An American Control Electronics Brand

HTL10 Series

USER MANUAL

HTL10-D-4Q

Dear Valued Consumer:

Congratulations on your purchase of the **HTL10 Series** drive. This User Manual was created for you to get the most out of your new device and assist with the initial setup. Please visit www.minarikdrives.com to learn more about our other drives.

Thank you for choosing **Minarik Drives**!

Safety First!

SAFETY WARNINGS

Text in gray boxes denote important safety tips or warnings. 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 using proper grounding techniques, 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 Drives 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 trim pots. Use approved personal protective equipment and insulated tools if working on this drive with power applied.

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Section 1. Regenerative Drives

Most non-regenerative, variable speed, DC drives control current flow to a motor in one direction. The direction of current flow is the same direction as the motor rotation. Non-regenerative drives operate in Quadrant I, and also in Quadrant III if the drive is reversible (see Figure 1). Motors must stop before reversing direction. Unless dynamic braking is used, non-regenerative drives cannot decelerate a load faster than coasting to a lower speed.

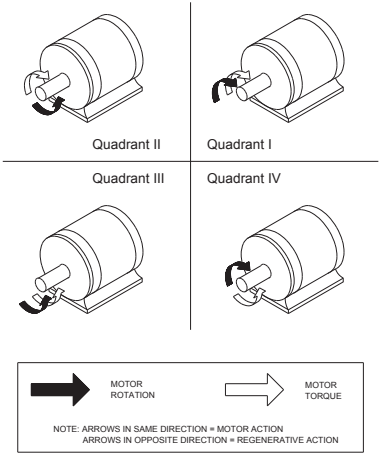


Figure 1. Four Quadrant Operation

Regenerative drives operate in two additional quadrants: Quadrant II and Quadrant IV. In these quadrants, motor torque is in the opposite direction of motor rotation.

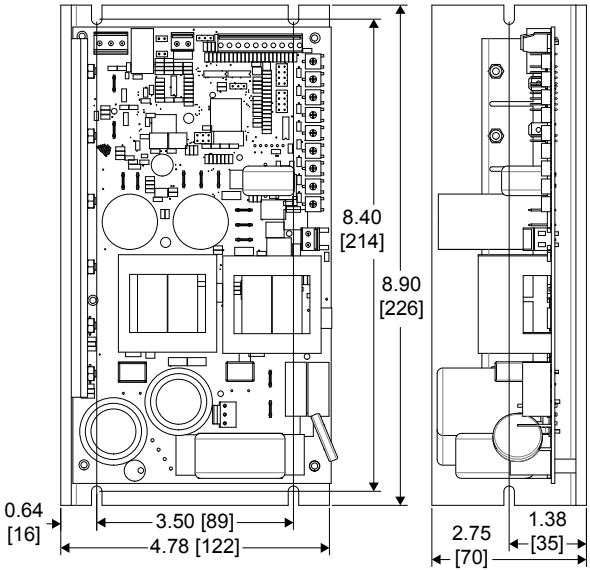
This allows regenerative drives to reverse a motor without contactors or switches, to control an overhauling load, and to decelerate a load faster than it would to coast to a lower speed.

Section 2. Specifications

Model	*Armature Voltage (VDC)*	*Continuous Current Rating (ADC)*	*10 Second Current Rating (ADC)*	*Horsepower Range Continuous (Peak)*
HTL10-D-4Q	*12*	*20.0*	*30.0*	*1/80 - 1/4 (1/3)*
	24	*10.0*	*15.0*	*1/40 - 1/4 (1/3)*
	36	*6.7*	*10.0*	*1/30 - 1/4 (1/3)*
	48	*5.0*	*7.5*	*1/20 - 1/4 (1/3)*

AC Line Voltage	115 / 230 VAC ± 10%, 50/60 Hz, single phase
DC Armature Voltage	0 - 12, 0 - 24, 0 - 36, 0 - 48 VDC
Acceleration Time Range	0.5 - 15 seconds
Deceleration Time Range	0.5 - 15 seconds
Analog Input Signal Range	0 to ± 5 VDC, 0 to ± 10 VDC, 4 - 20 mA
Form Factor	1.05
Load Regulation	
12 VDC	8% of base speed
24 VDC	4% of base speed
36 VDC	3% of base speed
48 VDC	2% of base speed
Speed Range	80:1
Vibration	0.5G maximum (0 - 50 Hz) 0.1G maximum (> 50 Hz)
Weight	2.59 lbs
Ambient Temperature Range	10°C - 40°C

Section 3. Dimensions



ALL DIMENSIONS IN INCHES [MILLIMETERS]

Figure 2. HTL10-D-4Q Dimensions

Section 4. Installation

Do not install, rewire, or remove this control with input power applied. Failure to heed this warning may result in fire, explosion, or serious injury. Make sure you read and understand the Safety Precautions on page i before attempting to install this product.

Mounting

- Drive components are sensitive to electrostatic discharge. Avoid direct contact with the circuit board. Hold the drive by the chassis or heat sink only.
- Protect the drive from dirt, moisture, and accidental contact.
- Provide sufficient room for access to the terminals and calibration trim pots.
- Mount the drive away from heat sources. Operate the drive within the specified ambient operating temperature range.
- Prevent loose connections by avoiding excessive vibration of the drive.
- Mount the drive with its board in either a horizontal or vertical plane. Six 0.19" (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 should be earth grounded.

Remote Adjust Potentiometer

WARNING!

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

If using a remote potentiometer, mount the 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 remote adjust potentiometer.

Twist the remote adjust potentiometer wire to avoid picking up unwanted electrical noise. If the remote adjust potentiometer wires are longer than 18 in. (46 cm), use shielded cable. Keep the remote adjust potentiometer wires separate from power leads (L1, L2, A1, A2).

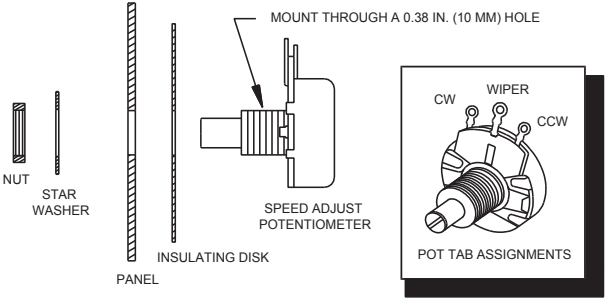


Figure 3. Remote Adjust Potentiometer

Wiring

Do not install, rewire, or remove this control with input 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 while the drive is running 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 signal from remote devices for over temperature protection. If motor over protection is needed in the end-use product, it needs to be provided by additional equipment in accordance with NEC standards.

- Use 18 - 24 AWG wire for logic wiring. Use 14 - 16 AWG wire for AC line and motor wiring.

Shielding Guidelines

Under no circumstances should power and logic level leads be bundled together. Induced voltage can cause unpredictable behavior in any electronic device, including motor controls.

As a general rule, it is recommended to shield conductors. If it is not practical to shield power conductors, it is recommended to shield all logic-level leads. If shielding of all 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.

Line Fusing

The drive is preinstalled with two 250V, 5A fast-acting fuses.

Section 5. Jumper Settings

WARNING!

Change switch settings only when the drive is disconnected from AC line voltage. Make sure all switches are set to their correct position. If the switches are improperly set, the motor may not run at full voltage or overspeed, which may cause motor damage, or result in bodily injury or loss of life.

AC Input Voltage Selection Jumper

Set the input voltage select jumper "AC Voltage Selection Jumper" to either 115 or 230 to match the AC line voltage. Jumper must be set before power up and cannot be change while power is applied. A 230V setting with a 115 VAC line will create unstable conditions while a 115V setting with a 230 VAC line will damage the drive. Refer to Figure 4.

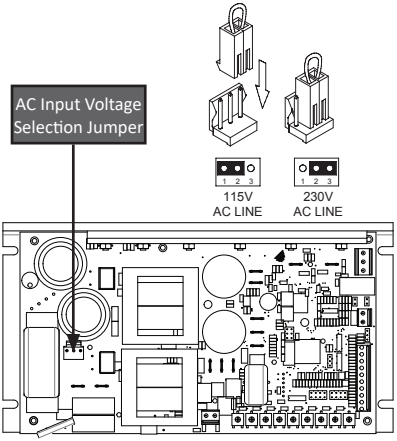


Figure 4. AC Input Voltage Selection Jumper

Motor Voltage Selection Jumper

Set the motor voltage select jumper “MOTOR VOLT” to either 12, 24, 36, or 48 VDC to match the DC motor voltage. Jumper must be set before power up and cannot be change while power is applied. Refer to Figure 5.

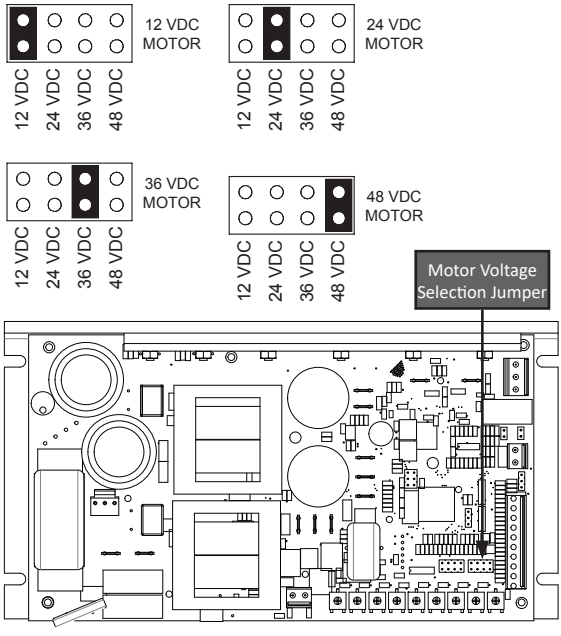


Figure 5. DC Motor Voltage Selection Jumper

Inhibit Mode Selection Jumper

Jumper "INHIB MODE" determines whether the inhibits (limit switches in some operational modes) are Normally Open or Normally Closed. This jumper can be changed while the drive is powered. Refer to Figure 6.

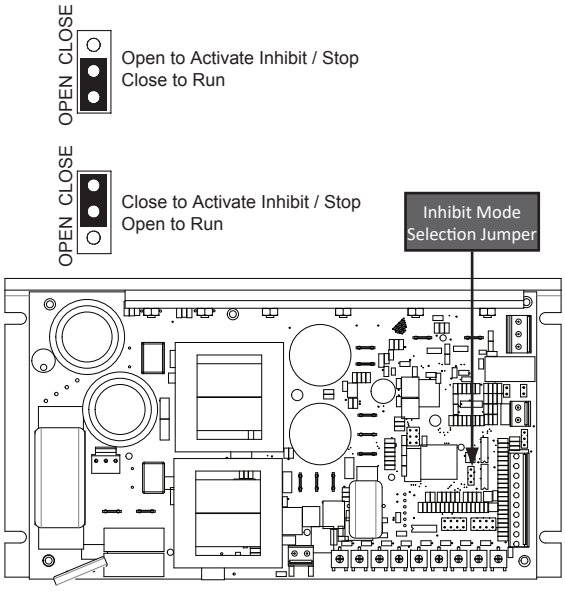
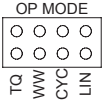


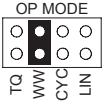
Figure 6. Inhibit Mode Selection Jumper

Operation Mode Selection Jumper



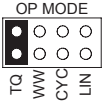
Speed Mode

In Speed Mode, the external speed adjust potentiometer or analog reference signal is used to command speed. The drive will output whatever current (torque) is necessary to achieve the commanded voltage (speed).



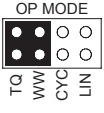
Speed Mode with WigWag Control

Just like Speed Mode above, but now the drive can be bidirectionally controlled with a unidirectional signal. For exmaple, if using a 0-10 VDC signal; 0 VDC is full speed reverse, 5 VDC is stop, and 10 VDC is full speed forward.



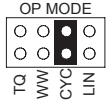
Torque Mode

In Torque Mode, the external torque adjust potentiometer or analog reference signal is used to command torque. The drive will output whatever voltage (speed) is necessary to achieve the commanded current (torque). Typically used in tensioning applications.



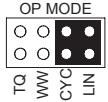
Torque Mode with WigWag Control

Just like Torque Mode above, but now the drive can be bidirectionally controlled with a unidirectional signal. for exmaple, if using a 0-10 VDC signal; 0 VDC is full reverse torque, 5 VDC is stop, and 10 VDC is full forward torque.



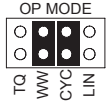
Cycling Mode - Single Cycle and Auto Cycle

The motor travels in the commanded direction until the corresponding limit switch is activated. After a dwell time, the motor will automatically run in the opposite direction until the other limit switch is activated. The motor will stop for a another dwell period before looking for another start command.



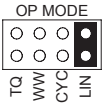
Cycling Mode - Half Cycle

The motor travels in the commanded direction until the corresponding limit switch is activated. After a dwell time, the motor will look for another start command on the other direction. It does not automatically change direction when the limit switch is activated.



Cycling Mode - Jog Cycle

Similiar to a half cycle described above, only now the Forward Start and Reverse Start commands need to be maintained. The motor will only run in the command direction while the command is present and the corresponding limit switch has not been activated.



Positioning Mode

In Positioning Mode, the controller compares the commanded positon on terminal 2 with the feedback position on terminal 5 to determine if the motor should mvoe forward or reverse until the two signals match. Typically used with linear actuators.

Signal Selection Jumpers

The “POT/SIG” jumper determines which signal the drive will follow.

If using a 10K potentiometer, set the jumper to “POT” and leave the other 2 jumpers open.

If using a 0 to ± 10 VDC signal, set the jumepr to “SIG” and leave the other 2 jumpers open.

If using a 0 to ± 5 VDC signal, set the jumper to “SIG” and place another jumper on “5V Sig”.

If using a 4-20 mA signal, set the jumper to “SIG” and place another jumper on the “4-20mA”.

While it may be possible to toggle between a potentiometer and analog signal during operation, there will be a brief 0 VDC/torque command during this transistion which may cause issues in the application.

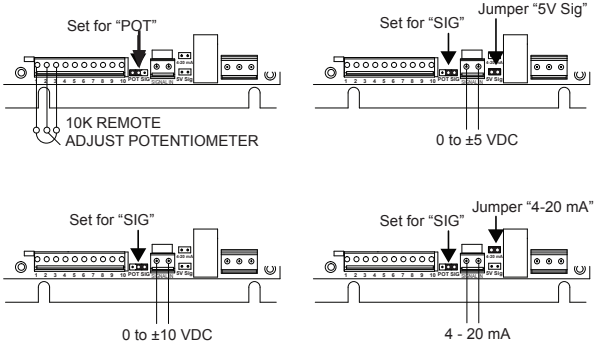


Figure 7. Signal Selection Jumpers

Section 5. Connections

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

Minarik Drives strongly recommends the installation of a master power switch in the voltage input line, as shown in Figure 8 (page 17). The switch contacts should be rated at a minimum of 200% of motor nameplate current and 250 volts.

AC Line Input

Connect the AC line power leads to terminals L1 and L2. It is recommended to use a single-throw, double-pole master power switch. The switch should be rated at a minimum of 250 volts and 200% of motor current. Refer to Figure 8 on page 17.

Motor Armature

Drives supply motor armature 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 the motor does not spin in the desired direction, remove power and reverse the A1 and A2 connections.

Connect a DC motor to terminals A1 and A2. Refer to Figure 8 on page 17. Ensure that the motor voltage rating is consistent with the drive's output voltage.

Voltage Source Access Tabs

Any power drawn from the BUS voltage must be subtracted from the overall power capability of the control. The control is rated for 240W continuous, 360W peak.

Any power drawn from the 5V, 12V, or 24V tabs must be doubled when calculating the new output power capability. If 12W is being consumed at 12V, 24W must be subtracted from the overall power capability.

The voltage source access tabs are NOT protected in any way, including from overcurrent, overvoltage, short circuit, etc. Improper connections and/or mistreatment may result in permanent damage to the controller.

The controller provides access to the DC BUS to provide a voltage supply to external components. All voltage potentials are in relation to the GND terminal and isolated from the AC line. Refer to Figure 8 on page 17 for terminal locations.

+5V Terminal: 5 VDC, 250 mA maximum source current. No sinking capability.

+12V Terminal: 12.5 VDC nominal (11 VDC minimum, 14 VDC maximum), 2A maximum source current. No sinking capability.

+24V Terminal: 26.5 VDC nominal (25 VDC minimum, 30 VDC maximum with properly sized regenerative dump resistors installed, 37.5 VDC maximum without regenerative dump resistors). 5A continuous source current, 7A peak. No sinking capability.

+48V Terminal: 53 VDC nominal (50 VDC minimum, 60 VDC maximum with properly sized regenerative dump resistors installed, 75 VDC maximum without regenerative dump resistors). 5A continuous source current, 7A peak. 5A short-term sinking current with regenerative dump resistors.

Brake Coil Terminals

The controller provides a 5, 12, 24, or 48 VDC output that can be used to power an electromagnetic brake. If an electromagnetic brake is to be used, the COIL IN terminal must be connected to the proper voltage source access tab. For example, if using a 12 VDC brake, the "COIL IN" terminal must be connected to the "+12V" terminal.

Connect the electromagnetic brake to the COIL OUTPUT screw terminal. The COIL OUTPUT is short-circuit protected. If shorted, the COIL OUTPUT will cease and a red LED, labeled "COIL SHORT" will illuminate.

Refer to Figure 8 on page 15 wiring and terminal locations.

Regenerative Dump Resistor

The controller may require external regenerative dump resistors for high inertia applications that need quick braking and/or reversing. Without the regenerative dump resistors, the controller may not be able to brake the motor quick enough, fault out, or may even be damaged from an overhauling load.

It is recommended to use one 10Ω, 100W resistor (or two 20Ω, 50W resistors in parallel). For quicker braking, use a resistor of less resistance with more power capacity. Refer to Figure 8 on page 15 for wiring terminal locations.

Alarm Outputs

The controller provides 2 contact outputs to signal when it's in motoring current limit, one normally open (NO) that closes during the alarm and the other is normally closed (NC) and opens during an alarm. The contacts are rated for 1A @ 30 VDC, up to 250 VDC. Refer to Figure 8 on page 17 for wiring terminal location.

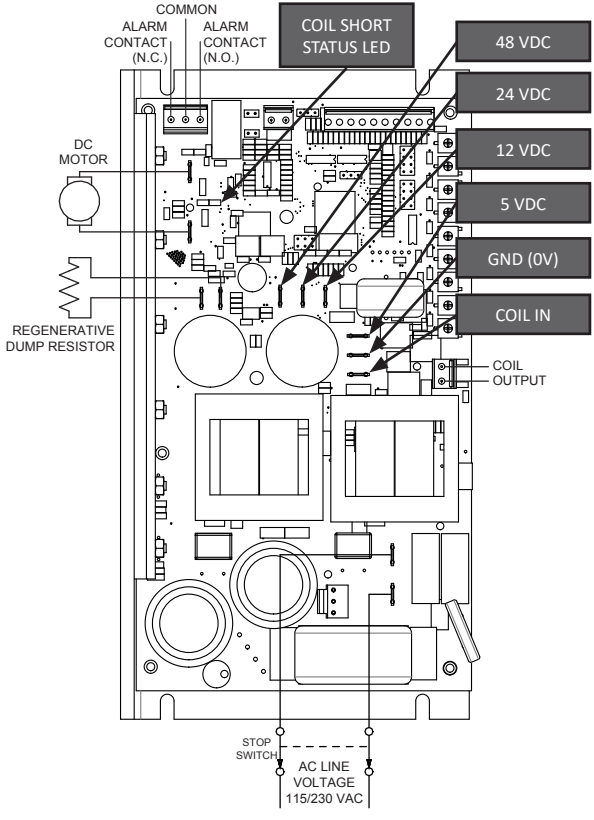


Figure 8. Power, Motor, Brake Coil, and Alarm Connections

Remote Adjust Potentiometer

In Speed or Cycling Modes, a remote adjust potentiometer can be used to command the speed. In Torque Mode, it can be used to command the torque. In Positioning mode, it can be used for commanding the position. Use a 10K ohm, 1/4 W potentiometer. Connect the counter-clockwise end of the potentiometer to terminal 3 (common), the wiper to terminal 2 (reference), and the clockwise end to terminal 1 (+5V). If the potentiometer works inversely of the desired functionality (e.g. to increase motor speed you must turn the potentiometer counterclockwise), power off the drive and swap the terminal 1 and 3 connections. Refer to Figures 10 through 13 on pages 22 and 23 for wiring diagrams.

In Speed or Torque Mode, the potentiometer can also be used in a WigWag setup, where the potentiometer determines the speed or torque, and the direction. Turning the potentiometer fully counterclockwise results in a full speed reverse (or full reverse torque) and fully clockwise results in a full speed forward (or full forward torque). For information on how to setup the drive for WigWag Mode, refer to page 11.

Analog Input Signal

Instead of using a remote adjust potentiometer, the drive may be wired to follow an analog input signal that is isolated or non-isolated from earth ground. Refer to Figure 9 for "SIGNAL IN" terminal location and wiring.

Acceptable analog input ranges are 0 to ± 5 VDC, 0 to ± 10 VDC, or 4 - 20 mA. Refer to Figure 7 on page 13 for locations of jumpers to set the drive for the appropriate analog signal range. In Cycling and Positioning Modes, a negative signal will be treated as a positive.

If only a unidirectional signal (ie 0-5V, 0-10V, or 4-20 mA) is available, but direction must be determined by the analog signal as well, refer to WigWag Mode on page 11. In WigWag Mode, a 0V or 4mA signal will result in full speed reverse (or full reverse torque) and 5V, 10V, or 20 mA will result in a full speed forward (or full forward torque). Using a negative signal in WigWag mode will produce undesirable behavior.

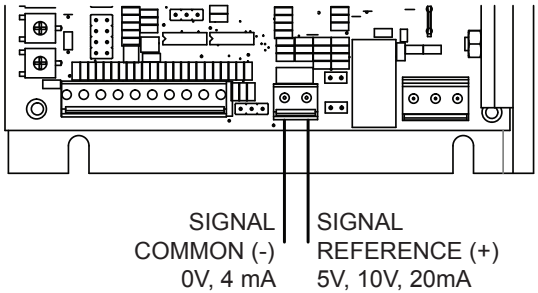


Figure 9. Analog Input Signal Connections

Terminal 4 - Enable / Forward Start & Stop

In Speed, Torque, or Positioning Mode, terminal 4 acts as an Enable switch. Keeping terminal 4 open disables the drive. Connecting terminal 4 to common (terminal 6) enables the drive and allows for motor movement. Opening the Enable switch during motor operation will coast the motor to a stop. Refer to Figures 10 and 11 on page 22.

In Cycling Mode, terminal 4 is used as a Start Forward command. Connecting terminal 4 to common (terminal 6) starts a single cycle with initial travel in the forward direction. The Start Forward command only needs to be momentary, meaning the motor will continue the cycle even after the Start Forward command is opened. Once the reverse limit switch is activated, the controller will stop the motor and wait for another Start Forward command. For continuous cycling, keep the switch closed (maintained). Refer to Figures 12 and 13 on page 23.

Terminal 5 - Direction / Feedback / Forward Start & Stop

In Speed or Torque mode, terminal 4 acts as a Direction switch. Keep terminal 4 open to run in the forward direction. Connect terminal 4 to common (terminal 6) to run in the reverse direction. Refer to Figure 10 on page 22.

In Positioning Mode, terminal 5 is used as an input for the analog feedback signal. Refer to Figure 11 on page 22 for wiring.

In Cycling Mode, terminal 4 is used as a Start Reverse command. Connecting terminal 5 to common (terminal 6) starts a single cycle with initial travel in the reverse direction. The Start Reverse command only needs to be momentary, meaning the motor will continue the cycle even after the Start Reverse command is opened. Once the forward limit switch is activated, the controller will stop the motor and wait for another Start Reverse command. For continuous cycling, keep the switch closed (maintained). Refer to Figures 12 and 13 on page 23.

Terminal 7 - Forward Inhibit / Forward Limit

In Speed, Torque, and Positioning Mode, terminal 7 is used as a forward inhibit. Connecting terminal 7 to common (terminal 8) regeneratively brakes the motor to zero speed and prevents further movement in the forward direction. Movement in the reverse direction is still permitted. See Figures 10 and 11 on page 22 for wiring. The Forward Inhibit can be inverted so that it is close to run, open to stop. Refer to page 10.

In Cycling Mode, terminal 7 is for a forward limit switch. When activated, it will regeneratively brake the motor to zero speed. It may or may not automatically reverse depending on the cycling mode selected. The Forward Limit Switch can be inverted to work with normally closed limit switches. Refer to page 10.

Terminal 9 - Reverse Inhibit / Reverse Limit

In Speed, Torque, and Positioning Mode, terminal 9 is used as a reverse inhibit. Connecting terminal 9 to common (terminal 10) regeneratively brakes the motor to zero speed and prevents further movement in the reverse direction. Movement in the forward direction is still permitted. See Figures 10 and 11 on page 22 for wiring. The Reverse Inhibit can be inverted so that it is close to run, open to stop. Refer to page 10.

In Cycling Mode, terminal 9 is for a reverse limit switch. When activated, it will regeneratively brake the motor to zero speed. It may or may not automatically cycle depending on the cycling mode selected. The Reverse Limit Switch can be inverted to work with normally closed limit switches. Refer to page 10.

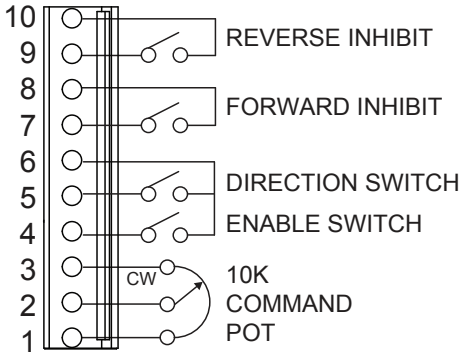


Figure 10. Speed and Torque Mode Connections

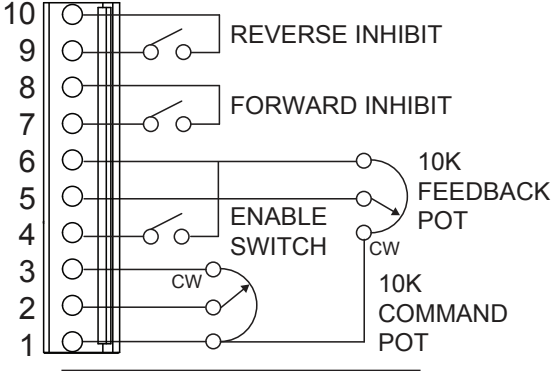


Figure 11. Positioning Mode Connections

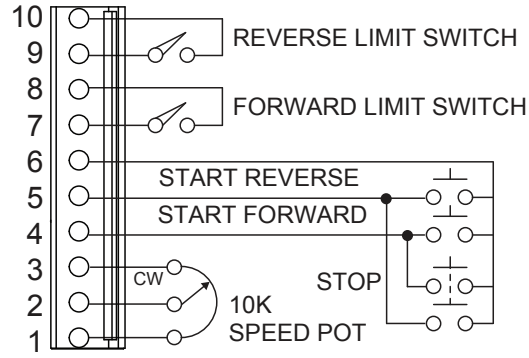


Figure 12. Cycling Mode Connections (Momentary for Single Cycle)

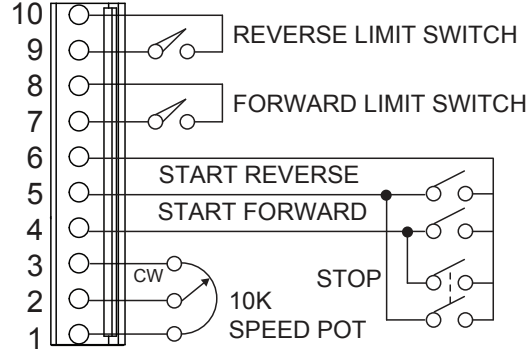


Figure 13. Cycling Mode Connections (Maintained for Continuous Cycling)

Section 6. Operation

Dangerous voltages exist on the drive when it is powered. 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, page 45, for further assistance.

Before Applying Power

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

Starting and Stopping Methods

Regenerative braking, coasting to a stop, or decelerating to minimum speed 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 lines) is the only acceptable method for emergency stopping.

For this reason, American Control Electronics strongly recommends installing an emergency stop switch on both AC line inputs (see Figure 8 on page 17).

Frequent starting and stopping can produce high torque. This may cause damage to motors, especially gearmotors that are not properly sized for the application.

Automatic Restart Upon Power Restoration

All drives automatically run to set speed when power is applied and the the Enable, Regen Brake, and Inhibit are set to run.

Line Starting and Stopping

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

Regenerative Decel to Minimum Speed

The Enable switch (terminal 4) will coast the motor to a stop when de-activated. The Inhibit switches (terminals 7 and 9) will regeneratively brake the motor as fast as the drive can, regardless of deceleration rates set by the trim pots.

To decelerate the motor at the decleration rate, use a single-pole, single-throw switch across terminals 2 and 3. This will mimic the remote adjust potentiometer being turned fully counterclockwise.

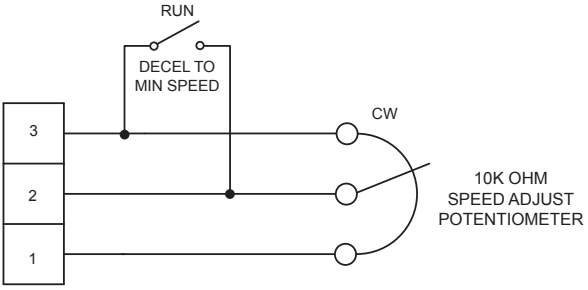


Figure 14. Decelerate Switch

Speed Mode Startup

1. Turn the remote adjust potentiometer or analog input signal to minimum speed.
2. Apply AC line voltage.
3. Slowly advance the remote adjust potentiometer clockwise (CW) or increase the analog input signal. The motor slowly accelerates as the potentiometer is turned CW or as the analog input 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.

Torque Mode Startup

1. Turn the remote adjust potentiometer or analog input signal to minimum torque.
2. Apply AC line voltage.
3. Slowly advance the remote adjust potentiometer clockwise (CW) or increase the analog input signal. The motor should try to run away to maximum speed or until the motor is pulling the commanded amount of current. Continue until the desired torque is reached.
4. Remove AC line voltage from the drive to coast the motor to a stop.

Cycling Mode Startup

1. Turn the speed adjust potentiometer or analog input signal to minimum speed.
2. Apply AC line voltage and give a forward start command.
3. Slowly advance the speed adjust potentiometer clockwise (CW) or increase the analog input signal. The motor slowly accelerates as the potentiometer is turned CW or as the input 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 or activate the forward limit switch to regeneratively brake.

Positioning Mode Startup

1. Turn the remote adjust potentiometer or analog input signal to the minimum position.
2. Apply AC line voltage.
3. Slowly advance the remote adjust potentiometer clockwise (CW) or increase the analog input signal. The motor accelerates (ie. the actuator extends) as the potentiometer is turned CW or as the analog input signal is increased until the feedback signal matches the commanded signal. Continue until the desired position is reached.
4. Remove AC line voltage from the drive.

Section 8. Calibration

Dangerous voltages exist on the drive when it is powered. When possible, disconnect the voltage input from the drive before adjusting the trim pots. If the trim pots 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.

HTL10 series drives have user-adjustable trim pots. Each drive is factory calibrated to its maximum current rating. Readjust the calibration trim pot settings to accommodate lower current rated motors.

All adjustments increase with CW rotation and decrease with CCW rotation. Use a non-metallic screwdriver for calibration. Each trim pot is identified on the printed circuit board.

Potentiometer 1

Speed, Torque, and Cycling Modes (Acceleration)

Potentiometer 1 is used to set an acceleration rate, the time the motor takes to ramp to a higher speed in either the forward or reverse direction, within the limits of available torque. Turning the trim pot clockwise increases the amount of time it takes the motor to ramp up to a higher speed.

Positioning Mode (Feedback Offset)

Potentiometer 1 is used to set the feedback offset, the minimum retract / starting position. Turning the trim pot clockwise will extend the actuator / move the motor in a forward direction.

Potentiometer 2

Speed, Torque, and Cycling Modes (Deceleration)

Potentiometer 2 is used to set deceleration rate, the time the motor takes to ramp to a lower speed in either the forward or reverse direction, within the limits of available torque. Turning the trim pot clockwise increases the amount of time it takes the motor to ramp down to a lower speed.

Positioning Mode (Feedback Gain)

Potentiometer 1 is used to set the feedback gain, the maximum extend / ending position. Turning the trim pot clockwise will extend the actuator / move the motor in a forward direction.

Potentiometer 3 (Forward Maximum Speed)

Speed, Torque, Cycling, and Positioning Modes

Potentiometer 3 is used to set the maximum speed in the forward direction. Turning the trim pot clockwise increases the maximum forward speed.

To calibrate the forward maximum speed:

1. Set Potentiometer 3 full CCW.
2. Set the speed adjust potentiometer or input signal for maximum forward speed.
3. Adjust Potentimeter 3 until the desired forward maximum speed is reached.

Potentiometer 4 (Reverse Maximum Speed)

Speed, Torque, Cycling, and Positioning Modes

Potentiometer 4 is used to set the maximum speed in the reverse direction. Turning the trim pot clockwise increases the maximum reverse speed.

To calibrate the reverse maximum speed:

1. Set Potentiometer 4 full CCW.
2. Set the speed adjust potentiometer or input signal for maximum reverse speed.
3. Adjust Potentimeter 4 until the desired reverse maximum speed is reached.

Potentiometer 5

Speed Mode (Motoring Torque)

Potentiometer 5 is used to set maximum current for accelerating and driving the motor in the forward and reverse directions.

Torque Mode (Forward Motoring Torque)

Potentiometer 5 is used to set maximum current for accelerating and driving the motor in the forward direction only.

Cycling and Positioning Modes (Forward Torque)

Potentiometer 5 is used to set maximum current for accelerating and driving the motor in the forward direction. It also sets the current limit for braking the motor from forward speed to zero.

Potentiometer 6

Speed Mode (Regening Torque)

Potentiometer 6 is used to set maximum current for decelerating the motor in the forward and reverse directions.

Torque Mode (Forward Regening Torque)

Potentiometer 5 is used to set maximum current for decelerating the motor when intially moving in the forward direction only.

Cycling and Positioning Modes (Reverse Torque)

Potentiometer 5 is used to set maximum current for accelerating and driving the motor in the reverse direction. It also sets the current limit for braking the motor from reverse speed to zero.

Potentiometer 7

Speed and Cycling Modes

Potentiometer 7 is used to set the IR Compensation. Refer to page 36 for IR Compensation calibration.

Torque Mode (Reverse Motoring Torque)

Potentiometer 7 is used to set maximum current for accelerating and driving the motor in the reverse direction only.

Positioning Mode (Error Gain)

Potentiometer 7 is used to set how close the feedback must be to the commanded signal before deciding it's close enough. The higher (more clockwise) trimpot 7 is, the more precise the ending position will be. However, too much error gain may cause oscillation as the actuator tries to achieve the exact commanded position.

Potentiometer 8

Speed Mode (Minimum Speed)

Potentiometer 8 is used to set the minimum speed. Turning the trim pot clockwise increases the minimum speed.

To calibrate the forward maximum speed:

1. Set Potentiometer 8 full CCW.
2. Set the speed adjust potentiometer or input signal for minimum forward speed.
3. Adjust Potentimeter 3 until the desired forward minimum speed is reached.

Torque Mode (Reverse Regening Torque)

Potentiometer 8 is used to set maximum current for decelerating the motor when intially moving in the reverse direction only.

Cycling Mode (Forward Dwell)

Potentiometer 8 is used to set the dwell time after the forward limit switch is activated. 0 to 40 seconds.

Positioning Mode

Inactive

Potentiometer 9

Speed and Torque Modes (Zero Adjust)

Potentiometer 9 is used to adjust out any drift that may be caused from using a 4-20 mA signal. To adjust out, apply the minimum 4 mA signal and adjust the trim pot until the drive runs at zero speed. Then adjust the minimum speed potentiometer 8 is a minimum speed other than 0 VDC is desired.

Cycling Mode (Reverse Dwell)

Potentiometer 9 is used to set the dwell time after the reverse limit switch is activated. 0 to 40 seconds.

Positioning Mode (Error Gain)

Inactive

Torque Calibration

Torque 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 Drives representative for assistance.

To calibrate a torque trim pot, refer to the recommended settings in Figure 15 on page 37 or use the following procedure:

1. With the power disconnected from the drive, connect a DC ammeter in series with the armature.
2. Set the torque trim pot to minimum (full CCW).
3. Set the remote adjust potentiometer full CW or analog input signal to maximum speed.
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 trim pot CW until the armature current is 120% of motor rated armature current.
7. Turn the remote adjust potentiometer CCW or decrease the analog input signal.
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 Calibration

In Speed or Cycling Modes, potentiometer 7 is used to calibration the IR Compensation. The IR Compensation determines the degree to which motor speed is held constant as the motor load changes.

Use the following procedure to recalibrate the IR Compensation setting:

1. Set potentiometer 7 to minimum (full CCW).
2. Increase the speed adjust potentiometer or input voltage signal until the motor runs at midspeed without load (for example, 900 RPM for an 1800 RPM motor). A handheld 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 trim pot until the motor runs at the speed measured in step 2. If the motor oscillates (overcompensation), potentiometer 7 may be set too high (CW). Turn potentiometer 7 CCW to stabilize the motor.
5. Unload the motor.

See Figure 15 on page 37 for recommended IR COMP settings.

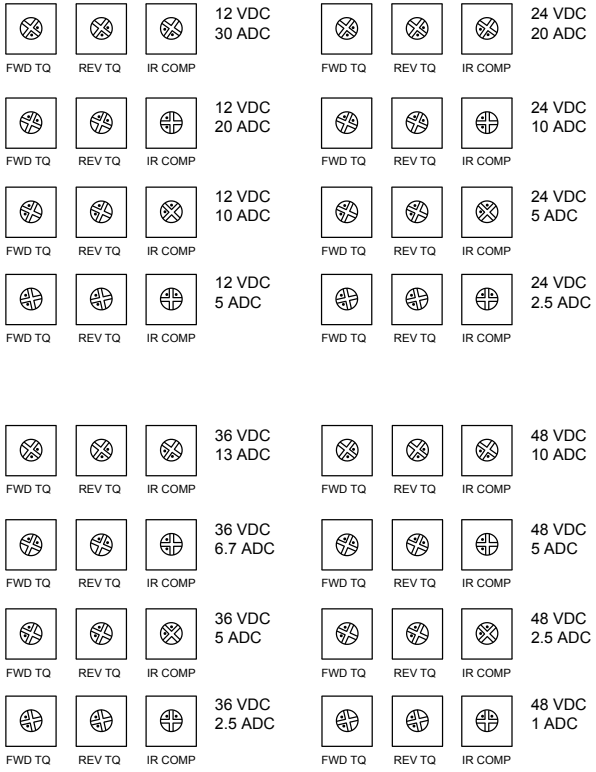


Figure 15. Recommended Torque and IR Compensation Settings
(actual settings may vary with each application)

Section 9. Application Notes

Multiple Fixed Speeds

Replace the speed adjust potentiometer with a series of resistors with a total series resistance of 10K ohms (Figure 16). Add a single pole, multi-position switch with the correct number of positions for the desired number of fixed speeds.

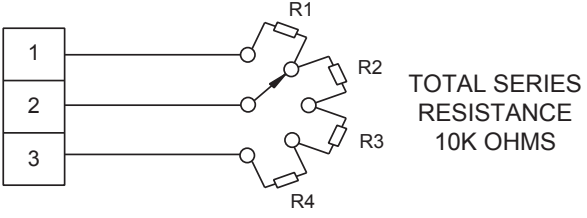


Figure 16. Multiple Fixed Speeds

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 17 shows a connection for high and low speed adjust potentiometers.

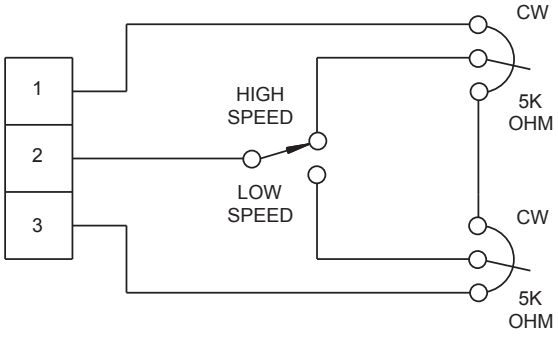


Figure 17. Adjustable Speeds Using Potentiometers In Series

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 18 shows the connection of two independent speed adjust potentiometers that can be mounted at two separate operating stations.

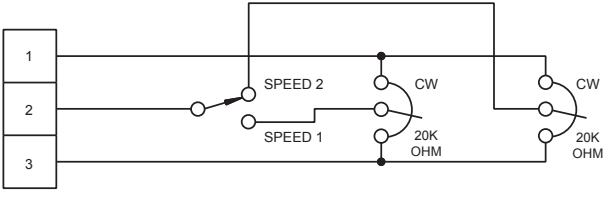


Figure 18. Independent Adjustable Speeds

RUN/JOG Switch - Potentiometer Connection

Connect the RUN/JOG switch and the JOG pushbutton as shown in Figure 19. 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.

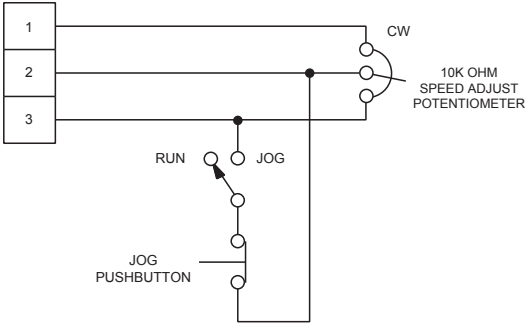


Figure 19. RUN/JOG Switch - Speed Adjust Potentiometer Connection

Leader-Follower Application

In this application, use a PCM4 to monitor the speed of the leader motor (Figure 20). 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.

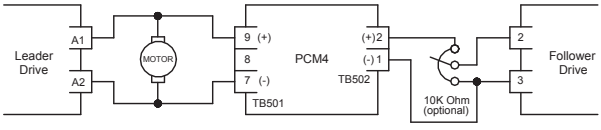


Figure 20. Leader-Follower Application

Section 10. Diagnostic LEDs

HTL10 series drives are equipped with three diagnostic LEDs:

- Solid Green: Drive is powered and enabled.
- Solid Green & Solid Red: Drive is in a motoring current limit.
- Solid Green & Solid Yellow: Drive is in a regenerative current limit.
- Solid Green & Flashing Red & Flashing Yellow: Thermal Limit has been reached and the amount of current the controller will source/sink will be diminished as a result, until the temperature is reduced.
- Solid Green & Flashing Yellow: Regenerative voltage limit. An indication that either regenerative dumping resistors are not being used, failed, or are not sufficient for the application.

- Flashing Green: Drive is powered but disabled (ENABLE terminal 4 is not being shorted to common) or the inhibit is active (see page 10).
- Flashing Red: Hardware failure detected. Needs to be repaired or replaced.
- Flashing Red & Flashing Yellow in unison: Voltage Selection Error. Verify that the jumper is installed and doesn't conflict with other configurations. Motor operation is ceased until the fault is removed and AC power is cycled.

- Alternating Green & Yellow: Command speed reference selection jumper not placed. Install jumper for operation.
- Alternating Red & Yellow: Mode Error - Verify jumper is installed (or not removed during operation) and that the mode selected is permissible. Motor operation will cease until the fault is removed nd the AC power is cycled.

Refer to Figure 21 on page 46 for LED locations.

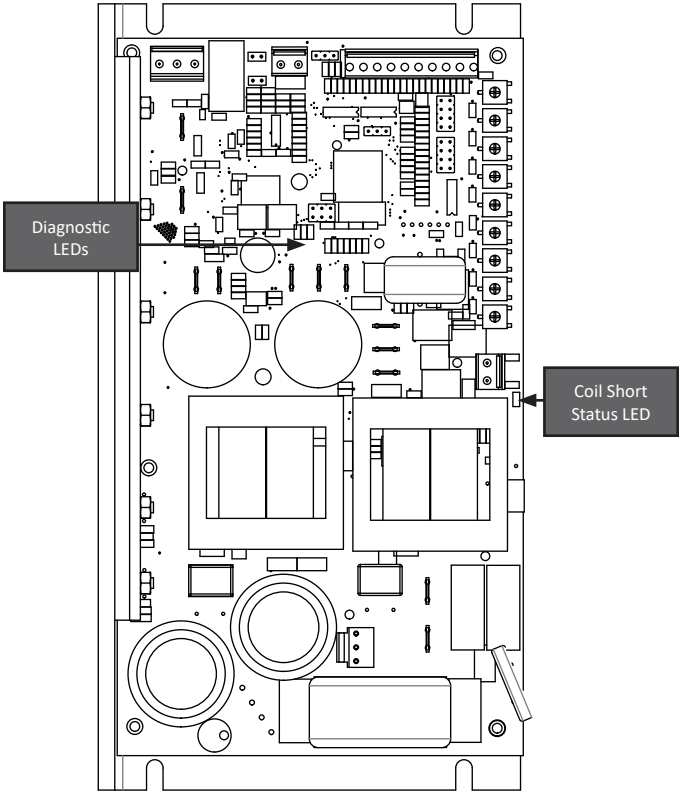


Figure 21. Diagnostic LED Locations

Section 11. Troubleshooting

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 is consistent with the motor ratings.

For additional assistance, contact your local Minarik Drives distributor or the factory direct:

(800) MINARIK or FAX: (800) 394-6334

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
Line fuse blows.	1. Line fuse is the wrong size.	1. Check that the line fuse is correct for the motor size.
	2. Motor cable or armature is shorted to ground.	2. Check motor cable and armature for shorts.
	3. Nuisance tripping caused by a combination of ambient conditions and high-current spikes (i.e. reversing).	3. Add a blower to cool the drive components, decrease FWD TQ / REV TQ settings, resize motor and drive for actual load demand, or check for incorrectly aligned mechanical components or "jams". See pages 29 or 30 for information on adjusting the FWD TORQUE / REV TQ trim pot.
Line fuse does not blow, but the motor does not run.	1. Speed adjust potentiometer or input voltage signal is set to zero speed.	1. Increase the speed adjust potentiometer setting or input voltage signal.
	2. Inhibit is active.	2. Remove the short from the inhibit terminals
	4. Drive is in current limit.	4. Verify that the motor is not jammed. Increase FWD TQ / REV TQ setting if set too low.
	5. Drive is not receiving AC line voltage.	5. Apply AC line voltage.
	6. Motor is not connected.	6. Remove power. Connect the motor to A1 and A2. Reapply power.
Motor does not stop when the speed adjust potentiometer is full CCW.	1. MIN SPD setting is too high.	1. Decrease MIN SPD setting.
	2. Noise on logic wires.	2. Place a .01 µF capacitor across terminals S0 and S2.

PROBLEM	POSSIBLE CAUSE	SUGGESTED SOLUTIONS
Motor runs in the opposite direction	1. Motor connections to A1 and A2 are reversed.	1. Remove power. Reverse connections to A1 and A2. Reapply power.
Motor runs too fast.	1. MAX SPD is set too high.	1. Calibrate MAX SPD.
Motor will not reach the desired speed.	1. MAX SPD setting is too low.	1. Increase MAX SPD setting.
	2. IR COMP setting is too low.	2. Increase IR COMP setting.
	3. FWD TQ / REV TQ setting is too low.	3. Increase FWD TQ / REV TQ setting.
	4. Motor is overloaded.	4. Check motor load. Resize the motor and drive if necessary.
Motor pulsates or surges under load.	1. IR COMP is set too high.	1. Adjust the IR COMP setting slightly CCW until the motor speed stabilizes.
	2. Motor bouncing in and out of current limit.	2. Make sure motor is not undersized for load; adjust FWD TQ / REV TQ trim pot CW.

Section 12. Accessories & Replacement Parts

Displays

Closed Loop..... DLC600
Open Loop..... VT8

Kits

Potentiometer
10K Pot, Insulating Washer..... 201-0158

Unconditional Warranty

A. Warranty

American Control Electronics warrants that its products will be free from defects in workmanship and material for twelve (12) months or 3000 hours, whichever comes first, from date of manufacture thereof. Within this warranty period, American Control Electronics will repair or replace, at its sole discretion, such products that are returned to American Control Electronics, 14300 De La Tour Drive, South Beloit, Illinois 61080 USA.

This warranty applies only to standard catalog products, and does not apply to specials. Any returns of special controls will be evaluated on a case-by-case basis. American Control Electronics 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 American Control Electronics's sole obligation and exclude all other warranties of merchantability for use, expressed or implied. American Control Electronics 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 American Control Electronics's obligations, whether expressed or implied, and particularly of any other claim or breach of warranty contained in Paragraph A, or of any other warranties, expressed or implied, or claim of liability that might, despite Paragraph B, be decided against American Control Electronics by lawful authority, American Control Electronics shall under no circumstances be liable for any consequential damages, losses, or expenses arising in connection with the use of, or inability to use, American Control Electronics'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, American Control Electronics'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 American Control Electronics 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.

HTL10-D-4Q

An American Control Electronics Brand

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