

The SPARK Motor Controller is 12V 60A PWM-controlled brushed DC motor controller designed for *FIRST@* Robotics Competition robots.

This Quick Start Guide gives a brief overview of the SPARK features and the necessary information to get it up and running. More detailed information about each feature can be found in the SPARK User's Manual at www.revrobotics.com/spark.

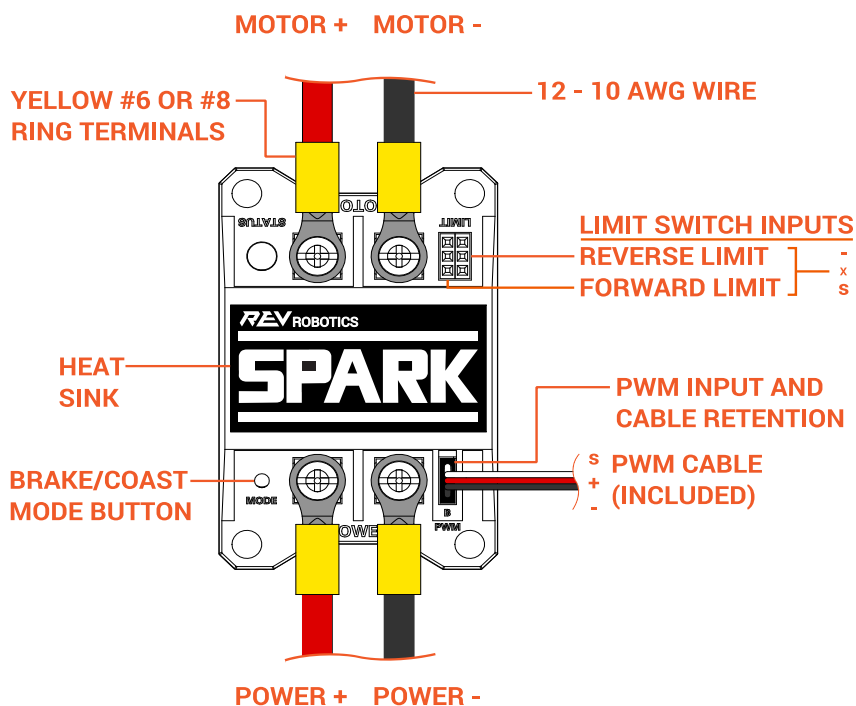
POWER AND MOTOR CONNECTIONS

The SPARK has four M3 sized screw terminals; two each for power and motor connections. Using an appropriate wire gauge for the expected current draw, tightly crimp either a ring or fork terminal on the wire. Insert the crimped terminal into the screw terminal and tighten the screw. The table below lists the recommended crimp terminal sizes and styles.

Connect a 12 V brushed DC motor to the SPARK motor terminals M+ and M-. It is recommended to maintain a consistent polarity convention for all motors so that the same PWM signal will turn all motors in the same direction.

Connect a 12 V power source, such as a 12 V battery with an appropriate circuit breaker, to the power input terminals V+ and V-.

SPARK Features and Connection Diagram



Compatible Wire Terminal Sizes		
Terminal Screw/Stud Size	Ring	Fork
#6	Compatible	Compatible
#8	Compatible	Not Recommended
M3	Compatible	Compatible

CAUTION

DO NOT reverse polarity on the power input connections. The SPARK does not contain reverse polarity protection. This can permanently damage the SPARK and will void the warranty.

CAUTION

DO NOT swap the motor and power connections. This can result in uncontrolled motor operation and can permanently damage the SPARK, voiding the warranty.

SERVO-PWM INPUT

The SPARK accepts a standard servo/PWM input signal through a standard 3-wire servo/PWM cable. Please refer to the connection diagram or the SPARK housing for polarity indicators. Align the ground/negative wire with the B marking on the case. This wire is usually black, but may be brown in some cases. The signal wire should be closest to the SPARK logo on the heat sink. This wire is usually white but may also be yellow or orange.

Motor speed is controlled by sending the SPARK a standard servo-style PWM signal. By default, the SPARK responds to a standard 1000 μ s to 2000 μ s pulse corresponding to full reverse and full forward rotation with 1500 μ s as the neutral position (no rotation). The pulses are proportionally related to the motor output's duty cycle, therefore variable speed can be achieved with pulses in between the extremes. The spark can be calibrated to respond to a different pulse range (see CALIBRATION section). The following table describes the pulse ranges in more detail.

	Pulse Width (μ s)				
	Full Reverse	Prop. Reverse	Neutral	Prop. Forward	Full Forward
Factory Default Range	$p \leq 1000$	$1000 < p < 1440$	$1440 \leq p \leq 1440$	$1500 < p < 2000$	$2000 \leq p$
Max Range	$500 \leq p \leq 2500$				
	Min		Nominal		Max
Frequency (Hz)	16		50		200

HEAT DISSIPATION

At the center of the SPARK is an aluminum heat sink. This heat sink draws heat away from the high-power components of the SPARK. For most applications, a cooling fan isn't necessary. Airflow should be kept in mind when using the SPARK in high-load applications.

CAUTION

Under heavy loading conditions and prolonged periods of high current the SPARK heat sink may become hot. Use caution when handling a SPARK that has been used under heavy loading conditions.

LIMIT SWITCH INPUTS

The SPARK has two limit switch inputs that, when triggered, can independently prevent motion in both the forward and reverse directions.

When the signal (s) pin is shorted to the ground (-) pin, the SPARK will override an input command for the respective direction and force the SPARK to its neutral state. The Status LED will turn white and pulse the corresponding direction color when either of the two limits are triggered and overriding the input command (see LED STATUS CODES section).

For example, if the Forward Limit Switch is triggered, a forward command from the PWM input is overridden and the output is forced into its neutral state. However, reverse commands are still accepted and sent to the output.

The SPARK has two 3-pin connectors that can accept standard 3-wire sensor cables. The center pin is not used for the limit switch inputs. Please refer to the SPARK Features and Connection Diagram for the locations of the Forward and Reverse connectors as well as the pinout. It is recommended to use a limit switch that is Normally Open (NO). When it is pressed, the switch closes and shorts the signal (s) and ground (-) pins.

MODE BUTTON

The Mode Button is located near the power input terminals and is labeled as MODE on the SPARK housing. It is used to switch between Brake and Coast mode, to start calibration, and to reset to factory defaults.

Use a straightened paper clip or other small implement to press the Mode Button.

BRAKE/COAST MODE

When not driving the motor, the SPARK will short the motor terminals to dissipate electrical energy, effectively braking the motor. Alternatively, the SPARK can be put in a Coast Mode which allows the motor to spin down at its own rate.

Press and release the Mode Button to toggle between brake and coast mode. When in Brake Mode (default), the Status LED will display a solid or blinking blue color. When in Coast Mode, the Status LED will display a solid or blinking yellow color.

This mode is saved in memory and persists through a power cycle.

CALIBRATION

The default input pulse width times should be compatible with most controllers. However, if a different mapping is desired, the SPARK can be calibrated as follows:

The SPARK must be receiving a signal to begin calibration. It is recommended that the motor be disconnected while calibrating to prevent unwanted movement.

1. Press and hold the Mode Button for 3 seconds. The Status LED will start to blink white.
2. Sweep the input signal through the entire desired range.
3. Return the signal to the desired neutral value.
4. Release the Mode Button.

If the calibration routine was successful, the status LED will blink white and green for several seconds while the SPARK immediately begins responding to the new signal range.

If the calibration routine was unsuccessful, the Status LED will blink white and red and the previous values are restored. Check that the signal didn't violate the timing constraints and/or the neutral value wasn't too close to the full forward or full reverse values.

Calibration values are saved to memory and persist through a power cycle.

FACTORY RESET

The SPARK can be reset to its factory default settings by the following procedure:

1. Disconnect power to the SPARK
2. Press and hold the Mode Button
3. Reconnect power while still holding the button
4. The Status LED will illuminate white
5. Release the button
6. The Status LED will blink white and green indicating that the factory defaults have been restored.

LED STATUS CODES

		LED Status Code	
Time Scale		1 second	1 second
State		Normal Operation	
No Signal	Brake		
	Coast		
Full Forward			
Proportional Forward			
Neutral	Brake		
	Coast		
Proportional Reverse			
Full Reverse			
Forward Limit Tripped			
Reverse Limit Tripped			
		Calibration	
Calibration Mode			
Successful Calibration			
Failed Calibration			
		Factory Reset	
		Mode button held during power up	Mode button released
Reset to Factory Defaults			