

RFSM6525EM357 Reference Design

Overview

The RFSM6525EM357 reference design is a partnership between RFMD and Ember presenting a complete 2.4GHz IEEE 802.15.4-2003-compliant radio transceiver solution. Ember presents a fully integrated system-on-chip (SoC) with 32-bit ARM® Cortex™-M3 microprocessor, flash memory, and RAM memory, delivering unmatched performance and EmberZNet PRO network protocol stack to designers of ZigBee-based systems. RFMD presents a family of world class front end modules (FEM) for efficient extended output power above 20dBm with harmonic filtering, diversity switch, and LNA option for "bypass mode" that perfectly mate with, and increases the link budget of the EM300 Series and EM200 Series System-on-Chips (SoCs). These front end modules include the RF6525, RF6535 and RF6515.

This document briefly describes the RFSM6525EM357 reference design and how it is set up and configured for Engineering Evaluation of the RF6525 FEM using Ember's nodetest application firmware, pre-flashed on the EM357 SoC. Snapshots of Tx and Rx data are included.

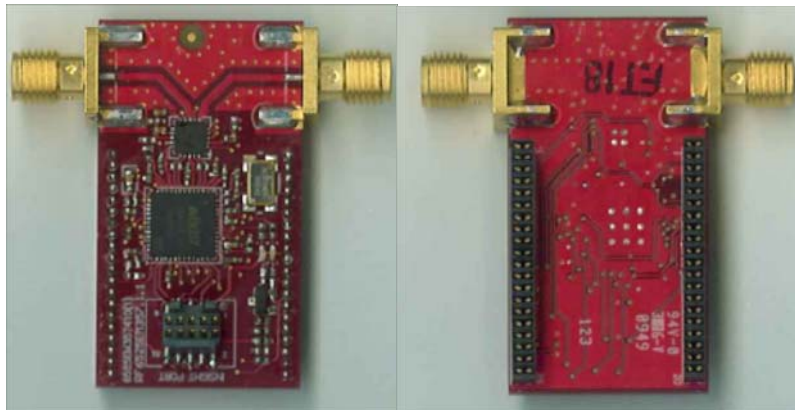
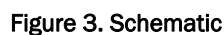
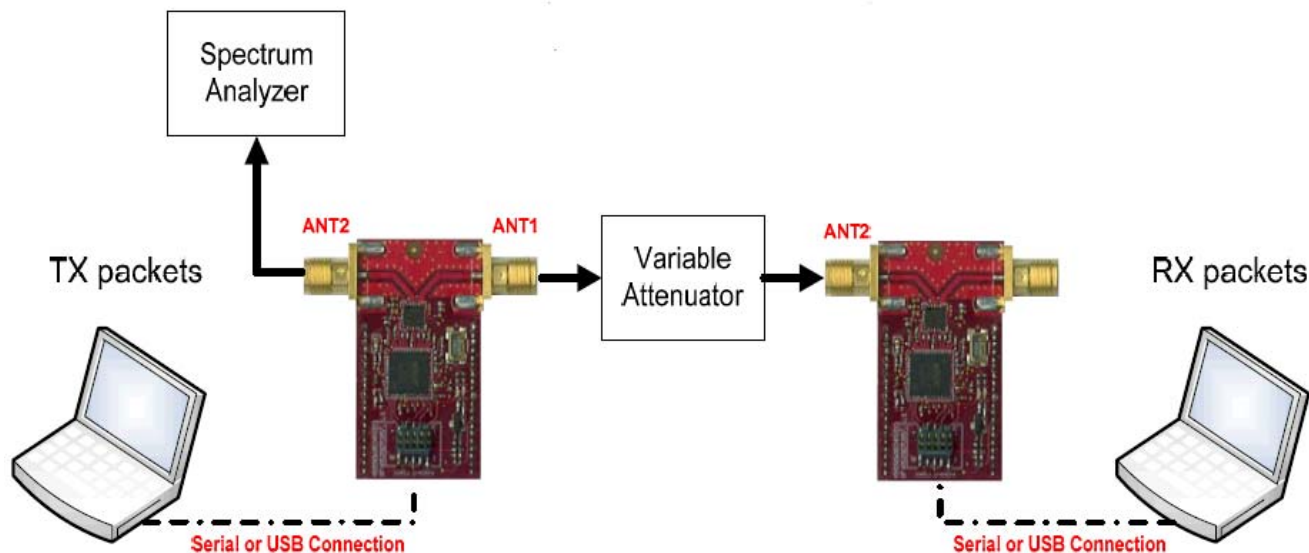


Figure 1. Top and Bottom View of RFSM6525EM357 Reference Design



Complete reference design files, including layout, schematic, BOM, and Gerber files are available from RFMD.com.

Test Setup



Evaluation and Configuration

The RFSM6525EM357 reference design is evaluated on the Ember EM35X breakout board (EM35X-BBRD) using an RS-232 interface or USB interface with onboard RS-232 conversion. Power is provided using a USB supply, external supply, or external battery pack.

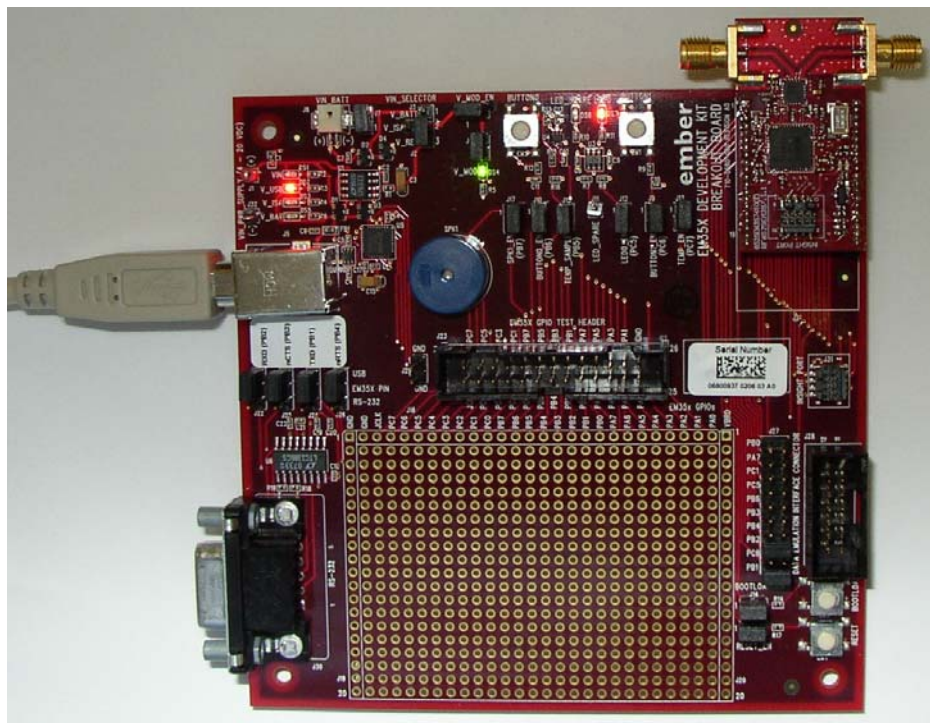


Figure 4. RFSM6525EM357 Reference Design Using USB Interface and Power

With the RFSM6525EM357 reference design powered and connected to a computer, a terminal emulator can establish communication with the appropriate RS-232 COM Port or USB interface, depending on which type of connection is in use. If you do not have the proper FTDI drivers installed, please go to www.ftdichip.com/FTDrivers.htm and install the drivers for your operating system. These drivers are needed to establish communication. Note that these drivers may have to be installed twice to ensure proper operation. After connection is established with that port, set field values as follows:

| Field | Value |
|-----------------|----------|
| Bits per Second | 115,200 |
| Data Bits | 8 |
| Parity | none |
| Stop Bits | 1 |
| Flow Control | Hardware |

Press "Enter" to establish a response from the EM357 SoC. Configuration of the RF6525 FEM can then occur.

```
Ember Node Test Application v1.0
Jan 11 2010. 18:41:17

[INIT crashinfo]
[INIT initTokens]
[INIT initRadio]
PCS/PC6 are not being used for a power amplifier and are being
configured for BOARDLED2 and BUTTON1. If using a breakout board,
BUTTON1's jumper, BUTTON1_EN/J9, should be installed.
[INIT seedPrg]
[INIT setPerTestTx]
[INIT resetstring]
RESET: PWR-HV
>
```

Figure 5. RFSM6525EM357 Reference Design Response from Hyperterminal

RF6525 Configuration with EM357 Using Node Test Application v1.0

At the prompt ">", the following commands are utilized to configure the RF6525 FEM for continuous transmit in channel 19 (as an example scenario) in the following order:

| Step | Command | Description | Note |
|------|-------------------------------|---------------------------------------|---------------------------------|
| 1 | gpioconfig c 18944919 "Enter" | Configure GPIO "PC1" for RFMD FEM | Default Antenna 1 |
| 2 | setchannel 13 "Enter" | Set Transmit Channel to 19 | 2.445GHz |
| 3 | settxpowmode 0 1 "Enter" | Configure EM357 extended mode | |
| 4 | settxpower -e "Enter" | Set EM357 Pout to -14dBm | |
| 5 | txtone "Enter" | Transmit continuous carrier frequency | Not required for configuration. |
| 6 | e | Exit continuous transmit | |

Steps 5 and 6 can be replaced with the following for a continuous stream of random symbols:

| Step | Command | Description | Note |
|------|------------------|--|------|
| 5 | txStream "Enter" | Transmit continuous stream of random symbols | |
| 6 | e | Exit continuous transmit | |

Steps 5 and 6 can be replaced with the following for receive mode:

| Step | Command | Description | Note |
|------|------------|-------------------------|------|
| 5 | rx "Enter" | Receive Mode | |
| 6 | e | Exit continuous receive | |

Additional Commands

Select Antenna 2 or Antenna 1:

| Step | Command | Description | Note |
|------|----------------------|------------------|------|
| | gpioout c E5 "Enter" | Select Antenna 2 | |
| | gpioout c E7 "Enter" | Select Antenna 1 | |

Configure and Toggle LEDs:

| Step | Command | Description | |
|------|----------------------------|---|--|
| 1 | gpiocfg b 91194491 "Enter" | Configure GPIO "PB5" and "PB6" for LEDs | |
| | gpioout b 61 "Enter" | Turn both LEDs off | |
| | gpioout b 1 "Enter" | Turn both LEDs on | |
| | gpioout b 41 "Enter" | Turn "PB5" LED on ("PB6" LED off) | |
| | gpioout b 21 "Enter" | Turn "PB6" LED on ("PB5" LED off) | |

Radio Channels

| Channel # | Command | Frequency (GHz) |
|-----------|-----------------------|-----------------|
| 11 | setchannel 0B "Enter" | 2.405 |
| 12 | setchannel 0C "Enter" | 2.41 |
| 13 | setchannel 0D "Enter" | 2.415 |
| 14 | setchannel 0E "Enter" | 2.42 |
| 15 | setchannel 0F "Enter" | 2.425 |
| 16 | setchannel 10 "Enter" | 2.43 |
| 17 | setchannel 11 "Enter" | 2.435 |
| 18 | setchannel 12 "Enter" | 2.44 |
| 19 | setchannel 13 "Enter" | 2.445 |
| 20 | setchannel 14 "Enter" | 2.45 |
| 21 | setchannel 15 "Enter" | 2.455 |
| 22 | setchannel 16 "Enter" | 2.46 |
| 23 | setchannel 17 "Enter" | 2.465 |
| 24 | setchannel 18 "Enter" | 2.47 |
| 25 | setchannel 19 "Enter" | 2.475 |
| 26 | setchannel 1A "Enter" | 2.48 |

Transceiver Output

| Power Out (dBm) | Command |
|-----------------|------------------------|
| -43 | settxpower -2b "Enter" |
| -26 | settxpower -1a "Enter" |
| -20 | settxpower -14 "Enter" |
| -17 | settxpower -11 "Enter" |
| -14 | settxpower -e "Enter" |
| -11 | settxpower -b "Enter" |
| -9 | settxpower -9 "Enter" |
| -8 | settxpower -8 "Enter" |
| -7 | settxpower -7 "Enter" |
| -6 | settxpower -6 "Enter" |
| -5 | settxpower -5 "Enter" |
| -4 | settxpower -4 "Enter" |
| -3 | settxpower -3 "Enter" |
| -2 | settxpower -2 "Enter" |
| -1 | settxpower -1 "Enter" |
| 0 | settxpower 0 "Enter" |
| 1 | settxpower 1 "Enter" |
| 2 | settxpower 2 "Enter" |
| 3 | settxpower 3 "Enter" |
| 4 | settxpower 4 "Enter" |
| 5 | settxpower 5 "Enter" |
| 6 | settxpower 6 "Enter" |
| 7 | settxpower 7 "Enter" |
| 8 | settxpower 8 "Enter" |

Tx Data at 25 °C

| MHz | Channel | TXVR Power (dBm) | Output Power at Antenna (dBm) | 2fo (dBm/MHz) | 3fo (dBm/MHz) |
|------|---------|------------------|-------------------------------|---------------|---------------|
| 2405 | 11 | -9 | 20.5 | -50 | -56.8 |
| 2410 | 12 | -9 | 20.5 | | |
| 2415 | 13 | -9 | 20.5 | | |
| 2420 | 14 | -9 | 20.5 | | |
| 2425 | 15 | -9 | 20.5 | | |
| 2430 | 16 | -9 | 20.5 | | |
| 2435 | 17 | -9 | 20.5 | | |
| 2440 | 18 | -9 | 20.5 | -48.6 | -47.4 |
| 2445 | 19 | -9 | 20.4 | -48.6 | -46.7 |
| 2450 | 20 | -9 | 20.4 | | |
| 2455 | 21 | -9 | 20.3 | | |
| 2460 | 22 | -9 | 20.3 | | |
| 2465 | 23 | -9 | 20.2 | | |
| 2470 | 24 | -9 | 20.1 | | |
| 2475 | 25 | -9 | 20 | | |
| 2480 | 26 | -9 | 20 | -49.6 | -45.3 |

Rx Sensitivity Performance

| Rx Sensitivity Data | 1% (PER) | 20% (PER) | 35% (PER) |
|---------------------|----------|-----------|-----------|
| Channel 11 | -104.5 | -105.5 | -106 |
| Channel 19 | -104.5 | -105.5 | -106 |
| Channel 26 | -104.5 | -105.5 | -106 |