

USER'S MANUAL

LV Series

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

Models: LV01-24AC-E10U
LV02-24AC
LV02-24DC



Copyright © 2013 by
Minarik Drives

All rights reserved. No part of this manual may be reproduced or transmitted in any form without written permission from Minarik Drives. The information and technical data in this manual are subject to change without notice. Minarik Drives makes no warranty of any kind with respect to this material, including, but not limited to, the implied warranties of its merchantability and fitness for a given purpose. Minarik Drives assumes no responsibility for any errors that may appear in this manual and makes no commitment to update or to keep current the information in this manual.

Printed in the United States of America.



Safety Warnings



SHOCK
HAZARD




AVOID
HEAT



KEEP
DRY



AVOID
VIBRATION

Throughout this manual, this symbol  denotes an important safety tip. Read these sections **very carefully!**

- Have a qualified electrical maintenance 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.** To stop the drive in an emergency, ensure that a master switch has been installed in the AC line.
- **This drive is not isolated from earth ground.** Circuit potentials of up to 115 VAC exist on the board. Direct contact with the printed circuit board or with circuit elements poses the risk of serious injury or fatality. Use a non-metallic screwdriver for adjusting the calibration trimpots

Contents

Safety Warnings	i
Specifications	1
Dimensions	2
Installation	4
Mounting	4
Wiring	5
Line Fusing	5
Shielding guidelines	6
Speed adjust potentiometer installation	7
Connections (LV series)	8
Connections (LV-E10U series)	10
Voltage follower (LV series)	11
Voltage follower (LV-E10U series)	12
Operation	13
Before applying power	13
Startup	13
Line starting and stopping	14
Decelerating to a stop	14
Dynamic braking	15
Calibration	16
MINIMUM SPEED (MIN SPD)	18
MAXIMUM SPEED (MAX SPD)	18
TORQUE LIMIT (TQ LIMIT)	19
IR COMPENSATION (IR COMP)	20

Application Notes	21
Multiple fixed speeds21
Adjustable speeds using potentiometers in series22
Independent adjustable speeds23
RUN/JOG switch24
Reversing25
Troubleshooting	26
Before troubleshooting26
Replacement Parts29
Limited Warranty	inside back cover

Illustrations

Figure 1. LV Series Dimensions	2
Figure 2. LV-E10U Series Dimensions	3
Figure 3. Speed Adjust Potentiometer	7
Figure 4. LV Series Line Input and Speed Potentiometer Connections	8
Figure 5. LV Series Motor Connections	9
Figure 6. LV-E10U Series Drive Connections	10
Figure 7. LV Series Voltage Follower Connections	11
Figure 8. LV-E10U Voltage Follower Connections	12
Figure 9. Run/Decelerate to Zero Speed Switch	14
Figure 10. Dynamic Brake Connection	15
Figure 11. LV SERIES Calibration Trimpot Layout	16
Figure 12. LV-E10U SERIES Calibration Trimpot Layout	17
Figure 13. Multiple Fixed Speeds	21
Figure 14. Adjustable Fixed Speeds Using Potentiometers in Series	22
Figure 15. Independent Adjustable Speeds	23
Figure 16. RUN/JOG Switch Connection to Speed Adjust Potentiometer	24
Figure 17. Reversing Circuit Connection	25

Specifications

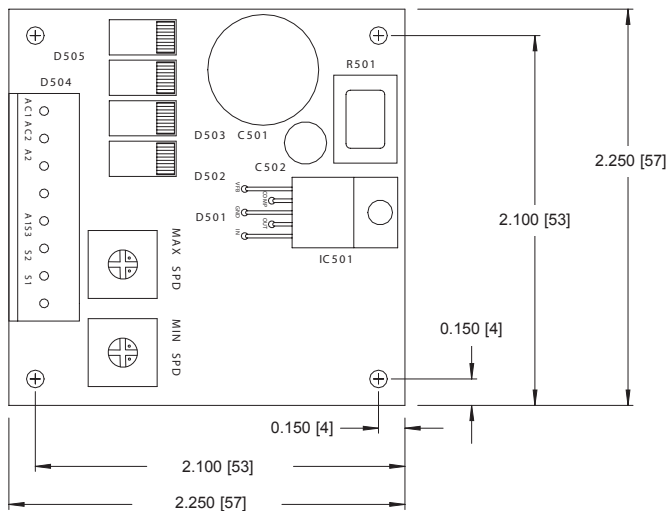
Model	Input Voltage	Maximum Armature Current (Amps DC)	Armature Voltage Range**	HP Range
LV01-24AC-E10U	8-24 VAC*	1.0	0-22 VDC	1/500-1/100
LV02-24AC	8-24 VAC*	2.0	0-22 VDC	1/250-1/50
LV02-24DC	10-36 VDC	2.0	0-22 VDC	1/250-1/50

* AC input voltage is $\pm 10\%$, 50/60 Hz, single phase

** Maximum output voltage is 91% of input voltage. Rating shown is with 24V input.

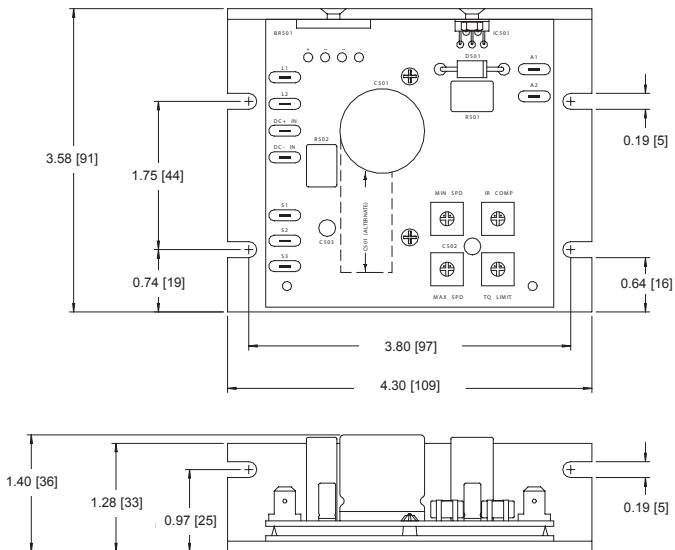
Form Factor	1.05 at base speed
Acceleration Time	1 second
Deceleration Time	1 second
Load Regulation (at base speed)	2%
Ambient Temp. Range	10°C-40°C
Vibration	0.5g max (0 - 50 Hz) 0.1g max (above 50 Hz)
Analog Input Voltage Range (S1 to S2)	0-4.6 VDC

Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 1. LV01 Series Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 2. LV02 Series Dimensions

Installation



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 on pg i before attempting installation.

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 trim pots.
- 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.

**Does not apply to LV01-24AC/DC-E10U*

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.

This product does not have internal solid state motor overload protection. It does not contain speed-sensitive overload protection, thermal memory retention or provisions to receive and act upon signals from remote devices for over temperature protection. If motor overload protection is needed in the end-use product, it needs to be provided by additional equipment in accordance with NEC standards.

Line Fusing

Protect all Minarik Drives's drives with a line fuse. Use fast acting fuses rated for 250 volts, 3 amps.

- For LV01/02-24AC drives, fuse only the *hot* side of the AC line (L1).
- For LV01/02-24DC drives, fuse the DC+ IN side of the DC voltage input.

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 Drives recommends shielding of all conductors.

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

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.

Speed adjust potentiometer installation



Warning

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

Install the circular insulating disk between the panel and the 10K ohm speed adjust potentiometer. Mount the speed adjust potentiometer through a 0.38 inch (10 mm) hole with the hardware provided (Figure 3). Twist the speed adjust potentiometer wire to avoid picking up unwanted electrical noise. If potentiometer leads are longer than 18 inch (457 mm), use shielded cable.

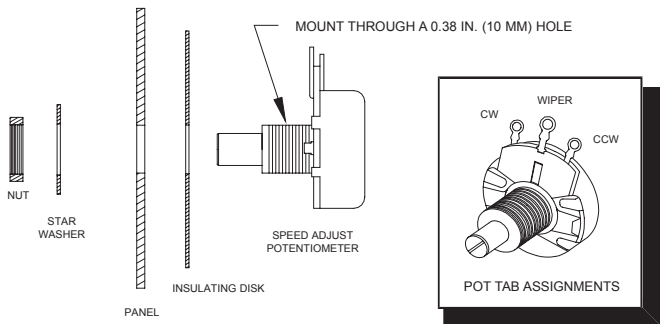


Figure 3. Speed Adjust Potentiometer

Connections (LV series)

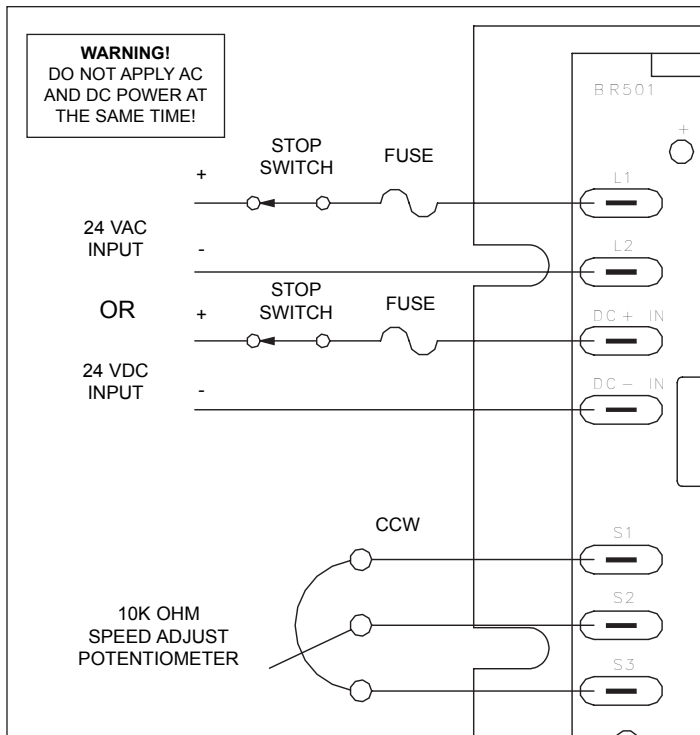


Figure 4. LV Series Line Input and Speed Potentiometer Connections

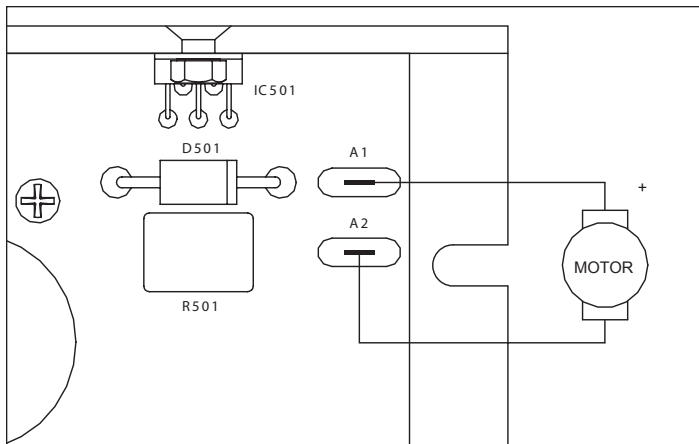


Figure 5. LV Series Motor Connections

ASSUMPTIONS: Minarik Drives's drives supply motor voltage to terminals A1 and A2 (A1 is positive with respect to A2). It is assumed throughout this manual that the driven motor will rotate clockwise (CW) while looking at the output shaft protruding from the front of the motor. If the opposite is desired, simply reverse the wiring of A1 and A2.

Connections (LV-E10U series)

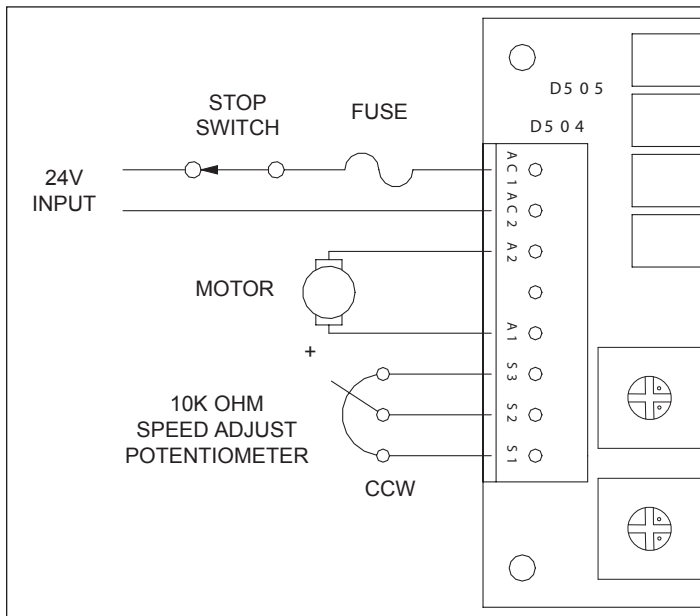


Figure 6. LV-E10U Series Drive Connections

Voltage follower (LV series)



Warning

Do not connect a non-isolated input voltage signal to an LV series drive. Connecting a non-isolated signal will damage the drive.

Instead of using a speed adjust potentiometer, the drive may be wired to follow a 0 – 4.6 VDC voltage signal that is isolated from earth ground (Figure 7). Connect the signal input (-) to S1. Connect the signal common (+) to S2. Make no connection to S3. A potentiometer can be used to scale the analog input voltage. To achieve greater linearity and control, use an interface device such as Minarik Drives model PCM4 to scale the analog input voltage. Follow the same wiring guidelines used for speed adjust potentiometer wiring (see page 5).

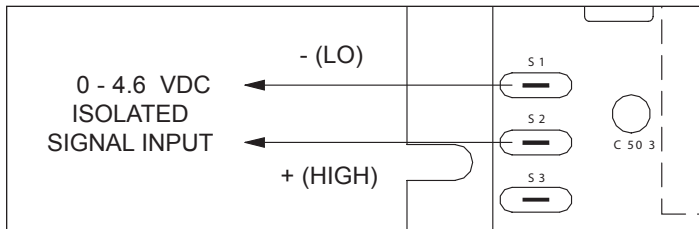


Figure 7. LV Series Voltage Follower Connections

Voltage follower (LV-E10U series)



Warning

Do not connect a non-isolated input voltage signal to an LV-E10U series drive. Connecting a non-isolated signal will damage the drive.

Instead of using a speed adjust potentiometer, the drive may be wired to follow a 0 – 4.6 VDC voltage signal that is isolated from earth ground (Figure 8). Connect the signal input (-) to S1. Connect the signal common (+) to S2. Make no connection to S3. A potentiometer can be used to scale the analog input voltage. To achieve greater linearity and control, use an interface device such as Minarik Drives model PCM4 to scale the analog input voltage. Follow the same wiring guidelines used for speed adjust potentiometer wiring (see page 5).

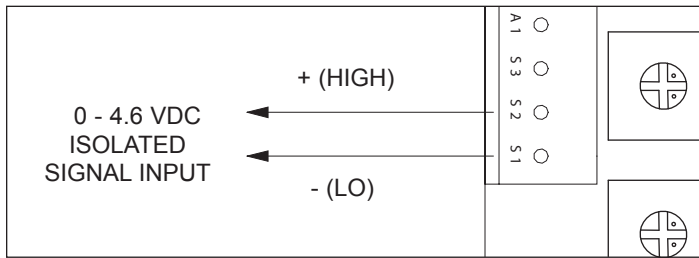


Figure 8. LV-E10U Voltage Follower Connections

Operation

Before applying power

- Verify that no conductive material is present on the printed circuit board.
- Verify that the AC supply is properly balanced.
- Turn the speed adjust potentiometer (if installed) to zero speed (fully CCW).

Startup



Warning

DO NOT apply AC and DC power to the drive at the same time. This may cause severe damage to the drive.

To start the drive:

1. Apply 24 VAC or 24 VDC to the drive.
2. Rotate the speed adjust potentiometer knob clockwise until the desired motor speed is reached.
3. To shut down the drive, rotate the speed adjust potentiometer fully CCW (zero or minimum speed). Remove power and let the motor coast to a stop.

Line starting and stopping

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

Decelerating to a stop

A switch may be used to decelerate the motor to a stop. Connect the switch as shown in Figure 9. Close the switch between S1 and S2 to stop the motor from set speed. Open the switch to accelerate the motor to set speed.

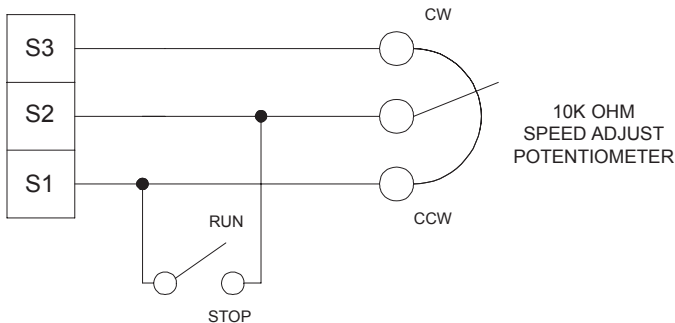


Figure 9. Run/Decelerate to Zero Speed Switch

Dynamic braking



Warning

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

Dynamic braking may be used to rapidly stop a motor (Figure 10). 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.

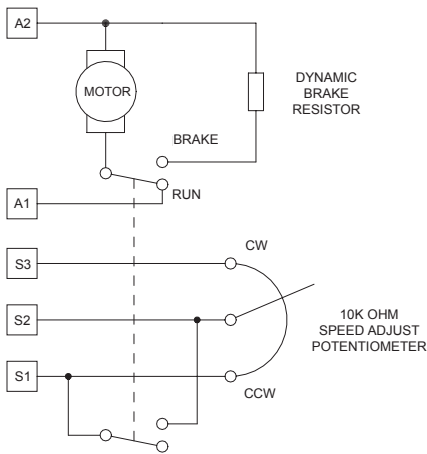


Figure 10. Dynamic Brake Connection

Calibration

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

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.

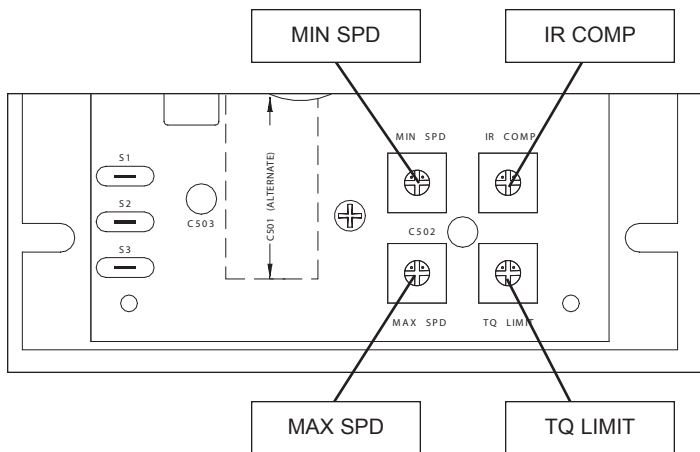


Figure 11. LV SERIES Calibration Trimpot Layout

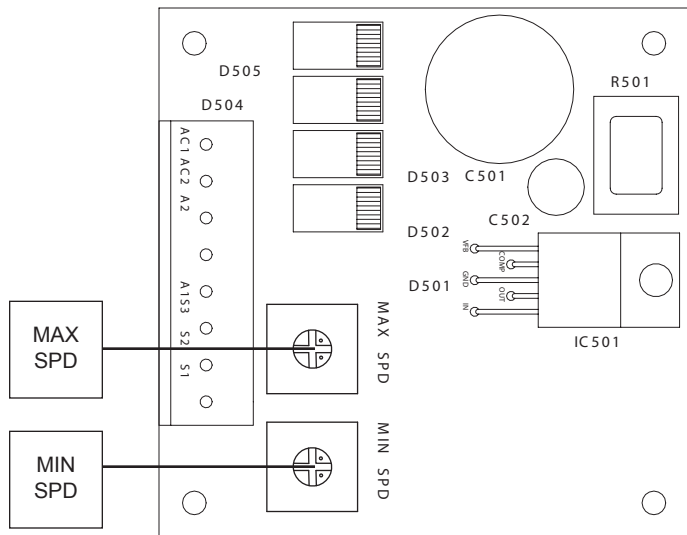


Figure 12. LV-E10U SERIES Calibration Trimpot Layout

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 to zero speed.

To calibrate MIN SPD:

1. Turn the speed adjust potentiometer full CCW.
2. Adjust the MIN SPD trimpot until the motor has stopped, or is running at the desired minimum speed.

Note: Check the MIN SPD and MAX SPD adjustments after recalibrating to verify that the motor runs at the desired minimum and maximum speed.

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 MAX SPD:

1. Set the MAX SPD 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.

TORQUE LIMIT (TQ LIMIT)

Note: The TORQUE LIMIT trimpot is not installed on LV-E10U series drives.

The TORQUE LIMIT setting determines the maximum armature current output of the drive. It is factory set at 120% of rated motor current.

To calibrate TORQUE LIMIT:

1. With the power disconnected from the drive, connect a DC ammeter in series with the armature.
2. Set the TORQUE LIMIT trimpot to minimum (full CCW).
3. Connect power to the drive.
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 TORQUE 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 stall from the motor.

IR COMPENSATION (IR COMP)

Note: The IR COMP trimpot is not installed on LV-E10U series drives.

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.

To calibrate IR COMP:

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. 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. 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.

Application Notes

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.

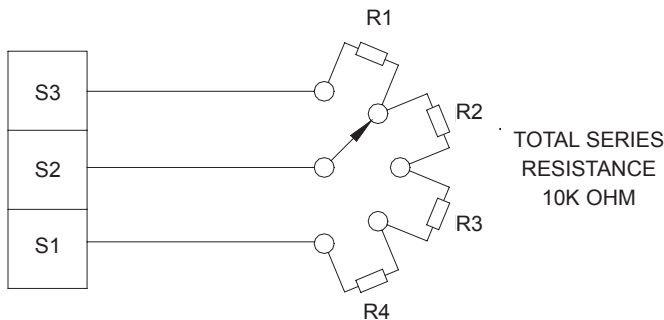
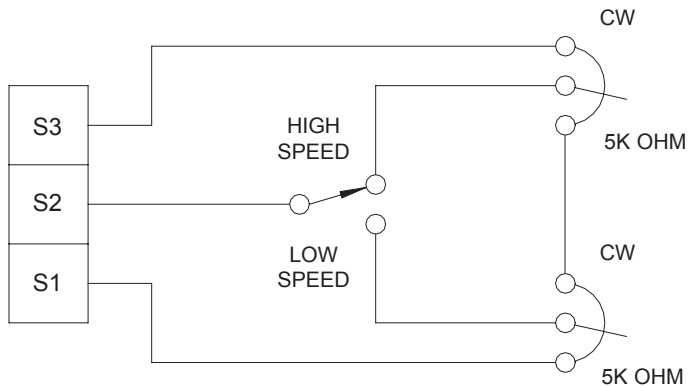


Figure 13. Multiple Fixed Speeds

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 14 shows a connection for fixed high and low speed adjust potentiometers.



**Figure 14. Adjustable Fixed Speeds
Using Potentiometers in Series**

Independent adjustable speeds

Replace the speed adjust potentiometer with a single-pole, multi-position switch, and two or more potentiometers in parallel, with a total parallel resistance of 10K ohms. Figure 15 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

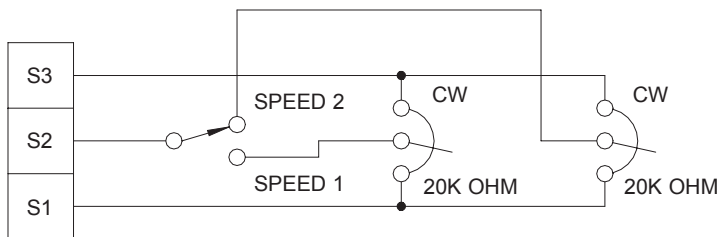


Figure 15. Independent Adjustable Speeds

RUN/JOG switch

Using a RUN/JOG switch is recommended in applications where quick stopping is not needed and frequent jogging is required. Use a single pole, two position switch for the RUN/JOG switch, and a single pole, normally closed, momentary operated pushbutton for the JOG pushbutton as shown in Figure 16. 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.

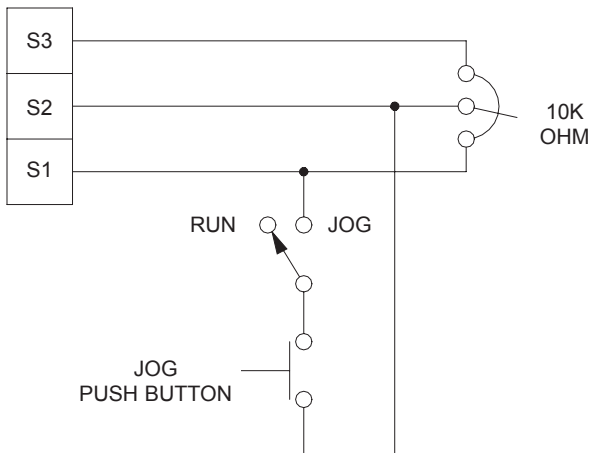


Figure 16. RUN/JOG Switch Connection to Speed Adjust Potentiometer

Reversing

A dynamic brake may be used when reversing the motor direction (Figure 17). 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.

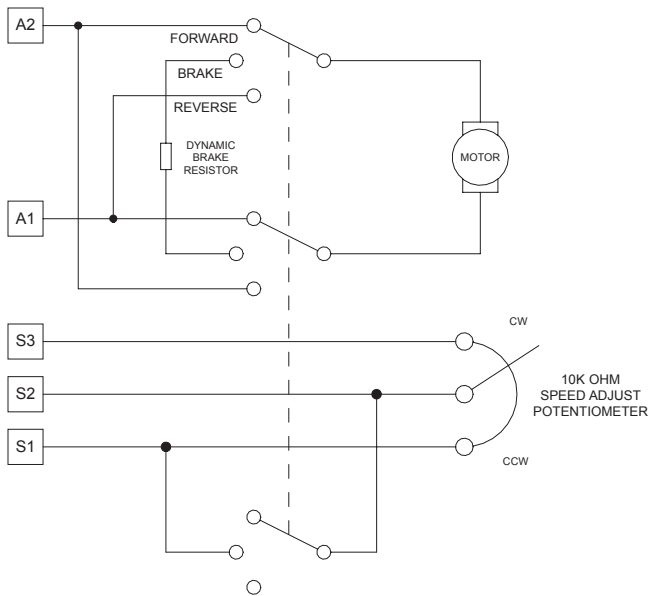


Figure 17. Reversing Circuit Connection

Troubleshooting



Warning

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

Before troubleshooting

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

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 Drives distributor or the factory direct: (800) MINARIK

Problem	Possible Causes	Suggested Solutions
Line fuse blows	<ol style="list-style-type: none">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.	<ol style="list-style-type: none">1. Check that line fuses are CORRECT.2. Check motor cable and armature for shorts.3. Decrease CURR. LIMIT setting.
Line fuse does not blow, but the motor does not run	<ol style="list-style-type: none">1. Speed adjust potentiometer is set to zero speed.2. Speed adjust potentiometer connections are open.3. Drive is in current limit.4. Drive is not receiving line voltage.5. Motor is not connected.	<ol style="list-style-type: none">1. Increase speed adjust potentiometer setting.2. Check that the speed adjust potentiometer connections are not open.3. Verify that the motor is not jammed.4. Apply line voltage to L1 and L2.5. Connect motor to A1 and A2.

Problem	Possible Causes	Suggested Solutions
Motor runs too fast at maximum speed setting	MIN SPD and MAX SPD settings are too high.	Recalibrate MIN SPD and MAX SPD.
Motor runs too slow or too fast	MIN SPD and MAX SPD are not calibrated.	Calibrate MIN SPD and MAX SPD.
Motor will not reach the desired speed.	<ol style="list-style-type: none">1. MAX SPD setting is too low.2. IR COMP setting is too low.3. Motor is overloaded.	<ol style="list-style-type: none">1. Increase MAX SPD setting.2. Increase IR COMP setting.3. Check motor load. Resize the motor if necessary.
Motor pulsates or surges under load	<ol style="list-style-type: none">1. IR COMP is set too high.2. Motor “bouncing” in and out of current limit.	<ol style="list-style-type: none">1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes.2. Make sure motor is not undersized for load; adjust CURR. LIMIT setting.

Replacement Parts

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

Replacement Parts			
LV01-24AC-E10U	C501	Capacitor, 1000 μF, 63V	011-0151
	C502	Capacitor, 100 μF, 25V	011-0079
	D501	Schottky Diode, 40V 3A	071-0057
	IC501	Switching Regulator	061-0028
	P501	Pot, 50k Ohm	121-0305
	P502	Pot, 25k Ohm, 1/4W	121-0304
	R501	Resistor, 1K Ohm, 5W Pot Kit, 10k Ohm	032-0098 202-0005
LV02-24AC LV02-24DC	BR501	GBU8J Bridge	073-0006
	C501	Capacitor, 3300 μF, 50V	011-0131
	C502	Capacitor, 6.8 μF, 35V	011-0050
	C503	Capacitor, 100 μF, 25V	011-0079
	D501	Schottky Diode, 60V 3A	071-0127
	IC501	Switching Regulator	061-0028
	P501	Pot, 5k Ohm	121-0302
	P502 – 504	Pot, 25k Ohm, 1/4W	121-0304
R501	Resistor, 0.2 Ohm, 5W	032-0093	
R502	Resistor, 600 Ohm, 5W Pot Kit, 10k Ohm	032-0145 202-0066	

Notes

Notes

Notes

Unconditional Warranty

A. Warranty - Minarik Drives 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, Minarik Drives will repair or replace, at its sole discretion, such products that are returned to Minarik Drives, 14300 De La Tour Drive, South Beloit, IL 61080-3006 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. Minarik Drives 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 Minarik Drives sole obligation and exclude all other warranties of merchantability for use, express or implied. Minarik Drives 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 Minarik Drives 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 Minarik Drives by lawful authority, Minarik Drives shall under no circumstances be liable for any consequential damages, losses, or expense arising in connection with the use of, or inability to use, Minarik Drives 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, Minarik Drives 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 Minarik Drives 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.



Document Number 250-0250, Revision 4
Printed in the U.S.A. - 08/13