

ECM ENGINE CONTROL
AND MONITORING

miniPEMSTM

Portable Emissions Monitoring System

Instruction Manual

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Introduction

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

miniPEMS hardware consists of a package that is carried on the vehicle. This package contains:

1. A data storage/communication device (a.k.a. CAN adapter or logger).
2. A power switch box.
3. A remote "Power to Logger" switch.
4. A battery (with external charger).
5. Measurement modules. Choices of measurement modules are:
 - i. gpsCAN - 10 hz speed and position
 - ii. NOxCAN – NO_x, O₂, Lambda
 - iii. CO/CO₂CAN – CO, CO₂, O₂, Lambda
 - iv. NH₃CAN – NH₃
 - v. LambdaCAN – O₂, Lambda
 - vi. 4tcCAN – 4 temperature channels
 - vii. obdCAN – vehicle datastream information

miniPEMS 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.



Measurement
Modules

Battery



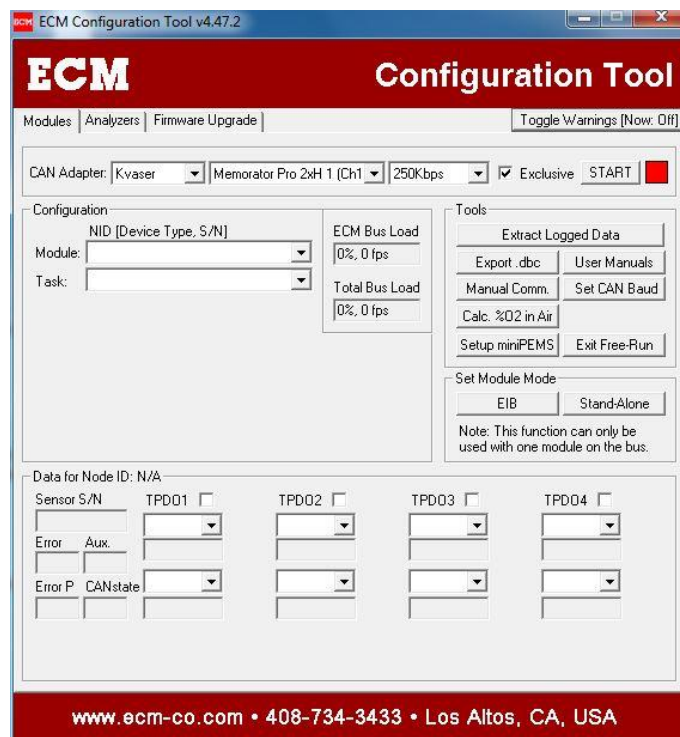
Quick Start

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

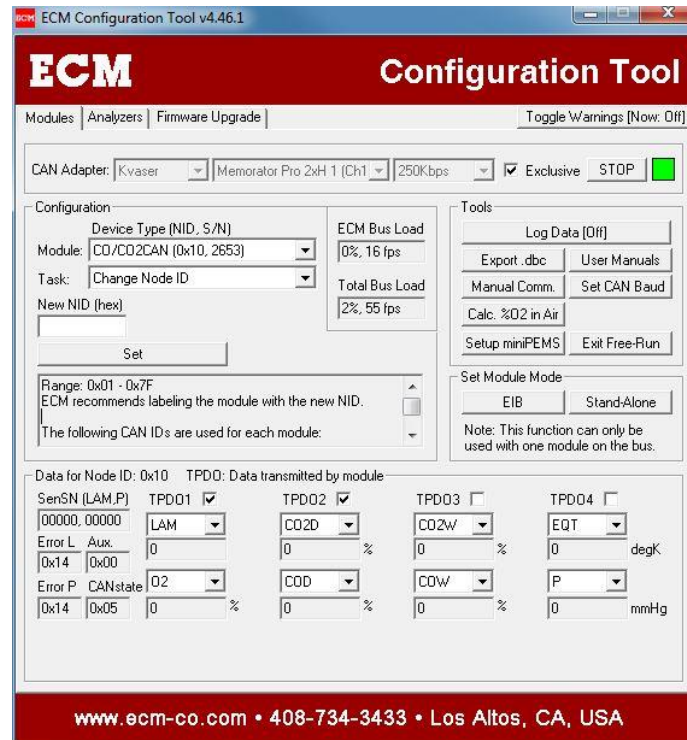
Setup (software)

Prior to shipping, miniPEMS 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 miniPEMS yourself, proceed as follows:

- i. With the PC on, connect the “Ch. 1” (DB9 connector) of the logger to the white DB9 miniPEMS connector, and the USB connector to the PC. Just the green “PWR” light will come on at the logger.
- ii. Turn on the “System Power” switch in the miniPEMS.
- 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”.



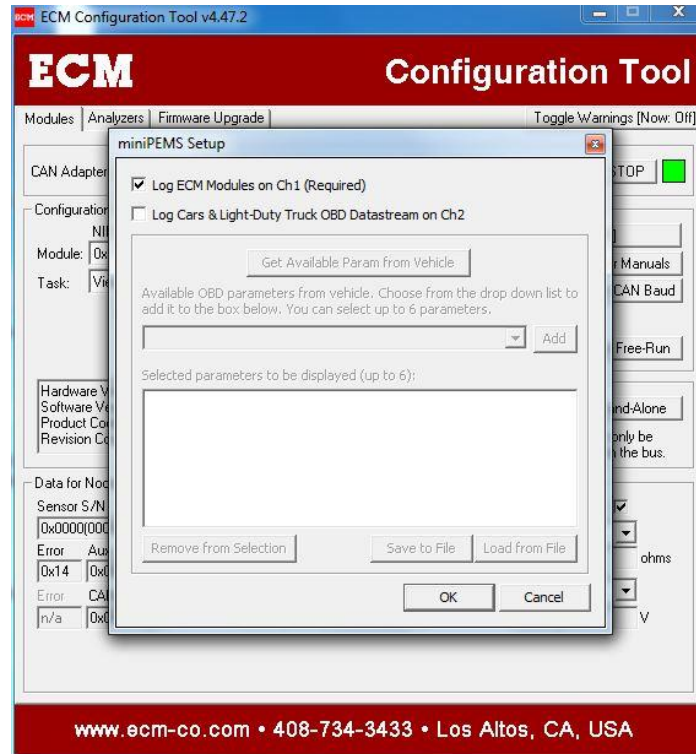
- iv. Make sure the “CAN Adapter” section shows: “Memorator Pro 2xH (Ch1)”, and “250kbps”.
- v. Click “Start”. The software will find the modules in miniPEMS and then the screen should appear similar to as shown below. Now the logger’s “PWR” light will be green and its “COM1” light will be orange.



- vi. Open the “Module:” selection in “Configuration”. Each line represents a module in the miniPEMS. When you highlight one of those 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 sent from the module and how often. Each transmission is logged during data collection so to avoid overly large files, you should make these selections carefully. gpsCAN and 4tcCAN are not programmable. gpsCAN will transmit all five parameters every 100ms. 4tcCAN is set at all four temperatures every 200ms.

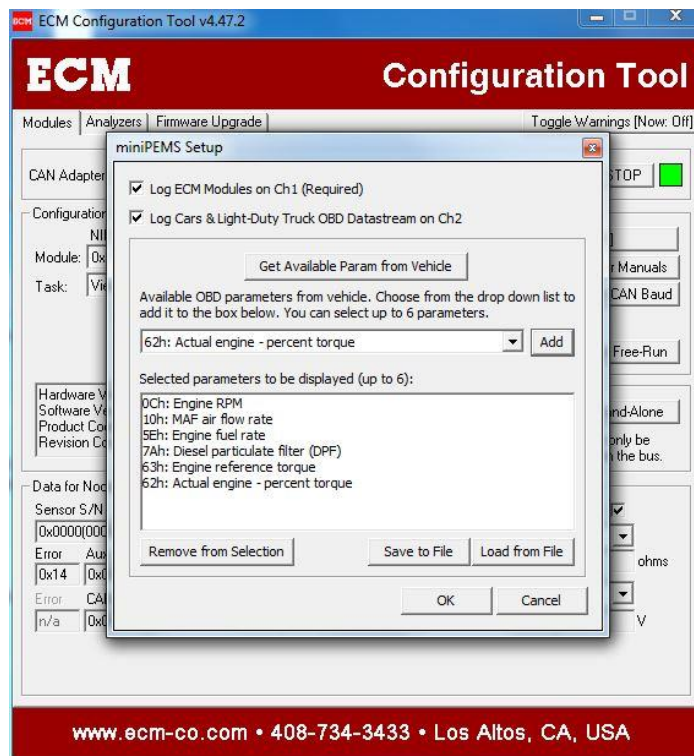
For the modules where you can select the parameters, you select them by activating TPDOs (by checking them) and selecting them in the pull-down menus in the “Data for Node ID:” section. To set the broadcasting rate of the set of parameters, select “Set Broadcast Rate” from the “Task:” menu in the “Configuration” 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 miniPEMS does not have the obdCAN option, click on the “OK” button. This will download to the logger’s SD card a file (mpems.dbc) that will be used to recode recorded data. If you later want to change what is being stored or how often it is stored, you will have to download (using “Setup miniPEMS”) this new configuration. After clicking on “OK”, click “STOP” in the Configuration Tool, turn the “System Power” switch off in the miniPEMS, disconnect the logger from the PC, and wrap the USB cable inside miniPEMS.

If your miniPEMS has the obdCAN option and you want to record vehicle datastream information, select “Log Cars & Light-Duty Truck OBD Datastream 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. If it’s available, you’ll see it; if you don’t, it isn’t. After making your selection, click the “OK” button. This will download to the logger’s SD



card a file (mpems.dbc) that will be used to recode recorded data. If you later want to change what is being stored or how often it is stored, you will have to download (using “Setup miniPEMS”) this new configuration. After clicking on “OK”, click “STOP” in the Configuration Tool, turn the “System Power” switch off in the miniPEMS, disconnect the logger from the PC, and wrap the USB cable inside miniPEMS.

Installation

Instructions on how to install the exhaust sensors are given in their respective instruction manuals. 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 light load conditions. For spark-ignition engines that run closed-loop at $\lambda = 1$ conditions, dilution can be easily detected by looking in the %O₂ signals which should, on-average, be within 0.5% of 0%.

Data Collection

Data collection is simple. First of all, the logger must be disconnected from the PC for logging. Prior to data collection, it is preferential to have just the “System Power” switch on (and the “Power to Logger” switch off) for at least 10 minutes to warm up the exhaust sensors. Then, each time you turn the “Power to Logger” switch (or the remote “Power to Logger” switch) on, 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.



Remote “Power to Logger” Switch

Data Uploading

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

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 data 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 selections should match the adapter and the channel connected to the modules. The baud rate must be set at 250 kbps and each of the modules must communicate at that rate. gpsCAN and 4tCAN are 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 the CAN adapter.

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 4tCAN 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 4tCAN 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. Most companies believe that their manuals are perfect and that their products are intuitive and without bugs. We also believe that. However, our technical support is pretty good so if you have a problem, please call us at 408-734-3433 between 10am and 6pm PST (we’re in California).

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 miniPEMS 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 miniPEMS 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:

miniPEMS
NOx 5210 Analyzer
Lambda 5220 Analyzer
EGR 5230 Analyzer
NOx/NH₃ 5240 Analyzer
NH₃ 5250 Analyzer
LambdaCAN, LambdaCANc, LambdaCANd, LambdaCANp Lambda Modules
NOxCAN, NOxCANg, NOxCANt, NOx1000 NOx Modules
NH₃CAN Module
baroCAN Module
dashCAN, dashCANc, dashCAN+, dashCAN2
appsCAN
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
September 3, 2016

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