POWERTUNE DIGITAL CAN I/O EXTENDER USER MANUAL (V1.0)

FULL MANUAL: https://www.powertunedigital.com/pages/manual

Thank you for your purchase of the PowerTune Digital CAN I/O extender!

Terms & Conditions:
It is recommended that your CAN I/O EXTENDER is installed by a trained professional. Incorrect installation can result in damage to your vehicle, electronics or components. Vehicles & vehicle components are not considered part of Powertune Digitals warranty repairs.

-Never short-circuit the wires of the vehicle's wiring loom or the inputs/outputs of the CAN extender.
- All modifications to the vehicle's wiring must be performed with the positive terminal of the battery disconnected.
-It is critical that all connections in the wiring are properly insulated and that no metal wiring is left exposed after installation has been completed.

Broadcasting CAN IDs on your vehicle's can-bus that conflict with existing addresses already used by the ECU/manufacturer could interfere with any vehicle system, safety systems, or any critical vehicle systems (airbags, brakes, cruise control). It is vital to ensure the correct procedure is followed to identify and set the correct CAN addresses to be broadcast by the CAN extender.
FORD CUSTOMERS MUST ENSURE THE CAN ID IS SET TO ID 600.

Warranty:
PowerTune Digital's products are manufactured to high quality standards and are put through thorough tests and inspections before they are sold to you. PowerTune Digital provides a 12 months warranty against defects in relation to the hardware components of our products on the terms of our Warranty Sheet. PowerTune Digital products are designed for off road use only.

PowerTune Digital will not be liable for any incidental, special or consequential loss or damages, or damages for loss of data, business or business opportunity, goodwill, anticipated savings, profits or revenue arising under or in connection with any products we sell, except to the extent this liability cannot be excluded under the Competition and Consumer Act 2010 (Cth) or any other applicable law.

See full warranty terms and conditions at:
https://www.powertunedigital.com/pages/warranty

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ITEMS REQUIRED TO COMPLETE INSTALLATION

-Flathead screwdriver, Wire strippers, crimping tool OR soldering iron, multimeter, electrical tape/heat shrink

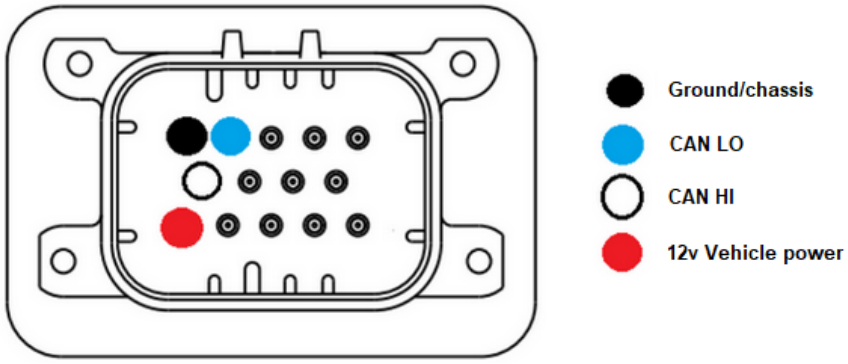
-Additional wiring to join/connect the input channel wires to the location of the desired sensor/source

-Wire joiners/crimps, OR, soldering iron/solder

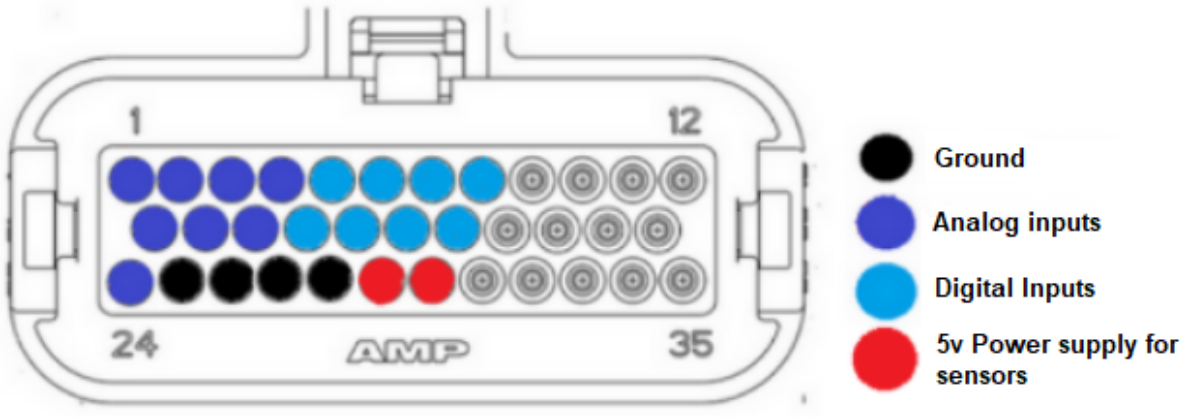
-Laptop or USB keyboard

Section 1 - Connector Pinouts

CONNECTOR A: 14 Pin ECU/vehicle side connector (pictured facing rear side of connector)



CONNECTOR B: 35 Pin Digital / analog input connector (pictured facing rear side of connector)



Pinout table: (pin numbers are located in the corners of the connector picture)

Pin 1 : Analog input channel 1 **Pin 2 : Analog input channel 3** **Pin 3 : Analog input channel 5** **Pin 4 : Analog input channel 7**	**Pin 5: Digital input channel 2** **Pin 6: Digital input channel 4** **Pin 7: Digital input channel 6** **Pin 8: Digital input channel 8**	**Pin 13: Analog input channel 2** **Pin 14: Analog input channel 4** **Pin 15: Analog input channel 6**

Pin 16: Digital input channel 1 **Pin 17: Digital input channel 3** **Pin 18: Digital input channel 5** **Pin 19: Digital input channel 7**	**Pin 24 : Analog input channel 0** **Pins 25 - 26 : Ground** **Pins 27 - 28 : Ground** **Pins 29 - 30 : 5v Power supply**	**Pins 9 - 12 : Unused** **Pins 20 - 23: Unused** **Pins 31 - 35 : Unused**

-Do not assume a red wire is power, always check the connector pinout to verify.
-Do not assume a wire that is NOT colored red does NOT carry power.
Always trace the wires to the connector and verify against the connector pinout during installation to ensure you have the correct wire/pin location.
Do not depend solely on colors to determine the correct wire to select.

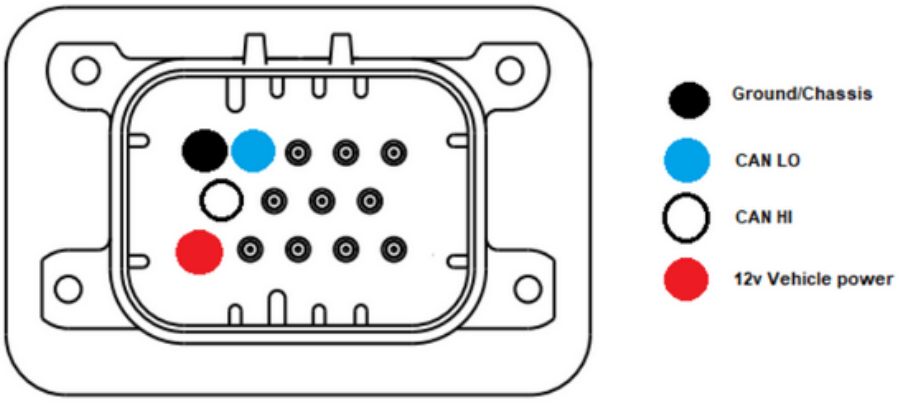
Section 2 - Wiring instructions

Ensure all equipment is fully powered down during any wiring (digital dash/vehicle/CAN extender and any accessories). Consult an auto electrician for professional wiring guidance.

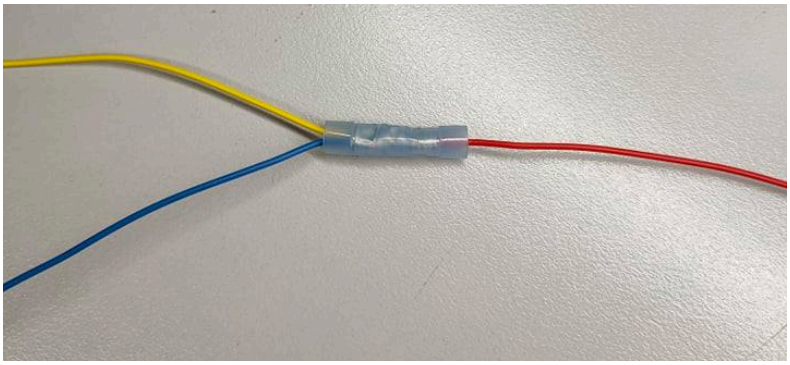
14 PIN CONNECTOR A: Ground/earth, CAN-bus, 12v power

Step 1: Begin with **CONNECTOR A** that has the smaller 14 pin plug, by inserting the plug into the can extender box (requires firm press!)

Connect the black ground wire from **CONNECTOR A** to earth/vehicle ground.	Connect the red power wire from **CONNECTOR A** to a 12v power source in the vehicle.

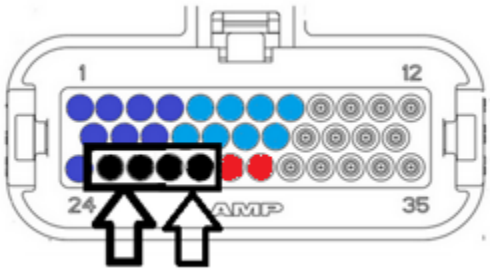


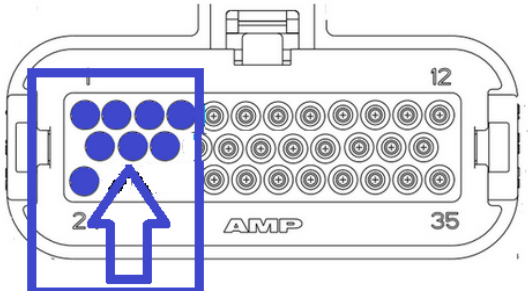
Step 2: Locate the blue and white wires on the same 14 pin connector, connect the blue to CAN-LO on your digital dash, white to CAN-HI on your digital dash. If you already have ECU wires running to your digital dash and cannot insert additional wires, use an electrical joiner to connect multiple CAN wires into a single wire (pictured below). **For now, leave the additional wires disconnected, disconnect the ECU/other devices from the dash and connect the extender directly to the dash.**

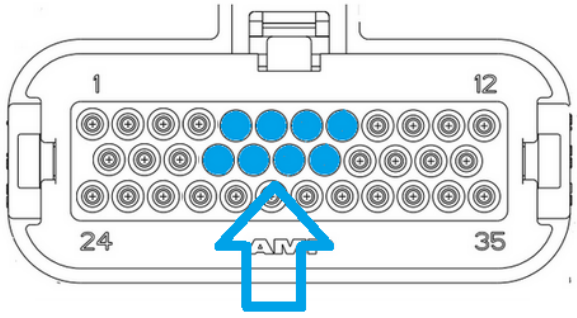


(example of multiple CAN H wires being joined together)

35 PIN CONNECTOR B: Ground wires + digital & analog inputs

Step 5: Plug the larger 35 pin connector into the CAN extender box (requires firm press!) and connect any required sensor grounds. (pins 25, 26, 27 and 28 can be used for sensor grounds). Pin 29 or 30 can provide 5v power supply to a sensor when required.	

Step 6: Sensor signal wires can be connected to the analog inputs. The left set of wires (pictured as the purple circles) is for **analog inputs.** (Used for voltage and resistance based sensors) **For fuel tank level input use Analogue input 7 (features dampening).**	

Step 7: The middle set of wires (pictured as the blue circles) is for **digital inputs.** (Used for indicators, lights, on/off signals)	

Pinout table: (pin numbers are located in the corners of the connector pictures)

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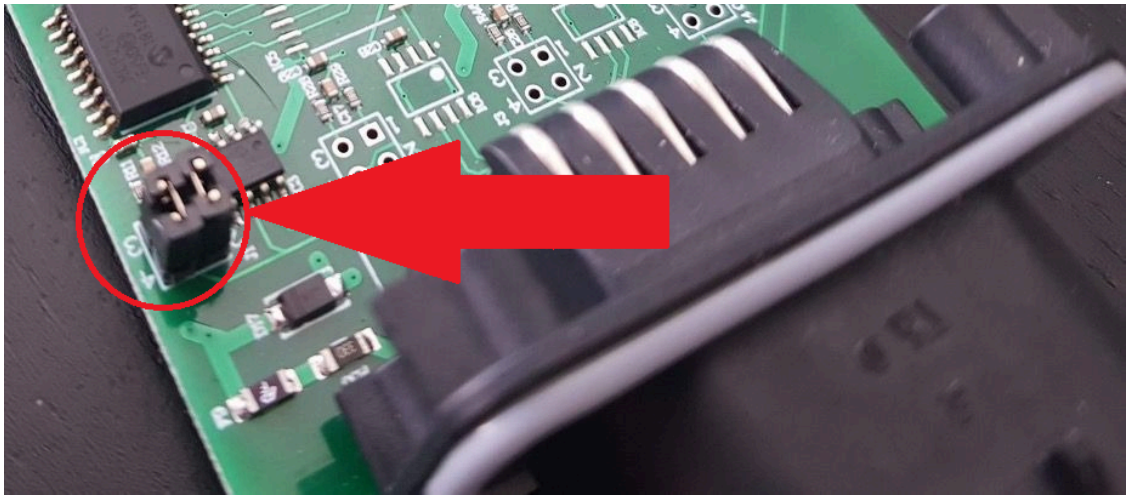
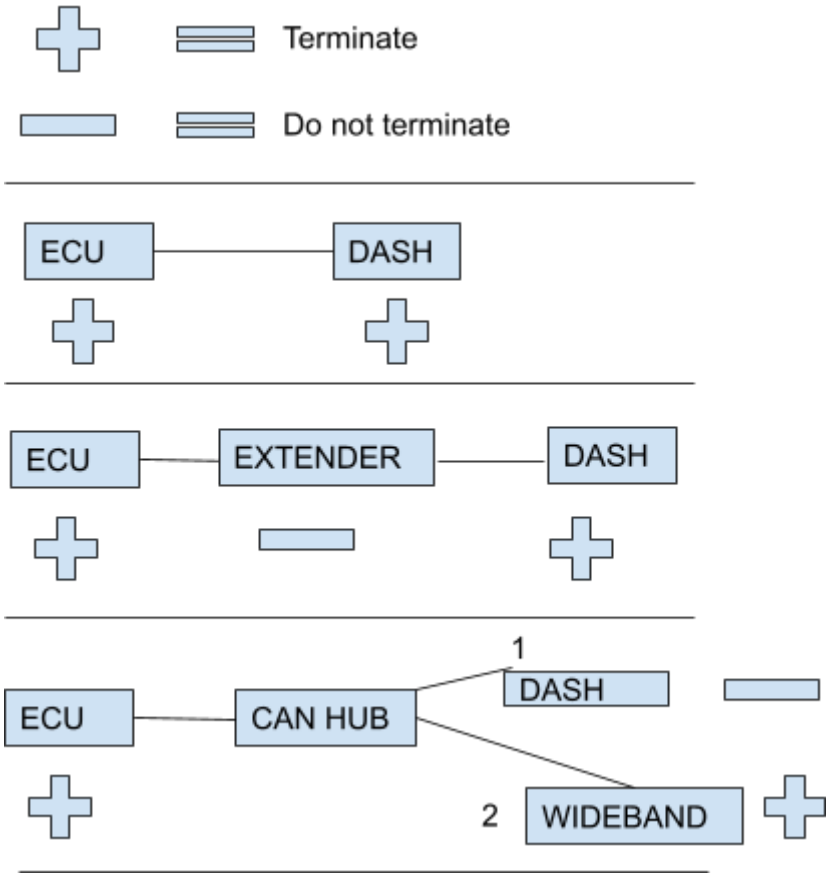
Section 3 - Termination

Each extender comes with a terminated internal 120ohm resistor. Depending on your CAN network topology, the resistor may not need to be terminated. The termination can be removed by removing the black plastic housing (pinch the sides of the base of the extender box whilst simultaneously pulling the lid up) and softly pull the two plastic jumpers upwards to remove them from the termination pins. Store in a safe place! Default position is to bridge pins 1-2 and 3-4. **See network examples below, the first and last device in line should always be terminated. The "last" device in line is determined by the longest cable length to reach the device.**

(located towards the end with the SMALLER 14 pin connector) pictured below:

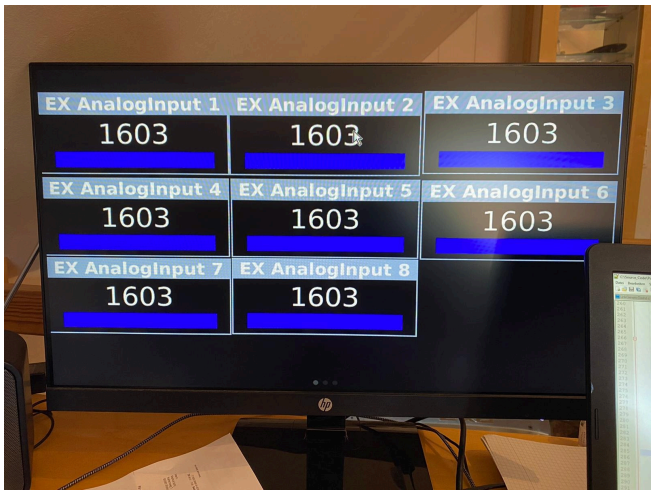




Section 4 - Wiring check

Once all wiring is completed **(as per Section 2, step 2, leave ALL other devices disconnected from the dash except the extender)**, turn on the vehicle ignition (engine can remain off) so your digital dash and CAN extender all receive power from the vehicle. To check if your extender is correctly wired, double tap a layout and add a new gauge for one of the analog or digital input channels you have wired up. You can also import either of the following layouts : “Analog inputs” or “Digital inputs” by pressing the import button in the layout menu which will import all 8 input channels at once. Inputs that do not have a sensor wired to them will not show any values.

ALL EXTENDERS SHIP AT 500kb CAN BAUDRATE. THE DASH MUST HAVE A 500KB BAUDRATE APPLIED DURING THE WIRING CHECK VIA THE THE STARTUP TAB OF THE DASH SETTINGS. SET THE DASH BACK TO CORRECT BAUDRATE TO MATCH ECU AFTER TESTING.



Alternatively to manually check communication with the extender, connect to your Powertune Digital dash over Wi-Fi from a computer using the program Putty. If you don't have a computer, you can connect a keyboard to your Powertune Digital dash, press “quit” from MAIN settings menu and login with username “pi” and password “raspberry” to access the backend command line (see full instructions in the digital dash user manual)

-To check if your extender is broadcasting, type the following command and press enter:
candump can0
-Wait a few seconds, then press CONTROL C

Briefly look through the CAN data. The CAN extender broadcasts data on IDs 401, 402 and 403 by default. If your extender is broadcasting, you will see the following IDs in the dump result (you may also see other CAN IDs from your ECU/vehicle mixed in between the messages, which you can ignore)

```
can0  403   [8]  00 00 01 00 00 00 00 00
can0  401   [8]  00 00 00 00 00 00 00 00
can0  402   [8]  3F 00 3F 00 01 00 00 00
can0  403   [8]  00 00 01 00 00 00 00 00
can0  401   [8]  00 00 00 00 00 00 00 00
```

Section 5 - Baud rate settings

Once you have communication, press CONTROL C to stop the candump and either one of the following commands:

(note: use shift + \ to get a # symbol on the command line)

USE for ALL AFTERMARKET (1MB BAUDRATE) ECUs:
This example results in the maximum transmit speed being applied at baud rate of 1MB on CAN address 400:
cansend can0 604#00000401

USE for ALL STANDARD ECUs (500KB BAUDRATE) EXCEPT FORD:
This example results in the maximum transmit speed being applied at baud rate of 500kb on CAN address 400:
cansend can0 604#00000402

For Factory Ford BA/BF/FG ECUs, use the following extender setup command to broadcast on CAN ID 600 at 500kb:
cansend can0 604#00000602

Section 6 - Inputs & Channel names

There are 8 digital inputs with a 3.5v - 12v switch point.
This means at a voltage above 3.5V, this state will be ENABLED/ON.

There are 8 analogue inputs with a 0-5v range and switchable resistance to voltage converter. The first three analogue inputs can also be used for non-linear (resistance based) sensors (Eg. temperature sensors). The remaining can inputs can be used for linear sensors.

CAN Extender only reads positively switched sources/sensors. It is not compatible with sensors switched to ground. (example, the temperature side of a bosch combo sensor is NOT supported due to being switched to ground). Best practice is to always use 2-pin sensors.

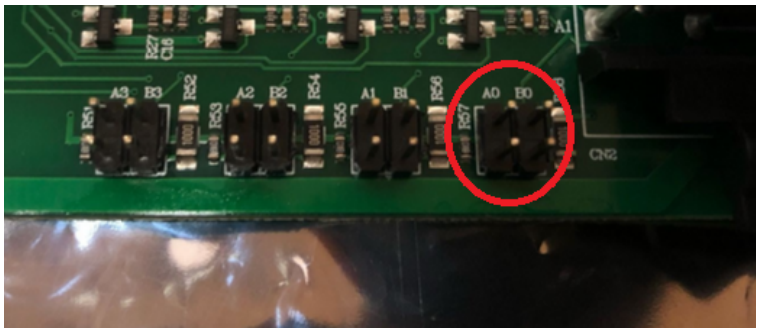
For fuel tank level input use Analogue input 7 as this channel has a dampening setting to average the values (to prevent readings from spiking as fuel sloshes through corners)

Resistance/temperature sensors should be on AN 0, 1 or 2.
Input impedance of the analogue inputs is 1.43k (with jumpers open)
Wire the signal output from the sensor to the desired input wire on the extender.

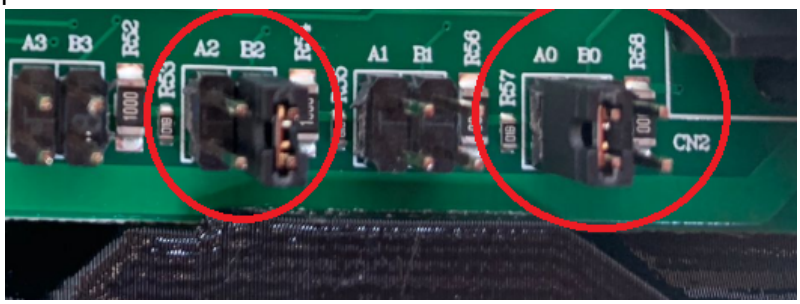
The user can change the total resistance by opening the extender case (softly loosen the clamps on the sides) and adding jumpers to put an additional 100 Ω **(jumper B)** and or 1000 Ω resistor **(jumper A)** **in parallel** for the input channels Analog 0 - Analog 3..(see image next page)

Please refer to the online calculator: LINK
This will let you calculate the best setting to get the maximum resolution for your specific sensor.
OR download HERE

The first pictured example below, with open jumpers, the resistance is by default 1.43K.



The second pictured example below, channel 0 has been set to add an additional 1,000 ohms resistance in parallel. Channel 2 has been set to add an additional 100 ohms resistance in parallel.



- For analog inputs, your Powertune Digital dash displays data on two gauge channels

- Analog input 0 broadcasts a signal to gauge channels named “ExAnalog-input 0” and ExAnalog-input calc 0” on your Powertune Digital dash. Whereby ExAnalog-input 0 will display the “raw” voltage reading. ExAnalog-input calc 0 will display the computed value to make it human readable (eg PSI..)

- Each Digital input broadcasts to one corresponding gauge channel, example digital input 7 broadcasts to channel named “ExDigital-input 7”. A value of 0 indicates OFF, a value of 1 indicates ON.

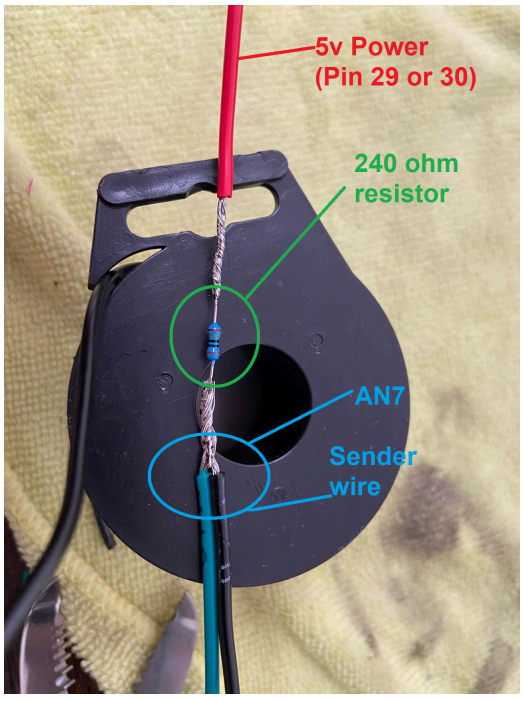
Fuel tank signals require a voltage divider circuit (240 ohm)

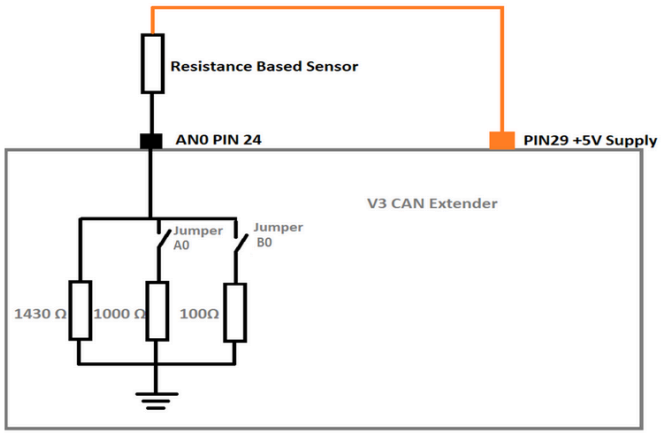
Voltage divider calculator: LINK (most people will use this sheet)

(If your ranges sit within 0.5 - 4.5V, use the RANGE CONVERTER tab toconvert the range to 0v - 5V)

Example 240ohm voltage divider circuit using 5v power supply and AN7 from CAN extender with **fuel sender** (pictured left).

Example circuit using resistance based sensor to AN0 (pictured right)

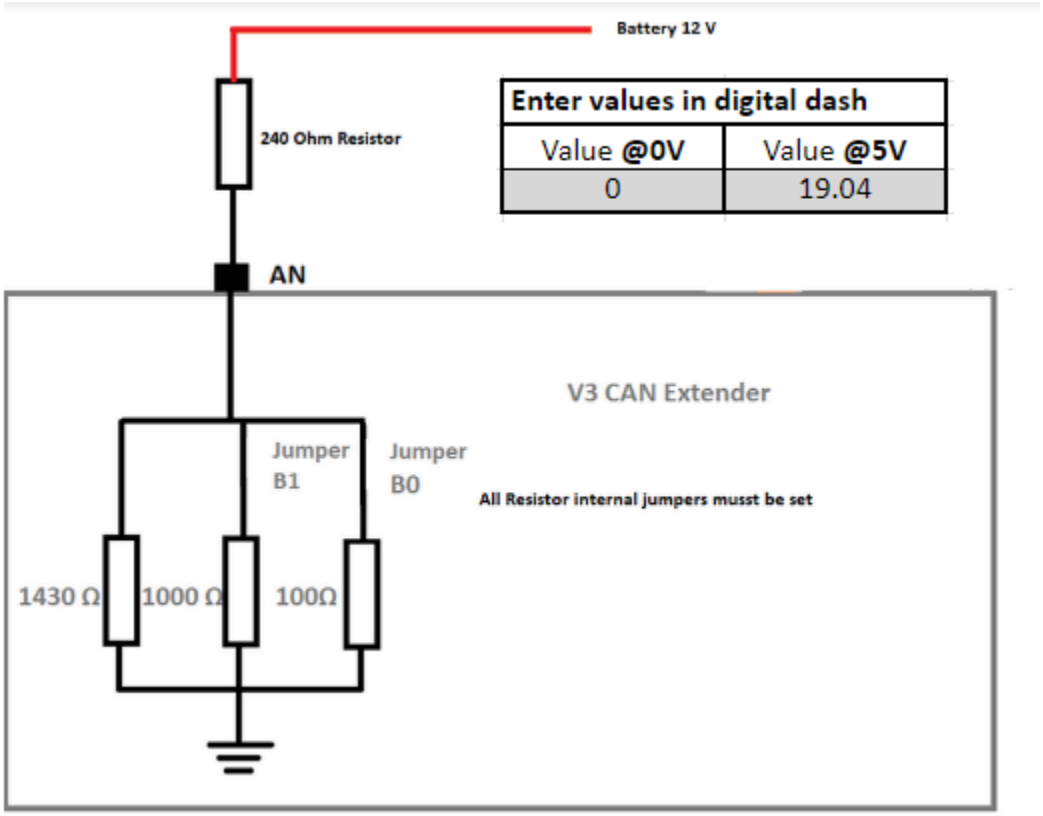




CAN EXTENDER SENSOR GROUND CAN ALSO BE TIED INTO THE BLUE CIRCLED AREA IF FUEL SENDER IS NOT ALREADY GROUNDED / HAS A BAD GROUND.

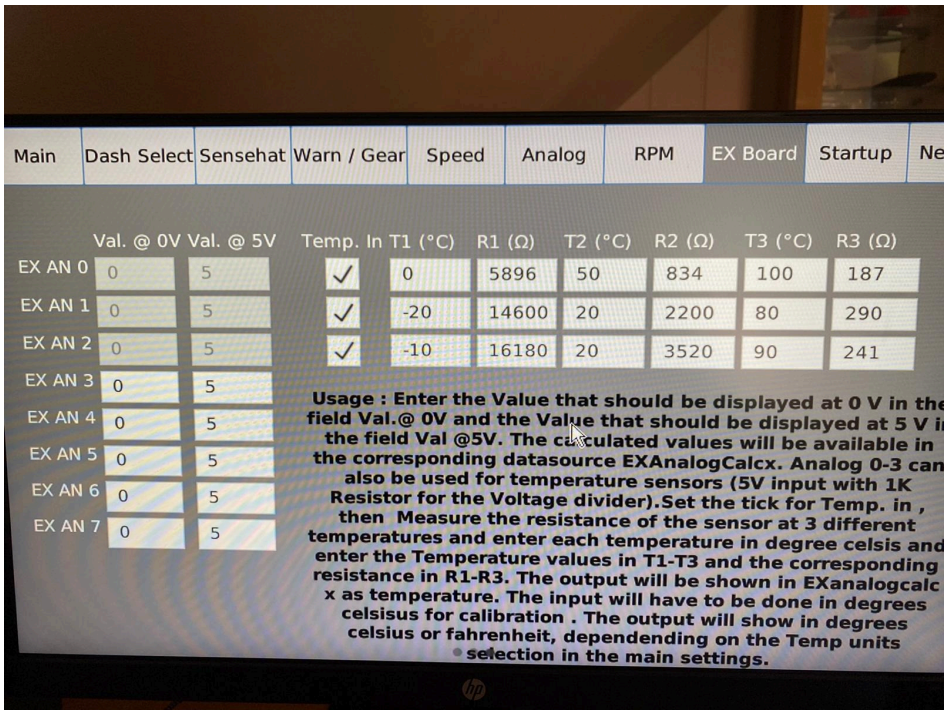
BATTERY VOLTAGE EXAMPLE:

Connect the 12 volt wire with a 240 Ohms resistor, then connect the other side of the resistor to an analog input on the extender. Set all jumpers so all internal resistors are set like in the picture (**SEE SECTION 6**) and set the settings in PowerTune Digital dash like in the picture below (framed in red)



Enter values in digital dash	
Value @0V	Value @5V
0	19.04

Section 7 - Dash settings + analog calculator



Enter the value that should be displayed at 0V in the field Val. @ 0v and the value that should be displayed in the field Val @ 5V (according to the documentation of the sensor manufacturer).

The calculated values will be available in the corresponding datasource ExAnalogCalc. Analog 0-3 can also be used for temperature sensors (5V input with a voltage divider explained in section 7)

Set the tick for temp, in, then measure the resistance of the sensor at 3 different temperatures (or consult the sensors datasheet) and enter each temperature in degrees celsius and enter the Temperature values in T1-T3 and the corresponding resistance in R1-R3. The output will be shown in EXanalogcalc x as temperature. The input will have to be done in degrees celsius for calibration, the output will show in degrees celsius or fahrenheit, depending on the Temp units selection in the main settings.

Section 8 - I/O Extender transmit settings

Consult our technical support team before changing any of the following settings. Incorrect use may result in the extender becoming unavailable.

Your CAN I/O extender defaults to transmit data at the fastest possible rate (32 messages per second per CAN ID).

You can adjust the transmit (refresh) rate and other settings by sending a CAN message on CAN ID 604 to the I/O extender from Putty (or using a keyboard in the command line of your digital dash). This assumes the base CAN address has not already been changed.

0x04 byte positions:

Byte 0	Leave this always 00
Byte 1-2	**Leave this 0004.** (base address 0x400) for Aftermarket ECU's
	Change this to 0006 (base address 0x600 for Ford Barra)
Byte 3	Baud rate. (8 bits)

0 = Auto detect baud rate
1 = 1mb
2 = 500kb
3 = 250 kb
4 = 125kb

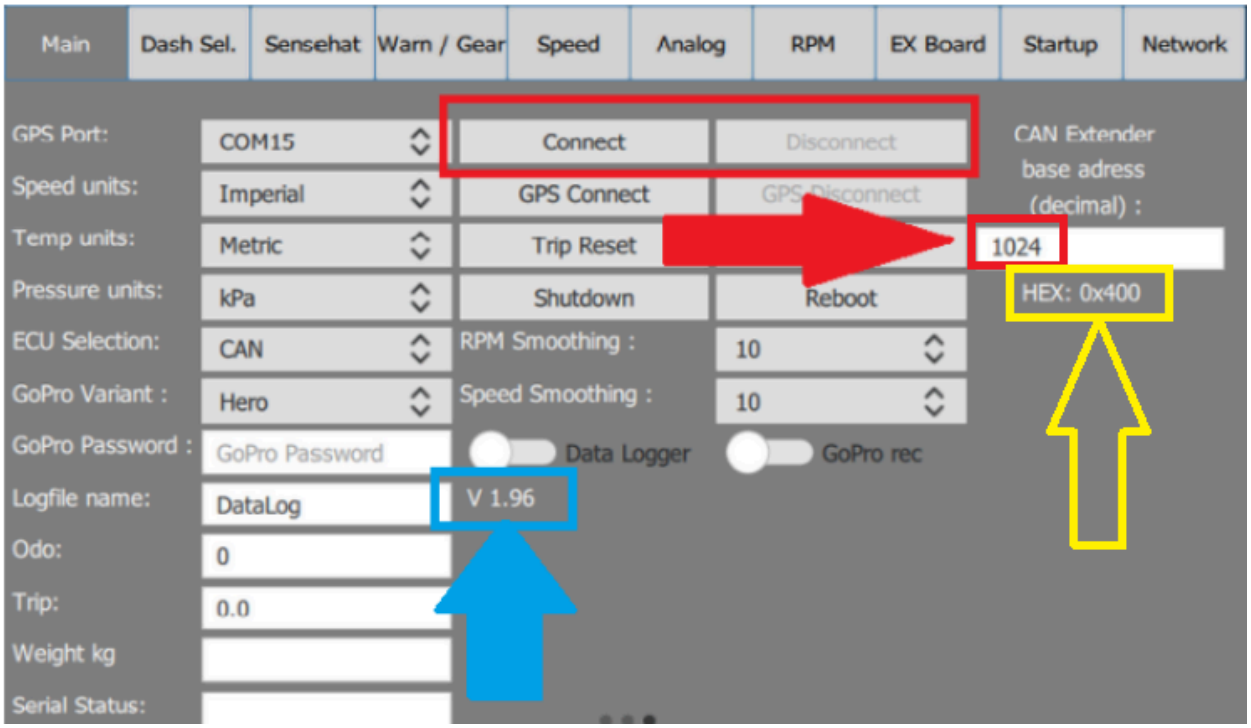
USE for ALL AFTERMARKET (1MB BAUDRATE) ECUs:
This example results in the maximum transmit speed being applied at baud rate of 1MB on CAN address 400:
cansend can0 604#00000401

USE for ALL STANDARD (or aftermarket) ECU (500KB BAUDRATE) EXCEPT FORD/WRX:
This example results in the maximum transmit speed being applied at baud rate of 500kb on CAN address 400:
cansend can0 604#00000402

For WRX OR Factory Ford BA/BF/FG ECUs, use the following extender setup command to broadcast on CAN ID 600 at 500kb:
cansend can0 604#00000602

THIS STEP REQUIRES DASH VERSION 1.96 OR HIGHER.
Older versions will not have the CAN extender base address section in the MAIN settings tab.

If you are lower than version 1.95, select the NETWORK tab at the top right of settings and run either one or two update cycles to upgrade your unit to 1.96 or higher.
(two updates may be required in a row to progress to 1.95)



Press disconnect and enter can extender base address in decimal

Use: 1024 = 0x400 (ALL OTHER ECUs)
1536 = 0x600 (**DEFAULT** / FORD V8/BARRA / WRX)

Then press connect.