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 feed forward, 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
- 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 Field Weakening for maximum Speed & Torque
- Automatic Motor Characterization
- Advanced performance optimization algorithms (Anti-cogging, notch filter, ...)
- 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

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, faulty firmware, errors in user script or user program, or controller hardware failure.

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 Terminals Identifications and Connection

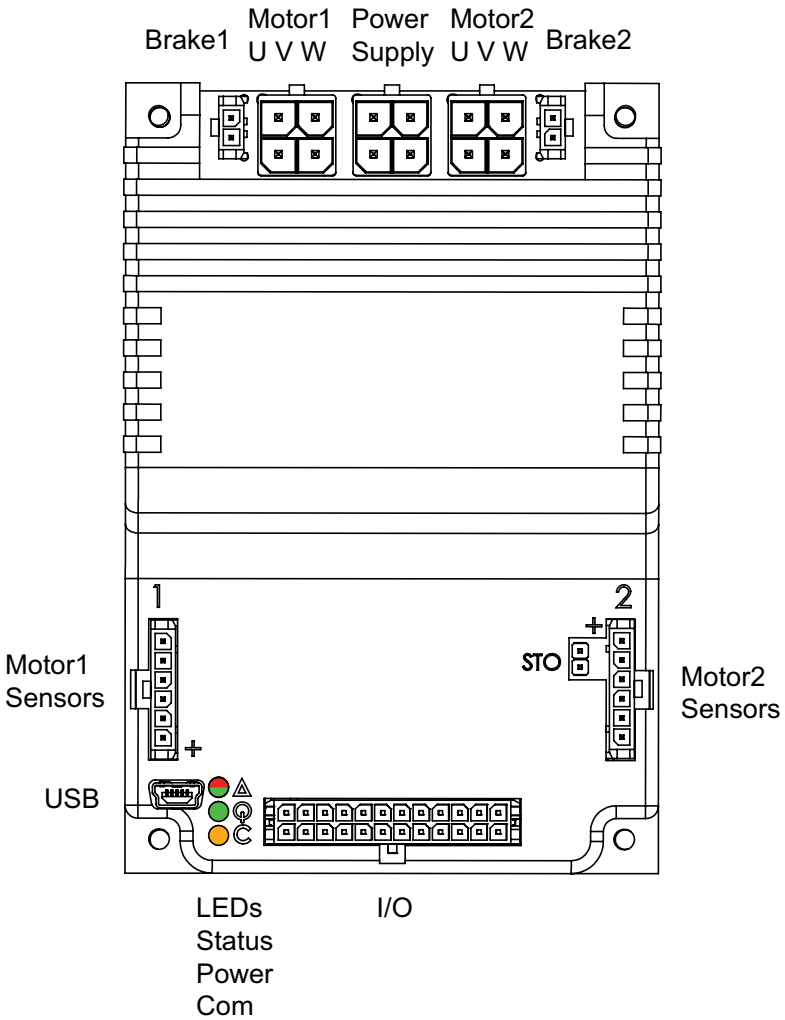


FIGURE 1. SBLMG23xx Outline

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

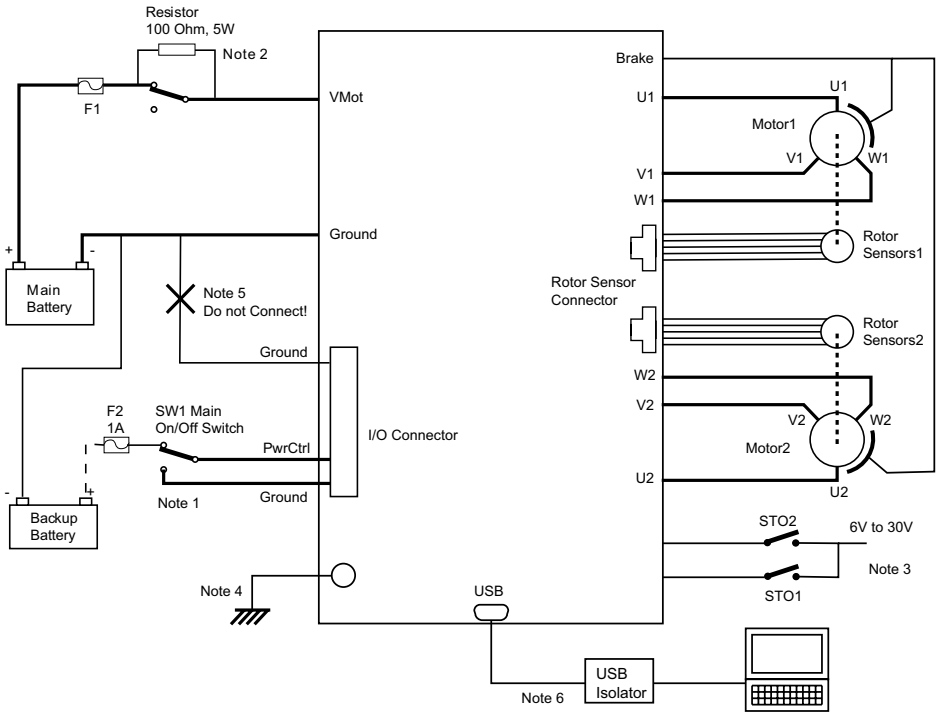


FIGURE 2. Powering the Controller. Thick lines identify MANDATORY connections

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.

Mandatory 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 line are mandatory.

Emergency Switch or Contactor

The battery must be connected in permanence to the controller's VMot tab via a high-power emergency switch or contactor SW2 as additional safety measure. The user must be able to deactivate the switch or contactor at any time, independently of the controller state. Use a suitable high-current fuse F1 as a safety measure to prevent damage to the wiring in case of major controller malfunction.

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 short duration but important 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 the figure. 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 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 in the User Manual.

Connection to Chassis

Note 4: For improved EMI immunity and reduce 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 the plate. There is, however, a capacitor between the controller's ground and the bottom plate, and therefore AC conductivity.

Avoid Alternate Ground Paths

Note 5: Beware not to create a path from the ground pins on the I/O connector and the battery minus terminal. It is highly recommended to avoid this connection as current could circulate in the signals ground, which could create noise on the low power signals. If the main ground power terminal is loose or disconnected, very high current may circulate in the signals ground wire and damage it.

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, you may connect the metallic heatsink of the controller to your battery negative terminal.

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.

Single Channel Wiring

On the Single Channel SBLM2360S, the each of the motor wire must be connected to both output terminal of the same letter as shown in the figure below. Use the Encoders and/or Hall sensors of Channel 1 for operation.

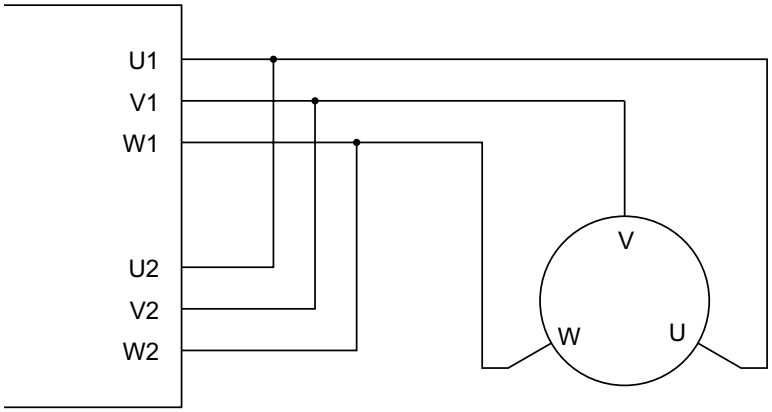


FIGURE 3. Single Channel Wiring Diagram

Important Warning

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

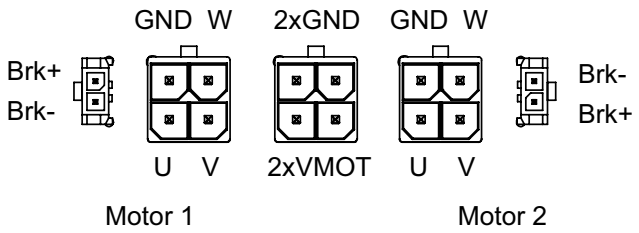


FIGURE 4. SBLMG23xx Power and Motor Connectors

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 Warning

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.

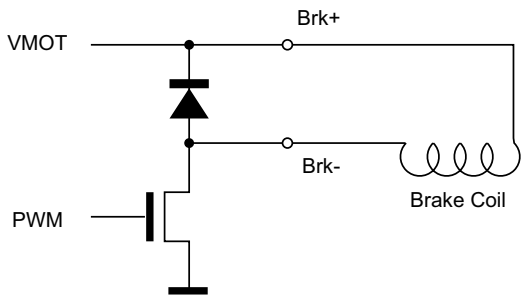


FIGURE 5. Brake drive circuit and connection

Controller Mounting

During motor operation, the controller will generate heat that must be evacuated. The published amps rating can only be fully achieved if adequate cooling is provided. Good conduction cooling can be achieved by having the bottom surface of the case making direct contact with a metallic surface (chassis, cabinet). The mounting has to be like that, so that the thermal-safety limits are not exceeded.

Hall Sensors Connection

Connection to the Hall Sensors is done using a special connector on the front side of the controller. The Hall sensor connector is a 6-pin Molex Microfit 3.0, ref. 43645-0600. Pin assignment is in the table below.

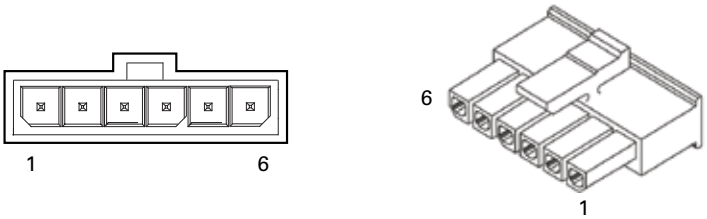


FIGURE 6. Hall Sensors Connector

TABLE 1.

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

Hall Sensor vs Motor Output sequencing

The controller requires the Hall sensors inside the motor to be 120 degrees apart. The controller's 3-phase bridge will activate each of the motor winding according to the sequence shown in the figure below..

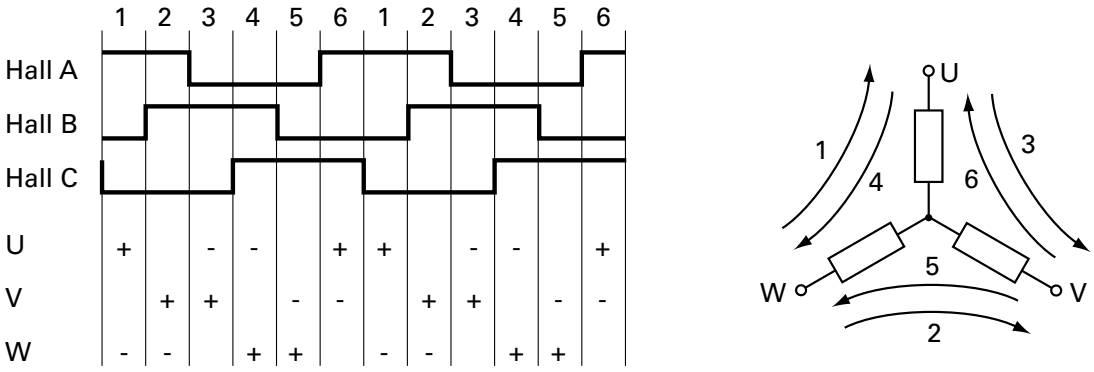


FIGURE 7. Hall Sensors Sequence

Connection to SSI Absolute Encoder

In Sinusoidal Mode, the controller can use motors equipped with absolute angle sensors with SSI interface. When enabled, the SSI signals are found on the 6-pin Molex connectors that is otherwise used for the Hall Sensors. The controller issues a differential clock signal and expects a up to 16-bit differential data signal from the encoder. When two motors are used, these signals must be connected to both sensors. Serial data from each sensor is captured on separate input pins.

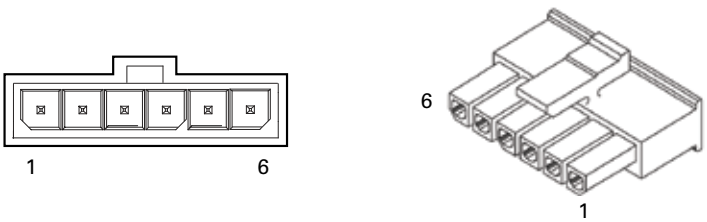


FIGURE 8. Motor sensor connector used for SSI Encoders

TABLE 2.

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

Connection to Analog Sin/Cos Absolute Encoder

The SBLM2360 has 4 high-speed analog inputs that can be used to capture absolute angle position from resolvers or magnetic sensors with sin/cos voltage outputs. The signal must be 0-5V max with the 0 at 2.500V. The sensor can be single ended or differential.

TABLE 3. Differential Sin/Cos signals on the SBLMG23xxx

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

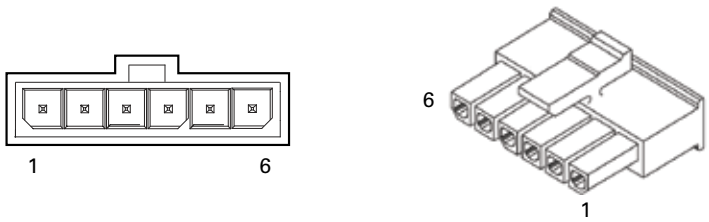


FIGURE 9. Motor sensor connector pin identification

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 44914-24010 or 44914-24000. The functions of many pins vary depending on controller model and user configuration. Pin assignment is found in the table below.

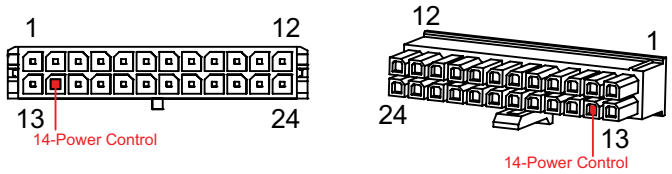


FIGURE 10. Main Connector Pin Locations

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

For safety reasons, the Analog command mode is disabled by default. To enable the Analog mode, use the PC utility and set Analog in Command Priority 2 or 3 (leave Serial as priority 1). Note that by default the additional securities are enabled and will prevent 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.

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.

Important Warning

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.

CAN Communication

CAN is the SBLMG23xx'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 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 11. Normal Operation Flashing Patterns

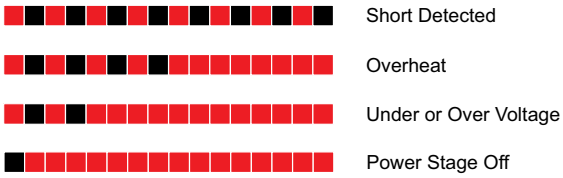


FIGURE 12. Exception or Fault Flashing Patterns

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

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

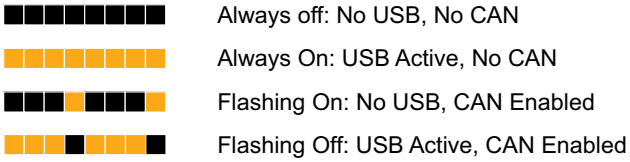


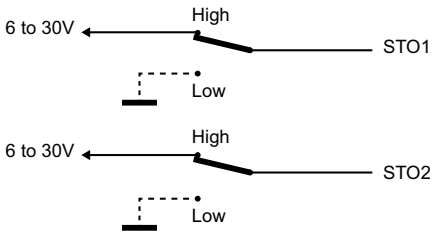
FIGURE 13. Communication LED Flashing Patterns

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, 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 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.

By factory default STO functionality is disabled. It must be enabled by removing the jumper located on the

controller's PCB. STO functionality is only available in the T version of the controller.



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

FIGURE 14. 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

Important Warning

Activating STO does lead to no more torque generation on the motor. The motor will not be actively stopped but run out. In case of a multiple fault in the power stage a rotation might occur.

Electrical Specifications

Absolute Maximum Values

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

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 25ºC ambient)

TABLE 6.

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			20 (6)	Amps
		SBLMG23xxS			40 (6)	Amps
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

TABLE 7.

Parameter	Measure point	Model	Min	Typ	Max	Units
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 7.

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
Pulse Capture Resolution	Pulse inputs		1		us

TABLE 7.

Parameter	Measure point	Min	Typ	Max	Units
Frequency Capture	Pulse inputs	100		2000	Hz
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 8.

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 load L/R and maximum electric operating speed requirements. The minimum required inductance is necessary in order to ensure low Total Harmonic Distortion (THD) of the motor current. Furthermore, to achieve proper current response and stability, the controller's current loop sampling rate will limit the minimum permissible motor time constant τ=L/R and the maximum operating electric speed.

TABLE 9.

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 - 120	0.063	msec
Maximum operating electric speed (2)	0 - 120	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 10.

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 11.

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 12.

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	ºC
STO Storage temperature		–20		70	ºC
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 13.

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

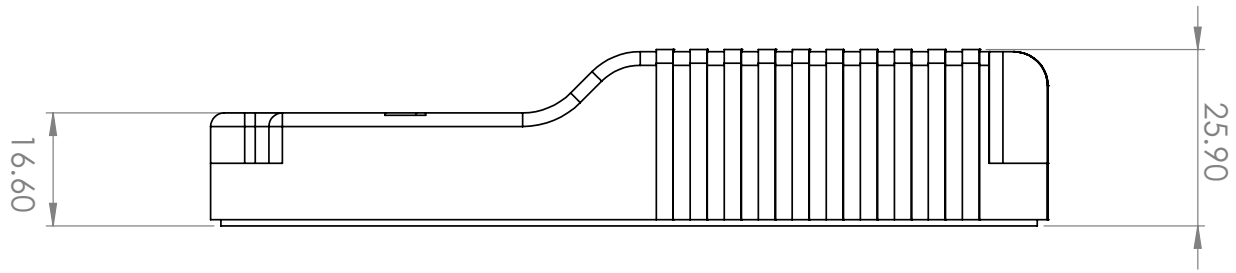


FIGURE 15. SBLMG23xx Side View and Dimensions

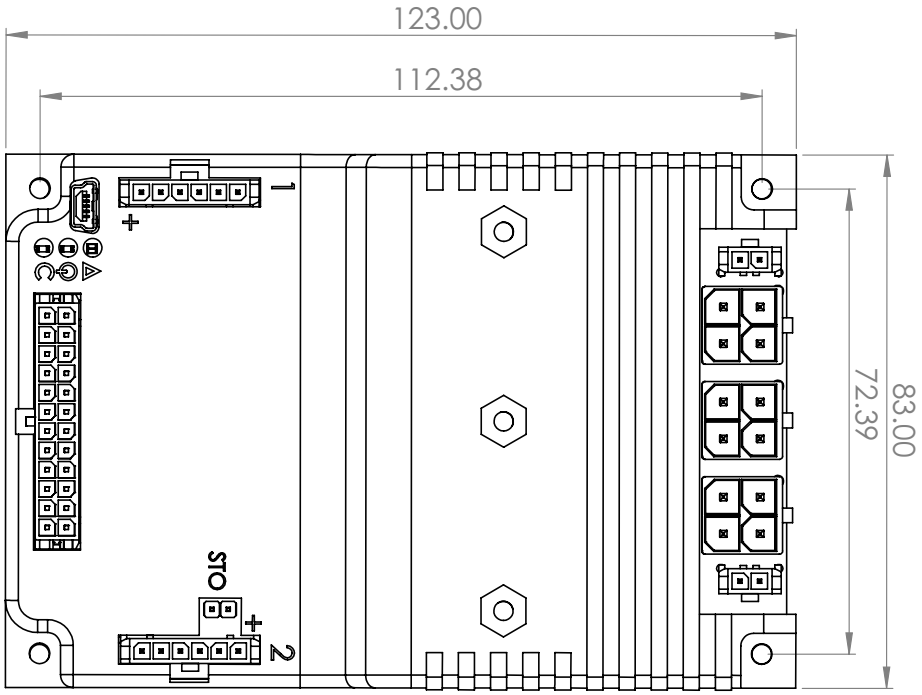


FIGURE 16. SBLMG23xx Top View and Dimensions

Revision history

Revision	Date	Additions/Changes
1.0	August 10, 2022	First Release