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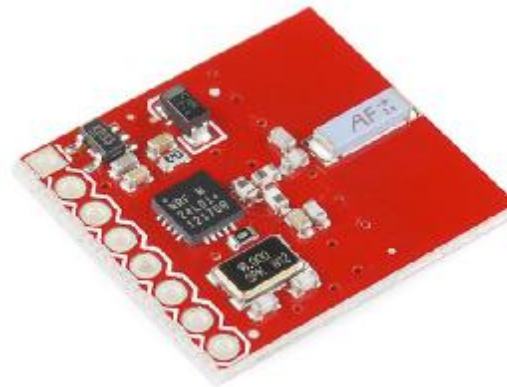
nRF24L01+ Transceiver Hookup Guide

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Introduction

These breakout boards provide SPI access to the nRF24L01+ transceiver module from Nordic Semiconductor. The transceiver operates at 2.4 GHz and with power supplies 3.3V-5V. It has 250kbps, 1Mbps and 2Mbps on-air data-rate options and is applicable for low-power applications.

nRF24L01+ Transceiver Breakout: on-board antennna version.

Required Materials

To follow along with this tutorial, we recommend you have access to the following materials.

nRF24L01+ Hookup Wishlist SparkFun Wish List
(2) Jumper Wires Premium 12" M/F Pack of 10 PRT-09385 This is a SparkFun exclusive! These are 12" long jumper wires termi…
Break Away Male Headers - Right Angle PRT-00553 A row of right angle male headers - break to fit. 40 pins that can be c…
(2) SparkFun RedBoard - Programmed with Arduino DEV-12757 At SparkFun we use many Arduinos and we're always looking for th…
(2) SparkFun Transceiver Breakout - nRF24L01+ WRL-00691 This module uses the newest 2.4GHz transceiver from Nordic Semic…
2.4GHz Duck Antenna RP-SMA WRL-00145 2.4GHz Duck Antenna 2.2dBi with Reverse Polarized - SMA RF con…
SparkFun Transceiver Breakout - nRF24L01+ (RP-SMA) WRL-00705 The nRF24L01 module is the latest in RF modules from SparkFun. T…
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 nRF24L01+ Breakouts.
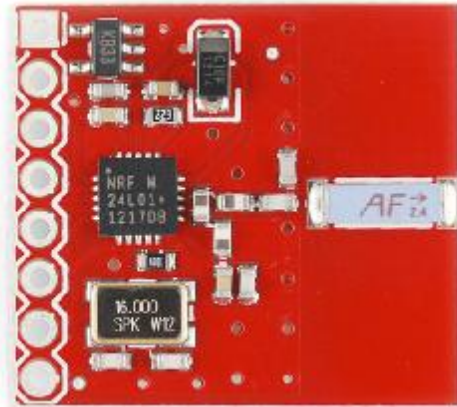
- Installing the Arduino IDE
- How to Power Your Project
- How to Solder
- Serial Peripheral Interface

Hardware Overview

Antenna Options

SparkFun carries two versions of the breakout, listed below.

On-board Chip Antenna

SparkFun Transceiver Breakout nRF24L01+ with chip antenna (WRL-00691)

The first version is the SparkFun Transceiver Breakout - nRF24L01+ with chip antenna. The on-board chip antenna allows for a more compact version of the breakout. However, the smaller antenna also means a lower transmission range. Keep that in mind if you plan on mounting this board in an enclosure. The enclosure material may also decrease the range of this board, as you cannot move the antenna outside of any interference. This antenna should be suitable for most applications.

RP-SMA
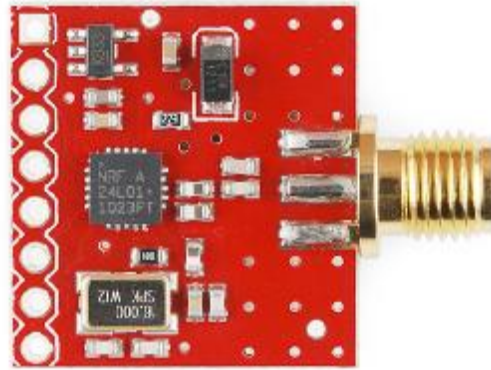
SparkFun Transceiver Breakout - nRF24L01+ with RP-SMA antenna
(WRL-00705)

If you need more range in your wireless connection or if you need to move your antenna outside an interference zone, we recommend the RP-SMA antenna version of the breakout. You can learn more about SMA connectors here. This version works with the RP-SMA 2.4GHz antenna and its larger counterpart. Because of the external antenna on this version of the breakout, it has a greater range than the on-board antenna version.

Pins
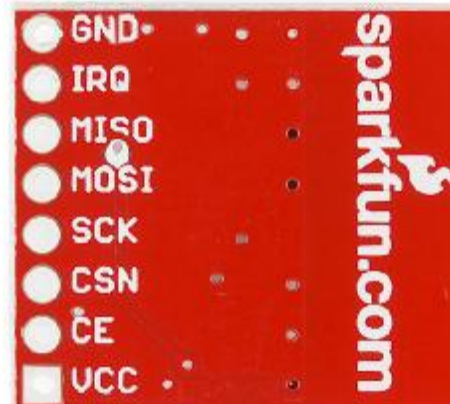
Broken out pins with labels

While the nRF24L01+ IC has 20 pins available, our breakout board simplifies this down to the 8 pins required to get up and running. These pins are the same on both versions of the board. The pins function as follows:

- **GND** - Ground
- **IRQ** - Interrupt pin. This pin is active **LOW**.
- **MISO** - 3.3V-5V tolerant SPI slave output.
- **MOSI** - 3.3V-5V tolerant SPI slave input.
- **SCK** - 3.3V-5V tolerant SPI clock.
- **CSN** - 3.3V-5V tolerant SPI chip select.
- **CE** - 3.3V-5V tolerant chip enable. This pin toggles the nRF24L01+ IC between transmit (TX), receive (RX), standby, and power-down mode.
- **VCC** - This is VRAW and is regulated on-board down to 3.3V for the proper functionality of the nRF24L01+. Voltage range on this pin is **3.3V-7V**.

Functionality

Transmission Mode

The IC can either work in transmit or receive mode. This mode is determined by both the CE pin state, the PWR_UP register, and the PRIM_RX register. The following chart shows the various configurations.

Transmission Mode Truth Table

Mode	PWR_UP Register	PRIM_RX Register	CE Pin	FIFO State
RX Mode	1	1	1	-
TX Mode	1	0	1	Data in TX FIFOs. Will empty all levels in TX FIFOs
TX Mode	1	0	Minimum 10µs high pulse	Data in TX FIFOs.Will empty one level in TX FIFOs.

Standby-II	1	0	1	TX FIFO empty.
Standby-I	1	-	0	No ongoing packet transmission.
Power Down	0	-	-	-

Hardware Hookup

Solder Connection Points

We recommend soldering headers to the nRF24L01+ board to allow you to prototype your circuit. To avoid interference with the antenna on the nRF24L01+, use right-angle male headers. If you need a review for PTH soldering, check out our tutorial here.
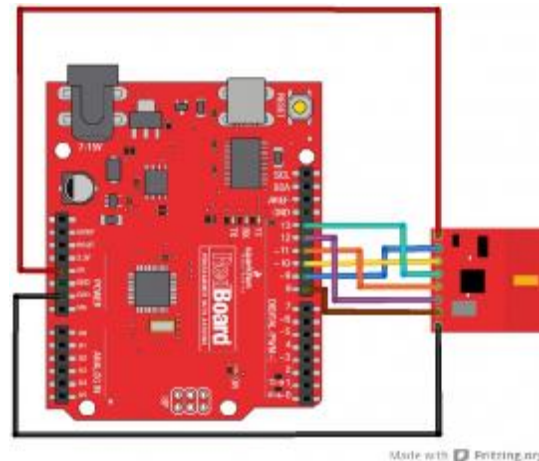
Connect the Wires

Now that you have your headers attached, you can plug in the jumper wires. Connect the Redboard and nRF24L01 as listed.

Redboard → nRF24L01+

- 3.3V → VCC
- GND → GND
- D8 → IRQ
- D9 → CE
- D10 → CSN
- D11 → MOSI
- D12 → MISO
- D13 → SCK

Final Circuit

Once you have everything connected, your system should look like the following:

nRF24L01+ Circuit Assembly

Repeat!

Since these are radio modules, you'll need **at least two** modules to talk to each other. Duplicate the connections between another Redboard and nRF24L01+ module. Don't forget to attach the antenna to your nRF24L01+ if you have the RP-SMA version.

Arduino Code

There are a lot of libraries available for this module, but we recommend using the RF24 library, originally written by maniacBug, and updated for Arduino 1.6x by TMRh20.

You can find the most up-to-date version of the library here. Alternatively, you can download this zip and install it into your Arduino IDE libraries folder. If you need help with the library installation, please check out our tutorial.

DOWNLOAD THE RF24 LIBRARY

Once you have your code properly installed, open up *Examples → RF24 → GettingStarted.ino*.

Check out the User Configuration section of the code, and make sure you update yours as shown below.

```
/***************** User Config ***********************/
/***       Set this radio as radio number 0 or 1        ***/
bool radioNumber = 1;

/* Hardware configuration: Set up nRF24L01 radio on SPI bus pl
us pins 9 & 10 */
RF24 radio(9,10);
```

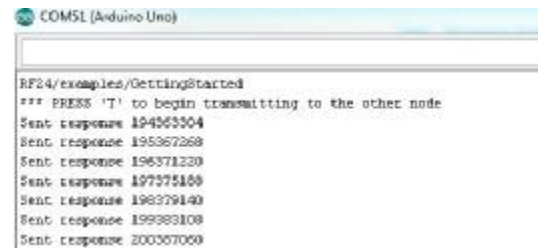One radio should have the **radioNumber** set to **0** and the other should be set to **1** .

Upload the code to your Redboards. Once you have them both set up, you can open up two terminals set at 115200 bps, 8-N-1, and you should see the following appear on the terminal.

```
RF24/examples/GettingStarted
*** PRESS 'T' to begin transmitting to the other node
```

Press **T** in one terminal, press **R** in the other, and wait until you start seeing your radios communicating! You should see something similar in your terminal.

Receiver output in the terminal.

Resources and Going Further

Going Further

Now that you have your nRF24L01+ up and running, you can start creating your own awesome wireless projects. There are several other examples in the library – use these to to keep exploring your nRF24L01+ modules or modify them for your own personal projects.