RoboteQ a Nidec Brand

SBLMG23xx

Fourth Generation 2 x 45A or 1 x 90A Brushless DC Motor Controller with USB and CAN

Roboteq's SBLMG2360 is a features-packed, high-current, dual or single channel controller for brushless DC motors. It is a direct replacement for the company's popular SBLM23xx, using a 4th generation processor and implementing many performance, algorithmic, and other qualitative enhancements. 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 networkse.

The SBLMG2360 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. For mobile robot applications, the controller's two motor channels can either be operated independently or mixed to move and steer a vehicle.

The controller's operation can be extensively automated and customized using Basic Language scripts. 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

- Automatic Guided Vehicles
- Small Electric Vehicles, Electric Bikes
- Terrestrial and Underwater Robotic Vehicles
- Police and Military Robots
- Hazardous Material Handling Robots
- Telepresence Systems
- Animatronics

Key Features

- USB, Serial, 0-5V Analog, or Pulse (RC radio) command modes
- One RS232 serial ports
- Optional RS485 (Special Order)
- MODBUS ASCII & RTU Support over RS232 or RS485
- CAN bus up to 1 Mbit/s. Multi-Protocol support
  - CANOpen DS402
  - RoboCAN Meshed Network
  - RawCAN Customizable to Any Protocol
- Auto switch between Serial, USB, CAN, Analog, or Pulse based on user-defined priority
- Built-in dual 3-phase high-power drivers for two brushless DC motors
- 2x45A Max, 2x20A continuous Current with I2T protection algorithm
- Output channels can be paralleled in order to drive a single motor at up to 90A
- Programmable current limit up to 45A (90A on single channel version) per motor 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 Motor Operating mode
  - 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)
- Field Oriented Control in Sinusoidal modes

- Automatic Field Weakening for maximizing motor speed and torque
- Full forward & reverse motor control. Four quadrant operation. Supports regeneration
- Operates from a single 10V-60V power source
- STO - Safe Torque Off support. (Certification Pending)
- Locking connectors for communication, IO and Feedback Signals
- Accurate speed and odometry measurement using Hall Sensor or encoder data
- Up to 8 Analog Inputs for use as command and/or feedback
- Up to 8 Pulse Length, Duty Cycle or Frequency Inputs for use as command and/or feedback
- Up to 10 Digital Inputs for use as dead-man switch, limit switch, emergency stop or user inputs
- 4 general purpose 24V, 1.5A outputs brake release or accessories
- Adjustable PWM Output for motor brakes
- Built-in Basic-like scripting 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 Motor Characterization
- Advanced performance optimization algorithms (Anti-cogging, notch filter, Decoupling control, ...)
- Support for 10 KOhm NTC temperature sensors through analog inputs (requires an external 10 KOhm pull-up resistor)
- Configurable data logging of operating parameters on
- serial outputs for telemetry or analysis
- Built-in battery voltage and temperature sensors
- Connector for external motor windings temperature sensor
- Optional 12-24V 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
- No consumption by output stage when motors stopped
- Stall detection and selectable triggered action if current is outside user-selected range
- Short circuit protection
- 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
- ABS cover. IP 40 Protection
- 123mm x 83mm x 25mm
- -40° to +85° C operating environment
- Easy configuration, tuning and monitor using provided PC utility
- Field upgradeable software for installing latest features via the Internet

Orderable Product References

Reference	Number of Channels	Amps/Channel	Volts
SBLMG2360T	2	45	60
SBLMG2360TS	1	90	60

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 Terminals Identifications and Connection

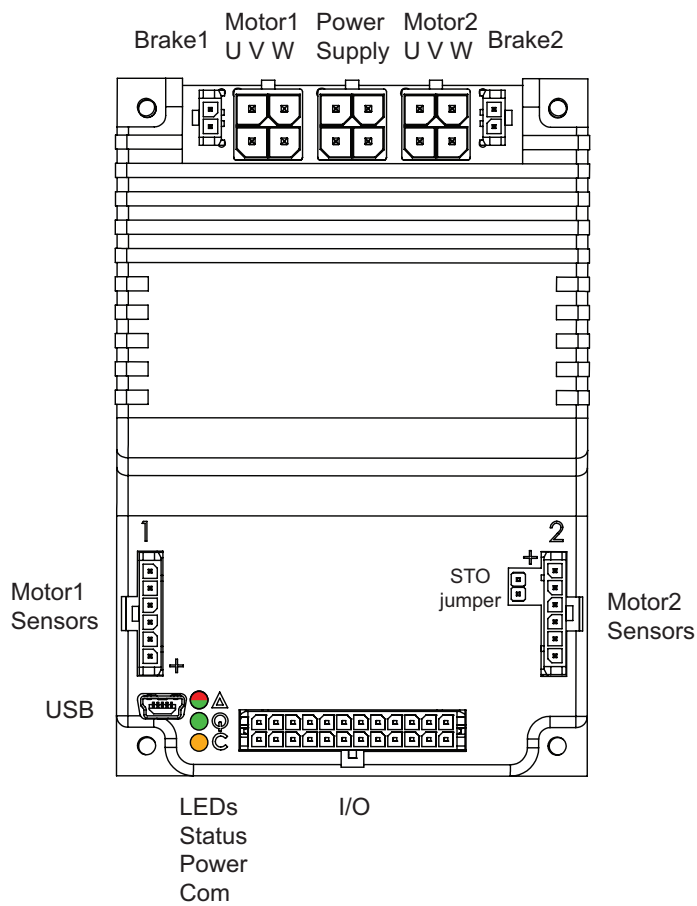


FIGURE 1. SBLMG23xx Outline

Figure 2, below, shows how to wire the controller in a dual motor configuration, and how to turn power On and Off.

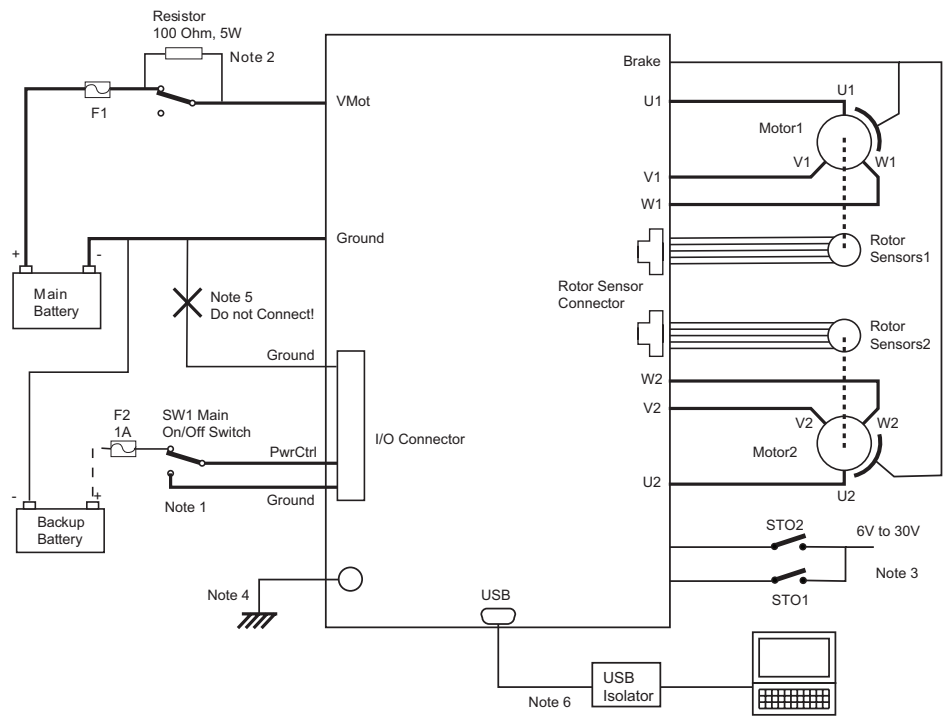


FIGURE 2. Powering the Controller. Thick lines identify MANDATORY connections

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 in 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, fuse and/r the contactor, insert a precharge resistors 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: When the STO jumper is off, STO is enabled and 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.

Connection to Chassis

Note 4: 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 5: 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 61000-6-4, Roboteq Motor Controllers are 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, connect the metallic heatsink of the controller to the battery's negative terminal.

Precautions When Connecting PC via USB

Note 6: 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.

Single Channel Wiring

On the Single Channel SBLM2360S, each of the motor wires must be connected to both output tabs labeled with the same letter, as shown in figure 3. The sensors connected to Channel One will be used for the motor's operation.

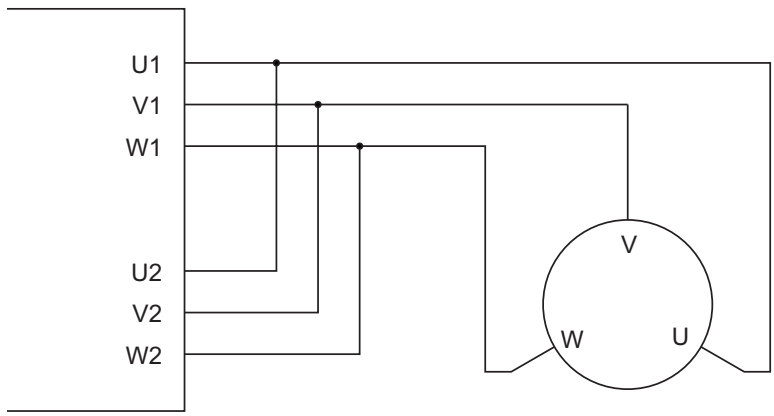


FIGURE 3. Single Channel Wiring Diagram

Caution

This wiring must be done only on the single channel version of the controller. Paralleling the wires on a dual channel product will cause permanent damage. Verify that your controller is an SBLM2360S before you wire in this manner.

Power and Motor Connections

Connection to the battery is made using two a 4-pin Molex MegaFit connectors. Use mating connector model 170001-0104. Both GND and VMOT pins are doubled in order to carry higher current.

Another 4-pin Molex MegaFit connector is provided for each motor. 3 pins supply the U, V and W phase voltages. A Ground pin can be used for an optional motor cable shield.

A 2-pin Molex MicroFit connector is provided for connecting a brake for each motor (see next section). Use mating connector model 43645-0200

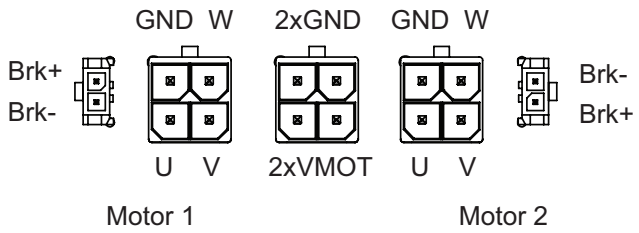


FIGURE 4. SBLMG23xx Power and Motor Connectors

Motor Brake Connection

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

Important Note

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

Note that brake outputs activations 1 and 2 are shared with digital outputs 3 and 4 on the 24-pin I/O connector.

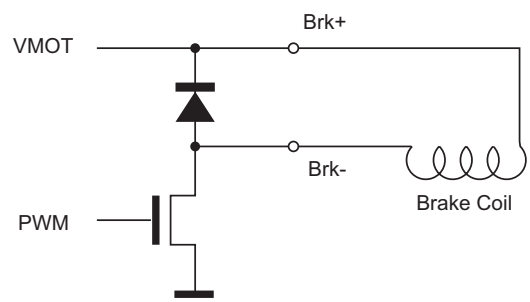


FIGURE 5. Brake drive circuit and connection

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.

Hall Sensors Connection

Connection to the Hall Sensors is done using a 6-pin Molex Microfit 3.0, ref. 43645-0600. Pin assignment is in table 1.

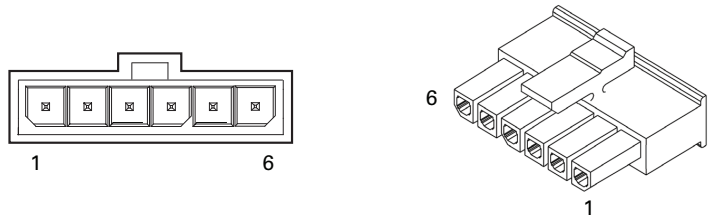


FIGURE 6. Hall Sensors Connector

TABLE 1.

Pin Number	1	2	3	4	5	6
Signal	5V		Hall C	Hall B	Hall A	Ground

Connection to SSI Absolute Encoder

Both multi-turn and single-turn SSI sensors are supported in sinusoidal mode, with a resolution of up to 48 bits. These SSI sensors must be connected to the 6-pin Molex connectors, which are also used for Hall sensors. The specific sensor connected to the Molex connectors can be determined through the controller's configuration settings. The controller employs differential signals for both clock and data. The Molex connector pin assignment for the SSI sensor is shown in Table 2.

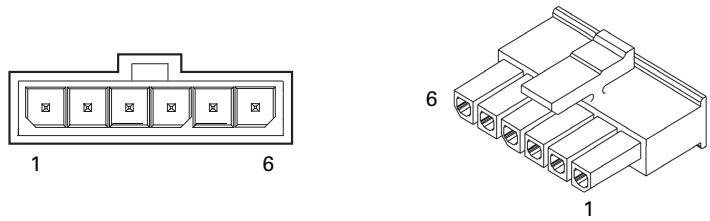


FIGURE 7. Motor sensor connector used for SSI Encoders

TABLE 2.

Pin Number	1	2	3	4	5	6
Signal	5V	Clock –	Clock +	Data –	Data +	Ground

Connection to Analog Sin/Cos Absolute Encoder

SBLMG2360T features eight high-speed analog inputs, designed to capture the absolute angular position data from magnetic sensors that have sin/cos voltage differential outputs. The signal must range from 0 to 5V, with 0 at 2.500V. The table 3 shows the signals assignment on the 6-pin Molex connector.

TABLE 3. Differential Sin/Cos signals on the SBLMG23xxx

Pin Number	1	2	3	4	5	6
Signal	5V	Cos–	Cos+	Sin–	Sin+	Ground

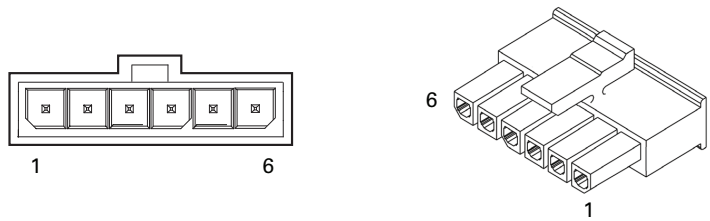


FIGURE 8. Motor sensor connector pin identification

Commands and I/O Connections

Connection to RC Radios, Microcomputers, Joysticks and other low current sensors and actuators are done via the 24-pin Molex Microfit connector. Use mating connectors models 43025-2400. The functions of many pins vary depending on controller model and user configuration. Pin assignment is found in the table below.

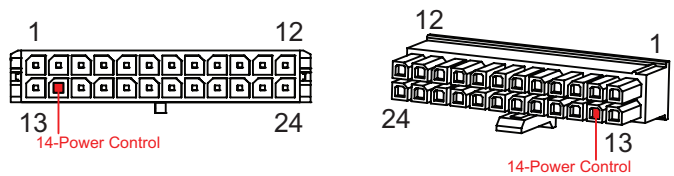


FIGURE 9. Main Connector Pin Locations

TABLE 4.

Connector Pin	Power	Dout	Com	Pulse	Ana	Dinput	Enc	STO	Hall (1)
1	GND								
13	5VOut								
2				PIN8	ANA8	DIN8	ENC1B		
14	Power Ctrl								
3									
15				PIN7	ANA7	DIN7	ENC1A		
4									
16				PIN6	ANA6	DIN6	ENC2B		Hall2C
5			CANL						
17				PIN5	ANA5	DIN5	ENC2A		Hall2B
6		DOUT4							
18			CANH						
7		DOUT2							
19		DOUT3							
8	GND								
20		DOUT1							
9				PIN3 (2)	ANA3	DIN3		STO1 (1)	Hall1C
21				PIN4 (2)	ANA4	DIN4		STO2 (1)	Hall2A
10			RS RxD						
22				PIN2	ANA2	DIN2			Hall1B
11			RS TxD						
23				PIN1	ANA1	DIN1			Hall1A
12	GND								
24	5VOut								

Note1: Hall inputs are activated in DB25 connector in firmware v2.0 or later and only if Molex input is configured as SSI Input. In that case user has to install 1K pull up resistor between each hall signal and 5VOut.

Note 1: STO jumper must be removed for STO signals to be active

Note 2: Not recommended for use as MultiPWM inputs.

Enabling Analog Commands

The Analog command mode is disabled by default. To enable this mode, use the PC utility and set "Analog" in Command Priority 2 or 3 (leave "Serial" as priority 1). Note that by default, additional safety features are enabled, preventing the motor from starting unless the potentiometer is centered, or if the voltage is below 0.25V or above 4.75V. The drawing shows suggested assignment of Pot 1 to ANA1 and Pot 2 to ANA4. Use the PC utility to enable and assign analog inputs.

Connecting Thermistors

10 KOhm NTC temperature sensors can be connected to the controller's analog inputs. This enables reading of motor temperature through the controller's runtime variables and allows for active temperature protection. This connection can be achieved by using a 10 KOhm pull-up resistor between the analog input and the controller's 5V output. For more information about motor temperature readings and controller parameterization, please refer to the Roboteq Controller's User Manual.

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.

CAN Communication

CAN is the SBLMG23xx's primary and recommended communication interface. Up to 127 drives can be networked on a 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 5. 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

Status LEDs and Flashing Patterns

The controller is equipped with 3 LEDs. A Green Power LED, a Red/Green Status LED, and a Yellow Communication LED. After the controller is powered on, the Power LED will tun on, indicating that the controller is On. The Status LED will be flashing at a two second interval. The flashing pattern and colour provides operating or exception status information.

FIGURE 10. Normal Operation Flashing Patterns

FIGURE 11. Exception or Fault Flashing Patterns

Additional information about the controller's status and fault conditions can be obtained by monitoring the controller through the PC utility. The Communication LED indicates the status of USB and CAN Bus connectivity.

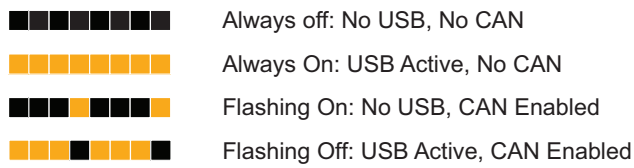


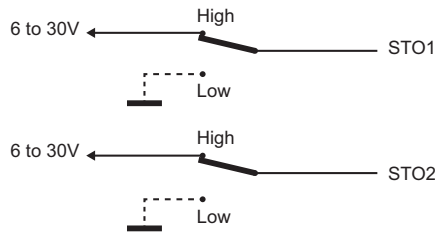
FIGURE 12. Communication LED Flashing Patterns

Safe Torque Off - STO (Certification Pending)

Safe Torque Off (STO) is a secure method for switching the controller into a state where no torque is generated, regardless of whether the controller is operating normally or is faulty. The STO functionality is achieved through redundant circuitry, incorporated into the STO1 and STO2 inputs of the controller. For the controller to operate normally, both STO inputs must be supplied with a voltage ranging from 6 to 30V. The controller performs a self-test of the STO circuitry every time it powers on, or when both STO inputs go high. If the STO circuitry is found to be functioning properly, the controller will allow the motor to be energized. In the event of an STO failure or if not both STO inputs are in a high state, the power stage will be cut off. Since STO is a hardware implementation and has been verified and validated by Roboteq, it can be trusted to bring the motor to a no-torque condition without the need for an external relay to cut power to the motor. For more information about STO functionality, refer to the STO Manual.

By factory default, the STO functionality is disabled by adding a jumper that bypasses the STO circuitry. To enable the STO feature, remove the jumper located on the front side of the controller and then enable the STO function in the controller's configurations. STO functionality is only available in the T version of the controller. The exact location of the jumper can be observed in figure 1.

Figure 13 illustrates the STO operation. To properly trigger the STO, both STO inputs must be in a high state. To properly release the STO, both STO inputs must be low. Having only one of the two STO inputs in a high state will trigger the "STO fault" alarm.



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

The STO function is compliant to:

- IEC 61800-5-2:2007, SIL 3
- IEC 61508:2010, SIL 3
- IEC 62061:2005, SIL 3
- ISO 13849-1:2015, Category 3 Performance Level e

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.

Electrical Specifications

Absolute Maximum Values

The values in Table 6 should never be exceeded, as doing so may result in permanent damage to the controller.

TABLE 6.

Parameter	Measure point	Min	Typ	Max	Units
Battery Leads Voltage	Ground to VBat			60 (2)	Volts
Reverse Voltage on Battery Leads	Ground to VBat	–1			Volts
Power Control Voltage	Ground to Pwr Control wire			30 (2)	Volts
Motor Leads Voltage	Ground to U, V, W wires			60 (2)	Volts
Digital Output Voltage	Ground to Output pins			30	Volts
Analog and Digital Inputs Voltage	Ground to any signal pin on 15-pin & Hall inputs			30	Volts
RS232 I/O pins Voltage	External voltage applied to Rx pin			30 (3)	Volts
Case Temperature	Case	–40		85	°C
Humidity	Case			100 (4)	%

Note 1: Only PELV/SELV voltages shall be used

Note 2: Can be even higher because of regeneration voltage. Never inject a DC voltage from a battery or other fixed source

Note 3: No voltage must be applied on Tx pin

Note 4: Non condensing

Power Stage Electrical Specifications (at 25°C ambient)

TABLE 7.

Parameter	Measure point	Model	Min	Typ	Max	Units
Battery Leads Voltage	Ground to VMot	All	0 (1)		60	Volts
Input Continuous current	Power source current	All			40	Amps
Output Voltage	Ground to U, V, W wires	All	0 (1)		60 (2)	Volts
Power Control Voltage	Ground to Power Control wire	All	0 (1)		65	Volts
Minimum Operating Voltage	VBat or Pwr Ctrl wires	All	10 (3)			Volts
Over Voltage protection range	Ground to VMot	All	5	60 (4)	63	Volts
Under Voltage protection range	Ground to VMot	All	0	5 (4)	63	Volts
Input Capacitance	Ground to VMot	All		2350		uF
Idle Current Consumption	VMot or Pwr Ctrl wires	All	50	100 (5)	150	mA
ON Resistance (Excluding wire resistance)	VMot to U, V or W. Ground to U, V or W	SBLMG23xx		3.3		mOhm
		SBLMG23xxS		1.65		mOhm
Max Current for 2s	Motor current	SBLMG23xx			45	Amps
		SBLMG23xxS			90	Amps
Max Current for 30s	Motor current	SBLMG23xx			30	Amps
		SBLMG23xxS			60	Amps
Continuous Max Current per channel	Motor current	SBLMG23xx			16 (6)	Amps
		SBLMG23xxS			32 (6)	Amps

TABLE 7.

Parameter	Measure point	Model	Min	Typ	Max	Units
Current Limit range	Motor current	SBLMG23xx	10	30 (7)	45	Amps
		SBLMG23xxS	20	60 (7)	90	Amps
Stall Detection Amps range	Motor current	SBLMG23xx	10	30 (7)	45	Amps
		SBLMG23xxS	20	60 (7)	90	Amps
Stall Detection timeout range	Motor current	All	1	500 (8)	65000	msec
Short Circuit Detection threshold (9)	Between Motor wires or Between Motor wires and ground or Between Motor wires and Vmot	SBLMG23xx			85 (10)	Amps
		SBLMG23xxS			190 (10)	Amps
Motor Acceleration/ Deceleration range	Motor Output	All	100	500 (11)	65000	msec
Power cable thickness	Power input and output	All		12		AWG

Note 1: Negative voltage will cause a large surge current. Protection fuse needed if battery polarity inversion is possible
Note 2: Can be even higher because of regeneration voltage. Never inject a DC voltage from a battery or other fixed source
Note 3: Minimum voltage must be present on VBat 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 VBat or PwrCtrl wires
Note 6: Estimate. Limited by case temperature. Current may be higher with better cooling
Note 7: Factory default value. Adjustable in 0.1A increments
Note 8: Factory default value. Time in ms that Stall current must be exceeded for detection
Note 9: Controller will stop until zero command given in case of short circuit detection
Note 10: Approximate value
Note 11: Factory default value. Time in ms for power to go from 0 to 100%

Command, I/O and Sensor Signals Specifications

TABLE 8.

Parameter	Measure point	Min	Typ	Max	Units
Main 5V Output Voltage	Ground to 5V pins on	4.6	4.75	4.9	Volts
5V Output Current	5V pins on Molex and DSub25			150 (1)	mA
Digital Output Voltage	Ground to Output pins			30 (2)	Volts
Output On resistance	Output pin to ground		0.25	0.5	Ohm
Output Short circuit threshold	Output pin	1.7		3.5	Amps
Digital Output Current	Output pins, sink current			1.5(2)	Amps
Input Impedances (except DIN7-8)	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		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
Pulse durations	Pulse inputs	20000		10	us
Pulse repeat rate	Pulse inputs	50		250	Hz

TABLE 8.

Parameter	Measure point	Min	Typ	Max	Units
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
Note 1: Sum of all 5VOut outputs Note 2: Outputs are Open Drain. They pull to ground when on and float when off. Load must be connected between output and positive voltage					

Operating & Timing Specifications

TABLE 9.

Parameter	Measure Point	Min	Typ	Max	Units
Command Latency	Command to output change	0	0.5	1	ms
PWM Frequency	Motor Output	10	16	25	kHz
Closed Loop update rate	Internal		1000 (1)		Hz
Current Loop update rate	Internal		16000		Hz
RS232 baud rate	Rx & Tx pins		115200 (2)		Bits/s
RS232 Watchdog timeout	Rx pin	1 (3)		65000	ms
Note 1: Applies to closed loop speed and closed loop position modes only Note 2: 15200, 8-bit, no parity, 1 stop bit, no flow control Note 3: May be disabled with value 0					

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 10.

Parameter	Input DC Voltage (V)	Value	Units
Minimum load phase inductance (1)	12	25	uH
	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			

Scripting

TABLE 11.

Parameter	Measure Point	Min	Typ	Max	Units
Scripting Flash Memory	Internal		32000		Bytes
Max Basic Language programs	Internal	1000		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 12.

Parameter	Measure Point	Min	Typ	Max	Units
Case Temperature	Case	–40		85 (1)	°C
Thermal Protection range	Case	80		90 (2)	°C
Power Dissipation	Case			10	Watts
Thermal resistance	Power MOSFETs to plate			0.6	°C/W
Humidity	Case			95	%
Ambient temperature	Ambient			55	°C
Pollution Degree	-	PD 2			
Fast fuse to install(3)(4)	SBLMG23xx	20	2 x 20		Amps
	SBLMG23xxS		2 x 20		Amps
Overload protection	-	Check Note 5			

Note 1: Thermal protection will protect the controller power

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

Note 3: There are two power terminals. Fuse should be installed in both of them for safety.

Note 4: In dual channel controller, for operating only one channel install 20A fuse and for operating both channels 2 x 20A fuse should be installed. Power source must be capable to blow the fuse instantly in case of short circuit

Note 5: Current limiting mechanism available through firmware. External overload motor protection can be used if required (provided by user)

STO Specifications (Certification Pending)

TABLE 13.

Parameter	Measure Point	Min	Typ	Max	Units
STO Input High Level	Ground to STO input pin	6		30	Volts
STO Input Low Level	Ground to STO input pin	0		1	Volts
STO Response Time	Input to output change			5	msec
STO Operating temperature		–20		55	°C
STO Storage temperature		–20		70	°C
Humidity		5		95	%
IP degree				IP30	
Operating Altitude				2000	m
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				

Mechanical Specifications

TABLE 14.

Parameter	Measure Point	Min	Typ	Max	Units
Weight	Board		215 (0.47)		g (lbs)
Power Connectors Wiring	Terminals	12		22	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)

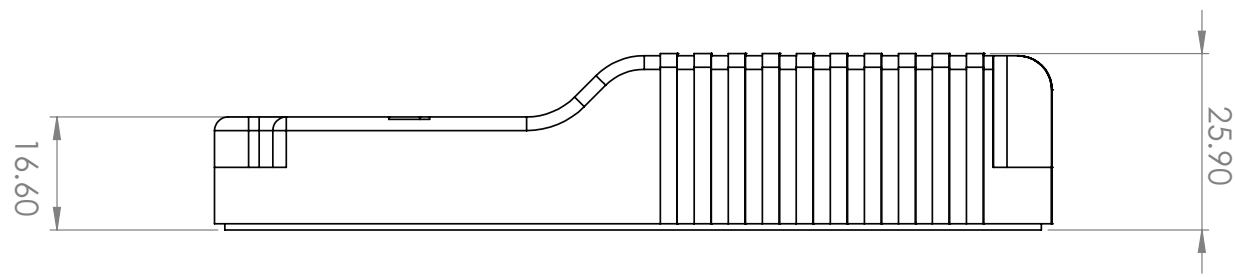


FIGURE 14. SBLMG23xx Side View and Dimensions

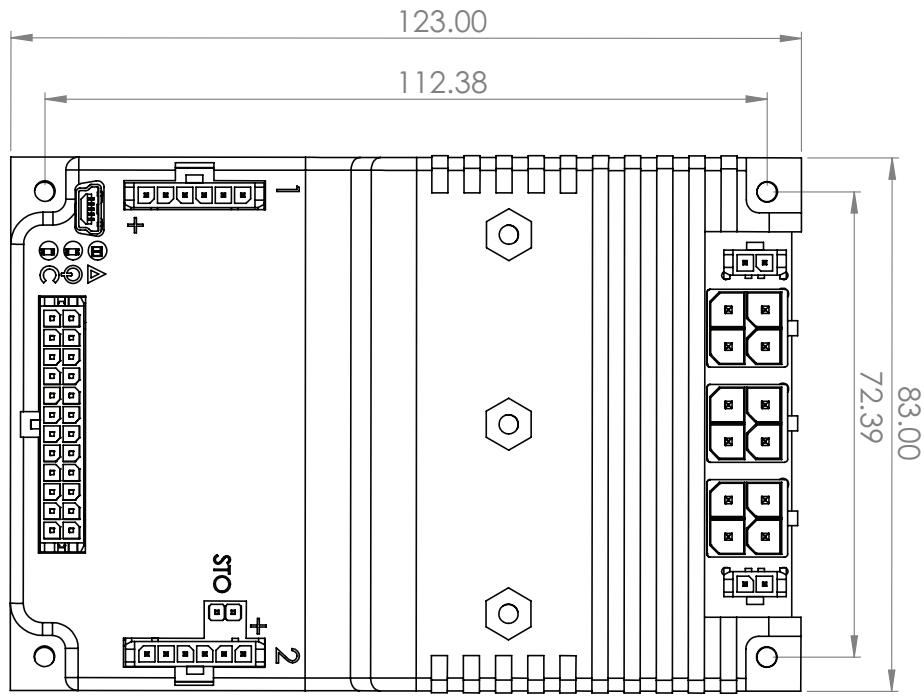


FIGURE 15. SBLMG23xx Top View and Dimensions