canfield connector

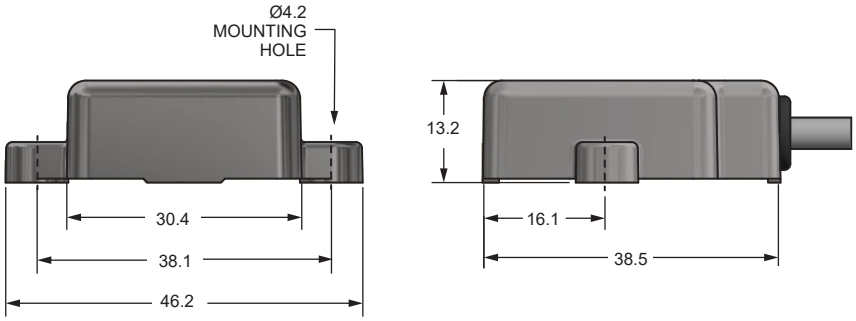
EiS SERIES
J1939 AND CANOPEN
ELECTRONIC
INCLINOMETER SENSORS

GENERAL DESCRIPTION

The Canfield Connector Electronic Inclinometer Sensor EiS is available in two versions, CANopen and SAE J1939 communication interfaces. The EiS CAN BUS versions feature dual axis output designed to measure angles of slope or tilt angles of an object with respect to gravity based on an artificial horizon. Synonyms include tilt sensor, tilt switch, clinometer, slope sensor, slope gauge, level sensor, level meter, tiltmeter or pitch and roll sensor. The EiS Series is an all solid-state, MEMs device designed to measure tilt while reporting the data via CANopen or SAE J1939 within 0.3 degrees accuracy +/- 90°. The unit features a miniature metal housing and is epoxy encapsulated for vibration, water and dust resistance and is rated up to IP 69K environmental rating. The unit boasts a temperature drift of +/- 1° maximum with a temperature range of -40 to 85°C. The EiS CAN BUS versions are precisely calibrated to remove non-linearity in the sensing range. Applications for inclinometers such as the EiS Series include platform leveling, motion sensing, filter vibrations, boom angle sensing, cameras, machine arm angle sensing, engine management as well as mobile security systems. The unit comes with high quality 9 ft. PVC jacketed wire, other lengths and quick connections as options, and is mounted in place by use of two 4.2mm holes.

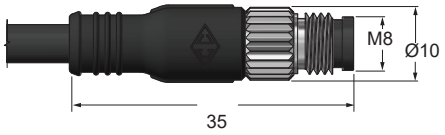
DIMENSIONAL DATA

All dimensions are in millimeters unless otherwise noted.

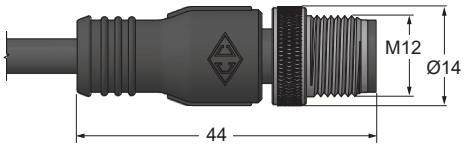


CONNECTION OPTIONS

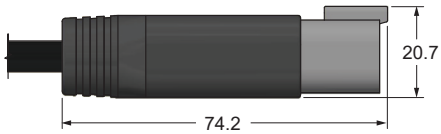
8mm



12mm



GT 4 Pin

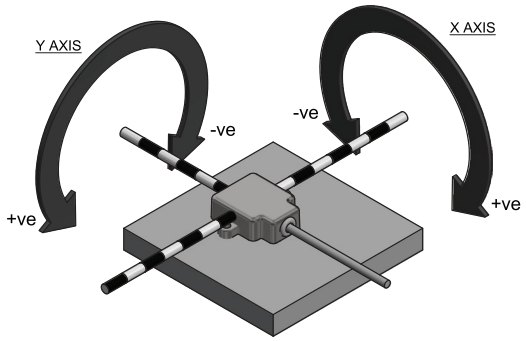


TECHNICAL DATA

Accuracy @ 20°C	-0.3° to +0.3°
Environmental Protection	Up to IP 69K
Materials	Housing: Zinc die-cast Housing Finish: Black powder coat
Number of Axis	Dual: 2
Angle Range	Both Axis -90° to +90°
Supply Current	30 mA Maximum
CAN Speed	250 kbps (default)
Startup Time	Vcc = 0V to VCC = 12V 1 sec.
Resolution	0.01°
Update Rate	100 Hz
Supply Voltage	8 to 30V
Temperature Drift	+/- 1° Maximum
Temperature Range	-40° to +85°C
Cable Type	PVC (PUR on request. Consult Factory)
Wire Gauge	24 AWG

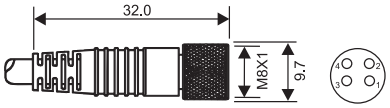
MOUNTING / SENSING ORIENTATION

Mounted on Horizontal Surface



(ADDITIONAL) MATING CORDSETS / PIN CONFIGURATION

8mm female molded locking connector



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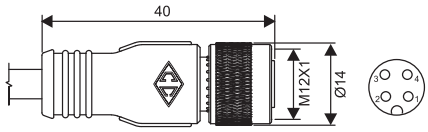
White = Pin 2
Blue = Pin 3
Black = Pin 4

Order P/N:
RC08-AFM040-0120C10A (2m length)
RC08-AFM040-0150C10A (5m length)

12mm female molded locking connector



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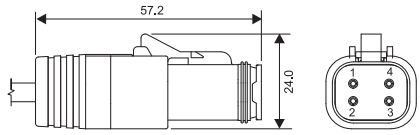
GT Deutsch style locking plug



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Green = Pin 4

Order P/N:
GT0604-U000-1A (2m length)
GT0604-X000-1A (5m length)

ORDERING INFORMATION

EiS10-C00☐ -3F☐ ☐

Axis
2 - Dual

Output Type
A - J1939
B - CANOpen

Connection Options
0 - 9 ft PVC cable
1 - 8mm quick connect male pigtail*
2 - 12mm quick connect male pigtail*
3 - GT04 4 pin receptacle Deutsch style pigtail*
**Mates with cordsets shown above*
Consult factory for PUR and shielded versions

Ordering Example: EiS10-C002-3FA0

Dual Axis, J1939, 9 ft. PVC cable.

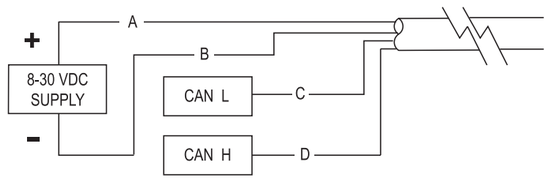
Technical Data

OPERATING PARAMETERS

Accuracy @ 20°C	-0.3° to +0.3°
Environmental Protection	Up to IP 69K
Materials	Housing: Zinc die-cast Housing Finish: Black powder coat
Number of Axis	Dual: 2
Angle Range	Both Axis -90° to +90°
Supply Current	30 mA Maximum
CAN Speed	250 kbps (default)
Startup Time	Vcc = 0V to VCC = 12V 1 sec.
Resolution	0.01°
Update Rate	100 Hz
Supply Voltage	8 to 30V
Temperature Drift	+/- 1° Maximum
Temperature Range	-40° to +85°C
Cable Type	PVC (PUR on request. Consult Factory)
Wire Gauge	24 AWG

Wiring

Dual Axis



Wire Color Code

	Flying Leads	M8 / M12	GT Deutsch
A	Brown	Pin 1	Pin 1
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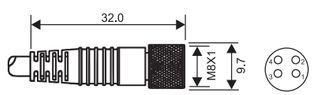
Optional Mating Cordsets and Pin Configuration

8mm female molded locking connector



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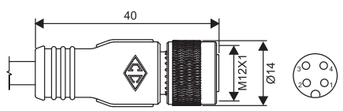

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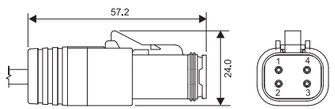

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canfield connector
8510 Foxwood Court
Youngstown, Ohio 44514
(330) 758-8299 Fax: (330) 758-8912
www.canfieldconnector.com

EiS SERIES
CANopen

INSTALLATION GUIDE
USER MANUAL

> > STOP! *Read this first.* < <

This inclinometer is not to be used in applications where personal safety depends on device function.
The product is not a safety device according to EC machinery directives.

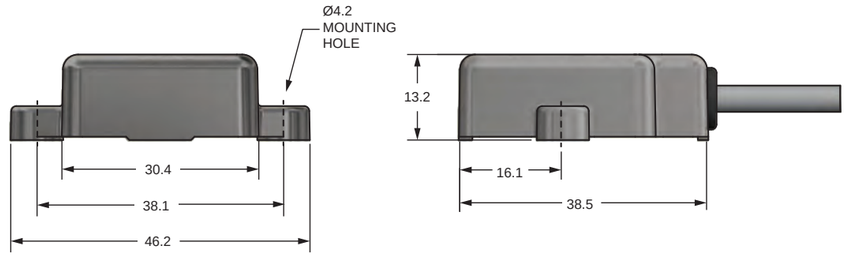
Canfield Connector Inclinometer products are miniaturized solid state electronic devices using mems electronic chips at their core. As such they are subject to proper installation and use in accordance with the technical information supplied for each product. When used to specification, standard warranties apply but, poor sources of electricity, over or under voltage conditions, voltage spikes beyond specification, unauthorized tapering, altering of the device, or uses beyond the published intended use of the product may cause the device to malfunction and void to warranty.

General Description

The Canfield Connector Electronic Inclinometer Sensor EiS is an instrument designed to measure angles of slope, tilt, or elevation of an object with respect to gravity based on an artificial horizon. Synonyms include tilt sensor, tilt switch, clinometer, slope sensor, slope gauge, level sensor, level meter, tiltmeter or pitch and roll sensor. The EiS Series is an all solid-state MEMs device designed to measure tilt while reporting the data within 0.3 degrees accuracy +/- 90° with CANopen output. The unit features a miniature metal housing and is epoxy encapsulated for vibration, water and dust resistance and is rated IP67 environmental rating. Available in 2 axis version, the unit boasts a temperature drift of +/- 1° maximum with a temperature range of -40 to 85°C. The EiS Series is precisely calibrated to remove non-linearity in the sensing range. Applications for inclinometers such as the EiS Series include platform leveling, motion sensing, filter vibrations, boom angle sensing, cameras, machine arm angle sensing as well as mobile security systems. The unit comes with PVC wire (PUR on request), 9ft. length with other lengths and quick connections available. The unit is installed in place by use of two 4.2mm holes.

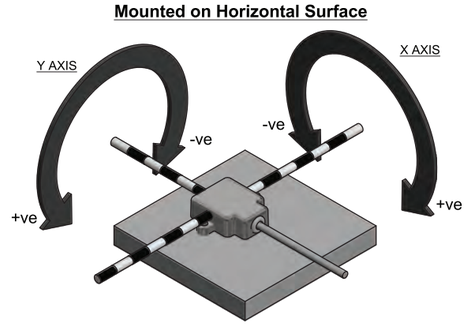
Dimensional Data

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED



Mounting / Sensing Orientation

Mounted on Horizontal Surface



Start up

The EiS starts up in pre-operational mode. It can be commanded into operational mode by sending:

Address	DB0
000h	01h

TPDO message

The EiS has one TPDO. It contains the current X and Y angle values. The data is displayed below:

DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7
X-angle value OR: 6010h		Y-angle value OR: 6020h		not used			

TPDO Transmission Types

Cyclic Operation Mode
The EiS can automatically send its TPDO when the 1800/05 index has a value greater than 0 stored. This value is the time interval in milliseconds. For correct operation the 1800/02 index needs to be set to value 254. These settings can be saved to non-volatile memory by sending "save" (65766173h) to index 1010.

Synchronized Send after SYNC message received
The EiS can respond to a SYNC message sent from the master, if the 1800/02 index has a value of 1 - 240 stored. The value stored is the SYNC count at which the EiS responds. After the EiS receives the "nth" SYNC message the EiS will respond with its TPDO. This setting can be saved to non-volatile memory by sending "save" (65766173h) to index 1010.

Manufacturer Specific Object Dictionary

Index	Sub-Index	Parameter	Data Type	Access	Default Value	Save
2000h	00	Node ID	UNS8	rw	01h	X
2001h	00	CAN bit rate	UNS16	rw	250	X
		20, 50, 125, 250, 500, 800, 1000 (kbits)				

Node ID and CAN bit rate
The change of the Node ID and CAN bit rate only become valid on a reset. So to make these changes you need to save these parameters to non-volatile memory by sending "save" (65766173h) to index 1010 before resetting the EiS. If you do not send the "save" command, the changes WILL NOT take place.

Profile Specific (per CiA DSP-410)

Index	Sub-Index	Parameter	Data Type	Access	Default Value	Save
6000h	00	Resolution (multiple of 0.001 °)	UNS16	ro	100	
6010h	00	X-Axis Value (hundredfold angle value in °)	INT16	ro	0	
6020h	00	Y-Axis Value (hundredfold angle value in °)	INT16	ro	0	

X and Y Angle data
The EiS angle data is stored at index 6010h and 6020h. The values are stored as a two's compliment hundredfold degree value. To calculate the actual angle you need to divide the value by 100.
Example: if value of 6010h = 5678 -> the actual angle is 5678 / 100 = 56.78 °

Heartbeat
The EiS is capable of send the heartbeat message when the value of index f1017 is greater than 0. This value is the transmission rate in milliseconds. The value can be stored to non-volatile memory by sending "save" (65766173h) to index 1010.

Object Dictionary (per CiA DS-301)

The EiS object dictionary can be accessed via the Standard SDO process. All parameter changes are immediate with the exception of the Node ID (2000h) and the CAN bit rate (2001h). The save column indicates which parameters can be saved to non-volatile memory by sending "save" (65766173h) to index 1010. If the "save" command is not sent and the EiS is reset, all previous values will be restored. With the Node ID and CAN bit rate, the "save" command needs to be sent before resetting the device to make the changes.

If the "load" command is sent to index 1011, all the values in the Default value column are restored. With the exception of the Node ID and CAN bit rate these will only update when accessing them directly.

Index	Sub-Index	Parameter	Data Type	Access	Default Value	Save
1000h	00	Device Type (device profile 410, two axis)	UNS32	const	2019Ah	
1001h	00	Error Register	UNS8	ro	0	
1003h		Pre-defined Error Field				
	00	Number of error entries	UNS32	rw	0	
	01-08	Error code (oldest error in highest index)	UNS32	ro	0	
1005h	00	COB ID SYNC message	UNS32	rw	80h	
1010h		Store Parameters				
	00	Highest Supported Sub-index	USN32	ro	1	
	01	Store All Parameters (signature: "save" - 65766173h)	USN32	rw	0	
1011h		Restore Default Parameters				
	00	Highest Supported Sub-index	USN32	ro	1	
	01	Restore Default Parameters (signature: "load" - 64616F6Ch)	USN32	rw	0	
1014h	00	COB ID EMCY message	USN32	ro	80h + NID	
1015h	0000	EMCY inhibit time (multiple of 100us)	USN16	rw	0	X
1017h	00	Heartbeat interval time(multiple of 1ms, 0 deactivated)	UNS16	rw	0	X
1018h		Identity				
	00	Highest Supported Sub-index	UNS8	ro	4	
	01	Vendor ID	UNS32	ro		
	02	Product Code	UNS32	ro		
	03	Revision No.	UNS32	ro		
	04	Serial No.	UNS32	ro		
1029h	00	Error Behavior	UNS8	ro	0	
1200h		SDO Parameters				
	00	Highest Supported Sub-index	UNS8	ro	2	
	01	COB ID Client > Server	UNS32	ro	600h + NID	
	02	COB ID Server > Client	UNS32	ro	580h + NID	
1800h		TPDO Parameters				
	00	Highest supported Sub-index	UNS8	ro	6	
	01	COB ID	UNS32	ro	180h + NID	
	02	Transmission Type	UNS8	rw	FEh	X
	03	TPDO Inhibit Time (multiple of 100us)	UNS16	rw	0	X
	04	Compatibility entry	UNS8	ro	0	
	05	TPDO Event Timer (multiple of 1ms, 0 deactivate)	UNS16	rw	0	X
1A00h		TPDO mapping				
	00	Highest Supported Sub-index	UNS8	ro	2	
	01	X-Axis Value (hundredfold angle value in °)	UNS32	ro	60100010h	
	02	Y-Axis Value (hundredfold angle value in °)	UNS32	ro	60200010h	
Manufacturer Specific Object Dictionary						
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2001h	00	CAN bit rate	UNS16	rw	250	X
		20, 50, 125, 250, 500, 800, 1000 (kbits)				

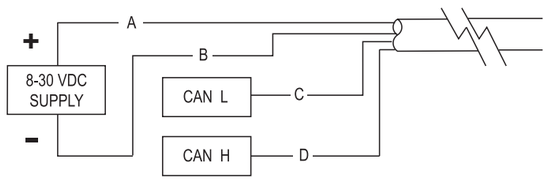
Technical Data

OPERATING PARAMETERS

Accuracy @ 20°C	-0.3° to +0.3°
Environmental Protection	Up to IP 69K
Materials	Housing: Zinc die-cast Housing Finish: Black powder coat
Number of Axis	Dual: 2
Angle Range	Both Axis -90° to +90°
Supply Current	30 mA Maximum
CAN Speed	250 kbps
Startup Time	Vcc = 0V to VCC = 12V 1 sec.
Resolution	0.01°
Update Rate	100 Hz
Supply Voltage	8 to 30V
Temperature Drift	+/- 1° Maximum
Temperature Range	-40° to +85°C
Cable Type	PVC (PUR on request. Consult Factory)
Wire Gauge	24 AWG

Wiring

Dual Axis



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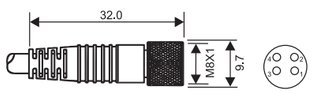
Optional Mating Cordsets and Pin Configuration

8mm female molded locking connector



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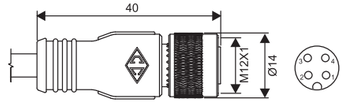

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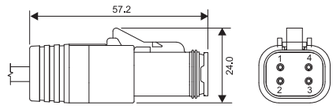

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EiS SERIES
SAE J1939 CAN 2.0B

INSTALLATION GUIDE
USER MANUAL

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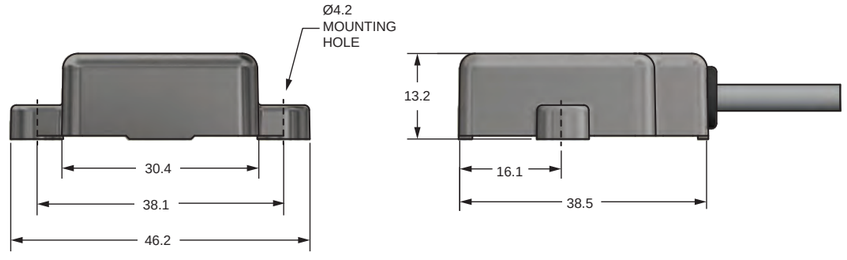
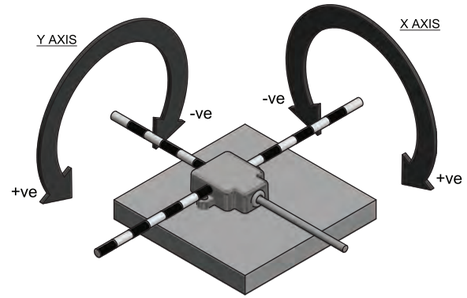


Mounting / Sensing Orientation

Mounted on Horizontal Surface



EiS Address Claim Message

J1939 STANDARD PROCESS

Priority: 3
PGN: 0xEEFF
Source Address: 0x80 (default)
Transmit Rate: Once after 500 ms startup

Data Byte	Function
00	Serial Number, Bits 0 – 7
01	Serial Number, Bits 8 – 15
02	Serial Number, Bits 16 – 20, Manufacture Code, Bits 0 – 2
03	Manufacture Code, Bits 3 – 10
04	ECU Instance, Bits 0 – 2, Function Instance, Bits 3 – 7
05	Function
06	Vehicle System, Bits 1 – 7
07	Vehicle System Instance, Bits 0–3, Industry Group, Bits 4–6, Arbitrary Address, Bit 7

Manufacturing Code: 0x3D2 (Canfield Connector)
ECU Instance: 0x0
Function Instance: 0x0
Function: 0x88 (Slope Sensor)
Vehicle System: 0x0 (Non-Specific System)
Vehicle System Instance: 0x0
Industry Group: 0x3 (construction equipment)
Arbitrary Address: 0x0 (Not Arbitrary)

EiS Tilt Angle Message

Priority: 3
PGN: 0xFF8B
Source Address: 0x80 (default)
Transmit Rate: 250 ms (default)

Data Byte	Function
00	X-Angle (MSB)
01	X-Angle (LSB)
02	Y-Angle (MSB)
03	Y-Angle (LSB)
04	Z-Angle (MSB)
05	Z-Angle (LSB)
06	Sensitivity (0 = Most, 7 = Least, Default = 4)
07	Firmware Revision

Data Examples: X and Y angles are broadcast in hundredths of a degree.

X Angle
DB0 = 0xEE and DB1 = 0x6C -> combined 0xEE6C = -4500 -> the angle is -45.00

Y Angle
DB2 = 0x18 and DB3 = 0x73 -> combined 0x1873 = +6259 -> the angle is +62.59

EiS Master Command Message

Priority: 3
PGN: 0xFF8A
Source Address: MA (master's address)
Transmit Rate: On request

Data Byte	Function
00	Command Byte
01	As defined for command byte
02	As defined for command byte
03	As defined for command byte
04	As defined for command byte
05	As defined for command byte
06	As defined for command byte
07	As defined for command byte

EiS Master Commands

Request for EiS S/N
all Canfield Connector EiS's on the bus will respond

Data Byte	Function
00	0x00
01	not used
02	not used
03	not used
04	not used
05	not used
06	not used
07	not used

Request to change EiS Source Address
the EiS will perform an address claim on the new address

Data Byte	Function
00	0x01
01	New source address (0x80 to 0xF7) anything outside this range will be denied and the EiS will return to default 0x80
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

Request to stop transmitting
ask EiS to stop transmitting on bus

Data Byte	Function
00	0x02
01	not used
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

Request to start transmitting
ask EiS to start transmitting on bus at previous transmission rate

Data Byte	Function
00	0x03
01	not used
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

Request a single Tilt Angle Message
ask EiS to only transmit one Tilt message

Data Byte	Function
00	0x04
01	not used
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

EiS Master Commands Cont.

Request to change transmission rate (msec > 50)
ask EiS to change the transmission rate of the Tilt Angle Message

Data Byte	Function
00	0x05
01	Desired time (MSB)
02	Desired time (LSB)
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

Request to return EiS back to factory Source Address
ask EiS to return to factory Source Address (0x80)

Data Byte	Function
00	0x06
01	Current EiS source address
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

Request EiS Manufacture Date
ask EiS to send its manufacture date

Data Byte	Function
00	0x07
01	Desired time (MSB)
02	Desired time (LSB)
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

Request EiS to Zero/Calibrate Output
ask EiS to set current location to artificial horizon (zero)
* EiS will respond with calibration status message*

Data Byte	Function
00	0x08
01	not used
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

Request EiS to Reset "Zero" Position Back to Factory
ask EiS to set "Zero" back to factory location (horizon)
EiS will not respond but angles will reflect the change

Data Byte	Function
00	0x09
01	not used
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

EiS Master Commands Cont.

Request EiS to Change Sensitivity (0-7)
ask EiS to change the Sensitivity of the output response
0 = Most Sensitive, 7 = Least Sensitive, Default = 0

Data Byte	Function
00	0x0A
01	Sensitivity Setting (0x00 - 0x07)
02	not used
03	not used
04	not used
05	EiS Serial Number (MSB)
06	EiS Serial Number
07	EiS Serial Number (LSB)

EiS Responses to Master Commands

Serial Number Response (sends one message on bus)
Priority: 3
PGN: 0xFF8C
Source Address: 0x80 (default)
Transmit Rate: once

Data Byte	Function
00	EiS Serial Number (MSB)
01	EiS Serial Number
02	EiS Serial Number (LSB)
03	n/a
04	n/a
05	n/a
06	n/a
07	n/a

Manufacture Date Response (sends one message on the bus)
Priority: 3
PGN: 0xFF8D
Source Address: 0x80 (default)
Transmit Rate: once

Data Byte	Function
00	Month
01	Day
02	Year (MSB)
03	Year (LSB)
04	n/a
05	n/a
06	n/a
07	n/a

Zero/Calibrate Status Response
Priority: 3
PGN: 0xFF8E
Source Address: 0x80 (default)
Transmit Rate: once

Data Byte	Function
00	Calibration Status (0x00 = Calibration Done, 0x01 = Calibrating)
01	n/a
02	n/a
03	n/a
04	n/a
05	n/a
06	n/a
07	n/a