



High Country Tek, Inc.

Electronic Pump Controller: **epc-2**

Open Loop control of single or dual coil pump Compensators & Strokers

Electronic Control Solutions for the Global Fluid Power Industry

High Country Tek, Inc. (HCT)

is the Fluid Power Industries premier Independent electro-hydraulic controls supplier with best in class products, service and training.

HCT provides the most 'Ruggedized' electronic control solutions for a wide variety of applications that are successfully applied across the globe in all areas of the fluid power industry.

To compliment our **epc-2** controller, HCT has released a free software application that allows immediate operation of the controller with two separate channels, each offering the opportunity to control dual solenoid projects.

For further system optimization, a free pre-written Graphical User Interface (GUI) for use with Windows based PC's or the HCT TekBook, allows the user to fine tune the various parameters typically seen in an open loop controller of this type.



Standard HCT Product Features:

- Dual channel open loop controller ready for voltage or mA analog command signals
- Operates with all major OEM electro-hydraulic valve and pump equipment
- Sealed & protected to >IP68 (NEMA 6P)
- Environmentally hardened by 'Solid' potting with flame retardant materials
- SAE J1939 & HCT-CAN communication protocols
- Full CE compliance for confident global application on all mobile equipment
- SAE J1455 for 'Load-dump' protection
- Patented **Intella™** system configuration software for fast implementation
- Industry standard Cinch or Metripack 30 way connectors used
- Comprehensive on-line literature, manuals, user guides and application information



www.hctcontrols.com

Application Overview:

The epc-2 controller allows the user to connect, calibrate and immediately use two separate input and output channels in one controller, making it ideal and very cost effective for controlling up to two (2) individual open loop pump compensator or stroker control solutions.

The controller operates from a wide supply range of +10 to +32VDC so one unit can interface with any OEM coils of either 12VDC or 24VDC with a current maximum requirement of up to 3amps per coil.

Industry standard 0-5VDC or 4-20mA command signals can be selected, making this a very flexible unit for mobile or industrial application usage.

The PC based user interface is designed around three easy to navigate pages that allow the user to quickly configure and set-up the module to cost effectively control one or two separate pumps from one controller

Installation Guidelines:

ALWAYS do the following:

- Take a few minutes to FULLY read THESE information / data sheets BEFORE starting.
- Keep High Voltage AC cables separate from Low Voltage DC signal and supply cables.
- Make sure the units supply voltage is the same or greater that the coils on the valve(s) being driven !
- Check the units supply voltage is CORRECT, ' ELECTRICALLY CLEAN ' and STABLE.
- Ensure that you are aware of the adjustments and consequences on the electronics and hydraulics.
- Make sure you have the correct tools to do the intended job (i.e. Tekbook, P.C., software) e.t.c.
- 'Isolate' this unit from all other equipment BEFORE any form of welding takes place.
- Check ALL wire connections to and from this unit to ensure NO short or OPEN circuits are present.
- Operate the units within specified operating temperature for best & reliable performance.
- Ensure that any unused wires / terminals are terminated safely and not shorted together.
- Isolate the controller if ANY form of battery charging or battery boosting takes place on the vehicle.
- Ensure that any HCT recommended fuses, circuit breakers or safety devices are fitted as required
- Ensure ALL valve connectors are wired correctly, secure, locked and connected to correct coils.
- Observe the set-up procedures in this manual for best operational results.
- Follow and abide by local and country health & safety standards – protect yourself and others !



NEVER do the following:

- Operate this unit without the recommended fuse as required by HCT
- Arc Weld or Charge Batteries with this driver unit connected as damage can occur.
- Attempt to use this unit if you are unsure of electrical OR hydraulic connections or expected operation.
- Attempt to use this unit in Areas where other AC or DC coils HAVE NOT been fully suppressed.
- Use a power supply that is not rated for the correct required O/P current under full load.
- Allow wires TO or FROM the unit to short circuit (to each other or chassis/cabinet e.t.c.).
- Attempt to use this unit in areas of intense RF without adequate screening measures.
- Disconnect or connect wires to or from this unit unless it isolated from the power supply.
- Use this unit in temperatures that exceed those specified as operation may be effected.
- Start this unit without ensuring ALL work areas are clear of personnel !



If you are unsure about any part of the controller wiring or installation, contact local professionals or High Country Tek Inc. technical support for guidance BEFORE you apply power or damage the controller or application.



epc-2 & evc-2 Specification Overview (General):

1. Module size/format:	High Country Tek Inc. Mobile 'easy-mount' format
2. Design Standards:	Full CE classification
3. Power Supply type and range:	10 to 32VDC (max)
4. Recommended module protection:	5A AGC fuse in power supply line
5. User stabilized voltage:	+ 5VDC \pm 10%
6. Output current:	500mA (max)
7. Protection:	Current limited, short circuit protected
8. Digital Input number:	3x ON/OFF inputs
9. Digital Input type:	DCV - level shift
10. Digital input values:	0V to +VPower supply max
11. Universal input number:	2x inputs
12. Universal input type:	DC voltage or DC Current
13. Universal input values:	0 to +5v or 4 to 20mA
14. Voltage Command I/P Impedance:	10 KOhm
15. Current command shunt resistor value:	100 Ohms
16. Proportional Output number:	2x PWM
17. Protection:	Open and short circuit protection
18. Proportional output Current:	0 to 3 amps max
19. Digital Output number:	6x High Side
20. Digital output type:	ON/OFF level shift
21. Proportional output Current:	0 to 3 amps max
22. Protection:	Open and short circuit protection
23. Digital output values:	0V to +V module supply voltage -0.5VDC
24. Operating Temperature range:	-40C to +85C
25. Storage temperature range:	-40C to +100C
26. Ingress protection rating:	IP 68 / NEMA 6P
27. Connector type:	Metri-Pack 30 way male

Contact HCT customer service or your nearest HCT Product distributor for other connection/Hardware configurations if required

REMOTE ENABLE Important Note:

- The Enable input is DIGI 1 (connector pin S2) and is configured to be active HIGH
- The user **MUST** pull the input 'S2' to +V supply to allow normal operation.
- The enable input is failsafe, with the input pin 'S2' pulled LOW (0V) internally.



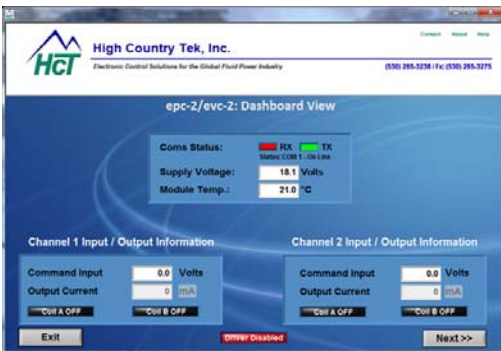
Dual Path epc-2 & evc-2 Graphical User Interface (GUI) Guide:



1. Install user interface program onto Windows PC or laptop or HCT TekBook following the on-screen instructions
2. Connect epc-2 controller to suitable, stabilized power supply (10-32VDC)
3. Connect RS232 communications cable to epc-2 and Windows PC noted in 1
4. Locate the epc-2 program in the PC 'START' menu and click to open
5. Once started, the program will open with the screen shown to the left and attempt to make communications with the epc-2 module

NOTE:

As required, messages will be displayed to alert the user to issues or items that need attention. Typically GREEN message backgrounds are good while bright RED should be taken as a warning or notice of a setting or state that could need attention.



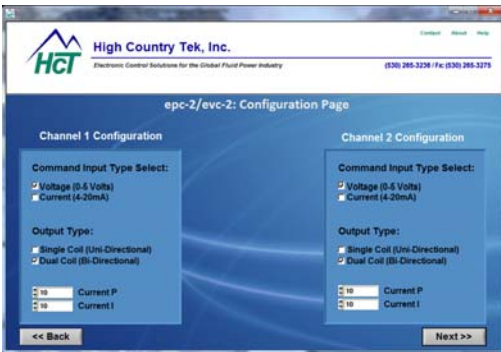
This screen gives the user a 'Dashboard View' of the controller settings and operation in one easy to read screen.

The module communications status RX and TX lights will alternate red/green when in communication, while the module supply voltage and internal temperature can also be seen in the middle box.

The boxes lower left and right display the 'Command Input' and 'Output Current' for channel one and channel two as well as which coil (A or B) is being driven at any time.

The single light bar at bottom middle, will be **RED = 'Driver disabled'** or **GREEN = 'Driver enabled'**, to show the status of the global enable input and all outputs (proportional AND digital) on the module.

Clicking the 'Next >>' button will move the user to the next screen or clicking 'Exit' will close the interface and return the user to Windows desktop.



The 'Configuration Page' allows the user to set the command signal type to either DC Voltage (0 to +5VDC) or Current (4 to 20mA) and also to single or dual coiled valve drive configuration on the pump being controlled.

Selecting a single coil gives the full command signal over the output current, while selecting a dual coil, immediately offsets the command to give mid value for zero drive to each coil.

The 'Current P' and 'Current I' settings allow the user to optimize the response of the controller to any type or make of valve being driven - see page 11 for guidelines.

Clicking the 'Next >>' button will move the user to the next screen or clicking '<< Back' will take the user to the previous screen.



The 'Fine Tune Page' offers the user options to customize each channel and to ensure that the pump reacts as desired and is optimized - see page 6 for details.

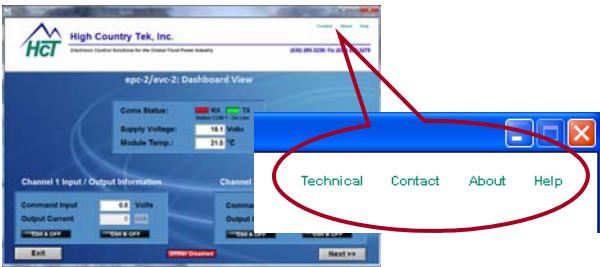
As long as the user is connected to a epc-2 module, any changes made here are transmitted immediately to the module and will change the characteristic in the non-volatile memory updating the settings and making them the new levels even after power ON/OFF, so care should be taken to make small changes while also making sure that the correct parameter is being altered.

User editable value box's have a blue background with yellow text. Each window has 'min' and 'max' limits pre-set so prevent the user from entering a value that may cause issues.

Clicking the 'Dashboard' button will move the user back to the observation screen or clicking '<< Back' will take the user to the previous screen.



Dual Path epc-2 & evc-2 Graphical User Interface (GUI) Guide: Cont...



Click the following for these functions:

Technical:

This will open a PDF version of this manual that is installed with the Graphical User Interface software so it is available as a reference at all times.

Contact:

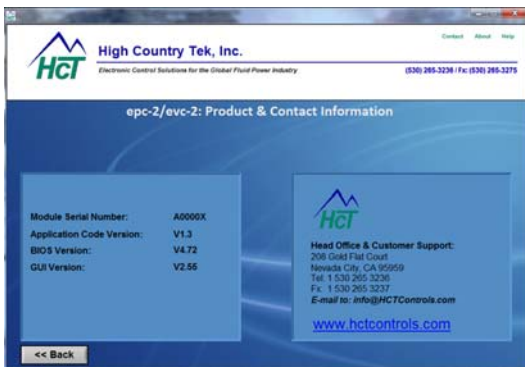
This opens the users E-mail program and enters the HCT address and subject ready for the user to communicate and send whatever information required to HCT.

About:

Opens the 'Miscellaneous Information' page displayed below, giving important information on the module and versions of software that may be needed during any conversations or E-mail with HCT technical or field support personnel.

Help:

This opens a PDF document on the epc-2 going into more details on the programming that the user can utilize to modify this original application software program if required (GUI will NOT reflect any user changes made)



The 'Miscellaneous Information' page shows the module serial number as well as all versions of the software and GUI being used. This information may be asked for by HCT support personnel during any contact you require for help and guidance e.t.c.

The other information shown on this page is the HCT mailing address and also the direct E-mail to our customer support group.

There is also a live link (if PC is connected to the Internet) to the HCT website where extra information as well as the latest literature and product details can be found as required.

Clicking the 'Back >>' button will take the user to the previous screen.

PC to epc/evc-2 connections:

To use the set-up program described above, the user must connect a communication cable between the epc/ evc-2 and the user PC. This is achieved by using an HCT supplied RS232 cable that will allow direct connection between a 15 way Serial Port 'D' connector on the PC and a polarized 4 way tower WeatherPack connector.

HCT Part Number:

999-10075



See page 8 for connection details

USB to RS232 Adaptor:

In the event that the PC does NOT have a 15 way Serial Port 'D' connector, a high quality, broad band USB to RS232 adaptor must be used.

For best results, only use adaptors recommended, tested and approved by HCT.

Please contact our customer service department to discuss your needs if required.

HCT Part Number:

108-00119



epc-2 & evc-2 User Interface 'Fine Settings Page' Guide:

1. Channel X coil 1A Imin Out Current (mA):

Minimum value allowed = 0mA

This is the minimum current value that that will be sent to valve coil 1A when the command signal is approximately $\pm 5\%$ of 2.5V (~125mV)

2. Channel X coil 1A Imax Out Current (mA):

Maximum value allowed = 3000mA

This is the maximum current value that that will be sent to valve coil 1A when the command signal is at approximately $\pm 100\%$ i.e. 0% command = Coil B at 100%, 50% command - Both coils OFF, 100% command = Coil A at 100%.

3. Channel X coil 1B Imin Out Current (mA):

Same function and action as noted in item 1. above

4. Channel X coil 1B Imax Out Current (mA):

Same function and action as noted in item 2. above

5. Channel X coil 1A Ramp UP time (Seconds):

Minimum value allowed = 0 seconds - Maximum value allowed = 65 seconds

This is the total time taken for the output current to go between the Imin and Imax settings for a 0% to 100% command input. The time is scaled for 0 to 100% command meaning that if the command goes from 50% to 100% the time taken will be 50% of the seconds set.

6. Channel X coil 1A Ramp DOWN time (Seconds):

Minimum value allowed = 0 seconds - Maximum value allowed = 65 seconds

This is the total time taken for the output current to go between the Imax and Imin settings for a 100% to 0% command input. The time is scaled for 0 to 100% command meaning that if the command goes from 100% to 50% the time taken will be 50% of the seconds set.

7. Channel X coil 1B Ramp UP time (Seconds):

Minimum value allowed = 0 seconds - Maximum value allowed = 65 seconds

Same function and action as noted in item 5. above

8. Channel X coil 1B Ramp DOWN time (Seconds):

Minimum value allowed = 0 seconds - Maximum value allowed = 65 seconds

Same function and action as noted in item 6. above

9. Channel X Dither Amplitude: Minimum value allowed = 0% - Maximum value allowed = 100% (in 10% increments)

This is the level of 'Dither' signal applied to the output current as a fixed percentage - i.e. if you set 50% here, the amplitude will be ratiometric over the entire PWM output range of 5 to 95 PWM.

Valve OEM's usually recommend a % level here If no information is available, set to 30% for initial trials and optimize at later stage if needed.

10. Channel X Dither Frequency (Hz): pre-set values - 33, 45, 50, 55, 76, 100, 125, 142, 200, 250, 333 & 500HZ

This is the 'Dither' frequency that will be on the PWM output.

Valve OEM's usually recommend a frequency here, if no information is available, initially set 140Hz - 250Hz for cartridge and smaller valves and 100Hz - 140Hz for larger industrial valves.

11. Channel X Command Min:

The value entered here, sets the Minimum command input allowed. Below this value, the respective epc-2 proportional output is disabled

12. Channel X Command Mid:

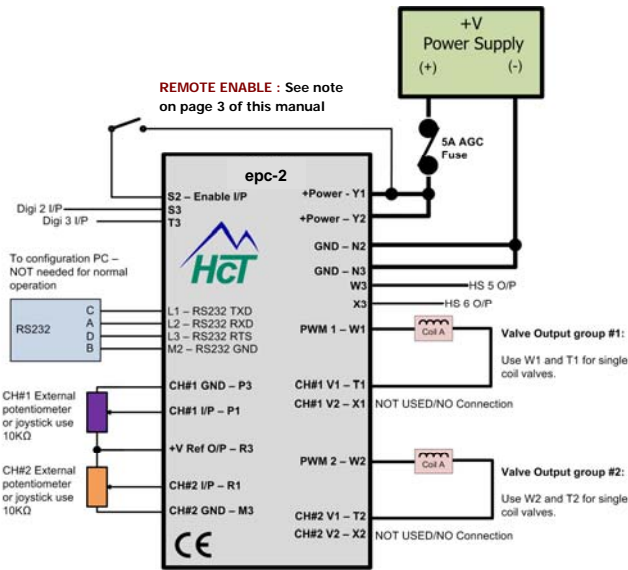
The value entered here, sets the Mid command for crossover in dual coil mode, ignored for single coil mode

13. Channel X Command Max:

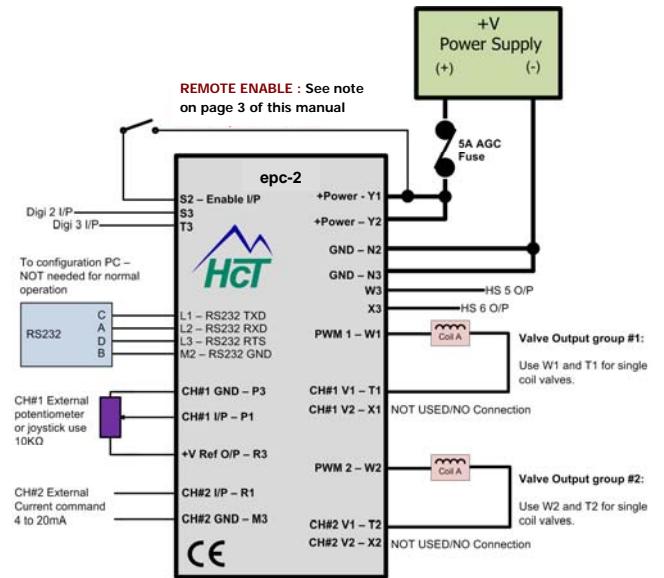
The value entered here, sets the Maximum command input allowed. Above this value, the respective epc-2 proportional output is disabled



Dual Path with Single coil connections: (see Appendix A for output graphs)

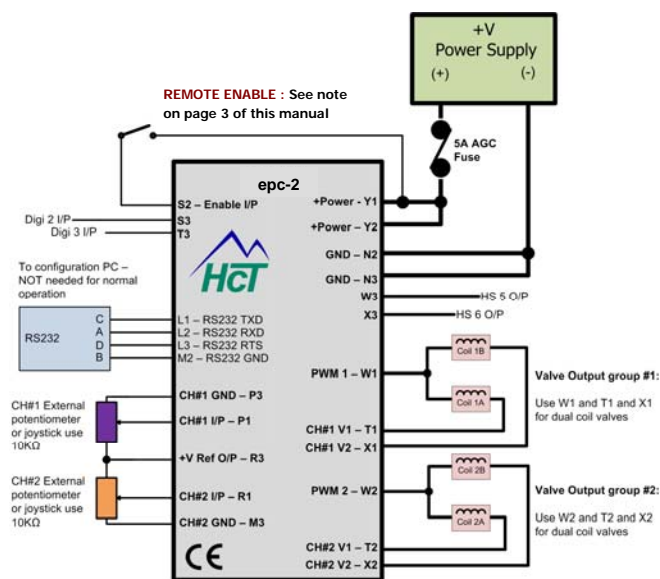


Configuration shown using 2x potentiometers or joysticks with internal regulated +5V to control 1x valve coil per channel.

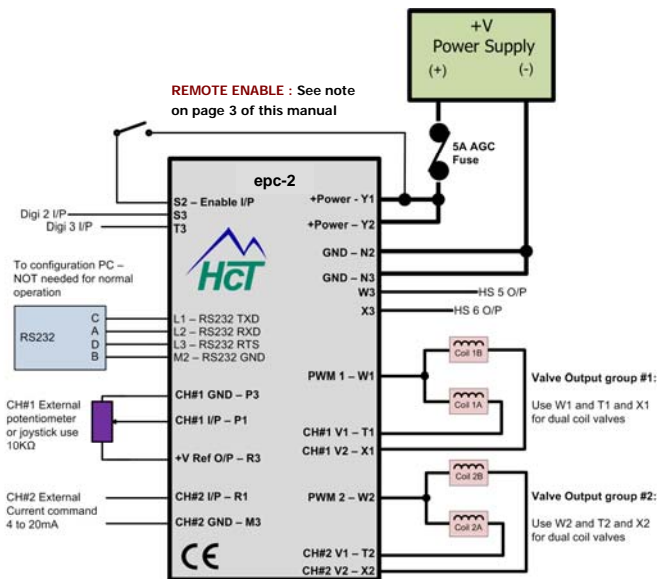


Configuration shown using 1x potentiometer or joystick with internal regulated +5V and 1x externally provided 4-20mA command input to control 1x valve coil per channel.

Dual Path with Dual coil connections: (see Appendix A for output graphs)



Configuration shown using 2x potentiometers or joysticks with internal regulated +5V to control 2x valve coil per channel.



Configuration shown using 1x potentiometers or joysticks with internal regulated +5V and 1x externally provided 4-20mA command input to control 2x valve coil per channel.

Additional ON/OFF control features:

To allow low level signals to drive high current loads (i.e. lamps/alarms) , the application provides 2 extra ON/OFF drives for convenience:

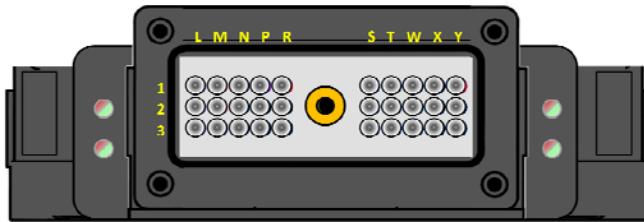
Digi 2 (Connector pin S3) is internally connected to HS 5 (Connector pin W3)

Digi 3 (Connector pin T3) is internally connected to HS 6 (Connector pin X3)

epc-2 Module connection details:

epc-2 Connector Designation Tables					
30 Pin Metri-Pak Connector (Male, Plug)					
PIN	Name	Function	PIN	Name	Function
L1	TXD	Transmit RS232 Data - Pin 'C'	P3	PWR COM	Channel #1 Command GND/OV
L2	RXD	Receive RS232 Data - Pin 'A'	R1	UNI-2	Channel #2 Command I/P
L3	RTS	Request To Send - RS232 Pin 'D'			
			R3	+5V USER	+5V regulated user output
M2	PWR COM	RS232 GND/OV			
M3	PWR COM	Channel #2 Command GND/OV			
			S2	DIG-1	Global Enable I/P
N2	PWR COM	Ground / OV / Signal Common	S3	DIG-2	Digital I/P #2 (Turns ON W3)
N3	PWR COM	Ground / OV / Signal Common	T1	HS-1	Channel #1 Coil A
P1	UNI-1	Channel #1 Command I/P	T2	HS-3	Channel #2 Coil A
			T3	DIG-3	Digital I/P #3 (Turns ON X3)
			W1	PWM-1	Chanel #1 PWM O/P
			W2	PWM-2	Chanel #2 PWM O/P
			W3	HS-5	Digital O/P (from Digi 2 I/P)
			X1	HS-2	Channel #1 Coil B
			X2	HS-4	Channel #2 Coil B
			X3	HS-6	Digital O/P (from Digi 3 I/P)
			Y1	+PWR IN-1	+V Supply Power Input
			Y2	+PWR IN-2	+V Supply Power Input

999-10075 Connector Details			
RS232 (PC) to epc-2 Communication Cable			
epc-2 PIN	Name	Function	999-10076
L1	TXD	Transmit RS232 Data - Pin 'C'	C
L2	RXD	Receive RS232 Data - Pin 'A'	A
L3	RTS	Request To Send - RS232 Pin 'D'	D
M2	PWR COM	RS232 GND (OV)	B



HCT Part Number:
999-10075

LED operation and description:

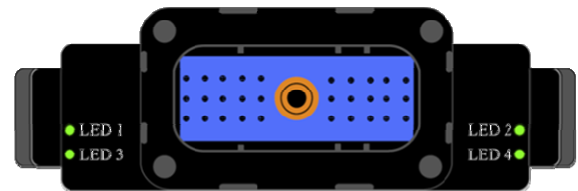
LED 1:

- OFF = NOT Used in this application



LED 2: Output 1 or Output 2 (Red / Green):

- The LED will change from Red (0%) to Green (100%) through Yellow (50%), to indicate the duty cycle status of the corresponding output.
- OFF = NO PWM outputs are active
- Blinking Green = PWM Output 'Open Circuit' detected
- Blinking Red = PWM Output 'Short Circuit' detected



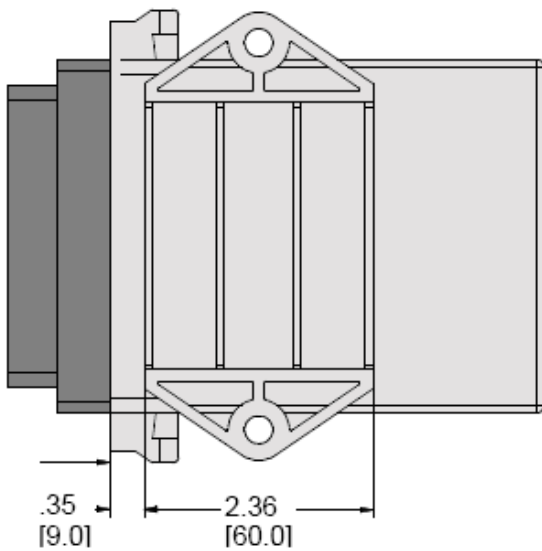
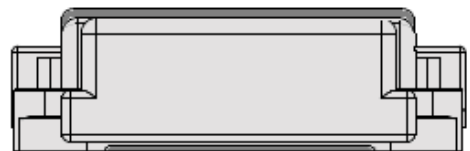
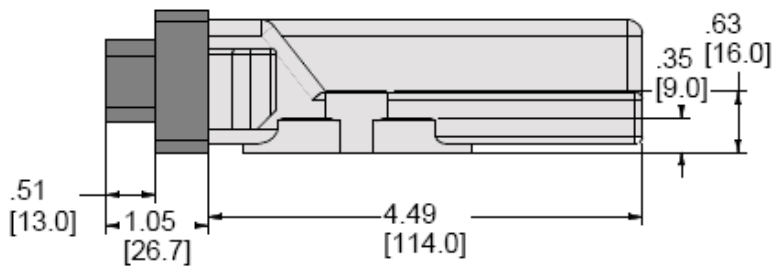
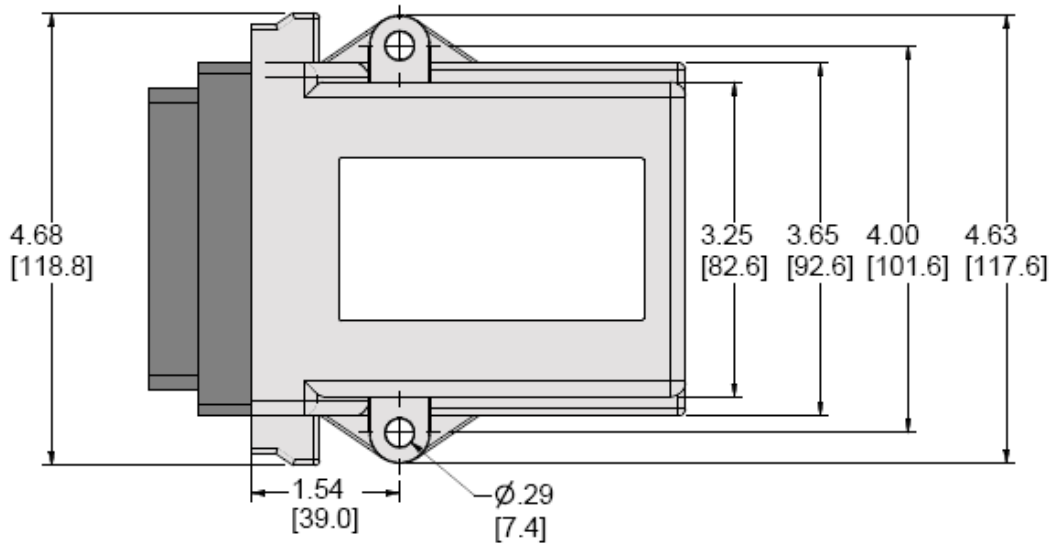
LED 3: (MS) - Module Status (Red / Yellow / Green):

- OFF = No power applied to module.
- ON Green = Module operating normally
- ON Red = Module has unrecoverable fault detected - *contact factory*
- Flashing Red = Low supply voltage (<8.5VDC)

LED 4: Status Indicator (Red / Yellow / Green):

- This Indicator is programmable and can be used by the application code to show fault codes or display system operational conditions e.t.c.
- Off = NO Errors / faults detected
- ON Red = PWM1 Open or Short circuit detected
- ON Green = PWM2 Open or Short circuit detected
- Blinking Yellow = High Side Open or Short circuit detected
- Blinking Red = User programmable / defined fault blink codes

epc-2 Module Mechanical Details:



IMPORTANT NOTE:

Recommended tightening torques for the securing bolts are as follows:

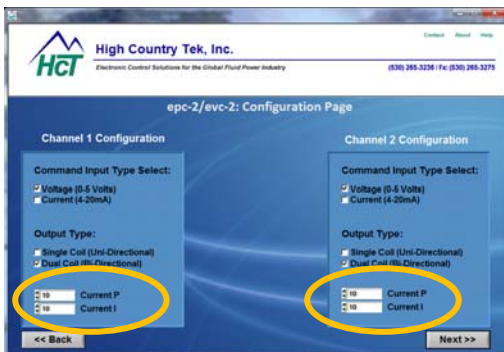
For a 1/4-20 bolt, SAE Grade 5

DRY Torque: 8 Ft-Lbs

Lubricated Torque: 6.3 Ft-Lbs



'P' and 'I' settings:



The P & I setting boxes (circled in orange, Left) for each channel are **factory pre-set to P = 10 and I = 10 default values** (= gain/time of ~0.16)

P & I max values allowed: The window only allows the user to enter from 0 to 255 max values in whole numbers.

The P & I operation in the DVC is scaled such that 255 is equivalent to a gain of 4, with 64 equaling a gain of 1

These default values allow the majority of proportional coils/valves/pumps to operate normally and meet expected product OFF to ON and ON to OFF times. Always return to these values if the system needs to be reset.

If it is found that the coil/valves/pumps is not responding as desired, the user may change the values in each box by selecting the window with the PC mouse and entering a new number.

The '**P term**' affects the amount of output current change relative to the output current error value that is derived from the scaling of the command signal to the Imin & Imax settings. Increasing the value makes the change more aggressive for a smaller error. Too aggressive a change can cause the valve/pump to oscillate (Under-damped), too low a value setting will result in slow response (Over-damped).

The '**I Term**', affects the output current error correction time . Increasing the value too much can result in the error being corrected too slowly to matter (Over-damped), too small a value can result in corrective current overshoot and multiple iterations until stable (Under-damped).

Settings for P & I are also effected by the system configuration, capacity and even viscosity changes, so the ideal setting is when the coil being driven responds as the manufacturers specification regarding slew rates for rise and fall times and delivers the system performance needed for a successful application.

P & I Set-up Guide:

1. Always start running the system using the default P & I settings as supplied to get a base line of operation
2. Use a fast changing command signal with small demand changes to see reaction (use square wave if possible)
3. If better response is needed, start to increase the 'P' setting first, in SMALL increments (increase by count of 5)
4. Test system response by using method described in 2. above - readjust as needed to get required response
5. Once the P is set, start to adjust the I setting to get current output stability and system response as required.

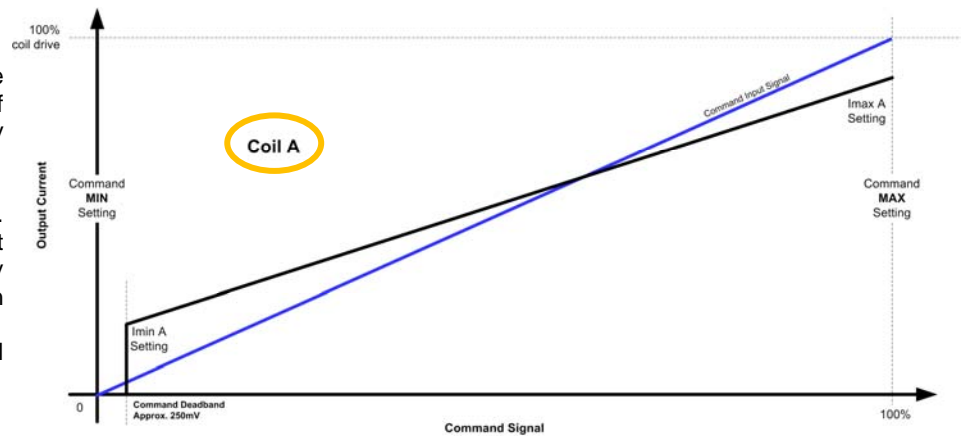
NOTE:

Because system characteristics change with oil temperature, viscosity, hose lengths and loading, It is important when setting P & I values different to the defaults provided, that the user tests the command signal to output stability over a wide range of settings to ensure the best possible stability and response has been achieved.

Appendix A: Dual Path with Single coil connections

This option allows each input to control one output channel and take full advantage of the 10 bit (1024 steps) resolution offered by the epc-2controller.

The dead band is internally set to approx. $\pm 5\%$ of the chosen command, shown here at 250mV for a 5V input and is to allow for any mechanical wear, tolerance or movement in the command potentiometer or joystick. When using 4 to 20mA, the deadband is still $\pm 5\%$ which equates to approx. 0.8mA

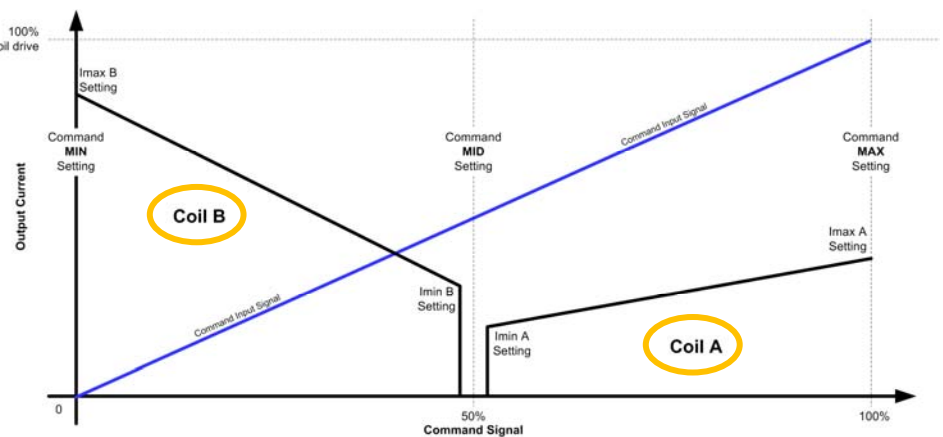


Appendix A: Dual Path with Dual coil connections

This option allows each input to control one output channel but *two valve coils*. The input command signal is configured such that at ~mid-value, both coils are OFF.

The command dead-band is internally set to $\pm 5\%$ as before and as soon as this level is seen, the output immediately jumps to the relative Imin setting and smoothly proceeds from there to Imax for max command.

Coil A command is from ~mid value to +max value (i.e. 2.5V to +5VDC) while Coil B command is from ~mid value to +0 value (i.e. 2.5V to 0V).



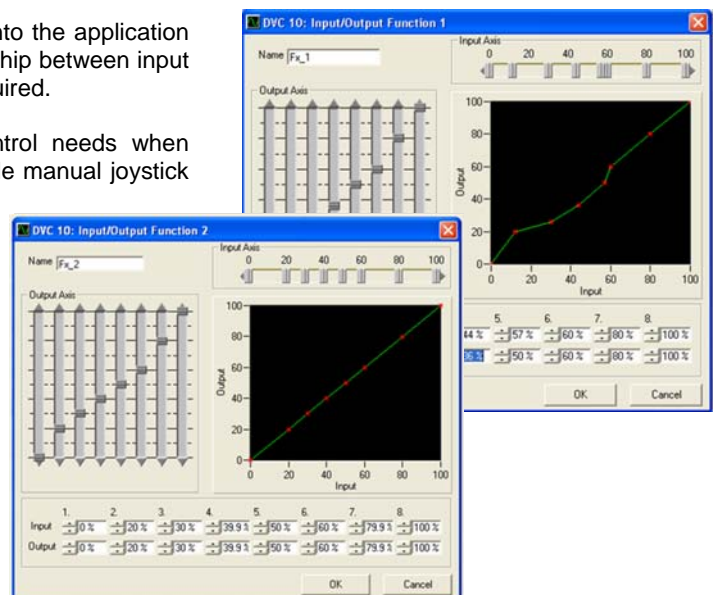
Input /Output Function Curve:

The epc-2 has the patented HCT I/O curve function integrated into the application software and is available to allow the user to change the relationship between input command and output current to something other than linear if required.

This unique feature give precise optimization of machine control needs when options such as 'creep' and 'full speeds' are needed from a single manual joystick movement.

This adjustment has restricted access to avoid any issues with standard operation but can easily be changed by a qualified HCT Intella™ software programmer user using the free HCT Program Loader Monitor (PLM).

Please contact the HCT customer service or your local distributor for details on how to access this feature or to find your nearest qualified Intella™ software programmer.





Services and Resources:

- ❖ 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
- ❖ Emission Controls
- ❖ Integrated Drivers
- ❖ Valve & Pump Controls



HCT Product Sales and Support:

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www.hctcontrols.com/distributors/index.htm

For more information:

Customer Service:

To discuss anything in this brochure, order product, get price and delivery or book a training course, please send an e-mail to us at: info@hctcontrols.com

www.hctcontrols.com



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