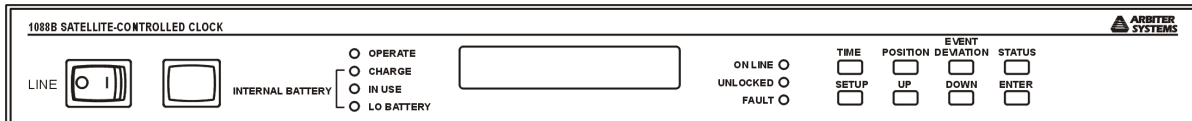




# MODEL 1088A/B SATELLITE-CONTROLLED CLOCK OPERATION MANUAL



Arbiter Systems, Inc.  
Paso Robles, CA 93446  
U.S.A.  
[www.arbiter.com](http://www.arbiter.com)

**Description**

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

**Contact Information**

Arbiter Systems, Inc.  
1324 Vendels Circle, Suite 121  
Paso Robles, CA 93446  
(805) 237-3831  
Website: [www.arbiter.com](http://www.arbiter.com)  
<mailto:techsupport@arbiter.com>  
<mailto:sales@arbiter.com>

**What This Manual Covers**

This manual describes the set up and operation of the Model 1088A/B series satellite-controlled clocks.

**ROM Dates**

This version of the manual is written for these model clocks having ROM dates of 1 March 2007 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 powerup 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<sup>1</sup>. 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.

THE WARRANTY SET FORTH HEREIN CONSTITUTES THE ONLY WARRANTY OBLIGATIONS OF ARBITER SYSTEMS, EXPRESSED OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE. ARBITER SYSTEMS DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND BUYER EXPRESSLY WAIVES ALL OTHER WARRANTIES.

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.

---

<sup>1</sup>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 1088A/B Satellite-Controlled Clock

## Operation Manual

Chapter 1	Unpacking the Clock
Chapter 2	Front and Rear Panels
Chapter 3	Connecting Inlet Power, Input and Output Signals
Chapter 4	Antenna and Cable Information
Chapter 5	Setting Internal Jumpers
Chapter 6	The Setup Menus
Chapter 7	Timing, IRIG-B and Pulses
Chapter 8	Relay Contacts and Event Inputs
Chapter 9	Serial Communications and Command Set
Chapter 10	Startup and Basic Operation
Appendix A	Specifications and Technical Details
Appendix B	Using Surge Protectors
Appendix C	Options List
Appendix D	CE Mark Certification
Appendix E	Statement of Compliance
Index	

Copyright Arbiter Systems Incorporated September 2007 All rights reserved. International copyright secured.

PD0013700I



# Contents

<b>1</b>	<b>Unpacking the Clock</b>	<b>1</b>
1.1	Introduction . . . . .	1
1.2	Precautions . . . . .	1
1.3	Unpacking and Locating Accessories . . . . .	1
1.4	Attaching Rack-Mount Ears to 1088A/B Series Clocks . . . . .	2
1.4.1	Mounting Instructions . . . . .	2
<b>2</b>	<b>Front and Rear Panels</b>	<b>5</b>
2.1	Introduction . . . . .	5
2.2	Front Panel Controls and Indicators . . . . .	5
2.2.1	Annunciator LED Definitions . . . . .	6
2.2.2	LED Status Indicators . . . . .	6
2.2.3	Command Key Definitions . . . . .	7
2.2.4	LCD Display . . . . .	7
2.2.5	Front Panel Keys . . . . .	7
2.3	Rear Panel Identification and Connectors . . . . .	8
2.3.1	Power Inlet . . . . .	9
2.3.2	Antenna Input . . . . .	10
2.3.3	Event Input . . . . .	10
2.3.4	RS-232 Communication Ports . . . . .	10
2.3.5	Form C, Relay Contacts . . . . .	11
2.3.6	Standard Input/Outputs . . . . .	11
<b>3</b>	<b>Connecting Inlet Power, Input and Output Signals</b>	<b>13</b>
3.1	Physical Configuration . . . . .	13
3.2	Standard IEC-320 Power Inlet Module . . . . .	13
3.2.1	Cordsets and Plug Styles for IEC-320 Inlet Module . . . . .	14
3.2.2	IEC-320, Connecting Power to the 1088B . . . . .	14
3.3	Option 07, 110 to 370 Vdc Terminal Power Strip . . . . .	14
3.3.1	Option 07, Connecting Inlet Power . . . . .	15
3.4	Option 08, 10 to 60 Vdc Power . . . . .	15
3.4.1	Option 08, Connecting Inlet Power . . . . .	15
3.5	Option 15A, 110 to 170 Vdc Terminal Power Strip . . . . .	15
3.5.1	Option 15A, Connecting Inlet Power . . . . .	16
3.6	Option 15B, 110 to 330 Vdc Terminal Power Strip . . . . .	16
3.6.1	Option 15B, Connecting Inlet Power . . . . .	16

3.7	Fuse Types and Locations . . . . .	16
3.7.1	Replacing Fuses . . . . .	16
3.8	Connecting Output Signals . . . . .	17
3.9	Connecting Input Signals . . . . .	17
3.9.1	Connecting an Event Input at J3 or J4 . . . . .	17
<b>4</b>	<b>GPS Antenna and Cable Information</b>	<b>19</b>
4.1	GPS Antenna Installation . . . . .	19
4.1.1	Mounting the Antenna . . . . .	19
4.1.2	Optional Antenna Mounting Kit . . . . .	20
4.2	Antenna and Cable Testing . . . . .	22
4.2.1	Checking the Antenna Voltage . . . . .	22
4.2.2	Power Supply Check . . . . .	22
4.2.3	Checking the Antenna Resistance . . . . .	22
4.3	Antenna Surge Suppressor . . . . .	22
4.3.1	Using the Antenna Surge Suppressor . . . . .	22
4.4	Technical Details on GPS, Antennas and Cables . . . . .	23
4.4.1	Antenna Cable . . . . .	23
<b>5</b>	<b>Setting Internal Jumpers</b>	<b>27</b>
5.1	Introduction . . . . .	27
5.2	Changing Hardware Settings Via Internal Jumpers . . . . .	27
5.2.1	Cover Removal . . . . .	29
5.2.2	JMP1 – Event “A” Selection . . . . .	29
5.2.3	JMP2 – Frequency Reference Selection . . . . .	29
5.2.4	JMP3 – External Reference Input Frequency . . . . .	30
5.2.5	JMP4, JMP7, JMP10, JMP13 – Output Function Selection . . . . .	30
5.2.6	JMP5, JMP8, JMP11, JMP14 – Output Function Selection . . . . .	30
5.2.7	JMP6, JMP9, JMP12, JMP15 – Output Mode Selection . . . . .	30
5.2.8	I/O Connectors Used as Output . . . . .	31
5.2.9	JMP16 – Battery Backed RAM . . . . .	32
5.2.10	JMP17 – Output Enable . . . . .	32
5.2.11	I/O Connector Used as Input . . . . .	32
<b>6</b>	<b>The Setup Menus</b>	<b>33</b>
6.1	Setup Menus . . . . .	33
6.1.1	To Begin Configuring . . . . .	33
6.1.2	Numeric Data Entry Mode . . . . .	34
6.1.3	Default Firmware Settings . . . . .	34
6.1.4	To Exit Setup Menus . . . . .	35
6.2	Setting the Main RS-232C Port . . . . .	35
6.2.1	Setting Port Parameters . . . . .	36
6.2.2	Setting the Broadcast Mode from Main RS-232 . . . . .	36
6.3	Set Local Hour . . . . .	37
6.3.1	Set Daylight Saving Time (DST) . . . . .	38
6.4	Set Out of Lock . . . . .	39
6.5	Set Back Light . . . . .	40



---

6.6	Set System Delays . . . . .	41
6.7	Set Programmable Pulse Mode . . . . .	42
6.7.1	Entering Numerical Values . . . . .	42
6.7.2	Prog Pulse – Seconds–Per–Pulse Mode . . . . .	43
6.7.3	Prog Pulse – Pulse–Per–Hour Mode . . . . .	44
6.7.4	Prog Pulse – Pulse–Per–Day Mode . . . . .	45
6.7.5	Prog Pulse – Single Trigger . . . . .	46
6.7.6	Prog Pulse – Slow Code . . . . .	47
6.7.7	Prog Pulse – Pulse Polarity . . . . .	48
6.8	Set IRIG Time Data . . . . .	49
6.9	Setting the Event / Deviation Modes (A or B) . . . . .	50
6.9.1	Arming the Event Input . . . . .	51
6.9.2	Setting The Frequency Reference . . . . .	52
6.10	Setting the Auto Survey Mode . . . . .	53
6.10.1	Number of Fixes . . . . .	53
6.11	Set Position Hold ON or OFF . . . . .	54
6.12	Set Option Control . . . . .	55
<b>7</b>	<b>Timing, IRIG-B and Pulses</b> . . . . .	<b>57</b>
7.1	Introduction . . . . .	57
7.2	Timing Output Description . . . . .	58
7.2.1	Standard Inputs/Outputs . . . . .	58
7.2.2	Digital Drivers . . . . .	58
7.2.3	Analog Driver . . . . .	58
7.3	Output Signal Description . . . . .	59
7.3.1	IRIG-B Description . . . . .	59
7.3.2	Modulated and Unmodulated IRIG-B . . . . .	60
7.3.3	Available IRIG-B Signals . . . . .	60
7.3.4	IRIG-B IEEE 1344 Extension . . . . .	61
7.3.5	1 Pulse-per-Second (1 PPS) . . . . .	61
7.3.6	Programmable Pulse (PROG PULSE) . . . . .	61
7.4	Connecting Outputs . . . . .	61
7.4.1	Attaching Cables to Screw Terminals . . . . .	62
7.4.2	How Far Can I Run IRIG-B Cabling? . . . . .	62
7.4.3	Synchronizing Multiple IED’s From One Masterclock Output . . . . .	62
7.4.4	Connecting Unmodulated IRIG-B . . . . .	63
7.4.5	Connecting Modulated IRIG-B . . . . .	63
7.4.6	Wire Losses . . . . .	63
7.4.7	Voltage Matching for Modulated IRIG-B . . . . .	64
7.4.8	Cable Delays . . . . .	64
7.4.9	Solutions . . . . .	65
<b>8</b>	<b>Relay Contacts and Event Inputs</b> . . . . .	<b>67</b>
8.1	Relay Contacts . . . . .	67
8.1.1	By Option . . . . .	67
8.2	Event Inputs . . . . .	67

8.2.1	Event Timing Input . . . . .	67
8.2.2	Event Timing Latency . . . . .	67
8.2.3	Deviation Measurement . . . . .	68
8.2.4	Measurement Principle . . . . .	68
8.2.5	Event Timer Input Channel Configuration . . . . .	68
8.2.6	Firmware Setup . . . . .	68
8.2.7	Displaying Data . . . . .	68
8.2.8	RS-232C Event Trapping . . . . .	69
8.2.9	Event Trapping Setup . . . . .	70
<b>9</b>	<b>Serial Communication and Command Set</b>	<b>71</b>
9.1	Introduction . . . . .	71
9.2	Command Set . . . . .	71
9.2.1	Broadcast Mode Commands . . . . .	73
9.2.2	Event Mode Commands . . . . .	77
9.2.3	Status Mode Commands . . . . .	79
9.2.4	Local / Daylight Savings Time Setup Commands . . . . .	83
9.2.5	Front Panel Control Commands . . . . .	84
9.2.6	IRIG-B Data Output Commands . . . . .	85
9.2.7	Position Data Commands . . . . .	86
9.2.8	Survey Mode Commands . . . . .	88
9.2.9	Date and Time Commands . . . . .	89
9.2.10	Programmable Pulse Output Commands . . . . .	90
9.2.11	Antenna System Delay Commands . . . . .	92
9.2.12	Out-of-Lock Commands . . . . .	92
9.2.13	Miscellaneous Commands . . . . .	92
9.3	Communication Port Information . . . . .	94
<b>10</b>	<b>Startup and Basic Operation</b>	<b>95</b>
10.1	Initial Startup Sequence . . . . .	95
10.1.1	Clock Time, Startup Mode . . . . .	95
10.2	Front Panel Indication . . . . .	96
10.2.1	Display Indication at Startup . . . . .	96
10.2.2	Other Display Indications When Unlocked . . . . .	96
10.2.3	Status Display Indications . . . . .	97
10.2.4	Event/Deviation Display . . . . .	97
10.2.5	IRIG-B Time Data . . . . .	98
10.3	Clock Status Display Mode . . . . .	98
10.4	Time Display Modes . . . . .	98
10.4.1	Date and Time Display, Universal Time Coordinated (UTC) . . . . .	98
10.4.2	Time of Year Display, UTC . . . . .	99
10.4.3	Date and Time Display, Local Time . . . . .	99
10.4.4	Time of Year Display, Local Time . . . . .	99
10.4.5	Daylight Saving–Summer Time . . . . .	100
10.5	Position Display Modes . . . . .	100
10.5.1	Longitude Display . . . . .	100

---

10.5.2	Latitude Display . . . . .	100
10.5.3	Elevation Display . . . . .	100
<b>A</b>	<b>Technical Specifications and Operating Parameters</b>	<b>101</b>
A.1	Scope . . . . .	101
A.2	Receiver Characteristics . . . . .	101
A.2.1	Input Signal . . . . .	101
A.2.2	Timing Accuracy . . . . .	101
A.2.3	Internal Oscillator, Stability . . . . .	101
A.2.4	Position Accuracy (rms) . . . . .	101
A.2.5	Satellite Tracking . . . . .	102
A.2.6	Acquisition . . . . .	102
A.3	I/O Configuration . . . . .	102
A.3.1	I/O Connectors . . . . .	102
A.3.2	Standard Output Signals . . . . .	102
A.3.3	Input Functions . . . . .	102
A.3.4	Event Inputs . . . . .	103
A.3.5	Programmable Pulse Output . . . . .	103
A.3.6	Synchronization . . . . .	103
A.4	Antenna System . . . . .	103
A.4.1	Antenna Cable . . . . .	103
A.5	Operator Interface . . . . .	104
A.5.1	Setup Methods . . . . .	104
A.5.2	Setup Functions . . . . .	104
A.5.3	Display . . . . .	104
A.5.4	Display Functions . . . . .	104
A.5.5	Annunciators . . . . .	104
A.6	System Interface . . . . .	105
A.6.1	RS-232C Interface . . . . .	105
A.6.2	Broadcast Data Formats . . . . .	105
A.7	Physical Specifications . . . . .	105
A.7.1	Dimensions . . . . .	105
A.7.2	Weight . . . . .	105
A.7.3	Power Requirements . . . . .	106
A.7.4	Power Connector . . . . .	106
A.7.5	Electro-Magnetic Interference (EMI) . . . . .	106
A.7.6	Temperature and Humidity . . . . .	106
<b>B</b>	<b>Using Surge Protectors</b>	<b>107</b>
B.1	Introduction . . . . .	107
B.2	Grounding . . . . .	107
<b>C</b>	<b>Options List</b>	<b>109</b>
C.1	Introduction . . . . .	109
C.2	Option 01: Backlighted LCD Display . . . . .	110
C.2.1	General Description . . . . .	110
C.2.2	Specifications . . . . .	110

C.2.3	Configuration . . . . .	110
C.3	Option 02: GPS Battery Backup - <i>Obsolete</i> . . . . .	111
C.3.1	General Description . . . . .	111
C.3.2	Specifications . . . . .	111
C.4	Option 03: Four Additional Outputs . . . . .	112
C.4.1	General Description . . . . .	112
C.4.2	Specifications . . . . .	112
C.4.3	Digital Outputs . . . . .	112
C.5	Option 04: Parallel BCD Output (1 millisecond Resolution) . . . . .	117
C.5.1	General Description . . . . .	117
C.5.2	Option 04 Firmware Setup . . . . .	118
C.5.3	Specifications . . . . .	119
C.5.4	Digital Outputs . . . . .	120
C.5.5	Option 04 Connector Pin Designation . . . . .	121
C.5.6	Configuration . . . . .	123
C.6	Option 07: Inlet Power Supply Description . . . . .	128
C.6.1	85 to 264 Vac, 47 to 440 Hz, 110 to 370 Vdc, IEC-320 Connector . . . . .	128
C.6.2	Specifications . . . . .	128
C.7	Option 08: Inlet Power Supply Description . . . . .	129
C.7.1	10 to 60 Vdc ONLY, Terminal Power Strip, SWC . . . . .	129
C.7.2	Specifications . . . . .	129
C.8	Options 10 – Battery Backup – Obsolete . . . . .	130
C.9	Option 11 – Four Additional Outputs and Battery Backup – Obsolete . . . . .	130
C.10	Option 12: OCXO and Four Additional Outputs . . . . .	131
C.10.1	General Description . . . . .	131
C.10.2	Specifications . . . . .	131
C.10.3	Firmware Setup for Option 12 . . . . .	131
C.10.4	Main Board Setup via Internal Jumpers . . . . .	131
C.10.5	Digital Outputs . . . . .	132
C.10.6	Changing Output Settings via Internal Jumpers . . . . .	133
C.10.7	General Information . . . . .	133
C.10.8	Main Board Hardware Setup via Internal Jumpers . . . . .	133
C.11	Option 15A and 15B: Inlet Power Supply Description . . . . .	135
C.11.1	110 to 370 Vdc, 85 to 264 Vac, 47 to 440 Hz Terminal Power Strip, SWC . . . . .	135
C.11.2	Specifications . . . . .	135
C.12	Option 17: Parallel BCD Output and Second RS-232 Port . . . . .	136
C.12.1	General Description . . . . .	136
C.12.2	Option 17 Firmware Setup Procedure . . . . .	137
C.12.3	Specifications . . . . .	138
C.12.4	Digital Outputs . . . . .	139
C.12.5	Option 17 Connector Pin Designation . . . . .	141
C.12.6	Configuration . . . . .	143
C.13	Option 17A Second RS-232 Interface . . . . .	148
C.13.1	General Description . . . . .	148
C.13.2	Specifications . . . . .	148
C.13.3	Commands . . . . .	148

---

C.13.4	RS-232 Pinout . . . . .	148
C.13.5	Option 17A Field Installation Kit Parts List . . . . .	148
C.13.6	Option 17A Firmware Setup . . . . .	149
C.13.7	Installation . . . . .	150
C.14	Option 18: IRIG-B BUS Distribution, Fault Monitor and 2nd RS-232 Port . . . . .	152
C.14.1	General Description . . . . .	152
C.14.2	Specifications . . . . .	152
C.14.3	Discussion - IRIG-B Distribution System . . . . .	153
C.14.4	Option 18 Firmware Setup . . . . .	156
C.14.5	Typical Network Configuration . . . . .	157
C.14.6	Option 18 Component Wiring Diagrams . . . . .	158
C.14.7	Discussion Redundant Timing Operation . . . . .	158
C.14.8	Option 18 Setup . . . . .	159
C.15	Option 19: Model 1088B Fault Relay . . . . .	162
C.15.1	General Description . . . . .	162
C.15.2	Specifications . . . . .	162
C.15.3	Relay Contacts . . . . .	162
C.15.4	Terminal Strip . . . . .	162
C.15.5	Option 19 Firmware Setup . . . . .	163
C.15.6	Connections . . . . .	163
C.15.7	Configuration . . . . .	163
C.16	Option 20A: Four Fiber Optic Outputs . . . . .	166
C.17	Option 23, COMTRADE Sample Rate Generator . . . . .	169
C.17.1	General Description . . . . .	169
C.17.2	Principles of Operation . . . . .	169
C.17.3	Other Features . . . . .	169
C.17.4	Specifications . . . . .	170
C.17.5	Performance . . . . .	171
C.17.6	Outputs . . . . .	171
C.17.7	Drive Capability . . . . .	171
C.17.8	Setup . . . . .	171
C.17.9	Option 23, Front Panel Setup . . . . .	172
C.17.10	Changing Hardware Settings via Internal Jumpers . . . . .	173
C.18	Option 27: 8-Channel High Drive . . . . .	176
C.18.1	General Description . . . . .	176
C.18.2	Specifications . . . . .	176
C.18.3	Option Setup . . . . .	176
C.19	Option 28: Time, Frequency and Phase Monitor . . . . .	178
C.19.1	General Description . . . . .	178
C.19.2	Discussion . . . . .	178
C.19.3	System Reference Connection . . . . .	178
C.19.4	Firmware Configuration . . . . .	178
C.19.5	Calibration . . . . .	179
C.19.6	Phase Calibration . . . . .	180
C.19.7	Amplitude Calibration . . . . .	180

C.19.8 Option 28 Firmware Setup Procedure . . . . .	181
C.19.9 Option 28–Specific RS-232 Commands . . . . .	182
C.19.10 Option 28 Commands . . . . .	183
C.20 Option 29: Four Additional Outputs; Dry Contacts; +25/50 Vdc . . . . .	188
C.20.1 General Description . . . . .	188
C.20.2 Specifications . . . . .	188
C.20.3 Firmware Configuration . . . . .	190
C.20.4 Output Jumper Setting Changes . . . . .	191
C.21 Option 32: Internal NTP Server . . . . .	193
C.21.1 General Description . . . . .	193
C.21.2 Jumper Settings. . . . .	195
C.21.3 Firmware Configuration. . . . .	196
C.21.4 General Configuration . . . . .	198
C.21.5 NTP Server Parameters . . . . .	198
<b>D CE Mark Certification</b>	<b>199</b>
D.1 Introduction . . . . .	199
<b>E Statement of Compliance</b>	<b>201</b>
E.1 Introduction . . . . .	201

# List of Figures

1.1	Packaging of Accessories . . . . .	2
1.2	Attaching Rack-Mount Ears . . . . .	3
2.1	Model 1088B Front Panel Description . . . . .	5
2.2	Model 1088A/B Rear Panel Description . . . . .	8
2.3	Standard Power Supply . . . . .	9
2.4	Option 07 Power Supply, Terminal Power Strip Connector . . . . .	9
2.5	Option 08 Power Supply Terminal Strip Connector . . . . .	9
2.6	Option 15A Power Supply Terminal Strip Connector . . . . .	9
2.7	Option 15B Power Supply Terminal Strip Connector . . . . .	10
2.8	GPS Antenna Connector . . . . .	10
2.9	Communication Port Connector . . . . .	10
2.10	Standard Input/Output Connectors . . . . .	11
3.1	IEC-320 Power Supply Inlet Description . . . . .	14
3.2	Option 07 Power Supply Inlet Connector . . . . .	15
3.3	Option 08 Power Supply Inlet Connector . . . . .	15
3.4	Option 15A Power Supply Inlet Connector . . . . .	16
3.5	Option 15B Power Supply Inlet Connector . . . . .	16
4.1	Antenna Assembly for Mounting . . . . .	20
4.2	Antenna Mounting Bracket . . . . .	21
4.3	Antenna Mounting with AS0044600 . . . . .	21
4.4	GPS Surge Suppressor . . . . .	22
5.1	Model 1088B Main Board . . . . .	28
6.1	Main RS-232C Setup . . . . .	35
6.2	Port Parameter Setup . . . . .	36
6.3	Broadcast Setup . . . . .	36
6.4	Local Hour Setup . . . . .	37
6.5	Auto Daylight Saving Setup . . . . .	38
6.6	Out-of-Lock Setup . . . . .	39
6.7	Back Light Setup . . . . .	40
6.8	System Delay Setup . . . . .	41
6.9	Programmable Pulse Setup . . . . .	42
6.10	Seconds-Per-Pulse Setup . . . . .	43

6.11	Pulse-Per-Hour Setup . . . . .	44
6.12	Pulse-Per-Day Setup . . . . .	45
6.13	Single Trigger Setup . . . . .	46
6.14	Slow Code Setup . . . . .	47
6.15	Pulse Polarity Setup . . . . .	48
6.16	IRIG-B Time Data Setup . . . . .	49
6.17	Event/Deviation Mode Setup . . . . .	50
6.18	Arming the Event Mode From Front Panel . . . . .	51
6.19	Setting the Frequency Reference From Front Panel . . . . .	52
6.20	Survey Mode Setup . . . . .	53
6.21	Position Hold Mode Setup . . . . .	54
6.22	Option Control Setup . . . . .	55
7.1	Rear Panel Descriptions . . . . .	58
7.2	IRIG-B Waveforms . . . . .	60
C.1	Option 03 Jumper Configuration . . . . .	115
C.2	Option 04 Firmware Setup . . . . .	118
C.3	Option 04 Output Connector . . . . .	122
C.4	Option 04 Output Jumper Settings . . . . .	126
C.5	Option 04 Board Layout and Jumper Locations . . . . .	127
C.6	Option 07 Power Supply Inlet Description . . . . .	128
C.7	Option 08 Power Supply Inlet Description . . . . .	129
C.8	Option 12 Output Signal Jumper Locations . . . . .	134
C.9	Option 17 Firmware Setup . . . . .	137
C.10	Option 17 Output Connector . . . . .	142
C.11	Option 17 Output Jumper Settings . . . . .	146
C.12	Option 17 Board Layout and Jumper Locations . . . . .	147
C.13	Option 17 RS-232 Port Setup . . . . .	149
C.14	Option 18 Firmware Setup . . . . .	156
C.15	Option 18 Network Configuration . . . . .	157
C.16	Option 18 Wiring Diagrams . . . . .	158
C.17	Option 19 External Wired Fault Relay . . . . .	162
C.18	Option 19 Relay Connections . . . . .	163
C.19	Option 19 Relay Circuit without Resistor . . . . .	164
C.20	Option 19 Relay Circuit with Resistor . . . . .	164
C.21	Option 19 Relay Relay Board with Resistor . . . . .	165
C.22	Option 20A Jumper Locations . . . . .	168
C.23	Option 23 Front Panel Setup . . . . .	172
C.24	Option 23 Internal Jumper Setup . . . . .	175
C.25	Option 27 Jumper Locations . . . . .	177
C.26	Option 28 Firmware Setup Procedure . . . . .	181
C.27	Option 29 Jumper Locations . . . . .	191
C.28	Option 29 Connector – Signal Locations . . . . .	192
C.29	Option 32 Rear Panel . . . . .	193
C.30	Option 32 Board-Jumper Locations . . . . .	196



# List of Tables

2.1	Annunciator LED Definitions . . . . .	6
2.2	Command Key Definitions . . . . .	7
3.1	Available IEC-320 Cordsets by Country . . . . .	14
3.2	Fuse Chart . . . . .	17
4.1	Antenna Mounting Bracket Parts List . . . . .	20
4.2	GPS Cable Data and Accessory Information . . . . .	24
5.1	External Reference Input Frequency Settings (JMP3) . . . . .	29
5.2	Output Signal Function Selection . . . . .	31
5.3	Rear Panel I/O Connector Input Functions . . . . .	32
6.1	Front-Panel Setup Menus . . . . .	34
6.2	Default Firmware Settings . . . . .	35
7.1	Drive Current vs. Voltage . . . . .	59
7.2	IRIG-B Time Code Types Available . . . . .	59
7.3	IRIG-B Code Designations . . . . .	60
7.4	IRIG-B Code Designations . . . . .	62
9.1	Fault Indications and Definitions . . . . .	74
9.2	Survey (Sn) / Position-Hold Status (Pm) . . . . .	81
9.3	System Status Information Chart . . . . .	82
9.4	Unlocked Time Quality . . . . .	82
9.5	Auto Survey Setup Conditions . . . . .	88
9.6	Option Control Settings . . . . .	93
9.7	Main RS-232C Port Pin Definitions . . . . .	94
10.1	Fault Conditions . . . . .	98
A.1	Setup Functions Listed . . . . .	104
A.2	Main RS-232 Port Pin Definitions . . . . .	105
A.3	Temperature and Humidity List . . . . .	106
C.1	Output Connector Jumper Settings . . . . .	116
C.2	Option 04 Connector Pin Designation . . . . .	121
C.3	Digital Outputs . . . . .	132

---

C.4	Option 17 Connector Pin Designation . . . . .	142
C.5	Pinout of Option 17 RS-232 Port . . . . .	148
C.6	Option 20A, Four Fiber Optic Output Configuration . . . . .	167
C.7	Option 23, Sample Rates, $f_{LCM} = 384 \times f_{base}$ . . . . .	170
C.8	Option 23, Sample Rates, $f_{LCM} = 3200 \times f_{base}$ . . . . .	170
C.9	Option 23, Output Signal Selection Jumper Settings . . . . .	174
C.10	Option 28 B2 Broadcast, Time Deviation Values . . . . .	185
C.11	Operating Modes of SSR Outputs . . . . .	189
C.12	Output Connectors and Setup Jumpers . . . . .	190
C.13	JMP1 and JMP2 Settings . . . . .	195
C.14	JMP3 Settings . . . . .	195

# 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:

- 1088A/B 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 1088A/B 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 1088A/B 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

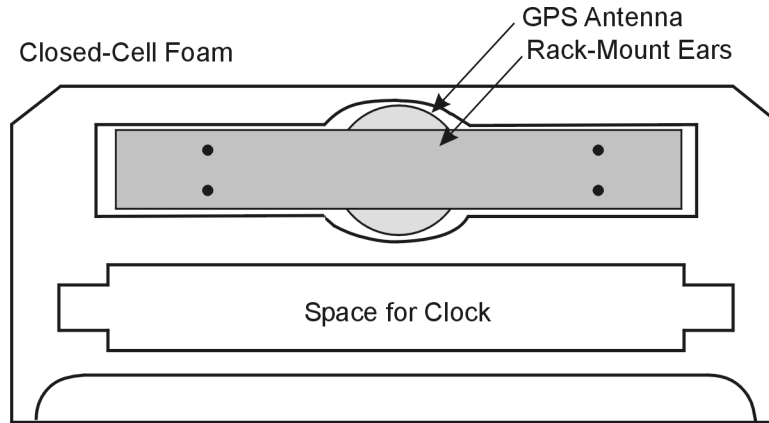


Figure 1.1: Packaging of Accessories

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 1088A/B Series Clocks

Each Model 1088A/B 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.*

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

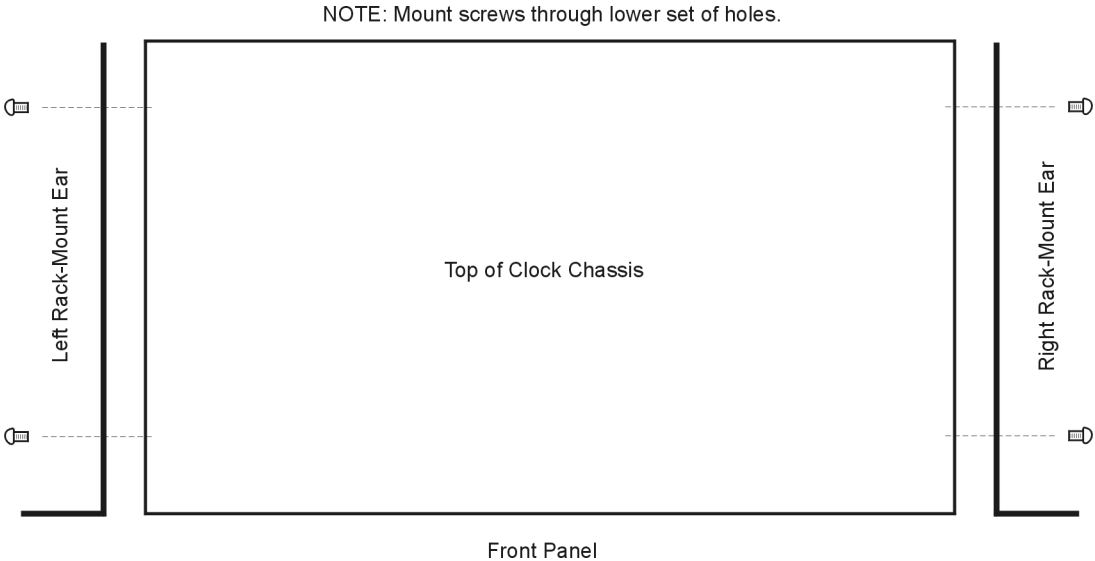


Figure 1.2: Attaching Rack-Mount Ears



# 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 1088A/B series clocks. The Model 1088B replaced the Model 1088A. 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 panel of the Model 1088A and 1088B are the same except the 1088A does not have the indicator LEDs or optional internal battery switch.

The Model 1088B has seven annunciator LED's, two-line by twenty-character LCD, eight-button keypad, ON/OFF switch, the battery power option switch is optional. The upper row of keys are Information keys and the lower row of keys are Configuration keys. In the figure below are illustrated the front panels of all of these clocks, illustrating all of the indicators and controls.

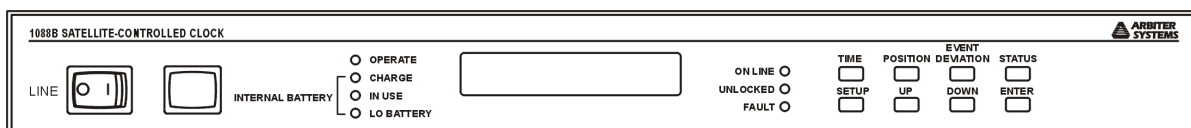


Figure 2.1: Model 1088B Front Panel Description

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
Charge*	Green	Illuminates when the charging circuit for the internal battery is in the high charge mode.
In Use*	Green	Illuminates when the power is supplied by backup battery.
Lo Battery*	Red	Illuminates when the battery voltage falls below 5.6 volts.
On Line	Green	Indicates Active Clock**
Unlocked	Red	Out-of-Lock when ON
Fault	Red	Internal/External Faults***

Table 2.1: Annunciator LED Definitions

\* Only active with clock power backup battery. Refer to the option information sheet for details about the internal battery operation.

\*\* 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.

### 2.2.2 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.

Three LED's provide information about the clock power backup battery. The Charge and In Use LEDs are green and the Lo Battery LED is red.

The following definitions apply to these indicators:

- **OPERATE:** Indicates that power is being supplied to the clock.
- **CHARGE:** Indicates that the charging circuit for the internal battery is in the high charge mode. Whenever power is present at the rear-panel power inlet, the charging circuit will provide a trickle charge. If the battery charge level falls below a preset threshold, the high charge mode will be activated.
- **IN USE:** Indicates that the internal battery is supplying power to the clock.
- **LO BATTERY:** Indicates the backup battery voltage falls below 5.6 volts.



- **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.

### 2.2.3 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

### 2.2.4 LCD Display

The Model 1088A/B 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 reference Sec:FE.Enable, 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 information, see Event Inputs in Chapters 5, 6, 8 and 9.

**Status**

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

**Setup**

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

**Up**

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

**Down**

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

**Enter**

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

## 2.3 Rear Panel Identification and Connectors

This section contains information to assist you in identifying where to connect inlet power, the GPS antenna cable and all of the input and output cables on the Model 1088A/B series clocks.

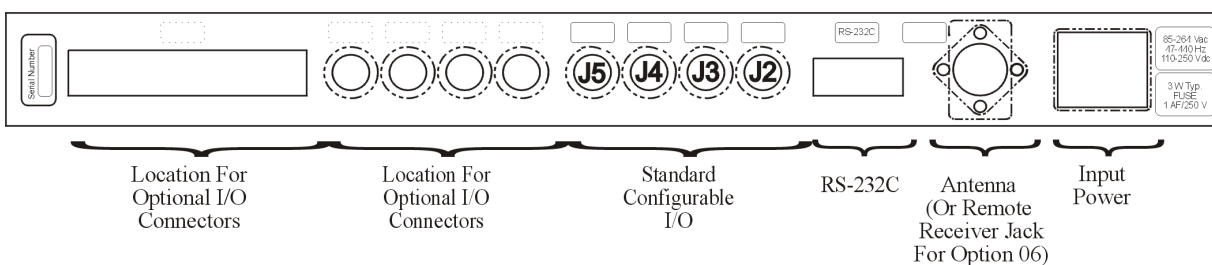


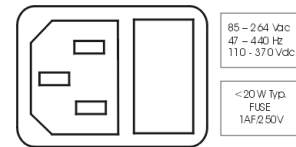
Figure 2.2: Model 1088A/B Rear Panel Description

### 2.3.1 Power Inlet

To cover all of the possible inlet power conditions, the Model 1088B 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:

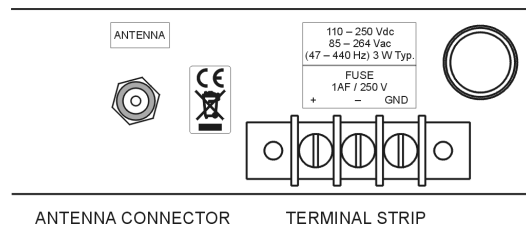
- Standard, IEC-320 supply with a range of 86 to 264 Vac, 47 to 440 Hz and 110 to 370 Vdc

Figure 2.3: Standard Power Supply



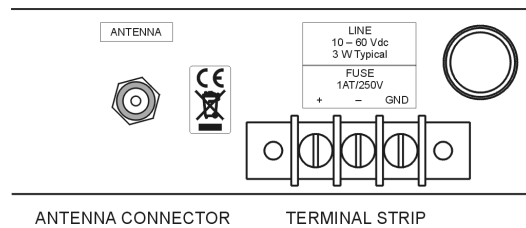
- Option 07, Terminal Power Strip

Figure 2.4: Option 07 Power Supply, Terminal Power Strip Connector



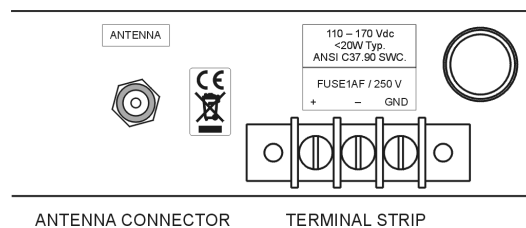
- Option 08, 10 to 60 Vdc ONLY, Terminal Power Strip. **BE SURE TO OBSERVE CORRECT POLARITY**, as the power supply used with Option 08 will not accept reverse input polarity.

Figure 2.5: Option 08 Power Supply Terminal Strip Connector



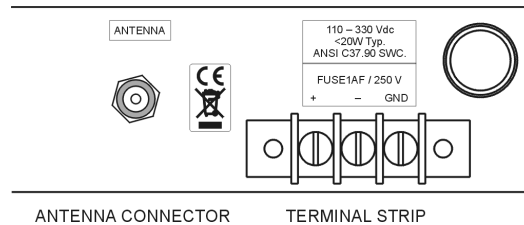
- Option 15A, 125 Vdc Terminal Power Strip with Surge Withstand Protect Circuitry (SWC)

Figure 2.6: Option 15A Power Supply Terminal Strip Connector



- Option 15B, 250 Vdc Terminal Power Strip with Surge Withstand Protect Circuitry (SWC)

Figure 2.7: Option 15B Power Supply Terminal Strip Connector

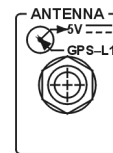


### 2.3.2 Antenna Input

The Model 1088A/B 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 2.8: GPS Antenna Connector



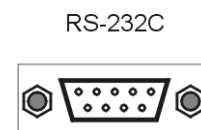
### 2.3.3 Event Input

For timing external events based on the GPS-synchronized time, use the Event Input function with two separate connectors: J3 Event B input (Standard I/O) and J4 Event A input (Standard I/O). See Figure ref Fig:Mainboard, which illustrates the location of these connectors and jumpers.

### 2.3.4 RS-232 Communication Ports

The Model 1088A/B has one standard and one optional communication ports. 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 2.9: Communication Port Connector



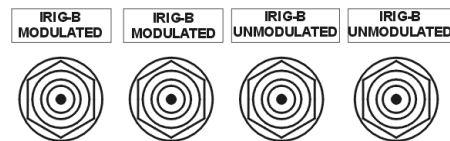
### 2.3.5 Form C, Relay Contacts

The Model 1088A/B can be fitted with dry contacts by installing an internal option board in Option Slot B. Using Option 19, the 1088B can have one set of Form C mechanical contacts. With Option 29, the 1088B can have two solid-state contacts that can also source +25 or +50 Vdc. For additional information on these two options, see Option 19 and Option 29 in Appendix C. For specifications and information on how to connect to them, see Chapter 8, Relay Contacts and Event Inputs.

### 2.3.6 Standard Input/Outputs

The Model 1088B has four BNC connectors used for configurable inputs and outputs, the functions of which are based on setting internal jumpers. The factory sets these jumpers at the time of purchase, and they may be changed at any time as required. As outputs, all connectors may be set to one of twenty-two different signals, and as inputs, two may be set as an event inputs, one as auxiliary input and one set to function as an external timing reference. The connector labels reflect the original setting from the factory.

Figure 2.10: Standard Input/Output Connectors





## Chapter 3

# Connecting Inlet Power, Input and Output Signals

### 3.1 Physical Configuration

The Model 1088B 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. 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 ref Sec:AntDelay); 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 ref Tbl:Cables. If a longer antenna cable than this is required, please contact the factory for advice.

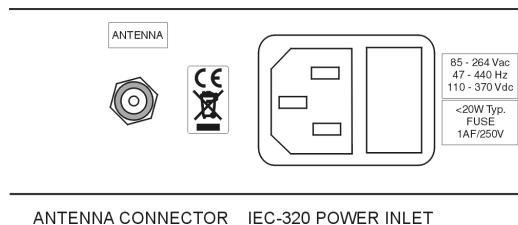
#### Model 1088B Power Supplies

To provide for a wide range of inlet power sources, the 1088B can be ordered with 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 module before connecting power to the clock.

### 3.2 Standard IEC-320 Power Inlet Module

The standard 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: IEC-320 Power Supply Inlet Description



### 3.2.1 Cordsets and Plug Styles for IEC-320 Inlet Module

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 IEC-320, Connecting Power to the 1088B

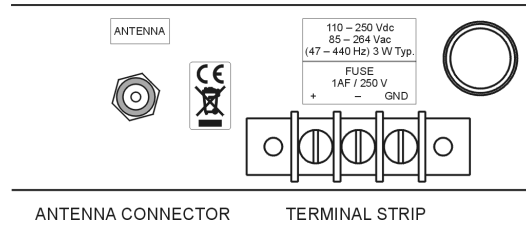
Connect the IEC-320 plug to the IEC-320 connector on the 1088B, and then connect the wall plug into the wall socket.

## 3.3 Option 07, 110 to 370 Vdc Terminal Power Strip

This option replaces the standard IEC-320 inlet with a 3-pole terminal strip. Input voltages are: 85 to 264 Vac, 47 to 440 Hz, or 110 to 370 Vdc, < 20 VA typical.



Figure 3.2: Option 07 Power Supply Inlet Connector



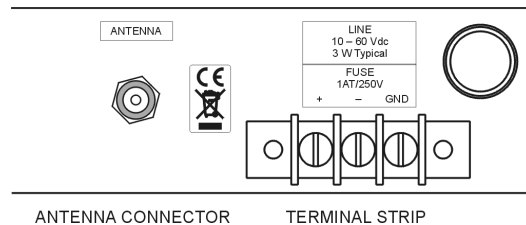
### 3.3.1 Option 07, Connecting Inlet Power

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 07 terminals.

## 3.4 Option 08, 10 to 60 Vdc Power

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

Figure 3.3: Option 08 Power Supply Inlet Connector



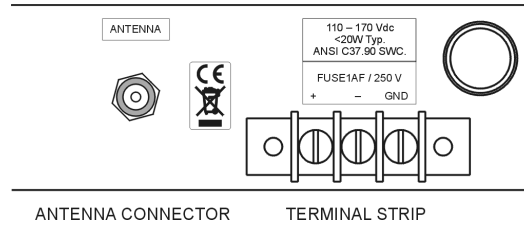
### 3.4.1 Option 08, Connecting Inlet Power

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.*

## 3.5 Option 15A, 110 to 170 Vdc Terminal Power Strip

Option 15A for the Model 1088A/B is designed to provide power inlet surge withstand capability in compliance with ANSI C37.90-1 and IEC 801-4. Option 15A also incorporates Option 07, which is a three-pole barrier strip inlet for 125 volt DC substation power.

Figure 3.4: Option 15A Power Supply Inlet Connector



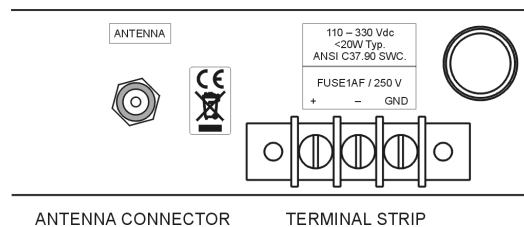
### 3.5.1 Option 15A, Connecting Inlet Power

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 07 terminals.

## 3.6 Option 15B, 110 to 330 Vdc Terminal Power Strip

Option 15B for the Model 1088A/B is designed to provide power inlet surge withstand capability in compliance with ANSI C37.90-1 and IEC 801-4. Option 15B also incorporates Option 07, which is a three-pole barrier strip inlet for 250 volt DC substation power.

Figure 3.5: Option 15B Power Supply Inlet Connector



### 3.6.1 Option 15B, 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 07 terminals.

## 3.7 Fuse Types and Locations

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

### 3.7.1 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. The fuse compartment is located directly adjacent to the input connector socket, and can be opened by pulling both sides directly out away from the chassis, or by gently prying with a small flag-blade screwdriver. Check Table 3.2 for replacement fuse information.

PS Option	Arbiter PN	Fuse ID	Size, mm
Standard	FU0001816	F1AL250V	5 x 20
07	FU0001816	F1AL250V	5 x 20
08	FU0001416	T1AL250V	5 x 20
15A/15B	FU0001816	F1AL250V	5 x 20

Table 3.2: Fuse Chart

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 07, 08 or 15A/15B, the input power module includes separate fuse holder adjacent to the terminal power strip. To check the fuse, first disconnect power to the clock. Grasp the fuse-holder cover and turn it 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.

## 3.8 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.

## 3.9 Connecting Input Signals

Input signals may be connected through the designated I/O terminals, J2, J3, J4, and J5. J2 is used for auxiliary inputs, J2 and J3 are both used for timing events and J5 can be used to connect an external timing reference, instead of using the internal oscillator. 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.

### 3.9.1 Connecting an Event Input at J3 or J4

An event input may be connected to the Model 1088B series clock through two I/O connectors: J3 and J4. Refer to the rear-panel drawing in Figure 2.2.



## Chapter 4

# GPS Antenna and Cable Information

The standard Model 1088B comes 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 1088B clock. 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

To mount the antenna, you will need a short piece of grey, 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.

#### **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
3. Thread the plastic pipe into the antenna
4. Mount the plastic pipe and antenna/cable assembly to a fixture

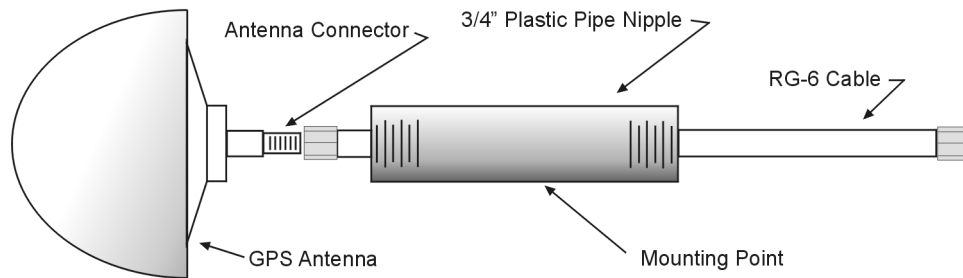


Figure 4.1: Antenna Assembly for Mounting

### 4.1.2 Optional Antenna Mounting Kit

The AS0044600 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	HP0014800
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 21 illustrate the antenna mounting bracket and a typical installation using the AS0044600 Antenna Mounting Kit.

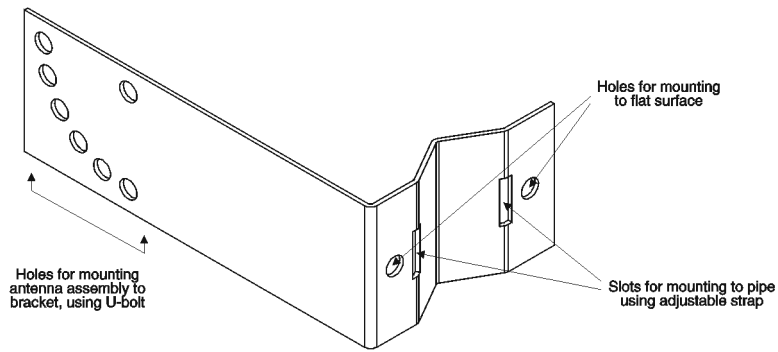


Figure 4.2: Antenna Mounting Bracket

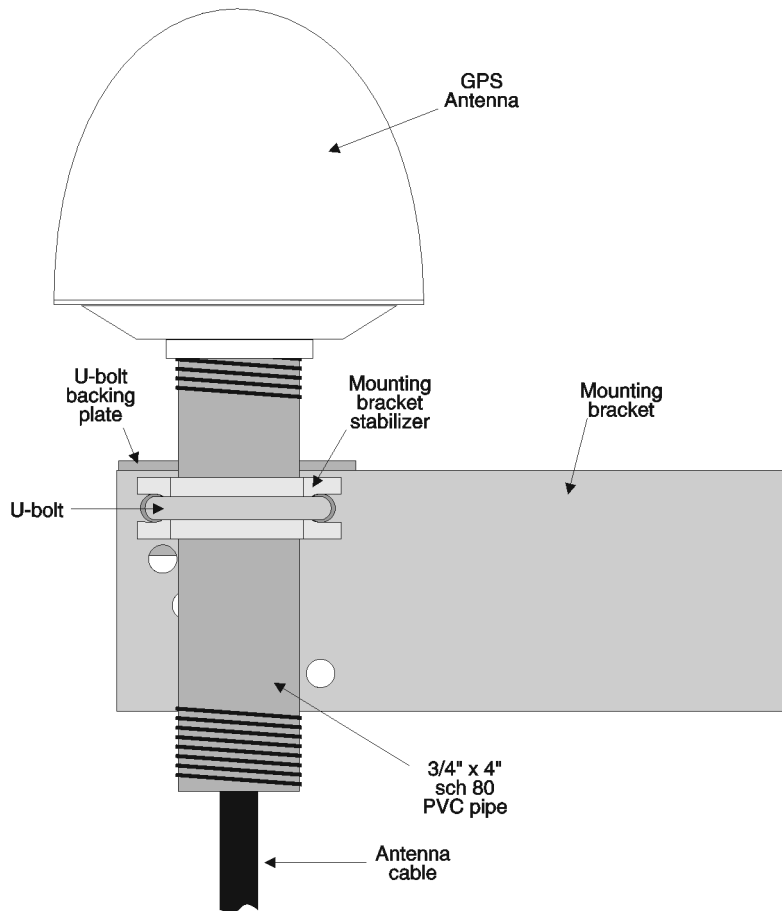


Figure 4.3: Antenna Mounting with AS0044600

## 4.2 Antenna and Cable Testing

The antenna and cable assembly can easily be tested prior to or after installation. All that is required is a basic multimeter that measures DC volts and resistance.

### 4.2.1 Checking the Antenna Voltage

The GPS clock provides a +5 Vdc signal at 30 mA maximum, carried through the antenna cable to the GPS antenna. 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. You can verify this signal by setting your voltmeter to DC volts and measuring from the center pin to the threads at the antenna connector on the rear panel. This signal should be between 4.9 and 5.1 Vdc.

### 4.2.2 Power Supply Check

The Antenna Voltage test (above) actually tests the main power supply voltage for all models of clocks.

### 4.2.3 Checking the Antenna Resistance

The current antenna is a Trimble Bullet 3 and has a nominal internal resistance of about 270 ohms. Measure this with the antenna cable disconnected from the clock and connected to the antenna. This way you will know if you have a good connection. Change your multimeter to read resistance and measure from the center pin of the cable connector to the threads (shield).

## 4.3 Antenna Surge Suppressor

If you have ordered the GPS Surge Suppressor kit, you should mount it in line with the antenna cable, preferably close to a grounding point. Additional information on grounding GPS antennas, and grounding in general, are available from Arbiter (Kit P/N AS0049000).

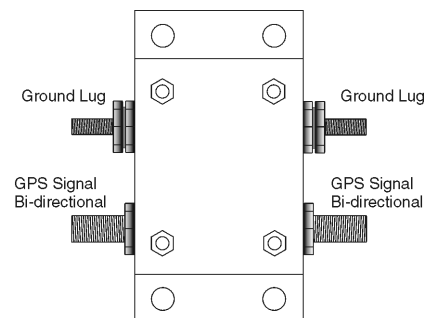


Figure 4.4: GPS Surge Suppressor

### 4.3.1 Using the Antenna Surge Suppressor

If using the antenna surge suppressor, it would be good to review documentation on this device, including tips on grounding. Please check Appendix B in this manual for details on the importance of using surge suppressors and proper grounding.



## 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:

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

Where:

- T = Cable delay, in nanoseconds;
- $\lambda$  = Cable length, in meters;
- C = Speed of light ( $3 \times 10^8$  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 60°C (140°F). Exercise care when routing the cable near sources of heat to avoid cable damage.

### **Adjacent Signals**

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

### **Antenna Power**

The RF preamplifier within the antenna requires 5 Vdc at 30 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 installation by performing the Power Supply Test and Antenna Resistance Test above.

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



# Chapter 5

## Setting Internal Jumpers

### 5.1 Introduction

Jumpers in the the 1088B series clocks are already set up at the factory according to the purchase order. If it should be necessary to change any jumpers or to enable any new function, you should follow the instructions in this section.

This section should assist you with understanding and setting the internal main board jumpers in the Model 1088B. 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. Most settings may also be configured 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 Changing Hardware Settings Via Internal Jumpers

The 1088B incorporate a flexible input and output (I/O) selection system, which is made possible by an innovative internal jumper scheme. Each of the four, standard, rear-panel I/O connectors can be reconfigured to perform any of the available output functions. Alternatively, any or all of the I/O connectors can be set to act as an input to the 1088B. However, each of the I/O connectors is assigned only one specific and exclusive input function.

Besides configuring the four main output connectors, there are other settings that will be explained in this section. These include whether to use the RS-232 port or one of the standard I/O connectors for event input signals, setting the frequency reference for the clock, and setting the battery-backed RAM.

When changing any of the jumpers you will want to refer to the main board layout diagram in Figure 5.1 to locate jumper positions. Tables 5.1, 5.2 and 5.3 will also help to identify meanings to the various settings.

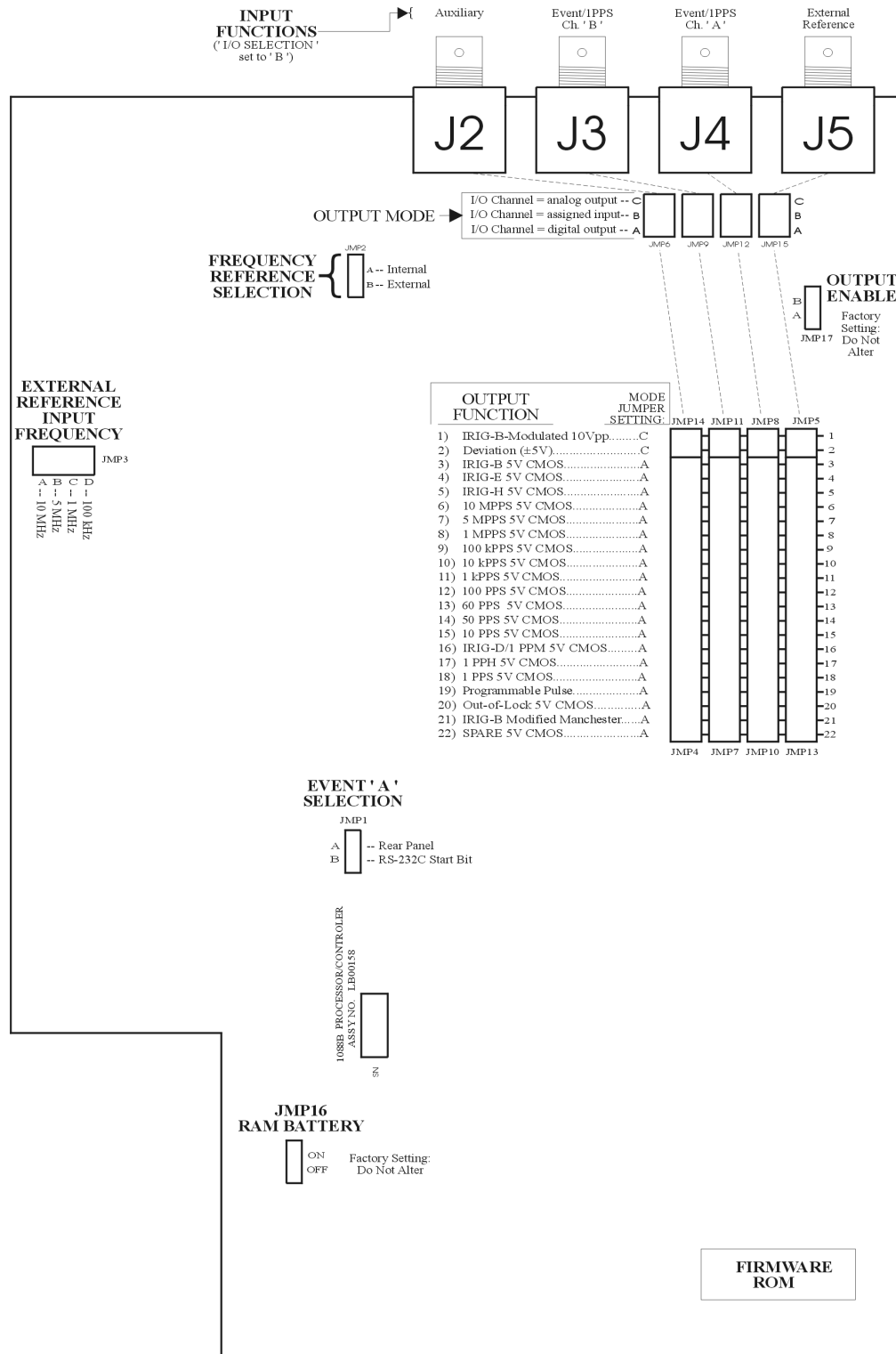


Figure 5.1: Model 1088B Main Board

### 5.2.1 Cover Removal

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

1. On all Models disconnect the power cord. If equipped with Option 04 (power switch), first turn the power switch to OFF.
2. Using a T-25 driver, remove the four screws securing the cover (and rack-mount ears, if used).
3. Lift the cover off.
4. Figure 5.1 illustrates the main board and locates all the jumpers. Also, a label located on the inside of the top cover provides a quick reference for the I/O functions and their respective jumper settings.

**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.

### 5.2.2 JMP1 – Event “A” Selection

The Model 1088B has the capability to provide for two possible event inputs: Event A and Event B. Jumper 1 selects the port to which the Event A signal is applied, either the standard I/O connector (J4) or the main RS-232 port. Position A selects the standard I/O and position B selects the main RS-232 port. Event B input is always applied to J3. Event A and Event B alternatively provide for 1 PPS deviation measurements. These measurements are continuously updated each second.

### 5.2.3 JMP2 – Frequency Reference Selection

The Model 1088B is able to use an external timing reference instead of the internal clock signal. Usable signals are 100 kHz, 1 MHz, 5 MHz and 10 MHz. For external reference operation set JMP2 to position B and select the External Reference Input Frequency with JMP3. Acceptable signal levels for an external reference are 5-volt TTL/CMOS. See Table 5.1

Reference Frequency	JMP2	JMP3	JMP15	Source
Internal Standard	A*	X	A,C	Internal
Option 12A	B	B	A,C	Internal
External 10 MHz	B	A	B	External
External 5 MHz	B	B	B	External
External 1 MHz	B	C	B	External
External 100 kHz	B	D	B	External

Table 5.1: External Reference Input Frequency Settings (JMP3)

### 5.2.4 JMP3 – External Reference Input Frequency

Used in conjunction with Jumper 2 in setting up an external reference signal to replace the Model 1088B internal clock. Four choices are available: “A” – 10 MHz, “B” – 5 MHz, “C” – 1 MHz and “D” – 100 kHz. If you are going to apply an external reference signal, make sure to read details of JMP2 above. See Table 5.1.

### 5.2.5 JMP4, JMP7, JMP10, JMP13 – Output Function Selection

Jumpers JMP4, JMP7, JMP10, and JMP13 determine the output signals, which can be made available at I/O connectors J2, J3, J4, and J5, respectively. Figure 5.1 illustrates the relationship between these jumpers and the I/O connectors (the position of some jumpers is slightly different in the Model 1088A). 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 5.2 lists the jumper settings required for various signals. JMP5, JMP8, JMP11 and JMP14 (located at the top of the columns of Output Function jumpers) refer to the two analog signals available from setting jumper positions 1 and 2. They will not be referred to in the setup, but listed for your information.

### 5.2.6 JMP5, JMP8, JMP11, JMP14 – Output Function Selection

These jumpers are essentially the same as JMP13, JMP10, JMP7 and JMP4, in that order. They exist because they were used to signify the difference between digital signals and analog signals. Jumpers 5, 8, 11 and 14 are designated for analog, however output all functions will be referred to as Jumpers 4, 7, 10 and 13.

### 5.2.7 JMP6, JMP9, JMP12, JMP15 – Output Mode Selection

The next step in configuring the I/O connectors is to determine whether the assigned signal is an analog output, a digital output, or an input (configuring the connectors as inputs is described later in this chapter) . Select the output mode by setting jumpers JMP6, JMP9, JMP12, and JMP15 to the appropriate positions. These jumpers correspond to connectors J2, J3, J4, and J5, respectively (see Figure 5.1). 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 5.2 lists jumper positions for individual output signals.



<b>Output Signal Description</b>	<b>Output-Function Jumper Position</b>	<b>Output-Mode Jumper Position</b>
IRIG-B Modulated 10 V <sub>pp</sub>	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
Spare 5 V CMOS	22	A

Table 5.2: Output Signal Function Selection

### 5.2.8 I/O Connectors Used as Output

For each I/O connector, it is necessary to set 2 jumpers in order to assign the output (or input) signal. The following paragraphs describe the procedure for setting these jumpers. For standard configuration, J2 and J3 are set to unmodulated IRIG-B, J4 and J5 are set to modulated IRIG-B. For example, to set J2 as modulated, JMP4 = 1 and JMP6 = C.

### 5.2.9 JMP16 – Battery Backed RAM

Jumper 16 is used to connect the battery to program RAM. This specific RAM is used to store any user-configured information such as serial port preferences, local offsets and timing settings – anything found in SETUP menu. With the battery disconnected (JMP16 set to OFF), all the user-configured information would be lost when the clock is powered off or loses power.

### 5.2.10 JMP17 – Output Enable

This jumper is used at the factory for setting the output enable for the 5V CMOS output buffers. 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 CMOS outputs to be paralleled and driven by the on-line clock. Normally, this jumper will be configured as required when delivered from the factory and set to position “A”.

### 5.2.11 I/O Connector Used as Input

Any of the four I/O connectors included with the standard model can be reconfigured to operate as an input. However, each connector is restricted to the input function listed for it as seen below in Table 5.3.

To reconfigure any I/O connector as “an input”, all that is required is to set the corresponding I/O jumper to position “B”. It is not necessary to change the position of the output function jumper, as this will have no effect on input operation.

Connector	Function
J2	Auxiliary Input
J3	Event B Input
J4	Event A Input
J5	External Reference Input

Table 5.3: Rear Panel I/O Connector Input Functions

# Chapter 6

## The Setup Menus

This section should guide you in configuring the Model 1088B operation using the SETUP Menus or RS-232C port(s). These menus allow you to configure the operation according to your preferences. Logically, use the setup menus after installing the clock for the first time, or changing any of the main-board jumpers as described in Chapter 5.

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 correct time in your locale, you will need to configure the Local Offset (from UTC) and Daylight Saving, 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 methods available for configuring the Model 1088B: (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. 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

#### 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

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	Freq. Reference	Set to Internal or External
10	Set Auto Survey	Set Survey mode
11	Position Hold	Set ON or OFF
12	Option Control	Set Main board and Aux. board options

Table 6.1: Front-Panel Setup Menus

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.

### 6.1.3 Default Firmware Settings

When shipped from the factory, and unless specified otherwise, all models will be configured with default settings. Many 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
Freq. Reference	Internal	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 menu 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 Figure 6.1). To set up the broadcast mode, press SETUP (instead of ENTER) and skip to Section 6.2.2 below.

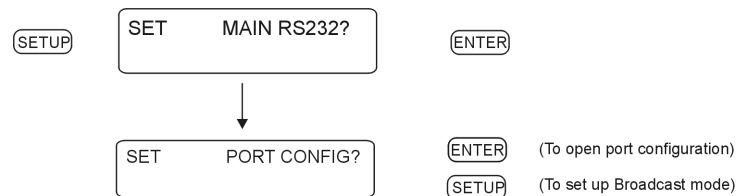


Figure 6.1: Main RS-232C Setup

### 6.2.1 Setting Port Parameters

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 from the front panel.*

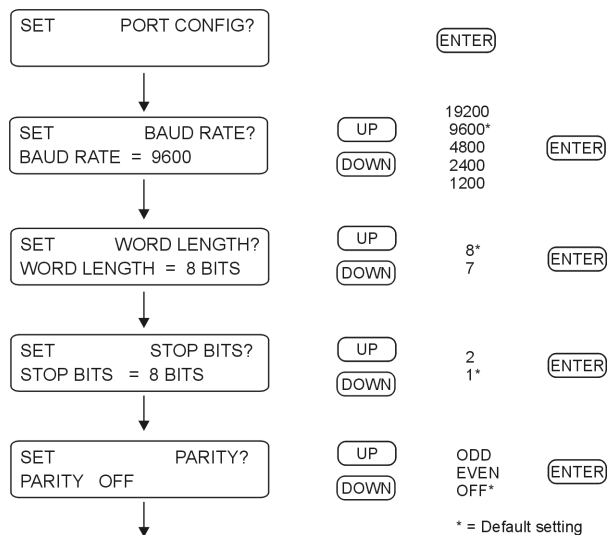


Figure 6.2: Port Parameter Setup

### 6.2.2 Setting the Broadcast Mode from Main RS-232

The “Set Broadcast Mode” menu allows you to configure any of these clock models to broadcast ASCII time/date-related data from the available RS-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.*

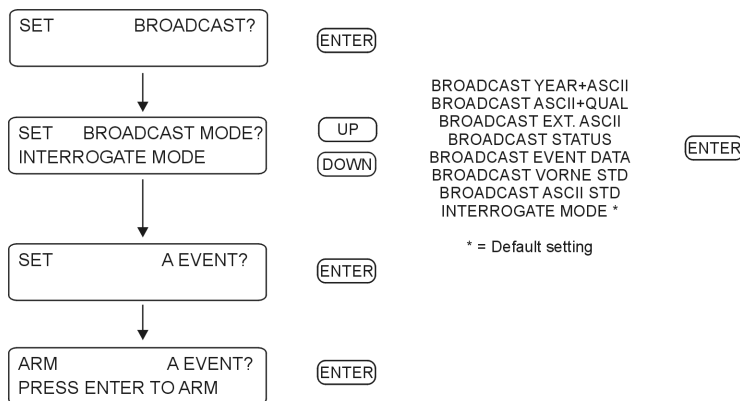


Figure 6.3: Broadcast Setup

## 6.3 Set Local Hour

Use “Set Local Hour” to set the offset in time from UTC to your locale and any Daylight Saving settings if they apply. Offsets may be adjusted in 15-minute increments, up to plus or minus 12 hours. Daylight Saving is adjusted for start and stop times, based on month, week of month, day and time of day. Use this menu to set up basic DST adjustment. *RS-232C: see Section 9.2.4.*

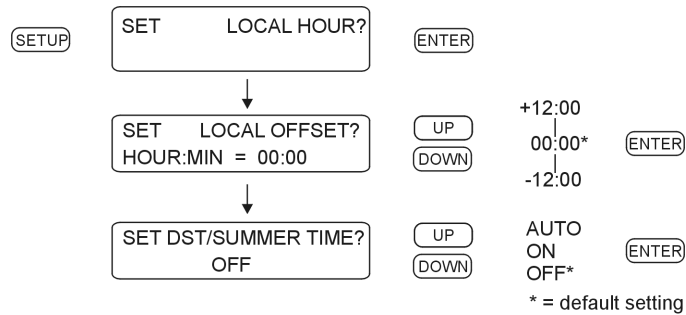


Figure 6.4: Local Hour Setup

### 6.3.1 Set Daylight Saving Time (DST)

For automatic changeover, use the AUTO setting explained above. Make sure to determine the changeover requirements in your locale before trying to adjust these clock settings. The default setup is for North America, where DST begins on the second Sunday of March at 2 am and ends on the first Sunday of November at 2 am. Go through each setting and verify that the settings are valid. To adjust and install values, press the UP/DOWN keys to adjust the desired value and ENTER key to install that value and proceed to the next setting. *RS-232C: see Section 9.2.4.*

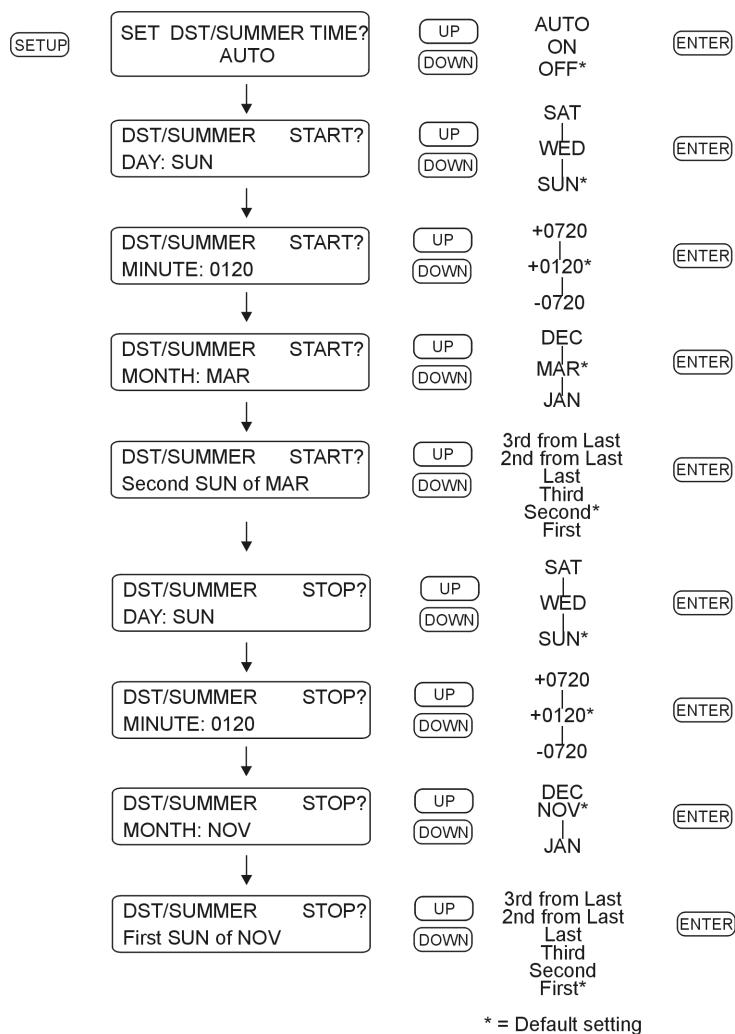


Figure 6.5: Auto Daylight Saving Setup



## 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. Out of Lock means that the GPS receiver in the clock is no longer tracking any satellites and that the time may drift according to characteristics of the internal clock and environmental conditions. Adjust these settings so that, in the event of an out-of-lock condition, you will be notified in a reasonable amount of time. The default setting is for the clock to alarm after being unlocked for a period of one minute. Unlocked indications include the red UNLOCKED LED being ON, and (if equipped) the Out-of-Lock relay changing state. *RS-232C*: see Section 9.2.12.

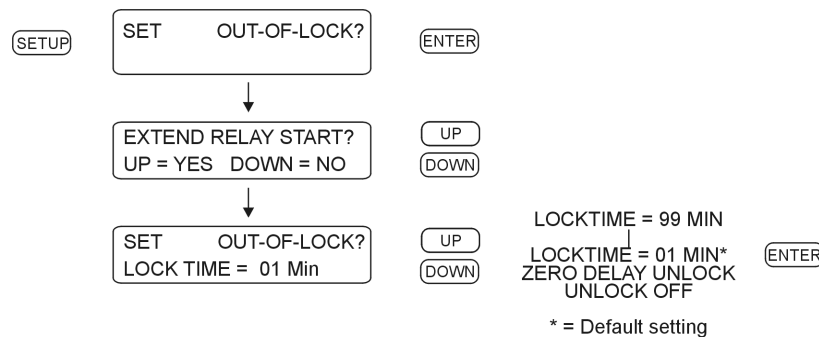


Figure 6.6: Out-of-Lock Setup

Extend Relay Start means that the clock will extend the time that the clock is not considered stabilized, the unlocked LED is lit, and (if equipped) 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 until completing the internal counting function.

## 6.5 Set Back Light

If the optional back light (Option 01) is installed in the clock, use the “Set Back Light” menu to configure how the back light operates. If back light is not installed, then the “Set Back Light” menu will have no effect. Settings are either (1) Back Light OFF, (2) Back light ON, or (3) Back light AUTO. In the Auto setting, the back light will operate for approximately 30 seconds before switching OFF. *RS-232C: see Section 9.2.5.*

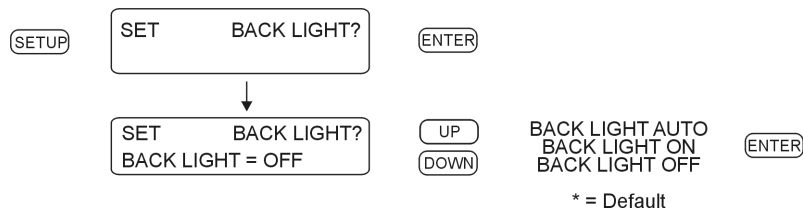


Figure 6.7: Back Light Setup

## 6.6 Set System Delays

Use the “Set System Delays” menu to set 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 slow by this amount. *RS-232C: see Section 9.2.11.*

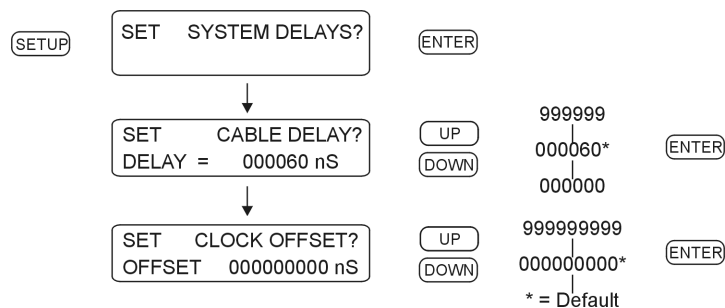


Figure 6.8: System Delay Setup

## 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 J2 – J5 (see Table 5.2 and Figure 5.1) at a predetermined interval or rate. Also, there is a “pulse-per-day” mode and a “pulse-per-year” mode. Programming includes adjusting the pulse width, from a minimum of 10 milliseconds to 600 seconds, depending on the application, and configuring the pulse to occur at either UTC or Local time. *RS-232C: see Section 9.2.10.*

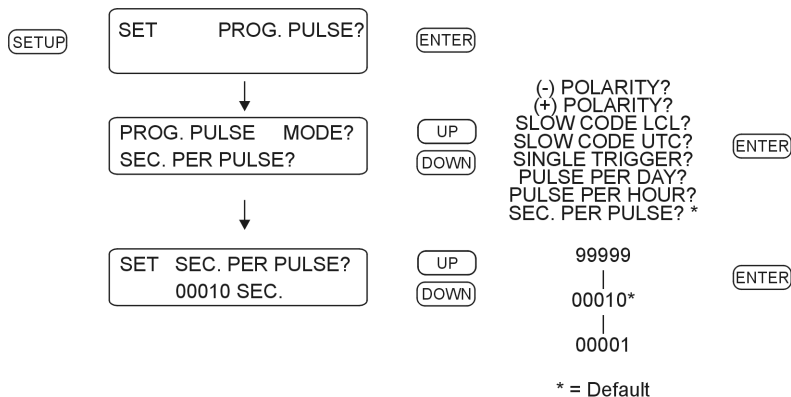


Figure 6.9: Programmable Pulse Setup

### 6.7.1 Entering Numerical Values

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

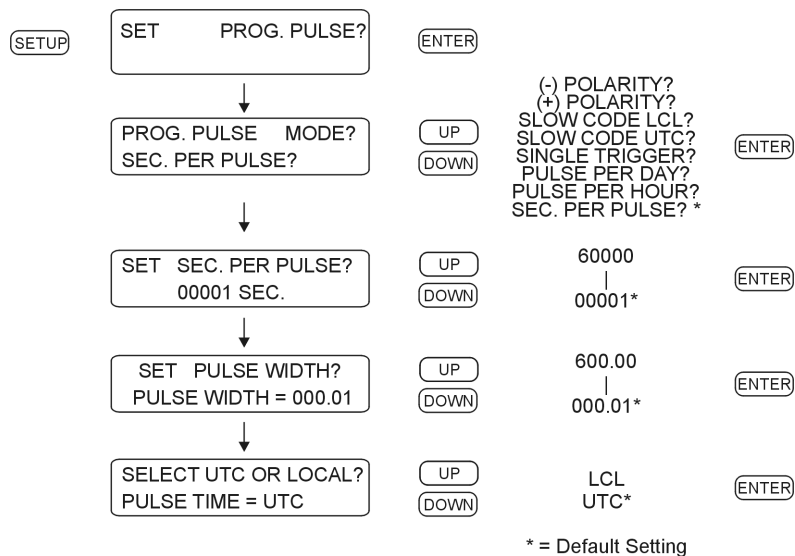


Figure 6.10: Seconds–Per–Pulse Setup

### 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 Numerical Values. *RS-232C: see Section 9.2.10.*

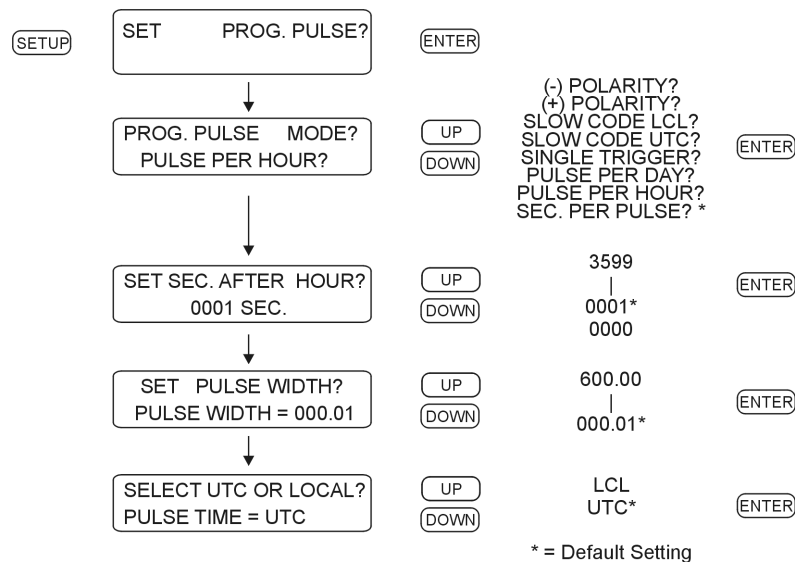


Figure 6.11: Pulse-Per-Hour Setup

### 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.*

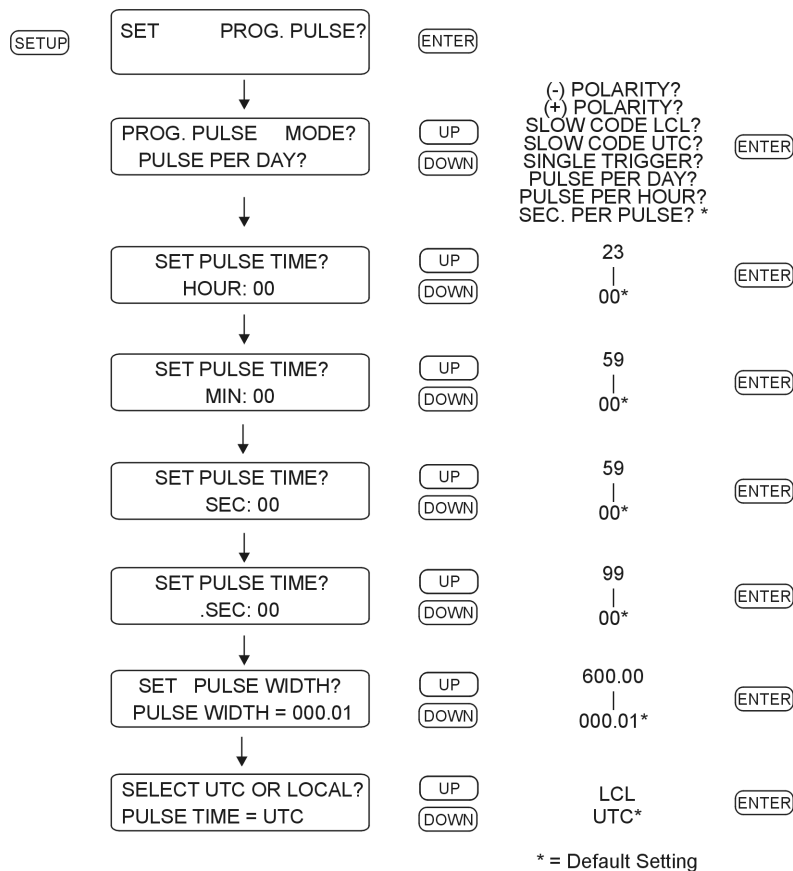


Figure 6.12: Pulse-Per-Day Setup

### 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.*

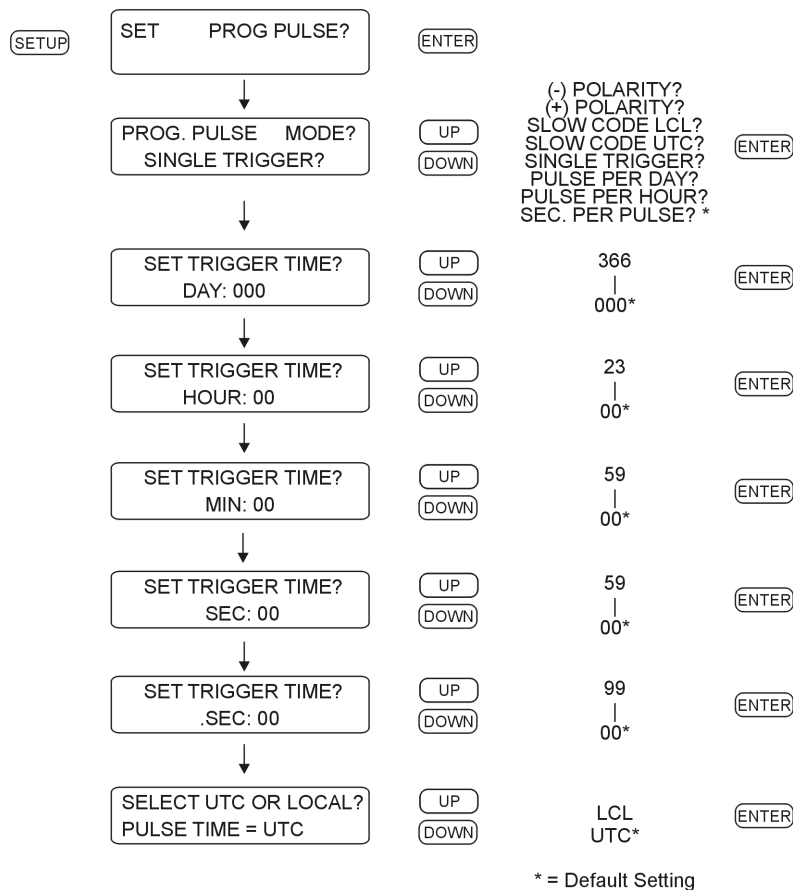


Figure 6.13: Single Trigger Setup



### 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.

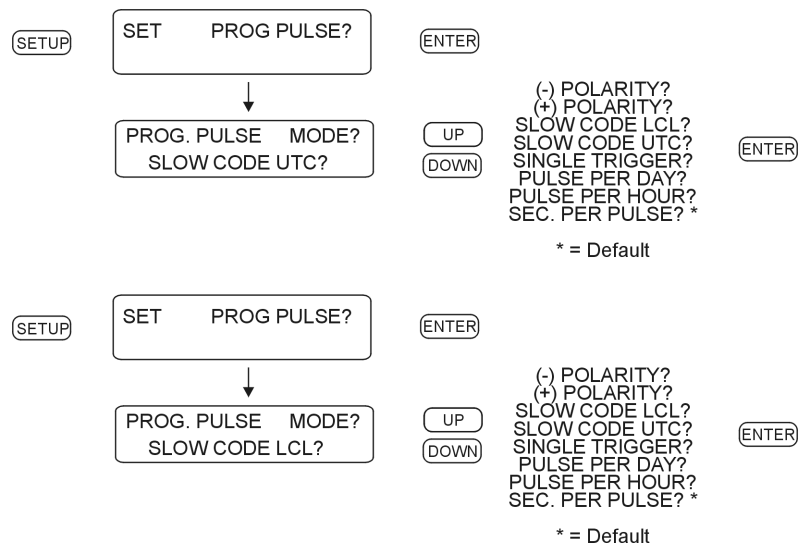


Figure 6.14: Slow Code Setup

### 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.*

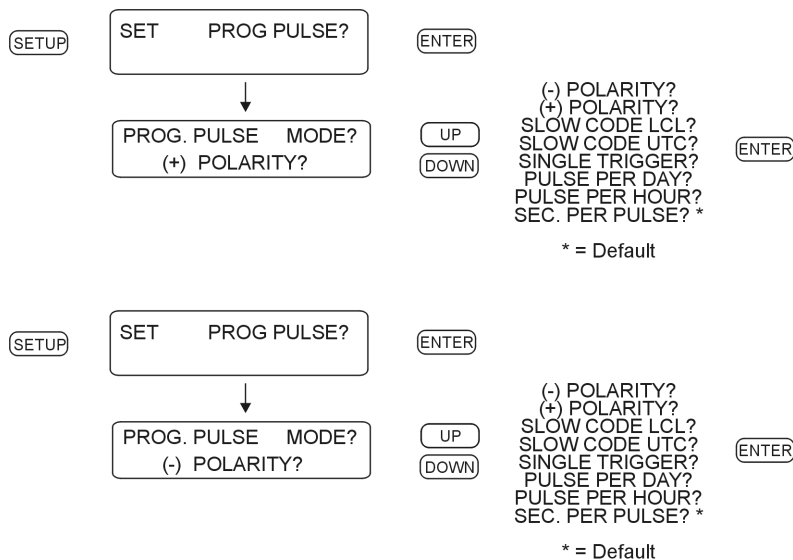


Figure 6.15: Pulse Polarity Setup

## 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 7.3.4). *RS-232C*: see Section 9.2.6.

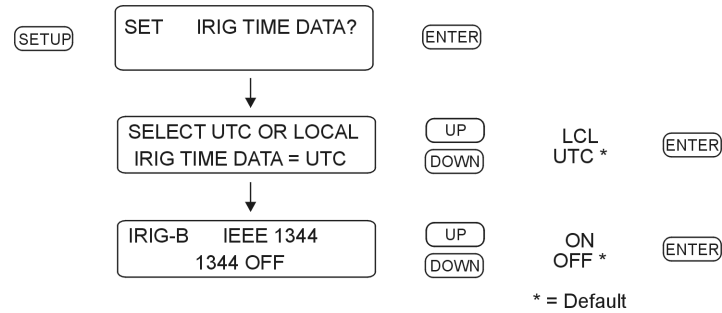


Figure 6.16: IRIG-B Time Data Setup

## 6.9 Setting the Event / Deviation Modes (A or B)

Use the Event/Deviation Mode to capture an event at J3 and/or J4; alternatively use the main RS-232C port for Event A. Configure for either event timing (up to 300 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.*

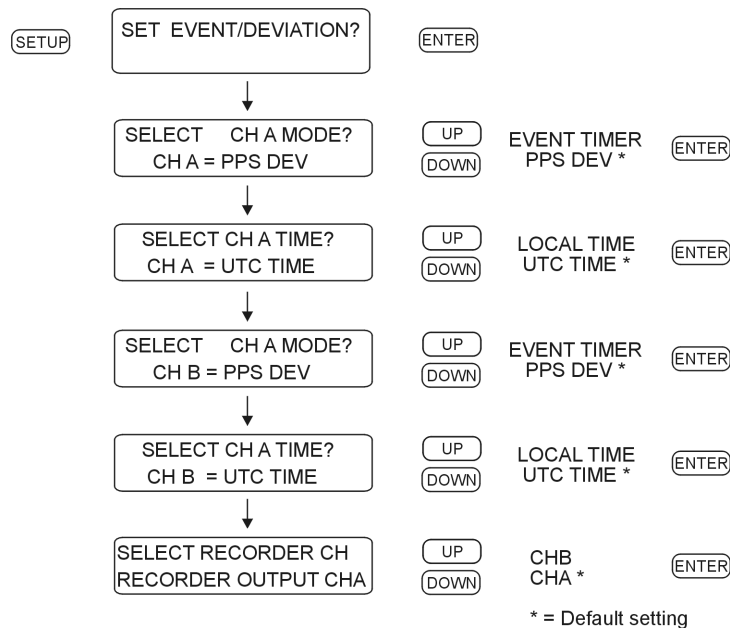


Figure 6.17: Event/Deviation Mode Setup

### 6.9.1 Arming the Event Input

When using J3 or J4, 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.

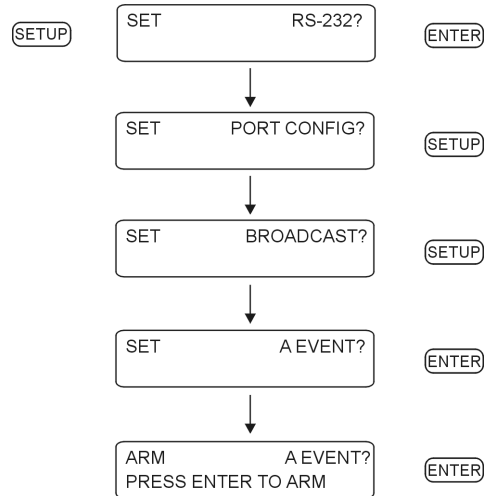


Figure 6.18: Arming the Event Mode From Front Panel

### 6.9.2 Setting The Frequency Reference

The Model 1088B can accept an external clock signal in place of the internal clock signal. If you are going to use an external Frequency Reference, connect it to J5 on the rear panel. Acceptable signals are 100 kHz, 1 MHz, 5 MHz and 10 MHz. To allow for an external clock signal, you must first set jumpers correctly (See Section 5.2.4) and configure the clock for use with an external reference. Set this through the setup menu, “SET FREQ. REFERENCE?”.

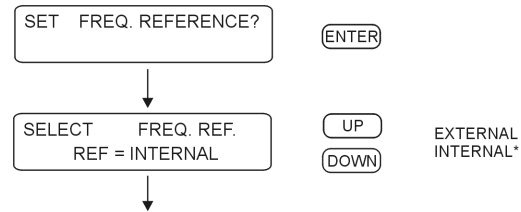


Figure 6.19: Setting the Frequency Reference From Front Panel

## 6.10 Setting the Auto Survey Mode

Use one of the Auto Survey modes to control how and when the clock determines position information. The accuracy of the position (and indirectly, time) is based on averaging the assigned number of position fixes surveyed, either during startup or by a single survey. At the conclusion of a survey, the 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

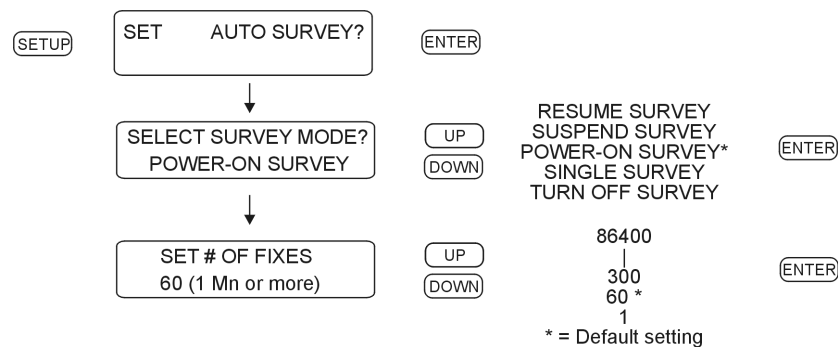


Figure 6.20: Survey Mode Setup

### 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.*

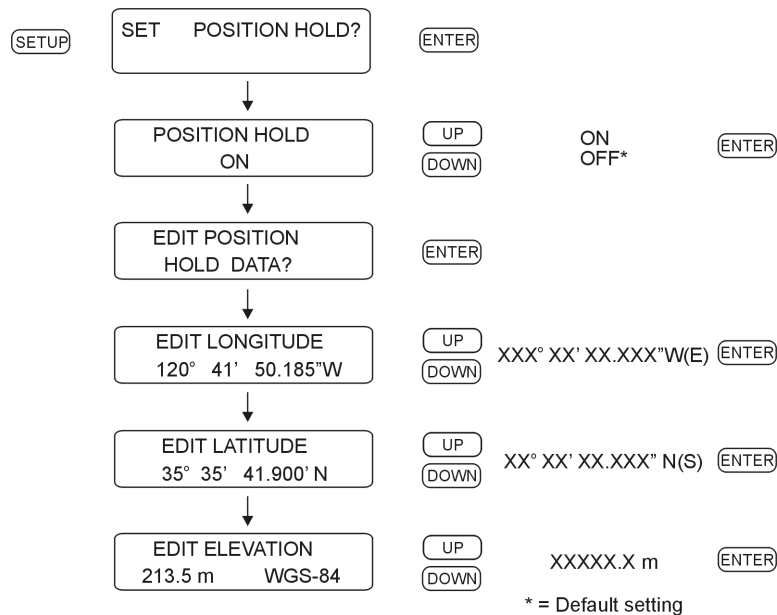


Figure 6.21: Position Hold Mode Setup



## 6.12 Set Option Control

The Model 1088B has two internal option slots (Slot A and Slot B) to increase its functionality. Use the “Set Option Control” menu to configure any Slot A or Slot B option mounted in the clock. Some of these options require you to configure additional settings; information for configuring specific options is located in the Option List (see Appendix C), by option number. *RS-232C: see Section 9.2.13.*

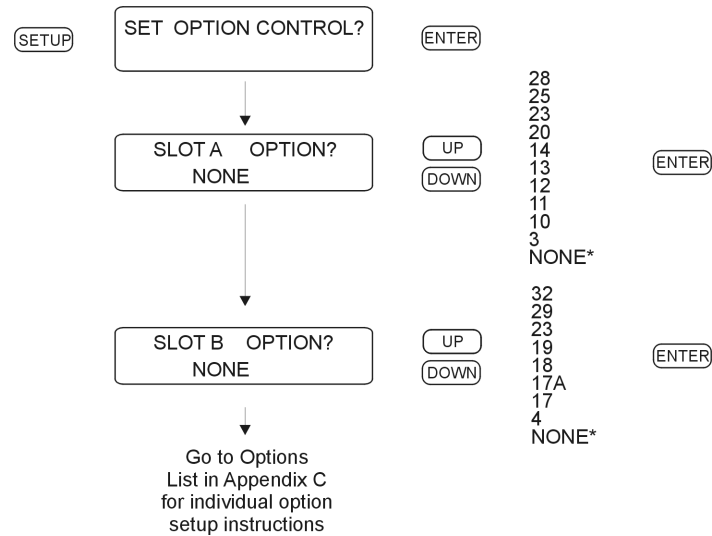


Figure 6.22: Option Control Setup



# 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 1088B 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?

Often, questions arise about how many loads the output driver will support, and how they should be connected. Questions arise concerning how to connect cabling between the clock and the relay. Certain protective relays, or digital fault recorders may use a different style connector than available at the clock outputs. Finally, simple questions about which type of cabling (coax or a twisted pair) is best. This section should help to answer these common questions.

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 panel of the Model 1088B, 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, one DB-9 serial connectors, and two option plates. The option plates are covers for Slot A and Slot B, which are used to house accessory boards that provide additional functionality to the 1088B.

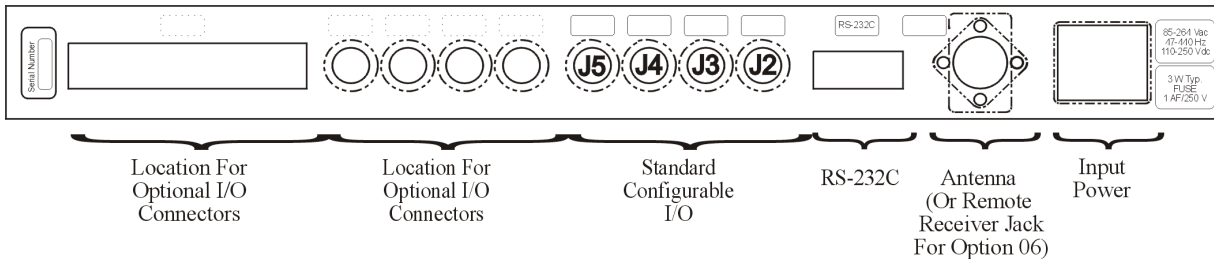


Figure 7.1: Rear Panel Descriptions

### 7.2.1 Standard Inputs/Outputs

The Model 1088B has four BNC female connectors that can supply up to twenty-two different timing signals to external equipment. Two of these connectors (J3 and J4) may also be configured for an event/deviation inputs. All of the outputs are designed for digital and analog signals that are configured using internal jumpers. Signals supplied to the digital drivers include unmodulated IRIG-B, many different pulse outputs per second, and programmable pulse.

### 7.2.2 Digital Drivers

Each of the digital outputs is driven by a CMOS 74HC126 quad driver capable of supplying 18 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 1 mA, one output channel should be able to support 18 such devices. If the load current is more or less, then you can connect any number of devices up to the current limit for one output.

### 7.2.3 Analog Driver

The 1088B has one analog driver per output available exclusively for *modulated IRIG-B signals*. Additional analog drivers may be added as options (e.g. Option 03, 27, 29). The analog driver uses a series of LF353 op amps, which supply a 10 Volt peak-to-peak signal (4.5 Vpp on Option 27) through a 557-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.

Drive Current, mA	Actual Drive Voltage, Vpp
0	10.0 (no load)
1	9.4
10	4.43
15	1.64

Table 7.1: Drive Current vs. Voltage

## 7.3 Output Signal Description

All models can provide different digital signals and two analog signal that are listed in Table 5.2. With an option card installed, all of these signals are available at the option card as well; 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 (and other pulse timing signals) are mainly used for synchronization, in conjunction with another timing signal. It 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. There is also a pulse polarity option that allows you to specify for positive- or negative-going pulses.

### 7.3.1 IRIG-B Description

IRIG-B is a complete serial time code that occurs once per second and is defined by four terms: Format, Modulation Frequency, Frequency Resolution, and Coded Expressions (e.g. for B120, B = Format B, 1 = sinewave, 2 = 1 kHz, and 0 = BCD, CF and SBS). The Model 1088B clocks allow Format B with four variations as seen in Table 7.2. Other allowable IRIG formats are D, E, and H. 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 <sub>TOY</sub> , CF, SBS
B003	Pulse width code, No carrier	BCD <sub>TOY</sub> , SBS
B120/B124	Sine wave, amplitude modulated, 1 kHz	BCD <sub>TOY</sub> , CF, SBS
B123	Sine wave, amplitude modulated, 1 kHz	BCD <sub>TOY</sub> , SBS

Table 7.2: IRIG-B Time Code Types Available

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, recycling daily. Position identifiers separate the various components of the IRIG-B time code and provide time references.

### 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.

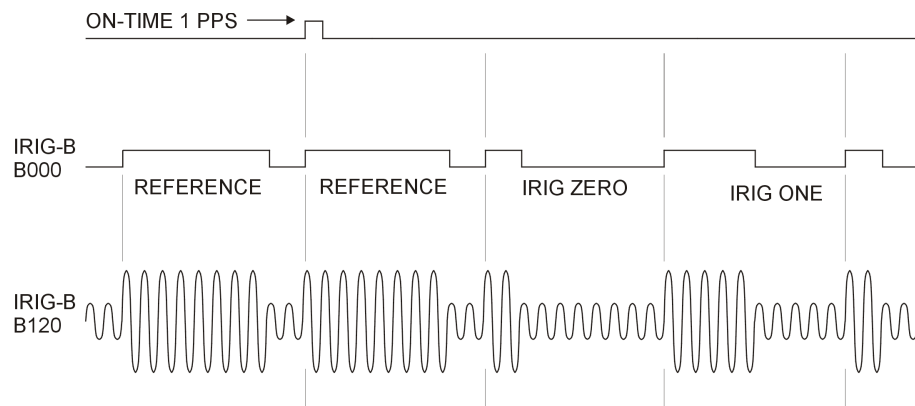


Figure 7.2: IRIG-B Waveforms

The IRIG-B time code consists of 100 bits produced every second, 74 bits of which contains the time-related information contained in the signal. Consisting of logic ones, zeros and position identifier bits, the time code provides a reliable method of transmitting time to synchronize various equipment.

### 7.3.3 Available IRIG-B Signals

All clocks can provide IRIG-B that follows four type codes: two with unmodulated IRIG-B and two with modulated IRIG-B. The two signal types for each group are because of the IEEE 1344 extension, or CF portion of the time code. Turn the IEEE 1344 extensions ON or OFF, the differences depicted in Table 7.3, by configuration through the front panel keys or through the serial port(s).

IRIG-B Type	1344 ON	1344 OFF
Unmodulated, B00X	B000*	B003
Modulated, B12X	B120*	B123

Table 7.3: IRIG-B Code Designations

\*The IRIG Standard 200-04 has changed the designations so that Year information is now considered part of BCD and denoted as  $BCD_{YEAR}$ . This means that what was formerly considered B000 and B120 would now be denoted as B004 and B124.

### 7.3.4 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 *BCDYEAR*)
- 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://www.arbiter.com/catalog/timing\\_freq\\_index.php](http://www.arbiter.com/catalog/timing_freq_index.php) and click on IRIG-B.*

### 7.3.5 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). It has the same drive power as any other digital signal available from the 1088B. See Figure 7.2 for a comparison between unmodulated IRIG-B and 1 PPS.

### 7.3.6 Programmable Pulse (PROG PULSE)

The Model 1088B has an independent programmable pulse feature that requires setting a jumper on the main board and configuring the pulse mode through the SETUP menus or RS-232 port. Programmable pulse modes include setting the pulse width (except for Single Trigger and Slow Code modes) and time zone. To configure, please see Sections 5.2 and 6.7.

## 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<sup>1</sup>, 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.

---

<sup>1</sup>Pomona Electronics, [www.pomonaelectronics.com](http://www.pomonaelectronics.com), (800) 444-6785, (425) 446-6010, part no. 4969 and 4970

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 7.4: IRIG-B Code Designations

### 7.4.1 Attaching Cables to Screw Terminals

Some of the option boards mounted in the Model 1088B 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, and 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:

<http://www.arbiter.com/ftp/datasheets/>

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://www.arbiter.com/ftp/datasheets/>.

### 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. To compute number of possible loads per output, first determine 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:

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



If you were to connect ten of the same IED's to the same output, then the total current drawn would be  $10 \times 0.001 \text{ A} = 0.01 \text{ A}$  (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 desired 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 18 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 10 V<sub>pp</sub>, so any connected loads will cause the available voltage to drop. It is a simple task to compute the available output voltage (V<sub>pp</sub>) with a known current.

$$(7.2) \quad V_{pp} = 10 \text{ V}_{pp} - I \times 557 \text{ Ohms}$$

Therefore, if you had 10 mA of load current (I load) the available voltage (V<sub>pp</sub>) would be 4.43 V<sub>pp</sub>. If the load current equals 15 mA, then the available voltage would be 1.64 V<sub>pp</sub>. 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 10 mA of current) for 500 feet of wire including the source resistor would be:

$$(7.3) \quad V_{pp} \text{ available} = 10 - I \times 557 \text{ source} - I \times 19.6 \text{ wire} = 1.35 \text{ V}_{pp}$$

So, you can see that most of the drive voltage is lost with 15 mA of current and 500 feet of 22 AWG twisted pair transmission line; this includes the voltage losses at the source resistor. 1.35 V<sub>pp</sub> may very likely not be detected by the decoder in some 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 V<sub>pp</sub> ±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 V<sub>pp</sub>, the (nominal) acceptable voltage is 3.3 V<sub>pp</sub>, and the device current is 10 mA. Determine the dropping resistor value.

$$(7.4) \quad R_{drop} = V_{diff} \div I_{dev} = (4.5 - 3.3) \div 0.01 = 120 \text{ Ohms}$$

The Power dissipation (P) is:

$$(7.5) \quad P = I^2 R = 0.01^2 \times 120 = 0.012 \text{ Watts}$$

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.

$$(7.6) \quad C \approx 9.84 \times 10^8 \text{ feet/second}$$

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

#### 8.1.1 By Option

Model 1088B can supply relay contacts through installation of an optional accessory. Option 19 provides one Form C (SPDT) set of contacts that can be used for the Out-of-Lock function. Option 29 provides four additional timing outputs and has two solid-state relays available with output multiple functions and +25/50 Vdc supplies. For additional information on relay specifications and operation, please see Option 19 and Option 29 in Appendix C, Options List

### 8.2 Event Inputs

#### 8.2.1 Event Timing Input

When configured for event timing, the 1088B can provide two input channels with 0.1 microsecond resolution. These two channels are called Event A and Event B. Event A 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 J4; see Figure 5.1 and Section 5.2.2. Event B may only be applied to J3 and must be a 5 V CMOS signal.

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 300. As soon as data is retrieved for a recorded event, its address (000 - 299) 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

Both Channel A and B inputs 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 300 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 300 events per channel, each Event Time Record will be overwritten once every 300 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 1088B 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 Section 6.9 and 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 (000 to 299) and associated event times, using the following format:

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

Where: “nnn” = event number (000 to 499)  
 “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.ssssss” = 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
```

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

Clocks display the CLEAR EVENT prompt only if the event capture channel was previously configured for event time recording. Press ENTER during this display to delete all of the records in the event buffer, and to allow recording of new event times, starting with event number 000.

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 ±XXXXXX.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 1088B 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 300 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

The Model 1088B has one main RS-232C port, and one optional RS-232C port (Option 17A). 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 equals 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, or if programming, by sending a sequence of carriage-return/line-feed characters.

In this section, the syntax of each command follows the word "Command:" and is in bold font.

The following symbols and syntax are used:

- ▷ = Shorthand for carriage-return, line-feed
- 'U' = UTC Time
- 'L' = Local Time
- 'soh' = An ASCII character (start of header) = Hex 01
- 'bel' = An ASCII character = Hex 07
- 'n' = integer used for various numerical values (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: >

#### 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 >

#### 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 >(UTC/Local Time)  
 55ddd >(day of year)  
 11nn >(out-of-lock time)  
 bel (bel = Hex 07; sounds at the end of the time code)

The number and order of strings returned depend upon options ordered with clock (for example, see Option 28 in Appendix C, Options List, page 178):

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.ssssss nnnAL >  
 (UTC) mm/dd/yyyy hh:mm:ss.ssssss 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 Installed*	4	16	Out-of-Lock
1	2	Reserved (set to 0)	5	32	Time Error
2	4	Power Supply Error	6	64	OCXO Error**
3	8	IRIG Bus Fault	7	128	Receiver Failure

Table 9.1: Fault Indications and Definitions

\*set to 1, \*\*out of bounds

**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:            >  
                      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 >

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 >

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.ll,a,yyyy.yy,a,hhmmss.ss,A >

Where: GLL = Geographic Position, Latitude / Longitude

llll.ll = Latitude of position

a = N or S

yyyy.yy = Longitude of position

a = E or W

hhmmss.ss in UTC

A = status: A = valid data

**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:         $\$-ZDA, hhmmss.ss, dd, mm, yyyy, xx, xx \rhd$

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

**9.2.2 Event Mode Commands****Return Specific Event**

Command: **nnnA**

nnnA sets the event buffer read index to a specific event number (0 to 499), 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.ssssss nnnL  $\rhd$   
                   or  
                   UTC mm/dd/yyyy hh:mm:ss.ssssss nnnU  $\rhd$

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:     $\rhd$

**Set Channel – Deviation**

Command: **AD**

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

Response:     $\rhd$

**Set Channel – Event**

Command: **AE**

AE sets Channel A to the event recording mode.

Response: >

**Clear Event Buffer**

Command: **CA**

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

Response: >

**Return Deviation for Event Channel**

Command: **DA**

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

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

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

**Arm Event Trigger**

Command: **AR**

AR arms the RS-232C event capture circuitry.

Response: >

**Return Single Event**

Command: **EA**

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

Response: Local Time mm/dd/yyyy hh:mm:ss.ssssss nnAL >  
 UTC time mm/dd/yyyy hh:mm:ss.ssssss nnnAU >

Format: A = Channel A  
 U = UTC time, Channel A  
 L = Local time, Channel A  
 NO DATA > (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 (000 to 499)  
 mmm = Channel write index (000 to 499)

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 Eddd:mm:ss.sss Ndd:mm:ss.sss Hmmmmm.mm >

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

Table 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

## 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 in

Bit	Weight	Function	Bit	Weight	Function
0 (LSB)	1	OCXO Not Inst. (Set to 1)	4	16	Out of Lock
1	2	Reserved (Set to 0)	5	32	Time Error
2	4	Power Supply Error	6	64	VCXO Tune 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

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).

### 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 >  
 START:02:00 Second SUN of MAR >  
 STOP :02:00 First SUN of NOV >

#### Set Daylight Saving/Summer Time Mode

Command: **1,mDT**

1,mDT activates the Daylight Saving mode, where m = 0, 1, 2, with 0 = OFF, 1 = ON, and 2 = AUTO. When OFF this time adjust feature does not add the specified offset to local time display and output. With m = 1 (ON), the Daylight Saving / Summertime feature is always on. With m = 2, the Daylight Saving / Summertime feature will automatically change at the specified dates and times. To complete the Daylight Saving / Summer Time setup, you must also use the “Set Daylight Saving Auto Start” and “Stop” commands that follow below.

Response: >

#### Set Daylight Saving/Summer Auto Start Time

Command: **2,w,x,y,zDT**

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

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

Response: >

#### Set Daylight Saving/Summer Auto Stop Time

Command: **3,w,x,y,zDT**

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

Where: w = Month (0 through 11), with 0 = Jan, 1 = Feb, ... 11 = Dec.  
 x = WeekOfMonth (0 through 5), with 0 = First, 1 = Second, 2, = Third,  
 3 = Last, 4 = Second from Last, and 5 = Third from Last.

$y$  = DayOfWeek (0 through 6), with 0 = Sun, 1 = Mon, ..., 6 = Sat.  
 $z$  = Minutes after midnight  $z$  (0 through 1440).

Response:  $\rhd$

### Local Offset Command

Command:  $\pm$ hh:[mm]L

$\pm$ 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:  $\rhd$

## 9.2.5 Front Panel Control Commands

### Disable Control Panel

Command: **FB**

FB disables all control-panel keys and blanks the front panel display.

Response:  $\rhd$

### Enable Control Panel

Command: **FE**

FE enables all control-panel keys and activates the front panel display.

Response:  $\rhd$

### Lock Setup Keys

Command: **FL**

FL disables setup control keys and activates the front panel display.

Response:  $\rhd$

### Set Backlight – OFF

Command: **L0**

L0 disables the backlight operation with Option 01 installed.

Response:  $\rhd$

### Set Backlight – ON

Command: **L1**

L1 selects the continuous backlight operation with Option 01 installed.

Response:  $\rhd$

**Set Backlight – AUTO**

Command: **L2**

L2 enables the automatic backlight operation with Option 01 installed. It keeps the backlight active for 30 seconds after any key is pressed.

Response: ⤵

**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 7.3.4.

Response: ⤵

**IRIG Data – Local**

Command: **IL**

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

Response: ⤵

**IRIG Data – UTC**

Command: **IU**

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

Response: ⤵

## 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.

Response:  $\rhd$

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. Position Hold must be enabled to set position.

Response:  $\rhd$

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. Position Hold must be enabled to set position.

Response:  $\rhd$

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  $\rhd$  (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 >

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 >

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: >

### 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 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: >

## 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: >

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

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: ddmmyyyy >

### Return UTC Date

Command: **DU**

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

Response: ddmmyyyy >

### 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:  $\rhd$

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:  $\text{~} \rhd$

Format: m = 0, seconds-per-pulse mode  
 m = 1, pulse-per-hour mode  
 n = 1 – 60000 seconds if seconds-per-pulse mode  
 n = 1 – 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:  $\triangleright$

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:  $\triangleright$

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:  $\triangleright$

### 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: **Z**

Z returns the contents of Display Buffer.

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 option Slot A and m = 1 for the option Slot B. See Table 9.6.

Where:

m = 0 for option Slot A, and m = 1 for option Slot B.

n = option number (see table below)

k = security key; 1088

l = *use only if n specifies Option 28*. l = 0 for 60 Hz and l = 1 for 50 Hz.

Response:  $\rhd$

Slot A, n =	Option Number	Slot B, n =	Option Number
0	NONE	0	NONE
1	03	1	4
2	10	2	17
3	11	3	17A
4	12	4	18
5	13	5	19
6	14	6	23
7	20	7	NONE
8	23	8	29
9	25	9	32
10	28	—	—

Table 9.6: Option Control Settings

### Option Control Examples

#### 1. Model 1088B, Slot B Option 28

1,4,1088,0XI

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

#### 2. Model 1088B, Slot A Option 03

1,1,1088XI

### 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 Input
2	RS-232, Rx Data	7	Not Connected
3	RS-232, Tx Data	8	RS-422/485, Tx-A
4	RS-232C Output/Prog Pulse	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 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.
- The Out-of-Lock Relay will be in the out-of-lock position and the FAULT relay should switch to the OK (unfaulted) position.
- Eventually, the UNLOCKED LED should extinguish.
- If equipped, the Out-of-Lock Relay should change to Locked (non-faulted) position after a few minutes.
- The LCD should indicate that the clock is Locked.

#### 10.1.1 Clock Time, Startup Mode

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

TIME NOT AVAILABLE

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

000:00:00:01  
000:00:00:02  
000:00:00:03

.  
 265:13:45:21  
 265:13:45:21 (these values chosen for illustrative purposes only)

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

## 10.2 Front Panel Indication

### 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) 2006 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.

### 10.2.4 Event/Deviation Display

There are separate displays when pressing the EVENT/DEVIATION key, depending on the setting. Successive events appear when repeatedly pressing the EVENT/DEVIATION key, or if configured for DEVIATION, it will indicate the 1-PPS Deviation (updates once per second) and Sigma. If there are no records, the second line will indicate "NO DATA".

#### Event Display

```
Ch A EVENT nnn
ddd:hh:ss.ssssss
```

Where:

```
nnn = event number(000 to 499)
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.ssssss = second and fractional seconds of the event
```

#### Deviation Display

```
1PPS: 0.00 uS
SIGMA: 0.00 uS
```

The 1088B displays the following indication if you have configured Channel A or B for event input, and not 1-PPS Deviation.

```
Clear Event (A)?
```

Press the ENTER key to clear the event channel.

### 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*. There are several faults that are indicated, if they exist, and are as follows:

Bit	Weight	Function
0	1	OCXO Not Installed (set to 1)
1	2	Reserved (set to 0)
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 (out of bounds)
7	128	Receiver Failure

Table 10.1: Fault Conditions

For additional information on internal faults, please see Chapter 2, Front and Rear Panels, and Chapter 9, Serial Communications and Command Set, status commands, page 74.

## 10.4 Time Display Modes

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 / Summer Time (DST) configuration feature allows expanded settings. The addition of AUTO allows the user to customize the DST/Summertime settings to match the requirements of locations in either Northern or Southern latitudes. For setup information through the front–panel interface, please see Section 6.3.1.

The DST/Summertime 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

When the clock is first powered ON and acquiring satellites, the only position information available is the previous position, stored in the clocks 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 1088B Satellite Controlled Clock. 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  $\pm 100$  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,  $1 \times 10^{-6}$ , typical

#### A.2.4 Position Accuracy (rms)

- 25 meters, SA (USA Department of Defense Selective Availability) OFF,
- 100 meters, SA ON.
- Elevation, 140 meters, SA on

### A.2.5 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.2.6 Acquisition

- less than 5 minutes current almanac
- less than 20 minutes without current almanac.
- greater than 20 minutes in areas where antenna has limited or obstructed view of the sky.

## A.3 I/O Configuration

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

### A.3.1 I/O Connectors

Standard I/O connectors may be configured to any one of the output signals listed in Section A.3.2 below, or a specific input function as listed, or any function listed in additional outputs as listed in the option list in Appendix C.

- Signals on standard outputs, four BNC user configurable
- Option 03, adds four additional configurable outputs; Option 27 adds eight, high-drive IRIG-B outputs; Option 29 adds four additional configurable outputs with 75 mA per channel.

### A.3.2 Standard Output Signals

- IRIG-B: 1 kHz modulated, 10 Vpp
- IRIG-B, D, E, or H: 5 V CMOS level shift
- 1 PPS, 1 PPM, 1 PPH: 5 V CMOS
- 10, 50, 60, or 100 PPS
- 1, 10, or 100 kPPS
- 1, 5, 10 MPPS
- 5 V CMOS
- 1-PPS deviation (chart recorder):  $\pm 5$  V at  $10 \mu\text{s}/\text{v}$
- IRIG-B Modified Manchester (IEEE Std 1344)
- Out of Lock: 5 V CMOS (HI = Locked, LO = Unlocked)
- Programmable Pulse, user-selectable: 5 V CMOS
- CMOS outputs are buffer type (74HC126) with 47-ohm source resistors
- Analog outputs are op-amp (LF353) followers with 557-ohm protective resistors

### A.3.3 Input Functions

- Event A/1-PPS Input: 5 V TTL/CMOS
- Event B/1-PPS Input: 5 V TTL/CMOS
- External Timebase Input: 100 kHz, 1, 5, or 10 MHz
- Units with S/N of A119 and below: 5 V TTL/CMOS



- Units with S/N of A120 and above: AC- or DC-Coupled signals with a slew rate of 10 V/ $\mu$  minimum and level of 5 Vpp maximum
- Uncommitted input for special configurations

User configurable outputs are 5-V CMOS bus drivers with 47-Ohm source impedance and  $\pm 18$ -mA drive capability.

### A.3.4 Event Inputs

- These inputs have 100-ns timing resolution and can record up to 300 sequential events, provided that the events are separated by at least 11 milliseconds. Read the event log later from either the front panel or RS-232 interface. A command is also provided to clear the event log. Event data is stored in battery-backed RAM.
- The Event A and B inputs may also be configured to accept an external 1-PPS signal, and measure the deviation from 1 PPS/GPS with 100-ns resolution.

### A.3.5 Programmable Pulse Output

1. Seconds-per-pulse; repetitive pulse, every 1 – 60,000 seconds
2. Pulse-per-hour: every 0 – 3599 seconds after the hour
3. Pulse per day; at the specified hour, minute, seconds and fractional seconds
4. Single Trigger; output transitions at the specified day, hour, minute, second and fraction second, and remains at that voltage
5. Slow Code – UTC, LCL; transitions for 6 seconds on the day, four seconds on the hour and two seconds on the minute
6. Pulse Polarity: positive and negative; positive: held low and transitions high, or negative: held high and transitions low.

### A.3.6 Synchronization

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

## A.4 Antenna System

The included antenna is directly mounted in 19-mm (3/4-in.) hole. 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

### A.5.2 Setup Functions

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

Table A.1: Setup Functions Listed

### A.5.3 Display

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

### A.5.4 Display Functions

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

### A.5.5 Annunciators

- Operate (Green)
- On line (Green)
- Unlocked (Red)
- Fault (Red)
- Internal Battery
  - Charge (Green)
  - In Use (Green)
  - LO Battery (Red)

## A.6 System Interface

### A.6.1 RS-232C Interface

Pin No.	Function	Pin No.	Function
1	Not Connected	6	Note Connected
2	RS-232, Rx Data	7	Not Connected
3	RS-232, Tx Data	8	Auxiliary Input
4	Auxiliary Output	9	Not Connected
5	Ground	–	–

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

#### 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 Broadcast 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.ssssss 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 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 1088B can be ordered with one of five user-specified internal power supplies. Additionally, the antenna receives power through the antenna cable connected to the Type F connector on the rear panel.

- Standard: IEC-320 power inlet connector, 85 – 264 Vac, 47 – 440 Hz, or 110 – 370 Vdc, < 20 W typical
- Option 07: 85 – 264 Vac, 47 – 440 Hz, or 110 – 370 Vdc, < 20 W typical
- 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
- Option 15A: 110 – 370 Vdc, < 20 VA or 85 – 264 Vac, 47 – 440 Hz, with three-position Terminal Power Strip and Surge-Withstand Capability (110 – 170 Vdc)
- Option 15B: 110 – 370 Vdc, < 20 VA or 85 – 264 Vac, 47 – 440 Hz, with three-position Terminal Power Strip and Surge-Withstand Capability (110 – 330)

### A.7.4 Power Connector

- Standard Power Supply: This includes a fused IEC-320 power inlet module with mating ac cord. Plug type specified as Options P1 through P10 (see Section 3.2.1).
- Options 07, 08, 15A and 15B: Using a 3-pole terminal strip power inlet with Surge-Withstand Capability.

### A.7.5 Electro-Magnetic Interference (EMI)

- Conducted Emissions: power supply (Options 07 and 08) comply with FCC 20780, Class A and VDE 0871/6.78, Class A
- Surge Withstand Capability (SWC), power inlet (Options 15A and 15B) 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 60°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 Protectors

### B.1 Introduction

<sup>1</sup> Today's data equipment has become extremely vulnerable to a phenomenon known as voltage and electrical transients. A single IC package can contain over 100,000 memory bits and more than 5,000 logic gates. The high sensitivity due to the small size of the chips used in these packages makes them susceptible to quick degradation from voltage surges and transients. PLCs, MUXs, HUBs, RTUs, SCADA, and Telemetry equipment are especially vulnerable to electrical surges because of their low operation voltages. Many of these components can be damaged beyond repair by an electrical surge as low as 20 volts.

Sources of electrical surges are numerous. The most common is a nearby lightning strike, which will affect nearby data lines through induction. Industrial transients are also significant because they are man made disturbances caused by switching and commuting of electrical motors. The operation of such devices can cause abrupt shifts in the ground potential that can generate a current flow through a nearby data-line in order to equalize the ground potential.

Electrostatic discharge is another form of an electrical surge that can be included in this group. Although often overlooked, (ESD) can potentially be a very harmful transient to fragile data equipment. ESD occurs due to two non-conducting materials rubbing together, causing electrons to transfer from one material to another.

The consequences of electrical surges and transients may be severe. Although the life span of these electrical phenomena is very short, the amount of energy that is carried can be extremely high. A typical transient event can last from a few nanoseconds to several milliseconds carrying several thousand volts and at least a few hundred amps of current. These events may cause burnt-line cards, lockups, loss of memory, problems in retrieving data, altered data, garbling...etc.

### B.2 Grounding

A protection system with a poor ground is the same as having no protection at all. Too many times proper grounding has been overlooked. Recommended grounds are the utility company ground, a

---

<sup>1</sup>Citel, Inc. 1515 NW 167th Street, Miami, FL 33169, USA, (800) 248-3548 / (305) 621-0022, [www.citelprotection.com](http://www.citelprotection.com)

ground rod, well casings, and cold water pipes that are of continuous metal. Caution! Sometimes the metal-cold water pipes are repaired and/or extended PVC piping. The introduction of PVC material renders the cold water pipe ground unacceptable. A thorough investigation of a cold water pipe ground is important since the PVC repairs or extensions may be covered by drywall.

Grounds that are unacceptable include sprinkler pipes, PVC pipe, conduit, buried wire, and any ground that cannot be verified.

Bonding ensures the most effective ground. Bonding ties all of the grounds in the building together electrically. If there is a rise in ground potential and all of the grounds are bonded, no damage will occur since it is differential voltage that causes problems.

It is absolutely necessary to make sure that the ground used for the AC power is the same as the ground used for the data-line surge protectors. A common ground reference must be achieved for all equipment. All ground wires must be as short as possible and it is imperative that the ground wire not be coiled or looped. The ground wire must be as straight as possible; remember that it must be the path of least resistance. Regarding the diameter of the ground wire, the larger the better. The larger the diameter, the better electrical conductivity. Finally, the earth ground resistance on which the whole grounding system relies must be less than 5 ohms.

Lines that typically need protection include incoming central office trunks, lines to off-premise sites, local area networks and campus environments with multiple buildings. A good rule of thumb to remember is that all lines entering or exiting a building need protection. Both ends of the cables between buildings must be protected!

For additional technical details, please contact Citel, Inc. at [www.citelprotection.com](http://www.citelprotection.com).

# Appendix C

## Options List

### C.1 Introduction

Each Arbiter Model 1088B Satellite-Controlled Clock has a number of 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 1088B, 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 may not apply to the other clock models than the Model 1088B because these 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

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 transfective LCD. An Electro-luminescent (EL) panel located behind the transfective 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<sup>2</sup> minimum
- **Service Life:** 4000 hours (down to 10 cd/m<sup>2</sup>)

### 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 84.



## 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 1088B 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, 1084A/B/C and 1093A/B/C clocks do not contain a RAM backup battery because an EEPROM has replaced the RAM.

### C.3.2 Specifications

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

## C.4 Option 03: Four Additional Outputs

### C.4.1 General Description

Option 03 adds four rear-panel outputs, which may be configured to any available signal in the 1088B series clocks. Note that there are more jumper settings on the Option 03 board than the 1093A/B/C and the 1084A/B/C clocks are capable of providing. The configuration of the four outputs can be changed at any time via internal jumper settings.

### C.4.2 Specifications

#### General

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

#### Analog Outputs

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

### C.4.3 Digital Outputs

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

---

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.

## 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.

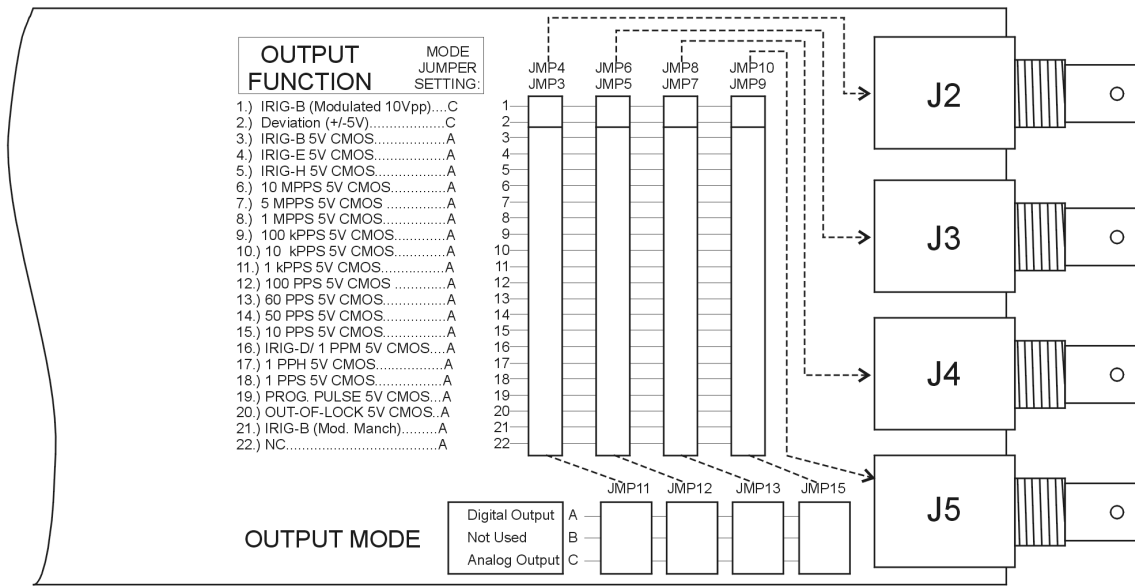


Figure C.1: Option 03 Jumper Configuration

<b>Output Signal</b>	<b>Function Select Jumper</b>	<b>Mode Select Jumper</b>
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

## C.5 Option 04: Parallel BCD Output (1 millisecond Resolution)

### C.5.1 General Description

Option 04 for the Model 1088B 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.5.2 Option 04 Firmware Setup

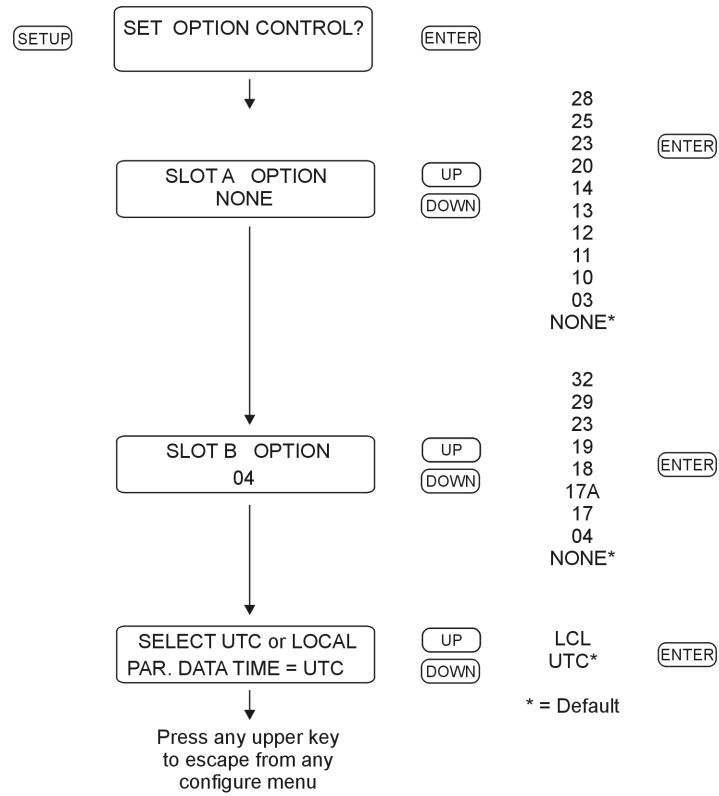


Figure C.2: Option 04 Firmware Setup



### C.5.3 Specifications

#### General

Output Connector:	50 contact;Amphenol P/N 850-57L-40500-2700or 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 Chapter 5 in this 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; $\pm 5$ volts analog, corresponding to 1 PPS deviation channel A or B.

### C.5.4 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 Chapter 6 and Appendix C). Setting of 00 disables this function (output remains "high").

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

### C.5.5 Option 04 Connector Pin Designation

PinNo:	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

Table C.2: Option 04 Connector Pin Designation

Note: Table C.2 continued on next page.

Table C.2 continued.

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 04.

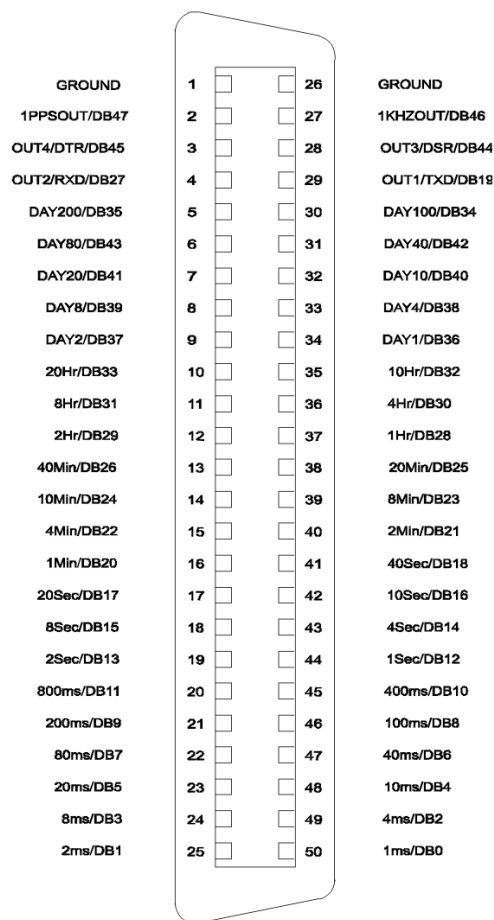


Figure C.3: Option 04 Output Connector

## C.5.6 Configuration

### General

#### Case Removal

To change the configuration of Option 04, 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 04 (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 04.

### BCD Output Mode

#### General

When configured for BCD output of time data, Option 04 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 04 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 Chapter 6.

## 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 04 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 04 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.4: Option 04 Output Jumper Settings



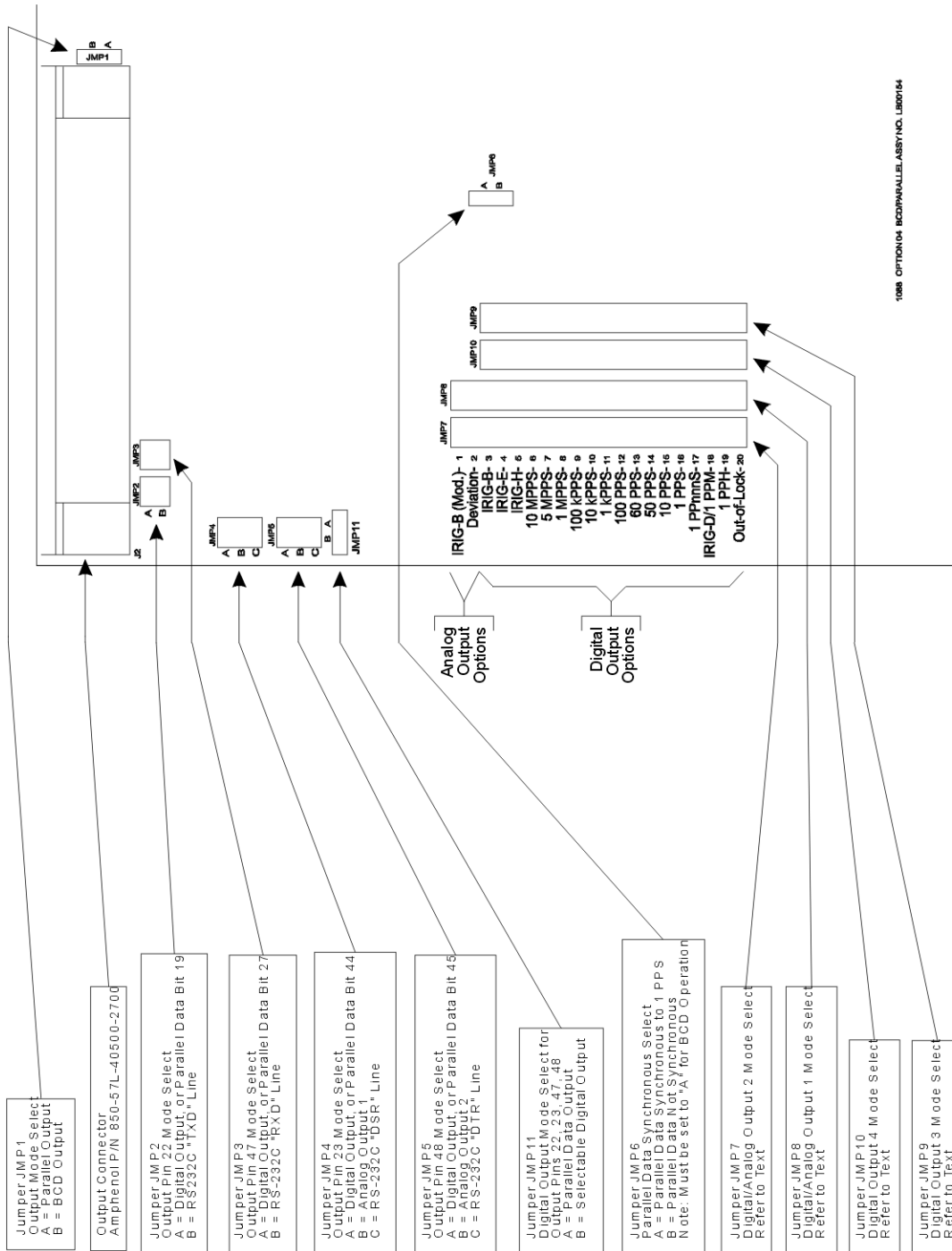


Figure C.5: Option 04 Board Layout and Jumper Locations

## C.6 Option 07: Inlet Power Supply Description

### C.6.1 85 to 264 Vac, 47 to 440 Hz, 110 to 370 Vdc, IEC-320 Connector

Option 07 provides an ac/dc power module, which includes an IEC-320 type inlet and mating ac cord. Input voltages are 85 to 264 Vac, 47 to 440 Hz or 110 to 370 Vdc, less than 20 Volt-Amps maximum. Various plug styles are available as Options P01 through P10. See Section 3.2.1 for a list of available cordsets.

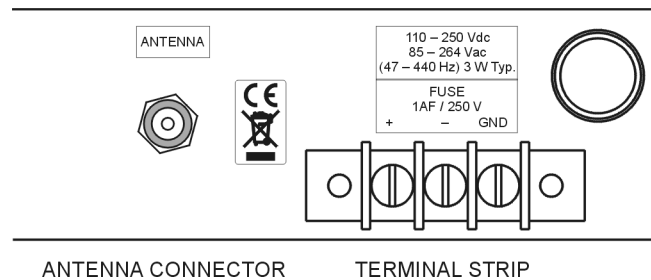


Figure C.6: Option 07 Power Supply Inlet Description

### C.6.2 Specifications

#### Fuse

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

#### Input Power

AC Voltage Range: 85 to 264 Vac.  
 Frequency Range: 47 to 440 Hz.  
 DC Voltage Range: 110 to 370 Vdc.

## C.7 Option 08: Inlet Power Supply Description

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

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

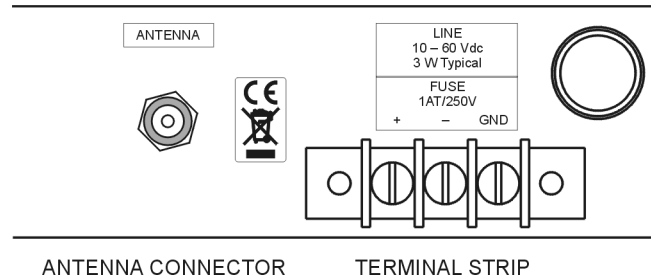


Figure C.7: Option 08 Power Supply Inlet Description

### C.7.2 Specifications

#### Input Power

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

#### Terminal Strip

Terminal Assignment: Ground, (-), (+).  
 Left to right, viewed from rear.  
 Block Size: 49 mm W x 15mm 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: 9mm (0.35").  
 Approvals: U.L. recognized; C.S.A. approved.

#### Fuse

Type: Bussman GDC-1A.  
 Current Rating: 1 Ampere, time tag.  
 Voltage Rating: 250 Volts.  
 Size: 5mm x 20mm.

#### Surge Withstand Protection (SWC)

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

**C.8 Options 10 – Battery Backup – Obsolete**

**C.9 Option 11 – Four Additional Outputs and Battery Backup – Obsolete**

## C.10 Option 12: OCXO and Four Additional Outputs

### C.10.1 General Description

Option 12 for the Model 1088A/B adds a disciplined oven-controlled crystal oscillator (OCXO) having stability of 1 part in  $10^7$  over temperature, and four additional configurable outputs.

### C.10.2 Specifications

#### General

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

Oscillator: Oven-controlled,  $1 \times 10^{-7}$  over 0 to 50° C.

### C.10.3 Firmware Setup for Option 12

Hardware and firmware configuration of the Model 1088A/B is performed at the factory when this option is ordered at the same time as the clock. The following instructions are intended primarily for field installation or maintenance. In addition, if the instrument configuration is ever reset to factory default settings, then this initialization will need to be performed so that the units firmware will automatically recognize the Option 12 assembly.

To change the firmware setup for Option 12, use the SETUP menu of the Model 1088A/B. Press the SETUP key repeatedly until SET OPTION BOARD appears in the display. Press ENTER, and then press the UP key until OPTION 12 appears. Press ENTER again, and select the option (if any) present in the B option slot of the unit. Press ENTER again. This completes the firmware configuration for Option 12. More information about instrument firmware configuration with the SETUP menus is found in section 5 of the Model 1088A/B Operation Manual.

### C.10.4 Main Board Setup via Internal Jumpers

Hardware and firmware configuration of the Model 1088A/B is performed at the factory when this option is ordered at the same time as the clock. The instructions, which follow are intended primarily for field installation.

#### Case Removal:

To change the main board configuration for Option 12, 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.

Jumpers 2 and 3 of the main board assembly (see Figure 3-2 in the 1088A/B Operation Manual) must be set properly to allow the Option 12 oscillator to drive the clock. The setting for Jumper 2 should be changed to B (External Reference) and the setting for Jumper 3 should be changed to B (5 MHz). When these settings have been completed, reinstall the instrument cover and reapply power.

### C.10.5 Digital Outputs

Output Type:	High-Speed CMOS (74HC126), 0 to 5 volts, with 47 ohm series resistance.
Available Outputs:	Note: All outputs available on Model 1088B and other clocks as noted.
IRIG-B:	IRIG format B time code (unmodulated). Also available on clock Models 1088B, 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:	1 PPS (10 ms high), synchronous to 1 PPS/GPS. <i>Also available on clock Models 1084A/B/C, 1088B and 1093A/B/C.</i>
Programmable:	Outputs a single pulse at a preprogrammed time, or a continuous pulse train having a period of one day or less. Pulse width is adjustable from 0.01 to 600 seconds. Also available on clock Model 1093A/B/C.
Out-of-Lock:	Normally HI after acquisition of satellite signals. Toggles LO nn minutes after loss of satellite signal lock. Range for nn is 00 to 99, 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. <i>Also available on clock Model 1084A/B/C.</i>

Table C.3: Digital Outputs

## C.10.6 Changing Output Settings via Internal Jumpers

### Case Removal

To change the configuration of Option 12, 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.

## C.10.7 General Information

Option 12 incorporates an extremely flexible output selection system, which is made possible by the same jumper scheme used in the main clock. Each of the four rear-panel BNC-type I/O connectors included with Option 12 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 12 board.

### Function Selection:

Jumpers JMP3 through JMP10 determine what 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. 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 1. Table 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.

## C.10.8 Main Board Hardware Setup via Internal Jumpers

Hardware and firmware configuration of the Model 1088A/B is performed at the factory when this option is ordered at the same time as the clock. The following instructions are intended primarily for field installation.

### Case Removal

To change the main board configuration for Option 12, 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.

Jumpers 2 and 3 of the main board assembly (see Figure 5.1 in this Manual) must be set properly to allow the Option 12 oscillator to drive the clock. The setting for Jumper 2 should be changed to B (External Reference) and the setting for Jumper 3 should be changed to B (5 MHz). When these settings have been completed, reinstall the instrument cover and reapply power.

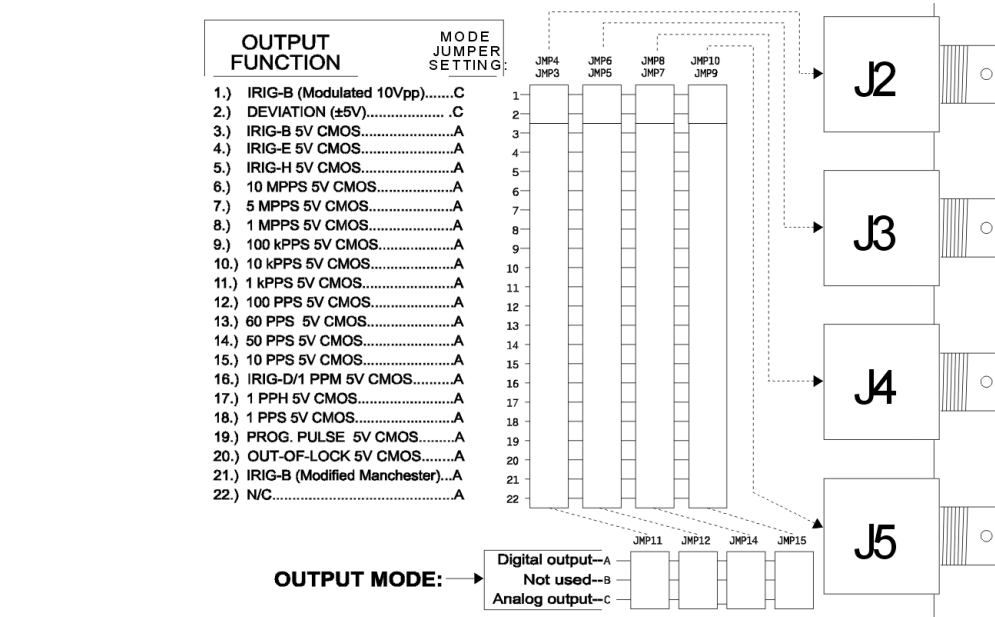


Figure C.8: Option 12 Output Signal Jumper Locations

**Note:** See also Table 5.2 for a list of jumpers.



## C.11 Option 15A and 15B: Inlet Power Supply Description

### C.11.1 110 to 370 Vdc, 85 to 264 Vac, 47 to 440 Hz Terminal Power Strip, SWC

Option 15A and 15B each replace the standard IEC-320 power input module with a three-position, screw-type terminal block, including Surge Withstand Capability (SWC). Option 15A is designed for use with 125-volt station batteries, and the 15B is designed for use with 250-volt station batteries. This feature is intended for use in installations where it is necessary or desirable to have the instrument power hard-wired. See Section 3.3.

#### C.11.2 Specifications

**Input Power:**

AC Voltage Range:	85 to 264 Vac.
Frequency Range:	47 to 440 Hz.
DC Voltage Range:	110 to 370 Vdc.

**Terminal Block:**

Terminal Assignment:*	Ground, (–), (+), left to right, viewed from rear.
Block Size:	15mm W x 18mm H x 30mm 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:	5mm x 20mm.

**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 Section 3.3).

## C.12 Option 17: Parallel BCD Output and Second RS-232 Port

### C.12.1 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.12.2 Option 17 Firmware Setup Procedure

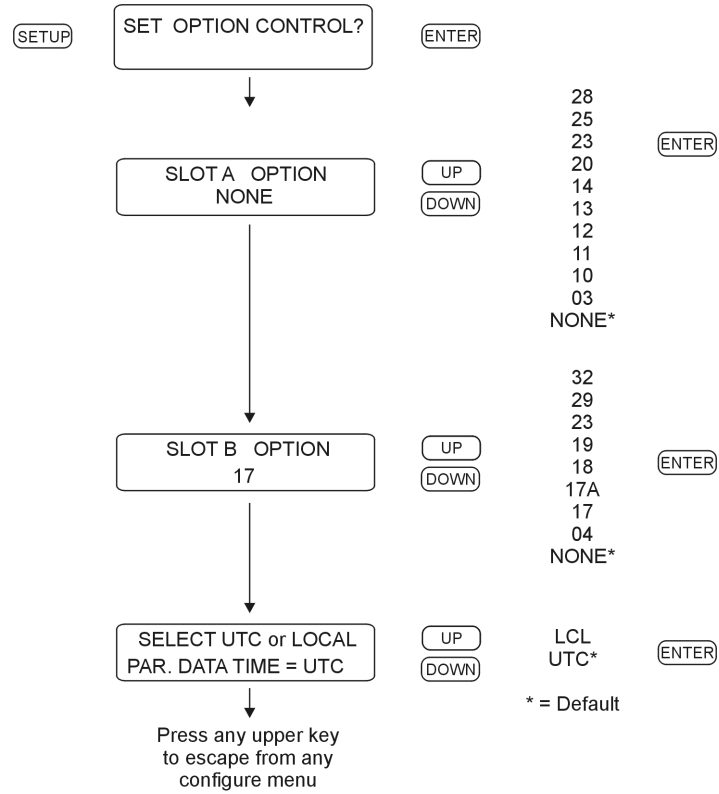


Figure C.9: Option 17 Firmware Setup

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

### C.12.3 Specifications

#### General

Output Connector:	50 contact;Amphenol P/N 850-57L-40500-2700or 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 Chapters 5 and 6).
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; $\pm 5$ volts analog, corresponding to 1 PPS deviation channel A or B.

### C.12.4 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 Chapter 6 and Appendix C). Setting of 00 disables this function (output remains "high").

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

**RS-232C**

Output Type:	CMOS, -12 to +12 volts.
Input Type:	Standard RS-232C levels.
<u>Inputs Available:</u>	
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.
<u>Outputs Available:</u>	
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.12.5 Option 17 Connector Pin Designation**

PinNo:	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	—

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.4: Option 17 Connector Pin Designation

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

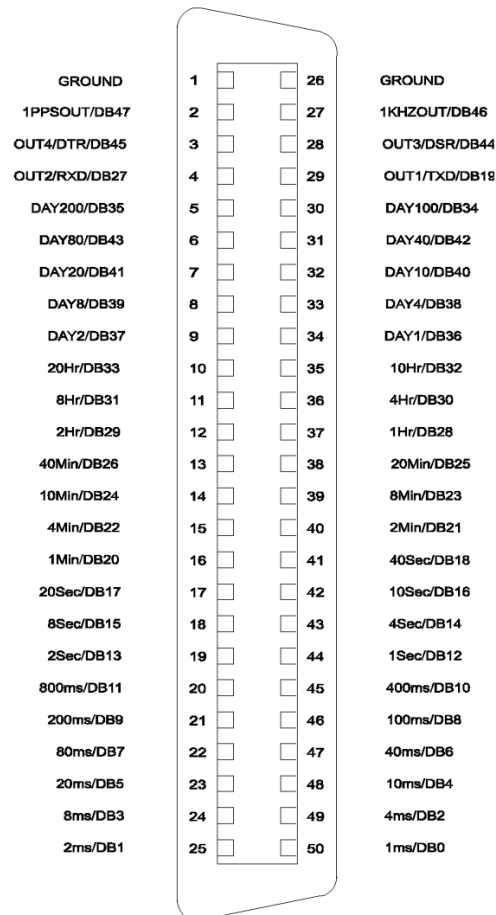


Figure C.10: Option 17 Output Connector



## C.12.6 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 2). 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 1088B 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 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 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.11: Option 17 Output Jumper Settings

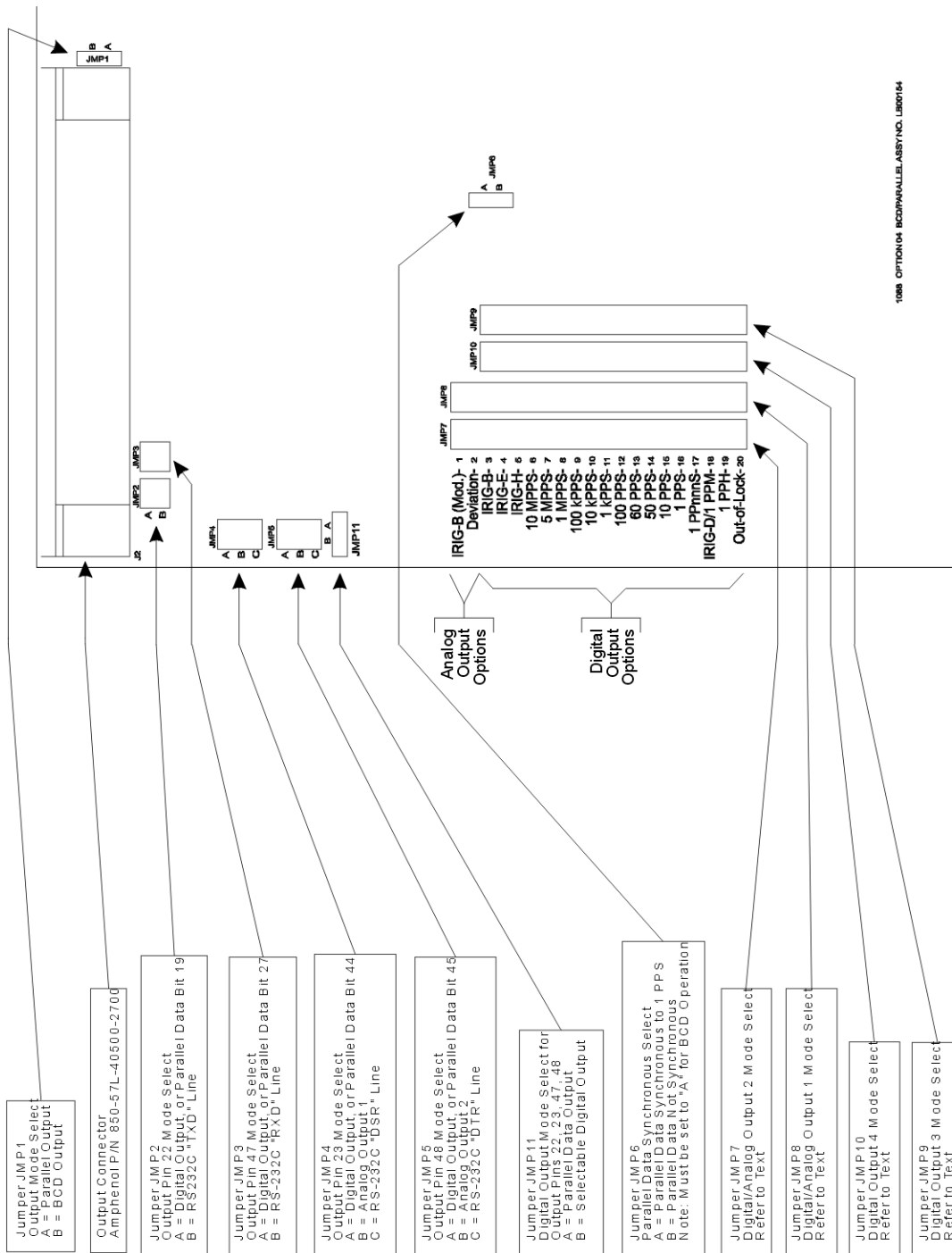


Figure C.12: Option 17 Board Layout and Jumper Locations

## C.13 Option 17A Second RS-232 Interface

### C.13.1 General Description

Option 17A for the Model 1088B adds a second RS-232C port, allowing communications and control via a 9-pin connector on the rear panel. This document provides specifications and instructions for installing this option in the Model 1088B Satellite-Controlled Clock.

### C.13.2 Specifications

### C.13.3 Commands

All commands which are available for the main RS-232C port on the Model 1088B may be used with Option 17A. A list of commands is located in the back of the operation manual.

### C.13.4 RS-232 Pinout

**NOTE:** These pins may be programmed at customer request, for example, for modem or printer control. In the standard unit, they have no function. The pinout of the RS-232 connector is as follows:

Pin 1	No Connection
Pin 2	Receive Data input (RXD)
Pin 3	Transmit Data output (TXD)
Pin 4	RS-232 Aux. Output1
Pin 5	Signal Common
Pin 6	RS-232 Aux. Input1
Pin 7	RS-232 Aux. Output1
Pin 8	RS-232 Aux. Input1
Pin 9	No Connection

Table C.5: Pinout of Option 17 RS-232 Port

### C.13.5 Option 17A Field Installation Kit Parts List

Assembly Number; AS0070600

1. CA0015402 Clock Option Interface Cable, 1 each
2. HD0043700, 1088 Option 17A Mounting Bracket, 1 each
3. Screw, M3 x 0.5 x 8mm Lg., T-10 panhead, machine, 2 each
4. LA0005002, Rear Panel Label, Option RS-232, 1 each
5. LB0015601, 1088 OPT. 17A Board; Second RS-232 Port, 1 each
6. PD0017900A, Installation Instructions, Option 17A, 1 each

### C.13.6 Option 17A Firmware Setup

Option 17A is physically located in Option Slot B. Check Section 6.12, on page 55, and the flowchart below for setup information.

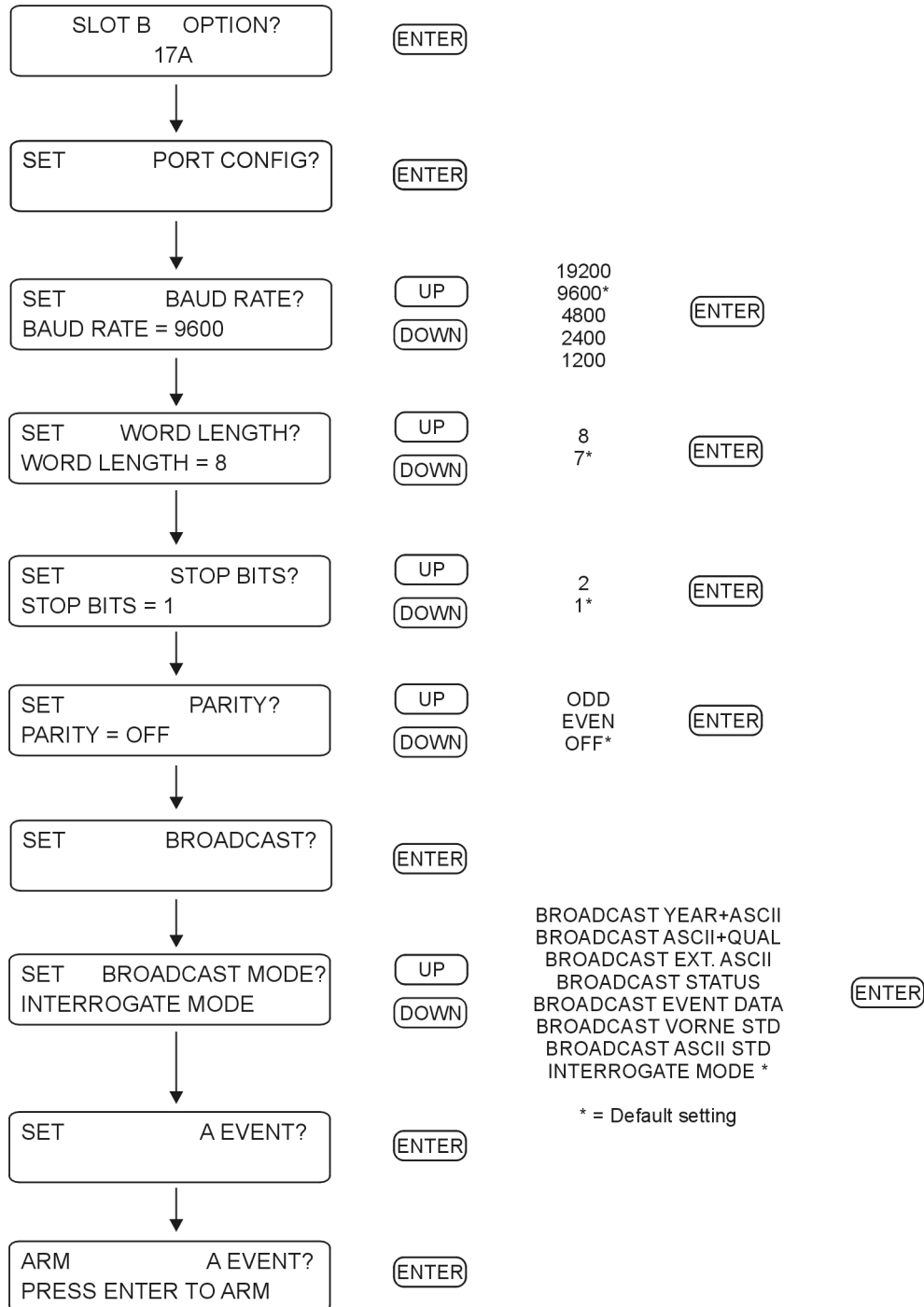


Figure C.13: Option 17 RS-232 Port Setup

## C.13.7 Installation

### Physical Installation

Option 17A may be installed in a Model 1088B Satellite-Controlled Clock by performing the following steps:

1. Disconnect the power source from the instrument.
2. Using a T-25 torx driver (or large slot screwdriver), remove the four screws holding the instrument top cover in place. Remove the cover.
3. Locate the rear-panel opening for optional I/O connectors. When viewing the instrument from the front, the opening is located at the right-rear, and is covered by a plate.
4. Using a T-10 torx driver, remove the two screws holding the cover plate, and remove the cover plate. Save the screws.
5. Insert the Option 17A Bracket (HD0043700) included with Option 17A kit in place of the old cover plate, but do not install the screws.
6. Carefully punch two holes in the Mylar tape on the bottom of the option board to allow screws to pass through the Option 17A board and the mounting bracket.
7. Position the Option 17A circuit board over the four mounting studs, with the 9-pin connector protruding through the rear-panel opening.
8. Secure the option board and the cover plate in place, using the two screws removed in step 4 and the two screws included with Option 17A.
9. Install the interconnect cable between J9 on the Model 1088B main circuit board and J1 on the Option 17A circuit board. The connectors on the cable are keyed so as to prevent backwards installation.
10. Install the middle connector if a second option board is already installed in option slot A (located between Option 17A and the main board).
11. Replace the instrument top cover and screws, restore input power, and turn the instrument ON.

### Firmware Configuration

The internal operating firmware for the Model 1088B must be configured to recognize that the Option 17A has been installed. This is accomplished by performing the following steps:

1. Enter the Setup Menu by pressing the SETUP key.
2. Press the UP key repeatedly, until the display reads SET OPTION BOARD. Press the ENTER key.
3. The display will indicate whether an option is installed in Option Slot A. Press the ENTER key to confirm this status without changing it.



4. The display will now indicate the status of Option Slot B. Press the UP or DOWN keys until the display reads:

OPTION SLOT B

OPTION 17A

5. Pressing the ENTER key confirms the selection of Option 17A and enables a series of sub-menus for configuration of communications parameters. When all of the parameters have been set, the display returns to the top level of the Setup Menu. Pressing any of the top row function keys returns the instrument to normal operation.

## C.14 Option 18: IRIG-B BUS Distribution, Fault Monitor and 2nd RS-232 Port

### C.14.1 General Description

Option 18 for the Model 1088B adds several capabilities to the clock, which are often used in systems applications. These capabilities include:

- An IRIG-B distribution bus amplifier that drives dozens of loads over distances of hundreds of meters
- A fault monitor that expands the ability of the Model 1088B to detect internal faults and provides two form-C (SPDT) fail-safe relay contact sets to indicate the Unlocked and Fault conditions. These relay contacts are for connection to external equipment such as a digital fault recorder.
- A second serial (RS-232) port, which can be used as a status event logger, for a broadcast time output, to connect to a second computer; or as a redundant clock interface allowing two Model 1088B clocks to be interconnected to form a redundant timing system.

### C.14.2 Specifications

<b>IRIG-B Distribution Bus</b>	
Output Connector:	Pluggable terminal strip, 5mm centers.
Loads	24, minimum, with Model 10882A load taps.
Bus Length	Limited by bus configuration; will drive 500m (1500') of AWG18 twisted-pair cable in a linear configuration.
Delay	Less than 100 microseconds, typical; depends on loading and bus configuration.
Output Level, Tap Output	6.4-11 Vpp, open-circuit; 3.2-5.5 Vpp, into 600 ohm load.

<b>Fault Monitor</b>	
Indication:	Via rear-panel relay, front-panel display, or serial port.
Faults Detected:	
IRIG-B Distribution:	Three fault modes will generate an alarm: Any break in the distribution bus; or A short circuit, or load impedance below 50 ohms; or Any loss of the IRIG-B drive signal.
Processor:	Watchdog violation or other reset condition.
Power Supply:	5 volt, +12 volt and -12 volt supplies out of limits.

<b>Redundant Clock Control Interface</b>	
Interconnect:	Using Arbiter Systems P/N CA0017200 cable assembly.
Communications:	Uses RS-232 port and two dedicated hardware lines.

<b>Relays</b>	Two, form-C (SPDT), fail-safe (in faulted position with power off).
Contact Rating:	130 Vdc at 0.3 A;24 Vdc at 1 A.
Function:	Unlocked (energized when locked to satellites);Fault (energized when no fault conditions present).

### Associated Products

Model 10882A	IRIG-B Distribution Tap
Model 10883A	IRIG-B Distribution Bus Splitter
Model 10884A	IRIG-B Distribution Bus Terminator
Model 10885A	IRIG-B Distribution Redundant Ring Adapter

### C.14.3 Discussion - IRIG-B Distribution System

Option 18 for the Model 1088B GPS Satellite-Controlled Clock provides an IRIG-B distribution bus output which is capable of driving 24 separate taps, loaded at 600 ohms, over a length of 500 meters of cable. Longer cable lengths, or more taps, may be possible, depending on the loading and signal levels required.

Option 18 includes a built-in distribution system monitor, which continually checks for two conditions: the presence of an IRIG signal at the bus output terminals, and dc electrical continuity in the distribution bus cable. Any fault in the clock mainframe or Option 18 board which results in loss of IRIG drive, any bus short within approximately one kilometer of the clock (or more, depending on bus configuration and loading), and any electrical open circuit (a cut cable, for instance) will be detected and reported as a FAULT via the front-panel FAULT LED, the FAULT relay output, and RS-232.

Even in the presence of a break in the cable, service may be maintained at all taps, and the break detected and reported for maintenance, using the Model 10885A IRIG-B Distribution Redundant-Ring Adapter with a ring or loop-configured distribution bus (where the 'far end' of the bus is physically brought back to the start). This allows the system to offer a substantial degree of survivability with respect to broken cables, while nonetheless reporting the problem for corrective action. The Model 10885A also provides 3750 Vrms isolation from the return end of the bus to the clock mainframe, to prevent voltages induced in the bus loop from causing currents to flow in the distribution bus or its shield.

The Model 10882A tap is used to provide a decoupled, isolated output signal to your system loads. The source impedance of this tap is approximately 600 ohms, and it will provide an open-circuit signal level of 6.4 to 11 Vpp, depending on overall system loading and distance from the clock mainframe. Each tap provides 3750 Vrms isolation from the distribution bus to the load, as well as surge suppression and EMI filtering. The taps are capacitively-isolated from the dc bus monitoring current.

One Model 10884A terminator is located at the end of a linear distribution bus, and one at the end of each branch. This inductive terminator provides a high impedance to the IRIG-B signal while providing a return path for the dc loop current used for continuity monitoring.

The Model 10883A splitter is used to drive a branch from the main distribution bus, or to split a bus into two branches. It drives the two output branches in parallel as far as the IRIG-B signal is concerned, while they are connected in series for the dc loop monitoring current.

### **Bus Configurations**

Using these three components, a linear or branched network can be assembled in any required configuration, while maintaining the ability of the Option 18 bus monitor to detect an open-circuit fault at any point along the bus or any branch. If the Model 10885A redundant-ring adapter is used to build a basic ring network, the Model 10884A terminator and Model 10883A splitter are not required. However, as shown in the accompanying figures, a complex system can be built using rings, branches, and linear segments in various combinations as needed to satisfy your requirements.

### **Determining Actual Signal Output Levels**

The actual signal levels at the outputs of the various taps may be approximated with acceptable accuracy by treating the network as a resistive array. The source impedance of the Option 18 bus output is approximately 21 ohms. The recommended cable (Belden 8760 or equivalent, #18 AWG shielded twisted pair) has a resistance of 43 ohms per kilometer (13 ohms per thousand feet). The Model 10885A redundant-ring adapter has an effective series resistance to the ac signal of approximately 10 ohms. The Model 10883A splitter has an effective series resistance of less than one ohm.

Each Model 10882A tap places a load across the bus of approximately 580 ohms plus the load impedance it is driving; i.e. the tap acts like a 580-ohm resistor in series with the load, with which it forms a voltage divider. The Model 10884A terminator may be treated as an open circuit so far as the IRIG signal is concerned.

By using these numbers, along with the load impedances, in a suitable circuit-analysis program, or by solving the loop equations manually, the attenuation from the Option 18 bus output to the load at each tap may be determined. The open-circuit output level at the Option 18 bus output is nominally 11 volts peak-to-peak with a tolerance of +5%; knowing this, along with the attenuation values, you can calculate the signal level at each tap.

### **Total DC Resistance Limit - Bus Monitor**

There is a 500-ohm limit on the total dc resistance of the distribution system to ensure proper operation of the bus continuity monitor. This limit will not normally be a factor in system design. Still, loop dc resistance should be calculated for each system.

Since all of the components which pass dc current are effectively in series as far as the dc current is concerned, the resistances can simply be summed up. If the total is less than 500 ohms, proper operation is ensured.

The cable resistance is 43 ohms/km (13 ohms/Mft.) for the dc monitor current. The dc resistance of the Model 10885A redundant-ring adapter is 4 ohms. The dc resistance of each Model 10884A terminator and each Model 10883A splitter is 30 ohms. The number of taps has no effect on the system dc resistance.

The magnitude of the dc monitor current is 10 mA +10% with a maximum dc open-circuit voltage of 8.5 volts. In the USA, NEC class-2 wiring is acceptable.

### **Detection of Short Circuits; Drive Capability**

The Option 18 bus output is intended to drive a total ac load of 50 ohms or greater, although it will continue to operate without excessive signal distortion into any impedance. The bus monitor includes a circuit which detects the presence of the IRIG-B signal at the system output. The bus monitor is sensitive to both the waveshape of the signal at the bus output (it must look like a modulated IRIG-B signal), and the level of that signal.

If the load impedance drops below approximately 40 ohms, a drop in signal level will occur due to the 21-ohm source resistance of the bus driver. At this point, the output level will drop below the threshold required by the bus monitor, in turn causing a bus FAULT to be reported. Since in normal operation the system load exceeds 50 ohms, such a fault must be the result of a short circuit at some point along the bus.

Thus, the bus monitor function of the Option 18 IRIG-B distribution output is capable of detecting the three most likely types of system fault: failure of the IRIG-B drive signal at the source, an open circuit along the distribution bus, or a short of the distribution bus.

### **Installation**

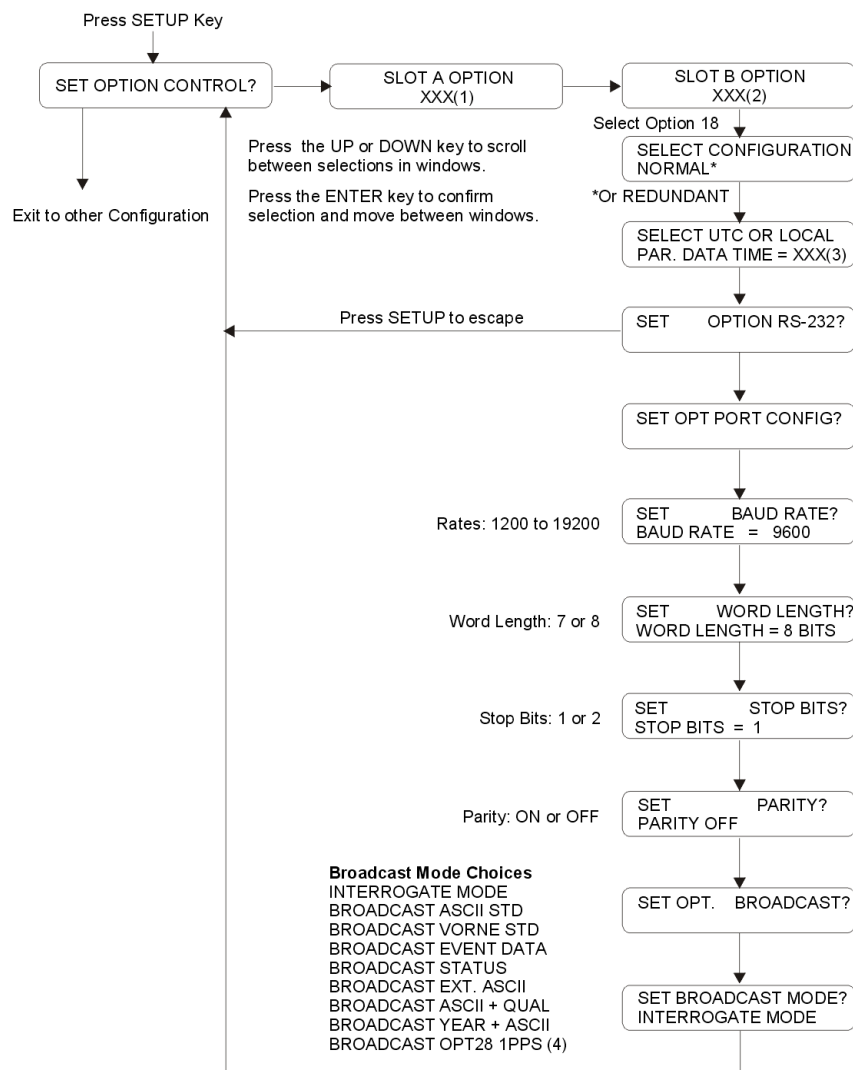
Installation of the IRIG-B distribution bus is straightforward for those experienced with the installation of control and communication wiring. No special tools are required. All of the components are terminated with pluggable, screw-type terminal blocks. A 3 mm (1/8") flat-bladed screwdriver, wire cutters and strippers are all that is required to terminate the cable.

The figures which follow show typical network topologies. The various components may be connected together in any configuration desired, provided that the basic rules described above are not broken. Multiple branches or loops may be used, and the number of taps is limited only by the loading and signal level requirements described above. The limit of 24 taps only applies if they all are loaded with 600 ohms; for higher or lower load impedances, a greater or fewer number of taps will be possible.

When connecting the network, observe polarity of all components. Both the IRIG-B signal and the dc loop monitor current have polarity which must be observed for proper operation. All of the components needed to assemble your system are marked for polarity.

The output of the taps is isolated and floating, and either end may be grounded. However, if the signal polarity is incorrect, the device being driven by the tap may not operate properly.

### C.14.4 Option 18 Firmware Setup



**Notes:**

- (1) XXX = NONE, 3, 10, 11, 12, 13, 14, 20, 23, 25 or 28; (Options 10, 11, 13, 14 and 25 are no longer available)
- (2) XXX = 4, 17, 17A, 18, 23, 27, 29 or 32
- (3) XXX = LCL or UTC
- (4) Only available with Option 28 installed and configured

Figure C.14: Option 18 Firmware Setup

C.14.5 Typical Network Configuration

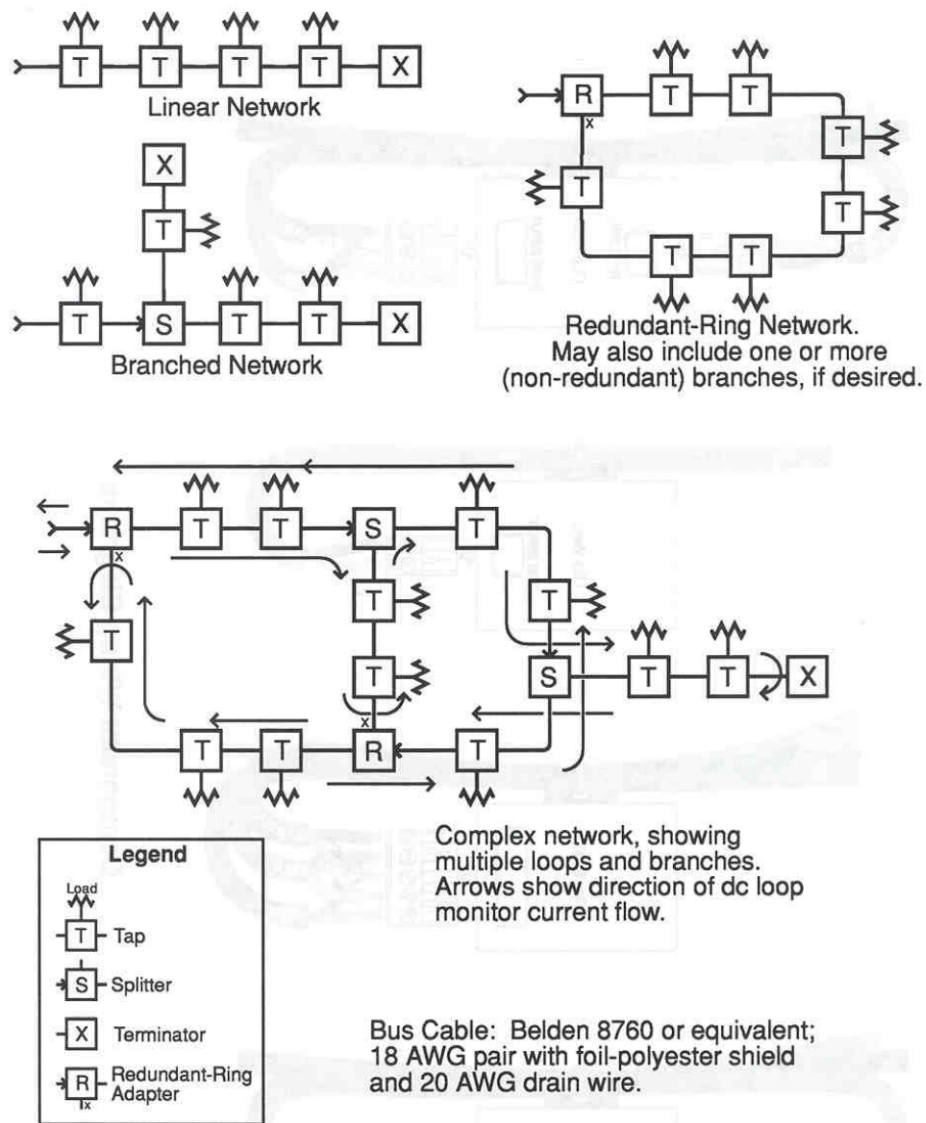


Figure C.15: Option 18 Network Configuration

### C.14.6 Option 18 Component Wiring Diagrams

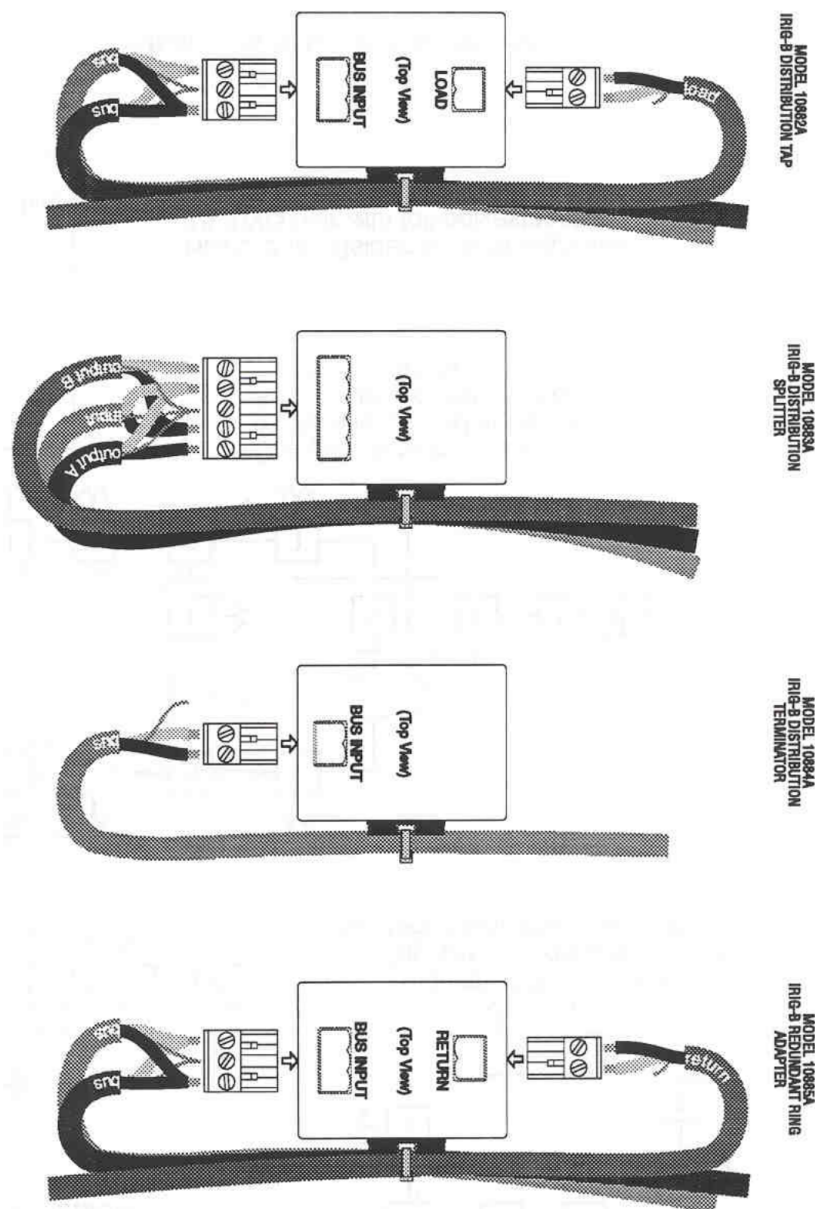


Figure C.16: Option 18 Wiring Diagrams

### C.14.7 Discussion Redundant Timing Operation

In redundant-clock mode, two Model 1088B clocks, each with Option 18, are interconnected with the Arbiter Systems part number CA0017200 cable assembly. This cable installs between the two 9-pin D-subminiature connectors on the Option 18 assemblies of the two units. Either end of the cable may go to either clock; neither unit has higher or lower priority than the other.



## Output Signal Enable and Configuration

When jumper JMP17 on the main clock board is set properly, the digital outputs of that clock are controlled by the redundant-control interface. The status of the drivers is indicated by the 'On Line' LED annunciator on the clock front panel. Refer to paragraphs 3.2 through 3.3.4 of the 1088B Operation manual if it should be necessary to modify the jumper settings; they are normally preset at the factory prior to shipment.

To make the best use of the redundant clock feature, both clocks should have their main four outputs set for the same set of signals. Then, the outputs may be directly tied in parallel, and the 'On Line' clock will drive the connected loads. Note that the output enable only affects the digital outputs (everything except IRIG-B modulated and chart recorder output). If you connect two analog outputs together, no damage will be done, but both signals will be present simultaneously. The IRIG bus distribution output of the Option 18 assembly should be used for a redundant modulated IRIG-B output; it includes an on-line enable relay, which is also controlled by the output enable function.

## On-Line Control and Arbitration

In normal operation, when no fault is detected, the 'On Line' clock is determined by the 'luck of the draw.' The only exception to this is if one of the clocks includes a higher-stability internal timebase, such as Option 12. In this case, the clock with the higher-quality timebase will be the nominal on-line clock.

Once each second, the clocks exchange status information via the RS-232 interface. In the event that one of the clocks determines that it is not as healthy as the other, it will automatically relinquish on-line status to the other unit. For the most part, this is performed in firmware; however, there is also a hardware input to the redundant-control circuit, which is driven by the microprocessor watchdog/reset generator. If this circuit detects any error, a direct hardware transfer to the other unit is performed. Thus, in the event of a processor failure which might prevent the clock from relinquishing on-line status via firmware, the transfer will be accomplished automatically through this hardware feature.

Determination of the on-line clock in the event of multiple failures is made by comparison of the status bytes (refer to paragraph 4.4 for a discussion of clock status). The clock with the lower-valued status byte will be elected to on-line status. The status of both clocks may be monitored from either of the clocks via the SS RS-232 command; see Appendix A of the 1088B Operation manual for a description.

## Use With Other Options

Certain other options, including Options 03 and 20, can be installed in the clock mainframe along with the Option 18 board, and also can provide redundant control of their outputs via the redundant clock control function of the Option 18 assembly. See the documentation for these options to determine if any jumper settings are required to take advantage of this feature.

### C.14.8 Option 18 Setup

The setup menu to control the operation of the Option 18 interface is shown earlier in this section (Option 18 Firmware Setup). No internal configuration is necessary for proper operation of the

Option 18, except to convert between redundant and normal operation as regards the output-enable control for the clock digital output drivers. If you need to change this setting, refer to paragraph 3.3 of the 1088B Operation Manual for instructions. These jumpers are normally configured at the factory to match each customer's order.

### RS-232 Pinout

The pinout of the RS-232 connector is as follows:

Pin 1	Redundant Control Interface Disable Input <sup>2</sup>
Pin 2	TXD, Transmit Data output
Pin 3	RXD, Receive Data input
Pin 4	RS-232 Aux. Output <sup>1</sup>
Pin 5	Signal Common
Pin 6	RS-232 Aux. Input <sup>2</sup>
Pin 7	RS-232 Aux. Output <sup>2</sup>
Pin 8	RS-232 Aux. Input <sup>2</sup>
Pin 9	Redundant Control Interface Disable Output <sup>2</sup>

<sup>1</sup> These pins may be programmed at customer request, for example, for modem or printer control. In the standard unit, they have no function.

<sup>2</sup> These pins have 5-volt CMOS levels, unlike the others, which have RS-232 levels. If you are not using the redundant clock interface, do not connect these pins.

### Terminal Strip Pinout

Pin 1 is the leftmost pin, viewing the panel from the rear. Pin 9 is the rightmost. Three mating connectors (three pins each), Arbiter Systems part number CN0019203A, are included with the unit.

Pin 1	Fault Relay Normally-Closed Contact <sup>1</sup>
Pin 2	Fault Relay Normally-Open Contact <sup>2</sup>
Pin 3	Fault Relay Common Contact
Pin 4	Unlocked Relay Normally-Closed Contact <sup>1</sup>
Pin 5	Unlocked Relay Normally-Open Contact <sup>2</sup>
Pin 6	Unlocked Relay Common Contact
Pin 7	IRIG Bus Positive Polarity Output
Pin 8	IRIG Bus Common (Chassis Ground)
Pin 9	IRIG Bus Negative Polarity Output

1 The normally-closed contact is connected to Common when power is off, and when the relay is in the 'fault' or 'unlocked' state.

2 The normally open contact is connected to Common during normal operation, with no fault conditions present.

## C.15 Option 19: Model 1088B Fault Relay

### C.15.1 General Description

Option 19 for the Model 1088B Satellite-Controlled Clock incorporates a fail-safe single-pole, double-throw (SPDT) relay into the Out-of-Lock function already available in the standard instrument. Relay activation is subject to the same user-configurable delay as the standard output; thus it will occur at the same moment as the logic-level Out-of-Lock signal from the rear panel (if so configured). Normally-open, normally-closed, and common connections are available at screw terminals on the rear panel.

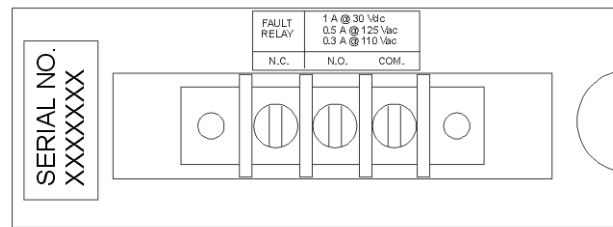


Figure C.17: Option 19 External Wired Fault Relay

### C.15.2 Specifications

#### C.15.3 Relay Contacts

Type:	Dry; gold-clad silver.
Contact Resistance:	60 milliohms
UL/CSA Ratings:	1 A @ 30 Vdc; 0.5 A @ 125 Vac 0.3 A @ 110 Vdc

#### C.15.4 Terminal Strip

Terminal Assignment:	N.C./N.O./COM. 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
Screw Material:	Cadmium-plated steel.

### C.15.5 Option 19 Firmware Setup

There is no setup in firmware for this option.

### C.15.6 Connections

All connections to the rear-panel terminal strip should be made using spade lugs or ring lugs suitable for use with #6 screws. Refer to Figure 1 and the specifications given above for terminal assignments. The designations normally-open and normally-closed refer to the position of the relay contacts during normal operation, prior to encountering an out-of-lock condition. This is a fail-safe relay; it is in the faulted state with power OFF.



Figure C.18: Option 19 Relay Connections

Note that in the above diagrams, n.c. and n.o. correspond to the rear-panel terminal markings, and refer to the condition when the relay is energized (normal clock operation).

### C.15.7 Configuration

After the connections have been made, configuration of the fault relay is accomplished in the same manner as configuration of the Out-of-Lock function (the relay is driven internally by the Out-of-Lock circuitry). The Out-of-Lock function is enabled and configured using the SETUP menu for the 1088B, which is described in Section 5 of the 1088B Operation Manual.

The SETUP menu allows entry of a value between 00 and 99 for Out-of-Lock Delay Time. The delay time value represents the amount of time, in minutes, that satellite synchronization must be continuously lost before the instrument outputs an Out-of-Lock signal and simultaneously activates the Out-of-Lock relay. If the value is set to 00, the Out-of-Lock function is disabled, and the Out-of-Lock output and the relay are both in the locked state whenever power is on.

The procedure for setting the Out-of-Lock function is as follows:

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 OUT-OF-LOCK?. Press the ENTER key to select the Out-of-Lock sub-menu. The current out-of-lock delay time (between 00 and 99) will be displayed.
3. Pressing the UP and DOWN keys will change the selection. When the desired out-of-lock delay time is displayed, press the ENTER key to confirm the choice and return to the first level of the SETUP menu. To return the 1088B to normal operation, press one of the function keys in the top row of the front panel keyboard.

### Special Note

In some applications, the fault relay may be required to switch into a capacitive load. An example would be an input to a substation DFR or SER, in which a capacitor is placed across the input terminals for surge or noise suppression (see schematic below).

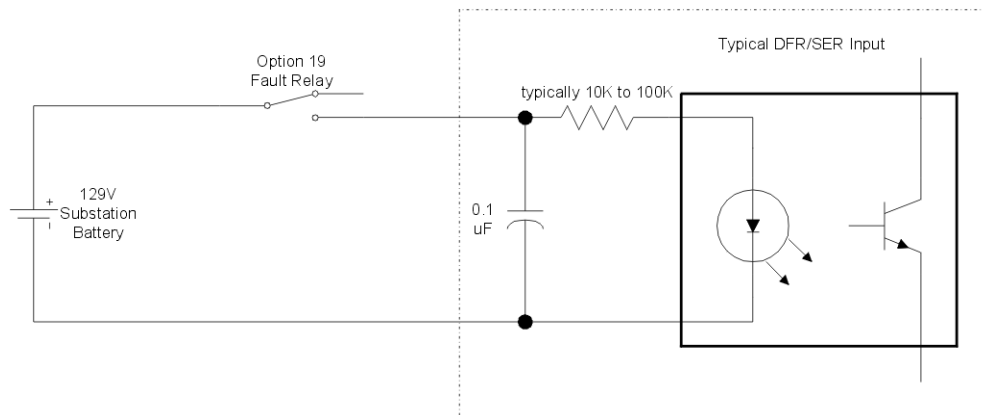


Figure C.19: Option 19 Relay Circuit without Resistor

Note that if the relay contacts are closed, a substantial momentary current will flow into the 0.1 uF capacitor. This could damage or degrade the contacts of the relay. This problem may be alleviated by adding a 100 ohm, 0.5 watt resistor in series with the relay, thereby limiting the charging current to the capacitor (see below).

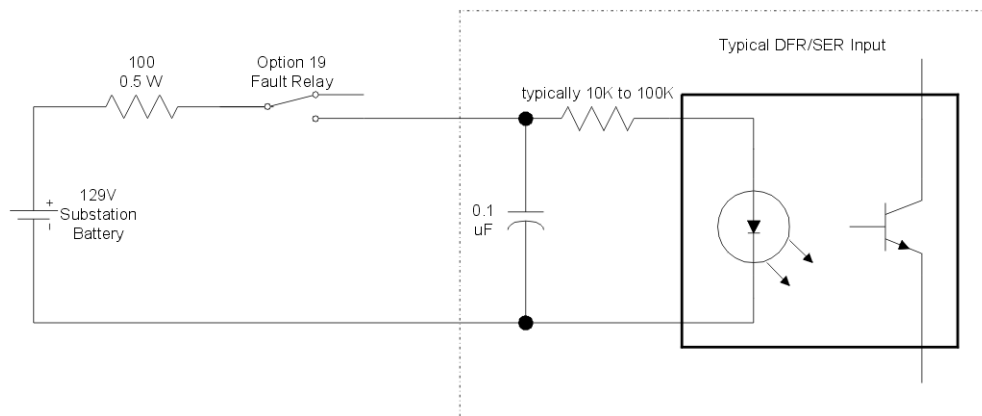


Figure C.20: Option 19 Relay Circuit with Resistor

This resistor is not normally installed at the factory, due to the range of different applications in which Option 19 may be used, and the fact that in many applications, no resistor is needed or desired.

The modification can be implemented by adding a resistor to the Option 19 circuit board inside of the Model 1088B. The following steps describe the procedure necessary for installing the resistor.

1. Disconnect the input power to the Model 1088B.
2. Using a T-25 torx driver (or a flat-blade screwdriver), remove the four screws securing the top cover of the instrument, and remove the cover.
3. Locate the Option 19 terminal strip assembly. Using a T-10 torx driver, remove the two screws holding the assembly to the main chassis.
4. Remove the three-wire connector from the header on the Option 19 circuit board. (Note: It will be necessary to perform step 3 prior to removing the connector, in order to allow clearance.)
5. Remove the entire Option 19 fault relay assembly from the Model 1088B.
6. The location for the optional resistor is shown on the circuit board as R1. Directly below this lettering on the board is a via (a plated-through hole connecting the two board layers). Using a number 60 (.040) or larger drill bit, carefully enlarge the via to remove the plating, which will break the connection between the two layers. CAUTION: The via is the middle of three holes; be careful not to drill out either of the two outside holes.
7. Install a 100 ohm, 0.5 watt resistor (or the value of your choice) between the two outside holes, and solder into place.
8. Re-attach the connector to the Option 19 circuit board, using care to insure the proper polarity.
9. Install the Option 19 assembly back into the Model 1088B, and secure in place with the two mounting screws.
10. Replace the instrument top cover, and secure with the four T-25 screws.

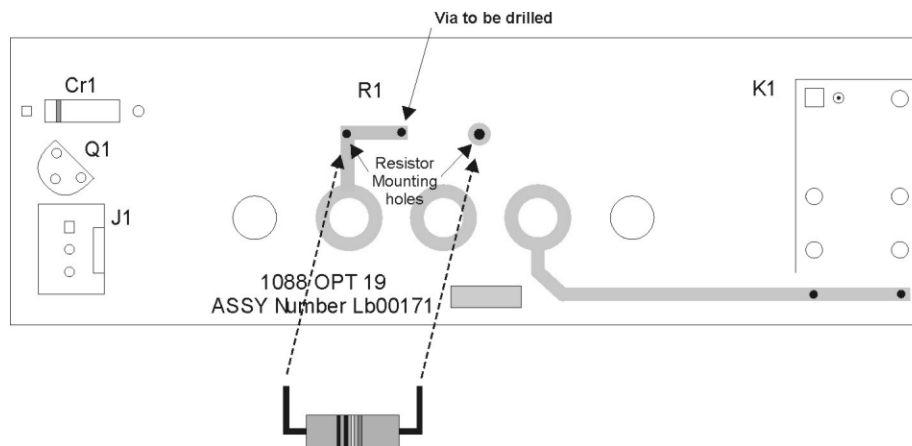


Figure C.21: Option 19 Relay Relay Board with Resistor

## C.16 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 820nm transmitters compatible with multi-mode fiber.

### Specifications

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

Option 20A provides an optical power output of -15dBm minimum (-12dBm typical) into 62.5/125- $\mu$ m 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.22.

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.6: 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

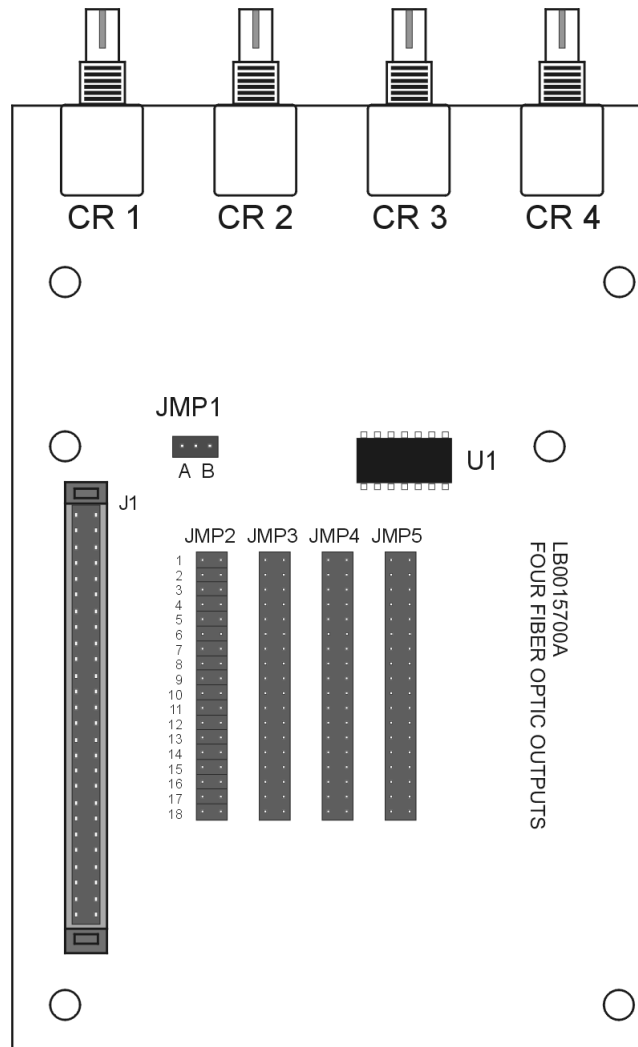


Figure C.22: Option 20A Jumper Locations

## C.17 Option 23, COMTRADE Sample Rate Generator

### C.17.1 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 5V CMOS-level square wave in both normal (rising edge of clock synchronous with 1PPS) and complemented (falling edge of clock synchronous with 1PPS) polarities. The sampling pulse is synchronized to within 50ns of 1PPS, and has sample-to-sample jitter less than 1ns.

### C.17.2 Principles of Operation

The Option 23 assembly generates sampling signals, which are precisely locked to 1PPS-GPS by phase locking a precision voltage-controlled crystal oscillator (VCXO) to the internal 1kPPS 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 1PPS-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.17.3 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 1088B. The Option 23 assembly may be installed in the standard option slot available (Slot B).

## C.17.4 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.7: 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.8: Option 23, Sample Rates,  $f_{LCM} = 3200 \times f_{base}$

### C.17.5 Performance

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

### C.17.6 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.17.7 Drive Capability

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

### C.17.8 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.

Figure C.23 illustrates the Option 23 SETUP menu for 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:  $\triangleright$

Where:

m	0 = 50 Hz
	1 = 60 Hz
r	see Table C.7 or Table C.8 for SAMPLES/CYCLE number.

### C.17.9 Option 23, Front Panel Setup

The information provided on this page should help you to configure the Option 23 on the Model 1088B. If you should need additional information on setting up from the front panel keys, please go to Chapter 9 on page 71.

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.

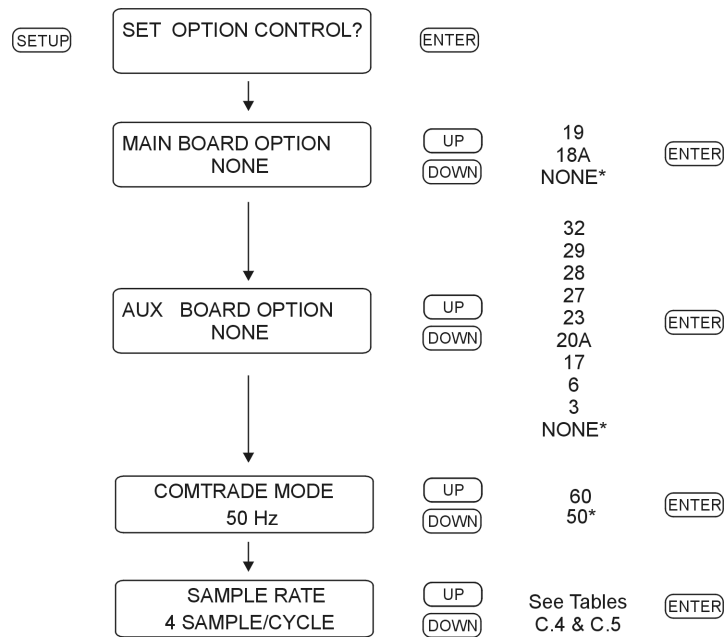


Figure C.23: Option 23 Front Panel Setup

### C.17.10 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 6-1, 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.24 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.9 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.24). 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.9 lists jumper positions for individual output signals.

<b>Output Signal</b>	<b>Output Function</b>	<b>Output Mode</b>
IRIG-B Modulated, 10 V <sub>pp</sub>	1	C
Deviation ( $\pm 5$ 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.9: Option 23, Output Signal Selection Jumper Settings



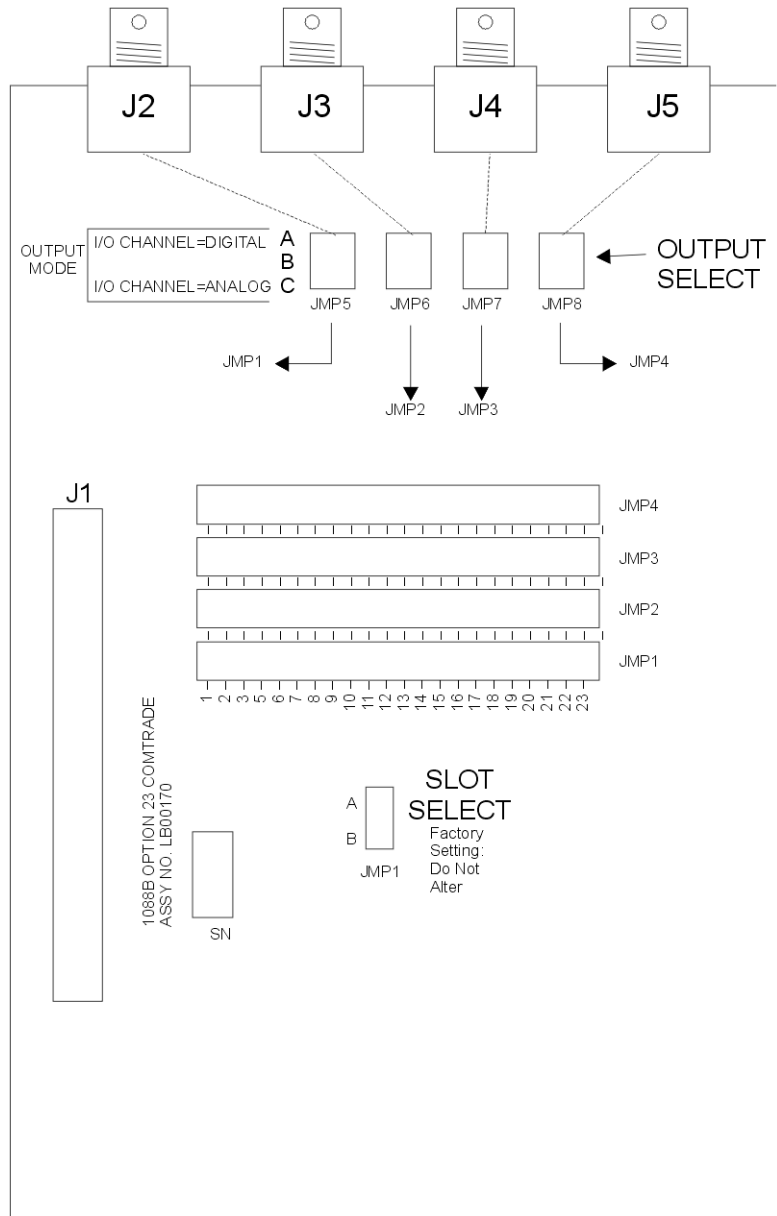


Figure C.24: Option 23 Internal Jumper Setup

## C.18 Option 27: 8-Channel High Drive

### C.18.1 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.25.

### C.18.2 Specifications

**Output Selection** Each output is jumper selectable for either a Modulated or Unmodulated signal. See Figure C.25 for jumper locations and configuration settings.

Number of Channels: Eight (8).

#### Signal Levels:

Modulated: 4.5 V<sub>pp</sub> with 20-Ohm source impedance; each channel will drive a 50-Ohm load to 3 V<sub>pp</sub> 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.

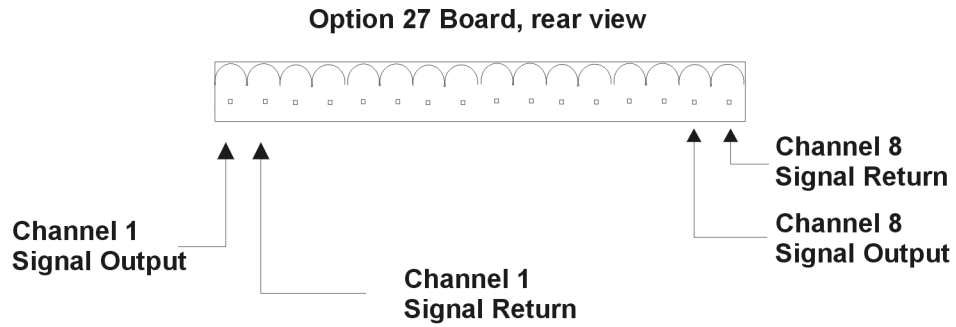
### C.18.3 Option Setup

#### Using Front Panel Keys

To set up Option 27 from the front-panel keys, please follow the guidelines in Section 6.12, on page 55.

#### Using RS-232C Port

To set up Option 27 using the RS-232C port, please follow the guidelines in Section 9.2.13 on page 93.



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

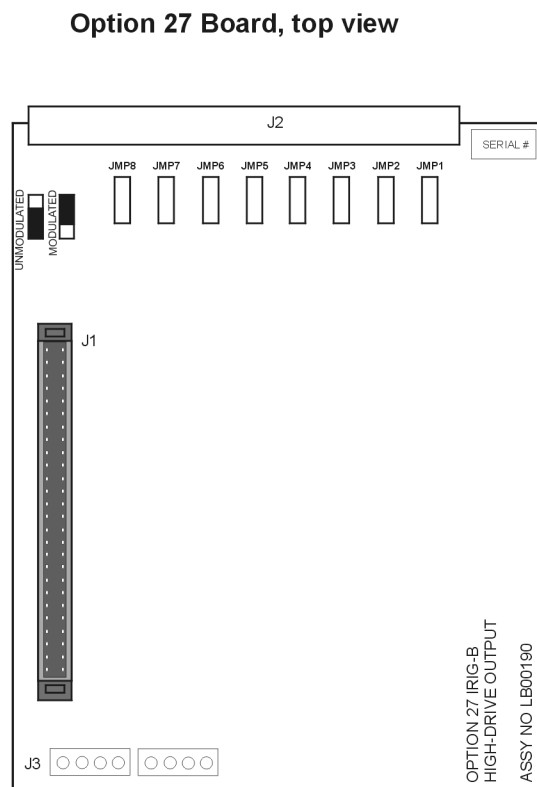


Figure C.25: Option 27 Jumper Locations

## C.19 Option 28: Time, Frequency and Phase Monitor

### C.19.1 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.19.2 Discussion

Option 28 provides the clock with the ability to accept either a 50Hz or 60Hz, 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  $\pm 180$ ) 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.19.3 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 6m (20 ft.) length of twinaxial 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.19.4 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  $\Delta F$  and  $\Delta T$ , press the EVENT/DEVIATION key a second time:

```
System  $\Delta F$  -0.0010 Hz
 $\Delta T$  +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.19.5 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.19.6 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 Procomm or Windows Terminal. 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):

-0.16,1088PC

### C.19.7 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.19.8 Option 28 Firmware Setup Procedure

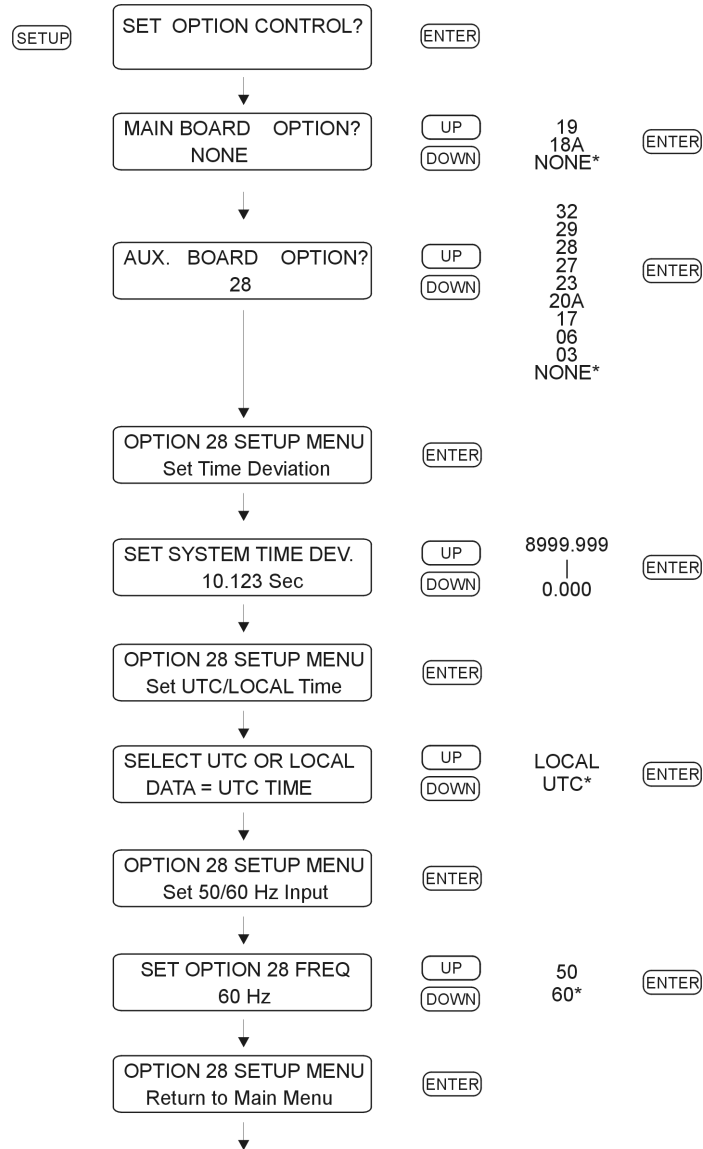


Figure C.26: Option 28 Firmware Setup Procedure

### C.19.9 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:

↵	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 1PPS-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 1PPS-GPS, the phase angle will be just above zero, and if the zero crossing occurs just prior to 1PPS-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.19.10 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 >	Time Deviation*
	66hhmmss >	System Time
	77nn.nnn >	System Frequency
	88nnn.nn >	System Phase

89nnn.nn >	System Magnitude
55ddd >	Day of Year
<BEL>	<BEL> = hex 07

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

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

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

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

<b>Time Deviation Range</b>	<b>Format (b=blank)</b>
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. 1088)

### Set Voltage Amplitude Correction

Command: **v:kRV**

“v:kRV” sets the system voltage amplitude correction.

Response: >

Where: v = Voltage correction per unit with 1.000000 equal to no correction.  
k = Security Key (e.g. 1088)

### Return Time, Frequency, Phase Deviation with UTC Time

Command: **nPD**

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

Response:

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

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

Where:

mm/dd/yyyy	= Date
hh:mm:ssU	= Time of Day, UTC
(or)	
hh:mm:ssL	= Time of Day, Local
ss	= Status (0 = Locked, 1 = Unlocked)
	(first character is Reference Status:)
	(second character is clock status per IEEE 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.20 Option 29: Four Additional Outputs; Dry Contacts; +25/50 Vdc

### C.20.1 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, 5V CMOS outputs; two are Aromat AQV210E solid-state relays (SSRs). A +25 or +50VDC supply is available on-board and may be switched by the SSR outputs.

### C.20.2 Specifications

#### General

Connector                    16-position, 5mm 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<sup>2</sup> (AWG 12 to 22). See Table C.12 and Figure C.28 for Connector Configuration.

#### Digital Outputs

Quantity                    4

Type:                        5V CMOS, individually configurable

Rating:                      +5V open-circuit, nominal  
75mA peak current, per channel  
+3.5V typical at 75mA 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.27 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  $\mu$ s Nominal, to 50%.  
Rise Time, 50  $\mu$ s 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 default width of pulse provided by the clock mainframe.
- Available Configurations:
1. Dry contact closure.
  2. Contact closure to ground.
  3. +25/50 VDC switched for grounded load
  4. +25/50 VDC with contact closure to ground for non-grounded load.
- See Table C.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: 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/50 ms Default = 50 ms
12	+25/50VDC 1	JMP10: +25/50VDC Default = 50 VDC
13	Ground	–
14	SSR Output 2	JMP6: Signal Select Default = 1 PPM
15	SSR Output 2	JMP8: Standard/50 ms Default = 50 ms
16 (Leftmost)	+25/50VDC 2	JMP11: +25/50 VDC Default = 50 VDC

Table C.12: Output Connectors and Setup Jumpers

### C.20.3 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.20.4 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 (4 screws).
3. Locate the appropriate Jumper using Figure C.27 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 set the Line Power switch to ON position (if equipped).

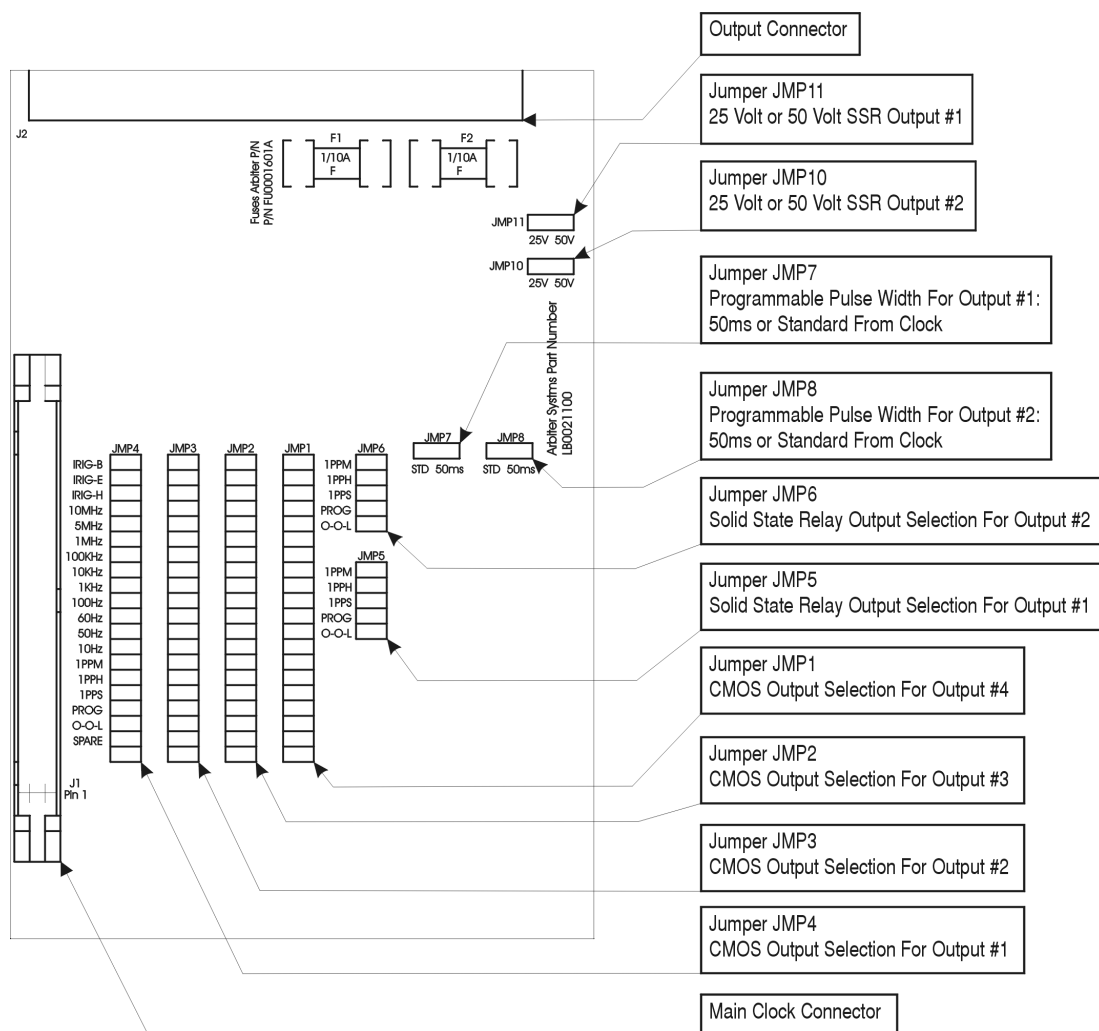
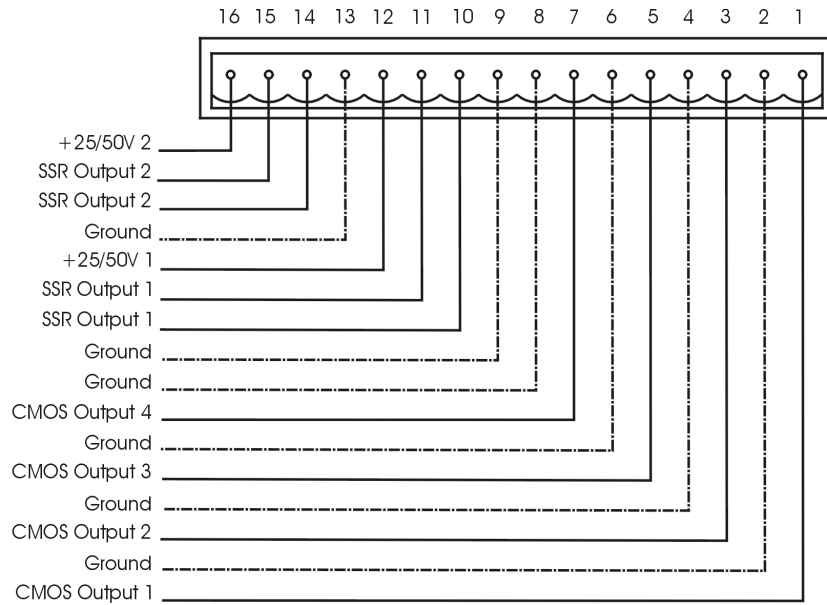
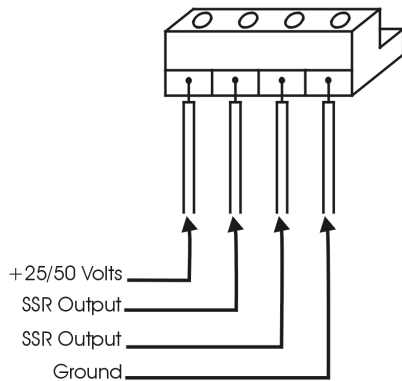


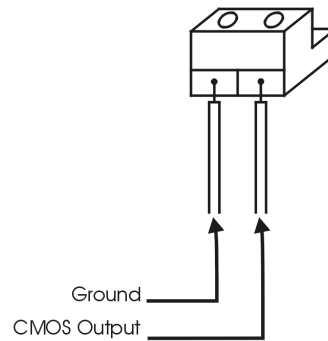
Figure C.27: Option 29 Jumper Locations



CLOCK OUTPUT CONNECTOR



SOLID STATE RELAY CONNECTOR



CMOS OUTPUT CONNECTOR

Figure C.28: Option 29 Connector – Signal Locations

## C.21 Option 32: Internal NTP Server

### C.21.1 General Description

Option 32, Internal Network Time Protocol (NTP) Server, is used in the Arbiter Systems line of 19-inch, rack mount Satellite-Controlled Clocks.

#### Option 32

Option 32 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 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 40ms for checking and generating the cryptograms, which is covered and averaged out by the protocol. Option 32 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 consists of two building blocks; an OEM NTP module and an interface to the GPS clock. The NTP Server (Option 32) is connected to the main board via the standard 50 pin option cable. The NTP Server has two external connectors, an RS-232 (DB-9 male) and a 10/100 Base-T (RJ 45). In addition to the connectors there are three status LED's on the rear Panel. See Figure C.29.

#### 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.21.2 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.

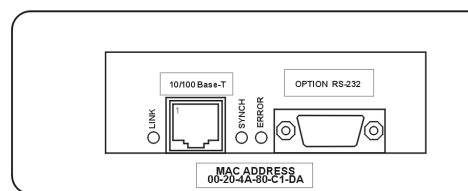


Figure C.29: Option 32 Rear Panel

**RS-232**

The RS-232 port uses a 9 pin d-sub connector. This connector is configured as a DTE device with the following pin out:

Receive (RXD)	Pin 2
Transmit (TXD)	Pin 3
Ground (GND)	Pin 5

**10/100 Base-T**

Option 32 uses the standard 10/100 base-T connection for connecting to an Ethernet. Figure C.29 indicates the location of pin 1.

Txd +	Pin 1
Txd -	Pin 2
Rxd +	Pin 3
Rxd -	Pin 6

**Status LED's**

There are three status LED's on the rear panel of Option 32. The LED's are Link (green), Synch (green) and Error (red). Option 32 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.21.2 Jumper Settings.

There are three jumpers on Option 32. Jumpers 1 and 2 (JMP1 and JMP2, Figure C.30 and Table C.13) control the serial port. When JMP1 and JMP2 are in position A (top), Option 32 will operate as an NTP Server. Setting JMP1 and JMP2 to the B (middle) allows the clock to be interrogated. Both JMP1 and JMP2 must be placed in position C (bottom) to configure the NTP module via the RS-232 port. Jumper 3 (JMP3) is set according to clock model as described in Table C.14.

Position	Function
A	Clock connected to the NTP module (default)
B	Clock connected to the external RS-232 port *
C	NTP module connected to the external RS-232 port.

Table C.13: JMP1 and JMP2 Settings

\*The clock must be configured for the second RS-232 Option 17A (Model 1088B) to allow bi-directional communication.

JMP1 and JMP2 should be in the same position and are required to be in position A for normal operation of Option 32.

Position	Function
A	For installation in the Model 1088B
B	For installation in the Model 1084A/B/C or Model 1093A/B/C

Table C.14: JMP3 Settings

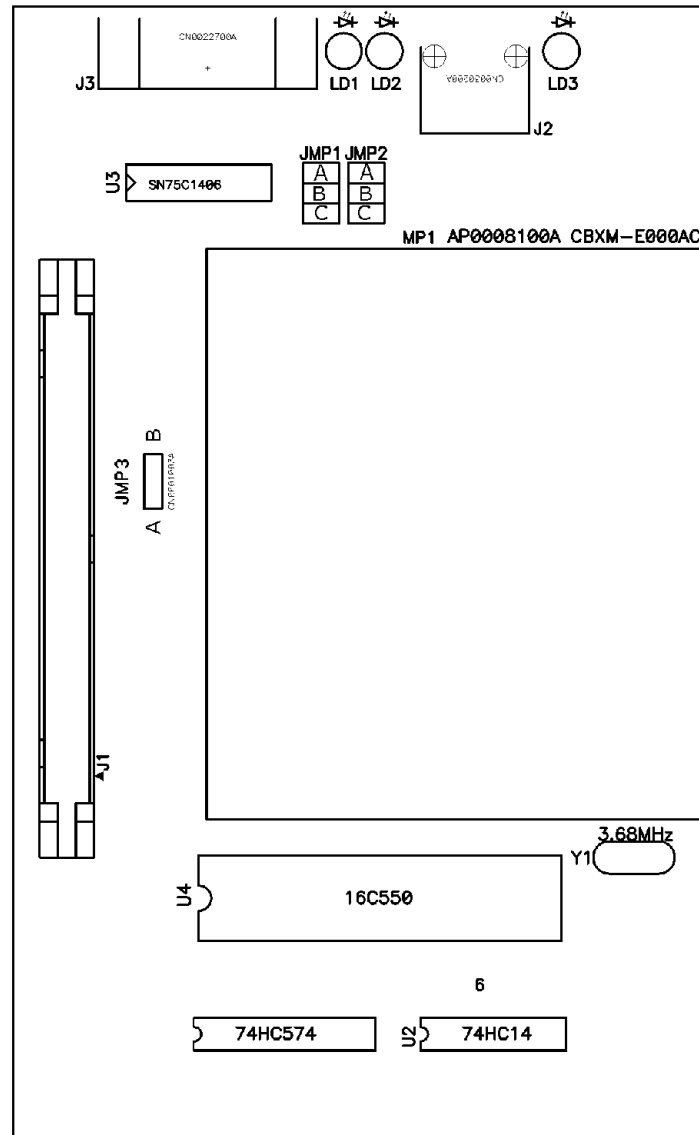


Figure C.30: Option 32 Board–Jumper Locations

### C.21.3 Firmware Configuration.

Firmware configuration for the Option 32 is performed in two parts: the first part involves setting the correct option number via the front panel; the second part requires configuring the Ethernet port via the Ethernet port, or the optional RS-232C port on the NTP module.

#### Front Panel

1. Apply power and observe the front panel display, when CLOCK STATUS STARTUP is displayed, press the SETUP key.
2. Navigate through the series of menu selections, using either the DOWN, UP or SETUP key,

until SET OPTION BOARD? Appears (Slot B for the Model 1088B).

3. Press ENTER, and then press the UP key until Option 32 is displayed. Press ENTER.

## NTP Module

The NTP module can be configured over the Ethernet port or the option RS-232 port. The Ethernet is the preferred port, as no configuration changes are required to use this port.

### Ethernet

To configure the NTP module over the network, establish a Telnet connection to port 9999. The default IP number for the Ethernet is 192.168.0.232. 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. The address can also be calculated from the serial number. Below is the command example for WinNT/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. **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.

### Serial

An ASCII terminal or PC with a terminal emulation can be connected to the option RS-232 port, but JMP1 and JMP2 must be set to “C”. The terminal (or PC) should be configured to 9600 Baud, no parity, 8 data-bits, 1 stop-bit. 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.21.4 General Configuration

After configuration mode is entered (confirm with <CR>), the parameters can be changed; default values can be confirmed with the enter key. When leaving the setup mode after selecting function 9 all parameters are stored in a nonvolatile memory and the NTP server resets.

### 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.

**Netmask:** A netmask 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 netmask for the actual IP address is used. The NTS prompts for the number of host bits, and then calculates the netmask. 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.21.5 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.



## 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 1088B.

## Declaration of Conformity with European Union Directives

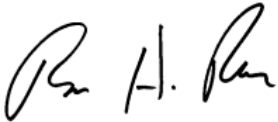
Date of Issue: June 30, 2003

Directives: 89/336/EEC Electromagnetic Compatibility  
73/23/ EEC Low Voltage Safety

Model Number(s): 1088B GPS Satellite-Controlled Clock

Manufacturer: Arbiter Systems, Inc.  
1324 Vendels Circle, Suite 121  
Paso Robles, CA 93446 – USA

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

Signed:   
\_\_\_\_\_

Signatory: Bruce H. Roeder

This certificate declares that the described equipment conforms to the applicable requirements of the directives on Electromagnetic Compatibility 89/339/EEC, Safety 73/23/EEC, and amendments by 93/68/EEC adopted by the European Union.

## Appendix E

# Statement of Compliance

### E.1 Introduction

The following page is a statement of compliance that includes Model 1088B.

## G.P.S. Satellite Clock Statement of Compliance

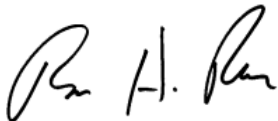
February 5, 2008

TO WHOM IT MAY CONCERN:

All Arbiter Systems, Incorporated G.P.S. Satellite Controlled Clocks are Primary Standards. They provide time traceable to U.T.C. and U.S.N.O. within published accuracy specifications anywhere in the world. All Arbiter Systems Incorporated G.P.S. Satellite Controlled Clocks also carry a limited lifetime warranty, which is based on in field MTBF (Mean Time Between Failures) of over one million (1,000,000) hours. These products are available with all known time synchronization signals presently in use world wide by the electric power industry.

Arbiter Systems does not supply a type test certificate as requested for G.P.S. systems as the accuracy is a function of the G.P.S. system and not of the receiver. However we (Arbiter) hereby certify that this equipment conforms to all Arbiter Systems Incorporated specifications for material and process. All Arbiter Systems calibration products are supplied with a type test certificate guaranteeing traceability to National Standards, but are inappropriate for G.P.S. clocks, which are Primary Standards by definition.

Regards,



Bruce H. Roeder  
International Marketing Manager  
Arbiter Systems, Inc.  
BHR/sc

# Index

- 1-PPS
  - description, 59
- accessories
  - antenna & cable, 24
  - included, 1
- altitude, see elevation display
- amplifier
  - antenna cable, 24
- analog drivers, 56
- antenna
  - clock connection, 25
  - connection, 19, 25
  - installation, 19
  - mounting assembly, 20
  - mounting kit, 19, 20
  - mounting procedure, 19
  - power supplied to, 25
  - resistance, 22
  - surge protector, 22
  - user-supplied cables, 25
  - voltage, 22
- antenna & cable testing, 22
- antenna cable
  - attenuation, 24
  - DC resistance, 24
  - delay, 23
  - details, 23
  - effects of cable parameters, 23
- Appendix
  - A, 101
  - B, 109
  - C, 111
  - D, 203
- cable
  - accessory, 24
  - adjacent signal interference, 25
  - delays, 62
  - distance, 60
  - physical protection, 24
  - timing output, 60
  - user-supplied, 25
  - wire losses, 62
- CE Compliance Notice, 203
- CE mark certifications, 203
- chapter list, iv
- comm ports, 69
- command key
  - definitions, 7
- configure
  - begin, 33
  - firmware setup, 33
  - settings
    - auto survey, 52
    - back light, 40
    - broadcast, 36
    - daylight saving time, 38
    - event/deviation, 50
    - irig time data, 49
    - local hour, 37
    - option control, 54
    - out of lock, 39
    - port parameters, 36
    - programmable pulse, 42
    - RS-232, 35
    - system delays, 41
- connecting
  - modulated IRIG-B, 61
  - outputs, 60
  - unmodulated IRIG-B, 61
- connecting power to the clock, see inlet power
- connector
  - antenna, 11, 19
  - event input, 11
  - power inlet, 9
  - relay contacts, 11

- serial communications, 11
  - timing output, 12
- contact information, ii
- copyright, iv
- cordsets
  - IED-320 power inlet connector, 14
- crimp tool
  - RG-11, 24
- digital drivers, 56
- display
  - startup, 94
- display modes
  - Position, 98
  - Time, 96
- drive current vs. output voltage, 57
- driver
  - analog, 56
  - digital, 56
- elevation display, 99
- event display indication, 95
- event trapping, 68
  - arming, 68
- fault indication
  - serial port, 72
- fault modes, 96
- firmware
  - updates, ii
- front panel drawing, see panel drawing, front
- fuses
  - replacing, 17
  - types and location, 17
- handling
  - precautions, 1
- IEC-320 connector, 9
- initial clock time, 93
- initial LED indication, 93
- initial startup sequence, 93
- inlet power, 14
- IRIG-B
  - IEEE 1344 description, 59
  - initial indication, 96
  - modulated
    - voltage matching, 62
  - timecode description, 58
  - type codes, 58
  - unmodulated, 58
  - waveform comparison, 58
- IRIG-B Time code types, 58
- issuance, ii
- keys
  - description, 8
  - Down, 8
  - Enter, 8
  - Event/Deviation, 8
  - Position, 8
  - Setup, 8
  - Status, 8
  - Time, 8
  - Up, 8
- latitude display, 99
- LCD
  - display, 8
- LED
  - annunciator
    - definitions, 6
    - status indicators, 6
- longitude display, 98
- mounting kit
  - antenna, 19
- numeric data entry mode, 34
- Option
  - 07, terminals, 9
  - 08, terminals with SWC, 10
  - 15A, terminals with SWC, 10
  - 15B, terminals with SWC, 10
  - power, 07, 15, 16
  - power, 08, 15
- Options List
  - Option 01, Backlight, 112
  - Option 02, Battery Backup, 112
  - Option 03, Four Additional Outputs, 114
  - Option 07, IEC-320 Power Inlet, 130
  - Option 08, 10 – 60 Vdc Power Inlet, 131
  - Option 10, 110 – 370 Vdc Power Inlet, 137
  - Option 19, Fault Relay, 164
  - Option 20A, Four Fiber Optic Outputs, 168

- Option 23, COMTRADE Sample Rate Generator, 171
- Option 27, 8-Channel High Drive, 178
- Option 28, Power System Time, Frequency and Phase Monitor, 180
- Option 29, Four Outputs, Dry Contacts, 190
- Option 32, Internal NTP Server, 195
- output signal
  - description, 57
- panel
  - rear
    - description, 56
- panels
  - drawing
    - front, 5
    - rear, 9
  - front, 5
  - rear, 5
- position display modes, 98
  - datum, 99
- power supply
  - voltage, 22
- programmable pulse
  - description, 59
  - pulse width, 59
- rack mount
  - mounting instructions, 2
- rear panel, see panel, rear
- RG-11
  - cable, 24
  - crimp tool, 24
- ROM date, ii
- serial command
  - antenna delay
    - set, 90
  - arm event trigger, 76
  - backlight auto, 83
  - backlight off, 82
  - backlight on, 82
  - broadcast ASCII + Quality, 73
  - broadcast ASCII Std, 71
  - broadcast Event Data, 71
  - broadcast Extended ASCII, 73
  - broadcast NMEA183 GLL, 74
  - broadcast NMEA183 ZDA, 75
  - broadcast Status, 72
  - broadcast strings, 71
  - broadcast Vorne Std, 71
  - broadcast Year + ASCII, 74
  - broadcast, interrogate, 71
  - clear event buffer, 76
  - clock offset
    - set, 90
  - Configure Option 23, 173
  - DST/Summertime
    - activate, 81
    - return settings, 81
    - start time, 81
    - stop time, 81
  - enable front panel, 82
  - Event
    - channel time, 75
    - return deviation, 76
  - Event number, 75
  - front panel, disable control panel, 82
  - Local Offset, 82
  - lock setup keys, 82
  - Opt28
    - commands, 185
  - Option 28
    - return System status, 186
    - return time, freq, dev, UTC, 189
    - set deviation, 188
    - set phase calibration, 188
    - set System time as Local, 186
    - set System time as UTC, 186
    - set voltage correction, 189
    - start Broadcast ASCII, 188
    - start Broadcast Vorne, 186
    - system frequency, 185
    - system frequency deviation, 185
    - system phase, 185
    - system time, 185
    - system time deviation, 185
  - out-of-lock alarm
    - set time, 90
  - Prog Pulse
    - pulse polarity, 89
    - set pulse width, 88
    - set time mark, 89

- Pulse Per Hour, 88
- Return
  - display buffer, 90
  - elevation, 84
  - firmware version, 90
  - latitude, 85
  - local date, 87
  - local time, 87
  - longitude, 85
  - UTC date, 87
  - UTC time, 87
- Seconds per Pulse, 88
- Set deviation operation, 75, 76
- set elevation, 84
- Set event operation, 76
- set IEEE 1344 mode, 83
- set latitude, 84
- set local time, 83
- set longitude, 84
- set receiver time, 87
- set UTC time, 83
- Status
  - clock, 77
  - EEPROM, 78
  - receiver, 78
  - status of event/deviation, 77
  - survey, 79
  - system, 79
  - time quality, 80
- survey mode, 86
- serial port
  - output symbols, 70
  - pin definitions, 92, 105
- Setup menu list, 33
- signal
  - output
    - description, 57
- startup sequence, 93
- status display indication, 95
- support
  - request, iii
- synchronizing
  - multiple devices on one port, 61
- time display modes, 96
- timing outputs
  - description, 56
  - intro, 55
  - title page, iv
- unpacking the clock, 1
- version
  - manual, iv
- warranty, iii