



AMERICAN<sup>TM</sup>  
CONTROL  
ELECTRONICS

*DCN300/600 SERIES*

*USER MANUAL*

DCN300-16  
DCN300-60  
DCN600-60

Dear Valued Consumer:

Congratulations on your purchase of the **DCN 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](http://www.americancontrolelectronics.com) to learn more about our other drives.

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

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# Safety First!

## SAFETY WARNINGS



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

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



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

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

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## Section 1. Specifications

<i>Model</i>	<i>DC Source Voltage (VDC)</i>	<i>Maximum Armature Current (ADC)</i>	<i>HP Range with 12 VDC Motor</i>	<i>HP Range with 24 VDC Motor</i>	<i>Enclosure</i>
<i>DCN300-16</i>	<i>12 / 24</i>	<i>16</i>	<i>1/20 - 1/5</i>	<i>1/10 - 2/5</i>	<i>Chassis</i>
<i>DCN300-60</i>	<i>12 / 24</i>	<i>60</i>	<i>1/8 - 3/4</i>	<i>1/4 - 1 1/2</i>	<i>Chassis</i>
<i>DCN600-60</i>	<i>36 / 48</i>	<i>60</i>	<i>1/3 - 2 1/4</i>	<i>1/2 - 3</i>	<i>Chassis</i>

### DC Input Voltage

*DCN300 models*

10 - 32 VDC

*DCN600 models*

32 - 50 VDC

### DC Armature Voltage

Up to 95% of Source Voltage

### Acceleration Time Range

0.5 - 10 seconds

### Deceleration Time Range

coast to a stop

### Analog Input Range

0 - 10 VDC

### Input Impedance (S1 to S2)

200K ohms

### Form Factor

1.01

### Load Regulation

1% base speed or better

### Speed Range

80:1

### Vibration

0.5G maximum (0 - 50 Hz)

0.1G maximum (> 50 Hz)

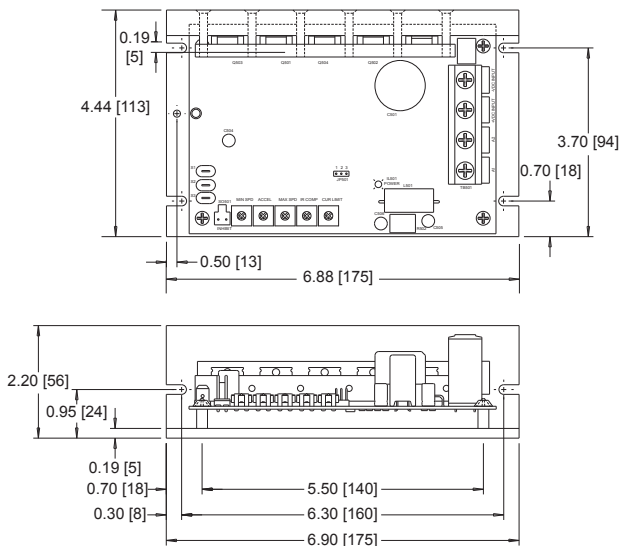
### Safety Certifications

UL/cUL Listed Equipment, File # E132235

### Ambient Temperature Range

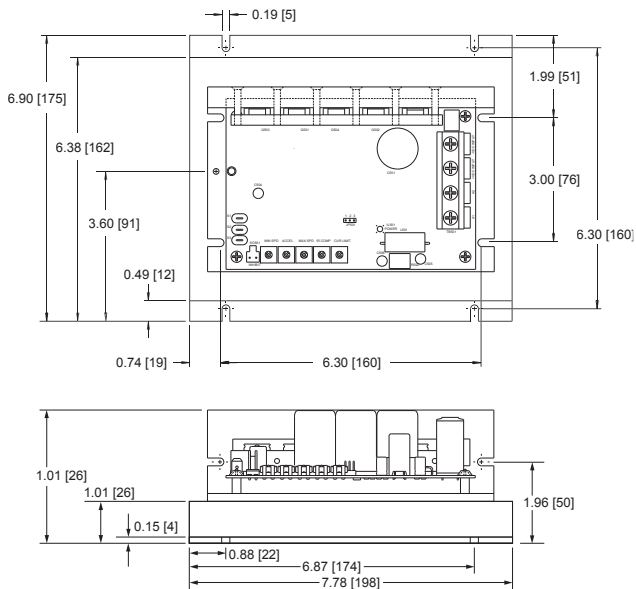
10°C - 40°C

## Section 2. Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. DCN300-16 Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 2. DCN300-60 and DCN600-60 Dimensions

## Section 3. Installation



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

### Mounting

- Drive components are sensitive to electrostatic discharge. Avoid direct contact with the circuit board. Hold the drive by the chassis or 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 and four in the heat sink 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.

## Speed Adjust Potentiometer



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 3). 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 (+VDC INPUT, -VDC INPUT, A1, A2).

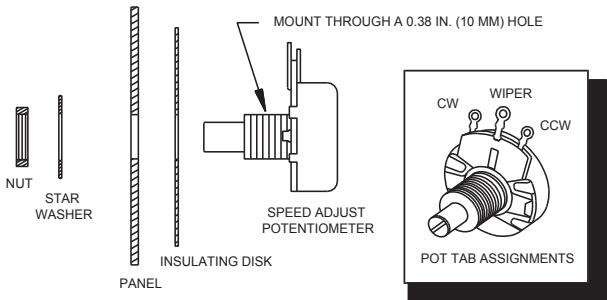


Figure 3. Speed Adjust Potentiometer

## 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.

The drive is isolated from earth 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.

- For logic wiring, use 18 AWG wire for logic wiring.
- For power wiring, use 14 AWG wire for 0 - 19 amps, up to 8 feet. Use 10 AWG wire for 20 - 32 amps, up to 10 feet. Use 8 AWG wire 32 - 60 amps, up to 10 feet.

## 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.

### **DC Power Fusing**

The drives should be fused for protection. Use fast acting fuses rated for 200% of maximum armature current and voltage. Fuse +VDC INPUT only.

## 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 Figure 5 (page 11). The switch contacts should be rated at a minimum of 150% of input voltage and 200% of motor nameplate current.

### Power Input

Connect the DC power leads to terminals +VDC INPUT and -VDC INPUT. American Control Electronics recommends the use of a single-throw, double-pole master power switch. The switch should be rated at a minimum of 150% of input voltage and 200% of motor current. Refer to Figure 5 on page 11.

### Motor

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

Connect a DC motor to terminals A1 and A2 as shown in Figure 5 on page 11.

## Speed Adjust Potentiometer

Use a 10K ohm, 1/4 W potentiometer for speed control. Connect the counter-clockwise end of the potentiometer to S1, the wiper to S2, and the clockwise end to S3. If the potentiometer works inversely of the desired functionality (e.g. to increase motor speed you must turn the potentiometer counterclockwise), power off the drive and swap the S1 and S3 connections. Refer to Figure 5 on page 10.

## 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 4). Connect the signal common (–) to S1. Connect the signal reference (+) to S2. Make no connection to S3. A potentiometer can be used to scale the analog input voltage. An interface device, such as American Control Electronics model ISO202-1, may be used to scale and isolate an analog input voltage.

An analog input voltage range of 0–10 VDC is required to produce an armature voltage range of 0–100% output VDC.

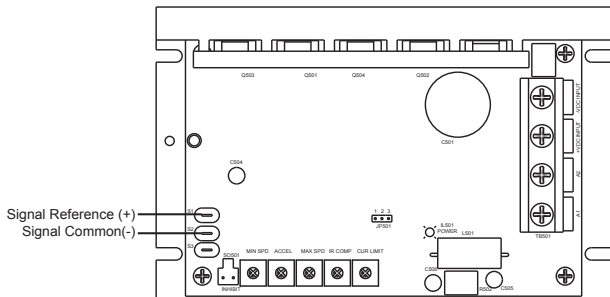


Figure 4. Analog Input Signal Connections

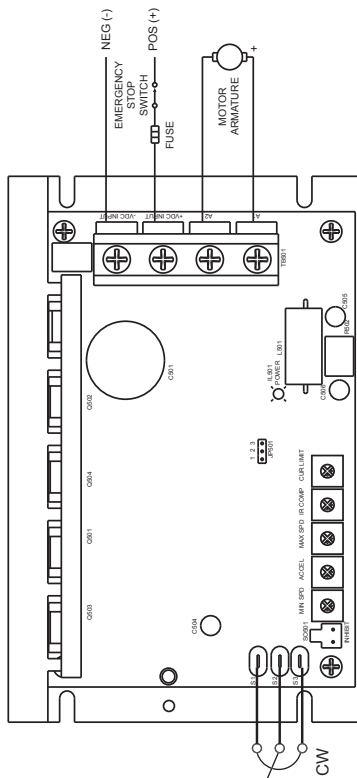


Figure 5. Connections

## Section 4. Operation



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

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

If the motor or drive does not perform as described, disconnect the AC line voltage immediately. Refer to the Troubleshooting section, page 33, for further assistance.

### Before Applying Power

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

## Select Jumpers

### Input Voltage Select Jumper (JP501)

Jumper pins 1 and 2 if using a 24 VDC input (alternatively, leave all pins open as pin 1 is just a place holder). Jumper pins 2 and 3 if using a 12 VDC input. Refer to Figure 6.

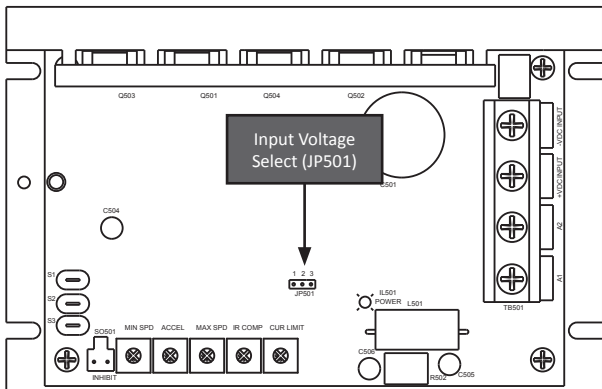


Figure 6. Select Jumpers

### Startup

1. Turn the speed adjust potentiometer full counterclockwise (CCW) or set the input voltage signal to minimum.
2. Apply AC line voltage.
3. Slowly advance the speed adjust potentiometer clockwise (CW) or increase the input voltage signal. The motor slowly accelerates as the potentiometer is turned CW or as the input voltage signal is increased. Continue until the desired speed is reached.
4. Remove the DC source voltage from the drive to coast the motor to a stop.

## Starting and Stopping Methods



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

For this reason, American Control Electronics strongly recommends installing an emergency stop switch on the positive DC input (see Figure 5 on page 11).

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

### Automatic Restart Upon Power Restoration

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

### Line Starting and Stopping

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

## Dynamic Braking



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

Dynamic braking may be used to rapidly stop a motor (Figure 7). For the RUN/BRAKE switch, use a two pole, two position switch rated for at least the armature voltage rating and 150% of the armature current rating. For the dynamic brake resistor, use a high power wirewound resistor.

Sizing the dynamic brake resistor depends on load inertia, motor voltage, and braking time. Use a lower-value, higher-wattage dynamic brake.

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

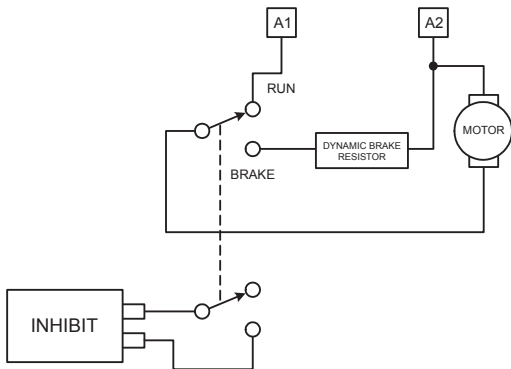


Figure 7. Dynamic Brake Wiring

## Inhibit Terminals

Short the INHIBIT terminals to coast the motor to a stop (see Figure 8 for INHIBIT terminal location). Open the INHIBIT terminals to accelerate the motor to set speed.

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

American Control Electronics offers two accessory plug harnesses for connecting to the INHIBIT terminals: part number KTW-0001 [plug with 18 in. (46 cm) leads]; and part number KTW-0002 [plug with 36 in. (91 cm) leads].

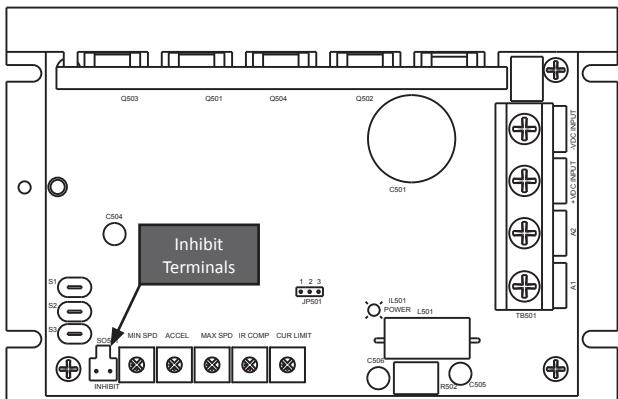


Figure 8. Inhibit Terminals

### Section 5. Calibration

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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.

DCN300/600 series drives have user-adjustable trim pots. Each drive is factory calibrated to its maximum current rating. Readjust the calibration trim pot settings to accommodate lower current rated motors.

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

## Minimum Speed (MIN SPD)

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

To calibrate the MIN SPD:

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

## Maximum Speed (MAX SPD)

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

To calibrate MAX SPD:

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

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

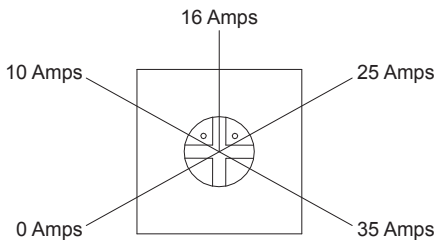
### Torque (CURRENT LIMIT)



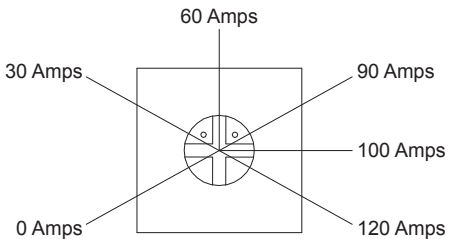
CURRENT LIMIT should be set to 120% of motor nameplate current rating. Continuous operation beyond this rating may damage the motor. If you intend to operate beyond the rating, contact your American Control Electronics representative for assistance.

The CURRENT LIMIT setting determines the maximum torque for accelerating and driving the motor. To calibrate CURRENT LIMIT, refer to the recommended CURRENT LIMIT settings in Figure 9 on page 21 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 CURRENT LIMIT trim pot to minimum (full CCW).
3. Set the speed adjust potentiometer full CW or input voltage signal to maximum speed.
4. Carefully lock the motor armature. Be sure that the motor is firmly mounted.
5. Apply line power. The motor should be stopped.
6. Slowly adjust the CURRENT LIMIT trim pot CW until the armature current is 120% of motor rated armature current.
7. Turn the speed adjust potentiometer CCW or decrease the input voltage signal.
8. Remove line power.
9. Remove the stall from the motor.
10. Remove the ammeter in series with the motor armature if it is no longer needed.



DCN300-16



DCN300-60 and DCN600-60

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Figure 9. Recommended CURRENT LIMIT Settings

### IR Compensation (IR COMP)

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

Use the following procedure to recalibrate the IR COMP setting:

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

## Acceleration (ACCEL)

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

To set the acceleration time:

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

## Section 6. Application Notes

### Multiple Fixed Speeds

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

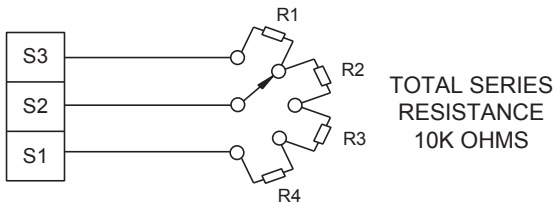


Figure 10. Multiple Fixed Speeds

## Adjustable Speeds Using Potentiometers In Series

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

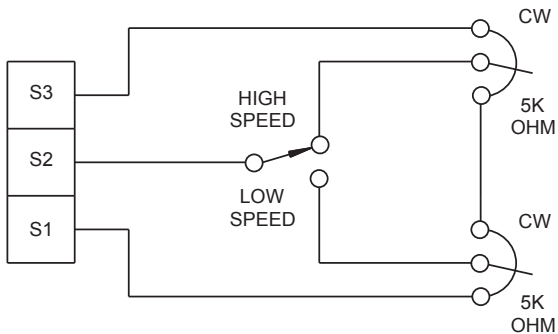


Figure 11. Adjustable Speeds Using Potentiometers In Series



## RUN/JOG Switch - Inhibit Connection

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

Connect the RUN/JOG switch and JOG pushbutton to the inhibit plug as shown in Figure 13. 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.

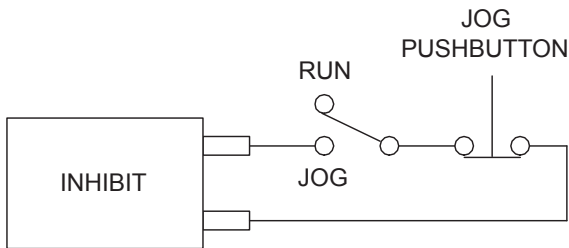


Figure 13. RUN/JOG Switch - Inhibit Connection

## RUN/JOG Switch - Potentiometer Connection

Connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 14. When the RUN/JOG switch is set to JOG, the motor decelerates to minimum speed (minimum speed is determined by the MIN SPD trim pot setting). Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

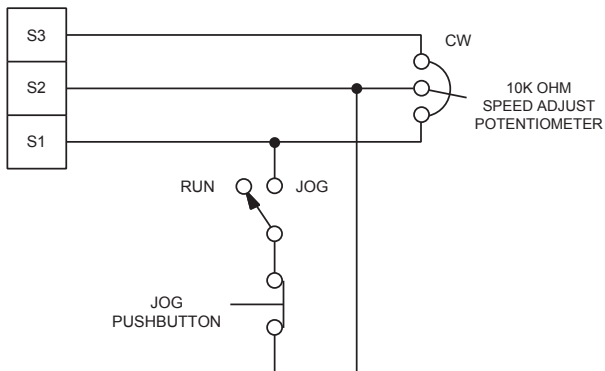


Figure 14. RUN/JOG Switch - Potentiometer Connection

## Leader-Follower Application

In this application, use an ISO202-1 to monitor the speed of the leader motor (Figure 15). 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.

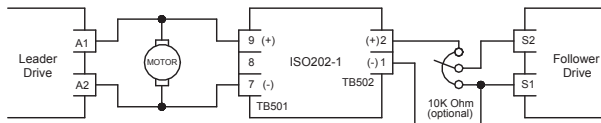


Figure 15. Leader-Follower Application

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

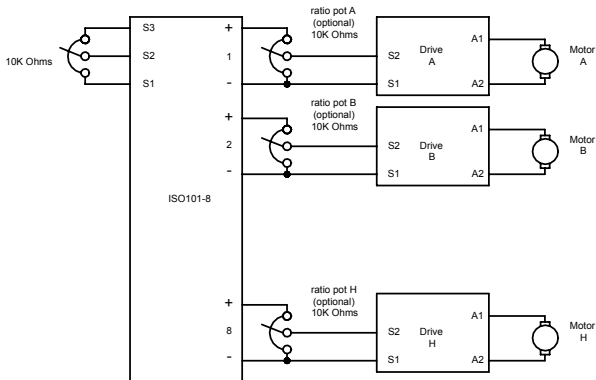


Figure 16. Single Speed Potentiometer Control of Multiple Drives

## Reversing

A dynamic brake may be used when reversing the motor direction (Figure 17). Use a three pole, three position switch rated for at least the maximum DC armature voltage and maximum braking current. Wait for the motor to stop completely before switching it to either the forward or reverse direction. See the Dynamic braking section on page 16.

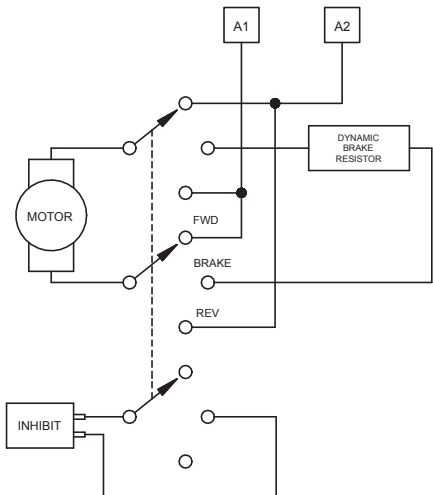


Figure 17. Reversing Circuit Wiring

## Section 7. Diagnostic LEDs

DCN300/600 series drives are equipped with one diagnostic LED:

- Power (POWER): Green LED lights whenever AC line voltage is applied to the drive.

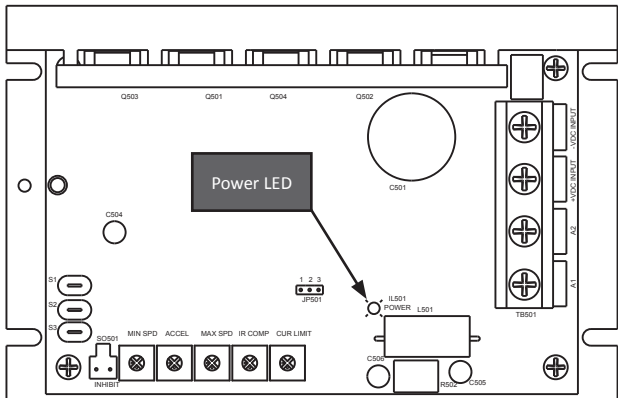


Figure 18. Diagnostic LED Location

## Section 8. Troubleshooting

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

### Before Troubleshooting

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

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

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

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

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
<b>Line fuse blows.</b>	1. Line fuse is the wrong size.	1. Check that the line fuse is correct for the motor size.
	2. Motor cable or armature is shorted to ground.	2. Check motor cable and armature for shorts.
	3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes (i.e. reversing).	3. Add a blower to cool the drive components, decrease CURRENT LIMIT settings, resize motor and drive for actual load demand, or check for incorrectly aligned mechanical components or "jams". See page 20 for information on adjusting the CURRENT LIMIT trim pot.
<b>Line fuse does not blow, but the motor does not run.</b>	1. Speed adjust potentiometer or input voltage signal is set to zero speed.	1. Increase the speed adjust potentiometer setting or input voltage signal.
	2. INHIBIT mode is active.	2. Remove the short from the INHIBIT terminals or add a short to INHIBIT terminals if INHIBIT mode is set to INVERTED.
	3. S2 is shorted to S1.	3. Remove the short.
	4. Drive is in current limit.	4. Verify that the motor is not jammed. Increase CURRENT LIMIT setting if set too low.
	5. Drive is not receiving DC power.	5. Apply DC power.
	6. Motor is not connected.	6. Remove power. Connect the motor to A1 and A2. Reapply power.

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

## Section 9. Accessories & Replacement Parts

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### Displays

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

### Kits

#### Potentiometer

10K Pot, Insulating Washer.....	KTP-0001
10K Pot, Insulating Washer, 9 Non-insulated Tabs.....	KTP-0031

#### Wiring

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

### Logic Cards

#### Current Sensing

5 Amps.....	CMC100-5
20 amps.....	CMC100-20
30 amps.....	CMC100-30

#### Isolation Cards

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