RELIANCE ELECTRIC

DC3R Regenerative DC Drive
User Guide
1/4 to 2 HP, 115/230 VAC

Instruction Manual D2-3453

Rockwell Automation

The information in this manual is subject to change without notice.

Throughout this manual, the following notes are used to alert you to safety considerations:

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

IMPORTANT: Identifies information that is critical for successful application and understanding of the product.

ATTENTION: The control circuit is at line potential when the drive is energized. Use a non-metallic screwdriver when making adjustments to the circuit board potentiometers. Exercise extreme caution as hazardous voltage exists. Failure to observe these precautions could result in severe bodily injury of loss of life.

ATTENTION: Only qualified personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, and/or service this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The user is responsible for conforming with all applicable local and national codes. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: It is possible for a drive to run at full speed as a result of a component failure. Please ensure that a master switch has been placed in the AC line to stop the drive in an emergency.

ATTENTION: Reduce the chance of an electrical fire, shock, or explosion by proper grounding, over-current protection, thermal protection and enclosure. Follow sound maintenance procedures.

ATTENTION: Starting and Stopping with the inhibit terminal pins does not disconnect AC power in the stop position; a hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

ATTENTION: This Drive contains ESD (Electric Static Discharge) sensitive parts and assemblies, Static control precautions are required when installing, testing, servicing, or repairing this assembly. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

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Specifications

Model	Max. Armature Current (Amps DC)	HP Range with 115 VAC Applied	HP Range with 230 VAC Applied
DC3R	10.0 †	1/4–1 †	1/2–2 †

† Maximum armature current and horsepower range apply when drive is attached to additional heat sink: Reliance Electric part number DC3R-HS-00. Use heat sink when armature current is above 7 ADC. Heat sinks are pre-mounted on DC3R enclosed drives.

AC Line Voltage	115/230 VAC, ±10%, 50/60 Hz, single phase
Maximum Allowable Symmetrical AC Line Current	5000 A
Maximum AC Line Distribution kVA	
with 115 VAC Input	25 kVA
with 230 VAC Input	50 kVA
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
Maximum Speed Trimpot Adjustment Range (% of rated voltage)	0 - 90%
Minimum Speed Trimpot Adjustment Range (% of rated voltage)	0 - 25%
Forward Torque Maximum Adjustment (% of rated current)	200%
Reverse Torque Maximum Adjustment (% of rated current)	200%
Accel. Time Range (with no load)	0.5 – 6 seconds
Decel. Time Range (with no load)	0.5 – 6 seconds
Analog Input Voltage Range (isolated; S1 to S2)	-10 VDC to +10 VDC
IR Drop Compensation (% of rated armature voltage)	0 to 15%
Input Impedance (S0 to S2)	32K ohms
Maximum Load	150% for 1 minute
Service Factor	1
Speed Range	60:1
Speed Regulation (with 95% load change)	
with Armature Feedback	1% of base speed or better
with Tachogenerator Feedback	0.1% of base speed
Environmental Conditions	
Ambient Temp. Range (chassis drive)	10°C–55°C
Ambient Temp. Range (enclosed drive)	10°C–40°C
Vibration	0.5g max (0 – 50 Hz)
	0.1g max (above 50 Hz)
Elevation	3300 ft (1000m) max without derating*
Atmosphere (non-condensing relative humidity)	0% to 95%

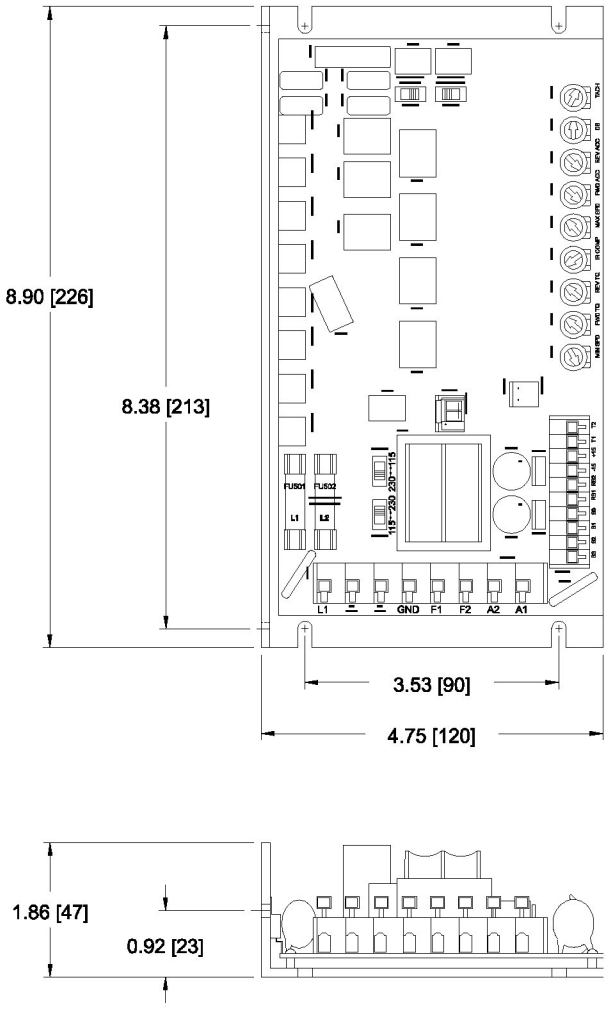
* Derate the current by 1% for every 300-ft. elevation change, up to 10,000 ft (3000m)

Safety Certification	UL Listed Component
	cUL Listed Component
	CE Approved Component

Drive Rating

Motor HP	Rated AC Line Amps	Input KVA	DC Amature Voltage	DC Armature Current	Field Voltage	Field Current
1/4	4.2		90	2.7	50	1
	4.2		100	2.7	100	1
1/3	5.5		90	3.5	50	1
	5.5		100	3.5	100	1
1/2	7.5		90	5	50	1
	3.8		180	2.5	100	1
	3.8		180	2.5	200	1
3/4	10.9		90	7.6	50	1
	5.9		180	3.8	100	1
	5.1		180	3.8	200	1
1	12.1		90	10	50	1
	6.7		180	5	100	1
	6.7		180	5	200	1
1 1/2	--	--	--	--		
	9.8		180	7	100	1
	9.8		180	7	200	1
2	--	--	--	--		
	11.7		180	9.2	100	1
	11.7		180	9.2	200	1

Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. DC3R Chassis Drive Dimensions

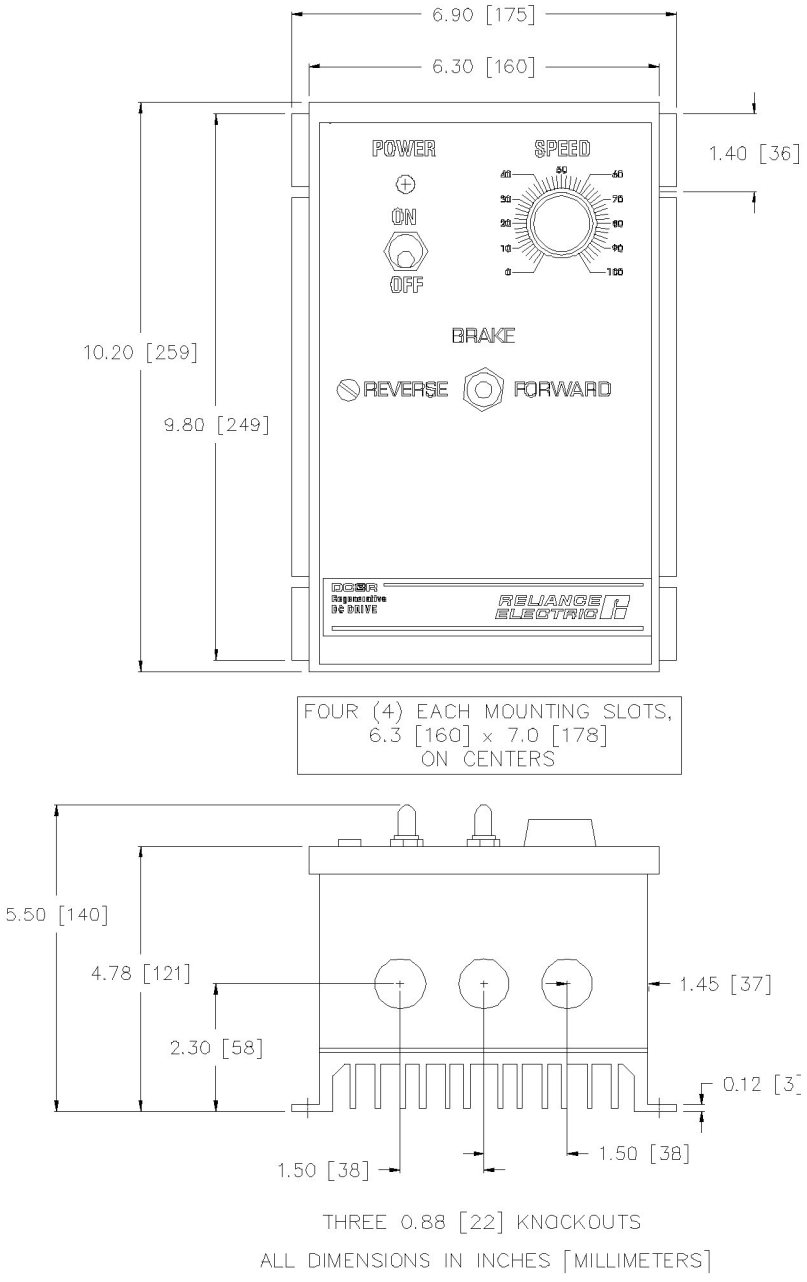


Figure 2. DC3R NEMA 4X Drive Dimensions

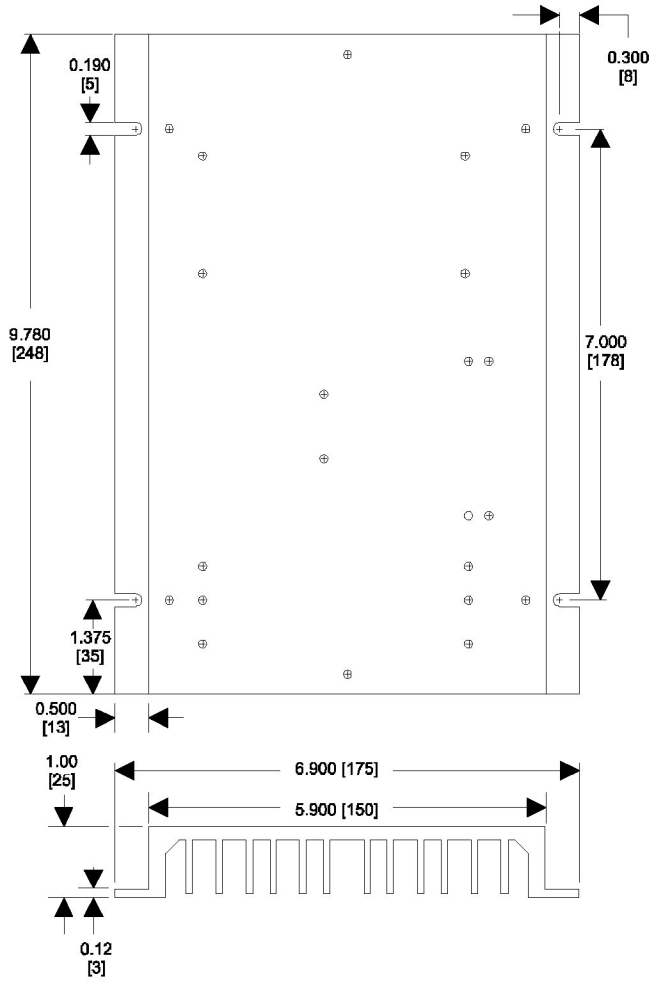


Figure 3. DC3R Heat Sink Dimensions

Installation

ATTENTION: Only qualified technical personnel, familiar with the construction and operation of this equipment and the hazards involved, should install, adjust, operate and/or service this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: This equipment is at line voltage when AC power is connected. Disconnect and lockout all ungrounded conductors of the AC power line before working on the unit. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The user is responsible for conforming with all applicable local and national codes. Failure to observe this precaution could result in severe bodily injury or loss of life.

Wiring

ATTENTION: The control circuit is at line potential when the drive is energized. Use a non-metallic screwdriver when making adjustments to the circuit board potentiometers. Exercise extreme caution as hazardous voltage exists. Failure to observe these precautions could result in severe bodily injury of loss of life.

ATTENTION: 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 may destroy the drive, or cause severe injury or loss of life.

ATTENTION: Installation of a master power switch in the input line is required. This is to disconnect power from the motor. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

ATTENTION: To provide the motor with overload protection, local, national, and international codes (e.g.,NEC/CEC) require that a motor thermostat, internal to the motor, be installed or an electronic thermal motor overload relay, sized to protect the motor, be installed between the motor and the drives output terminals.

Use 18-24 AWG wire for speed adjust potentiometer wiring. Use 14–16 AWG wire for AC line (L1, L2) and motor (A1 and A2) wiring.

Shielding guidelines

ATTENTION: If it is not practical to shield power conductors, Reliance Electric recommends shielding all logic-level leads. If shielding is not practical, use twisted pair control wiring to minimize induced electrical noise.

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

As a general rule, Reliance Electric recommends shielding of all conductors if:

- wire lengths exceed 4 inches and power and logic leads must be bundled together*; or
- radiated and/or conducted noise must be minimized due to sconcerns about immunity or general compliance (CE, FCC, etc.)

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.

*Reliance Electric considers this an unfavorable condition and does not recommend bundling of power and logic leads for any length.

Optional isolation transformer

> **ATTENTION:** Distribution system capacity above the maximum recommended system KVA requires the use of an isolation transformer, a line reactor, or other means of adding similar impedance to the drive power input. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

Input isolation transformers might be needed to help eliminate the following:

- Damaging line voltage transients from reaching the drive.
- Line noise from the drive back to the incoming power source.
- Damaging currents that could develop if a point inside the drive becomes grounded.

Observe the following guidelines when installing an isolation transformer:

- A power disconnecting device must be installed between the power line and primary of the transformer.
- If the power disconnecting device is a circuit breaker, the circuit breaker trip rating must be coordinated with the in-rush current (10-12 times full load current) of the transformer.

Mounting chassis drives

> **ATTENTION:** This drive contains ESD (Electric Static Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing, or repairing this assembly. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

Protect the drive from dirt, moisture, and accidental contact. Provide sufficient room for access to the terminal block and calibration trimpots.

Mount the drive away from other 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 0.188 inch (4.8 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 must be earth grounded for noise suppression. To ground the chassis, connect earth ground to the GND terminal on terminal block 501 (TB501).

Mounting enclosed drives

NEMA 4X enclosed drives come with three 0.88 inch (22 mm) conduit knockout holes at the bottom of the enclosure. The units may be vertically wall mounted using the four 0.25 inch (6 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 enclosure. The right side of the cover is hinged to the enclosure. Lift or pull the slotted screw to open the enclosure.

3. Carefully remove the conduit knockouts by tapping them into the enclosure and twisting them off with pliers.

4. Install conduit hardware through the 0.88 inch (22 mm) conduit holes. Connect external wiring to the terminal block.

5. Grasp the slotted screw and tilt the front cover back into place. Avoid pinching any wires between the front cover and the enclosure.

6. Turn the slotted screw clockwise until tight to secure the front cover.

7. Set the POWER switch to the "0" or OFF position before applying the AC line voltage.

Heat sinking

Chassis DC3R models require an additional heat sink when the continuous armature current is above 7 ADC. Use Reliance® part number DC3R-HS-00. All enclosed drives have sufficient heat sinking in their basic configurations. Use a thermally conductive heat sink compound (such as Dow Corning® 340 Heat Sink compound) between the drive chassis and the heat sink surface for optimum heat transfer.

Cage-clamp terminal block

Connections to the DC3R drive are made to a cage-clamp terminal block (Figure 4). To insert a wire into the terminal block, press down on the lever arm using a small screwdriver. Insert stripped wire into the large opening in front of the terminal block. Release the lever arm to clamp the wire.

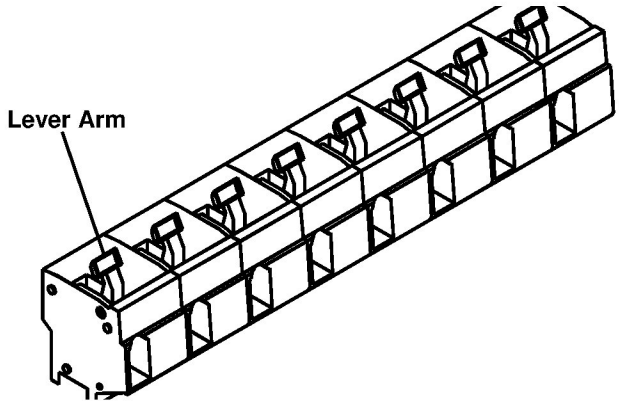


Figure 4. Cage-Clamp Terminal Block

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 1 lists the field output connections.

Table 1. 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

Tachogenerator feedback

> **ATTENTION:** Applying the incorrect polarity to the tachogenerator can cause an overspeed condition. Make sure the positive (+) wire is connected to terminal T1 and the negative (-) wire is connect to terminal T2 when the motor is running in the forward direction. Failure to observe this precaution could result in bodily injury.

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 502 (TB502). The polarity is + for T1 and – for T2 when the motor running in the forward direction. The polarity is reversed when the motor is running in the reverse direction.

Connections

Chassis drive connections

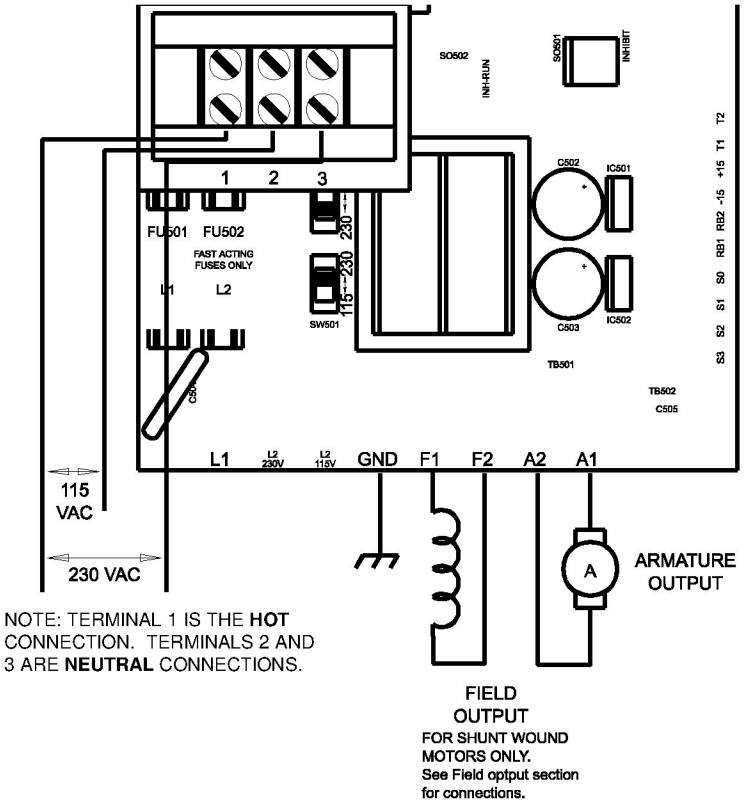


Figure 5. Chassis Drive Connections

Enclosed drive connections

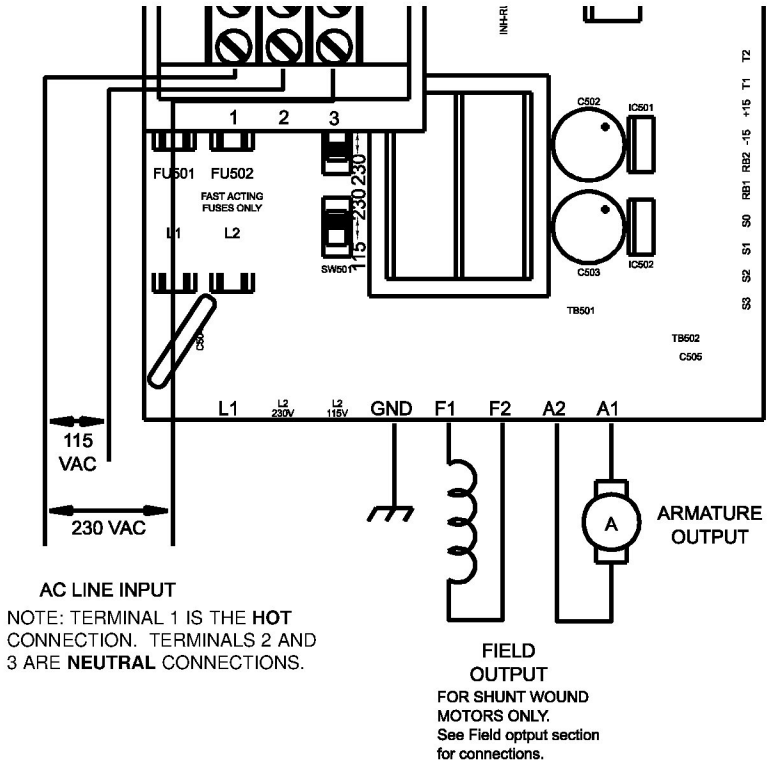


Figure 6. Enclosed Drive Connections

Speed adjust potentiometer installation

ATTENTION: Because the reference potentiometer is connected through the regulator to the armature power circuit, its terminals are at line potential. Use a potentiometer that has a insulating shaft to insulate the operator knob from this power circuit and that is capable of withstanding Hi-pot tests at 2000 Volts DC for one minute. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Be sure that the potentiometer tabs do not make contact with the potentiometer enclosure. Grounding the input will cause damage to the drive.

On chassis drives, install the circular insulating disk between the panel and the 10 Kohm speed adjust potentiometer. Mount the speed adjust potentiometer through a 0.38 in. (0.96 cm) hole with the hardware provided (see Figure 7). Twist the speed adjust potentiometer wire to avoid picking up unwanted electrical noise. If potentiometer leads are longer than 18 in. (46 cm), use shielded cable. Speed adjust potentiometers are installed on all enclosed drives.

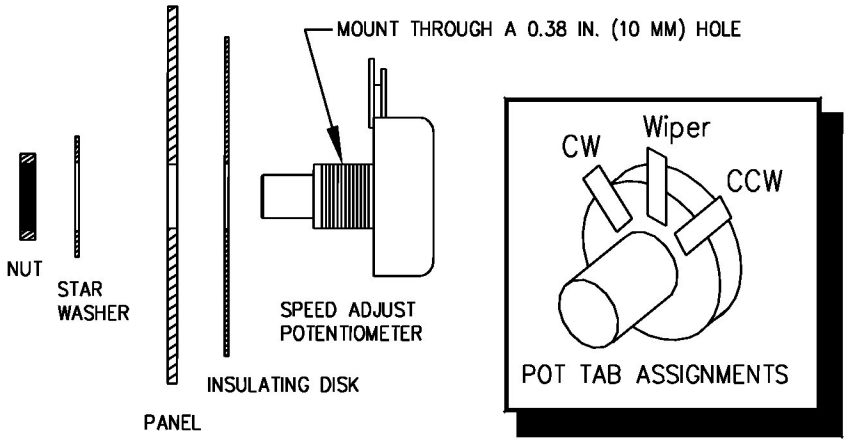


Figure 7. Speed Adjust Potentiometer

Speed adjust potentiometer connections

ATTENTION: At very low input levels, noise or drift could cause analog input polarity to change. This could cause the motor to rotate in the opposite direction. Proper precautions should be taken as this could result in damage to, or destruction of, the equipment.

The motor can operate in one direction (unidirectional) or in two directions (bidirectional) depending on how the speed adjust potentiometer is connected to the drive.

Connect the speed adjust potentiometer as shown in Figure 8(a) for speed control in one direction.

Connect the speed adjust potentiometer as shown in Figure 8(b) for speed control in two directions. The motor does not rotate when the wiper is in the center position. Turning the wiper CW from the center position causes the motor to rotate in one direction, while turning the wiper CCW from the center position causes the motor to rotate in the opposite direction.

Refer to the Application Notes section for additional speed adjust potentiometer connections.

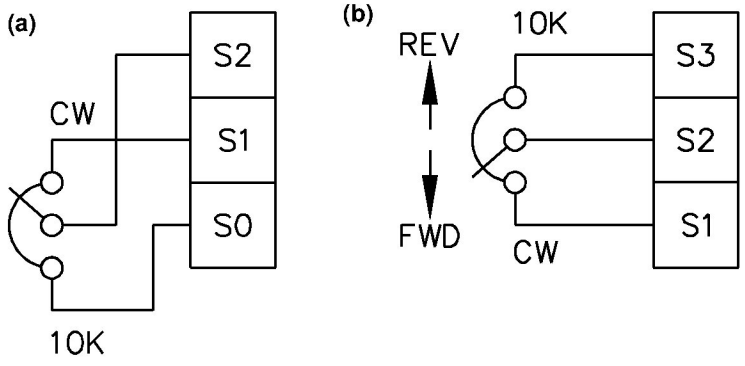


Figure 8. Speed Adjust Potentiometer Connections for (a) Unidirectional Operation, and (b) Bidirectional Operation

+15 and –15 terminals

ATTENTION: The equipment is at line voltage when AC power is connected. Disconnect and lockout all ungrounded conductors of the AC power line. Failure to observe this precaution could result in severe bodily injury or loss of life.

DC3R drives can supply a regulated +15 and –15 VDC signal (each sourcing 25 mA maximum) to isolated, external devices. These voltage supply terminals are located on terminal block 502 (TB502).

IMPORTANT: Do not short +15 and –15 terminals for any reason! Shorting these terminals may damage the drive.

Line Fusing for DC3R Drives

ATTENTION: Most code requires that upstream branch protection be provided to protect input power wiring. Failure to observe this precaution could result in severe bodily injury or loss of life.

DC3R drives require fuses for protection. Use fast acting fuses rated for 250 VAC or higher, and approximately 150% of the maximum armature current. Fuse both L1 and L2 when the line voltage is 230 VAC.

Table 2 lists the recommended line fuse sizes.

Table 2. Fuse Chart

90 VDC Motor Horsepower	180 VDC Horsepower	Max. DC Armature Current (amps)	AC Line Fuse Size (amps)
1/20	1/10	0.5	3
1/15	1/8	0.8	3
1/8	1/4	1.5	5
1/6	1/3	1.7	5
1/4	1/2	2.6	8
1/3	3/4	3.5	8
1/2	1	5.0	10
3/4	1 1/2	7.6	15
1	2	10	20

Install the required, user-supplied branch circuit protection fuses according to the applicable local, national, and international codes (e.g., NEC/CEQ. The fuses must be installed in the line before the drive input terminals.

Voltage follower

The drive may be wired to follow a floating (isolated) 0 to ±10V signal that is isolated from earth ground instead of using a speed adjust potentiometer. Connect the signal input to S2, and the signal common to S0 (see Figure 9).

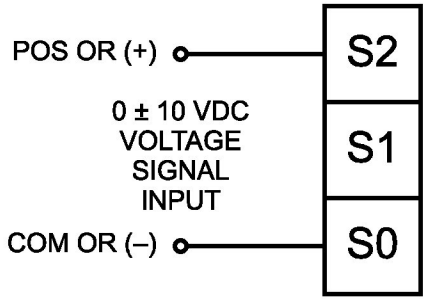


Figure 9. Voltage Follower Connections

Operation

ATTENTION: Only qualified technical personnel, familiar with the construction and operation of this equipment and the hazards involved, should install, adjust, operate and/or service this equipment. Read and understand this instruction manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: This equipment is at line voltage when AC power is connected. Disconnect and lockout all ungrounded conductors of the AC power line before working on the unit. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The user is responsible for conforming with all applicable local and national codes. Failure to observe this precaution could result in severe bodily injury or loss of life.

Before applying power

> ⚠ **ATTENTION:** 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 severe bodily injury or loss of life.

1. Check connections before applying AC line voltage to the drive.

2. Check that no conductive material is present on the printed circuit board.

3. Verify that all selector switches are set correctly (see the following section for selector switch settings). See Figure 10 for all switch locations.

Selector switch settings

> ⚠ **ATTENTION:** Change slide switch settings only when the drive is disconnected from the AC line voltage. Make sure both line voltage and motor 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 transformer damage. If the switches are improperly set to a higher voltage position, the motor will overspeed, which may cause motor damage or severe bodily injury or loss of life.

1. Set the line voltage selector switches (SW501 and SW502) to 115 if using 115 VAC line voltage, or to 230 if using 230 VAC line voltage.

2. Set the armature voltage selector switch (SW503) to 90 if using a 90 VDC motor, or to 180 if using a 180 VDC motor.

3. Set the feedback selector switch (SW504) to TACH if using a tachogenerator; otherwise set it to ARM for armature feedback.

IMPORTANT: You may be required to derate a 90 VDC motor when 230 VAC is applied to the drive. Contact the factory for details.

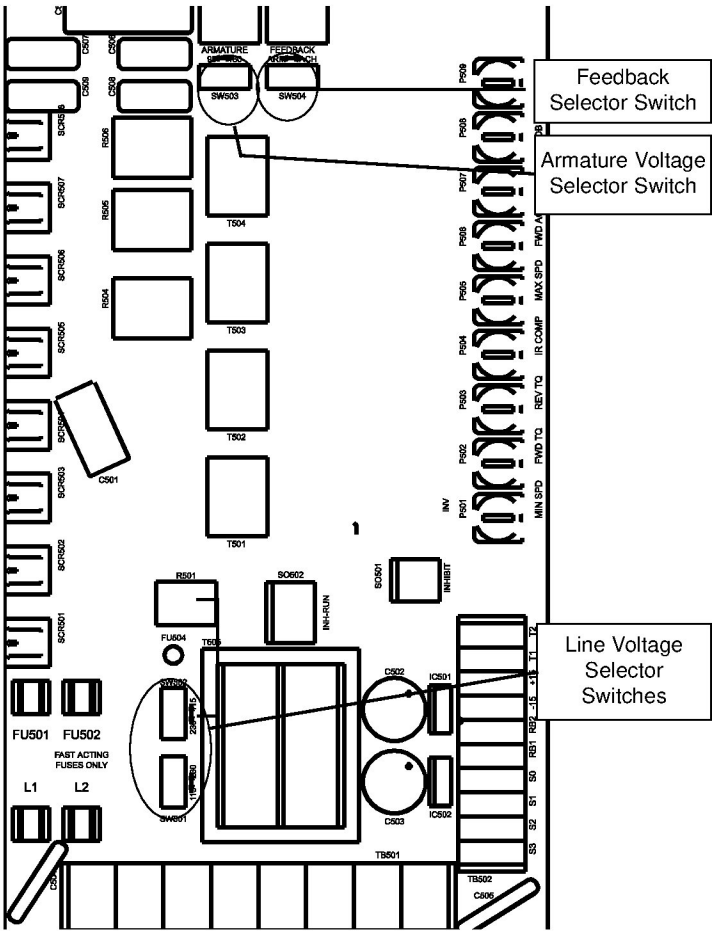


Figure 10. Selector Switch Locations

Startup

Chassis drive

1. Set the speed adjust potentiometer for zero speed.
2. Apply AC line voltage.
3. Slowly advance the speed adjust potentiometer clockwise (CW). The motor slowly accelerates as the potentiometer is turned CW. Continue until the desired speed is reached.
4. Remove AC line voltage from the drive to coast the motor to a stop.

Enclosed drive

1. Set the FORWARD/BRAKE/REVERSE switch to the BRAKE position.
2. Set the speed adjust potentiometer to "0" (full CCW).
3. Apply AC line voltage.
4. Set the POWER switch to the ON position.
5. Set the FORWARD/BRAKE/REVERSE switch to the desired direction of rotation.
7. Slowly advance the speed adjust potentiometer clockwise (CW). The motor slowly accelerates as the potentiometer is turned CW. Continue until the desired speed is reached.
8. To brake the motor, set the FORWARD/BRAKE/REVERSE switch to the BRAKE position. To coast the motor to a stop, set the POWER switch to the OFF position.
9. To reverse direction:
   a. Set the FORWARD/BRAKE/REVERSE switch to the BRAKE position.
   b. After the motor comes to a complete stop, set the FORWARD/BRAKE/REVERSE switch to the desired direction of rotation.
10. Set the POWER switch to OFF to remove power from the drive.

Starting and Stopping Methods

ATTENTION: For frequent starts and stops, use regenerative deceleration (shorting RB1 and RB2), regenerative braking (shorting INHIBIT terminals to each other), coasting to a stop (shorting INHIBIT–RUN terminals 1 and 2), or decelerating to minimum speed (shorting S2 to S0). Do not use any of these methods for emergency stopping. They may not stop a drive that is malfunctioning. Removing AC line power (both L1 and L2) is the only acceptable method for emergency stopping.

ATTENTION: Starting and stopping with the inhibit terminal pins does not disconnect AC power in the stop position. A hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

Line starting and line stopping

Line starting and line 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. When AC line voltage is removed, the motor coasts to a stop.

Automatic restart upon power restoration

All drives automatically run to set speed when power is applied. Wiring a latching relay into the AC line is one way to prevent automatic restarting following a power outage.

Regenerative deceleration

ATTENTION: Starting and stopping with the inhibit terminal pins does not disconnect AC power in the stop position. A hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

ATTENTION: At very low input levels, noise or drift could cause analog input polarity to change. This could cause the motor to rotate in the opposite direction. Proper precautions should be taken as this could result in damage to, or destruction of, the equipment.

Short terminals RB1 and RB2 to regeneratively decelerate a motor to a stop (Figure 11). Since terminal RB1 bypasses the MIN SPD circuit, shorting RB1 and RB2 will decelerate a motor to a stop instead of minimum speed. Calibrate the deceleration time by adjusting the opposite-direction acceleration trimpot.

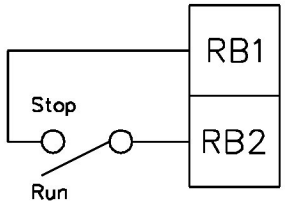


Figure 11. Regenerative Deceleration Switch Connection

Regenerative braking using the INHIBIT circuit

> **ATTENTION:** Starting and stopping with the inhibit terminal pins does not disconnect AC power in the stop position. A hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

Short the INHIBIT terminals to regeneratively brake the motor (see Figure 12 for INHIBIT terminal location). Reopening the INHIBIT terminals causes the motor to accelerate to set speed.

The INHIBIT terminals bypass both the MIN SPD circuit and the deceleration circuit. This causes the motor to stop rapidly when the INHIBIT terminals are shorted. Braking torque is determined by the opposite-direction torque setting.

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 in. (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.

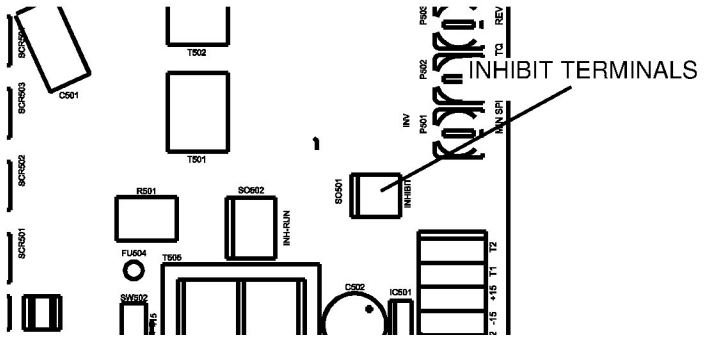


Figure 12. Inhibit Terminals

Coast to a stop using the INHIBIT circuit

ATTENTION: Starting and stopping with the inhibit terminal pins does not disconnect AC power in the stop position. A hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

To coast the motor to a stop without removing power to the drive, jumper INHIBIT–RUN terminals 1 and 2 (Figure 13). To restart the motor, jumper INHIBIT–RUN terminals 2 and 3. A single-throw, double-pole switch may be used as a COAST/RUN switch.

IMPORTANT: Each drive is assembled with INHIBIT–RUN terminals 2 and 3 jumpered. These terminals must be connected for the motor to run.

Certain Reliance Electric drives (regenerative and non-regenerative) coast to minimum speed when the inhibit terminals are shorted to each other. IR COMP and CURRENT LIMIT (FWD TQ and REV TQ on regenerative drives) are still active while the drive is in the inhibit mode.

Frequent regenerative deceleration, regenerative braking, coasting to a stop, or decelerating to minimum speed produces high torque. This may cause damage to motors, especially gearmotors that are not properly sized for the application.

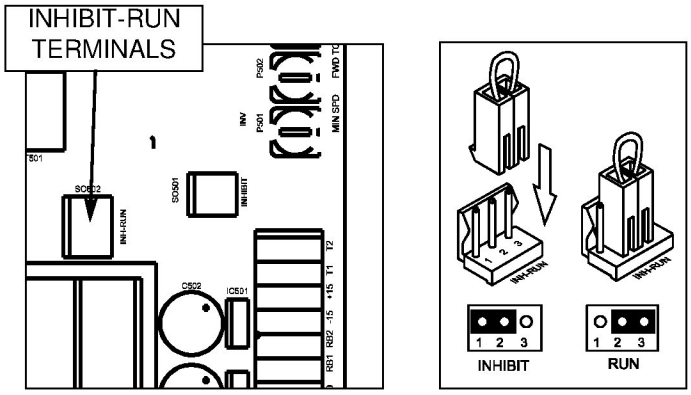


Figure 13. INHIBIT-RUN Terminals

Decelerate to minimum speed

ATTENTION: Starting and stopping with the inhibit terminal pins does not disconnect AC power in the stop position. A hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

The circuit shown in Figure 14 may be used to decelerate a motor to a minimum speed. Closing the switch between S2 and S0 decelerates the motor from set speed to a 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 S2 and S0 is closed. The DECEL trimpot setting determines the rate at which the drive decelerates. Set the switch to the RUN position to accelerate the motor to set speed at a rate determined by the ACCEL trimpot setting.

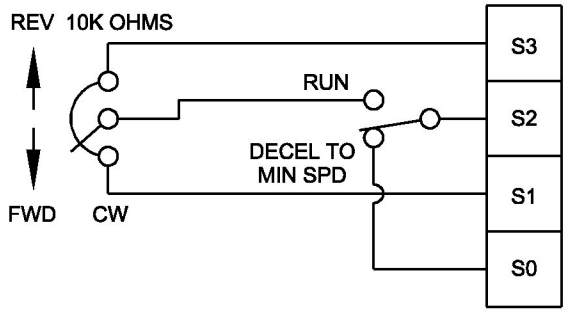


Figure 14. Run/Decelerate to Minimum Speed Switch (shown with bidirectional speed adjust potentiometer connection)

Calibration

ATTENTION: The following adjustments are made with power on. Exercise extreme caution as hazardous voltage exists. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The control circuit is at line potential when the drive is energized. Use a non-metallic screwdriver when making adjustments to the circuit board potentiometers. Exercise extreme caution as hazardous voltage exists. Failure to observe these precautions could result in severe bodily injury or loss of life.

Each drive is factory calibrated to its maximum horsepower rating. Readjust the calibration trimpot settings to accommodate lower horsepower 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.

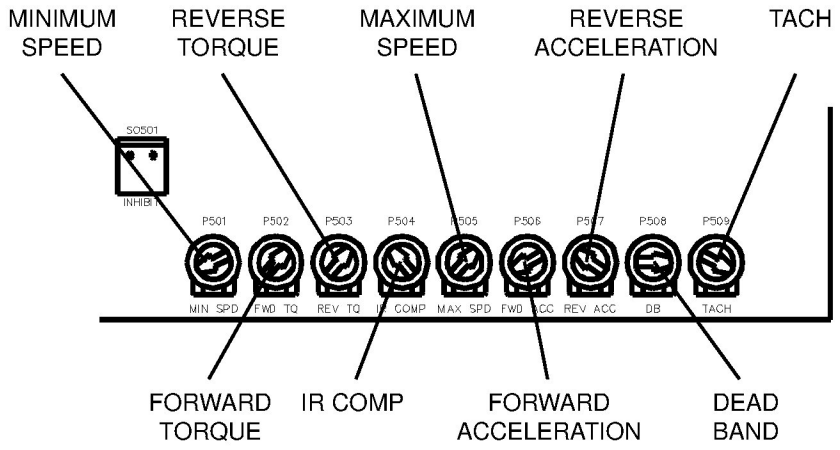


Figure 15. Calibration Trimpot Layout

MIN SPD

ATTENTION: The DC3 Drive is intended to operate at a predetermined minimum speed. If the application requires zero speed operation, the user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

ATTENTION: At very low input levels, noise or drift could cause analog input polarity to change. This could cause the motor to rotate in the opposite direction. Proper precautions should be taken as this could result in damage to, or destruction of, the equipment.

The MIN SPD setting determines the minimum speed when the speed adjust potentiometer is turned full CCW. It is factory set to zero speed.

IMPORTANT: The minimum speed feature applies only when the drive is operating in unidirectional mode.

To calibrate, set the speed adjust potentiometer full CCW. Adjust the MIN SPD trimpot until the motor turns at the desired minimum speed.

MAX SPD

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

To calibrate, set the speed adjust potentiometer full CW. Adjust the MAX SPD trimpot until the motor turns at the desired maximum speed.

FWD TQ

ATTENTION: Although FWD TQ is set to exceed the motor nameplate current rating, continuous operation beyond that rating may damage the motor.

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. FWD TQ is factory set at 120% of rated motor current.

If the time it takes to accelerate a load is too long due to the forward torque setting, increase the forward torque setting to 130% of rated motor current. The decision to change the forward torque setting must be made after considering the gearbox and drivetrain ratings, duty cycle, and motor characteristics. See Figure 16 for typical FWD TQ settings.

REV TQ

ATTENTION: Although REV TQ is set to exceed the motor nameplate current rating, continuous operation beyond that rating may damage the motor.

The REV TQ setting determines the maximum torque for accelerating and driving the motor in the reverse direction. It also sets the maximum torque for decelerating in the forward direction. REV TQ is factory set at 120% of rated motor current.

If the time it takes to accelerate a load is too long due to the reverse torque setting, increase the reverse torque setting to 130% of rated motor current. The decision to change the reverse torque setting must be made after considering the gearbox and drivetrain ratings, duty cycle, and motor characteristics. See Figure 16 for typical REV TQ settings.

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. See Figure 19 for typical IR COMP settings, 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 (CW). Turn the IR COMP trimpot CCW until the drive stabilizes.

FWD ACC

The FWD ACC setting determines the time the motor takes to ramp to either a higher speed in the forward direction or a lower speed in the reverse direction, within the limits of available torque. The FWD ACC setting is factory set for its fastest forward acceleration time.

Turn the FWD ACC trimpot CW to increase the forward acceleration time, and CCW to decrease the forward acceleration time.

REV ACC

The REV ACC setting determines the time the motor takes to ramp to either a higher speed in the reverse direction or a lower speed in the forward direction, within the limits of available torque. The REV ACC setting is factory set for its fastest reverse acceleration time.

Turn the REV ACC trimpot CW to increase the reverse acceleration time, and CCW to decrease the reverse acceleration time.

DB (Range)

The deadband trimmer potentiometer determines the time that will elapse between the application of current in one direction before current is applied in the opposite direction.

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

Deadband is factory calibrated to approximately the 3 o'clock position for 60 Hz AC line operation. Recalibrate the deadband to the 9 o'clock position for 50 Hz AC line operation. See Figure 17 for recommended deadband settings.

TACH

> **ATTENTION:** Applying the incorrect polarity to the tachogenerator can cause an overspeed condition. Make sure the positive (+) wire is connected to terminal T1 and the negative (-) wire is connect to terminal T2 when the motor is running in the forward direction. Failure to observe this precaution could result in bodily injury.

Calibrate the TACH setting only when a tachogenerator is used. The TACH setting, like the IR COMP setting, determines the degree to which motor speed is held constant as the motor load changes.

To calibrate the TACH trimpot:

1. Disconnect power from drive.
2. Connect the tachogenerator to T1 and T2. The polarity is + for T1 and – for T2 when the motor running in the forward direction.
3. Set switch 504 (SW504) to ARM for armature feedback.
4. Apply power to drive.
5. Set the speed adjust potentiometer full CW. Measure the armature voltage across A1 and A2 using a voltmeter.
6. Set the speed adjust potentiometer to 0 (zero speed).
7. Disconnect power from drive.
8. Set SW504 to TACH for tachogenerator feedback.
9. Set the IR COMP trimpot full CCW.
10. Set the TACH trimpot full CW.
11. Apply power to drive.
12. Set the speed adjust potentiometer full CW.
13. Adjust the TACH trimpot until the armature voltage is the same value as the voltage measured in step 5.

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

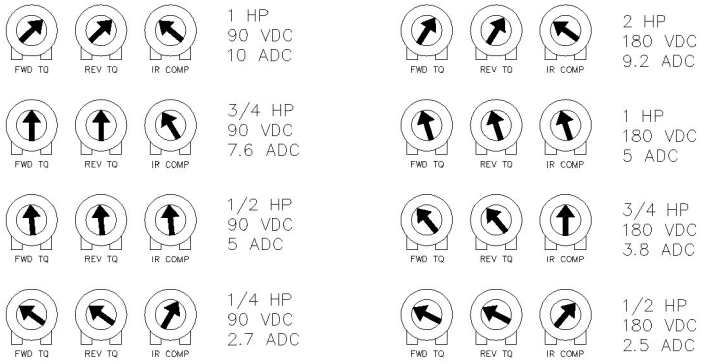


Figure 16. Typical FWD TQ, REV TQ, and IR COMP Settings (actual settings may vary with each application)

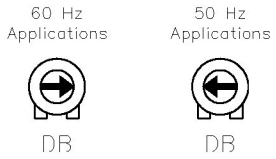


Figure 17. Deadband Settings

Application Notes

ATTENTION: The equipment is at line voltage when AC power is connected. Disconnect and lockout all ungrounded conductors of the AC power line. Failure to observe this precaution could result in severe bodily injury or loss of life.

Optional speed adjust potentiometer connections

ATTENTION: At very low input levels, noise or drift could cause analog input polarity to change. This could cause the motor to rotate in the opposite direction. Proper precautions should be taken as this could result in damage to, or destruction of, the equipment.

FWD-REV switch

Use a single-pole, two-position switch with a single speed adjust potentiometer to plug reverse the motor (Figure 18). The MIN SPD setting is in effect for either direction.

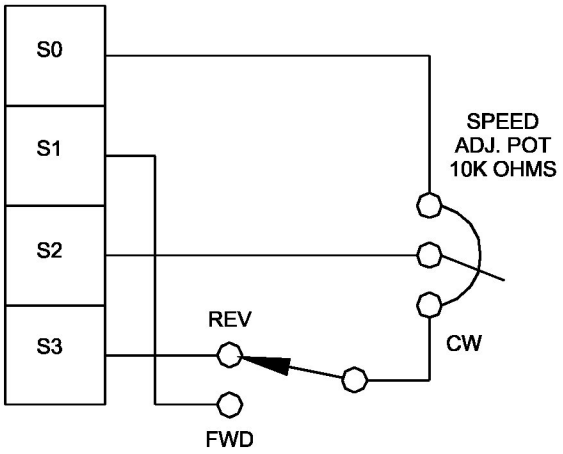


Figure 18. Forward-Reverse Switch

FWD-STOP-REV switch

ATTENTION: Starting and stopping with the inhibit terminal pins does not disconnect AC power in the stop position. A hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

Use a single-pole, three-position switch with a single speed adjust potentiometer to stop a motor between reversals (Figure 19). Set the switch to the center position to decelerate the motor to a stop.

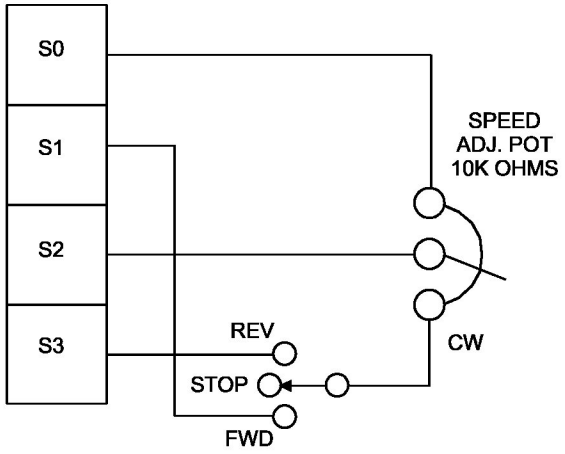


Figure 19. Forward-Stop-Reverse Switch

Independent adjustable speeds

Connect two speed adjust potentiometers with a single-pole two-position switch to select between two independent speeds shown in the forward direction (Figure 20). The speed adjust potentiometers can be mounted at two separate operating stations.

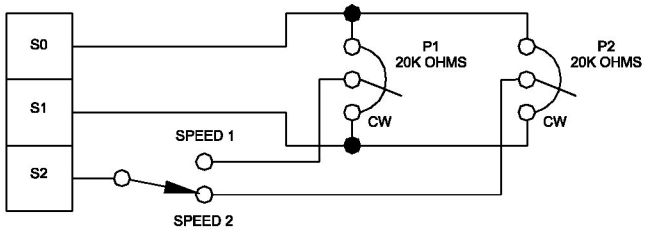


Figure 20. Independent Adjustable Speeds (Forward Direction)

Independent forward and reverse speeds

ATTENTION: At very low input levels, noise or drift could cause analog input polarity to change. This could cause the motor to rotate in the opposite direction. Proper precautions should be taken as this could result in damage to, or destruction of, the equipment.

Connect two speed adjust potentiometers as shown in Figure 21 to select between independent forward and reverse speeds.

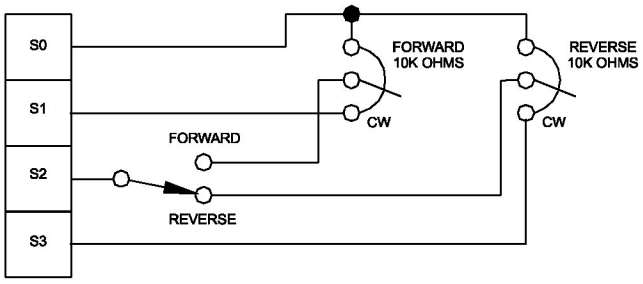


Figure 21. Independent Forward and Reverse Speeds

Independent Forward and Reverse Speeds with a Forward-Stop-Reverse Switch

ATTENTION: Starting and stopping with the inhibit terminal pins does not disconnect AC power in the stop position. A hardwired AC power disconnection switch must be mounted in close proximity to the operator's start/stop controls. This is required, as the DC3 drive does not have an armature loop contactor. A single fault like a power device short may cause motor rotation when in the stop mode. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audio or visual alarms, or other devices. Failure to observe these precautions could result in bodily injury.

Use a single-pole, three-position switch to stop the motor when the switch is in the center position (Figure 22).

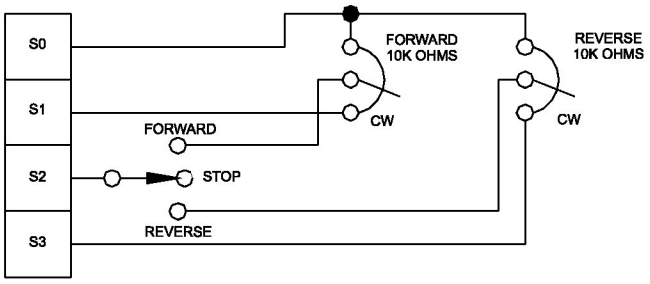


Figure 22. Independent Forward and Reverse Speeds with a Forward-Stop-Reverse Switch

Troubleshooting

ATTENTION: This equipment is at line voltage when AC power is applied. Disconnect and lockout all ungrounded conductors of the AC power line before working on the unit, Failure to observe this precaution may result in severe bodily injury or loss of life.

Check the following before proceeding:

- The AC line voltage must match the voltage on the drive nameplate.
- On dual voltage drives, check that the voltage switches are set to the correct position.
- The deadband (DB) must be set approximately at the 3 o'clock position for 60 Hz AC line frequency or at 9 o'clock for 50 Hz AC line frequency.
- The motor must be rated for the drive's rated armature (all motors) and field outputs (shunt wound motors only).
- Do not make any connections to F1 and F2 if using a permanent magnet motor.
- Terminal block connections should be consistent with the connections shown in this manual.
- Check that line fuse FU501 (and FU502 for 230 VAC line voltage) is properly sized and not blown.

Line fuse blows

1. Disconnect AC line voltage from the drive.
2. Check that the motor cable and armature is not shorted or grounded.
   a. Armature resistance should measure approximately 1 to 100 ohms, depending on motor horsepower.
   b. A resistance reading from the motor frame to either armature side should show open when an ohmmeter is used on its high resistance scale.
3. Check that the field circuit is not open.
4. A combination of ambient conditions and frequent high-current spikes (i.e. reversing) causes fuse to "nuisance trip". Consider using a slow-blow fuse, or over-rating the fuse 120%

Motor pulsates or surges under load

Readjust the IR COMP setting slightly CCW until the motor speed is stabilized.

Line fuse does not blow, but the motor does not run

1. Verify that the speed adjust potentiometer is not set to its zero speed position.
2. Check the speed adjust potentiometer for continuity.
3. Verify that the inhibit pins are not shorted together.
4. Check that INHIBIT–RUN terminals 2 and 3 are connected.
5. Verify that the drive is receiving AC line voltage.
6. Check that the drive is not in current limit. If the drive is in current limit, verify that the motor is not jammed. It may be necessary to increase the FWD TQ or REV TQ setting if it is set lower than the current rating of the motor.
7. Check that the speed adjust potentiometer connections to the terminal block are correct and not open.

Motor runs too fast at the maximum speed setting

1. Check that the MIN SPD and MAX SPD setting is not set too high.
2. Check that the field output connections are secure if you are using a shunt wound motor.

Motor will not reach the desired speed

> **ATTENTION:** The control circuit is at line potential when the drive is energized. Use a non-metallic screwdriver when making adjustments to the circuit board potentiometers. Exercise extreme caution as hazardous voltage exists. Failure to observe these precautions could result in severe bodily injury of loss of life.

1. Check the MAX SPD setting and increase if necessary.
2. Check that the IR COMP setting is not set too low.
3. Check that the motor is not overloaded.

Prewired Connections for Enclosed Drive

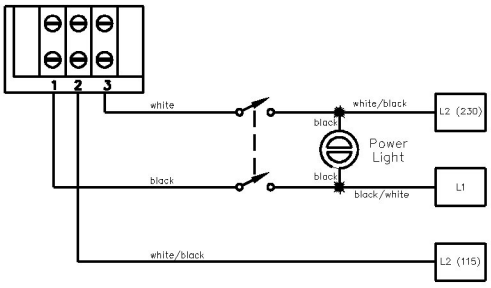


Figure 23. Prewired Connections to L1, L2(115) and L2(230)

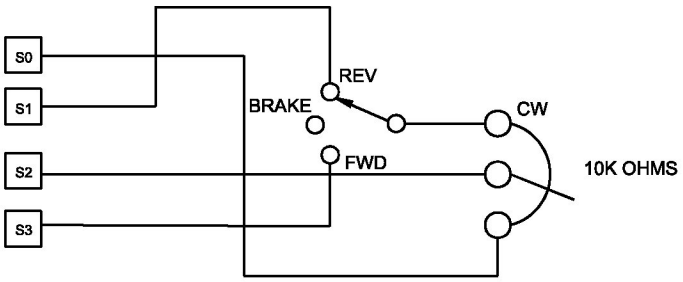


Figure 24. Prewired Speed Adjust Potentiometer Connections for Enclosed Drives

Regenerative Drives

Most non-regenerative, variable speed, DC drives control current flow to a motor in one direction. The direction of torque is the same direction as the motor rotation. Non-regenerative drives operate in Quadrant 1, and also in Quadrant 3 if the drive is reversible (see Figure 25). Motors must stop before reversing direction. Unless dynamic braking is used, non-regenerative drives cannot oppose an overhauling load, and cannot decelerate a load faster than coasting to a lower speed.

Regenerative drives operate in two additional quadrants: Quadrant 2 and Quadrant 4. In these quadrants, motor torque is in the opposite direction of motor rotation.

Regenerative drives can reverse a motor without contactors, switches, brake resistors, and inhibit plugs. They can also control an overhauling load and decelerate a load faster than it would take to coast to a lower speed.

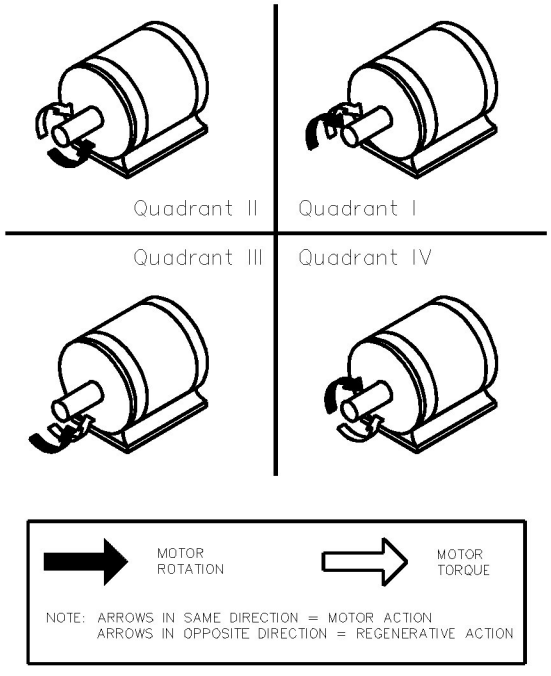


Figure 25. Four Quadrant Operation

CE Compliance

Reliance Electric hereby certifies that its DC3 series drives have been approved to bear the "CE" mark provided the conditions of approval (listed in Exhibit "A") have been met by the end user.

The DC3 series has been tested to the following test specifications:
EN55011:1991 (emissions), and
EN50082-1:1992 (immunity)

Compliance allows Reliance Electric's DC3 series to bear the CE mark.

The end user, as described herein, falls into one of two categories:

1. The Consumer will deploy a stand-alone unit as an integral, yet external, portion of the machine he/she is operating.

2. The Original Equipment Manufacturer (OEM) will implement the product as a component of the machine being manufactured.

Exhibit "A": Line Filters

In addition to EMI/RFI safeguards inherent in the DC3 series' design, external filtering is required.

Reliance Electric requires the Corcom® filters listed in Table 3. If the exact filter is not available, the specifications are as follows:

L = 1.8 milliHenries.
C = 0.01 microFarad (Line to Ground); 1.1 microFarads (Line to Line).
Discharge Resistor = 330Kohms.
Rated current: 1.4 times maximum DC motor current.
Filter type: Balanced 2-section.

Table 3. Corcom® Filters

Nameplate Current of Motor Wired to the Drive	Corcom® Filter Part Number
0 to 4 amps	6VV1
4.1 to 13 amps	20VV1

The filters in Table 3 should be wired to the AC line within 0.25 meters of the drive. The ground connection from the filter must be wired to solid earth ground (resistance less than 500 ohms); not machine ground. This is very important!

Armature Filters

If the end-user is using a CE-approved motor, the correct filter from Table 3 is all that is necessary to meet the EMC directives listed herein.

If the end-user is not using a CE-approved motor, a Reliance Electric CEXXRG filter must be deployed on the output. XX is the rated current on the filter

The CE20RG is a Real-Pole Balanced-Pi 3-pole filter. If the exact filter is not available, the specifications are as follows:

L & L1 = 2 * (0.8) milliHenries.
C & C1 = 2 * (0.1) microFarads @ 400W VDC.
Rin = 0.1 ohm; Rout = 1.2 ohm.

Table 4. Armature Filters

Nameplate Current of Motor Wired to the Drive	Reliance® Filter Part Number
0 to 4 amps	CE4RG
4.1 to 13 amps	CE20RG

The filters in Table 2 must be wired to the DC output of the drive, as close to the drive as possible. The ground connection from the filter must be wired to solid earth ground (resistance less than 500 ohms); not machine ground. This is very important!

The end user must use the filtration listed in Exhibit A to comply with CE. The OEM may choose to provide alternative filtering that encompasses the Reliance drive and other electronics within the same panel.

The OEM has this liberty because CE is a machinery directive. Whether or not every component in the OEM's machinery meets CE, the OEM must still submit his machine for CE approval. Thus, no component must necessarily meet CE within the machine, as long as the OEM takes the necessary steps to guarantee the machine does meet CE. By the same token, even if every component in the OEM's machine does meet CE, the machine will not necessarily meet CE as a machine.

Using CE-approved wiring practices (like proper shielding) and the filters listed in Exhibit A guarantee the drive will meet EN55011 (1991 emissions standard) and EN50082-1 (1992 immunity standard).

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