Chapter 60

Using the AXN/TCG/401

TEC/NOT/091

The AXN/TCG/401/B is a time-code generator with GNSS/IRIG input with voice-to-digital converter (CVSD).

This technical note introduces the AXN/TCG/401/B module, and describes how to set it up, as well as troubleshooting GNSS. This paper is divided into the following sections:

NOTE: The AXN/TCG/401 only functioned as a voice-to-digital converter (CVSD); that is, it did not feature time code generation functionality. This technical note only applies to the AXN/TCG/401/B and later. Any mention of AXN/TCG/401 in this technical note is referring to AXN/TCG/401/B or later.

60.1 Module overview

The AXN/TCG/401 can accept time from an IRIG-B time source, from its onboard GNSS receiver (external antenna required), or from an external GNSS receiver outputting NMEA messages and a one PPS signal.

The AXN/TCG/401 also has two channels of audio-to-digital conversion. The encoding scheme used is Continuously Variable Slope Delta (CVSD) modulation.

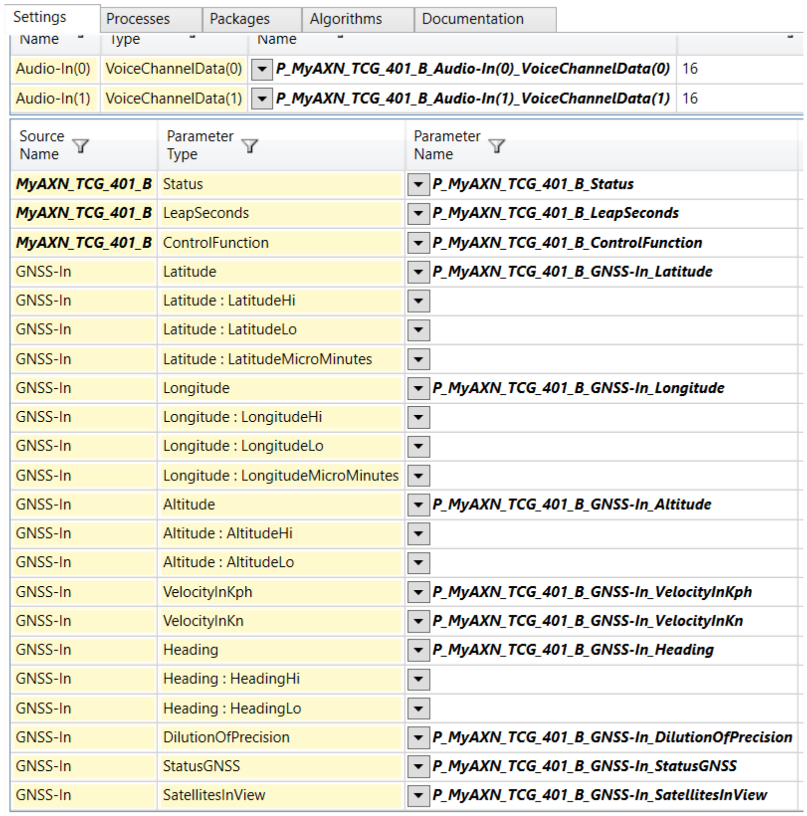
60.2 Setting up the AXN/TCG/401 using DAS Studio 3

You can use DAS Studio 3 software to configure the AXN/TCG/401. 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*.

The module can concurrently receive up to two GNSS systems GPS together with GLONASS.

60.2.1 Settings tab

The Settings tab as shown in the following figure, shows available parameters for the module. The parameters shown in the Settings tab are defined in the *AXN/TCG/401* data sheet.



Settings | Processes | Packages | Algorithms | Documentation

Name	Type	Name	
Audio-In(0)	VoiceChannelData(0)	***P_MyAXN_TCG_401_B_Audio-In(0)_VoiceChannelData(0)***	16
Audio-In(1)	VoiceChannelData(1)	***P_MyAXN_TCG_401_B_Audio-In(1)_VoiceChannelData(1)***	16

Source Name	Parameter Type	Parameter Name
MyAXN_TCG_401_B	Status	***P_MyAXN_TCG_401_B_Status***
MyAXN_TCG_401_B	LeapSeconds	***P_MyAXN_TCG_401_B_LeapSeconds***
MyAXN_TCG_401_B	ControlFunction	***P_MyAXN_TCG_401_B_ControlFunction***
GNSS-In	Latitude	***P_MyAXN_TCG_401_B_GNSS-In_Latitude***
GNSS-In	Latitude : LatitudeHi	
GNSS-In	Latitude : LatitudeLo	
GNSS-In	Latitude : LatitudeMicroMinutes	
GNSS-In	Longitude	***P_MyAXN_TCG_401_B_GNSS-In_Longitude***
GNSS-In	Longitude : LongitudeHi	
GNSS-In	Longitude : LongitudeLo	
GNSS-In	Longitude : LongitudeMicroMinutes	
GNSS-In	Altitude	***P_MyAXN_TCG_401_B_GNSS-In_Altitude***
GNSS-In	Altitude : AltitudeHi	
GNSS-In	Altitude : AltitudeLo	
GNSS-In	VelocityInKph	***P_MyAXN_TCG_401_B_GNSS-In_VelocityInKph***
GNSS-In	VelocityInKn	***P_MyAXN_TCG_401_B_GNSS-In_VelocityInKn***
GNSS-In	Heading	***P_MyAXN_TCG_401_B_GNSS-In_Heading***
GNSS-In	Heading : HeadingHi	
GNSS-In	Heading : HeadingLo	
GNSS-In	DilutionOfPrecision	***P_MyAXN_TCG_401_B_GNSS-In_DilutionOfPrecision***
GNSS-In	StatusGNSS	***P_MyAXN_TCG_401_B_GNSS-In_StatusGNSS***
GNSS-In	SatellitesInView	***P_MyAXN_TCG_401_B_GNSS-In_SatellitesInView***

Figure 60-1: 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 the following figure, shows available settings for the module. These settings are defined in the *AXN/TCG/401* data sheet.

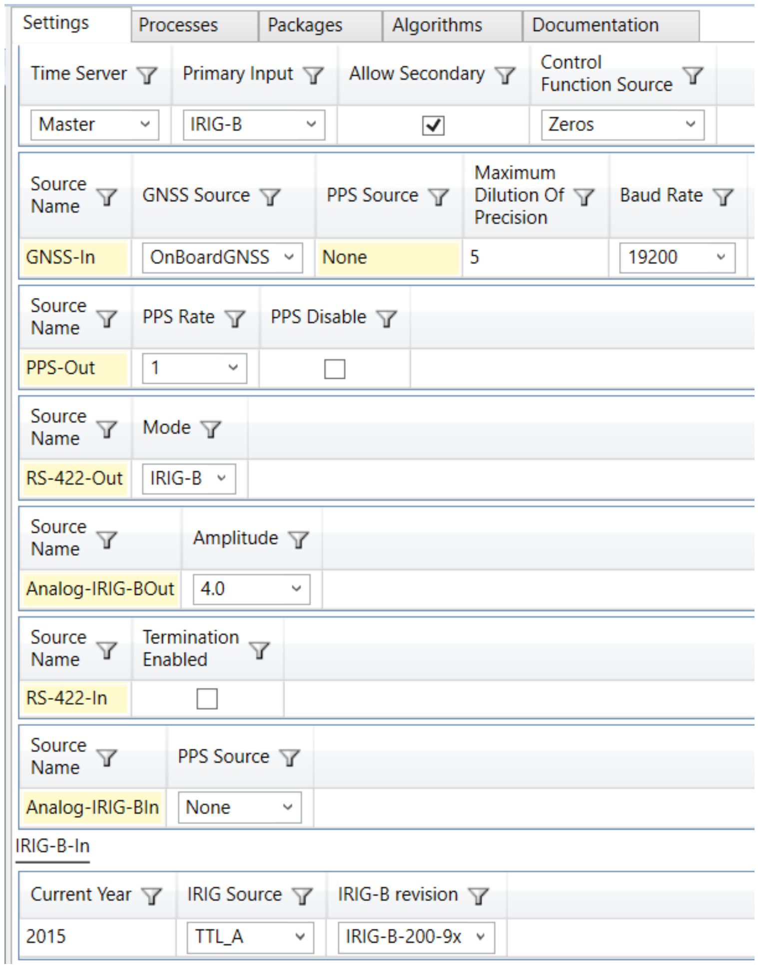


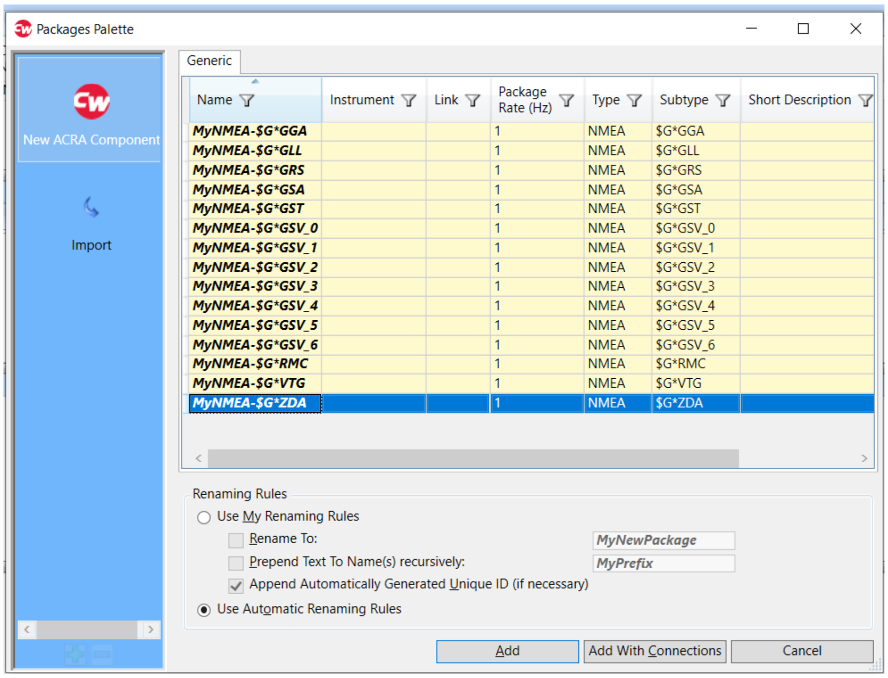
Figure 60-2: Settings tab showing available settings

60.2.2 Packages tab - setting parser of NMEA packages

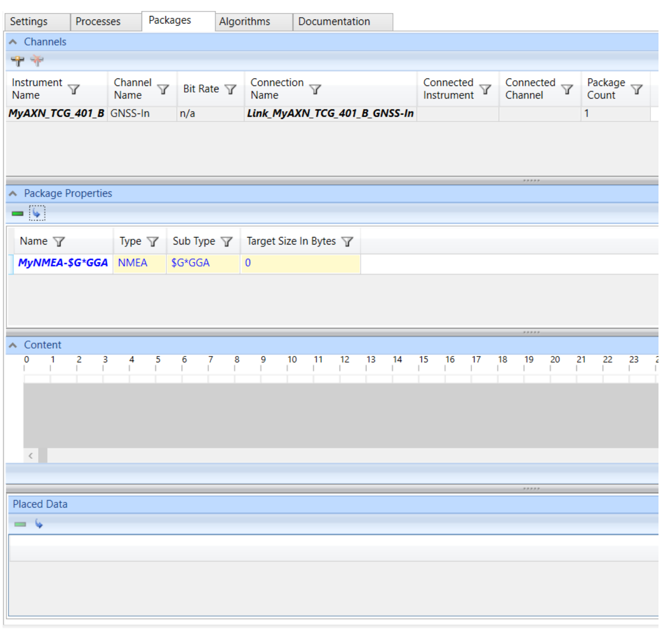
The AXN/TCG/401 allows parsing of any of the 15 predefined National Marine Electronics Association (NMEA) messages supported by the module: GGA, GLL, GRS, GSA, GST, GSV0 to GSV6, RMC, VTG and ZDA. For further information regarding NMEA 0183, refer to the latest standard available.

To create an NMEA message, the corresponding predefined package needs to be created. Refer to the following to create the predefined package.

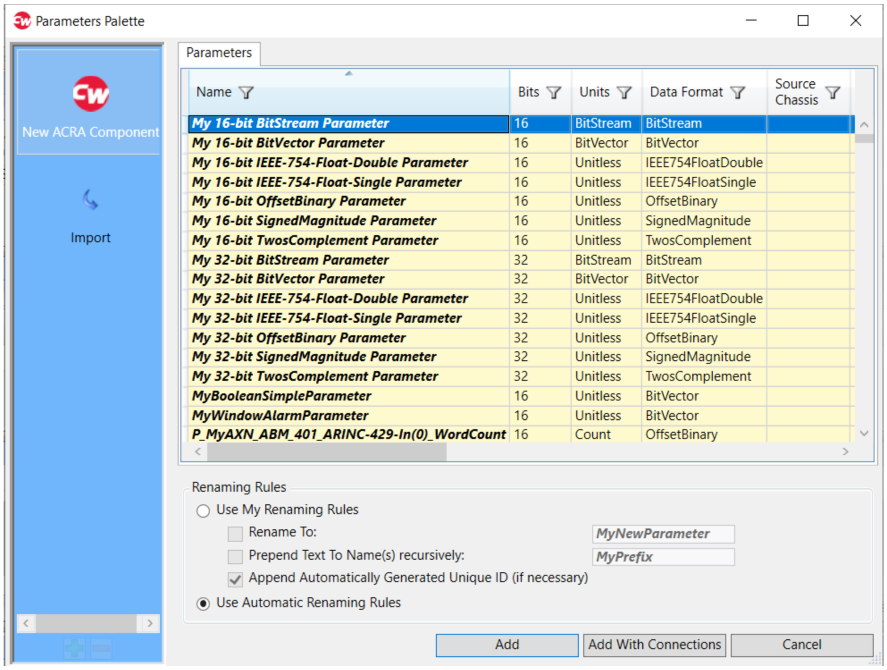
1. On the **Packages** tab of the AXN/TCG/401, click the arrow under **Package Properties**.
   The following screen with the 15 predefined NMEA messages supported by the AXN/TCG/401 appears.



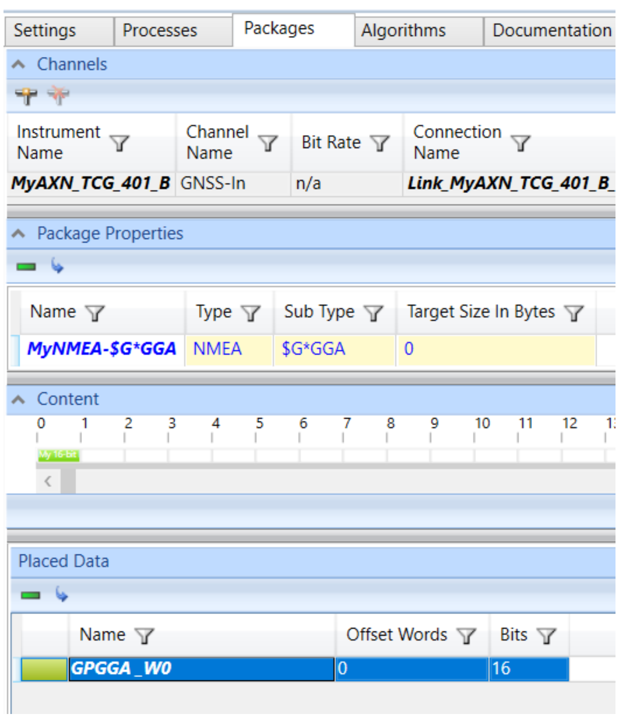
2. Select a message to parse (for example $G*GGA) and then click **Add**.
   The new NMEA is created.



3. Click the arrow under **Placed Data**.
Parameters Palette appears.



4. Select a 16-bit parameter such as **My 16-bit BitStream Parameter** and then click **Add**.
A generic 16-bit parameter with the default message name and offset 0 is created. This can be renamed to a more meaningful name such as **GPGGA_W0** (see following screen), which corresponds to the first two bytes of the $G*GGA message.



In the previous example, the first data word with offset 0 for $GPGGA has the following result: $G, a second word with offset 1 results in PG and so on. Additional data words can be added up to a maximum offset of 41 (the maximum supported length of full NMEA 0183 messages is 82 characters). Full NMEA 0183 messages consist of a maximum of 79 characters between start of message "$" or "!" and terminating delimiter <CR><LF> (HEX 0D and 0A).

An additional Info register associated with each NMEA message to indicate the status of the message can be added. See “60.2.3.1 Parsers – Setting up MessageInfo” on page 6.

60.2.3 Processes tab

The following Processes tab shows available processes for the module. The processes shown in the Processes tab are defined in the *AXN/TCG/401* data sheet.

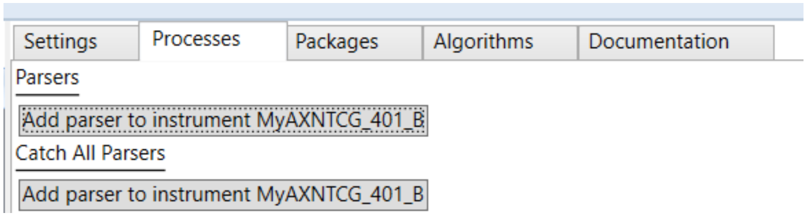


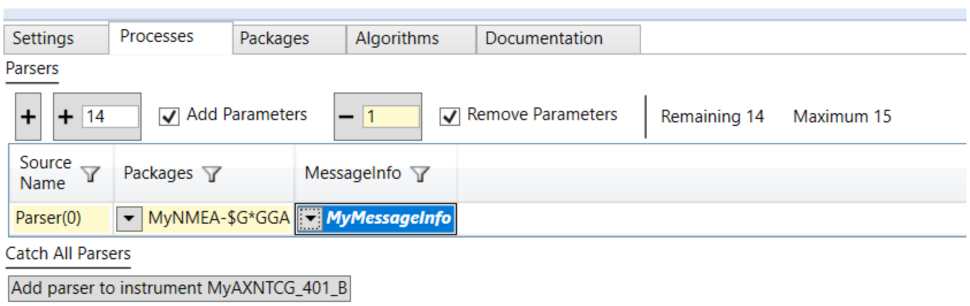
Figure 60-3: Processes tab showing available processes

60.2.3.1 Parsers – Setting up MessageInfo

The MessageInfo register indicates the status of the message as empty (no message), stale (repeated) and skipped. The Parsers process allows you to associate the MessageInfo parameter with one of the 15 predefined NMEA packages previously set in “60.2.2 Packages tab - setting parser of NMEA packages” on page 4.

Refer to the following to create the MessageInfo.

1. On the **Processes** tab, click **Add parser to instrument AXN/TCG/401**.
2. Click **Packages** and then click **Add package reference**.
3. Select one of the NMEA packages already added in the packages tab and then click **Add reference**. An example of message $G*GGA is shown below.



NOTE: For further details on how to use a process, refer to the “Processes tab” section in the *DAS Studio User Manual*.

60.2.3.2 Catch All Parsers

Any package that is not assigned to a parser is sent to this catchall parser where it can be sampled if required. Unlike Parsers, Catch All Parsers automatically sets 41 words and MessageInfo.

This feature is not recommended and should be used as a debug tool only.

60.3 Example configurations

60.3.1 External GNSS receiving NMEA messages over RS-422

The setup for an external GNSS receiving NMEA RS-422 at 19,200 bps is shown in the following two figures.

NOTE: For the following two sample configurations, it is assumed that the secondary input IRIG is not used.

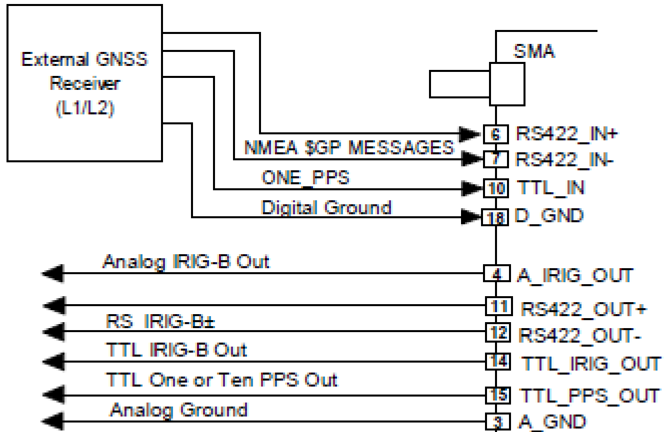


Figure 60-4: Setup for external GNSS receiving RS-422

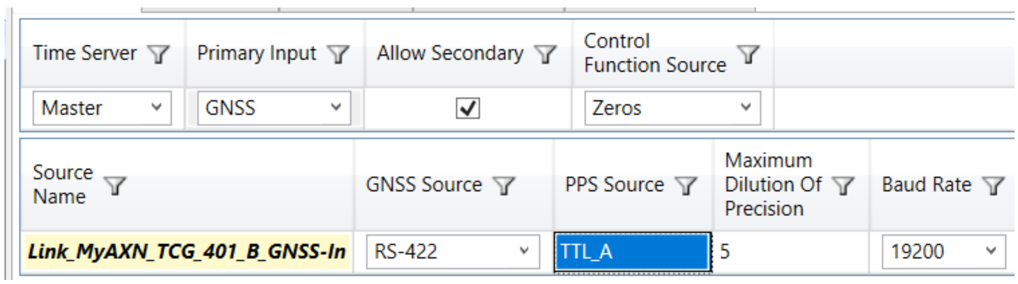


Figure 60-5: Example of setup for external GNSS receiving RS-422 in DAS Studio 3

NOTE: ONE_PPS is required for the AXN/TCG/401 to synchronize its time with the minimum set of external NMEA messages.

60.3.2 Active GNSS antenna

The setup for an active GNSS antenna is shown in the following two figures.

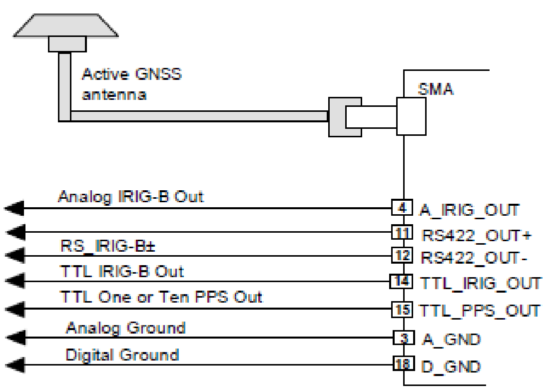
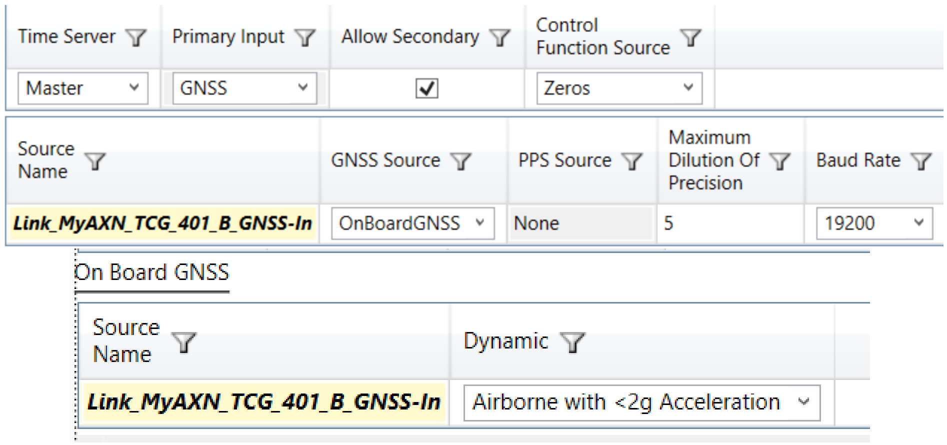


Figure 60-6: Setup for active GNSS antenna



Time Server	Primary Input	Allow Secondary	Control Function Source
Master	GNSS	☑	Zeros

Source Name	GNSS Source	PPS Source	Maximum Dilution Of Precision	Baud Rate
Link_MyAXN_TCG_401_B_GNSS-In	OnBoardGNSS	None	5	19200

On Board GNSS

Source Name	Dynamic
Link_MyAXN_TCG_401_B_GNSS-In	Airborne with <2g Acceleration

Figure 60-7: Example of setup for active GNSS antenna in DAS Studio 3

NOTE: Leap Seconds are automatically updated on Axon.

60.3.3 External GNSS receiver using NMEA messages over RS-232 and one PPS TTL

The setup for an external GNSS receiver using NMEA RS-232 at 19,200bps and TTL_IN_A one PPS is shown in the following two figures.

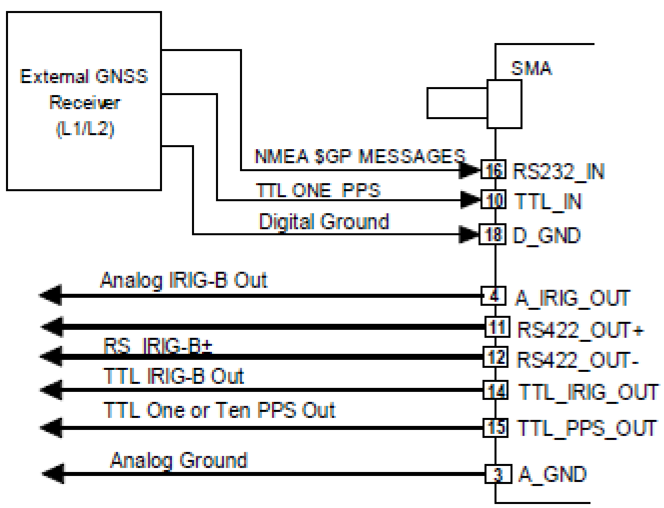
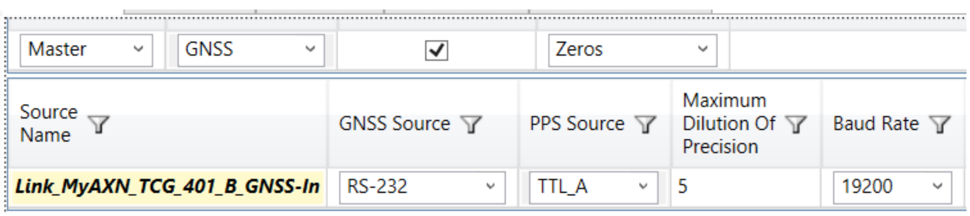


Figure 60-8: Setup for external GNSS receiver using RS-232 and TTL PPS



Master	GNSS	☑	Zeros

Source Name	GNSS Source	PPS Source	Maximum Dilution Of Precision	Baud Rate
Link_MyAXN_TCG_401_B_GNSS-In	RS-232	TTL_A	5	19200

Figure 60-9: Example of setup for external GNSS receiver using RS-232 and TTL in DAS Studio 3

60.3.4 Analog IRIG-B input

The setup for an analog IRIG-B input is shown in the following two figures.

NOTE: Analog IRIG-B only support 1 PPS signal over pin 9 TTL_IN_B.

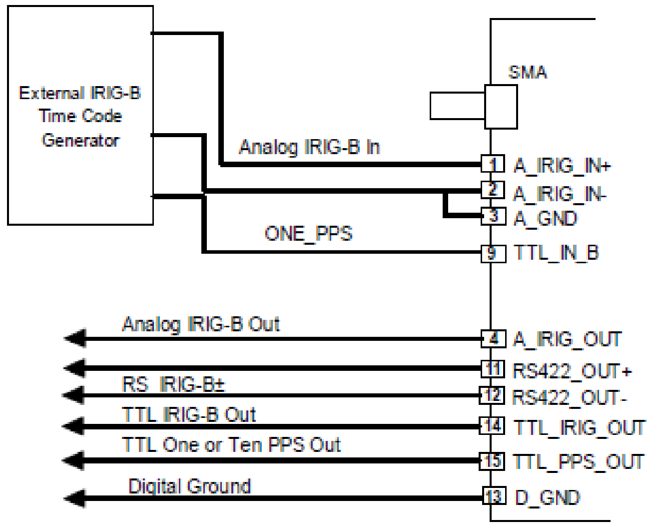


Figure 60-10: Setup for analog IRIG-B input with 1 TTL PPS

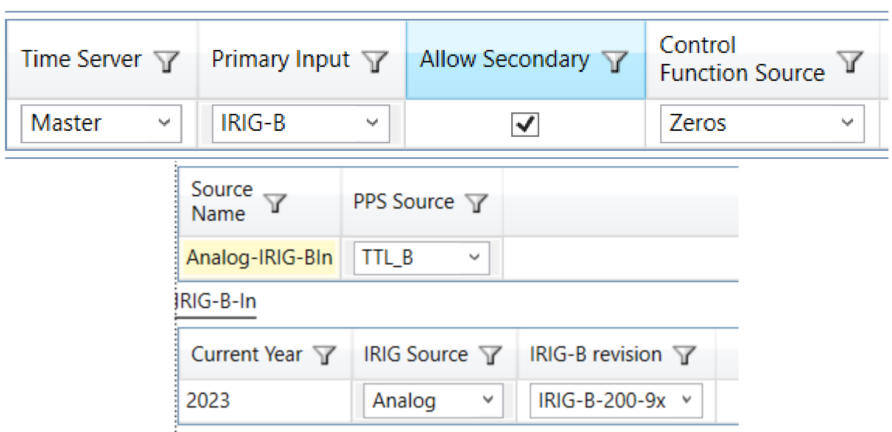


Figure 60-11: Example of setup for analog IRIG-B input with 1 PPS in DAS Studio 3

NOTE: ONE_PPS connection is optional on the previous figure, however it is recommended in order to increase accuracy. When IRIG-B-200-04 is selected, the module decodes the year from the control function (CF) bits, however IRIG-B-200-9x does not contain year information.

60.3.5 Digital IRIG-B input - TTL

The setup for a digital IRIG-B input is shown in the following two figures.

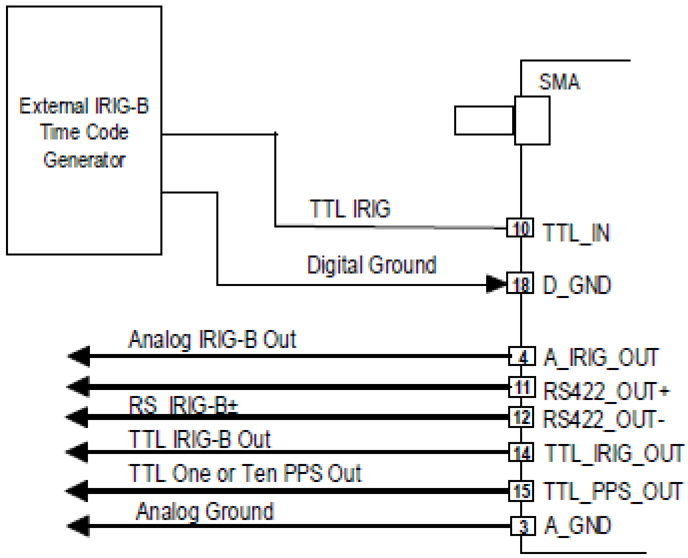


Figure 60-12: Setup for digital IRIG-B input

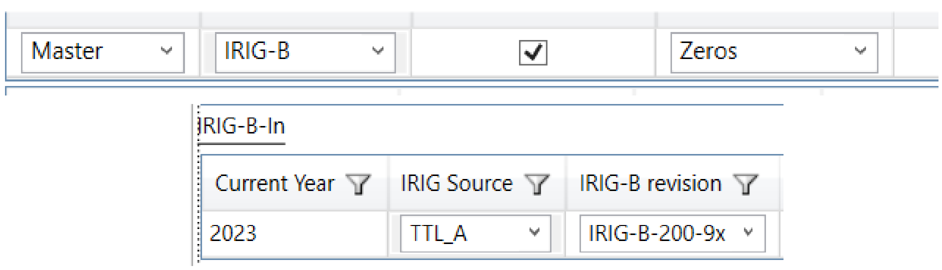


Figure 60-13: Example of setup for digital IRIG-B input in DAS Studio 3

60.3.6 Digital IRIG-B input - RS-422

The setup for a RS-422 IRIG-B input is shown in the following two figures.

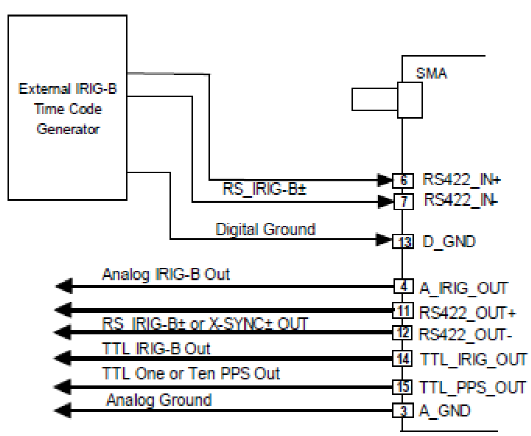


Figure 60-14: Setup for RS-422 IRIG-B input

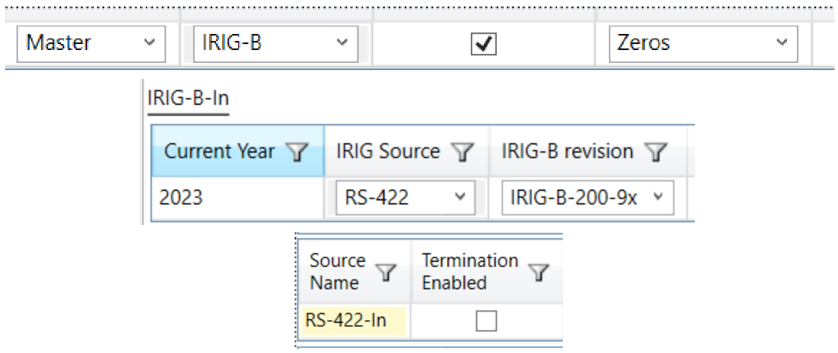


Figure 60-15: Example of setup for RS-422 IRIG-B input in DAS Studio 3

NOTE: When termination is enabled, a 120-ohm termination resistor is active between input pins RS422_IN(+) and RS422_IN(-). This resistor is not active when the module is powered off.

60.3.7 Voice channels

The module supports Audio. The encoding scheme used is Continuously Variable Slope Delta (CVSD) modulation. IADS supports this encoding. Due to the compression scheme, an Audio-In parameter can be transmitted into different sinks (Ethernet or PCM for example) but it must be transmitted at the same rate. For audio quality versus sampling rate recommendations, see the *AXN/TCG/401* data sheet, “Voice-to-digital converter” section.

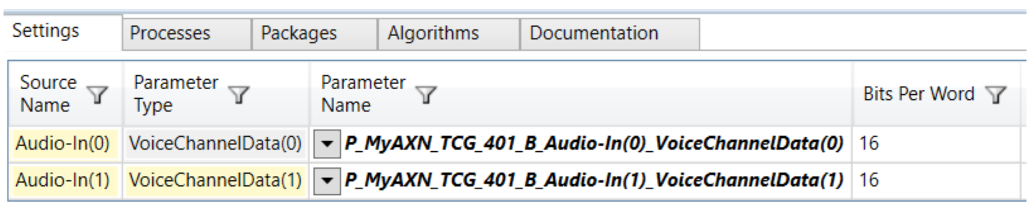


Figure 60-16: Voice channels

60.4 Troubleshooting GNSS

This section explains the most common issues with GNSS. For GNSS antenna recommendations, see the *AXN/TCG/401* data sheet.

60.4.1 GNSS not in lock

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

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

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

If bit 15 is set to 1 (GNSS lock) but the position is incorrect, check bit 11. If bit 11 of the StatusGNSS 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 (SatellitesInView parameter) and the number of satellites in use (StatusGNSS[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 Axon chassis with the AXN/TCG/401.

60.4.2 Multipath errors

A multipath environment exists if GNSS signals arrive at the antenna directly from the satellite and also from reflective surfaces, for example water or building walls (see the following figure).

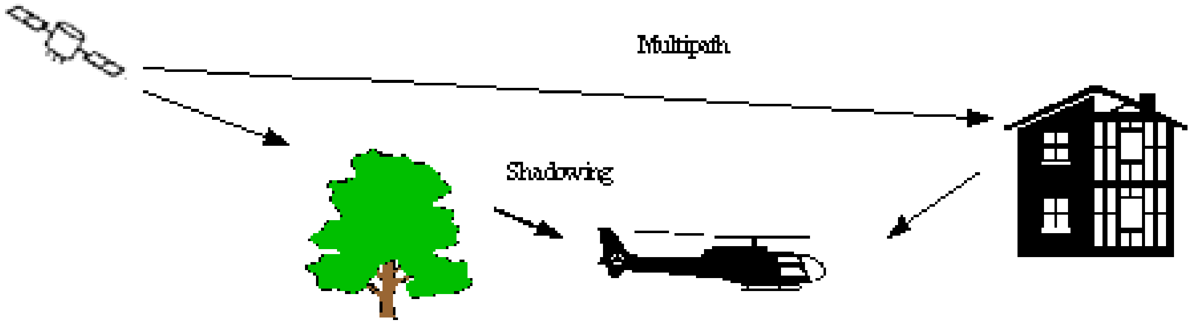


Figure 60-17: Multipath environment

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.

60.4.3 Antenna shortcomings

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

- Inadequate gain of the GNSS antenna
- Poor directivity of the GNSS 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
- GNSS antenna is connected to the module after the Axon is powered up.

For more information on getting the most from the antenna, see the *AXN/TCG/401* data sheet.

60.5 Tips

60.5.1 Power up

The module has no battery backup and cannot be connected to a battery backup. The module will cold power-up each time.

60.5.2 Representing GNSS position in IADS

Contact Curtiss-Wright support (acra-support@curtisswright.com) to obtain a copy of technical document TSD/AC/005 IADS derive equation for TCG Altitude Latitude Longitude Heading.

Latitude/Longitude are specified in degrees/minutes/seconds (DMS) in the *AXN/TCG/401* data sheet while some GNSS localization system may express it in Decimal Degrees (DD).

60.5.3 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.

60.5.4 SMA torque setting

The recommended torque setting for the SMA connector on the AXN/TCG/401 is 0.45 Nm (0.33 foot pound-force).

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