CAN Output Specification - Overview

The TDR-2-J1939 series inclinometer utilises a communications interface in accordance with the SAE J1939 standard. It utilises the proprietary PGN 0xFF52 for serial number information, 0xFF53 for angle data, and 0xFF54 for user-adjustable settings. Standard PGNs 0xEE00 and 0xEA00 are used for arbitrary address functions, however AAC is not enabled in this product.

Interface		
CAN Specification	ISO 11898, Basic and Full CAN 2.0 B	
Transceiver	24V-compliant, not isolated	
Communication profile	SAE J1939	
Bit rate	250Kbps	
Termination Resistor	None (factory fit option)	
Default Address	TDR-...-1: 0xC2 TDR-...-2: Default 0xC0, adjustable 0x80-0xF7	
Name Field		
Arbitrary address capable	0	No (factory configurable)
Industry Group	3	Global
Vehicle System	0	Non specific
System Instance	0	
Function	136	Unspecified
Function Instance	0	
ECU Instance	0	
Manufacturer	664	Manufacturer ID
Identity Number	nnn	Manufacturers Serial Number
PGNs		
Serial No. request	Proprietary B 0xFF52	
Sensor Tilt Data	Proprietary B 0xFF53	
Control Commands	Proprietary B 0XFF54	
Address claim & request	0xEE00 & 0xEA00	

PGN 65363 (FF53h) - Tilt Sensor Information (Proprietary B)

The vendor-specific PGN is detailed below. It is transmitted with a priority of 4 and a default interval of 40 ms. The CAN ID is 0x10FF53(SA), where 'SA' is the source address:

SPN	Read/ Write	SPN Name	Function	Data Range	Resolution	Offset	Bit Start	Bit Length	Default (After Scaling)	Units (After Scaling)
-	Read	X Axis Tilt	Outputs X axis tilt reading x100 transmitted as signed integers with Byte 0 = LSB, Byte 1 = MSB	-90° to +90°	0.01° / LSB	0	0	16	-	Degrees
-	Read	Y Axis Tilt	Outputs Y axis tilt reading x100 transmitted as signed integers with Byte 2 = LSB, Byte 3 = MSB	-90° to +90°	0.01° / LSB	0	16	16	-	Degrees
-	Read	Temperature	Outputs Internal temperature in °C transmitted as a signed byte	-127°C to 127°C	1°C / LSB	0	32	8	-	°/C
-	Read	Software Version	Outputs software version bits 4-7 = major, bits 0-3 = minor E.g. 0x3C = 3.12	N/A	N/A	0	40	8	-	-
-	Read	Time Stamp	Increments value at each transmission to prevent stagnant transmission. Resets to 0000b after 1111b	0 to 15	N/A	0	48	4	-	-
-	Read	Data Status	Reports data validity 0001 = Data available and valid 0011 = Error, see byte 7 error code	0 to 3	1 state / bit	0	52	4	-	-
-	Read	Error Codes	Reports 1 in respective bit position if a fault exists, 0 otherwise: Bit position: 0 = EEPROM Error 1 = Sensor Element Error (X-axis)* 2 = Sensor Element Error (Y-axis)* 3 = Not used 4 = Not used 5 = Over-temperature Error *In event of error, the respective axis output bytes are set to 0xFFFF	NA	1 state / bit	0	56	8	-	-

PGN 60928 (EE00h) - Tilt Sensor Address Claim Message

The TDR inclinometer broadcasts an Address Claim message when connected to a network, powered on, or requested to do so by the host. Arbitrary Address Claiming (AAC) is not enabled, therefore the Address Claim message is solely used to identify the sensor within the network and share information with other devices. AAC may be available as a customisation for OEM applications. For more information, please contact our sales team (sales@leveldevelopments.com).

In accordance with the J1939 standard, the broadcast includes a 29-bit identifier followed by 10 data fields, collectively referred to as the device's "Name". The Name is an 8-byte label that provides a unique identity for each ECU. The structure and contents of the Name field is shown in the table below and overleaf.

From a user's perspective, the Name field is constructed in reverse order compared to how it is sent. For example, the Address Claim Message "40 E2 01 53 00 88 00 30" is sent with byte 0 (0x40) first and byte 7 last (0x30), but when analysing the bytes in that order, it is apparent that the data field bytes are arranged in a non-consecutive order.

See overleaf for an analysis of the same message with reverse byte order.

Read/ Write	Field	Data Range	Resolution	Offset	Byte Location	Bit Length	Default (After Scaling)	Units (After Scaling)
Read	Arbitrary address bit	0 to 1	1	0	Byte 7 Bit 7	1	0	-
Read	Industry group	3 only	1	0	Byte 7 Bits 6 to 4	3	3	-
Read	Vehicle system instance	0 only	1	0	Byte 7 Bits 3 to 0	4	0	-
Read	Vehicle system	0 only	1	0	Byte 6 Bits 7 to 1	7	127	-
Read	Reserved bit	0 only	NA	0	Byte 6 Bit 0	1	0	-
Read	Function	136 only	1	0	Byte 5 Bits 7 to 0	8	136	-
Read	Functions Instance	0 only	1	0	Byte 4 Bits 7 to 3	5	0	-
Read	ECU Instance	0 only	1	0	Byte 4 Bit 2 to 0	3	0	-
Read	Manufacturers code	664 only	1	0	MSB: Byte 3 bits 7 to 0. LSB: Byte 2 bits 7 to 5	11	664	-
Read	Serial number	0 to 2097151	1	0	MSB: Byte 2 Bits 4 to 0. (Middle:) Byte 1 Bits 7 to 0. LSB: Byte 0 Bits 7 to 0	21	[Serial no.]	-

PGN 60928 (EE00h) - Tilt Sensor Address Claim Message (Continued)

The example shown on the previous page is transmitted with byte 0 first ("40 E2 01 53 00 88 00 30"), but the fields are constructed in reverse byte order as shown below:

Bit index	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Byte	Byte 7								Byte 6								Byte 5								Byte 4								
Value (hex)	0x30								0x00								0x88								0x00								
Function	Arbitrary Address Bit	Industry group			Vehicle system Instance				Vehicle System							Reserved bit	Function								Function Instance					ECU Instance			Continued below...
Binary	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	

...	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Byte 3								Byte 2								Byte 1								Byte 0							
	0x53								0x01								0xE2								0x40							
	Manufacturer Code MSB								Manufactur-er Code LSB				Serial Number MSB				Serial Number (Middle byte)								Serial Number LSB							
	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0

Field	Length (bits)	Example Values (Binary)	Example Values (Decimal)
Arbitrary address bit	1	0	0
Industry group	3	011	3
Vehicle system Instance	4	0000	0
Vehicle system	7	0000000	0
Reserved bit	1	0	0
Function	8	1000 1000	136
Function Instance	5	00000	0
ECU Instance	3	000	0
Manufacturer Code	11	01010011 000	664
Serial Number	21	00001 11100010 01000000	123456

PGN 59904 (EA00h) - Tilt Sensor Address Claim Request

The Address Claimed Request is used to prompt the transmission of an Address Claimed Message from either a specific node on the network (identified by its Source Address, SA) or all nodes (by using the global destination address 255 as the 'SA').

The CAN ID is 18EA(SA)(MA) where SA is the Source Address of the sensor and MA is the Requestor Source Address.

This request follows the format specified in J1939-21, Section 5.4.2, with a default priority of 6. The data payload is 3 bytes long and contains the PGN being requested.

SPN	Read/Write	SPN Name	Function	Data	Resolution	Offset	Bit Start	Bit Length	Default (After Scaling)	Units (After Scaling)
-	Read	PGN (LSB)	Requestor Source Address (MA)	00	N/A	0	0	8	NA	NA
-	Read	PGN	Indicates Address Claim (0xEA)	0xEA	N/A	0	8	8	NA	NA
-	Read	PGN (MSB)	Source Address (SA) or global (255)	(SA) / 0xFF	N/A	0	16	8	NA	NA

The table below shows the commands used to request the Address Claim Message response from each of the two available TDR-...-CANJ product variants. The examples are based on a requestor address 0xF8.

Part Number	CAN ID	Data	Description
TDR-2-[ ]-J1939-1	18EAC0F8	00 EA C0	Initiates an Address Claim message with the fixed Source Address (0xC0).
TDR-2-[ ]-J1939-2	18EAC2F8	00 EA C2	Initiates an Address Claim message with the Source Address set to the default (0xC2).

PGN 65364 (FF54h) - Master Control Commands (Proprietary B)

Control commands allow configuration and operational control of the TDR sensor. These commands are initiated by sending a specific command byte, with the remaining data defined based on the selected command. The CAN ID is 0x10FF54(MA), where 'MA' is the controller source address.

Please note: Source Address change commands are not available for TDR-2-[ ]-J1939-1, and all example commands below assume the target sensor's serial number is 123456.

The fundamental format for the control commands is as follows:

Byte(s)	Function
0	Command Byte
1-7	Controls the parameters of the command,

The complete list of available commands and adjustable parameters are outlined below:

Command Type	Byte 0	Byte 1	Bytes 2-7	Example Command (hex)
Request sensor S/N from sensor (see overleaf for response format)	0x00	Not used (0xFF)	Not used (0xFF)	00 FF FF FF FF FF FF FF
Request source address change for specified SN. 0x80 - 0xF7 allowed	0x01	New Source Address (Hex)	Serial Number in BCD	01 C1 00 00 00 12 34 56 (change to C1)
Request sensor to pause all transmission, including replies	0x02	Not used	Not used	02
Request sensor to resume repetitive transmission & replies	0x03	Not used	Not used	03
Request transmission rate change (from min 10ms to max 255ms)	0x04	Transmission rate (ms in Hex)	Serial Number in BCD	04 0A 00 00 00 12 34 56 (set to 10ms)
Request specified SN & SA to return to default source address	0x09	Current Source Address (Hex)	Serial Number in BCD	09 C1 00 00 00 12 34 56 (target SA: C1)
Request a Change to the Low Pass Damping Filter Setting Please note: The low pass filter affects the smoothing (damping) of the output, it does not control the Output Data Rate (ODR) of the sensor)	0x10	0x00 - 0.4Hz damping filter 0x01 - 0.5Hz damping filter 0x02 - 1Hz damping filter 0x03 - 2Hz damping filter 0x04 - 3Hz damping filter 0x05 - 4Hz damping filter 0x06 - 5Hz damping filter 0x07 - 7Hz damping filter 0x08 - 10Hz damping filter 0x09 - 15Hz damping filter 0x0A - 20Hz damping filter	Serial Number in BCD	10 00 00 00 00 12 34 56 10 01 00 00 00 12 34 56 10 02 00 00 00 12 34 56 10 03 00 00 00 12 34 56 10 04 00 00 00 12 34 56 10 05 00 00 00 12 34 56 10 06 00 00 00 12 34 56 10 07 00 00 00 12 34 56 10 08 00 00 00 12 34 56 10 09 00 00 00 12 34 56 10 0A 00 00 00 12 34 56

PGN 65362 (FF52h) - Sensor Serial Number (Proprietary B)

When the sensor receives a request to output it's serial number information, it will respond with an 8 byte message in the following format.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
00	00	00	12	34	56	10	10
Not used	Serial no part 1	Serial no. part 2	Serial no. part 3	Serial no. part 4	Serial no. part 5	Software Version Major	Software Version Major

Byte 0, and the upper nibble of byte 1 are not used. The lower nibble of byte 1 is concatenated with bytes 2 through 5 to give the serial number in BCD (Binary Coded Decimal) format. In the example above, the serial number is "123456" (any leading zeros can be ignored).

Byte 6 holds the software version major in BCD format, while byte 7 holds the software version minor in BCD format. In the example above, the software version is "10.10".