MCA-85

Inclinomètre biaxe +/- 85° - SAE J1939 (CAN)

▶ GENERAL DESCRIPTION

MCA-85 is a Tilt Sensor with CANbus Interface (SAE J1939) designed for the field of industrial control, built-in high-precision A / D differential converter, through 5 filtering algorithm, which can measure the angle of sensor output relative to the horizontal tilt and pitch tilt.

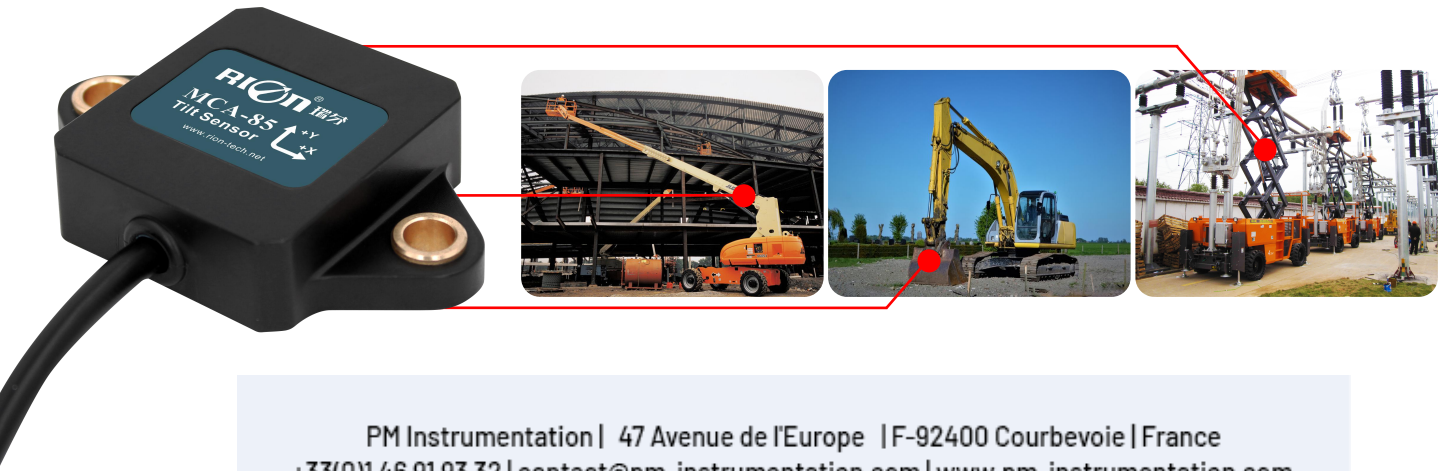
Because of built in high precision digital temperature sensor that can correct the sensor temperature drift in accordance with the changes of the built-in temperature sensor, to ensure high repeatability of the product in the low-temperature and high-temperature environment. The output frequency response standards up to 100Hz, for higher response frequency division we can customize according to the user requests. The products are truly industrial-grade products, reliable performance, scalability, and a variety of output options. Suitable for a variety of harsh industrial control environment.

▶ FEATURES

- Tilt Sensor
- Accuracy: refer to the technical data
- Wide temperature working: -40～+85°C
- I P67 protection class
- Direct lead cable interface
- Wide voltage input: 9～36V
- Resolution: 0.01°
- Highly anti-vibration performance >100g

▶ APPLICATION

- Satellite positioning Search
- oil-well drilling equipment
- Radar detection of vehicle platform
- Rail-mobile monitoring
- Based on the angle direction measurement
- Ship’s navigation posture measurement
- Gun Barrel angle measurement in early shooting
- Satellite communications vehicle posture detection
- engineering mechanical measurement of dip angle



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▶ TECHNICAL DATA

PARAMETERS	CONDITIONS	MCA-85	UNIT
Measure range		±85	°
Measure axis		X,Y	
Resolution		0.01	°
Measure accuracy	20°C~30°C	0.1	°
	-40°C~85°C	0.3	°
Long term stability		0.1	°
Power on time		1	S
Response time		0.2	S
Cross-Axis	Full range ±85°	＜0.1	°
Temperature drift	-20°C~60°C	0.007	°/°C
	-40°C~85°C	0.01	
Refresh rate	100Hz		
Output Interface	SAE J1939 CAN2.0B （250 kbps Source Address:0xC0 (default); settable in the range of [0x80–0xF7]）		
EMC	According to EN61000-4-2；ISO7637-2:2011；EN55011		
MTBF	＞80000 hours		
Insulation Resistance	≥100M Ω		
Shockproof	100g@11ms、3 Axial Direction (Half Sinusoid)		
Anti-vibration	10grms、10～1000Hz		
Protection glass	IP67		
Cables	4 wire 0.3mm^2 ,outer diameter Ø6.0 mm；length incl. connector 400 mm, full temperature range, flexible		
Size	L70.5*W45*H15		
Weight	＜80g(Including cable)		

KEY WORDS

Resolution： Refers to the sensor in measuring range to detect and identify the smallest changed value.

Measure accuracy：Refers to in the normal temperature circumstances the sensor linearity, repeatability, hysteresis, zero deviation, and transverse error comprehensive error.

Long term stability : Refers to the sensors in normal temperature conditions, the deviation between the maximum and minimum values after a year's long time work.

Response time： Refers to the sensor in an angle change, the sensor output value reached the standard time required.

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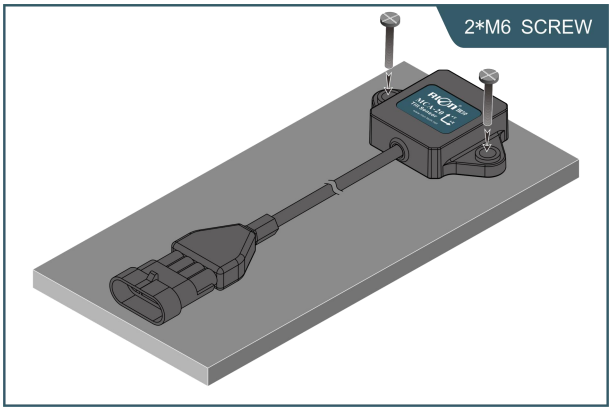
ELECTRONIC CHARACTERISTICS

PARAMETERS	CONDITIONS	MIN	STANDARD	MAX	UNIT
Power supply	Standard	9	12、24	36	V
Working current			＜30		mA
Working temperature		-40		+85	℃
Store temperature		-40		+85	℃

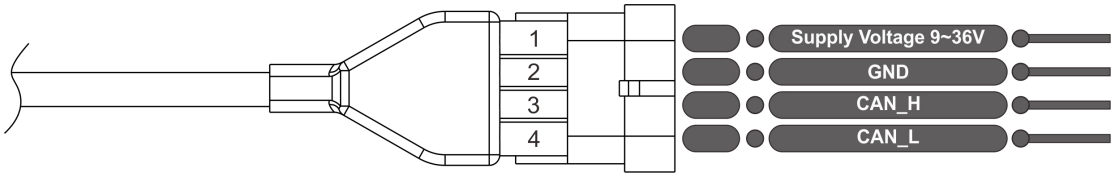
MECHANICAL PARAMETERS

- Protection glass：IP67
- Enclosure material：Plastic
- Installation：2*M6 screws



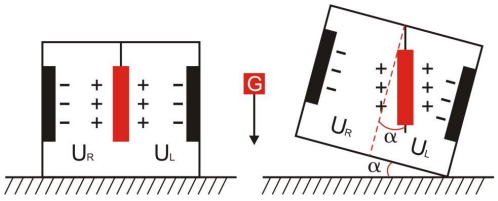
ELECTRICAL CONNECTION

LINE COLOR FUNCTION	PIN1	PIN2	PIN3	PIN4
	9-36V	GND	CAN_H	CAN_L



WORKING PRINCIPLE

Adopt the European import of core control unit, using the capacitive micro pendulum principle and the earth gravity principle, when the the inclination unit is tilted, the Earth's gravity on the corresponding pendulum will produce a component of gravity, corresponding to the electric capacity will change, , by enlarge the amount of electric capacity , filtering and after conversion then get the inclination.



U_R, U_LRespectively is the pendulum left plate and the right plate corresponding to their respective voltage between theelectrodes, when the tilt sensor is tilted, U_R, U_L Will change according to certain rules, so f(U_R, U_L,) On the inclination of α function:

$$\alpha = (U_R, U_L,)$$

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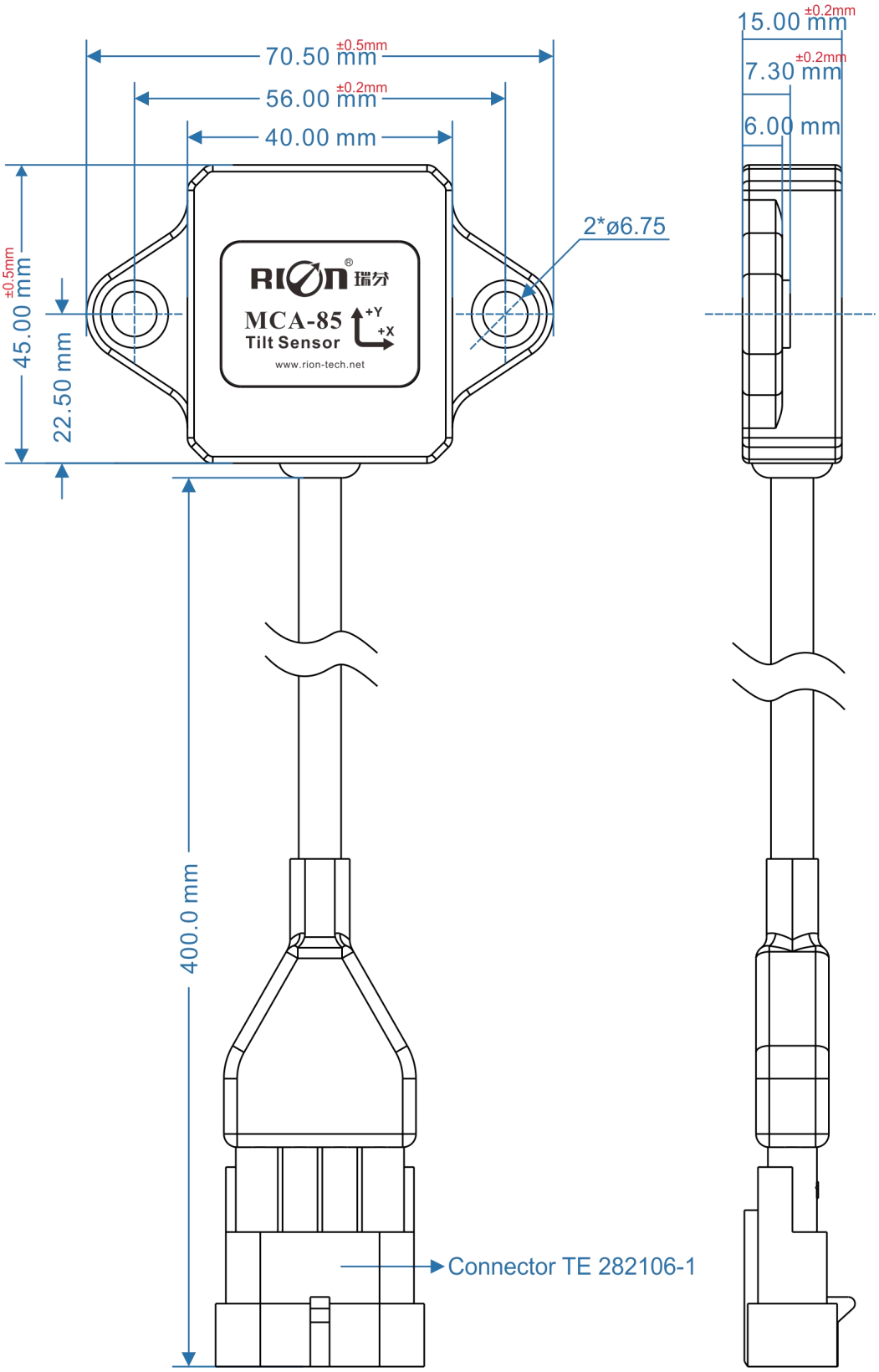
DIMENSION



Shell size: L70.5×W45×H15mm

Installation size: L40×H7.3mm

ounting screws: 2M6 screws

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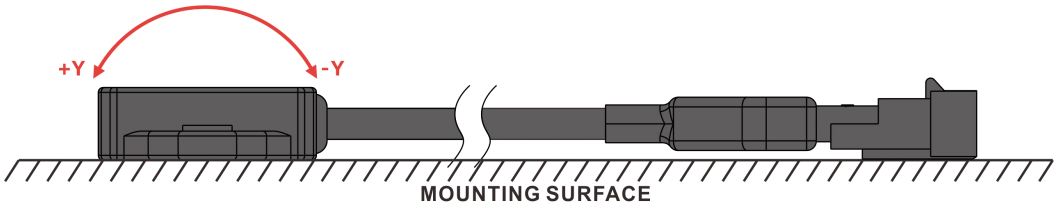
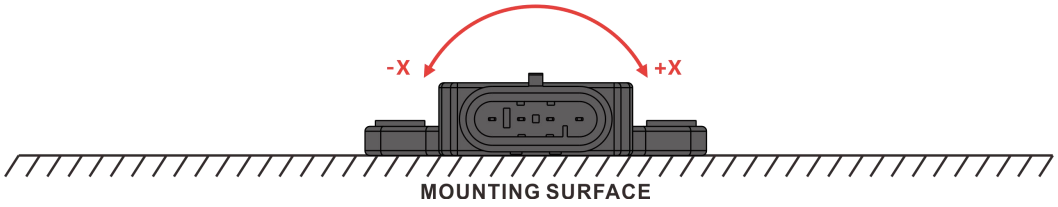
▶ MEASURING DIRECTIONS&FIX

The installation must guarantee the product bottom is parallel to measured face， and reduce the influence of dynamic and acceleration to the sensor. This product can be installed horizontally or mounted vertically (mounted vertically selection is only applicable to the single axis), for installation please refer to the following scheme.



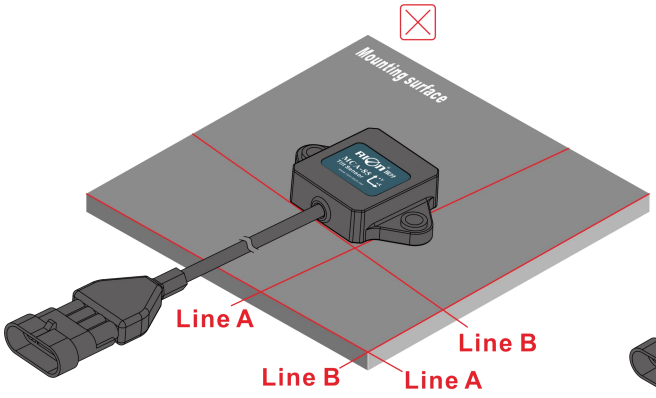


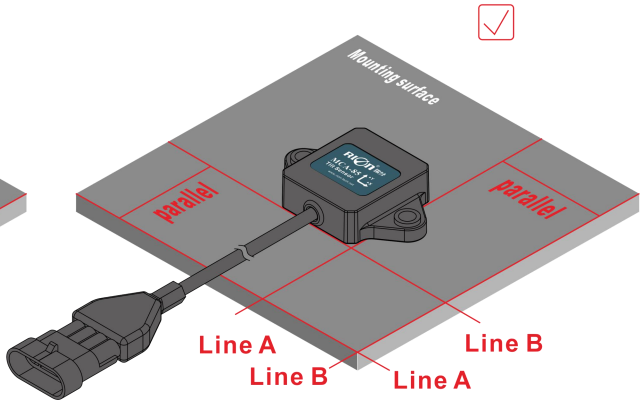
▶ PRODUCTION INSTALLATION NOTES

Please follow the correct way to install tilt sensor, incorrect installation can cause measurement errors, with particular attention to the "surface", "line":：

1）The Sensor mounting surface and the measured surface must be fixed closely, smoothly, stability,if mounting surface uneven likely to cause the sensor to measure the angle error.

2) The sensor axis and the measured axis must be parallel ,the two axes do not produce the angle as much as possible.





▶ PRODUCT PROTOCOL

1. Conventions

The inclinometer complies with SAE J1939 CAN2.0B and uses a baud rate of 250kbps. Proprietary A(0xEF) and B(0xFF) portions of SAE J1939 are used. The 29-bit message identifiers can be formulated using the following scheme.

BIT POSITION	DESCRIPTION
28:26	Priority (6 is lowest; 0 is highest)
25:24	Always 0:0 for SAE J1939
23:16	Data Content (PF)
15:8	Data Content (PS)
7:0	Source Address of Tx Module

2. Source Addresses

The inclinometer sends a onetime address claim message 500ms after startup and upon request by the host.

The following is currently defined.

MODULE	SOURCE ADDRESS
Requestor (MA)	Various (except Inclinometer source address)
Inclinometer (SA)	[0x80 - 0xF7]; 0xC0 (uninitialized)

3. Tilt Angle

Priority: 4 Source Address: SA

Data Content (PF): 0xFF (Proprietary B)

Data Content (PS): 0x53 Repetition Rate: 40mS

DATA	BYTE	FUNCTION
X	0	X-Axis Tilt Reading x100 (Signed Word, LSB)
X	1	X-Axis Tilt Reading x100 (Signed Word, MSB)
X	2	Y-Axis Tilt Reading x100 (Signed Word, LSB)
X	3	Y-Axis Tilt Reading x100 (Signed Word, MSB)
X	4	Internal Temperature (Signed Byte)
X	5	Software Version (Major, Minor upper and lower nibble)
X	6	Data Status and Time Stamp
X	7	Error Codes

Description of Operation:

The inclinometer broadcasts this message periodically to update the host module.

DATA DEFINITION	
Data Bytes 0-1	X-Axis Tilt Reading in hundredths of a degree **Example:**Data Bytes 0, 1 are 0x64, 0x19 for +65.00 deg
Data Bytes 2-3	Y-Axis Tilt Reading in hundredths of a degree **Example:**Data Bytes 2, 3 are 0xD8, 0xDC for -90.00 deg

Data Byte 4	Internal Temperature in degrees Centigrade **Example:**Data Byte 4 is 0x55 for +85 °C Data Byte 4 is 0xD8 for -40 °C
Data Byte 5	Software Version (Major bits 4-7; Minor bits 0-3 in hexadecimal; 0x3C for version 3.12 – decimal implied)
Data Byte 6	Data Status → lower nibble, bits 0-3 0x0000 b During power up or when data is invalid 0x0001 b Data available and valid 0x0011 b Error (see Byte 7 error code for definitions) Time Stamp → upper nibble, bits 4-7 0xXXXX b this number is incremented for every transmission to prevent a stagnant transmission, when 0x1111 b is reached, value rolls over to 0x0000 b
Data Byte 7	Error Codes (bit set = 1 when fault exists; cleared = 0 when no fault present).For error codes refer to Table below.

3.1 Error Codes

FAULT TOPIC	BIT	= 0	=1
EEPROM Error	0	Checksum Ok	Checksum Failure Byte 6 status = 11 b Positional and temperature data transmitted
Not defined	1	Not defined	Not defined
Not defined	2	Not defined	Not defined
Supply Voltage Detection	3	Supply Voltage ≥ 8V	Supply Voltage < 8 V Byte 6 status = 11 b Positional and temperature data transmitted
Overvoltage Error	4	Supply voltage ≤ 28V	Supply Voltage > 28 V Byte 6 status = 11 b Positional and temperature data transmitted
Overtemperature Error	5	PCBA temperature ≤ 90°C	Temperature > 90 °C Byte 6 status = 11 b Positional and temperature data transmitted
Not defined	6	Not defined	Not defined
Not defined	7	Not defined	Not defined

4. Inclinometer Address Claim

Priority: 6 Source Address: SA

Data Content (PF): 0xEE

Data Content (PS): 0xFF Repetition Rate:Once 500ms after startup On Request

DATA	BYTE	FUNCTION
X	0	Serial Number (LSB)
X	1	Serial Number
X	2	Serial Number (MSB), Manufacture Code (LSB)
X	3	Manufacture Code (MSB)

00	4	ECU Instance, Function Instance
88	5	Function
00	6	Reserved
30	7	Vehicle System Instance, Industry Group, Arbitrary Address Claim

Description of Operation:

The inclinometer broadcasts this message per J1939-81, 4.2.2.1 with byte definitions as follows:

DATA DEFINITION	
Data Byte 0	Serial Number, Bits 0 - 7
Data Byte 1	Serial Number, Bits 8 - 15
Data Byte 2, Bits 0-4	Serial Number, Bits 16 - 20
Data Byte 2, Bits 5-7	Manufacturer Code, Bits 0 - 2
Data Byte 3	Manufacturer Code, Bits 3 - 10
Data Byte 4, Bits 0-2	ECU Instance = 0
Data Byte 4, Bits 3-7	Function Instance = 0
Data Byte 5	Function = 136 (Slope Sensor)
Data Byte 6, Bit 0	Reserved = 0
Data Byte 6, Bits 1-7	Vehicle System = 0 (Non-Specific System)
Data Byte 7, Bits 0-3	Vehicle System Instance = 0
Data Byte 7, Bits 4-6	Industry Group = 3 (Construction equipment)
Data Byte 7, Bit 7	Arbitrary Address Claim = 0 (Not Arbitrary)

5.Inclinometer Address Claim Request

Priority: 6 Source Address: MA

Data Content (PF): 0xEA CAN ID 0x10FF54(SA)

Data Content (PS): SA Repetition Rate: As controls dictate

DATA	BYTE	FUNCTION
00	0	PGN (LSB)
EA	1	PGN
C2	2	PGN (MSB)

Description of Operation:

The inclinometer broadcasts the “Inclinometer Address Claim” message upon receiving this message per J1939-21, 5.4.2 with byte definitions as follows:

DATA DEFINITION	
Data Byte 0	PGN – Requestor Source Address
Data Byte 1	PGN (PF) – 0xEA (Address Claim)
Data Byte 2	PGN (PS) – 0xC2 (Chassis Tilt Sensor)

6. Master Control Commands – Chassis Tilt Sensor

Priority: 4 Source Address: MA

Data Content (PF): 0xFF (Proprietary B)

Data Content (PS): 0x54 Repetition Rate: On Request

BYTE	FUNCTION
0	Command Byte
1	As defined for Command Byte
2	As defined for Command Byte
3	As defined for Command Byte
4	As defined for Command Byte
5	As defined for Command Byte
6	As defined for Command Byte
7	As defined for Command Byte

Description of Operation:

The Master shall request the S/N of the Tilt Sensor. The intent is to assign different source addresses to the Chassis Tilt Sensor so that multiple sensors can operate on one CAN Bus. The first byte is the Command Byte specifying the meaning for the rest of the message. The rest of the data depends on the Command Byte as detailed below.

REQUEST FOR SENSOR S/N	
Data Byte 1	0x00 (commands sensor to respond with Sensor Serial Number message)
Data Bytes 2-8	0xFF; not used

REQUEST FOR SOURCE ADDRESS CHANGE	
Data Byte 1	0x01 (commands sensor with specified S/N to change SA to given value; this SA shall be stored in the sensor non-volatile memory)
Data Bytes 2	New Source Address in hexadecimal
Data Bytes 3-8	Serial Number in BCD

REQUEST FOR WAIT	
Data Byte 1	0x02 (commands sensor to send nothing until they get a “GO” message. This includes no response to a subsequent request for serial number commands or address claim)
Data Bytes 2-7	Not used

REQUEST FOR REPETITIVE TRANSMISSION OF DATA	
Data Byte 1	0x03 (“GO” message – commands the sensor to begin repetitive transmission of data)
Data Bytes 2-7	Not used

REQUEST FOR TRANSMISSION RATE CHANGE	
Data Byte 1	0x04 (commands sensor with specified S/N to change the repetitive data transmission rate to given value; this transmission rate shall be stored in the sensor non-volatile memory)
Data Bytes 2	New Transmission Period in milliseconds in hexadecimal (E.g., 20ms=0x14 100ms=0X64 Range:10MS~1000MS Time default is 40MS)
Data Bytes 3-8	Serial Number in BCD

REQUEST FOR RETURN TO UNINITIALIZED SOURCE ADDRESS	
Data Byte 1	0x09 (commands sensor with specified SA and S/N to change its SA currently stored in the sensor non-volatile memory to the uninitialized SA = 0xC0)
Data Bytes 2	Current Source Address in hexadecimal of target sensor
Data Bytes 3-8	Serial Number in BCD of target sensor

6.1 Sensor Serial Number

This message gets transmitted in response to Master Command S/N request.

Priority: 4 Source Address: Inclinometer

Data Content (PF): 0xFF (Proprietary B)

Data Content (PS): 0x52 Repetition Rate:Response

DATA	BYTE	FUNCTION
X	0	Serial Number in BCD (set = 00); populate extra positions with zero
X	1	Serial Number in BCD (set upper nibble=0; upper digit year of production lower nibble; year of production; ex. 14 for 2014; AA)
X	2	Serial Number in BCD (set upper nibble=0; upper digit year of production lower nibble; year of production; ex. 14 for 2014; AA)
X	3	Serial Number in BCD (lower digit of calendar week upper nibble; reserved X lower nibble)
X	4	Serial Number in BCD (most significant sequence digits; upper CC)
X	5	Serial Number in BCD (least significant sequence digits; lower CC)
X	6	Software Revision Major Number in BCD
X	7	Software Revision Minor Number in BCD

SENSOR COMMUNICATION EXAMPLE
After power-up, the Master requests serial number information: Message Sent by Master (MA = 0xD4): 0x10FF54D40000000000000000+CRC…
Response from Uninitialized Sensor: 0x10FF52C00001435000560105+CRC… – Sensor is unassigned (not calibrated; assignment occurs during calibration) & is S/N = 143500056,SW Rev = 1.5 decimal is implied)

The ground control assigns sensor (S/N 143500056) the ID of 0xC1

Message Sent:

0x10FF54D401C1000143500056+CRC…

Message Sent by Master:

0x10FF54D40000000000000000+CRC…

Response from Sensor:s

0x10FF52C10001435000560105+CRC…

The Master sends the “wait for GO” command to the Sensor until conditions are clear to transmit.Message Sent by Master: 0x10FF54D40200000000000000+CRC…
The Master sends the GO message and the sensor responds with data every 40mS Message Sent by Master: 0x10FF54D40300000000000000+CRC… Sensor responds with: (@ 40mS intervals) 0x10FF53C1B400F20F00000000+CRC…