

Complete Guide for nRF24L01 – 2.4GHz RF Transceiver Module With Arduino

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This post aims to be a complete guide for nRF24L01 – 2.4GHz RF Transceiver module. explain what it does, show its specs and share an Arduino project example that you can take and apply to your own projects.

I have more complete guides for other popular sensors, check them below:

- » [Complete Guide for Ultrasonic Sensor HC-SR04](#)
- » [Complete Guide for DHT11/DHT22 Humidity and Temperature Sensor](#)
- » [Complete Guide for RF 433MHz Transmitter/Receiver Module](#)
- » [Arduino with PIR Motion Sensor](#)

Description

These RF modules are very popular among the Arduino tinkerers. The nRF24L01 is used on a wide variety of applications that require wireless control. They are transceivers which means that each module can transmit and receive data.

These modules are very cheap and you can use them with any microcontroller (MCU).

Specifications nRF24L01 – 2.4GHz RF Transceiver

- » Low cost single-chip 2.4GHz GFSK RF transceiver IC
- » Range with Antenna: 250Kb rate (Open area) >1000 meter

- » Power: Ultra low power consumption
- » Input Voltage: 3.3V
- » Pins: 5V tolerant
- » Price: \$2

Where to buy?

You can purchase these modules from eBay for just a few dollars. [Click here to see nRF24L01 module on eBay](#). They come in two versions with external antenna (more range) or built-in antenna (less range).



Arduino with nRF24L01

You need the following components to make this example:

- » 2x Arduino ([eBay](#))
- » 2x nRF24L01 – 2.4GHz RF Transceiver ([eBay](#))
- » Breadboard ([eBay](#))

Library download

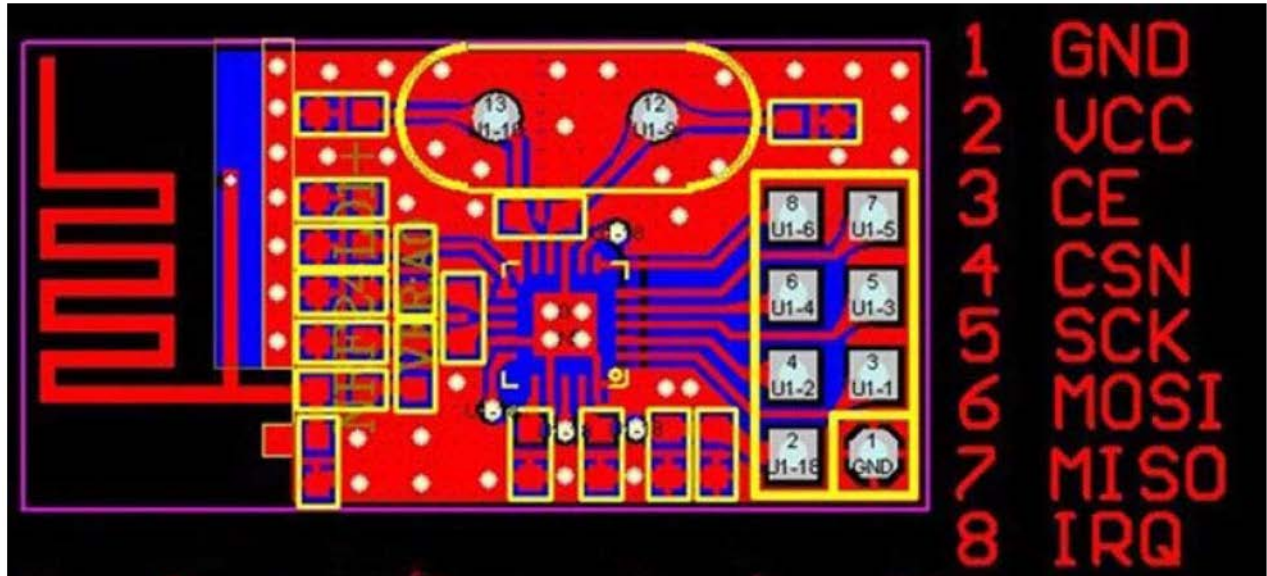
Here's the library you need for this project:

1. Download the **RadioHead library**
2. Unzip the RadioHead library
3. Install the RadioHead library in your Arduino IDE

4. Restart your Arduino IDE

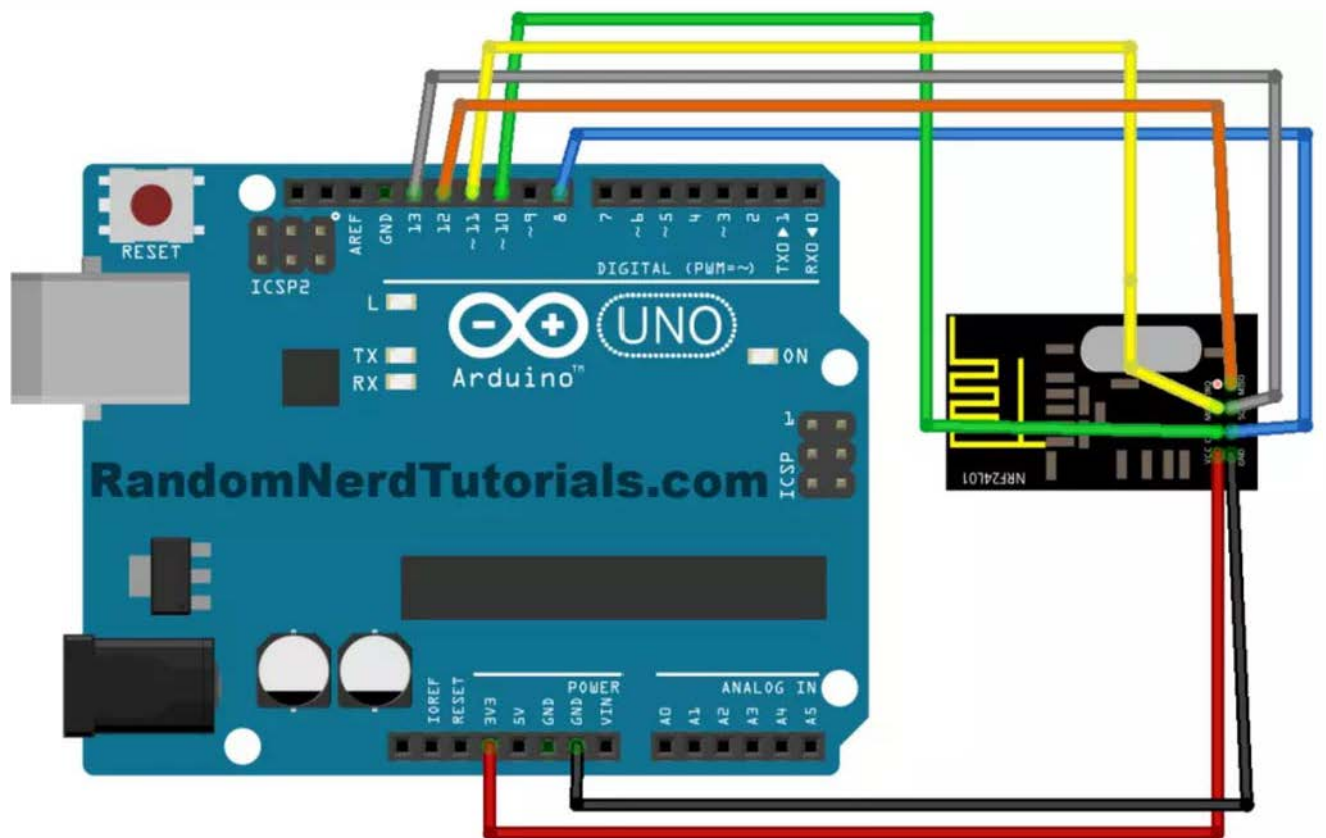
The RadioHead library is great and it works with almost all RF modules in the market. ' can read more about this project [here](#).

Pinout



Top view of NRF24L01

Client Circuit



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Important: Input voltage is of 1.9V~3.6V, do not exceed this voltage, otherwise it will fry your module.

Follow the circuit above for your client. Then upload the code below which can be found in your Arduino IDE (after installing the RadioHead library).

Go to File > Examples > RadioHead > nrf24 > nrf24_client.

```
// nrf24_client

#include <SPI.h>
#include <RH_NRF24.h>

// Singleton instance of the radio driver
RH_NRF24 nrf24;

// RH_NRF24 nrf24(8, 7); // use this to be electrically compatible with Mirf
// RH_NRF24 nrf24(8, 10); // For Leonardo, need explicit SS pin
// RH_NRF24 nrf24(8, 7); // For RFM73 on Arduino Mini

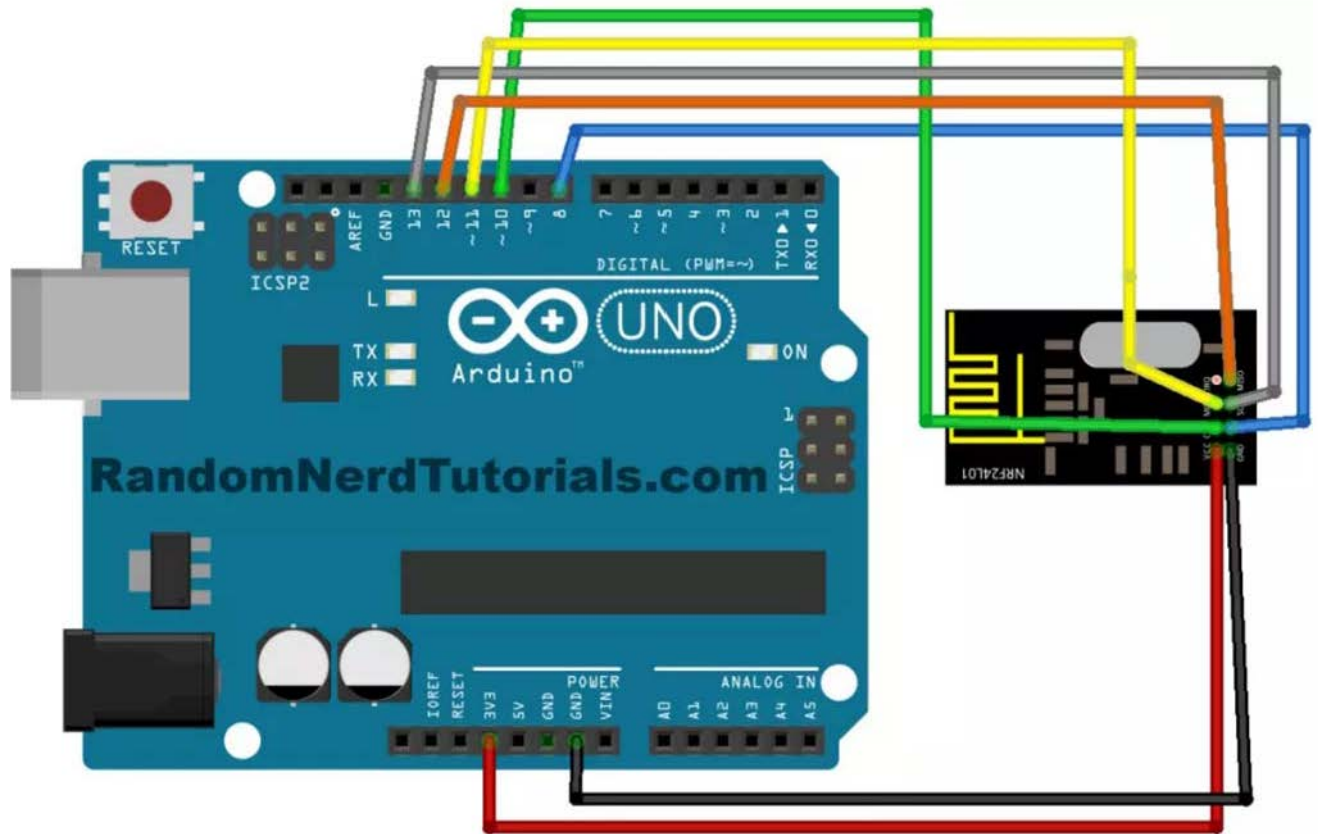
void setup()
{
  Serial.begin(9600);
  while (!Serial)
    ; // wait for serial port to connect. Needed for Leonardo only
  if (!nrf24.init())
    Serial.println("init failed");
  // Defaults after init are 2.402 GHz (channel 2), 2Mbps, 0dBm
  if (!nrf24.setChannel(1))
    Serial.println("setChannel failed");
  if (!nrf24.setRF(RH_NRF24::DataRate2Mbps, RH_NRF24::TransmitPower0dBm))
    Serial.println("setRF failed");
}

void loop()
```

```
{  
  Serial.println("Sending to nrf24_server");  
  // Send a message to nrf24_server  
  uint8_t data[] = "Hello World!";  
  nrf24.send(data, sizeof(data));  
  
  nrf24.waitPacketSent();  
  // Now wait for a reply  
  uint8_t buf[RH_NRF24_MAX_MESSAGE_LEN];  
  uint8_t len = sizeof(buf);  
  
  if (nrf24.waitForAvailableTimeout(500))  
  {  
    // Should be a reply message for us now  
    if (nrf24.recv(buf, &len))  
    {  
      Serial.print("got reply: ");  
      Serial.println((char*)buf);  
    }  
    else  
    {  
      Serial.println("recv failed");  
    }  
  }  
  else  
  {  
    Serial.println("No reply, is nrf24_server running?");  
  }  
  delay(400);  
}
```

[Projects/nrf24_client.ino](#) view :

Server Circuit



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Important: Input voltage is of 1.9V~3.6V, do not exceed this voltage, otherwise it will fry your module.

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Follow the circuit above for your server. Then upload the code below which can be found in your Arduino IDE (after installing the RadioHead library).

Go to File > Examples > RadioHead > nrf24 > nrf24_server.

```
// nrf24_server

#include <SPI.h>
#include <RH_NRF24.h>

// Singleton instance of the radio driver
RH_NRF24 nrf24;

// RH_NRF24 nrf24(8, 7); // use this to be electrically compatible with Mirf
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// RH_NRF24 nrf24(8, 7); // For RFM73 on Arduino Mini
```



```
void setup()
{
  Serial.begin(9600);
  while (!Serial)
    ; // wait for serial port to connect. Needed for Leonardo only
  if (!nrf24.init())
    Serial.println("init failed");
  // Defaults after init are 2.402 GHz (channel 2), 2Mbps, 0dBm
  if (!nrf24.setChannel(1))
    Serial.println("setChannel failed");
  if (!nrf24.setRF(RH_NRF24::DataRate2Mbps, RH_NRF24::TransmitPower0dBm))
    Serial.println("setRF failed");
}

void loop()
{
  if (nrf24.available())
  {
    // Should be a message for us now
    uint8_t buf[RH_NRF24_MAX_MESSAGE_LEN];
    uint8_t len = sizeof(buf);
    if (nrf24.recv(buf, &len))
    {
      // NRF24::printBuffer("request: ", buf, len);
      Serial.print("got request: ");
      Serial.println((char*)buf);

      // Send a reply
      uint8_t data[] = "And hello back to you";
      nrf24.send(data, sizeof(data));
      nrf24.waitPacketSent();
      Serial.println("Sent a reply");
    }
  }
}
```

```
else
{
    Serial.println("recv failed");
}
}
}
```

[Projects/nrf24 server.ino](#) **view** :

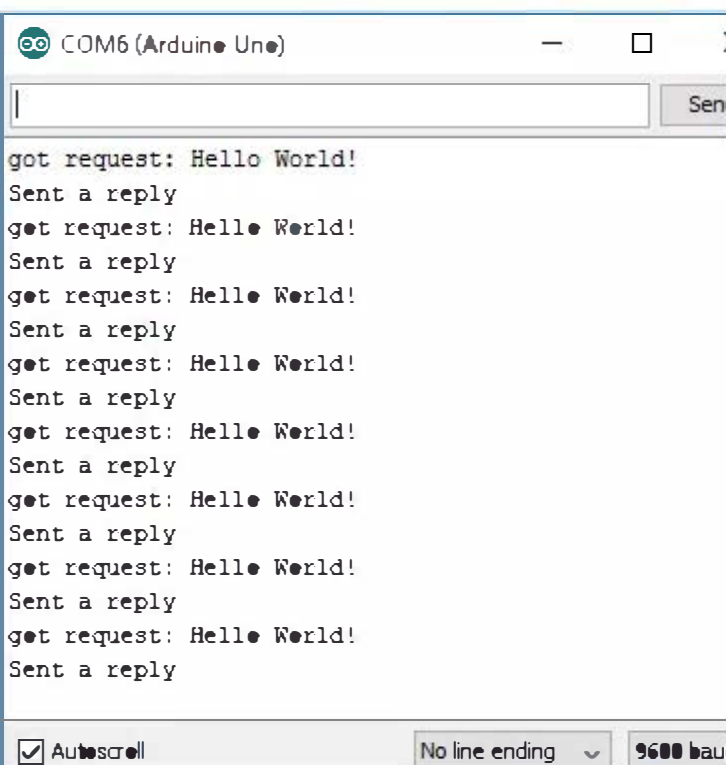
Demonstration

In this project the client is sending a message "Hello World!" to the server via RF and the server is sending back the following message "And hello back to you". Those messages are being displayed in the serial monitor. Here's what you should see in your serial terminal windows (see Figure below).

Client Circuit



Server Circuit



Note: On the left window, I'm establishing a serial communication with PuTTY.org. On right window, I'm using the Arduino IDE Serial Monitor.

Conclusion

You need to have some realistic expectations when using this module. They work very well when the receiver and transmitter are quite close to each other. If you separate

them too far you'll lose the communication.

The communication range will vary. It depends on how much noise in your environment if there's any obstacles and if you're using an external antenna.

I hope you found this guide useful.

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Thanks for reading,

-Rui Santos



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Biplab Roy says

September 2, 2015

Hello,

I've been following your posts from quite a few days. The nRF tutorial is really helpful. I have a query. Can we use this library for wireless sensor nodes. How to communicate with different clients with different device addresses?

Suppose we have 2 clients & 1 server. Then how to ask for data from a specific client at a time? Please help.

→ Reply

Rui Santos says

September 13, 2015

Hi Roy,

Thank you for trying my projects! Yes you can have multiple nodes and you can set different device addresses to allow multiple clients. The library comes with an example that will help you use that concept.

Having the library installed in your Arduino IDE. Go to File > Examples > Radiohead > nrf24

And use these examples "nrf24_reliable_datagram_client" and "nrf24_reliable_datagram_server".

If you look at the code you can set different addresses to each device

→ Reply

Emil Mashiah says

September 3, 2015

Great job, as always! I hadn't tried it yet, but I definitely will. I hope I'll succeed.

Thank you Rui

→ Reply

Rui Santos says

September 13, 2015

Thank you Emil for your continuous support! Have a great day,
-Rui

→ Reply

arun says

September 7, 2015

when i insert code of nrf24_server into arduino uno, at serial monitor it shows init failed .

nrf24_client working fine, sending data but nothing is happening from server site , it shows only INIT FAILED.

I created server on both uno and mega 2560 but getting same response i.e init failed,

Please help me in these case, its urgent.

Thanks

→ Reply

Rui Santos says

September 13, 2015

Have you followed my exact schematics?

Are you using the proper nrf example for the Arduino IDE?

Check carefully the COM ports while uploading the Arduino code

→ Reply

luke says

February 9, 2016

see this page:

http://www.airspayce.com/mikem/arduino/RadioHead/classRH_NRF24.html

you must swap 10>53, 13>52, 11>51, 12>50 on the arduino mega, and instantiate (line 7) using the following instead:

```
RH_NRF24 nrf24(8, 53); //mega
```

having said that, I can get the mega to act as client but not as server.

→ Reply

Eduardo says

September 20, 2015

Hello, this module is popular, common, is that transmits audio, which is the nRF24L01z has little information on his internet, you want to do some tutorial?

→ Reply

Rui Santos says

September 24, 2015

Hi,

I don't know any tutorial on that subject... Sorry

Thanks for asking!

→ Reply

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