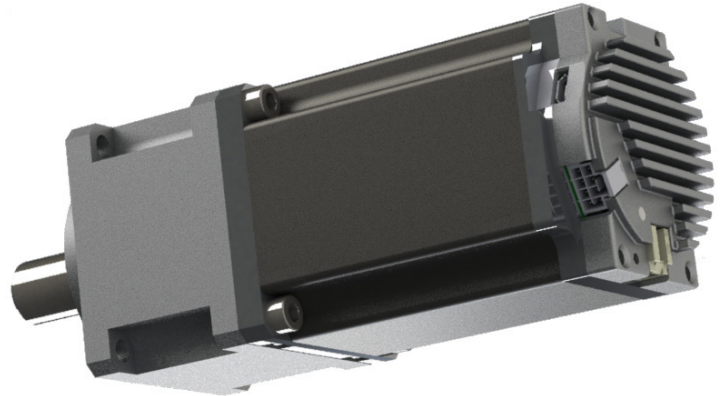


High-Performance 60mm Frame Integrated Servo Motor & Drive with CANbus



Motor shown with optional gearbox

The iLD60Mxxxx is a highly integrated Motor with Drive unit that merges Roboteq's advanced motion control technology and Nidec's leadership in servo motors. The result is a space-saving unit, incorporating motor, encoder and drive that is ready to install and use within minutes into a multitude of Robotics and Industrial Automation application. The iLD60Mxxxx can be powered from any of 12 to 70V DC power source to deliver up to 520W of smooth rotation, at 4Nm peak and 3000 Max RPM. Multiple iLD60Mxxxx can be daisy chained over a CANbus network.

The iLD60Mxxxx includes several safety features, including Safe Torque Off to ensure that no torque is accidentally generated, regardless whether the controller is operating normally or is faulty, without the need for external contactors or relays.

The iLD60Mxxxx's operation can be extensively automated and customized using its built-in Scripting Language. The drive can be configured and tuned in real-time using a RoboteQ's free PC utility. The controller can also be reprogrammed in the field with the latest features by downloading new operating software from Roboteq.

Applications

- Collaborative Robotic Arms
- Automatic Guided Vehicles (AGV's)
- Multi-Axis Machinery
- Conveyor Belts
- Warehouse Automation Systems
- Cobots

Key Features

- High-Efficiency, compact 60mm frame permanent magnet motor
- Built-in, miniature three-phase motor controller
- USB, CAN, 0-5V Analog, or PWM command modes
- Auto switch between command inputs based on user-defined priority
- Low-voltage, 12-70 VDC Operation
- Four quadrant operation. Supports regeneration
- Available in 300W (0.6Nm) to 520W (1.8Nm) continuous rating
- 3000 RPM Max, 4Nm Peak
- Smooth & quiet Sinusoidal Commutation with Field Oriented Control (Vector Control)
- Fast, 16kHz current loop for precise control
- Integrated encoder 4096 counts per revolution
- Multiple CANBus protocol support:
 - CANOpen
 - RoboCAN Meshed Network
 - Any custom Protocol by using RawCAN & Scripting
- Support CANOpen DS402 Profile and Operating modes:
 - Cyclic sync torque
 - Cyclic sync velocity
 - Cyclic sync position
 - Profile position
 - Profile velocity
 - Position
 - Velocity
 - Torque
- PDO's - support cyclic sync and free run modes. Cyclic

- messages can be set for 20 objects on 4 maps
- Orderable with optional STO - Safe Torque Off support. Design compliant/approval UL 61800-5-2
 - Custom orderable with RS485 port MODBUS ASCII and RTU (CANbus disabled)
 - User Programmable current limit up to 25A for protecting the Drive, wiring, and power supply
 - Accurate speed and Odometry measurement
 - Optional integrated mechanical brake with efficient PWM control
 - Available with optional precision gearbox
 - Four general purpose inputs configurable as
 - STO1 and STO2 inputs on version with STO support
 - Digital Inputs for use as Limit Switch, Emergency Stop or user input
 - Analog Inputs for use as command and/or feedback
 - Pulse Length, Duty Cycle or Frequency Inputs for use as command and/or feedback
 - One AB Quadrature Encoder input
 - Two 5A Open Drain outputs for brake resistor, electromechanical brake and/or user device
 - Over and Undervoltage Protection.
 - Over temperature protection using sensor in motor windings and on electronic controller
 - Stall detection and selectable triggered action if Amps is outside user-selected range
 - Diagnostic LEDs for Operation Status and Communication
 - Short circuit protection
 - Fool-proof, keyed Power and Signal connectors
 - Watchdog for automatic motor shutdown in case of command loss
 - Built-in Scripting language for customizing features and functionality
 - Easy configuration, tuning and monitoring using provided PC utility
 - Field upgradeable software for installing latest features and control algorithms
 - 0° to + 45° C ambient operating environment
 - Weight: 1000g (without gearbox)

Orderable Product References

	Frame Length	Cont Power	Motor Speed @48V	Brake	STO
iLD60MA30B-GSC	A	300W	3000	No	Yes
iLD60MA30B-GSC	A	300W	3000	Yes	Yes
iLD60MB30N-GSC	B	400W	3000	No	Yes
iLD60MB30B-GSC	B	400W	3000	Yes	Yes
iLD60MA30B-GIC	A	300W	3000	No	No
iLD60MA30B-GIC	A	300W	3000	Yes	No
iLD60MB30N-GIC	B	400W	3000	No	No
iLD60MB30B-GIC	B	400W	3000	Yes	No

Important Safety Disclaimer

Dangerous uncontrolled motor runaway condition can occur for a number of reasons, including, but not limited to: command or feedback wiring failure, configuration error, hardware/firmware failure, or errors in user script or user program.

The user must assume that such failures can occur and must make his/her system safe in all conditions. Roboteq will not be liable in case of damage or injury as a result of product misuse or failure.

Power and Signal Connectors Identifications

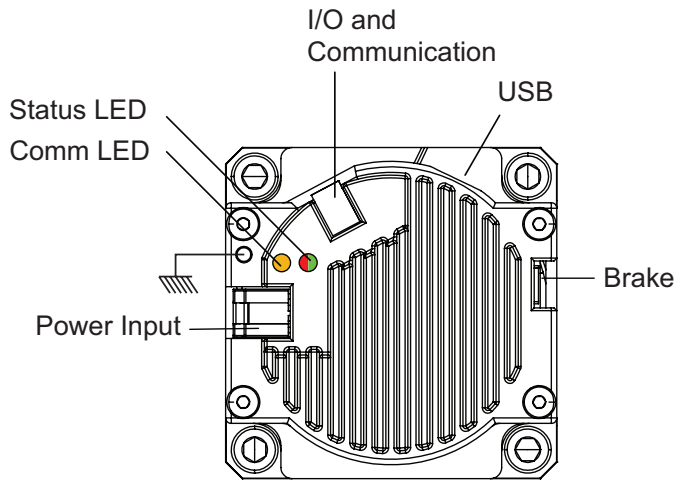


FIGURE 1. iLD60Mxxxx connectors

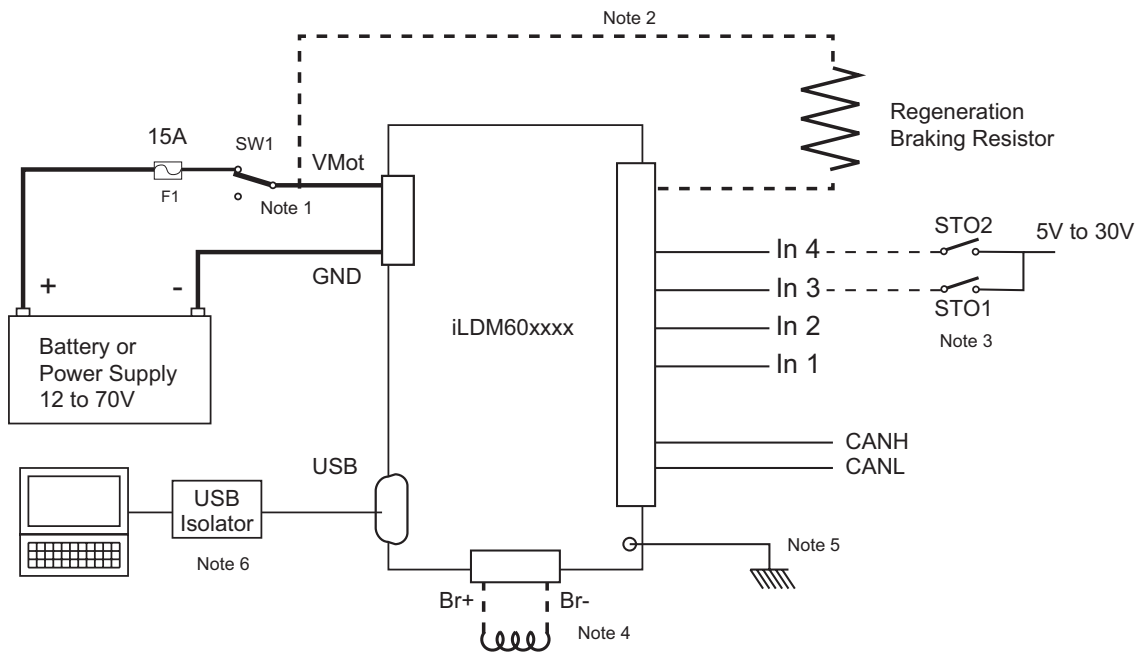


FIGURE 2. iLDM60xxxx wiring

Important Warning

Carefully follow the wiring instructions provided in the Power Connection section of the User Manual. The information on this datasheet is only a summary.

Power Connections

It is imperative that the controller is connected as shown in the above diagram in order to ensure a safe and trouble-free operation. All connections shown as thick black lines are mandatory. The controller must be powered On/Off using switch SW1 on the main power line. Use a suitable high-current fuse F1 as a safety measure to prevent damage to the wiring in case of major controller malfunction.

Note 1: The drive has built in capacitors totally 60uF. This will cause a very brief but large current inrush at the time the switch closes. Use a switch that is rated 30A or higher. Wires should not exceed 2m total length between the power supply and the drive.

Regeneration Protection and Braking

During rapid deceleration, the kinetic energy will cause regeneration current flow out of the motor, back to the power source. When using a battery, the current will recharge the battery and create a dynamic braking effect. When a power supply is used, current will not be able to flow back to the source. Without that return path, the regeneration will cause voltage to rise up to dangerous level for the electronics.

Note 2: An external resistor must be connected as shown, in order to dissipate the excess energy when using a power supply, or if current is otherwise blocked from returning to the battery.

Enable Safe Torque Off

Note 3: On versions of the ILD60xxxx with STO support, the Motor will be prevented from running until its STO inputs are both connected to a voltage of 5V or higher. If one or both STO lines are floated or grounded, the drive will be ON and able to communicate but the motor will not be driven. See details further down in this datasheet and the User Manual.

Connection to Mechanical Brake

Note 4: On versions of the iLD60Mxxx that are not already fitted with internal mechanical brake, the two-pin connector is available for the user to connect an external brake.

Connection to Chassis

Note 5: For improved EMI immunity and reduce emissions, it is recommended to connect the motor's casing to the system's chassis. A threaded hole is available for that purpose. Note that the integrated controller's ground is not electrically connected the motor's casing.

Precautions When Connecting PC via USB

Note 6: Always use an USB isolator to protect the drive and the PC against possible electrical damage. When using a portable PC, operate it from battery to avoid accidental return ground path via the charger.

Precautions and Optional Connections

Note 1: Backup battery to ensure motor operation with weak or discharged batteries, connect a second battery to the Power Control wire/terminal via the SW1 switch.

Motor Specification

TABLE 1. Motor Specification

Feature	Value	
Motor Type	Permanent magnet-excited three-phase synchronous motor	
Feedback	Internal encoder, 4096 Counts per Revolution	
Frame	Flange-mounted 60mm	
Cooling	Convection	
IP Protection Class	IP54	
Operating Temperature	0 - +45 deg C	
Storage Temperature	-25 – +85 deg C	
	iLD60MAxxx	iLD60MBxxx
Stall Torque	0.64 Nm	1.28 Nm
Rated Torque	0.64 Nm	1.28 Nm
Peak Torque	1.92 Nm	3.84 Nm
Motor Power	300W	400W

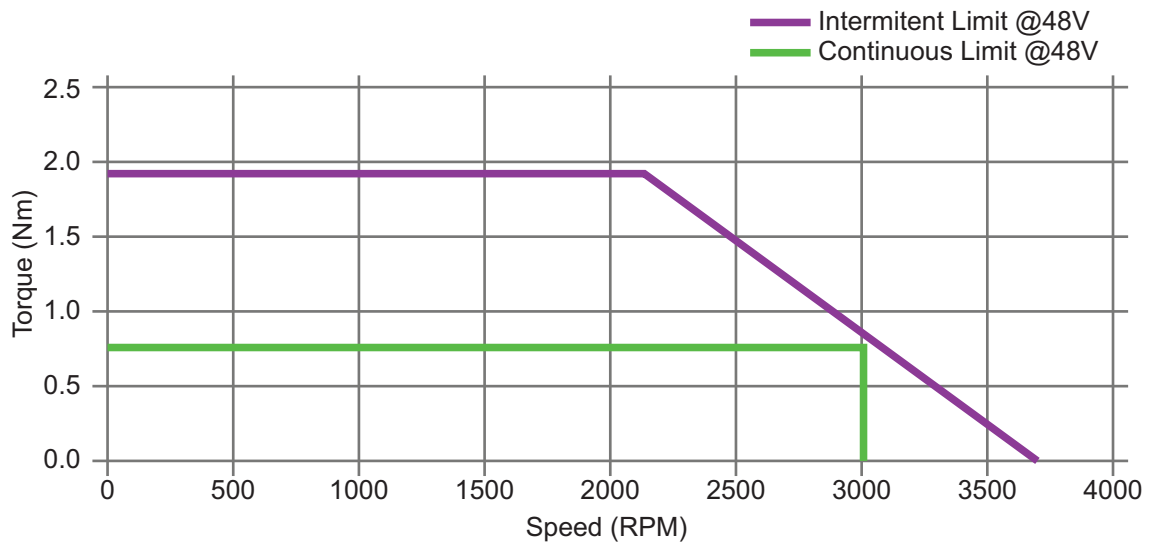


FIGURE 3. iLD60MAxxx Speed vs Torque Curve

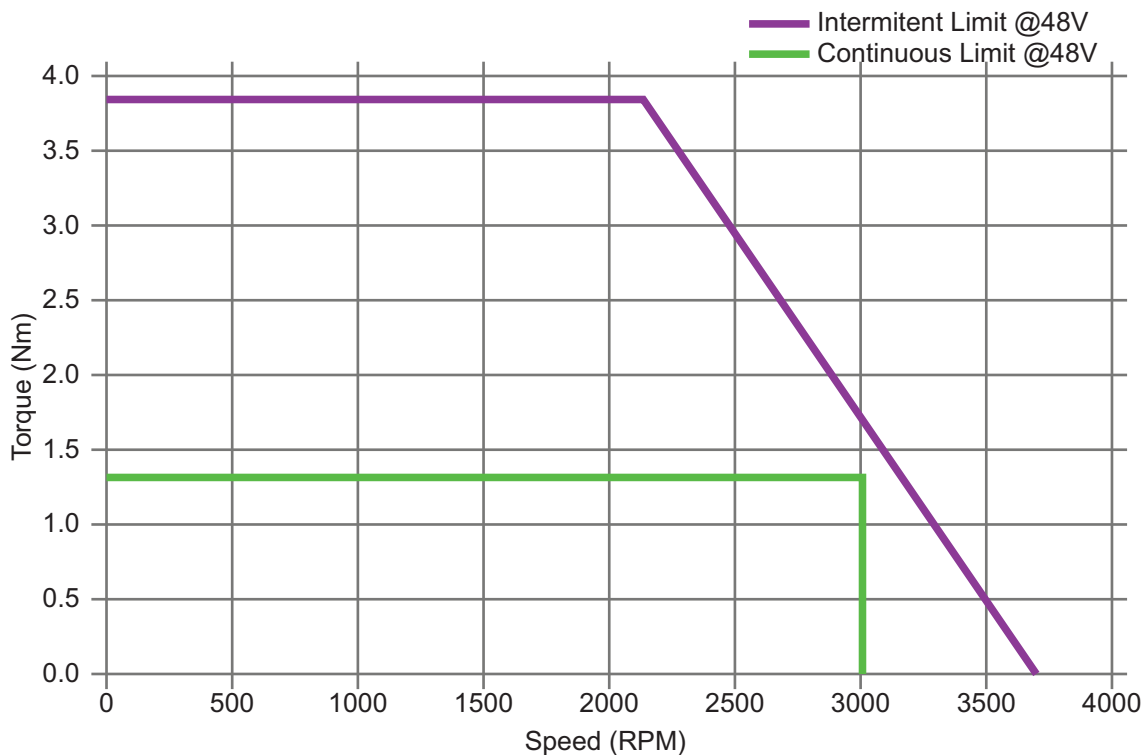


FIGURE 4. iLD60MBxxx Speed vs Torque Curve

Electrical Specification

Absolute Maximum Values

The values in the table below should never be exceeded, permanent damage to the controller may result.

TABLE 2.

Parameter	Measure point	Min	Typ	Max	Units
Battery Leads Voltage	Ground to Vmot			75	Volts
Reverse Voltage on Battery Leads	Ground to Vmot	-1			Volts
Digital Output Voltage	Ground to Output pins			75	Volts
Analog and Digital Inputs Voltage	Ground to any signal pin			30	Volts
CAN/RS485 Voltage	External voltage applied to pins	-25		25	Volts
Case Temperature	Case	-40		85	°C
Humidity	Case			100 (1)	%
Note 1: Non condensing					

Power Stage Electrical Specifications (at 25°C ambient)

TABLE 3.

Parameter	Measure point	Min	Typ	Max	Units
-----------	---------------	-----	-----	-----	-------

Input Voltage	Ground to Vmot	12 (1)		70	Volts
Input continuous Max Current	Power source current			15	Amps
Over Voltage protection range	Ground to Vmot	5	65 (2)	70	Volts
Under Voltage protection range	Ground to Vmot	0	5 (2)	70	Volts
Idle Current Consumption	Vmot	20	50 (3)	100	mA
Peak Current for 5s	Motor current		2.5	25	Amps RMS
Max Current for 10 min	Motor current			12.5	Amps RMS
Continuous Max Current	Motor current			10 (4)	Amps RMS
Current Limit range	Motor current	2	12.5	25	Amps RMS
Stall Detection Amps range	Motor current	2	25	25	Amps RMS
Stall Detection timeout range	Motor current	1	500 (5)	65000	msec
Motor Acceleration/ Deceleration range	Motor Output	100	500(6)	65000	msec
Note 1: Negative voltage will cause a large surge current. Protection fuse needed if battery polarity inversion is possible					
Note 2: Factory default value. Adjustable in 0.1V increments					
Note 3: Current consumption is lower when higher voltage is applied to the controller's VMot					
Note 4: Estimate. Limited by motor case and heatsink temperature. Current may be higher with better cooling					
Note 5: Factory default value. Time in ms that Stall current must be exceeded for detection					
Note 6: Factory default value. Time in ms for power to go from 0 to 100%					

Command, I/O and Sensor Signals Specifications

TABLE 4.

Parameter	Measure point	Min	Typ	Max	Units
Digital Output Voltage	Ground to Output pins			70	Volts
Output On resistance	Output pin to ground		0.025		Ohm
Digital Output Current	Output pins, sink current			5 (1)	Amps
Input Impedances	AIN/DIN Input to Ground		53		kOhm
Digital Input 0 Level	Ground to Input pins	-1		1	Volts
Digital Input 1 Level	Ground to Input pins	3		30	Volts
Analog Input Range	Ground to Input pins	0		5.1	Volts
Analog Input Precision	Ground to Input pins		0.5		%
Analog Input Resolution	Ground to Input pins		1		mV
External Encoder Frequency				500	kHz
Pulse durations	Pulse inputs	20000		10	us
Pulse repeat rate	Pulse inputs	50		250	Hz
Pulse Capture Resolution	Pulse inputs		1		us

TABLE 4.

Parameter	Measure point	Min	Typ	Max	Units
Frequency Capture	Pulse inputs	100		1000	Hz

Note 1: **Unprotected Open Drain** MOSFET outputs. Sink Current.

Operating & Timing Specifications

TABLE 5.

Parameter	Measure Point	Min	Typ	Max	Units
Command Latency	Command to output change	0	0.25	1	ms
Closed Loop update rate	Internal		16000		Hz
485 baud rate	Comm signals		115200		Bits/s
Command Watchdog timeout	CAN, USB, or RS485	1 (1)		65000	ms

Note 1: May be disabled with value 0

Scripting

TABLE 6.

Parameter	Measure Point	Min	Typ	Max	Units
Scripting Flash Memory	Internal		32K		Bytes
Max Basic Language programs	Internal	2000		3000	Lines
Integer Variables	Internal		4096		Words (1)
Boolean Variables	Internal		8192		Symbols
Execution Speed	Internal	50 000	100 000		Lines/s

Note 1: 32-bit words

Thermal Specifications

TABLE 7.

Parameter	Measure Point	Min	Typ	Max	Units
Maximum Winding Temperature	Motor windings			100 (1)	°C
Maximum Controller Temperature	Heatsink		75	80 (2)	°C
Humidity	Case			95	%
Ambient temperature	Ambient	-40		45	°C
Overload motor protection	-	Note 1			

Note 1: Motor will shut down when max temperature is reached

Note 2: Max allowed power out starts lowering at minimum of range, down to 0 at max of range

Connectors

Power Connector

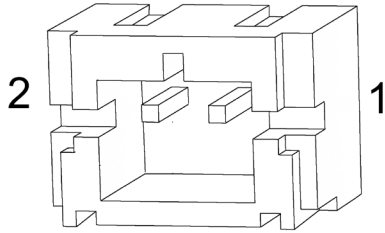


TABLE 8. DC Power supply DF63M-2P-3.96DS connector

Pin	Signal	Description
1	VMOT	DC Positive Power Input
2	PWR_GND	DC Negative Power Input

Motor Brake Connector

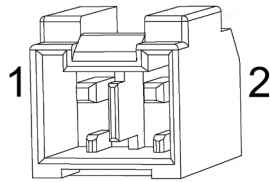


TABLE 9. JST S2B-PH-SM4-TB(LF)(SN) connector

Pin	Signal	Description
1	Motor_Brake-	Motor Brake Negative Output
2	Motor_Brake+	Motor Brake Positive Output

IO and Communication Connector

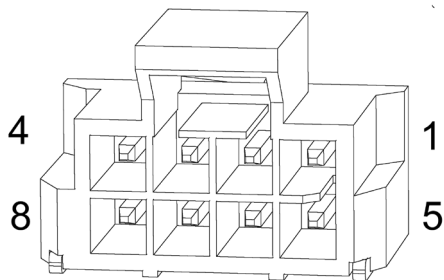


TABLE 10. IO Connector molex nanofit header 1054051108

Pin	Signal	Description
1	CAN_H / RS485+	CAN High or RS485 Positive
2	CAN_L / RS485 -	CAN Low or RS485 Negative
3	STO1/DIN3	Safe Torque Off input 1 or Digital Input 3 (Build option)
4	STO2/DIN4	Safe Torque Off input 2 or Digital Input 4 (Build option)
5	ENC/DIN/ANA/RC1	Encoder input 1 or Digital Input 1 or Analog Input 1 or RC 1
6	ENC/DIN/ANA/RC2	Encoder input 2 or Digital Input 2 or Analog Input 2 or RC 2
7	DOUT/ R_Shunt_Neg	Negative terminal of the regeneration brake resistor
8	GND	Signals ground

CAN Communication

CAN is the iLD60Mxxx's primary and recommended communication interface. Up to 127 drives can be networked on a low cost twisted pair network up to 1000m long and at speeds up to 1Mbit/s. Roboteq support four CAN protocols:

- CANOpen for interoperability with other vendor's DS301 and DS402 compliant devices
- RoboCAN, a simple and effective peer to peer meshed network protocol
- MiniCAN, a simplified subset of CANOpen PDOs
- Raw CAN, a low-level system used with scripting for constructing and parsing CAN frames to handle any protocols

TABLE 11. CANOpen Communications Specification

Feature	Value
Motion Network type	CAN, CANOpen
CANOpen Standards Support	DS301, DS402
Operating Modes	cyclic sync torque, cyclic sync velocity, cyclic sync position, profile position, profile velocity, profile torque modes, homing
Process Data Objects (PDO)	Cyclic sync and free run modes. Cyclic messages can be set for 20 objects on 4 maps

USB Communication

Use USB only for configuration, monitoring and troubleshooting. USB is not a reliable communication method when used in an electrically noisy environments and communication will not always recover after it is lost without unplugging and replugging the connector, or restarting the controller. Always prefer RS232 communication when interfacing to a computer.

Always use an USB isolator inbetween the PC and the Drive to ensure communication reliability and for protecting the PC.

Status LED Flashing Patterns

After the controller is powered on, the Power LED will turn on, indicating that the controller is On. The Status LED will be flashing at a two second interval. The flashing pattern and color provides operating or exception status information.

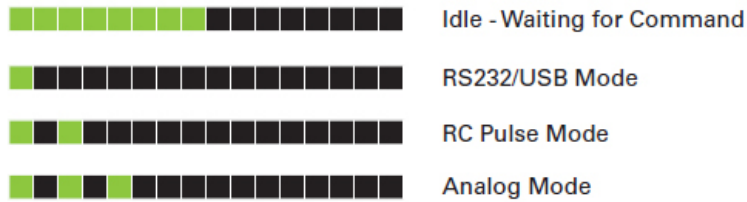


FIGURE 5. Normal Operation Flashing Patterns

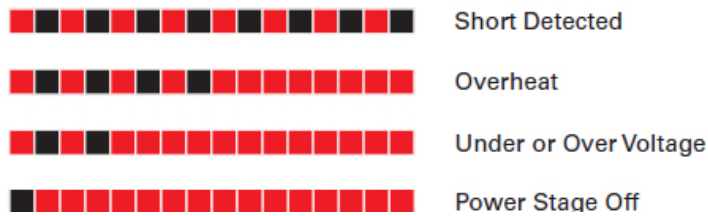


FIGURE 6. Exception or Fault Flashing Patterns

The communication LED gives status information on the CAN and USB.

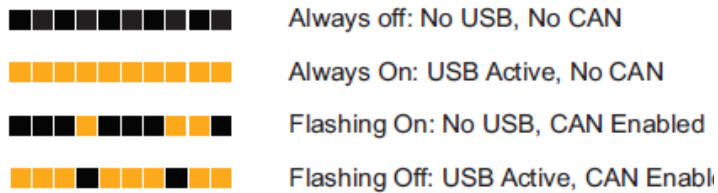


FIGURE 7. Communication LED Flashing Patterns

Additional status information may be obtained by monitoring the controller with the PC utility.

Safe Torque Off - STO (Certification Pending)

This section refers only to versions of the iLD60Mxxx with the STO option.

Safe Torque Off is a safe method for switching controller in a state where no torque is generated, regardless whether the controller is operating normally or is faulty. On models with STO is enabled, two digital inputs, DIN3 and DIN4 are remapped as STO1 and STO2. The inputs are redundant and both must have a 6V to 30V signal present at the same time in order for the Power MOSFETs to be energized. The controller will perform a self-check of the STO circuit at every power on and every time the STO inputs go from any state to both high. Once the STO hardware is verified to work, the controller will safely allow the motors to be energized. If either input is floated or is below 1V, the motor will be floated.

The electronic circuitry used for STO circuit is independently verified against industry standards and validated by TUV. They can therefore be trusted instead of external relays. See [STO Manual](#) for more information and maintenance instructions.

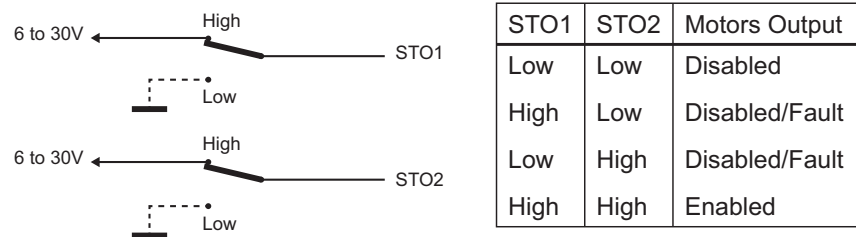


FIGURE 8. STO input levels effects on controller output

Important Warning

Activating STO will electrically disconnect motor from the controller. The motor is not actively stopped and will therefore continue to turn, slowed and stopped by friction or/and the activation of a mechanical brake.

Safety and Thermal Protection

TABLE 12. STO Input Specification

Feature (Safe Torque Off Inputs)	Value
STO Input Qty	2
Rated Voltage	24V
Rating*	SIL3 Ple (Pending)
Certification	IEC 61800-5-2:2007, SIL 3 IEC 61508:2010, SIL 3 IEC 62061:2005, SIL 3 ISO 13849-1:2015, Cat 3 Performance Level e

TABLE 13. Certification Specification

Feature	Value
Conformance	EN 61800-5-1, 61800-5-2 (Pending)
Certification	UL, CE (Pending)

Electrostatic Discharge Protection

In accordance with IEC 61000-6-4, the iLD60Mxxx designed to withstand ESD up to 4kV touch and 8kV air gap. This protection is implemented without any additional external connections required. Some specifications, such as EN12895, require a higher level of protection. To maximize ESD protection, up to 8kV touch and 15kV air gap, you may connect the metallic heatsink of the controller to your battery negative terminal. See App Note 062918 for example connections.

Mechanical

Thermal and Mounting Considerations

During motor operation, the motor and its electronics will generate heat that must be evacuated. The published power/torque rating can only be fully achieved if adequate cooling is provided.

Allow as much airflow as possible to reach the heatsink's fins. Mount the motors preferably so that the fins are vertical.

Additional cooling will be achieved through thermal conduction by mounting the motor's face against a metal plate or chassis.

Dimensions

The Drawings below show the dimensions of the iLD60M with A-Frame length and optional gearbox.

