SPECTRACOM
PUBLIC SAFETY) SECURITY) GOVERNMENT

MODEL 8195A

GPS AGELESS™ OSCILLATOR

INSTRUCTION MANUAL

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

PART NUMBER MAN8195A
MANUAL REVISION A
MARCH 2004

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.

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

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

EXTENDED WARRANTY COVERAGE_____

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

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GENERAL INFORMATION

1.0   INTRODUCTION

The patented Spectracom Model 8195A 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 8195A is ideally suited as a site master oscillator for communication systems. Typical transmitter applications include land mobile simulcast, SMR (Specialized Mobile Radio), paging simulcast, satellite/microwave communications links, cellular telephone, and broadcast television.
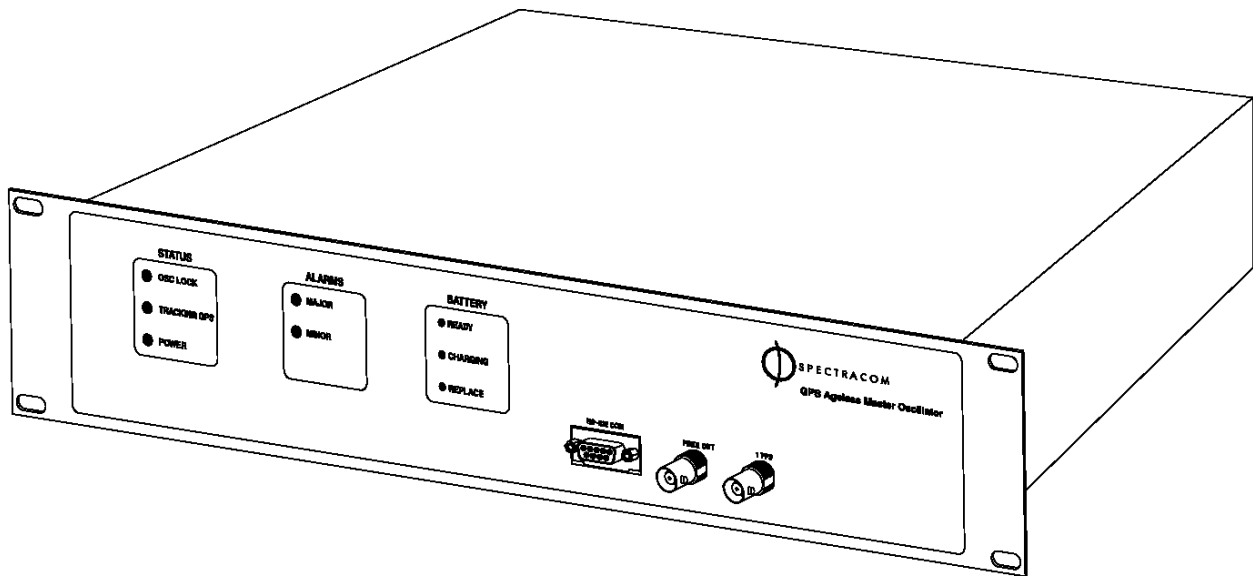
FIGURE 1-1 MODEL 8195A AGELESS OSCILLATOR

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* PATENT NO. 4,525,685

1.1   FEATURES

The Spectracom Model 8195A 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 8195A 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.

- Flexibility: Several power and output options are available to suit various applications.

1.2   WARRANTY INFORMATION AND PRODUCT SUPPORT

Warranty information is found on the leading pages of this manual. The Model 8195A 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. All completed entries are automatically entered into a monthly prize give away drawing.

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 14623

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 8195A ancillary kits.

MODEL 8195A ANCILLARY KITS							
Description	Part Number	Standard Power	Option 03 Distribution	Option 52 ±12 VDC	Option 53 ±24 VDC	Option 53R +24 VDC	Option 54 ±48 VDC
Fuse, 2.0A Slo-Blo	F012R0	1	1	0	0	1	0
Fuse, 1.5A Slo-Blo	F011R5	1	1	0	0	0	0
Fuse, 10.0A Slo-Blo	F0110R	0	0	1	0	0	0
Fuse, 6.25A Slo-Blo	F016R0	0	0	0	1	0	0
Fuse, 3.0A Slo-Blo	F013R0	0	0	0	0	0	1
Line Cord	W01000	1	1	0	0	0	0
Terminal Block, 6-position	P13006	1	1	1	1	1	1
Terminal Block, 7 position	P13007	1	1	1	1	1	1
Terminator, 50-ohm	004492	4	0	4	4	4	4
Ferrite Bead	L160-0200-0000	4	4	4	4	4	4
Terminator, DC isolated	004490	0	4	0	0	0	0

TABLE 1-1   MODEL 8195A ANCILLARY KITS

1.5   Specifications

This section contains specifications for the standard Model 8195A GPS Ageless Oscillator, Model 8225 GPS Antenna, Model 8226 Impulse Suppressor and the Model 8227 Inline Amplifier. Specifications pertaining to the Model 8195A 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: Typically <20 minutes during initial installation. Having DC
                            Backup Power or Option 02 Battery reduces the acquisition time to
                            one minute on subsequent power cycles.

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: 10 dB typical, 13 dB maximum 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 @ 1000Hz.
                                 <138 dBc @ 10 kHz.

Signature Control: The Frequency Outputs can be configured with Signature Control. Under Signature Control, the outputs are removed whenever a Major Alarm is asserted. The outputs are restored when the fault condition is corrected. The Signature Control feature is set via the RS-232 communication port.

Simulcast Offsets: The 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 ±0.5, 1.0, 1.5, 2.0 Hz at UHF frequencies. Offsets are selected by software commands.

Output Options: The following options are available for the Model 8195A:

                                 Option 03 Distribution Amplifier: Allows the Model 8195A to drive Spectracom distribution products. This option adds a 12 Volt DC offset to the rear panel Frequency Outputs.

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

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

                                 Option 08: Changes the rear panel Frequency Outputs and front panel 10-MHz output to 1.0 MHz.

                                 Option 31: 10 Hz TV channel offsets provide additional ±10 Hz offset when translated to the visual carrier frequency.

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.

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 ports.

1.5.5   1544 kHz Timing Outputs

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

Connector: RJ-11, rear panel.

Signal Level: RS-485.

Duty Cycle: 50% ± 2%.

Accuracy: $\pm 1.0 \times 10^{-11}$ when locked to GPS, 24-hour average, no frequency offsets selected.

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

1.5.6   2048 kHz Timing Outputs

Signal:	2048 kHz, derived from the GPS disciplined 10-MHz oscillator.
Connector:	RJ-11, rear panel.
Signal Level:	RS-485.
Duty Cycle:	50 ± 2%.
Accuracy:	$\pm 1.0 \times 10^{-11}$ when locked to GPS, 24 hour average, no frequency offsets selected.
Additional Outputs:	Major alarm relay contacts; C, NO, NC are provided on this connector.
Optional Outputs:	Option 06, 12.8-MHz outputs, changes the 2048-kHz output to 1.6 MHz.

1.5.7   Data Clock Timing Outputs

Signals:	1PPS, 9.6 kHz, 18.0 kHz, derived from the GPS disciplined 10 MHz oscillator.
Connector:	DB9 female, rear panel.
Signal Level:	RS-485.
Duty Cycle:	1PPS: 20% ±5%. 9.6 kHz, 18.0 kHz: 50% ±2%.
Accuracy:	The Data Clock 1PPS is made leading edge synchronized to the recovered GPS 1PPS. Using the 1PPS offset command, 1PO, the Data Clock 1PPS output can be offset from 0 to 1 second in 0.1 microsecond steps. The Data Clock 1PPS shall be synchronized within ±500 nanoseconds of other Model 8195A/8197 receivers having the same 1PO offset. The 9.6 kHz output is leading edge synchronized to within ±150 nanoseconds of the Data Clock 1PPS output. The 18 kHz output is not leading edge synchronized.
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 circuited.

1.5.8   *Data Sync Timing Outputs*

Signals:	17 2/3 Hz, 33 1/3 Hz, 18 kHz, 64 kHz, derived from the GPS disciplined 10 MHz oscillator.
Connector:	DB15 Female, rear panel.
Signal Level:	RS-485.
Duty Cycle:	18 kHz, 64 kHz: 50% ± 2%. 17 2/3: 888 microsecond pulse width. 33 1/2: 208 microsecond pulse width.
Accuracy:	The 17 2/3 Hz and 33 1/3 Hz Data Sync outputs are leading edge synchronized to within ±400 nanoseconds of the Data Clock 1PPS output. The 64 kHz and 18 kHz outputs are not leading edge synchronized.
Additional Outputs:	Major alarm relay contacts NO, NC and common, are provided on this connector.
Optional Outputs:	Option 14, CTCSS Outputs, replaces the 33-1/3 Hz and 17-2/3 Hz signals with CTCSS #1 and CTCSS #2 respectively. Option 06, 12.8 MHz outputs, changes the 64-kHz output to 50 kHz.

1.5.9   *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.
Optional Indicators:	Receivers equipped with Option 2, Internal Battery Backup, include indicator lamps to communicate battery status: Ready, Charging, and Replace.

1.5.10   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.

1.5.10.1   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.

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

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

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

Frequency Offset: A new simulcast or TV offset (Option 31) value is 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.

1.5.10.2   Tracking Alarm Classifications

Three configurable alarm tracking timeouts, AT1, AT2, and AT3, indicate how long the Model 8195A 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.

1.5.10.3   Alarm Interface

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

Alarm Outputs: Major Alarm, Minor Alarm.

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

Data Sync: Major Alarm.

Connector: DB15 Female, rear panel.
Contacts: NO, NC and Common.
Contact Rating: 30 VDC, 500 milliamps.

Data Clock: Major alarm.

Connector: DB9 Female, rear panel.
Contact Rating: 30 VDC, 500 milliamps.

1544 kHz: Major alarm.

Connector: RJ-11, rear panel.
Contacts: NO,NC and Common
Contact Rating: 30 VDC, 250 milliamps.

2048 kHz: Major alarm.

Connector: RJ-11, rear panel.
Contacts: NO,NC and Common
Contact Rating: 30 VDC, 250 milliamps.

1.5.11   Communication Ports

The Model 8195A has a front panel RS-232 and a rear panel RS-485 communication port. The communication ports are used to monitor and set operational parameters.

1.5.11.1   RS-232 Com

Signal: RS-232C, DCE.

Connector: DB9 female, front panel.

Bit Rate: 9600 Baud.

Character Structure: ASCII, 1 start, 8 data, 1 stop, no parity, xon/xoff flow control.

1.5.11.2   RS-485 Com

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

1.5.12   Input Power

AC Input:	90 to 264 VAC, 50/60 Hz, 20 Watts. Option 02, Internal Battery Backup, requires an additional 20 Watts. Option 03, Built-in Distribution Amplifier, requires an additional 25 Watts.
Fuse:	1.5 Amp, 250V, Slo-Blo.
Connector:	3-conductor, IEC 320 C-13, rear panel.
DC Standby:	+24 VDC $\pm$ 5%, 10 Watts. Powers the oscillator and GPS receiver whenever AC power is removed.
Fuse:	2 Amp, 250V, Slo-Blo.
Connector:	6-position terminal block, rear panel.
DC Power Options:	Option 52, $\pm$12 VDC, 20 Watts.
	Option 53, $\pm$24 VDC, 20 Watts. Option 53R +24 VDC, 15 Watts.
	Option 54, $\pm$48 VDC, 20 Watts.
Fuse:	Option 52, 10.0 Amp, 250V, Slo-Blo.
	Option 53, 6.25 Amp, 250V, Slo-Blo. Option 53R, 2.0 Amp, 250V, Slo-Blo.
	Option 54, 3.0 Amp, 250V, Slo-Blo.
Connector:	6-position terminal block, rear panel.

1.5.13   Mechanical

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

1.5.14   Environmental

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

1.5.15   Agency Approval

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

> *NOTE: The Model 8195A requires the addition of ferrite beads to the rear panel 10 MHz coax cables to achieve FCC compliance. Four ferrite bead assemblies are provided in each Model 8195A Ancillary Kit.*
>
> *NOTE: FCC compliance is only applicable to AC powered units. FCC compliance testing has not been performed on units equipped with DC power options 52, 53 or 54.*

1.5.16   Model 8225 GPS Antenna Specifications

1.5.16.1   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.

1.5.16.2   Mechanical Specifications

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

1.5.17   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

1.5.18   Model 8227 Inline Amplifier

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

MODEL 8195A

SECTION 2

INSTALLATION

INSTALLATION

2.0 INTRODUCTION

This section describes the installation of the Model 8225 GPS Antenna and related accessories. This section also describes the Model 8195A 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 bandpass filter and preamplifier within the antenna. The active antenna circuitry provides 30 dB of gain and requires +5 VDC at 27 milliamps. The Model 8195A 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.
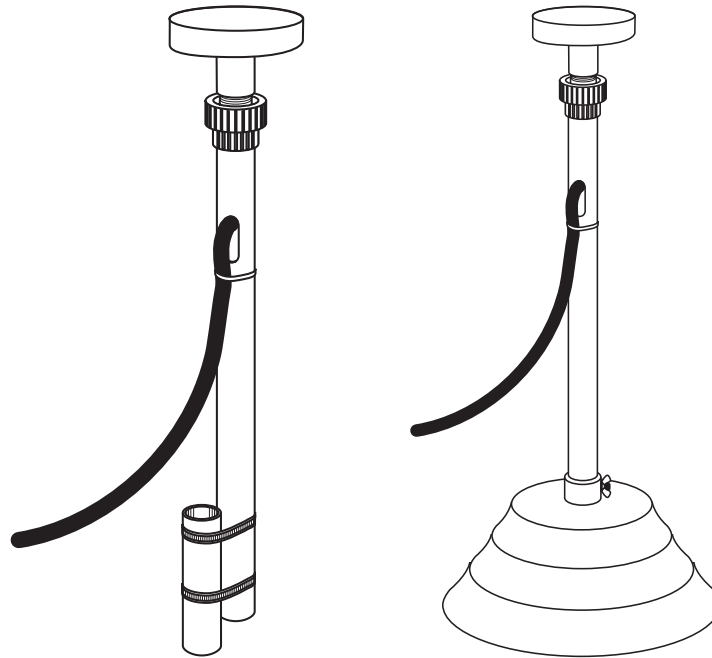
FIGURE 2-1 ANTENNA INSTALLATION

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 8195A 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, Impulse Suppressor, to protect the receiver from damaging voltages occurring on the antenna coax. Voltages exceeding the impulse suppresser trip point are shunted to the system ground. The Model 8226 is designed to withstand multiple surges.

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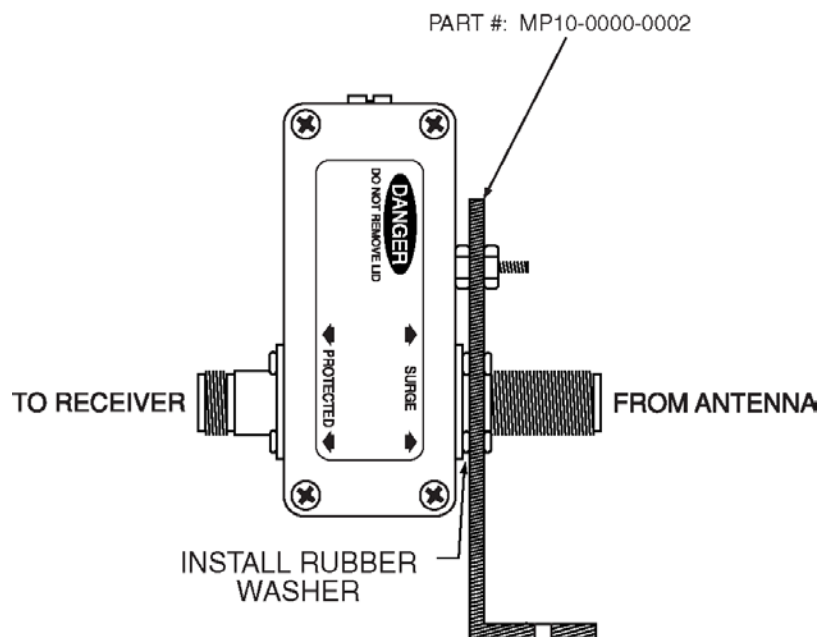
FIGURE 2-2   MODEL 8226 IMPULSE SUPPRESSOR

In addition, Spectracom offers a copper grounding panel, 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.
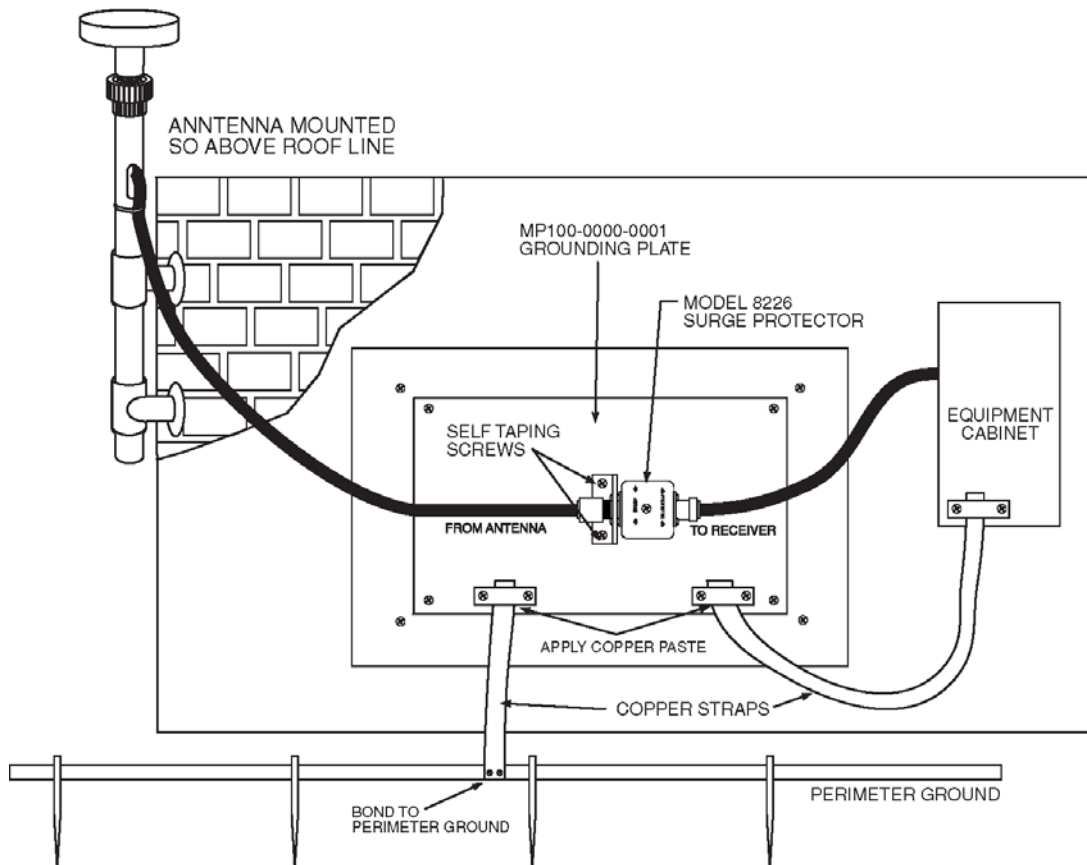
FIGURE 2-3 GROUNDING PANEL INSTALLATION

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

Nut   Washer Gasket   Clamp   Male Contact   Plug Body
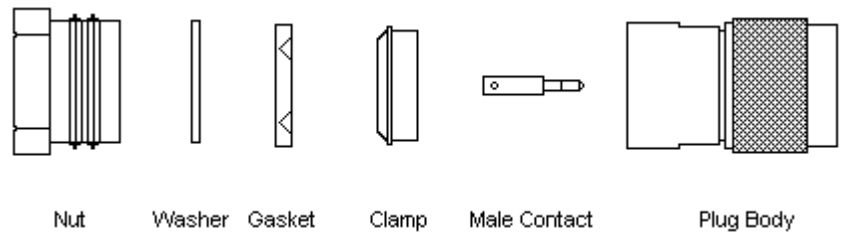
Step 1   Cut the cable end squarely and place the nut, washer, and gasket onto the cable as shown. Make certain the gasket's "V" groove is oriented towards the end of the cable. Cut the cable jacket back to dimension A of 0.359 inches (9.1 mm). Do not cut or knick the braid.
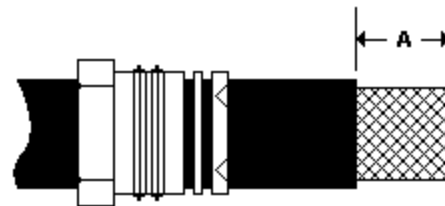
Step 2 Comb out the braid and fold back to expose the dielectric. Cut the dielectric back to dimension B of 0.234 inches (6.0 mm). Do not cut or knick the center conductor.
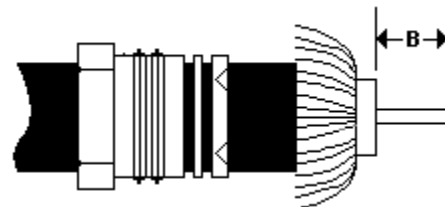
Step 3   Comb the braid forward and slide the clamp onto the cable as shown. Make certain that the beveled edge of the clamp is oriented towards the gasket "V" groove to form a weatherproof seal.
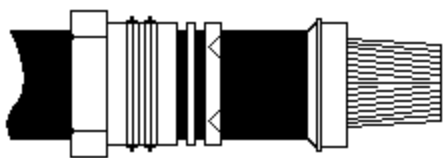
Step 4 Fold the braid back over the clamp. Comb the braid to evenly distribute it over the clamp and trim to the proper length as shown.
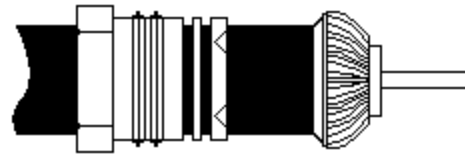
Step 5 Verify there is no braid or dielectric foil that may short against the center conductor. Tin the center conductor and then solder on the male contact as shown.
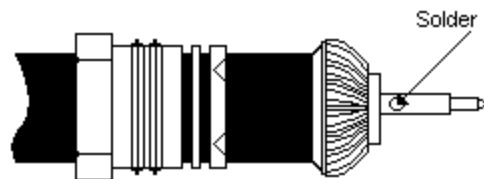
Step 6 Insert the cable assembly into the connector body. Verify the gasket "V" grooves fit into the clamp edges. Hold the body with the 11/16" wrench and tighten the nut using the 5/8" wrench. Using the multimeter, measure continuity of the center conductors on each end of the cable. It should be close to 0 Ω. Measure the continuity between the center conductor and connector body. It should be an open circuit.
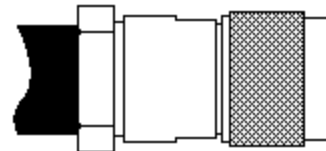
FIGURE 2-4 N CONNECTOR ASSEMBLY INSTRUCTIONS

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.
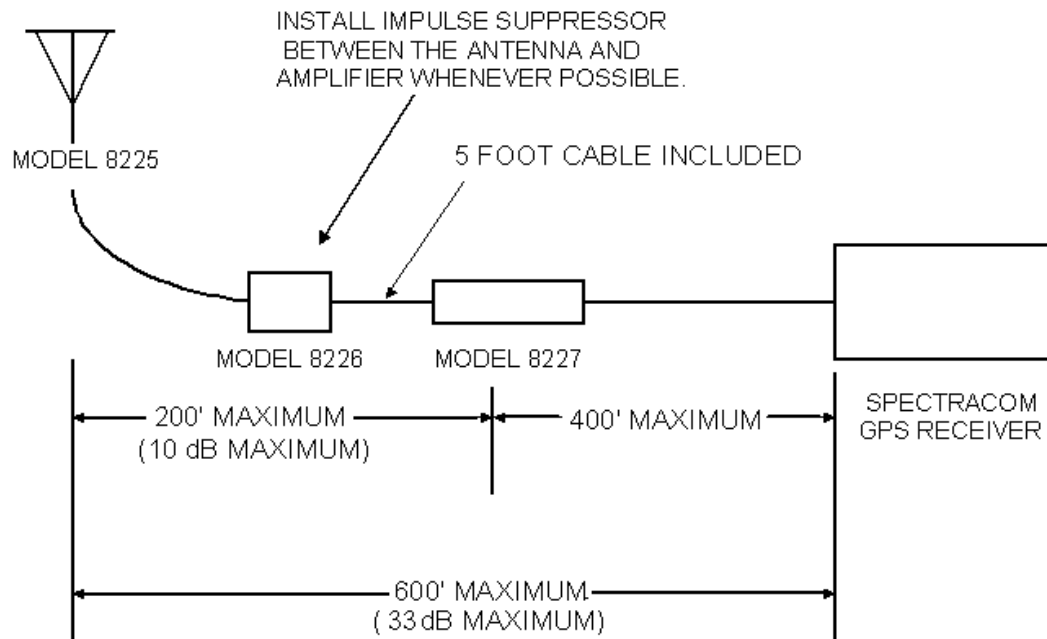
FIGURE 2-6   CABLE GUIDELINES

2.5   MODEL 8195A PREPARATION FOR USE

This section outlines the set-up procedure to prepare the Model 8195A 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 8195A 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 8195A accepts the complete range of 90 to 264 VAC without a change in instrument setup. Do not change the AC fuse or line voltage selector.**

On AC powered units, the DC power connector allows connection of a backup power source. The backup source powers the oscillator and GPS receiver whenever AC power is interrupted. Backup power speeds recovery time when AC power is restored by eliminating oscillator warm-up and retrace and GPS reacquisition time. The backup power requirement is +24 VDC, 10 Watts maximum. The DC power connector is shown in Figure 2-7.

2.5.3   *DC Power*

DC power options allow operation from various DC power sources. Table 2-1 lists the DC power configurations available.

Power Option	Nominal Voltage	Input Range	Power
Option 52	± 12 VDC	11.1 - 16.5 VDC	20 Watts
Option 53	± 24 VDC	22.1 - 33.1 VDC	20 Watts
Option 53R	+24 VDC	22.8 - 25.2 VDC	15 Watts
Option 54	± 48 VDC	44.2 - 66.2 VDC	20 Watts

TABLE 2-1 DC POWER CONFIGURATIONS

Connect the DC Power inputs to the 6-position terminal block as shown in Figure 2-7, DC Power Connector. The mating connector is included in the ancillary kit. Redundant

power sources may be connected for improved system reliability. Be certain to observe the polarity markings when connecting power. The DC power options, 52, 53, and 54, have isolated inputs, which permits operation from a positive or negative power source. To reduce RFI/EMI emissions use a shielded power cable. Connect the cable shield to the chassis ground pin labeled "G".

> *NOTE: Place the DC power switch in the OFF position*
> *when connecting DC power.*
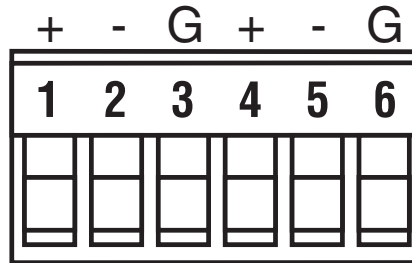
FIGURE 2-7 DC POWER CONNECTOR

2.5.4   *Chassis Ground*

The chassis ground lug allows the Model 8195A 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 8195A 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, or less than 10 seconds if a backup power source is present.

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 2.8 for troubleshooting assistance.

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

2.7.1   GPS Signal Status

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

Issue the GSS command as shown below.

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

An example response is shown below:

```
TRACKING 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 $0 \leq DOP < 10$ 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 2.8 for troubleshooting assistance.

2.7.2   Tracking Histogram

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

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 2.8.2 for recommendations.

2.8 RECEPTION TROUBLESHOOTING

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

2.8.1 No Reception

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

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

TABLE 2-2   TYPICAL ANTENNA CABLE RESISTANCE VALUES

Failed impulse suppressor: The Model 8226 has a high impedance when measuring from the center conductor to ground and a low throughput resistance. A failing impulse suppressor may be tripping prematurely. The easiest way to test the Model 8226 is to temporarily replace it with a Type N barrel connector. If the receiver begins tracking satellites within 20 minutes, the impulse suppressor has failed and must be replaced.

Cable length: Excessively long or improper cable type may prevent the receiver from tracking satellites. Refer to Section 2.2 for GPS cable recommendations.

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 SSS.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.

2.8.2   *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 8195A can be configured to operate in low GPS quality conditions by selecting an alternate GPS qualifying algorithm. Refer to Appendix A for additional information.

2.9   *FACTORY CONFIGURATION*

Several of the Model 8195A outputs and operational parameters are configurable using the RS-232 communication port and set-up DIP switches. Table 2-3 lists the selectable parameters, factory default, and if it is command or switch selectable. Refer to Section 3, Operation, for a complete description of the various outputs and set-up switches. Refer to Section 4, Software Commands, for information on the various commands.

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

TABLE 2-3   DEFAULT SETTINGS

MODEL 8195A

SECTION 3

OPERATION

OPERATION

3.0   INTRODUCTION

This section describes the front and rear panel functions, and operational information for the Model 8195A GPS Ageless™ Oscillator.

3.1   FRONT PANEL FUNCTIONS

The front panel of the Model 8195A 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 8195A divides alarm conditions into two categories, Major and Minor. A Major Alarm is asserted when fault conditions exist which affect the operation or accuracy of the unit. A Minor Alarm warns of conditions having no immediate effect on total operation, but may require corrective action.

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

3.1.2.1   *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 exceeds1×10^{-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.   A shorted cable could cause the fault, reflections due to an unterminated cable or Signature Control removed the outputs.
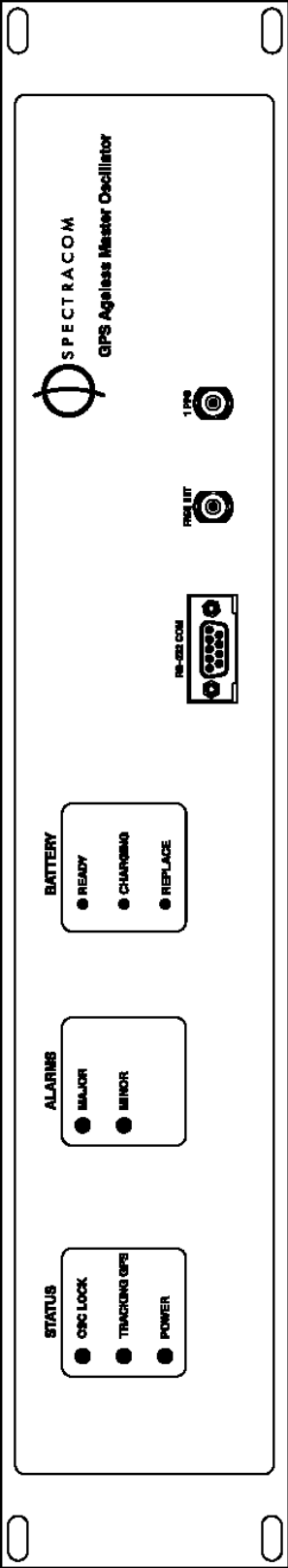
FIGURE 3-1 MODEL 8195A FRONT PANEL

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

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

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

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

Frequency Offset: A new simulcast or TV offset (Option 31) value is entered. The alarm remains active until the standard oscillator has corrected for the offset.

Antenna Problem: Antenna sense circuitry warns when the antenna is not connected or a cable short or open is detected.

Test Mode: Unit is placed in Test Mode operation.

3.1.3   Battery Lamps (Option 02 only)

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

3.1.3.1   Ready Lamp

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

3.1.3.2   Charging Lamp

This yellow lamp is on when the battery is charging.

3.1.3.3   Replace Lamp

This red lamp turns on and a Minor Alarm asserted when the battery has failed the daily test. The battery must be replaced; refer to Section 6, Service Information.

3.1.4   RS-232 Com

This is the RS-232 serial communication port. Commands to configure selectable parameters, output operational status and events, and Test Mode functions are entered here. Refer to Section 4.2 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.
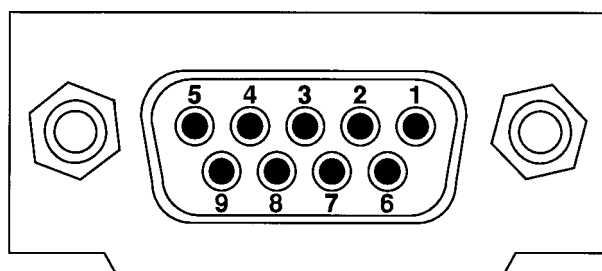
FIGURE 3-2 RS-232 COM PIN NUMBERING

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.

3.1.5   10-MHz Output

This BNC connector outputs a 10-MHz sine wave signal derived from the disciplined oscillator. The 10-MHz output can be user-configured for simulcast paging or optional TV offsets. Refer to the Ten MHz Offset command, 1F0, found in Section 4.2 for additional information. This output is changed to 12.8 MHz when equipped with Option 06, 5 MHz with Option 07, and 1 MHz for Option 08 units.

3.1.6   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 8195A 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 sine wave into a 50-ohm load. The harmonic suppression is 30 dB.

> *NOTE: To achieve FCC compliance, ferrite beads must be added to the 10 MHz coax cables. Four clamp on ferrite EMI Filters are provided in the ancillary kit. For best results, place the beads close as possible to the rear panel and use RG-58 coax.*

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 8195A 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.
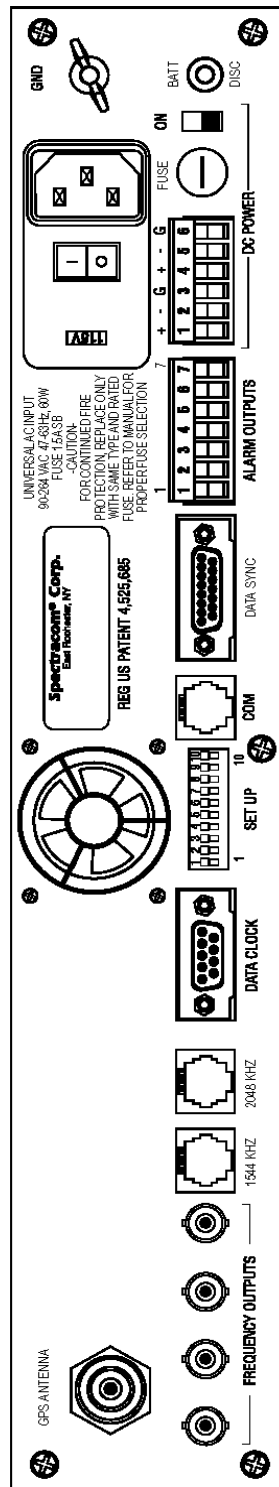
FIGURE 3-3   MODEL 8195A REAR PANEL

3.2.2.2   Simulcast Offsets

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

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

The Spectracom Model 8195A 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: $\Delta f_C =$ carrier offset
$F_C =$ carrier frequency
$\Delta f_S =$ offset of 10 MHz standard (from the tables)

3.2.2.3   Output Options

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

Option 03, Built-in Distribution Amplifier
Option 06, 12.8-MHz Outputs
Option 07, 5-MHz Outputs
Option 08, 1-MHz Outputs
Option 31, TV 10-Hz Offsets

3.2.3   1544 kHz and 2048 kHz Timing Outputs

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

NOTE: Selecting Simulcast or Television Offsets affects the accuracy of the timing outputs.

The connector pin numbering is shown in Figure 3-4 and pin assignments listed in Table 3-4.
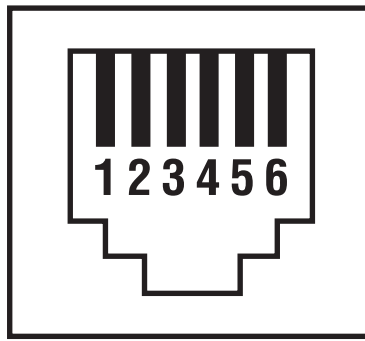
FIGURE 3-4   TIMING OUTPUT CONNECTOR

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

TABLE 3-4 TIMING OUTPUT PIN ASSIGNMENTS

NOTE: Units equipped with Option 06, 12.8 MHz outputs, change the 2048-kHz output to 1.6 MHz.

3.2.3.1   RS-485 Outputs

RS-485 is a balanced differential transmission requiring twisted pair cabling. Refer to Figure 3-5 for a schematic representation of the RS-485 output driver. Relative to RS-485 specifications, the A terminal (Pin 2) is negative with respect to the B terminal (Pin 1) for a Binary 1. The A terminal is positive relative to the B terminal for a Binary 0.
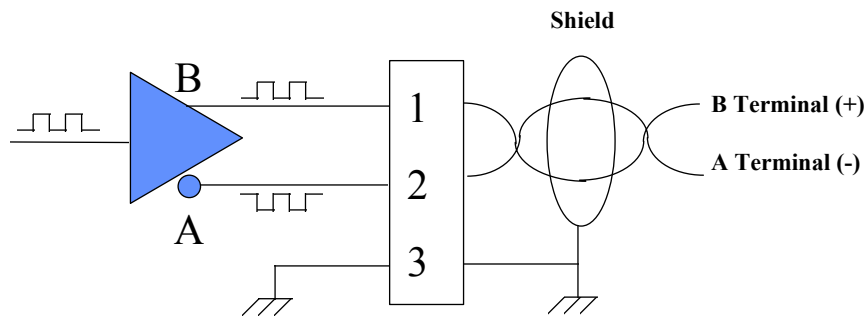
FIGURE 3-5   RS-485 OUTPUT

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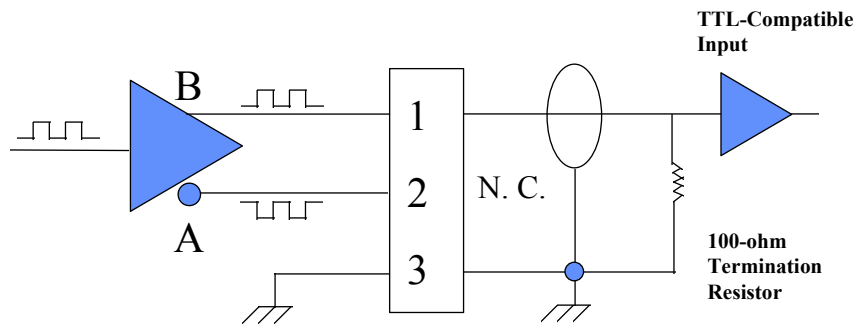
FIGURE 3-6   SINGLE-ENDED CONNECTION

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

3.2.3.2   *Major Alarm Contacts*

Major Alarm relay contacts are found on Pins 4, 5 and 6 of each timing output connector.
During normal operation the Major Alarm relay is energized causing continuity between
Pin 4 and Pin 6. When a Major Alarm is asserted the relay is deactivated causing
continuity between Pin 4 and Pin 5. The relay remains in alarm condition until the
condition causing the alarm is corrected or is reset by the clear alarm, CA, command.
Refer to section 3.1.2 for a complete description of Major Alarms.

3.2.4   **Data Clock Timing Outputs**

This connector provides RS-485 clock signals of one pulse per second (1PPS), 9.6 kHz,
18 kHz and Major Alarm relay contacts. The connector is a 9-pin series D numbered as
shown in Figure 3-7. Data Clock pin assignments are listed in Table 3-5.
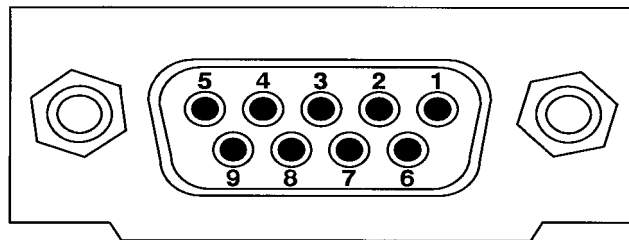
FIGURE 3-7 DATA CLOCK CONNECTOR

PIN	SIGNAL	NOTES
1	+ 9.6 kHz	RS-485 B Terminal
2	+18 kHz	RS-485 B Terminal
3	+ 1 PPS	RS-485 B Terminal
4	Major Alarm	Ground = Normal
5	Ground	Cable Shield
6	- 9.6 kHz	RS-485 A Terminal
7	-18 kHz	RS-485 A Terminal
8	- 1 PPS	RS-485 A Terminal
9	Ground	Cable Shield

TABLE 3-5 DATA CLOCK PIN ASSIGNMENTS

The Data Clock timing signals are derived from the 10 MHz GPS disciplined oscillator.
The 1PPS and 9.6-Hz outputs are leading edge synchronized to the GPS 1 PPS output.

Using the 1PPS offset command; 1PO, the outputs can be offset from 0 to 1 second in 0.1 microsecond steps. Refer to Section 4 for additional information on the 1PO Command.

The 18-kHz output is not made leading edge synchronized.

3.2.4.1   *RS-485 Outputs*

RS-485 is a balanced differential transmission requiring twisted pair cable. Cable lengths up to 4000 feet are possible when using cables specifically designed for RS-485 applications, like Belden 9844 or equivalent. These cables have a braided shield, nominal impedance of 120 ohms, and a capacitance of 12 to 15 picofarads per foot. Refer to Figure 3-8 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.
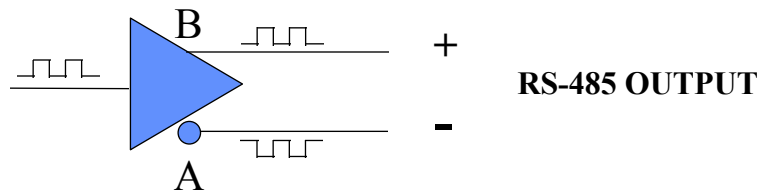
FIGURE 3-8   RS-485 LINE DRIVER

3.2.4.2   *Major Alarm Relay*

Major Alarm status can be monitored using Pin 4 of this connector. Under normal operation, Pin 4 is connected to ground. When a Major Alarm is asserted, Pin 4 switches to a high impedance (open circuit). Refer to Section 3.1.2 for a complete description of Major Alarms.

3.2.5   Set Up Switches

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

3.2.5.1   RS-485 Address

The Address switches give each Model 8195A installed on an RS-485 bus a unique identity. The address may range from 0 - 31. DIP switches 1 through 5 enter the binary equivalent of the selected address. Table 3-6 lists the RS-485 addresses and the corresponding DIP switch settings.

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

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

1 = SWITCH ON, 0 = SWITCH OFF

TABLE 3-6   ADDRESS SELECTION

3.2.5.2   RS-485 Baud Rate

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

3.2.5.3   *Spares*

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

3.2.5.4   *Termination*

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

3.2.6   **RS-485 COM**

The RS-485 communication port permits remote configuration control and monitoring of performance and status. The RS-485 Com port uses a protocol and command set described in Section 4.3 of this manual. The Com connector pin numbering is shown in Figure 3-9. Table 3-7 lists the Com pin assignments.
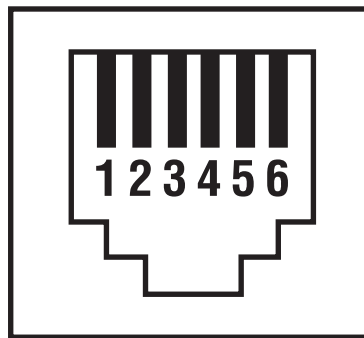
FIGURE 3-9   COM CONNECTOR

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

TABLE 3-7   RS-485 COM PIN ASSIGNMENTS

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

RS-485 is a balanced differential transmission requiring twisted pair cable. The RS-485 standard defines the A terminal (-) to be negative with respect to the B terminal (+) for a Binary 1 (MARK or OFF) state. The A terminal (-) is positive to the B terminal (+) for a Binary 0 (SPACE or ON) state. Figure 3-10 illustrates the relationship between the A and B terminals for the Transmit and Receive connections.
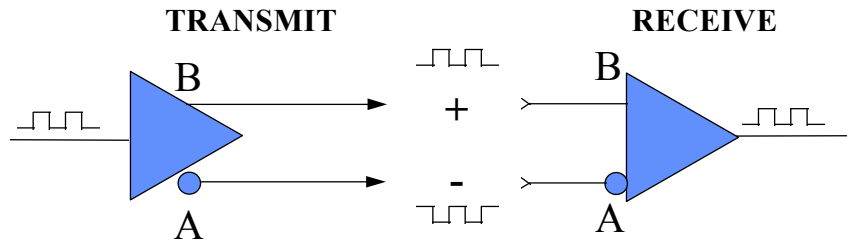
FIGURE 3-10   RS-485 CONNECTION

3.2.7   *Data Sync Timing Outputs*

This connector provides RS-485 clock signals of 17 2/3 Hz, 33 1/3 Hz, 18 kHz, 64 kHz and Major Alarm relay contacts. The connector is a 15-Pin series D female numbered as shown in Figure 3-11. Data Sync pin assignments are listed in Table 3-8.
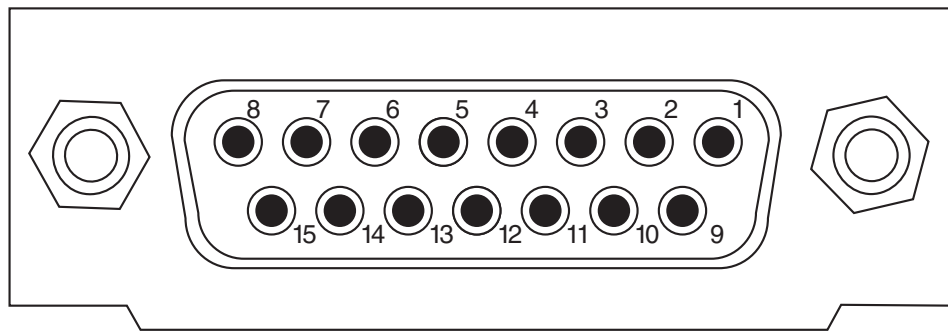

FIGURE 3-11 DATA SYNC CONNECTOR

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

TABLE 3-8 DATA SYNC PIN ASSIGNMENTS

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

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

Refer to Section 5, Options and Accessories, for additional information on Options 14 and 6.

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

The 17 2/3-Hz and 33 1/3-Hz outputs are derived from the 10-MHz GPS disciplined oscillator and are triggered by the GPS 1PPS output. Using the 1PPS offset command, 1PO, these outputs can be offset from 0 to 1 second in 0.1 microsecond steps. Refer to Section 4 for additional information on the 1PO command. The leading edges of the 17 2/3-Hz and 33 1/3-Hz outputs are synchronized within ±400 nanoseconds of the Data Clock 1PPS output.

3.2.7.1   RS-485 Outputs

RS-485 is a balanced differential transmission requiring twisted pair cable. Cable lengths up to 4000 feet are possible when using cables specifically designed for RS-485 applications, like Belden 9844 or equivalent. These cables have a braided shield, nominal impedance of 120 ohms, and a capacitance of 12 to 15 picofarads per foot. Refer to Figure 3-12 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.
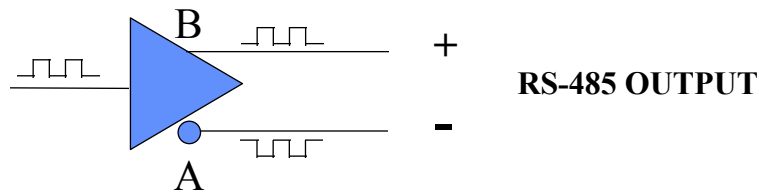
FIGURE 3-12 DATA SYNC DRIVERS

3.2.7.2   Major Alarm Contacts

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

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

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

3.2.8   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 3-13, is furnished in the ancillary kit.
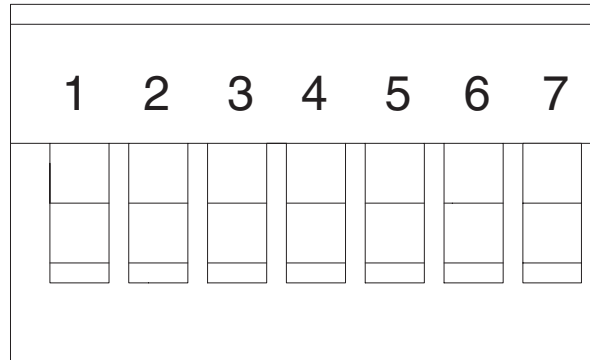
FIGURE 3-13 ALARM OUTPUTS TERMINAL BLOCK

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

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

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

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

Table 3-9 lists the Alarm status and the corresponding contact status. The relay contacts remain in the alarm condition until the fault is corrected 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 3-9 ALARM OPERATION

3.2.9   *DC Power*

The DC Power connector provides primary or backup power to the Model 8195A.

On AC powered units, the DC Power connector allows connection of a backup power source. The backup source powers the oscillator and GPS Receiver whenever AC power is interrupted. Backup power speeds recovery time when AC power is restored by eliminating oscillator warm-up and GPS reacquisition time. The backup power requirement is +24 VDC ± 5%, 10 Watts maximum.

DC power options allow operation from alternate power sources. Table 3-10 lists the various DC power configurations available.

Power Option	Nominal Voltage	Input Range	Power	Fuse
Option 52	± 12 VDC	11.1 - 16.5 VDC	20 Watts	10.0 A Slo-Blo
Option 53R	+24 VDC	22.8 - 25.2 VDC	15 Watts	2.0 A Slo-Blo
Option 53	± 24 VDC	22.1 - 33.1 VDC	20 Watts	6.25 A Slo-Blo
Option 54	± 48 VDC	44.2 - 66.2 VDC	20 Watts	3.0 A Slo-Blo

TABLE 3-10 DC POWER CONFIGURATIONS

Connect the DC power inputs to the 6-position terminal block as shown in Figure 3-14, DC POWER CONNECTOR. The mating connector is included in the ancillary kit. Redundant power sources may be connected for improved system reliability.   Be certain to observe the polarity markings when connecting power. DC power options, 52, 53, and 54, have isolated inputs, which permits operation from a positive or negative power source. To reduce RFI/EMI emissions use a shielded power cable. Connect the cable shield to the chassis ground pin labeled "G".

> *NOTE: Place the DC power switch in the OFF position prior to connecting DC power.*
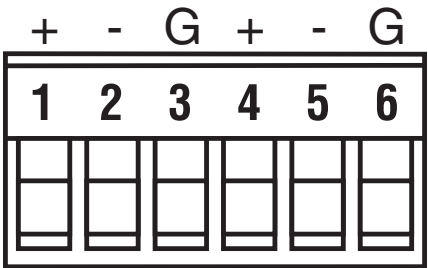
FIGURE 3-14   DC POWER CONNECTOR

3.2.10   AC Power

The standard Model 8195A 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 3-15, 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 8195A 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.*
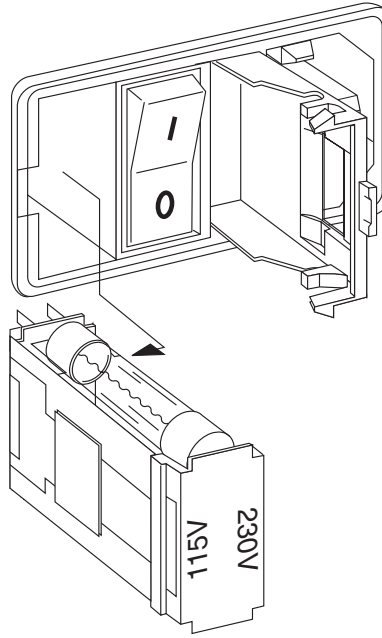
FIGURE 3-15   AC POWER MODULE

3.2.11   Cooling Fan

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

3.2.12   Chassis Ground

The chassis ground lug allows the Model 8195A 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 8195A receiver performance.

3.2.13   Battery Disconnect Switch

This switch is included on units equipped with Option 02, Internal Battery Backup. Depressing this switch removes the backup battery power from the GPS receiver and ovenized oscillator. The Battery Disconnect switch is only operational when AC power is removed. This feature prevents battery discharge when shipping or storing the Model 8195A.

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

MODEL 8195A

SECTION 4

SOFTWARE COMMANDS

SOFTWARE COMMANDS

4.0   INTRODUCTION

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

4.1   RS-232 COMMANDS

From the front panel RS-232 COMM port the user may configure, control and monitor the 8195A. 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 8195A 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 8195A functions. Test Mode allows the user access to special test commands, as well as all standard commands. After entering Set Mode or Test Mode, the unit will time out and return to Read Mode after 15 minutes of inactivity.
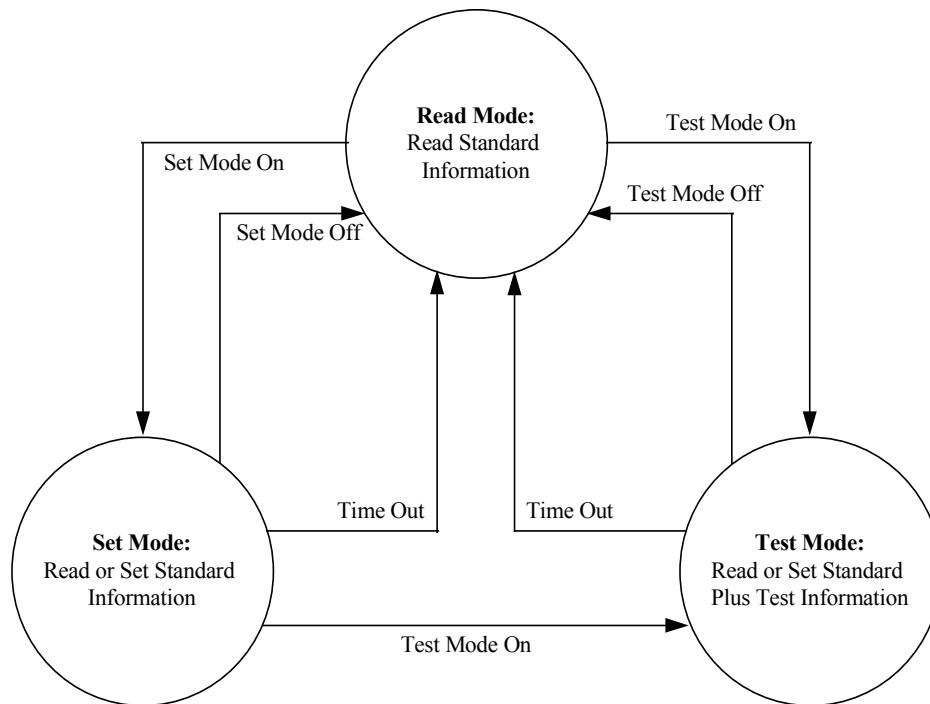
FIGURE 4-1 COMMAND STRUCTURE

COMMAND	DESCRIPTION	MODE	SECTION
ACD	Antenna Cable Delay	READ/SET	4.2.1
ATx	Alarm Time Out	READ/SET	4.2.2
CA	Clear Alarms	SET	4.2.3
CA BAT	Clear Battery Alarm	SET	4.2.4
CONF	Configuration	READ	4.2.5
DAL	Display Alarm Log	READ	4.2.6
DATE	Date	READ/SET	4.2.7
DFM	Display Frequency Measurement	READ	4.2.8
DOL	Display Oscillator Log	READ/TEST	4.2.9
DH	Display Tracking Histogram	READ/TEST	4.2.10
EO	Event Output	READ/SET	4.2.11
GSS	GPS Signal Status	READ	4.2.12
H,Help,?	Help	READ	4.2.13
LOC	Location	READ/SET	4.2.14
SC	Signature Control	SET	4.2.15
SM	Set Mode	---	4.2.16
STAT	Status Information	READ	4.2.17
TIME	Time	READ/SET	4.2.18
TM	Test Mode	---	4.2.19
TZO	Time Zone	READ/SET	4.2.20
U2G	UTC to GPS Time Offset	READ	4.2.21
VER	Version	READ	4.2.22
1FO	Frequency Offset	READ/SET	4.2.23
1PO	One PPS Offset	READ/SET	4.2.24

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 8195A 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.

4.2.1   ANTENNA CABLE DELAY

The command, *ACD*, reads or sets the antenna cable delay value expressed in microseconds. The on-time point is offset by the delay value entered to compensate for antenna cable and in-line amplifier delays. The expected cable and amplifier delays are typically negligible. The *ACD* command is intended for advanced user setup. The advanced user can calculate the delay based 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= 2000-03-24 STATUS CHANGE <TEMP= +36.0>
                    COOLING FAN= OFF
                    ALARM RELAYS: MAJOR= OFF MINOR= OFF
                    ACTIVE ALARMS: MAJOR
                    FREQUENCY

4.2.4 CLEAR BATTERY ALARM

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

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

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

> TYPE: *CA BAT<ent>*

Example Response:

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

4.2.5   CONFIGURATION

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

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

```
            TYPE:        CONF<ent>
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
```

4.2.6   DISPLAY ALARM LOG

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

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

> Type: **DAL**<ent>

 Example Response:

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

4.2.7   DATE

The **DATE** command reads or sets the date of the Model 8195A. 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*

4.2.8   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 2000-03-24*

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 2000-03-24

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

4.2.9   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 8195A 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 8195A.

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 >$1.0x10^{-9}$ 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 8195A*
> *SOFTWARE VERSION 2.07 DATE: FEBRUARY 29, 2000 11:05:49*
> *UNIT STARTED 12:47:07 2000-03-24*
> *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= 2000-03-24 PHASE ADJUSTMENT*
> *AVG LEN= 0168 TOTAL= 0001653A*
> *DAC= B201(69%) TEMPERATURE= +37.5*
> *PHASE ERROR= +129.55 nSEC*
> * TIME= 11:36:07 DATE= 2000-03-24 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= 2000-03-24 PHASE ADJUSTMENT*
> *AVG LEN= 0168 TOTAL= 00012001*
> *DAC= B1FE(69%) TEMPERATURE= +37.5*
> *PHASE ERROR= +104.44 nSEC*
> *MORE<ANY> QUIT<ESC>*

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

4.2.10   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.

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

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

TIME= 10:00:00 DATE= 2000-03-24 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= 2000-03-24 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= 2000-03-24 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= 2000-03-24 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= 2000-03-24 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

4.2.11   EVENT OUTPUT

The Model 8195A 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 factory default is 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*

4.2.12   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 date.

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*

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, $0 \leq DOP < 10$
> 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	

4.2.13   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

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

1PO [XXXXXX.XXX]= 1PPS OFFSET

ACD [XXX.XXX]= ANTENNA CABLE DELAY

1FO [SCn so|TV sc]= 10MHZ OFFSET

ATx [DDD HH:MM:SS]= ALARM TIME OUTS x= 1,2 OR 3

SC [ON|OFF]= SIGNATURE CONTROL, CTC [1-4|TABLE] [CODE]= CTCSS SETUP

CA= CLEAR ALARMS

EO [ON|OFF]= EVENT OUTPUT

SM [ON|OFF]= SET MODE

VER= SOFTWARE VERSION NUMBERS

FOR FURTHER INFORMATION PLEASE CONSULT YOUR MANUAL

4.2.14   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

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

4.2.15   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 8195A 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*

4.2.16   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_

4.2.17   STATUS INFORMATION

The ***STAT*** command provides the current operational status of the Model 8195A. The Status Log includes a time and date stamp, oscillator status, GPS tracking status, position, battery status, temperature, cooling fan operation, 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= 2000-03-24*
> *OSCILLATOR STATUS= LOCKED*
> *GPS SIGNAL= QUALIFIED*
> *BATTERY STATUS= READY*
> *INTERNAL TEMP= +37.5 DEGREES C COOLING FAN= OFF*
> *ALARM RELAYS: MAJOR= OFF   MINOR= OFF*
> *ACTIVE ALARMS: NONE*

4.2.18   TIME

The command, **TIME**, reads or sets the time of the Model 8195A.

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*

4.2.19   *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= 2000-03-24 STATUS CHANGE <TEMP= +37.5>
                COOLING FAN= OFF
                ALARM RELAYS: MAJOR= ON MINOR= ON
                ACTIVE ALARMS: MAJOR
                IN TEST MODE
                   - OR -
                TEST MODE= ON

4.2.20   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 8195A 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
	:= Colon separator
	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 ±HH:MM<ent>*
Where:	*±HH:MM = As described above*

A response reflecting the selected offset value is output.

4.2.21   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*

4.2.22   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 8195A*
>
> *SOFTWARE VERSION 2.07 DATE: FEBRUARY 29, 2000 11:05:49*
>
> *UNIT STARTED 12:47:07 2000-03-24*
>
> *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

4.2.23   FREQUENCY OFFSET

The *1FO* 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: $\Delta f_c =$ carrier offset
             $F_c =$ carrier frequency
             $\Delta f_s =$ offset of 10 MHz standard (from the tables)

To read the 10 MHz offset value issue the **1FO** command as shown below:

            Type: **1FO <ent>**
  Default Response: *10MHZ OFFSET = NONE*

To select a 10 MHz simulcast offset, place the unit in Set mode and issue the **1FO** command as follows:

            Type: **1FO 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 **1FO** command as follows:

            Type: **1FO 0<ent>**

Examples:
Configure the Model 8195A 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 1FO command as shown below:

            Type: **SM ON <ent>**
        Response: *SET MODE ON*
            Type: **1FO 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.

4.2.24   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 and Data Sync output signals that are leading edge synchronized to the GPS 1PPS will follow the offset value. The Data Clock 1PPS and 9.6 kHz outputs are leading edge synchronized. The Data Sync leading edge synchronized outputs are $17\,{}^2/_3$ Hz and $33\,{}^1/_3$ Hz or CTCSS outputs #1 and #2 if Option 14 is present.

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

Type: *1PO <ent>*
Default Response: *1PPS Offset = 000000.00 Microseconds*

To select a 1PPS offset, place the unit in Set mode and issue the *1PO* command as follows:
Type: ***1PO XXXXXX.XX <ent>***
Where: *XXXXXX.XX = 000000.000 TO 999999.99 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 999999.99 microseconds.

4.3   RS-485 COMMAND STRUCTURE

The commands described here must conform to a specific command protocol. The protocol is shown in Table 4-5.

FIELD	SIZE	DESCRIPTION
Start Word	2 Bytes	Unique characters <#> <$> used to synchronize with data stream
Source Address	1 Byte	0-31= unit address 32-254= reserved 255= broadcast
Destination Address	1 Byte	0-31= unit address 32-254=reserved 255= broadcast
Message Length	2 Bytes	Variable length from 1 to 502 bytes
Message	1 to 502 Bytes	4 character commands plus parameters
Check Word	2 Bytes	Running sum including all bytes after the start word through the last message byte.
Stop Word	2 Bytes	Unique characters (<cr><lf>) used to synchronize with data stream

TABLE 4-5 RS-485 COMMAND PROTOCOL

All inputs via the RS-485 port must follow this format, or they will be ignored. The descriptions that follow are for the Message field of the commands. When the first character of a command is 'w' this indicates the controller is writing information to the 8195A. If the first character is 'r' the controller is reading information. The RS-485 Com port operates at 9600 baud, character structure is 1 start, 8 data, 1 stop, and no parity.

4.4   RS-485 COMMAND DESCRIPTIONS

Table 4-6 provides an alphabetical listing of the *RS-485 Command* set.

	DESCRIPTION	READ	WRITE	SECTION
acd	Antenna Cable Delay	√	√	4.4.1
aeg	Alarm Event History	√		4.4.2
ast	Alarm Status Display	√		4.4.3
at1	Alarm Time Out 1	√	√	4.4.4
at2	Alarm Time Out 2	√	√	4.4.4
at3	Alarm Time Out 3	√	√	4.4.4
cah	Clear Alarm History		√	4.4.5
gss	GPS Signal Strength	√		4.4.6
loc	Full location	√	√	4.4.7
rrsn	Signal Selection	√		4.4.8
sts	Short Status Display	√		4.4.9
tad	Time and Date	√		4.4.10
tzo	Time Zone		√	4.4.11
who	Vendor, Version	√		4.4.12
1fo	Ten MHz Offset	√	√	4.4.13
1po	One PPS Offset	√	√	4.4.14

TABLE 4-6   ALPHABETICAL LIST OF RS-485 COMMANDS

4.4.1   ANTENNA CABLE DELAY

This command is to read or set the antenna cable delay. Although this value is generally negligible, the 1PPS timing can be affected by the antenna cable delay. The default is 0. The maximum delay value is 999.999 microseconds.

wacdXXXXXX.XXX
 where XXXXXX.XXX is a number in microseconds.
wacdXXXXXX.XXX
racd
racdXXXXXX.XXX

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, i.e. 66% = .66

Value is provided by cable manufacturer.

4.4.2   ALARM EVENT HISTORY

This command is to read ***Alarm Events***. The 8195A will respond with the most recent alarm event not yet returned by this command. When all events have been read, the most recent event is returned with the valid entry indicator set to 'n' (event already read).

raeh
raeh VHHMMSSsHHMMDDMMYYYYtNTFOCsssAOGBss where V = y or n indicating if this entry is a valid entry, HHMMSS= time of event, sHHMM= time zone offset of the unit, DDMMYYY= date of event, t(y/n) = 10 MHz out of specification (AT3), N(y/n) = 9.6 kHz out of spec (AT2), T(y/n)= in test mode, F(y/n)= in Free Run, O(y/n)= Oscillatory Failure (Frequency Alarm), C(y/n)= CPU alarm, sss= three spares, A(y/n)= Adjust Oscillator, O(y/n)= Output fault, G(y/n)= GPS out of spec (AT1), B(y/n)= replace battery, ss= two spares.

4.4.3   ALARM STATUS

This command read ***Alarm Status***. This is a short command designed to let the controller know if there are any alarms present.

rast
rastC where C = y or n indicating if there are alarm conditions present.

4.4.4   ALARM TIMEOUTS

This command is to read or set the three **Alarm Time outs** individually. Each time-out controls the status of an alarm relay. If the GPS receiver stops tracking satellites the timers start counting down. If the timer reaches 0 before the receiver begins to track satellites again, the alarm relay is activated. In addition, if Alarm Time out 1 occurs, this is a minor alarm. Alarm Time out 2 and Alarm Time out 3 are Major alarms. Defaults are: AT1 = 1 minute, AT2 = 2½ hours, AT3 = 30 days.

watXDDDHHMMSS where X = 1,2, or 3 indicating which time out.
watXDDDHHMMSS
ratX
ratXDDDHHMMSS

4.4.5   CLEAR ALARM HISTORY

This command is to **Clear the Alarm History**. This command accompanies the **raeh** command and is used to "erase" the alarm history. After this is issued, subsequent use of the **raeh** command will respond with the valid entry character set to 'n', until a new alarm event occurs.

wcah
wcah

4.4.6   GPS SIGNAL STATUS

The GPS Signal Status Command, **rgss**, lists the parameters used in qualifying the received GPS signal. This command can be used to verify proper antenna placement and receiver performance. The total message length is 76 bytes.

rgssTPSDD.DIIMSSSCCIIMSSSCCIIMSSSCCIIMSSSCCIIMSSSCCIIMSSSCCIIMSSSCCIIMSSSCCQ

WHERE:

T =	Number of satellites currently tracking, 0…8.	
P =	Position Hold, Y=Yes, N=No.	
S =	Receiver Status, 2= 2-D fix, 3= 3-D fix, A=Acquiring Satellites, O= Other.	
DD.D =	Dilution of Precision, 00.0…99.9.	
	Indicates the degree of uncertainty in a position fix. In Position Hold Mode, DOP= 00.0. In all other Modes, lower DOP values, except 00.0, indicate a lower degree of uncertainty.	
II =	Satellite ID Number, 00 - 37.	
B =	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	

SSS =   Signal strength value relative to SNR, 000…055. The higher the number, the greater the received signal. The minimum acceptable signal level is 40.

CC =   Channel status, flag, 00 to ff. 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

Q =   Qualified GPS: YES=Y, NO=N.

The received quality of the GPS signal is continuously monitored. The criteria used in qualifying the GPS signal is listed below:

Dilution of Precision, $0 \leq DOP < 10$
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 (4) or more satellites meet the above criteria for one (1) minute.

4.4.7   *LOCATION*

This command is to read or set the ***Location***. The GPS receiver will automatically find its correct position, but the time to first fix can be shortened by entering an approximate position.

wlocLDDMMSSMMMLDDDMMSSMMM
wlocLDDMMSSMMMLDDDMMSSMMM Where L= latitude direction N or S, DD= degrees 00 to 90, MM= minutes, SS= seconds, MMM= milliseconds, L= longitude direction E or W, DDD= degrees 000 to 180, MM= minutes, SS= seconds, MMM= milliseconds.

rloc
rlocLDDMMSSMMMLDDDMMSSMMMHHHHHP
First 21 characters same as wloc, plus HHHHHP where HHHHH= height in meters, and P= Y or N for position Hold yes or no.

4.4.8   SIGNAL SELECTION

This command reads the MUX timing outputs available on the rear panel.

Rrsn
rrsn #   where # =   1 for 1.544-MHz outputs.
                        2 for 2.048-MHz outputs.
                        3 for a 1.544-MHz and a 2.048-MHz output.
                  0 for all other configurations.

4.4.9   SHORT STATUS

This command gives a **Short Status** string. The controller can read this status information for alarm conditions. This command would generally be issued after the controller has polled the 8195A using the Alarm Status command.

rsts
rstsSDDDHHMMSSDDDHHMMSSDDDHHMMSSSDD.D32TFFFCsssAO1Bss where S = number of satellites, DDD= days remaining T1, HHMMSS= time remaining T1, DDD= days remaining T3, HHMMSS= time remaining T3, DDD= days remaining T2, HHMMSS= time remaining T2, SDD.D= internal temperature, 3=y or n for T3 timed out, 2(y/n)= T2 timed out, T(y/n)= test mode, F(y/n)= free run, F(y/n)= Frequency alarm (oscillator failure), C(y/n)= cpu alarm, sss = three spares, A(y/n)= oscillator adjust, O(y/n)= output fault, 1(y/n)=T1 time out, B(y/n)= replace battery, ss = two spares.

4.4.10   TIME AND DATE

This command is to read the ***Date and Time***. The leading character of the RS-485 protocol message is the "on-time" point.

rtad
rtadHHMMSSsHHMMDDMMYYYY where HH = hours 00 to 23, MM = minutes, SS = seconds, s = sign of Time Zone offset, HHMM = hours and minutes of Time Zone offset, DD = days, MM = months, and YYYY = year.

4.4.11   TIME ZONE OFFSET

This command allows the user to set the 8195A's clock to local time. All time stamps will reflect the time zone offset. The default setting is 0000, which is UTC time.

wtzoSHHMM
wtzoSHHMM where S= + or -, and HH = 00 to 23, and MM=00 to 59

NOTE: The GPS time system does not correct for Daylight Savings Time. If the user wishes to have the time reflect DST they will need to change the time zone offset twice per year. Table 4-7 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	-0400	-0300
Eastern	-0500	-0400
Central	-0600	-0500
Mountain	-0700	-0600
Pacific	-0800	-0700

TABLE 4-7   COMMON OFFSET VALUES

4.4.12   WHO

This command is to inform the controller of the vendor and software version.
rwho
rwhoSPECTRACOMMODEL8195AVX.XX Where X.XX is software version.

4.4.13   10MHZ OFFSET

This command allows the user to read or set the ***10MHz Offset***. The default is no offset selected. Table 4-8 lists the 10 MHz offset selections available when using the RS-485 COMM port.   Additional offset values are available through the RS-232 COMM port command ***1PO***. Refer to section 4.2.23 for additional information.

w1foSX where S = + or - and X = 1 to 4
w1foSX
r1fo
r1foSX

Offset	**Offset Δf_s**	**Output Frequency**	**Offset @**

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

TABLE 4-8 VHF HI SIMULCAST OFFSETS

4.4.14   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 and Data Sync output signals that are leading edge synchronized to the GPS
1PPS will follow the offset value. The Data Clock 1PPS and 9.6 kHz outputs are leading
edge synchronized. The Data Sync leading edge synchronized outputs are $17\,{}^{2}/_{3}$ Hz and
$33\,{}^{1}/_{3}$ Hz or CTCSS outputs #1 and #2 if Option 14 is present.

The 10MHz outputs are not affected by this offset. The default offset value is 0.

w1poXXXXXX.X where XXXXXX.X is a number in microseconds.
w1poXXXXXX.X
r1po
r1poXXXXXX.X

MODEL 8195A

SECTION 5

OPTIONS AND ACCESSORIES

OPTIONS AND ACCESSORIES

5.0   INTRODUCTION

This section describes the following options and accessories that are available for the Model 8195A.

- Internal Battery Backup - Option 02

- Internal Distribution Amplifier - Option 03

- Distribution Accessories: Model 8140T Line Taps, Model 8140TA Line Extender Amplifier, Model 8140VT VersaTap™ Frequency Synthesizer, Model 8140MT MultiTap

- 12.8-MHz Outputs - Option 06

- 5-MHz Outputs - Option 07

- 1-MHz Outputs - Option 08

- Slides for Rack Mount - Option 11

- CTCSS Outputs - Option 14

- 10 Hz Channel Offset - Option 31

Power options are described in Section 3.2 of this manual. The input power options are:

        Option 52   ±12 VDC input.

        Option 53   ±24 VDC input.

        Option 53R   +24 VDC input.

        Option 54   ±48 VDC input.

5.1   OPTION 02 INTERNAL BATTERY BACKUP

Option 02 equips the Model 8195A with an internal battery backup power source.   The battery powers the 10 MHz OCXO and GPS receiver module whenever AC power fails or is turned off. The primary benefit the battery option provides is that the Data Clock and Data Sync timing outputs are available for simulcast usage within 20 seconds of power on. This is possible because the GPS receiver continues to track satellites and maintaining power to the OCXO eliminates warm up and retrace issues when AC power is restored.   The battery pack typically provides 18 hours of backup operation.

> *NOTE: The battery backup powers only the 10 MHz OCXO and GPS receiver board during AC power failures. Outputs are not provided under backup operation.*
>
> *NOTE: A Frequency Alarm is asserted when AC power is restored. Battery backup shortens the recovery period to two (2) hours when AC power returns by eliminating oscillator warm up and GPS reacquisition. Without backup power, a 3-4 hour recovery period is required.*

The battery is continuously float-charged whenever AC power is present. Maximum recharge period is 20 hours. The battery is tested daily to verify battery operation. At midnight "receiver time" the microprocessor enables the battery pack to power the oscillator and GPS receiver for approximately four minutes. The battery test is transparent to unit operation. If the battery falls below the minimum voltage set point, the test is discontinued and the Replace Battery alarm is asserted. Refer to Section 6, Service Information, for battery replacement instructions.

A battery disconnect switch is provided on the rear panel to prevent battery discharge when shipping or storing the Model 8195A. To disconnect the battery, first remove the unit from AC power and then depress the recessed switch labeled BATT DISC.

> *NOTE: Failing to disable a battery prior to shipment or storage may result in reduced capacity and shortened battery life.*

5.1.1   Battery Lamps

Units equipped with Option 02 include front panel indicators to communicate battery status.

Ready Lamp: This green lamp is on when the battery is OK and fully charged. This lamp is off while the battery is tested.

Charging Lamp: This yellow lamp is on when the battery is charging. This lamp is off while the battery is tested.

Replace Lamp: This red lamp turns on and a Minor Alarm asserted when the battery has remained in charge mode for two days or has failed the daily test. The battery must be replaced, refer to the service section of this manual.

5.1.2   Option 02 Specifications

Battery: 12V, 7 A/H, sealed lead acid.

Backup Operation: 12 hours minimum.
                                   18 hours typical.

Recharge Rate: 20 hours maximum from complete discharge.

Charge Current: 500 milliamps maximum.
                                   10 milliamps float-charge.

Battery Life: 4 years typical.

5.2   OPTION 03 BUILT IN DISTRIBUTION AMPLIFIER

Option 03 allows counters and synthesizers throughout a facility to use the GPS disciplined
outputs from a Model 8195A 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.

5.2.1   System Components

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

5.2.1.1 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.

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).

5.2.1.2 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).

5.2.1.3 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.

5.2.1.4 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

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)

5.2.2   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 to1500 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 8195A in the geographical center of the installation, running distribution lines in both directions and achieving a coverage of 3000 linear feet (914 m).
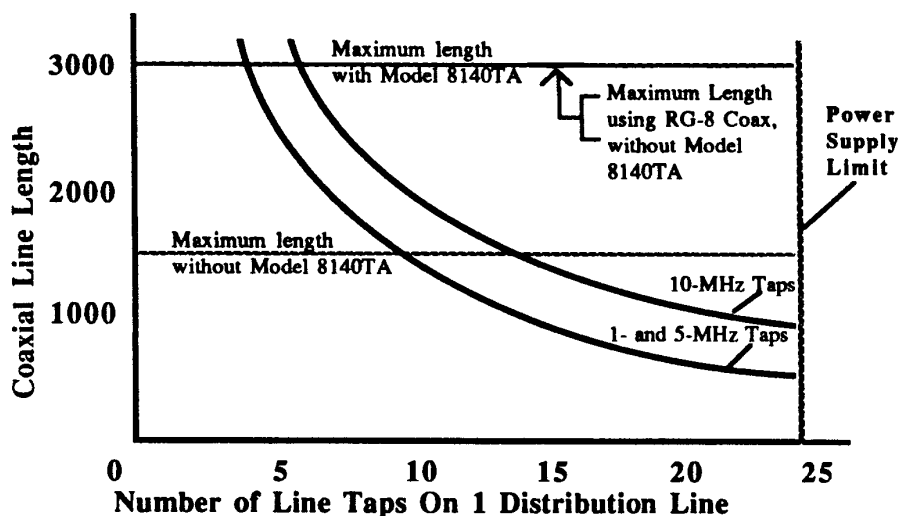
FIGURE 5-1 LINE TAP NUMBER AND DISTANCE CHART - OPTION 03

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.

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.
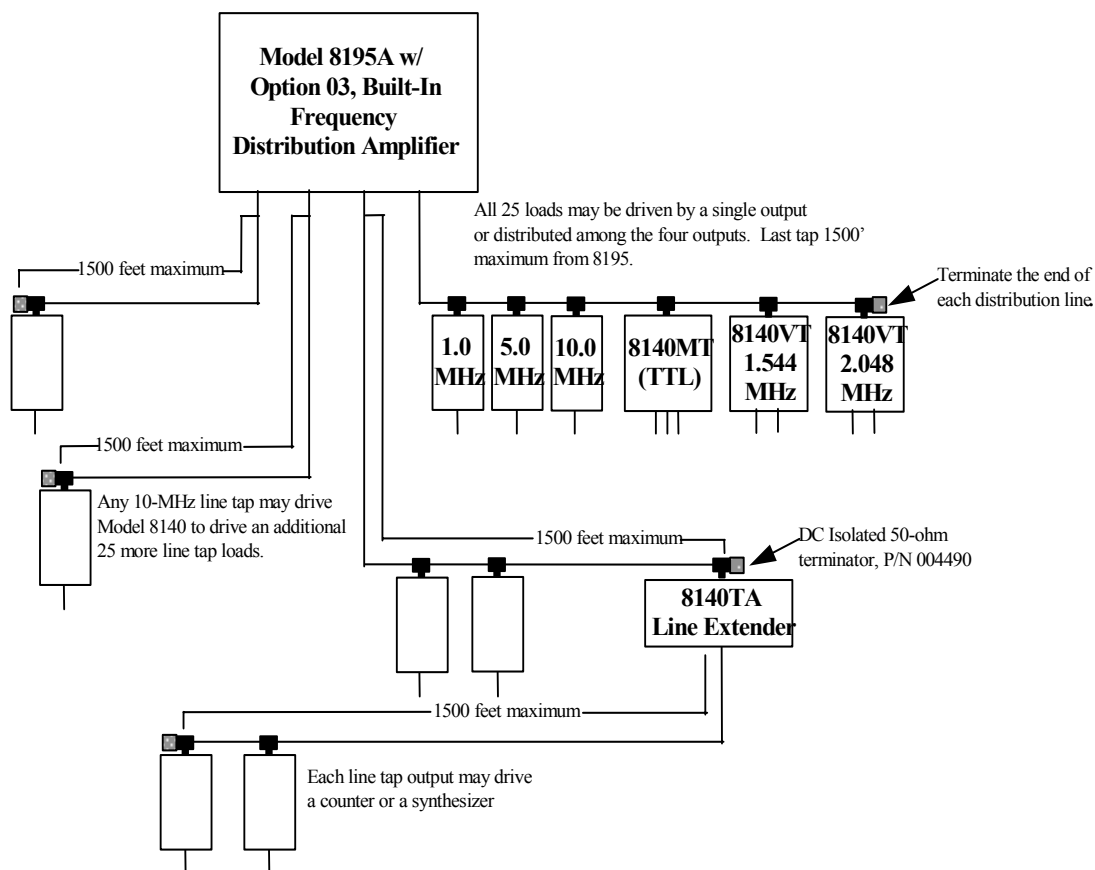
FIGURE 5-2 TYPICAL INTERCONNECTION DIAGRAM

5.3   OPTION 06 - 12.8-MHZ OUTPUTS

Option 06 changes the front and rear panel from 10.0 MHz outputs to 12.8 MHz. These outputs provide a 700 mV rms sine wave into 50 ohms. Harmonic suppression is better than -30 dBc. The 12.8 MHz is synthesized from the GPS disciplined 10-MHz oscillator using a phase lock loop.

> *NOTE: This option reconfigures the phase lock loop used to synthesize the 2048-kHz output. This changes the output frequency found on the 2048-kHz connector to 1.6 MHz.*
>
> *This change also affects the 64-kHz output found on the DB15 Data Sync connector. This output is changed from 64 kHz to 50 kHz.*

5.4   OPTION 07 - 5-MHZ OUTPUTS

Option 07 changes the front and rear panel from 10.0 MHz outputs to 5 MHz. These outputs provide a 700 mV rms sine wave into 50 ohms. Harmonic suppression is better than -30 dBc.

5.5   OPTION 08 - 1-MHZ OUTPUTS

Option 08 changes the front and rear panel from 10.0 MHz outputs to 1.0 MHz. These outputs provide a 700 mV rms sine wave into 50 ohms. Harmonic suppression is better than -30 dBc.

5.6   OPTION 11 - RACK MOUNT SLIDES

Option 11 allows the Model 8195A 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.

QUANTITY	*DESCRIPTION*
1	Right hand slide assembly
1	Left hand slide assembly
2	Filler plates (not used)
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 8195A 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 8195A to the rack using the front panel mounting holes.

STATIONARY
SECTION

NUT PLATES
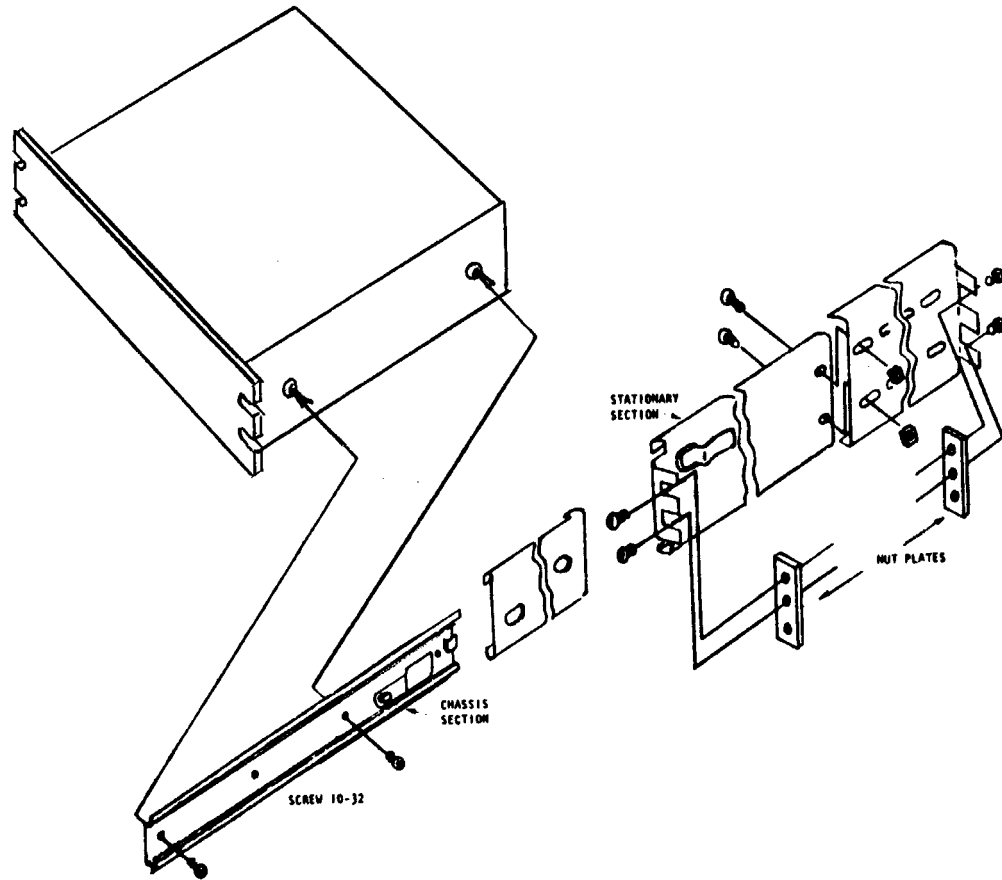
CHASSIS
SECTION

SCREW 10-32

FIGURE 5-3 SLIDES, OPTION 11

5.7   OPTION 14 - CTCSS OUTPUTS

Option 14 provides the Model 8195A with two selectable Continuous Tone Coded Squelch System (CTCSS) outputs. The available CTCSS frequencies range from 67.0 to 254 Hz. The rear panel Data Sync connector provides the CTCSS frequencies in RS-485 levels. These outputs are typically used with the Spectracom Model 93000 CTCSS Tone Generator. The Model 93000 converts the applied RS-485 signal to a sinewave and features adjustable signal level and PTT delay with output inhibit capability.

5.7.1   Data Sync Timing Outputs

Option 14 replaces the Data Sync 33-1/3 Hz and the 17-2/3 Hz outputs with CTCSS #1 and CTCSS #2 outputs. The Data Sync connector is a DB15 female numbered as shown in Figure 5-4. Option 14 Data Sync pin assignments are listed in Table 5-3.
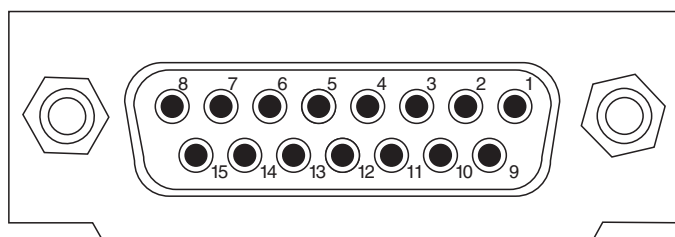
FIGURE 5-4   DATA SYNC CONNECTOR

PIN	SIGNAL	DESCRIPTION
1	+ 64 kHz*	RS-485 B Terminal
2	-64 kHz*	RS-485 A Terminal
3	+18 kHz	RS-485 B Terminal
4	-18 kHz	RS-485 A Terminal
5	+ CTCSS #2	RS-485 B Terminal
6	- CTCSS #2	RS-485 A Terminal
7	+ CTCSS #1	RS-485 B Terminal
8	- CTCSS #1	RS-485 A Terminal
9	Ground	Cable Shield
10	Major - C	Common Contact
11	Major - NO	Normally Open
12	Major - NC	Normally Closed
13, 14, 15	Ground	Cable Shield

TABLE 5-3   OPTION 14 DATA SYNC PIN ASSIGNMENTS

The 64-kHz and 18-kHz Data Sync outputs are derived from the 10-MHz GPS disciplined oscillator. *The 64-kHz signal is changed to 50-kHz on units equipped with Option 06, 12.8 MHz outputs.

The CTCSS #1 and CTCSS #2 outputs are derived from the 10-MHz GPS disciplined oscillator and are triggered by the GPS 1PPS output. Using the 1PPS offset command, 1PO, these outputs can be offset from 0 to 1 second in 0.1 microsecond steps. Refer to Section 4 for additional information on the 1PO command. The leading edges of the CTCSS #1and CTCSS #2 outputs are synchronized within ± 2.0 microseconds (± 0.25°) of the Data Clock 1PPS output.

CTCSS #1 and CTCSS #2 can be configured to provide any frequency listed in Table 5-4. The default CTCSS frequency is 67.00 Hz. Refer to section 5.7.6 for information on configuring the CTCSS outputs.

CTCSS FREQUENCIES (Hz)					
67.00	69.33	72.00	74.33	77.00	79.66
82.66	85.33	88.66	91.66	94.66	97.33
100.00	103.66	107.33	111.00	114.66	118.66
123.00	127.33	131.66	136.66	141.33	146.33
151.33	156.66	162.33	168.00	173.66	180.00
186.33	192.66	203.66	206.66	210.66	218.00
225.66	229.00	233.66	241.66	250.33	254.00

TABLE 5-4   CTCSS #1 AND CTCSS #2 FREQUENCY LIST

5.7.2   *Data Sync Alarm Contacts*

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

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

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

5.7.3   RS-485 Timing Signals

The Data Sync timing signals are output in RS-485 levels. 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 Pico farads per foot. Refer to Figure 5-5 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.
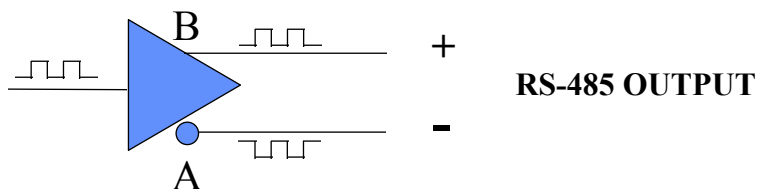
FIGURE 5-5   DATA SYNC DRIVERS

5.7.4   CTCSS Configuration

The CTCSS outputs are configured using the front panel RS-232 COM port. The **C**TCSS **T**one **C**ontrol command, CTC, is used to read or set the configuration or provide a listing of all CTCSS frequencies available.

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 8195A are shown in *Italics*. 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.

To retrieve the current CTCSS output configuration, issue the ***CTC*** command as shown below:

Type: ***CTC <ent>***

Default Response: *CTCSS GENERATOR SETTINGS*

1= XZ (67.00Hz) 2= XZ (67.00Hz) 3= NOT PRESENT 4= NOT PRESENT

To configure the CTCSS outputs, the unit must first be placed in *Set Mode*. Issue the **CTC** command followed by the CTCSS generator number and corresponding time code. The **CTC** command structure is shown below:

Type: **CTC # *xx* <ent>**

where: # = CTCSS generator number, 1or 2.

xx = Two digit code corresponding to a CTCSS tone frequency. Refer to Table 5-5 for code listings.

XZ (67.00Hz)	WZ (69.33Hz)	XA (72.00Hz)
WA (74.33Hz)	XB (77.00Hz)	WB (79.66Hz)
YZ (82.66Hz)	YA (85.33Hz)	YB (88.66Hz)
ZZ (91.66Hz)	ZA (94.66Hz)	ZB (97.33Hz)
1Z (100.00Hz)	1A (103.66Hz)	1B (107.33Hz)
2Z (111.00Hz)	2A (114.66Hz)	2B (118.66Hz)
3Z (123.00Hz)	3A (127.33Hz)	3B (131.66Hz)
4Z (136.66Hz)	4A (141.33Hz)	4B (146.33Hz)
5Z (151.33Hz)	5A (156.66Hz)	5B (162.33Hz)
6Z (168.00Hz)	6A (173.66Hz)	6B (180.00Hz)
7Z (186.33Hz)	7A (192.66Hz)	M1 (203.66Hz)
8Z (206.66Hz)	M2 (210.66Hz)	M3 (218.00Hz)
M4 (225.66Hz)	9Z (229.00Hz)	M5 (233.66Hz)
M6 (241.66Hz)	M7 (250.33Hz)	0Z (254.00Hz)

TABLE 5-5 CTCSS TONE LIST

Example: Configure CTCSS #1 to provide a 74.33 Hz tone.

Type: **SM ON <ent>**

Response: *SET MODE = ON*

Type: **CTC 1 WA <ent>**

Response: *Configure CTCSS #1*

CTCSS GENERATOR SETTINGS
1= WA (74.33Hz) 2= XZ (67.00Hz) 3= NOT PRESENT 4= NOT PRESENT

Configure the remaining CTCSS generator as required.

To view the entire CTCSS code table, issue the **CTC** command as shown below:

Type: **CTC TABLE <ent>**

Response: *CTCSS TABLE:*

XZ (67.00Hz)   WZ (69.33Hz)   XA (72.00Hz)

WA (74.33Hz)   XB (77.00Hz)   WB (79.66Hz)

YZ (82.66Hz)   YA (85.33Hz)   YB (88.66Hz)

ZZ (91.66Hz)   ZA (94.66Hz)   ZB (97.33Hz)

1Z (100.00Hz)   1A (103.66Hz)   1B (107.33Hz)

2Z (111.00Hz)   2A (114.66Hz)   2B (118.66Hz)

3Z (123.00Hz)   3A (127.33Hz)   3B (131.66Hz)

4Z (136.66Hz)   4A (141.33Hz)   4B (146.33Hz)

5Z (151.33Hz)   5A (156.66Hz)   5B (162.33Hz)

6Z (168.00Hz)   6A (173.66Hz)   6B (180.00Hz)

7Z (186.33Hz)   7A (192.66Hz)   M1 (203.66Hz)

8Z (206.66Hz)   M2 (210.66Hz)   M3 (218.00Hz)

M4 (225.66Hz)   9Z (229.00Hz)   M5 (233.66Hz)

M6 (241.66Hz)   M7 (250.33Hz)   0Z (254.00Hz)

5.8   OPTION 31   10-HZ CHANNEL OFFSET

To avoid interference between TV stations operating on the same frequency, geographical separation and radiated powers are carefully selected. Nevertheless, considerable co-channel interference has been encountered.

Co-channel interference between TV stations appears to viewers as a horizontal pattern of alternating light and dark bars much like the shadows cast by venetian blinds. The visibility of these bars varies cyclically as a function of the difference frequency of the interfering carriers.[2]

Co-channel interference can be minimized if the transmitter frequencies are tightly controlled. To minimize the interference, the visual carrier of an interfering station is offset by either plus or minus 10,010 Hz. The 10-kHz offset and the direction (i.e. plus or minus) is assigned by the FCC. This offset is normally provided in the transmitter. The Model 8195A GPS Ageless Oscillator with Option 31 provides a precise 10-MHz standard with offset control that, when translated to the visual carrier frequency, results in an additional 10 Hz offset.

The television offsets are selected using the RS-232 COMM port and the *1FO* command. Television Offsets are available in both positive and negative offsets for channels 2 through 13. Table 5-6 lists the available offset channel number and the corresponding 10 MHz offset. The *1FO* command is used to read or set offset value. To read the 10 MHz offset value issue the *1FO* command as shown below:

> Type: *1FO <ent>*
> Default Response: *10MHZ OFFSET = NONE*

To select a 10 MHz television offset, place the unit in Set mode and issue the *1FO* command as follows:

> Type: *1FO TV so<ent>*
> Where: *s* = Sign, positive or negative: + or -.
> *o* = Channel #: 2...13.

To remove a TV offset and return the unit to no offset 10 MHz operation, place the unit in Set mode and issue the *1FO* command as follows:

> Type: *1FO 0<ent>*

---

[2] "Precise Frequency Control, Theory and Practice" by J. L. Klecker and A. H. Bott, Engineering Report, Harris Corporation, Broadcast Division, 123 Hampshire St., Quincy, IL 62301.

Example:
Configure the Model 8195A for a TV channel offset of +8.

To allow configuration changes place the unit in Set Mode and issue the ***1FO*** command as shown below:

Type:	***SM ON <ent>***
Response:	*SET MODE ON*
Type:	***1FO TV +8 <ent>***
Response:	The unit shall respond with a message stating that the Phase Lock Process has been halted and a frequency offset has been specified.

Allow the unit two hours to obtain Oscillator Lock before placing the unit in service.

OFFSET NAME	OUTPUT FREQUENCY
TV + 2	10,000,001.810
TV + 3	10,000,001.632
TV + 4	10,000,001.487
TV + 5	10,000,001.294
TV + 6	10,000,001.201
TV + 7	10,000.000.571
TV + 8	10,000.000.552
TV + 9	10,000.000.534
TV + 10	10,000.000.517
TV + 11	10,000.000.502
TV + 12	10,000.000.487
TV + 13	10,000.000.473
TV - 2	9,999,998.190
TV - 3	9,999,998.367
TV - 4	9,999,998.513
TV - 5	9,999,998.706
TV - 6	9,999,998.799
TV - 7	9,999,999.429
TV - 8	9,999,999.448
TV - 9	9,999,999.466
TV - 10	9,999,999.483
TV - 11	9,999,999.498
TV - 12	9,999,999.513
TV - 13	9,999,999.527

TABLE 5-6   TV OFFSETS

MODEL 8195A

SECTION 6

SERVICE INFORMATION

SERVICE INFORMATION

6.0   INTRODUCTION

This section provides information on battery replacement, oscillator adjustment and clearing the front panel RS-232 Serial Com port lock up. Refer to Section 2.8 for troubleshooting GPS reception problems. Please direct all service calls to Spectracom customer service at: **585-321-5800**.

6.1   BATTERY REPLACEMENT

Option 02 provides the Model 8195A with an internal battery backup power source. Battery life expectancy is typically four years. The battery is tested daily to verify it is available for backup operation. If the battery fails the daily test, or if it remained in continuous charge mode for 2 days, a Replace Battery alarm is asserted. This condition latches the front panel Replace Battery lamp on and asserts a Minor Alarm. The unit will remain in alarm condition until the battery either again passes the daily test or is replaced.

Replacement batteries can be ordered from Spectracom. Specify Part Number B00004. Batteries can also be obtained locally. Select a 12 Volt, 7.0 Amp/Hour sealed lead acid battery. Power Sonic part number PS-1270, Panasonic LC-R127R2P and Power Patrol SLA1075 are acceptable replacements. Batteries may also be purchased from DigiKey, a large mail order electronics distributor. Call 1-800 DIGIKEY, specify their part number P078-ND.

A Phillips screwdriver and a PC with terminal emulation software, i.e. HyperTerminal, ProComm Plus, and a straight through (one to one) pinned DB9 RS-232 cable is required.

Set the terminal emulation program for 9600 baud, 8 data, 1 stop, no parity and XON/XOFF flow control.

6.1.1   Battery Replacement Instructions

1. Connect a computer running HyperTerminal or ProComm to the front panel RS-232 Com connector. Issue the configuration command *CONF* to view the current configuration. Record the values of the following parameters:

    Time Zone = _____
    1PPS Offset = _____Microseconds
    Antenna Cable Delay = _____Microseconds

2. Turn off the rear Panel AC power switch.

3. Remove the top cover. Rack mounted units, unless equipped with Option 11, Rack Mount Slides, must be removed. The cover is secured by 12 screws.

4. Disconnect the two-position battery cable from the front panel circuit board. Note the orientation of the connector before removing it.

5. Remove four screws securing the cover of the battery holder assembly and then remove the battery. Please note that it is a tight fit, carefully work the battery out.

6. Remove the battery cable from the old battery and connect to the new battery. Make certain the red wire is connected to the positive battery terminal.

7. Install the replacement battery into the holder and reinstall the holder cover.

8. Reconnect the two-position plug to the front panel circuit board. Verify the plug is properly mated to the header to maintain the correct polarity.

9. Reinstall the top cover.

10. Reapply power to the unit.

> *NOTE: The Replace Battery lamp will remain on after replacing the battery. The lamp can be reset using the RS-232 command CA BAT, or will self-clear upon successfully completing the first battery test (typically 48 hours).*

12. Connect the PC to the front panel RS-232 Com port and issue the command *CA BAT* to reset the latched Replace Battery alarm lamp.

    The Reset Battery Alarm command is a Set Mode command. Place the unit in Set Mode by sending the following command:

    Type: *SM ON <ent>*

    The unit will respond with an acknowledgement that Set Mode is enabled. Issue Battery Reset command as follows:

    Type: *CA BAT <ent>*

    The Battery Status lamps shall now indicate that the battery is Charging or is Ready.

13. Verify the Time Zone offset, 1PPS Offset and Antenna Cable parameters values are correct. Issue the configuration command *CONF* and verify these values are what was recorded in step 1 of this procedure. Reset the parameters as required using the *TZO*, *1PO* and *ACD* commands. Refer to Section 4 Software Commands for a complete description of these commands.

This completes the battery replacement procedure. The unit will require a two to three hour period to obtain oscillator lock to the GPS reference.

6.2 OSCILLATOR ADJUSTMENT

Over time the Model 8195A ovenized oscillator may require an adjustment to compensate for crystal aging. The Model 8195A 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 ovenized oscillator.

> *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 8195A 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

    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 8195A will require a two to three hour period to phase lock to the GPS reference.

6.3   RS-232 COM PORT PROBLEMS

On rare occasions the front panel RS-232 Com port may experience a lockup condition. When this occurs the port will no longer accept commands or output data. This condition happens when the serial port simultaneously tries to output data and receive commands.

The lockup problem can be cleared by sending the & (shift 7) character. A block of data is output as the buffer is emptied. The RS-232 Com port is now unlocked and ready for use.

Note: Clear the RS-232 buffer by sending the & character (shift 7).

To reduce the possibility of port contention the use of XON/XOFF flow control is recommended. Please select this method of flow control when configuring the terminal emulation program (HyperTerminal, ProComm, etc.) used to communicate with the RS-232 port.

Another method is to disable the automatic status and log entries from the Model 8195A. The Event Output command, ***EO*** is used to enable or disable automatic status and log entries.

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

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

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

Type: ***SM ON***
Response: *SET MODE ON*

Type: ***EO OFF<ent>***
Response: *EVENT OUTPUT DISABLED*

MODEL 8195A

APPENDIX A

OPERATION WITH LOW GPS QUALITY

OPERATION WITH LOW GPS QUALITY

A.0   INTRODUCTION

The Spectracom Model 8195A 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 radiobroadcasts, 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	2nd
23	3rd
10	8th
7	9th
6	18th & 19th
5	20th

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	15th
98.3 - 98.7	16th
92.5 - 92.9	17th
87.3 - 87.7	18th

TABLE A-2   FM RADIO FREQUENCIES WITH GPS JAMMING POTENTIAL

A.1   GPS QUALIFYING ALGORITHM SELECTION

The Model 8195A 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 $\pm1 \times 10^{-11}$ 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 aTest 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.