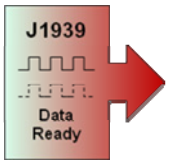
EMC-1P
EMC-1PL

(For Rev. E and higher)

Electric Fan Controller User Manual



www.hctcontrols.com

Revision Record

Rev	Description	Date Released	Last Updated by
Rev 1.0	Initial Revision	1-Dec-12	
Rev B	LED codes, CAN data rate and GUI changes	30-Jun-14	WB

Contents

HCT Introduction

Welcome to **High Country Tek** Inc. HCT is North America's foremost independent designer and producer of modular, ruggedized digital and analog electronic controllers for the fluid power industry.

From our factory in California, we manufacture 'specialty' controllers for specific functions and the user programmable 'DVC family' to enable large area networked system solutions.

The modules are used in mobile, industrial and marine applications. They are also applied successfully in other industry segments.

HCT products are encapsulated in solid flame resistant material for maximum durability, electrical integrity and complete environmental security.

HCT is a market leader in many application arenas, including hydraulic generator, *e-Fan* and hydraulic fan system controls. These controllers facilitate significant fuel, emission and operational savings.

HCT's market neutrality offers integration with any hydraulic OEM valves, pumps, sub-systems or systems.

For more information, please visit us at: **www.hctcontrols.com**.

Product Use Limitations

HCT products may not be suited for any of the following applications:

- Any product which comes under the Federal Highway Safety Act, namely steering or braking systems for passenger-carrying vehicles or on-highway trucks.
- Aircraft or space vehicles.
- Ordinance or military equipment.
- Life support equipment.
- Any end product which, when sold, comes under U.S. Nuclear Regulatory Commission rules and regulations.

HCT does not have any performance assurance programs for testing their products for the above applications.

HCT's products are not designed for these applications and HCT does not warrant, recommend, or specifically approve its products for these applications.

The user shall be solely responsible for any loss or damages occasioned by breach of the provisions of this paragraph and shall carry product liability and liability insurance to insure against such loss or damages.

Cautions

Changing setup values or operating modes while a machine is running may cause unintended machine movement. It could lead to possible **injury** or **death**. Any moving parts should be disabled prior to changing setup values or operating modes. In every case, exercise caution and work should be completed only by qualified personnel.

Product Application Guidelines

ALWAYS do the following

- FULLY read this manual and accompanying data sheets BEFORE starting.
- Isolate this unit from all other equipment BEFORE any form of welding.
- Isolate the controller from ANY form of battery charging or battery boosting.
- Be aware of the electrical & mechanical connections, and the expected reactions of the equipment.
- Operate the units within the temperature range.
- Use the correct tools to do the job (i.e. P.C., software) etc.
- Separate High Voltage AC cables from Low Voltage DC signal and supply cables.
- Make sure power supply is CORRECT, ELECTRICALLY CLEAN, STABLE, and rated for the full load.
- Make sure the controller output voltage & current is compatible with the equipment.
- All unused wires / terminals should be terminated safely.
- Ensure ALL connectors have no unintended SHORT or OPEN circuits.
- Ensure ALL connectors are wired correctly, secure, locked in place and fully connected.
- Disconnect or connect wires to or from this unit only when the power supply is disconnected.
- Use adequate screening in areas of intense Radio Frequency fields.
- Ensure ALL work areas are clear of personnel before operating the controller.
- Follow and abide by local and country health & safety standards.

Controller Specification

Housing Type	HCT encapsulated block
Power Supply Voltage	9 to 32VDC *(Absolute maximum)*
Current Consumption	Valve current + 200mA Quiescent *(Max)*
Command Inputs	**SAE J1939** for charge air, transmission oil and water temperature 3x option selection switches *(ON/Off)* 2x inputs for fan diagnostics *(On/Off)* 1x input for temperature sensor/switch *(Max temp = 50Ω, min temp = 2mΩ)*
Outputs	1x 0 to 100% PWM duty cycle *(Sourcing for EMC-1P, Sinking for EMC-1PL, max 250mA, short circuit protection)* 2x 3A on/off for fan reverse and alarm indicators
PWM Dither Freq.	Software adjustable - 33 to 500Hz
Module Connector	DTF15-12PB Male, 3-way SAE J1939
Communication	4 way, Weatherpak connector, RS232
Housing Material	Black, Polycarbonate
Encapsulation	Flameproof epoxy resin
Mounting	3x No.8 *(5mm)* screws
Temperature Range	-40 to +85ºC *(Operational)* -60 to +90ºC *(Storage)*
NEMA/IP Rating	NEMA 6P/IP67
CAN Data Rate	250Kbps & 500Kbps for all revisions

Controller Dimensions / Mounting Information

- Controller weight is approximately 250g.
- Mount controller in an easily accessible location.
- Mount controller to a flat surface.
- If mounting to a hydraulic product, allow at least a 2mm air gap underneath the unit.
- Use THREE mounting holes with #8 SAE Grade 2 screws.
- DO NOT mount controller with connector facing UP if possible.

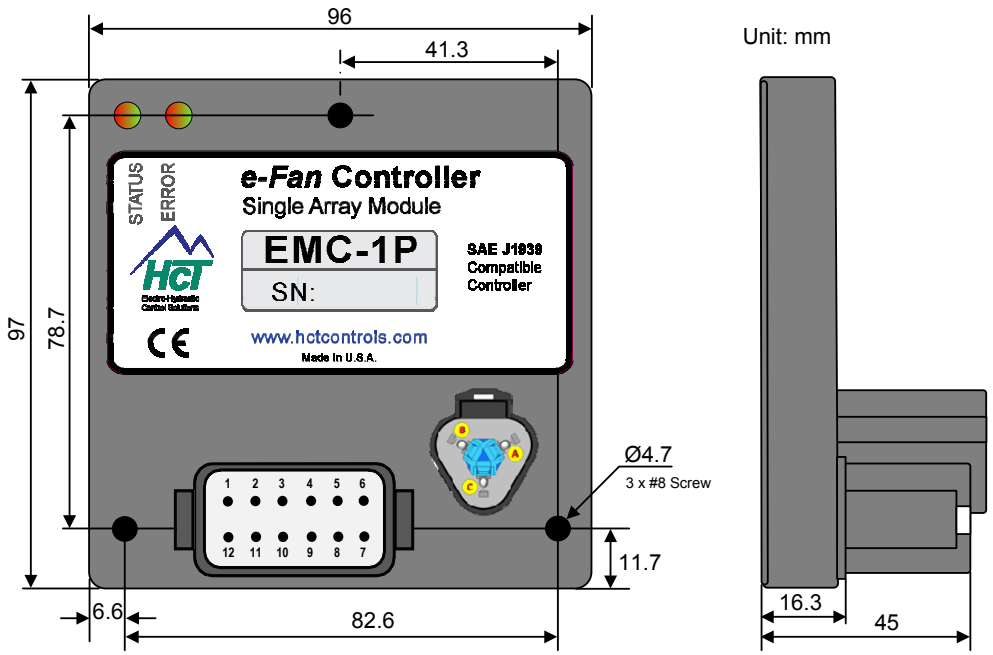


Figure 1

Wiring Diagram

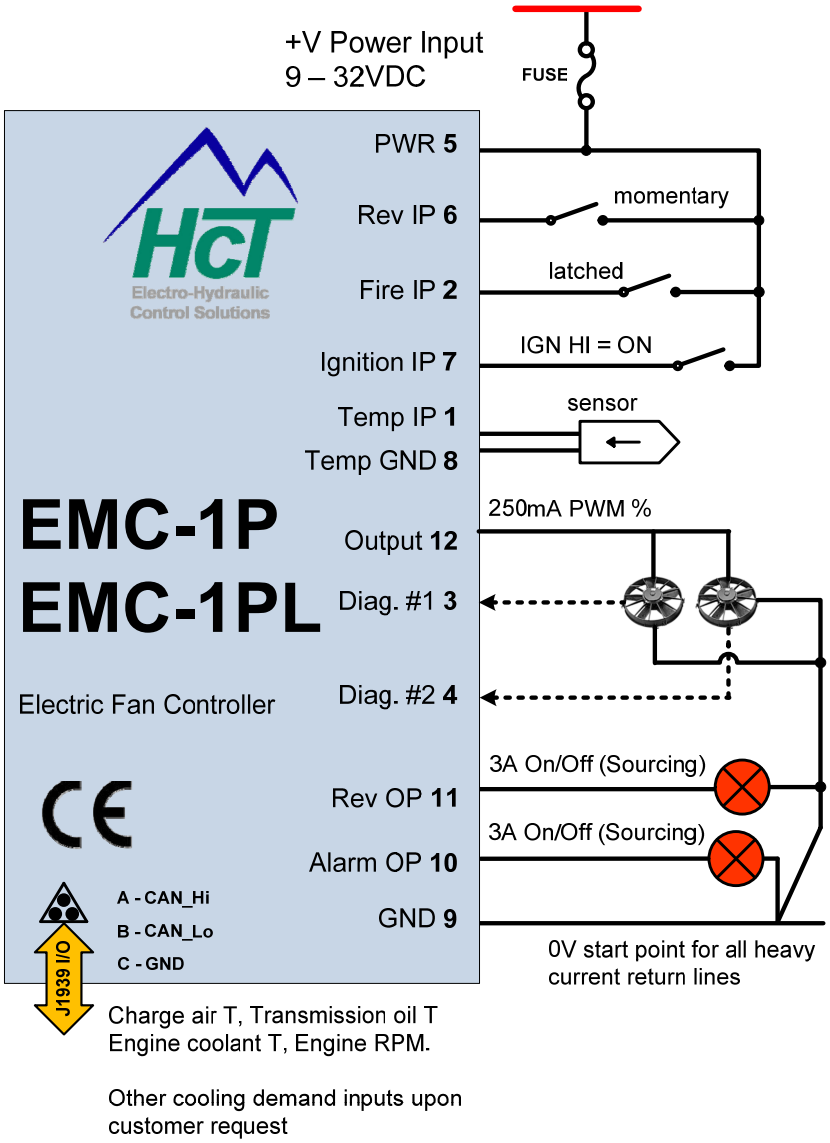
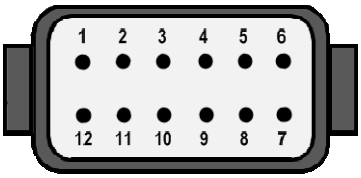


Figure 2

PWM% output is sourcing for EMC-1P. PWM% output is sinking for EMC-1PL.

Pinout

The module has a 12-Pin Deutsch connector with a 4-way Weatherpak for RS232 communication and a 3-way SAE J1939 connector.



EMC-1P/L Connector Designation	
12-way Deutsch Connector DTF15-12PB (Male, Plug)	
PIN	Name
Pin 1	Thermistor/Switch input +
Pin 2	Fire input
Pin 3	Fan #1 diagnostic input
Pin 4	Fan #2 diagnostic input
Pin 5	9-32VDC power supply input +
Pin 6	Reverse fan input (Momentary)
Pin 7	Ignition input
Pin 8	0V - Signal GND
Pin 9	0V - Power supply GND
Pin 10	3A max On/Off for alarm indicator (sourcing)
Pin 11	3A max On/Off for Reverse indicator (sourcing)
Pin 12	0-100% Proportional PWM output (250mA, sourcing for EMC-1P, sinking for EMC-1PL)

3-way Male SAE J1939 Connector	
Pin A	CAN_HI **(SAE J1939)** input
Pin B	CAN_LO **(SAE J1939)** input
Pin C	Not used

LED Diagnostic Codes

Status	Error	Error Description	Alarm Output	Fan Output	Reverse Output	See Note
Off	Off	Power Supply < 8.9VDC or >32 VDC	Off	Off	Off	
On	On	Normal Operation	Off	Normal	Normal	
On	Off	J1939 Message timeout	On	Maximum Fan Speed	Off	
On	On	RPM < Minimum Setting	Off	Minimum Fan Speed	Manual only	
Flashing	On	Reverse sequence active	Off	Reverse Speed	On	
On	Flashing	J1939 Message over temp	On	Maximum Fan Speed	Manual only	1
On	Flashing	Thermistor over temp	On	Maximum Fan Speed	Manual only	1
Flashing	On	Diagnostic error	On	Max Fan Speed	Off	2
Flashing	On	Alarm Output Short	Off	Normal	Off	3
Flashing	On	Reverse Output Short	On	Normal	Off	4
Flashing	On	Thermistor Open/Short	On	Maximum Fan Speed	Off	1
On	On	Unit Over Temp > 80°C	Off	Maximum Fan Speed	Off	1
Flashing	Flashing	Fire Alarm active	On	Fan OFF	Off	

Notes:

1	Maximum fan speed until corrected
2	Attempts maximum fan speed until error is cleared
3	There must be alarm condition before alarm output short happens. GUI displays the 1st error. Only after the 1st error is removed, GUI will display the 2nd error – alarm short. Cycle the power to clear the error if retry output coil errors is not checked.
4	Detects short at the end of reverse cycle.

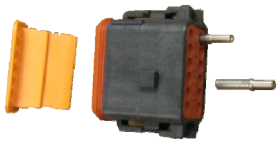
The EMC-1P and EMC-1PL only report the 1st error. After the 1st error is cleared, the unit will report the 2nd error.

If thermistor over temperature happens before the J1939 message times out, the module will report thermistor over temperature only. After thermistor over temperature is cleared, the module will report J1939 message timeout.

Accessories

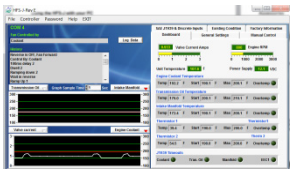
999-10156

Prototype Harness (3M length)



999-10155

12 Way Deutsch Mating Connector Kit



CD-EMC-1P

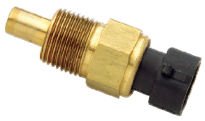
PC set-up software
System diagnostics
Data logging feature

999-10075

4-way weatherpak to RS232

108-00119

RS232 to PC USB



206-00083 (3/8”-18NPT)
206-00083M (M12x1.5)

Liquid thermistor
-40°C to +150°C.

999-10213 (Mating connector)

For both liquid and dry thermistors

206-00084 (3/8”-18NPT)

Dry Thermistor
-40°C to +150°C.

Example Applications

EMC-1P controls 1 bank of 4 E-fans

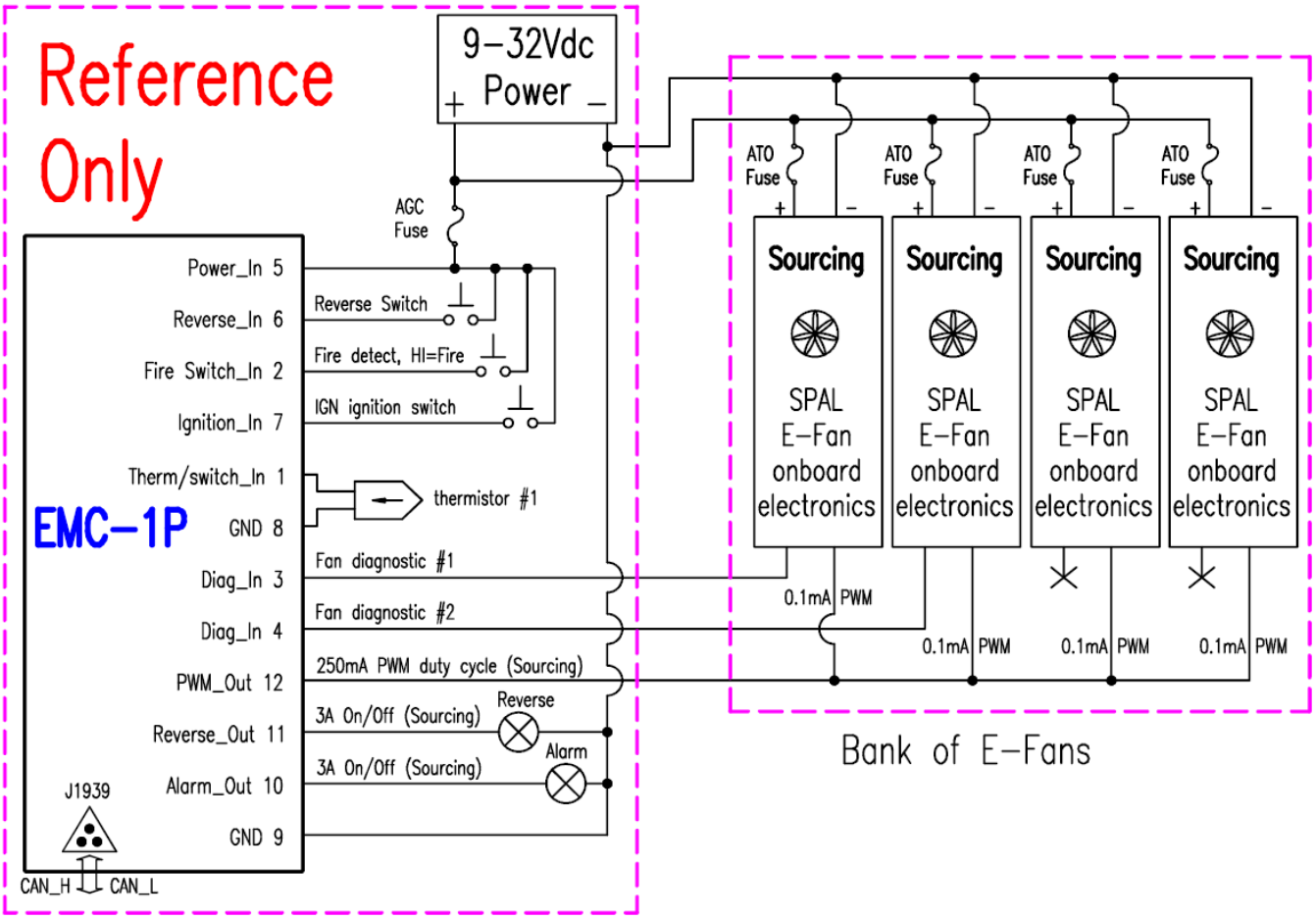


Figure 3

EMC-1PL controls 1 bank of 4 E-fans

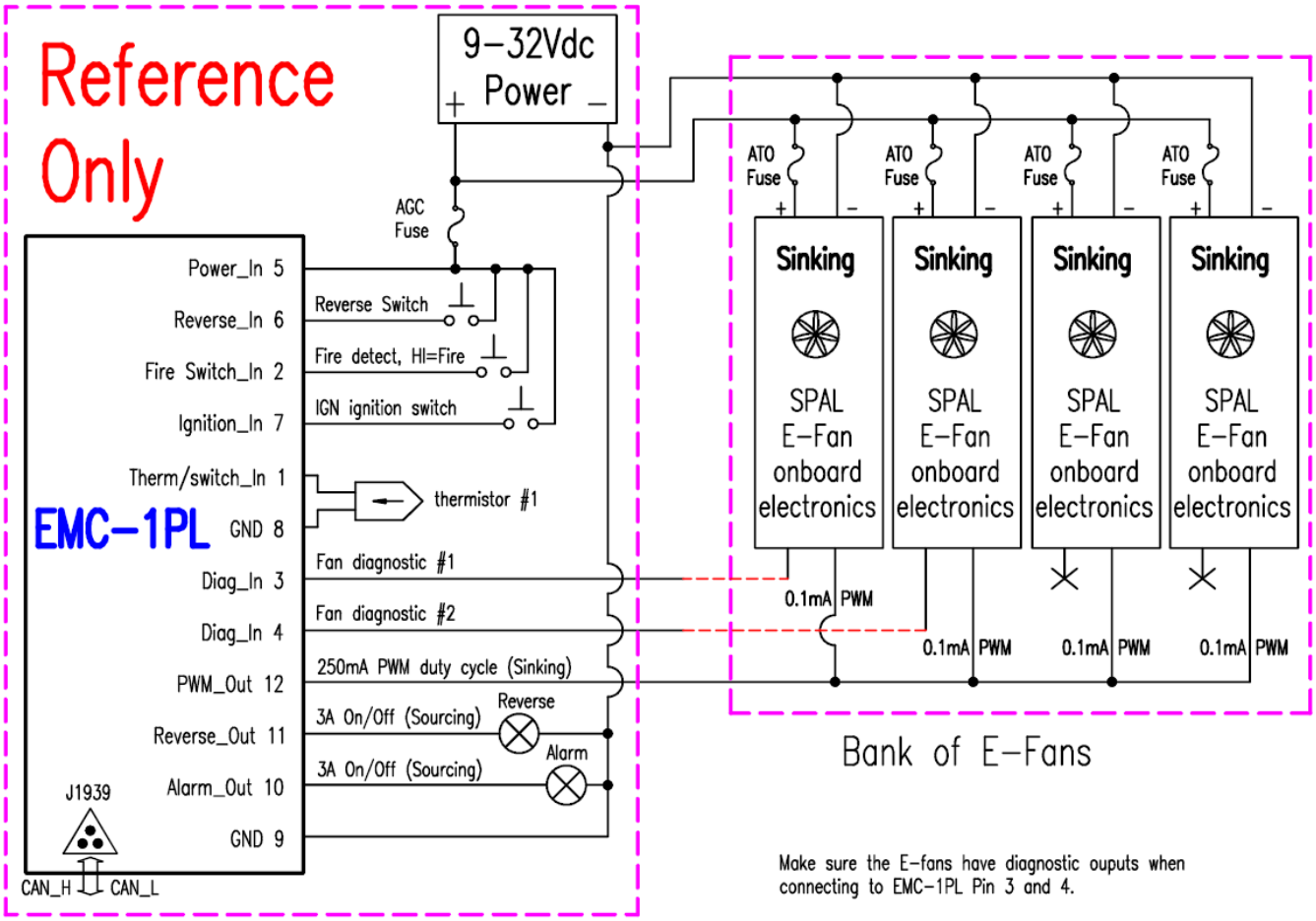


Figure 4

GUI Installation

Use the default file locations for easy future update when installing the Graphical User Interface (GUI). The user has the option to choose file location.

Do NOT run the GUI from a network drive as it needs to access certain files only in the local Windows directories.

System Requirements

- Windows XP, Vista, Windows 7 or 8, 100MB or greater free disk space.

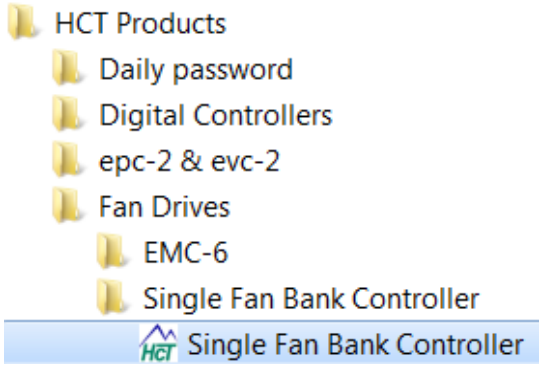
Installation Steps

- Insert the CD and follow the on screen instructions. This will install the GUI, manual and help files.
- Go to Help menu, install the CommFront driver or Mini USB driver.
- To insure a complete install for CommFront, install it twice.
- Install all software and drivers before plugging in the USB dongle or USB cable.

Launch the GUI

Click Start ⇒ HCT Products ⇒ Fan Drives ⇒ Single Fan Bank Controller

The Single Fan Bank Controller GUI is applicable for HFS-J, HFS-J-BUS, EMC-1P, EMC-1PL and EMC-1V.

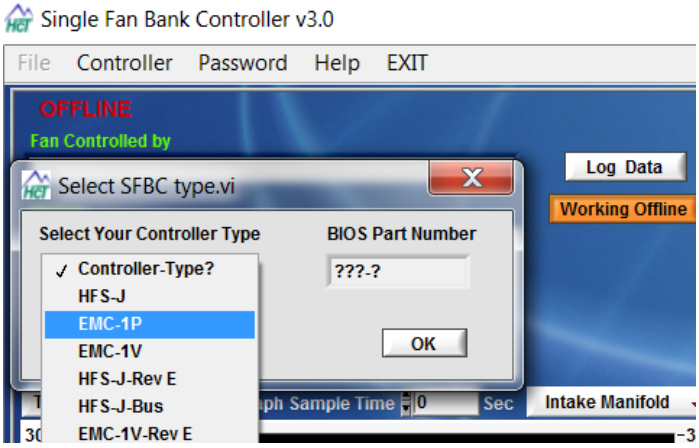


GUI Overview

At start up the GUI searches all the PC communication ports and identifies the controller. The GUI appears once the module is identified. The GUI recognizes the hardware and seamlessly transits to the respective GUI.

- **Work Off Line** – allows the user to work with GUI offline without the module.
- **Select Your Controller Type** – allows the user to select the respective controller to work with GUI. Single Fan Bank Controller GUI works with HFS-J, HFS-J-BUS, EMC-1P, EMC-1PL and EMC-1V.
- **BIOS Part Number** – displays the BIOS part number of the chosen controller.

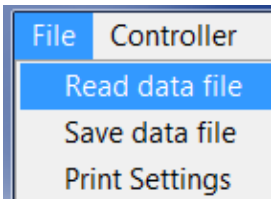
The user can load any existing data files, modify them or create new data files and save them to the PC without an OEM password.



Software Compatibility

EMC-1P(L) can be used with old GUI and new GUI.

File



- **Read data file** – reads the data file from the PC to the GUI and writes it to the controller permanently.
- **Save data file** - saves the settings to a data file that may be loaded into any EMC-1P/L controller.
- **Print Settings** – prints settings into a text file or to a printer.

Settings not permanently saved will be lost after a power cycle.

Controller

- **Reconnect to Unit** - the GUI resets communication with the module, re-reads and updates all variables.

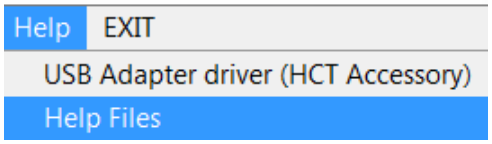
Password

- **OEM** Level – allows full access to view settings, setup data files, apply changes or upload data files to controllers and manual control.

Passwords are *'**cAsE SeNsitivE**'*.

Help

- **USB Adapter Drivers** – opens the folder where USB driver installation instruction and USB driver install are located.
- **Help Files** - opens the folder in C:\HCT products/Fan Drives/Single Fan Bank Controller.

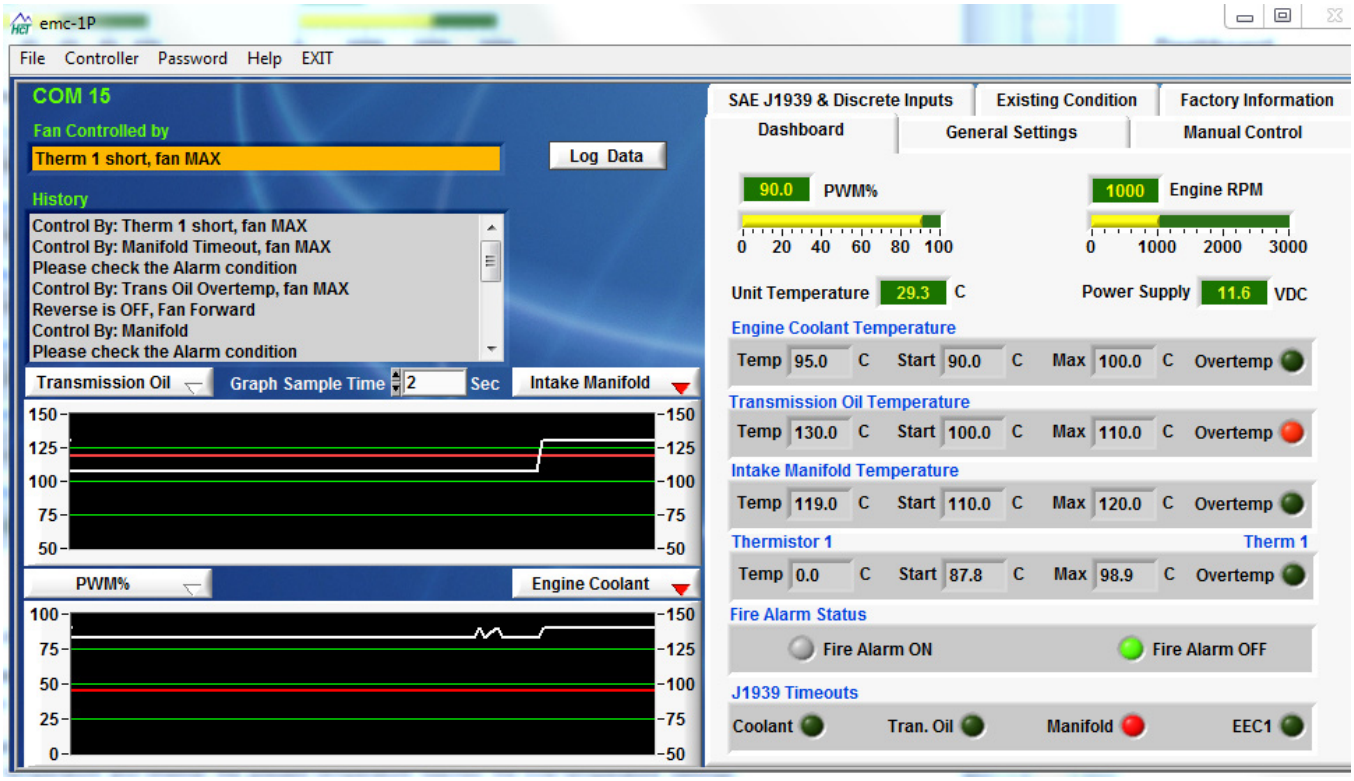


Exit

Exit Program – exits the GUI and frees up the communication port and memory used by the application.

Dashboard

The Dashboard monitors the fan system in real time.



- **PWM%** – displays the PWM duty cycle output.
- **Engine RPM, Unit Temperature, Power Supply** – displays the engine rpm, the unit temperature and voltage at the power supply.
- **Engine Coolant Temperature** - displays the current, fan start, fan maximum temperature of the engine coolant and whether the current temperature reaches the over temperature settings or not.
- **Transmission Oil Temperature** - displays the current, fan start, fan maximum temperature of the transmission oil and whether the current temperature reaches the over temperature settings or not.
- **Intake Manifold Temperature** - displays the current, fan start, fan maximum temperature of the intake manifold and whether the current temperature reaches the over temperature settings or not.

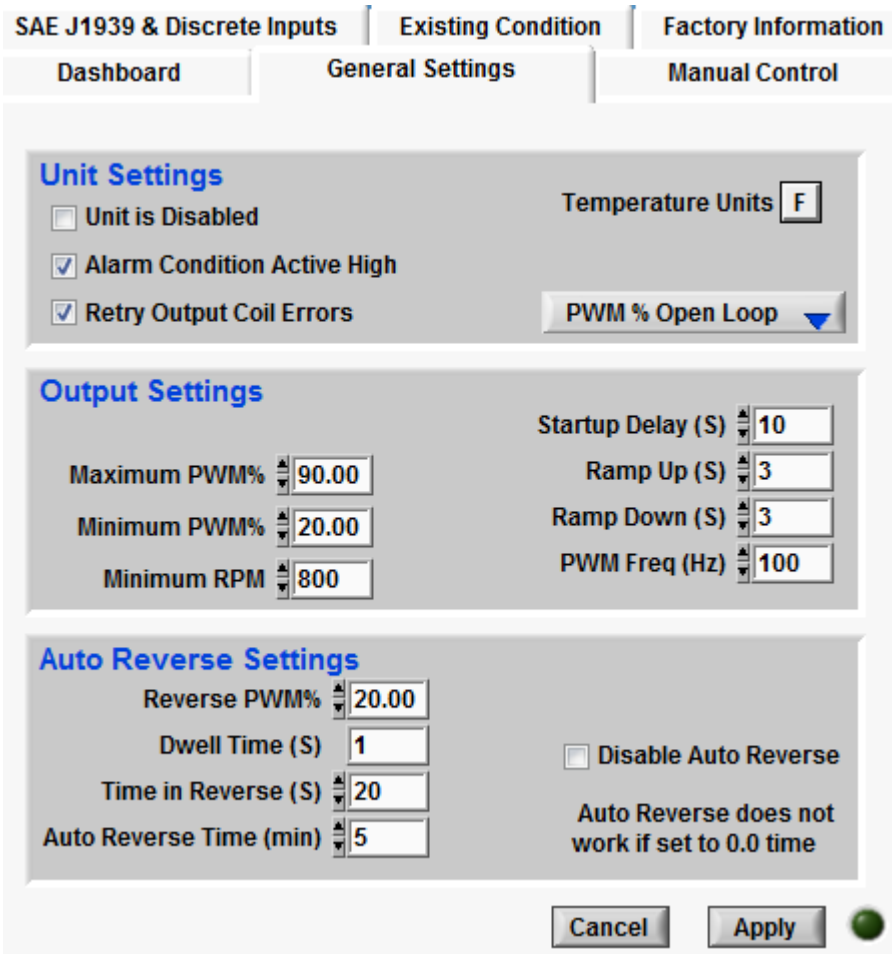
- **Thermistor 1** - displays the current, fan start, fan maximum temperature of the thermistor 1 and whether the current temperature reaches the over temperature settings or not.
- **Fire Alarm Status** - displays whether fire input is ON or OFF.
- **J1939 Timeouts -** displays the status of J1939 message. Red indicates timeout, green indicates valid.
- **History window** - displays the current operating condition and the operating history.
- **Log data** - logs the operational data in Excel format. The file size is only limited by the PC's hard-drive capacity.

  Each log begins with a list of settings followed by operational information. The sample rate depends on the workload of the PC and the controller at recording. A timestamp scales the logs appropriately. Subsequent logs may be saved in a new file or appended to the original file by selecting the original file.

  The log file is saved as a .csv file. Microsoft Excel can be used to open this file.
- **Graphing window** – tracks two variables that are individually scaled. Select the variable from the **Pull Down Menus** and scale the graphs.
- **Graph Sample Time** - changes the speed of the graph display. Increase it to have slower speed.

General Settings

The user may define the features and parameters of the electric fan system.



- **Temperature Units** – displays the temperature input in °C or °F. “Apply” the change, the GUI will update.
- **Unit is Disabled** – factory default. Uncheck it to enable the controller.
- **Alarm Condition Active High** – when checked, the alarm output is normally low. When the input goes high, the alarm is ON. When not checked the logic is reversed.
- **Retry Output Coil Errors** – This only applies to reverse and alarm output short.

  When an output short is detected, the LED’s will indicate a short condition until the unit is cleared with a power cycle or if Retry Output Coil Errors is checked, the error is reset once the short is no longer detected.

- **PWM % Open Loop** – EMC-1P and EMC-1PL only outputs PWM duty cycle.
- **Maximum PWM%** (0 to 100%) – sets the maximum PWM% output. Set it according to the E-fan's specification and the designed maximum fan rpm.
- **Minimum PWM%** (0 to 100%) – sets the minimum PWM% output when there is any cooling demand. The PWM% is 0 when there is no cooling demand. Set it according to the E-fan's specification.
- **Minimum RPM** (0 to 4000) – is the Minimum Engine RPM that the controller considers the engine is running normally.
- **Startup Delay** (0 to 30 seconds) – is the time delay to ensure the engine to reach high idle before fan runs.
- **Ramp Up** (1 to 30 Seconds) – the Output PWM% ramps **UP** from minimum to maximum setting in forward direction.
- **Ramp Down** (1 to 30 Seconds) – the Output PWM% ramps **Down** from maximum to minimum setting in forward direction.
- **PWM Frequency Hz** (33 to 500Hz) – sets the PWM frequency according to the E-fan's specification.
- **Reverse PWM%** (0 to 100%) – sets the reverse PWM% according to the E-fan's specification.
- **Dwell Time** (1 second) – the time when PWM% is 0% between the forward and reverse direction. It is hard-coded for EMC-1P/L.
- **Time in Reverse** (0 to 600 seconds) – see the EMC-1P(L) reverse cycle definition (figure 6). It is the time between the start of caging and start of E-Fan coasting down in reverse direction.
- **Auto Reverse Time** (0 to 1440 minutes) – see the EMC-1P(L) reverse cycle definition (figure 6). It is the time between the start of fan normal forward speed and when the reverse signal occurs.
- **Disable Auto Reverse** – enables or disables auto reverse feature.

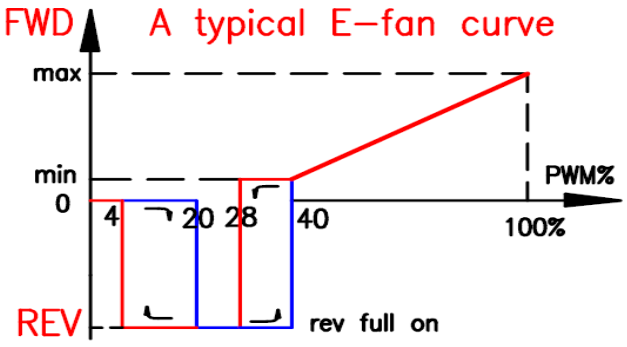


Figure 5

EMC-1P/L Reverse Cycle Definition

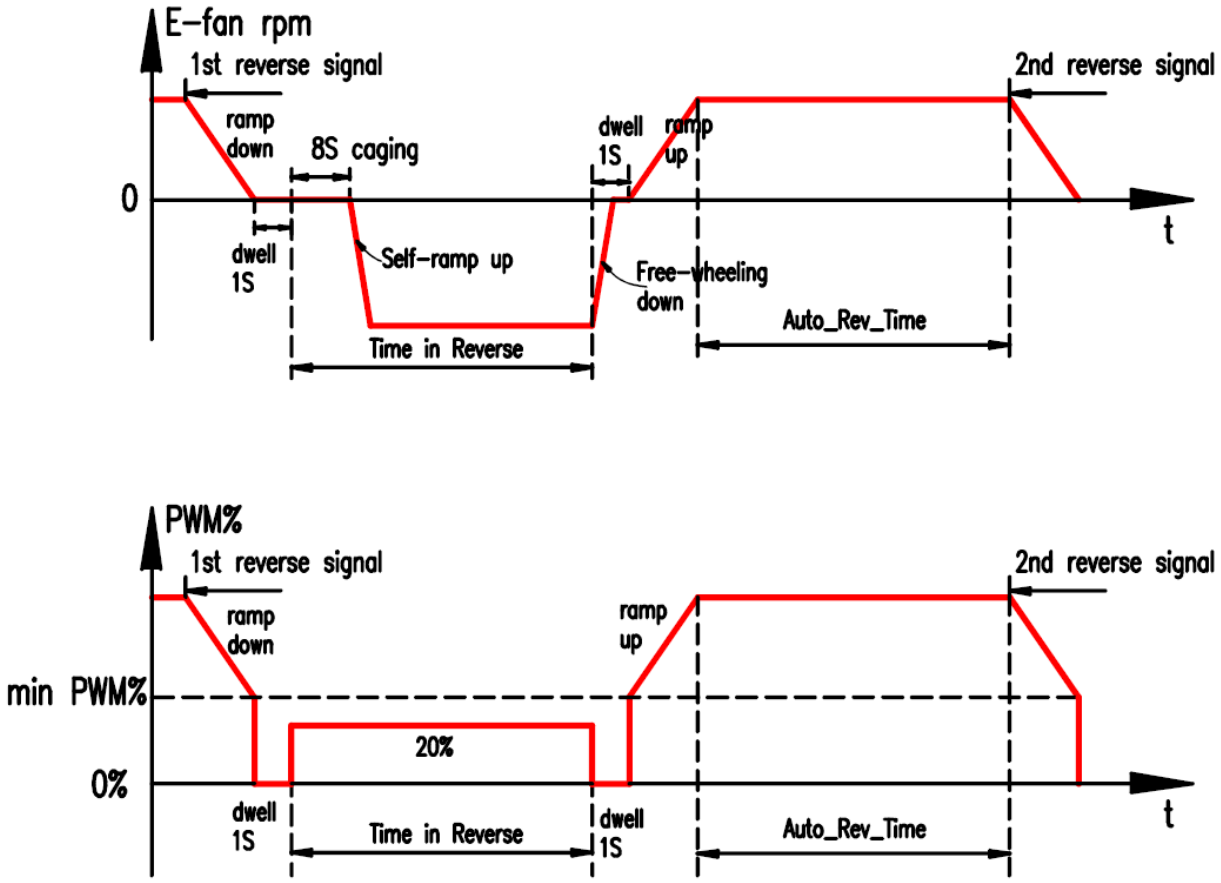
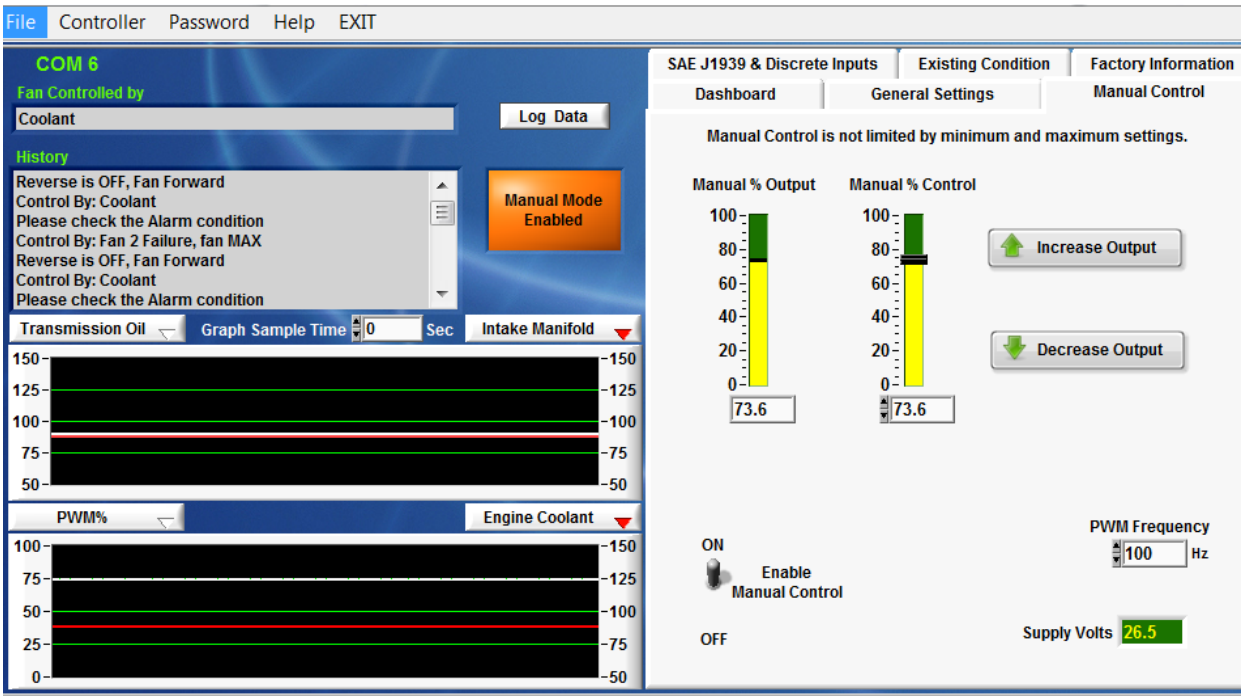


Figure 6

Manual Control

The user may manually verify that the E-fans are working properly and determine the maximum, minimum and reverse PWM duty cycles.

- **Enable / Disable Manual Control** – turns On/Off manual control.
- **Manual % Output** – displays the PWM duty cycle output.
- **Manual % Control** – displays the command input. To change it, the user can drag the bar, type the value or click the increase/decrease arrows.

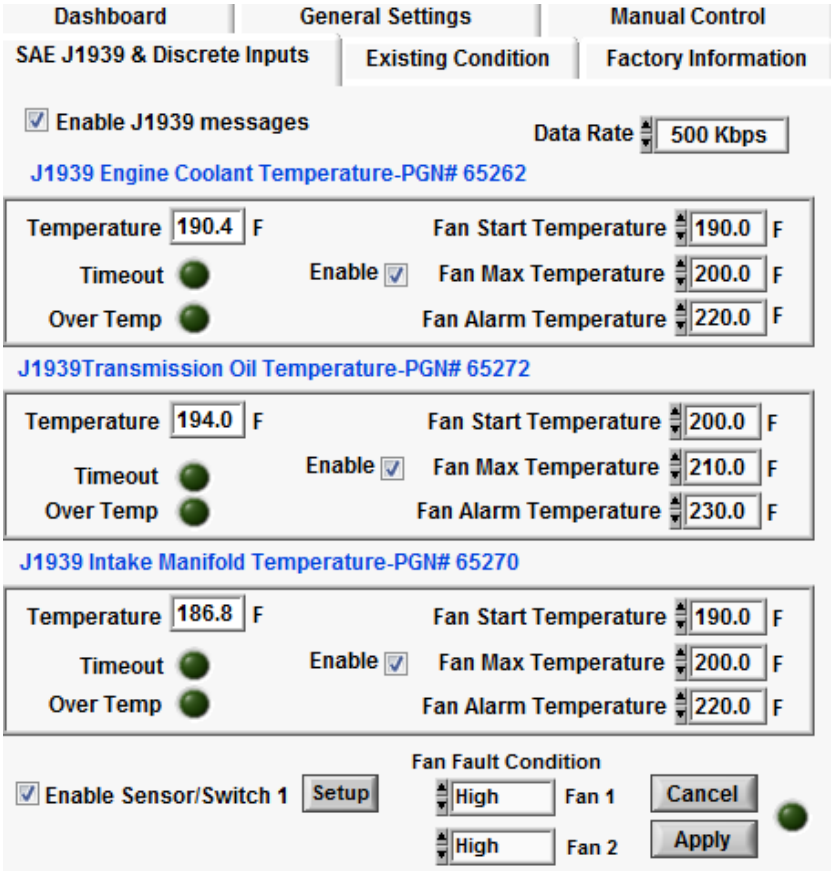


Caution

- *Only allowed with the OEM password.*
- *All settings on this tab will immediately affect the output.*
- *All limits and controls are bypassed.*
- *The controller goes back to normal operation when disabling the manual mode.*
- *Cycling power on the unit will exit the manual model.*

SAE J1939 & Discrete Inputs

The user may define up to 3x J1939 temperature messages from engine coolant, transmission oil and charge air and 1x thermistor/switch input. The user also defines the diagnostic pin for the E-fan fault conditions.



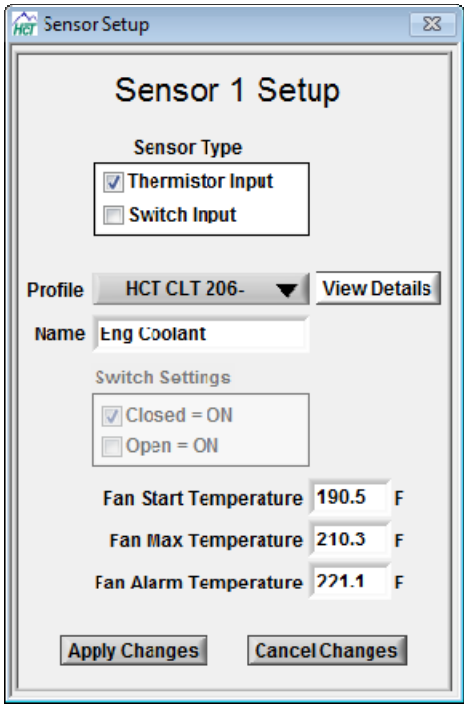
- **Enable J1939 messages** – enables the J1939 messages. The messages received are engine coolant temperature, transmission oil temperature, charge air temperature and the engine RPM.

  If you are not using J1939 messages in the fan drive system, disable it so that minimum engine rpm does not affect the controller functions.

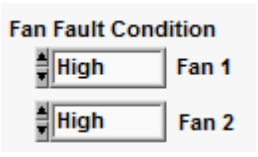
- **Data Rate** – selects the J1939 CAN BUS data rate. The CAN data rate on the GUI has to match data rate of the J1939 message from the engine. If mismatched, the controller cannot communicate with the engine.

  CAN Data rate changes will not take effect until cycling the power.

- **J1939 Engine Coolant Temperature PGN# 65262** – sets the fan start, fan maximum rpm temperature and the temperature to turn on the alarm output controlled by the engine coolant.
- **J1939 Transmission Oil Temperature PGN# 65272** – sets the fan start, fan maximum rpm temperature and the temperature to turn on the alarm output controlled by the transmission oil.
- **J1939 Intake Manifold Temperature PGN# 65270** – sets the fan start, fan maximum rpm temperature and the temperature to turn on the alarm output controlled by the charge air.
- **Enable Sensor/Switch 1** – When the thermistor input is selected, it sets fan start, fan maximum rpm temperature and the temperature to turn on the alarm output controlled by the external sensor. When the switch input is selected, switch input ON means maximum fan rpm, switch input OFF means fan 0rpm.



- **Fan Fault Condition** –
  - If set at High, the alarm output will be ON when the diagnostic inputs are high.
  - if set at Open, the alarm output will be ON when the diagnostic inputs are open.
  - If set at Low, the alarm output will be ON when the diagnostic inputs are low.
  - If set at disabled, there will be no alarm condition for diagnostic inputs.



For tier III engines, the default settings are 190°F to 200°F for engine coolant and charge air temperature, 200°F to 210°F for transmission oil temperature.

The PWM duty cycle output is proportional to the highest cooling demand among all these inputs.

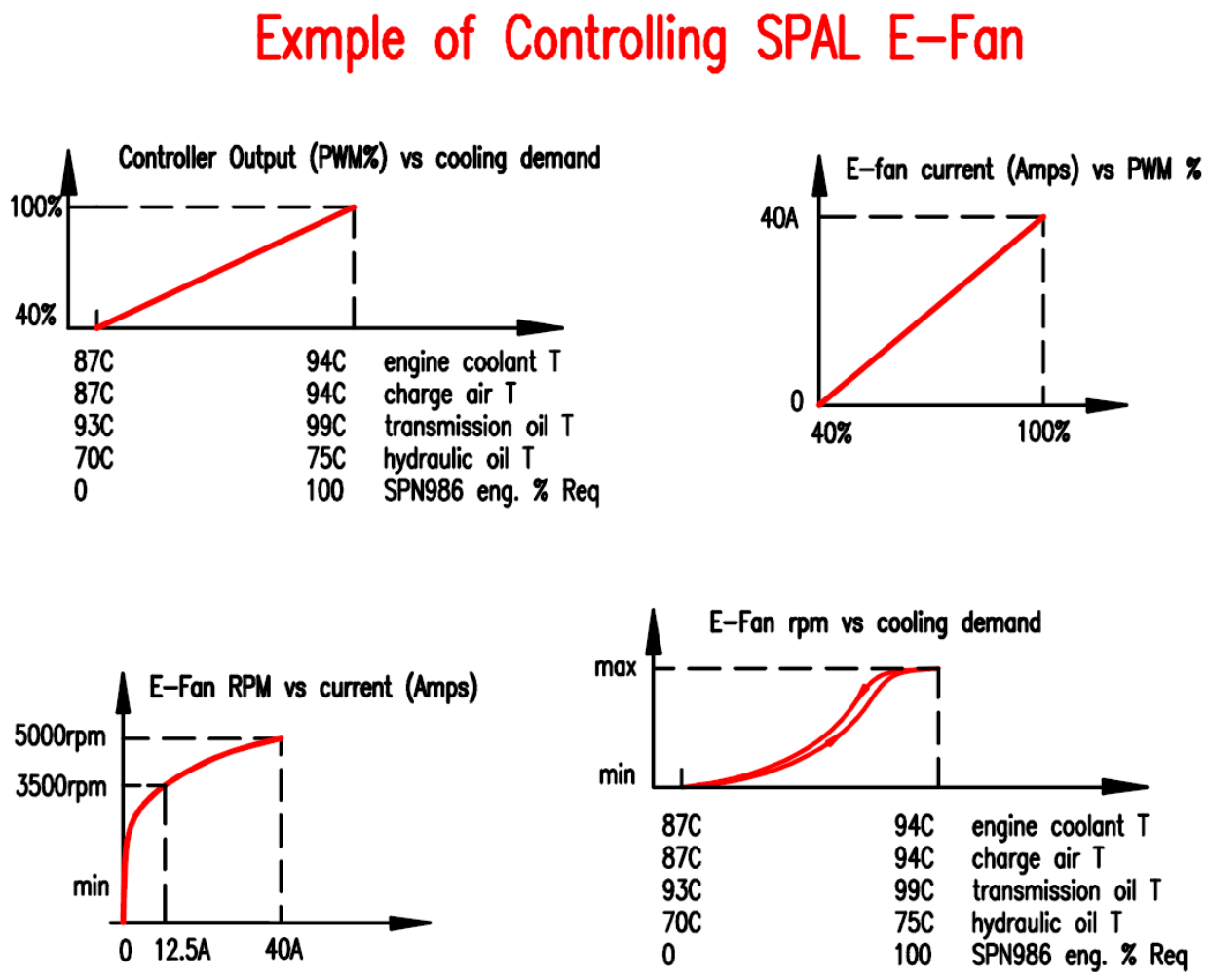
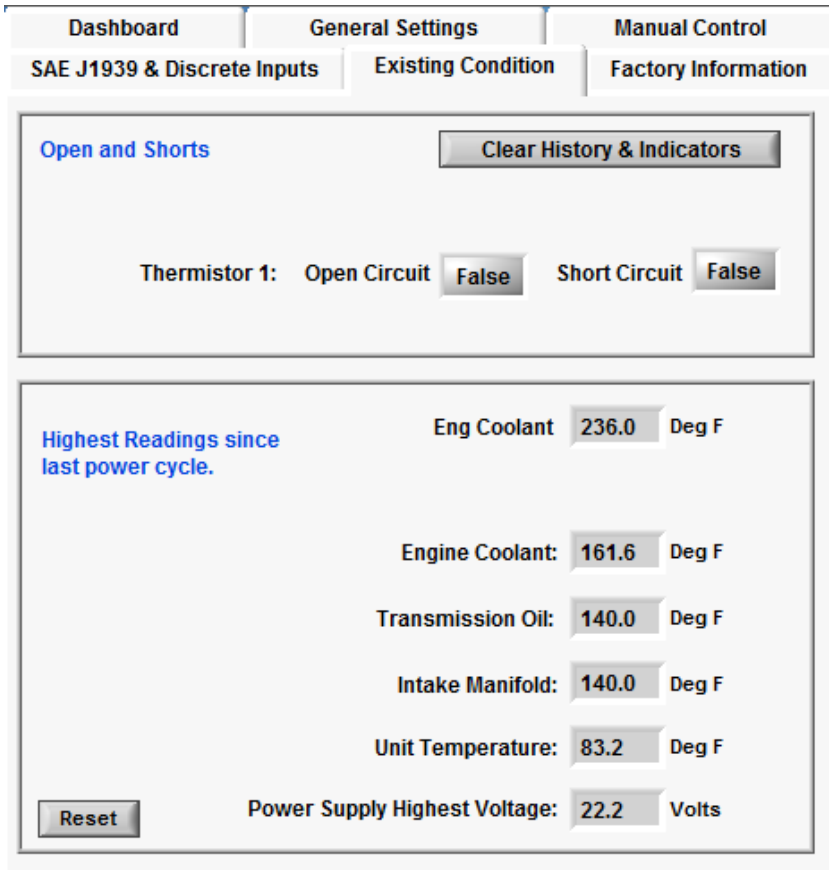


Figure 7

Existing Condition

The controller registers the thermistor open and short errors, the highest readings since the last power cycle. This will help troubleshooting the controller.

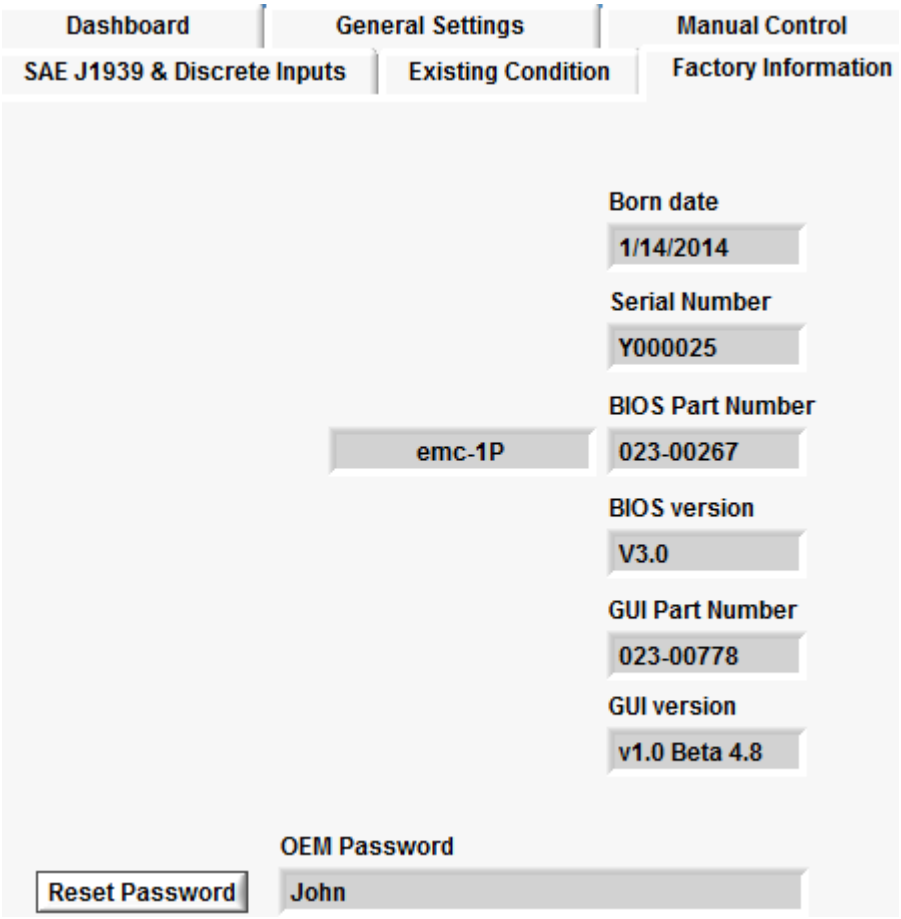
Power cycle will reset and clear the history.



- **Clear History & Indicators** – clears the history in the history window and the open or short indicators on this page.
- **Reset** – resets the temperature and voltage readings to the current value.

Factory Settings

The GUI displays the controller serial number, BIOS and GUI part number, etc.



- **Born Date -** is the date when the module is configured first time after leaving the factory.
- **Serial Number** – displays the serial number of the specific unit.
- **BIOS Part Number and Version** - displays the BIOS part number of the specific unit, reference to the factory record.
- **GUI Part Number and Version** – displays the GUI part number and version of the GUI.
- **OEM Password** - the **OEM Password** is included in the GUI CD. Users may reset the OEM password. Just don't forget it.

Appendix A Troubleshooting Communication Port Adapters

Windows does not like Com ports with the same name, and some devices might hang onto a com port when not in use. Here is how to clean and remove problem ports.

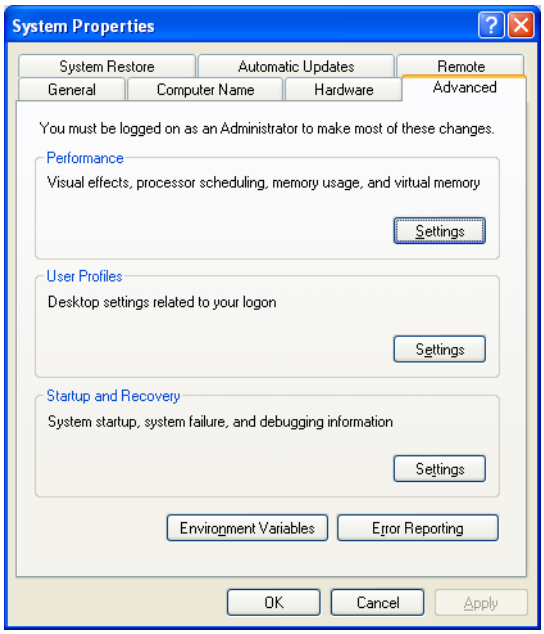
Option 1

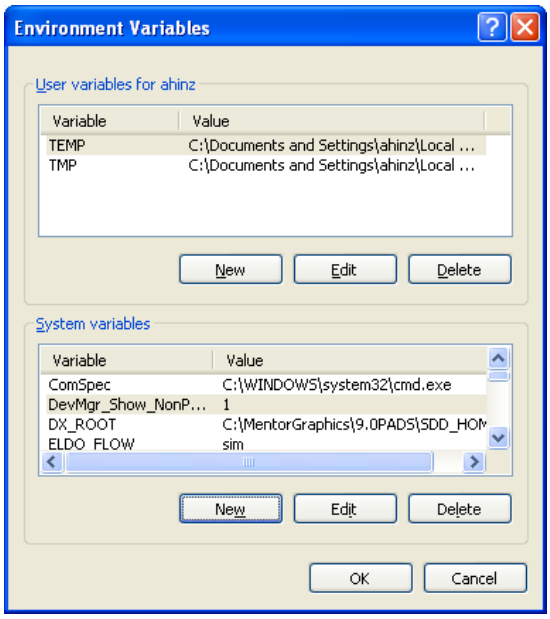
Devices that have been installed but are not currently available are "phantom devices". These devices are not usually displayed in the device manager, but can be made to be displayed.

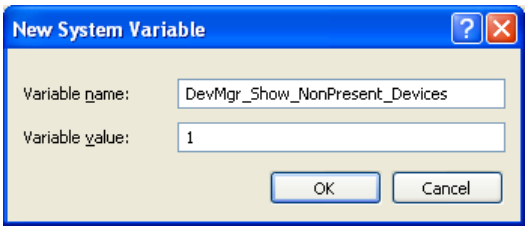
This allows device properties to be changed or devices to be uninstalled even though the device is not physically connected to the PC.

Control Panel ⇒ System Properties ⇒ "Advanced" option and click "Environment Variables"

⇒ In the System Variables sections, click "New"
⇒ "DevMgr_Show_NonPresent_Devices" and set the value to 1 ⇒ OK ⇒ Close the System Properties panel.



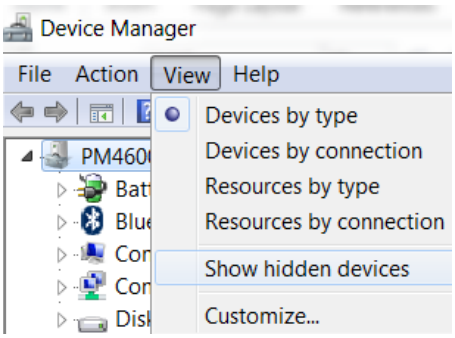


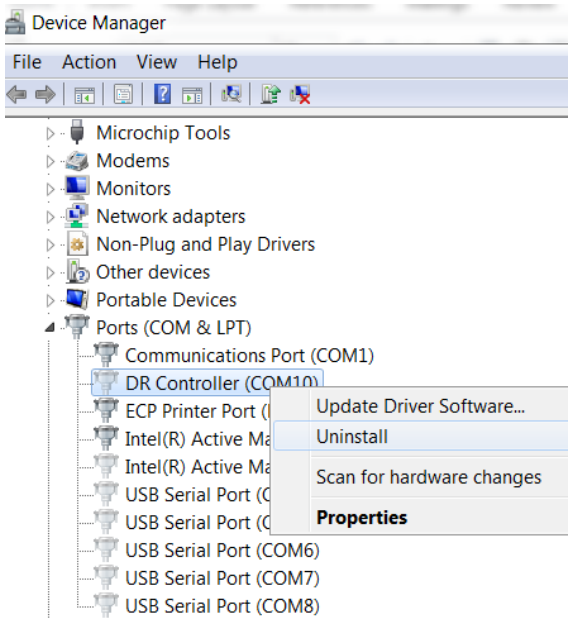


⇒ Open the Device Manager
⇒ "View" ⇒ Show Hidden Devices".

Device Manager will show all hidden and phantom devices.

⇒ Uninstall the phantom devices by right clicking on them, and 'delete'.
⇒ Reboot the PC.





Option 2

Open the Control Panel: Add or Remove Programs

Remove old versions of FTDI drivers Windows Driver Package – FTDI CDM Driver Package

Reinstall the FTDI Drivers as explained in Software Installation above.

The current driver package for your operating system may be obtained directly from the vendor at http://www.ftdichip.com/FTDrivers.htm

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- Agriculture
- Cranes & lifts
- Refuse & Re-cycling
- Construction
- Off-Road vehicles
- Forestry, Wood & Pulp
- Reclamation & Salvage
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