AN500 – J1939 Inclinometers

Inclinometer Usages

- An inclinometer is designed to measure pitch and roll inclination angles.
- Axiomatic inclinometers support the SAE J1939 CAN interface.
- Axiomatic inclinometers are configured using the Electronic Assistant Module and mating connectors (AX070502).
- Inclinometers can be modified in several ways: they may have gyroscopes on all three axes or only on one axis and can be configured to operate in a regular or an extended range of disturbances.
- Inclinometer modifications with gyroscopes on all three axes can dynamically compensate all measurement angles.
- A more cost-effective single-axis gyroscope modification can only compensate one angle in the direction of the gyroscope measurements.
- This modification is normally used for single-angle measurements, but it can measure all inclination angles without gyroscope compensation.
- Extended dynamic range inclinometers have accelerometers and gyroscopes with larger measurement ranges. This allows them to operate without saturation through a wider range of dynamic disturbances. Their separate precision accelerometer provides accurate static measurements of all inclination angles.

By default, the inclinometer transmits:

- PGN 61459 (Slope Sensor Information) with SPN 3318 (Pitch Angle), SPN 3319 (Roll Angle), SPN 3323 (Pitch Angle Figure of Merit), SPN 3324 (Roll Angle Figure of Merit), SPN 3327 (Roll and Pitch Measurement Latency).
- PGN 65256 (Vehicle Direction/Speed) with SPN 583 (Pitch).
- PGN 64905 (Vehicle Roll) with SPN 3623 (Vehicle Roll).

Axiomatic Technologies Oy
Höytämöntie 6
33880 LEMPÄÄLÄ, Finland
Tel. +358 103 375 750
salesfinland@axiomatic.com
www.axiomatic.fi

Axiomatic Technologies Corporation
1445 Courtneypark Dr. E.
Mississauga, ON Canada L5T 2E3
Tel. 1 905 602 9270
sales@axiomatic.com
www.axiomatic.com

Other PGN's that can be used:

PGN 61485 ACCS:

- The PGN 61485 Acceleration Sensor outputs acceleration in [m/s^2] and uses the Z-up coordinate system.
- The inclinometer, in contrast, uses the Z-down coordinate system.
- Due to this difference, some accelerations are multiplied by (-1) to reverse their acceleration sign so that it aligns with the Z-up coordinate system.
- The inclinometer's internal function blocks present continuous data in floating point variables that can be scaled into any signal width: 1-bit to 32-bit.
- Binary functions are needed to convert acceleration units from (g) to (m/s^2). They multiply the raw acceleration signal by 9.8065 (m/s^2/g).
- The result of the Binary Function is assigned to the appropriate data position in the outgoing CAN message, according to the desired SPN.

Proprietary PGN's:

- A proprietary PGN may be used.
- Binary functions are not needed for unit conversion if acceleration is outputted in [g] units.
- Any width may be used for the PGN's acceleration signals. The limits here are the overall 8-bit width of the PGN data and signal resolution requirements.

Application Example: Using X-Axis Acceleration signal as SPN 5347

PGN 61485 ***Acceleration Sensor*** ***ACCS***

The acceleration sensor message shall provide a measurement of the vehicle's acceleration in the lateral, longitudinal, and vertical axes. The vehicle dynamics measurements in this message shall be according to a Z-Up axis system as referenced in SAE J670.

Transmission Repetition Rate:	10 ms (default) or 20 ms
Data Length:	8
Extended Data Page:	0
Data Page:	0
PDU Format:	240
PDU Specific:	45 PGN Supporting Information:
Default Priority:	2
Parameter Group Number:	61485 (0x00F02D)

Start Position	Length	Parameter Name	SPN
1-2	2 bytes	Lateral Acceleration Extended Range	5347
3-4	2 bytes	Longitudinal Acceleration Extended Range	5348
5-6	2 bytes	Vertical Acceleration Extended Range	5349
7.1	2 bits	Lateral Acceleration Extended Range Figure of Merit	5350
7.3	2 bits	Longitudinal Acceleration Extended Range Figure of Merit	5351
7.5	2 bits	Vertical Acceleration Extended Range Figure of Merit	5352
7.7	2 bits	Support Variable Transmission Repetition Rate for Acceleration Sensor	5353

SPN 5347 ***Lateral Acceleration Extended Range***

Indicates lateral acceleration of the vehicle (the component of vehicle acceleration vector along the Y-axis). A positive lateral acceleration signal results when the vehicle is accelerated to the left. This parameter is defined according to a Z-Up axis system and the sign of the value is in accordance to the right-hand rule, as specified in SAE J670. As specified in SAE J670, a Z-Up Axis System has positive X directed forward, positive Y to the left, and positive Z directed up. See SPN 1809 for an alternate range and resolution.

Data Length:	2 bytes	
Resolution:	0.01 m/s² per bit, -320 m/s² offset	
Data Range:	-320 to +322.55 m/s²	Operational Range: same as data range
Type:	Measured	
Supporting Information:		
PGN reference:	61485	

***From Standard J1939**

Configuration Steps:

1. Assign setpoint 'Global Continuous Constant Signal 1' with value 9.80665. The conversion factor for g to m/s^2 acceleration units.

Setpoint Group Name: Global Parameters

Setpoint Name	Setpoint Value	Comment
Global Continuous Constant Signal	9.80665	
Global Discrete Constant Signal	0x00	

2. Edit the setpoints of 'Binary Function #1' to create the function:

*X-Axis Acceleration * 9.8665*

Setpoint Group Name: Binary Function #1

Setpoint Name	Setpoint Value	Comment
Binary Function	* Multiplication	
Output Scale	1	
Output Offset	0	
Input #1 Signal Source	X-Axis Acceleration	
Input #1 Signal Default	No	
Input #1 Signal Default Value	0	Not used in this mode
Unary Function #1	Undefined	
Scale #1	1	
Offset #1	0	
Input #2 Signal Source	Global Continuous Constant Signal	
Input #2 Signal Default	No	
Input #2 Signal Default Value	0	Not used in this mode
Unary Function #2	Undefined	
Scale #2	1	
Offset #2	0	

3. Assign Binary Function # 1 as Data Source for the outgoing CAN message.
Edit byte position and signal encoding according to SPN 5347.

Setpoint Group Name: CAN Output Message #1

Setpoint Name	Setpoint Value	Comment	
PGN	0x0f02d	PDU2 PGN	PGN 61485
Transmission Enable	Yes		
Transmission Rate	10	[ms] On request only, if 0	
Destination Address	0xff	Not used in this mode	
Length	8	[byte]	
Priority	3		
Signal #1 Type	Continuous		
Signal #1 Source	Binary Function #1		X-Axis acceration measurement converted to units m/s^2
Signal #1 Byte Position	1		signal is in 1st byte position
Signal #1 Bit Position	1		
Signal #1 Size	16	[bit]	signal size = 2 bytes
Signal #1 Resolution	0.01	[signal units / bit]	resolution = 0.01 m/s^2
Signal #1 Offset	-320	[signal units]	offset = -320 m/s^2

Version	Date	Author	Comments
1.00	August 20, 2021	Greg Laronde / Sue Thomas / Kiril Mojsov	Initial release