

User's Manual

MM2000A Series



Models:

MM2111A

MM2121A

SCR, Adjustable Speed Drives
for DC Brush Motors

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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.

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Table 1. MM20000A Series Numbering System

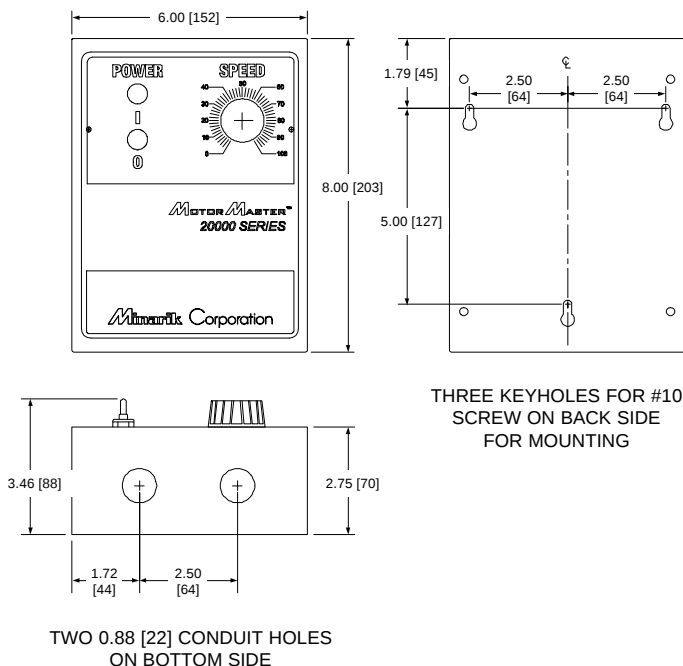
MODEL NUMBER					
MotorMaster 20000 Series INPUT VOLTAGE 1 = 115 VAC 2 = 230 VAC 3 = 115/230 VAC (selectable) Voltage Tolerance is $\pm 10\%$, 50/60 Hz CONFIGURATION 0 = Uncased (Chassis) Drive 1 = NEMA 1 Case, Unidirectional Drive 2 = NEMA 1 Case, Bidirectional Drive 4 = NEMA 4/12 Non-reversing 5 = NEMA 4/12 Reversing TYPE 1 = Unfiltered, 1/8 HP or less FEATURES 1 = MAX SPD, MIN SPD, TQ LIM, IR COMP, ACCEL, and DECEL trimpots with Field Voltage Output REVISION A = Standard B = Conformal Coating C = Used in Europe (obsolete)					
M	M	2	1	2	1
			1	1	1
					A

Specifications

Model	Max. Input Voltage (AC)	Max. Input Current (Amps AC)	Armature Current (Amps DC)	HP Range with 115 VAC Applied	Style
MM21111A	115	3	1.5	1/20 – 1/8	NEMA 1
MM21211A	115	3	1.5	1/20 – 1/8	NEMA 1

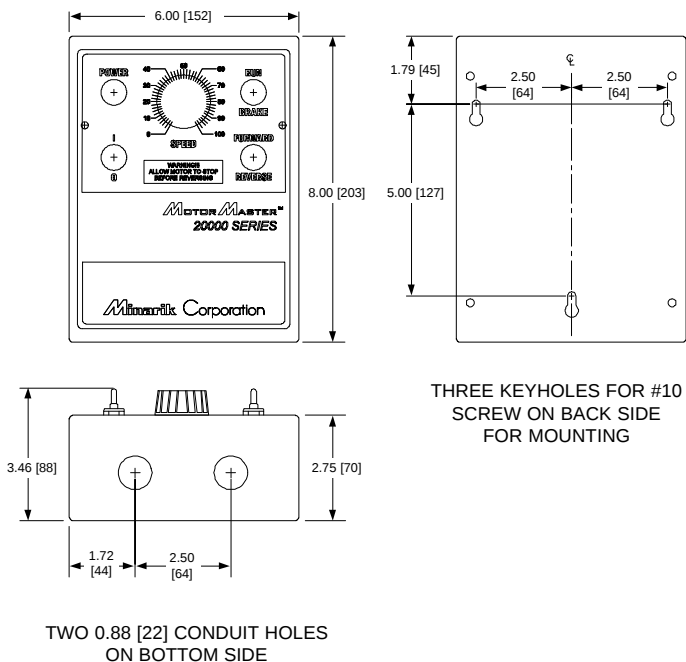
AC Line Voltage Tolerance	±10%, 50/60 Hz, single phase
Armature Voltage	0 – 90 VDC
Field Voltage (1 ADC max)	50 – 100 VDC
Maximum Output Field Current	0.5 ADC
Form Factor	1.37 at base speed
Accel. Time Range (for 0–90 VDC Armature Voltage)	0.5 – 11 seconds
Decel. Time Range (for 0-90 VDC Armature Voltage)	coast to a stop – 13 seconds
Analog Input Voltage Range (signal must be isolated; S1 to S2)	0 – 1.4 VDC
Input Impedance (S1 to S2)	100K ohms
Load Regulation	1% base speed or better
Vibration	0.5G max (0 – 50 Hz) 0.1G max (>50 Hz)
Ambient Temp. Range	10°C – 40°C

Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. MM21111A Drive Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 2. MM21211A Drive Dimensions

Installation

Drive mounting



Warning

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

NEMA 1 cased drives such as the MM21111A and MM21211A come with 0.88 inch (22 mm) conduit holes at the bottom of the case. The units may be vertically wall mounted or horizontally bench mounted using the three keyholes on the back of the case. See Figures 1 and 2 (pages 2 and 3) for mounting hole locations.

1. For access to the keyholes and the terminal strip, remove the two screws from the front of the case by turning them counterclockwise. Grasp the front cover and lift it straight out.
2. Install the mounting screws in the three keyholes.
3. Install conduit hardware through the conduit holes at the bottom of the case. Connect external wiring to the terminal block.
4. Reinstall the front cover. Avoid pinching any wires between the front cover and the case.
5. Replace the two screws on the front cover. Turn the screws clockwise to tighten.
6. Set the POWER switch to the OFF position before applying AC line voltage.

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 potential is at 115 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 18-24 AWG wire for speed adjust potentiometer wiring. Use 14-16 AWG wire for AC line (L1, L2), field (F1, F2) 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 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 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 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.

Speed adjust potentiometer connections

MM21111A

The speed adjust pot connections on MM21111A drives are configured for unidirectional (one-way) operation. Reversing is accomplished by swapping the A1 and A2 motor armature leads.

MM21211A



Warning

Do not change the FORWARD/REVERSE switch setting while the motor is still running. Plug reversing the motor (not allowing the motor to come to a stop before reversing) will cause excessively high currents to flow in the armature circuit, which can damage the control and/or motor and is not recommended.

The speed adjust potentiometer is prewired for bidirectional operation on MM21211A drives. Reversing is accomplished by setting the FWD/REV switch on the front panel to the desired position.

Field output

The field output is for shunt wound motors only. **Do not make any connections to F1 and F2 when using a permanent magnet motor.** See Table 2 for field output connections.

Table 2. Field Output Connections

Line Voltage (VAC)	Approximate Field Voltage (VDC)	Connect Motor Field To
115	50	F1 and L1
115	100	F1 and F2

Use 18 AWG wire to connect the field output to a shunt wound motor.

Heat sinking

All MM21000 series drives contain sufficient heat sinking in their basic configurations. No additional heat sinking is necessary.

Line fusing

Minarik drives require an external fuse for protection. Use fast acting fuses rated for 250 VAC or higher, and approximately 150% of the maximum armature current. Fuse blocks are included on MM21111A and MM21211A only. Table 3 lists the recommended line fuse sizes.

Table 3. Fuse Chart

90 VDC Motor Horsepower	Max. DC Armature Current (amps)	AC Line Fuse Size (amps)
1/20	0.5	1
1/15	0.8	1.5
1/8	1.5	3
1/6	1.7	3
1/4	2.5	5
1/3	3.5	8
1/2	5.0	10
3/4	7.5	15
1	10	15

Minarik Corporation offers two fuse kits: part number 050-0066 (1-5A Fuse Kit) and 050-0071 (5-15A Fuse Kit).

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.

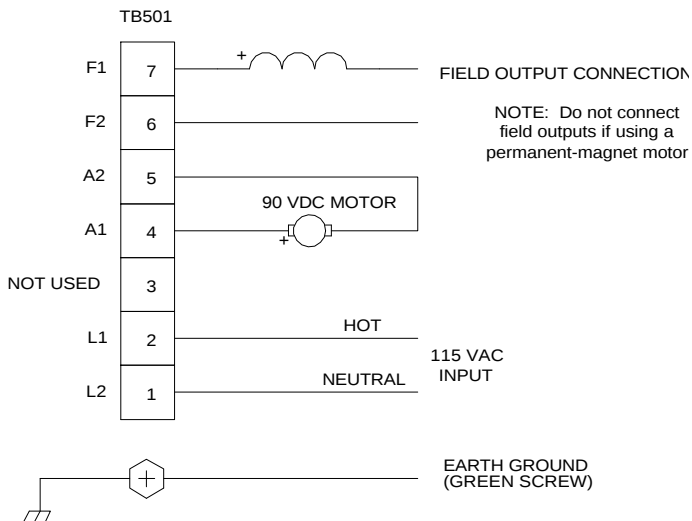
Drive motor connections

Minarik 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 terminals A1 and A2 as shown in Figure 3, page 12. **Ensure that the motor voltage rating is consistent with the drive's output voltage.**

Drive power connections

Connect the AC line power leads to terminals L1 and L2 as shown in Figure 3, page 12.

**Figure 3. MM21111A and MM21211A Connections**

Operation



Warning

Dangerous voltages exist on the drive when it is powered.
BE ALERT. High voltages can cause serious or fatal injury.

Before applying power

- Verify that no conductive material is present on the printed circuit board.
- Verify that the AC supply is properly balanced.

MM21111A drive startup and shutdown

1. Turn the speed adjust potentiometer to zero speed (full CCW).
2. Set the POWER switch to ON (|). The POWER ON indicator will light.
3. Slowly turn the speed adjust knob clockwise until the desired speed is reached.

To shut down the drive

Set the POWER switch to OFF. The motor will coast to a stop.

MM21211A drive startup and shutdown

1. Set the RUN/BRAKE switch to the BRAKE position.
2. Set the speed adjust knob to zero speed (full CCW).
3. Set the POWER switch to ON (|).
4. Set the FORWARD/REVERSE switch to the desired direction of rotation.
5. Set the RUN/BRAKE switch to the RUN position.
6. Turn the speed adjust knob CW to the desired speed.
7. The motor may be started and stopped at any speed setting with the RUN/BRAKE switch. When placed in the BRAKE position the motor is dynamically braked to a stop. Motor may be started and stopped with the ON/OFF toggle switch but when switched off will coast to a stop.
8. To reverse the motor direction, first stop the motor by setting the RUN/BRAKE switch to the BRAKE position. Set the FORWARD/REVERSE switch to the desired direction of rotation. Then, set the RUN/BRAKE switch to the RUN position.

To shut down the drive

Set the RUN/BRAKE switch to BRAKE. Set the POWER switch to OFF. To coast to a stop, set the POWER switch to OFF without first braking the motor.

Starting and Stopping Methods



Warning

NOTE: Minarik strongly recommends the installation of an emergency stop switch. The switch contacts should be rated at a minimum of 125 volts and 200% of maximum motor current.

Line starting and stopping

When AC line voltage is applied to the drive, the motor accelerates to the set speed. When AC line voltage is removed, the motor coasts to a stop. Line starting and stopping (applying and removing AC line voltage) is recommended for stopping in emergency situations only. It is not recommended for frequent starting and stopping.

MM21111A

Set the POWER switch to OFF. The motor will coast to a stop. Alternatively, dynamic braking may be used (Figure 4, page 17).

MM21211A

Set the RUN/BRAKE switch to BRAKE. The motor will quickly stop using dynamic braking. To coast the motor to a stop, set the POWER switch to OFF without first setting the RUN/BRAKE switch to BRAKE.

Dynamic braking



Warning

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

NOTE: 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.

MM21111A

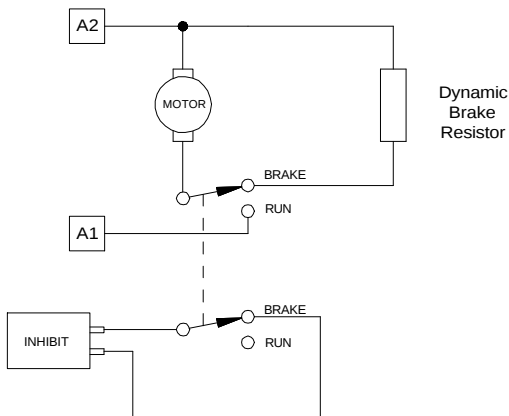
Dynamic braking may be used to rapidly stop a motor (Figure 4, page 17). For the RUN/BRAKE switch, use a double-pole, double-throw switch rated for at least the maximum DC armature voltage and maximum braking current.

MM21211A

MM21211A drives have built-in dynamic braking, which is activated when the RUN/BRAKE switch is set to BRAKE.

Table 4. Recommended Dynamic Brake Resistor Sizes

Motor Armature Current Rating	Minimum Dynamic Brake Resistor Value	Minimum 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

**Figure 4. Dynamic Brake Connection**

Calibration



Warning

Dangerous voltages exist on the drive when it is powered. 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.

MM21000A Series drives have six 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 5 (page 19) for trimpot location.

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

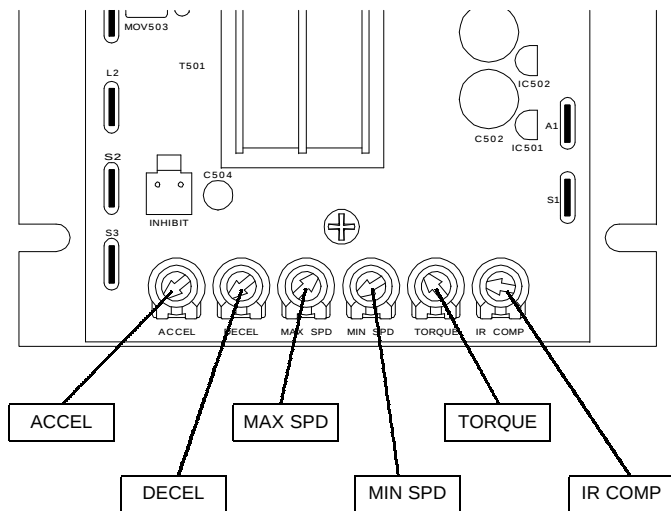


Figure 5. Calibration Trimpot Layout

MINIMUM SPEED (MIN SPD)

The MIN SPD setting determines the motor speed when the speed adjust potentiometer is turned full CCW. It is factory set for zero speed.

To calibrate, set the MIN SPD trimpot full CCW. Turn the speed adjust potentiometer full CCW. Adjust the MIN SPD trimpot until the desired minimum motor speed is reached.

MAXIMUM SPEED (MAX SPD)

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

To calibrate, set the MAX SPD trimpot full CCW. Turn the speed adjust potentiometer full CW. Adjust the MAX SPD trimpot until the desired maximum motor speed is reached.

TORQUE



Warning

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

The TORQUE trimpot setting determines the maximum torque for accelerating and driving the motor. See Figure 6 on page 25 for recommended TORQUE settings, or recalibrate using the following procedure:

1. With the power disconnected from the drive, connect a DC ammeter in series with the motor armature.
2. Turn the TORQUE trimpot to minimum (full CCW).
3. Set the speed adjust potentiometer to maximum speed (full CW).
4. Carefully lock the motor armature. Be sure that the motor is firmly mounted.
5. Apply line power. The motor should be stopped.
6. Slowly adjust the TORQUE trimpot CW until the armature current is 120% of motor rated armature current.
7. Turn the speed adjust potentiometer full CCW.
8. Remove line power.
9. Remove the stall from the motor.
10. Remove the ammeter in series with the motor armature if it is no longer needed.

IR COMPENSATION (IR COMP)

The IR COMP trimpot setting determines the degree to which motor speed is held constant as the motor load changes. It is factory set for optimum motor regulation.

See Figure 6 on page 25 for recommended IR COMP trimpot settings, or recalibrate using the following procedure:

1. Set the IR COMP trimpot to minimum (full CCW).
2. Rotate the speed adjust potentiometer until the motor runs at midspeed without load (for example, 900 RPM for an 1800 RPM motor). A hand held tachometer may be used to measure motor speed.
3. Load the motor armature to its full load armature current rating.
4. While keeping the load on the motor, rotate the IR COMP trimpot until the motor runs at the speed measured in step 2. If the motor oscillates (overcompensation), the IR COMP trimpot may be set too high (CW). Turn the IR COMP trimpot CCW to stabilize the motor.
5. Unload the motor.

ACCELERATION (ACCEL)

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

To set the acceleration time:

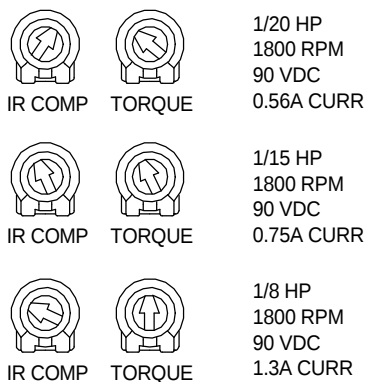
1. Set the speed adjust potentiometer full CCW. The motor should run at minimum speed.
2. Turn the speed adjust potentiometer full CW and measure the time it takes the motor to go from minimum to maximum speed.
3. If the time measured in step 2 is not the desired acceleration time, turn the ACCEL trimpot CW for a slower acceleration time, or CCW for a faster acceleration time. Repeat steps 1 through 3 until the acceleration time is correct.

DECELERATION (DECEL)

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

To set the deceleration time:

1. Set the speed adjust potentiometer full CW. The motor should run at maximum speed.
2. Turn the speed adjust potentiometer full CCW and measure the time it takes the motor to go from maximum to minimum speed.
3. If the time measured in step 2 is not the desired deceleration time, turn the DECEL trimpot CW for a slower deceleration time, or CCW for a faster deceleration time. Repeat steps 1 through 3 until the deceleration time is correct.



**Figure 6. Typical IR COMP and TORQUE Settings
(settings may vary by application)**

Application Notes

FWD-REV switch



Warning

Do not change the FORWARD/REVERSE switch setting while the motor is still running. Plug reversing the motor (not allowing the motor to come to a stop before reversing) will cause excessively high currents to flow in the armature circuit, which can damage the control and/or motor.

Use a single-pole, two-position switch to reverse a motor without swapping motor leads (Figure 7). The switch contacts should be rated at a minimum of 125 volts and 150% to 200% of motor nameplate current.

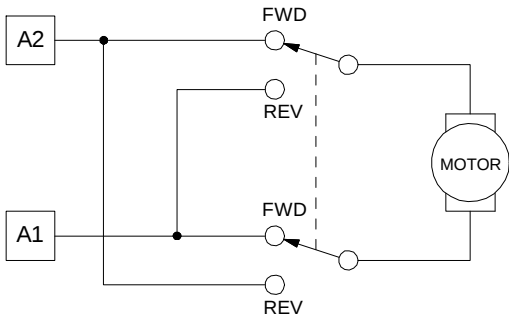


Figure 7. Forward-Reverse Switch

FWD-STOP-REV switch



Warning

Do not change the FORWARD/REVERSE switch setting while the motor is still running. Plug reversing the motor (not allowing the motor to come to a stop before reversing) will cause excessively high currents to flow in the armature circuit, which can damage the control and/or motor.

Use a single-pole, three-position switch with a single speed adjust potentiometer to coast to a stop between reversals (Figure 8). Set the switch to the center position to decelerate the motor to a stop. The switch contacts should be rated at a minimum of 125 volts and 150% to 200% of motor nameplate current.

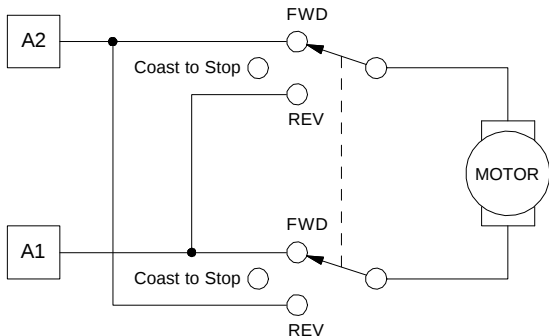


Figure 8. Forward-Stop-Reverse Switch

Reversing with dynamic braking

A dynamic brake may be used when reversing the motor direction (Figure 9). 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.

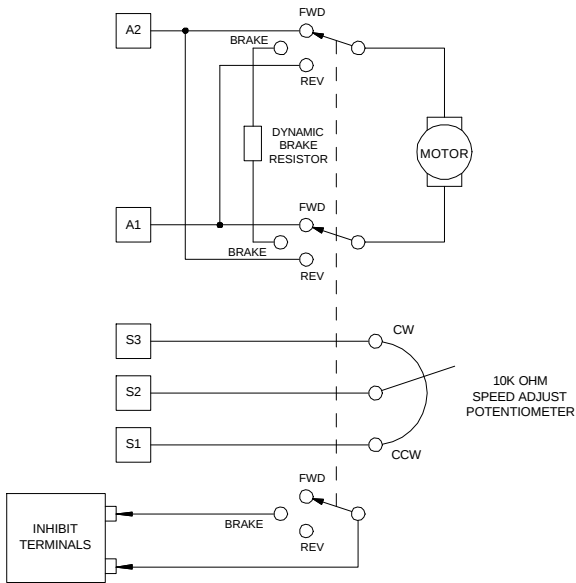


Figure 9. Reversing Circuit Connection

Reversing with a DLC600

A DIGI-LOK controller, model DLC600 can be used in a reversing application. The DIGI-LOK must be inhibited while braking. Without the inhibit feature, the DIGI-LOK will continue to regulate. This will cause oversoot when the DIGI-LOK is switched back to the drive. Figure 10 shows the connection of the reversing circuit to an MM21000 series drive and a DLC600.

Note: Only one DLC option (Optical Encoder or Magnetic Pickup) may be used at a time.

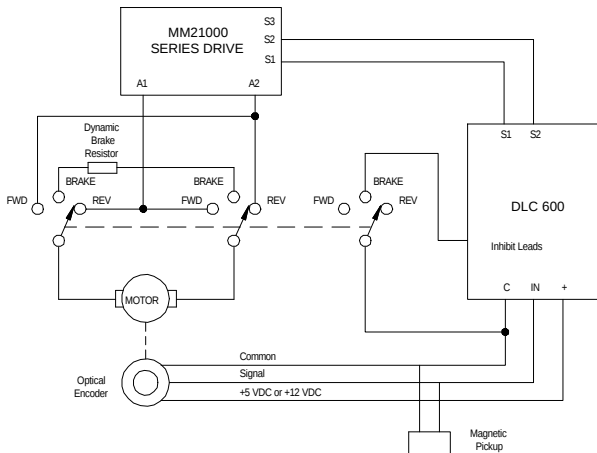


Figure 10. Reversing with a DLC600

Independent Adjustable Speeds

Connect two speed adjust potentiometers with a single pole two position switch to select between two independent speeds shown in the forward direction (Figure 11). The speed adjust potentiometers can be mounted at two separate operating stations.

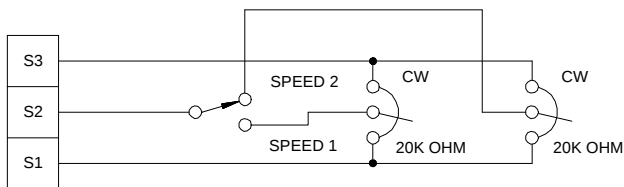


Figure 11. Independent Adjustable Speeds (Forward Direction)

Adjustable speeds using potentiometers in series

Replace the speed adjust potentiometer with a single-pole, multi-position switch, and two or more potentiometers in series, with a total series resistance of 10K ohms. Figure 12 shows a connection for fixed high and low speed adjust potentiometers.

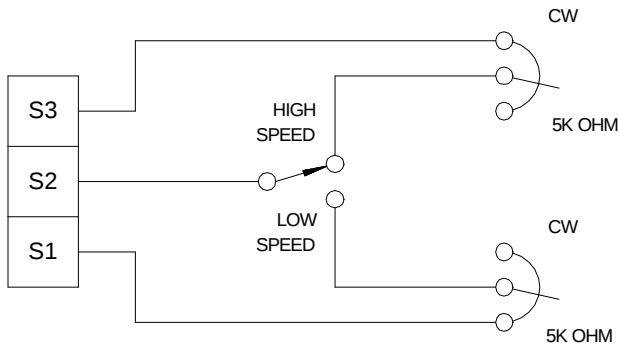


Figure 12. Adjustable Fixed Speeds Using Potentiometers in Series

Multiple fixed speeds

Replace the speed adjust potentiometer with series resistors with a total series resistance of 10K ohms (Figure 13). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

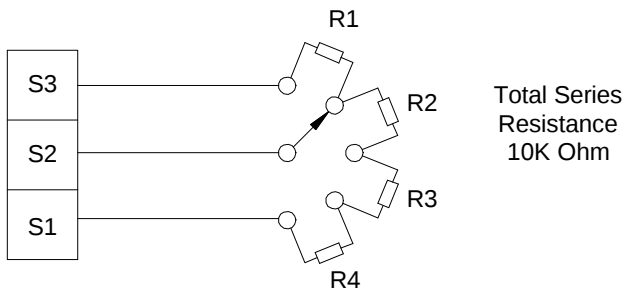


Figure 13. Multiple Fixed Speeds

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 closed, momentary operated pushbutton for the JOG pushbutton as shown in Figure 14. When the RUN/JOG switch is set to JOG, the motor decelerates to zero speed. Press the JOG pushbutton to jog the motor. Return the RUN/JOG switch to RUN for normal operation.

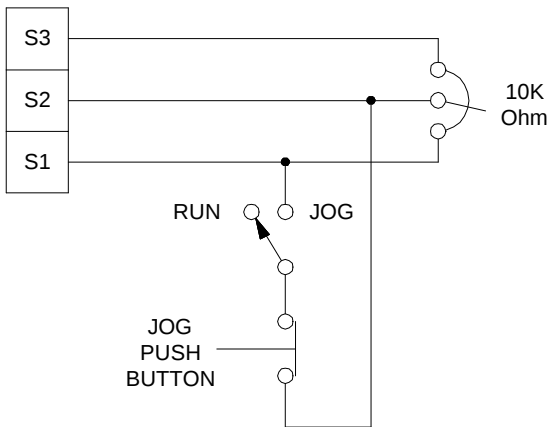


Figure 14. RUN/JOG Switch Connection to Speed Adjust Potentiometer

Leader-follower application

In this application, use a PCM4 to monitor the speed of the leader motor (Figure 15). The PCM4 isolates the leader motor from the follower drive, and outputs a voltage proportional to the leader motor armature voltage. The follower drive uses this voltage reference to set the speed of the follower motor. An optional ratio potentiometer may be used to scale the PCM4 output voltage.

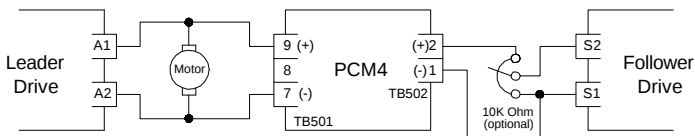


Figure 15. Leader-Follower Application

Single speed potentiometer control of multiple drives

Multiple drives can be controlled with a single speed adjust potentiometer using a PCM4 at the input of each drive to provide isolation (Figure 16). Optional ratio potentiometers can be used to scale the PCM4 output voltage, allowing independent control of each drive.

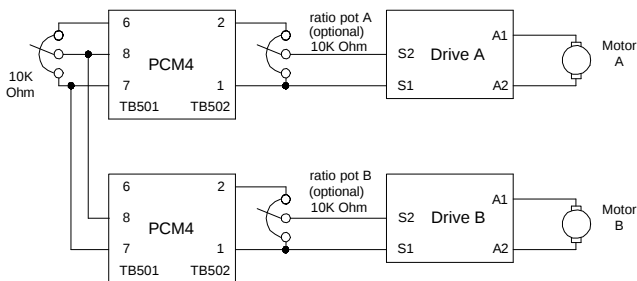


Figure 16. Single Speed Potentiometer Control of Multiple Drives

Troubleshooting



Warning

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

Before troubleshooting

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

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

For additional assistance, contact your local Minarik distributor, or the factory direct: PHONE (800) MINARIK or (800) 646-2745
FAX (800) 394-6334

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. 4. Field circuit is shorted.	1. Check that line fuses are 3 A. 2. Check motor cable and armature for shorts. 3. Decrease TORQUE setting (page 21). 4. Send in drive to Minarik repair department.
Line fuse does not blow, but the motor does not run	1. Speed adjust pot or reference voltage is set to zero speed. 2. Speed adjust pot or reference voltage connections are open. 3. Drive is overloaded. 4. Drive is not receiving AC line voltage. 5. Motor is not connected.	1. Increase speed adjust pot or reference voltage setting. 2. Check that the speed adjust pot or reference voltage connections are not open. 3. Verify that the motor is not jammed. Increase TORQUE setting (page 21). 4. Apply AC line voltage to L1 and L2. 5. Connect motor to A1 and A2.

Symptom	Possible Causes	Suggested Solutions
Motor runs too fast at maximum speed setting	1. MIN SPD and MAX SPD settings are too high. 2. Field connections are loose (shunt-wound motors only).	1. Recalibrate MIN SPD and MAX SPD (page 20). 2. Check field connections.
Motor runs too slow or too fast	1. MIN SPD and MAX SPD are not calibrated.	1. Recalibrate MIN SPD and MAX SPD (page 20).
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 (page 20). 2. Increase IR COMP setting (page 22). 3. Check motor load. Resize the motor and drive if necessary.
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 (page 22). 2. Check that motor and drive are of sufficient horsepower and amperage.

Replacement Parts

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

Table 5. Replacement Parts

Model No.	Symbol	Description	Minarik® P/N
MM21111A	D501-503	1N5406 Diode	071-0007
	SCR501-502	S8020L High-power SCR	072-0043
	R501	0.05 Ohm, 3W Resistor	032-0073
	T501	ST-3-3109 115VAC Transformer	230-0083
		Chassis	222-0079
		10K Ohm Pot Kit	202-0031
		Green Neon Lamp	040-0043
		Toggle Switch	080-0037
		10K Ohm, 5W Pot	120-0009
		MM100 Knob	140-0013
		3A, 3AG Fast-Blow Fuse	050-0021
		NEMA 1 Case	260-0094
MM21211A		Same as MM21111A except:	
		10K Ohm, 2W Carbon Pot	120-0047
		DPDT Toggle Switch	080-0003

Certificate of Compliance

Minarik Corporation hereby certifies that its MM20000 series drives have been approved to bear the “CE” mark provided the conditions of approval (listed in Exhibit “A”) have been met by the end user.

The MM20000 series has been tested to the following test specifications:

EN55011:1991 (emissions), and
EN50082-1:1992 (immunity)

Compliance allows Minarik’s MM21000 series to bear the CE mark.

The end user, as described herein, falls into one of two categories:

1. The Consumer will deploy a stand-alone unit as an integral, yet external, portion of the machine he/she is operating.
2. The Original Equipment Manufacturer (OEM) will implement the product as a component of the machine being manufactured.

Exhibit “A”

In addition to EMI/RFI safeguards inherent in the MM20000 series’ design, external filtering is required.

Minarik requires the Corcom® filters listed in Table 6. If the exact filter is not available, the specifications are as follows:

$L = (1.73 + 0.03)$ milliHenries.

$C = (0.27 + 0.54)$ microFarads (X); 0.0055 microFarads (Y).

$R = 330$ Kohms.

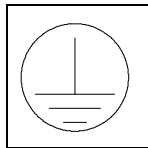
Rated current: 1.4 times maximum DC motor current.

Filter type: Balanced 2-section.

Table 6. Corcom® Filters

Nameplate Current of Motor Wired to the Drive	Corcom® Filter Part Number
0 to 4 amps	6VV1
4.1 to 13 amps	20VV1

The filters in Table 6 should be wired to the AC line within 0.25 meters of the drive. The ground connection from the filter must be wired to solid earth ground (resistance less than 500 ohms); not machine ground. This is very important!



If the end-user is using a CE-approved motor, the correct filter from Table 6 is all that is necessary to meet the EMC directives listed herein.

If the end-user is not using a CE-approved motor, a second filter, part number CEXXMM, must be deployed on the output. XX = rated current of the filter.

The CE20MM is a Real-Pole Balanced-Pi 3-pole filter. If the exact filter is not available, the specifications are as follows:

$L \text{ \& } L1 = 2 * (0.8) \text{ milliHenries.}$

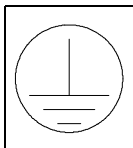
$C \text{ \& } C1 = 2 * (0.1) \text{ microFarads @ 400 VDC.}$

$R_{in} = 0.1 \text{ ohm; } R_{out} = 1.2 \text{ ohm.}$

Table 7. Minarik Filters

Nameplate Current of Motor Wired to the Drive	Minarik Filter Part Number
0 to 4 amps	CE4MM
4.1 to 13 amps	CE20MM

The filters in Table 7 must be wired to the DC output of the drive, as close to the drive as possible. The ground connection from the filter must be wired to solid earth ground (resistance less than 500 ohms); not machine ground. This is very important!



The end user must use the filtration listed in Exhibit A to comply with CE. The OEM may choose to provide alternative filtering that encompasses the Minarik drive and other electronics within the same panel.

The OEM has this liberty because CE is a machinery directive. Whether or not every component in the OEM's machinery meets CE, the OEM must still submit his machine for CE approval. Thus, no component must necessarily meet CE within the machine, as long as the OEM takes the necessary steps to guarantee the machine does meet CE. By the same token, even if every component in the OEM's machine does meet CE, the machine will not necessarily meet CE as a machine.

Using CE-approved wiring practices (like proper shielding) and the filters listed in Exhibit A guarantee the drive will meet EN55011 (1991 emissions standard) and EN50082-1 (1992 immunity standard).

Notes

Notes

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 or 3,000 hours, whichever comes first, from date of manufacture thereof. Within this warranty period, the Corporation will repair or replace, at its sole discretion, such products that are returned to Minarik Corporation, 901 East Thompson Avenue, Glendale, CA 91201-2011 USA.

This warranty applies only to standard catalog products, and does not apply to specials. Any returns for special controls will be evaluated on a case-by-case basis. 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

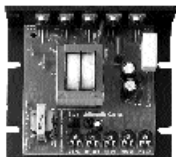
In the event of any claim for breach of any of the Corporation's obligations, whether express or implied, and particularly of any other claim or breach of warranty contained in Paragraph A, or of any other warranties, express or implied, or claim of liability that might, despite Paragraph B, be decided 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.

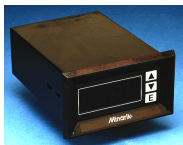
If for any reason any of the foregoing provisions shall be ineffective, the Corporation's liability for damages arising out of its manufacture or sale of equipment, or use thereof, whether such liability is based on warranty, contract, negligence, strict liability in tort, or otherwise, shall not in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

Other drives from Minarik Corporation:



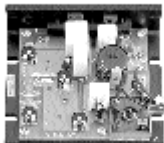
PC20000 Series



DLC600



MM23000 Series



XP Series
(AC or DC Input)



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Document Number 250-0077, Revision 3

Printed in the U.S.A – 6/01

\$12.00 North America, \$13.00 Outside North America