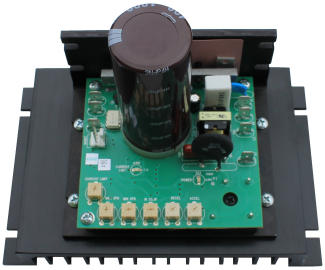
User's Manual

Models:

MMP 90V-5A

MMP 90V-10A



Pulse-Width Modulated, Adjustable Speed Drives for DC Brush Motors

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. MMP 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.

Specifications

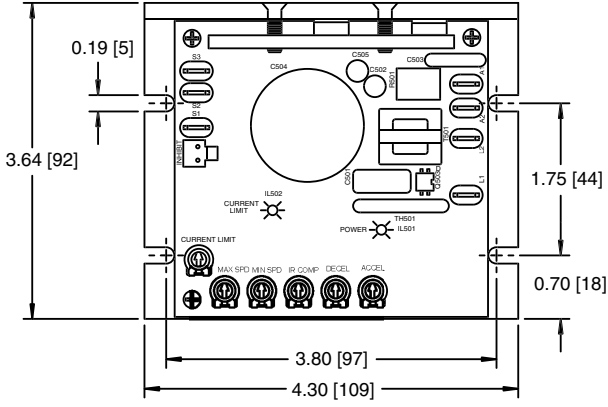
Model	AC Line Voltage	Max. Continuous Armature Current (Amps DC)	HP Range with 120 VAC Applied	HP Range with 240 VAC Applied
MMP 90V-5A	**120 OR 240**	**5**	**1/4 – 1/2**	**1/2 – 1**
MMP 90V-10A	**120 OR 240**	**10**	**1/2 – 1**	**1 – 2**

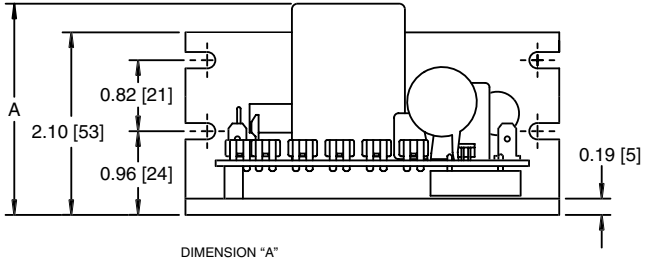
AC Line Voltage	120/240 VAC ± 10%, 50/60 Hz, single phase
Armature Voltage Range	
120 VAC input	0-130 VDC
240 VAC input	0 – 240 VDC
Form Factor (at base speed)	1.05
Acceleration/Deceleration Time Range (no load)	0.5 – 6 seconds
Analog Input Voltage Range [S1(–) to S2(+)]	0 – 5 VDC
Input Impedance (S1 to S2 with 5 VDC input)	approximately 70K ohms
Potentiometer Circuit Isolation (-PCM models only)	HCPL 7840:2500 VAC
Inhibit Circuit Isolation (-PCM models only)	HCPL 0453:2500 VAC
Speed Regulation	1% base speed or better
Ambient Temp. Range (chassis drive)	10°C – 40°C

MMP 90V-10A is rated for 10 amps DC max @ 25ºC ambient.
De-rate to 7 amps DC when ambient temp is above 25ºC.

Vibration	0.5g max (20 – 50 Hz) 0.1 g max (>50 Hz)
Weight	
MMP 90V-5A	0.72 lb [0.32 kg]
MMP 90V-10A	0.82 lb [0.37 kg]

Dimensions MMP 90V-5A

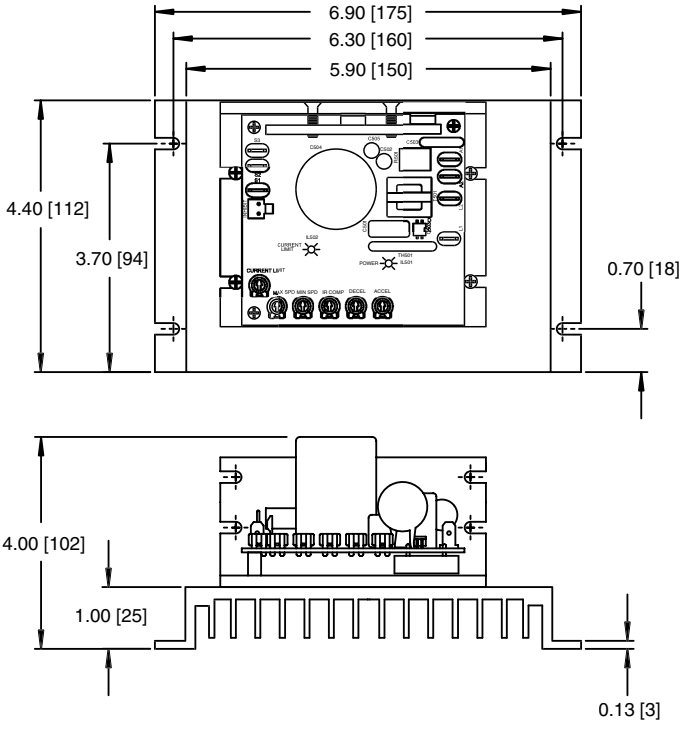




MODEL	DIMENSION "A" HEIGHT
MMP 90V-5A	3.20 [81]
MMP 90V-10A	3.90 [99]

ALL DIMENSIONS IN INCHES [MILLIMETERS]

Dimensions MMP 90V-10A



ALL DIMENSIONS IN INCHES [MILLIMETERS]

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.

- 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.
- Mount drive with its board in either a horizontal or vertical plane. Six 0.19 in. (5 mm) wide slots in the chassis accept #8 pan head screws. Fasten either the large base or the narrow flange of the chassis to the subplate.

- 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 or the drive is disabled. Opening any one motor lead may destroy the drive.

- Use 16–20 AWG wire for speed adjust potentiometer wiring. Use 14–16 AWG wire for AC line (L1, L2) and motor (A1 and A2) 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, MMP recommends shielding of all conductors.

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

Model MMP 90V-10A utilizes a heat sink. All other chassis drives have sufficient heat sinking in their basic configurations.

Apply a thermally conductive heat sink compound (such as Dow Corning® 340 Heat Sink Compound) between the drive chassis and heat sink surface for optimum heat transfer.

Line fusing

Protect all MMP drives with AC line fuses. Use fast acting AC line fuses rated for 250 volts, and approximately 150% – 200% of the maximum armature current. Fuse only the “hot” side of the AC line (L1) if using 115 VAC line voltage. Do not add line fuses to L1 and L2 unless you use 240 VAC line voltage. See Table 1 on page 8 for recommended line fuse sizes:

Table 1. Recommended Line Fuse Sizes

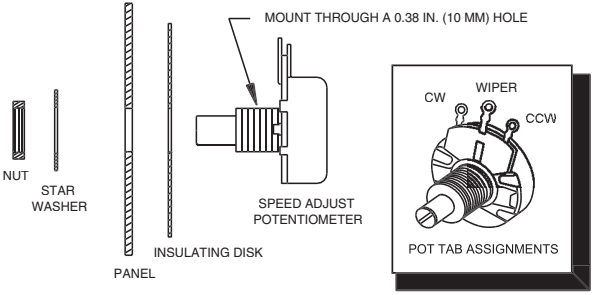
Maximum Armature Current (DC Amps)	AC Line Fuse Rating (AC Amps)
1.5 and below	3
2.6	5
3.5	8
5.0	10
7.6	15
10	15

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 3). Install the circular insulating disk between the panel and the 10K ohm speed adjust potentiometer. Twist the speed adjust potentiometer wire to avoid picking up unwanted electrical noise. If 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, A1, A2).



Isolation

NOTE:
Isolation is incorporated in MMP 90V-5A and MMP 90V-10A drives. The reference circuit (S1, S2 and S3) is optically isolated from the rest of the drive electronics. It will accept either a grounded or isolated signal reference.

The inhibit input is also optically isolated from the rest of the drive electronics. It will accept a grounded or isolated bit-type open collector (or switch) input.

Connections

Warning

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

MMP 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, fuse and motor connections

Connect the power input leads, an external line fuse and a DC motor to the drive's printed circuit board (PCB).

Master power switch

Decelerating to minimum speed, regenerative braking, or coasting to a stop may not stop a drive that is malfunctioning. Removing AC line power (both L1 and L2) is the only acceptable method for emergency stopping. For this reason, MMP strongly recommends installing an emergency stop switch on both the L1 and L2 inputs. The switch contacts must be rated at a minimum of 250 volts and 200% of maximum drive current.

Motor

MMP drives supply motor voltage from A1 and A2 terminals. It is assumed throughout this manual that, when A1 is positive with respect to A2 , the motor will rotate clockwise (CW) while looking at the output shaft protruding from the front of the motor. If this is opposite of the desired rotation, simply reverse the wiring of A1 and A2 with each other.

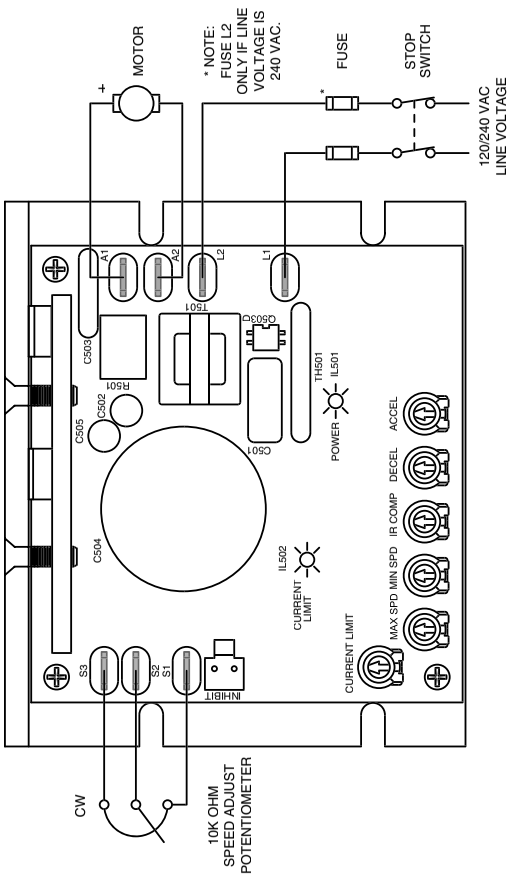
Connect a DC motor to PCB terminals A1 and A2 as shown in Figure 4. Ensure that the motor voltage rating is consistent with the drive's output voltage.

Power input

Connect the AC line power leads to PCB terminals L1 and L2, or to a double-throw, single-pole master power switch (recommended).

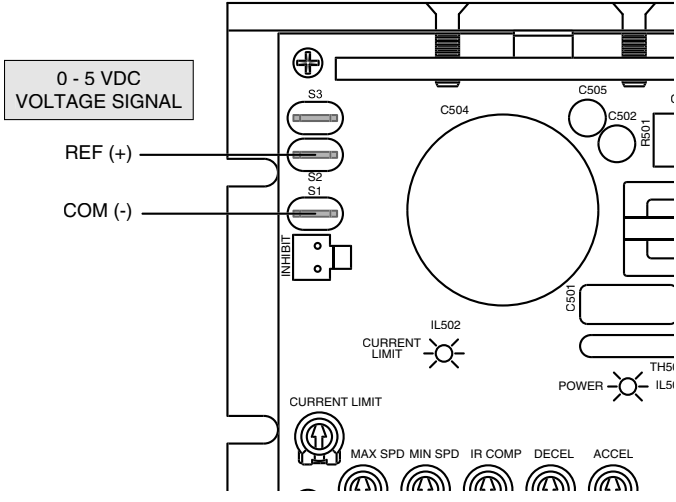
Line fuse

Wire an external line fuse between the stop switch (if installed) and the L1 terminal the circuit board. An additional line fuse should be installed on L2 if the input voltage is 230VAC. The line fuse(s) should be rated at 250 volts and 150 - 200% of maximum motor nameplate current. Refer to the line fuse chart on page 8 for fuse ratings.


MOTOR
+
* NOTE:
FUSE L2
ONLY IF LINE
VOLTAGE IS
240 VAC.
FUSE
*
STOP
SWITCH
120/240 VAC
LINE VOLTAGE
A1
A2
L2
L1
T501
D503
C503
R501
C502
C505
C501
TH501
IL501
POWER
ACCEL
DECEL
IR COMP
MIN SPD
MAX SPD
CURRENT LIMIT
IL502
CURRENT
LIMIT
C504
S3
S2
S1
INHIBIT
CW
10K OHM
SPEED ADJUST
POTENTIOMETER

Voltage follower

Instead of using a speed adjust potentiometer, the drive may be wired to follow a 0 – 5 VDC grounded* or isolated voltage signal (Figure 5). Connect the signal return (–) to S1. Connect the signal high or (+) to S2. Make no connection to S3. A potentiometer can be used to scale the analog input voltage.



Operation

Warning

Dangerous voltages exist on the drive when it is powered, and up to 30 seconds after power is removed and the motor stops. 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 for further assistance.

Before applying power

- Verify that no conductive material is present on the printed circuit board.

- Ensure that all jumpers are properly set.

Startup

To start the drive:

1. Turn the speed adjust potentiometer full counterclockwise (CCW). If the drive is following a voltage signal, set the voltage signal to 0 VDC.
2. Apply AC line voltage.
3. Slowly advance the speed adjust potentiometer clockwise (CW). If the drive is following a voltage signal, slowly increase the voltage signal. The motor slowly accelerates as the potentiometer is turned CW, or the 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

Warning

Decelerating to minimum speed, regenerative braking, or coasting to a stop 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 L1 and L2) is the only acceptable method for emergency stopping.

For this reason, **MMP strongly recommends installing an emergency stop switch on both the L1 and L2 inputs**.

Frequent decelerating to minimum speed or regenerative braking produces high torque. This may cause damage to motors, especially gearmotors that are not properly sized for the application.

Line starting and line stopping

Line starting and line 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. When AC line voltage is removed, the motor coasts to a stop.

Automatic restart upon power restoration

All drives automatically run to set speed when power is applied and the drive is enabled. The drive will accelerate at a rate controlled by the ACCEL trimpot. Refer to the Calibration section for information on adjusting this setting.

Inhibit terminals

Warning

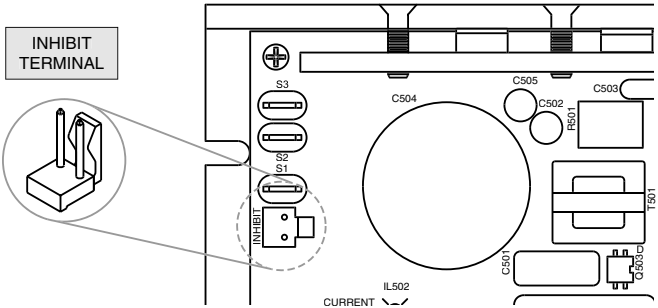
Inhibit is used for frequent starts and stops. It must never be used as an emergency stop because it may not stop a drive that is malfunctioning. Removing AC power (L1 and L2) is the only acceptable method for emergency stopping.

Jumper the inhibit terminals to coast the motor to a stop. Remove the jumper to accelerate the motor to set speed.

The inhibit terminals are optically isolated from the drive electronics. The user may apply a simple switch closure or an open-collector input, which may be isolated or non-isolated.

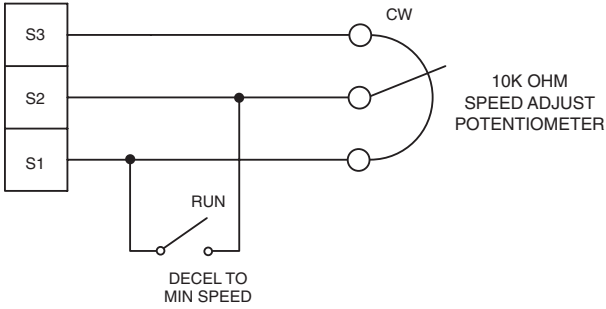
Inhibit plug

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



Decelerating to minimum speed

A switch may be used to decelerate the motor to minimum speed. Connect the switch. Close the switch between S1 and S2 to decelerate the motor from set speed. Open the switch to accelerate the motor to set speed. The ACCEL and DECEL trim-pot settings determine the rate at which the motor accelerates and decelerates, respectively.



Dynamic braking

Warning

Wait for the motor to come to a complete stop before setting the RUN/BRAKE switch to RUN. This will prevent high armature currents from damaging the motor or drive.

Dynamic braking may be used to rapidly stop a motor.
For the RUN/BRAKE switch, use a double-pole, double throw switch rated for at least the maximum DC armature voltage and maximum braking current.

RUN/BRAKE switch

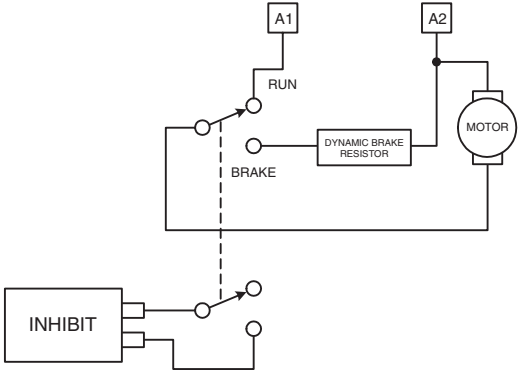
Install a double-pole, double-throw switch between the INHIBIT terminals and a dynamic brake resistor. Set the switch to the BRAKE position to dynamically brake the motor to a stop. Set the switch to the RUN position to accelerate the motor to set speed at a rate controlled by the ACCEL trim-pot.

Dynamic brake resistor sizes

Size the dynamic brake resistor according to the motor current rating. The dynamic brake resistance listed in the table is the smallest recommended resistance allowed to prevent possible demagnetization of the motor. The motor stops less rapidly with higher brake resistor values.

Minimum Motor Armature Current Rating	Minimum Dynamic Brake Resistor Value	Dynamic Brake Resistor Wattage
Less than 2 ADC	1 ohm	1W
2–3 ADC	5 ohm	5W
3–5 ADC	10 ohm	10W
5–10 ADC	20 ohm	20W
10–17 ADC	40 ohm	50W

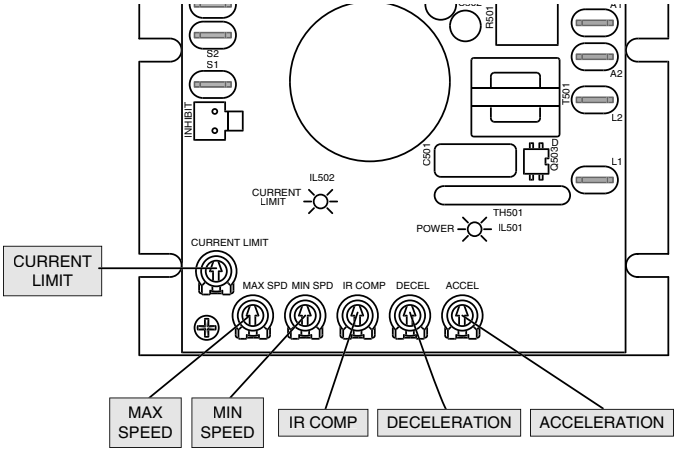
For motors rated 1/17 horsepower and lower, a brake resistor is not necessary since the armature resistance is high enough to stop the motor without demagnetization. Replace the dynamic brake with 12 gauge wire.



Calibration

Each drive is factory calibrated to its maximum current rating. Readjust the calibration trimpot settings to accommodate lower current motors.

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.



Calibration procedure

Before applying power

1. Verify that no conductive material is present on the printed circuit board.
2. Set all trimpots full except CURRENT LIMIT full counterclockwise (CCW).
3. Set the CURRENT LIMIT trimpot full clockwise (CW).
4. Set the speed adjust potentiometer or input signal to zero speed.
5. Set the INHIBIT switch to INHIBIT, or install the jumper between the INHIBIT terminals of SO501.
6. Apply line voltage to the drive. The green POWER LED shall light, but the motor should remain stopped.
7. Set the INHIBIT switch to ENABLE, or remove the jumper between the INHIBIT terminals of SO501.

MINIMUM SPEED (MIN SPD)

MIN SPD determines the minimum speed when the speed adjust potentiometer is turned full CCW. It is factory set to zero speed. To calibrate MIN SPD:

1. Set the speed adjust potentiometer full CCW.
2. Adjust the MIN SPD trimpot until the motor turns at the desired minimum speed.

MAXIMUM SPEED (MAX SPD)

The MAX SPD setting determines the maximum motor speed when the speed adjust potentiometer is turned full CW. It is factory set for maximum rated motor speed. To calibrate MAX SPD:

1. Set the MAX trimpot full CCW.
2. Turn the speed adjust potentiometer full CW.
3. Adjust the MAX SPD trimpot until the desired maximum motor speed is reached.

ACCELERATION (ACCEL)

The ACCELERATE setting determines the time the motor takes to ramp to a higher speed. The ACCELERATE setting is factory set to its minimum value (full CCW).

Turn the ACCEL trim-pot CW to increase the acceleration time and CCW to decrease the acceleration time.

DECELERATION (DECEL)

The DECELERATE setting determines the time the motor takes to ramp to a lower speed. The DECELERATE setting is factory set to its minimum value (full CCW).

Turn the DECEL trim-pot CW to increase the deceleration time and CCW to decrease the deceleration time.

REGULATION (IR COMP)

The IR COMP setting determines the degree to which motor speed is held constant as the motor load changes. It is factory set for optimum motor regulation. Recalibrate the IR COMP setting when using a lower current rated motor.

To recalibrate, use the following procedure:

If the motor does not maintain set speed as the load changes, gradually rotate the IR COMP trim-pot CW. If the motor oscillates (overcompensation), the IR COMP trim-pot may be set too high (CW). Turn the IR COMP trim-pot CCW to stabilize the drive.

CURRENT LIMIT (CURR LIM)

Warning

Although the current limit trimpot can be set to exceed the motor's maximum armature current rating, MMP recommends you do not run the motor continuously beyond that rating. Continuous operation beyond the maximum armature current rating may cause thermal degradation of the motor and drive.

The CURRENT LIMIT setting determines the maximum torque for accelerating and driving the motor. CURRENT LIMIT is factory set at 120% of maximum drive current. You must recalibrate the CURRENT LIMIT setting if using a lower current rated motor.

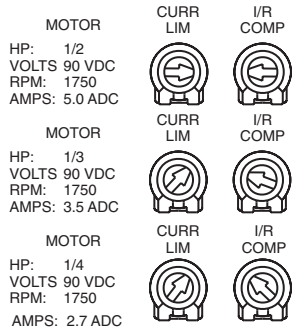
1. With no power applied to the drive, connect a DC ammeter in series with the motor armature.
2. Set the CURRENT LIMIT trimpot to full CCW.
3. Carefully lock the motor armature.
   Ensure that the motor is firmly mounted.
4. Apply line power. The motor should be stopped.
5. Set the speed potentiometer or reference signal to maximum speed. The motor should remain stopped.

CURRENT LIMIT (cont.)

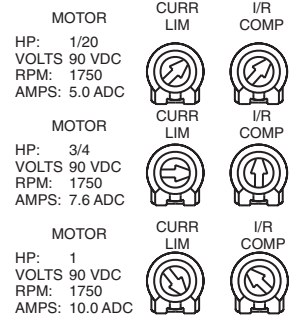
6. Slowly rotate the CURRENT LIMIT trimpot clockwise (CW) until the ammeter reads 120% of maximum motor armature current.
7. Set the speed adjust potentiometer or reference signal to zero speed.
8. Remove power from the drive.
9. Remove the lock from the motor shaft.
10. Remove the ammeter in series with the motor armature.

Approximate CURRENT LIMIT and IR COMP Settings for 120 VAC in, 90 VDC out (actual settings may vary)

MMP 90V-5A



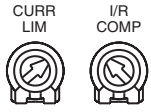
MMP 90V-10A



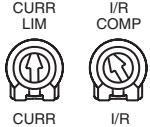
Approximate CURRENT LIMIT and IR COMP Settings for 120 VAC in, 130 VDC out (actual settings may vary)

MMP 90V-5A

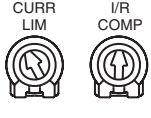
MOTOR
HP: 1/2
VOLTS: 130 VDC
RPM: 2500
AMPS: 3.8 ADC



MOTOR
HP: 1/3
VOLTS: 130 VDC
RPM: 2500
AMPS: 2.6 ADC

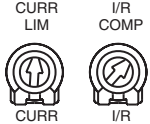


MOTOR
HP: 1/4
VOLTS: 130 VDC
RPM: 2500
AMPS: 2.0 ADC

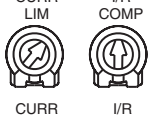


MMP 90V-10A

MOTOR
HP: 1/2
VOLTS: 130 VDC
RPM: 2500
AMPS: 3.8 ADC



MOTOR
HP: 3/4
VOLTS: 130 VDC
RPM: 1750
AMPS: 5.7 ADC



MOTOR
HP: 1
VOLTS: 130 VDC
RPM: 1750
AMPS: 7.5 ADC

Approximate CURRENT LIMIT and IR COMP Settings for 240 VAC in, 180 VDC out (actual settings may vary)

MMP 90V-5A

MOTOR
HP: 1
VOLTS: 180 VDC
RPM: 1750
AMPS: 5.0 ADC

MOTOR
HP: 3/4
VOLTS: 180 VDC
RPM: 1750
AMPS: 3.5 ADC

MOTOR
HP: 1/2
VOLTS: 180 VDC
RPM: 1750
AMPS: 2.7 ADC

MMP 90V-10A

MOTOR
HP: 1
VOLTS: 180 VDC
RPM: 1750
AMPS: 5.0 ADC

MOTOR
HP: 1 1/2
VOLTS: 180 VDC
RPM: 1750
AMPS: 7.6 ADC

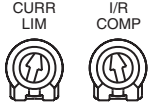
MOTOR
HP: 2
VOLTS: 180 VDC
RPM: 1750
AMPS: 10.0 ADC

Approximate CURRENT LIMIT and IR COMP Settings for 240 VAC in, 240 VDC out (actual settings may vary)

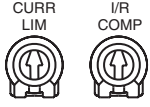
MMP 90V-5A

MOTOR
HP: 1
VOLTS: 180 VDC
RPM: 1750
AMPS: 5.0 ADC

MOTOR
HP: 3/4
VOLTS: 240 VDC
RPM: 2500
AMPS: 2.7 ADC

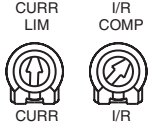


MOTOR
HP: 1/2
VOLTS: 240 VDC
RPM: 2500
AMPS: 2.0 ADC

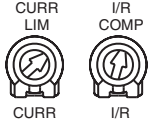


MMP 90V-10A

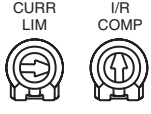
MOTOR
HP: 1
VOLTS: 240 VDC
RPM: 2500
AMPS: 3.8 ADC



MOTOR
HP: 1 1/2
VOLTS: 240 VDC
RPM: 2500
AMPS: 5.7 ADC



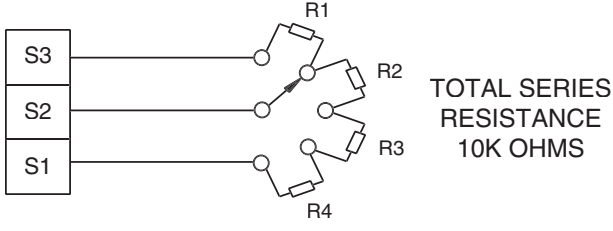
MOTOR
HP: 2
VOLTS: 240 VDC
RPM: 2500
AMPS: 7.5 ADC



Application Notes

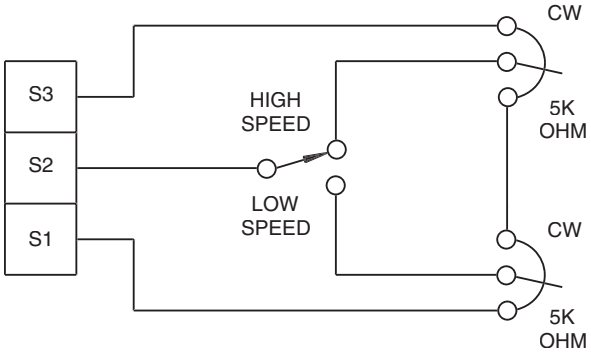
Multiple fixed speeds

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



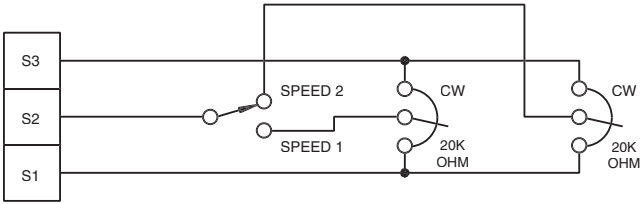
Adjustable speeds using potentiometers in series

Connect two speed adjust potentiometers in series to select between independent forward and reverse speeds.



Independent adjustable speeds

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

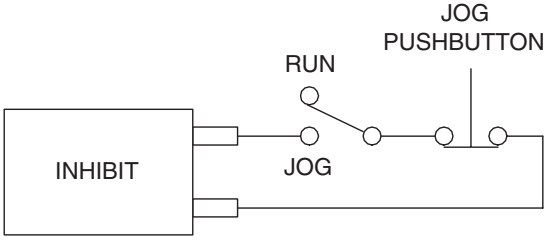


RUN/JOG switch

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-closed, momentary operated pushbutton for the JOG pushbutton.

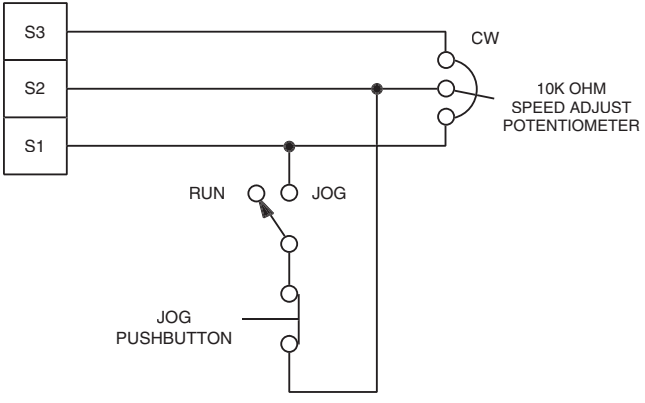
RUN/JOG option #1

In option #1 (shown below), connect the RUN/JOG switch and the JOG push-button to the INHIBIT terminals. When the RUN/JOG switch is set to JOG, the motor coasts to minimum speed.
Press the JOG push-button to jog the motor.
Return the RUN/JOG switch to RUN for normal operation.



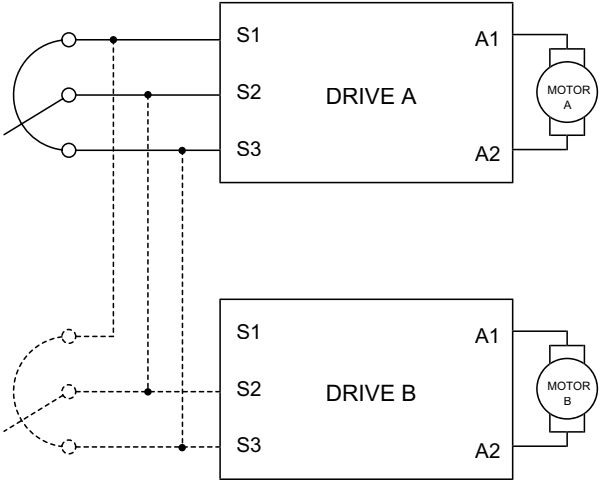
RUN/JOG option #2

In option #2, connect the RUN/JOG switch to the speed adjust potentiometer using a single-pole, two-position switch for the RUN/JOG switch, and a single-pole, normally-closed, momentary operated pushbutton for the JOG push-button.
When the RUN/JOG switch is set to JOG, the motor decelerates to minimum speed. Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.



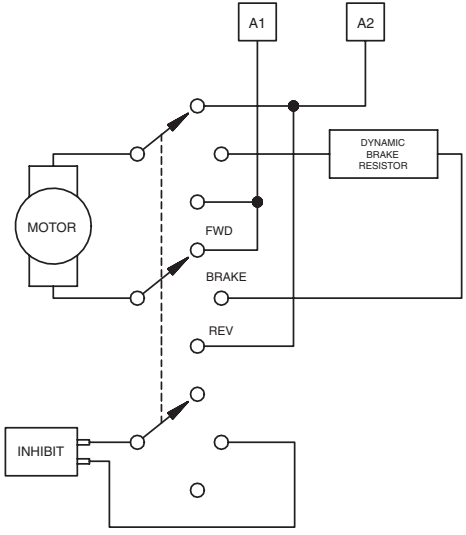
Single speed potentiometer control of multiple drives

Because the potentiometer circuit is optically isolated from the drive circuitry, the inputs may be tied together. Up to eight (8) drives can be controlled with a single speed adjust potentiometer.



Reversing

A dynamic brake may be used when reversing the motor direction (Figure 21). Use a three-pole, three-position switch rated for at least the maximum DC armature voltage and maximum braking current. Wait for the motor to stop completely before switching it to either the forward or reverse direction. See the *Dynamic braking* section for sizing the dynamic brake resistor.



Troubleshooting

Warning

Dangerous voltages exist on the drive when it is powered, and up to 30 seconds after power is removed. 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:

- Disconnect AC line voltage from the drive.
- Check the drive closely for damaged components.
- Check that no conductive 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 voltage selection switch settings match the AC line and output voltages.
- Check that the drive's rated armature and field outputs are consistent with the motor ratings.

For additional assistance, contact MMP.

Diagnostic LEDs

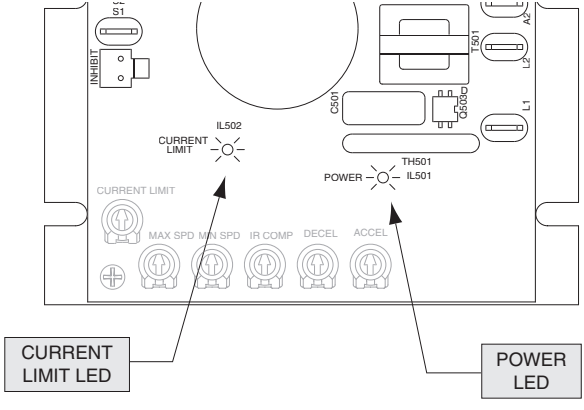
MMP 90V-5A and MMP 90V-10A drives are equipped with the following diagnostic LEDs to aid in troubleshooting or monitoring equipment status.

POWER

Green LED lights when AC line voltage is applied to the drive.

CURRENT LIMIT (CL/FLT)

Red LED lights when drive output current exceeds the threshold set by the CURRENT LIMIT trimpot.



Symptom	Possible Causes	Suggested Solutions
Line fuse blows	1. Line fuses are the wrong size. 2. Motor cable or armature is shorted to ground. 3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes.	1. Check that line fuses are the proper size. 2. Check motor cable and armature for shorts. 3. Add a blower to cool the drive components; decrease CURRENT LIMIT settings, **or** resize motor and drive for actual load demand, **or** check for incorrectly aligned mechanical components or “jams”.
Line fuse does not blow, but the motor does not run	1. Reference signal or speed adjust pot is set to zero speed. 2. Reference signal or speed adjust potentiometer connections are open.	1. Increase reference signal or speed adjust potentiometer setting. 2. Check that the reference signal or speed adjust potentiometer connections are not open.

Symptom	Possible Causes	Suggested Solutions
Line fuse does not blow, but the motor does not run (cont.)	3. Drive is overloaded. 4. Drive is not receiving AC line voltage. 5. Motor is not connected.	3. Verify that the motor is not jammed. Increase CURRENT LIMIT setting 4. Apply AC line voltage to L1 and L2. 5. Connect motor to A1 and A2.
Motor runs too fast at maximum speed setting	1. MIN SPD and MAX SPD settings are too high.	1. Recalibrate MIN SPD and MAX SPD
Motor runs too slow or too fast	1. MIN SPD and MAX SPD are not calibrated.	1. Recalibrate MIN SPD and MAX SPD
Motor will not reach the desired speed.	1. MAX SPD setting is too low. 2. IR COMP setting is too low. 3. Motor is overloaded.	1. Increase MAX SPD setting. 2. Increase IR COMP setting. 3. Check motor load. Resize the motor if necessary.

Symptom	Possible Causes	Suggested Solutions
Motor pulsates or surges under load	1. IR COMP is set too high. 2. Control is in current limit mode.	1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes 2. Check that motor and drive are of sufficient horsepower and amperage. You may need to replace the motor and/or the drive.