ECM ENGINE CONTROL AND MONITORING

NH_3CAN Module

Instruction Manual

Important Note

Due to the nature of CAN instrumentation, you cannot just physically connect a measurement module to a bus and expect data from that module to be available. The NH_3CAN measurement module has to be set up to send the data required and the receiving device (ex. data acquisition software) has to know what is being sent. The setting up of modules and the production of a .dbc file used by the receiving device to interpret the data sent, is performed using the supplied Configuration Tool (software) which runs on a PC.

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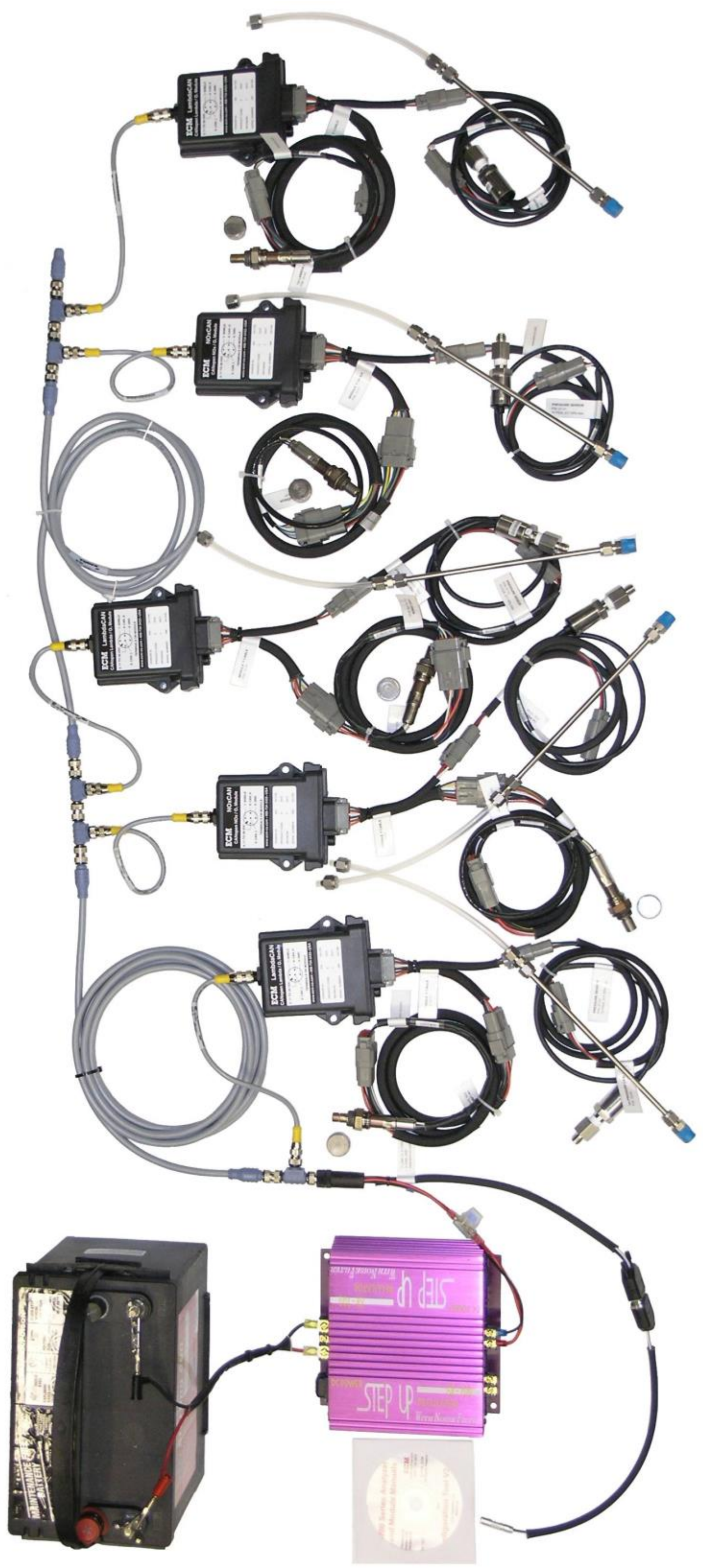
Table of Contents



Complex measurement systems can be easily built with LambdaCAN*, NOxCAN*, NH_3CAN, and baroCAN modules. Here is a five-channel lambda, O_2, and NOx pressure-compensated in-vehicle system.

Introduction

The NH_3CAN module kit is a compact, ceramic sensor-based NH_3 measurement device. See Appendix A for kit contents. The specification for the kit is as follows:

Ranges: **NH_3:** 0 to 2000 ppm (wet), ($\lambda > 1$ only)
Pressure: 0 to 517 kPa, 0 to 75 Psia

Accuracy: **NH_3**: ± 5 ppm (0 to 200 ppm)
Pressure: ± 5.2 kPa, ± 0.75 Psia

Response Times: **NH_3:** Less than 1 sec.
Pressure: < 5 ms

NH_3 Sensor Mounting: 18mm x 1.5mm thread. 22mm hex. Preferentially mount the sensor in a location where its sensing end is unlikely to be immersed or sprayed with liquid water, urea, oil, fuel, or antifreeze.

Maximum Exhaust Temperature: 450 °C, 842 °F

The NH_3 sensor is designed to be used downstream of a SCR (Selective Catalytic Reduction) catalyst or where there is not significant amounts of CO (carbon monoxide). This is due to the sensor's cross-sensitivity to CO (i.e. 40 ppm of CO appears as 1 ppm of NH_3).

Setup and calibration of the NH_3CAN kit is performed using the supplied PC software program called "The Configuration Tool". The Configuration Tool requires a CAN communication device to communicate with one or more ECM CAN modules (i.e. NH_3CAN, NOxCAN*, LambdaCAN*, baroCAN, appsCAN) or analyzers (i.e. NOx 5210, Lambda 5220, EGR 5230, NH_3 5250). While the tool is being used with modules, just ECM modules set to stand-alone mode (see Appendix B) should be connected to the CAN bus. While the tool is being used with analyzers, just analyzers should be connected to the CAN bus. With analyzers, the Configuration Tool is just used to produce .dbc files. However with modules, the Configuration Tool replaces the analyzer's display head as the user interface so it must do much more. This document focuses on using the Configuration Tool with ECM's NH_3CAN module.

The Configuration Tool supports four CAN communication devices: Kvaser, ETAS, Peak USB-to-CAN adapters, and the VectorCAN CAN adapter card. Driver software for one of these adapters must be installed prior to using the Configuration Tool. This software will be supplied with the adapter or be available on-line. ECM's Configuration Tool is delivered on a CD.

Once the adapter's driver and the Configuration Tool software are installed, and with the module(s) powered and connected to the CAN adapter, start the Configuration Tool software. Click on the "Modules" tab, select the CAN adapter, and click on the "START" button.

The software will identify the modules on the bus and display them in the "Module" field. If this does not happen, make sure that the CAN bus is properly terminated (i.e. resistors). Open the Module field to see all the modules on the bus. If a module is not listed, one reason could be that its Node ID is the same as another module. To resolve this, remove all modules except the "missing" one from the CAN bus, STOP then START the software, and change that module's Node ID. Another reason that a module is not listed could be that the module is in EIB mode instead of stand-alone mode. All modules must be in stand-alone mode.

To configure one of the modules (ex. change its Node ID) or to look at that module's data, you have to select that module in the "Module" field.

There are three things you can do with modules using the Configuration Tool:

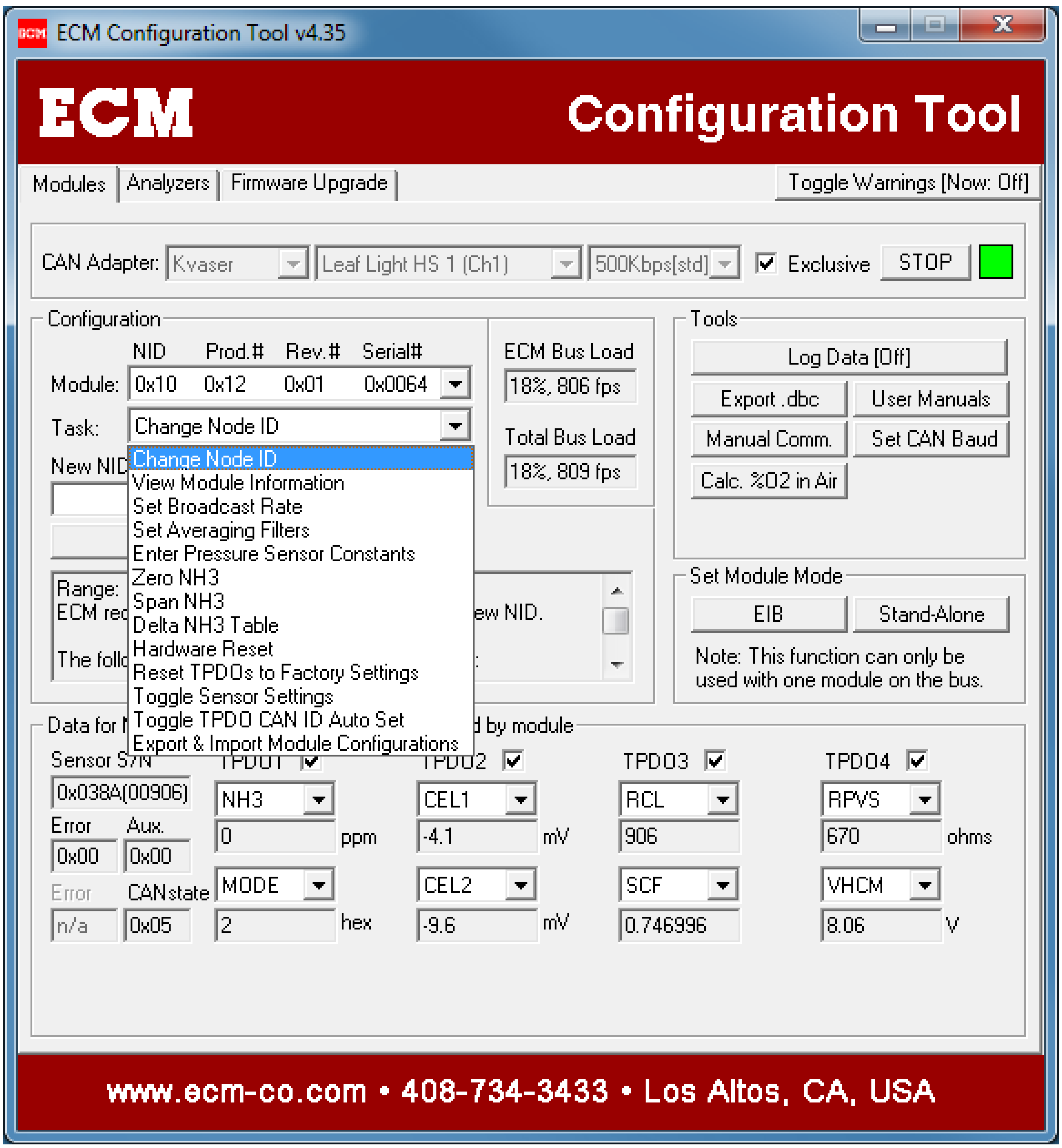
1. Configure a module. This includes calibrating a sensor attached to the module.
2. Look at data coming from that module in real-time and optionally log it.
3. Produce a .dbc file to be used by a device receiving module data.

Alternatively, 1. and 2. (above) can be performed by direct CAN communication with the NH_3CAN module using user-written software. For information on how to do this and detailed information about the modules, refer to the NH_3CAN Programmer's Manual.

Configuring a Module

Normally, you will be configuring a module to be used in stand-alone mode. Stand-alone mode is used when the modules are connected to a CAN bus that goes directly to a data acquisition or control system. In stand-alone mode, a module's configuration is performed by selecting one of the tasks in the "Task" field. When a module is connected to a NOx 5210, Lambda 5220, EGR 5230, or NH_3 5250 Analyzer, it must be in EIB mode. In EIB mode, most of these tasks are performed using the analyzer. Appendix B describes how to configure a module to operate in one mode or the other.

The following assumes that the module is to be used in stand-alone mode. The tasks available for NH_3CAN modules are listed in Table 1.



Change Node ID: Allowable range 0x01 to 0x7F (hex). When you assign a Node ID (NID), the following CAN IDs **cannot be used** by any other devices on the bus: 0x00, 0x80 + NID, 0x180 + NID, 0x280 + NID, 0x380 + NID, 0x480 + NID, 0x580 + NID, 0x600 + NID, 0x700 + NID, 0x7E4, 0x7E5.

View Module Information: Manufacturer's Name, Hardware Version, Software Version

Set Broadcast Rate: All activated TPDOs are transmitted every "n" milliseconds. "n" can be programmed. 5 ms is the minimum. Default: 5 ms.

Set Averaging Filters: Before the data is transmitted by the module (at the broadcast rate), it can be averaged. There are two averaging filters (alphas): one for NH_3 and one for Pressure. Alphas can range from 0.001 to 1 and are used in the recursive averaging filter: $AvgData_t$ = alpha x $Data_t$ + (1-alpha) x $AvgData_{t-1}$.

Where: $AvgData_t$ is the transmitted average data at time "t".

$Data_t$ is the raw data at time "t".

$AvgData_{t-1}$ is the previously transmitted average data.

This formula is executed every 5 ms regardless of broadcast rate. Note that if Alpha = 1, there is no averaging and the data taken at time "t" becomes the average value at time "t" and hence the broadcast value. When changing the NH_3 filters, make them both the same value. Default Alpha values: 0.375.

Enter Pressure Sensor Constants: N and C are the gain and offset of the pressure sensor. N and C are written on a label attached to the pressure sensor. P (psia) = N x (V - C). V = voltage from sensor.

Zero NH_3: User enters displayed NH3 value (TPDO data) and the actual NH_3 value of the "zero" gas. Zero gas does not necessarily have to be exactly zero. A non-zero value can be entered.

Span NH_3: User enters displayed NH3 value (TPDO data) and the actual NH_3 value of the gas. Preferentially Span near the upper NH_3 value to be measured.

Delta NH_3 Table: This table is used to modify the calculated NH_3 (parameter NH3R) via a user-entered look-up table generating a new NH3 parameter (parameter NH3). NH3 = NH3R + Delta. Linear interpolation is performed between delta points.

Hardware Reset: Equivalent to powering the module down then up again.

Reset TPDOs to Factory Settings: These are the parameters displayed and transmitted. TPDO stands for Transmit Process Data Object.

Toggle Sensor Settings: Allows power to ceramic sensor to be turned on and off and enables rapid sensor warm-up scheduling (Default: On (fast)).

Toggle TPDO CAN ID Auto Set: Enable and disable TPDO CAN ID Auto Set.

Default: Enabled.

Export & Import Module Configurations: This simplifies the task of programming several modules the same way.

Table 1: Task List for NH_3CAN Modules

Calibration of the NH_3 Sensor

Sensors shipped with NH_3CAN modules have been calibrated (i.e. zeroed and spanned) before leaving the factory. It is recommended that they be calibrated periodically during use. How often can only be determined by your experience. Alternatively, sensors can be sent to ECM for recalibration.

Calibration information (both factory calibration and user calibration) for the NH_3 sensors is stored in a memory chip in the sensor's connector. Therefore, the sensor does not have to be used with the module it was calibrated with. Once calibrated, the sensor can be sent to another site to be used. After use, the sensor can be returned to the calibration center for recalibration thus compensating for any sensor aging. Centralization of calibration in this way improves measurement consistency and extends useful sensor life.

Zero and Spanning the NH_3 Sensor

A Zero should be performed before a SPAN. A user-performed Zero and Span can be cleared, reverting the sensor to using the factory Zero and Span.

The NH_3 sensor can be zero'd in ambient air or in the exhaust of an engine. To perform a Zero:

1. The NH_3 sensor and pressure sensor (if so equipped) should on for at least 20 minutes.
2. Hang the NH_3 sensor and the pressure sensor (if equipped) in ambient, stationary air. Or put the NH_3 sensor in the exhaust of zero NH_3.
3. Select NH3 as a TPDO parameter.
4. Select the Task "Zero NH3". Enter the displayed NH3 (the TPDO parameter) and the actual NH_3 (which should be zero), then click on "Zero".

There are two ways to perform a Span of the NH_3 sensor: using model gases or in the exhaust of an engine. To perform a Span:

1. The NH_3 sensor and pressure sensor (if so equipped) should on for at least 20 minutes.
2. Put the NH_3 sensor and the pressure sensor (if so equipped) in the model gas calibration apparatus shown in Figure 1 or in the exhaust of an engine.
3. For the case of the model gas calibration apparatus, adjust the flowrates to get approximately 15% O_2, 1.5% H_2O, your target calibration NH_3 ppm (typically 100), balance N_2. For the NH_3 tank concentration shown and a target of 100 ppm NH_3, the flowrate through flowmeter #2 will be about $1/9^{th}$ that through the bubbler. This will give the approximate 1.5% H_2O required. To set the %O_2 and NH_3 ppm level, use a NOxCANt or NOx 5210T analyzer. With the Type T NOx sensor used in these devices, NH_3 will be read as NOx. The NH_3 must not be bubbled nor should there be any condensed water from the output of the bubbler to downstream of the NH_3 sensor. Otherwise, the condensed water will absorb the NH_3 and the span process will be problematic.

4. For the case of using the exhaust of an engine to span the NH_3 sensor, you must know the wet NH_3 concentration from another instrument.
5. Select NH3 as a TPDO parameter.
6. Select the Task “Span NH3”. Enter the displayed NH3 (the TPDO parameter) and the actual NH_3, then click on “Span”.

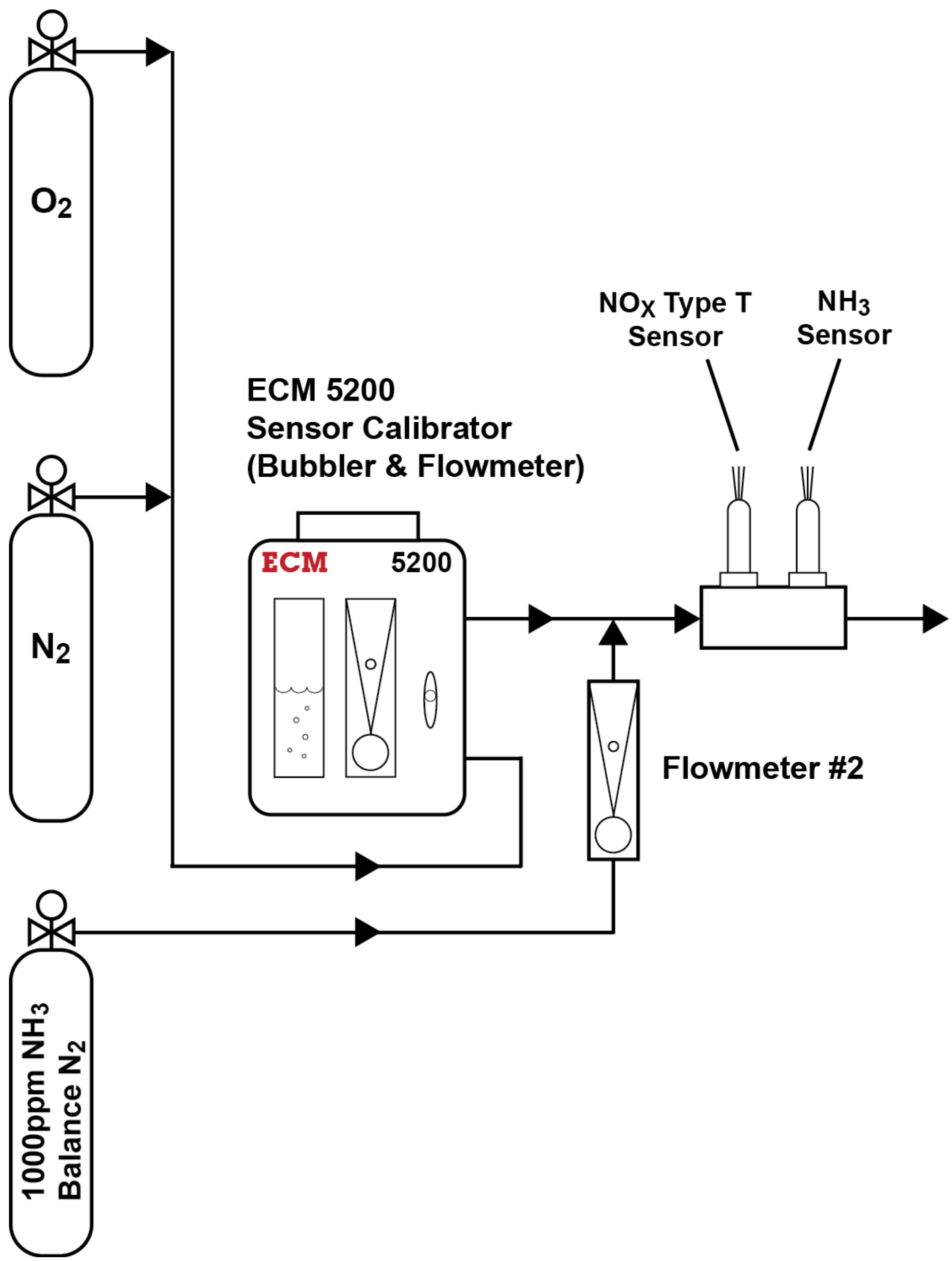


Figure 1: Model Gas Calibration Apparatus

Selecting What Data is to be Sent (TPDOs)

Data sent from NH_3CAN modules is packaged as TPDOs (Transmit Process Data Object). Each TPDO contains two pieces of data and each module can send up to four TPDOs. All selected TPDOs will be sent at the broadcast rate. For example, if the broadcast rate is 5 ms and four TPDOs were selected to be sent, then eight pieces of data would be transmitted every 5 ms. To avoid slowing down the effective data rate on the CAN bus, select the number of TPDOs to be sent and the broadcast rate sparingly. For the case of multiple modules sending multiple TPDOs on the same CAN bus, the minimum (i.e. fastest) broadcast rate is given by:

Minimum Broadcast rate (ms) = The total number of TPDOs for all modules x 0.3125

For example, if there are eight modules, each sending two TPDOs, the minimum broadcast rate is 5 ms.

The data transmitted is selected in the "Data" area of the Configuration Tool. Activate the number of TPDOs to be used by clicking in its box to put in a check mark. Select the data contained in each TPDO using the pull-down windows. The list of available parameters for the NH_3CAN module is given in Table 2.

Note that in the parameter list, there are two NH_3s: NH3R (NH_3 Real) and NH3 (NH_3).

NH3R is the NH_3 value calculated by the module.

NH3 is the NH_3 value calculated by the module and modified by the Delta NH3 Table according to the relationship:

NH3 = NH3R + Delta NH3 Table value (interpolated from table)

Name	Parameter Description
NH3R	NH_3 before the addition of Delta NH3 Table (ppm)
CEL1	Cell 1 voltage (mV)
CEL2	Cell 2 voltage (mV)
RPVS	NH_3 sensor internal Vs cell resistance (Ohms)
VHCM	Desired heater voltage commanded by the module (V)
VS	NH_3 sensor internal Vs cell voltage
VSW	Supply voltage at the module (V)
VH	Actual heater voltage at the module (V)
TEMP	Temperature of the module circuit board (deg C)
C1R	Cell 1 raw bits (bits)
C2R	Cell 2 raw bits (bits)
ERFL	Module error flags (unsigned long format)
ERCd	ECM CANOpen Error Code (unsigned integer)
PR10	10 bit Pressure sensor output voltage (unsigned integer format)
P	Pressure sensor measured pressure (absolute) in mmHg
MODE	NH_3 measurement mode (hex)
RCL	NH_3 cal constant (no units)
SCF	NH_3 scale factor (no units)
NH3	NH_3 after addition of Delta NH3 Table (ppm)
PVLT	Raw volts from pressure sensor (V)
PKPA	Pressure sensor measured pressure (absolute) in kPa
PBAR	Pressure sensor measured pressure (absolute) in bar
PPSI	Pressure sensor measured pressure (absolute) in psi

Table 2: NH_3CAN Parameter List

Producing a .dbc File

A .dbc file describes to the device receiving data from one or more CAN modules what is in the data packages. For each module, the packages will contain data for the parameters selected in the activated TPDOs and an error code. The Configuration Tool has a tool called "Generate .dbc…" that will generate a .dbc file for all the CAN modules on a CAN bus. Make sure that each module is configured as desired and that all modules are on the bus before the "Generate .dbc…" button is pushed. Data package information from all the modules is stored in the one .dbc file produced.

Programs importing the .dbc file and applying it to the CAN data transmitted by the modules will see data, etc identified as follows:

Data: **name_nid[units]**

where: name = parameter name. See Table 2.
nid = node id of module in hex
units = units of parameter

for example: NH3_0X01[%] which is the NH3 parameter from module with nid 0X01

Error code: **ECM_Error_Code_nid**

where nid = node id of module in hex
error code is in hex and given in Table 3

for example: ECM_Error_Code_0x11

Auxiliary: **ECM_Auxiliary _time[sec]**

where: time = decrementing countdown to module activation in hex

for example: ECM_Auxiliary_0X12[sec]

Error Code	Module LED Action	Description of Error
0000	Green ON	All OK, (green LED constantly on)
0001	Flashing Green 10hz	Sensor warm-up period
0002	Green/Both/Red 2s	Power on reset / Init hardware
0011	Pulse Red 1x/2s	16 bit ADC failed to init. Internal module error. Contact ECM.
0012	Pulse Red 1x/2s	+Vsw shorted. Internal module error. Contact ECM.
0013	Red ON	NH_3 sensor turned off (red LED constantly on)
0014	Pulse Red 1x/2s	NH_3 sensor heater or cable open, or NH_3 sensor not connected.
0015	Pulse Red 1x/2s	NH_3 sensor heater or cable shorted. Bad NH_3 cable or sensor.
0021	Pulse Red 2x/2s	Memory chip in NH_3 sensor's shorted. Bad NH_3 cable or sensor.
0022	Pulse Red 2x/2s	No memory chip in NH_3 sensor detected. Bad NH_3 cable or sensor.
0023	Pulse Red 2x/2s	CRC16 error. Bad NH_3 cable or sensor.
0024	Pulse Red 2x/2s	Invalid NH_3 sensor memory chip parameter. Wrong sensor.
0025	Pulse Red 2x/2s	Non-compatible NH_3 sensor memory chip format (old Rev.)
0031	Pulse Red 3x/2s	Vsw < 6 for > 7 sec. Supply voltage too low.
0032	Pulse Red 3x/2s	Vsw > 32 V. Supply voltage too high.
0041	Pulse Red 4x/2s	VS too high. Bad NH_3 cable or sensor.
0051	Pulse Red 5x/2s	RPVS too high. Sensor too cold, bad, or battery voltage too low.
0052	Pulse Red 5x/2s	(VH Commanded – VH Measured) > 0.5 V for > 10 sec. Battery voltage too low.
0065	Pulse Red 6x/2s	User data (span) in NH_3 sensor memory chip corrupted. User must reperform NH_3 sensor span.

Table 3: NH_3CAN Error Codes List

Using the dashCAN* Display

dashCAN* (i.e. all dashCANs) is a small (105 mm x 63 mm x 63 mm for dashCAN and dashCAN2, or 105 mm x 63 mm x 165 mm for dashCAN+) display for CAN networks containing ECM CAN modules. dashCAN has two displays and no analog outputs. dashCAN2 has two displays and two programmable analog outputs. dashCAN+ has two displays and six programmable analog outputs. dashCAN* comes with a two meter cable and a "T" (P/N 09-05). Simply attach dashCAN* to the CAN bus and parameters from one or two ECM CAN modules can be displayed and converted to analog outputs (dashCAN2 or dashCAN+ only). The top display and half the analog outputs can be assigned to one module and the bottom display and the other half of the analog outputs can be assigned to the same or another module. Multiple dashCAN* displays can be attached to the CAN bus.

dashCAN* has two modes of operation: RUN (when measurements are displayed) and SYS (where dashCAN* is set-up). The SYS key toggles between the modes.

While in RUN mode:

i. If the ↑ button is pressed, the displays will show the serial numbers of the modules assigned to the displays.
ii. If the ↓ button is pressed, the displays will show the parameter names assigned to the displays. See Table 2.
iii. If the ENT button is pressed, the displays will show the units of the parameters. "PCTG" is %. "dIM" means dimensionless.

In RUN mode, four things other than data can be displayed:

i. "ERR" and "####" where "####" is an error code. See Table 3.
ii. "…." which means that a module has not been assigned to that display.
iii. "----" which means that dashCAN* has an internal problem.
iv. "XXXX" which means that dashCAN* is not receiving any data from the module assigned to that display.

When first entering SYS mode, either "MOd" will be on the top display or "LOCK" will be on the bottom display. If "MOd" is displayed, the ↑ and ↓ keys will roll through the setup options (see Table 4). First the options for the module assigned to the top display are shown on the top display, followed by identical options for the module assigned to the bottom display, ending with the global CONF (Configuration) setup. Pressing the ENT key will select the displayed setup option and allow its programming.

If "LOCK" is displayed, the dashCAN* has been locked and its setup cannot be changed until it is unlocked. Appendix F describes how to LOCK and unlock dashCAN*.

Setup Option	Level 1	Function
MOd		Select module s/n to be assigned to the display. Default is NONE.
RATE		Set parameter averaging rate. Range 0.001 to 1.000 Default is 1.000. 1.000 means no averaging.
AOUT (dashCAN+ only)		
	A1	Program analog output 1 from module assigned to top display
	A2	Program analog output 2 from module assigned to top display
	A3	Program analog output 3 from module assigned to top display
	A4	Program analog output 4 from module assigned to bottom display
	A5	Program analog output 5 from module assigned to bottom display
	A6	Program analog output 6 from module assigned to bottom display
AOUT (dashCAN2 only)		
	A1	Program analog output 1 from module assigned to top display
	A2	Program analog output 2 from module assigned to bottom display
dISP		Select parameter. Note: Parameters available are those contained in TPDOs programmed to be transmitted from the module (programmed using the Configuration Tool).
CONF	LEdS	dashCAN+ only. Set display intensity. Default is 3333. dashCAN and dashCAN2 have a knob for display intensity.
	1V4V	dashCAN2 and dashCAN+ only. Command 1V and 4V outputs.
	LOCK	Lock and Unlock Display for Programming

MOd, RATE, AOUT, and dISP appear on the top display for the module assigned to the top display and then on the bottom display for the module assigned to the bottom display. CONF just appears on the bottom display and is for global dashCAN* setup. All entries must be followed by pressing the ENT key.

Table 4: Menu Tree for dashCAN*

MOd (Module) Setup Option

In MOd setup, the serial number of the module assigned to the top or bottom display is entered. The serial number is written on a label on the module. The module assigned to the top display will be assigned the first half of the analog outputs. The module assigned to the bottom display will be assigned to the second half of the analog outputs. The same module can be assigned to both displays or different modules can be assigned to each display.

After entering MOd (i.e. press ENT when "MOd" is displayed), the serial numbers of the available modules will be displayed. Select using ↑ and ↓ followed by the ENT key.

RATE Setup Option

Data is transmitted from modules at the broadcast rate and the programmed averaging that was programmed using the Configuration Tool. This transmitted data can then be further averaged before being displayed on the displays. Separate averaging can be programmed for the top display and the bottom display. RATE does not affect the analog outputs.

The averaging is programmed with values from 0.001 (heavy averaging) to 1.000 (no averaging). The default is 1.000. The averaging is performed as follows:

$$\mathbf{DisplayedValue_t = \alpha \times Parameter_t + (1 - \alpha) \times DisplayedValue_{t-1}}$$

where:

$DisplayedValue_t$ = the new displayed averaged value

α = The user-programmable averaging.
Range: 0.001 (heavy averaging) to 1.000 (no averaging).

$Parameter_t$ = the latest value transmitted by the module

$DisplayedValue_{t-1}$ = the previous displayed averaged value

AOUT (Analog Outputs) Setup Option (dashCAN+ and dashCAN2 Only)

The dashCAN2 display head has two 0 to 5V programmable analog outputs. The dashCAN+ display head has six 0 to 5V programmable analog outputs. The analog outputs are updated at the module Broadcast Rate (see Table 1). This can be as fast as every 5 ms. Keep in mind that the data may be averaged (see **Set Averaging Filters** in Table 1) before being broadcast by the module.

Parameter information from the module assigned to the top display (see MOd) can be sent to analog output 1 (for dashCAN2) or 1, 2, and 3 (for dashCAN+). Parameter information from the module assigned to the bottom display can be sent to analog output 2 (for dashCAN2) or 4, 5, and 6 (for dashCAN+). Only parameters selected as active TPDOs for that module (using the Configuration Tool) can be output.

Here is an example of setting analog output 2 for a dashCAN+ (i.e. A2):

1. Press the SYS key so that "MOd" appears on the top display.
2. Press the ↓ key until "AOUT" is on the top display. Then press the ENT key.
3. Press the ↓ key until "A2" (analog output 2) is on the display. Then press the ENT key.
4. Press the ↑ and ↓ key until the parameter (see Table 2) that will drive A2 is displayed. Then press the ENT key.
5. When 0V is displayed, press ENT. Using the ↑, ↓, and ENT keys, set the parameter value that you want to result in an analog output voltage of 0V on analog output 2. The first time you do this, it may be a little tricky. You are setting one digit at a time and for some numbers, the display will shift to the left so you can set the right-most digits. If you get into trouble when programming, press the SYS key twice to exit and re-enter setup to try again.
6. When 5V is displayed, press ENT. Using the ↑, ↓, and ENT keys, set the parameter value that you want to result in an analog output voltage of 5V on analog output 2.
7. When "AOUT" is displayed, press SYS to return to RUN mode.

If in the above example analog output 4 was being programmed, AOUT, A4, 0V, 5V, and your entries would be shown on the bottom display.

dISP (Display) Setup Option

The dashCAN* display head has two displays, the top display and the bottom display.

In dISP setup, a parameter from the module assigned to the display (see MOd) can be shown on the display. Only parameters selected as active TBDOs for that module (using the Configuration Tool) can be displayed.

Here is an example of setting the parameter to be displayed on the top display:

1. Press the SYS key so that "MOd" is displayed.
2. Press the ↓ key until "dISP" is on the top display. Then press the ENT key.
3. Press the ↑ and ↓ key until desired parameter name is displayed. See Table 2. Then press the ENT key.
4. Press SYS to return to RUN mode.

CONF (Configure) Setup Option

CONF setup appears at the end of the setup list on the bottom display. To enter CONF, press the SYS key so that "MOd" appears on the top display, press the ↓ key until "CONF" appears on the bottom display, and then press the ENT key. CONF is for global dashCAN* setup.

◆ LEdS (dashCAN+ only)

The display intensity is programmable. Press the ENT key when "LEdS" appears on the bottom display, press the ↑ or ↓ keys until the display intensity is suitable, press ENT, and press SYS to return to RUN mode.

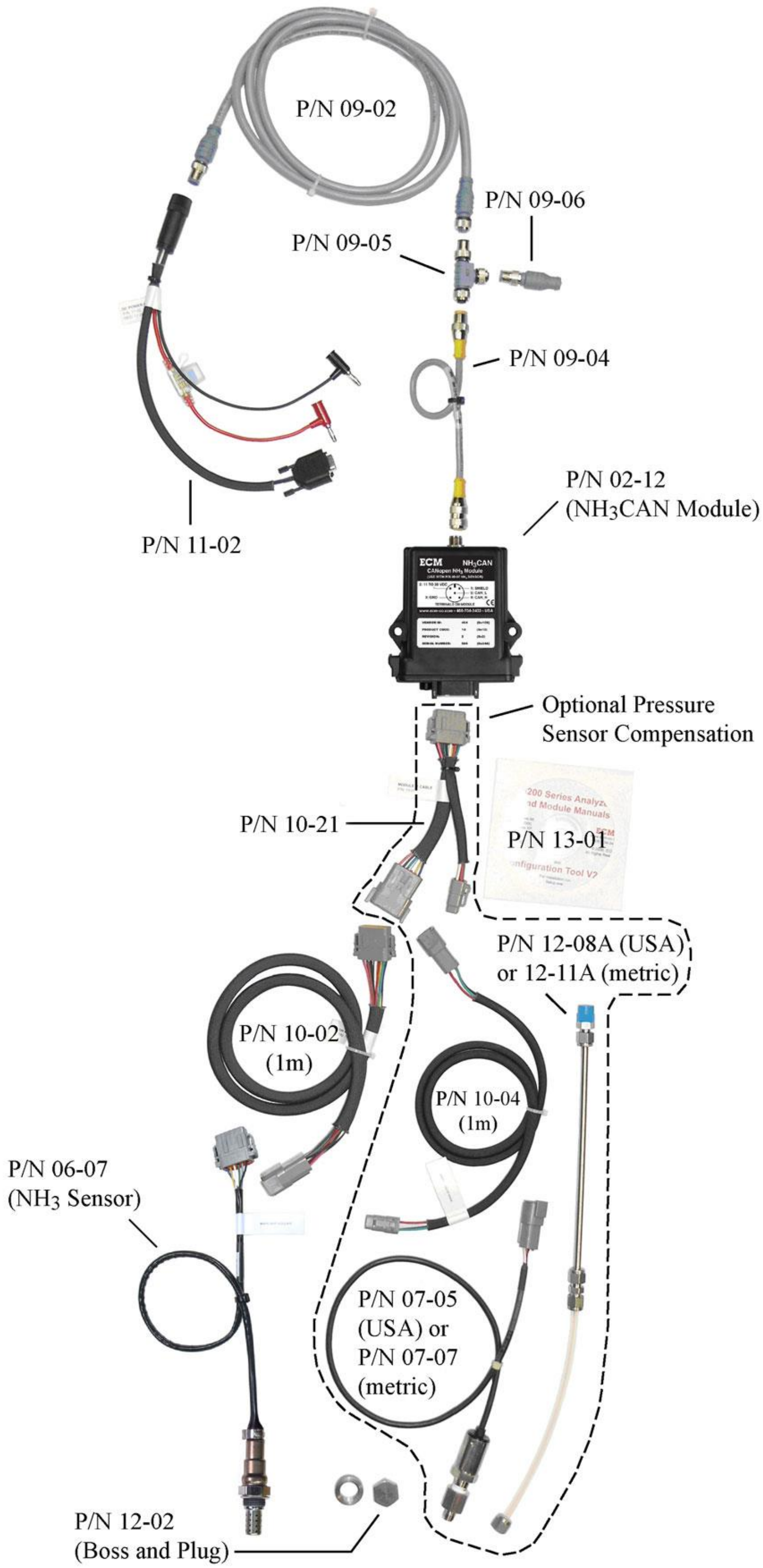
◆ **1V4V (dashCAN2 and dashCAN+ only)**

"1V4V" commands the analog outputs to go to 1V then 4V. This is used to verify that the data acquisition system reading the analog outputs is correctly reading them.

◆ **LOCK**

"LOCK" locks the MOd, RATE, AOUT, dISP, and LEdS setup. This stops unauthorized modification of the display. Refer to Appendix F for more information.

Appendix A: NH_3CAN Kit Contents



The NH_3CAN Kit consists of:

	Description	P/N	Quantity
1.	NH_3CAN Control Module	02-12	1
2.	NH_3 Sensor	06-07	1
3.	NH_3 Sensor Extension Cable	10-02 (1m)	1
4.	Flexi-Eurofast Cable	09-04 (0.3m)	1
5.	Eurofast "T"	09-05	1
6.	Eurofast Terminating Resistor	09-06	1
7.	2m Eurofast 12mm Cable	09-02	1
8.	DC Power Cable, DB9F, Banana	11-02	1
9.	NH_3 Sensor Boss & Plug (18mm x 1.5mm)	12-02	1
10.	Manuals and Configuration software CD	13-01	1

Optional Pressure Compensation (add /P to kit part number):

1.	Pressure Sensor, 0-75 psia, 517 kPa	07-05 (USA) or 07-07 (metric)	1
2.	Pressure Sensor Tubing	12-08A (USA) or 12-11A (metric)	1
3.	Pressure Extension Cable	10-04 (1m)	1
4.	Module Y Cable	10-21	1

Optional Cables:

1.	NH_3 Sensor Extension Cable	10-03 (2m)	1
2.	Pressure Cable	10-05 (2m)	1
3.	DC Power Cable, DB9F, Spades	11-01	1

Optional Power Supplies, Heater, and CAN-to-USB Adapter:

1.	AC/DC Power Supply, Universal 24VDC @ 4.2A (requires P/N 11-17 Deutsch DTM3M to DB9F Cable)	04-01	1
2.	Vboost Supply, 10-14VDC to 24VDC @ 14.5A	04-02	1
3.	Kvaser Leaf Light CAN Adapter	13-02	1

Appendix B: Module Stand-alone Mode and EIB Mode

CAN data from CAN modules (ex. NH_3CAN, NOxCAN, LambdaCAN) can either be taken directly from the modules themselves or from the CAN port of display heads connected to the modules. When data is taken directly from one or more modules, each module must in Stand-alone mode. When data is taken from one or more display heads of a NOx 5210, Lambda 5220, EGR 5230, or NH_3 5250 analyzer, each module must be in EIB mode.

Therefore, the module must be properly configured in Stand-alone mode or EIB mode depending on how it will be used. When CAN modules are sold alone, they are delivered in Stand-alone mode. When CAN modules are sold as part of a NOx 5210, Lambda 5220, EGR 5230, or NH_3 5250 analyzer, they are delivered in EIB mode.

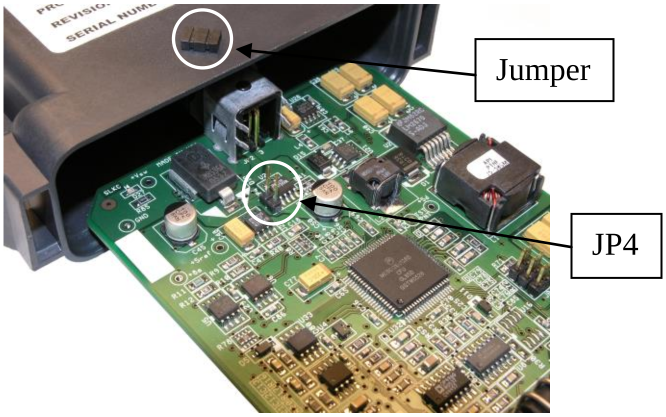
To convert from one mode to the other requires software reprogramming of the module (using the Configuration Tool) followed by the installation (to set to Stand-alone) or removal (to set to EIB) of a jumper inside the module.

◆ **To convert a module from EIB to Stand-alone Mode**

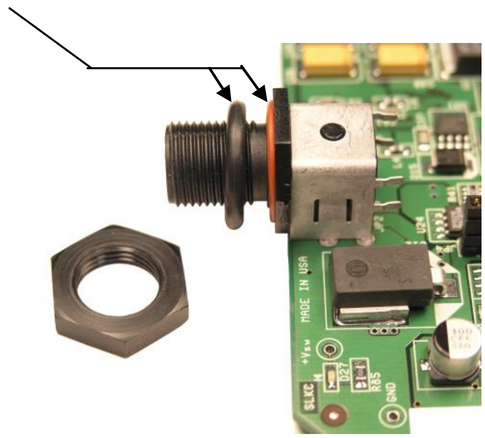
1. Take the nut off the end of the module. Use an 18mm socket without the wrench.

2. Release the two tangs at each side of the module.

3. Slide the PCB out. Install a jumper on JP4.



4. Make sure both O-rings are on the threaded connector.



5. Slide the PCB into the enclosure until the two tangs "click".

6. Put the nut on and tighten ONLY ½ turn from where it is seated. If this nut is tightened too much, the connector will crack and the enclosure will not be sealed.

7. Connect the module to a power supply and a PC (via a CAN communication adapter) using the cabling shown. A sensor does not have to be connected to the module. Note that only one module is connected and a display head is not involved.

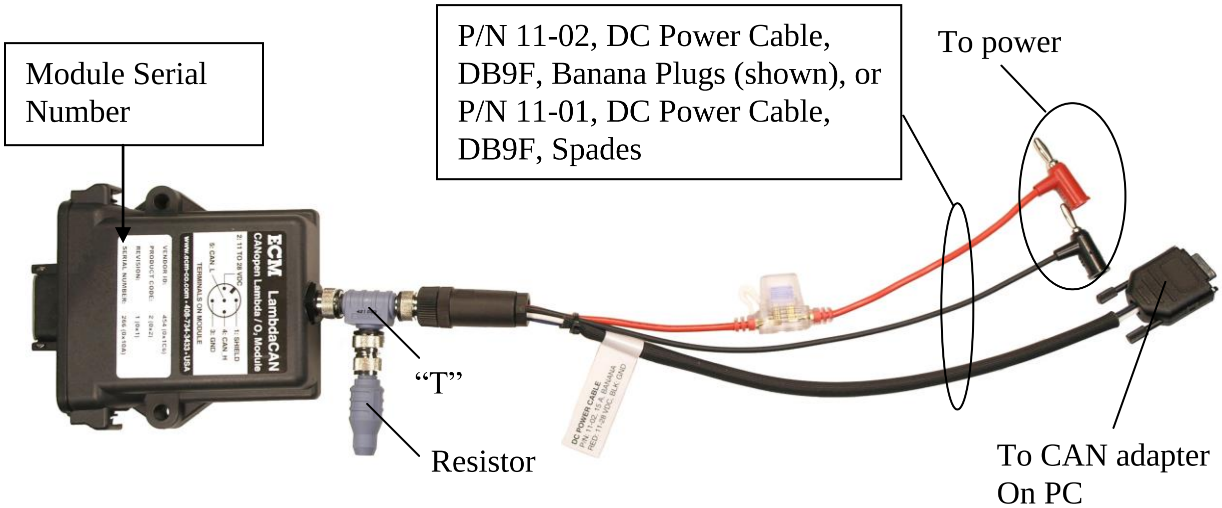
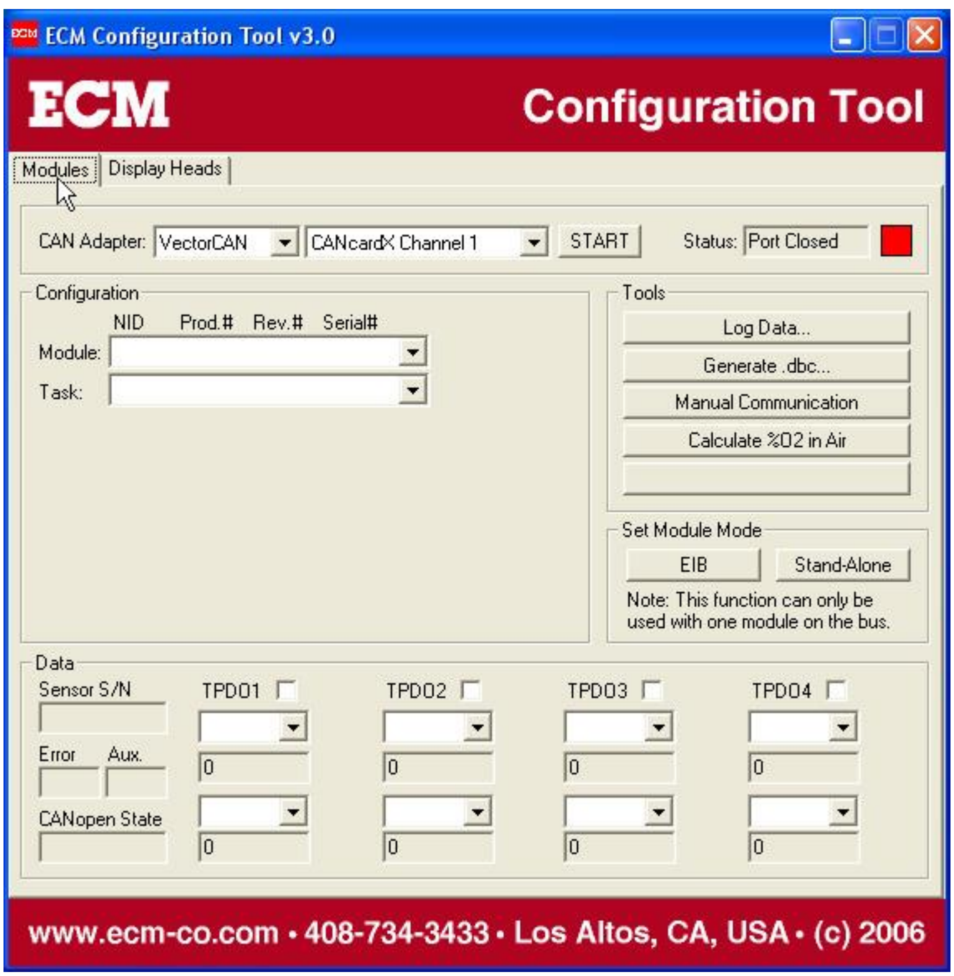


Figure A1: Module prepared for Reprogramming

9. Start the Configuration Tool (software). Click on the “Module” tab. Select the CAN adapter being used. Then start the communication.



10. Click on the “Set to Stand-Alone Mode”. Wait for “Done” Message.
    Stop communication and exit program. The module is in Stand-alone mode.

◆ **To convert a module from Stand-alone Mode to EIB Mode**

1. Use the Configuration Tool to “Set to EIB Mode”.
2. Remove the jumper on JP4 in the lambda module.

Appendix C: Interpreting Data from NH_3CAN Modules

◆ **Wet versus Dry Measurements**

Percentages of components in the exhaust of an engine are expressed as percentages (molecule count or volume) or ppm (parts per million. 10,000 ppm = 1%). The numerator used to calculate these percentages and ppm contains the molecule-of-interest count and the denominator contains the total number of molecules in the sample containing the "count". One of the molecules produced by the process of combustion, and in significant quantities, is H_2O. The percentage of H_2O depends on the fuel composition and Lambda but typically ranges from 2 to 12%

Percentages and ppm calculated by NH_3CAN consider the water molecules in the denominator and are called "wet" percentages (or ppm). This makes sense since the sensors are directly in the exhaust where the H_2O is present. In contrast to this, classical gas-bench analyzers almost always remove the water before the gas sample reaches the analyzers. This is because the analyzers cannot tolerate condensed water. Therefore, gas-bench analyzers will report percentages and ppms as "dry" percentages and ppms (i.e. without H_2O molecules counted in the denominator). Some gas benches are able to report both "dry" and "wet" numbers.

Therefore, when comparing "wet" (or "true") NH_3 data from NH_3CAN to "dry" data from gas-bench analyzers, realize that the dry percentages and ppm will be 2% to 12% higher than the wet (or true) readings. To convert from wet to dry percentages use the formula:

$$\text{Dry percentage (or ppm)} = \text{Wet percentage (or ppm)} / (1 - \%H_2O/100))$$

This formula assumes a 100% removal of water before the dry measurement.

Appendix D: Setting Up ETAS INCA for ECM Modules

Hardware Setup: Using ETAS ES591.1

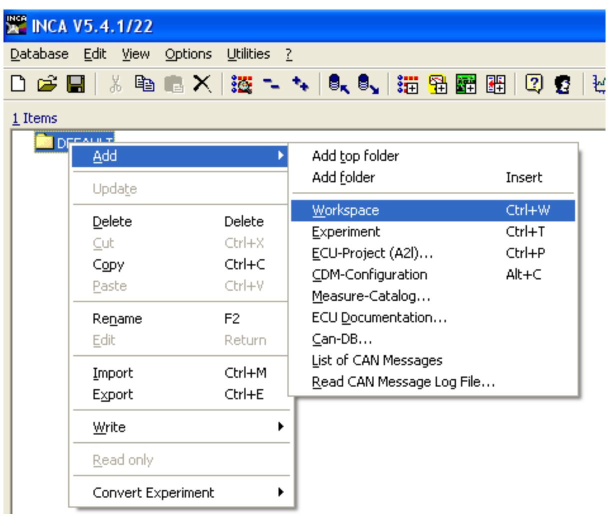
1. Connect the power port to a power source between 6V and 32V.
2. Connect the Ethernet port directly to the Ethernet port on your PC. This port does not use an internet/intranet connection like a router.
3. Connect either the CAN1 or CAN2 port to a CAN network (i.e. ECM modules or display heads).

Software Setup: Using ETAS INCA V5.4.1, Hotfix 22, GM Install

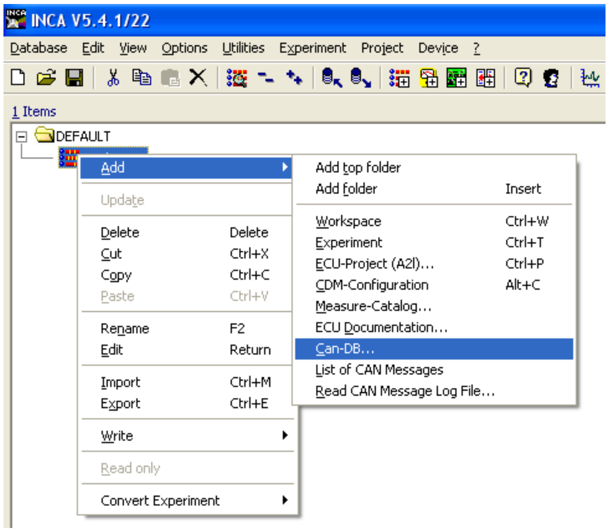
1. Double click the INCA V5.4 icon to open the software.

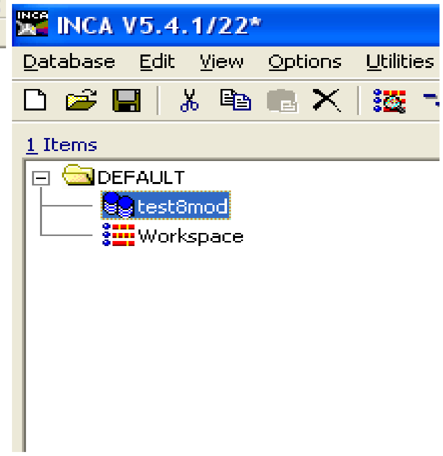
2. **Create a new Database**. In the Database menu, select New. Give your database a name (i.e. a folder name). In INCA, a Database means the current working directory. Each project is created in a unique directory. When INCA is opened, it will default to the last Database that was used.

3. **Add a new Workspace**. Right click on the "DEFAULT" folder icon, select Add > Workspace. You can rename it to whatever you want.

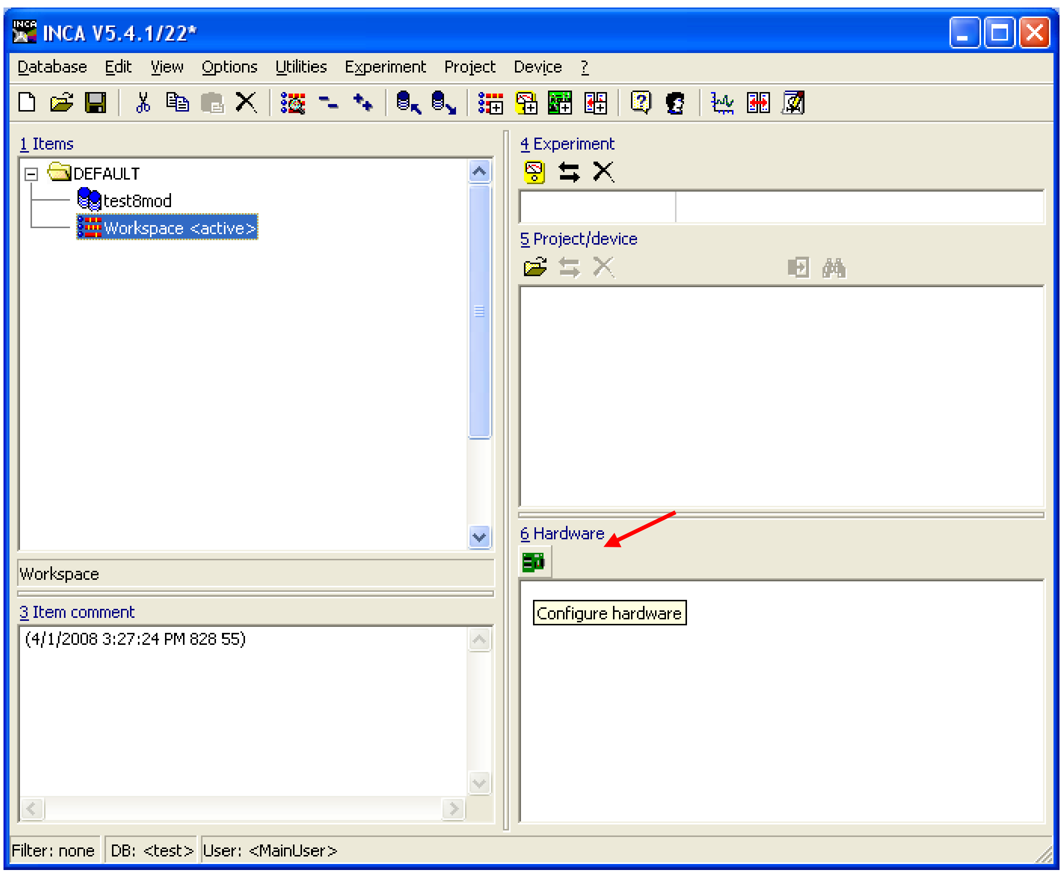


4. **Add a new dbc file for your project.** Right click on the workspace you created in step 3, select Add > Can-DB. Browse to your dbc file and click open. In this example, we are using a file named test8mod.dbc. An INCA log window will pop up. You can ignore this.

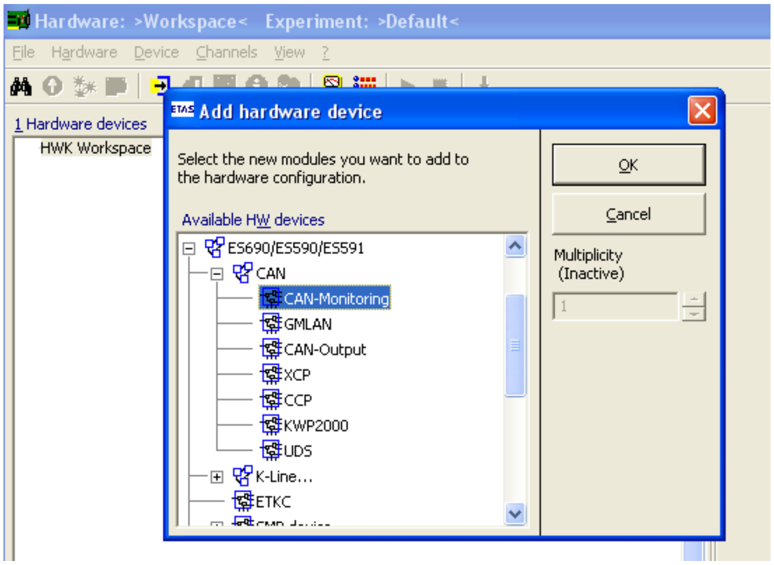




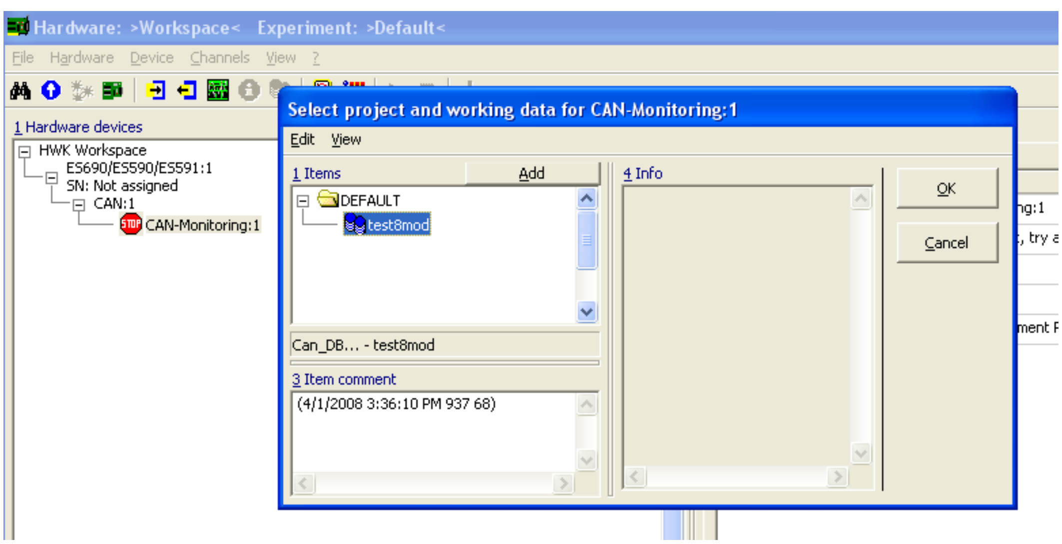
5. **Configure the hardware.** Click on the icon for the workspace you created in step 3. Open the Hardware Configuration icon under the section text “6. Hardware”. A hardware configuration window will open.



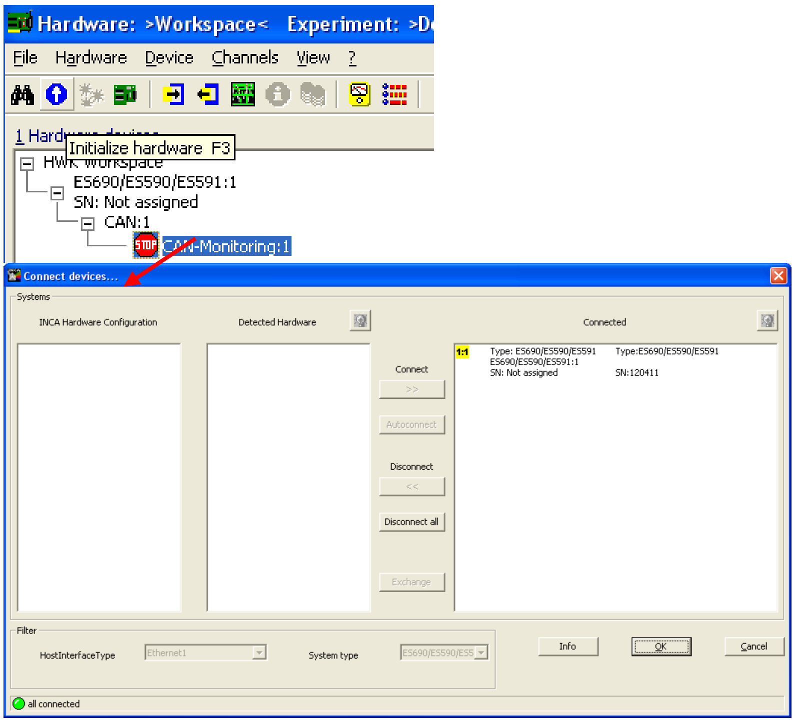
6. **Select the hardware.** In the hardware configuration window, right click the "HWK Workspace" listed under the section text "1. Hardware Devices", and select Insert. Select the ETAS device you wish to use. In this example, we are using an ETAS ES591.1. Expand the selection tree by clicking the "+" next to the hardware device model. Expand the CAN selection and select CAN-Monitoring. Click OK.



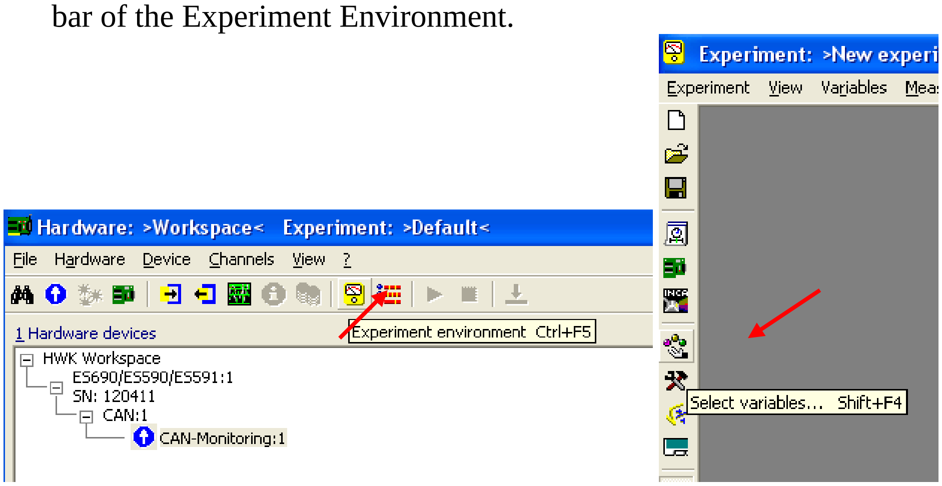
7. **Associate the dbc.** When you clicked OK in the last step, another window will pop up that will allow you to select a dbc that you have added to your workspace from step 4. Expand the selection tree, select your dbc file, and click OK.



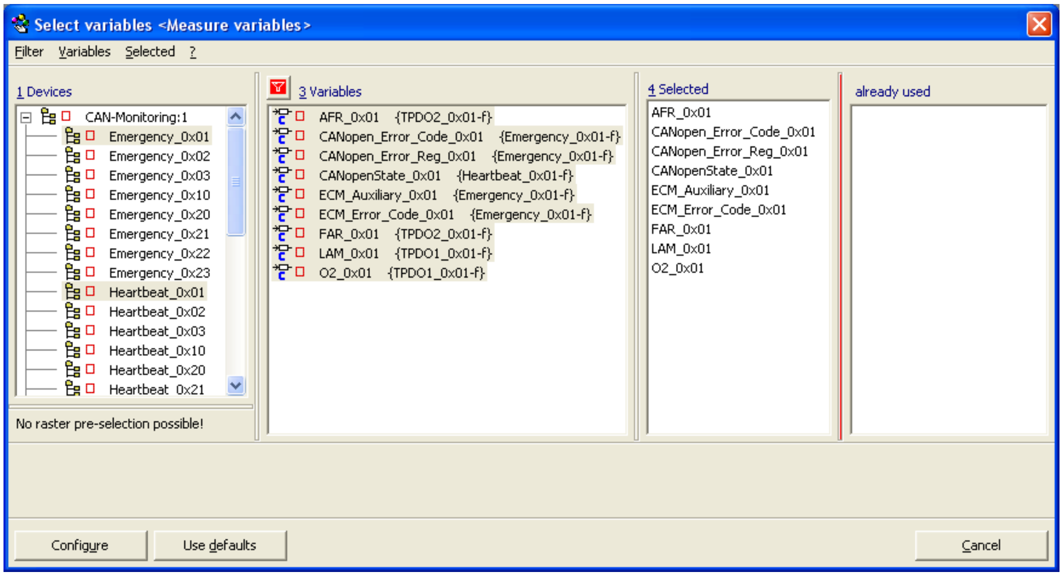
8. **Initialize hardware.** The hardware is currently stopped, as indicated by the red stop sign icon next to the selected hardware. You must initialize it before you can use it to collect data. Click on the Initialize Hardware button on the upper tool bar and wait for the hardware to complete its initialization. Another window will pop up to confirm the device to connect to. Click OK.



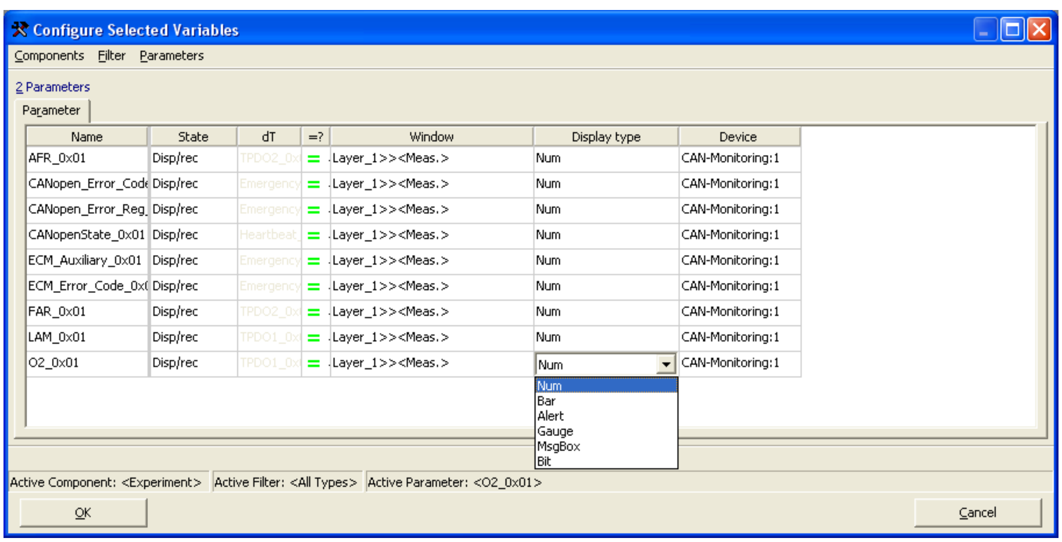
9. **Open an Experiment Environment.** Click on the Experiment Environment button on the upper tool bar to open an Experiment Environment. The Experiment Environment is where you can setup the monitoring of the CAN bus. By default, the Experiment Environment will be blank. You must select the variables from the dbc file that you wish to monitor. Click on the Select Variables icon in the left hand tool bar of the Experiment Environment.



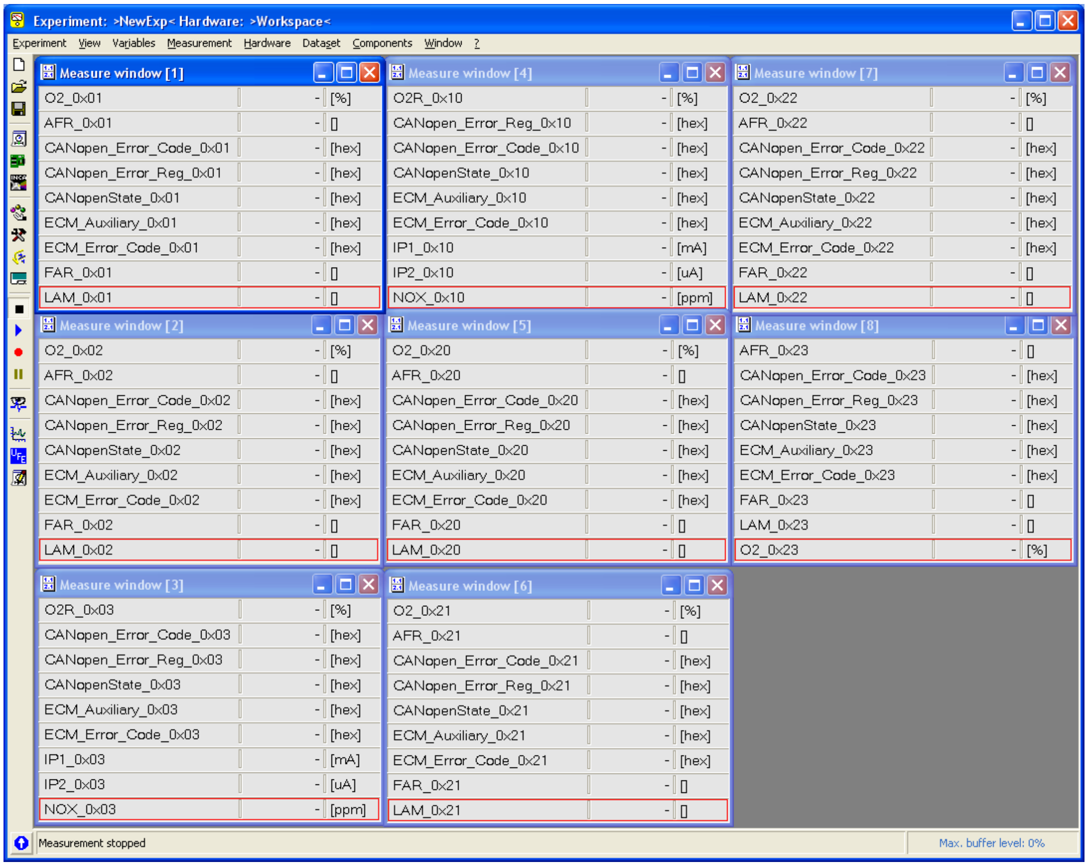
10. **Select and Configure Variables.** Select the variables that you wish to monitor in the Experiment Environment. These variables names are based on the data found in the dbc file. Click Configure.



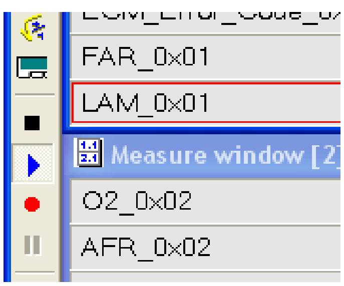
11. Another window will pop up to configure each selected variable. You can configure, for each variable, whether to record or simply display the data, how the data will be displayed (graphs, charts, gauges, numeric, etc.). When complete, click OK. We have left all configurations at default for this example.



12. A new sub-window will be added to the Experiment Environment. You do not need to select all the variables you want to monitor all at once. You can click on the Select Variables icon again at a later time to add more variables. Each set of variables you add will be placed in a new sub-window unless it is configured to join an existing sub-window. In this example, we have created a sub-window for each of the eight modules in the dbc file.



13. **Start CAN monitoring.** Right now there is no data displayed. That is because the CAN monitoring is stopped. To begin CAN monitoring, click on the Start Visualization icon (blue triangle) on the left hand tool bar. To stop CAN monitoring, click the Stop Measuring icon (black square) on the left hand tool bar. To begin recording the data, click on the Start Recording icon (red circle) on the left hand tool bar.



Appendix E: Setting Up ATI Vision for ECM Modules

NOTE: While shown here for a single LambdaCAN module, the same procedure applies for any of ECM's CAN-based devices (ex. NH_3CAN) as well as for multiple modules simultaneously connected on the same bus.

Introduction

Connecting ECM LambdaCAN hardware to ATI VISION software is simple and does not require any third-party software interface. Using the ECM Configuration Tool software to produce a .dbc database file, and the ATI VISION CANMonitor interface, any available hardware CAN interface can be used to read LambdaCAN data.

Hardware Setup

A typical hardware configuration is shown in Figure 1. In this example, a Kvaser Leaf Light CAN-USB adapter is used. Other supported adapters have a similar procedure. Connect the DB9 CAN connector of the LambdaCAN to the PC to CAN adapter. Supply 11-28V DC (5A min. supply) to the LambdaCAN.

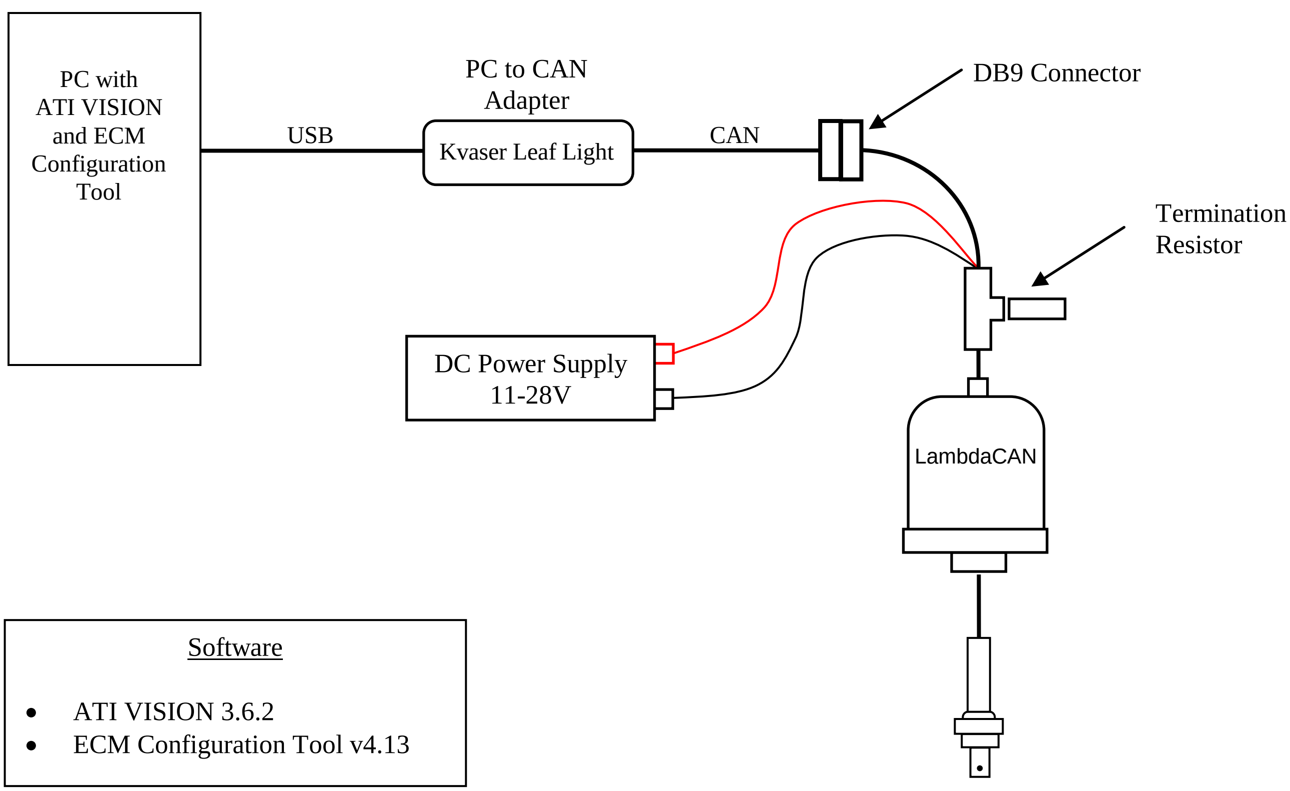


Figure 1: Equipment Schematic Layout

Creating a .dbc File

The ECM Configuration Tool is used to create a .dbc database file for describing the CAN messages broadcast from the LambdaCAN. All ECM products with a CAN interface use the CANopen protocol at 500kHz by default. To generate a .dbc file using ECM Configuration Tool:

1. Connect hardware as shown in Figure 1. Ensure LambdaCAN bi-color LED indicator near sensor connector is visible (green during normal operation, flashing red without sensor attached).
2. Run ECM Configuration Tool software, and select the Modules tab (or the Analyzers tab if connecting to 5200 series analyzers).
3. Select CAN adapter from drop down menus as shown in Figure 2, and click START.
4. After LambdaCAN module(s) have initialized, select desired parameters to transmit from the TPDO drop down menus for each module.
5. Click Generate .dbc, and save this file in a location such as the VISION Projects folder.
6. Click STOP to end CAN connection.

NOTE: Whenever TPDO's are modified, a new .dbc file must be created.

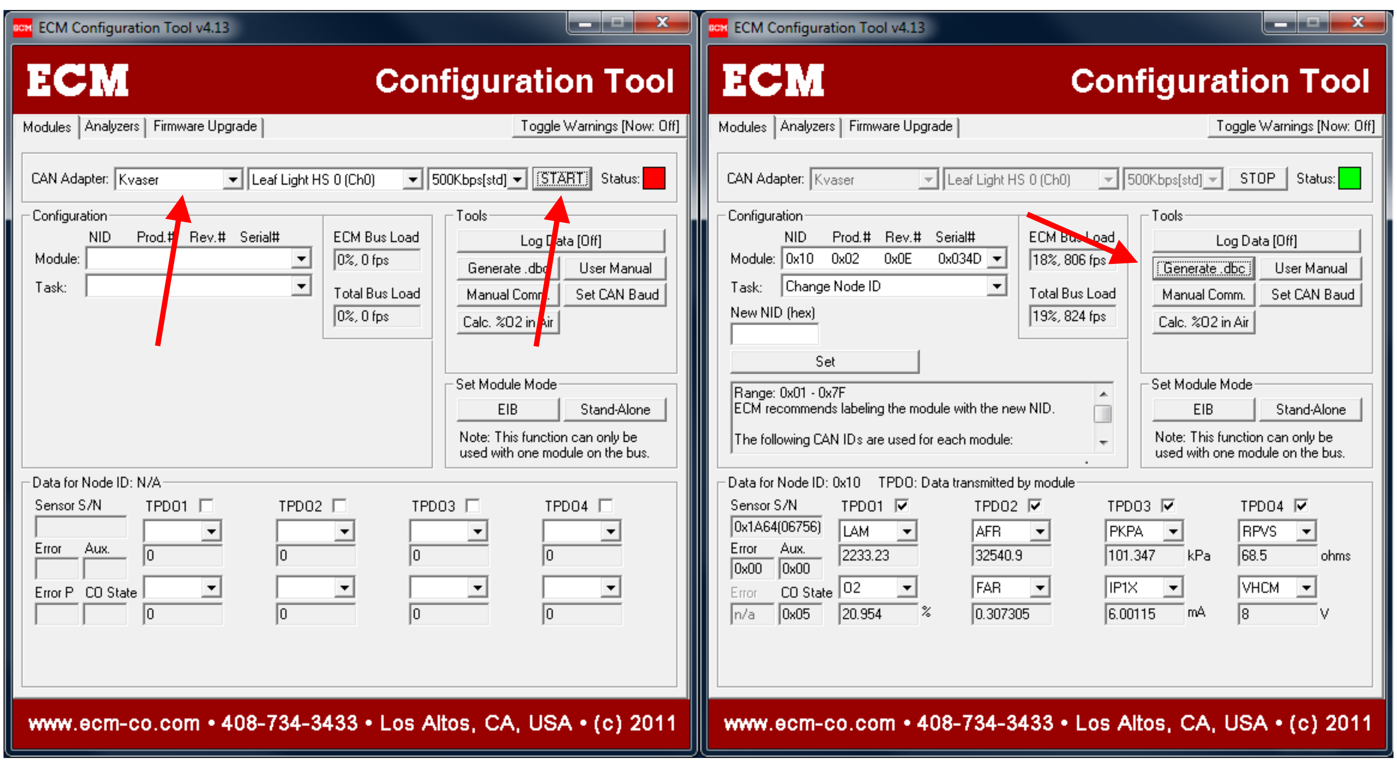
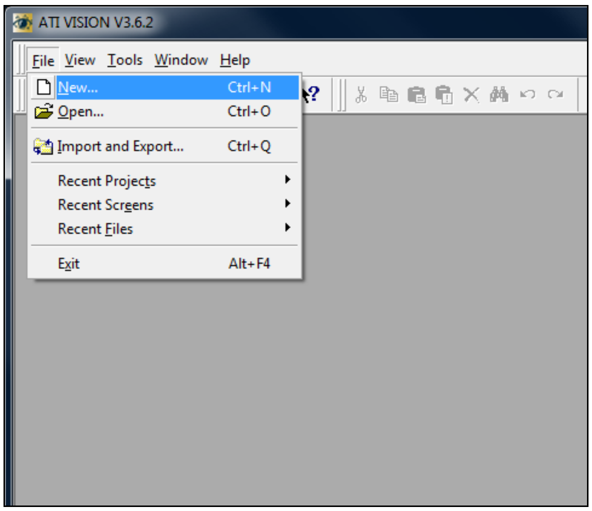


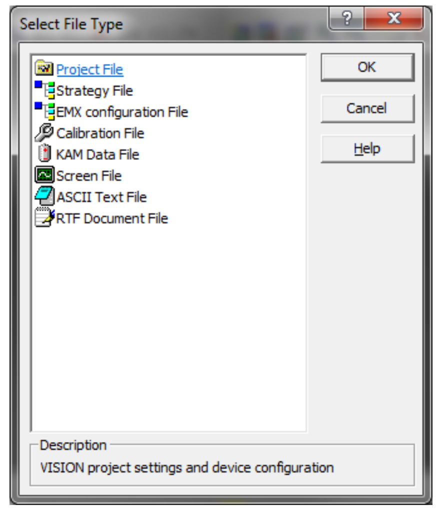
Figure 2: ECM Configuration Tool

Setup CANMonitor using ATI VISION

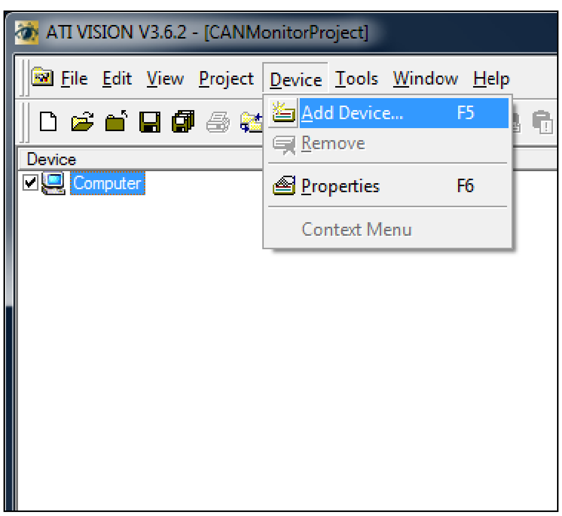
ATI VISION CANMonitor provides a method of reading general purpose information from any available CAN channel. The .dbc file generated by the ECM Configuration Tool is used to describe the format of the information available to VISION. To setup a CANMonitor in ATI VISION:

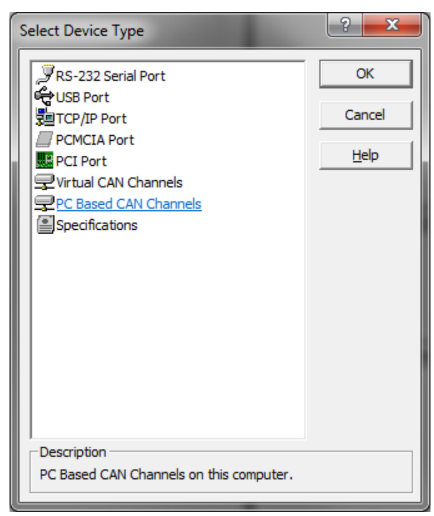
1. Run ATI VISION and open an existing Project File or create a new one by clicking File → New → Project File. In this example the Project has been named CANMonitorProject.



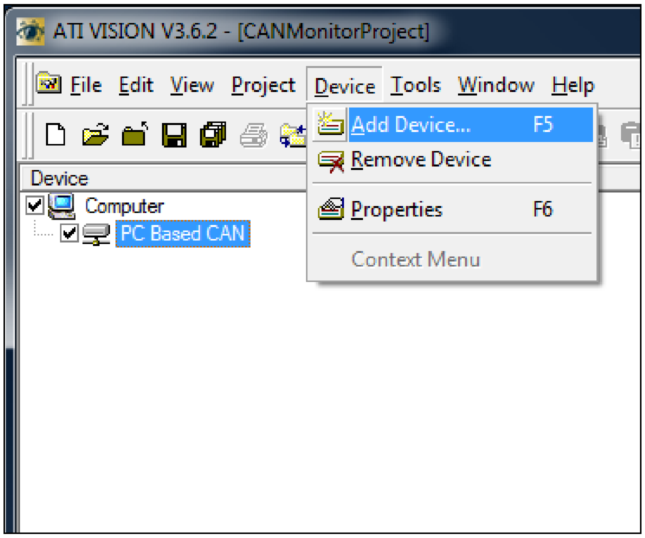


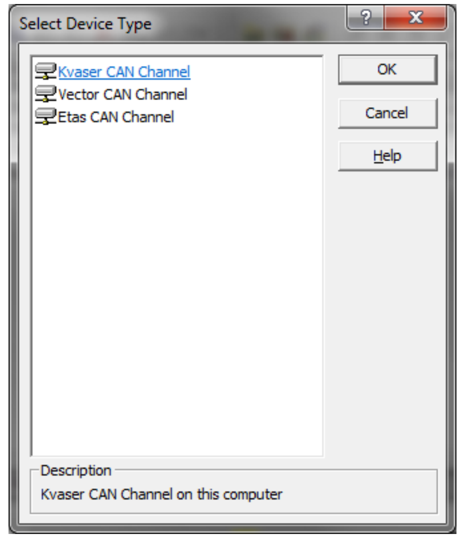
2. Add a Device by clicking Device → Add Device, select PC Based CAN Channels from the list.



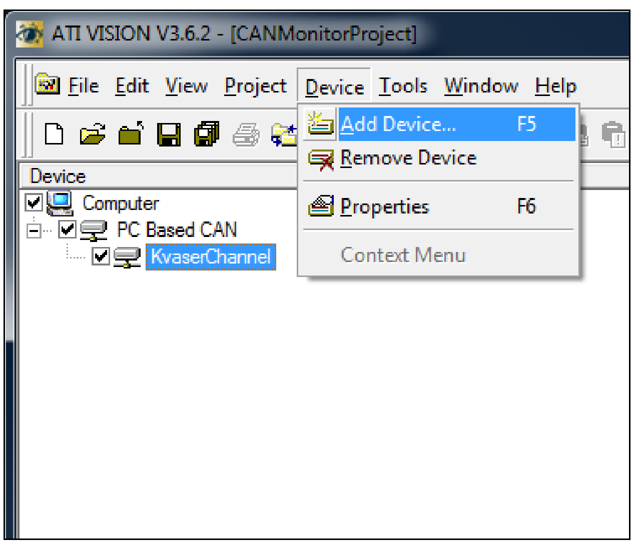


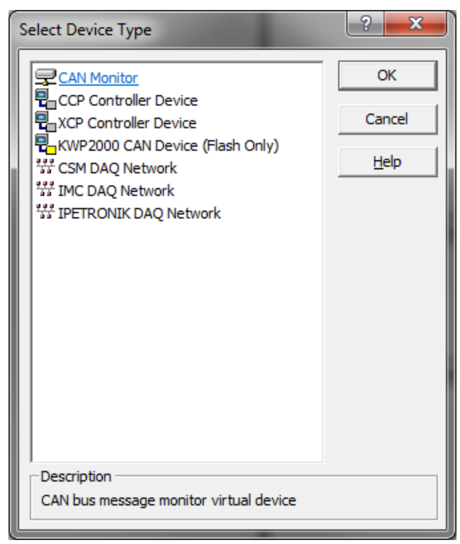
3. Add a physical hardware device by clicking Device → Add Device, and select Kvaser CAN Channel.



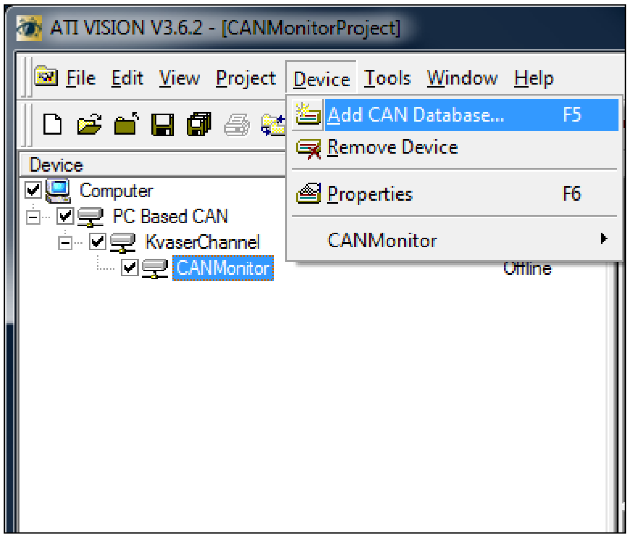


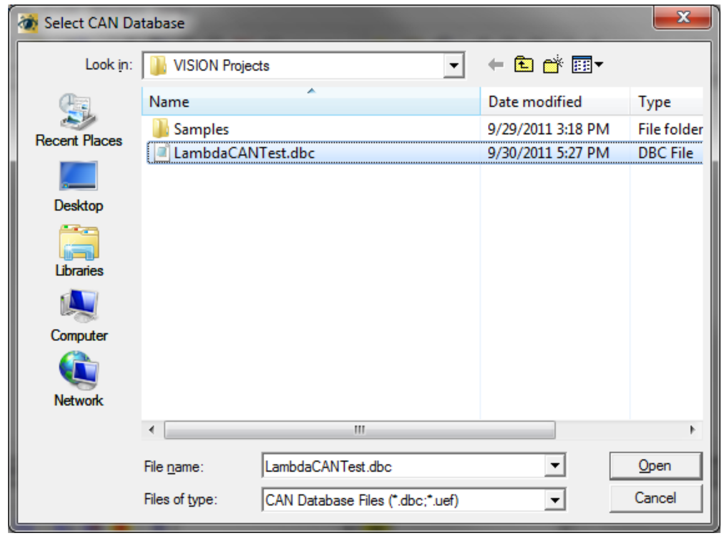
4. Select a CANMonitor device by again clicking Device → Add Device, and select CANMonitor.



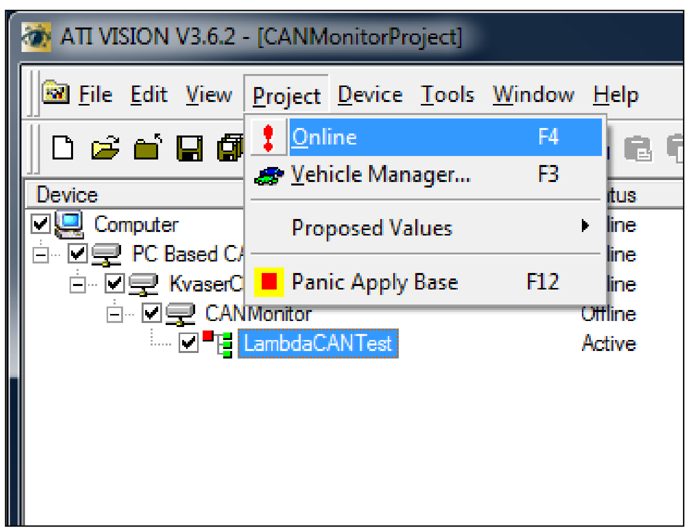


5. Add the .dbc file generated from the ECM Configuration Tool to CANMonitor by clicking Device → Add CAN Database and browsing to the previously created .dbc file.

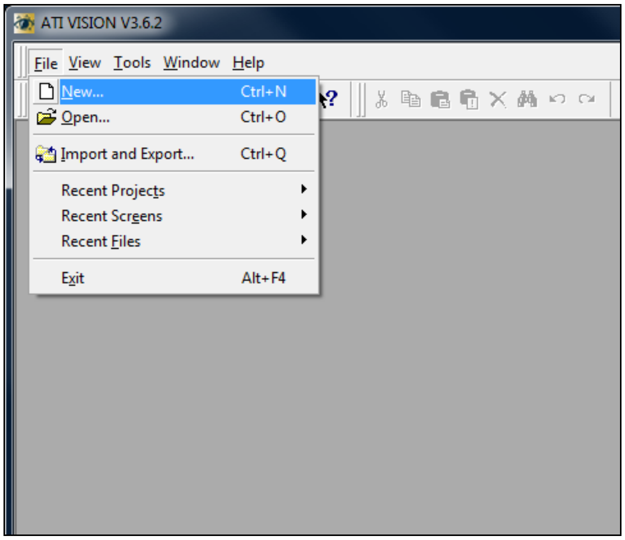


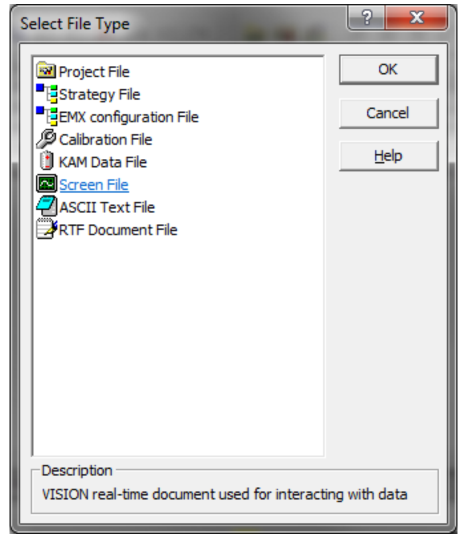


6. Enable the hardware by clicking Project → Online. The status of all of the devices should now show a Status of Online, and a value should appear in the Data Rate column of the Project window.

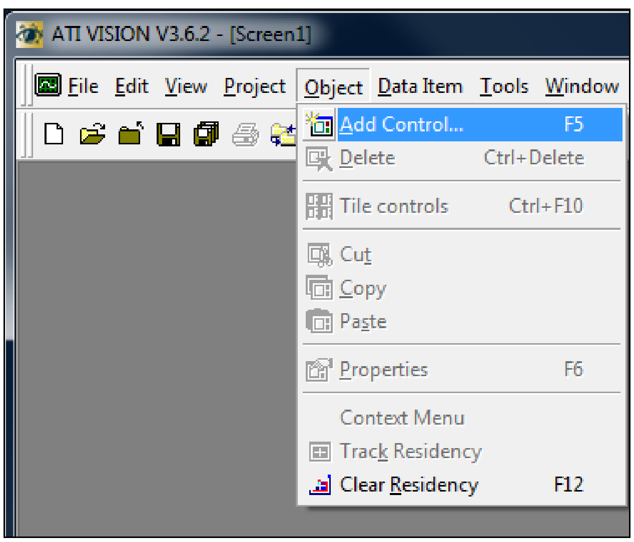


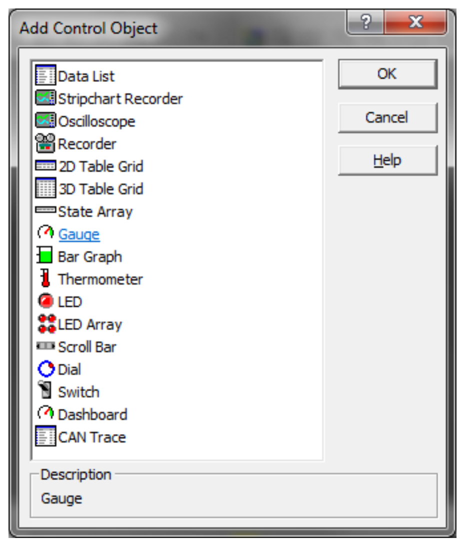
7. To view data, create a new Screen File and add a Control. Click File → New → Screen File



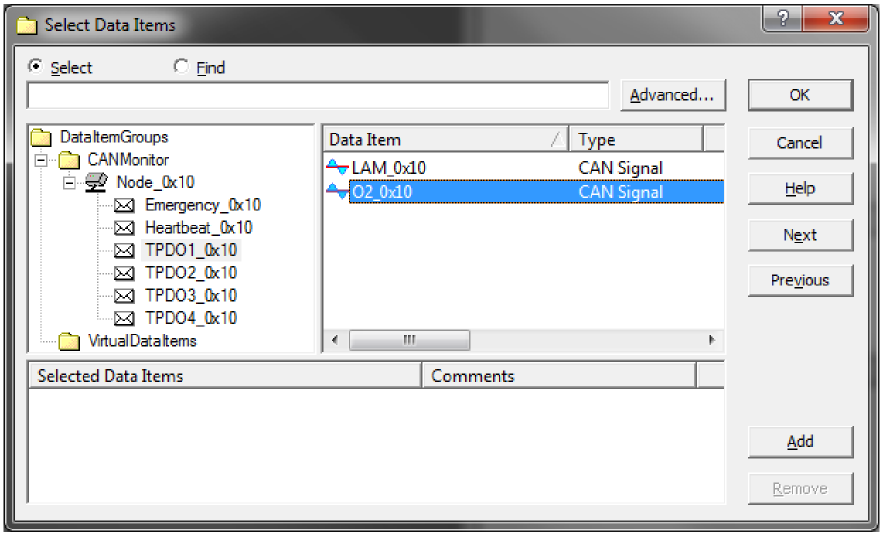


8. Select Object → Add Control → Gauge

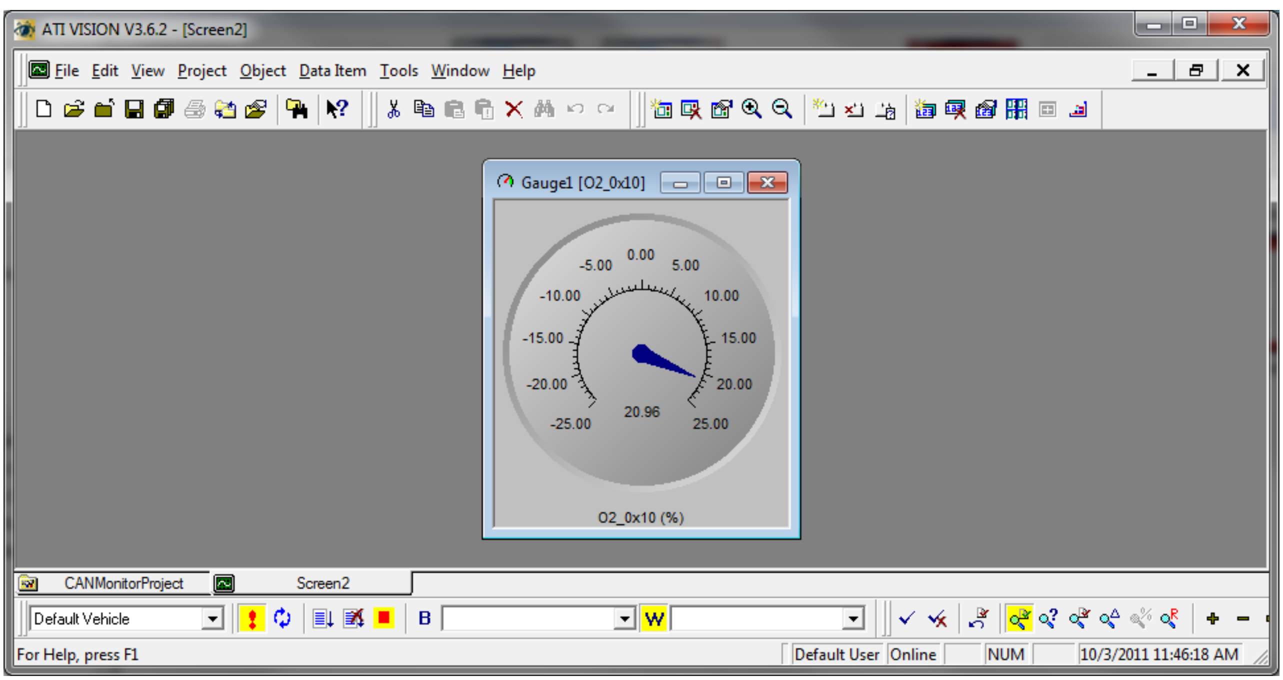




9. In the Select Data Items window open the CANMonitor file tree to view all of the available signals. Here the O2% from Node 0x10 has been selected. Click OK to add the Data Item to the Control.



10. Data should be visible on the gauge.



Appendix F: LOCKing and unLOCKing dashCAN*

When dashCAN* is locked, its setup cannot be modified.

◆ **To LOCK dashCAN***

1. Press SYS until "MOd" is displayed.
2. Press ↓ until "CONF" is displayed. Then press ENT.
3. Press ↓ until "LOCK" is displayed. Then press ENT.
4. "50" will be displayed. Press ↑ until "60" is displayed. Then press ENT. dashCAN* is now LOCKed.

◆ **To unLOCK dashCAN***

1. Press SYS until "LOCK" is displayed. Then press ENT.
2. "50" will be displayed. Press ↑ until "60" is displayed. Then press ENT. dashCAN* is now unLOCKed.

If an unauthorized person learns that 60 is the key number, contact ECM.

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EC DECLARATION OF CONFORMITY

We declare under our sole responsibility that the products:

AFM1540 Lambda Module
AFM1600L, AFM1600D Modules
DIS1000 Display head
EGR 4830 Analyzer
NOx 5210 NOx Analyzer
Lambda 5220 Lambda Analyzer
EGR 5230 EGR Analyzer
NOx/NH_3 5240 NOx and NH_3 Analyzer
NH_3 5250 Analyzer
LambdaCAN, LambdaCANc, LambdaCANd, LambdaCANp Lambda Modules
NOx 1000, NOxCAN, NOxCANg, NOxCANt NOx Modules
NH_3CAN Module
baroCAN Module
dashCAN, dashCANc, dashCAN+, dashCAN2
appsCAN
SIM200, SIM300, SIM400, SIM500, SIM600, SIM700, SIM800
BTU200

To which this declaration relates are in conformity with the essential requirements of the following standards:
EN61326: 1997/A2: 2001 (Class A & Annex A)
EN61010-1: 2001 (Electrical Safety)

And therefore conform to the requirements of the following directives:
89/336/EEC Electromagnetic Compatibility (EMC)
72/23/EEC Low Voltage Directive (LVD)

RSPatrick

Ronald S. Patrick
Vice President Sales
February 20, 2015

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