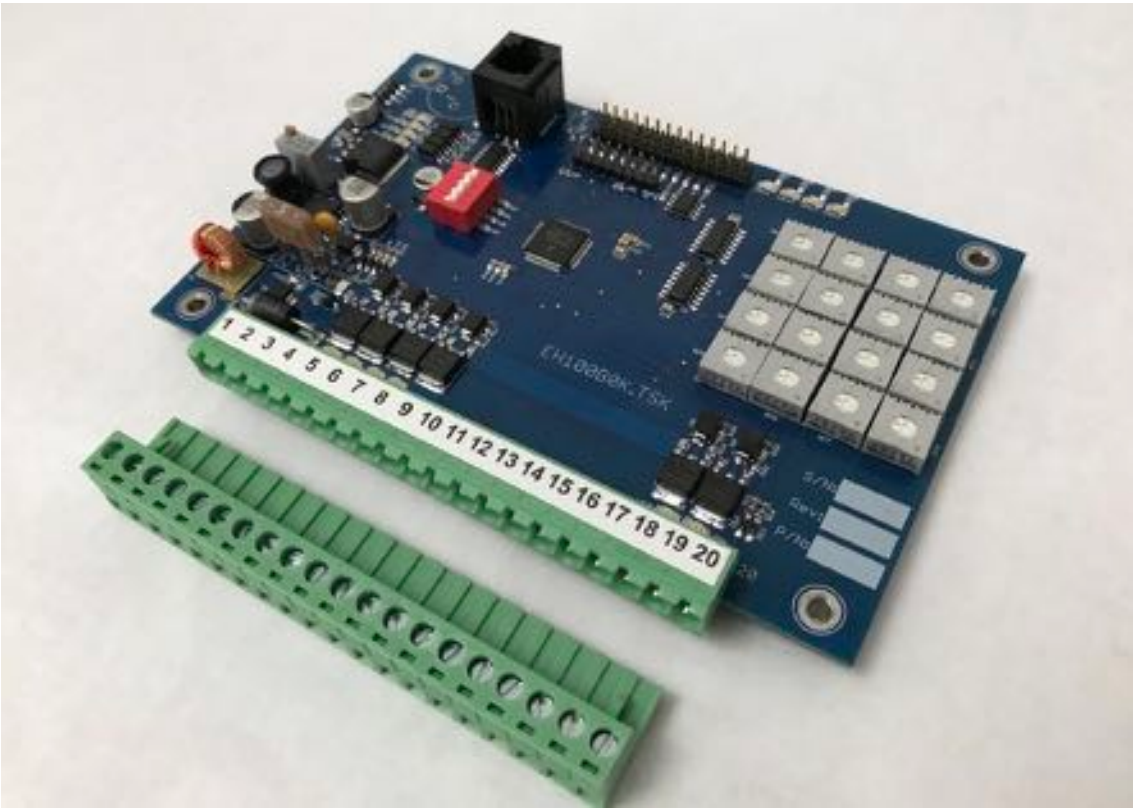
EH100
Electro-hydraulic Controller

Operations Manual

doc. EH101M1C



Product Manual **EH101M1C**

Application p/n: **EH100F1F**

Hardware EH101, 102, 103

The EH100 is a general purpose electro-hydraulic controller. It features flexible hardware with a pre-programmed embedded micro controller to implement joystick (open loop) positioning and speed control schemes used for controlling hydraulic machinery. This manual describes how to set-up the EH100.

Index

General overview

Hardware Features 3
Block Diagram 3
Hardware Part Numbers 4
Operation (modes 1,2,3) 4

Setup 5
Setup Max/Mins & Mode 5
Output enable 6
Analog Inputs 7
Analog Jumpers 7
Voltage Reference & Signal Ground 7
Axis Enable 8
Input-output ratio 8
Dip Switch 9
Status LED's 9
Trim Pots 9
Min/Max Trim 10
Valve trim adjustments 10
Ramps 11
Joystick inputs 11

RD202 Handheld Program Tool

Description 12
Operation 12
Mode Based Menus
Mode 1 13
Mode 2 14
Mode 3 15

LAYOUT 16
Dimensions 17

Hardware Interface Detail 18

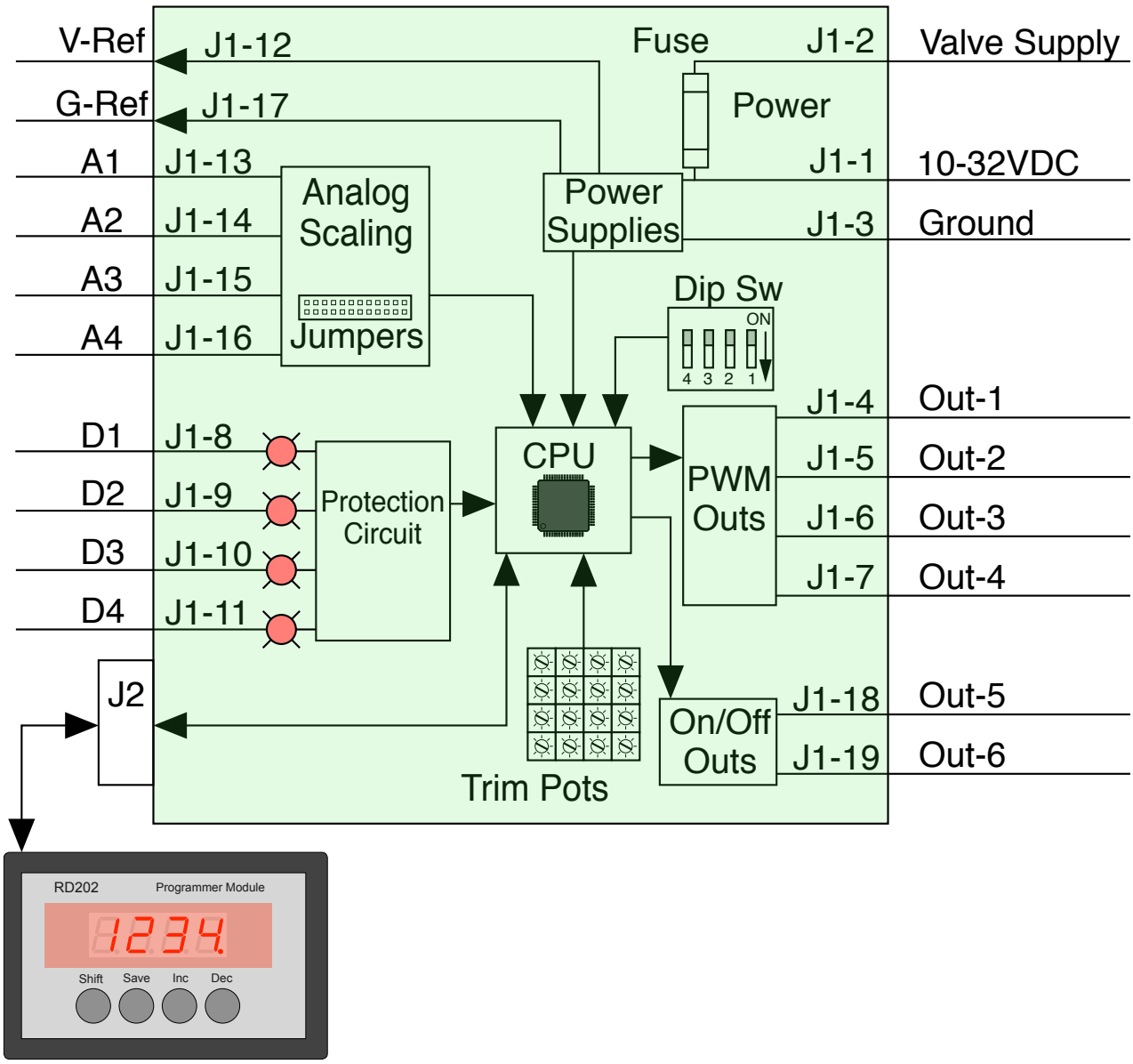
Example System Diagrams

X-Y Joystick (2) 4 way Proportional Outputs 19
X-Y Joystick with Limit Sw. 20
4 Independent PLC controlled Valves 21
X-Y Joystick (2) 3-way Sol. Directional & (2) Proportional Valves 22
4 Independent Potentiometer Controlled Valves 23

Hardware Features

- 10-32 vdc input voltage, -40 to +85 deg C, non-condensing
- (4) proportional valve drives, PWM type, 2.5 amps
- PWM Freq. adjustable 30 to 250 hertz
- (2) solenoid valve drives, bang-bang type, 2.5 amps
- (4) digital inputs, device sinking, edge or level sensing, 4khz
- (4) analog inputs, 8 bit, (optional gain-offset amps with negative reference)
- (12) user selectable jumpers to scale analog inputs; 4 ch, 0-5v, 0-10v, 4-20ma
- LED indicators, (4) digital inputs, (6) FET outputs, (4) CPU status, (1) fuse-OK
- (16) trim pots, live adjustment valve trims; min, max, ramp up and ramp down
- (4) dip switches to selecting special features
- Handheld program tool, RD202

Eh100 Block Diagram



Hardware Part Numbers

EH101A1A	Two axis version;	(6) out, (4) digital in, (4) analog in, (16) adj. pots adj. ref., fuse 5A, status LED's, DIN6
EH102A1A	One axis version;	(2) out, (4) digital in, (4) analog in, (8) adj. pots adj. ref., fuse 5A, status LED's, DIN6
EH103A1A	Reduced version;	(6) out, (4) digital in, (4) analog in, NO adj. pots adj. ref., fuse 5A, status LED's, DIN6, (requires using a RD202)
RD202A1A	Handheld;	Mod-6 connector, 24" cable

Operation

The EH100 has three different operational modes. Each mode provides the same individually adjustable valve settings; minimum output, maximum output, ramp up and ramp down. The analog and digital inputs control different functions based on the selected mode.

The EH100 uses the RD202 hand-held program tool to access the full range of control features; digital tuning, finer control and diagnostics. When the RD202 is not available, a simple set-up routine is provided by using the switches and pots. located on the circuit board. Refer to section; **setup-lite**

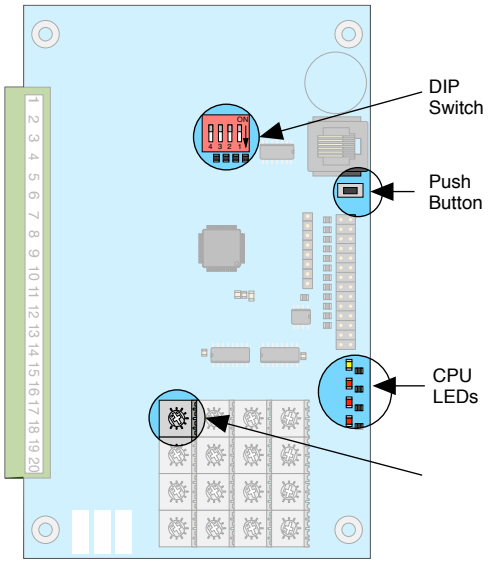
Mode 1 provides a standard two axis joystick drive function. The two axis's are independent and directly accommodates a typical x-y crossing joystick. Each axis comprises a pair of valve coil outputs, (forward-reverse, up-down, left-right, etc.) Each axis (or coil pair) requires one analog input command signal that can originate from a PLC, panel pot. or joystick. The outputs are Off when the joystick is centered, Vref/2. Each driver has an individual digital input enable for implementing; end of travel, dead-man switch, etc. Two analog inputs are set up for reading operator switches to select a pre-set input-output slope control and a global enable. The two solenoid outputs are activated individually whenever the corresponding axis is enabled.

Mode 2 also provides a two axis function as described in mode 1, the valve configuration instead uses a standard 4-way bang-bang valve for direction and a single proportional flow valve to regulate the speed for each axis. Mode 2 uses all six valve drivers to implement the two axis control. The digital and analog inputs apply the same features as in mode 1.

Mode 3 is a general purpose valve driver for driving four PWM outputs. An individual analog command, (0-Vref) and digital enable is used each output. Mode 3 is ideal for PLC interfaces, giving the designer individual control over each of the four valve drivers.

SETUP

When the RD202 had held programmer is not available the EH100 provides the installer with a basic set-up procedure. The DIP Sw #3 puts the EH100 into a self program mode. A small push button [located opposite to J1] is used to step through a series of LED patterns. Each pattern defines an adjustment step. The installer can select; mode 1,2,3, PWM freq. and adjust the various output min's, max's and ramps. The dip switch gives two choices for dead-band The analog jumpers give three input voltage selections. The adjustable V-ref is used to center the joystick.



To program:

Start: Slide DIP Sw #3 to ON (down) to select self program mode (all Led's blink), Press-&-release PB to scroll thru the CPU Led patterns Each pattern identifies a step from the chart below

first: Go to step 9,10 or 11 and set the mode, slide DIP Sw #3 to Off to save

second: Go to step 12 and set the PWM freq., slide DIP Sw #3 to Off to save

third: Go thru steps 1 thru 8 to set up the PWM valve drives. Use DIP Sw #4 to activate outputs

End:

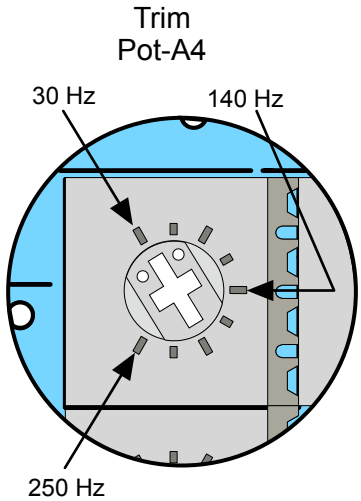
PB STEP	CPU LED's 11 12 13 14	
0	◎ ● ● ●	All blink when program mode is selected
1	● ○ ○ ○	Out1 min trim
2	◎ ○ ○ ○	Out1 max tirm
3	○ ● ○ ○	Out2 min trim
4	○ ◎ ○ ○	Out2 max trim
5	○ ○ ● ○	Out3 min trim
6	○ ○ ◎ ○	Out3 max trim
7	○ ○ ○ ●	Out4 min trim
8	○ ○ ○ ◎	Out4 max trim
9	● ● ● ○	**Mode 1**
10	● ● ○ ●	**Mode 2**
11	● ○ ● ●	**Mode 3**
12	○ ● ● ●	Set PWM freq.

○ LED = off
● LED = on steady
◎ LED = blinking

Trim assist feature:
Press PB to step to desired adjustment --- 1 thru 8
Set DIP Sw #4 = ON (right) [note, outputs go active]
> adjust mins for desired min speed
> adjust maxs for desired max speed
> for each adjustment verify the live hydraulic function
Press PB to step to the next valve adjustment, repeat

Use PB to scroll to desired mode 9, 10, 11 slide the DIP Sw #3 to left to save the mode

Use Trim Pot-A4, lower left to set PWM freq. full CCW = 30 hz and full CW = 250 hz extrapolate to select desired freq. Once set, do not change this trim pot setting until after DIP Sw #3 is returned left to the Run mode



Outputs

The EH100 has six high efficiency Power Mosfet (FET) output drivers. Each is configured as a current sinking low-side switch, "on resistance" 0.05 ohms. There is an output verification LED for each output FET and each output has a fly back diode for noise suppression. Overload protection is an on-board supply side fuse with LED. The first four FET drivers; Out-1,2,3, & 4 are pulse width modulated outputs for driving proportional valve coils. The last two outputs, Out-5 & 6 are an on-off type or (bang-bang) used to drive standard solenoid valve coils.

The EH100 outputs are voltage control, making the current load dependent. If a direct short of the output to an un-fused supply the output FET could be damaged.

Output enable

There are several ways enable the outputs of the EH100.

The four digital inputs are dedicated to enabling/disabling outputs. Each input has an associated LED to verify the input is active (low). The enabling logic is active low requiring the input device to sink the input to ground. If the installer does not require any individual enable logic the inputs should be jumped to G-ref at terminal J1-17. Optionally all (4) digital inputs can be connected to a single enabling device.

Input	Terminal	Action
D1	J1-8	enables output Out-1
D2	J1-9	enables output Out-2
D3	J1-10	enables output Out-3
D4	J1-11	enables output Out-4

End of travel limit (example)

To create an end-of-travel limit use a normally closed limit switch on the full forward and full reverse positions of the x-axis hydraulic cylinder such that each limit switch opens when the cylinder reaches the end of travel. As the forward limit switch opens, Digital Input-1 goes (high) inactive and Output-1 driver output will turn off and stop any further forward movement of the cylinder. At this point the Digital Input-2 for the reverse limit switch is still active (low) and as the analog input goes to reverse, the cylinder will be allowed to travel in reverse. When the cylinder reverses off the forward limit switch, Digital Input-1 goes low and the forward output will regain operation.

Some joystick devices have internal direction switches that can be used to create an output enable. If you connect these joystick direction switches to the digital inputs the corresponding output will only be enabled if the joystick lever is moved in the correct direction.

Analog Inputs

The EH100 has (4) analog input channels, 8 bit conversion, internal 5v reference. Each channel has an input network for scaling. Jumpers allow the installer to select a divide by two for (0-10v) scaling or a 250Ω impedance to G-ref. for 4-20ma inputs. The inputs channels can also accept switch inputs since the jumpers can also select pull-up and/or pull-down 5K resistors. Channels A1 and A2 have a factory option to be amplified, with offset, gain adjustments and a negative ref. for scaling transducer outputs on custom applications.

Analog jumpers

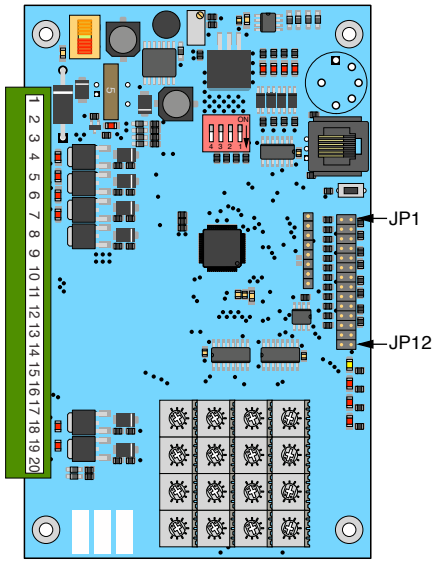
The jumper options available for each analog channel differ with the mode selection. The jumpers are named JP1, JP2, … JP12.

Analog Input selections for Modes 1 and 2

A1	**JP1, 2, 3**	set up the X-axis input scaling, select; 0-5v, 0-10v, 4-20ma
A2	**JP4, 5, 6**	set up the Y-axis input scaling, select; 0-5v, 0-10v, 4-20ma
A3	**JP7, 8, 9**	set up AN3 for external enable device
A4	**JP10,11,12**	set up AN4 for external slope device

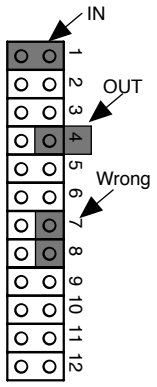
Analog Input selections for Modes 3

A1	**JP1,2,3**	set up input scaling	0-5v, 0-10v, 4-20ma
A2	**JP4,5,6**	set up input scaling	0-5v, 0-10v, 4-20ma
A3	**JP7,8,9**	set up input scaling	0-5v, 0-10v, 4-20ma
A4	**JP10,11,12**	set up input scaling	0-5v, 0-10v, 4-20ma



Use the following chart to select analog jumper locations

jumper assignment			
Analog input A1 J1-13	JP1	JP2	JP3
Analog input A2 J1-14	JP4	JP5	JP6
Analog input A3 J1-15	JP7	JP8	JP9
Analog input A4 J1-17	JP10	JP11	JP12
Analog input scaling			
0-10 vdc (divide by two scaling)	Out	Out	**In**
0-5 vdc (no scaling)	Out	Out	Out
4-20 ma (250 ohm)	**In**	Out	Out
Switch input			
pull up	Out	**In**	Out



The jumpers, also known as shunts, slide over either one or two pins. From the table above; **Out** means to leave the shunt placed on one pin and **In** means the shunt is placed over both pins Do not install shunts cross-ways, see drawing for correct jumper installation.

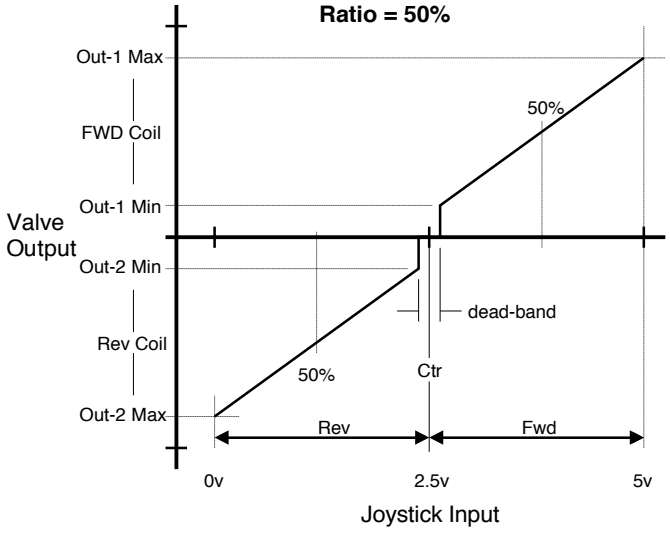
Voltage Reference & Signal Ground

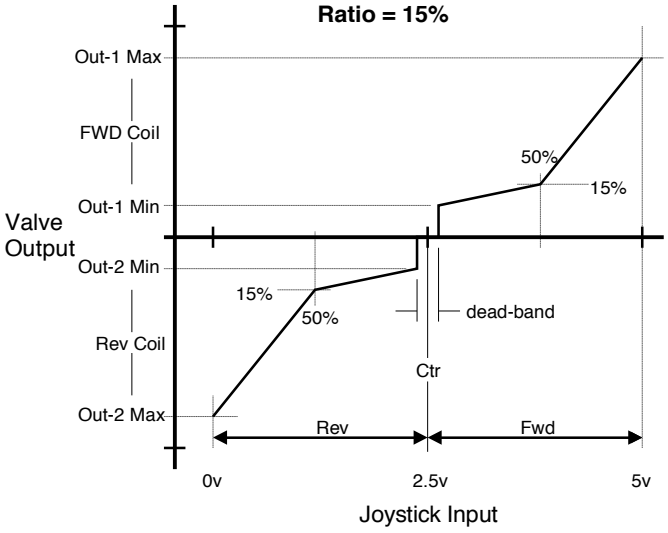
Voltage Reference and Signal Ground (Pins 12 & 17) are provided to power low current joysticks, potentiometers, or sensors. The voltage out can be adjusted with the trim pot (See Layout). Keep in mind: the output voltage can only be as high as 1.5 volts **below** board power, and the current output shouldn't exceed 100 mA.

Axis Enable The EH100 offers two options for enabling the valve drive outputs. The first self-enabling meaning when the joystick is moved outside of the dead-band area the axis activates. The second switch-enabling meaning to use a trigger switch or other hand switch the operator must maintain to activate the axis. The safety switch is a N.O. contact between analog input #3 (J1-15) and G-ref (J1-17).

Jumper settings **A3** (J1-15)	JP7	JP8	JP9	
Self-enable	out	out	in	(no safety switch)
Switch-enable	out	in	out	(trigger switch)
Safety switch	out	out	out	(Normally Open SW between J1-15 to J1-17)

Input-output ratio This feature allows the operator to select a pre-set ratio for how the joystick command effects the valve output. The normal ratio is 50% (1:1) where half of the joystick travel will produce half the valve output. The ratio defines the joystick command at 50%. With the ratio feature the installer can customize the joystick sensitivity for fine control. The operator can select between a ratio of 1:1 and the pre-set ratio with a switch (N.O.) connected between analog input # 4 (J1-16) and G-ref (J1-17). When the switch contact is open the ratio is 1:1, when closed the pre-set ratio is used.



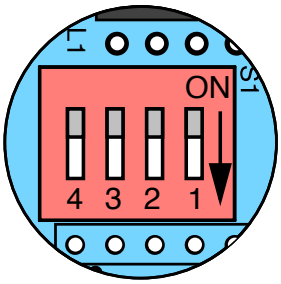


Jumper settings **A4** (J1-16)	JP10	JP11	JP12	
Operator selectable	in	out	out	(users switch enables/disables A4)
Ratio = pre-set	out	out	in	(A4 always enabled, no switch)
Ratio = 1:1	out	in	out	(A4 always disabled, no switch)

Dip Switch

The four position dip switch is used to setup features when RD202 is not used.

DIP Switch



DIP Sw	Off (left)	On (right)	(feature)
1	0-5,10 vdc	4-20 ma	(analog input type)
2	130 mv	210 mv	(dead-band)
3	run	prog	(prog. mode)
4	off	on	(trim assist, output active)

Status LED's

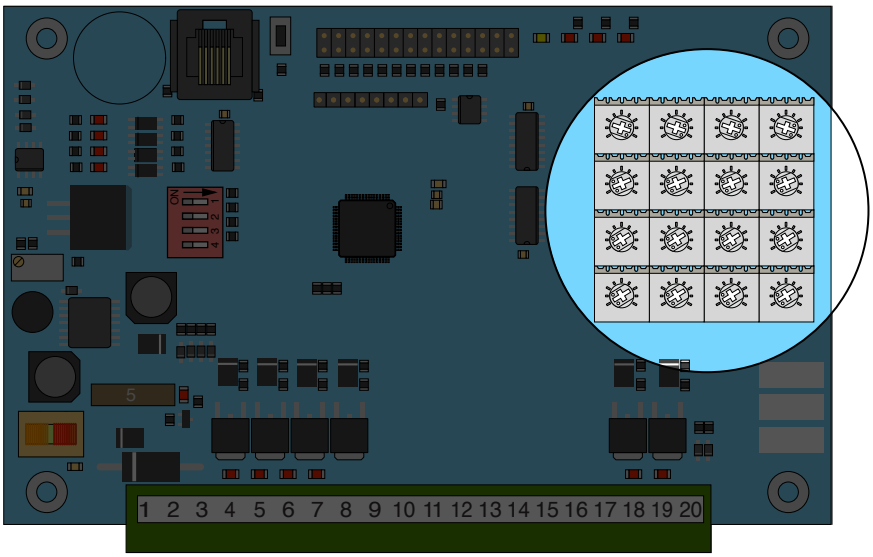
The EH100 has ten hardware status LED's; the four digital input LED's and the six output LED's. These LED's can only indicate the hardware state of the corresponding input or output. There are four CPU driven status LED's indicating the following:

LED11 = heartbeat Yellow, steady blink to indicate normal operation
LED12 = n/a Red, not used in run mode
LED13 = A3 input Red, On = outputs enabled
LED14 = A4 input Red, On = knee control active

Trim Pots

The EH100 has (16) single turn trim pots. located on the board. Each of these adjusts a specific variable within the application program. These trim pots are normally live and any adjustment will create an immediate effect on the output. There is a provision to lock these values using the RD202 hand-held program tool. The following chart define the trim pot functions.

	Output-1	Output-2	Output-3	Output-4
1	Maximum	Maximum	Maximum	Maximum
2	Minimum	Minimum	Minimum	Minimum
3	Ramp Up	Ramp Up	Ramp Up	Ramp Up
4	Ramp Down	Ramp Down	Ramp Down	Ramp Down



Min/Max Trim

Always use caution when working on live hydraulics systems. Powerful and sudden movements can occur while making these adjustments.

The min and max trim pots set the minimum and maximum output levels and should be adjusted first. Your system needs to be fully wired, all jumpers and dip switches set, power ready and hydraulics ready and operating at normal temperature. You also must have a way to freely adjust the analog inputs. If you are using a PLC to drive the analog inputs, make sure the analog output can be held at any given level.

The minimum output usually is a very slow creep speed and the maximum output is where the valve just reaches full flow. Your application may call for the trims to be different. The EH101 is very flexible and here are several guidelines to keep in mind,

1) The max trim overrides the min trim and can be used to force the minimum down to a lower level.

2) There is no interaction between the min and max trims but you may see hydraulic interaction depending on the valve and overall hydraulic circuit.

3) Try to refrain from setting the max trim too high, drive currents higher than those necessary for full flow can cause some valve coils to overheat.

4) If you use an electrical meter to verify your valve trim adjustments remember to connect your volt meter across the valve coil, *not from the coil to ground.* If using a current meter, connect it in series with either valve coil lead. The PWM frequency will not cause any appreciable error with your meter.

5) Allow the hydraulic oil to reach normal temperature before making the trim settings.

6) The EH100 does not regulate the valve current independent of the voltage supply. Poorly regulated supplies can cause small changes in the valve drive.

Valve trim adjustments (three methods can be used)
The first is, described below, its fast and easy. It only requires a steady hand on the joystick and a small screwdriver to adjust the on-board trim pots, but the results may have small differences between axis fwd and axis rev. The alternate method uses a built-in trim assist feature. It requires you step through a procedure of lights and push button strokes to adjust each valve trim with a good degree of accuracy. The third and most complete method is to use the RD202 hand-held terminal.

<u>The simple method</u>
Set the minimum trim first with the ramp adjustments to their lowest setting (full CCW). Raise the analog input up the point where it just breaks out of dead-band You should see the output LED begin to glow. It may appear dim since the output is normally very low at this point. While holding the analog input to the edge of the dead-band, adjust the min trim pot so that the hydraulic function just begins to creep. Adjust above and below this point to ensure you have correctly found the beginning of creep motion. Next, increase and hold your analog input signal to it's maximum level, adjust the maximum trim to the desired output. Make these trim adjustments for both the forward and reverse outputs. Watch the hydraulics and determine if it is smooth and balanced motion.

Ramps

Ramps are used to limit the rate of change for each output with a change to the input signal. Typically this is used to dampen or slow down the response in a hydraulic system.

The ramp timers on the EH100 can be configured two ways. The standard approach is to apply the ramp timers to only follow the analog inputs. This means that when an analog input changes the output will be ramped. And if the output enable for that channel were removed the output would shut-off immediately (not be ramped).

The alternate approach is to apply the ramp timers to both the analog input and the output enable. By example; this allows the input to be at say 50% and when the output enable is applied the output would ramp up to 50%. The same effect would occur for removing the output enable while the output is active. The output would continue to be ramped with any changes to the normal analog input.

Menu 15 is used to apply the ramps; 0 = ramp analog inputs only 1 = ramp both inputs and output enable

The ramp rate adjustments are set independently, with a separate ramp up and ramp down setting for each output. The ramp time range can be either short (0.0 sec. to 5.0 sec.) or long (0.0 sec. to 30.0 sec.). The ramp up adjusts the ramp rate for an increasing output. Ramp down adjusts the ramp rate for a decreasing output. Usually the ramp settings are adjusted equally for up and down, but unequal ramp up and ramp down rates can be used to create special effects. There is no typical ramp adjustment. Start by setting the ramps to their minimum (full CCW). Add ramp time to improve the smoothness and overall load handling.

Menu 16 sets the ramp timer range. 0 = short 0–5 sec 1 = long 0–30 sec

Joystick inputs

There is a special calibration routine used for setting up joysticks. The calibration will correct for a joystick voltage offset. This is when the mechanical center of the actual joystick is not equal to the center of the joystick output voltage. For each of the joystick's positions, center, full forward and full reverse. With two axis joysticks this calibration must be done for each axis.

<u>To calibrate the joystick using the RD202 hand-held programmer</u>

1) Go to menu 07 for AN1 (X-axis) and menu 08 for AN2 (Y-axis).
2) Let the joystick return to it mechanical center
3) Press the **Save** key to store the center value.
4) Position the joystick to its maximum positive output, press **Inc** key to store the maximum value.
5) Position the joystick to its minimum negative output, press the **Dec** key to store the minimum value.

The RD202's decimal points will blink to indicate the joystick calibration values are being saved. When the decimal points stop blinking the calibration save is competed. Each of the joystick's 3 critical points, min., center and max. are now stored in the EH100. The program will use these stored values to construct a correction table.

RD202 Handheld Program Tool

The RD202 hand-held allows the user to view and adjust the stored parameters. The RD202 has no internal memory, all variables are stored within the EH100's non-volatile memory.

The RD202 connects with a Mod-6 plug, slowly push the plug into the mating board receptacle, J4. The RD202 can be safely installed or removed from the EH100 while the system is powered. Use care not to bend or pull or mechanically stress the board connector.

Store the RD202 in a clean, dry environment.

Photo is typical, connector may be different than shown

1. Press and hold the **Shift** key while using the **Inc / Dec** keys to scroll to an address release and view the setting at the selected address. When you reach the end of the address list, continue scrolling to wrap around to one.

2. To change the setting, (remember to release the **Shift** key) and use the **Inc / Dec** keys while viewing the change. Depending on the variable being changed your selection may take effect immediately and result in an unwanted change to a live output. Use caution.

3. Press and hold the **Save** key (~1 sec) to store your selection. The display brightness changes briefly if the data value saved is new. *NOT* to save your selection is useful to test settings. Your unsaved changes will be lost upon the next cycling of the power.

Refer to the menu table for a complete list of addresses, data ranges, setting definitions, input and output verification, software version, security lock, trims, ramps, dead-band, ratio settings, etc. See also special notes for various menus that reassign the RD202's for special purposes.

Mode 1 **Standard 2 Axis Joystick Application, (4 coil ver)** (2) 4-way prop. valves

Menu	Applies to:	Variable Name	Range	Description
01	setting the mode	Version number	0102	**Mode 1** standard two axis joystick application
02		Check sum	0000 - FFFF	4 digit hexadecimal value, confirms correct firmware
03	all adjustments	Memory	0 = pots 1 = non-volatile	Non-volatile req. RD202
04	all outputs	PWM Freq.	30 to 285 Hz	valve pulse width modulation frequency
05	all inputs	Dead Band	0 to 15 (20 mv per)	non action area in mechanical center of joystick
06	both axis's	Axis 1,2 sol logic	0=pos 1=neg	set pos or neg logic for Out-5 & 6
	Analog inputs			
07	AN1	Joystick X	100% to -100%	View analog input and joystick 3-point calib
08	AN2	Joystick Y	100% to -100%	View analog input and joystick 3-point calib
09	AN3	Joystick Enable	0= enable 100= disable	0 (low) = decimal pt 100 (hi) = no-decimal pt.
10	AN4	Fine Control	0 = fine 100 = normal	decimal pt. = normal, no dec. = fine
11	all analog inputs	Knee	0 - 100	joystick transfer function, 50% input = knee
12	not assigned			
	Digital inputs			
13	D1 - 4	Output Enables	one LED per channel	Enable logic: active low = LED On
14	S1: 1-4	Dip switch	0000 to 1111	0 = Off (left) 1 = On (right)
15	all ramps	Ramp enable sel	0= ana 1= OE	0= ana (ramp only inputs) 1= OE (ramp w/ OE)
16	all ramp timers	Ramp Timer Range	0= 0-5 sec 1= 0-30 sec	select short or long ramp timer range
17-20	not assigned			
	Monitor Outputs			
21	Out-1 pwm	X Fwd out	0% to 100%	read only
22	Out-2 pwm	X Rev out	0% to 100%	read only
23	Out-3 pwm	Y Fwd out	0% to 100%	read only
24	Out-4 pwm	Y Rev out	0% to 100%	read only
25	Out-5 sol	Out-1 or 2 active	0 = Off 1 = On	read only, logic follows menu 06
26	Out-6 sol	Out-3 or 4 active	0 = Off 1 = On	read only, logic follows menu 06
27-29	not assigned			
	Valve Adjust Trim pot location			
30	A - 1	X Fwd Max	0% to 100%	Out-1 X Fwd speed
31	A - 2	X Fwd Min	0% to 100%	Out-1 X Fwd speed
32	A - 3	X Fwd Ramp Up	0.0 sec to 5.0 / 30 sec	Out-1 X Fwd speed
33	A - 4	X Fwd Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-1 X Fwd speed
34	B - 1	X Rev Max	0% to 100%	Out-2 X Rev speed
35	B - 2	X Rev Min	0% to 100%	Out-2 X Rev speed
36	B - 3	X Rev Ramp Up	0.0 sec to 5.0 / 30 sec	Out-2 X Rev speed
37	B - 4	X Rev Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-2 X Rev speed
38	C - 1	Y Fwd Max	0% to 100%	Out-3 X Fwd speed
39	C - 2	Y Fwd Min	0% to 100%	Out-3 X Fwd speed
40	C - 3	Y Fwd Ramp Up	0.0 sec to 5.0 / 30 sec	Out-3 X Fwd speed
41	C - 4	Y Fwd Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-3 X Fwd speed
42	D - 1	Y Rev Max	0% to 100%	Out-4 X Rev speed
43	D - 2	Y Rev Min	0% to 100%	Out-4 X Rev speed
44	D - 3	Y Rev Ramp Up	0.0 sec to 5.0 / 30 sec	Out-4 X Rev speed
45	D - 4	Y Rev Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-4 X Rev speed
46-99	not assigned			

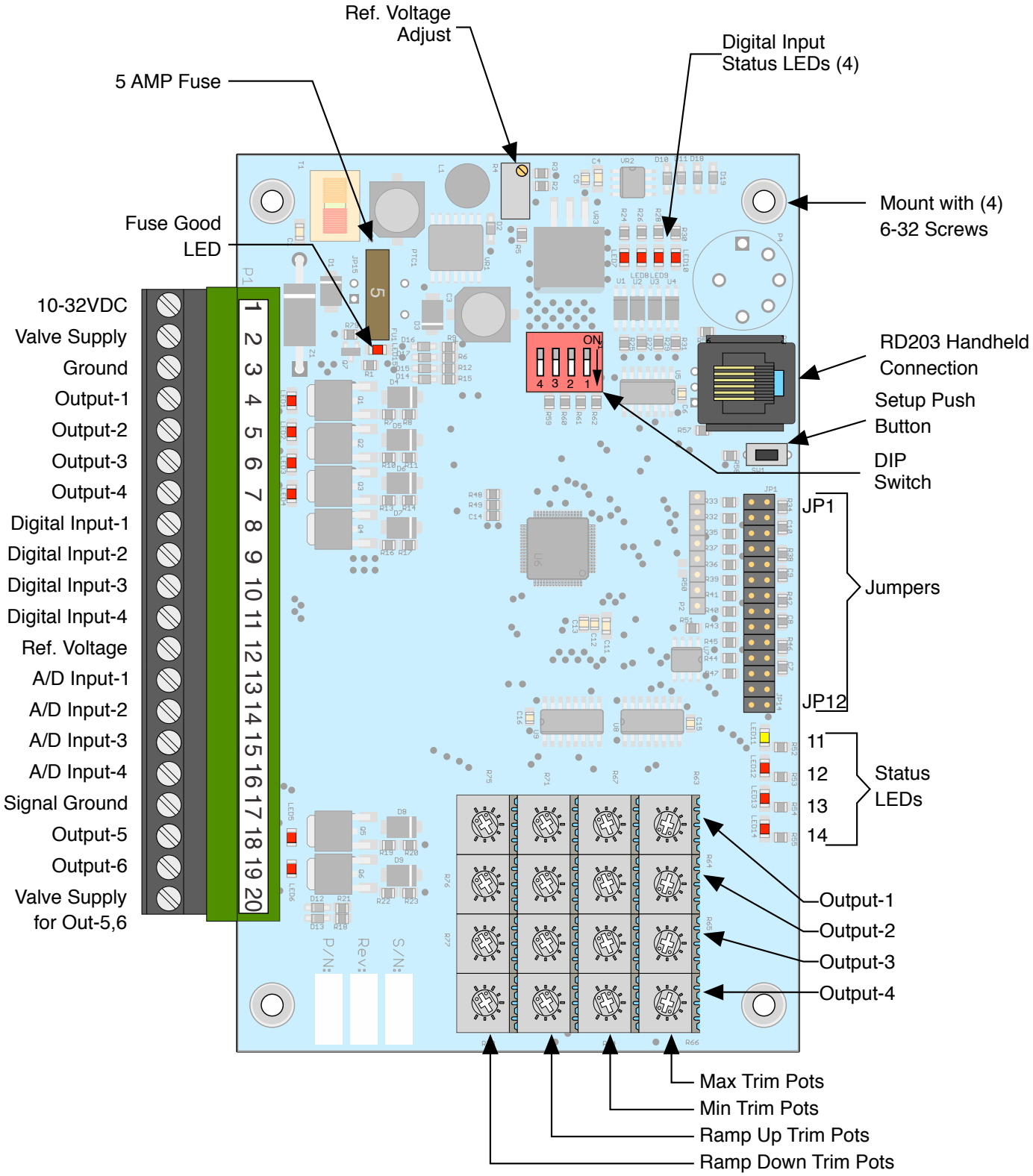
Mode 2 **Non-std. Two Axis Joystick Application (6 coil ver)** (2) 4-way sol. valves + (2) 3-way prop. valves

Menu	Applies to	Variable Name	Range	Description
01	setting the mode	Version number	0202	**Mode 2** non-std two axis joystick application
02		Checksum	0000 - FFFF	4 digit hexadecimal value, confirms correct firmware
03	all adjustments	Memory	0 = pots 1 = non-volatile	Non-volatile req. RD202
04	all outputs	PWM Freq.	30 to 285 Hz	valve pulse width modulation frequency
05	all inputs	Dead Band	0 to 15 (20 mv per)	non action area in mechanical center of joystick
06	both axis's	Axis 1,2 sol logic	0=pos 1=neg	Out-5,6 logic not adjustable in Mode 2
	Analog inputs			
07	AN1	Joystick X	100% to -100%	View analog input and joystick 3-point calib
08	AN2	Joystick Y	100% to -100%	View analog input and joystick 3-point calib
09	AN3	Output Enable	0 = enable 100 =disable	0 (low) = decimal pt 100 (hi) = no-decimal pt.
10	AN4	Fine Control	0 = fine 100 = normal	decimal pt. = normal, no dec. = fine
11	all analog inputs	Knee	0 - 100	joystick transfer function, 50% input = knee
12	not assigned			
	Digital inputs			
13	D1 - 4	Output Enables	0000 to 1111	Enable logic: active low = LED On
14	S1: 1-4	Dip switch	0000 to 1111	0 = Off (left) 1 = On (right)
15	all ramps	Ramp Enable sel	0= ana 1= OE	0= ana (ramp only inputs) 1= OE (ramp w/ OE)
16	all ramp timers	Ramp Timer Range	0= 0-5 sec 1= 0-30 sec	select short or long ramp timer range
17-20	not assigned			
	Monitor Outputs			
21	Out-1 pwm	X F/R pwm out	0% to 100%	read only
22	Out-2 sol	X Fwd sol	0 = Off 1 = On	read only
23	Out-3 sol	X Rev sol	0 = Off 1 = On	read only
24	Out-4 pwm	Y F/R pwm out	0% to 100%	read only
25	Out-5 sol	Y Fwd sol	0 = Off 1 = On	read only
26	Out-6 sol	Y Rev sol	0 = Off 1 = On	read only
27-29	not assigned			
	Valve Adjust Trim pot location			X Fwd = AN1 (51-100) X Rev = AN1 (00-49)
30	A - 1	X Fwd Max	0% to 100%	Out-1 X Fwd speed
31	A - 2	X Fwd Min	0% to 100%	Out-1 X Fwd speed
32	A - 3	X Fwd Ramp Up	0.0 sec to 5.0 / 30 sec	Out-1 X Fwd speed
33	A - 4	X Fwd Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-1 X Fwd speed
34	B - 1	X Rev Max	0% to 100%	Out-1 X Rev speed
35	B - 2	X Rev Min	0% to 100%	Out-1 X Rev speed
36	B - 3	X Rev Ramp Up	0.0 sec to 5.0 / 30 sec	Out-1 X Rev speed
37	B - 4	X Rev Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-1 X Rev speed
38	C - 1	Y Fwd Max	0% to 100%	Out-4 Y Fwd speed
39	C - 2	Y Fwd Min	0% to 100%	Out-4 Y Fwd speed
40	C - 3	Y Fwd Ramp Up	0.0 sec to 5.0 / 30 sec	Out-4 Y Fwd speed
41	C - 4	Y Fwd Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-4 Y Fwd speed
42	D - 1	Y Rev Max	0% to 100%	Out-4 Y Rev speed
43	D - 2	Y Rev Min	0% to 100%	Out-4 Y Rev speed
44	D - 3	Y Rev Ramp Up	0.0 sec to 5.0 / 30 sec	Out-4 Y Rev speed
45	D - 4	Y Rev Ramp Dn	0.0 sec to 5.0 / 30 sec	Out-4 Y Rev speed
46-99	not assigned			

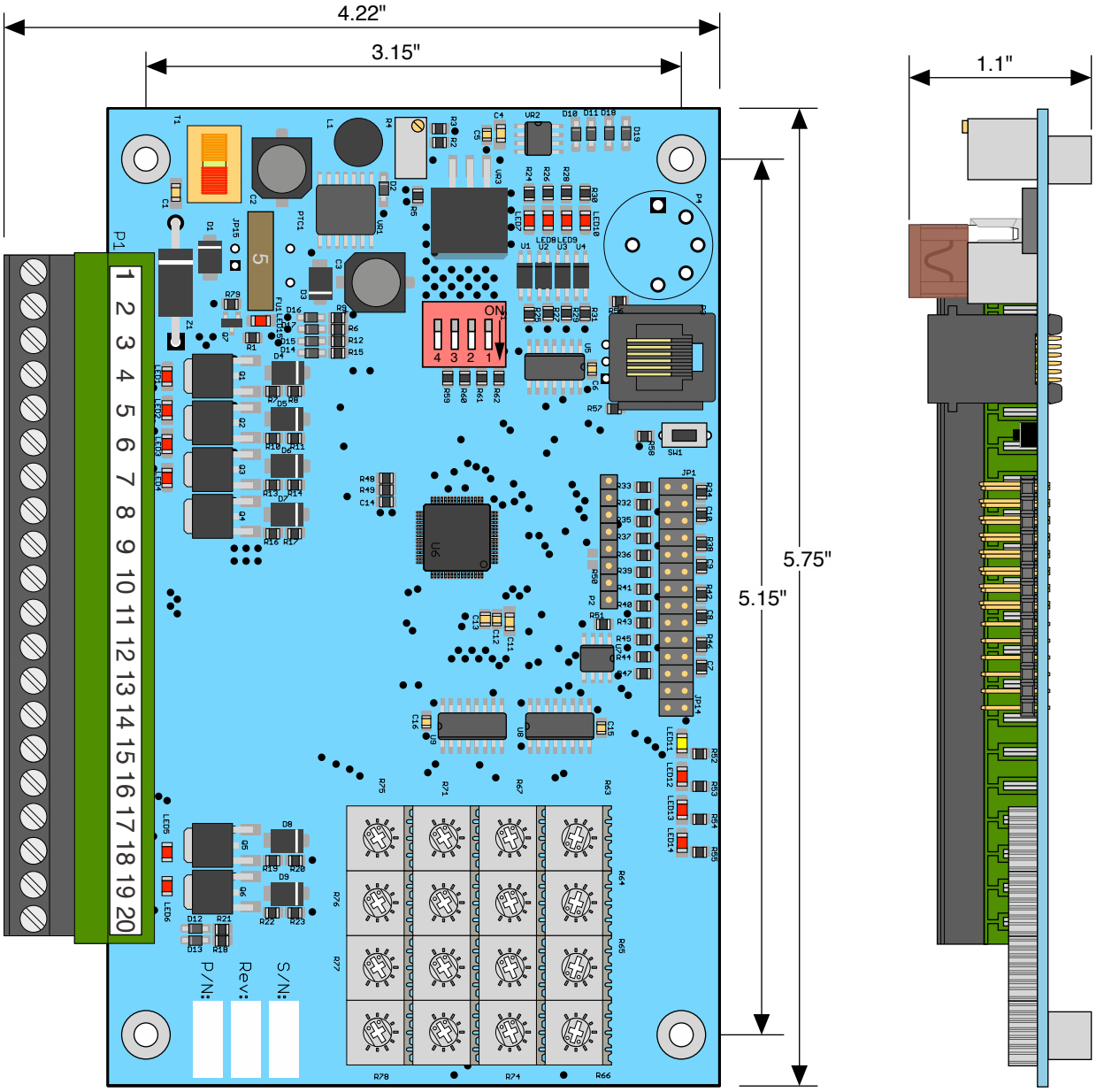
Mode 3 (4) PWM Channels Application (4) 3-way proportional valves

Menu	Applies to	Variable Name	Range	Description
01	setting the mode	Version number	0302	**Mode 3** four individual PWM driver application
02		Checksum	0000 - FFFF	4 digit hexadecimal value, confirms correct firmware
03	all adjustments	Memory	0 = pots 1 = non-volatile	Non-volatile req. RD202
04	all outputs	PWM Freq.	30 to 285 Hz	valve pulse width modulation frequency
05	all inputs	Dead Band	0 to 15 (20 mv per)	non action area in mechanical center of joystick
06	both axis's	Axis 1,2 sol logic	0= pos 1= neg	set pos or neg logic for Out-5, Out-6
	Analog inputs			
07	AN1	analog input #1	0 to 100%	View analog input
08	AN2	analog input #2	0 to 100%	View analog input
09	AN3	analog input #3	0 to 100%	View analog input
10	AN4	analog input #4	0 to 100%	View analog input
11-12	not assigned			
	Digital inputs			
13	D1 - 4	Output Enables	0000 to 1111	Enable logic: active low = LED On
14	S1: 1-4	Dip switch	0000 to 1111	0 = Off (left) 1 = On (right)
15	all ramps	Ramp enable sell	0= ana 1= OE	0= ana (ramp only inputs) 1= OE (ramp w/ OE)
16	all ramp timers	Ramp Timer Range	0= 0-5 sec 1= 0-30 sec	select short or long ramp timer range
17-20	not assigned			
	Monitor Outputs			
21	Out-1 pwm	Out #1	0% to 100%	read only
22	Out-2 pwm	Out #2	0% to 100%	read only
23	Out-3 pwm	Out #3	0% to 100%	read only
24	Out-4 pwm	Out #4	0% to 100%	read only
25	Out-5 sol	Out-1 or 2 active	0 = Off 1 = On	read only, logic follows menu 06
26	Out-6 sol	Out-3 or 4 active	0 = Off 1 = On	read only, logic follows menu 06
27-29	not assigned			
	Valve Adjust Trim pot location			
30	A - 1	Out #1 Max	0% to 100%	Out-1
31	A - 2	Out #1 Min	0% to 100%	Out-1
32	A - 3	Out #1 Ramp Up	0.0 sec to 5.0 sec	Out-1
33	A - 4	Out #1 Ramp Dn	0.0 sec to 5.0 sec	Out-1
34	B - 1	Out #2 Max	0% to 100%	Out-2
35	B - 2	Out #2 Min	0% to 100%	Out-2
36	B - 3	Out #2 Ramp Up	0.0 sec to 5.0 sec	Out-2
37	B - 4	Out #2 Ramp Dn	0.0 sec to 5.0 sec	Out-2
38	C - 1	Out #3 Max	0% to 100%	Out-3
39	C - 2	Out #3 Min	0% to 100%	Out-3
40	C - 3	Out #3 Ramp Up	0.0 sec to 5.0 sec	Out-3
41	C - 4	Out #3 Ramp Dn	0.0 sec to 5.0 sec	Out-3
42	D - 1	Out #4 Max	0% to 100%	Out-4
43	D - 2	Out #4 Min	0% to 100%	Out-4
44	D - 3	Out #4 Ramp Up	0.0 sec to 5.0 sec	Out-4
45	D - 4	Out #4 Ramp Dn	0.0 sec to 5.0 sec	Out-4
46-99	not assigned			

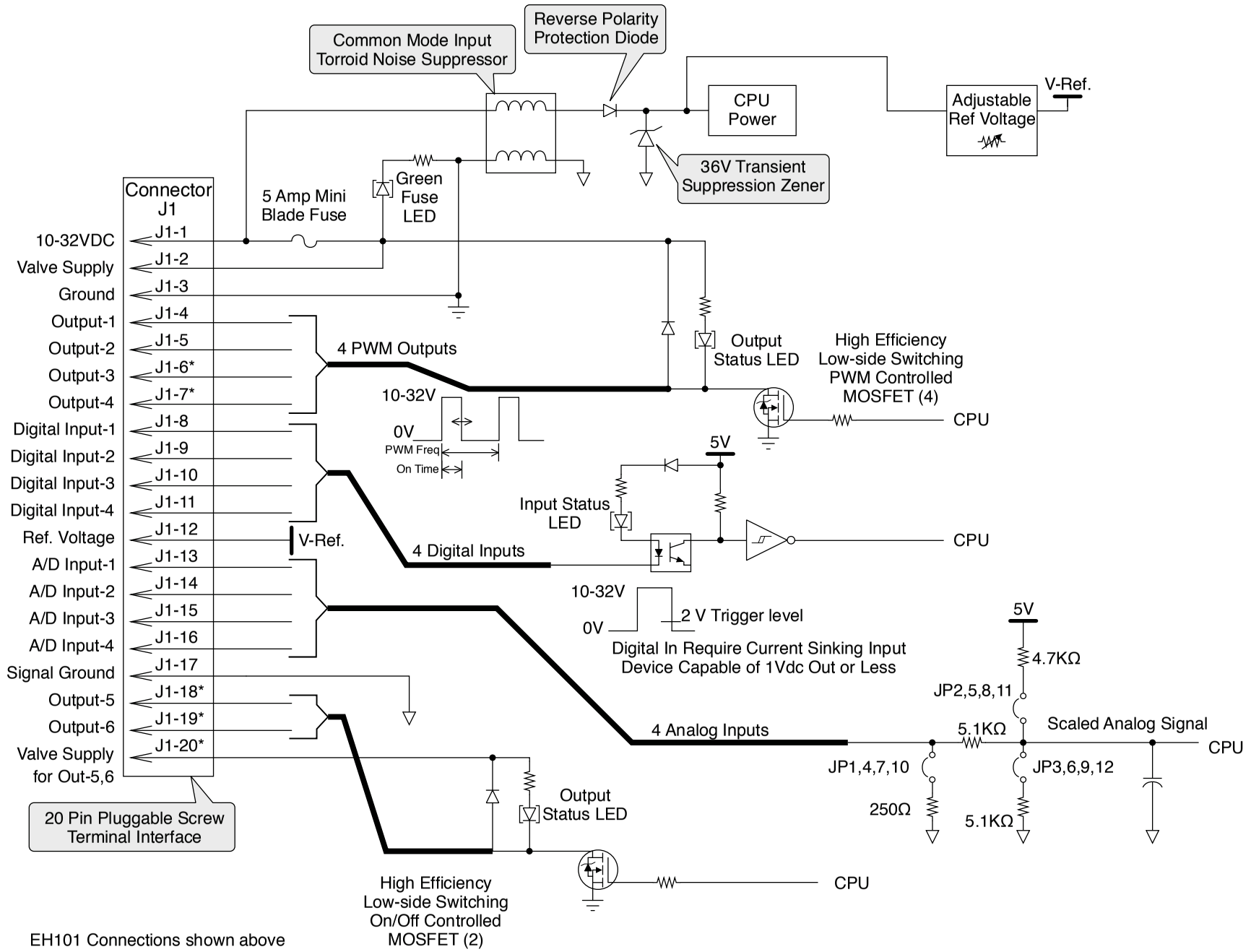
EH100 Layout



EH1 Mechanical (shown with Pluggable Terminal Strip Installed)



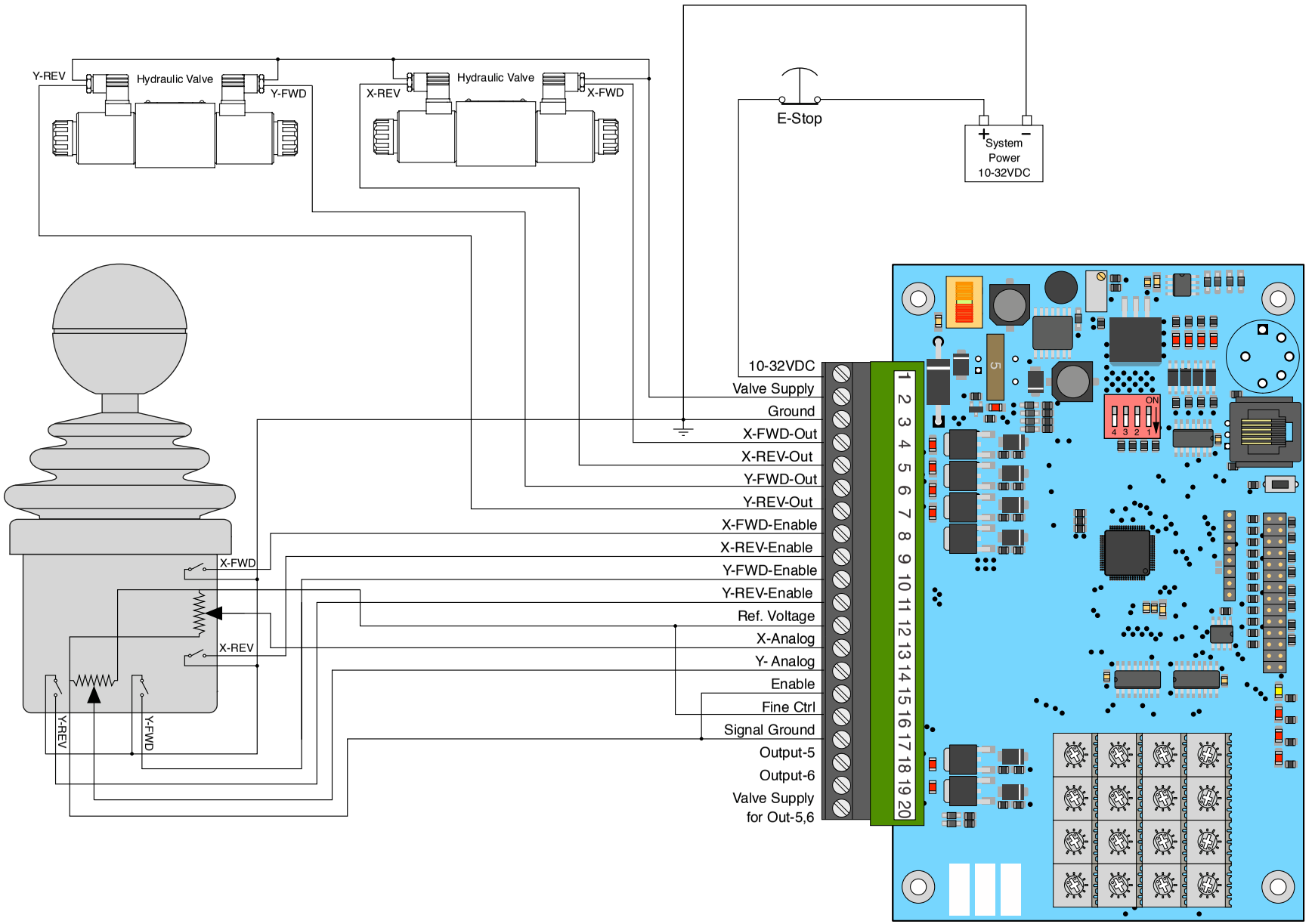
EH100 Hardware Interface Detail



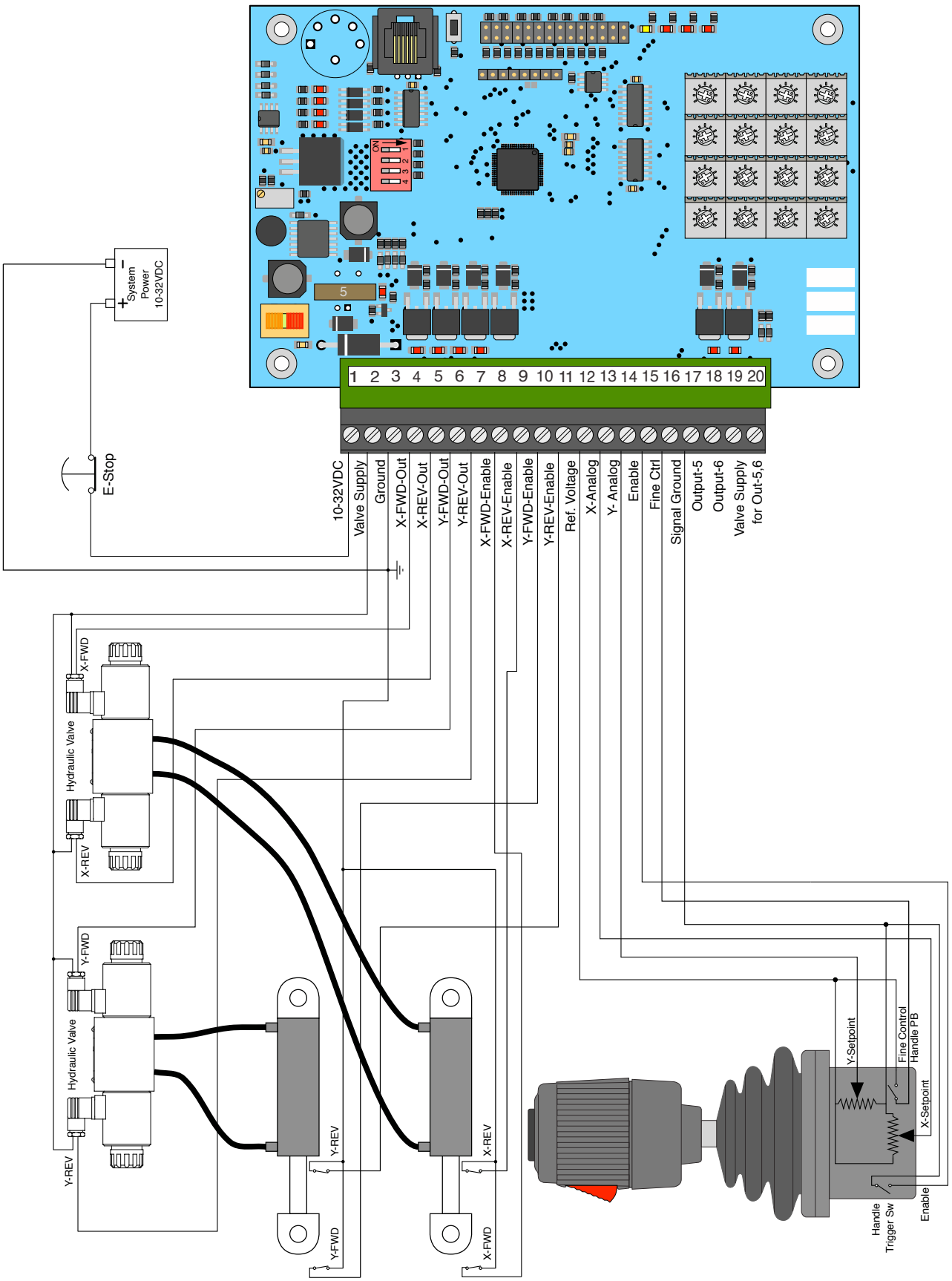
EH101 Connections shown above

* EH102 Pins 6, 7, 18,19, 20 **Not Used**

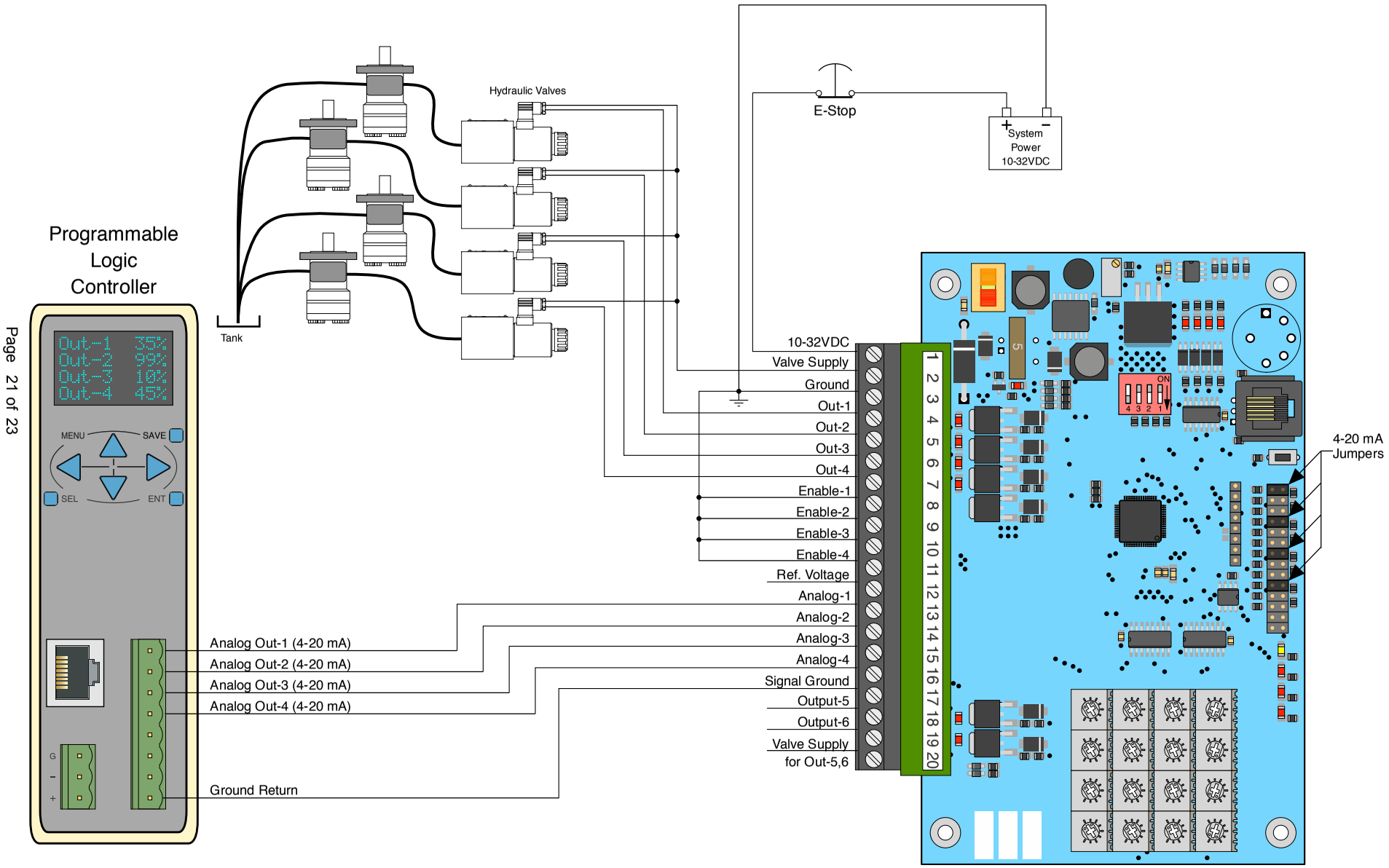
Example Joystick System using enable inputs as centering switches, and controlling (2) 4-way proportional valves (Mode-1).



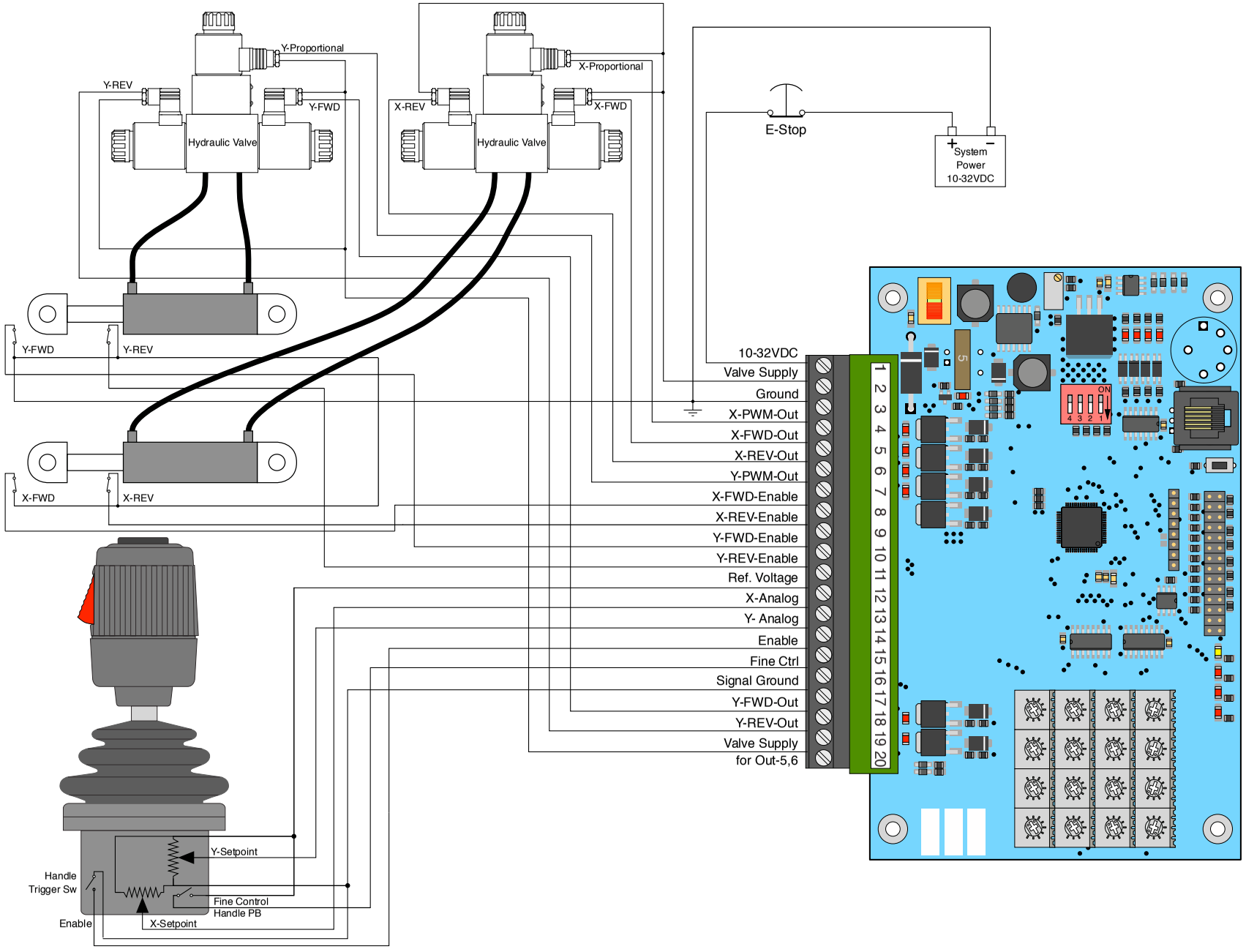
Example Joystick System with fine control using (2) 4-way proportional valves (Mode-1). Enable inputs are setup as limit switches



Example PLC controlled system. Use (4) PLC 4-20 mA outputs to control (4) independent functions each with their own Max/Min and Ramps (Mode-3).



Example Joystick System with fine control using (2) 4-way Solenoid Valves and (2) 3-way proportional Valves for Speed control (Mode-2). Enable inputs are setup as limit switches



Example System: Independent Speed controls (Mode 3) with ramping on/off switches