An American Control Electronics Brand

MDVF03

Open Chassis Microprocessor-based Variable Frequency Drive with Isolation for Single and Three Phase AC Motors

Specifications

Model	Line Voltage (VAC)	Motor Voltage (VAC)	Continuous Motor Current (Amps)	Motor Horsepower Range
MDVF03-D230-PCM	115 or 230	115 230	3.0*	1/16 - 3/8 1/8 - 3/4

* When mounted to allow upwards airflow across the plate.
De-rate to 2.5 amps when mounted in any other configuration.

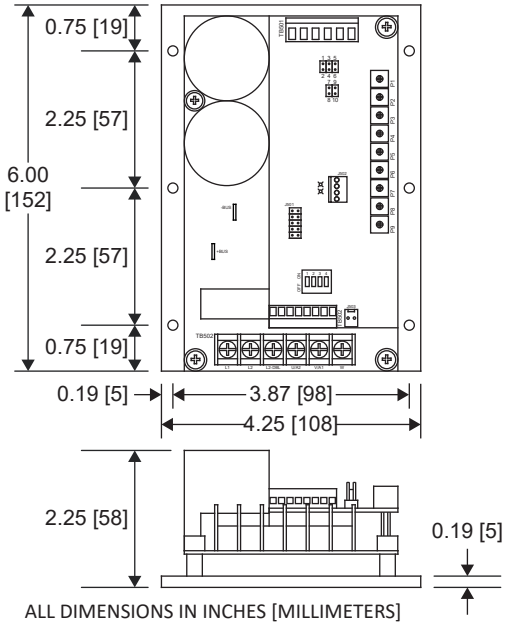
AC Line Voltage.....115 / 230 VAC ± 10%, 50/60 Hz, single phase
AC Line Current *with 115 VAC line voltage with a 115V motor*.....6.7 amps
with 115 VAC line voltage with a 230V motor.....10.7 amps
with 230 VAC line voltage with a 230V motor.....6.7 amps
AC Motor Voltage.....115 or 230 VAC, 50/60 Hz, single or three phase
Overload Capability.....200% (2x) for 1 minute
Standard Carrier Frequency.....1.6 or 16 kHz
Output Frequency Range.....0 - 120 Hz
DC Injection Voltage.....0 - 27 VDC
DC Injection Voltage Time.....0 - 5 seconds
Acceleration Time Range *(0 - 60 Hz)*.....0.5 - 12 seconds
Deceleration Time Range *(60 - 0 Hz)*.....0.5 - 12 seconds
Analog Input Signal Range.....0 ± 5 VDC, 0 ± 10 VDC, 4 - 20 mA
Input Impedance (S1 to S2).....>50K ohms
Maximum Vibration *(0 - 50 Hz, >50 Hz)*.....0.5G, 0.1G maximum
Surrounding Air Temperature Range.....32°F - 104°F (0°C - 40°C)
Weight.....1.20 lbs (0.54 kilograms)
Safety Certifications.....cULus Listed, UL 61800-5-1, File # E132235

Safety Warnings

READ ALL SAFETY WARNINGS BEFORE INSTALLING THIS EQUIPMENT

- **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.
- **Circuit potentials are at 115 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 protection equipment and insulated tools if working on this drive with power applied.
- 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.
- **Minarik Drives strongly recommends the installation of a master power switch in the line voltage input.** The switch contacts should be rated for 250 VAC and 200% of motor nameplate current.
- **Removing AC line power is the only acceptable method for emergency stopping.** Do not use DC injection braking, decelerating to minimum speed, or coasting to a stop for emergency stopping. They may not stop a drive that is malfunctioning.
- Line starting and stopping (applying and removing AC line voltage) is recommended for infrequent starting and stopping of a drive only. Regenerative braking, decelerating to minimum speed, or coasting to a stop is recommended for frequent starts and stops. Frequent starting and stopping can produce high torque. This may cause damage to motors.
- **Do not disconnect any of the motor leads from the drive** unless power is removed or the drive is disabled. Opening any one lead while the drive is running may damage the drive.
- Under no circumstances should power and logic level wires be bundled together.
- Be sure potentiometer tabs do no make contact with the potentiometer's body. Grounding the input will cause damage to the drive.
- **Only connect to terminal L2-DBL if using a 115 VAC line with a motor rated higher than 120 VAC.**
- Caution should be taken when operating fan-cooled motors at low speeds because their fans may may not move sufficient air to properly cool the motor. Minarik Drives recommends "inverter-duty" motors when the speed range is beyond 10:1.
- **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 signals from remote devices for over temperature protection. If motor protection is needed in the end-use product, it needs to be provided by additional equipment in accordance with NEC standards.

Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Installation

Mounting

- Drive components are sensitive to electrostatic discharge. Avoid direct contact with the circuit board. Hold the drive by the plate 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 surrounding air 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 0.17" (4 mm) holes in the plate accept #8 pan head screws. If mounted horizontally, the drive must be de-rated to 2.5 amps.
- The plate should be earth grounded.

Wiring: Use 16 - 18 AWG 75°C wire for AC line (L1, L2, L2-DBL) and motor (U/A2, V/A1, W) wiring. Use 18 - 24 AWG wire for logic wiring (COM, DIR, EN, S1, S2, S3). Follow NEC standards for wiring.
Tightening torque for power terminal TB502 on the bottom board is 9 lb-in (1.0 N-m).
Tightening torque for logic terminals TB501 and TB502 on the top board is 1.77 lb-in (0.2 N-m).

Shielding Guidelines: 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 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 the drive, ground the shield at the end away from the drive. Do not ground both ends of the shield.

Short Circuit Current Rating (SCCR): This drive is suitable for use on a circuit capable of delivering not more than 5,000 rms Symmetrical Amperes, 115/230 volts maximum.

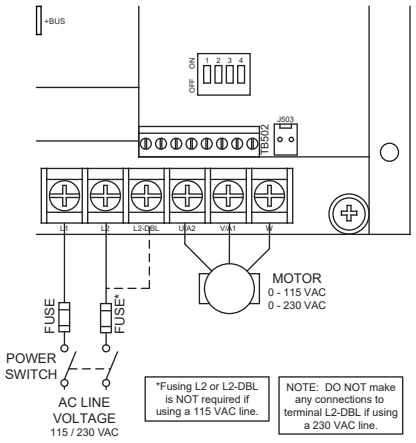
Branch Circuit Protection: This product has integral solid state circuit protection, which does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes. The UL Listing requires the use of Class J, Class CC, or Class T fuses rated at a minimum of 230 VAC. It is recommended to use fuses rated for 200% of the maximum motor current, unless using the drive in doubler operation, in which case the fuses should be rated for 400% of maximum motor current. Fuse the HOT leg of the AC line when using 115 VAC and both lines when using 230 VAC.

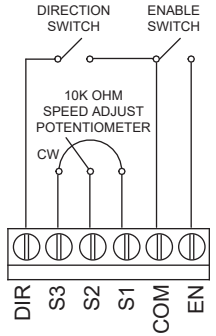
Connections

POWER (BOTTOM BOARD)

AC Line Input
Connect the AC line voltage to terminals L1 and L2. If doubler mode is to be used (230 VAC output with 115 VAC input), connect the AC line voltage to terminals L1 and L2-DBL. Do not make any connections to L2-DBL if using a 230 VAC line source.

Motor
Connect the motor leads to terminals U/A2, V/A1, and W. If the motor does not spin in the desired direction, power down the drive and reverse any two of these three connections.





The logic connections on TB501 are isolated up to approximately 4 kV.

LOGIC (TOP BOARD)

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

Analog Input Signal Range
Instead of using a potentiometer, the drive may be wired to follow an analog input signal. This input signal can be in the form of voltage (0 ± 5, 0 ± 10 VDC) or current (4-20 mA). The built in isolation allows the the input signal to be grounded or ungrounded (floating). Connect the signal common / negative (-) to S1 and the signal reference /positive (+) to S2. Refer to the Startup section for related jumper settings.

Enable
Short terminals EN and COM to accelerate the motor to set speed. Open the ENABLE terminals to coast or brake the motor to zero speed. Refer to DIP Switch 3 in the Statup section for jumper settings. If no ENABLE switch is desired, wire a jumper between terminals COM and EN.
Do not use the enable for emergency stopping.

Direction
Short terminals DIR and COM to change the direction of the motor. If no direction switch is desired, leave this connection open.

Startup

SELECT SWITCHES

Select Switch (SW501)

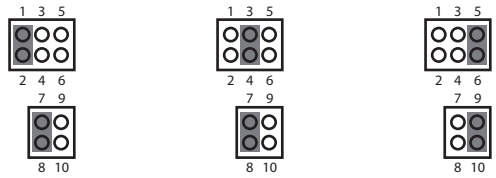
Dip Switch 1: ON - 115 VAC Output - Sets a 115 VAC output with either 115 or 230 VAC input.
OFF - 230 VAC Output - Sets a 230 VAC output with either 115 or 230 VAC input.

Dip Switch 2: ON - 50 Hz - Sets a base frequency of 50 Hz on the output.
OFF - 60 Hz - Sets a base frequency of 50 Hz on the output.

Dip Switch 3: ON - Brake Mode - Opening the ENABLE switch will brake the motor to zero speed with DC Injection braking without applying the decel ramp.
OFF - Enable Mode - Opening the ENABLE switch will coast the motor to a stop.

Dip Switch 4: ON - 1.6 kHz Carrier Frequency (Audible, but prevents GFI tripping).
OFF - 16 kHz Carrier Frequency (Inaudible, but may cause GFI tripping).

JUMPERS



0 to ± 5 VDC or Potentiometer
Jumper Pins 1&2 and 7&8

0 to ± 10 VDC
Jumper Pins 3&5 and 7&8

4-20 mA
Jumper Pins 5&6 and 9&10

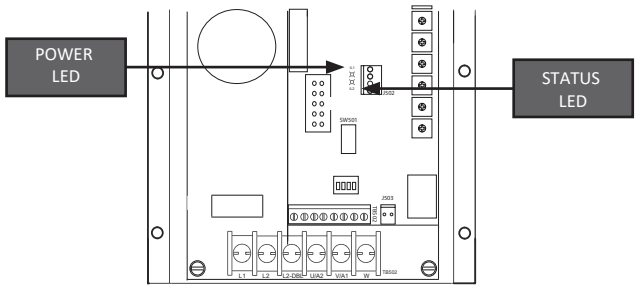
STARTUP

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

1. Turn the speed adjust potentiometer full counterclockwise (CCW) or set the analog input signal to minimum.
2. Apply AC line voltage.
3. Close the enable switch and verify that the green Power LED (IL1) if flashing.
4. Slowly advance the speed adjust potentiometer clockwise (CW) or increase the analog input signal. The motor should accelerate as the potentiometer is turned CW or as the analog signal is increased. Continue until the desired speed is reached.
5. Remove AC line voltage from the drive to coast the motor to a stop.

LEDs

Power (IL1): Green LED is solid when AC line voltage is applied to the drive, but the drive is disabled. It flashes whenever AC line voltage is applied to the drive and the drive is enabled.
Status (IL2): Red LED is solid when in current limit or flashes following fault code:
2 Flashes: Undervoltage - Internal DC BUS voltage dropped too low.
3 Flashes: Overvoltage - Internal DC BUS voltage rose too high.
4 Flashes: Current Limit or Short Circuit - The drive is in current limit or has detected a short across the motor.
5 Flashes: Overtemperature Shut Down - Drive's temperature has reached critical temperature.
6 Flashes: Overtemperature Warning - Drive's temperature is approaching critical temperature. Maximum motor current is being reduced gradually as the drive's temperature rises.



Operation

MOTOR TYPES

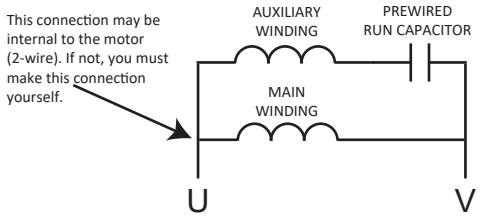
Acceptable motor types are 3-phase induction, permanent split capacitor (PSC), shaded pole, and AC synchronous. It is not recommended to use capacitor-start type motors.

The PMF series is designed to output a varying frequency and proportional voltage to vary a single phase motor's speed. However, single phase motors are optimized for full speed operation and may not operate with expected torque at speeds other than full rated speed. Since the PMF has the capability to convert a single phase 115 VAC input into a three phase 230 VAC output, it is recommended to use three phase motors in new applications.

MOTOR CONNECTIONS

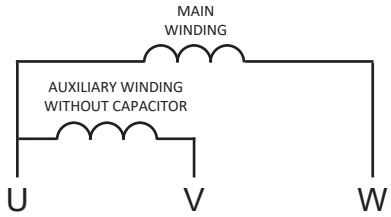
Single Phase Operation - Non-reversing

For single phase operation, connect the motor as show in the figure below. 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 three leads, you must make this connection yourself.



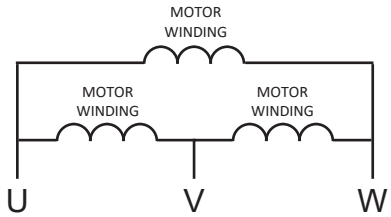
Single Phase Operation - Reversing

Remove the capacitor and connect the motor as show in the figure below. While allowing for solid-state reversing, this wiring scheme may result in sub-optimal motor operation. Depending on the motor construction and application requirements, the motor may need to be derated.



Three Phase Operation

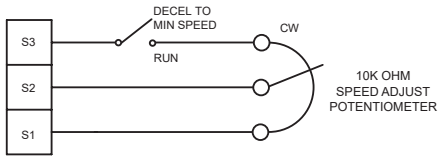
For three phase operation, connect the motor as show in the figure below. Connect to terminals U, V, and W as shown.



DECELERATING & STOPPING

Decelerate to Minimum or Zero Speed

The switch shown below may be used to decelerate a motor to a minimum speed. Opening the switch between S3 and the potentiometer decelerates the motor from set speed to a minimum speed determined by the MIN SPEED trim pot setting. If the MIN SPEED trim pot is set full CCW, the motor decelerates to zero speed when the switch is opened. The DECEL TIME trim pot setting determines the rate at which the drive decelerates. By closing the switch, the motor accelerates to set speed at a rate determined by the ACCEL TIME trim pot.



Calibration

Minimum Speed (P1): The MIN SPEED setting determines the minimum motor speed when the speed adjust potentiometer or analog signal is set for minimum speed (full CCW). It is factory set for zero speed. To calibrate the MIN SPEED:
1. Set the MIN SPEED trim pot full CCW.
2. Set the speed adjust potentiometer or analog signal for minimum speed.
3. Adjust the MIN SPEED trim pot until the desired minimum speed is reached or is just at the threshold of rotation.

Maximum Speed (P2): The MAX SPEED setting determines the maximum motor speed when the speed adjust potentiometer or analog signal is set for maximum speed. It is factory set for maximum motor rated speed. To calibrate the MAX SPEED:
1. Set the MAX SPEED trim pot full CCW.
2. Set the speed adjust potentiometer or analog signal for maximum speed.
3. Adjust the MAX SPEED trim pot until the desired maximum speed is reached.

Check the MIN SPEED and MAX SPEED adjustments after recalibrating to verify that the motor runs at the desired minimum and maximum speeds.

Acceleration (P3): The ACCEL TIME setting determines the time the motor takes to ramp to a higher speed regardless of direction. To calibrate the ACCEL TIME, turn the ACCEL TIME trim pot CW to increase the forward acceleration time and CCW to decrease the forward acceleration time.

Deceleration (P4): The DECEL TIME setting determines the time the motor takes to ramp to a lower speed when commanded by the potentiometer or analog signal, regardless of direction. To calibrate the DECEL TIME, turn the DECEL TIME trim pot CW to increase the deceleration time.

Slip Compensation (P5): The SLIP COMP setting determines the degree to which motor speed is held constant as the motor load changes. To calibrate the SLIP COMP:
1. Set the SLIP COMP trim pot full CCW.
2. Increase the speed adjust potentiometer until the motor runs at midspeed without load. A handheld tachometer may be used to measure motor speed.
3. Load the motor to its full load current rating. The motor should slow down.
4. While keeping the load on the motor, rotate the SLIP COMP trim pot until the motor runs at the speed measured in step 2. If the motor oscillates (overcompensation), the SLIP COMP trim pot may be set too high (CW). Turn the SLIP COMP trim pot CCW to stabilize the motor.
5. Unload the motor.

Voltage Boost (P6): The VOLTAGE BOOST setting increases the 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 the VOLTAGE BOOST:
1. Run the motor at the lowest continuous speed/frequency required.
2. Increase the VOLTAGE BOOST trim pot until the motor runs smoothly. **Continuous operation beyond the motor's current rating may damage the motor.**

Torque (P7): The TQ LIMIT setting determines the maximum torque for accelerating and driving the motor. To calibrate the TQ LIMIT.
1. With power disconnected from the drive, connect a RMS ammeter in series with one of the motor leads.
2. Turn the TQ LIMIT trim pot to full CW. Apply power and adjust the motor speed to full rated speed.
3. Load the motor so that it draws the RMS current previously determined.
4. Slowly turn the TQ LIMIT trim pot CCW until the red LED starts flickering. Then turn the trim pot slightly more so that it just starts to reduce the motor amps on the RMS ammeter.

Brake Voltage (P8): The brake voltage determines the voltage level at which the drive will apply current for DC Injection Braking. The higher the voltage, the more current will be motor. DC Injection Braking will only occur in Braking Mode (Dip Switch 3 = ON).

Brake Time-Out (P9): The BRAKE TIME-OUT determines how long the DC Injection Braking current will be applied when braking. DC Injection Braking will only occur in Braking Mode (Dip Switch 3 = ON).