AMERICAN CONTROL ELECTRONICS

RGA SERIES

USER MANUAL

RGA400-3
RGA400-10
RGA403-3
RGA403-10
RGA440-3
RGA440-10

Dear Valued Consumer:

Congratulations on your purchase of the **RGA 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 (ACE) 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. Regenerative Drives

Most non-regenerative, variable speed, DC drives control current flow to a motor in one direction. The direction of current flow is the same direction as the motor rotation. Non-regenerative drives operate in Quadrant I, and also in Quadrant III if the drive is reversible (see Figure 1). Motors must stop before reversing direction. Unless dynamic braking is used, non regenerative drives cannot decelerate a load faster than coasting to a lower speed.

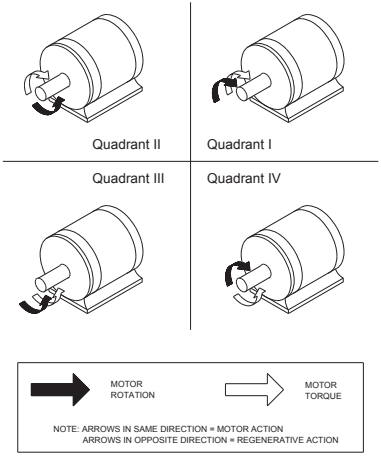


Figure 1. Four Quadrant Operation

Regenerative drives operate in two additional quadrants: Quadrant II and Quadrant IV. In these quadrants, motor torque is in the opposite direction of motor rotation.

This allows regenerative drives to reverse a motor without contractors or switches, to control an overhauling load, and to decelerate a load faster than it would to coast to a lower speed.

Section 2. Specifications

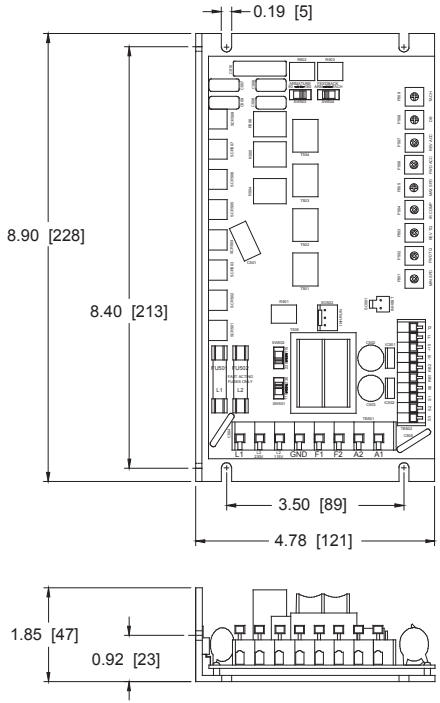
Model	*Maximum Armature Current (ADC)*	*HP Range with 90 VDC Motor*	*HP Range with 180 VDC Motor*	*Enclosure*
RGA400-3	*3.0*	*1/20 - 1/4*	*1/10 - 1/2*	*Chassis*
RGA403-3				*Chassis*
RGA440-3				*NEMA 4X*
*RGA400-10**	*10.0*	*1/8 - 1*	*1/4 - 2*	*Chassis*
*RGA403-10**				*Chassis*
RGA440-10				*NEMA 4X*

* Heat sink kit part number HSK-0003 must be used when the continuous current output is over 7 amps.

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	0.5 - 15 seconds
Deceleration Time Range	0.5 - 15 seconds
Analog Input Range	
RGA400 / RGA440 models	
(signal must be isolated; RB1 to S2)	
Voltage Signal Range	0 to ± 10 VDC
RGA403 models	
Voltage Signal Range	0 to ± 250 VDC
Current Signal Range	4 - 20 mA

Input Impedance	
RGA400 / RGA440 models (RB1 to S2)	32K ohms
-RGA403 models (Voltage Signal)	>25K ohms
-RGA403 models (1-5 mA Signal)	1K ohms
-RGA403 models (4-20 mA Signal)	235 ohms
-RGA403 models (10-50 mA Signal)	100 ohms
Form Factor	1.37 at base speed
Load Regulation	
with Armature Feedback	1% base speed or better
with Tachogenerator Feedback	0.1% base speed
Vibration	0.5G maximum (0 - 50 Hz) 0.1G maximum (> 50 Hz)
Safety Certification	UL Recognized Component, File # E132235 CSA Certified Component, File # LR41380
Ambient Temperature Range	
Chassis models	10°C - 55°C
Enclosed models	10°C - 40°C

Section 3. Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 2. RGA400 Dimensions

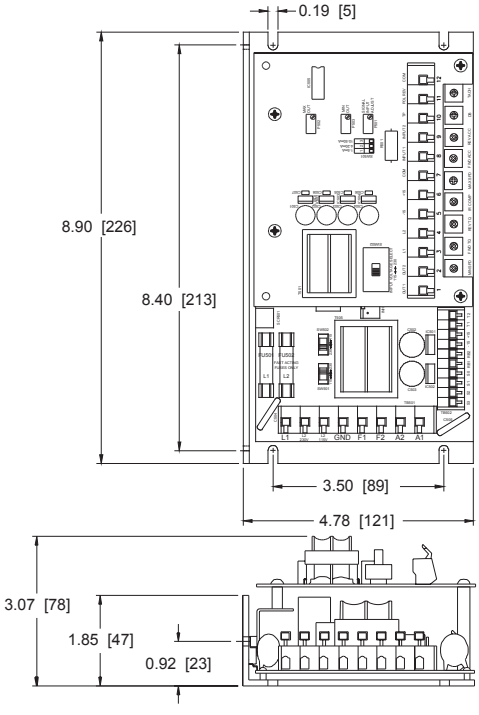


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Figure 3. RGA403 Dimensions

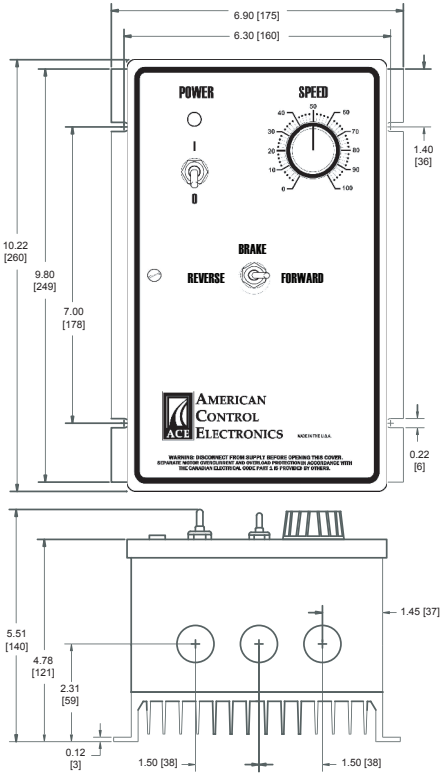

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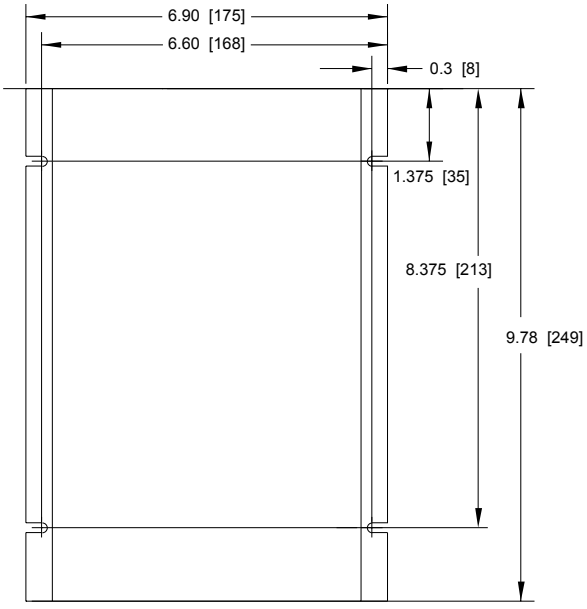
Figure 4. RGA440 Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 5. HSK-0003 Dimensions

Section 4. 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.

Heat Sinking

Chassis

Models RGA400-10 and RGA403-10 require an additional heat sink when the continuous armature current is above 7 amps. Use heat sink kit part number HSK-0001. All other chassis drives have sufficient heat sinking in their basic configuration. Use a thermally conductive heat sink compound (such as Dow Corning® 340 Heat Sink Compound) between the chassis and the heat sink surface for optimum heat transfer.

NEMA 4X

All NEMA 4X models come with the heat sink already attached. Therefore, all NEMA 4X drives have sufficient heat sinking in their basic configuration.

Mounting

Chassis

- Drive components are sensitive to electrostatic discharge. Avoid direct contact with the circuit board. Hold the drive by the heat sink only.
- Protect the drive from dirt, moisture, and accidental contact.
- Provide sufficient room for access to the terminals and calibration trim pots.
- Mount the drive away from heat sources. Operate the drive within the specified ambient operating temperature range.
- Prevent loose connections by avoiding excessive vibration of the drive.
- Mount the drive with its board in either a horizontal or vertical plane. Six 0.19" (5 mm) wide slots in the chassis accept #8 pan head screws. Fasten either the large base or the narrow flange of the chassis to the subplate.
- The chassis should be earth grounded. Use a star washer beneath the head of at least one of the mounting screws to penetrate the anodized surface and to reach bare metal.

Speed Adjust Potentiometer

WARNING!

Be sure that the potentiometer tabs do not make contact with the potentiometer's body. Grounding the input will cause damage to the drive.

If using a remote potentiometer with a chassis drive, mount the speed adjust potentiometer through a 0.38 in. (10 mm) hole with the hardware provided (Figure 6). Install the circular insulating disk between the panel and the 10K ohm speed adjust potentiometer.

Twist the speed adjust potentiometer wire to avoid picking up unwanted electrical noise. If the speed adjust potentiometer wires are longer than 18 in. (46 cm), use shielded cable. Keep the speed adjust potentiometer wires separate from power leads (L1, L2, A1, A2, F1, F2).

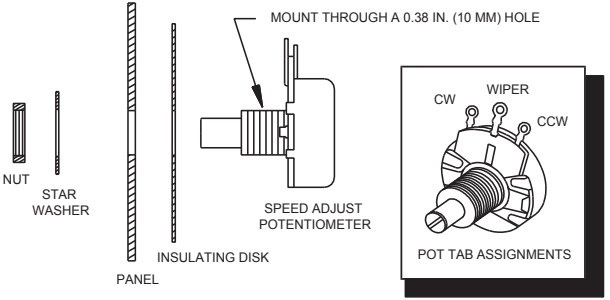


Figure 6. Speed Adjust Potentiometer

Mounting (NEMA 4X Enclosures)

NEMA 4X cased drives come with two 0.88 inch (22 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, turn the slotted screw on the front cover counterclockwise until it is free from the case. The right side of the cover is hinged to the case. Pull the slotted screw to open the case.
3. Carefully remove the conduit knockouts by tapping them into the case and twisting them off with pliers.
4. Set the POWER switch to the OFF position before applying the AC line voltage.
5. Install conduit hardware through the 0.88 inch (22 mm) knockout holes. Connect external wiring to the terminal block.
6. Grasp the slotted screw and tilt the front cover back into place. Avoid pinching any wires between the front cover and the case.
7. Turn the slotted screw clockwise until tight to secure the front cover.

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

Models RGA400-10, RGA403-10, and RGA440-10 are preinstalled with 20 amp fuses. Models RGA400-3, RGA403-3, and RGA440-3 are preinstalled with 8 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 on page 15 to install a lower rated fuse.

Refer to Table 2 on page 15 for Short Circuit Current Ratings (SCCR).

Table 1. Recommended Line Fuse Sizes

90 VDC Motor Horsepower	*180 VDC Motor Horsepower*	*Maximum DC Armature Current (amps)*	*AC Line Fuse Size (amps)*
1/20	*1/10*	*0.5*	*1*
1/15	*1/8*	*0.8*	*1.5*
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*	*10*
3/4	*1 ½*	*7.5*	*15*
1	*2*	*10*	*15*

See Section 9: Accessories and Replacement Parts for fuse kit part numbers.

Table 2. Short Circuit Current Ratings

Drive Model	**Short Circuit Current Rating**		**Types of Branch Circuit Protection**		**Maximum Rating of Overcurrent Protection**
	Maximum Current, kA	**Maximum Voltage, V**			
RGA400-10	10,000	240 V	Non-time Delay K5 Fuse	Inverse Time Circuit Breaker	30 A
RGA403-10					
RGA440-10					

Connections

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

American Control Electronics strongly recommends the installation of a master power switch in the voltage input line, as shown in Figures 11 and 12 on pages 24 and 25. The switch contacts should be rated at a minimum of 200% of motor nameplate current and 250 volts.

Power Input

For chassis models, connect the AC line power leads to terminals L1 and L2 (115) if using a 115 VAC line or to terminals L1 and L2 (230) if using a 230 VAC line. American Control Electronics recommends the use of a single-throw, double-pole master power switch. The switch should be rated at a minimum of 250 volts and 200% of motor current. Refer to Figures 11 and 12 on page 24 and 25.

For NEMA 4X models, the connect the AC line power leads to terminals 1 and 2 if using a 115 VAC line or to terminals 1 and 3 if using a 230 VAC line. Refer to Figure 13 on page 26.

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 Figures 11, 12 and 13 on pages 24, 25 and 26. 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 14 - 16 AWG wire to connect the field output to a field / 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*

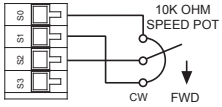
Speed Adjust Potentiometer

Use a 10K ohm, 1/4 W potentiometer for speed control. The motor can operate in one direction (unidirectional) or two directions (bidirectional) depending on how the speed adjust potentiometer is connected to the drive.

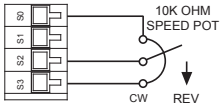
For unidirectional operation in the foward direction, connect the speed adjust potentiometer as shown in Figure 7(a).

For unidirectional operation in the reverse direction, connect the speed adjust potentiometer as shown in Figure 7(b).

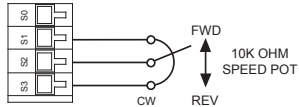
For bidirectional operation, connect the speed adjust potentiometer as shown in Figure 7(c). The motor does not operate when the potentiometer is in the center position. Turning the potentiometer clockwise (CW) from the center position causes the motor to rotate in the forward direction, while turning the potentiometer counterclockwise (CCW) causes rotation in the reverse direction.



(a). Unidirectional Forward



(b). Unidirectional Reverse



(c). Bidirectional

Figure 7. Speed Adjust Potentiometer Connections

Speed Adjust Potentiometer (RGA403 models)

Use a 10K ohm, 1/4 W potentiometer for speed control. The motor can operate in one direction (unidirectional) or two directions (bidirectional) depending on how the speed adjust potentiometer is connected to the drive.

For unidirectional operation in the foward direction, connect the speed adjust potentiometer as shown in Figure 8(a).

For unidirectional operation in the reverse direction, connect the speed adjust potentiometer as shown in Figure 8(b).

For bidirectional operation, connect the speed adjust potentiometer as shown in Figure 8(c). The motor does not operate when the potentiometer is in the center position. Turning the potentiometer clockwise (CW) from the center position causes the motor to rotate in the forward direction, while turning the potentiometer counterclockwise (CCW) causes rotation in the reverse direction.

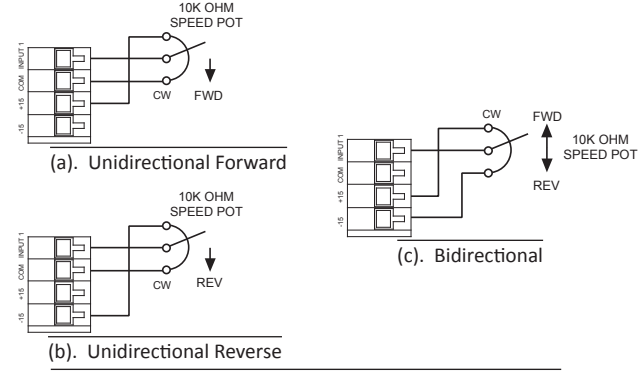


Figure 8. RGA403 Speed Adjust Potentiometer Connections

Analog Input Signal

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 9). Connect the signal common (–) RB1. Connect the signal input (+) to S2. A potentiometer can be used to scale the analog input voltage. An interface device, such as American Control Electronics model ISO401-1, may be used to scale and isolate an analog input voltage.

An isolated analog input voltage range of -10 to 10 VDC is required to produce an armature voltage range of -90 to 90 VDC with 115 VAC line voltage or -180 to 180 VDC with 230 VAC line voltage.

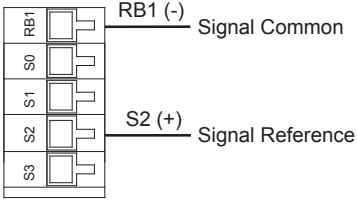


Figure 9. Analog Input Signal Connections

Analog Input Signal (RGA403 models)

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 terminal 7 (COM). If using an input current signal or an input voltage signal of 0 to ± 25 VDC or less, connect the signal reference (+) to terminal 8 (INPUT 1), or if using an input voltage signal greater than 0 to ±25 VDC, connect the signal reference (+) to terminal 9 (INPUT 2).

Refer to Figures 15 and 16 on page 29 for switch SW501 settings and location.

If using an input current signal, the signal may be used to determine motor speed only. To change direction, a direction switch must be used.

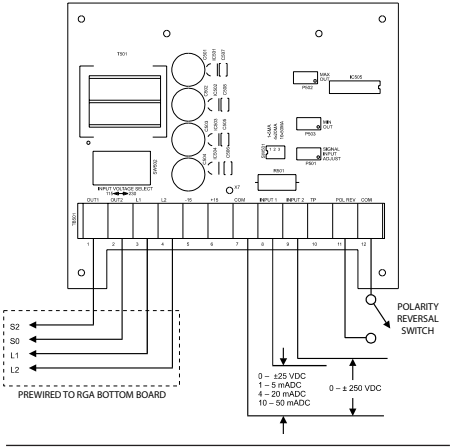


Figure 10. RGA403 Analog Input Signal Connections

+15 and -15

Do not short the +15 and -15 terminals for any reason. Shorting these terminals will damage the drive.

RGA series drives can supply a regulated +15 and -15 VDC signal (each sourcing 15 mA maximum) with respect to RB1, to isolated, external devices. See Figure 10 for voltage supply terminal locations.

Enable, Regen Brake, and Inhibit

See the "Starting and Stopping Methods" section on pages 32 through 36 for a detailed description of the Enable, Inhibit, and Regen Braking (RB1, RB2) connections.

Direction Switch

For RGA400 and RGA440 models, refer to Figures 22 and 23 on page 50.

For RGA403 models, a single-pole, single-throw switch can be used as a reversal switch. Connect the switch to terminals COM and DIR. Close the switch to reverse the motor. Open the switch to return the motor back to it's original direction. Refer to Figure 12 on page 25.

Tachogenerator Feedback

Using tachogenerator feedback improves speed regulation from approximately 1% of motor base speed to approximately 0.1% of motor base speed. Use tachogenerators rated from 7 VDC per 1000 RPM to 50 VDC per 1000 RPM. Connect the tachogenerator to terminals T1 and T2 of terminal block TB502. The polarity is positive (+) for T1 and negative (-) for T2 when the motor is running in the forward direction. Place SW504 in the TACH position. See Figures 11, 12 and 13 on pages 24, 25 and 26 for tachogenerator connections. The TACH trim pot must be adjusted prior to operating with tachogenerator feedback. Refer to the Calibration section for instructions on calibrating the TACH trim pot.

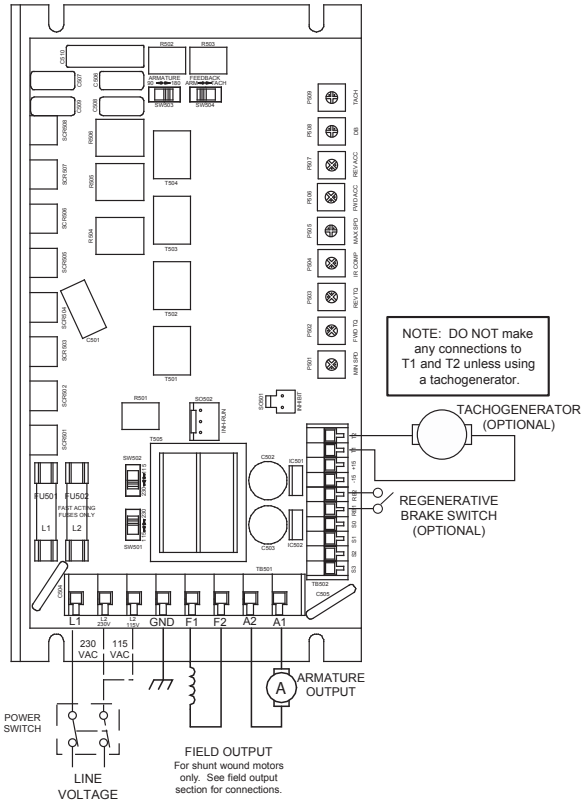


Figure 11. RGA400 Connections

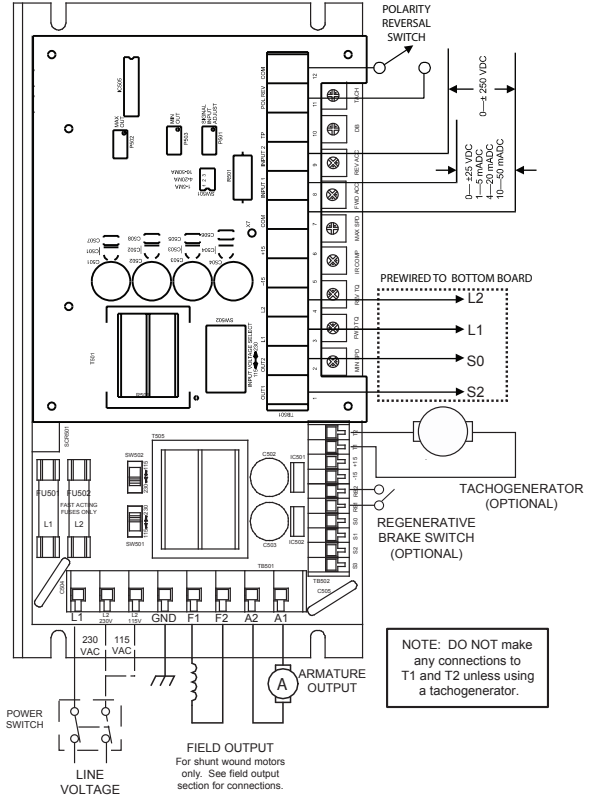


Figure 12. RGA403 Connections

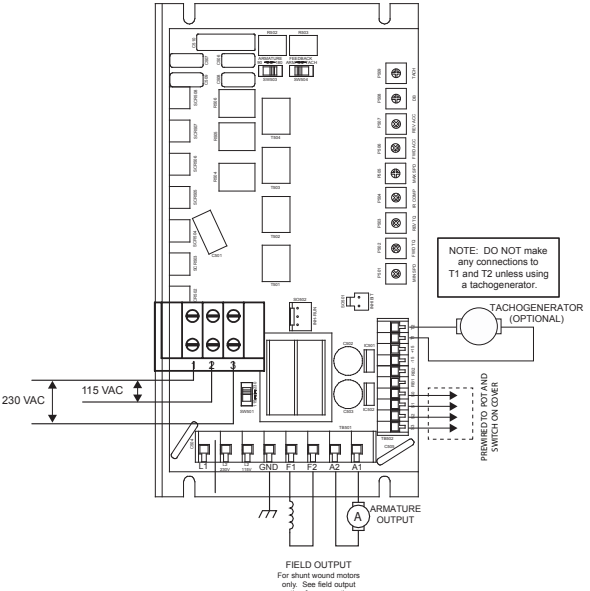


Figure 13. RGA440 Connections

Section 5. 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 59, 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, SW502)

Set the input voltage select switches SW501 and SW502 to either 115 or 230 to match the AC line voltage. See Figure 14.

Armature Voltage Select (SW503)

Set the armature voltage select switch SW503 to either 90 or 180 to match the maximum armature voltage. See Figure 14.

Feedback Select (SW504)

Set the feedback select switch SW504 to either ARM for armature feedback or TACH for tachogenerator feedback. See Figure 14.

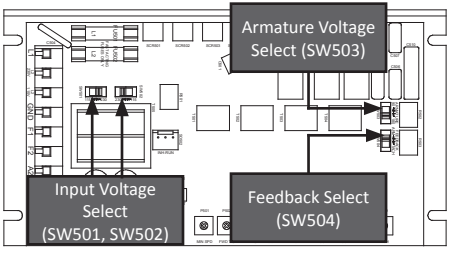


Figure 14. Select Switches

Signal Select (SW501) (RGA403 models)

Set the signal switch SW501 based on the type of input signal to be used. See Figure 15 for settings and Figure 16 for location.

INPUT SIGNAL LEVEL	DIP SWITCH SETTING		
	1	2	3
VDC	OFF	OFF	OFF
1 - 5 mA	ON	OFF	OFF
4 - 20 mA	OFF	ON	OFF
10 - 50 mA	OFF	OFF	ON

Figure 15. SW501 Settings

Input Voltage Select (SW502) (RGA403 models)

Set the input voltage select switch SW502 to either 115 or 230 to match the AC line voltage. See Figure 16.

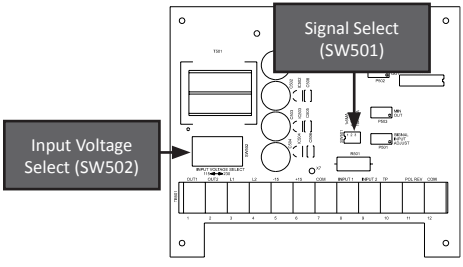


Figure 16. RGA403 Select Switches

Startup

RGA400 and RGA403

1. Turn the speed adjust potentiometer full counterclockwise (CCW) or set the input voltage or current signal to minimum.
2. Apply AC line voltage.
3. Slowly advance the speed adjust potentiometer clockwise (CW) or 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. Remove AC line voltage from the drive to coast the motor to a stop.

RGA440

1. Set the FORWARD/BRAKE/REVERSE switch to the BRAKE position.
2. Turn the speed adjust potentiometer to “0” (full CCW) or set the input voltage signal to minimum.
3. Set the POWER switch to the ON position.
4. Set the FORWARD/BRAKE/REVERSE switch to the desired direction of rotation.
5. 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.
6. To brake the motor to a stop, set the FORWARD/BRAKE/REVERSE switch to the BRAKE position. To coast the motor to a stop, set the POWER switch to the “O” (OFF) position.
7. To reverse direction, set the FOWARD/BRAKE/REVERSE switch to the desired direction.
8. Set the POWER switch to the OFF position.

Starting and Stopping Methods

Regenerative 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.

For this reason, American Control Electronics strongly recommends installing an emergency stop switch on both AC line inputs (see Figures 11 and 12 on pages 23 and 24).

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, the drive is enabled, and the inhibit is open.

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.

Regenerative Brake to Zero Speed (INHIBIT Terminals)

Short the INHIBIT terminals to regeneratively brake the motor to zero speed (see Figure 17). The inhibit bypasses both the MIN SPD trim pot and the deceleration rate set by the FWD ACC or REV ACC trim pots. 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 KTW-0001 [plug with 18 in. (46 cm) leads]; and part number KTW-0002 [plug with 36 in. (91 cm) leads].

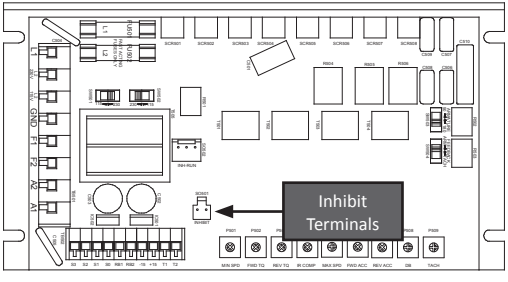


Figure 17. Inhibit Terminals

Regenerative Decel to Zero Speed (RB1 and RB2 Terminals)

Short the RB1 and RB2 terminals to regeneratively brake the motor to zero speed. See Figures 11, 12 and 13 on pages 24, 25 and 26. The RB1 and RB2 circuit follows the deceleration rate set by the FWD ACC and REV ACC trim pots. Open the RB1 and RB2 terminals to accelerate the motor to set speed.

Regenerative Decel to Minimum Speed

The switch shown in Figure 18 may be used to decelerate a motor to a minimum speed. Closing the switch between S0 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. The REV ACC or FWD ACC trim pot setting determines the rate at which the drive decelerates, depending on the direction of deceleration. By opening the switch, the motor accelerates to set speed.

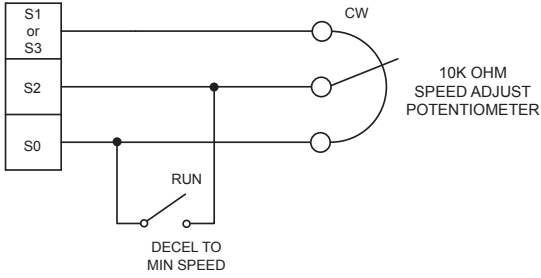


Figure 18. Run/Decelerate to Minimum Speed Switch

Coast to Zero Speed (INHIBIT-RUN)

To coast the motor to a stop, without removing power to the drive, jumper INHIBIT-RUN terminals 1 and 2. To restart the motor, jumper INHIBIT-RUN terminals 2 and 3. A single-pole, double-throw switch may be used as a COAST/RUN switch. **Each drive is assembled with INHIBIT-RUN terminals 2 and 3 jumpered. These terminals must be connected for the motor to run.** See Figure 19.

American Control Electronics offers an accessory plug harness for connecting to the INHIBIT-RUN terminals: part number KTW-0197 [plug with 18 in. (46 cm) leads].

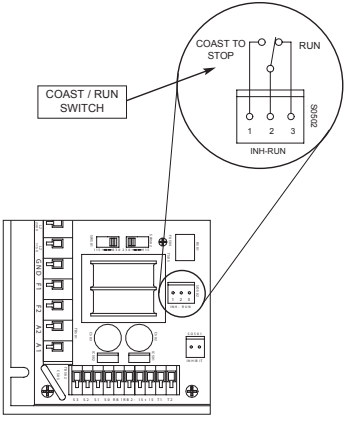


Figure 19. Inhibit-Run Terminal Location and Run/Coast Switch

Section 6. 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.

RGA 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 in unidirectional operation when the speed adjust potentiometer or input voltage signal is set for minimum speed.

To calibrate the MIN SPD:

1. Set the speed adjust potentiometer or input voltage signal for minimum speed.
2. 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 in the forward and reverse direction when the speed adjust potentiometer or input voltage signal is set for maximum speed.

To calibrate MAX SPD:

1. Set the speed adjust potentiometer or input voltage signal for maximum speed.
2. 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.

Note: If using models RGA403-3 or RGA403-10, set the MIN SPD to full CCW and the MAX SPD to full CW. Use the MIN OUT and MAX SPD trim pots located on the top board for minimum and maximum speed calibration. See page 45 for calibration of those trim pots.

Forward Torque (FWD TQ)

FWD TQ 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 FWD TQ setting determines the maximum torque for accelerating and driving the motor in the forward direction. It also sets the maximum torque for decelerating the motor in the reverse direction. To calibrate FWD TQ, refer to the recommended FWD TQ settings in Figure 20 (page 42) 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 FWD TQ trim pot to minimum (full CCW).
3. Set the speed adjust potentiometer or input voltage or current 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 FWD TQ trim pot CW until the armature current is 150% of motor rated armature current.
7. Set the speed adjust potentiometer CCW or decrease the input voltage or current signal to minimum speed.
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.

Reverse Torque (REV TQ)

REV TQ 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 REV TQ setting determines the maximum torque for decelerating the motor in the forward direction. It also sets the maximum torque for accelerating and driving the motor in the reverse direction. To calibrate REV TQ, refer to the recommended REV TQ settings in Figure 20 (page 42) 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 REV TQ trim pot to minimum (full CCW).
3. Set the speed adjust potentiometer or input voltage or current 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 REV TQ trim pot CW until the armature current is 150% of motor rated armature current.
7. Set the speed adjust potentiometer CCW or decrease the input voltage or current signal to minimum speed.
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 or current 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 20 on page 42 for recommended IR COMP settings.

RGA4xx-10 Models

1 HP
90 VDC
10 ADC

3/4 HP
90 VDC
7.6 ADC

1/2 HP
90 VDC
5 ADC

1/4 HP
90 VDC
2.7 ADC

2 HP
180 VDC
9.2 ADC

1 HP
180 VDC
5 ADC

3/4 HP
180 VDC
3.8 ADC

1/2 HP
180 VDC
2.5 ADC

RGA4xx-3 Models

1/8 HP
90 VDC
1.3 ADC

1/10 HP
90 VDC
1.1 ADC

1/20 HP
90 VDC
0.56 ADC

1/4 HP
180 VDC
1.4 ADC

1/8 HP
180 VDC
0.67 ADC

Figure 20. Recommended FWD TQ, REV TQ, and IR COMP settings (actual settings may vary with each application)

Forward Acceleration (FWD ACC)

The FWD ACC setting determines the time the motor takes to ramp to a higher speed in the forward direction or to a lower speed in the reverse direction. See Specifications on page 2 for approximate acceleration times. ACCEL is factory set for the fastest acceleration time (full CCW).

Turn the FWD ACC trim pot CW to increase the foward acceleration time and CCW to decrease the foward acceleration time.

Reverse Acceleration (REV ACC)

The REV ACC setting determines the time the motor takes to ramp to a lower speed in the forward direction or to a higher speed in the reverse direction. See Specifications on page 2 for approximate acceleration times. REV ACC is factory set for the fastest acceleration time (full CCW).

Turn the REV ACC trim pot CW to increase the reverse acceleration time and CCW to decrease the reverse acceleration time

Deadband (DB)

The DB setting determines the time that will elapse between the application of current in one direction before current is applied in the opposite direction.

The DB affects the resistance that a motor has to changes in the shaft position at zero speed. It does this by applying an AC voltage to the motor armature.

The deadband is factory calibrated to approximately 3/4 of a turn position for 60 Hz AC line operation. Recalibrate the trim pot to approximately the 1/4 of a turn position for 50 Hz AC line operation. If you hear motor noise (humming), the deadband might be set too high. Turn the DB trim pot CCW until the motor noise ceases.

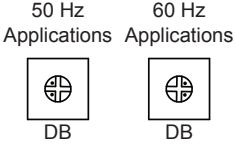


Figure 21. Deadband settings

Tachogenerator (TACH)

Calibrate the TACH setting only when a tachogenerator is used.

The TACH setting, like IR COMP setting, determines the degree to which motor speed is held constant as the motor load changes. To calibrate the TACH trim pot:

1. Connect the tachogenerator to T1 and T2. The polarity is positive (+) for T1 and negative (-) for T2 when the motor is running in the forward direction.
2. Set the feedback select switch SW504 to ARM for armature feedback.
3. Set the speed adjust potentiometer or input voltage or current signal to maximum speed. Measure the armature voltage across A1 and A2 using a voltmeter.
4. Set the speed adjust potentiometer or input voltage or current signal to zero speed.
5. Set SW504 to TACH for tachogenerator feedback.
6. Set the IR COMP trim pot to full CCW.
7. Set the TACH trim pot to full CW.
8. Set the speed adjust potentiometer or input voltage or current signal to maximum speed.
9. Adjust the TACH trim pot until the armature voltage is the same value as the voltage measured in step 3.

Check that the TACH is properly calibrated. The motor should run at the same set speed when SW504 is set to either armature or tachogenerator feedback.

Minimum Speed (MIN OUT), Maximum Speed (MAX OUT) & Signal Input Adjust (RGA403 models)

The following minimum and maximum values should be known.

INmin - Minimum analog input signal.
INmax - Maximum analog input signal.
OUTmin - Minimum analog output signal.
OUTmax - Maximum analog output signal.

INmin and **INmax** is the voltage applied across terminals 7(COM) and 8 (INPUT 1) or 9 (INPUT 2). **OUTmin** and **OUTmax** is the voltage across terminals 1 (OUT 1) and 2 (OUT 2) that connect to the lower board.

Calibration Procedure

1. Ensure that switch SW501 on the top board is properly set. See page 29 for switch settings.

2. Connect (but do not power) the analog input signal as follows.

   - Connect the signal negative (-) to terminal 7 (COM).
   - For a current signal or a 0 - ± 25 VDC voltage signal, connect the signal positive (+) to terminal 8 (INPUT 1).
   - For a 0 - ± 250 VDC voltage signal, connect the signal positive (+) to terminal 9 (INPUT 2).

3. Calibrate the regenerative drive's MIN SPD trim pot full CCW and the MAX SPD trim pot full CW.
4. Apply AC line voltage and the analog input signal.
5. Set the input signal to **INmin**.
6. Adjust the MIN OUT trim pot (P503) so that the output voltage is **OUTmin**.
7. Set the analog input signal to **INmax**.
8. Calculate the test point voltage, V_{tp};

$$V_{tp} = \frac{\textbf{INmax} * m}{2} \quad \text{where} \quad m = \frac{\textbf{OUTmax} - \textbf{OUTmin}}{\textbf{INmax} - \textbf{INmin}}$$

9. Adjust the SIGNAL INPUT ADJ trim pot (P501) so that the voltage between terminals 7 (COM) and 10 (TP) is V_{tp}.
10. Adjust the MAX OUT trim pot (P502) so that the voltage output signal is **OUTmax**.
11. Repeat steps 4, 5, 6, 7, 9, and 10 using the same values.

Section 7.Application Notes

Direction Switch

For a Forward/Reverse switch, use a single-pole, two-position switch with a single speed adjust potentiometer to regeneratively reverse the motor (Figure 22). If a Forward/Stop/Reverse switch is desired, use a single-pole, three-position switch (Figure 23). The MIN SPD setting is in effect for either direction.

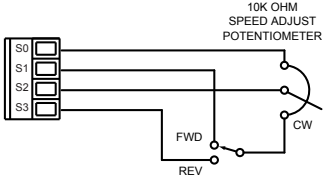


Figure 22. Forward-Reverse Switch

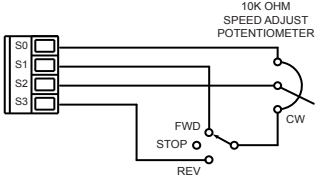


Figure 23. Forward-Stop-Reverse Switch.

Multiple Fixed Speeds

Replace the speed adjust potentiometer with a series of resistors with a total series resistance of 10K ohms (Figure 24). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

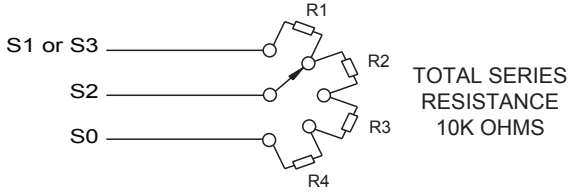


Figure 24. Multiple Fixed Speeds

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 25). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

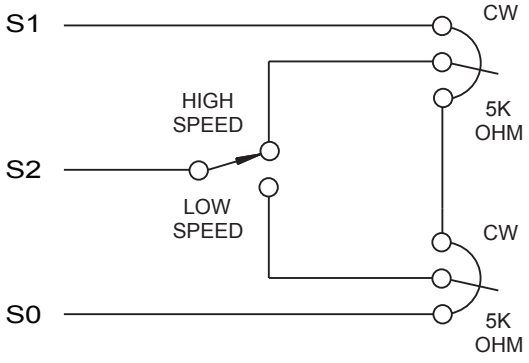


Figure 25. Adjustable Speeds Using Potentiometers In Series

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 26 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

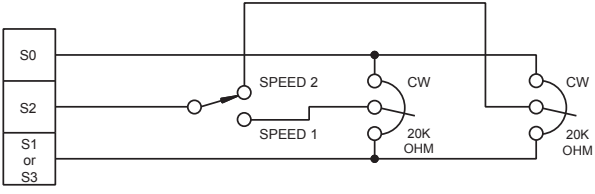


Figure 26. Independent Adjustable Speeds

Independent Adjustable Forward and Reverse 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. Figures 27 and 28 show the connection of two independent forward and reverse speed adjust potentiometers that can be mounted at two separate operating stations.

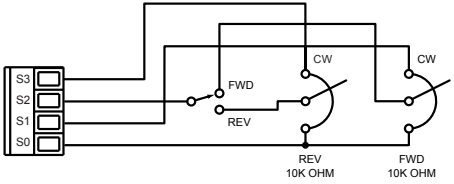


Figure 27. Independent Adjustable Forward and Reverse Speeds

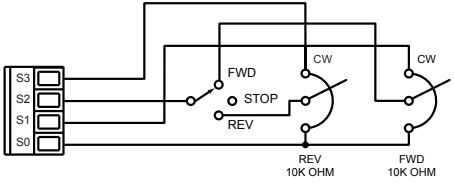


Figure 28. Independent Adjustable Forward and Reverse Speeds with Stop

RUN/JOG Switch - Inhibit Connection

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 terminals as shown in Figure 29. 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.

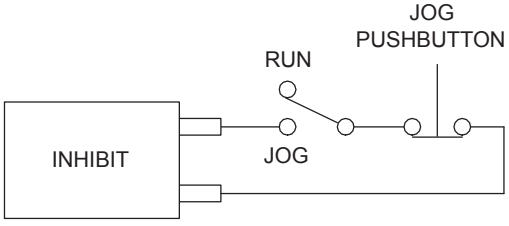


Figure 29. RUN/JOG Switch - Inhibit Connection

RUN/JOG Switch - Potentiometer Connection

Connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 30. When the RUN/JOG switch is set to JOG, the motor decelerates to zero speed. Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

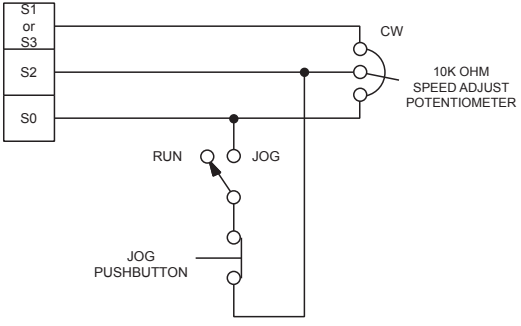


Figure 30. RUN/JOG Switch - Speed Adjust Potentiometer Connection

Leader-Follower Application

In this application, use a ISO202-1 to monitor the speed of the leader motor (Figure 31). 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.

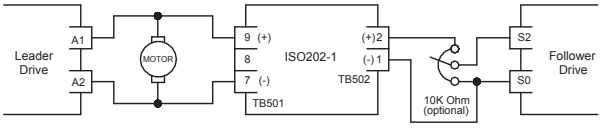


Figure 31. Leader-Follower Application

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 32). Optional ratio potentiometers can be used to scale the ISO101-8 output voltage, allowing independent control of each drive.

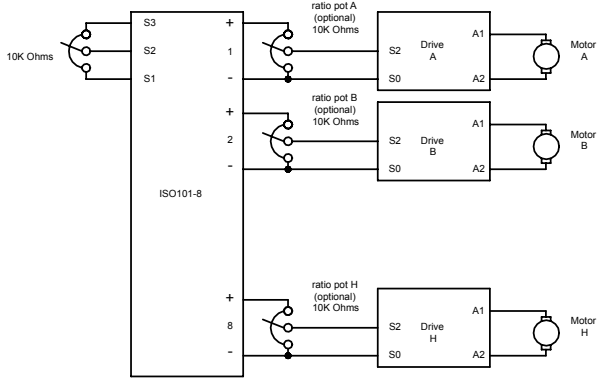


Figure 32. Single Speed Potentiometer Control of Multiple Drives

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 drive's rated armature is consistent with the motor ratings.

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

(800) 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 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 FWD TQ or REV TQ settings, or resize motor and drive for actual load demand, or check for incorrectly aligned mechanical components or "jams". See pages 38 and 39 for information on adjusting the FWD TQ and REV TQ trim pots.
Line fuse does not blow, but the motor does not run.	1. Speed adjust potentiometer or speed reference voltage is set to zero speed.	1. Increase the speed adjust potentiometer setting or speed reference signal.
	2. INHIBIT mode is active.	2. Remove the short from the INHIBIT.
	3. S2 is shorted to S0 or RB1.	3. Remove the short.
	4. Drive is in current limit.	4. Verify that the motor is not jammed. Increase FWD TQ or REV TQ setting if set too low. See pages 39 and 40.
	5. Drive is not receiving AC line voltage.	5. Apply AC line voltage to L1 and L2.
	6. Motor is not connected.	6. Connect the motor to A1 and A2.
	7. Drive is not enabled	7. Make sure jumper SO502 is set to RUN.

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
Motor runs in the opposite direction (non-reversing drives)	1. Motor connections to A1 and A2 are reversed.	1. Reverse connections to A1 and A2.
Motor runs too fast.	1. MAX SPD and MIN SPD are set too high.	1. Calibrate MAX SPD and MIN SPD. See page 38.
	2. Motor field connections are loose.	2. Check motor field connections.
Motor will not reach the desired speed.	1. MAX SPD setting is too low.	1. Increase MAX SPD setting. See page 38.
	2. IR COMP setting is too low.	2. Increase IR COMP setting. See page 41.
	3. Torque setting is too low.	3. Increase FWD TQ or REV TQ setting. See pages 39 and 40.
	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. See page 41.
	2. Motor bouncing in and out of current limit.	2. Make sure motor is not unddersized for load; adjust FWD TQ or REV TQ trim pot CW. See pages 39 and 40.

Section 9. Accessories & Replacement Parts

Displays

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

Heat Sinks

HSK-0001..... HSK-0001

Kits

Potentiometer & Connector
RGA400 Pot KTP-0001
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

Logic Cards

Current Sensing
5 Amps.....CMC100-5
20 amps CMC100-20
Isolation Cards
Adder Board ISO401-1
Unidirectional, 8 outputs.....ISO101-8

Notes

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

The provisions of Paragraph A are American Control Electronics's sole obligation and exclude all other warranties of merchantability for use, expressed or implied. American Control Electronics further disclaims any responsibility whatsoever to the customer or to any other person for injury to the person or damage or loss of property of value caused by any product that has been subject to misuse, negligence, or accident, or misapplied or modified by unauthorized persons or improperly installed.

C. Limitations of Liability

In the event of any claim for breach of any of Americn Control Electronics's obligations, whether expressed or implied, and particularly of any other claim or breach of warranty contained in Paragraph A, or of any other warranties, expressed or implied, or claim of liability that might, despite Paragraph B, be decided against American Control Electronics by lawful authority, American Control Electronics shall under no circumstances be liable for any consequential damages, losses, or expenses arising in connection with the use of, or inability to use, American Control Electronics's product for any purpose whatsoever.

An adjustment made under warranty does not void the warranty, nor does it imply an extension of the original 12-month warranty period. Products serviced and/or parts replaced on a no-charge basis during the warranty period carry the unexpired portion of the original warranty only.

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.

RGA400-3

RGA403-3

RGA440-3

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