Operating Manual

CM OM 6-18

HOERBIGER

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Purpose of this Manual

This manual was created to describe the installation and operation of the Catalyst Monitor for use with Gas Engines with three-way or oxidation catalysts.

The Catalyst Monitor is designed to log data for differential pressure and temperature to notify the user of unacceptable conditions to ensure the engine remains in continuous compliance. This real-time information system will keep our customers fully informed of the origins of emissions control system problems, and keep the downtime spent trouble-shooting the initial problem to a minimum.

The goal is to provide a monitor for various inputs and outputs to NCSR and Oxidation catalysts to provide some assurance that these devices were working as intended.

The Catalyst Monitor is available in three different configurations: The first is solely intended to gather information from the exhaust system and log that data. The second will include dual wide-band O2 sensor controllers.

For dynamic adjustment of the AFR set point: The third version will communicate via CAN-Bus with the Air Fuel Ratio Controller to make corrections to the set point to maintain low emissions levels and extend the useful life of the catalyst by using a special post catalyst NOx sensor, to help establish the correct O2 sensor set point for optimum control.

Various local and federal agencies require monitoring of various engine parameters. Parameters often consist of catalyst inlet and outlet temperature monitoring. The catalyst monitor will meet this continuous monitoring requirement.

Here are some of the key parameters which the shutdown or alarm will respond to in order to maintain continuous compliance; differential pressure readings, pre- and post-catalyst readings, a thirty minute time to reach a minimum catalyst temperature, and temperature rolling averages after the four hour interval.

NSPS Part 60 JJJJ (Quad J) Standards for Stationary New Spark Ignition Engines

NEW EMISSION STANDARDS

Engine Type and Fuel	Max Engine Horse Power	Manufacture Date	g/HP-hr			ppmvd @ 15% O2		
			NOx	CO	VOC	NOx	CO	VOC
SI Natural Gas and Lean Burn LPG	≥100 <500	7/1/2008	2	4	1	160	540	86
	≥500 <1350	1/1/2011	1	2	0.7	82	270	60
SI Lean Burn Natural Gas and LPG	≥500	7/1/2007	2	4	1	160	540	86
	≥500	7/1/2010	1	2	0.7	82	270	60
SI Natural Gas and SI Lean Burn LPG (except Lean Burn > 500 < 1350HP)	≥500	7/1/2007	2	4	1	160	540	86
	≥500	7/1/2010	1	2	0.7	82	270	60
Landfill /Digester Gas (except lean burn > 500 < 1350 HP)	<500	7/1/2008	3	5	1	220	610	80
		1/1/2011	2	5	1	150	610	80
	≥500	7/1/2007	3	5	1	220	610	80
		7/1/2010	2	5	1	150	610	80
Landfill/Digester Gas	>500 <1350	1/1/2008	3	5	1	220	610	80
		1/1/2010	2	5	1	150	610	80

Background

Years ago, before exhaust emissions were a concern; the natural gas engines used mainly by the natural gas industry were designed to run with 2% to 4% excess air. The air-fuel ratio controllers were mechanical devices that were not very accurate. The air-fuel ratio would often vary with load and as long as the engine would carry the load and didn't detonate or missfire, this was considered acceptable.

Later, when exhaust emissions became important, it was discovered that these engines were running with very high NOx levels, sometimes at the peak of the NOx curve. Two strategies evolved to reduce the NOx while containing the CO and unburned hydrocarbons.

RICE NESHAP

In 1970 Congress passed the Clean Air Act (CAA) which created the Environmental Protection Agency (EPA) EPA was tasked with reducing air pollution by regulating and removing air pollutants.

In 1990 Congress passed the revised CAA which gave the EPA broader powers to reduce air borne pollutants. These pollutants included, amongst others, Oxides of Nitrogen (NOx), Carbon Monoxide (CO), Non-Methane Hydrocarbons, and Particulate Matter (PM10, PM2.5).

On February 17, 2010, the Environmental Protection Agency (EPA) issued a final rule that will reduce emissions of toxic air pollutants from existing diesel powered stationary reciprocating internal combustion engines (RICE). These engines also are known as compression ignition (CI) engines. RICE NESHAP is an acronym for Reciprocating Internal Combustion Engines National Emission Standards for Hazardous Air Pollutants.

The EPA officially made the RICE NESHAP ruling in August of 2010. The ruling is intended to reduce emissions of toxic air pollutants like formaldehyde, acetaldehyde, acrolein, methanol and other air toxics from several categories of previously unregulated stationary engines. Major sources of air toxins are defined as those that emit or have the > potential to emit 10 short tons per year of a single hazardous air > pollutant (HAP) or 25 short tons per year of any combination of HAPs.

RICE NESHAP consists of two separate rulings. Compression ignited stationary engines (diesel) are overseen by the Feb, 2010 ruling with an enforcement deadline of May, 2013. Natural gas fueled stationary engines need to comply with the Spark Ignited RICE NESHAP (SI RICE NESHAP) ruling. The ruling was passed in August, 2010, with a final compliance date of November, 2013.

This final rule applies to stationary diesel engines that meet specific siting, age and size criteria. It will control emissions of formaldehyde, acetaldehyde, acrolein, methanol and other air toxics from diesel engines. To determine the HAP requirements for your specific engine, you must know the following information: Horsepower, operating hours per year, and if you have an area or major source of emissions.

Affected stationary diesel engines must comply with carbon dioxide or formaldehyde emission limits or be fitted with emission controls, such as an oxidation catalyst.

The rule is applicable to anyone using the following natural gas engines: Current spark ignited engines in use (not new), 4 Stroke Lean Burn (SLB) engines, 4 Stroke Rich Burn (SRB) engines, and Landfill or Digester Gas engines, 2 Stroke Lean Burn (SLB) engines. For compliance specifications, please advise the chart below for subsequent categories of the engine and their appropriate numerical emission standards.

Oxidation catalysts are widely available and recommended by the EPA to meet the emission regulations for rich-burn engine.

Theory of Operation

The Catalyst Monitor comes in three versions and features an optional new component: NOx sensor. NOx sensor feedback also will be used to automatically trim the pre-catalyst O2 set point. Based on the recorded emissions data analysis can be done to determine the optimum pre-catalyst oxygen sensor set-point (or O2 set point schedule) to accommodate for load transitions, changing BTU, etc. This feature can be accommodated to any of the three versions of the catalyst monitor.

Description

Features of the Catalyst Monitor:

- Alarm
- Shutdown Temperature
- Pressure

The cat monitor has two relays that interface with the engine controller; they can be programmed as shutdowns or warnings. The relays can be programmed to trigger on any of the inputs, or multiple inputs. Instantaneous reading or an average. There is a programmable time delay. The relay will open upon triggering. The factory settings will meet the RICE NESHAP requirements.

An input is provided for resetting the alarms and shutdowns.

Data Logging On Board For Periodic Or Continuous Data Retrieval

Data logging is available to a 4GB thumb drive through the on board usb port.

The 4GB drive will hold three years of data logging at a rate of once a second.

This is written as a comma delimited file easily imported in to any spread sheet or data base.

Engine Classifications

Engines which qualify as a major source are as follows:

Subcategory	Numerical Emission Standards (except during Startup)
4SLB Non-Emergency >500HP operating >24 hrs/yr	47 ppmvd CO at 15% O2 or 93% CO reduction
4SLB Non-Emergency >500HP operating >24 hrs/yr	2.7 ppmvd formaldehyde at 15% O2 or 76% formaldehyde reduction

Area sources are those that are not classified as major sources:

Subcategory	Numerical Emission Standards (except during Startup)
2SLB Non-Emergency 100<HP<500	225 ppmvd CO at 15% O2
4SLB Non-Emergency 100<HP<500	47 ppmvd at 15% O2
4SRB Non-Emergency 100<HP<500	10.3 ppmvd formaldehyde at 15% O2
Landfill/Digester Gas Non-Emergency 100<HP<500	177 ppmvd CO at 15% O2

Component Specifications

Data logged consists of the following:

1. Date
2. Time
3. Pre-cat Temp
4. Post-cat Temp
5. Catalyst Temp
6. Catalyst DP
7. Left O2
8. Right O2
9. Hour Meter

Automatic Adjustment to AFR Controllers

When using the Cat monitor in conjunction with an AFR product and NOx sensor. The Catalyst Monitor can provide a setpoint trim to the AFR via the can bus.

Operator Configurable

The alarms, data collection and rate are programmable.

Variety of I/O Supported

(2) Relay outputs
(2) 0-5Vdc analog outputs
Ethernet
2.4Ghz radio
(2) thermocouples

Non-Resettable Real Time Clock and Hour Meter.

The Cat Monitor has a real-time clock, so all data is time stamped. The factory data logging settings meet the RICE NESHAP requirements.

The data is also available through the Cat Monitor Ethernet port using Modbus/TCPIP. A 2.4Ghz radio serial link is also provided using Modbus protocol.

Voltage**

These numbers for current may change after testing. Voltage specifications for the catalyst monitor is 10-30V. Current will be somewhere near the following: CM1 (single connector, no O2 sensors) – 1 amp. CM2 (one O2 sensor) – 3 amp. CM3 (two O2 sensors) – 5 amp. The thermocouple inputs are type K. The first version of the NOx sensor requires 12V while the second version is 24V.

Status Lights

There are two green/yellow bi-color lights; the top light is the STATUS light, which has five distinct color patterns:

- Solid Green – Engine is not running, there is no alarm or shutdown
- Flashing Green/Off – Engine is running, but no alarm and no shutdown
- Flashing Green/Yellow – Engine is running with alarm enabled, but no shutdown
- Flashing Yellow/Off – Engine is not running, alarm is enabled
- Solid Yellow – Shutdown

The bottom light is the logging light, which has three distinct color patterns:

- Solid Green – USB disk is detected
- Flashing Green – Writing to USB disk (WARNING: do not remove while flashing)
- Solid Yellow – No disk detected, or disk error

Thumb Drive

USB data disks are manufactured with the heat capacities of 0-60 degree Celsius. Bearing this parameter in mind, it is highly advised that when operating around a catalyst monitor with temperature ranges from 40-85 degrees Celsius, one should be wary of not placing it near or on surfaces which reach temperatures capable of damaging the memory device. If a catalyst monitor needs to be placed in a high-temperature location, accommodations must be made to keep the thumb drive safe from overheating or meltdown.

Relays

There are two relay outputs in the Catalyst Monitor. With 10 amp contacts, they have the ability to be programmed to custom alarm and shutdown thresholds. These relays will open if a shutdown is triggered.

Functional Description

The Catalyst Monitor possesses two relays that can be programmed in accordance with RICE NESHAP requirements. These requirements are to satisfy 40CFR Part 63 subpart Quad Z.

The Catalyst Inlet temperature must be averaged over an hour. That hourly average must be combined into a 4-hour roll-ing average. The readings will be read and averaged multiple times per second to ensure accuracy of results with real-time feedback. The Catalyst Monitor will alarm the system and shut down in the event of:

- The catalyst inlet temperature does not reach a minimum temperature of 750°F thirty minutes after start of ignition, or as designated by the operator.
- If the unit is not “loaded” thirty minutes after start of ignition.
- If the catalyst temperature 4-hour rolling average falls below the minimum temperature of 750°F.
- The 4-hour rolling average must be recorded continuously while the unit is running. No data needs to be collected when the engine is rolling down after the stop of ignition.

The catalyst differential pressure must be recorded once monthly when the unit is operating. In the event of a change of more than two inches of water the alarm will be activated.

Model CM1: 2 Thermocouples, 1 DP

Application for compliance with RICE NESHAP emissions standards, basic monitoring features:

The standard version is used in data logging applications, and includes DP transducer, and pre- and post-catalyst thermocouples. It provides continuous monitoring of pre- and post-catalyst temperatures, along with differential pressure (pressure across the catalyst). Version 1 offers alarms related to DP, DT, and pre- and post-catalyst temperatures. DP measurement helps detect deposits in the catalyst (cat masked). Catalyst temperatures must meet certain limits within a certain time frame for the catalyst to operate efficiently and safely. There are minimum, maximum, delay, and shutdown settings for each key catalyst monitor parameter, as well as a non-resettable clock (shutdown will be optional).

Model CM2: 2 Thermocouples, 1 DP, 1 O2 sensor (Pre-Catalyst)

New component: pre-catalyst O2 sensor. This has the same functionality as version 1, plus support for two wide-band oxygen sensors.

Model CM3: 2 Thermocouples, 1 DP, 2 O2 sensors (Used for dual-bank engines or occasionally pre- and post-catalyst exhaust monitoring). Plus support for post-cat NOx sensor.

New component: post catalyst O2 sensor. Configuration 3 can be used in conjunction with ECV5 or EGC for minimizing engine emissions. The system continuously measures the post-catalyst O2 sensor feedback and manipulates the pre-cat O2 sensor setpoint in accordance with the algorithm controlling the amount of fuel entering the catalyst. The customer has access to the algorithm settings which allows control over the emissions managing process. The NOx sensor is an optional addition available for dynamic feedback systems communicating to engine control via CAN systems (whether EGC or ECV), in order to configure the O2 set point.

There are 2 relays that can be programmed for different shutdown ranges.

Applications

Rich-Burn Combustion

The first method, and the easiest to implement, is to operate the engines at a Stoichiometric fuel mixture. This is also referred to as a “rich-burn” operation. A stoichiometric mixture is the chemically correct fuel mixture for combustion, with near-zero oxygen remaining in the exhaust.

This method of operation is suitable for a three-way catalytic converter. The mixture must be precisely controlled in order for the reaction in a catalytic converter to oxidize the CO and COXYGEN, and reduce the NO and NOXYGEN to N2 and OXYGEN without undesirable products remaining.

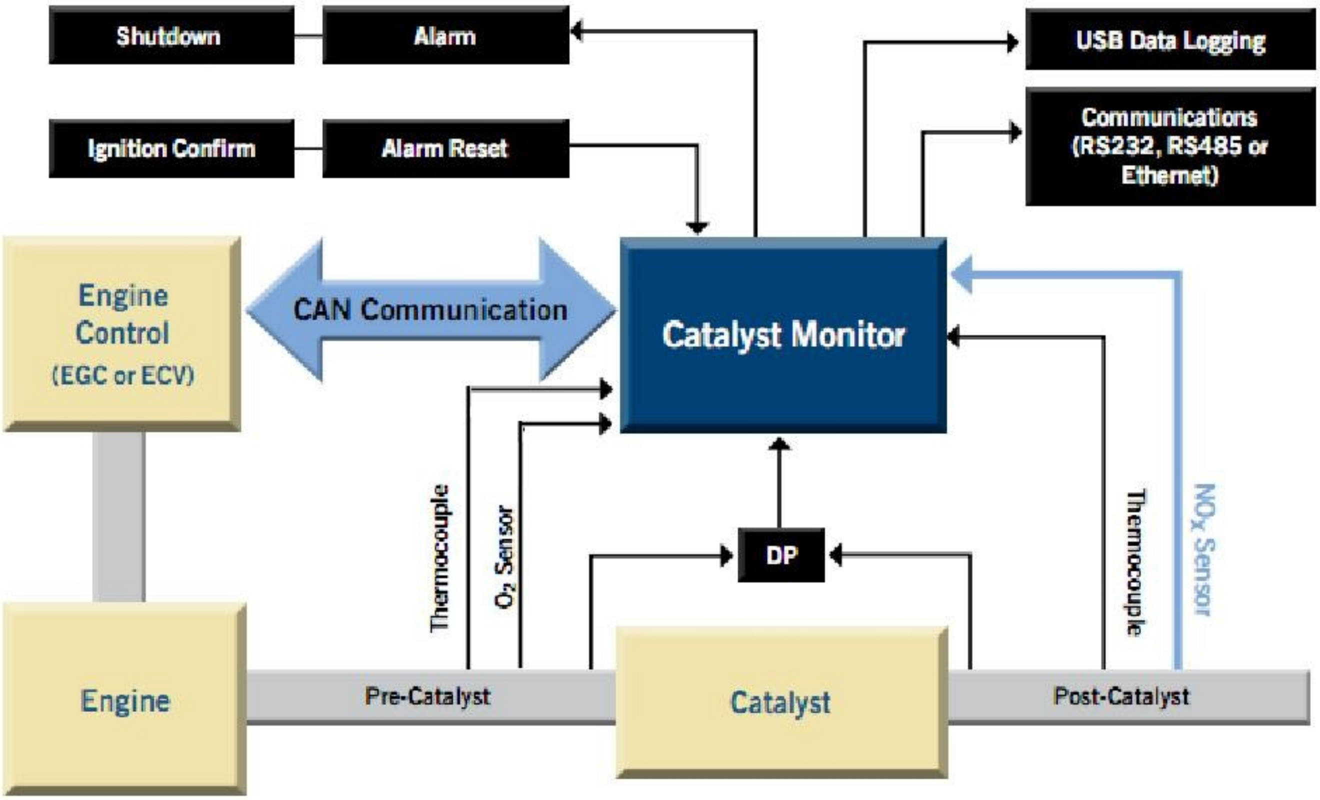
Rich-Burn Oxygen Sensor

In order to achieve the precise mixture required for the catalyst, an OXYGEN sensor is fed back to the control device to close the loops on the amount of oxygen in the exhaust. The mixture is controlled to maintain very low oxygen content in the exhaust (less than 0.02%). This results in combustion that is consuming nearly all of the oxygen. If higher oxygen content is indicated, the engine is running too lean and lower oxygen content indicates the mixture is too rich.

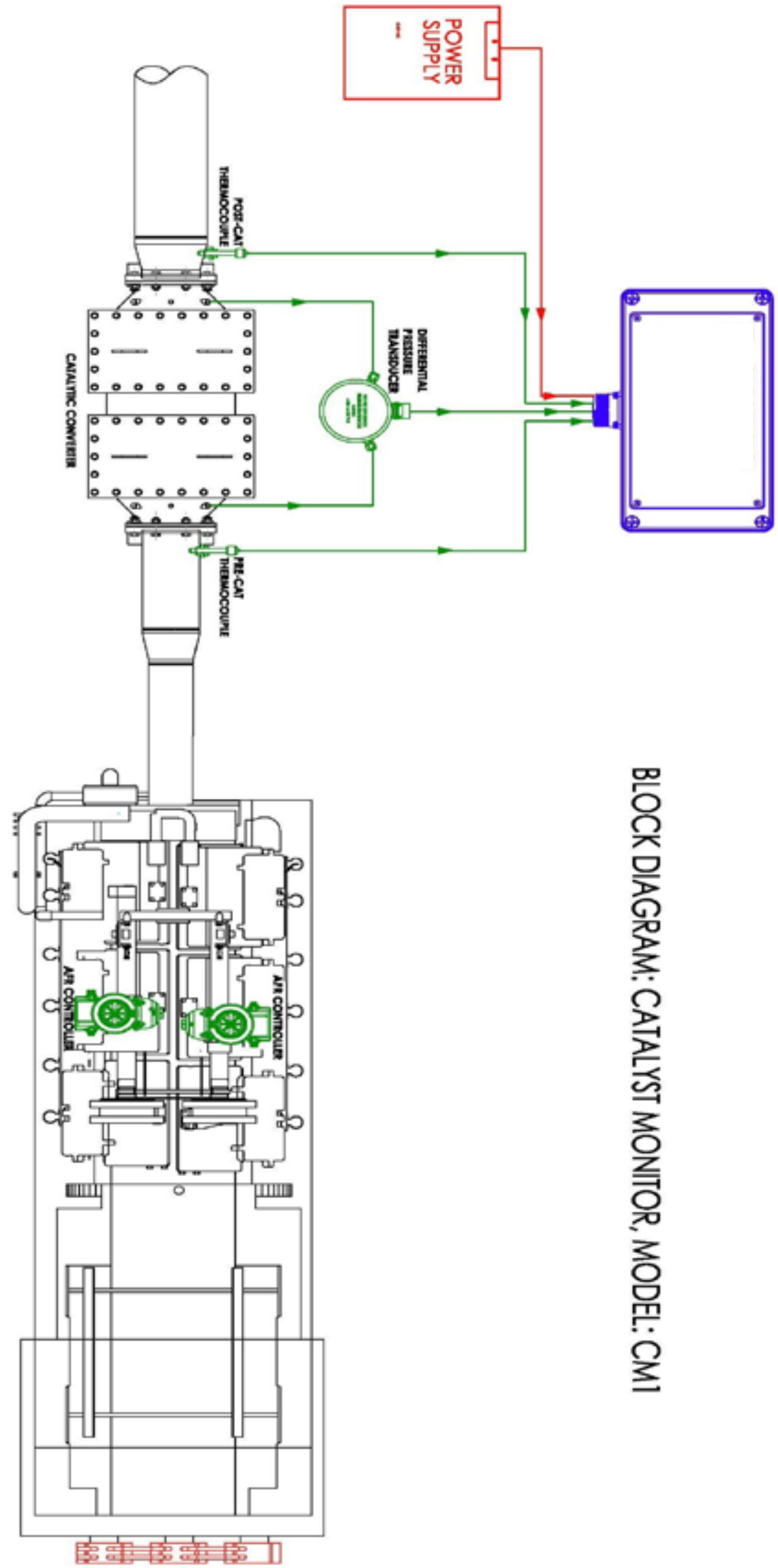
Benefits of Rich-Burn

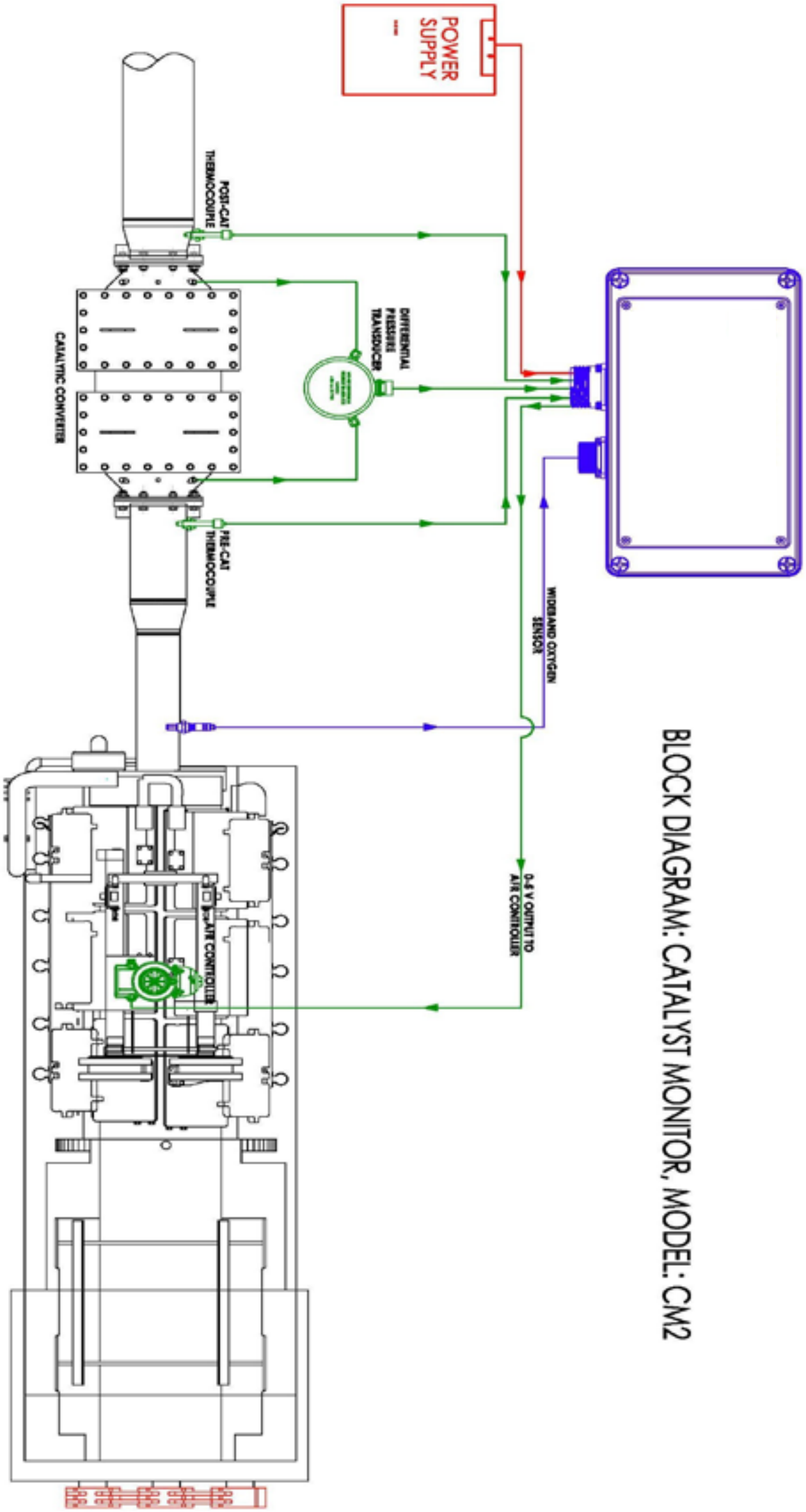
One of the benefits of engines running in Rich-Burn Mode is that a catalytic converter operates with very small quantities of NOx emissions and CO in the exhaust. NOx in the range of a few parts per million is achievable.

Catalyst Monitor: System Level



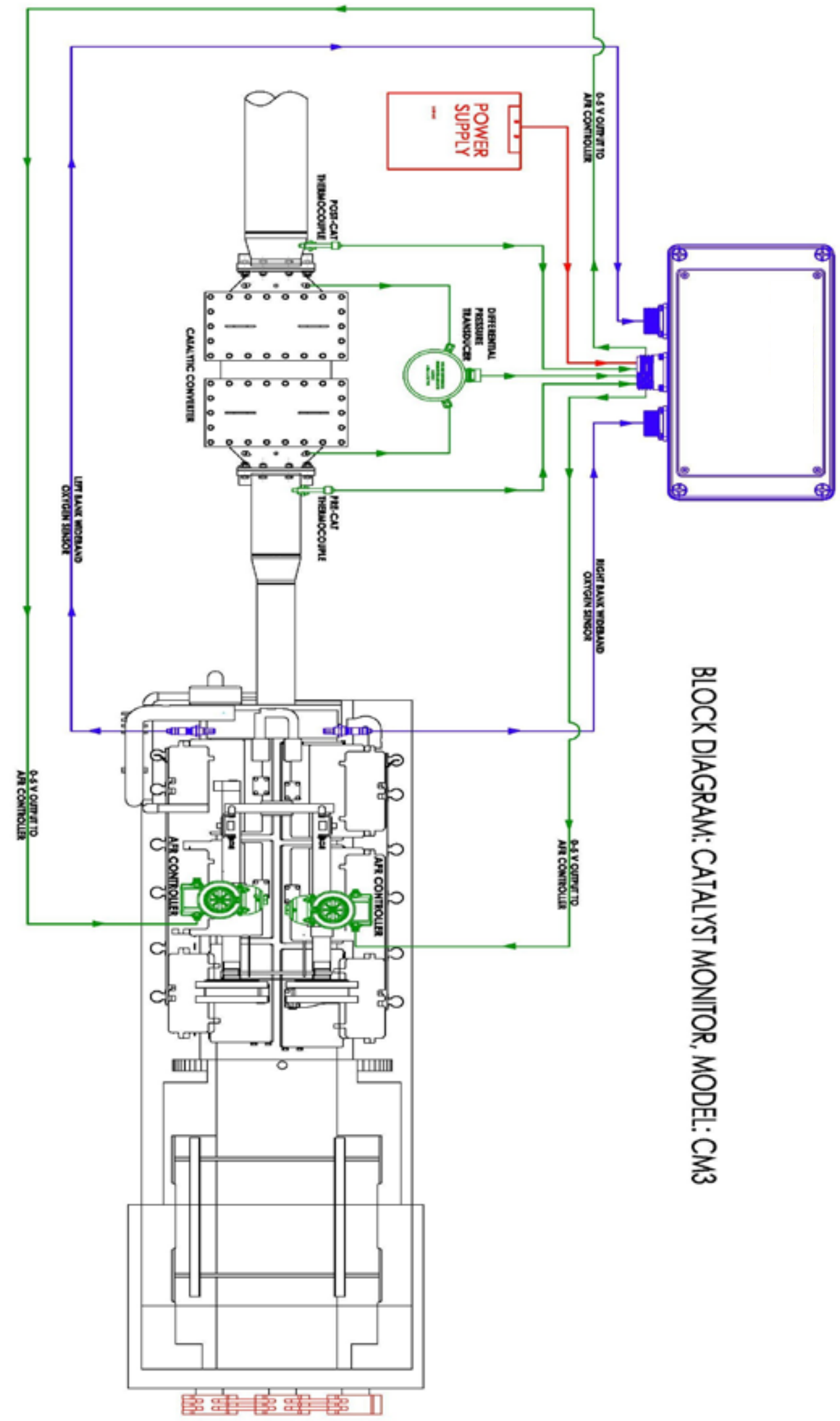
BLOCK DIAGRAM: CATALYST MONITOR, MODEL: CM1

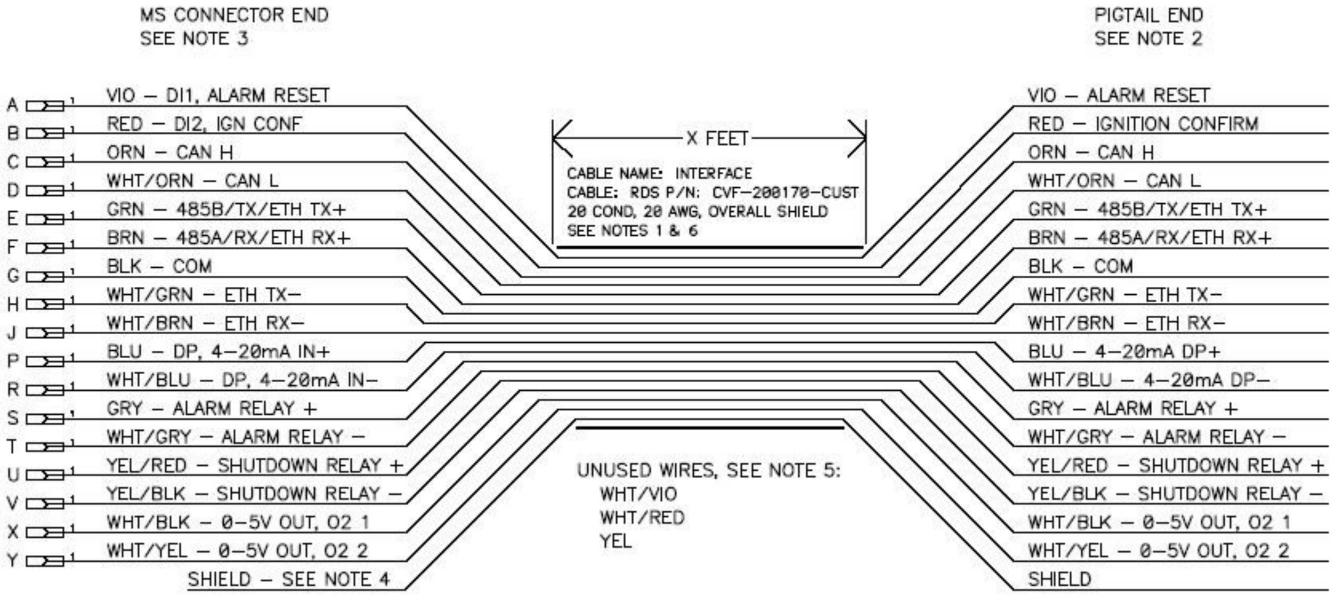


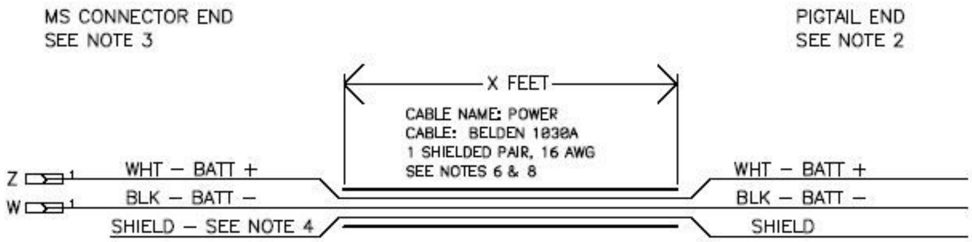


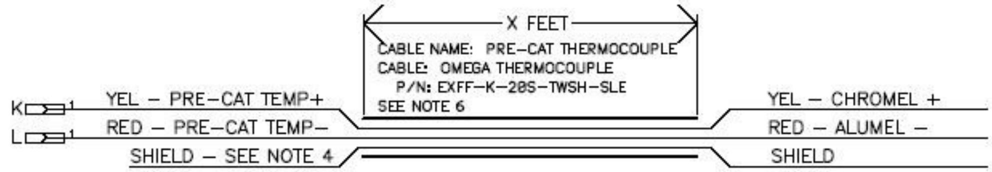
BLOCK DIAGRAM: CATALYST MONITOR, MODEL: CM2

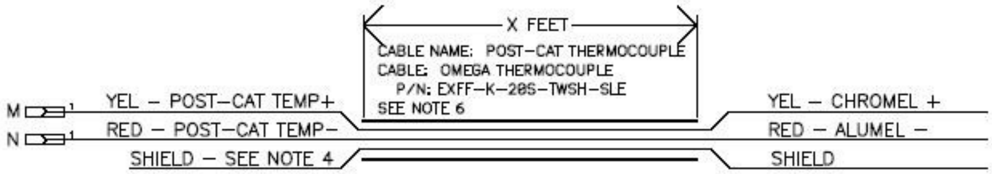
BLOCK DIAGRAM: CATALYST MONITOR, MODEL: CM3

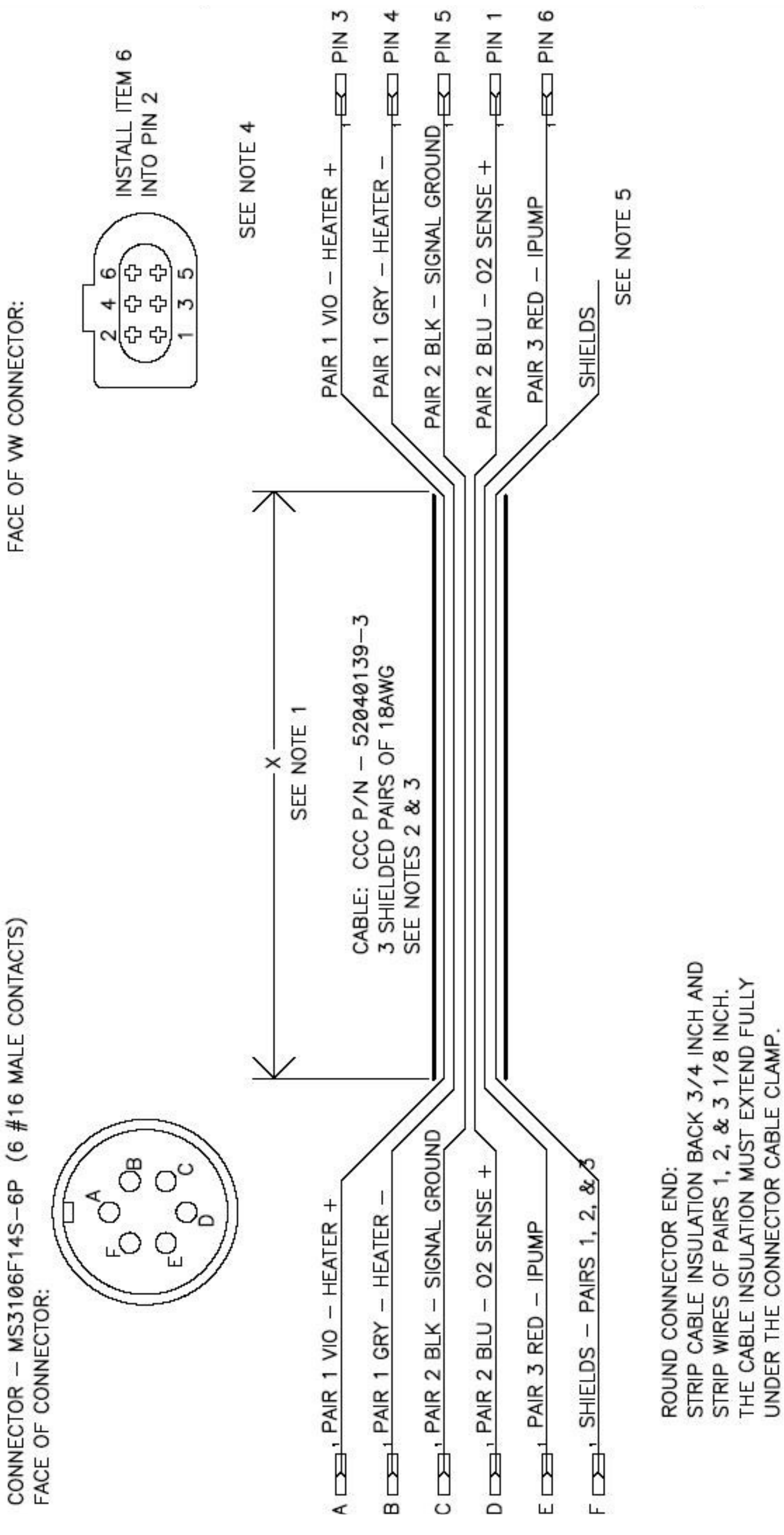



MS CONNECTOR END
SEE NOTE 3
PIGTAIL END
SEE NOTE 2
A VIO – DI1, ALARM RESET
B RED – DI2, IGN CONF
C ORN – CAN H
D WHT/ORN – CAN L
E GRN – 485B/TX/ETH TX+
F BRN – 485A/RX/ETH RX+
G BLK – COM
H WHT/GRN – ETH TX–
J WHT/BRN – ETH RX–
P BLU – DP, 4–20mA IN+
R WHT/BLU – DP, 4–20mA IN–
S GRY – ALARM RELAY +
T WHT/GRY – ALARM RELAY –
U YEL/RED – SHUTDOWN RELAY +
V YEL/BLK – SHUTDOWN RELAY –
X WHT/BLK – 0–5V OUT, O2 1
Y WHT/YEL – 0–5V OUT, O2 2
SHIELD – SEE NOTE 4
X FEET
CABLE NAME: INTERFACE
CABLE: RDS P/N: CVF-200170-CUST
20 COND, 20 AWG, OVERALL SHIELD
SEE NOTES 1 & 6
UNUSED WIRES, SEE NOTE 5:
WHT/VIO
WHT/RED
YEL
VIO – ALARM RESET
RED – IGNITION CONFIRM
ORN – CAN H
WHT/ORN – CAN L
GRN – 485B/TX/ETH TX+
BRN – 485A/RX/ETH RX+
BLK – COM
WHT/GRN – ETH TX–
WHT/BRN – ETH RX–
BLU – 4–20mA DP+
WHT/BLU – 4–20mA DP–
GRY – ALARM RELAY +
WHT/GRY – ALARM RELAY –
YEL/RED – SHUTDOWN RELAY +
YEL/BLK – SHUTDOWN RELAY –
WHT/BLK – 0–5V OUT, O2 1
WHT/YEL – 0–5V OUT, O2 2
SHIELD


MS CONNECTOR END
SEE NOTE 3
PIGTAIL END
SEE NOTE 2
X FEET
CABLE NAME: POWER
CABLE: BELDEN 1030A
1 SHIELDED PAIR, 16 AWG
SEE NOTES 6 & 8
Z WHT – BATT +
W BLK – BATT –
SHIELD – SEE NOTE 4
WHT – BATT +
BLK – BATT –
SHIELD


X FEET
CABLE NAME: PRE-CAT THERMOCOUPLE
CABLE: OMEGA THERMOCOUPLE
P/N: EXFF-K-20S-TWSH-SLE
SEE NOTE 6
K YEL – PRE-CAT TEMP+
L RED – PRE-CAT TEMP–
SHIELD – SEE NOTE 4
YEL – CHROMEL +
RED – ALUMEL –
SHIELD


X FEET
CABLE NAME: POST-CAT THERMOCOUPLE
CABLE: OMEGA THERMOCOUPLE
P/N: EXFF-K-20S-TWSH-SLE
SEE NOTE 6
M YEL – POST-CAT TEMP+
N RED – POST-CAT TEMP–
SHIELD – SEE NOTE 4
YEL – CHROMEL +
RED – ALUMEL –
SHIELD


CONNECTOR – MS3106F14S–6P (6 #16 MALE CONTACTS)
FACE OF CONNECTOR:
A
B
C
D
E
F
PAIR 1 VIO – HEATER +
PAIR 1 GRY – HEATER –
PAIR 2 BLK – SIGNAL GROUND
PAIR 2 BLU – O2 SENSE +
PAIR 3 RED – IPUMP
SHIELDS – PAIRS 1, 2, & 3
ROUND CONNECTOR END:
STRIP CABLE INSULATION BACK 3/4 INCH AND
STRIP WIRES OF PAIRS 1, 2, & 3 1/8 INCH.
THE CABLE INSULATION MUST EXTEND FULLY
UNDER THE CONNECTOR CABLE CLAMP.
X
SEE NOTE 1
CABLE: CCC P/N – 52040139–3
3 SHIELDED PAIRS OF 18AWG
SEE NOTES 2 & 3
FACE OF VW CONNECTOR:
INSTALL ITEM 6
INTO PIN 2
SEE NOTE 4
PAIR 1 VIO – HEATER +
PAIR 1 GRY – HEATER –
PAIR 2 BLK – SIGNAL GROUND
PAIR 2 BLU – O2 SENSE +
PAIR 3 RED – IPUMP
SHIELDS
SEE NOTE 5
PIN 3
PIN 4
PIN 5
PIN 1
PIN 6

Service Options & Replacement Parts

- Bosch O2 Sensor: 2000 hours expected life. (Part No. 52040029)
- NOx Sensor: Replace as needed 12V: (Part No. 60202029) 24V: (Part No. 60202039)
- CM Battery: 20+ Years expected life.
- Thermocouples: Type K, replace as necessary.
- Transducer: (Part No. 60202019)
- DP: The 4-20mA 0-5" pressure transducer is: Dwyer, model 631B, Part No. (631B-3)
- Thumb Drive: Three years expected life.

If any other performance issues are requiring customer service or attention the customer must send the Catalyst Monitor back to Altronic.

Software Description

The primary function of the catalyst monitor is to provide data logging services and an optional real-time intelligent feedback system which maintains continuous compliance with the AFR set point.

Interface to wide-band O2 sensor needs an intelligent controller to interact with the oxygen sensor to control heater, pump current, provides linear 0-5v signal proportional to oxygen content.

Add a level of control to a standard AFR controller, utilizing either a post-catalyst wide-range O2 sensor or NOx sensor.

The Catalyst Monitor receives input from the DP the pre and post catalyst thermocouple feedback as the primary source of information gathering. Upgraded catalyst monitors are also equipped with NOx sensors with CAN communication which retains compliance without the need for human intervention by automatically designating a new AFR set point.

The Catalyst Monitor Software Overview

The Catalyst Monitor is a Microsoft Windows-based application used for interfacing the engine control systems.

The Catalyst Monitor application provides real-time monitoring of control functions via data collection and gives the user overall control over the Catalyst functionality, serves as a diagnostic tool to help detect and evaluate problems related to fuel control and emissions reduction on natural gas engines.

The Catalyst Monitor is an intuitive, user-friendly software tool which offers an advanced array of features like easy set-up of all user-definable setpoints in the Catalyst, monitoring key data points, optional data logging, playback of history files, settings report, zoom feature, digital inputs control, and other features

Communications Setup

Communication Port

Communication Port Properties

Main Menu —> Comm Setup

The catalyst monitor automatically establishes communications with EGC using default communication port COM 1 and Device ID1. However, it is possible to specify different communication port and/or device ID.

Communication setup guide:

1. Go to Comm Setup —> Comm port
2. Communications Port dialogue box should open up.
3. Enter communication port number and device ID.
4. Press OK to apply changes. Communication Port Properties dialogue box will open up automatically. Do not change any settings! Press OK to close the dialogue box. Catalyst Monitor will apply new settings to establish communications with the engine.

COMM Properties

Default communication port settings:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

Playback

Action / Log File

Main Menu —> Action —> Log File

Optional real-time data logging allows storing the crucial information on a PC running Windows OS software. Data Logging is enabled by default.

Playback

Main menu —> Action —> Playback

This feature enables the user to play back all the history files in order to detect and evaluate problems related to fuel control and emissions reduction on natural gas engines.

Playback guide:

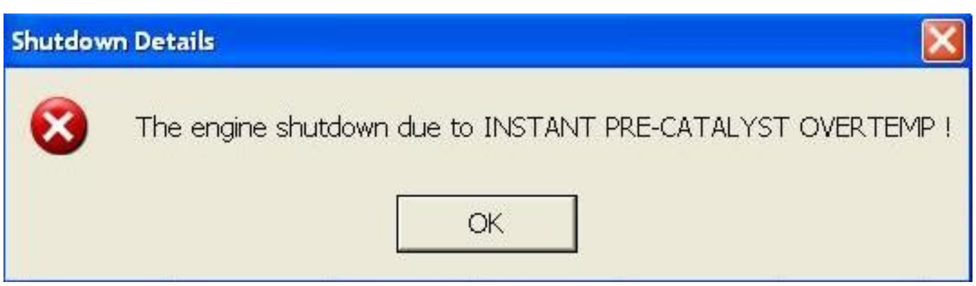
1. Select a date from the drop down calendar menu.
2. Click "Open File" to select a log file, created on a specific date.
3. Playback Setup dialogue box should open up.
4. Select a date from the drop-down menu to display available log files.
5. Press "Open File" button to select a log file.
6. Playback track bar is ready to navigate.
7. For easy navigation use Play, Stop, Rewind, Pause, Fast Forward Buttons.

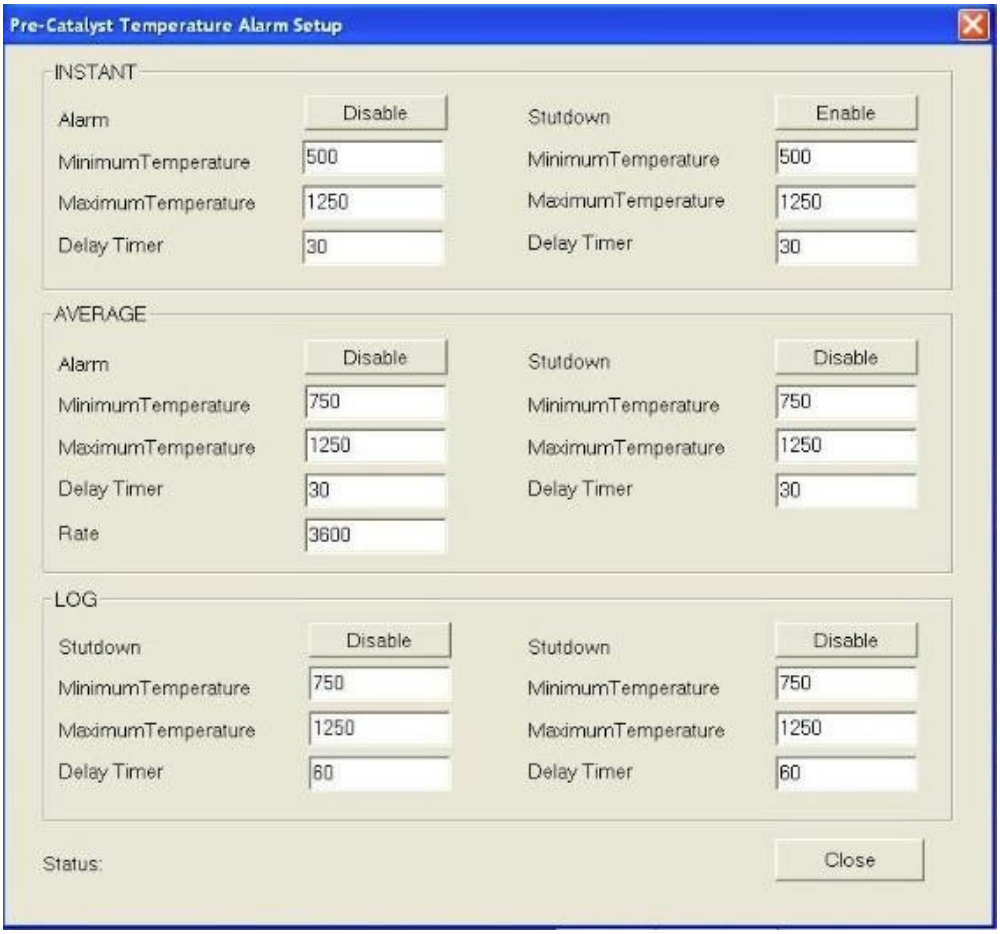
Alarms and Shutdown

There are a total of 24 alarms which are to trigger if the catalyst is not behaving normally.

The alarm can be brought into greater detail when the user presses the "View" button on the right of the alarm signal. There, the user can identify the cause of the alarm and take preventative measures to stop a shutdown.

Multiple alarms can trigger simultaneously but only one will lead to a shutdown. The Catalyst Monitor will cite the source of the shutdown. The shutdown details will be clearly defined for the user when the window is displayed





Pre-Catalyst Alarm Setup

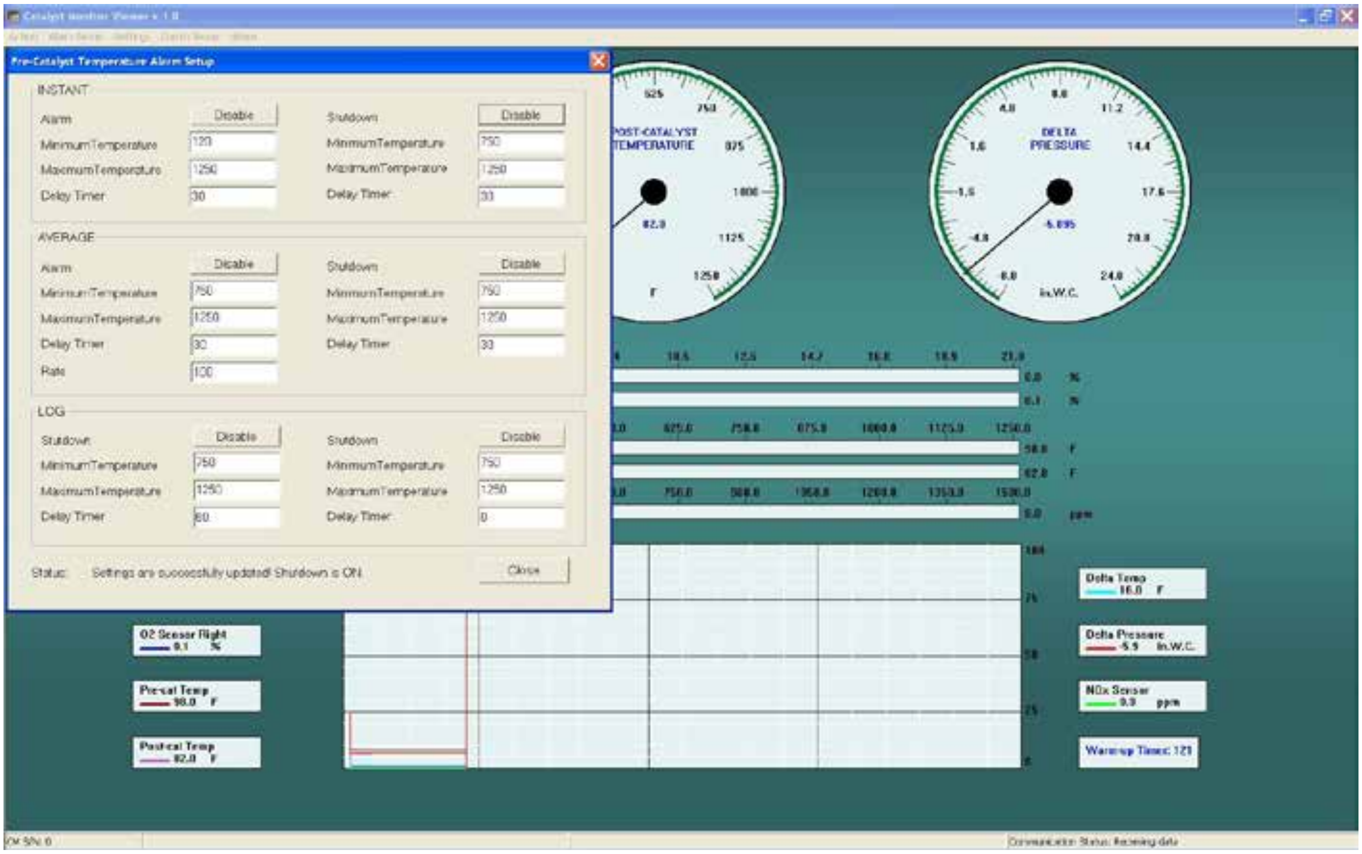
Go to Main Menu:

—> Action
- —> Connect
- —> Disconnect
- —> Playback
- —> Exit

—> Alarm Setup
- —> Pre-Cat Temp Alarm
- —> Post-Catalyst
- —> Differential Temperature Alarm
- —> Differential Pressure Alarm

—> Settings
- —> Log & Filter
- —> Calibrate Catalyst Monitor

—> Comm Setup
- —>Comm Port
- —>Comm Port Properties
- —> About



Alarm Interface

The alarm interface which governs the alarm and shutdown ranges can be categorized into three measurements over differing spans of time.

The first of the measurements is an “Instant”, or real-time feedback data collecting programs which are meant to provide instantaneous information regarding the minimum and maximum temperatures of the catalyst, and the delay (usually set to 30 minutes after ignition confirm). This delay can be adjusted according to user discretion.

The second measurement is what is referred to as the “Average” which is taken as between hour intervals of the Catalyst Monitor. The average can be adjusted the any customer interval, based upon user need, with a one hour default setting.

The third measurement is what is referred to as the “Log” which is taken from a four hour rolling average of the Catalyst Monitor. This is the “average of the average” value which can be user definable, with a four hour default setting.

Calibrate Catalyst Monitor

Main Menu —> Settings —> Calibrate CM

Password protected feature gives the user complete access to all the settings within the Catalyst Monitor. Should you need to use this feature, please contact Altronic to obtain the password.

Telephone: (330) 545-9768

Calibration guide:

1. Locate and select the setting that needs to be changed.
2. Its current value will be displayed in the edit box.
3. Type in the value, click change button.
4. Press “Save” button to save the new settings, otherwise press “Close” button.

Changing Calibration Settings

Entering the password to access the interface opens the calibration menu. This menu allows access to all of the parameters open for augmentation, as well as the default settings.

The user must hit “Save & Close” in order to keep the new settings after making changes to original calibration. If they exit before this is done, the changes will not be saved and the Catalyst Monitor will revert to previous settings.

Modbus Registers

Address	Name	Description
30000	pre_cat_nox	Not Used
30001	post_cat_nox	NOx Reading from Post-Cat NOx Sensor
30002	pre_cat_o2	Not Used
30003	post_cat_o2	O2 Reading from Post-Cat NOx Sensor
30004	pre_cat_temp	Pre-Catalyst Temperature
30005	post_cat_temp	Post-Catalyst Temperature
30006	pre_status_supply	Not Used
30007	pre_status_sensor_heater	Not Used
30008	pre_status_nox_signal	Not Used
30009	pre_status_o2_signal	Not Used
30010	post_status_supply	NOx Sensor Supply Status
30011	post_status_sensor_heater	NOx Sensor Heater Status
30012	post_status_nox_signal	NOx Sensor NOx Signal Status
30013	post_status_o2_signal	NOx Sensor O2 Signal Status
30014	pre_status_nox_error	Not Used
30015	pre_status_o2_error	Not Used
30016	post_status_nox_error	NOx Sensor NOx Error
30017	post_status_o2_error	NOx Sensor O2 Error
30018	rtc_sec	Real Time Clock: Seconds
30019	rtc_min	Real Time Clock: Minute
30020	rtc_hour	Real Time Clock: Hour
30021	rtc_wday	Real Time Clock: Week Day
30022	rtc_mdate	Real Time Clock: Date
30023	rtc_month	Real Time Clock: Month
30024	rtc_year	Real Time Clock: Year
30025	ecu_lb_can_off	Left Bank EGC CAN Bus Not Detected/Turned Off
30026	ecu_rb_can_off	Right Bank EGC CAN Bus Not Detected/Turned Off
30027	pre_nox_can_off	Not Used
30028	post_nox_can_off	NOx Sensor CAN Bus Not Detected/Turned Off
30029	battery_voltage	Catalyst Monitor Supply Voltage
30030	milliamp_input	mA reading from DP
30031	catalyst_dp	Differential Pressure across Catalyst
30032	nox_heater	NOx Heater ON/OFF Flag
30033	warmup_timer	NOx/O2 Heater Warmup Timer
30034	left_bank_o2_setpoint	EGC Left Bank O2 Setpoint
30035	left_bank_o2_feedback	EGC Left Bank O2 Feedback
30036	left_bank_press_setpoint	EGC Left Bank Pressure Setpoint
30037	left_bank_press_feedback	EGC Left Bank Pressure Feedback
30038	left_bank_manifold_press	EGC Left Bank Manifold Pressure
30039	left_bank_actuator_output	EGC Left Bank Actuator Output
30040	left_bank_speed	EGC Left Bank Speed
30041	left_bank_sequence	EGC Left Bank Sequence

Address	Name	Description
30042	right_bank_o2_setpoint	EGC Right Bank O2 Setpoint
30043	right_bank_o2_feedback	EGC Right Bank O2 Feedback
30044	right_bank_press_setpoint	EGC Right Bank Pressure Setpoint
30045	right_bank_press_feedback	EGC Right Bank Pressure Feedback
30046	right_bank_manifold_press	EGC Right Bank Manifold Pressure
30047	right_bank_actuator_output	EGC Right Bank Actuator Output
30048	right_bank_speed	EGC Right Bank Speed
30049	right_bank_sequence	EGC Right Bank Sequence
30050	o2_sp_trim	O2 Setpoint Trim
30051	post_cat_nox_avg	Average Post-Cat NOx
30052	ign_confirm	Ignition Confirm Flag
30053	alarm_reset	Alarm Reset Flag
30054	pre_temp_avg	Average Pre-Catalyst Temperature
30055	post_temp_avg	Average Post-Catalyst Temperature
30056	dp_avg	Average Catalyst Differential Pressure
30057	o2_1_avg	Average Left Bank O2 Reading
30058	o2_2_avg	Average Right Bank O2 Reading
30059	pre_temp_log	Long Average/Log Pre-Catalyst Temperature
30060	post_temp_log	Long Average/Log Post-Catalyst Temperature
30061	dp_log	Long Average/Log Catalyst Differential Pressure
30062	o2_1_log	Long Average/Log Left Bank O2 Reading
30063	o2_2_log	Long Average/Log Right Bank O2 Reading
30064	alarm_status_high	Over-Range Alarm Status
30065	alarm_status_low	Under-Range Alarm Status
30066	shutdown_status_high	Over-Range Shutdown Status
30067	shutdown_status_low	Under-Range Shutdown Status
30068	filesize	Current Log File Size
30069	freespace	USB Disk Freespace
30070	dac1_output	Left Bank O2 DAC Output
30071	dac2_output	Right Bank O2 DAC Output
30072	o2_heater	O2 Heater ON/OFF Flag
30073	percent_o2_1	Left Bank O2 - Percent
30074	o2_1_heater_pv	Left Bank O2 Heater Feedback
30075	o2_1_heater_avg	Left Bank O2 Heater Average Feedback
30076	o2_1_heater_out	Left Bank O2 Heater Output
30077	percent_o2_2	Right Bank O2 - Percent
30078	o2_2_heater_pv	Right Bank O2 Heater Feedback
30079	o2_2_heater_avg	Right Bank O2 Heater Average Feedback
30080	o2_2_heater_out	Right Bank O2 Heater Output
30081	n3x_regs	Number of Data Registers

Address	Name	Description
40000	rtc_update	Not Used
40001	min_adjust_o2_trim	Not Used
40002	max_adjust_o2_trim	Not Used
40003	version	Software Version
40004	milliamp_gain	mA Input Gain
40005	milliamp_offset	mA Input Offset
40006	serial_number	Serial Number
40007	modbus_address	Modbus Address
40008	calibrated	Flag Used to Reset Original Calibration
40009	f_ign_confirm	Force Ingition Confirm
40010	f_alarm_reset	Force Alarm Reset
40011	save_data_command	Save Modbus Calibration Registers
40012	warmup_timer_start	Warmup Timer Duration
40013	ma_min	Min mA Input
40014	ma_max	Max mA Input
40015	dp_min	Min Catalyst Differential Pressure
40016	dp_max	Max Catalyst Differential Pressure
40017	nox_transmit_rate	CAN Transmit Rate - NOx
40018	cm_info_transmit_rate	CAN Transmit Rate - Catalyst Monitor Info
40019	o2_trim_transmit_rate	CAN Transmit Rate - O2 Setpoint Trim
40020	f_heater	Force NOx/O2 Heater
40021	o2_trim_step	O2 Setpoint Trim Increment
40022	nox_filter_rate	NOx Average Filter Rate
40023	min_meter	Minute Meter - Read Only
40024	hour_meter	Hour Meter - Read Only
40025	data_log_enable	USB Data Logger Enable Flag
40026	log_rate	USB Data Logger Rate
40027	sample_rate	O2 Averaging Rate
40028	overall_rate	Not Used
40029	log_time_after_shutdown	Time in Seconds to Continue Logging Data After Shutdown
40030	pre_temp_shutdown	Pre-Catalyst Temperature Shutdown/Alarm Enable
40031	pre_temp_avg_shutdown	Average Pre-Catalyst Temperature Shutdown/Alarm Enable
40032	pre_temp_log_shutdown	Long Average/Log Pre-Catalyst Temperature Shutdown/Alarm Enable
40033	pre_temp_avg_rate	Pre-Catalyst Temperature Averaging Rate
40034	pre_temp_alarm_min	Pre-Catalyst Temperature Alarm Min
40035	pre_temp_alarm_max	Pre-Catalyst Temperature Alarm Max
40036	pre_temp_alarm_delay	Pre-Catalyst Temperature Alarm Delay
40037	pre_temp_avg_alarm_min	Average Pre-Catalyst Temperature Alarm Min
40038	pre_temp_avg_alarm_max	Average Pre-Catalyst Temperature Alarm Max
40039	pre_temp_avg_alarm_delay	Average Pre-Catalyst Temperature Alarm Delay
40040	pre_temp_log_alarm_min	Long Average/Log Pre-Catalyst Temperature Alarm Min
40041	pre_temp_log_alarm_max	Long Average/Log Pre-Catalyst Temperature Alarm Max

Address	Name	Description
40042	pre_temp_log_alarm_delay	Long Average/Log Pre-Catalyst Temperature Alarm Delay
40043	pre_temp_shutdown_min	Pre-Catalyst Temperature Shutdown Min
40044	pre_temp_shutdown_max	Pre-Catalyst Temperature Shutdown Max
40045	pre_temp_shutdown_delay	Pre-Catalyst Temperature Shutdown Delay
40046	pre_temp_avg_shutdown_min	Average Pre-Catalyst Temperature Shutdown Min
40047	pre_temp_avg_shutdown_max	Average Pre-Catalyst Temperature Shutdown Max
40048	pre_temp_avg_shutdown_delay	Average Pre-Catalyst Temperature Shutdown Delay
40049	pre_temp_log_shutdown_min	Long Average/Log Pre-Catalyst Temperature Shutdown Min
40050	pre_temp_log_shutdown_max	Long Average/Log Pre-Catalyst Temperature Shutdown Max
40051	pre_temp_log_shutdown_delay	Long Average/Log Pre-Catalyst Temperature Shutdown Delay
40052	post_temp_shutdown	Post-Catalyst Temperature Shutdown/Alarm Enable
40053	post_temp_avg_shutdown	Average Post-Catalyst Temperature Shutdown/Alarm Enable
40054	post_temp_log_shutdown	Long Average/Log Post-Catalyst Temperature Shutdown/Alarm Enable
40055	post_temp_avg_rate	Post-Catalyst Temperature Averaging Rate
40056	post_temp_alarm_min	Post-Catalyst Temperature Alarm Min
40057	post_temp_alarm_max	Post-Catalyst Temperature Alarm Max
40058	post_temp_alarm_delay	Post-Catalyst Temperature Alarm Delay
40059	post_temp_avg_alarm_min	Average Post-Catalyst Temperature Alarm Min
40060	post_temp_avg_alarm_max	Average Post-Catalyst Temperature Alarm Max
40061	post_temp_avg_alarm_delay	Average Post-Catalyst Temperature Alarm Delay
40062	post_temp_log_alarm_min	Long Average/Log Post-Catalyst Temperature Alarm Min
40063	post_temp_log_alarm_max	Long Average/Log Post-Catalyst Temperature Alarm Max
40064	post_temp_log_alarm_delay	Long Average/Log Post-Catalyst Temperature Alarm Delay
40065	post_temp_shutdown_min	Post-Catalyst Temperature Shutdown Min
40066	post_temp_shutdown_max	Post-Catalyst Temperature Shutdown Max
40067	post_temp_shutdown_delay	Post-Catalyst Temperature Shutdown Delay
40068	post_temp_avg_shutdown_min	Average Post-Catalyst Temperature Shutdown Min
40069	post_temp_avg_shutdown_max	Average Post-Catalyst Temperature Shutdown Max
40070	post_temp_avg_shutdown_delay	Average Post-Catalyst Temperature Shutdown Delay
40071	post_temp_log_shutdown_min	Long Average/Log Post-Catalyst Temperature Shutdown Min
40072	post_temp_log_shutdown_max	Long Average/Log Post-Catalyst Temperature Shutdown Max
40073	post_temp_log_shutdown_delay	Long Average/Log Post-Catalyst Temperature Shutdown Delay
40074	catalyst_dp_shutdown	Catalyst Differential Pressure Shutdown/Alarm Enable
40075	catalyst_dp_avg_shutdown	Average Catalyst Differential Pressure Shutdown/Alarm Enable
40076	catalyst_dp_log_shutdown	Long Average/Log Catalyst Differential Pressure Shutdown/Alarm Enable
40077	catalyst_dp_avg_rate	Catalyst Differential Pressure Averaging Rate
40078	catalyst_dp_alarm_min	Catalyst Differential Pressure Alarm Min
40079	catalyst_dp_alarm_max	Catalyst Differential Pressure Alarm Max
40080	catalyst_dp_alarm_delay	Catalyst Differential Pressure Alarm Delay
40081	catalyst_dp_avg_alarm_min	Average Catalyst Differential Pressure Alarm Min
40082	catalyst_dp_avg_alarm_max	Average Catalyst Differential Pressure Alarm Max
40083	catalyst_dp_avg_alarm_delay	Average Catalyst Differential Pressure Alarm Delay

Address	Name	Description
40084	catalyst_dp_log_alarm_min	Long Average/Log Catalyst Differential Pressure Alarm Min
40085	catalyst_dp_log_alarm_max	Long Average/Log Catalyst Differential Pressure Alarm Max
40086	catalyst_dp_log_alarm_delay	Long Average/Log Catalyst Differential Pressure Alarm Delay
40087	catalyst_dp_shutdown_min	Catalyst Differential Pressure Shutdown Min
40088	catalyst_dp_shutdown_max	Catalyst Differential Pressure Shutdown Max
40089	catalyst_dp_shutdown_delay	Catalyst Differential Pressure Shutdown Delay
40090	catalyst_dp_avg_shutdown_min	Average Catalyst Differential Pressure Shutdown Min
40091	catalyst_dp_avg_shutdown_max	Average Catalyst Differential Pressure Shutdown Max
40092	catalyst_dp_avg_shutdown_delay	Average Catalyst Differential Pressure Shutdown Delay
40093	catalyst_dp_log_shutdown_min	Long Average/Log Catalyst Differential Pressure Shutdown Min
40094	catalyst_dp_log_shutdown_max	Long Average/Log Catalyst Differential Pressure Shutdown Max
40095	catalyst_dp_log_shutdown_delay	Long Average/Log Catalyst Differential Pressure Shutdown Delay
40096	delta_temp_shutdown	Catalyst Differential Temperature Shutdown/Alarm Enable
40097	delta_temp_avg_shutdown	Average Catalyst Differential Temperature Shutdown/Alarm Enable
40098	delta_temp_log_shutdown	Long Average/Log Catalyst Differential Temperature Shutdown/Alarm Enable
40099	delta_temp_avg_rate	Catalyst Differential Temperature Averaging Rate
40100	delta_temp_alarm_min	Catalyst Differential Temperature Alarm Min
40101	delta_temp_alarm_max	Catalyst Differential Temperature Alarm Max
40102	delta_temp_alarm_delay	Catalyst Differential Temperature Alarm Delay
40103	delta_temp_avg_alarm_min	Average Catalyst Differential Temperature Alarm Min
40104	delta_temp_avg_alarm_max	Average Catalyst Differential Temperature Alarm Max
40105	delta_temp_avg_alarm_delay	Average Catalyst Differential Temperature Alarm Delay
40106	delta_temp_log_alarm_min	Long Average/Log Catalyst Differential Temperature Alarm Min
40107	delta_temp_log_alarm_max	Long Average/Log Catalyst Differential Temperature Alarm Max
40108	delta_temp_log_alarm_delay	Long Average/Log Catalyst Differential Temperature Alarm Delay
40109	delta_temp_shutdown_min	Catalyst Differential Temperature Shutdown Min
40110	delta_temp_shutdown_max	Catalyst Differential Temperature Shutdown Max
40111	delta_temp_shutdown_delay	Catalyst Differential Temperature Shutdown Delay
40112	delta_temp_avg_shutdown_min	Average Catalyst Differential Temperature Shutdown Min
40113	delta_temp_avg_shutdown_max	Average Catalyst Differential Temperature Shutdown Max
40114	delta_temp_avg_shutdown_delay	Average Catalyst Differential Temperature Shutdown Delay
40115	delta_temp_log_shutdown_min	Long Average/Log Catalyst Differential Temperature Shutdown Min
40116	delta_temp_log_shutdown_max	Long Average/Log Catalyst Differential Temperature Shutdown Max
40117	delta_temp_log_shutdown_delay	Long Average/Log Catalyst Differential Temperature Shutdown Delay
40118	dac1_offset	Left Bank O2 Voltage Output Offset
40119	dac1_gain	Left Bank O2 Voltage Output Gain
40120	dac2_offset	Right Bank O2 Voltage Output Offset
40121	dac2_gain	Right Bank O2 Voltage Output Gain
40122	o2_1_offset	Left Bank O2 Offset
40123	o2_1_gain	Left Bank O2 Gain
40124	o2_2_offset	Right Bank O2 Offset
40125	o2_2_gain	Right Bank O2 Gain

Address	Name	Description
40126	o2_heater_i	O2 Heater Integral Gain
40127	o2_heater_p	O2 Heater Proportional Gain
40128	o2_heater_sp	O2 Heater Setpoint
40129	o2_heater_ramp_rate	O2 Heater Warmup Ramp Rate
40130	o2_cal_timer_start	O2 Calibration Warmup Timer Duration
40131	o2_1_enable	Left Bank O2 Sensor Enable
40132	o2_2_enable	Right Bank O2 Sensor Enable
40133	n0regs	Not Used
40134	nregs	Number of Calibration Registers

Warranty

Altronic, LLC warrants that all goods are free from defects in workmanship and material as of the time and place of delivery.

As a matter of general warranty policy, Altronic, LLC honors an original buyer's warranty claim in the event of failure within 12 months of shipment to the end-user, when the equipment has been installed and operated under normal conditions and in accordance with installation instructions contained in the operating manual and generally accepted operating practices.

All warranty work must be performed at the Altronic manufacturing facility in Girard, Ohio. The customer is responsible for shipment or delivery of the product to the facility. Altronic will pay return ground freight. The customer will pay any expedited freight fees.

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