Using the KAM/TCG/102

TEC/NOT/060

The KAM/TCG/102 is a combined GPS and IRIG input module. This technical note introduces the KAM/TCG/102 module and describes how to set it up, as well as troubleshoot GPS. This paper is divided into the following sections:

34.1 Overview of the KAM/TCG/102

The KAM/TCG/102 module comprises a GPS receiver, a GPS reader, and an IRIG reader which decode incoming signals. For more information, see the *KAM/TCG/102* data sheet.

34.1.1 Key features of the KAM/TCG/102

- Synchronizes with IRIG-B or GPS
- Interfaces to an onboard L1 GPS receiver or to an external National Marine Electronics Association (NMEA) stream
- Accepts and generates analog and digital IRIG-B
- Time is maintained from an external battery during power-down
- GPS navigation information available
- Secondary time source input

34.2 Setting up the KAM/TCG/102 using KSM-500

kSetup software can be used to configure the KAM/TCG/102. kSetup is included in the KSM-500 suite of tools. Features to be configured are described in "34.2.3 Setup tab setting" on page 5. If NMEA messages are required to be parsed, refer to "34.2.2 Setting NMEA Messages" on page 3.

34.2.1 Setting parameters

The Parameters tab (see Figure 34-1 on page 2) displays all parameters available from the module. To select parameters from the KAM/TCG/102, select the module in the Task Explorer pane of kSetup. From the Parameters tab, complete the fields described in Table 34-1 on page 2. For more information on using kSetup, contact Curtiss-Wright support (acra-support@curtisswright.com).

Figure 34-1: Parameters tab in kSetup

Table 34-1: Parameters tab settings

Field name	Description
Parameter Name	Name of the parameter.
Mode	Time or navigation data such as position, altitude, velocity and heading. For more information on the Mode column values, see the Parameter definition table in the *KAM/TCG/102* data sheet.
Packages	When you place the parameter in a PCM frame, you can double-click a Packages cell. A window displays the transmission details in the PCM frame, such as the transmission rate.
Comment	User-defined text relating to the parameter.

34.2.2 Setting NMEA Messages

When GPS is used, the NMEA Messages shown in Figure 34-2 on page 3 are available.

Figure 34-2: NMEA Messages tab in kSetup

Table 34-2: NMEA Messages tab settings when GPS is used

Field name	Description
Message Type	A read only field representing the NMEA messages.
Payload	Clicking an Edit button activates words from the NMEA messages (see Figure 34-3 on page 4).

For more information on NMEA message definition, see the *KAM/TCG/102* data sheet.

34.2.2.1 Defining Payload settings

To define payload settings, click an Edit button (see Figure 34-2 on page 3). When the Configure NMEA Message window displays (see Figure 34-3 on page 4), complete the fields described in Table 34-3 on page 4.
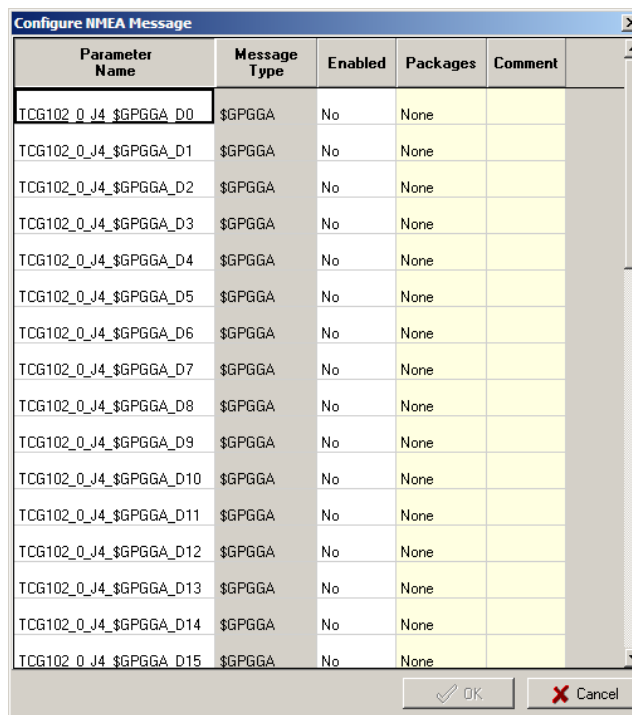

Figure 34-3: Payload settings

Table 34-3: Configure NMEA Messages settings when GPS is used

Field name	Description
Parameter Name	Name of the parameter.
Message Type	A read only field representing the NMEA messages.
Enabled	If set to Yes, the word from the message is available for transmission. If set to No, the word from the message is not available for transmission.
Packages	When you place the parameter in a PCM frame, you can double-click a Packages cell. A window displays the transmission details in the PCM frame, such as the transmission rate.
Comment	User-defined text relating to the parameter.

NOTE: The data words from the NMEA message read the full NMEA messages. The first data word for $GPGGA has the following result: $G.
You can select up to 41 data words from any NMEA message. An NMEA message may be less than 82 characters. As stated in the NMEA 0183 specification version 3.01, the maximum number of characters is 82, consisting of a maximum of 79 characters between start of message "$" or "!" and terminating delimiter <CR><LF> (HEX 0D and 0A).

34.2.3 Setup tab setting

Fields on the Setup tab (see Figure 34-4 on page 5) allow you to configure available settings for the KAM/TCG/102. For more information on Setup definition, see the *KAM/TCG/102* data sheet.

Figure 34-4: Setup tab in kSetup

34.3 Setting up the KAM/TCG/102 using DAS Studio 3

You can use DAS Studio 3 software to configure the KAM/TCG/102. Features that can be set up include configuring channels, setting messages, and adding data words to messages. More information on these settings can be found in the "Setting up packages" and "Setting up datalinks" sections of the *KAM/TCG/102* data sheet.

DAS Studio 3 is used to create a configuration file which contains the various elements which make up your data acquisition system. You then use this configuration file to manage and program these elements. To see how hardware is represented in the DAS Studio 3 graphical user interface, see Figure 1 in the *DAS Studio 3 User Manual*.

34.3.1 Settings tab settings

The Settings tab as shown in Figure 34-5 on page 6, shows available parameters for the module. The parameters shown in the Settings tab are defined in the *KAM/TCG/102* data sheet.

Figure 34-5: Settings tab showing available parameters

NOTE: To see module settings, the module must be in context in the Navigator. Refer to the *DAS Studio 3 User Manual* for more information.

The Settings tab as shown in Figure 34-6 on page 7, shows available settings for the module. These settings are defined in the *KAM/TCG/102* data sheet.

NOTE: At the time of writing this technical note, DAS Studio 3.3.3 was the current release. In that release, NMEA messages in ASCII form cannot be parsed.
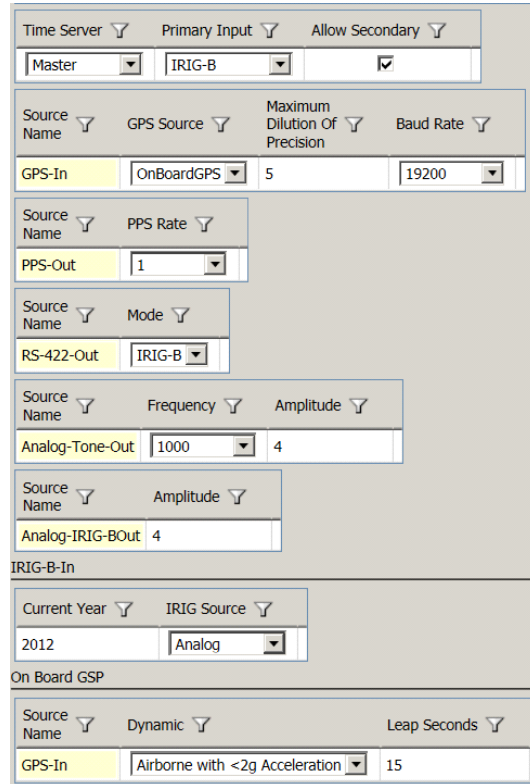
Figure 34-6: Settings tab showing available settings

34.4 Example configurations

34.4.1 External GPS receiving RS-422

The setup for an external GPS receiving RS-422 at 19,200bps is shown in Figure 34-7 on page 7, Figure 34-8 on page 8, and Figure 34-9 on page 8.

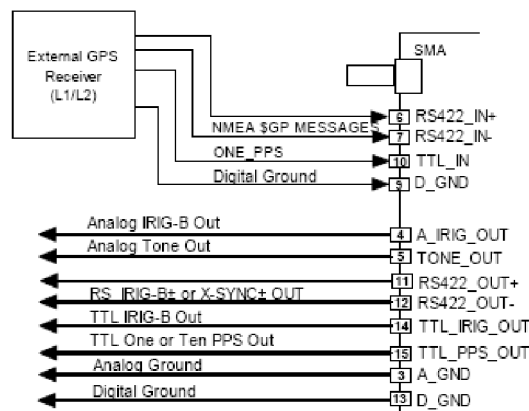**NOTE:** For all sample configurations below, it is assumed that the secondary input IRIG is not used.

Figure 34-7: Setup for external GPS receiving RS-422

Figure 34-8: Example of setup for external GPS receiving RS-422 in kSetup

Figure 34-9: Example of setup for external GPS receiving RS-422 in DAS Studio 3

34.4.2 Active GPS antenna

The setup for an active GPS antenna is shown in Figure 34-10 on page 9, Figure 34-11 on page 9, and Figure 34-12 on page 10.
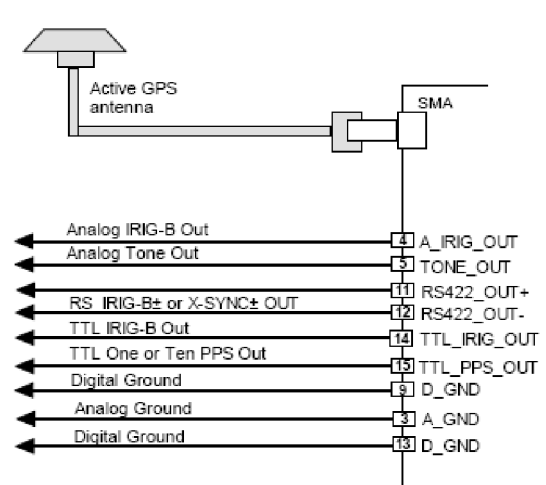

Figure 34-10: Setup for active GPS antenna

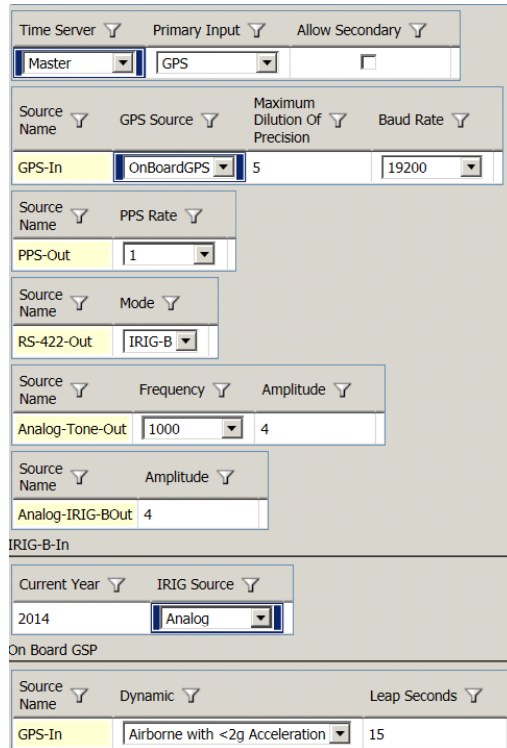*Figure 34-11: Example of setup for active GPS antenna in kSetup*

Figure 34-12: Example of setup for active GPS antenna in DAS Studio 3

34.4.3 External GPS receiver using RS-232 and TTL

The setup for an external GPS receiver using RS-232 at 19,200bps and TTL is shown in Figure 34-13 on page 10, Figure 34-14 on page 11, and Figure 34-15 on page 11.

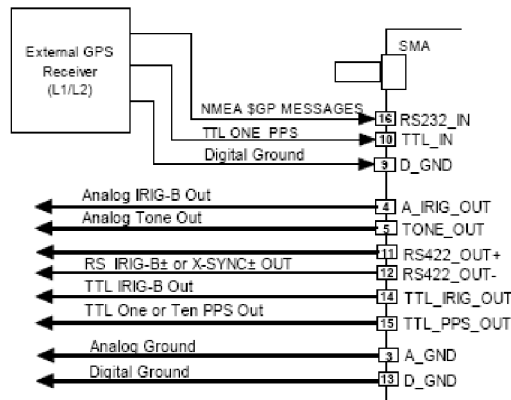*Figure 34-13: Setup for external GPS receiver using RS-232 and TTL*

Figure 34-14: Example of setup for external GPS receiver using RS-232 and TTL in kSetup

Figure 34-15: Example of setup for external GPS receiver using RS-232 and TTL in DAS Studio 3

34.4.4 Analog IRIG-B input

The setup for an analog IRIG-B input is shown in Figure 34-16 on page 12, Figure 34-17 on page 12, and Figure 34-18 on page 13.

Figure 34-16: Setup for analog IRIG-B input

Figure 34-17: Example of setup for analog IRIG-B input in kSetup
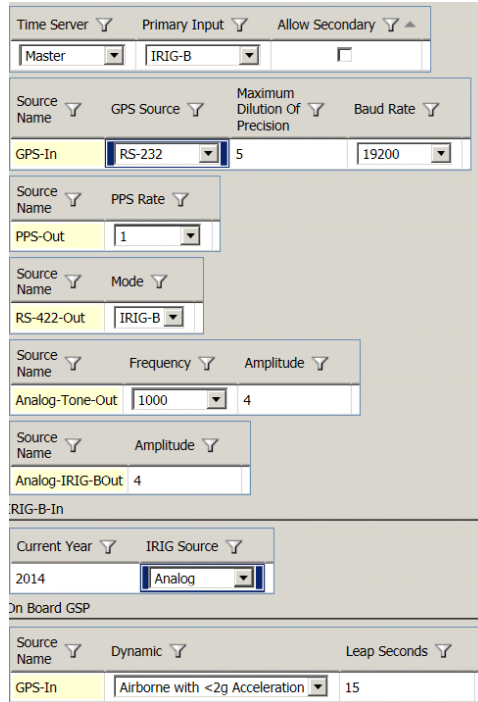
Figure 34-18: Example of setup for analog IRIG-B input in kSetup DAS Studio 3

34.4.5 Digital IRIG-B input

The setup for a digital IRIG-B input is shown in Figure 34-19 on page 13, Figure 34-20 on page 14, and Figure 34-21 on page 14.

Figure 34-19: Setup for digital IRIG-B input

Figure 34-20: Example of setup for digital IRIG-B input in kSetup

Figure 34-21: Example of setup for digital IRIG-B input in DAS Studio 3

34.4.6 RS-422 IRIG-B input

The setup for a RS-422 IRIG-B input is shown in Figure 34-22 on page 15, Figure 34-23 on page 15, and Figure 34-24 on page 16.
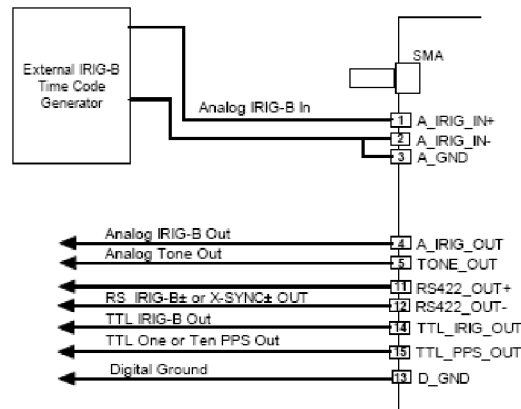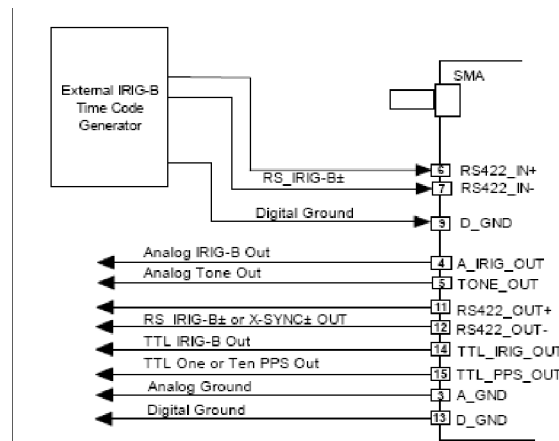

Figure 34-22: Setup for RS-422 IRIG-B input

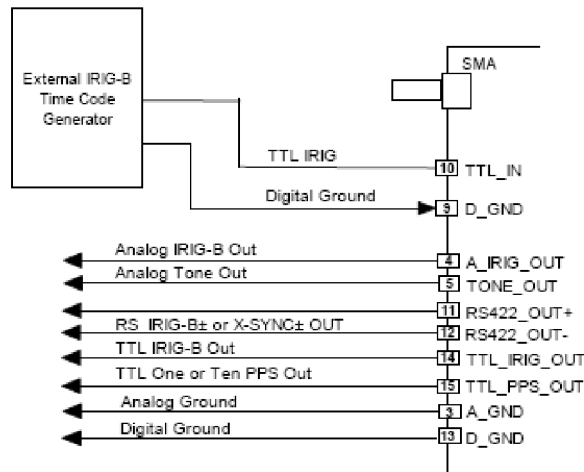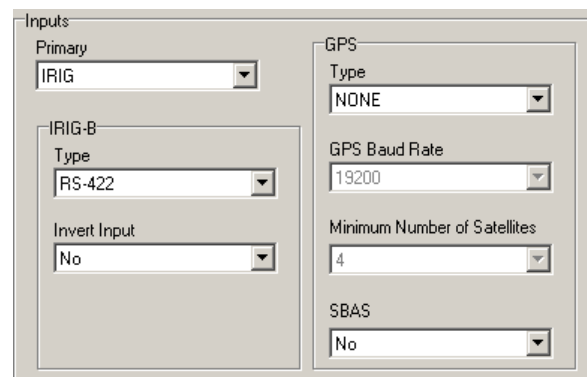*Figure 34-23: Example of setup for RS-422 IRIG-B input in kSetup*
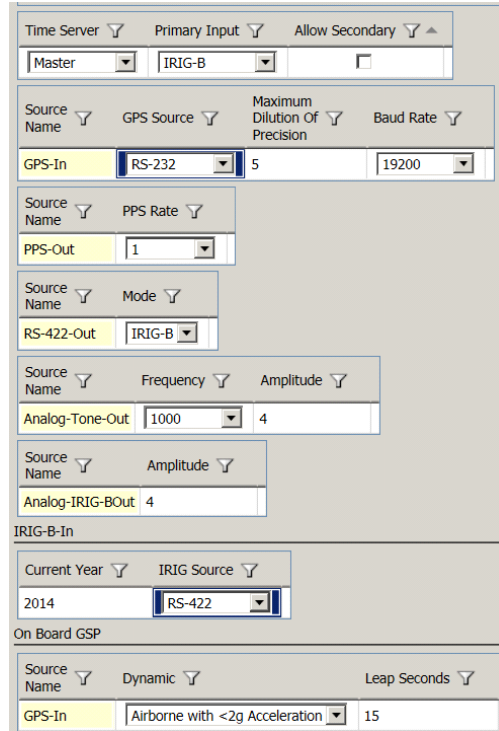
Figure 34-24: Example of setup for RS-422 IRIG-B input in kSetup DAS Studio 3

For GPS antenna recommendations, see the *KAM/TCG/102* data sheet.

34.5 Troubleshooting GPS

34.5.1 GPS not in lock

Check the StatusGPS parameter. This parameter provides information on the current GPS status, such as GPS lock, Dilution of Precision (DOP) in and out of range, and number of satellites in use.

NOTE: Bit 15 of the StatusGPS parameter defaults to 0, which indicates the module does not have GPS lock. Bit 15 is only set to 1 when the GPS receiver has achieved GPS lock.

If bit 15 remains at 0, the module is unable to achieve GPS lock and there are problems with satellite coverage. This may be due to poor satellite coverage or issues with the GPS antenna or cabling.

If bit 15 is set to 1 (GPS lock) but the position is incorrect, check bit 11. If bit 11 of the StatusGPS parameter is set to 1, this indicates that the DOP figures are out of range. The actual DOP figures can be read from the DilutionOfPrecision parameter.

Also, check the number of satellites in view (StatusGPS[7:4]) and the number of satellites in use (StatusGPS[3:0]). If the number of satellites in view is less than four, try the other troubleshooting hints in this section.

NOTE: The antenna must be connected before powering up the Acra KAM-500 chassis with the KAM/TCG/102.

34.5.2 Multipath errors

A multipath environment exists if GPS signals arrive at the antenna directly from the satellite and also from reflective surfaces, for example water or building walls (see Figure 34-25 on page 17).

Figure 34-25: Multipath environment

If there is a direct path in addition to the reflected path available, the receiver can usually detect the situation and compensate to some extent. If there is no direct line of sight, but only reflections, the receiver is not able to detect the situation.
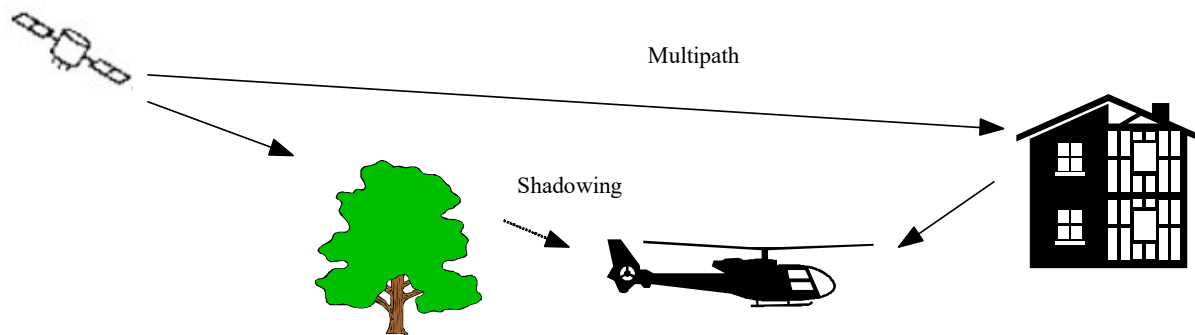
Under multipath conditions, range measurement to the satellite provides incorrect information to the navigation solution, resulting in less accurate positioning. If there are few satellites in view, the navigation solution might be wrong by several hundred meters.

Location of the antenna close to a vertical metal surface can be harmful owing to the fact that metal is an almost perfect reflector. When mounting an antenna on top of a reflective surface, the antenna should be mounted as close to the surface as possible. Then, the reflective surface acts as an extension of the antennas ground place and not as a source multipath.

34.5.3 Antenna shortcomings

Although GPS can work with a weak signal, to have a reliable GPS system the antenna selection and location should be considered carefully as inappropriate selection and poor location degrades GPS performance. Factors which degrade the GPS performance include the following:

- Inadequate gain of the GPS antenna
- Poor directivity of the GPS antenna
- Improper orientation of the antenna to the sky
- Poor matching of antenna, cable, and receiver impedance
- Poor noise performance of the input stage of the antenna amplifier

For more information on getting the most from the antenna, see the *KAM/TCG/102* data sheet.

34.6 Tips

Battery drift

The data sheet states a drift of 3ppm when acting as a generator. What is the drift when not powered-up and an external battery is connected?

The drift does not change when powered with an external battery. However, the module shows a jump in time when the module is powered up with a battery connected. It is not a constant jump and increases with the number of power-ups.

Pulses Per Second (PPS)

No more then one PPS should be used with the KAM/TCG/102 as the Phase Locked Loop has been designed to work with one PPS only.

GPS input in relation with IRIG-B output

What delay in time, if any, exists in the KAM/TCG/102 between a received RF GPS input and the derived modulated IRIG-B output?

The internal circuitry of the module compensates for any known fixed delays between the GPS input and the IRIG-B output. This means that the latency is as defined on the data sheet to within one microsecond.

NMEA

The following NMEA messages GGA, GSV, ZDA, GSA, GLL are the minimum required for the KAM/TCG/102 to function. These NMEA messages and one PPS are sufficient for the KAM/TCG/102 to synchronize time with the Acra KAM-500.

Circular Error Probable (CEP)

The error quoted for CEP takes into account any glitch that might happen due to reflections or generally corrupted reception. In practice, 99% of the time, the accuracy remains around 2.5m but a glitch can happen giving a sample up to 22m of accuracy.

Since parameters from the KAM/TCG/102 are updated every second, such a sample can be easily spotted and discarded.
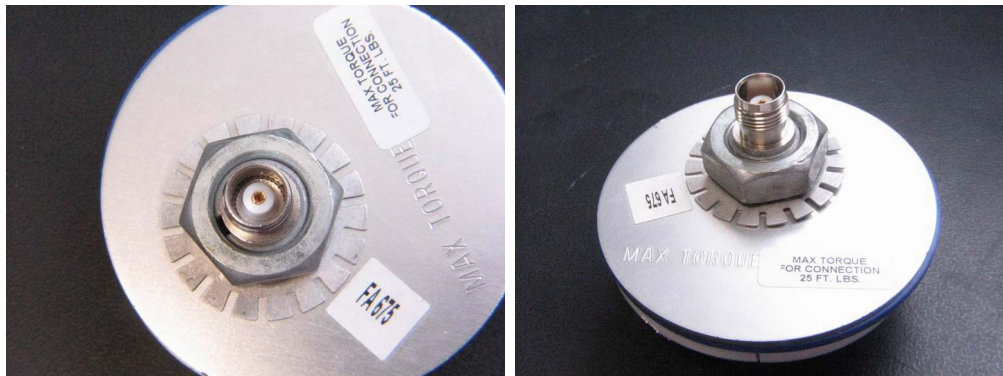
DOP

DOP is a unitless value that indicates when the satellite geometry provides the most accurate results. It's the mathematical representation of the quality of the navigation solution, based on the geometry of the satellites used in the calculation. DOP is mainly controlled by the number of visible satellites and their relative positions in the sky. Satellites spread over the sky give better results (lower DOP).

The most commonly used DOP is Position Dilution Of Precision (PDOP). It's a combination of Horizontal Dilution Of Precision (HDOP) and Vertical Dilution Of Precision (VDOP). A PDOP of one indicates an optimum satellite constellation and high quality data. The quality of the data decreases as the PDOP value increases.

A PDOP with a value in excess of eight is considered poor. A point calculated with PDOP of 30 may be off by more than 150 meters from its true location.

RFE/AEG/001

There are no special accessories required to mount this antenna; it is shipped complete for mounting. The antenna in this series is hard-mounted through a unique single hole feed structure and includes gaskets to prevent air and water leaks. The mounting is a through hole 5/8-18UNC-2A thread.

34.7 References

ASCII code reference can be found under http://nemesis.lonestar.org/reference/telecom/codes/ascii.html

NMEA reference: http://www.gpsinformation.org/dale/nmea.htm