High Country Tek, Inc.

Electronic Pump Controller: epc-2

Open Loop control of single or dual coil valves, pumps & other equipment

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:

This pre-written epc-2 software application and corresponding PC based graphical user interface (GUI) 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 open loop pump control or directional proportional control solutions.

The controller operates from a wide supply range of +10 to +32VDC so this one unit can interface with any OEM coils of either 12VDC or 24VDC with a current requirement of upto 3amps per coil.
The GUI is designed around three easy to navigate pages where page 1 is the 'Dashboard' giving a real time overview of the controller health and input/output state.
Page 2 allows the user to quick-configure the type of command required, choosing from DC Volts (0-+5V) or Current (4-20mA) and also select single or dual coil output configuration, while page 3 shows all the other necessary adjustments that will be needed to individually set-up and optimize each channel, including Min & Max coil currents, UP/DOWN ramp times and dither amplitude / frequencies e.t.c.

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 unit supply voltage is the same as the coils on the valve being driven !
- 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. P.C., software) e.t.c.
- 'Isolate' this unit from all other equipment BEFORE any form of welding takes place.
- Check ALL connections to and from this unit to ensure NO short or OPEN circuits.
- Check the units supply voltage is CORRECT, ' ELECTRICALLY CLEAN ' and STABLE.
- 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 Specification Overview (General):

1.	Module size/format:	High Country Tek Inc. proprietary 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 ±10%
6.	Output current:	500mA (max)
7.	Protection:	Current limited, short circuit protected
8.	Analog Inputs number:	2x Inputs
9.	Analog input type:	DC Volts only
10.	Analog input values:	DC Volts (0 to +5V max)
11.	Digital Input number:	3x ON/OFF inputs
12.	Digital Input type:	DCV - level shift / Pulse
13.	Digital input values:	0 to +Power supply max
14.	Universal input number:	3x inputs
15.	Universal input type:	DC Volts, mA or pulse
16.	Universal input values:	0 to +5v, 0 to 20mA or 0 to24kHz total (8KHz each)
17.	Voltage Command I/P Impedance:	10 KOhm
18.	Current command shunt resistor value:	100 Ohms
19.	Proportional Output number:	2x PWM
20.	Protection:	Open and short circuit protection
21.	Proportional output range:	0 to 3 amp max
22.	Digital Output number:	6x High Side
23.	Digital output type:	ON/OFF level shift
24.	Digital output values:	0 to module supply voltage -0.5VDC
25.	Operating Temperature range:	-40C to +85C
26.	Storage temperature range:	-40C to +100C
27.	Ingress protection rating:	IP 68 / NEMA 6P
28.	Connector type:	Metri-Pack 30 way male

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 Graphical User Interface (GUI) Guide:

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

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 is intended to give the user a '**Dashboard**' overview of the controller settings in one easy to read screen.

The 'command input' and 'output current' for each channel can be seen while also observing the status of the RS232 communications between the PC and the module.

Top right of the screen is also a display box for the module supply voltage and actual internal temperature reading displayed in real time.

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'** shown here, allows the user to set the basic input command type to either DC Voltage (0 to +5VDC) or to Current (4 to 20mA) and how many coils will be connected to each output.

This process is important as selecting the single coil output type will scale the 0 to 100% command input across only one output while selecting a dual coil output type will split the command across coil A and Coil B, effectively halving the command resolution.

Clicking the 'Next >>' button will move the user to the next screen or clicking '<< Back' will take the user to the previous screen.
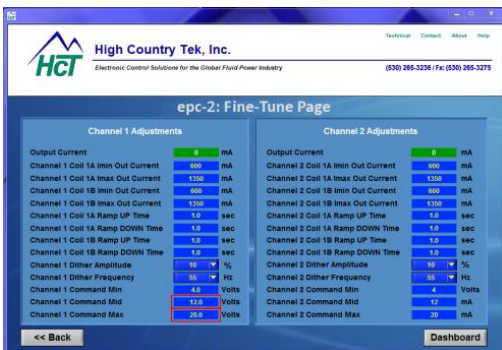
The '**Fine Tune Page'** offers the user options to customize each channel and to ensure that the valve or pump being controlled, acts as desired and is optimized.

As long as the user is connected to a epc-2module, 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 Graphical User Interface (GUI) Guide: Cont...
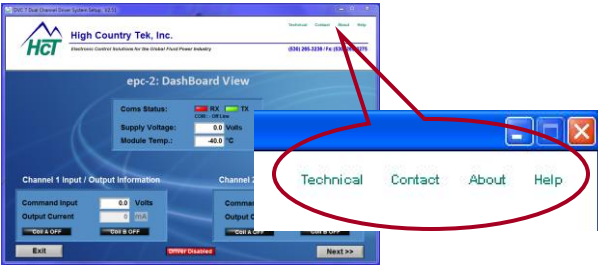
Click the following for these functions:

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.
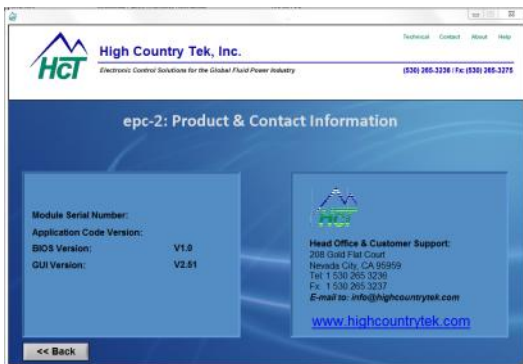
Contact:

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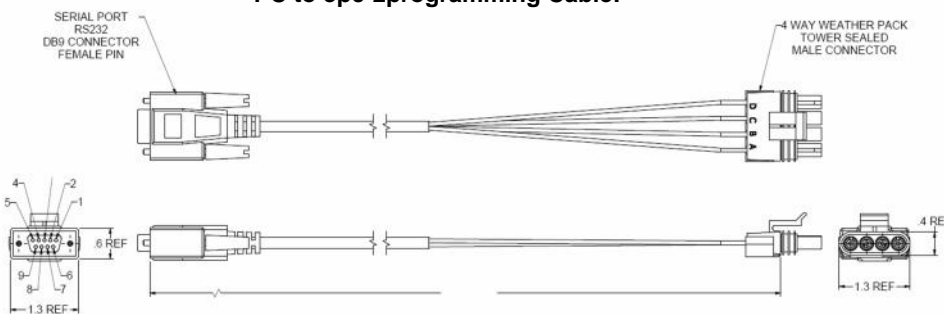
There is also a live link (if PC is connected to the Internet) to the HCT website where extra information as well as the latest literature and product details can be found as required.

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

PC to epc-2programming Cable:

HCT Part Number:

999-10075

PIN	FUNCTION
1	DATA CARRIER DETECT
2	RECEIVED DATA
3	TRANSMIT DATA
4	DATA TERMINAL READY
5	SIGNAL GROUND
6	DATA SET READY
7	REQUEST TO SEND
8	CLEAR TO SEND
9	RING INDICATOR

D-SUB FROM	TO	WEATHER PACK	FUNCTION
1	4	N/C	JUMPER
2	---	C	TXD
3	---	A	RXD
5	---	B	COM
7	---	D	RTS

PIN	FUNCTION
A	RECEIVED DATA
B	SIGNAL GROUND
C	TRANSMIT DATA
D	REQUEST TO SEND

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

1. **Channel X coil 1A Imin Out Current (mA):**
   This is the minimum current value that that will be sent to valve coil 1A when the command signal is approximately ± 5% of 2.5V (~125mV)

2. **Channel X coil 1A Imax Out Current (mA):**
   This is the maximum current value that that will be sent to valve coil 1A when the command signal is at approximately ±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):**
   This is the total time taken for the relative 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):**
   This is the total time taken for the relative 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):**
   Same function and action as noted in item 5. above

8. **Channel X coil 1B Ramp DOWN time (Seconds):**
   Same function and action as noted in item 6. above

9. **Channel X Dither Amplitude (0-100%):**
   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):**
    This is the 'Dither' frequency that will be on the PWM output. Again, Valve OEM's usually recommend frequency here, if no information is available, initially set 150Hz for cartridge and smaller valves and 100Hz for larger industrial valves.
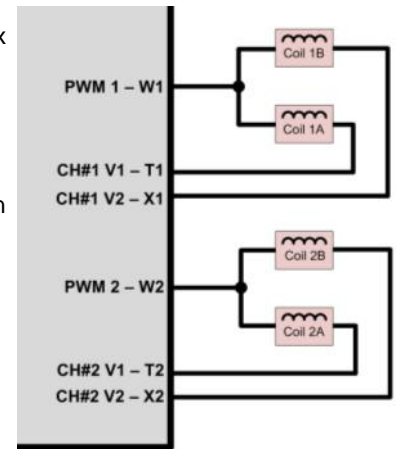
11. **Channel X Command Min:**
    Value sets the Max command input allowed

12. **Channel X Command Mid:**
    Value sets the Mid command for changeover in dual coil mode, ignored for single coil mode

13. **Channel X Command Max:**
   Value sets the Mid command allowable

Parameter	Max Value	Min Value	Action	Text
Channel 1 coil 1A Imin out current	3000mA	0mA		
Channel 1 coil 1A Imax out current	3000mA	0mA		
Channel 1 coil 1B Imin out current	3000mA	0mA		
Channel 1 coil 1B Imax out current	3000mA	0mA		
Channel 1 coil 1A Ramp up	65 sec	0sec		
Channel 1 coil 1A Ramp down	65 sec	0sec		
Channel 1 coil 1B Ramp up	65 sec	0sec		
Channel 1 coil 1B Ramp down	65 sec	0sec		
Channel 1 coil 1A Dither Amp	10% -100% in 10% increments			
Channel 1 coil 1A Dither Freq	33,45,50,55,76,100,125,142,200, 250, 333 & 500 Hz			
Channel 1 Command Min	5.0V	0V	Limits Input to 5v	
Channel 1 Command Mid	5.0V	0V	RED Warning box	out of range
Channel 1 Command Max	5.0V	0V	RED Warning box	out of range

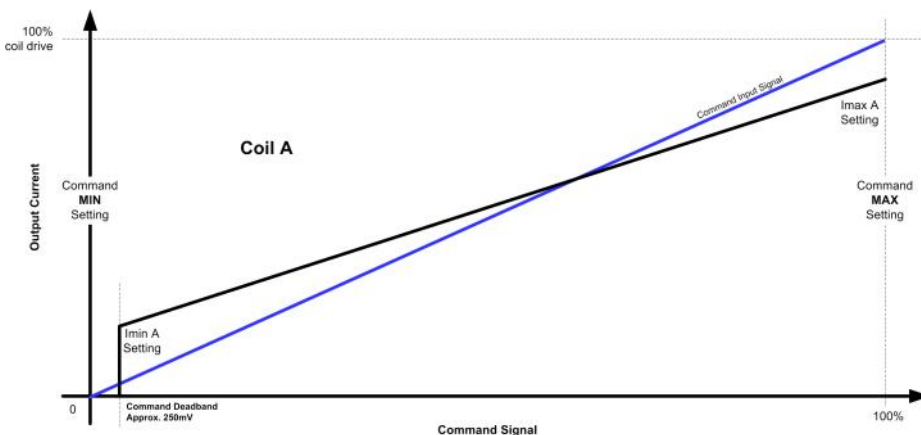## Dual Path with <u>Single coil</u> connections and applications:
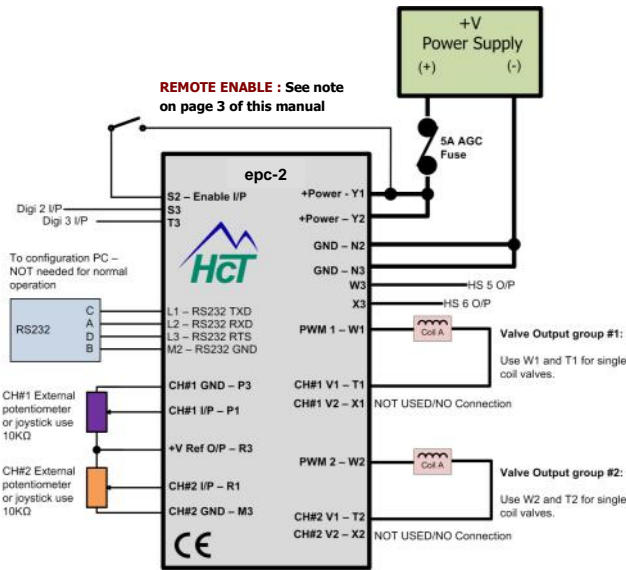
Configuration shown using 2x potentiometers or joysticks with internal regulated +5V to control 1x valve coil per channel.
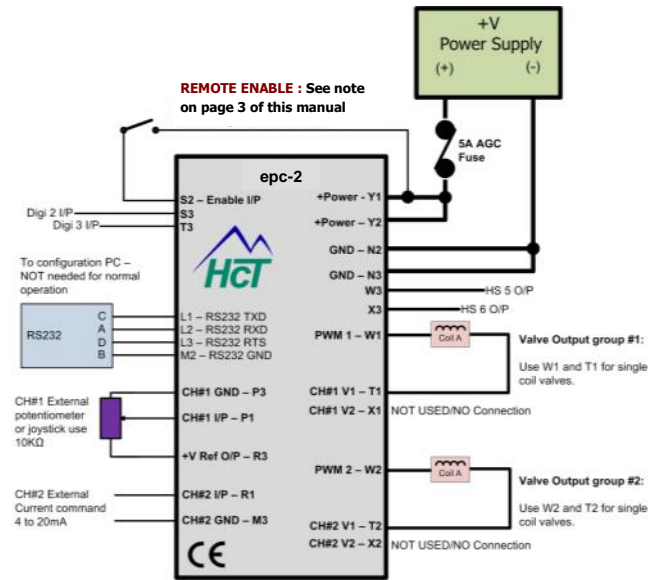
Configuration shown using 1x potentiometer or joystick with internal regulated +5V and 1x externally provided 4-20mA command input to control 1x valve coil per channel.


Cost Effective Proportional Applications: *Uni-Directional Projects*

- **Power units with need to control separate pressure and/or flow control valves**

- **Pump pressure compensator control (one and/or two pump individual control)**

- **Rotary or butterfly valves actuation (sprung return)**

- **Uni-directional Motor speed control**

- **Back-pressure control**

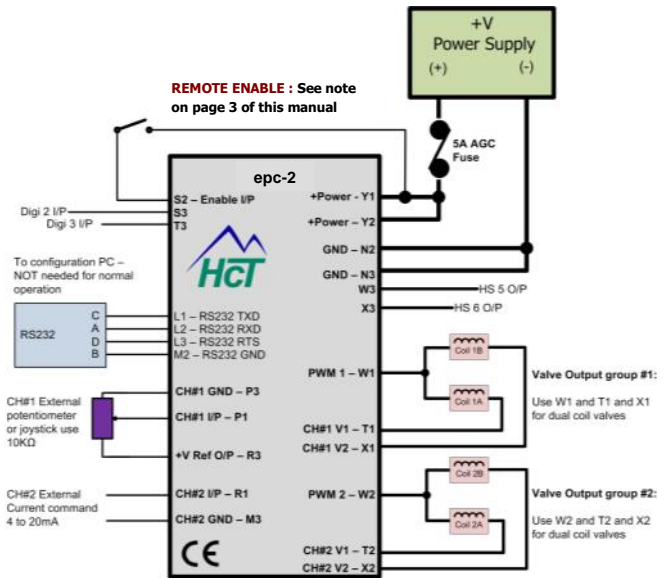- **Open loop dual driver for tough environmental applications**

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. ±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 ±5% which equates to approx 0.8mA

## Dual Path with <u>Dual coil</u> connections and applications:
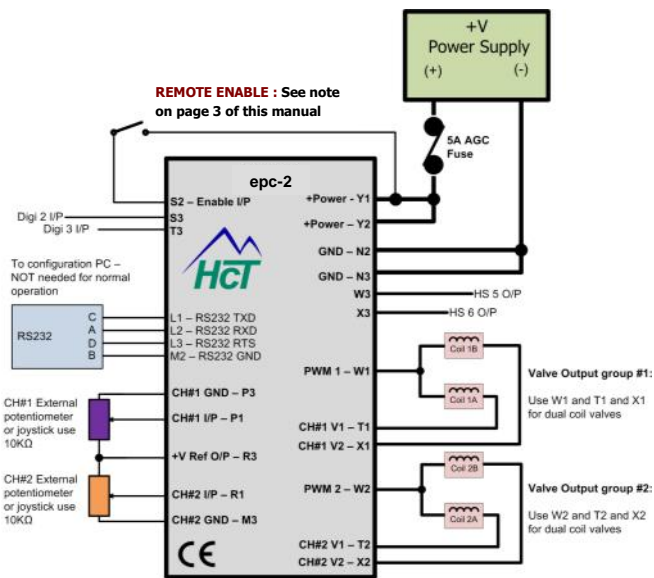
Configuration shown using 2x potentiometers or joysticks with internal regulated +5V to control 2x valve coil per channel.

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.

Cost Effective Proportional Applications: *Bi-Directional Projects*

- **Dual coiled directional Proportional valves**
- **Forward & backward or Up & Down variable control applications**
- **Cylinder speed & direction control**
- **Open Loop Pump Over center stroker control**
- **Open Loop Motor speed and direction control**
- **Hydrostatic control of Pump and Motor**
- **Open Loop Marine jet or bow thruster controls**
- **Open loop dual driver for tough environmental applications**
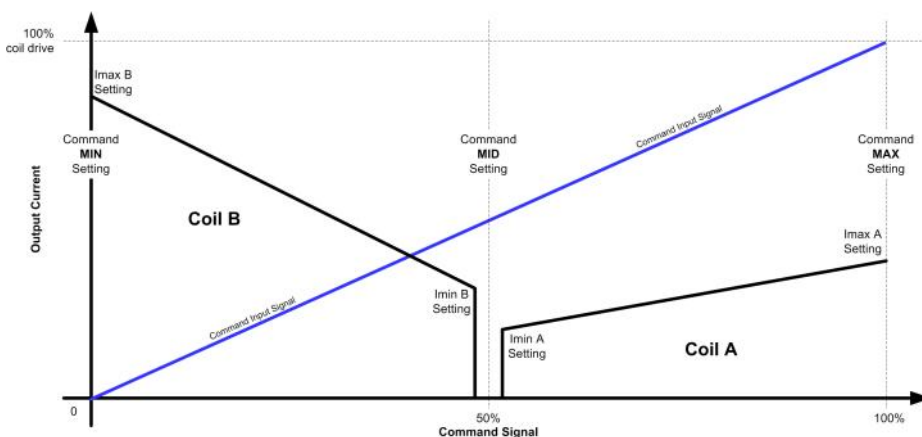
This option allows each input to control one output channel but *two valve coils.* The input command signal is configured such that at ~mid-value, both coils are OFF. The command dead-band is internally set to ±5% as before and as soon as this level is seen, the output immediately jumps to the relative 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).

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:

30 PIN METRI-PAK 150

PIN	FUNCTION	PIN	FUNCTION	PIN	FUNCTION
L1	RS232 TXD	P2	ANA 1	T3	DIG 3
L2	RS232 RXD	P3	PWR COM	W1	PWM 1
L3	RS232 RTS	R1	UNI 2	W2	PWM 2
M1	CAN H	R2	ANA 2	W3	HS 5
M2	PWR COM	R3	+5V REF OUT	X1	HS 2
M3	PWR COM	S1	UNI 3	X2	HS 4
N1	CAN L	S2	DIG 1	X3	HS 6
N2	PWR COM	S3	DIG 2	Y1	+POWER IN 1
N3	PWR COM	T1	HS 1	Y2	+POWER IN 2
P1	UNI 1	T2	HS 3	Y3	+POWER IN 3

HCT FACTORY ACCESSORIES

DVC Serial Port Adapter:	999-10076
RS232 Cable Assembly:	999-10075
Intella Programming Tool:	998-00003
DVC7 Mating Connector Kit:	999-10143
DVC7 Proto-Type Harness (3 Meter):	999-10141

RS232 CONNECTION
HCT PN: 999-10076

| DVC7	SIGNAL	999-10076
L1	TXD	C
L2	RXD	A
L3	RTS	D
M2	GND	B

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
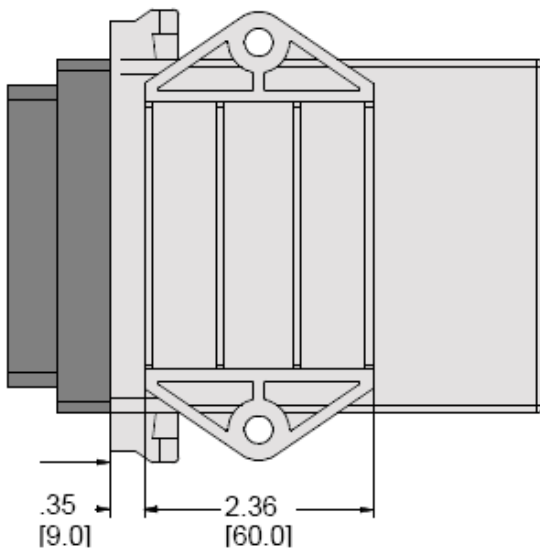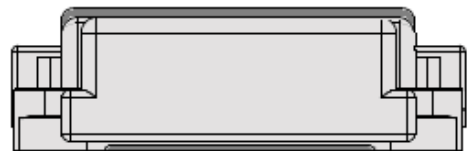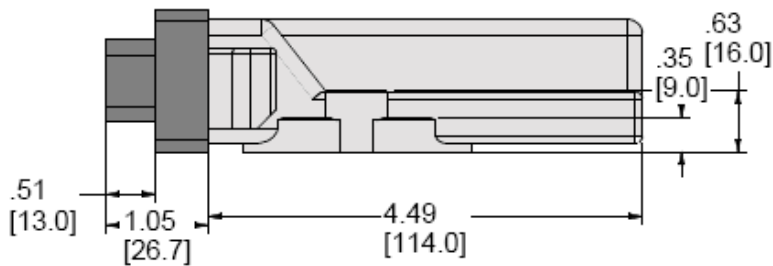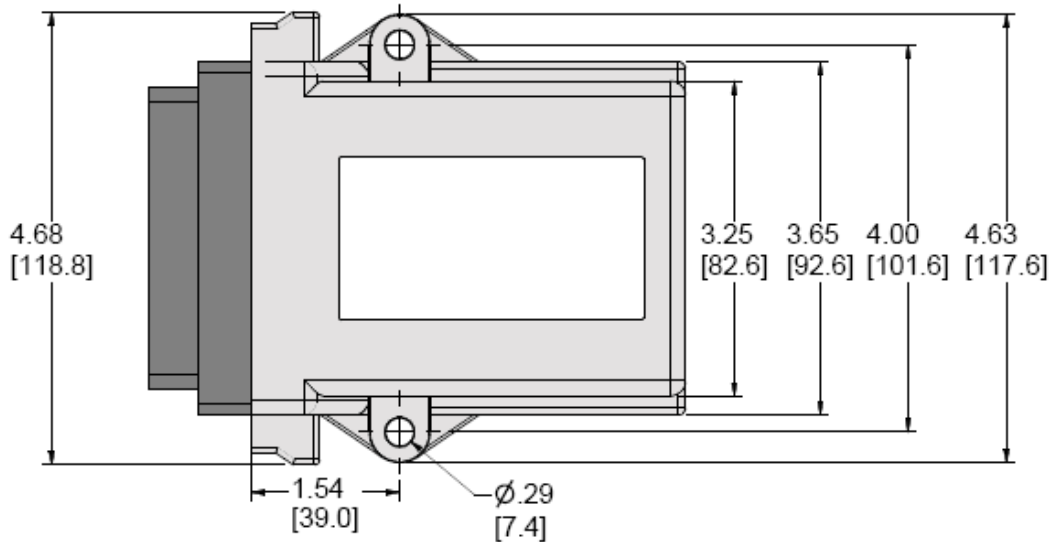- Blinking Red = PWM Output 'Short Circuit' detected
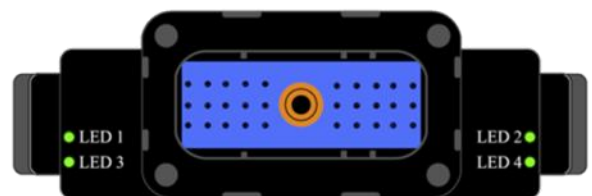
LED 3: (MS) - Module Status (Red / Yellow / Green):

- 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

9

epc-2 Module Mechanical Details:

Dimension	Value
4.68 [118.8]	
3.25 [82.6]	
3.65 [92.6]	
4.00 [101.6]	
4.63 [117.6]	
1.54 [39.0]	
Ø.29 [7.4]	

.63 [16.0]
.35 [9.0]

.51 [13.0]
1.05 [26.7]
4.49 [114.0]

.35 [9.0]
2.36 [60.0]

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

Gold Cup Specific Information

DENISON Hydraulics   **Parker**

The 9A control controls displacement in proportion to an electric current between zero and ~350 mA (max) for the 24 volt version, and up to ~700 mA (max) for the 12 volt version.

The O/P to the coils is a Pulse Width Modulated (PWM) signal, with current to one coil driving the pump in one direction, and to the other coil in the opposite direction. Adjustable mechanical maximum displacement stops are provided.

9A Stroker Specifications:	Note: 12V coils are approx. double values shown below
Hysterisis	5% typical, 8% maximum
Linearity	8%
Response	P6,7,8 - 0.9 Seconds, zero to full stroke or back
	P11,14 - 1.5 Seconds, zero to full stroke or back
	P24,30 - 1.8 Seconds, zero to full stroke or back
Repeatability	2%
Temperature null shift	<2% per 100°F (38°C)
Servo Pressure required	200 - 1000PSI (14-70bar), 400 nominal (28bar)
Coil resistance	41 ohms (24v coil) & 10 ohms (12v coil)
Electrical input	270 mA minimum, 325 mA nominal, 350 mA maximum (24v coil)
Neutral deadband	150 mA minimum, 180 mA nominal, 210 mA maximum (24v coil)
Manual override	3/16" Allen wrench, 30 in-lb (3.4Nm) with zero signal
Fluid types	All
Electrical connector	DIN 43650 type AF, 16-01008-8

TO VANE CHAMBERS

SERVO
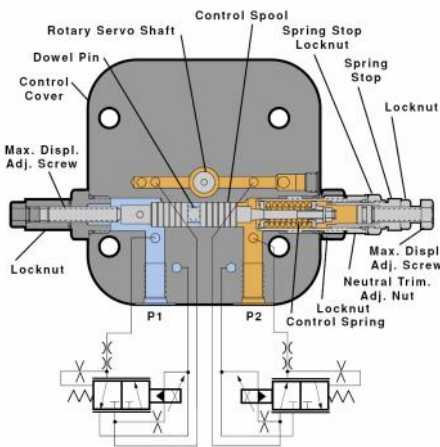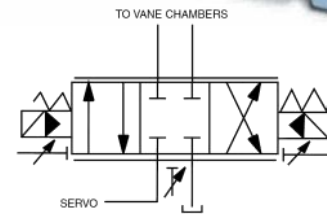
The valves used on the Gold Cup 9A stroker are 2 separate proportional cartridge valves using DIN 43650 connectors, mounted into the control assembly as shown in the diagram above.

The commonly used hydraulic symbol is shown the left of this description for reference.

The curves shown below, left are a representative guide of the flow curve that can be expected using the DVC 7 to control displacement and direction of the Gold Cup series of open loop pumps or motors.

The Gold Cup series has a mechanical deadband which can be reduced or adjusted out by setting the correct value in mA of the I Min output relative to a small input command signal. Typically the command signal deadband is set between ±125 and ±250mV to ensure that electrically noisy signals do not inadvertently cause the stroker to begin operation.

With the command signal past the deadband setting above, the relative coils I Min (A or B) setting should be increased from zero until the 9A stroker starts to operate the Gold Cup product. At this stage, the I Min value should be reduced to give no stroke.

The command signal can then be increased to maximum and the relative coils I Max (A or B) adjusted to achieve the desired maximum product displacement required for the application in either direction.

Dither frequency and amplitude as well as Ramp UP and DOWN can be set to suit the application operation and reaction speed of the Gold Cup product being controlled.

Ensure you select the right voltage coil(s) to match the DVC 7 supply voltage to get maximum resolution from the I Min and I max settings.

High Country Tek, Inc products can be used for single product control as shown here or complete system operation. Please contact us for training on how to use our Intella™ software and create an optimized solution that
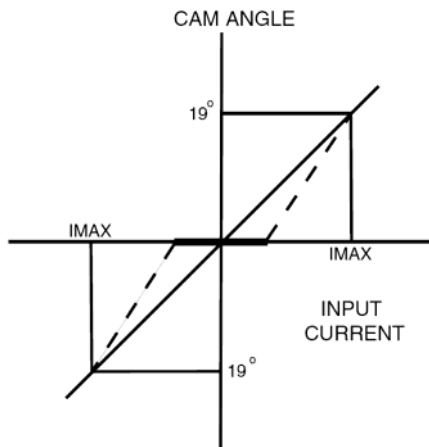
Services and Resources:

- ### People & Product Training:

We offer structured hardware and software information sessions, tailored to suit your level of staff need, from entry level to advanced deep-dive or specific target areas, making you self-sufficient on HCT modules, meaning more projects can be worked on and no more delays or contractor costs to budget for.

- ### Application Knowhow & Sound Advice:

Our experienced Field Application Engineers (FAE's) can work with you to optimize the chosen controller solution and realize successful efficient implementation of your end configuration.

- ❖ Mining & Exploration
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