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Catalysts

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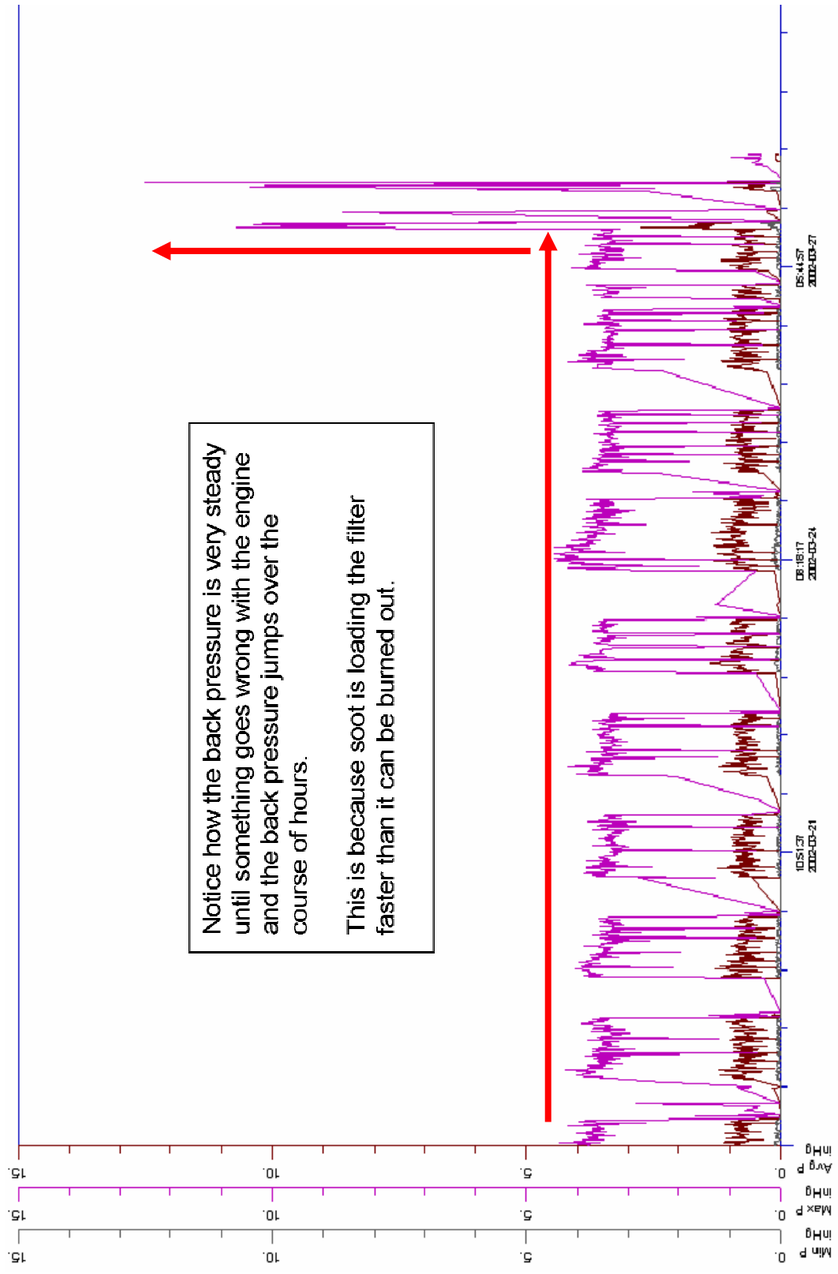
CRTdm
Communications Software Manual

Part Number: 977888

ENVIRONMENTAL CATALYSTS AND TECHNOLOGIES

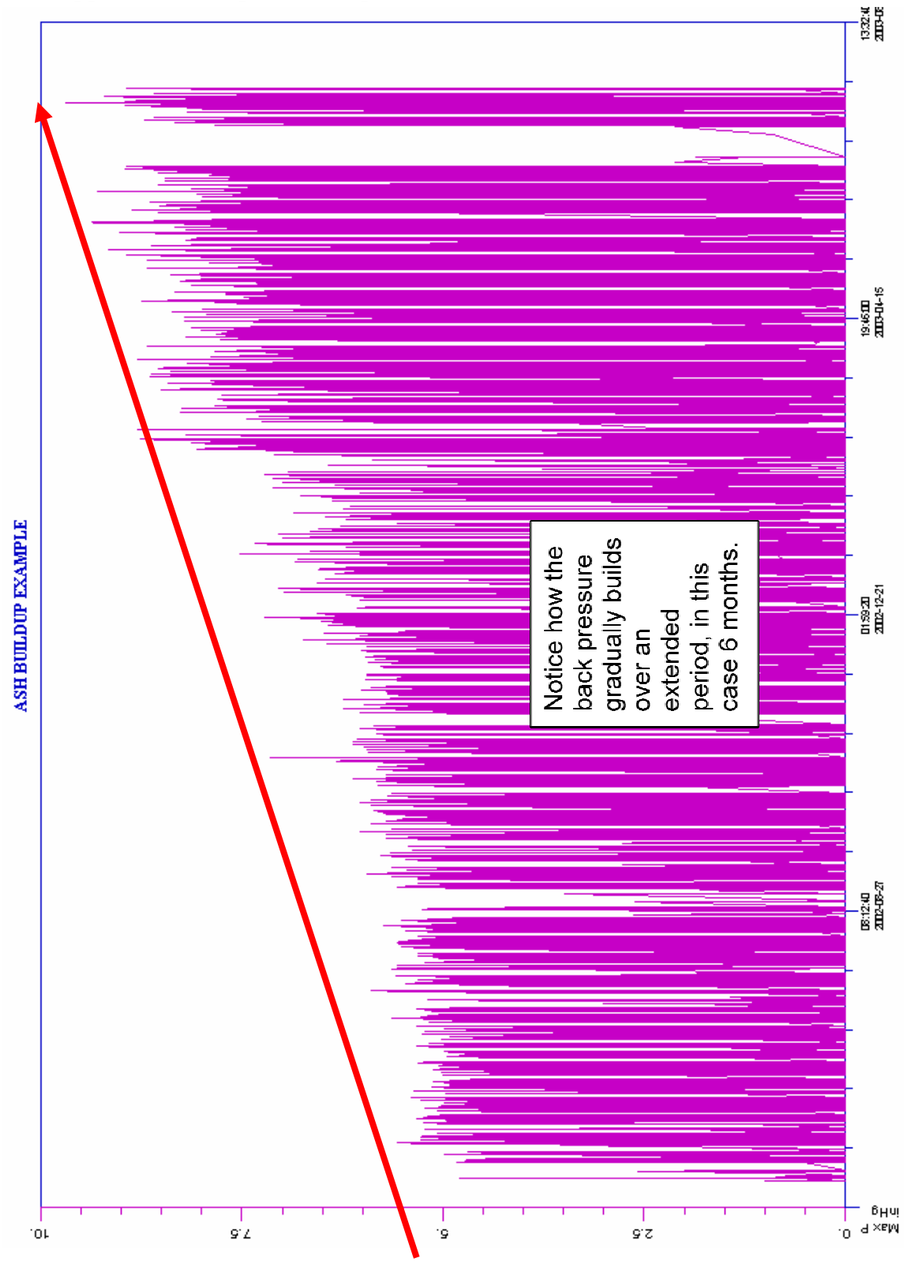
Revision Number:2

Appendix 2: Graphed Example of Engine Upset Causing High Back Pressure



CRTdm
Continuously Regenerating Technology (CRT®)
Diagnostic Module Interface Software Guide

Appendix 1: Graphed Example of Ash Accumulation in Filter Over Time



Note how the back pressure increases slowly, in this case 12 months. Ash accumulated in the filter since CRT installation and the filter required ash cleaning. The CRTdm lit the Check Engine light and eventually derated the engine. The operator initially ignored the Check Engine light, and as the back pressure increased, the CRTdm derated the engine. The filer was cleaned and reinstalled.

Notes

Introduction and Overview

The Continuously Regenerative Technology Diagnostic Module (CRTdm) is a diagnostic and alarming device designed to monitor installed Johnson Matthey CRT®'s. The CRTdm provides critical information to the vehicle operator and maintenance staff relative to operating performance of the installed CRT device.

System

The CRTdm monitors exhaust temperature and pressure with the ability to control alarm outputs based upon specific user defined parameters in order to warn the CRT user of potential exhaust system problem. The CRTdm is equipped with integral non-volatile memory and is capable of logging (recording) one or two temperature inputs, exhaust back pressure and alarm event data during operation of the vehicle. Data can be logged over time then downloaded via a serial link to a PC running the CRTdm Communications software for further analysis. The CRTdm contains alarm outputs which can be interfaced to remote displays and/or the vehicle ECM to activate driver warnings.

CRTdm Module

The CRTdm is ruggedly packaged, able to accommodate a wide temperature range, and designed for retrofit into buses, trucks, and other industrial vehicles.

Temperature Inputs: The CRTdm can record two different temperature inputs[1], and provides alarm capabilities for both channels. Temperature is sensed by Type K thermocouples.

Pressure Input: Pressure is sensed by a replaceable internal pressure sensor and transmitted via a ¼" copper tube included in the CRTdm Installation Kit. Other methods are available to transmit pressure. Check with your distributor for others options.

Alarm Output: The CRTdm is equipped two separate alarm outputs and up to 8 different alarms. Both alarms drive a ground signal. Alarm output 1 is a transistorized open collector output. Output 2 is a normally open relay output that closes providing ground when an alarm condition is met or when the CRTdm loses power.

CRTdm Communications Software

The CRTdm software is a simple single screen program that operates under Windows 95, 98, 2000, NT, and XP. Once installed the program allows for CRTdm communication, alarm program setup, data downloading, alarm diagnosis, and conditioning of the data from its raw form to a text form that can be imported into Microsoft Excel or other spreadsheet programs.

The raw data can be viewed in graph form through the Launch Plotter function or can be converted into text through the Create All Reports function.

The software enables you to properly diagnose CRTdm alarms, monitor the state of your CRT/CCRT and the health of your engine. The key is to understand and interpret the data the CRTdm records. This data is very valuable because it allows you see an operational trend over an extended period of time, sometimes up to 2 years[2] or more! This trend allows you to diagnose if an engine related problem is causing the CRTdm to alarm or if normal periodic maintenance is required.

[1] If configured. Generation 1 and 2 CRTdms can monitor one channel. Generation 3 CRTdms can record two channels.

[2] Length of time is determined by how many hours/day your vehicle runs and by the data acquisition rate programmed by the user.

Software Setup and Operation

Install

To install the Windows CRTdm software insert the program disk in the CD drive. The software will self install, however if it doesn't, browse for the setup.exe program through the Windows Start-Run Menu and execute. Follow the on-screen directions.

Data and Folder Location

The program will create a folder on your C drive called **Logic Beach.** It will also create a file inside the Logic Beach folder called **CRTdm Communications** (C:/Logic Beach/CRTdm Communications). All data and alarm programs you create will be stored in the CRTdm Communications folder unless you direct otherwise. The **Launch Plotter** function and **Create All Reports** functions are linked to the CRTdm Communications folder to make data analysis and viewing easier.

CRTdm Installation

Please review the CRTdm installation manuals for proper installation instructions, mechanical connections, and electrical connections. The installation manuals also have spare part numbers as well as instructions for replacing various parts and cleaning the CRT/CCRT filter manually using compressed air.

Note: The CRTdm helps to diagnose when a CRT/CCRT requires maintenance. Please review the filter maintenance procedures in the CRT/CCRT installation manuals. In addition, your distributor may offer a cleaning program. Please consult with your distributor regarding filter cleaning.

Generations 1 and 2 vs. Generation 3 CRTdms

This software is compatible with all versions of the CRTdm. However, certain features are only available with the Generation 3 CRTdm. The most obvious difference between Generation 3 and previous generations of the CRTdm are the number of pigtails exiting from the enclosure.

Generations 1 and 2 have two pigtails exiting the enclosure gland fittings and an additional unused third gland fitting (figure 1). *Note: Generation 1 CRTdms have only two gland fittings.*

Generation 3 CRTdms have three pigtails exiting from the gland fittings (figure 2). In addition, Generation 3 is printed on the front of the CRTdm below "**CRTdm"** in white script.

Figure 1: Generations 1 and 2 CRTdm

Figure 2: Generation 3 CRTdm

Problem	Possible Cause	Possible Solution
"Bad Character Echo" Error Received During A Firmware Upgrade	Trying to flash firmware to a CRTdm using CRTdm Communications Software version 1.35 and earlier.	On the top toolbar click on Help/About CRTdm. A window will open with the CRTdm version number. If you are running Version 1.35 and earlier you need the latest software. ***DO NOT ATTEMPT TO UPGRADE ANYMORE CRTdms UNTIL YOUR SOFTWARE IS UPGRADED TO VERSION 1.36 OR LATER.***
	Communications speed to fast between the CRTdm and PC.	Slow down the communications speed between the CRTdm and PC (Page 15). Your CRTdm must be returned to Johnson Matthey for upgrade and repair. It is not operating in it's current state.

Contact Information

For further information on installation, operation or troubleshooting of your CRT / CRTdm or for other products you may require to meet emission regulations contact your distributor or:

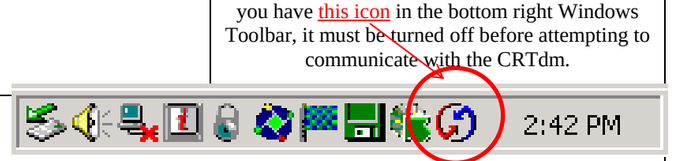
JM
Johnson Matthey
Catalysts

380 Lapp Road
Malvern, PA 19355
1-800-RX for Air
(1-800-793-6724)

Troubleshooting CRTdm Communications Problems

If you encounter problems connecting to the CRTdm or communicating with the CRTdm, check Table 3 for possible causes and solutions.

Table 3: Communications Troubleshooting

Problem	Possible Cause	Possible Solution
Cannot Connect To CRTdm	Cable not connected properly to CRTdm or PC	Check cable connection at PC and CRTdm
	CRTdm not powered up.	Check to see if the Green System Status LED is flashing on the front of the CRTdm. If the LED is not flashing consult Page 26 for possible problems and solutions.
	Com port settings	Verify the com port is set properly for your PC in the Options/Settings tab (page 16).
	Another application has latched on to the com port.	Do you have a Palm handheld assistant? Palm software latches onto the com port and won't allow other applications to use the com port. If you have this icon in the bottom right Windows Toolbar, it must be turned off before attempting to communicate with the CRTdm. 
Communications error while downloading data from the CRTdm	Communications speed to fast between the CRTdm and PC.	In the Options/Settings screen (page 15), slow the communications speed between the CRTdm and CRT.

Connection to Computer

Use the supplied cable to connect your computer to the CRTdm. The round connector is indexed so there is only one way that it can fit on the front of the CRTdm. The other connector will plug into the RS-232 port on your computer.

> **Note:** Some newer laptops are not equipped with RS-232 serial ports. In this case, you will need to purchase a USB to serial adapter from an electronics or computer store.

Once the cable is connected to the CRTdm and your computer you can access information within the CRTdm by launching the CRTdm Communication Software. Double click the "Shortcut to CRTdm" (Figure 1) icon on your desktop. After the program is launched click on the **Connect** button to establish communications with the CRTdm.

Figure 1: Shortcut to CRTdm

Software Overview

The CRTdm communications software is used for programming the alarms and data logging options, as well as checking system status and viewing data in real-time. The software is a simple communications program visible from a single self- explanatory window. All options are available to the user with only a few mouse clicks.

Figure 2 is a screen shot of the CRTdm program. The left side of the screen accesses communications, real-time viewing, plotter and the reports functions. The right side of the screen is for programming of the alarms and the data logger function of the CRTdm.

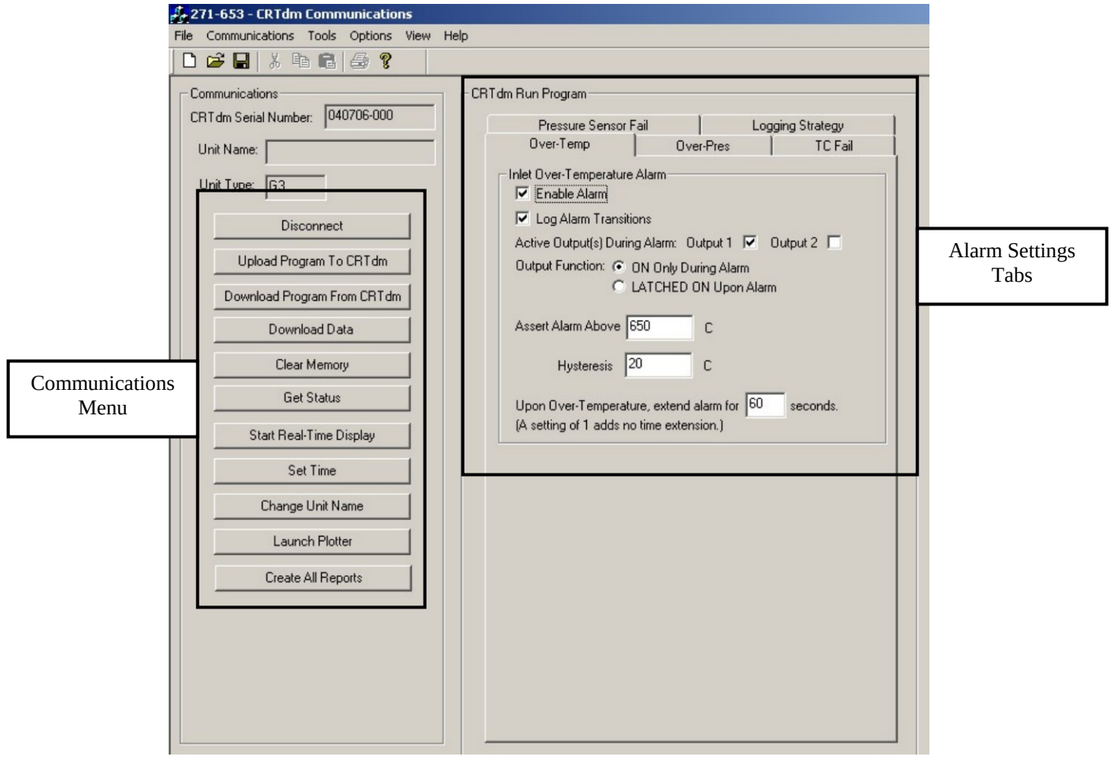


Figure 4: Opening Screen shot

The CRTdm comes pre-programmed from Johnson Matthey; however these settings may not be optimized for your vehicle. Please check with your distributor for the optimal settings for your vehicle(s). You can also create your own alarm settings by typing values into the different alarm tabs.

Note: Do not exceed the engine manufacturer's maximum allowable back pressure and exhaust temperature limits. Exceeding these limits may void your engine warranty and will void the CRT/CCRT warranty. Check with your distributor regarding the engines back pressure and temperature limits.

"True" Alarm	Possible Cause	Possible Solution
Shorted Thermocouple Alarm	Temperature Does Not Change Or Changes Very Little	Thermocouple wiring is broken or shorted or the thermocouple tip has broken off. Replace the thermocouple.
	Incorrect Alarm Settings For Your Application	Verify Alarm settings are correct for your application. Contact your distributor.
Open Thermocouple Alarm	Temperature Reads Over 1000C	The thermocouple probe has broken. Replace the thermocouple.
No Change In Pressure Alarm	The Back Pressure Is Not Changing Enough During Normal Operation	Check the Copper tubing for holes or leaks from the CRT back to the CRTdm. Check to make sure the fitting at the CRT and the CRTdm are tight and that the copper tubing has not broken. Clean out any blockages or water in the tubing that connects the CRTdm to the CRT. Check all exhaust pipes for leaks.
	The No Change In Pressure Alarm Settings Need Adjustment	Adjust settings for the No Change in Pressure Alarm if the tubing is not broken or blocked and the fittings are tight. Contact your distributor before making changes to these alarm settings.
Negative Pressure Alarm	Excessive Negative Pressure Readings	The pressure sensor may need to be re-calibrated. Contact your distributor to have the CRTdm recalibrated. Adjust settings for the alarm. Contact your distributor. Water may be condensing in the tubing. Clear the tubing. If problem persists, reroute tubing so water flows back to CRT.

NOTE: If either the ADC Calibration or Memory Error System State Flags are TRUE in the Get Status screen contact your distributor immediately. The CRTdm must be returned to Johnson Matthey for analysis.

"True" Alarm	Possible Cause	Possible Solution
Over Pressure Warning	Ash Accumulation	Graph the max pressure data and look at the peaks of the graph. If the back pressure gradually increased over a period of weeks or months (Appendix 1, page 35) then the filter needs to be cleaned of ash. Consult your filter cleaning procedure for instructions on cleaning ash or contact your distributor for a Filter Cleaning Service. **Note: If this alarm occurs more than twice during a two (2) month period, there may be something wrong with the engine (engine upset making too much soot or high oil consumption creating excessive ash) or the exhaust temperature may be to cold for complete CRT regeneration. Contact your distributor.**
Over Pressure Alarm	Soot or Ash Accumulation	This is a high level alarm. Download and graph the Max Pressure data. If the back pressure increased gradually over an extended period of time (weeks or months) ash has accumulated in the filter and requires cleaning immediately. If the back pressure increased rapidly (hours or days, appendix 2, page 36) the filter is plugging with soot and requires cleaning immediately. **In this case the engine must be diagnosed for potential component failure before the filter is reinstalled (i.e. turbo failure/oil leak, injector leaks or failure, fuel pump failure, injection timing etc).** If the engine checks out OK, then the exhaust temperature must be analyzed. Forward data file to your distributor for analysis.

Once the program is uploaded to the CRTdm it resides in memory and executes until replaced. An internal lithium battery protects the program and data from loss should a vehicle power failure occur.

Note: All CRTdms are pre-programmed and ready to install. Your engine manufacturer may have other recommended alarm programs for your engine/vehicle. Please check with your distributor for additional programs.

Alarm programs are created by entering values into the CRTdm Alarm Program tabs. The CRTdm has up to 8 different alarms. They are:

1. **Over Temperature:** Generation 1and 2 CRTdms have one Over Temperature alarm. Generation 3 CRTdms can be configured for two Over Temperature Alarms. These alarms typically drive a Check Engine light or a yellow indicator on a remote display. In Generation 3 2 TC mode, the alarms are labeled:
    a. Inlet Over Temperature Alarm
    b. Outlet Over Temperature Alarm
2. **Over Pressure:** All CRTdms have two over pressure alarms.
    a. Over Pressure Warning: This alarm alerts the user that filter back pressure has reached the point requiring filter cleaning and typically drives a Check Engine Lamp or yellow indicator on a remote display.
    b. Over Pressure Alarm: This alarm alerts the user that the back pressure is exceeding the engine limits and indicates immediate filter maintenance is required. This alarm typically drives an engine derate function/check engine lamp and/or a Red indicator lamp on a remote display.
3. **Thermocouple Failure Alarms (TC Fail)**: There are two thermocouple failure alarms. These alarms typically drive a Check Engine lamp or yellow lamp on a remote display.
    a. Open Thermocouple Detect: Detects when a thermocouple probe breaks or becomes disconnected from the CRTdm.
    b. Shorted Thermocouple Detect: Detects when a thermocouple becomes unresponsive due to age or shorted wiring.
4. **Pressure Sensor Fail Alarms:** There are two alarms that monitor the condition of the pressure sensor. These alarms typically drive a Check Engine light or yellow lamp on a remote display.
    a. No Change Alarm: Monitors if a pressure sensor becomes unresponsive due to age, broken pressure tubing, or water in the pressure tubing.
    b. Negative Pressure: Monitors pressure sensor calibration and if water condenses in the pressure tubing.
5. **Logging Strategy:** This tab determines when the CRTdm will start logging data, how it stores the logged data, and how often it samples the collected data.

Single Thermocouple CRTdm Data Collection

The CRTdm collects data every second. Exhaust temperature triggers when the CRTdm starts to save data. If the exhaust temperature is above the "Logging Threshold" value in the Logging Strategy tab, the CRTdm will save a back pressure and temperature data point to a buffered portion of the memory every second. At a certain time interval determined by the "Record Interval" the CRTdm reviews the buffered memory and saves:

1. The minimum temperature in the buffered memory
2. The minimum pressure in the buffered memory
3. The maximum temperature in the buffered memory
4. The maximum pressure in the buffered memory

It then computes a simple average of ALL the pressure and temperature data points in the buffered memory. After computing the averages it adds these two points to the Min/Max mentioned above, date/time stamps the data point and records all 6 points to semi-permanent memory. This data can only be erased if Clear Memory, Upload Program, Change Date/Time, or Flash Program commands are initiated. An example of the logged data in text format is seen in Figure 5.

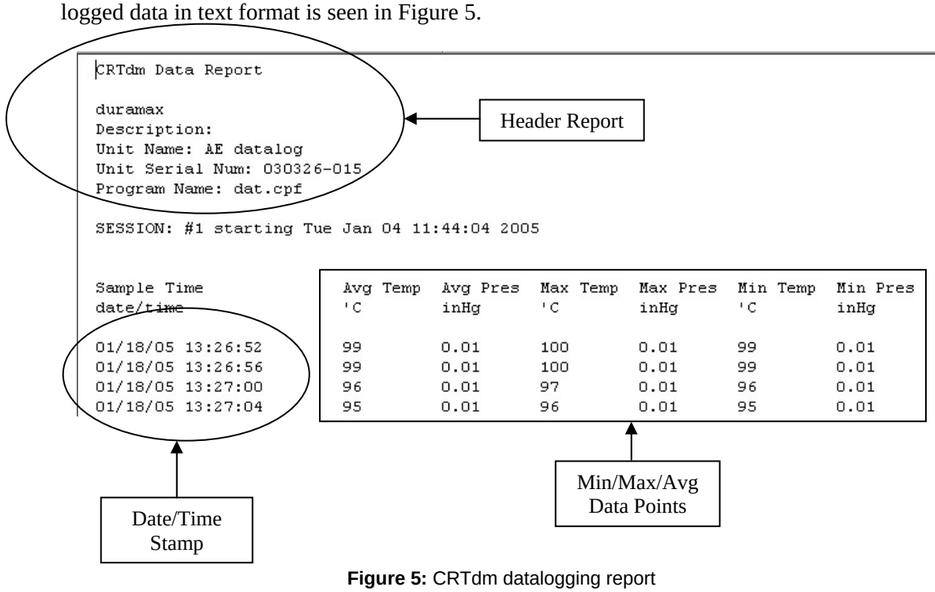


Figure 5: CRTdm datalogging report

Dual Thermocouple Data Collection

The 3rd Generation CRTdm has the ability to record two temperature inputs. The first input should always be at the Inlet of the CRT. The second typically is at the Outlet of the CRT, however it can be used in any way required. It records data in the same way as the single thermocouple above with one exception; it substitutes the minimum pressure and temperature with Outlet Average Temperature and Outlet Maximum Temperature.

Table 2: Alarm Diagnosis Chart

"True" Alarm	Possible Cause	Possible Solution
Over-Temp Alarm	Damaged Thermocouple *(If accompanied by an Open Thermocouple Alarm)*	Remove the thermocouple from the CRT for inspection. If the thermocouple is broken the thermocouple must be replaced. If the thermocouple probe is not broken, inspect the thermocouple wire back to the CRTdm. Make sure the insulation is not melted by touching an exhaust pipe. Ensure the thermocouple is plugged in at the CRTdm.
	Unplugged thermocouple	
	Engine Upset Condition	Plot the Max temperature data (See Hyperplot Graphic Display section, Page 29) and note how often the exhaust temperature exceeded the alarm threshold. Check the Alarm Threshold by downloading the program from the CRTdm and noting the temperature at which the alarm is enabled. If the graph has a noticeable spike where the alarm threshold was exceeded only once then there may have been an engine upset condition that needs to be investigated.
	Engine Upset Condition *(If Over-Temp Alarm is accompanied by Over Pressure Warning or Over Pressure Alarm)*	The filter may have experienced an uncontrolled regeneration. Remove the filter and inspect the outlet face of the filter. If more than 20 cells show soot on the outlet (clean) side of the filter then the filter needs to be replaced. ***Check Engine Operation before installing a new filter. This is a sign that the engine is producing to much soot. Ensure that all fuel related components are operating per manufacturer's specification.***
	Incorrect Alarm Setting	If the graph shows that the Max. Temperature was consistently exceeding the alarm threshold then the alarm threshold may be set to low for your application. Note the highest temperatures that exceeded the alarm setting and contact your distributor to get a new setting.

Troubleshooting CRTdm Alarms

Indications of a CRTdm related alarm:

- Check/Stop Engine light or engine derate (if CRTdm is interfaced with the engine ECM).
- Yellow or Red light on a remote display.
- One or more of the three red LEDs on the front of the CRTdm is illuminated.

When one of the above occurs:

- Connect the CRTdm interface cable from a laptop computer to the front of the CRTdm.
- Start the CRTdm Communications Software.
- From the Communications menu Choose ***Connect***.
- Click on the ***Get Status*** button.

The ***Status*** dialog box will open (Figure 33). In the lower left portion (Alarm History Flags) of the dialog box there is a list of the alarm flags. If the box next to a given alarm reads "True" that alarm was activated. The lower right side shows System State Flags. If ADC Calibration Error or Memory Error flags are "True", contact your distributor for a replacement CRTdm.

Table 2 shows possible causes of alarms and possible solutions.

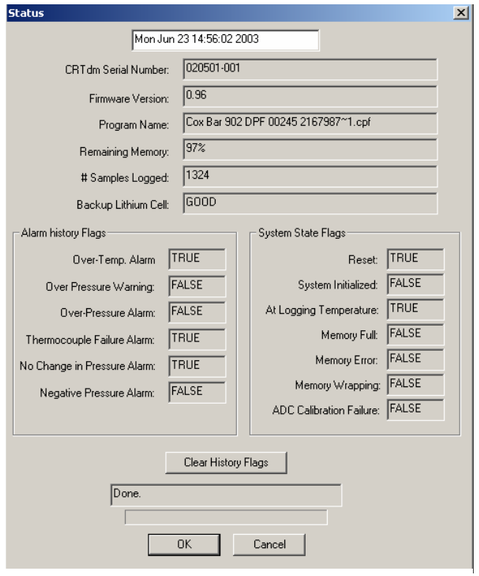


Figure 33: Get Status screen

Communications Menu

The communication menu allows you to communicate with the CRTdm. Simple single button access initiates each function. See Figure 6.

The plotting program and create all reports function are also accessible through this menu.

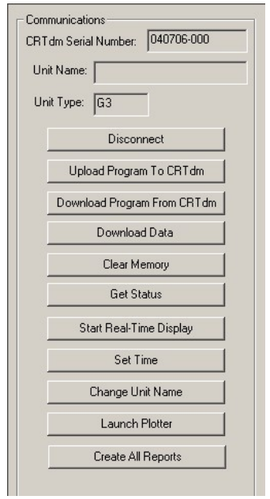


Figure 6: Comm Menu

CRTdm Serial Number

Each CRTdm contains an electronic serial number embedded into the firmware. This serial number will automatically appear when a communications link is established with the CRTdm. The serial number cannot be changed.

Unit Name

The "Unit Name" is displayed when communications is established. Use this name to help further identify the module. This field is not mandatory. To change the unit name click on the button *Change Unit Name*.

Unit Type

The "Unit Type" refers to the Generation of CRTdm. This will be either G2 or G3. G2 has only one temperature input. G3 has two temperature inputs.

Disconnect/Connect

Click on *Connect/Disconnect* to initiate or terminate the communications procedure between the PC and the CRTdm. Once connected, the button will change to disconnect. Programming, data transfer, and other communication tasks may now be accomplished. Always press the disconnect button before disconnecting the cable from either the CRTdm or computer.

> **Note:** If unable to establish communications, please refer to Page 36, Troubleshooting CRTdm Communications Problems.

Upload and Download Programs

Alarm Programs are viewed in the *CRTdm Run Program* area. Once a CRTdm program has been developed you may upload the new program to the CRTdm by pressing the *Upload Program to CRTdm* button. Uploading programs to the CRTdm overwrites the current program and clears any data stored in the CRTdm memory.

> **Note:** Download data from the CRTdm before uploading a new CRTdm Alarm Program. Failure to do so will erase all stored data permanently.

Pressing the *Download Program from CRTdm* button will download the current alarm program from the CRTdm and display the alarm parameters in the *CRTdm Run Program* area. This alarm program remains in memory until it is changed and a new program is uploaded.

Download Data

This will download the memory from the CRTdm to the PC. You will be requested to enter a file name for the data (Figure 7). Suggested file names include the vehicle number followed by the date (ie: 1234_61603). Please note that dots (.), dashes (-), number sign (#), and sign (&), percentage sign (%) are not allowed in the file name.

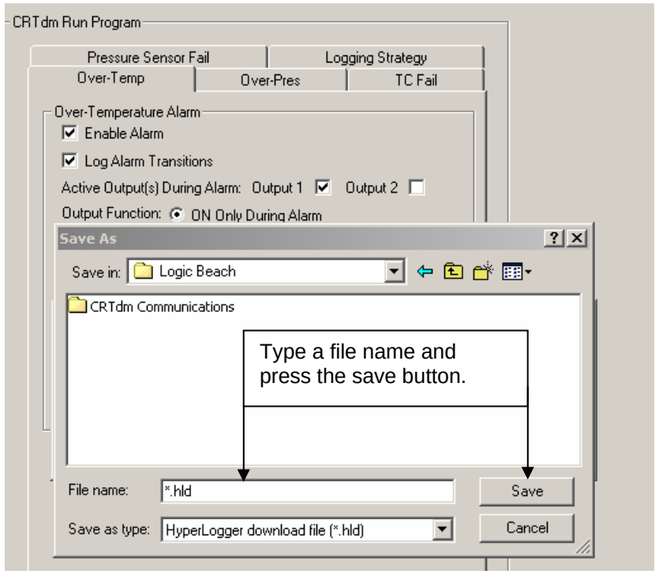


Figure 7: Naming Downloaded Data

After naming the file, you will be prompted to enter a title for the graph that is created (Figure 8). You can enter any characters and name the graph anything you would like. Typically, the graph is titled with the vehicle number, date, and any other information you would like to be reminded of at a later date.

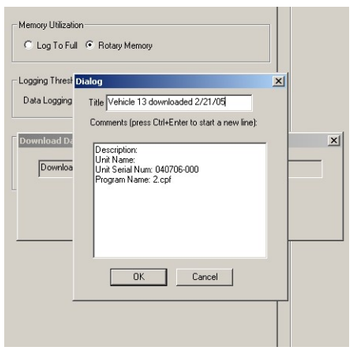


Figure 8: Title Block

The data file is stored in an *.HLD file which is a propriety file type used with this software. *.HLD files may be viewed by pressing the Launch Plotter button or converted to text by running the Create All Reports function. Text files may be imported into a spreadsheet program such as Excel.

Operation And Troubleshooting

Operation

Once the CRTdm has been programmed and is running no other operations are required. The Four operational lights need to be monitored for routine maintenance. See Table 1 below for LED information.

Table 1

Status LEDs and information	
System Status	Will blink ON every 2 seconds indicating normal operation and program is running
Over-Pressure Alarm	ON with over-pressure alarm
Over-Temperature Alarm	ON with over-temperature alarm
System Problem	ON with a System Problem such as a Thermocouple or Pressure sensor failure

The Green System Status LED will blink every two seconds indicating that the CRTdm is powered up and operating normally. If this LED is not on or is not blinking, check the following:

- Make sure the power supply is between 10 and 30Vdc.
- Make sure the fuse is not blown
- Make sure the power supply is connected correctly (ie: wires are not crossed at/from the source).
- If the power supply is a switched source (meaning power is supplied only when the vehicle ignition key is turned on), make sure the key is turned on.
- If the vehicle is equipped with a Master Battery Disconnect switch, make sure the switch is on.
- If the CRTdm is receiving the proper uninterrupted power supply, it may be malfunctioning. Contact your distributor or Johnson Matthey for details.

If the Red Over-Temp, Over-Press, or System Problem LED(s) are on, please refer to the trouble shooting section (Page 32).

To return to the Auto-scaling mode, merely click on the Auto checkbox and the range will automatically be rescaled to fit the screen.

Units
The individual data channel units from the Download file are listed. The units are preassigned.

Help
The Help menu provides access to the Help information through the standard Windows techniques.

Plotting Large Files with HyperPlot

If a Download file contains a channel with greater than 20,000 samples, the plot must be broken into two or more pages for plotting. If a file of this size is plotted, an information dialog box will display asking if the User wants to advance to the next page before plotting.

When a page of data (beyond the first page) is selected for plotting, the X-axis will display the time from the start of the file, however data will only be plotted in the right half of the screen. Plotted data can then be expanded to full screen using the conventional Zooming method.

Integrating HyperPlots into other Software Applications

Via Bitmap Files
Through the *File/Save File as Bitmap* menu choice (explained previously) HyperPlots can be saved to a bitmap file format (*.BMP) which can then be utilized in a multitude of other Windows applications.

From within other applications, menu commands are available that allow User's to specify a location and the bitmap file to be integrated. For example, from within Microsoft's Word for Windows, using the Insert Frame and insert Picture commands results in a seamless integration of the plot into a document. Other applications have similar procedures for integrating plots.

HyperPlot bitmap files can also be annotated and/or edited further from within graphic editing applications such as Windows Paintbrush.

Via the Windows Clipboard
For quick and simple integration of plots into other applications, the plot can be captured to the Windows clipboard, then pasted into another document. To perform this procedure, display the plot on the screen, then save the screen to the clipboard by pressing <ALT> and <Print Screen>. Change to the other application and utilize the Paste command to integrate it into the document.

Clear Memory

This will erase any data residing in the CRTdm, but does not affect the Alarm program settings. This command can also be password protected.

> **Note:** Download any data from the CRTdm before clearing memory because when Clear Memory is pressed, it will erase all data permanently.

Get Status

This will retrieve CRTdm status, error, and alarm information stored in the CRTdm. This shows CRTdm alarm history, system operation, and basic information (alarm file name, firmware version, remaining memory, and state of the backup battery). If an Alarm is set, it will remain "True" until the *Clear History Flags* button is pressed, ***even if the alarm is not currently active***. (Figure 9).

> **Note: This window is extremely useful when diagnosing CRTdm alarms. This is covered further in the Troubleshooting section.**

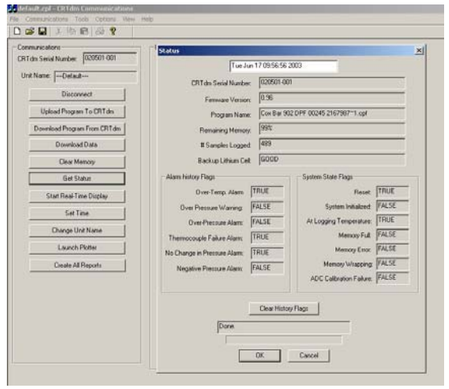


Figure 9: Get Status Screen

Start Real-Time Display

After a communication link is established this button opens a pop-up window that displays second by second data and alarm states from the CRTdm. Data will be updated at the rate of once per second while CRTdm is running a Run Program. This window displays actual pressure and temperature readings and all current alarms (Figure 10).

This is also a very useful tool when diagnosing CRTdm alarms. Real Time Display uses are covered further in the Troubleshooting section.

> **Note: This window shows if an alarm is currently active only. See Get Status for past alarms.**

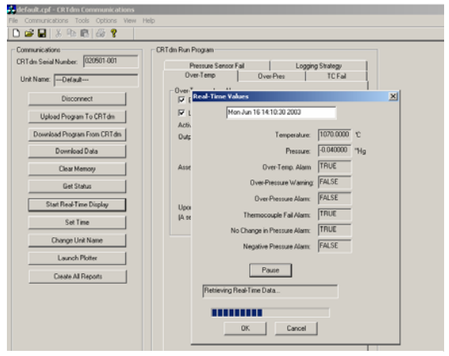


Figure 10: Start Real Time Display Screen

Set CRTdm Time

The on-board real-time clock is set here. You can set the clock to your PC's time or to a user defined time (Figure 11).

You can set to your PC time or set to any other time you require.

This function can be password protected.

Note: Resetting the clock will erase any data stored in the CRTdm. Download any data you would like to save before resetting the clock.

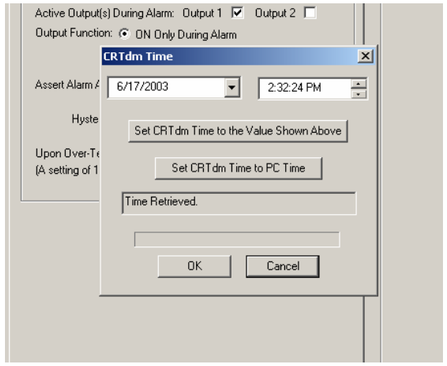


Figure 11: Set Time Screen

Change Unit Name

You may assign a name to each CRTdm. Press the *Change Unit Name* button on the Communications menu and enter up to 15 characters in the New Unit Name box. Press the apply button (Figure 12).

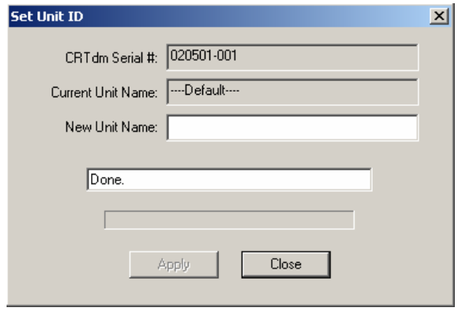


Figure 12: Change Unit Name Screen

Launch Plotter

The CRTdm Communications program includes a Plotting program, HyperPlot™, which displays the graphic plot of downloaded data. The Plotting software is a simple, yet powerful plotting program launched directly from the Communications screen by pressing the *Launch Plotter* button (Figure 13).

Please see the section titled Hyperplot for complete details.

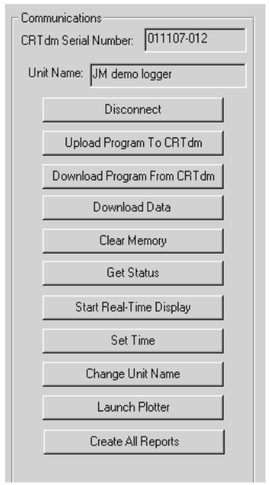


Figure 13: Communications

Time Interval

Using the provided **Time Interval** text box, the time base (essentially a manual time base zoom function) can be manually specified. The entered value in units (approximate) will be used for the time window displayed in a single view. For example, if the value is entered as 60, the HyperPlot view will be time zoomed to display approximately 60 units (seconds, hours, etc) in a single full screen view.

Time Shift

Individual channel plots can be shifted in time from milliseconds to days. Following the example format, in a Channel's text box, enter in the time to shift that plot.

The **Time Shift** capability can be very convenient for time registering (aligning) plots of data within a *Before / After* Merged file for easy graphic comparison.

Y-Axis

The Y-Axis dialog provides User control over grids, scaling and symbols used during the plotting of data. See Figure 32. Descriptions of User selectable options follow:

Channel Name

The individual data channel names from the Download file are listed. The names are fixed within the CRTdm.

Display Channel

Checking a data channel's checkbox results in that channel being plotted.

Display Grid

A row of radio buttons specifies to which channel's Y-axis the horizontal grid should be connected.

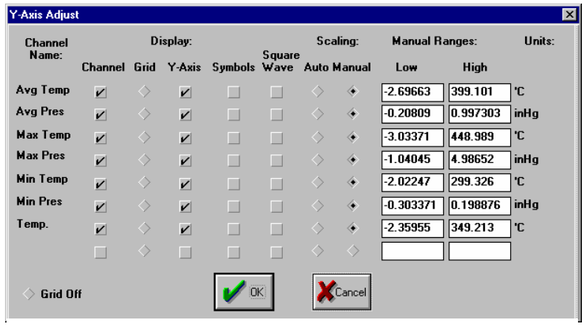


Figure 32: Y-Axis Configuration

Display Y-Axis

Checking a data channel's Y-Axis checkbox results in that channels Y-Axis being displayed. In many plots, it may only be necessary to display a single Y-axis if the scaling is the same for all channels. For example if four channels of temperature data are being plotted and they all are scaled from 0 to 100F, only a single Y-Axis is required, allowing more area for data display.

Display Symbols

Check boxes are provided for the enabling of symbols for each displayed channel.

Scaling Auto / Manual

When a Download file is first plotted, all channels are autoscaled to fit on the screen. This auto-scaling feature can be disabled by the User and a manual range specified by clicking the Manual checkbox and entering a High and Low limit in the **Manual Ranges** text boxes. (As a short-cut, editing of the Manual Range text boxes automatically switches the Auto / Manual checkbox to Manual).

Calculations

Zoom All

Returns the view to show all of the data file.

Zoom Last

Returns the view to show the last level of zoom.

Cursor

Brings a vertical cursor onto the view. The cursor shows on the left edge of the screen with a small triangle displaying just above the time axis. The cursor can be moved by locating the mouse cursor over the vertical line (the cursor will change to a double-ended arrow) then clicking the left mouse button and dragging the cursor left and right.

At the right edge of the view, the time and channel values intersected by the cursor will be displayed.

> *NOTE: When zoomed into a sufficient level that individual data points can be discerned on the screen, the cursor will appear to hop from data point to data point.*

Analyze View

Analyze View provides a quick display of the average, minimum value, maximum value, and the time integral for each data channel for the currently displayed view. This dialog can be copied to the Windows clipboard (hit <alt> P while the dialog is displayed) and then pasted into another application.

Options

X-Axis

The Time (X-Axis) axis can be displayed in a number of different formats at the User's discretion. Selecting the *X-Axis* menu results in a dialog box allowing for User specification of the following options. (See Figure 31).

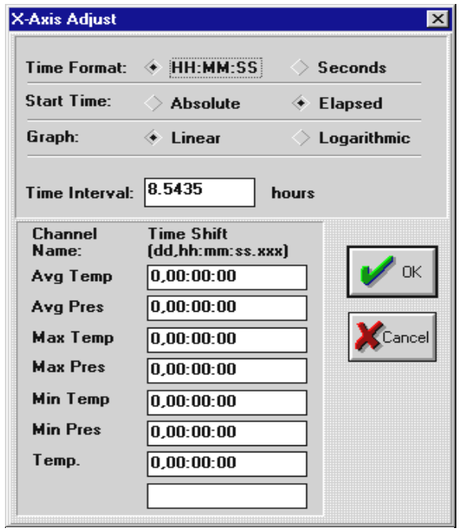


Figure 31: Time Shift / X-Axis

Time Format

Selection of the appropriate radio buttons

- **HH:MM:SS** or **Seconds** Time Base; specifies the time display format for Hours, Minutes and Seconds, or in Seconds only.
- **Elapsed** or **Absolute** Time display; With **Elapsed** mode, the time display starts with Time 0 as the time of the first data sample. With **Absolute** mode, the time and date when the CRTdm stored the sample is used.
- **Linear** or **Logarithmic**; The X-axis is scaled linearly or on a base 10 log scale.

Create All Reports

Files downloaded from the CRTdm are stored with a *.HLD file extension. *Create All Reports* allows the user to specify a source *.HLD data file and to convert it to a text file for viewing in a word processing or spreadsheet program.

Two sets of output reports are available. The Data Report shows all the data recorded in the CRTdm including the time stamp and header report. The Failure Log shows the time and date when an alarm cycled on or cycled off, which alarm went active, and the back pressure/temperature when the alarm cycled on or off.

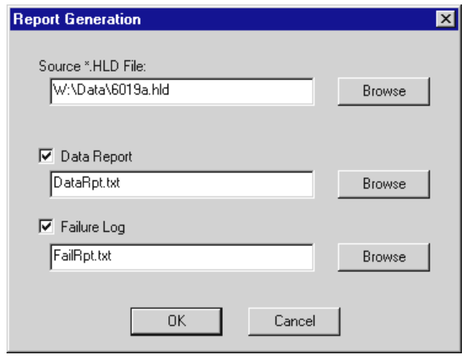


Figure 14: Report Generation

Follow the steps below to use the Create All Reports function.

1. Press the Create All Reports button
2. Press the Browse button next two the Source *.HLD file and choose the file you'd like converted to text format.
3. Press the Browse button next to the Data Report box and name the data file.
4. Press the Browse button next to the Failure Log box and name the failure log.
5. Click on OK

Two text boxes will open on your tool bar at the bottom of your desktop. Both text files are saved to C:/Logic Beach/CRTdm Communications, unless you specify otherwise. The *.HLD files are stored here as well.

You will still be able to view the file in the plotter program.

CRTdm Run Programs

Overview

The CRTdm constantly monitors exhaust back pressure and exhaust temperature to alert you if a problem is noted within the CRT. It also monitors the exhaust temperature sensor(s) and back pressure sensor included with the CRTdm. If a problem is noted with either sensor an alarm can be set to alert you to replace/repair the sensor. To do this, the CRTdm must contain a valid run program. Run programs are created by checking boxes or entering values for the various parameters. If a Run Program is not valid you will be unable to upload it to the CRTdm. You can access the various functions by clicking on the Over-Temp, Over-Pres, TC Fail, Pressure Sensor Fail, and Logging Strategy tabs in the CRTdm Run Program area (Figure 15).

The CRTdm is preprogrammed from Johnson Matthey with an alarm program called NYCTA1. This program was designed for trucks or buses which see heavy service for greater than 12 hours per day. If your truck or bus runs less than 12 hours per day Johnson Matthey suggests you change your alarm parameters to the settings in the following sections. This will give you the greatest data resolution and provide the highest protection for your CRT and engine.

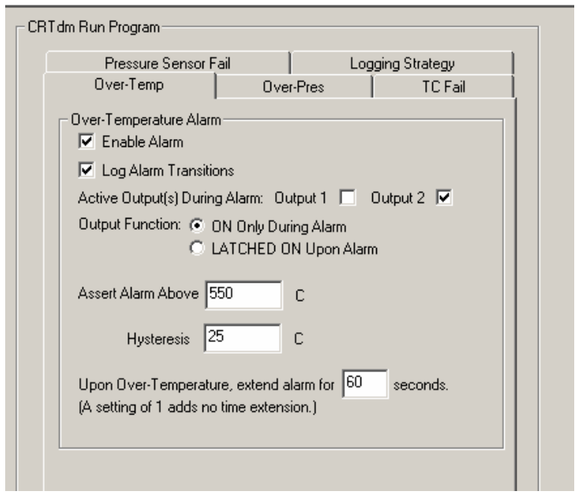


Figure 15: CRTdm Run Program Tabs

Note: A suggested Alarm program is shown in figures 16 through 23. ***These are suggested parameters only***. Your engine manufacturer may have an alternate program. Please check with your distributor regarding available programs for your engine**.**

Note: Never exceed the engine manufacturer's maximum back pressure and temperature limits. This may void your engine warranty and will void the CRT/CCRT warranty.

Data Axis

Up to seven vertical axes can be displayed on a single plot, each with unique scaling. At the bottom of each axis is the data channel name and units assigned. Upon initial display, the axes are auto-scaled to allow the data to fit on the workspace. If required, scaling may be expressed with scientific notation (engineering format) and the multiplier will appear near the top of the appropriate axis.

Slide Bars

Slide bars are displayed at the right side and the bottom of the window which can be used for panning vertically and horizontally. Drag the slide button or click on the arrows at each end of the slide bars to pan the display.

Zooming

Areas of a plot can be enlarged via the Zooming feature. To zoom into an area of interest, a rectangular outline can be drawn around a region using the mouse and the display will change to fill the window with the outlined plot. Auto-scaling corrects the time and channel data axes as necessary.

To zoom into a region:

1. Locate the mouse on one corner of the rectangular area to be defined.
2. While holding the left mouse button down, drag a rectangular box around the region to be enlarged.
3. Release the mouse button and the outlined area will fill the screen.

To zoom out, use the *Zoom All* or *Zoom Last* commands under the *Calculations* menu (see following Menu bar details).

Menu Bar

The Menu bar along the top edge of the HyperPlot window provides User control of the plotting features within HyperPlot.

HyperPlot Menu Bar

The conventional Windows menu bar techniques are used to load files for plotting, modify plotting parameters, and output plots. Descriptions of the features within each menu follow:

File

Open View

Loads a new Download file for plotting.

Save as Bitmap

Outputs the currently displayed screen view as a Windows bitmap file. The bitmap file format is readily integrated into other software applications. When selected, a filename is requested and the file extension *.BMP is appended.

Print View

Outputs the currently displayed screen view to the Windows default printer.

Data File Information

Displays the Title, Unit Name, Serial Number, Program Name and Comments. Title and Comments in the Download file are entered at the time of Download.

HyperPlot™ Graphic Data Display

Overview

HyperPlot is an integral sub-program of the CRTdm Communications program that provides graphic data display of collected data versus time. Autoscaling, zoom/unzoom, data analysis, and bitmap file (*.BMP) generation are features of HyperPlot. HyperPlot displays data from the Download file format (*.HLD).

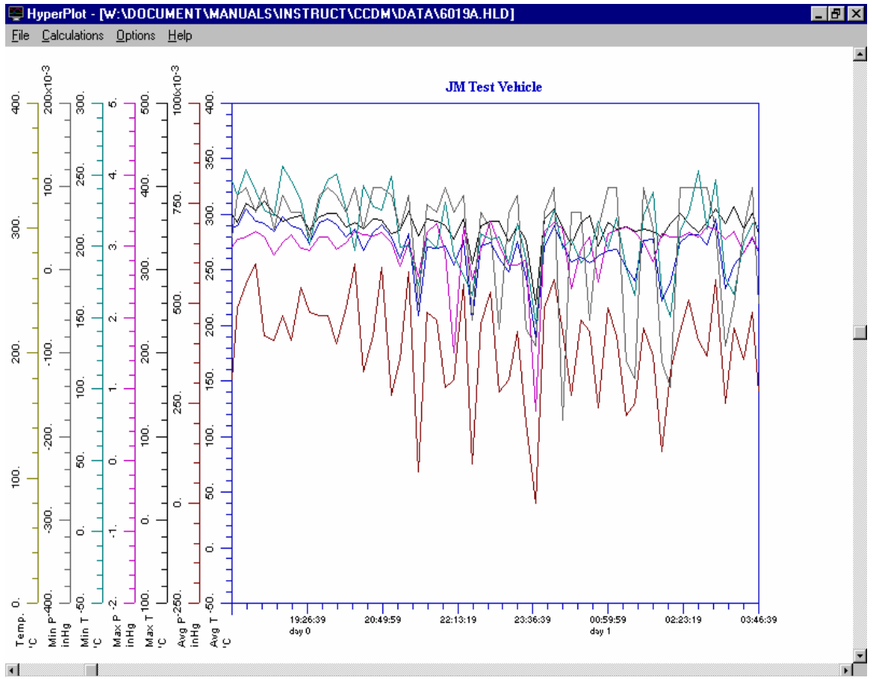


Figure 30: HyperPlot Graph

Presented in this section is information on launching the HyperPlot program, details on using the various display options, and methods used for outputting graphed data for inclusion into reports or printing.

Launching HyperPlot

The HyperPlot program can be launched two ways…

- Directly from the CRTdm Communications Window by pressing Launch Plotter.
- From the drop-down menu selection under Communications.

HyperPlot Window Overview

When HyperPlot starts, the window shown in Figure 30 is displayed (with or without data graphed). Details on the various components of the HyperPlot window follow.

Time Axis

A horizontal axis is used for display of time. The time can be displayed in elapsed or absolute modes with either linear or logarithmic scaling.

Alarms and Shared Functions

All of the CRTdm alarms are equipped with two physical alarm outputs. The operation of these two alarm outputs is controlled by checking one, none, or both ***Output*** boxes. The following functions are common to all the alarms. The two physical alarm outputs are:

Output 1 (or alarm 1) is an "open collector" transistor output with a 100 ohm series limiting resistor. Upon alarm, this output is pulled to ground through the 100 ohm resistor and the transistor. Typically Output 1 is used for "High Level" alarms like the Over Pressure Alarm and possibly Over Temperature depending on the installed location of the CRT.

Output 2 (or alarm 2) is a relay output. The "normally closed" contacts of this relay are used to add a level of "fail-safe" integrity to the system in the event of a system power failure. The relay will short to ground upon alarm condition or in the event of a power failure of the CRTdm. Output 2 is typically used to alert you if a pressure or temperature sensor is malfunctioning, or an Over Pressure Warning.

The Alarm Functions are accessible from the tabs within the CRTdm Run Program section of the communications screen. Many settings are common to all of the different alarm types. Common settings include:

- **Enable Alarm Checkbox:** When you check the ***Enable Alarm*** box (Figure 16), the CRTdm will watch for this alarm. When the alarm function is enabled various settings become available for User specification (check boxes, text boxes for thresholds, etc).
- **Log Alarm Transitions:** When this box is checked, the CRTdm will record when an alarm cycles on/off, and the back pressure and temperature when the alarm cycles. Alarm transitions are logged to memory during operation and can be viewed later in the Failure Report by using the ***Create All Reports*** button (Page 13).
- **Active Output(s) During Alarm:** This controls which alarm output will be enabled when an alarm is realized. To enable a physical alarm output, select Output 1, Output 2, or both check boxes.
- **Output Function:** The alarm output function can be configured to remain ***ON Only During Alarm*** or can be ***LATCHED ON Upon Alarm***. When *Latched On*, the alarm is on until the alarm reset button on the front of the CRTdm is pressed.
- **Alarm Time Extension:** When *On Only During Alarm* is checked, a triggered alarm can be extended after the alarm cycles off.

Figure 16: Alarm Output Functions

Logging Strategy

The *Logging Strategy* determines memory usage method, when a logging session takes starts/stops and the time intervals for saving data to memory. See Figure 17 for recommended settings.

Memory Utilization

Select **Rotary Memory (recommended)** or **Log to Full**. **Rotary Memory** will continue to log when the memory fills, overwriting older data on a first in, first out basis. The **Log to Full** selection will fill memory until the logger's memory can no longer accept data. ***With Full memory, the CRTdm still continues to operate and run the program checking for enabled alarms***.

Logging Threshold

The temperature entered in this text box determines when data is stored to memory. When powered-up, the CRTdm monitors the pressure and temperature sensors every second. However, only when the Logging Threshold temperature is exceeded is data stored to CRTdm local memory. The assumption is that below the entered temperature the vehicle is not operating and therefore no data is required. A fixed 5C hysteresis is built into this threshold.

Record Interval

A Minimum, Maximum, and Average value for each parameter will be calculated and stored every *Record Interval* (see page 8 for more detail). Enter the number of minutes or seconds over which you wish to average the 1 per second reading in the **Min/Max/Avg. Record Interval Box**. Absolute date and time data will be maintained with all sampled data. Typical time intervals are 10 to 15 minutes. Selecting 10 minutes (recommended) will provide approximately 270 days of data based upon the engine running 8 hours per day, 5 days per week.

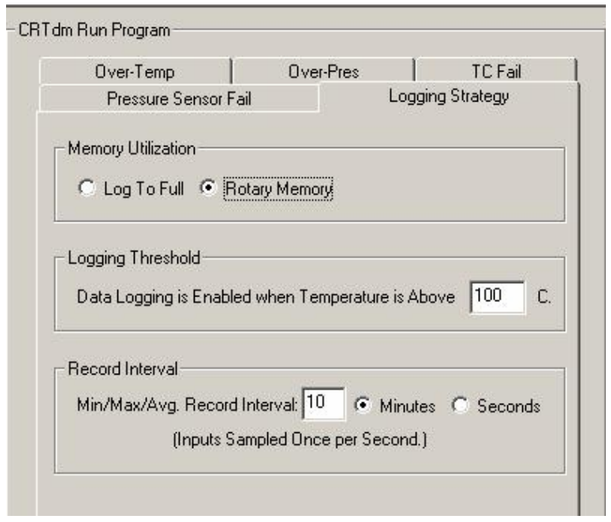


Figure 17: Suggested Settings in the Logging Strategy Tab

Options / Settings

The Options / Settings screen allows you to configure the COM port settings, speed at which the CRTdm communicates with your PC, what mode is the default for the CRTdm Software to operate in, if data stored in the CRTdm memory should be erased when a new version of the CRTdm firmware is uploaded, and finally if you would like to software to automatically download the Alarm program when you connect to the CRTdm. Details about each function follow below.

To change the Communications settings, disconnect from the CRTdm (leaving the cable in place between the CRTdm and your PC). Click on ***Options*** followed by ***Settings***, and a dialog box will open (Figure 29).

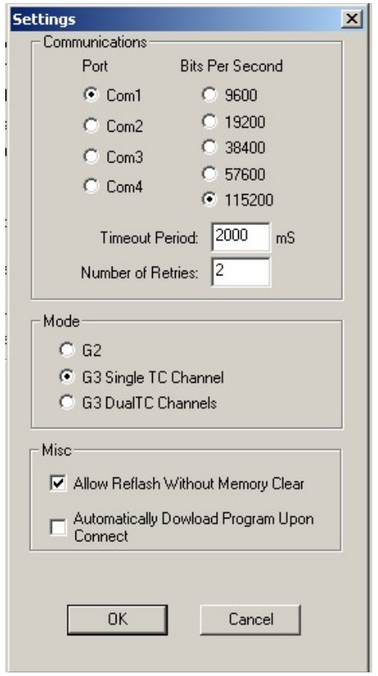


Figure 29: Settings Box

Com Port Setting

Com1 is the default as the communications port between the CRTdm and your PC, however your PC may be configured differently. If you can't communicate with the CRTdm, try changing the COM port settings.

Bits per Second

On some PCs with slower processor speeds, it may be necessary to slow the communications speed between the CRTdm and your PC. This will be noted by a Communications Error while downloading data. If this occurs, slow the communications speed until the error stops.

Mode

This is the default mode the software tries to operate in when connecting to a CRTdm. It automatically switches between modes when it recognizes the need. If you have mostly or all G2 product, you should leave the G2 checked. If you work with both G2 and G3 with single thermocouples check the G3 Single TC Channel.

If you attempt to connect to a G3 Dual Channel in G3 Single TC Channel mode, or vice versa, an alert will open asking you if you want to change modes. The software will automatically switch between G2 and G3 modes without an alert.

Allow Reflash without Memory Clear

Typically, when upgrading the CRTdm firmware the recorded data will be erased. However, you have the option to save the data during a reflash operation by checking the *Allow Reflash Without Memory Clear* box. You will still be prompted during the reflash operation if you want to save the memory in the CRTdm.

Download Program Upon Connect

This feature downloads the program from the CRTdm when you connect. Check this box if you would like to see the alarm program values every time you connect.

Manage Passwords

Software versions 1.44 and later have the ability to password protect certain critical parameters from being changed unless a password is entered. Clear Memory, Upload Program to CRTdm, Set Date/Time, Flash Program CRTdm, and Calibrate Pressure Sensor are all protected when you enable the password protection feature.

If your software version is earlier than 1.44 you may update free of charge. Please contact your distributor for the latest version of the software.

All CRTdms are shipped with the password protection turned off. You will need to enable password protection. A single password can protect multiple CRTdms. Click on the Tools drop down menu, click on Manage Passwords, and follow the directions below.

First Enabling Password Protection

1. Leave the "Enter Old Password" blank
2. Enter your password in the "Enter New Password" box
3. Reenter your password into the "Reenter New Password" box
4. Click "Go"
5. Click OK to close box

Changing a password

1. Enter the current password in the "Enter Old Password"
2. Enter a new password in the "Enter New Password" box
3. Reenter the new password in the "Reenter New Password" box
4. Click "Go"
5. Click OK to close box

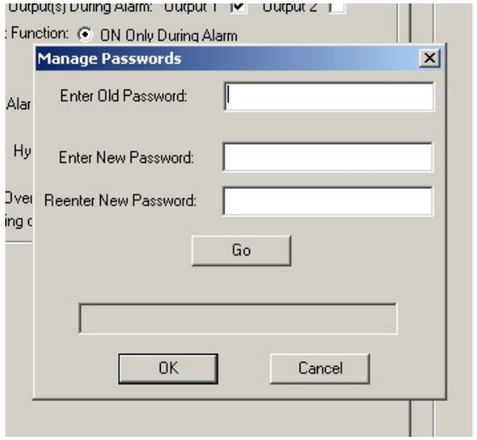


Figure 28: Manage Passwords dialog box

Single Over-Temperature Alarm

Enter a temperature in degrees Celsius at which point the alarm should turn ON and the value for a **Hysteresis**, below which the alarm must fall in order to change to a non-alarm status. The alarm state will remain ON until the temperature falls below the **Assert Alarm** value less the **Hysteresis** value. For instance, in Figure 18 the alarm would come on at 550C and turn off at 525C. The Alarm Output 2 would remain active only during the alarm and would shut off 60 seconds after the temp falls below 525C.

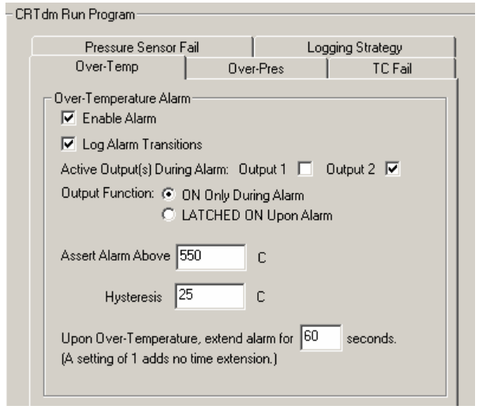


Figure 18: Over Temperature Alarm Setting

Dual Over Temperature Alarms

Generation 3 CRTdms are capable of recording two temperature inputs and both can alarm if a certain temperature is exceeded. Figure 19 shows the Dual Over-Temp Alarm screen. The alarms are configured independently of each other. Both alarms are programmed like the step above.

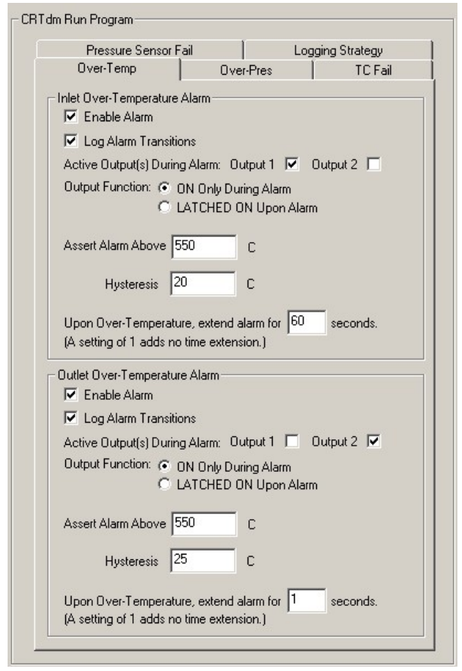


Figure 19: Dual Over-Temp Alarm Screen

Over-Pressure Alarms

Over Pressure Warning

The CRTdm has two back pressure alarms. The low level alarm, or **Over Pressure Warning**, is designed to warn the operator that the CRT filter needs cleaning. The Over Pressure Warning usually triggers Output 2 and can illuminate the *Check Engine* light if the engine is electronically controlled, or a yellow LED on the Johnson Matthey Remote Display. Recommended settings are shown in Figure 20.

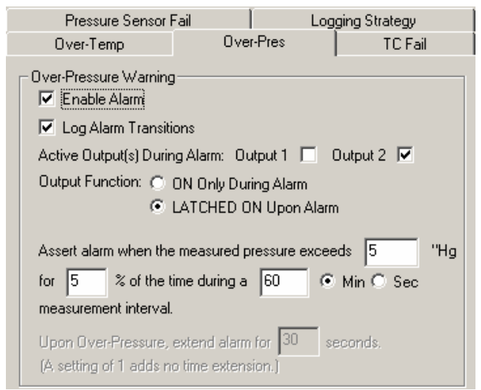


Figure 20: Over Pressure Warning Alarm Setting

NOTE: DO NOT EXCEED THE ENGINE MANUFACTURERS BACK PRESSURE RECOMMENDATIONS. FAILURE TO COMPLY MAY VOID THE ENGINE WARRANTY AND WILL VOID CRT WARRANTY, AND MAY CAUSE SEVERE DAMAGE TO THE ENGINE AND CRT.

Over Pressure Alarm

The high level alarm, or **Over Pressure Alarm**, is used to alert the operator that serious engine damage can occur if the vehicle continues to operate in this condition. The Over Pressure Alarm usually triggers Output 1 and can derate some electronic engines or illuminate the red LED on the Johnson Matthey Remote Display. Recommended settings are shown in Figure 21.

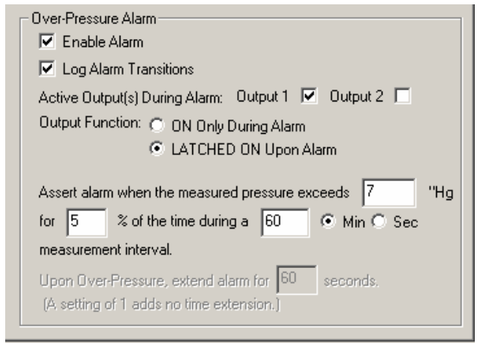


Figure 21: Over Pressure Alarm Settings

NOTE: DO NOT EXCEED THE ENGINE MANUFACTURERS BACK PRESSURE RECOMMENDATIONS. FAILURE TO COMPLY WILL MAY VOID THE ENGINE WARRANTY AND WILL VOID THE CRT WARRANTY, AND MAY CAUSE SEVERE DAMAGE TO THE ENGINE AND CRT.

Calibrate Pressure Sensor

The CRTdm utilizes an integral pressure transducer. This transducer outputs a voltage corresponding to sensed pressure. The CRTdm comes from the factory pre-programmed with voltage signal to pressure calibration. However, during the life of the sensor the calibration may drift causing either false negative pressures or false higher than normal pressures.

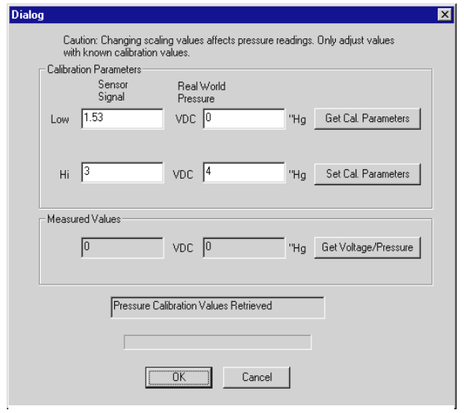


Figure 27: Pressure calibration

These calibration parameters can be changed in the field, ***however adjustment of these calibration parameters should only be done by knowledgeable technicians utilizing certified pressure references.***

Pressure transducer calibration is done by entering the two-point calibration information in the *Calibration Parameters* screen (Figure 27). Calibration is done by entering a Pressure Transducer output voltage (Sensor Signal, VDC) and its corresponding 'real-world' pressure in inches of mercury ("Hg) for two different pressures… a low and a high pressure. This is done at the factory and matches the pressure transducer shipped with the CRTdm.

To read the current calibration parameters currently loaded into the CRTdm, click on the *Get Cal. Parameters* button. The parameters will display after a short delay.

An in-field calibration can be performed as follows:

1. Click on the *Get Cal Parameters* button and write down the Low and Hi current settings to fall back on in the event that a problem occurs in the following sequence.
2. Connect a pressure calibration source/reference to the CRTdm pressure transducer port.
3. Input a 'low' level pressure (eg approximately 1"Hg) into the CRTdm pressure transducer
4. Click on the *Get Voltage/Pressure* button
5. Enter the returned voltage into the "Low" **Sensor Signal** text box and the value of the currently applied pressure (from the pressure calibration source) into the "Low" **Real-World Pressure** text box.
6. Adjust the pressure calibration source for a "Hi" reference pressure (approximately 9" Hg)
7. Click on the *Get Voltage/Pressure* button
8. Enter the returned voltage into the "Hi" **Sensor Signal** text box and the value of the currently applied pressure (from the pressure calibration source) into the "Hi" **Real-World Pressure** text box.
9. Click on the *Set Cal. Parameters* button and the newly entered calibration parameters will be uploaded into the CRTdm for use in subsequent logging sessions

View ADC Calibration Values

There is no user useful information contained in this field. This information is used by Johnson Matthey to diagnose a problem if the CRTdm malfunctions.

Thermocouple Sensor Failure Alarms

There are two alarm methods to detect a failed thermocouple. Both alarms will drive the same Alarm Output. These alarms will watch both thermocouples when in Dual TC mode.

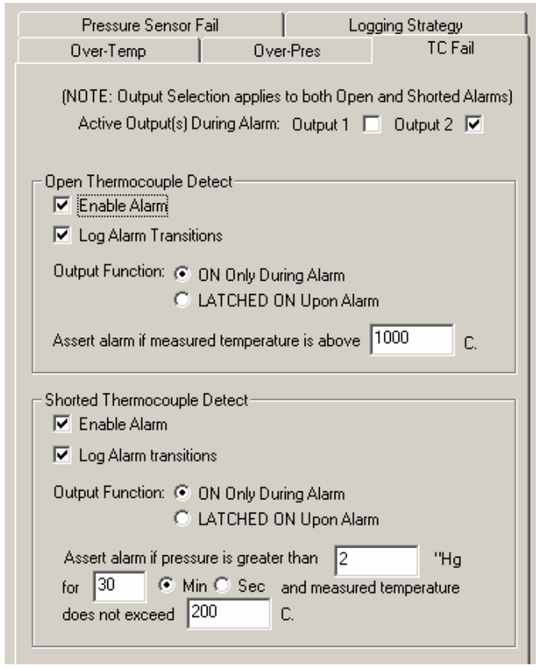


Figure 22: TC Fail Alarms

Open Thermocouple Detect

Enables the selected alarm output(s) if the temperature exceeds a user-specified value which typically indicates the thermocouple is open. The maximum value a CRTdm sensed thermocouple can report is approximately 1000C. Recommended settings are shown in Figure 22.

Shorted Thermocouple Detect

Enables the selected alarm output if a user-specified pressure is reached for a specific time, indicating the vehicle is operating, but a reasonable operating temperature is not being detected which could indicate a shorted thermocouple. See Figure 22.

You will need to supply the name of a *.mot program file that will come from Johnson Matthey or your distributor. Select the file name and click Open to begin the process (Figure 25).

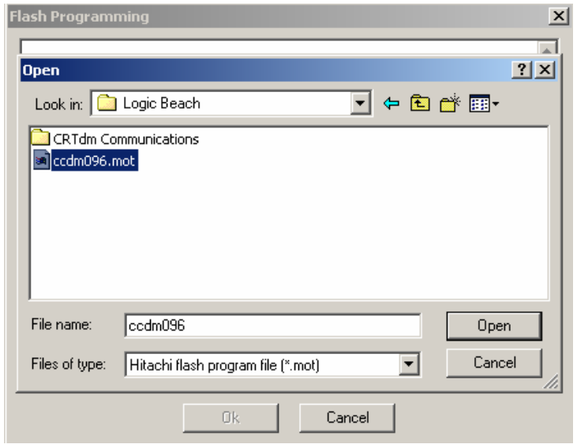


Figure 25: Choose the *.mot file

Click the *OK* button in the opened dialog box (Figure 26). To begin the upload process you will need to press the Alarm Reset button on the front of the CRTdm within 15 seconds of pressing the *OK* button. Text messages will appear the *Flash Programming* box detailing the upload progress.

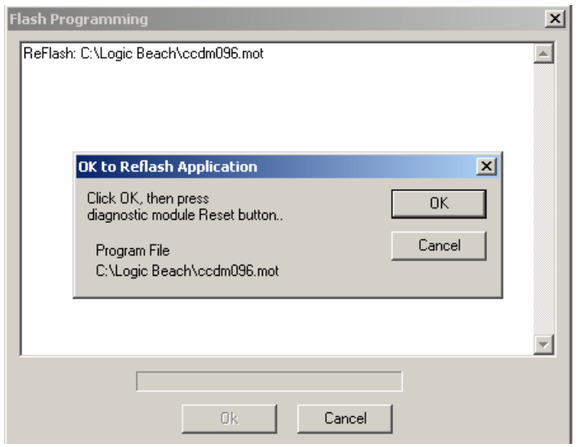


Figure 26: Click the *OK* button

After *Reflash Operation Complete* appears in the Flash Programming box, the reflash operation is complete. All critical parameters such as the Alarm Program, date/time, Unit Name, CRTdm serial number, and pressure transducer calibrations were automatically saved before the reflash operation began and do not need to be changed or updated.

The CRTdm starts operating normally after completing after a reflash operation.

Pressure Sensor Failure Alarms

There are also two alarm methods employed to detect a failed pressure sensor.

No Change Alarm

The first method, *No Change Alarm*, enables the selected alarm(s) if a user-specified exhaust temperature is reached for a specific time (indicating the vehicle is operating), and the operating pressure remains relatively static within the parameters specified. This situation would be indicative of a non-responding pressure transducer (or associated pressure source connection failure).

Enter appropriate values for operating time and temperature and a minimum pressure reading that should be realized.

Negative Pressure Alarm

The second method, *Negative Pressure Alarm*, enables the selected alarm(s) if the temperature exceeds a user-specified value for a specified time (indicating the vehicle is operating) and a reasonable operational pressure is not obtained. Thus indicating the vehicle is operating but the pressure sensor is not functioning correctly. See Figure 23.

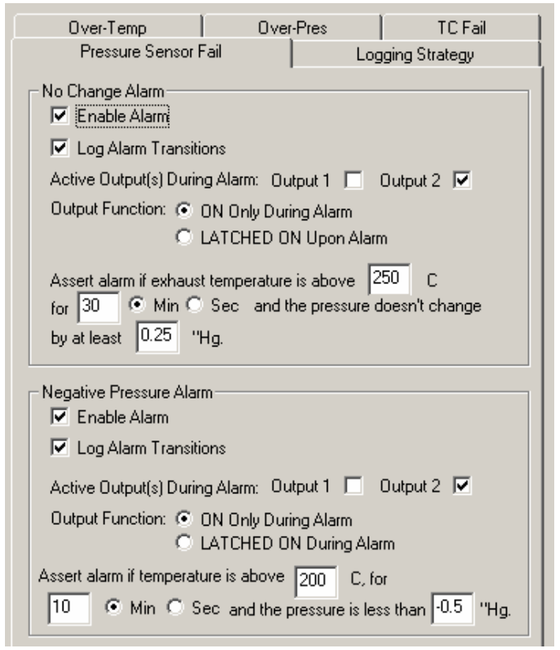


Figure 23: Pressure sensor failure alarms

When you have configured your alarm program you should first save it by pressing the *File, Save As* button on the top tool bar. After *Save as* is pressed, your PC will ask you to name the file. Type a name into the box and press Save.

You may now upload the new program to the CRTdm by pressing the Upload Program to CRTdm button located on the Communications side (left) of the screen.

Note: Be sure to download and save any data from the CRTdm before uploading a new program. Uploading a new program will erase any stored data in the CRTdm.

Toolbar Menu

At the top of the screen there is a toolbar with *File, Communications, Tools, Options, View and Help.* Each tool is explained below.

File

A dropdown menu allows you to open, save or create new alarm programs.

Communications

This is a second way to communicate to the CRTdm.

Tools

There are four important features located in this drop down menu; Flash Program CRTdm, Calibrate Pressure Sensor, View ADC Calibration Values, and Manage Passwords.

Flash Program CRTdm

The firmware program that resides semi-permanently inside flash memory within the CRTdm microcontroller can be field replaced and upgraded with newer release versions that include new features or enhancements.

DO NOT ATTEMPT TO UPGRADE A CRTdm FIRMWARE USING SOFTWARE VERSIONS 1.35 AND EARLIER. FAILURE TO DO SO MAY CAUSE THE CRTdm TO STOP OPERATING.

To check your software version, click on the *Help/About CRTdm* button on the top toolbar. A window will open with the software version number. If your version is 1.35 or earlier contact your distributor for the latest copy of the software. You may reflash CRTdms using software versions 1.36 and later.

After establishing communications with the CRTdm, select Tools – Flash Program CRTdm (Figure 24) and follow the dialog boxes.

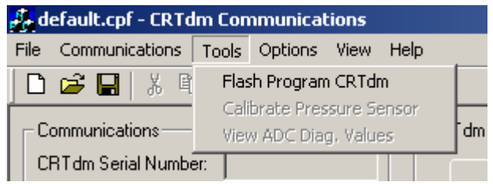


Figure 24: Tools Menu, Flash Program to CRTdm