

Operating the TRF4903 With MSP430 Evaluation Kit in the 868-MHz European Band

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ABSTRACT

This application note discusses the implementation details to operate the TRF4903 with the MSP430 Evaluation Kit in the 868-MHz European ISM Band. A separate version of firmware has been developed for this purpose and is available for download from Texas Instruments ISMRF website at www.ti.com/ismrf.

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1 Introduction

The European (EU) ISM band extends from 868 to 870 MHz. The channel spacing varies depending on the actual frequency band as illustrated in Table 1.

Table 1. Channel Spacing in 868.3-MHz Band

Frequency Band (MHz)	Effective Radiated Power (ERP) mW	Maximum Duty Cycle (%)	Channel Spacing (kHz)
868 to 868.6	25	1	No channel spacing specified
868.6 to 868.7	10	0.1	25 kHz or one wideband channel
868.7 to 869.2	25	0.1	No channel spacing specified
869.2 to 869.25	10	0.1	25 kHz
869.25 to 869.3	10	0.1	25 kHz
869.3 to 869.4	10	100	25 kHz
869.4 to 869.65	500	10	25 kHz or one wideband channel
869.65 to 869.7	25	10	25 kHz
869 to 870	5	100	No channel spacing specified

A separate set of firmware has been developed to evaluate the TRF4903 with MSP430 evaluation kit in the European 868 to 870-MHz ISM band. See the *TRF4903 With MSP430 Demonstration and Development Evaluation Kit* user's guide (SWRU010) for detailed information on the evaluation kit.

2 Operation at 868 to 870-MHz EU Band

2.1 Frequency Settings

The current version of the firmware sets the transmit frequency to 868.352 MHz. The receive LO frequency is set for High-side injection and is set to 879.0016 MHz. See the *Operating the TRF6903 With MSP430 Evaluation Kit in the 868-MHz European ISM band* (SWRA040) for further information on configuring the TRF6903 evaluation kit in the receive mode at 868 MHz. The Game application register values are shown in Table 2.

Table 2. TRF4903 Register Settings Used

REGISTER	PARAMETER	VALUE
A	PA attenuation	0 dB
	Charge Pump	0.5 mA
	Frequency Band	868/915 MHz
	TX Frequency (Mode low)	868.352 MHz
B	PA attenuation	0 dB
	Modulation	FSK
	Brownout Threshold	2.2 V
	Brownout Detector	OFF
	TX Frequency (Mode High)	868.352 MHz
C	Reference Divider	48
	Reference Frequency	409.6 kHz (using a 19.6608 MHz crystal)
D	Crystal Tune	20.23 pF
	Reset Signal for PFD	Derived from Prescaler
	Crystal Switch	Closed
E	Receive Data Mode (RXM)	Self Train
	Dividers D1 D2 D3	38.4 kbps
	Transmit Capture Select	Set
	Multiplexed Output	Lock Detect/Data Clock

Due to the narrow-band nature of the European ISM band, the 16 different frequency settings (selecting using the 4-bit DIP switch SW1) **cannot** be used. The application is demonstrated using a SINGLE TX/RX pair of frequency as shown in Table 3. The DIP switch setting used for the 868-MHz EU band operation is shown in Table 3.

Table 3. DIP Switch Settings for 868-MHz Band Operation

1234 SW1 Setting (1=On, 0=Off)	TX Frequency (MHz)	RX Frequency (MHz)
0000	868.352	879.0016
0001-1111	NOT USED	NOT USED

WARNING:

The DIP switch setting 0 (0000) is used to demonstrate 868-MHz band operation. Both the transmit (TRF4903 demo kit) and receive EVK (TRF6903 demo kit) **MUST** be set to this DIP switch setting. The other switch settings are NOT used.

2.2 Downloading the Code

The workspace file for compiling the demo source code is `4903_EUBAND_DEMO.eww`, developed with IAR compiler version 3.20.

The following steps show how to open the project file and program the MSP430.

1. Insert the two AAA batteries and slide the on/off switch to ON.
2. Start the Workbench (START->PROGRAMS->IAR SYSTEMS->IAR EMBEDDED WORKBENCH)
3. Use FILE->OPEN WORKSPACE to open the workspace file at: `<Installation root>\...\4903_EUBAND_DEMO.eww`
4. Use PROJECT->REBUILD ALL to compile and link the source code. You can view the source code by double-clicking Common Sources and then double-clicking on the source files in the workspace window.
5. Use PROJECT->DEBUG to start C-SPY. C-SPY erases the device Flash and downloads the application object file.
6. In C-SPY, use EXECUTE->GO to start the application.
7. In C-SPY, use FILE->EXIT to exit C-SPY.
8. In Workbench, use FILE->EXIT to exit Workbench.

The MSP430 is now programmed with the game demonstration code and is ready to operate.

2.3 PA Match at 868 MHz

The PA Matching components in the TRF4903 evaluation kit schematic (SWRU010) have been optimized for the 915-MHz band. To optimize the design for the 868 MHz band, the PA matching components may need to be reoptimized.

NOTE: The firmware for 868-MHz band **can** be downloaded and the gaming application can be demonstrated on the evaluation kit optimized for 915 MHz. However, the PA matching may not be optimal.

Using the EasyRF™ software, the PA matching components can be calculated for the 868-MHz band. These matching values are a very good initial estimate but would need to be fine-tuned during testing and production. A screen-shot of the EasyRF™ software with matching component values for the 868-MHz EU band is shown in Figure 1.

Table 4 summarizes the PA matching component changes for the 868-MHz EU band of operation.

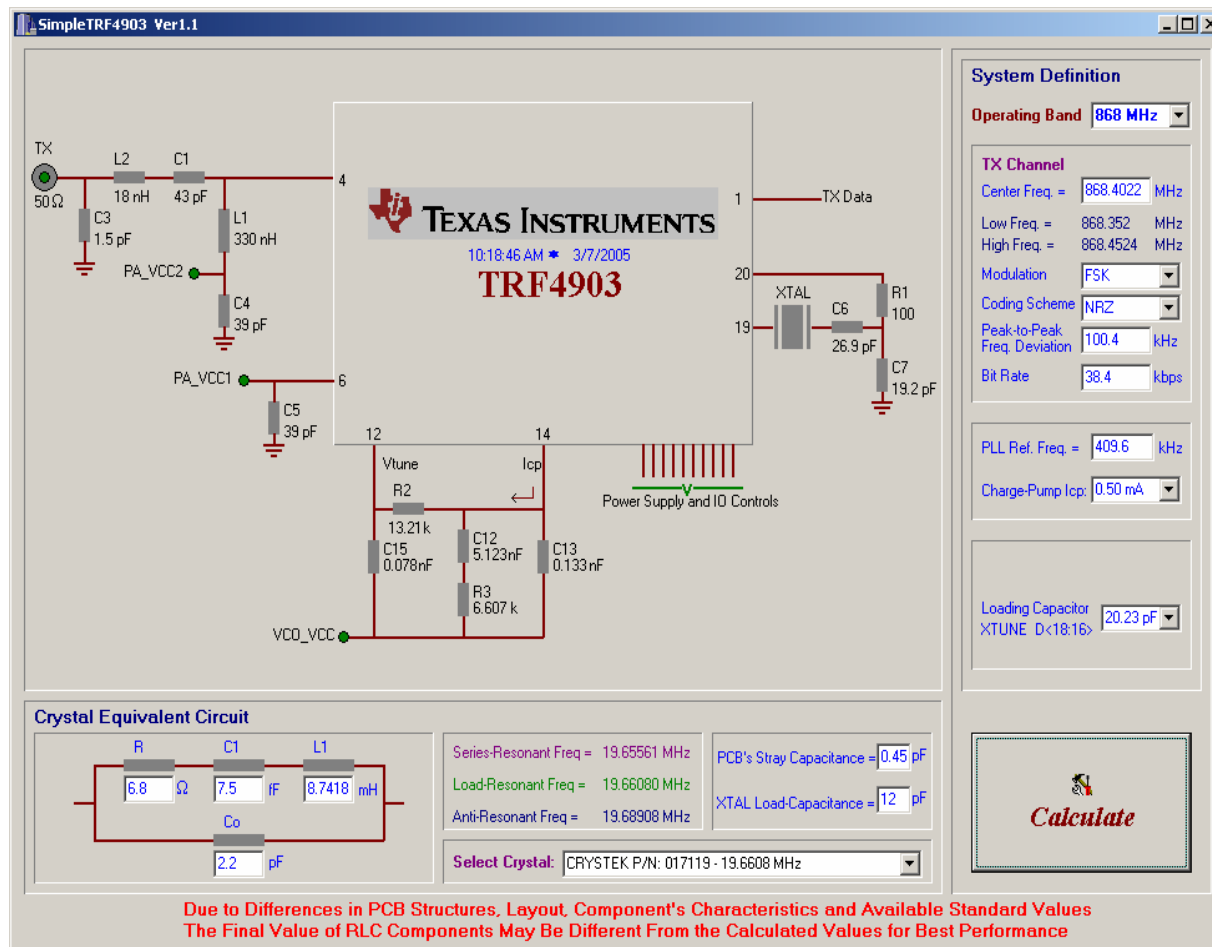


Figure 1. EasyRF™ Software Setup for TRF4903 in the 868-MHz Operating Band

Table 4. PA Matching Values for 868-MHz Band Operation

Reference Designator	868-MHz EU Band	915-MHz US ISM Band (Default)
L1	330 nH	270 nH
L2	18 nH	15 nH
C4	39 pF	33 pF
C5	39 pF	33 pF

References

1. TRF4903 Single-Chip Multi-Band RF Transceiver data sheet (SWRS023)
2. TRF6903 Design Guide (SWRU009)
3. TRF6903 with MSP430 Demonstration and Development Evaluation Kit user's guide (SWRU008)
4. TRF4903 with MSP430 Demonstration and Development Evaluation Kit user's guide (SWRU010)

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