

TROUBLESHOOTING GPS RECEPTION ISSUES WITH THE SPECTRACOM MODELS 8183, 8184, AND 8189

There are a few factors that can inhibit GPS reception in certain pieces of Spectracom equipment. This GPS reception Application Note is intended to aid in the troubleshooting of GPS reception-related issues concerning the Spectracom series 8183, 8184, and 8189.

- **Section 1** of this document describes how to tell if a GPS reception issue exists. Section 1A covers how to send equipment logs to Tech Support for us to review them for you.
- **Section 2** of this document is used when no GPS reception is present (Tracking 0 satellites).
- **Section 3** of this document is for low GPS Quality/reduced GPS reception.
- **Section 4** of this document is for when the Model 8228 indoor window-mount GS antenna is used in place of the Model 8225 outdoor GPS antenna.
- **Section 5** of this document contains Technical Support contact information and how to obtain an RMA Number for equipment return authorization.

REQUIRED TEST EQUIPMENT

- Analog or Digital Multimeter with test leads.
- PC with either Microsoft HyperTerminal or Procomm installed (PC needs to have either a DB9M serial port or will require the use of a USB to serial adapter with the applicable driver files installed on the PC).
- Straight-thru DB9M to DB9F serial cable (minimum pinout is pin 2 to 2, pin 3 to 3 and pin 5 to 5). Null-modem cables and some data cables supplied with bench-top UPS power supplies will not work for communication with the Spectracom equipment.

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SECTION 1: IDENTIFYING A GPS RECEPTION ISSUE

The Spectracom Models 8183, 8184, and 8189 have built-in indications of a GPS reception issue with the equipment. These include front panel indications and built-in logs that can be obtained using the rear panel Serial Setup Interface port.

The front panel GPS Lock (applicable to the Model 8183 only) and Time Sync lamps should be illuminated uninterrupted green within 20 minutes of equipment power-up (provided the GPS antenna is connected and installed outdoors with a good view of the horizon) and should remain illuminated thereafter. If the LEDs fail to turn from uninterrupted red to uninterrupted green roughly 20 minutes after initial power-up with the GPS antenna connected, or if either or both lights turn uninterrupted red (or the Time Sync lamp is flashing green) anytime thereafter, a GPS reception issue exists with the equipment. Entries in the alarm log and the quality of the data in the Display Histogram logs will also indicate whether a GPS reception issue exists.

The first step in troubleshooting a reception issue is to determine if the GPS reception is reduced or is non-existent. If the front panel GPS Lock and Time Sync lamps are still uninterrupted red about 20 minutes or so after initial installation (the unit has not been power-cycled within the last 20 minutes), there has been a reception issue for greater than 2 hours. If the Time Sync lamp is flashing green, the reception issue has been present for less than two hours.

If a GPS reception issue is present, connect to the unit's rear panel RS-232 Serial Setup Interface port/setup port (DB9F serial connector) using a straight-thru standard serial cable (not a null-modem serial cable). Connect the other end of the serial cable to a serial comm port of a PC running HyperTerminal (or connect to a USB to RS-232 converter if the PC does not have a DB9 serial port).

The comm port properties for the HyperTerminal session are **9600 baud, No parity, 8 bit, 1 stop bit** (flow control setting does not matter). For additional assistance with HyperTerminal, refer to the Application Note at: http://www.spectracomcorp.com/portals/0/support/pdf/using_hyperterminal.pdf.

NOTE: When changing the default baud rate of 2400 to 9600 baud, be aware that this change does NOT take effect until the call is disconnected and then reconnected.

Once connected with HyperTerminal, perform the following commands to retrieve the logs:

STAT command — Retrieve the current status of the unit by typing STAT <enter>. The unit will respond with the current status of the unit, including current active alarms and the reason for these alarms.

If the response displays “GPS SIGNAL = NOT QUALIFIED”, a reception issue exists.

If the response contains “Antenna Problem”, a short or open in the antenna coax cable likely exists.

NOTE: Earlier versions of the Models 8183, 8184, and 8189 used a GPS receiver that did not have the antenna sense circuit. Refer to section 2 for more information on how to determine if the unit has the antenna sense circuit.

DSS Command — Type DSS <enter> to display the number of satellites currently being tracked. A sample DSS response is shown below:

```
DSS
TRACKING 08 SATELLITES
GPS STATE= POS-HOLD DOP= 00.0
LATITUDE= N 43 07 01.942 LONGITUDE= W 077 29 15.050 HEIGHT= +00095 METERS
QUALITY= PASSED
```

Indicates total number of satellites currently being tracked. In this example, 8 satellites are being tracked.

| CHAN | VID | MODE | STREN | STAT |
|------|-----|------|-------|------|
| 01 | 08 | 08 | 050 | 08A0 |
| 02 | 27 | 08 | 049 | 08A0 |
| 03 | 31 | 08 | 052 | 08A0 |
| 04 | 03 | 08 | 048 | 08A0 |
| 05 | 15 | 08 | 051 | 08A0 |
| 06 | 18 | 08 | 051 | 08A0 |
| 07 | 13 | 08 | 049 | 08A0 |
| 08 | 19 | 08 | 042 | 08A0 |

Indicates which receiver channels are tracking GPS satellites, the mode of satellite reception, and the strength of the satellites being tracked.

If the unit responds with “Tracking 00 satellites”, refer to Section 2 for troubleshooting loss of all GPS satellites. The minimum number of qualified satellites is 1 at all times.

DAL command — Type DAL <enter> to display the Alarm Log. For more history on the Alarm log, place the unit in Test Mode first by typing TM ON <enter> before typing DAL P <enter> (where the letter “P” pages the entries for ease in reviewing the log).

The Alarm Log entries will provide a history of the Minor and Major alarms the unit has experienced and the reasons for the alarms. Recent and past log entries can be used in identifying reception issues and can also be used to help troubleshoot these issues. Below are the possible Alarm Log entries that are related to reception issues.

Antenna Problem- (Minor alarm) — Indicates the presence of an open or short in the antenna cable between the GPS receiver and the antenna. This alarm may also be present if the receiver has been damaged by a power surge. Refer to Section 2 for troubleshooting.

NOTE: Earlier versions of the Models 8183, 8184, and 8189 used a receiver that did not have the antenna sense circuit in the receiver. To determine whether the GPS receiver has the sense circuit installed, type TM ON <enter> and then VER <enter>.

- A. If the unit responds with “8 channel VP receiver”, the receiver does not have the sense circuit and will not generate the Antenna Problem alarm if a short or open in the cable exists. A multimeter will be required to test for opens or shorts in the cable.
- B. If the unit responds with “8 channel GT receiver”, the receiver does have the antenna sense circuit and should generate the “Antenna Problem” alarm if a short or open in the cable exists. The alarm may also be present if the receiver has been damaged by a power surge, even if the antenna cable is OK.

NOTE: Lightning and surges can cause damage to the antenna sense circuit. When this condition occurs, it is possible for the antenna sense circuit to generate the Antenna Problem alarm even though the cable is fine (the GPS receiver may or may not be tracking satellites). A damaged circuit also might *not* generate the alarm even though an antenna cable issue exists.

Low GPS Quality (Minor alarm) — Indicates that during that particular hour, 3000 out of the 3600 seconds in the hour did not meet the minimum qualification for GPS reception (at least 4 satellites with greater than the minimum signal strength values). The “Q” value in The Tracking Histogram log will be 3000 or below for that particular hour. Refer to Sections 2 and 3 for troubleshooting.

CPU Alarm (Major alarm) — This alarm indicates the GPS receiver is not communicating with the main log IC board, or indicates a loss of the 1PPS output from the GPS receiver. During this alarm condition, GPS reception will likely not be present. This alarm can be caused by either a momentary bad power input to the unit (such as a switchover to a back-up generator) or a hardware issue with the GPS antenna, cable, or the internal GPS receiver.

To determine if the issue was caused by a bad power input or is a hardware failure, try power-cycling the unit. Disconnect power from the rear panel for a few moments and then reapply power to the Model 8183, 8184, or 8189. Within about 20 minutes, if the front panel GPS Lock (Model 8183 only) and Time Sync lamps turn from uninterrupted red to uninterrupted green, the issue is resolved. If the lights remain red, a hardware issue exists (an issue with the cable, antenna, preamplifier, or the NetClock). CPU alarms that don’t clear after a power cycle usually indicate the NetClock needs to be returned for repair. Refer to Section 2 for troubleshooting this condition.

SECTION 1A: SENDING LOGS TO SPECTRACOM FOR REVIEW

If desired, the built-in unit logs can be emailed to Spectracom Technical Support for review. The logs can be captured to a file and then the file sent as an attachment.

HyperTerminal data should be captured to a file and the file emailed to Spectracom. Do not take screen shots. Screen shots of HyperTerminal can scramble the data, making it difficult to analyze. To send the logs to us for review, in HyperTerminal, select “Transfer” on the top of the page and then select “Capture Text” from the drop-down. Choose a temporary file location to store the logs (this will be the file to email to us). Click Start. Type the following commands in HyperTerminal (followed by the <enter> key after each command) to capture the internal logs:

STAT DSS DOL TM ON VER DH DAL (click the enter key after each command)

Once the commands have been entered, in HyperTerminal, click on Transfer/Capture and then Stop to stop the data capture. Then email the saved file to us at techsupport@spectracomcorp.com, along with your contact information. We will be happy to evaluate the logs for you and let you know what we find.

SECTION 2: NO GPS RECEPTION (TRACKING 0 SATELLITES)

This section covers troubleshooting conditions in which the GPS receiver is dropping to 0 satellites for periods of time, or never tracking a single satellite.

Cable or connector problem: Using a multimeter, measure the antenna cable resistance to verify the integrity of the cable and connectors. Remove the antenna cable from the rear panel of the NetClock and measure the resistance from the coax center to shield. Refer to Table 1-1 for typical resistance values of the antenna and inline amplifier, alone and when combined.

| DEVICE | RESISTANCE |
|-------------------------|------------|
| 8225 GPS antenna | 177 ohms |
| 8228 indoor GPS antenna | 240 ohms |
| 8227 preamplifier | 165 ohms |
| 8225 and 8227 | 85 ohms |

Table 1-1 Typical Antenna Cable Resistance Values

No +5VDC output voltage: The GPS receiver outputs +5VDC to the rear panel antenna jack to power the antenna. Verify this voltage is present. With the antenna cable removed from the rear panel of the receiver, measure the DC voltage from the coax center to shield. There should be 5VDC ± 0.3VDC present.

When the Models 8183, 8184, or 8189 have a Motorola GT version receiver installed, the Antenna Problem alarm being present in the STAT command will indicate there is an open or short currently being detected in the connection to the antenna. If this alarm is present in the Alarm Log but not in the STAT command, this indicates a history of the antenna having a short or open in the cable (but the fault condition is not currently

being detected). Intermittent antenna problem alarms usually indicate a loose connection in the antenna cable run.

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 being able to track any satellites (cable loss is too high). Refer to the appropriate instruction manual for GPS antenna cable recommendations.

Antenna location: The antenna must be installed outdoors and have an unobstructed view of the sky. Refer to appropriate installation manual for antenna installation guidelines. Tracking 0 satellites may indicate that the antenna has an obstructed view of the sky.

CPU alarm: The presence of a CPU alarm that does not clear after a power cycle typically indicates an issue with the NetClock. If the unit is tracking satellites with a CPU alarm still present, this usually indicates the GPS receiver 1PPS is no longer present. If the CPU alarm is present and the unit is not able to track any satellites, this indicates the GPS receiver is not able to communicate with the main board. Units with CPU alarms that don't clear with a power cycle should be returned to Spectracom for repair.

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

Type: TM ON <ent>

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

Type: RGPS <ent>

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

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

Type: SM ON <ent>

Response: SET MODE = ON

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

Where:N = North Latitude

S = South Latitude

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

E = East Longitude

W = West Longitude

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

NOTE: An approximate location is adequate. Zeros may be used for the seconds values. Allow 20 minutes for the receiver to begin tracking satellites.

If the reception problem is still present, the NetClock and/or the GPS antenna will likely need to be returned for repair. Refer to Section 5 of this document.

SECTION 3: LOW GPS QUALITY

This section covers troubleshooting conditions in which the GPS receiver is not tracking 0 satellites consistently, but instead is only occasionally tracking the minimum of tracking at least 1 qualified satellite.

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 (Spectracom Model 8227). Refer to the appropriate instruction manual for GPS cable recommendations and 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 the appropriate instruction manual for antenna installation guidelines.

Local interference: Harmonics from a local broadcasts may interfere with the GPS L1 carrier (1575.42 MHz). Certain television and FM radio broadcasts, while operating within their frequency allocations, can cause GPS jamming because of the harmonics of the carrier.

Table A-1 lists the potential problem television stations and their respective GPS harmonics.

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

TABLE A-1: TELEVISION STATIONS WITH GPS JAMMING POTENTIAL

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

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

TABLE A-2: FM RADIO FREQUENCIES WITH GPS JAMMING POTENTIAL

If the intermittent reception problem is still present, the Model 8183, 8184, or 8189 and/or the Model 8225 outdoor GPS antenna will likely need to be returned for evaluation and repair. Refer to Section 5 of this document.

SECTION 4: USE OF A MODEL 8228 WINDOW-MOUNT ANTENNA WITH A NETCLOCK

Spectracom offers a window-mount antenna (Model 8228) that can be used for those applications in which the use of an outdoor GPS antenna is not desirable or feasible. The Models 8184 and 8189 typically shipped with an indoor antenna instead of an outdoor antenna. There are a couple of conditions that must be addressed when using the GPS antenna in a window.

Any tinting or metallic screening present on or in the glass is very likely to attenuate the GPS signal to unusable levels. Also, building overhangs and other nearby buildings may block the GPS satellites from view. The antenna must be installed in a window (because of the orbits of the GPS satellites, it makes very little difference on which side of the building the antenna is installed) that has a good view of the sky and no tinting or screening on the glass. If there is tinting or screening on the glass, the NetClock probably will not track any satellites at all.

The building itself blocks a large majority of the satellite orbital view. Window-mounted antennas will normally track less than four satellites because of this.

If the minimum of 1 satellite can't be maintained consistently, the NetClock will go into holdover mode and may even lose time sync. The amount of time that the unit can stay in holdover mode is two hours from the moment the unit stops tracking any satellites.

If it is physically impossible to install the antenna in a window that doesn't have tinting or screening on or in the glass, or if physical obstructions prevent the antenna from being able to "see" enough of the sky to track satellites, contact our Sales department at US +1.585.321.5800 to discuss replacing the window-mount antenna and cabling with an outdoor antenna, cabling, and surge suppressor.

If the intermittent reception problem is still present, the Model 8183, 8184, or 8189 and/or the Model 8228 GPS antenna will likely need to be returned for evaluation and repair. Refer to Section 5 of this document for information on obtaining an RMA Number and for additional Technical Support.

SECTION 5: TECHNICAL SUPPORT

If you have any questions about your Spectracom equipment, please contact Spectracom Technical Support for assistance. Technical Support is available Monday through Friday from 8:00 a.m. to 5:00 p.m. EST. Support is available by phone and through e-mail. Contact Keith Wing at US +1.585.321.5823, Dave Lorah at US +1.585.321.5824, or via e-mail at techsupport@spectracomcorp.com.

All Spectracom equipment returned for evaluation and repair requires an RMA Number to authorize the return. To receive an RMA Number, contact us via phone or email. We will need to know the Model and Serial Number(s) of the equipment being returned, the ship-to and bill-to addresses, and basic contact information (phone number/email address). With this information, we will assign an RMA number and provide the address so you may send the equipment to us for repair.

NOTE: The Models 8183, 8184 and 8189 are all discontinued equipment. For more information on newer versions of these products, which include many new features and capabilities not available on the Models 8183, 8184, and 8189, please contact our sales team at US +1.585.321.5800.