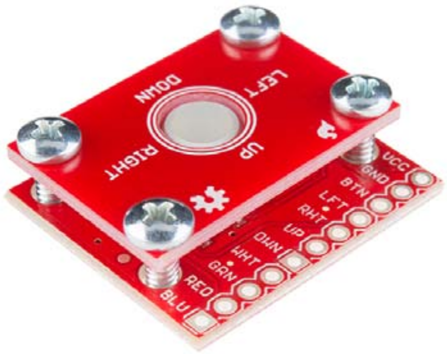
BlackBerry Trackballer Breakout Hookup Guide

The SparkFun BlackBerry Trackballer Breakout gives the user easy access to a trackball which measures up, down, left, and right movements, as well as clicks on the board. It also adds a bit of flair to your project with 4 LEDs.



Materials Required

We recommend the following products to follow along with this hookup guide.

Blackberry Trackballer Hookup Guide SparkFun Wish List	
	Break Away Male Headers - Right Angle PRT-00553 A row of right angle male headers - break to fit. 40 pins that can be cu…
	Jumper Wires Premium 12" M/F Pack of 10 PRT-09385 This is a SparkFun exclusive! These are 12" long jumper wires termin…
	SparkFun RedBoard - Programmed with Arduino DEV-12757 At SparkFun we use many Arduinos and we're always looking for the…
	SparkFun USB Mini-B Cable - 6 Foot CAB-11301 This is a USB 2.0 type A to Mini-B 5-pin cable. You know, the mini-B…

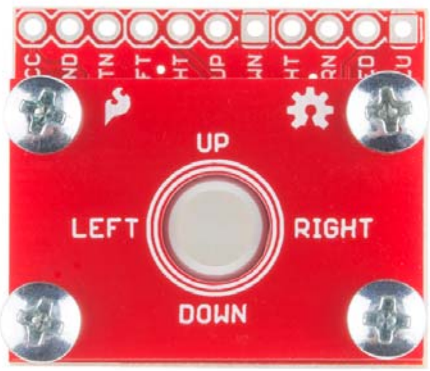
Suggested Reading

If you aren't familiar with the following concepts, we recommend reviewing them before beginning to work with the BlackBerry Trackballer Breakout.

- Installing the Arduino IDE
- How to Power Your Project
- How to Solder
- Working with Wire
- Light-Emitting Diodes
- Switch Basics
- Analog vs. Digital

Hardware Overview

There are five main features to the breakout board of which the user should be aware.



Don't let the sleek interface fool you- there's a lot going on with this little board!

Trackball

The BlackBerry trackball is the main feature of this board. Four tiny spindles on the trackball each have small magnets on their ends. These each trigger a paired SMD hall effect sensor, giving the user the ability to track up, down, left, and right movement of the trackball.

The four directions can be tracked as outputs on the header pins labeled **LFT**, **RHT**, **UP**, and **DWN**.

Pushbutton

Underneath the trackball, there is a small SMD momentary switch. This allows the user to trigger events or make selections with a simple 'click'.

This output is broken out to the header pin labeled **BTN**.

LEDs

Additionally, underneath the trackball are four LEDs. The LED colors include:

- White
- Red
- Green
- Blue

These LEDs can light up the clear trackball any color desired by the user. Combinations of the four LEDs lit up can also be used to customize the trackball color.

Each LED is broken out to its own header pin. The header pins are labeled **WHT**, **GRN**, **RED**, and **BLU**.

Power Connection

In order to properly run the hall effect sensors, momentary switch, and LEDs, the user must supply power on two headers broken out, labeled **VCC** and **GND**. Power supplied to the board should be regulated, but can be anywhere from **2.5-5.25V**.

Mounting PCB

The final feature of the breakout is the mounting PCB, included to mechanically stabilize the trackball. It is mounted to the breakout board using four Phillips 4-40 screws and four nylon 4-40 standoffs. This PCB is included to prevent the trackball from being ripped off of the breakout board.

> **Please note:** We test the mounting boards in-house before shipping the trackballer breakouts out to customers, but keep in mind adjusting the tightness of the screws and standoffs may affect the functionality of the trackball. Overtightening the screws may cause malfunctions of some of the hall effect sensors.

This mounting board can be replaced with other types of mechanical stabilization provided by the user. For example, if the trackballer breakout is mounted into a project enclosure, the top mounting PCB may be removed.

Hardware Hookup

Now that you are familiar with the Trackballer Breakout board, it's time to hook everything up!

Solder Headers

We recommend using right angle headers to solder to the standard 0.1" breakout pins. This will allow you to easily read the header labels without jumper wires in the way. However, you could also solder bare wires directly to the PCB if you wish. If you're unsure how to do this, please check out our tutorial here.

Pin Connections

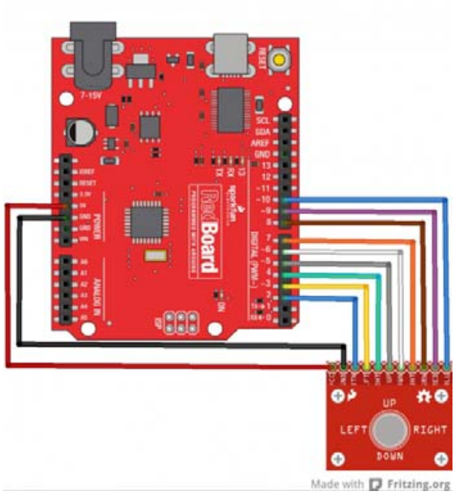
Once headers are soldered on the board, you can now use jumper wires to connect the trackball breakout to the RedBoard. Use the following connections.

Trackballer Breakout → RedBoard

- VCC → 5V
- GND → GND
- BTN → D2
- LFT → D3
- RHT → D4
- UP → D5
- DWN → D6
- WHT → D7
- GRN → D8
- RED → D9
- BLU → D10

Final Circuit

Once everything is connected, your circuit should look like the following diagram:



Arduino Code

Once the circuit is hooked up properly, it’s time to upload code to the RedBoard and start playing with the trackballer.

If you are unfamiliar with how to use the Arduino IDE, please check out our tutorial here.

First, download the demo sketch, and open it up in your Arduino IDE.

Download SparkFun Trackballer Breakout Demo Sketch
https://cdn.sparkfun.com/assetslearn_tutorials/2/4/6SparkFun_BlackBerry_Trackballer_Breakout_Demo.zip

You can also download the most up-to-date code from the GitHub repo.

Make sure to select `Uno` in the board drop-down menu, and select the correct COM port for your RedBoard. Upload the code.

With the code uploaded, open up your favorite serial port monitor. Use the settings `9600bps, 8, N, 1`. If you are unsure how to do this, check out our Serial Terminal Basics tutorial.

Let’s take a look at what the code does. In the first section, we are declaring pin connections between the trackballer and the RedBoard. This includes the four trackball pins, the button, and the LEDs. We also declare our variables we will be using later in the sketch.

```
//Define Trackballer Breakout pin connections to Arduino
#define Btn 2
#define Lft 3
#define Rht 4
#define Up 5
#define Dwn 6
#define WHT_LED 7
#define GRN_LED 8
#define RED_LED 9
#define BLU_LED 10

//Define variables used in sketch
int buttonClick;
unsigned long mouse_Lft;
unsigned long mouse_Rht;
unsigned long mouse_Up;
unsigned long mouse_Dwn;
int x_position;
int y_position;
```

The `setup` loop is where we tell the RedBoard what to do with all those pins we just defined. First, we set all of the trackball pins and button pins as inputs (the RedBoard will be *receiving* information from these pins). We then declare the LED pins as outputs (the RedBoard will be *controlling* these pins).

We begin our serial port at 9600bps, and begin cycling through turning on each of the LEDs, one at a time. Each LED remains on for one second, then turns off. Once all the LEDs have been cycled, we move on to the main loop where the trackball shows its capabilities.

```
/*********************Setup Loop*************************/
void setup() {

  //Define pin functionality on the Arduino
  pinMode(Btn, INPUT);
  pinMode(Lft, INPUT);
  pinMode(Rht, INPUT);
  pinMode(Up, INPUT);
  pinMode(Dwn, INPUT);
  pinMode(WHT_LED, OUTPUT);
  pinMode(GRN_LED, OUTPUT);
  pinMode(RED_LED, OUTPUT);
  pinMode(BLU_LED, OUTPUT);

  //Pull LED pins low to prevent flickering
  digitalWrite(WHT_LED, LOW);
  digitalWrite(GRN_LED, LOW);
  digitalWrite(RED_LED, LOW);
  digitalWrite(BLU_LED, LOW);

  //Start Serial port for debugging.
  Serial.begin(9600);
  Serial.println("Begin Trackballer Demo");

  //Demo each LED by turning them on individually for one second.
  Serial.println("Turn on LEDs individually");
  digitalWrite(WHT_LED, HIGH);
  delay(1000);
  digitalWrite(WHT_LED, LOW);

  digitalWrite(GRN_LED, HIGH);
  delay(1000);
  digitalWrite(GRN_LED, LOW);

  digitalWrite(RED_LED, HIGH);
  delay(1000);
  digitalWrite(RED_LED, LOW);

  digitalWrite(BLU_LED, HIGH);
  delay(1000);
  digitalWrite(BLU_LED, LOW);

  Serial.println("Begin Trackball tracking");
}
```

When the main loop begins, the RedBoad will be waiting for input from the trackball, and will output a coordinate to the serial monitor. The RedBoard first polls each of the trackball pins. The function `pulseIn` waits for up to 20000 microseconds to determine if there is any pulse (the pin driving `HIGH`) coming in from the trackballer. If so, the pulse length (again, in microseconds) is recorded to the variable name, and the RedBoard moves on to the next pin. If no pulse comes in, the variable is assigned the value of `0`. You can find more information on this function here.

```
/*********************Main Loop*************************/
void loop() {

  //Wait for 2ms on each direction pin for movement.
  //Pins are driven HIGH by the breakout board.
  //pulseIn measures the length of each pulse in microseconds.
  mouse_Lft = pulseIn(Lft, HIGH, 20000);
  mouse_Rht = pulseIn(Rht, HIGH, 20000);
  mouse_Up = pulseIn(Up, HIGH, 20000);
  mouse_Dwn = pulseIn(Dwn, HIGH, 20000);
```

Once the variables have been written, the RedBoard then compares each value to determine if there was any pulse input. In our case, we simply want to see any movement, so we compare to a time of `0` seconds. If you want to only register long scrolls, you can increase the value being compared. If pulses were recorded, we adjust the x- and y-coordinates accordingly. Since we are basing this off of a Cartesian coordinate system, we record `Up` and `Right` movement as positive incrementations, while `Down` and `Left` movements are negative incrementations.

These coordinates are then printed to the Serial monitor.

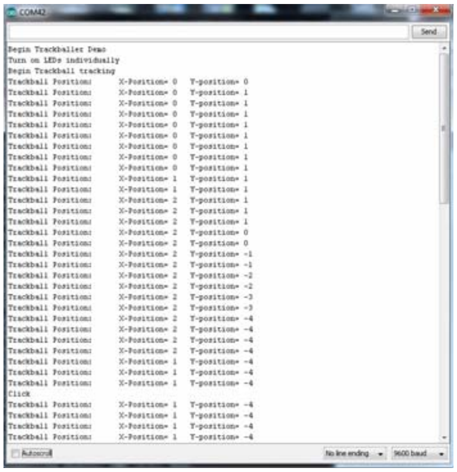
```
  //Determine if there was movement in any direction.
  //If movement occurred, adjust x/y coordinates based on movements.
  //Directionality is based off of an x/y plane (i.e., Up 1 unit and Right 1 unit = (1,1))
  if (mouse_Lft > 0)
  {
    x_position= --x_position;
  }
  if (mouse_Rht > 0)
  {
    x_position= ++x_position;
  }
  if (mouse_Up > 0)
  {
    y_position= ++y_position;
  }
  if (mouse_Dwn > 0)
  {
    y_position= --y_position;
  }

  //Output x/y coordinates to Serial terminal
  Serial.print("Trackball Position: \t X-Position= ");
  Serial.print(x_position);
  Serial.print(" \t Y-position= ");
  Serial.print(y_position);
  Serial.println();
```

Finally, we check for any button clicks. If the RedBoard reads the button pin as `LOW`, the button has been clicked, and this is output to the Serial terminal.

```
  //Check for button click. If present, print to Serial monito
r.
  buttonClick = digitalRead(Btn);
  if (buttonClick == LOW)
  {
    Serial.println("Click");
  }
}
```

If your trackballer is hooked up correctly and your RedBoard has been programmed without issue, you should see the following output on your terminal monitor. Try scrolling the trackball and clicking the button to verify everything is working correctly. The trackball position counter will increment up or down, depending on how you roll the ball.



```
Begin Trackballer Demo
Turn on LEDs individually
Begin Trackball tracking
Trackball Position:     X-Position= 0   Y-position= 0
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 0   Y-position= 1
Trackball Position:     X-Position= 1   Y-position= 1
Trackball Position:     X-Position= 1   Y-position= 1
Trackball Position:     X-Position= 2   Y-position= 1
Trackball Position:     X-Position= 2   Y-position= 1
Trackball Position:     X-Position= 2   Y-position= 1
Trackball Position:     X-Position= 2   Y-position= 0
Trackball Position:     X-Position= 2   Y-position= 0
Trackball Position:     X-Position= 2   Y-position= -1
Trackball Position:     X-Position= 2   Y-position= -1
Trackball Position:     X-Position= 2   Y-position= -2
Trackball Position:     X-Position= 2   Y-position= -2
Trackball Position:     X-Position= 2   Y-position= -3
Trackball Position:     X-Position= 2   Y-position= -3
Trackball Position:     X-Position= 2   Y-position= -4
Trackball Position:     X-Position= 2   Y-position= -4
Trackball Position:     X-Position= 2   Y-position= -4
Trackball Position:     X-Position= 2   Y-position= -4
Trackball Position:     X-Position= 1   Y-position= -4
Trackball Position:     X-Position= 1   Y-position= -4
Trackball Position:     X-Position= 1   Y-position= -4
Click
Trackball Position:     X-Position= 1   Y-position= -4
Trackball Position:     X-Position= 1   Y-position= -4
Trackball Position:     X-Position= 1   Y-position= -4
Trackball Position:     X-Position= 1   Y-position= -4
```

In this example, I rolled the trackball up and to the right. I then rolled it down several times and to the left. You can see when I clicked the push button towards the bottom.

Resources and Going Further

Going Further

Once you've successfully gotten data out from your trackballer breakout, it's time to create your own project based around the breakout board! Will you use it as a driver for a remote robot? Or perhaps an interactive art display? We want to see what you come up with! If you need some ideas to get started, try customizing the LED color of the trackball to light up when you press the button. Alternatively, try using your trackballer as a drawing tool in Processing!

If you have any feedback, please visit the comments or contact our technical support team at TechSupport@sparkfun.com.

Additional Resources

Check out these additional resources for more information and other project ideas.

- BlackBerry Trackballer Repository
- Hall Effect Sensor Datasheet
- HID Control of a Web Page
- Interfacing Arduino to Processing