SPECTRACOM

GPS AGELESS® MASTER OSCILLATOR

MODEL 8194B, 8195B, 8197B

INSTRUCTION MANUAL

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Specifications subject to change or improvement without notice.

SPECTRACOM LIMITED WARRANTY

LIMITED WARRANTY

Spectracom warrants each new product manufactured and sold by it to be free from defects in software, material, workmanship, and construction, except for batteries, fuses, or other material normally consumed in operation that may be contained therein AND AS NOTED BELOW, for five years after shipment to the original purchaser (which period is referred to as the "warranty period"). This warranty shall not apply if the product is used contrary to the instructions in its manual or is otherwise subjected to misuse, abnormal operations, accident, lightning or transient surge, repairs or modifications not performed by Spectracom.

The GPS receiver is warranted for one year from date of shipment and subject to the exceptions listed above. The power adaptor, if supplied, is warranted for one year from date of shipment and subject to the exceptions listed above.

THE ANALOG CLOCKS ARE WARRANTED FOR TWO YEARS FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

THE TIMECODE READER/GENERATORS ARE WARRANTED FOR ONE YEAR FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

The Rubidium oscillator, if supplied, is warranted for two years from date of shipment and subject to the exceptions listed above.

All other items and pieces of equipment not specified above, including the antenna unit, antenna surge suppressor and antenna pre-amplifier are warranted for 5 years, subject to the exceptions listed above.

WARRANTY CLAIMS

Spectracom's obligation under this warranty is limited to in-factory service and repair, at Spectracom's option, of the product or the component thereof, which is found to be defective. If in Spectracom's judgment the defective condition in a Spectracom product is for a cause listed above for which Spectracom is not responsible, Spectracom will make the repairs or replacement of components and charge its then current price, which buyer agrees to pay.

Spectracom shall not have any warranty obligations if the procedure for warranty claims is not followed. Users must notify Spectracom of the claim with full information as to the claimed defect. Spectracom products shall not be returned unless a return authorization number is issued by Spectracom.

Spectracom products must be returned with the description of the claimed defect and identification of the individual to be contacted if additional information is needed. Spectracom products must be returned properly packed with transportation charges prepaid.

Shipping expense: Expenses incurred for shipping Spectracom products to and from Spectracom (including international customs fees) shall be paid for by the customer, with the following exception. For customers located within the United States, any product repaired by Spectracom under a "warranty repair" will be shipped back to the customer at Spectracom's expense unless special/faster delivery is requested by customer.

Spectracom highly recommends that prior to returning equipment for service work, our technical support department be contacted to provide trouble shooting assistance while the equipment is still installed. If equipment is returned without first contacting the support department and "no problems are found" during the repair work, an evaluation fee may be charged.

EXCEPT FOR THE LIMITED WARRANTY STATED ABOVE, SPECTRACOM DISCLAIMS ALL WARRANTIES OF ANY KIND WITH REGARD TO SPECTRACOM PRODUCTS OR OTHER MATERIALS PROVIDED BY SPECTRACOM, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Spectracom shall have no liability or responsibility to the original customer or any other party with respect to any liability, loss, or damage caused directly or indirectly by any Spectracom product, material, or software sold or provided by Spectracom, replacement parts or units, or services provided, including but not limited to any interruption of service, excess charges resulting from malfunctions of hardware or software, loss of business or anticipatory profits resulting from the use or operation of the Spectracom product or software, whatsoever or howsoever caused. In no event shall Spectracom be liable for any direct, indirect, special or consequential damages whether the claims are grounded in contract, tort (including negligence), or strict liability.

EXTENDED WARRANTY COVERAGE

Extended warranties can be purchased for additional periods beyond the standard five-year warranty. Contact Spectracom no later than the last year of the standard five-year warranty for extended coverage.

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1 General Information

1.1 Introduction

The patented Spectracom Ageless® Master Oscillator*, shown in Figure 1-1, is a highly accurate frequency source available in oven-stabilized crystal oscillator (OCXO) and Rubidium versions. Its outputs are locked to the United States Naval Observatory via the NAVSTAR Global Positioning System (GPS). Spectracom's field-proven Ageless Oscillator technology provides continual automatic frequency control. A long-term averaging algorithm compensates for oscillator aging and temperature drift.

The Spectracom Ageless Master Oscillator is ideally suited as a site master oscillator for communication systems. Typical transmitter applications include land mobile simulcast, SMR (Specialized Mobile Radio), paging simulcast, satellite/microwave communications links, cellular telephone, and broadcast television.

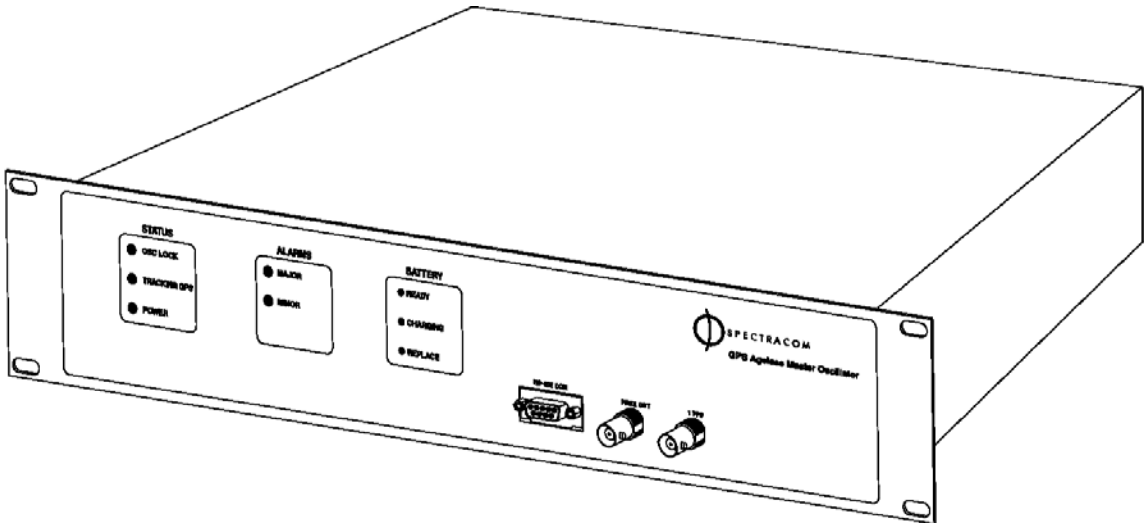


Figure 1-1 Spectracom Ageless Master Oscillator

1.2 Features

The Master Oscillator offers the following features:

- **Accuracy:** Continuous self-calibration to GPS provides ± 1.0 x 10^{-11} frequency accuracy with the OCXO versions and ± 1.0 x 10^{-12} frequency accuracy for Rubidium version.

- **Precise Offsets**: The Model 8194B/8195B disciplined 10 MHz outputs can be offset in precise steps to improve VHF - Hi simulcast.

** PATENT NO. 4,525,685*

- **Reliable Worldwide Operation:** The Master Oscillator can receive and track up to twelve satellites simultaneously. Receivers qualify the received GPS broadcast using T-RAIM. T-RAIM, Time Receiver Autonomous Integrity Monitoring is an algorithm that disqualifies a satellite from a solution if its message is not within a reasonable window of other satellites currently tracked.

- **Flexibility:** Several power and output options are available to suit various applications. Refer to Table 1-1 for a comparison of product features and available options.

S = Standard, O = Option Available, NA = Not Available

Ageless GPS Master Oscillator	Model 8195B	Model 8197B	Model 8194B
Standard Features			
Oscillator			
Quartz	S	NA	S
Rubidium	NA	S	NA
Front Panel			
(1) 10 MHz	S	S	S
(1) 1 PPS	S	S	S
(1) RS-232 Comm Port	S	S	S
Rear Panel			
(4) 10 MHz Output	S	S	S
(1) Timing Output 1544 kHz	S	S	NA
(1) Timing Output 2048 kHz	S	S	NA
(1) Data Clock Output (including disciplined 1 PPS)	S	S	S
(1) Data Sync Output	S	S	NA
(1) RS-485 Comm Port	S	S	NA
Software Features			
Simulcast Frequency Offset	S	NA	S
Fast Frequency Lock Recovery	S (w/ Opt 02)	NA	S (w/ Opt 02)
Available Options			
02 – Internal Battery	O (w/ AC only)	NA	O (w/ AC only)
03 – Internal Frequency Distribution Amplifier	O	O	O
06 – 12.8 MHz Outputs	O	O	NA
07 – 5 MHz Outputs	O	O	O
11 – Mounting Slides	O	O	O
14 – CTCSS Outputs One and Two	O	O	NA
16 – 1PPS on Third and Fourth Rear Panel Frequency Output	O	O	NA
17 – CTCSS Outputs Three and Four	O	O	NA
52 – 12 VDC Power	O	O	O
53 – 24 VDC Power	O	O	O
54 – 48 VDC Power	O	O	O
SP294 – Adds (2) DS1 outputs	O (NA w/ Opt 02)	O	NA
SP295 – Adds (2) E1 outputs	O (NA w/ Opt 02)	O	NA

Table 1-1 Product Comparison Table

1.3 Warranty Information and Product Support

Warranty information is found on the leading pages of this manual. This product includes component assemblies that are not manufactured by Spectracom Corporation.

The components listed below shall carry the original manufacturer's warranty.

- The GPS receiver carries a one-year warranty.
- The Rubidium oscillator carries a two-year warranty.

The remainder of the product is covered under Spectracom's five-year warranty. Should it become necessary to exercise the warranty, contact Spectracom Corporation to obtain a replacement or service.

Spectracom continuously strives to improve its products and therefore greatly appreciates any and all customer feedback given. Please participate in Spectracom's Customer Satisfaction Survey found on our web site:

http://www.spectracomcorp.com

Technical support is available by telephone, e-mail, or online. Please direct any comments or questions regarding application, operation, or service to Spectracom Customer Service Department. Customer Service is available Monday through Friday from 8:30 A. M. to 5:00 P.M. Eastern time.

Telephone Customer Service at: **585.321.5800**.

In addition, please contact Customer Service to obtain a Return Material Authorization Number (RMA#) before returning any instrument to Spectracom Corporation. Please provide the serial number and failure symptoms. Transportation to the factory is to be prepaid by the customer. After obtaining an RMA#, ship the unit back to the following address:

Spectracom Corporation
Repair Department, RMA# xxxxx
95 Methodist Hill Drive
Rochester, NY 14623

Product support is also available by e-mail. Questions on equipment operation and applications may be e-mailed to Spectracom Sales Support at:

sales@spectracomcorp.com

Repair or technical questions may be e-mailed to Spectracom technicians at:

techsupport@spectracomcorp.com

Visit our web page for product information, application notes and upgrade notices as they become available at:

http://www.spectracomcorp.com

1.4 Manual Errata and Special Documentation

Information concerning manual corrections or product changes occurring after printing is found in the Errata Section. The Errata Section, when required, is found at the end of this manual. Please review and incorporate changes into the manual whenever an Errata Section is included.

Spectracom will make instrument modifications on special request. A documentation packet associated with the modification will be provided in addition to this manual.

1.5 Unpacking

On receipt, carefully examine the carton and its contents. If there is damage to the carton resulting in damage to the unit, contact the carrier immediately. Retain the carton and packing materials in the event the carrier wishes to witness the shipping damage. Failing to report shipping damage immediately may forfeit any claim against the carrier. In addition, notify Spectracom Corporation of shipping damage or shortages to obtain a replacement or repair services.

Remove the packing list from the envelope on the outside of the carton. Check the packing list against the contents to be sure all items have been received, including an instruction manual and ancillary kit. Table 1-2 lists the items included in the various ancillary kits. Please note that all items included in the ancillary kit may not be required for some configurations of the product. For example, a line cord is not required on units equipped with DC input power Options 52, 53 and 54. Replace fuses with only the same type and rating as originally installed for the product configuration.

Description	Part Number	Standard	Option 03 Distribution
Fuse, 2.0A Slo-Blo	F012R0	1	1
Fuse, 1.5A Slo-Blo	F011R5	1	1
Fuse, 10.0A	F0010R	1	1
Fuse, 6.25A Slo-Blo	F016R0	1	1
Fuse, 3.0A Slo-Blo	F013R0	1	1
Line Cord	W01000	1	1
Terminal Block, 6-position	P13006	1	1
Terminal Block, 7 position	P13007	1	1
Terminator, 50-ohm	004492	4	0
Terminator, DC isolated	8140-0000-1000	0	4
RS-232 Cable	050008	1	1

Table 1-2 Ancillary Kits

1.6 Specifications

This section contains specifications for the standard Master Oscillator, Model 8225 GPS Antenna, Model 8226 Impulse Suppressor, and the Model 8227 Inline Amplifier. Specifications pertaining to the Master Oscillator options are found in Section 5. Some options and features are only available on certain models in the Spectracom Ageless Master Oscillator family. The details on the options and features available for each model are found in the Table 1-1 Product Comparison Table.

1.6.1 Receiver

Received Standard:	L1 C/A Code transmitted at 1575.42 MHz
Satellites Tracked:	Up to 12 simultaneously
Acquisition Time:	Typically <20 minutes during initial installation or if the receiver has been moved to a new location. Acquisition time is reduced to one minute on subsequent power cycles.
Acquisition Sensitivity:	-110 dBm to -137 dBm
Optimum Gain Range:	18 to 36 dB at receiver input
Timing Accuracy:	<10 nanoseconds while in Position Hold mode

1.6.2 Standard Frequency Outputs

Signal:	10 MHz sine wave derived from GPS disciplined oscillator
Connector:	BNC female, one front panel, four rear panel
Signal Level:	10 dB typical, 13 dB maximum into 50 ohms (10 dB = 2Vpp = 750 mV RMS)
Impedance:	50 ohms
Harmonics:	Better than 30 dB down
Spurious:	Better than 40 dB down
Phase Noise:	<97 dBc @ 1 Hz <110 dBc @ 10 Hz <125 dBc @ 100 Hz <135 dBc @ 1000Hz <138 dBc @ 10 kHz
Signature Control:	The Frequency Outputs can be configured with Signature Control. Under Signature Control, the outputs are removed whenever a Major Alarm is asserted. The outputs are restored when the fault condition is corrected. The

Signature Control feature is set via the RS-232 communication port.

Simulcast Offsets: The 8195B 10MHz outputs can be offset in precise steps to minimize co-channel interference. The offsets provide steps of ±3, 5, 7, 9 Hz at VHF-HI transmitter frequencies, and ±0.5, 1.0, 1.5, 2.0 Hz at UHF transmitter frequencies. Offsets are selected by software commands.

Output Options: The following options are available for the Spectracom Ageless Master Oscillator:

Option 03: Adds internal distribution amplifier that allows the Master Oscillator to drive Spectracom distribution products. This option adds a 12 Volt DC offset to the rear panel Frequency Outputs.

Option 06: Changes the rear panel Frequency Outputs and front panel 10 MHz output to 12.8 MHz.

Option 07: Changes the rear panel Frequency Outputs and front panel 10 MHz Output to 5.0 MHz.

Option 16: Changes the third and fourth rear panel Frequency Outputs from 10MHz to 1PPS.

1.6.3 Ovenized Oscillator Frequency Stability

Oscillator Type: 10 MHz OCXO, SC cut. For Model 8194B and 8195B

Locked Accuracy: $\pm 1 \times 10^{-11}$, 24-hour average when locked to GPS and no frequency offsets selected.

$\pm 1 \times 10^{-10}$, 24-hour average when locked to GPS and frequency offsets selected (8194B/8195B only).

Unlocked Accuracy: Corrections are applied to the oscillator based on learned oscillator aging characteristics. Holdover accuracy is <5 microseconds over 5 hours.

Recovery: During a power failure, the oscillator control value is retained and the connected standby supply provides power to the oscillator and GPS receiver. At power-on, the disciplined oscillator returns to the set frequency plus any incurred aging. Two hours from holdover to oscillator lock. Four hours from cold start. Recovery times are reduced with Option 02 Battery Backup.

Aging Rate: Unit automatically corrects for oscillator aging when locked to GPS. After 30 days of continuous operation, when unlocked, <5 x 10^{-10}/day.

1.6.4 Rubidium Oscillator Frequency Stability

Oscillator Type: 10 MHz Rubidium. For Model 8197B

Locked Accuracy: 24-Hour Average accuracy is typically ±1 x 10^{-12} when locked to GPS

Unlocked Accuracy: Corrections are applied to the Rubidium oscillator based on learned aging. Holdover accuracy is typically <2 microseconds/day.

Short Term: 3 x 10^{-11} / 1 second
1 x 10^{-11} / 10 seconds
3 x 10^{-12} / 100 seconds

Recovery: During a power failure, the oscillator control value is retained and the connected standby supply provides power to the oscillator and GPS receiver. At power-on, the disciplined oscillator returns to the set frequency plus any incurred aging.

Without standby power applied Rubidium lock < 4 minutes @ 25°C, Oscillator Lock < 4 hours. Retrace 5 x 10^{-11}.

Aging Rate: Unit automatically corrects for oscillator aging when locked to GPS. If not locked to GPS, drift is 2 x 10^{-11}/day under constant ambient conditions.

1.6.5 1PPS Output

Signal: 1PPS derived from the 10 MHz GPS disciplined oscillator

Connector: BNC female, front panel

Signal Level: TTL compatible into loads >100 ohms

Duty Cycle: 20% ± 5%

Accuracy: Leading edge synchronized to UTC typically within ±500 nanoseconds with SA off and in Position Hold

Delay Control: This output is made leading edge synchronized to the recovered GPS 1PPS. Using the 1PPS offset command, 1PO, the Data Clock 1PPS output can be offset from 0 to 1 second in 0.001 microsecond steps. The front panel 1PPS shall be synchronized within ±500 nanoseconds of other Master Oscillator receivers having the same 1PO offset.

1.6.6 1544 kHz Timing Outputs

Signal: 1544 kHz, derived from the 10 MHz GPS disciplined oscillator

Connector: RJ-11, rear panel

Signal Level: RS-485

Duty Cycle: 50% ± 2%

Accuracy: 8195B: ± 1.0 x 10^{-11} when locked to GPS, 24-hour average, no frequency offsets selected

8197B: ± 1.0 x 10^{-12} when locked to GPS, 24-hour average

Additional Outputs: Major alarm relay contacts; C, NO, NC are provided

1.6.7 2048 kHz Timing Outputs

Signal: 2048 kHz, derived from the 10 MHz GPS disciplined oscillator

Connector: RJ-11, rear panel

Signal Level: RS-485

Duty Cycle: 50 ± 2%

Accuracy: 8195B: ± 1.0 x 10^{-11} when locked to GPS, 24-hour average, no frequency offsets selected

8197B: ± 1.0 x 10^{-12} when locked to GPS, 24-hour average

Additional Outputs: Major alarm relay contacts; C, NO, NC are provided on this connector

Optional Outputs: Option 06, 12.8 MHz outputs, changes the 2048 kHz output on this connector to 1600 kHz

1.6.8 Data Clock Timing Outputs

Signals: 1PPS, 9.6 kHz, 18.0 kHz, derived from the 10 MHz GPS disciplined oscillator

Connector: DB9 female, rear panel

Signal Level: RS-485

Duty Cycle: 1PPS: 20% ±5%
9.6 kHz, 18.0 kHz: 50% ±2%

Accuracy: The Data Clock 1PPS is made leading edge synchronized to the recovered GPS 1PPS. Using the 1PPS offset command, 1PO, the Data Clock 1PPS output can be offset from 0 to 1 second in 0.001 microsecond steps. The Data Clock 1PPS shall be synchronized within ±500 nanoseconds of other Master Oscillator receivers having the same 1PO offset. The 9.6 kHz output is leading edge synchronized to within ±150 nanoseconds of the Data Clock 1PPS output. The 18 kHz output is not leading edge synchronized.

Alarm Outputs: Major alarm status is provided on this connector. Under normal operation, the alarm pin is ground and high impedance when a Major Alarm is asserted.

Optional Outputs: Option 17, CTCSS Outputs, replaces the 9.6 kHz and 1 PPS signals on the Data Clock (DB9) connector with CTCSS#3 and CTCSS #4 respectively.

1.6.9 Data Sync Timing Outputs

Signals: 17 $^{2}/_{3}$ Hz, 33 $^{1}/_{3}$ Hz, 18 kHz, 64 kHz, derived from the 10 MHz GPS disciplined oscillator

Connector: DB15 Female, rear panel

Signal Level: RS-485

Duty Cycle: 18 kHz, 64 kHz: 50% ± 2%
17 $^{2}/_{3}$: 888 microsecond pulse width
33 $^{1}/_{3}$: 208 microsecond pulse width

Accuracy: The 17 $^{2}/_{3}$ Hz and 33 $^{1}/_{3}$ Hz Data Sync outputs are leading edge synchronized to within ±400 nanoseconds of the Data Clock 1PPS output. Using the 1PPS offset command, 1PO, the Data Clock 1PPS output can be offset from 0 to 1 second in 0.001 microsecond steps. The Data Clock 1PPS shall be synchronized within ±500 nanoseconds of other Master Oscillator receivers having the same 1PO offset.

The 64 kHz and 18 kHz outputs are not leading edge synchronized.

Alarm Outputs: Major alarm relay contacts; NO, NC and common, are provided on this connector

Optional Outputs: Option 06, 12.8 MHz outputs, changes the 64 kHz output to 50 kHz

Option 14, CTCSS Outputs, replaces the 33-1/3 Hz and 17-2/3 Hz signals with CTCSS #1 and CTCSS #2 respectively

1.6.10 Indicator Lamps

Front panel status lamps when lit indicate the following:

Power: Primary power source is connected and switched ON.

Tracking GPS: Receiver is tracking at least four qualified GPS satellites.

Oscillator Locked: Oscillator is disciplined to the received GPS signal.

Major Alarm: Alarm condition classified as “major” is active.

Minor Alarm: Alarm condition classified as “minor” is active.

Optional Indicators: Receivers equipped with Option 2, Internal Battery Backup, include indicator lamps to communicate battery status: Ready, Charging, and Replace.

1.6.11 Alarms

Alarm relays allow remote monitoring of operational status. Relay contacts are provided for Major Alarms and Minor Alarms. Alarm status is also included in performance and status logs obtained using software commands.

1.6.11.1 Alarm Classifications

Major Alarm: A Major alarm is asserted when detected faults compromise output accuracy. The alarm relays reset when the fault condition is corrected. Faults and conditions listed below actuate a Major Alarm:

- **Frequency Error Alarm:** Measured oscillator frequency error exceeds 1 x 10^{-8} or whenever an AT2 Alarm is asserted. A Frequency Alarm is also asserted at Power On.
- **GPS Tracking Timeout 2:** The AT2 time period allotted for operation without tracking a minimum of four qualified satellites has expired. An AT2 Alarm is also asserted during start-up.
- **GPS Tracking Timeout 3:** The AT3 time period allotted for operation without tracking a minimum of four qualified satellites has expired. An AT3 Alarm is also asserted during start-up.
- **CPU Fault:** The CPU is unable to communicate with the GPS receiver.
- **Test Mode:** Unit has been manually placed in Test Mode operation from RS-232 communication port.
- **Free Run:** The automatic frequency control feature has been disabled (for factory testing only).
- **Short Gate:** Gate time is shortened for test purposes. Measurement resolution is reduced.

Minor Alarm: A minor alarm is asserted when failures detected do not immediately affect output accuracy. The alarm relays reset when the fault condition is corrected. Faults and conditions listed below actuate a Minor Alarm:

- **Output Fault:** No output is detected from one or more of the four-rear panel Frequency Outputs. Fault could be caused by a shorted cable, reflections due to an un-terminated cable or removed by a Major Alarm when Signature Control is enabled.
- **Oscillator Adjust:** Warns that oscillator is operating within 10% of the minimum or maximum control setting. The oscillator requires manual calibration and adjustment. Refer to the service information section for details on this.
- **GPS Tracking Timeout 1:** The AT1 time period allotted for operation without tracking a minimum of four qualified satellites has expired. An AT1 Alarm is also asserted during start-up.

- **Low Quality Alarm:** Warns of low GPS signal quality. The alarm is asserted whenever the "Q" value in Tracking Histogram is below 3000.

- **Replace Battery:** Internal battery pack, Option 02 only, has failed daily test, needs replacement.

- **Frequency Offset:** A new simulcast offset value is entered. The alarm remains active until the standard oscillator has corrected for the offset.

- **Test Mode:** Unit has been manually placed in Test Mode operation from RS-232 communication port.

- **Antenna Problem:** Warns that the antenna is not connected or a cable short or open is detected. It warns when the antenna power supply is under or over current. This alarm may also be asserted when the receiver is connected to an antenna splitter device that does not have a simulated load.

1.6.11.2 Tracking Alarm Classifications

Three configurable alarm tracking timeouts, AT1, AT2, and AT3, indicate how long the Master Oscillator has been unable to receive qualified GPS satellites. Countdown timers are started whenever the receiver is not tracking a minimum of four qualified satellites. As the period configured for each Alarm Timeout expires, the associated Tracking Alarm is asserted. The alarm timeouts are configured via the RS-232 and RS-485 communication ports. Timeout range is 1 second to 999 days.

Alarm tracking status is provided to the communication ports using the STAT and DAL commands.

AT1 (Alarm Tracking Timeout 1): Period of time the receiver has not tracked at least four qualified satellites has expired. Factory default is 1 minute. This is a Minor Alarm that also extinguishes front panel TRACKING GPS lamp. The AT1 Alarm resets on acquisition of at least four qualified satellites for one minute.

AT2 (Alarm Tracking Timeout 2): Period of time the receiver has not tracked at least four qualified satellites has expired. Factory default is 2 hours 30 minutes. This condition is classified as a Major Alarm. An AT2 alarm asserts a frequency alarm and extinguishes the OSC LOCK lamp. The AT2 Alarm resets when the receiver has reacquired a minimum of four qualified satellites for one minute.

AT3 (Alarm Tracking Timeout 3): Period of time the receiver has not tracked at least four qualified satellites has expired. Factory default is 30 days. This is a Major Alarm. The AT3 Alarm resets when the receiver has reacquired a minimum of four qualified satellites for one minute.

1.6.11.3 Alarm Interface

Alarm relay contacts are provided on the Alarm Outputs, Data Sync, Data Clock, 1544 kHz and 2048 kHz timing output connectors.

Alarm Outputs:	Major Alarm, Minor Alarm.
Connector:	7-position terminal block, rear panel
Contacts:	NO, NC, and Common
Contact Rating:	30 VDC, 2 Amps

Data Sync:	Major Alarm
Connector:	DB15 Female, rear panel
Contacts:	NO, NC and Common
Contact Rating:	30 VDC, 500 milliamps

Data Clock:	Major alarm
Connector:	DB9 Female, rear panel
Contact Rating:	30 VDC, 500 milliamps

1544 kHz:	Major alarm
Connector:	RJ-11, rear panel
Contacts:	NO,NC and Common
Contact Rating:	30 VDC, 250 milliamps

2048 kHz:	Major alarm
Connector:	RJ-11, rear panel
Contacts:	NO,NC and Common
Contact Rating:	30 VDC, 250 milliamps

1.6.12 Communication Ports

The Master Oscillator has a front panel RS-232 and a rear panel RS-485 communication port. The communication ports are used to monitor and set operational parameters.

RS-232 Com

Signal:	RS-232C, DCE
Connector:	DB9 female, front panel
Bit Rate:	9600 Baud
Character Structure:	ASCII, 1 start, 8 data, 1 stop, no parity, xon/xoff flow control

RS-485 Com

Signal:	RS-485, 1 pair Transmit, 1 pair Receive
Connector:	RJ-11, rear panel
Impedance:	Hi Z /120 ohms, switch selectable
Bit Rate:	9600 baud
Address:	0 - 31, switch selectable
Character Structure:	ASCII, 1 start, 8 data, 1 stop, no parity
Message Format:	Start word, source address, destination address, message length, message, check word, stop word

1.6.13 Input Power

AC Input:	90 to 264 VAC, 50/60 Hz, 20 Watts for ovenized oscillator units, 60 Watts for Rubidium unit. Option 02, Internal Battery Backup, requires an additional 20 Watts Option 03, Built-in Distribution Amplifier, requires an additional 25 Watts
Fuse:	1.5 Amp, 250V, Slo-Blo
Connector:	3-conductor, IEC 320 C-13, rear panel
DC Standby:	Non-isolated +24 VDC ± 5%, 10 Watts. Powers the oscillator and internal GPS receiver module whenever AC power is removed Fuse: 2 Amp, 250V, Slo-Blo
Connector:	6-position terminal block, rear panel

DC Power Options	Isolated Input Power Option 52, ±12 VDC Option 53, ±24 VDC Option 54, ±48 VDC
Fuse:	Option 52, 10.0 Amp, 250V, Fast Option 53, 6.25 Amp, 250V, Slo-Blo Option 54, 3.0 Amp, 250V, Slo-Blo
Connector:	6-position terminal block, rear panel

1.6.14 Mechanical

Dimensions:	3.5H x 19.0W x 12.5D inches (89H x 483W x 315D mm)
Weight:	15 lbs.(6.8 kg) maximum
Shipping Weight:	20 lbs. (9.1 kg).
Rack Mount:	EIA 19”, front panel drilled for two standard rack units
Optional:	Option 11 Rack Mount Slides

1.6.15 Environmental

Operating Temperature:	-30 to +60°C.
Storage Temperature:	-40 to +85°C.
Humidity:	95% R. H. non-condensing.

1.6.16 Agency Approval

This device complies with part 15-class B of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: Units equipped with DC input power Option 52 have not been tested for FCC compliance.

1.6.17 Model 8225 GPS Antenna Specifications

1.6.17.1 Electrical Specifications

Type:	Active.
Frequency:	1575.42 MHz.
Temperature Range:	-30° to 80° C (-22° to 176°F)
Gain:	30 dB
Connector:	N type, Female
Recommended Cable:	LMR-400
Maximum Cable Length:	200 feet or 12 dB cable loss before additional preamplifier is required
Power:	5 Volts, 27 milliamps, powered by receiver

1.6.17.2 Mechanical Specifications

Assembled Length:	24 inches (61 cm)
Housing Diameter:	3.5 inches (8.9 cm)
Housing Material:	PVC
Weight:	1.3 lbs. (.60 kg).
Mounting:	Hose clamps (furnished) on vent pipe

1.6.17.3 Model 8226 Impulse Suppressor

Connectors:	Type N Female
Turn On Time:	4 nanoseconds for 2 kV/ns
Turn On Voltage:	+7 V, -1 VDC
Frequency Range:	1.2 to 2.0 GHz
VSWR:	1.1:1 or better
Insertion Loss:	0.1 dB maximum
Mounting:	Optional mounting bracket available. Specify part number MP10-0000-0002.
	Optional grounding panel kit, includes MP10-0000-0002 bracket, specify part number 8226-0002-0600.

1.6.17.4 Model 8227 Inline Amplifier

Connectors:	Type N Female
Gain:	20 ±3 dB
VSWR:	≤1.5:1
Power:	3 - 9 VDC, 7.5 ±1 milliamps

2 Installation

2.1 Introduction

This section describes the installation of the Model 8225 GPS Antenna and related accessories. This section also describes the Master Oscillator preparation for use, initial operation, installation qualification and factory configuration. To ensure proper operation, please read this section prior to equipment installation and usage.

Refer to the options and accessories section of this manual for information on installing the Option 11 Rack Mount Slides.

2.2 Model 8225 GPS Antenna

The Model 8225 is an active antenna tuned to receive the GPS 1575.42 MHz L1 band satellite broadcast. The received signals are passed through a narrow band pass filter and preamplifier within the antenna. The active antenna circuitry provides 30 dB of gain and requires +5 VDC at 27 milliamps. The Master Oscillator's receiver provides this over the antenna coax. Each antenna is terminated with a type "N" female connector. The Model 8225 features a compact weatherproof design measuring 3.5 inches in diameter.

2.2.1 Antenna Installation

The GPS antenna must be installed outdoors in a location where an unobstructed view of the sky exists. Rooftops generally make good locations due to clear overhead sky with views to the horizon. This type of location allows the antenna to see and track the maximum number of satellites throughout the day. Installations with obstructed views may prove operational, but can experience reduced reception quality and the inability to simultaneously track the maximum number of satellites. In addition to clear sky coverage, select a site, which would not allow the antenna to become buried in drifted or accumulated snow or ice. Avoid placing the GPS antenna in close proximity to broadcast antennas whenever possible.

Each antenna includes a mating PVC mast assembly and two hose clamps to simplify installation. The hose clamps can be used to affix the mast assembly to a vent pipe. Spectracom offers an antenna base, Model 8213, for installations where vent pipe mounting is not practical or desired. The Model 8213 is constructed of aluminum and is furnished with ballast for stability. Both mounting methods are illustrated in Figure 2-1.

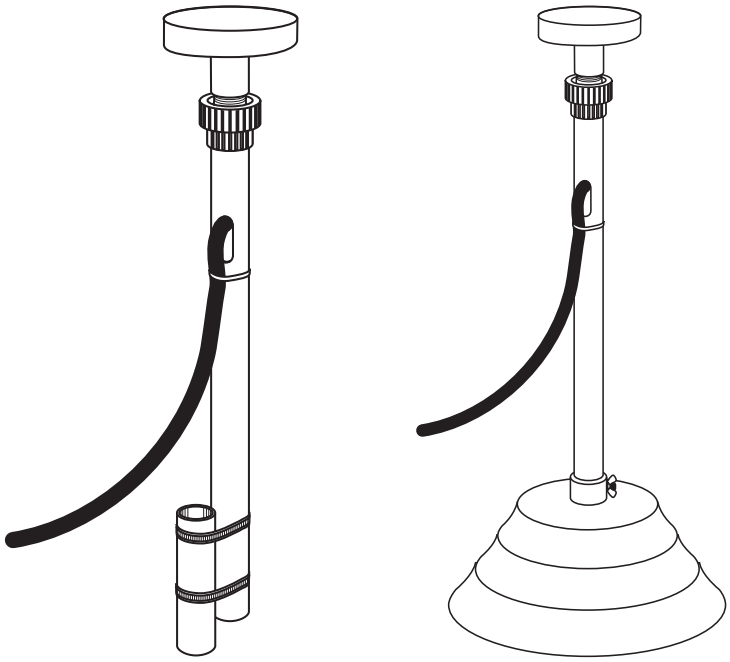


Figure 2-1 Antenna Installation

2.3 Antenna Cable

Spectracom recommends low loss coax, such as Times Microwave LMR-400, for the GPS antenna cable. To simplify the installation process, Spectracom offers GPS cable assemblies terminated with Type N Male connectors. Specify part number CAL7xxx, where xxx equals the length in feet.

If the antenna cable is purchased locally, select coax suitable for outdoor use. Consider the cable's weather ability, temperature range, UV resistance, and attenuation characteristics.

Do not allow the antenna cable to be placed in standing water, as water may permeate through the coax jacket over time. On flat roof installations, the coax can be suspended by cable hangers or placed in sealed PVC conduit. Apply a weather proofing sealant or tape over all outdoor connections.

Installation of a surge protection device in the antenna line is recommended to protect the Master Oscillator's receiver and connected devices from lightning damage. Spectracom offers the Model 8226 Impulse Suppressor to shunt potentially damaging voltages on the antenna coax to ground. Refer to Section 2.4 for a complete description of the Model 8226 impulse suppressor.

2.3.1 Cable Lengths

Using Spectracom CAL7xxx or LMR-400 coax, the maximum antenna cable length permitted is 200 feet. These cables attenuate the GPS signal by 5.4 dB per 100 feet of coax. Installations requiring longer antenna cables may use the Model 8227 Inline Amplifier or lower loss cable. Refer to Section 2.5 for additional information on the Model 8227 Inline amplifier.

When selecting alternate antenna cable sources, the attenuation characteristics at the GPS frequency of 1575.42 MHz must be known. To ensure optimum receiver performance, the total antenna cable attenuation must not exceed 12 dB. Cable attenuations greater than 12 dB require the use of a Model 8227 Inline Amplifier.

2.4 Model 8226 Impulse Suppressor

Spectracom recommends the use of an inline coaxial protector for all products with an outside antenna. Spectracom offers the Model 8226, Impulse Suppressor, to protect the receiver from damaging voltages occurring on the antenna coax. Voltages exceeding the impulse suppresser trip point are shunted to the system ground. The Model 8226 is designed to withstand multiple surges.

Install the suppressor indoors, preferably where the coax enters the building.
Connect the largest gauge grounding wire available to the Model 8226 ground stud. Optionally the suppressor can be mounted to a grounding panel or bulkhead using the BF adapter bracket as shown in Figure 2-2. Spectracom offers the bracket under part # MP10-0000-0002.

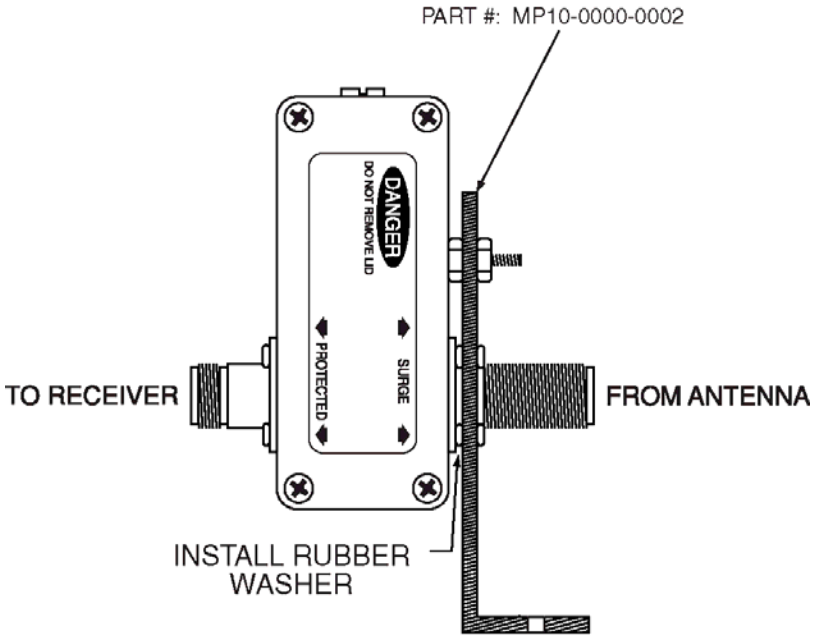


Figure 2-2 Model 8226 Impulse Suppressor

In addition, Spectracom offers a copper grounding panel kit, part number 8226-0002-0600, as a single point ground connection for the antenna surge suppressor, equipment rack, GPS receiver and other surge protection devices to a perimeter ground system. A single point ground system is recommended to provide optimum protection from lightning strikes.

Each grounding panel includes mounting hardware, hardware to secure protective devices to the copper plate, 20 feet of 1.5 inch wide copper strap, two strap clamps, the MP10-0000-0002 bracket and copper paste.

Mount the grounding panel indoors, preferably close to where the antenna coax enters the building and direct access to the system ground is available. Refer to Figure 2-3 for installation guidelines. The ground panel must be connected to a low impedance (both low resistance and low inductance) ground system to assure proper operation of the surge protection equipment. To minimize the inductance between the ground plate and system ground interconnection keep the copper grounding strap as straight as possible, limit bends to a radius of 8 inches or larger. Thoroughly clean the copper panel to remove any oxidation or contaminants prior to installation. Apply the supplied copper paste to all junctions on the copper panel to maintain a low impedance connection.

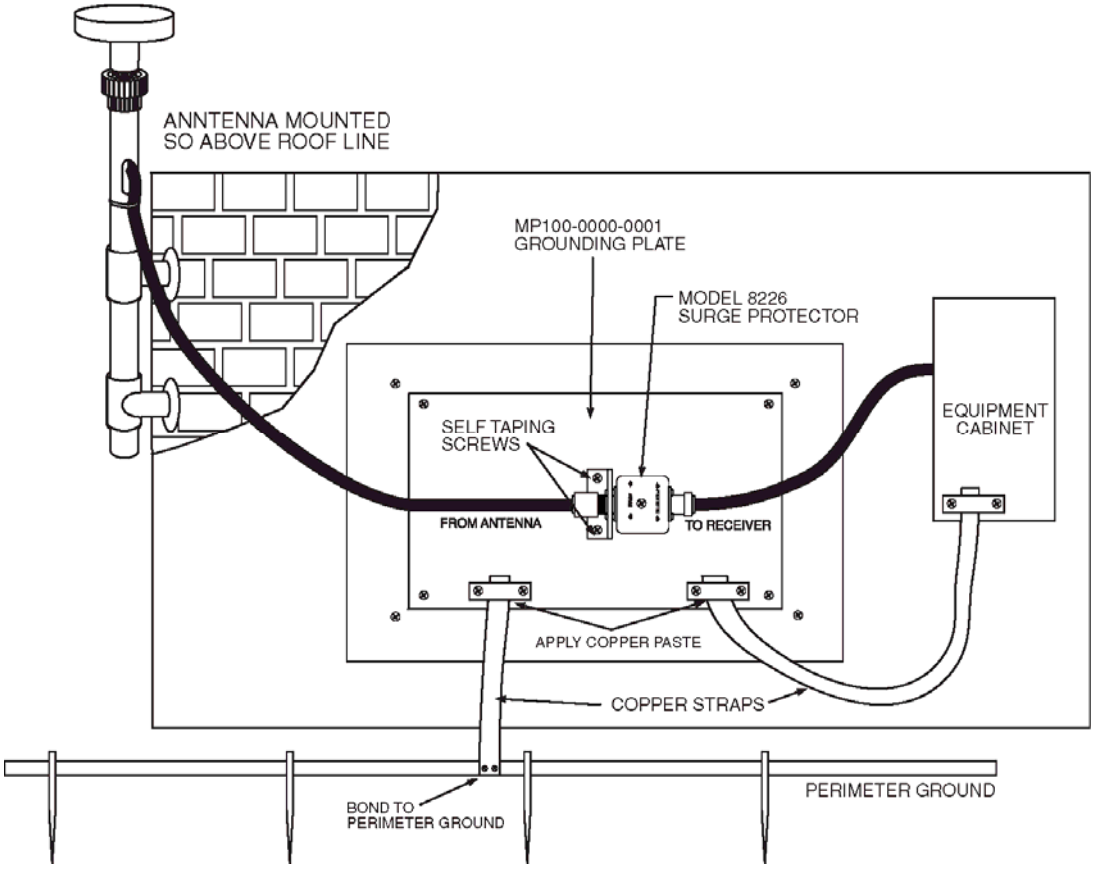


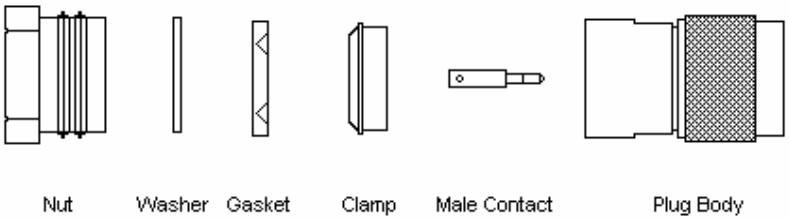
Figure 2-3 Grounding Panel Installation

Each Model 8226 includes two clamp type male N connectors. These connectors can be used to splice the Model 8226 into the antenna coax. The connectors are compatible with Spectracom CAL7xxx cable assemblies and Times Microwave LMR-400 equivalent coax. Connector assembly instructions are shown below in Figure 2-4.

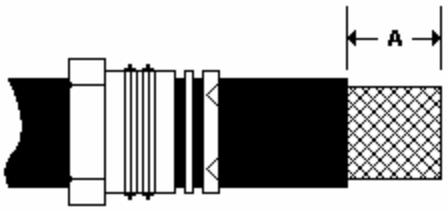
Assembly Instructions
Part Number P051-0001-0100 Type N Connectors

The table below lists the recommended tools needed to assemble the connectors. Verify all parts of the connector have been received as shown in connector diagram below.

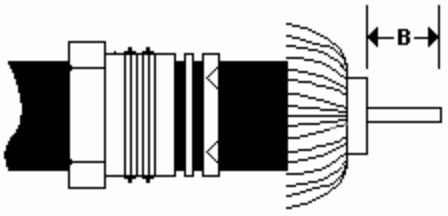
Tools Required
Sharp Knife / Razor Blade
Cable Cutter
Soldering Iron and Solder
Ruler
Wire Cutters/Scissors
5/8” Open End Wrench
11/16” Open End Wrench
Multimeter



Step 1
Cut the cable end squarely and place the nut, washer, and gasket onto the cable as shown. Make certain the gasket’s “V” groove is oriented towards the end of the cable. Cut the cable jacket back to dimension A of 0.359 inches (9.1 mm). Do not cut or knick the braid.

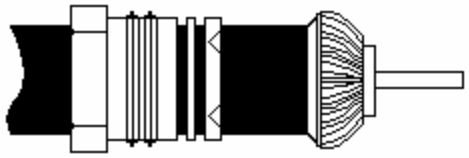


Step 2
Comb out the braid and fold back to expose the dielectric. Cut the dielectric back to dimension B of 0.234 inches (6.0 mm). Do not cut or knick the center conductor.

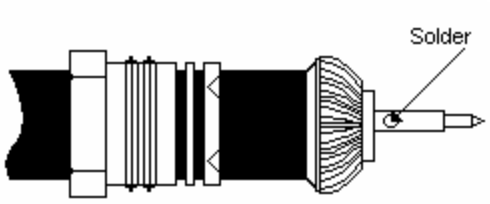


Step 3
Comb the braid forward and slide the clamp onto the cable as shown. Make certain that the beveled edge of the clamp is oriented towards the gasket “V” groove to form a weatherproof seal.

Step 4
Fold the braid back over the clamp. Comb the braid to evenly distribute it over the clamp and trim to the proper length as shown.



Step 5
Verify there is no braid or dielectric foil that may short against the center conductor. Tin the center conductor and then solder on the male contact as shown.



Step 6
Insert the cable assembly into the connector body. Verify the gasket "V" grooves fit into the clamp edges. Hold the body with the 11/16" wrench and tighten the nut using the 5/8" wrench. Using the multi meter, measure continuity of the center conductors on each end of the cable. It should be close to 0 Ω. Measure the continuity between the center conductor and connector body. It should be an open circuit.

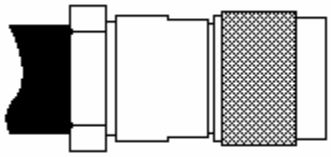


Figure 2-4 N Connector Assembly Instructions

2.5 Model 8227 GPS Inline Amplifier

An inline amplifier is required whenever GPS antenna cable lengths cause greater than 12 dB attenuation. Using Spectracom CAL7xxx or LMR-400 coax, an amplifier is needed whenever antenna cable lengths exceed 200 feet.

The Model 8227 GPS Inline Amplifier, shown in Figure 2-5, extends the maximum cable length to 600 feet. The Model 8227 provides 20 dB of gain and is powered by the GPS receiver.

Figure 2-5 Model 8227 Inline Amplifier

Each Model 8227 includes two clamp type male N connectors. These connectors can be used to splice the Model 8227 into the antenna coax. The connectors are compatible with LMR-400 type coax such as Spectracom CAL7xxx or LMR-400. Refer to Figure 2-4 for connector assembly instructions.

A five-foot long coaxial cable is also provided with each Model 8227. This cable connects the amplifier to the Model 8226 surge suppressor. This cable is rated for indoor usage only.

Refer to Figure 2-6 for Model 8227 installation guidelines. The cable lengths shown in Figure 2-6 represent Spectracom CAL7xxx cable. The equivalent cable loss expressed in dB, is provided for use with other cables.

Place the inline amplifier within 200 feet (10 dB cable loss) of the antenna to optimize the signal to noise ratio. Whenever possible install the inline amplifier indoors and after the impulse suppressor. Connect the surge suppressor to the inline amplifier using the supplied 5-foot cable. The amplifier can be installed outdoors, providing care is taken to weatherproof the connections.

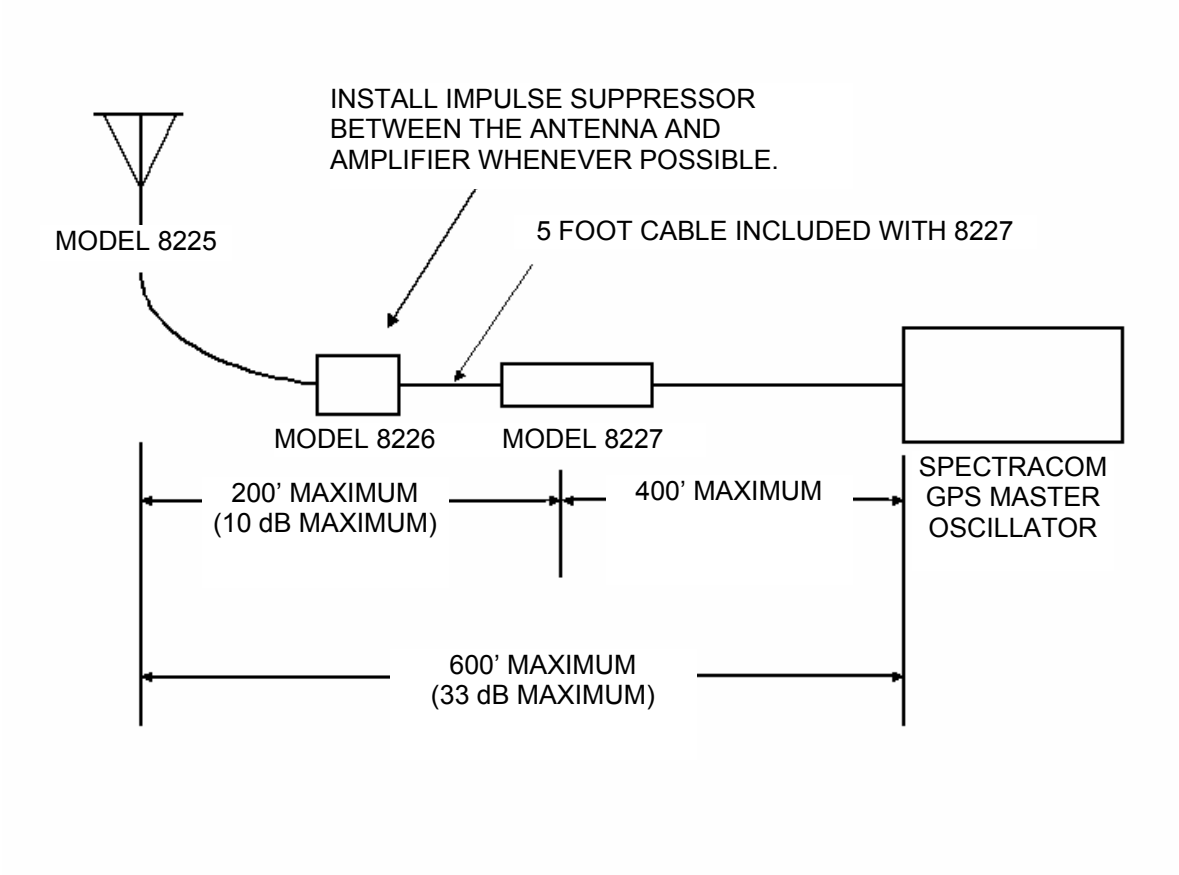


Figure 2-6 Cable Guidelines

2.6 Master Oscillator Preparation for Use

This section outlines the set-up procedure to prepare the Master Oscillator for operation.

2.6.1 Antenna Connection

Install the Model 8225 Antenna and related accessories as outlined previously in this section. Connect the antenna cable to the rear panel GPS ANT connector.

2.6.2 AC Power

The standard Master Oscillator receives primary power from a 90 to 264 VAC 50/60 Hz power source. A detachable line cord is furnished in the ancillary kit. The supplied line cord is compatible with AC receptacles (NEMA 5-15R) commonly found in the United States and Canada. Alternate type line cords may be obtained locally. Connect the line cord to the rear panel AC module and a properly grounded power receptacle.

NOTE: The Master Oscillator accepts the complete range of 90 to 264 VAC without a change in instrument setup. DO NOT change the AC fuse or line voltage selector.

On AC powered units, the DC power connector allows connection of a backup power source. Backup keeps the unit in standby. It is NOT operational. The backup source powers the oscillator and GPS receiver module whenever AC power is interrupted. Backup power speeds recovery time when AC power is restored by eliminating oscillator warm-up and retrace and GPS reacquisition time. The backup power source must be +24 VDC, non-ground isolated supply of 10 Watts maximum. When connecting the backup power source, connect a wire jumper from the negative (-) pin to the ground (G) pin as shown in Figure 2-7. The DC power connector is shown in Figure 2-8.

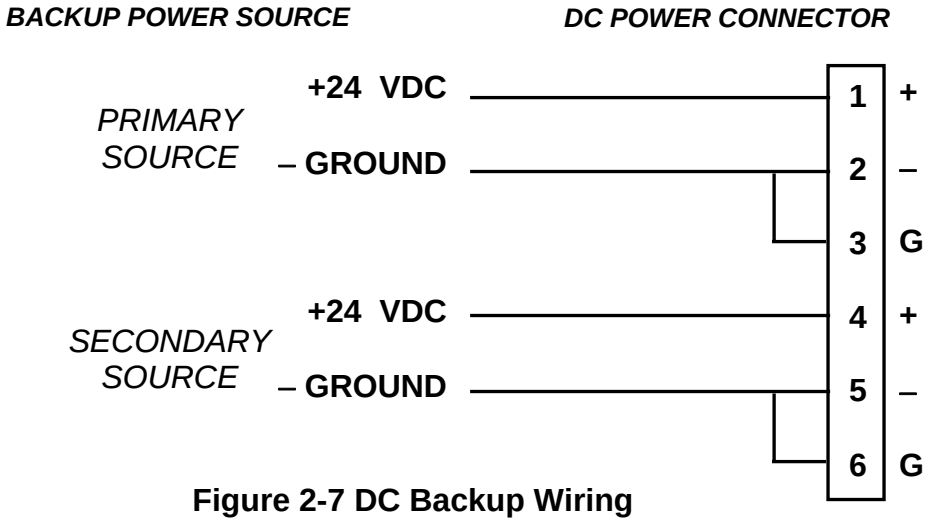


Figure 2-7 DC Backup Wiring

2.6.3 DC Power

DC power options allow operation from various DC power sources. Table 2-1 lists the DC power configurations available. Power is 20 Watts for 8195B units and 60 watts for Model 8197B units. DC power options are not available on the Model 8194B.

Power Option	Nominal Voltage	Input Range
Option 52	± 12 VDC	11.1 - 16.5 VDC
Option 53	± 24 VDC	22.1 - 33.1 VDC
Option 54	± 48 VDC	44.2 - 66.2 VDC

Table 2-1 DC Power Configurations

Connect the DC Power inputs to the 6-position terminal block as shown in Figure 2-8, DC Power Connector. The mating connector is included in the ancillary kit. Redundant power sources may be connected for improved system reliability. Be certain to observe the polarity markings when connecting power. The DC power Options, 52, 53, and 54, have isolated inputs, which permits operation from a positive or negative power source. To reduce RFI/EMI emissions use a shielded power cable. Connect the cable shield to the chassis ground pin labeled “G”.

NOTE: Place the DC power switch in the OFF position when connecting DC power.

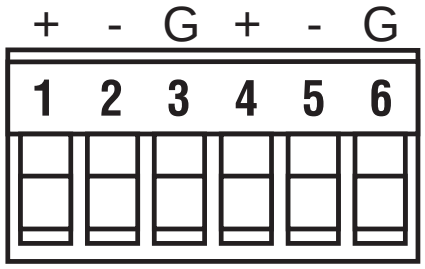


Figure 2-8 DC Power Connector

2.6.4 Chassis Ground

The chassis ground lug allows the unit’s chassis to be connected to an earth ground in addition to the power line safety ground. Connecting the chassis to a single point ground system may be required in some installations to ensure optimum lightning protection. A separate earth ground is also recommended in installations where excessive noise on the power line degrades the unit’s receiver performance.

2.7 Initial Operation

After completing antenna and power connections, switch on the power. Observe that the front panel POWER lamp turns on. The Major and Minor Alarm lamps are also turned on during initial operation. The receiver will now acquire and lock to GPS satellites currently in view of the antenna. The TRACKING GPS lamp turns on and the Minor Alarm lamp turns off when the receiver acquires a minimum of four satellites and has achieved a 3-D fix for one minute. This typically takes less than 20 minutes to accomplish during initial installation. Once the receiver has a 3-D fix in its new location, the position information is loaded into non-volatile RAM. Having current position information greatly reduces the time to first fix on subsequent power cycles to less than one minute, or less than 10 seconds if a backup power source is present.

Models 8194B and 8195B require a minimum of 4 hours to reach operational temperature and stabilize and discipline to GPS. The Model 8197B may require up to 6 hours. The OSC LOCK lamp turns on and the Major Alarm lamp turns off when the oscillator is disciplined to the GPS reference. The unit will now operate in accordance with the specifications listed in this manual.

2.8 Qualifying the Installation

Typically, the front panel Tracking GPS lamp illuminates within 20 minutes of turn on. This lamp indicates that receiver is tracking at least 4 qualified satellites and a 3-D position fix has been obtained. If the Tracking GPS lamp does not turn on, a cable or reception problem may exist. Refer to Section 2.9 for troubleshooting assistance.

Reception quality can be evaluated using the performance and status logs provided by the receiver. Commands to retrieve operational information are issued through the front panel RS-232 Com port. To communicate with the receiver, a terminal or computer with terminal emulation software (i.e. ProComm Plus, Hyper-Terminal, etc.) is required. Configure the terminal for ANSI emulation, 9600 baud and a character structure of 1 start, 8 data, and 1 stop with no parity. Flow control is not required, though xon / xoff is supported.

2.8.1 GPS Signal Status

The **G**PS **S**ignal **S**tatus command, **GSS**, provides an instantaneous view of the GPS reception quality. This command is used to verify proper antenna placement and receiver performance of an installation. The GSS response indicates the number of satellites the receiver is currently tracking and their relative signal strength. The resulting GPS quality and Position Fix Status are also included. A complete description of the **GSS** command can be found in Section 4 of this manual.
Issue the GSS command as shown below.

Type: ***GSS <ent>***

An example response is shown below:

```
TRACKING 08 SATELLITES
GPS STATE= POS-HOLD  DOP= 00.0
LATITUDE= N 43 07 01.942 LONGITUDE= W 077 29 15.050 HEIGHT= +00095 METERS
QUALITY= PASSED
CHAN VID MODE STREN      STAT
01    08    08    050    08A0
02    27    08    049    08A0
03    31    08    052    08A0
04    03    08    048    08A0
05    15    08    051    08A0
06    18    08    051    08A0
07    13    08    049    08A0
08    19    08    042    08A0
09    00    00    000    0000
10    00    00    000    0000
11    00    00    000    0000
12    00    00    000    0000
```

Tracking: The receiver must track at least 4 qualified satellites to operate. Typically the receiver shall track 6 or more satellites.

GPS State: Under normal operation the receiver will indicate either 3-D Fix or Position Hold. A Searching or 2-D Fix message indicates that fewer than 4 qualified satellites are currently tracked.

DOP: Dilution of Precision indicates the degree of uncertainty of a Position Fix. The DOP value shall be $0 \leq DOP < 10$ when in 3-D Fix mode and 0.0 when in Position Hold mode.

Quality: A passed message indicates the receiver is tracking at least 4 qualified satellites. A failed message indicates the received GPS signals did not meet minimum requirements.

Satellite Data: Data on each satellite currently tracked is provided in table form.

The **CHAN** column represents the GPS Receiver Channel Number, 1 through 12.

VID is the Vehicle (satellite) Identification Number, 1 through 37.

The **MODE** column provides the Channel Tracking Mode for each satellite. The GPS qualifying algorithm accepts only satellites having a Mode value of 08.

The relative signal strength of each satellite currently tracked is found in the **STREN** column. The minimum acceptable level is 40. The maximum level is 55.

The satellite status flag code is found in the **STAT** column. Typically the STAT value is 0A80.

If the receiver does not meet the minimum requirements described above, refer to Section 2.9 for troubleshooting assistance.

2.8.2 Tracking Histogram

The **D**isplay Tracking **H**istogram command, **DH**, is used to evaluate the long-term reception quality. The tracking histogram records the number of satellites tracked and qualified every second. At the end of the hour, a log is created and the counters are restarted. The command responds with the last four hourly entries and the histogram currently in process. A complete description of the **DH** command is found in Section 4 of this manual.

NOTE: Allow the receiver to operate for at least 5 hours before evaluating the tracking histogram.

Issue the DH command as shown below:

Type: ***DH <ent>***

An example response is shown below:

```
TIME= 12:00:00 DATE= 2004-03-24
  0= 00000    1= 00000    2= 00000  3= 00000  4= 00000
  5= 00000    6= 00019    7= 01537  8= 02044  9= 00000
10= 00000  11= 00000  12= 00000  Q= 03600

TIME= 13:00:00 DATE= 2004-03-24
  0= 00000    1= 00000    2= 00000  3= 00000  4= 00000
  5= 00000    6= 00016    7= 01004  8= 02580  9= 00000
10= 00000  11= 00000  12= 00000  Q= 03600

TIME= 14:00:00 DATE= 2004-03-24
  0= 00000    1= 00000    2= 00000  3= 00000  4= 00000
  5= 00000    6= 00000    7= 00067  8= 03430  9= 00103
```

```
10= 00000  11= 00000  12= 00000  Q= 03600

TIME= 15:00:00 DATE= 2004-03-24
  0= 00000    1= 00000    2= 00000  3= 00000  4= 00000
  5= 00000    6= 00000    7= 00000  8= 02678  9= 00580
10= 00342  11= 00000  12= 00000  Q= 03600

TIME= 15:01:59  DATE= 2004-03-24
  0= 00000    1= 00000    2= 00000  3= 00000  4= 00000
  5= 00000    6= 00000    7= 00000  8= 00000  9= 00027
10= 00091  11= 00000  12= 00000  Q= 00118

END OF LOG
```

In this example, the receiver tracked six satellites for 19 seconds, seven satellites for 1537 seconds, and eight satellites for 2044 seconds for the hour ending 12:00:00. The "Q" value of 3600 indicates the receiver had tracked at least four qualified satellites for the entire hour (3600 seconds). Note the partial histogram shown in the time stamp of 15:01:59.

For optimum performance, the receiver should consistently track four or more satellites. The Q value should typically be 3600 for most entries. Occasional drops below 3600 are considered acceptable. If the majority of the histograms show tracking less than four satellites, or Q values less than 3000, the receiver may not provide reliable operation. Refer to Section 2.9.2 for recommendations.

2.9 Reception Troubleshooting

Please review this section prior to calling the Spectracom Customer Service Department. If the reception problem cannot be solved following the guidelines outlined in this section, please call for Customer Service at 585.321.5800.

2.9.1 No Reception

Cable or connector problem: Measure the antenna cable resistance to verify the integrity of the cable and connectors. Remove the antenna cable from the rear panel of the receiver and measure the resistance from the coax center to shield. Refer to Table 2-2 for typical resistance values of the antenna and inline amplifier alone and when combined.

DEVICE	RESISTANCE
8225	180 ohms
8227	165 ohms
8225 and 8227	85 ohms

Table 2-2 Typical Antenna Cable Resistance Values

Failed impulse suppressor: The Model 8226 has a high impedance when measuring from the center conductor to ground and a low throughput resistance. A failing impulse

suppressor may be tripping prematurely. The easiest way to test the Model 8226 is to temporarily replace it with a Type N barrel connector. If the receiver begins tracking satellites within 20 minutes, the impulse suppressor has failed and must be replaced.

Cable length: Excessively long or improper cable type may prevent the receiver from tracking satellites. Refer to Section 2.3 for GPS antenna cable recommendations.

Antenna location: The antenna must be installed outdoors and have a good view of the sky. Refer to Section 2.2.1 for antenna installation guidelines.

GPS reset: In rare occasions, the GPS receiver may require a reset to set the receiver to default values. The receiver must be placed in Test Mode to issue the GPS Reset command. Issue the GPS Reset command, **RGPS**, as shown below:

Type: ***TM ON <ent>***

The unit will respond with a message stating Test Mode has been enabled. During Test Mode operation, the Major and Minor alarms are asserted.

Type: ***RGPS <ent>***

After an approximate 10 second delay, the receiver responds with a reset status message. Allow 20 minutes for the receiver to begin tracking satellites.

Receiver location: Setting the current receiver position may assist in obtaining a satellite fix. To enter a new location place the clock in *Set Mode* and issue the ***LOC*** command as follows:

Type: **SM ON <ent>**
Response: SET MODE = ON

Type: **LOC [N:S] [DD MM SS.SSS][E:W] [*DDD MM SSS.SSS*]<ent>**
Where: N = North Latitude
S = South Latitude
D MM SS.SSS = Latitude Degrees:Minutes:Seconds
E = East Longitude
W = West Longitude
DDD MM SSS.SSS = Longitude Degrees:Minutes:Seconds

NOTE: The approximate location is adequate; zeros may be used for the seconds values.

Allow 20 minutes for the receiver to begin tracking satellites.

2.9.2 Low GPS Quality

Cable Length: Excessively long or improper cable type may cause low GPS quality due to cable attenuation. Long GPS antenna lengths may require an inline amplifier. Refer to Section 2.3 for GPS cable recommendations and Section 2.5 for inline amplifier information.

Antenna location: The antenna must have an unobstructed overhead view of the sky with views to the horizon. Nearby obstructions can reduce the receiver's ability to track the maximum number of satellites available. Refer to Section 2.2.1 for antenna installation guidelines.

Local interference: One reason for poor reception is harmonics from a local broadcast interfering with the GPS L1 carrier of 1575.42 MHz. Certain television or FM radio broadcasts, while operating within their frequency allocation, can cause GPS jamming due to harmonics of the carrier.

The unit can be configured to operate in low GPS quality conditions by selecting an alternate GPS qualifying algorithm. Refer to Appendix A for additional information.

2.10 Default Factory Configuration

Several of the unit's outputs and operational parameters are configurable using the RS-232 communication port and set-up DIP switches. Table 2-3 lists the selectable parameters, factory default, and if it is command or switch selectable. Refer to Section 3, Operation, for a complete description of the various outputs and set-up switches. Refer to Section 4, Software Commands, for information on the various commands.

FUNCTION	FACTORY DEFAULT	COMMAND OR SWITCH
Antenna Cable Delay	No Delay	Command, ACD
Alarm Timeout AT1	1 Minute	Command, AT1
Alarm Timeout AT2	2.5 Hours	Command, AT2
Alarm Timeout AT3	30 Days	Command, AT3
CTCSS Tone	67.00 Hz (Option 14 & 17)	Command, CTC
Event Output	OFF	Command, EO
Signature Control	OFF	Command, SC
Set Mode	OFF	Command, SM
Test Mode	OFF	Command, TM
Time Zone Offset	No Offset	Command, TZO
10 MHz Offset	No Offset	Command, 1FO
One PPS Offset	No Offset	Command, 1PO
RS-485 Address	00	Switch selectable
RS-485 Baud Rate	9600	Switch selectable
RS-485 Termination	ON	Switch selectable

Table 2-3 Default Setting

3 Operation

3.1 Introduction

This section describes the front and rear panel functions, and operational information for the Spectracom GPS Ageless Master Oscillator.

3.2 Front Panel Functions

The front panel (with the battery option) is shown in Figure 3-1. The paragraphs below describe the indicators and connectors found on the front panel.

3.2.1 Status Lamps

Power
This green lamp indicates that the unit is connected to the primary power source and is turned on.

Tracking GPS
During initial operation the TRACKING GPS lamp turns on when the receiver has tracked at least four qualified satellites for one minute. The lamp turns off when fewer than four qualified satellites are tracked and Alarm Timeout 1, AT1, expires. The lamp turns back on when at least four satellites are reacquired and qualified for one minute.

Oscillator Locked
The green OSC LOCKED lamp is off during start-up. The lamp turns on when the standard oscillator is phase locked to the GPS reference. Entering a new frequency offset, an Alarm Timeout 2 (AT2) or Frequency alarm turns this lamp off until oscillator phase lock is achieved.

3.2.2 Alarm Lamps

The Master Oscillator divides alarm conditions into two categories, Major and Minor. A Major Alarm is asserted when fault conditions exist which affect the operation or accuracy of the unit. A Minor Alarm warns of conditions having no immediate effect on total operation, but may require corrective action.

Major and Minor Alarm conditions are communicated by the front panel lamps and relay contacts on the rear panel Alarm Output connector. In addition Major alarm relay contacts are found on the 1544 kHz, 2048 kHz, Data Clock and Data Sync output connectors. Alarm status may also be monitored using the front panel RS-232 or rear panel RS-485 communication ports. Refer to Section 4 for a complete listing of alarm status and alarm clearing commands.

3.2.2.1 Major Alarm Lamp

This lamp turns on when any of the Major Alarm condition is present. The lamp turns off when the fault condition is corrected. A Major Alarm is asserted when the following conditions exist:

Frequency Error: Measured oscillator frequency error exceeds1 x 10^{-8} or whenever an AT2 Alarm is asserted. A frequency alarm is also asserted during start-up.

GPS Tracking Timeout 2: The period of time (AT2) allotted for operation without tracking a minimum of four qualified satellites has expired. Factory default period is 2.5 hours. An AT2 Alarm is also asserted during start-up.

GPS Tracking Timeout 3: The period of time (AT3) allotted for operation without tracking a minimum of four qualified satellites has expired. Factory default period is 30 days. An AT3 Alarm is also asserted during start-up.

CPU Fault: The CPU is unable to communicate with the GPS receiver.

Test Mode: Unit has been placed in TEST MODE operation.

Free Run: While in Test Mode, the automatic frequency control feature has been disabled.

Short Gate: While in Test Mode, gate time has been configured for 10 seconds, measurement resolution is reduced.

3.2.2.2 Minor Alarm Lamp

This lamp turns on whenever a Minor Alarm condition is present. The lamp turns off when the fault condition is corrected. A Minor Alarm is asserted when:

Output Fault: No output is detected from one or more of the four rear panel frequency outputs. A shorted cable could cause the fault, reflections due to an un-terminated cable or Signature Control removed the outputs.

Oscillator Adjust: Warns that oscillator is operating within 10% of the minimum or maximum control setting. The oscillator requires manual adjustment. Refer to Section 6, Service Information, for the oscillator adjustment procedure.

GPS Tracking Timeout 1: The period of time (AT1) allotted for operation without tracking a minimum of four qualified satellites has expired. Factory default =1.0 minute. An AT1 Alarm is also asserted during start-up.

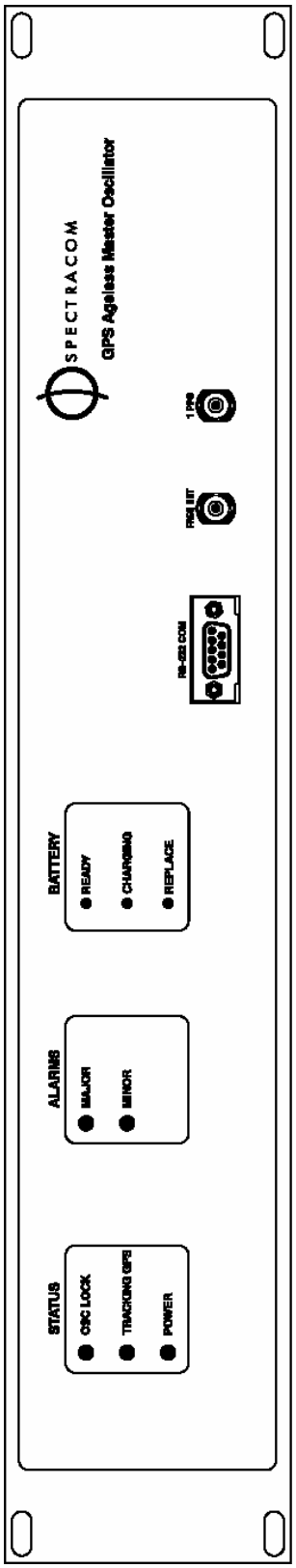


Figure 3-1 Spectracom Master Oscillator Front Panel

Low Quality Alarm: Warns of low GPS signal quality. The alarm is asserted whenever the "Q" value in the Tracking Histogram is below 3000.

Replace Battery: Internal battery pack, Option 02 only, has failed daily test, needs replacement. Refer to Section 6, Service Information, for battery replacement instructions.

Frequency Offset: A new simulcast offset value is entered. The alarm remains active until the standard oscillator has corrected for the offset.

Antenna Problem: Antenna sense circuitry warns when the antenna is not connected or a cable short or open is detected. It warns when the antenna power supply is under or over current. This alarm may also be asserted when the receiver is connected to an antenna splitter device that does not have a simulated load.

Test Mode: Unit is placed in Test Mode operation.

3.2.3 Battery Lamps (Option 02 only)

These lamps monitor the status of the optional internal battery backup. Refer to Section 5, Options and Accessories, for additional battery information.

Ready Lamp
This green lamp is on when the battery is OK and fully charged.

Charging Lamp
This yellow lamp is on when the battery is charging.

Replace Lamp
This red lamp turns on and a Minor Alarm asserted when the battery has failed its daily test. The battery must be replaced; refer to Section 6, Service Information. Refer to the Options and Accessories section for details on the battery daily test.

3.2.4 RS-232 Com

This is the RS-232 serial communication port. Commands to configure selectable parameters, output operational status and events, and Test Mode functions are entered here. Refer to Section 4.3 for a complete description of the RS-232 commands and responses.

The RS-232 COM connector is a 9-pin series D female. Connector pin numbering is shown in Figure 3-2. Pin assignments are listed in Table 3-1.
The RS-232 Com port transmits and receives ASCII characters at 9600 baud structured as 1 start, 8 data, 1 stop, no parity and xon / xoff flow control.

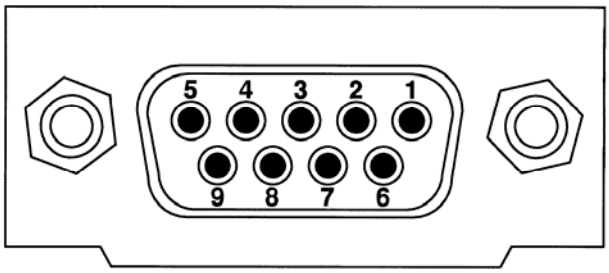


Figure 3-2 RS-232 Com Pin Numbering

PIN	SIGNAL	I/O	DESCRIPTION
2	RXD	O	Receive Data
3	TXD	I	Transmit Data
5	GND	-	Signal Common
6	DSR	O	Data Set Ready
7	RTS	*	Request to Send
8	CTS	*	Clear to Send

* Pins 7 and 8 are connected together internally.

Table 3-1 RS-232 Com Pin Assignments

The RS-232 Com port is configured as data communication equipment (DCE). Data is output on Pin 2, RXD and commands are input on Pin 3, TXD. When interfacing to data terminal equipment, DTE, (i.e. a personal computer) a one-to-one cable is used. Interfacing to a DCE requires reversing Pins 2 and 3 or a null modem connection. The RS-232 COM port does not require hardware handshaking. The Request to Send and Clear to Send signals are internally connected together, and the DSR signal are held high through a pull-up resistor.

3.2.5 10 MHz Output

This BNC connector outputs a 10 MHz sine wave signal derived from the disciplined oscillator. The 10 MHz output can be user-configured for simulcast operation. Refer to the Frequency Offset command, 1F0, found in Section 4.3 for additional information. This output is changed to 12.8 MHz when equipped with Option 06, and 5 MHz with Option 07 units.

3.2.6 1PPS Output

This BNC connector outputs a one pulse-per-second TTL-compatible signal. The signal is derived from the GPS disciplined 10 MHz oscillator. The leading edge of the signal is the on time point adjusted by any cable or offset delays that have been user-configured. Refer to the Antenna Cable Delay command, ACD, and the One PPS Offset command, 1PO, descriptions found in Section 4.3 for additional information.

3.3 Rear Panel Functions

The Model 8195B and 8197B rear panel is shown in Figure 3-3. The Model 8194B rear panel is shown in Figure 3-4. The following paragraphs describe each of the rear panel functions that are available for the Spectracom Master Oscillator Family. Note that the Model 8194B does not have all of the rear panel functions. Refer to the Product Comparison Chart for details on the different features and options that are available for each model in the Spectracom Master Oscillator family. The Product Comparison Chart can be found in Section 1.2.

3.3.1 GPS Antenna

This type N connector is the antenna input to the GPS receiver. The Model 8225 GPS Antenna and the Model 8227 Inline Preamplifier receive operational power, +5 VDC, from this connector.

3.3.2 Frequency Outputs

The Frequency Outputs are derived from the GPS disciplined oscillator. Four BNC outputs at 10.0 MHz are provided. The signal is a 750 mV rms sine wave into a 50-ohm load. The harmonic suppression is 30 dB.

3.3.2.1 Signature Control

The Frequency Outputs may be placed under signature control. Signature Control removes the outputs whenever a Major Alarm occurs. The outputs return when the fault condition is cleared. The unit is shipped with this feature disabled. The Signature Control feature may be enabled using the front panel RS-232 Com port. Refer to the Signature Control command, SC, found in Section 4, Software Commands.

3.3.2.2 Simulcast Offsets

In simulcast radio systems, it is desirable to cover large geographic areas with multiple base station transmitters. Simulcasting requires precise control of transmitter frequencies to reduce interference between adjacent transmitters on the same channel.

Ineffective transmitter frequency control can reduce system coverage and cause "dead spots," "false pages," and message distortion. These adverse effects are reduced or eliminated by providing a carrier frequency offset between adjacent transmitters. The offset values are selected to minimize co-channel interference. To assure maximum performance of the system, periodically checking and adjusting the transmitter oscillators to maintain the desired frequency offsets must neutralize the effects of transmitter oscillator “aging”.

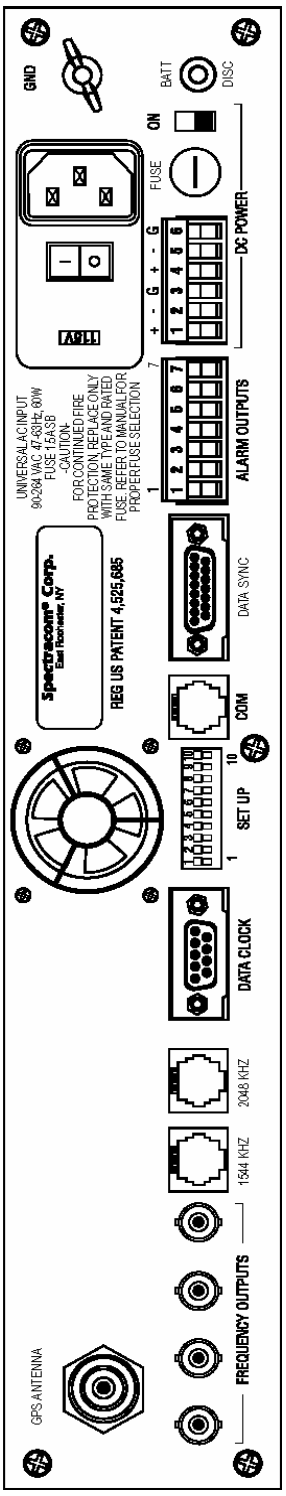


Figure 3-3 Spectracom Master Oscillator Model 8195B and 8197B Rear Panel

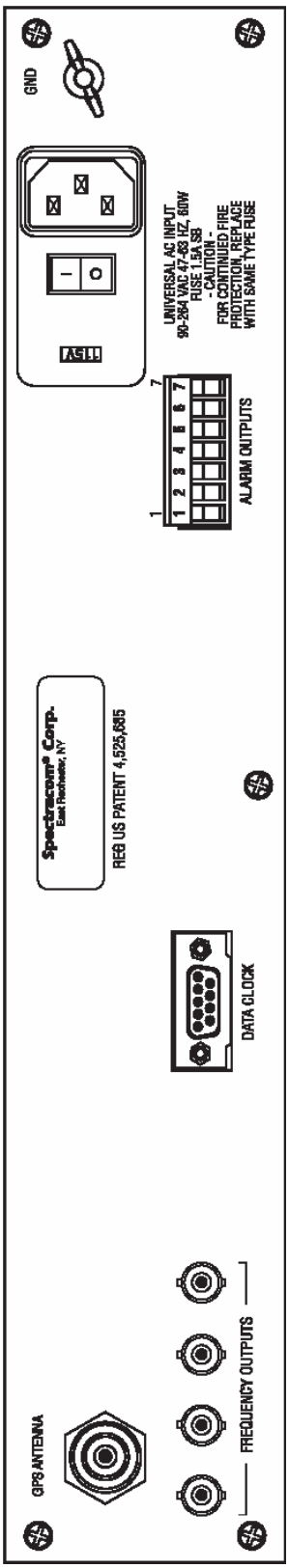


Figure 3-4 Spectracom Master Oscillator Model 8194B Rear Panel

The Spectracom Master Oscillator Simulcast Transmitter Offset provides an accurate, controlled frequency reference that is continuously "frequency locked" to GPS. This reference can be used by synthesized transmitters to provide "ageless" frequency control, including offsets, at an accuracy of $\pm 1.0 \times 10^{-10}$.

The simulcast offsets are divided into two groups; Simulcast 1 (SC1) and Simulcast 2 (SC2). Simulcast 1 has offset steps sized for UHF as listed in Table 3-2. Simulcast 2 has offset steps sized for VHF Hi as listed in Table 3-3. Within each group exist four positive offset steps and the complimentary negative offset steps.

The simulcast offsets are selected using software commands. Refer to the 10 MHz Offset command, 1F0, found in Section 4 for additional information.

Offset Name	Offset Δf_s	Output Frequency	Offset @ 450 MHz
SC1 + 1	+1.1E-9	10,000,000.011 Hz	+0.5 Hz
SC1 + 2	+2.2E-9	10,000,000.022 Hz	+1.0 Hz
SC1 + 3	+3.3E-9	10,000,000.033 Hz	+1.5 Hz
SC1 + 4	+4.4E-9	10,000,000.044 Hz	+2.0 Hz
SC1 - 1	-1.1E-9	9,999,999.989 Hz	-0.5 Hz
SC1 - 2	-2.2E-9	9,999,999.978 Hz	-1.0 Hz
SC1 - 3	-3.3E-9	9,999,999.967 Hz	-1.5 Hz
SC1 - 4	-4.4E-9	9,999,999.956 Hz	-2.0 Hz

Table 3-2 UHF Simulcast Offsets

Offset Name	Offset Δf_s	Output Frequency	Offset @ 150 MHz
SC2 + 1	+2.0E-8	10,000,000.200 Hz	+3.0 Hz
SC2 + 2	+3.4E-8	10,000,000.340 Hz	+5.0 Hz
SC2 + 3	+4.7E-8	10,000,000.470 Hz	+7.0 Hz
SC2 + 4	+6.0E-8	10,000,000.600 Hz	+9.0 Hz
SC2 - 1	-2.0E-8	9,999,999.800 Hz	-3.0 Hz
SC2 - 2	-3.4E-8	9,999,999.660 Hz	-5.0 Hz
SC2 - 3	-4.7E-8	9,999,999.530 Hz	-7.0 Hz
SC2 - 4	-6.0E-8	9,999,999.400 Hz	-9.0 Hz

Table 3-3 VHF HI Simulcast Offsets

The frequency offset at the carrier frequency is determined by the formula:

$$\Delta f_C = F_C \times \Delta f_S$$

where: Δf_C = carrier offset
F_C = carrier frequency
Δf_S = offset of 10 MHz standard (from the tables)

3.3.2.3 Output Options

Several output options are available to configure the Frequency Outputs for various applications. The output options are listed below. Refer to Section 5, Options and Accessories, for a complete description.

- Option 03, Built-in Distribution Amplifier
- Option 06, 12.8 MHz Outputs
- Option 07, 5 MHz Outputs
- Option 16, 1PPS on the third and fourth rear panel frequency outputs

3.3.3 1544 kHz and 2048 kHz Timing Outputs

Each of these RJ-11 receptacles provide an RS-485 Timing Output of the indicated frequency. The output signals, 1544 kHz and 2048 kHz, are synthesized from the 10 MHz GPS disciplined oscillator. Major Alarm relay contacts are included on each output connector.

NOTE: Simulcast Offsets affects the accuracy of the timing outputs.

The connector pin numbering is shown in Figure 3-5 and pin assignments listed in Table 3-4.

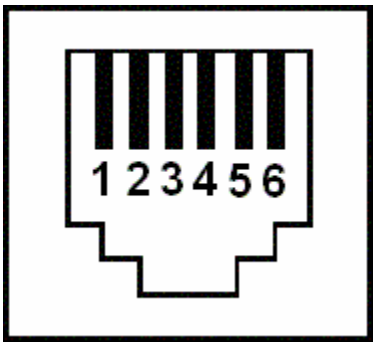


Figure 3-5 Timing Output Connector

PIN	SIGNAL	NOTES
1	+ Frequency	RS-485 B Terminal
2	- Frequency	RS-485 A Terminal
3	Ground	Cable Shield/Relay Ground
4	MAJOR C	Common
5	MAJOR NO	Normally Open
6	MAJOR NC	Normally Closed

Table 3-4 Timing Output Pin Assignments

NOTE: A units equipped with Option 06, 12.8 MHz outputs, changes the 2048 kHz output to 1600 kHz.

3.3.3.1 RS-485 Outputs

RS-485 is a balanced differential transmission requiring twisted pair cabling. Refer to Figure 3-6 for a schematic representation of the RS-485 output driver. Relative to RS-485 specifications, the A terminal (Pin 2) is negative with respect to the B terminal (Pin 1) for a Binary 1. The A terminal is positive relative to the B terminal for a Binary 0.

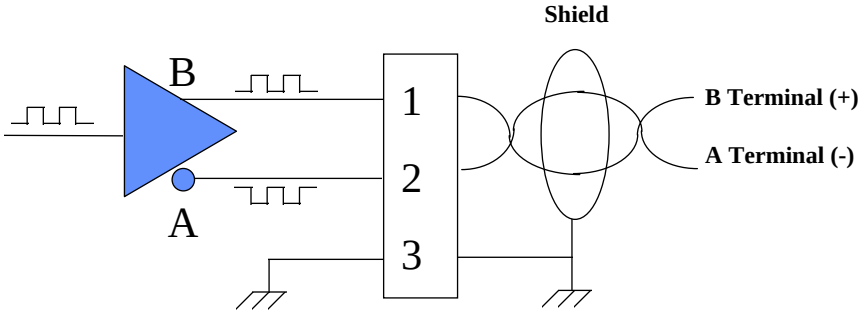


Figure 3-6 RS-485 Output

The RS-485 output driver can provide a TTL-compatible clock signal when connected in a single-ended configuration. Connect as shown in Figure 3-7 for a TTL clock reference.

The 100-ohm termination resistor is required at the cable destination to prevent ringing and reflections.

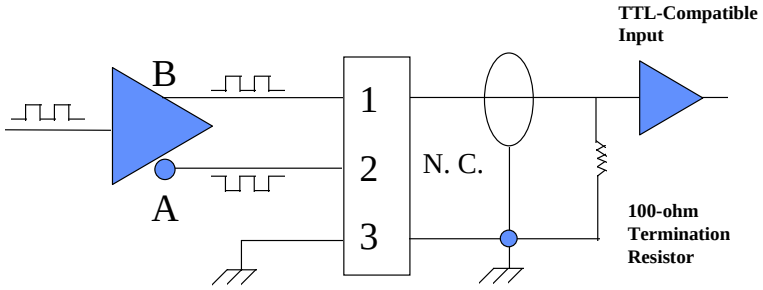


Figure 3-7 Single-Ended Connection

3.3.3.2 Major Alarm Contacts

Major Alarm relay contacts are found on Pins 4, 5 and 6 of each timing output connector. During normal operation the Major Alarm relay is energized causing continuity between Pin 4 and Pin 6. When a Major Alarm is asserted the relay is deactivated causing continuity between Pin 4 and Pin 5. The relay remains in alarm condition until the condition causing the alarm is corrected or is reset by the clear alarm, CA, command. Refer to section 3.2.2.1 for a complete description of Major Alarms.

3.3.4 Data Clock Timing Outputs

This connector provides RS-485 clock signals of one pulse per second (1PPS), 9.6 kHz, 18 kHz and Major Alarm relay contacts. The connector is a 9-pin series D numbered as shown in Figure 3-8. Data Clock pin assignments are listed in Table 3-5.

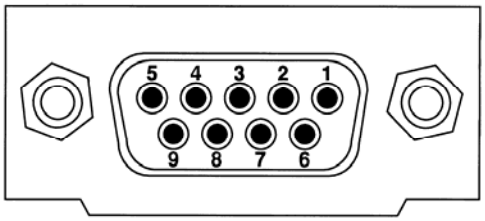


Figure 3-8 Data Clock Connector

PIN	SIGNAL	NOTES
1	+ 9.6 KHZ	RS-485 B TERMINAL
2	+18 KHZ	RS-485 B TERMINAL
3	+ 1 PPS	RS-485 B TERMINAL
4	MAJOR ALARM	GROUND = NORMAL
5	GROUND	CABLE SHIELD
6	- 9.6 KHZ	RS-485 A TERMINAL
7	-18 KHZ	RS-485 A TERMINAL
8	- 1 PPS	RS-485 A TERMINAL
9	GROUND	CABLE SHIELD

Table 3-5 Data Clock Pin Assignments

The Data Clock timing signals are derived from the 10 MHz GPS disciplined oscillator. The 1PPS and 9.6 Hz outputs are leading edge synchronized to the GPS 1 PPS output. Using the 1PPS offset command; 1PO, the outputs can be offset from 0 to 1 second in 0.001 microsecond steps. Refer to Section 4 for additional information on the 1PO Command. The 18 kHz output is not made leading edge synchronized.

NOTE: Option 17, replaces the 9.6 kHz and 1PPS signals with the selected CTCSS outputs #3 and #4 respectively

3.3.4.1 RS-485 Outputs

RS-485 is a balanced differential transmission requiring twisted pair cable. Cable lengths up to 4000 feet are possible when using cables specifically designed for RS-485 applications, like Belden 9844 or equivalent. These cables have a braided shield, nominal impedance of 120 ohms, and a capacitance of 12 to 15 picofarads per foot. Refer to Figure 3-9 for a schematic representation of an RS-485 line driver. Relative to RS-485 specifications the A Terminal (-) is negative with respect to the B Terminal (+) for a Binary 1. The A Terminal (-) is positive to the B Terminal for a Binary 0.

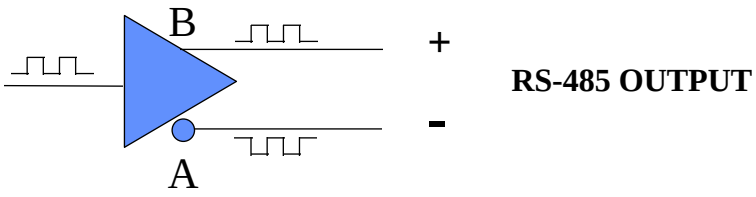


Figure 3-9 RS-485 Line Driver

3.3.4.2 Major Alarm Relay

Major Alarm status can be monitored using Pin 4 of this connector. Under normal operation, Pin 4 is connected to ground. When a Major Alarm is asserted, Pin 4 becomes a high-impedance (open circuit). Refer to Section 3.2.2.1 for a complete description of Major Alarms.

3.3.5 Set Up Switches

The Set-Up Switches configure the RS-485 address, baud rate and termination.

3.3.5.1 RS-485 Address

The Address switches give each unit installed on an RS-485 bus a unique identity. The address may range from 0 – 31, DIP-switches 1 through 5 enter the binary equivalent of the selected address. Table 3-6 lists the RS-485 addresses and the corresponding DIP-switch settings.

The RS-485 protocol includes address source and destination information.

RS-485 ADDRESS	DIP SWITCH 1	2	3	4	5	RS-485 ADDRESS	DIP SWITCH 1	2	3	4	5
0	0	0	0	0	0	16	0	0	0	0	1
1	1	0	0	0	0	17	1	0	0	0	1
2	0	1	0	0	0	18	0	1	0	0	1
3	1	1	0	0	0	19	1	1	0	0	1
4	0	0	1	0	0	20	0	0	1	0	1
5	1	0	1	0	0	21	1	0	1	0	1
6	0	1	1	0	0	22	0	1	1	0	1
7	1	1	1	0	0	23	1	1	1	0	1
8	0	0	0	1	0	24	0	0	0	1	1
9	1	0	0	1	0	25	1	0	0	1	1
10	0	1	0	1	0	26	0	1	0	1	1
11	1	1	0	1	0	27	1	1	0	1	1
12	0	0	1	1	0	28	0	0	1	1	1
13	1	0	1	1	0	29	1	0	1	1	1
14	0	1	1	1	0	30	0	1	1	1	1
15	1	1	1	1	0	31	1	1	1	1	1

1 = SWITCH ON, 0 = SWITCH OFF

Table 3-6 Address Selection

3.3.5.2 RS-485 Baud Rate

DIP-switch 6 is reserved for future implementation of 19200 baud operation of the RS-485 COM port. To ensure proper operation, place this switch in the OFF position. This configures the COM port for 9600 baud.

3.3.5.3 Spares

DIP Switches 7, 8, and 9 are reserved for test and future expansion. To ensure proper operation, place these switches in the OFF position.

3.3.5.4 Termination

Switch 10 terminates the RS-485 Receive line with 120 ohms. Place Switch 10 in the ON position when the unit is installed at the end of the RS-485 bus. Place this switch in the OFF position when the unit is not the last device on the bus.

3.3.6 RS-485 COM

The RS-485 communication port permits remote configuration control and monitoring of performance and status. The RS-485 Com port uses a protocol and command set described in Section 4.2 of this manual. The Com connector pin numbering is shown in Figure 3-10. Table 3-7 lists the Com pin assignments.

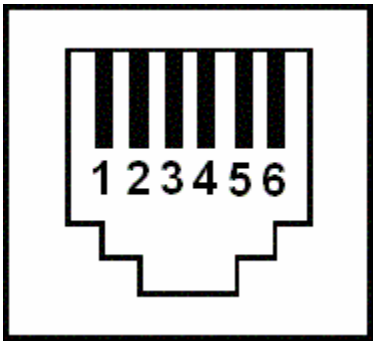


Figure 3-10 RS458 COM Connector

PIN	SIGNAL	NOTES
1	- Transmit	RS-485 A terminal
2	+ Transmit	RS-485 B terminal
3	- Receive	RS-485 A terminal
4	+ Receive	RS-485 B terminal
5	Ground	Cable Shield
6	Ground	Cable Shield

Table 3-7 RS-485 COM Pin Assignments

The rear panel DIP-switch selects the RS-485 address and termination as described in previous paragraphs. Transmitted characters are in ASCII form with a bit structure of 1 start, 8 data, 1 stop and no parity, data rate is 9600 baud.

RS-485 is a balanced differential transmission requiring twisted pair cable. The RS-485 standard defines the A terminal (-) to be negative with respect to the B terminal (+) for a Binary 1 (MARK or OFF) state. The A terminal (-) is positive to the B terminal (+) for a Binary 0 (SPACE or ON) state. Figure 3-11 illustrates the relationship between the A and B terminals for the Transmit and Receive connections.

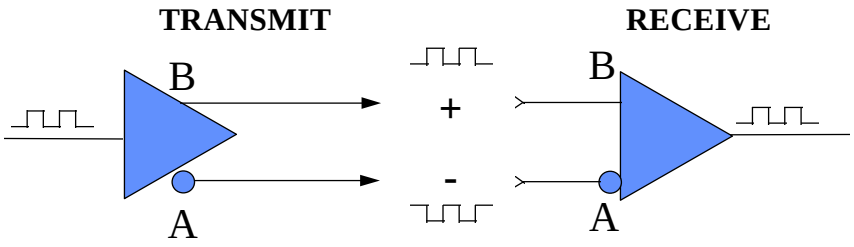


Figure 3-11 RS-485 Connection

3.3.7 Data Sync Timing Outputs

This connector provides RS-485 clock signals of 17 $^{2}/_{3}$ Hz, 33 $^{1}/_{3}$ Hz, 18 kHz, 64 kHz and Major Alarm relay contacts. The connector is a 15-Pin series D female numbered as shown in Figure 3-12. Data Sync pin assignments are listed in Table 3-8.

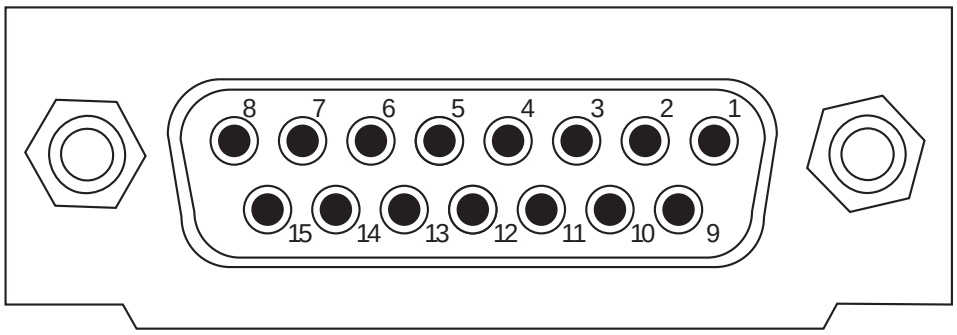


Figure 3-12 Data Sync Connector

PIN	SIGNAL	DESCRIPTION
1	+ 64 kHz	RS-485 B Terminal
2	-64 kHz	RS-485 A Terminal
3	+18 kHz	RS-485 B Terminal
4	-18 kHz	RS-485 A Terminal
5	+ 17 $^{2}/_{3}$ Hz	RS-485 B Terminal
6	-17 $^{2}/_{3}$ Hz	RS-485 A Terminal
7	+33 $^{1}/_{3}$ Hz	RS-485 B Terminal
8	-33 $^{1}/_{3}$ Hz	RS-485 A Terminal
9	Ground	Cable Shield
10	Major - C	Common Contact
11	Major - NO	Normally Open
12	Major - NC	Normally Closed
13	Ground	Cable Shield
14	Ground	Cable Shield
15	Ground	Cable Shield

Table 3-8 Data Sync Pin Assignments

NOTE: Option 06, 12.8 MHz outputs, changes the 64 kHz output to 50 kHz.

Option 14, CTCSS Outputs, replaces the 33-1/3 Hz and 17-2/3 Hz signals with the selected CTCSS outputs #1 and #2 respectively.

Refer to Section 5, Options and Accessories, for additional information on Options 06 and 14.

The 64 kHz and 18 kHz Data Sync outputs are derived from the 10 MHz GPS disciplined oscillator.

The 17 $^{2}/_{3}$ Hz and 33 $^{1}/_{3}$ Hz outputs are derived from the 10 MHz GPS disciplined oscillator and are triggered by the GPS 1PPS output. Using the 1PPS offset command, 1PO, these outputs can be offset from 0 to 1 second in 0.001 microsecond steps. Refer to Section 4 for additional information on the 1PO command. The leading edges of the 17 $^{2}/_{3}$ Hz and 33 $^{1}/_{3}$ Hz outputs are synchronized within ±400 nanoseconds of the Data Clock 1PPS output.

3.3.7.1 RS-485 Outputs

RS-485 is a balanced differential transmission requiring twisted pair cable. Cable lengths up to 4000 feet are possible when using cables specifically designed for RS-485 applications, like Belden 9844 or equivalent. These cables have a braided shield, nominal impedance of 120 ohms, and a capacitance of 12 to 15 picofarads per foot.

Refer to Figure 3-13 for a schematic representation of an RS-485 line driver. Relative to RS-485 specifications the A Terminal (-) is negative with respect to the B Terminal (+) for a Binary 1. The A Terminal (-) is positive to the B Terminal for a Binary 0.

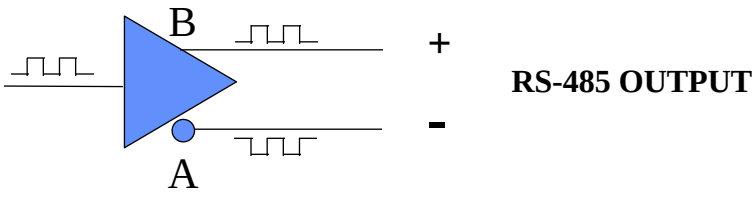


Figure 3-13 Data Sync Drivers

3.3.8 Major Alarm Contacts

Major Alarm relay contacts are found on Pins 10, 11 and 12 of the Data Sync connector. A Major Alarm is asserted whenever any of the following alarm conditions exist: Frequency, Tracking Alarm 2, Tracking Alarm 3, CPU or the unit is placed in Test Mode.

During normal operation the Major Alarm relay is energized. The energized relay causes continuity between the common contact, Pin 10 and the normally open contact, Pin 11.

A Major Alarm or power failure de-activates the relay causing continuity between common, Pin 10 and normally closed, Pin 12. The relay remains in alarm condition until the fault is corrected or reset by the clear alarm, CA, command.

3.3.9 Alarm Outputs

The Alarm Outputs connector provides relay contact closures for Major and Minor alarms. Relay contacts are rated at 2 Amps, 30 VDC. The mating 7-position terminal block, shown in Figure 3-14, is furnished in the ancillary kit.

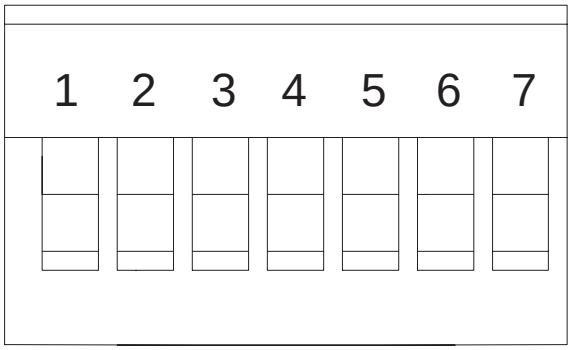


Figure 3-14 Alarm Outputs Terminal Block

A Major Alarm is asserted when any of the following Alarm conditions exist: Frequency, Tracking Alarm 2, Tracking Alarm 3, CPU or the unit is placed in Test Mode. During normal operation the Major Alarm relay is energized. The energized relay causes continuity between common contact, Pin 2, and the normally open contact, Pin 3.

A Major Alarm or power failure de-activates the relay causing continuity between common, Pin 2, and the normally closed contact, Pin 1.

A Minor Alarm is asserted when any of the following alarm conditions exist: Output Fault, Adjust Oscillator, Tracking Alarm 1, Replace Battery, Low GPS Quality, Antenna Problem, Frequency offset or the unit is placed in Test Mode operation. During normal operation the Minor Alarm relay is de-activated. This causes continuity between common, Pin 5, and the normally closed contact, Pin 6.

When a Minor Alarm is asserted the relay is activated causing continuity between common, Pin 5, and the normally open contact, Pin 4.

Table 3-9 lists the Alarm status and the corresponding contact status. The relay contacts remain in the alarm condition until the fault is corrected. If a minor alarm is caused by a replace battery alarm, it will remain until a Clear Alarm, CA, command is issued.

ALARM STATUS	PINS SHORTED*	PINS OPEN*
Major Alarm Off	2 , 3	1 , 2
Major Alarm On	1 , 2	2 , 3
Minor Alarm Off	5 , 6	4 , 5
Minor Alarm On	4 , 5	5 , 6

***Ground is found on Pin 7*

Table 3-9 Alarm Operation

3.3.10 DC Power

The DC Power connector provides primary or backup power to the unit

On AC powered units, the DC power connector allows connection of a backup power source. The backup source powers the oscillator and GPS receiver module whenever AC power is interrupted. Backup power speeds recovery time when AC power is restored by eliminating oscillator warm-up and retrace and GPS reacquisition time. The backup power source must be +24 VDC, non-ground isolated supply of 10 Watts maximum. When connecting the backup power source, connect a wire jumper from the negative (-) pin to the ground (G) pin as shown in Figure 3-15. The DC power connector is shown in Figure 3-16.

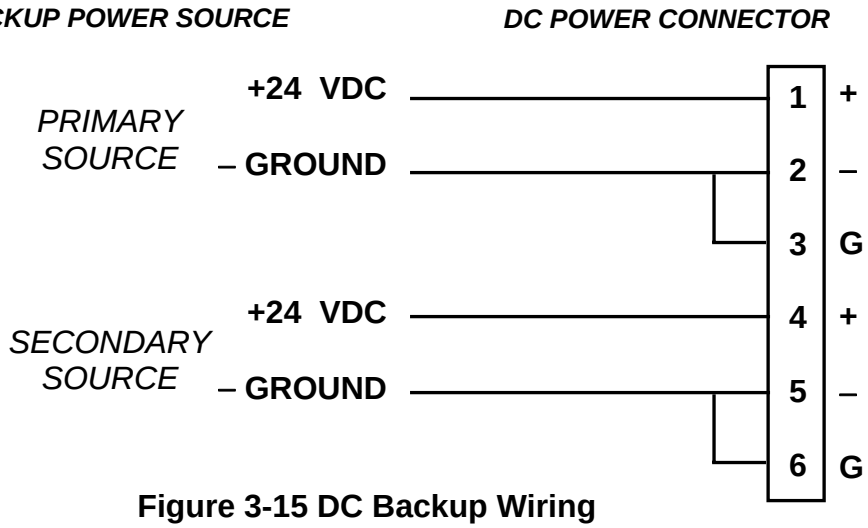


Figure 3-15 DC Backup Wiring

DC power options allow operation from alternate power sources. Table 3-10 lists the various DC power configurations available. Power is 20 Watts for Model 8195B and 60 Watts for Model 8197B.

Power Option	Nominal Voltage	Input Range	Fuse
Option 52	± 12 VDC	11.1 - 16.5 VDC	10.0 A
Option 53	± 24 VDC	22.1 - 33.1 VDC	6.25 A Slo-Blo
Option 54	± 48 VDC	44.2 - 66.2 VDC	3.0 A Slo-Blo

Table 3-10 DC Power Configurations

Connect the DC power inputs to the 6-position terminal block as shown in Figure 3-16, DC Power Connector. The mating connector is included in the ancillary kit. Redundant power sources may be connected for improved system reliability. Be certain to observe the polarity markings when connecting power.

DC power options, 52, 53, and 54, have isolated inputs, which permits operation from a positive or negative power source. To reduce RFI/EMI emissions use a shielded power cable. Connect the cable shield to the chassis ground pin labeled “G”.

NOTE: Place the DC power switch in the OFF position prior to connecting DC power.

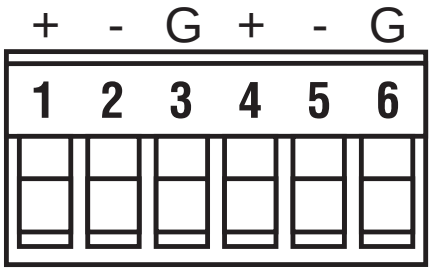


Figure 3-16 DC Power Connector

3.3.11 AC Power

The standard Master Oscillator receives primary power from a 90 to 264 VAC 50/60 Hz power source. A detachable line cord is furnished in the ancillary kit. The supplied line cord is compatible with AC receptacles (NEMA 5 - 15R) commonly found in the United States and Canada. Alternate type line cords may be obtained locally. Connect the line cord to the rear panel AC module and a properly grounded power receptacle.

The AC power module is equipped with a power switch, line voltage selector, EMI filtering, and a fuse. Figure 3-17, AC Power Module, illustrates fuse replacement. The AC fuse requires a 1.5 Amp, 250V Slo-Blo fuse. A spare is found in the ancillary kit.

NOTE: The unit accepts the complete range of 90-264 VAC without a change in instrument setup. Do not change the AC fuse value or line voltage selector. The ‘115’ label must appear in the cover cutout.

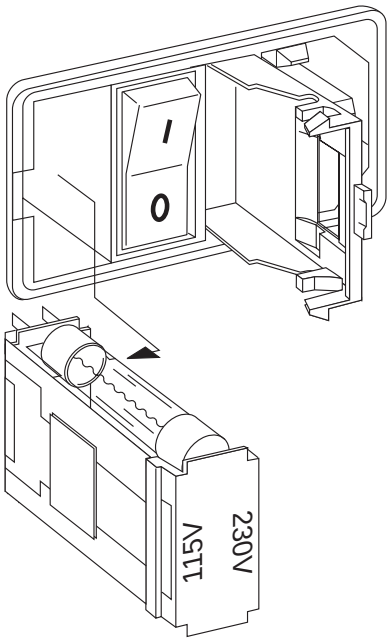


Figure 3-17 AC Power Module

3.3.12 Cooling fan

Cooling fan operation is microprocessor controlled. The fan is turned on when the internal temperature measures 50°C and off when the temperature reaches 30°C.

3.3.13 Chassis Ground

The chassis ground lug allows the unit's chassis to be connected to an earth ground in addition to the power line safety ground. Connecting the chassis to a single point ground system may be required in some installations to ensure optimum lightning protection. A separate earth ground is also recommended in installations where excessive noise on the power line degrades the unit's receiver performance.

3.3.14 Battery Disconnect Switch

Depressing this switch removes the backup battery power from the GPS receiver and ovenized oscillator. The Battery Disconnect switch is operational only on units equipped with Option 02 and when AC power is removed. This feature prevents battery discharge when shipping or storing the unit.

NOTE: The internal battery must be disabled prior to shipment or storage. Failing to disable the battery may result in reduced capacity and shortened battery life.

NOTE: The Battery Disconnect Switch is populated on all versions of the Model 8195B. The switch is only operational on units equipped with Option 02.

4 Software Commands

4.1 Introduction

This chapter describes commands that are asserted through the front panel RS-232 COMM and the rear panel RS-485 COMM connectors.

4.2 RS-232 Commands

From the front panel RS-232 COMM port the user may configure, control and monitor the unit. Table 4-1 lists the RS-232 commands available to provide user access to the operation of the unit. These commands contain a hierarchy of Read, Set and Test modes. Figure 4-1 illustrates the Master Oscillator command structure. Read Mode is the base level and when in Read Mode the user may access standard commands. From Read Mode the user may select to enter Test or Set Mode. Set Mode allows the user to not only access standard commands, but in addition, allows them to make changes to certain functions. Test Mode allows the user access to special test commands, as well as all standard commands. After entering Set Mode or Test Mode, the unit will time out and return to Read Mode after 15 minutes of inactivity.

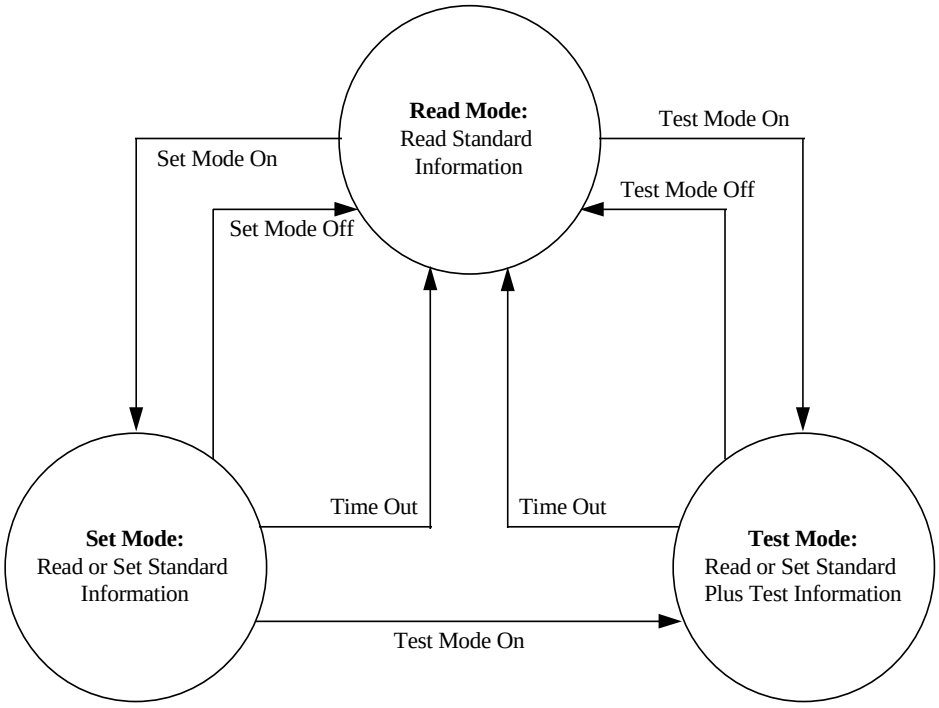


Figure 4-1 Command Structure

COMMAND	DESCRIPTION	MODE	SECTION
ACD	Antenna Cable Delay	READ/SET	4.3.1
ATx	Alarm Time Out	READ/SET	4.3.2
BA	Battery Status	READ	4.3.3
CA	Clear Alarms	SET	4.3.4
CONF, DC	Display Configuration	READ	4.3.5
DAL	Display Alarm Log	READ	4.3.6
DATE, D	Date	READ/SET	4.3.7
DFM	Display Frequency Measurement	READ	4.3.8
DOL	Display Oscillator Log	READ/TEST	4.3.9
DH	Display Tracking Histogram	READ/TEST	4.3.10
EO	Event Output	READ/SET	4.3.11
GSS, DSS, SS	GPS Signal Status	READ	4.3.12
H, Help, ?	Help	READ	4.3.13
LOC	Location	READ/SET	4.3.14
SC	Signature Control	SET	4.3.15
SM	Set Mode	---	4.3.16
STAT, DS	Display Status Information	READ	4.3.17
TIME, T	Time	READ/SET	4.3.18
TM	Test Mode	---	4.3.19
TZO	Time Zone	READ/SET	4.3.20
U2G	UTC to GPS Time Offset	READ	4.3.21
VER	Version	READ	4.3.22
1FO	Frequency Offset	READ/SET	4.3.23
1PO	One PPS Offset	READ/SET	4.3.24

Table 4-1 Alphabetical List of RS-232 Commands

4.3 RS-232 Command Descriptions

In the following command descriptions, characters in ***Bold Italics*** are keys typed by the user. Terminate all command lines with the enter key. The enter key is represented by ***<ent>.*** The responses from the Master Oscillator are in *Italics*. A new line is represented by the carriage return symbol <*cr*>.

Configure the terminal for ANSI, 9600 baud and xon/xoff flow control. The character structure is ASCII, 1 start, 8 data, 1 stop and no parity.

NOTE: All log entries are recorded in UTC time, unless the TZO command is used to set a local time zone.

4.3.1 Antenna Cable Delay

The command, ***ACD***, reads or sets the antenna cable delay value expressed in microseconds. The on-time point is offset by the delay value entered to compensate for antenna cable and in-line amplifier delays. The expected cable and amplifier delays are typically negligible. The ***ACD*** command is intended for advanced user setup. The advanced user can calculate the delay based on the cable manufacturer's specifications.

Range:	0.000 to 999.999 microseconds
Default Value:	0.000 microseconds
Resolution:	1 nanosecond

To read the antenna cable delay, issue the ***ACD*** command as shown below:

Type:	***ACD <ent>***
Response:	*ANT CABLE DELAY = XXXXXX.XXX MICROSECONDS*
Where:	*XXXXXX.XXX* = 000000.000 to 000999.999 microseconds.

To enter a cable delay, place the clock in *Set Mode* operation, issue the ***ACD*** command as follows:

Type:	**ACD XXXXXX.XXX** <ent>
Where:	**XXXXXX.XXX** = 000000.000 to 000999.999 microseconds.

NOTE: It is not necessary to fill every digit space when entering a delay value. The delay value can range from 1 to 9 digits long.

The clock then responds with the antenna cable delay value entered. For example, the calculated cable delay for 100 feet of LMR-400 cable is 119 nanoseconds. Follow the example below to compensate the on-time point by the antenna cable delay.

Type:	**SM ON <ent>**
Response:	SET MODE ON
Type:	**ACD 0.119<ent>**
Response:	ANT CABLE DELAY = 000000.119 MICROSECONDS

Cable delay can be calculated using the formula:

$$D = \frac{L \times C}{V}$$

Where: D = Cable delay in nanoseconds.
L = Cable length in feet.
C = Constant derived from velocity of light; 1.016.
V = Nominal velocity of propagation expressed as a decimal, ex. 85% = .85
Value is provided by cable manufacturer.

4.3.2 Alarm Timeouts

The command ***ATx*** reads or sets the time out period allotted for tracking alarms AT1, AT2 and AT3. The default time out periods are ***AT1 = 1 minute, AT2 = 2 1/2 hours***, and ***AT3 = 30 days***.

When the receiver is unable to track at least four qualified satellites a count down timer is started. If the receiver is unable to reacquire qualified satellites within the assigned time out periods the expired time out alarm is asserted. An AT1 alarm is classified as a Minor alarm. AT2 and AT3 are Major alarms.

To read the current time out values issue the ***ATx*** command as follows:

Type: ***ATx <ent>***
Where x = 1, 2, 3.
Example Response:
ALARM TIMEOUT x = DDD HH:MM:SS
Where x = 1, 2, 3
DDD = Days 000 … 999
HH = Hours 00 … 23
: = Colon Separator
MM = Minutes 00 … 59
SS = Seconds 00 …59

To change the alarm time out periods, place the unit in set mode and issue the ***ATx*** command as shown below:

Type: ***ATx DDD HH:MM:SS***
Response: *ALARM TIMEOUT x = DDD HH: MM:SS*

4.3.3 Battery Status (Option 02 only)

The **BA** commands displays the status of the battery on units that is equipped with the internal battery backup. It will indicate one of three conditions. **READY** indicates the battery good and fully charged, **CHARGING** indicates the battery is OK, but is not yet fully charged, and **REPLACE** indicates the battery failed a test and should be replaced. The replace battery condition is a minor alarm. This information is also provided in the Display Status command and is displayed using the front panel LED on units with internal battery backup installed. To read the battery status issue the BA command as follows:

Type: **BA<*ent*>**

Response:

BATTERY STATUS= READY

-OR-

BATTERY STATUS = CHARGING

-OR-

BATTERY STATUS= REPLACE

4.3.4 Clear Alarm

The ***Clear Alarm*** command, ***CA***, resets the Major and Minor Alarm relays even though the fault conditions are still present. If a new alarm condition arises the appropriate alarm relay will be reasserted. The front panel alarm lamps are not reset by this command. The indicator alarm lamps remain on until the fault condition is corrected.

When a ***CA*** command is issued the unit responds with a change in status report. This report time stamps when the relays were reset and lists the active alarms.

To reset the alarm relays, place the unit in Set Mode and issue the ***CA*** command as follows:

Type: **CA<ent>**
Response:

TIME= 13:44:06 DATE= 2000-03-24 STATUS CHANGE <TEMP= +36.0>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= OFF
ACTIVE ALARMS: MAJOR
FREQUENCY

The ***CA BAT*** command is used to reset just the Replace Battery lamp and the Minor Alarm relay. This command should be used only to reset the alarms after replacing a failed battery. Resetting the alarms without battery replacement will temporarily clear the alarm. The alarm may reassert when performing the daily battery test at midnight.

When a CA BAT command is issued, the unit responds with a change in status report. This report time stamps when the Replace Battery Alarm was reset.

To clear the Replace Battery Alarm, place the unit in Set Mode and issue the ***CA BAT*** command as follows:

TYPE: ***CA BAT<ent>***

Example Response:

TIME= 12:34:14 DATE= 2000-03-24 STATUS CHANGE <TEMP= +36.0>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= OFF
ACTIVE ALARMS: NONE

4.3.5 Configuration

The ***Configuration*** command, ***CONF***, provides a listing of all user selectable parameters and their current values. The RS-485 address and baud rate selection is made using the rear panel set up switches. All other parameters are configured using RS-232 or RS-485 command sets.

To retrieve configuration information issue the ***CONF*** command as shown below:

Type: ***CONF<ent>***
-OR-
DC<ent>

Response:

TIME ZONE= +00:00
1PPS OFFSET= 000000.000 MICROSECONDS
ANT CABLE DELAY= 000000.000 MICROSECONDS
10 MHZ OFFSET= NONE
SIGNATURE CONTROL= OFF
EVENT OUTPUT= ON
RS-485 ADDRESS= 00 BAUD RATE= 9600
ALARM TIME OUT 1= 000 00:01:00
ALARM TIME OUT 2= 000 02:30:00
ALARM TIME OUT 3= 030 00:00:00

4.3.6 Display Alarm Log

An alarm log entry is made each time there is a change in the alarm relay status. The alarm log can be viewed by using the ***Display Alarm Log*** command ***DAL***. The log contains a time and date stamp of when the alarm status change occurred, alarm relay status and active alarms.

To retrieve the alarm log issue the ***DAL*** command as shown below:

Type: ***DAL***<ent>

Example Response:

TIME= 12:57:53 DATE= 2000-03-24 STATUS CHANGE <TEMP= +43.0>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= ON
ACTIVE ALARMS: MINOR
ANTENNA PROBLEM
TIME= 12:58:54 DATE= 2000-03-24 STATUS CHANGE <TEMP= +43.5>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= ON
ACTIVE ALARMS: MINOR
TRACKING ALARM 1
ANTENNA PROBLEM
TIME= 13:00:39 DATE= 2000-03-24 STATUS CHANGE <TEMP= +43.5>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= OFF
ACTIVE ALARMS: NONE