RF-BREAKOUT-MVK MAVRK Module

User's Guide

Texas Instruments

Literature Number: SLAU382
December 2011

Contents

1 **EVM Overview** **5**
- 1.1 EVM Description 5
- 1.2 Highlighted Products 6
- 1.3 Block Diagram 6
- 1.4 EVM Wiki 6
- 1.5 EVM Landing Page 6

2 **Hardware Description** **7**
- 2.1 Power Requirements 7
- 2.2 Getting Started: Configuring the EVM 7
- 2.3 EVM Connectors, Fuses, and Switches 7
- 2.4 EVM Test Points 8
- 2.5 EVM LEDs 9
- 2.6 RF Header Definition and Utilization 10
  - 2.6.1 RF I2S Header Definition 10
  - 2.6.2 RF SDIO Header Definition 11
  - 2.6.3 RF GPIO Header Definition 12
  - 2.6.4 RF SPI Header Definition 13
  - 2.6.5 RF UART Header Definition 14
  - 2.6.6 RF I2C Header Definition 15
  - 2.6.7 RF Audio Header Definition 16

3 **Software Description** **17**
- 3.1 MAVRK Software Minimum Requirements 17
- 3.2 How to get the MAVRK Software 17
- 3.3 Where do I find the MAVRK Qt Demo Application? 17
- 3.4 Where do I find the Demo and Test Code? 17

4 **Software Project** **18**
- 4.1 Getting Started 18
- 4.2 Setting up the Demo Hardware 19
- 4.3 Accessing RF-Breakout-MVK External Signals 20
  - 4.3.1 GPIO Demo Breakdown 20
    - 4.3.1.1 GPIO Demo 21
    - 4.3.1.2 GPIO APIs 21
  - 4.3.2 UART Demo 26
  - 4.3.3 SPI Demo 27
  - 4.3.4 I2C Demo 29

5 **Board Files** **31**
- 5.1 Bill of Materials (BOM) 31
- 5.2 Layout (PDF) 31
- 5.3 Schematics (PDF) 32
- 5.4 Fabrication Drawings (PDF) 32
- 5.5 Request Gerber and Schematic files 32

6 **Application Note** **32**

7 MAVRK Links 33
- 7.1 I want more info on MAVRK 33
- 7.2 I have MAVRK Questions 33
- 7.3 I want more Technical Info on MAVRK Hardware 33
- 7.4 I want more Technical Info on MAVRK Software 33
- 7.5 I want to get a MAVRK board 33

8 Important Notices 34
- 8.1 ESD Precautions 34
- 8.2 Certifications 34
- 8.3 Evaluation Board/Kit/Module (EVM) Additional Terms 34
- 8.4 United States FCC and Canada IC Regulatory Compliance Information 35
- 8.5 Evaluation Board/Kit/Module (EVM) Warnings, Restrictions, and Disclaimers 35
  - 8.5.1 Your Sole Responsibility and Risk 35
  - 8.5.2 Certain Instructions 35
  - 8.5.3 Agreement to Defend, Indemnify and Hold Harmless 36
  - 8.5.4 Safety-Critical or Life-Critical Applications 36

RF-BREAKOUT-MVK MAVRK Module

This document contains general information pertinent to this module.

1 EVM Overview

1.1 EVM Description

The RF-Breakout-MVK module is a special module which is intended to create an easy way for a user to debug the signals on the RF bus. The breakout modules implements two ways of debugging:

- Visual debugging through the use of the LED arrays
- Manual debugging of the electrical signals using oscilloscopes or logic analyzers.

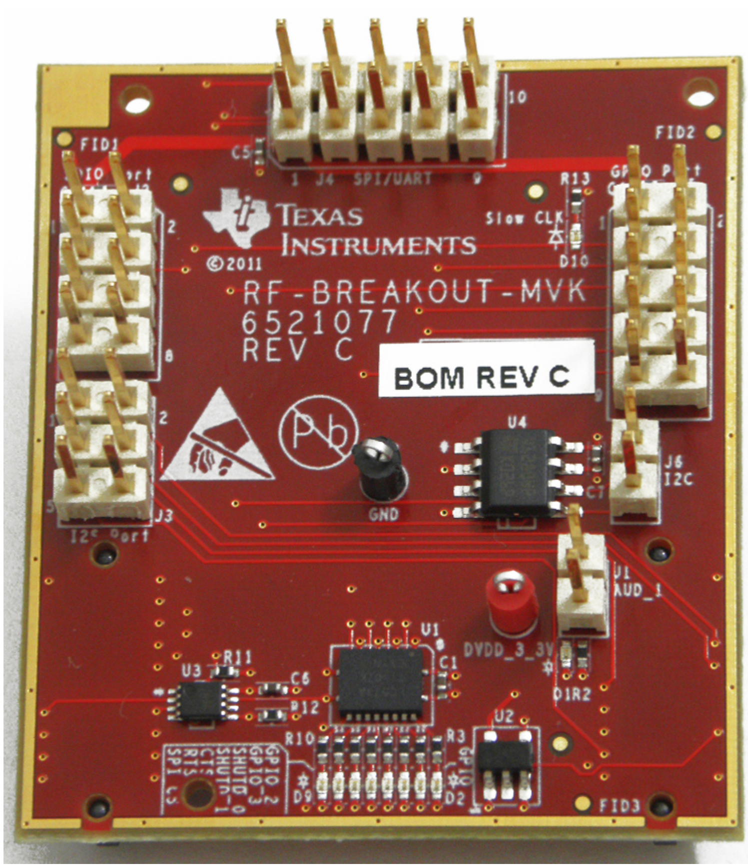

Figure 1. RF Breakout Module

The main features of the RF-Breakout-MVK board are the expansion headers on the left and the row of LEDs down the middle of the design.

The RF-Breakout-MVK enables easy debug of the RF bus making all the pins available on standard 100mil pin headers for probing or connecting to an external logic analyzer. Please be aware that the 100mil headers are connected directly to the RF bus and care should be taken when probing it as un-intentional behavior could result.

Furthermore there is an array of LEDs connected to the RF bus used for simple visual inspection of the singal levels on the RF bus.

This module connects to the Modular and Versatile Reference Kit (MAVRK) Motherboard's RF port.

For a full list of RF pinouts with description please see the RF Pinout for MAVRK wiki page.

1.2 Highlighted Products

- 10-Ohm SPST Analog Switch
- Dual-Channel 10-Ohm SPST Analog Switch
- Octal Transparent D-Type Latches With 3-State Outputs

1.3 Block Diagram

The figure below shows the main functional blocks of the RF-Breakout-MVK. The LED array is located behind an array of logic latches. Therefore the state of the LEDs only changes when the module has been selected. However, by keeping the module select high at all times, it will be possible to see the state of all IO's at all times on the RF bus.

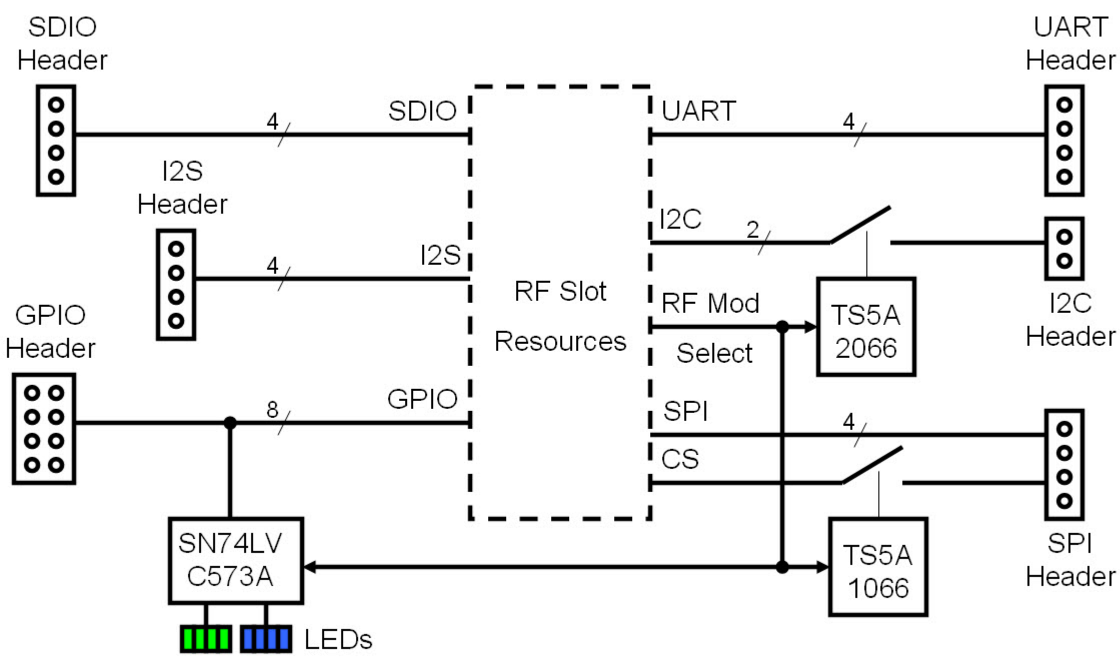

Figure 2. A block diagram of the RF-Breakout-MVK

1.4 EVM Wiki

RF-BREAKOUT-MVK MAVRK Module wiki page

1.5 EVM Landing Page

RF-BREAKOUT-MVK MAVRK Module tool folder

2 Hardware Description

2.1 Power Requirements

3.3V DC is supplied to the RF-BREAKOUT-MVK through the RF Connector (RF2, pin 9). The RF-TCA8418-MVK module can operate over the voltage range of 1.65V to 3.65V DC with a typical current draw of less than 25mA.

2.2 Getting Started: Configuring the EVM

2.3 EVM Connectors, Fuses, and Switches

The RF-BREAKOUT-MVK EVM has two connectors on the back side of the module that connect it to an RF slot on a motherboard like the MB-PRO-MVK. For a full list of RF pinouts with description please see the RF Pinout for MAVRK wiki page.

Figure 3. Back side of the RF Breakout Module, showing the RF connectors

2.4 EVM Test Points

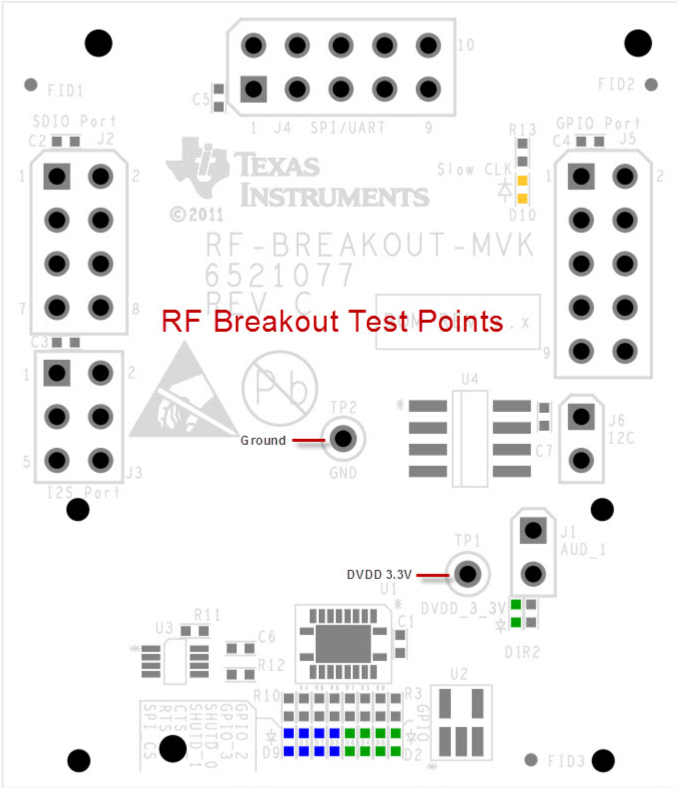

Figure 4. Test points on the RF Breakout Module

2.5 EVM LEDs

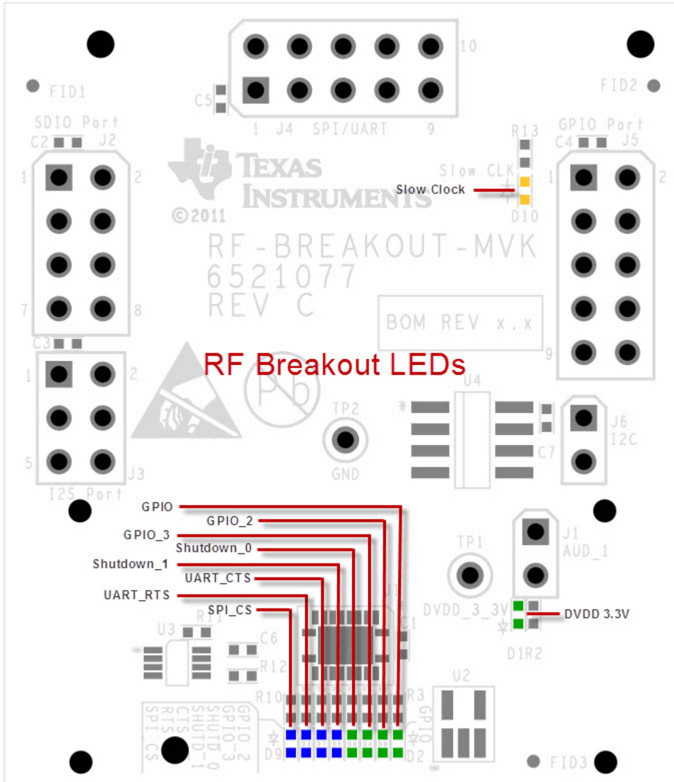

Figure 5. LEDs on the RF Breakout Module

2.6 RF Header Definition and Utilization

For a full list of RF pinouts with description please see the RF Pinout for MAVRK wiki page. The table below describes the mapping of all the IO's coming in the RF-Breakout-MVK from the RF1/RF2 connectors to each of the breakout connectors and various LEDs.

2.6.1 RF I2S Header Definition

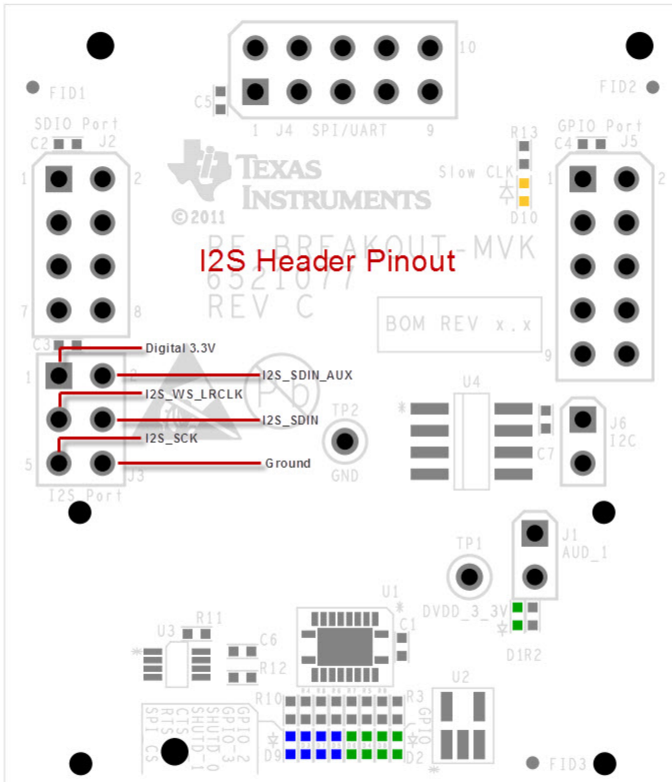

Figure 6. RF I2S Header Pinout

Table 1. RF I2S Header Definition

RF BREAKOUT		I2S	
Signal Name	Header	Pin #	LED# / color
RF_AUDIO_CLK	J3	5	N/A
RF_AUDIO_FSYNC	J3	3	N/A
RF_AUDIO_DIN	J3	4	N/A
RF_AUDIO_DOUT	J3	2	N/A

2.6.2 RF SDIO Header Definition

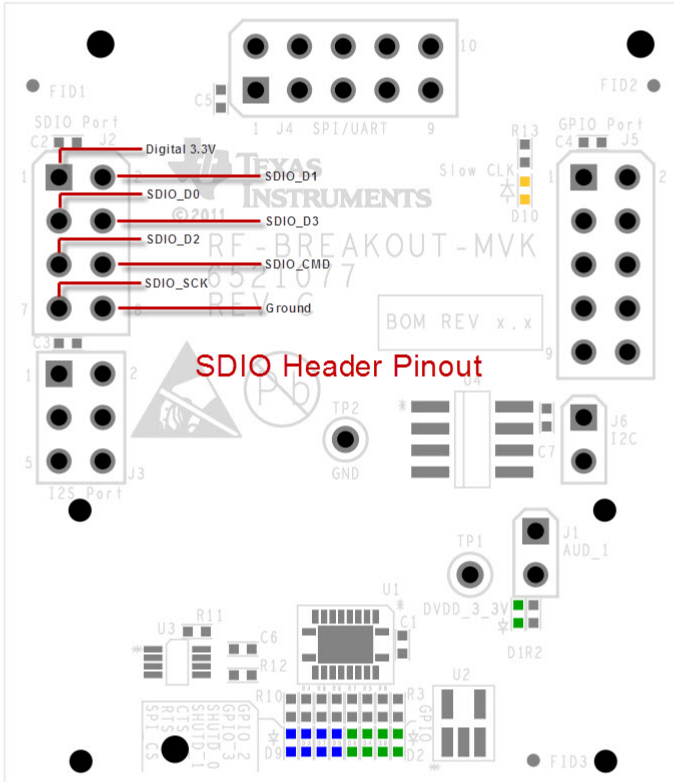

Figure 7. RF SDIO Header Pinout

Table 2. RF SDIO Header Definition

RF BREAKOUT		SDIO	
Signal Name	Header	Pin #	LED# / color
RF_SDIO_CLK	J2	7	N/A
RF_SDIO_CMD	J2	6	N/A
RF_SDIO_D0	J2	3	N/A
RF_SDIO_D1	J2	2	N/A
RF_SDIO_D2	J2	5	N/A
RF_SDIO_D3	J2	4	N/A

2.6.3 RF GPIO Header Definition

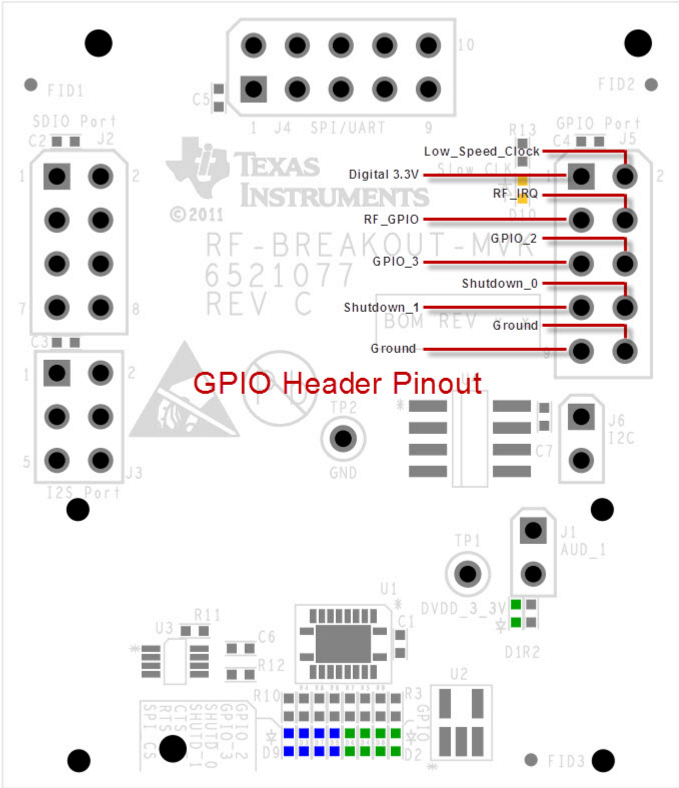

Figure 8. RF GPIO Header Pinout

Table 3. RF GPIO Header Definition

RF BREAKOUT		I/O	
Signal Name	Header	Pin #	LED# / color
RF_SPI_GDO0	U2 - 573 (Latch)	J2-07	Blue
RF_SPI_GDO2	U2 - 573 (Latch)	J2-08	Blue
RF_GPIO2	U3 - 573 (Latch)	J2-09	Green
RF_GPIO3	U3 - 573 (Latch)	J2-10	Green
RF_NSHUTDN	U3 - 573 (Latch)	J2-12	Green
RF_RSTN	U3 - 573 (Latch)	J3-11	Green
RF_SLOW_CLK	U4 - 573 (Latch)	J3-12	Green

2.6.4 RF SPI Header Definition

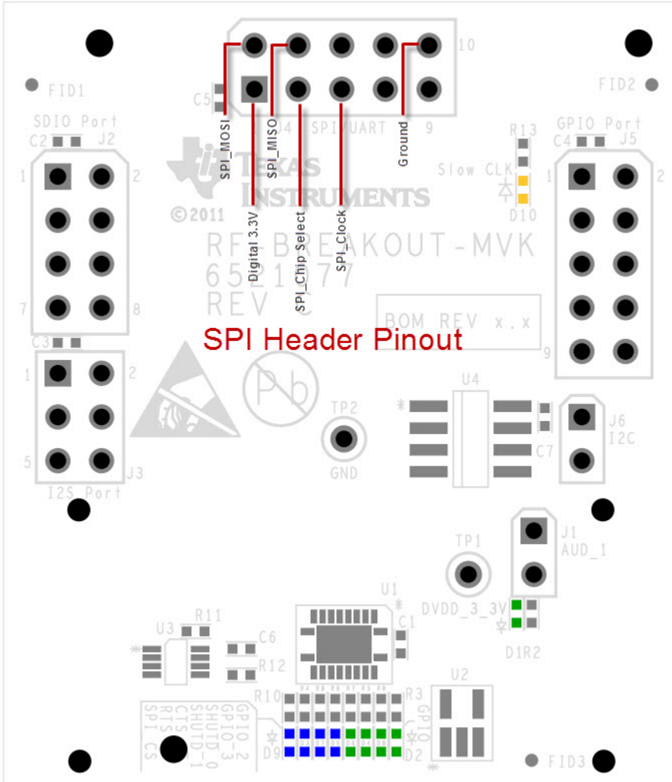

Figure 9. RF SPI Header Pinout

Table 4. RF SPI Header Definition

RF BREAKOUT		SPI	
Signal Name	Header	Pin #	LED# / color
RF_SPI_CLK	J4	5	N/A
RF_SPI_CS	J4	3	LED9, Blue
RF_SPI_MOSI	J4	2	N/A
RF_SPI_MISO	J4	4	N/A

2.6.5 RF UART Header Definition

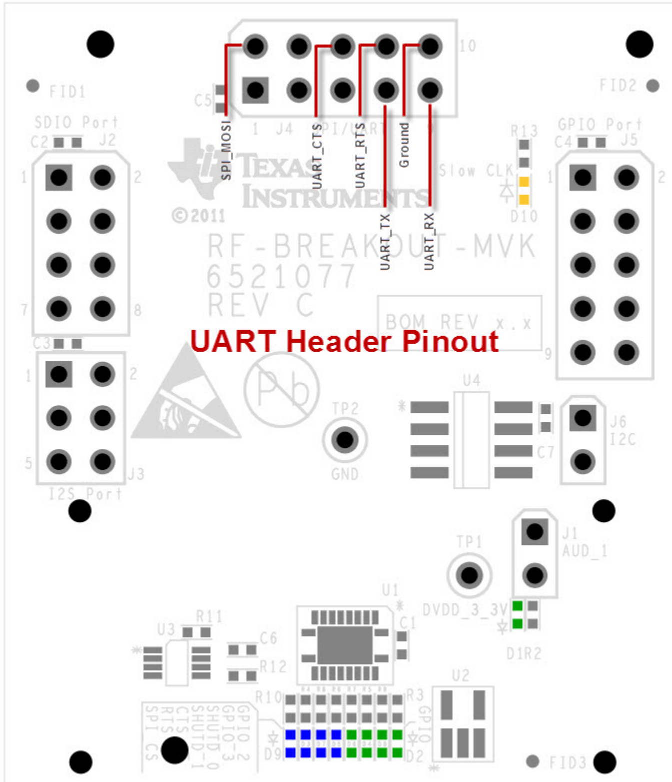

Figure 10. RF UART Header Pinout

Table 5. RF UART Header Definition

RF BREAKOUT		UART	
Signal Name	Header	Pin #	LED# / color
RF_UART_RTS	U3 - 573 (Latch)	J3-03	Orange
RF_UART_CTS	U3 - 573 (Latch)	J3-04	Orange
RF_UART_TX	U3 - 573 (Latch)	J3-05	Orange
RF_UART_RX	U3 - 573 (Latch)	J3-06	Orange

2.6.6 RF I2C Header Definition

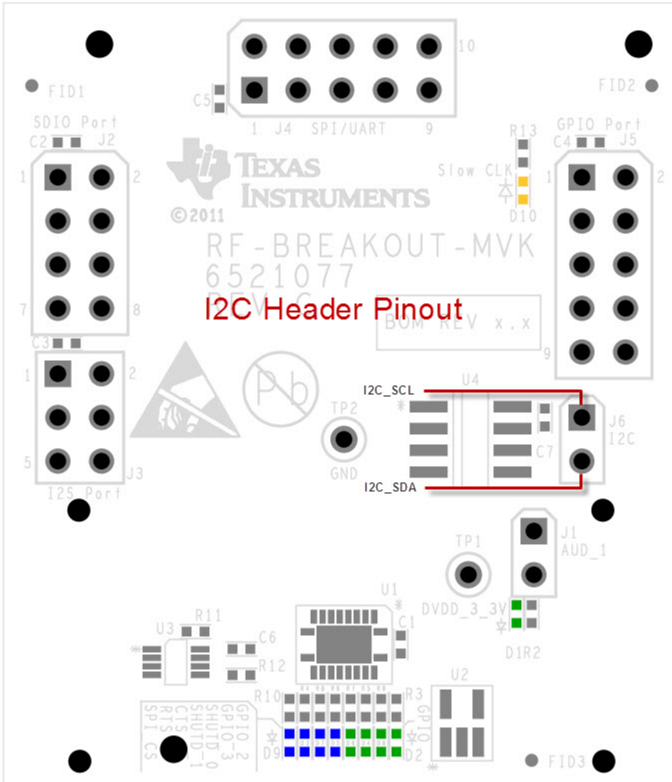

Figure 11. RF I2C Header Pinout

Table 6. RF I2C Header Definition

RF BREAKOUT		I2C	
Signal Name	Header	Pin #	LED# / color
RF_I2C_SCL	U4 - 573 (Latch)	J3-07	White
RF_I2C_SDA	U4 - 573 (Latch)	J3-08	White

2.6.7 RF Audio Header Definition

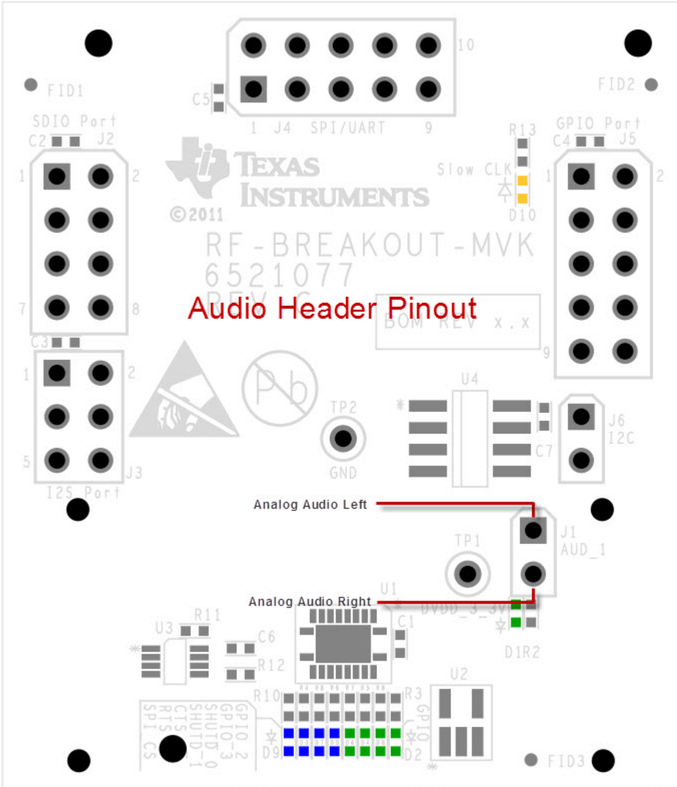

Figure 12. RF Breakout Module Audio Header Pinout

Table 7. RF Audio Header Definition

RF BREAKOUT		Audio	
RF_AUDIO_DL	U-NA	J1-11	TP8
RF_AUDIO_DR	U-NA	J1-12	TP7

3 Software Description

3.1 MAVRK Software Minimum Requirements

- IAR Embedded Workbench software or TI Code Composer Studio software installed on PC
- MSP-FET430UIF - MSP430 USB Debugging Interface
- USB Cable(A to Micro AB) to power the MAVRK Pro motherboard
- Windows XP SP3 or Windows 7

3.2 How to get the MAVRK Software

You will need the MAVRK Software repository installed on your PC. This repository will sync the MAVRK firmware to your PC.

Please see Software Installation Guide.

3.3 Where do I find the MAVRK Qt Demo Application?

An application to visual packet information from the embedded system can be found in the **mavrk_qt_tool** software repository under the **Released Version - QT Demo Application** directory. Please see Software Installation Guide for instructions on cloning the QT Tool project.

If you desire to create your own Qt demonstration, please reference the following resources:

- MAVRK Qt GUI SDK Installation Guide
- MAVRK Qt GUI Build Guide

3.4 Where do I find the Demo and Test Code?

From the software library, synchronized from the Gerrit server you will find:

- Driver code related to the specific part can be found in a folder under the **mavrk_embedded\Modular_EVM_Libraries\Components** directory.
- Projects utilizing this part are located under the **mavrk_embedded\Modular_EVM_Projects** folder.
- Specific related projects for this part are: **mavrk_embedded\Modular_EVM_Projects\Component_Demo_Projects\RF_Breakout_Board_Demo_Project**

4 Software Project

4.1 Getting Started

A software project named RF_Breakout_Demo exists in the **mavrk_embedded\Modular_EVM_Projects\Component_Demo_Projects\RF_Breakout_Board_Demo_Project** software repository directory. This project contains demo code for using the UART, SPI, I2C, and GPIO for the RF Breakout board. MAVRK or other EVM boards may be interconnected via the AFE breakout boards using the above mentioned busses.

There are actually four different configurations in the RF_Breakout_Board_Demo_Project (one each bus and the GPIO). Using IAR, to select one of the configurations, click on the drop down box in the "workspace" window as shown in the figure below:

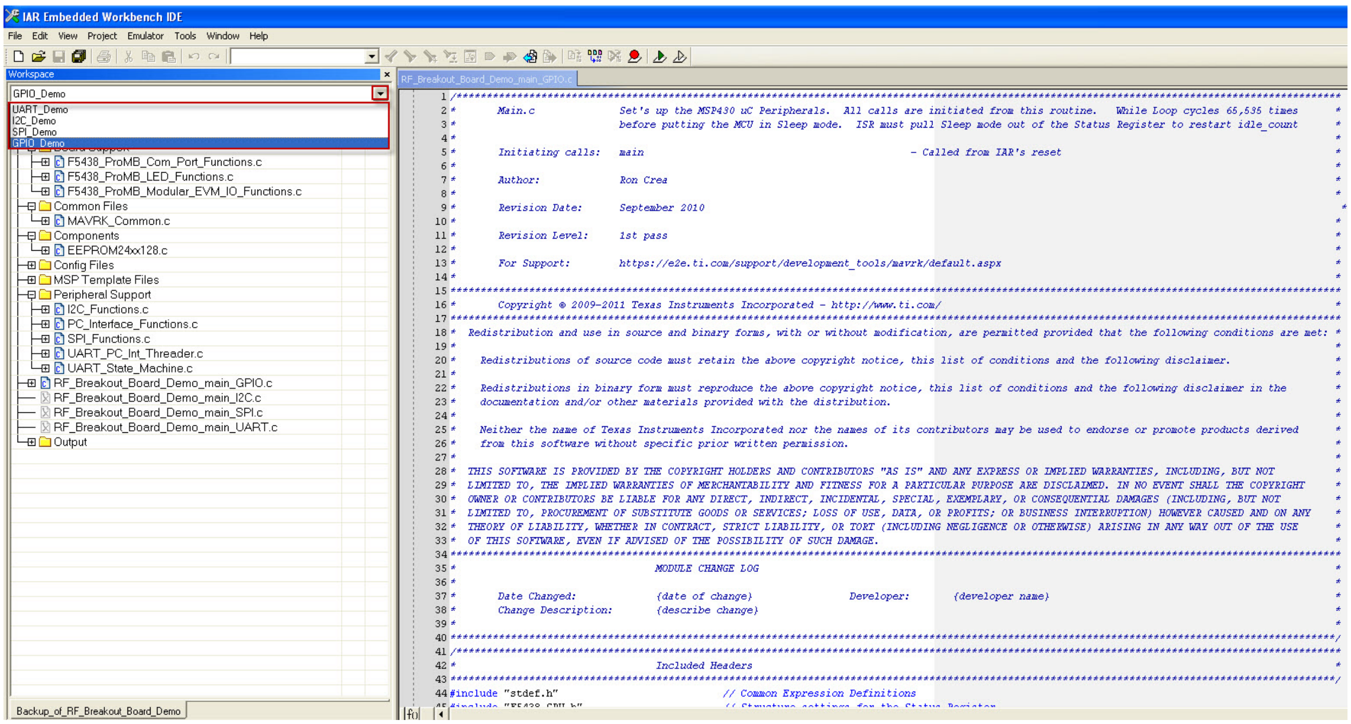

Figure 13. Changing workspaces in IAR to change what the RF Breakout demo shows

Only one configuration can be used at one time. The four choices are:

- GPIO_Demo
- UART_Demo
- SPI_Demo
- UART_Demo

After selecting one of the configurations, compile it (using "Make" and download it to the board (using "Debug")

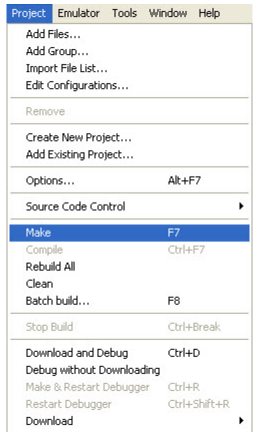

Figure 14. Making the RF Breakout Module project

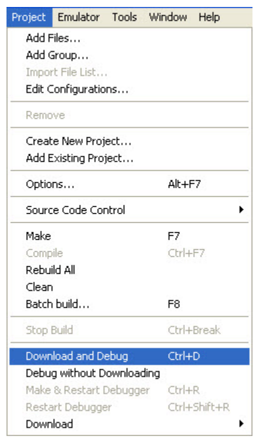

Figure 15. Downloading and debugging the RF Breakout Module project

4.2 Setting up the Demo Hardware

The demo expects the RF breakout to be in the MAVRK_RF3 slot.

The preferred method of working with this EVM is through the use of the MAVRK Pro motherboard, the motherboard will provide the needed power and digital control for this EVM. In the image below, the RF-Breakout-MVK is shown in the RF Slot3 (upper right hand corner), however it is also possible to insert the RF-Breakout-MVK into any of the four RF slots and retain full functionality.

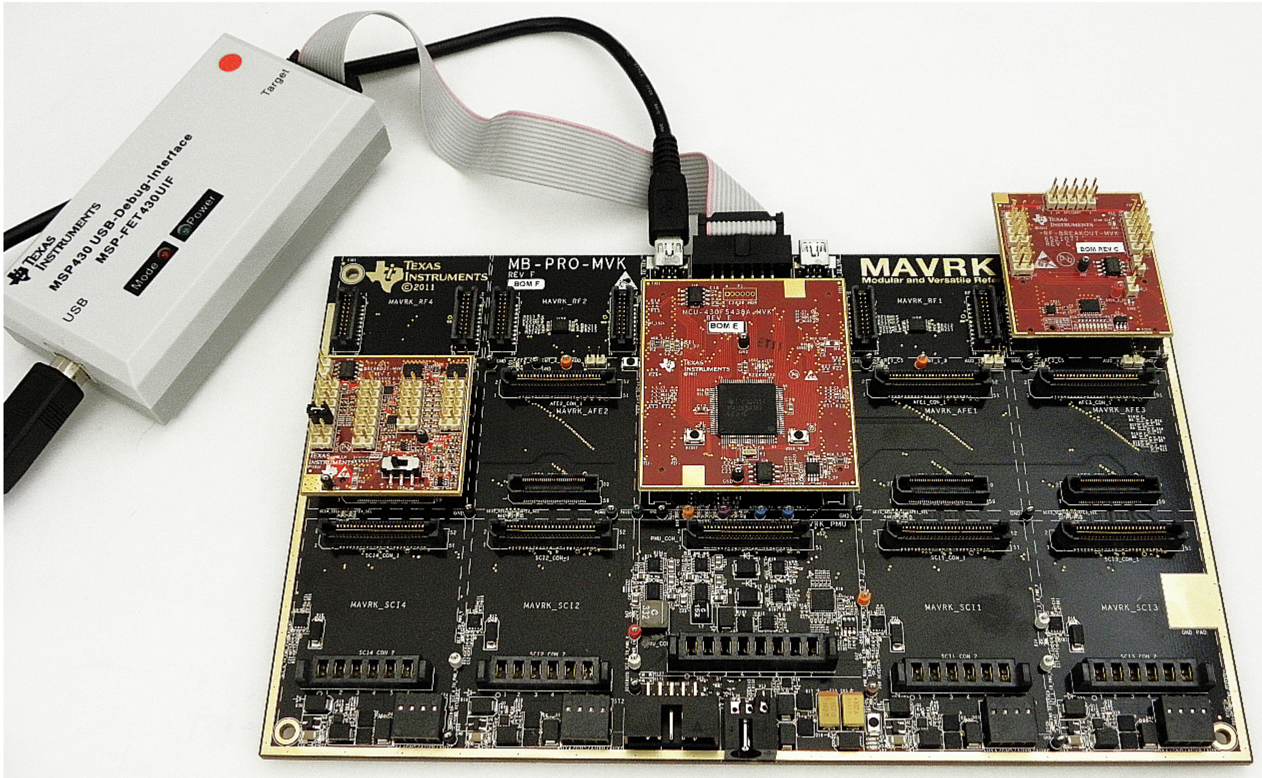

Figure 16. RF Breakout Module on the MAVRK Pro Motherboard

4.3 Accessing RF-Breakout-MVK External Signals

4.3.1 GPIO Demo Breakdown

The RF Breakout board has LEDs that signal the states of the RF slots GPIOs. These GPIOs are categorized as either shared or exclusive.

Shared GPIOs are:

- RF Ready to Send (RTS)
- RF Clear to Send (CTS)

RTS and CTS can either be an input or an output.

Exclusive GPIOs are:

- RF Shutdown 0
- RF Shutdown 1
- RF GPIO
- RF GPIO 2
- RF GPIO 3
- Chip Enable

RF GPIO can be either an input for an output. Chip Enable, RF Shutdown 0,1 and RF GPIO 2,3 are outputs.

Note on Chip Enable: Chip Enable is a common pin from the MCU slot, but is made exclusive to each slot by a Switch controlled by the RF Module Select lines.

4.3.1.1 GPIO Demo

The GPIO_Demo when run will strobe through all of the GPIOs to light the LEDs. For a more useful function, refer to the GPIO APIs below.

4.3.1.2 GPIO APIs

The GPIO Demo configuration uses API calls to manipulate the GPIOs. Exclusive GPIOs require the target MAVRK slot to be passed, Shared GPIOs do not.

- **Ready to Send and Clear to Send APIs** - These GPIO are shared, so the API does not require passing the Device Slot
  - 'mvk_Set_RF_RTS' and 'mvk_Set_RF_CTS' require the function of the GPIO ('INPUT' or 'OUTPUT') and if an output the direction ('HIGH (ENABLE)' or 'LOW (DISABLE)') - This is used to control the output level of the GPIO or to set the GPIO as an input (passing 'NULL' for the output direction.
  - 'mvk_Get_RF_RTS' and 'mvk_Get_RF_CTS' are used to read the input of the RTS or CTS line. The values passed by these APIs are either 'HIGH' or 'LOW' or *INVALID_PARAMETER_VALUE* if the line is set as an output.

The RTS and CTS pins and LEDs are highlighted in the figure below:

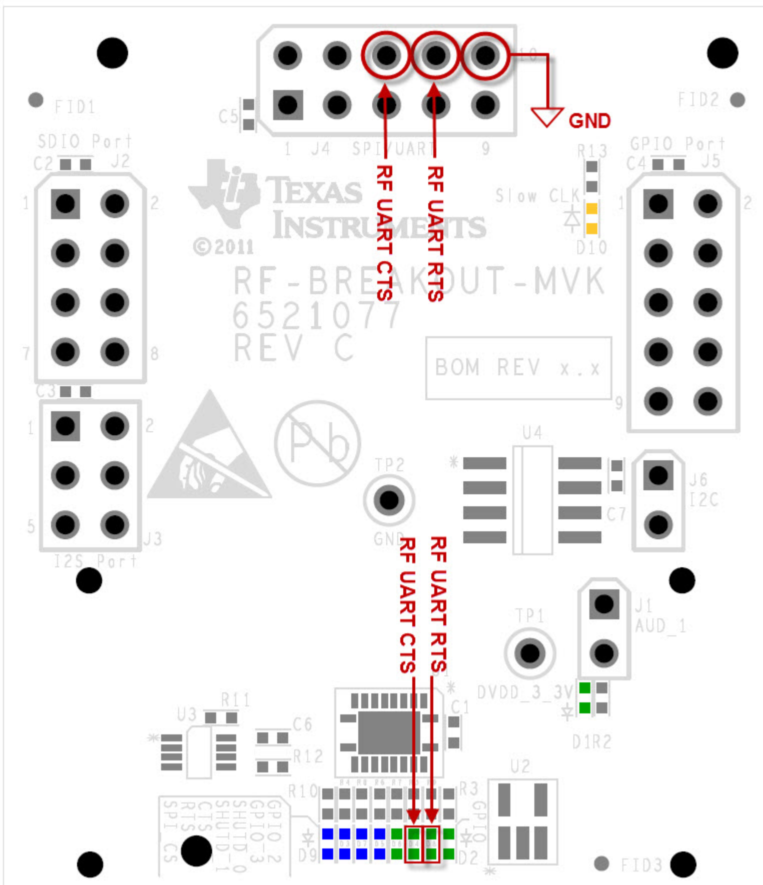

Figure 17. Locations of RTS and CTS pins on the RF Breakout Module

To use the RTS and CTS signals, your circuit will need to use the GND pin which is also highlighted in the figure.

Setting the RTS or CTS lines ('ENABLE' or 'HIGH') will light the LEDs.

- **Shutdown 0 and Shutdown 1 APIs -** These GPIO are exclusive, so the API does requires passing the Device Slot

– 'mvk_Set_RF_SHUTD_0' and 'mvk_Set_RF_SHUTD_1' require the device slot (MAVRK_RF1 - MAVRK_RF4)and the direction ('HIGH (ENABLE)' or 'LOW (DISABLE)') - This is used to control the output level of the Shutdown Pin.

The Shutdown Pins and LEDs are highlighted in the figure below:

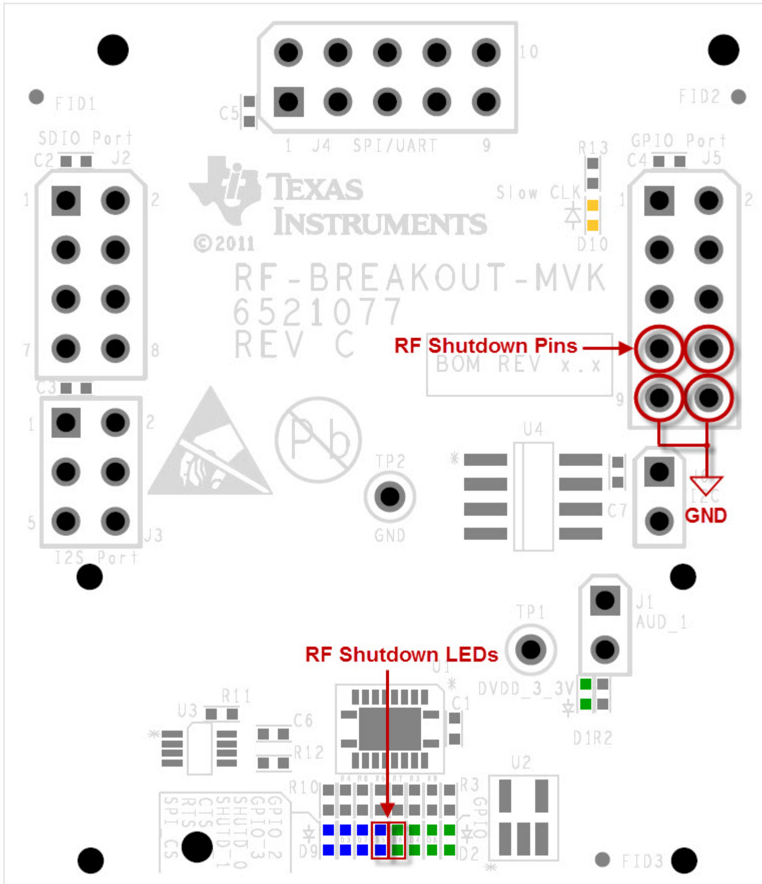

Figure 18. Locations of Shutdown pins on the RF Breakout Module

To use the Shutdown signals, your circuit will need to use the GND pin which is also highlighted in the figure.

Setting the Shutdown lines ('ENABLE' or 'HIGH') will light the LEDs.

- **RF GPIO APIs** - These GPIO are exclusive, so the API does requires passing the Device Slot
  – 'mvk_Set_RF_GPIO' requires the function of the GPIO ('INPUT' or 'OUTPUT') and if an output the direction ('HIGH (ENABLE)' or 'LOW (DISABLE)') - This is used to control the output level of the GPIO or to set the GPIO as an input (passing 'NULL' for the output direction.
  – 'mvk_Get_RF_GPIO' is used to read the input of the GPIO line. The values passed by these APIs are either 'HIGH' or 'LOW' or *INVALID_PARAMETER_VALUE* if the line is set as an output.
  – 'mvk_Set_RF_GPIO_2' and 'mvk_Set_RF_GPIO_3' require the device slot (MAVRK_RF1 - MAVRK_RF4)and the direction ('HIGH (ENABLE)' or 'LOW (DISABLE)') - This is used to control the output level of the Shutdown Pin.

The RF GPIO Pins and LEDs are highlighted in the figure below:

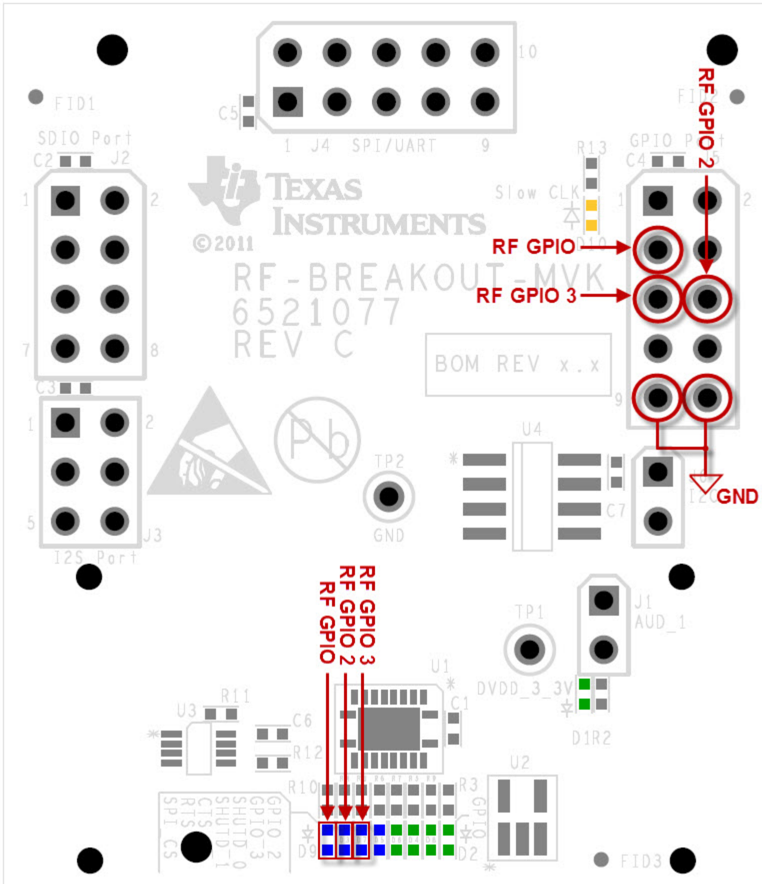

Figure 19. Locations of GPIO pins on the RF Breakout Module

To use the GPIO signals, your circuit will need to use the GND pin which is also highlighted in the figure.

Setting the GPIO lines ('ENABLE' or 'HIGH') will light the LEDs.

- **Chip Enable APIs** - These GPIO are exclusive, so the API does requires passing the Device Slot
  - 'mvk_Set_Chip_Enable' and 'mvk_Clear_Chip_Enable' require the device slot (MAVRK_RF1 - MAVRK_RF4)- This is used to control the output level of the Chip Enable.

The Chip Enable Pin and LED are highlighted in the figure below:

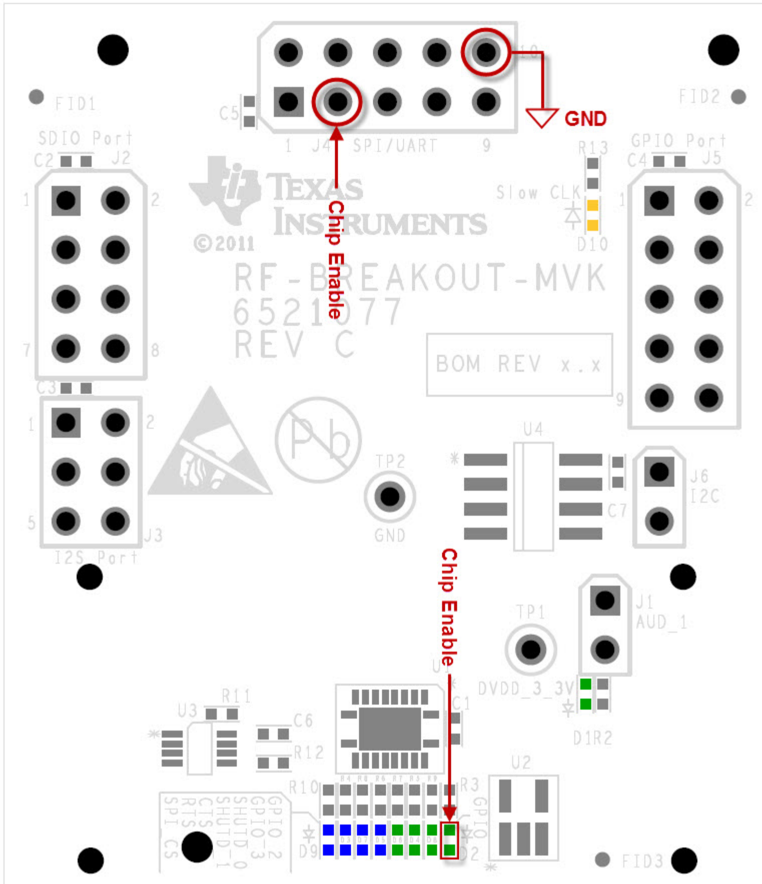

Figure 20. Location of Chip Enable pin on the RF Breakout Module

To use the Chip Enable, your circuit will need to use the GND pin which is also highlighted in the figure.

The Chip Enable is used primarily for the SPI bus(SPI Demo) as a signal to the device it is being communicated to. Clearing the Chip Enable will light the LED.

4.3.2 UART Demo

Generally for board to board communications, there would be at least two boards. In this case only one is used. The way that send and receive is verified in this project is by connecting the RX and TX lines on the RF breakout board. What the loopback does is any signal that is transmitted will come back to this device. So when there is a valid receive this proves that the device can transmit and receive successfully. The signals for the UART bus are located on the J4 header on the RF breakout board. The TX signal is located on header J4 on the 7th pin. The RX signal is on the same header on the 9th pin. A standard jumper may be used to interconnect these two signals.

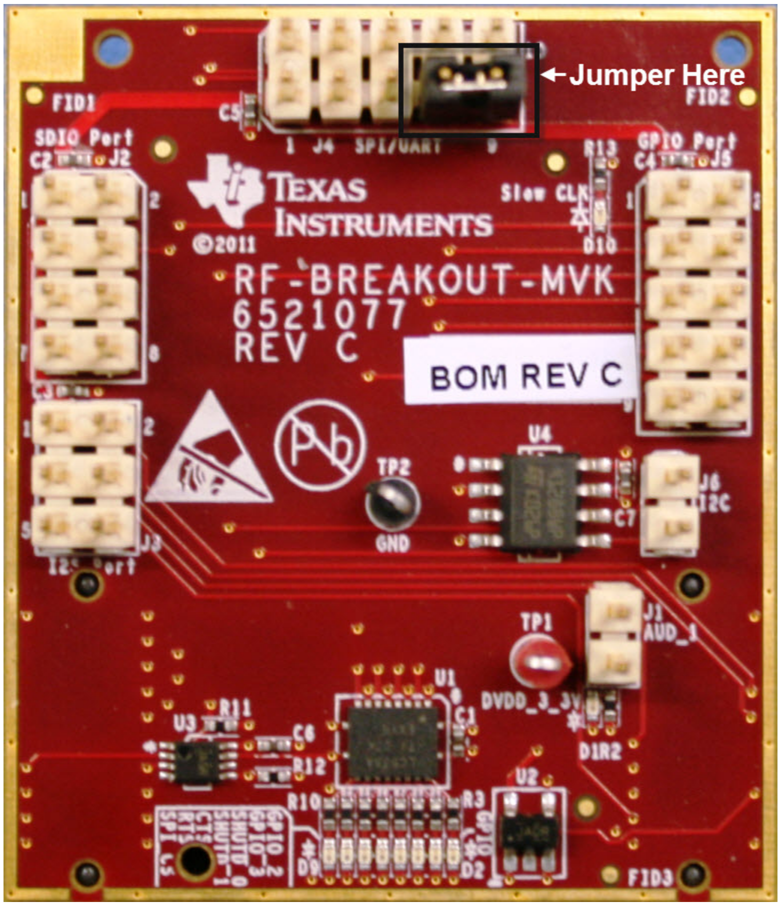

Figure 21. Jumper placement for the UART demo

The UART is set by default in the *mvk_Init_MAVRK_Standard_Settings* function to a baud rate of 460K and 8 bits data, no parity and one stop bit.

Before writing to the UART a handle has to be created and registered using this function call:

UartDebugHandle = mvk_Register_UART_Tx (MAVRK_UART_P1P2, RF_BREAKOUT_BOARD_SLOT, 2, SET, CLEAR); // Priority 2, Fast Print, Do not overwrite

This sets the *UartDebugHandle* to the device which is in RF_BREAKOUT_BOARD_SLOT. This handle is later used to communicate with this device.

Then it continually makes this function call mvk_UART_Debug_PrintF_Flush (UartDebugHandle, "Hello from MCU UART", 19); which sends the message out.

The demo continually sends a "Hello from UART". To verify that this transfer is sending and receiving correctly, a breakpoint may be placed on the mvk_Receive_UART_Data (RF_BREAKOUT_BOARD_SLOT, (char *)data_in) function call as seen in the figure below:

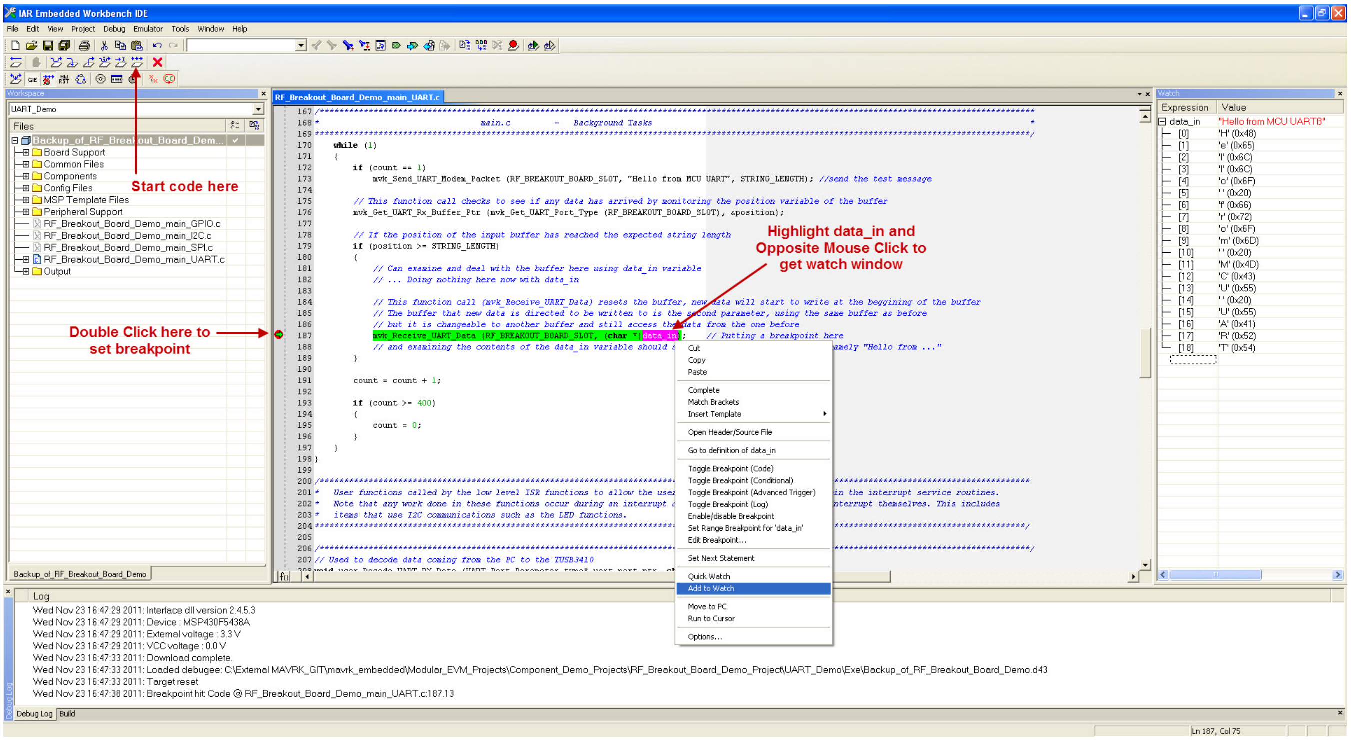

Figure 22. Verifying correct UART transmission with a breakpoint in IAR

This function is called when there is an incoming UART character. The character that has arrived is given in the *data* parameter. A watch may be placed on this variable and viewed to determine which character has just arrived.

For more information on using the MAVRK UART APIs please refer to MAVRK UART Functions.

4.3.3 SPI Demo

The SPI demo continually sends a message through the SPI bus. As in the case with UART, a loopback is used on the MOSI (output) and MISO (input) pins to test the input portion of the SPI bus.

The signals for the SPI bus are located on the J4 header on the AFE breakout board. The SPI clock is on pin 5, the chip select in on pin 3, MOSI is on pin 2 and MISO in on pin 4.

To set up the loop back of MOSI and MISO jumper pins 2 and 4 as shown in the figure below:

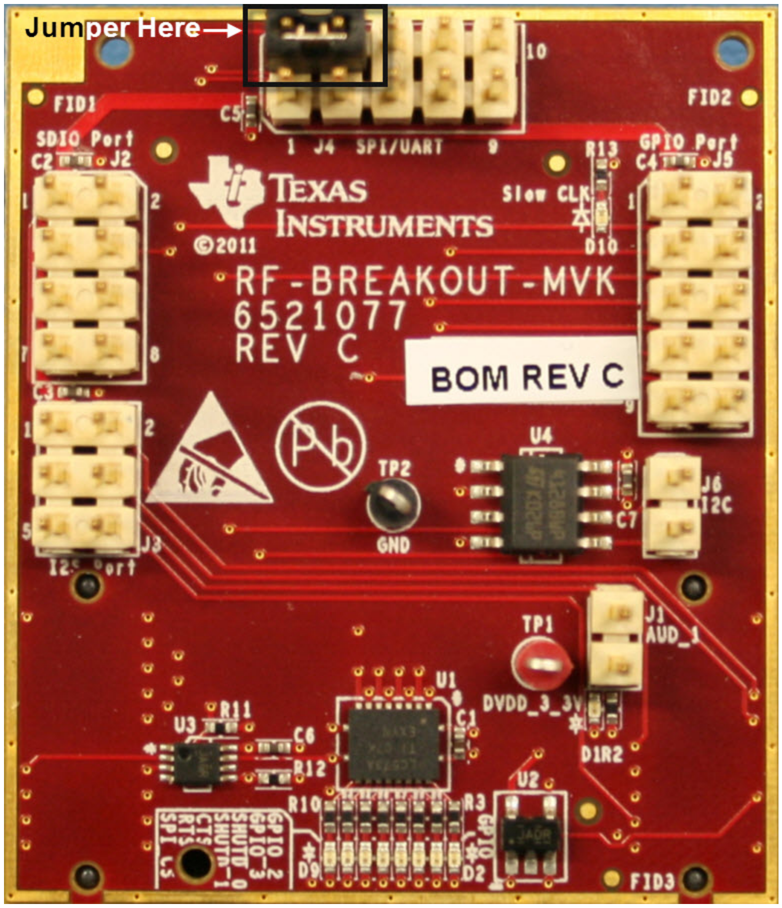

Figure 23. Jumper placement for the SPI demo

The SPI settings required for the port are set by:

SPI_Device_Parameter_type RF3_SPI_device_settings = {LOW_POLARITY, RETARDED_DATA, _4MHZ_MAX_CLOCK, NULL};

To setup the SPI port this function call is used:

mvk_Configure_SPI_Device_Working_Settings (MAVRK_RF3, &RF3_SPI_device_settings);

Which configures the SPI bus to the RF3 module device settings.

The project continually sends "Hello from MCU SPI". This sending and receiving may be verified by placing a breakpoint on the SPI call (mvk_Write_SPI_Payload (MAVRK_RF3, "Hello from MCU SPI", read, 18, 0). After this line is executed the *read* variable will hold the results of the input (which should be the message).

The figure below shows the location to place the break point and the watch variable set up:

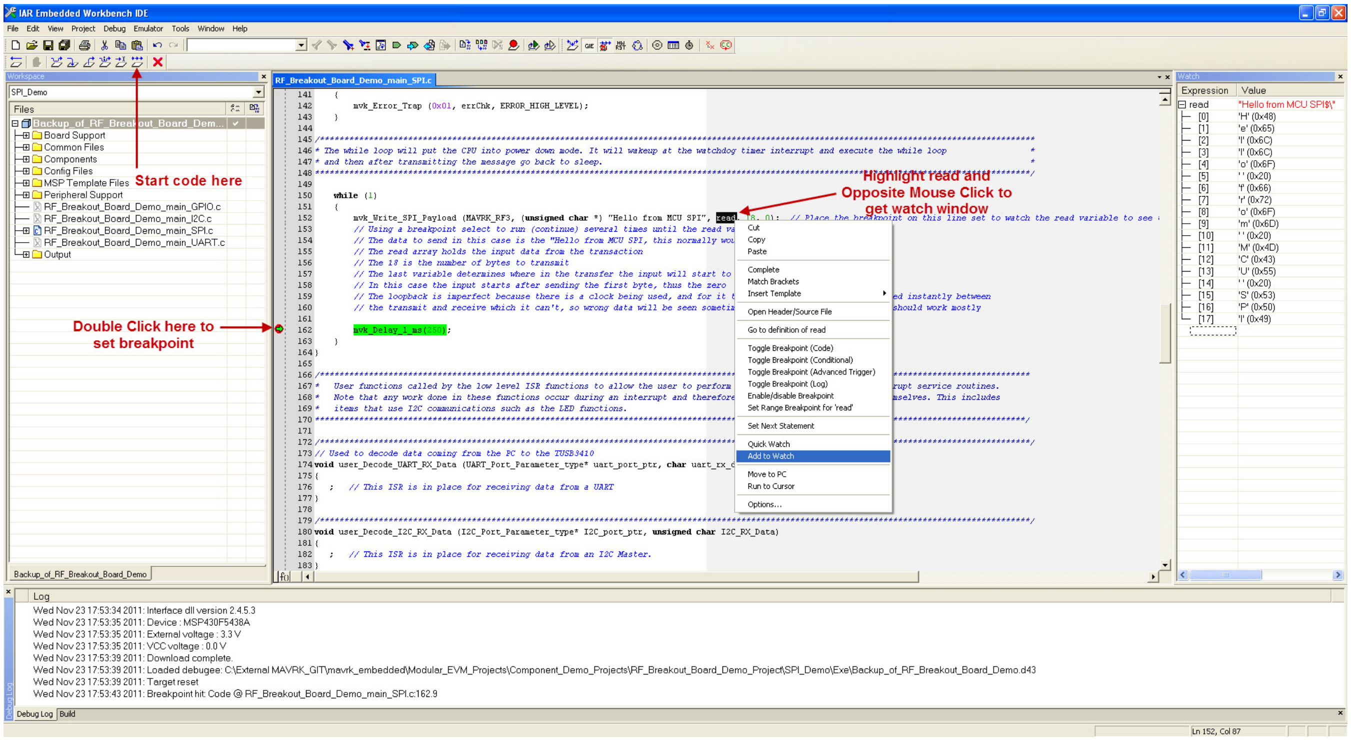

Figure 24. Verifying correct SPI transmission with a breakpoint in IAR

For more information on using the MAVRK SPI APIs please refer to MAVRK SPI Functions.

4.3.4 I2C Demo

The I2C demo is different from the previous buses demo in that it does not use a loopback. It however writes to an EEPROM chip that is located on the RF breakout board. This EEPROM (16Kx8) is used to store device information for the breakout board. This information is stored on the highest 256 bytes of the memory. This area should not be overwritten. Any other area is free to be used.

The project writes to the EEPROM chip an 8-bit value and reads that value back to make sure that it was written properly. The bus that is used to do this transfer is I2C.

The actual I2C write call happens deeper in the program but one example is this:

mvk_Write_I2C (I2C_slave_address, device_slot, EEPROM24xx128_I2C_write_data, total_number_write_bytes);

The first parameter is the I2C slave address to write to, the second is the device slot to use for the write (in this case MAVRK_RF3), then the write data, and the amount of data to write. An example of the I2C read function may be found in the mvk_Read_EEPROM_24xx128 () function which may be found in EEPROM24xx128.c.

In the demo, we write 18 bytes of code defined by: data_in [18] = {'H','e','l','l','o',' ','f','r','o','m',' ','M','C','U',' ','I','2','C'};

We define the address in the EEProm we want to write to with: address = 0x1000;

Note: Avoid writing to any address at or above 0x3F00. This are is used at device test to store board description information.

To initiate an I2C write to the EEPROM: mvk_Write_EEPROM_24xx128 (address,&data_in[0],data_size,device_slot,RF_I2C_device_address);

To read back the information on the EEPROM: mvk_Read_EEPROM_24xx128 (address,&data_out[0],data_size,device_slot,RF_I2C_device_address);

The demo writes the data_in to the EEPROM starting at address 0x1000 and reads back the data stored in data_out. The program then verifies that data_in is equal to data_out.

If the verify fails the code will go into an error trap and the RED LED on the MCU will flash.

If the verify passes the code will pass into a while(1) loop and place the MCU in a sleep condition.

To see the resulting data_out, set a watch window and a break point as shown in the figure below:

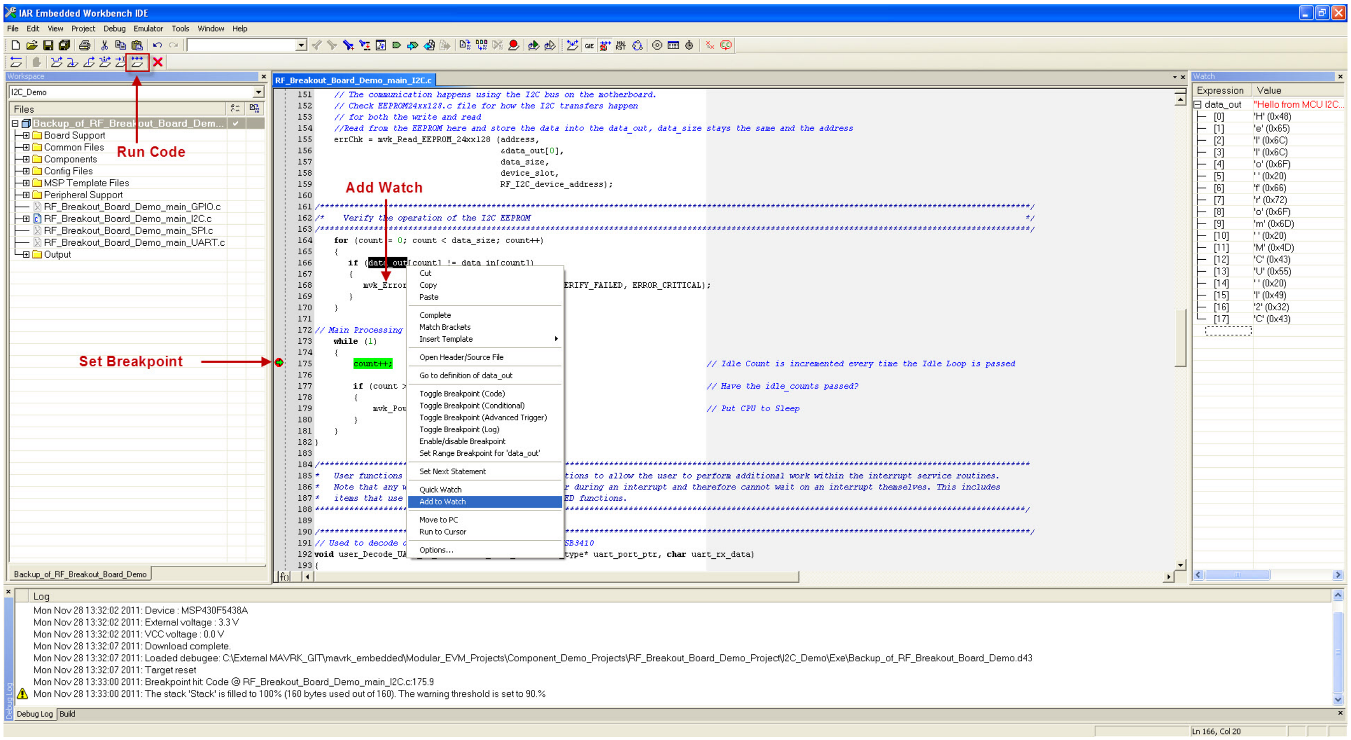

Figure 25. Verifying correct I2C transmission with a breakpoint in IAR

For more information on using the MAVRK I2C APIs please refer to MAVRK I2C Bus Functions.

5 Board Files

5.1 Bill of Materials (BOM)

Download a PDF of the bill of materials.

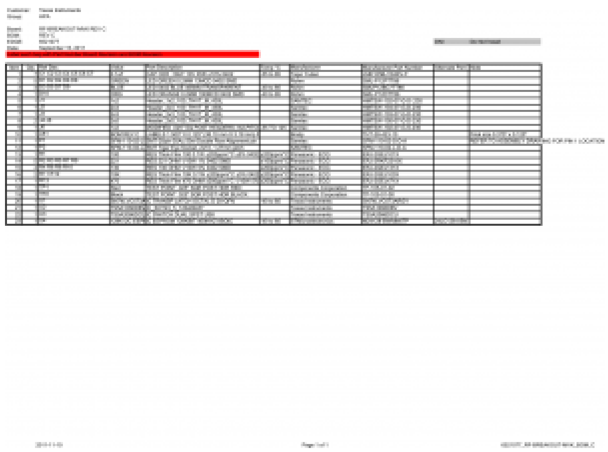

Figure 26. RF-BREAKOUT-MVK Bill of Materials

5.2 Layout (PDF)

Download a PDF of additional board layers.

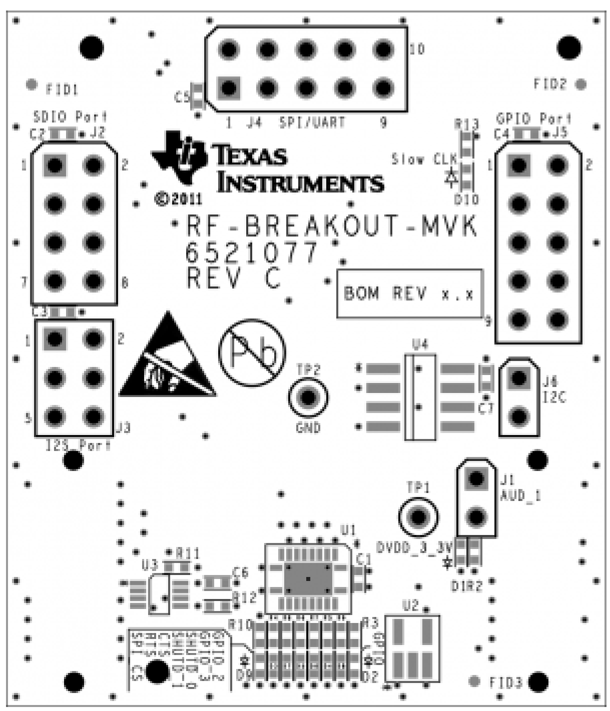

Figure 27. RF-BREAKOUT-MVK Board Top Silkscreen

5.3 Schematics (PDF)

Download a PDF of the schematic.

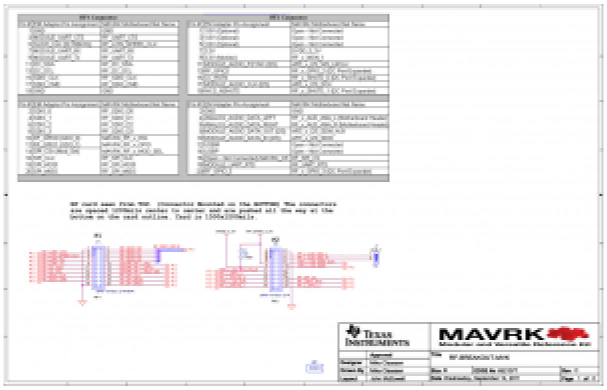

Figure 28. RF-BREAKOUT-MVK Schematic

5.4 Fabrication Drawings (PDF)

Download a PDF of the fabrication drawing.

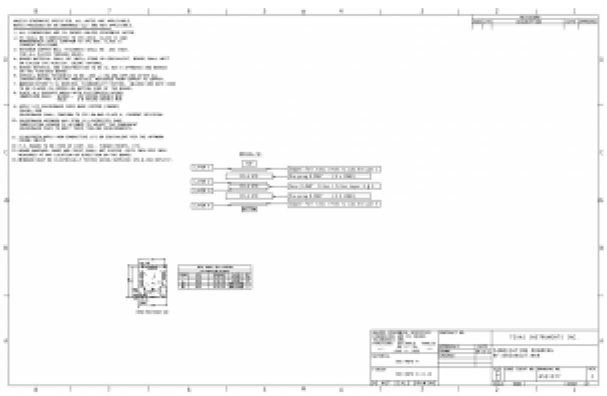

Figure 29. RF-BREAKOUT-MVK Fabrication Drawing

5.5 Request Gerber and Schematic files

To request Gerber or schematic files for the RF-BREAKOUT-MVK module, please visit the MAVRK Gerber Request webpage.

6 Application Note

The I2C and SPI circuits are gated by the MODULE SELECT signal. This means that the breakout will not send through I2C or SPI signals unless the MODULE SELECT line is active. Standard MAVRK software functions that perform I2C and SPI read/writes manage the MODULE SELECT line for the user.

If the user is using the breakout module to monitor I2C or SPI bus activity, the system will need to enable the MODULE SELECT line for the device slot that contains the breakout card. In the software, this is done via the *mvk_Set_Module_Select()* function.

7 MAVRK Links

7.1 I want more info on MAVRK

MAVRK Home Page

7.2 I have MAVRK Questions

MAVRK Forum (Recommended):

7.3 I want more Technical Info on MAVRK Hardware

Table 8.

• Hardware Design Guide for MAVRK MCU Modules • Hardware Design Guide for MAVRK Modules • Hardware Design Guide for MAVRK PMU Charger Sub-Modules • Hardware Design Guide for MAVRK PMU DC/DC Sub-Modules	• Hardware Design Guide for MAVRK PMU Gas Gauge Sub-Modules • Hardware Design Guide for MAVRK PMU High-Power DC/DC Sub-Modules • Hardware Design Guide for MAVRK SCI Modules • Hardware Design Guide for MAVRK SCI Sub-Modules	• Hardware Design Guide for the uMAVRK Analog Interface • Hardware Design Guide for the uMAVRK Power Interface • Template - Hardware User's Guide

7.4 I want more Technical Info on MAVRK Software

• How to Convert a Project from IAR to CCS	• Software - CC11xx, CC25xx, CC430 Radio API Guide

7.5 I want to get a MAVRK board

MAVRK Home Page

8 Important Notices

8.1 ESD Precautions

The following guidelines should be followed in order to avoid ESD damage to the board components:

- Any person handling boards must be grounded either with a wrist strap or ESD protective footwear, used in conjunction with a conductive or static-dissipative floor or floor mat.
- The work surface where boards are placed for handing, processing, testing, etc., must be made of static-dissipative material and be grounded to ESD ground.
- All insulator materials either must be removed from the work area or they must be neutralized with an ionizer. Static-generating clothes should be covered with an ESD-protective smock.
- When boards are being stored, transferred between operations or workstations, or shipped, they must be maintained in a Faraday-shield container whose inside surface (touching the boards) is static dissipative.

8.2 Certifications

FCC standard EMC test report for the RF-BREAKOUT-MVK MAVRK Module aboard a MAVRK Pro Motherboard

ICES standard EMC test report for the RF-BREAKOUT-MVK MAVRK Module aboard a MAVRK Pro Motherboard

Eco-Info & Lead-Free Home

RoHS Compliant Solutions

Statement on Registration, Evaluation, Authorization of Chemicals (REACh)

8.3 Evaluation Board/Kit/Module (EVM) Additional Terms

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions: The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/ kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

8.4 United States FCC and Canada IC Regulatory Compliance Information

This EVM complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This Class A or B digital apparatus complies with Canadian ICES-003. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada. Les changements ou les modifications pas expressément approuvés par la partie responsible de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

8.5 Evaluation Board/Kit/Module (EVM) Warnings, Restrictions, and Disclaimers

8.5.1 Your Sole Responsibility and Risk

You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.

2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.

3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.

8.5.2 Certain Instructions

It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60° C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

8.5.3 Agreement to Defend, Indemnify and Hold Harmless

You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

8.5.4 Safety-Critical or Life-Critical Applications

If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

IMPORTANT NOTICE