Application Report
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# RF1A Library for CC430F613x/F513x Sub-1GHz SoCs

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MSP430

**ABSTRACT**

The RF1A radio module consists of the CC1101-based radio core and the RF1A interface, which interfaces the MSP430F5xx and the radio core within the CC430 devices.. The RF1A library provides functions that implement the most common operations when using the RF1A interface, such as sending command strobes, reading and writing the RF configuration registers, and writing to the PA Table. This application report documents the definition and proper use of the available library calls.

The related code files can be downloaded from http://www.ti.com/lit/zip/slaa460.

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## 1 Glossary of Acronyms

| | |
|---|---|
| FIFO | First In First Out |
| MSB | Most Significant Bit |
| RX | Receive |
| TX | Transmit |
| PA | Power Amplifier |

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# 2 RF1A Library

## 2.1 Introduction to the RF1A Interface

The RF1A interface is the mailbox module between the MSP430 and the CC1101-based radio core, whose registers sit within the linear memory map of the MSP430 and can be accessed as with any other MSP430 peripheral. The radio interface registers, logical channels, and their relation to the radio core, are depicted in Figure 1.

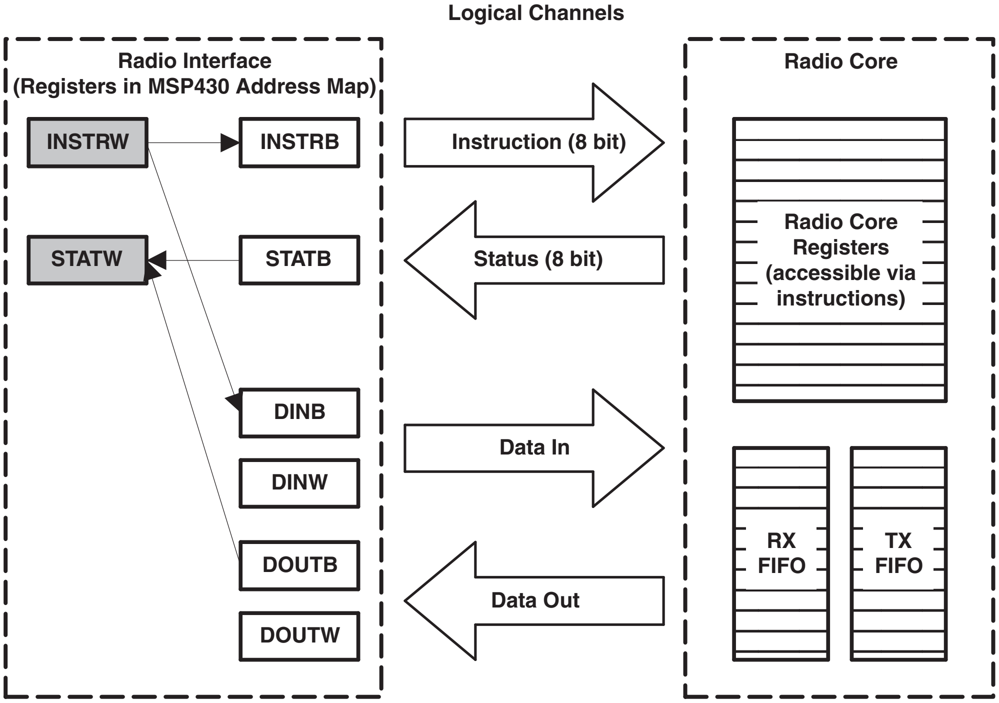


**Figure 1. RF1A Interface Usage**

There are essentially three types of instruction-based (i.e., non-interrupt) interactions that one can make with the CC1101-based core through the RF1A interface:

1. Changing the state of the Radio Core through command strobes (e.g., IDLE to RX mode)
2. Reading from or writing to the radio configuration, PA table, or status registers
3. Read from or writing to the RX and TX FIFOs

The RF1A library provides functions for handling all three scenarios while observing the recommended protocol for interfacing the Instruction, Data, and Status Registers, per the *CC430 Family User's Guide*. For a detailed description of the RF1A interface, register description, and recommended protocol, see the *CC430 Family User's Guide* (SLAU259).[1]

## 2.2 Using the RF1A.h/.c

The RF1A.h file declares the RF1A functions as well as a structure type, RF_SETTINGS, to hold the register values output by SmartRF® Studio. The functions are described in the following sections.

### 2.2.1 void ResetRadioCore (void);

Resets the radio, putting the radio state machine into SLEEP mode.

### 2.2.2 unsigned char Strobe(unsigned char strobe);

Used to send a command strobe to the radio. Includes the workaround RF1A7.[2] Note that this workaround includes an 810-µs delay in software (using the __delay_cycles() intrinsic) that is dependent on the frequency of operation. As the frequency changes from the default MCLK of 1.05 MHz, the value in the __delay_cycles() intrinsic should be adjusted accordingly to result in a delay of at least 810 µs.

**Parameters**

strobe

The RF_xxx command strobe that changes the state of the radio.

**Returns**

A status byte indicating the current state of the radio and the number of bytes available in the RX or TX FIFO, depending on the MSB of the input strobe parameter.

**Examples**

```
Strobe( RF_NOP );              // Retrieve status byte, including bytes in TX FIFO
Strobe( RF_NOP | RF_RXSTAT );  // Retrieve status byte, including bytes in RX FIFO
Strobe( RF_SIDLE );            // Enter IDLE mode
```

### 2.2.3 void WriteRfSettings(RF_SETTINGS *pRfSettings);

Copies the full set of SmartRF Studio settings from the RF_SETTINGS structure pointed to by pRfSettings to the configuration register set of the CC1101-based core.

**Parameters**

pRfSettings

A pointer to the RF_SETTINGS structure that has been generated using SmartRF Studio – see Section 2.2.10 of this document for how to generate the appropriate structure using SmartRF Studio.

### 2.2.4 void WriteSingleReg(unsigned char addr, unsigned char value);

Write a single CC1101 configuration register.

**Parameters**

addr

The address of the configuration register to be written. The value could also be the address of the TX FIFO.

value

The intended value of the configuration register

**Examples**

```
WriteSingleReg(FSCTRL1, pRfSettings->fsctrl1);  // Write FSCTRL1 config register
```

### 2.2.5 void WriteBurstReg(unsigned char addr, unsigned char *buffer, unsigned char count);

Write multiple radio core configuration registers.

**Parameters**

addr

The address of the configuration register to be written. The value could also be the address of the TX FIFO

buffer

A pointer to the array holding the values to be written consecutively into the radio register(s)

count

The total number of values to be written

**Examples**

```
WriteBurstReg(TXFIFO, buffer, length);  // Write the 'buffer' array to the TX FIFO
```

### 2.2.6 unsigned char ReadSingleReg(unsigned char addr);

Read a single radio core configuration register.

**Parameters**

addr

The address of the configuration register to be read. The value could also be the address of the RX FIFO.

**Returns**

value

The value of the register at address

**Examples**

```
ReadSingleReg(RSSI);  // Read the current RSSI value from the RSSI status register
```

### 2.2.7 void ReadBurstReg(unsigned char addr, unsigned char *buffer, unsigned char count);

Read multiple radio core configuration registers.

**Parameters**

addr

The address of the configuration register to be read. The value could also be the address of the RX FIFO.

buffer

A pointer to the array that will hold the values that are read consecutively from the radio register(s)

count

The total number of values to be read

**Examples**

```
// Read RxBufferLength bytes from the RX FIFO
ReadBurstReg(RXFIFO, RxBuffer, RxBufferLength);
```

### 2.2.8 void WriteSinglePATable(unsigned char value);

Write a single byte to the PA Table.

**Parameters**

value

The intended value of the PA setting

### 2.2.9 void WriteBurstPATable(unsigned char *buffer, unsigned char count);

Write multiple radio core configuration registers (i.e., for ASK modulation).

**Parameters**

buffer

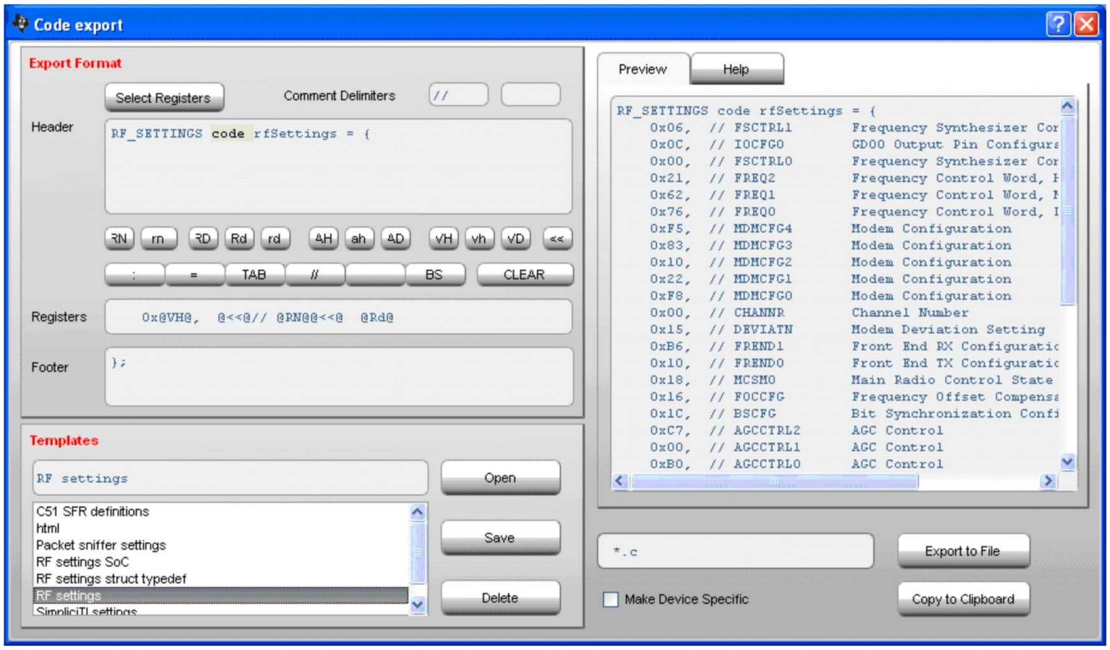
A pointer to the array holding the values to be written consecutively into the PA Table

count

The total number of values to be written

### 2.2.10 Code Export Using SmartRF® Studio

The SmartRF Studio can output a file that defines the RF_SETTINGS structure referred to in the WriteRfSettings() description. In the Code Export window of the SmartRF Studio tool, select RF settings as the Template to apply, and then delete code from the Header entry prior to generating the file. The generated .c file can then be used by the application, by including the RF1A.h file, to easily initialize the radio to the settings defined using SmartRF studio (see Figure 2).



Comment Delimiters: //

Header:
```
RF_SETTINGS code rfSettings = {
```

Registers:
```
    0x@VH@,  @<<@// @RN@@<<@  @Rd@
```

Footer:
```
};
```

Templates: RF settings

- C51 SFR definitions
- html
- Packet sniffer settings
- RF settings SoC
- RF settings struct typedef
- RF settings
- SimpliciTI settings

Preview:
```
RF_SETTINGS code rfSettings = {
    0x06,  // FSCTRL1      Frequency Synthesizer Cor
    0x0C,  // IOCFG0       GDO0 Output Pin Configura
    0x00,  // FSCTRL0      Frequency Synthesizer Cor
    0x21,  // FREQ2        Frequency Control Word, H
    0x62,  // FREQ1        Frequency Control Word, M
    0x76,  // FREQ0        Frequency Control Word, I
    0xF5,  // MDMCFG4      Modem Configuration
    0x83,  // MDMCFG3      Modem Configuration
    0x10,  // MDMCFG2      Modem Configuration
    0x22,  // MDMCFG1      Modem Configuration
    0xF8,  // MDMCFG0      Modem Configuration
    0x00,  // CHANNR       Channel Number
    0x15,  // DEVIATN      Modem Deviation Setting
    0xB6,  // FREND1       Front End RX Configuratic
    0x10,  // FREND0       Front End TX Configuratic
    0x18,  // MCSM0        Main Radio Control State
    0x16,  // FOCCFG       Frequency Offset Compensa
    0x1C,  // BSCFG        Bit Synchronization Confi
    0xC7,  // AGCCTRL2     AGC Control
    0x00,  // AGCCTRL1     AGC Control
    0xB0,  // AGCCTRL0     AGC Control
```

*.c

□ Make Device Specific

**Figure 2. Defining the RF_SETTINGS struct Using SmartRF Studio**

For a detailed description on how to use SmartRF Studio, see the *SmartRF® Studio User Manual* (SWRU070).[3] For an example on how to use the CC430 RF1A.h/.c files, see the CC430 RF Code Examples on the CC430F6137 product page.

## 3 References

1. *CC430 Family User's Guide* (SLAU259)

2. *CC430F613x Device Erratasheet* (SLAZ052)

3. *SmartRF™ Studio User Manual* (SWRU070)

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