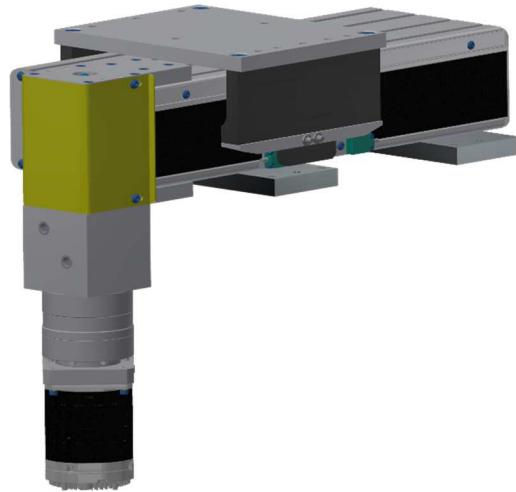


## MES OPERATION MANUAL



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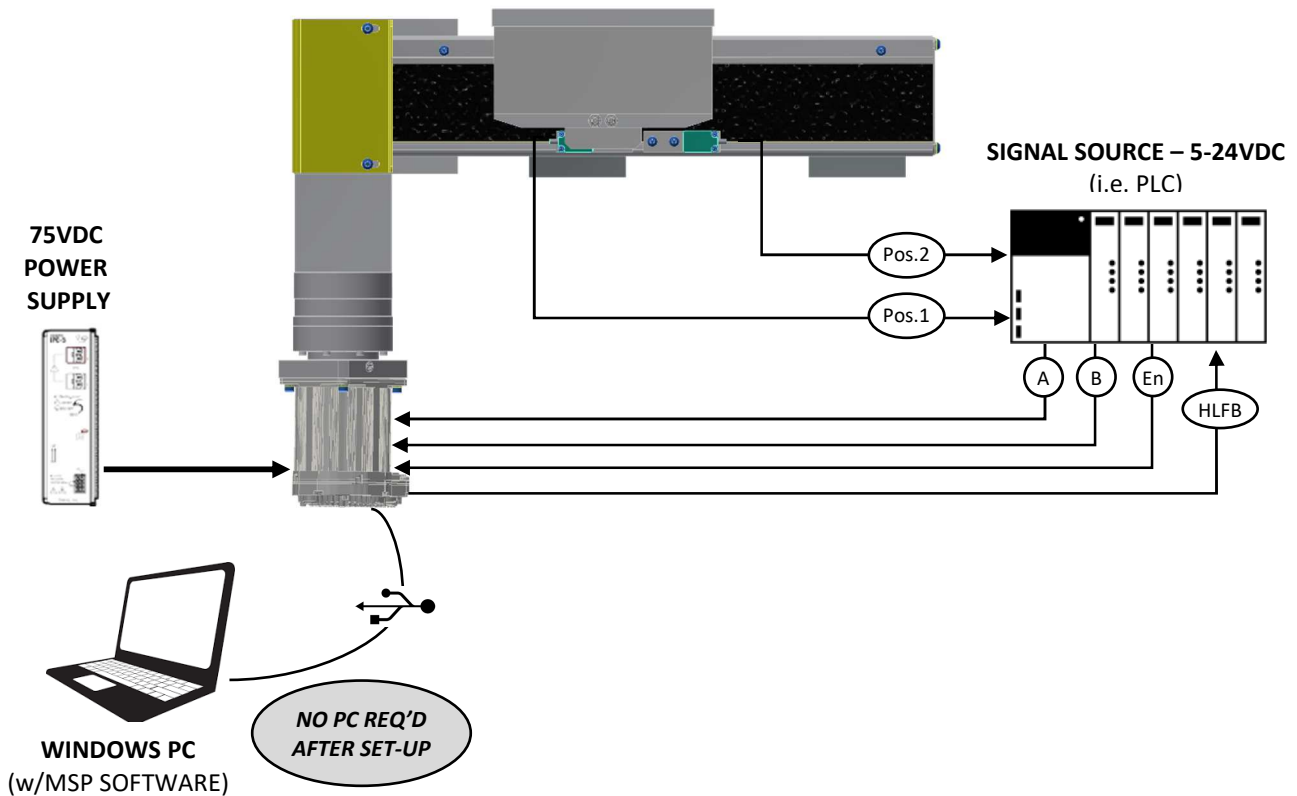
### OVERVIEW

This manual covers the basic operation for the standard motor option for the Welker MES Slide. This motor is a Teknic ClearPath integrated brushless DC servo motor. This NEMA 34 frame size motor has a built-in motion controller with high resolution encoder. The motor is pre-programmed from the factory and requires no additional programming other than to modify stopping positions if required.

The end user is responsible for all power and logic programming and wiring.

### SUMMARY OF OPERATION

The figure below provides an overview of the basic system set-up. Once the motor is initially programmed at the factory it requires (3) low voltage discrete input signals from a PLC, switches, or similar. One digital output (HLFB) is provided and is configured to change state if a motor shutdown occurs. This HLFB is the only user available output. Additionally, (2) position sensors mounted to the slide are provided.



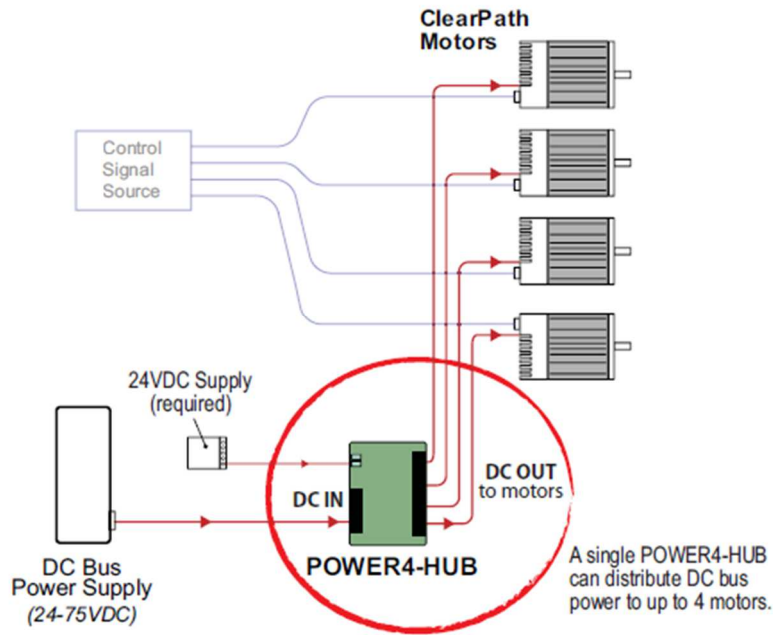
## POWER SUPPLY

Although the ClearPath motor can be powered from 24-75 VDC power supplies, the Welker MES requires 75VDC bus voltage. See Common Specifications section for power requirements. Suitable power supplies are available from Welker upon request.

### LOGIC POWER BACK-UP

The motor requires constant bus power to retain “home” encoder position and HLFB status monitoring. If your application requires retention of encoder position and/or continuous status monitoring, a POWER4-HUB accessory card is required. This board distributes DC bus power to up to (4) motors and delivers low voltage logic power to the motor(s). A separate 24VDC power supply is required. See POWER4-HUB documentation for details. This card is available from Welker upon request.

### POWER4-HUB OVERVIEW

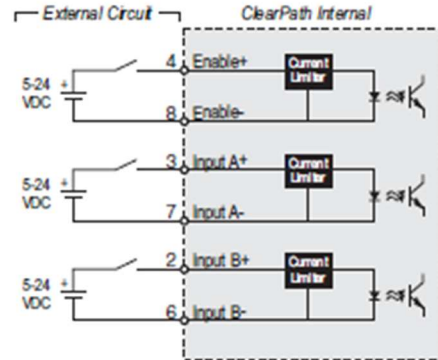


## MOTOR INPUTS AND OUTPUTS

### INPUTS

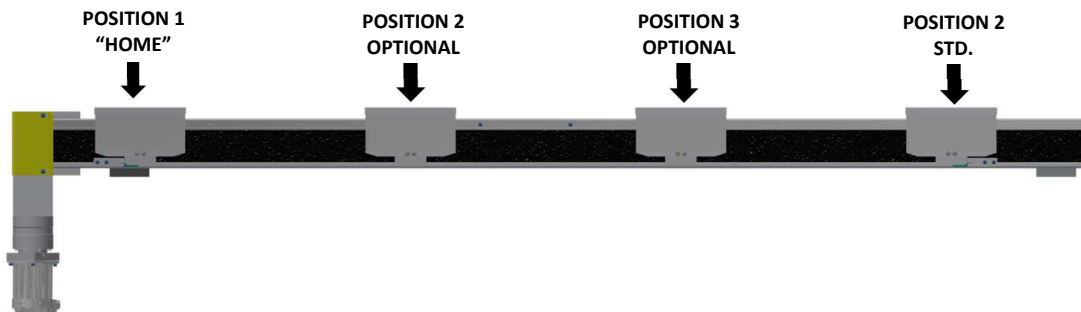
The motor has three (3) inputs, designated ENABLE, INPUT A, and INPUT B. These inputs are designed for use with a 5-24VDC logic signal from a variety of sources and devices including PLCs, microcontrollers, and switches/relays.

**Enable Input:** Controls power to the motor coils. When the motor is powered up and the Enable Input is asserted (i.e. 5-24VDC is present at the Enable Input) the motor windings energize and the motor is able to respond to control signals at Inputs A and B.



**Inputs A & B:** Control inputs. The state of the inputs determines the position of the slide carriage as shown in the table below.

	POSITION 1*	POSITION 2*	POSITION 3	POSITION 4
<b>INPUT A STATE</b>	LOW	HIGH	LOW	HIGH
<b>INPUT B STATE</b>	LOW	LOW	HIGH	HIGH
<b>ENABLE STATE</b>	HIGH			



\*NOTE: Position 1 (“HOME”) and Position 2 are the standard positions programmed at the factory. “Position 2” is the index specified in the part number ordering string. Positions 2 & 3 are optional and require user programming. See User Software section for details on adding these additional positions.

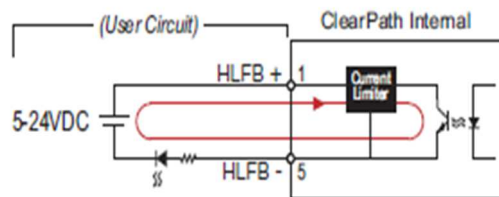
**DAMAGE WARNING:** to prevent motor damage, never connect unprotected inductive loads (things like relay coils, solenoids, contactor coils, brake coils, etc.) such that they can discharge across motor inputs or outputs. Doing so will blow out the motor I/O circuits, causing permanent damage.

## OUTPUT

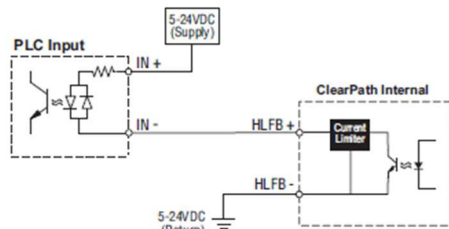
The motor has one digital output (HLFB, high level feedback). The output asserts (conducts) when the motor is enabled and not in a shutdown state. This signal is often used to monitor the motor for shutdowns, or as the control signal for an external brake.

Notes: 1) the HLFB circuit is not internally powered; it requires an external 5–24VDC power supply capable of sourcing/sinking at least 1mA, non-inductive. In typical HLFB applications, power is supplied by the PLC, control board, or an external supply. 2) the HLFB circuit cannot directly drive an external brake.

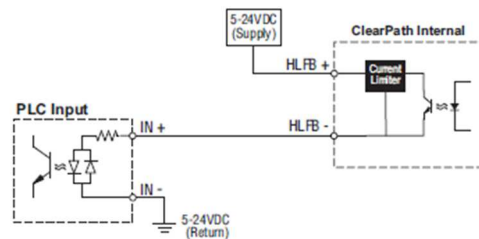
High Level Feedback Circuit



HLFB as a Sinking Output



HLFB as a Sourcing Output



Whether you use sourcing or sinking topology, current supplied to the HLFB circuit from an external device should be limited to 30mA maximum.

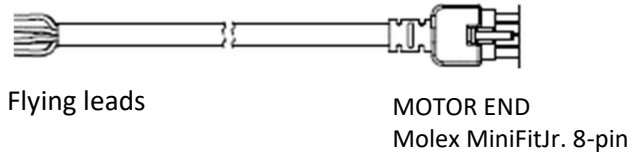
## CONNECTORS

The motor connectors for power and logic control are Molex MiniFit Jr. 4-pin and 8-pin connectors, respectively.

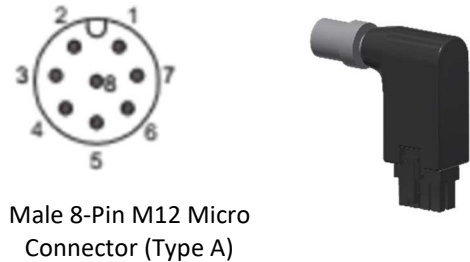
Two options for connecting to the motor are available: 1) direct connection via cables or 2) adapters to convert from the Molex connection to standard M12 micro quick connect.

CONTROL CABLE (CPM-CABLE-CTRL-MU120): 3m long cable with over molded motor end connector and flying leads

Pin	Color	Name
1	GRN	HLFB+
2	BLK	INPUT B +
3	WHT	INPUT A +
4	BLU	ENABLE +
5	RED	HLFB -
6	YEL	INPUT B -
7	BRN	INPUT A-
8	ORN	ENABLE -

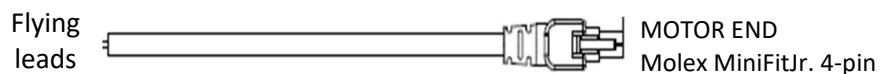


Male 8-Pin M12 Micro Connector (Type A) Pin	Name
1	HLFB+
2	INPUT B +
3	INPUT A +
4	ENABLE +
5	HLFB -
6	COMMON (INPUT A, INPUT B, ENABLE)
7	NOT USED
8	NOT USED



POWER CABLE (CPM-CABLE-PWR-MS120)

Pin	Color	Name
2	BLK	GND
3	RED	V +



POWER CABLE ADAPTER (TM-CABLE-PWR)

Male 4-Pin M12 Micro Connector (Type S) Pin	Name
1	+75VDC
2	NOT USED
3	-75VDC
4	NOT USED



## **HOMING**

The motor will move through a homing procedure at the first Enable action after a power-up. If NOT using a Logic Power Back-up, the motor will run through the homing sequence once powered-up and enabled.

Note, if using a Logic Power Back-up, you must cycle both power sources before homing will be allowed.

The homing move will consist of the carriage moving toward the motor end at a pre-programmed speed until hitting an internal hard stop. After hitting the internal hard stop, the carriage will advance 10mm to “HOME” position. A homing pin is provided to verify “HOME” position. In the event that the “HOME” is not able to be verified, check mechanical connections for slippage or excessive lash. If an offset or adjustment is need, See Programming Software section for how to adjust/modify stopping positions.

## **PROGRAMMING SOFTWARE**

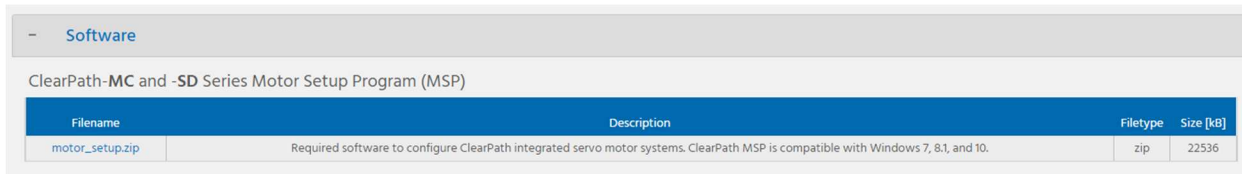
Although the motor is pre-programmed from the factory, accessing the motor’s control parameters may be necessary for service and to modify stopping positions or identify Exceptions (faults).

NOTE: MODIFICATION OF ANY PARAMETERS OTHER THAN THOSE SHOWN HERE WITHOUT PERMISSION FROM WELKER WILL VOID WARRANTY ARE DONE SO AT THE RISK OF THE USER.

The ClearPath Motor Setup Program (MSP) software is available for download from the manufacturer’s website: [www.teknic.com/downloads](http://www.teknic.com/downloads). User registration is required.

### INSTALLING MSP

Download the MSP installer and follow the on-screen prompts to complete the installation.



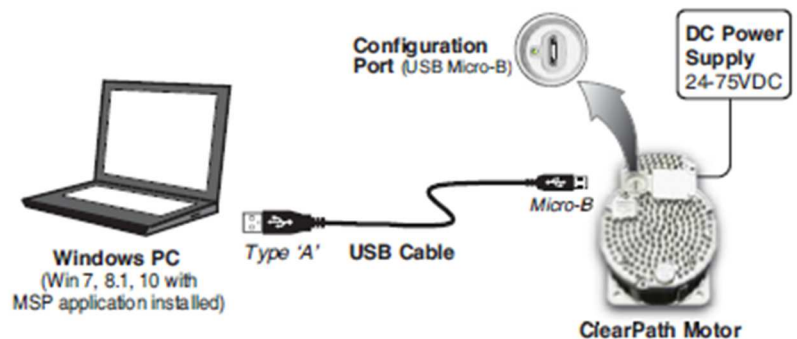
Filename	Description	Filetype	Size [KB]
motor_setup.zip	Required software to configure ClearPath integrated servo motor systems. ClearPath MSP is compatible with Windows 7, 8.1, and 10.	zip	22536

### COMMUNICATING WITH MOTOR VIA MSP

After installing MSP on your PC, follow the directions below to establish a communication link between the motor and the MSP software.

Items required for communication setup:

- A powered-up motor
- A PC running Windows 7, 8.1, or 10 with MSP software installed
- A USB cable (Type A to Micro-B) that supports high speed data transfer. “Charging only” cable will not work.



## First Time Communications Setup

1. Install MSP
2. Power-up the motor
3. Remove the silicone access plug. Connect the motor to the PC with the USB cable.
4. Wait! In most cases Windows will detect the connected motor and install the correct USB driver software automatically. This step can take a few minutes to complete. Proceed only after Windows reports the device is installed and ready for use.
5. Launch the MSP software.

The motor can operate under several different operating modes available in the MSP software. The operating mode used for this application is “Move to Absolute Position (4-Position, Home to Hard Stop).” CHANGING THE OPERATING MODE WITHOUT PERMISSION FROM WELKER WILL VOID WARRANTY AND IS DONE SO AT THE RISK OF THE USER.

When connected to the motor the following screen will appear.

**Menu Bar**

**Mode of Operation**

**Mode Controls**  
All mode-specific controls are displayed here. This section of the UI changes based on the selected mode.

**Dashboard**  
Displays ClearPath "Enable" status, real-time encoder position & velocity, and exception information.

**Mode Controls:** this section contains settings specific to the currently active operational mode. The motor can operate under several different operating modes available in the MSP software. The operating mode used for this application is “Move to Absolute Position (4-Position, Home to Hard Stop).” CHANGING THE OPERATING MODE WITHOUT PERMISSION FROM WELKER WILL VOID WARRANTY AND IS DONE SO AT THE RISK OF THE USER.

**Dashboard:** this section contains several virtual gauges and readout related the motors performance and operational status. See below.

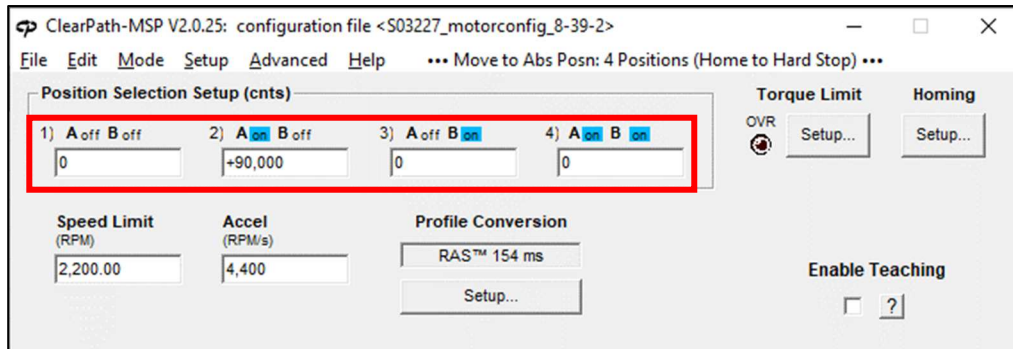


## MODE CONTROLS – POSITION SELECTION SETUP

The stopping positions may be changed or added by entering new values in the appropriate box. The values used for positioning are encoder counts (from pre-programmed home). All values must be positive (+) integers.

If a home offset is needed, Position 1 may be modified as required. A negative (-) integer adjusts the position toward the motor end, a positive (+) integer will adjust position away from the motor end

NOTE: 1mm travel = 50cnts.



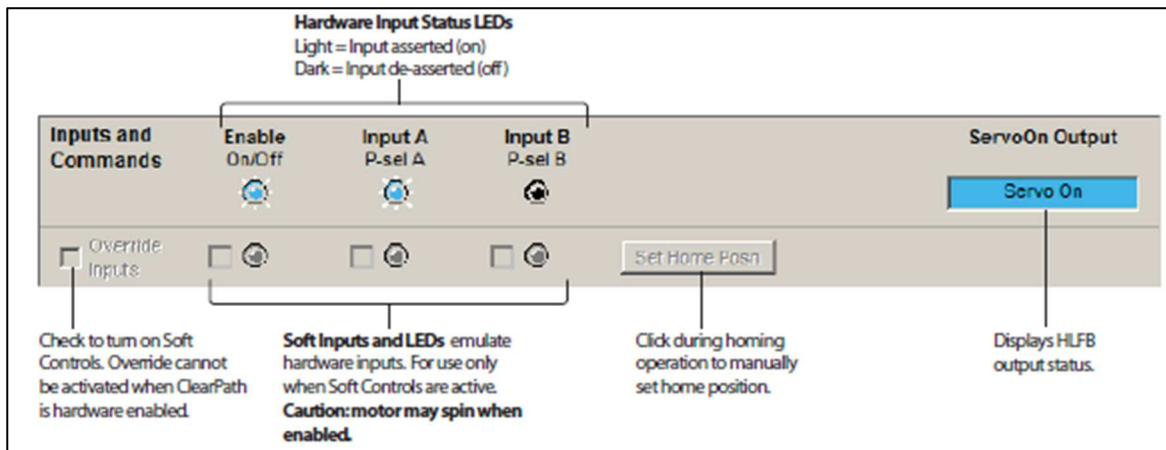
NOTE: MODIFICATION OF ANY PARAMETERS OTHER THAN THOSE SHOWN HERE WITHOUT PERMISSION FROM WELKER WILL VOID WARRANTY ARE DONE SO AT THE RISK OF THE USER.

### NOTES:

- If Input A or B changes while the motor is moving, the behavior will depend on the new move target. If the new move target is in the same direction as the current motion, the move will continue until the new target location is reached. If the new move target is in the opposite direction of current motion, the move will decelerate to a stop and then immediately begin the move to the new target location.
- Changing the state of Input A and/or B while the motor is in motion cancels the move in progress. The motor immediately ramps to a stop and initiates a new move to the newly indicated target position.
- The user-defined positions can be 'taught' instead of entered numerically through MSP. To do this, the motor must be in a Logic Power Backup (LPB) state (using a POWER4-HUB board). The main bus power must be off.
- To teach a position, de-assert the Enable input with the motor in the position you want to teach (or de-assert the Enable and then move the axis by hand to the desired spot). Set inputs A and B to the binary state you want to teach and assert the Enable input. The current location will then be linked to the current input A/B state. De-assert Enable and repeat as desired with other A/B states. This may be done via hardware controls or via the Soft Controls shown below.

## MODE CONTROLS - SOFT CONTROLS

The MSP software allows the user to override external control and operate the motor via the Soft Control shown below. This is useful for setting position without the need to change state of PLC inputs.



### DASHBOARD – MONITORING MOTOR STATUS

This section contains several virtual gauges and readout related the motors performance and operational status.

**Emergency Stop Button**  
 Click here (or hit "Esc" on keyboard) to de-energize motor coils. Toggle Enable to restore operation.

**Position Counter**  
 Displays position of motor shaft in encoder counts.

**Exception Messages**  
 Displays message associated with any active ClearPath exception condition.

**Motor Status**  
 Disabled [Red X icon]

**RMS Meter**  
 Displays real-time (and peak recorded) RMS current. ClearPath shuts down at RMS=100% to prevent burnout.

**Velocity Meter**  
 Displays motor shaft velocity in kcounts/sec or RPM.

**Motor Status Legend**

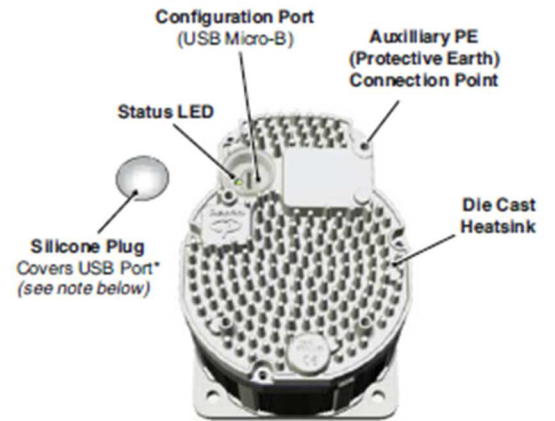
Motor Status	Description
Enabled	ClearPath is enabled via user hardware. <b>Caution:</b> Motor is energized and capable of motion.
SW Enabled	ClearPath is enabled via MSP software controls. <b>Caution:</b> Motor is energized and capable of motion.
Disabled	ClearPath is disabled (Enable is de-asserted). Motor coils are not energized.
Lockdown	ClearPath is in a lockdown state. <b>Caution:</b> Motor is energized with shaft "locked".
Shutdown	ClearPath is in a shutdown state. Motor coils are not energized.
No Power	ClearPath is connected to a PC but not powered up. (This indicates low or no DC power.)

If an Exception Message is displayed, clicking on the ? will bring a pop-up box with information on troubleshooting the exception.

Shutdown	Lockdown	Warning	Alert
Disallows motion	Disallows motion	Allows motion if cause is no longer present	Allows motion
Servo turns off	Servo stays on	Servo stays on	Servo stays on
Yellow LED slow blinks in groups of 2, 3, 4, 5, 6, or 7 OR yellow strobe	Yellow/Green alternating LED slow blinks	Green LED slow blinks in groups of 2	Green LED slow blinks in groups of 3
Toggle Enable input to clear	Toggle Enable input to clear	Clears automatically at start of next move or when cause is no longer present	Clears automatically when cause is no longer present

## LED BLINK CODES

There is a status LED located on the end of the motor. This LED is covered with a silicone plug. Removal of the plug will increase visibility to the LED.



*\* Always keep USB port covered with silicone plug when port is not in use.*

In cases where the same blink code is used for multiple different exceptions, connect the motor to the MSP software to view the specific exception/shutdown information.

LED Code	Exception Type	Effect on Motion	Servo Status	How to Clear Exception	Status or Exception Message Reported in UI
No LED Activity	N/A	N/A	Servo off	N/A	<b>No (or low) Power</b> Verify power is correctly wired and within specified voltage range.
Yellow - on solid	N/A	N/A	Servo off	N/A	<b>Status: Disabled</b> Motor power is turned off.
Yellow - flicker	N/A	N/A	Servo on	N/A	<b>Status: Performing Commutation Start-up</b>
Green - flicker	N/A	N/A	Servo on	N/A	<b>Status: Enabled</b> Motor power is on. ClearPath will respond to motion commands.
Yellow - 2 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>User Stop</b> ESC key or button was pressed by the user.
Yellow - 2 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Motor Enable Conflict</b> The hardware inputs did not match the active software override inputs when the motor was enabled via the hardware enable line.
Yellow - 3 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Max Bus Voltage Exceeded</b> Probable cause: large regenerated voltage upon deceleration or high AC line voltage. Enable the Vector Regen Shunt (VRS) under the advanced menu as a possible remedy.
Yellow - 3 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Power Event Detected</b> Probable cause: Dropped AC phase; Bus volts under operating voltage.

Yellow - 3 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Bus Under Operating Voltage</b> Possible causes: Brown out, power supply undersized, Minimum Operating Bus Voltage set too high (this setting is in MSP under Advanced>Power and Temperature
Yellow - 4 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Command Speed Too High</b> Probable cause: commanded speed/velocity is beyond motor spec.
Yellow - 4 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Tracking Error Limit Exceeded</b> Possible causes: excessive friction, mechanical misalignment, vel/accel too high, low DC bus voltage.
Yellow - 4 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>RMS Torque Limit Exceeded</b> Possible causes: excessive friction, mechanical misalignment, duty cycle too high, undersized motor.
Yellow - 4 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Excessive Bus Current</b> Probable cause: bad tuning, low bus voltage.
Yellow - 5 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Excessive Motor Temp</b> Possible causes: ambient temperature too high for motor load, poor cooling, fan failure (if used), maximum temperature setting too low (this setting can be found under Advanced>Power and Temperature.
Yellow - 6 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Momentary Low Bus Voltage</b> Power supply drooped below 18V, insufficient current capabilities, and/impedance too high.
Yellow - 7 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Old Config File Version</b> Probable cause: Firmware updated after config file was saved. Create or load new config file.
Yellow - 7 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Motor Phase Overload</b> Phase current is beyond allowed ADC limit. Probable cause: incorrect tuning or wrong config file.
Yellow - 7 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Hard Stop Gave Way</b> A mechanical hard stop was detected during homing but it gave way before homing was completed.
Yellow - 7 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Excessive Bus Current</b> Probable cause: bad tuning, low bus voltage.
Yellow - 7 blinks	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Commutation Startup Error</b> DC bus too low for proper commutation start-up. Possible causes: brown out, incorrect power supply voltage, supply configured for higher AC line voltage.

Yellow - strobe	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Velocity Set Too High</b> Velocity/speed limit exceeds motor's factory-set maximum speed.
Yellow - strobe	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>RAS Change Rejected</b> Unexpected error. Contact Teknic for work-around or new firmware.
Yellow - strobe	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Step Input Timing Error</b> Possible causes: Step input pulse width too short, electrical noise, loose or shorted wires. A pull-up resistor may be required. Read Step Timing section of user manual for details.
Yellow - strobe	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>Speed Too High For RAS</b> Unexpected error. Contact Teknic for work-around or new firmware.
Yellow - strobe	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>MagAlign Distance Error</b> Distance traveled does not match expected value. Possible cause: motor against an end stop, incorrect motor settings.
Yellow - strobe	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>MagAlign Direction Error</b> Direction traveled is incorrect. Probable cause: external forces during MagAlign procedure.
Yellow - strobe	Shutdown	Disallows motion	Servo off	Toggle Enable input	<b>DSP Watchdog Restart</b> Firmware problem. Re-flash firmware with same or newer firmware version. Return unit to Teknic if problem not solved.
Green/Yellow alternating	Lockdown	Disallows motion	Servo on	Toggle Enable input	<b>Travel Limits Violated (lockdown)</b> Commanded position is on the wrong side of the home position.
Green/Yellow alternating	Lockdown	Disallows motion	Servo on	Toggle Enable input	<b>Travel Limits Violated (lockdown)</b> Commanded position is beyond the Max Travel from Home position as specified in Homing Setup.
Green/Yellow alternating	Lockdown	Disallows motion	Servo on	Toggle Enable input	<b>Motor Enable Conflict</b> The hardware inputs did not match the active software override inputs when the motor was enabled via the hardware enable line.
Green – 2 blinks	Warning	Allows motion (if cause is no longer present)	Servo on	Auto-clears at start of next move if cause is no longer present	<b>Travel Limits Violated (warning)</b> Commanded position is on the wrong side of the home position.
Green – 2 blinks	Warning	Allows motion (if cause is no longer present)	Servo on	Auto-clears at start of next move if cause is no longer present	<b>Travel Limits Violated (warning)</b> Commanded position is beyond the Max Travel from Home position as specified in Homing Setup.
Green – 2 blinks	Warning	Allows motion (if cause is no longer present)	Servo on	Auto-clears at start of next move if cause is no longer present	<b>Move Buffer Underrun</b> Possible causes: move increments too small or sent too slowly.

Green - 3 blinks	Alert	Allows motion	Servo on	Auto-clears when cause is no longer present	<b>Torque Saturation</b> Power supply may be insufficient for application, torque Limit may be set too low for command. Try lowering acceleration.
Green - 3 blinks	Alert	Allows motion	Servo on	Auto-clears when cause is no longer present	<b>Voltage Saturation</b> Available torque is limited by DC bus voltage. Commanded speed may exceed motor spec. Try lowering speed or using a higher voltage power source (if possible)
Green - 3 blinks	Alert	Allows motion	Servo on	Auto-clears when cause is no longer present	<b>Over Speed</b> Commanded speed exceeds motor max speed limit. Try lowering speed.
Green - 3 blinks	Alert	Allows motion	Servo on	Auto-clears when cause is no longer present	<b>Over Temp</b> Internal electronics above shutdown threshold. Add fan.
Red Toggle	Motor Failure	Disallows Motion	Servo off	Not clearable	<b>Motor Has Failed</b> Return to Teknic for repair or replacement.

If the motor shows no LED activity

During operation, if the motor DC bus voltage drops below approximately 18VDC, the following will occur:

- The motor will go into a shutdown state.
- The LED will turn off. Note: The motor will continue to communicate if voltage remains high enough.
- The LED will remain off. Toggling the Enable will not clear this shutdown.

Once voltage returns to approximately 20VDC or higher:

- The motor will remain in a shutdown state but the LED will “wake up” and flash a yellow blink code 6 (see table above for complete description of this exception code).
- At this point, toggle the enable to clear the shutdown.

## **MOTOR SPECIFICATIONS**

### **Electrical Power Requirements:**

Supply Voltage, Typical:	24VDC to 75VDC
Supply Voltage, Absolute Min:	21.5VDC (as measured at input terminals)
Supply Voltage, Absolute Max:	90VDC (as measured at input terminals)
Continuous Bus Current, Typical:	1A to 4A (application dependent)
Continuous Bus Current, Maximum:	10A
Idle Power usage from Bus	4W (enabled, no torque used by axis or load) 3W (disabled)

### **Electrical I/O:**

Logic Input Voltage Range:	4.0VDC to 28VDC
Input Current @ 5V:	7.5mA (min.)
Input Current @ 28V:	12.0mA (min.)
HLFB Absolute Maximum Voltage	30VDC (across output terminals)
HLFB Output Current, Maximum:	9mA (non-inductive load)
HLFB Output voltage drop @ 2mA:	0.30VDC (+/- 100mV)
HLFB Output voltage drop @ 5mA:	0.55VDC (+/- 100mV)

### **Motor Bearing:**

Maximum Radial Load:	220N (50-lbs), applied 25mm (1.0in)
from front bearing Maximum Thrust Load:	44N (10-lbs)
Bearing Life:	2.4 x10 <sup>9</sup> to 5.3 x10 <sup>9</sup> revs (typ., load dependent.)

### **Environmental:**

Shock (peak, maximum):	10G (applied no more than twice)
Vibration (RMS, 2 Hz-200 Hz):	1.0G or 0.5mm,
whichever is less Maximum External Shaft Deceleration:	250,000 rad/s <sup>2</sup>
Ambient Temperature:	-40°C to +70°C
Maximum Body Temp.:	100°C
Maximum Rear Cover Temp.:	70°C
Humidity:	0% to 95%, Non-Condensing
Recommended Optional Fan:	60mm square, 70.71 mm bolt center, >14CFM

### **Environmental Sealing:**

Front Face, without shaft seal option:	IP53 Body/rear, with dielectric sealing
grease in connectors	IP55
Body/rear, no sealing provisions	IP53

### **Compliance:**

Regulatory Certifications:	UL recognized, CE, RoHS
Electrical Safety:	UL508C, EN 61010-1
EMI:	EN 61326-1

**Country of Origin:** USA