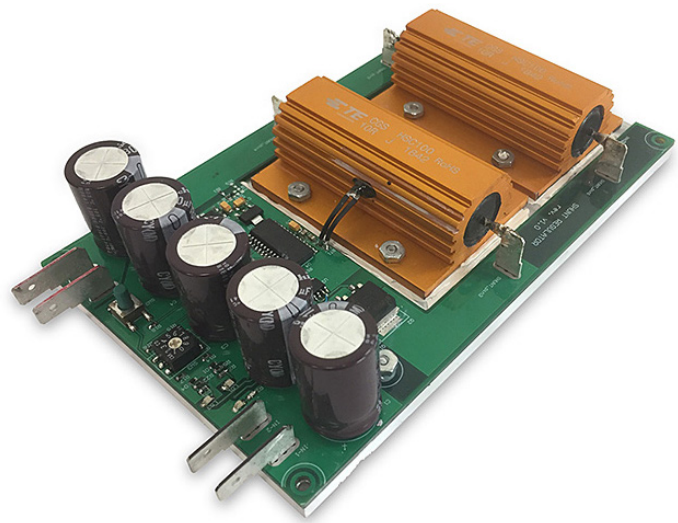
Smart 2000W Shunt Regulator



Overview

The SR2K60V25R Shunt Regulator is designed to work in conjunction with a wide variety of power sources and motor drives. Overvoltage shunting may be required when a four quadrant drive is used to decelerate an electric motor, as this can lead to power regeneration and therefore an increase in DC bus voltage. This increased voltage can be harmful to the power supply and associated electronics. The Roboteq Shunt Regulator solves this issue by applying a heavy two-level resistive load during overvoltage conditions, bringing voltages back to safe levels. The voltage threshold at which the resistors will be connected can be set by the user using the device's rotary switch. An auto option is also available, where the regulator automatically determines the threshold level. The device is self-protected by monitoring the resistor's temperature and calculating the I2T current, ensuring that it safely ceases operation to prevent permanent damage.

Applications

- Automatic Guided Vehicles
- Small Electric Vehicles, Electric Bikes
- Police and Military Robots
- Hazardous Material Handling Robots
- Automated Delivery Robots
- Motorized Factory Machinery

Standard Features

- Dissipates Excess EMF and Regeneration voltage to prevent system failure or damage.
- Simple on-the-fly adjustment of six preset shunt voltages.
- Full Auto shunt threshold set for a full range of voltages from 12 to 60 volts.
- The overheating protection can activate and protect the device repeatedly without needing to replace an inline fuse or circuit breaker.
- Fast easy connection to unit using Fast-On type connectors and standard crimp style lugs.
- Solid 6061 aluminum base plate for easy mounting and superb heatsinking.
- 2000 Watt instantaneous, 110 Watts continuous load capability.
- Flashing Status LED to indicate the operational mode including Scan, Relay ON, and Resistor Cooling modes.
- Active relay switching indication LEDs during shunting operation.
- Compact, Low Cost with Simple Operation.

Ordering Information

Reference	Channels	Watts	Volts	Presets	Max Load R
SR2K60V25R	1	110	60	7	2.5 Ohm

Operation

The Shunt Regulator is connected across the DC power source where all other operating electronics are connected. It continuously monitors the DC bus voltage and connects the resistors to the DC bus when the voltage exceeds the configured threshold. It then disconnects the resistors once the voltage level drops below the threshold. A hysteresis is introduced to the threshold for stability. The resistors are switched alternately when the overvoltage is less than 2 V, which is equivalent to having one resistor permanently connected. Once the overvoltage exceeds 2 V, both resistors are permanently connected to the DC bus.

The device continuously measures the resistor temperature and disables the resistors once the temperature exceeds the overtemperature limit. Additionally, it continuously monitors the resistor's current and calculates the dissipated energy using an I2T algorithm. The resistors will be disabled once the accumulated current exceeds the I2T limit.

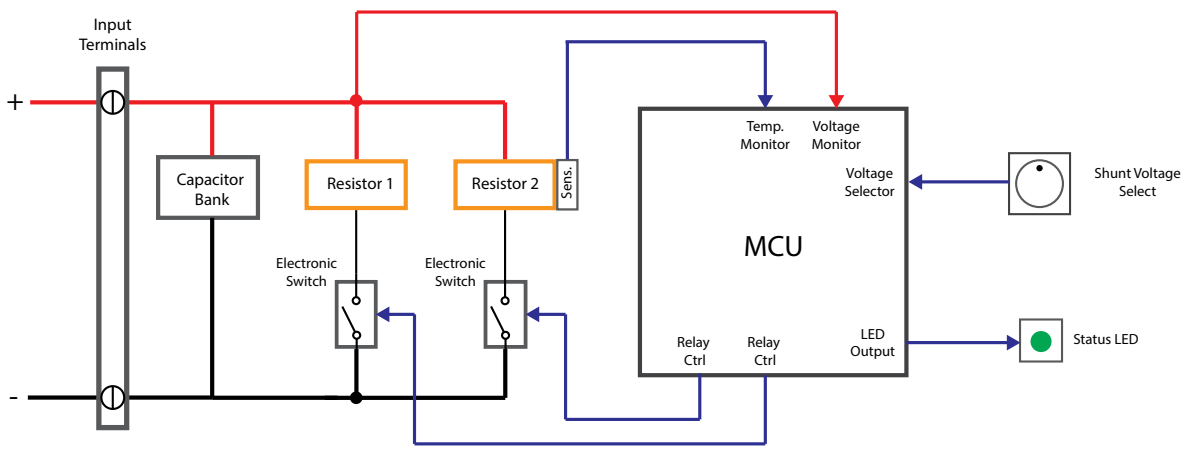


FIGURE 1. Block Diagram of Shunt Regulator Assembly

The graph of figure 2 illustrates the deceleration of vehicle speed and the corresponding increase in bus voltage during deceleration. The shunt regulator is configured to clip the bus voltage at 60 V.

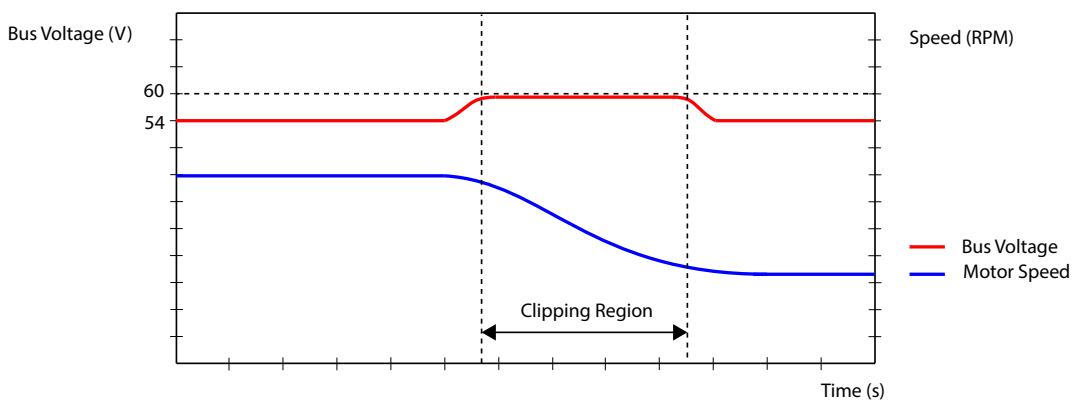


FIGURE 2. Bus voltage vs speed

Electrical connections

The connection to the shunt regulator is illustrated in figure 2. Please note that if the auxiliary power connectors are used, the motor drive's current will constantly flow through the fast-on connectors. Use the connection illustrated in Figure 3 only if you can guarantee that the application's continuous current remains below 40 A, which is the maximum rating for the fast-on connectors.

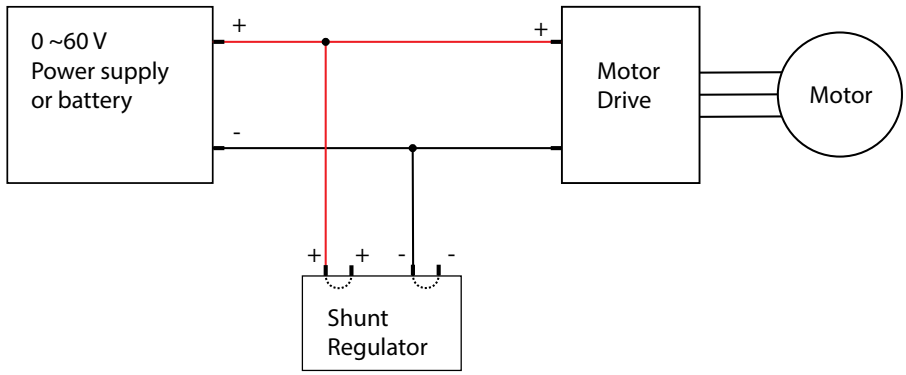


FIGURE 3. General Connection Diagram

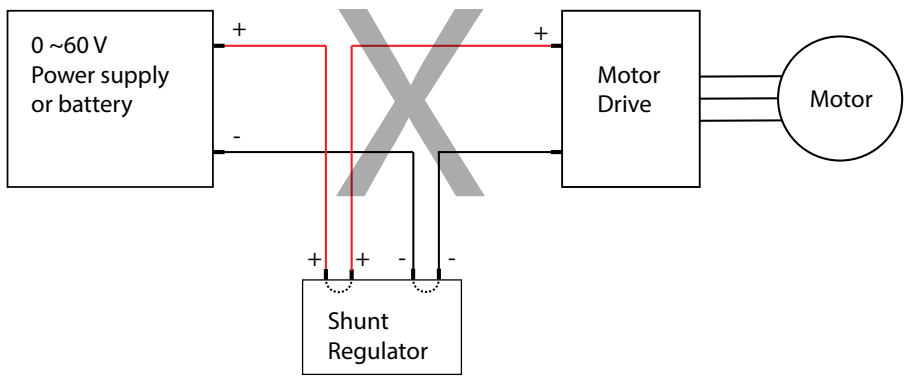


FIGURE 4. Recommended Connection Diagram (When Current < 40 A)

Compatibility with other Roboteq products

The SR2K60V25R Shunt Regulator module is fully compatible with all Roboteq motor controllers which include both brushed and brushless types.

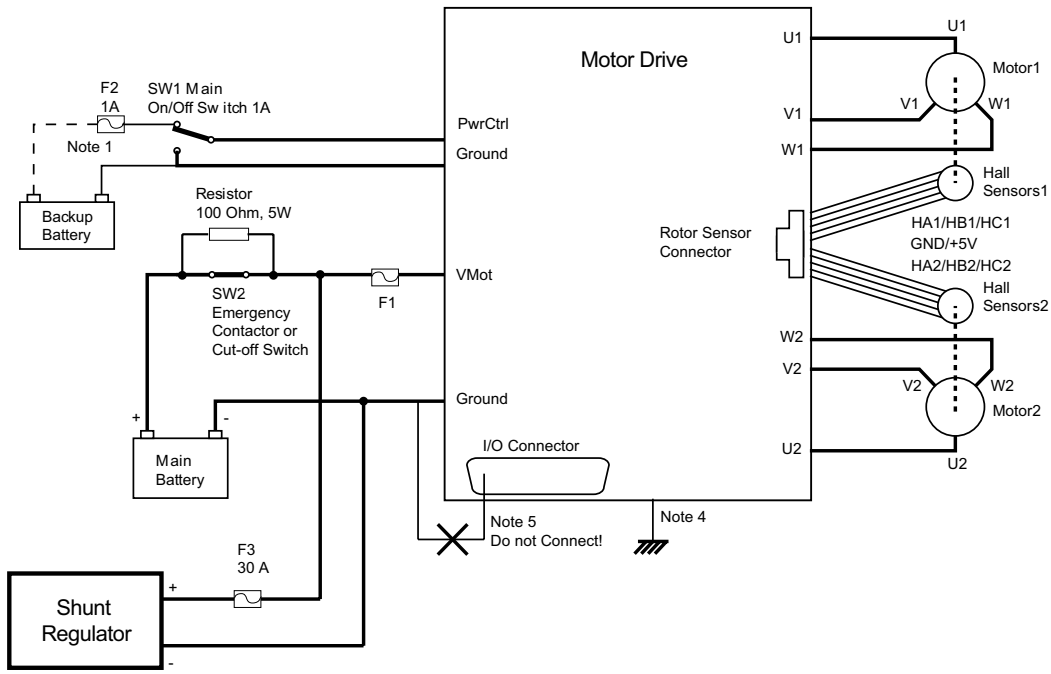


FIGURE 5. Typical wiring with Roboteq controller

Configuration

Voltage selection is accomplished by setting a rotary PCB mounted switch.

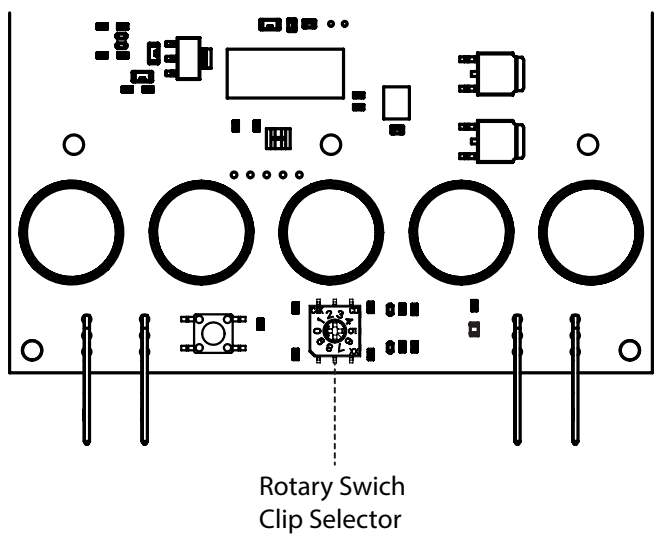


FIGURE 6. Location of Rotary switch

The following shunting voltages are preset:

TABLE 1. Rotary Switch Configuration

Switch	Clip Voltage
0	AUTO
1	20V
2	25V
3	30V
4	35V
5	40V
6	60V
7	-
8	-
9	-

The *preset voltages* for shunting can be set at any time during operation. The selection of a proper shunt clip voltage above the power supply voltage is crucial for proper operation. Standard shunting voltages from 20 volts to 60 volts maximum are available on the switch.

Auto Mode is active when switch position "0" is selected. The processor reads the power line voltage around 3 seconds upon power up and sets a fixed preset threshold (about 5v) above that value. This configuration allows for intermediate values to be obtained for shunting. The auto voltage threshold can be reprogrammed at any time by pressing the shunt regulator's built-in button.

Caution

In auto mode, the voltage shunting threshold is determined 3 seconds after the device powers on. The threshold will be set at the measured battery voltage plus 5V, regardless of subsequent changes in the battery voltage level. Ensure that the battery voltage stabilizes within 3 seconds after power on when using pre-charge.

Caution

Be aware that if the device is in auto mode and is charging, resistors may connect to the system as the voltage increases. Despite the built-in I2T protection temporarily disconnecting the resistors, repeated cycling can lead to their damage. To prevent this, always switch to appropriate manual rotary switch position, to ensure Shunt Regulator does not activate during battery charging.

Caution

Rotary switch positions marked with '-' are not supported and should not be used. Setting the switch to these positions will cause the system to act unpredictably.

LEDs and Fault Handling

The status of the SBS is reported through the status LED which is illustrated in figure 7.

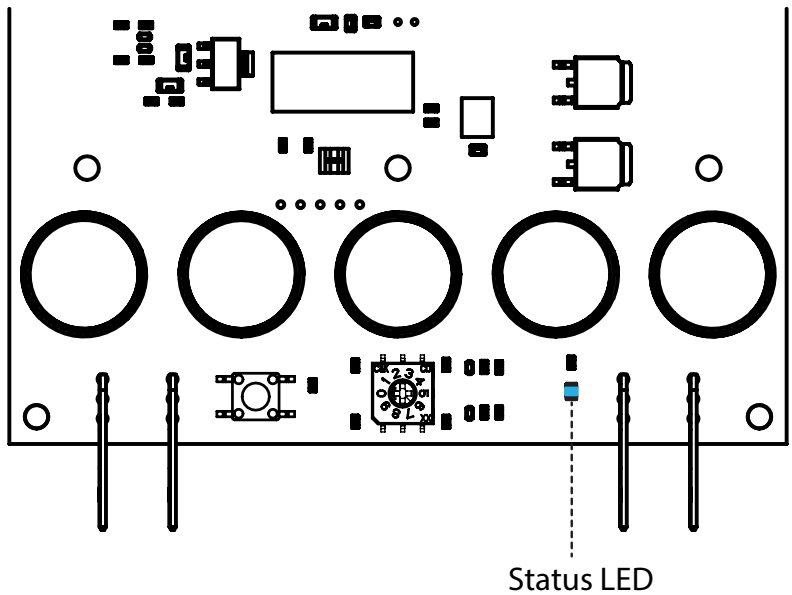


FIGURE 7. Location of Indicator LED

Overtemperature protection will be triggered when the resistor's temperature exceeds 80 degrees. The system will then enter cooldown mode until the resistor's temperature drops below 60 degrees. Additionally, the device uses an I2T protection algorithm and continuously measures the resistor's current. The system will enter cooldown mode once the dissipated energy exceeds the limits of the resistor. It will return to normal operation once the measured current integrators decrease. In cooldown mode, the respective LED pattern will flash, and the resistors will be cut off.

LED Indicator Summary

The Status LED operation is described in the following table:

TABLE 2. Operation and LED patterns

Operating State	Status LED
Normal	1 short blink over 500 ms
OV: Resistors switching alternatively or permanently connected	Off
I2T protection Triggered	On
Overtemperature	2 sequential fast blinks

Product Specifications

Electrical Specifications

TABLE 3. Electrical Specifications

Parameter	Value	Unit
Voltage Operating range	12 - 60	V
Absolute maximum voltage	75	V
Current Consumption at 50vdc	40	mA
Current Consumption at 25vdc	20	mA
Filter Capacitance	1650	uF
Peak Power Dissipation	2000 (1)	W
Peak Power Dissipation Time	7.7	s
Maximum Continuous Power Dissipation	110 (1)	W
Total Load Resistance	2.5	Ohm
SCAN mode Sampling rate	10	ms
DC voltage stabilize time	3 (2)	s
Auto mode Threshold Voltage (3)	Vdc + 5	V
Required Heatsink Thermal Resistance	0.22	C/W
Note 1: Both the Peak and Nominal Power values are contingent on the use of the specified heatsink as documented. Note 2: Time after power-on when the shunt regulator will read the DC bus voltage in auto mode. By this time, the bus voltage should have stabilized. Note 3: The threshold voltage that the resistors will be connected in auto mode.		

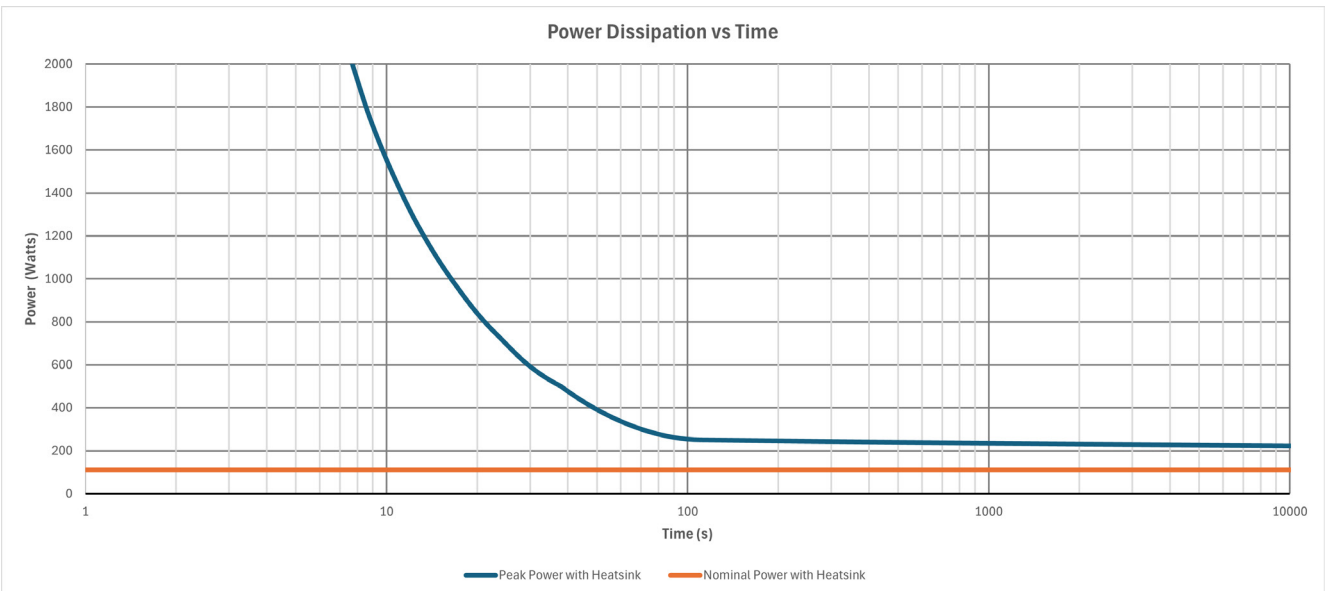


FIGURE 8. Overload vs. Duration for the Shunt Regulator Loading Profile

TABLE 4. Heat Disipation vs Time

Peak Power with Extra Heatsink (W)	Time (s)
250	110.8
500	37.9
750	22.9
1000	16.4
1250	12.7
1500	10.4
1750	8.8
2000	7.7

Caution

All documented ratings have been measured and are guaranteed with the heatsink whose specifications are listed in the Specifications table. The device will not be capable of achieving the reported specifications without an additional heatsink and can be damaged if a proper heatsink is not used.

Table 5 provides the power dissipation for different clip voltages with single and dual loads.

TABLE 5. Max Amperage at various clip level settings

Case 1: Single 5 ohm primary loading

Clip Voltage	Amperage	Watts
20	4	80
30	6	180
40	8	320
50	10	500
60	12	720

Case 2: Dual Load 2.5 ohm loading

Clip Voltage	Amperage	Watts
20	8	160
30	12	360
40	16	640
50	20	1000
60	24	1440

Mechanical Specifications

Size (H x W x D)	35mm x 100mm x 159mm
Weight	0.54 kg

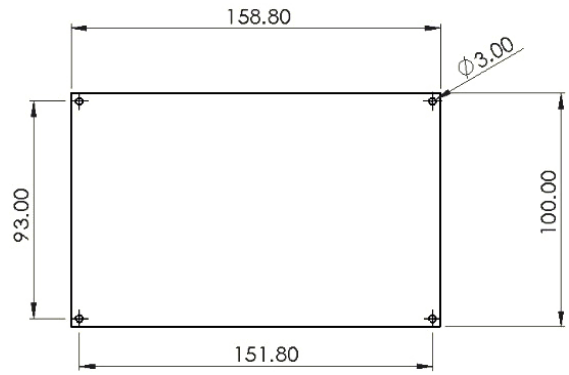


FIGURE 9. Mounting Plate Hole Location