

Populations, Activity and Emissions of Diesel Nonroad Equipment in EPA Region 7

PAMS Installation Standard Operating Procedures Appendix G

Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Prepared for EPA by
Eastern Research Group, Inc. (ERG)
EPA Contract No. EP-C-06-080

General Standard Installation Procedures for PAMS Installations

Find out how much time is available and plan accordingly.
Get a key and learn how to start the engine without moving the vehicle.
If you need to return the key, figure out how, when, who, etc.

Figure out where to put the logger and RPM sensors.
If equipment is 1999 or newer, locate and connect to CAN connector, if available.

Determine power sources, for Corsas, install on switched power (Corsa is dead when key is off), for Isaacs, power should be steady (non-switched), but use switched power (key on) as input signal to start datalogger.

Ensure switched power (for Isaac input of Corsa main power) is constant and continuous during engine operation, not cycling (such as a relay) or intermittent

USE 24V to 12V power transformer for 24V systems!

Route the wires. Don't obstruct any filler caps, access doors, etc.
Complete the instrumentation collection forms, including determining info about which months the equipment is used throughout the year.

Take legible "close-up" picture of all engine tags

Initiate the PAMS software on the configuration laptop
Mount and prepare the logger ensuring the datacard (or dataport) is accessible for future downloads
Ensure fuse is inline with logger for power on/power off.

Ensure logger is mounted in correct orientation to prevent water incursion, and ensure the CF port is sealed with tape on the Corsa dataloggers

Ensure optical RPM sensor is mounted at slight/correct angle to reflective tape

Power the logger and confirm communications with the computer (Ping).

Send the correct config file to the logger,

Calibrate the RPM

Ensure acquisition frequency is 1 hz

Ensure the date and time stamps are correct, must be correct on laptop (and no DST for Corsas) (sync this twice for each datalogger)

Ensure datalogger shuts off during inactivity and turns on again during activity

Check the real-time data to see if it looks good and is accurate (e.g., Sensor Check on Corsa).
Remove the installation data from the datalogger memory
Make sure everything is still working
Filename is "XXXX_YYYY_PAMS", where XXXX is last 4 digits of estab ID, YYYY, is last 4 digits of serial #

Perform dataogger startup delay testing according to data collection form instructions

Seal and secure equipment appropriately, tighten up zip ties and wire bundles.
Zip tie bolts etc. that were removed for the install. Note them on data sheet.
ERG do final inspect of installation
Close it up.

Verify all data collection is complete, and legible pictures have been taken

Regularly revisit all dataloggers to ensure they are secure, operating properly, and have sufficient unused memory. Download interim data, transmit it to FTP site and email Michael.Sabisch@erg.com

IMPORTANT SAFETY NOTES:

Safety note regarding use of optical RPM mounting magnets:

The RPM mounts use high-powered Neodymium magnets. They must be handled with care to avoid personal injury. Fingers can get severely pinched between magnets or a magnet and a metal surface. Magnetic attraction can slam a magnet against another magnet or metal surface, resulting in shattering of the magnet. Eye protection must be worn when handling these mounts, as shattering magnets can launch pieces at great speed. Never allow the magnets to be near computers, dataloggers, or electronic equipment of any type. If you have a pacemaker, metal stitches, or any metal objects in your body, do not work with or near the magnets.

Ensure the magnet is mounted in a location where it will not be heated above 175F.

Always tether the magnets with mount and zip ties.

Other general safety info:

Always follow all site safety guidelines.

Always tag out ignition when working on engines

When starting engines, always call out to verify nobody is working in the engine compartment or under equipment

Avoid moving and hot components when working on equipment

Always secure ladders and persons when climbing equipment

Guidelines for Corsa Datalogger software setup:

Set up an appropriate configuration file:

- Set up channels (tabs) for the two RPM inputs (see Images 1 and 2)
- Set up supply voltage tab, use 13 V as the auto start / auto stop settings (see Image 3)
- Do not set auto start/auto stop on any of the other tabs (RPMs) (see Image 3)
- RPM scale should be set at 1000, unless a decimal voltage is required for on/off, then set scale to 100 (See the “Other Installation Tips From Corsa” page)
- Ensure sample rate is 1 sample per second
- Do not set auto start/auto stop on any of the other tabs (RPMs) (see Image 3)
- RPM scale should be set at 1000, unless a decimal voltage is required for on/off, then set scale to 100 (See the “Other Installation Tips From Corsa” page)

The screenshot shows the WinCorsa software configuration window. The title bar indicates the file path: C:\Documents and Settings\MSabisch\My Documents\National PEMS Deployment_backup\New for T Drive\Project Data\july ...

At the top, there are fields for "Sample Rate" (set to 1) and "Periodic Period" (set to 3600). Below these are tabs for "Capalec RPM", "Optical RPM", "Supply Voltage", and "Example J1939 (RPM)".

The "Optical RPM" tab is selected. It contains the following settings:

- Name: Capalec RPM
- Device: Data Logger
- Channel: B1 RPM - Data Logge
- Zero ref: 0
- Scale: 0.061
- Auto Start: ☐ (empty)
- Auto Stop: ☐ (empty)
- Alarm 1 on: ☐ off
- Alarm 2 on: ☐ off

On the right, the "WinCorsa Settings" panel is visible, showing:

- Window #: 1
- Plot Color: Dark Red
- Averaging: 1 point
- Display Low: 0
- Display High: 10000
- Drop zeros: 0
- Noise filter: 0

At the bottom left, the "Channel Properties" section includes:

- Period Flag: ☐ Disable Auto Threshold, ☐ On falling edge, ☐ Every 4th rising edge
- Channel Size: 4

At the bottom right, there are buttons for "Add Channel", "Copy Channel", and "Delete". At the very bottom, there are "Save Configuration" and "Cancel" buttons.

Image 1 Optical Sensor Configuration Channel Tab

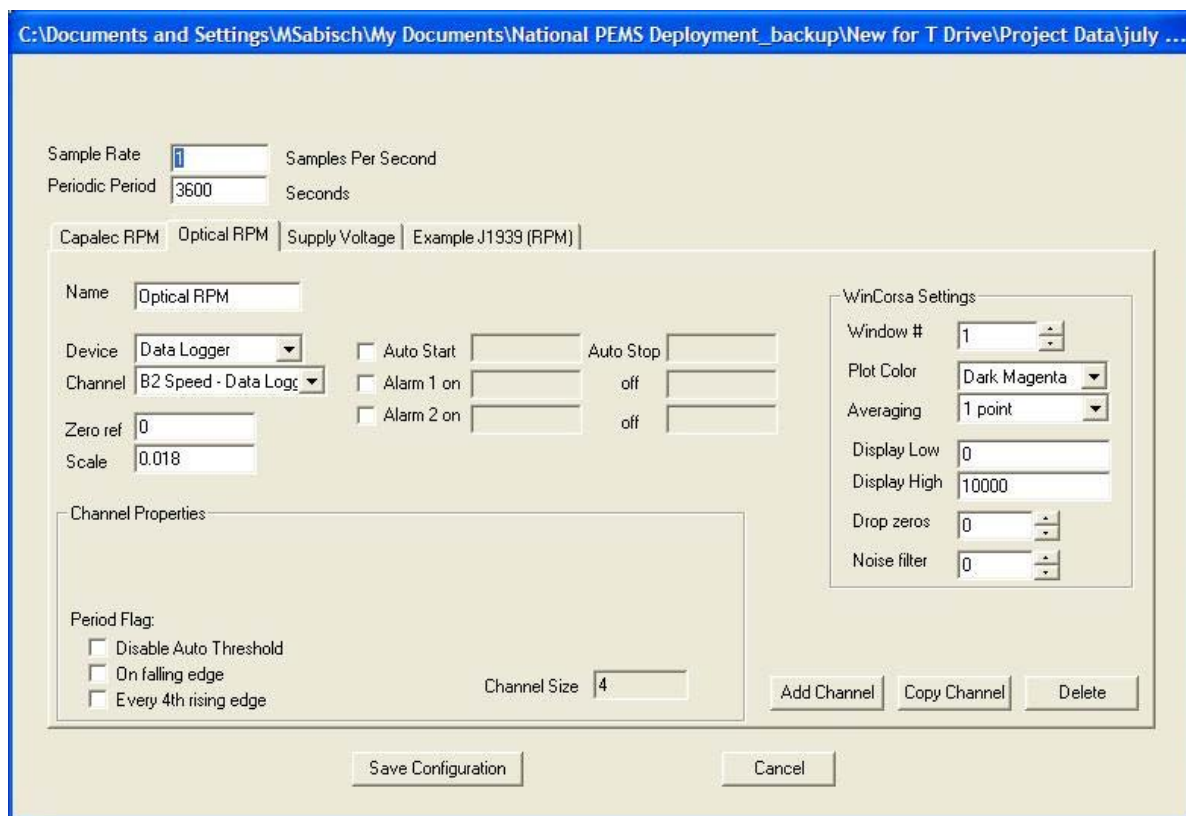


Image 2: Capelec RPM Configuration Channel Tab

- Under the “Datalogger” drop-down menu, select “send config file to datalogger”
- Disregard the unable to restart datalogger pop up error message, it’s erroneous
- Start vehicle/equipment, and under the “Datalogger” menu, select “Sensor Check” to see real-time values
- In Sensor Check screen, ensure datalogger is acquiring reasonable data.
- Verify/calibrate two recorded RPMs (optical/capelec) with tach on equipment or handheld tach, record values on datasheet after calibration. To do this, cycle the Capelec thru all 9 settings (1, 2, 3, 4, 5, 6, 8, 10, 12) at idle, 1500, and 2000 RPM (confirmed via onboard, handheld, or optical tach) to find setting where Capelec gives proper RPM. It may be easier doing this by creating and reviewing after running this “cycle”.
- After a few minutes of engine operation, turn off engine, and watch datalogger. Ensure “Run” LED shuts off (or flashes).
- Select “Save Data File from Datalogger” under the “Datalogger” drop down menu.
- Under the “File” drop-down menu, open the file you just saved using the “Open Data File” menu selection.
- Once the data is shown (as the strip chart), select the “view” drop-down menu, and select the “Data values” option.
- Review the data values to ensure that data is recorded when it should be (when the engine is started), and that acquisition quits when the engine is shut off (i.e., verify that voltage rises above 13V and data recording begins when vehicle is started and that voltage drops below 13V and acquisition stops when vehicle is shut off).

- Verify RPMs and all other recorded data in the datafile are reasonable.

C:\Documents and Settings\MSabisch\My Documents\National PEMS Deployment_backup\New for T Drive\Project Data\july ...

Sample Rate Samples Per Second
 Periodic Period Seconds

Captec RPM | Optical RPM | **Supply Voltage** | Example J1939 (RPM)

Name

Device ☒ Auto Start Auto Stop
 Channel ☐ Alarm 1 on ☐ Alarm 2 on

Zero ref
 Scale

WinCorsa Settings
 Window #
 Plot Color
 Averaging
 Display Low
 Display High
 Drop zeros
 Noise filter

Channel Properties

Channel Size

Add Channel Copy Channel Delete

Save Configuration Cancel

Image 3: Supply Voltage Configuration Channel Tab

Guidelines for retrieval of files from Corsa Dataloggers:

When retrieving Corsa PAMS datafiles from the Corsa dataloggers, follow the following steps:

- Attempt to communicate remotely with system (ping), note result on data collection form
- Remove equipment from protective case/bags
- Remove inline fuse to power down datalogger
- On your laptop, create directory for download named with last four digits of establishment #, last four digits of Equip Serial #, and date in the format of "XXXX_XXXX_2008MMDD".
- Using flash card reader, copy all *.EZD files from the card into the directory on your laptop
- Reinstall card in datalogger, reseal unit, power up.
- When done with all your file retrievals (once back in your hotel), upload all new data directories onto the secure project FTP site under the "PSU1 PAMS Data" main directory into the "Incoming from field" subdirectory.
- Update the Update "PAMS Tracking Master.xls" on CVS with all of the download visits
- Email Michael.Sabisch@erg.com to advise that new files are in the "incoming folder"
- Archive all data on EPA laptop
- NOTE: DO NOT DOWNLOAD VIA RF RADIO, AS THIS FILE TYPE WILL NOT CONTAIN EMBEDDED DATE/TIME STAMPS. DATA MUST BE COPIED DIRECTLY FROM CF CARD REMOVED FROM DATALOGGER.

Guidelines for office processing of Corsa datafiles (to be done in Austin)

- Move new *.ezd files from "incoming" folder to proper folder, and download from FTP site into proper location on T drive
- Open Corsa software, select the "CF Card" drop down menu, then "Save Data file from CF", then select "As Comma Separated Values (.csv)". A popup should be displayed that asks if you want to export (or save, or something), your events, please select "yes" (this will save the file with embedded date/time stamps for each record).
- Import into SAS, append as needed, process and analyze. Archive the original processed files (*.csv) and the original unprocessed files (*.ezd).

Additional Corsa system installation suggestions

6/5/06, Erik Kaupa, Corsa Instruments

ESD precautions (quick summary)

- Connect ground and bus cables, and black "drain" ground wire first.
- Ground yourself to chassis frequently as you work.
- Drain any charge off thermocouple leads before plugging them in.

Connectors

- The 11-pin connectors on the EZ-CF unit are fragile.
- Inspect both ends before connecting, check for bent pins.
- Orient the two ends with the notches lined up before you push them together
- Do not use excessive torque on the lock ring
- Sockets not at exactly the same depth are a manufacturing tolerance issue, not necessarily a cause for concern.

Power wiring

- Corsa recommended practice is to ground the datalogger (black and brown wires) to the chassis.
- Grounding the datalogger to the negative battery terminal is acceptable if the battery terminal is connected directly to the chassis.
- DO NOT ground the datalogger to the negative battery terminal if there is a disconnect switch in the negative power lead from battery to chassis. Use the chassis side of the disconnect switch instead.
- Corsa recommended practice is to connect the red power wire to the vehicle side of the master disconnect switch.
- Connecting red power wire directly to the battery is acceptable. Consider safety and service issues.
- On 24 volt trucks, connect the red power wire to +12, not to +24 volts.
- Corsa system can also be powered through the J1939 module, in this case 12 or 24 volts is OK.
- If system is powered through CAN module it is still important to connect the black and brown ground wires from the "veh" connector to the chassis.

Cables

- If a cable is constrained so that all the flexing happens at one point, it will fail.
- Cable failures are most common right at the connector.
- Cables must not be over-constrained
- There must be some room for flex at the connector
- Cable installation problems (too tight, too heavy, too loose, no room to flex) can also cause the connectors to fail or go intermittent.

Other Installation Tips From Corsa:

To be able to set the Voltage threshold to the 10th of a volt:

- Modify the config file as follows:
- Change the scale factor for the Box Voltage from 1000 to 100. That will cause the box voltage to be recorded as VoltsX10 (i.e., 12.5 V will be recorded as 125).
- Change the name of the tab from Box Voltage to Box Voltage X 10. That will remind the post processors when they get the data.

You should now be able to enter a record start/stop threshold of 13.3, or whatever is appropriate.

Each time you go check a logger that doesn't have a fuse on the hot leg of the power circuit (i.e., the red wire attached to the solenoid or battery), put a fuse on it. That way the next time we power down the loggers we will be able to conveniently do it by removing the fuse instead of the risky practice of unplugging the power circuit plug.

Whenever you check a Corsa logger and have trouble communicating or need to power it down:

- Note the LEDs. See if the Error light is on, etc.
- Watch the LEDs as it powers down. The CF LED should blink as the logger releases the empty space of the CF from itself.
- Record the file names and sizes if you find the CF is full with a corrupted file. That means the logger never released the empty space for some reason.

Corsa has only seen this when a CF is removed before powering down the logger or when a logger's internal battery gets too weak to support the normal power-down sequence. We have seen it under circumstances they have never seen, so we should help them figure out what is happening by using the above steps.

Additional Suggestions for maximizing error-free data retrieval

7/21/2006 ver 1.0

This document will outline some practices and procedures for successful operation of the Corsa CF Data Logger. Following these procedures will maximize the rate of error-free data retrieval.

Installation and setup:

- Wire so power is always on -- not turned off with truck
- Make sure truck provides steady 12v or more
- Install a switch for power down when removing cards
- Don't plug and unplug fragile 11-pin connectors

Startup and checkout prior to logging session:

- With power off install "ready" CF media (see below for media prep)
 - Turn power on
 - See LED's -- green PWR, amber ERR, green CF.
 - CF will blink and go on steady, ERR will turn off, RUN will blink at sampling rate (1hz)
- If LED's are OK as above, if there is no time or personnel to do a more thorough test, send the truck out now.

- Only if needed, send new config. Best to leave the config alone if it's OK.
 - Check clock, set if needed
 - Check status
 - Optional, sensor check.
 - Download the short recording via radio and verify all channels OK, etc.
 - Verify that RUN LED is blinking, ERR is off, CF is on steady, may have short flashes.
- Now ready to go.

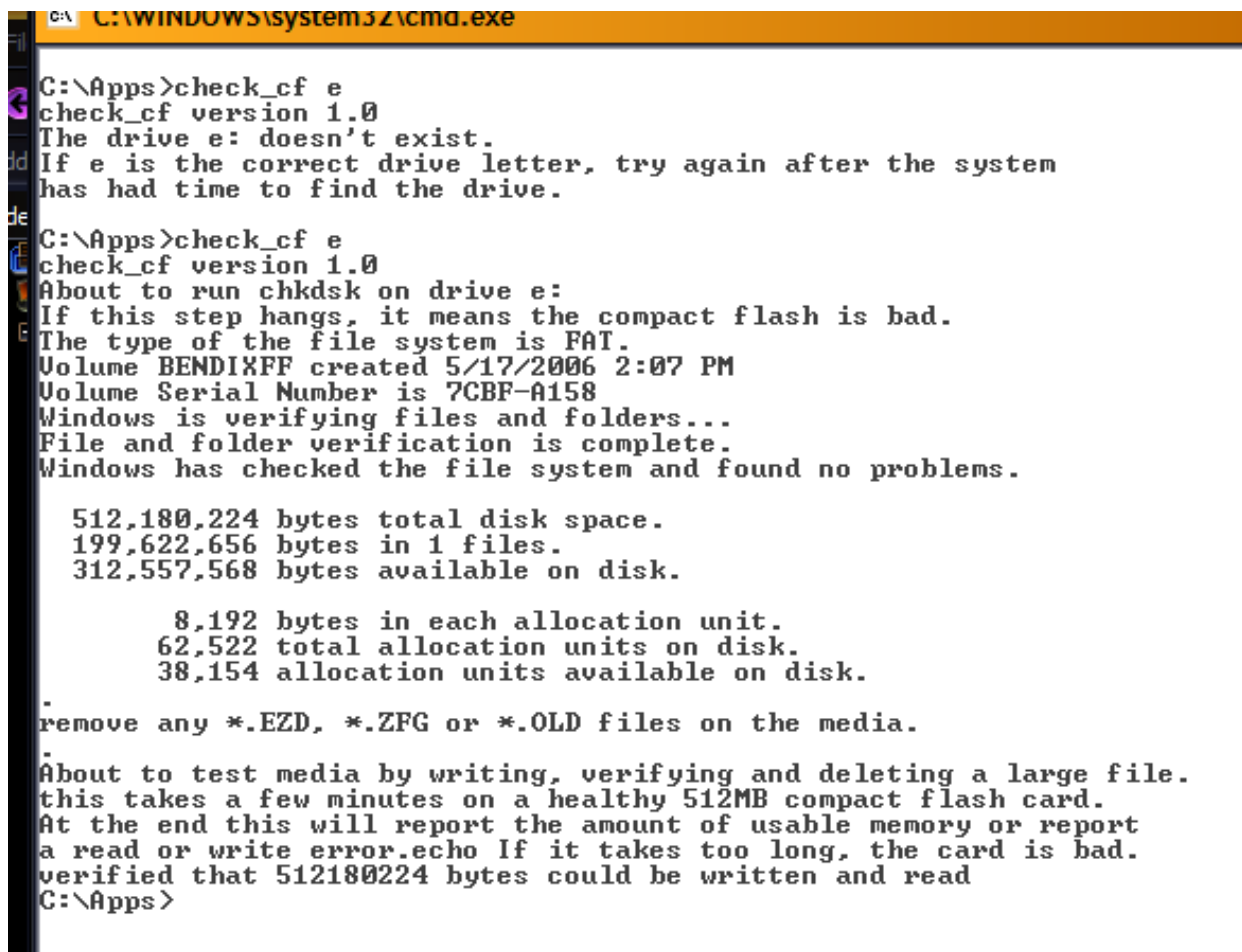
CF media preparation

- If there are any non-Corsa files on the CF card, delete them.
- run Check_CF
- from the Windows XP start menu, select run, and fill in CMD in the box.
- in the black command window, go to the directory where the program files are. for instance d: (enter) then cd \apps (enter)
- type check_cf and the drive letter for your CF card, for instance check_cf f
- Verify that check_cf reports media type FAT
- Check the amount of space reported on the last line of check_cf versus the chkdsk report higher on the screen and versus the card size.
- If no errors and Check_CF does not hang, card is OK to use.
- If CF check reports errors or hangs, send the card to Corsa for evaluation or throw it away.

Explanation of CF Check:

- consists of files cf_check.bat and cf_rw.exe
- Checks type of file system
- deletes files a*.ezd, *.old, *.zfg
- runs chkdsk
- Writes and reads a special pattern to the entire card to verify function.
- Leaves this special pattern on the card so that Corsa data blocks beyond the file pointers will be obvious. This will make retrieval of damaged files easier.

Example screen shot from good CF card:



```
C:\WINDOWS\system32\cmd.exe

C:\Apps>check_cf e
check_cf version 1.0
The drive e: doesn't exist.
If e is the correct drive letter, try again after the system
has had time to find the drive.

C:\Apps>check_cf e
check_cf version 1.0
About to run chkdsk on drive e:
If this step hangs, it means the compact flash is bad.
The type of the file system is FAT.
Volume BENDIXFF created 5/17/2006 2:07 PM
Volume Serial Number is 7CBF-A158
Windows is verifying files and folders...
File and folder verification is complete.
Windows has checked the file system and found no problems.

    512,180,224 bytes total disk space.
    199,622,656 bytes in 1 files.
    312,557,568 bytes available on disk.

        8,192 bytes in each allocation unit.
        62,522 total allocation units on disk.
        38,154 allocation units available on disk.

-
remove any *.EZD, *.ZFG or *.OLD files on the media.
-
About to test media by writing, verifying and deleting a large file.
this takes a few minutes on a healthy 512MB compact flash card.
At the end this will report the amount of usable memory or report
a read or write error.echo If it takes too long, the card is bad.
verified that 512180224 bytes could be written and read
C:\Apps>
```

Installation and Setup – Isaac Logger

Initial Setup of Logger

- Make sure software is installed on laptop and that the Isaac driver has also been installed.
- Connect to logger using USB cable and power on the logger
- Start the Isaac Analyzer software. If it is the first time it has been run on your computer, run the License Manager from the Help menu. Fill out using the information in the CD holder.
- From the Tools menu, select Communication Parameters and open the advanced window.
- Choose Test Connection, which should display the connected logger. Select Ok.

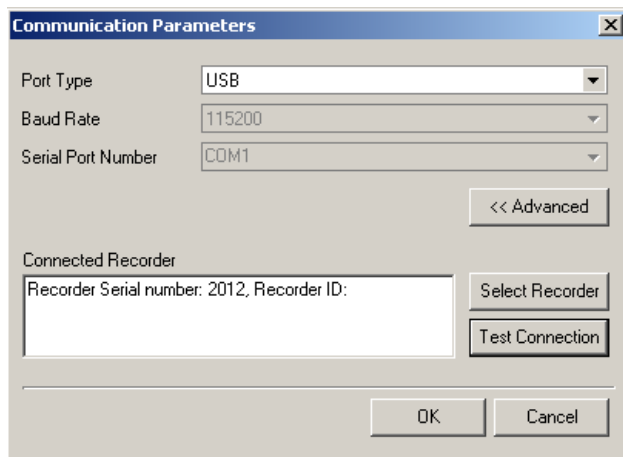


Image 4. Isaac Communications Parameters

Configuring Channels and Recording Conditions (Autostart)

- From the Tools menu, select Recording and data processing parameters

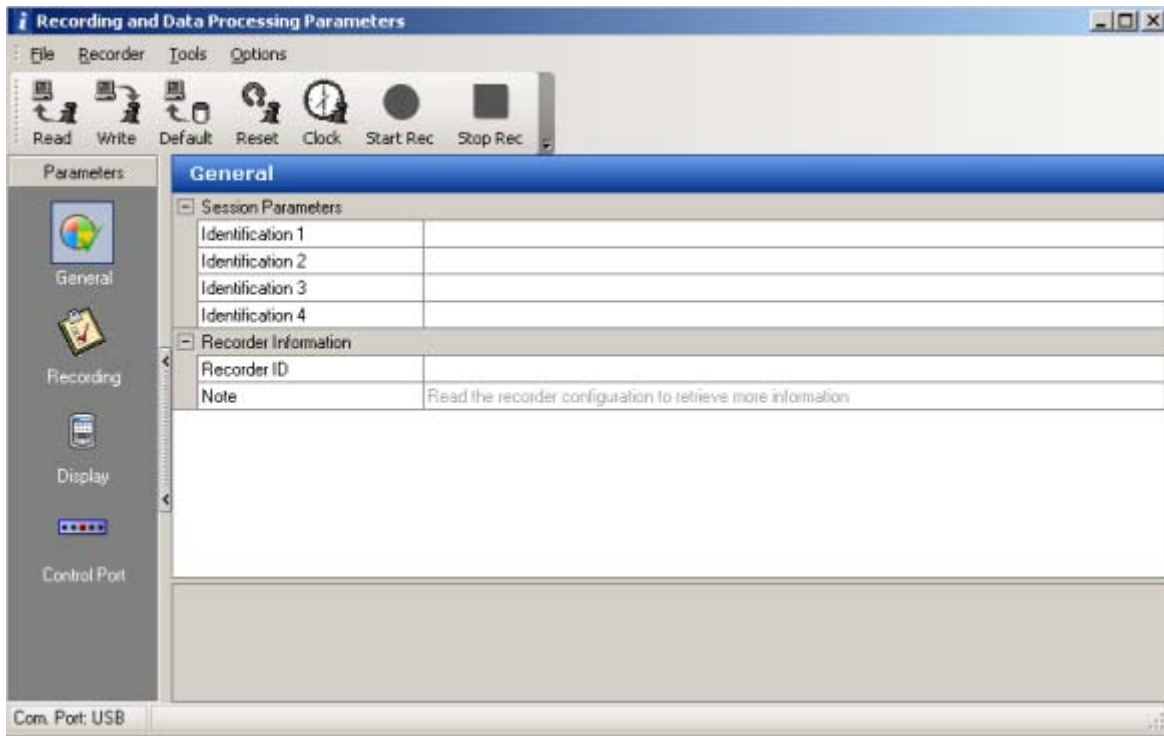


Image 5. Isaac Recording and Data Processing Parameters Window

- Select “Read” to read the current configuration from the logger
- The 4 buttons on the left of the screen indicate the parameters for recording and displaying data. Select General.
- The general parameters allow notes and labels and are primarily for organization.
- Select Recording Parameters.
- Set up the 2 RPM channels under Detectors including the names and pulses per revolution.
- The column to the right of Channel indicates whether a channel is recorded, and the column header is the number of samples per second. Be sure the 2 RPM signals and the voltage are checked and the column heading is 1 Hz
- The D column is for display options. Check the same rows as the sampling column.
- The RC column is for recording conditions. Clicking anywhere in this column brings up the recording conditions window.

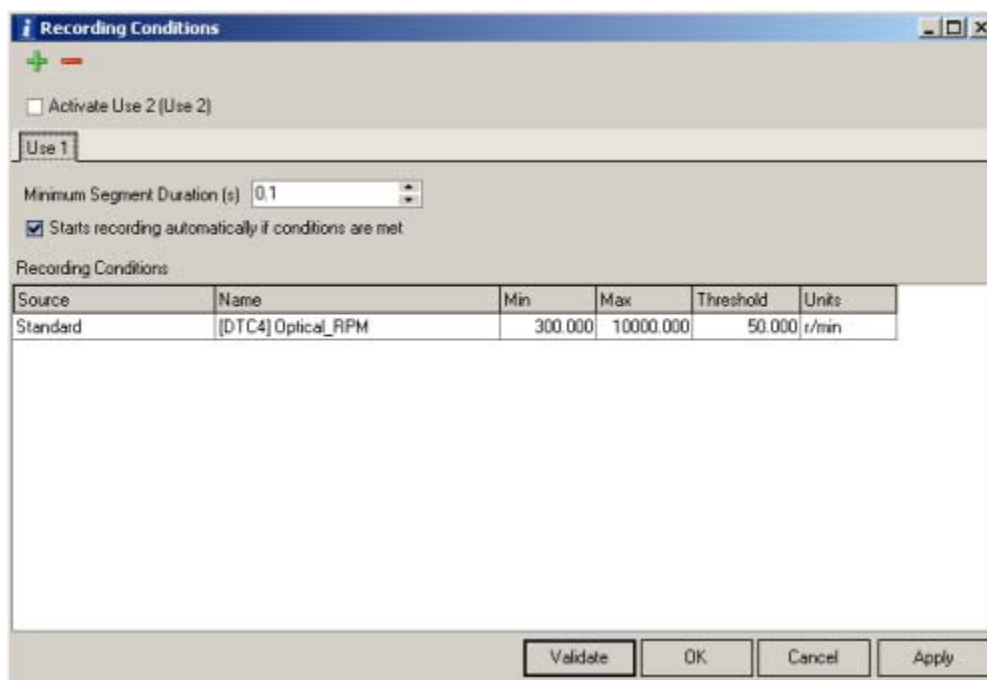


Image 6. Isaac Recording Conditions Window

- Make sure to check “Starts recording automatically if conditions are met.” Click the name of the channel to select the input used to start and stop recording. Enter the range of measured values within which recording is desired. The threshold refers to the deadband that prevents recording from cycling on and off near the ends of the range. Click Ok when the Recording Conditions are set up satisfactorily.
- If switched power is used to start recording, its input will need to be added under Detectors with the RPM signals.
- The Display parameter indicates how the information will be displayed by the Isaac software. The desired channels must be turned on and set to some type of meter type to be shown when monitoring signals.
- Save the configuration for the Recording and Data Processing Parameters from the file menu.
- Click Write to write the configuration to the Isaac recorder.

Recovering Data from Logger

- Make sure logger is powered and connect to computer. Start Isaac Analyzer software.
- From the File menu, choose New. Create a directory for download named with last four digits of establishment #, last four digits of Equip Serial #, and date in the format of “XXXX_XXXX_2007MMDD”. Name the file similarly and click Save.
- Look over the check boxes and then click the right arrow to begin the file transfer.
- Revisit Channels and recording parameters to verify that the logger is still configured properly. If any changes are needed, be sure to write them back to the logger.
- It is likely that the Red LED will be on to indicate that the system is stopped after data transfer. Either turn the box off and on or press reset from the Recording and Data Processing Parameters window to make the system ready to record again. Ensure the green or yellow LEDs are flashing, indicating that it is ready. A flashing yellow LED indicates that the memory is greater than 50% full.

- When back from the field, the data must be exported to a CSV file in order to be read by a program other than Isaac Analyzer V8. Select File, Export while the Data File window is open. Choose CSV file and select a filename and location.
- Note: If you encounter an error during file retrieval (or the associated data processing step), shut down and restart the Isaac datalogger and retry to download the file. Be sure to collect the raw datafile, even if a restart doesn't correct the processing error.
- **Always save all data before resetting the datalogger.**

Collecting CAN Data from Isaac DataLogger

Per “Jaques” at Isaac:

The big circle Deutsch connectors will give a indication whether it is 1708 or J1939. If you have 6 pins it is 1708, if you have 9 pins it can be either. But the triangle connector with the triangle center with the pin inside is J1939 and if you see that in the future it is a solid confirmation of J1939. He said we can use the triangle connector that fits our data logger connector. Now how to configure our config file for J1939 communication. Once you are connected to the logger click the tools Icon or go from the drop down menu and click recording and data processing parameters. Click the recording Icon, this will bring up your config file. Choose CAN1 from the channels column. In the CAN1 right hand window choose J1939 under the none drop down window. Under the messages column click the click here to add messages link. This will bring up a CAN message selection window. In this window there are 3 icons in the upper left hand corner. Click the one that isn't the plus or minus, it will be the Import DBC Database icon. This will bring up a open window. Select SAE_j1939 and open it. This will bring up a long list of message definitions. Your will need to add which definitions you think you will need to get a good RPM signal to the selected messages and click import. Now you will have the definitions under the CAN1 channel and you can set them to any special parameters you wish.

For additional guidance, please call Jaques at 450-658-7520.

Installation of CarDAQ-AVIT with DAWN Software

Setup of CarDAQ-AVIT

- Power up logger using either the DB25 (parallel) or the vehicle (J1939) connections
 - For the DB25, pins 22,23, and 25 are ground while pin 24 is +12V
- Using a crossover network cable, connect the AVIT to your computer
- Set up a network to autodetect network settings, then enable. The upper right LED above "Status" should light, along with the upper right LED on the Ethernet plug. You can also fix the address at 192.168.0.102.
- Start an internet program and find the address 192.168.0.101. This should bring up the logger web page.

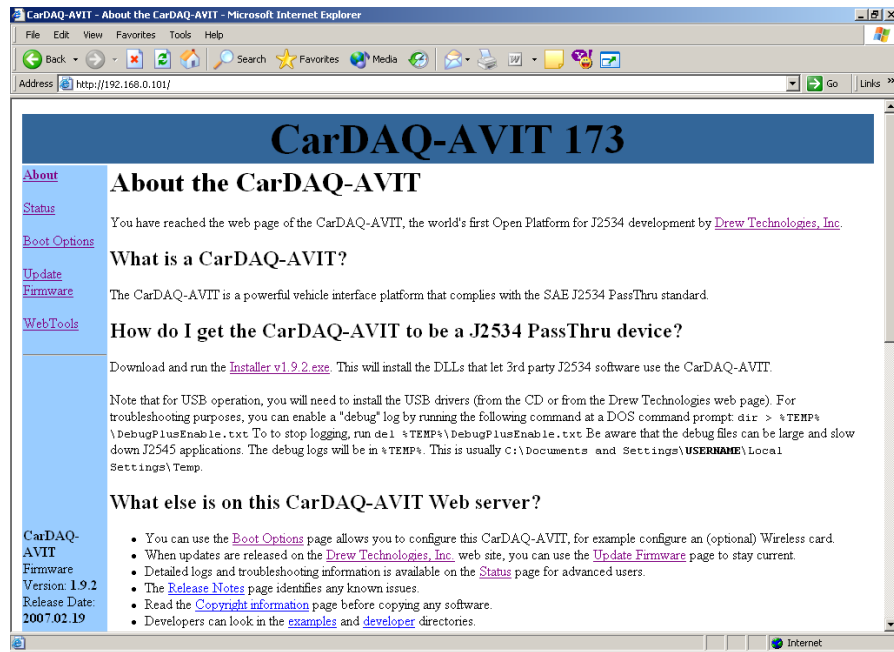


Image XX. The CarDAQ-AVIT web page

- Click and open the link for the Installer to get the AVIT to be a J2534 passthru device. Install the AVIT drivers. Some links require a username and password:
 - Username: root
 - Password: powerful
-