

# CAN-EGT by DIYAutoTune.com

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## 1 Introduction

The first question you may have is, "Why have a special board for EGT sensors?" Many other sensors can be wired straight to a MegaSquirt, including throttle position sensors, coolant temperature sensors, and narrow band oxygen sensors. What makes EGT different?

Most automotive sensors are designed to work on a zero to five volt scale, since automotive microcontrollers typically have built in analog to digital converter circuits that can read a zero to five volt output. However, the only sensor type that holds up well to the intense heat in exhaust gas is a thermocouple, and these put out a signal in the millivolt range. Even the hottest EGT readings you can produce on an engine are not likely to push the output over 0.05 volts. So converting these signals into something a 5 volt electronics system can use requires a precision amplifier.

The CAN-EGT board lets you collect input from EGT probes and bring it in to a MegaSquirt through the CAN connection, or allows you to log the EGT readings through TunerStudio over USB. It is compatible with MS2, MS3, DIYPNP, MicroSquirt, and second generation MegaSquirt PNP systems. It also has analog outputs that allow it to serve as an EGT amplifier for other devices that can only accept 0-5 volt signals.

CAN-EGT features:

- 8 inputs for K-type thermocouples
- Cold junction compensation
- 0-1250 °C input range
- Measures both exhaust gas and cylinder head temperature
- 8 analog 0-5 volt outputs
- CANbus connection for connecting to MegaSquirt
- RS232 connection that connects to an Innovate LogChain - currently supports up to 8 Innovate wideband O2 sensors

- USB port for laptop connection
- Multiple CAN-EGT units can be daisy chained together

## 2 Installation

### 2.1 EGT probes

The CAN-EGT module uses standard K-type thermocouples, such as the DIYAutoTune.com Red Avenger or Black Stinger EGT probes. These attach to the numbered screw terminals under the text reading “Thermocouple Interface by DIYAutoTune.com”. K-type thermocouples have an industry standard marking in North America: Red is negative, yellow is positive. This can be a bit confusing as a lot of equipment uses red for positive. The yellow terminals go to the + inputs, and the red terminals to the -. If you encounter EGT probes that use different colors on their wires and are not certain which terminals it uses, you will need to contact the manufacturer of the probe. There are a number of other standards that exist in Europe and Asia.

Note that you must connect the actual thermocouple wire to the input terminals. Do not attempt to extend a thermocouple’s wiring with copper wire; this will throw off the reading.

### 2.2 Power and ground

The CAN-EGT can be powered through either the CAN plug or the 10 pin terminal block. For the CAN plug, the tip is 12 volt power and the sleeve is ground. For the 10 pin terminal block, the 12 volt power and ground pins are marked on the case lid. It should receive switched 12 volt power with a 2 amp fuse. We recommend grounding the CAN-EGT unit to the cylinder head or engine block, preferably close to the location of one of the EGT probes. Grounding the CAN-EGT to the same as the probe bodies will make for a more accurate reading.

### 2.3 Connecting to a MegaSquirt

The 4 pin barrel plug included with the CAN-EGT unit allows using a single point for power, ground, and CAN connections. The wires are color coded, as follows:

Color	Function
Green	Ground to engine block
Red	12 volt power
Black	CAN H
Yellow	CAN L

If you are wiring up a 4 pin barrel plug from scratch, use these connection points: The tip is for 12 volt power (use the same source as the MegaSquirt),

and the sleeve connects to ground. The ring next to the tip connects to CANH, and the ring next to the sleeve connects to CANL. Note: The CAN connection is not “hot-swappable” - you must not have the CAN-EGT powered up when the CAN cable is connected.

## **2.4 Connecting to data logging devices with 0-5 volt analog inputs**

The CAN-EGT board has 8 linear analog outputs for use with other devices, under the numbered terminals on the 10 pin connector. These put out 0 volts at 0 °C and 5 volts at 1250 °C, with a slope of 4 mV/°C.

## **2.5 Connecting an Innovate LC-1**

The CAN-EGT board can talk to Innovate LC-1s directly over serial, bypassing any digital to analog conversions. Simply connect the LC-1's OUT serial connection to the WB port on the CAN-EGT board, using a standard Innovate serial patch cable. You may connect up to 8 LC-1s with current firmware, daisy chained together. Make sure to insert the terminator plug is on the IN connection of the first LC-1 in the chain.

## **2.6 Internal switches**

There is a 3 position DIP switch inside the CAN-EGT board. Here is what the switches do. By default, they are all set to ON.

V+ and GND: These should be set to ON if you are powering the CAN-EGT through the 10 position screw terminal and using the CAN cable to power a second CAN device (maximum current 100 mA). They should also be set to ON if you are powering the CAN-EGT board through the CAN cable. Under any other circumstances, set this to OFF.

R: Termination resistor. Switch this ON if the CAN-EGT is the last node on the CAN network, OFF if there are other ones down the line.

# **3 TunerStudio settings**

The CAN-EGT board can talk to TunerStudio either directly through its USB port, or through a MegaSquirt in CAN passthrough mode. Either way, you will need to set it up with the appropriate INI file. If you do not have a copy of this file from TunerStudio and it does not auto-detect the firmware, you may download it here:

CAN-EGT configuration file

Save this file in a convenient folder, such as the TunerStudio Projects folder in My Documents for most Windows installations.

### **3.1 Connecting to TunerStudio over USB**

Click the Other firmware checkbox, select Browse, and specify this file.

There are two project properties settings you may specify. The Temperature Display option lets you display degrees in Fahrenheit or Celsius. The Serial setting allows you to choose whether you are connecting to the CAN-EGT board directly over CAN. If connecting directly to the CAN-EGT using USB, select Activated.

After you have created the project, go to File -> Project -> Project Properties, and set up the CAN Devices tab. If TunerStudio is talking directly to the CAN-EGT board, you will need to set the Main Controller CAN ID to 1. If the CAN-EGT board will be connected to a MS3, set the Serial Protocol drop down box to "Force - MS3 1.1+".

### **3.2 Connecting to TunerStudio through an MS2 or MS3**

The MS2 will require setting up Project Properties; with an MS3, this is not required to read data from a CAN-EGT.

#### **3.2.1 Project Properties**

When connecting an MS2 to work with the CAN-EGT board, you will need to set this up under the CAN Devices tab under Project Properties from your MegaSquirt project. This is not required on an MS3 unless you wish to change the settings on the CAN-EGT itself in pass through form. Click the "+" button next to the CAN Devices field to add the CAN-EGT. Type in an appropriate description under the Device Identifier and Device Description. The CAN Device ID defaults to 1; you only need to change this if you already have another device with this ID on your network. Click the "..." button under Device Configuration File, and select the CAN-EGT configuration file. The CAN-EGT configuration settings will then appear underneath the Device Configuration File field and you can set these up. Since you are connecting over CAN passthrough, set Serial to Deactivated. You will have a check box marked Disable Runtime Data.

On an MS3, you should always check this box as the MS3 will log the EGT readings on its own. For an MS2, you may leave it unchecked if you wish to use the CAN-EGT to log both AFR and EGT readings at the same time, but checking the box will speed up data logging significantly if you only need one or the other. Once you click OK, TunerStudio will refresh its information, and you will now see two new buttons marked "CAN EGT setup" and "Data". These are used to send settings to the CAN-EGT board.

#### **3.2.2 MS3 settings**

Under the CAN bus / Testmode parameters, use the settings below under CAN parameters.

**CAN Parameters**

**File**

**CAN Parameters**

My CAN ID: 0

Enable PWM polling: Disable

Remote CAN Id: 5

Remote table number for PWM data: 7

Remote table offset for PWM data(bytes): 58

Remote clock(MHz): 24

Remote prescale: 16

Remote divider: 3

Enable ADC polling: Enable

**Digital ports**

Remote CAN Id: 5

Table: 7

Enable input port: Disable

Offset(bytes): 77

Enable output port: Disable

Offset(bytes): 75

Enable PWM outputs: Disable

Remote CAN Id: 5

Table: 7

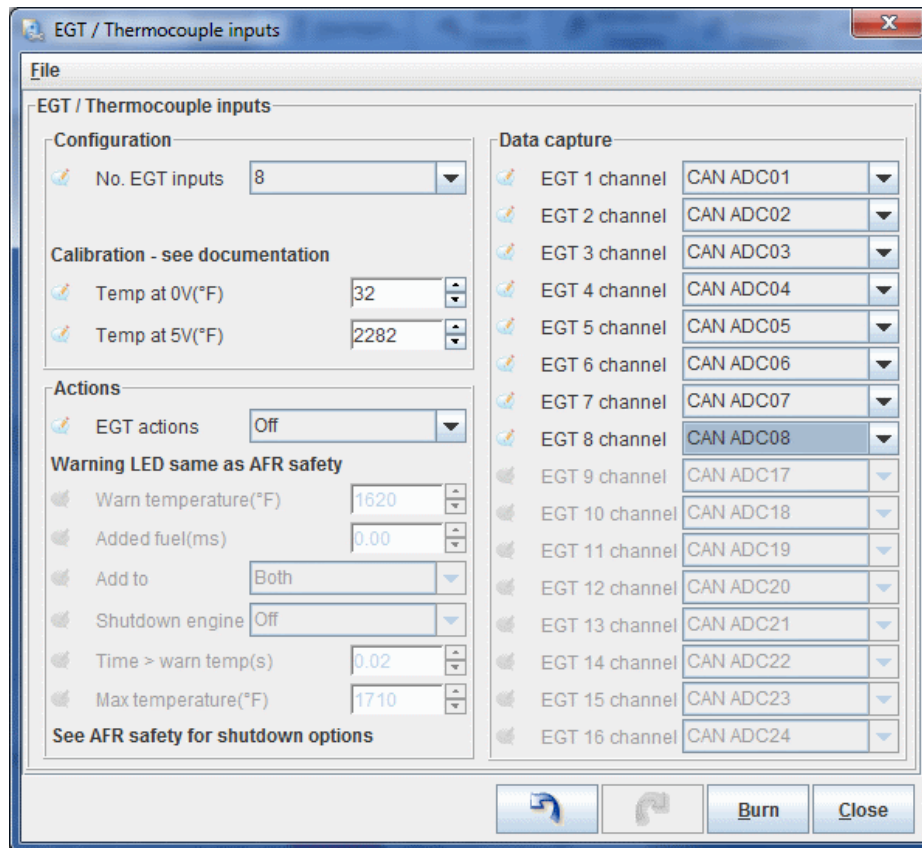
Offset(bytes): 94

**CAN ADC selection**

CAN ADC group on/off	CAN Id	Table	Offset
CAN ADC 1-4: On	1	7	2
CAN ADC 5-8: On	1	7	10
CAN ADC 9-12: Off	5	7	18
CAN ADC 13-16: Off	5	7	26
CAN ADC 17-20: Off	5	7	34
CAN ADC 21-24: Off	5	7	42

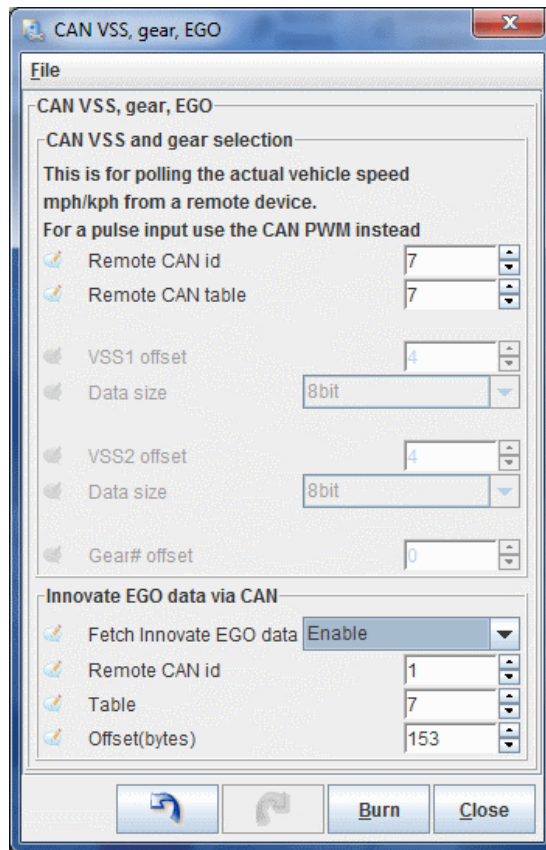
Buttons: [Back] [Forward] [Burn] [Close]

Under the Advanced Engine menu, you can enable thermocouple input under the EGT / Thermocouple Inputs screen. EGT channels 1 through 8 correspond to CAN ADC01 through CAN ADC08, as shown in the screen below. For Calibration, set Temp at 0V to 32 °F or 0 °C, and Temp at 5V to 2282 °F or 1250 °C.



See the MS3 manual for the Actions settings.

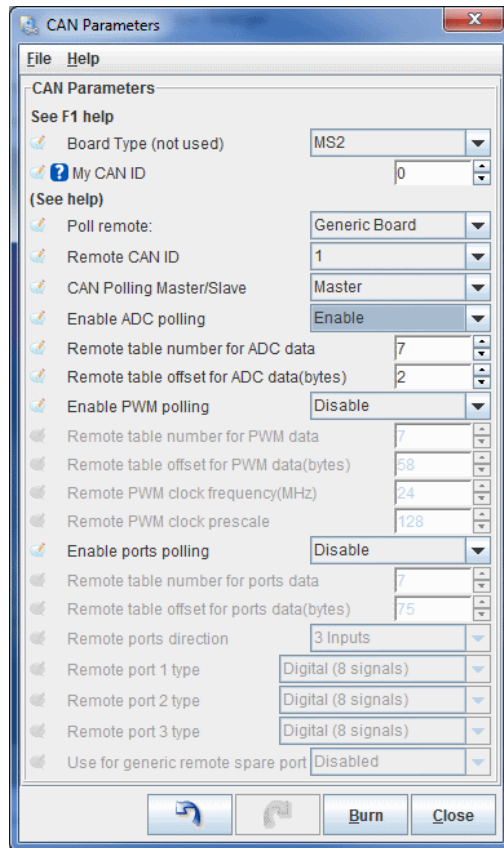
To enable air/fuel ratio data over CAN, go to the CAN bus / Testmode menu and select the "CAN VSS, gear" screen. Set the Innovate EGO data via CAN section to the settings below:



Under Fuel Settings, select AFR / EGO Control, and enter the number of sensors. Set all EGO ports in use to CAN EGO. You may then assign the EGO sensors to their respective cylinders under AFR / EGO Sensor Mapping.

### 3.2.3 MS2 settings

To set the MS2 to talk to the CAN-EGT board, go to Advanced and select CAN Parameters. Enable these settings to allow the MS2 to talk to the CAN-EGT board.



If you have checked the Disable Realtime Data box in the Project Properties to speed up data logging, you will need to download this special INI file for EGT logging and save it in the ProjectCfg subfolder in your TunerStudio project folder.

If you are using the CAN-EGT's LC-1 digital input, you will need to change the Remote Table Offset for ADC Data number from 2 to 153. Note that if you set the Remote Table Offset to 153, the only way to view or log the EGT data with current firmware (this may be changed in future releases of MS2/Extra) is to uncheck Disable Runtime Data. There aren't any EGT specific settings in MS2/Extra, as MS2/Extra uses the EGT only for logging. To use the air/fuel ratio data from the CAN-EGT board for wideband correction, go to Basic Setup -> EGO Control, and change 1st EGO sensor port from Local to "Remote ADC0." If you wish to use a second LC-1, set 2nd EGO sensor port to "Remote ADC1."

### 3.2.4 ADC settings

ADC resolution changes the accuracy the inputs use. Current MS3 firmware requires setting this to 10 bits. You can set the EGT inputs that are actually connected to Active, and EGT inputs that are not in use to Disabled. The Lag



Factor setting allows for software noise reduction. Valid entries are 1 through 100. It multiplies the current sample by the Lag Factor as a percent and the previous setting by 100% minus the Lag Factor to get the reading. 100% Lag Factor means no filtering, while 0% Lag Factor will prevent the EGT readings from updating at all. As EGT inputs are fairly noise sensitive, we recommend using a lag factor from 10 to 30. Our experience is that this lag factor still responds quite well, but filters out noise.

### **3.2.5 Serial ports settings**

These settings allow connecting an LC-1 (or a daisy chained set of multiple LC1s) to the “WB” connection. To communicate with the LC-1, set Serial Port 2 Baud Rate to 19200, and set Auxiliary Data Configuration to “Enable LC-1 reading from serial port 2”. If you want to configure the LC1s from the PC, you need to enable the serial passthrough. However, NEVER enable serial passthrough if you only communicate to the CAN-EGT using the USB port; only use this when connecting through CAN passthrough. This will disable the serial port communication because the CPU no longer looks at the data from the PC but simply passes it along to the serial port. The only way to recover from this is to use a CAN device or reload the firmware to reinitialize the setting.

## **4 Updating firmware**

Normally, you will not need to reload the firmware, but reloading the firmware can serve as a “reset button” to erase corrupted settings. It is also possible that we may release future firmware upgrades to provide additional functionality.

To reload the firmware to the CAN-EGT, download the can-egt\_firmware.zip file and copy its contents to a new folder. Right click on the ioxloader.bat file and select Edit. There is a single line in there which should read “ioedlser COM1 115200 can\_egt.s19”. Change COM1 to the COM port number of the USB port the CAN-EGT board is using. Then save the file and double click it. The program will then load the firmware.