

A. Appendix A – Operation with Low GPS Quality

A.1 Introduction

The Spectracom Master Oscillator 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	2 nd
23	3 rd
10	8 th
7	9 th
6	18 th & 19 th
5	20 th

Table A-1 Television Stations with GPS Jamming Potential

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

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

Table A-2 FM Radio Frequencies with GPS Jamming Potential

A.2 GPS qualifying algorithm selection

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

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

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

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

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

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

A.3 GQA Command

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

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

Type: **TM ON <ent>**

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

Type: **GQA <ent>**
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.