

Instruction, Installation and Operation Guide for:

HAD Series Controllers



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Description

The HAD, provides precise control of a dual coil proportional valve. The HAD will accept a control input of -5V to +5V, 0V to +5V, 0V to +10V or 4 to 20 mA from an external source or a potentiometer driven by the onboard reference output. It will accept power supply voltages from 11 to 30 volts DC and is able to drive coils with requirements from 31mA to 5.0 A. Options include ramping, dither, waterproof potentiometers and WeatherPak connectors.

Indicator

B Light – Lights when the “B” coil is selected because the command input is in the “B” coil range.

Wiring

Connect the unit as shown in Figure 3, using only one of the three command input configurations. Use 16 AWG wire for power and coil wiring. Use shrouded coil connectors. Locate the fuse as close to the power supply as possible to protect the wiring and the valve controller.

Fusing

Use an AGC-5 fuse for systems up to 3.3 amps and an AGC-10 for systems from 3.4 to 5.0 amps. Place fuse as close to the battery as possible.



Failure to properly fuse the unit invalidates the warranty.

Set up procedure:

Compare the part number on your unit to the Part Number Index in Figure 4, for an explanation of options specific to your unit.

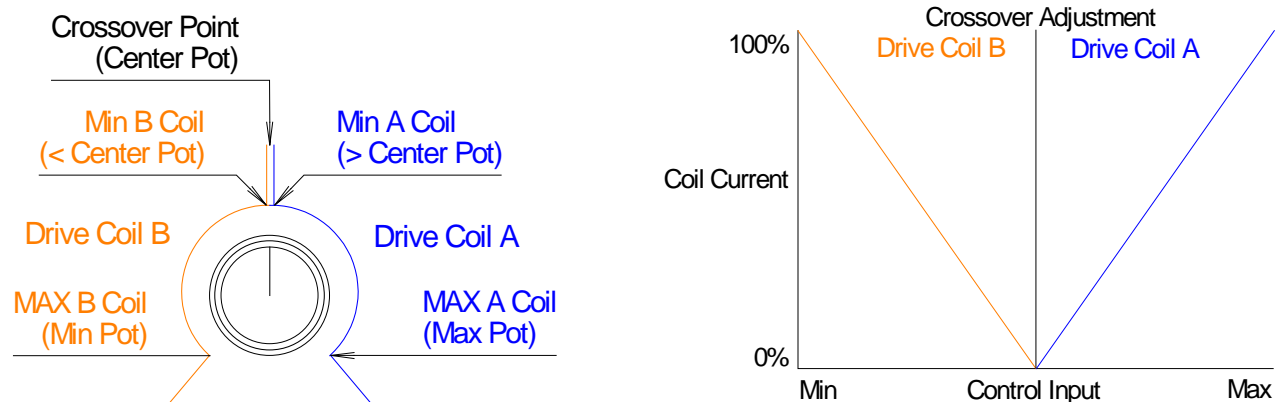
This controller is best adjusted by observing system response. Coil current can be used, but coil voltage is not accurate. Coil current may be measured by installing a 0.1 or 1.0 ohm resistor in series with the coil and measuring the voltage drop across the resistor using a volt meter. Current may be calculated by $I = E_{RES}/R$ or current equals the voltage across the resistor divided by the resistance in ohms.

INITIAL SETUP

1. Turn the MAX pot 10 turns CCW then 5 turns CW (set to center of pot)
2. Turn the MINA & MINB pots 10 turns CCW (off)
3. Turn all RAMP pots 10 turns CCW (off)
4. Turn the DITHER AMP pot 10 turns CCW (off)

Alignment

Turn on the power supply.



Figure, 1

CROSSOVER is the point at which the valve driver output changes between A and B coils. Only one coil will be active at a time. The **CROSSOVER** pot is used to tell the valve driver what input value will cause this change. For control inputs just above the crossover point, the output will be **MIN A**, and will increase to **MAX** for the A coil as the control input increases. For control inputs just below the crossover point, the output will increase to **MAX** for the B coil as the control input decreases. When the B **LIGHT** is off, the A coil will be energized and the **MIN A** control is active. When the B **LIGHT** is on, the B coil will be energized and the **MIN B** control is active. Typically the crossover point is the midpoint of the control input range. See Figure, 1 above.

1. Set the control input to the desired crossover point.
2. With the command input at the **CROSSOVER** point (i.e. 5 volts on a 0 – 10 volt input), if the B **LIGHT** is on turn the **CROSSOVER** pot CW until the B **LIGHT** goes off. If the B **LIGHT** is off, turn the **CROSSOVER** pot CCW until the B **LIGHT** goes on. Very slowly, adjust the **CROSSOVER** pot back and forth, observing the midpoint of where the B **LIGHT** goes off and on, and set the **CROSSOVER** pot to this midpoint.
3. Adjust the command input for the desired minimum response point for coil “A”. Observing system response, adjust the **MIN A** pot for the desired minimum current (spool shift) on COIL A. Turn the **MIN A** pot CW for more current. The **MIN** controls are provided to allow the user to add or eliminate the valve's Deadband.
4. Adjust the command input for the desired minimum response point for coil “B”. Observing system response, adjust the **MIN B** pot for the desired minimum current (spool shift) on COIL B. Turn the **MIN B** knob CW for more current.
5. The **MAX** pot controls the maximum current (spool shift) for both the A and B coils. Set the control input to its maximum, (20 mA, 10 V or 5 V or the high end of an external 10K pot for example) and observing system response, adjust the **MAX** pot for the desired maximum COIL A current (spool shift). Turn the **MAX** pot CW for more current.



Do not adjust the unit to supply more current than is required to fully shift the valve; additional current may exceed the coil's rating, will reduce the useful range of the control input and may damage the valves coil.

6. Adjust the control input to fully shift the B coil and check system response. If the coil has not fully shifted, adjust the MAX pot as necessary.
7. The MIN, MAX, and CROSSOVER pots interact and the hydraulic system response may change as it warms up. Warm up the system and repeat steps 1 through 6 until the system reacts as desired.

Ramp (Optional)

Depending on the model number, your unit may have one or more RAMP pots. Ramp time is the time it takes for an output to reach its desired setting in relation to a given change in input. The following illustration explains the adjustment procedure for a unit with RAMP adjustments in both directions for each coil. Only adjust what is supplied on your specific model and needed for your own application. See the RAMP section in Figure, 4 for an explanation of different ramp options.

1. Set the RAMP UP pot/s to the desired value by quickly switching the command for that coil from minimum to maximum, while observing the speed of response. Note that the minimum control input is just above or below the crossover point. Turning the ramp pot adjustment CW increases the ramp time.
2. Set the RAMP DOWN pot/s the same way, but going from maximum command to minimum command for each coil.

Dither (Optional)

The DITHER AMP pot (if equipped) is set fully CCW (no dither) at the factory. Dither is used to keep the valve moving back and forth a small amount at all times to avoid hysteresis and stiction. You can visit our website for further explanation of hysteresis and stiction.

If the valve shift is erratic or if the valve sticks, adjust the DITHER AMP pot for the desired amplitude.



Note that the dither may cause both coils to be energized at the midpoint of the control input. The higher the dither amplitude, the larger the control input region is where both coils can be energized simultaneously.

Dither acts as if the control input were changing and it may crossover the point between the COIL A and B. If necessary, the user may adjust the Min pots to add a larger Deadband to reduce any undesired system response.

System Wiring Best Practices

All sophisticated electronic systems require attention as to how various components are wired together to insure reliable operation without interference to or from other components. What follows is a brief explanation of issues associated with PWM Valve Drivers and some tips to help you avoid difficulties arising from noise generated by inductive switching.

The industry technique most commonly used to control proportional hydraulic valves is called Pulse Width Modulation (PWM). PWM varies the effective voltage across and inductor by applying the full supply voltage to the coil then quickly switching it off. Regulating the ratio of on time verses off time of the pulse at a fast enough frequency, an average voltage is seen across the coil and this can be controlled to position a hydraulic valve with a high degree of



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resolution. PWM control of inductive devices causes voltage spikes on the power supply or battery positive wires. These voltage spikes are a product of Flyback Current which is result of the decaying magnetic field of an inductor (valve coil) when voltage is removed during the PWM switching. These spikes of voltage can generate electromagnetic noise that may affect the operation of other components or sensors within the system.

The best solution to avoid problems stemming from these current spikes is to first dedicate an isolated, regulated power supply for powering sensitive sensors (Not all sensor manufacturers filter their inputs or outputs). Secondly, it is recommended that all power, input and output cables used on the PWM module and its valve control wires be twisted pair and/or shielded and grounded at one end. Routing of the cables to and from the valves should be in separate cable bundles and routed separately from cables that go to delicate instruments. Greater physical separation between the positive battery wires and the wires to and from sensitive sensors helps minimize the noise coupling. If it is necessary to cross cables that connect to sensitive instruments, cross the cables at a 90° angle in order to reduce noise coupling. Power cables for PWM modules should come directly from the battery or main system power supply and run separately from those going to other equipment. Finally, if necessary we recommend installing a commonly available engine noise filter on the battery line they are available at most auto parts stores.

Trouble shooting

If the set up procedure does not achieve the desired results, double check the wiring, perform the following tests and record the test results.

Tools required:

A battery operated multi-meter and a small screwdriver are required.

Check the power input:

The card will not function correctly unless the +POWER to PWR COM voltage is at least 11 V. If this voltage is more than 30 V the card may be damaged.

Check the control input you are using:

Pot input: Measure the wiper voltage between the VOLT and SIG COM terminals. With a 10 K ohm pot, the wiper will go from 0 to 9 V. The difference in voltage should be more than 5 V from minimum to maximum. The voltage must not be less than 0 V or more than 10 V.

Current loop input: Measure the current into the CUR terminal. The difference in current should be at least 10 mA from minimum to maximum. The current must not be negative or more than 20 mA. If a current meter is not available, measure the voltage from the CUR terminal to the SIG COM terminal and divide by 150 for an approximate reading.

Voltage input: The difference in voltage between the VOLT and SIG COM terminals should be greater than 5 V from minimum to maximum. The voltage must not be less than -5 V or more than +10 V.

NOTE: Only one type control input at a time may be connected.

Verify the coil is not shorted:

If the +COIL to -COIL is shorted, the valve driver will shut down its output until the short is removed. Disconnect the wires going to the +COIL and -COIL terminals and measure the resistance between the wires. Verify it is correct for the coil being driven.

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Check the card at full on and full off:

Do not try the full on test if the power supply is 50% higher than the coil's rated voltage. Temporarily disconnect all wires from the VOLT and CUR inputs. To test the card at full on, turn the MAX and MIN pots 10 turns CW and temporarily short the VOLT and REF terminals together. Measure the voltage from +COIL to -COIL and from +POWER to PWR COM. The voltage difference should be no more than one volt if the card is operating correctly. To check the card at full off, disconnect the VOLT and REF terminals and turn the MAX pot 10 turns CW and the MIN pot 10 turns CCW. The +COIL to -COIL voltage should be zero.

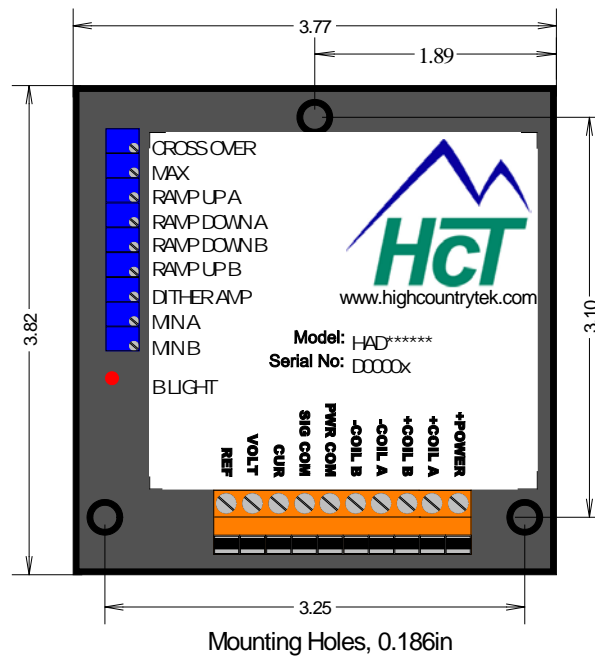
If the valve won't fully shift:

If the card passes the "full on test" above, the problem is in the system. Measure the power supply voltage at the power supply or battery and the voltage across the coil's terminals. Compare these readings to the values taken at the card. If there is excessive voltage drop in any of those wires, they should be shortened or replaced with smaller gauge wires (larger conductor). Bad frame ground connections can cause large voltage drops.

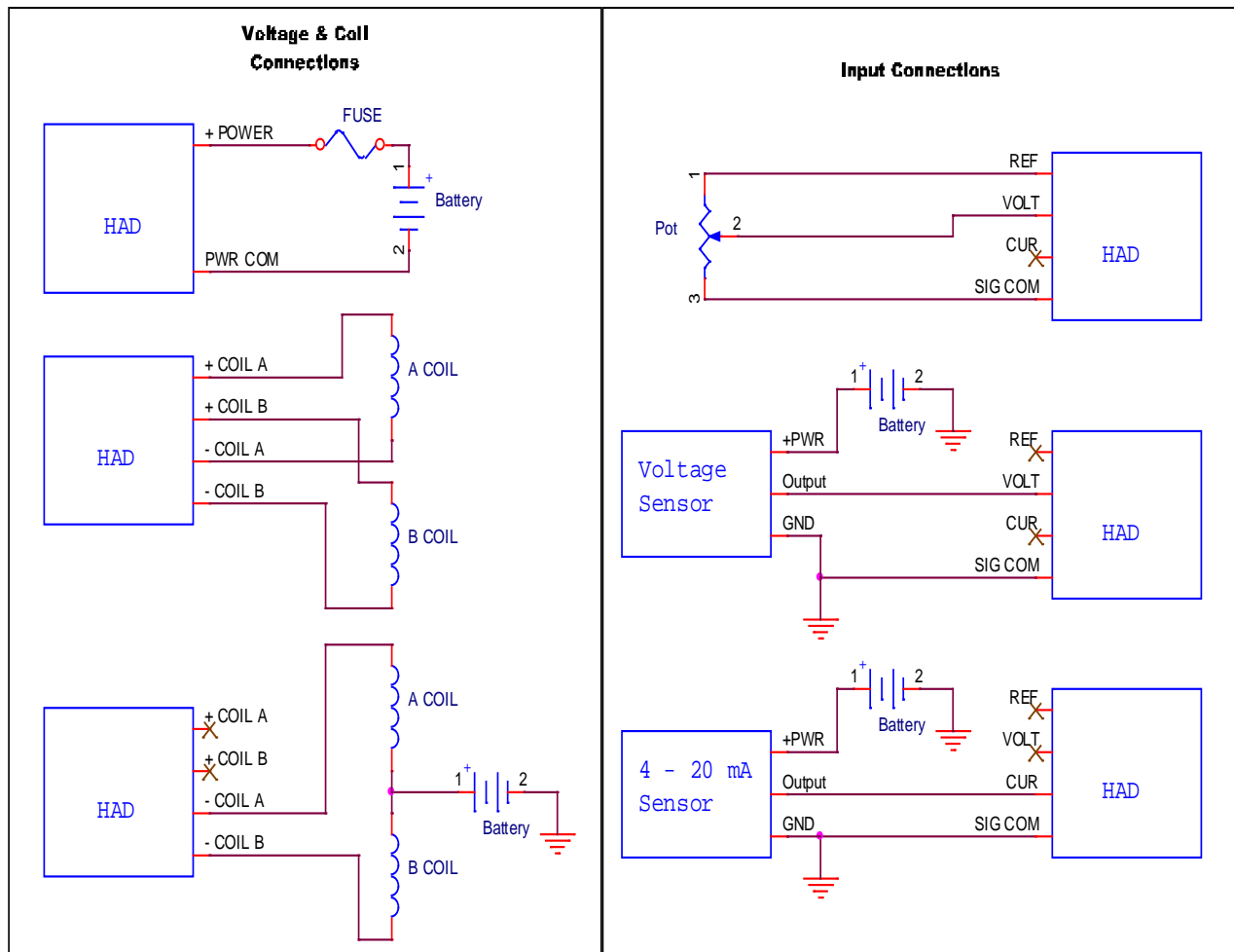
When the coil heats up in use, it increases its resistance. Most coils will be able to draw sufficient current to fully shift the valve if their rated voltage is supplied to the card and the card causes less than one volt drop. When this is not the case, you must use a coil rated for less voltage or increase the power supply voltage. By using current regulation, the card will have no trouble safely driving a 12 V coil from a 24 V supply, or a 10 V coil from a 12 V supply for example. You will need a different card if the new coil draws more current than the card is rated for.

If the valve shift is erratic:

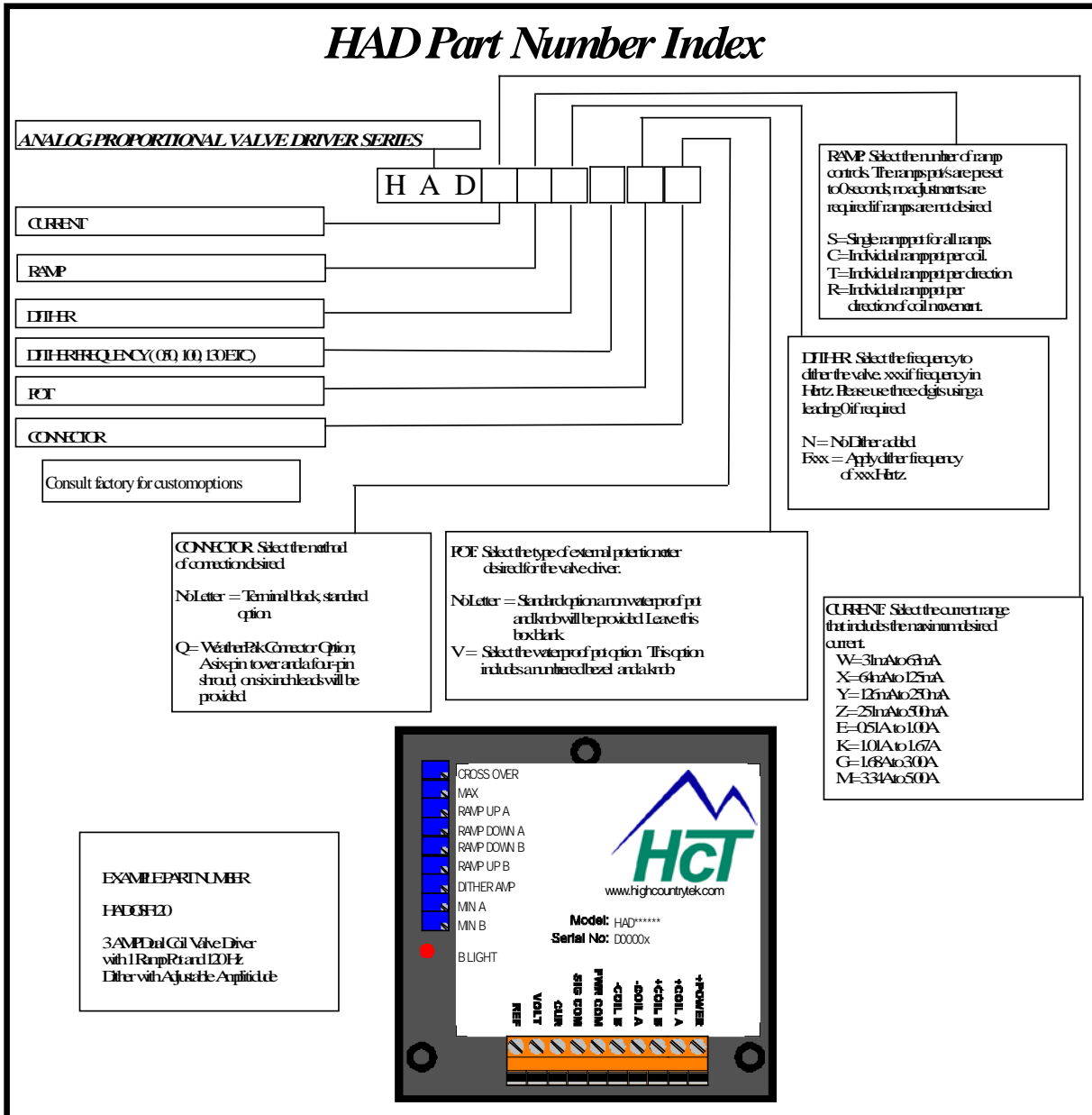
See the set up procedure section for Dither or visit our website for more help with troubleshooting including an explanation of hysteresis and stiction.



Figure, 2



Figure, 3



Figure, 4

Additional information may be obtained by visiting our website at <http://hctcontrols.com>.