

MMXL Series

Models:

C1MMXLO5-D240AC

C4MMXLO5-D240AC

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

Minarik Automation
& Control

User's Manual


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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 120 VAC or 240 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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Specifications

| Model | AC Line Voltage | Max. Continuous Armature Current (Amps DC) | HP Range with 120 VAC Applied | HP Range with 240 VAC Applied |
|------------------|-----------------|--|-------------------------------|-------------------------------|
| C1MMXL05-D240AC† | 120 OR 240 | 5 | 1/4 – 1/2 | 1/2 – 1 |
| C4MMXL05-D240AC† | 120 OR 240 | 5 | 1/4 – 1/2 | 1/2 – 1 |

† Requires Minarik heat sink kit p/n 223-0360 when continuous current is 5 amps

AC Line Voltage 120/240 VAC ± 10%, 50/60 Hz, single phase

Armature Voltage Range

with 120 VAC input 0 – 130 VDC

with 240 VAC input 0 – 240 VDC

Form Factor (at base speed) 1.05

Acceleration/Deceleration Time Range (no load) 0.5 – 6 seconds

Input Impedance (S1 to S2 with 5 VDC input) approximately 70K ohms

Speed Regulation 1% base speed or better

Ambient Temp. Range (chassis drive) 10°C–40°C

Vibration 0.5g max (20 – 50 Hz)

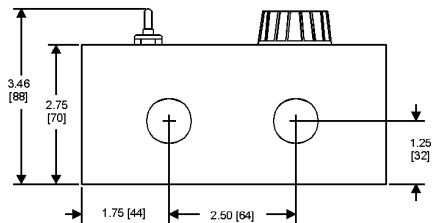
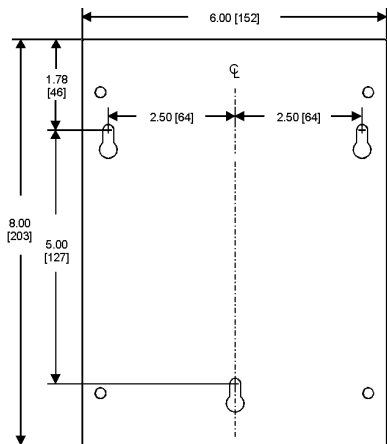
0.1g max (>50 Hz)

Weight

C1MMXL SERIES 3.3 lb [1.5 kg]

C4MMXL SERIES 4.7 lb [2.1 kg]

Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. C1MMXL Series Dimensions

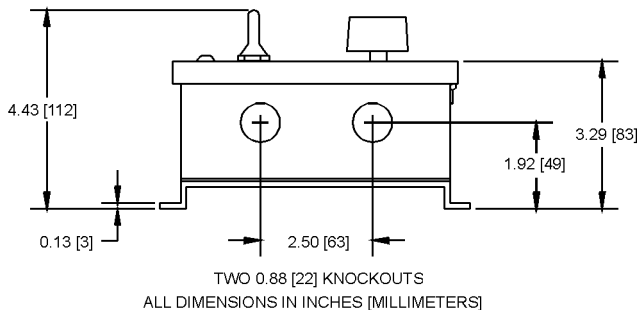
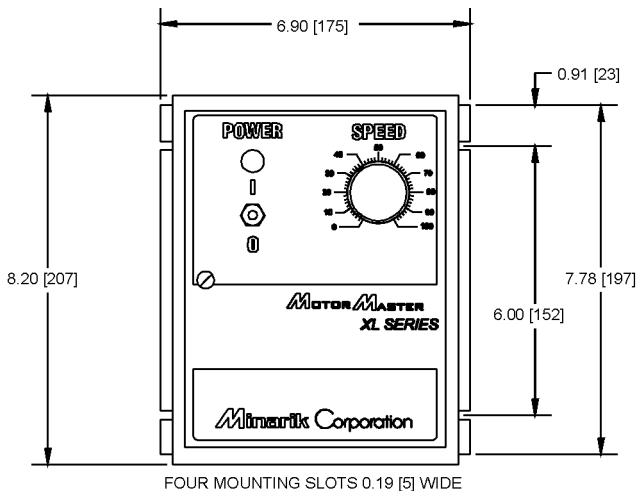


Figure 2. C4MMXL Dimensions

Installation



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 before attempting installation.

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.

Mounting

- 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.

C1MMXL Mounting

C1MMXL drives come with two 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.

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 to the front cover. Turn the screws clockwise to tighten.
6. Set the **POWER** switch to the **OFF** position before applying the AC line voltage.

C4MMXL Mounting

C4MMXL drives come with two 0.88 inch (22 mm) conduit knockout holes at the bottom of the case. The units may be vertically wall mounted using the four 0.19 inch (5 mm) slotted holes on the attached heat sink. For motor loads less than 5 ADC, the drive may be bench mounted horizontally, or operated without mounting.

1. Install the mounting screws.
2. For access to the terminal strip, turn the slotted screw on the front cover counterclockwise until it is free from the case. The right side of the cover is hinged to the case. Pull the slotted screw to open the case.
3. Carefully remove the conduit knockouts by tapping them into the case and twisting them off with pliers.
4. Install conduit hardware through the 0.88 inch (22 mm) knockout holes. Connect external wiring to the terminal block.
5. Grasp the slotted screw and tilt the front cover back into place. Avoid pinching any wires between the front cover and the case.
6. Turn the slotted screw clockwise until tight to secure the front cover.

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 14–16 AWG wire for AC line (L1, L2) and motor (A1 and A2) wiring. Use 16 AWG wire to connect the field output to a shunt wound motor.

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 all conductors.

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

Heat sinking

C1MMXL and C4MMXL series drives contain sufficient heat sinking in their basic configurations. There is no need for additional heat sinking.

Line fusing

Minarik drives require fuses for protection. Cased MMXL drives are prewired with two internal 15A fuses. Use fast acting fuses rated for 250 VAC or higher and approximately 150% of the maximum armature current.

Table 1 lists the recommended line fuse sizes.

Table 1. Recommended Line Fuse Sizes

| 130 VDC Motor Horsepower | 240 VDC Motor Horsepower | Max. DC Armature Current (amps) | AC Line Fuse Size (amps) |
|-----------------------------|-----------------------------|------------------------------------|-----------------------------|
| 1/20 | 1/10 | 0.5 | 3 |
| 1/15 | 1/8 | 0.8 | 3 |
| 1/8 | 1/4 | 1.5 | 5 |
| 1/6 | 1/3 | 1.7 | 5 |
| 1/4 | 1/2 | 2.6 | 8 |
| 1/3 | 3/4 | 3.5 | 8 |
| 1/2 | 1 | 5.0 | 10 |
| 3/4 | 1 1/2 | 7.6 | 15 |
| 1 | 2 | 10 | 20 |

Minarik Corporation offers two fuse kits: part number 050-0069 (3-8A Fuse Kit) and 050-0073 (5-20A Fuse Kit).

Connections



Warning

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

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 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 connections

Connect the AC line power leads to terminals L1 and L2.

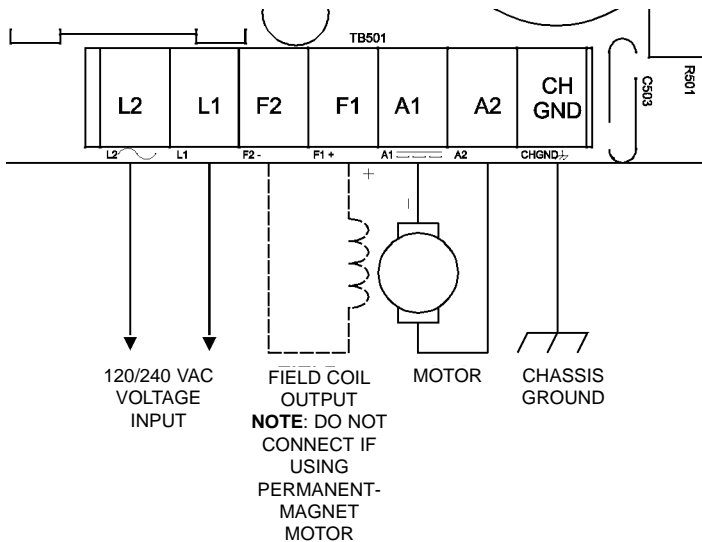


Figure 4. C1/C4MMXL Series Connections

Field output connections

The field output is for shunt wound motors only. Do not make any connections to the field output when using a permanent magnet motor. Table 2 shows where to connect the field leads of a shunt wound motor.

Table 2. Field Output Connections

| Line Voltage (VAC) | Approximate Field Voltage (VDC) | C1/C4MMXL Connections |
|-------------------------------|--|----------------------------------|
| 115 | 50 | F1 and L1 |
| 115 | 100 | F1 and F2 |
| 230 | 100 | F1 and L1 |
| 230 | 200 | F1 and F2 |

Use 16 AWG wire to connect the field output to a shunt wound motor.

A fuse is connected to field output connection F2. The value of this fuse must be a minimum of 250 volts and 150% of the rated motor field current.

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.

Before applying power

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

If the motor or drive does not perform as described, disconnect the AC line voltage immediately. Refer to the Troubleshooting section, page 27, for further assistance.

Startup

C1MMXL

To start the drive:

1. Turn the speed adjust potentiometer full counterclockwise (CCW).
2. Set the POWER switch to ON.
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. Continue until the desired speed is reached.
4. Set the POWER switch to OFF to coast the motor to a stop.

C4MMXL

To start the drive:

1. Turn the speed adjust potentiometer full counterclockwise (CCW).
2. Set the POWER switch to ON.
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. Continue until the desired speed is reached.

To shut down the drive:

1. Set the speed adjust potentiometer to zero. The motor will slowly decelerate to minimum speed.
2. Set the POWER switch to OFF.

Line starting and line 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 line stopping (applying and removing AC line voltage) is not necessary, and therefore not recommended for starting and stopping except for emergency situations.

Calibration



Warning

Dangerous voltages exist on the drive when it is powered, and up to 30 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.

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

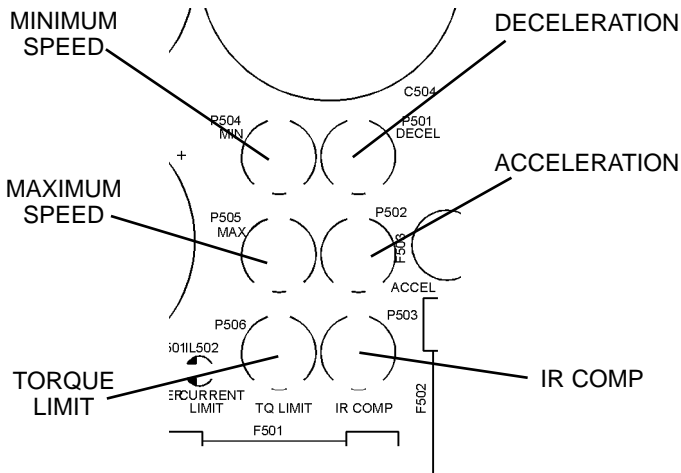


Figure 5. Calibration Trimpot Layout

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.

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 minimum rated 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.

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 horsepower motor. Refer to the recommended IR COMP settings on page 25, or recalibrate using the following procedure:

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

To calibrate IR COMP (exact calibration):

1. Turn the IR COMP trimpot full CCW.
2. Set 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. The motor should slow down.
4. While keeping the load on the motor, rotate the IR COMP trimpot until the motor runs at the speed measured in step 2.

Approximate calibration:

If the motor does not maintain set speed as the load changes, gradually rotate the IR COMP trimpot CW. 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 speed.

ACCELERATION (ACCEL)

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

Turn the ACCEL trimpot CW to increase the duration of acceleration and CCW to decrease the duration of acceleration.

DECELERATION (DECEL)

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

Turn the DECEL trimpot CW to increase the duration of deceleration and CCW to decrease the duration of deceleration.

CURRENT LIMIT (CURR LIM)





Warning



Although CURRENT LIMIT is set to 120% of motor nameplate current rating, continuous operation beyond that rating may damage the motor. If you intend to operate beyond the rating, contact your Minarik representative for assistance.



Recalibrate the CURRENT LIMIT setting when using a lower horsepower motor. Refer to the recommended CURRENT LIMIT settings on page 25, or recalibrate using the following procedure.

1. With the power disconnected from the drive, connect a DC ammeter (0–15 A minimum scale) in series with the armature.
2. Set the CURRENT LIMIT trimpot to minimum (full CCW).
3. Connect power to the drive. The motor should remain stopped.
4. Lock the motor armature. Be sure that the motor is firmly mounted.
5. Set the speed adjust potentiometer to maximum (full CW).
6. Adjust the CURRENT LIMIT trimpot CW slowly until the armature current is 120% of motor rated armature current.
7. Set the speed adjust potentiometer to minimum and remove the lock from the motor shaft.



120 VAC IN, 90 VDC OUT



| | | |
|---|--|--|
| MOTOR HP: 1/2 VOLTS: 90 VDC RPM: 1750 AMPS: 5.0 ADC | CURR LIM  | I/R COMP  |
|---|--|--|



| | | |
|---|--|--|
| MOTOR HP: 1/3 VOLTS: 90 VDC RPM: 1750 AMPS: 3.5 ADC | CURR LIM  | I/R COMP  |
|---|--|--|

| | | |
|---|--|--|
| MOTOR HP: 1/4 VOLTS: 90 VDC RPM: 1750 AMPS: 2.7 ADC | CURR LIM  | I/R COMP  |
|---|--|--|



120 VAC IN, 130 VDC OUT



| | | |
|--|--|--|
| MOTOR HP: 1/2 VOLTS: 130 VDC RPM: 2500 AMPS: 3.8 ADC | CURR LIM  | I/R COMP  |
|--|--|--|



| | | |
|--|--|--|
| MOTOR HP: 1/3 VOLTS: 130 VDC RPM: 2500 AMPS: 2.6 ADC | CURR LIM  | I/R COMP  |
|--|--|--|

| | | |
|--|--|--|
| MOTOR HP: 1/4 VOLTS: 130 VDC RPM: 2500 AMPS: 2.0 ADC | CURR LIM  | I/R COMP  |
|--|--|--|



240 VAC IN, 180 VDC OUT



| | | |
|--|--|--|
| MOTOR HP: 1 VOLTS: 180 VDC RPM: 1750 AMPS: 5.0 ADC | CURR LIM  | I/R COMP  |
|--|--|--|

| | | |
|--|--|--|
| MOTOR HP: 3/4 VOLTS: 180 VDC RPM: 1750 AMPS: 3.5 ADC | CURR LIM  | I/R COMP  |
|--|--|--|

| | | |
|--|--|--|
| MOTOR HP: 1/2 VOLTS: 180 VDC RPM: 1750 AMPS: 2.7 ADC | CURR LIM  | I/R COMP  |
|--|--|--|

240 VAC IN, 240 VDC OUT

| | | |
|--|--|--|
| MOTOR HP: 1/2 VOLTS: 240 VDC RPM: 2500 AMPS: 1.9 ADC | CURR LIM  | I/R COMP  |
|--|--|--|

| | | |
|--|--|--|
| MOTOR HP: 1/3 VOLTS: 240 VDC RPM: 2500 AMPS: 1.0 ADC | CURR LIM  | I/R COMP  |
|--|--|--|



| | | |
|---|--|--|
| MOTOR HP: 1/4 VOLTS: 240 VDC RPM: 2500 AMPS: 0.75 ADC | CURR LIM  | I/R COMP  |
|---|--|--|

Figure 6. Approximate TORQUE LIMIT and IR COMP Settings (actual settings may vary)

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:

- 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 your local Minarik® distributor, or the factory direct:

(800) MINARIK (phone) or (800) 394-6334 (fax).

Diagnostic LEDs

Cased MMXL drives have two diagnostic LEDs on the printed circuit board to aid in troubleshooting and checking system status.

POWER ON

Green LED lights when power is applied to the drive and the ON-OFF switch is set to ON.

CURRENT LIMIT

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

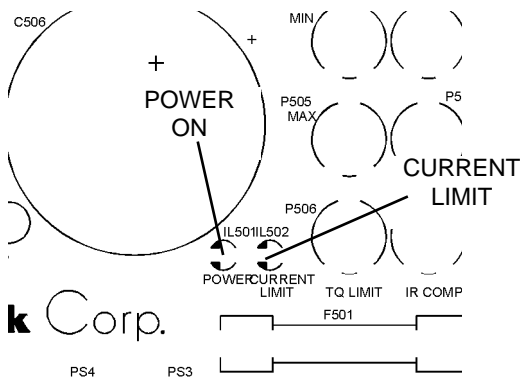


Figure 10. Diagnostic LED Location

Motor does not run

1. Check for blown fuses or tripped circuit breaker.
2. Verify that the speed adjust potentiometer is connected correctly.
3. Verify that the speed adjust potentiometer is not set to its zero position.
4. Verify that the inhibit pin connections are not shorted together or closed.
5. Verify that the drive is receiving AC line voltage.
6. Check that the drive is not in current limit. The red current limit LED must be off. If the red current limit LED is on, verify that the motor is not jammed. It may be necessary to increase the CURR LIMIT setting if it is set to a value lower than the current rating of the motor (page 24).

Fuses or circuit breaker blows

1. Check all wiring for shorts, grounds, or misconnections.
2. Check that the drive is configured to match the motor rating.
3. Check that the motor is not jammed or restricted from movement.
4. Check that the fuse size is correct for the motor being driven.

Motor runs too fast at the maximum speed setting

1. Check that the MIN SPD and MAX SPD setting are not set too high (page 21).
2. Check that the field output connections are secure if you are using a shunt wound motor.

Motor will not stop when the speed adjust potentiometer is full counterclockwise

Turn the MIN SPD trimpot CCW until the motor stops (page 21).

Motor runs in the opposite direction

1. Remove AC line voltage.
2. Reverse connections to the motor armature.

Motor slows under load

1. Check that the drive has been correctly calibrated for the motor.
2. Check that the motor is not overloaded.
3. Readjust the IR COMP slightly CW until motor runs at proper speed (page 22)

Motor is unstable under load

Readjust the IR COMP setting slightly CCW until motor speed is stabilized (page 22).

Motor only runs at full speed

1. Check if the speed adjust potentiometer is open.
2. Check if the connections to S1, S2, and S3 are open.
3. Check that the minimum speed trimpot is not set too far CW (page 21).

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 |
|------------------------|----------------|-----------------------------|---------------------|
| C1MMXL05-D240AC | | | |
| | C504, 506, 507 | 470 mF, 400 V Capacitor | 011-0120 |
| | D501 | 16 A, 600 V Diode | 071-0044 |
| | Q501 | IGBT | 070-0086 |
| | Q502 | Power MOSFET | 070-0085 |
| | Q503 | Power MOSFET | 070-0083 |
| | R501 | 0.1 Ω , 5 W Resistor | 032-0129 |
| | T501 | Transformer TSD1017 | 230-0108 |
| | | 15A 3AB Fuse | 050-0018 |
| C4MMXL05-D240AC | | Same as above | |

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 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.



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