.

Synch LED flashing 50% duty cycle: Some information received, but not yet synchronized reliably.

Error LED

If the Error LED is on or blinking the Synch LED will give a diagnostics code.

Error (red) LED stable on, Synch (green) LED flashing

- 1x: EPROM-checksum error
- 2x: RAM-error
- 3x: Network controller error
- 4x: EEPROM checksum error, or is bad
- 5x: IP address already used on network

Error LED flashing, Synch LED flashing

- 4x: Faulty network connection
- 5x: No DHCP response was received

C.14.2 Jumper Settings.

There are five jumpers on Option 32/33. Jumper 1 (JMP1) is determined by the clock model; Jumper 2 (JMP2) determines board operation with JMP3 and JMP4; Jumper 3 (JMP3) determines board operation with JMP2 and JMP4; JMP2 and JMP3 always move as a pair; Jumper 4 is used with configuring NTP servers over the RS-232 port; Jumper 5 sets the board for Option 32 or 33. See jumper settings in Table C.8.

Jumper	Position	Option Mode (Rev.B and following)	Rev.A Board Modes
JMP1	A B	Determined by Model 1088B Det. by Model 1084A/B/C or 1093A/B/C	(same) (same)
JMP2	A B C D	NTP Server(s) Clock serial port Configure NTP Server 1* via RS-232 only Configure NTP Server 2* via RS-232 only	(same) (same) (same) (same)
JMP3	A B C D	NTP Server(s) Clock serial port Configure NTP Server 1* via RS-232 only Configure NTP Server 2* via RS-232 only	(same) (same) (same) (same)
JMP4	A B	NTP Server(s) NTP Configuration	NTP Configuration NTP Server(s)
JMP5	A B	Option 33 Option 32	(same) (same)

Table C.8: Option 32/33 Jumper Truth Table – *Must set JMP4 into the Configuration mode – “B” position for Rev B or later boards, “A” position for Rev. A boards.

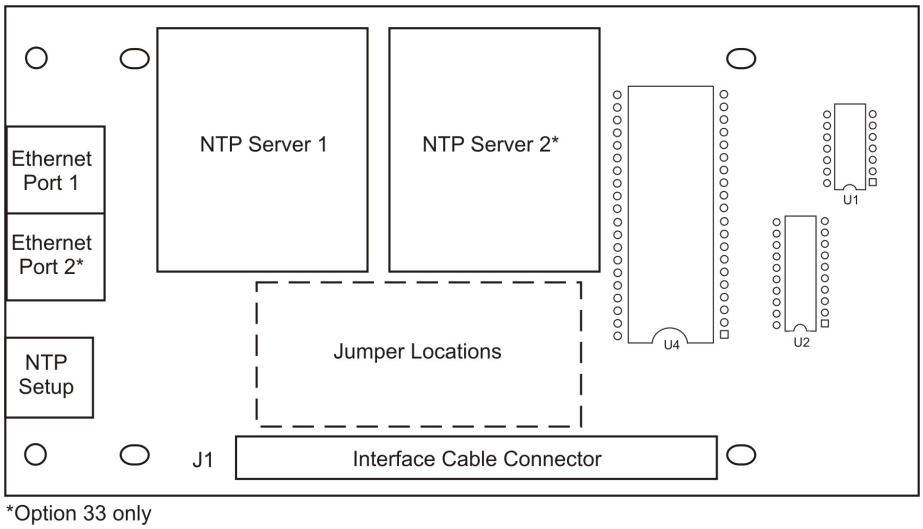


Figure C.12: Option 32/33 Board, Jumper Locations

C.14.3 Firmware Configuration.

Setup for Option 32/33 operation is in two parts: (1) setting the correct option number (i.e. 32 or 33) via the front panel, or through the RS-232 port (1093A); (2) configuring the NTP server(s) via the the individual Ethernet port, or option RS-232 port.

Front Panel (1093B/C)

1. Apply power and observe the front panel display; press the SETUP key when it displays "CLOCK STATUS STARTUP".
2. Navigate through the series of menu selections, using either the DOWN, UP or SETUP key, until "SET OPTION CONTROL?" appears; press ENTER; the display should read "MAIN BOARD OPTION"; press ENTER and it should read "AUX. BOARD OPTION"; press ENTER.
3. Press the UP or DOWN key to select 32 or 33 and ENTER.
4. Press any of the upper row of keys to exit the configuration menu.

RS-232 Port (1093A)

To set up Option 32/33 in the 1093A, you will need to use a terminal program like HyperTerminal or Tera Term Pro. For Option 32, type the following in the terminal window, "1,6,1093XI"; for Option 33, type "1,7,1093XI".

NTP Module

The NTP module can be configured over the appropriate Ethernet port or the option RS-232 port. The Ethernet is the preferred port to configure, with no required jumper changes.

Ethernet

Initially, NTP servers are programmed with the IP address of 192.168.0.232. To configure the NTP module over the network, establish a Telnet connection to port 9999. If the IP address of the NTP Server (NTS) is unknown or undefined, the following sets a temporary IP address:

a) Set a static ARP with the desired IP address using the hardware address of the NTS, which is printed on the product label. Alternately, you can calculate the address from the serial number. Below is the command example for WinXP, using the DOS prompt, when the hardware address of the NTS is 00-20-4A-02-64-0B.

arp -s 192.168.0.232 00-20-4A-02-64-0B

NOTE: In order for the ARP command to work in Windows, the ARP table on the PC must have at least one IP address defined other than its own. Type "ARP A" at the DOS command prompt to verify that there is at least one entry in the ARP table. If there is no other entry beside the local machine, ping another IP machine on your network to build the ARP table. This has to be a host other than the machine that you're working on. Once there is at least one entry in the ARP table, use the listed commands to ARP an IP address to the NTP Server.

The command example for most Unix systems is:

arp -s 192.168.0.232 00:20:4A:02:64:0B

b) Open a telnet connection to port number 1. This connection will fail, but the NTS will change its IP address to the desired one in that step, e.g.

telnet 192.168.0.232 1

c) Open a telnet connection to port 9999 and set all required parameters.

telnet 192.168.0.232 9999

NOTE: The temporary IP address is reverted after every power reset of the NTS. Be sure to enter the configuration and store the parameters to make the changes permanent.

After making a connection to configure the NTP server (either through the Ethernet or RS-232 port), the screen should display the top four lines; to enter the Setup Mode, you must press Enter on the terminal (pc).

```
*** NTS ***
MAC address 00204AAB5E8A
Software version V5.8.13.RC2 (050126) CPK_580_M100

Press Enter to go into Setup Mode

*** basic parameters
Hardware:  Ethernet TPI
IP addr 192.168.0.232, no gateway set
 *** Security
 SNMP is               enabled
 SNTP Community Name:  public
 Telnet Setup is       enabled
 TFTP Download is      enabled
 Port 77FEh is         enabled
 ECHO is               enabled
 *** NTS parameters

Antenna Type:  GPS/Arbiter

   Encryption is disabled
   Sending UDP datagram to Port 024C(hex) every 000 minutes
   Send UDP datagram to:

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

Serial

An ASCII terminal or PC with a terminal emulation can be connected to the option RS-232 port, but JMP2 and JMP3 must be set to “C” (for Ethernet Port 1) or “D” (for Ethernet Port2), and JMP4 set to “B”. The terminal (or PC) should be configured to 9600 Baud, 8 data-bits, 1- stop bit, no parity. The power must be cycled to enter the configuration mode. The self-test begins after power-up. About a half-second later the Error (red) LED starts blinking. Now send three

lowercase 'x' characters to the NTP Server. These characters must all be sent within one second to start configuration mode.

NOTE: The easiest way to enter configuration mode is to hold down the "x" key at the terminal (emulation) and then powering the NTP Server. This will ensure that the x characters will arrive in time.

C.14.4 General Configuration

After entering the configuration mode (press ENTER/RETURN), the parameters can be changed; confirm default values with the enter key. Leaving the setup mode after selecting function 9 stores all parameters in a nonvolatile memory, and the NTP server resets.

C.14.5 Basic Parameters

To change the basic parameters, type '0'. The following values can be set/changed:

Ethernet Interface: Set to (N).

IP Address: The IP address must be set to a unique value in your network. If the NTP Server is set to an address, which is already in use, it will display an error code with the LEDs (see "LED Status") and will not connect to the network.

Gateway IP Address: The router/gateway address is needed to communicate to other LAN segments. The default gateway must be set to address the router that connects these segments. This address must be within the local network. If in doubt, consult the network administrator.

Net mask: A net mask defines how many bits from the IP address are to be taken as the network section and how many bits are to be taken as the host section (reminder: Standard class A 8/24 [net/host], class B 16/16, class C 24/8 bits). If set to 0, the standard appropriate net mask for the actual IP address is used. The NTS prompts for the number of host bits, and then calculates the net mask. It is shown in standard format "255.255.xxx.xxx" when parameters are displayed.

Telnet Config Password: The Telnet configuration password can be set to disable unauthorized access to the setup menu through a Telnet connection to the setup port (9999). For the setup through the serial port, it is not necessary to enter the password. The controller can be configured over a Telnet connection to port 9999 (assuming the network parameters are set correctly and the NTS is connected to the network).

C.14.6 NTP Server Parameters

The network operations of the server are controlled by various parameters.

Antenna Type: Verify that it is set to 6=GPS/Arbiter

UDP-Port: The UDP port selects the port number for the NTP proprietary protocol.

Send Block Every n Minutes: This parameter determines how often the data block should be sent.

Send UDP-Broadcast: If the time information should be sent to all devices connected to this LAN (broadcast), set this parameter to "Y" = yes.

UDP-Target Address: This parameter determines the target addresses to which the data block should be sent. The data block can be sent over a Gateway or other devices to another part of the network. The maximum number of defined addresses is eight. NTP and UDP/time port

numbers are fixed to the values defined in RFC-37 and RFC-123 respectively. If the authentication option is enabled, up to seven MD5 or DES keys can be entered (key numbers 1 ... 7). All key input must be done in hexadecimal format; MD5 key length is limited to eight characters.

When leaving the setup mode after selecting function 9 all parameters are stored in a nonvolatile memory and the NTP server resets. Select 8 to exit without saving modifications.

C.15 Option 34: NTP/PTP Server

C.15.1 General Description

Option 34 provides Network Time Protocol (NTP) and Precision Time Protocol (PTP)[2] servers in Arbiter Models 1084A/B/C, 1088A/B and 1093A/B/C GPS series clocks. These instructions will assist you in the setup and configuration of the Option 34 NTP/PTP server. Configure Option 34 using the Web Interface or the SSH Console.

Standard configuration includes two copper Ethernet ports. Optionally, order fiber optic connectors. Standard fiber connector is type LC, 62.5/125 μm 50/125 μm multimode fiber. Contact factory for other connector types.

Option 34 has two independent server ports that can access either the NTP (versions 1, 2, 3 or 4 frames) or the PTP servers. This option has been designed in accordance with the latest NTP and PTP standards and may be updated whenever new firmware is available.

PTP with hardware assist offers much better accuracy than with NTP, however to achieve these accuracies requires PTP-enabled network components that provide for latency and jitter to be determined between the clock and each component. When designing for the ultimate in PTP accuracy, evaluate every component in the complete network.

Network Time Protocol (NTP) Server

Option 34 allows the clock to act as network (NTP) time server over an Ethernet network and understands NTP version 1 – 4 frames, while optionally supporting authentication via DES and MD5 cryptographic checksums as defined in RFC 5905[3]. Option 34 supports symmetric key authentication. Time is distributed over the network interface to computers, controllers and other equipment needing the correct time. Option 34 allows a secure connection to configure, using either the preferred HTTPS Web Interface, or using the SSH Console.

Precision Time Protocol (PTP) Server

Option 34 allows the clock to act as a Precision Time Server (PTP) according to Standard IEEE 1588 2008. However for highest accuracy, the entire network where PTP is required must have PTP-enabled network components. Without hardware assist through the physical interface, PTP will provide time with the same accuracy as with NTP. Accuracy with hardware assist using PTP should be better than 1 microsecond. Accuracy without hardware assist should be better than 100 microseconds.

Configuration Protocols

Three types of configuration protocols are allowed on the Option 34: HTTP, HTTPS and Secure Shell (SSH). Of the three, HTTPS and SSH permit secure channels on the network between the user and the Option 34. If a secure channel is required, choose either HTTPS using the Web Interface, or SSH using the Console. HTTPS requires that a valid signed certificate (PEM file) be uploaded into the Option 34. Use of Console does not require a signed certificate. Both of these methods are discussed in the following pages, and both require a Username and Password to open a connection. To access Option 34 using the Web Interface you will need Web browser. To access

[2]IEEE 1588v2 – IEEE 1588-2008
[3]Includes RFC 5906, 5907 and 5908

Option 34 using the Console, you will need an SSH client. These instructions use an SSH client called PuTTY when describing the Console Interface. Option 34 comes by default configured for an HTTP connection, and may be configured to use HTTPS.

C.15.2 Option 34 Setup

This section covers initial setup of the Option 34, NTP/PTP server. Before the Option 34 can serve time accurately, the clock must be locked to the GPS and stable. Once meeting these conditions, the Option 34 can provide reliable time to a network. The three subsections below will guide you through this initial phase of starting up the clock and configuring Option 34.

Option 34 can be ordered with either static IP addresses, DHCP assigned IP addresses, or both static and DHCP. This information should help you decide how to configure the Option 34.

Note: If your Option 34 has fiber optic connectors installed, do not disconnect cable while clock is operating or the ntp/ptp service may not recover. If fiber optic cables are disconnected while clock is operating and service stops, power cycle the clock.

Default Port Addresses

By default, Option 34 comes configured as follows:

```
Port 1 IP address -- STATIC:  192.168.0.232
       Netmask                255.255.255.0
       Gateway                xxx.xxx.xxx.xxx

Port 2 IP address -- DHCP:    xxx.xxx.xxx.xxx
```

Selecting Option 34 in Clock

Before you can use Option 34 in your clock, make sure that it is selected as an option. Selection may be checked at the front panel for Models 1084B/C, 1088A/B and 1093B/C. For Models 1084A and 1093A, select it through the serial port. These instructions include both methods.

Clocks With a Display

Models 1084 and 1093 are very similar in that they have a main board option and aux board option. For these models, Option 34 is selected in the AUX Board section. Model 1088A/B has two choices: Slot A and Slot B. For Model 1088A/B, select Option 34 in the Slot B section.

1. Press the SETUP key until you reach “SET OPTION CONTROL” and press “ENTER”.
2. Navigate to either AUX Board Option or SLOT B Option, depending on clock model.
3. Use the UP key to select (OPTION) 34 and press “ENTER.”
4. Option 34 should now be selected in the clock.

Clocks Without a Display

Models 1084A and 1093A do not have a keypad or LCD display, so that Option 34 must be selected through the RS-232 port. To select Option 34, use a terminal program (HyperTerminal or Tera

Term[4]) and null-modem cable. Important pins for a null-modem cable are indicated in Table C.9 below.

PC Port Pins	Clock Port Pins	Port Function
2	3	Transmit
3	2	Receive
5	5	Ground

Table C.9: Null-Modem Cable Connections

1. Make sure that you have the terminal program open at the same baud rate as the clock. For 1084A and 1093A it will be 9600 baud.
2. Type the letter "v" to verify communication. It should return the firmware date code.
3. For Model 1084A, type "1,11,1084XI".
4. For Model 1093A, type "1,8,1093XI".
5. Option 34 should now be selected in your clock.
6. To test it, type "IP" and it should return the IP addresses of the two Ethernet ports. With no Ethernet cable connected to a port, the IP command will return dashes for the IP address of that port. The MAC address will still be returned as illustrated below.

```
NET1:192.168.000.232 64:73:E2:XX:XX:XX
NET2:---.---.---.--- 64:73:E2:XX:XX:XX
```

NTP Status Display Indications

GPS Clock and Server Stabilizing

During the stabilization process, the clock will display different status messages that indicate whether the NTP server is ready to serve time. Clock stabilization requires the clock to be locked to the GPS for a period of time after which it will provide its time to the Option 34. Press the STATUS key on the clock to access these status messages.

Server Status – Waiting for clock to lock to satellites

```
NTP: PLEASE WAIT...
PTP: PLEASE WAIT
```

Server Status – Waiting for NTP to stabilize (up to 1 hour)

```
NTP: UNLOCKED
PTP: RUNNING
```

Server Status – Normal Operation

```
NTP: SYNCHRONIZED
PTP: RUNNING
```

[4]To download a free copy of Tera Term, see Arbiter website at http://www.arbiter.com/software/index.php.

Server Status – Synchronization problem on Option 34

```
NTP: ERROR
PTP: RUNNING
```

After the Clock and Server Have Stabilized

After the GPS clock and NTP/PTP server have stabilized, press the Status button to view server status, link status and port addresses (IP and MAC address).

Server Status

```
NTP: SYNCHRONIZED
PTP: RUNNING
```

Link Status – indicates whether the network connection is good or bad.

```
NET1:  GOOD LINK
NET2:  BAD LINK
```

Port Address:

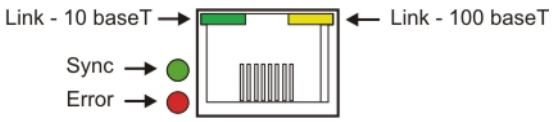
```
NET1:192.168.000.232
64:73:E2:XX:XX:XX
```

To Determine IP Address for 1093A/1084A

For clocks without a display, type "IP" at the terminal window, as explained in Section C.15.2, and the clock should return the IP and MAC addresses for both ports in separate lines.

Option 34 LED Indications

To view the Option 34 Status LEDs, see the Option 34 rear panel. The figure and Table C.10 below describe the indications.



LED Name	Color	Meaning
LINK	Steady Green	Good Link, 10 Mb/s
	Steady Yellow	Good Link, 100 Mb/s
	OFF	Bad Link
SYNC	Steady Green	NTP Server Synchronized
	OFF	NTP Server not Synchronized
ERROR	Red	Startup/Error
	OFF	No Errors

Table C.10: Option 34 LED Indications

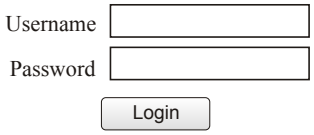
C.15.3 Web Interface

Instructions in this section cover the setup and maintenance of the Option 34 using the Web Interface. Configure the Option 34 insecurely through the Web Interface using HTTP, or securely using HTTPS. Both methods are discussed in this section. Instructions on using the Secure Shell (SSH) Console Interface for the same purpose are found in Section C.15.4. Option 34 may only be configured through one of the Ethernet ports. However, to configure the clock use the front panel or RS-232 port.

Logging in to the Web Interface

The Web Interface responds when you open a web browser and type in the IP address of one of its ports. IP address may also be viewed in the 1093B/C front panel display.

1. Connect an Ethernet cable between one of the Ethernet ports on the Option 34 and your network. This step should speed up the connecting process.
2. Open your web browser and type in the IP address of one of the ports in the web browser address bar. Normally, one of the Ethernet ports is assigned a static IP address. Press the STATUS key on the clock to determine which Ethernet port is assigned a static IP address and use that one.
3. Press the ENTER key, which should open the web interface login as seen below.



4. Type in the Username and Password. The Username is clockoption, and the default Password is password.
5. Click the Login button. If you typed in the correct Username and Password, the web interface should appear as shown in Figure C.13.

The IP Address

By default, Net1 Ethernet port is set to a static IP address and Net2 Ethernet port is set for DHCP. The front panel will indicate the IP address of each port provided a network cable is connected. Press the SETUP key to view any network-related information, such as the connection (Link) status, the IP address or hardware address.

Important Configuration Change Notes

Certain configuration changes will cause you to lose the web interface connection. These configuration changes include (1) changing from HTTP to HTTPS, (2) changing a Network configuration, or (3) changing a System configuration **on the port which you are connected**. If you are making changes to another port, the web interface connection will not be dropped. To make the changes persist, you will need to re-log in to the web interface using the new setting(s). To lose changes, reboot the clock. After making any changes to the NTP service, you may experience a delay of up to five minutes for the NTP service to start.

Startup Page – System

When logging in to the Option 34 using the web interface, the opening screen should be the System Status information page. This provides an overview of the operation of the Option 34, NTP/PTP servers. Figure C.13 illustrates the opening System Status page.

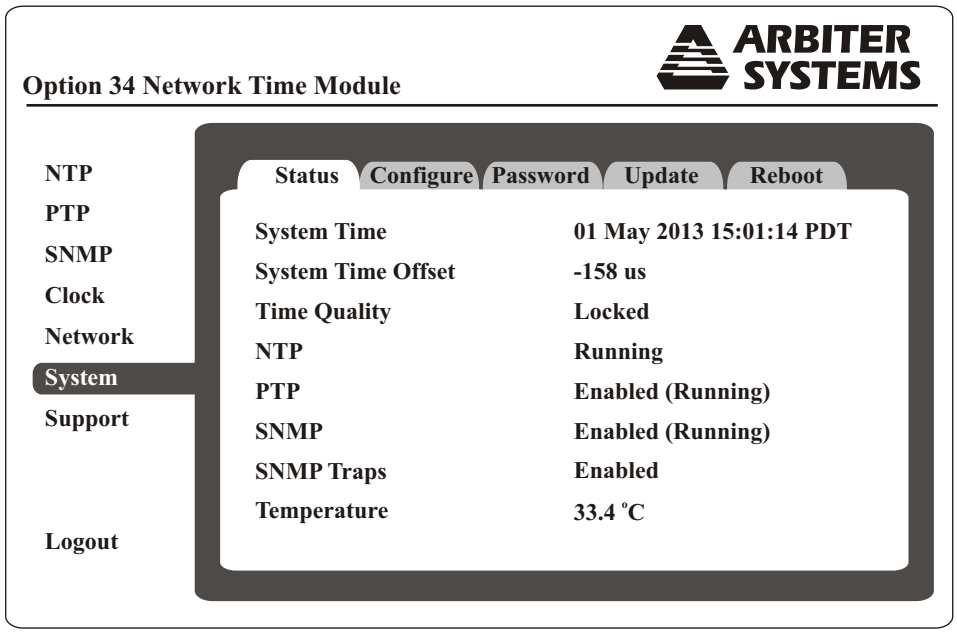


Figure C.13: Startup Page

System Configure Page

Figure C.14 illustrates the System configuration page for Option 34. It includes configuring for HTTP or HTTPS (see next section), enabling session time outs for the web interface and console, responding to ping requests and setting your time zone. Time zone setting only changes the time as it is read on the clock display. Just as the receiving device must convert the NTP/PTP time as it arrives at the device to local time zone, so the clock can display local time.

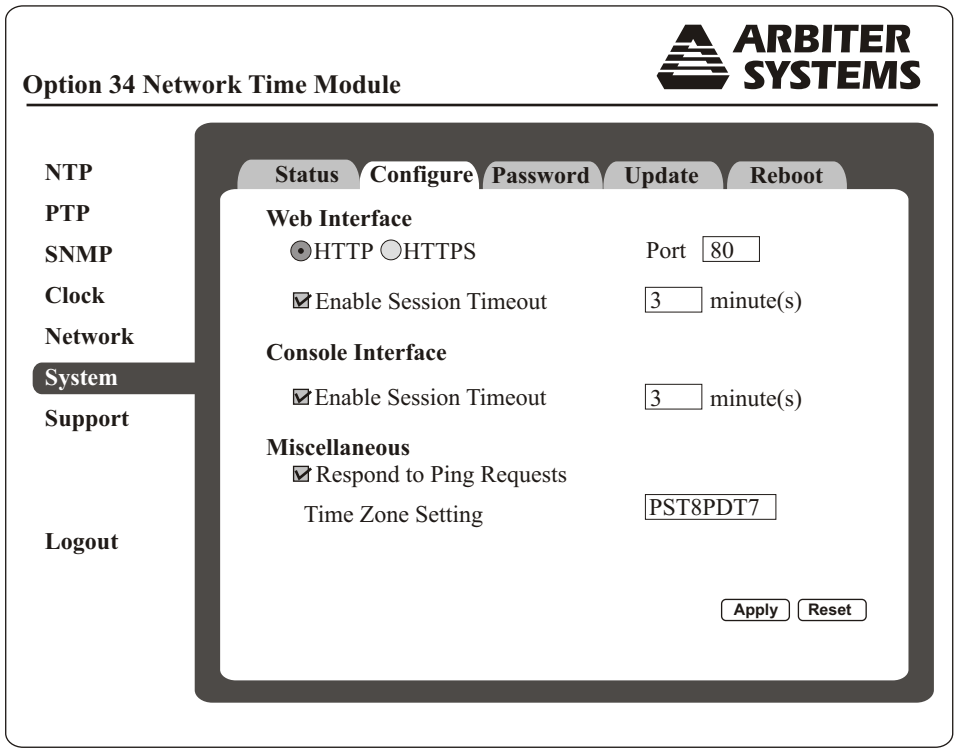


Figure C.14: System Configure Page

System Configure HTTPS Page

To configure the HTTPS page, follow these instructions. Figure C.15 shows how configuring for HTTPS protocol opens up a dialog to upload a PEM file to the Option 34 system. After opening the System Configuration page (shown in Section C.15.3 click the HTTPS button and it will open the PEM file dialog shown in Figure C.15. Notice that the ports have changed from 80 with HTTP to 443 with HTTPS.

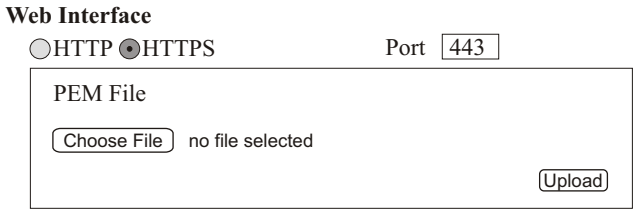


Figure C.15: Configure HTTPS

System Configure Password

To configure the system password follow these instructions. From Figure C.14, select the Password tab. Figure C.16 shows where to configure the System password. In the System page, click the Password tab and fill in the old and new password. Click the Apply button. Remember to write down any new password and keep it in a safe place.

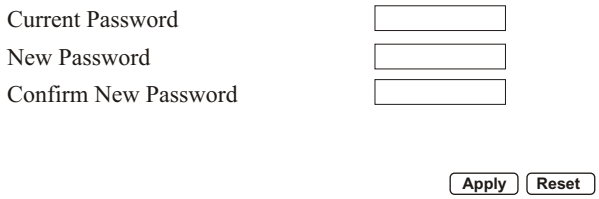


Figure C.16: Configure System Password

System Update

To update any Option 34 firmware package follow these instructions. From Figure C.14, select the Update tab and click the Choose File button shown in Figure C.17. This should open your file browser in which you should be able to locate the file package obtained from Arbiter Systems. Click the Update button and the file should load to the Option 34. After uploading the package the Option 34 must be rebooted for the changes to take effect.

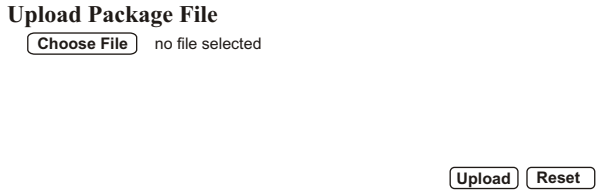


Figure C.17: Update System Firmware Package

System Reboot

To reboot the Option 34 follow these instructions. From Figure C.14 select the Reboot tab. Figure C.18 shows only one button to click to reboot the system. Be aware that rebooting the system will disconnect all active sesstions with the Option 34.

Figure C.18: Rebooting the System

Network Settings and Information

To view the network status of your Option 34 follow these instructions. Figure C.19 displays network status for both Ethernet ports, 1 and 2. This includes the IP addresses, MAC addresses and some standard data traffic statistics.

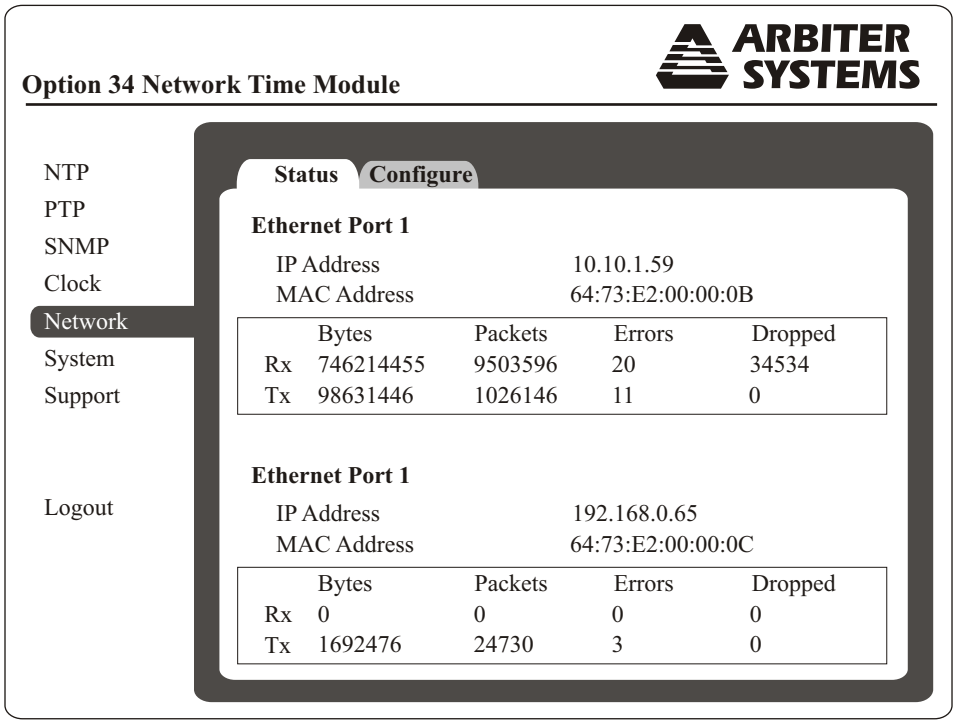


Figure C.19: Checking Network Status

Configure Network Settings

To configure the network settings of your Option 34 follow these instructions. Figure C.20 illustrates the configurable network functions on Option 34. Notice that the Ethernet Port 1 Mode is selected as DHCP and Ethernet Port 2 Mode is selected as Static. When selecting Static, the additional settings (i.e. Address, Netmask and Gateway) will appear.

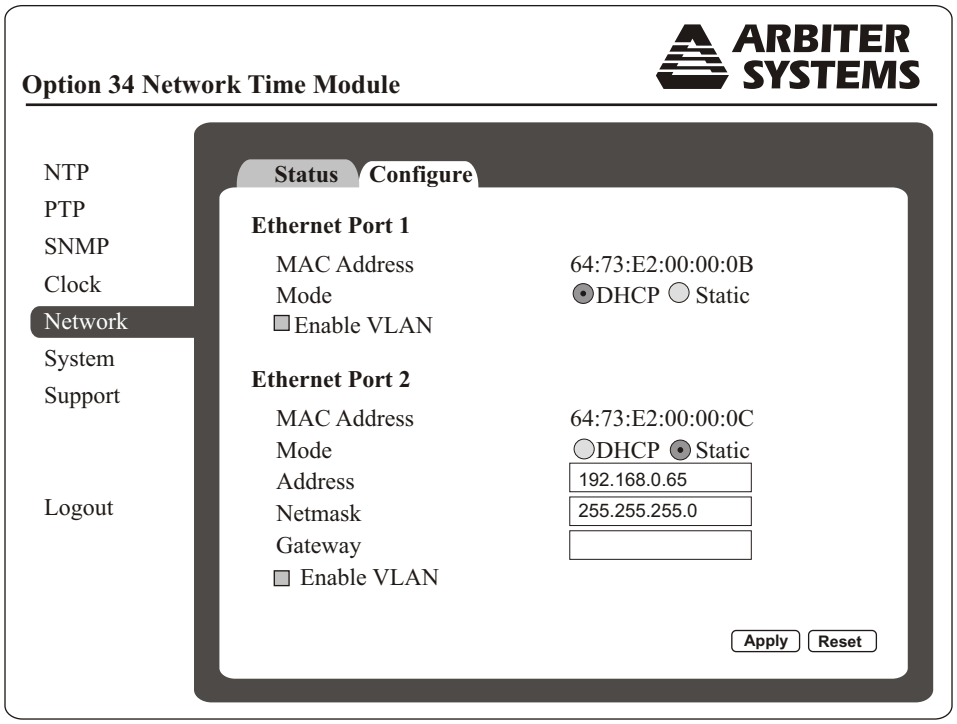


Figure C.20: Configure Network Settings

Configure VLAN

To configure VLAN network settings, follow these instructions. Check the box to the left of Enable VLAN to open these settings as seen in Figure C.21. Settings include an integer ID number, and priority value from 0 to 7 seen in the drop down box.

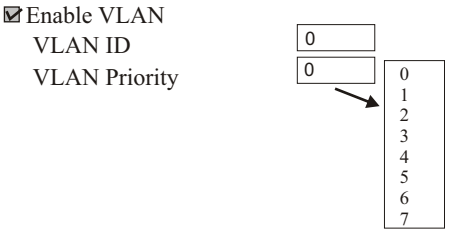


Figure C.21: Configure VLAN Network Settings

GPS Status and Time Quality

This web interface page displays basic GPS satellite information and time quality. Select this page to view Time Quality, Satellite information and Leap Seconds accumulated and pending, as shown in Figure C.22.

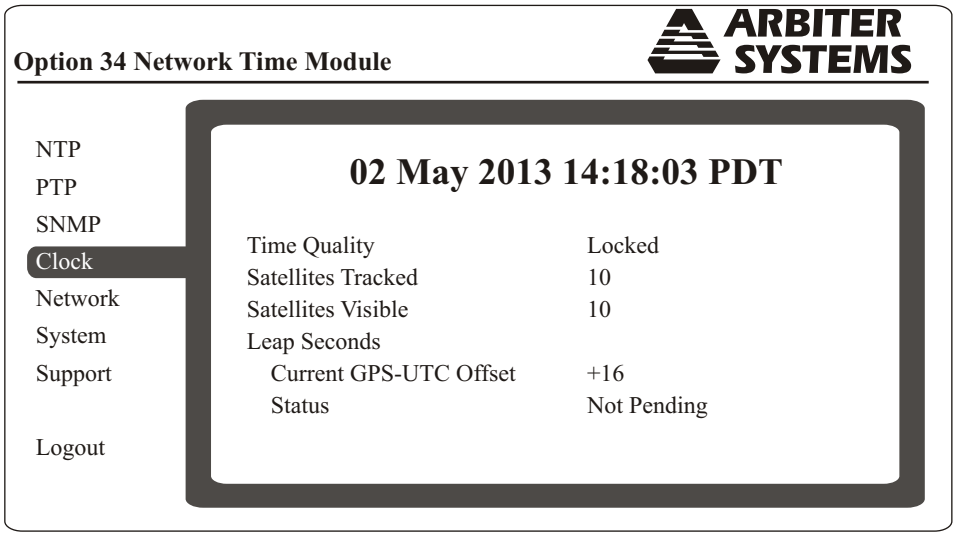


Figure C.22: View Operation

SNMP Status

View this web interface page to check the SNMP status as illustrated in Figure C.23. For additional detail on SNMP in the Model 1093A/B/C, see SNMP Support in Section C.15.5.

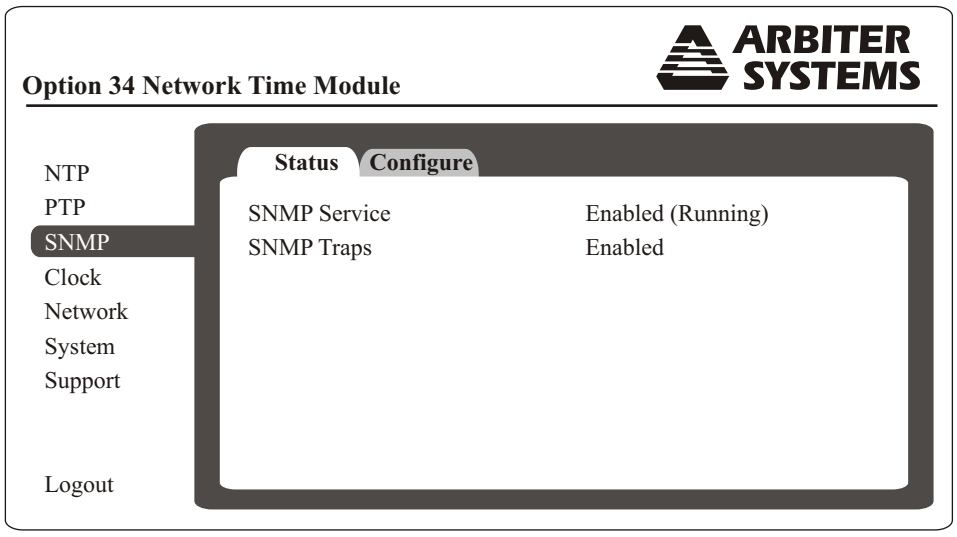


Figure C.23: View SNMP Operation

Configure SNMP

Follow these instructions to configure SNMP operation in the Option 34. Figure C.24 illustrates the different selections for enabling the service and selecting traps (notifications). For definitions of SNMP "Configure" selections, see Section C.15.5.

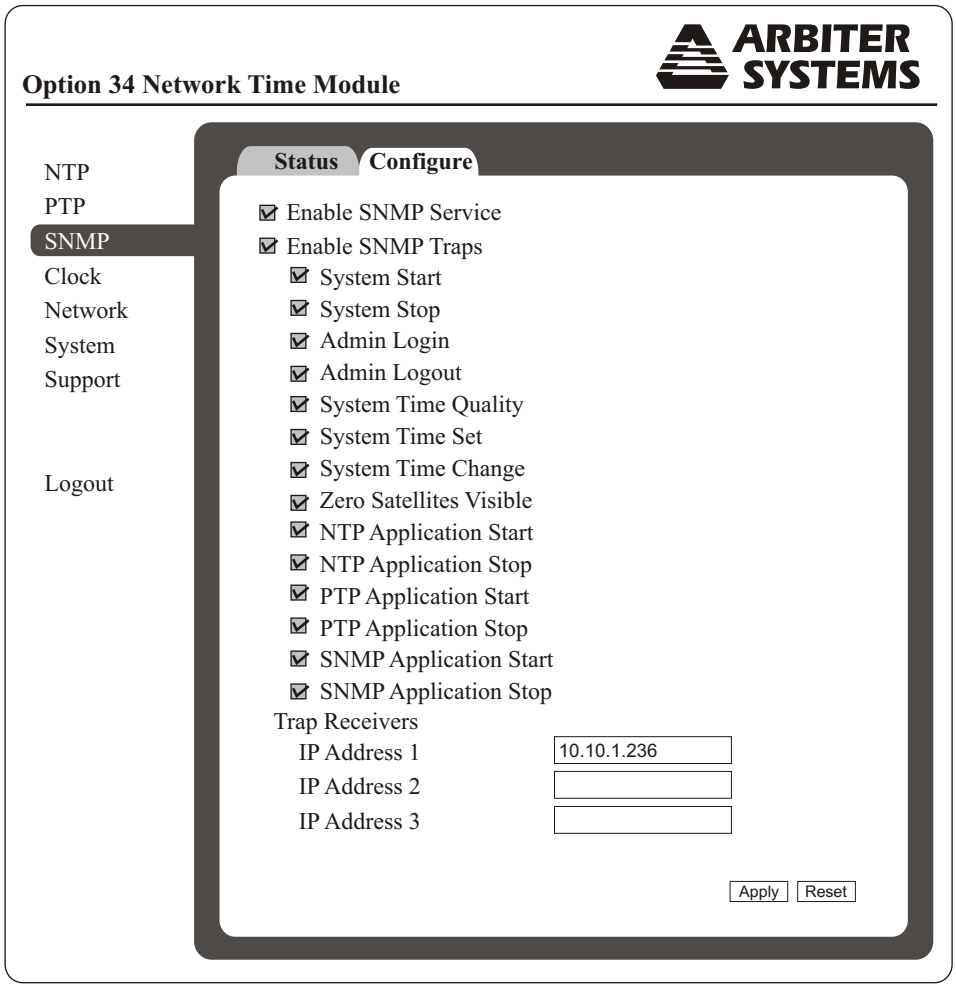


Figure C.24: SNMP Configuration Page

Checking the box enables the specific item; unchecking disables the specific item in the SNMP Configure page. For example, checking the "Enable SNMP Service" turns ON the service. Enabling SNMP Traps and checking specific SNMP traps (or notifications) will not send any notification unless a Trap Receiver is specified by an IP address. Make sure to click the Apply button or the changes will be lost.

PTP Status Page

To view the PTP service, select PTP tab on the left and the Status tab above. "+35" is the Current UTC-PTP Offset in seconds. Figure C.25 illustrates the status of PTP.

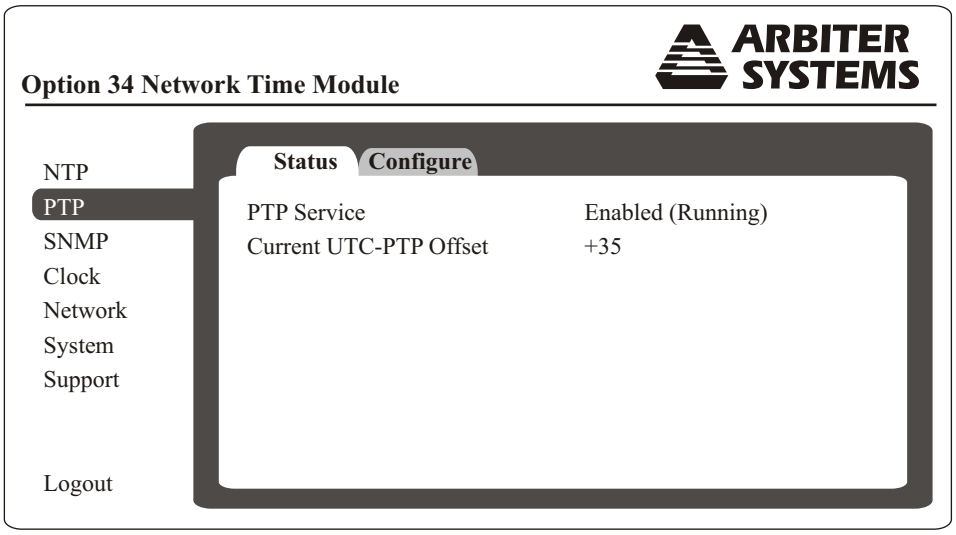


Figure C.25: PTP Status Page

PTP Configuration

To configure PTP follow these instructions. Figure C.26 illustrates the PTP configuration page. Choices for the Delay Mechanism include either P2P (Peer to Peer) or E2E (End to End). Protocol choices include UDP IPv4, UDP IPv6 or Layer 2. Figure C.26 shows the Advanced settings, which can be hidden using the Hide Advanced button.

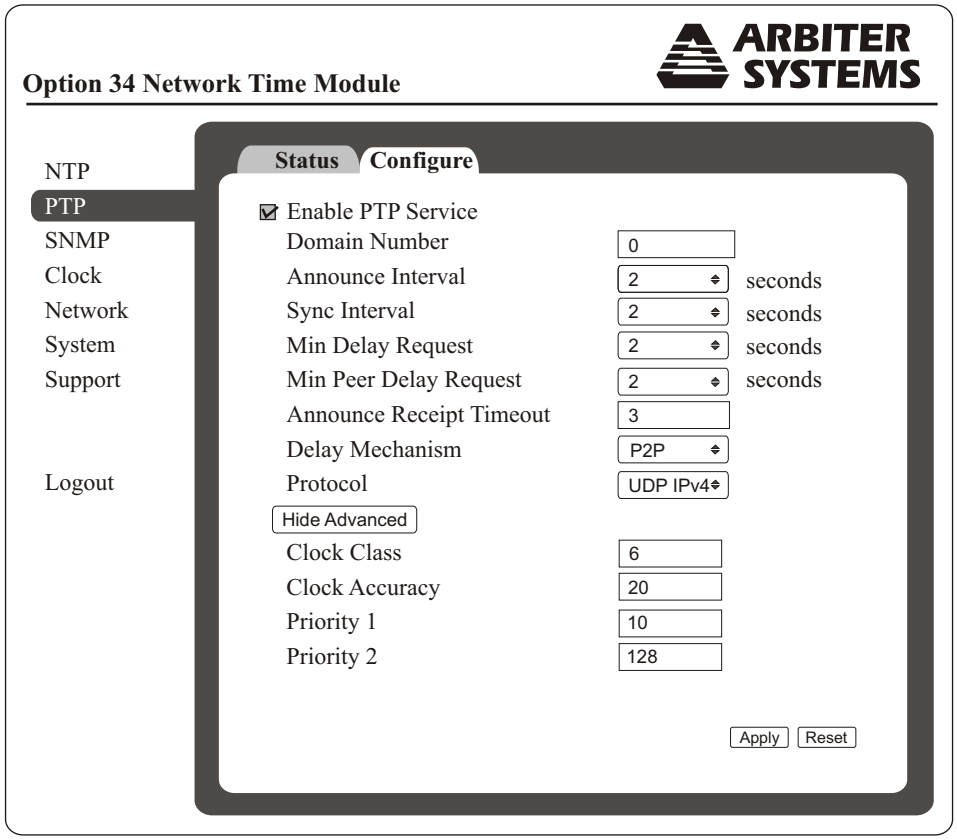


Figure C.26: PTP Configuration Page

PTP Terms

- Domain – a collection of one or more PTP subdomains. A subdomain is a logical grouping of 1588 clocks that synchronize to each other using the PTP protocol, but that are not necessarily synchronized to PTP clocks in another PTP subdomain. Subdomains provide a way of implementing disjoint sets of clocks, sharing a common network, but maintaining independent synchronization within each set.
- Announce interval – specifies the time for sending announce messages. The range is from 0 to 4 seconds; the default is 2 seconds.
- Sync interval – the time for sending synchronization messages. The range is from -1 to 1 seconds; the default is 1 second.
- Delay request interval – specifies the time recommended to the member devices to send delay request messages when the port is in the master state. The range is -1 second to 6 seconds. The default is 5 (32 seconds).

- Peer Delay Request – allows the requesting device to calculate the propagation delay for the individual segment.
- Announce receipt timeout – specifies the number of announceInterval that has to pass without receipt of an Announce message before the occurrence of the event ANNOUNCE_RECEIPT_TIMEOUT_EXPIRE.
- Delay mechanism – communication delay, end to end or peer to peer.
- Protocol – UDP IPv4, UDP IPv6 or Layer2.
- Clock class value – used to advertise the quality level of the clock. A GPS clock is given the value of 6.
- Clock accuracy – 22 is used for clock accuracy to within 250 ns.
- Priority 1 – used in the execution of the best master clock algorithm.
- Priority 2 – used in the execution of the best master clock algorithm.

NTP Status Page

To view the NTP service, select NTP tab on the left and the Status tab above. Figure C.27 illustrates the status of NTP.

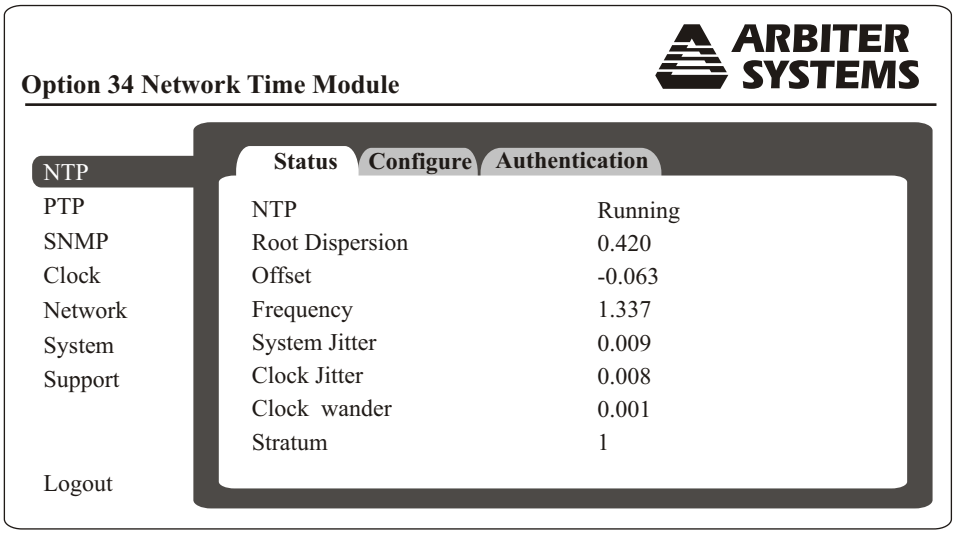


Figure C.27: NTP Status Page

NTP Terms

- NTP – either running or stopped.
- Root Dispersion – (or dispersion) represents the maximum error of the local clock relative to the reference clock.
- Offset – (or clock offset) represents the amount to adjust the local clock to bring it into correspondence with the reference clock.
- Frequency – frequency offset (PPM) relative to hardware clock.
- System Jitter (psi) – is defined as the root-mean-square (RMS) average of the most recent offset differences, and it represents the nominal error in estimating the offset (of the system).

- Clock Jitter – is defined as the root-mean-square (RMS) average of the most recent offset differences, and it represents the nominal error in estimating the offset (of the clock).
- Clock wander – is the RMS of exponentially weighted frequency differences. This is not used directly, but can, along with the jitter, be a highly useful monitoring and debugging tool.
- Stratum – the level of each server in the hierarchy is defined by a stratum number. Primary servers are assigned stratum one.

NTP Configure

To configure NTP follow these instructions. Figure C.28 illustrates the NTP configuration page. Choices for the NTP Version include Versions 1, 2, 3 and 4. Multicast and Broadcast addresses may be typed in the assigned boxes.

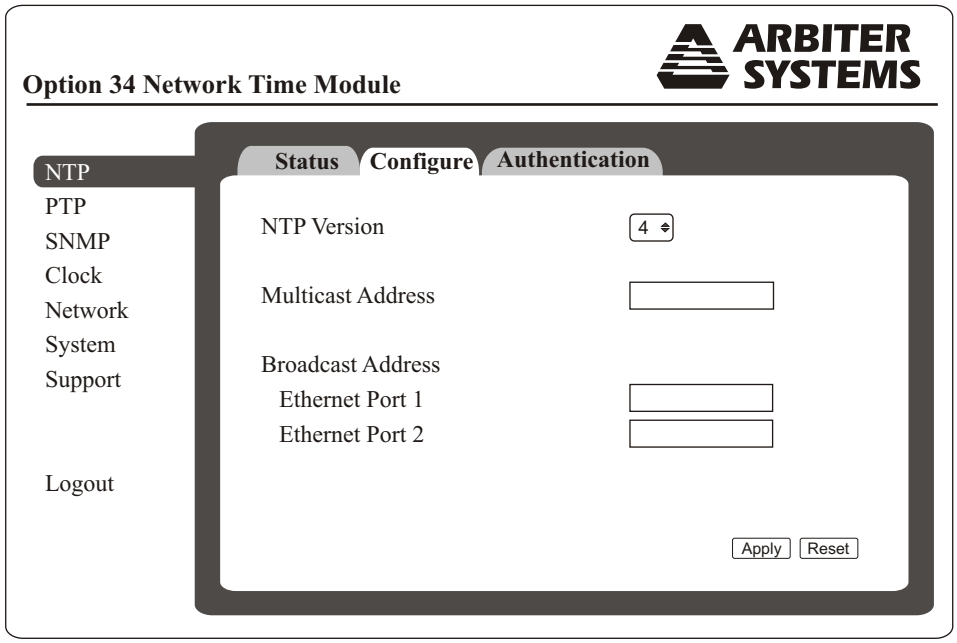


Figure C.28: NTP Configure Page

NTP Authentication

Authentication involves advanced configuration for NTP, and used to prevent tampering with the timestamps on the logs generated by devices. You can configure a device to authenticate the time sources to which the local clock is synchronized. When you enable NTP authentication, the device synchronizes to a time source only if the source carries one of the authentication keys specified by the ntp trusted-key command. The device drops any packets that fail the authentication check and prevents them from updating the local clock. NTP authentication is disabled by default.

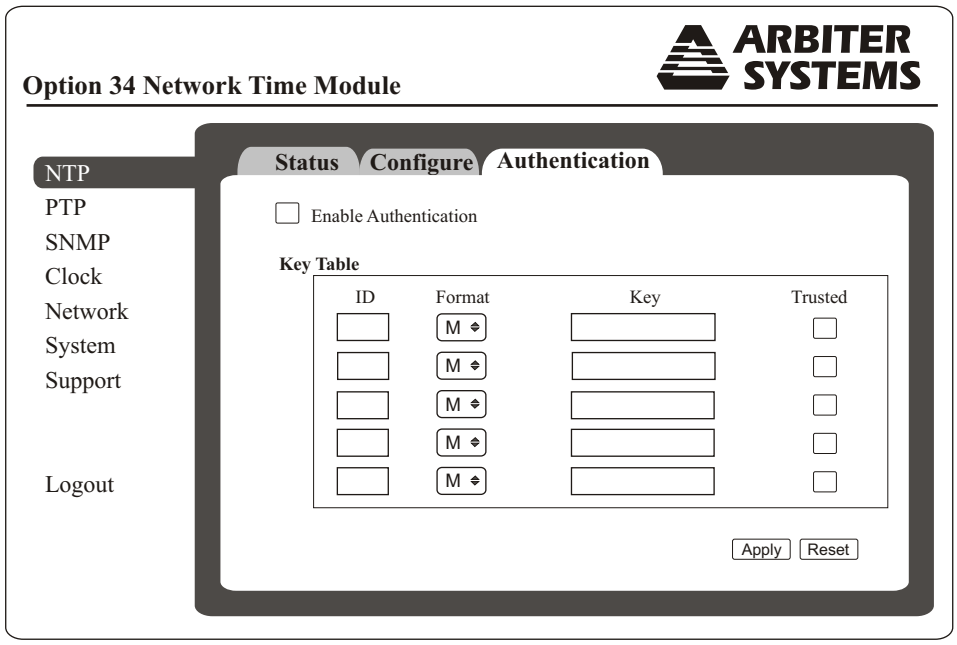
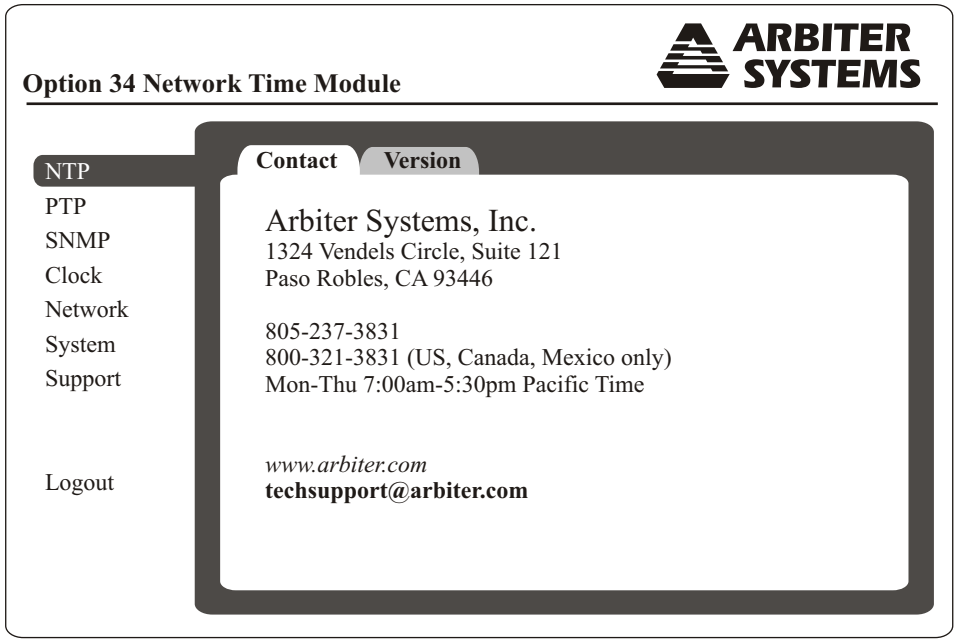


Figure C.29: NTP Authentication Page

There are four authentication formats (S, N, A, M) with different rules for each of the keys. For example, a type M format (MD5) allows the key to have up to 31 ASCII characters like a password. The key ID is an integer and identifies the NTP server key. If authentication is enabled, the client will only synchronize with the server if it is trusted. Therefore, you must select the "Trusted" check box on the authentication page.

Option 34 Support Pages

Use this page, with Figure C.30, to contact Arbiter Systems and for version support.



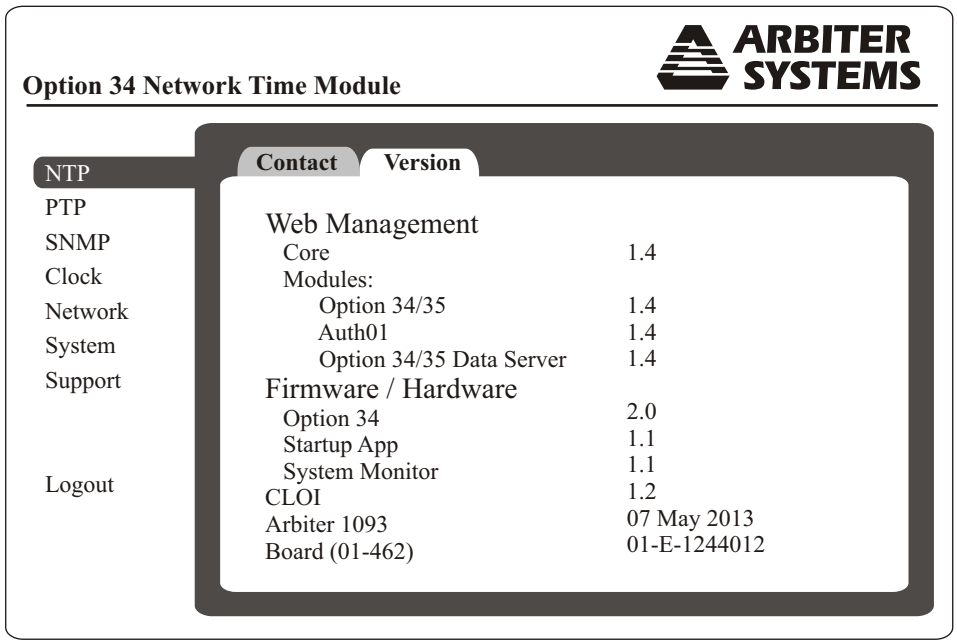


Figure C.30: Contact and Version Information Pages

C.15.4 SSH Console Interface

These instructions cover the setup and maintenance of the 1093A/B/C using the Secure Shell (SSH) Console Interface. Secure Shell is an alternative to using the Telnet protocol, and used for securely gaining access to a remote system like the Model 1093A/B/C. Configure all 1093A/B/C settings through one of the Ethernet ports. Instructions on using the Web Interface for the same purpose are found in section C.15.3.

Any Secure Shell (SSH) client, like OpenSSH or PuTTY^{TM}, is suggested. Make sure to select SSH and type in the device's IP address and connect. For Mac users, Terminal works fine. At the command prompt (▷ is the command prompt) type: ▷`ssh clockoption@ip_address`

Press ENTER after typing the IP address. Shortly, you should be prompted for the password. Type in the password and press ENTER. The console interface should open and appear similar to Figure C.31.

Startup Page – System Status

When logging in to the Option 34 using SSH console the opening screen should be the System Status information page. This provides an overview of the operation of the Option 34, NTP/PTP servers. Figure C.31 illustrates the opening page.

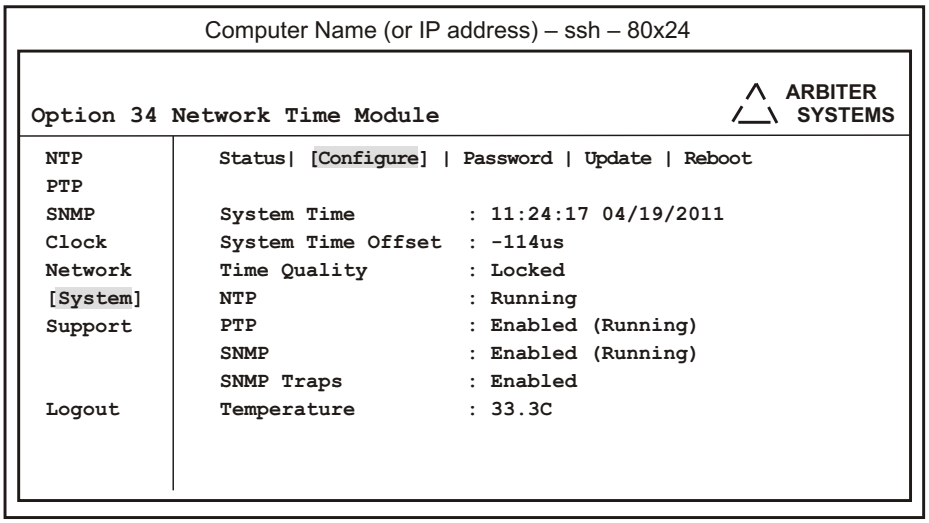


Figure C.31: SSH Console Interface – Startup Screen

If you do not know the IP address of the port you are connected to, press the STATUS key on the front panel. Messages should appear separately for NET1 (port 1) and for NET2 (port 2). If the IP addresses do not appear, then check to make sure a network cable is connected between the chosen port and an active network. If there is no DHCP server on the network, a port set for DHCP will not display. Factory default settings include one port set with a static IP address. Make sure that the Link LED is lit.

IP addresses for all Ethernet ports of the installed Option 34 are either set automatically by the Dynamic Host Configuration Protocol (DHCP) server on your network, or set to a static address. The front panel will indicate the IP address of each port.

Useful Keys for Console Navigation

Arrow Keys	–	navigate up, down, left, and right
Enter	–	accept the current selection
SPACE	–	accept the current selection except in edit fields (same as Enter)
Tab	–	cancel an edit/change
Q or q	–	select the Logout menu item

Use the cursor keys to navigate the console elements.

System Configure Page

Figure C.32 illustrates the System configuration page for Option 34. It includes configuring for HTTP or HTTPS (see next section), enabling session time outs for the web interface and console, responding to ping requests and setting your time zone. Time zone setting only changes the time as it is read on the clock display. Just as the receiving device must convert the NTP/PTP time as it arrives at the device to local time zone, so the clock can display local time.

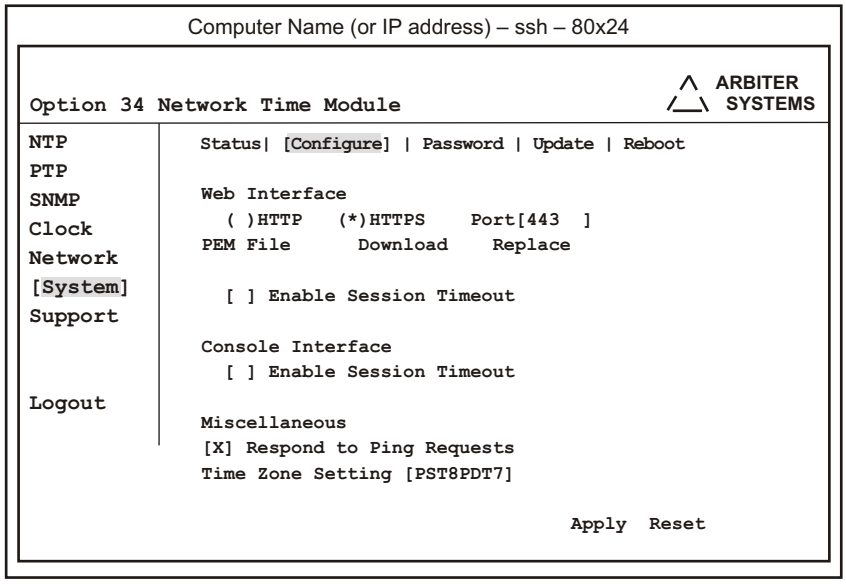


Figure C.32: System Configure Page Using SSH

Configure HTTPS Page

To configure the HTTPS page you must use the Web Interface. For more information see Section C.15.3.

Configure Session Timeouts

From the System Configure page, use the cursor keys to navigate to the specific timeout feature (either Web Interface or Console Interface) and press ENTER to select. Press ENTER again to deselect.

Configure Password

Using the cursor keys navigate to the System Password page (Figure C.33). In the System/Password page, fill in the old and new password. Remember to write down any new password and keep it in a safe place.

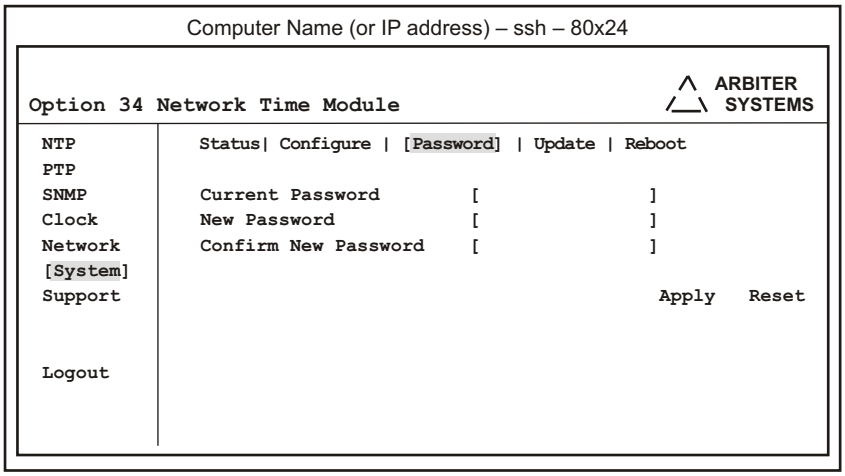


Figure C.33: Configure System Password Using SSH

System Update

Use the Web Interface to perform any update. For more information, see Section C.15.3.

System Reboot

Use the cursor keys to navigate to System Reboot, highlight Reboot and press ENTER. Select Yes or No to confirm your choice and press ENTER again. After the system has rebooted, you will need to log back on to Option 34.

Network Settings and Information

To view the network status of your Option 34 using the SSH Console follow these instructions. Use the cursor keys to navigate to Network Status (Figure C.34), which should display the network status for both Ethernet ports, 1 and 2. This includes the IP addresses, MAC addresses and some standard data traffic statistics.

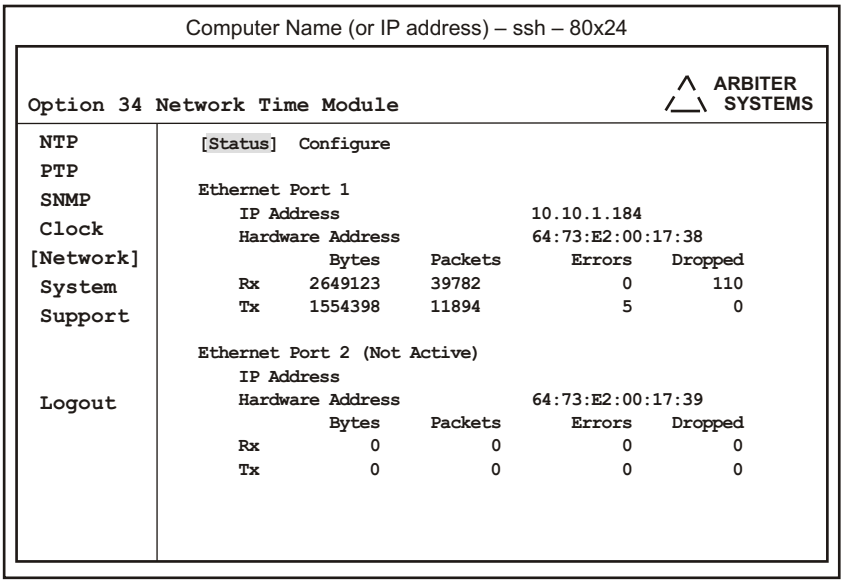


Figure C.34: Checking Network Status Using SSH

Configure Network Settings

To configure the network settings of your Option 34 follow these instructions. Figure C.35 illustrates the configurable network functions on Option 34. Notice that the Ethernet Port 1 Mode is selected as DHCP and Ethernet Port 2 Mode is selected as Static. When selecting Static, the additional settings (i.e. Address, Netmask and Gateway) will appear as seen on Ethernet Port 2.

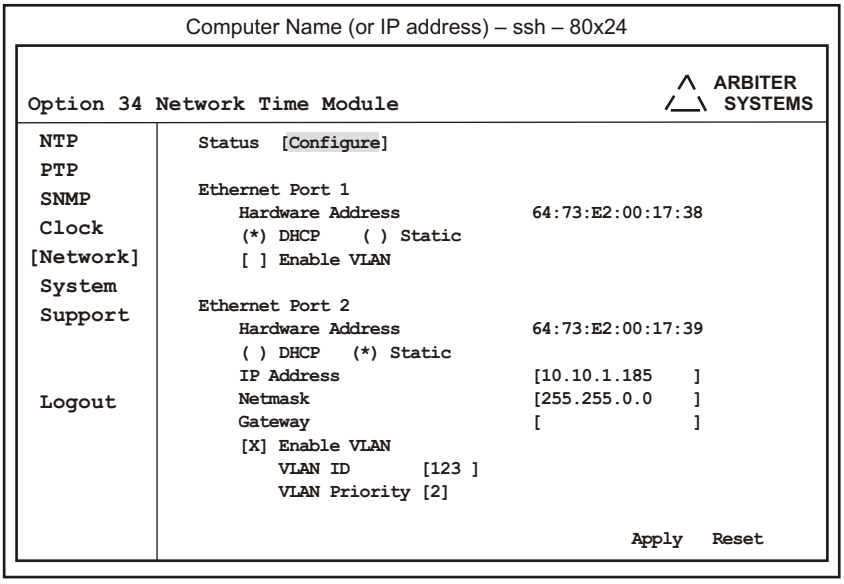


Figure C.35: Configure Network Settings Using SSH

Enable VLAN

From Figure C.35 notice that on Ethernet Port 2 that Enable VLAN is selected. When selected, the two lines below Enable VLAN appear. These two lines disappear when Enable VLAN is deselected. For VLAN ID, type in up to any four-digit integer. For VLAN Priority, type in any value between 0 and 7.

GPS Status and Time Quality

This web interface page displays basic GPS satellite information and time quality. Select this page to view Time Quality, Satellite information and Leap Seconds accumulated and pending, as shown in Figure C.36.

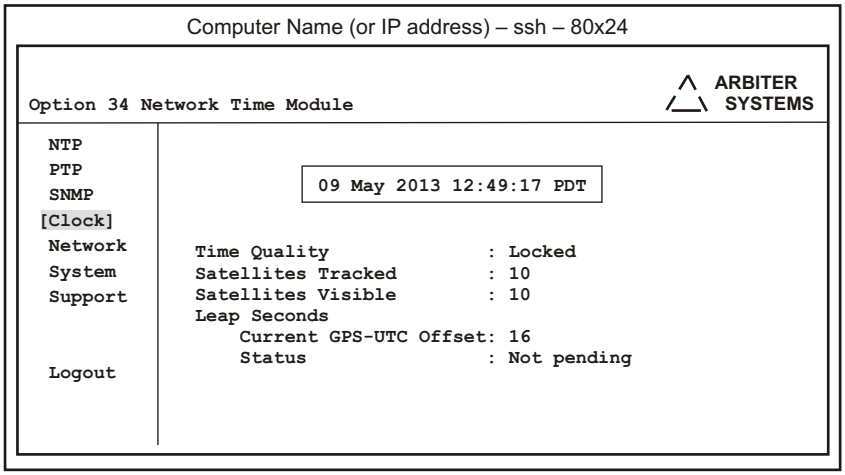


Figure C.36: View Operation Using SSH

SNMP Status

Use the cursor keys to select SNMP, then Status and press ENTER to view the SNMP status as illustrated in Figure C.37.

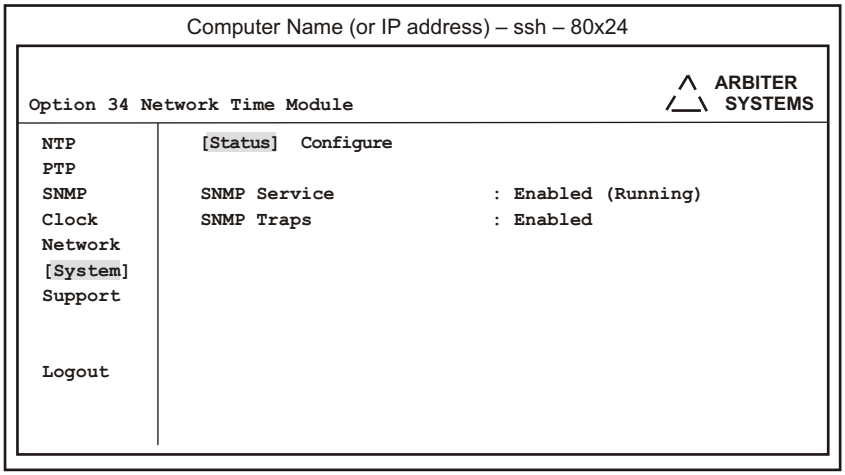


Figure C.37: View SNMP Operation Using SSH

Configure SNMP

Please use the Web Interface to configure SNMP. See Section C.15.3 for more instructions.

PTP Status Page

To view the PTP service, select PTP tab on the left and the Status tab above. Figure C.38 illustrates the status of PTP.

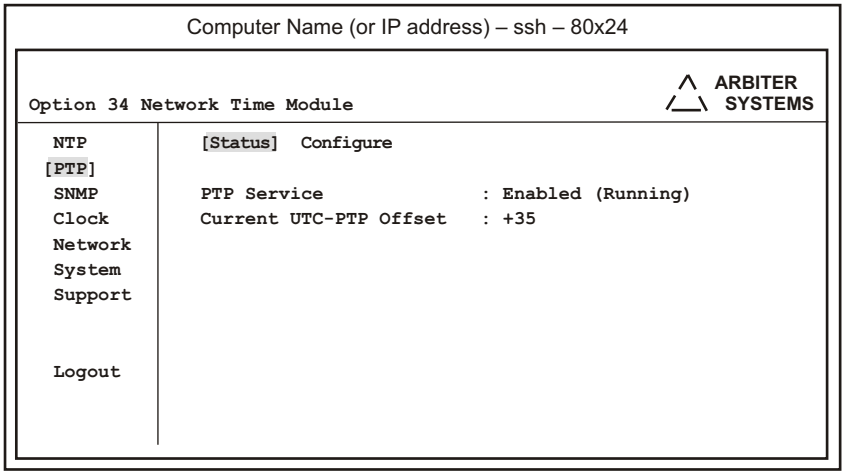


Figure C.38: PTP Status Page Using SSH

Configure PTP Service

Please use the Web Interface to configure PTP. See Section C.15.3 for more information.

NTP Status Page

Use the cursor keys to select NTP, then Status and press ENTER. Figure C.39 illustrates the status page for NTP.

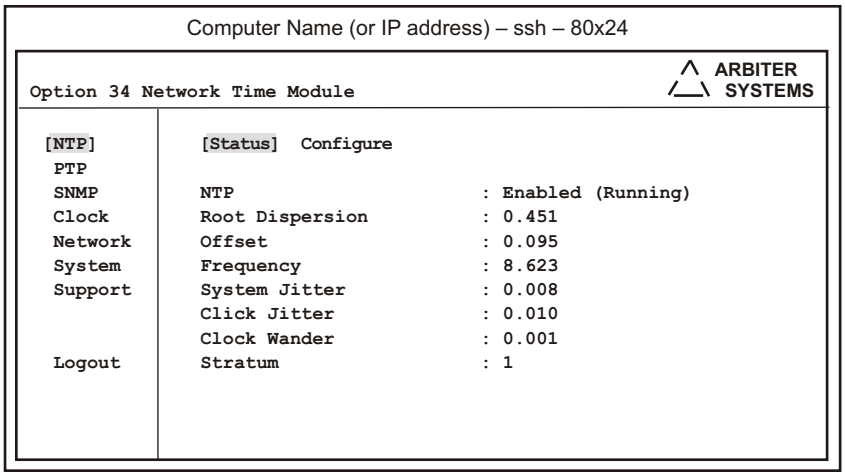


Figure C.39: NTP Status Page Using SSH

NTP Terms

- **NTP** – reveals that it is either running or stopped.
- **Root Dispersion** – (or dispersion) represents the maximum error of the local clock relative to the reference clock.
- **Offset** – (or clock offset) represents the amount to adjust the local clock to bring it into correspondence with the reference clock.
- **Frequency** – frequency offset (PPM) relative to hardware clock.
- **System Jitter** – is defined as the root-mean-square (RMS) average of the most recent offset differences, and it represents the nominal error in estimating the offset (of the system).
- **Clock Jitter** – is defined as the root-mean-square (RMS) average of the most recent offset differences, and it represents the nominal error in estimating the offset (of the clock).
- **Clock wander** – is the RMS of exponentially weighted frequency differences. This is not used directly, but can, along with the jitter, be a highly useful monitoring and debugging tool.
- **Stratum** – the level of each server in the hierarchy is defined by a stratum number. Primary servers are assigned stratum one.

NTP Configure

To configure NTP follow these instructions. Use the cursor keys to select NTP, then Configure and press ENTER. Figure C.40 illustrates the NTP configuration page. Choices for the NTP Version include Versions 1, 2, 3 and 4. Multicast and Broadcast addresses may be typed in the assigned boxes.

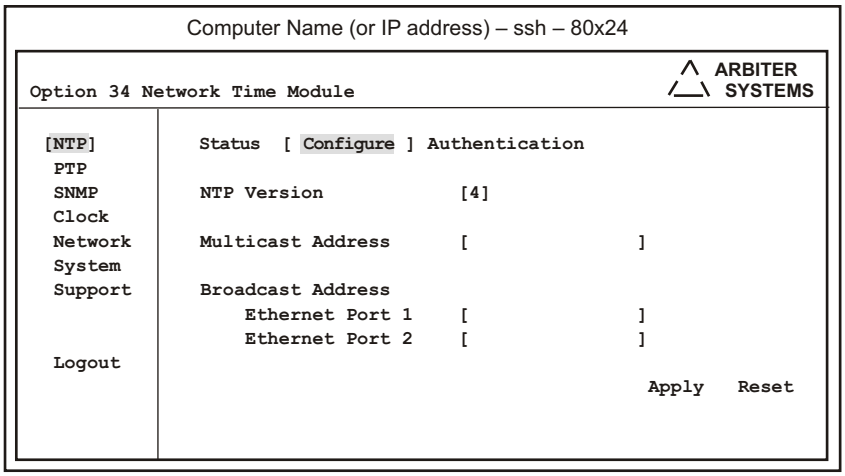


Figure C.40: NTP Configure Page Using SSH

NTP Authentication

Authentication involves advanced configuration for NTP, and used to prevent tampering with the timestamps on the logs generated by devices. You can configure a device to authenticate the time sources to which the local clock is synchronized. When you enable NTP authentication, the device synchronizes to a time source only if the source carries one of the authentication keys specified by the ntp trusted-key command. The device drops any packets that fail the authentication check and prevents them from updating the local clock. NTP authentication is disabled by default.

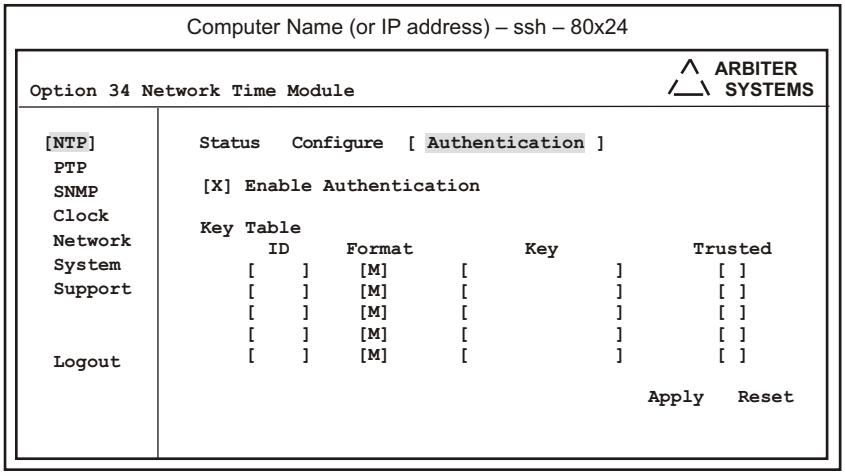


Figure C.41: NTP Authentication Page Using SSH

There are four authentication formats (S, N, A, M) with different rules for each of the keys. For example, a type M format (MD5) allows the key to have up to 31 ASCII characters like a password. The key ID is an integer and identifies the NTP server key. If authentication is enabled, the client will only synchronize with the server if it is trusted. Therefore, you must select the "Trusted" check box on the authentication page.

Option 34 Support Pages

Use this page, with Figure C.42, to contact Arbiter Systems and for version support.

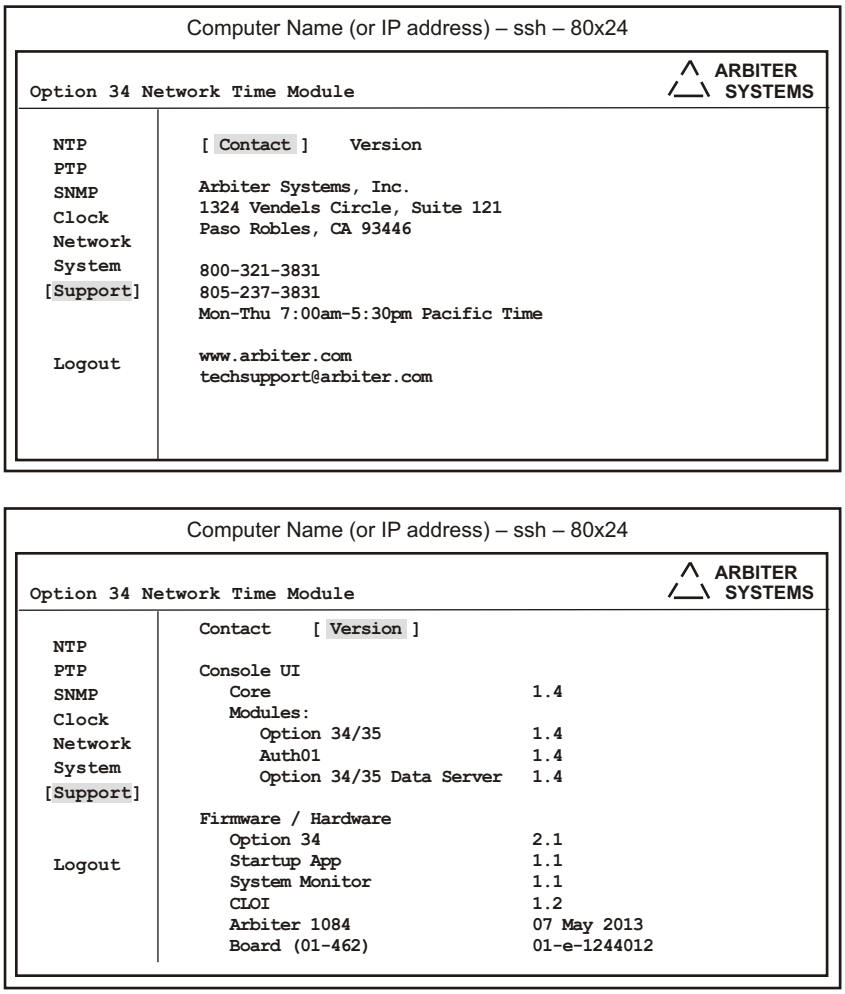


Figure C.42: Contact and Version Information Pages Using SSH

C.15.5 SNMP Support

This section reviews in some more detail SNMP on the Model 1093A/B/C. Simple Network Management Protocol (SNMP) was created to provide a standard for managing different networks and the devices on the networks. As such, SNMP is designed to operate on the application layer using different transport protocols (e.g. TCP/IP and UDP), making it independent of network hardware. SNMP operates on this basis in the Model 1093A/B/C.

An SNMP managed network consists of three components: A managed device, an agent and a network-management system (NMS). The 1093A/B/C is a managed device running an SNMP agent that responds to queries from the network-management system.

SNMP Version Information

Currently, there are three versions of SNMP defined: SNMP v1, v2 and v3. The Model 1093A/B/C supports these three versions. Here are some differences between versions.

SNMP v1. Basic Operations and Features

- GetUsed by the NMS to retrieve the value of one or more object instances from and agent.
- GetNextUsed by the NMS to retrieve the value of the next object instance in a table or a list within an agent.
- SetUsed by the NMS to set the values of the object instances within an agent.
- TrapUsed by agents to asynchronously inform the NMS of a significant event.

SNMP v2. Additional Operations and Features

- GetBulkUsed by the NMS to efficiently retrieve large blocks of data.
- InformAllows one NMS to send trap information to another NMS and to then receive a response.

SNMP v3. Security Enhancement

- User-based Security Model (USM) for SNMP message security.
- View-based Access Control Model (VACM) for access control.
- Dynamically configure the SNMP agents using SNMP SET commands.

Management Information Base (MIB) Table

Object names are stored in a (MIB) table that reside on a computer, and correspond to values in a managed device (the 1093A/B/C). The agent in the Option 34 will respond to queries from the management program to return values of these objects. The management program may also be able to configure some settings in the Model 1093A/B/C. See Section C.15.5 for a print out of the current MIB table. To obtain a soft copy of the MIB table for the Model 1093A/B/C, you may download it from the Arbiter Systems website at the following address: www.arbiter.com.

SNMP Service

Descriptions that follow are based on the web interface. The SNMP service (agent) runs on the Option 34 when enabled in the configuration. Figure C.23 illustrates the SNMP Status screen,

which shows that both the SNMP service and traps are enabled. To view the SNMP Status screen, log in to the Option 34 with the web interface and select the SNMP tab on the left.

Note that SNMP configuration is available only through the web interface.

SNMP Traps

SNMP Traps (v1) or Notifications (v2) may be used to:

- send notification of a change
- signify a problem with the system
- notify that some needed system maintenance was performed
- notify that someone has logged on to the system

Traps, or notifications, are generally sent to an IP address of a computer running SNMP management software. Option 34 can store up to three separate target IP addresses.

Enabling SNMP Service and Configuring SNMP Traps

To configure snmp, open your web browser and log in to the Option 34. *Note: SNMP cannot be configured using the SSH Console.* Select "SNMP" on the left and "Configure" tab at the top. Figure C.24 illustrates a list of selection boxes to configure your snmp service and traps. At the bottom are three boxes for IP addresses designated as trap receivers, where trap messages may be sent.

SNMP Configuration Reference

Listed below are the configurable options available for snmp traps. Trap events will only be sent out if the Trap Receivers are selected and identified by a valid IP address.

- **Enable SNMP Service** – Select this item to make the snmp service active.
- **Enable SNMP Traps** – Select this item to make any snmp trap active.
    1. **Enable System Start** – notifies when the "System" (i.e. Option 34) starts up.
    2. **Enable System Stop** – notifies when the "System" (i.e. Option 34) stops.
    3. **Enable Admin Login** – notifies when someone logs in to Option 34.
    4. **Enable Admin Logout** – notifies when someone logs out from Option 34.
    5. **System Time Quality** – notifies when the time quality changes.
    6. **System Time Set** – notifies when the system locks to the GPS after being turned on.
    7. **System Time Change** – notifies when the clock gets adjusted at some time after being initially set.
    8. **Zero Satellites Visible** – notifies when the clock loses lock.
    9. **NTP Application Start** – notifies when NTP service starts.
    10. **NTP Application Stop** – notifies when NTP service stops.
    11. **PTP Application Start** – notifies when PTP service starts.

12. **PTP Application Stops** – notifies when PTP service stops.
13. **SNMP Application Start** – notifies when SNMP service starts.
14. **SNMP Application Stop** – notifies when SNMP service stops.

- **Trap Receivers** – Select this item to enable SNMP to send messages to snmp receivers.
  1. **IP Address 1** – Type in the IP address of snmp receiver number 1.
  2. **IP Address 2** – Type in the IP address of snmp receiver number 2.
  3. **IP Address 3** – Type in the IP address of snmp receiver number 3.

MIB Table

The text of the MIB table, listed below, is current as of the publication date of this manual, and is produced by Arbiter's technical team. Updates are available by download from the Arbiter web site. Also, the SNMP agent that runs on Option 34 is also available for download and use in the Model 1093A/B/C. The MIB table is normally loaded in a MIB browser and the agent is normally uploaded into the Option 34.

```
–
– ARBITER ALL MIB, Revision 0.0003, 3 DEC 2012
–
ARBITER-ALL-MIB DEFINITIONS ::= BEGIN
IMPORTS
MODULE-IDENTITY, OBJECT-TYPE, enterprises, Integer32, Unsigned32 FROM SNMPv2-SMI
TEXTUAL-CONVENTION, TruthValue FROM SNMPv2-TC
;
–
– The position within the OID hierarchy of this MIB:
–
arbiter OBJECT IDENTIFIER ::= { enterprises 39849 }
sys MODULE-IDENTITY
LAST-UPDATED “201205250000Z”
ORGANIZATION “Arbiter Systems”
CONTACT-INFO
“
Arbiter Systems, Inc.
Paso Robles, CA
Tel: +1 805 237 3831”
DESCRIPTION
“This MIB module defines a MIB which provides general information
about an Arbiter Systems' product.”
::= { arbiter 1 }

device OBJECT IDENTIFIER ::= { sys 1 }
diag OBJECT IDENTIFIER ::= { sys 2 }
config OBJECT IDENTIFIER ::= { sys 3 }
gnss OBJECT IDENTIFIER ::= { sys 4 }
```

```
systrap OBJECT IDENTIFIER ::= { sys 5 }

ntp MODULE-IDENTITY
LAST-UPDATED “201205230000Z”
ORGANIZATION “Arbiter Systems”
CONTACT-INFO
“
Arbiter Systems, Inc.
Paso Robles, CA
Tel: +1 805 237 3831”
DESCRIPTION
“This MIB module defines a MIB which provides mechanisms to
monitor and control an NTP server.”
::= { arbiter 3 }

ntpsys OBJECT IDENTIFIER ::= { ntp 1 }
ntptrap OBJECT IDENTIFIER ::= { ntp 2 }

–
– Textual Conventions:
–

MilliUnits ::= TEXTUAL-CONVENTION
DISPLAY-HINT “d-3”
STATUS current
DESCRIPTION “”
SYNTAX INTEGER

MicroUnits ::= TEXTUAL-CONVENTION
DISPLAY-HINT “d-6”
STATUS current
DESCRIPTION “”
SYNTAX INTEGER

–
– General Device Information
–
sysDevLabel OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “String identifier for the General Information group.”
::= { device 1 }

sysDevProduct OBJECT-TYPE
SYNTAX OCTET STRING
```

MAX-ACCESS read-only
STATUS current
DESCRIPTION “The product family on which this agent is running.”
::= { device 2 }

sysDevModel OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { device 3 }

sysDevSerialNumber OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { device 4 }

version OBJECT IDENTIFIER ::= { device 5 }

sysDevVerLabel OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { version 1 }

sysDevVerCore OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { version 2 }

sysDevVerMonitor OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { version 3 }

sysDevVerCLOI OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current

DESCRIPTION “The device model.”
::= { version 4 }

sysDevVerClock OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { version 5 }

sysDevVerNTP OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { version 6 }

sysDevVerPTP OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { version 7 }

sysDevVerSNMP OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { version 8 }

sysDevClockModel OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The device model.”
::= { device 6 }

sysDiagLabel OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “Diagnostic information.”
::= { diag 1 }

sysDiagTemp OBJECT-TYPE

SYNTAX MilliUnits
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The current temperature of the device.”
::= { diag 2 }

sysDiagTimeQuality OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “Clock time quality status.”
::= { diag 3 }

sysDiagNtpStatus OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “The operational status of NTP”
::= { diag 4 }

rec1 OBJECT IDENTIFIER ::= { gnss 1 }

gnssRec1Label OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “String identifier for receiver 1.”
::= { rec1 1 }

gnssRec1Type OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “Receiver 1 GNSS system type.”
::= { rec1 2 }

gnssRec1SatsVisible OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only
STATUS current
DESCRIPTION “Number of GNSS Satellites visible to receiver 1”
::= { rec1 3 }

gnssRec1SatsTracked OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only

```
STATUS current
DESCRIPTION “Number of GNSS Satellites tracked by receiver 1”
::= { rec1 4 }

systrapPowerUp OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “System powering up”
::= { systrap 1 }

systrapShutDown OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “System shutting down”
::= { systrap 2 }

systrapAdminLogin OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “System administrative login”
::= { systrap 3 }

systrapAdminLogout OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “System administrative logout”
::= { systrap 4 }

systrapTimeQuality OBJECT-TYPE
SYNTAX INTEGER32
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “System time quality change”
::= { systrap 5 }

–
– NTP System Group
–
ntpSysString OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
```

DESCRIPTION “ String identifier for the NTP System Group.”
::= { ntpsys 1 }

ntpSysClock OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “the current local time. Local time is derived
from the hardware clock of the particular machine and
increments at intervals depending on the design used.”
::= { ntpsys 2 }

ntpSysClockDateTime OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “the current local time. Local time is derived
from the hardware clock of the particular machine and
increments at intervals depending on the design used.”
::= { ntpsys 3 }

ntpSysOffset OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only
STATUS current
DESCRIPTION “”
::= { ntpsys 4 }

ntpSysFreq OBJECT-TYPE
SYNTAX MilliUnits
MAX-ACCESS read-only
STATUS current
DESCRIPTION “”
::= { ntpsys 5 }

ntpSysSysJitter OBJECT-TYPE
SYNTAX MilliUnits
MAX-ACCESS read-only
STATUS current
DESCRIPTION “”
::= { ntpsys 6 }

ntpSysClkJitter OBJECT-TYPE
SYNTAX MilliUnits
MAX-ACCESS read-only
STATUS current

DESCRIPTION “”
::= { ntpsys 7 }

ntpSysClkWander OBJECT-TYPE
SYNTAX MilliUnits
MAX-ACCESS read-only
STATUS current
DESCRIPTION “”
::= { ntpsys 8 }

ntpSysRootDelay OBJECT-TYPE
SYNTAX MilliUnits
MAX-ACCESS read-only
STATUS current
DESCRIPTION “the total roundtrip delay to the primary
reference source at the root of the synchronization
subnet, in seconds”
::= { ntpsys 9 }

ntpSysRootDispersion OBJECT-TYPE
SYNTAX MilliUnits
MAX-ACCESS read-only
STATUS current
DESCRIPTION “ the maximum error relative to the primary
reference source at the root of the synchronization
subnet, in seconds. Only positive values greater
than zero are possible”
::= { ntpsys 10 }

ntpSysLeap OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only
STATUS current
DESCRIPTION “ two-bit code warning of an impending leap
second to be inserted in the NTP timescale.”
::= { ntpsys 11 }

ntpSysStratum OBJECT-TYPE
SYNTAX Integer32 (0..255)
MAX-ACCESS read-only
STATUS current
DESCRIPTION “ indicating the stratum of the local clock.
0, unspecified
1, primary reference (e.g.,, calibrated atomic clock,
radio clock)
2-255, secondary reference (via NTP)”

::= { ntpsys 12 }

ntpSysPrecision OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only
STATUS current
DESCRIPTION “signed integer indicating the precision
of the various clocks, in seconds to the nearest power
of two.”
::= { ntpsys 13 }

ntpSysRefTime OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS read-only
STATUS current
DESCRIPTION “ the local time when the local clock was last
updated. If the local clock has neverbeen synchronized,
the value is zero.”
::= { ntpsys 14 }

ntptrapPowerUp OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “NTP server powering up”
::= { ntptrap 1 }

ntptrapShutDown OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “NTP server shutting down”
::= { ntptrap 2 }

ntptrapSynchronized OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “NTP server synchronized to GPS”
::= { ntptrap 3 }

ntptrapSynchronizationLost OBJECT-TYPE
SYNTAX OCTET STRING
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION “NTP server GPS synchronized lost”

::= { ntptrap 4 }

END

NTP MIB Object Definitions

- **ntpSysLeap** – two-bit code warning of an impending leap second to be inserted in the NTP timescale.
- **ntpSysStratum** – indicating the stratum of the local clock. 0, unspecified; 1, primary reference (e.g., calibrated atomic clock, radio clock); 2 – 255, secondary reference (via NTP).
- **ntpSysPrecision** – signed integer indicating the precision of the various clocks, in seconds to the nearest power of two.
- **ntpSysRootDelay** – the total roundtrip delay to the primary reference source at the root of the synchronization subnet, in seconds.
- **tpSysRootDispersion** – the maximum error relative to the primary reference source at the root of the synchronization subnet, in seconds. Only positive values greater than zero are possible.
- **ntpSysRefId** – the particular reference clock. In the case of stratum 0 (unspecified) or stratum 1 (primary reference source), this is a pour-octet, left-justified, zero-padded ASCII string. In the case of stratum 2 and greater (secondary reference) this is the four-octet Internet address of the peer selected for synchronization.
- **ntpSysRefTime** – the local time when the local clock was last updated. If the local clock as never been synchronized, the value is zero.
- **ntpSysPoll** – the minimum interval between transmitted messages, in seconds as a power of two. For instance, a value of six indicates a minimum interval of 64 seconds.
- **ntpSysPeer** – the current synchronization source. Usually this will be a pointer to a structure containing the peer variables. The special value NULL indicates there is no currently valid synchronization source.
- **ntpSysPhase** – The system clock offset per selected source. (needs verification)
- **ntpSysFreq** – The system clock frequency correction per ntpd. (needs verification)
- **ntpSysError** – The current system error per ntpd? (needs verification)
- **ntpSysClock** – the current local time. Local time is derived from the hardware clock of the particular machine and increments at intervals depending on the design used.
- **ntpSysSystem** – the type of local Operating System.
- **ntpSysProcessor** – the type of the local Processor.

C.15.6 Specifications

Performance

NTP:	< 100 microseconds, depending on network load and clock accuracy
PTP:	< 100 microseconds (software) < 1 microsecond with hardware assist

Interface

Network	Two Ethernet (Version 2.0/IEEE 802.3) 10/100BT or multimode SSF modules
Protocols	NTP, SNTP, PTP (IEEE 1588™-2008), UDP, ICMP, SNMP, TCP, SSH, SCP, SSL, HTTP, HTTPS.

Operator Interface

Management	Web and SSH Console
Status LEDs	Sync (green) Fault (red) Link (green – 10baseT, yellow – 100baseT)
Setup	IP number (DHCP or Static) Net Mask Reference Identifier UDP Broadcast parameters MD5 and DES authentication keys are optional

C.15.7 HTTPS/SSL Certificate

This section discusses a method of generating a PEM file for use with HTTPS. As is the case with any web server, in order to provide a secure connection via HTTPS, the Option 34 must be configured with an SSL Certificate. The Option 34 uses a single PEM File which includes the private key and the certificate. This guide illustrates a method of creating a PEM File using the free and publicly available OpenSSL package. OpenSSL is merely one of many possible solutions – please see your toolkit documentation for exact instructions. This guide assumes you have already downloaded and installed the OpenSSL tools on a Linux system.

Note: In the following examples, the symbol '▷' denotes the command prompt.

Step 1 - Generate a Private Key

The following command will generate a 1024 bit RSA private key. Please keep this file safe, secure, and not accessible to the public.

```
▷openssl genrsa -out private.key 1024
```

The generated file (private.key) might look like the following:

```
-----BEGIN RSA PRIVATE KEY-----
MIICXgIBAAKBgQDPoNigXmq2JAlw9DrDOP5Og5c5xsEnt9bPjfuE7MGkDEGN09sC

...more data...

8XxzzgU4xizBdLmONkHu7b/h7GL6u5smkWVOCesCCROmKw==
-----END RSA PRIVATE KEY-----
```

Step 2 - Generate a Certificate Signing Request (CSR)

The following command will generate a CSR (certificate signing request) file using the private key generated in Step 1. OpenSSL will prompt for several pieces of information, our example responses are in BOLD text. If you are purchasing a certificate from a commercial vendor, the information provided during this step must match exactly the information you will be providing to the vendor.

```
▷openssl req -new -key private.key -out my.csr

You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:US
State or Province Name (full name) [Some-State]:California
Locality Name (eg, city) [ ]:Paso Robles
Organization Name (eg, company) [Widgits Pty Ltd]:Arbiter Systems, Inc.
```

```
Organizational Unit Name (eg, section) [ ]:Lab
Common Name (eg, YOUR name) [ ]:
Email Address [ ]:  techsupport@arbiter.com

Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password [ ]:
An optional company name [ ]:
```

The generated file (my.csr) might look like the following:

```
-----BEGIN CERTIFICATE REQUEST-----
MIIBsDCCARkCAQAwcDELMAkGA1UEBhMCVVMxEzARBgNVBAgTCkNhbGlmb3JuaWEx

...more data...

YA/JCw==
-----END CERTIFICATE REQUEST-----
```

Step 3A - Purchase a Certificate

To prevent web browsers from warning users about untrusted certificates, an SSL Certificate must be purchased from a trusted authority. If you do not require this level of protection, you may go to Step 3B (Generate a Self Signed Certificate).

Most certificate vendors will ask for the generated CSR file (from Step 2) to be pasted into a field in a web page during the purchase procedure. Be sure to copy the entire contents of the file (including the BEGIN and END tags with the dashes) into the vendor's web form.

Once the purchase has been completed, and other verification steps completed (this will vary from vendor to vendor), they will provide you with a certificate file. You may skip to Step 4.

Step 3B - Generate a Self Signed Certificate

If you do not need a commercially purchased certificate, the following command will generate a Self Signed Certificate using the files created from steps 1 and 2. Most web browsers will warn users that the certificate is not trusted or signed by a trusted authority. Also note that the certificate generated will be valid for 365 days. After this period, users will be additionally warned about an expired certificate until a new certificate is generated and uploaded to the Option 34.

```
▷openssl x509 -req -days 365 -in my.csr -signkey private.key -out my.crt
```

The generated file (my.crt) might look like the following:

```
-----BEGIN CERTIFICATE-----
MIICVzCCAcACCQC7uu43uMF1+jANBgkqhkiG9w0BAQUFADBwMQswCQYDVQQGEwJV

...more data...

Jo+H1MXknNISZtcu/xb9gghHG42veveZSg72
-----END CERTIFICATE-----
```

Step 4 - Create the PEM File

Once you have a purchased or self signed certificate file, the following command will create a single PEM file including the key and the certificate from the previous steps.

```
▷cat private.key my.crt > mycert.pem
```

Please note the “greater than” symbol ‘>’ between ‘my.crt’ and ‘mycert.pem’.

The file mycert.pem can now be uploaded to the Option 34 in order to enable HTTPS.

C.15.8 Time Zone Format Strings

This section lists some common time zones as discussed on page 143. For further information regarding the time zone format, please go to the following link:

http://www.gnu.org/s/hello/manual/libc/TZ-Variable.html.

Some Useful Time Zone Values

“Greenwich Mean Time”	GMT0	–	
“Universal Coordinated Time”	UTC0	“Guam Standard Time”	GST-10
“Fernando De Noronha Std”	FST2FDT	“Eastern Australian Standard”	EAS-10EAD
“Brazil Standard Time”	BST3	“Central Australian Standard”	CAS-9:30CAD
“Eastern Standard (Brazil)”	EST3EDT	“Japan Standard Time”	JST-9
“Greenland Standard Time”	GST3	“Korean Standard Time”	KST-9KDT
“Newfoundland Standard Time”	NST3:30NDT	“China Coast Time”	CCT-8
“Atlantic Standard Time”	AST4ADT	“Hong Kong Time”	HKT-8
“Western Standard (Brazil)”	WST4WDT	“Singapore Standard Time”	SST-8
“Eastern Standard Time”	EST5EDT	“Western Australian Standard”	WAS-8WAD
“Chile Standard Time”	CST5CDT	“Java Standard Time”	JST-7:30
“Acre Standard Time”	AST5ADT	“North Sumatra Time”	NST-7
“Cuba Standard Time”	CST5CDT	“Indian Standard Time”	IST-5:30
“Central Standard Time”	CST6CDT	“Iran Standard Time”	IST-3:30IDT
“Easter Island Standard”	EST6EDT	“Moscow Standard Time”	MSK-4
“Mountain Standard Time”	MST7MDT	“Eastern Europe Time”	EET-2
“Pacific Standard Time”	PST8PDT	“Israel Standard Time”	IST-2IDT
“Alaska Standard Time”	AKS9AKD	“Middle European Time”	MEZ-1MES
“Yukon Standard Time”	YST9YST	“Swedish Winter Time”	SWT-1SST
“Hawaii Standard Time”	HST10HDT	“French Winter Time”	FWT-1FST
“Somoa Standard Time”	SST11	“Central European Time”	CET-1CES
“New Zealand Standard Time”	NZS-12NZD	“West African Time”	WAT-1

C.16 Option 36: Four Configurable Outputs

C.16.1 General Description

Option 36 adds four rear-panel outputs, which may be configured to any available signal in the 1093A/B/C series clocks. Note that there are many more jumper settings on the Option 36 board than the 1093A/B/C is capable of providing. The configuration of the four outputs can be changed at any time via internal jumper settings.

C.16.2 Specifications

General

Output Connectors: BNC-type RF connectors (4).

Analog Outputs

Output Type	Operational amplifier (LF353) output, with 557-ohm series resistor.
Available Output:	Modulated IRIG-B with Option 92 installed.
Signal characteristics:	IRIG-B time code, modulated onto 1 kHz 4.5 Vpp sine wave carrier.

Digital Outputs

Output Type:	High-Speed CMOS (74HC126), 0 to 5 volts, with 47 ohm series resistance.
Available Outputs:	Unmodulated IRIG-B, 1 PPS, Programmable Pulse, Out-of-Lock.
IRIG-B:	IRIG format B time code (unmodulated).

C.16.3 Changing Outputs via Internal Settings

Case Removal

To change the configuration of Option 36, the top cover of the instrument must be removed. Turn off the instrument, and disconnect the power cord. Using a T-25 Torx driver, remove the four screws holding the cover (and rack mount ears, if used) in place, and lift the cover off.

WARNING Do not remove the top cover while power is applied. Hazardous voltages are present while the power cord is connected. Always disconnect the unit from the input power source before removal of the top cover.

General Information

Option 36 incorporates a flexible output selection system using jumpers on the Option 36 printed circuit board. Each of the four rear-panel BNC-type I/O connectors, included with Option 36, can be configured to perform any of the available output functions. Figure C.43 shows the locations and Table C.11 indicates the functions for all of the jumpers on the Option 36 board.

Function Selection

Jumpers JMP1, JMP2, JMP3 and JMP4 control which output signal arrives at a respective output connector.

Desired Signal Jumper	Output Connector
JMP1	J2
JMP2	J3
JMP3	J4
JMP4	J5

Compare each jumper position with the items in Table C.11 to match your desired signal type. For example, to provide unmodulated IRIG-B at output connector J2, set JMP1 jumper pin to position 3. If all of the four outputs need to be set to provide unmodulated IRIG-B, place each function jumper to position 3.

Mode Selection

Jumpers JMP9, JMP10, JMP11, JMP12 control the signal driver for each output: analog or digital. Make sure to select these output mode jumpers for each output. For each output, position A selects a digital driver and position B selects an analog driver. The table below indicates the correct jumper for each output.

Desired Mode Jumper	Output Connector
JMP9	J2
JMP10	J3
JMP11	J4
JMP12	J5

On the 1093A/B/C only one signal is defined as analog: modulated IRIG-B. However, Option 92 must be installed to produce modulated IRIG-B on the Model 1093A/B/C. On all Mode jumpers, JMP9 – JMP12, analog signals use position B. Digital signals, like unmodulated IRIG-B, use position A.

Clock Model Selection

Use one of two jumpers, JMP13 or JMP14, to select the clock model in which Option 36 is mounted. JMP13 selects for Model 1088B and JMP14 selects for Model 1084A/B/C, Model 1093A/B/C and Model 1201B/C. *Make sure to to set this jumper to JMP14 or Option 36 will not operate correctly in the Model 1093A/B/C.*

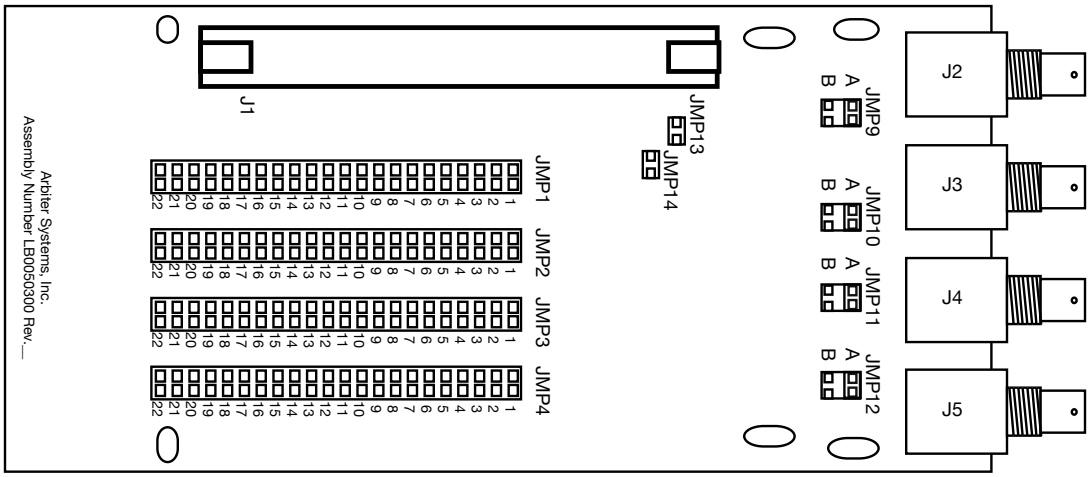
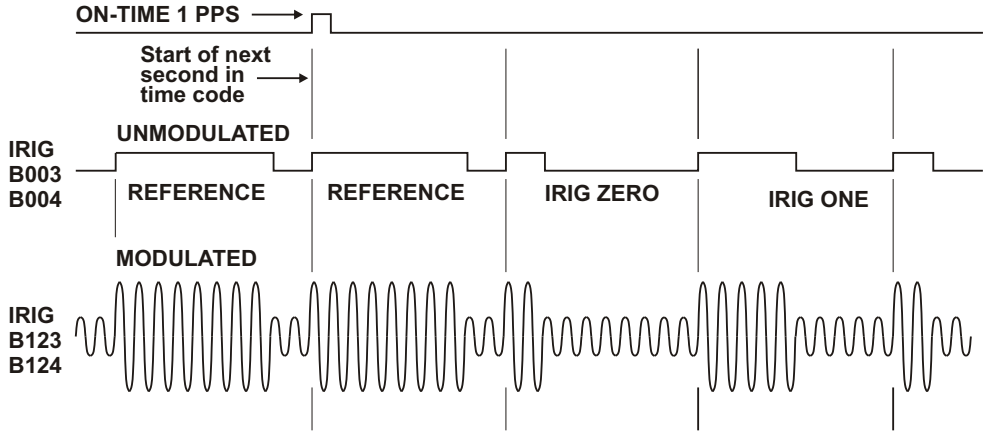


Figure C.43: Option 36 Jumper Configuration

Output Signal	**Function Jumper**	**Mode Jumper**
IRIG-B Modulated	1	B
IRIG-B Unmodulated	3	A
1 PPS	18	A
Programmable Pulse	19	A
Out of Lock	20	A

Table C.11: Option 36 Output Connector Jumper Settings

If IRIG-B is chosen as the output signal, then each selected output should produce a waveform very similar to the drawings in the figure below.



NOTE: If any of the jumpers were changed, replace the cover to the chassis before returning to service.

C.17 Option 91: 1-Microsecond Accuracy, RAIM - Obsolete

Please Note: This option is obsolete.

Provides for accuracy of 1-μs peak and Receiver Autonomous Integrity Monitoring (RAIM) system, which monitors received satellite signals and ignores satellites with large timing errors. Units with Option 91 are specifically tested by Arbiter to assure that clock accuracy is within one microsecond. *Option 91 is not field installable.*

Option 91 is no longer available or necessary as all models described in this manual automatically provide better than 1-microsecond accuracy.

C.18 Option 92: IRIG-B Modulated Output

Model 1092A/B/C and 1093A/B/C

Option 92 adds a modulated IRIG-B distribution bus, which provides a low-impedance, fault-protection output (4 Vpp, 20-Ohm source impedance). A second EPROM adds IRIG-B modulation and is mounted on the main board. *Option 92 is field installable.*

C.19 Option 93: Out-of-Lock Relay

Model 1092A/B/C and Model 1093A/B/C

Option 93 adds a single form-C single-pole, double-throw (SPDT) relay, activated by the out-of-lock signal. This is a fail-safe relay, which is in the faulted condition with power off. The rear-panel terminal strip provides external connection. For details on relay operation and setup, see Section 2.3.5 and 9.1. *Option 93 is not field installable.*

C.20 Option 94: RS-422/485 Driver

Model 1092A/B/C and Model 1093A/B/C

Provides RS-422/485 line driver output at the standard serial port with the standard RS-232 output. See serial-port technical information in Section 10.3 for pin locations. *Option 94 is not field installable.*

C.21 Option 95: Four BNC Connectors

Model 1093A/B/C Only

C.21.1 General Description

This document describes the BNC output connectors option; which is used in the Arbiter Systems Model 1093 satellite-controlled clocks (order P/N 1093opt95). Option 95 is installed in option slot A. *Option 95 is not field installable.*

BNC Output Connectors Option

The BNC output connectors option provides the Model 1093A/B/C with three BNC output connectors and one BNC input connector. The three BNC outputs are connected in parallel with the existing pluggable terminal strip outputs, while the fourth connector provides a BNC event/deviation input. The standard pluggable terminal strip outputs are still usable, but both connectors now share the drive capability.

Physical Configuration

The connectors are mounted on an option plate connected to the rear panel with four M3 Kepnuts and connected to the main board with a five-pin connector (J3). The signals on the output are (when viewing the rear of the clock):

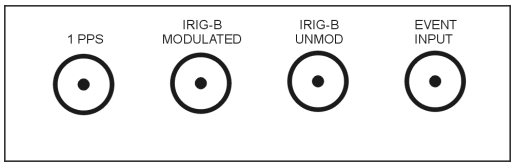


Figure C.44: Option 95 Rear-Panel Layout

C.22 Option 96: Programmable Pulse Output

Model 1092A/B/C and Model 1093A/B/C

The 1-PPS output at J4 is converted to programmable pulse, and marked on rear plug-style, strip connector. For programmable pulse information, see Section 7.8, the Setup Menus, and 10.2.12, Programmable Pulse Output Commands.

C.23 Option 97: IRIG-B Output Reconfigured to Programmable Pulse

Model 1092A/B/C and Model 1093A/B/C

IRIG-B unmodulated output at J4 is reconfigured to programmable pulse, and marked on rear plug-style, strip connector. For programmable pulse information, see Section 7.8, the Setup Menus, and 10.2.12, Programmable Pulse Output Commands.

C.24 Option 98: Event Input

Model 1092A/B/C and Model 1093A/B/C

Event input is converted from the standard IRIG-B modulated output. Configuration allows 5 VDC TTL-level inputs to be timed and recorded based on the GPS clock time. For background information and setup, see Sections 2.3.3, 7.10 and 9.2.1 for additional information.

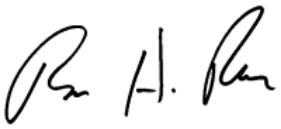
Appendix D

CE Mark Certification

D.1 Introduction

On the following pages contain the individual CE Mark Certifications for models covered in this manual. This includes Model 1092A, 1092B, 1092C, 1093A, 1093B, and 1093C.

Declaration of Conformity with European Union Directives

Date of Issue:	June 30, 2003
Directives:	89/336/EEC Electromagnetic Compatibility 73/23/ EEC Low Voltage Safety
Model Number(s):	1092A/B/C GPS Satellite-Controlled Clock 1093A/B/C GPS Satellite-Controlled Clock
Manufacturer:	Arbiter Systems, Inc. 1324 Vendels Circle, Suite 121 Paso Robles, CA 93446 − USA
Harmonized Standard Referenced:	EN55011 Class A, Radiated and Conducted Emissions EN50082-1 Generic Immunity, Part 1 Residential, Commercial and Light Industrial Environments EN61010-1 Safety requirements of Electrical Equipment for Measurement, Control and Laboratory Use.
Signed:	
Signatory:	Bruce H. Roeder

This certificate declares that the described equipment conforms to the applicable requirements of the directives on Electromagnetic Compatibility 89/339/EEC, Safety 73/23/EEC, and amendments by 93/68/EEC adopted by the European Union.

Appendix E

Statement of Compliance

E.1 Introduction

The following page is a statement of compliance that includes Model 1092A, 1092B, 1092C, 1093A, 1093B, and 1093C.

G.P.S. Satellite Clock Statement of Compliance

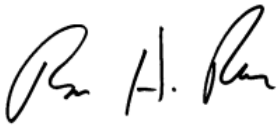
February 5, 2008

TO WHOM IT MAY CONCERN:

All Arbiter Systems, Incorporated G.P.S. Satellite Controlled Clocks are Primary Standards. They provide time traceable to U.T.C. and U.S.N.O. within published accuracy specifications anywhere in the world. All Arbiter Systems Incorporated G.P.S. Satellite Controlled Clocks also carry a limited lifetime warranty, which is based on in field MTBF (Mean Time Between Failures) of over one million (1,000,000) hours. These products are available with all known time synchronization signals presently in use world wide by the electric power industry.

Arbiter Systems does not supply a type test certificate as requested for G.P.S. systems as the accuracy is a function of the G.P.S. system and not of the receiver. However we (Arbiter) hereby certify that this equipment conforms to all Arbiter Systems Incorporated specifications for material and process. All Arbiter Systems calibration products are supplied with a type test certificate guaranteeing traceability to National Standards, but are inappropriate for G.P.S. clocks, which are Primary Standards by definition.

Regards,



Bruce H. Roeder
International Marketing Manager
Arbiter Systems, Inc.
BHR/sc

Index