NRF24L01+ Wireless 2.4G Communication Module

Typically, two units are required, both being integrated for transmitting and receiving. However, one unit can only transmit or receive, rather than simultaneously!

1. Product Features

(1) 2.4 GHz global open ISM band license-free use.

(2) Maximum data rate of 2Mbps, high-efficiency GFSK modulation, strong anti-interference capability, making it ideal for industrial control applications.

(3) 125 channels for multi-point communication and frequency hopping communication.

(4) Hardware CRC error detection and point-to-multipoint communication address control.

(5) Low-power operation at 1.9～3.6V, with a current of only 1uA in Power Down mode.

(6) Built-in 2.4GHz antenna, compact in size at about 24x24mm(excluding the antenna).

(7) The module can be programmed with an address, and data (with interrupt indication) is only output upon receiving the local address. It can directly connect to various microcontrollers for software programming.

(8) The voltage stabilization circuit ensures excellent communication performance when using various power supplies like DC or DC switch.

(9) Standard DIP spacing interface for easy integration into embedded systems.

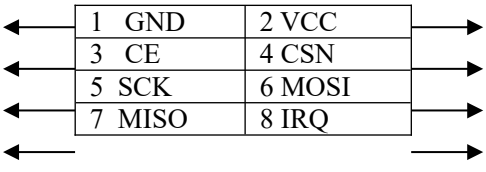
(10) RFModule-Quick-DEV rapid development system (development board, source code, etc.), which is ready-to-use and easy to get started.

2. Performance Parameters

(1) 100m unobstructed line of sight in open areas.

(2) Dimensions of 34mm * 17mm * 1mm

(3) Audio and video transmission



NRF24L01 Transmitter Code

```
/*********************************************************************
**  Device:  nRF24L01+                                              **
**  File:   EF_nRF24L01_TX.c                                        **
**   SPI-compatible                                                 **
**   CS - to digital pin 8                                          **
**   CSN - to digital pin 9  (SS pin)                               **
**   SCK - to digital pin 10 (SCK pin)                              **
**   MOSI - to digital pin 11 (MOSI pin)                            **
**   MISO - to digital pin 12 (MISO pin)                            **
**   IRQ - to digital pin 13 (MISO pin)                             **
*********************************************************************/


#include "NRF24L01.h"

//*************************************************
#define TX_ADR_WIDTH    5   // 5 unsigned chars TX(RX) address width
#define TX_PLOAD_WIDTH  32  // 32 unsigned chars TX payload

unsigned char TX_ADDRESS[TX_ADR_WIDTH]  =
{
  0x34,0x43,0x10,0x10,0x01
}; // Define a static TX address

unsigned char rx_buf[TX_PLOAD_WIDTH] = {0}; // initialize value
unsigned char tx_buf[TX_PLOAD_WIDTH] = {0};
//*************************************************
void setup()
{
  pinMode(CE,  OUTPUT);
  pinMode(SCK, OUTPUT);
  pinMode(CSN, OUTPUT);
  pinMode(MOSI,  OUTPUT);
  pinMode(MISO, INPUT);
  pinMode(IRQ, INPUT);
  //  attachInterrupt(1, _ISR, LOW);// interrupt enable
  Serial.begin(9600);
  init_io();                          // Initialize IO port
  unsigned char status=SPI_Read(STATUS);
  Serial.print("status = ");
  Serial.println(status,HEX);     // There is read the mode鈥樷 status register, th
e default value should be 鈥槓鈥?  Serial.println("******************TX_Mode Start
```

```
**************************");
  TX_Mode();                          // set TX mode
}
void loop()
{
  int k = 0;
  for(;;)
  {
    for(int i=0; i<32; i++)
        tx_buf[i] = k++;
    unsigned char status = SPI_Read(STATUS);                    // read register STA
TUS's value
    if(status&TX_DS)                                            // if receive data r
eady (TX_DS) interrupt
    {
      SPI_RW_Reg(FLUSH_TX,0);
      SPI_Write_Buf(WR_TX_PLOAD,tx_buf,TX_PLOAD_WIDTH);       // write playload to
TX_FIFO
    }
    if(status&MAX_RT)                                           // if receive data re
ady (MAX_RT) interrupt, this is retransmit than  SETUP_RETR
    {
      SPI_RW_Reg(FLUSH_TX,0);
      SPI_Write_Buf(WR_TX_PLOAD,tx_buf,TX_PLOAD_WIDTH);      // disable standy-mode
    }
    SPI_RW_Reg(WRITE_REG+STATUS,status);                       // clear RX_DR or TX_D
S or MAX_RT interrupt flag
    delay(1000);
  }
}

//*************************************************
// Function: init_io();
// Description:
// flash led one time,chip enable(ready to TX or RX Mode),
// Spi disable,Spi clock line init high
//*************************************************
void init_io(void)
{
  digitalWrite(IRQ, 0);
  digitalWrite(CE, 0);            // chip enable
  digitalWrite(CSN, 1);                 // Spi disable
}
```

```
/**************************************************
 * Function: SPI_RW();
 *
 * Description:
 * Writes one unsigned char to nRF24L01, and return the unsigned char read
 * from nRF24L01 during write, according to SPI protocol
 **************************************************/
unsigned char SPI_RW(unsigned char Byte)
{
  unsigned char i;
  for(i=0;i<8;i++)                      // output 8-bit
  {
    if(Byte&0x80)
    {
      digitalWrite(MOSI, 1);
    }
    else
    {
      digitalWrite(MOSI, 0);
    }
    digitalWrite(SCK, 1);
    Byte <<= 1;                         // shift next bit into MSB..
    if(digitalRead(MISO) == 1)
    {
      Byte |= 1;                         // capture current MISO bit
    }
    digitalWrite(SCK, 0);
  }
  return(Byte);                        // return read unsigned char
}
/**************************************************/

/**************************************************
 * Function: SPI_RW_Reg();
 *
 * Description:
 * Writes value 'value' to register 'reg'
/**************************************************/
unsigned char SPI_RW_Reg(unsigned char reg, unsigned char value)
{
  unsigned char status;

  digitalWrite(CSN, 0);                  // CSN low, init SPI transaction
  status = SPI_RW(reg);                  // select register
```

```
  SPI_RW(value);                          // ..and write value to it..
  digitalWrite(CSN, 1);                   // CSN high again

  return(status);                   // return nRF24L01 status unsigned char
}
/****************************************************/

/****************************************************
 * Function: SPI_Read();
 *
 * Description:
 * Read one unsigned char from nRF24L01 register, 'reg'
/****************************************************/
unsigned char SPI_Read(unsigned char reg)
{
  unsigned char reg_val;

  digitalWrite(CSN, 0);           // CSN low, initialize SPI communication...
  SPI_RW(reg);                    // Select register to read from..
  reg_val = SPI_RW(0);            // ..then read register value
  digitalWrite(CSN, 1);           // CSN high, terminate SPI communication

  return(reg_val);                // return register value
}
/****************************************************/

/****************************************************
 * Function: SPI_Read_Buf();
 *
 * Description:
 * Reads 'unsigned chars' #of unsigned chars from register 'reg'
 * Typically used to read RX payload, Rx/Tx address
/****************************************************/
unsigned char SPI_Read_Buf(unsigned char reg, unsigned char *pBuf, unsigned char by
tes)
{
  unsigned char status,i;

  digitalWrite(CSN, 0);                   // Set CSN low, init SPI tranaction
  status = SPI_RW(reg);               // Select register to write to and read statu
s unsigned char

  for(i=0;i<bytes;i++)
  {
```

```
    pBuf[i] = SPI_RW(0);    // Perform SPI_RW to read unsigned char from nRF24L01
  }

  digitalWrite(CSN, 1);                   // Set CSN high again

  return(status);                  // return nRF24L01 status unsigned char
}
/****************************************************/

/****************************************************
 * Function: SPI_Write_Buf();
 *
 * Description:
 * Writes contents of buffer '*pBuf' to nRF24L01
 * Typically used to write TX payload, Rx/Tx address
/****************************************************/
unsigned char SPI_Write_Buf(unsigned char reg, unsigned char *pBuf, unsigned char b
ytes)
{
  unsigned char status,i;

  digitalWrite(CSN, 0);                  // Set CSN low, init SPI tranaction
  status = SPI_RW(reg);             // Select register to write to and read status
unsigned char
  for(i=0;i<bytes; i++)             // then write all unsigned char in buffer(*pBu
f)
  {
    SPI_RW(*pBuf++);
  }
  digitalWrite(CSN, 1);                   // Set CSN high again
  return(status);                  // return nRF24L01 status unsigned char
}
/****************************************************/

/****************************************************
 * Function: TX_Mode();
 *
 * Description:
 * This function initializes one nRF24L01 device to
 * TX mode, set TX address, set RX address for auto.ack,
 * fill TX payload, select RF channel, datarate & TX pwr.
 * PWR_UP is set, CRC(2 unsigned chars) is enabled, & PRIM:TX.
 *
 * ToDo: One high pulse(>10us) on CE will now send this
```

```
 * packet and expext an acknowledgment from the RX device.
 ***********************************************/
void TX_Mode(void)
{
  digitalWrite(CE, 0);

  SPI_Write_Buf(WRITE_REG + TX_ADDR, TX_ADDRESS, TX_ADR_WIDTH);    // Writes TX_Add
ress to nRF24L01
  SPI_Write_Buf(WRITE_REG + RX_ADDR_P0, TX_ADDRESS, TX_ADR_WIDTH); // RX_Addr0 same
as TX_Adr for Auto.Ack

  SPI_RW_Reg(WRITE_REG + EN_AA, 0x01);      // Enable Auto.Ack:Pipe0
  SPI_RW_Reg(WRITE_REG + EN_RXADDR, 0x01);  // Enable Pipe0
  SPI_RW_Reg(WRITE_REG + SETUP_RETR, 0x1a); // 500us + 86us, 10 retrans...
  SPI_RW_Reg(WRITE_REG + RF_CH, 40);        // Select RF channel 40
  SPI_RW_Reg(WRITE_REG + RF_SETUP, 0x07);   // TX_PWR:0dBm, Datarate:2Mbps, LNA:HCU
RR
  SPI_RW_Reg(WRITE_REG + CONFIG, 0x0e);     // Set PWR_UP bit, enable CRC(2 unsigne
d chars) & Prim:TX. MAX_RT & TX_DS enabled..
  SPI_Write_Buf(WR_TX_PLOAD,tx_buf,TX_PLOAD_WIDTH);

  digitalWrite(CE, 1);
}
```

****

NRF24L01 Receiver Code

```
/*********************************************************************
**  Device:  nRF24L01+                                              **
**  File:   EF_nRF24L01_TX.c                                        **
**   SPI-compatible                                                 **
**   CS - to digital pin 8                                          **
**   CSN - to digital pin 9  (SS pin)                               **
**   SCK - to digital pin 10 (SCK pin)                              **
**   MOSI - to digital pin 11 (MOSI pin)                            **
**   MISO - to digital pin 12 (MISO pin)                            **
**   IRQ - to digital pin 13 (MISO pin)                             **
*********************************************************************/

#include "NRF24L01.h"
```

```
//*************************************************
#define TX_ADR_WIDTH    5   // 5 unsigned chars TX(RX) address width
#define TX_PLOAD_WIDTH  32  // 32 unsigned chars TX payload

unsigned char TX_ADDRESS[TX_ADR_WIDTH]  =
{
  0x34,0x43,0x10,0x10,0x01
}; // Define a static TX address

unsigned char rx_buf[TX_PLOAD_WIDTH];
unsigned char tx_buf[TX_PLOAD_WIDTH];
//*************************************************
void setup()
{
  pinMode(CE,  OUTPUT);
  pinMode(SCK, OUTPUT);
  pinMode(CSN, OUTPUT);
  pinMode(MOSI,  OUTPUT);
  pinMode(MISO, INPUT);
  pinMode(IRQ, INPUT);
  //  attachInterrupt(1, _ISR, LOW); // interrupt enable
  Serial.begin(9600);
  init_io();                         // Initialize IO port
  unsigned char status=SPI_Read(STATUS);
  Serial.print("status = ");
  Serial.println(status,HEX);      // There is read the mode鈥樷 status register, t
he default value should be 鈥槓鈥?
  Serial.println("*****************RX_Mode start*****************************R");
  RX_Mode();                         // set RX mode
}
void loop()
{
  for(;;)
  {
    unsigned char status = SPI_Read(STATUS);                          // read regist
er STATUS's value
    if(status&RX_DR)                                                  // if receive
data ready (TX_DS) interrupt
    {
      SPI_Read_Buf(RD_RX_PLOAD, rx_buf, TX_PLOAD_WIDTH);              // read playlo
ad to rx_buf
      SPI_RW_Reg(FLUSH_RX,0);                                         // clear RX_FI
FO
```

```
      for(int i=0; i<32; i++)
      {
          Serial.print(" ");
          Serial.print(rx_buf[i],HEX);                                  // print rx_buf
      }
      Serial.println(" ");
    }
    SPI_RW_Reg(WRITE_REG+STATUS,status);                                 // clear RX_DR
or TX_DS or MAX_RT interrupt flag
    delay(1000);
  }
}

//****************************************************
// Function: init_io();
// Description:
// flash led one time,chip enable(ready to TX or RX Mode),
// Spi disable,Spi clock line init high
//****************************************************
void init_io(void)
{
  digitalWrite(IRQ, 0);
  digitalWrite(CE, 0);           // chip enable
  digitalWrite(CSN, 1);                 // Spi disable
}

/****************************************************
 * Function: SPI_RW();
 *
 * Description:
 * Writes one unsigned char to nRF24L01, and return the unsigned char read
 * from nRF24L01 during write, according to SPI protocol
 ****************************************************/
unsigned char SPI_RW(unsigned char Byte)
{
  unsigned char i;
  for(i=0;i<8;i++)                      // output 8-bit
  {
    if(Byte&0x80)
    {
      digitalWrite(MOSI, 1);    // output 'unsigned char', MSB to MOSI
    }
    else
    {
```

```
      digitalWrite(MOSI, 0);
    }
    digitalWrite(SCK, 1);                     // Set SCK high..
    Byte <<= 1;                           // shift next bit into MSB..
    if(digitalRead(MISO) == 1)
    {
      Byte |= 1;                           // capture current MISO bit
    }
    digitalWrite(SCK, 0);             // ..then set SCK low again
  }
  return(Byte);                       // return read unsigned char
}
/****************************************************/

/****************************************************
 * Function: SPI_RW_Reg();
 *
 * Description:
 * Writes value 'value' to register 'reg'
/****************************************************/
unsigned char SPI_RW_Reg(unsigned char reg, unsigned char value)
{
  unsigned char status;

  digitalWrite(CSN, 0);                   // CSN low, init SPI transaction
  status = SPI_RW(reg);                   // select register
  SPI_RW(value);                          // ..and write value to it..
  digitalWrite(CSN, 1);                   // CSN high again

  return(status);                   // return nRF24L01 status unsigned char
}
/****************************************************/

/****************************************************
 * Function: SPI_Read();
 *
 * Description:
 * Read one unsigned char from nRF24L01 register, 'reg'
/****************************************************/
unsigned char SPI_Read(unsigned char reg)
{
  unsigned char reg_val;

  digitalWrite(CSN, 0);           // CSN low, initialize SPI communication...
```

```
  SPI_RW(reg);                    // Select register to read from..
  reg_val = SPI_RW(0);            // ..then read register value
  digitalWrite(CSN, 1);           // CSN high, terminate SPI communication

  return(reg_val);                // return register value
}
/**************************************************/

/**************************************************
 * Function: SPI_Read_Buf();
 *
 * Description:
 * Reads 'unsigned chars' #of unsigned chars from register 'reg'
 * Typically used to read RX payload, Rx/Tx address
/**************************************************/
unsigned char SPI_Read_Buf(unsigned char reg, unsigned char *pBuf, unsigned char by
tes)
{
  unsigned char status,i;

  digitalWrite(CSN, 0);                   // Set CSN low, init SPI tranaction
  status = SPI_RW(reg);               // Select register to write to and read statu
s unsigned char

  for(i=0;i<bytes;i++)
  {
    pBuf[i] = SPI_RW(0);    // Perform SPI_RW to read unsigned char from nRF24L01
  }

  digitalWrite(CSN, 1);                    // Set CSN high again

  return(status);                  // return nRF24L01 status unsigned char
}
/**************************************************/

/**************************************************
 * Function: SPI_Write_Buf();
 *
 * Description:
 * Writes contents of buffer '*pBuf' to nRF24L01
 * Typically used to write TX payload, Rx/Tx address
/**************************************************/
unsigned char SPI_Write_Buf(unsigned char reg, unsigned char *pBuf, unsigned char b
ytes)
```

```
{
  unsigned char status,i;

  digitalWrite(CSN, 0);                    // Set CSN low, init SPI tranaction
  status = SPI_RW(reg);             // Select register to write to and read status
unsigned char
  for(i=0;i<bytes; i++)             // then write all unsigned char in buffer(*pBu
f)
  {
    SPI_RW(*pBuf++);
  }
  digitalWrite(CSN, 1);                   // Set CSN high again
  return(status);                  // return nRF24L01 status unsigned char
}
/****************************************************/

/**************************************************
 * Function: RX_Mode();
 *
 * Description:
 * This function initializes one nRF24L01 device to
 * RX Mode, set RX address, writes RX payload width,
 * select RF channel, datarate & LNA HCURR.
 * After init, CE is toggled high, which means that
 * this device is now ready to receive a datapacket.
/**************************************************/
void RX_Mode(void)
{
  digitalWrite(CE, 0);
  SPI_Write_Buf(WRITE_REG + RX_ADDR_P0, TX_ADDRESS, TX_ADR_WIDTH); // Use the same
address on the RX device as the TX device
  SPI_RW_Reg(WRITE_REG + EN_AA, 0x01);      // Enable Auto.Ack:Pipe0
  SPI_RW_Reg(WRITE_REG + EN_RXADDR, 0x01);  // Enable Pipe0
  SPI_RW_Reg(WRITE_REG + RF_CH, 40);        // Select RF channel 40
  SPI_RW_Reg(WRITE_REG + RX_PW_P0, TX_PLOAD_WIDTH); // Select same RX payload width
as TX Payload width
  SPI_RW_Reg(WRITE_REG + RF_SETUP, 0x07);   // TX_PWR:0dBm, Datarate:2Mbps, LNA:HCU
RR
  SPI_RW_Reg(WRITE_REG + CONFIG, 0x0f);     // Set PWR_UP bit, enable CRC(2 unsigne
d chars) & Prim:RX. RX_DR enabled..
  digitalWrite(CE, 1);                             // Set CE pin high to enable RX
device
  //  This device is now ready to receive one packet of 16 unsigned chars payload f
rom a TX device sending to address
```

```
  //  '3443101001', with auto acknowledgment, retransmit count of 10, RF channel 40
and datarate = 2Mbps.
}
/*************************************************/
```