



GS10 Series

MODELS:

GS10

GS10-R


NEMA 4X SCR

MOTOR CONTROLS

User's Manual

Safety Warnings



- This symbol  denotes an important safety tip or warning. 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 proper grounding, over-current protection, thermal protection, and enclosure. Follow sound maintenance procedures.



WARNING

It is possible for a drive to run at full speed as a result of a component failure. Manufacturer 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 trimpots. Use approved personal protective equipment and insulated tools if working on this drive with power applied.

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Specifications

Model	Max. Armature Current (Amps DC)	HP Range Current with 115 VAC Applied	HP Range Current with 230 VAC Applied	Style
GS10 SERIES	10	1/8–1	1/4–2	NEMA 4X
AC Line Voltage		115/230 VAC ±10%, 50/60 Hz, single phase		
Armature Voltage (115 VAC Input)		0–90 VDC		
Armature Voltage (230 VAC Input)		0–180 VDC		
Form Factor		1.37 at base speed		
Field Voltage (115 VAC Input)		50 VDC (F1 to L1); 100 VDC (F1 to F2)		
Field Voltage (230 VAC Input)		100 VDC (F1 to L1); 200 VDC (F1 to F2)		
Max. Field Current		1 ADC		
Decel. Time Range:				
for 0-90 VDC Armature Voltage		1 - 15 seconds		
for 0-180 VDC Armature Voltage		1 - 15 seconds		
Decel. Time Range:				
for 0-90 VDC Armature Voltage		coast to a stop–13 seconds		
for 0-180 VDC Armature Voltage		coast to a stop–25 seconds		
Analog Input Voltage Range (signal must be isolated; S1 to S2):				
for 0-90 VDC Armature Voltage		0–1.4 VDC		
for 0-180 VDC Armature Voltage		0–2.8 VDC		
Current Limit Range:				
for 0-90 VDC Armature Voltage		0 - 14 A		
for 0-180 VDC Armature Voltage		0 - 13.5 A		
Input Impedance (S1 to S2)		3M ohms		
Load Regulation		1% base speed or better		
Vibration				
1G max (0–50 Hz)				
Ambient Temp. Range (cased drive)		10°C–40°C		

Dimensions

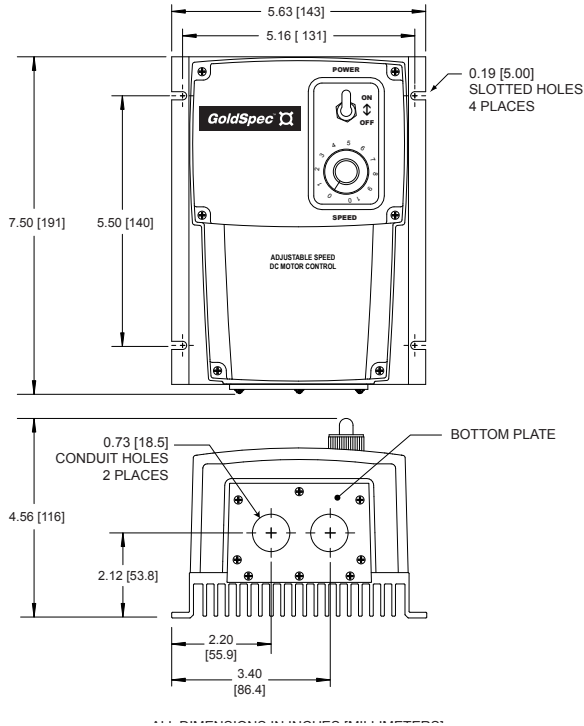


Figure 1. GS10 Series Dimensions

Overview

The following is an overview of the steps taken to set up a GS10 Series control. For more detailed installation information, read the Installation and Calibration sections of this manual.

1. Mount the control using the 4 slotted holes on the heat sink. The slotted holes are 0.19 inches [5 mm] (see Figure 1).
2. Remove the plastic cover by unscrewing the 6 screws on the front cover and 5 screws on the bottom plate. NOTE: Do not remove the 3 screws securing the bottom plate to the heatsink.
3. Change the line fuse if necessary. If the horsepower rating of the motor being used is less than the maximum HP rating of the drive, the line fuse may have to be replaced with a lower rated one.
4. Wire the control through the conduit holes, or optional aluminum hardware. NOTE: Do not connect the control while power is applied.
5. Assure that settings on voltage switches are correct (SW501 & SW502).
6. Apply power to the drive.
7. Calibrate the trimmer pots, if necessary.
8. Re-install the plastic cover.

Installation

Mounting

GS10 Series drives may be vertically wall mounted using the four 0.19 inch (5 mm) slotted holes on the attached heat sink (see Figure 1, Page 2). For motor loads less than 5 ADC, the drive may be bench mounted horizontally, or operated without mounting.

Removing the Plastic Cover

Connections, calibration, and other settings must be made internally. After mounting, use the following procedure to remove the plastic cover and configure the control:

1. Remove the six (6) phillips screws on the front cover.
NOTE: The two shorter screws (#6 - 32 x 2 1/2) are for the two lower holes on the front of the cover (see Figure 2, page 5).
2. Remove the five (5) phillips screws on the bottom plate (see Figure 2, page 5). NOTE: DO NOT remove the 3 screws securing the bottom plate to the heatsink.

Line fusing

Line fuses are preinstalled on all GS10 Series drives. If the current rating of the motor being used is less than the maximum current rating of the drive, the line fuse may have to be replaced with a lower rated one. Refer to Table 1 for recommended line fuse sizes.

Table 1. Recommended Line Fuse Sizes

MOTOR HP	FUSE SIZE (AMPS) @ 115 VAC INPUT	FUSE SIZE (AMPS) @ 230 VAC INPUT
1/4	5	3
1/3	8	3
1/2	8	5
3/4	10	8
1	15	8
1 1/2	–	10
2	–	15

Connections



WARNING

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

1. Install conduit hardware through the two 0.73 inch (18.5 mm) conduit holes or by using aluminum cord connectors attached to the line seal plate on the bottom of the case.
2. Connect external wiring to the terminal block as shown in Figure 3.

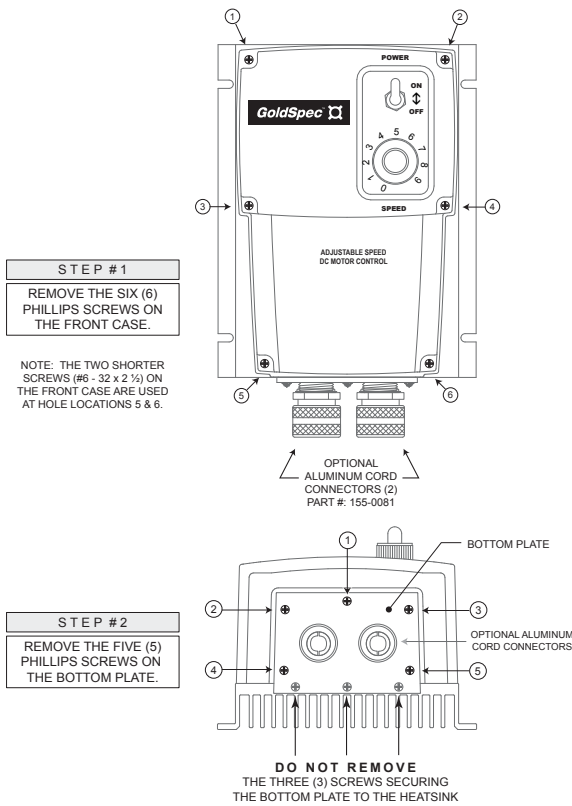
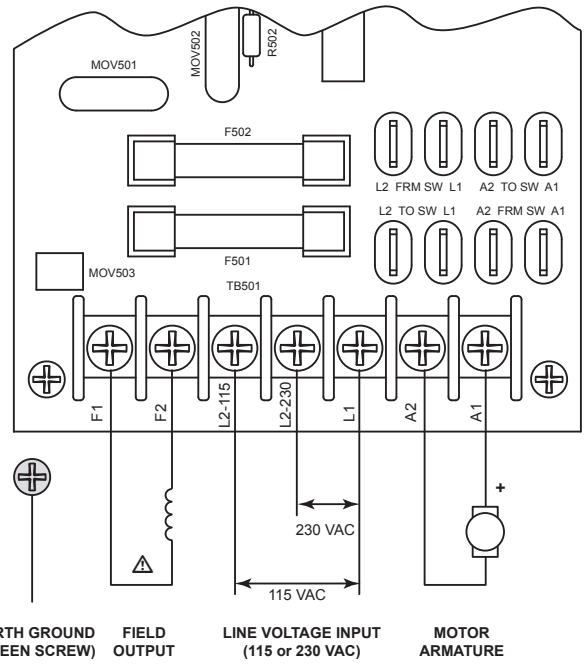


Figure 2. Cover removal for terminal strip access



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.

For field connections, see Table 2.

Figure 3. Drive connections

Field Output

The field output is for shunt wound motors only. Do not make any connections to F1 and F2 when using a permanent magnet motor. Use 18 AWG wire to connect the field output to a shunt wound motor. Table 2 lists the field output connections.

MOTOR HP	FUSE SIZE (AMPS) @ 115 VAC INPUT	FUSE SIZE (AMPS) @ 230 VAC INPUT
1/4	5	3
1/3	8	3
1/2	8	5
3/4	10	8
1	15	8
1 1/2	–	10
2	–	15

Table 2. Field Output Connections

Installation (Continued)

Voltage Switches

- Set voltage switch SW501 to either 115 or 230 to match the AC line voltage (see Figure 4).
- Set voltage switch SW502 to either 90 or 180 to match the maximum motor armature voltage (see Figure 4).

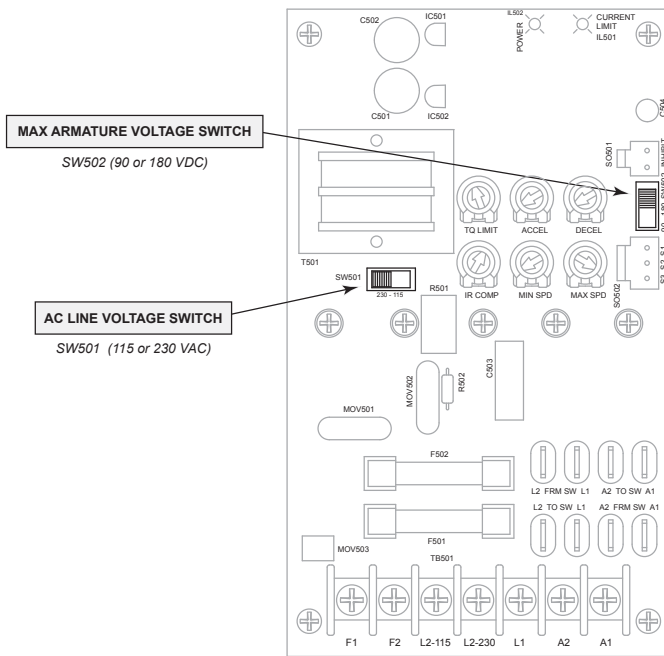


Figure 4. Voltage Switches

Calibration



WARNING

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the voltage input from the drive before adjusting the trimpots. If the trimpots 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.

All drives have six user-adjustable trimpots: Torque Limit (TORQUE), Acceleration (ACCEL), Deceleration (DECEL), Regulation (IR COMP), Minimum Speed (MIN SPD), and Maximum Speed (MAX SPD). Each drive is factory calibrated to its maximum current rating. Readjust the calibration trimpot 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 trimpot is identified on the printed circuit board. Refer to Figure 5 for trimpot locations and Figure 6 (page 8) for typical TORQUE LIMIT and IR COMP settings.

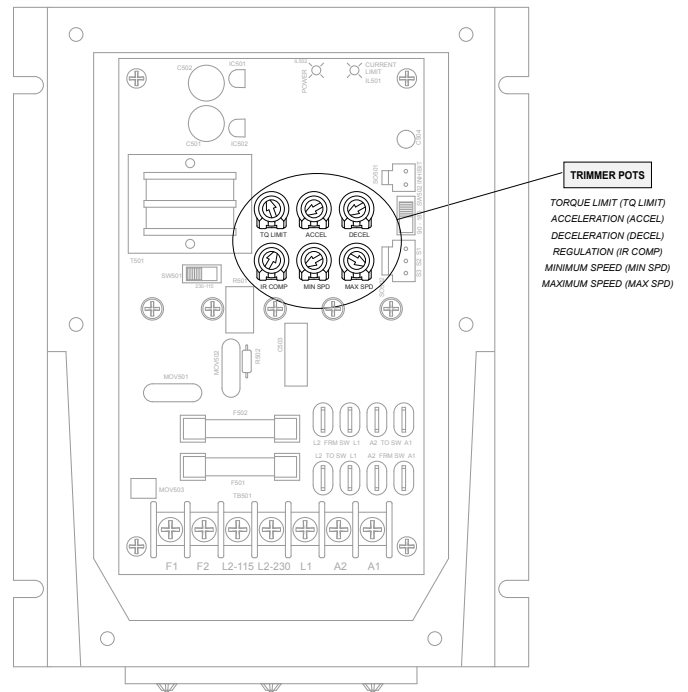


Figure 5. Calibration Trimpot Layout

Calibration procedure

Calibrate the drive using the following procedure:

1. Set the MIN SPD, IR COMP, ACCEL and DECEL trimpots to zero (full CCW).
2. Set the TORQUE trimpot to maximum (full CW).
3. Set the MAX SPD trimpot to midrange (approximate 12 o'clock position).
4. Turn the speed adjust potentiometer on front cover to zero.
5. Apply power to the drive.
6. Calibrate the trimpots as follows:

MINIMUM SPEED (MIN SPD)

The MIN SPD setting determines the motor speed when the speed adjust potentiometer is turned full CCW or reference signal is at its minimum. It is factory set to zero speed.

To calibrate, turn the speed adjust potentiometer full CCW or reference signal is at its minimum. Adjust the MIN SPD trimpot until the motor has stopped, or is running at the desired minimum speed.

MAXIMUM SPEED (MAX SPD)

The MAX SPD setting determines the motor speed when the speed adjust potentiometer is turned full CW or reference signal is at its maximum. It is factory set for maximum rated speed.

To calibrate, set the MAX SPD trimpot full CCW. Turn the speed adjust potentiometer full CW or reference signal is at its maximum. Adjust the MAX SPD trimpot until the desired maximum motor 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.

REGULATION (IR COMP)

The IR COMP setting determines the degree to which motor speed is held constant as the motor load changes. It is factory set for optimum motor regulation.

Recalibrate the IR COMP setting when using a lower horsepower motor. Refer to the recommended IR COMP settings in Figure 6 (page 8), or recalibrate using the following procedure:

If the motor does not maintain set speed as the load changes, gradually rotate the IR COMP trimpot CW. If the motor oscillates (overcompensation), the IR COMP trimpot may be set too high. Turn the IR COMP trimpot CCW to stabilize the motor.

TORQUE LIMIT (TORQUE)



WARNING

Although TORQUE is set to 150% of drive nameplate current rating, continuous operation beyond that rating may damage the motor. If you intend to operate beyond the rating, contact your Applied Industrial Technologies representative for assistance.

The TORQUE setting determines the maximum torque for accelerating and driving the motor. TORQUE is factory set at 150% of maximum drive current. You must recalibrate the TORQUE setting if using a lower current rated motor. See Figure 6 (page 8) for typical TORQUE and IR COMP settings.

1. With no power applied to the drive, connect a DC ammeter in series with the motor armature.
2. Set the TORQUE trimpot to full CCW.
3. Carefully lock the motor armature. Ensure that the motor is firmly mounted.
4. Apply line power. The motor should be stopped.
5. Set the speed potentiometer or reference signal to maximum speed. The motor should remain stopped.
6. Slowly rotate the TORQUE trimpot clockwise (CW) until the ammeter reads 150% of maximum motor armature current.
7. Set the speed adjust potentiometer or reference signal to zero speed.
8. Remove power from the drive.
9. Remove the lock from the motor shaft.
10. Remove the ammeter in series with the motor armature.

Calibration (continued)

ACCELERATION (ACCEL)

The ACCEL setting determines the time the motor takes to ramp to a higher speed. See Specifications on page 3 for approximate acceleration times. The ACCEL setting is factory set to its minimum value (full CCW).

Turn the ACCEL trimpot CW to increase the acceleration time, and CCW to decrease the acceleration time.

DECELERATION (DECEL)

The DECEL setting determines the time the motor takes to ramp to a lower speed. See Specifications on page 3 for approximate decelerating times. The DECEL setting is factory set to its minimum value (full CCW).

Turn the DECEL trimpot CW to increase the deceleration time, and CCW to decrease the deceleration time.

Calibration procedure conclusion

This concludes the calibration procedure. The control should now be calibrated for optimum operation.

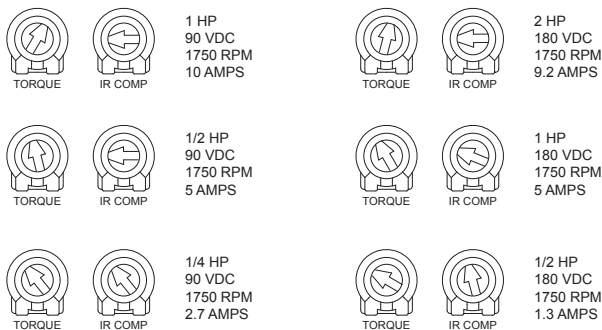


Figure 6. Recommended TORQUE and IR COMP Settings for GS10 Series Controls

Operation



WARNING

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. If the switches are improperly set to a higher voltage position, the motor will overspeed, which may cause motor damage.

Before applying power

- Set voltage switch SW501 to either 115 or 230 to match the AC line voltage (see Figure 4, page 6).
- Set voltage switch SW502 to either 90 or 180 to match the maximum armature voltage (see Figure 4, page 6).
- Verify that no conductive material is present on the printed circuit board.
- If using a 90 VDC or 130 VDC motor with 230 VAC line voltage, derate the nameplate motor torque by at least 30%.

Startup

GS10



WARNING

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

1. Set the speed adjust potentiometer (SPEED dial) to "0", or full CCW.
2. Apply AC line voltage.
3. Set the POWER switch to the ON position.
4. Slowly advance the speed adjust potentiometer CW. The motor slowly accelerates as the potentiometer is turned CW. Likewise, the motor slowly decelerates as the potentiometer is turned CCW. Continue until the desired speed is reached.
5. To bring the motor to a stop, turn the speed adjust potentiometer to "0" or set the POWER switch to the OFF position.

GS10-R



WARNING

Do not change the motor 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 may damage the drive and/or motor.

1. Set the FORWARD/OFF/REVERSE switch to the OFF position.
2. Set the speed adjust potentiometer (SPEED dial) to "0", or full CCW.
3. Apply AC line voltage.
4. Set the FORWARD/OFF/REVERSE switch to the desired direction of rotation.
5. Slowly advance the speed adjust potentiometer CW. The motor slowly accelerates as the potentiometer is turned CW. Likewise, the motor slowly decelerates as the potentiometer is turned CCW. Continue until the desired speed is reached.
6. To bring the motor to a stop, turn the speed adjust potentiometer to "0" or set the FORWARD/OFF/REVERSE switch to the OFF position.
7. To reverse direction:
 - a. Set the FORWARD/OFF/REVERSE switch to the OFF position.
 - b. After the motor comes to a complete stop, set the FORWARD/OFF/REVERSE switch to the desired direction of rotation.

Signal Operation Calibration

1. Set the Signal/Manual Switch located on the enclosure to the SIGNAL position.
2. Apply the AC line voltage.
3. Set the POWER switch to the ON position.
4. Apply minimum current or voltage signal. Adjust the SIG MIN trimpot to achieve the desired minimum motor speed.
5. Apply the maximum current or voltage signal. Adjust the SIG MAX trimpot to achieve the desired maximum motor speed.
6. Application Notes

Application Notes



WARNING

Decelerating to minimum speed, inhibit operation, or coasting to a stop 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 the AC line power (both L1 and L2) is the only acceptable method for emergency stopping.

Inhibit circuit

Maintaining a connection between the inhibit pins (Figure 7) causes the motor to coast to minimum speed. Removing the connection between the inhibit pins allow the motor to accelerate to the speed set by the speed adjust potentiometer.

GoldSpec™ offers two accessory plug harnesses for connecting to the INHIBIT terminals: part number GS201-0024 [inhibit plug with 18 inches (46 cm) leads]; and part number GS201-0079 [inhibit plug with 36 inches (91 cm) leads].

Twist inhibit wires and separate them from other 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.

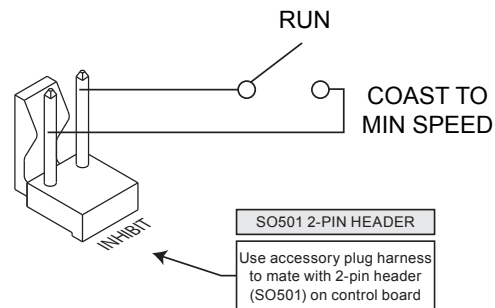


Figure 7. Inhibit Plug with Run/Coast to Minimum Speed

Application Notes (continued)

Decelerating to minimum speed

The switch shown in Figure 8 may be used to decelerate a motor to minimum speed. Closing the switch between S1 and S2 decelerates the motor from set speed to minimum speed determined by the MIN SPD trimpot setting. If the MIN SPD trimpot is set full CCW, the motor decelerates to zero speed when the switch between S1 and S2 is closed. The DECEL trimpot 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 trimpot setting.

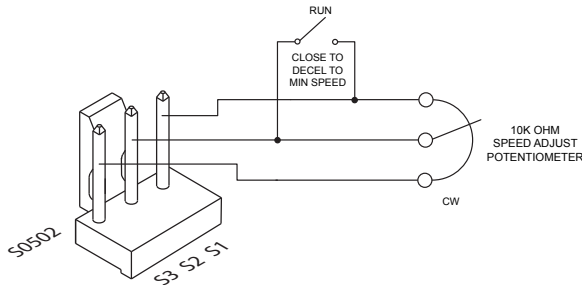


Figure 8. Run/Decelerate to Minimum Speed Switch

Dynamic Braking



WARNING

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

Dynamic braking may be used to rapidly stop a motor (Figure 9). For the RUN/BRAKE switch, use a two-pole, two-position switch rated for at least the maximum DC armature voltage and maximum braking current. 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.

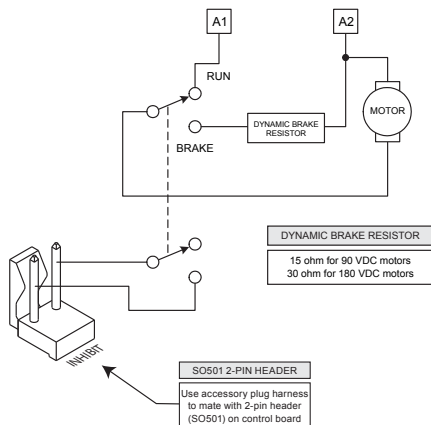


Figure 9. Dynamic Brake Connection

Multiple Fixed Speeds

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

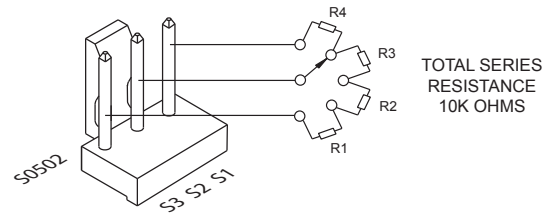


Figure 10. Multiple Fixed Speeds

Adjustable speeds using potentiometers in series

Replace the speed adjust potentiometer with a single-pole, multi-position switch, and two or more potentiometers in series, with a total series resistance of 10K ohms. Figure 11 shows a connection for fixed high and low speed adjust potentiometers.

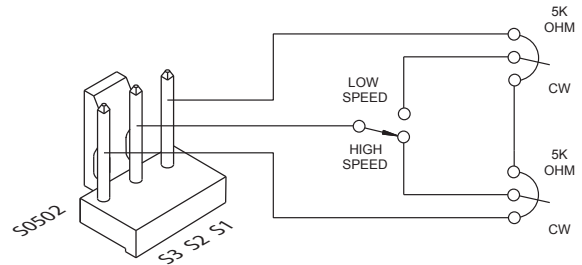


Figure 11. Adjustable Fixed Speeds Using Potentiometers in Series

Independent adjustable speeds

Replace the speed adjust potentiometer with a single pole, multiposition switch, and two or more potentiometers in parallel, with a total parallel resistance of 10K ohms. Figure 12 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

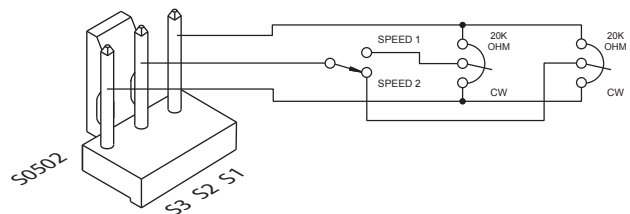


Figure 12. Independent Adjustable Speeds

RUN/JOG Switch

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.

RUN/JOG option #1

In the first wiring option, connect the RUN/JOG switch and JOG pushbutton to the inhibit plug as shown in Figure 13. The motor coasts to minimum speed 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.

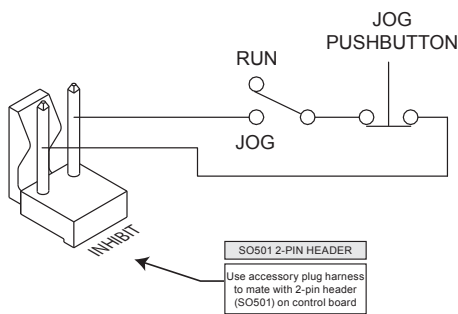


Figure 13. RUN/JOG Switch Option #1

RUN/JOG option #2

In the second wiring option, connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 14. When the RUN/JOG switch is set to JOG, the motor decelerates to minimum speed (minimum speed is determined by the MIN SPD trimpot setting). Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

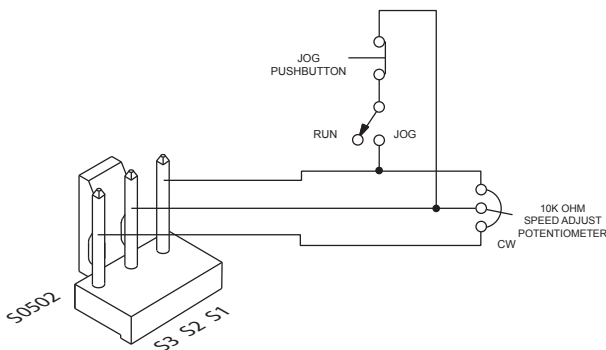


Figure 14. RUN/JOG Switch Option #2

Leader-follower application

In this application, use a Process Control Module (GS4) to monitor the speed of the leader motor (Figure 15). The GS4 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 GS4 output voltage.

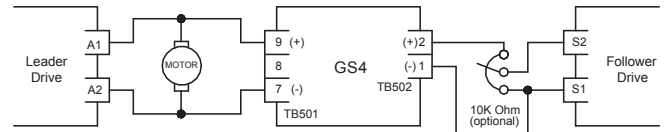


Figure 15. Leader-Follower Application

Single speed potentiometer control of multiple drives

Multiple drives can be controlled with a single speed adjust potentiometer using a Process Control Module (GS4) at the input of each drive to provide isolation (Figure 16). Optional ratio potentiometers can be used to scale the GS output voltage, allowing independent control of each drive.

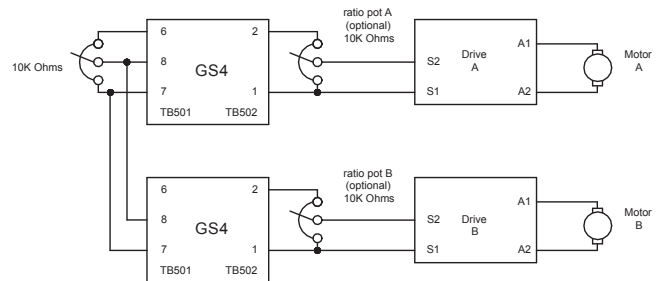


Figure 16. Single Speed Potentiometer Control of Multiple Drives

Application Notes (continued)

Reversing

A dynamic brake may be used when reversing the motor direction (Figure 17). 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, page 10, for recommended dynamic brake resistor sizes. NOTE: Model GS10-R is equipped with the reversing feature, but not the dynamic brake feature.

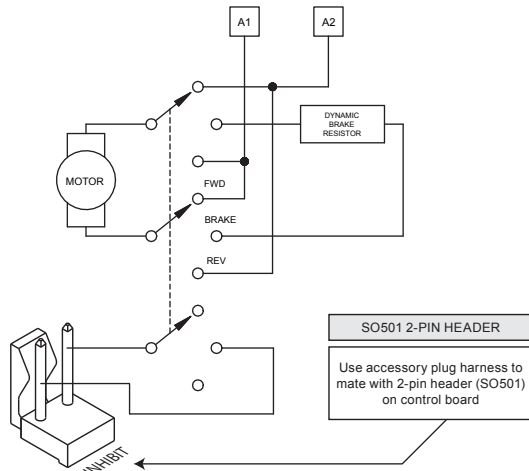


Figure 17. Reversing Circuit Connection

Troubleshooting



WARNING

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

Before troubleshooting

- Perform the following steps before starting any procedure in this section:
- Disconnect AC line voltage from the drive.
- Check the drive closely for damaged components.
- Check that no conductive or other foreign material has become lodged on the printed circuit board.
- Verify that every connection is correct and in good condition.
- Verify that there are no short circuits or grounded connections.
- Check that the voltage switch settings match the AC line and maximum armature output voltages.
- Check that the drive's rated armature outputs are consistent with the motor ratings.

Power and Current Limit LEDs

Patriot Series drives are equipped with a green, PCB-mounted power LED and a red, PCB-mounted current limit LED.

POWER LED (IL502)

The green power LED turns on when AC line voltage is applied to the drive.

CURRENT LIMIT (IL501)

The red current limit LED turns on when the drive reaches current limit and turns off whenever the drive is not in current limit (normal operation).

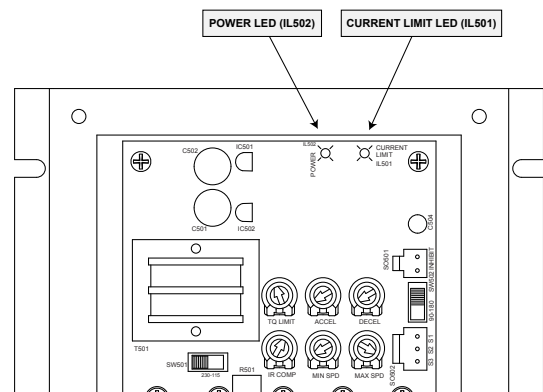


Figure 18. Current Limit LEDs

Problem	Possible Causes	Suggested Solutions
Line fuse blows.	<ol style="list-style-type: none"> 1. Line fuse is the wrong size. 2. Motor cable or armature is shorted to ground. 3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes (i.e. reversing). 	<ol style="list-style-type: none"> 1. Check that the line fuse is correct for the motor size. 2. Check motor cable and armature for shorts. 3. Add a blower to cool the drive components; decrease TORQUE settings, or resize motor and drive for actual load demand, or check for incorrectly aligned mechanical components or "jams". See page 7 for information on adjusting the TORQUE trimpot.
Line fuse does not blow or circuit breaker does not trip, but the motor does not run	<ol style="list-style-type: none"> 1. Reference signal or speed adjust pot is set to zero speed. 2. Reference signal or speed adjust potentiometer connections are open. 3. Drive is in current limit. 4. Drive is not receiving AC line voltage. 5. Motor is not connected. 	<ol style="list-style-type: none"> 1. Increase reference signal or speed adjust potentiometer setting. 2. Check that the reference signal or speed adjust potentiometer connections are not open. 3. Verify that the motor is not jammed. Increase TORQUE setting (page 7). 4. Apply AC line voltage to L1 and L2. 5. Connect motor to A1 and A2.

Problem	Possible Causes	Suggested Solutions
Motor runs too fast at maximum speed setting.	<ol style="list-style-type: none"> 1. MIN SPD and MAX SPD are not calibrated. 	<ol style="list-style-type: none"> 1. Recalibrate MIN SPD (page 7) and MAX SPD (page 7).
Motor runs too slow or too fast.	<ol style="list-style-type: none"> 1. MIN SPD and MAX SPD are not calibrated. 	<ol style="list-style-type: none"> 1. Recalibrate MIN SPD (page 7) and MAX SPD (page 7).
Motor will not reach the desired speed.	<ol style="list-style-type: none"> 1. MAX SPD setting is too low. 2. IR COMP setting is too low. 3. Motor is overloaded. 	<ol style="list-style-type: none"> 1. Increase MAX SPD setting (page 7). 2. Increase IR COMP setting 3. (page 7). 4. Check motor load. Resize the motor or drive if necessary.
Motor pulsates or surges under load.	<ol style="list-style-type: none"> 1. R COMP is set too high. 2. Control is in current limit mode. 	<ol style="list-style-type: none"> 1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes (page 7). 2. Check that motor is of sufficient horsepower and amperage.
On non-reversing drives, motor runs in the opposite direction.	<ol style="list-style-type: none"> 1. Reverse connections to the motor armature. 	<ol style="list-style-type: none"> 1. Reverse connections to the motor armature.
Motor will not stop when the speed adjust potentiometer or reference signal is set to zero speed.	<ol style="list-style-type: none"> 1. MIN SPD trimpot is not adjusted properly. 	<ol style="list-style-type: none"> 1. Slowly rotate the MIN SPD trimpot until the motor stops.



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