

Operating the TRF6903 with MSP430 Evaluation Kit in the 868 MHz European ISM Band

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ABSTRACT

This application note discusses the implementation details to operate the TRF6903 with 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 TI-ISMRF website at www.ti.com/ismrf

1 Introduction

The European 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)
868.00-868.60	25	1	No Channel Spacing Specified
868.60-868.70	10	0.1	25 kHz or 1 wideband channel
868.70-869.20	25	0.1	No Channel Spacing Specified
869.20-869.250	10	0.1	25 kHz
869.250-869.300	10	0.1	25 kHz
869.300-869.400	10	100	25 kHz
869.400-869.650	500	10	25 kHz or 1 wideband channel
869.650-869.700	25	10	25 kHz
869.00-870.00	5	100	No Channel Spacing Specified

A separate set of firmware has been developed to evaluate the TRF6903 with MSP430 evaluation kit in the European 868-870 MHz ISM Band. Refer to the TRF6903 with MSP430 demonstration and development evaluation kit user's guide (TI Literature SWRU008) for detailed information on the Evaluation kit.

NOTE

The MSP430 schematic indicates that resistors R33 and R34 can be used to choose between US and European band of operation. MSP430 Port P6.6 can be probed to determine the band of operation. If R33 is placed, Port P6.6 is high and US band of operation is selected. If R34 is placed, Port P6.6 is low and EU band is selected. This feature is **NOT** implemented in the current version of the firmware for simplicity purposes. However designers have the flexibility to choose this feature if needed.

2 Operation at 868-870 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. The Game application register values are shown in [Table 2](#).

Table 2. TRF6903 Register Settings Used

REGISTER	PARAMETER	VALUE
A	PA attenuation	0 dB
	Mode 0	TX
	Charge Pump	0.5 mA
	Frequency Band	868/915 MHz
	TX Frequency	868.352
B	PA attenuation	0 dB
	Mode 0	RX
	Modulation	FSK
	BrownOut Threshold	2.2 V
	BrownOut Detector	OFF
	RX Frequency	879.0016 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

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 frequencies as shown in Table 2. 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
0000-1111	Not Used	Not Used

CAUTION

The DIP switch setting 0 (0000) is used to demonstrate 868 MHz band operation. Both the Transmit and Receive EVK's MUST be set to this DIP switch setting. The other switch settings are NOT used.

2.2 Downloading the Code

The project file for compiling the demo source code is TRF6903_EU.prj, developed with IAR compiler version 1.26a. Newer versions of the IAR compiler will convert the old project file (.prj) to a workspace project file (.ewp). The conversion is one-way (not reversible).

Please refer to the guide to run demo software on newer version (2.21B) of IAR compilers (slwa029.pdf) if a new version of IAR compiler is used for development.

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 to open the project file at: <Installation root>\...\ TRF6903Demo_EU.eww
4. Use PROJECT->BUILD 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 TRF6903_demo.prj window
5. Ensure that the C-SPY Debugger is properly configured (with DEBUG selected at PROJECT->OPTIONS->C-SPY); 1. PARALLEL PORT->PARALLEL PORT->LPT1 (default) or LPT2 or LPT3
6. Use PROJECT->DEBUGGER to start C-SPY. C-SPY erases the device Flash and downloads the application object file
7. In C-SPY, use EXECUTE->GO to start the application
8. In C-SPY, use FILE->EXIT to exit C-SPY
9. In Workbench, use FILE->EXIT to exit Workbench

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

2.3 PA and LNA Match at 868 MHz

The PA and LNA Matching components in the Evaluation kit schematic (document SWRU008) have been optimized for the 915-MHz band. To optimize the design for the 868-MHz band, the PA and LNA matching components may need to be re-optimized.

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 and LNA matching may not be optimal.

Using the EasyRF software, the PA and LNA 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 is shown in [Figure 1](#).

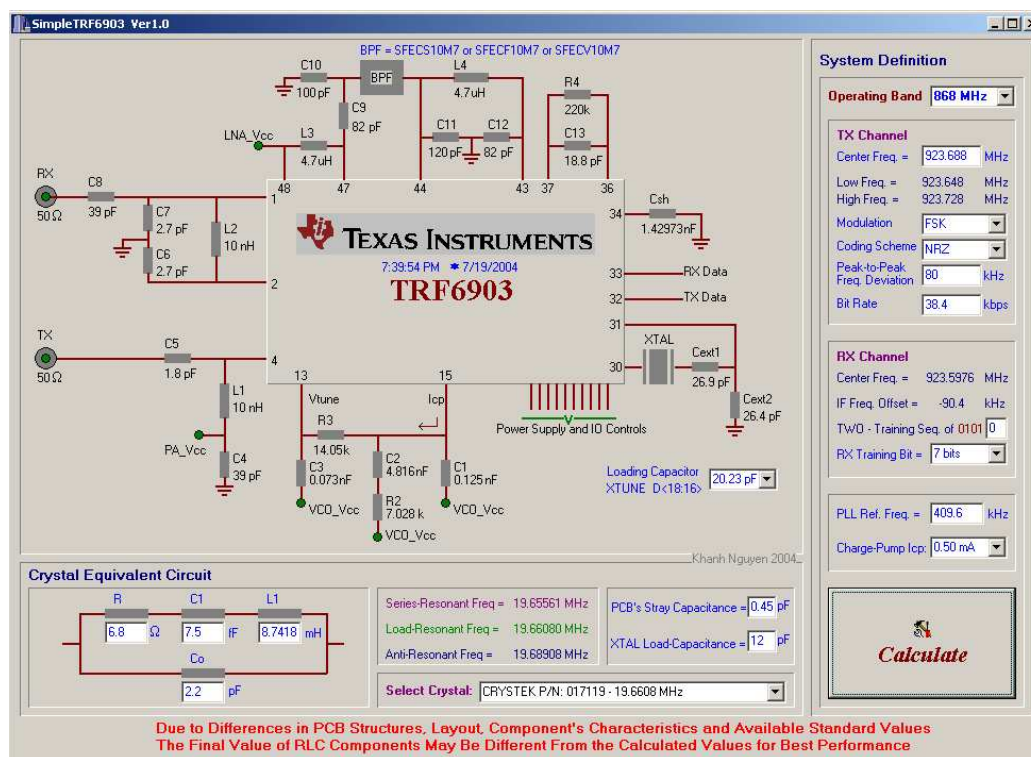


Figure 1. EasyRF Software Set for 868-MHz Operating Band

3 References

- TRF6903 Single-Chip Multiband RF Transceiver Data sheet ([SWRS022](#))
- TRF6903 Design Guide (SWRU009)
- TRF6903 with MSP430 Demonstration and Development Evaluation Kit User's Guide (SWRU008)
- Implementing a Bidirectional Wireless UART Application with TRF6903 and MSP430 (SWRA039)

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