ARBITER SYSTEMS

MODEL 1084A/B/C SATELLITE-CONTROLLED CLOCK

OPERATION MANUAL

1084A SATELLITE-CONTROLLED CLOCK — ARBITER SYSTEMS

ON/OFF
- ○ OPERATE
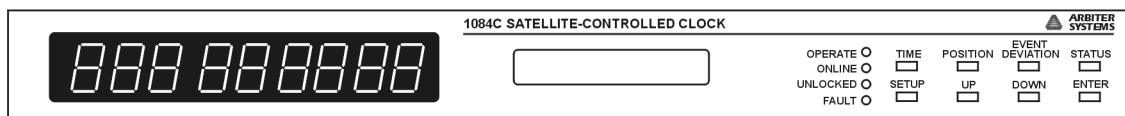- ○ ONLINE
- ○ UNLOCKED
- ○ FAULT

Model 1084A

1084B SATELLITE-CONTROLLED CLOCK — ARBITER SYSTEMS

ON/OFF
- ○ OPERATE
- ○ ONLINE
- ○ UNLOCKED
- ○ FAULT

| TIME | POSITION | EVENT DEVIATION | STATUS |
| SETUP | UP | DOWN | ENTER |

Model 1084B

1084C SATELLITE-CONTROLLED CLOCK — ARBITER SYSTEMS

- OPERATE ○
- ONLINE ○
- UNLOCKED ○
- FAULT ○

| TIME | POSITION | EVENT DEVIATION | STATUS |
| SETUP | UP | DOWN | ENTER |

Model 1084C

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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 1084A/B/C series satellite-controlled clocks.

ROM Dates
This version of the manual is written for these model clocks having ROM dates of 11 October 2010 or later. Any changes made in subsequent revisions which affect operation or specifications will be noted with either (a) a new manual or (b) a revised version of this manual. To display the ROM date for your instrument, press and release the SETUP key at power up and the ROM date should appear briefly.

Firmware Updates
Firmware updates are available to customers by contacting Arbiter Systems at the information given above. 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.

For warranty service or repair, products must be returned to a service facility designated by Arbiter Systems. Buyer shall prepay all shipping charges to Arbiter Systems, and Arbiter Systems shall pay shipping charges incurred in returning the product to Buyer. However, Buyer shall pay all shipping charges, duties and taxes for products returned to Buyer in a country other than the United States of America.

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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.

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[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 1084A/B/C

Satellite–Controlled Clock

Operation Manual

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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:

- 1084A/B/C GPS Clock (includes internal power supply)
- Antenna Cable, 50 feet with connectors
- GPS Antenna
- Rack-Mount Ears, 2 ea.
- 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 1084A/B/C series clocks 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.

1.3   Unpacking and Locating Accessories

The Model 1084A/B/C series clocks, and included accessories, are packed between two closed-cell foam shells. 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
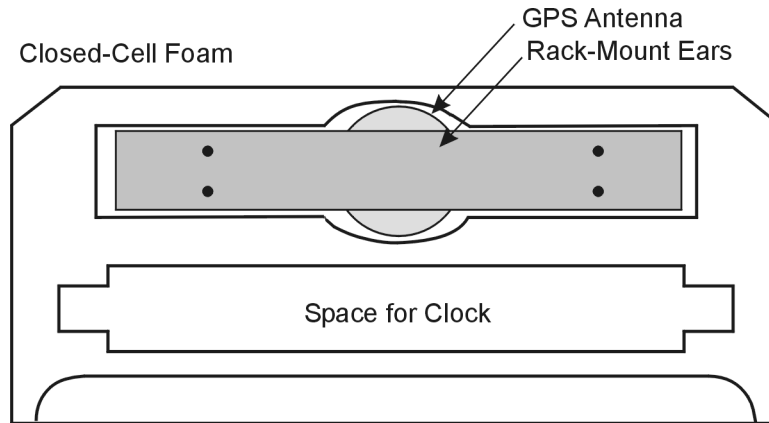
Figure 1.1: Packaging of Accessories

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 1084A/B/C Series Clocks

Each Model 1084A/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 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.* See Chapter 5, Setting Internal Jumpers, for information on selecting jumpers.

1.4.1   Mounting Instructions

1. Using a Torx T25 driver or large slot screwdriver, remove the four M25 screws attaching the clock cover to the chassis. Use either a T-25 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 M25 screws.

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

NOTE: Mount screws through lower set of holes.

Left Rack-Mount Ear

Top of Clock Chassis

Right Rack-Mount Ear

Front Panel
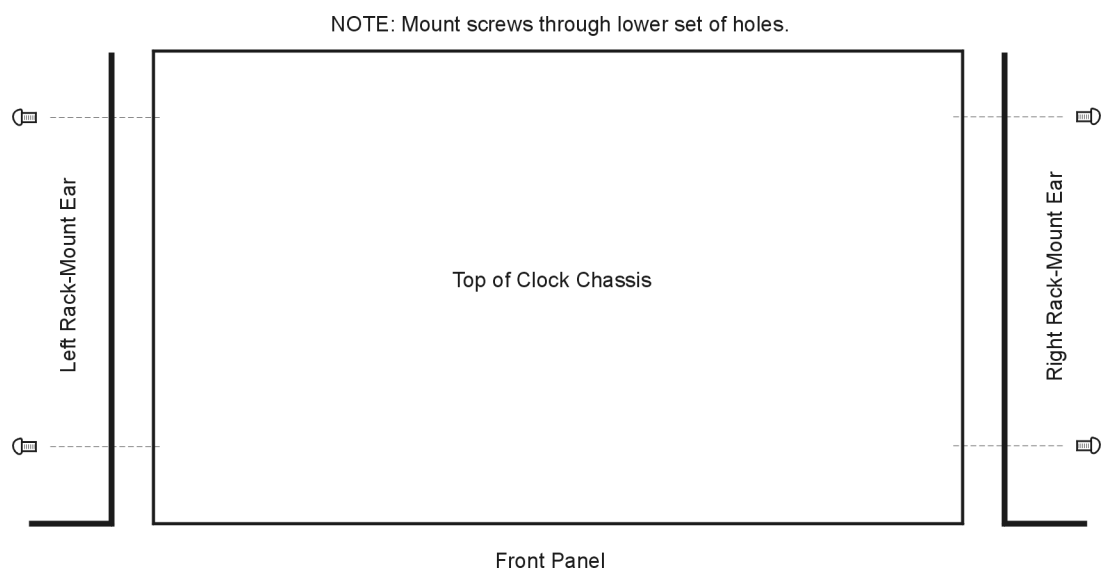
Figure 1.2: Attaching Rack-Mount Ears

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 1084A/B/C series clocks. Take care to review all of these items prior to connecting cables to and configuring these products.

2.2   Front Panel Controls and Indicators

The front panels of the Model 1084A/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.

The Model 1084A has four annunciator LED's; the Model 1084B adds to that the two-line by twenty-character LCD and eight-button keypad; the Model 1084C adds to the Model 1084B 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. Illustrated below are the front panels of all of the 1084A, 1084B and 1084C, showing all of the indicators and controls.
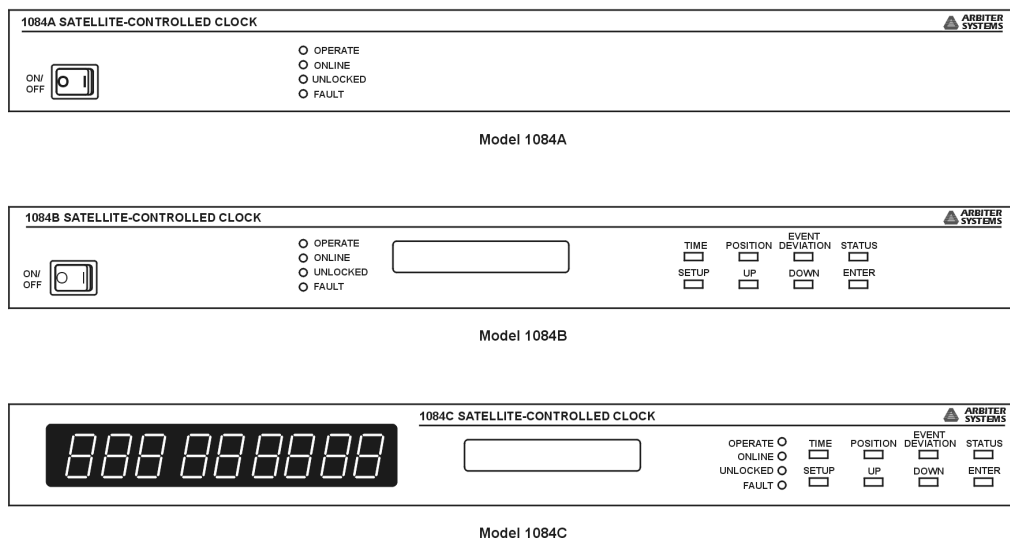
Figure 2.1: Model 1084A/B/C Front Panel Description

Definitions for the annunciator LEDs are found in Table 2.1 and definitions for keys in Table 2.2. Each of upper row of keys allow you to view clock information, like time and date, geographical position and instrument status. Each of the lower row of keys have specific and alternate functions for configuring operation. To configure, see Chapter 6, The Setup Menus.

2.2.1   Annunciator LED Definitions

Annunciator LED	Color	Purpose
Operate	Green	Clock Operating
On Line	Green	Indicates Active Clock*
Unlocked	Red	Out-of-Lock when ON
Fault	Red	Internal/External Faults**

Table 2.1: Annunciator LED Definitions

* When used with Option 18, Redundant Interface, the On Line LED indicates which of the two interconnected clocks is active.
** Illuminates when a fault condition exists with the clock or GPS receiver. See Table 10.1 for a list of faults.

2.2.2   Command Key Definitions

Table 2.2 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	NA
POSITION	view latitude, longitude and elevation	NA
EVENT or DEVIATION	view event or deviation	NA
STATUS	view clock and receiver status	NA
SETUP	enter 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 2.2: Command Key Definitions

2.2.3   LED Status Indicators

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

- **OPERATE**: Indicates that power is being supplied to the clock.

- **ON LINE**: Indicates the active clock, especially when using the Option 18, Redundant Interface, when two clocks are interconnected.

- **OUT OF LOCK**: Illuminates when the clock has not yet synchronized, or has lost synchronization, with the GPS.

- **FAULT**: Indicates when a GPS receiver or clock fault occurs.

2.2.4   LCD Display

The Model 1084B and 1084C series clocks contain a liquid crystal display (LCD), which provides a 20-character by 2-line readout. The readout displays instrument status, time, position and event/deviation data. The readout is also used to display the current configuration of operation parameters.

2.2.5   Front Panel Keys

Control various functions and configuration of operational parameters using the eight pushbutton keys on the front panel. However, using an RS-232 command, you can control the operation of the keypad and display (lock, enable, blank). Refer to Section 9.2.5, 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. 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, or averaged, position fix.

Event/Deviation Selects Event and/or Deviation Data recorded by the specific Model clock; up to 500 event records or updated 1-PPS deviation data. For additional details, see Event Inputs in Chapters 5, 6, 8 and 9.

Status Toggles the display between four status display modes: Clock, Receiver, DCXO and EEP-ROM, 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 1084A/B/C series clocks.
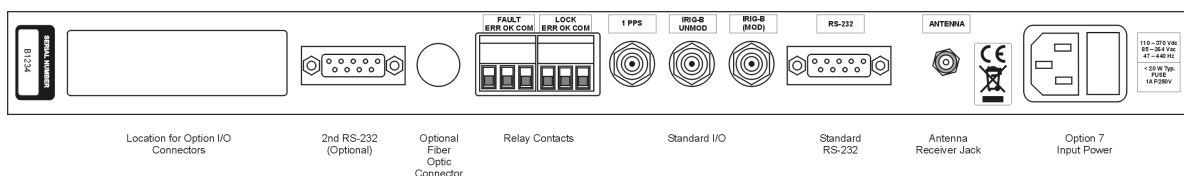
Figure 2.2: Model 1084A/B/C Rear Panel Description

2.3.1 Power Inlet

To cover all of the possible inlet power conditions, the Model 1084A/B/C has three optional power supplies. Please examine the paperwork you received, to make sure you have correctly identified the inlet connection. Supply types are listed below:

- Option 07, IEC-320 supply with a range of 86 to 264 Vac, 47 to 440 Hz and 110 to 370 Vdc

Figure 2.3: Option 07 Power Supply Inlet Connector
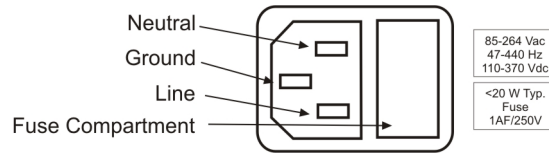
- Option 08, 10 to 60 Vdc ONLY, Terminal Power Strip with Surge Withstand Protect Circuitry (SWC) power

Figure 2.4: Option 08 Power Supply Inlet Connector
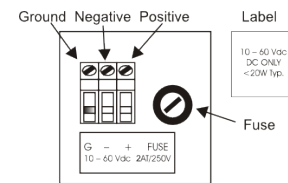
- Option 10, 110 to 350 Vdc and 85 to 250 Vac, 47 to 440 Hz, Terminal Power Strip with Surge Withstand Protect Circuitry (SWC)

Figure 2.5: Option 10 Power Supply Inlet Connector
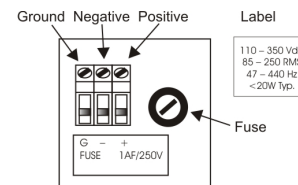
2.3.2 Antenna Input

The Model 1084A/B/C provides a type-F, GPS antenna input connector not only as the connection point for GPS signal, but also supplies 5 volts to energize the antenna. It is equipped with a threaded, type-F female connector.

Shown below is a diagram of the antenna connector. To check for this 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.

Figure 2.6: GPS Antenna Connector

2.3.3 Event Input

For timing external events based on the GPS-synchronized time, use the Event Input function with two separate connectors: P3 (Standard I/O) and J2 (RS-232C). See Figure 5.1, which illustrates the location of these connectors and jumpers.

2.3.4 RS-232 and RS-485 Communication Ports

The Model 1084A/B/C have one standard and one optional communication port; the standard with RS-232 and RS-485 supported, and the optional port with RS-232. 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). Generally, for RS-232 communications, you will only need pins 2, 3 and 5 using a null-modem cable. For more information, see Chapter 9, Serial Communications and Command Set.

Figure 2.7: Communications Port Connector
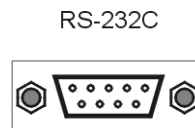
2.3.5 Form C, Relay Contacts

The Model 1084A/B/C has two sets of Form C relay contacts that have three contact points: ERR (Normally Closed), OK (Normally Open) and COM (Common), where "Normally" refers to clock powered OFF. For information on how to connect to them and their specifications, see Chapter 8, Relay Contacts and Event Inputs.

Figure 2.8: Relay Contact Connectors
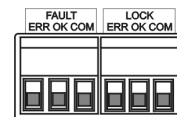
2.3.6 Standard Input/Outputs

The Model 1084A/B/C has three standard timing outputs for separate timing signals; when viewed from left to right, 1 Pulse Per Second (PPS), unmodulated IRIG-B, and modulated IRIG-B. Outputs are as follows:

- IRIG-B modulated, bus driver, 4 Vpp, 20 ohms source impedance, drives a 50-ohm load at 3 Vpp.
- IRIG-B unmodulated or programmable pulse; jumper selectable
- IPPS, IRIG-B unmodulated or IRIG-B modified Manchester; jumper selectable
- Jumper-selectable outputs are 5 V CMOS bus drivers with 10 ohms source impedance and ±75 mA drive capability.

Single connectors may also be connected in parallel to drive multiple loads. For more information concerning connecting timing signals, see Chapter 7, Timing, IRIG-B and Pulses.

Figure 2.9: Standard Input/Output Connectors
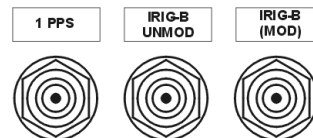
Chapter 3

Connecting Inlet Power, Input and Output Signals

3.1   Physical Configuration

The Model 1084A/B/C Satellite-Controlled Clock is designed for operation in an environment having an ambient temperature range of 0° to 50° C (32° to 122° F). No external ventilation is necessary. Operation is possible at temperatures of -20° to +65° C, although operation of the LCD display will be degraded (Model 1084A is not affected). Normal operation will be restored once the temperature has returned to the specified range.

Allow adequate clearance for rear-panel connections, especially in rack-mounting situations. Adequate clearance reduces the possibility of damage to the connectors, cables, or the instrument. Ideally, the clock should be located close enough to the antenna location so that the standard 15-meter (50-foot) cable can be used. The loss and delay characteristics of the cable are important factors in the calibration and accuracy of the instrument (refer to Section 4.4.1); thus, the entire cable length should be used, with any excess coiled up and placed out of the way.

Arbiter Systems offers standard accessories allowing the antenna to be mounted up to 240 m (800 ft) from the clock if longer cable runs are required. These are described in Table 4.2. If a longer antenna cable than this is required, please contact the factory for advice.

Model 1084A/B/C Power Supplies

To provide for a wide range of inlet power sources, the 1084A/B/C 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. Make sure to check the inlet voltage ranges before connecting power to the clock.

3.2 Option 07, IEC-320 Power Inlet Module

The Option 07, IEC-320 power inlet module has a "computer type" power connector with power cord for the required country code. Voltage and system frequency are given below with an outline of the connector. Input voltages are 85 to 264 Vac, 47 to 440 Hz, or 110 to 370 Vdc, < 20 Watts.

Figure 3.1: Option 07 Power Supply Inlet Description

Neutral
Ground
Line
Fuse Compartment

85-264 Vac
47-440 Hz
110-370 Vdc

<20 W Typ.
Fuse
1AF/250V
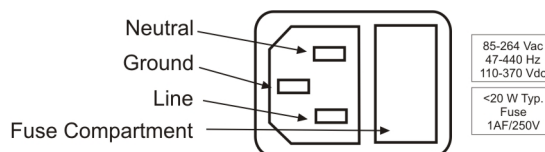
3.2.1 Cordsets and Plug Styles for Option 07

Make sure that the cordset matches the wall connector for your country. The following are available IEC-320 mating cordset plug style and specifications:

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

3.2.2 Option 07, Connecting Power to the 1084A/B/C

Connect the IEC-320 plug to the IEC-320 connector on the 1084A/B/C, and then connect the wall plug into the wall socket.

3.3 Option 08, 10 to 60 Vdc Power With Terminal Power Strip and Surge Withstand

This option replaces the standard power supply with one accepting 10 to 60 Vdc (DC 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
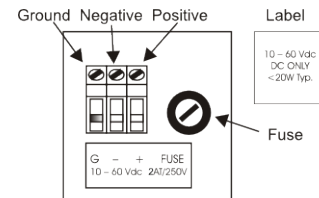
3.3.1 Option 08, Connecting Inlet Power

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). Line and neutral terminals are marked on a label below as "+" and −. After connecting a ground wire, connect the positive and negative leads from the station batteries to the corresponding Option 08 terminals. Be sure to observe the correct polarity, as the power supply used with the Option 08 will not accept reverse input polarity. *CAUTION: DO NOT connect Option 08 module to any ac voltage source.*

3.4 Option 10, 110 to 350 Vdc Terminal Power Strip, Surge Withstand

This option 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
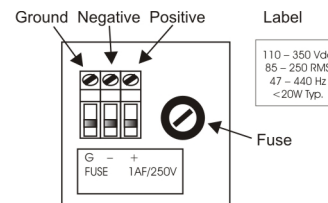
3.4.1 Option 10, Connecting Inlet Power

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

3.5   Fuse Types and Locations

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

PS Option	Arbiter PN	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

3.5.1   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 flat-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.

With an Option 08 or 10, the input power module includes separate fuse holder adjacent to the terminal power strip. See Table 3.2 above for the correct fuse configured for your option.

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.

3.6   Connecting Output Signals

Output signals may be connected through designated standard BNC or option connector. For standard I/O connectors, see Section 2.3.6. Connectors are standard female BNC. 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.

3.7   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. As an example, the Option 27 uses Phoenix-style terminals 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.

3.7.1   Connecting an Event Input at P3 or Main RS-232 Port

An event input may be connected to the Model 1084A/B/C series clock through the P3 (the standard 1-PPS output) or the main RS-232C port. For complete details, see Section 5.2.2.

Before connecting any input signal to P3, make sure to read about how to wire P3 for input and configure it through the Event/Deviation menu (on 1084B/C models) or through the main RS-232 port (all models); see Section 5.2.2. To connect input wiring to P3, use either a shielded coax, or a pair of wires that are connected to a BNC male connector[1].

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[1]Alternately, use a BNC Breakout such as sold by Pomona Electronics, P/N 4970. www.pomonaelectronics.com, (888) 403-3360

Chapter 4

GPS Antenna and Cable Information

The Model 1084A/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. 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) to the Model 1084A/B/C series clocks. It should also be a source of information if you should need to trouble shoot the antenna cable system. These clocks achieve their accuracy by comparing and adjusting the internal clock signal to the incoming GPS signal.

4.1 GPS Antenna Installation

To properly receive GPS signals, the GPS antenna needs to be mounted clear of buildings and surrounding elements that would 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" 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, and is illustrated in Figures 4.1, 4.2 and 4.3.
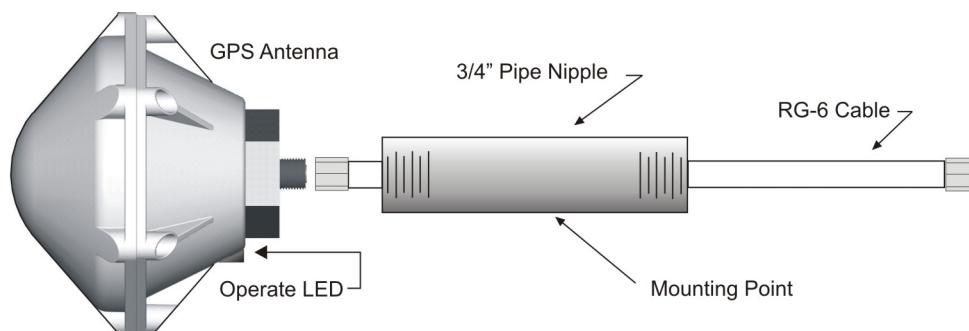
Figure 4.1: Antenna Assembly for Mounting

Antenna mounting procedure:

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

4.1.2   Optional Antenna Mounting Kit

The Antenna Mounting Kit (P/N AS0044600) 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 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", with 2 hex nuts	HP0014700
1	3/4" x 4" 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 and 4.3 on page 19 illustrate the antenna mounting bracket and a typical installation using the AS0044600 Antenna Mounting Kit.
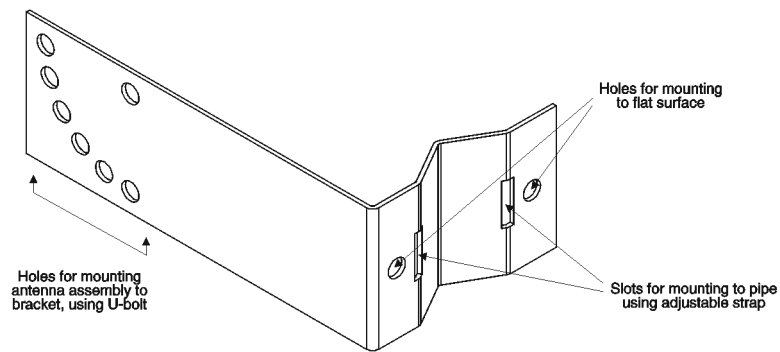
Figure 4.2: Antenna Mounting Bracket
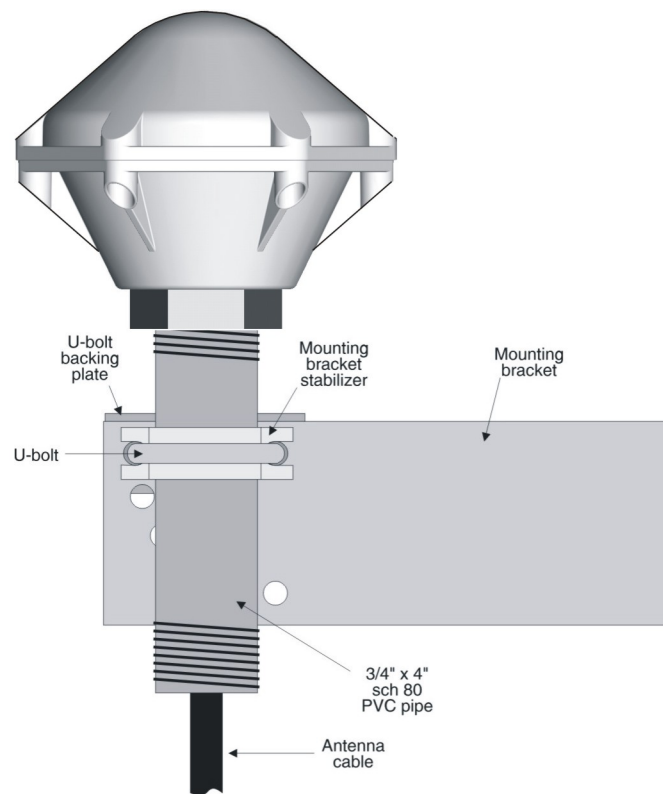
Figure 4.3: Antenna Mounting with AS0044600

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 13 mA. Check the voltage at the antenna connector on the rear panel. Without the signal, the antenna and 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 operation 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.
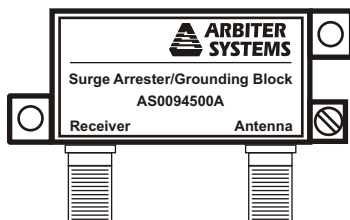
Figure 4.4: GPS Surge Arrester

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:

$$(4.1) \qquad\qquad T = \lambda \frac{1}{CKv} + 1ns$$

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 sources of high RF power, 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 13 mA maximum 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- 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 operation before installation.

   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 1084A/B/C series clocks are already set up at the factory according to the purchase order. Should it be necessary to change any jumpers to enable any new function, follow the instructions in this section.

This section covers all of the functions of hardware jumpers in the Model 1084A/B/C, and how to set them. After correctly setting the necessary jumpers, go to Chapter 6, The Setup Menu, for details on how to configure these signals from the front panel keys. If your clock does not have a keypad and liquid crystal display (LCD) you will need to make configuration changes through the RS-232 port. If you wish to know additional technical details about timing signals, please see Chapter 7, Timing, IRIG-B, and Pulses. **NOTE:** *Values in tables marked with an "*" show default positions.*

5.2 Input/Output, Function Selection

Jumpers JMP3 and JMP2 determine which output signals are available at I/O connector P3 and the fiber-optic output connector U46 (Option 20) respectively. The position of the jumper determines which output signal will be made available at the specified I/O connector. Table 5.1 provides a cross-reference list of I/O connector, output signals, and jumper positions.

Output Signal	P1, Fixed	P2, JMP9†	P3, JMP3	U46, JMP2*
IRIG-B Manchester	N/A	N/A	B	B
1 PPS	N/A	N/A	C*	C
IRIG-B Unmodulated	N/A	A*	A	A
Programmable Pulse	N/A	B	N/A	N/A
IRIG-B Modulated	Yes	N/A	N/A	N/A

Table 5.1: Output Signal Selection Jumper Settings

*Default positions; U46 (JMP2) determined when Option 20 is ordered.
†Not available on early versions.
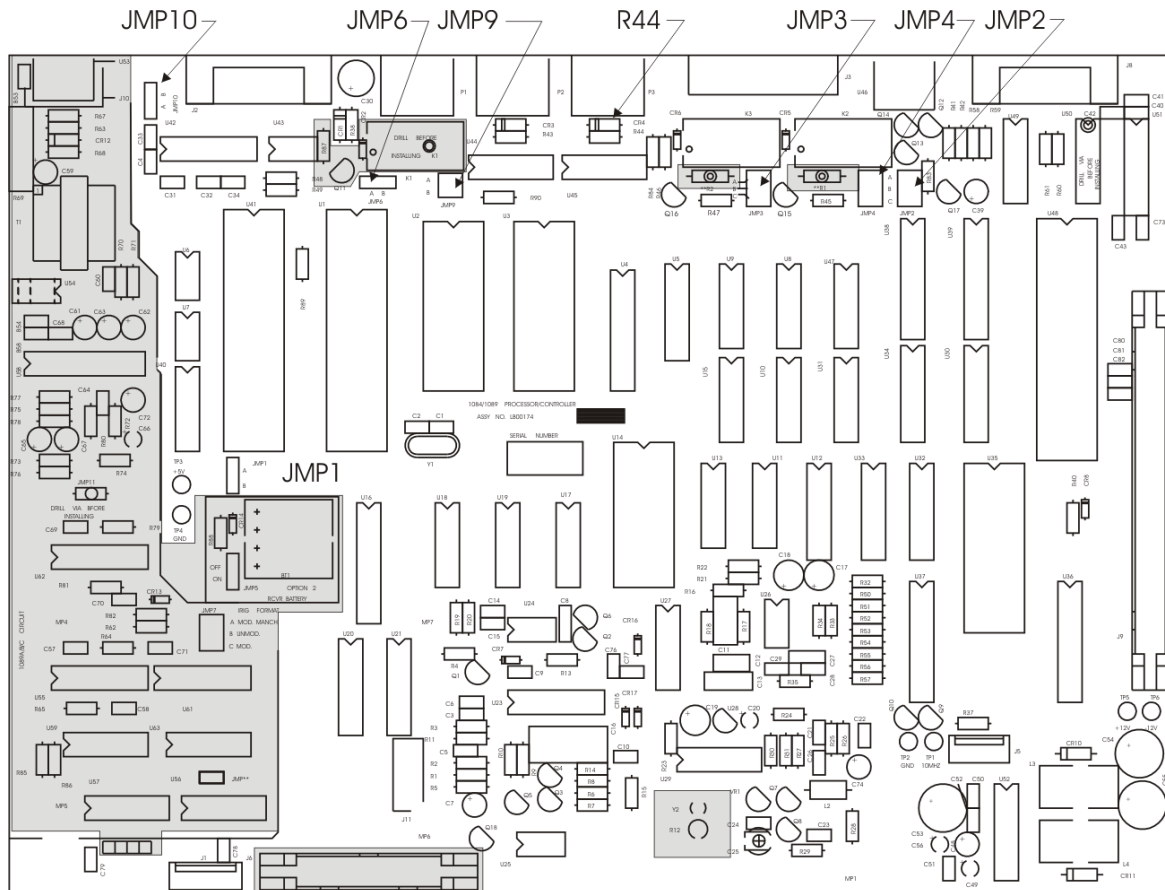
Figure 5.1: Model 1084A/B/C Main Board

(Not all components are shown. Components shown are for the purpose of locating jumpers.)

5.2.1   Output Function at P1, No Jumper

The output function at P1 is dedicated to modulated IRIG-B (analog) and cannot be changed. There are no jumpers available to change this output to any other function.

5.2.2   JMP1, I/O Connector Used as Input

The Model 1084A/B/C can accept event data input through I/O connectors P3 and J2 (Event A/Deviation and RS-232 respectively). To accomplish this, set jumper JMP1 to either the B or A position, corresponding to connectors P3 and J2 respectively.

Event and Deviation Channel Configuration

To record and display the various event and deviation measurements requires re-configuring the hardware and event settings on the Model 1084A/B/C. As illustrated in Figure 5.1, on a standard Model 1084A/B/C there are two I/O connectors, which can also be used for an input function. These input functions and their assigned connectors are as follows:

I/O Connector	Function	Jumper No. & Position
J2	RS-232	JMP 1, Position "A"
P3	Channel A Event/1 PPS	JMP 1, Position "B"*

Table 5.2: JMP1, Event Input Jumper Selection

Wiring for Channel A Event/1 PPS Usage

To use P3 as a data line to trigger the event timer, first remove R44 (see Figure 5.1) and add a wire on the main board from the left-hand side (facing front of instrument) of where R44 was located to JMP1, position B. Then set JMP1 to position B. It is not necessary to perform this modification when using the main RS-232 port as an event input. Just set JMP1 to position A.

5.2.3   JMP2, Fiber Optic Output (Option 20)

Jumper JMP2 is used to control which output signal is available at the Fiber Optic rear panel connector U46: IRIG-B Unmodulated, IRIG-B Modified Manchester, or 1 PPS. Output signals and jumper positions are as follows:

Output Signal	JMP2 Position
IRIG-B Unmodulated	A*
IRIG-B Modified Manchester	B
1 PPS	C

Table 5.3: Fiber Optic Output, JMP2

5.2.4   JMP3, Digital Output at P3

Jumper JMP3 selects the output on P3 to be unmodulated IRIG-B, IRIG-B Manchester or 1 PPS. See Table 5.1 for identification.

5.2.5   JMP4, Relay Control Output

Jumper JMP4 is used to control the FAULT relay function available at rear panel connector J3. Available functions are 1 PPH, Programmable Pulse, or Fault (Fail-Safe). See Table 5.4 for output signals and jumper positions. The OUT-OF-LOCK relay is a dedicated function.

5.2.6   JMP5, Receiver Battery (Option 02) − Obsolete

Not used on current Model 1084A/B/C clocks. Earlier clocks, with Option 02, use a circuit board mounted Ni-Cd battery enabled with JMP5. New Model 1084A/B/C clocks use a receiver with its own manganese dioxide rechargeable lithium ($MnO_2 - Li$) data backup battery. These batteries offer approximately 1 month of battery backup service with loss of instrument power. Backup batteries are kept charged under normal conditions from the clock power supply and have an expected life of 5 years or more.

Relay Output Signal	JMP4 Position
1 PPH	A
Programmable Pulse	B
Fault (Fail-Safe)	C*

Table 5.4: FAULT Relay Output Control, JMP4

5.2.7   JMP6, Output Enable

The factory uses jumper JMP6 for enabling the 5 V CMOS output buffers. For normal operation, set jumper to position A. Normally, this jumper will be configured as required when delivered from the factory. **Note:** JMP6 is located near Pin-40 of U1; however, its reference designation was inadvertently omitted from the silk screen on some early units.

5.2.8   JMP7, Model 1089A/B/C Timing Input Selection – Obsolete

The Model 1089A/B/C is obsolete and the jumper selection, JMP7, is no longer valid.

5.2.9   JMP9, P2 Output Selection

JMP9 selects the output on P2 between unmodulated IRIG-B and programmable pulse on later model 1084A/B/C clocks. Clocks dating back to 1996 have the jumper installed.

5.2.10   JMP10, RS-232 DSR or Prog. Pulse Output Selection

Select DSR or programmable pulse on pin 6 of the main serial port by jumper, JMP10. Position A selects DSR output and position B selects programmable pulse.

5.2.11   JMP11, Model 1089A/B/C – Obsolete

JMP11 may be found on the Model 1084A/B/C main board and is obsolete as it was used in the Model 1089A/B/C, which is obsolete.

Chapter 6

The Setup Menus

This section should guide you in configuring the Model 1084A/B/C operation using the SETUP Menus or RS-232C port(s) according to your preferences. Logically, use the setup menus prior to installing the clock for the first time, or changing any of the main board jumpers as described in Chapter 5.

Two of the most common setup menus for any application are (1) configuring the Local Offset and Daylight Saving values, and (2) setting up the IRIG-B outputs for the correct time zone. To operate with the local time in your region, you will need to configure the Local Offset (from UTC) and Daylight Savings (or Summer Time), changeover settings. There are a number of other settings that may be important to your application, however local time offsets are normally fundamental requirements. For a complete list of setup menus, see Table 6.1.

There are two available methods for configuring the 1084B/C: (1) Using the lower row of keys on the front panel, and (2) remotely, using either the main RS-232C port or Option RS-232C port. *To configure Model 1084A, you must use the RS-232C 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 9, Serial Communication and Command Set.

At the end of each SETUP menu section are references to the corresponding RS-232C command(s) for configuring these functions.

Table 6.1 lists the various menus used to configure the operation of these clock models.

6.1   Setup Menus

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

Table 6.1: Front-Panel Setup Menus

6.1.1   To Begin Configuring

Press the SETUP key to enter the clock configuration menus, starting with communication port parameters (Set Main RS-232?).

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, press SETUP to move 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, press ENTER to move 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.

6.1.2 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. For example, suppose you are in the System Delays menu. When you press the ENTER key, you should see something like the following menu.

```
SET CABLE DELAY?
DELAY = 000060 ns
```

To change the setting, you will first need to press either the UP or DOWN key to start changing the setting value. In this example, the "ones" digit will change. Next, press the SETUP key to move the cursor to the left to the "tens" digit. Now, use the UP or DOWN key to change the value. At the conclusion, press the ENTER to move the cursor back to the "ones" digit and ENTER again to install the new value.

6.1.3 Default Firmware Settings

All models will be configured with default settings when shipped from the factory, unless specified otherwise at the time of order. Most users elect to modify the clock settings to fit their locale and desired operation. Default settings are listed in Table 6.2.

Menu Item	Default	Menu Item	Default
Main RS-232	9600, 8, N, 1	Local Offset & DST	none, OFF
Out-of-Lock	01 min.	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 6.2: Default Firmware Settings

6.1.4 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.

6.2 Setting the Main RS-232C Port

Press SETUP key to configure the main RS-232C port, and press the ENTER key to begin setting up the RS-232C port parameters; see Section 6.2.1. To set up the broadcast mode, press SETUP and skip to Section 6.2.2.

NOTE: port settings may not be changed 1084A series clock since it does not have a keypad, and there are no port setting commands.
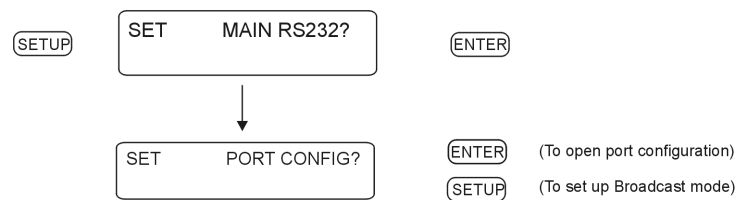
Figure 6.1: Main RS-232C Setup

6.2.1 Setting Port Parameters

Enter this menu from the "Set Main RS-232?" menu; see Figure 6.1. The "Set Port Config" menu allows you to configure any of the RS-232C port parameters from the front panel. Use the UP and DOWN keys to adjust the parameter values. *RS-232C: Port parameters may not be changed from RS-232C ports. They may only be changed with Models 1084B/C series clocks from the front panel.*
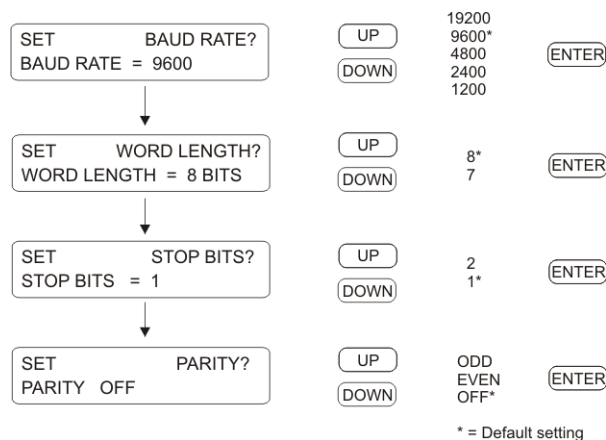
Figure 6.2: Port Parameter Setup

6.2.2 Setting the Broadcast Mode from Main RS-232

Enter this menu from the "Set Main RS-232?" menu; see Figure 6.1. The "Set Broadcast Mode" menu allows you to configure the Model 1084A/B/C to broadcast ASCII time/date-related data from the available RS-232C ports. With the UP/DOWN keys select the desired broadcast mode and press ENTER to immediately start the broadcast. *RS-232C: see Section 9.2.1.*
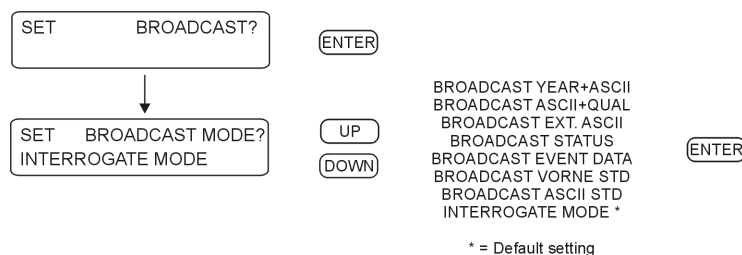
Figure 6.3: Broadcast Setup

6.3   Set Local Hour

There are two local hour settings: (1) Local Offset, and (2) DST/Summertime. Use "Set Local Off-set" to adjust the difference in time between UTC to your local standard time. Local offset may be adjusted in 15-minute increments up to plus or minus 12 hours. Optionally, use DST/Summertime to automatically add and remove one hour to your local time. See Section 6.3.2 to set up basic DST features. *RS-232C: see Section 9.2.4.*
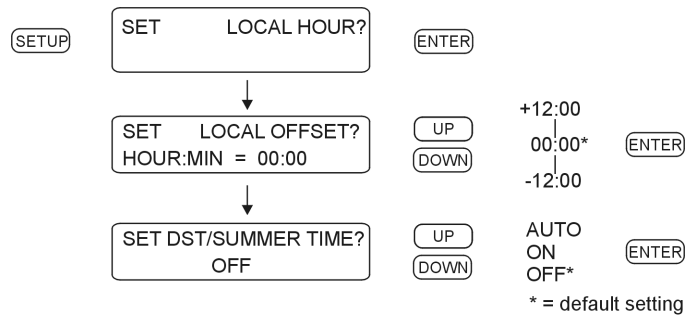
Figure 6.4: Local Hour Setup

6.3.1   Examples

1. Los Angeles (USA) has a local offset of -8:00. During Daylight Saving Time, Los Angeles (USA) has an overall offset from UTC of -7:00 hours.

2. Nairobi, Kenya has a local offset of +3:00. DST/Summertime is not observed.

3. Selecting DST/Summer Time "ON" immediately adds one hour to the time and does not change back to standard time.

4. Selecting "DST/Summer Time" to "OFF" never adds one hour to the time.

6.3.2   Set Daylight Saving Time (DST)

For automatic changeover, use the AUTO setting described in Figure 6.4. Make sure to determine the changeover requirements in your locale before trying to adjust these clock settings. The default setting 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. *RS-232C: see Section 9.2.4.*
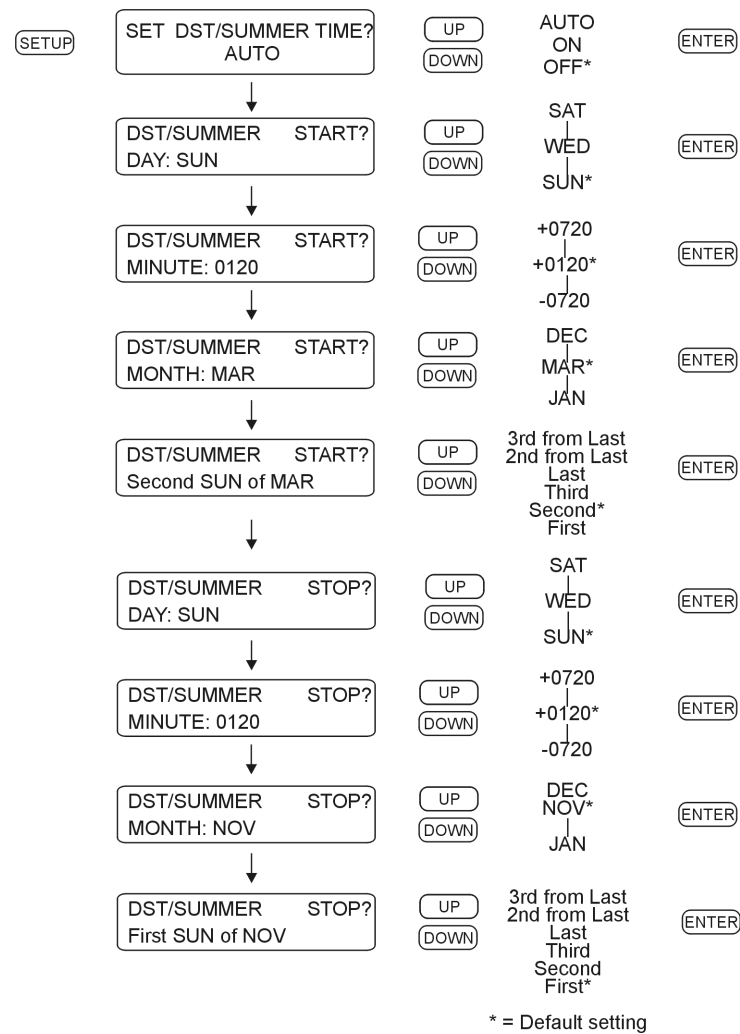
Figure 6.5: Auto Daylight Saving Setup

6.4   Set Out of Lock

Use the "Set Out of Lock" feature to control how the clock responds to an out-of-lock condition. Unlocked indications include the red UNLOCKED LED being lit, and the Out-of-Lock relay on the rear panel switching to the unlocked 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. *RS-232C: see Section 9.2.12.*
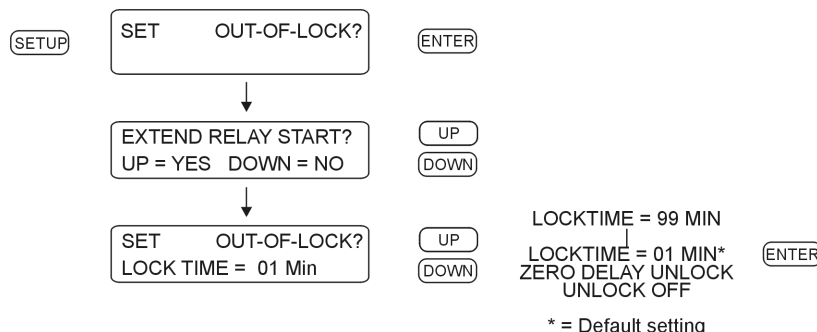
Figure 6.6: Out-of-Lock Setup

Extend Relay Start means that the clock will extend the time that the clock is *not considered stabilized*, the unlocked LED is lit, and the out-of-lock relay indicates an out-of-lock condition. Choose NO for the standard (shorter) indication, or YES to lengthen the out-of-lock indication to approximately 5 minutes under good satellite reception. Note that when choosing the extended relay start condition, the clock may be tracking sufficient satellites to be considered "locked" however it does not *indicate* that it is locked until completing the internal counting function.

6.5 Set Back Light

If the optional LCD 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. Use the Auto setting to extend the life of the LCD. *RS-232C: see Section 9.2.5.*
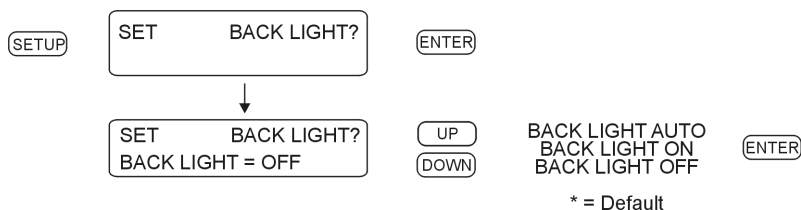
Figure 6.7: Back Light Setup

6.6 Set System Delays

6.6.1 Cable Delay

Use the "Set System Delays" menu to offset the delay in time for the GPS signal received at the GPS antenna to reach 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 delayed by this amount. *RS-232C: see Section 9.2.11.*

6.6.2 Clock Offset

Clock offset accomplishes the same objective as with the cable delay but advancing the time by a greater value than with "Cable Delay."
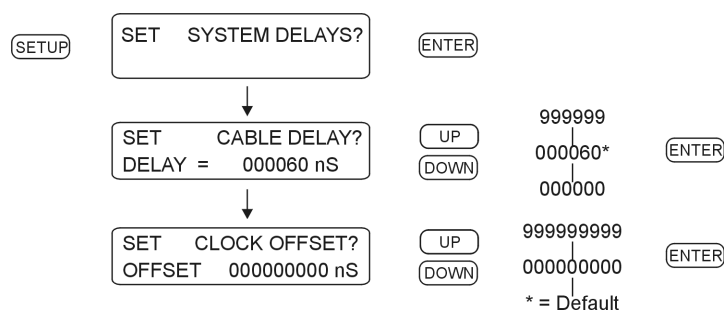
Figure 6.8: System Delay Setup

6.7   Set Programmable Pulse Mode

Use the "Set Prog. Pulse" menu to set up one of the many pulse modes available for broadcasting a pulse from P2 at a predetermined interval or rate (see Table 5.1 and Figure 5.1). Pulse modes include Seconds per Pulse, Pulse per Hour, Pulse per Day, Single Trigger (pulse per year), Slow Code and Pulse Polarity. Programming includes adjusting the pulse width, from a minimum of 10 milliseconds to 600 seconds, depending on the application, and configuring the pulse to occur at either UTC or Local time. *RS-232C: see Section 9.2.10.*
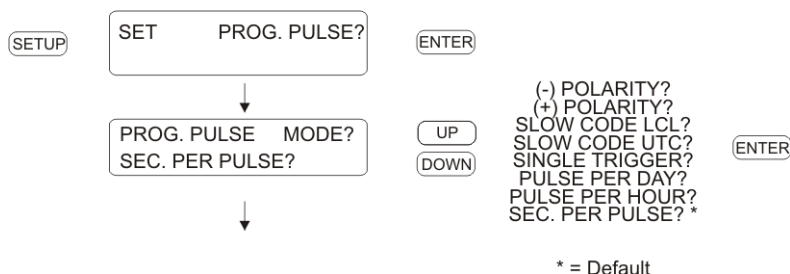
Figure 6.9: Programmable Pulse Setup

6.7.1   Entering Numerical Values

When installing numerical values first use the UP/DOWN keys to change the digits and then use the SETUP and ENTER keys to move the cursor left or right. 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.

6.7.2   Prog 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 6.7 above for additional detail on the programmable pulse mode. *RS-232C: see Section 9.2.10.*
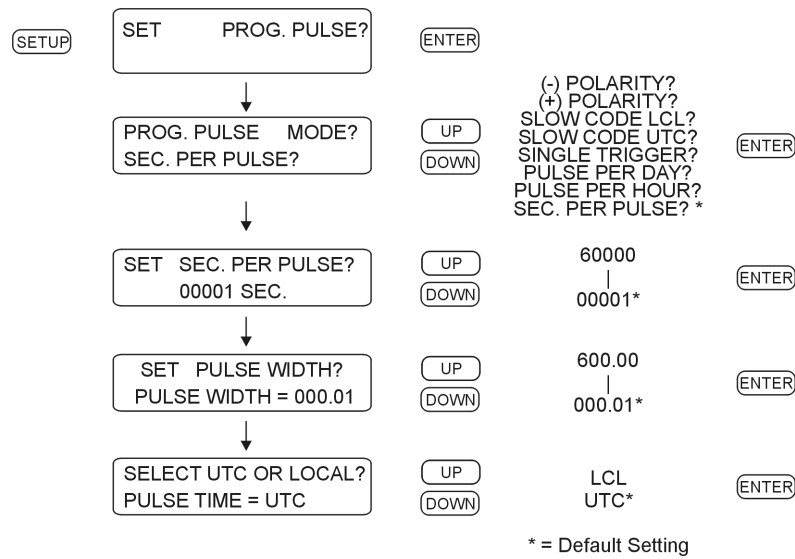
Figure 6.10: Seconds–Per–Pulse Setup

6.7.3   Prog 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 6.7 above for additional detail on the programmable pulse mode, and entering eumerical values. *RS-232C: see Section 9.2.10.*
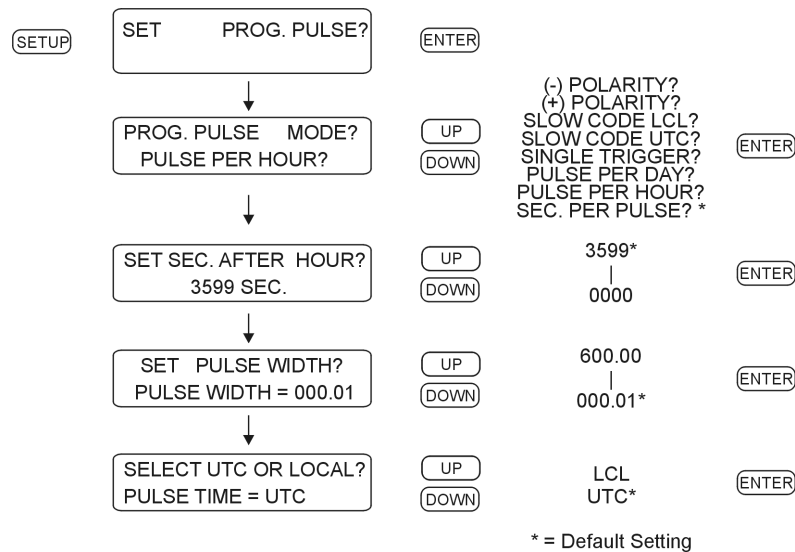
Figure 6.11: Pulse–Per–Hour Setup

6.7.4 Prog 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 6.7 above for additional detail on the programmable pulse mode, and entering numerical values. *RS-232C: see Section 9.2.10.*
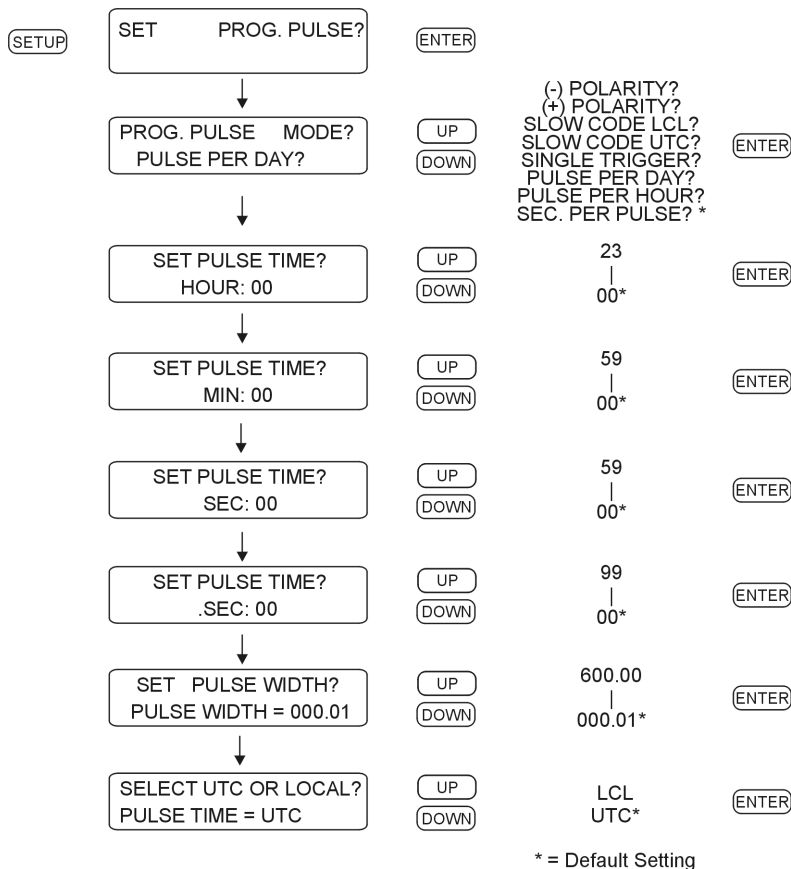
Figure 6.12: Pulse–Per–Day Setup

6.7.5   Prog 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 6.7 above for additional detail on the programmable pulse mode, and entering numerical values. *RS-232C: see Section 9.2.10.*
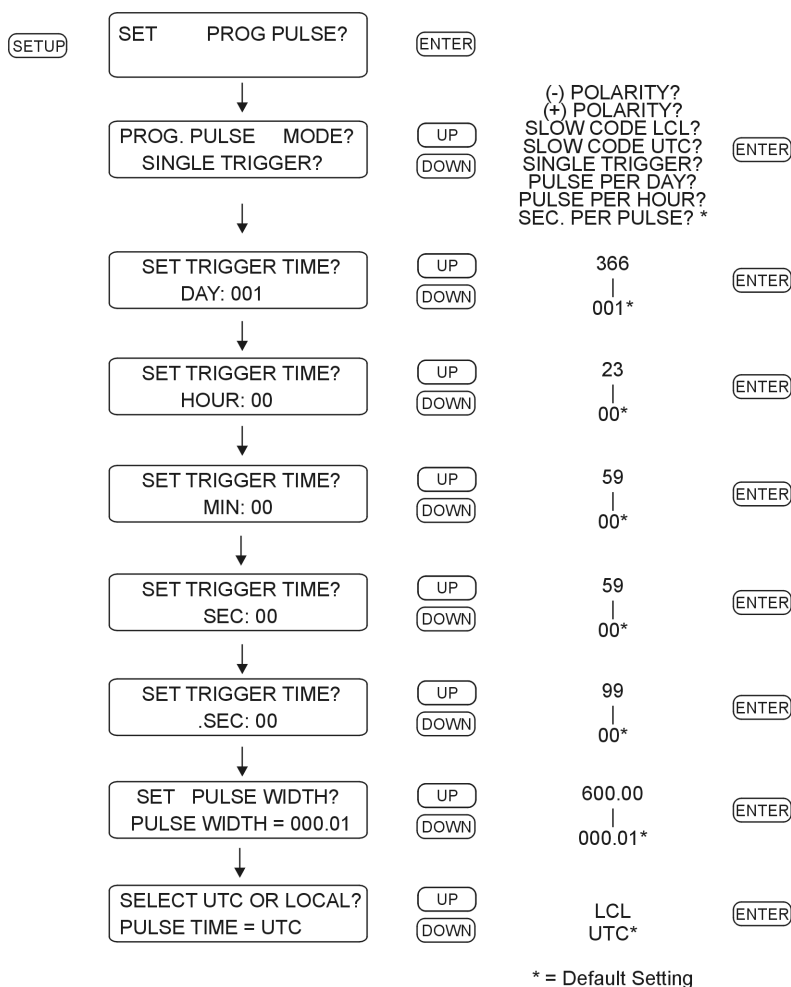
Figure 6.13: Single Trigger Setup

6.7.6 Prog Pulse, Slow Code

Slow code is a programmable pulse mode that 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. Note: make sure to set the Pulse Polarity to negative for normal operation. See Section 6.7.7. *RS-232C: see Section 9.2.10.*
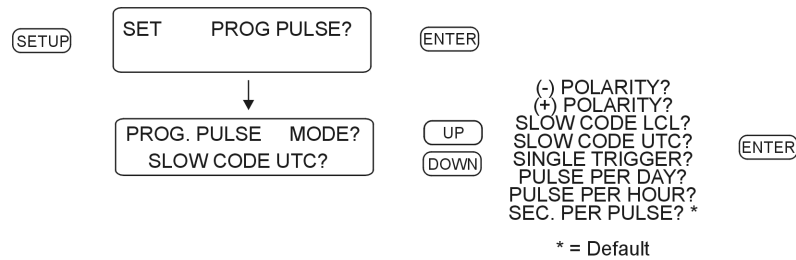
Figure 6.14: Slow Code Setup

6.7.7 Prog 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. *RS-232C: see Section 9.2.10.*
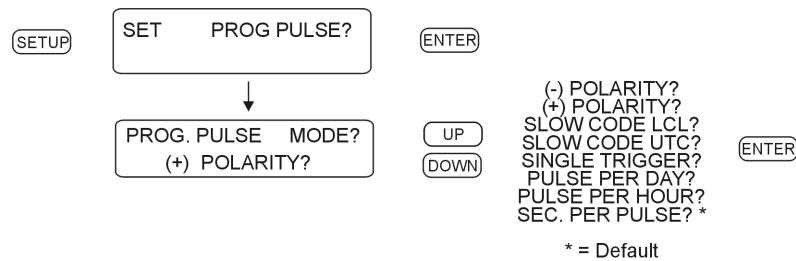
Figure 6.15: Pulse Polarity Setup

6.8   Set IRIG Time Data

Use the "Set IRIG Time Data" menu to adjust the time zone for *IRIG-B Time Data* between your locale and UTC, 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 7.3.3). *RS-232C: see Section 9.2.6.*
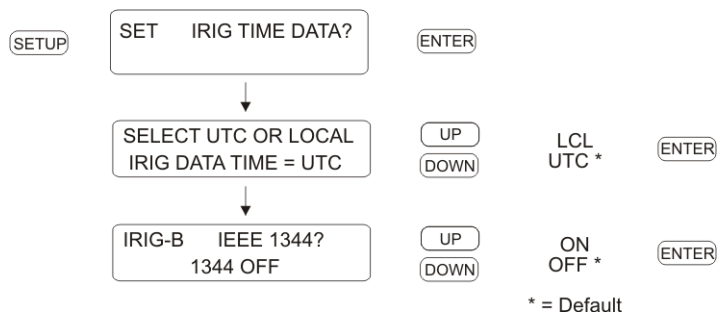
Figure 6.16: IRIG-B Time Data Setup

6.9   Set the Event or Deviation Modes

Use the Event/Deviation mode to capture an event (signal) at either P3 (standard I/O) or J2 (main RS-232C port). Configure for either event timing (up to 500 stored events) or one pulse-per-second (1 PPS) deviation, including sigma (see Section 8.2.3 for details on the principle of deviation measurement). *RS-232C: see Section 9.2.2.*
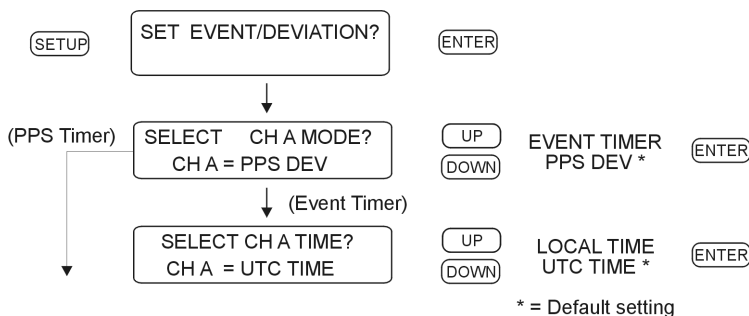
Figure 6.17: Event/Deviation Mode Setup

6.9.1   Arming the Event Input

When using P3, note that the event function continually arms itself for the next event until the buffer is full. When using the RS-232C port as the input, you must arm the event function for each event from the front panel or by using the AR command. To arm the Event Input from the front panel see Figure 6.18 below.
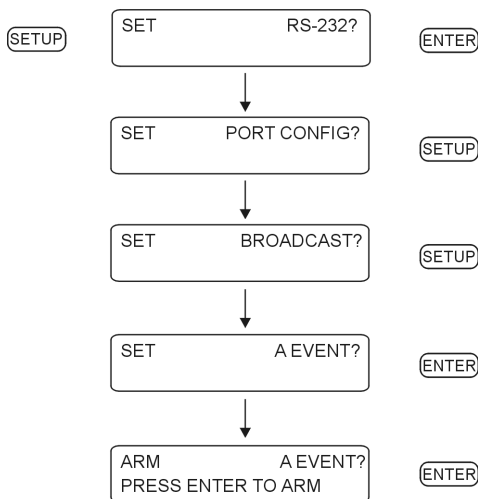
Figure 6.18: Arming the Event Mode From Front Panel

6.10   Set 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 clock is placed in Position Hold mode and the averaged position is placed into memory. If accurate position information is used, this results in a reduced standard deviation for the time data. *RS-232C: see Section 9.2.8.*

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
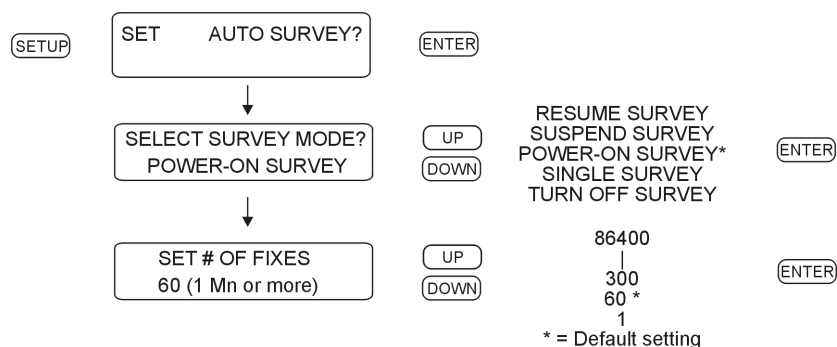
Figure 6.19: Survey Mode Setup

6.10.1   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.

6.11   Set 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. In the Fix mode, the position information will appear to be changing each second as viewed on the clock display or being returned from the RS-232C port.*RS-232C: see Section 9.2.7.*

Figure 6.20: Position Hold Mode Setup

6.11.1   Edit Position Data

To manually edit geographical position and elevation, you must first turn Survey mode to OFF and Position Hold ON. Position may then be edited using RS-232 commands listed in Section 9.2.7. Note that the entered position data must be accurate or the time will not be accurate.

6.12   Set 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; information on configuring specific options is located in the Option List (see Appendix C), by option number. *RS-232C: see Section 9.2.13.*
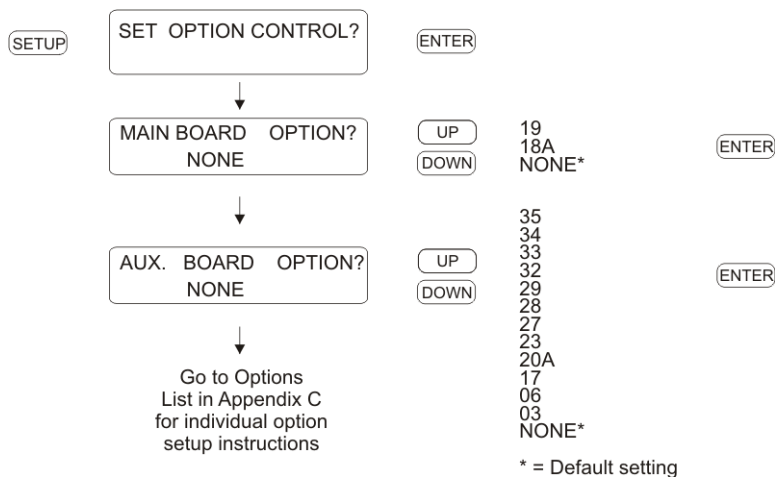
Figure 6.21: Option Control Setup

Chapter 7

Timing, IRIG-B and Pulses

7.1 Introduction

This section should help you with understanding, choosing and connecting the correct outputs from the Model 1084A/B/C series clocks to synchronize your external equipment, such as protective relays. It should also answer some basic questions, such as:

- 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 type 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 that you know:

1. the type of timing signal each piece of equipment requires, and

2. how to enable the equipment to receive the timing signal.

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

7.2 Timing Output Description

When viewing the rear panels of the Model 1084A/B/C, you will see that there are a number of different types of connectors as illustrated in Figure 7.1. Generally, there is a power inlet connector, a GPS antenna connector, two DB-9 serial connectors (one is an optional RS-232 port), two SPDT relay connectors and three timing outputs. If required, space for an optional fiber optic port with type ST connector is available. Finally, the Model 1084A/B/C series clocks also have an option plate that may be replaced by any one of several auxiliary boards.
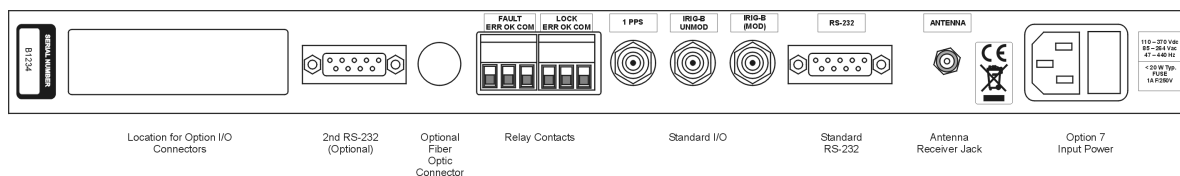
Figure 7.1: Rear Panel Descriptions

7.2.1 Standard Inputs/Outputs

All of these models have three, BNC female connectors that can supply timing signals to external equipment. One of these connectors (P3) may also be configured for an event/deviation input. Two of the outputs are designed for digital signals and one for analog. Signals supplied to the digital drivers include unmodulated IRIG-B, 1 pulse per second, and programmable pulse. The third connector is set up for a modulated IRIG-B only.

7.2.2 Digital Drivers

Each of the digital outputs is driven by a CMOS 74HC126 quad driver capable of supplying 75 mA at 5 Vdc, which may be fanned out to a number of devices. To determine the maximum number of devices that the digital drivers can support, you will need to determine the load current, or input impedance, for each device. For example, if the IED timing input signal (e.g. IRIG-B003) requires 10 mA, one output channel should be able to support 7 identical devices.

7.2.3 Analog Driver

The 1084A/B/C has one analog driver available exclusively for *modulated IRIG-B signals*. Additional analog drivers may be added as options (e.g. Option 03, 27, 29). The analog driver is basically a push-pull audio design (MMBT4401/4403), which supplies a 4.5 Volt peak-to-peak (10 Vpp on Option 03) signal through a 19.6-ohm source resistor to IED's. As the load current increases (by adding external IED's), more voltage is dropped across the clock source resistor and the drive voltage decreases. Matching the modulated IRIG-B output voltage to the IED input is sometimes critical, so it is important to match the modulated IRIG-B peak-to-peak voltage to within the specified range of the IED. Table 7.1 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 of adequate power rating.

Drive Current, mA	Actual Drive Voltage, Vpp
0	4.5 (no load)
1	4.48
10	4.3
100	2.54

Table 7.1: Drive Current vs. Voltage

7.3 Output Signal Description

All models can provide three different digital signals and one analog signal. Digital signals consist of unmodulated IRIG-B, 1 PPS and Programmable Pulse. With option cards installed, many other digital signals are available; see Appendix C for output options with listed digital signals. Most of the information in this section is devoted to IRIG-B, its specifications and differences.

1 PPS occurs once each second and has a duration (pulse width) of 10 milliseconds. Programmable pulse modes are similar to 1 PPS only they have an adjustable period and pulse width. Programmable pulse modes include seconds per pulse, pulse per hour, pulse per day, single trigger (once per year) and slow code.

7.3.1 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 1084A/B/C transmits Format B with four variations as seen in Table 7.2. 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 Old/New	Signal Type	Code Components
B000/B004	Pulse width code, No carrier	BCD_{TOY}, CF, SBS
B003	Pulse width code, No carrier	BCD_{TOY}, SBS
B120/B124	Sine wave, amplitude modulated, 1 kHz	BCD_{TOY}, CF, SBS
B123	Sine wave, amplitude modulated, 1 kHz	BCD_{TOY}, SBS

Table 7.2: 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 position identifier bits, the time code provides a reliable method of transmitting time to synchronize various equipment.

There are three functional groups of bits in the IRIG-B time code, in the following order: Binary Coded Decimal (BCD), Control Function (CF) and Straight Binary Seconds (SBS). The BCD group contains only time information including the seconds, minutes, hours and days, recycling yearly. The CF group contains other time-related information including year, time quality, leap year, pending leap seconds and parity. The SBS consists of the total elapsed seconds, restarting daily. Position identifiers separate the various components of the IRIG-B time code.

7.3.2 Modulated and Unmodulated IRIG-B

Figure 7.2 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 digital waveform, where the information is contained.
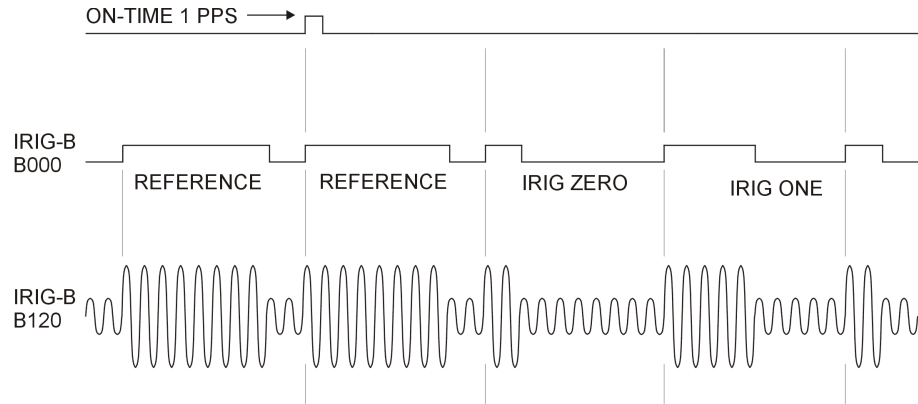
Figure 7.2: IRIG-B Waveforms

7.3.3 IRIG-B IEEE 1344 Extension

As mentioned above, the IEEE 1344 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 use the link to the Arbiter web site.

http://arbiter.com/resources/documentation.php and select Timing and Frequency, then select Application Notes/Option Information.

7.3.4 1 Pulse-per-Second (1 PPS)

A one pulse-per-second timing output signal is very simple in concept. It is a digital bit transmitted every second with a pulse width of 10 milliseconds. Probably the most critical part of this signal is that the rising edge is "on time" as 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 7.2 for a comparison between unmodulated IRIG-B and 1 PPS.

7.3.5   Programmable Pulse (PROG PULSE)

Models 1084A/B/C series clocks have an independent programmable pulse feature that requires some jumper and firmware configuration. Models 1084B/C may be configured from the front panel and 1084A must be configured through the RS-232 port. Programmable pulse modes include setting the pulse width and time zone. To configure, please see Sections 5.2 and 6.7.

Prog 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	ON or OFF
Pulse Polarity	positive or negative–going pulse

Table 7.3: Programmable Pulse Types

7.4   Connecting Outputs

All clocks come equipped with BNC female connectors, however if you are using twisted pair cabling, you can use a BNC breakout. See the reference below[1], or other similar adapter.

NOTE: If using a shielded, twisted-pair cable (like Belden 8760), DO NOT connect the cable shield at the clock. Always connect a cable shield at the receiving equipment (IED) grounding point.

7.4.1   Attaching Cables to Screw Terminals

Some of the option boards mounted in the Model 1084A/B/C series clocks have screw terminals instead of BNC connectors to connect wiring. To mount wiring 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. Tighten the screws down on the wire. Do not ground the shield to the Arbiter clock, rather ground it at the receiving end.

7.4.2   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.

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 below.

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

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

http://arbiter.com/resources/documentation.php and select *Timing and Frequency*, then select *Application Notes/Option Information.*

7.4.3   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. For example, if the input impedance of the IED is 5 kilohms, determine the device current (I) as follows:

$$(7.1) \qquad\qquad I = V \div R_{dev} = 5 \ Volts \div 5000 \ Ohms = 0.001 \ Amps \ (1 \ mA)$$

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).

7.4.4   Connecting Unmodulated IRIG-B

To drive multiple loads from one unmodulated IRIG-B output, make sure that the loads are wired in parallel. Some technicians might call this "daisy-chaining", however the idea is to drive all of these loads in parallel from the single output. It is much simpler to connect loads to unmodulated IRIG-B than for modulated, because all of the loads are driven at the same voltage.

To determine load current for one Unmodulated IRIG-B output:
  1. determine the number of loads to be connected to a single clock output
  2. determine the impedance (or resistance) of each load
  3. calculate the load current for each device ($I_{dev} = 5V \div R_{dev}$)
  4. sum up all the load currents for the total current for one clock output.

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.

7.4.5   Connecting Modulated IRIG-B

The total load capacity for the modulated IRIG-B driver depends on the type and number of loads. The main difference in computing the load capacity for modulated IRIG-B and unmodulated IRIG-B is that most of the modulated IRIG-B decoders are fairly sensitive to the peak-to-peak voltage. When adding loads, the clock's modulated driver produces more current, which is passes through the internal source resister, dropping the available output voltage. The open circuit voltage (i.e. with no loads) is approximately 4.5 Vpp, so any connected loads will cause the available voltage to drop. It is a simple task to compute the available output voltage (Vpp) with a known current.

$$(7.2) \qquad\qquad\qquad Vpp = 4.5 \ Vpp - I \times 19.6 \ Ohms$$

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 7.1.

7.4.6   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. If we use a twisted pair of 22 AWG (copper as above), then the available voltage (at 100 mA of current) for 500 feet of wire including the source resistor would be:

$$(7.3) \qquad Vpp \ available = 4.5 - I \times 19.6 \ source - I \times 19.6 \ wire = 0.58 \ Vpp$$

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 very likely not be detected by the decoder in most IED's. Remember to make your cable runs as short as possible, to use a larger diameter cable, and to carefully distribute the loads.

7.4.7   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 4.5 Vpp, the (nominal) acceptable voltage is 3.3 Vpp, and the device current is 10 mA. Determine the dropping resistor value (including the voltage drop due to source resistor).

$$(7.4) \qquad R_{drop} = V_{diff} \div I_{dev} = (4.3 - 3.3) \div 0.01 = 100.4 \ Ohms$$

The Power dissipation (P) is:

$$(7.5) \qquad P = I^2 R = 0.01^2 \times 120 = 0.01 \ Watts$$

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

For a voltage that is too low, 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 cable loss by increasing the wire size, or (3) by using an amplifier.

7.4.8   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 7.6.

$$(7.6) \qquad\qquad\qquad C \approx 9.84 \times 10^8 \; feet/second$$

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.

7.4.9   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 8

Relay Contacts and Event Inputs

8.1 Relay Contacts, Out Of Lock and Fault

8.1.1 Introduction

Model 1084A/B/C has two sets of relay contacts; both are a Form-C single–pole, double–throw (SPDT) relays. One is used for indicating an out-of-lock condition and one indicates other fault conditions. Both of these Form C contacts have a limited lifetime of approximately 100,000 cycles.

Figure 8.1 illustrates the two relays with labels that indicate the three terminals. These terminals are labeled ERR (Normally Closed), OK (Normally Open) and COM (Common), where "Normally" refers to the clock being powered OFF.
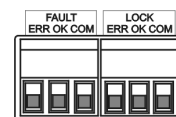
Figure 8.1: Relay Contact Connectors

8.1.2 Out-of-Lock Relay Operation

The Model 1084A/B/C considers the out-of-lock condition as a fault, but reports it separately to the Out-of-Lock relay and the Out-of-Lock LED. The Out-of-Lock relay changes state when the clock loses synchronization with the GPS or is powered OFF. ERR is then shorted with respect to COM and OK is open with respect to COM. When not synchronized with the GPS, the out-of-lock relay will change state (faults) based on the "Out-of-Lock" setup. Configure this through the front panel or the RS-232 interface (see Section 6.6). Out-of-Lock settings are (1) unlock OFF, (2) zero delay unlock, and (3) 1 to 99 minute delay for unlock.

8.1.3 Fault Relay Operation

The fault relay changes state when a fault occurs, other than Out of Lock (see above), or the clock is powered OFF. Unlike the out-of-lock relay, when any other fault occurs the fault relay *immediately* changes state. See Table 10.1 for a list of faults. The fault relay may be configured to indicate (1) 1 pulse per hour (PPH), (2) programmable pulse, or (3) fault. To configure, see Table 5.4.

8.1.4 Failsafe Operation

Both the out-of-lock and fault relays also provide a fail–safe indication by switching to the faulted condition when the clock loses power.

8.2   Event Inputs

8.2.1   Event Timing Input

When configured for event timing, the 1084A/B/C series clocks can provide one input channel with 0.1 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 P3; see Figure 5.1 and Section 5.2.2.

Data for individual recorded events can be recalled using either the Event/Deviation key or via the RS-232C interface (see Section 9.2.2). 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 events reaches 500. As soon as data is retrieved for a recorded event, its address (001 – 500) is made available for data corresponding to a new incoming event.

8.2.2   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.

8.2.3   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.

8.2.4   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 first 500 events; new Event Data is given priority over existing data, and will overwrite it. Since the incoming signal is at 1 Hz and the circular buffer holds 500 events per channel, each Event Time Record will be overwritten once every 500 seconds.

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.

8.2.5   Event Timer Input Channel Configuration

In order for the Model 1084A/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 5.2.2.

8.2.6   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 6.17 for detail on configuring the Event/Deviation parameters from the front panel. See Section 9.2.2 for details on using the RS-232C interface to manage event/deviation recording.

8.2.7   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. Press the EVENT/DEVIATION key and the display will enter a circular scroll. It begins by showing the data (if any is present) for Channel A, as previously configured for Event Recording in Figure 6.17 and Section 9.2.2. The readout will display one of the records (001 to 500) and associated event times, using the following format:

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

Where:
"`nnn`" = event number (001 to 500)
"`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)

Press the UP or DOWN key to scroll through all events presently stored in the event time buffer. After exiting and re-entering the event display mode, 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)?
UP=YES DOWN=NO
```

Press the UP key 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 000. **NOTE:** If the event capture channel is not configured for event time recording, it will not display the CLEAR EVENT prompt.

If the event capture channel is configured for 1–PPS Deviation, 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 μS
SIGMA: XXXXX.XX μS
```
Where:

1. 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.

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

8.2.8   RS-232C Event Trapping

The event capture channel of the Model 1084A/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, thereby allowing up to 500 events to be recorded.

8.2.9   Event Trapping Setup

Configuring the clock to trap events (incoming data) on the RS-232C interface requires making the configuration changes described in Section 5.2.2.

Arm the Event-Trapping circuit from the front panel using the SET RS-232 sub-menu from the SETUP key. 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:

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

   ```
   SET        A EVENT?
   ```

2. Press ENTER again and the display should indicate the following:

   ```
   ARM        A EVENT?

   PRESS ENTER TO ARM
   ```

3. 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 from 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 9.2.2.

Chapter 9

Serial Communication and Command Set

9.1 Introduction

Model 1084A/B/C series clocks have one main RS-232C port, and one optional RS-232C port. These are labeled RS-232C and Option RS-232C. 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-232C combines an RS-485 function in the same connector. *It is important to note that the Option RS-232C port does not have an RS-485 function, either RS-232C ports do not 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 recent substation equipment has 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.

9.2 Command Set

This section provides information for controlling and communicating with these clocks via the RS-232C serial interface. All of the RS-232C commands are functionally grouped into similar categories. For example, Section 9.2.1 lists all of the commands used to both set and retrieve 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 is 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-232C 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 needed. Strings are normally terminated with carriage return and line feed characters, however sometimes this is not the case. Enter any RS-232C command as written in these tables *without* pressing ENTER. Characters are automatically entered when typed. If including any of these commands in a programming sequence, do not include any carriage-return or line-feed characters.

In this section, the syntax of each command 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:

         ↄ = 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 (e.g. nnn in minutes)
         yyyy = four digit year
         ddd = Julian day-of-year
         mm = month
         hh = hour
         mm = minute
         ss = second

Underlines are used for clarity only and graphically represent the location of ASCII spaces.

9.2.1 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-232C port. O0 deactivates the RS-232C broadcast mode on the option RS-232C port.

Response: ↄ

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-232C port. O1 configures the clock to broadcast ASCII standard data from the option RS-232C port.

Response: <soh>ddd:hh:mm:ss ↄ

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-232C port. O2 configures the clock to broadcast from the option RS-232C port Vorne-formatted data. Refer to Arbiter Systems Application Note 103 for more information on using large format displays with Arbiter Systems' GPS clocks.

Response: 44hhmmss ↄ (UTC/Local Time)
     55ddd ↄ (day of year)
     11nn ↄ (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, see Option 28 in Appendix C, Options List, page 156):

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-232C port any event data at the time it is
recorded. O3 configures the clock to broadcast from the option RS-232C 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
          L = Local Time

Broadcast Mode – STATUS

Command: **B4, O4**
B4 configures the clock to broadcast any status data from the main RS-232C port when it changes.
O4 configures the clock to broadcast any status data from the option RS-232C port when it changes.
NOTE: When a valid fault is detected, the specific status fault is broadcast once (with Julian day,
and time) to the chosen serial port. 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	OCXO Not Inst. (set to 1)	4	16	Out-of-Lock
1	2	Stabilized (stab. = 1)	5	32	Time Error
2	4	Power Supply Error	6	64	VCXO Error
3	8	IRIG Bus Fault	7	128	Receiver Failure

Table 9.1: Fault Indications and Definitions

Broadcast Mode – EXT. ASCII

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

Response: ↄ
Q_yy_ddd_hh:mm:ss.000___

Format: Q = Time quality indicator, and may be represented by:
                 _   = (a space, ASCII 32) meaning it is locked with maximum accuracy.
                 ?   = (ASCII 63) unlocked, accuracy not guaranteed
                 __ = (underline) graphically represents the location of an ASCII space
                         and is used for clarity only.

Broadcast Mode – ASCII plus QUAL

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

Response: <soh>yyyy:ddd:hh:mm:ssQ ↄ

Format: soh = Hex 01 – the start bit of the soh character is transmitted on time.
                 Q   = Time quality indicator. may be represented by:
                 _   = (a space, ASCII 32) 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 plus ASCII

Command: **B8, O8**
B8 configures the clock to broadcast from the main RS-232C 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-232C port. YEAR plus 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 ↄ

Format: soh = Hex 01 – the start bit of the soh character is transmitted on time.
                     Q   = Time quality indicator. may be represented by:
                     _   = (a space, ASCII 32) 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-232C 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 ↄ

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   = UTC
          A   = status: A = valid data
          *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-232C 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

9.2.2   Event Mode Commands

Return Specific Event

Command: **nnnA**
nnnA sets the event buffer read index to a specific event number (001 to 500), 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 ⏎
                 or
               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: C

Clear Event Buffer

Command: **CA**

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

Response: C

Return Deviation for Event Channel

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

Response: dddd.dd ssss.ss C   (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: C

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 nnnAL C
             UTC time   mm/dd/yyyy hh:mm:ss.sssssss nnnAU C

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

9.2.3   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 500)
             mmm = Channel write index (001 to 500)

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.

Response: ±tt.t°C ±pp.pp PPM ⤶
Format: tt.t   = Ambient temperature in degrees C – Not used on these models
             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 Fnnnn #nnnn Tyyyy:dd:hh:mm:ss E(W)ddd:mm:ss.sss N(S)dd:mm:ss.sss Hmmmmm.mm ⤸

Format: Sn   = status of the Auto-Survey mode
            Pm   = status of the Position-Hold mode
            Fnnnn   = current number of fixes
            #nnnn   = total number of fixes required
            yyyy:ddd:hh:mm:ss = completion time of the most recent average
            E(W)ddd:mm:ss.sss = surveyed longitude, E=East, W=West
            N(S)dd:mm:ss.sss   = surveyed latitude, N=North, S=South
            Hmmmmm.mm   = surveyed elevation

Table 9.2 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 9.2: 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 9.1 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. See Table 9.3

Bit	Weight	Function	Bit	Weight	Function
0 (LSB)	1	OCXO Not Inst. (Set to 1)	4	16	Out of Lock
1	2	Stabilized (stab. = 1)	5	32	Time Error
2	4	Power Supply Error	6	64	VCXO Error
3	8	IRIG-B Bus Fault	7	128	Receiver Failure

Table 9.3: System Status Information Chart

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, 1344. Table 9.4 gives the returned value and error category.

Value	Error	Value	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 9.4: Unlocked Time Quality

9.2.4   Local / Daylight Savings Time Setup Commands

Return Daylight Saving/Summer Time Settings

Command: **0DT**

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

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

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: ↄ

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: ↄ

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' equal the number of hours and minutes, positive (East) or negative (West).

Response: ∽

9.2.5   Front Panel Control Commands

Disable Control Panel

Command: **FB**

FB disables all control–panel keys and blanks the front panel display – Model 1084B/C only.

Response: ∽

Enable Control Panel

Command: **FE**

FE enables all control–panel keys and activates the front panel display – Model 1084B/C only.

Response: ∽

Lock Setup Keys

Command: **FL**

FL disables setup control keys and activates the front panel display – Model 1084B/C only.

Response: ∽

Set Backlight – OFF

Command: **L0**

L0 disables the backlight operation – Model 1084B/C only, with Option 01 installed.

Response: ∽

Set Backlight – ON

Command: **L1**

L1 selects the continuous backlight operation – Model 1084B/C only, with Option 01 installed.

Response: ↄ

Set Backlight – AUTO

Command: **L2**

L2 enables the automatic backlight operation – Model 1084B/C only, with Option 01 installed. It keeps the backlight active for 30 seconds after any key is pressed.

Response: ↄ

9.2.6 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. For additional information, see Section 7.3.3.

Response: ↄ

IRIG Data – Local

Command: **IL**

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

Response: ↄ

IRIG Data – UTC

Command: **IU**

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

Response: ↄ

9.2.7   Position Data Commands

Set Position Hold – Elevation

Command: **MMMMM.mmH**

MMMMM.mmH command sets the antenna elevation in meters MSL (mean sea level); fractional meters of elevation are optional. Survey must be turned OFF and Position Hold ON to enter position data.

Response: ꝁ

Format: MMMMM.mmH
             M = meters
             m = fractional meters

Set Position Hold – Latitude

Command: **dd:mm:ss.sssN(S)**

dd:mm:ss.sssN(S) sets antenna latitude (in Position-Hold Mode) in degrees, minutes and seconds, North or South. Survey must be turned OFF and Position Hold ON to enter position data.

Response: ꝁ

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

Set Position Hold – Longitude

Command: **ddd:mm:ss.sssE(W)**

ddd:mm:ss.sssE(W) sets antenna longitude (in Position-Hold Mode) in degrees, minutes and seconds, East or West. Survey must be turned OFF and Position Hold ON to enter position data.

Response: ꝁ

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

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 ↄ (from -1000.00 to +18000.00 meters WGS-84)

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 ↄ

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

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

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.

Response: ↄ

9.2.8   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 9.5. Use the SQ command during a survey to obtain the survey status. Activate the Position–Hold mode with the PH1 command.

Response: ↄ

m	Condition
0	Survey Off
1	Initiate single auto survey
2	Perform auto survey at power on
3	Temporarily suspend auto survey
4	Resume suspended auto survey
n	**Condition**
0	Single position fix
1	60 fixes (1 minute)
2	300 fixes (5 minute)
3	900 fixes (15 minute)
4	1800 fixes (30 minute)
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 9.5: Auto Survey Setup Conditions

9.2.9   Date and Time Commands

Set Receiver Time

Command: **yyyy:mm:dd:hh:mmTS**

TS sets the receiver time to the entered value (UTC format), *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

Command: **DL**

DL returns the current date, in the Local time zone.

Response: ddmmmyyyy ↪

Return UTC Date

Command: **DU**

DU returns the current date, in the UTC time zone.

Response: ddmmmyyyy ↪

Return Local Time

Command: **TL**

TL returns the current Local time.

Response: ddd:hh:mm:ss ↪

Return UTC Time

Command: **TU**

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

9.2.10   Programmable Pulse Output Commands

Pulse Width

Command: **nnn.nnPW**

nnn.nnPW configures the Programmable Pulse output pulse width in seconds, from 0.01 to 600 seconds, in Seconds per Pulse, Pulse per Hour and Pulse per Day modes.

Response: ↄ

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: ↄ

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 format. OL sets the time at which the clock issues the programmable pulse, in the Local format. 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: ꙅ

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: ꙅ

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 transitions high. Negative means that the output voltage is held high until the beginning of the pulse period, at which time it transitions low.

Response: ꙅ

9.2.11   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: ⊃

Set Clock Offset

Command: **nnnnnnnnnDS**

nnnnnnnnnDS sets internal system delay compensation value. This includes the remote receiver cable delay. It is also used to advance the output pulse by an arbitrary offset of zero up to one millisecond, from actual time.

Response: ⊃

9.2.12   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. 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: ⊃

9.2.13   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: **nZ**

nZ returns the contents of Display Buffer based on the values for "n" indicated in the list below.

n = 0 turns off the display broadcast
n = 1, 2, 3 and 4 return time displays
n = 5, 6 and 7 return position displays

n = 8, 9 and 10 return status displays
n = 11 returns event/deviation display

Response: Echoes current display (40 characters); no line wrap. For display contents, see Chapter 10, 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. See Table 9.6.

Where:

m = 0 for Main board option, and m = 1 for Aux board option.
n = option number (see table below)
k = security key; 1084
l = *use only if n specifies Option 28.* l = 0 for 60 Hz and l = 1 for 50 Hz.

Response: ↄ

Option Number, n	Main Board Option	Aux Board Option
0	NONE	NONE
1	18A	03
2	19	06
3	–	17
4	–	20A
5	–	23
6	–	27
7	–	28
8	–	29
9	–	32
10	–	33
11	–	34
12	–	35

Table 9.6: 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 1084A, Main board Opt. 19, Aux board Opt. 28

0,2,1084XI
1,7,1084,0XI

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

Example 2 – Model 1084A, Main board Opt. none, Aux board Opt. 32

0,0,1084XI
1,9,1084XI

Return IP/MAC Address

Command: **IP**
This command 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 ↵
```

9.3   Communication Port Information

Table 9.7 gives a list of functions and associated pins for both the RS-232C and RS-485 ports.

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

Table 9.7: Main RS-232C Port Pin Definitions

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

Chapter 10

Startup and Basic Operation

10.1 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 things should happen[1] in the sequence listed below:

- The four annunciator LED's initially should flash momentarily, then the operate, on line and unlocked LED should light steadily.

- The LCD should display several introductory messages - see below (for 1084B/C clocks only).

- The out-of-lock relay will be in the faulted position and the fault relay should switch to the unfaulted position.

- Eventually, the unlocked LED should extinguish.

- The out-of-lock relay should change to non-faulted position after a few minutes.

- The LCD should indicate that the clock is locked (for 1084B/C clocks).

10.1.1 Clock Time, Startup Mode – 1084B/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:

<div align="center">TIME NOT AVAILABLE</div>

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:

---

[1]Startup behavior is based on Models 1084B/C clocks with a display. Startup behavior for the 1084A have no visible display other than four annunciator LEDs. For the 1084A, time and position (and other) data may be viewed if monitoring through a RS-232 port.

                    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 should extinguish and the Out-of-Lock relay change states.

10.2   Front Panel Indication – 1084B/C

10.2.1   Display Indication at Startup

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

                    ARBITER SYSTEMS GPS
                    SUBSTATION CLOCK
followed by:
                    COPYRIGHT (C) 2010
                    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 extinguish after the GPS receiver begins tracking satellites.

10.2.2   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
                        TRACKING: 00

10.2.3   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.
followed by:
                        GPS RECEIVER STATUS
                        TRACKING: 00*

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

followed by:
                        DCXO STATUS
                        $\pm$XX.X$^\circ$C $\pm$nn.nn PPM
followed by:
                        EEPROM STATUS
                        CORR. ERRORS = 0

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

10.2.4   Event/Deviation Display

There are separate displays when pressing the EVENT/DEVIATION key, depending on the setting. Scroll through successive events by pressing the UP or DOWN key. 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 500)
                        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

10.2.5   IRIG-B Time Data

IRIG-B time is immediately sent out, 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 Unlocked LED extinguishes.

10.3   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. If they exist, faults are indicated as follows:

Bit	Weight	Function
0	1	OCXO Not Installed (set to 1)
1	2	Stabilized (stabilized = 1)
2	4	Power Supply Error
3	8	IRIG BUS Fault (was Opt. 18)
4	16	Out of Lock
5	32	Time Error
6	64	VCXO Error
7	128	Receiver Failure

Table 10.1: Fault Conditions

For additional information on internal faults, please see Section 2.3.5, Section 8.1.3 and the System Status command including Table 9.3 starting on page 73.

10.4   Time Display Modes – 1084B/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).

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

The Date and Time Display UTC 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

Where:

> www = day of the week (Mon - Sun)
> dd = day of the month
> mmm = month (Jan - Dec)
> yyyy = the year
> hh = the hour (00 - 23)
> mm = the minute (00 - 59)
> ss = the second (00 - 59)

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

10.4.2 Time of Year Display, UTC

The Time of Year Display 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

Where:

> ddd = day of the year (001 - 366)

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.

10.4.3 Date and Time Display, Local Time

The Date and Time Display 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

10.4.4 Time of Year Display, Local Time

The Time of Year Display 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.

10.4.5 Daylight Saving–Summer Time

The Daylight Saving Time or 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. For setup information through the front–panel interface, please see Section 6.3.2.

DST configuration can be changed through the serial port or through the front panel keypad. For setup information through the RS-232C port, please see Section 9.2.4.

10.5 Position Display Modes – 1084B/C

When the clock is first powered ON and acquiring satellites, the only position information available is the previous position, stored in the clock setup 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 POSITION key 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.

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.

10.5.1 Longitude Display

ANTENNA LONGITUDE
XXX° XX' XX.XXX" W*

Where:

*W = WEST, or E = EAST

10.5.2 Latitude Display

ANTENNA LATITUDE
XX° XX' XX.XXX" N*

Where:

*N = NORTH, or S = SOUTH

10.5.3   Elevation Display

ANTENNA ELEVATION
XXXXX.XX m WGS-84

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

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 1084A/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 ±100 ns rms (at 1-PPS output), when receiving 4 or more satellites (one satellite if position is known within 25 meters) in the presence of Selective Availability (SA).

- < 40 ns, typical in Position–Hold mode

A.2.3   Internal Oscillator, Stability

- Standard: DCXO, 1×10^{-7}

A.2.4   Allen Variance (locked to GPS, in Position–Hold Mode

- 1 second 5×10^{-10} (2×10^{-10}, typical)

- 1 day 5×10^{-13}

A.2.5   Position Accuracy (rms)

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

- Elevation, 140 meters, SA on

A.2.6   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.2.7   Acquisition

- 150 seconds typical, cold start

- 15 minutes, 90% confidence, cold start

- 40 seconds typical, with almanac < 1 month old

A.3   I/O Configuration

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

A.3.1   I/O Connectors

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

- Signals, three BNC, with output signals as described below.

- Relays, two sets, 5-mm plug-type terminal block

A.3.2   Standard Output Signals

- IRIG-B: Modulated (1 kHz carrier). Analog outputs are complementary emitter follower (2N4401/4403) with 20-Ohm protective resistors, driven by a (LF442) op-amp. Modulated, bus driver, 4 Vpp, 20-Ohm source impedance, and drives a 50-Ohm load at 3 Vpp – one BNC connector

- User configurable: IRIG-B Unmodulated, or Programmable Pulse – one BNC connector

- User configurable: 1 PPS (10-ms pulse-width), IRIG-B Unmodulated (not available on earlier units) or IRIG-B Modified Manchester (IEEE Std 1344) – one BNC connector

User configurable outputs are 5-V CMOS bus drivers with 10-Ohm source impedance and $\pm$75-mA drive capability.

A.3.3 Relay Contacts

- 2 sets, form-C (SPDT) fail safe, 0.3 A at 130 Vdc; one is set to Locked function; and the second one may be configured to Fault, 1 PPH, or Programmable Pulse – jumper-selectable.

A.3.4 Programmable Pulse Output

- Five Modes: (1) Seconds-per-pulse; repetitive pulse, every $1 - 60,000$ seconds; (2) Pulse-per-hour: every $0 - 3599$ seconds after the hour, (3) starting at the top of the hour; (4) Set Alarm Time Mark: daily at a specified time of day; or one-shot at a specified time of year, (5) Slow Code $-$ UTC, LCL ($+$ or $-$). Pulse duration programmable $0.01 - 600$ seconds, except in one-shot mode, where the output is Low prior to the specified time and High thereafter.

A.3.5 Event A Input – Alternate Function

- Input provides one input as an alternate function, with a simple hardware modification to the 1-PPS configurable output. The input may be configured to accept an external 1-PPS signal, and measure the deviation from the 1-PPS/GPS signal with 100-ns resolution.

- Input also allows configuration of 1-PPS input to accept an external signal to record up to 500 sequential events with 100-ns resolution, provided that the events are separated by 11 ms. Event data is stored in battery-backed RAM.

A.4 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-in. 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 Figure 4.2).

- Magnet mount, lip mount, or post mount (30-mm max. diameter) available

A.4.1 Antenna Cable

- 15-meter (50-foot) cable included with antenna.

- Other cable styles and lengths available see Table 4.2.

A.5 Operator Interface

A.5.1 Setup Methods

- Via RS-232C Interface

- 8 Front-panel keys (Models 1084B/C Only)

A.5.2   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.5.3   Display

- 2-line by 20-character supertwist LCD; backlight available (Option 01)

- 9-character by 0.8-in. LED for day and time readout (Model 1084C only)

- Time: UTC or Local

- 1-PPS (input) Deviation

- Position: Latitude, Longitude and Elevation

- Event Time

- Status: clock, Receiver, EEPROM, and DCXO

A.5.4   Display Functions

- Time: UTC or Local

- 1 PPS (input) Deviation

- Position: Latitude, Longitude and Elevation

- Event Time

- Status: Clock, Receiver, DCXO & EEPROM

- Configuration (1084B/C)

A.5.5   Annunciators

- Operate (Green)

- On line (Green)

- Unlocked (Red)

- Fault (Red)

A.6   System Interface

A.6.1   RS-232C Interface

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

Table A.2: Main RS-232 Port Pin Definitions

NOTE: pins 6 – 9 are not connected on the optional RS-232 port. RS-422/485: Transmit only.

Communication Parameters

- Selectable, $300 - 19{,}200$ baud, 7 or 8 data bits, 1 or 2 stop bits, odd/even/no parity

- Supports all keyboard functions

A.6.2   Data Formats

Supports continuous output data in the following formats:

<SOH>ddd:hh:mm:ss<CRLF>	Broadcast Mode, ASCII
44hhmmss<CRLF> 55ddd<CRLF><BEL>	Broadcast Mode, Vorne
mm/dd/yyyy hh:mm:ss.sssssss nnn <CRLF>	Broadcast Mode, Event
ddd:hh:mm:ss I=nn:nn X=nn:nn <CRLF>	Broadcast Mode, Status
<CRLF> Q yy ddd hh:mm:ss.000 (space)	Broadcast Mode, Extended ASCII
<SOH> ddd:hh:mm:ssQ <CRLF>	Broadcast Mode, ASCII w/Time Quality
<SOH> yyyy:ddd:hh:mm:ssQ <CRLF>	Broadcast, ASCII, year w/Time Quality
(For other broadcast strings, see Section 9.2.1)	

For more information refer to RS-232 Broadcast Commands contained in Appendix A, Table A-1.

A.7   Physical Specifications

A.7.1   Dimensions

- **Instrument:**   430-mm W x 44-mm H x 280-mm D (16.9-in. x 1.7-in. x 11.0-in.)
- **Antenna:**   77-mm diameter x 66-mm height (3.05-in. x 2.61-in.)

A.7.2   Weight

- 2.0 kg (4.4 lbs.) net. (Instrument)
- 2.2 kg (4.84 lbs.) net. (Antenna and Cable)
- 0.5 kg (1.1 lbs.) net. (Option 06)
- 8 kg (18 lbs.) includes antenna, cables, and accessories. (Shipping)

A.7.3   Power Requirements

The Model 1084A/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.

- Option 07: 85 – 264 Vac, 47 – 440 Hz, or 110 – 370 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 – 250 Vac, 47 – 440 Hz, with three-position Terminal Power Strip and Surge-Withstand Capability

A.7.4   Power Connector

- Option 7, Standard Power Supply: This includes a fused IEC-320 power inlet module with mating ac cord. Plug type specified as power cord options P1 through P10 (see Section 3.2.1).
- Options 08 and 10: Using a 3-pole terminal strip power inlet with Surge-Withstand Capability (see Section 3.3 and 3.4).

A.7.5   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.

A.7.6   Temperature and Humidity

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.3: Temperature and Humidity List

Appendix B

Using Surge Arresters

B.1 Introduction

These instructions cover the installation of the Arbiter Systems Model AS0094500, Surge Arrester. 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.

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, or use an external rubber port seal.

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.1 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.

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)

GPS Antenna

Structure

To GPS Clock
Receiver

50mm

15mm

ARBITER
SYSTEMS

Surge Arrester/Grounding Block
AS0094500A

Receiver   Antenna
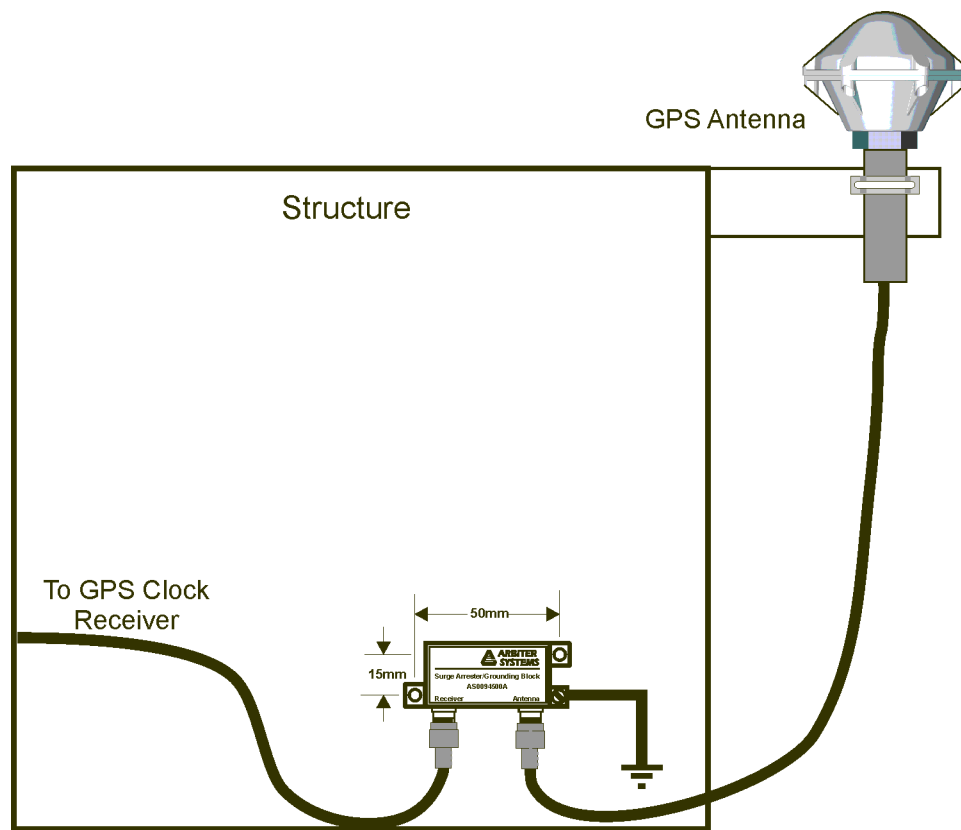
Figure B.1: Suggested Mounting of the AS0094500 Surge Arrester

Appendix C

Options List

C.1   Introduction

Each Arbiter Model 1084A/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 1084A/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. Some of these signals do not apply to the Model 1084A/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 – 1084B/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 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 Appendix A, page 76.

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 1084A/B/C 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, 1083B, 1093A/B/C and 1084A/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 – *Obsolete*

Option 03 has been replaced by Option 36, Four Configurable Outputs. See Section C.20

C.4.1   General Description

Option 03 adds four rear-panel outputs, which may be configured to any available signal in the 1084A/B/C series clocks. Note that there are more jumper settings on the Option 03 board than the 1084A/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 Available Outputs:	Operational amplifier (LF353) output, with 557-ohm series resistor. 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 (1088A/B):	±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).

C.4.3   Digital Outputs

Output Type:	High-Speed CMOS (74HC126), 0 to 5 volts, with 47 ohm series resistance.
Available Output:	*Note: All outputs available on Model 1084A/B/C and other clocks as noted.*
IRIG-B:	IRIG format B time code (unmodulated). *Available on clock Models 1088BP, 1084A/B/C and 1093A/B/C.*

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 "high"), synchronous to 1 PPS/GPS.
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.
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.

*not available in the Model 1084A/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 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 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 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.
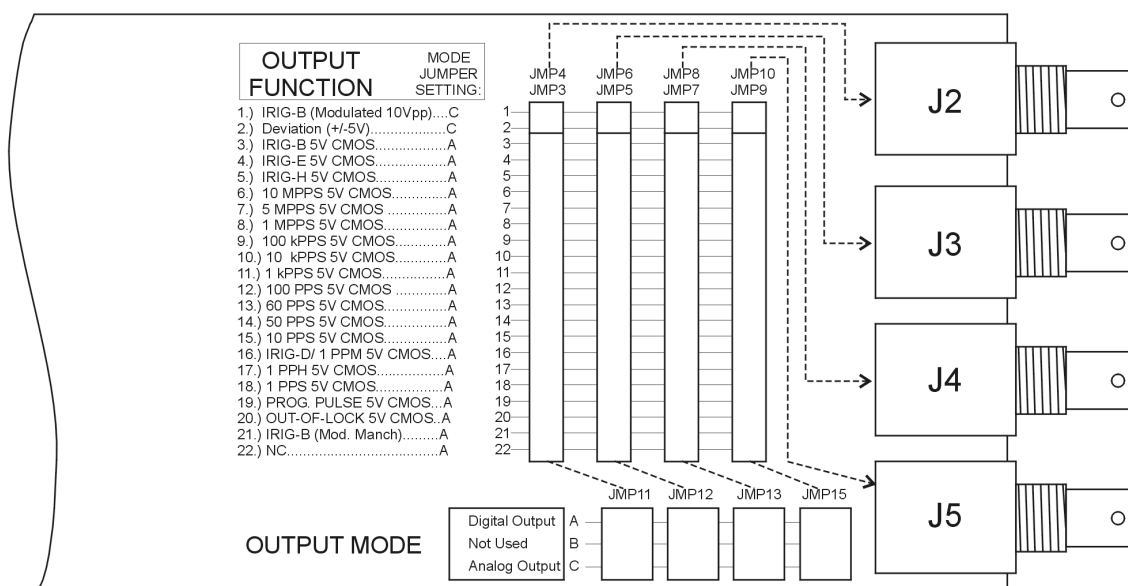
Figure C.1: Option 03 Jumper Configuration

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.1: Output Connector Jumper Settings

*not available in Model 1084A/B/C

C.5   Option 04: ON/OFF Switch

Option 04, ON/OFF switch for satellite-controlled clocks, can be mounted in Models 1084A/B only. Model 1084C LED uses the full front panel and Option 04 switch cannot be mounted.
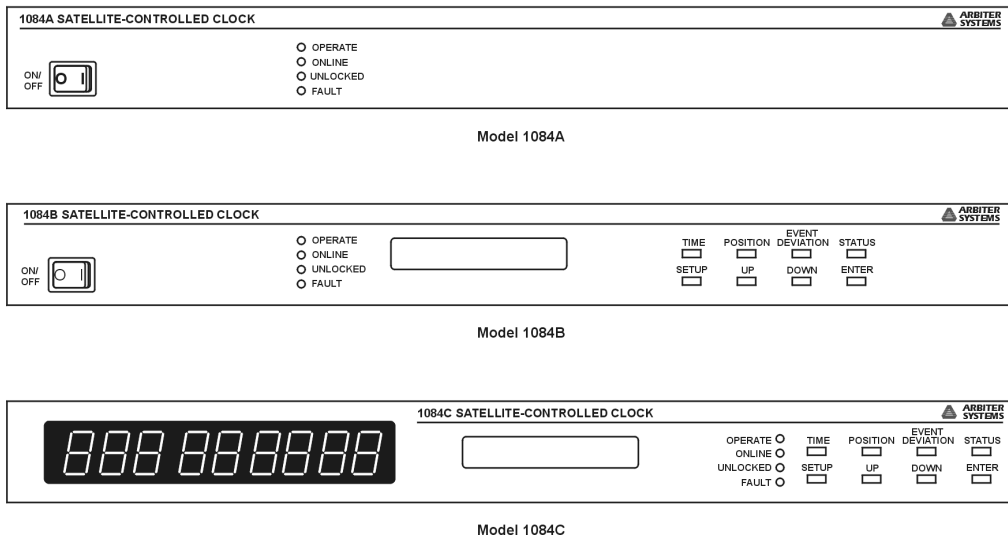
Figure C.2: Model 1084A/B/C Clocks

C.6 Option 06: Parallel BCD Output (1 millisecond Resolution)

C.6.1 General Description

Option 06 for the Model 1084A/B/C expands the capabilities of the instrument to include:

- Either of the following:

  - Time-of-year output in Binary-Coded Decimal (BCD) format, with resolution down to 1 millisecond;
  - Parallel Data output, with up to 48 bits that can be custom-configured at the factory for specific applications;

- A continuous 1 pulse-per-second (1 PPS) output, with the rising edge of a 10 millisecond-wide pulse synchronous to the rising edge of 1 PPS/GPS;

- A continuous 1,000 PPS (1 kPPS) square wave output, with rising edges synchronous to the rising edge of 1 PPS/GPS;

- Four pins of the output connector that can be configured with combinations* of the following:

  - Up to four digital signal outputs, the functions of which can be selected individually from 18 choices.
  - Up to two analog signal outputs, the functions of which can be selected individually from two choices.

*Note: Since these auxiliary functions must share four connector pins, certain limitations will apply when selecting combinations:

1. Enabling any one (or more) of the digital signal outputs precludes four bits from the parallel data output, if used;

2. Each analog signal output used precludes one of the digital signal outputs; if two analog signal outputs are employed, only two digital signal outputs are possible. Also, each analog signal output displaces one bit from the parallel data interface, if used;

C.6.2   Option 06 Firmware Setup
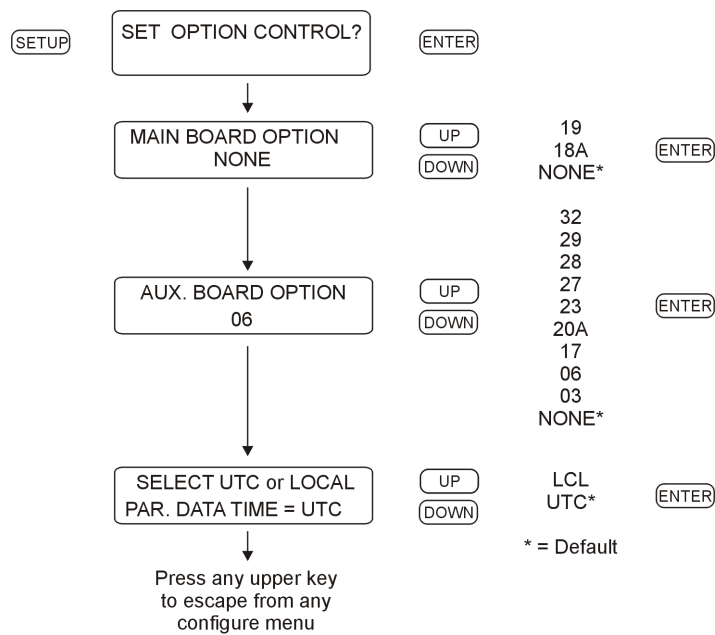
Figure C.3: Option 06 Firmware Setup

C.6.3 Specifications

General

Output Connector:	50 contact; Amphenol P/N 850-57L-40500-2700 or equivalent.
Mating Connectors:	
Plastic:	Amphenol P/N 850-57F-30500-20
Metal Shell:	Amphenol P/N 850-57FE-30500-20

Parallel BCD Output

Data Bus Width:	42 bits. For weighting, refer to Table 1.
Output Type:	High-Speed CMOS, buffered, (74HCXXX), 0 to 5 volts.
Time Data Format:	UTC or Local time data; corresponds to setting for IRIG time data (see 1084A/B/C Operation Manual).
Time Accuracy:	Rising edge delay of 100 nS maximum (1 mS bit), relative to 1 PPS output rising edge.

Analog Outputs

Output Type:	Operational amplifier (LF353) output, with 562 ohm series resistor.
Pin Numbers:	Output 1: pin 22
	Output 2: pin 47
IRIG-B, Modulated:	IRIG format B time code, modulated onto 1 kHz 10 Vpp sine wave carrier.
Deviation:	Model 1088B Only; ±5 volts analog, corresponding to 1 PPS deviation channel A or B.

C.6.4   Digital Outputs

Output Type:	High-Speed CMOS (74HCXXX), 0 to 5 volts, with 47 ohm series resistance.
Pin Numbers:	Output 1: pin 22
	Output 2: pin 47
	Output 3: pin 23
	Output 4: pin 48
Available Outputs:	
IRIG-B:	IRIG format B time code, 5 V CMOS (unmodulated).
IRIG-E:	IRIG format E time code, 5 V CMOS.
IRIG-H:	IRIG format H time code, 5 V CMOS.
IRIG-D/1 PPM:	IRIG format D time code (1 pulse per minute), 5 V CMOS. Rising edge on time.
10 MPPS:	10 MHz square wave, synchronous to the 1 PPS output.
5 MPPS:	5 MHz square wave, synchronous to the 1 PPS output.
1 MPPS:	1 MHz 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.
1 PPS:	1 PPS (10 mS "high"), synchronous to 1 PPS/GPS.
1 PPnnnS:	1 pulse per "nnn" seconds (10 mS "high", synchronous to 1 PPS/GPS); "nnn" corresponds to a number of seconds entered by the user.
1 PPH:	1 pulse per hour, rising edge on time.
Out-of-Lock:	5 volt CMOS levels. Normally "high" after acquisition of satellite signals. Toggles "low" nn minutes after loss of satellite signal lock. Range for "nn" is 00 to 99, and is set using the SETUP menu or RS-232C (refer to 1084A/B/C Operation Manual). Setting of 00 disables this function (output remains "high"). This output follows the standard "out-of-lock" function on the 1084A/B/C.

* Available only with the Model 1088A/B series clocks.

C.6.5   Option 06, Connector Pin Designation

Pin No:	BCD Mode Function/Bit Weighting:	Parallel Data Mode Function:
1	Ground	Ground
2	1 PPS output	Data Bit 47
*3	Output 4 (Dig. only)	Data Bit 45
*4	Output 2 (Dig./An.)	Data Bit 27
5	Day 200	Data Bit 35
6	Day 80	Data Bit 43
7	Day 20	Data Bit 41
8	Day 8	Data Bit 39
9	Day 2	Data Bit 37
10	20 Hr.	Data Bit 33
11	8 Hr.	Data Bit 31
12	2 Hr.	Data Bit 29
13	40 Min.	Data Bit 26
14	10 Min.	Data Bit 24
15	4 Min.	Data Bit 22
16	1 Min.	Data Bit 20
17	20 Sec.	Data Bit 17
18	8 Sec.	Data Bit 15
19	2 Sec.	Data Bit 13
20	800 mS	Data Bit 11
21	200 mS	Data Bit 9
22	80 mS	Data Bit 7
23	20 mS	Data Bit 5
24	8 mS	Data Bit 3
25	2 mS	Data Bit 1
26	Ground	Ground
27	1 kPPS output	Data Bit 46
*28	Output 3 (Dig. only)	Data Bit 44
*29	Output 1 (Dig./An.)	Data Bit 19
30	Day 100	Data Bit 34
31	Day 40	Data Bit 42
32	Day 10	Data Bit 40
33	Day 4	Data Bit 38
34	Day 1	Data Bit 36
35	10 Hr.	Data Bit 32
36	4 Hr.	Data Bit 30
37	1 Hr.	Data Bit 28
38	20 Min.	Data Bit 25
39	8 Min.	Data Bit 23
40	2 Min.	Data Bit 21

41	40 Sec.	Data Bit 18	–
42	10 Sec.	Data Bit 16	–
43	4 Sec.	Data Bit 14	–
44	1 Sec.	Data Bit 12	–
45	400 mS	Data Bit 10	–
46	100 mS	Data Bit 8	–
47	40 mS	Data Bit 6	–
48	10 mS	Data Bit 4	–
49	4 mS	Data Bit 2	–
50	1 mS	Data Bit 0	–

Table C.2: Option 06, Connector Pin Designation

*These pins can be configured for any of the listed functions, regardless of the main mode of operation for Option 06.
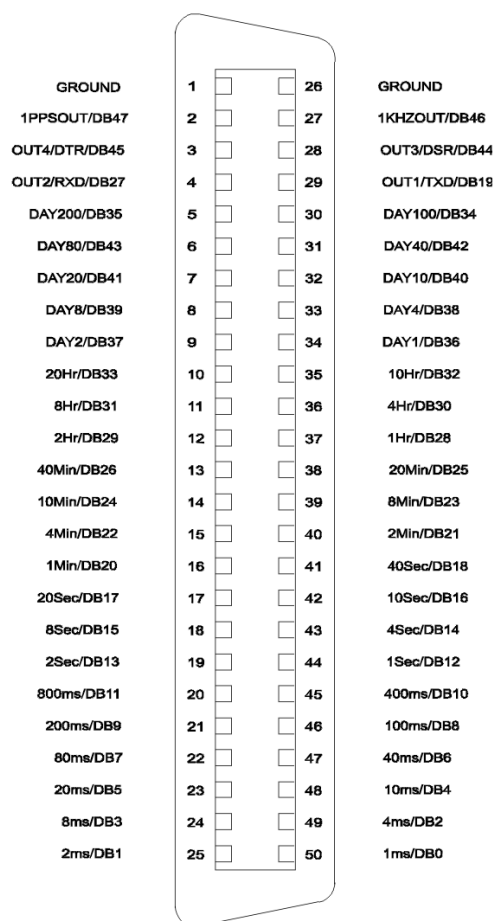
Figure C.4: Option 06 Output Connector

C.6.6 Configuration

General

Case Removal

    To change the configuration of Option 06, the top cover of the instrument must be removed. Turn off the instrument, and disconnect the power cord. Using a T-25 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.

Jumper Functions and Locations

Upon removal of the top cover, locate the circuit board for Option 06 (a diagram of the board, showing jumper locations, is given in Figure 2). The following sections outline the jumper setting changes and other steps necessary to utilize the various features available with Option 06.

BCD Output Mode

General

When configured for BCD output of time data, Option 06 utilizes pins 1 through 21 and 26 through 46, along with ground pins 25 and 50. The weighting for the individual bits, along with the connector pin locations, is given in Table 1. To configure Option 06 for BCD operation, observe the following steps:

    a. Set jumper JMP1 to position "B". This enables the BCD output mode.

    b. Set jumper JMP6 to position "A". This jumper is included to set the timing mode when utilizing the parallel data output, and must be set to position "A" for the BCD output to function properly.

Operation in the BCD output mode allows use of the analog and/or digital signal outputs, the 1 PPS and 1 kPPS outputs. Refer to the appropriate sections of this document for details of these functions.

Time Data Format

The format of the BCD time data which is output from the rear-panel connector can be either Local time or Coordinated Universal Time (UTC), and will be the same as the time format which is specified in the SETUP menu for the IRIG time data outputs. For further details, refer to the flowchart titled "Set IRIG Time DATA? in the 1084A/B/C Operation manual.

Parallel Data Output Mode

Full operation in the parallel data output mode utilizes all 50 contacts of the output connector. However, use of any combination of digital signal outputs or analog signal outputs will reduce the number of data bits available by up to four (data bits 19, 27, 44, and 45). For details, refer to the sections pertaining to these individual functions.

The functions of the individual data bits are defined for specific customer applications, upon request.

To configure Option 06 for parallel data mode, observe the following steps:

a. Set jumper JMP1 to position "B". This jumper enables the parallel data output mode.

b. Set jumpers JMP2, JMP3, JMP4, JMP5, and JMP11 to position "A" (these settings will vary if the analog and/or digital signal outputs are used; refer to the applicable sections for more information on these functions).

c. If it is desired that the parallel output data be synchronous to the 1 PPS output, set jumper JMP6 to position "A"; for non-synchronous operation, set this jumper to position "B".

Digital Signal Outputs

The four digital signal outputs can be individually enabled and configured, using the following steps:

a. Set jumper JMP11 to position "A". This enables the digital signal output mode. At the same time, making this jumper selection eliminates parallel data bits 19, 27, 44, and 45.

b. To enable digital signal output number 1, set jumper JMP2 to position "A".

c. To set the type of output signal for digital signal output number 1, make the appropriate selection on jumper JMP8 (refer to Figure 2). Note that positions 1 and 2 correspond to analog signal outputs, and will be occupied by a jumper only if analog signal output number 1 is enabled.

d. To enable digital signal output number 2, set jumper JMP3 to position "A".

e. To set the type of output signal for digital signal output number 2, make the appropriate selection on jumper JMP7 (refer to Figure 2). Note that positions 1 and 2 correspond to analog signal outputs, and will be occupied by a jumper only if analog signal output number 2 is enabled.

f. To enable digital signal output number 3, set jumper JMP4 to position "A". This also eliminates the possibility of using analog signal output number 1.

g. To set the type of output signal for digital signal output number 3, make the appropriate selection on jumper JMP9 (refer to Figure 2).

h. To enable digital signal output number 4, set jumper JMP5 to position "A". This also eliminates the possibility of using analog signal output number 2.

i. To set the type of output signal for digital signal output number 4, make the appropriate selection on jumper JMP10 (refer to Figure 2).

Analog Signal Outputs

The two analog signal outputs can be individually enabled and configured, using the following steps:

To enable analog signal output number 1, set jumper JMP4 to position "B". This setting also eliminates the possibility of having parallel data bit 44, digital signal output number 3.

To select the type of signal for analog output 1, remove the jumper from jumper strip JMP9 (which is no longer active, since it corresponds to digital signal output number 3), and place it on jumper strip JMP8 in either position 1 or 2 (refer to Figure 2).

To enable analog signal output number 2, set jumper JMP5 to position "B". This setting also eliminates the possibility of having parallel data bit 45, digital signal output number 4.

To select the type of signal for analog output 2, remove the jumper from jumper strip JMP10 (which is no longer active, since it corresponds to digital signal output number 4), and place it on jumper strip JMP7 in either position 1 or 2 (refer to Figure 2).

1 Pulse-per-Second (1 PPS) Output, 1,000 Pulse-per-Second (1 kPPS) Output

The 1 PPS and 1 kPPS outputs are enabled whenever Option 06 is placed in the BCD output mode (jumper JMP1 set to position "B").

J2 Pin	Function	JMP1	JMP2	JMP3	JMP4	JMP5	JMP6	JMP11
22	Synchronous (1 PPS) Parallel Data Bit 19	A	A	--	--	--	A	A
22	Asynchronous Parallel Data Bit 19	A	A	--	--	--	B	A
22	Digital Signal Output 1	--	A	--	--	--	--	B
22	RS-232C "T–D"	--	B	--	--	--	--	--
47	Synchronous (1 PPS) Parallel Data Bit 27	A	--	A	--	--	A	A
47	Asynchronous Parallel Data bit 19	A	--	A	--	--	B	A
47	Digital Signal Output 2	--	--	A	--	--	--	B
47	RS-232C "R–D"	--	--	B	--	--	--	--
23	Asynchronous Parallel Data Bit 44	A	--	--	A	--	--	A
23	Digital Signal Output 3	--	--	--	A	--	--	B
23	RS-232C "DSR"	--	--	--	C	--	--	--
23	Analog Signal Output 1	--	--	--	B	--	--	--
48	Asynchronous Parallel Data bit 45	A	--	--	--	A	--	A
48	Digital Signal Output 4	--	--	--	--	A	--	B
48	RS-232C "DTR"	--	--	--	--	C	--	--
48	Analog Signal Output 2	--	--	--	--	B	--	--

Figure C.5: Option 06 Output Jumper Settings
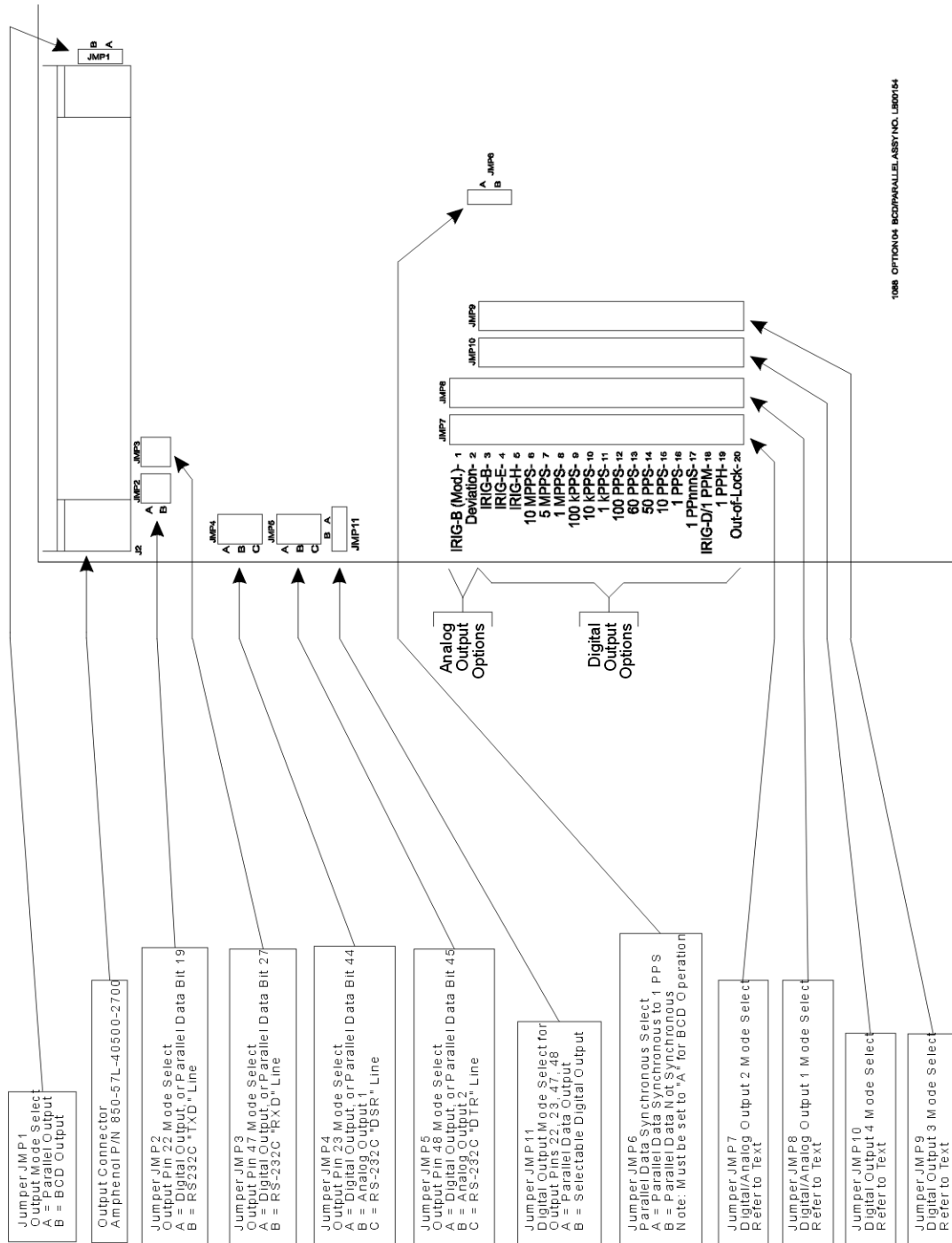
Figure C.6: Option 06 Board Layout and Jumper Locations

C.7   Option 07: Inlet Power Supply Description

C.7.1   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 maximum. Various plug styles are available as Options P01 through P10. See Section 3.2.1 for a list of available cordsets.

Figure C.7: Option 07 Power Supply Inlet Connector
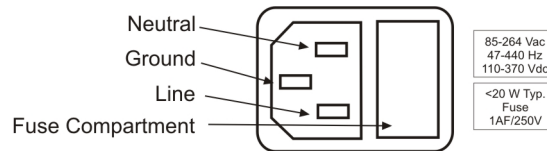
C.7.2   Specifications

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.8 Option 08: Inlet Power Supply Description

C.8.1 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.

Figure C.8: Option 08 Power Supply Inlet Connector
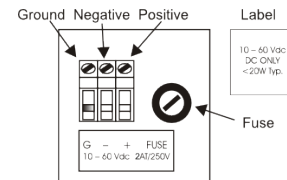
C.8.2 Specifications

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.9   Option 10: Inlet Power Supply Description

C.9.1   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 3.3.

Figure C.9: Option 10 Power Supply Inlet Connector
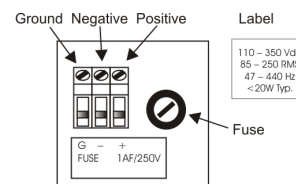
C.9.2   Specifications

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 3.3).

C.10   Option 17: Parallel BCD Output and Second RS-232C Port

C.10.1   General Description

Option 17 for the standard Model 1084A/B/C and 1088A/B clocks expand the capabilities of the instrument to include:

- Either of the following:

  a. Time-of-year output in Binary-Coded Decimal (BCD) format, with resolution down to 1 millisecond; or

  b. Parallel Data output, with up to 48 bits that can be custom-configured at the factory for specific applications;

- A continuous 1 pulse-per-second (1 PPS) output, with the rising edge of a 10 millisecond-wide pulse synchronous to the rising edge of 1 PPS/GPS;

- A continuous 1,000 PPS (1 kPPS) square wave output, with rising edges synchronous to the rising edge of 1 PPS/GPS;

- Four pins of the output connector that can be configured with combinations* of the following:

  a. Up to four digital signal outputs, the functions of which can be selected individually from 18 choices.

  b. Up to two analog signal outputs, the functions of which can be selected individually from two choices.

  c. An RS-232C serial communications port, which can use between two and four lines.

*Note: Since these auxiliary functions must share four connector pins, certain limitations will apply when selecting combinations:

- Enabling any one (or more) of the digital signal outputs precludes four bits from the parallel data output, if used;

- Each analog signal output used precludes one of the digital signal outputs; if two analog signal outputs are employed, only two digital signal outputs are possible. Also, each analog signal output displaces one bit from the parallel data interface, if used;

- A two- or four-wire RS-232C port configuration uses two or four of the data output lines, so these lines become unavailable for digital and/or analog signal outputs, or for the assigned data bits of the parallel output (if used).

C.10.2   Option 17 Firmware Setup Procedure


```
(SETUP)   ┌─────────────────────┐   (ENTER)
          │ SET  OPTION CONTROL?│
          └─────────────────────┘
                     │
                     ↓
          ┌─────────────────────┐   ( UP  )         19        (ENTER)
          │ MAIN BOARD OPTION   │                   18A
          │       NONE          │   (DOWN )        NONE*
          └─────────────────────┘

                                                     32
                                                     29
                                                     28
          ┌─────────────────────┐   ( UP  )         27        (ENTER)
          │ AUX. BOARD OPTION   │                   23
          │         17          │   (DOWN )         20A
          └─────────────────────┘                   17
                                                     06
                                                     03
                                                    NONE*

          ┌─────────────────────┐   ( UP  )        LCL        (ENTER)
          │ SELECT UTC or LOCAL │                  UTC*
          │ PAR. DATA TIME = UTC │  (DOWN )
          └─────────────────────┘               * = Default
                     │
                     ↓
          Press any upper key
          to escape from any
          configure menu
```
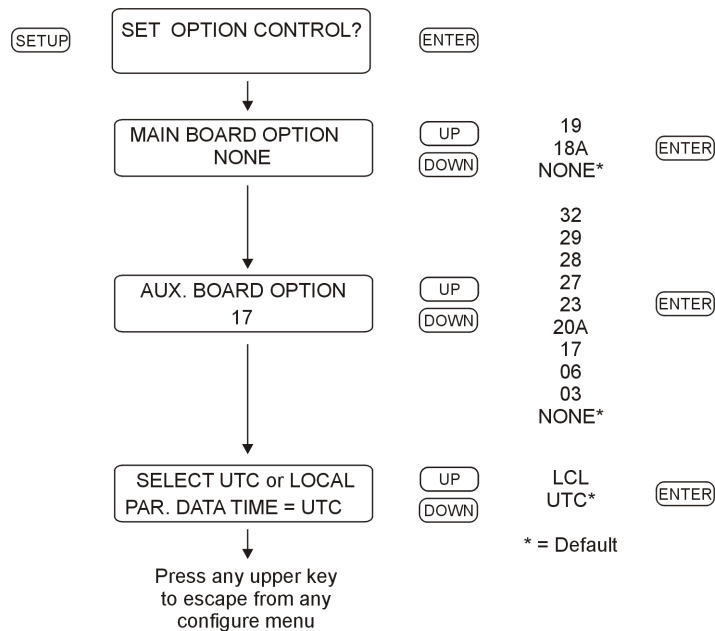
Figure C.10: Option 17 Firmware Setup

Note: For additional programming information on other options, please see Chapter 6 or other options in Appendix C.

C.10.3 Specifications

General

Output Connector:	50 contact;Amphenol P/N 850-57L-40500-2700 or equivalent.
Mating Connectors:	
Plastic:	Amphenol P/N 850-57F-30500-20
Metal Shell:	Amphenol P/N 850-57FE-30500-20

Parallel BCD Output

Data Bus Width:	42 bits. For weighting, refer to Table 1.
Output Type:	High-Speed CMOS, buffered, (74HCXXX), 0 to 5 volts.
Time Data Format:	UTC or Local time data; corresponds to setting for IRIG time data (see 1084A/B/C Operation Manual).
Time Accuracy:	Rising edge delay of 100 nS maximum (1 mS bit), relative to 1 PPS output rising edge.

Analog Outputs

Output Type:	Operational Amplifier (LF353) output, with 562-ohm series resistor.
Pin Numbers:	Output 1: pin 22
	Output 2: pin 47
IRIG-B, Modulated:	IRIG format B time code, modulated onto 1 kHz 10 Vpp sine wave carrier.
Deviation:	Model 1088B Only; ± 5 volts analog, corresponding to 1 PPS deviation channel A or B.

C.10.4   Digital Outputs

Output Type:	High-Speed CMOS (74HCXXX), 0 to 5 volts, with 47 ohm series resistance.
Pin Numbers:	Output 1: pin 22
	Output 2: pin 47
	Output 3: pin 23
	Output 4: pin 48
Available Outputs:	
IRIG-B:	IRIG format B time code, 5 V CMOS (unmodulated).
IRIG-E:	IRIG format E time code, 5 V CMOS.
IRIG-H:	IRIG format H time code, 5 V CMOS.
IRIG-D/1 PPM:	IRIG format D time code (1 pulse per minute), 5 V CMOS. Rising edge on time.
10 MPPS:	10 MHz square wave, synchronous to the 1 PPS output.
5 MPPS:	5 MHz square wave, synchronous to the 1 PPS output.
1 MPPS:	1 MHz 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.
1 PPS:	1 PPS (10 mS "high"), synchronous to 1 PPS/GPS.
1 PPnnnS:	1 pulse per "nnn" seconds (10 mS "high", synchronous to 1 PPS/GPS); "nnn" corresponds to a number of seconds entered by the user.
1 PPH:	1 pulse per hour, rising edge on time.
Out-of-Lock:	5 volt CMOS levels. Normally "high" after acquisition of satellite signals. Toggles "low" nn minutes after loss of satellite signal lock. Range for "nn" is 00 to 99, and is set using the SETUP menu or RS-232C (refer to 1084A/B/C Operation Manual). Setting of 00 disables this function (output remains "high"). This output follows the standard "out-of-lock" function on the 1084A/B/C.

* Available only with the Model 1088A/B series clocks.

RS-232C

Output Type:	CMOS, -12 to +12 volts.
Input Type:	Standard RS-232C levels.

Inputs Available:

Receive Data ("RXD"):	Connector pin 4. Receives data from external device.Requires that JMP3 be set to position "B". Precludes use of digital signal output 2 or parallel data bit 27.
Data Terminal Ready ("DTR"):	Connector pin 3. Informs clock that remote device is ready to receive data.Requires that JMP5 be set to position "C". Precludes the use of digital signal output 4, analog signal output 2, or parallel data bit 45.

Outputs Available:

Transmit Data ("TXD"):	Connector pin 29. Sends data to external device.Requires that JMP2 be set to position B. Precludes the use of digital signal output 1 or parallel data bit 19.
Data Set Ready ("DSR"):	Connector pin 28. Informs the remote device that clock is prepared to send data.Requires that JMP4 be set to position "C". Precludes the use of digital signal output 3, analog signal output 1, or parallel data bit 44.

C.10.5   Option 17, Connector Pin Designation

Pin No:	BCD Mode Function/Bit Weighting:	Parallel Data Mode Function:	RS-232C Function
1	Ground	Ground	Ground
2	1 PPS output	Data Bit 47	−
*3	Output 4 (Dig. only)	Data Bit 45	DTR
*4	Output 2 (Dig./An.)	Data Bit 27	RXD
5	Day 200	Data Bit 35	−
6	Day 80	Data Bit 43	−
7	Day 20	Data Bit 41	−
8	Day 8	Data Bit 39	−
9	Day 2	Data Bit 37	−
10	20 Hr.	Data Bit 33	−
11	8 Hr.	Data Bit 31	−
12	2 Hr.	Data Bit 29	−
13	40 Min.	Data Bit 26	−
14	10 Min.	Data Bit 24	−
15	4 Min.	Data Bit 22	−
16	1 Min.	Data Bit 20	−
17	20 Sec.	Data Bit 17	−
18	8 Sec.	Data Bit 15	−
19	2 Sec.	Data Bit 13	−
20	800 mS	Data Bit 11	−
21	200 mS	Data Bit 9	−
22	80 mS	Data Bit 7	−
23	20 mS	Data Bit 5	−
24	8 mS	Data Bit 3	−
25	2 mS	Data Bit 1	−
26	Ground	Ground	Ground
27	1 kPPS output	Data Bit 46	−
*28	Output 3 (Dig. only)	Data Bit 44	DSR
*29	Output 1 (Dig./An.)	Data Bit 19	TXD
30	Day 100	Data Bit 34	−
31	Day 40	Data Bit 42	−
32	Day 10	Data Bit 40	−
33	Day 4	Data Bit 38	−
34	Day 1	Data Bit 36	−
35	10 Hr.	Data Bit 32	−
36	4 Hr.	Data Bit 30	−
37	1 Hr.	Data Bit 28	−
38	20 Min.	Data Bit 25	−
39	8 Min.	Data Bit 23	−
40	2 Min.	Data Bit 21	−

Table C.3: Option 17, Connector Pin Designation

Note: Table C.3 continued on next page.

Note: Table C.3 continued below.

41	40 Sec.	Data Bit 18	–
42	10 Sec.	Data Bit 16	–
43	4 Sec.	Data Bit 14	–
44	1 Sec.	Data Bit 12	–
45	400 mS	Data Bit 10	–
46	100 mS	Data Bit 8	–
47	40 mS	Data Bit 6	–
48	10 mS	Data Bit 4	–
49	4 mS	Data Bit 2	–
50	1 mS	Data Bit 0	–

*These pins can be configured for any of the listed functions, regardless of the main mode of operation for Option 17.

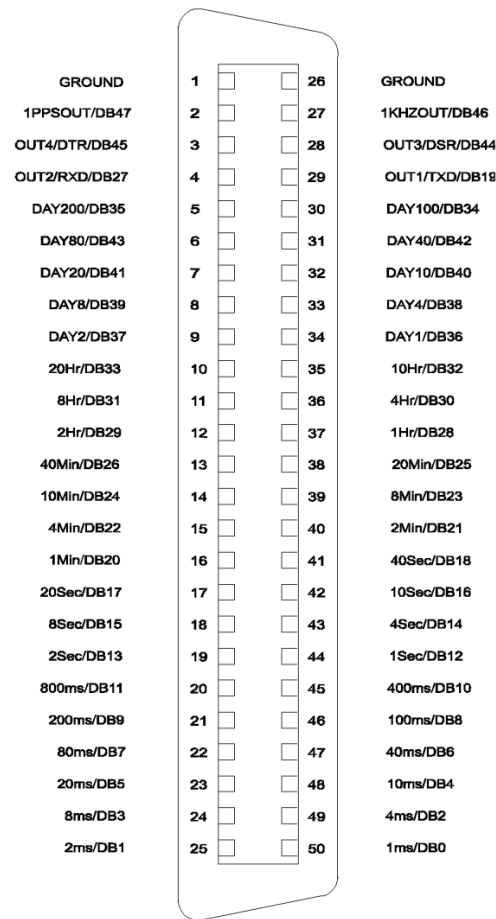| GROUND	1			26	GROUND
1PPSOUT/DB47	2			27	1KHZOUT/DB46
OUT4/DTR/DB45	3			28	OUT3/DSR/DB44
OUT2/RXD/DB27	4			29	OUT1/TXD/DB19
DAY200/DB35	5			30	DAY100/DB34
DAY80/DB43	6			31	DAY40/DB42
DAY20/DB41	7			32	DAY10/DB40
DAY8/DB39	8			33	DAY4/DB38
DAY2/DB37	9			34	DAY1/DB36
20Hr/DB33	10			35	10Hr/DB32
8Hr/DB31	11			36	4Hr/DB30
2Hr/DB29	12			37	1Hr/DB28
40Min/DB26	13			38	20Min/DB25
10Min/DB24	14			39	8Min/DB23
4Min/DB22	15			40	2Min/DB21
1Min/DB20	16			41	40Sec/DB18
20Sec/DB17	17			42	10Sec/DB16
8Sec/DB15	18			43	4Sec/DB14
2Sec/DB13	19			44	1Sec/DB12
800ms/DB11	20			45	400ms/DB10
200ms/DB9	21			46	100ms/DB8
80ms/DB7	22			47	40ms/DB6
20ms/DB5	23			48	10ms/DB4
8ms/DB3	24			49	4ms/DB2
2ms/DB1	25			50	1ms/DB0

Figure C.11: Option 17 Output Connector

C.10.6   Configuration

General

Case Removal
To change the configuration of Option 17, the top cover of the instrument must be removed. Turn off the instrument, and disconnect the power cord. Using a T-25 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.

Jumper Functions and Locations

Upon removal of the top cover, locate the circuit board for Option 17 (a diagram of the board, showing jumper locations, is given in Figure C.12). The following sections outline the jumper setting changes and other steps necessary to utilize the various features available with Option 17.

BCD Output Mode

General
When configured for BCD output of time data, Option 17 utilizes pins 1 through 21 and 26 through 46, along with ground pins 25 and 50. The weighting for the individual bits, along with the connector pin locations, is given in Table 1. To configure Option 17 for BCD operation, observe the following steps:

   a. Set jumper JMP1 to position "B". This enables the BCD output mode.

   b. Set jumper JMP6 to position "A". This jumper is included to set the timing mode when utilizing the parallel data output, and must be set to position "A" for the BCD output to function properly.

Operation in the BCD output mode allows use of the analog and/or digital signal outputs, the 1 PPS and 1 kPPS outputs, and the RS-232C communications port. Refer to the appropriate sections of this document for details of these functions.

Time Data Format
The format of the BCD time data which is output from the rear-panel connector can be either Local time or Coordinated Universal Time (UTC), and will be the same as the time format which is specified in the SETUP menu for the IRIG time data outputs. For further details, refer to the flowchart titled "Set IRIG Time DATA? in the 1084A/B/C Operation manual.

Parallel Data Output Mode

Full operation in the parallel data output mode utilizes all 50 contacts of the output connector. However, use of any combination of digital signal outputs or analog signal outputs, or RS-232C will reduce the number of data bits available by up to four (data bits 19, 27, 44, and 45). For details, refer to the sections pertaining to these individual functions.

The functions of the individual data bits are defined for specific customer applications, upon request.

To configure Option 17 for parallel data mode, observe the following steps:

a. Set jumper JMP1 to position "B". This jumper enables the parallel data output mode.

b. Set jumpers JMP2, JMP3, JMP4, JMP5, and JMP11 to position "A" (these settings will vary if the analog and/or digital signal outputs or RS-232C port are used; refer to the applicable sections for more information on these functions).

c. If it is desired that the parallel output data be synchronous to the 1 PPS output, set jumper JMP6 to position "A"; for non-synchronous operation, set this jumper to position "B".

Digital Signal Outputs

The four digital signal outputs can be individually enabled and configured, using the following steps:

a. Set jumper JMP11 to position "A". This enables the digital signal output mode. At the same time, making this jumper selection eliminates parallel data bits 19, 27, 44, and 45.

b. To enable digital signal output number 1, set jumper JMP2 to position "A". This also eliminates the TXD RS-232C line.

c. To set the type of output signal for digital signal output number 1, make the appropriate selection on jumper JMP8 (refer to Figure C.13). Note that positions 1 and 2 correspond to analog signal outputs, and will be occupied by a jumper only if analog signal output number 1 is enabled.

d. To enable digital signal output number 2, set jumper JMP3 to position "A".

e. To set the type of output signal for digital signal output number 2, make the appropriate selection on jumper JMP7 (refer to Figure C.13). Note that positions 1 and 2 correspond to analog signal outputs, and will be occupied by a jumper only if analog signal output number 2 is enabled.

f. To enable digital signal output number 3, set jumper JMP4 to position "A". This also eliminates the possibility of using analog signal output number 1.

g. To set the type of output signal for digital signal output number 3, make the appropriate selection on jumper JMP9 (refer to Figure C.13).

h. To enable digital signal output number 4, set jumper JMP5 to position "A". This also eliminates the possibility of using analog signal output number 2.

i. To set the type of output signal for digital signal output number 4, make the appropriate selection on jumper JMP10 (refer to Figure C.13).

Analog Signal Outputs

The two analog signal outputs can be individually enabled and configured, using the following steps:

To enable analog signal output number 1, set jumper JMP4 to position "B". This setting also eliminates the possibility of having parallel data bit 44, digital signal output number 3.

To select the type of signal for analog output 1, remove the jumper from jumper strip JMP9 (which is no longer active, since it corresponds to digital signal output number 3), and place it on jumper strip JMP8 in either position 1 or 2 (refer to Figure C.13).

To enable analog signal output number 2, set jumper JMP5 to position "B". This setting also eliminates the possibility of having parallel data bit 45, digital signal output number 4.

To select the type of signal for analog output 2, remove the jumper from jumper strip JMP10 (which is no longer active, since it corresponds to digital signal output number 4), and place it on jumper strip JMP7 in either position 1 or 2 (refer to Figure C.13).

1 Pulse-per-Second (1 PPS) Output, 1,000 Pulse-per-Second (1 kPPS) Output

The 1 PPS and 1 kPPS outputs are enabled whenever Option 17 is placed in the BCD output mode (jumper JMP1 set to position "B").

J2 Pin	Function	JMP1	JMP2	JMP3	JMP4	JMP5	JMP6	JMP11
22	Synchronous (1 PPS) Parallel Data Bit 19	A	A	–	–	–	A	A
22	Asynchronous Parallel Data Bit 19	A	A	–	–	–	B	A
22	Digital Signal Output 1	–	A	–	–	–	–	B
22	RS-232C "T–D"	–	B	–	–	–	–	–
47	Synchronous (1 PPS) Parallel Data Bit 27	A	–	A	–	–	A	A
47	Asynchronous Parallel Data bit 19	A	–	A	–	–	B	A
47	Digital Signal Output 2	–	–	A	–	–	–	B
47	RS-232C "R–D"	–	–	B	–	–	–	–
23	Asynchronous Parallel Data Bit 44	A	–	–	A	–	–	A
23	Digital Signal Output 3	–	–	–	A	–	–	B
23	RS-232C "DSR"	–	–	–	C	–	–	–
23	Analog Signal Output 1	–	–	–	B	–	–	–
48	Asynchronous Parallel Data bit 45	A	–	–	–	A	–	A
48	Digital Signal Output 4	–	–	–	–	A	–	B
48	RS-232C "DTR"	–	–	–	–	C	–	–
48	Analog Signal Output 2	–	–	–	–	B	–	–

Figure C.12: Option 17 Output Jumper Settings
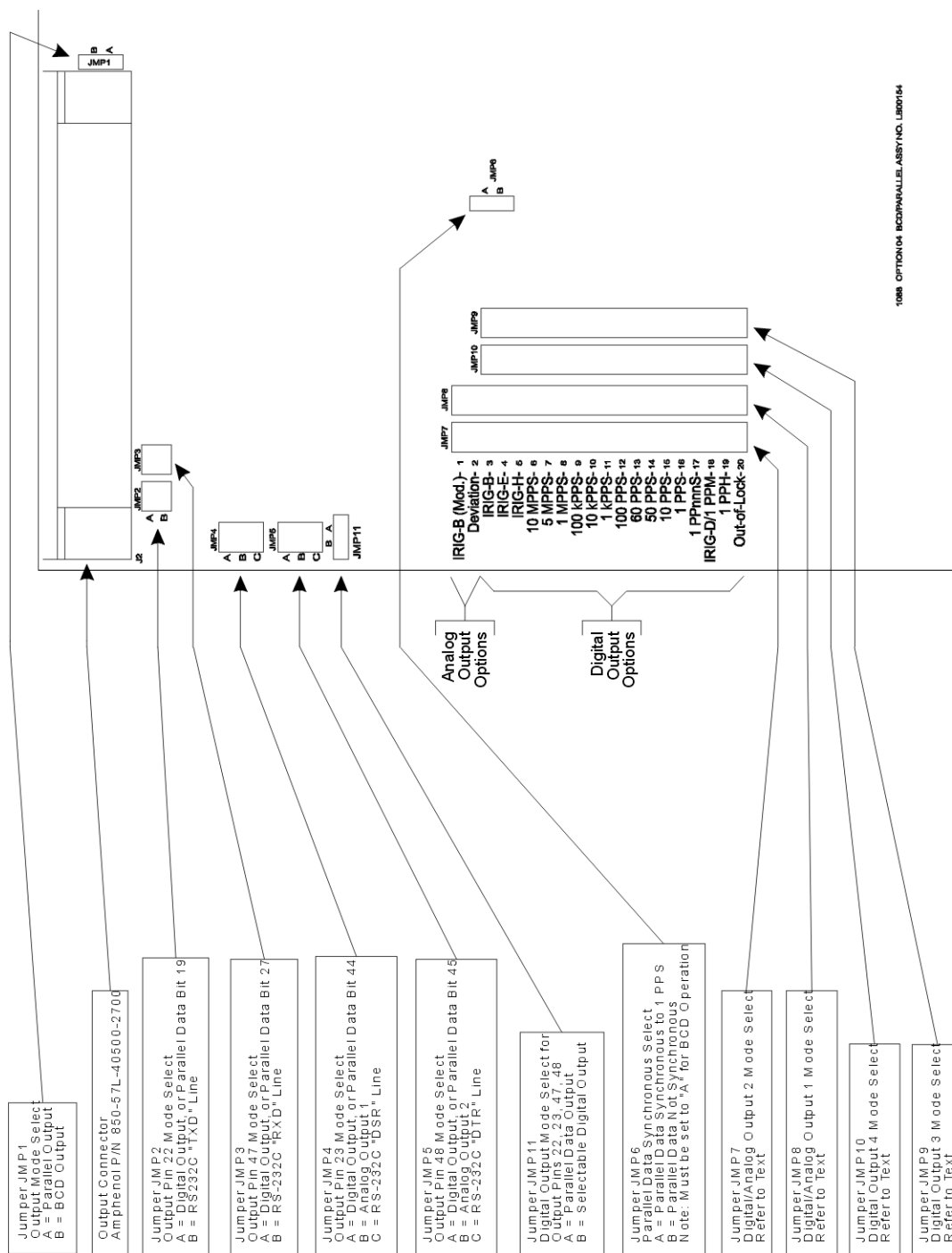
Figure C.13: Option 17 Board Layout and Jumper Locations

C.11 Option 19: Second RS-232C Interface

C.11.1 General Description

Option 19 for the Model 1084A/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.11.2 Specification

Commands

All commands, which are available for the main RS-232C port on the Model 1084A/B/C, may be used with Option 19. See Chapter 9 for list of RS-232 commands. Note that broadcast commands supporting the main RS-232 port begin with the letter "B" and broadcast commands supporting the second RS-232 port begin with the letter "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
1	No Connection
2	Receive Data input (RXD)
3	Transmit Data output (TXD)
4	No Connection
5	Signal Common
6	No Connection
7	No Connection
8	No Connection
9	No Connection

Table C.4: Option 19, Second RS-232 Port Pin Locations

C.12 Option 20: Fiber Optic Output, type ST 820nm

C.12.1 Purpose

When installed into the standard Model 1084A/B/C, Option 20 provides one selectable fiber-optic output with Type ST connector and 820-nm transmitter compatible with multimode fiber.

C.12.2 Specifications

One fiber-optic output is jumper-configurable to each of the standard digital (CMOS) signal outputs: IPPS, IRIG-B unmodulated and IRIG-B Modified Manchester(IEEE P1344 High-Precision Time Code). Analog signals, IRIG-B Modulated, and ± 5 V Recorder are not selectable.

Option 20 provides an optical power output of -15 dBm minimum (-12 dBm typical) into 62.5/125-μm fiber. The transmitter is also usable with 50/125μm, 100/140μm and 200μm PCS fiber.

The optical signal is ON whenever the selected logic signal is HI. Transmitter bandwidth is compatible with all available logic signals. Fiber optic signal may be converted back to electrical format using the Model 10881A Fiber Optic to Logic converter, available separately from Arbiter Systems.

C.12.3 Output Jumper Configuration (JMP2)

Select standard digital (CMOS) output signals for output via the fiber-optic output transmitter by setting jumper JMP2 on the main board. The following table provides a list of digital available and jumper locations for configuration to a fiber-optic output connector.

Position	Signal
A	IRIG-B Unmodulated
B	IRIG-B Modified Manchester
C	1 PPS

C.13   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 Slot A of Model 1084A/B/C, in either Slot A or B of the standard Model 1088A/B clock and in Slot A of Model 1093A/B/C clock.

Output Enable (JMP1)

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 illustrated in Figure C.14.

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	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.5: Option 20A, Four Fiber Optic Output Configuration

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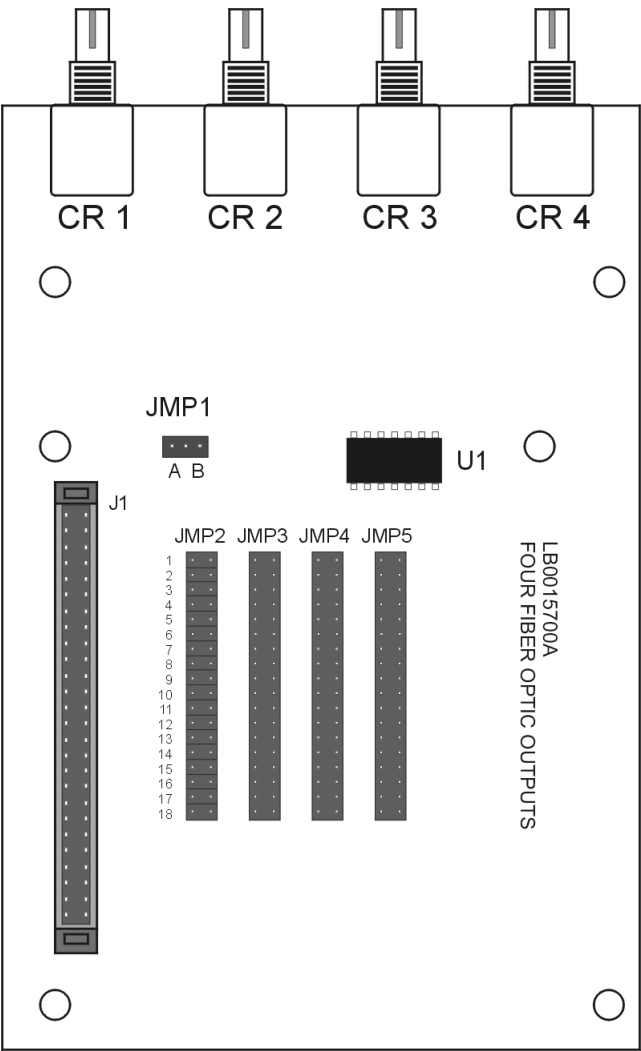3. Signals available on the Model 1084A/B/C

Figure C.14: Option 20A Jumper Locations

C.14   Option 23, COMTRADE Sample Rate Generator

C.14.1   General Description

When equipped with the Option 23 COMTRADE Sample Rate Generator, the Satellite-Controlled Clock generates any one of the 48 standard sampling rates for waveform digitization in 50 or 60 Hz systems which are defined in IEEE Standard C37.111-1991, Data Exchange (COMTRADE) for Power Systems. Standard COMTRADE Sampling Rates are listed in Tables 1 and 2 (on following page).

The selected sample rate is available as a 5 V CMOS-level square wave in both normal (rising edge of clock synchronous with 1 PPS) and complemented (falling edge of clock synchronous with 1 PPS) polarities. The sampling pulse is synchronized to within 50 ns of 1 PPS, and has sample-to-sample jitter less than 1 ns.

C.14.2   Principles of Operation

The Option 23 assembly generates sampling signals, which are precisely locked to 1 PPS-GPS by phase locking a precision voltage-controlled crystal oscillator (VCXO) to the internal 1 kPPS signal present in the clock. This VCXO output signal is then divided down to obtain the desired sampling rate. Synchronization logic is also provided, to ensure that the output divider is synchronized to 1 PPS-GPS. By using a precision VCXO, pulse-to-pulse sampling jitter is held to an absolute minimum, and is specified not to exceed 1 ns rms. The output signals have a 50% duty cycle (square wave).

C.14.3   Other Features

The Option 23 assembly includes four configurable BNC outputs, which are in addition to those available for the standard model clock. Either normal or complemented-polarity COMTRADE sampling frequency signals may be made available at each of these additional outputs. Furthermore, any output not configured for a COMTRADE sampling rate output can be used as a general-purpose configurable output, and can deliver any of the 21 standard signals available in the Model 1084A/B/C. The Option 23 assembly may be installed in the standard option slot available (Slot B).

C.14.4   Specifications

Sampling Rates

Samples/cycle	f_s for 60 Hz	f_s for 50 Hz
384	23040	19200
192	11520	9600
128	7680	6400
96	5760	4800
64	3840	3200
48	2880	2400
32	1920	1600
24	1440	1200
16	960	800
12	720	600
8	480	400
6	360	300
4	240	200

Table C.6: Option 23, Sample Rates, $f_{LCM} = 384 \times f_{base}$

Samples/cycle	f_s for 60 Hz	f_s for 50 Hz
3200	192000	160000
1600	96000	80000
800	48000	40000
640	38400	32000
400	24000	20000
320	19200	16000
200	12000	10000
160	9600	8000
128	7680	6400
100	6000	5000
80	4800	4000
64	3840	3200
50	3000	2500
40	2400	2000
32	1920	1600
20	1200	1000
16	960	800
10	600	500
8	480	400
4	240	200

Table C.7: Option 23, Sample Rates, $f_{LCM} = 3200 \times f_{base}$

C.14.5   Performance

Accuracy:	± 50 ns from 1 PPS, max (-10 ns, typical)
Jitter:	1 ns rms, max. pulse to pulse (guaranteed by design, not production tested)

C.14.6   Outputs

Connectors:	Four, BNC 50-ohm, configurable
Signals:	Normal Polarity COMTRADE Sample Rate, 50% Duty Cycle
	Complemented COMTRADE Sample Rate, 50% Duty Cycle
	All 21 Other Signals Available in 1088B or 1084A/B/C Clock

C.14.7   Drive Capability

Digital:	5 V CMOS Buffer, 50 Ohms Impedance
Analog:	Op amp Buffer, 600 Ohms Impedance

C.14.8   Setup

Setup Menu

The SETUP menu allows the user to modify internal operating firmware parameters within both the Model 1084A/B/C and Model 1088A/B. The SETUP menu can be easily accessed from the front panel keyboard.

The Option 23 SETUP menu is illustrated in Figure C.15 for the standard clock Model 1084A/B/C. Figure 5-2 illustrates the standard Model 1088A/B SETUP menu. However, for clarity only Option 23 is described.

RS-232C Commands

Option 23 can also be configured via the RS-232C interface using one of the following commands:

Configure Option 23

Command: **m:rCA, m:rCB**
m:rCA configures Option 23 to operate correctly from Option Slot A in the Model 1084A/B/C, or from the Model 1088B. m:rCB configures Option 23 to operate correctly from Option Slot B from the Model 1088B only.
Response: ↄ

Where:

m	$0 = 50$ Hz	
	$1 = 60$ Hz	
r	see Table C.6 or Table C.7 for SAMPLES/CYCLE number.	

C.14.9   Option 23, Front Panel Setup

The information provided on this page should help you to configure the Option 23 on the Model 1084A/B/C clocks. If you should need additional information on setting up from the front panel keys, please go to Chapter 6.

To enter the Aux Board Setup menu, press SETUP, until you reach SET OPTION CONTROL, then press ENTER. Make choices using the UP/DOWN keys to select the desired value and ENTER key to confirm the selection and move on.
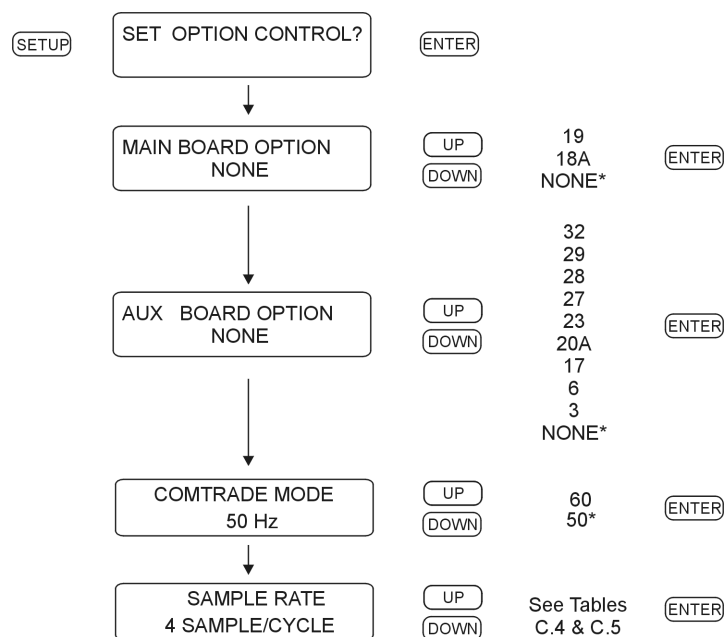

Figure C.15: Option 23 Front Panel Setup

C.14.10   Changing Hardware Settings via Internal Jumpers

It is necessary to set a jumper in order to assign the output signal to a specific I/O connector. The following paragraphs describe the procedure for setting these jumpers.

Cover Removal

To change the I/O configuration of the rear-panel connectors, the top cover of the instrument must be removed. Turn off the instrument, and disconnect the power cord. Using a T-25 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 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.

The Option 23 COMTRADE Board is illustrated in Figure C.16, which shows the location of all the jumpers along with a brief description.

Output Function Selection

Jumpers JMP1, JMP2, JMP3, and JMP4 determine the output signals which can be made available at I/O connectors J2, J3, J4, and J5, respectively. Figure C.16 illustrates the relationship between these jumpers and the I/O connectors. The first step in setting an I/O channel for a specific output signal is to move the associated jumper to the location corresponding to the desired signal. Table C.8 lists the jumper settings required for various signals.

Output Mode Selection

The next step in configuring the I/O connectors is to determine whether the assigned signal is an analog output or a digital output. This selection is accomplished by setting jumpers JMP5, JMP6, JMP7, and JMP8 to the appropriate positions. These jumpers correspond to connectors J2, J3, J4, and J5, respectively (see Figure C.16). If the I/O channel is to be used as a digital output, the corresponding jumper should be set to position "A". If the I/O channel is to be used as an analog output, the jumper should be set to position "C". Table C.8 lists jumper positions for individual output signals.

Output Signal	Function Jumpers	Mode Jumpers
IRIG-B Modulated, 10 Vpp	1	C
Deviation (± 5 V)*	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 PPH	17	A
1 PPS	18	A
Programmable Pulse	19	A
Out of Lock	20	A
IRIG-B Modified Manchester	21	A
Normal Polarity COMTRADE	22	A
Complemented Polarity COMTRADE	23	A

Table C.8: Option 23, Output Signal Selection Jumper Settings

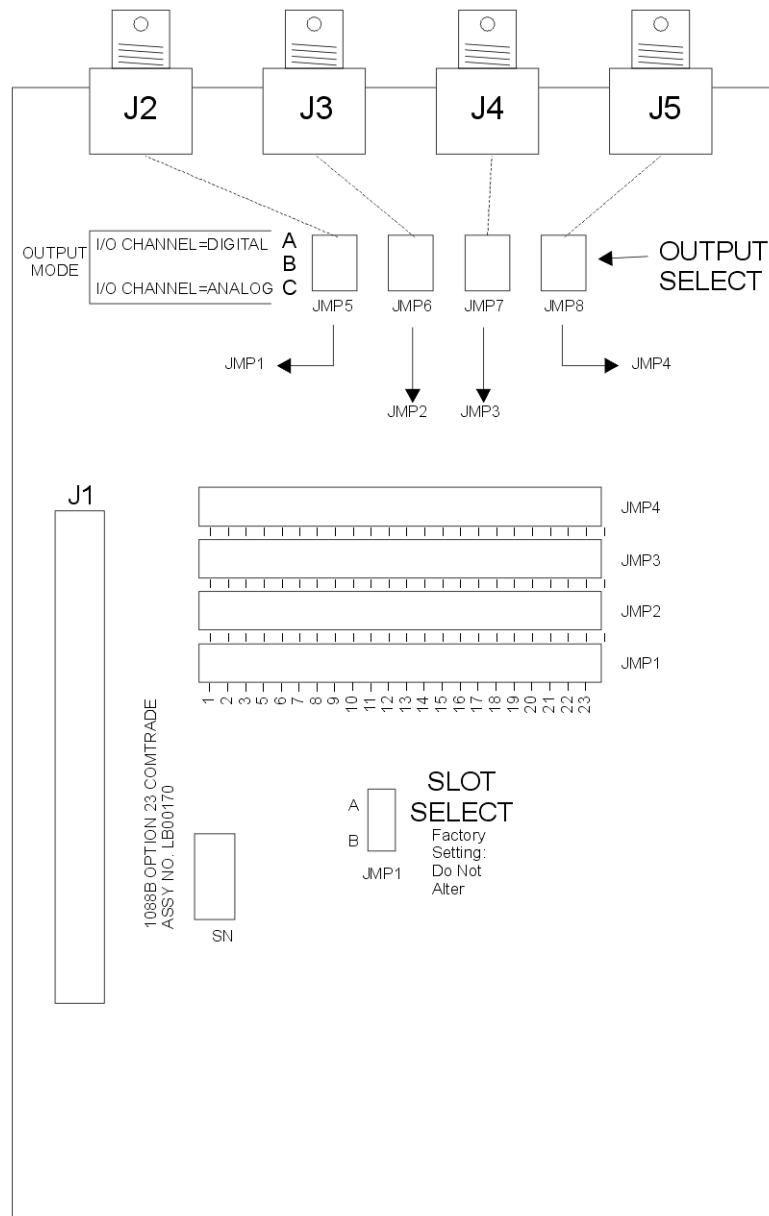*available in Model 1088B only

Figure C.16: Option 23 Internal Jumper Setup

C.15   Option 27: 8-Channel High Drive

C.15.1   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.17.

C.15.2   Specifications

Output Selection Each output is jumper selectable for either a Modulated or Unmodulated signal. See Figure C.17 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
                                       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

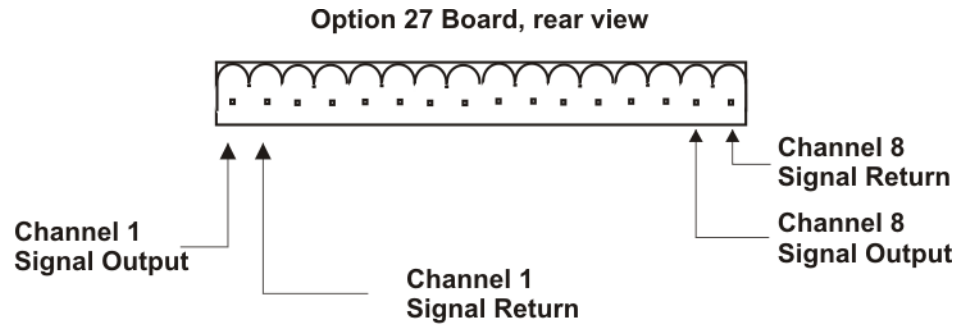16-position pluggable 5-mm (Phoenix-type) terminal strip with eight 2-position mating connectors.

C.15.3   Option Setup

Using Front Panel Keys

To set up Option 27 from the front-panel keys, please follow the guidelines in Section 6.12.

Using RS-232C Port

To set up Option 27 using the RS-232C port, please follow the guidelines in Section 9.2.13.

Option 27 Board, rear view

Channel 1
Signal Output

Channel 1
Signal Return

Channel 8
Signal Return

Channel 8
Signal Output

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

Option 27 Board, top view

J2

SERIAL #

JMP8 JMP7 JMP6 JMP5 JMP4 JMP3 JMP2 JMP1

UNMODULATED

MODULATED

J1

J3

OPTION 27 IRIG-B
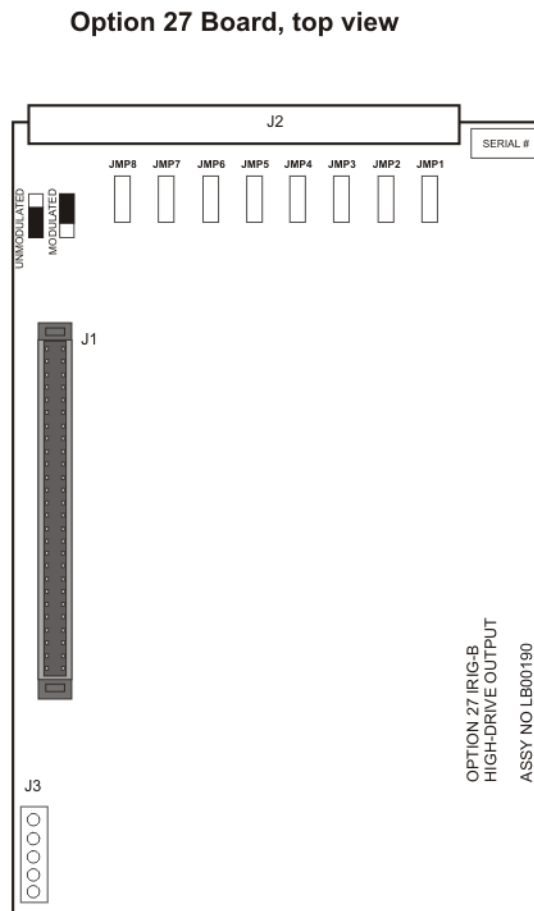HIGH-DRIVE OUTPUT

ASSY NO LB00190

Figure C.17: Option 27 Jumper Locations

C.15.4   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.9 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.9: 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.15.5   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.
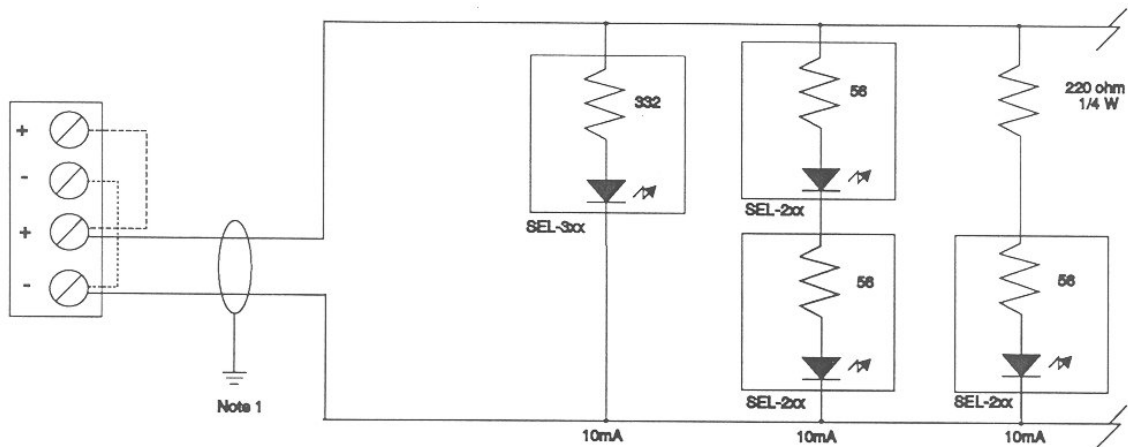
Note 1:

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.15.6   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;

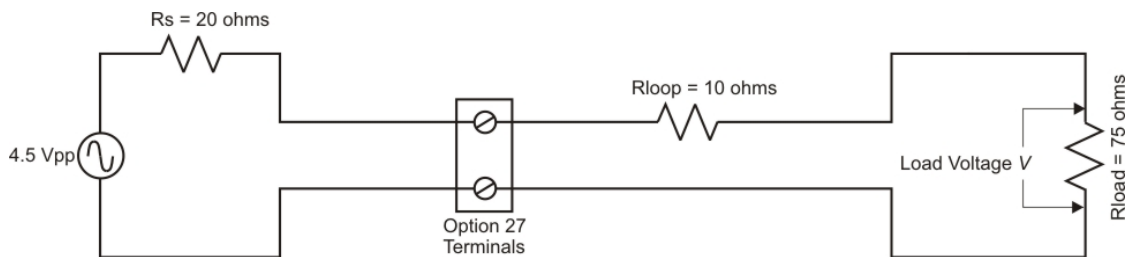$$ \text{(C.1)} \qquad\qquad V = \frac{R_{load}}{R_S + R_{loop} + R_{load}} \times 4.5 $$

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

C.16.1   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.16.2   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.16.3   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.

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.

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.

C.16.4   Firmware Configuration

Apply power and observe front panel display, when the clock indicates "CLOCK STATUS STARTUP," 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 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 the System voltage and phase angle, press the EVENT/DEVIATION key on the front panel:

> System Input 114.91 V
> Phase 359.60°

2. To view Δ F and Δ T, press the EVENT/DEVIATION key a second time:

> System Δ F -0.0010 Hz
> Δ T +0.0000 Sec

3. To view System frequency and time, press the EVENT/DEVIATION key a third time:

> 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 to display the following:

> 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 5.2.2.

C.16.5   Calibration

The clock is now configured for operation. Calibration for phase and amplitude are not necessary for most applications, however if necessary, can be 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 degree, and can be reduced to 0.1 degree 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.16.6   Phase Calibration

The factory performs phase calibration, and supplies the calibration factor with the assembly. To be effective, it must be entered into the clock non-volatile memory. Entering this factor into the clock requires connecting the clock to a computer or terminal via the RS-232 interface (see clock manual). For the computer, use a terminal-emulation program such as Windows HyperTerminal or Tera Term Pro (see Arbiter website). 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.16.7   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 applying 120 Vrms 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 "1.0076,1084RV" to calibrate the unit (model 1084B/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 "1,1088RV." Again, use either 1084, 1088 or 1093 to match the clock model number.
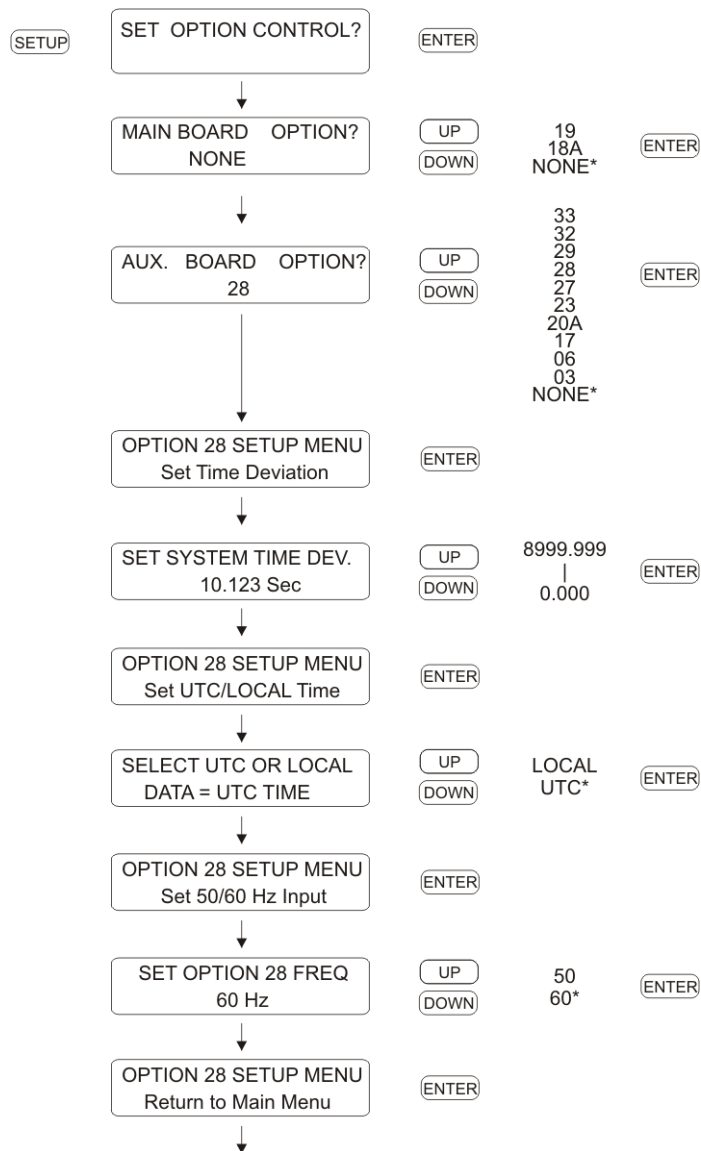
C.16.8 Option 28 Firmware Setup Procedure

Figure C.18: Option 28 Firmware Setup Procedure

C.16.9   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:

ↄ	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 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.16.10   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

Return System Frequency Deviation

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

Response: SS±f.fff ⤸
Where: SS = UTC seconds

             f.fff = frequency

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

Return System Time

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

Response: MM DD YYYY hh:mm :ss.ssss SS ⟩

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

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 first bit of the <BEL> character. Refer to Arbiter Systems Application Note 103 for more information.

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

34±sss.sss ↄ	Time Deviation*
66hhmmss ↄ	System Time
77nn.nnn ↄ	System Frequency
88nnn.nn ↄ	System Phase
89nnn.nn ↄ	System Magnitude
55ddd ↄ	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.10: 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 1344
+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.

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. 1084)

Set Voltage Amplitude Correction

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

Response: ↄ
Where: v = Voltage correction per unit with 1.000000 equal to no correction.
              k = Security Key (e.g. 1084)

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 ↄ

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

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 1344)
+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.17   Option 29: Four Additional Outputs; Dry Contacts; +25/50 Vdc

C.17.1   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.17.2   Specifications

General

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.12 and Figure C.20 for Connector Configuration.

Digital Outputs

Quantity	4
Type:	5 V CMOS, individually configurable
Rating:	+5 V open-circuit, nominal
	75 mA peak current, per channel
	+3.5 V typical at 75 mA peak current
Available 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.19 for Jumper location and selections.

Solid State Relay Output

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

Solid State Relay Output, continued

Power Supply: Individually configurable for 0 VDC, +25 VDC, or +50 VDC.

Available Signals: 1 PPH, 1 PPM, 1 PPS, Programmable Pulse, Locked and
                       Out of Lock.

Pulse Width: Individually configurable for a fixed, 50-ms pulse, or the de-
                       fault width of pulse provided by the clock mainframe.

Available   1. Dry contact closure.
Configurations:

                       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.11: Operating Modes of SSR Outputs.

Mode	SSR Output 1	SSR Output 2
Dry Contact Closure	Connect load to pins 10 & 11 (polarity not important)	Connect load to pins 14 & 15 (polarity not important)
Contact Closure to Ground	Short pins 9 & 10, connect load to pin 11	Short pins 13 & 14, connect load to pin 15
+25/50 VDC Switched to Grounded Load	Short pins 11 & 12, connect load to pins 9 ($-$) & 10 ($+$)	Short pins 15 & 16, connect load to pins 13 ($-$) & 14 ($+$)
+25/50 VDC Switched to Floating Load	Short pins 9 & 10, connect load to pins 11 ($-$) & 12 ($+$)	Short pins 13 & 14, connect load to pins 15 ($-$) & 16 ($+$)

Table C.11: Option 29, Operating Modes of SSR Outputs

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.12: Option 29, Output Connectors and Setup Jumpers

C.17.3   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 it displays "CLOCK STATUS STARTUP," press the SETUP key.

3. Press the SETUP key until SET OPTION CONTROL? appears.

4. Press ENTER twice so that "AUX. BOARD OPTION" appears. Press the UP key so that the option number indicates "29" and press ENTER.

5. Press any of the upper row of keys to exit the setup menus.

C.17.4   Output Jumper Setting Changes

1. Set Line Power switch to OFF position (if equipped). Disconnect the power cord from rear-panel.

2. Remove rack-mount ears (if equipped) and remove top cover using a T25 Torx driver.

3. Locate the appropriate Jumper using Figure C.19 and move the jumper to the desired setting.

4. Replace the top cover and rack-mount ears (if equipped).

5. Connect the power cord to the rear-panel and power the clock ON.
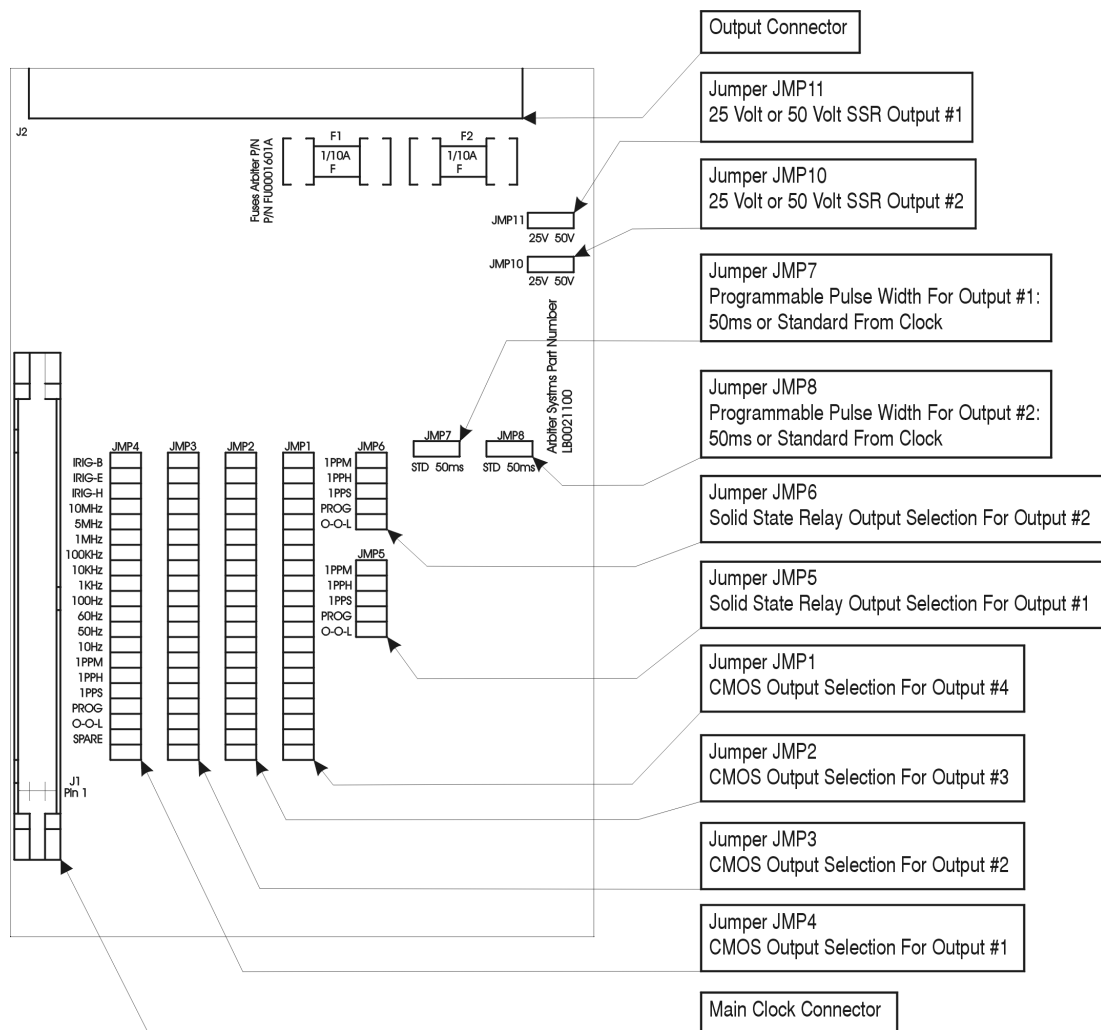
Figure C.19: Option 29 Jumper Locations

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

+25/50V 2
SSR Output 2
SSR Output 2
Ground
+25/50V 1
SSR Output 1
SSR Output 1
Ground
Ground
CMOS Output 4
Ground
CMOS Output 3
Ground
CMOS Output 2
Ground
CMOS Output 1

CLOCK   OUTPUT   CONNECTOR

+25/50 Volts
SSR Output
SSR Output
Ground

Ground
CMOS Output

SOLID   STATE   RELAY   CONNECTOR   CMOS   OUTPUT   CONNECTOR
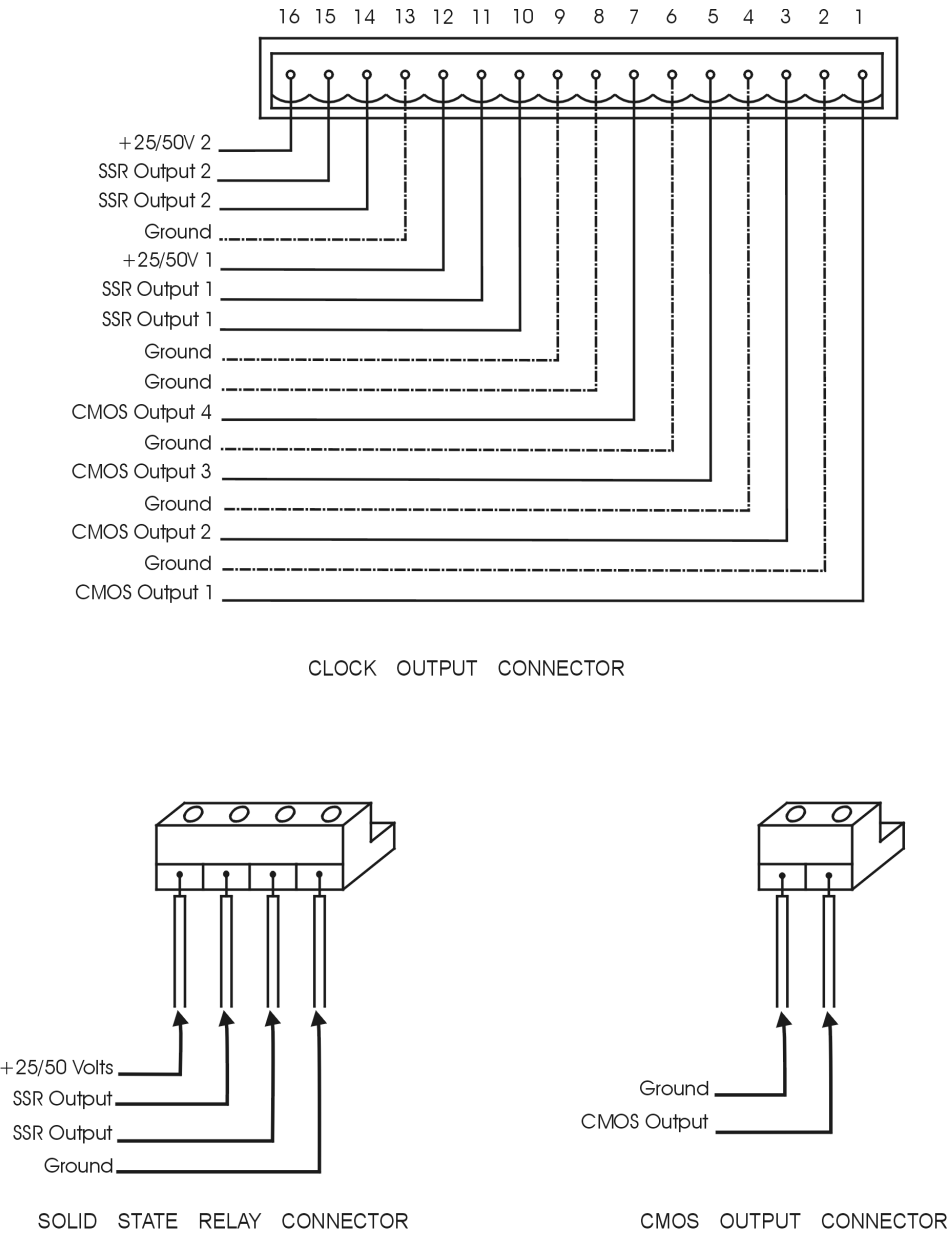
Figure C.20: Option 29 Connector − Signal Locations

C.18 Option 32/33: NTP Server – Obsoleted by Opt34

C.18.1 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 DB9F adapter for connecting to the RS-232, or NTP Setup, port. For Model 1084B/C clocks, the NTP Status display should indicate as follows:

NTP1(2): SYNCHRONIZED (ERROR)
NETWORK: GOOD LINK (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.21.

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.18.2 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.21: Option 32/33 Rear Panel
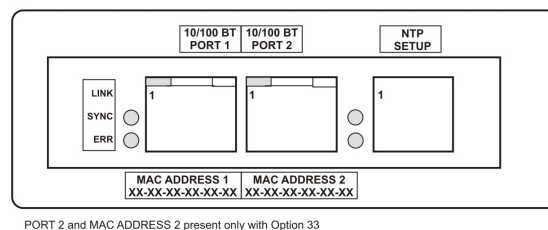
RS-232, NTP Setup

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

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.21 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.18.2   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 when configuring NTP servers over the RS-232 port; Jumper 5 sets the board for Option 32 or 33. See jumper settings in Table C.13.

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

Table C.13: Option 32/33, Jumper Truth Table

*Must set JMP4 into the "B" position – Configuration mode
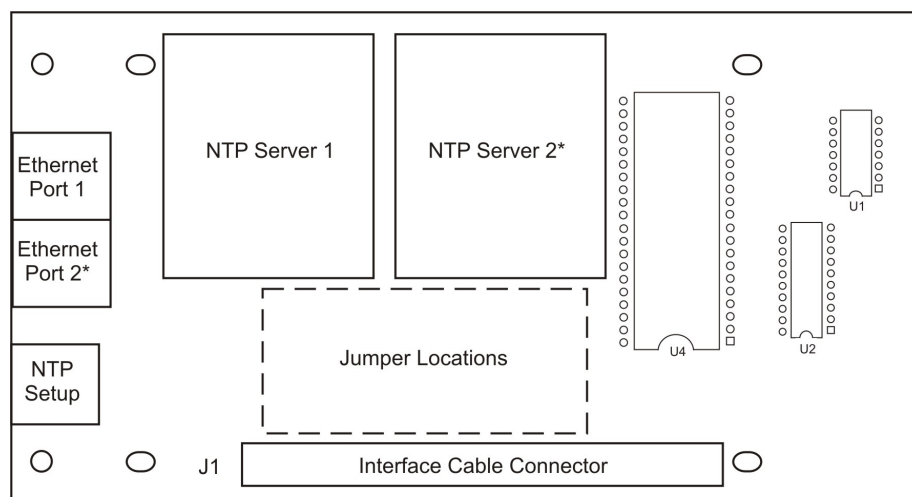
Figure C.22: Option 32/33 Board, Jumper Locations

C.18.3   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 (1084A); (2) configuring the NTP server(s) via the the individual Ethernet port, or option RS-232 port.

Front Panel (1084B/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 "SET AUX. BOARD?"
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 (1084A)

To set up Option 32/33 in the 1084A, you will need to use a terminal program like HyperTerminal or Tera Term Pro. For a Model 1084A, type the following in the terminal window, "1,9,1084XI".

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.18.4   General Configuration

After entering the configuration mode (confirmed with <CR>), 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.18.5   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.18.6   NTP Server Parameters

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

Antenna Type: Set type 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.19   Option 34: NTP/PTP Server

C.19.1   General Description

Option 34 provides Network Time Protocol (NTP) and Precision Time Protocol (PTP)[1] 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 m 50/125 m 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[2]. 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

---

[1]IEEE 1588v2 – IEEE 1588-2008
[2]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.19.2   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[3]) and null-modem cable. Important pins for a null-modem cable are indicated in Table C.14 below.

PC Port Pins	Clock Port Pins	Port Function
2	3	Transmit
3	2	Receive
5	5	Ground

Table C.14: 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
```

---

[3]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: ERROR
```

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.19.2, 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.15 below describe the indications.
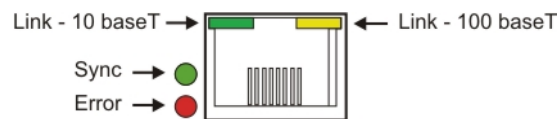
LED Name	Color	Meaning
LINK	Steady Green	Good Link, 10 Mb/s
	Steady Yellow	Good Link, 100 Mb/s
	OFF	Bad Link
SYNC	Steady Green	NTP Server Synchronized
	OFF	NTP Server not Synchronized
ERROR	Red	Startup/Error
	OFF	No Errors

Table C.15: Option 34 LED Indications
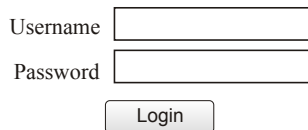
Web Interface

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.19.3. 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 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.

    Username [   ]
    Password [   ]
             [Login   ]

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.23.

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.23 illustrates the opening System Status page.
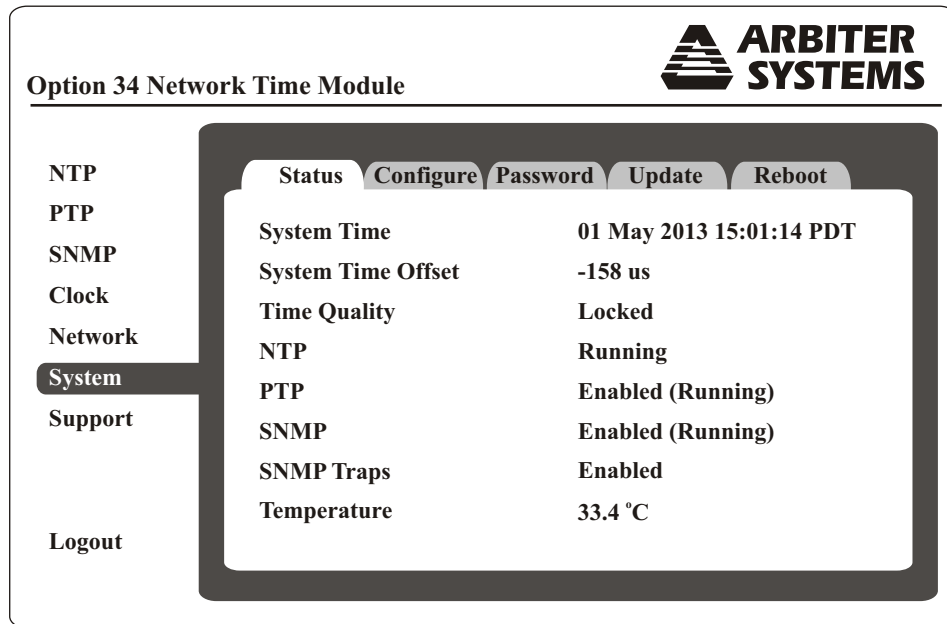
Figure C.23: Startup Page

System Configure Page

Figure C.24 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.24: System Configure Page

System Configure HTTPS Page

To configure the HTTPS page, follow these instructions. Figure C.25 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.19.2 click the HTTPS button and it will open the PEM file dialog shown in Figure C.25. Notice that the ports have changed from 80 with HTTP to 443 with HTTPS.

Figure C.25: Configure HTTPS

System Configure Password

To configure the system password follow these instructions. From Figure C.24, select the Password tab. Figure C.26 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.

Current Password

New Password

Confirm New Password

Apply   Reset

Figure C.26: Configure System Password

System Update

To update any Option 34 firmware package follow these instructions. From Figure C.24, select the Update tab and click the Choose File button shown in Figure C.27. 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.

Upload Package File
Choose File   no file selected

Upload   Reset

Figure C.27: Update System Firmware Package

System Reboot

To reboot the Option 34 follow these instructions. From Figure C.24 select the Reboot tab. Figure C.28 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.

WARNING:
Rebooting the system will disconnect all
active sessions (including this one).

Reboot

Figure C.28: Rebooting the System

Network Settings and Information

To view the network status of your Option 34 follow these instructions. Figure C.29 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.29: Checking Network Status

Configure Network Settings

To configure the network settings of your Option 34 follow these instructions. Figure C.30 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.30: 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.31. Settings include an integer ID number, and priority value from 0 to 7 seen in the drop down box.

Figure C.31: 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.32.
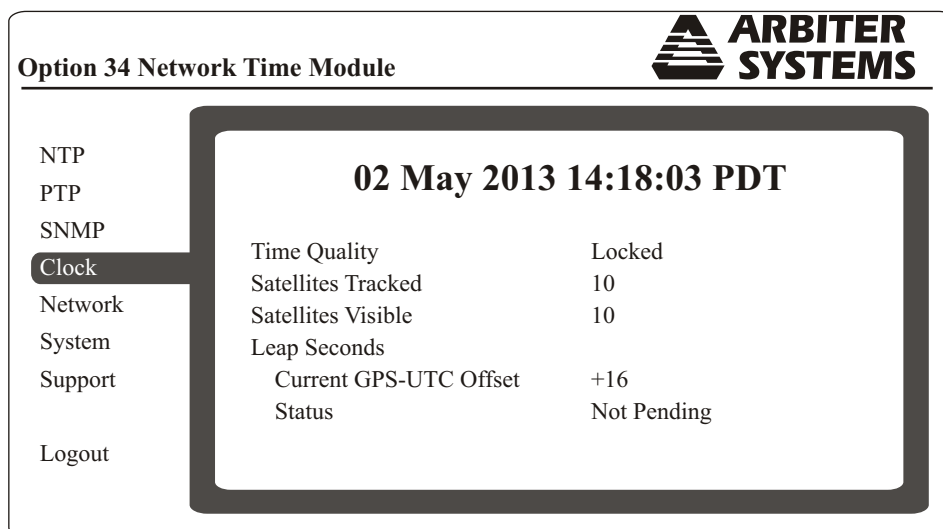
Figure C.32: View Operation

SNMP Status

View this web interface page to check the SNMP status as illustrated in Figure C.33. For additional detail on SNMP in the Model 1084A/B/C, see SNMP Support in Section C.19.4.
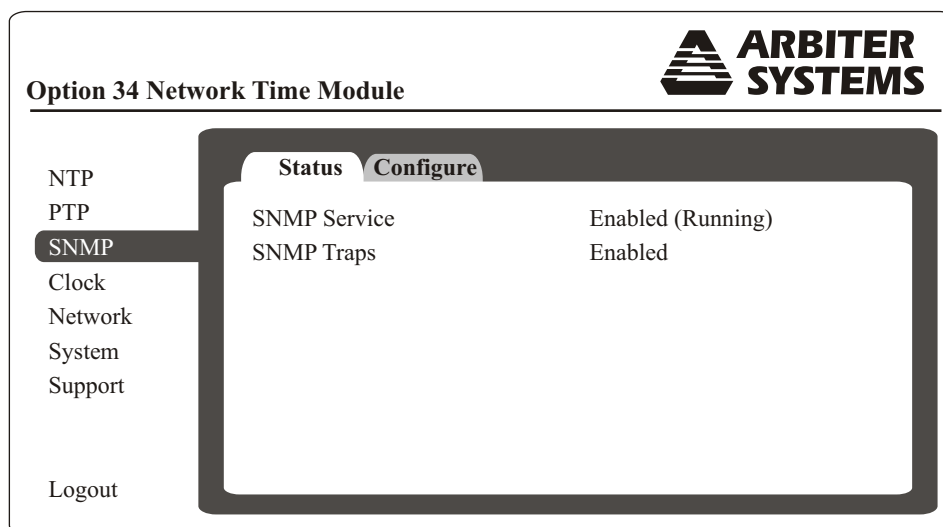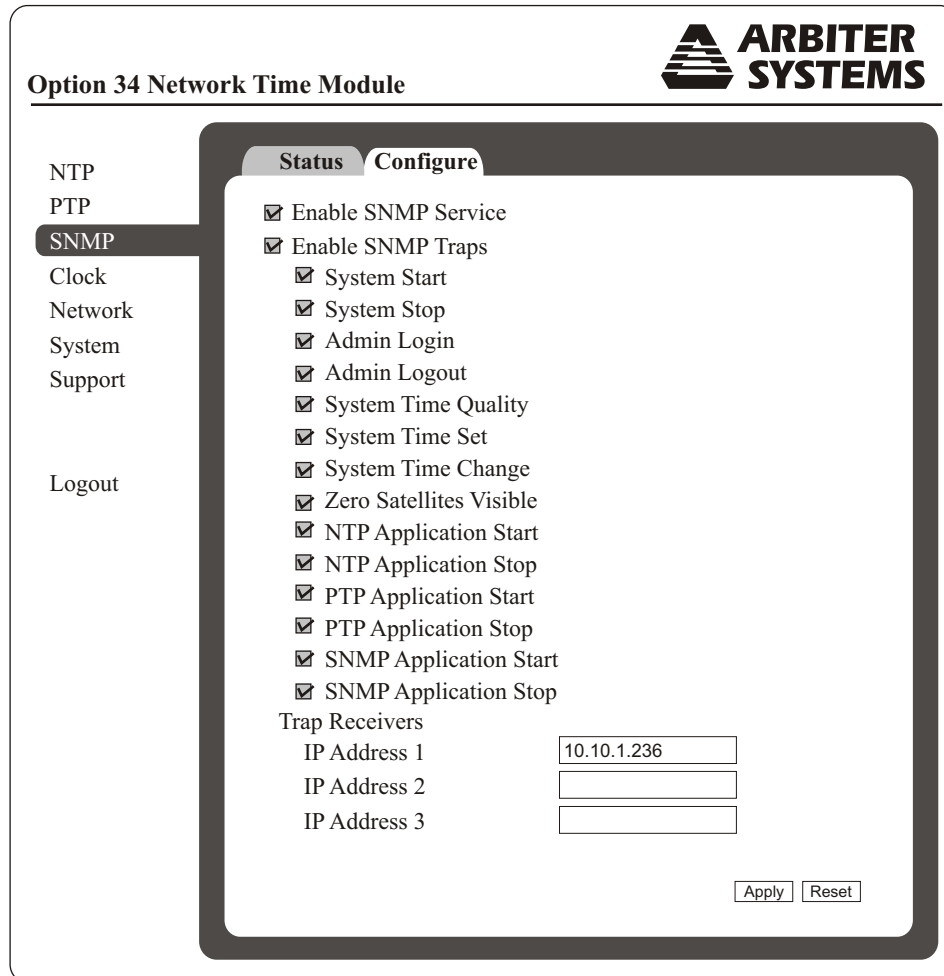
Figure C.33: View SNMP Operation

Configure SNMP

Follow these instructions to configure SNMP operation in the Option 34. Figure C.34 illustrates the different selections for enabling the service and selecting traps (notifications). For definitions of SNMP "Configure" selections, see Section C.19.4.

Figure C.34: 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.35 illustrates the status of PTP.
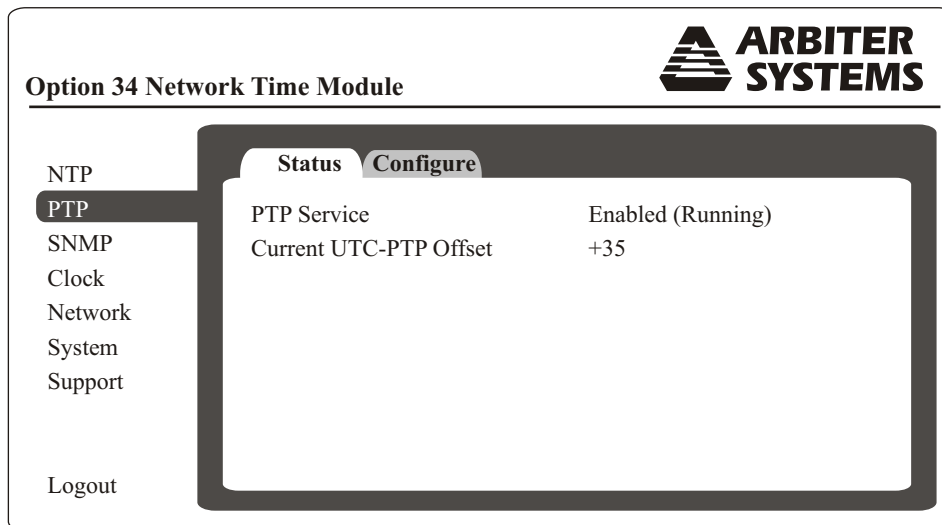

Figure C.35: PTP Status Page

PTP Configuration

To configure PTP follow these instructions. Figure C.36 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.36 shows the Advanced settings, which can be hidden using the Hide Advanced button.

Figure C.36: 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 AN-NOUNCE_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.37 illustrates the status of NTP.

Option 34 Network Time Module

ARBITER SYSTEMS

	Status	Configure	Authentication

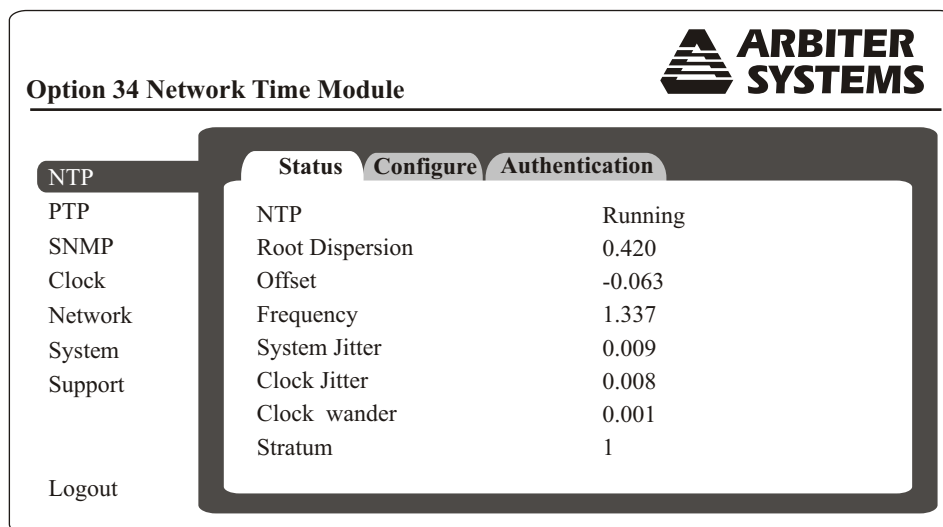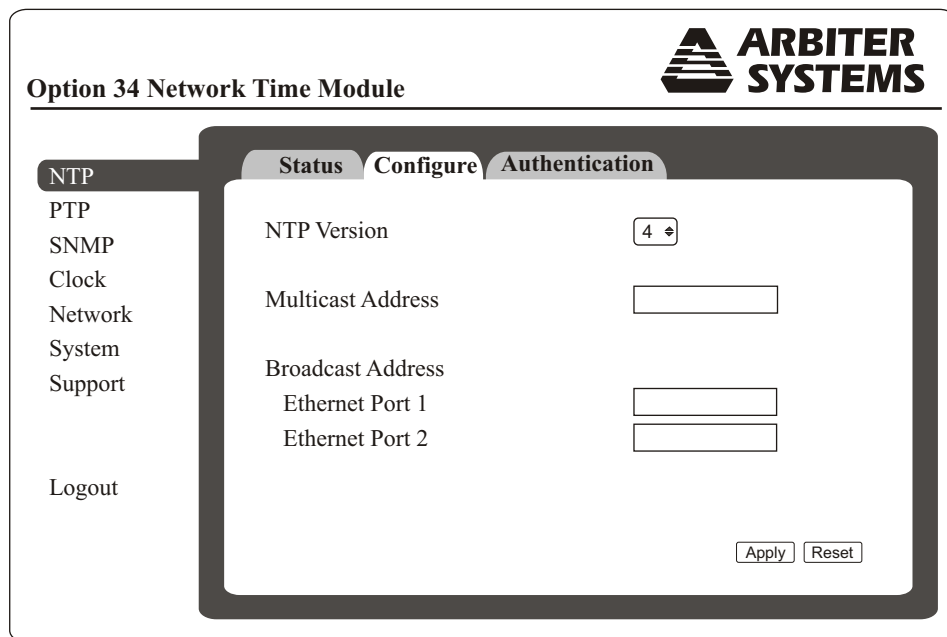| NTP	
PTP	
SNMP	NTP	Running
Clock	Root Dispersion	0.420
Network	Offset	-0.063
System	Frequency	1.337
Support	System Jitter	0.009
	Clock Jitter	0.008
	Clock wander	0.001
	Stratum	1
Logout	

Figure C.37: 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.38 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.38: 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.39: 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.40, to contact Arbiter Systems and for version support.

Figure C.40: Contact and Version Information Pages

C.19.3   SSH Console Interface

These instructions cover the setup and maintenance of the 1084A/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 1084A/B/C. Configure all 1084A/B/C settings through one of the Ethernet ports. Instructions on using the Web Interface for the same purpose are found in section C.19.2.

Any Secure Shell (SSH) client, like OpenSSH or PuTTY$^{\text{TM}}$, 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 ($\triangleright$ is the command prompt) type: $\triangleright$`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.41.

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.41 illustrates the opening page.

```
                    Computer Name (or IP address) – ssh – 80x24

                                                          ∧   ARBITER
    Option 34 Network Time Module                        /__\  SYSTEMS

      NTP              Status| [Configure] | Password | Update | Reboot
      PTP
      SNMP             System Time              : 11:24:17 04/19/2011
      Clock            System Time Offset  : -114us
      Network          Time Quality             : Locked
      [System]         NTP                      : Running
      Support          PTP                      : Enabled (Running)
                       SNMP                     : Enabled (Running)
                       SNMP Traps               : Enabled
      Logout           Temperature              : 33.3C
```

Figure C.41: 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.42 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.

```
                    Computer Name (or IP address) – ssh – 80x24


                                                       ∧   ARBITER
        Option 34 Network Time Module                 /__\  SYSTEMS

        NTP            Status| [Configure] | Password | Update | Reboot
        PTP
        SNMP           Web Interface
        Clock            ( )HTTP    (*)HTTPS    Port[443 ]
        Network        PEM File      Download    Replace
        [System]
        Support          [ ] Enable Session Timeout

                       Console Interface
                         [ ] Enable Session Timeout
        Logout
                       Miscellaneous
                       [X] Respond to Ping Requests
                       Time Zone Setting [PST8PDT7]

                                                 Apply   Reset
```

Figure C.42: 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.19.2.

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.43). 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.

```
                    Computer Name (or IP address) – ssh – 80x24

                                                          ∧  ARBITER
         Option 34 Network Time Module                   /_∖  SYSTEMS
         NTP            Status| Configure | [Password] | Update | Reboot
         PTP
         SNMP           Current Password        [               ]
         Clock          New Password            [               ]
         Network        Confirm New Password    [               ]
         [System]
         Support                                          Apply   Reset


         Logout
```

Figure C.43: Configure System Password Using SSH

System Update

Use the Web Interface to perform any update. For more information, see Section C.19.2.

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.44), 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.

```
                       Computer Name (or IP address) – ssh – 80x24

                                                          ∧  ARBITER
    Option 34 Network Time Module                        /__\ SYSTEMS

    NTP              [Status]  Configure
    PTP
                     Ethernet Port 1
    SNMP                 IP Address                  10.10.1.184
    Clock                Hardware Address            64:73:E2:00:17:38
    [Network]                   Bytes     Packets      Errors   Dropped
    System               Rx     2649123   39782             0       110
                         Tx     1554398   11894             5         0
    Support

                     Ethernet Port 2 (Not Active)
                         IP Address
    Logout               Hardware Address            64:73:E2:00:17:39
                                Bytes     Packets      Errors   Dropped
                         Rx          0         0            0         0
                         Tx          0         0            0         0
```

Figure C.44: Checking Network Status Using SSH

Configure Network Settings

To configure the network settings of your Option 34 follow these instructions. Figure C.45 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.

```
┌─────────────────────────────────────────────────────────────────┐
│           Computer Name (or IP address) – ssh – 80x24             │
│ ┌───────────────────────────────────────────────────────────────┐ │
│ │                                                                 │ │
│ │                                                  ∧   ARBITER    │ │
│ │  Option 34 Network Time Module                  /_∖  SYSTEMS    │ │
│ │  NTP          Status  [Configure]                              │ │
│ │  PTP                                                           │ │
│ │  SNMP         Ethernet Port 1                                  │ │
│ │                   Hardware Address         64:73:E2:00:17:38   │ │
│ │  Clock            (*) DHCP    ( ) Static                       │ │
│ │ [Network]         [ ] Enable VLAN                             │ │
│ │  System                                                       │ │
│ │  Support      Ethernet Port 2                                  │ │
│ │                   Hardware Address         64:73:E2:00:17:39   │ │
│ │                   ( ) DHCP   (*) Static                       │ │
│ │                   IP Address               [10.10.1.185   ]   │ │
│ │  Logout           Netmask                  [255.255.0.0   ]   │ │
│ │                   Gateway                  [             ]   │ │
│ │                   [X] Enable VLAN                             │ │
│ │                       VLAN ID      [123 ]                     │ │
│ │                       VLAN Priority [2]                       │ │
│ │                                                               │ │
│ │                                              Apply   Reset    │ │
│ └───────────────────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────────────────┘
```

Figure C.45: Configure Network Settings Using SSH

Enable VLAN

From Figure C.45 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.46.

```
                    Computer Name (or IP address) – ssh – 80x24

                                                        ∧   ARBITER
    Option 34 Network Time Module                      /__\  SYSTEMS

        NTP
        PTP
        SNMP                       09 May 2013 12:49:17 PDT
        [Clock]
        Network        Time Quality              : Locked
        System         Satellites Tracked        : 10
        Support        Satellites Visible        : 10
                       Leap Seconds
                           Current GPS-UTC Offset: 16
                           Status                 : Not pending
        Logout
```

Figure C.46: 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.47.

```
                    Computer Name (or IP address) – ssh – 80x24

                                                        ∧   ARBITER
    Option 34 Network Time Module                      /__\  SYSTEMS

        NTP            [Status]  Configure
        PTP
        SNMP           SNMP Service              : Enabled (Running)
        Clock          SNMP Traps                : Enabled
        Network
        [System]
        Support


        Logout
```

Figure C.47: View SNMP Operation Using SSH

Configure SNMP

Please use the Web Interface to configure SNMP. See Section C.19.2 for more instructions.

PTP Status Page

To view the PTP service, select PTP tab on the left and the Status tab above. Figure C.48 illustrates the status of PTP.

```
                    Computer Name (or IP address) – ssh – 80x24

                                                          /\   ARBITER
 Option 34 Network Time Module                           /__\  SYSTEMS

     NTP             [Status]   Configure
    [PTP]
     SNMP            PTP Service              : Enabled (Running)
     Clock           Current UTC-PTP Offset   : +35
     Network
     System
     Support


     Logout
```

Figure C.48: PTP Status Page Using SSH

Configure PTP Service

Please use the Web Interface to configure PTP. See Section C.19.2 for more information.

NTP Status Page

Use the cursor keys to select NTP, then Status and press ENTER. Figure C.49 illustrates the status page for NTP.

```
                    Computer Name (or IP address) – ssh – 80x24

                                                          /\   ARBITER
 Option 34 Network Time Module                           /__\  SYSTEMS

    [NTP]            [Status]   Configure
     PTP
     SNMP            NTP                      : Enabled (Running)
     Clock           Root Dispersion          : 0.451
     Network         Offset                   : 0.095
     System          Frequency                : 8.623
     Support         System Jitter            : 0.008
                     Click Jitter             : 0.010
                     Clock Wander             : 0.001
     Logout          Stratum                  : 1
```

Figure C.49: 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.50 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.

```
                      Computer Name (or IP address) – ssh – 80x24

                                                      ∧  ARBITER
      Option 34 Network Time Module                  /__\ SYSTEMS

         [NTP]          Status  [ Configure ] Authentication
          PTP
          SNMP          NTP Version           [4]
          Clock
          Network       Multicast Address     [               ]
          System
          Support       Broadcast Address
                            Ethernet Port 1   [               ]
                            Ethernet Port 2   [               ]
          Logout
                                                  Apply   Reset
```

Figure C.50: 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.

```
                    Computer Name (or IP address) – ssh – 80x24

                                                         ∧  ARBITER
    Option 34 Network Time Module                       /_∖ SYSTEMS

      [NTP]           Status   Configure  [ Authentication ]
      PTP
      SNMP            [X] Enable Authentication
      Clock
      Network         Key Table
      System              ID      Format           Key            Trusted
      Support             [    ]    [M]    [                ]       [ ]
                          [    ]    [M]    [                ]       [ ]
                          [    ]    [M]    [                ]       [ ]
                          [    ]    [M]    [                ]       [ ]
      Logout              [    ]    [M]    [                ]       [ ]

                                                        Apply   Reset
```

Figure C.51: 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.52, to contact Arbiter Systems and for version support.

```
┌────────────────────────────────────────────────────────────────────────┐
│              Computer Name (or IP address) – ssh – 80x24                 │
│  ┌──────────────────────────────────────────────────────────────────┐   │
│  │                                                    ∧  ARBITER      │   │
│  │  Option 34 Network Time Module                    /__\  SYSTEMS    │   │
│  │                                                                    │   │
│  │   NTP            [ Contact ]    Version                            │   │
│  │   PTP                                                              │   │
│  │   SNMP           Arbiter Systems, Inc.                             │   │
│  │   Clock          1324 Vendels Circle, Suite 121                    │   │
│  │   Network        Paso Robles, CA 93446                             │   │
│  │   System                                                           │   │
│  │  [Support]       800-321-3831                                      │   │
│  │                  805-237-3831                                      │   │
│  │                  Mon-Thu 7:00am-5:30pm Pacific Time                │   │
│  │                                                                    │   │
│  │   Logout         www.arbiter.com                                   │   │
│  │                  techsupport@arbiter.com                           │   │
│  │                                                                    │   │
│  └──────────────────────────────────────────────────────────────────┘   │
└────────────────────────────────────────────────────────────────────────┘
```

```
┌────────────────────────────────────────────────────────────────────────┐
│              Computer Name (or IP address) – ssh – 80x24                 │
│  ┌──────────────────────────────────────────────────────────────────┐   │
│  │                                                    ∧  ARBITER      │   │
│  │  Option 34 Network Time Module                    /__\  SYSTEMS    │   │
│  │                  Contact     [ Version ]                           │   │
│  │   NTP                                                              │   │
│  │   PTP            Console UI                                        │   │
│  │   SNMP              Core                     1.4                   │   │
│  │   Clock             Modules:                                       │   │
│  │   Network              Option 34/35          1.4                   │   │
│  │   System               Auth01               1.4                   │   │
│  │  [Support]             Option 34/35 Data Server  1.4              │   │
│  │                                                                    │   │
│  │                  Firmware / Hardware                               │   │
│  │                     Option 34             2.1                      │   │
│  │   Logout            Startup App           1.1                      │   │
│  │                     System Monitor        1.1                      │   │
│  │                     CLOI                  1.2                      │   │
│  │                     Arbiter 1084          07 May 2013              │   │
│  │                     Board (01-462)        01-e-1244012             │   │
│  └──────────────────────────────────────────────────────────────────┘   │
└────────────────────────────────────────────────────────────────────────┘
```

Figure C.52: Contact and Version Information Pages Using SSH

C.19.4   SNMP Support

This section reviews in some more detail SNMP on the Model 1084A/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 1084A/B/C.

An SNMP managed network consists of three components: A managed device, an agent and a network-management system (NMS). The 1084A/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 1084A/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 1084A/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 1084A/B/C. See Section C.19.4 for a print out of the current MIB table. To obtain a soft copy of the MIB table for the Model 1084A/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.33 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.34 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 1084A/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.19.5 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^{TM}-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.19.6   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-----
MIICXgIBAAKBgQDPoNigXmq2JAlw9DrD0P5Og5c5xsEnt9bPjfuE7MGkDEGN09sC

...more data...

8Xxzzgu4xizBdLmONkHu7b/h7GL6u5smkWVOCesCCR0mKw==
-----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.19.7   Time Zone Format Strings

This section lists some common time zones using the System Configure panel as discussed on page 183. 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.20   Option 36: Four Configurable Outputs

C.20.1   General Description

Option 36 replaces Option 03 and adds four rear-panel outputs, which may be configured to any available signal in the 1084A/B/C series clocks. The configuration of the four outputs can be changed at any time via internal jumper settings.

C.20.2   Specifications

General

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

Analog Outputs

Output Type   Operational amplifier (LF353) output, with 557-ohm series resistor.

Available Outputs: Modulated IRIG-B.

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: *Note: Available on Model 1084A/B/C are shown in Ta-*
                           ble C.16.

IRIG-B: IRIG format B time code (unmodulated).

C.20.3   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.53 shows the locations and Table C.16 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 Output Connector	Function Jumper
J2	JMP1
J3	JMP2
J4	JMP3
J5	JMP4

Compare each jumper position with the items in Table C.16 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 Output Connector	Mode Jumper
J2	JMP9
J3	JMP10
J4	JMP11
J5	JMP12

On the 1084A/B/C one signal is defined as analog: modulated IRIG-B. On all Mode jumpers, JMP9 – JMP12, use position B for analog signals, and use position A for digital signals.

Clock Model Selection

Jumpers JMP13 and JMP14 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 1084A/B/C.*
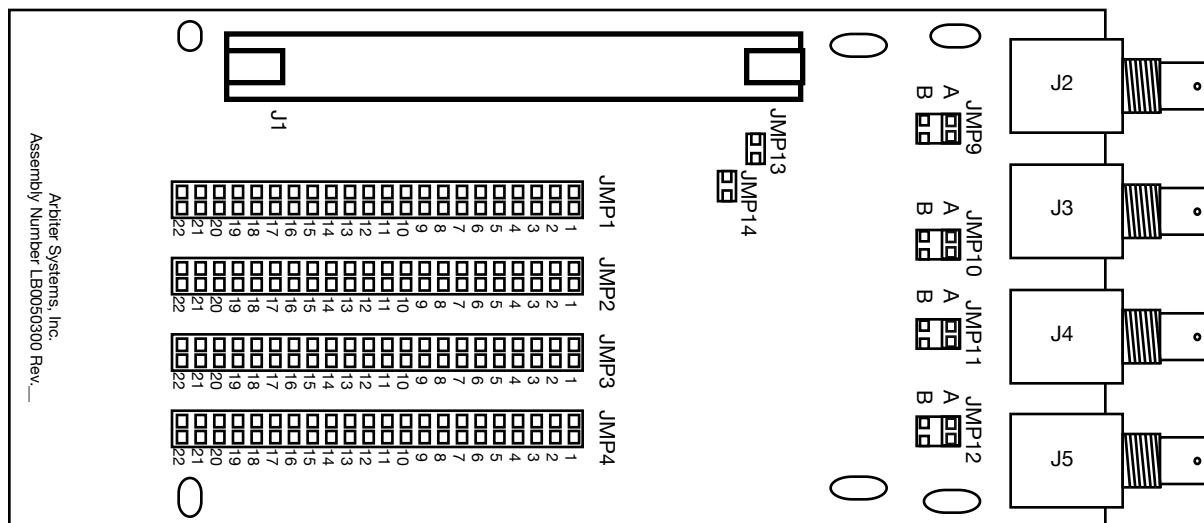
Figure C.53: Option 36 Jumper Configuration

If IRIG-B is chosen as the output signal, then each selected output should produce a waveform very similar to one of the drawings in Figure C.54 below.
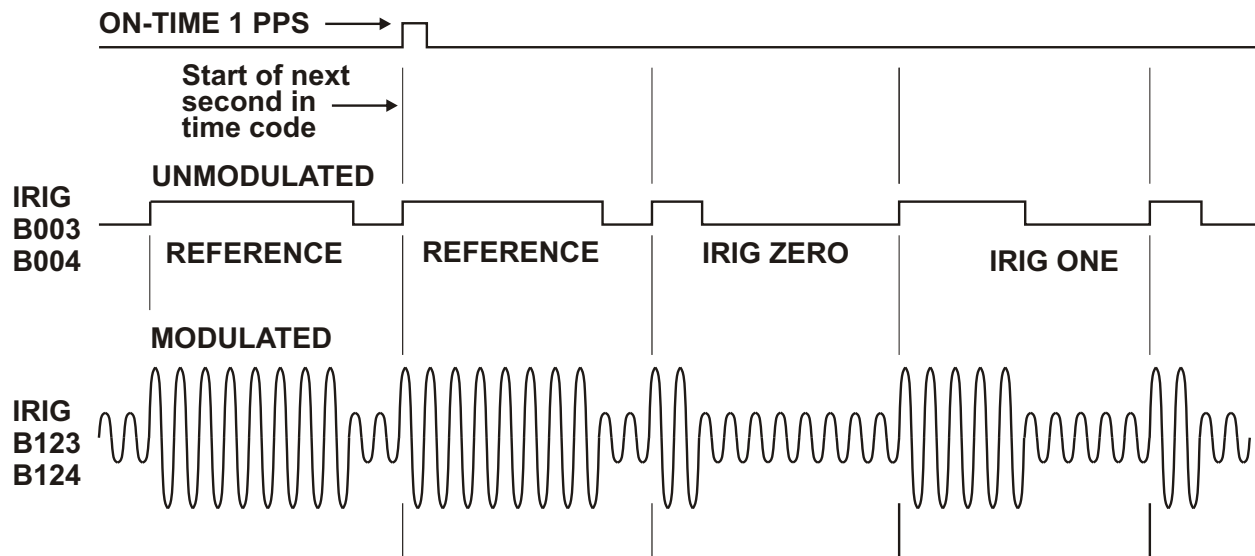
Figure C.54: IRIG-B Waveforms and 1 Pulse Per Second

Output Signal	Function Select Jumper	Mode Select Jumper
IRIG-B Modulated	1	B
Deviation*	2	B
IRIG-B Unmodulated	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.16: Option 36 Output Connector Jumper Settings

*Not available on the Model 1084A/B/C.

NOTE: If any of the jumpers were changed, replace the cover to the chassis before returning to service.

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 1084A, 1084B, 1084C.

Declaration of Conformity with European Union Directives
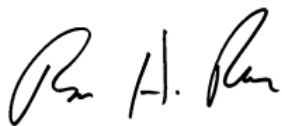
Date of Issue:	<u>June 30, 2003</u>
Directives:	89/336/EEC Electromagnetic Compatibility
	73/23/ EEC Low Voltage Safety
Model Number(s):	<u>1084A GPS Satellite-Controlled Clock</u>
Manufacturer:	Arbiter Systems, Inc.
	1324 Vendels Circle, Suite 121
	Paso Robles, CA 93446 − USA

Harmonized	EN55011 Class A, Radiated and Conducted Emissions
Standard	EN50082-1 Generic Immunity, Part 1
Referenced:	Residential, Commercial and Light Industrial Environments
	EN61010-1 Safety requirements of Electrical Equipment for Measurement, Control and Laboratory Use.

Signed: _____

Signatory: <u>Bruce H. Roeder</u>

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.

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):   1084B GPS Satellite-Controlled Clock

Manufacturer: Arbiter Systems, Inc.

                                  1324 Vendels Circle, Suite 121

                                  Paso Robles, CA 93446 − USA

Harmonized   EN55011 Class A, Radiated and Conducted Emissions

Standard   EN50082-1 Generic Immunity, Part 1

Referenced: 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.

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):   1084C GPS Satellite-Controlled Clock

Manufacturer: Arbiter Systems, Inc.

1324 Vendels Circle, Suite 121

Paso Robles, CA 93446 − USA

Harmonized   EN55011 Class A, Radiated and Conducted Emissions

Standard   EN50082-1 Generic Immunity, Part 1

Referenced: 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 1084A, 1084B, and 1084C.

G.P.S. Satellite Clock Statement of Compliance
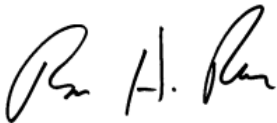
February 5, 2008

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

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