# MODEL 1083A
# SATELLITE-CONTROLLED
# FREQUENCY STANDARD

## OPERATION MANUAL

**ARBITER SYSTEMS, INC.**
**PASO ROBLES, CALIFORNIA**
**U.S.A.**

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**ROM Dates**

The ROM date can be read via RS-232, using the "V" command; see Appendix A. 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.

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# Model 1083A
## Satellite-Controlled Frequency Standard

# Operation Manual

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PD0018500C

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# 1.0 General Information

## 1.1 Scope

This manual describes the Model 1083A GPS Satellite-Controlled Frequency Standard. It is divided into five sections and one appendix as follows:

Section 1. General Information
Section 2. Technical Specifications and Operational Parameters
Section 3. Physical Configuration and Installation
Section 4. Operation
Section 5. Firmware Setup and Configuration
Appendix A. RS-232C Commands

## 1.2 Accessories

The standard Model 1083A uses detachable connectors for Power, Antenna, and all Input and Output connections.

### 1.2.1 Supplied Accessories

A standard Model 1083A Satellite-Controlled Frequency Standard comes equipped with the following accessories:

| | |
|---|---|
| GPS Antenna, pipe mount | AP0004800 |
| 15-meter (50-foot) Antenna Cable | CA0021315 |
| Rack Mount Kit (for standard 19-inch rack) | AS0028200 |
| Operation Manual | AS0034100 |
| Power Cord Options | P01 – P10 |

**Antenna and Cable:** The antenna supplied with the 1083A is specifically designed for use with GPS receivers. It is housed in a weatherproof case and includes 15 meters (50 feet) of RG-6 weatherproof, low loss, coaxial cable. Longer cable runs require one of the optional cable assemblies listed below intended to be added to the existing 15-meter cable. For optional antenna cables, see paragraph 1.2.2 and section 3.0.

**Main Power Module:** The standard 1083A configuration includes a user-specified power input module. The three standard options available are:

- Option 07: 85 – 264 Vac, 47 – 440 Hz or 110 – 270 Vdc, 3 VA, IEC-320 type power input module, with an IEC-320 power cord.
- Option 08: 10 – 85 Vdc, 3 W typical, power module with Surge Withstand Capability (SWC) using a 3-pole terminal strip for power inlet.
- Option 10: 85 – 264 Vac, 47 – 440 Hz or 110 – 270 Vdc, 3 VA typical, power module with SWC using a 3-pole terminal strip for power inlet.

Refer to paragraph 1.3 for a detailed description of each power module option.

**Mounting:** Mounting accessories include two separate brackets for mounting the Model 1083A in a 19-inch rack, and rubber feet for desktop use. Cover mounting hardware allows easy attachment of the rack-mount ears (See paragraph 3.1.5).

### 1.2.2 Available Accessories

The following list names available accessories for the Model 1083A.

| Description | Order No. |
|---|---|
| 30-meter (100-foot) RG-6 Antenna Cable | CA0021330 |
| 45-meter (150-foot) RG-6 Antenna Cable | CA0021345 |
| 60-meter (200-foot) RG-6 Antenna Cable | CA0021360 |
| 75-meter (250-foot) RG-6 Antenna Cable | CA0021375 |
| GPS Antenna Mounting Kit | AS0044600 |
| 21-dB In-Line Preamplifier | AS0044700 |
| GPS Surge-Protector Kit | AS0049000 |
| Grounding-Block Kit | AS0048900 |
| 1000-foot Roll RG-11 Cable | WC0004900 |
| RG-6 Crimp Tool | TF0006400 |
| RG-11 Crimp Tool with 25 Connectors | AS0044800 |

For cable lengths of greater than 75 meters (250 feet) Arbiter Systems offers an inline 21-dB preamplifier to make up for the signal loss (see section 3.0 for further information concerning Antennas and Cables). The same 21-dB preamplifier makes up the signal loss for RG-11 cable lengths of greater than 122 meters (400 feet) and up to 244 meters (800 feet).

**Standard, RG-6 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 RF connectors. Cable delay is 1.19 ns per 100 feet. Optional lengths of RG-6 coax are separately available for longer runs; see paragraph 3.5.1.3.

**GPS Antenna Mounting Kit**

A mounting kit, separately available as P/N AS0044600, can be used to mount the antenna to a vertical mast (up to approximately 2-in. diameter), or to the wall or roof of a structure such as an antenna tower or a building. This kit contains a short length of threaded, plastic pipe, a stainless steel bracket, and hardware to attach the pipe to the bracket in any of several orientations. With this kit, it is possible to mount the bracket to any surface from vertical to horizontal, while maintaining acceptable orientation for the antenna. This bracket will accept user-supplied screws for surface mounting, and straps (such as pipe clamps) for mounting to a pipe or mast.

**GPS Surge Protector Kit**

Designed for GPS protection against lightning and other surges. Multi-stage circuitry with a heavy-duty gas discharge tube, toroidal inductor, MOV, and capacitors provides less than 1 nanosecond response time and power handling capacity of 20,000 amps (8/20 µs). Passes dc power to the antenna and preamplifier. Connections are two female, Type F connectors. Includes tow mating connectors for RG-6; crimp tool is available separately. Operating temperature is –40° to +120° C.

**Grounding Block Kit**
The Grounding Block Kit consists of a Type-F bulkhead feedthrough mounted in an extruded aluminum bracket with grounding screw. It also includes two mating connectors for RG-6; a crimp tool is available.

**RG-11 Cable, 1000-ft Roll**
A larger diameter cable, RG-11 comes in a 1000-foot roll for individual applications. With a lower loss characteristic than RG-6 (5.25 dB compared to 9 dB), it can be used where longer runs are required. Also, its quad-shield design and provides better shielding from nearby interfering signals to the low-level GPS signal.

**RG-6 Crimp Tool**
This crimp tool is designed for use with a 0.360” RG-6, hex crimp connector. Advanced design crimp ring of connector can accommodate a wide range of cable sizes, and is made of brass. Connection provides excellent shielding and mechanical retention.

**RG-11 Crimp Tool with 25 Connectors**
This crimp tool is designed for use with 0.480” RG-11, hex crimp connector. Crimp-on center pin of 0.030” prevents potential damage to F female. Attached crimp ring, of connector, provides excellent electrical shielding and mechanical retention.

## 1.3 Options

The Model 1083A allows for installation of options, which can enhance various aspects of performance and/or features. Listed below is a description of the available options for the Satellite Controlled Frequency Standard, the Model 1083A.

### 1.3.1 Option 07, Power Input Module:

Provides an AC/DC power module, which includes an IEC-320 type inlet and mating power cord. Input voltages: 85 – 264 Vac, 47 – 440 Hz or 110 – 270 Vdc, 10 VA typical. Various power cords are available as Options P01 through P10 (See paragraph 3.1.3.5).

### 1.3.2 Option 08, Power Input Module (SWC):

Provides input surge protection (SWC) for compliance with ANSI C37.90-1 and IEC 801-4. Input voltages are 10 – 85 Vdc, 10 W, typical. Utilizes a 3-pole terminal strip for power inlet.

### 1.3.3 Option 10, Power Input Module (SWC):

Provides input surge protection for compliance with ANSI C37.90-1 and IEC 801-4. Input voltages: 85 – 264 Vac, 47 – 440 Hz, or 110 – 270 Vdc, 10 VA typical. Utilizes a 3-pole terminal strip for power inlet.

### 1.3.4 Option 12, Clock Backup Battery:

Includes an internal sealed, gelled-electrolyte lead-acid storage battery with charger. Provides continuous operation in the event of a main power failure for approximately 15 hours. Also, includes a front-panel battery switch.

### 1.3.5 Option 26, Rack Slide Kit

Rack slides and custom mounts for a standard 19-in. EIA relay rack. Includes thumbscrews to lock unit in place. Rack slides are detachable; unit may be removed from the rack without special tools.

# 2.0 Technical Specifications and Operational Parameters

## 2.1 Scope

This section contains information pertinent to the functional and operational characteristics of the standard Model 1083A Satellite Controlled Frequency Standard. This section describes Receiver Characteristics, Operator Interface(s), System Interface(s) and Physical Characteristics.

**NOTE:** Specifications are subject to change without notice.

## 2.2 Receiver Characteristics

### 2.2.1 Input Signal

- 1575.42 MHz, GPS L1 C/A code

### 2.2.2 Time Accuracy

- ±200 ns peak (at 1-PPS output), to GPS/UTC time, when receiving 4 or more satellites (one satellite if position is known within 25 meters). Typically is <30 ns rms over 24 hours.

### 2.2.3 Position Accuracy (rms)

- 25 meters, with SA[1] off
- 100 meters, with SA on
- 140 meters (Elevation), with SA on
- 10 meters (referenced to WGS84) after 24 hours of averaging in a static position.

### 2.2.4 Satellite Tracking

8 channel, C/A code (1575.42 MHz)

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

### 2.2.5 Acquisition

- 30 seconds (90% confidence), with ephemeris[2] less than 4 hours old or uninterrupted clock operation.
- 66 seconds (90% confidence), with almanac less than 1 month old or uninterrupted clock operation.
- 2 minutes (typical)
- 25 minutes (90% confidence), cold start

[1] USA Department of Defense Selective Availability: Time accuracy and long-term frequency stability specifications apply in the presence of SA, when used in Position-Hold Mode. With Position-Hold Mode off, a degradation of 3x to 4x is possible.
[2] Ephemeris data is a list of (accurate) positions or locations of a celestial object as a function of time. Available as “broadcast ephemeris” or as postprocessed “precise ephemeris.”

### 2.2.6 Antenna:

- External, ¾ in. pipe thread mounting (19-mm)
- Size: 77.3-mm diameter x 74.6-mm height (3.04 in. x 2.94 in.)

### 2.2.7 Antenna Cable:

- 15 meters (50 feet) included
- Other cable styles and lengths available – see section 3.3.1.3

## 2.3 Frequency Stability and Spectral Purity

Includes warm-up, locking to GPS signal and the effects of SA when used in the Position-Hold Mode. With Position-Hold – Off, a degradation of 3x to 4x is possible.

### 2.3.1 Phase Noise (@ 5 MHz):

-130 dBc/Hz, 10 Hz offset
-155 dBc/Hz, 100 Hz offset
-165 dBc/Hz, 1 kHz or greater offset

### 2.3.2 Spurious:

-100 dBc, non-harmonically related.
-65 dBc, sub-harmonics (10 MHz output)

### 2.3.3 Harmonics:

-40 dBc

### 2.3.4 Allan Variance:

| | |
|---|---|
| 1 second | $5.0 \times 10^{-12}$ |
| 10 seconds | $3.0 \times 10^{-12}$ |
| 1 day | $5.0 \times 10^{-13}$ |

### 2.3.5 Oscillator

| | |
|---|---|
| Type: | Wenzel Associates Small Fry; 5 MHz, third-overtone SC-cut ovenized |
| Stability: | 1 day: $1.0\times10^{-9}$; Over Temperature: $5.0\times10^{-9}$ |
| Warm-up: | 1 hour |

## 2.4 Operator Interface

### 2.4.1 Setup Functions

Via RS-232C Interface

### 2.4.2 Annunciators

- Operate: (Green)
- Stabilized: (Green)
- Unlocked: (Red)
- Fault: (Red)

### 3.1.3.2 Internal Battery Annunciators (Active only with Option 12):

- Charge: (Green)
- In Use: (Red)
- Lo Battery: (Red)

## 2.5 System Interface

<u>RS-232C Port:</u>

- Connector: 9-pin D-type subminiature:
  Pin 2 = Receive Data
  Pin 3 = Transmit Data
  Pin 4 = Auxiliary Output
  Pin 5 = Ground
  Pin 8 = Auxiliary Input
- Baud Rate 1,200 – 19,200 baud; 7 or 8 data bits, 1 or 2 stop bits, odd/even/no parity.
- Supports all keyboard functions, plus continuous output data in the following formats:

| | |
|---|---|
| <SOH>ddd:hh:mm:ss<CR><LF> | Broadcast Mode, ASCII |
| 44hhmmss<CR><LF>55ddd<CR><LF> ...<BEL> | Broadcast Mode, Vorne |
| mm/dd/yyyy hh:mm:ss.ssssss nnn<CR><LF> | Broadcast Mode, Event |
| ddd:hh:mm:ss I=nn:nn X=nn:nn<CR><LF> | Broadcast Mode, Status |
| <CR><LF>Q_yy_ddd_hh:mm:ss.000____<CR><LF> | Broadcast Mode, Extended ASCII |
| <SOH>ddd:hh:mm:ssQ<CR><LF> | Broadcast Mode, ASCII w/Time Quality |

<SOH> = Hex 01; <CR><LF> = Hex 10 Hex13; <BEL> = Hex 07

### 2.5.1 I/O Configuration

### 3.1.3.2 I/O Connectors

- Signals, four 50-Ω BNC
- Relays, two 5-mm pluggable terminal blocks

### 3.1.3.2 Output Signals

- Sine wave; one each at 1, 5, and 10 MHz, +12 dBm (2.5 Vpp) nominal into 50 Ω
- 1PPS, 5V CMOS; one at 10-Ω source impedance; drive capability ±75 mA

### 3.1.3.2 Relay Contacts:

- Two sets, form-C (SPDT) fail-safe, 0.3 A at 130 Vdc; one is Locked function; second is Stabilized function

## 2.6 Physical Characteristics

### 2.6.1 Dimensions

- Instrument: 430 mm W x 44 mm H x 260 mm D (16.9 in. x 1.7 in. x 10.05 in.)
- Antenna: 77.3 mm diameter x 74.6 mm H (3.04 in. x 2.94 in.)

### 2.6.2 Weight

- Instrument: 2.0 kg (4.5 lbs.) net
- Antenna and Cable: 0.8 kg (1.8 lbs.) net
- Shipping: 8.0 kg (17 lbs.)

### 2.6.3 Output Functions

- Sine wave (3 ea), 1, 5, or 10 MHz, +12 dBm (2.5 Vpp), nominal
- 1 PPS (1 ea), 5 V CMOS

### 2.6.4 Power Requirements (Instrument)

- 85 – 264 Vac, 47 – 440 Hz, 10 VA Max. (Option 07)
- 10 – 85 Vdc, 10 W Max (Option 08)
- 110 – 270Vdc, 85 – 190 Vac, 10 W (Option 10)

### 2.6.5 Power Connector

- Option 07: IEC-320 fused; mating ac or dc cord provided (specified as option P1 through P10) – see paragraph 3.1.3.5
- Option 08 and 10: 3-pole terminal strip

### 2.6.6 Electro-Magnetic Interference (EMI)

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

- Radiated Susceptibility: passes walkie-talkie test

### 2.6.7 Temperature and Humidity

| | Operating | Storage |
|---|---|---|
| Instrument | 0 to 50ºC | -40 to 75ºC |
| Antenna | -40 to 85ºC | -55 to 100ºC |
| Antenna Cable | -40 to 60ºC | -40 to 80ºC |
| | 10 to 90% | non-condensing |

# 3.0 Physical Configuration

## 3.1 Instrument

### 3.1.1 Location Considerations

The Model 1083A Satellite-Controlled Frequency Standard is designed for operation in an environment having an ambient temperature range of 0°C to 50°C (32°F to 122°F). No external ventilation is necessary. Operation is possible at temperatures from -20° to +65°C, although performance may be degraded (e.g. oscillator frequency drift). 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, to prevent damage to the connectors, cables, or the instrument. Ideally, locate the Model 1083A close enough to the antenna to use the standard 15-meter (50-foot) cable. The loss and delay characteristics of the cable are important factors in the calibration and accuracy of the instrument (refer to paragraph 3.3.1.1); thus, the entire cable length should be used, with any excess coiled up and placed out of the way.

Using RG-6 style cable, the Model 1083A can operate with antenna cable lengths up to 75 meters (250 feet) without a preamplifier and up to 150 meters (500 feet) using an in-line preamplifier. Using RG-11 style cable, operation is possible with cable lengths of up to 122 meters (400 feet) without a preamplifier and up to 244 meters (800 feet) with an in-line preamplifier. Refer to paragraph 1.2.2 for a description of available accessories and 1.3 for options and part numbers.

### 3.1.2 Power Requirements

The Model 1083A Satellite-Controlled Frequency Standard can be configured with one of three different power supplies. Option 07 is standard.

- Option 07 (standard): 85 Vac – 264 Vac, 47 Hz – 440 Hz or 110 – 275 Vdc, 3 VA typical, IEC-320 type power input module including an IEC-320 ac power cord (see paragraph 3.1.3.1).
- Option 08: 10 – 85 Vdc, 3 W typical, power module with Surge Withstand Capability (SWC) using a 3-pole terminal strip for power inlet (see paragraph 3.1.3.2).
- Option 10: 85 – 190 Vac, 47 – 440 Hz or 110 – 270 Vdc, 3 VA typical, power module with Surge Withstand Capability (SWC) using a 3-pole terminal strip for power inlet (see paragraph 3.1.3.3).

If frequent power interruptions are anticipated, or if the instrument will be moved periodically to different locations, note that the GPS receiver now has its own standard, data backup battery. This will keep the memory in the GPS receiver section of the Model 1083A active during power outages, resulting in greatly reduced satellite acquisition time when the power is restored. The backup battery is manganese-dioxide lithium, and an internal circuit maintains the charge level. As installed, the data backup battery will support the GPS receiver data memory for six months on a full charge, and has a lifetime of up to five years.

### 3.1.3 Power Line Connection

The standard Model 1083A is equipped with a *user specified* Power Input Module. The available power modules are described in the following paragraphs.

#### 3.1.3.2 Option 07, AC/DC Power Input Module (IEC-320 Inlet)

##### 3.1.3..1 AC Operation

This power-inlet module operates with an ac input voltage range of 85 – 264 Vac, 47 – 440 Hz. The mating ac/dc cord depends upon the option (P1 through P10) which was specified at the time of purchase. For further information about ac/dc power cords see paragraph 3.1.3.5.

To connect the input power, first plug the end of the power cord having the mating IEC connector into the power inlet module on the rear panel, then plug the other end into an appropriate power outlet.

| | |
|---|---|
| **WARNING** | For maximum safety and best performance, always connect the input cord to a properly grounded power source. |

##### 3.1.3..2 DC Operation

For 110 – 270 Vdc operation, the dc voltage should be applied between the LINE and NEUTRAL terminals of the power-inlet module, without regard to polarity (the internal power supply will accept either polarity). When viewing the power-inlet module from the rear of the instrument, the LINE connection is the one nearest the bottom, and the NEUTRAL is nearest the top. The GROUND terminal is offset from the others, and protrudes slightly farther out of the connector.

| | |
|---|---|
| **WARNING** | Only connect the input to a properly grounded power source. |

#### 3.1.3.2 Option 08, DC Power Input Module

If Option 08 is ordered, the power module accepts *only* dc-input voltages from 10 – 85 Vdc. The standard IEC-320 inlet is replaced with a 3-pole terminal strip with input surge protection (SWC). The terminal strip is intended for connection to dc power sources only. When connecting power to a clock with Option 08, **BE SURE TO OBSERVE CORRECT POLARITY**, as the power supply used with Option 08 will not accept reverse input polarity.

| | |
|---|---|
| **CAUTION** | *DO NOT* connect Option 08 module to an AC Voltage Source. |

#### 3.1.3.2 Option 10, AC/DC Power Input Module

##### 3.1.3..1 AC Operation

This option provides a input power module which operates with an ac input voltage range of 85 – 190 Vac, 47 – 440 Hz. Line connection is via a 3-Pole terminal strip which provides SWC. This terminal strip is intended for connection to dc power sources, although the unit is capable of operation from both ac and dc sources.

### 3.1.3..2 DC Operation

The input power module supplied with this option also accepts dc voltages from 110 – 270 Vdc via the 3-Pole terminal strip (with SWC).

### 3.1.3.2 Fuse Replacement

The IEC-320 power connector includes a 1 A, 250 V fast acting 5 x 20-mm fuse. The fuse is contained in a small compartment with a snap-fit latch, which also has a compartment for a spare fuse.

| | |
|---|---|
| **CAUTION** | For continued protection, replace the input fuse only with one of the same type, voltage rating, and current rating as originally supplied. |

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

For instruments supplied with Option 08 or 10, the fuse is located in the fuse holder on the rear panel near the power inlet terminal strip. The fuse is a 1 A, 250 V fast acting (Option 10) or time-delay (Option 08) 5 x 20-mm fuse. No spare fuse is provided for Options 08 or 10.

### 3.1.3.2 Power Cords and Plug Styles

The following list shows the available IEC-320 power cords and plug styles.

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

### 3.1.4 Rear Panel Layout

When viewed from the behind, the rear panel of a standard Model 1083A is arranged in the following manner, left to right (see Figure 3-1, shows Option 07 power inlet connector):

- Four BNC-type connectors used for standard sine wave outputs (1 PPS, 1 MHz, 5 MHz, 10 MHz).
- One 6-position pluggable terminal strip for use with the form-C (SPDT) relay contacts. Used for Locked (one contact set) and Stabilized functions (second contact set).
- A 9-pin D-subminiature connector for the RS-232C serial interface. For pin designations, refer to paragraph 2.5.
- An “F” type RF connector (female) to accept the antenna cable.
- For Option 07, an IEC-320 power inlet connector with built-in fuse holder is provided. For Options 08 or 10, a 3-Pole terminal strip and separate fuse holder is provided.

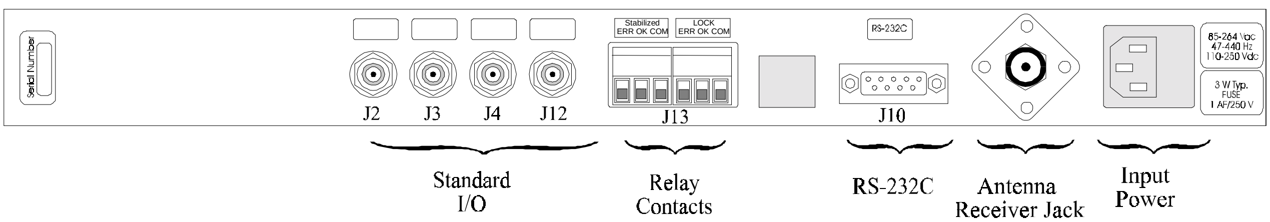


**Figure 3-1. Model 1083A Rear Panel**

### 3.1.5 Rack Mounting

Rack-mounting ears are included to facilitate mounting the instrument in a standard 483-mm (19-inch) equipment rack. To install the rack-mounting ears, observe the following steps:

1. Using a T-25 driver, remove the two screws on one side of the unit. Leave the cover in place.
2. Position one of the rack-mounting ears on the side of the unit, so that the rack-mounting flange is at the front of the instrument and extends away from the front panel.
3. Replace the cover screws by routing them through the lower set of holes in the rack-mounting ear, and back into the threaded holes in the instrument.
4. Repeat the above steps for the opposite rack-mounting ear.

## 3.2 Antenna

### 3.2.1 Antenna Location

The antenna module supplied with the standard Satellite Clock is designed for outdoor use in all weather conditions. The operating temperature range extends from -40°C to +85°C (-40°F to +185°F), and the module is both weatherproof and waterproof. For maximum signal strength and satellite acquisition capability, the antenna should be mounted out-of-doors and away from large structures. Mounting height is not particularly critical, provided that the antenna has the clearest possible view of the sky in all directions. An ideal installation is one in which the view is unobstructed from the horizon to directly overhead at each point of the compass.

Alternatively, mount the antenna indoors, below a skylight or other structure that is transparent to RF energy at the GPS-L1 frequency of 1.575 GHz. When in doubt as to the suitability of such a structure, there is no harm in trying it. Such an installation can reduce costs and improve reliability, because even though the antenna and cable are intended for outdoor mounting, operating life will be extended by exposure to a more benign environment.

### 3.2.2 Antenna Gain Pattern

When the antenna module is mounted to a vertical pole, the maximum-gain lobe extends vertically above the antenna, and is nearly spherical in shape. Therefore, the antenna should be oriented with the mounting surface parallel to the ground, i.e. mounted to a vertical pole. In this position, the gain of the antenna above the horizon will be nearly uniform in all directions, which will allow the best overall reception of all visible satellites. Mount to non-vertical surfaces using the GPS Antenna Mounting Bracket (Part No. AS0044600).

### 3.2.3 Antenna Mounting

The standard antenna module is designed for pole mounting on a 26-mm (1.05-in. or ¾-in. pipe) pole, with either a standard 1in. – 14 (approximately M25.4 x 1.81) marine-mount thread or a ¾-in. NPT pipe thread. The “F” type connector on the inside of the antenna module is protected from direct exposure to the elements when the antenna is mounted in this way. This will extend the operational life of the antenna-to-cable interface.

When mounting the antenna, route the supplied antenna cable up through the pole and attach the “F” connector on the end of the cable to the mating connector inside the antenna-mounting socket before mounting on the pole. If possible, to reduce stress on the cable and connection, allow the cable to rotate freely when screwing the antenna onto the pole. Or, you can rotate the pole while holding the antenna in a fixed position.

### 3.2.4 Optional Antenna Mounting Kit

A mounting kit, separately available as P/N AS0044600, can be used to mount the antenna to a vertical mast (up to approximately 2 inches in diameter), or to the wall or roof of a structure such as an antenna tower or a building. This kit contains a short length of threaded plastic pipe, a stainless-steel bracket, and hardware to attach the pipe to the bracket in any of several orientations. With this kit, it is possible to mount the bracket to any surface from vertical to horizontal, while maintaining acceptable orientation for the antenna. This bracket will accept user-supplied screws for surface mounting, and straps (such as pipe clamps) for mounting to a pipe or mast.

## 3.3 Antenna Cable

### 3.3.1 Length and Loss Considerations

#### 3.1.3.2 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 “F” type RF connectors. Optional lengths of RG-6 coax are separately available for longer runs; see paragraph 3.3.1.3.

#### 3.1.3.2 Effects of Cable Parameters

The type and length of the cable are important with regard to proper reception of GPS signals and operation of the clock, 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.

#### 3.3.1..1 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 in section 3.3.1.3. The formula for calculating cable delay is:

$$T = \lambda \frac{1}{CK_v} + 1ns$$

Where:

T = Cable delay, in nanoseconds;

$\lambda$ = Cable length, in meters;

C = Speed of light ($3x10^8$ meters per second);

$K_v$ = 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.

#### 3.3.1..2 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 AS0044700 21-dB in-line preamplifier.

#### 3.3.1..3 DC Resistance

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

### 3.1.3.2 Available Antenna Cables and Accessories for Longer Runs

Arbiter Systems offers longer antenna cables for use with all clock models when the standard 15-meter (50-foot) cable is inadequate. In addition, using a 21-dB in-line amplifier (P/N AS0044700) allows use of antenna cables having twice the length and loss (as without the amplifier). By using lower-loss, RG-11 cable (P/N AS0044700), runs of 120 meters (400 feet) without the in-line preamplifier or 240 meters (800 feet) with the AS0044700 amplifier are possible.

The available cables and accessories are summarized here:

| Part No. | Description | Delay, ns | Gain/Loss |
|---|---|---|---|
| CA0021315 | 15-m (50-ft) cable, RG-6 trishield (standard) | 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 quadshield cable (unterminated) | 3.92 ns/m<br>1.19 ns/ft | -17.5 dB/100 m<br>-5.25 dB/100 ft |
| AS0044800 | Kit, crimp tool and 25 connectors for RG-11 style cable | N/A | N/A |
| AS0044700 | 21-dB in-line amplifier | 1 ns | +21 dB |

## 3.3.2 Routing Considerations

### 3.1.3.2 Orientation

The ends of the antenna cable have identical connectors, so cable orientation is not important.

### 3.1.3.2 Physical Protection

The antenna cable should be routed in such a way as to protect it from physical damage, which may result from closing doors, falling objects, foot traffic, etc. Also, when routing around corners, sufficient bend radius should be allowed to prevent kinking. 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.

The cable should not be stretched 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 type of cable provided with the clock has a maximum operating temperature rating of 60°C (140°F). Exercise care when routing the cable near sources of heat to avoid cable damage.

#### 3.1.3.2 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 type cable (P/N WC0004900). Its quad-shielded design provides even more isolation.

### 3.3.3 Antenna Module Power

The RF preamplifier within the antenna module requires 5 Vdc at 22 mA for operation. A power supply within the clock generates this voltage, which is applied to the antenna module 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 contained in paragraph 3.3.6.

### 3.3.4 Connection to Antenna

The male "F" type RF connector on one end of the antenna cable mates with the female "F" connector on the antenna module. Avoid placing mechanical stress on the cable attachment to the antenna module. See paragraph 3.2.3.

### 3.3.5 Connection to Clock

The male "F" type RF connector on the opposite end of the antenna cable connects to the female "F" connector on the rear panel of the Satellite Clock.

### 3.3.6 Antenna and Cable Operational Test

Prior to initial operation or any time antenna/cable problems are suspected, perform the following procedure:

> **NOTE** Perform the following test with the antenna connected normally at the far end of antenna cable. *The results of this test will be affected if your installation includes the AS0044700 in-line amplifier. Consult the separate data provided with this unit for guidance.*

1. Disconnect antenna cable from rear panel of the clock.
2. At the rear panel Antenna connector, connect a voltmeter between the center connector and ground. The voltage measured should be approximately +5 V.
3. Connect an ohmmeter between the cable center conductor and the cable shield. The dc resistance should be approximately 4 kΩ but should not exceed 10 kΩ (typically from 2K to 8 kΩ).
4. If the resistance measured exceeds 10 kΩ, it may indicate an open-circuit condition (typically measuring >100 kΩ if open).

5. If the resistance measured is less than 1 kΩ it may indicate a short-circuit condition (typically measuring <100 Ω if shorted).

| | |
|---|---|
| **CAUTION** | Do not attempt to operate the Model 1083A until all errors are corrected. Any errors encountered during this test will prevent proper operation. |

### 3.3.7 User-Supplied Antenna Cables

Any RF cable meeting the requirements described above for loss (≤21 dB at 1575 MHz) and dc resistance (≤15 Ω total loop resistance) may be used with the clock. However, prior to using a non-standard antenna cable, verify proper installation by performing the Operational Test contained in paragraph 3.3.6.

# 4.0 Operation

## 4.1 Front Panel Controls and Indications

The Model 1083A front panel is illustrated in Figure 4-1 and described in the following paragraphs.


**Figure 4-1. Model 1083A Front Panel**

### 4.1.1 LED Status Indicators

Four LED indicators are located to the right of the line switch and three farther right. These indicators provide specific information about the operational status of the instrument. Each indicator is described below:

### 3.1.3.2 OPERATE

Indicates that the Model 1083A is powered on.

### 3.1.3.2 CHARGE

Illuminates when 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 provides a trickle charge. If the battery charge falls below a preset threshold, the 'high-charge' mode is activated.

### 3.1.3.2 IN USE

Indicates that the internal battery is supplying power to the instrument.

### 3.1.3.2 LO BATTERY

Provides a warning when the battery voltage falls below +5.6 volts.

### 3.1.3.2 STABILIZED

Illuminates steady when meeting the following conditions: (1) the temperature-controlled, ovenized crystal oscillator has reached operating temperature, (2) the unit has locked to satellites, and (3) sufficient time has elapsed for the oscillator frequency to stabilize, typically about 5 minutes.

#### 3.1.3.2 UNLOCKED

Illuminates when loss of satellite lock occurs (after a preset delay). This indication exactly follows the ‘Out-of-Lock’ signal available from the rear-panel relay connector.

#### 3.1.3.2 FAULT

Illuminates when Fault conditions exist in the receiver or when the Ovenized Crystal Oscillator (OCXO) tune voltage is out of range (refer to paragraph 4.4). May also illuminate during initial power-on sequence prior to satellite lock. If the LED remains illuminated, Position-Hold data may be invalid and/or a hardware problem may be present.

## 4.2 Satellite Acquisition and Position Data

### 4.2.1 Almanac and Positional Data

The GPS receiver module employed in the Model 1083A Satellite-Controlled Frequency Standard includes non-volatile memory for storage of almanac (satellite orbit) data and position (longitude, latitude, and elevation) information. During normal operation, the 1083A updates position data stored in non-volatile memory when all of the following conditions are met (for a period of 10 seconds, or more):

- Position shift of greater than 50 km.
- A Position Dilution of Precision (PDOP) of less than 5.
- Continuous position fixes from at least four satellites.

If input power is removed from the instrument, the last recorded values for these parameters are retained. This will expedite the acquisition of satellites when power is restored.

### 4.2.2 Satellite Acquisition Time

When the unit is received from the factory, initial satellite acquisition could take as long as 25 minutes. The time required for acquisition of satellites is dependent upon the accuracy and age of the almanac and position data last stored. An updated version of this information will be stored for the new operating location in accordance with paragraph 4.2.1. After this, satellite acquisition will typically occur in about 2 minutes. With the standard data backup battery installed, acquisition time will usually be shorter, particularly after brief power interruptions of less than 4 hours.

## 4.3 Startup Sequence

Upon initial power-on sequence, the OPERATE and UNLOCKED LEDs will illuminate. The FAULT LED may also illuminate until satellite lock is achieved and the STABILIZED LED illuminates.

## 4.4 Fault Conditions

The front panel FAULT LED may illuminate during initial power-on sequence until satellite lock is achieved. However, in the event of an error, which causes the FAULT LED to illuminate steadily, use the RS-232C command System Status, ‘SS’, to view the error code. The meaning of this error code is determined by interpreting it as an 8-bit byte, with the following assignments for Bit, Weight and Function:

| Bit | Weight | Function |
|---|---|---|
| 0 (LSB) | 1 | Reserved (set to 1) |
| 1 | 2 | Frequency Not Stabilized |
| 2 | 4 | Reserved (Set to zero) |
| 3 | 8 | Reserved (Set to zero) |
| 4 | 16 | Out-of-Lock |
| 5 | 32 | Time Error |
| 6 | 64 | VCXO Tune Error (out-of-bounds) |
| 7 (MSB) | 128 | Receiver Failure |

### 4.4.1 Fault Condition Examples

Fault conditions may be viewed using the SS command over the Model 1083A RS-232C serial port. For more information concerning the SS command, please see Appendix A, Table A-2, Status Mode Commands. Remember that the numbers returned are *hexadecimal* representations of the fault conditions. Do not confuse fault conditions with the Fault LED. While each fault condition listed above may be examined using the SS command, only certain fault conditions illuminate the Fault LED. For these conditions, see paragraph 4.1.1.7.

| | System Status Response | Fault Condition(s) | LED |
|---|---|---|---|
| 1. | ssI=13:00 X=FF:00 | Out-of-Lock<br>Frequency Not Stabilized | Not Illuminated |
| 2. | ssI=93:00 X=FF:00 | Frequency Not Stabilized<br>Out-of-Lock<br>Receiver Failure | Illuminated |
| 3. | ssI=53:53 X=FF:FF | Frequency Not Stabilized<br>Out-of-Lock<br>VCXO Tune Error | Illuminated |

Remember to add “1” for the zero bit in each of the examples above. It is reserved and set to 1. Note that the initial “ss” preceding the System Status Response is the actual command for System Status. Commands are initiated with the last relevant character entered. Pressing ENTER, or using carriage-return line-feed characters (in programming) is not necessary.

## 4.5 Position-Hold and Auto-Survey Modes

Operation in the Position-Hold Mode forces the clock to utilize a single set of position data as a reference for time calculations, rather than the position information obtained from the continuously updated receiver position fix. Using accurate Position-Hold information results in a reduced standard deviation for the time data. Position-Hold data originates from one of three sources: (1) a value previously stored in the receiver non-volatile memory, (2) a new position fix determined at power-up (Auto-Survey), or (3) a value entered via RS-232C command (refer to Appendix A, Tables A-4 & A-5).

The Model 1083A can also determine its own position with greater accuracy than is possible with a single fix using the Auto-Survey Mode. This function operates by accurately averaging a specified number of position fixes from 1 to 86,400 (no averaging to approximately 24 hours of fixes, respectively). Because Selective Availability (SA) is a pseudo-random error, it is reduced by averaging, thus delivering an approximate position uncertainty (1 sigma) of 0.2 arc-seconds (approximately 6 meters) in latitude and longitude, and 20 meters in elevation for a 1-hour average.

For longer and shorter averages these errors scale approximately with the inverse square root of the ratio of the number of fixes. For example, for 24 hours of averaging the results will be approximately $1/\sqrt{24}$ or 0.2 times the uncertainty for a 1-hour average, or approximately 0.04 arc-seconds and 4 meters elevation (1 sigma).

### 4.5.1 Position Accuracy Requirements

Errors in position of up to 100 meters have only a small effect on frequency stability. A GPS position fix, even in the presence of SA, is generally within 100 meters of the correct position, and can be used directly with minimal errors if a more accurate position is not available. If a surveyed position is available, using this data can eliminate these residual errors. A position within 0.5 arc-seconds of latitude and longitude and 5 meters elevation is sufficient to eliminate these residual errors almost completely.

If only one or two of the position parameters are accurately known, it is best to edit these parameters while leaving the others unchanged. This may be the case if, for example, latitude and longitude are known from an accurate survey but elevation is unknown; or if elevation is obtained from a topographic map, but accurate longitude and latitude position is unavailable. Using the best available information will give the best overall performance. This is particularly true for elevation, because elevation errors will cause a bias error (offset) in the time solutions of up to 3 nanosecond per meter. In general, latitude and longitude errors, if large enough, cause an increase in the rms variations of the time solution, but cause only a minimal bias error.

### 4.5.2 Default Settings

As supplied from the factory, the Model 1083A is configured to perform a 1-minute Auto-Survey at power on, and then enter Position-Hold Mode. These settings may be changed via the RS-232C port as described in Appendix A, Tables A-4 and A-5.

## 5.0 Appendix A. RS-232C Command Summary

This appendix summarizes the RS-232C commands available for communicating with the 1083A Satellite-Controlled Frequency Standard. Organized in 9 separate tables, as listed below, these commands provide complete control over the operational and data retrieval functions of the Model 1083A. The first line of each command is given in bold, with the command name on the left and serial command sequence on the right.

Initially, configure the baud rate and communications parameters of the computer to match those of the Model 1083A. Default configuration of the Model 1083A from the factory is 9600 baud, 8N1 (8 data bits, No parity, 1 stop bit). Communication parameters may be configured differently after establishing communications with the Model 1083A.

Note that the data formats found throughout the Command Summary reflect the maximum number of digits allowed. The number of digits may be scaled according to specific format requirements except as noted in this Summary.

The following symbols and syntax are used throughout and are repeated here for emphasis:

1. ↵ shorthand for <CR><LF> (Carriage-Return, Line-Feed).
2. Underlines are used for clarity only and graphically represents the location of ASCII SPACES.

Enter serial commands exactly as shown on the right of first line of the tables. Commands that require configuration values must include the correct numerical value as described in the comments below each command. For example, the DA (Set Antenna Delay) command is normally prefaced with a numerical value from 0 to 999999, in nanoseconds. The antenna delay for the standard 15-meter cable is 60 nanoseconds. Therefore, the complete command to set 60 ns as the internal antenna delay is:

60DA

Type each command without pressing ENTER, or send a program sequence without a carriage-return, line-feed character.

## A-1. Broadcast Mode Commands

### Broadcast Mode – Off **B0**

B0 deactivates the RS-232C Broadcast Mode (resets to Interrogate Mode).

Response: ↵

### Broadcast Mode – ASCII **B1**

B1 configures the RS-232C Broadcast Mode to send time-of-day as ASCII data.

Response: SOH>ddd:hh:mm:ss↵

<SOH> = Hex 01. The start-bit of the <SOH> character is transmitted on time, and is broadcast once per second.

### Broadcast Mode-Vorne **B2**

B2 configures the RS-232C Broadcast Mode to support Vorne large-format time displays. See Application Note 103 for more information.

| | | |
|---|---|---|
| Response: | 11nn↵ | (out-of-lock time) |
| | 44hhmmss↵ | (UTC/Local time) |
| | 55ddd↵ | (day-of-year) |
| | <BEL> | <BEL> = hex 07 |

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 – Status **B3**

B3 configures the RS-232C Broadcast Mode to send status data.

Response: ddd:hh:mm:ss I=nn:nn X=nn:nn↵

(Updates whenever the status changes.)

| | |
|---|---|
| "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. |

The 8-bits of the Status byte are weighted and assigned as follows:

| Bit | Weight | Function | Bit | Weight | Function |
|---|---|---|---|---|---|
| 0 | 1 | Reserved (Set to 1) | 4 | 16 | Out-of-Lock |
| 1 | 2 | Freq. not stabilized | 5 | 32 | Time Error |
| 2 | 4 | Reserved (Set to 0) | 6 | 64 | VCXO Tune Error* |
| 3 | 8 | Reserved (Set to 0) | 7 | 128 | Receiver Error |

* out-of-bounds

## Broadcast Mode – Extended ASCII **B5**

B5 configures the RS-232C Broadcast Mode to send time-of-day as ASCII data using an extended format prefaced with a time quality indicator.

Response: <CRLF>Q_yy_ddd_hh:mm:ss.000↵

| | | |
|---|---|---|
| Format: | <CRLF> | Carriage-return, line-feed. The start-bit of a carriage-return is transmitted on time. |
| | Q | Time Quality Indicator, and may be represented by: |
| | a space | Locked, maximum accuracy |
| | ? | (ASCII 63) Unlocked, accuracy not guaranteed |
| | underline | Used here for clarity only and graphically represents the location of ASCII spaces. |

## Broadcast Mode-ASCII with Time Quality Indicator **B6**

B6 configures the RS-232C Broadcast Mode to send time-of-day as ASCII data appended with a Time Quality Indicator.

Response: <SOH>ddd:hh:mm:ssQ↵

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

## Broadcast Data-Local **BL**

BL configures the RS-232C Broadcast Mode to send data using the local time reference. Broadcast Data – Local may be used concurrently with other Broadcast commands.

Response: ↵

## Broadcast Data-UTC **BU**

BU configures the RS-232C Broadcast Mode to send data using the UTC time reference. Broadcast Data – UTC may be used concurrently with other Broadcast commands.

Response ↵

## A-2. Status Mode Commands

### Clock Status — SC

SC returns the current Clock Status.

Response: L/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). If the out-of-lock function is deactivated, this field is returned as S = Off. |

### Oven-Controlled Crystal Oscillator (OCXO) Status — SD

SD returns the DCXO Status

Response: ±tt.tC ±pp.pp PPM↵

Format:

| | |
|---|---|
| tt.t | Ambient temperature in degrees C |
| pp.pp | Residual, corrected OCXO error |

### EEPROM Status — SE

SE returns the EEPROM Status.

Response: T=t CE=eee

Format:

| | |
|---|---|
| t | = 0, No Timeout Error |
| | = 1, Timeout Error |
| eee | = Number of corrected errors in reading EEPROM data |

### Receiver Status — SR

SR returns the current Receiver Status.

Response: V=vv S=ss T=t P=Off E=0↵

Format:

| | |
|---|---|
| vv | Number of satellites, which should be visible to the antenna, per almanac. |
| ss | Indication of relative signal strength. |
| t | Number of satellites being actively tracked |
| 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 that 3 satellites are visible, OR if Position-Hold is active. |
| E=0 | Describes the status of internal communications between the receiver and clock boards. A “0” indicates no errors. If clock operation is improper and any other character is persistently returned, contact Arbiter Systems. |

### Survey Status SQ

SQ returns Auto-Survey Mode data. For a survey in progress, the current status of the survey is returned. For a completed survey, the final results of the survey are returned, i.e. the averaged position.

Response: Sn Pm Fnnnn #nnnnTyyyy:ddd:hh:mm:ss Eddd:mm:ss.sss Ndd:mm:ss.sss Hmmmmm.mm↵

| | | |
|---|---|---|
| Format: | Sn | Represents the status of the Auto-Survey Mode |
| | Pn | Represents the status of the Position-Hold Mode |
| | Fnnnn | Current number of fixes |
| | #nnnn | Total number of fixes required |
| | yyyy:ddd:hh:mm:ss | Time of completion of the most recent average, updated each 60 fixes, approximately each minute. |
| | Eddd:mm:ss.sss | Current surveyed antenna longitude. (East or West) |
| | Ndd:mm:ss.sss | Current surveyed antenna latitude. (North or South) |
| | Hmmmmm.mm | Current surveyed antenna elevation. (MSL) |

Table 1 shows the significant three bits of the Auto-Survey Status byte, weighting and assignments. Table 2 shows the significant three bits of the Position-Hold Status byte, weighting and assignments.

TABLE 1 – Auto-Survey Status byte

| Bit | Weight | Function* |
|---|---|---|
| 0 (LSB) | 1 | Single Auto-Survey |
| 1 | 2 | Power-On Auto-Survey |
| 2 | 4 | Suspend Survey |
| 3-7 | N/A | |

TABLE 2 – Position-Hold Status byte

| Bit | Weight | Function* |
|---|---|---|
| 0 (LSB) | 1 | Position-Hold Enabled |
| 1 | 2 | Position-Hold Active |
| 2 | 4 | Position-Hold ID:<br>0: Surveyed<br>1: User-Entered |
| 3-7 | N/A | |

* may simultaneously set more than one bit.

The remainder of the information is the running position average, including all fixes since the beginning of the Auto-Survey cycle.

## System Status SS

SS returns the instrument operational status whenever the status changes.

Response: I=nn:nn X=nn:nn

Format:

| | | |
|---|---|---|
| Format: | "I" | Internal clock conditions |
| | "X" | External clock conditions, returned as FF |
| | "nn:nn" | Hexadecimal representations of the status byte. The two digits preceding the colon describe present condition of the instrument. The two digits after the colon indicate the parameters that have changed. |

Table 3 shows the eight bits of the status byte, their weighting and assignments.

| Bit | Weight | Function | Bit | Weight | Function |
|---|---|---|---|---|---|
| 0 | 1 | Reserved (Set to 1) | 4 | 16 | Out-of-Lock |
| 1 | 2 | Frequency not stabilized | 5 | 32 | Time Error |
| 2 | 4 | Reserved (Set to 0) | 6 | 64 | VCXO Time Error |
| 3 | 8 | Reserved (Set to 0) | 7 | 128 | Receiver Comm. Failure |

## Time Quality TQ

TQ returns a single ASCII Hex character (0-9, A-F) indicating estimated worst case time quality, following IEEE Standard P1344

Response: h↵

| h | Condition | h | Condition |
|---|---|---|---|
| 0 | Clock locked, maximum accuracy | 7 | Clock unlocked, accuracy < 1 ms |
| F | Clock failure, time not reliable | 8 | Clock unlocked, accuracy < 10 ms |
| 4 | Clock unlocked, accuracy < 1 us | 9 | Clock unlocked, accuracy < 100 ms |
| 5 | Clock unlocked, accuracy < 10 us | A | Clock unlocked, accuracy < 1 s |
| 6 | Clock unlocked, accuracy < 100 us | B | Clock unlocked, accuracy < 10 s |

## A-3. Local Daylight Savings Time Setup Commands.

**Daylight Saving Off D0**

D0 deactivates the Daylight Saving time-adjust feature (does not add 1 hour to local time display and output).

Response: ↵

**Daylight Saving On D1**

D1 activates the Daylight Saving time feature (adds 1 hour to local time display and output).

Response: ↵

**Daylight Saving Auto D2**

D2 provides for the automatic adjustment of local time to standard daylight saving time. Time changes occur on the first Sunday in April (add 1 hour) and the last Sunday in October (subtract 1 hour). Local time adjustment normally occurs at 0200 and can be changed using the DT command.

Response: ↵

**Daylight Saving Auto Changeover Time hh:mmDT**

hh:mmDT provides the ability to define when the daylight saving time automatic adjustment occurs (a time other than 0200).

Format: "hh:mm" can be any time between 00:00 to 23:59.

Response: ↵

**Local Offset ±hh:[mm]L**

hh:mmL configures the instrument to display and output Local time corresponding to UTC by setting the time offset (number of hours difference between local and UTC).

Format: "±hh" are hours, and "[mm]" are minutes

Maximum offset: ±12 hours, 30 minutes [minutes optional]

Response: ↵

## A-4. Position Data and Position-Hold Commands

### Set Position-Hold – Elevation MMMMM.mmH

MMMMM.mmH sets antenna elevation in meters MSL (mean sea level); fractional meters elevation optional.

Format: "MMMMM.mm" is in meters.

Response: ↵

### Set Position-Hold – Latitude dd:mm:ss.sssN(S)

dd:mm:ss.sssN(S) sets the antenna latitude.

| | | |
|---|---|---|
| Format: | "dd" | Degrees |
| | "mm" | Minutes |
| | "ss.sss" | Seconds |
| | "N" | North ("S" for South) |

Response: ↵

### Set Position-Hold – Longitude ddd:mm:ss.sssE(W)

ddd:mm:ss.sssE(W) sets the antenna longitude.

| | | |
|---|---|---|
| Format: | "ddd" | Degrees |
| | "mm" | Minutes |
| | "ss.sss" | Seconds |
| | "E" | East ("W" for West) |

Response: ↵

### Latitude LA

LA returns the current antenna latitude. In Position-Hold mode, it returns the current Position-Hold latitude setting.

Response: N(S)dd:mm:ss.sss↵

| | | |
|---|---|---|
| Format: | "N" | North ("S" for South) |
| | "dd" | Degrees |
| | "mm" | Minutes |
| | "ss.sss" | Seconds |

## Elevation LH

LH returns the current antenna elevation. In Position-Hold mode, returns the current Position-Hold elevation setting.

Response: nnnnn.nn↵

Format: “nnnnn.nn” Antenna elevation in meters above sea level

## Longitude LO

LO returns the current antenna longitude. In Position-Hold mode, returns the current Position-Hold longitude setting.

Response: Wddd:mm:ss.sss↵

| | | |
|---|---|---|
| Format: | “W” | West (“E” for East) |
| | “ddd” | Degrees |
| | “mm” | Minutes |
| | “ss.sss” | Seconds (fractional seconds optional) |

## Position-Hold – Off PH0

PH0 deactivates the Position-Hold timing mode. The receiver resumes computing time and position solutions.

Response: ↵

## Position-Hold – On 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.

Position-Hold position information is set using the Set Position-Hold RS-232C command, or the Auto-Survey function.

Due to the risk that previously-stored position data my be inaccurate, *exercise caution* when activating the Position-Hold mode without either performing an Auto-Survey or setting the position directly. Failure to observe these precautions may result in serious timing errors.

Response: ↵

## A-5. Survey-Mode Commands.

### Auto-Survey Mode m:nQ

m:nQ sets the Survey Mode (m) and the number of fixes to average (n). Used to automatically determine antenna position for Position-Hold Mode.

Format:

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

Response: ↵

Obtain a Survey Status with the “SQ” command. Activate Position-Hold Mode with the PH1 command.

## A-6. Date and Time Commands.

### Set Receiver Time yyyy:mm:dd:hh:mmTS

Sets the receiver UTC Time. Ignored when locked to satellites. When the receiver is initially activated, and has not locked onto satellites, acquisition time may be improved by using the TS command. Give 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.

| | | |
|---|---|---|
| Format: | "yyyy" | Year |
| | "mm" | Month |
| | "dd" | Day |
| | "hh" | Hour |
| | "mm" | Minute |

Response: ↵

### Local Date DL

DL returns the current date, in local time.

Response: dddmmmyyyy↵

| | | |
|---|---|---|
| Format: | "ddd" | Day of year |
| | "mmm" | Three letter abbreviation of month (e.g. APR = April) |
| | "yyyy" | Year |

### UTC Date DU

DU returns the current date, in UTC time.

Response: dddmmmyyyy↵

| | | |
|---|---|---|
| Format: | "ddd" | Day of year |
| | "mmm" | Three letter abbreviation of month (e.g. APR = April) |
| | "yyyy" | Year |

### Local Time TL

TL returns current Local Time.

Response: ddd:hh:mm:ss↵

| | | |
|---|---|---|
| Format: | "ddd" | Day of year |
| | "hh" | Hour |
| | "mm" | Minute |
| | "ss" | Seconds |

### UTC Time TU

TU returns current UTC time.

Response: ddd:hh:mm:ss↵

Format:

| | | |
|---|---|---|
| | "ddd" | Day of year |
| | "hh" | Hour |
| | "mm" | Minute |
| | "ss" | Seconds |

## A-7. Antenna and System Delay Commands.

### Set Antenna Delay nnnnnnDA

nnnnnnDA sets the antenna system delay compensation value. Note that the Factory default setting for standard 15-meter (50-foot) cable is 60 ns. The exact syntax for a 60-ns delay is 60DA.

Time Range: "nnnnnn" can be from 0 to 999999ns.

Response: ↵

### Set Clock Offset nnnnnnDS

nnnnnnDS sets the internal system delay compensation value. Includes remote receiver cable delay. Also used to advance the output 1 PPS pulse by an arbitrary offset of up to one millisecond, from actual time.

Time Range: "nnnnnn" can be from 0 to 999999 ns.

Response: ↵

## A-8. Out-of-Lock Commands.

### Set Out-of-Lock Time (-)nnK

nnK sets 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 and/or front panel LED indicator.

Range: "nn" can be from 0 to 99 minutes*.
"-nn" disables this function (Out-of-Lock always "HI" when power is ON).

*A value of 0 results in no delay between loss of lock and out-of-lock indication.

Response: ↵

## A-9. Miscellaneous Commands.

### Firmware Version V

Returns Firmware Revision date of installed ROM.

Response: dd mmm yyyy↵

| | | |
|---|---|---|
| Format: | "dd" | Day of year |
| | "mmm" | Month |
| | "yyyy" | Year |

## 6.0 Index

**S**



**T**



**V**



**W**