AMERICAN CONTROL ELECTRONICS™

PAT SERIES

USER MANUAL

PAT440-10
PAT443-10
PAT450-10

Dear Valued Consumer:

Congratulations on your purchase of the **PAT Series** drive. This User Manual was created for you to get the most out of your new device and assist with the initial setup. Please visit www.americancontrolelectronics.com to learn more about our other drives.

Thank you for choosing **American Control Electronics**!

Safety First!

SAFETY WARNINGS

Text in gray boxes denote important safety tips or warnings. Please read these instructions carefully before performing any of the procedures contained in this manual.

- DO NOT INSTALL, REMOVE, OR REWIRE THIS EQUIPMENT WITH POWER APPLIED. Have a qualified electrical technician install, adjust and service this equipment. Follow the National Electrical Code and all other applicable electrical and safety codes, including the provisions of the Occupational Safety and Health Act (OSHA), when installing equipment.
- Reduce the chance of an electrical fire, shock, or explosion by using proper grounding techniques, over-current protection, thermal protection, and enclosure. Follow sound maintenance procedures.

It is possible for a drive to run at full speed as a result of a component failure. American Control Electronics strongly recommends the installation of a master switch in the main power input to stop the drive in an emergency.

Circuit potentials are at 115 VAC or 230 VAC above earth ground. Avoid direct contact with the printed circuit board or with circuit elements to prevent the risk of serious injury or fatality. Use a non-metallic screwdriver for adjusting the calibration trim pots. Use approved personal protective equipment and insulated tools if working on this drive with power applied.

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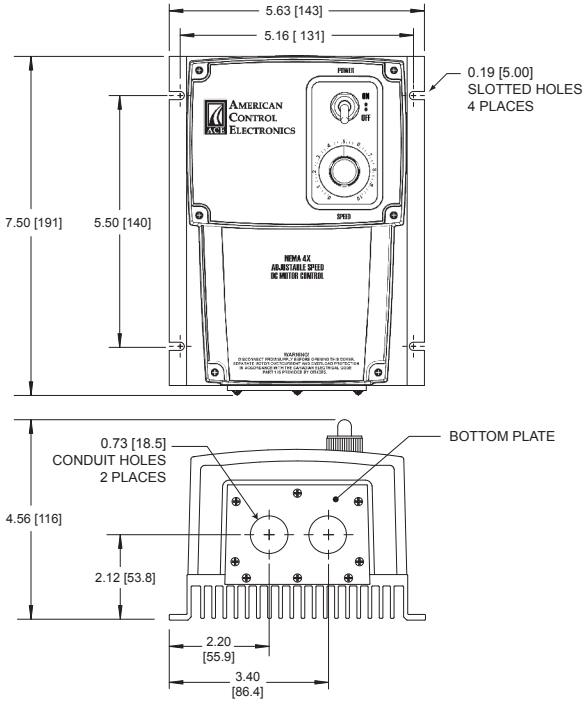
Section 1. Specifications

Model	*Maximum Armature Current (ADC)*	*HP Range with 90 VDC Motor*	*HP Range with 180 VDC Motor*	*Enclosure*
PAT440	*10*	*1/8 - 1*	*1/4 - 2*	*NEMA 4X*
PAT443				*NEMA 4X*
PAT450				*NEMA 4X*

AC Line Voltage	115/230 VAC ± 10%, 50/60 Hz, single phase
DC Armature Voltage	
with 115 VAC Line Voltage	0 - 90 VDC
with 230 VAC Line Voltage	0 - 180 VDC
Field Voltage	
with 115 VAC Line Voltage	50 VDC (F1 to L1); 100 VDC (F1 to F2)
with 230 VAC Line Voltage	100 VDC (F1 to L1); 200 VDC (F1 to F2)
Maximum Field Current	1 ADC
Acceleration Time Range	1 - 15 seconds
Deceleration Time Range	coast to a stop - 15 seconds
Analog Input Range	
PAT440 and PAT450 (signal must be isolated; S1 to S2)	
with 115 VAC Line Voltage	0 - 1.4 VDC
with 230 VAC Line Voltage	0 - 2.8 VDC
PAT443 (2 to 3)	
Voltage Signal Range	0 - 10 VDC
Current Signal Range	1 - 5, 4 - 20, 10 - 50 mA
Input Impedance (S1 to S2)	>100K ohms
Form Factor	1.37 at base speed
Load Regulation	1% base speed or better
Speed Range	60:1

Vibration	1G maximum (0 - 50 Hz) 0.1G maximum (> 50 Hz)
Safety Certifications	UL/cUL Listed Equipment, File # E132235
Ambient Temperature Range	10°C - 40°C

Section 2. Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. PAT440-10 Dimensions

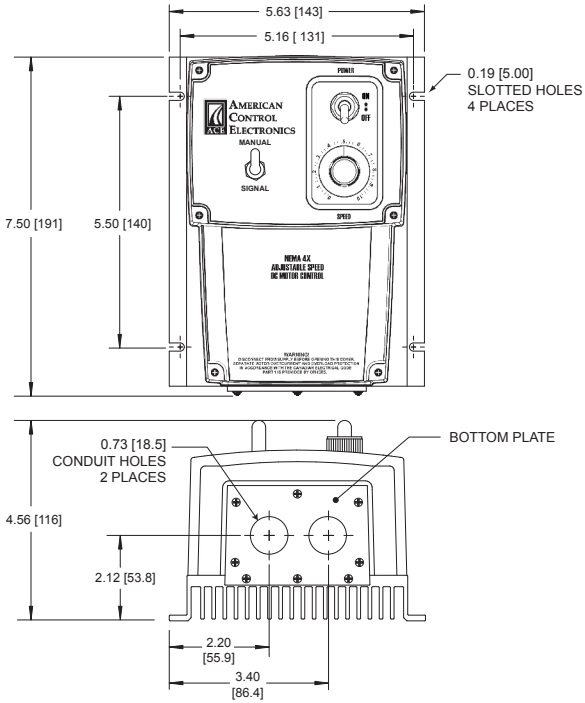


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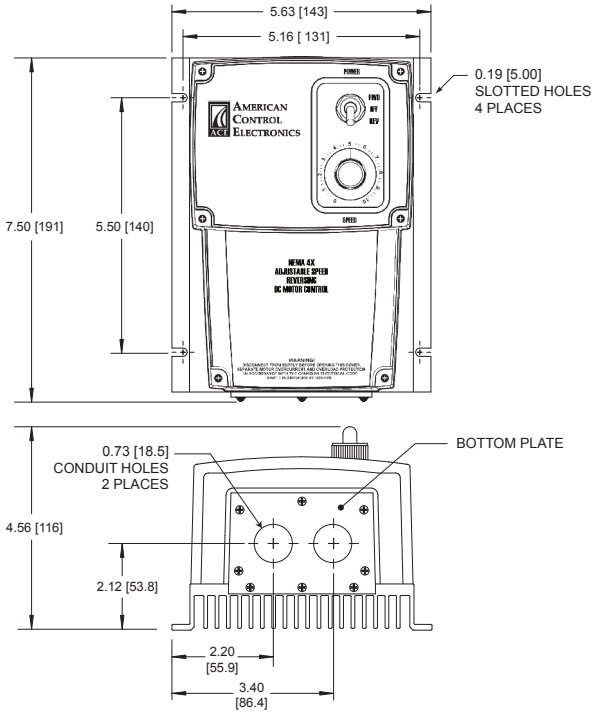
Figure 2. PAT443-10 Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 3. PAT450-10 Dimensions

Section 3. Installation

Do not install, rewire, or remove this control with input power applied. Failure to heed this warning may result in fire, explosion, or serious injury. Make sure you read and understand the Safety Precautions on page i before attempting to install this product.

Mounting

NEMA 4X cased drives come with two 0.73 inch (18.5 mm) conduit knockout holes at the bottom of the case. The units may be vertically wall mounted using the four 0.19 inch (5 mm) slotted holes on the attached heat sink. For motor loads less than 5 ADC, the drive may be bench mounted horizontally or operated without mounting.

1. Install the mounting screws.
2. For access to the terminal strip, remove the six phillips screws on the front cover.
3. Remove the five phillips screws on the bottom plate. **Do not remove the three screws securing the bottom plate to the heat sink.**
4. Set the POWER switch to the off position before applying applying AC line voltage.
5. Install conduit hardware through the 0.73 inch (18.5 mm) knockout holes. Connect external wiring to the terminal block.
6. Place the front cover back into place. Avoid pinching any wires between the front cover and the heat sink.
7. Reinstall the 6 screws on the front cover. **The two shorter screws are for the two lower holes of the front cover.** Reinstall the 5 screws on the bottom plate.

Wiring

Do not install, rewire, or remove this control with input power applied. Failure to heed this warning may result in fire, explosion, or serious injury.

Circuit potentials are at 115 or 230 VAC above ground. To prevent the risk of injury or fatality, avoid direct contact with the printed circuit board or with circuit elements.

Do not disconnect any of the motor leads from the drive unless power is removed or the drive is disabled. Opening any one motor lead while the drive is running may destroy the drive.

This product does not have internal solid state motor overload protection. It does not contain speed-sensitive overload protection, thermal memory retention or provisions to receive and act upon signal from remote devices for over temperature protection. If motor over protection is needed in the end-use product, it needs to be provided by additional equipment in accordance with NEC standards.

- Use 18 - 24 AWG wire for logic wiring. Use 14 - 16 AWG wire for AC line and motor wiring.

Shielding Guidelines

Under no circumstances should power and logic level leads be bundled together. Induced voltage can cause unpredictable behavior in any electronic device, including motor controls.

As a general rule, it is recommended to shield all conductors. If it is not practical to shield power conductors, it is recommended to shield all logic-level leads. If shielding of all logic-level leads is not practical, the user should twist all logic leads with themselves to minimize induced noise.

It may be necessary to earth ground the shielded cable. If noise is produced by devices other than the drive, ground the shield at the drive end. If noise is generated by a device on the drive, ground the shield at the end away from the drive. Do not ground both ends of the shield.

If the drive continues to pick up noise after grounding the shield, it may be necessary to add AC line filtering devices, or to mount the drive in a less noisy environment.

Logic wires from other input devices, such as motion controllers and PLL velocity controllers, must be separated from power lines in the same manner as the logic I/O on this drive.

Line Fusing

Drives are preinstalled with 15 amp fuses.

Preinstalled line fuses are rated for maximum horsepower. If the horsepower rating of the motor being used is less than the maximum horsepower rating of the drive, the line fuse may have to be replaced with a lower rated one. Fuses should be rated for 250 VAC or higher and approximately 150% of the maximum armature current. Refer to Table 1 to install a lower rated fuse.

Table 1. Recommended Line Fuse Sizes

90 VDC Motor Horsepower	*180 VDC Motor Horsepower*	*Maximum DC Armature Current (amps)*	*AC Line Fuse Size (amps)*
1/8	*1/4*	*1.5*	*3*
1/6	*1/3*	*1.7*	*3*
1/4	*1/2*	*2.5*	*5*
1/3	*3/4*	*3.5*	*8*
1/2	*1*	*5.0*	*8*
3/4	*1 ½*	*7.5*	*15*
1	*2*	*10*	*15*

See Section 10: Accessories and Replacement Parts for fuse kit part numbers.

Short-circuit current rating (SCCR) is the maximum short-circuit current that the speed control can safely withstand when protected by a specific over-current protective device(s).

Table 2. Short Circuit Current Ratings

Drive Model	Short Circuit Current Rating		Types of Branch Circuit Protection		Maximum Rating of Overcurrent Protection
	Maximum Current, A	Maximum Voltage, V			
PAT440-10	10,000	240 V	Non-time Delay K5 Fuse	Inverse Time Circuit Breaker	30 A
PAT443-10					
PAT450-10					

Connections

Do not connect this equipment with power applied. Failure to heed this warning may result in fire, explosion, or serious injury.

Power Input

Connect the AC line power leads to screw terminals L1 and L2 115 if using a 115 VAC line or to terminals L1 and L2 230 if using a 230 VAC line. Refer to Figure 4 on page 13.

Motor

Drives supply motor armature voltage from A1 and A2 terminals. It is assumed throughout this manual that, when A1 is positive with respect to A2, the motor will rotate clockwise (CW) while looking at the output shaft protruding from the front of the motor. If the motor does not spin in the desired direction, remove power and reverse the A1 and A2 connections.

Connect a DC motor to terminals A1 and A2 as shown in Figure 4 on page 13. Ensure that the motor voltage rating is consistent with the drive's output voltage.

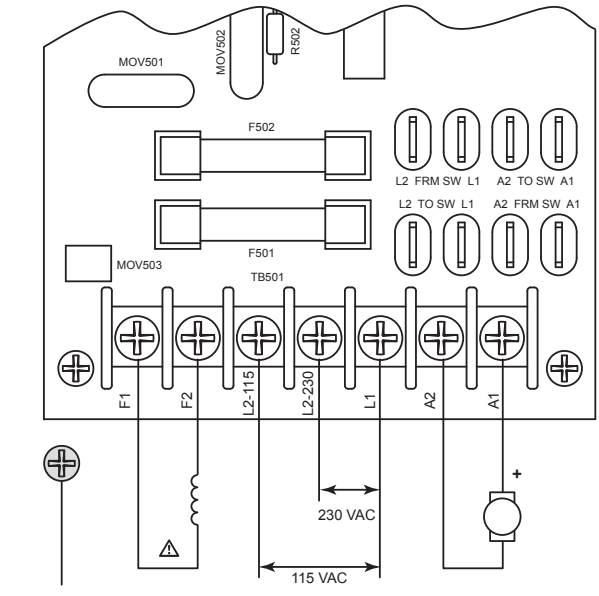
Field Output Connections

The field output is for shunt wound motors only. Do not make any connections to F1 and F2 when using a permanent magnet motor.

See Table 3 for field output connections. Use 18 AWG wire to connect the field output to a shunt wound motor.

Table 3. Field Output Connections

Line Voltage (VAC)	*Approximate Field Voltage (VDC)*	*Connect Motor Field To*
115	*50*	*F1 and L1*
115	*100*	*F1 and F2*
230	*100*	*F1 and L1*
230	*200*	*F1 and F2*



NOTE: DO NOT make any connections to F1 and F2 if using a permanent magnet motor.

Figure 4. Power Connections

Analog Input Signal (PAT440 and PAT450)

Instead of using a speed adjust potentiometer, the drive may be wired to follow an analog input voltage signal that is isolated from earth ground (Figure 5). Connect the signal common (–) to S1. Connect the signal reference (+) to S2. Make no connection to S3. A potentiometer can be used to scale the analog input voltage. An interface device, such as American Control Electronics model ISO202-1, may be used to scale and isolate an analog input voltage.

With 115 VAC line voltage, an analog input voltage range of 0–1.4 VDC is required to produce an armature voltage range of 0–90 VDC. With 230 VAC line voltage, an analog input voltage range of 0–2.8 VDC is required to produce an armature voltage range of 0–180 VDC.

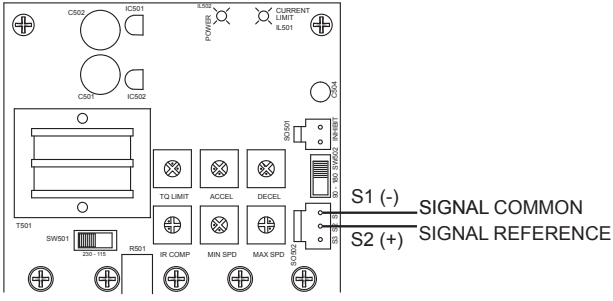


Figure 5. Analog Input Signal Connections (PAT440 and PAT450)

Analog Input Signal (PAT443)

Instead of using a speed adjust potentiometer, the drive may be wired to follow an analog input voltage or current signal that is either isolated or non-isolated from earth ground. Connect the signal common (-) to S1. Connect the signal reference (+) to S2. Refer to Figure 6.

An analog input signal range of 0–10 VDC, 1-5 mA, 4–20 mA, or 10-50 mA is required to produce an armature voltage range of 0–90 VDC with 115 VAC line voltage or 0-180 VDC with 230 VAC line voltage.

If using an analog input current signal range of 4-20 mA or 10-50 mA, a resistor (RSH) must be placed between terminals 1 and 4. Refer to Figure 6 for resistor values.

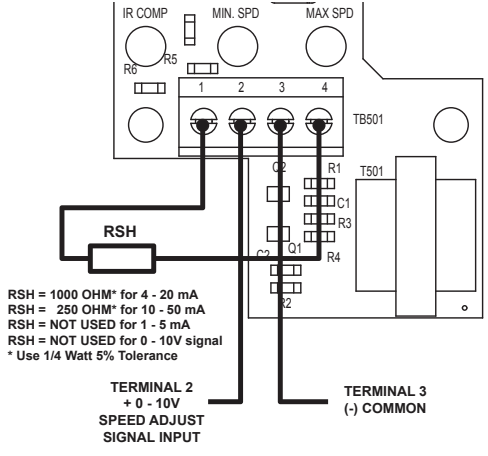


Figure 6. Analog Input Signal Connections (PAT443)

Section 4. Operation

Change voltage switch settings only when the drive is disconnected from AC line voltage. Make sure both switches are set to their correct position. If the switches are improperly set to a lower voltage position, the motor will not run at full voltage and may cause damage to the transformer. If the switches are improperly set to a higher voltage position, the motor will overspeed, which may cause motor damage, or result in bodily injury or loss of life.

Dangerous voltages exist on the drive when it is powered. BE ALERT. High voltages can cause serious or fatal injury. For your safety, use personal protective equipment (PPE) when operating this drive.

If the motor or drive does not perform as described, disconnect the AC line voltage immediately. Refer to the Troubleshooting section, page 40, for further assistance.

Before Applying Power

1. Verify that no foreign conductive material is present on the printed circuit board.
2. Ensure that all switches are properly set.

Select Switches

Input Voltage Select (SW501)

Set the input voltage select switch SW501 to either 115 or 230 to match the AC line voltage. See Figure 7.

Armature Voltage Select (SW502)

Set the armature voltage select switch SW502 to either 90 or 180 to match the maximum armature voltage. See Figure 7.

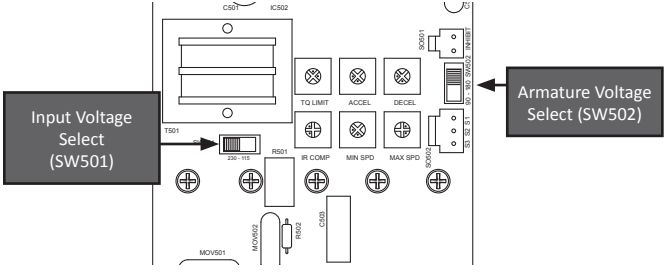


Figure 7. Select Switches

Operation Modes (PAT443)

Manual Mode

In Manual Mode, the potentiometer adjusts the speed (voltage) of the motor.

Signal Mode

In Signal Mode, the drive follows an analog input signal of either 0-10 VDC, 1-5 mA, 4-20 mA, or 10-50 mA for adjust the speed (voltage) of the motor.

Startup

PAT440

1. Turn the speed adjust potentiometer to “0” (full CCW) or set the input voltage signal to minimum.
2. Set the POWER switch to the ON position.
3. Slowly advance the speed adjust potentiometer clockwise (CW) or increase the input voltage signal. The motor slowly accelerates as the potentiometer is turned CW or as the input voltage signal is increased. Continue until the desired speed is reached.
4. Set the POWER switch to the OFF position to coast the motor to a stop.

PAT443

1. Turn the speed adjust potentiometer to “0” (full CCW) or set the input voltage signal to minimum.
2. If using a speed adjust potentiometer, set the MANUAL/SIGNAL switch to MANUAL. If using a input voltage or current signal, set it to SIGNAL.
3. Set the POWER switch to the ON position.
4. If in manual mode, slowly advance the speed adjust potentiometer clockwise (CW). If is signal mode, increase the input voltage or current signal. The motor slowly accelerates as the potentiometer is turned CW or as the input voltage or current signal is increased. Continue until the desired speed is reached.
4. Set the POWER switch to the OFF position to coast the motor to a stop.

PAT450

Do not change direction while the motor is running. The motor must come to a complete stop before reversing. Changing motor direction before allowing the motor to completely stop will cause excessively high current to flow in the armature circuit, and will damage the drive and/or motor.

1. Set the FWD/OFF/REV switch to the OFF position.
2. Turn the speed adjust potentiometer to “0” (full CCW) or set the input voltage signal to minimum.
3. Set the FWD/OFF/REV switch to the desired direction of rotation.
4. Slowly advance the speed adjust potentiometer clockwise (CW) or increase the input voltage signal. The motor slowly accelerates as the potentiometer is turned CW or as the input voltage signal is increased. Continue until the desired speed is reached.
5. To reverse direction:
   a. Set the FWD/OFF/REV switch to the OFF position.
   b. **Wait for the motor to come to a complete stop.**
   c. Set the FWD/OFF/REV switch to the desired direction of rotation.

Starting and Stopping Methods

Dynamic braking, coasting to a stop, or decelerating to minimum speed is recommended for frequent starts and stops. Do not use any of these methods for emergency stopping. They may not stop a drive that is malfunctioning. Removing AC line power (both lines) is the only acceptable method for emergency stopping.

Frequent starting and stopping can produce high torque. This may cause damage to motors, especially gearmotors that are not properly sized for the application.

Automatic Restart Upon Power Restoration

All drives automatically run to set speed when power is applied and the inhibit is not active.

Line Starting and Stopping

Line starting and stopping (applying and removing AC line voltage) is recommended for infrequent starting and stopping of a drive only. When AC line voltage is applied to the drive, the motor accelerates to the speed set by the speed adjust potentiometer or analog signal. When AC line voltage is removed, the motor coasts to a stop.

Dynamic Braking

Wait for the motor to completely stop before switching back to RUN. This will prevent high armature currents from damaging the motor or drive.

Dynamic braking may be used to rapidly stop a motor (Figure 8 on page 22). For the RUN/BRAKE switch, use a two pole, two position switch rated for at least the armature voltage rating and 150% of the armature current rating. For the dynamic brake resistor, use a 40 watt minimum, high power, wirewound resistor.

Sizing the dynamic brake resistor depends on load inertia, motor voltage, and braking time. Use a lower-value, higher-wattage dynamic brake resistor to stop a motor more rapidly. Refer to Table 4 on page 22 for recommended dynamic brake resistor sizes.

Table 4. Minimum Recommended Dynamic Brake Resistor Values

Motor Armature Voltage	*Dynamic Brake Resistor Value*
90 VDC	*15 ohms*
180 VDC	*30 ohms*

For motors rated 1/17 horsepower and lower, a brake resistor is not necessary since the armature resistance is high enough to stop the motor without demagnetization. Replace the dynamic brake with 12-gauge wire.

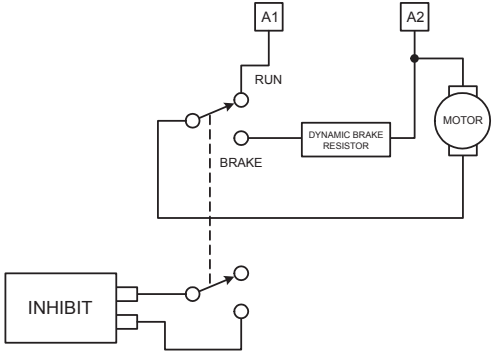


Figure 8. Dynamic Braking

Inhibit Terminals

Short the INHIBIT terminals to coast the motor to minimum speed (see Figure 9 for INHIBIT terminal location). Open the INHIBIT terminals to accelerate the motor to set speed.

Twist inhibit wires and separate them from power-carrying wires or sources of electrical noise. Use shielded cable if the inhibit wires are longer than 18 inches (46 cm). If shielded cable is used, ground only one end of the shield to earth ground. Do not ground both ends of the shield.

American Control Electronics offers two accessory plug harnesses for connecting to the INHIBIT terminals: part number 201-0024 [plug with 18 in. (46 cm) leads]; and part number 201-0079 [plug with 36 in. (91 cm) leads].

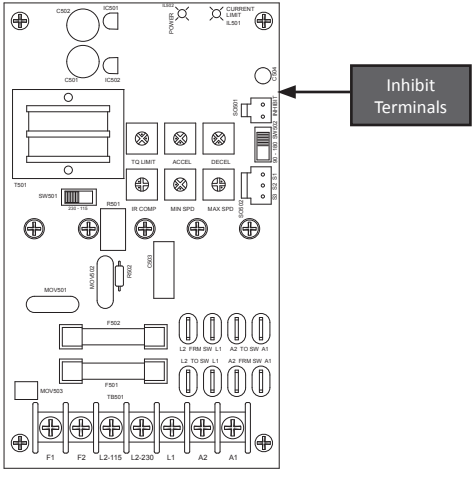


Figure 9. Inhibit Terminals

Decelerating to Minimum Speed

The switch shown in Figure 10 may be used to decelerate a motor to a minimum speed. Closing the switch between S1 and S2 decelerates the motor from set speed to a minimum speed determined by the MIN SPD trim pot setting. If the MIN SPD trim pot is set full CCW, the motor decelerates to zero speed when the switch between S1 and S2 is closed. The DECEL trim pot setting determines the rate at which the drive decelerates. By opening the switch, the motor accelerates to set speed at a rate determined by the ACCEL trim pot setting.

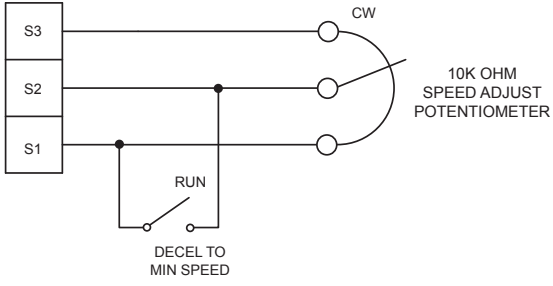


Figure 10. Run/Decelerate to Minimum Speed Switch

Section 5. Calibration

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the voltage input from the drive before adjusting the trim pots. If the trim pots must be adjusted with power applied, use insulated tools and the appropriate personal protection equipment. **BE ALERT.** High voltages can cause serious or fatal injury.

PAT series drives have user-adjustable trim pots. Each drive is factory calibrated to its maximum current rating. Readjust the calibration trim pot settings to accommodate lower current rated motors.

All adjustments increase with CW rotation, and decrease with CCW rotation. Use a non-metallic screwdriver for calibration. Each trim pot is identified on the printed circuit board.

Minimum Speed (MIN SPD)

The MIN SPD setting determines the minimum motor speed when the speed adjust potentiometer or input voltage signal is set for minimum speed. It is factory set for zero speed.

To calibrate the MIN SPD:

1. Set the MIN SPD trim pot full CCW.
2. Set the speed adjust potentiometer or input voltage signal for minimum speed.
3. Adjust MIN SPD until the desired minimum speed is reached or is just at the threshold of rotation.

Maximum Speed (MAX SPD)

The MAX SPD setting determines the maximum motor speed when the speed adjust potentiometer or input voltage signal is set for maximum speed.

To calibrate MAX SPD:

1. Set the MAX SPD trim pot full CCW.
2. Set the speed adjust potentiometer or input voltage signal for maximum speed.
3. Adjust MAX SPD until the desired maximum speed is reached.

Note: Check the MIN SPD and MAX SPD adjustments after recalibrating to verify that the motor runs at the desired minimum and maximum speed.

Torque (TQ LIMIT)

TQ LIMIT should be set to 150% of motor nameplate current rating. Continuous operation beyond this rating may damage the motor. If you intend to operate beyond the rating, contact your American Control Electronics representative for assistance.

The TQ LIMIT setting determines the maximum torque for accelerating and driving the motor. To calibrate TORQUE, refer to the recommended TQ LIMIT settings in Figure 11 on page 29 or use the following procedure:

1. With the power disconnected from the drive, connect a DC ammeter in series with the armature.
2. Set the TQ LIMIT trim pot to minimum (full CCW).
3. Set the speed adjust potentiometer full CW or input voltage signal to maximum speed.
4. Carefully lock the motor armature. Be sure that the motor is firmly mounted.
5. Apply line power. The motor should be stopped.
6. Slowly adjust the TQ LIMIT trim pot CW until the armature current is 150% of motor rated armature current.
7. Turn the speed adjust potentiometer CCW or decrease the input voltage signal.
8. Remove line power.
9. Remove the stall from the motor.
10. Remove the ammeter in series with the motor armature if it is no longer needed.

IR Compensation (IR COMP)

The IR COMP setting determines the degree to which motor speed is held constant as the motor load changes.

Use the following procedure to recalibrate the IR COMP setting:

1. Set the IR COMP trim pot to minimum (full CCW).
2. Increase the speed adjust potentiometer or input voltage signal until the motor runs at midspeed without load (for example, 900 RPM for an 1800 RPM motor). A handheld tachometer may be used to measure motor speed.
3. Load the motor armature to its full load armature current rating. The motor should slow down.
4. While keeping the load on the motor, rotate the IR COMP trim pot until the motor runs at the speed measured in step 2. If the motor oscillates (overcompensation), the IR COMP trim pot may be set too high (CW). Turn the IR COMP trim pot CCW to stabilize the motor.
5. Unload the motor.

See Figure 11 on page 29 for recommended IR COMP settings.

MODELS PAT440-10, PAT443-10, PAT450-10

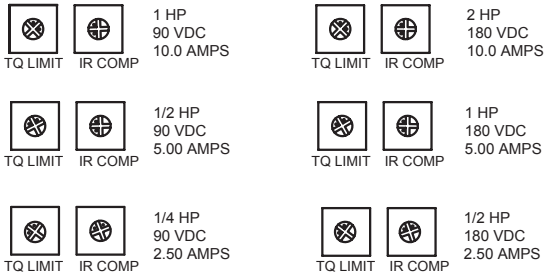


Figure 11. Recommended TQ LIMIT and IR COMP Settings
(actual settings may vary with each application)

Acceleration (ACCEL)

The ACCEL setting determines the time the motor takes to ramp to a higher speed. See Specifications on page 1 for approximate acceleration times. ACCEL is factory set for the shortest acceleration time (full CCW).

To set the acceleration time:

1. Set the speed adjust potentiometer or input voltage signal for minimum speed. The motor should run at minimum speed.
2. Set the speed adjust potentiometer or input voltage signal for maximum speed. Measure the time it takes the motor to go from minimum to maximum speed.
3. If the time measured in step 2 is not the desired acceleration time, turn the ACCEL trim pot CW for a longer acceleration time or CCW for a shorter acceleration time. Repeat steps 1 through 2 until the acceleration time is correct.

Deceleration (DECEL)

The DECEL setting determines the time the motor takes to ramp to a lower speed. See Specifications on page 1 for approximate deceleration times. DECEL is factory set for the shortest deceleration time (full CCW).

To set the deceleration time:

1. Set the speed adjust potentiometer or input voltage signal for maximum speed. The motor should run at maximum speed.
2. Set the speed adjust potentiometer or input voltage signal for minimum speed. Measure the time it takes the motor to go from maximum to minimum speed.
3. If the time measured in step 2 is not the desired deceleration time, turn the DECEL trim pot CW for a longer deceleration time or CCW for a shorter deceleration time. Repeat steps 1 through 2 until the deceleration time is correct.

Section 6.Application Notes

Multiple Fixed Speeds

Replace the speed adjust potentiometer with a series of resistors with a total series resistance of 10K ohms (Figure 12). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

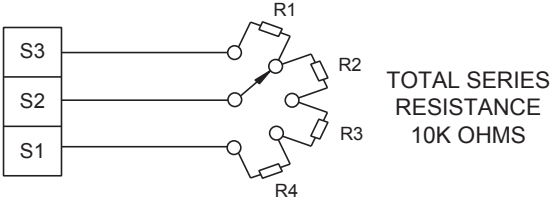


Figure 12. Multiple Fixed Speeds

Adjustable Speeds Using Potentiometers In Series

Replace the speed adjust potentiometer with a series of resistors with a total series resistance of 10K ohms (Figure 13). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

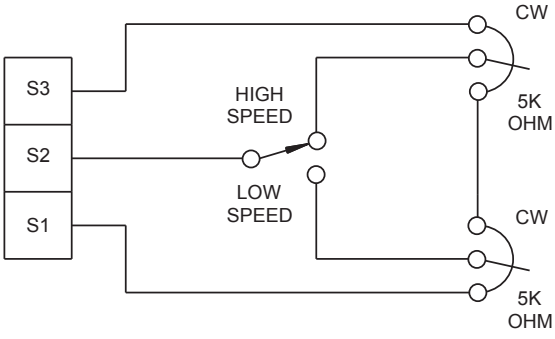


Figure 13. Adjustable Speeds Using Potentiometers In Series

Independent Adjustable Speeds

Replace the speed adjust potentiometer with a single pole, multi-position switch, and two or more potentiometers in parallel, with a total parallel resistance of 10K ohms. Figure 14 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

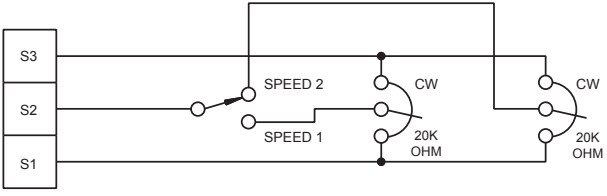


Figure 14. Independent Adjustable Speeds

RUN/JOG Switch - Inhibit Connection

Using a RUN/JOG switch is recommended in applications where quick stopping is not needed and frequent jogging is required. Use a single pole, two position switch for the RUN/JOG switch, and a single pole, normally closed, momentary operated pushbutton for the JOG pushbutton.

Connect the RUN/JOG switch and JOG pushbutton to the inhibit plug as shown in Figure 15. The motor coasts to a stop when the RUN/JOG switch is set to JOG. Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

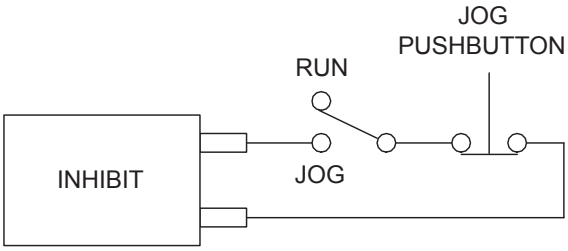


Figure 15. RUN/JOG Switch - Connection to Inhibit Plug

RUN/JOG Switch - Potentiometer Connection

Connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 16. When the RUN/JOG switch is set to JOG, the motor decelerates to minimum speed (minimum speed is determined by the MIN SPD trim pot setting). Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

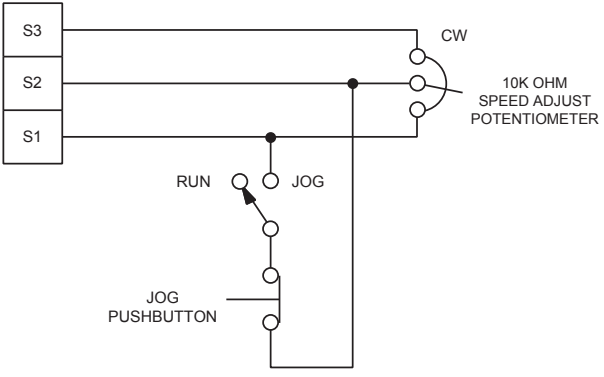


Figure 16. RUN/JOG Switch - Connection to Speed Adjust Potentiometer

Leader-Follower Application

In this application, use a PCM4 to monitor the speed of the leader motor (Figure 17). The ISO202-1 isolates the leader motor from the follower drive, and outputs a voltage proportional to the leader motor armature voltage. The follower drive uses this voltage reference to set the speed of the follower motor. An optional ratio potentiometer may be used to scale the ISO202-1 output voltage.

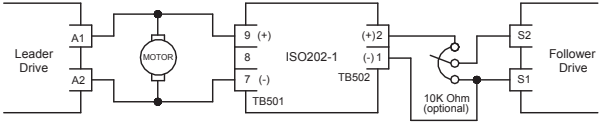


Figure 17. Leader-Follower Application

Single Speed Potentiometer Control Of Multiple Drives

Multiple drives can be controlled with a single speed adjust potentiometer using a ISO101-8 at the input of each drive to provide isolation (Figure 18). Optional ratio potentiometers can be used to scale the ISO101-8 output voltage, allowing independent control of each drive.

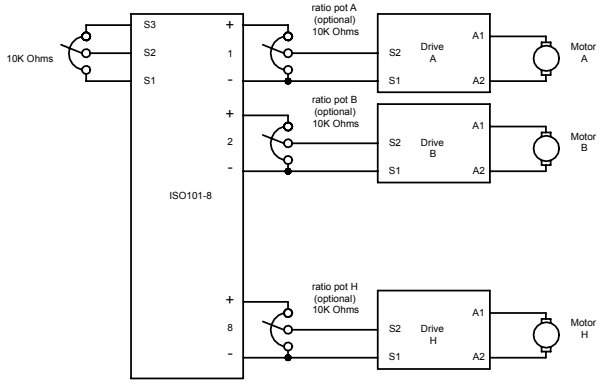


Figure 18. Single Speed Potentiometer Control of Multiple Drives

Reversing

A dynamic brake may be used when reversing the motor direction (Figure 19). Use a three pole, three position switch rated for at least the maximum DC armature voltage and maximum braking current. Wait for the motor to stop completely before switching it to either the forward or reverse direction. See the Dynamic braking section on page 22 for recommended dynamic brake resistor sizes.

NOTE: Model PAT450-10 is equipped with the reversing feature, but not the dynamic brake feature.

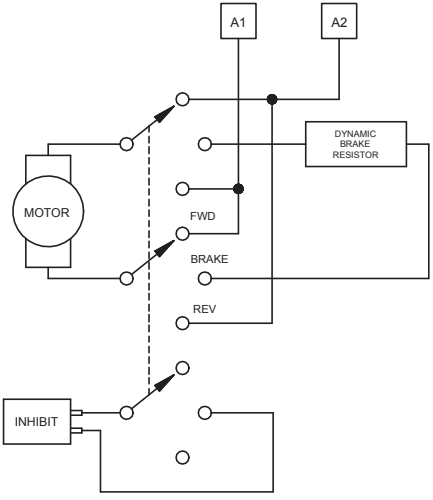


Figure 19. Reversing Circuit Wiring

Section 7. Diagnostic LEDs

PAT series drives are equipped with two diagnostic LEDs:

- Power (POWER): Green LED lights whenever AC line voltage is applied to the drive.
- Current Limit (TQ LIMIT): Red LED lights whenever the drive reaches current limit.

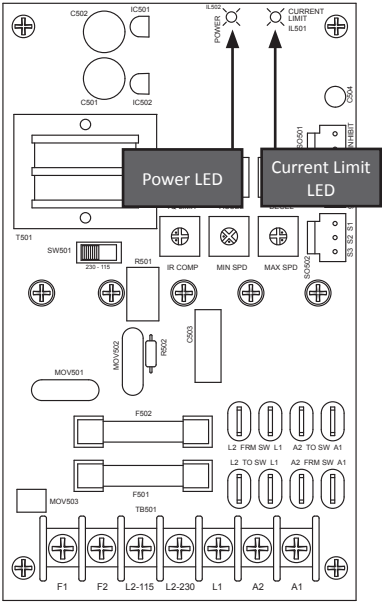


Figure 20. Diagnostic LED Locations

Section 8. Troubleshooting

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the drive while troubleshooting. High voltages can cause seroius or fatal injury.

Before Troubleshooting

Perform the following steps before starting any procedure in this section:

1. Disconnect AC line voltage from the drive.
2. Check the drive closely for damaged components.
3. Check that no conductive or other foreign material has become lodged on the printed circuit board.
4. Verify that every connection is correct and in good condition.
5. Verify that there are no short circuits or grounded connections.
6. Check that the selection switch settings are correctly set.
7. Check that the drive's rated armature is consistent with the motor ratings.

For additional assistance, contact your local American Control Electronics distributor or the factory direct:

(844) AMCNTRL or FAX: (800) 394-6334

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
Line fuse blows.	1. Line fuse is the wrong size.	1. Check that the line fuse is correct for the motor size.
	2. Motor cable or armature is shorted to ground.	2. Check motor cable and armature for shorts.
	3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes (i.e. reversing).	3. Add a blower to cool the drive components, decrease TQ LIMIT settings, resize motor and drive for actual load demand, or check for incorrectly aligned mechanical components or "jams". See page 27 for information on adjusting the TQ LIMIT trim pot.
Line fuse does not blow, but the motor does not run.	1. Speed adjust potentiometer or input voltage or current signal is set to zero speed.	1. Increase the speed adjust potentiometer setting or input voltage or current signal.
	2. INHIBIT mode is active.	2. Remove the short from the INHIBIT terminals.
	3. S2 is shorted to S1.	3. Remove the short.
	4. Drive is in current limit.	4. Verify that the motor is not jammed. Increase TQ LIMIT setting if set too low.
	5. Drive is not receiving AC line voltage.	5. Apply AC line voltage.
	6. Motor is not connected.	6. Remove power. Connect the motor to A1 and A2. Reapply power.

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
Motor does not stop when the speed adjust potentiometer is full CCW.	1. MIN SPD is set too high.	1. Calibrate MIN SPD.
Motor runs in the opposite direction	1. Motor connections to A1 and A2 are reversed.	1. Remove power. Reverse connections to A1 and A2. Reapply power.
Motor runs too fast.	1. MAX SPD is set too high.	1. Calibrate MAX SPD.
Motor will not reach the desired speed.	1. MAX SPD setting is too low.	1. Increase MAX SPD setting.
	2. IR COMP setting is too low.	2. Increase IR COMP setting.
	3. TQ LIMIT setting is too low.	3. Increase TQ LIMIT setting.
	4. Motor is overloaded.	4. Check motor load. Resize the motor and drive if necessary.
Motor pulsates or surges under load.	1. IR COMP is set too high.	1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes.
	2. Motor bouncing in and out of current limit.	2. Make sure motor is not undersized for load; adjust TQ LIMIT trim pot CW.

Section 9. Accessories & Replacement Parts

Displays

Closed Loop..... CLD100-1
Open Loop..... OLD100-1

Kits

Fuse

2 1.5 Amp 250V 3AG Fast-blow Glass Fuses..... KTF-0001
2 3 Amp 250V 3AG Fast-blow Glass Fuses..... KTF-0002
2 5 Amp 250V 3AG Fast-blow Glass Fuses..... KTF-0003
2 8 Amp 250V 3AG Fast-blow Glass Fuses..... KTF-0004
2 10 Amp 250V 3AB Normal-blow Ceramic Fuses..... KTF-0005
2 15 Amp 250V 3AB Normal-blow Ceramic Fuses..... KTF-0006

Wiring

Inhibit Plug (18 in. leads)..... KTW-0001
Inhibit Plug (36 in. leads)..... KTW-0002

Logic Cards

Current Sensing

5 Amps.....CMC100-5
20 amps.....CMC100-20

Isolation Cards

Unidirectional, 8 outputs.....ISO101-8
Bidirectional, 1 output.....ISO202-1

Unconditional Warranty

A. Warranty

American Control Electronics warrants that its products will be free from defects in workmanship and material for twelve (12) months or 3000 hours, whichever comes first, from date of manufacture thereof. Within this warranty period, American Control Electronics will repair or replace, at its sole discretion, such products that are returned to American Control Electronics, 14300 De La Tour Drive, South Beloit, Illinois 61080 USA.

This warranty applies only to standard catalog products, and does not apply to specials. Any returns of special controls will be evaluated on a case-by-case basis. American Control Electronics is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to and from the repair point.

B. Disclaimer

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If for any reason any of the foregoing provisions shall be ineffective, American Control Electronics's liability for damages arising out of its manufacture or sale of equipment, or use thereof, whether such liability is based on warranty, contract, negligence, strict liability in tort, or otherwise, shall not in any event exceed the full purchase price of such equipment.

Any action against American Control Electronics based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment or the use thereof, must be commenced within one year after the cause of such action arises.

PAT440-10

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