



AMERICAN<sup>TM</sup>  
CONTROL  
ELECTRONICS

## *VFD Series*

### *USER MANUAL*

VFD100-2.4

VFD100-4

VFD300-2.4

VFD300-4

VFD600-2.4

VFD600-4

Dear Valued Consumer:

Congratulations on your purchase of the **VFD 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.

Circuit potentials are at 115 VAC or 230 VAC above earth ground. Avoid direct contact with the printed circuit board or with circuit elements to prevent the risk of serious injury or fatality. Use a non-metallic screwdriver for adjusting the calibration trim pots. Use approved personal protective equipment and insulated tools if working on this drive with power applied.

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### Section 1. Variable Frequency Drives

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The VFD Series drives are solid-state, variable frequency AC motor controls. They utilize a 115 or 230 VAC, 50/60 Hz, single phase input to operate any 115 or 208/230-volt, three-phase AC-induction or single-phase permanent split capacitor motor and can be user calibrated for 0 through 120 Hz output.

Many 3-phase inverter manufacturers claim that they can run single phase motors effectively. This is normally accomplished by wiring only 2 phases; however, this method may cause instabilities due to the lack of feedback from one of the motor connections. Furthermore, motor torque will be considerably reduced because the phases are 120° apart. Although the VFD uses this method of connection, its fundamental design enables it to operate efficiently under these conditions.

Although VFD inverters can operate over their full speed range, most motors will operate with constant torque over a 10:1 speed range (6 - 60 Hz), and constant horsepower above 60 Hz. Inverter-duty rated motors may operate satisfactorily over a 20:1 speed range. Some motors can be satisfactorily operated at speeds as low as 50 RPMs (50:1 speed range). Below 50 RPMs, some motors may show signs of “stepping” or “cogging” and may run warmer.

In addition to standard 3-phase induction motors, the following motor types may be used with a VFD:

- Permanent Split Capacitor (PSC)
- Shaded Pole
- AC Synchronous



## Section 2. Specifications

<i>Model</i>	<i>Input Voltage (ADC)</i>	<i>Output Voltage (ADC)</i>	<i>Maximum Armature Current</i>	<i>HP Range</i>
VFD100-2.4	115 VAC	115 VAC	2.4	1/16 - 1/4
VFD300-2.4	230 VAC	230 VAC	2.4	1/8 - 1/2
VFD600-2.4	115 VAC 230 VAC	230 VAC	2.4	1/8 - 1/2
VFD100-4	115 VAC	115 VAC	4.0	1/8 - 1/2
VFD300-4	230 VAC	230 VAC	4.0	1/4 - 1
VFD600-4	115 VAC 230 VAC	230 VAC	4.0	1/4 - 1
<b>AC Line Voltage</b>		115 or 230 VAC $\pm$ 10%, 50/60 Hz, 1 $\emptyset$		
<b>AC Motor Voltage</b>		115 or 230 VAC, 50/60 Hz, 1 $\emptyset$ or 3 $\emptyset$		
<b>Output Frequency Range</b>				0 - 120 Hz
<b>Adjustable Maximum Frequency Range</b>				30 - 120 Hz
<b>Standard Carrier Frequency</b>				16 kHz
<b>Acceleration Time Range</b>				1 - 12 seconds
<b>Deceleration Time Range</b>				1 - 12 seconds
<b>Analog Input Range</b> (signal must be isolated; S1 to S2*)				0 - 5 VDC
<b>Input Impedance (S1 to S2)</b>				$\sim$ 100K ohms
<b>Vibration</b>				0.5G maximum (0 - 50 Hz) 0.1G maximum (> 50 Hz)

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**Safety Certifications**

UL/cUL Listed Equipment, File # E132235

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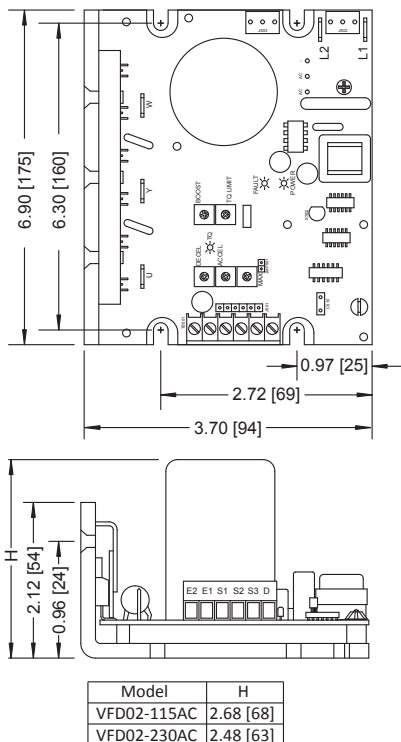
**Ambient Temperature Range**

10°C - 40°C

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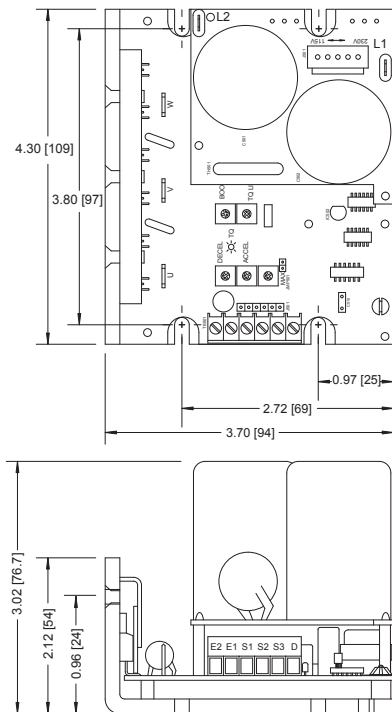
\* An isolation board option that allows for a non-isolated 0-5 VDC, 0-10 VDC, or 4-20 mA input signal is available; part number ISO301-1. This option is mounted in the field directly above the main board, maintaining the same footprint.

## Section 3. Dimensions



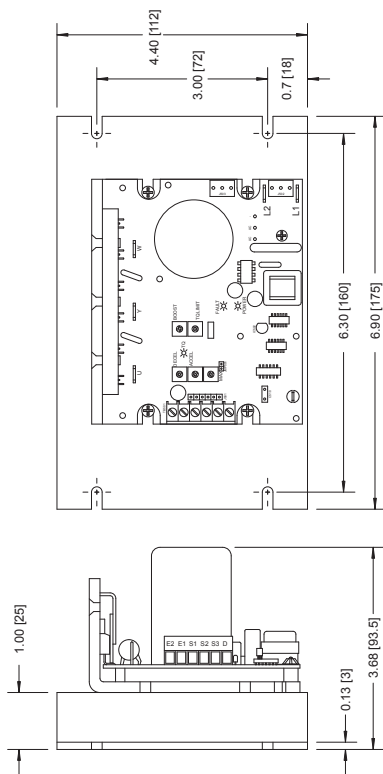
ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. VFD100-2.4 and VFD300-2.4 Dimensions



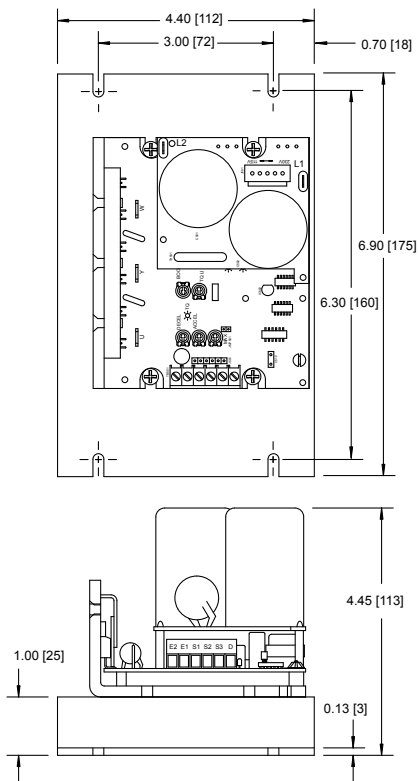
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Figure 2. VFD600-2.4 Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 3. VFD100-4 and VFD300-4 Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 4. VFD600-4 Dimensions

## Section 4. Installation



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

### 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 4 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 or heat sink should be earth grounded. Use a star washer beneath the head of at least one of the mounting screws to penetrate the anodized surface and to reach bare metal.

## Speed Adjust Potentiometer



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 5). Install the circular insulating disk between the panel and the 10K ohm speed adjust potentiometer.

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

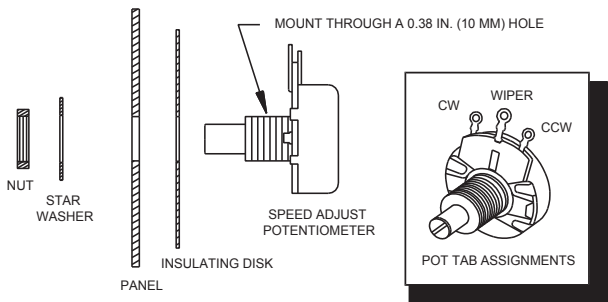


Figure 5. Speed Adjust Potentiometer



## 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.

Circuit potentials are at 115 or 230 VAC above ground. To prevent the risk of injury or fatality, avoid direct contact with the printed circuit board or with circuit elements.

Do not disconnect any of the motor leads from the drive unless power is removed or the drive is disabled. Opening any one motor lead while the drive is running may destroy the drive.

This product does not have internal solid state motor overload protection. It does not contain speed-sensitive overload protection, thermal memory retention or provisions to receive and act upon signal from remote devices for over temperature protection. If motor over protection is needed in the end-use product, it needs to be provided by additional equipment in accordance with NEC standards.

- Use 18 - 24 AWG wire for logic wiring. Use 14 - 16 AWG wire for AC line and motor wiring.

### Shielding Guidelines



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

As a general rule, it is recommended to shield all conductors. If it is not practical to shield power conductors, it is recommended to shield all logic-level leads. If shielding of all logic-level leads is not practical, the user should twist all logic leads with themselves to minimize induced noise.

It may be necessary to earth ground the shielded cable. If noise is produced by devices other than the drive, ground the shield at the drive end. If noise is generated by a device on the drive, ground the shield at the end away from the drive. Do not ground both ends of the shield.

If the drive continues to pick up noise after grounding the shield, it may be necessary to add AC line filtering devices, or to mount the drive in a less noisy environment.

Logic wires from other input devices, such as motion controllers and PLL velocity controllers, must be separated from power lines in the same manner as the logic I/O on this drive.

## Line Fusing

The drives should be fused for protection. Use fast acting fuses rated for 250 VAC or higher and 150% of maximum armature current. Fuse HOT L1 only when the line voltage is 115 VAC. Fuse both L1 and L2 when the line voltage is 230 VAC. Table 1 lists the recommended line fuse sizes.

**Table 1. Recommended Line Fuse Sizes**

<i>Drive</i>	<i>Single Phase Input Voltage (VAC)</i>	<i>Maximum Horsepower</i>	<i>AC Line Current (amps)</i>	<i>AC Line Fuse Size (amps)</i>
VFD100-2.4	115	1/4	7	10
VFD300-2.4	230	1/2	7	10
VFD600-2.4	115 / 230	1/2	10 / 7	15 / 10
VFD100-4	115	1/2	10	15
VFD300-4	230	1	10	15
VFD600-4	115 / 230	1	15 / 10	20 / 15

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

## Connections



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

American Control Electronics strongly recommends the installation of a master power switch in the voltage input line, as shown in Figures 6, 7, and 8 (pages 13 and 15). The switch contacts should be rated at a minimum of 200% of motor nameplate current and 250 volts.

### Power Input (VFD100 or VFD300)

Connect the AC line power leads to terminals L1 and L2. American Control Electronics recommends the use of a single-throw, double-pole master power switch. The switch should be rated at a minimum of 250 volts and 200% of motor current. Refer to Figure 6.

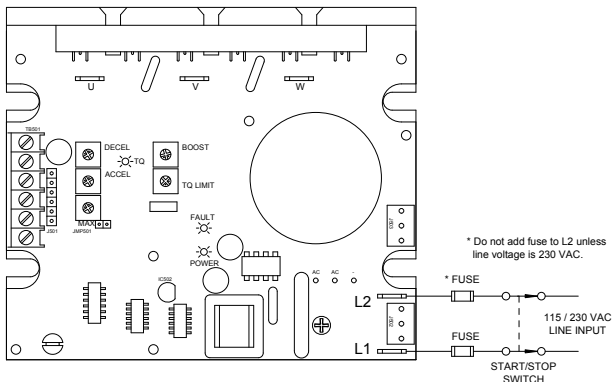


Figure 6. VFD100 and VFD300 AC Line Connections

## Power Input (VFD600)



Do not connect a 230 VAC line input when the drive is set for a 115 VAC input. This will result in severe damage to the motor and the drive, and can lead to explosion and/or injury. Check jumper settings before connecting the AC power input.

The VFD600 series drives are equipped with a voltage doubling feature which converts a 115 VAC input into a 230 VAC output for use with 230 VAC motors. The drive output current rating remains the same. User caution when connecting this input.

If the input voltage is 115 VAC and the motor is rated for 230 VAC, set the drive for voltage-doubler mode. Set jumper J501 for 115V as shown in Figure 7.

If the input voltage is 230 VAC and the motor is rated for 230 VAC, set the drive for non-voltage-doubler mode. Set jumper J501 for 230V as shown in Figure 8.

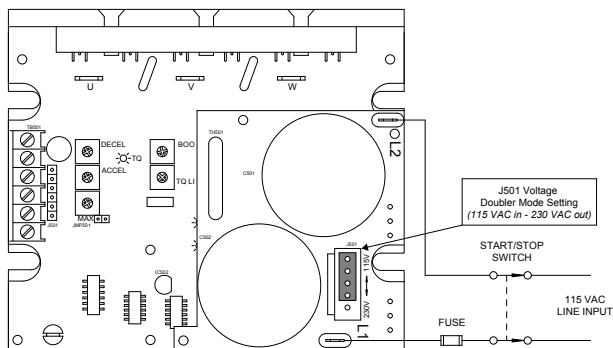


Figure 7. VFD600 Connections for a 115 VAC Line

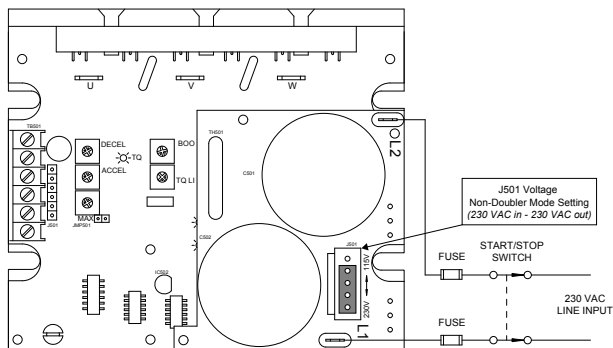


Figure 8. VFD600 Connections for a 230 VAC Line



Caution should be taken when operating fan-cooled motors at low speeds because their fans may not move sufficient air to properly cool the motor. It is recommended to use “inverter-duty” rated motors when the speed range is beyond 10:1.

**The following motor types MAY NOT be used:**

- Split Phase
- Repulsion Induction
- Series Universal AC/DC
- Any motor with a starting switch (centrifugal or relay) and/or a separate starting winding.

In general, the drive can work with capacitor-start motors, but it is conditional on the current pull when the capacitor is in effect and how long the application calls for a speed that the capacitor will stay in the auxiliary winding. It is recommended to contact the motor manufacturer to see if the motor can be ran with a VFD.

## Motor Connections (Single Phase Operation)

For single phase operation, connect the motor as shown in Figure 9. Ensure that the prewired capacitor and its associated motor coil are connected to terminals U and V as shown. This connection may be internal if using a 2-wire motor. If the motor has 3-leads, you may need to make this connection yourself.

To reverse a single phase split capacitor motor, connect the motor as shown in Figure 10. The motor run cap must be removed from the circuit.

## Motor Connections (Three Phase Operation)

Connect the motor to terminals U, V, and W as shown in Figure 11.

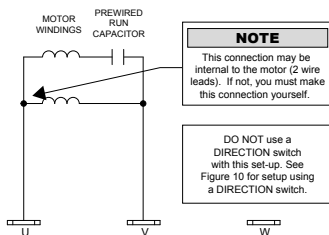


Figure 9. Single Phase Motor Connections

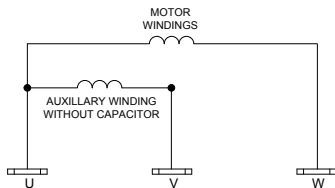


Figure 10. Single Phase Motor Connections - Reversing

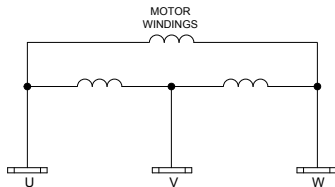


Figure 11. Three Phase Motor Connections



## 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 12.

## Enable Switch

Connect a single-pole, single throw ENABLE switch between terminals E1 and E2. Open the switch to disable the drive and coast the motor to a stop. Close the switch to enable the drive and accelerate to set speed at a rate determined by the ACCEL trim pot.

## Direction Switch

Connect a single-pole, single throw DIRECTION switch between terminals E1 and D. Open the switch to run the motor in the forward direction. Close the switch to run the motor in the reverse direction.

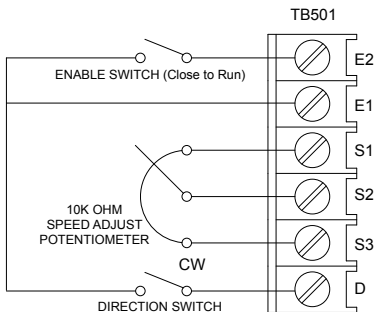


Figure 12. Potentiometer and Switch Connections

### Analog Input Signal

Instead of using a speed adjust potentiometer, the drive may be wired to follow an analog input voltage signal that is isolated from earth ground (Figure 13). 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. Adder board ISO301-1 may be used to isolate an analog input voltage.

An analog input voltage range of 0–5 VDC is required to produce an voltage range of 0 - full speed.

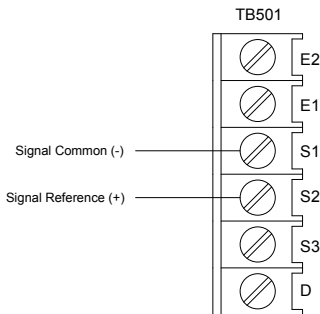


Figure 13. Analog Input Signal Connections

## 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 41, for further assistance.

### Before Applying Power

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

## Select Switches

### Input Voltage Select (J501) (VFD600 models only)

Set the input voltage select jumper J501 to either 115 or 230 to match the AC line voltage. See Figure 14.

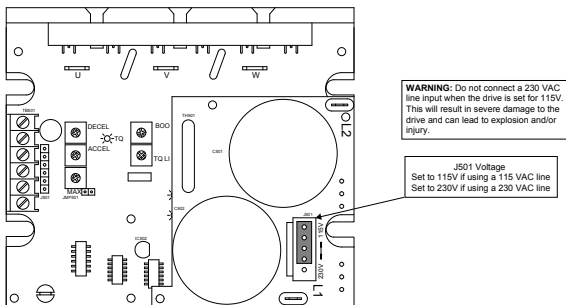


Figure 14. J501 Settings

## 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 AC line 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 AC line power (both lines) is the only acceptable method for emergency stopping.

For this reason, American Control Electronics strongly recommends installing an emergency stop switch on both AC line inputs (see Figures 6, 7, and 8 on pages 13 and 15).

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 enable is closed.

### Line Starting and Stopping

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

## Decelerating to Zero Speed

The switch shown in Figure 15 may be used to decelerate a motor to zero speed. The DECEL trim pot setting determines the rate at which the drive decelerates. By opening the switch, the motor accelerates to set speed at a rate determined by the ACCEL trim pot setting.

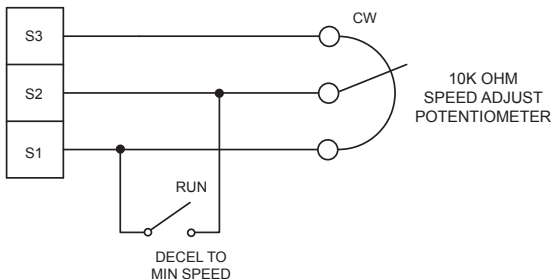


Figure 15. Run/Decelerate to Minimum Speed Switch

## Coast to Zero Speed (Enable)

The enable switch may be used to coast a motor to a stop. Refer to page 18.

### 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.

VFD 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.



## Maximum Speed (MAX)

The MAX setting determines the maximum motor speed (voltage/frequency) when the speed adjust potentiometer or input voltage signal is set for maximum speed.

To calibrate MAX:

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

### Torque (TQ LIMIT)



TQ 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 TQ LIMIT setting determines the maximum torque for accelerating and driving the motor.

To calibrate TQ LIMIT:

1. With the power disconnected from the drive, connect a DC ammeter in series with the armature.
2. Set the TQ 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 TQ 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.

## Boost (BOOST)

The BOOST trim pot is used to increase motor torque at low speeds. The minimum setting is sufficient for most applications and does not need to be adjusted. If the motor stalls or runs erratically at very low speeds (below 10 Hz), the boost trim pot may need adjustment.

To calibrate BOOST:

1. Run the motor at the lowest continuous frequency/speed required.
2. Monitor the motor phase current (with a true RMS meter) while very slowly turning the BOOST trim pot CW until the motor operates properly, or 100% of the motor nameplate current is reached.

**NOTE:** Use the absolute minimum amount of BOOST necessary to achieve proper motor operation. Improper use of the BOOST feature may cause motor and/or drive overheating and failure.

### 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.

### Deceleration (DECEL)

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

To set the deceleration time:

1. Set the speed adjust potentiometer or input voltage signal for maximum speed. The motor should run at maximum speed.
2. Set the speed adjust potentiometer or input voltage signal for minimum speed. Measure the time it takes the motor to go from maximum to minimum speed.
3. If the time measured in step 2 is not the desired deceleration time, turn the DECEL trim pot CW for a longer deceleration time or CCW for a shorter deceleration time. Repeat steps 1 through 2 until the deceleration 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 16). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

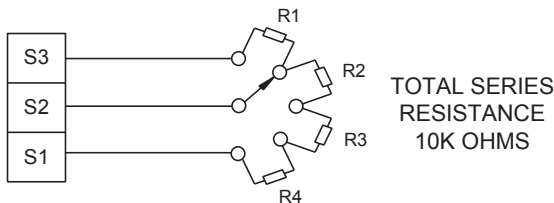


Figure 16. Multiple Fixed Speeds

## Adjustable Speeds Using Potentiometers In Series

Replace the speed adjust potentiometer with a series of resistors with a total series resistance of 10K ohms (Figure 17). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

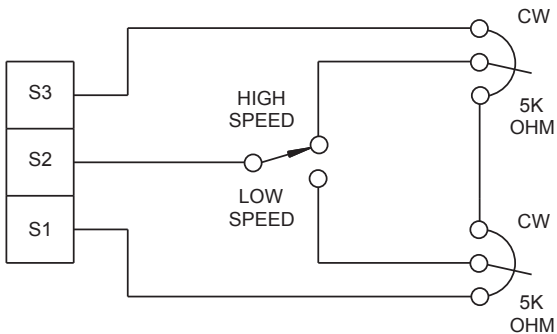


Figure 17. Adjustable Speeds Using Potentiometers In Series

## Independent Adjustable Speeds

Replace the speed adjust potentiometer with a single pole, multi-position switch, and two or more potentiometers in parallel, with a total parallel resistance of 10K ohms. Figure 18 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

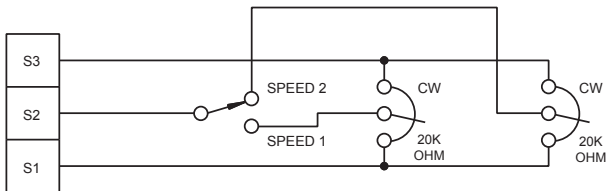


Figure 18. Independent Adjustable Speeds

## Independent Adjustable Speeds with Direction Switch

Replace the speed adjust potentiometer with two single-pole, double throw switches, and two potentiometers in parallel with a total parallel resistance of 10K ohms. Figure 19 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

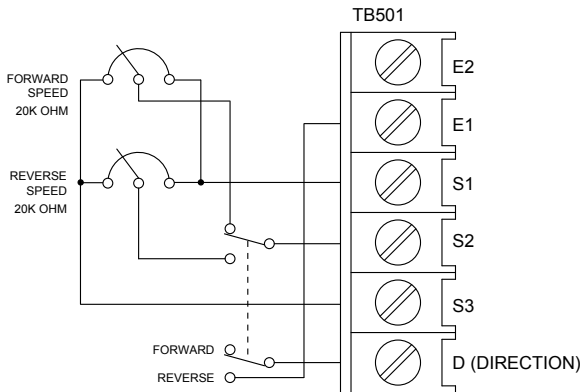


Figure 19. Independent Adjustable Speeds with a Direction Switch



## RUN/JOG Switch - Enable Connection

Connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 20. When the RUN/JOG switch is set to JOG, the motor coasts to zero speed. Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

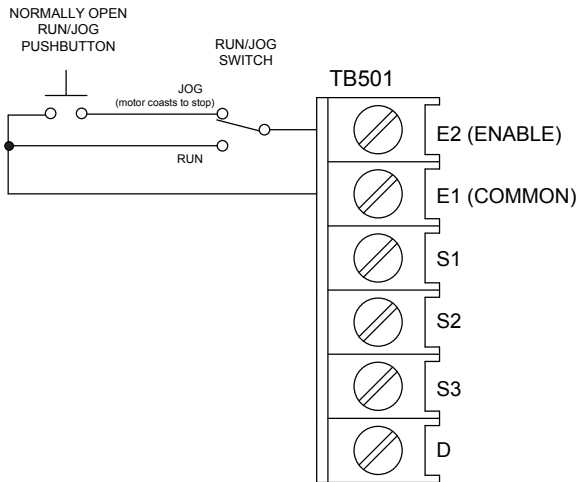


Figure 20. RUN/JOG Switch - Connection to Speed Adjust Potentiometer

## RUN/JOG Switch - Potentiometer Connection

Connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 21. When the RUN/JOG switch is set to JOG, the motor decelerates to zero speed at a rate determined by the DECEL trim pot. Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

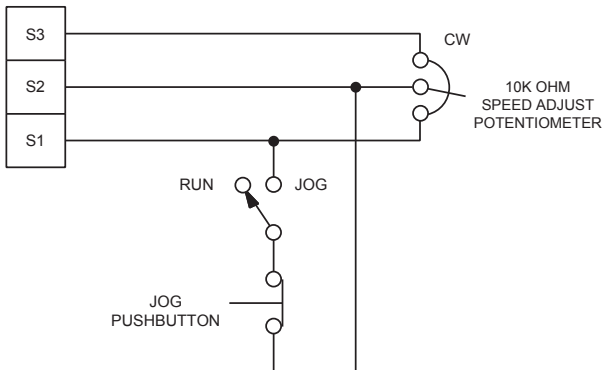


Figure 21. RUN/JOG Switch - Connection to Speed Adjust Potentiometer

## Leader-Follower Application

In this application, use a ISO202-1 to monitor the speed of the leader motor (Figure 22). 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.

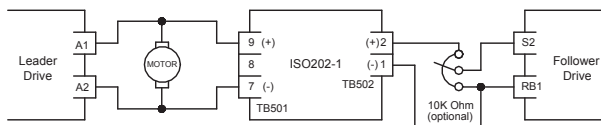


Figure 22. Leader-Follower Application

## Single Speed Potentiometer Control Of Multiple Drives

Multiple drives can be controlled with a single speed adjust potentiometer using an ISO101-8 at the input of each drive to provide isolation (Figure 23). Optional ratio potentiometers can be used to scale the ISO101-8 output voltage, allowing independent control of each drive.

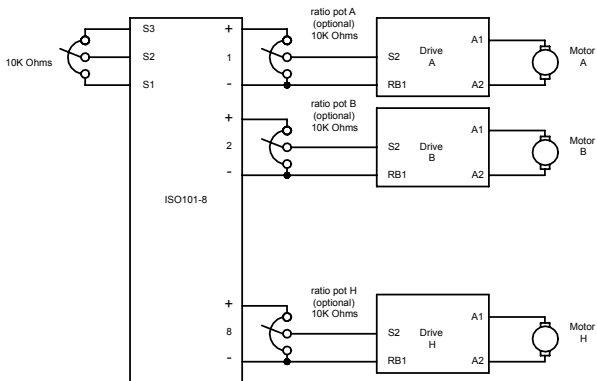


Figure 23. Single Speed Potentiometer Control of Multiple Drives

## Quick Reversing

To reverse the direction of the motor shaft rotation, install a DPDT center off switch as shown below (Figure 24). The drive will brake the motor before reversing, so there is no need to wait for the motor to coast to a stop before changing direction.

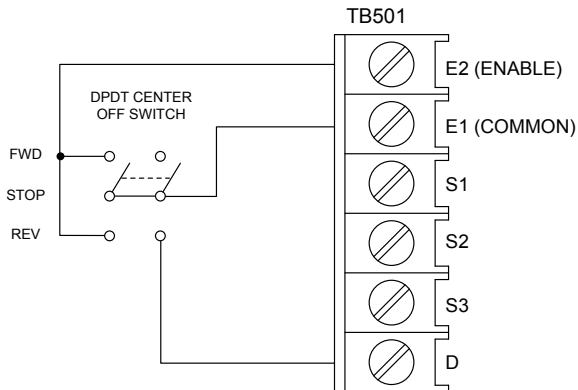


Figure 24. Quick Reversing Circuit Wiring

### Section 7. Diagnostic LEDs

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VFD series drives are equipped with three diagnostic LEDs:

- **Power (POWER):** Green LED lights whenever AC line voltage is applied to the drive.
- **Current Limit (TQ):** Yellow LED lights whenever the drive reaches current limit.
- **Fault (FAULT):** Red LED lights whenever one of the following conditions has occurred.
  1. **Undervoltage**  
115 VAC line: DC bus dropped below 100 VDC (93.5 VAC rms).  
230 VAC line: DC bus dropped below 200 VDC (187 VAC rms).
  2. **Overvoltage**  
115 VAC line: DC bus exceeded 200 VDC (152.5 VAC rms).  
230 VAC line: DC bus exceeded 400 VDC (302 VAC rms).
  3. **Instantaneous Overcurrent Trip**  
Inverter output current has exceeded safe levels.

To remove a fault condition, the enable must be cycled. Cycling the AC line power will remove a fault as well, but the capacitors must completely discharge before re-applying power for the fault to clear.

Refer to Figure 25 on page 40 for LED locations.

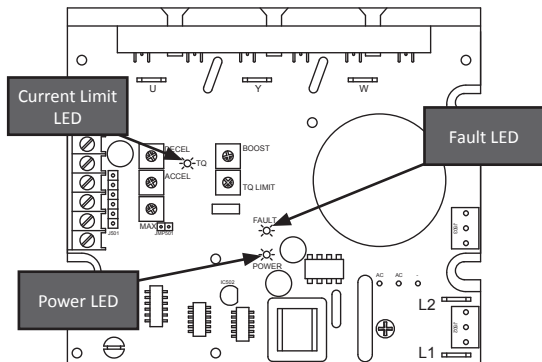


Figure 25. Diagnostic LED Locations

# Section 8. Troubleshooting



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 AC line voltage from the drive.
2. Check the drive closely for damaged components.
3. Check that no conductive or other foreign material has become lodged on the printed circuit board.
4. Verify that every connection is correct and in good condition.
5. Verify that there are no short circuits or grounded connections.
6. Check that the 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 TQ LIMIT settings, resize motor and drive for actual load demand, or check for incorrectly aligned mechanical components or "jams". See page 27 for information on adjusting the TQ 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. Speed adjust potentiometer or input voltage signal is not properly connected to drive input; connections are open.	2. Check connections to input. Verify that connections are not open.
	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 TQ LIMIT setting if set too low.
	5. Drive is in a FAULT condition.	5. Disable and then re-enable drive.
	6. Drive is disabled.	6. Make sure there is a short between terminals COM and EN.
	7. Drive is not receiving AC line voltage.	7. Apply AC line voltage.
	6. Motor is not connected.	6. Remove power. Connect the motor to U, V, and W. Reapply power.

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
<b>Motor runs too slow or too fast at set speed.</b>	1. MAX trim pot is not calibrated correctly.	1. Calibrate the MAX trim pot (page 26).
<b>Motor will not reach the desired speed.</b>	1. MAX setting is too low.	1. Increase MAX setting (page 26).
	2. Nominal input voltage may be too low for motor.	2. Compare motor voltage to input voltage; replace motor is necessary.
	3. Motor is overloaded.	3. Check motor load. Resize the motor if necessary.
<b>Motor pulsates or surges under load.</b>	1. Motor “bouncing” in and out of torque limit.	1. Make sure the motor is not undersized for load; adjust TQ LIMIT setting CW (page 27).
<b>Motor does not reverse.</b>	1. Defective DIRECTION switch connection.	1. Check DIRECTION switch connection.
	2. Reversing circuit not working properly.	2. Check reversing circuit by shorting TB501 D terminal and EN terminal with jumper wire.
<b>TQ LIMIT is unsatisfactory at high speeds.</b>	1. TQ LIMIT set too low.	1. Check TQ LIMIT setting (page 27).
	2. Load may exceed rating of motor/drive.	2. “Fix” load (i.e., straighten mounting, coupling, etc.); or replace motor and drive with motor and drive rated for higher horsepower.
	3. Nominal input voltage may be too low for motor.	3. Compare motor voltage to input voltage. Replace motor if necessary.

## Section 9. Accessories & Replacement Parts

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### Displays

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

### Kits

#### Potentiometer & Connector

Pot Kit .....	KTP-0108
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#### Fuse

2 1.5 Amp 250V 3AG Fast-blow Glass Fuses .....	KTF-0001
2 3 Amp 250V 3AG Fast-blow Glass Fuses .....	KTF-0002
2 5 Amp 250V 3AG Fast-blow Glass Fuses .....	KTF-0003
2 8 Amp 250V 3AG Fast-blow Glass Fuses .....	KTF-0004
2 10 Amp 250V 3AB Normal-blow Ceramic Fuses .....	KTF-0005
2 15 Amp 250V 3AB Normal-blow Ceramic Fuses .....	KTF-0006

### Logic Cards

#### Isolation Cards

Adder Board .....	ISO301-1
Unidirectional, 8 outputs.....	ISO101-8

## Section 10. Optional C510 Capacitor Kit

In some applications, lower carrier frequency reduces switching losses and increases bearing life in some motors. American Control Electronics provides an optional capacitor kit for lowering the carrier frequency.

The default carrier frequency on a VFD series control is 16 kHz. Using one of the capacitors supplied in kit KTP-0108, the carrier frequency can be lowered to a range of 12 kHz to 4 kHz.

Note: Audible noise will be increase as carrier frequency is lowered.

To lower the carrier frequency on a VFD series control, install one of the following 2-pin capacitors (C510) on the bottom board. Refer to Figure 26 on page 46.

Table 2. KTP-0108 Capacitor Values and Carrier Frequency

<i>Frequency</i>	<i>Label on Capacitor</i>	<i>Value</i>
12 kHz	3n3J	0.0033 $\mu$ F
10 kHz	6n8	0.0068 $\mu$ F
8 kHz	10n	0.01 $\mu$ F
4 kHz	33n	0.033 $\mu$ F



### Notes

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## Unconditional Warranty

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### A. Warranty

American Control Electronics warrants that its products will be free from defects in workmanship and material for twelve (12) months or 3000 hours, whichever comes first, from date of manufacture thereof. Within this warranty period, American Control Electronics will repair or replace, at its sole discretion, such products that are returned to American Control Electronics, 14300 De La Tour Drive, South Beloit, Illinois 61080 USA.

This warranty applies only to standard catalog products, and does not apply to specials. Any returns of special controls will be evaluated on a case-by-case basis. American Control Electronics is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to and from the repair point.

### B. Disclaimer

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### C. Limitations of Liability

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

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

If for any reason any of the foregoing provisions shall be ineffective, American Control Electronics's liability for damages arising out of its manufacture or sale of equipment, or use thereof, whether such liability is based on warranty, contract, negligence, strict liability in tort, or otherwise, shall not in any event exceed the full purchase price of such equipment.

Any action against American Control Electronics based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment or the use thereof, must be commenced within one year after the cause of such action arises.



VFD100-2.4



VFD300-2.4



VFD600-2.4



VFD100-4



VFD300-4



VFD600-4



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