2020



# Application Note

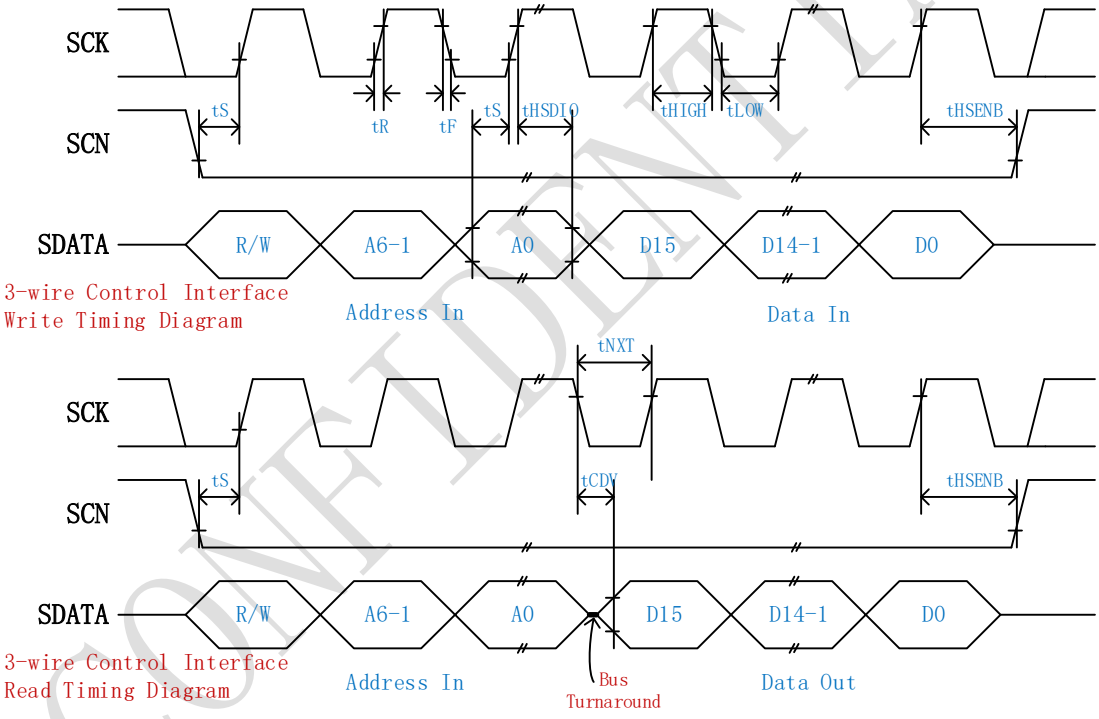
DODO

BK4819(V3)

# 目录

## MCU Interface - 3 Wire SPI

| Parameter | Symbol | Min. | Typ. | Max. |
|---|---|---|---|---|
| *SCK Frequency* | *fSCK* | *0 MHz* | *—* | *8 MHz* |
| *SCK High Time* | *tHIGH* | *25 ns* | *—* | *—* |
| *SCK Low Time* | *tLOW* | *25 ns* | *—* | *—* |
| *SDATA Input, SCN to SCK ↑ Setup* | *tS* | *20 ns* | *—* | *—* |
| *SDATA Input to SCK ↑ Hold* | *tHSDATA* | *10 ns* | *—* | *—* |
| *SCN Input to SCK ↓ Hold* | *tHSCN* | *10 ns* | *—* | *—* |
| *SCK ↓ to SDATA Output Valid* | *tCDV* | *2 ns* | *—* | *25 ns* |
| *SCK ↓ to next SCK ↑ after Address In* | *tNXT* | *1 us* | *—* | *—* |
| *SCK, SCN, SDATA, Rise/Fall Time* | *tR,tF* | *—* | *—* | *10 ns* |




## Reigster Initialization

芯片上电后进行 SoftReset、内部 PowerUp 和其他初始化设置。使用 RF_Initial()，在 RF_Initail() 里根据需求设置静噪门限、接收音量、接收 AGC、MIC 灵敏度、VoX 门限、调制深度、发射功率、亚音频等。

# Tx/Rx Audio

1. 初始化后默认状态为正常 Speech 模式，可进行语音（300~3kHz）收发。

2. 开启压扩需要设置 RF_EnterCompander()，关闭压扩使用 RF_ExitCompander()

| Register | Default | Description |
|---|---|---|
| *REG_31<3>* | *0* | *Enable Compander Function.*<br>*1= Enable; 0=Disable* |
| *REG_28<15:14>* | *0b01* | *Expander (AF Rx) Ratio.*<br>*00=Disable; 01=1:2; 10=1:3; 11=1:4* |
| *REG_28<13:7>* | *0x56* | *Expander (AF Rx) 0 dB point(dB)* |
| *REG_28<6:0>* | *0x38* | *Expander (AF Rx) noise point(dB)* |
| *REG_29<15:14>* | *0b10* | *Compress (AF Tx) Ratio.*<br>*00=Disable; 01=1.333:1; 10=2:1; 11=4:1* |
| *REG_29<13:7>* | *0x56* | *Compress (AF Tx) 0 dBpoint(dB)* |
| *REG_29<6:0>* | *0x40* | *Compress (AF Tx) noise point(dB)* |
| *REG_6F<6:0>* | *Read Only* | *AF Tx/Rx Input Amplitude(dB)* |

3. 开启扰频需要设置 RF_EnterScramble()，关闭扰频使用 RF_ExitScramble()

| Register | Default | Description |
|---|---|---|
| *REG_31<1>* | *0* | *Enable Scramble Function.*<br>*1=Enable; 0=Disable* |
| *REG_71<15:0>* | *0x8517* | *Scramble/Tone1FrequencyControlWord.*<br>*=3300(Hz)*10.32444 for XTAL 13M/26M or*<br>*=3300(Hz)* 10.48576 for XTAL 12.8M/19.2M/25.6M/38.4M.*<br>*- The scrambler inversion mixing frequency should be kept between 2.6kHz and 3.5kHz* |

4. 滤波器开关使能

| Register | Default | Description |
|---|---|---|
| *REG_2B<10>* | *0* | *Disable AFRxHPF300filter.*<br>*0=Enable; 1=Disable* |
| *REG_2B<9>* | *0* | *Disable AF RxLPF3K filter.*<br>*0=Enable; 1=Disable* |
| *REG_2B<8>* | *0* | *Disable AF Rx de-emphasisfilter.*<br>*0=Enable; 1=Disable* |
| *REG_2B<2>* | *0* | *Disable AFTxHPF300filter.* |

| | | |
|---|---|---|
| | | *0=Enable; 1=Disable* |
| *REG_2B<1>* | *0* | *Disable AFTxLPF1filter.*<br>*0=Enable; 1=Disable* |
| *REG_2B<0>* | *0* | *Disable AFTxpre-emphasisfilter.*<br>*0=Enable; 1=Disable* |
| *REG_43<8:6>* | *0b001* | *AFTxLPF2 filter Band Width(Apass=1dB) Selection.*<br>*100 = 4.5 kHz*<br>*101 = 4.25 kHz*<br>*110 =4kHz*<br>*111 = 3.75 kHz*<br>*000 = 3 kHz (for 25k Channel Space)*<br>*001 = 2.5 kHz (for 12.5k Channel Space)*<br>*010 = 2.75 kHz*<br>*011 =3.5 kHz* |

5. 音频响应调整使用 RF_SetAfResponse(u8 tx, u8 f3k, u8 db)，其中参数 tx=1 发射/tx=0 接收，f3k=1 调整 3kHz/f3k=0 调整 300Hz，db=调整范围-1~+4dB。例如：
   发射 300Hz 增大 2dB：RF_SetAfResponse(1,0,2);
   接收 3kHz 减小 3dB：RF_SetAfResponse(0,1,-3);

6. 接收音量设置

| Register | Default | Description |
|---|---|---|
| *REG_48<11:10>* | *0b00* | *AF Rx Gain1.*<br>*00=0dB;01=-6dB;10=-12dB;11=-18dB* |
| *REG_48<9:4>* | *0x3C* | *AF Rx Gain2.*<br>*-26dB~5.5dB, 0.5dB/step.*<br>*0x00=mute* |
| *REG_48<3:0>* | *0b1111* | *AF DAC Gain (after Gain1 and Gain2).*<br>*1111=max; 0000=min; about 2dB/step* |

7. 发射调制设置及发射 mute

| Register | Default | Description |
|---|---|---|
| *REG_40<12>* | *1* | *Enable RF TxDeviation.*<br>*1=Enable; 0=Disable* |
| *REG_40<11:0>* | *0x4D0* | *RF Tx Deviation Tuning (Apply for both in-band signal and sub-audio signal).*<br>*0=min; 0xFFF=max* |
| *REG_50<15>* | *0* | *Enable AF Tx Mute (for DTMF Tx or other applications).*<br>*1=Mute; 0=Normal* |

8. MIC 灵敏度设置

| Register | Default | Description |
|---|---|---|
| *REG_7D<4:0>* | *0x10* | *MIC Sensitivity Tuning.*<br>*0x00=min; 0x1F=max; 0.5dB/step* |

9. AF 输出选择使用 RF_SetAf(u8 mode)，产生本地按键音、提示音可参考 RF_Key()，产生铃音并发射可参考 RF_Call()

| Register | Default | Description |
|---|---|---|
| *REG_47<13>* | *1* | *AF Output Inverse Mode.*<br>*1=Inverse* |
| *REG_47<11:8>* | *0x1* | *AFOutputSelection.*<br>*0x0=Mute;*<br>*0x1=Normal AF Out;*<br>*0x2=Tone Out for Rx (Should enable Tone1 first);*<br>*0x3=Beep Out for Tx (Should enable Tone1 first and set REG_03[9]=1 to enable AF;*<br>*0x6=CTCSS/CDCSS Out for Rx Test;*<br>*0x8=FSK Out for Rx Test;*<br>*Others=Reserved;* |

## CTCSS/CDCSS

1. 开启 CTCSS 需要设置 RF_SetCtcss()和 RF_SetCtc2()，其中后者仅用于接收频率 55Hz（或其他 100Hz 以内频率）的 CTCSS 尾音；前者用于接收和发射正常 CTCSS。

2. 开启 CDCSS 需要设置 RF_SetCdcss()，需要设置 134.4Hz 码率和 CDCSS 码。

3. 关闭亚音频使用 RF_ExitSubau()

4. 发射结束时产生尾音使用 RF_GenTail()，相位尾音使用参数 CTC120/CTC180/CTC240，如 RF_GenTail(CTC180)；换频尾音（如 55Hz）使用参数 CTC55,如 RF_GenTail(CTC55)；在 CDCSS 模式下产生 134.4Hz 尾音使用参数 CTC134,如 RF_GenTail(CTC134)

5. 读取 CTCSS 状态使用 RF_GetCtcss()，返回 1 表示收到 CTC1（主 CTC），返回 2 表示收到 CTC2（如 55Hz 尾音）；读取 CDCSS 状态使用 RF_GetCdcss()，返回 1 表示收到 CDC 正码，返回 2 表示收到 CDC 反码；读取相位尾音状态使用 RF_GetTail()，返回 1 表示收到 120°相位变化尾音，返回 2 表示收到 180°相位变化尾音，返回 3 表示收到 240°相位变化尾音。

| Register | Default | Description |
|---|---|---|
| REG_51<15> | 0 | 1=Enable TxCTCSS/CDCSS; 0=Disable |
| REG_51<14> | 0 | 1= GPIO6(PIN2)Input for CDCSS; 0=Normal Mode.(for BK4819v3) |
| REG_51<13> | 0 | 1=Transmit negative CDCSS code<br>0=Transmit positive CDCSScode |
| REG_51<12> | 0 | CTCSS/CDCSS mode selection.<br>1=CTCSS, 0=CDCSS |
| REG_51<11> | 0 | CDCSS 24/23bit selection.<br>1=24bit, 0=23bit |
| REG_51<10> | 0 | 1050HzDetectionMode.<br>1=1050/4 Detect Enable, CTC1 should be set to 1050/4 Hz |
| REG_51<9> | 0 | Auto CDCSS Bw Mode.<br>1=Disable; 0=Enable. |
| REG_51<8> | 0 | Auto CTCSS Bw Mode.<br>0=Enable; 1=Disable |
| REG_51<6:0> | 0 | CTCSS/CDCSS Tx Gain1 Tuning.<br>0=min; 0x7F=max |
| REG_2E<9:8> | 0x10 | CTCSS/CDCSS Tx Gain2 Tuning (after Gain1).<br>00=12dB; 01=6dB; 10=0dB; 11=-6dB |
| REG_07<15:0> | | When <15:13>=0 for CTC1<br><12:0>=CTC1 frequencycontrolword<br>= freq(Hz)*20.64888 for XTAL 13M/26M or<br>=freq(Hz)*20.97152 for XTAL 12.8M/19.2M/25.6M/38.4M<br><br>When<15:13>=1 for CTC2(Tail 55Hz Rx detection)<br><12:0>=CTC2(should below 100Hz)frequencycontrolword<br>= 25391/freq(Hz) for XTAL 13M/26M or<br>= 25000/freq(Hz)for XTAL 12.8M/19.2M/25.6M/38.4M<br><br>When <15:13>=2 for CDCSS 134.4Hz<br><12:0>=CDCSS baud rate frequency(134.4Hz) controlword<br>= freq(Hz)*20.64888 for XTAL 13M/26M or<br>=freq(Hz)*20.97152 for XTAL 12.8M/19.2M/25.6M/38.4M |
| REG_08<15:0> | | <15>=1 for CDCSS high 12bit<br><15>=0 for CDCSS low 12bit<br><11:0>=CDCSShigh/low 12bit code |
| REG_52<15> | 0 | Enable 120/180/240 degree shift CTCSS or 134.4Hz Tail when CDCSS mode.<br>0=Normal, 1=Enable |
| REG_52<14:13> | 0b00 | CTCSS tail modeselection (only valid when REG_52<15>=1). |

| | | |
|---|---|---|
| | | *00= for 134.4Hz CTCSS Tail when CDCSS mode.*<br>*01=CTCSS0 120° phase shift,*<br>*10= CTCSS0 180° phase shift*<br>*11= CTCSS0 240° phase shift* |
| *REG_52<12>* | *0* | *CTCSSDetectionThreshold Mode,*<br>*1=~0.1%; 0=0.1 Hz* |
| *REG_52<11:6>* | *0x0A* | *CTCSS found detect threshold.* |
| *REG_52<5:0>* | *0x0F* | *CTCSS lost detect threshold.* |
| *REG_0C<15:14>* | *Read Only* | *<14>:CDCSS positive code received*<br>*<15>:CDCSS negative code received* |
| *REG_0C<13:12>* | *Read Only* | *CTCSS Phase Shift Received.*<br>*00=No phase shift*<br>*01=CTCSS0 120° phase shift,*<br>*10= CTCSS0 180° phase shift*<br>*11= CTCSS0 240° phase shift* |
| *REG_0C<10:11>* | *Read Only* | *<11>:CTC2(55Hz) received*<br>*<10>:CTC1 received* |

## SELCALL

1. 开启 SELCALL(5Tone)模式使用 RF_Enter5tone()，该函数仅对接收频率系数、接收门限、发射通路进行了设置，不会影响到正常音频收听。

2. 退出 SELCALL(5Tone)模式使用 RF_Exit5tone()

3. 发射 SELCALL(5Tone)使用 RF_5toneTransmit()，使用 MCU 计时根据发射码更换发射 SELCALL(5Tone)的频率（Tone1）。

4. 接收 SELCALL(5Tone)使用 RF_5toneReceive()，返回 1 失败，返回 0 成功

## DTMF

1. 开启 DTMF 模式使用 RF_EnterDtmf()，该函数仅对 DTMF 接收频率系数、接收门限、发射通路进行了设置，不会影响到正常音频收听。

2. 退出 DTMF 模式使用 RF_ExitDtmf()

3. 发射 DTMF 使用 RF_DtmfTransmit()，使用 MCU 计时根据发射码更换发射 DTMF 的频率（Tone1+Tone2）。

4. 接收 DTMF 使用 RF_DtmfReceive()，返回 1 失败，返回 0 成功

| Register | Default | Description |
|---|---|---|
| *REG_70<15>* | *0* | *Enable TONE1*<br>*1=Enable; 0=Disable.* |
| *REG_70<14:8>* | *0* | *TONE1tuninggain* |
| *REG_70<7>* | *0* | *Enable TONE2*<br>*1=Enable; 0=Disable.* |
| *REG_70<6:0>* | *0* | *TONE2/FSK tuninggain* |
| *REG_71<15:0>* | *0x8517* | *TONE1/Scramblefrequencycontrolword.*<br>*=freq(Hz)*10.32444 for XTAL 13M/26M or*<br>*=freq(Hz)* 10.48576 for XTAL 12.8M/19.2M/25.6M/38.4M.* |
| *REG_72<15:0>* | *0x2854* | *TONE2/FSK frequencycontrolword*<br>*=freq(Hz)*10.32444 for XTAL 13M/26M or*<br>*=freq(Hz)* 10.48576 for XTAL 12.8M/19.2M/25.6M/38.4M.* |
| *REG_50<15>* | *0* | *Enable AF Tx Mute (for DTMF Tx or other applications).*<br>*1=Mute; 0=Normal* |
| *REG_0B<11:8>* | *Read Only* | *DTMF/5Tone Code Received.* |

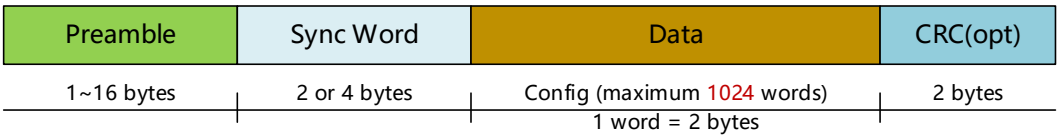
## FSK

1. 开启 FSK 模式使用 RF_EnterFsk()，不会影响到正常音频收听，且可以同时进入 DTMF/SELCALL 模式进行接收。FSK 速率寄存器与 Tone2 寄存器复用。使用 2400bps 模式需要开启宏定义 FSK2400

2. 退出使用 RF_ExitFsk()

3. 发射 FSK 使用 RF_FskTransmit()，返回 1 失败，返回 0 成功

4. FSK 帧格式（CRC 为可选），如果要兼容 BK4815/BK4818 则需要在 Data 部分完成 BK4815/BK4818FSK 帧结构里的 Addr/Type/Size/CRCA/Payload/CRCB 数据组帧，并且关掉 BK4819 FSK 帧结构的 CRC 部分，设置相同的 Preamble 和 SyncWord。




5. 接收 FSK 使用 RF_FskReceive()，返回 1 失败，返回 0 成功

| Register | Default | Description |
|---|---|---|
| *REG_58<15:13>* | *000* | *FSK Tx Mode Selection.*<br>*000 for FSK1.2K and FSK2.4K Tx;*<br>*001 for FFSK1200/1800 Tx;*<br>*011 for FFSK1200/2400 Tx;*<br>*101 for NOAA SAME Tx* |
| *REG_58<12:10>* | *000* | *FSK Rx Mode Selection.*<br>*000 for FSK1.2K, FSK2.4K Rx and NOAA SAME Rx;*<br>*111 for FFSK1200/1800 Rx;*<br>*100 for FFSK1200/2400 Rx;* |
| *REG_58<9:8>* | *00* | *FSK Rx Gain.* |
| *REG_58<5:4>* | *00* | *FSK Preamble Type Selection.*<br>*11=0xAA; 10=0x55; 00=0xAA or 0x55 due to the MSB of FSK Sync Byte 0.* |
| *REG_58<3:1>* | *000* | *FSK Rx BandWidth Setting.*<br>*100 for FSK 2.4K and FFSK1200/2400;*<br>*000 for FSK 1.2K;*<br>*001 for FFSK1200/1800;*<br>*010 for NOAA SAME Rx* |
| *REG_58<0>* | *0* | *FSK Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_59<15>* | *0* | *Clear TX FIFO, 1=clear* |
| *REG_59<14>* | *0* | *Clear RX FIFO, 1=clear* |
| *REG_59<13>* | *0* | *1=Enable FSK Scramble* |
| *REG_59<12>* | *0* | *1=Enable FSK RX* |
| *REG_59<11>* | *0* | *1=Enable FSK TX* |
| *REG_59<10>* | *0* | *1=Invert FSK data when RX* |
| *REG_59<9>* | *0* | *1=Invert FSK data when TX* |
| *REG_59<7:4>* | *0* | *FSK Preamble Length Selection*<br>*0=1 byte; 1=2 bytes; 2=3 bytes; ...; 15=16 bytes.* |
| *REG_59<3>* | *0* | *FSK SyncLength Selection.*<br>*1=4 bytes (FSK Sync Byte 0,1,2,3)*<br>*0=2 bytes (FSK Sync Byte 0,1)* |
| *REG_5A<15:8>* | *0x85* | *FSK Sync Byte 0 (Sync Byte 0 first, then 1,2,3)* |
| *REG_5A<7:0>* | *0xCF* | *FSK Sync Byte 1* |

| | | |
|---|---|---|
| *REG_5B<15:8>* | *0xAB* | *FSK Sync Byte 2* |
| *REG_5B<7:0>* | *0x45* | *FSK Sync Byte 3* |
| *REG_5C<6>* | *1* | *CRC Option Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_5D<15:8>* | *0x0F* | *FSK Data Length(Byte)*<br>*Low 8bits(Total 11 bits for BK4819v3).*<br>*For example, 0xF means 16 bytes length.* |
| *REG_5D<7:5>* | *0* | *FSK Data Length(Byte)*<br>*High 3bits(Total 11 bits for BK4819v3).* |
| *REG_5E<9:3>* | *64* | *FSK Tx FIFO (Total 128 Words) Almost Empty Threshold.* |
| *REG_5E<2:0>* | *4* | *FSK Rx FIFO (Total 8 Words) Almost Full Threshold.* |
| *REG_5F<15:0>* | *x* | *FSK Word Input/Output.* |
| *REG_70<6:0>* | *0* | *TONE2/FSK tuninggain* |
| *REG_72<15:0>* | *0x2854* | *TONE2/FSK frequencycontrolword*<br>*=freq(Hz)*10.32444 for XTAL 13M/26M or*<br>*=freq(Hz)* 10.48576 for XTAL 12.8M/19.2M/25.6M/38.4M.* |
| *REG_0B<7>* | *Read Only* | *FSK Rx SyncN Fround.* |
| *REG_0B<6>* | *Read Only* | *FSK Rx SyncP Fround.* |
| *REG_0B<4>* | *Read Only* | *FSK Rx CRC Indicator.*<br>*1=CRC Pass; 0=CRC Fail.* |

## MDC1200

1. 开启 MDC 模式使用 RF_EnterMdc()，不会影响到正常音频收听，且可以同时进入 DTMF/SELCALL 模式进行接收。MDC 速率寄存器与 Tone2 寄存器复用。默认模式为 1200/1800，若想使用 1200/2400 模式需要开启宏定义 MDC2400

2. 退出使用 RF_ExitMdc()

3. 发射 MDC 使用 RF_MdcTransmit()，返回 1 失败，返回 0 成功

4. 接收 MDC 使用 RF_MdcReceive()，返回 1 失败，返回 0 成功

5. 可支持 HDC1200 模式

## NOAA SAME

1. 接收 NOAASAME 码使用 RF_EnterNoaa ()，不会影响到正常音频收听，且可以同时进入 NOAA 模式进行接收。NOAA 速率寄存器与 Tone2 寄存器复用

2. 退出使用 RF_ExitNoaa()

3. 接收 FSK 使用 RF_NoaaReceive()，返回 1 失败，返回 0 成功，MCU 根据收到的码进行协议处理

## VoX

1. 开启 VoX 使用 RF_EnterVox()；关闭使用 RF_ExitVox()

2. 获取 VoX 状态使用 RF_GetVox()，返回 1 收到 MIC 语音，返回 0 未收到语音。

3. 获取 VoX 幅度使用 RF_GetVoxAmp()，返回值为 MIC 语音幅度，供 MCU 自行 VoX 判断使用。

| Register | Default | Description |
|---|---|---|
| *REG_31<2>* | *0* | *Enable VOX detection.*<br>*1=Enable; 0=Disable* |
| *REG_7A<15:12>* | *8* | *VoX=0 Detection delay, *128ms* |
| *REG_46<10:0>* | *0x50* | *Voice AmplitudeThreshold for VOX=1 detect* |
| *REG_79<15:11>* | *8* | *VoX Detection Interval Time.* |
| *REG_79<10:0>* | *0x40* | *Voice Amplitude Threshold for VOX=0 detect* |
| *REG_64<15:0>* | *Read Only* | *Voice AmplitudeOut.* |
| *REG_0C<2>* | *Read Only* | *VoX Indicator*<br>*0: No*<br>*1: Yes* |

## Power Saving

1. 进入睡眠使用 RF_Slee()，唤醒可以使用 RF_WakeUp()，也可以直接进入发射 RF_Txon() 或接收 RF_Rxon()
2. 睡眠状态下电流 200uA？（待改进）；唤醒后 IDLE 电流 3mA？

| Register | Default | Description |
|---|---|---|
| *REG_37<14:12>* | *0b001* | *DSP Voltage Setting.* |
| *REG_37<11>* | *1* | *ANA LDO Selection.*<br>*1=2.7v, 0=2.4v* |
| *REG_37<10>* | *1* | *VCO LDO Selection.*<br>*1=2.7v, 0=2.4v* |
| *REG_37<9>* | *1* | *RF LDO Selection.*<br>*1=2.7v, 0=2.4v* |
| *REG_37<8>* | *1* | *PLL LDO Selection.*<br>*1=2.7v, 0=2.4v* |
| *REG_37<7>* | *0* | *ANA LDO Bypass.*<br>*1=Bypass, 0=Enable.* |
| *REG_37<6>* | *0* | *VCO LDO Bypass.*<br>*1=Bypass, 0=Enable.* |
| *REG_37<5>* | *0* | *RF LDO Bypass.*<br>*1=Bypass, 0=Enable.* |
| *REG_37<4>* | *0* | *PLL LDO Bypass.*<br>*1=Bypass, 0=Enable.* |
| *REG_37<3>* | *0* | *Reserved.* |
| *REG_37<2>* | *0* | *DSP Enable.*<br>*1=Enable, 0=Disable.* |
| *REG_37<1>* | *0* | *XTAL Enable.*<br>*1=Enable, 0=Disable.* |
| *REG_37<0>* | *0* | *Band-Gap Enable.*<br>*1=Enable, 0=Disable.* |

## Tx/Rx Mode Switch

1. 发射使用 RF_Txon()
2. 接收使用 RF_Rxon()
3. 发射带侧音（如发送铃音）时，使用 RF_Txon_Beep()

| Register | Default | Description |
|---|---|---|
| *REG_30<15>* | *0* | *VCO Calibration Enable.*<br>*1=Enable, 0=Disable* |
| *REG_30<13:10>* | *0* | *Rx Link Enable (include LNA/MIXER/PGA/ADC).*<br>*1111=Enable, 0000=Disable* |
| *REG_30<9>* | *0* | *AF DAC Enable.*<br>*1=Enable, 0=Disable.* |
| *REG_30<7:4>* | *0* | *PLL/VCO Enable.* |

| | | |
|---|---|---|
| | | *1111=Enable, 0000=Disable* |
| *REG_30<3>* | *0* | *PA Gain Enable.*<br>*1=Enable, 0=Disable* |
| *REG_30<2>* | *0* | *MIC ADC Enable.*<br>*1=Enable, 0=Disable* |
| *REG_30<1>* | *0* | *Tx DSP Enable.*<br>*1=Enable, 0=Disable* |
| *REG_30<0>* | *0* | *Rx DSP Enable.*<br>*1=Enable, 0=Disable* |

## Squelchuelch,RSSI,Ex-Noise, Gltich

可通过 RF_GetRssi()，RF_GetNoise()，RF_GetGlitch()获取相应的参数，便于设置静噪等级

| Register | Default | Description |
|---|---|---|
| *REG_78<15:8>* | *0x48* | *RSSI threshold for Squelch=1, 0.5dB/step* |
| *REG_78<7:0>* | *0x46* | *RSSI threshold for Squelch =0, 0.5dB/step* |
| *REG_4F<14:8>* | *0x2F* | *Ex-noise threshold for Squelch =0* |
| *REG_4F<6:0>* | *0x2E* | *Ex-noise threshold for Squelch =1* |
| *REG_4D<7:0>* | *0x20* | *Glitch threshold for Squelch =0* |
| *REG_4E<7:0>* | *0x08* | *Glitch threshold for Squelch =1* |
| *REG_4E<13:11>* | *0b101* | *Squelch=1 Delay Setting.* |
| *REG_4E<10:9>* | *0b111* | *Squelch=0 Delay Setting.* |
| *REG_67<8:0>* | *Read Only* | *0.5dB/step, RSSI (dBm) ~= REG_67**<8:0>**/2 – 160.* |
| *REG_65<6:0>* | *Read Only* | *Ex-noiseindicator, dB/step.* |
| *REG_63<7:0>* | *Read Only* | *Glitch indicator.* |
| *REG_0C<1>* | *Read Only* | *Squelch resultoutput.*<br>*1=Link; 0=Loss* |

## AFC, ALC, MIC AGC

MIC PGA 增益自动控制可扩展 MIC 信号动态范围，使较大幅度 MIC 信号不失真发射。用在 DMR 方案中发射时应该关掉此功能（***REG_19<15>=1***），同时 ALC 功能也应关闭（***REG_4B<5>=1***）。

| Register | Default | Description |
|---|---|---|
| *REG_73<13:11>* | *0b000* | *Automatic Frequency Correction(AFC) Range Selection.*<br>*000=max; 111=min* |
| *REG_73<4>* | *0* | *Automatic Frequency Correction(AFC) Disable.*<br>*1=Disable; 0=Enable.* |

| | | |
|---|---|---|
| *REG_19<15>* | *1* | *Automatic MIC PGA Gain Controller(MIC AGC) Disable.*<br>*1=Disable; 0=Enable.* |
| *REG_4B<5>* | *0* | *AF Level Controller(ALC) Disable.*<br>*1=Disable; 0=Enable.* |

## Frequency Setting

设置频率使用 RF_SetFreq(u16 freq_hi16, u16 freq_lo16)，注意换算公式：
Frequency(Hz)= (freq_hi16<<16 + freq_lo16)*10

| Register | Default | Description |
|---|---|---|
| *REG_38<15:0>* | *0x3A98* | *Frequency(Hz)= (freq_hi16<<16 + freq_lo16)*10* |
| *REG_39<15:0>* | *0x0271* | |

如设置 409.75MHz 频点，则 RF_SetFreq((40975000>>16)&0xFFFF, 40975000&0xFFFF)

## Tx Output Power

| Register | Default | Description |
|---|---|---|
| *REG_36<15:8>* | *0* | *PA Biasoutput 0~3.2V*<br>*0x00=0V*<br>*…*<br>*0xFF=3.2V* |
| *REG_36<7>* | *0* | *1=Enable PACTLoutput; 0=Disable(Output 0 V)* |
| *REG_36<5:3>* | *0b111* | *PA Gain1 Tuning.*<br>*111(max)->000(min)* |
| *REG_36<2:0>* | *0b111* | *PA Gain2 Tuning.*<br>*111(max)->000(min)* |

功率输出表（近似）

| ***Power(dBm)*** | ***PA Gain1*** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***PA Gain2*** | *111* | *110* | *101* | *100* | *011* | *010* | *001* | *000* |
| ***111*** | *7.26* | *7.01* | *6.67* | *6.17* | *5.39* | *4.10* | *1.52* | *-5.02* |
| ***110*** | *6.38* | *6.08* | *5.67* | *6.06* | *4.12* | *2.53* | *-0.72* | *-9.45* |
| ***101*** | *5.65* | *5.30* | *4.82* | *4.13* | *3.03* | *1.18* | *-2.58* | *-13.4* |
| ***100*** | *5.01* | *4.62* | *4.08* | *3.30* | *2.08* | *0.01* | *-4.16* | *-16.9* |
| ***011*** | *4.19* | *3.73* | *3.11* | *2.21* | *0.84* | *-1.48* | *-6.11* | *-20.5* |
| ***010*** | *2.60* | *2.04* | *1.24* | *0.13* | *-1.56* | *-4.25* | *-9.50* | *-22.9* |
| ***001*** | *1.04* | *0.35* | *-0.63* | *-1.98* | *-3.90* | *-6.80* | *-12.3* | *-23.7* |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *000* | *-0.70* | *-1.51* | *-2.65* | *-4.16* | *-6.20* | *-9.35* | *-14.9* | *-24.3* |

## Interrupt

中断信号可由任意 GPIO 送出（见 GPIO 设置函数），也可轮询 *REG_0C<0>*位，高有效，默认低。

中断可由芯片任意 GPIO 口输出，中断通过对 *REG_02* 寄存器写任意值来清除，如

RF_Write (0x02,0x0000); //clear interrupt

中断高电平（或中断寄存器 *REG_0C<0>*为 1）有效，得到中断时，要先清除中断，才能去读取中断向量表。

| Register | Default | Description |
|---|---|---|
| *REG_0C<0>* | *Read Only* | *Interrupt Indicator.*<br>*1=Interrupt Request; 0=No Request.* |
| *REG_3F<15>* | *0* | *FSK Tx Finished Interrupt Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<14>* | *0* | *FSK FIFO Almost Empty Interrupt Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<13>* | *0* | *FSK Rx Finished Interrupt Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<12>* | *0* | *FSK FIFO Almost FullInterrupt Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<11>* | *0* | *DTMF/5TONE Found Interrupt Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<10>* | *0* | *CTCSS/CDCSSTail Found InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<9>* | *0* | *CDCSS Found InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<8>* | *0* | *CDCSS Lost InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<7>* | *0* | *CTCSS Found InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<6>* | *0* | *CTCSS Lost InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<5>* | *0* | *VoX Found InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<4>* | *0* | *VoX Lost InterruptEnable.*<br>*1=Enable; 0=Disable.* |

| | | |
|---|---|---|
| *REG_3F<3>* | *0* | *Squelch Found InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<2>* | *0* | *Squelch Lost InterruptEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_3F<1>* | *0* | *FSK Rx Sync Interrupt Enable.*<br>*1=Enable; 0=Disable.* |
| *REG_02<15>* | *Read Only* | *FSK Tx Finished Interrupt.* |
| *REG_02<14>* | *Read Only* | *FSK FIFO Almost Empty Interrupt Enable.* |
| *REG_02<13>* | *Read Only* | *FSK Rx Finished Interrupt Enable.* |
| *REG_02<12>* | *Read Only* | *FSK FIFO Almost FullInterrupt.* |
| *REG_02<11>* | *Read Only* | *DTMF/5TONE Found Interrupt.* |
| *REG_02<10>* | *Read Only* | *CTCSS/CDCSSTail Found Interrupt.* |
| *REG_02<9>* | *Read Only* | *CDCSS Found Interrupt.* |
| *REG_02<8>* | *Read Only* | *CDCSS Lost Interrupt.* |
| *REG_02<7>* | *Read Only* | *CTCSS Found Interrupt.* |
| *REG_02<6>* | *Read Only* | *CTCSS Lost Interrupt.* |
| *REG_02<5>* | *Read Only* | *VoX Found Interrupt.* |
| *REG_02<4>* | *Read Only* | *VoX Lost Interrupt.* |
| *REG_02<3>* | *Read Only* | *Squelch Found Interrupt.* |
| *REG_02<2>* | *Read Only* | *Squelch Lost Interrupt.* |
| *REG_02<1>* | *Read Only* | *FSK Rx Sync Interrupt.* |

## GPIO

1. 根据对应的 PIN 及输出的模式使用 RF_SetGpioOut(u8 num, u8 type, u8 val)，其中 num 为 GPIO 序号，type 为输出模式，val 为 GPIO 输出模式下输出值。输出模式详见参考代码 drive.c

2. 获取 GPIO 输入值使用 RF_GetGpioIn(u8 num)，其中 num 为 GPIO 序号。

| Register | Default | Description |
|---|---|---|
| *REG_0A<6>* | *Read Only* | *GPIO0 (PIN28) Input Indicator.*<br>*1=High; 0=Low.* |
| *REG_0A<5>* | *Read Only* | *GPIO1(PIN29) Input Indicator.*<br>*1=High; 0=Low.* |
| *REG_0A<4>* | *Read Only* | *GPIO2 (PIN30) Input Indicator.*<br>*1=High; 0=Low.* |
| *REG_0A<3>* | *Read Only* | *GPIO3 (PIN31) Input Indicator.*<br>*1=High; 0=Low.* |
| *REG_0A<2>* | *Read Only* | *GPIO4 (PIN32) Input Indicator.* |

| | | |
|---|---|---|
| | | 1=High; 0=Low. |
| REG_0A<1> | Read Only | GPIO5 (PIN1) Input Indicator.<br>1=High; 0=Low. |
| REG_0A<0> | Read Only | GPIO6(PIN2) Input Indicator.<br>1=High; 0=Low. |
| REG_33<14> | 1 | GPIO0(PIN28) Output Disable.<br>1=Output Disable; 0=Output Enable. |
| REG_33<13> | 1 | GPIO1(PIN29) Output Disable.<br>1=Output Disable; 0=Output Enable. |
| REG_33<12> | 1 | GPIO2(PIN30) Output Disable.<br>1=Output Disable; 0=Output Enable. |
| REG_33<11> | 1 | GPIO3(PIN31) Output Disable.<br>1=Output Disable; 0=Output Enable. |
| REG_33<10> | 1 | GPIO4(PIN32) Output Disable.<br>1=Output Disable; 0=Output Enable. |
| REG_33<9> | 1 | GPIO5(PIN1) Output Disable.<br>1=Output Disable; 0=Output Enable. |
| REG_33<8> | 1 | GPIO6(PIN2) Output Disable.<br>1=Output Disable; 0=Output Enable. |
| REG_33<6> | 0 | GPIO0(PIN28) Output Value.<br>1= High when Output Enable; 0=Low when Output Enable. |
| REG_33<5> | 0 | GPIO1(PIN29) Output Value.<br>1= High when Output Enable; 0=Low when Output Enable. |
| REG_33<4> | 0 | GPIO2(PIN30) Output Value.<br>1= High when Output Enable; 0=Low when Output Enable. |
| REG_33<3> | 0 | GPIO3(PIN31) Output Value.<br>1= High when Output Enable; 0=Low when Output Enable. |
| REG_33<2> | 0 | GPIO4(PIN32) Output Value.<br>1= High when Output Enable; 0=Low when Output Enable. |
| REG_33<1> | 0 | GPIO5(PIN1) Output Value.<br>1= High when Output Enable; 0=Low when Output Enable. |
| REG_33<0> | 0 | GPIO6(PIN2) Output Value.<br>1= High when Output Enable; 0=Low when Output Enable. |
| REG_34<15:12> | 0x0 | GPIO3(PIN31) Output Type Selection.<br>The Definitions is the same as REG_34<3:0>. |
| REG_34<11:8> | 0x0 | GPIO4(PIN32) Output Type Selection.<br>The Definitions is the same as REG_34<3:0>. |
| REG_34<7:4> | 0x0 | GPIO5(PIN1) Output Type Selection.<br>The Definitions is the same as REG_34<3:0>. |
| REG_34<3:0> | 0x0 | GPIO6(PIN2)Output Type Selection.<br>0=High/Low<br>1=Interrupt |

| | | |
|---|---|---|
| | | *2=Squelch*<br>*3=VoX*<br>*4=CTCSS/CDCSS Compared Result*<br>*5=CTCSS Compared Result*<br>*6=CDCSS Compared Result*<br>*7=Tail Detected Result*<br>*8=DTMF/5Tone Symbol Received Flag*<br>*9=CTCSS/CDCSS Digital Wave*<br>*Others=Reserved* |
| *REG_35<11:8>* | *0x0* | *GPIO0(PIN28)Output Type Selection.*<br>*The Definitions is the same as REG_34<3:0>.* |
| *REG_35<7:4>* | *0x0* | *GPIO1(PIN29) Output Type Selection.*<br>*The Definitions is the same as REG_34<3:0>.* |
| *REG_35<3:0>* | *0x0* | *GPIO2(PIN30) Output Type Selection.*<br>*The Definitions is the same as REG_34<3:0>.* |

## XTAL

1. 芯片支持 26M，25.6M，13M，12.8M，19.2M 和 38.4M 的晶体或温补。默认 26M，若使用 26M 外的其他频率晶体或温补使用 RF_SetXtal(u8 mode)，如 RF_SetXtal(XTAL19M2)

## Frequency Scan

1. 扫频使用 RF_FreqScan()可以获取 LNAIN 脚的射频频率（需要较大幅度>-40dBm），返回 1 表示失败，返回 0 表示成功。频率写入到全局变量 *FRQ_HI16* 和 *FRQ_LO16*。

2. 扫到频率后，设置接收频率到该频点，使用 RF_CtcDcsScan()可获取 CTCSS 频率或 CDCSS 码，返回 0 表示失败，返回 1 表示收到 CTCSS 且频率写入全局变量 *CtC_FREQ*，返回 2 表示收到 23bit CDCSS，返回 3 表示收到 24bitCDCSS，23 或 24bitCDCSS 均写入全局变量 *DCS_HI12* 和 *DCS_LO12*。

| Register | Default | Description |
|---|---|---|
| *REG_32<15:14>* | *0b00* | *FrequencyScan Time.*<br>*00=0.2 Sec; 01=0.4 Sec; 10=0.8 Sec; 11=1.6 Sec* |
| *REG_32<0>* | *0* | *FrequencyScanEnable.*<br>*1=Enable; 0=Disable.* |
| *REG_0D<15>* | *Read Only* | *Frequency Scan Indicator.*<br>*1=Busy; 0=Finished.* |
| *REG_0D<10:0>* | *Read Only* | *Frequency Scan High 16 bits.* |

| | | |
|---|---|---|
| *REG_0E<15:0>* | *Read Only* | *Frequency Scan Low 16 bits.*<br>*= **REG_0D<10:0>**<<16 + **REG_0E<15:0>**, unit is 10Hz* |
| *REG_68<15>* | *Read Only* | *CTCSS Scan Indicator.*<br>*1=Busy; 0=Found.* |
| *REG_68<12:0>* | *Read Only* | *CTCSS Frequency.*<br>*Frequency(Hz)*<br>*= **REG_68<12:0>/**20.64888 for 13M/26M XTAL and*<br>*= **REG_68<12:0>/**20.97152 for 12.8M/19.2M/25.6M/38.4M XTAL* |
| *REG_69<15>* | *Read Only* | *CDCSS Scan Indicator.*<br>*1=Busy; 0=Found.* |
| *REG_69<14>* | *Read Only* | *23 or 24 bit CDCSS Indicator.(for BK4819v3)*<br>*1=24 bit; 0=23 bit.* |
| *REG_69<11:0>* | *Read Only* | *CDCSS High 12 bits.* |
| *REG_6A<11:0>* | *Read Only* | *CDCSS Low 12 bits.* |

## Channel Spacing

芯片支持多种带宽，包括常见的 12.5k/25k/6.25k/20k，使用 RF_SetChnSpace(u8 space)，输入参数 SPACE_12K5/SPACE_25K/SPACE_6K25/SPACE_20K 即可。可根据实际需求设置发射接收带宽。

| Register | Default | Description |
|---|---|---|
| *REG_43<14:12>* | *0b100* | *RF filter bandwidth (Apass=0.1dB)*<br>*000 = 1.7 kHz*<br>*001 = 2 kHz*<br>*010 = 2.5 kHz*<br>*011 = 3 kHz*<br>*100 = 3.75 kHz*<br>*101 = 4 kHz*<br>*110 = 4.25 kHz*<br>*111 = 4.5 kHz*<br>*if REG_43<5>=1, RF filter bandwidth *=2;* |
| *REG_43<11:9>* | *0b000* | *RF filter bandwidth when signal is weak (Apass=0.1dB)*<br>*000 = 1.7 kHz*<br>*001 = 2 kHz*<br>*010 = 2.5 kHz*<br>*011 = 3 kHz*<br>*100 = 3.75 kHz*<br>*101 = 4 kHz* |

| | | |
|---|---|---|
| | | *110 = 4.25 kHz*<br>*111 = 4.5 kHz*<br>*if REG_43<5>=1, RF filter bandwidth *=2;* |
| *REG_43<8:6>* | *0b001* | *AFTxLPF2 filter Band Width (Apass=1dB) Selection.*<br>*100 = 4.5 kHz*<br>*101 = 4.25 kHz*<br>*110 =4kHz*<br>*111 = 3.75 kHz*<br>*000 = 3 kHz (for 25k Channel Space)*<br>*001 = 2.5 kHz (for 12.5k Channel Space)*<br>*010 = 2.75 kHz*<br>*011 =3.5 kHz* |
| *REG_43<5:4>* | *0b00* | *BW Mode Selection.*<br>*00=12.5k; 01=6.25k; 10=25k/20k* |

## Digital Walkie-Talkie

当做数字收发机使用时需要 bypass 所有音频滤波器，使用 RF_EnterBypass()，退出该模式使用 RF_ExitBypass()

## Hardware Design

SeeBK4819Datasheet.