USER'S MANUAL
MMVFD Series

Models:

MMVFD03-115AC
MMVFD04-115AC
MMVFD03-230AC
MMVFD04-230AC
MMVFD03-D230AC
MMVFD04-D230AC

Variable-frequency drives for
3-phase AC motors

Minarik Automation & Control

Printed in the United States of America.

Safety Warnings

- This symbol ⚠ denotes an important safety tip or warning. **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 proper grounding, 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.** Minarik 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 trimpots. Use approved personal protective equipment and insulated tools if working on this drive with power applied.

General Information

The Minarik MotorMaster Variable Frequency Drive (MMVFD) Series are solid-state, ASIC-based, variable-frequency AC motor drives. With a 115 or 230 VAC, 50/60 Hz, single-phase input, MMVFDs are factory calibrated for an output of 1* to 60 Hz. They will operate any 1 HP or smaller, 115- or 208/230-volt, three-phase-AC-induction, single-phase or permanent split capacitor motor through a speed range of zero* through nameplate speed. They can be user calibrated for 1* through 120 Hz output.

Although MMVFD inverters can operate over a 30:1 speed range, most motors will operate over a 10:1 speed range with constant torque at 1* to 60 Hz and constant horsepower above 60 Hz. (Inverter-duty motors may operate satisfactorily over a 20:1 speed range.) Some motors can be satisfactorily operated at speeds as low as 50 rpm (speed range 50:1). Below 50 rpm, some motors may show signs of “stepping” or “cogging”, or run warmer.

*Although the MMVFD will allow a minimum of 1 Hz, the actual minimum frequency is dependent on motor type and load. The motor may need to be derated for low-frequency (30 Hz and lower) operation. Please consult the motor manufacturer.

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 primitive method may cause instabilities due to the lack of feedback from one of the motor connections. Furthermore, motor torque will be reduced considerably because the phases are still 120º apart. The MMVFD can efficiently operate a single-phase motor because the ASIC changes the phase shift to 180º in order to develop maximum torque.

A 90º phase-shifted output is provided in two-phase operation in order to eliminate the start capacitor.

The MMVFD series features solid-state reversing with adjustable acceleration and deceleration. The MMVFD may also interface with motor thermal protection through the enable circuit.

MMVFD Series Features

- ASIC-based
- Solid-state circuitry
- Adjustable minimum and maximum speed
- Adjustable acceleration and deceleration
- Solid-state braking and reversing
- Adjustable current limit
- Adjustable V/Hz during acceleration
- Adjustable voltage boost at low speeds
- Multiple motor operation
- Three-phase and single-phase motor control
- Power LED
- Current limit LED (“D” versions only)
- DC injection braking

IMPORTANT INFORMATION

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. Minarik recommends “inverter-duty” motors when the speed range is beyond 10:1.

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

- Permanent split capacitor (PSC)
- Shaded pole
- AC synchronous
- AC stepping: 28.8, 72 and 200-RPM type.

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

- Split phase
- Capacitor start
- Repulsion induction
- Series Universal AC/DC
- Any motor with starting switch (centrifugal or relay) and/or separate starting winding.

Contents

Illustrations

Tables

Notes

Specifications

Drive	1-Phase Input (VAC)	1 or 3-Phase Output (VAC)	Max HP	Max Continuous Output Current (AC)	AC Amps In
MMVFD03-115AC	115	115	¼	2.4	7
MMVFD03-D230AC*	115/230	230	½	2.4	11/7
MMVFD03-230AC	230	230	½	2.4	7
MMVFD04-115AC	115	115	½	4.0†	10
MMVFD04-D230AC*	115/230	230	1	4.0†	16/10
MMVFD04-230AC	230	230	1	4.0†	10

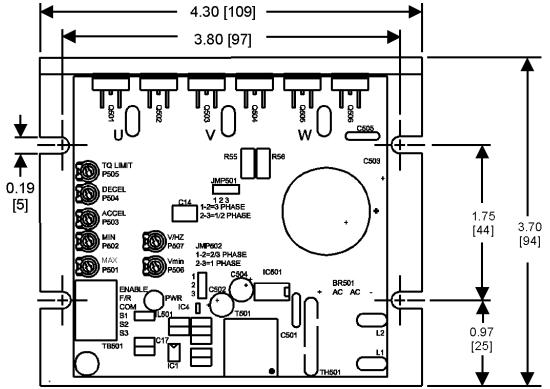
*Connect only 115 VAC line input to the 115 VAC terminals. Do not connect 230 VAC line input to the 115 VAC terminals. This will result in severe damage to the motor and drive, and possible explosion and injury.

†Requires Minarik heat sink kit p/n 223-0159 when continuous current is greater than 3 amps or if ambient temperature is above 40º C. Derate current by 2% per degree if the operating temperature is above 40º C. Under no circumstances may the ambient temperature exceed 55º C.

AC Voltage Input Range	
MMVFDxx-115AC drives	115 VAC ± 10%, 50/60 Hz single phase
MMVFDxx-230AC drives	230 VAC ± 10%, 50/60 Hz single phase
MMVFDxx-D230AC drives	115/230 VAC ± 10%, 50/60 Hz single phase
Fundamental Carrier Frequency	15 KHz
Output Frequency Range	1 – 120 Hz
Adjustable Minimum Output Frequency Range	1** – 11 Hz
Maximum Output Frequency Range (60 Hz input)	40 – 120 Hz
Acceleration Time Range (no load)	2 seconds
Deceleration Time Range (no load)	2 seconds
Analog Input Voltage Range (signal must be isolated; S1 [-] to S2 [+])	0 – 5VDC
Input Impedance, S1 to S2	~ 50K ohms
Vibration	0.5G max (20 – 50 Hz) 0.1G max (>50 Hz)
Weight	1.2 lb
Ambient Operating Temperature Range	10º – 40º C

**The actual minimum frequency you observe is dependent on your motor and system setup.

Dimensions



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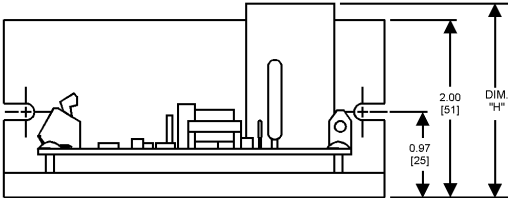
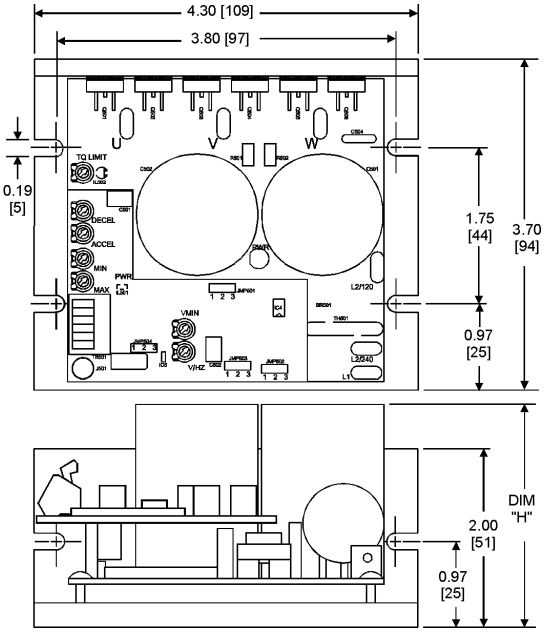


DRIVE	DIM. "H"
MMVFD03-115AC	2.15 [55]
MMVFD04-115AC	2.54 [65]
MMVFD03-230AC	2.34 [60]
MMVFD04-230AC	2.50 [68]

Figure 1. MMVFDxx-115AC and MMVFDxx-230AC Dimensions



DRIVE	DIM. "H"
MMVFD03-D230AC	2.30 [59]
MMVFD04-D230AC	2.50 [64]

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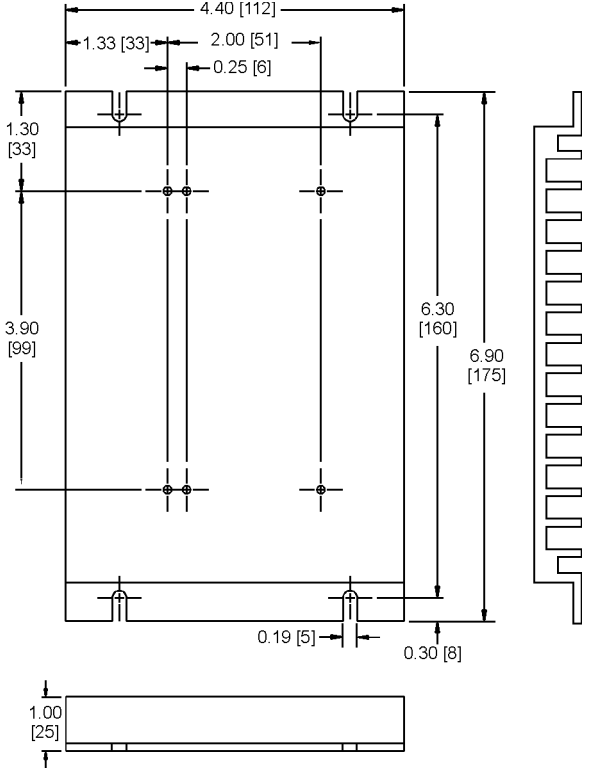
Figure 2. MMVFDxx-D230AC Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 3. Heat Sink Dimensions

Installation

Mounting

Warning

Do not install, rewire, or remove this control with input power applied. Doing so may cause fire or serious injury. Make sure you have read and understood the Safety Warnings before attempting installation.

NOTE: Horizontal mounting may require derating the drive. See your Minarik representative for more information.

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

Wiring

Warning

Do not install, remove, or rewire this equipment with 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. Opening any one motor lead may destroy the drive.

- Use 20 – 24 AWG wire for speed adjust potentiometer wiring. Use 14 – 16 AWG wire for AC line (L1, L2) and motor (U,V and W) wiring.

Shielding guidelines

Warning

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

As a general rule, Minarik recommends shielding of all conductors.

If it is not practical to shield power conductors, Minarik recommends shielding all logic-level leads. If shielding the logic 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.

Heat sinking

MMVFD04-series drives require heat sink p/n 223-0159 when the continuous armature current is above 3 amps AC. All other MMVFD series drives have sufficient heat sinking in their basic configurations. No additional heat sinking is necessary.

Fusing

MMVFD series drives require external AC power line fuses. Connect the external line fuse(s) in series with the AC voltage input. See *Connections* on page 11. Use fast-acting fuses rated for 250 VAC or higher. See Table 1 for recommended line fuse sizes.

Table 1. Line Fusing Chart

Drive	1-Phase Input (VAC)	Max HP	AC Amps In	AC Line Fuse Size (Amps)
MMVFD03-115AC	115	¼	10	15
MMVFD03-D230AC	115/230	½	11/7	20/15
MMVFD03-230AC	230	½	7	15
MMVFD04-115AC	115	½	10	15
MMVFD04-D230AC	115/230	1	16/10	25/15
MMVFD04-230AC	230	1	10	15

Speed adjust potentiometer

Warning

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

Mount the speed adjust potentiometer through a 0.38 in. (10 mm) hole with the hardware provided (Figure 4). 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 speed adjust potentiometer wires are longer than 18 in. (457 mm), use shielded cable. Keep speed adjust potentiometer wires separate from power leads (L1, L2, U, V, W).

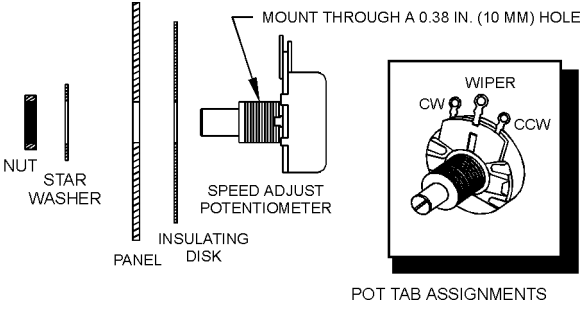
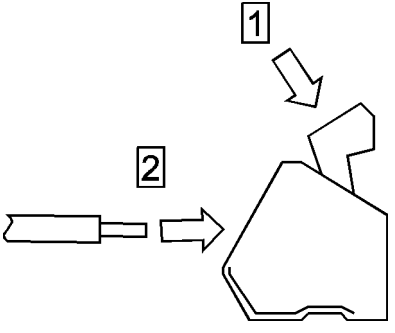


Figure 4. Speed Adjust Potentiometer

Cage-clamp terminals

MMVFD Series connections include cage-clamp terminals (see Figure 5). To insert a 20 AWG or smaller wire into a terminal:

1. Press down on the lever arm using a small screwdriver.
2. Insert wire into the wire clamp.
3. Release the lever arm to clamp wire.



Side view of wire installation

Figure 5. Cage-Clamp Terminal

Connections

Warning

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

Minarik strongly recommends the installation of a master power switch in the voltage input line. The switch contacts should be rated at a minimum of 200% of motor nameplate current and 250 volts.

Power and fuse connections

MMVFDxx-115AC and MMVFDxx-230AC series

Connect the AC power input to L1 and L2 as shown in Figure 6 (page 12). Connect an external fuse between the drive and master stop switch. Install the switch between the external fuse and AC power input as shown.

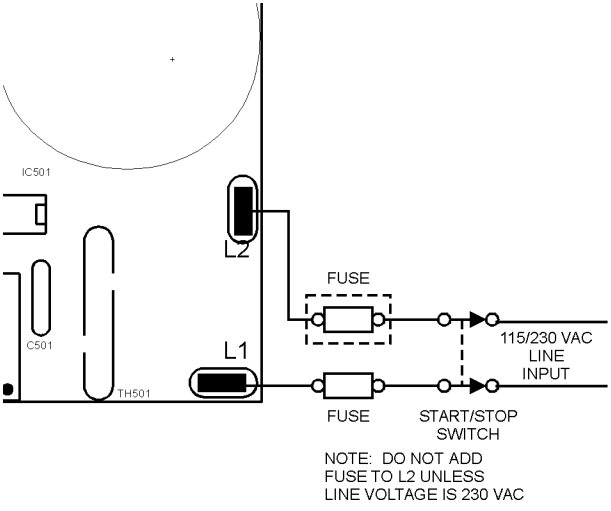


Figure 6. AC Line and Fuse Connections for MMVFDxx-115AC and MMVFDxx-230AC Series Drives

MMVFDxx-D230AC series

Warning

Do not connect 230 VAC line input to the 115 VAC terminals. This will result in severe damage to the motor and drive, possible explosion and severe injury.

Connect AC power input to L1 and L2 as shown in Figure 7 or Figure 8 (page 14), depending on your power needs.

NOTE: MMVFDxx-D230AC-series drives are equipped with a voltage-doubling feature, which converts a 115 VAC input to a 230 VAC output, for use with 230V motors. The drive current output remains the same. Use caution when connecting this output.

- If the input voltage is 115 VAC and the desired output voltage is 230 VAC (voltage doubler mode), connect L1 and L2/120 as shown in Figure 7. Do not add a line fuse to L2.

- If the input voltage is 115 VAC and the desired output voltage is 115 VAC (no voltage doubler), connect L1 and L2/240 as shown in Figure 8. Do not add a line fuse to L2.

- If the input voltage is 230 VAC and the desired output voltage is 230 VAC (no voltage doubler), connect L1 and L2/240 as shown in Figure 8. Add a line fuse to L1 and L2/240. **Do not use the voltage doubler with 230 VAC line voltage.**

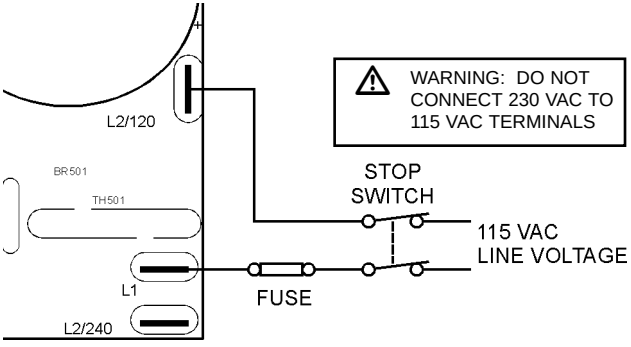


Figure 7. AC Line and Fuse Connections for MMVFDxx-D230AC Series Drives (Voltage Doubler Mode)

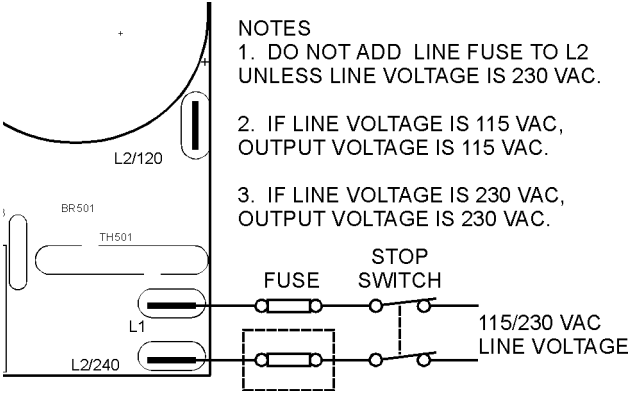


Figure 8. AC Line and Fuse Connections for MMVFDxx-D230AC Series Drives (No Voltage Doubler)

Motor connections (all MMVFD-series controls)

Single-phase operation

Warning

It is very important that terminal V, the center motor terminal on the circuit board, be left open (no connection) for single-phase operation.

NOTE: If the motor and capacitor are sold separately, Minarik highly recommends buying only the motor and operating in 2-phase mode as described below. The resulting speed range will be considerably wider, while starting torque will approach that of a 3-phase motor.

If the motor capacitor is permanently mounted to the motor by the factory, Minarik recommends leaving the capacitor attached (thereby reducing the potential for human error) and running the drive and motor in single-phase mode.

NOTE: Ensure that jumper terminals JMP501 and JMP502 are properly set before applying power to the motor and drive. Refer to *Jumper Settings* (page 23) for more information.

For single-phase operation, connect the motor as shown in Figure 9 (page 16). Ensure that the prewired capacitor and its associated motor coil are connected to terminals U and W as shown. This connection may be internal if using a 2-wire motor. If the motor has three leads, you must make this connection yourself. Make no connection to terminal V.

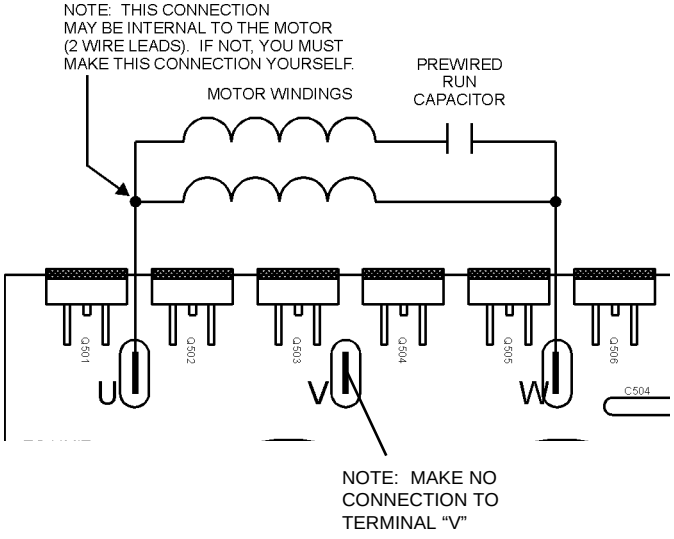


Figure 9. Motor Connections for Single-Phase Operation (Motor With Pre-Wired Capacitor)

Two-phase operation

Warning

For two-phase operation, ensure that the start capacitor is not connected.

NOTE: Ensure that jumper terminals JMP501 and JMP502 are properly set before applying power to the motor and drive. Refer to *Jumper Settings* (page 23) for more information.

Connect the motor as shown in Figure 10 (page 18). Ensure that terminals U and V are connected through the motor coil as shown. In a three-wire motor, this connection may be internal. If the motor has four leads, you must make this connection yourself. Make no connection between terminals V and W.

Three-phase operation

NOTE: Ensure that jumper terminals JMP501 and JMP502 are properly set before applying power to the motor and drive. Refer to *Jumper Settings* (page 23) for more information.

Connect a three-phase motor to terminals U, V and W as shown in Figure 11 (page 19).

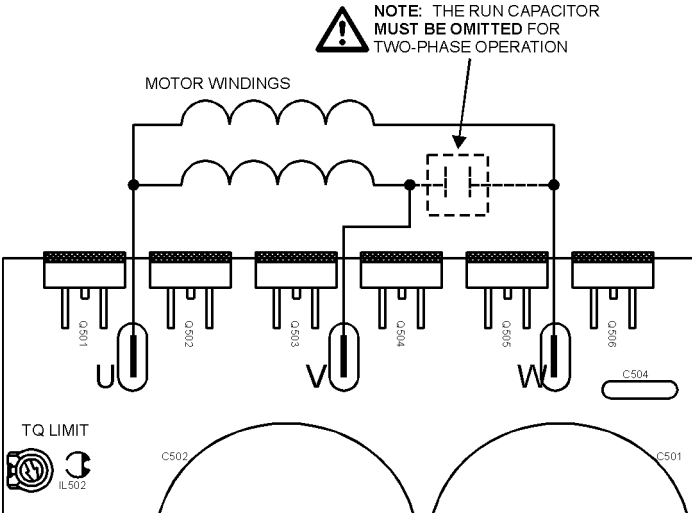


Figure 10. Motor Connections for Two-Phase Operation (No Pre-Wired Capacitor)

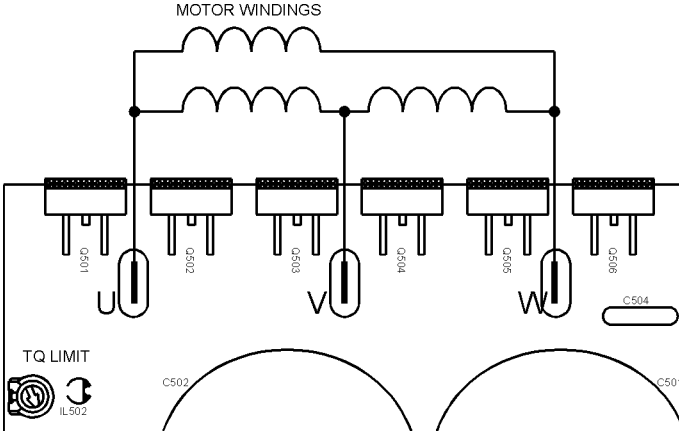


Figure 11. Motor Connections for Three-Phase Motors

Signal and Optional Switch Connections

Make all signal and switch connections at TB501 as shown in Figure 12. TB501 is located on the upper board on MMVFDxx-D230AC-series drives. Terminal board orientation and terminal names are identical for all MMVFD03 and -04 series drives.Use 20-24 AWG wire for speed adjust pot and switch connections.

Speed adjust potentiometer

Connect a speed adjust potentiometer to terminals S1, S2 and S3. Make sure the potentiometer is connected so that the motor speed will increase as the wiper (S2) is turned clockwise (CW).

ENABLE/DISABLE switch

Connect a single-pole, single-throw ENABLE/DISABLE switch between the ENABLE (EN) and COM terminals as shown. Open the switch to disable the drive and coast to a stop. Close the switch to accelerate to set speed at a rate controlled by the ACCEL trimpot.

DIRECTION (DIR) switch

Connect a single-pole, single-throw DIR switch between the DIR and COM terminals as shown. Opening the switch will cause the motor to rotate in the forward direction; closing the switch will reverse motor rotation.

The drive will decelerate the motor to a stop before reversing, so there is no need to wait for the motor to coast to a stop before changing direction.

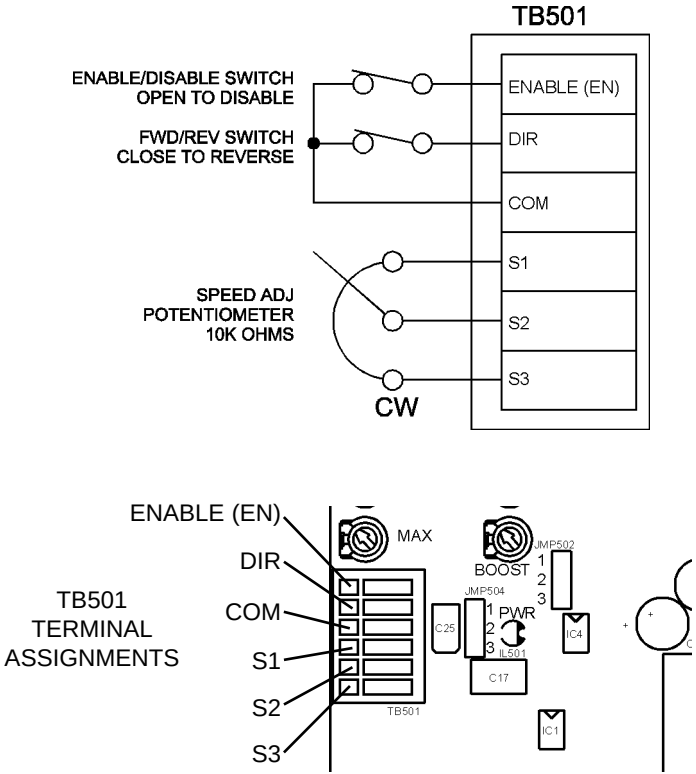


Figure 12. Signal and Optional Switch Connections

Operation

Warning

Dangerous voltages exist on the drive when it is powered, and up to 60 seconds after power is removed and the motor stops. BE ALERT. High voltages can cause serious or fatal injury.

Do not change jumper settings with power applied. Ensure that jumper settings are compatible with the motor being controlled.

VOLTAGE INPUT WARNING FOR MMVFDxx-D230AC DRIVES

Do not connect 230 VAC line input to the 115 VAC terminals. This will result in severe damage to the motor and drive, and possible explosion and injury.

Jumper Settings

Warning

Do not change jumper settings with power applied. Ensure that jumper settings are compatible with the motor being controlled.

The MMVFD series is equipped with four jumper terminals, which control different aspects of drive operation. Refer to Figure 15 (page 27) for terminal locations.

Drive phase output (JMP501 and JMP502)

JMP501 and JMP502 must be set to match the phase of the motor being controlled. The factory (default) setting is three-phase operation (terminals 1 and 2 jumpered). Refer to Table 2 for optional jumper settings.

Table 2. Jumper Settings

Motor Operation	JMP501 Settings	JMP502 Settings
Single-phase	2-3	2-3
Two-phase	2-3	1-2
Three-phase	1-2	1-2

Acceleration mode select (JMP503)

The MMVFD-D230AC series is equipped with a dual V/Hz feature, which allows the setting of a linear or variable V/Hz characteristic. The linear setting should be used for all constant torque applications. The use of the variable characteristic in the appropriate applications can save energy at speeds below the base motor speed. Figure 13 (page 26) shows a simple graph illustrating the difference between linear- and variable-V/Hz modes.

Linear acceleration mode produces a constant V/Hz and torque (current) output from the drive.

In contrast, variable-torque mode produces a variable V/Hz and torque (current) output from the drive. As a result, fans and centrifugal pumps, which normally dissipate energy at low speeds, can be much more efficient.

For linear-torque mode, jumper terminals 1 and 2 of JMP503 (this is the factory setting). For variable-torque mode, jumper terminals 2 and 3. Refer to Figure 15 (page 27) for terminal locations, and Figure 17 (page 28) for jumper settings.

Braking mode select (JMP504)

The MMVFD series is equipped with DC injection braking, for use with high-inertia applications (see Figure 14, page 26).

As a rule, DC motors do not convert AC ripple in the DC signal to mechanical energy; instead, it is dissipated as waste heat. AC motors perform in the opposite fashion: any DC component of an AC signal is converted to mechanical energy and acts as drag on an AC motor.

When injection braking is selected and the drive is disabled, the normal AC phase output to the motor from the drive is set to its minimum frequency. The drive simultaneously introduces a DC voltage (not to exceed the threshold set by the CURRENT LIMIT trimpot) into the motor stator for two (2) seconds. The motor will brake for two seconds, then coast to a stop. This stops the motor much more quickly and efficiently than simply coasting to a stop, while avoiding high currents which may damage the motor and drive.

For normal operation, jumper terminals 1 and 2 of terminal JMP504 (this is the factory setting). To enable DC injection braking, jumper terminals 2 and 3. Refer to Figure 15 (page 27) for terminal locations, and Figure 17 (page 28) for jumper settings.

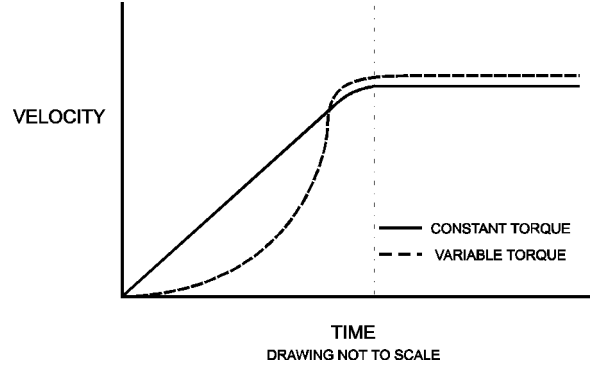


Figure 13. MMVFDxx-D230AC Acceleration Personality

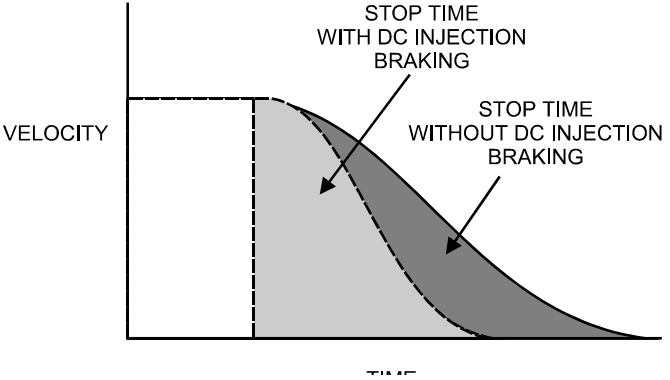
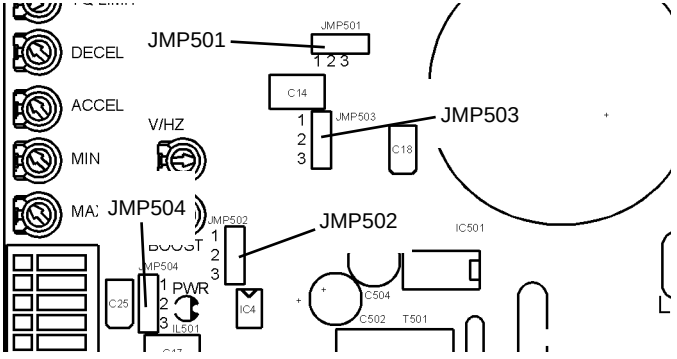
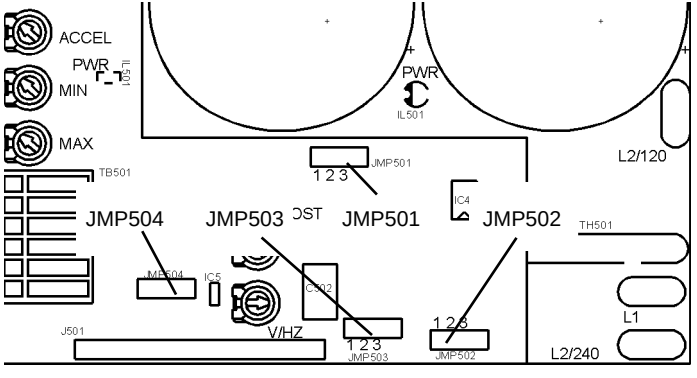


Figure 14. MMVFDxx-D230AC Braking Personality



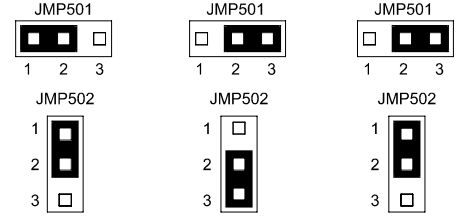
MMVFDxx-115AC and MMVFDxx-230AC



MMVFDxx-D230AC

Figure 15. Jumper Terminal Locations

MOTOR PHASE JUMPER SETTINGS (JMP501 AND JMP502)



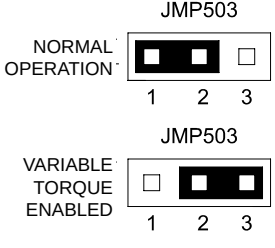
NOTES ON JUMPER SETTINGS:

1) 3-PHASE MOTOR

2) SINGLE-PHASE MOTOR WITH PREWIRED RUN CAPACITOR

3) SINGLE-PHASE MOTOR WITHOUT PREWIRED RUN CAPACITOR (2-PHASE OPERATION)

ACCEL/TORQUE SETTINGS (JMP503)



BRAKING SETTINGS (JMP504)

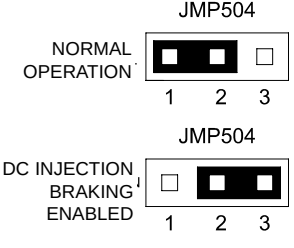


Figure 16. Jumper Settings

Voltage doubler output

Warning

Do not connect 230 VAC line input to the 115 VAC terminals. This will result in severe damage to the motor and drive, possible explosion and severe injury.

MMVFDxx-D230AC-series drives are equipped with a unique voltage-doubling feature, for use when 230 VAC input voltage is not available. This feature converts a 115 VAC input to a 230 VAC output, for use with 230V motors. The drive current output remains the same.

Refer to Figure 7 (page 14) for connection information. Use extreme caution when connecting this feature. Incorrect use of this feature may result in fire and serious injury.

Startup

Warning

Do not change jumper settings with power applied. Ensure that jumper settings are compatible with the motor being controlled.

1. Verify that no conductive material is present on the PCB.
2. Verify that the correct voltage is connected to the inputs before applying power. **DO NOT CONNECT 230 VAC LINE VOLTAGE TO A 115 VAC DRIVE.** Applying power in this manner will damage the motor and drive.
3. Verify that jumpers are set to the correct phasing for the motor under load.
4. Set the speed adjust potentiometer to zero (full CCW).
5. Set the DIR switch (if installed) to the desired direction. If no switch is installed, install or remove a jumper across the DIR and COM terminals, as required.
6. Set the ENABLE/DISABLE switch (if installed) to ENABLE, or short the ENABLE (EN) and COM terminals on TB501.
7. Apply 115 or 230 VAC, 50/60 Hz, single-phase power to the drive. The green POWER LED will come on after an initial delay of 1- 2 seconds, in which all logic circuits are checked for proper function. If the POWER LED does not light, check the external line fuses to ensure that they are properly installed and not blown.

8. If you attempt to start and the red TQ LIMIT LED comes on, the control has entered torque limit mode. To avoid this occurrence, you may:
   a. increase the torque limit setting*, or
   b. lengthen the acceleration time enough to accommodate the needed starting torque by adjusting the ACCEL trimpot.

To reverse motor direction:

To reverse the direction of motor shaft rotation while the motor is running, set the DIR switch to the opposite position. If no DIR switch is installed, open or short the DIR and COM terminals on TB501, as required.

When a new direction is selected, there is no need to close the BRAKE input or open the ENABLE input. The control will automatically decelerate the motor down to zero speed and then reverse direction, accelerating and decelerating at a rate controlled by the ACCEL/DECEL trimpot setting.

*Do not set the torque limit setting above 150% of the motor's nameplate current rating.

Starting and stopping methods

To coast the motor to a stop without disconnecting power:

Open the ENABLE/DISABLE switch, or remove the jumper between the ENABLE (EN) and COM terminals of TB501. Refer to *Application Notes* (page 41) for instructions on switch installation.

Thermal protection of the motor

The enable input can also act as a motor thermal protection circuit for motors having a built-in thermal protector. These thermal protectors are operated only by motor heat and open the enable circuit when the motor reaches a temperature which could cause damage to the motor winding.

Normally, these thermal protectors automatically close the circuit when the motor has cooled to a safe temperature. In operation, when the drive is disabled, or when the motor overheats, the thermal protector opens the circuit (Figure 17).

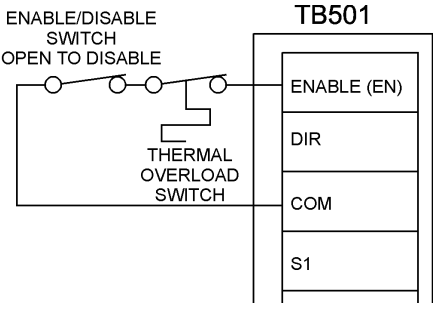


Figure 17. Thermal Overload Switch with Optional Enable/Disable Switch

Line starting and line stopping

Minarik strongly recommends the installation of a master power switch in the voltage input line (see *Power and Fuse Connections*, pg. 11). The switch contacts should be rated at a minimum of 200% of motor nameplate current and 250 volts.

Line starting and line stopping (applying and removing AC voltage input) is recommended for infrequent starting and stopping of the drive only. It is also the recommended method for emergency stopping of the drive. When AC voltage input is applied to the drive, the motor accelerates to the speed set by the speed adjust potentiometer. When AC voltage input is removed, the motor coasts to a stop. To “jog” a motor, install a normally-open pushbutton switch on the ENABLE input.

Calibration

Warning

Dangerous voltages exist on the drive when it is powered, and up to 60 seconds after power is removed and the motor stops. When possible, disconnect the voltage input from the drive before adjusting the trimpots. If the trimpots 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.

The MMVFD series has seven user-adjustable trimpots. Each drive is factory calibrated to its maximum horsepower rating. Readjust the calibration trimpot settings to accommodate lower horsepower motors. See Figure 18 for MMVFDxx-D230AC trimpot location. See Figure 19 (page 36) for MMVFDxx-115/230AC trimpot location.

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

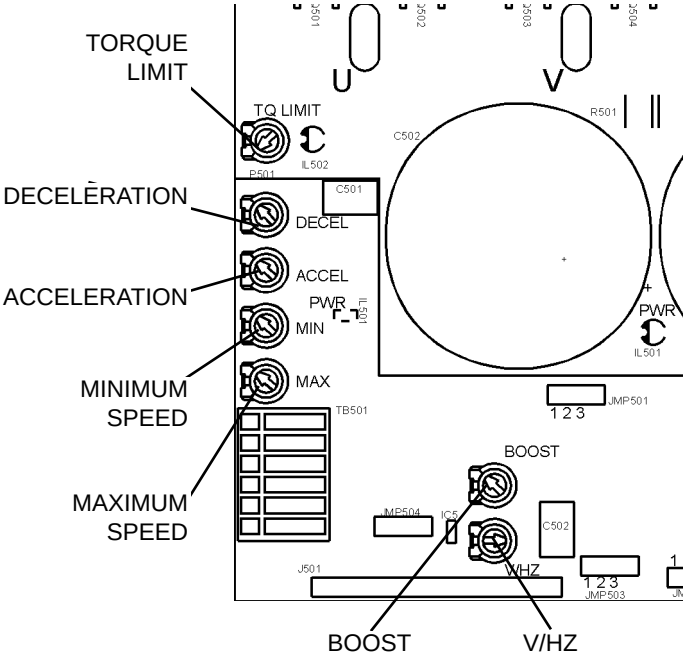


Figure 18. MMVFDxx-D230AC Calibration Trimpot Layout

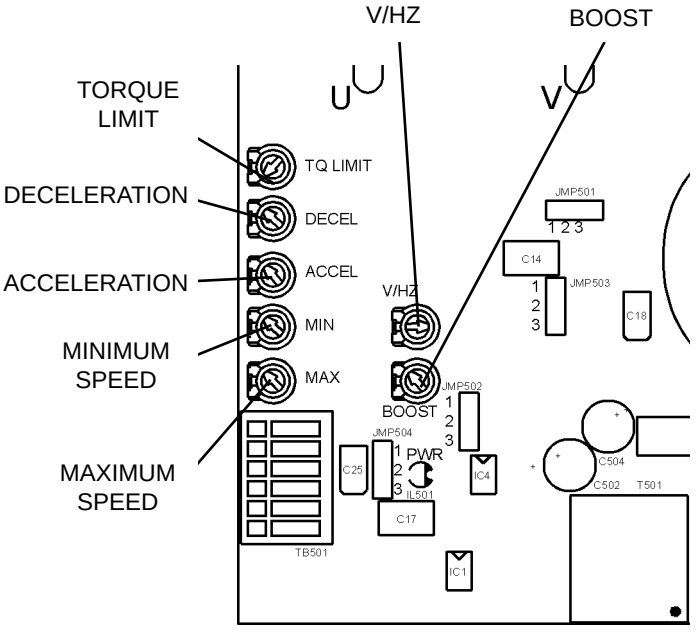


Figure 19. MMVFDxx-115AC and MMVFDxx-230AC Calibration Trimpot Layout

Calibration Procedure Setup for 60 Hz Motors:

1. Set the ENABLE switch to the DISABLE (open) position. If no switch is installed, remove the jumper between the ENABLE (EN) and COM terminals of TB501.
2. Set the DIR switch to the FWD (open) position. If no switch is installed, remove the jumper between the DIR and COM terminals of TB501.
3. Set all trimpots except TQ LIM and V/HZ fully counterclockwise (CCW).
4. Set the TQ LIM trimpot to maximum (full CW).
5. Set the V/Hz trimpot to center of travel (12 o'clock position).
6. Set JMP501 & JMP502 to 1-2 position (3-phase output).
7. Set the speed adjust pot to zero (full CCW).
8. Calibrate the trimpots as follows:

MINIMUM SPEED (MIN SPD)

1. Apply power to the drive.
2. Set the ENABLE switch to the ENABLE (closed) position.
3. Slowly rotate the MIN SPD trimpot CW until the motor begins to turn, then slowly rotate the pot CCW until the motor just stops.

This step calibrates the MIN SPD pot to zero speed without hysteresis.

MAXIMUM SPEED (MAX SPD)

Rotate the speed adjust pot full CW. Using a hand-held tachometer or analog frequency meter as a reference, adjust the MAX SPD trimpot until the desired speed or frequency is reached.

TORQUE LIMIT (TQ LIM)

Warning

Although the TQ LIM trimpot can be set up to 120% of the drive nameplate rating, continuous operation beyond the drive nameplate rating may cause damage to the motor and/or drive.

1. With no power applied to the drive, connect a DC ammeter in series with the motor armature.
2. Set the TQ LIM trimpot to full CCW.
3. Carefully lock the motor armature. Ensure that the motor is firmly mounted.
4. Apply line power. The motor should be stopped.
5. Set the speed potentiometer or reference signal to maximum speed. The motor should remain stopped.
6. Slowly rotate the TQ LIM trimpot clockwise (CW) until the ammeter reads 120% of maximum motor armature current.
7. Set the speed adjust potentiometer or reference signal to zero speed.

8. Remove power from the drive.
9. Remove the lock from the motor shaft.
10. Remove the ammeter in series with the motor armature.

BOOST

The boost trimpot 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 runs rough or noisily at low speeds, the boost trimpot may need adjustment. Contact your Minarik representative for assistance.

ACCELERATION (ACCEL)

1. Set the speed adjust pot to zero (full CCW) and wait for the motor to come to a stop (or minimum speed).
2. Set the speed adjust pot or reference signal to maximum speed (full CW) and note the time the motor takes to accelerate to maximum speed.
3. If the acceleration time differs from the desired time, adjust the ACCEL trimpot until the desired time is reached. Rotating the ACCEL pot CW increases the acceleration time.

DECELERATION (DECEL)

1. Set the speed adjust pot to maximum (full CW) and wait for the motor to come to maximum speed.
2. Set the speed adjust pot to minimum speed (full CCW) and note the time the motor takes to decelerate to minimum speed.
3. If the deceleration time differs from the desired time, adjust the DECEL trimpot until the desired time is reached. Rotating the DECEL pot CW increases the deceleration time.

Calibration Procedure Conclusion

1. Set the speed adjust pot to zero (full CCW).
2. Disable the drive by opening the ENABLE/DISABLE switch or removing the jumper from the ENABLE (EN) and COM terminals.
3. Remove power to the motor and drive. Calibration is now complete.

Application Notes

Decelerate to minimum speed

The circuit shown in Figure 20 may be used to decelerate a motor to a minimum speed. Closing the switch between S2 and S1 decelerates the motor from set speed to a minimum speed determined by the MIN SPD trimpot setting. If the MIN SPD trimpot is set full CCW, the motor decelerates to zero speed when the switch is closed. Calibrate the ACCEL and DECEL trimpots to control the acceleration and deceleration ramp. Set the switch to the RUN position to accelerate the motor to set speed.

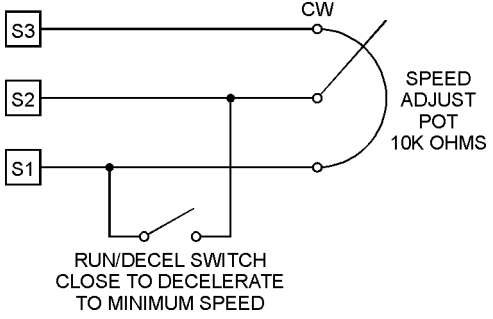


Figure 20. Run/Decelerate to Minimum Speed Switch

Independent adjustable speeds with DIR switch

Replace the speed adjust potentiometer with two single-pole multi-position switches, and two or more potentiometers in parallel, with a total parallel resistance of 10K ohms. Figure 21 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

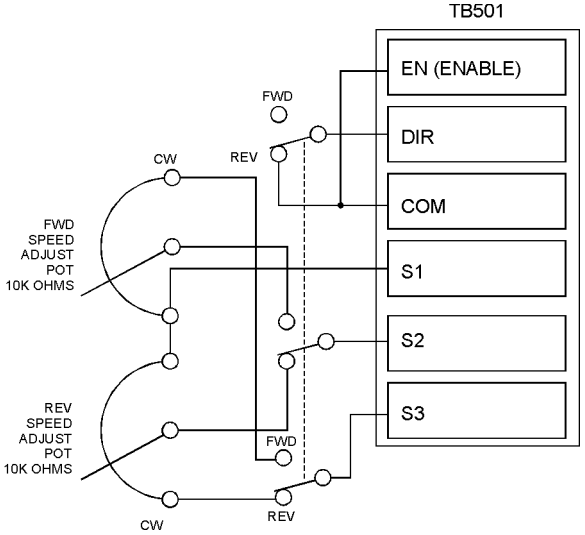


Figure 21. Independent Adjustable Speeds

RUN/JOG switch

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 open, momentary operated pushbutton for the JOG pushbutton.

Connect the RUN/JOG switch and JOG pushbutton to terminal board TB501 as shown in Figure 22. 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.

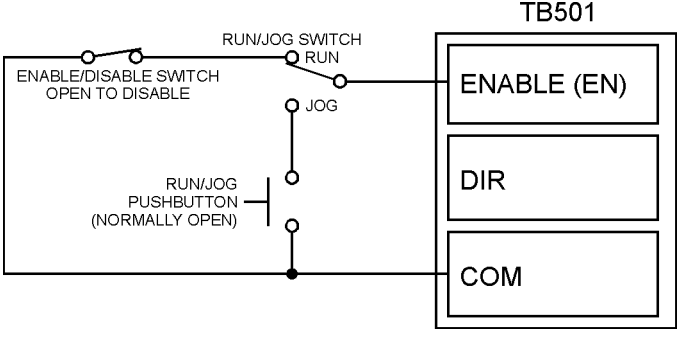


Figure 22. RUN/JOG Switch

Single speed potentiometer control of multiple motors

Warning

The combined current draw of all motors must not exceed the current rating of the drive.

The MMVFD series of controls is capable of operating up to eight 3-phase motors simultaneously. All motors must be of the same type and must control similar loads. Connect each motor as shown in Figure 23 below.

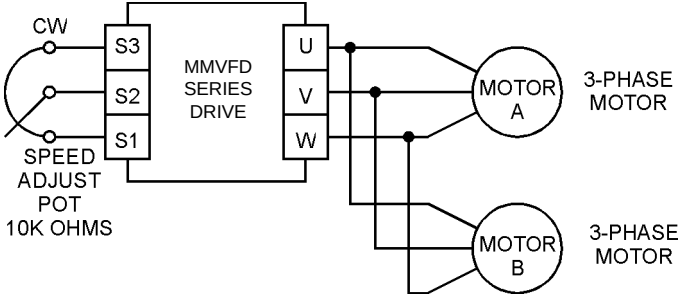


Figure 23. Single Speed Potentiometer Control of Multiple Motors

Troubleshooting

Warning

Dangerous voltages exist on the drive when it is powered, and up to 60 seconds after power is removed and the motor stops. When possible, disconnect the voltage input from the drive while troubleshooting. BE ALERT. High voltages can cause serious or fatal injury.

Before troubleshooting

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

- Disconnect AC or DC voltage input from the drive. Wait 60 seconds for power to discharge. The green POWER LED will blink while power is discharging.
- Check the drive closely for damaged components.
- Check that no wire, chips, or other foreign material has become lodged on the printed circuit board.
- Verify that every connection is correct and in good condition.
- Verify that there are no short circuits or grounded connections.
- Check that the drive's rated phase current and RMS voltage are consistent with the motor ratings.

For additional assistance, contact your local Minarik® distributor, or the factory direct by telephone at:
1-800-MINARIK (646-2745) or Fax: 1-800-394-6334

Diagnostic LEDs

Minarik's MMVFD series is equipped with diagnostic LEDS to assist the user in troubleshooting and monitoring equipment status while in use. Refer to Figure 24 for diagnostic LED locations.

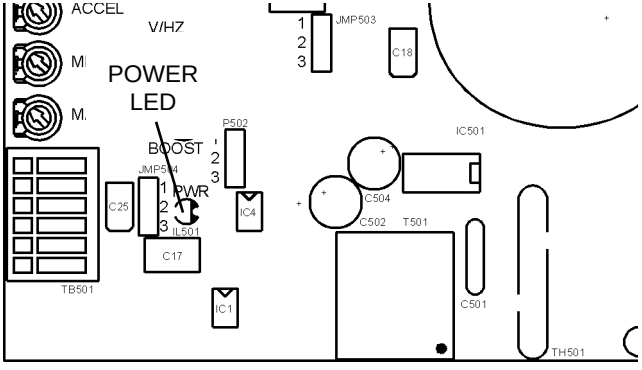
Power

NOTE: The MMVFDxx-D230AC series has two POWER LEDS (one LED on each board).

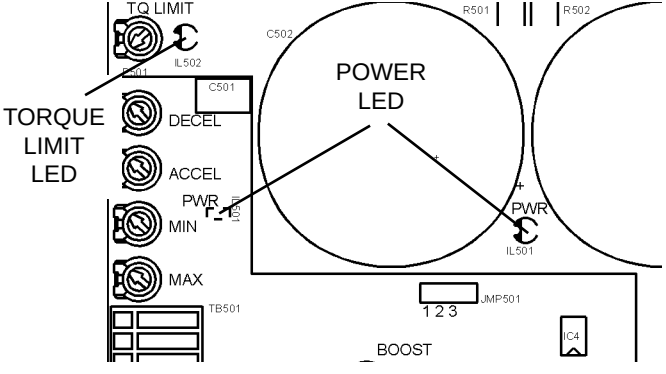
The green POWER LED lights when AC line voltage is applied and the control's low-voltage power supply is operational.

TQ LIMIT (MMVFDxx-D230AC series only)

The red TORQUE LIMIT LED lights when the drive output current exceeds the threshold set by the TQ LIMIT trimpot. If this LED lights, shut down the motor and drive by the disabling method or by removing power. Check the motor to make sure it is not jammed or overloaded. The TQ LIMIT trimpot may need to be recalibrated. See the *Calibration* section (page 34) for information on calibrating the TQ LIMIT trimpot.



MMVFDxx-115AC and MMVFDxx-230AC Series



MMVFDxx-D230AC Series

Figure 24. Diagnostic LED location

Problem	Possible Cause	Suggested Solution
External line fuse blows	1. Line fuses are the wrong size. 2. Motor or motor cable is shorted to ground. 3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes (i.e. reversing).	1. Check that line fuses are properly sized for the motor being used. 2. Check motor cable and motor for shorts. 3. Add a blower to cool the drive components; increase TQ LIM settings (page 38).
External line fuse does not blow, but the motor does not run	1. Speed adjust potentiometer or voltage input signal is set to zero speed. 2. Speed adjust potentiometer or voltage input signal is not properly connected to drive input; connections are open.	1. Increase the speed adjust potentiometer setting or voltage input signal. 2. Check connections to input. Verify that connections are not open.

Problem	Possible Cause	Suggested Solution
External line fuse does not blow, but the motor does not run (cont.)	3. Drive is “tripped” off or has gone into thermal overload.	3. Disable, then re-enable the drive.
	4. Drive has been disabled.	4. Ensure that ENABLE (EN) and COM terminals are properly connected.
	5. Drive is in current limit.	5. Verify that motor is not jammed. Increase TQLIM setting if it is set too low (page 38).
	6. Drive is not receiving AC voltage input.	6. Apply AC line voltage to L1 and L2.
	7. Motor is not connected.	7. Connect motor to drive outputs U, V and W.
Motor runs too slow or too fast at set speed	1. MIN and MAX SPD are not calibrated correctly.	1. Calibrate MIN and MAX SPD trimpots (pp 37-38).
Motor will not reach the desired speed	1. MAX SPD setting is too low.	1. Increase MAX SPD setting (page 38).

Problem	Possible Cause	Suggested Solution
Motor will not reach the desired speed (cont.)	2. Nominal input voltage may be too low for motor 3. Motor is overloaded.	2. Compare motor voltage to input voltage; replace motor if necessary 3. Check motor load. Resize the motor or drive if necessary.
Motor pulsates or surges under load	1. Motor “bouncing” in and out of torque limit.	1. Make sure motor is not undersized for load; adjust TQ LIM setting CW (page 38).
Motor does not reverse	1. Bad DIR switch connection. 2. Reversing circuit not working properly.	1. Check DIR switch connection. 2. Check reversing circuit by shorting DIR terminal to COM terminal with jumper wire.

Problem	Possible Cause	Suggested Solution
TQ is unsatisfactory at high speeds.	1. TQ LIMIT set too low.	1. Check TQ LIM setting (page 38).
	2. TQ BOOST set too low.	2. Check TQ BOOST setting (page 39).
	3. Load may exceed rating of motor/drive.	3. “Fix” load (i.e., straighten mounting, coupling, etc.); or replace motor and drive with motor and drive rated for higher horsepower.
	4. Nominal input voltage may be too low for motor.	4. Compare motor voltage to input voltage. Replace motor if necessary.

Replacement Parts

Replacement parts are available from Minarik Corporation and its distributors for this drive series.

Table 3. Replacement Parts

Model No.	Symbol	Description	Minarik® P/N
MMVFD03-115AC			
	C502	120 uF, 25 VDC Capacitor	011-0122
	C503	1500 uF, 250 VAC Capacitor	011-0089
	C504	47 uF, 35 VDC Capacitor	011-0066
	Q501-Q506	IGBT	070-0085
	TH501	20-amp Thermistor	033-0007
	TB501	6-pin Wago Terminal Block	160-0163
		10k ohm Potentiometer Kit	202-0099
MMVFD04-115AC		**Same as above, except:**	
	C503	1500 uF, 250 VAC Capacitor	011-0089
MMVFD03-230AC		**Same as 115 VAC models, except:**	
	C503	470 uF, 400 VAC Capacitor	011-0120
MMVFD04-230AC		**Same as 115 VAC models, except:**	
	C503	1000 uF, 400 VAC Capacitor	011-0099
MMVFD03-D230AC		**Same as 115 VAC models, except:**	
	C501-502	820 uF, 250 VDC Capacitor	011-0135
	C503-504	.01 uF, 1000 VDC Capacitor	010-0015
	C505	120 uF, 25 VDC Capacitor	011-0122
		10k ohm Potentiometer Kit	202-0101

MMVFD04-D230AC	**Same as 115 VAC models, except:**	
C501 - 503	1500 uF, 250 VAC Capacitor	011-0089
Potentiometer kit 202-0099		
	10K ohm, 5W Potentiometer	
	3/8-32 X 1/2 Nut	
	3/8IN Int. Tooth Lockwasher	
	Pot Insulating Washer	
	Non-insulated Female Connector	
Potentiometer kit 202-0101	**Same as above except**	
	3 ea Insulated Female Connector	

Index

Notes

Unconditional Warranty

A. Warranty

Minarik Corporation (referred to as “the Corporation”) warrants that its products will be free from defects in workmanship and material for twelve (12) months from date of manufacture thereof. Within this warranty period, the Corporation will repair or replace such products that are returned to Minarik Corporation, 901 East Thompson Avenue, Glendale, CA 91201-2011 USA.

This warranty shall not apply to any product that has been repaired by unauthorized persons. The Corporation is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to and from the repair point.

B. Disclaimer

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

C. Limitations of Liability

In the event of any claim for breach of any of the Corporation’s obligations, whether express or implied, and particularly of any other claim or breech of warranty contained in Paragraph A, or of any other warranties, express or implied, or claim of liability that might, despite Paragraph B, be decided against the Corporation by lawful authority, the Corporation shall under no circumstances be liable for any consequential damages, losses, or expense arising in connection with the use of, or inability to use, the Corporation’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, the Corporation’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 the Corporation 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.

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