TARS SENSORS CORRECTED ACCELERATION

Technical Note

1.0 DESCRIPTION

The TARS sensors can utilize motion information (speed and direction changes) from the machine ECU to help improve the quality of the reported attitude (roll/pitch).

The message data format for Corrected Acceleration is the same as the format for the standard acceleration broadcast data message, J1939-PGN61485, which also uses the Z-up convention. Data from the most recent Corrected Acceleration message are active and are used by the algorithm to calculate pitch & roll angles for 60 ms and then resets to 0 m/s^2 when time expires. A new Corrected Acceleration message restarts this process and may be sent at any time.

FIGURE 1. TARS IN DEFAULT MOUNTING ORIENTATION

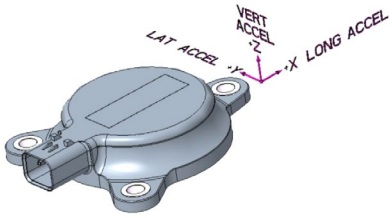
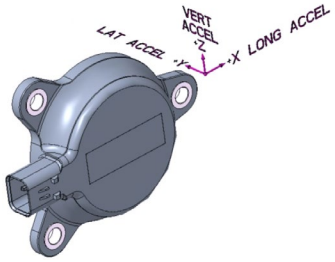


FIGURE 2. TARS IN NON-DEFAULT MOUNTING ORIENTATION



2.0 APPLICATION OF CORRECTED ACCELERATIONS

Corrected Accelerations are applied to the body reference frame as shown in Figures 1 and 2. Figure 1 shows the TARS sensor in its default mounting orientation with axes in the Z-up (East/North/Up) direction, where +X axis is forward, +Y axis faces left, and the +Z axis faces up. If the TARS' mounting orientation has been configured for a non-default mounting orientation, as shown in Figure 2, note that the Corrected Accelerations are still applied in the body reference frame.

3.0 CORRECTION EXAMPLES

The lateral and longitudinal acceleration correction examples shown in sections 3.1 and 3.2 below may be made in one PGN61184 message. They are shown as two separate messages for demonstration purposes only.

3.1 LATERAL ACCELERATION

A TARS sensor, mounted in the default mounting orientation shown in Figure 1, on a bus with a wheelbase (WB) of 8 m, travels around a left turn at 10 m/s. The steering wheel angle (Ψ) is 4.57°. Lateral Acc = v^2 * tan(Ψ)/WB = 10^2 * tan(4.57°)/8 = 1.00 m/s^2.

TABLE 1. PGN 61184

Frame Format	29-Bit ID						Data (8 Bytes)							
Field	P	EDP	DP	PF	DA	SA	ID	Lateral (Y)[1]		Longitudinal (X)[1]		Vertical (Z)[1,2]		CMD[3]
# Bits	3	1	1	8	8	8	8	8	8	8	8	8	8	8
CAN Message	0x19			0xEF	0xE2	0xF6	0xA1	0x64	0x7D	0x00	0x7D	0x00	0x7D	0x00
								BL	BH	BL	BH	BL	BH	

Lateral acceleration (0x7D64h ≥ (32100d - 32000d)/100 = 1.00 m/s^2) and CMD Moving (0x00)

SA: Source Address (vehicle control module address)
DA: Destination Address (TARS address)

[1] Acceleration (m/s^2) = (uint16 - 32000)/100

[2] In this example, where Corrected Acceleration is used to mitigate non-inertial acceleration effects from turning, vertical acceleration should not be corrected; hence, the values for vertical acceleration are 0.

[3] CMD Definition: Only two bits are used to describe the machine motion.

0x00	00B	Moving	0x02	10B	Unused
0x01	01B	Stationary	0x03	11B	Invalid

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3.2 LONGITUDINAL ACCELERATION

A TARS sensor, mounted on a bus, decelerates from 10 m/s to 0 m/s in 10 s. Longitudinal Acc = dV/dT = -10$^{m/s}$ / 10^{s} = -1.00 m/s^2.

TABLE 2. PGN 61184

Frame Format	29-Bit ID						Data (8 Bytes)							
Field	P	EDP	DP	PF	DA	SA	ID	Lateral (Y)[1]		Longitudinal (X)[1]		Vertical (Z)[1,2]		CMD[3]
# Bits	3	1	1	8	8	8	8	8	8	8	8	8	8	8
CAN Message	0x19			0xEF	0xE2	0xF6	0xA1	0x00	0x7D	0x9C	0x7C	0x00	0x7D	0x00
								BL	BH	BL	BH	BL	BH	

Longitudinal acceleration (0x7C9Ch ≥ (31900d - 32000d)/100 = -1.00 m/s^2) and CMD Moving (0x00)

SA: Source Address (vehicle control module address)
DA: Destination Address (TARS address)

[1] Acceleration (m/s^2) = (uint16 - 32000)/100

[2] In this example, where Corrected Acceleration is used to mitigate non-inertial acceleration effects from the decelerating bus, vertical acceleration should not be corrected; hence, the values for vertical acceleration are 0.

[3] CMD Definition: Only two bits are used to describe the machine motion.

0x00 00B Moving
0x01 01B Stationary
0x02 10B Unused
0x03 11B Invalid

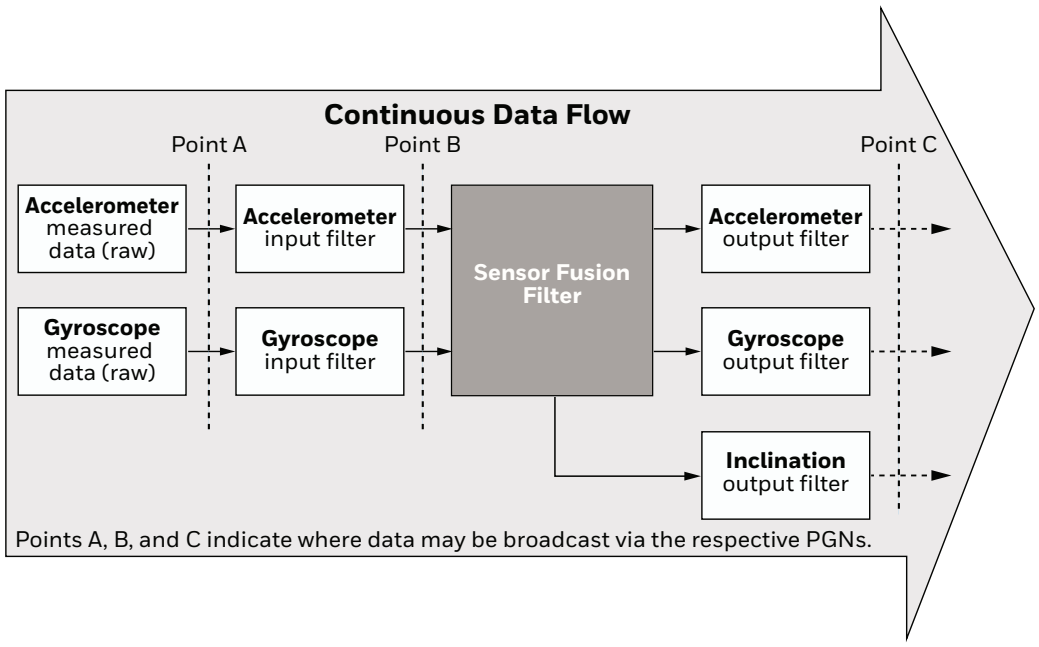
4.0 ACCELERATION DATA BROADCAST OPTIONS

When the corrected acceleration function is used, the TARS sensor must be configured to broadcast the desired type of acceleration data, corrected or uncorrected, on broadcast message PGN61485. The type of acceleration data that is broadcast is determined by the output point selected in the part configuration. Refer to Table 3 and Figure 3 to determine the output point for the type of acceleration data to be broadcast. The configuration file for the TARS, including selection of the output point for acceleration data, may be created using the TARS Configurator Tool (reference TARS Installation Instructions 3011-2912-001).

TABLE 3. DATA FLOW OUTPUT POINT VS TYPE OF ACCELERATION DATA

Data Output Point	Point A	Point B	Point C
Acceleration (PGN61485)	Uncorrected Accel Data	Uncorrected Accel Data	Corrected Accel Data

FIGURE 3. TARS CONTINUOUS DATA FLOW BLOCK DIAGRAM



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