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Installing and Operating Reliance Electric DC-1 V★S Drives



Instruction Manual D2-3078
June, 1985

RELIANCE ELECTRIC

DESCRIPTION

The Reliance® DC-1 V★S® Drive consists of a solid state controller which converts single-phase A-C line power to adjustable D-C power for adjustable speed armature control of shunt wound and permanent magnet D-C motors rated from ¼ thru 2 horsepower. Reliance DC-1 controllers are compatible with all permanent magnet and wound field Reliance D-C motors and are specifically performance matched to Reliance DC-1 machines.

Controller

The Reliance DC-1 controller is available, housed in its own NEMA/UL Type 12K enclosure, either with or without appropriate operator's devices mounted and wired to the enclosure cover. The DC-1 controller is also available in an open chassis configuration intended for mounting within an electrical enclosure provided either by the machine builder or the final user. Refer to Table 1 for controller configurations.

D-C Motor

The DC-1 controller is compatible with all ¼ thru 2 horsepower permanent magnet or wound field D-C motors with compatible armature (and field) voltages. It will operate all Reliance D-C motors in this horsepower range and has been specifically performance matched to the Reliance DC-1 permanent magnet motor to provide the most compact and economical controller/motor package.

DRIVE FEATURES

The standard controller models provide enclosure and feature selection to match many application requirements. Refer to Table 1. The following basic features are common to DC-1 controller Models DC1-1 thru DC1-12.

Basic Features of All DC-1 Controllers

- Jumper calibration for operation of motors from ¼ thru 1 hp at 90-volt D-C armature (115-volt single-phase A-C input) and from ½ thru 2 hp at 180-volt D-C armature (230-volt single-phase A-C input).
- Jumper reconnectable for operation from either 115-volt A-C or 230-volt A-C single-phase power.

Table 1. Controller model by controller configuration and features.

Controller Features	Open Chassis without Operator's Devices	NEMA 12 Enclosed without Operator's Devices	NEMA 12 Enclosed with Operator's Devices
Basic Features	DC1-1	DC1-2	DC1-3
Basic + Dynamic Braking and Switch Reversing	N/A	N/A	DC1-6①
Basic + Isolated Process Interface	DC1-7	DC1-8	DC1-9
Basic with Torque Regulation	DC1-10	DC1-11	DC1-12

① See Table 4 for braking capabilities.

- Run/stop control.
- Provisions for use of remote start and/or stop control.
- Operable without modification on either 50 or 60 Hertz power.
- Full-wave, half-controlled armature rectifier with back diode for improved form factor.
- Half-wave field supply for shunt field excitation of shunt wound D-C motors.
- Short circuit protection by means of incoming line fuse.
- Line transient protection by means of metal oxide varistor.
- Unidirectional operation with coast-to-rest on stop.
- Motor overload protection by means of internal motor thermostat.

Additional Features Available

MODELS DC1-1 THRU DC1-6

- Motor speed adjustment by potentiometer.
- Fixed rate acceleration.
- Adjustable current limit.
- Independently adjustable maximum and minimum speeds by separate potentiometers.
- Jumper reconnectable to allow absolute zero minimum speed, if application requires.
- Jumper reconnectable for armature voltage (90 VDC or 180 VDC) or tachometer feedback regulation.
- Adjustable IR drop compensation.

DYNAMIC BRAKING AND SWITCH REVERSING MODEL DC1-6

- Direction of rotation by a forward/off/reverse selector switch; OFF position applies dynamic braking (braking capabilities listed in Table 4).
- Selector switch has detent feature which requires release of pressure on the switch itself when passing from forward to reverse. When combined with dynamic braking action, this feature minimizes the possibility of plug reversing the motor.

CAUTION: The drive must be at zero speed before changing direction of rotation. Failure to observe this precaution could result in damage to the motor or the controller.

ISOLATED PROCESS INTERFACE MODELS DC1-7 THRU DC1-9

- Motor speed adjustment by potentiometer (manual mode) or process controller output signal (automatic mode).
- Manual/automatic mode switching by means of selector switch.
- Jumper reconnectable to accept 1 to 5 mA, 4 to 20 mA, 10 to 50 mA, or 0 to 10 VDC reference signal (grounded) in automatic mode.
- Fixed rate acceleration.
- Adjustable current limit.
- Independently adjustable maximum and minimum speeds in manual mode by separate potentiometers.
- Jumper reconnectable to allow absolute zero minimum speed, if application requires.
- Jumper reconnectable for armature voltage (90 VDC or 180 VDC) or tachometer feedback regulation.
- Adjustable IR drop compensation.

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TORQUE REGULATION MODELS DC1-10 THRU DC1-12

- Motor torque adjustment by potentiometer.
- Fixed rate reference timing.
- Independently adjustable minimum and maximum torque by separate potentiometers.
- Adjustable speed limit.
- Jumper reconnectable to allow absolute zero minimum torque, if application requires.
- Jumper reconnectable to provide speed limit by armature voltage (90 VDC or 180 VDC) or by tachometer feedback.

CONTROLLER SPECIFICATIONS

Ratings

- Service Factor: 1.0
- Continuous Duty
- Overload capacity: 150% for 1 minute, 250% for 1 second
- Maximum allowable symmetrical A-C line fault current: 5000 amperes
- For all other drive ratings, see Table 2.
- Controller incoming line fuse: 20 amperes, 250 volts, Type ABC, Ceramic

A-C Line Requirements

- Maximum allowable symmetrical short circuit current: 5,000 amperes
- Maximum branch circuit transformer size immediately upstream of drive: 40 KVA
- Branch circuit fuse size:

¼ hp, 115 VAC:	10A
⅓ and ½ hp, 115 VAC:	15A
½, ¾, and 1 hp, 230 VAC:	15A
¾ hp, 115 VAC:	20A
1½ hp, 230 VAC:	20A
1 hp, 115 VAC:	25A
2 hp, 230 VAC:	25A

CAUTION: Fuse must be one-time, Class K5. The use of dual element, slow blow, Class K5 fuse could damage controller.

Table 2. Controller ratings by motor horsepower.

Motor HP	115-Volt A-C Input / 230-Volt A-C Input					
	Rated A-C Line Amperes①	Input KVA	D-C Armature Voltage	Rated Armature Current (Amperes)	Available Field Voltage	Available Field Current (Amperes)
¼	3.5	.75	90	2.5	50	2.0
	—	—	—	—	—	—
⅓	5.2	.75	90	3.7	50	2.0
	—	—	—	—	—	—
½	7.0	1.0	90	5.0	50	2.0
	3.5	1.0	180	2.5	100	1.0
¾	10.5	1.5	90	7.5	50	2.0
	5.2	1.5	180	3.7	100	1.0
1	14.0	2.0	90	10.0	50	2.0
	7.0	2.0	180	5.0	100	1.0
1½	—	—	—	—	—	—
	10.5	3.0	180	7.5	100	1.0
2	—	—	—	—	—	—
	14.0	5.0	180	10.0	100	1.0

① Does not include current required by motor field where used.

Operating Conditions

- Line voltage variations: ±10% of rated
- Line frequency: 48 to 62 Hertz
- Ambient temperature: 0° C to 40° C (32° F to 104° F) for NEMA/UL Type 12K enclosed models and 0° C to 55° C (32° F to 131° F) for open chassis models
- Altitude: 3300 feet (1000 meters) maximum

Performance Specifications

- Controlled speed (torque) range: zero to motor base speed
- Efficiency (at rated speed and load): Controller 97%, controller and motor 81% typical
- Displacement power factor (at rated speed and load): 65%

Adjustment Ranges

MODELS DC1-1 THRU DC1-6

- Minimum speed: 10 to 50% of motor base speed with the ability to provide zero minimum speed by a reconnectable jumper (J6).
- Current limit: 10 to 250% rated current
- IR drop compensation: 0 to 12% rated armature voltage
- For speed regulation characteristics, see Table 3.
- Dynamic braking, provided in Model DC1-6 only: designed for applications requiring infrequent stops of loads in which the inertia as reflected to the D-C motor is approximately equivalent to or less than motor armature inertia. Refer to Table 4.

CAUTION: Using dynamic braking on applications with reflected inertias higher than motor armature inertia or frequent stops may destroy the dynamic braking resistor and damage the controller.

Table 3. Speed regulation characteristics.

Type of Regulation	Line Voltage ±10%	Load Change 95%	Regulated Speed Range	Temperature ±10° C	Field Heating Cold/ Normal①
Armature Feedback (Voltage)	0.1%	2-5%②	20:1	1.0%	5-12%
Tachometer Feedback (Speed)③	0.1%	1%	30:1	1.5%	0.5%

① Applies to wound field D-C motors only.
② Dependent upon specific motor characteristics and IR drop compensation adjustment.
③ Applicable to non-reversing models only.

Table 4. Dynamic braking capabilities.

Description	Input Voltage	Motor Horsepower						
		¼	⅓	½	¾	1	1½	2
Braking Torque (% Full Load Torque)	115	129	103	66	44	34	—	—
	230	—	—	200	190	130	88	62
Allowable Stops Per Minute	115	12	11	8	6	2	—	—
	230	—	—	8	6	1	1	1

MODELS DC1-7 THRU DC1-9

- Manual maximum speed: 50 to 100% of motor base speed with manual speed setting potentiometer at its maximum setting. Effective in manual mode only.
- Automatic maximum speed: 50 to 100% of motor base speed with automatic mode speed reference at its maximum value. Effective in automatic mode only.
- Manual minimum speed: 10 to 50% of motor base speed with manual speed setting potentiometer at its minimum setting. Effective in manual mode only. (Jumper J6 allows absolute zero minimum speed. See Step 9, "Installation and Wiring.")
- Automatic minimum speed: 10 to 50% of motor base speed with automatic mode speed reference at its minimum value. Effective in automatic mode only. (Jumper J6 allows absolute zero minimum speed. See Step 9, "Installation and Wiring.")
- Current limit: 10 to 250% rated current.
- IR drop compensation: 0 to 12% rated armature voltage.
- For speed regulation characteristics, see Table 3.

MODELS DC1-10 THRU DC1-12

- Minimum torque: 10 to 50% of rated motor torque with the ability to provide zero minimum torque by a reconnectable jumper (J6).
- Maximum torque: 50 to 150% rated motor torque.
- Speed/voltage limit: 80 to 110% base speed.

INSTALLATION AND WIRING

WARNING

THIS EQUIPMENT SHOULD BE INSTALLED, ADJUSTED AND SERVICED BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THE EQUIPMENT AND THE HAZARDS INVOLVED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Use the typical interconnection diagram (Figure 1) as reference throughout this installation procedure.

1. Review all installation and wiring instructions thoroughly before proceeding.
2. Install the D-C motor in accordance with its own installation instructions. Care should be taken to assure that the motor is properly aligned with the driven machine to minimize unnecessary motor loading due to shaft misalignment.
3. Remove the controller cover and inspect for any physical damage. Report any shipping damage to the carrier.
4. Mount the controller in a vertical, upright position. See Figure 2 for dimension and mounting data for both the enclosed and open chassis controllers.
5. Be certain that ambient temperatures are within 0° C and 40° C (32° F and 104° F) for enclosed controllers or 0° C and 55° C (32° F and 131° F) for open chassis controllers. Do not impede air flow required over the rear mounted cooling fins or sides.
6. In cabinet models, make conduit entry thru the two prepunched openings at the cabinet bottom allowing entry for two separate metallic conduits: one for power and control wiring and the second for signal wiring for speed reference, tachometer feedback, etc. (Figure 4). The enclosure is fully gasketed. It is the user's responsibility to properly seal conduit entry openings in the cabinet using Reliance part 608826-2A (metal hub) and 608826-1A (plastic plug) or equivalent hardware to maintain NEMA/UL Type 12K cabinet integrity.
7. Care should be taken to see that all interconnecting wiring is sized and installed in conformance with the National Electrical Code (NEC), published by the National Fire Protection Association, or the Canadian Electrical Code (CEC), and other applicable local codes. Refer to controller and motor nameplates for electrical data.

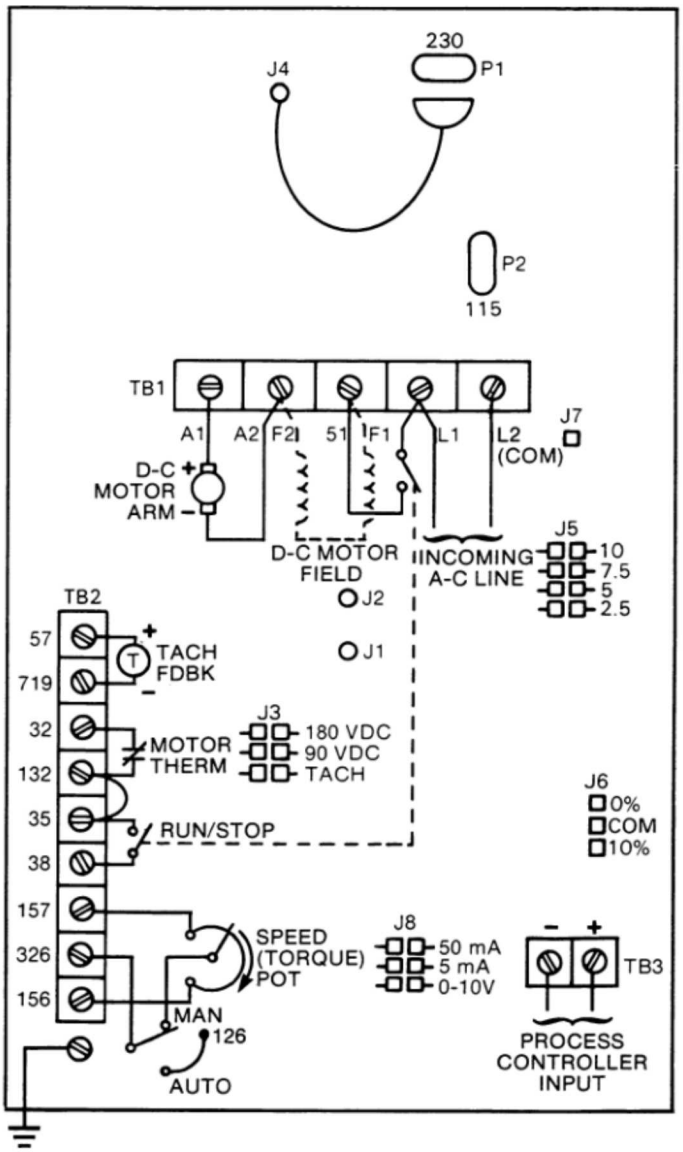


Figure 1. Typical interconnection diagram (process follower shown).

DANGER

THE NATIONAL ELECTRICAL CODE REQUIRES THAT AN NEC APPROVED FUSED DISCONNECT SWITCH OR CIRCUIT BREAKER BE USED AHEAD OF THE CONTROLLER IN THE INCOMING A-C SUPPLY LINE AND BE LOCATED WITHIN SIGHT OF THE CONTROLLER. DO NOT OPERATE THE CONTROLLER UNTIL THIS CODE REQUIREMENT HAS BEEN MET. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN FATAL INJURY.

8. Connect the GND (green/ground) wire to the terminal provided in the controller (Figure 4). A ring type connector is recommended. It is the responsibility of the user to assure that the ground wire is connected to the plant ground at the drive system source.

DANGER

BE ABSOLUTELY CERTAIN THAT A GROUND WIRE BROUGHT IN WITH THE INCOMING A-C POWER LINE IS PROPERLY CONNECTED TO THE CHASSIS GREEN GROUND TERMINAL PROVIDED. ALSO BE CERTAIN THE CONTROLLER, MOTOR FRAME AND OPERATOR'S STATION ARE GROUNDED AT A COMMON POINT. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN FATAL INJURY.

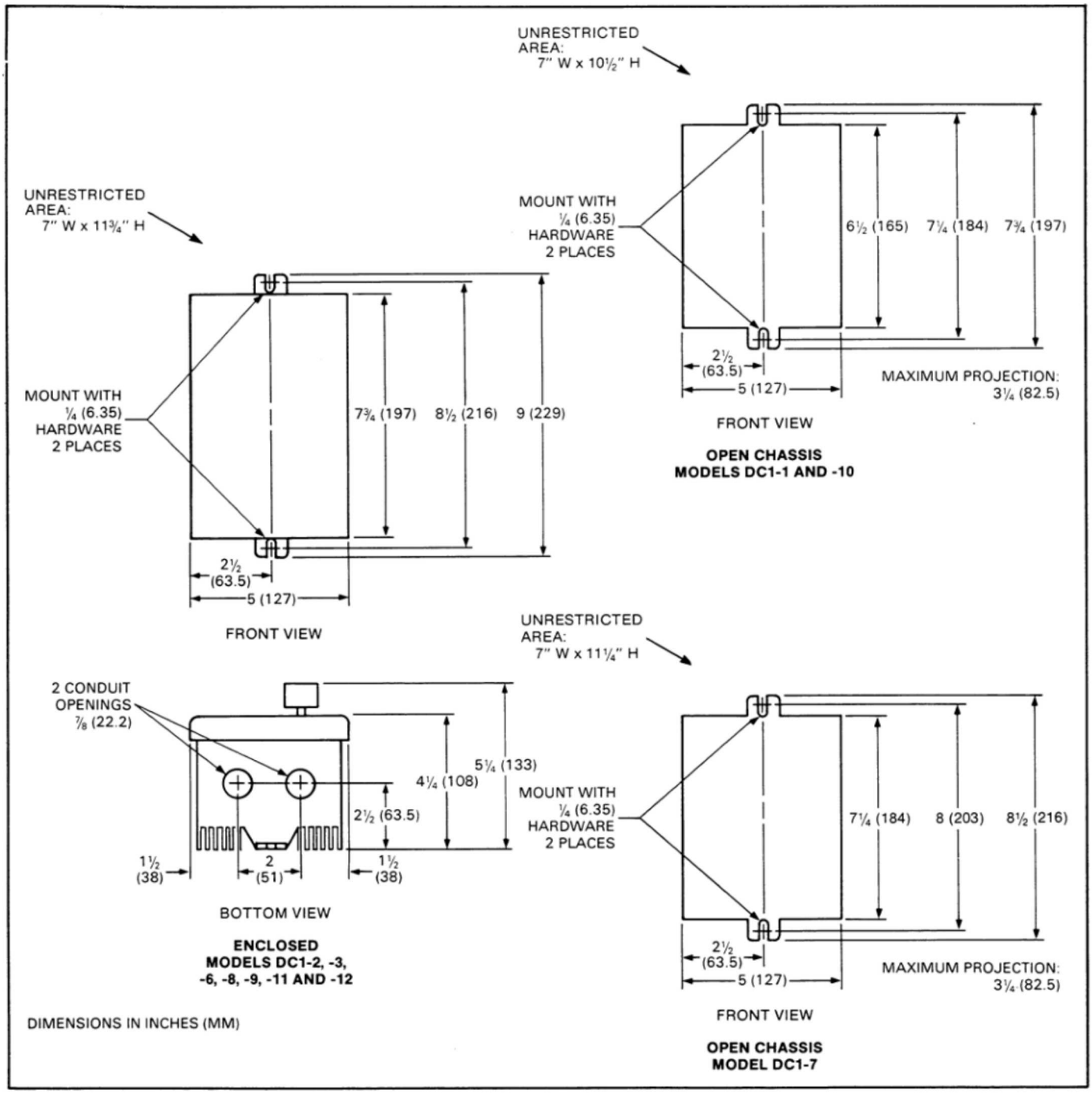


Figure 2. Dimension data.

9. Verify the proper positioning of all jumpers within the controller:

J3: Regulation mode jumper is factory set at 230 VAC input, 180 VDC armature and is reconnectable for 115 VAC input, 90 VDC armature; or tachometer feedback, 20 VDC per 1000 rpm (TACH).

Since DC-1 Models DC1-10 thru DC1-12 operate as armature current regulators, they control motor shaft torque delivered to the load. If the load is lost (web break, belt or coupling break, etc.) motor speed will rise rapidly. Maximum speed under such no-load conditions may be limited by regulating applied armature voltage or by regulating motor speed with a tachometer.

J4: Line voltage selection jumper is factory set for 230-volts A-C incoming line power (P1). For 115-volts A-C incoming line power, reconnect to P2.

J5: Armature current scaling jumper is factory set at 2.5 amperes. Jumper is reconnectable to correspond to the appropriate motor rated armature amperes.

J6: Minimum speed (torque) range jumper is factory set at 10% and common. Reconnect jumper at 0% and common if absolute zero minimum speed (torque) is desired.

DANGER

ALTHOUGH ZERO SET ADJUSTMENT ON THIS CONTROLLER ALLOWS FOR ADJUSTMENT DOWN TO ZERO SPEED (TORQUE), THIS ZERO SPEED (TORQUE) SETTING MUST NOT BE USED WHERE THE OPERATOR MAY RELY ON A MAINTAINED ZERO SPEED (TORQUE). ELECTRICAL NOISE, IMPROPER WIRING, POWER LINE, OR MALFUNCTIONING COMPONENTS COULD CAUSE THE CONTROLLER TO TURN ON WHILE AT THE ZERO SPEED (TORQUE) SETTING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN FATAL INJURY.

J8: Automatic mode reference scaling jumper (Models DC1-7 thru DC1-9) allows use of a number of common milliampere reference signal levels or 0-10 volts D-C:

Reference Signal	Jumper Position
1-5 mA	5 mA
4-20 mA	50 mA
10-50 mA	50 mA
0-10 VDC	0-10 V

DANGER

BEFORE WIRING, MAKE SURE THE A-C LINE DISCONNECT SWITCH IS LOCKED OPEN. EVEN IF POWER HAS NOT BEEN APPLIED TO THE INCOMING LINE, THIS PRACTICE ASSURES PERSONAL SAFETY. IF NO LOCKOUT DEVICE EXISTS, REMOVE THE FUSES WHICH ARE PART OF THE DISCONNECT SWITCH WITH AN INSULATED TOOL AND PLACE A WARNING TAG ON THE BOX. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN FATAL INJURY.

10. Terminate incoming line power (L1 and L2). See Figure 1. Refer to Table 2 for incoming line current and KVA requirements as a function of incoming A-C line voltage and motor horsepower. The user is responsible for branch circuit protection as required by NEC and other local codes. Maximum allowable available symmetrical short circuit fault current is 5000 amperes. On 115-volt A-C applications, L1 must be connected to the incoming hot lead and L2 to the common.

11. Terminate power wiring to the motor armature (A1 and A2). See Figure 1. Refer to Table 2 for armature current and voltage ratings as a function of incoming A-C line voltage and motor horsepower.

12. Terminate shunt field wiring to the motor (F1 and F2), if applicable. See Figure 1. Operation on 115-volt A-C incoming power produces a 50-volt D-C field supply rated at 2 amperes. Controller operation on 230-volt incoming A-C power produces a 100-volt D-C shunt field rated at 1 ampere.

13. Connect any cover mounted devices, remote operator devices or remote reference to the controller using Figure 1.

- **5000 ohm, 0.25 watt, linear speed (torque) setting potentiometer.**

DANGER

THE SPEED SETTING POTENTIOMETER IS CONNECTED THRU THE DRIVE REGULATOR TO THE ARMATURE POWER CIRCUIT. ITS TERMINALS ARE AT LINE POTENTIAL AND ARE POTENTIALLY LETHAL. THE SPEED (TORQUE) SETTING POTENTIOMETER FURNISHED BY RELIANCE IN ENCLOSED DC-1 CONTROLLERS HAS A PLASTIC SHAFT TO INSULATE THE SPEED (TORQUE) SETTING KNOB FROM THIS POWER CIRCUIT. REMOTE-MOUNTED POTENTIOMETERS USED WITH THIS DRIVE CONTROLLER MUST BE RELIANCE PART 608870-76R OR AN EQUIVALENT CAPABLE OF WITHSTANDING HI-POT TESTS AT 1500 VOLTS D-C FOR ONE MINUTE AND MUST HAVE A PLASTIC OR OTHER NON-CONDUCTING SHAFT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN FATAL INJURY.

May be locally or remotely located. If remotely located, connect to drive controller using a minimum of #16 AWG twisted triple conductor cable with at least two twists per inch (Reliance part 417900-76EAD or 125° C, 600-volt [RMS], UL/CSA listed wire or equivalent) and routed in separate metallic conduit. **Do not** run speed (torque) potentiometer wiring in the same conduit as control or power wiring either internally or externally to this controller. Do not use shielded cable.

- **Optional tachometer feedback.**

DANGER

USE A D-C TACHOMETER HAVING INSULATION RATED FOR 230 VAC WITH RESPECT TO GROUND. THE D-C TACHOMETER TERMINALS ARE AT LINE POTENTIAL AND ARE POTENTIALLY LETHAL. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN FATAL INJURY.

WARNING

POLARITY OF THE TACHOMETER CONNECTIONS 57(+) AND 719(−) IS IMPORTANT. IF CONNECTED WITH REVERSE POLARITY, THE RESULTING POSITIVE FEEDBACK MAY TURN ON THE DRIVE TO MAXIMUM SPEED CAUSING A HAZARDOUS OVERSPEED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY AND/OR EQUIPMENT DAMAGE.

WARNING

CONNECTING A D-C TACHOMETER TO THE REVERSING CONTROLLER (DC1-6) MAY TURN ON THE DRIVE TO MAXIMUM SPEED CAUSING A HAZARDOUS OVERSPEED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY AND/OR EQUIPMENT DAMAGE.

Use a D-C tachometer with 18.5 to 21 volts per 1000 rpm. Applicable for non-reversing controllers with motor base speeds of 1750 rpm only. Tachometer feedback wiring must be a minimum of #16 AWG twisted two conductor cable with at least two twists per inch (Reliance part 417900-79X or 125° C, 600-volt [RMS], UL/CSA listed wire or equivalent) and routed in a metallic conduit separate from control or power wiring. Do not use shielded cable.

- **Manual/automatic switch** (Models DC1-7 thru DC1-9 only) allows reference signal selection. In the automatic mode the drive will follow the signal wired to the (+) and (−) terminals of TB3 and wire 126 soldered to the printed circuit board. In manual mode the drive will respond to the setting of the speed setting potentiometer.
- **Automatic mode speed reference signal (grounded) input** (Models DC1-7 thru DC1-9 only) of 1-5 mA, 4-20 mA, 10-50 mA or 0-10 VDC. Polarity is important. Connect the (+) to the right terminal and the (−) to the left terminal of TB3.

WARNING

THE PROCESS FOLLOWER TERMINALS ARE FLOATING AT LINE POTENTIAL AND LIMITED POWER. ALSO, THE REFERENCE EQUIPMENT SHOULD BE GROUNDED. A HAZARD OF SHOCK EXISTS AND COULD RESULT IN BODILY INJURY.

Connect to drive controller using a minimum of #16 AWG twisted two conductor cable with at least two twists per inch (Reliance part 417900-79X or 125° C, 600-volt [RMS], UL/CSA listed wire or equivalent) and routed in a metallic conduit separate from control or power wiring. Do not use shielded cable.

- **The cover-mounted run/stop switch** is connected as shown in Figure 1. On a Run command, the momentary run contact wired between terminals 35 and 38 initiates an electronic start. On a Stop command, a maintained open contact opens incoming line power between terminals 51/F1 and L1. In this way, the cover-mounted run/stop switch provides a "line break" function when the run/stop switch is placed into the stop position, providing a positive disconnect between the plant line and the D-C motor.

WARNING

WHEN APPLYING DRIVE CONTROLLERS WITHOUT CABINET-MOUNTED OPERATOR'S DEVICES, SOME MEANS OF POSITIVE DISCONNECT BETWEEN THE PLANT LINE AND THE D-C MOTOR (BETWEEN TERMINALS 51/F1 AND L1) MUST BE PROVIDED BY THE MACHINE BUILDER OR FINAL USER. FAILURE TO DO SO COULD RESULT IN BODILY INJURY.

- **Remote run/stop control** may be done in a number of ways. Two possibilities are shown in Figure 3 for reference only. ***NOTE:*** *Terminals 35 and 132 are factory-jumpered. If a remote stop device is required, remove jumper and wire the normally closed device between these two terminals.*

WARNING 1

A POSITIVE DISCONNECT BETWEEN THE PLANT LINE AND THE D-C MOTOR MUST BE PROVIDED. DC-1 CONTROLLERS WITH CABINET-MOUNTED OPERATOR'S DEVICES PROVIDE THIS DISCONNECT THRU THE ACTION OF THE RUN/OFF SWITCH. WITH OTHER DC-1 MODELS THIS DISCONNECT MUST BE PROVIDED BY THE MACHINE BUILDER OR FINAL USER AND WIRED BETWEEN TERMINALS 51/F1 AND L1. THIS DEVICE MUST BE WITHIN EASY REACH OF THE OPERATOR BECAUSE IT PROVIDES PERSONNEL PROTECTION. THE DEVICE MUST BE CAPABLE OF CARRYING FULL RATED LINE CURRENT. (SEE TABLE 2.) FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING 2

AFTER AN OVER-TEMPERATURE TRIP, THE INTERNAL MOTOR THERMOSTAT WILL AUTOMATICALLY RECLOSE WHEN MOTOR TEMPERATURE AGAIN REACHES NORMAL LEVELS. CONTROL CIRCUITS USING MAINTAINED RUN CONTACTS WILL AUTOMATICALLY RESTART THE MOTOR UPON THIS CLOSURE WITHOUT ANY SPECIFIC ACTION BY THE OPERATOR. IN MAINTAINED RUN CONTACT CONTROL CIRCUITS, THE INTERNAL MOTOR THERMOSTAT SHOULD BE LEFT DISCONNECTED AND AN OVERLOAD DEVICE WITH MANUAL RESET SHOULD BE WIRED INTO THE MOTOR ARMATURE CIRCUIT. THE NORMALLY CLOSED OUTPUT OF THIS DEVICE MUST BE WIRED BETWEEN TERMINALS 32 AND 132. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

14. Connect the motor thermostat between terminals 32 and 132. See Figure 1. This thermostat, standard in all Reliance D-C motors intended for use with this controller, provides thermal overload protection for the motor and outgoing wiring and is an integral part of the overall drive protection scheme.

    If this controller is being used with a D-C motor without a thermostat, the user is responsible for supplying an appropriate overload device sensitive to armature current. The normally closed output from this device must

be connected between 32 and 132. Without a connection between these two terminal points, the drive will not run.

CAUTION: The motor thermostat or alternate device is required by NEC for complete equipment protection.

15. The value of the capacitor connected between wire wrap pins J1 and J2 determines acceleration time (reference timing). Factory setting provides approximately 6 seconds acceleration to full speed (reference timing). This time can be adjusted by changing the capacitance value as follows:

20 seconds	2 μfd	2 seconds*	.47 μfd*
10 seconds	.68 μfd	1 second*	.22 μfd*
6 seconds	as shipped	½ second*	.1 μfd*
4 seconds*	.68 μfd*		

*For times lower than 6 seconds, capacitor (C6) must be cut. See Figure 4 for the physical location of this capacitor.

16. Recheck all wiring for proper terminations and tight connections.

STARTUP AND ADJUSTMENTS

WARNING

BEFORE OPERATING AND/OR ADJUSTING THIS EQUIPMENT, THE QUALIFIED ELECTRICAL MAINTENANCE PERSON WHO IS FAMILIAR WITH THIS TYPE OF EQUIPMENT AND THE HAZARDS INVOLVED SHOULD READ THIS ENTIRE INSTRUCTION MANUAL. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

1. Set the potentiometers (Figure 4) as follows:

MODELS DC1-1 THRU DC1-6

- maximum speed - fully counterclockwise
- minimum speed - fully counterclockwise
- IR drop compensation - fully counterclockwise
- current limit - mid scale
- speed setting - fully counterclockwise

MODELS DC1-7 THRU DC1-9

- both manual and automatic maximum speeds - fully counterclockwise.
- both manual and automatic minimum speeds - fully counterclockwise.
- IR drop compensation - fully counterclockwise.
- current limit - mid scale.
- manual speed setting potentiometer - fully counterclockwise.

Place the manual/automatic switch in the manual position.

MODELS DC1-10 THRU DC1-12

- maximum torque - fully counterclockwise
- minimum torque - fully counterclockwise
- speed limit - mid scale
- torque setting - fully counterclockwise

DANGER

THE REMAINING STEPS ARE MADE WITH POWER ON. EXERCISE EXTREME CAUTION AS HAZARDOUS VOLTAGE EXISTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN FATAL INJURY.

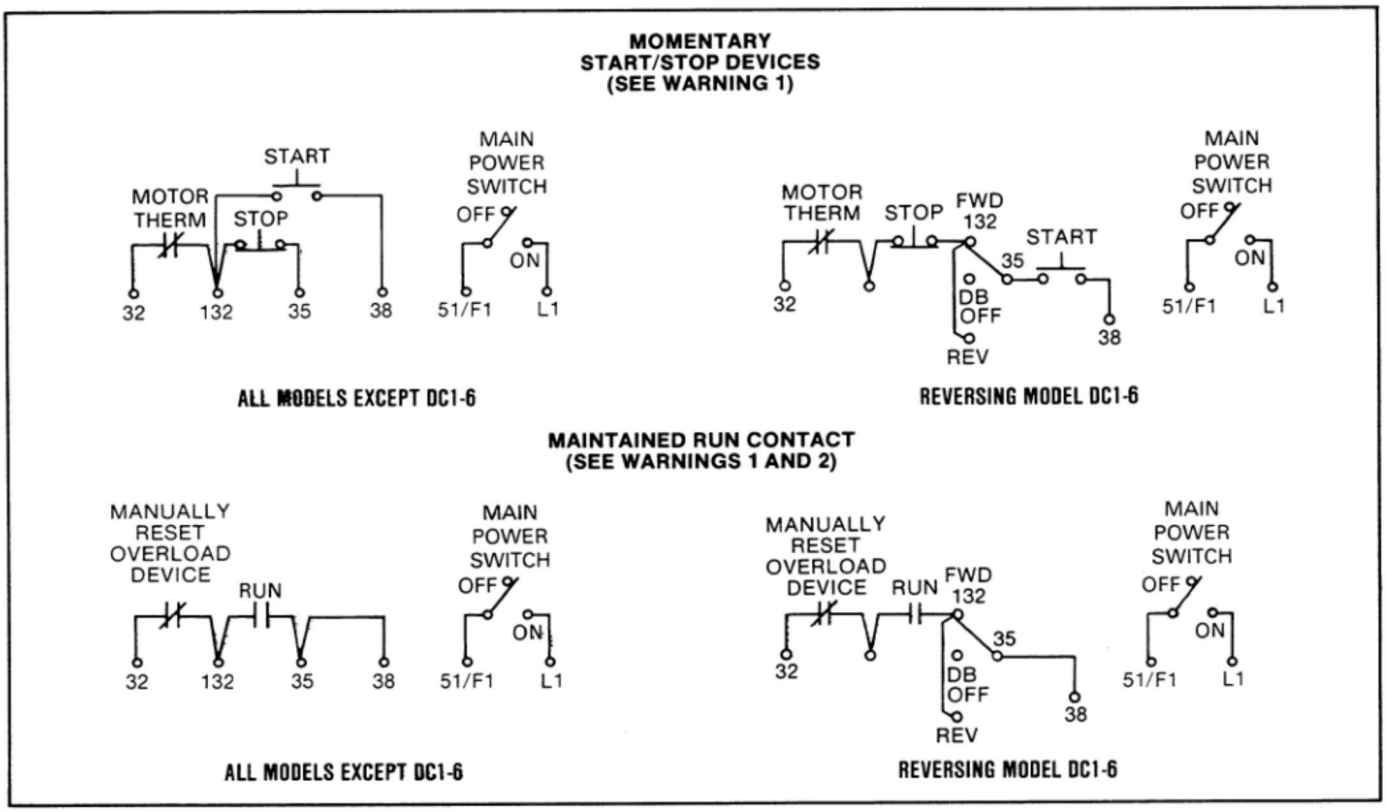


Figure 3. Alternate run/stop control connections.

2. Apply incoming power.

WARNING

WHEN STARTING UP THE DC-1 CONTROLLER, KEEP ALL BODY PARTS CLEAR OF MOVABLE MACHINERY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

3. Start the drive by momentarily placing the run/stop switch into the RUN position and then back into the STOP position to check that motor shaft rotation is correct. It may be necessary to repeat, slowly and carefully, turning the manual speed (torque) setting potentiometer clockwise to achieve shaft rotation. If shaft rotation is incorrect, stop the drive and wait until the motor has completely stopped; remove incoming A-C supply power; then reverse the motor armature leads (A1 and A2). Restart the drive.

   If a D-C tachometer is used, repeat the momentary run/stop procedure to check for correct tachometer polarity of 57 (+) and 719 (−) for the correct shaft rotation. If shaft rotation is incorrect, remove incoming A-C supply power, and reverse the tachometer leads. Restart the drive.

4. Slowly advance the setting of the manual speed (torque) potentiometer to fully clockwise. The drive should now be operating at about 50% of base speed (50% rated torque and significantly below rated torque). Use a hand tachometer to monitor motor speed.

5. Carefully advance the setting of the manual maximum speed (torque) potentiometer as necessary to obtain rated motor base speed (to set maximum desired torque).

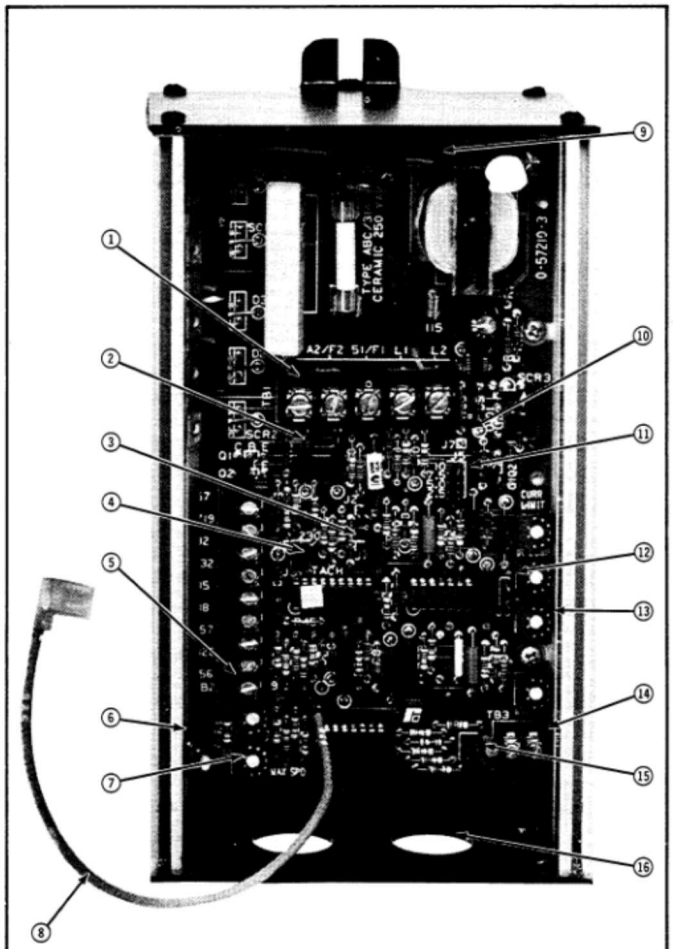
6. Set the current limit potentiometer at 60% of its fully clockwise value. This will set drive current limit at approximately 150%. Turning this potentiometer counterclockwise will reduce the current limit setting.

7. If the drive is used as a speed regulator with tachometer feedback (Models DC1-1 thru DC1-3 and DC1-7 thru DC1-9), keep the IR drop compensation potentiometer at full counterclockwise. If applied as an armature voltage regulator, IR drop compensation may be used to provide less speed change as a function of load. Turning the IR drop compensation potentiometer clockwise will increase the effect of IR drop compensation. Excessive IR drop compensation can cause motor instability and hunting. When properly adjusted, IR drop compensation will minimize motor speed change with changes in load without hunting or instability.

8. Place the operator's manual speed (torque) potentiometer in its minimum position and adjust the manual minimum speed (torque) potentiometer for desired minimum speed (torque). ***NOTE:*** *This drive incorporates a minimum speed (torque) circuit that allows minimum speed (torque) adjustment of between 10 and 50% motor base speed (rated torque). This provides motor rotation any time the motor is energized even with the operator's manual speed (torque) potentiometer set at zero. This provides visible indication of motor energization and minimizes the risk of inadvertent operator injury. If your application provides adequate protection against this type of potential injury and if absolute zero minimum speed (torque) is an application necessity, minimum speed (torque) may be adjusted to zero by reconnecting jumper J6 (Figure 4). To reposition this jumper, stop the drive, remove all sources of incoming power; then reconnect jumper J6. Restart the drive.*

DANGER

ALTHOUGH ZERO SET ADJUSTMENT ON THIS CONTROLLER ALLOWS FOR ADJUSTMENT DOWN TO ZERO SPEED (TORQUE), THIS ZERO SPEED (TORQUE) SETTING MUST NOT BE USED WHERE THE OPERATOR MAY RELY ON A MAINTAINED ZERO SPEED. LOSS OF CONNECTED LOAD, ELECTRICAL NOISE, IMPROPER WIRING, POWER LINE, OR MALFUNCTIONING COMPONENTS COULD CAUSE THE CONTROLLER TO UNEXPECTEDLY ACCELERATE THE MACHINE FROM REST. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN FATAL INJURY.



1. TB1
2. Capacitor (C6)
3. J1 and J2
4. J3
5. TB2
6. Ground (GND)
7. Pots (from top to bottom)
   - Auto Min Speed
   - Auto Max Speed
8. Wire 126 (Auto)
9. J4
10. J7
11. J5
12. J6
13. Pots (from top to bottom)
    - Current Limit
    - IR Drop Compensation
    - Manual Min Speed (Torque)
    - Manual Max Speed (Torque)
14. TB3
15. J8
16. 2 Conduit Entry Points

Figure 4. Controller details.

9. With Models DC1-7 thru DC1-9, place the manual/automatic switch in the automatic position and adjust automatic mode minimum and maximum speeds. With the automatic mode reference at its maximum value, maximum drive speed may be trimmed by using the automatic maximum speed potentiometer. With automatic mode reference at its minimum value, the automatic minimum speed potentiometer will adjust minimum speed. Refer to Step 8 above for absolute minimum speed.

WARNING

ADJUST THE MINIMUM AND MAXIMUM SPEED POTENTIOMETERS IN SMALL INCREMENTS. MISADJUSTMENT OF THESE POTENTIOMETERS IN AUTOMATIC MODE MAY TURN ON THE DRIVE CAUSING A HAZARDOUS OVERSPEED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY AND/OR EQUIPMENT DAMAGE.

10. With Models DC1-10 thru DC1-12, stop the drive and remove all sources of incoming power. Break the coupling between the motor and driven load. Restart the drive and slowly advance the torque setting potentiometer while observing motor speed with a tachometer. Using the speed limit potentiometer, limit no-load motor speed to a safe value when the torque setting potentiometer is at its maximum setting.

11. Stop the drive and remove all sources of incoming power. Reconnect the motor coupling if disconnected in Step 10 above. If applicable, replace the cabinet cover and tighten securely into place. This completes the start-up and adjustments of the drive.

WARNING

SHOULD THERE BE A DEVICE FAILURE, THE CONTROLLER MAY RESTART AFTER A POWER LOSS IF IN THE STANDBY MODE. FAILURE TO TAKE THE DRIVE OUT OF STANDBY MODE AFTER A POWER LOSS COULD RESULT IN BODILY INJURY.

SERVICING

The DC-1 controller contains all regulator circuitry, all power conversion circuitry, and all termination points on one printed circuit board. It is intended that this drive controller be serviced by replacing the entire controller eliminating the need to troubleshoot. Should there be any difficulty with drive operation, review Table 5 before performing any drive service. Refer to Table 6 for replacement parts information.

DANGER

SERVICING IS DONE WITH POWER ON. EXERCISE EXTREME CAUTION WHEN PERFORMING THESE CHECKS AS HAZARDOUS VOLTAGE EXISTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN FATAL INJURY.

Table 5. Servicing steps.

Indication	Possible Cause	Corrective Action
Controller incoming line fuse blows when power is applied to the controller.	Faulty incoming A-C line wiring or an inadvertent ground in the branch circuit or within the controller enclosure.	Check all incoming A-C wires and terminations to and within the controller. Correct any faulty wiring and remove any grounds. Replace blown fuse.
Controller incoming line fuse blows when Start command is given.	Motor armature shorted or grounded.	Repair or replace motor. Replace blown fuse.
	Shorted SCR or faulty regulator.	Replace entire controller.
Controller incoming line fuse blows while motor is running.	Loose or corroded connection or faulty, incorrect or grounded wiring.	Check all terminal connections and wiring between the line, controller and motor and correct. Replace blown fuse.
Controller incoming line fuse blows while motor is running.	Sudden, severe application of overload to the motor.	Investigate driven equipment for possible cause and correct. Replace blown fuse.
	Circuit board faulty.	Replace entire controller.
Motor does not rotate.	Faulty, incorrect or grounded wiring.	Check all external wires and terminations at the controller. Check all wiring within the motor conduit box. Correct any faulty wiring.
	Incoming line fuse blown and/or upstream protection devices open.	Investigate upstream equipment for possible cause and correct. Replace blown fuse.
	Open or faulty manual speed (torque) setting potentiometer.	Check all speed (torque) potentiometer wiring and operation of speed (torque) potentiometer and correct.

(Continued on next page.)

Table 5. Servicing steps (continued).

Indication	Possible Cause	Corrective Action
Motor does not rotate (continued).	With Models DC1-7 thru DC1-9, faulty, misconnected or miscalibrated automatic mode reference signal.	Check automatic mode reference signal for presence and value. Check for proper polarity. Check jumper J8 for proper calibration. Correct as necessary.
	Run/stop or forward/off/reverse switch faulty or in the incorrect position.	Investigate and/or replace switch as necessary.
	Motor thermostat open.	Check for continuity with ohmmeter. Let motor cool if found to be open.
	Open circuit between terminals 132 and 35. Either a jumper or normally closed remote stop device must be connected between these two terminals in order for the drive to operate.	Repair faulty switch or insert jumper as required.
	Current feedback jumper J5 set lower than applied motor horsepower.	Recheck and reset as necessary.
Drive will not go to zero speed (torque).	Improperly set minimum speed (torque) potentiometer(s).	Reset minimum speed (torque) potentiometer(s).
	With Models DC1-7 thru DC1-9, automatic mode reference signal greater than expected minimum value.	Adjust source of automatic mode reference signal for proper output signal range.
	Drive, as shipped, has a minimum speed (torque) setting of 10% of motor base speed (rated torque). See "Startup and Adjustments" Step 8 for setting minimum speed (torque) to a lower value.	Proceed as indicated in "Startup and Adjustments."
	Controller faulty.	Replace entire controller.
Motor does not reach top speed (or deliver rated torque).	Low line voltage.	Check for rated line voltage ±10% and correct.
	With Models DC1-7 thru DC1-9, improperly set maximum speed potentiometers.	Reset maximum speed potentiometers.
	With Models DC1-7 thru DC1-9, automatic mode reference signal producing less then expected maximum value.	Adjust source of automatic mode reference signal for proper output signal range.
	Overload.	Check for cause of overload and correct.
	Improperly calibrated J5 jumper.	Check and reset as necessary.
	Faulty circuit board.	Replace entire controller.
Unstable speed or poor regulation when applied as an armature voltage regulator.	Incorrectly set IR drop compensation potentiometer.	Readjust IR drop compensation.
	Faulty circuit board.	Replace entire controller.

Table 6. Replacement parts.

Description	Model Number		
	DC1-1 thru DC1-6	DC1-7 thru DC1-9	DC1-10 thru DC1-12
Printed Circuit Board Assembly	0-57210	0-57210-3	0-57210-1
Incoming Line Fuse (Type ABC, 250V, 20A, Ceramic)	64676-35G	64676-35G	64676-35G
Operator Devices:			
Speed (Torque) Potentiometer Assembly	608870-76R	608870-76R	608870-76R
Potentiometer Knob	602949-8A	602949-8A	602949-8A
Run/Off Switch	49869-17A	49869-17A	49869-17A
Forward/Off/Reverse Switch	705385-67R (DC1-6 only)	—	—
Manual/Automatic Switch	—	608870-77R	—
Plastic Jumper (J3, J5, J6, J8)	405504-69A	405504-69A	405504-69A

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