# RF12 programming guide

## 1. Brief description

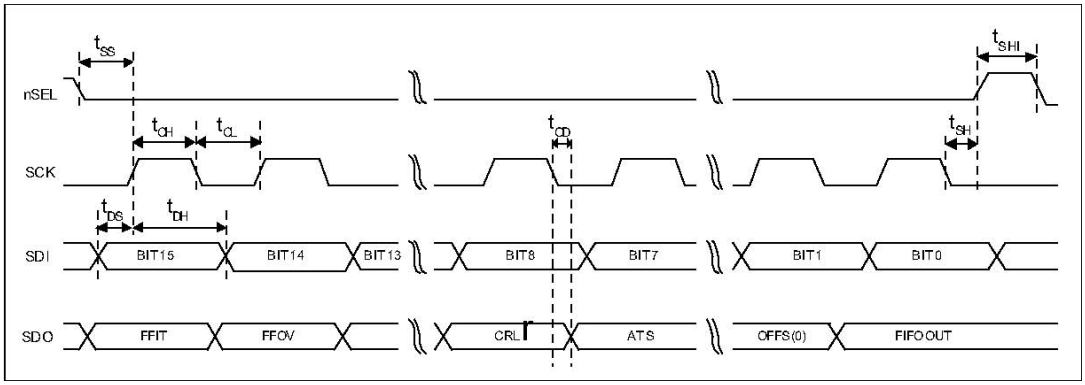
RF12 is a low cost FSK transceiver IC witch integrated all RF functions in a single chip. It only need a MCU, a crystal, a decouple capacitor and antenna to build a hi reliable FSK transceiver system. The operation frequency can cover 300 to 1000MHz.

RF12 supports a command interface to setup frequency, deviation, output power and also data rate. No need any hardware adjustment when using in frequency-hopping applications

RF12 can be used in applications such as remote control toys, wireless alarm, wireless sensor, wireless keyboard/mouse, home-automation and wireless data collection.

## 2. Commands

### 1. Timing diagram




### 2. Configuration Setting Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | el | ef | b1 | b0 | x3 | x2 | x1 | x0 | 8008h |

e l: Enable TX register

e f: Enable RX FIFO buffer

b1..b0: select band

| b1 | b0 | band[MHz] |
|---|---|---|
| 0 | 0 | 315 |
| 0 | 1 | 433 |
| 1 | 0 | 868 |
| 1 | 1 | 915 |

x3..x0: select crystal load capacitor

| x3 | x2 | x1 | x0 | load capacitor [pF] |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 8.5 |
| 0 | 0 | 0 | 1 | 9.0 |
| 0 | 0 | 1 | 0 | 9.5 |
| 0 | 0 | 1 | 1 | 10.0 |
| …… | | …… | | |
| 1 | 1 | 1 | 0 | 15.5 |
| 1 | 1 | 1 | 1 | 16.0 |

### 3. Power Management Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | er | ebb | et | es | ex | eb | ew | dc | 8208h |

er： Enable receiver
ebb： Enable base band block
et： Enable transmitter
es： Enable synthesizer
ex： Enable crystal oscillator
eb： Enable low battery detector
ew： Enable wake-up timer
dc： Disable clock output of CLK pin

### 4. Frequency Setting Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 1 | 0 | f11 | f10 | f9 | f8 | f7 | f6 | f5 | f4 | f3 | f2 | f1 | f0 | A680h |

f11..f0: Set operation frequency:
315band: Fc=310+F*0.0025 MHz
433band: Fc=430+F*0.0025 MHz
868band: Fc=860+F*0.0050 MHz
915band: Fc=900+F*0.0075 MHz
Fc is carrier frequency and F is the frequency parameter. 36≤F≤3903

### 5. Data Rate Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | cs | r6 | r5 | r4 | r3 | r2 | r1 | r0 | C623h |

r6..r0: Set data rate:

BR=10000000/29/（R+1）/（1+cs*7）

### 6. Receiver Control Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 0 | 1 | 0 | p20 | d1 | d0 | i2 | i1 | i0 | g1 | g0 | r2 | r1 | r0 | 9080h |

p20: select function of pin20

| p20 | |
|---|---|
| 0 | External interrupt in |
| 1 | VDI output |

i2..i0:select baseband bandwidth

| i2 | i1 | i0 | Baseband Bandwidth [kHz] |
|---|---|---|---|
| 0 | 0 | 0 | reserved |
| 0 | 0 | 1 | 400 |
| 0 | 1 | 0 | 340 |
| 0 | 1 | 1 | 270 |
| 1 | 0 | 0 | 200 |
| 1 | 0 | 1 | 134 |
| 1 | 1 | 0 | 67 |
| 1 | 1 | 1 | reserved |

d1..d0: select VDI response time

| d1 | d0 | Response |
|---|---|---|
| 0 | 0 | Fast |
| 0 | 1 | Medium |
| 1 | 0 | Slow |
| 1 | 1 | Always on |

g1..g0: select LNA gain

| g1 | g0 | LNA gain (dBm) |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | -6 |
| 1 | 0 | -14 |
| 1 | 1 | -20 |

r2..r0: select DRSSI threshold

| r2 | r1 | r0 | RSSIsetth [dBm] |
|---|---|---|---|
| 0 | 0 | 0 | -103 |
| 0 | 0 | 1 | -97 |
| 0 | 1 | 0 | -91 |
| 0 | 1 | 1 | -85 |
| 1 | 0 | 0 | -79 |
| 1 | 0 | 1 | -73 |
| 1 | 1 | 0 | -67 |
| 1 | 0 | 1 | -61 |

The actual DRSSI threshold is related to LNA setup:

$RSSI_{th} = RSSI_{setth} + G_{LNA.}$

### 7. Data Filter Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | al | ml | 1 | s | 1 | f2 | f1 | f0 | C22Ch |

al: Enable clock recovery auto-lock

ml: Enable clock recovery fast mode

s1..s0: select data filter type

| s1 | s0 | Filter type |
|---|---|---|
| 0 | 0 | OOK |
| 0 | 1 | Digital filter |
| 1 | 0 | reserved |

f1..f0: Set DQD threshold

### 8. Output and FIFO mode Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | f3 | f2 | f1 | f0 | 0 | al | ff | dr | CA80h |

f3..f0: Set FIFO interrupt level

al: select FIFO fill start condition

| al | |
|---|---|
| 0 | Sync-word |
| 1 | Always |

ff: Enable FIFO fill

dr: Disable hi sensitivity reset mode

### 9. Receiver FIFO Read Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B000h |

This command is used to read FIFO data when FFIT interrupt generated. FIFO data output starts at 8th SCK period.

10. **AFC Command**

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | a1 | a0 | rl1 | rl0 | st | fi | oe | en | C4F7h |

a1..a0: select AFC auto-mode：

| a1 | a0 | |
|---|---|---|
| 0 | 0 | Controlled by MCU |
| 0 | 1 | Run once at power on |
| 1 | 0 | Keep offset when VDI hi |
| 1 | 1 | Keeps independently from VDI |

rl1..rl0: select range limit

| r1 | r0 | range（fres） |
|---|---|---|
| 0 | 0 | No restriction |
| 0 | 1 | +15/-16 |
| 1 | 0 | +7/-8 |
| 1 | 1 | +3-4 |

fres

315，433band: 2.5kHz
868band: 5kHz
915band: 7.5kHz

st: st goes hi will store offset into output register
fi: Enable AFC hi accuracy mode
oe: Enable AFC output register
en: Enable AFC funcition

11. **AFC Command**

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 0 | 1 | 1 | 0 | 0 | mp | m3 | m2 | m1 | m0 | 0 | p2 | p1 | p0 | 9800h |

m: select modulation polarity
m2..m0: select frequency deviation:

| m3 | m2 | m1 | m0 | frequency deviation [kHz] |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 15 |
| 0 | 0 | 0 | 1 | 30 |
| 0 | 0 | 1 | 0 | 45 |
| 0 | 0 | 1 | 1 | 60 |
| 0 | 1 | 0 | 0 | 75 |
| 0 | 1 | 0 | 1 | 90 |

| | | | | |
|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 105 |
| 0 | 1 | 1 | 1 | 120 |
| 1 | 0 | 0 | 0 | 135 |
| 1 | 0 | 0 | 1 | 150 |
| 1 | 0 | 1 | 0 | 165 |
| 1 | 0 | 1 | 1 | 180 |
| 1 | 1 | 0 | 0 | 195 |
| 1 | 1 | 0 | 1 | 210 |
| 1 | 1 | 1 | 0 | 225 |
| 1 | 1 | 1 | 1 | 240 |

p2..p0: select output power

| p2 | p1 | p0 | Output power[dBm] |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | -3 |
| 0 | 1 | 0 | -6 |
| 0 | 1 | 1 | -9 |
| 1 | 0 | 0 | -12 |
| 1 | 0 | 1 | -15 |
| 1 | 1 | 0 | -18 |
| 1 | 0 | 1 | -21 |

### 12. Transmitter Register Write Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | t7 | t6 | t5 | t4 | t3 | t2 | t1 | t0 | B8AAh |

This command is use to write a data byte to RF12 and then RF12 transmit it

### 13. Wake-Up Timer Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 1 | r4 | r3 | r2 | r1 | r0 | m7 | m6 | m5 | m4 | m3 | m2 | m1 | m0 | E196h |

The wake-up period is determined by:

$T_{wake-up} = M * 2^R$ [ms]

For continual operation, bit 'ew' must be cleared and set

### 14. 低占空比命令（Low Duty-Cycle Command）

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | d6 | d5 | d4 | d3 | d2 | d1 | d0 | en | C8OEh |

d6..d0: Set duty cycle

D.C.= (D * 2 +1) / M *100%

en：Enable low duty cycle mode

### 15. Low Battery Detector and Microcontroller Clock Divider Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | d2 | d1 | d0 | v4 | v3 | v2 | v1 | v0 | C000h |

d2..d0: select frequency of CLK pin

| d2 | d1 | d0 | Clock frequency[MHz] |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1.25 |
| 0 | 1 | 0 | 1.66 |
| 0 | 1 | 1 | 2 |
| 1 | 0 | 0 | 2.5 |
| 1 | 0 | 1 | 3.33 |
| 1 | 1 | 0 | 5 |
| 1 | 1 | 1 | 10 |

CLK signal is derive form crystal oscillator and it can be applied to MCU clock in to save a second crystal.

If not used, please set bit “dc” to disable CLK output

To integrate the load capacitor internal can not only save cost, but also adjust reference frequency by software

v4..v0: Set threshold voltage of Low battery detector：

Vlb=2.2+V*0.1 [V]

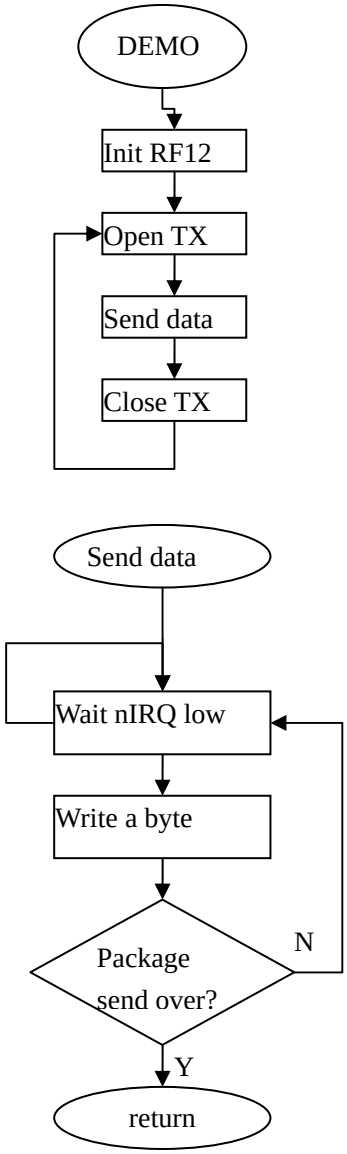
### 16. Status Read Command

| bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | POR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | - |

This command starts with a 0 and be used to read internal status register

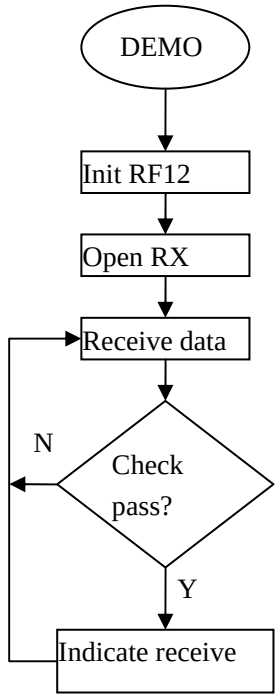
## 3. Demo flow diagram

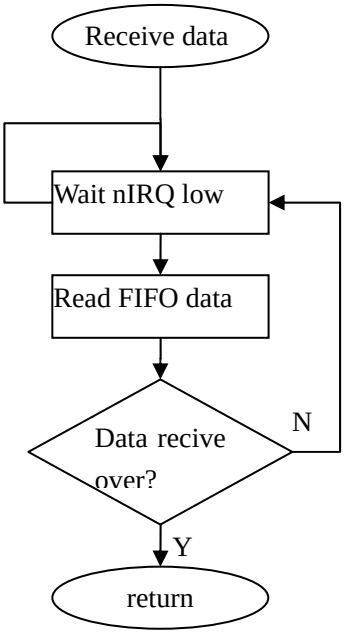
Transmitter:




Note: Initialize RF12 and open transmitter, RF12 will transmit a byte and pull nIRQ low when transmit over, then MCU can write next byte to transmit

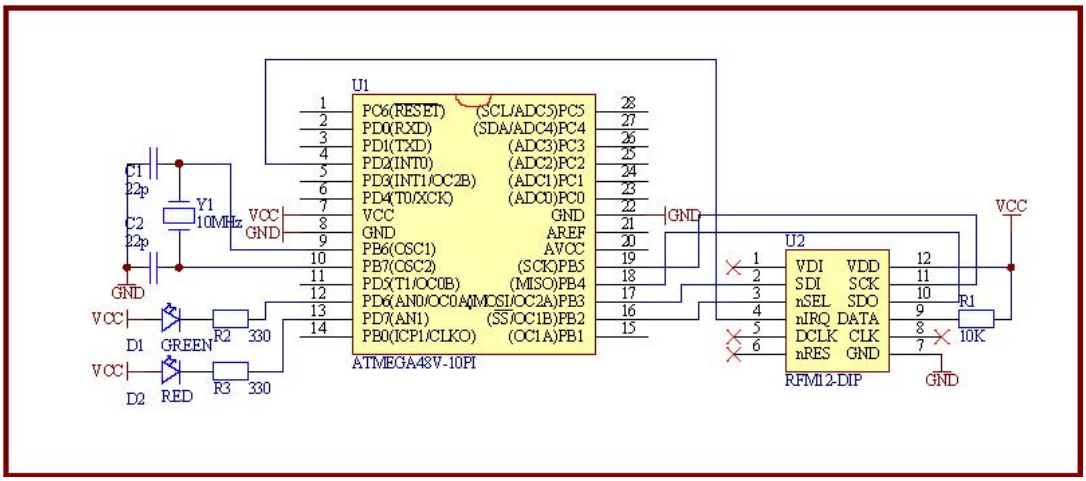
Receiver:




**Note:** After RF12 initialization, Open FIFO receive mode and wait nIRQ low, only then MCU can read received and stored in FIFO data. For next package receive, please reset FIFO.

## 4. Example 1（for AVR microcontroller）




RF12 transmitter demo:

```
/*
                ;   copyright (c) 2006
                ;Title              RF12 TX simple example based on AVR C
                ;Company:           Hope microelectronic Co.,Ltd.
                ;Author:            Tank
                ;Current version:   v1.0
                ;Date:              2006-11-13
                ;processor          ATMEGA48
                ;Clock:             10MHz Crystal
                ;Contact:           +86-0755-86106557
                ;E-MAIL:            hopefsk@hoperf.com


                Connections

      ATMEGA48 SIDE       RF12 SIDE
        SCK---------------->SCK
       MISO---------------->SDO
       MOSI---------------->SDI
         SS---------------->nSEL
       INT0<----------------nIRQ

       PD6: LED GREEN
       PD7: LED RED

*/
```

```
#include <mega48.h>


#define DDR_IN          0
#define DDR_OUT         1

#define PORT_SEL        PORTB
#define PIN_SEL         PINB
#define DDR_SEL         DDRB

#define PORT_SDI        PORTB
#define PIN_SDI         PINB
#define DDR_SDI         DDRB

#define PORT_SCK        PORTB
#define PIN_SCK         PINB
#define DDR_SCK         DDRB

#define PORT_SDO        PORTB
#define PIN_SDO         PINB
#define DDR_SDO         DDRB

#define PORT_DATA       PORTD
#define PIN_DATA        PIND
#define DDR_DATA        DDRD

#define PB7             7//--\
#define PB6             6//  |
#define RFXX_SCK        5//  |
#define RFXX_SDO        4//  |RF_PORT
#define RFXX_SDI        3//  |
#define RFXX_SEL        2//  |
#define NC              1//  |
#define PB0             0//--/

#define SEL_OUTPUT()    DDR_SEL |= (1<<RFXX_SEL)
#define HI_SEL()        PORT_SEL|= (1<<RFXX_SEL)
#define LOW_SEL()       PORT_SEL&=~(1<<RFXX_SEL)

#define SDI_OUTPUT()    DDR_SDI |= (1<<RFXX_SDI)
#define HI_SDI()        PORT_SDI|= (1<<RFXX_SDI)
```

```
#define LOW_SDI()        PORT_SDI&=~(1<<RFXX_SDI)

#define SDO_INPUT()      DDR_SDO&= ~(1<<RFXX_SDO)
#define SDO_HI()         PIN_SDO&(1<<RFXX_SDO)

#define SCK_OUTPUT()     DDR_SCK |= (1<<RFXX_SCK)
#define HI_SCK()         PORT_SCK|= (1<<RFXX_SCK)
#define LOW_SCK()        PORT_SCK&=~(1<<RFXX_SCK)

#define RF12_DATA        4//PD4
#define DATA_OUT         DDR_DATA|=1<<RF12_DATA
#define HI_DATA          PORT_DATA|=1<<RF12_DATA

#define LEDG_OUTPUT()    DDRD|=~(1<<6)
#define LEDR_OUTPUT()    DDRD|=~(1<<7)

#define LEDG_ON()        PORTD&=~(1<<6)
#define LEDG_OFF()       PORTD|=~(1<<6)
#define LEDR_ON()        PORTD&=~(1<<7)
#define LEDR_OFF()       PORTD|=~(1<<7)


void RFXX_PORT_INIT(void){
  HI_SEL();
  HI_SDI();
  LOW_SCK();
  SEL_OUTPUT();
  SDI_OUTPUT();
  SDO_INPUT();
  SCK_OUTPUT();
}
unsigned int RFXX_WRT_CMD(unsigned int aCmd){
  unsigned char i;
  unsigned int temp;
  LOW_SCK();
  LOW_SEL();
  for(i=0;i<16;i++){
    temp<<=1;
    if(SDO_HI()){
      temp|=0x0001;
    }
    LOW_SCK();
    if(aCmd&0x8000){
      HI_SDI();
```

```
    }else{
      LOW_SDI();
    }
    HI_SCK();
    aCmd<<=1;
  };
  LOW_SCK();
  HI_SEL();
  return(temp);
}
void RF12_INIT(void){
  RFXX_WRT_CMD(0x80D7);//EL,EF,433band,12.0pF
  RFXX_WRT_CMD(0x8239);//!er,!ebb,ET,ES,EX,!eb,!ew,DC
  RFXX_WRT_CMD(0xA640);//434MHz
  RFXX_WRT_CMD(0xC647);//4.8kbps
  RFXX_WRT_CMD(0x94A0);//VDI,FAST,134kHz,0dBm,-103dBm
  RFXX_WRT_CMD(0xC2AC);//AL,!ml,DIG,DQD4
  RFXX_WRT_CMD(0xCA81);//FIFO8,SYNC,!ff,DR
  RFXX_WRT_CMD(0xC483);//@PWR,NO RSTRIC,!st,!fi,OE,EN
  RFXX_WRT_CMD(0x9850);//!mp,90kHz,MAX OUT
  RFXX_WRT_CMD(0xE000);//NOT USE
  RFXX_WRT_CMD(0xC800);//NOT USE
  RFXX_WRT_CMD(0xC040);//1.66MHz,2.2V
}
void RF12_SEND(unsigned char aByte){
  while(PIND&(1<<2));//wait for previously TX over
  RFXX_WRT_CMD(0xB800+aByte);
}

void Delay_ms(unsigned char amS){
  unsigned char i;
  unsigned int j;
  for(i=0;i<amS;i++)for(j=0;j<914;j++);
}
void main(void)
{
  unsigned int i,j;
  unsigned char ChkSum;

  #asm("cli");
  DDRB=0x00;//PB INPUT;
  DDRD=0x00;//PD INPUT;

  //POWER ON indication: both LEDR and LEDG blink 3 times
```

```
LEDG_OFF();
LEDR_OFF();
LEDG_OUTPUT();
LEDR_OUTPUT();
for(i=0;i<3;i++){
  Delay_ms(200);
  LEDG_ON();
  LEDR_ON();
  Delay_ms(200);
  LEDG_OFF();
  LEDR_OFF();
}

  LEDG_OFF();
  LEDR_OFF();

RFXX_PORT_INIT();

RF12_INIT();

DDRD|=(1<<RF12_DATA);
PORTD|=(1<<RF12_DATA);// SET nFFS pin HI when using TX register
DDRD&=~(1<<2);        //PD2(INT0)


while(1){
  LEDR_ON();
  RFXX_WRT_CMD(0x0000);//read status register
  RFXX_WRT_CMD(0x8239);//!er,!ebb,ET,ES,EX,!eb,!ew,DC

  ChkSum=0;
  RF12_SEND(0xAA);//PREAMBLE
  RF12_SEND(0xAA);//PREAMBLE
  RF12_SEND(0xAA);//PREAMBLE
  RF12_SEND(0x2D);//SYNC HI BYTE
  RF12_SEND(0xD4);//SYNC LOW BYTE
  RF12_SEND(0x30);//DATA BYTE 0
  ChkSum+=0x30;
  RF12_SEND(0x31);//DATA BYTE 1
  ChkSum+=0x31;
  RF12_SEND(0x32);
  ChkSum+=0x32;
  RF12_SEND(0x33);
  ChkSum+=0x33;
```

```
    RF12_SEND(0x34);
    ChkSum+=0x34;
    RF12_SEND(0x35);
    ChkSum+=0x35;
    RF12_SEND(0x36);
    ChkSum+=0x36;
    RF12_SEND(0x37);
    ChkSum+=0x37;
    RF12_SEND(0x38);
    ChkSum+=0x38;
    RF12_SEND(0x39);
    ChkSum+=0x39;
    RF12_SEND(0x3A);
    ChkSum+=0x3A;
    RF12_SEND(0x3B);
    ChkSum+=0x3B;
    RF12_SEND(0x3C);
    ChkSum+=0x3C;
    RF12_SEND(0x3D);
    ChkSum+=0x3D;
    RF12_SEND(0x3E);
    ChkSum+=0x3E;
    RF12_SEND(0x3F);    //DATA BYTE 15
    ChkSum+=0x3F;
    RF12_SEND(ChkSum);  //send chek sum
    RF12_SEND(0xAA);//DUMMY BYTE
    RF12_SEND(0xAA);//DUMMY BYTE
    RF12_SEND(0xAA);//DUMMY BYTE

    RFXX_WRT_CMD(0x8201);
    LEDR_OFF();
    LEDG_OFF();
    for(i=0;i<10000;i++)for(j=0;j<123;j++);//sleep 1 second appr.

  };
}
```

RF12 receiver demo

```
/*
                ;   copyright (c) 2006
                ;Title              RF12 RX simple example based on AVR C
                ;Company:           Hope microelectronic Co.,Ltd.
```

```
                ;Author:            Tank
                ;Current version:   v1.0
                ;Date:              2006-11-17
                ;processor          ATMEGA48
                ;Clock:             10MHz Crystal
                ;Contact:           +86-0755-86106557
                ;E-MAIL:            hopefsk@hoperf.com


                Connections

       ATMEGA48 SIDE       RF12 SIDE
         SCK---------------->SCK
        MISO<----------------SDO
        MOSI---------------->SDI
          SS---------------->nSEL
         PD4---------------->FSK/DATA
        INT0<----------------nIRQ

        PD6: LED GREEN
        PD7: LED RED

*/

#include <mega48.h>


#define DDR_IN          0
#define DDR_OUT         1

#define PORT_SEL        PORTB
#define PIN_SEL         PINB
#define DDR_SEL         DDRB

#define PORT_SDI        PORTB
#define PIN_SDI         PINB
#define DDR_SDI         DDRB

#define PORT_SCK        PORTB
#define PIN_SCK         PINB
#define DDR_SCK         DDRB

#define PORT_SDO        PORTB
#define PIN_SDO         PINB
```

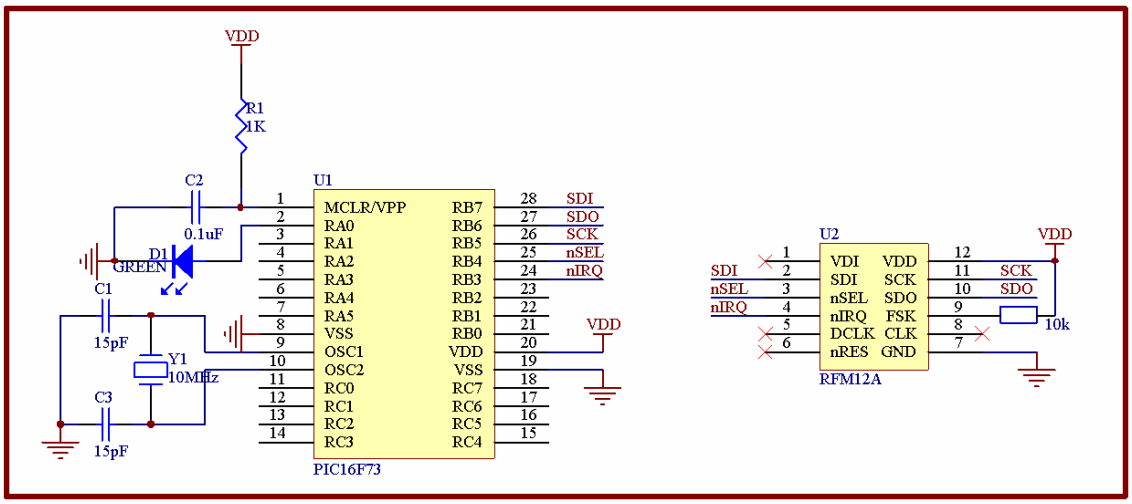
```
#define DDR_SDO          DDRB

#define PORT_IRQ         PORTD
#define PIN_IRQ          PIND
#define DDR_IRQ          DDRD

#define PORT_DATA        PORTD
#define PIN_DATA         PIND
#define DDR_DATA         DDRD

#define PB7              7//--\
#define PB6              6//  |
#define RFXX_SCK         5//  |
#define RFXX_SDO         4//  |RF_PORT
#define RFXX_SDI         3//  |
#define RFXX_SEL         2//  |
#define NC               1//  |
#define PB0              0//--/

#define SEL_OUTPUT()     DDR_SEL |= (1<<RFXX_SEL)
#define HI_SEL()         PORT_SEL|= (1<<RFXX_SEL)
#define LOW_SEL()        PORT_SEL&=~(1<<RFXX_SEL)

#define SDI_OUTPUT()     DDR_SDI |= (1<<RFXX_SDI)
#define HI_SDI()         PORT_SDI|= (1<<RFXX_SDI)
#define LOW_SDI()        PORT_SDI&=~(1<<RFXX_SDI)

#define SDO_INPUT()      DDR_SDO&= ~(1<<RFXX_SDO)
#define LOW_SDO()        PORT_SDO&= (1<<RFXX_SDO)
#define SDO_HI()         PIN_SDO&(1<<RFXX_SDO)

#define SCK_OUTPUT()     DDR_SCK |= (1<<RFXX_SCK)
#define HI_SCK()         PORT_SCK|= (1<<RFXX_SCK)
#define LOW_SCK()        PORT_SCK&=~(1<<RFXX_SCK)

#define RF12_IRQ         2
#define IRQ_IN()         DDR_IRQ &=~(1<<RF12_IRQ)
#define WAIT_IRQ_LOW()   while(PIND&(1<<RF12_IRQ))

#define RF12_DATA        4//PD4
#define DATA_OUT()       DDR_DATA|=1<<RF12_DATA
#define HI_DATA()        PORT_DATA|=1<<RF12_DATA

#define LEDG_OUTPUT()    DDRD|=~(1<<6)
```

```
#define LEDR_OUTPUT()    DDRD|=~(1<<7)

#define LEDG_ON()        PORTD&=~(1<<6)
#define LEDG_OFF()       PORTD|= (1<<6)
#define LEDR_ON()        PORTD&=~(1<<7)
#define LEDR_OFF()       PORTD|= (1<<7)


void RFXX_PORT_INIT(void){
  HI_SEL();
  HI_SDI();
  LOW_SCK();
  //SET nFFS pin HI when using FIFO
  HI_DATA();
  SEL_OUTPUT();
  SDI_OUTPUT();
  SDO_INPUT();
  SCK_OUTPUT();
  IRQ_IN();
  DATA_OUT();
}
unsigned int RFXX_WRT_CMD(unsigned int aCmd){
  unsigned char i;
  unsigned int temp;
  temp=0;
  LOW_SCK();
  LOW_SEL();
  for(i=0;i<16;i++){
    if(aCmd&0x8000){
      HI_SDI();
    }else{
      LOW_SDI();
    }
    HI_SCK();
    temp<<=1;
    if(SDO_HI()){
      temp|=0x0001;
    }
    LOW_SCK();

    aCmd<<=1;
  };
  HI_SEL();
  return(temp);
```

```
}
void RF12_INIT(void){
  RFXX_WRT_CMD(0x80D7);//EL,EF,433band,11.5pF
  RFXX_WRT_CMD(0x82D9);//!er,!ebb,ET,ES,EX,!eb,!ew,DC
  RFXX_WRT_CMD(0xA640);//434MHz
  RFXX_WRT_CMD(0xC647);//4.8kbps
  RFXX_WRT_CMD(0x94A0);//VDI,FAST,134kHz,0dBm,-103dBm
  RFXX_WRT_CMD(0xC2AC);//AL,!ml,DIG,DQD4
  RFXX_WRT_CMD(0xCA81);//FIFO8,SYNC,!ff,DR
  RFXX_WRT_CMD(0xC483);//@PWR,NO RSTRIC,!st,!fi,OE,EN
  RFXX_WRT_CMD(0x9850);//!mp,90kHz,MAX OUT
  RFXX_WRT_CMD(0xE000);//NOT USE
  RFXX_WRT_CMD(0xC800);//NOT USE
  RFXX_WRT_CMD(0xC040);//1.66MHz,2.2V
}
unsigned char RF12_RECV(void){
  unsigned int FIFO_data;
  WAIT_IRQ_LOW();
  RFXX_WRT_CMD(0x0000);
  FIFO_data=RFXX_WRT_CMD(0xB000);
  return(FIFO_data&0x00FF);
}
void Delay_ms(unsigned char amS){
  unsigned char i;
  unsigned int j;
  for(i=0;i<amS;i++)for(j=0;j<914;j++);
}
void main(void)
{
  unsigned char i;
  unsigned char ChkSum;

  //POWER ON indication: both LEDR and LEDG blink 3 times

  LEDG_OFF();
  LEDR_OFF();
  LEDG_OUTPUT();
  LEDR_OUTPUT();

  for(i=0;i<3;i++){
    Delay_ms(200);
    LEDG_ON();
    LEDR_ON();
    Delay_ms(200);
```

```
    LEDG_OFF();
    LEDR_OFF();
  }

    LEDG_OFF();
    LEDR_OFF();

  //Initialize command port
  RFXX_PORT_INIT();

  //Initialize RF12 chip
  RF12_INIT();

  //Init FIFO
  RFXX_WRT_CMD(0xCA81);

  while(1){
    //Enable FIFO
    RFXX_WRT_CMD(0xCA83);
    ChkSum=0;

    //Receive payload data
    for(i=0;i<16;i++){
      ChkSum+=RF12_RECV();
    }

    //Receive Check sum
    i=RF12_RECV();

    //Disable FIFO
    RFXX_WRT_CMD(0xCA81);

    //Package chkeck
    if(ChkSum==i){
      LEDG_ON();
      Delay_ms(200);
      LEDG_OFF();
    }
  }
}
```

## 5. Example 2（for PIC microcontroller）




RF12 transmitter demo:

```
/*********************************************************
    copyright (c) 2006
Title:              RFM12A transmitter simple example based on PIC C
Current version:    v1.0
Function:           Package send Demo
Processor           PIC16F73 DIP-28
Clock:              10MHz Crystal
Operate frequency:  434MHz
Data rate:          4.8kbps
Package size:       23byte
Author:             Robben
Company:            Hope microelectronic Co.,Ltd.
Contact:            +86-0755-86106557
E-MAIL:             hopefsk@hoperf.com
Date:               2006-11-21
*********************************************************/
#include "pic.h"

typedef unsigned char uchar;
typedef unsigned int  uint;

#define  SDI            RB7
#define  SDO            RB6
#define  SCK            RB5
#define  nSEL           RB4
```

```
#define  SDI_OUT()     TRISB7=0
#define  SDO_IN()      TRISB6=1
#define  SCK_OUT()     TRISB5=0
#define  nSEL_OUT()    TRISB4=0

void Init_RF12(void);
void Write0( void );
void Write1( void );
void WriteCMD( uint CMD );
void DelayUs( uint us );
void DelayMs(uint ms);
void WriteFSKbyte( uchar DATA );

__CONFIG(0x3FF2);

void Init_RF12(void)
{
  nSEL_OUT();
  SDI_OUT();
  SDO_IN();
  SCK_OUT();
  nSEL=1;
  SDI=1;
  SCK=0;
  WriteCMD(0x80D8);//enable register,433MHz,12.5pF
  WriteCMD(0x8208);//Turn on crystal,!PA
  WriteCMD(0xA640);//
  WriteCMD(0xC647);//
  WriteCMD(0x94C0);//VDI,FAST,134kHz,0dBm,-103dBm
  WriteCMD(0xC2AC);
  WriteCMD(0xCA80);
  WriteCMD(0xCA83);//FIFO8,SYNC,
  WriteCMD(0xC49B);
  WriteCMD(0x9850);//!mp,90kHz,MAX OUT
  WriteCMD(0xE000);//NOT USE
  WriteCMD(0xC80E);//NOT USE
  WriteCMD(0xC000);//1.0MHz,2.2V
}

void main()
{
  uint ChkSum=0;
  Init_RF12();
```

```
while(1)
 {
   WriteCMD(0x8228);     //OPEN PA
   DelayUs( 4 );
   WriteCMD(0x8238);
   NOP();
   NOP();
   WriteFSKbyte( 0xAA );
   WriteFSKbyte( 0xAA );
   WriteFSKbyte( 0xAA );
   WriteFSKbyte( 0x2D );
   WriteFSKbyte( 0xD4 );

   WriteFSKbyte( 0x30 );//DATA0
   ChkSum+=0x30;
   WriteFSKbyte( 0x31 );//DATA1
   ChkSum+=0x31;
   WriteFSKbyte( 0x32 );
   ChkSum+=0x32;
   WriteFSKbyte( 0x33 );
   ChkSum+=0x33;
   WriteFSKbyte( 0x34 );
   ChkSum+=0x34;
   WriteFSKbyte( 0x35 );
   ChkSum+=0x35;
   WriteFSKbyte( 0x36 );
   ChkSum+=0x36;
   WriteFSKbyte( 0x37 );
   ChkSum+=0x37;
   WriteFSKbyte( 0x38 );
   ChkSum+=0x38;
   WriteFSKbyte( 0x39 );
   ChkSum+=0x39;
   WriteFSKbyte( 0x3A );
   ChkSum+=0x3A;
   WriteFSKbyte( 0x3B );
   ChkSum+=0x3B;
   WriteFSKbyte( 0x3C );
   ChkSum+=0x3C;
   WriteFSKbyte(0x3D);
   ChkSum+=0x3D;
   WriteFSKbyte( 0x3E );
   ChkSum+=0x3E;
   WriteFSKbyte( 0x3F );//DATA15
```

```
      ChkSum+=0x3F;
      ChkSum&=0x0FF;
      WriteFSKbyte( ChkSum );
      WriteFSKbyte( 0xAA );
      WriteCMD( 0x8208 );       //CLOSE PA
      DelayMs(1000);

    }
}

void Write0( void )
{
  SDI=0;
  SCK=0;
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  SCK=1;
  NOP();
}

void Write1( void )
{
  SDI=1;
  SCK=0;
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
```

```
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  SCK=1;
  NOP();
}

void WriteCMD( uint CMD )
{
  uchar n=16;
  SCK=0;
  nSEL=0;
  while(n--)
   {
     if(CMD&0x8000)
      Write1();
     else
      Write0();
     CMD=CMD<<1;
   }
  SCK=0;
  nSEL=1;
}

void WriteFSKbyte( uchar DATA )
{

  uchar RGIT=0;
  uint temp=0xB800;
  temp|=DATA;
Loop: SCK=0;
  nSEL=0;
  SDI=0;
  SCK=1;
  if(SDO)                //Polling SDO
   {
    RGIT=1;
```

```
   }
  else
   {
    RGIT=0;
   }
  SCK=0;
  SDI=1;
  nSEL=1;
  if(RGIT==0)
   {
    goto Loop;
   }
  else
  {
   RGIT=0;
   WriteCMD(temp);
  }
}


void DelayUs( uint us )
{
  uint i;
  while( us-- )
    {
       i=2;
       while( i-- )
         {
           NOP();
         }
    }
}

void DelayMs(uint ms)
{
  uchar i;
  while(ms--)
  {
   i=35;
   while(i--)
   {
     DelayUs(1);
   }
  }
```

```
}


RF12 receiver demo:
/*************************************************************
    copyright (c) 2006
Title:              RFM12A transmitter simple example based on PIC C
Current version:    v1.0
Function:           Package send Demo
Processor           PIC16F73 DIP-28
Clock:              10MHz Crystal
Operate frequency:  434MHz
Data rate:          4.8kbps
Package size:       23byte
Author:             Robben
Company:            Hope microelectronic Co.,Ltd.
Contact:            +86-0755-86106557
E-MAIL:             hopefsk@hoperf.com
Date:               2006-11-17
*************************************************************/
#include "pic.h"

typedef unsigned char uchar;
typedef unsigned int  uint;

#define  SDI            RB7
#define  SDO            RB6
#define  SCK            RB5
#define  nSEL           RB4
#define  nIRQ           RB3
#define  LED            RA0
#define  LED_OUT()      TRISA0=0
#define  nIRQ_IN()      TRISB3=1
#define  SDI_OUT()      TRISB7=0
#define  SDO_IN()       TRISB6=1
#define  SCK_OUT()      TRISB5=0
#define  nSEL_OUT()     TRISB4=0

void Init_RF12(void);
void Write0( void );
void Write1( void );
void WriteCMD( uint CMD );
uchar RF12_RDFIFO(void);
```

```
void Delayus( uint us );

__CONFIG(0x3FF2);
bank1 uchar RF_RXBUF[19];
void Init_RF12(void)
{

  LED_OUT();
  nSEL_OUT();
  SDI_OUT();
  SDO_IN();
  SCK_OUT();
  nIRQ_IN();
  nSEL=1;
  SDI=1;
  SCK=0;
  SDO=0;
  LED=0;
  WriteCMD(0x80D8);//enable register,433MHz,12.5pF
  WriteCMD(0x82D8);//enable receive,!PA
  WriteCMD(0xA640);//
  WriteCMD(0xC647);//
  WriteCMD(0x94C0);//VDI,FAST,134kHz,0dBm,-103dBm
  WriteCMD(0xC2AC);
  WriteCMD(0xCA80);
  WriteCMD(0xCA83);//FIFO8,SYNC,
  WriteCMD(0xC49B);
  WriteCMD(0x9850);//!mp,90kHz,MAX OUT
  WriteCMD(0xE000);//NOT USE
  WriteCMD(0xC800);//NOT USE
  WriteCMD(0xC000);//1.0MHz,2.2V
}

void main()
{
  uchar i=0,j=0;
  uint  CheckSum;

  Init_RF12();

  while(1)
   {
     while(!nIRQ)
     {
```

```
      RF_RXBUF[i++]=RF12_RDFIFO();
      if(i==17)
       {
        i=0;
        WriteCMD(0xCA80);
        WriteCMD(0xCA83);        //reset FIFO and read to receive next Byte
        CheckSum=0;
        for(j=0;j<16;j++)
         CheckSum+=RF_RXBUF[j];  //add 0x30-----0x3F
        CheckSum&=0x0FF;
        if(CheckSum==RF_RXBUF[16])
         {
           LED=1;
         }
        Delayus(1);
        LED=0;
        }
       }
   }
}

void Write0( void )
{
  SDI=0;
  SCK=0;
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  SCK=1;
  NOP();
}
```

```
void Write1( void )
{
  SDI=1;
  SCK=0;
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  NOP();
  SCK=1;
  NOP();
}

void WriteCMD( uint CMD )
{
  uchar n=16;
  SCK=0;
  nSEL=0;
  while(n--)
   {
     if(CMD&0x8000)
      Write1();
     else
      Write0();
     CMD=CMD<<1;
   }
  SCK=0;
  nSEL=1;
}
```

```
uchar RF12_RDFIFO(void)
{
  uchar i,Result;
  SCK=0;
  SDI=0;
  nSEL=0;
  for(i=0;i<16;i++)
  {                     //skip status bits
    SCK=1;
    NOP();
    NOP();
    SCK=0;
    NOP();
    NOP();
  }
  Result=0;
  for(i=0;i<8;i++)
   {                    //read fifo data byte
    Result=Result<<1;
    if(SDO)
    {
      Result|=1;
    }
    SCK=1;
    NOP();
    NOP();
    SCK=0;
    NOP();
    NOP();
   }
  nSEL=1;
  return(Result);
}
void Delayus( uint us )
{
  uint i;
  while( us-- )
    {
       i=1000;
       while( i-- )
         {
           NOP();
         }
    }
```

}

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