



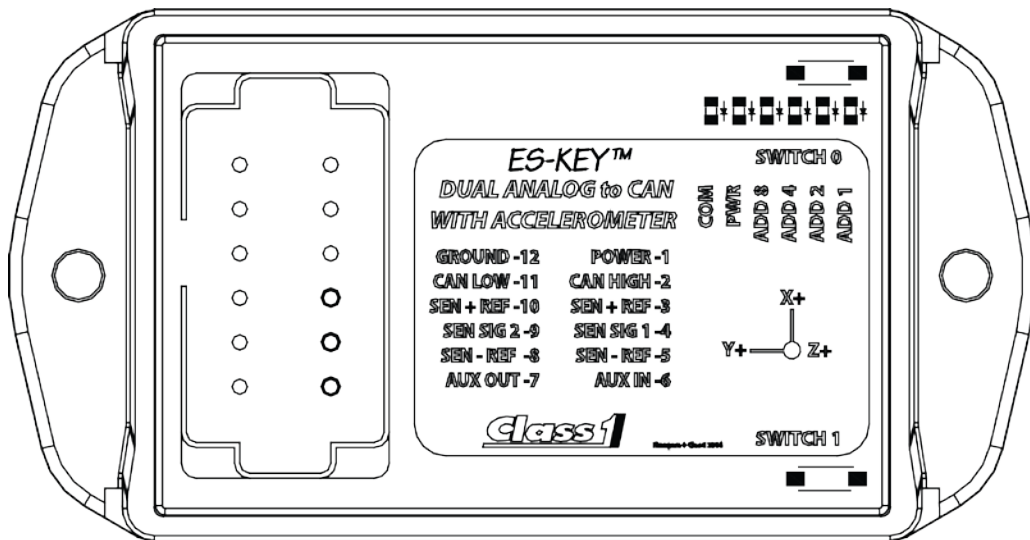
Class 1

ISO 9001 CERTIFIED

607 NW 27th Ave
Ocala, FL 34475
Phone: (352) 629-5020 or 800-533-3569
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OPERATION MANUAL

Dual Analog to CAN With Accelerometer





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 Ocala, FL 34475
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OPERATION MANUAL



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REV	1.08
BY	GMC

PRODUCT GROUP	ES-Key	P/N	FSG-MNL-00106
PRODUCT	Dual Analog to CAN with Accelerometer		

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1. Revision Log

Rev	Date	Approved	Changes
1.00	6-30-2014	GMC	Initial requirements
1.01	8-15-2014	GMC	Added reference to additional CAN message
1.02	1-15-2015	GMC	Added reference to Zero offset in legacy O2 Mode
1.03	1-29-2015	GMC	Fixed a typo in section 6.18 and 6.19
1.04	2-19-2015	GMC	Fixed section 5.1.6 to reference both 9 volt references
1.05	3-06-2015	GMC	Added reference to being able to disable Impact Sensor
1.06	5-13-2016	GMC	Added 0-30 volt support and Tilt angle support message
1.07	9-21-2016	GMC	Added reference to Temp profile in normal mode.
1.08	6-21-2017	GMC	Added reference to the 112701 Legacy mode.

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2. System Overview

2.1. Scope

The Dual Analog to CAN with Accelerometer is designed to monitor two analog inputs and transmit the information on the CAN bus. It has the ability to allow the user to select how the analog inputs and reference voltages are configured. The user can select each channel to read a 0-5 volt signal, 0-30 volt signal, Battery monitor, 4-20mA signal, Thermistor signal, Temperature signal, and one channel can be set to read a frequency. (Note: Temperature, 0-30, and Battery are only available starting with hardware revision F and software version 3.1) The user can select if the channel reference voltage is enabled or disabled. If the reference is enabled it can be selected to deliver a 5 volt or a 9 volt output. The module also is an accelerometer that can be used as a inclinometer or impact sensor that reads g-forces in 2 axis and transmit the information to the ES-Key network.

2.2. Part numbers

Dual Analog to CAN with Accelerometer Hale – p/n 610-00033

3. Operation

3.1. Module Operation



For detailed operation of each module type (see section 7).

3.2. LED indications

The module uses LEDs to show the device address, power status, and communication status (see section 16).

3.3. Magnetic switches

The module has two magnetic switches (SWITCH 0 and SWITCH 1). The switches are activated by touching a magnet to either side of the module (see section 6.2).

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3.4. Show device address

The device address will be displayed for 5 seconds if the show device address password is entered (see section 6.1). The address is represented by the 4 ADD LED's in a binary number format. NOTE: Address 0 will flash all the LED's

ADD 8	ADD 4	ADD 2	ADD 1	ADDRESS #
FLASH	FLASH	FLASH	FLASH	0
OFF	OFF	OFF	ON	1
OFF	OFF	ON	OFF	2
OFF	OFF	ON	ON	3
OFF	ON	OFF	OFF	4
OFF	ON	OFF	ON	5
OFF	ON	ON	OFF	6
OFF	ON	ON	ON	7
ON	OFF	OFF	OFF	8
ON	OFF	OFF	ON	9
ON	OFF	ON	OFF	10
ON	OFF	ON	ON	11
ON	ON	OFF	OFF	12
ON	ON	OFF	ON	13
ON	ON	ON	OFF	14
ON	ON	ON	ON	15

4. Analog Channel Setup

4.1. Channel Configuration



When used in normal operation the user has the ability to select how the analog input channel and corresponding reference outputs will work. The user has the ability to set the channels for the following operation by entering a password (see section 6.2) or set the channels from a CAN message (see section 7.6).

4.1.1. Analog Input Channel 0

- 0-5 volt input
- 4-20mA input
- Thermistor Input with a top end of 2.80K
- Frequency input (Only 5 volt Peak to Peak signal capable)
- 0-30 volt input (Note: Available on Revision F or greater Hardware starting with software version 3.1.)
- Battery Monitor (Note: Available on Revision F or greater Hardware starting with software version 3.1.)
- Tempe Sensor (Note: Available on Revision F or greater Hardware starting with software version 3.1 and used for reading a temp sensor Hale part number 115722.)

4.1.2. Analog Input Channel 1

- 0-5 volt input
- 4-20mA input
- Thermistor Input with a top end of 2.80K
- Frequency input
- 0-30 volt input (Note: Available on Revision F or greater Hardware starting with software version 3.1.)
- Battery Monitor (Note: Available on Revision F or greater Hardware starting with software version 3.1.)
- Temp Sensor (Note: Available on Revision F or greater Hardware starting with software version 3.1 used for reading a temp sensor Hale part number 115722)

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4.1.3. Reference Voltage Channel 0

- Disabled
- Enabled
- 5 volt
- 9 volt

4.1.4. Reference Voltage Channel 1

- Disabled
- Enabled
- 5 volt
- 9 volt

5. Module Configuration

5.1. Module Configuration

The user can select the module operation by entering a password (see section 6.2). The module can be configured for the following operation.

5.1.1. Normal Operation

- Accelerometer functions
 - Inclinator (2 axis)
 - Impact Sensor (1 axis user selectable)
- 2 user selectable analog inputs
- 1 polarity selectable input
- 1 negative .25amp output

5.1.2. Legacy 113651 Operation

- 2 analog inputs 0-5 volt
- Reference voltage 5 volts

5.1.3. Legacy 113652 Operation



- 2 analog inputs 4-20mA
- Reference voltage 9 volts

5.1.4. Legacy 115819 Operation

- 1 analog input 0-5 volt (used for reading a current sensor Hale part number 115762)
- Reference voltage 9 volts

5.1.5. Legacy 122397 Operation

- 2 analog inputs 0-5 volt (used for reading a temp sensor Hale part number 115722)
- Reference voltage 5 volts

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5.1.6. Legacy 112701 Operation

- 2 analog inputs 0-30 volt (used for reading battery voltage)



5.1.7. Legacy mixed Operation

- 1 analog inputs 0-5 volt (used for reading a current sensor Hale part number 115762)
- 1 analog inputs 4-20mA
- Reference voltage 9 volt
- Reference voltage 9 volt

6. Passwords

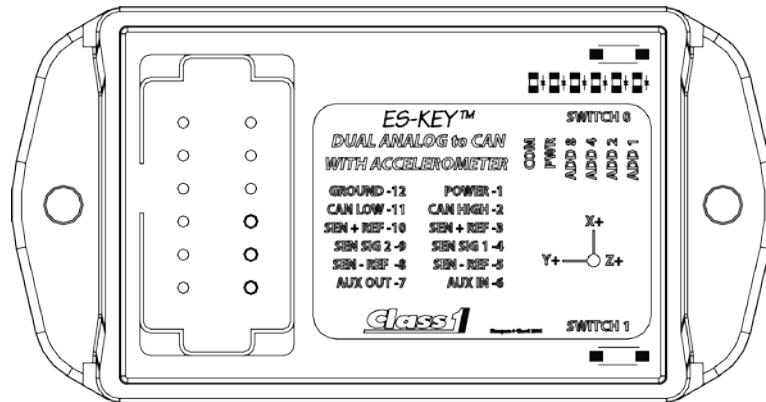
6.1. Password List

1100 0000 (0xC0)	Set module operation to normal
1100 0001 (0xC1)	Set module operation to legacy 113651
1100 0010 (0xC2)	Set module operation to legacy 113652
1100 0011 (0xC3)	Set module operation to legacy 115819
1100 0100 (0xC4)	Set module operation to legacy 122397 (dual channel enable does not apply)
1100 0101 (0xC5)	Set module operation to legacy mixed
1100 0110 (0xC6)	Dual channel enable in legacy mode
1100 0111 (0xC7)	Enable or disable the Accelerometer Impact Feature
1100 1011 (0xCB)	Set module operation to legacy 112701
1000 0001 (0x81)	Calibrate X-axis offset
1000 0010 (0x82)	Calibrate Y-axis offset
1000 0011 (0x83)	Set Input polarity (positive or negative)
1000 0100 (0x84)	Enable-Disable channel 0 reference voltage
1000 0101 (0x85)	Enable-Disable channel 1 reference voltage
1000 0110 (0x86)	Select reference voltage level for channel 0
1000 0111 (0x87)	Select reference voltage level for channel 1
1000 1000 (0x88)	Select Channel 0 analog function
1000 1001 (0x89)	Select Channel 1 analog function
1000 1010 (0x8A)	Zero offset in Legacy O2 mode channel 0
1000 1010 (0x8B)	Zero offset in Legacy O2 mode channel 1
1001 0000 (0x90)	Set The module address.
1001 0001 (0x91)	Show the module address.
1001 0010 (0x92)	Set Accelerometer Axis to read from (X-axis or Y-axis) for impact sensor.
1001 0101 (0x95)	Enter Boot load Mode
1111 0000 (0xF0)	Load Defaults

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6.2. Password Entry

To enter a password, a magnetic switch must activate the two magnetic switches in a specific order. Switch 0 will indicate a 0 from the password list and Switch 1 will indicate a 1 from the password list. When the switch is activated by a magnet, the address LED's will turn on to indicate the switch was activated. Switch 0 will activate ADD 1 and Switch 1 will activate all the ADD LED's. If a password is entered incorrectly or a password is entered that is not in the password list, the ADD LED's will alternate On and OFF to indicate an invalid password was entered.



6.3. Set Module operation to Normal

Enter the password 1100 0000 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved.

6.4. Set Module operation to Legacy 113651

Enter the password 1100 0001 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved.

6.5. Set Module operation to Legacy 113652

Enter the password 1100 0010 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved.

6.6. Set Module operation to Legacy 115819



Enter the password 1100 0011 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved.

6.7. Set Module operation to Legacy 122397

Enter the password 1100 0100 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved.

6.8. Set Module operation to Legacy 112701

Enter the password 1100 1011 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved.

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6.9. Set Module operation to Legacy Mixed

Enter the password 1100 0101 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved.

6.10. Set Legacy Module operation to use both channels

Enter the password 1100 0110 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. (**Note: dual channel selection will only work if the module is set to Legacy 113651 or Legacy 113652 mode**)

ADD 8	ADD 4	ADD 2	ADD 1	MODE
OFF	ON	ON	OFF	1-Channel
ON	OFF	OFF	ON	2-Channel

6.11. Enable or Disable the Accelerometer Impact feature

Enter the password 1100 0111 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. (**Note: will only work if the module is set to Normal mode**)

ADD 8	ADD 4	ADD 2	ADD 1	MODE
OFF	ON	ON	OFF	Disabled
ON	OFF	OFF	ON	Enabled

6.12. Calibrate X-Axis offset

Proper orientation is needed during installation (see section 13.2). Enter the password 1000 0001 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password.

6.13. Calibrate Y-Axis offset

Proper orientation is needed during installation (see section 13.2). Enter the password 1000 0010 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password.

6.14. Zero Channel 0 in Legacy Mode.

Make sure that there is no pressure on the transducer.

Enter the password 1000 1010 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password.



6.15. Zero Channel 1 in Legacy Mode.

Make sure that there is no pressure on the transducer.

Enter the password 1000 0011 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password.

6.16. Input Polarity

Enter the password 1000 0011 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current polarity will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the polarity. Once the desired polarity is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the polarity was saved.

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ADD 8	ADD 4	ADD 2	ADD 1	Polarity
OFF	ON	ON	OFF	Negative
ON	OFF	OFF	ON	Positive

6.17. Channel 0 Reference Voltage enable

Enter the password 1000 0100 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. **(Note: will only work if the module is set to normal operation mode)**

ADD 8	ADD 4	ADD 2	ADD 1	Mode
OFF	ON	ON	OFF	Disabled
ON	OFF	OFF	ON	Enabled

6.18. Channel 1 Reference Voltage enable

Enter the password 1000 0101 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. **(Note: will only work if the module is set to normal operation mode)**

ADD 8	ADD 4	ADD 2	ADD 1	Mode
OFF	ON	ON	OFF	Disabled
ON	OFF	OFF	ON	Enabled

6.19. Channel 0 Reference Voltage setup



Enter the password 1000 0110 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. **(Note: will only work if the module is set to normal operation mode)**

ADD 8	ADD 4	ADD 2	ADD 1	Mode
OFF	ON	ON	OFF	5 volt
ON	OFF	OFF	ON	9 volt

6.20. Channel 1 Reference Voltage setup

Enter the password 1000 0111 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. **(Note: will only work if the module is set to normal operation mode)**

ADD 8	ADD 4	ADD 2	ADD 1	Mode
OFF	ON	ON	OFF	5 volt
ON	OFF	OFF	ON	9 volt

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6.21. Channel 0 Analog Input setup

Enter the password 1000 1000 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. **(Note: will only work if the module is set to normal operation mode)**

ADD 1	0-5 VOLT
ADD 2	4-20mA
ADD 4	Thermistor
ADD 8	Frequency
ADD 1 , ADD 4	0-30 VOLT
ADD 2 , ADD 4	Battery Monitor
ADD 1, ADD 2, ADD 4	Temp Sensor

6.22. Channel 1 Analog Input setup

Enter the password 1000 1001 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password. The current mode will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the mode. Once the desired mode is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. **(Note: will only work if the module is set to normal operation mode)**

ADD 1	0-5 VOLT
ADD 2	4-20mA
ADD 4	Thermistor
ADD 8	Frequency
ADD 1 , ADD 4	0-30 VOLT
ADD 2 , ADD 4	Battery Monitor
ADD 1, ADD 2, ADD 4	Temp Sensor

6.23. Set Address

To enter a device address, first use a magnetic switch and enter the password 1001 0000 (see section 6.2). The current address will be displayed (see section 3.4). Activating Switch 0 will increase the address by 1 every time the switch is activated. Once the desired address is displayed, activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved.



6.24. Set Axis orientation

The Accelerometer is selectable to read in either the X-axis or the Y-axis. Proper orientation is needed during installation (see section 13.2). For the Accelerometer to operate correctly, the orientation for data must be selected by entering the following password 1001 0010 (see section 6.2). The current orientation will be displayed by the 4 ADD LED's (see table). Activating Switch 0 will change the axis. Once the desired axis is selected activating Switch 1 will save the mode and all the ADD led's will flash to indicate the mode was saved. **(Note: will only work if the module is set to normal operation mode)**

ADD 8	ADD 4	ADD 2	ADD 1	AXIS
OFF	ON	ON	OFF	X-AXIS
ON	OFF	OFF	ON	Y-AXIS

6.25. Boot load



The device can have the software upgraded by entering the following password 1001 0101 (see section 6.2). The password must be entered within 30 seconds after the unit is powered up or the boot load password will be disabled.

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6.26. Defaults

Enter the password 1111 0000 (see section 6.2). ADD LED's 2 and 4 will flash to acknowledge the password and then all the ADD led's will flash to indicate the mode was saved. When the default password is entered the module will reset to the following operation.

- Normal operation
- Positive input polarity
- Address set to 1
- Analog inputs set to 0-5 volt operation
- Reference voltage output set to 5 volts
- Reference voltage enabled
- X-Axis impact sensor
- default axis offset calibrations.
- Enable the Impact Sensor.

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7. Module Operation and Device Network TX RX CAN messages

7.1. Normal Mode

When the module is configured as **Normal Operation** the module operates accordingly

7.1.1. Accelerometer

The module when used as an impact sensor uses ES-Key defined input memory space and is recognized on the ES-Key network as an I/O module device type 4. Every input equals .25g. The user has the ability to disable the Impact sensor (see section 6.10).

The module when used as an inclinometer transmits out the +/- incline data for both x and y axis over the CAN bus. Version 2.9 or Greater sends a dedicated +/- 90 angle (see section 7.7)

7.1.2. Analog Inputs

The module has two analog inputs that transmits a 10 bit raw A2D value over the CAN. Each input can be configured for different analog functionality and each channel has a corresponding voltage reference that can be configured as well (see section 6.16 to 6.21).



7.1.3. Auxiliary Input

The Input is polarity selectable digital input (see section 6.15). The state of the input is transmitted out the CAN bus. When the input is configured as a positive polarity it will activate when the input is greater than 60% of the system voltage. When the input is a negative polarity the input will activate when the input voltage is less than 20% of the system voltage. In version software 2.5 and newer the user can enter a password (see section 6.10) that will disable the Impact Sensor feature of the Accelerometer to allow the aux input to use ES-Key defined input memory space (see section 8).

7.1.4. Auxiliary Output

The Output is a negative output rated for .250 amps. The output is controlled form ES-Key defined output memory space (see section 8).

The ES-Key device ID for the Accelerometer is $4X_h$ (where X is the address value, 0 through E).

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7.2. TX Input status message (ES-Key designation 0x4X to 0x1E)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	64-78(40 ₁₆ -4E ₁₆)

Byte 0 – Inputs 0 through 7 state	(input 0 is in the LSb position)
Byte 1 – Inputs 8 through 15 state	(input 8 is in the LSb position)
Byte 2 – Inputs 16 through 23 state	(input 16 is in the LSb position)
Byte 3 – Inputs 24 through 31 state	(input 24 is in the LSb position)
Byte 4 – Channel 0 Analog Input States	
Byte 5 – Channel 1 Analog Input States	
Byte 6 – Aux Input Aux Output State	(High Nibble Aux Output--- Low Nibble Aux Input)
Byte 7 – Aux Input Polarity	(0 = Negative 1 = Positive)

Analog Input states



Bit 0	0-5	Bit 4	Reference Enabled
Bit 1	4-20mA	Bit 5	Reference 5 volt
Bit 2	Thermistor	Bit 6	Reference 9 volt
Bit 3	Frequency	Bit 7	Special

If The Special bit is active the low nibble Bit 0 - Bit 3 will show the current profile

Bit 3	Bit 2	Bit 1	Bit 0	Function
0	0	0	1	0-30
0	0	1	0	Battery
0	0	1	1	Temp Sensor
0	1	0	0	Reserved
0	1	0	1	Reserved
0	1	1	0	Reserved
0	1	1	1	Reserved
1	1	1	1	Reserved

7.3. TX Software Angle message (ES-Key designation 0x4X to 0xA1)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	64-78(40 ₁₆ -4E ₁₆)

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Byte 0 – Accelerometer Axis

Byte 1 – Adjusted Angle

Byte 2 – Horizontal Angle

Byte 3 – Vertical Angle

Byte 4 – Z – Angle

Byte 5 – Software Version

Byte 6 –

Byte 7 –

0 = X-Axis 1 = Y Axis

Selected Angle (+/- 90) with increased resolution

Measured X – Axis (+/- 90)

Measured Y – Axis (+/- 90)

Measured Z – Axis (+/- 90)

(high nibble = major rev, low nibble = minor rev)

Used for Testing

Used for Testing

7.4. TX Software version message (ES-Key designation 0x4X to 0xFF)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	64-78(40 ₁₆ -4E ₁₆)

Byte 0 – 0x00

Byte 1 – 0xFF

Byte 2 – 0x00

Byte 3 – 0x00

Byte 4 – Module address

Byte 5 – Software version

(high nibble = major rev, low nibble = minor rev)

Byte 6 – 0x00

Byte 7 – 0x00

7.5. TX Software Impact Data message (ES-Key designation 0x4X to 0xAA)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	170 (AA ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	64-78(40 ₁₆ -4E ₁₆)

Byte 0 – X-axis data low byte

Byte 1 – X-axis data high byte

Byte 2 – Y-axis data low byte

Byte 3 – Y-axis data high byte

Byte 4 – System Voltage Low byte

Byte 5 – System Voltage High Byte

Byte 6 – 0x00

Byte 7 – 0x00

Battery Voltage Low Byte in Battery Mode



Battery Voltage High Byte in Battery Mode

Battery Voltage Low Byte in Battery Mode

Battery Voltage High Byte in Battery Mode

System voltage example

0x4EA = 1258 = 12.58 volts

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7.6. TX Software Analog data message (ES-Key designation 0x9X to 0xFF)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	144-158(90 ₁₆ -9E ₁₆)



Byte 0 – Channel 0 A2D Value Low Byte
Byte 1 – Channel 0 A2D Value High Byte
Byte 2 – Channel 1 A2D Value Low Byte
Byte 3 – Channel 1 A2D Value High Byte
Byte 4 – Flow Rate Low Byte (Channel 0)
Byte 5 – Flow Rate High Byte (Channel 0)
Byte 6 – Flow Rate Low Byte (Channel 1)
Byte 7 – Flow Rate High Byte (Channel 1)

Note: Channel 0 is only capable of a 5 volt peak to peak signal

7.7. TX Software Tilt Angle data message (ES-Key designation 0x9X to 0xA1)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	161 (A1 ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	144-158(90 ₁₆ -9E ₁₆)

Byte 0 – Accelerometer Axis *0 = X-Axis 1= Y-Axis*
Byte 1 – Inclinator Angle *+/- 90 degree*
Byte 2 –
Byte 3 –
Byte 4 –
Byte 5 –
Byte 6 –
Byte 7 –

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7.8. RX USM message (ES-Key designation 0x1E to 0x4X)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	as received
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	64-79 (40 ₁₆ -4F ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	30(1E ₁₆)

Byte 0 – Output 0 (Output 0 is in the LSb position)

Byte 1 –

Byte 2 –

Byte 3 –

Byte 4 –

Byte 5 – Command Byte

Byte 6 – Validation Byte (Always 0x23)

Byte 7 – Activate Byte

This message is also used to verify that the module is communicating with the ES-Key Universal System Manager (USM) to determine the proper handling of the communication diagnostic LED (see section 16).

Command Byte

0x50	Bootload
0x51	Channel 0 Analog Input Configuration
0x52	Channel 1 Analog Input Configuration
0x53	Set Aux Input polarity
0x54	Enable or Disable the Accelerometer Impact Sensor Feature

Validation Byte is always 0x23

Activate Byte 0x01 for BootLoad command

If setting analog channels

High nibble

- 0 = Disable Reference Voltage output.
- 1 = Enable Reference Voltage set at 5 volts
- 2 = Enable Reference Voltage set at 9 volts

Low nibble



- 1 = Set Channel to 0-5 volt input
- 2 = Set Channel to 4-20mA input
- 3 = Set Channel to Thermistor input
- 4 = Set Channel to Frequency (only available on Channel 1)
- 5 = Set Channel to 0-30 volt input
- 6 = Set Channel to Battery Monitor
- 7 = Set Channel to Temp Sensor

Example Activate byte 0x22

Channel set to 4-20mA input with a 9 volt reference.

If setting input polarity 0x00 for negative 0x01 for positive.

If setting the impact sensor state 0x00 will disable 0x01 will enable.

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8. ES-Key Network Detail



8.1. Input/output memory space

The Accelerometer when used as an impact sensor uses ES-Key defined input memory space and is recognized on the ES-Key network as an I/O module device type 4. Every input equals .25g. If the Accelerometer Impact feature is disabled in Normal mode the aux input uses Input Memory Space 0 to report its state to the ES-Key network (see section 6.10)

8.1.1. Standard I/O memory space

INPUT MEMORY SPACE		OUTPUT MEMORY SPACE	
INPUT	DESCRIPTION	OUTPUT	LOCATION
0	Input 0 .25g / Aux Input	0	AUX Output
1	Input 1 .50g	1	<i>reserved</i>
2	Input 2 .75g	2	<i>reserved</i>
3	Input 3 1.00g	3	<i>reserved</i>
4	Input 4 1.25g	4	<i>reserved</i>
5	Input 5 1.50g	5	<i>reserved</i>
6	Input 6 1.75g	6	<i>reserved</i>
7	Input 7 2.00g	7	<i>reserved</i>
8	Input 8 2.25g	8	<i>reserved</i>
9	Input 9 2.50g	9	<i>reserved</i>
10	Input 10 2.75g	10	<i>reserved</i>
11	Input 11 3.00g	11	<i>reserved</i>
12	Input 12 3.25g	12	<i>reserved</i>
13	Input 13 3.50g	13	<i>reserved</i>
14	Input 14 3.75g	14	<i>reserved</i>
15	Input 15 4.00g	15	<i>reserved</i>
16	Input 16 4.25g	16	<i>reserved</i>
17	Input 17 4.50g	17	<i>reserved</i>
18	Input 18 4.75g	18	<i>reserved</i>
19	Input 19 5.00g	19	<i>reserved</i>
20	Input 20 5.25g	20	<i>reserved</i>
21	Input 21 5.50g	21	<i>reserved</i>
22	Input 22 5.75g	22	<i>reserved</i>
23	Input 23 6.00g	23	<i>reserved</i>
24	Input 24 6.25g	24	<i>reserved</i>
25	Input 25 6.50g	25	<i>reserved</i>
26	Input 26 6.75g	26	<i>reserved</i>
27	Input 27 7.00g	27	<i>reserved</i>
28	Input 28 7.25g	28	<i>reserved</i>
29	Input 29 7.50g	29	<i>reserved</i>
30	Input 30 7.75g	30	<i>reserved</i>
31	Input 31 8.00g	31	<i>reserved</i>

Table 1. Standard I/O memory space.

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9. Legacy 113651 and Legacy 113652 Operation and Device Network TX RX CAN messages

9.1. Auxiliary Input

The Input is a polarity selectable digital input (see section 6.15). The state of the input is transmitted out the CAN bus. When the input is configured as a positive polarity it will activate when the input is greater than 60% of the system voltage. When the input is a negative polarity the input will activate when the input voltage is less than 20% of the system voltage.

9.2. Auxiliary Output

The Output is a negative output rated for .250 amps.

9.3. Legacy 113651

The **Legacy 113651** module is used to read a 0-5 volt pressure transducer for displaying information. The Legacy 113651 profile will replace the current Hale part number 113651. The analog inputs are configured to be 0-5 volt inputs with a reference voltage of 5 volts. If the device is in single channel mode only channel 0 is used. If in dual channel mode both channel 0 and channel 1 are used. In single channel mode the module address can be set from 0 to 14. In dual channel mode the module address can be set from 0 to 13 and the module transmit in pairs. If the module is set for address X in dual mode the channel 0 information will transmit out address X and channel 1 information will transmit on address X + 1

The ES-Key device ID for the Module is $9X_h$ (where X is the address value, 0 through E) Single channel mode.

The ES-Key device ID for the Module is $9X_h$ (where X is the address value, 0 through D). Dual channel mode



9.4. Legacy 113652

The **Legacy 113652** module is used to read a 4-20mA pressure transducer (3000 PSI) to display O2 levels. The Legacy 113652 profile will replace the current Hale part number 113652. The analog inputs are configured to be 4-20mA inputs with a reference voltage of 9 volts. If the device is in single channel mode only channel 0 is used. If in dual channel mode both channel 0 and channel 1 are used. In single channel mode the module address can be set from 0 to 14. In dual channel mode the module address can be set from 0 to 13 and the module transmit in pairs. If the module is set for address X in dual mode the channel 0 information will transmit out address X and channel 1 information will transmit on address X + 1.

If needed the individual channels have the ability to enter a password to zero the pressure reading with no pressure on the transducer (see section. 6.12 and 6.13).

The ES-Key device ID for the Module is $9X_h$ (where X is the address value, 0 through E) Single channel mode.

The ES-Key device ID for the Module is $9X_h$ (where X is the address value, 0 through D). Dual channel mode

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9.5. TX message (ES-Key designation 0x9X to 0xFF)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	144-158(90 ₁₆ -9E ₁₆)

Byte 0 – A2D Value Low Byte

Byte 1 – A2D Value High Byte

Byte 2 – Configuration Byte

Byte 3 –

Byte 4 – Module Type

(value of 1 for 0-5V or value of 2 for 4-20mA)

Byte 5 – Software version

(high nibble = major rev, low nibble = minor rev)

Byte 6 – Calculated Low Byte

(a value from 1 to 20)

Byte 7 – Calculated High Byte

Configuration

1. Bit 0	(Aux Input State 0 = off 1 = on)
2. Bit 1	(Aux Output State 0 = off 1 = on)
3. Bit 2	(Aux Switch Polarity 0 = neg 1 = pos)
4. Bit 3	(Sensor Error High 0 = off 1 = on)
5. Bit 4	(Sensor Error Low 0 = off 1 = on)
6. Bit 5	(bad_cal 0 = off 1 = on)
7. Bit 6	(Calibration OK Low 0 = off 1 = on)
8. Bit 7	(Calibration OK High 0 = off 1 = on)

9.6. RX message (ES-Key designation 0x9F to 0x9X)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	as received
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	144-158 (90 ₁₆ -9E ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	159(9F ₁₆)

Byte 0 – Command

0x2F – Calibrate High

0x30 – Calibrate Low

0x36 – Set Factory Calibration

For selected channel (address dependent)

0x75 – Turn Off Aux Output

Not in original 113651 or 113652 module

0x76 – Turn On Aux Output

Not in original 113651 or 113652 module



0x76 – Set Aux Switch Polarity

Not in original 113651 or 113652 module

Byte 1 – Validation (0x23 = message approved)

Byte 2 – Activation (0x01 = message approved)

(If setting switch polarity 0x00 = NEG 0x01 = POS)

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PRODUCT	Dual Analog to CAN with Accelerometer			BY	GMC

10. Legacy 115819 Device Network TX RX CAN messages

10.1. Legacy 115819

The **Legacy 115819** module is used to read the InPower DCS35-300-2 current sensor (Hale part number 115762) to display charging current. The Legacy 115819 profile will replace the current Hale part number 115819. The channel 0 analog input is configured to be a 0-5 volt input with a reference voltage of 9 volts. Channel 1 is not used in this configuration.

The ES-Key device ID for the Module is 9X_h (*where X is the address value, 0 through E*).

10.2. TX message (ES-Key designation 0x9X to 0xFF)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	144-158(90 ₁₆ -9E ₁₆)

Byte 0 – A2D Value Low Byte

Byte 1 – A2D Value High Byte

Byte 2 – N/A

Byte 3 – N/A



Byte 4 – N/A

Byte 5 – Software version

(*high nibble = major rev, low nibble = minor rev*)

Byte 6 – N/A

Byte 7 – N/A

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	PRODUCT	Dual Analog to CAN with Accelerometer			BY	GMC

11. Legacy 112701 Device Network TX RX CAN messages

11.1. Legacy 112701

The **Legacy 112701** module is used to read a Battery Voltage. The Legacy 112701 profile will replace the current Hale part number 112701. The analog inputs are configured to be 0-30 volt inputs with no reference voltages. If the device is in single channel mode only channel 0 is used. If in dual channel mode both channel 0 and channel 1 are used. In single channel mode the module address can be set from 0 to 14. In dual channel mode the module address can be set from 0 to 13 and the module transmit in pairs. If the module is set for address X in dual mode the channel 0 information will transmit out address X and channel 1 information will transmit on address X + 1

The ES-Key device ID for the Module is $9X_h$ (where X is the address value, 0 through E) Single channel mode.
 The ES-Key device ID for the Module is $9X_h$ (where X is the address value, 0 through D). Dual channel mode

11.2. TX message (ES-Key designation 0x9X to 0xFF)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	144-158(90 ₁₆ -9E ₁₆)

Byte 0 – A2D Battery Voltage Low Byte

Byte 1 – A2D Battery Voltage High Byte

Byte 2 – N/A

Byte 3 – N/A



Byte 4 – N/A

Byte 5 – Software version

(high nibble = major rev, low nibble = minor rev)

Byte 6 – N/A

Byte 7 – N/A

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12. Legacy 122397 Device Network TX RX CAN messages

12.1. Legacy 122397

The **Legacy 122397** module is used to read two temperature sensor modules Hale part number 115722 to display ambient temperature. The Legacy 122397 profile will replace the current Hale part number 122397. The analog inputs are configured to be 0-5 inputs with a reference voltage of 5 volts.

The ES-Key device ID for the Module is 9X_n (where X is the address value, 0 through F).

12.2. TX message (ES-Key designation 0x9X to 0xFF)

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	144-159(90 ₁₆ -9F ₁₆)

Byte 0 – Internal Temp in Celsius

Byte 1 – External Temp in Celsius

Byte 2 – Internal A2D Value High Byte

Byte 3 – Internal A2D Value Low Byte

Byte 4 – Sensor Error

Byte 5 – Software version


(high nibble = major rev, low nibble = minor rev)

Byte 6 – External A2D Value High Byte

Byte 7 – External A2D Value Low Byte

Sensor Error

1. Bit 0	Internal Voltage Good	0 = off 1 = on
2. Bit 1	External Voltage Good	0 = off 1 = on
3. Bit 2	Internal Voltage Low	0 = off 1 = on
4. Bit 3	External Voltage Low	0 = off 1 = on
5. Bit 4	Internal Voltage High	0 = off 1 = on
6. Bit 5	External Voltage High	0 = off 1 = on

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	PRODUCT	Dual Analog to CAN with Accelerometer			BY	GMC

13. Legacy Mixed Device Network TX RX CAN messages

13.1. Legacy Mixed

The **Legacy Mixed** module uses channel 0 to read the InPower DCS35-300-2 current sensor (Hale part number 115762) to display charging current. Channel 1 is used to read a 4-20mA pressure sensor for displaying O2 levels. The Legacy Mixed profile will replace the current Hale part number 115819 and Hale part number 113652 for 1 O2 bottle. The channel 0 analog input is configured to be a 0-5 volt input with a reference voltage of 9 volts. Channel 1 input is configured to be a 4-20mA input with a 9 volt reference. The module transmits two can addresses in pairs so the module address can only be set from 0 to 13. If the module is set for address X channel 0 information will transmit out address X and channel 1 information will transmit on address X + 1.

The ES-Key device ID for the Module is 9X_h (*where X is the address value, 0 through D*).

13.2. TX message (ES-Key designation 0x9X to 0xFF) for Channel 0

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	144-157(90 ₁₆ -9D ₁₆)

Byte 0 – A2D Value Low Byte

Byte 1 – A2D Value High Byte

Byte 2 – N/A

Byte 3 – N/A

Byte 4 – N/A

Byte 5 – Software version

(*high nibble = major rev, low nibble = minor rev*)

Byte 6 – N/A

Byte 7 – N/A

13.3. TX message (ES-Key designation 0x9X to 0xFF) for Channel 1

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	10 per second
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	255 (FF ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	145-158(91 ₁₆ -9E ₁₆)

Byte 0 – A2D Value Low Byte

Byte 1 – A2D Value High Byte

Byte 2 – Configuration Byte

Byte 3 –

Byte 4 – Module Type

(*value of 5 for Mixed*)



Byte 5 – Software version

(*high nibble = major rev, low nibble = minor rev*)

Byte 6 – Calculated Low Byte

(*a value from 1 to 20*)

Byte 7 – Calculated High Byte

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Configuration

7.	Bit 0	(Aux Input State 0 = off 1 = on)
8.	Bit 1	(Aux Output State 0 = off 1 = on)
9.	Bit 2	(Aux Switch Polarity 0 = neg 1 = pos)
10.	Bit 3	(Sensor Error High 0 = off 1 = on)
11.	Bit 4	(Sensor Error Low 0 = off 1 = on)
12.	Bit 5	(bad_cal 0 = off 1 = on)
13.	Bit 6	(Calibration OK Low 0 = off 1 = on)
14.	Bit 7	(Calibration OK High 0 = off 1 = on)

13.4. RX message (ES-Key designation 0x9F to 0x9X) for Channel 1

Message/Frame Format	SAE J1939 CAN 2.0B (PDU1 Format)
Transmission Repetition Rate:	as received
Data Length:	8 Bytes
Data Page:	0
PDU Format:	239 (EF ₁₆) Proprietary A
PDU Specific:	144-158 (90 ₁₆ -9E ₁₆)
Default Priority:	6
Parameter Group Number (PGN):	61184 (EF00 ₁₆)
Source address:	159(9F ₁₆)

Byte 0 – Command

0x2F – Calibrate High	
0x30 – Calibrate Low	
0x36 – Set Factory Calibration	For channel 1
0x75 – Turn Off Aux Output	Not in original 113652 module
0x76 – Turn On Aux Output	Not in original 113652 module
0x77 – Set Aux Switch Polarity	Not in original 113652 module

Byte 1 – Validation (0x23 = message approved)

Byte 2 – Activation (0x01 = message approved)

(If setting switch polarity 0x00 = NEG 0x01 = POS)



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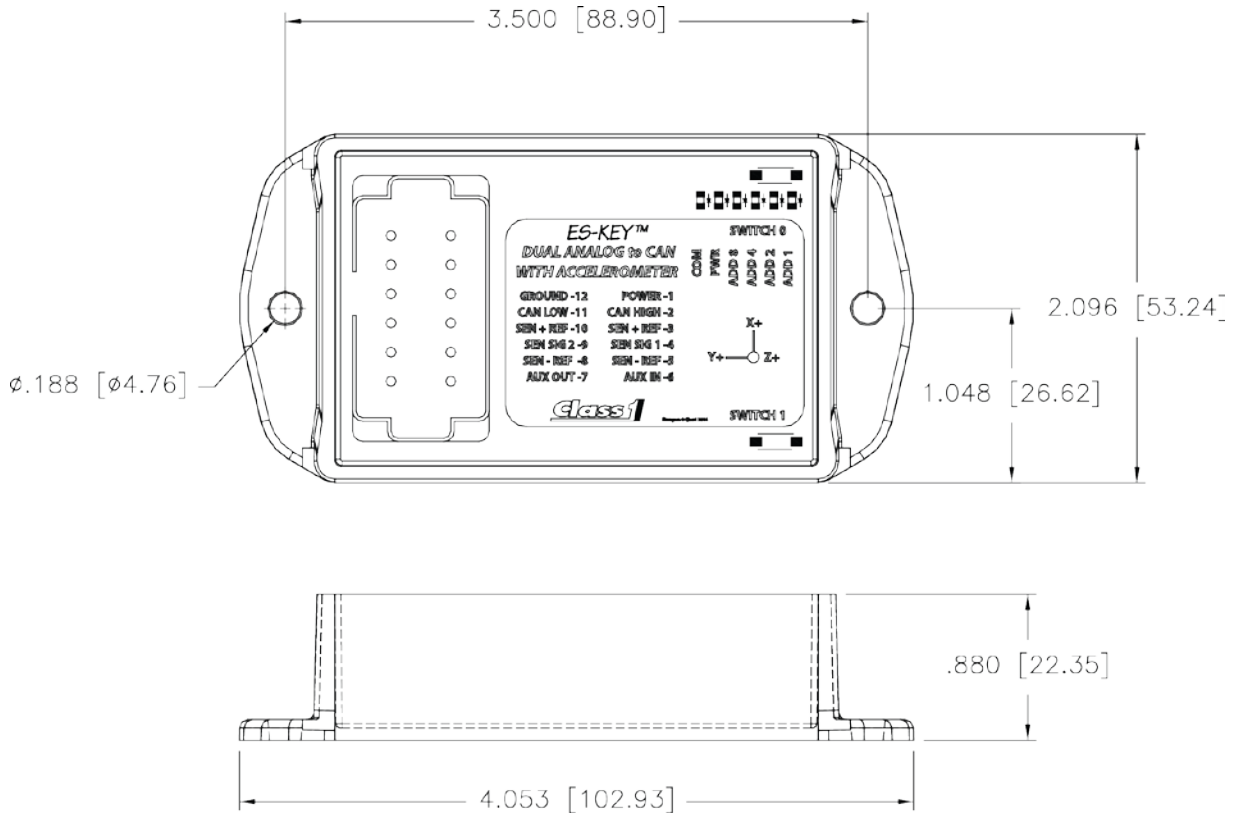
REV 1.08

PRODUCT Dual Analog to CAN with Accelerometer



BY GMC

14. Installation

14.1. Mounting dimensions

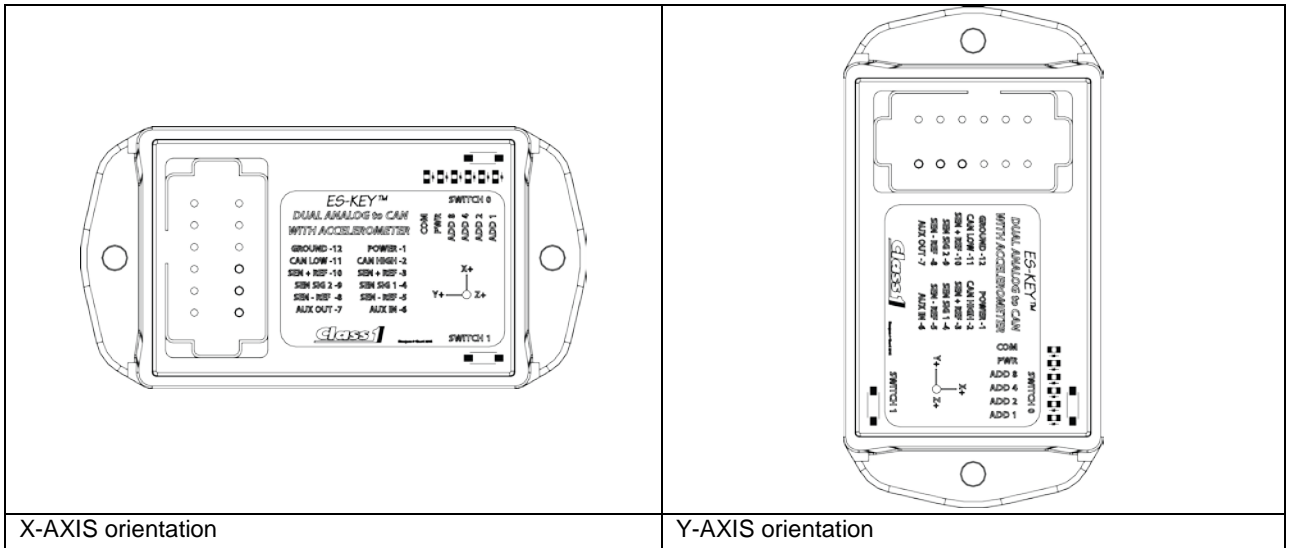




Unit of scale: inches [millimeters]

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14.2. Mounting orientation

If the unit is to be used as an Accelerometer the unit must be mounted in the desired orientation for either the X-axis or Y-axis operation. Once the desired orientation has been selected the correct password needs to be entered for proper operation (see section 6.2).



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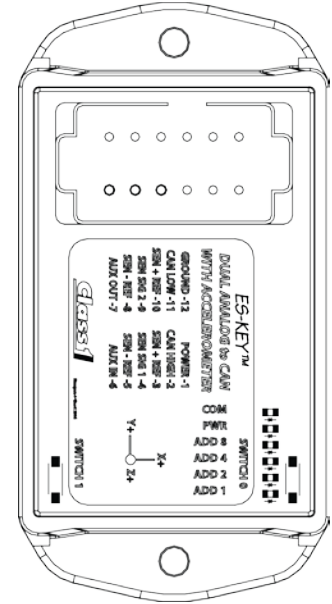
15. Wiring

15.1. Dual Analog to CAN with Accelerometer connector

The Module has one connector and the following definitions apply:

Mating connector: Deutsch DT06-12SA
Mating sockets: Deutsch 0462-201-16141
Wedge lock: Deutsch W12S
Plug Seal: Deutsch 114017
Recommended wire gage: 16-18 AWG

PIN	CIRCUIT	DESCRIPTION
1	SUPPLY (+)	(INPUT) – battery voltage (+9VDC...+32VDC)
2	CAN HIGH	(DATA) – SAE J1939 CAN 2.0B, 250Kbits/s
3	Sensor REF	(OUTPUT) – Selectable +5V or +9V
4	Sensor SIGNAL	(INPUT) – Selectable 0-5V, 4-20mA, Thermistor
5	Sensor GND	(OUTPUT) – Reserved
6	AUX Input	(INPUT) – Selectable Polarity
7	AUX Output	(OUTPUT) – .25A Negative Output
8	Sensor GND	(OUTPUT) – Reserved
9	Sensor SIGNAL	(INPUT) – Selectable 0-5V, 4-20mA, Thermistor, Freq
10	Sensor REF	(OUTPUT) – Selectable +5V or +9V
11	CAN LOW	(DATA) – SAE J1939 CAN 2.0B, 250Kbits /s
12	SUPPLY (-)	(INPUT) – battery ground

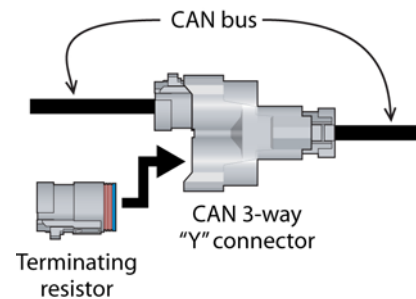


15.1.1. Terminating resistor requirement (CAN communication)

Two terminating resistors (120 Ohm) are required on the CAN bus for proper operation (one at each end of the CAN bus). Only two terminating resistors are allowed on a CAN bus.



Terminating resistor p/n DT06-3S-P006

CAN 3-way "Y" connector p/n DT04-3P-P007



15.2. System compatibility

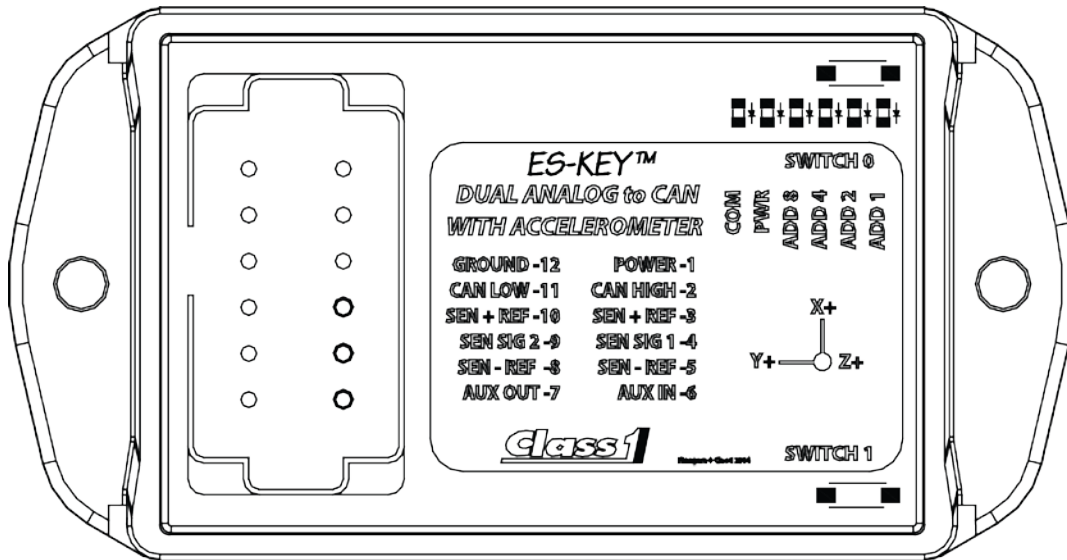
The Dual Analog to CAN with Accelerometer is compatible with other Class 1 CAN devices.



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16. Upgrade from a 123394 Accelerometer to the new 610-00033 Dual Analog to CAN module with Accelerometer

Upgrade from a 123394 Accelerometer Module to a 610-00033 Dual Analog to CAN Module with Accelerometer:

The new 610-00033 no longer uses pin 10 for the CAN Shield. If a new 610-00033 is being used to replace or upgrade an existing 123394 installation then the wire installed in pin 10 must be removed.



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17. Diagnostics

The **Accelerometer module** has 2 diagnostic LEDs which are viewable through the potting compound.

PWR - +9...+32VDC Module power
COM - Module status indicator

The COM LED indicates the module's CAN communication status.

On Solid

Module on-line

Flashing slow (2Hz)

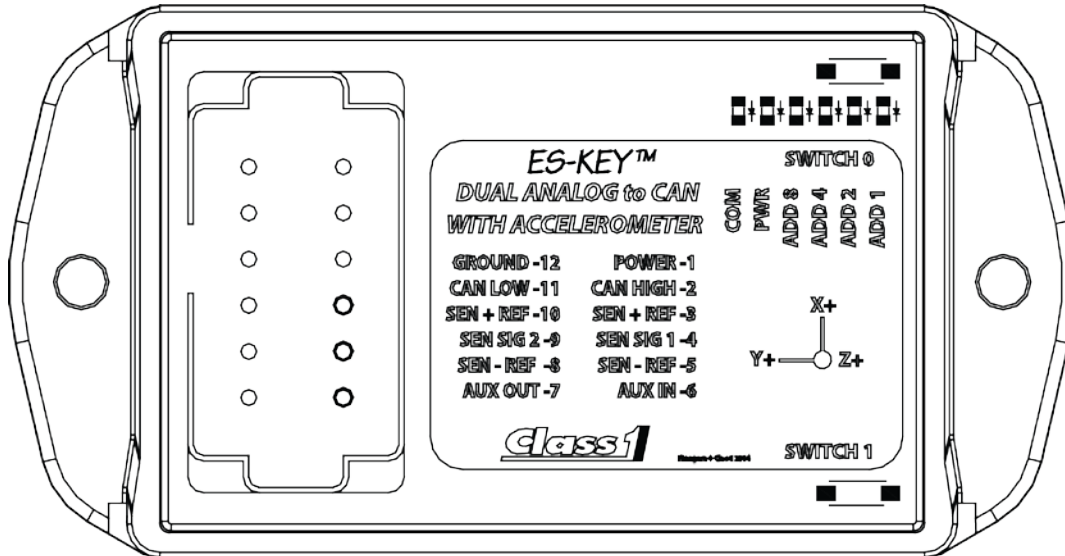
CAN bus okay, but the module is not receiving messages from the Universal System Manager (USM).



Flashing fast (8Hz)

CAN bus error, no communications or not connected.

Double flash

CAN bus has an *ACTIVE* error, no communications.



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18. Glossary

LED	<u>L</u> ight <u>E</u> mitting <u>D</u> iode. The lights on the display used to show tank level and information.
CAN	<u>C</u> ontroller <u>A</u> rea <u>N</u> etwork. SAE J1939 communication method.
EEPROM	<u>E</u> lectrically <u>E</u> rasable <u>P</u> rogrammable <u>R</u> ead- <u>O</u> nly <u>M</u> emory. The memory of the tank level display, used to store the display information (tank level points, display type, dim value, etc).
OEM	<u>O</u> riginal <u>E</u> quipment <u>M</u> anufacturer.
SAE	<u>S</u> ociety of <u>A</u> utomotive <u>E</u> ngineers.
ESD	<u>E</u> lectro <u>S</u> tatic <u>D</u> ischarge.
IP	<u>I</u> ngress <u>P</u> rotection (IP 67, etc).
p/n	part <u>n</u> umber

19. Technical details

19.1. Technical details

Product category	ES-Key
Voltage range	+9VDC...+32VDC
Power consumption	
@13.8VDC (25°C)	30 mA
@27.6VDC (25°C)	50 mA
Operational temperature range	-40°C...+85°C
Environmental range	IP 67
CAN specification	SAE J1939 proprietary, 250 Kbits/second
Protection	Internal thermal fuse Reverse voltage protection (pins 1 and 12 of connector) CAN buses protected to 24V ESD voltage protected to SAE J1113 specifications Transient voltage protected to SAE J1113 specifications
Dimensions (W x H x D) in inches [mm]	3.500 [88.90] x 2.096 [53.24] x .880 [22.35]

19.2. WEEE (Waste of Electrical and Electronic Equipment) directive



This symbol [crossed-out wheeled bin WEEE Annex IV] indicates separate collection of waste electrical and electronic equipment in the European Union countries.

Please do not throw the equipment into the domestic refuse.

Each individual European Union member state has implemented the WEEE regulations into national law in slightly different ways. Please follow your national law when you want to dispose of any electrical or electronic products.

More details can be obtained from your national WEEE recycling agency.