Fourth Generation Single Channel 50A/60V Brushless DC Motor Controller

Roboteq's SBLMG13xx is a compact, full digital, high-performance and high-efficiency controller for Brushless DC motors. The controller supports a large selection of rotor position sensor types in order to generate smooth continuous rotation. The controller can be commanded via serial, USB, Analog or Pulse signals. Multiple controllers can be networked over a low-cost, twisted pair CANbus networks. For multi-axis applications requiring precise synchronized operation, the SBLMG13xx can be fitted with an optional EtherCAT communication module.

The SBLMG13xx uses the latest motion control technology, such as field-oriented control (FOC), acceleration/velocity Feedforward, and fast loop frequency to deliver quick and precise motion control in speed, torque or postilion modes. Numerous safety features, including Safe Torque Off (STO) are incorporated into the controller to ensure reliable and safe operation.

The controller's operation can be extensively automated and customized using its built-in scripting language. The controller can be configured, monitored 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

- Personal Mobility
- Machine Control
- Terrestrial and Underwater Robotic Vehicles
- Automatic Guided Vehicles
- Factory Automation
- Multi-Axis Robotic Arms
- Animatronics
- Industrial Controls
- Hydraulic Pumps control

Key Features

- USB, Serial, 0-5V Analog, or Pulse (RC radio) command modes
- RS232 and RS485 serial ports
- MODBUS ASCII & RTU Support over RS232 or RS485 (RS485 is available by special order.)
- CAN bus up to 1 Mbit/s. Multi-Protocol support
  - CANOpen DS402
  - RoboCAN Meshed Network
  - RawCAN Customizable to Any Protocol
- Optional EtherCAT Interface CANOpen over EtherCAT (CoE)
- Optional EthernetIP interface
- Built-in 3-phase high-power drivers for one brushless DC motor
- Support for 10 KOhm NTC temperature sensors through dedicated inputs
- 40A Max, 20A continuous Current with I2T protection algorithm
- Programmable current limit up to 40A for protecting controller, motor, wiring and battery.
- Supports Surface Permanent Magnet (SPM) motors or Internal Permanent Magnet (IPM) motors
- 97% or better typical Efficiency
- Multiple Switching modes
  - Trapezoidal with Hall Sensors
  - Sinusoidal with Hall+Encoder
  - Sinusoidal with Encoders
  - Sinusoidal with Hall Sensors
  - Sinusoidal with Absolute Encoder
- Support for absolute angle encoders
  - Sin/Cos analog
  - SSI (single-turn and multi-turn)
  - Resolver

- Full forward & reverse motor control. Four quadrant operation.
- Operates from a single 18 V-60V power source
- STO - Safe Torque Off support. (Certification Pending)
- Locking and key connectors for communication, IO and Feedback Signals
- Accurate speed and Odometry measurement using Hall Sensor or encoder data
- Up to six Analog Inputs for use as command and/or feedback
- Up to six Pulse Length, Duty Cycle or Frequency Inputs for use as command and/or feedback
- Up to six Digital Inputs for use as Dead-man Switch, Limit Switch, Emergency stop or user inputs
- Two general purpose 30V, 1A open collector outputs for accessories
- 5A Max Output for regeneration brake resistor
- Adjustable PWM Output for motor brake
- Custom scripting in Basic language. Execution speed up to 100000 lines per second
- Selectable min/max, center and deadband in Pulse and Analog modes Selectable exponentiation factors for each command inputs
- Trigger action if Analog, Pulse, Encoder or Hall counter capture are outside user selectable range (soft limit switches)
- Open loop speed control operation
- Closed loop speed, position and/or torque control
- Closed loop position control with encoder, hall sensors, analog or pulse/frequency feedback
- Cascaded Speed, Position, Torque PID loops
- High-Performance 16kHz Current Control loop
- Automatic Tuning of Torque, Speed and Position loops
- Automatic Field Weakening for maximum Speed & Torque
- Automatic Motor Characterization
- Configurable Data Logging of operating parameters on Serial Outputs for telemetry or analysis
- Separate Programmable acceleration and deceleration
- Built-in Battery Voltage and Temperature sensors
- Connector for external Motor Windings Temperature sensor
- Optional 14-24V backup power input for powering safely the controller if the main motor batteries are discharged
- Power Control wire for turning On or Off the controller from external microcomputer or switch
- Regulated 5V-100mA output for powering sensors, RF Modem or microcomputer
- Stall detection and selectable triggered action if Amps is outside user-selected range
- Ultra-efficient 3.4 mOhm ON resistance MOSFETs
- Short circuit protection with selectable sensitivity levels
- Over voltage and Under voltage protection
- Watchdog for automatic motor shutdown in case of command loss
- Over temperature protection
- Power and Diagnostic LED indicators
- Efficient heat sinking using conduction bottom plate. Operates without a fan in most applications
- IP40 case protection rating
- Power wiring via High-Current carrying Faston Terminals
- 70mm x 70mm x 27mm
- -10° to +70° C operating environment
- Easy configuration, tuning and monitor using provided PC utility
- Easy configuration, tuning and monitoring using provided PC utility
- Field upgradeable software for installing latest features via the Internet

Orderable Product References

Reference	Amps Max/Cont	Volts	STO	CAN	Fieldbus
SBLMG1360T	40 / 20	60	Yes	Yes	None
SBLMG1360TC	40 / 20	60	Yes	Yes	EtherCAT

Warning

A dangerous uncontrolled motor runaway condition can occur due to various reasons, including, but not limited to: command or feedback wiring failure, configuration errors, faulty firmware, errors in user scripts or programs, or controller hardware failure.

Users must be aware that such failures can occur and must ensure the safety of their system under all conditions. Roboteq will not be held liable for any damage or injury resulting from product misuse or failure.

Important Note

All products are not serviceable. If damage is suspected, the item must be replaced rather than repaired.

Attempting to service or repair the product voids any existing warranty and may pose safety risks.

Consult customer support for more information on replacements.

Power Wires Identifications and Connections

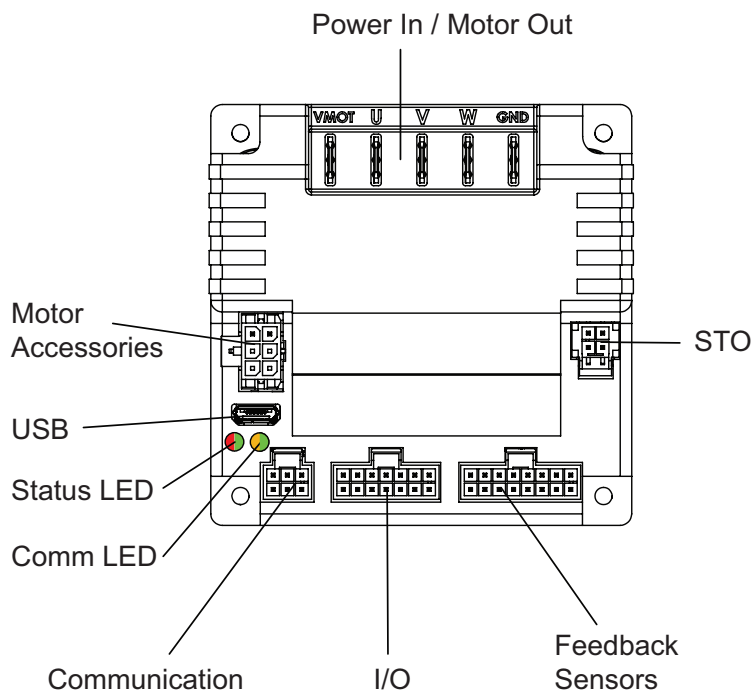


FIGURE 1. Controller Layout

Figure 2, below, shows how to wire the controller and how to turn power On and Off.

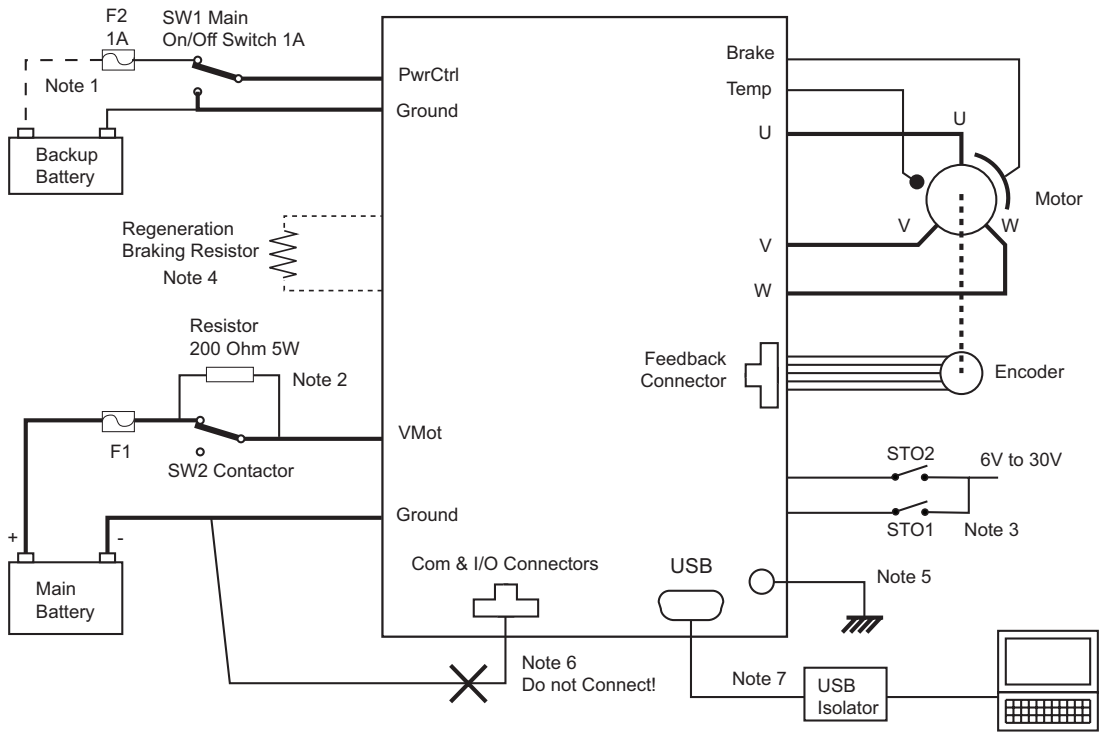


FIGURE 2. Powering the Controller. Thick lines identify **MANDATORY** connections

Caution

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

Mandatory Connections

It is imperative that the controller is connected as shown Figure 2 in order to ensure a safe and trouble-free operation. All connections shown as thick black lines line are mandatory.

Emergency Switch or Contactor

The battery must be connected Permanently to the controller's VMot tab via a high-power emergency switch or contactor SW2. The user must be able to deactivate the switch or contactor at any time, independently of the controller state. SW2 should be used only in emergency situations and not for normal operation. Opening SW2 while the motors are rotating can lead to permanent hardware damage. Use a suitable high-current fuse F1.

Power On/Off Switch

The **controller must be powered On/Off using switch SW1** on the Power Control pin.

Note 1: To ensure motor operation with weak or discharged batteries, connect a second battery to the Power Control pin via the SW1 switch. This will keep the controller alive and responding even if no voltage is present on the Vmot terminal.

Precharge Resistor

The controller has internal capacitance which will cause a brief yet significant current inrush the moment power is applied.

Note 2: If there is a concern that this current can overload the power supply or the contactor, insert a precharge resistor as shown in figure 2. For precharging to take place, the controller must be turned off by grounding the Power Control pin.

Enable Safe Torque Off

Note 3: On versions of the controller with STO support, the motor will be prevented from running until both of its STO inputs are connected to a voltage of 6V or higher. If one or both STO lines are left floating or grounded, the drive will be ON and able to communicate, but the motor will not be driven. For more details, refer to the STO chapter further down in this document and consult the Roboteq Controllers User Manual.

Regeneration Protection and Braking

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

Note 4: 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.

Connection to Chassis

Note 5: For improved EMI immunity and reduced emissions, it is recommended to connect the controller's bottom plate to the system's chassis. Note that the integrated controller's ground is not DC-electrically connected to the plate. However, there is a capacitor between the controller's ground and the bottom plate, providing AC conductivity.

Avoid Alternate Ground Paths

Note 6: Be cautious not to create a path between the ground pins on the I/O connector and the battery's negative terminal. An internal connection already exists between the battery's negative pole and the control ground. Avoiding an additional external connection is highly recommended, as this could allow current to circulate in the signal ground, potentially introducing noise into low-power signals. If the main power ground terminal becomes loose or disconnected, very high current from the motor may flow through the signal ground wire, causing damage.

Electrostatic Discharge Protection

In accordance with IEC 61800-5-2, Roboteq Motor Controllers are designed to withstand ESD up to 6kV contact and 8kV air gap. This protection is implemented without any additional external connections required.

Precautions When Connecting PC via USB

Note 7: Always use a USB isolator to protect both the drive and the PC against potential electrical damage. When using a portable PC, operate it on battery power to avoid creating an accidental return ground path via the charger.

EMI/EMC

All cables, including motor, battery, and control cables, should be kept shorter than 3 meters to minimize EMI/EMC issues. Depending on the source of interference and the cable type, the use of external filters or ferrite chokes may be necessary.

Controller Mounting

The drive should be mounted in such a way that its bottom surface makes direct contact with a metallic surface, such as the system chassis or cabinet. This will assist in dissipating the heat generated during the operation of the controller. It's important to note that the nominal and peak ampere values documented in the datasheet can only be fully achieved with adequate cooling.

Motor Connections

Power and Motor Connections

Connection to the battery is made using a row of five 0.25" (6.3mm) Faston tabs. Use any Faston mating connector and with AWG10 wire (recommended).

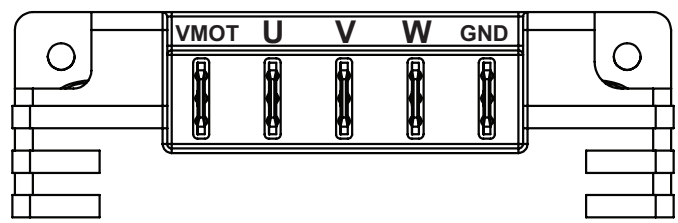


FIGURE 3. Power and Motor Connections

Low Power Signals Connections

The SBLMG1360 uses five Molex Nanofit connectors for the low power signals. Each connector has a different size to avoid erroneous connection.

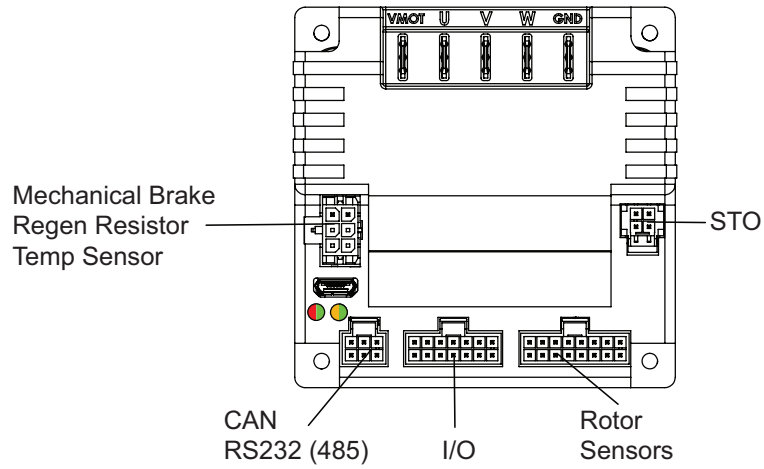


FIGURE 4. Connector Wiring Diagram

Communications Connector

Communication interface connector cable plug using a molex nanofit receptacle 1053081206.

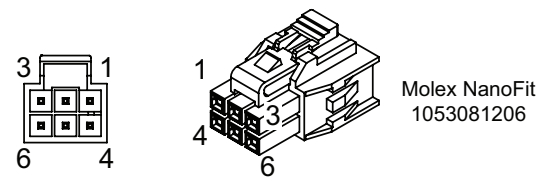


FIGURE 5. Communication Connector Pins Identification

TABLE 1. Pins Identification

Connector Pin	Signal	Description
1	CAN_H	CAN high bus line
4	CAN_L	CAN low bus line
2	RS232TxD	RS232 Transmit Data (RS485- Optional)
5	RS232RxD	RS232 Receive Data (RS485+ Optional)
3	GND	Ground
6	Shield	Cable Shield

The shield pin is not DC connected to the controller's ground. It is connected to ground via internal capacitors and thus provides an AC connection useful for EMI reduction.

Digital Feedback Sensors and I/O Connector

Digital rotor sensors signal must be wired to the 16-pin connector located in front of the controller. Some pins can alternatively be used as general purpose Analog, Digital or Pulse inputs. The functions of many pins vary depending on user configuration. Cable plug is using a molex microfit receptacle 1053081216.

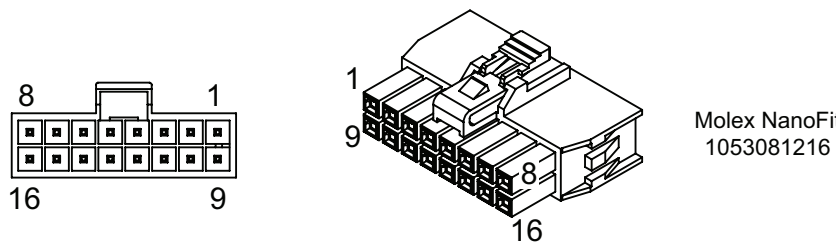


FIGURE 6. Connector Pin Locations

TABLE 2. Pins identification

Connector Pin	Power	Hall	Encoder	SSI	Analog In	Dinput	Pulse In
1	5VOut						
9	GND						
2		HallA+					
10		HallA- (1)					
3		HallB+					
11		HallB-					
4		HallC+		Clock-			
12		HallC-		Data-			
5			ENCA+		ANA1	DIN1	PIN1
13			ENCA- (1)				
6			ENCB+		ANA2	DIN2	PIN2
14			ENCB-				
7			ENCI+		ANA3	DIN3	PIN3
15			ENCI-				
8				Data+			
16				Clock+			

Note 1: Leave the minus (-) inputs unconnected when using single ended hall sensors or encoders

Analog Sensors and I/O Signal Connector

Analog rotor sensors signal must be wired to the 14-pin connector located in front of the controller. Some pins can alternatively be used as general purpose Analog, Digital or Pulse inputs. Two open drain digital outputs are also located on this connector. The functions of many pins vary depending on user configuration. Cable plug is using a molex microfit receptacle 1053081214.

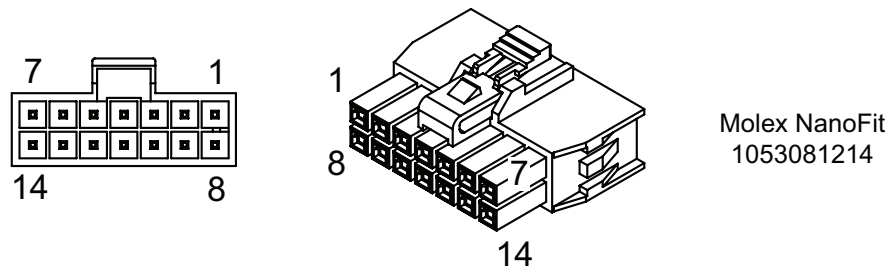


FIGURE 7. Connector Pin Locations

TABLE 3. Pins identification

Connector Pin	Power	Ana Sense	Ana Inputs	DInput	Pulse	DOutput
1						DOUT1
8		EXC- (4)				
2						DOUT2
9		EXC+ (4)				
3		SIN+ (2)				
10	GND					
4		SIN-				
11	**PwrCtrl (1)**					
5		COS+				
12	GND					
6		COS- (3)				
13	5VOut					
7			AIN4	DIN4	PIN4	
14	GND					

Note 1: Ground this pin for turning off the controller
Note 2: Use SIN and COS inputs for Sin/Cos sensors and resolvers
Note 3: Connect SIN- and COS- to ground when using single-ended Sin/Cos sensors
Note 4: Use Excitation signals with Resolvers

Motor Brake Connection

Two pins on the motor accessories connector are provided for connection to a mechanical motor brake. The output is modulated with a PWM signal so that a higher current can be initially applied to energize the coil, and then reduced to maintain the brake released while consuming less energy.

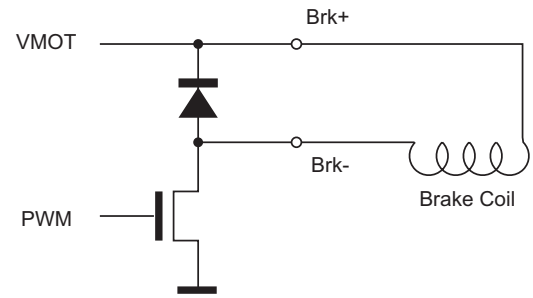


FIGURE 8. Mechanical Brake internal drive circuit and connection

Regeneration Brake Resistor Connection

Two pins on the motor accessories connector are provided for connecting a resistor. This resistor will burn off the motor's kinetic energy during rapid deceleration and must be installed in systems that are powered from power sources that cannot accept regeneration current.

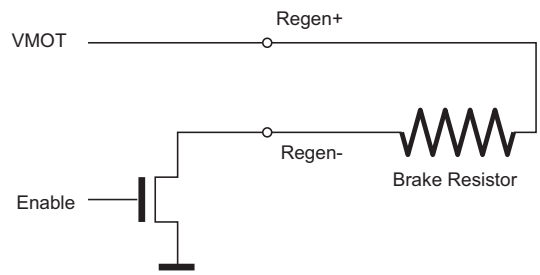


FIGURE 9. Regenerative Brake Resistor drive circuit and connection

The resistor value must be such that the current is under 5A at the Over voltage limit using the formula:

R (ohm) = Over voltage Limit (Volts) / 5(Amps)

The resistor value then determines the Power that will be burned during regeneration

P (Watts) = Over voltage Limit * Over voltage Limit (Volts) / R (ohm)

Example with 50V limit and 5A regen: R= 10 ohm, P=250W. This power will be dissipated for the duration of the braking.

Motor Accessories Connector

A six-pin Molex MicroFit connector provide the necessary connection to the mechanical brake, regeneration resistors and winding temperature sensor

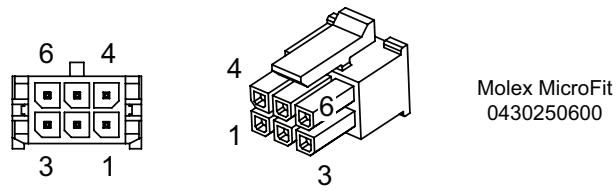


FIGURE 10. Motor Accessories Connector Pins Identification

TABLE 4. Pins identification

Connector Pin	Signal	Description
1	Regen Res+	Positive connection to Regen Brake Resistor. Internally connected to VMot.
4	Regen Res-	Regen Brake Resistor Switched connection to Ground
2	Motor Brake+	Positive connection to Mechanical Brake Coil. Internally connected to VMot
5	Motor Brake-	Mechanical Brake Switched connection to Ground
3	Temp+	NTC Temperature Sensor input+
6	Temp+	NTC Temperature Sensor Input-

Caution

The Brk+ and Regen+ are internally connected to the VMOT supply voltage. Exercise care to avoid short circuits during wiring.

Connecting Thermistors

A 10 KOhm NTC temperature sensor can be connected between the controller's Temp+ and Temp- inputs. This enables the reading of motor temperature through the controller's runtime variables and allows for active temperature protection. The controller has an integrated 10 KOhm pull-up resistor connected to 5V, so no additional resistor is required.

Connection to Analog Sin/Cos Absolute Encoder

The SBLMG13xx features four high-speed analog inputs, designed to capture the absolute angular position data from magnetic sensors that have differential sin/cos voltage outputs. The signal must range from 0 to 5V, with 0 at 2.500V.

The Table 5 shows the signals assignment on the 14-pin connector.

TABLE 5. Pins identification

Signal	Pin Number
Sin+ 3	3
Sin- 4	4
Cos+	5
Cos-	6

Connecting Resolver

The wiring for the resolver is similar to a Sin/Cos sensor with the addition of an excitation signal. Figure 11 shows the necessary connections.

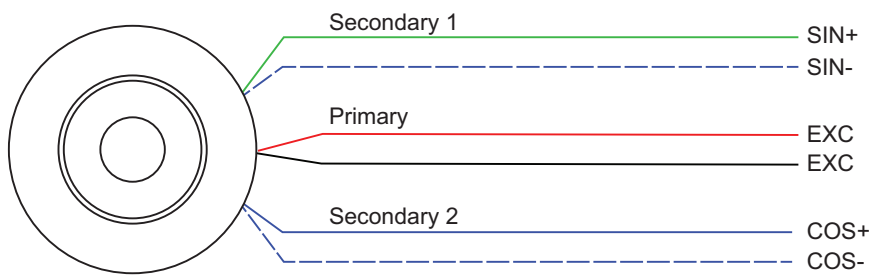


FIGURE 11. Resolver connections

Important Note

Sensor error detection should be disabled when performing motor/sensor setup through USB, as the protection might be triggered due to signal interference. This interference will not affect the motor/sensor setup process or motor control.

Connection to SSI Absolute Encoder

Both multi-turn and single-turn SSI sensors are supported in sinusoidal mode, with pure binary encoding (no Gray code, offset binary, etc.) and a resolution of up to 48 bits. The connection can be achieved through Pins 4, 8, 12, and 16 of the 16-pin connector. The pin assignment is provided in Table 6.

Extra Inputs Connector (STO Connector)

On versions of the SBLMG13xx without STO, the STO connector carries two Digital/Analog inputs signals. Connector cable plug is using a molex nanofit receptacle 1053081204.

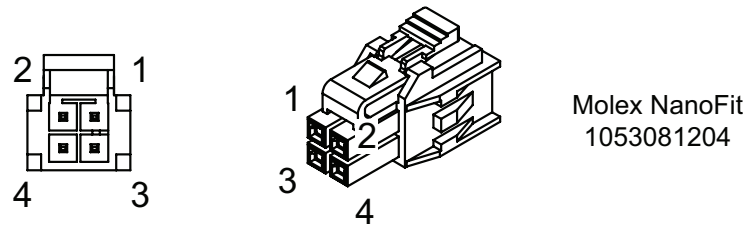


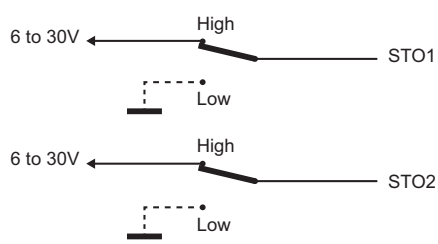
FIGURE 12. Extra Inputs Connector Pins Identification on STO connector

TABLE 6. Pins identification

Connector Pin	Power	Digital In	Analog In	Pulse In
1		DIN5	AIN5	PIN5
3		DIN6	AIN6	PIN6
2	5VOut			
4	GND			

Safe Torque Off - STO (Certification Pending)

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. When STO is enabled, two digital inputs, DIN5 and DIN6 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 below 1V, the controller's outputs will be disabled. The STO circuit is verified and validated and can therefore be trusted instead of external relays. See STO Manual for more information and maintenance instructions.



STO1	STO2	Motors Output
Low	Low	Disabled
High	Low	Disabled/Fault
Low	High	Disabled/Fault
High	High	Enabled

FIGURE 13. STO input levels effects on controller output

Warning

Activating STO causes the motor to float and cease torque generation. Since the motor will not be actively braked, it will decelerate solely due to the system's friction. In mobile robot applications, the robot may continue moving for several meters before coming to a complete stop. For safe operation, additional braking measures should be implemented when STO is enabled, such as utilizing a mechanical or electrical brake. Roboteq offers one solution in the form of the SBSxxxx Safety Electric Brake Switch series, which quickly stops the motor by shorting its phases when STO is triggered.

Important Note

Bypassing the STO functionality is not possible on the SBLMG1XXX drive; both STO inputs must be high for the drive to function properly.

STO Connector

This four-pin connector has the Safe Torque Off signals on controllers with the STO option. The STO signals can be also be read as Analog, Digital or Pulse input 5 and 6. The STO connector cable plug is using a molex nanofit receptacle 1053081204.

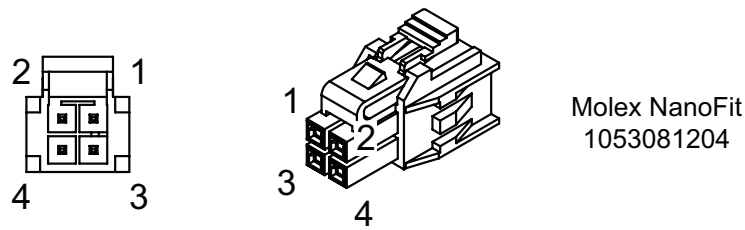


FIGURE 14. STO Connector Pins Identification

TABLE 7. Pins identification

Connector Pin	Power	STO Signal	Description
1		STO1	Connect both lines to 6-24V to Enable Motor
3		STO2	
2	5VOut		Ground
4	GND		Ground

CAN Communication

CAN is the SBLMG13xx'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 8. 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

EtherCAT Communication

The SBLMG13xx is available in several versions, each supporting different Ethernet-based communication protocols and fieldbuses.

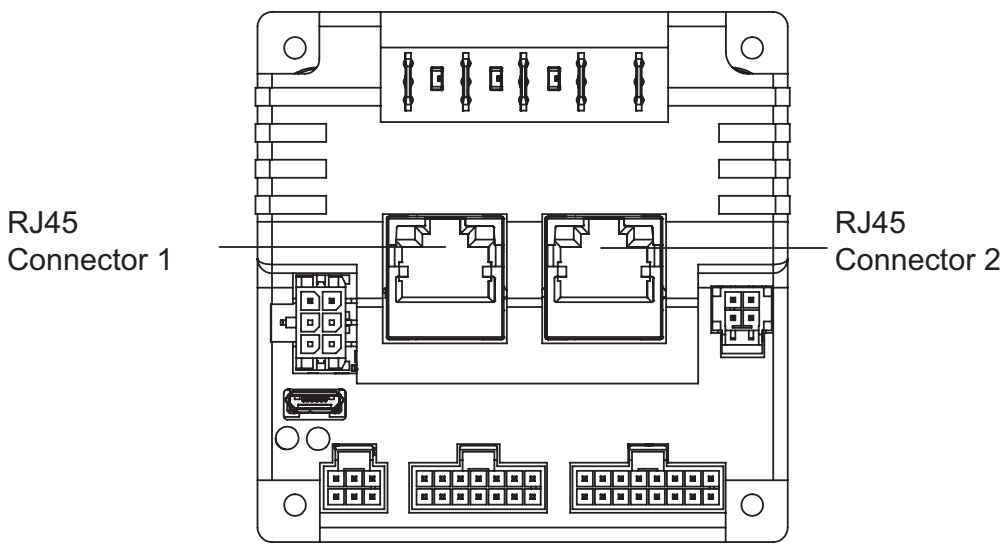


FIGURE 15. Connector Locations on optional EtherCAT and Profinet versions

The SBLMG13xxTC is a version that supports the EtherCAT interface. EtherCAT is an Ethernet-based communication protocol designed for fast and precise synchronization in multi-drive, multi-axis systems. The controller supports CANOpen over EtherCAT (CoE), meaning it utilizes the CANOpen DS402 object directory and operating modes. Connection to the EtherCAT bus is facilitated through two RJ45 connectors. See the EtherCAT/CAN Networking Manual for details.

The SBLMG13xxTE version supports all the controller's serial commands over a TCP/IP connection. Modbus TCP protocols are also supported in that version. Please note that the Motor and Tuning Wizard is not available through the TCP/IP connection.

USB communication

Use the USB only for configuration, monitoring, and troubleshooting purposes. USB is not a reliable method of communication and can lead to disconnections when used in electrically noisy environments. These disconnections often require resetting the USB connection or even the controller. For more reliable interfacing with a computer, always opt for RS232 communication.

Important Note

Always use a USB isolator to protect both the drive and the PC from potential electrical damage. When using a portable PC, operate it on battery power to avoid an accidental ground path return via the charger.

Status LED Flashing Patterns

After the controller is powered on, the Power LED will turn on, indicating that the controller is active. The Status LED will flash at two-second intervals. The flashing pattern and color provide information on operating status or exceptions. Additional status information may be obtained by monitoring the controller with the PC utility.

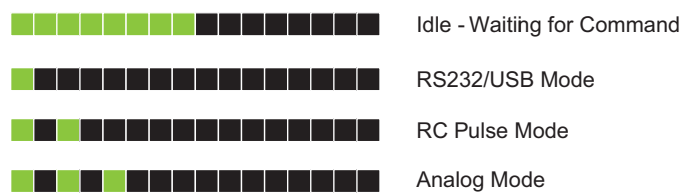


FIGURE 16. Status LED Normal Operation Flashing Patterns

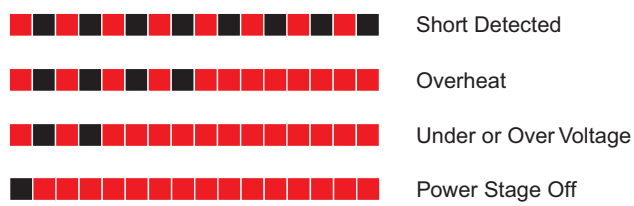


FIGURE 17. Status LED Exception or Fault Flashing Patterns

The communication LED gives status information on the CAN and USB. This LED is always ON with one color or the other when the controller is running.

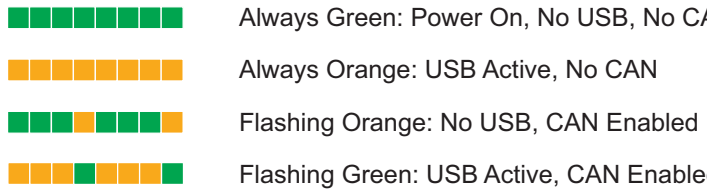


FIGURE 18. Power On and Communication LED

Electrical Specifications

Absolute Maximum Values

The values in Table 9 should never be exceeded, as doing so may result in permanent damage to the controller.

TABLE 9.

Parameter	Measure point	Min	Typical	Max	Units
Battery Leads Voltage	Ground to VMot			70	Volts
Reverse Voltage on Battery Leads	Ground to VMot	-1			Volts
Power Control Voltage	Ground to Pwr Control wire			70	Volts
Motor Leads Voltage	Ground to U, V, W wires			70 (1)	Volts
Digital Output Voltage	Ground to Output pins			30	Volts
Analog and Digital Inputs Voltage	Ground to any signal pin			30	Volts
RS232 I/O pins Voltage	External voltage applied to Rx/Tx pins			30(2)	Volts
Note 1: Maximum motor voltage including regeneration. Never inject a DC voltage from a battery or other fixed source Note 2: No voltage must be applied to the RS232 Tx pin					

Power Stage Electrical Specifications (at 25ºC ambient)

TABLE 10.

Parameter	Measure point	Min	Typical	Max	Units
Battery Leads Voltage	Ground to VMot	0 (1)		60	Volts
Motor Leads Voltage	Ground to U, V, W wires	0 (1)		60 (2)	Volts
Power Control Voltage	Ground to Power Control wire	0 (1)		60	Volts
Minimum Operating Voltage	VMot or Pwr Ctrl wires	18 (3)			Volts
Over Voltage protection range	Ground to VMot	5		60	Volts
Under Voltage protection range	Ground to VMot	0		50	Volts
Input Capacitance	Ground to VMot		400		uF

TABLE 10.

Parameter	Measure point	Min	Typical	Max	Units
Idle Current Consumption	VMot or Pwr Ctrl wires	50	100 (5)	150	mA
ON Resistance (Excluding wire resistance)	VMot to U, V or W. Ground to U, V or W		4		mOhm
Max Current for 30s	Motor current			40	Amps
Continuous Max Current	Motor current			20 (7)	Amps
Current Limit range	Motor current	5	30 (8)	40	Amps
Stall Detection Amps range	Motor current	5	40 (8)	40	Amps
Stall Detection timeout range	Motor current	1	65000 (9)	65000	milliseconds
Short Circuit Detection threshold (10)	Between Motor wires or Between Motor wires and Ground		85		Amps
Short Circuit Detection threshold	Between Motor wires and VMot	No Protection. Permanent damage will result			
Overvoltage Category Short			III (12)		
Circuit Current Rating	Motor current		600 (13)		A

Note 1: Negative voltage will cause a large surge current. Protection fuse needed if battery polarity inversion is possible

Note 2: Maximum regeneration voltage in normal operation. Never inject a DC voltage from a battery or other fixed source

Note 3: Minimum voltage must be present on either VMot or Power Control wire

Note 4: Factory default value. Adjustable in 0.1V increments

Note 5: Current consumption is lower when higher voltage is applied to the controller's VMot or PwrCtrl wires

Note 6: Max value is determined by current limit setting and by I2T algorithm. Duration is estimated and is dependent on ambient temperature cooling condition

Note 7: Estimate. Limited by heat sink temperature. Continuous current may be higher with better cooling

Note 8: Factory default value. Adjustable in 0.1A increments

Note 9: Factory default value. Time in ms that Stall current must be exceeded for detection

Note 10: Controller will stop until restarted in case of short circuit detection

Note 12: The product was evaluated for use in and under the provisions for installation in an Overvoltage Category III environment.

Note 13: At 25° C for 1 us

Command, I/O and Sensor Signals Specifications

TABLE 11.

Parameter	Measure point	Min	Typical	Max	Units
Main 5V Output Voltage	Ground to 5V pin on DSub15	4.7	4.9	5.1	Volts
5V Output Current	5V pin on I/O connectors			100	mA
Digital Output Voltage	Ground to Output pins			30	Volts
Digital Output Current	Output pins, sink current			1	Amps
Output On resistance	Output pin to ground		0.75	1.5	Ohm
Output Short circuit threshold	Output pin	1.05	1.4	1.75	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	3.8		30V	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
Pulse durations	Pulse inputs	20000		10	us
Pulse repeat rate	Pulse inputs	50		250	Hz
Pulse Capture Resolution	Pulse inputs		1		us
Frequency Capture	Pulse inputs	100		2000	Hz
Encoder count	Internal	-2.147		2.147	10^9 Counts
Encoder frequency	Encoder input pins			200	KHz
SSI Frequency	SSI input pins	680		10800	KHz
Note1: Encoders are disabled in factory default.					

Operating & Timing Specifications

TABLE 12.

Parameter	Measure Point	Min	Typical	Max	Units
Command Latency	Command to output change	0	0.5	1	ms
PWM Frequency	Motor outputs		16 (1)		kHz
Current Loop update rate	Internal		16000		Hz
Closed Loop update rate	Internal		1000		Hz
RS232/RS485 baud rate	Rx & Tx pins		115200 (2)		Bits/s
Command Watchdog timeout	Internal	1 (3)		65000	ms
Note 1: Frequency is fixed and cannot be changed Note 2: 115200, 8-bit, no parity, 1 stop bit, no flow control Note 3: May be disabled with value 0. Applies to commands from USB, RS232, RS485, CAN and EtherCAT					

Motor Characteristics Requirement for FOC current control

For proper FOC current control and motor operation under sinusoidal commutation, it is necessary for the motor to meet a minimum load inductance, minimum time constant (L/R) and maximum electric operating speed requirements. The minimum required inductance is necessary to ensure low Total Harmonic Distortion (THD) of the motor current. Furthermore, to achieve proper current control and stability, the controller's current loop sampling rate will determine the minimum permissible motor time constant and the maximum operating electric speed.

TABLE 13.

Parameter	Input DC Voltage (V)	Value	Units
Minimum load phase inductance (1)	24	40	uH
	48	60	uH
	60	80	uH
Minimum load inductance/resistance ratio (1)	0 - 60	0.063	msec
Maximum operating electric speed (2)	0 - 60	96000	RPM
Note 1: Star connected three phase load considered. In case the motor phase inductance does not fulfill the above requirements (minimum phase inductance and inductance/resistance ratio) an external AC inductor with proper inductance value is recommended to be added. Note 2: Maximum rotor speed is calculated from the maximum operating electric speed and pole pairs. For example, in a motor with 4 pole pairs the maximum operating rotor speed is 96000/4 = 24000 rpm			

STO Specifications

TABLE 14.

Parameter	Measure Point	Min	Typ	Max	Units
STO Input High Level	Ground to STO input pin		6	30 (1)	Volts
STO Input Low Level	Ground to STO input pin		0	1	Volts
STO Response Time	Input to output change		5		msec
STO Self Check Time	Internal		1080		msec
Cable Length	2				m
EMC Immunity	According to IEC 61800-3 and IEC 61800-5-2 Annex E				
CE Declaration	Available at www.roboteq.com				

Scripting

TABLE 15.

Parameter	Measure Point	Min	Typical	Max	Units
Scripting Flash Memory	Internal		32000		Bytes
Max Basic Language programs	Internal	1000		3000	Lines
Integer Variables	Internal			1024 4096(1)	Words (2)
Boolean Variables	Internal			8192	Symbols
Execution Speed	Internal	50 000	100 000		Lines/s
Note 1: 32-bit words					

Thermal Characteristics

Thermal and Environmental Specifications

TABLE 16.

Parameter	Measure Point	Min	Typical	Max	Units
Heatsink Temperature	External heatsink			75 (1)	°C
Thermal Protection range	PCB	0		80 (2)	°C
Power Dissipation	Case			20	Watts
Thermal Resistance	Power MOSFETs to Case			0.8	°C/W
Humidity	Case			93 (3)	%
Ambient Temperature	Ambient	-10		70	°C
Storage temperature	Ambient	-20		80	°C
Fast Fuse to install	Battery+ to VMot		50		Amps
IP Degree			IP40		
Pollution Degree				2 (4)	

Note 1: The motor drive features overtemperature protection, derating current and power when internal temperature reaches 85°C. Keep the cooling plate temperature below 75°C to maintain rated current at maximum ambient temperatures.

Note 2: Max allowed power will start degrade from the selected value.

Note 3: Non-condensing

Note 4: The product was designed to be used in a pollution 2 degree environment.

Mechanical Specifications

TABLE 17.

Parameter	Measure Point	Min	Typical	Max	Units
Weight	Board		96 (.21)		g (lbs)
Power Wire Gauge	FastOn			10	AWG
Torque	D-sub standard connector		0.4 (3.54)		Nm (in-lbs)
Torque	Terminal block		0.8 (7.10)		Nm (in-lbs)
Torque	Mounting screws (4/M2.5)		0.36 (3.2)		Nm (in-lbs)
IP rating			IP40		

Mechanical Dimensions

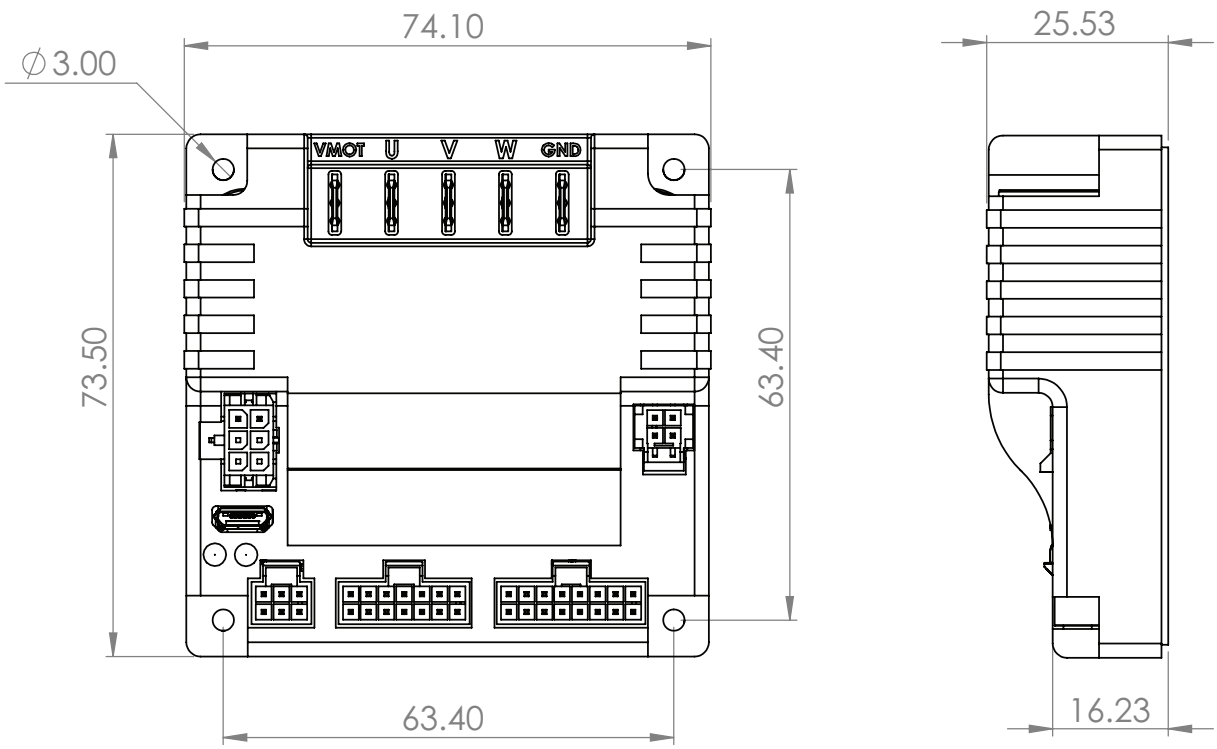


FIGURE 19. SBLMG13xx Front View and Dimensions

Conditions of Acceptability for UL recognition (CoA)

For use only in (or with) complete equipment where the acceptability of the combination is determined by UL LLC

1. Model SBLMG1360sSeries is suitable for factory wiring only. The suitability of the connections to the end use system shall be determined in the end use.
2. Series SBLMG1360 was not considered to have any accessible circuits. All circuits shall be enclosed in the end use application.
3. These models were tested with an additional heat sink, made of aluminum, dimensions 75 mm x 76.09mm x 50.8 mm, 8 cooling fins.
4. Considerations shall be given in the end-product evaluation to the conduct of a Temperature Test may be required, if another heat sink is used.
5. Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.
6. Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Canadian Electrical Code, Part I.
7. Use in a Pollution Degree 2 environment.
8. Suitable for use on a circuit capable of delivering not more than 5000 RMS symmetrical amperes, 60 DC volts maximum, when protected by 30A fuses per input line.