emc-3

3 array e-Fan
Electronic Controller
User Guide

High Country Tek, Inc. (HCT) is North America's foremost independent designer and producer of modular, ruggedized digital and analog electronic controller products for the fluid power industry.

From our factory in California, we build, test and produce 'specialty' controllers that provide solutions for specific everyday functions as well as our 'DVC family' of fully adaptable user programmable units that can be integrated together to enable large area networked system solutions.
The modules are typically used in mobile, industrial and marine applications, but are also applied successfully in several other growing global market segments.

Because High Country Tek has an industry unique non-repairable product protection system, with every module encapsulated in solid flame resistant material for maximum durability, electrical integrity and complete environmental security, we have to deliberately select the highest quality components from our suppliers at all times, ensuring our 100% operating shipped product.

HCT is also a market leader in many application arenas, including hydraulic generator, *e-Fan* and hydraulic fan system controls where significant fuel, emission and operational savings can be realized by using one of the aforementioned specialty units to optimize the applications operation.

HCT's market neutrality and flexible product configuration approach offers dependable integration with virtually any hydraulic OEM products for easy, simple and accurate control of valves, pumps, sub-systems or systems.

Our best-in-class customer service and product reliability is well known and trusted throughout the fluid power network and we look forward to working with you in the future.
For our latest information, products, updates, guides and accessories, please visit us on-line at:

www.hctcontrols.com

The information in this publication is intended as a guide only, and ***High Country Tek, Inc. (HCT)*** *takes NO responsibility for usage and implementation in any user entered values into the provided GUI structure.*

HCT strongly suggests that the user attends one of the product training courses to ensure correct and full understanding of this information and to learn further optimized methods of control techniques.
Please contact HCT customer service to book one of the scheduled training dates or to discuss arranging a course specific to your company needs.
Thank you for using High Country Tek Inc. Products*.*

Introduction

The emc-3application allows for independent control of up to three fan banks. Each bank is controlled by any three of the seven Command Inputs.

The emc-3 is designed to drive PWM controlled fans with up to 3 Amps/Channel by providing a High Side sourcing 100Hz PWM signal.

A normally low Alarm output notifies the user to check the fan system.

A normally low Reverse output notifies the user that the fans are in reverse.

The emc-3 has the following inputs:

- 3 thermistor inputs
- 8 configurable discreet inputs for fan diagnostics
- 1 discreet Ignition/Enable input
- 1 discreet Reverse input
- 1 configurable Fire Input

The emc-3 can be configured either by using the HCT Intella® PLM, or over the SAE J1939 CAN Bus using configuration messages.

A Status message is available that will transmit all the I/O status as well as thermistor temperatures and various program states on the SAE J1939 CAN Bus.

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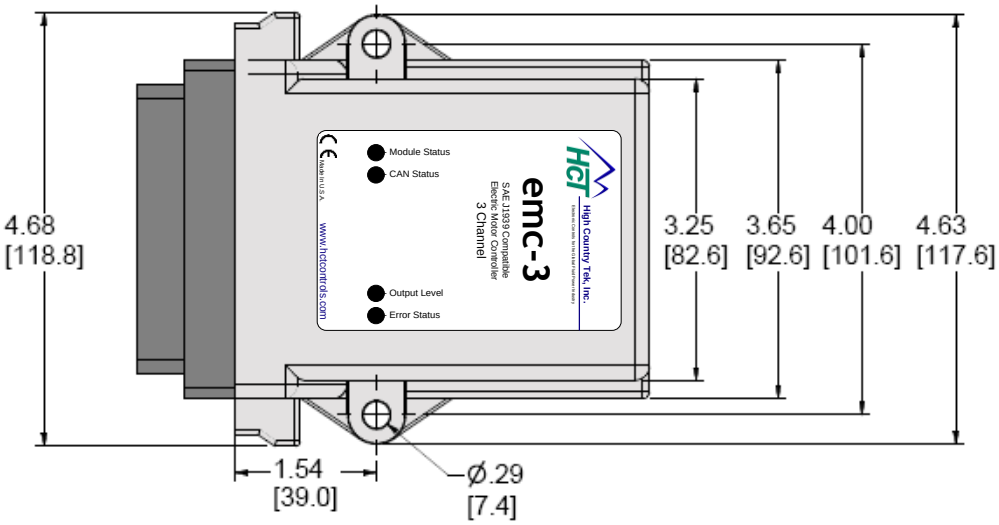
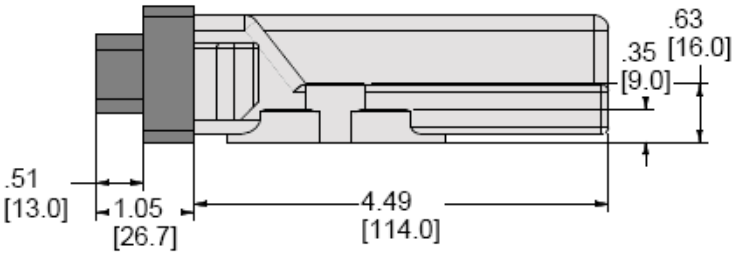
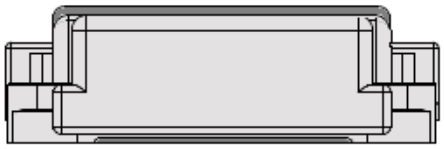
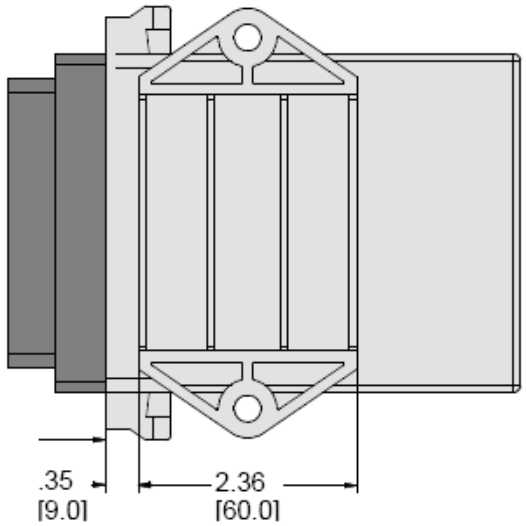
Controller Mechanical information









IMPORTANT NOTE:

Recommended tightening torques for the securing bolts are as follows:

For a 1/4-20 bolt, SAE Grade 5

DRY Torque: 8 Ft-Lbs
Lubricated Torque: 6.3 Ft-Lbs

Use 0.5” or 12-15mm spaces if mounted to hot surface 9 i.e. manifold assembly)

Mount with connector facing downwards to prevent collection of debris and liquids

Theory of Operation

Normal Operation

At Power On, the module will not run the fans until the Startup Delay has expired.

The Startup Delay is set by entering a value into the EE-Memory location "Startup_Delay_Seconds" using the PLM or SAE J1939 configuration messages.

After the delay the controller will check 2 inputs before enabling the outputs:

- The Minimum Engine RPM (must exceed entered value).
- The Ignition Switch (must be set to ON/+V to allow operation).

If the "Engine Minimum RPM" variable is set to 0 in EE-Memory, the emc-3 is enabled whenever the Ignition Switch is ON ($\geq 3.5_{VDC}$).

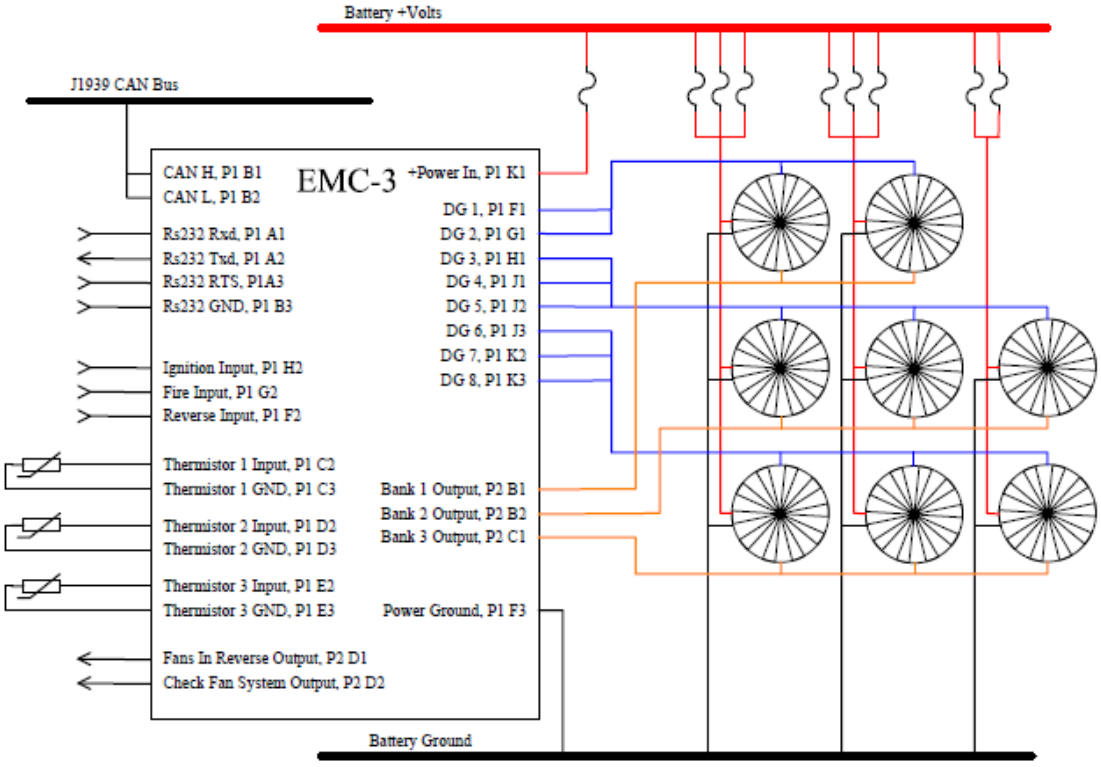
If the "Engine Minimum RPM" variable is set to a value greater than 0; if the Engine RPM read from the EEC1 message is greater than the "Minimum Engine RPM" set point and the ignition switch is on, the emc-3is enabled. If the module detects the Ignition Input as "Off" ($\leq 1.5_{VDC}$) while there is a valid Engine RPM message detected, the Module will be enabled as required and report an Ignition Input Error. Fans will continue to run as demanded by the current configuration.

When the emc-3 is enabled, the cooling demand is determined by the values set in the EE-Memory for each enabled input. Each input's demand is converted to a percentage for comparison and the highest demand will control the fan RPM independently for each Bank.

If the "Bank *n* Fan Idle Enable" is disabled (0) in the EE-Memory, and the cooling demand is 0, the fan is set to the "Bank *n* Off DYCY". If the "Bank *n* Fan Idle Enable" is enabled (> 0) in EE-Memory, that Bank will run at min RPM even when the cooling demand is 0 as long as the emc-3 is enabled. The minimum RPM is determined by setting the "Bank *n* Start DYCY" in EE-Memory.

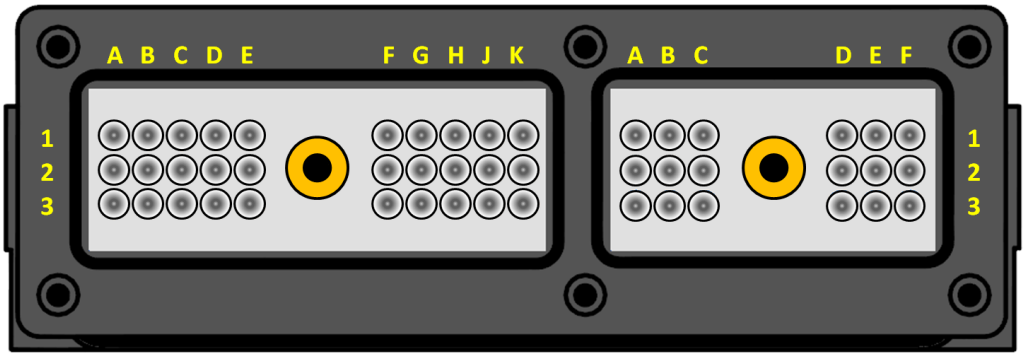
The "Minimum Fan Cycle Seconds" setting in the EE-Memory determines the minimum amount of time that the fans must run before stopping, assuming the fan controller is enabled. For example, if the "Minimum Fan Cycle Seconds" were set to 20 seconds and a Fan Banks demand rose above 0, the fans on that Bank would start. Then if the demand dropped back to 0 after 5 seconds, the fans on that bank would be set to the "Bank *n* Start DYCY" for the remaining 15 seconds of the "Minimum Fan Cycle Seconds" before shutting off. The "Minimum Fan Cycle Seconds" has no effect if the "Bank *n* Fan Idle Enable" is set.

Wiring


Battery +Volts
J1939 CAN Bus
EMC-3
CAN H, P1 B1
CAN L, P1 B2
Rs232 Rxd, P1 A1
Rs232 Txd, P1 A2
Rs232 RTS, P1A3
Rs232 GND, P1 B3
Ignition Input, P1 H2
Fire Input, P1 G2
Reverse Input, P1 F2
Thermistor 1 Input, P1 C2
Thermistor 1 GND, P1 C3
Thermistor 2 Input, P1 D2
Thermistor 2 GND, P1 D3
Thermistor 3 Input, P1 E2
Thermistor 3 GND, P1 E3
Fans In Reverse Output, P2 D1
Check Fan System Output, P2 D2
+Power In, P1 K1
DG 1, P1 F1
DG 2, P1 G1
DG 3, P1 H1
DG 4, P1 J1
DG 5, P1 J2
DG 6, P1 J3
DG 7, P1 K2
DG 8, P1 K3
Bank 1 Output, P2 B1
Bank 2 Output, P2 B2
Bank 3 Output, P2 C1
Power Ground, P1 F3
Battery Ground

Connector Pin Out

EMC-3 Connector Pin Out								
P1, 30 Pin Connector								
Pin	**Name**	**Function**	**Pin**	**Name**	**Function**	**Pin**	**Name**	**Function**
A1	RXD	RS232 RX - Pin A	D2	UNI 2	Thermistor 2	G3	GND	SIG COM
A2	TXD	RS232 TX - PIN C	D3	GND	SIG COM	H1	DIG 3	DG 3
A3	RTS	RS232 RTS - PIN D	E1	Vref	+5 V Regulated Output	H2	ANA 3	Ignition In
B1	CAN 1 H	J1939 CAN H	E2	UNI 3	Thermistor 3	H3	GND	SIG COM
B2	CAN 1 L	J1939 CAN L	E3	GND	SIG COM	J1	DIG 4	DG 4
B3	GND	RS232 GND - PIN B	F1	DIG 1	DG 1	J2	DIG 5	DG 5
C1	CAN 2 H	J1939 CAN H	F2	ANA 1	Reverse In	J3	DIG 6	DG 6
C2	UNI 1	Thermistor 1	F3	GND	SIG COM	K1	+PWR	+V Supply In
C3	GND	SIG COM	G1	DIG 2	DG 2	K2	DIG 7	DG 7
D1	CAN 2 L	J1939 CAN L	G2	ANA 2	Fire In	K3	DIG 8	DG 8
P2, 18 Pin Connector								
Pin	**Name**	**Function**	**Pin**	**Name**	**Function**	**Pin**	**Name**	**Function**
A1	+PWR	+V Supply In	C1	PWM 3	Bank 3 Output	E1	GND	SIG COM
A2	+PWR	+V Supply In	C2	HS 4		E2	GND	SIG COM
A3	GND	SIG COM	C3	Vref	+5 V Regulated Output	E3	GND	SIG COM
B1	PWM 1	Bank 1 Output	D1	HS 5	Fans In Reverse Output	F1	GND	SIG COM
B2	PWM 2	Bank 2 Output	D2	HS6	Check Fan System Output	F2	GND	SIG COM
B3	Vref	+5 V Regulated Output	D3	Vref	+5 V Regulated Output	F3	GND	SIG COM



30 Way Metri-Pak Connector

18 Way Metri-Pak Connector

Connectors Viewed In This Direction

Reverse Mode Operation

A Reverse Cycle may be initialized in Manual or Automatic mode.

Initiation of a **Manual Reverse Cycle** is done by momentarily toggling the Reverse Input at any time that the Ignition Switch is "On". A Manual Reverse Cycle Request is considered valid if the Reverse Input pulse is between 500mS and 3.0S in duration. Pulses of less than 500mS will be ignored. Pulses lasting longer than 3 seconds will be considered a fault and cancel the Reverse Cycle. This prevents a shorted switch from holding the fans in reverse.

The **Auto Reverse feature** will initiate a reverse cycle at a period determined by the "Auto Reverse Interval Minutes" set point. When set to 0, the Auto Reverse Feature is disabled. When the "Auto Reverse Interval Minutes" is set, the Auto Reverse Cycle timer is reset each time an Auto Reverse Cycle is initiated. This means that each Auto Reverse Cycle is run within the period for the next cycle.

Valid Auto Reverse Intervals are 2 to 500 Minutes (8 hours).

NOTE:
Momentarily toggling the Reverse Input during any active Reverse Cycle will cancel that Reverse Cycle.

Expiration of the Auto Reverse Interval Timer or toggling the Reverse Input anytime the System is enabled will cause a reverse cycle. During a Reverse Cycle, the following sequence takes place;

1. The "Fans in Reverse Output begins flashing at ≈ 1 Hz
2. All the fans freewheel for the period determined by the "Reverse Dwell Seconds" set point. (all Banks set to "Bank *n* Off DYCY")
3. The Reverse signal is sent to all Fan Banks, "Bank *n* Reverse DYCY"
4. All Banks remain in Reverse for the period determined by the "Reverse Cycle Seconds" Set point.
5. The "Fans in Reverse Output stops flashing
6. All fans banks resume normal operation.

Manual Control

To manually control the Fan Banks, set “Manual Control Enable” to a number greater than 0. Then do any one of the following;

1. Cycle power,
2. Cycle the Ignition Switch or
3. Reduce the engine RPM to less than the “Minimum Engine RPM” set point in the EE-Memory.

Once the emc-3 has entered Manual Mode, each Banks fan speed is determined by the “Bank *n* Manual DYCY” set points in the EE-Memory.

Valid settings are 0% to 100%

Auto dB Test Mode (field noise measurement)

The Auto dB Test Mode is designed to allow users to test the noise level of the fan banks without having to control the emc-3 from the PLM or the CAN Bus. When the Auto dB Test Mode is activated, the Fan Banks will be set to the value entered in the EE-Memory location “Auto dB Test Percent” for the duration determined by the “Auto dB Test Time” set point.

To enter the Auto dB Test Mode, set the Reverse Switch to “On” and hold it, then Cycle Power to the emc-3. When the Status LED on the emc-3module begins to blink (Red), release the Reverse Switch. When the test has timed out, the emc-3 resumes normal operation automatically.

Default values are;

Auto dB Test Time – 30 Seconds
Auto dB Test Percent – 70% of maximum fan speed

Inputs

Command Inputs

With only one exception, all command inputs have common settings:

1. Start Temp – The set point at which positive demand is calculated.
2. Max Temp – The set point for 100% demand.
3. Over Temp – The set point at which an error is reported due to over temperature.

An Input demand is calculated as a percentage of error between the Start and Max Temp set points.

The Exception to the above is when using the J1939 Percent Requested Fan Speed (SPN 986) message, as an input at which point the demand for the input (0% to 100%) is determined directly by the ECM.

Command Inputs are selected by entering their code number in the “Bank *n* Control *n*” EE-Memory locations. Each Bank has 3 controls available for assignment.

The available Command Inputs used to control the fans and their codes are as follows;

Code	Description
1	Percent Fan Request from ECM – PGN 57344 or 57599, automatically detected
2	Coolant Temp – PGN 65262
3	Manifold Temp – PGN 65270
4	Transmission Oil Temp – PGN 65272
5	Thermistor 1, Delphi HCT PN:206-00083 or 206-00084
6	Thermistor 2, Delphi HCT PN:206-00083 or 206-00084
7	Thermistor 3, Delphi HCT PN:206-00083 or 206-00084

NOTE:

1. Any Input may be used in more than one bank.
2. Individual J1939 CAN Messages are enabled / disabled by assigning them to control an output.

Diagnostic (digital) Inputs (ALL via 30 way)

There are eight digital inputs available on the emc-3, used to monitor fan health; they may be configured either as Active Low or Active High by setting the EE-Memory variable “Fan DG Input Enable” as follows;

0 – DG Inputs are disabled.
1 – DG Inputs Enabled active low.
2 – DG Inputs Enabled active high.

The number of digital Inputs interrogated by the emc-3 is determined by the sum of the Number of Fans assigned to all three banks. DG inputs are assigned for use in order and by Bank assignment.

For example if a 2 is entered in Bank 1 Number of Fans and 6 is entered in Bank 2 Number of Fans then DG inputs 1 & 2 are assigned to Bank 1 and DG inputs 3 – 8 are assigned to Bank 2.

Reverse Input (30 way / Pin F2)

The Reverse Input is an active high discreet input. It is used to manually initiate or cancel a Reverse Cycle. A Manual Reverse Cycle Request is considered valid if the Reverse Input pulse is between 500mS and 3.0S in duration. Pulses of less than 500mS will be ignored. Pulses lasting longer than 3 seconds will be considered a fault and cancel the Reverse Cycle. This prevents a shorted switch from holding the fans in reverse.

If a reverse cycle is active and the Reverse Switch is toggled again, the current reverse cycle will be cancelled. Auto Reverse cycles can also be canceled in this manner.

Fire Input (30 way / Pin G2)

The Fire Input is either an Active High or Active Low discreet input with a 500mS debounce. The Fire Input is configured as follows;

0 – DG Inputs are disabled.
1 – DG Inputs Enabled active low.
2 – DG Inputs Enabled active high.

When a Fire valid signal is detected, all outputs are set to their “Bank_*n*_Off_DYCY” setting until cleared.

Ignition Input (30 way / Pin H2)

The Ignition input is an Active High discreet input with a 500mS debounce.
If the “Engine Minimum RPM” is zero, the emc-3 is enabled whenever the Ignition Input is “On”.

If the “Minimum Engine RPM” variable is enabled, when the Ignition Input is “Off” and there is a valid Engine RPM message detected, the emc-3 will report an Ignition Input Error.

Outputs (all via 18 way)

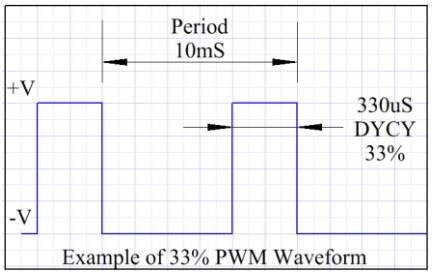
Output Bank Settings

Each Bank has the following configuration settings;

1. Off DYCY – The duty cycle used to turn the fan off
2. Start DYCY – The duty cycle used to run the fan at minimum speed
3. Max DYCY – The duty cycle used to run the fan at maximum speed
4. Rev DYCY – The duty cycle used to run the fan in reverse.
5. Number of Fans – The Number of fans assigned to the bank
6. Fans Idle Enable – When set, it makes the fans run at minimum speed when the system is enabled and there is no cooling demand.

Fan Bank Outputs

The Fan Bank Outputs source a 100Hz PWM signal up to 3 Amps/Channel by switching the input supply voltage at the output pin.



Example of 33% PWM Waveform

Fans In Reverse Output

The Fans In Reverse Output will source up to 3 amps at the input supply voltage during the Reverse Cycle. The Fans In Reverse Output is intended to drive an indicator that can notify the operator that a Reverse Cycle is in progress. Duty Cycle = 50%, Period = 1Hz

Check Fan System Output

The Check Fan System Output will source up to 3 amps at the input supply voltage whenever there is a trouble detected by the module. The Check Fan System Output is intended to drive an indicator to notify the operator that the Fan System requires attention. When no errors are detected, the output will be “Off”.

Normally, the Check Fan System Output is either on or off. In the event that the Module Internal Temperature ≥ 85°C, the module will pulse the output on and off as follows;
Duty Cycle = 50%, Period = 1Hz.

Indicators

Status LED

The Status LED will flash Red to indicate trouble codes. Module behavior varies according to the error detected. The following table lists the trouble codes for the emc-3 and their associated behavior;

1. DG Input Active — Indication Only (Load absorbed by the system)
2. Over Temp Active — Indication Only (Fans at Max Already)
3. CAN Bus Error — Affected Fan Bank(s) Max Speed until clear
4. Fire Input Active — All Fans Hard Stop (Bank_*n*_Off_DYCY)
5. Rev Mode Active — Indication only
6. Ignition Input Error — Indication only
7. Auto dB Test Active — Indication only
8. Manual Mode Active — Indication only
9. Thermistor Input Error — Indication only

NOTE: Any trouble detected will also cause the Check Fan System to turn “On”, normal operation such as a reverse cycle will not.

Module Status, CAN Status and % Output indicators are defined as follows;

Module Status	
LED STATE	**MEANING**
Off	There is no power applied to the module.
On **GREEN**	The module is operating in a normal condition.
Flashing **GREEN**	Device is in standby state. May need servicing.
On **RED**	Module has an unrecoverable fault.
On **YELLOW**	System Disabled active
Flashing **RED**	Low Supply Voltage.

CAN Status	
LED STATE	**MEANING**
Off or Flashing **GREEN**	Normal Indications

% Current O/P	
LED STATE	**MEANING**
Off (Outputs Disabled) **GRN** (0-33%) **YEL** (34-66%) **RED** (66-100%)	
Flashing **RED**	PWM or High Side output Short circuit detected

Error Status	
LED STATE	**MEANING**
Off	No errors
Flashing **YELLOW**	Output Short Detected
Multi Digit Blink Code **RED**	Application defined blink codes listed above.

Module Configuration

The EMC-3 may be configured by using either the DVC PLM or from the J1939 CAN Bus using any configurable CAN application.

PLM Configuration

Open the DVC PLM and enter at least a level 1 password;
Level 1 – ycz2ee
Level 2 – a4qz6v
Level 3 – wwqelr

Using the EE-MEMORY screen, enter the desired settings and save changes.

SAE J1939 CAN Bus Configuration

The emc-3 listens for the configuration message 18FF014Eh. When detected, it will transmit its current configuration settings on message 18FF814Eh. Both 18FF014Eh and 18FF814Eh are multiplexed messages. Currently there are 11 separate data sets that are transmitted or received by these messages. Byte 1 bits 1 – 4 of the messages are used for multiplexing; valid multiplexing address values are 01h through 0Bh. See below for details of each data set.

Transmitting 18FF014Eh to the emc-3 with a particular valid multiplex address value will cause the emc-3 to enable and transmit the same data set on address 18FF814Eh using the same multiplexing address. To write data to the emc-3 using a multiplexed data set, the user must set Byte 8 of 18FF014Eh to a value of D6h to enable writing to the EE-Memory.

SAE J1939 CAN Messages

All J1939 CAN messages for the emc-3 can be either enabled or disabled except the FD (fan drive) State message. The FD State is always transmitted when the system is enabled. The HCT Status message will be transmitted when it is enabled in the EE-Memory and the system is enabled.

Setting the Engine Minimum RPM to a value that is greater than 0 will enable the EEC1 message. All other messages are enabled by entering their corresponding control number in one of the nine Bank Control fields. All unused messages are automatically disabled in software to prevent false timeout errors.

Current messages and their control selection codes are as follows, reference SAE J1939-71 for specific information about the following messages and SPNs for the emc-3;

Received Messages

Name	PGN	Description	SPN / Measurement	Control Selection Code
CM1	57344	Percent Requested Fan Speed	SPN 986, Requested Fan Speed	1
CM1	57599	Percent Requested Fan Speed	SPN 986, Requested Fan Speed	1
ET1	65262	Engine Temperature 1	SPN 110, Engine Temperature	2
IC1	65270	Intake Conditions 1	SPN 105, Manifold Temperature	3
TF	65272	Transmission Fluids	SPN 177, Transmission Oil Temperature	4
EEC1	61444	Electronic Engine Control 1	SPN 190, Engine Speed	N/A

Send Messages

Name	PGN	Description
FD	65213	SPN 975 & SPN 977, Fan Drive State
HCT Status	65280	Status of Module Flags & I/O

HCT Status Message – enable/disable through the EE-Memory.
This message is multiplexed and alternately sends two data sets;

HCT Status Message

Transmission Cycle Time:	1000mS	
Data Length:	8	
Data Page:	0	
PDU Format:	180	
PDU Specific:	0	
Priority:	6	
Parameter Group Number:	46080	(B400)

Start Position	Length	Parameter Name
Byte 1	1 Byte	See Mux Table
Byte 2	1 Byte	See Mux Table
Byte 3	1 Byte	See Mux Table
Byte 4	1 Byte	See Mux Table
Byte 5	1 Byte	See Mux Table
Byte 6	1 Byte	See Mux Table
Byte 7	1 Byte	See Mux Table
Byte 8	1 Byte	See Mux Table

Data Set 1
Byte 1 Bits 1 – 4 Multiplex value 0x00h

HCT State Message Bytes 2 & 3

bit	Description
1	DG_1 State
2	DG_2 State
3	DG_3 State
4	DG_4 State
5	DG_5 State
6	DG_6 State
7	DG_7 State
8	DG_8 State
9	Coolant Over Temp
10	Manifold Over Temp
11	Transmission Over Temp
12	Therm1 Over Temp
13	Therm2 Over Temp
14	Therm3 Over Temp
15	Fire Detected State
16	System Enabled State

HCT State Message Bytes 4 & 5

bit	Description
1	EEC1 Message State
2	CM1 FF Message State
3	CM1 00 Message State
4	ET1 Message State
5	IC1 Message State
6	TF Message State
7	Therm1 error State
8	Therm2 error State
9	Therm3 error State
10	Ignition Input State
11	Reverse Input State
12	Fire Input State
13	Fans In Reverse Output State
14	Check Fan System Output State
15	Ignition Input Error State
16	Reserved

Data Set 1		
Byte 6	Bank 1 output PWM%	Offset = 0 Factor = 1
Byte 7	Bank 2 output PWM%	Offset = 0 Factor = 1
Byte 8	Bank 3 output PWM%	Offset = 0 Factor = 1

Data Set 2		
Byte 1	Bits 1 – 4	Multiplex value 0x01h
Byte 2	Reserved	
Byte 3	Reserved	
Byte 4	Reserved	
Byte 5	Reserved	
Byte 6	Thermistor 1 Temp	Offset = 0 Factor = 1
Byte 7	Thermistor 2 Temp	Offset = 0 Factor = 1
Byte 8	Thermistor 3 Temp	Offset = 0 Factor = 1

Current Configuration Message Format

Transmission Cycle Time:	100mS	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	128	
Priority:	6	
Parameter Group Number:	65409	(FF81)

Start Position	Length	Parameter Name
Byte 1	1 Byte	See Mux Table
Byte 2	1 Byte	See Mux Table
Byte 3	1 Byte	See Mux Table
Byte 4	1 Byte	See Mux Table
Byte 5	1 Byte	See Mux Table
Byte 6	1 Byte	See Mux Table
Byte 7	1 Byte	See Mux Table
Byte 8	1 Byte	See Mux Table

Change Settings Message Format

Transmission Cycle Time:	100mS	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	1	
Priority:	6	
Parameter Group Number:	65281	(FF01)

Start Position	Length	Parameter Name
Byte 1	1 Byte	See Mux Table
Byte 2	1 Byte	See Mux Table
Byte 3	1 Byte	See Mux Table
Byte 4	1 Byte	See Mux Table
Byte 5	1 Byte	See Mux Table
Byte 6	1 Byte	See Mux Table
Byte 7	1 Byte	See Mux Table
Byte 8	1 Byte	See Mux Table

emc-3 Configuration Message Multiplex Data Set Table

1st Data Set

Byte 1	Mux Control	0x01h
Byte 2	Coolant Start Temp	
Byte 3	Coolant Max Temp	
Byte 4	Coolant Over Temp	
Byte 5	Manifold Start Temp	
Byte 6	Manifold Max Temp	
Byte 7	Manifold Over Temp	
Byte 8	Write Enable (FF01 Only)	

2nd Data Set

Byte 1	Mux Control	0x02h
Byte 2	Trans Oil Start Temp	
Byte 3	Trans Oil Max Temp	
Byte 4	Trans Oil Over Temp	
Byte 5	Thermistor 1 Start Temp	
Byte 6	Thermistor 1 Max Temp	
Byte 7	Thermistor 1 Over Temp	
Byte 8	Write Enable (FF01 Only)	

3rd Data Set

Byte 1	Mux Control	0x03h
Byte 2	Thermistor 2 Start Temp	
Byte 3	Thermistor 2 Max Temp	
Byte 4	Thermistor 2 Over Temp	
Byte 5	Thermistor 3 Start Temp	
Byte 6	Thermistor 3 Max Temp	
Byte 7	Thermistor 3 Over Temp	
Byte 8	Write Enable (FF01 Only)	

4th Data Set

Byte 1	Mux Control	0x04h
Byte 2	Bank 1 Off DYCY	
Byte 3	Bank 1 Start DYCY	
Byte 4	Bank 1 Max DYCY	
Byte 5	Bank 1 Rev DYCY	
Byte 6	Bank 1 Number of Fans	
Byte 7	Bank 1 Fans Idle Enable	
Byte 8	Write Enable (FF01 Only)	

5th Data Set

Byte 1	Mux Control	0x05h
Byte 2	Bank 2 Off DYCY	
Byte 3	Bank 2 Start DYCY	
Byte 4	Bank 2 Max DYCY	
Byte 5	Bank 2 Rev DYCY	
Byte 6	Bank 2 Number of Fans	
Byte 7	Bank 2 Fans Idle Enable	
Byte 8	Write Enable (FF01 Only)	

6th Data Set

Byte 1	Mux Control	0x06h
Byte 2	Bank 3 Off DYCY	
Byte 3	Bank 3 Start DYCY	
Byte 4	Bank 3 Max DYCY	
Byte 5	Bank 3 Rev DYCY	
Byte 6	Bank 3 Number of Fans	
Byte 7	Bank 3 Fans Idle Enable	
Byte 8	Write Enable (FF01 Only)	

7th Data Set

Byte 1	Mux Control	0x07h
Byte 2	Bank 1 Control 1	
Byte 3	Bank 1 Control 2	
Byte 4	Bank 1 Control 3	
Byte 5	Bank 2 Control 1	
Byte 6	Bank 2 Control 2	
Byte 7	Bank 2 Control 3	
Byte 8	Write Enable (FF01 Only)	

8th Data Set

Byte 1	Mux Control	0x08h
Byte 2	Bank 3 Control 1	
Byte 3	Bank 3 Control 2	
Byte 4	Bank 3 Control 3	
Byte 5	Fan DG Input Enable	
Byte 6	Minimum Fan Cycle Seconds L	
Byte 7	Minimum Fan Cycle Seconds H	
Byte 8	Write Enable (FF01 Only)	

9th Data Set

Byte 1	Mux Control	0x09h
Byte 2	Manual Control Enable	
Byte 3	Bank 1 Manual DYCY	
Byte 4	Bank 2 Manual DYCY	
Byte 5	Bank 3 Manual DYCY	
Byte 6	Startup Delay Seconds L	
Byte 7	Startup Delay Seconds H	
Byte 8	Write Enable (FF01 Only)	

10th Data Set

Byte 1	Mux Control	0x0Ah
Byte 2	Reverse Interval Minutes L	
Byte 3	Reverse Interval Minutes H	
Byte 4	Reverse Cycle Seconds	
Byte 5	Reverse Dwell Seconds	
Byte 6	Reserved	
Byte 7	Reserved	
Byte 8	Write Enable (FF01 Only)	

11th Data Set

Byte 1	Mux Control	0x0Bh
Byte 2	Auto dB Test Percent	
Byte 3	Auto dB Test Time L	
Byte 4	Auto dB Test Time H	
Byte 5	Engine Minimum RPM	
Byte 6	HCT Status Message Enable	
Byte 7	Fire Input Enable	
Byte 8	Write Enable (FF01 Only)	

Appendix A, EE-Memory Configuration Codes

Fire Input Enable Settings

Code	Description
0	Disabled
1	Normally High, Trouble Low
2	Normally Low, Trouble High

DG Input Settings

Code	Description
0	Disabled
1	Normal, High - Trouble, Low
2	Normal, Low - Trouble, High

Bank Demand Input Assignment Codes

Code	Description
1	% Fan Request, SPN 986
2	Engine Temp, SPN 110
3	Manifold Temp, SPN 105
4	Transmission Oil Temp, SPN 177
5	Thermistor 1
6	Thermistor 2
7	Thermistor 3

Appendix B, Status LED Alarm Codes

Code	Description	Controller Action
1	DG Input Active	Indication Only (Load absorbed by the system)
2	Over Temp Active	Indication Only (Has Fans at Max Already)
3	CAN Bus Error	All Fans Max Speed until clear
4	Fire Input Active	All Fans Hard Stop (Bank_*n*_Off_DYCY)
5	Reverse Mode Active	Indication only
6	Ignition Input Error	Indication only
7	Auto dB Test Active	Indication only
8	Manual Mode Active	Indication only
9	Thermistor Input Error	All Fans Max Speed until clear

Appendix C, Settings and Limits

EE-Memory Variable	Min	Max	Description
Coolant_Start_Temp	0	Max - 1	Start Temp for J1939 Coolant Temperature
Coolant_Max_Temp	Start + 1	150	100% Demand for J1939 Coolant Temperature
Coolant_OverTemp	Max + 1	Max + 30	Over Temp Trip Point for J1939 Coolant Temp
Manifold_Start_Temp	0	Max - 1	Start Temp for J1939 Manifold Temperature
Manifold_Max_Temp	Start + 1	150	100% Demand for J1939 Manifold Temperature
Manifold_OverTemp	Max + 1	Max + 30	Over Temp Trip Point for J1939 Manifold Temp
TransOil_Start_Temp	0	Max - 1	Start Temp for J1939 Transmission Oil Temperature
TransOil_Max_Temp	Start + 1	150	100% Demand for J1939 Transmission Oil Temperature
TransOil_OverTemp	Max + 1	Max + 30	Over Temp Trip Point for J1939 Transmission Oil Temp
Thermistor1_Start_Temp	0	Max - 1	Start Temp for Thermistor 1
Thermistor1_Max_Temp	Start + 1	150	100% Demand for Thermistor 1
Thermistor1_OverTemp	Max + 1	Max + 30	Over Temp Trip Point for Thermistor 1
Thermistor2_Start_Temp	0	Max - 1	Start Temp for Thermistor 2
Thermistor2_Max_Temp	Start + 1	150	100% Demand for Thermistor 2
Thermistor2_OverTemp	Max + 1	Max + 30	Over Temp Trip Point for Thermistor 2
Thermistor3_Start_Temp	0	Max - 1	Start Temp for Thermistor 3
Thermistor3_Max_Temp	Start + 1	150	100% Demand for Thermistor 3
Thermistor3_OverTemp	Max + 1	Max + 30	Over Temp Trip Point for Thermistor 3
Auto_Rev_Interval_Minutes	0 or 2	500	8 Hours Max
Reverse_Cycle_Seconds	0	60	1 minute
Bank_1_Off_DYCY	0	Start - 1	DYCY to ensure fan is Off
Bank_1_Start_DYCY	0	Max - 1	DYCY for Minimum Fan Speed
Bank_1_Max_DYCY	Start + 1	100	DYCY for Maximum Fan Speed
Bank_1_Rev_DYCY	0	100	DYCY for Reverse Fan Operation
Bank_2_Off_DYCY	0	Start - 1	DYCY to ensure fan is Off
Bank_2_Start_DYCY	0	Max - 1	DYCY for Minimum Fan Speed

Bank_2_Max_DYCY	Start + 1	100	DYCY for Maximum Fan Speed
Bank_2_Rev_DYCY	0	100	DYCY for Reverse Fan Operation
Bank_3_Off_DYCY	0	Start - 1	DYCY to ensure fan is Off
Bank_3_Start_DYCY	0	Max - 1	DYCY for Minimum Fan Speed
Bank_3_Max_DYCY	Start + 1	100	DYCY for Maximum Fan Speed
Bank_3_Rev_DYCY	0	100	DYCY for Reverse Fan Operation
Startup_Delay_Seconds	0	300	Delay from Power on until the unit will operate fans
Minimum_Fan_Cycle_Seconds	0	300	Minimum time fans can run on each bank
Bank_1_Fans_Idle_Enable	0	65535	(False = 0, 1 - 65535 = True) Sets fans to run at min speed when system is enabled
Bank_2_Fans_Idle_Enable	0	65535	(False = 0, 1 - 65535 = True) Sets fans to run at min speed when system is enabled
Bank_3_Fans_Idle_Enable	0	65535	(False = 0, 1 - 65535 = True) Sets fans to run at min speed when system is enabled
Engine_Minimum_RPM	0	2500	Minimum RPM for system enable when EEC1 message is enabled
HCT_Status_Msg_Enable	0	65535	(False = 0, 1 - 65535 = True) Sets fans to run at min speed when system is enabled
Reverse_Dwell_Seconds	0	30	Dwell before fans go to the Reverse DYCY
Fire_Input_Enable	0	2	(False = 0, 1 = Active Low, 2 = Active High) Fire Input Enabled
Fan_DG_Input_Enable	0	65535	(False = 0, 1 = Active Low, 2 = Active High) True = DG Inputs Enabled
Bank_1_Control_1	0	7	Assignment for control input
Bank_1_Control_2	0	7	Assignment for control input
Bank_1_Control_3	0	7	Assignment for control input
Bank_2_Control_1	0	7	Assignment for control input
Bank_2_Control_2	0	7	Assignment for control input
Bank_2_Control_3	0	7	Assignment for control input

Bank_3_Control_1	0	7	Assignment for control input
Bank_3_Control_2	0	7	Assignment for control input
Bank_3_Control_3	0	7	Assignment for control input
Manual_Control_Enable	0	65535	(False = 0, 1 - 65535 = True) Turns on Manual Control
Bank_1_Manual_DYCY	0	100	DYCY output during Manual Control
Bank_2_Manual_DYCY	0	100	DYCY output during Manual Control
Bank_3_Manual_DYCY	0	100	DYCY output during Manual Control
Auto_Db_Test_Enable	0	65535	(False = 0, 1 - 65535 = True) Turns on Fan dB Test, Automatically resets after test
Auto_Db_Test_Percent	0	100	% Fan Speed Applied to fans during Fan dB Test
Auto_Db_Test_Time	0	300	Duration of Fan dB Test

Appendix D, Electrical Characteristics

Absolute Maximum Ratings

Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.

Supply Voltage	+/-32V_{DC}
Rs232 Port	Rxd, RTS = +/-15V_{DC} Txd = +/-8V_{DC}
CAN Ports	+/-14V_{DC}
Voltage at Input / Output Pin	+/-32V_{DC}
Current at Input Pin	+1mA
Current at Output Pin	3,000 mA
Current at 5V REF	500mA
Temperature	
Operating	-40°C to +85°C
Storage	-40°C to +100°C

Recommended Operating Parameters / Pin Functions

Pin	Name	Function/Features	Range
K1, a1, a2	POWER IN	Positive Power Supply Input	+12V_{DC} to +28V_{DC}
C2, D2, E2	Thermistor Inputs (Note: 3)	Analog	0-5V_{DC}
E1	5V REF	Reference Output	5V_{DC}, 500mA
F1, F2, G1, G2, H1, H2, J1, J2, J3, K2, K3	Digital Inputs (Note: 4)	On / Off	0 to +Supply
b1, b2, c1, c2, d1, d2	Outputs (Note:5)	Sourcing PWM Output or Sourcing Discreet Output	On = +Supply 3,000mA Off = +Supply 370µA, Supply = 28V_{DC} Off = +Supply 180µA, Supply = 13.6V_{DC}

Notes:

1, Maximum continuous current allowed on any single connector Pin = 8 Amps
2, All limits are guaranteed by testing or statistical analysis
3, Z = >100KΩ
4, Z = 32.4KΩ
5, Voltages applied above POWER IN will damage the outputs

Appendix E, the Program Loader Monitor (PLM)

Introduction:

The **Program Loader Monitor (PLM)** is used to download programs to the DVC family of controllers and to display information from the unit. It runs on your Windows PC / Laptop / TekBook and uses a RS232 cable (HCT P/No. 999-10075) to communicate with the EMC-3 module.

NOTE: To use the 999-10075, you MUST have an installed a 4 way serial port adaptor when installing the controller.

File types & Definitions:

There are 5 basic file types generated and used by the DVC series controllers:

1) ***.DVC files** – These are raw program files created during programming time when using the Intella suit.
   The contents of these files can be viewed and edited by anyone with access to a full legal version of the Intella suite, so care by the application writer must be taken to protect company intellectual property.

2) ***.PGM files** – This file contain the users compiled application code in an executable format and are automatically looked for by the PLM when uploading a new program for an application.

3) ***.MEM files** – This file contains all the memory information that specifies the configuration of the inputs and outputs and is pulled in automatically with the *.PGM file when loaded into a DVC with the PLM.

4) ***.DAT files** – This file contains the application information on all the ‘EE” memory variables and their respective default values.

5) ***.IMF files** – This file type is only generated if you use the “Export to File” feature in the PLM so save configuration changes done in the PLM and import them into the Programming tool to update the application.

Note:

*.IMF files contain all of the DVC configuration information (i.e. Input or Fx Curve settings etc.). If changes are made to the DVC configuration using the Program Loader Monitor, you can update the DVC program with the new configuration data by doing the following:-

1) Using the Program Loader Monitor, save a new *.IMF file by clicking on "Export to File".
2) Using the Programming Tool, open your project and click "File" and select "Load

Connecting the PC to the DVC Family:

The DVC controller uses the RS232 standard to communicate between itself and the PC. If a traditional 'DB 9' sub-miniature serial COMM port is available, please use this port or, use one of the HCT recommended USB to serial converters to ensure correct connection. Full details can be found on our website, and make sure that the converter software drivers are fully installed as recommended. For a standard 'DB 9' sub-miniature port follow the directions below:

- Install the Program Loader Monitor from the application disk provided, following all on-screen instructions.
- Apply power to the DVC module.
- Locate an open serial communications port on your Windows PC.
- Plug one end of the DVC Family RS232 serial cable into the chosen serial port (i.e. COM1, COM2, COM3, etc.) on the computer.
- Plug the other end into the DVC serial cable WeatherPack connector that comes from the DVC module main connector.

Important Notes – Accidental programming mode on DVC module:

If the RS232 serial cable is connected to the DVCmodule and the Program Loader Monitor program is not running, the DVC controller may enter programming mode on power up, indicated by NO LED illumination at all (NO power ON etc.)

To exit accidental programming mode try one of these solutions below:

- **START** the Program Loader Monitor program (this takes control of the COMM port) and cycle power to the DVCmodule
- Unplug the RS232 cable and cycle power to the DVCmodule.

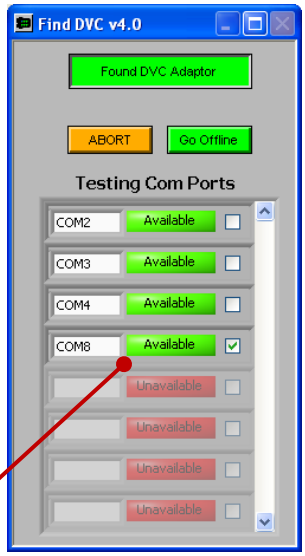
To **exit programming mode at ANY time**, disconnect the RS232 cable from the DVCmodule and cycle power to the controller.

Starting the Program Loader Monitor:

From Windows press the “Start” button and then from the menu select
HCT Products\Intella 700\PLM v5*xx*

OR

Using Windows file explorer, locate the file here:
C:\Program Files (x86)\HCT Products\Intella 700\PLM v5*xx*.exe

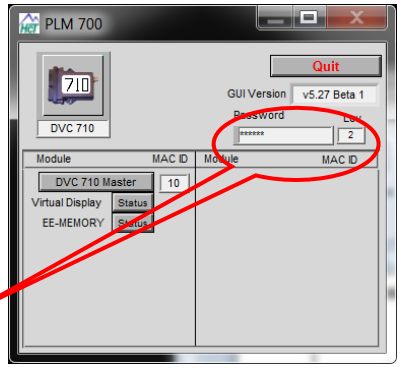


When opening the Program Loader Monitor application, the following screen appears:

The port selection should be automatic but under certain circumstances or if you have previously used the COMM or USB ports for other equipment, you may have to manually select the port to be used or to reset the PC hardware manager, restart your computer.
If required, select the PC COMM port to which your RS232 cable is attached or which has been allocated by the USB driver installation.

Main Program Loader Monitor Screen:

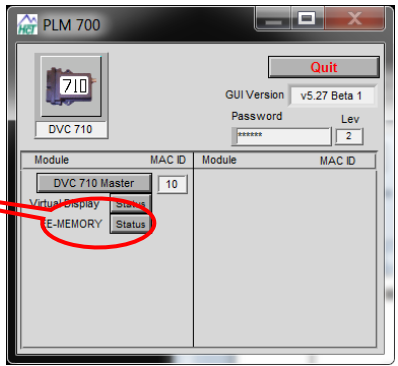
The first information screen you will see after port selection is successful is shown here.
This window shows all of the modules in your applications project. Module icons that are blurred indicate that the DVC controller is not communicating with that module.



You may need to enter a password to gain access to the download feature of the Program Loader Monitor. The minimum password authority is ‘2’ for downloading an application.

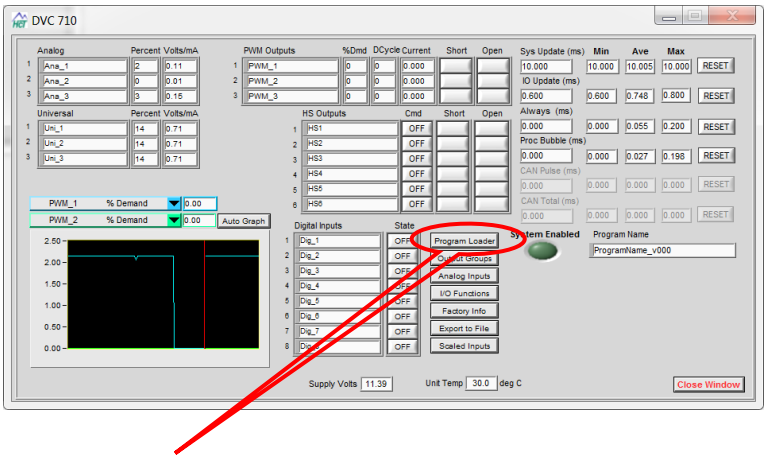
The password must be typed into the box labeled ‘Password’ and the number ‘2 or 3’ must then appear under the word ‘Level’ to indicate that you are now authorized to upload an application program to the controller.

Once the password has been successfully entered, the user MUST click the ‘DVC 710 Master’ button shown here to proceed and open the Master Display screen shown below:



DVC Family Master Display:

The Program Loader Monitor is used to observe the actual input and show specific information as your application executes.
The names assigned to them in the Programming Tool appear on the main screen shown below. The runtime graph is used to plot any two variables as fast as the computer can collect data from the DVC.

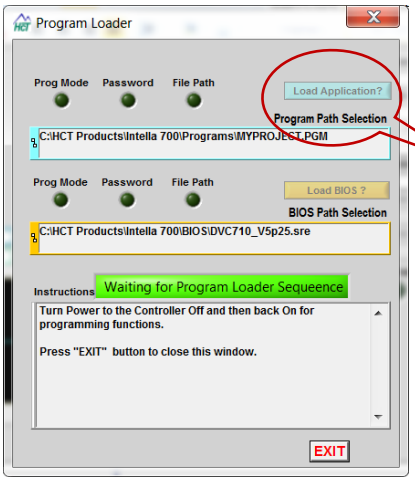


To allow the next step, and load the application, the user MUST click the 'Program Loader' button shown here:

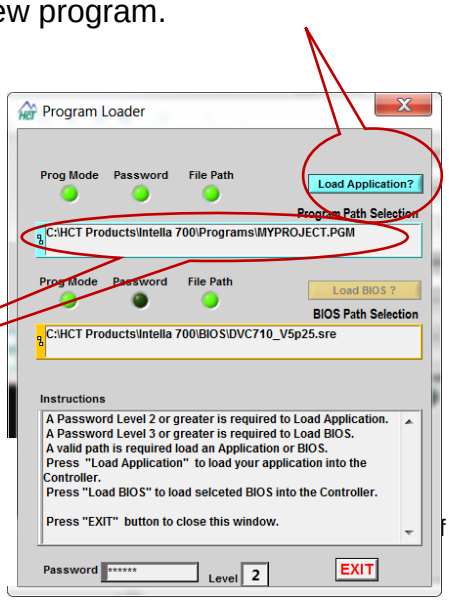
Program Loader

Once clicked the Program Loader button sets a signal in the serial cable that allows the DVC to go into programming mode when power is cycled.

After selecting the Program Loader button in 5) above, and power cycling the DVC, look for the indicator in the Program Loader window to change color and determine that the DVC controller is in programming mode:

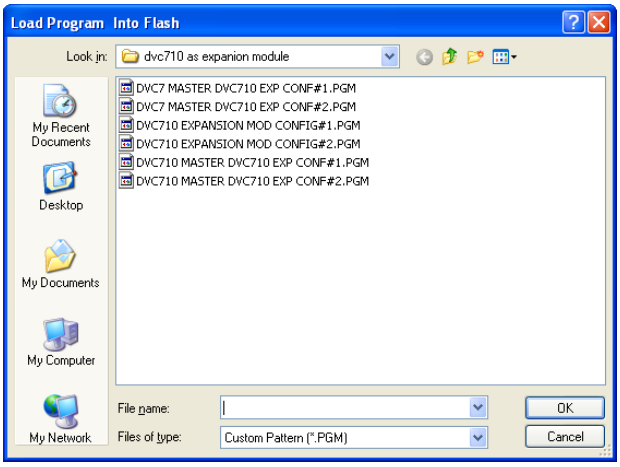


The **Load Application** Button will go from Unavailable (left) to available (below). The module is now ready to accept a new program.



To load your new application, Click in the Path Window to select an application file then select the **Load Application** button shown here.

When you click in the Path Window, the window shown to the right will open and allow the user to browse and navigate to the file for the project with the **.pgm** file extension.

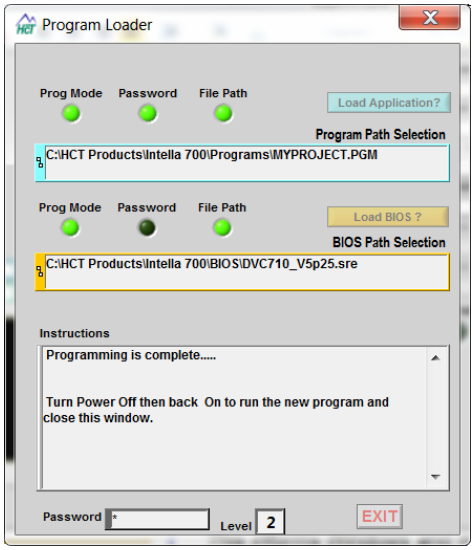


The browser window will filter all other file types so only valid files will be seen.

Once the correct application file has been found, the user should click one to highlight the choice in the list, and then click the 'OK' button.

At this point, pressing Load Application will download the new program.

Download time is variable, there is a progress bar that moves across the screen from left



After the program is successfully uploaded into the DVC module, the screen, change to the screen shown here.

The user is instructed to cycle power to the DVC module to take it out of program mode and into normal operation.

To finalize the operation, the user should click the 'Quit' button to correctly close the Program Loader Monitor (PLM).
This informs Windows and the PC that any resources or communications ports are now free to be allocated to other devices as required.

END of instructions:

Frequently Asked Questions:

Description: DVC controller goes into programming mode when powered on.

Models Affected: All DVC based Master Controllers including the emc-3

Background:

The DVC controller is in programming mode when *ALL the LED's are OFF* – even the power LED will extinguish in this mode.

The DVC controller normally goes into programming mode when the Program Loader Monitor running on your PC is active, the serial RS232 cable is connected between the PC and the DVC controller, you are attempting to load an application and the DVC power input is cycled. The DVC, when it is powered cycled looks at the RS232 lines (RTS specifically) to decide if it should go into programming or normal execution mode. On some PCs depending on the installed RS232 driver and the last program to access the serial port the RTS line can be left in a state where the DVC believes it should go into Programming mode even though the Program Loader Monitor is not running.

Solution:

To ensure that this does not happen, disconnect the serial cable from the PC or the DVC controller and power cycle the DVC. Reconnect the cables, and operate as normal.

emc-3 accessories

1. emc-3 30 way harness – auto-grade cables – 10 feet long: 999-10104
2. emc-3 18 way harness – auto grade cables – 10 feet long: 999-10107
3. emc-3 48 pin connector kit (30 way + 18 way): 999-10077
4. Communications cable (PC to module) – 6 feet: 999-10075
5. Serial port adaptor – USB-RS232: 999-10076
6. Temperature sensor (wet fluid): 206-00083
7. Temperature sensor (dry fluid): 206-00084
8. Temperature sensor connectors: 999-10213

‘Wet’ Fluid Sensor Information

‘WET’ fluid temperature sensor:
P/No.206-00083

Application Overview:

- **Hydraulic Fan drive systems**
- Closed loop temperature applications
- Direct installation into radiator plug ports
- Hydraulic Manifolds
- Direct installation into Hydraulic pumps / motors

Product Feature Overview:

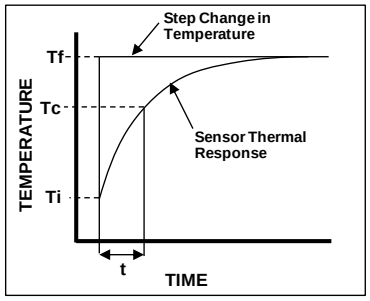
- Brass body - NO galvanic reactions with other metals
- Cost effective and robust product design
- Simple assembly process into application
- NO internally moving components
- Thermistor technology
- 100% calibration certified

Sensor Overview:

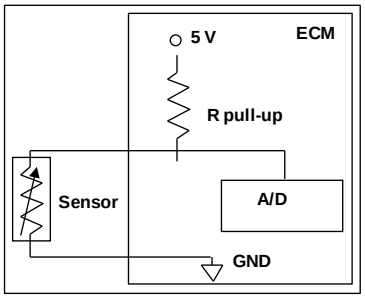
Housing Type:	Delphi Unique
Typical supply voltage:	+5VDC
Dissipation Constant*:	24mW/°C
Thermal Time Constant**:	17.5 to 23.5 seconds
Temperature range:	-40 to +150 ºC (operational)
NEMA/IP Rating:	NEMA 6P/68
Connector rating:	>IP67

Electrical Characteristics:

Thermal Time Constant



Circuit Schematic



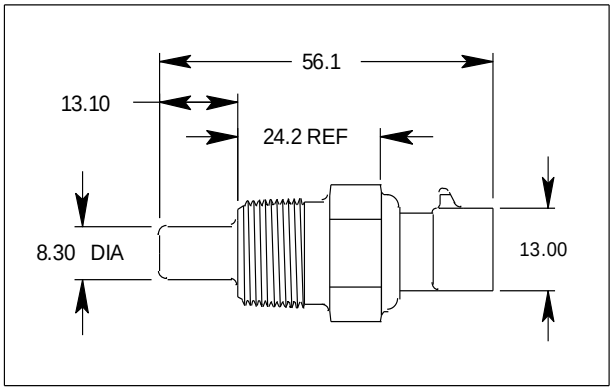
- The ratio, at a specified ambient temperature, of the change in the power dissipation of the sensor to the resultant temperature change of the thermistor. Test medium: silicone oil

- ** The time required for the sensor to achieve 63.2% of its steady state value when subjected to a step change in ambient temperature [Tc=(Tf-Ti)*63.2%+Ti]. Test medium: silicone oil.

- Mating Connector: 2 way sealed female connector
- *Contact HCT customer service for price and availability, see back page for contact details.*

Mechanical Details:

Sensor Body:	Brass
Connector Body:	PBT 30% Glass Filled
Hex Size:	18.9mm / 3/4”
Thread Size:	3/8’ - 18 NPTF
Thread Sealant:	GM09985473
Sealing Pressure:	145kPa
Installation Torque:	20Nm
Overall Weight:	40g



‘Dry’ Fluid Sensor Information

Application Overview:

- **Hydraulic Fan drive systems**
- Closed loop temperature applications
- Direct installation into radiator plug ports
- Charge Air Cooling (CAC) Manifolds
- Ambient air reference / offset applications
- Direct installation into dry fluid transfer pipes

‘DRY’ fluid temperature sensor:
P/No.206-00084

Product Feature Overview:

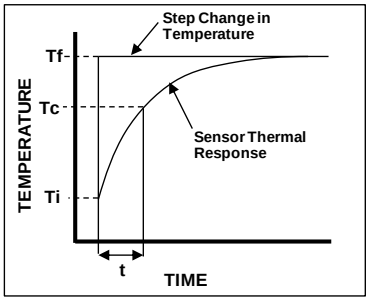
- Thermoplastic body - NO galvanic reactions with metals
- Cost effective and robust product design
- Simple assembly process into application
- NO internally moving components
- Pre applied ‘threadlock’ for positive seal
- Thermistor technology
- 100% calibration certified

Sensor Overview:

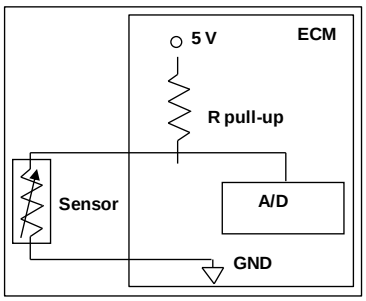
Housing Type:	Delphi Unique
Typical supply voltage:	+5VDC
Dissipation Constant*:	18mW/°C
Thermal Time Constant**:	60seconds
Temperature range:	-40 to +150 ºC (operational)
NEMA/IP Rating:	NEMA 6P/68
Connector rating:	>IP67

Electrical Characteristics:

Thermal Time Constant

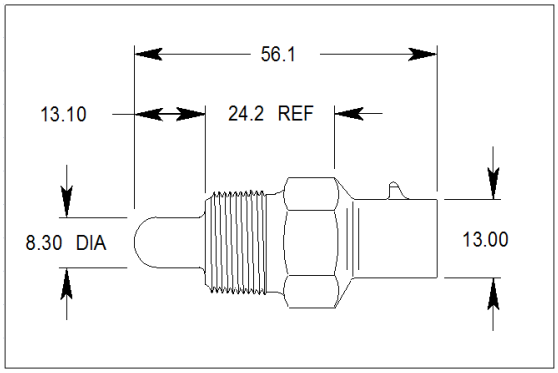


Circuit Schematic



Mechanical Details:

Sensor Body:	PEI (polyetherimide) 30% GF
Connector Body:	PBT 30% Glass Filled
Hex Size:	18.9mm / 3/4”
Thread Size:	3/8’ - 18 NPTF
Thread Sealant:	GM09985490
Sealing Pressure:	145kPa
Installation Torque:	10.8 - 16.3 Nm
Overall Weight:	13.2g
Color:	Black



- Mining & Exploration
- Agriculture
- Cranes & lifts
- Refuse & Recycling
- Construction
- Off-Road vehicles
- Forestry, Wood & Pulp
- Reclamation & Salvage
- Oil Field & Sands
- Demolition Equipment
- Cooling Solutions
- Military Apparatus
- Specialty Use
- Remote Control
- Power Generation
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