



MODEL 8194
GPS AGELESS™ OSCILLATOR
INSTRUCTION MANUAL

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REVISIONS, IF ANY, ARE LOCATED AT THE END OF THE MANUAL

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MANUAL REVISION A
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LIMITED WARRANTY

Spectracom warrants each new product manufactured and sold by it to be free from defects in material, workmanship, and construction, except for batteries, fuses, or other material normally consumed in operation that may be contained therein, 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 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.

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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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MODEL 8194

SECTION 1

GENERAL INFORMATION

- 1.0 INTRODUCTION
- 1.1 FEATURES
- 1.2 WARRANTY INFORMATION AND PRODUCT SUPPORT
- 1.3 MANUAL ERRATA AND SPECIAL DOCUMENTATION
- 1.4 UNPACKING
- 1.5 SPECIFICATIONS

GENERAL INFORMATION

1.0 INTRODUCTION

The patented Spectracom Model 8194 Ageless™ Oscillator*, shown in Figure 1-1, is an oven-stabilized highly accurate frequency source. 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 Model 8194 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. Other applications include use as a frequency standard in a Metrology Lab or as a factory reference to lock test equipment to a common traceable time base.

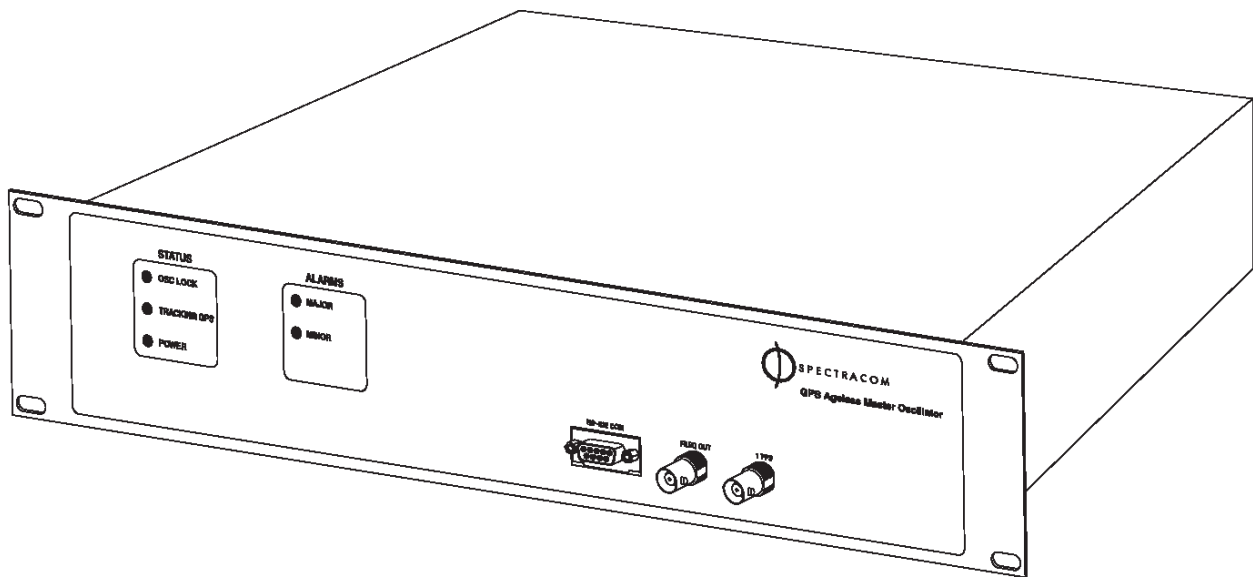


FIGURE 1-1 MODEL 8194 AGELESS OSCILLATOR

* PATENT NO. 4,525,685

1.1 FEATURES

The Spectracom Model 8194 offers the following features:

- **Accuracy:** Continuous self-calibration to GPS provides $\pm 1.0 \times 10^{-11}$ frequency accuracy.
- **Precise Offsets:** The disciplined 10 MHz outputs can be offset in precise steps to improve VHF - Hi simulcast and TV broadcasts.
- **Reliable Worldwide Operation:** The Model 8194 can receive and track up to eight 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.
- **Frequency Distribution:** With the addition of Option 03 Built-In Distribution Amplifier and Model 8140T Line Taps, the Model 8194 provides a reference frequency to counters, spectrum analyzers and signal generators located throughout a facility. Distributing the accurate and traceable reference eliminates the need to buy expensive, high stability time bases for each instrument.

1.2 WARRANTY INFORMATION AND PRODUCT SUPPORT

Warranty information is found on the leading pages of this manual. The Model 8194 contains a GPS receiver that is not manufactured by Spectracom Corporation. Therefore the GPS receiver carries a one-year warranty while the rest of the product is covered under a 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 at:

<http://www.spectracomcorp.com>

The online survey is also used for warranty registration of your new Spectracom products.

Technical support is available by telephone. 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 using the following address:

Spectracom Corporation
Repair Department, RMA# xxxxx
95 Methodist Hill Drive, Suite 500
Rochester, NY 14625

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

mailroom@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>

1.3 *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 upon special request. A customer documentation packet associated with the modification is included with this manual.

1.4 *UNPACKING*

Upon receipt, carefully examine the carton and its contents. If there is damage to the carton that results 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 1-1 lists the items included in the various Model 8194 ancillary kits.

Section 1: General Information

Description	Part Number	Standard Power	Option 03 Distribution
Fuse, 1.5A Slo-Blo	F011R5	1	1
Line Cord	W01000	1	1
Terminal Block, 7 position	P13007	1	1
Terminator, 50-ohm	004492	4	0
Terminator, DC isolated	004490	0	4

TABLE 1-1 MODEL 8194 ANCILLARY KITS

1.5 Specifications

This section contains specifications for the standard Model 8194 GPS Ageless Oscillator, Model 8225 GPS Antenna, Model 8226 Impulse Suppressor and the Model 8227 Inline Amplifier. Specifications pertaining to the Model 8194 options are found in Section 5.

1.5.1 Receiver

Received Standard:	L1 C/A Code transmitted at 1575.42 MHz.
Satellites Tracked:	Up to 8 simultaneously.
Acquisition Time:	Cold start typically <20 minutes.
Acquisition Sensitivity:	-105 dBm to -137 dBm.
Tracking Sensitivity:	-139 dBm.
Optimum Gain Range:	11 to 33 dB at receiver input.
Timing Accuracy:	<50 nanoseconds while in Position Hold mode and SA on. Typically <30 nanoseconds.

1.5.2 Standard Frequency Outputs

Signal:	10-MHz sinewave derived from GPS disciplined oscillator.
Connector:	BNC female, one front panel, four rear panel.
Signal Level:	700 mV rms $\pm$ 2 dB into 50 ohms.

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 @ 1000 Hz. <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 disciplined oscillator output can be offset in precise steps to minimize co-channel interference. The offsets provide steps of ± 3 , 5, 7, 9 Hz at VHF-HI frequencies, and ± 1 , 2, 3, 4 Hz at UHF frequencies. Offsets are selected by software commands.
Output Options:	Option 03 Distribution Amplifier: Allows the Model 8194 to drive Spectracom distribution products. This option adds a 12 Volt DC offset to the rear panel Frequency Outputs.

1.5.3 *Frequency Standard Stability*

Oscillator Type:	10-MHz OCXO, SC cut.
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.
Unlocked Accuracy:	Corrections are applied to the oscillator based upon learned oscillator aging characteristics. Holdover accuracy is <5 microseconds over 5 hours.
Recovery:	Two hours from holdover to oscillator lock. Four hours from cold start.
Aging Rate:	$< 5 \times 10^{-10}$ /day after 30 days. Unit automatically corrects for oscillator aging when locked to GPS.

Section 1: General Information

1.5.4 1 PPS Output

Signal:	One pulse-per-second square wave derived from the GPS receiver.
Connector:	BNC female, front panel.
Signal Level:	TTL compatible into loads >100 ohms.
Pulse Width:	200 milliseconds.
Accuracy:	Positive edge within ± 50 nanoseconds of UTC when in Position Hold Mode and NO DELAY selected.
Delay Control:	The 1PPS output can be delayed 0 - 1 second in 0.001 microsecond steps. The delay value is entered via the RS-232 or RS-485 communication port.

1.5.5 Data Clock Timing Output

Signal:	1PPS derived from the GPS disciplined 10 MHz oscillator.
Connector:	DB9 female, rear panel.
Signal Level:	RS-485.
Duty Cycle:	20% $\pm 5\%$.
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 0.1 microsecond steps. The Data Clock 1PPS shall be synchronized within ± 500 nanoseconds of other Model 8194/8195A/8197 receivers having the same 1PO offset.
Additional Outputs:	Major alarm status is provided on this connector. Under normal operation the alarm pin is Ground. Whenever a Major Alarm is asserted, this pin is open an circuit.

1.5.6 Indicator Lamps

Front panel LEDs, 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.

1.5.7 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.

1.5.7.1 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 1×10^{-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 placed in TEST MODE operation.

Free Run: The automatic frequency control feature has been disabled.

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 unterminated 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 adjustment.

Section 1: General Information

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.

Frequency Offset: An initial or new simulcast offset value has been entered. The alarm remains active until the standard oscillator has corrected for the offset.

Test Mode: Unit is 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.

1.5.7.2 Tracking Alarm Classifications

Three configurable alarm tracking timeouts, AT1, AT2, and AT3, indicate how long the Model 8194 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 upon 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.

1.5.7.3 Alarm Interface

Alarm relay contacts are provided on the Alarm Outputs and Data Clock 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 Clock: Major alarm.
Connector: DB9 Female, rear panel.
Contact Rating: 30 VDC, 500 milliamps.

1.5.8 RS-232 Communication Port

The front panel RS-232 Com port is used to monitor and set operational parameters.

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.

1.5.9 Input Power

AC Input: 90 to 264 VAC, 50/60 Hz, 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.

1.5.10 Mechanical

Dimensions: 3.5H x 19.0W x 12.5D inches.
(89H x 483W x 315D mm).
Weight: 9 lbs.(6.8 kg) maximum.
Shipping Weight: 12 lbs. (9.1 kg).
Rack Mount: EIA 19", front panel drilled for two standard rack units.
Optional: Option 11 Rack Mount Slides.

Section 1: General Information

1.5.11 Environmental

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

1.5.12 Model 8225 GPS Antenna Specifications

1.5.12.1 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: 350 feet or 20 dB cable loss before additional preamplifier is required.
Power: 5 Volts, 27 milliamps, powered by receiver.

1.5.12.2 Mechanical Specifications

Assembled Length: 24 inches (61 cm).
Housing Diameter: 3.5 inches (8.9 cm).
Housing Material: PVC.
Assembled Weight: 1.3 lbs. (.60 kg).
Shipping Weight: 3.5 lbs. (1.6 kg).
Mounting: Hose clamps (furnished) on vent pipe

1.5.13 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

1.5.14 Model 8227 Inline Amplifier

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

MODEL 8194

SECTION 2

INSTALLATION

- 2.0 INTRODUCTION
- 2.1 MODEL 8225 ANTENNA
- 2.2 ANTENNA CABLE
- 2.3 MODEL 8226 IMPULSE SUPPRESSOR
- 2.4 MODEL 8227 INLINE AMPLIFIER
- 2.5 MODEL 8194 PREPARATION FOR USE
- 2.6 INITIAL OPERATION
- 2.7 QUALIFYING THE INSTALLATION
- 2.8 FACTORY CONFIGURATION

INSTALLATION

2.0 INTRODUCTION

This section describes the installation of the Model 8225 GPS Antenna and related accessories. This section also describes the Model 8194 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 Section 5 of this manual for information on installing the Option 11 Rack Mount Slides.

2.1 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 Model 8194 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.

2.1.1 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.

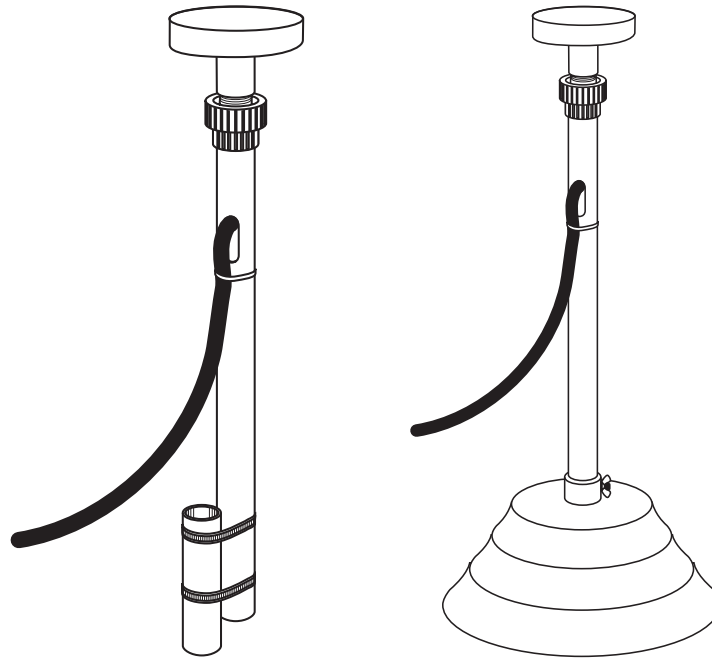


FIGURE 2-1 ANTENNA INSTALLATION

2.2 *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 Model 8194 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 2.3 for a complete description of the Model 8226.

2.2.1 Cable Lengths

Using Spectracom CAL7xxx or LMR-400 coax, the maximum antenna cable length permitted is 350 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 2.4 for additional information on the Model 8227.

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 20 dB. Cable attenuations greater than 20 dB require the use of a Model 8227 Inline Amplifier.

2.3 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, Surge Suppressor, to protect the receiver from damaging voltages occurring on the antenna coax. Voltages exceeding the impulse suppressor 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.

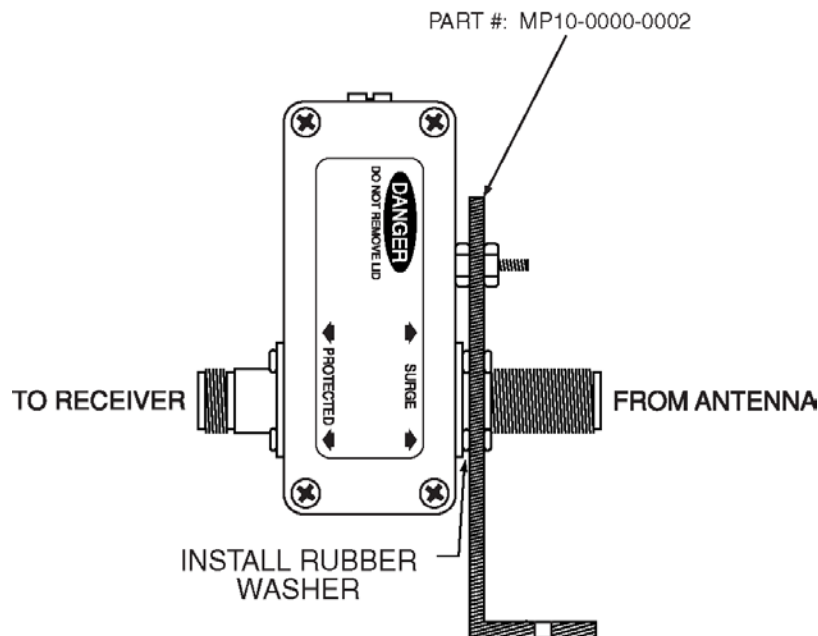


FIGURE 2-2 MODEL 8226 IMPULSE SUPPRESSOR

In addition, Spectracom offers a copper grounding panel, part number MP10-0000-0001, 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 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.

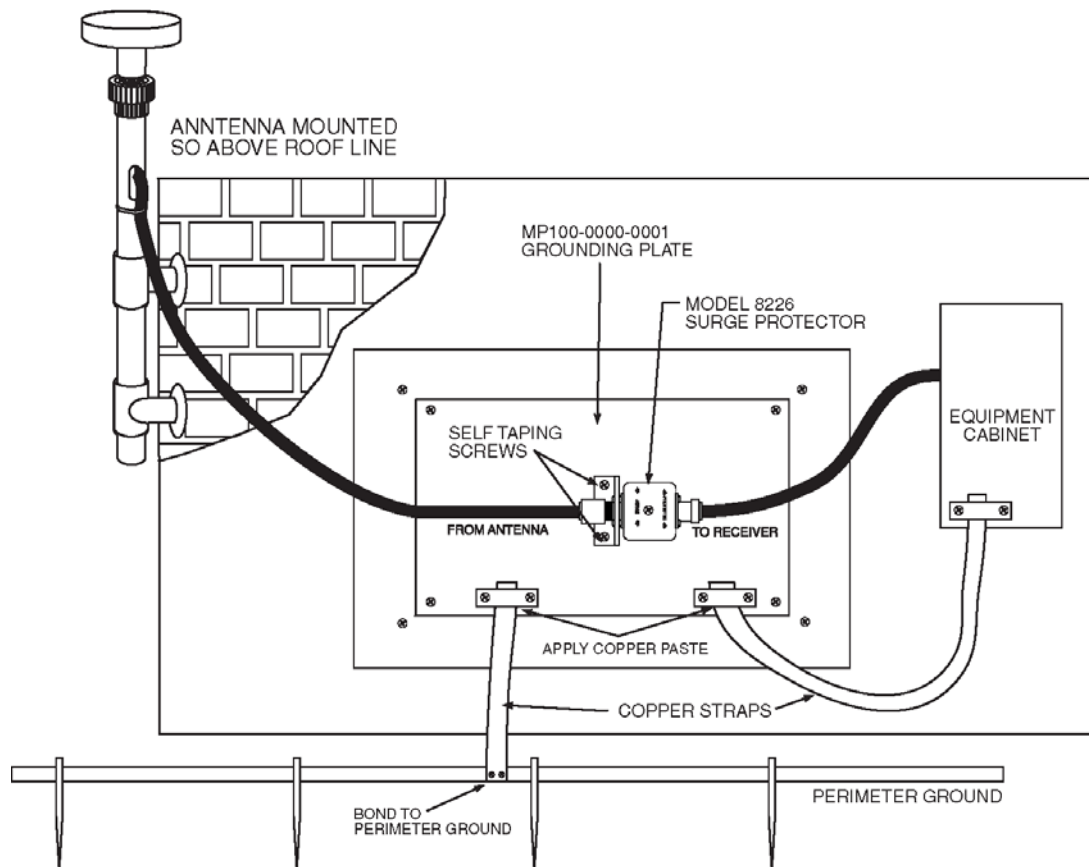


FIGURE 2-3 GROUNDING PANEL INSTALLATION

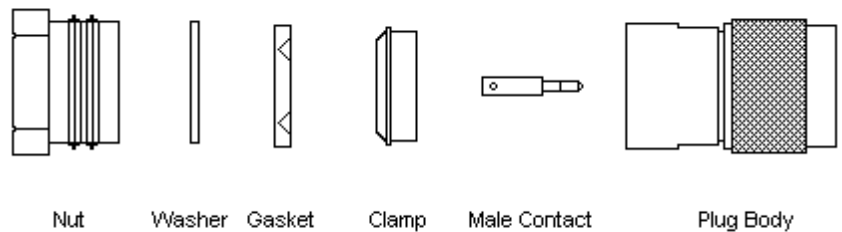
Each Model 8226 includes two clamp type male N connectors. These connectors can be used to splice the Model 8226 into the antenna coax. The connectors are compatible with Spectracom CAL7xxx cable assemblies and Times Microwave LMR-400 equivalent coax. Connector assembly instructions are shown below in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

Assembly Instructions

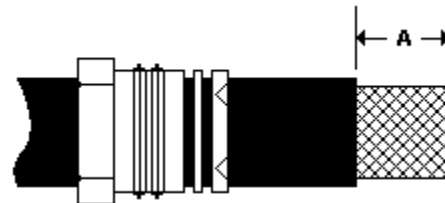
Part Number P051-0001-0100 Type N Connectors

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.

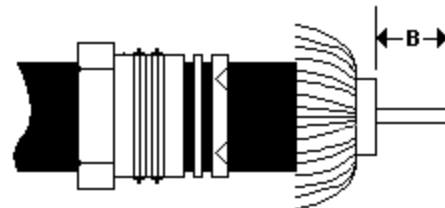
Tools Required
Sharp Knife or Razor
Cable Cutter
Soldering Iron and Solder
Ruler
Wire Cutters/Scissors
5/8" Open End Wrench
11/16" Open End Wrench
Multimeter



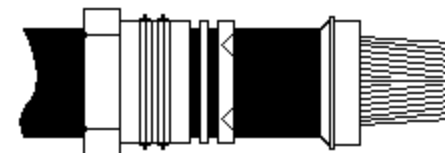
Step 1 Cut the cable end squarely and place the nut, washer, and gasket onto the cable as shown. Make certain the gasket's "V" groove is oriented towards the end of the cable. Cut the cable jacket back to dimension A of 0.359 inches (9.1 mm). Do not cut or nick the braid.



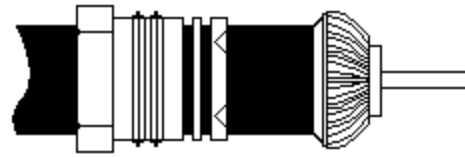
Step 2 Comb out the braid and fold back to expose the dielectric. Cut the dielectric back to dimension B of 0.234 inches (6.0 mm). Do not cut or nick the center conductor.



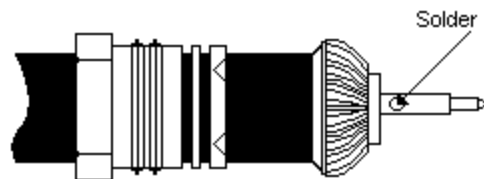
Step 3 Comb the braid forward and slide the clamp onto the cable as shown. Make certain that the beveled edge of the clamp is oriented towards the gasket "V" groove to form a weatherproof seal.



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 multimeter, 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.

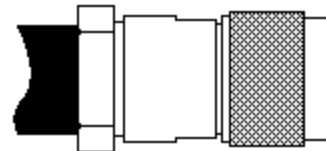


FIGURE 2-4 N Connector Assembly Instructions

2.4 **MODEL 8227 GPS INLINE AMPLIFIER**

An inline amplifier is required whenever GPS antenna cable lengths cause greater than 20 dB attenuation. Using Spectracom CAL7xxx or LMR-400 coax, an amplifier is needed whenever antenna cable lengths exceed 350 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 NetClock/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 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.

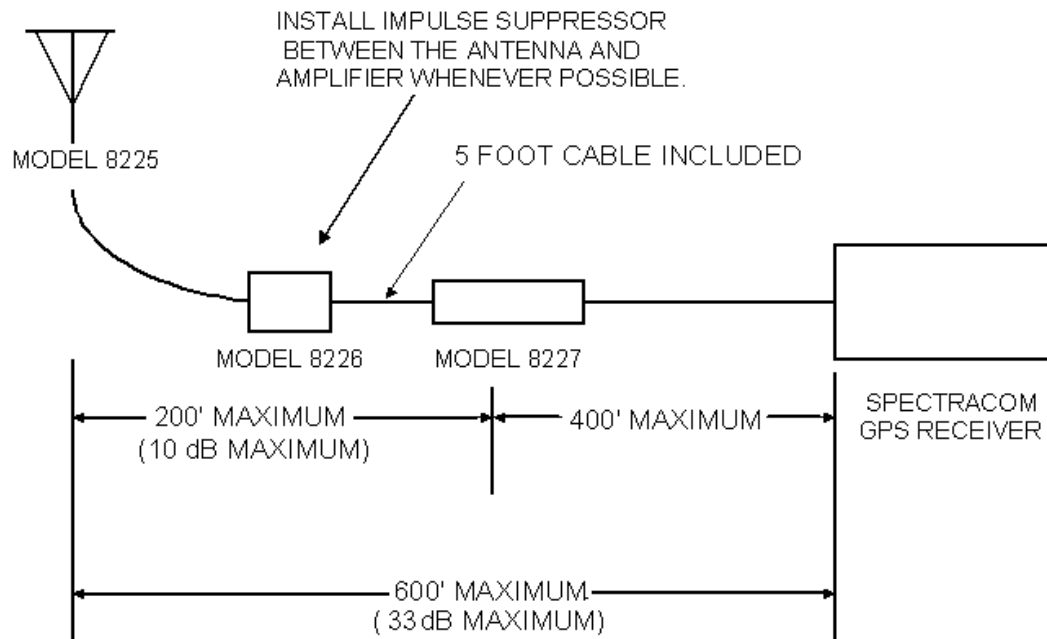


FIGURE 2-6 CABLE GUIDELINES

2.5 *MODEL 8194 PREPARATION FOR USE*

This section outlines the set-up procedure to prepare the Model 8194 for operation.

2.5.1 *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.

2.5.2 *AC Power*

The standard Model 8194 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 Model 8194 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.

2.5.3 *Chassis Ground*

The chassis ground lug allows the Model 8194 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 Model 8194 receiver performance.

2.6 *INITIAL OPERATION*

Upon completing antenna and power connections, turn on the power switch. Observe 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. The ovenized oscillator requires a minimum of 4 hours to reach operational temperature and stabilize. The OSC LOCK lamp turns on and the Major Alarm lamp turns off when the ovenized oscillator is disciplined to the GPS reference. The unit will now operate in accordance with the specifications listed in this manual.

2.7 *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 6 Service Information, 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 Comm 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.

2.7.1 *GPS Signal Status*

The **GPS** **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 6 SATELLITES
GPS STATE= 3D-FIX  DOP= 03.7
LATITUDE= N 43 06 59.746 LONGITUDE= W 077 29 15.242 HEIGHT= +00110 METERS
QUALITY= PASSED
CHAN VID MODE STREN STAT
01  24  08    053  AA
02  04  08    052  AA
03  10  08    053  AA
04  05  08    053  AA
05  18  08    044  AA
06  30  00    000  00
07  01  07    047  28
08  06  00    000  00
```

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 $0 \leq \text{DOP} < 10$ 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 8. 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, maximum level is 55.

The satellite status flag code is found in the STAT column. Typically the STAT value is A2.

If the receiver does not meet the minimum requirements described above, refer to Section 6 Service Information, for troubleshooting assistance.

2.7.2 *Tracking Histogram*

The **D**isplay **T**racking **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.

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= 2000-03-21 QUALIFIED HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00019 7= 01537 8= 02044 Q= 03600
```

```
TIME= 13:00:00 DATE= 2000-03-21 QUALIFIED HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00016 7= 01004 8= 02580 Q= 03600
```

```
TIME= 14:00:00 DATE= 2000-03-21 QUALIFIED HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00000 7= 00067 8= 03533 Q= 03600
```

```
TIME= 15:00:00 DATE= 2000-03-21 QUALIFIED HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00000 7= 00083 8= 03517 Q= 03600
```

```
TIME= 15:01:59 DATE= 2000-03-21 QUALIFIED HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00000 7= 00000 8= 00118 Q= 00118
```

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 6 Service Information, for recommendations.

2.8 *FACTORY CONFIGURATION*

Several of the Model 8194 outputs and operational parameters are configurable using the RS-232 communication port and set-up DIP-switches. Table 2-1 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
Antenna Cable Delay	No Delay	ACD
Alarm Timeout AT1	1 Minute	AT1
Alarm Timeout AT2	2.5 Hours	AT2
Alarm Timeout AT3	30 Days	AT3
Event Output	OFF	EO
Signature Control	OFF	SC
Set Mode	OFF	SM
Test Mode	OFF	TM
Time Zone Offset	No Offset	TZO
10-MHz Offset	No Offset	1FO
One PPS Offset	No Offset	1PO

TABLE 2-1 DEFAULT SETTINGS

MODEL 8194

SECTION 3

OPERATION

- 3.0 INTRODUCTION
- 3.1 FRONT PANEL FUNCTIONS
- 3.2 REAR PANEL FUNCTIONS

OPERATION

3.0 *INTRODUCTION*

This section describes the front and rear panel functions, and operational information for the Model 8194 GPS Ageless™ Oscillator.

3.1 *FRONT PANEL FUNCTIONS*

The front panel of the Model 8194 is shown in Figure 3-1. The paragraphs below describe the indicators and connectors found on the front panel.

3.1.1 *Status Lamps*

3.1.1.1 *Power*

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

3.1.1.2 *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.

3.1.1.3 *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.

3.1.2 *Alarm Lamps*

The Model 8194 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.

Section 3: Operation

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 Data Clock connector. Alarm status may also be monitored using the front panel RS-232 communication port. Refer to Section 4 for a complete listing of alarm status and alarm clearing commands.

3.1.2.1 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 exceeds 1×10^{-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.

3.1.2.2 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. The fault could be caused by a shorted cable, reflections due to an unterminated 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.

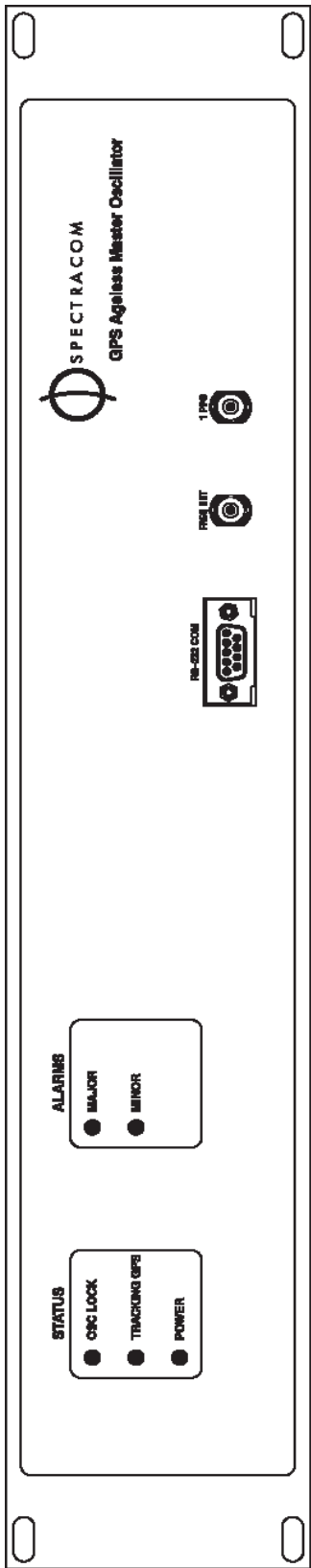


FIGURE 3-1 MODEL 8194 FRONT PANEL

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.

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

Frequency Offset: An initial or new simulcast offset value has been 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.

Test Mode: Unit is placed in Test Mode operation.

3.1.3 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 4.2 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.

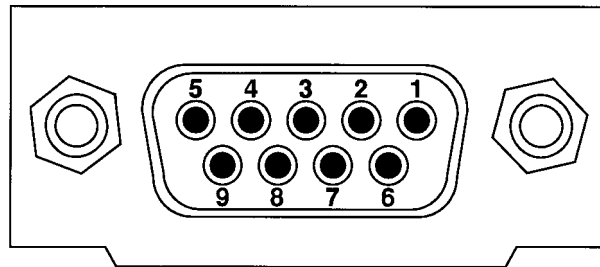


FIGURE 3-2 RS-232 COM PIN NUMBERING

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 is held high through a pull-up resistor.

3.1.4 Frequency 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 paging. Refer to the Ten MHz Offset command, 1F0, found in Section 4.2 for additional information.

3.1.5 1PPS Output

This BNC connector outputs a GPS one pulse-per-second TTL-compatible signal. 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 4.2 for additional information.

3.2 REAR PANEL FUNCTIONS

The rear panel of the Model 8194 is shown in Figure 3-3. The following paragraphs describe each of the rear panel functions.

3.2.1 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.

3.2.2 Frequency Outputs

The Frequency Outputs are derived from the GPS disciplined oscillator. Four BNC outputs at 10.0 MHz are provided. The signal is 700 mV rms sinewave into a 50-ohm load. The harmonic suppression is 30 dB.

3.2.2.1 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 Model 8194 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.

3.2.2.2 Optional Output

Option 03 adds a 12-volt DC offset to the four rear panel 10 MHz outputs. This option allows the Model 8194 to drive Spectracom distribution products such as the 8140T LineTap, 8140MT MultiTap and the Model 8140VT VersaTaps. Refer to Section 5, Options and Accessories, for a complete description of Option 03 and related accessories.



FIGURE 3-3 MODEL 8194 REAR PANEL

Section 3: Operation

3.2.2.3 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, the effects of transmitter oscillator "aging" must be neutralized by periodically checking and adjusting the transmitter oscillators to maintain the desired frequency offsets.

The Spectracom Model 8194 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, $\pm 1.0 \times 10^{-10}$.

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)

3.2.3 Data Clock Timing Outputs

This connector provides an RS-485 one pulse per second (1PPS) and Major Alarm relay contacts. The connector is a 9-pin series D numbered as shown in Figure 3-4. Data Clock pin assignments are listed in Table 3-4.

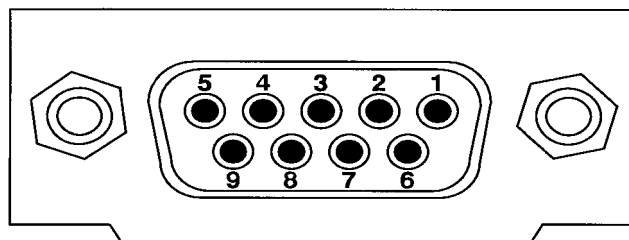


FIGURE 3-4 DATA CLOCK CONNECTOR

PIN	SIGNAL	NOTES
3	+ 1 PPS	RS-485 B Terminal
4	Major Alarm	Ground = Normal
5	Ground	Cable Shield
8	- 1 PPS	RS-485 A Terminal
9	Ground	Cable Shield

TABLE 3-4 DATA CLOCK PIN ASSIGNMENTS

The Data Clock timing signal is derived from the 10 MHz GPS disciplined oscillator. The 1PPS output is made 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 0.1 microsecond steps. Refer to Section 4 for additional information on the 1PO Command.

3.2.3.1 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 3-5 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.

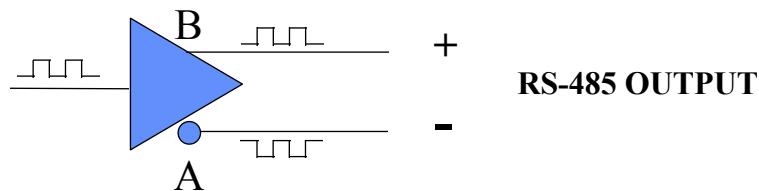


FIGURE 3-5 RS-485 LINE DRIVER

The RS-485 output driver can provide a TTL-compatible clock signal when connected in a single-ended configuration. Connect as shown in Figure 3-6 for a TTL clock reference.

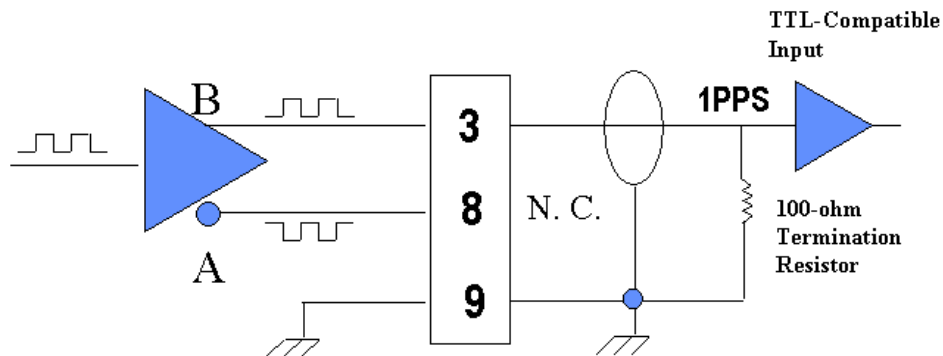


FIGURE 3-6 SINGLE-ENDED CONNECTION

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

3.2.3.2 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 switches to a high impedance (open circuit). Refer to Section 3.1.2 for a complete description of Major Alarms.

3.2.4 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 3-17, is furnished in the ancillary kit.

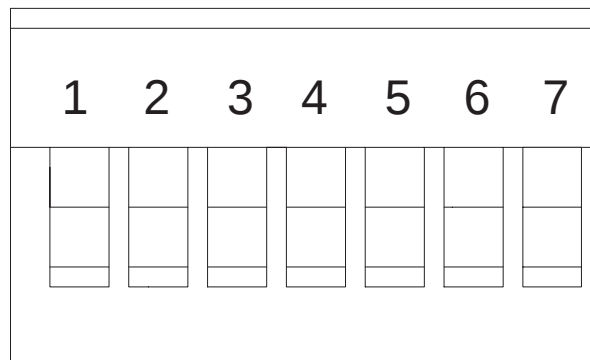


FIGURE 3-7 ALARM OUTPUTS TERMINAL BLOCK

Section 3: Operation

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, 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 3-5 lists the Alarm status and the corresponding contact status. The relay contacts remain in the alarm condition until the fault is corrected or 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 3-5 ALARM OPERATION

3.2.6 AC Power

The standard Model 8194 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 3-8, 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 Model 8194 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 cut-out.

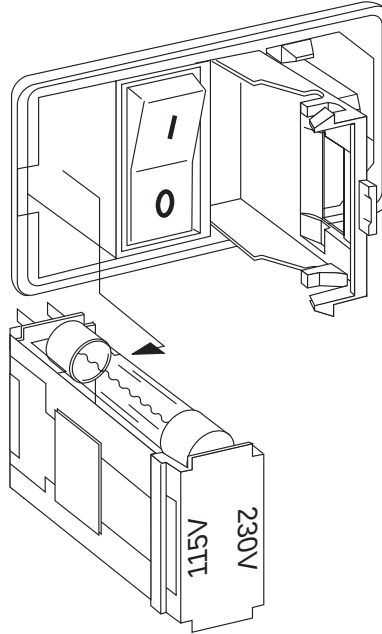


FIGURE 3-8 AC POWER MODULE

3.2.6 Chassis Ground

The chassis ground lug allows the Model 8194 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 Model 8194 receiver performance.

MODEL 8194

SECTION 4

SOFTWARE COMMANDS

- 4.0 INTRODUCTION
- 4.1 RS-232 COMMAND STRUCTURE
- 4.2 RS-232 COMMAND DESCRIPTIONS

SOFTWARE COMMANDS

4.0 INTRODUCTION

This chapter describes commands that are asserted through the front panel RS-232 COMM port.

4.1 RS-232 COMMANDS

From the front panel RS-232 COMM port the user may configure, control and monitor the 8194. 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 Model 8194 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 8194 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.

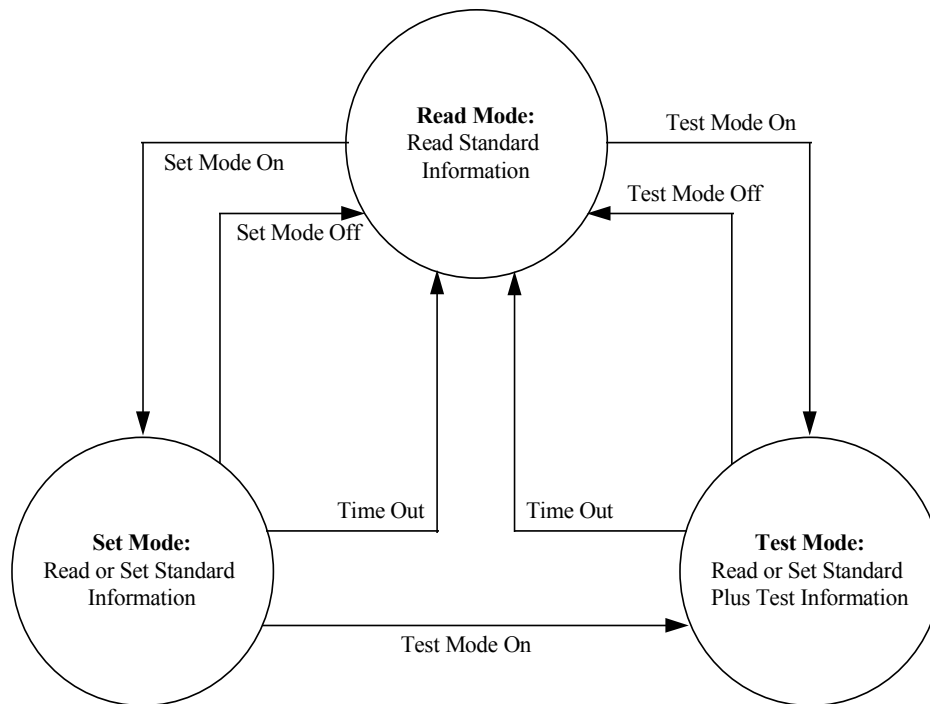


FIGURE 4-1 COMMAND STRUCTURE

Section 4: Software Commands

COMMAND	DESCRIPTION	MODE	SECTION
ACD	Antenna Cable Delay	READ/SET	4.2.1
ATx	Alarm Time Out	READ/SET	4.2.2
CA	Clear Alarms	SET	4.2.3
CONF	Configuration	READ	4.2.4
DAL	Display Alarm Log	READ	4.2.5
DATE	Date	READ/SET	4.2.6
DFM	Display Frequency Measurement	READ	4.2.7
DOL	Display Oscillator Log	READ/TEST	4.2.8
DH	Display Tracking Histogram	READ/TEST	4.2.9
EO	Event Output	READ/SET	4.2.10
GSS	GPS Signal Status	READ	4.2.11
H,Help,?	Help	READ	4.2.12
LOC	Location	READ/SET	4.2.13
SC	Signature Control	SET	4.2.14
SM	Set Mode	---	4.2.15
STAT	Status Information	READ	4.2.16
TIME	Time	READ/SET	4.2.17
TM	Test Mode	---	4.2.18
TZO	Time Zone	READ/SET	4.2.19
U2G	UTC to GPS Time Offset	READ	4.2.20
VER	Version	READ	4.2.21
1FO	Frequency Offset	READ/SET	4.2.22
1PO	One PPS Offset	READ/SET	4.2.23

TABLE 4-1 ALPHABETICAL LIST OF RS-232 COMMANDS

4.2 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 Model 8194 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.

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 upon 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.

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.

4.2.2 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.
Response: **ALARM TIMEOUT x = DDD HH:MM:SS**
 Where x = 1, 2, 3
 DDD = Days 000 ... 366
 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**

4.2.3 *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>***

Example Response:

TIME= 13:44:06 DATE= 2001-11-03 STATUS CHANGE <TEMP= +36.0>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= OFF
ACTIVE ALARMS: MAJOR
FREQUENCY

4.2.4 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>
Default 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
```

4.2.5 *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= 2001-11-03 STATUS CHANGE <TEMP= +43.0>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= ON
ACTIVE ALARMS: MINOR
ANTENNA PROBLEM
TIME= 12:58:54 DATE= 2001-11-03 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= 2001-11-03 STATUS CHANGE <TEMP= +43.5>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= OFF
ACTIVE ALARMS: NONE
```

Section 4: Software Commands

4.2.6 DATE

The **DATE** command reads or sets the date of the Model 8194. To retrieve the current UTC date, issue the **DATE** command as shown below:

Type: **DATE <ent>**
Response: **DATE = YYYY - MM - DD**
Where: **YYYY** = Year value, 1999, 2000, etc.
 MM = Month value, 01 to 12, 01= January, 04= April
 DD = Day of the month, 01 to 31
 - = Hyphen

To set the date, place the clock in *Set Mode*, then issue the **DATE** command as follows:

Type: **DATE YYYY-MM-DD <ent>**
Where: **YYYY-MM-DD** = As defined above.

The clock responds with the date message reflecting the date entered.

NOTE: The date can not be set on receivers tracking GPS satellites. The set date is overwritten with the received date information.

Example: Set the date for May 9, 2001.

Type: **SM ON <ent>**
Response: **SET MODE ON**
Type: **DATE 2001-05-09 <ent>**
Response: **DATE =2001-05-09**

4.2.7 *DISPLAY FREQUENCY MEASUREMENT*

The average 24-hour frequency accuracy can be displayed using the **DFM** command. The frequency accuracy is determined by subtracting the accumulated phase drift measured at midnight from the previous midnight value. To display the last frequency measurement, issue the **DFM** command as shown below:

Type: **DFM <ent>**

Example Response: **DFM**

DRIFT = 0003 ns = 3.5E-14 2001-11-03

Adding the "ALL" parameter to the **DFM** command displays up to 5 days of accuracy measurement.:

Type: **DFM ALL <ent>**

Example Response: *DRIFT = 0024 ns = 2.7E-13 2000-03-22*
 DRIFT = 0060 ns = 6.9E-13 2000-03-23
 DRIFT = 0003 ns = 3.5E-14 2001-11-03

If the phase lock process was interrupted, the message "**NOT AVAILABLE**" will appear in the response.

4.2.8 *DISPLAY OSCILLATOR LOG*

The Oscillator Log is a compilation of the last 25 log entries made, or approximately one hour's worth of data. In Test Mode the number of entries is expanded to 1,278, or approximately 3.5 days worth of data. Due to the large number of entries, this command is available with a page parameter **[P]**. This allows the log to be output one page at a time with an option to continue or exit after each page.

The Oscillator log can be used to determine overall receiver and oscillator performance. There are 14 different log entries, which may be included in the current oscillator log response. These are listed below:

1. Frequency Measurement: occurs every 1000 seconds and reports frequency error.
2. Automatic Frequency adjustment: when 3 of last 4 frequency measurements agree to within 6 parts in 10^{-10} an adjustment is made. These adjustments only occur during the frequency lock process NOT during phase lock.
3. Manual DAC adjustment: occurs when the Test Mode command DA is used to alter the DAC setting.
4. Reset: occurs when the Test Mode reset command is used to reset the GPS receiver, gates, RAM contents, etc.
5. Start-up: occurs at power on.
6. First satellite found: occurs when the 8194 detects a satellite for the first time since power on. This entry does not happen after a loss of satellites.
7. 3D-Fix: This occurs when the GPS receiver has a 3D-Fix for a period of 1 minute. When the unit is powered on this message coincides with the turning on of the Tracking GPS light. Throughout operation if the unit loses a 3D-Fix and regains it for 60 consecutive seconds this entry will occur again. Also, in the phase process the unit is in position hold, if the receiver drops to less than 4 qualified satellites it is considered to have lost a 3D-Fix. A log entry will occur when the receiver tracks 4 qualified satellites for 60 consecutive seconds. Once an initial 3D-Fix is acquired these log entries are inconsequential unless all satellites are lost. If a lot of 3D-Fix entries are in the log there is a reception problem.
8. Battery Check: occurs at 00:00:00 every day or when initiated by the Test Mode command TB.
9. Phase Calibration: occurs at initial entrance to the phase process and every 15 hours after.
10. Tight Phase Lock: occurs shortly after Phase Calibration.

11. Phase Center adjust: occurs every 5 hours after Phase Calibration.
12. 24 hour phase measurement: occurs at 00:00:00 every day while in Phase Lock.
13. Phase adjustment: occurs every 6 minutes.
14. Free Run Test: this is a factory test procedure to verify the stability of the ovenized oscillator.
15. Rubidium Lock Status: not applicable to the Model 8194.
16. Exit From Phase Lock: provides the reason the unit exited from the phase lock process. The possible causes are tracking 0 satellites, CPU alarm, Frequency Error $>1.0 \times 10^{-9}$ or Frequency Offset selected.

To retrieve the ***Oscillator Log*** issue the ***DOL*** command as shown below:

Type: ***DOL<ent>***

or

DOL P <ent> Paged Output

Example Response:

```
SPECTRACOM CORPORATION GPS DISCIPLINED OSCILLATOR 8194
SOFTWARE VERSION 1.00 DATE:OCTOBER 09, 2001 10:12:03
UNIT STARTED 12:47:07 2001-11-03
BAUD GENERATOR 1 = VERSION 2.01
BAUD GENERATOR 2 = VERSION 2.01
BAUD GENERATOR 3 = VERSION 2.01
GPS RECEIVER = 8 CHANNEL UT VERSION 3
  TIME= 11:34:43 DATE= 2001-11-03 PHASE ADJUSTMENT
AVG LEN= 0168 TOTAL= 0001653A
DAC= B201(69%) TEMPERATURE= +37.5
PHASE ERROR= +129.55 nSEC
  TIME= 11:36:07 DATE= 2001-11-03 D/A= B201(69%) FREQ ERROR=
+1.00E-10
LONG GATE 10MHZ OFFSET= NONE INTERNAL TEMP= +37.5
FREQ CNT= 10,000,000,001
  TIME= 11:40:43 DATE= 2001-11-03 PHASE ADJUSTMENT
AVG LEN= 0168 TOTAL= 00012001
DAC= B1FE(69%) TEMPERATURE= +37.5
PHASE ERROR= +104.44 nSEC
MORE<ANY> QUIT<ESC>
```

Section 4: Software Commands

When in Test Mode, the oscillator log can be sorted for a specific log entry type. Each log entry type is assigned a number, 1 through 16, as shown in the above description. Logs may also be viewed from a specified time and date parameter. The ***DOL*** response may be sorted using the command structure shown below:

Type: ***DOL P TYPE YYYY-MM-DDD HH:MM:SS <ent>***

Where:

- P* = Paged parameter
- Type* = Log entry type, 1 through 14.
- YYYY-MM-DD* = Start date of sort
- HH:MM:SS* = Start time of sort

4.2.9 **DISPLAY TRACKING HISTOGRAM**

The **Display Histogram** command, **DH**, provides the tracking histogram. The histogram records the number of satellites tracked each second. At the end of every hour a log entry is created and the counters start again. In *Read Mode* the command responds with the last four entries of the histogram and current histogram in process. While in *Test Mode*, this command responds with the entire histogram log, which provides tracking data collected over the past six days. The page parameter, **P**, causes the histogram to display one page at a time. In paged mode the user may quit or continue the display after each page is displayed. The tracking histogram is useful in verifying receiver and antenna performance.

Type: **DH <ent>**

- OR -

DH P <ent> (paged output)

The tracking histogram is output in the following format:

```
TIME= HH:MM:SS DATE= YYYY-MM-DD TRACKING HISTOGRAM
0= XXXXX 1= XXXXX 2= XXXXX 3= XXXXX 4= XXXXX
5= XXXXX 6= XXXXX 7= XXXXX 8= XXXXX Q=QQQQQ
```

Where:

HH:MM:SS =	UTC time log was created.
YYYY-MM-DD =	Date log was created.
XXXXX =	Number of seconds the receiver tracked the listed quantity of satellites since the beginning of the hour, 0...3600.
QQQQQ =	Number of seconds since the beginning of the hour the GPS signal was qualified, 0...3600.

Section 4: Software Commands

Example: To view the satellite tracking histogram type the following:

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

Response:

*TIME= 10:00:00 DATE= 2001-11-03 TRACKING HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00000 7= 02878 8= 00722 Q= 03600*

*TIME= 11:00:00 DATE= 2001-11-03 TRACKING HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00055 7= 02478 8= 01067 Q= 03600*

*TIME= 12:00:00 DATE= 2001-11-03 TRACKING HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00000 7= 00724 8= 02876 Q= 03600*

*TIME= 13:00:00 DATE= 2001-11-03 TRACKING HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00000 7= 00061 8= 03539 Q= 03600*

*TIME= 13:54:18 DATE= 2001-11-03 TRACKING HISTOGRAM
0= 00000 1= 00000 2= 00000 3= 00000 4= 00000
5= 00000 6= 00000 7= 00008 8= 03249 Q= 03257*

END OF LOG

4.2.10 *EVENT OUTPUT*

The Model 8194 maintains logs on alarm conditions, satellite tracking, oscillator performance and corrections. Entries made to these logs are automatically output to the RS-232 port they are generated. The ***Event Output*** command, ***EO***, can enable or disable the automatic output of these entries. The Model 8194 is factory shipped with the event output disabled.

To view the Event Output configuration issue the ***EO*** command as follows:

Type: ***EO<ent>***
Response: *EVENT OUTPUT ENABLED*
 - OR -
 EVENT OUTPUT DISABLED

To enable or disable the ***Event Output*** feature, place the unit in Set Mode and issue the following command:

Type: ***EO ON<ent>***
Response: *EVENT OUTPUT ENABLED*
 - OR -
Type: ***EO OFF<ent>***
Response: *EVENT OUTPUT DISABLED*

Section 4: Software Commands

4.2.11 GPS SIGNAL STATUS

The **GPS Signal Status** command, **GSS**, lists the parameters used in qualifying the received GPS signal. This command is useful in verifying proper antenna placement and receiver performance in an installation.

The **GSS** response provides overall tracking and mode status, as well as a table containing individual satellite data.

Issue the **GPS Signal Status** command as shown below:

Type: **GSS<ent>**

An example response is shown below:

```
TRACKING 8 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 A2
02 27 08 049 A2
03 31 08 052 A2
04 03 08 048 A2
05 15 08 051 A2
06 18 08 051 A2
07 13 08 049 A2
08 19 08 051 A2
```

The overall tracking and mode status is presented in the format shown below:

```
TRACKING N SATELLITES
GPS STATE = SSSSS DOP=###.#
QUALITY = QQQQQ
```

WHERE:

- N = Number of satellites currently tracking, 0...8.
- SSSSS = Fix Mode, 2-D fix, 3-D fix, Hold, Other
- ###.# = Dilution of Precision, 00.0...99.9.
This value indicates the degree of uncertainty in a position fix. When in Position Hold Mode, this value shall be 00.0. In all other Fix Modes, the lower the DOP value, except 00.0, the lower the degree of uncertainty.
- QQQQQ = Results of GPS qualification, Passed, Failed.
The received quality of the GPS signal is continuously monitored. The criteria used in qualifying the GPS signal is listed below:
 - Dilution of Precision, $0 \leq \text{DOP} < 10$
 - Vehicle Identification Number, VID>1
 - Channel Tracking Mode, MODE=08
 - Relative Signal Strength, STREN>40
 - Position Fix Bit Set, BIT7=1

The GPS signal is qualified whenever four or more satellites meet the above criteria for one minute.

Information on each satellite the receiver is currently tracking is presented in table form. The table columns are described below:

CHAN = Channel Number of the GPS receiver, 01...08

VID = Vehicle (satellite) Identification Number, 01...37

MODE = Channel Tracking Mode, 01...08.

Where: 00 - Code Search 05 - Message Sync Detect

01 - Code Acquire 06 - Satellite Time Avail

02 - AGC Set 07 - Ephemeris Acquire

03 - Freq Acquire 08 - Avail for Position

04 - Bit Sync Detect

STREN = Signal strength value relative to SNR, 00...55. The higher the number, the greater the received signal. The minimum acceptable level is 40.

STAT = Channel status flag. Convert the hexadecimal code word to binary to find the status flags set.

(MSB) Bit 7: Using for Position Fix

Bit 6: Satellite Momentum Alert Flag

Bit 5: Satellite Anti-Spoof Flag Set

Bit 4: Satellite Reported Unhealthy

Bit 3: Satellite Reported Inaccurate (>16 meters)

Bit 2: Spare

Bit 1: Spare

(LSB) Bit 0: Parity Error

Example: HEX code word A0 translates to the following flags set.

Bit 7: Using for Position Fix

Bit 5: Satellite Anti-Spoof Flag Set

Section 4: Software Commands

4.2.12 *HELP*

Help provides a list of commonly used commands and command parameters. *Help* is available by using the following commands:

Type: ***HELP*** <ent>
 - OR -
 ? <ent>
 - OR -
 H <ent>

Response:

SPECTRACOM CORPORATION GPS DISCIPLINED OSCILLATOR 8194
COMMAND LIST FOLLOWS (SET MODE MUST BE ON TO CHANGE PARAMETERS)
CONF= DISPLAY THE CONFIGURATION <DC>
DAL [P]= DISPLAY ALARM LOG <DP>
DOL [P]= DISPLAY THE PERFORMANCE LOG, DFM= DAILY FREQUENCY MEASUREMENT
DH [P]= DISPLAY THE HISTOGRAM LOG
STAT= DISPLAY STATUS INFORMATION <DS>
GSS= GPS SIGNAL STATUS <DSS> <SS>
DATE [YYYY-MM-DD]= CURRENT DATE <D>
TIME [HH:MM:SS]= CURRENT TIME <T>, U2G= UTC TO GPS OFFSET
TZO [+/-HH:MM]= READ OR SET THE TIME ZONE
LOC [D DD MM SS.sss D DDD MM SS.sss]= CURRENT LOCATION
IPO [XXXXXX.XXX]= 1PPS OFFSET
ACD [XXX.XXX]= ANTENNA CABLE DELAY
IFO [SCn so]= 10MHZ OFFSET
ATx [DDD HH:MM:SS]= ALARM TIME OUTS x= 1,2 OR 3
SC [ON|OFF]= SIGNATURE CONTROL
CA= CLEAR ALARMS
EO [ON|OFF]= EVENT OUTPUT
SM [ON|OFF]= SET MODE
VER= SOFTWARE VERSION NUMBERS
FOR FURTHER INFORMATION PLEASE CONSULT YOUR MANUAL

4.2.13 LOCATION

The command, **LOC**, is for reading or setting the current location of the receiver. This command displays the current latitude and longitude calculated by the GPS receiver. During initial installation it may speed up the time to first fix if the user inputs an approximate position using this command. The GPS receiver constantly calculates its position based on the satellites it is receiving. Once the unit has acquired its first fix, entering a new position using this command has no effect. Also, after initial installation the receiver will keep its current position in Non-Volatile RAM so that on subsequent power cycles the unit will reach first fix much faster than at initial installation.

To view the current receiver location, issue the **LOC** command as shown below:

Type: **LOC <ent>**

Example Response: **CURRENT LOCATION: LATITUDE = N 43 07 00.407 LONGITUDE = W 077 29 13.442**

To enter a new location place the clock in *Set Mode* and issue the **LOC** command as follows:

Type: **LOC [N:S] [DD MM SS.SSS]/[E:W] [DDD MM SS.SSS] <ent>**

Where: **N** = North Latitude

S = South Latitude

DD MM SS.SSS = Latitude Degrees:Minutes:Seconds

E = East Longitude

W = West Longitude

DDD MM SS.SSS = Longitude Degrees:Minutes:Seconds

Section 4: Software Commands

4.2.14 SIGNATURE CONTROL

The command **SC** reads or selects the Signature Control feature. Signature Control removes the front and rear panel 10-MHz outputs whenever a Major Alarm is asserted. The Model 8194 is factory shipped with Signature Control off.

To read the Signature Control configuration issue the **SC** command as follows:

Type: **SC <ent>**

Response: *SIGNATURE CONTROL ON*

- OR -

SIGNATURE CONTROL OFF

To configure Signature Control place the unit in Set Mode and issue the **SC** command as shown below:

Type: **SC ON <ent>**

Response: *SIGNATURE CONTROL ON*

- OR -

Type: **SC OFF <ent>**

Response: *SIGNATURE CONTROL OFF*

4.2.15 SET MODE

This command is used to read or enter *Set Mode* operation. As a safeguard, the unit must be placed into *Set Mode* whenever operational parameters are entered. The units “times out” of *Set Mode* and returns to *Read Mode* operation if no commands are issued for 15 minutes. To read the *Set Mode* status (ON or OFF), issue the **SM** command as shown below:

Type: **SM <ent>**
Response: *SET MODE ON*
 - OR -
 SET MODE OFF

To place the unit into *Set Mode*:

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

To return the unit to *Read Mode*:

Type: **SM OFF <ent>**
Response: *SET MODE OFF*

4.2.16 *STATUS INFORMATION*

The ***STAT*** command provides the current operational status of the Model 8194. The Status Log includes a time and date stamp, oscillator status, GPS tracking status, position, temperature, and alarm status.

To retrieve operational status information issue the ***STAT*** command as follows:

Type: ***STAT <ent>***

-OR-

DS <ent>

Example Response:

```
TIME= 14:54:18 DATE= 2001-11-03
OSCILLATOR STATUS= LOCKED
GPS SIGNAL= QUALIFIED
INTERNAL TEMP= +37.5 DEGREES C
ALARM RELAYS: MAJOR= OFF    MINOR= OFF
ACTIVE ALARMS: NONE
```

4.2.17 TIME

The command, **TIME**, reads or sets the time of the Model 8194.

To retrieve the current UTC time, issue the **TIME** command as shown below:

Type: **TIME <ent>**
Response: **TIME = HH:MM:SS**
Where: **HH =** UTC hours 00...23
 MM = Minutes 00...59
 SS = Seconds 00...60

To set the time, place the clock in *Set Mode* and issue the **TIME** command as follows:

Type: **TIME HH:MM:SS <ent>**
Where: **HH:MM:SS =** As defined above.

The clock responds with a time message reflecting the time entered.

NOTE: Receivers tracking GPS satellites can not be set using this command. The received time data overwrites the set time.

Example: Manually set the TIME 13:45:00.

Type: **SM ON <ent>**
Response: **SET MODE ON**
Type: **TIME 13:45:00 <ent>**
Response: **TIME = 13:45:00**

Section 4: Software Commands

4.2.18 TEST MODE

This command is used to read or enter *Test Mode* operation. *Test Mode* commands are used in factory testing and field trouble shooting. The unit “times out” of *Test Mode* and returns to *Read Mode* operation if no commands are issued for 15 minutes. Major and Minor alarms are asserted whenever the clock is in *Test Mode*.

To read the *Test Mode* status (ON or OFF), issue the **TM** command as shown below:

Type: **TM <ent>**
Response: *TEST MODE ON*
 - OR -
 TEST MODE OFF

To place the clock into *Test Mode* operation, issue the **TM** command as follows:

Type: **TM ON <ent>**
Response: *TIME=14:57:54 DATE=2001-11-03 STATUSCHANGE <TEMP=+37.5>*
 COOLING FAN= OFF
 ALARM RELAYS: MAJOR= ON MINOR= ON
 ACTIVE ALARMS: MAJOR
 IN TEST MODE
 - OR -
 TEST MODE= ON

4.2.19 TIME ZONE OFFSET

The **TZO** command reads or sets a Time Zone Offset value from UTC. This command allows all time stamps provided by the Model 8194 to reflect local time.

NOTE: Daylight saving time corrections are not automatically performed. DST/STD time changes requires changing the **Time Zone Offset** value.

The factory default value is +00:00 offset from UTC.

Table 4-2 lists the North American Time Zone offset values for periods of Standard time and Daylight Saving time.

TIME ZONE	STANDARD TIME (October -April)	DAYLIGHT SAVING TIME (April - October)
Atlantic	-04:00	-03:00
Eastern	-05:00	-04:00
Central	-06:00	-05:00
Mountain	-07:00	-06:00
Pacific	-08:00	-07:00

TABLE 4-2 COMMON OFFSET VALUES

To read the current **Time Zone Offset** value, issue the **TZO** command as shown below:

Type: **TZO<ent>**
 Response: *Time Zone = SHH:MM*
 Where: *S = + or - offset from UTC*
 HH = Hours 00 to 12
 MM = Minutes 00 to 59

A Time Zone Offset may be entered by placing the unit in set mode and issuing the TZO command as follows:

Type: **TZO ±HHMM<ent>**
 Where: *±HHMM = As described above*

A response reflecting the selected offset value is output.

Section 4: Software Commands

4.2.20 *UTC TO GPS TIME*

The ***U2G*** command displays the offset in seconds between UTC and GPS times. This offset is due to leap seconds that have occurred since the GPS system was launched.

To view the UTC to GPS offset, issue the ***U2G*** command as shown below:

Type: ***U2G <ent>***

Sample Response: *UTC TO GPS OFFSET= +013 SECONDS*

4.2.21 *VERSION*

The ***VER*** command provides the software version levels of the main and baud generator programs. Included in the response message is the time and date the unit was turned on and GPS receiver type. To retrieve version information, issue the ***VER*** command as shown below:

Type: ***VER <ent>***

Sample Response:

```
VER  
SPECTRACOM CORPORATION GPS DISCIPLINED OSCILLATOR 8194  
SOFTWARE VERSION 1.00 DATE: OCTOBER 09, 2001 10:12:03  
UNIT STARTED 12:47:07 2001-11-03  
BAUD GENERATOR 1 = VERSION 0.00  
BAUD GENERATOR 2 = VERSION 2.01  
BAUD GENERATOR 3 = VERSION 0.00  
GPS RECEIVER = 8 CHANNEL UT VERSION 3
```

4.2.22 FREQUENCY OFFSET

The **IFO** command allows the user to read or set the 10 MHz offset. 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 4-3. Simulcast 2 has offset steps sized for VHF Hi as listed in Table 4-4. Within each group exist four positive offset steps and the complimentary negative offset steps. Section 5.8 defines the Option 31 TV offset selections. The default offset value is none.

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 4-3 UHF SIMULCAST OFFSETS SC1

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 4-4 VHF HI SIMULCAST OFFSETS SC2

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)

To read the 10 MHz offset value issue the **IFO** command as shown below:

Type: **IFO <ent>**
Default Response: **10MHZ OFFSET = NONE**

To select a 10 MHz simulcast offset, place the unit in Set mode and issue the **IFO** command as follows:

Type: **IFO SCn so<ent>**
Where: n = Simulcast Offset Group: 1 or 2.
 s = Sign, positive or negative: + or -.
 o = Offset #: 1,2,3 or 4.

To remove a 10 MHz simulcast offset and return the unit to no offset operation, place the unit in Set mode and issue the **IFO** command as follows:

Type: **IFO 0<ent>**

Examples:

Configure the Model 8194 10 MHz outputs for a VHF 150 MHz simulcast offset of -7 Hz. From Table 4-4 this offset value is equivalent to SC2 -3.

To enter in the 10 MHz offset value place the unit in Set Mode to allow configuration changes then issue the **IFO** command as shown below:

Type: **SM ON <ent>**
Response: **SET MODE ON**
Type: **IFO SC2 -3 <ent>**
Response: The unit responds with a message stating that Phase Lock Process has been halted and a frequency offset has been specified.

4.2.23 1PPS OFFSET

The relative phase of the recovered GPS 1PPS output can be offset using the **1PO** command. The offset range is 0 - 1 second in .001 microsecond steps. In addition, the Data Clock 1PPS output signal is leading edge synchronized to the GPS 1PPS and therefore, will follow the offset value.

To read the 1PPS offset value issue the **1PO** command as shown below:

Type: **1PO <ent>**
Default Response: *1PPS Offset = 000000.000 Microseconds*

To select a 1PPS offset, place the unit in Set mode and issue the **1PO** command as follows:

Type: **1PO XXXXXX.XXX <ent>**
Where: *XXXXXX.XXX = 000000.000 TO 000999.999 microseconds*

NOTE: It is not necessary to fill every digit space when entering an offset value. The offset value can range from 1 to 9 digits long. The maximum offset value is 999.999 microseconds.

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SECTION 5

OPTIONS AND ACCESSORIES

- 5.0 INTRODUCTION
- 5.1 OPTION 02, INTERNAL BATTERY BACKUP
- 5.2 OPTION 11, RACK MOUNT SLIDES

OPTIONS AND ACCESSORIES

5.0 INTRODUCTION

This section describes the following options and accessories that are available for the Model 8194.

- Internal Distribution Amplifier - Option 03
- Slides for Rack Mount - Option 11

5.1 OPTION 03 BUILT IN DISTRIBUTION AMPLIFIER

Option 03 allows counters and synthesizers throughout a facility to use the GPS disciplined outputs from a Model 8194 as a common time base. Allowing equipment to share an accurate common time base eliminates the need to buy expensive, high stability time bases for each instrument or remove them from service for periodic calibration.

Units equipped with Option 03 may drive up to 25 remote stations. Multiple outputs are provided on the rear panel so that signals may be sent in several different directions. A Line Tap at each remote station receives DC power and the 10-MHz from the main coaxial trunk line cable. The signal is buffered then divided to the frequency needed at that station. After filtering, the signal is available at the Line Tap output. New stations are easily added to the system by inserting additional Line Taps.

5.1.1 System Components

A frequency distribution system may use Model 8140T Line Taps, Model 8140VT VersaTaps™, Model 8140TA Line Extender Amplifiers or Model 8140MT MultiTaps. The following paragraphs describe each of these units.

5.1.1.1 Model 8140T Line Taps.

These devices, powered by DC on the coaxial cable, are attached to the coaxial distribution network and provide an output frequency of 1 MHz, 5 MHz, or 10 MHz.

Input: Buffered high input impedance causes negligible mismatch on main trunk line distribution cable. Accepts signal levels provided by the base station equipped with Option 03.

Output Level: 600 mV rms sinewave into 50 ohms.

Output Frequencies: 10, 5.0, or 1.0 MHz. Specify frequency for each Line Tap ordered.

Harmonic Distortion of Output: -40 dB.

Section 5: Options and Accessories

Cross talk (Isolation): 80 dB minimum.

Output Phase Noise: Typically less than -130 dB/Hz 1 kHz from carrier for 10 MHz input to base station amplifier.

Line Tap Size: 5.25 L x 2.63 W x 1.71 H inches. (133 L x 67 W x 43 H mm). Mounting hole pattern: 4.75 x 1.75 inches (121 x 44 mm).

5.1.1.2 Model 8140VT VersaTap™ Frequency Synthesizer

The VersaTap™ is a single-frequency synthesizer whose output is factory-set to any frequency between 1 kHz and 16 MHz in 1-kHz increments and up to 20 MHz in 2 kHz increments. Some special frequencies can be furnished, such as the 3.5795454...MHz TV color sub-carrier. Exact frequencies must be specified at time of order.

Input: Buffered high impedance input. Accepts 10.0 MHz with signal level between 100 millivolts and 5.5 V p-p on a DC voltage of 7 to 12 VDC. The DC current requirement is 110 milliamps at +12 VDC.

Output A: A sine wave of 600 mV rms at the specified frequency into a 50-ohm load for frequencies greater than 60 kHz. A TTL output for frequencies below 60 kHz with a source impedance of 50 ohms (SN74S140) driver.

Output B: A TTL output at the specified frequency with a source impedance of 50 ohms (SN75S140 driver). If the internal jumper, W6, is moved to location W5, Output B is HIGH when the VersaTap™ is phase locked to the incoming reference and LOW when it is unlocked.

Lock LED: The LED will light when the VersaTap™ is locked to the incoming reference. The LED will blink if the DC input is low, which may cause the VersaTap™ to malfunction. The LED will be unlit when the VersaTap™ is not locked to the incoming reference.

VersaTap™ Size: 8.3 L x 4.2 W x 1.7 H inches. (211 L x 107 W x 43 H mm). Mounting hole pattern 8.88 x 2.75 inches (225.4 x 69.9 mm).

5.1.1.3 Model 8140TA Line Extender Amplifier

The Line Extender Amplifier must be used to boost the output signal when the coaxial distribution network is more than 1500 feet (457 m) long. The Line Extender will drive an additional 1500-feet (457 m) of RG58 coaxial cable with Model 8140 Line Taps installed along its length.

Two DC-isolated 50-ohm terminators must be used: one at the input tee connector of the Line Extender Amplifier and one at the far end of the cable connected to the output of the Line Extender Amplifier.

See the “Typical Interconnection Diagram” at the end of this section for an approved method of interconnection.

5.1.1.4 Model 8140MT MultiTap

The Spectracom Model 8140MT MultiTap is a programmable frequency divider/buffer. Three outputs can be configured to the same frequency or set independently. When used as part of your Spectracom Distribution System it decreases the cost per output and allows future modifications as requirements change.

Frequency Outputs: Three square wave outputs per MultiTap. 1.5V p-p into 50 ohms. Once a group is chosen, any divisor in a group may be individually selected.

Table of output divisors:

Group A	B	C	D
1	1	5	5
2	2	10	10
10	20	50	100
50	100	250	500
250	500	1250	2500

For a 10-MHz input, the available outputs in MHz are:

Group A	B	C	D
10.0	10.0	2.0	2.0
5.0	5.0	1.0	1.0
1.0	0.5	0.2	0.1
0.2	0.1	0.04	0.02
0.04	0.02	0.008	0.004

Section 5: Options and Accessories

Power Requirements: When driven by a Distribution Amplifier, the DC load equals three Line Taps. Option 40, which is required for stand-alone operation, reduces the distribution load to one Line Tap equivalent, and is required whenever output frequencies are below 100 kHz. Maximum current is less than 150 mA.

MultiTap size: 5.25L x 2.63W x 1.71H inches.
(133L x 67W x 43H mm)

Mounting hole: 4.75 x 1.75 inches. (121 x 44 mm)

5.1.2 Design of Distribution Networks

This section provides guidelines for using the Option 03 distribution outputs. In planning a system installation follow the guidelines listed below:

1. A maximum of 25 Line Tap loads may be driven from one base station. More than 25 loads are not permitted due to power supply limitations and impedance matching. Table 5-1, LINE TAP LOADS, lists the equivalent number of loads and current each distribution device consumes. The receiver may provide up to 1.2 Amps total to the distribution network.

DEVICE	LOADS	CURRENT (mA)
8140T All Versions	1	45
8140TA	1	45
8140VT Standard	3	150
8140VT w/Opt 45	5	250
8140VT w/Opt 48	4	200
8140VT w/Opt 62	4	200
8140MT	3	150

TABLE 5-1 LINE TAP LOADS

If more than 25 Line Tap loads are required you may:

Add a Model 8140 Frequency Distribution Amplifier. The Model 8140 contains an internal power supply and will feed an additional 25 Line Tap loads. A Line Tap is required (typically 10 MHz) to provide the input frequency source to the Model 8140. This “Daisy Chaining” may be continued indefinitely.

2. Voltage drops and signal attenuation limit the longest trunk line using RG-58 cable to 1500 feet (457 m).

Figure 5-1, LINE TAP NUMBER AND DISTANCE CHART, is used to calculate the number of Line Tap loads that may be used at various distances from the base station.

For example, if 25 Line Taps are used, their average distance from the amplifier is limited to 750 feet (228 m), using RG-58. Up to 12 Line Taps may be placed at 1500 feet (457 m) on any one trunk line.

If longer runs are required, you may:

- A. Locate the Model 8194 in the geographical center of the installation, running distribution lines in both directions and achieving a coverage of 3000 linear feet (914 m).

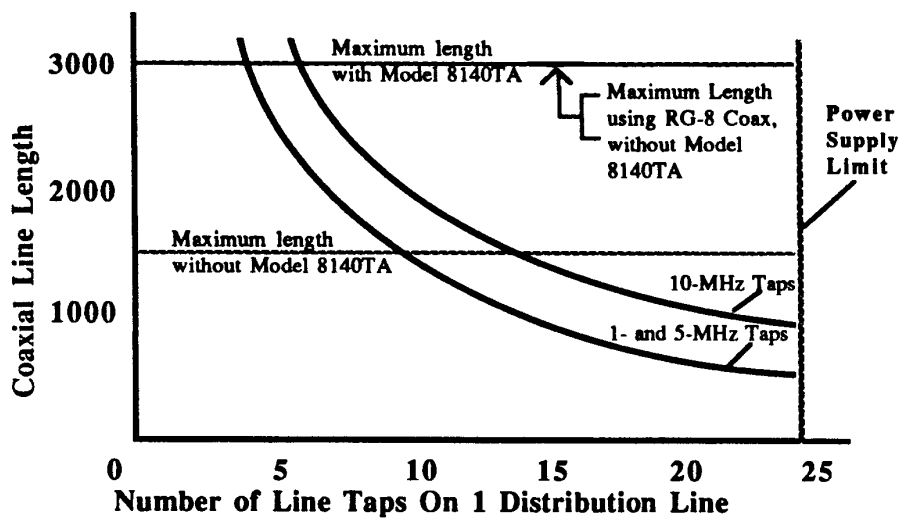


FIGURE 5-1 LINE TAP NUMBER AND DISTANCE CHART - OPTION 03

- B. Use a Model 8140TA Line Extender Amplifier at 1500 feet, allowing a further 1500-foot (457 m) extension of the distribution line. The Model 8140TA counts as one Line Tap towards the total number allowed. Use a DC-isolated 50-ohm terminator, part number 004490, at the input tee connector and at the end of the extended line section as shown in the "Typical Interconnection Diagram", Figure 5-2.
 - C. Use a Model 8140 Frequency Distribution Amplifier.
3. Each distribution line must be continuous from the base station to the DC isolated 50-ohm load that must be used at the far end. Line taps are inserted along the distribution line by using the supplied input tee connector. No branching or "Y" configurations may be used as this causes impedance mismatch on the line. Anything other than a 50-ohm line impedance may cause reflections, which can cancel the output waveform at the receiver triggering an output fault alarm. Refer to the Figure 5-2, TYPICAL INTERCONNECTION DIAGRAM, for an approved method of interconnection.
 4. Four DC-isolated 50-ohm loads are furnished with each unit equipped with Option 03. They may be found in the ancillary kit that is packed with each unit when it leaves the factory. If any of these loads are lost, replacements may be purchased from Spectracom. The part number to order is 004490. Terminators may be placed on any unused distribution output connector to prevent loss.

Section 5: Options and Accessories

5. Wherever practical, permanently mount the Line Taps to a lab bench or wall nearby. This avoids their loss or misplacement and discourages people from occasionally disconnecting them, thus cutting off the signal to stations further down the line.
6. NEVER DIRECTLY CONNECT A DISTRIBUTION LINE TO AN INSTRUMENT; always use a Line Tap, Multitap or VersaTap™. Direct connection may damage the instrument or cause an impedance mismatch on the distribution line.

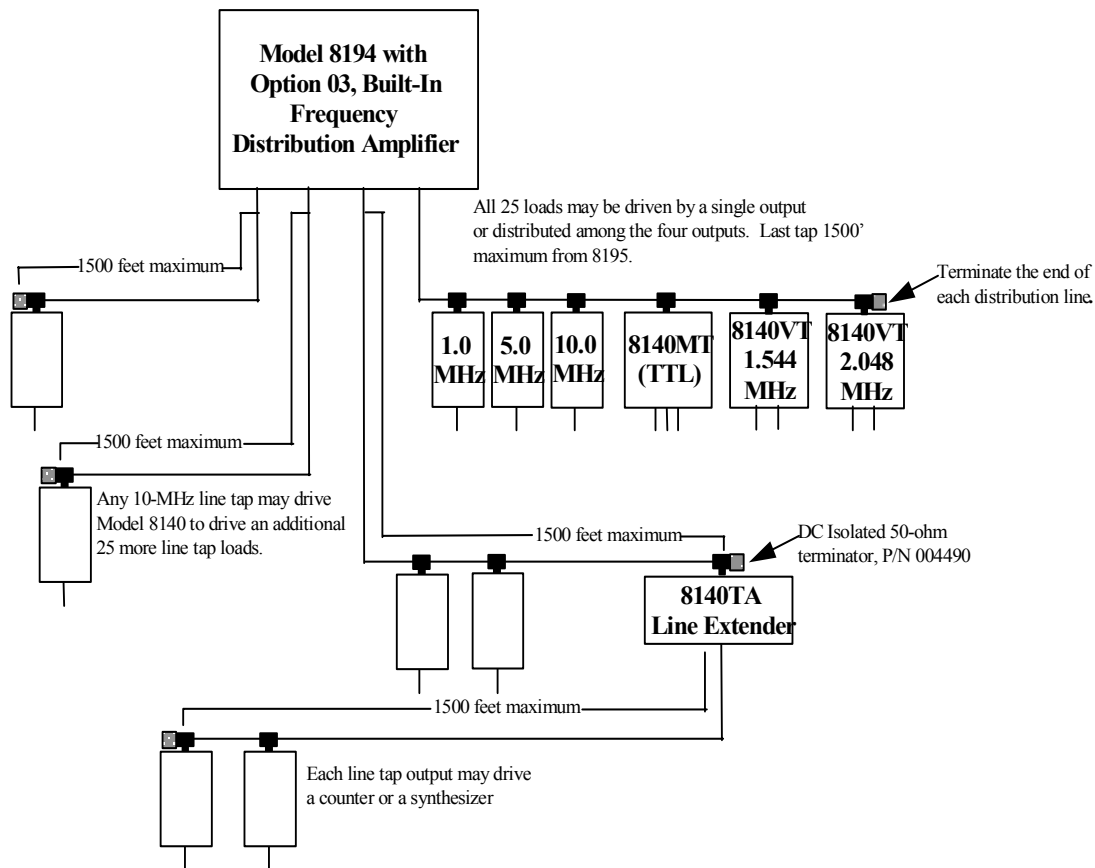


FIGURE 5-2 TYPICAL INTERCONNECTION DIAGRAM

5.2 **OPTION 11 - RACK MOUNT SLIDES**

Option 11 allows the Model 8194 to be mounted in a 19-inch rack with slide-out capabilities. Table 5-2 lists the hardware supplied with Option 11. Verify that these items have been received. Much of the hardware supplied with this option will not be used.

<i>QUANTITY</i>	<i>DESCRIPTION</i>
1	Right hand slide assembly
1	Left hand slide assembly
2	Adjustable rear support bracket
1	Hardware Pack containing nut plates, small rear support brackets, and assorted hardware
1	Hardware pack containing PEM nuts and #10-32 x 1/2 truss head screws
1	Hardware pack containing #10 KEP nuts and #10-32 x 3/8 pan head screws.

TABLE 5-2 OPTION 11 CHECKLIST

Install Option 11 as illustrated in Figure 5-3 and as described below:

1. Remove the chassis section from the right hand slide rail assembly. The right hand assembly is designated with the letters *RH* after the manufacturer's date code label. Attach the chassis section to the Model 8194 using #10-32 screws. The locking tab must be towards the rear of the unit.
2. Repeat Step 1 for the left chassis section.
3. Mount the right and left stationary sections into the rack using the appropriate rear support brackets, nut plates and required hardware.

NOTE: Insert the intermediate section into the stationary section prior to rack installation.

4. Insert the receiver into the rack assembly. Secure the Model 8194 to the rack using the front panel mounting holes.

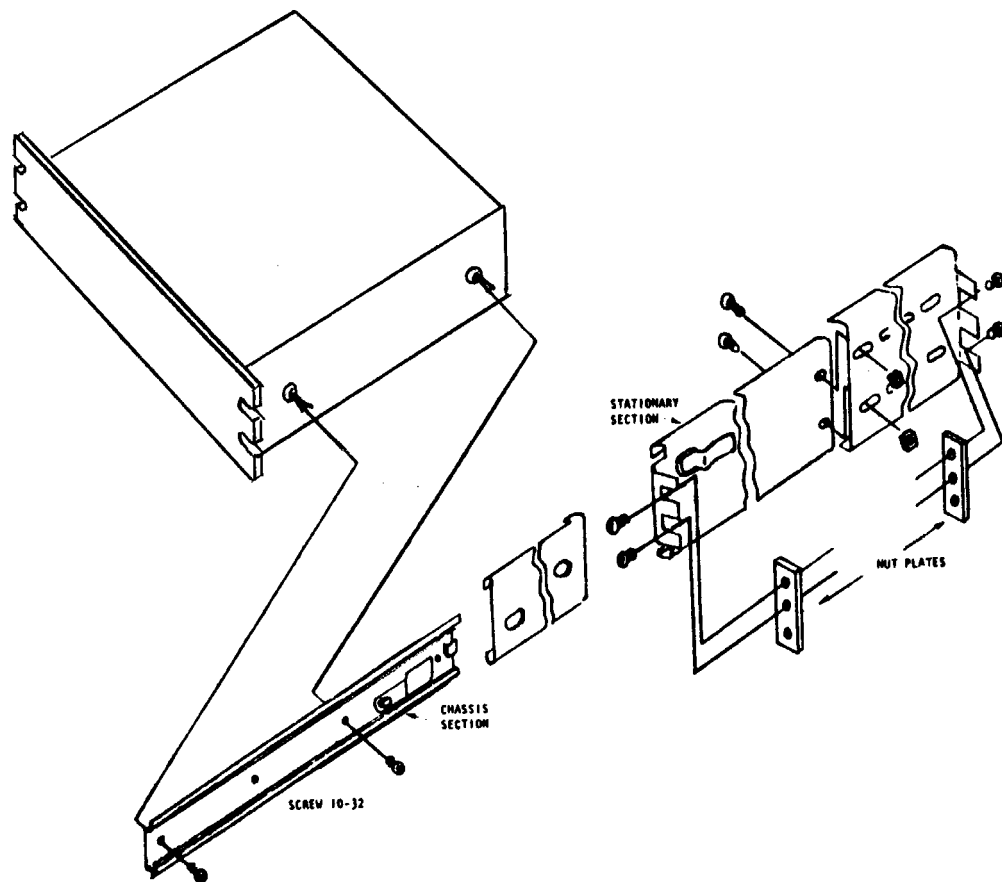


FIGURE 5-3 SLIDES, OPTION 11

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SECTION 6

SERVICE INFORMATION

- 6.0 INTRODUCTION
- 6.1 RECEPTION TROUBLESHOOTING
- 6.2 OSCILLATOR ADJUSTMENT

SERVICE INFORMATION

6.0 INTRODUCTION

This section provides information on reception troubleshooting and oscillator adjustment.

6.1 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.

6.1.1 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 6-1 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 6-1 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 2.2 for GPS cable recommendations.

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Antenna location: The antenna must be installed outdoors and have a good view of the sky. Refer to Section 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] [DD MM SS.SSS]<ent>**

where: N = North Latitude

S = South Latitude

D MM SS.SSS = Latitude Degrees:Minutes:Seconds

E = East Longitude

W = West Longitude

DD MM SS.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.

6.1.2 *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 2.2 for GPS cable recommendations and Section 2.4 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 2.1 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 Model 8194 can be configured to operate in low GPS quality conditions by selecting an alternate GPS qualifying algorithm. Refer to Appendix A for additional information.

6.2 *OSCILLATOR ADJUSTMENT*

Over time the Model 8194 oven oscillator may require an adjustment to compensate for crystal aging. The Model 8194 warns when this adjustment is needed by asserting an Adjust Oscillator Alarm. This condition activates the Minor Alarm status lamp and relay. An Adjust Oscillator Alarm is asserted when the frequency controlling D/A converter approaches a control range limit. Typically, this alarm provides a two to three month warning before a control range end is reached.

On rare occasions, an oscillator may experience a sudden shift in frequency, causing an Adjust Oscillator and a Frequency Alarm. When this occurs, both Major and Minor alarms are activated. The D/A is set to a control range end unable to correct the oscillator frequency. Frequency error shall exceed 1×10^{-8} .

This section describes the oscillator adjustment procedure using a frequency counter and an RS-232 terminal. Upon completing the adjustment procedure, the alarm lamps and relays are cleared, and the oscillator will reacquire phase lock to the GPS reference.

The frequency counter must have a time base accuracy and measurement resolution of at least 1×10^{-9} (0.01 Hz at 10 MHz).

A PC running terminal emulation software (HyperTerminal, ProComm Plus, etc.) can be used as an RS-232 terminal. Configure the terminal for ANSI emulation, 9600 baud and a character structure of 1 start, 8 data, 1 stop and no parity. Flow control is not required, although xon/xoff is supported.

6.2.1 *Adjustment Procedure*

Perform the steps listed below to adjust the 10 MHz OCXO.

NOTE: The oscillator must be powered for at least 1 hour prior to making this adjustment.

1. Remove the top cover. Rack mounted units, unless equipped with Option 11, Rack Mount Slides, must be removed.
2. Connect the terminal to the Model 8195 RS-232 Comm port.
3. Connect the frequency counter to the front panel 10-MHz output.

4. Place the Model 8194 in Test Mode by sending the TM command as follows:

Type: **TM ON <ent>**

Response:

*TIME= 16:11:43 DATE= 2000-03-27 STATUS CHANGE <TEMP= +37.0>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= ON MINOR= ON
ACTIVE ALARMS: MAJOR
IN TEST MODE
ADJUST OSCILLATOR*

5. Set the D/A control voltage to its maximum value by sending the SHI command

Type: **SHI<ent>**

Response: *D/A = FFFF (99%)*

6. Remove the seal screw from the ovenized oscillator. The oscillator is located on the right side of the front panel circuit board assembly. Insert a flat-bladed tuning tool into the access hole. Adjust the oscillator for a frequency measurement of 10,000,002.50 $\pm$.05 Hz.

Replace the seal screw and record the upper limit oscillator frequency.

F_{HI} = _____ Hz.

7. Set the D/A control value to its minimum value by sending the SLO command.

Type: **SLO<ent>**

Response: *D/A = 0000 (00%)*

Record the lower limit oscillator frequency

F_{LO} = _____ Hz.

8. Subtract the lower limit frequency, F_{LO} , from the upper limit frequency, F_{HI} , to determine the pull range of the oscillator. This difference is entered as the Hertz Range Value.

F_{HI} minus F_{LO} = HR

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9. Enter the hertz range value by sending the HR command as shown below:

Type: ***HR XXX.XXX***

where XXX.XXX = Hertz Range Value

Response: *Hertz Range = XXX.XXX D/A = C000*

9. Return the unit to normal operation by taking it out of Test Mode.

Type: ***TM OFF<ent>***

The oscillator adjustment procedure is now complete. Replace the top cover and reinstall the unit. The Model 8194 will require a two to three hour period to phase lock to the GPS reference.

MODEL 8194

APPENDIX A

OPERATION WITH LOW GPS QUALITY

A.0 INTRODUCTION

A.1 GPS QUALIFYING ALGORITHM SELECTION

A.2 GQA COMMAND

OPERATION WITH LOW GPS QUALITY

A.0 INTRODUCTION

The Spectracom Model 8194 is often used to provide a reference to transmitters when precise frequency control is needed. In some installations, the GPS reception has been poor or intermittent, preventing reliable operation of the disciplined oscillator.

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. Television interference presents a greater challenge due to higher output power, typically 2-3 MW. Table A-1 lists the potential problem television stations and their respective GPS harmonic.

CHANNEL	HARMONIC
66	2 nd
23	3 rd
10	8 th
7	9 th
6	18 th & 19 th
5	20 th

TABLE A-1 TELEVISION STATIONS WITH GPS JAMMING POTENTIAL

FM radio stations, while lower in radiated power, may cause GPS jamming also. Table A-2 lists the potential problem radio frequencies and their respective GPS harmonic.

FREQUENCY	HARMONIC
104.8 - 105.2	15 th
98.3 - 98.7	16 th
92.5 - 92.9	17 th
87.3 - 87.7	18 th

TABLE A-2 FM RADIO FREQUENCIES WITH GPS JAMMING POTENTIAL

A.1 *GPS QUALIFYING ALGORITHM SELECTION*

The Model 8194 is equipped with three selectable GPS qualifying algorithms. The factory default algorithm is GPS Qualifying Algorithm GQA1. This algorithm places strict requirements on the received GPS signal. Every second the GPS signal is qualified and receives a pass/fail quality judgment. Under GQA1, reception is of passing quality when the receiver is tracking at least four satellites with signal strengths >40 and a Tracking Mode of 08. This rigid qualifying process is needed to enable the phase locking algorithm. The phase lock algorithm produces accuracies of $\pm 1 \times 10^{-11}$ on the disciplined oscillator outputs.

In applications where GPS reception is marginal or intermittent, an alternate GPS qualifying algorithm may be selected. GPS qualifying algorithms GQA2 and GQA3 permit operation while tracking only a single satellite. These algorithms do not require a minimum signal strength threshold. A satellite is qualified for use whenever its Tracking Mode is set to 08.

The number of satellites tracked and their current Tracking Model value can be seen using the GSS command. Refer to Section 4 of this manual for a complete description of the GSS command.

GPS Qualifying Algorithm GQA3 initially begins similar to GPS Qualifying Algorithm GQA1. A minimum of four satellites with signal strengths greater than 40, Tracking Mode of 08 must be tracked and establish a 3D-fix for 1 minute. At this point, the Tracking GPS lamp will turn on and the qualifying parameters are reduced to tracking one satellite with a Tracking Mode of 08.

GPS Qualifying Algorithm GQA2 does not require an initial 3D-fix or track more than one satellite to operate. Select GPS Qualifying Algorithm GQA2 whenever local interference prevents the receiver from obtaining a 3D-fix. For example, select GQA2 for installations installed in close proximity to TV channels 66 or 23 transmitters.

NOTE: Selecting GPS Qualifying Algorithm GQA2 or GQA3 changes the oscillator-disciplining algorithm from phase locking to frequency locking. This reduces the output accuracy from 1×10^{-11} to 1×10^{-10} . This accuracy is sufficient to meet most transmitter frequency requirements.

A.2 *GQA COMMAND*

To select the GPS Qualifying Algorithm, a terminal or PC running terminal emulation software (Hyperterminal, Procomm Plus, etc.) will be needed to communicate with the RS-232 Comm port. Configure the terminal for ANSI emulation, 9600 baud, and a data structure of 1 start, 8 data, 1 stop and no parity. Flow control is not required, though xon/xoff is supported.

The GQA selection command is a Test Mode command. Place the unit in Test Mode by sending the following command:

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

The unit will respond with an acknowledgement that Test Mode is enabled. To read the current GQA selection, issue the command as shown below:

Type: ***GQA <ent>***

Default Response: GPS Qualifying Algorithm= 1

To change the GQA algorithm, issue the GQA command as follows:

Type: ***GQA1 <ent>***

or

GQA2 <ent>

The unit will respond with the selected algorithm.

Turn Test Mode operation off as shown below:

Type: ***TM OFF <ent>***

The unit shall respond with another Change in Status message.

Allow the receiver two to three hours to frequency lock the oscillator to GPS. When the oscillator is disciplined to GPS, the front panel OSC LOCK lamp turns on and the frequency and major alarms clear. The unit may now be placed in service.

It is recommended to periodically monitor the reception characteristics to guarantee reliable operation. Reception quality can easily be verified using the Display Alarm Log command, DAL. The alarm log records all changes in operational status. Total loss of reception may cause a tracking alarm to actuate. Tracking Alarm 1 is a minor alarm and is asserted whenever the GPS signal is lost for one minute. Tracking Alarm 2 is a major alarm, and is asserted whenever the GPS signal is lost for 2.5 hours. Due to the potentially large number of entries contained in this log, a page parameter "P" can be added to the command. This allows the log to be output a page at a time with an option to continue or exit after each page. To retrieve the alarm log, issue the DAL command as shown below:

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

or

DAL P <ent> Paged Output

An example of a Tracking Alarm is shown below:

```
TIME= 18:18:04 DATE= 1999-06-28 STATUS CHANGE <TEMP= +36.5>
COOLING FAN= OFF
ALARM RELAYS: MAJOR= OFF MINOR= ON
ACTIVE ALARMS: MINOR
TRACKING ALARM 1
```

Search the Alarm Log for the presence of Tracking Alarms, noting the time and date of these occurrences. An occasional Tracking Alarm 1 is considered acceptable. The presence of Tracking Alarm 2 represents reception problems and is not acceptable.