

# Installation Instructions for the Transportation Attitude Reference Sensor TARS Series

*Issue A***32332897**

## 1.0 GENERAL INFORMATION

Honeywell's Transportation Attitude Reference Sensor (TARS) Inertial Measurement Unit (IMU) is designed to provide motion sensing through 6 degrees of freedom and reporting of angular rate, acceleration, and inclination data through a CAN J1939 interface. It is packaged for harsh environments and demanding applications.



## 2.0 CALIBRATION

TARS-IMU devices are aligned to a flat surface and calibrated on an aerospace-grade rate table providing consistency between units and eliminating the customer's need to calibrate the IMU.

## 3.0 INSTALLATION

Mount the sensor using the three mounting holes and three non-magnetic, stainless-steel socket head cap screws, M8 or equivalent. Torque to 20 Nm  $\pm$ 2 Nm.

- Mating connector: AMPSEAL 16 Series, 776487-1 for 18-16 AWG conductors or 776524-1 for 20-18 AWG conductors
- Mounting direction: +Z

# Transportation Attitude Reference Sensor (TARS Series)

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## 4.0 SPECIFICATIONS

**Table 1. Sensor Specifications**

Characteristic	Min.	Typ.	Max.	Unit
<b>Gyroscope 3 axis performance</b>				
Angular rate range	-245	–	+245	deg/sec
Angular rate resolution	–	7.8125	–	mdps
In-run bias stability	–	1	–	mdps
Rate noise density	–	0.004	–	deg/sec/sqrt Hz
Offset (0 °C to 50 °C)	-0.8	–	+0.8	deg/sec
Offset (-40 °C to 85 °C)	-1.6	–	+1.6	deg/sec
<b>Accelerometer 3 axis performance</b>				
Acceleration range	-78.48	–	+78.48	m/s <sup>2</sup>
Acceleration resolution	–	0.01	–	m/s <sup>2</sup>
In-run bias stability	–	50	–	μg
Acceleration noise density	–	65	–	μg/sqrt Hz
Offset (0 °C to 50 °C)	–	±0.05	–	m/s <sup>2</sup>
Offset (-40 °C to 85 °C)	–	±0.15	–	m/s <sup>2</sup>
<b>Inclination (pitch and roll) performance</b>				
Range (2 axis x & y)	-85	–	+85	deg
Resolution	–	0.058	–	deg
Static inclination error (0 °C to 50 °C)	–	±0.3	–	deg
Static inclination error (-40 °C to 85 °C)	–	±0.9	–	deg
Translational acceleration error	–	±0.5	–	deg
Centripetal acceleration error	–	±0.5	–	deg
Settling time	–	–	2000	mSec

**Table 2. Electrical Characteristics • TARS-LCASS**

Characteristic	Min.	Nominal	Max.	Unit
Supply voltage	4.5	5	5.5	V
Supply current	–	–	100	mA
Start-up time	500	–	2000	mSec
Short circuit protection	CAN output shorted to power line and ground			
Open circuit protection	Single-line interruption and multiple-line interruption			
Reset response	Automatic after voltage drop			
<b>CAN output characteristics per SAE J1939</b>				
CAN Bus data rate	–	250	–	kBaud
Signal update rate	–	–	100	Hz

**Table 3. Electrical Characteristics • TARS-HCASS**

Characteristic	Min.	Nominal	Max.	Unit
Supply voltage	9	14/28	36	V
Supply current	–	–	100	mA
Reverse voltage	–	–	-36	V
Overvoltage	–	–	36	V
Start-up time	500	–	2000	mSec
Short circuit protection	CAN output shorted to power line and ground			
Open circuit protection	Single-line interruption and multiple-line interruption			
Reset response	Automatic after voltage drop			
<b>CAN output characteristics per SAE J1939</b>				
CAN Bus data rate	–	250	–	kBaud
Signal update rate	–	–	100	Hz

**Table 4. Environmental Specifications**

Characteristic	Parameter
Operating temperature	-40 °C to 85 °C [40 °F to 185 °F]
Storage temperature	-40 °C to 105 °C [40 °F to 221 °F]
Random vibration	8 hours per axis at 16.91 g RMS per MIL-STD-202, Method 214, Test Condition I, Letter E
Mechanical shock	50 g 11 mS half-sine, 3 each direction, 18 total, pulse per MIL-STD-202, Method 213
Chemical compatibility	Diesel fuel, hydraulic oil, ethylene glycol, motor oil, brake fluid, urea nitrogen, liquid lime, NPK fertilizer, ammonium hydroxide, alkaline degreaser, transmission oil, power steering fluid, and axle oil
Moisture resistance	per MIL-STD-202, Method 106 (10 cycles, 24 hours/cycle)
Thermal shock	250 cycles, -40 °C to 85 °C, 73 min dwells
Salt spray	5 % salt solution, 96 hours
Ingress protection	IP67, IP69K (DIN40050-1993) with mating connector installed
RoHS	Compliant
REACH	Compliant
UV rating	Enclosure material meets outdoor suitability requirements per UL746C F1 rating

**Table 5. EMC Specifications**

Characteristic	Standard	Test Level, Frequency
Radiated immunity	ISO 11452-2	125 V/m, 400 MHz to 2.5 GHz
Bulk current injection	ISO 11452-4: 2011	125 mA, 1 MHz to 400 MHz
Radiated emission	ISO 13766	30 MHz to 1 GHz
Mutual coupling	ISO 7637-3	Test pulse A, Test pulse B (-80 V, 80 V)
ESD direct contact discharge	ISO 10605	±8 kV
ESD air discharge	ISO 10605	±15 kV

# Transportation Attitude Reference Sensor (TARS Series)

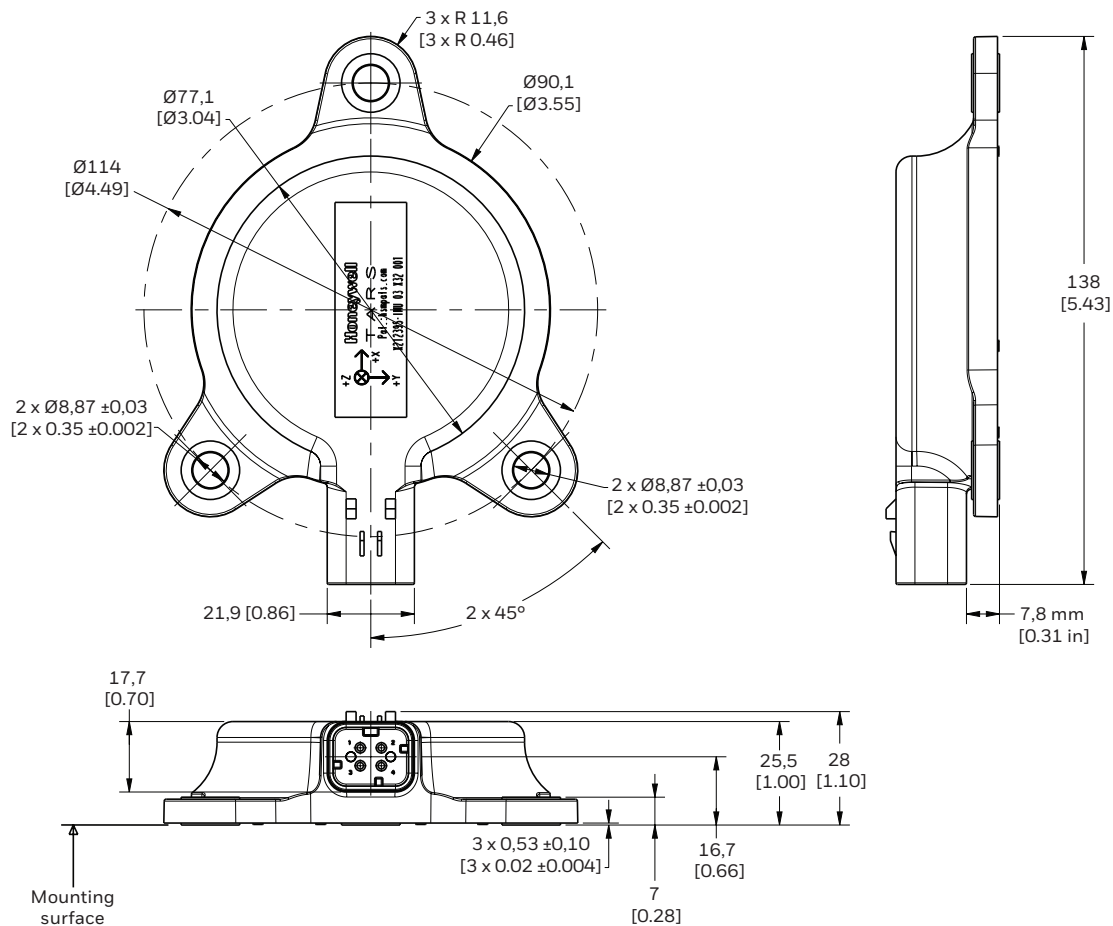
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Table 6. Installation Specifications

Characteristic	Parameter
Mating connector	AMPSEAL 16 Series, 776487-1 for 18-16 AWG conductors or 776524-1 for 20-18 AWG conductors
CAN termination	120 Ohm termination resistor, not included in TARS-IMU unit
Weight	170 g approx.
Mounting direction	+ Z
Mounting bolt	M8, installation torque 20 Nm $\pm$ 2 Nm

## 5.0 DIMENSIONS

Figure 1. TARS Dimensions



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Figure 2. TARS Mounting Hole Dimensions

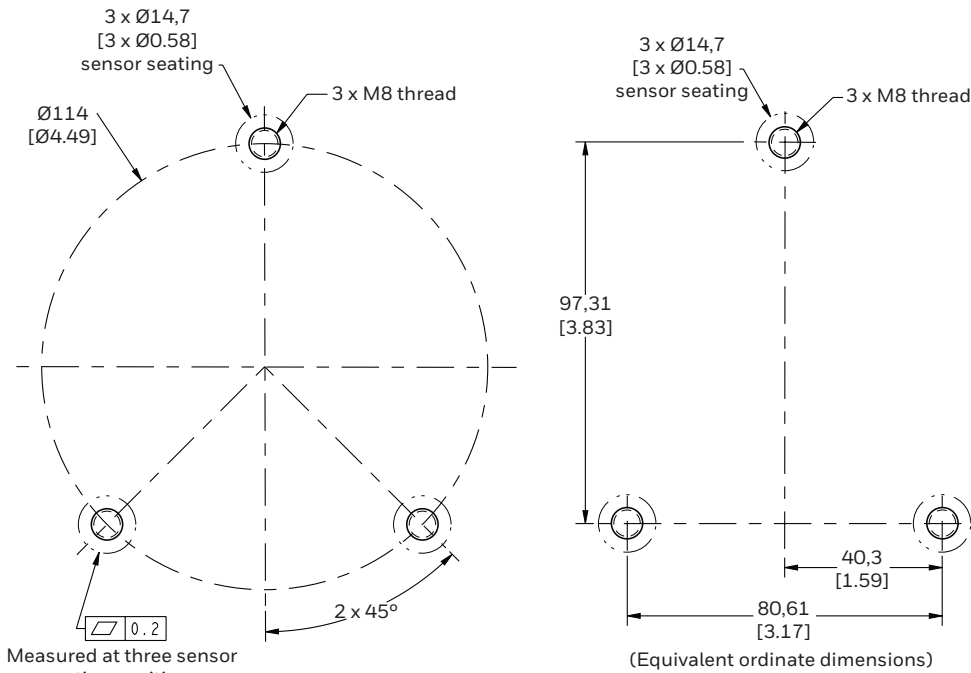


Figure 3. TARS Pin Output and Configuration

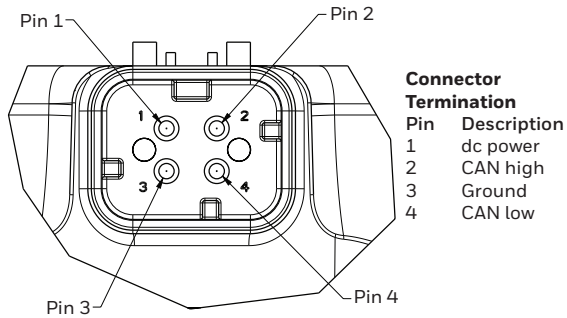
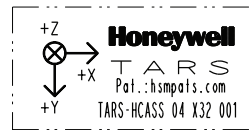


Figure 4. TARS Part Number and Label Details



**Where**

**04** Product configuration code

**X32** Date code, where:

**X:** Year code for 2016, Y for 2017, Z for 2018, A for 2019, etc.

**32:** Week of final test

**001** is a consecutive number, different for each product

## 6.0 CAN MESSAGES AND COMMUNICATION

TARS-IMU utilizes CAN J1939 protocol and message format to report data. Please refer to J1939 specification and standards for information regarding communication and implementing CAN J1939 systems.

### 6.1 CAN J1939 Device Identification

The ID is a 4-byte value to identify the message being transmitted.

- All J1939 messages are Ext CAN
- All messages have default priority 0 (lowest) <= priority <= 0x7 (highest)
- PDU formats < 0xF0 are peer to peer  
PDU Specific is filled with destination address
- PDU formats >= 0xF0 are broadcast  
PDU Specific further defines the message format
- PDU formats = 0xFF are global broadcast
- All J1939 messages end with the sending address in the last byte

**Table 7. J1939 ID Format**

Extended					PDU		SA
Ext CAN	Reserved	Priority	Reserved	Data Page	PDU Format	PDU Specific	Source Address
1 Bit	2 Bits	3 Bits	1 Bit	1 Bit	8 Bits	8 Bits	8 Bits
1 Byte					1 Byte	1 Byte	1 Byte

## 7.0 TARS-IMU SPECIFIC MESSAGES

The TARS-IMU transmits three messages every 10 mS (100 Hz).

### 7.1 PGN\_61481 (0xF029) Inclination Angle(°) broadcast data

**Table 8. PGN\_61481 Details**

Pitch Inclination Angle			Roll Inclination Angle			Status	Latency
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte
0x00	0x00	0x7D	0x00	0x00	0x7D	0x00	0x0A
BL	BM	BH	BL	BM	BH		

uint32\_t

$$\text{uint32} = B_H * 2^{16} + B_M * 2^8 + B_L$$

$$\text{Inclination angle}(\text{°}) = (\text{uint32} - 81920q100) / 32768$$

### 7.2 PGN\_61481 Status

The status byte is comprised of compensation status and MEMs status for each value.

**Table 9. PGN\_61481 Status**

Pitch		Roll	
Comp	Status	Comp	Status
00b	00b	00b	00b

All status definitions are defined as:

00b = FullyFunctional

01b = Degraded

10b = Error

11b = NotAvailable

i.e. 0xCF029E2, 0x00, 0x00, 0x7D, 0x00, 0x00, 0x7D, 0x00, 0x05

Transmit 0° inclination on both pitch and roll with priority 3, fully functional MEMs and compensation with 5 mS latency from address 0xE2.

### 7.3 PGN\_61482 (0xF02A) Gyro(°/s) broadcast

**Table 10. PGN\_61482 Details**

Pitch Rate		Roll Rate		Yaw Rate		Status	Latency
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte
0x00	0x7D	0x00	0x7D	0x00	0x7D	0x00	0x0A
BL	BH	BL	BH	BL	BH		

uint16\_t

$$\text{uint16} = B_H * 2^8 + B_L$$

$$\text{Rotation rate}(\text{°/s}) = (\text{uint16} - 32000) / (128 * \text{DEG\_PER\_RAD})$$

## 7.4 PGN\_61482 Status

The status byte is comprised of status for each value measure.

**Table 11. PGN\_61482 Status**

Status			Unused
Pitch	Roll	Yaw	
00b	00b	00b	00b

All status definitions are defined as:

00b = FullyFunctional

01b = Degraded

10b = Error

11b = NotAvailable

i.e. 0xCF02AE2, 0x00, 0x7D, 0x00, 0x7D, 0x00, 0x7D, 0x00, 0x05

Transmit 0°/s pitch rate, roll rate, and yaw rate with priority 3, fully functional MEMs with 5 mS latency from address 0xE2.

## 7.5 PGN\_61485 (0xF02D) Accelerometer broadcast

**Table 12. PGN\_61485 Details**

Lateral		Longitudinal		Vertical		Status	Latency
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte
0x00	0x7D	0x00	0x7D	0x00	0x7D	0x00	0x0A
BL	BH	BL	BH	BL	BH		

$$\text{uint16\_t} \text{uint16} = B_H * 2^8 + B_L$$

$$\text{Acceleration rate (m/s}^2\text{)} = (\text{uint16} - 32000) / (100 * \text{MS2\_PER\_G})$$

The status byte is comprised of status for each value measure.

**Table 13. PGN\_61485 Status**

Status			Unused
Pitch	Roll	Yaw	
00b	00b	00b	00b

All status definitions are defined as:

00b = FullyFunctional

01b = Degraded

10b = Error

11b = NotAvailable

i.e. 0xCF02DE2, 0x00, 0x7D, 0x00, 0x7D, 0xD5, 0x80, 0x00, 0x05

Transmit 0 m/s<sup>2</sup> on lateral and longitudinal acceleration, and +1 g (9.80665m/s<sup>2</sup>) on vertical acceleration with priority 3, fully functional MEMs with 5 mS latency from address 0xE2.

## **⚠ WARNING** **PERSONAL INJURY**

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

**Failure to comply with these instructions could result in death or serious injury.**

## **⚠ WARNING** **IMPROPER INSTALLATION**

- Consult with local safety agencies and their requirements when designing a machine-control link, interface, and all control elements that affect safety.
- Strictly adhere to all installation instructions.

**Failure to comply with these instructions could result in death or serious injury.**

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