



USER MANUAL
TILTIX MEMS ACS INCLINOMETER WITH J1939 INTERFACE



SAE J1939

User Manual

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1. General Safety Advice

1.1 Important Information

Read these instructions carefully, and have a look at the equipment to become familiar with the device before trying to install, operate, or maintain it.

The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention towards information that clarifies/simplifies a procedure.

Please Note: Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by POSITAL for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained personnel.



The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

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2. About this Manual

2.1 Background

This user manual explains how to install and configure the TILTIX inclinometer with J1939 interface.

2.2 Version Management

- Updated On: 20200305
- Manual_TILTIX_J1939

2.3 Imprint

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2.4 Copyright

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damages resulting from the use of the information contained herein. Further, this publication and features described herein are subject to change without notice.

2.5 User Annotation

All readers are highly welcome to send us feedback and comments about this document.
Depending on your region you can reach us by

e-mail at the following e-mail addresses. For America info@posital.com, for Asia info@fraba.sg, for Europe info@posital.eu.

2.6 Document History

Document	Manual_TILTIX_J1939
Created	20200305
Author	TSC
Reviewers	
Versions	First Release – 20160302

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TILTIX MEMS ACS INCLINOMETER WITH J1939 INTERFACE

3. Introduction

This manual explains how to install and configure the TILTIX gravity referenced inclinometers with a

J1939 interface, suitable for industrial, military and heavy duty applications.

3.1 TILTIX Inclinomter

TILTIX inclinometers sense and measure the angle of tilt (inclination/slope/elevation) of an object with respect to the force of gravity.

The basic principle behind this TILTIX inclinometer is a Micro-Electro-Mechanical Systems (MEMS) sensor cell that is embedded to a fully molded ASIC. The angle is measured with the relative change in electrical capacitance in the MEMS cell.

3.2 TILTIX J1939

The TILTIX J1939 inclinometer is available in industrial and heavy-duty housings, and two measurement axes variants. The single axis measurement variant with a range of 360° and a dual axis measurement capable TILTIX model with a range of $\pm 80^\circ$. In addition to high resolution, accuracy and protection class of IP69K, it has built-in active linearization and temperature

compensation. This makes TILTIX suitable for rugged environments and versatile applications in industrial, heavy duty and military applications.

Various software tools for configuration and parameter-setting are available from different suppliers.

3.3 Typical Applications of TILTIX

- Cranes and Construction Machinery
- Medical Systems
- Elevated Platforms
- Mobile Lifts and Fire Engines
- Automated Guided Vehicles (AGV)
- Automatic Assembling Machinery
- Boring and Drilling Applications
- Leveling and Flattening

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4. Technical Data

4.1 Electrical Data

Model	ACS-080-2-C901	ACS-080-2-C902	ACS-360-1-C901
Measurement Range	± 64°	± 80°	360°
Number of Axes	2	2	1
Resolution	0.01° (0.002 deg/bit)		
Accuracy (T = -10 °C to +40 °C)*	0.1°		
Temperature Gradient	0.004°/ K		
Sensor Response Time	10 ms (without filter)		
Recommended Measurement Rate	Up to 10 Hz		
Interface	SAE J1939 Transceiver According ISO 11898, Galvanically Isolated by Opto-Couplers		
Transmission Rate	Adjustable: Max. 1 MBaud (Default Setting : 250 kBaud)		
Addressing	Default Setting: 192		
Supply Voltage	10 to 30 VDC (Absolute Maximum Ratings)		
Current Consumption	Max. 57 mA at 10 V DC; Max. 53 mA at 24 V DC		
EMC	Emitted Interference: EN 61000-6-4		
	Noise Immunity : EN 61000-6-2		

4.2 Mechanical Data

For additional electrical and mechanical information please refer to the product specific datasheet available at posital.com

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4.3 Programmable Parameters

Resolution per 1°	The resolution parameter per 1° is used to program the desired number (1°, 0.1° and 0.01°) of steps per 1°.
Preset Value	The Preset value is the desired position value, which should be reached at a certain physical position of the axis. The position value is set to the desired process value by the preset parameter.
Moving Average-Filter	This filter can be used to adjust the bandwidth of measuring values to minimize the influence of vibration. Factory Setting: Moving average filter activated for 20 subsequent readouts.
Digital Recursive Filter	This filter can be used for weighting the last measured value with the last previous value. This is useful to suppress sudden peaks in the angle measurement.

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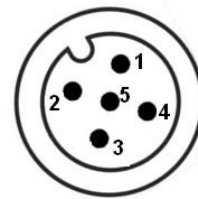
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5. Installation

5.1 Pin Assignment

The inclinometer is connected via an integrated cable or a 5-pin round M12 connector. (Standard M12, Male side at sensor, Female at connector counterpart or connection cable).

Signal	5 pin round connector (ACS...P_)	Cable Exit ACS...- _W)
CAN Ground	1	Green
VS Supply Voltage	2	Red
0 V Supply Voltage	3	Yellow
CAN High	4	White
CAN Low	5	Brown



5.2 Installation Precautions



Warning: Do not remove or mount while the inclinometer is under power!



Avert any modifications to the housing!



Avoid mechanical load!

Prior to installation, please check for all connections and mounting instructions to be complied with. Please also observe the general rules and regulations on operating low voltage technical devices, for safety and sustainability of TILTIX Inclinometers over a long period of time.

Please read the installation leaflet for detailed instructions and precautions during mounting and installation.

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5.3 Mounting Instructions

TILTIX is a pre-calibrated device which can be put into immediate operation, upon simple and easy installation. The mounting surface must be plane and free of dust and grease. We recommend hex-head screws with M4 or UNC bolts #6 (TILTIX Industrial) and M6 or UNC bolts $\frac{1}{4}$ (TILTIX Heavy-Duty) for the best possible and secure mounting.

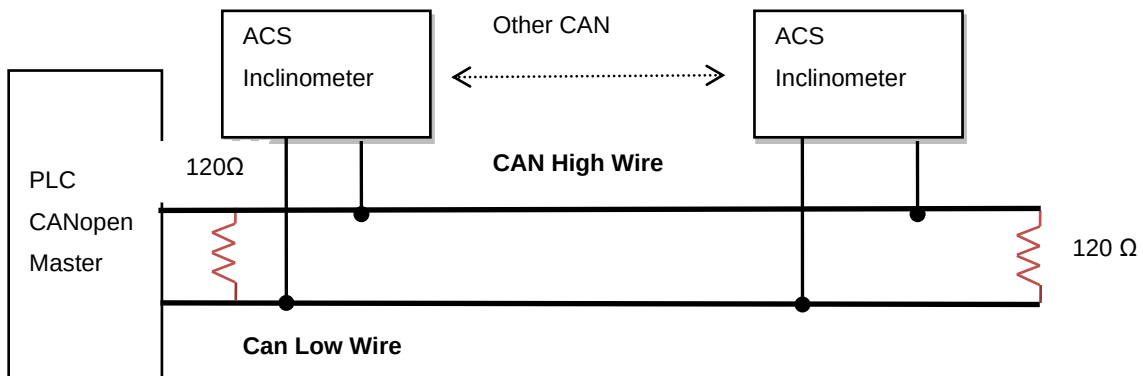
Use all screw holes for mounting but restrict the tightening torque in the range of 1.5 – 2.5 Nm for the screws. The M12 connectors are to be perfectly aligned and screwed till the end with a tightening torque in the range of 0.4 – 0.6 Nm. Use the same tightening torque for all the screws. Strain relief should be applied to the cable within 6" of mounting to prevent excessive stress on the housing.

5.4 Bus Termination

If the inclinometer is connected at the end or beginning of the bus or is used at transmission ≥ 50 kBaud a termination resistor of 120 Ohm must be used in order to prevent reflection of information back into the CAN bus. TILTIX sensors have built-in termination resistors that can be activated (1) or deactivated (0) if necessary.

The bus wires can be routed in parallel or twisted, with or without shielding in accordance with the electromagnetic compatibility requirements. A single line structure minimizes reflection.

The following diagram shows the components for the physical layer of a two-wire CAN bus:

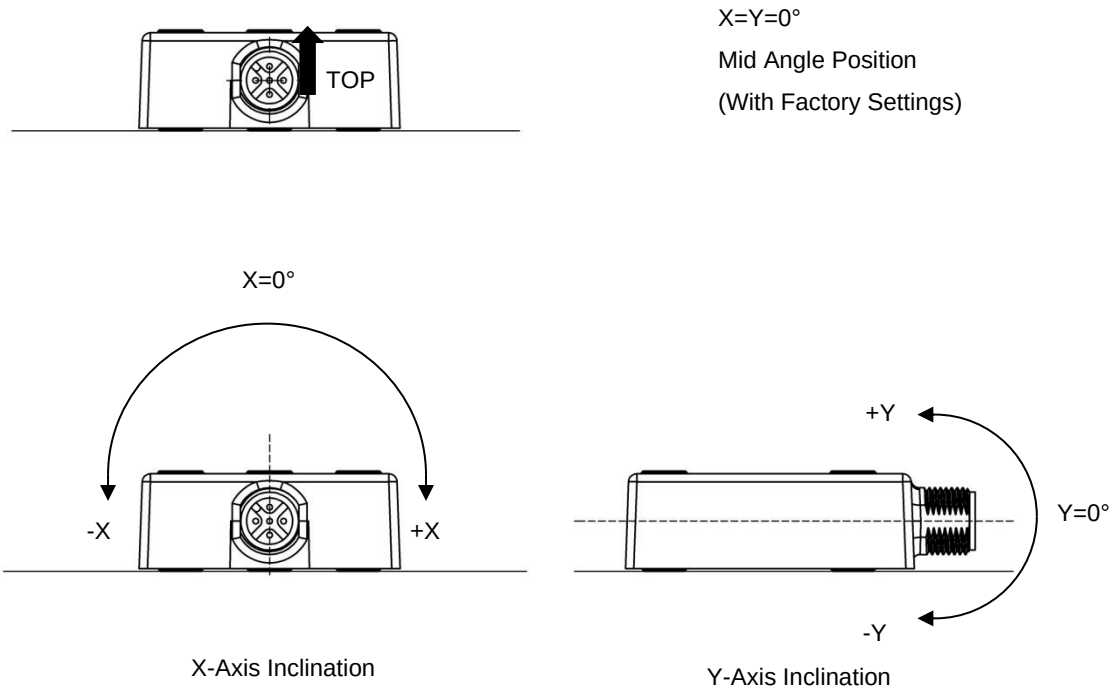


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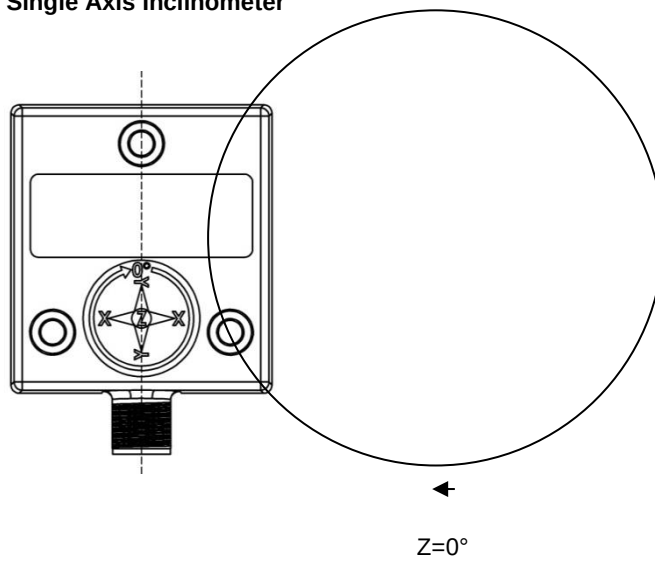
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5.5 Measurement Axes

TILTIX 80 – Dual Axis Inclinometer



TILTIX360 – Single Axis Inclinometer



Initial Starting Point (Factory Settings)

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5.6 LED Definition

Status LED (Dual colored) Green / Red LED	Meaning
Green off	No power supply
Green on	Normal operation mode
Red off	Normal operation mode
Red single flash	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
Red blinking	General configuration error (e.g. wrong baud rate)
Red on	The can controller is in state bus off. No communication is possible anymore. Too many error frames in the network.

Since a dual color LED is used, only the red LED is shown in cases where both green and red LED would light up.

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6. PGN, SPN, read/write parameter

For version **ACS-080-2-C901:**

SAE standard PGN 61459 (dual axis): Slope Sensor Information

Inclinometer position	Broadcast communication
Transmission repetition rate	10 ms (default)
Data Length	8 bytes
PDU format PF	0xF0
PDU specific PS	0x13
Default priority	6
Parameter group number PGN	61459

PGN 61459 SPN Content

SPN name	SPN position (bit)	SPN size (bit)	Resolution	Offset	Data range	Description
Pitch angle	0-15	16	0.002 °/bit	-64°	--64 to 64°	Pitch Angle
Roll angle	16-31	16	0.002 °/bit	-64°	--64 to 64°	Roll Angle Data
Pitch rate	32-47	2	4 states	-64°/s	--64 to 64°	Pitch rate not supported (0xffff)
Pitch angle figure of merit	48-49	2	4 states	0	0 to 3	00b: value in range, 01b: value out of range
Roll angle figure of merit	50-51	2	4 states	0	0 to 3	00b: value in range, 01b: value out of range
Pitch rate figure of merit	52-53	2	4 states	0	0 to 3	11b: not supported
Pitch and roll compensated	54-55	2	4 states	0	0 to 3	01b: compensation on
Pitch and roll measurement latency	56-63	8	0.5 ms/bit	0	0 to 125 ms	Estimated measurement latency (0.5 ms/count ->fixed @ 100ms right now)

Configuration write Parameter (for device address C0)

Identifier	CAN data	Meaning	Data type
0x18EFC0xx	01 00 xx xx xx xx xx xx	Index 0x01: Direction pitch (0: SAE J670, 1: opposite direction)	UINT8
0x18EFC0xx	02 00 xx xx xx xx xx xx	Index 0x02: Direction roll (0: SAE J670, 1: opposite direction)	UINT8
0x18EFC0xx	03 xx xx xx xx xx xx xx	Index 0x03: Resolution pitch (not settable, default: 500 -> 0.002°/count)	(UINT16)
0x18EFC0xx	04 xx xx xx xx xx xx xx	Index 0x04: Resolution roll (not settable, default: 500 -> 0.002°/count)	(UINT16)
0x18EFC0xx	05 0A 00 xx xx xx xx xx	Index 0x05: cycle time PGN 61459 (1ms/count, default: 10)	UINT16
0x18EFC0xx	06 C0 xx xx xx xx xx xx	Index 0x06: Address (0-253 allowed, default: 192)	UINT8
0x18EFC0xx	07 04 xx xx xx xx xx xx	Index 0x07: Baudrate (default: 4 -> 250kbaud)	UINT8
0x18EFC0xx	08 00 xx xx xx xx xx xx	Index 0x08: Active filter (0: mov. avg., 1: recursive, 2: linear regression; default: 0)	UINT8
0x18EFC0xx	09 00 00 xx xx xx xx xx	Index 0x09: Preset pitch (max offset of 15° with respect to default allowed)	INT16

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0x18EFC0xx	0A 00 00 xx xx xx xx xx	Index 0x0A: Preset roll (max offset of 15° with respect to default allowed)	INT16
0x18EFC0xx	0B 00 xx xx xx xx xx xx	Index 0x0B: Termination resistor (0: off, 1: on)	UINT8
0x18EFC0xx	0C 00 00 xx xx xx xx xx	Index 0x0C: Recursive filter factor (0-1000 old value, scaled with 1000; default: 0)	UINT16
0x18EFC0xx	0D 02 xx xx xx xx xx xx	Index 0x0D: Internal sensor update rate (1,2,4ms; default: 2ms)	UINT8
0x18EFC0xx	0E 64 xx xx xx xx xx xx	Index 0x0E: Mov. avg. Size (0-250; default: 100)	UINT8
0x18EFC0xx	FA 73 61 76 65 xx xx xx	Index 0xFA: Save all parameter non-volatile with reset	UINT32
0x18EFC0xx	FC 6C 6F 61 64 xx xx xx	Index 0xFC: Restore all parameter to factory default with reset	UINT32

xx: source/destination address

Configuration Read Parameter (for device address C0)

Direction	Identifier	CAN data	Meaning	Data type
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	01 00 FF FF FF FF FF FF	Index 0x01: Direction pitch (default: 0)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	02 00 FF FF FF FF FF FF	Index 0x02: Direction roll (default: 0)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	03 F4 01 FF FF FF FF FF	Index 0x03: Resolution pitch (default: 500 -> 0.002°/count)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	04 F4 01 FF FF FF FF FF	Index 0x04: Resolution roll (default: 500 -> 0.002°/count)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	05 0A 00 FF FF FF FF FF	Index 0x05: Cycle time in ms (default: 10, 1ms/count)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	06 C0 FF FF FF FF FF FF	Index 0x06: Address (default: 192)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	07 04 FF FF FF FF FF FF	Index 0x07: Baud rate (default: 4 -> 250kBaud)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	08 00 FF FF FF FF FF FF	Index 0x08: Active filter (default: 0 -> moving average)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	09 00 00 FF FF FF FF FF	Index 0x09: Preset pitch (default: 0)	INT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0A 00 00 FF FF FF FF FF	Index 0x0A: Preset roll (default: 0)	INT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0B 00 FF FF FF FF FF FF	Index 0x0B: Termination resistor (default: 0 -> off)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	
Response	0x18EFxxC0	0C 00 00 FF FF FF FF FF	Index 0x0C: Recursive filter factor (default: 0 -> off)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	
Response	0x18EFxxC0	0D 02 FF FF FF FF FF FF	Index 0x0D: Internal sensor update time (default: 2ms)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	
Response	0x18EFxxC0	0E 64 FF FF FF FF FF FF	Index 0x0E: Moving average filter size (default: 100)	UINT8

xx: source/destination address

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For version **ACS-080-2-C902:**

PGN 65283 (dual axis)

Inclinometer position	Broadcast communication
Transmission repetition rate	10 ms (default)
Data Length	8 bytes
PDU format PF	0xFF
PDU specific PS	0x03
Default priority	6
Parameter group number PGN	65283

PGN 65283 SPN Content

SPN name	SPN position (bit)	SPN size (bit)	Resolution	Offset	Data range	Description
Pitch angle (extended range)	0-15	16	0.01°	0	--80 to 80°	Pitch Angle
Roll angle (extended range)	16-31	16	0.01°	0	--80 to 80°	Roll Angle Data
Pitch rate	32-63	18	-	-	-	Reserved (0x00)

Configuration write Parameter (for device address C0)

Identifier	CAN data	Meaning	Data type
0x18EFC0xx	01 00 xx xx xx xx xx xx	Index 0x01: Direction pitch (0: SAE J670, 1: opposite direction)	UINT8
0x18EFC0xx	02 00 xx xx xx xx xx xx	Index 0x02: Direction roll (0: SAE J670, 1: opposite direction)	UINT8
0x18EFC0xx	03 xx xx xx xx xx xx xx	Index 0x03: Resolution pitch (not configurable, default: 100)	UINT8
0x18EFC0xx	04 xx xx xx xx xx xx xx	Index 0x04: Resolution roll (not configurable, default: 100)	UINT8
0x18EFC0xx	05 0A 00 xx xx xx xx xx	Index 0x05: Cycle time PGN 65283 (1ms/count, default: 10)	UINT16
0x18EFC0xx	06 C0 xx xx xx xx xx xx	Index 0x06: Address (0-255 allowed, default: C0 h; 192d)	UINT8
0x18EFC0xx	07 04 xx xx xx xx xx xx	Index 0x07: Baudrate (default: 4 -> 250kBaud)	UINT8
0x18EFC0xx	08 00 xx xx xx xx xx xx	Index 0x08: Active filter (0: mov. avg., 1: recursive, 2: linear regression; default: 0)	UINT8
0x18EFC0xx	09 00 00 xx xx xx xx xx	Index 0x09: Preset pitch	INT16
0x18EFC0xx	0A 00 00 xx xx xx xx xx	Index 0x0A: Preset roll	INT16
0x18EFC0xx	0B 00 xx xx xx xx xx xx	Index 0x0B: Termination resistor (0: off, 1: on)	UINT8
0x18EFC0xx	0C 00 00 xx xx xx xx xx	Index 0x0C: Recursive filter factor (0-1000 old value, scaled with 1000; default: 0)	UINT16
0x18EFC0xx	0D 02 xx xx xx xx xx xx	Index 0x0D: Internal sensor update rate (1,2,4ms; default: 2ms)	UINT8
0x18EFC0xx	0E 64 xx xx xx xx xx xx	Index 0x0E: Mov. avg. Size (0-250; default: 100)	UINT8
0x18EFC0xx	FA 73 61 76 65 xx xx xx	Index 0xFA: Save all parameter non-volatile with reset	UINT32
0x18EFC0xx	FC 6C 6F 61 64 xx xx xx	Index 0xFC: Restore all parameter to factory default with reset	UINT32

xx: source/destination address

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Configuration Read Parameter (for device address C0)

Direction	Identifier	CAN data	Meaning	Data type
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	01 00 FF FF FF FF FF FF	Index 0x01: Direction pitch (default: 0)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	02 00 FF FF FF FF FF FF	Index 0x02: Direction roll (default: 0)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	03 64 00 FF FF FF FF FF	Index 0x03: Resolution pitch (default: 100)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	04 64 00 FF FF FF FF FF	Index 0x04: Resolution roll (default: 100)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	05 0A 00 FF FF FF FF FF	Index 0x05: Cycle time in ms (default: 10, 1ms/count)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	06 C0 FF FF FF FF FF FF	Index 0x06: Address (default: 192)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	07 04 FF FF FF FF FF FF	Index 0x07: Baud rate (default: 4 -> 250kBaud)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	08 00 FF FF FF FF FF FF	Index 0x08: Active filter (default: 0 -> moving average)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	09 00 00 FF FF FF FF FF	Index 0x09: Preset pitch (default: 0)	INT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0A 00 00 FF FF FF FF FF	Index 0x0A: Preset roll (default: 0)	INT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0B 00 FF FF FF FF FF FF	Index 0x0B: Termination resistor (default: 0 -> off)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0C 00 00 FF FF FF FF FF	Index 0x0C: Recursive filter factor (default: 0 -> off)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0D 02 FF FF FF FF FF FF	Index 0x0D: Internal sensor update time (default: 2ms)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0E 64 FF FF FF FF FF FF	Index 0x0E: Moving average filter size (default: 100)	UINT8

xx: source/destination address

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For version **ACS-360-1-C901:**

PGN 65467 (single axis)

Inclinometer position	Broadcast communication
Transmission repetition rate	10 ms (default)
Data Length	8 bytes
PDU format PF	0xFF
PDU specific PS	0xBB
Default priority	6
Parameter group number PGN	65467

PGN 65467 (single axis) SPN Content

SPN name	SPN position (bit)	SPN size (bit)	Resolution	Offset	Data range	Description
Angle z-axis	0-31	32	0.1°	0	0 to 360°	z-axis angle
Pitch rate	32-63	18	-	-	-	Reserved (0x00)

Configuration write Parameter (for device address C0)

Identifier	CAN data	Meaning	Data type
0x18EFC0xx	01 00 xx xx xx xx xx xx	Index 0x01: Direction z-axis according to datasheet	UINT8
0x18EFC0xx	03 F4 01 xx xx xx xx xx	Index 0x03: Resolution z-axis (default: 500 -> 0.002°/count)	UINT16
0x18EFC0xx	05 0A 00 xx xx xx xx xx	Index 0x05: cycle time PGN 65467 (1ms/count)	UINT16
0x18EFC0xx	06 C0 xx xx xx xx xx xx	Index 0x06: Address (0-255 allowed, default: 192)	UINT8
0x18EFC0xx	07 04 xx xx xx xx xx xx	Index 0x07: Baudrate (default: 4 -> 250kBaude)	UINT8
0x18EFC0xx	08 00 xx xx xx xx xx xx	Index 0x08: Active filter (0: mov. avg., 1: recursive, 2: linear regression; default: 0)	UINT8
0x18EFC0xx	09 00 00 00 00 xx xx xx	Index 0x09: Preset z-axis (in current resolution, range 0-(360*res-1))	INT32
0x18EFC0xx	0B 00 xx xx xx xx xx xx	Index 0x0B: Termination resistor (0: off, 1: on)	UINT8
0x18EFC0xx	0C 00 00 xx xx xx xx xx	Index 0x0C: Recursive filter factor (0-1000 old value, scaled with 1000; default: 0)	UINT16
0x18EFC0xx	0D 02 xx xx xx xx xx xx	Index 0x0D: Internal sensor update rate (1,2,4ms; default: 2ms)	UINT8
0x18EFC0xx	0E 64 xx xx xx xx xx xx	Index 0x0E: Mov. avg. Size (0-250; default: 100)	UINT8
0x18EFC0xx	FA 73 61 76 65 xx xx xx	Index 0xFA: Save all parameter non-volatile with reset	UINT32
0x18EFC0xx	FC 6C 6F 61 64 xx xx xx	Index 0xFC: Restore all parameter to factory default with reset	UINT32

xx: source/destination address

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Configuration Read Parameter (for device address C0)

Direction	Identifier	CAN data	Meaning	Data type
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	01 00 FF FF FF FF FF FF	Index 0x01: Direction z-axis (default: 0)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	03 F4 01 FF FF FF FF FF	Index 0x03: Resolution z-axis (default: 500 -> 0.002°/count)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	05 0A 00 FF FF FF FF FF	Index 0x05: Cycle time in ms (default: 10, 1ms/count)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	06 C0 FF FF FF FF FF FF	Index 0x06: Address (default: 192)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	07 04 FF FF FF FF FF FF	Index 0x07: Baud rate (default: 4 -> 250kbaud)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	08 00 FF FF FF FF FF FF	Index 0x08: Active filter (default: 0 -> moving average)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	09 00 00 00 00 FF FF FF	Index 0x09: Preset z-axis (default: 0)	INT32
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0B 00 FF FF FF FF FF FF	Index 0x0B: Termination resistor (default: 0 -> off)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0C 00 00 FF FF FF FF FF	Index 0x0C: Recursive filter factor (default: 0 -> off)	UINT16
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0D 02 FF FF FF FF FF FF	Index 0x0D: Internal sensor update time (default: 2ms)	UINT8
Request	0x18EAC0xx	00 EF 00	Read request	-
Response	0x18EFxxC0	0E 64 FF FF FF FF FF FF	Index 0x0E: Moving average filter size (default: 100)	UINT8

xx: source/destination address

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7. Examples

Filter Examples

Moving Average Filter		
Filter time 300ms, internal sensor update time 2ms Therefore the moving average filter size: $300\text{ms}/2\text{ms} \rightarrow 150$		
Identifier	CAN data	Description
0x18EFC0xx	08 00 xx xx xx xx xx xx	Set moving average as active filter
0x18EFC0xx	0E 96 xx xx xx xx xx xx	Set moving average filter size to 150 (96h)
0x18EFC0xx	0D 02 xx xx xx xx xx xx	Set internal sensor update time to 2ms

Recursive Filter Example		
99% of end value after 200ms, internal sensor update rate 4ms $200\text{ms}/4\text{ms} = 50$ iterations, $100\% - 99\% = 1\% = 0.01 \rightarrow 50\text{th root of } 0.01 = 0.912 \rightarrow \text{filter value } 912$ (factor 1000)		
Identifier	CAN data	Description
0x18EFC0xx	08 01 xx xx xx xx xx xx	Set recursive filter as active filter
0x18EFC0xx	0C 90 03 xx xx xx xx xx	Set recursive filter factor to 912 (390h)
0x18EFC0xx	0D 04 xx xx xx xx xx xx	Set internal sensor update time to 4ms

Linear Regression Example		
Linear regression filter is not adjustable, but internal sensor update time is Filter time 125ms per 1ms internal sensor update time; filter time 250ms $\rightarrow$ internal sensor update time 2ms		
Identifier	CAN data	Description
0x18EFC0xx	08 02 xx xx xx xx xx xx	Set linear regression
0x18EFC0xx	0D 02 xx xx xx xx xx xx	Set internal sensor update time to 2ms

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8. Example to Change Address of Device

- Hardware : CAN Capture by Murphy Controls
- Software : dataTaker
- Part No: ACS-360-1-C901-VK2-PM

Original Address: 0xC0 (192d)

New Address: 0xC1 (193d)

Type	Priority	PDU-F	PDU-S	Src Addr	PGN	PID	DLC	Data
29-Bit	6	FF	BB	C0	FFBB	18FFBBC0	8	D4 AC 01 00 FF FF FF FF
29-Bit	6	EA	C0	00	EAC0	18EAC000	3	00 EF 00
29-Bit	6	EF	00	C0	EF00	18EF00C0	8	06 C1 00 FF FF FF FF FF
29-Bit	6	EF	C0	00	EFC0	18EFC000	8	FA 73 61 76 65 00 00 00
29-Bit	6	FF	BB	C1	FFBB	18FFBBC1	8	B2 B7 01 00 FF FF FF FF

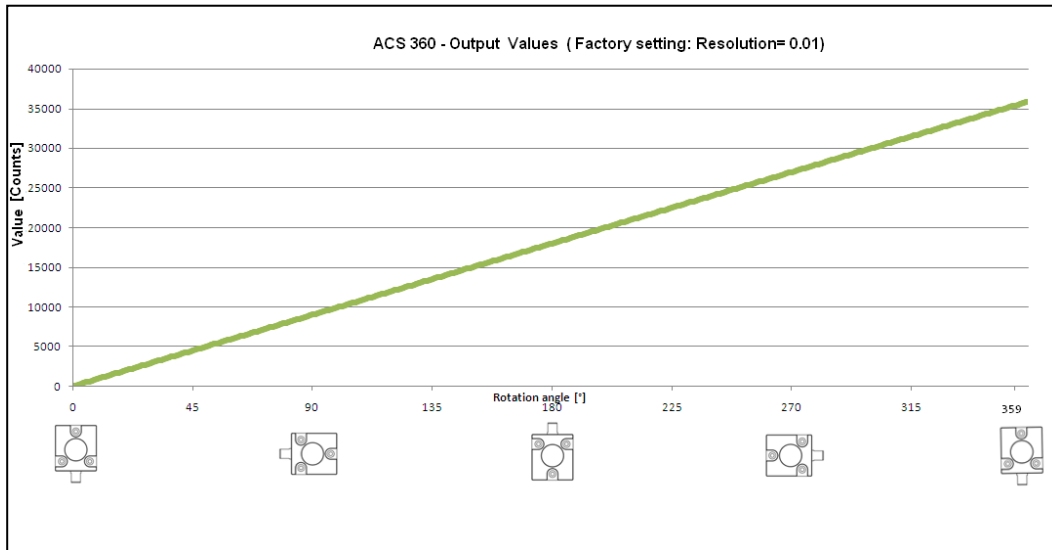
Row 3 is the example for data sent to change
Row 4 is the required store and reset message
sent on the older address

Row 5 is the new position value coming from the
newly addressed 0xC1

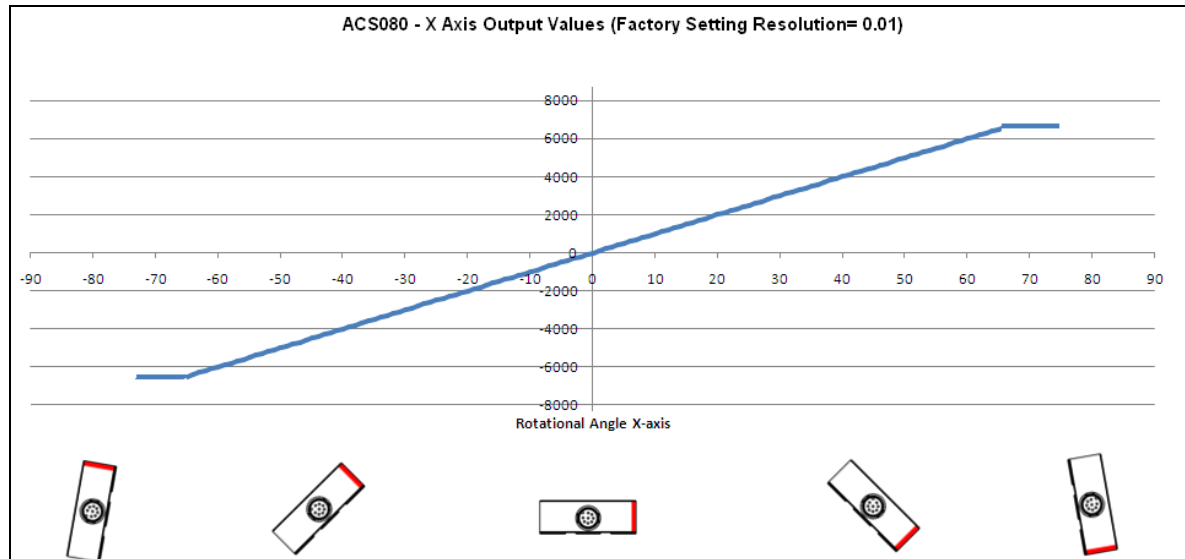
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9. Output Graphs

9.1 TILTIX 360: J1939 Output Values

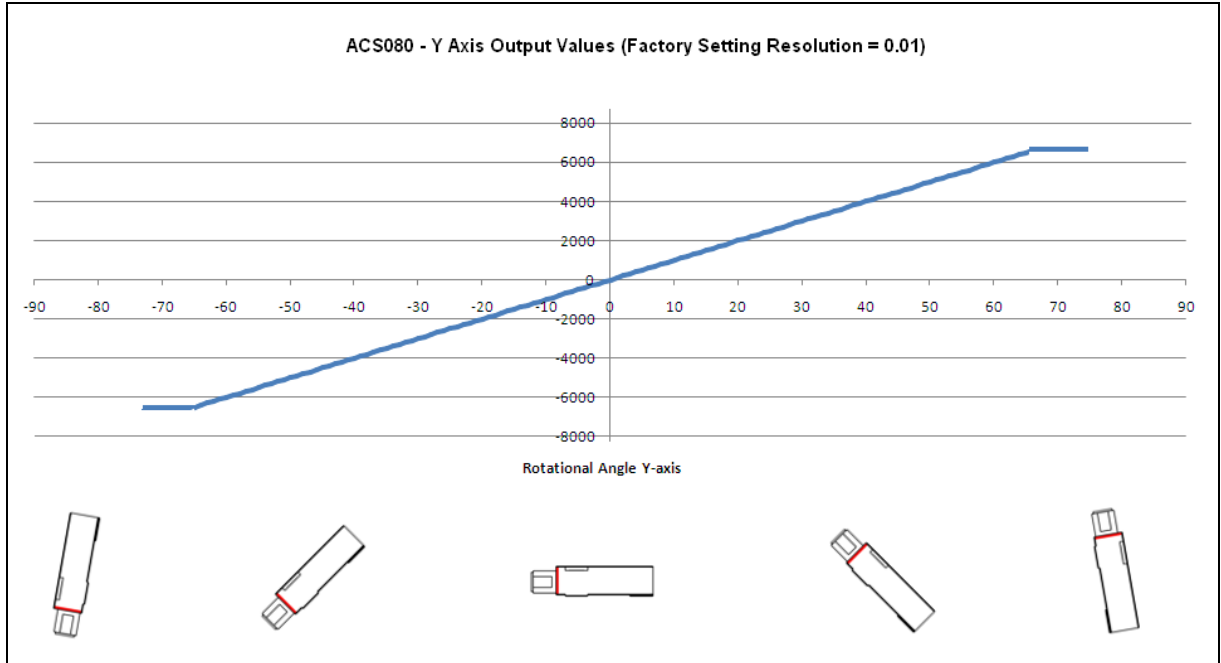


9.2 TILTIX 080: J1939 Output Values



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