Emtron Input Expansion to CAN

USER MANUAL

Rev 1.0

EIC10 / EIC16M

EMtron Australia

Kit Contents

When purchasing an EIC10 the following items are included:

- EIC10 Device with Flying Harness
- Deustch DTM 4-way connector and female pins (DTM06-4S)
- Deustch DTM 12-way connector and male pins (DTM04-12PA)

EIC10 kit pictured.

When purchasing an EIC16M the loom side mating Autosport connector is not included but can be purchased separately.

Contents

1.0 Description

EIC16M

The EIC16M is a Mil Spec device designed to increase the Input channel capability of all Emtron ECUs with 16 high resolution analog and/or 4 frequency based inputs. The device is connected via CAN bus and will be automatically detected which will significantly minimalize configuration time. The enclosure is made from billet 6061 aluminium and is waterproof, allowing for use in extreme environments. Installation is made simple through use of a Motorsport proven Deutsch Autosport connector system.

EIC10

The EIC10 is designed to increase the Input channel capability of all Emtron ECUs with 10 high resolution analog inputs and/or 4 frequency based inputs. The device is connected via CAN bus and will be automatically detected which will significantly minimalize configuration time. The waterproof enclosure is extremely compact and made from billet 6061 aluminium. The device implements a flying loom system, terminated with the reliable and environmentally sealed Deutsch DTM connectors.

2.0 Specification

Power Supply

- Operating Voltage: 7.0 to 22.0 Volts DC
- Operating Current: 30mA at 14.0V
- Reverse Battery Protection: 0mA current draw
- Battery Transient/Over Current Protection

Internal

- 64MHz 16-bit Automotive Processor
- Analog Channel Sampling Rate 500 Hz

Inputs - General

- Analog Inputs
  - Range 0.0V to 5.0V, Resolution. 1.22mV 12 Bit
- Frequency Inputs
  - Range 0.5Hz up to 6500.0Hz, Resolution. 0.1Hz
  - Magnetic and Hall effect sensor compatible
  - Rising Edge Threshold = 1.8V, Falling Edge Threshold = 1.0V

EIC10 – 10 Analog Inputs

- ANV1-6: Analog Inputs 0.0V - 5.0V Range, Resolution. 1.22mV 12 Bit
- ANV7-10 / Frequency Input 1-4
  - Analog Inputs 0.0 – 5.0V range. Resolution. 1.22mV 12 Bit
  - Switchable 1k Pullup with blocking diodes to 8V Supply
  - Range 0.5Hz up to 6500.0Hz, Resolution. 0.1Hz

EIC16M – 16 Analog Inputs

- ANV1-12: Analog Inputs 0.0V - 5.0V Range, Resolution. 1.22mV 12 Bit
  - Switchable 1k Pullup Resistor to 5V Sensor Supply (ANV 9-12).
- ANV13-16 / Frequency Input 1-4
  - Analog Inputs 0.0 – 16.0V range. Resolution. 4.02mV 12 Bit
  - Switchable 1k Pullups with blocking diode to 8V Supply
  - Range 0.5Hz up to 6500.0Hz, Resolution. 0.1Hz

Outputs

- 5V Sensor Supply. Output current 250mA. Short circuit to ground protected.

Communications

- CAN 2.0B Baud Rate: 250kBaud, 500kBaud or 1Mbaud Auto Detect
- CAN Transmit Rate Adjustable: 50Hz/100Hz/200Hz/500 Hz

Operating Temperature

- Operating Temperature Range: -30 to 100°C (-22 to 212°F)

Physical

EIC16M

- Enclosure Size 52 mm x 74 mm x 18 mm
- 125g

EIC10

- Enclosure Size 63mm x 54 mm x 20mm
- 160g

3.0 Installation

Each device has a M4 x 1.5 thread tapped into the base of the enclosure and can be used for mounting. In high vibration applications rubber mounting is recommended.

CAUTION: When mounting the device inside the engine compartment, it should be positioned in cooler areas and away from heat sources such as exhaust manifolds. Any unnecessary radiated heat may affect device performance.

3.1 EIC10 Pinout

The pinouts are shown below in Table 3.0 and Table 3.1.

Power and CAN Flying Loom Connector: DTM 4 pin (M).

Pin	Function	Wire Colour
1	Ground	BLACK
2	CAN Lo	GREEN
3	CAN Hi	YELLOW
4	12V Supply	RED

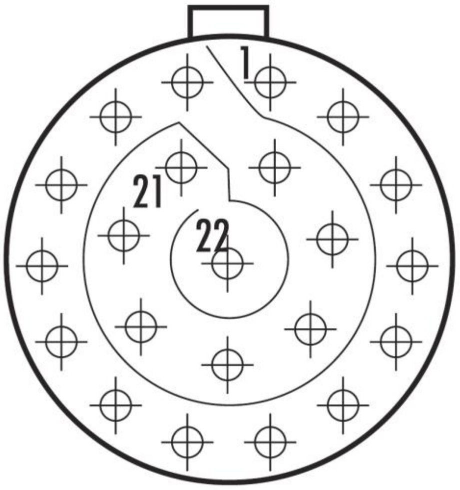
Table3.0. EIC10 Power and CAN Deustch Connector Pinout

Analog Input Flying Loom Connector: DTM 12 pin (F).

Pin	Function	Voltage Range	Pullup	Wire Colour
1	Analog Voltage 1	0 - 5.0V	No	BRN
2	Analog Voltage 2	0 - 5.0V	No	BLUE
3	Analog Voltage 3	0 - 5.0V	No	GREY
4	Analog Voltage 4	0 - 5.0V	No	W/GREY
5	Analog Voltage 5	0 - 5.0V	No	W/BLUE
6	5V Sensor Supply			W/BRN
7	Analog Sensor 0V Reference			W/RED
8	Analog Voltage 6	0 - 5.0V	No	W/BLACK
9	Analog Voltage 7/ Freq 1	0 - 5.0V	Yes	W/OR
10	Analog Voltage 8/ Freq 2	0 - 5.0V	Yes	OR
11	Analog Voltage 9/ Freq 3	0 - 5.0V	Yes	WHITE
12	Analog Voltage 10/Freq 4	0 - 5.0V	Yes	PUR

Table3.1. EIC10 Input Deustch Connector Pinout (DTM06-12SA)

3.2 EIC16M Pinout



Mating Connector Loom Side (Deutsch Autosport AS Series)
AS612-35SA (Yellow)

Pin	Function	Voltage Range	Pull-Up
1	14 V Supply		
2	Ground		
3	CAN Hi		
4	CAN Lo		
5	Analog Voltage 1	0.0 – 5.0V	No
6	Analog Voltage 2	0.0 – 5.0V	No
7	Analog Voltage 3	0.0 – 5.0V	No
8	Analog Voltage 4	0.0 – 5.0V	No
9	Analog Voltage 5	0.0 – 5.0V	No
10	Analog Voltage 6	0.0 – 5.0V	No
11	Analog Voltage 7	0.0 – 5.0V	No
12	Analog Voltage 8	0.0 – 5.0V	No
13	Analog Voltage 9	0.0 – 5.0V	Yes
14	Analog Voltage 10	0.0 – 5.0V	Yes
15	Analog Voltage 11	0.0 – 5.0V	Yes
16	Analog Voltage 12	0.0 – 5.0V	Yes
17	Analog Voltage 13/Frequency 1	0.0 – 16.5V	Yes
18	Analog Voltage 14/Frequency 2	0.0 – 16.5V	Yes
19	Analog Voltage 15/Frequency 3	0.0 – 16.5V	Yes
20	Analog Voltage 16/Frequency 4	0.0 – 16.5V	Yes
21	5.0V Sensor Supply		
22	0V Analog Sensor Reference		

Table 3.2. EIC16M Pinout

3.3 CAN Bus

The EIC10 or EIC16M can be connected to the ECUs CAN Bus 1 or 2.

All devices on the CAN Bus must be configured to use the same baud rate. For this reason, all Emtron CAN devices will Auto-scan the CAN bus until a successful baud rate has been detected. Once detected this rate will be stored and used at the next power up.

The device will scan 3 different Baud rates at 500ms intervals moving from 1Mbaud -> 500kBaud -> 250k Baud -> 1Mbaud and so on.

NOTE: For this process to function effectively, when **new** devices are introduced to the CAN bus, they should initially be connected **one at a time.** This allows each device to sync up to the CAN Bus baud rate and store that setting. This typically takes 3-5 seconds.

The EIC10 and EIC16M leave the factory programmed with individual serial numbers, but all have the same Base CAN Address ID used to transmit data over the Bus. The CAN Base address can be adjusted from the factory setting using the ID Reprogramming Tool. This is required when 2 or more of the same devices are connected to the CAN Bus (See section 4.2)

EIC10.

- Factory CAN Base Address of 718. Transmits data sequentially on the next 3 IDs. Total CAN ID Range is therefore 718 – 721.
- Up to 2x EIC10 devices can be used on the CAN Bus giving a total of 20 available Input Channels.

EIC16M.

- Factory CAN Base Address of 705. Transmits data sequentially on the next 5 IDs. Total CAN ID Range is therefore 705 – 710.
- Only 1 EIC16M device permitted on the CAN Bus.

3.4 Pullup Resistors

EIC10

The EIC10 has no switchable pullups to 5V, so an external 1k resistor will need to be fitted when connecting to a temperature sensor. The 5V Analog Sensor Supply pin can be used as the pullup supply.

Table 3.1 shows the inputs with software controlled 8V 1k Ohm pullup resistors plus blocking diode.

Pin	Function	Pull-Up
Pin 9	Analog Voltage 7 or Frequency Input 1	Yes – 8.0V
Pin 10	Analog Voltage 8 or Frequency Input 2	Yes – 8.0V
Pin 11	Analog Voltage 9 or Frequency Input 3	Yes – 8.0V
Pin 12	Analog Voltage 10 or Frequency Input 4	Yes – 8.0V

Table 3.1. EIC10 Inputs pullup resistor summary

EIC16M

Analog Voltage Channels 9 -12 have independent software controlled 5V 1k ohm pullup resistors. These are suitable for temperature measurement or as ON/OFF inputs by pulling the input to ground through a switch.

Analog Voltage Channels 13 -16/ Frequency Inputs 1-4 have software controlled 8V 1k Ohm pullup resistors plus blocking diode. A summary is shown in Table 3.2.

Pin	Function	Voltage Range	Pull-Up
13	Analog Voltage 9	0.0 – 5.0V	Yes – 5.0V
14	Analog Voltage 10	0.0 – 5.0V	Yes – 5.0V
15	Analog Voltage 11	0.0 – 5.0V	Yes – 5.0V
16	Analog Voltage 12	0.0 – 5.0V	Yes – 5.0V
17	Analog Voltage 13/Frequency 1	0.0 – 16.5V	Yes – 8.0V
18	Analog Voltage 14/Frequency 2	0.0 – 16.5V	Yes – 8.0V
19	Analog Voltage 15/Frequency 3	0.0 – 16.5V	Yes – 8.0V
20	Analog Voltage 16/Frequency 4	0.0 – 16.5V	Yes – 8.0V

Table 3.2. EIC16M Inputs pullup resistor summary

NOTE: The blocking diode on the 8V pullup prevents large frequency based signals back-feeding into the supply. If these channels are to be used for temperature measurement this pullup is not suitable. An external 1k resistor will need to be fitted and pulled up to the 5V Sensor Supply.

3.5 Frequency Inputs

The EIC10 and EIC16M have 4x Frequency Inputs which get shared with Analog Input pins as shown with Tables 3.3 and 3.4.

- Range 0.2Hz up to 6500.0Hz
- Resolution. 0.1Hz
- Rising Edge Threshold = 1.7V
- Falling Edge Threshold = 0.9V
- 8V independent software selectable 1k Ohm pullup resistors
- Both Falling or Rising Edges are software selectable.

EIC10

Pin 9	Analog Voltage 7 or Frequency Input 1
Pin 10	Analog Voltage 8 or Frequency Input 2
Pin 11	Analog Voltage 9 or Frequency Input 3
Pin 12	Analog Voltage 10 or Frequency Input 4

Table 3.3. EIC10 Frequency Input Summary.

EIC16M

Pin	Function
17	Analog Voltage 13/Frequency 1
18	Analog Voltage 14/Frequency 2
19	Analog Voltage 15/Frequency 3
20	Analog Voltage 16/Frequency 4

Table 3.4. EIC16M Frequency Inputs Input Summary.

NOTE: Any EIC configuration changes made from Emtune are immediately sent to the EIC10 or EIC16M device over the CAN Bus and stored automatically by the device.

3.6 Noise Immunity

To minimise signal contamination and maximise noise immunity, the wire pairs shown in Table 3.2 must be twisted. It is recommended to twist the wire pairs at a minimum one twist per 40mm of cable. This is very important and should always be implemented.

Pair 1		Pair 2
CAN High	<------->	CAN Low

Table 3.3. CAN Hi and Lo wire pairing for twisting

3.7 Sensor Wiring

5V Sensor Supply Pin

This is a 250mA 5V output designed to supply automotive sensors.

Analog Sensor 0V Reference Pin

This pin should be connected directly to the 0V (Ground) pin on any low current analog sensor, for example Pressure or Temperature.

- **DO NOT** connect the EIC 0V Reference pin directly to the Engine Block or ECU Ground. This is a dedicated and specialised 0V/ground output for analog sensors.
- **DO NOT** connect a sensor 0V/ground pin directly to the Engine Block or Device Ground. Instead this pin should be directly connected to the dedicated EIC 0V Reference pin. See Figure 3.1/3.2.
- **DO NOT** connect frequency based sensor grounds to the EIC 0V Reference pin; for example, an Ethanol content sensor. Use the main device ground.

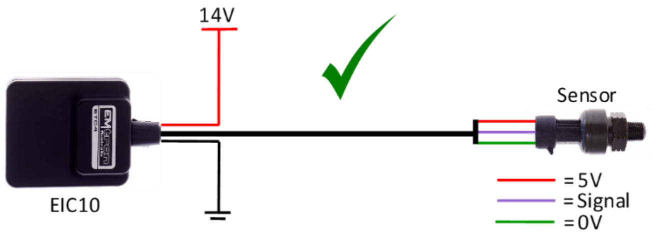


Figure 3.1. Correct MAP Sensor 0V Wiring

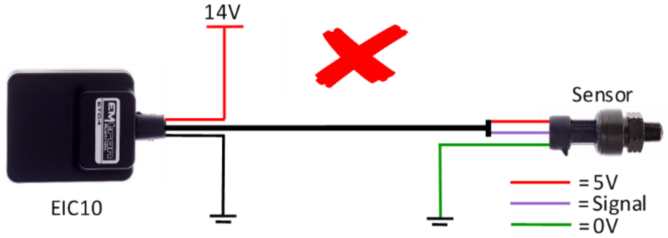


Figure 3.2. Incorrect MAP Sensor 0V Wiring

3.8 CAN Bus Wiring

- CAN Bus High and Low are differential signals, so twisted pair **MUST** be used. Failing to do so will compromise the entire CAN Bus System.
- In some extreme environments, shielded twisted pair may be required to help with reliability and data integrity.
- The less connectors in any transmission system the better. Unnecessary connectors are almost guaranteed to present an impedance discontinuity and hence may cause reflections and data loss.
- CAN Bus termination must be done correctly by using a 120 ohm 0.25W resistor at each END of the bus system.
- Maximum Stub length to a device from the main Bus is recommended at 0.3m, in accordance with High-Speed ISO 11898 Standard specification. See Figure 3.3.

The EIC16M and EIC10 devices do **not** include an on-board CAN termination resistor, allowing the device to be wired at any position on the Bus. CAN Bus termination must be done correctly by using a 120 ohm 0.25W resistor at each end of the bus system as mentioned above. Figures 3.1 and 3.2 show possible CAN Bus Implementation examples.

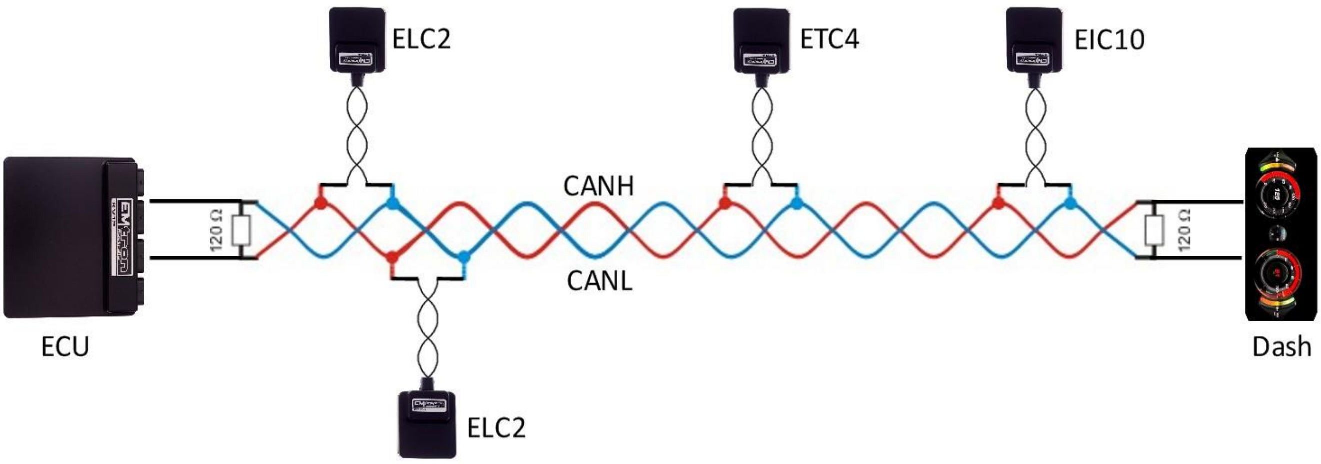


Figure 3.1. CAN Bus Wiring Example. ECU and Dash at each end with 120 Ohm Termination

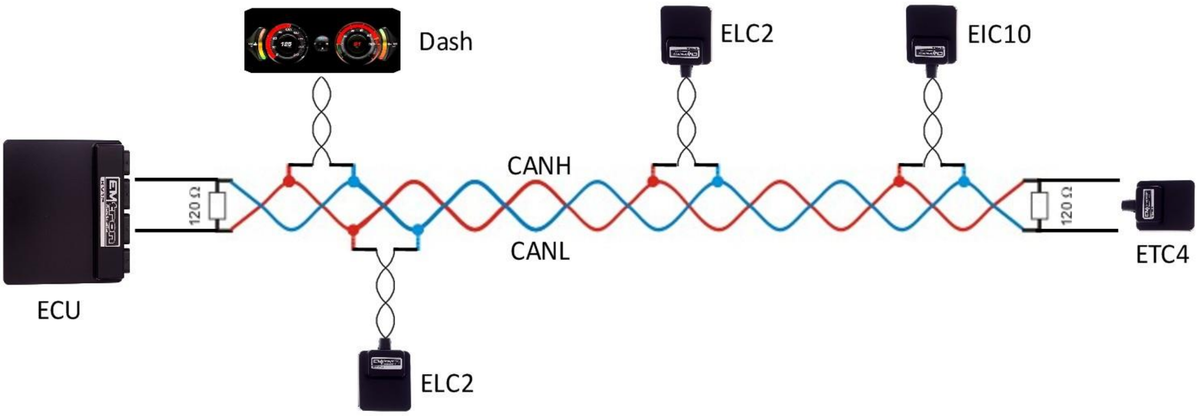


Figure 3.2. CAN Bus Wiring Example. ECU and EIC10 at each end with 120 Ohm Termination

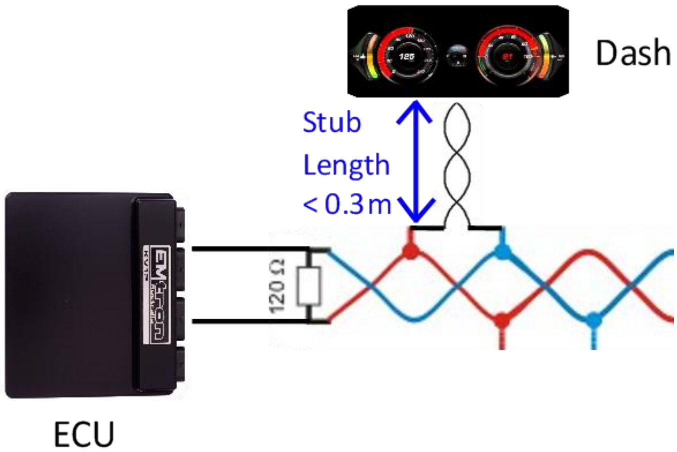


Figure 3.3. CAN Bus Wiring Example. Stub Length less than 0.3m

4.0 EIC Device Configuration

Once the EIC10 or EIC16M is powered and connected to the ECU's CAN bus, the following steps should be taken to complete the setup. All setup and device monitoring is done using Emtune, so this software needs to be installed and connected to the ECU.

4.1 EIC Single Device Setup

This section outlines the setup procedure for a single device and involves 3 steps:

1. Device Detection by the ECU
2. ECU CAN Bus configuration
3. EIC Live Data Monitoring

4.11 EIC Device Detection

To confirm the EIC device has been detected, connect to the ECU using Emtune. Open the ECU Runtime menu (F3) and select the Communications Tab. Within this tab there will be a list of Emtron CAN devices that the ECU has detected. It will list:

1. CAN Device Model
2. Device Serial Number
3. Device Firmware Version
4. Device Hardware Version
5. CAN Base Address ID

With a single EIC10 device connected, the data should look as shown in Figure 4.0. With a single EIC16M device connected, the data should look as shown in Figure 4.1.

Important:

- At this stage the ECU has only detected the device. It has not been configured to an ECU CAN Channel so the EIC data is not yet available.
- Note the CAN Base Address ID. This is required in the ECU CAN setup. The factory setting is ID 718 for the EIC10, and ID 705 for the EIC16M

CAN Device List		Device SN		Device FW Ver		Device HW Ver		CAN Base Addr	
CAN Slot 1:	EIC10	SN:	1229	Ver:	24	Ver:	16	CAN ID:	718
CAN Slot 2:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 3:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 4:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 5:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 6:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0

Figure 4.0. EIC10 connected to the CAN Bus

CAN Device List		Device SN		Device FW Ver		Device HW Ver		CAN Base Addr	
CAN Slot 1:	EIC16M	SN:	1230	Ver:	24	Ver:	16	CAN ID:	705
CAN Slot 2:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 3:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 4:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 5:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 6:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0

Figure 4.1. EIC16M connected to the CAN Bus

4.12 ECU CAN Configuration for Single Device

Next step is to configure an ECU CAN channel, allowing the ECU to decode the EIC CAN packets.

For this example, CAN 1- Channel 4 has been selected.

1. Set “Enable" to 1(ON)”
2. Set "CAN Base Address" to the Base Address shown in Figure 4.0 / 4.1. In this example select 718 for EIC10 or 705 for EIC16M.
3. **EIC10**. Set "DATA Set" to 73 (EIC10 1x Device). See Figure 4.2
   EIC16M. Set "DATA Set" to 69 (EIC16M 1x Device). See Figure 4.3

CAN 1 - Channel 4	
Enable	ON
CAN Base Address	718
DATA Set	Emtron EIC10 x1 Device (CAN PID 718/7...
Addressing	Single (11-BIT)
Direction	Receive
Transmitt Rate	10 Hz

Figure 4.2. EIC10 CAN Configuration

CAN 1 - Channel 4	
Enable	ON
CAN Base Address	718
DATA Set	Emtron EIC16M Device #1 (CAN PID 705...
Addressing	Single (11-BIT)
Direction	Receive
Transmitt Rate	10 Hz

Figure 4.3. EIC16M CAN Configuration

4.13 EIC Data Monitoring for Single Device

To confirm the EIC data is being decoded by the ECU, open the ECU runtime menu (F3) -> Emtron CAN Device Tab. The EIC10/EIC16M live data can be viewed. See Figure 4.4 and 4.5.

EIC10 Device 1/2 (CAN)		
CAN EIC10 (#1) - AN Volt 1	1.540	V
CAN EIC10 (#1) - AN Volt 2	0.013	V
CAN EIC10 (#1) - AN Volt 3	0.013	V
CAN EIC10 (#1) - AN Volt 4	3.471	V
CAN EIC10 (#1) - AN Volt 5	0.031	V
CAN EIC10 (#1) - AN Volt 6	0.000	V
CAN EIC10 (#1) - AN Volt 7	1.965	V
CAN EIC10 (#1) - AN Volt 8	4.561	V
CAN EIC10 (#1) - AN Volt 9	2.699	V
CAN EIC10 (#1) - AN Volt 10	1.971	V
CAN EIC10 (#1) - Freq 1	798.9	Hz
CAN EIC10 (#1) - Freq 2	797.1	Hz
CAN EIC10 (#1) - Freq 3	779.9	Hz
CAN EIC10 (#1) - Freq 4	779.0	Hz
CAN EIC10 (#1) - 5V Supply	4.989	V

Figure 4.4. EIC10 CAN Live Data – x1 Device

EIC16M Device 1 (CAN)		
CAN EIC16 #1 AN Volt 1	1.340	V
CAN EIC16 #1 AN Volt 2	0.013	V
CAN EIC16 #1 AN Volt 3	0.013	V
CAN EIC16 #1 AN Volt 4	3.671	V
CAN EIC16 #1 AN Volt 5	0.287	V
CAN EIC16 #1 AN Volt 6	0.000	V
CAN EIC16 #1 AN Volt 7	0.000	V
CAN EIC16 #1 AN Volt 8	4.563	V
CAN EIC16 #1 AN Volt 9	0.000	V
CAN EIC16 #1 AN Volt 10	1.879	V
CAN EIC16 #1 AN Volt 11	0.000	V
CAN EIC16 #1 AN Volt 12	0.000	V
CAN EIC16 #1 AN Volt 13	4.743	V
CAN EIC16 #1 AN Volt 14	4.739	V
CAN EIC16 #1 AN Volt 15	2.599	V
CAN EIC16 #1 AN Volt 16	1.980	V
CAN EIC16 #1 Freq 1	698.9	Hz
CAN EIC16 #1 Freq 2	697.1	Hz
CAN EIC16 #1 Freq 3	679.9	Hz
CAN EIC16 #1 Freq 4	679.0	Hz
CAN EIC16 (#1) - 5V Supply	4.987	V

Figure 4.5. EIC16M CAN Live Data– x1 Device

4.2 EIC Multiple Device Setup

As mentioned in section 3.4, the Base CAN Address ID used to transmit Data over the Bus by default is the same for each device type. The EIC10 has a factory CAN Base Address of 718 and EIC16M has a CAN Base Address of 705. When multiple EIC10/EIC16M devices are installed on the same CAN Bus, each device **MUST** have a unique CAN Base Address to avoid Bus conflicts. This means the CAN Base Address ID will need to be reprogrammed which is a simple task using the ID Reprogramming Tool as outlined in section 4.22.

<u>REMEMBER:</u> For this process to function effectively, when multiple **new** devices are introduced to the CAN bus, they should be initially connected **one at a time.** This allows each device to sync up to the CAN Bus baud rate and store that setting. This usually takes 3-5 seconds.

4.21 EIC Multiple Device Detection

The following example uses the EIC10. Connect to the ECU using Emtune. Open the ECU Runtime menu (F3) and select the Communications Tab. Within this tab will be a list of Emtron CAN devices that the ECU has detected. It will list:

1. CAN Device Model
2. Device Serial Number
3. Device Firmware Version
4. Device Hardware Version
5. CAN Base Address

With 2x EIC10 devices connected to the CAN bus, the CAN Summary List should look similar to that shown in Figure 4.6. In this example the following devices have been detected:

- Device 1 - SN 1230
- Device 2 - SN 1225

CAN Device List		Device SN		Device FW Ver		Device HW Ver		CAN Base Addr	
CAN Slot 1:	EIC10	SN:	1230	Ver:	24	Ver:	16	CAN ID:	718
CAN Slot 2:	EIC10	SN:	1235	Ver:	24	Ver:	16	CAN ID:	718
CAN Slot 3:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 4:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 5:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 6:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0

Figure 4.6 Example showing two EIC10 devices detected by the ECU

Note: ALL devices have the same Base Address of ID 718, which is the factory setting for a single device. To avoid Bus conflicts, the factory base address needs to be changed when multiple devices are used, to ensure each device has its own unique ID. When re-programming the Base Address for each device the IDs MUST be:

1) Sequential in order.
2) Have a gap of 4 numbers between each EIC10 device.

(Doesn't apply to EIC16M as only one device permitted on the Bus)

The Base Address ID can be any number but Emtron recommends the following:

- EIC10 Device 1: ID Base Address 718. (CAN ID Range 718-721)
- EIC10 Device 2: ID Base Address 722. (CAN ID Range 722-725)

The following Base Address is recommended for the EIC16M devices:

- EIC16M Device 1: ID Base Address 705 (CAN ID Range 705-710)

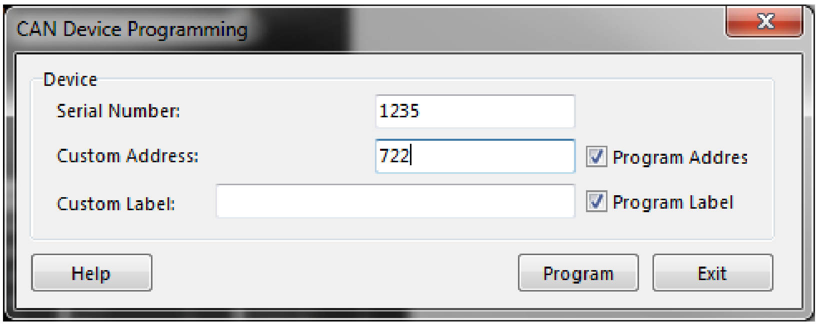
4.22 EIC CAN Base Address ID Reprogramming

To ensure each EIC device has a unique ID from the example in Figure 4.6, EIC10 Device 2 needs a new Base Address of 722.

This is easily done using Emtune from the Config view -> Communications Menu -> Emtron CAN Devices -> Emtron CAN Device Programming menu.

<u>Device 2 ID Reprogramming</u>
Enter in Serial Number = 1235
Enter in Custom Address = 722

Make sure the “Program Address” checkbox is ticked.



Select the “Program” button and the new Custom Address ID will be programmed into the device.

To check the device(s) have been programmed correctly with the new Base Address IDs, open the ECU Runtime menu (F3)-> Communications Tab. Each device now has a unique Base Address ID. See Figure 4.8.

CAN Device List		Device SN		Device FW Ver		Device HW Ver		CAN Base Addr	
CAN Slot 1:	EIC10	SN:	1230	Ver:	24	Ver:	16	CAN ID:	718
CAN Slot 2:	EIC10	SN:	1235	Ver:	24	Ver:	16	CAN ID:	722
CAN Slot 3:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 4:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 5:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0
CAN Slot 6:	Offline	SN:	0	Ver:	0	Ver:	0	CAN ID:	0

Figure 4.8. 2x EIC10 Devices detected by the ECU with reprogrammed IDs

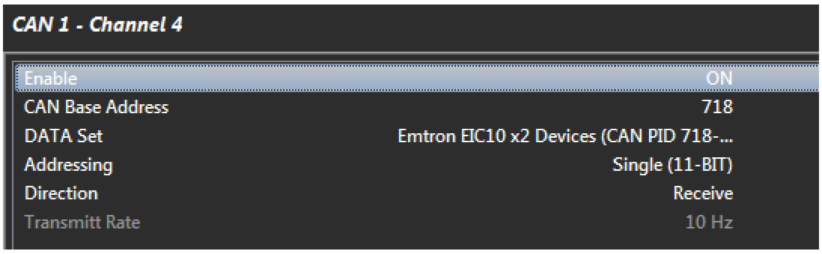
Each device now as a unique CAN Base Address ID and will be transmitting valid data on the Bus.

4.23 ECU CAN Configuration for Multiple Devices

The next step is to configure an ECU CAN channel, allowing the ECU to decode the EIC CAN packets.

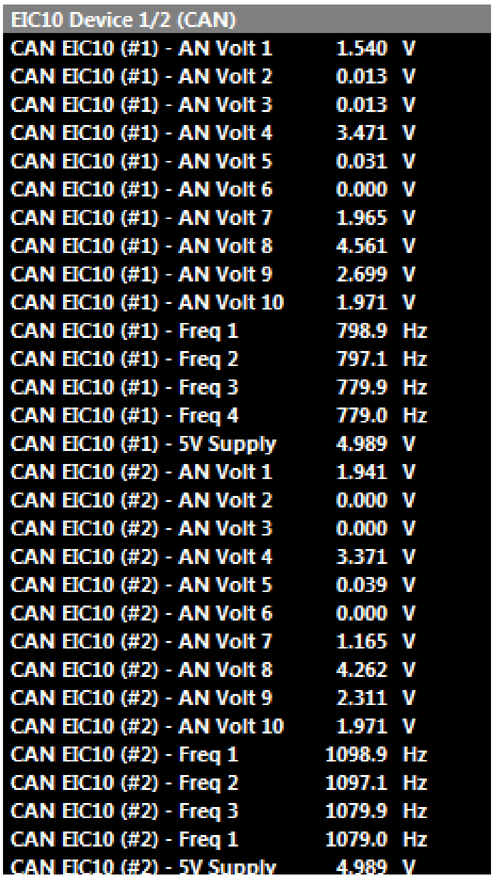
Only 1 CAN Channel is required for multiple devices. CAN 1 - Channel 4 has been selected. Config as follows:

1. Set “Enable" to 1(ON)”
2. Set "CAN Base Address" to the **Lowest** Base Address ID shown in Figure 4.8. In this example its 718.
3. Set "DATA Set" to 74 - Emtron EIC10 2x Devices (CAN PID 718/722).



The ECU is now configured and will receive data from all devices on IDs 718-721, 722-725.
NOTE: You only need to program in the lowest Base Address. The ECU automatically configures the remaining IDs based on the assumption that the IDs are sequential in order.

4.24 EIC Data Monitoring for Multiple Devices



To confirm the EIC10 data from multiple devices is being decoded by the ECU, open the Runtime menu (F3) -> Emtron CAN Device Tab to view the live data.

5.0 ECU Channel Configuration

Once the ECU has been configured to receive the EIC4/ECIC16M data, the next step is assigning the data to an ECU channel(s). The example shown in Figure 5.0 shows the following channel assignments:

- Compressor Inlet Pressure assigned to EIC16M channel 1
- Compressor Outlet Pressure assigned to EIC16M channel 2
- Compressor Inlet Temperature assigned to EIC16M channel 9
- Compressor Outlet Temperature assigned to EIC16M channel 10

NOTE: EIC16M pullup control is done through the Config View-> Communications -> Emtron CAN Devices -> Emtron Input to CAN Expansion menu. See Section 6.2 for more information.

Inputs Setup

Engine | Vehicle | Switches | VVT | Speed | DBW/Servo | Lambda Cyls | EGT | User | Motorsport | Turbo Dynamics | OE

Channel Name	Abrv	Input	Calibration	Units	Fault Lo	Fault	Filter
Compressor Inlet Temp	**TCIT**	**EIC16 #1 ANV 9**	**Bosch Std (2k5 at 20 DegC)**	**degC**	**OFF**	**OFF**	**0**
Compressor Outlet Temp	**TCOT**	**EIC16 #1 ANV 10**	**Bosch Std (2k5 at 20 DegC)**	**degC**	**OFF**	**OFF**	**0**
Compressor Inlet Pressure	**TCIP**	**EIC16 #1 ANV 1**	**Pressure User**	**kPa**	**OFF**	**OFF**	**0**
Compressor Outlet Pressure	**TCOP**	**EIC16 #1 ANV 2**	**Pressure User**	**kPa**	**OFF**	**OFF**	**0**
Wastegate Position 1	WGPOSN1	OFF					
Wastegate Position 2	WGPOSN2	OFF					
Wastegate Top Port Pressure 1	WGTPP1	OFF					
Wastegate Top Port Pressure 2	WGTPP1	OFF					
Pressure Bypass Valve Position		OFF					

Figure 5.0

6.0 EIC Custom Settings

The EIC10 and EIC16M have custom settings available for:

- Transmit Rates
- Pullup configurations
- Frequency Edge selection

NOTE: When any custom EIC setting is changed, the setting is automatically stored by the EIC device and therefore used on the next power cycle.

CAN Transmit Rates

The data is separated into 3 categories and can be independently adjusted. There are:

- Analog Voltage Channels 1-10 (EIC10) / Analog Voltage Channels 1-12 (EIC16M)
- Analog Voltage Channels 13-16 (EIC16M
- Frequency 1-4

For these setting see Config view-> Communications -> Emtron CAN Devices -> Emtron Input to CAN Expansion. Inside this menu will be an EIC10 and EIC16M menu. The Default value is 200Hz. It can be adjusted to suit the application and available CAN Bandwidth.

There are 4 options available.

- 200 Hz (Default)
- 50 Hz
- 100Hz
- 500Hz

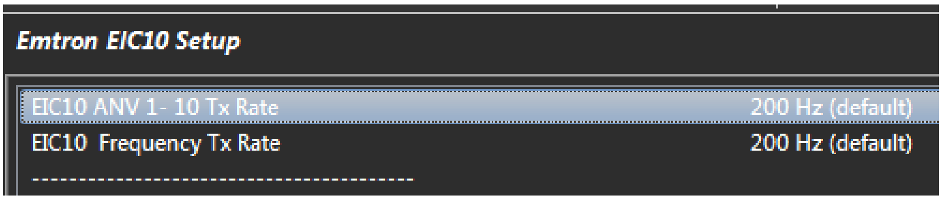


Figure 6.0. EIC10 Transmit Rate setup

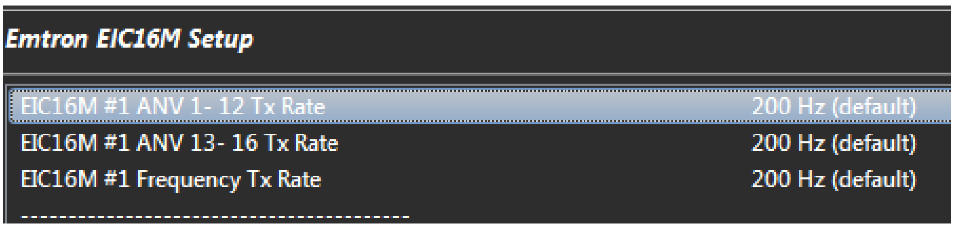


Figure 6.1. EIC16M Transmit Rate setup

Pullup Resistor Control

Section 3.5 previously summarises the Pullup options.

To adjust these setting see Config view-> Communications -> Emtron CAN Devices -> Emtron Input to CAN Expansion

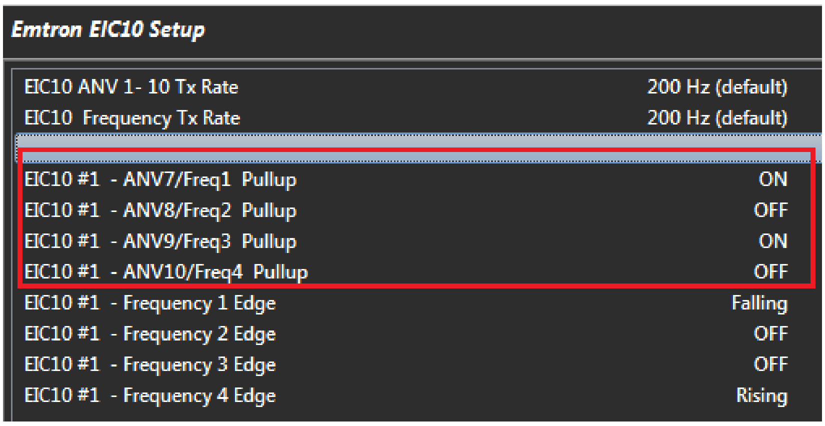


Figure 6.2. EIC10 Pullup Settings

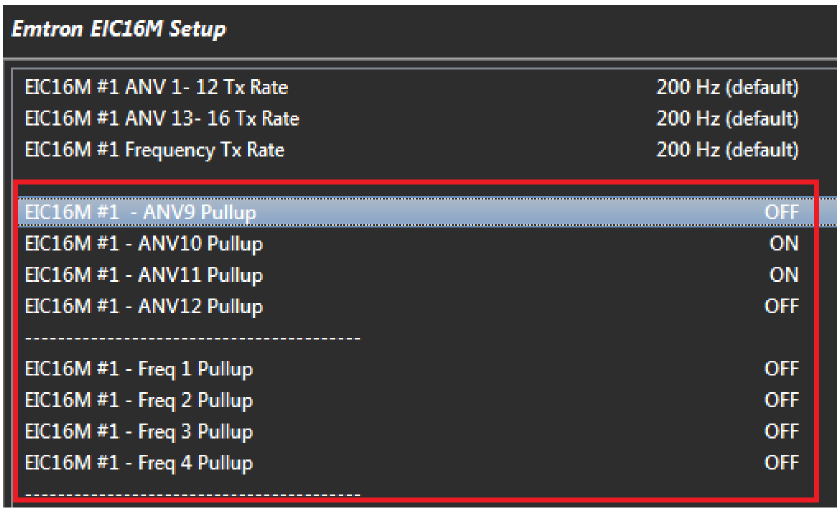


Figure 6.3. EIC16M Pullup Settings

Frequency Channel

Section 3.5 previously summarises the Frequency options. There are 3 frequency modes that can be selected:

- OFF
- Falling Edge
- Rising Edge

The Inputs can accept signals from Magnetic or Hall effect sensors. Magnetic sensors should have the edge selected to Falling. To adjust these setting see Config view-> Communications -> Emtron CAN Devices -> Emtron Input to CAN Expansion menu.

NOTE: The Frequency will not read until the Input Channel is selected to ON (i.e. Falling or Rising edge).

Emtron EIC10 Setup	
EIC10 ANV 1- 10 Tx Rate	200 Hz (default)
EIC10 Frequency Tx Rate	200 Hz (default)
--	
EIC10 #1 - ANV7/Freq1 Pullup	ON
EIC10 #1 - ANV8/Freq2 Pullup	OFF
EIC10 #1 - ANV9/Freq3 Pullup	ON
EIC10 #1 - ANV10/Freq4 Pullup	OFF
EIC10 #1 - Frequency 1 Edge	Falling
EIC10 #1 - Frequency 2 Edge	OFF
EIC10 #1 - Frequency 3 Edge	OFF
EIC10 #1 - Frequency 4 Edge	Rising

Figure 6.4. EIC10 Frequency Input Settings

Emtron EIC16M Setup	
EIC16M #1 ANV 1- 12 Tx Rate	200 Hz (default)
EIC16M #1 ANV 13- 16 Tx Rate	200 Hz (default)
EIC16M #1 Frequency Tx Rate	200 Hz (default)
--	
EIC16M #1 - ANV9 Pullup	OFF
EIC16M #1 - ANV10 Pullup	ON
EIC16M #1 - ANV11 Pullup	ON
EIC16M #1 - ANV12 Pullup	OFF
--	
EIC16M #1 - Freq 1 Pullup	OFF
EIC16M #1 - Freq 2 Pullup	OFF
EIC16M #1 - Freq 3 Pullup	OFF
EIC16M #1 - Freq 4 Pullup	OFF
--	
EIC16M #1 - Frequency 1 Edge	Falling
EIC16M #1 - Frequency 2 Edge	Rising
EIC16M #1 - Frequency 3 Edge	OFF
EIC16M #1 - Frequency 4 Edge	OFF

Figure 6.5. EIC16M Frequency Input Settings

7.0 Ordering Information

Product	Part Number
Emtron EIC10	593-10
Emtron EIC16M	593-1613

Appendices

Appendix 1. CAN Bus Data Packaging

This section outlines the CAN Protocol used to communicate with the EIC device(s). If the device is connected to an Emtron ECU, the CAN Bus packet is automatically decoded when correct CAN Dataset is selected and no additional setup is required. For more information refer to Section 4.0.

This section provides more detailed information on the CAN ID data structure and requires an understanding of both CAN protocols and data packaging.

Baud Rate

The EIC will Auto-scan the CAN bus until a successful baud rate has been detected. Once detected this rate will be stored by the device and used at the next power up.

The device will scan 3 different Baud rates at 500ms intervals moving from 1Mbaud -> 500kBaud -> 250k Baud -> 1Mbaud and so on.

EIC16M CAN Data Format

ID	705 /0x2C1 (Default)
Data	Voltage 3dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
705/0x2C1	AN Voltage 1	0	16	Little Endian	Unsigned
	AN Voltage 2	16	16	Little Endian	Unsigned
	AN Voltage 3	32	16	Little Endian	Unsigned
	AN Voltage 4	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	Example
705/0x2C1	AN Voltage 1	0.001	0	V	0.0 V	5.0V	CAN 3046 = 3.046V
	AN Voltage 2	0.001	0	V	0.0 V	5.0V	
	AN Voltage 3	0.001	0	V	0.0 V	5.0V	
	AN Voltage 4	0.001	0	V	0.0 V	5.0V	

ID	706 /0x2C2 (Default)
Data	Voltage 3dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
706/0x2C2	AN Voltage 5	0	16	Little Endian	Unsigned
	AN Voltage 6	16	16	Little Endian	Unsigned
	AN Voltage 7	32	16	Little Endian	Unsigned
	AN Voltage 8	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
706/0x2C2	AN Voltage 5	0.001	0	V	0.0 V	5.0V	CAN 3046 = 3.046V
	AN Voltage 6	0.001	0	V	0.0 V	5.0V	
	AN Voltage 7	0.001	0	V	0.0 V	5.0V	
	AN Voltage 8	0.001	0	V	0.0 V	5.0V	

ID	707 /0x2C3 (Default)
Data	Voltage 3dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
707/0x2C3	AN Voltage 9	0	16	Little Endian	Unsigned
	AN Voltage 10	16	16	Little Endian	Unsigned
	AN Voltage 11	32	16	Little Endian	Unsigned
	AN Voltage 12	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
707/0x2C3	AN Voltage 9	0.001	0	V	0.0 V	5.0V	CAN 3046 = 3.046V
	AN Voltage 10	0.001	0	V	0.0 V	5.0V	
	AN Voltage 11	0.001	0	V	0.0 V	5.0V	
	AN Voltage 12	0.001	0	V	0.0 V	5.0V	

ID	**708 /0x2C4 (Default)**
Data	Voltage 3dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
708/0x2C4	AN Voltage 13	0	16	Little Endian	Unsigned
	AN Voltage 14	16	16	Little Endian	Unsigned
	AN Voltage 15	32	16	Little Endian	Unsigned
	AN Voltage 16	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
708/0x2C4	AN Voltage 13	0.001	0	V	0.0 V	16.5V	CAN 13046 = 13.046V
	AN Voltage 14	0.001	0	V	0.0 V	16.5V	
	AN Voltage 15	0.001	0	V	0.0 V	16.5V	
	AN Voltage 16	0.001	0	V	0.0 V	16.5V	

ID	709 /0x2C5 (Default)
Data	Frequency 1dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
709/0x2C5	Frequency 1	0	16	Little Endian	Unsigned
	Frequency 2	16	16	Little Endian	Unsigned
	Frequency 3	32	16	Little Endian	Unsigned
	Frequency 4	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
709/0x2C5	Frequency 1	0.1	0	Hz	0	20000	CAN 65201 = 6520.1
	Frequency 2	0.1	0	Hz	0	20000	
	Frequency 3	0.1	0	Hz	0	20000	
	Frequency 4	0.1	0	Hz	0	20000	

ID	710 /0x2C6 (Default)
Data	Sensor Supply
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	2 bytes
Tx Rate	20Hz

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
710/0x2C6	5V Analog Supply	0	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
710/0x2C6	5V Analog Supply	0.001	0	V	0.0 V	5.5V	CAN 4989 = 4.989V

EIC10 CAN Data Format

ID	718 /0x2CE (Default)
Data	Voltage 3dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
718/0x2CE	AN Voltage 1	0	16	Little Endian	Unsigned
	AN Voltage 2	16	16	Little Endian	Unsigned
	AN Voltage 3	32	16	Little Endian	Unsigned
	AN Voltage 4	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	Example
718/0x2CE	AN Voltage 1	0.001	0	V	0.0 V	5.0V	CAN 3046 = 3.046V
	AN Voltage 2	0.001	0	V	0.0 V	5.0V	
	AN Voltage 3	0.001	0	V	0.0 V	5.0V	
	AN Voltage 4	0.001	0	V	0.0 V	5.0V	

ID	719 /0x2CF (Default)
Data	Voltage 3dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
719/0x2CF	AN Voltage 5	0	16	Little Endian	Unsigned
	AN Voltage 6	16	16	Little Endian	Unsigned
	AN Voltage 7	32	16	Little Endian	Unsigned
	AN Voltage 8	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
719/0x2CF	AN Voltage 5	0.001	0	V	0.0 V	5.0V	CAN 3046 = 3.046V
	AN Voltage 6	0.001	0	V	0.0 V	5.0V	
	AN Voltage 7	0.001	0	V	0.0 V	5.0V	
	AN Voltage 8	0.001	0	V	0.0 V	5.0V	

ID	**720 /0x2D0 (Default)**
Data	Voltage 3dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	6 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
720/0x2D0	AN Voltage 9	0	16	Little Endian	Unsigned
	AN Voltage 10	16	16	Little Endian	Unsigned
	5V Analog Supply	32	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
720/0x2D0	AN Voltage 9	0.001	0	V	0.0 V	5.0V	CAN 3046 = 3.046V
	AN Voltage 10	0.001	0	V	0.0 V	5.0V	
	5V Analog Supply	0.001	0	V	0.0 V	5.5V	CAN 4989 = 4.989V

ID	721 /0x2D1 (Default)
Data	Frequency 1dp
ID Type	Standard 11-bit identifier
Direction	Transmit from Device
Length	8 bytes
Tx Rate	Adjustable (50/100/200/500 Hz)

CAN ID	Name	Start bit	Length (bits)	Byte Order	Data Type
721/0x2D1	Frequency 1	0	16	Little Endian	Unsigned
	Frequency 2	16	16	Little Endian	Unsigned
	Frequency 3	32	16	Little Endian	Unsigned
	Frequency 4	48	16	Little Endian	Unsigned

Continuation:

CAN ID	Name	Multiplier	Offset	Units	Min	Max	*Example*
721/0x2D1	Frequency 1	0.1	0	Hz	0	20000	CAN 65201 = 6520.1
	Frequency 2	0.1	0	Hz	0	20000	
	Frequency 3	0.1	0	Hz	0	20000	
	Frequency 4	0.1	0	Hz	0	20000	

Appendix B. Magneto-Resistive Sensors

Magneto-resistive (MR) sensors are commonly used in driver assistance systems such as ABS, TCS and ESP to measure wheel speed, the frequency being proportional to the rotational speed of the wheel. These sensors detect a magnetic field and because there is no electrical contact the sensor can operate across a relatively large air gap. The amplitude of the output signal does not depend on speed.

These are active sensors which means they become "active" when a power supply is connected to it and a digital output waveform is then generated. However, the signal does not switch to ground like a conventional Hall sensor. Instead the signal swings between a high and low voltage, with the swing voltage dependant on the current passing through the sensor, i.e. the value of the pullup or pulldown current limiting resistor. Typical currents required to make to the sensor operate are 4 – 8mA.

Two important checks must be completed.

1) The polarity of the sensor must be correct.
2) The pullup/pulldown resistor might need adjustment to ensure it the digital signal swings within the correct levels. For the EIC16 this is 1.0V low and 1.8V high.

Sensor Polarity

The sensor polarity can be determined by measuring the diode voltage drop across the sensor, (sensor resistance cannot be used) using a Multimeter. The direction with the highest voltage drop is the correct polarity. See Table 6.0 as an example. Pin 1 should be connected to the pullup resistor and pin 2 should be connected the ground.

Diode Voltage Drop	Pin 1	Pin 2	Notes	
1.781 V	Positive	Negative	Correct Polarity	✓
0.637 V	Negative	Positive	Incorrect Polarity	✗

Table 6.0

Device Connection

An MT sensor can be connected directly to an Emtron ECU and the internal Scope function can be used to view the signal. Once you have the signal image, config the pullup resistor and correctly set the arming threshold.

Due to the variation in sensor outputs the EIC Device requires an interface device to condition the signal to match the factory EIC thresholds (1.0V low and 1.8V high).

Sensor Supply and Wiring

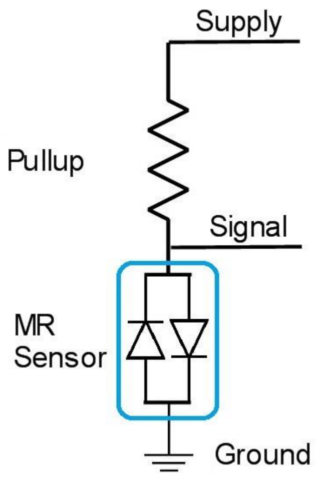


Figure 6.0. Sensor Wiring

The sensor is powered through a pullup resistor. The minimum supply voltage is 8V, ideally a regulated supply should be used to ensure consistent readings. Figure 6.0 illustrates how the sensor should be wired.

NOTE: If the pullup resistor is too big there will be insufficient current to make the output switch. Typical Pullup resistor range is 330 Ohms to 1000 Ohms.

NOTE: The Low and High outputs levels will vary with different sensors, so for signal integrity each sensor output should be checked using an oscilloscope. Table 6.1 show some typical results from a Toyota Sensor

Supply	Pullup Resistance	Low Output	High Output	Switching Range	Comments
5V	330 Ohms	5.2V	5.2V	0.0V	Insufficient Current
8V	330 Ohms	3.6V	5.9V	2.3V	✓ (see Figure 6.1)
12V	330 Ohms	7.6V	9.9V	2.3V	✓
8V	470 Ohms	5.25V	5.25V	0.0V	Insufficient Current
12V	470 Ohms	6.3V	9.45V	3.15V	✓

Table 6.1

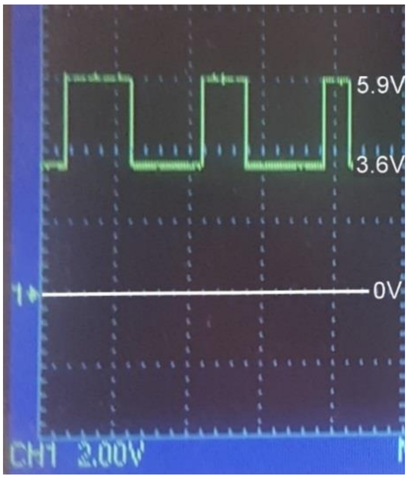


Figure 6.1. Scope trace of MR Sensor.

Figure 6.1 shows a scope trace of a MR Sensor with 330R pullup supplied at 8V. The High Output level is 5.9V and the Low Output Level is 3.6V.

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