Spike is an H-Bridge relay module custom designed for Robotics applications. The most common use of Spike is to drive small motors in Forward, Reverse or Off. Spike can also be used to turn ON or OFF solenoids and lights. Spike takes input power from a 12V battery (labeled 12V, GND) and provides two outputs (labeled M+, M-). M+ and M- are typically connected to a motor. The unit is controlled via a three-wire interface, which connects to the Innovation First Robot Controller. Spike has a 20A integrated fuse to help protect the unit and it has an indicator to show status.

WARNING. BEFORE APPLYING POWER:
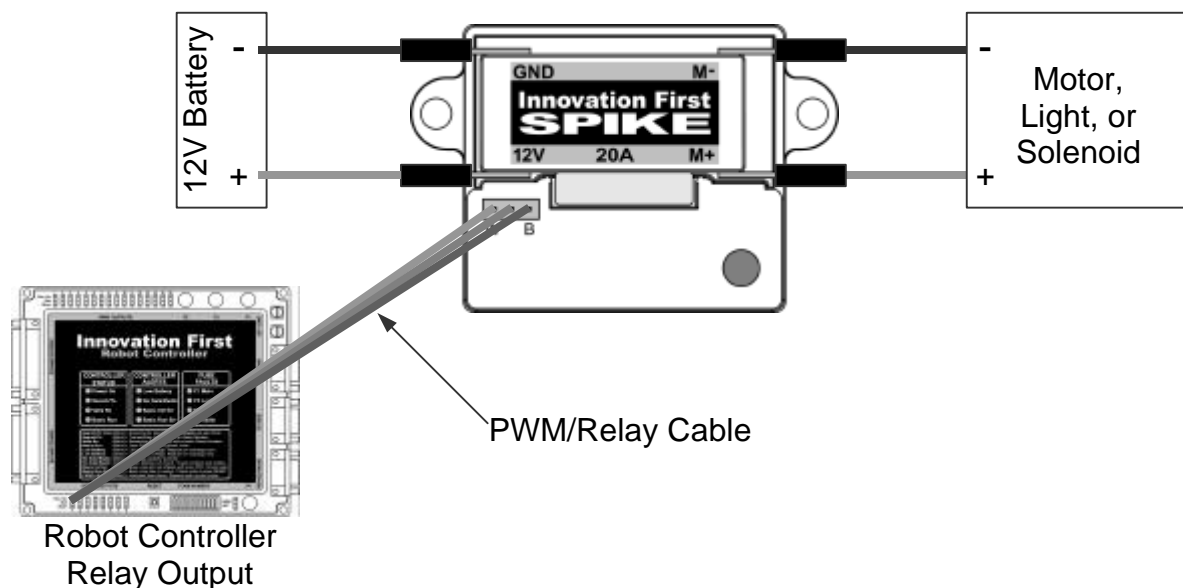1. **Ensure that there is not a short circuit on the output. A short circuit will destroy Spike.**

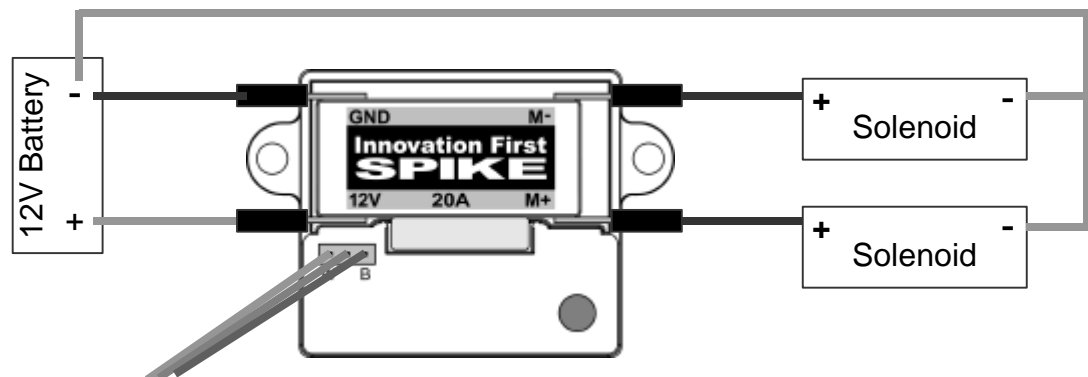**Figure 1: Spike Blue Wiring to One Motor, Light, or Solenoid**

Figure 2: Spike Blue Alternate Wiring for Two Solenoids

Notice: This Manual covers the Spike Blue (Not the Spike Red)

Motor and Solenoid Wiring

The two motor connections can be wired to either of the relay outputs. M+, and M- are only labeled to indicate the polarity of the output versus the control signal and Spike's indicator. If your motor turns opposite of the direction desired, swap the wires connected to M+ and M-. The table below shows the corresponding output versus the control signal and the indicator.

Table 1: Spike Blue P-BASIC software control, Spike output, Motor function

INPUTS		OUTPUTS			
Fwd	Rev	M+	M-	Indicator	Motor Function
0	0	GND	GND	Orange	OFF / Brake Condition (default)
1	0	+12v	GND	Green	Motor rotates in one direction
0	1	GND	+12v	Red	Motor rotates in opposite direction
1	1	+12v	+12v	Off	OFF / Brake Condition

Notes:
1. 'Brake' refers to the dynamic stopping of the motor due to the shorting of the motor inputs. This condition is not optional when going to an off state.
2. The INPUT Fwd and Rev are described in the Programming section on page3.

One or Two Solenoid Wiring

The Spike Relay Module can be used to control solenoids. The easiest method of connection is to wire one side of the solenoid to M+, and the other wire to the ground (GND) side of the Battery. When the relay is sent a Forward (Indicator Green) command, the solenoid will be activated. The same can be done with the M- connector to control another solenoid or the opposite direction of a double solenoid (see Figure 2 on page 1).

Table 2: Spike Blue P-BASIC software control, Spike output, Solenoid function

INPUT		OUTPUTS			
FWD	REV	M+	M-	Indicator	Solenoid Function
0	0	GND	GND	Orange	Both Solenoids OFF (default)
1	0	+12v	GND	Green	Solenoid connected to M+ is ON
0	1	GND	+12v	Red	Solenoid connected to M- is ON
1	1	+12v	+12v	Off	Both Solenoids ON

Note:
1. The INPUT Fwd and Rev are described in the P-BASIC Programming section on page3.

Notice: This Manual covers the Spike Blue (Not the Spike Red)

P-BASIC Programming for Spikes

The Robot Controller is supplied with a "Default" program in order to help get the robot up and running quickly. Refer to the Control System Users Manual for a description of the default control for relays. If more sophisticated control of the robot is desired, then a custom program, known as the user program, must be written. The source code for the default program, "Default Program.bsx" is available at www.innovationfirst.com/FIRSTRobotics.

Tables 1 and 2 on page 2 refer to the INPUT signals Fwd and Rev. These are aliases that are assigned in the P-BASIC code that you will set to either a '0' (OFF) or a '1' (ON) in the program section of the code depending on the function you wish to accomplish.

Below is the default code alias (variable) assignments made for each relay output on the Robot:

```
'---------- Aliases for each RC Relay outputs ----------------------------
'  Below are aliases for the relay outputs located on the Robot Controller.

relay1_fwd  VAR RelayA.bit0
relay1_rev  VAR RelayA.bit1
relay2_fwd  VAR RelayA.bit2
relay2_rev  VAR RelayA.bit3
relay3_fwd  VAR RelayA.bit4
relay3_rev  VAR RelayA.bit5
relay4_fwd  VAR RelayA.bit6
relay4_rev  VAR RelayA.bit7

relay5_fwd  VAR RelayB.bit0
relay5_rev  VAR RelayB.bit1
relay6_fwd  VAR RelayB.bit2
relay6_rev  VAR RelayB.bit3
relay7_fwd  VAR RelayB.bit4
relay7_rev  VAR RelayB.bit5
relay8_fwd  VAR RelayB.bit6
relay8_rev  VAR RelayB.bit7
```

The following are several examples for controlling the Relays. Refer to the default code for more examples.

```
'---------- Relay Control Examples -----------------------------------------
RelayA = 0              'sets Relays 1-4 OFF
RelayB = 0              'sets Relays 5-8 OFF

relay1_fwd = 1          'Relay 1 is always Forward (M+ is 12V, M- is GND)
relay2_rev = 0          'Relay 2 is always Reverse (M- is 12V, M+ is GND)
relay3_fwd = p1_sw_top  'Port 1 Top Button = Relay 3 Forward
relay3_rev = p1_sw_trig 'Port 1 Trigger Button = Relay 3 Reverse
relay4_fwd = rc_sw1     'Relay 4 is Fwd when Robot Controller SW1 is closed
```

Notice: This Manual covers the Spike Blue (Not the Spike Red)