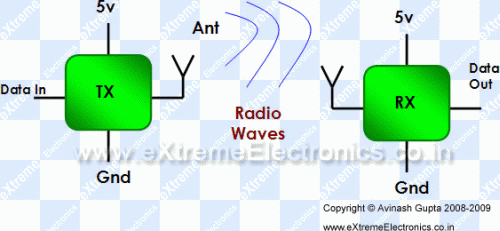
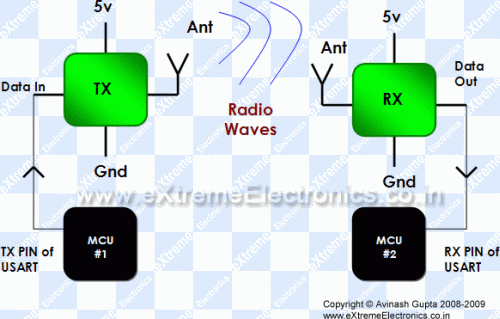
Working of RF Modules is simple but with a little trick. The working is shown in figure below.



Here what ever digital data you input on **"Data In"** of TX is available on **"Data Out"** of RX. Say, if you set "data in" high, the "data out" will become high as well. But here lies the trick! The fact is that you cannot Keep Logic HIGH or LOW for a Long period of time, say for a few millisecond second. If you apply a logic low on "data in" the "data out" will become low but only for few millisecond and it will start oscillating(become high/low repeatedly) after that. Same thing will happen if you set "data in" to high state.

Let us assume we have connected the RF modules with MCUs as shown below.



When the TX unit is switched off or not transmitting data, then as I said the **"data out**" of RX will be oscillating high and low and as this is connected to RX of MCU’s USART, the MCU#2 will be receiving garbage data. And when TX unit will send some data, MCU#2 will also be receiving them. So MCU #2 is always receiving data,even when MCU#1 is not sending anything. So their must be a mechanism to differentiate real data with garbage data.

Part III will be covering mostly the practical part, i.e. we will build a complete & working data transfer system. Here you will get circuit and program to implement the solution. The application is very simple in this case, just to transfer a byte of data from Tx station to the Rx station. Once you implement it and get it working you will have enough information and experience to make other RF based projects.

I request all users to follows the instruction exactly as given (unless they are smart enough to know what they are doing). The most important thing in this article is timing of the MCU, so

* Use the exact frequency crystals as used in the designs.
* Write High Fuse = **C9** (HEX Value) and Low Fuse **FF**(HEX Value) to enable external crystal.

Hardware

We will have two units. One is Tx (Transmitter) and Other is Rx (Receiver). Both units are based around ATmega16 MCU(you can use ATmega32 also) on external 16MHz crystal. On the Tx unit PORTC will act as input. While in Rx unit it will act as output. The value at PORTC of TX unit is constantly sent over the air to the RX unit where it is latched on its PORTC. That means whatever value you put in the PORTC of Tx station is available on PORTC of Rx station (8bits or 1 byte). We will connect 8 [micro switches](http://shop.extremeelectronics.co.in/product_info.php?cPath=24_33&products_id=88) on the PORTC of Tx station and 8 [leds](http://shop.extremeelectronics.co.in/product_info.php?cPath=24_41&products_id=90) on the PORTC of Rx station. For testing you can press keys on the Tx side and corresponding LED on the Rx side will glow. Simple!

You can then use the same techniques of sending/receiving data in any other application, like SWARM robotics.

### What is RF Module?

In generally, the wireless systems designer has two overriding constraints: it must operate over a certain distance and transfer a certain amount of information within a data rate. The RF modules are very small in dimension and have a wide operating voltage range i.e. 3V to 12V.

Basically the RF modules are 433 MHz RF transmitter and receiver modules. The transmitter draws no power when transmitting logic zero while fully suppressing the carrier frequency thus consume significantly low power in battery operation. When logic one is sent carrier is fully on to about 4.5mA with a 3volts power supply. The data is sent serially from the transmitter which is received by the tuned receiver. Transmitter and the receiver are duly interfaced to two microcontrollers for data transfer.

### Features of RF Module:

* Receiver frequency 433MHz
* Receiver typical frequency 105Dbm
* Receiver supply current 3.5mA
* Low power consumption
* Receiver operating voltage 5v
* Transmitter frequency range 433.92MHz
* Transmitter supply voltage 3v~6v
* Transmitter output power 4v~12v

### Main Factors Affecting RF Module’s Performance:

As compared to the other radio-frequency devices, the performance of an RF module will depend on several factors like by increasing the transmitter’s power a large communication distance will be gathered. However, which will result in high electrical power drain on the transmitter device, which causes shorter operating life of the battery powered devices. Also by using this devices at higher transmitted power will create interference with other RF devices.

### 4 Applications:

* Wireless security systems
* Car alarm systems
* Remote controls
* Sensor reporting
* [Automation systems](http://www.edgefxkits.com/rf-based-home-automation-system)

### 3 RF Modules

**1.      433 MHz RF Transmitter and Receiver:**

In many projects we use RF modules for transmit and receive the data because it has high volume of applications than IR. RF signals travel in the transmitter and receiver even when there is an obstruction. It operates at a specific frequency of 433MHz.

RF transmitter receives serial data and transmits to the receiver through an antenna which is connected to the 4th pin of the transmitter. When logic 0 applied to transmitter then there is no power supply in transmitter. When logic 1 is applied to transmitter then transmitter is ON and there is a high power supply in the range of 4.5mA with 3V voltage supply.

### Features of RF Transmitter and Receiver:

1. Receiver frequency: 433MHz
2. Receiver typical sensitivity: 105Dbm
3. Receiver current supply: 3.5mA
4. Receiver operating voltage: 5V
5. Low power consumption
6. Transmitter frequency range: 433.92MHz
7. Transmitter supply voltage: 3V~6V
8. Transmitter output power: 4~12Dbm

It has many applications in various areas like Remote lighting controls, long range RFID, wireless alarm and security systems, etc.

### Working of RF Transmitter Module:

From the circuit, the power supply +5V is connected to the 40 pin of microcontroller and ground is connected to 20th pin. Here, we got two switches which are duly connected to microcontroller with pulled up to 5V and this two switches form the input command to the microcontroller. We also got an LCD display for displaying the data to be transmitted. We also have an arrangement for a computer key board to be connected for positive and negative part from clock and data pin which is connected as input to the microcontroller from the output of key board and that data is ultimately displayed in the LCD. We also have one [RF transmitter](http://www.efxkits.com/rf-projects/). It has VCC supply, GND. Data pin which goes to microcontroller. The program is so written that by appropriate operation of this working we first make the key board active. Once the key board is made active by pressing the buttons then the keyboard entry can take place which is displays in LCD. If it has to be sent against codes varying from 0 to 9 this will be displayed in LCD. Here every press is advancing as per the code from 0 to 9 and ultimately when we press one of the push button for sending it will go to microcontroller and then to the RF transmitter module over a 433 MHz frequency transmitted from antenna.

### Working of RF Receiver Module:

At receiver end we have similar connections for power supply as microcontroller needs +5V. Similarly to transmitter, hear also we are using two push buttons with 10k pull up resistors through 5V supply for RF Module. We are using pin 3.0 to connect data pin of RF module and  1 and 2 pins of RF module is used for GND and VCC.

We also have two buttons for selection of code and for receiving the data. Once the data is received by the receiver module that data is demodulated and goes to the receiver pin 10 of microcontroller as per the program. It then displays the message on LCD display.

### Features:

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### 2 Applications involving RF Module

**1.      Remote operated Robotic Vehicle**

**Working:**

The robot is a moving vehicle remotely controlled by one transmitting unit and a receiving unit for its moment. In this we used HT12E encoder which converts 4 bit data to serial output. As explained above this is then fed to the RF module for transmitting the same to be received by the receiver. The RF module the output is fed to HT12D the serial decoder IC, the output of which is fed to microcontroller pin 1 to 4. The transmitting end microcontroller is connected to a set of pushbutton switches to its port 3 of 20 pin microcontroller AT89C2051. Thus while a particular button is pressed the program is executed to deliver corresponding 4-bit data which are then transmitted serially at port 1 as explained above. The data so received at the receiver end of port 1 of the Microcontroller.

A laser light is driven by transistor Q1 from the output of microcontroller pin 15, while the[robotic vehicle](http://www.edgefxkits.com/fire-fighting-robotic-vehicle) is manourved to the location by operating the left, right, forward and backward button etc. after it reaches the site the laser mounted on it takes position to throw the beam by operating specific action button.

**2.      Robotics without Microcontroller Circuit Diagram:**

Pin14 of encoder HT12E is given a low logic signal as data signals work on negative logic. The encoder converts the parallel signals to serial format and transfers them through the RF transmitter at a rate of 1 to 10kbps. The signals are decoded back to parallel signals by the decoder IC HT12D after being received by the receiver. The signals after being inverted are then applied to the motor driver IC, to drive the motor.  By varying the logics applied to pins 2, 7, 10 and 15, the motor directions can be changed.

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