

ECM ENGINE CONTROL
AND MONITORING

miniPEMS2TM

Portable Emissions Monitoring System



Instruction Manual

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Introduction

ECM's miniPEMS2™ is a compact instrumentation package for the auditing of combustion engine emissions. A key feature of miniPEMS2 is the use of ceramic exhaust emissions sensors. Ceramic exhaust sensors are smaller, more rugged, and faster responding than classical gas analyzers.

miniPEMS2 hardware consists of an instrumentation package stored in a 535 mm x 445 mm x 222 mm case. Fully loaded, the case weighs 13 kg. This package consists of:

1. A data storage/communication device (logger/CAN adapter).
2. A power switch box.
3. A remote "Power to Logger" switch.
4. Four 12V batteries connected in parallel (and an external charger).
5. An External Power Cable.
6. Measurement options (customer selected). Choices of measurements are:
 - i. NOxCAN Module – NO_x, O₂, Lambda
 - ii. CO/CO₂CAN Module – CO, CO₂, O₂, Lambda
 - iii. NH₃CAN Module – NH₃
 - iv. pmCAN – Particulate Matter
 - v. LambdaCAN Module – O₂, Lambda
 - vi. baroCAN – Rh, T, P, Dew Point, %O₂
 - vii. 4tcCAN Module – 4 temperature channels
 - viii. 10gpiCAN Module – 10 voltage, current, or frequency measurement channels
 - ix. gpsCAN - 10 hz speed and position, WAAS enabled
 - x. obdCAN – vehicle datastream information

Other modules are in development and can be added in the future.

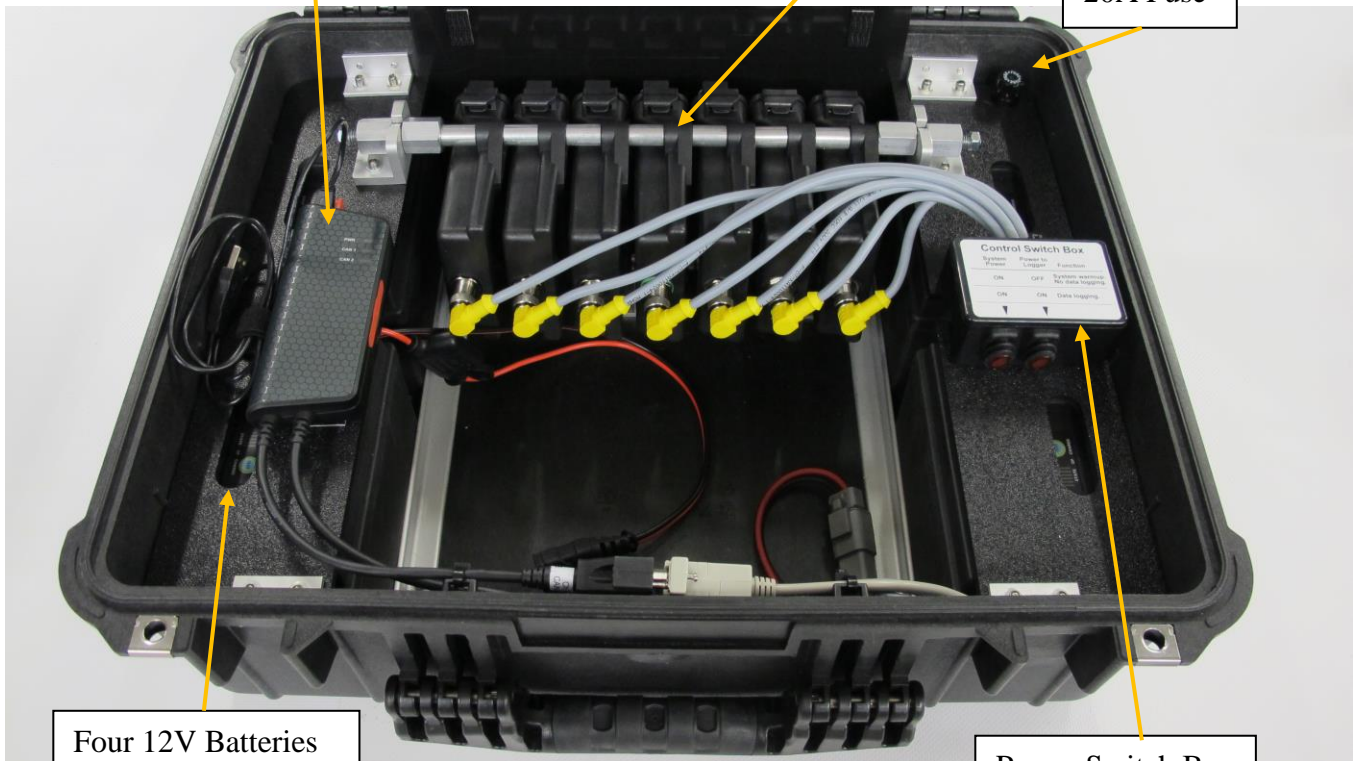
miniPEMS2 software consists of the PC "Configuration Tool" which allows:

1. Measurement module setup.
2. Calibration of measurement modules.
3. Real-Time monitoring of measured parameters.
4. Uploading of recorded data from the data storage device to a PC.

Data Storage/Communication Device
(logger/CAN adapter)

Measurement Modules
(maximum of 7)

20A Fuse



Four 12V Batteries
(one in each corner)

Power Switch Box

Remote "Power to Logger" Switch



Battery Charger



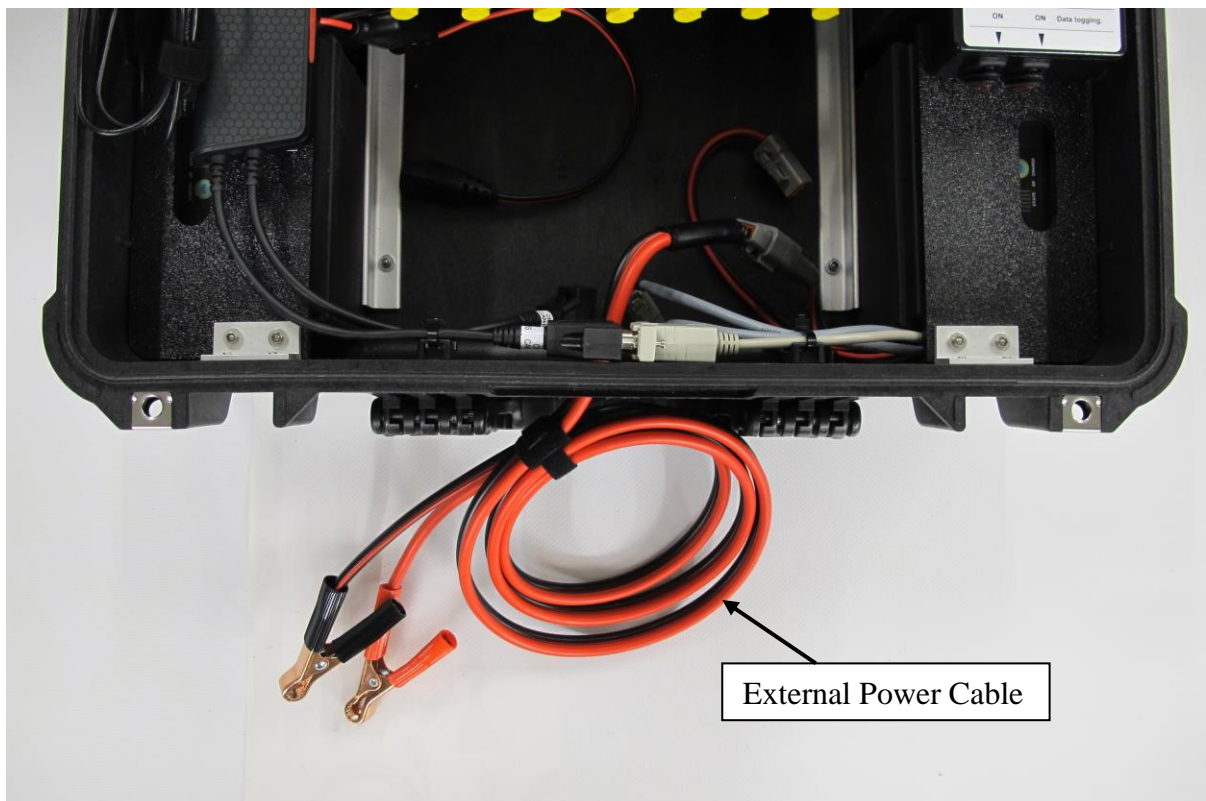
"100%" light



gpsCAN (roof mount)

OBD Connector

Remote "Power to Logger" Switch



External Power Cable

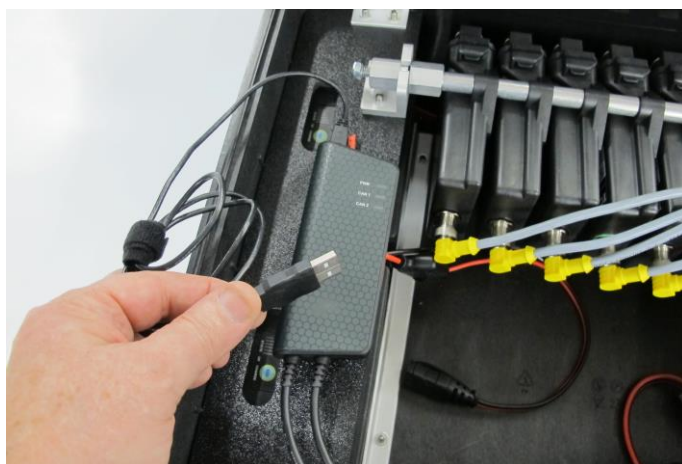
Quick Start

Before using miniPEMS2 for the first time, you need to install the Kvaser and ECM software onto your PC. The CD supplied with miniPEMS2 has both. Install the Kvaser software first. Once the software is installed, using miniPEMS2 is a simple four-step process: Setup (software), Setup (hardware), Data Collection, and Data Uploading.

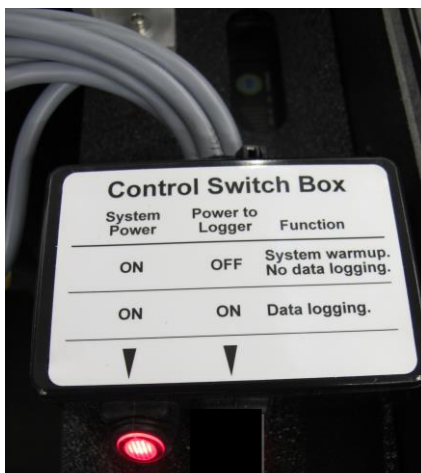
Setup (software)

Prior to shipping, miniPEMS2 is set up in a manner that should work fine for most testing. It is recommended that you start with this default setup. However, should you want to set up miniPEMS2 yourself, proceed as follows:

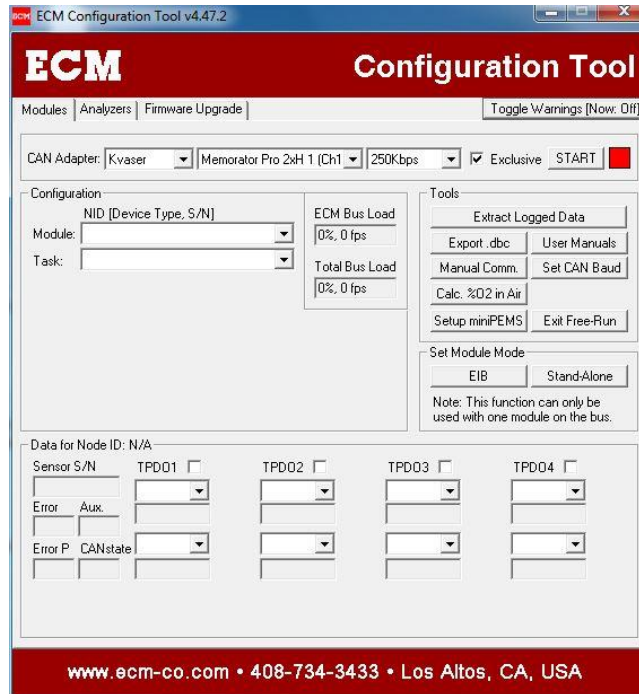
- i. Connect the USB connector to your PC. Just the green “PWR” light will come on at the logger.



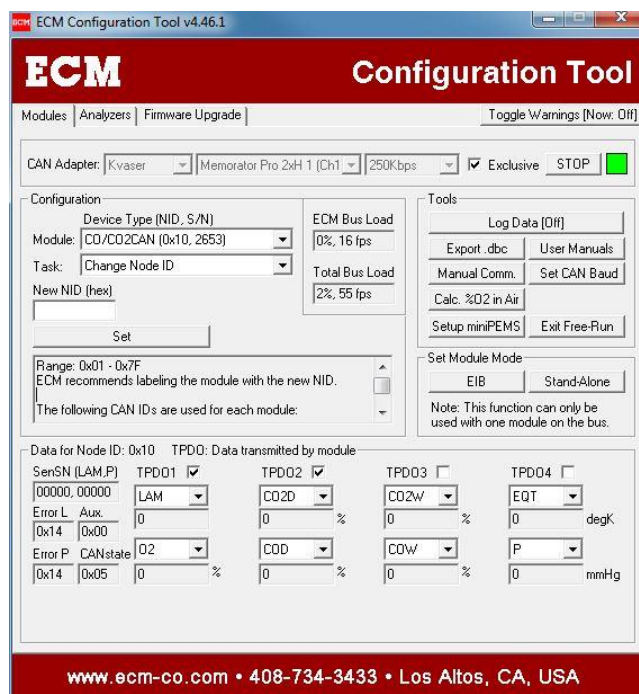
- ii. Turn on the “System Power” switch. The switch should light up.



- iii. Double click on the ECM logo on the PC. This opens the “Configuration Tool”. The screen should appear as shown below. Note that we are working on the “Modules” tab. There are five groupings of activities: “CAN Adapter”, “Configuration”, “Data for Node ID”, “Tools”, and “Set Module Mode”.



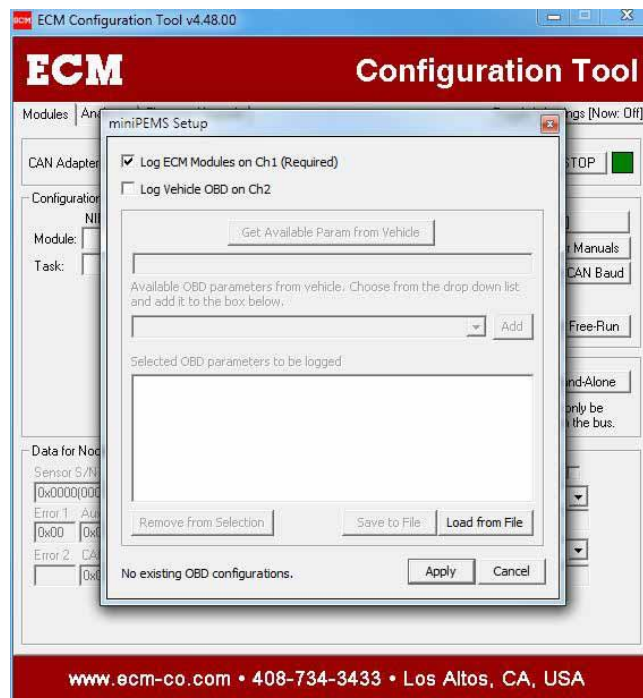
- iv. Make sure the “CAN Adapter” section shows: “Memorator Pro 2xH (Ch1)”, and “250kbps”. Therefore all modules must transmit at 250kbps.
- v. Click “Start”. The software will find the modules in miniPEMS2 and then the screen should appear similar to as shown below. Now the logger’s “PWR” light will be green and its “COM1” light will be orange.



- vi. Open the “Module:” selection in “Configuration”. Each line represents a module in the miniPEMS2. When you highlight one of the lines, the data being transmitted from that module appears in the “Data for Node ID:” section.
- vii. Select what parameters from each module are going to be transmitted and how often (Broadcast Rate). Each transmission is logged during data collection, so to avoid overly large files, you should make these selections carefully. gpsCAN is not programmable. gpsCAN will transmit speed, course, longitude, and latitude every 100ms and altitude every 1s.

For the modules where you can select the parameters, you select them by activating TPDOs (by checking them) and selecting them in the pull-down menus in the “Data for Node ID:” section. To set the broadcast rate of the set of parameters, select “Set Broadcast Rate” from the “Task:” menu in the “Configuration” section.

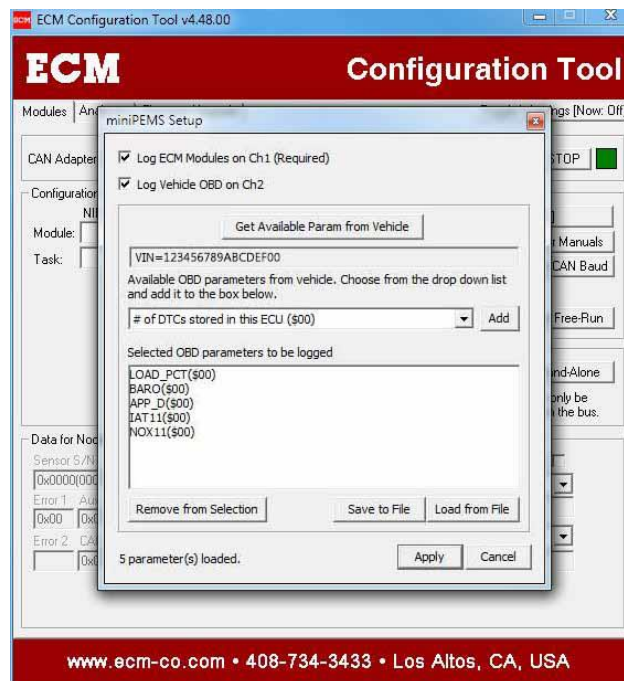
- viii. Once you have selected the parameters and rate at which you want to log them, click on the “Setup miniPEMS” button in the “Tools” panel. This will bring you to the following screen.



If your miniPEMS2 does not have the obdCAN option, click on the “Apply” button. This will download to the logger’s SD card a file (mpems.dbc) that will be used to translate recorded data. If you later want to change what is being recorded or how often it is recorded, you will have to download (using “Setup miniPEMS”) this new

configuration. After clicking “Apply”, click “STOP” in the Configuration Tool, turn the “System Power” switch in the miniPEMS2 off, disconnect the logger from the PC, and wrap the USB cable inside miniPEMS2.

If your miniPEMS2 has the obdCAN option and you want to record vehicle datastream information, select “Log Vehicle OBD on Ch2”, click on the “Get Available Parm(eters) from the Vehicle” button, and follow the instructions to select the parameters to be recorded. Pull down the menu beside the “Add” button to see the available parameters. When you “Add” parameters, they will appear on the list. Note that you can also remove parameters, save a file of selected parameters, and load (recall) it. What parameters are available is specific to each car/truck model. After making your selection, click the “Apply” button. This will download to the logger’s SD card a file (mpems.dbc) that will be used to translate recorded data.



OBD information is stored every second. If you later want to change what OBD parameters are stored, you will have to download (using “Setup miniPEMS”) this new configuration. After clicking on “Apply”, click “STOP” in the Configuration Tool, turn the “System Power” switch in the miniPEMS2 off, disconnect the logger from the PC, and wrap the USB cable inside miniPEMS2.

Setup (Hardware)

Connections to measurement modules come through the big rectangular opening in the back/bottom of the miniPEMS2 case. Connections to the Power to Logger Switch, the GPS antenna, the OBD connector, and the optional external power connection come through the round opening near the handle in the front/top of the case.

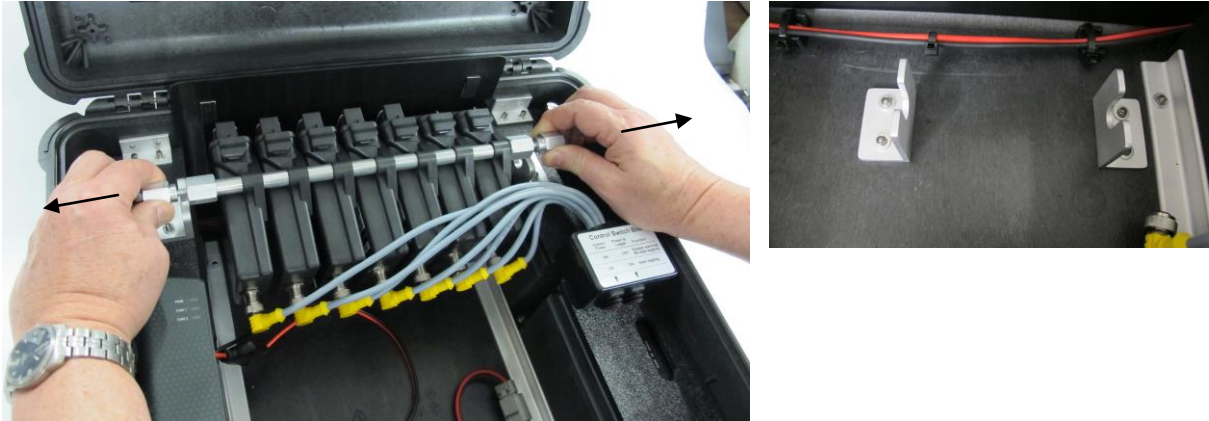


The small rectangular opening in the cover of the case is for accessing and viewing the switches and lights on the Control Switch Box when the cover is closed. Each opening has a removable thin plastic cover and a place to store that cover when not in use.

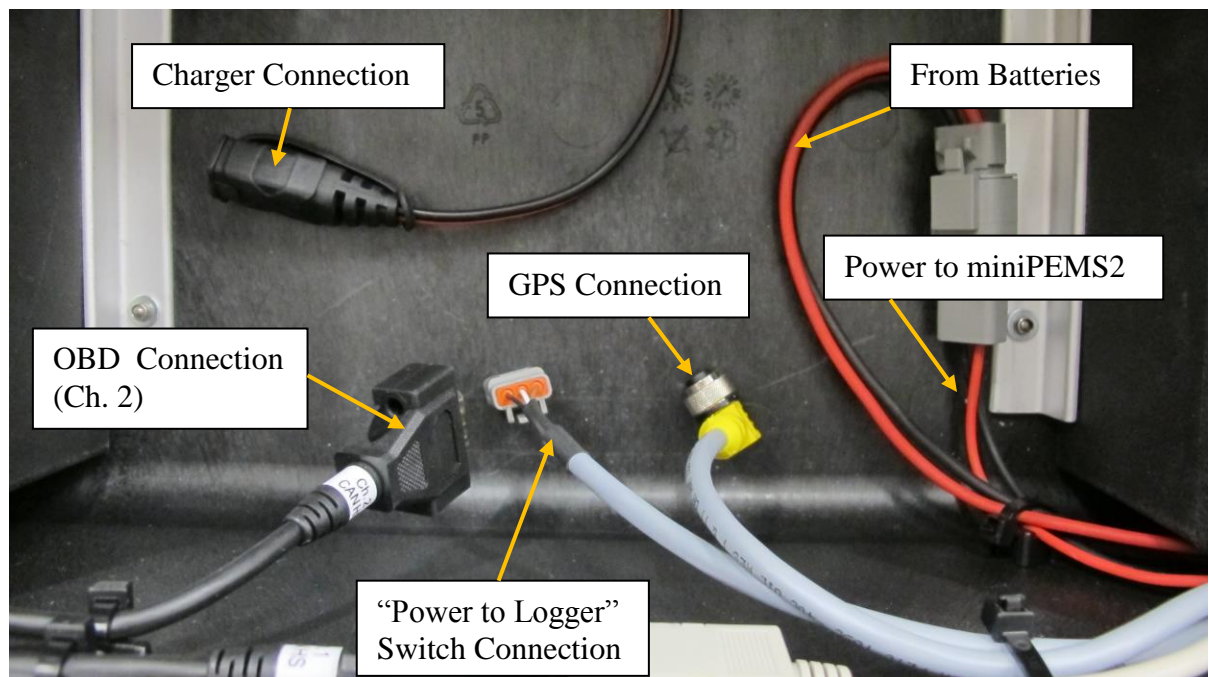


The modules will be supplied with cables and some modules with exhaust sensors. Instructions on how to install the exhaust sensors are given in their respective instruction manual attached to the back of this manual. The most important thing to remember is to always power the sensors if they are in the exhaust of a running engine (i.e. “System Power” switch on). Otherwise, you will plug up and damage the sensor. Keep in mind that the closer the exhaust sensors are mounted to the exhaust system’s exit, the more likely that their readings will be diluted by external air. This is most prevalent at low exhaust flowrate conditions. For spark-ignition engines that run closed-loop at $\lambda = 1$, dilution can be detected by looking in the %O₂ signals which should, on-average, be within 0.5% of 0%.

The connections to the modules inside miniPEMS2 are made via yellow-tipped, screw-on 12mm Eurofast connectors. The modules are held together as an assembly by two threaded rods (1/4"-20), spacers, two springs, and six nuts. There are two lengths of spacers, the longer one (20.7 mm) is used to space one module from another, and the shorter one (13.3 mm) other is used to take the place of a module if less than seven modules are in the assembly. The module assembly can be removed from the case by pulling outwards on the spring loaded ends of the upper threaded rod and lifting up on the assembly. The spacers on the lower treaded rod lock into place in two slotted brackets on the bottom of the case.



The connectors for the Power to Logger Switch, the GPS antenna, the OBD connector, and the External Power Cable are inside the case. It is obvious what hooks up to what. OBD information from the vehicle connects to CAN Ch. 2.



Battery Life

Before use, charge the batteries until the “100%” light on the charger is solidly green (not flashing). When charging, both switches on the Control Switch Box must be off (i.e. you cannot use the miniPEMS2 while charging). With a full charge, you will get “29 hours of use per heated sensor”. Some of the exhaust sensors are heated (NO_x, NH₃, Lambda, CO/CO₂) and some are not. For example, if you have just one heated sensor (ex. a NO_x sensor), you will get 29 hours of operation. If you have three heated sensors (ex. two NO_x and one NH₃), you will get over 9 hrs (29/3) of operation. The electronics of the logger and the modules use energy but a lot less than the heated sensors, so for practical purposes, ignore their consumption in the calculation.

On each battery, there is a “state of charge” test button that you can push to give an indication of the charge in the battery. When a battery is fully charged, all five blue bars should be lit when you press the button. However beyond that, it’s not a very accurate indicator of operating time available. After charging the batteries until the “100%” light on the charger is on, disconnect the charger, and press each battery test button (one at a time). Each should show five bars. If one battery doesn’t, it’s likely that battery is bad and has to be replaced. It takes approximately 3 ³/₄ hrs to fully charge the batteries.



You can also power miniPEMS2 using an external power source. An External Power Cable is supplied for this purpose. You use the cable by disconnecting the connector shown above and plugging it in. By doing this, you disconnect the internal batteries from the miniPEMS2. Your external power source will not charge the batteries but the battery charger can still be used to do this. Your external power supply can be from 12 to 28 VDC. It needs to supply 2A for every module with a heated sensor and 0.1A each for the GPS, logger, and each module. An AC line-powered external power supply is available from ECM (P/N: PWR-02).

Data Collection

Data collection is simple. First of all, the logger must be disconnected from the PC for logging. Prior to data collection, you should have just the “System Power” switch on (and the “Power to Logger” switch off) for at least 10 minutes to warm up the heated exhaust sensors. Then, each time you turn **on** the “Power to Logger” switch (or the remote “Power to Logger” switch), logging starts, and each time you turn it **off**, logging ends. Each on-off session creates a file. During logging, the “PWR” light on the logger will be flashing green and the “COM1” light will be steady orange. When you are finished with your data collection, turn the “Power to Logger” and “System Power” switches off.

Data Uploading

The logger can be removed from miniPEMS2 and brought to a computer for extracting the data. If it remains attached to miniPEMS2, turn off both the “Power to Logger” and “System Power” switches off, connect the logger to the PC, and double click on the ECM logo. Do not click on “START”. The three lights on the logger will be flashing, one at a time from the “COM 2” light to the “PWR” light. Click on “Extract Logged Data” in the “Tools” section.

You cannot take the memory card out of the logger and directly plug it into your PC at this time. The extraction of data from the logger must be performed using the logger.

Click on the file to export (i.e. to extract from the logger), click on the button with the three dots to enter a file name to call the exported file, then click the “Extract” button. Note that all the files in the logger can be deleted and the logger’s internal clock can be synchronized with the PC’s clock. The “Time Resolution (ms):” input is a file size management feature. Leave it at 100.

Double click the extracted file on the PC and it will open as an Excel .csv file.

Other Information

The Configuration Tool

The five activity areas in the Configuration Tool are described below.

CAN Adapter: The CAN adapter (logger) communicates with the modules, records (logs) the data from the modules, and uploads the data to the PC. The baud rate must be set at 250 kbps and each of the modules must communicate at that rate. gpsCAN is fixed at this rate but other ECM modules are programmable for rate. If a particular module cannot be “seen” by the software, its baud rate or NID (Node ID) should be checked when just that module is attached to miniPEMS2. This means if you add a module yourself, you must correctly set its NID and baud rate before installing it into MiniPEMS2 (see Note 1. in “Troubleshooting”).

Configuration: This is where the modules are configured and calibrated (under “Task:”). Explanations of the configuration and calibration of the modules can be found in that particular module’s instruction manual. There is no manual for the gpsCAN module because there is nothing to be configured or calibrated. There is no manual for the 4tcCAN module because the only things that can be configured are the NID and the thermocouple type.

Data for Node ID: Here is where the data transmitted from the selected module (see “Configuration”, “Module” section) is chosen and viewed. Error codes are also shown.

Tools: Normally only “Setup miniPEMS” and “Extract Logged Data” will be used. “Setup miniPEMS” saves the current configuration of the modules as a file stored on the logger. “Extract Logged Data” uploads data stored in the logger. “Set CAN Baud” is for programming a module’s baud rate. When using “Set CAN Baud”, the gpsCAN module and 4tcCAN module must be disconnected from the bus.

Set Module Mode: Normally not used.

Troubleshooting

1. If the “CAN 1” light is flashing, or not on when it should be, there is likely a problem with the CAN communication. Most often, this is caused by two or more of the modules having the same NID (Node ID) or the wrong CAN baud rate (it should be 250 kbps). You resolve this issue by disconnecting (via the yellow connectors) all but one module and checking that its NID is not shared by another module and that its CAN baud rate is 250 kbps. Change the NID under “Task:”, “Change Node ID” and baud rate via the “Set CAN Baud” button. You might have to change the baud rate of the Configuration Tool to a few rates until you can communicate with the module. Don’t forget to change the baud rate of the Configuration Tool back to 250 kbps.
2. If the Configuration Tool “locks up”, exit the program and restart it
3. Contact our technical support if you have a problem. Contact all us at 408-734-3433 between 10am and 6pm PST (we’re in California, USA) or at support@ecm-co.com.

Safety Warnings

In installation and use of this product, comply with the National Electrical Code and any other applicable Federal, State, or local safety codes.

The ceramic sensors are heated, get hot, and can burn you.

Always wear eye protection when working near engines, vehicles, or machinery.

During installation, turn off the power and take all other necessary precautions to prevent injury, property loss, and equipment damage. Do not apply power until all wiring is completed.

Never work on a running engine.

When installing miniPEMS2 cabling and sensor(s) on a stopped engine, it is best to think-out your moves before you make them.

Route and cable-tie all cables away from hot, moving, sharp, or high voltage (spark) objects.

Take into consideration the movement of the engine, chassis, and wind buffeting when instrumenting the engine.

Clear tools away from the engine before starting.

Operate the engine only in a well ventilated area and never when you or one of your co-workers is tired.

When operating miniPEMS2 in a moving vehicle, the operator should keep his or her eyes on the road.

One measure of professionalism is how much you and your co-workers can accomplish without an injury. Always be at your professional best. Think and act with safety in mind.

Warranty and Disclaimers

WARRANTY

The products described in this manual, with the exception of the sensors, are warranted to be free from defects in material and workmanship for a period of 365 days from the date of shipment to the buyer. Within the 365 day warranty period, we shall at our option repair such items or reimburse the customer the original price of such items which are returned to us with shipping charges prepaid and which are determined by us to be defective. This warranty does not apply to any item which has been subjected to misuse, negligence or accident; or misapplied; or modified; or improperly installed.

The sensors are considered an expendable part and as such cannot be covered by a warranty.

This warranty comprises the sole and entire warranty pertaining to the items provided hereunder. Seller makes no other warranty, guarantee, or representation of any kind whatsoever. All other warranties, including but not limited to merchantability and fitness for purpose, whether express, implied, or arising by operation of law, trade usage, or course of dealing are hereby disclaimed.

The warranty is void if a module or the display head is opened.

LIMITATION OF REMEDY

Seller's liability arising from or in any way connected with the items sold and/or services provided shall be limited exclusively to repair or replacement of the items sold or refund of the purchase price paid by buyer, at seller's sole option. In no event shall seller be liable for any incidental, consequential or special damages of any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with items sold and/or services provided to buyer, whether alleged to arise from breach of contract, express or implied warranty, or in tort, including without limitation, negligence, failure to warn or strict liability. In no event shall the company's liability to buyer arising out of or relating to the sale of any product or service exceed the purchase price paid by buyer to the company for such product or service.

PRODUCT CHANGES

We reserve the right to discontinue a particular product or to make technical design changes at any time without notice.

EC DECLARATION OF CONFORMITY

We declare under our sole responsibility that the products:

miniPEMS2
miniPEMS
PEMSchen
NOx 5210 Analyzer
Lambda 5220 Analyzer
EGR 5230 Analyzer
NOx/NH3 5240 Analyzer
NH₃ 5250 Analyzer
LambdaCAN, LambdaCANc, LambdaCAND, LambdaCANp, LambdaCANf Lambda Modules
NOxCAN, NOxCANg, NOxCANt, NOx1000 NOx Modules
NH₃CAN Module
baroCAN Module
CO/CO2CAN Module
dashCAN, dashCANc, dashCAN+, dashCAN2
appsCAN
gpsCAN
4tcCAN
10gpiCAN
SIM300, SIM400, SIM500, SIM600, SIM700, SIM800
BTU200
EGR 4830 Analyzer
AFM1540 Lambda Module
AFM1600 Lambda and O₂ Analyzer
DIS1000 Display Head

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)



Ronald S. Patrick
Vice President Sales
June 6, 2019

ECM ENGINE CONTROL AND MONITORING

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