RF430FRL152HEVM User's Guide

This document is a description of the RF430FRL152HEVM product that is designed to fully explore all of the capabilities that the RF430FRL152H part offers. To more easily experiment with all of the features of the part and the firmware that is in the ROM, a PC application is available, and its use is also described here, including software and driver installation.

The family of RF430RL15xH devices includes the RF430FRL152H, RF430FRL153H, and RF430FRL154H variants.

Contents

1 Introduction 2
2 Hardware Description 5
3 GUI Introduction 8
4 Overview 9
5 Setup of Demo System 19
6 RF430FRL152HEVM Schematics 26
7 References 30

List of Figures

1 RF430FRL152HEVM 3
2 TRF7970AEVM 3
3 Sensor Hub BoosterPack 4
4 RF430FRL152HEVM Block Diagram 5
5 RF430FRL152HEVM Hardware 6
6 PC Application 8
7 Setup Tab 9
8 Demo Tab 10
9 General Device Configuration Tab 11
10 Sensor Configuration Tab 14
11 Alarm Control Tab 15
12 Sensor Threshold Configuration 17
13 View Sensor Data Tab 18
14 BoosterPack Configuration 19
15 Position the EVMs 21
16 Custom Sensor Configuration Tab 23
17 Custom General Device Configuration 24
18 Custom View Data 25
19 MCU Section Schematic 26
20 I^2C or SPI Translators Section Schematic 27
21 JTAG Section Schematic 28
22 Power Section Schematic 29

MSP430 is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

Copyright © 2014, Texas Instruments Incorporated

1 Introduction

The RF430FRL152HEVM, including the user software, is a complete evaluation platform to evaluate the key features of the of the RF430FRL15xH devices:

- Passive communication and sensor measurement using ISO/IEC 15693
- Can program user code to FRAM memory through JTAG
- Collect sensor measurements over I^2C using the Sensor Hub BoosterPack (BOOSTXL-SENSHUB)
- Can develop drivers for custom digital sensors
- Interfaces with the PC GUI application to fully experiment with application functionality

1.1 Overview

To start evaluating the RF430FRL152H device, an RF430FRL152HEVM is available. This evaluation board allows you to experiment with all of the capabilities of the low-voltage (1.5-V) dynamic tag with an MSP430™ core.

Because this dynamic tag uses ISO/IEC 15693 (NFC-capable) passive communication, it needs an ISO/IEC 15693 reader/writer to explore its full capabilities. TI recommends that you use either a TRF7970AEVM in conjunction with a PC application or a custom NFC/RFID-capable handset.

Features and benefits of the RF430FRL152H MCU include:

- ISO/IEC 15693 RF interface
- Low-voltage MSP430 MCU (L092 based)
- Nonvolatile low-power FRAM memory (2kB)
- Sigma-delta 14-bit analog-to-digital converter
- Single-cell battery (1.5-V) operation
- Can run batteryless from RF scavenged energy provided by NFC/RFID reader
- Supports temperature measurement using a thermistor
- Single-chip solution for a contact-less sensor

The RF430FRL152HEVM is a development platform to evaluate the capabilities of the RF430FRL15xH devices and allows experimenting with all the features of the RF430FRL152H.

- Integrated PCB antenna
- Power over RF, battery, or USB
- Onboard thermistor and reference resistor for temperature measurement
- Onboard light sensor
- NFC/RFID ISO 15693 communication with NFC/RFID enabled reader/writer or smart phone
- Connector to enable compatibility with TI LaunchPads and BoosterPacks
- JTAG header for connection of MSP430-FET Emulation tool for programming

Copyright © 2014, Texas Instruments Incorporated

1.2 What is Included

- RF430FRL152HEVM (see Figure 1 below)
- USB cable
- Quick start guide

1.2.1 RF430FRL152HEVM

Figure 1 shows a photograph of the RF430FRL152HEVM.

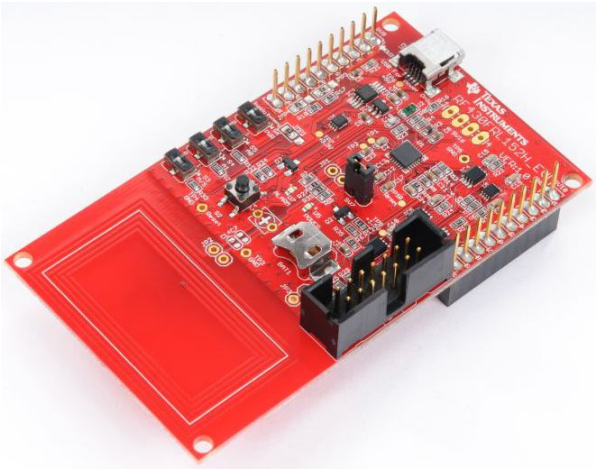


Figure 1. RF430FRL152HEVM

1.3 Required Additional Equipment

Optional recommended equipment:

- PC running Windows operating system to run the GUI for the TRF7970AEVM
- TRF7970AEVM for NFC/RFID communication with the RF430FRL152HEVM (TRF7970AEVM)

1.3.1 TRF7970AEVM

Figure 2 shows a photograph of the TRF7970AEVM. If the TRF7970AEVM was purchased around the same time as the RF430FRL152HEVM no code updates will be necessary. If there are communication issues with the RF430FRL152HEVM, make sure that the TRF7970AEVM is programmed with the latest firmware. The latest firmware for the TRF7970AEVM can be found here.



Figure 2. TRF7970AEVM

Copyright © 2014, Texas Instruments Incorporated

1.4 Recommended Additional Equipment

Optional recommended equipment:

- SensorHub Booster Pack – connection of digital sensors (BOOSTXL-SENSHUB)
- MSP430 FET Tool for code development / debugging and programming the device over JTAG (MSP-FET)

1.4.1 Sensor Hub BoosterPack

Figure 3 shows a photograph of the Sensor Hub BoosterPack.



Figure 3. Sensor Hub BoosterPack

1.5 Installation of the Software and Drivers

The most recent PC GUI and user's guide are available at www.ti.com/tool/RF430FRL152HEVM .

To install the PC GUI:

1. Download the RF430FRL152HEVM-1.1.2-windows-installer.exe file to the PC.
2. Run the executable and follow the prompts to install the software.
3. To run the application click on the Start menu, All Programs, then the Texas Instruments folder, then the "RF430FRL152HEVM Application" and finally the "RF430FRL152H GUI Interface" program.

The USB drivers for the TRF7970AEVM are available from this link:
http://www.silabs.com/products/mcu/pages/USBtoUARTbridgeVCPdrivers.aspx

Copyright © 2014, Texas Instruments Incorporated

2 Hardware Description

2.1 Block Diagram

Figure 4 shows the EVM block diagram.

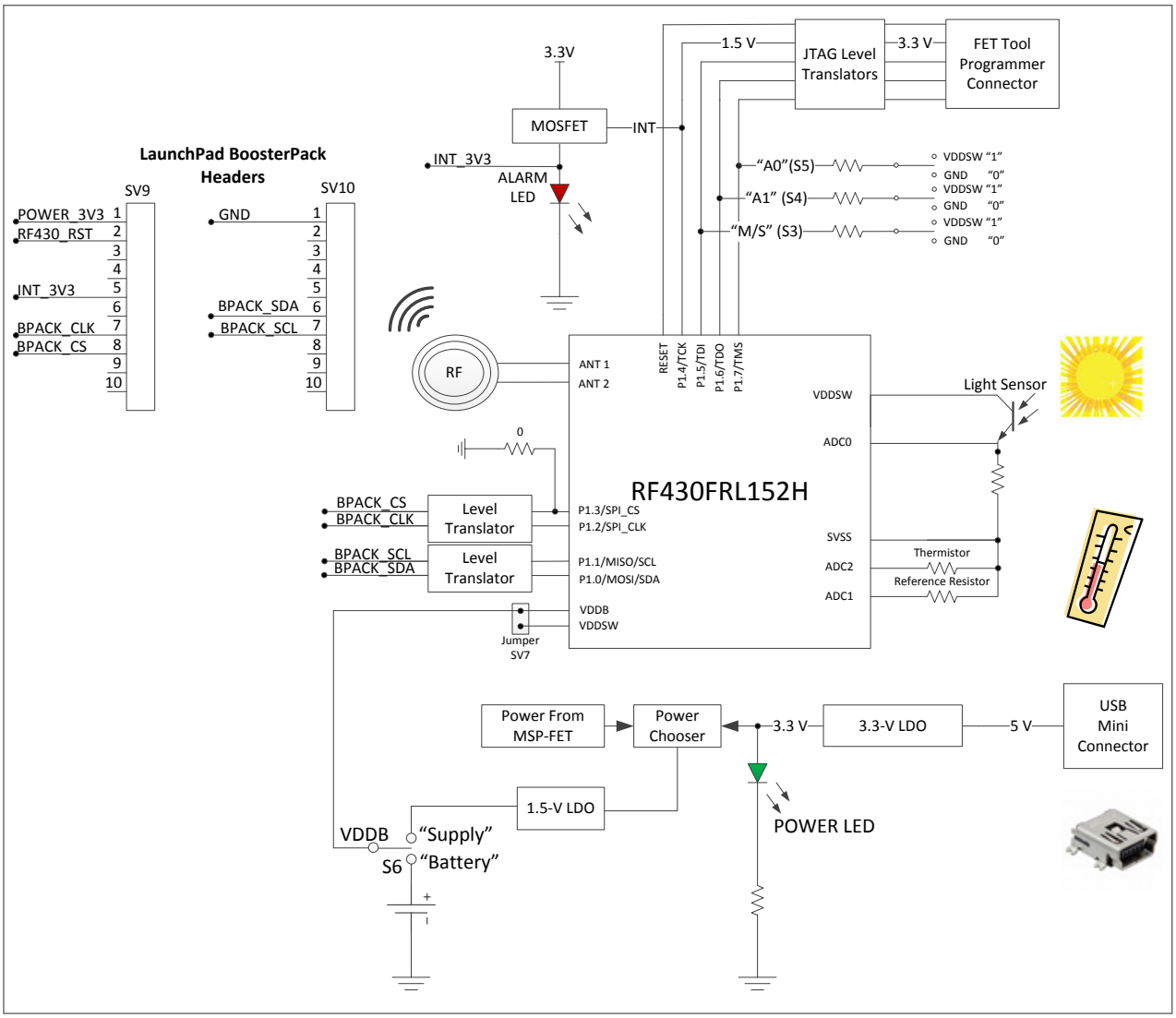


Figure 4. RF430FRL152HEVM Block Diagram

.

- The EVM board can be powered by RF scavenged energy, battery, FET emulator tool, or USB power. When powered through the USB connection or an MSP-FET emulation tool, switch S6 must be set to "Supply". If the EVM is powered by scavenged RF energy or a battery, switch S6 must be set to "Battery".
- Level translators are used on I^2C, SPI, and FET emulator interfaces.
- The power (green) LED should turns on only when the board is powered by a USB connection.
- Jumper SV7 is needed to bypass the internal battery switch and provide power directly to the core. This jumper should be populated for most use cases.
- When the EVM is powered by the USB connection, the Alarm LED briefly flashes at power-up or stays illuminated if there is an interrupt from the RF430FRL152H. It is normal for the Alarm LED to stay lit during MSP-FET tool programming.

Copyright © 2014, Texas Instruments Incorporated

2.2 Hardware Overview

Figure 5 shows an overview of the RF430FRL152HEVM hardware.

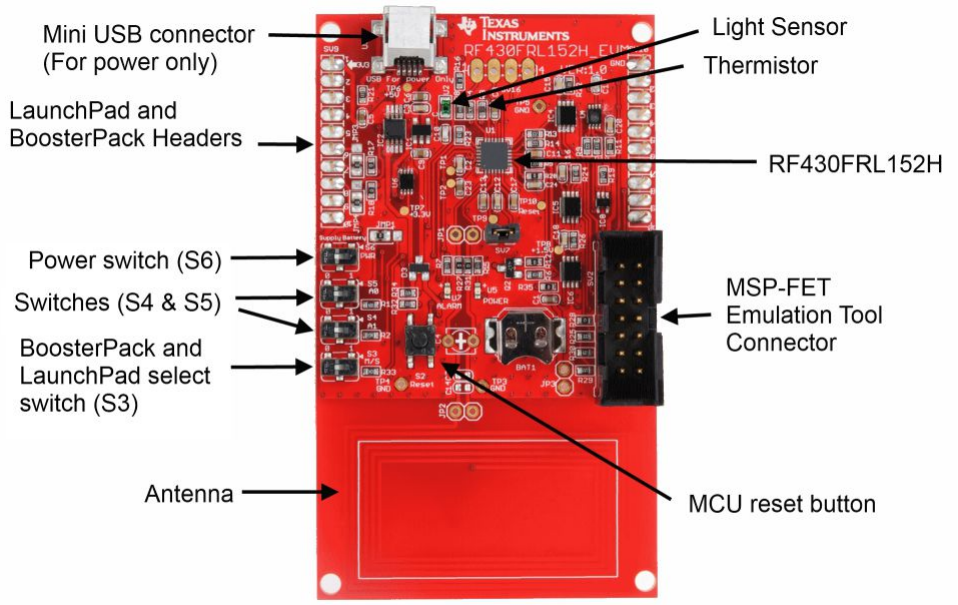


Figure 5. RF430FRL152HEVM Hardware

2.3 Hardware Configurations

2.3.1 Passive (Unpowered) Operation

In this mode, the RF430FRL152H is powered entirely from the RF field generated by the reader.

1. Set S6 to "Battery".
2. Set S3 to "S" (slave mode).
3. Make sure that USB and the MSP-FET emulation tool are not connected.
4. Place the EVM antenna on top of a NFC reader/writer to communicate.

Neither the "Alarm" or the "Power" LEDs illuminate in this mode of operation at any time. At this time a NFC/RFID reader may be used to communicate to the RF430FRL152HEVM.

2.3.2 Debugging or Programming

The following instructions show how to program the FRAM memory or debug the RF430FRL152H using a MSP-FET emulation tool. In this configuration the EVM is powered by the MSP-FET emulation tool.

1. Set switch S6 (near the BoosterPack headers) to "Supply".
2. Connect the MSP-FET430 emulation tool to the JTAG header, SV2.
3. Start a debug session using IAR or CSS IDE.
4. Connection with the USB cable is not necessary for debugging or programming the RF430FRL152H.

Note: The Alarm LED may be illuminated during the debugging process if the USB cable is connected. This is normal behavior.

Note: If the USB cable is not connected, the power LED (U5) and the Alarm LED (7) are not illuminated even if the emulation tool is connected. This is normal behavior.

The MSP-FET emulation tool can be used to program or debug the EVM at this point.

Copyright © 2014, Texas Instruments Incorporated

2.3.3 Using a BoosterPack or Digital Sensors

An example of this use case is using the Sensor Hub BoosterPack. In this configuration the EVM is powered by the USB connection.

1. Set switch S6 (near the BoosterPack headers) to "Supply".
2. Set switch S3 to "M" (master mode).
3. Attach the BoosterPack on top of the EVM, making sure it is in the correct orientation (pin 1 on the EVM matches pin 1 on the BoosterPack headers).
4. Connect the USB cable to either the BoosterPack or the RF430FRL152HEVM.

Note: When the USB cable is attached, the power LED (U5) stays illuminated. The Alarm LED (U7) should momentarily illuminate and then turn off.

Now the TRF7970AEVM can be used to communicate to the part and initiate samples of the various sensors.

2.3.4 Using a Host Controller

In this mode, the host LaunchPad is connected underneath the RF430FRL152HEVM. Make sure the orientations match.

1. Set switch S6 (near the BoosterPack headers) to "Supply" setting.
2. Set S3 to "S" (slave mode).
3. For a host that uses I^2C, S5 and S4 determine the two least significant bits of the I^2C slave address for the RF430FRL152H. For most cases, set these switches to the "0" positions.
4. For a host that uses SPI, S5 and S4 determine the SPI mode. For most cases, set these switches to the "0" positions.
5. Set S5 or S4 to desired setting at this time.
6. Connect the LaunchPad and the EVM together.
7. Power either the LaunchPad or the EVM by connecting either to a USB cable.

Note: When the USB cable is attached, the power LED (U5) stay illuminated. The Alarm LED (U7) should momentarily illuminate and then turn off.

2.3.5 Powering the EVM Using a Battery

1. Insert an SR66 1.5-V battery into the battery holder (BAT1).
2. Note: The first time that a battery is inserted, the batter holder may be tight. Carefully holding the board with a flat object, firmly slide in the battery. Make sure that the positive side of the battery is facing the positive (or top) side of the battery holder.
3. Set S6 to "Battery".
4. If the battery switch is open (the battery switch is inside the RF430FRL152H), SV7 needs to have a jumper to power the part. If the battery switch is closed, then SV7 does not need a jumper to power the RF430FRL152H.

Note: In this mode, the alarm and power LEDs are not illuminated. The device is still powered and operational.

Note: Also if S5, S4, or S3 positions are changed after powering the EVM, a reset is required for the changed settings to take effect. This can be done through the PC GUI or by pressing the reset switch (S2).

Note: If a battery is installed and another configuration (for example, debugging or using a BoosterPack) is required, set switch S6 to "Supply" to disconnect the battery and not drain it.

Copyright © 2014, Texas Instruments Incorporated

3 GUI Introduction

Figure 6 shows the Setup tab.

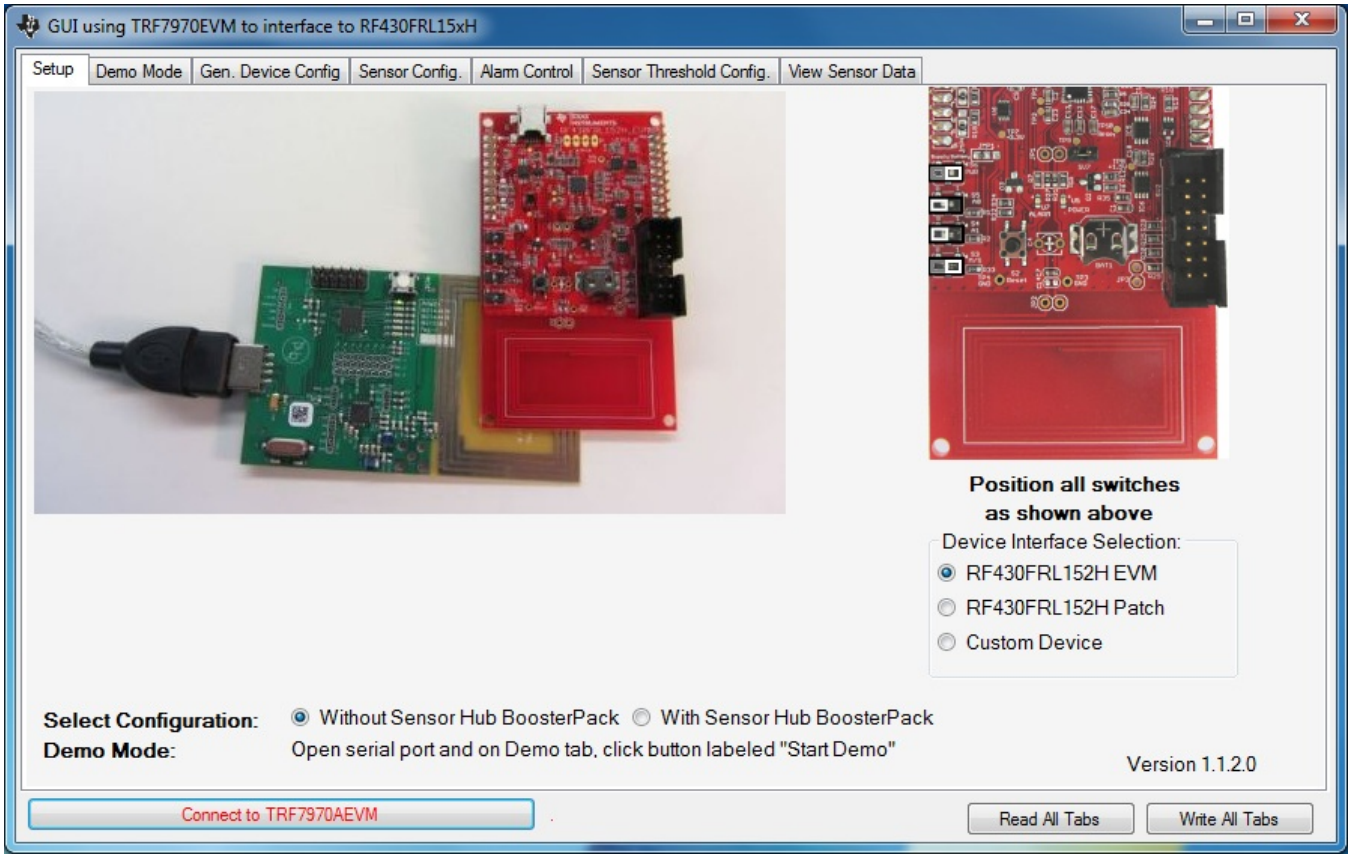


Figure 6. PC Application

Table 1. GUI Tabs

Name	Contents and Functions
Setup	This tab explains how to configure the system.
Demo Mode	Using an RF430FRL152HEVM, this tab allows automatic setup, measurement, and display of the thermistor and light sensor's measurements with one click of a button.
General Device Configuration	This tab contains controls that allow starting the sampling process, choosing the sensors to be used, and selecting the sampling frequency, among other options.
Sensor Configuration	This tab contains settings for the ADC for each analog sensor and also advanced settings.
Alarm Control	This tab contains settings for enabling and disabling the alarm settings.
Sensor Threshold Configuration	This tab contains settings for alarm thresholds for each sensor.
View Sensor Data	After a sampling process has completed, this tab allows the user to view the logged data.

Copyright © 2014, Texas Instruments Incorporated

4 Overview

This section describes the meaning of each of the options on each tab. Remember, checking an option does not immediately cause that option to be set. It is only set after a "Write" button click is performed. Any changes that have occurred on the part, like new status, will not be visible until a "Read" button click has been done.

4.1 Typical Sequence

In a typical sequence (for example, to do a thermistor measurement) follow these steps. These steps are more fully described in the *RF430FRL15xH Firmware User's Guide* (SLAU603).

1. Configure the thermistor measurement parameters:
   (a) Select the thermistor sensor.
   (b) Set how many times it needs to be sampled.
   (c) If sampled more than one time, select the delay between the samples.
   (d) Select the ADC configuration (resolution, PGA setting, and type of filter).
   These settings are written to the virtual registers in the FRAM memory using RF communication.
2. Write the start bit in the control register to start the sampling process.
3. There is a delay while the sampling process is being performed.
4. After sampling is complete, the requested measurements are stored into the log memory, typically FRAM (after the virtual registers).

4.2 Setup Tab

This tab is largely self-explanatory. First, in the "Device Interface Selection" select the board that is being used.

If the RF430FRL152HEVM is selected, an option to select whether or not a Sensor Hub BoosterPack is being used is presented. Make the selection (see Figure 7).

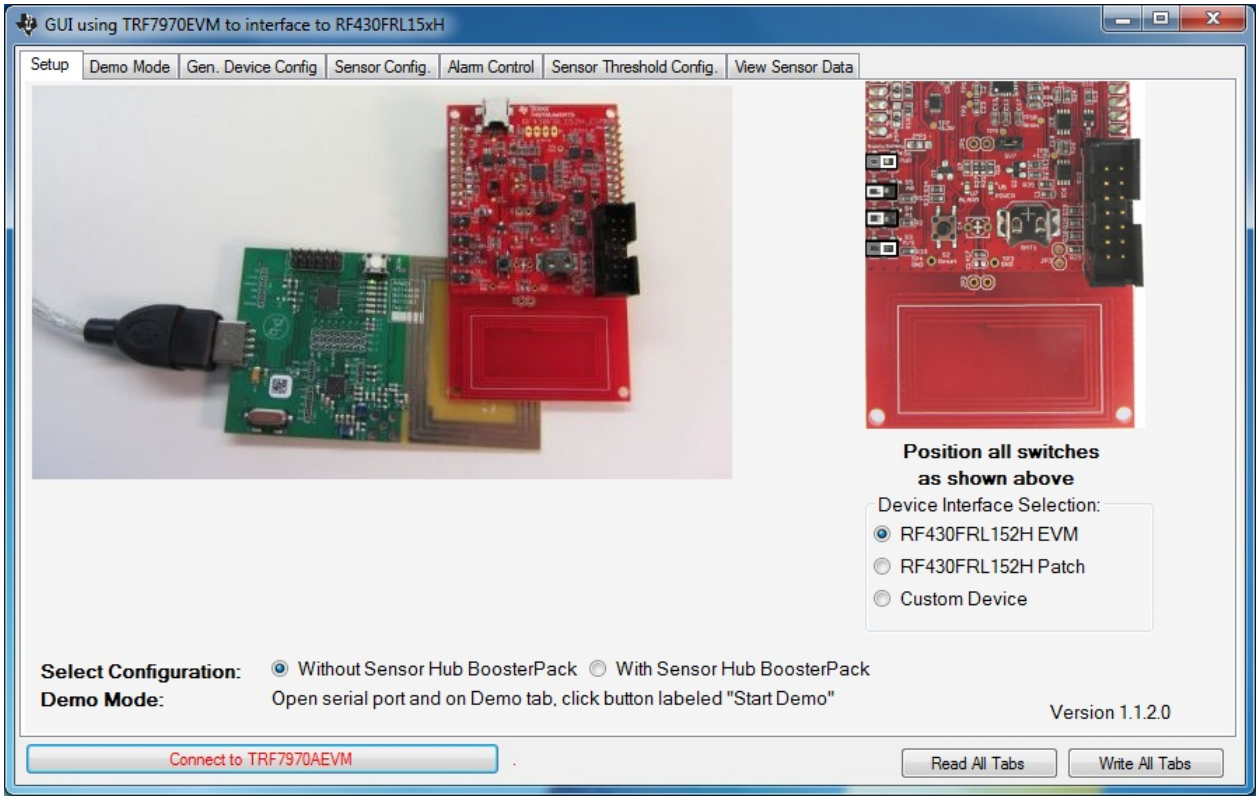


Figure 7. Setup Tab

Copyright © 2014, Texas Instruments Incorporated

4.3 Demo Mode Tab

Using this page a user can easily run a sensor acquisition. After positioning the boards as shown on the Setup tab, then pressing the "Start Demo" button, measurement will be started and temperature data and other sensor data like light intensity will be shown (see Figure 8).

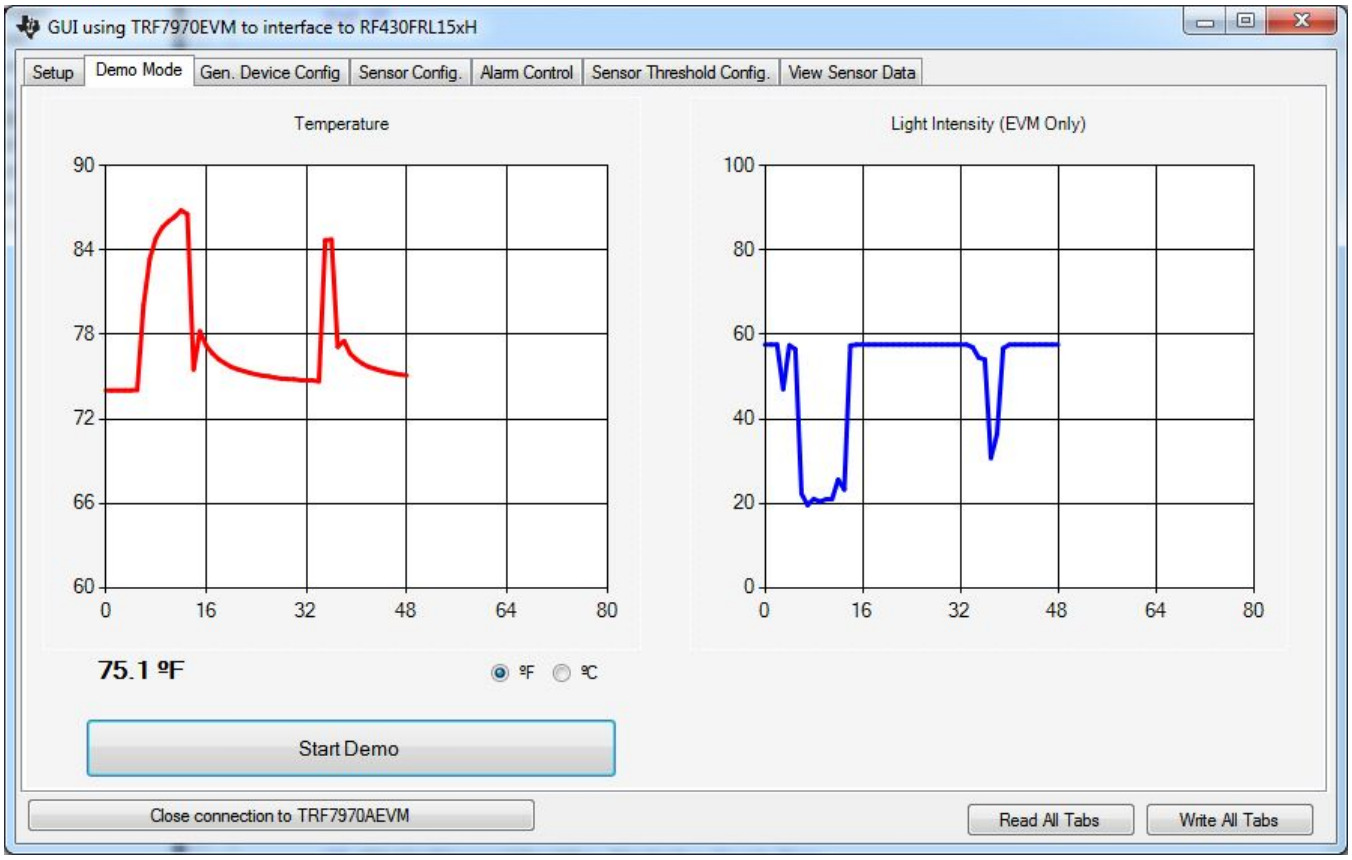


Figure 8. Demo Tab

Copyright © 2014, Texas Instruments Incorporated

4.4 General Device Configuration Tab

Figure 9 shows the "Gen. Device Config" tab.

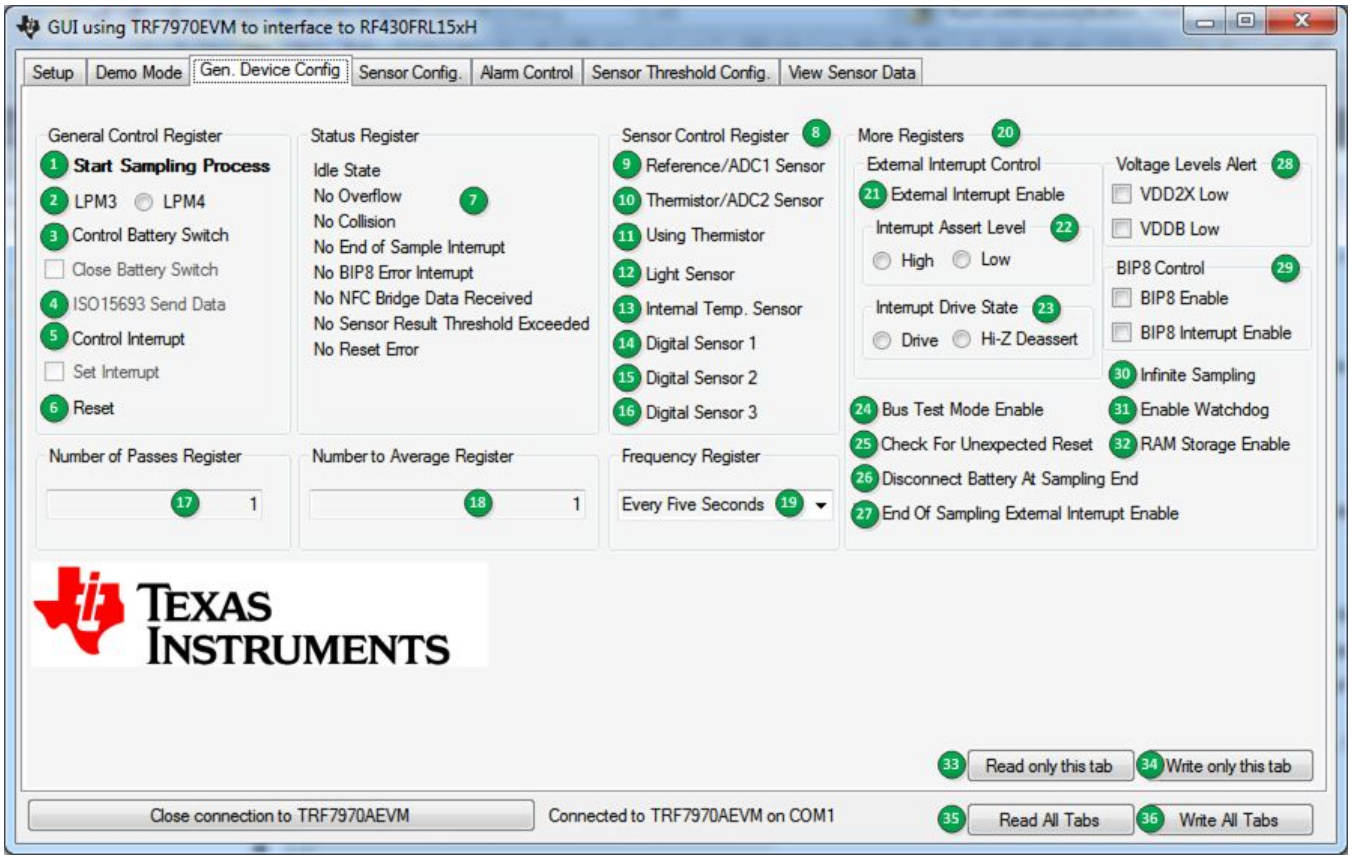


Figure 9. General Device Configuration Tab

1. Start Sampling Process

   Setting this bit causes the application ROM code to start the sampling process of all the sensors that were selected, based on all of the configurations.

2. LPM3 and LPM4

   Selects which power mode is used when the device enters idle mode.

3. Control Battery Switch and Close Battery Switch

   Controls the state of the battery switch on the device. To change the state, check "Control Battery Switch" and then to close the battery switch, check "Close Battery Switch". Otherwise, leave it unchecked, and the battery switch is set to open. The "Control Battery Switch" option is reset after the command is executed by the application ROM code.

4. ISO 15693 Send Data

   Allows sending of raw ISO/IEC 15693 commands. Disabled in the current version of the GUI.

5. Control Interrupt and Set Interrupt

   Controls the state of the external interrupt on the device. To change the state, check "Control Interrupt", and then to set the interrupt, check "Set Interrupt". Otherwise, leave it unchecked, and the interrupt and the associated flags are cleared. The "Control Interrupt" option is reset after the command is executed by the application ROM code. To generate an external interrupt manually with the GUI, more settings must be done using the "External Interrupt Control"

6. Reset

   Causes a PUC (a reset) to be generated on the device. The connection is maintained.

7. Status Register

Copyright © 2014, Texas Instruments Incorporated

This group box displays any interrupt or status that have occurred on the device.

Reset all status flags on next write resets all status to idle mode after the tab write.

8. Sensor Control Register

   Allows the selection of any sensor to be sampled. Selection of one or multiple sensors is possible.

9. Reference / ADC1 Sensor

   Analog Input. If "Using Thermistor", check 11. This causes the input to be configured for an external reference resistor measurement. Otherwise, it can function as a standalone generic analog sensor (ADC1).

10. Thermistor / ADC2 Sensor

    Analog Input. If "Using Thermister", check 11. This causes the input to be configured for an external thermistor measurement. Otherwise, it can function as a standalone generic analog sensor (ADC2).

11. Using Thermistor

    If using a thermistor, this option must be selected for the application ROM code to properly set up the measurement.

12. ADC0 / Light Sensor

    When using a RF430FRL152HEVM, this is an option to sample the light sensor. Otherwise, it is a generic analog sensor (ADC0).

13. Internal Temperature Sensor

    Allows sampling of the internal temperature sensor on the part.

14. Digital Sensor 1

    If using the RF430FRL152HEVM together with the Sensor Hub BoosterPack, this samples the SHT21 temperature sensor. Otherwise, it is an option to sample a generic digital sensor.

15. Digital Sensor 2

    If using the RF430FRL152HEVM together with the Sensor Hub BoosterPack, this samples the SHT21 humidity sensor. Otherwise, it is an option to sample a generic digital sensor.

16. Digital Sensor 3

    If using the RF430FRL152HEVM together with the Sensor Hub BoosterPack, this option samples the ISL29023 light sensor. Otherwise, it is an option to sample a generic digital sensor.

17. Number of Passes Register

    One pass is sampling all of the selected sensors one time.

18. Averaging Register

    Any value higher than 1 causes that many samples to be averaged into one result. Averaging mode in the "Alarm Control" tab selects the type of averaging used per sensor.

19. Frequency Register

    Selects the delay to be made in between each of the sampling passes. Note this delay must not be less than the time to complete sampling all of the sensors one time. If it is less, then a "collision" occurs.

20. More Registers

    This advanced section is not required in most cases. However, it is described below.

    Gating option to enable the external GPIO interrupt.

21. Interrupt Assert Level

    The level to be driven or pulled to if there is an interrupt

22. Interrupt Drive State

    Determines if the device drives an interrupt or is high impedance (user must provide the appropriate pullup or pulldown resistor).

23. Bus Test Mode Enable

    Allows access to protected memory using an I^2C or SPI host.

Copyright © 2014, Texas Instruments Incorporated

24. Check For Unexpected Reset

    If this option is selected, and an unexpected reset occurs, the reset code is logged at the end of the logging memory.

25. Disconnect Battery At Sampling End

    When the sampling process has been completed, this option causes the ROM code to open the battery switch.

26. End of Sampling External Interrupt Enable

    When the sampling process has completed, this option causes an external interrupt to be generated.

27. Voltage Levels Alert

    When these are set, it indicates that the voltage levels have gone too low on a particular rail at some point. Not self clearing.

28. BIP8 Control

    Error detection for I^2C or SPI protocol

29. Infinite Sampling

    Samples until the "Start Sampling Process" option is unchecked.

30. Enable Watchdog

    Enables the watchdog during a sampling process.

31. RAM Storage Enable

    Writes sampling results into RAM memory instead of FRAM.

32. Read only this tab

    Reads Gen. Device Config and populates the results on this tab.

33. Write only this tab

    Writes Gen. Device Config with all of the settings on this tab.

34. Read All Tabs

    Reads all of the information on all of the tabs from the virtual FRAM registers in the device using RF and populates the fields in the tabs.

35. Write All Tabs

    Writes all of the information to the virtual FRAM registers in the device over RF from all of the settings.

NOTE: Settings made on the following tabs do not take effect until a "Write only this tab" or "Write All Tabs" button is clicked:
Gen. Device Config.
Sensor Config.
Alarm Control
Sensor Threshold Config.

Likewise, the settings on these tabs are not updated until a "Read only this tab" or "Read All Tabs" button is clicked.

Copyright © 2014, Texas Instruments Incorporated

4.5 Sensor Configuration Tab

The options for the four different analog sensors can be controlled from this tab (see Figure 10). The options can be changed only if the corresponding sensor is enabled in the "Gen. Device Config" tab.

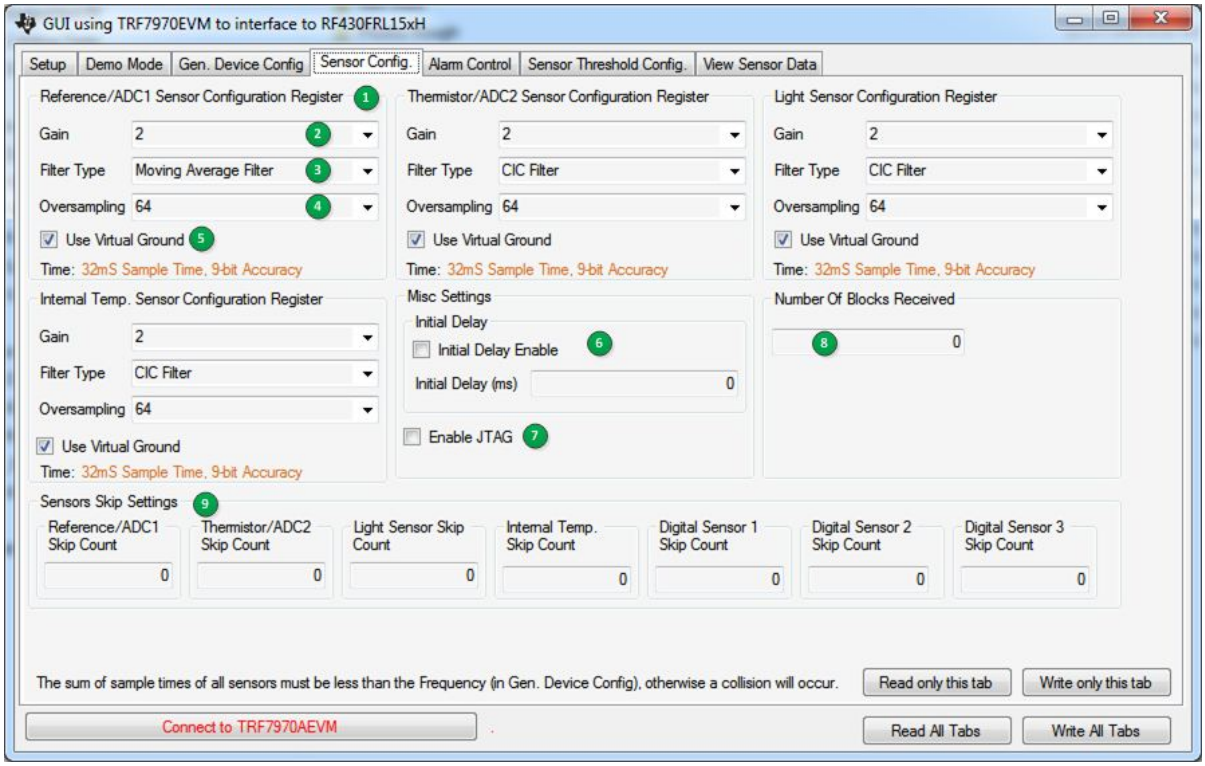


Figure 10. Sensor Configuration Tab

1. Sensor Configuration Sensor

   Allows control of the analog-to-digital configuration for a particular sensor.
2. Gain

   Selects the programmable gain amplifier (PGA) before the ADC.
3. Filter Type

   Select the filter to be used.
4. Oversampling

   Determines the resolution and time of the sample.
5. Use Virtual Ground

   If selected, raises the ADC and sensor ground level several hundred millivolts. It is recommended that this setting is consistent for all of the sensors.
6. Initial Delay Enable / Initial Delay (ms)

   Creates a delay of configured time after starting the sampling process.
7. Enable JTAG

   Because JTAG is normally disabled on the device, and if there is trouble establishing a JTAG connection, enabling this option can help establish connection. This setting takes effect only after a reset or power cycle.
8. Number of Blocks Received

   This is a counter that indicates how many ISO/IEC blocks have been received. Can be reset.
9. Sensor Skip Settings

   Allows control of the duty cycle for a sensor.

Copyright © 2014, Texas Instruments Incorporated

4.6 Alarm Control Tab

The alarm control options for the four different analog sensors can be controlled from this tab (see Figure 11). The options can be changed only if the corresponding sensor is enabled in the "Gen. Device Config" tab.

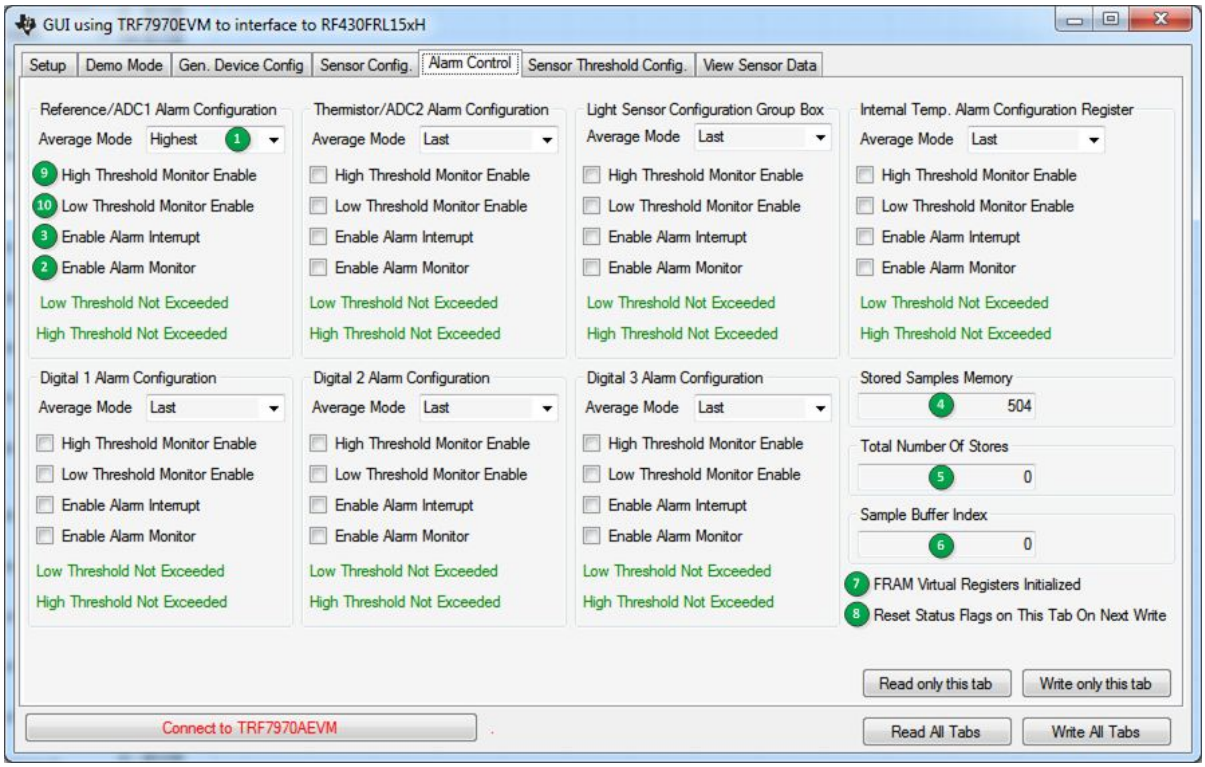


Figure 11. Alarm Control Tab

1. Averaging Mode

   True averaging is done only if the "Average" option is selected. The Lowest or Highest options store only the lowest or highest, respectively, sample for the selected sensor. The number of samples done before the result is stored is set in the "Averaging Register" setting on the "Gen. Device Config" tab. The "First" option stores the first sample of the selected sensor. If averaging is selected, during sampling passes after the first sample was stored, the remaining passes will skip this sensor.

2. Enable Alarm Monitor

   Enables a check for high or low thresholds for a particular sensor. The results are given in the labels below.

3. Enable Alarm Interrupt

   Enables a GPIO interrupt if a high or low threshold has been exceeded. The "Enable Alarm Monitor" must also be selected for this to take effect.

4. Stored Sample Memory

   Defines the length of the logged samples memory section.

5. Total Number Of Stores

   Reports how many samples were written to the log memory.

6. Sample Buffer Index

   Reports the index location of the last sample stored.

7. FRAM Virtual Registers Initialized

   If checked, indicates that the FRAM memory has been initialized.

Copyright © 2014, Texas Instruments Incorporated

8. Reset Status Flags on This Tab On Next Write

   Resets all of the flags on this tab the next time the "Write" button is clicked.

9. High Threshold Monitor Enable

   Enables monitoring of that particular sensor for a sample value that exceeds or is equal to the threshold value set in "Sensor Threshold Config." tab. If the sample meets that condition, the status for that sensor (in the same group box) changes to indicate that condition.

10. Low Threshold Monitor Enable

    Enables monitoring of that particular sensor for a sample value for that is less than or equal to the threshold value set in "Sensor Threshold Config." tab. If the sample meets that condition, the status for that sensor (in the same group box) changes to indicate that condition.

Copyright © 2014, Texas Instruments Incorporated

4.7 Sensor Threshold Configuration Tab

Figure 12 shows the Sensor Threshold Configuration tab. A sensor must be enabled in the "Gen. Device Config" tab to allow the Sensor Threshold Configuration tab to change its threshold.

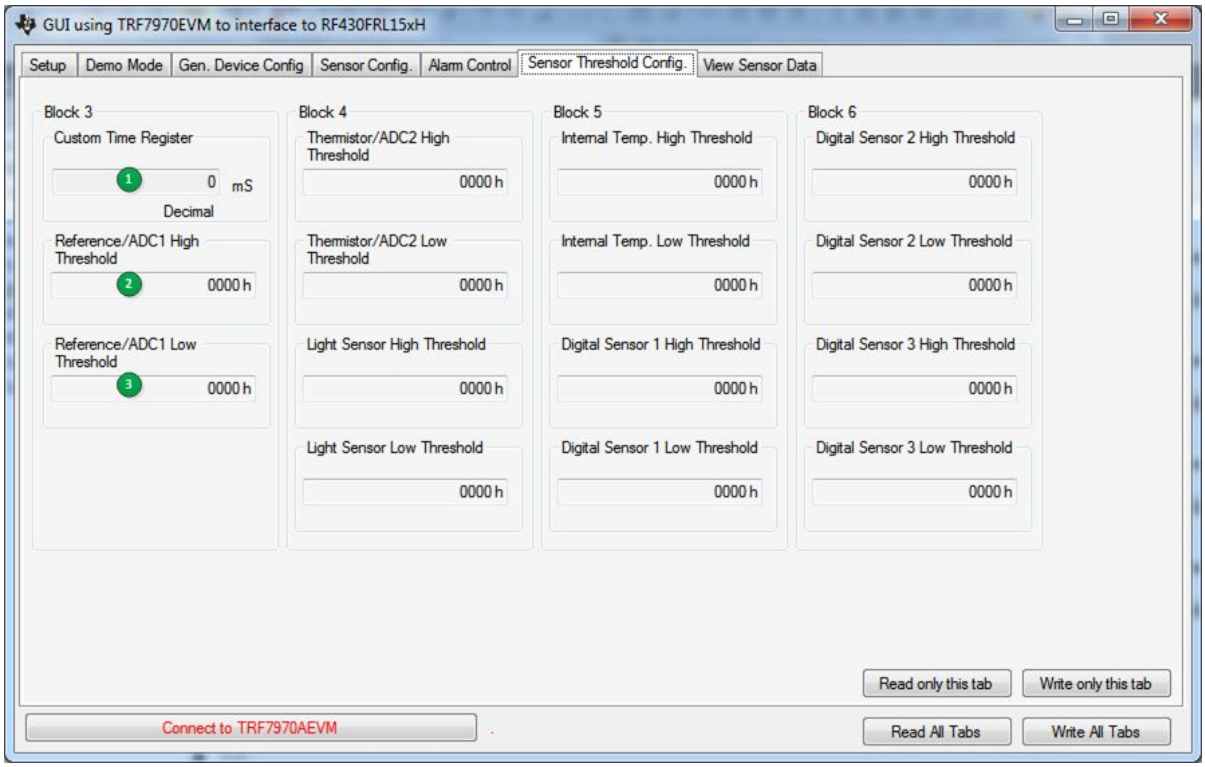


Figure 12. Sensor Threshold Configuration

1. Custom Time Register

   Available only if the "Frequency Register" has been set to the "Custom Time" option. Resolution is in milliseconds.

2. High Threshold

   If the sensor sample result meets or exceeds the high threshold set here, an alarm is generated. Operation depends on settings in the "Alarm Control" tab.

3. Low Threshold

   If the sensor sample result is lower or meets the low threshold set here, an alarm is generated. Operation depends on settings in the "Alarm Control" tab.

Copyright © 2014, Texas Instruments Incorporated

4.8 View Sensor Data Tab

After a sampling process has been completed, the logged data can be viewed using this tab (see Figure 13).

Click the "Read Logged Data" button to display the results in a table to the left of the button. Make sure that you do not change any settings on the GUI before clicking the button, because the settings are used to determine what type of sampling process occurred.

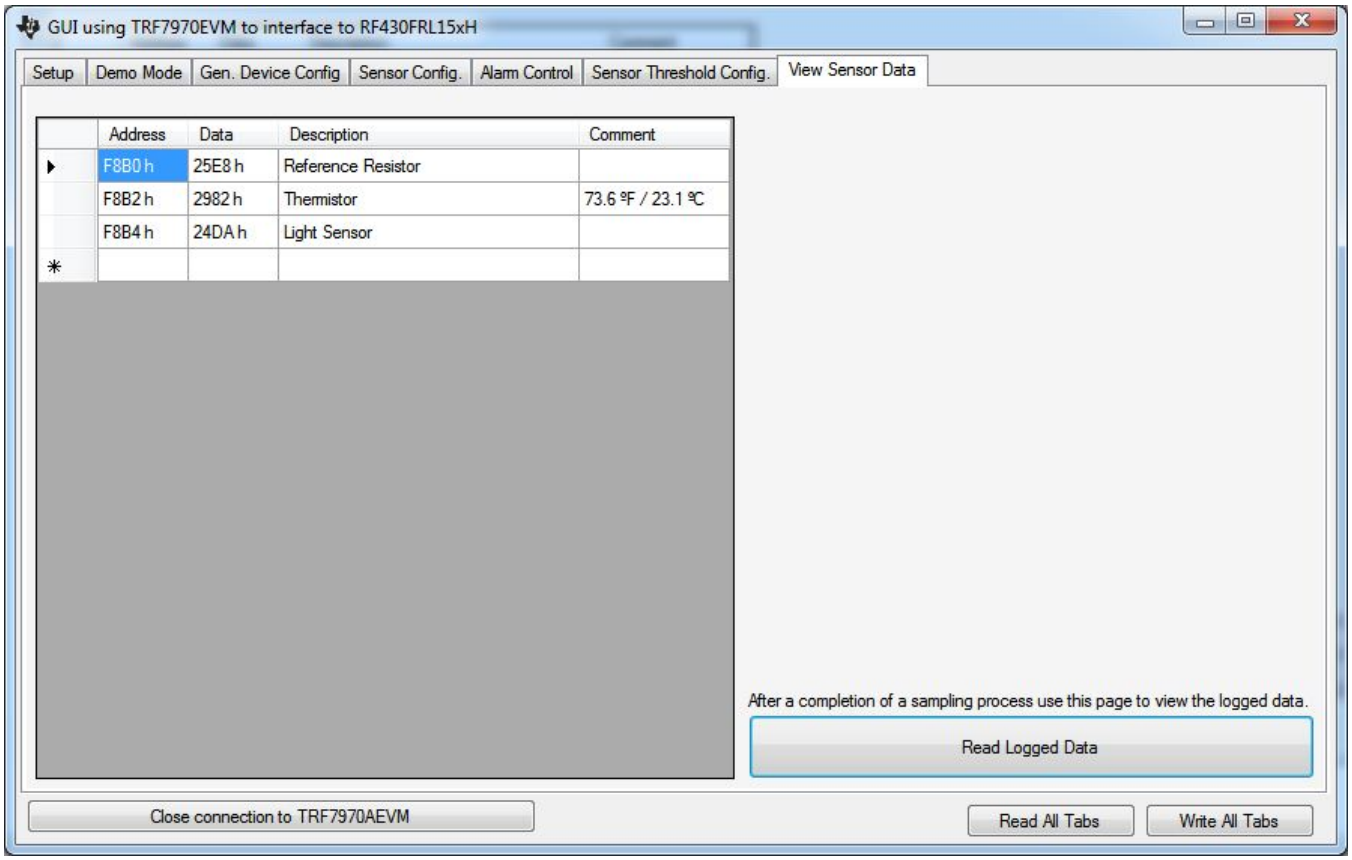


Figure 13. View Sensor Data Tab

Copyright © 2014, Texas Instruments Incorporated

5 Setup of Demo System

The following sections describe how to setup a demo with and without the Sensor Hub BoosterPack, and also for custom configuring and operation of the device.

5.1 Set up the RF430FRL152HEVM With Sensor Hub Demo Using the PC

This section describes how to setup and run the Sensor Hub BoosterPack demo. With this setup, the RF430FRL152HEVM samples over I^2C three different sensors on the SensorHub BoosterPack. They are temperature and humidity (SHT21) and a light sensor (ISL29023). After collecting the samples, the data is transmitted over RF to the TRF7970AEVM which reports them to the PC application. Finally the results are plotted on the graphs.

1. Connect the TRF7970AEVM to the PC with a USB cable.
2. On the RF430FRL152HEVM, use a pencil or pen to position the switches as shown in Table 2

Table 2. Switch Positions For Sensor Hub Operation

Switch ID	Position	Comment
S6	Supply	This will source power from the USB cable
S5	0	Does not matter what state this switch is in
S4	0	Does not matter what state this switch is in
S3	M	Device starts in I^2C/SPI master mode

3. Attach the Sensor Hub BoosterPack on top of the RF430FRL152HEVM. Make sure that the orientation is correct (see Figure 14).
4. Connect the RF430FRL152HEVM to the PC using the provided USB cable. Note that this USB connection is only for the power supply, and no data is passed through it.
5. Position the RF430FRL152HEVM antenna on the antenna portion of the TRF7970AEVM as shown in Figure 14. It is recommended to have an insulator between the two antennas or to hold them at a distance from each other to prevent any short circuits.

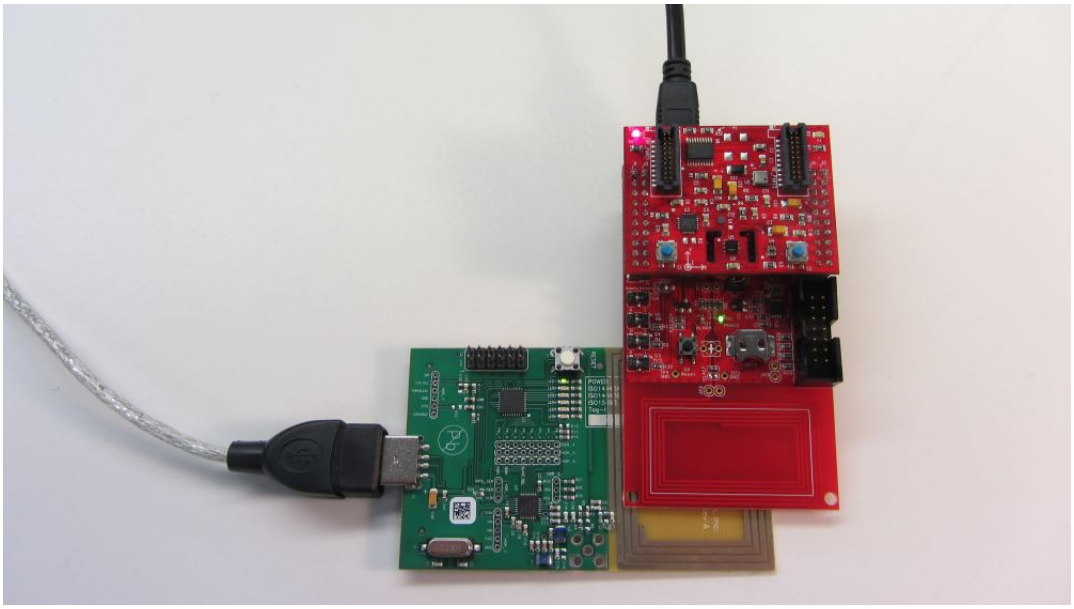


Figure 14. BoosterPack Configuration

6. Open the RF430FRL15xH GUI Interface application by going to the Start menu→All Programs→Texas Instruments→RF430FRL152H GUI .
7. Click the "Connect to TRF7970AEVM" button on the bottom of the window.
8. A few seconds after you click the "Connect" button, the label next to the button should show "Connected to TRF7970AEVM on COMx". If this is not shown, then a connection has not been made.

Copyright © 2014, Texas Instruments Incorporated

In this case, disconnect the TRF7970AEVM and reconnect it, then restart at step 1. If this still does not solve the problem, make sure that the TRF7970AEVM has the latest firmware downloaded from the TRF7970AEVM tool folder.

9. In the "Setup Tab", select the "With Sensor Hub BoosterPack" and "RF430FRL152HEVM" options on the Device Interface Selection.
10. Select the "Demo Mode" tab.
11. Click the "Start Sensor Hub Demo" button.
12. The GUI starts to plot the temperature and light intensity samples on the graphs.
    (a) To plot these values, the PC GUI configures the RF430FRL152HEVM through the TRF7970AEVM to take three different samples from the Sensor Hub BoosterPack. The RF430FRL152HEVM already has the drivers loaded into the FRAM to enable the measurements to be made.
    (b) When the samples are complete, the PC GUI reads the result from FRAM of the RF430FRL152HEVM through the TRF7970AEVM and plots it on the graphs in the PC GUI.
13. To change the measurements, you can place your hand over the light sensor or heat the thermistor (U5).

Copyright © 2014, Texas Instruments Incorporated

5.2 Set up the RF430FRL152HEVM Demo Using the PC

This section describes how to setup and run the sensor demo. With this setup, the RF430FRL152HEVM samples, using the onboard ADC, two external sensors, the thermistor and the light sensor. After collecting the samples, the data is transmitted over RF to the TRF7970AEVM which reports them to the PC application. Finally the results are plotted on the graphs. In this demo the RF430FRL152HEVM is run completely wireless, with no power or data connections.

1. Connect the TRF7970AEVM to the PC with a USB cable.
2. On the RF430FRL152HEVM, use a pen or pencil to set the mini-switches as shown in Table 3.

Table 3. Switch Positions For Passive Operation

Switch ID	Position	Comment
S6	Battery	There is no need for a battery to be present
S5	0	Does not matter what state this switch is in
S4	0	Does not matter what state this switch is in
S3	S	Device starts in I^2C/SPI slave mode

3. **The RF430FRL152HEVM should not be connected to a USB cable for this demo**. If it is connected, set switch S6 to the "Supply" position. The rest of the steps are the same.

   Note: If EnergyTrace technology is used, a USB cable should not be used and the EVM must be powered from the MSP-FET tool.
4. Position the RF430FRL152HEVM antenna on the antenna portion of the TRF7970AEVM as shown in Figure 15. It is recommended to have an insulator between the two antennas or to hold them at a distance from each other to prevent any short circuits.

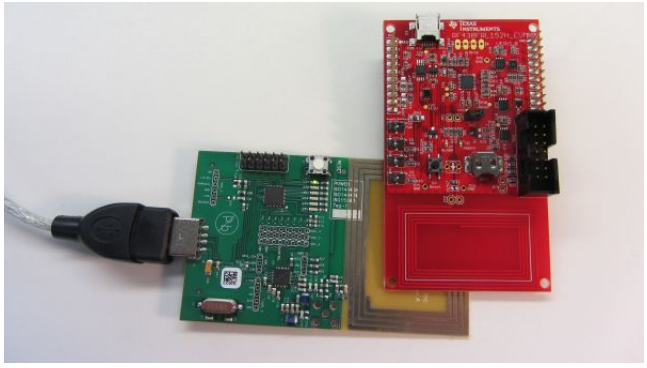


Figure 15. Position the EVMs

5. Open the RF430FRL15xH GUI Interface application by going to the Start menu→All Programs→Texas Instruments→RF430FRL152H GUI .
6. Press the "Connect to TRF7970AEVM" button on the bottom of the window.
7. A few seconds after you click the "Connect" button, the label next to the button should show "Connected to TRF7970AEVM on COMx".

   If this is not displayed, then a connection has not been made. In this case, disconnect the TRF7970AEVM and reconnect it, then restart at step 1. If this still does not solve the problem, make sure that the TRF7970AEVM has the latest firmware downloaded from the TRF7970AEVM tool folder.
8. In the "Setup Tab" select the "Without Sensor Hub BoosterPack" and "RF430FRL152HEVM" options.
9. Go to the "Demo Mode" tab.
10. Click the "Start Demo" button.
11. The GUI starts to plot the temperature and light intensity samples on the graphs.
    (a) To plot these values, the PC GUI configures the RF430FRL152HEVM through the TRF7970AEVM to take two different samples from the analog thermistor and light sensors.
    (b) When the samples are complete, the PC GUI reads the result from FRAM of the

Copyright © 2014, Texas Instruments Incorporated

RF430FRL152HEVM through the TRF7970AEVM and plots it on the graphs in the PC GUI.

12. To change the measurements, you can place your hand over the light sensor or press the thermistor with a finger to affect the temperature result. The light sensor and the thermistor locations on the EVM are shown in Section 2.

    The thermistor temperature measurement may not reach the true skin temperature, because some of the heat dissipates into the EVM.

    The light sensor reading value does not increase in the presence of extra light (for example, if you shine a flashlight on it), because of design reasons with the light sensor selected for this EVM. However, the light sensor shows a change for reduced light. Note that the light sensor on the Sensor Hub BoosterPack does not have this same limitation.

Copyright © 2014, Texas Instruments Incorporated

5.3 Using the PC Application for Advanced Custom Control of the RF430FRL152HEVM

This section describes how to set up the RF430FRL152HEVM for a custom sampling process. The example used here describes how to perform sampling of three sensors (reference, thermistor, and light sensor) with four passes at a rate of one sample per second. Various ADC configurations are made using the "Sensor Config." tab. This is a simple demonstration, and you can create more complex sampling processes and control as needed.

1. Follow the steps in Section 5.1 to start the PC application and connect to the TRF7970AEVM.
2. In the "Setup" tab, make sure that "Without Sensor Hub BoosterPack" and "RF430FRL152HEVM" are selected.
3. On the "Sensor Config." tab, for the reference and thermistor group boxes (near the top of the tab), make the following settings: gain of 2, filter type of CIC filter, oversampling of 256. When gain of 2 is used, the thermistor and reference input voltage does not use most of the analog voltage range. The CIC filter allows for shorter conversion times (using 256 oversampling).
4. For the light sensor configuration, select gain of 1, CIC filter, and oversampling of 256.
5. Also on the same group boxes, select "Use Virtual Ground". Virtual ground allows the ADC module and inputs to be raised above ground voltage by several hundred mV. Raising the ground allows the ADC to more accurately measure voltages near ground. This setting must be chosen, because the RF430FRL152HEVM was designed with virtual ground powering the thermistor and light sensors (the SVSS pin is the virtual ground).
6. Figure 16 shows the "Sensor Config." tab with these settings.

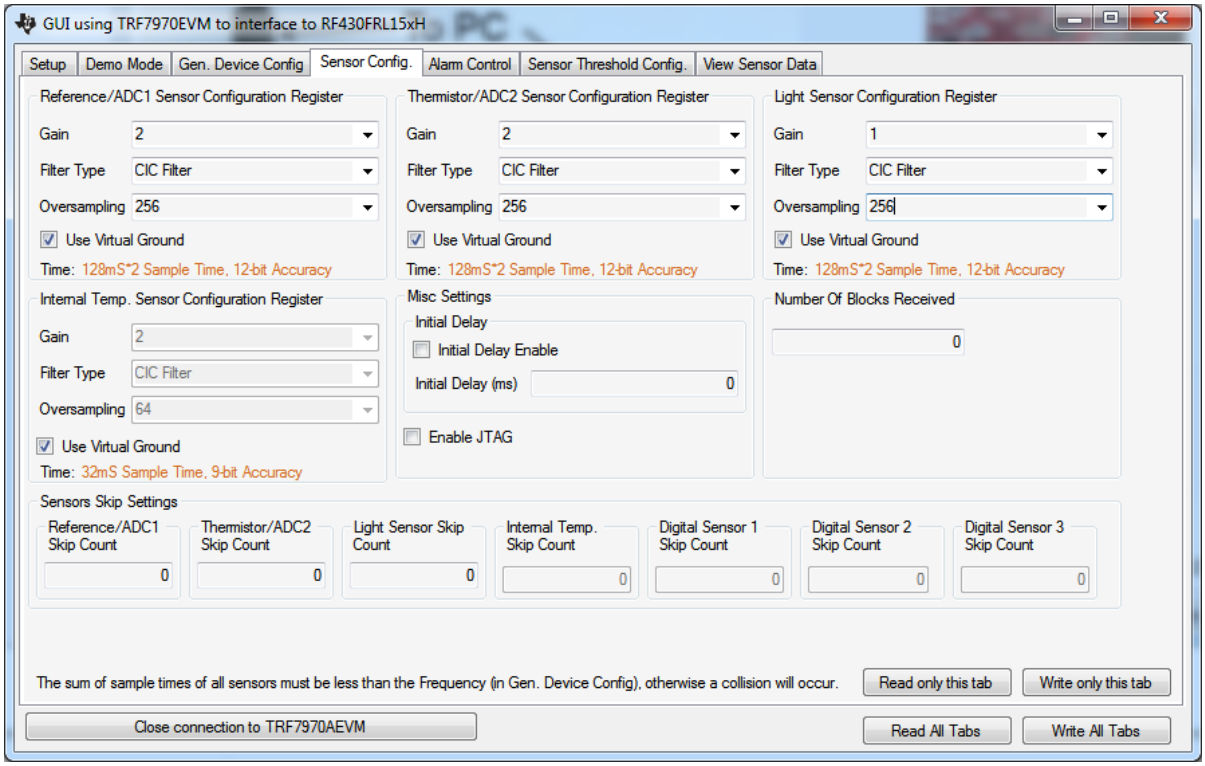


Figure 16. Custom Sensor Configuration Tab

7. Click the "Write only this tab" button on the bottom of the tab.
8. Go to the "Gen. Device Config" tab, and select the "Reference/ADC1", "Thermistor/ADC2", "Using Thermistor", and "Light Sensor" options in the "Sensor Control Register" group box. These settings determine which sensors are selected to be sampled.
9. Set "Number of Passes Register" to 4. This causes four sampling passes. A pass is sampling each of the selected sensors in the "Sensor Control Register" once, in the order that they are selected.
10. Set "Frequency Register" to the "Every Second" option. This setting causes the selected delay to occur between sampling processes.

Copyright © 2014, Texas Instruments Incorporated

11. Check "Start Sampling Process".
12. Figure 17 shows the "Gen. Device Config" tab with these settings.

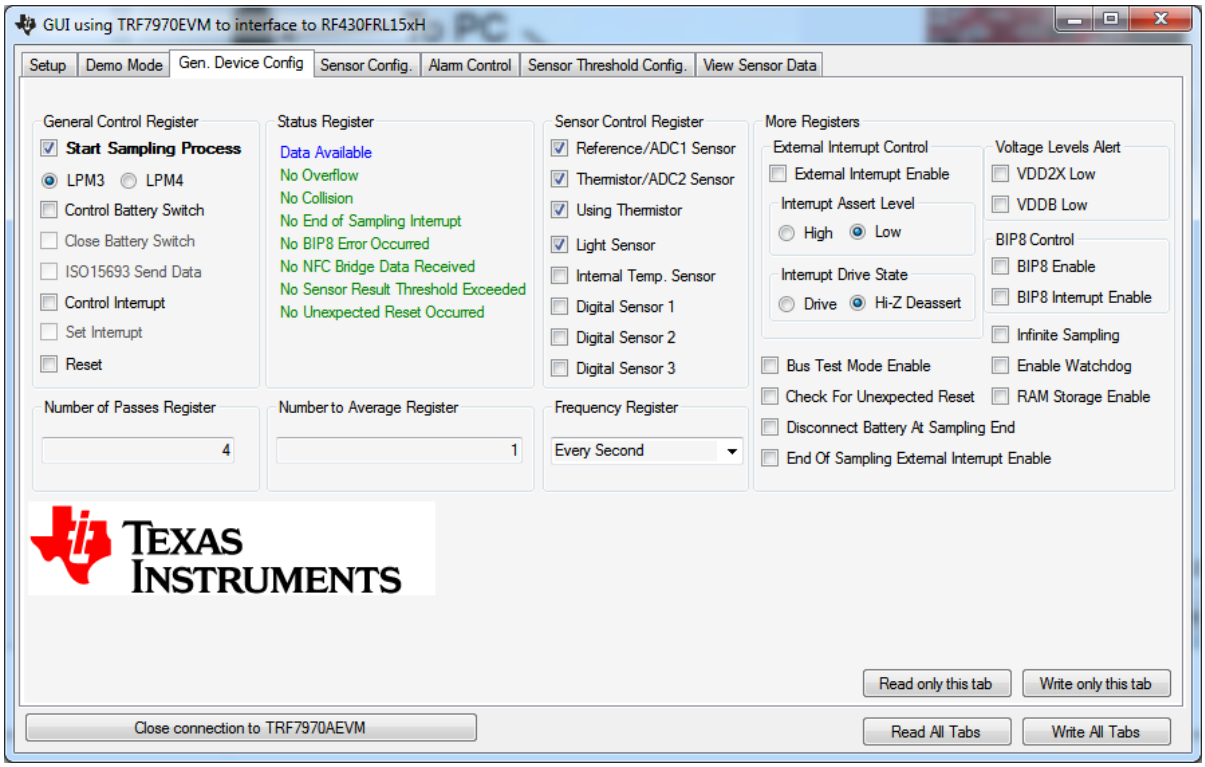


Figure 17. Custom General Device Configuration

13. Click the "Write only this tab" button.
14. The sampling process starts. You can click the "Read only this tab" button to check on the status of the sampling process. While the RF430FRL152H is still sampling, the "Status Register" displays the text "Sampling in Progress".
15. Continue to click the "Read only this tab" button until the "Status Register" displays the text "Data Available". The sampling process should take three seconds to complete.
16. When data is available, go to the "View Sensor Data" tab and click the "Read Logged Data" button. The GUI reads the logged data from the EVM and displays it (see Figure 18). This logged data is not designed to be human-readable. However, one use case of this function is to show the correlation and order of data to the sensor that took that data. In the logged data memory, the sensor that took that sample is not given and must be determined based on the configuration of the settings. However, the GUI shows which sensor is sampled and the expected order.

Copyright © 2014, Texas Instruments Incorporated

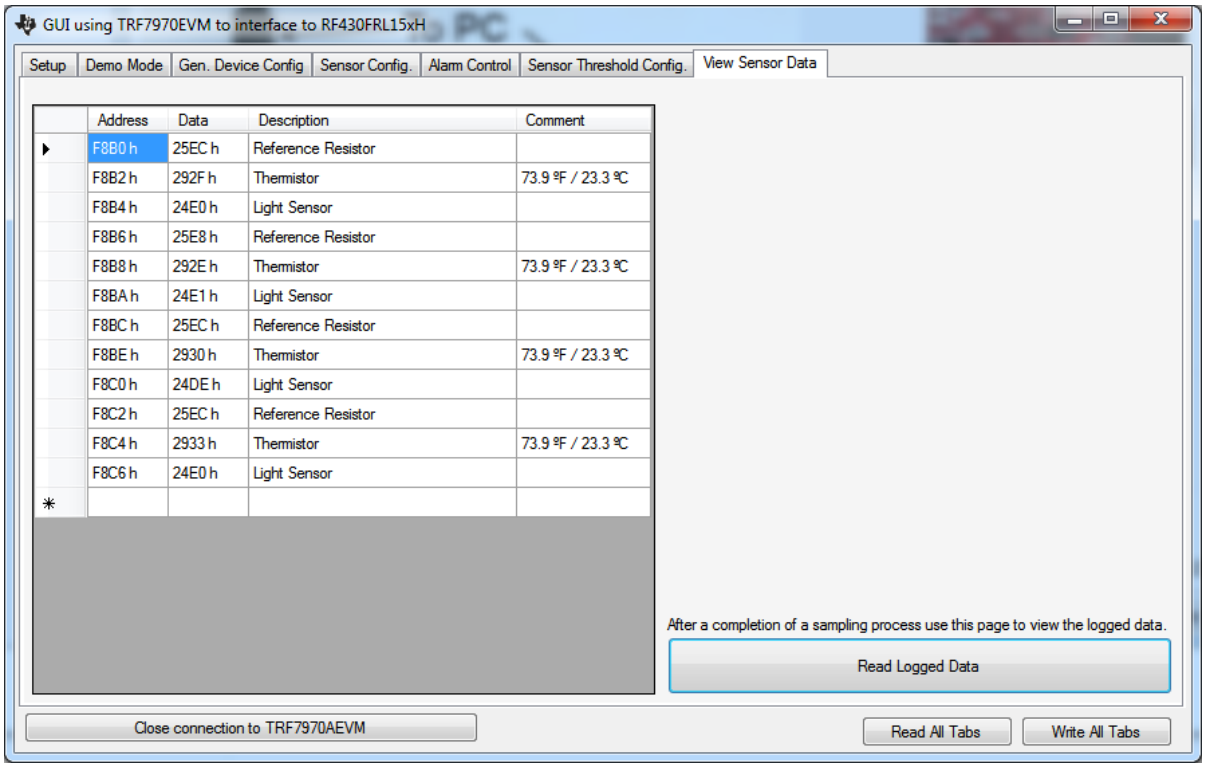


Figure 18. Custom View Data

Copyright © 2014, Texas Instruments Incorporated

6 RF430FRL152HEVM Schematics

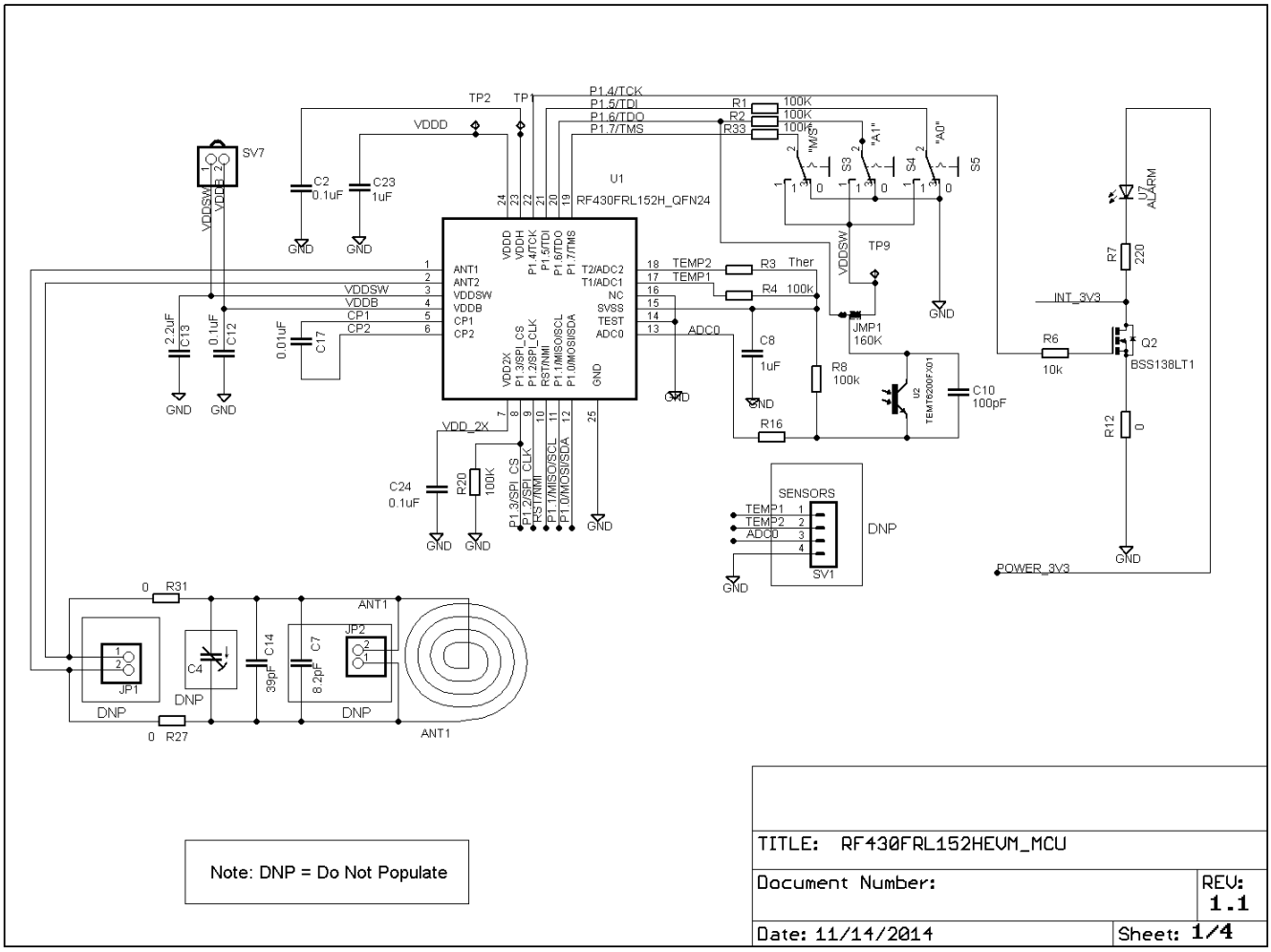


Figure 19. MCU Section Schematic

Copyright © 2014, Texas Instruments Incorporated

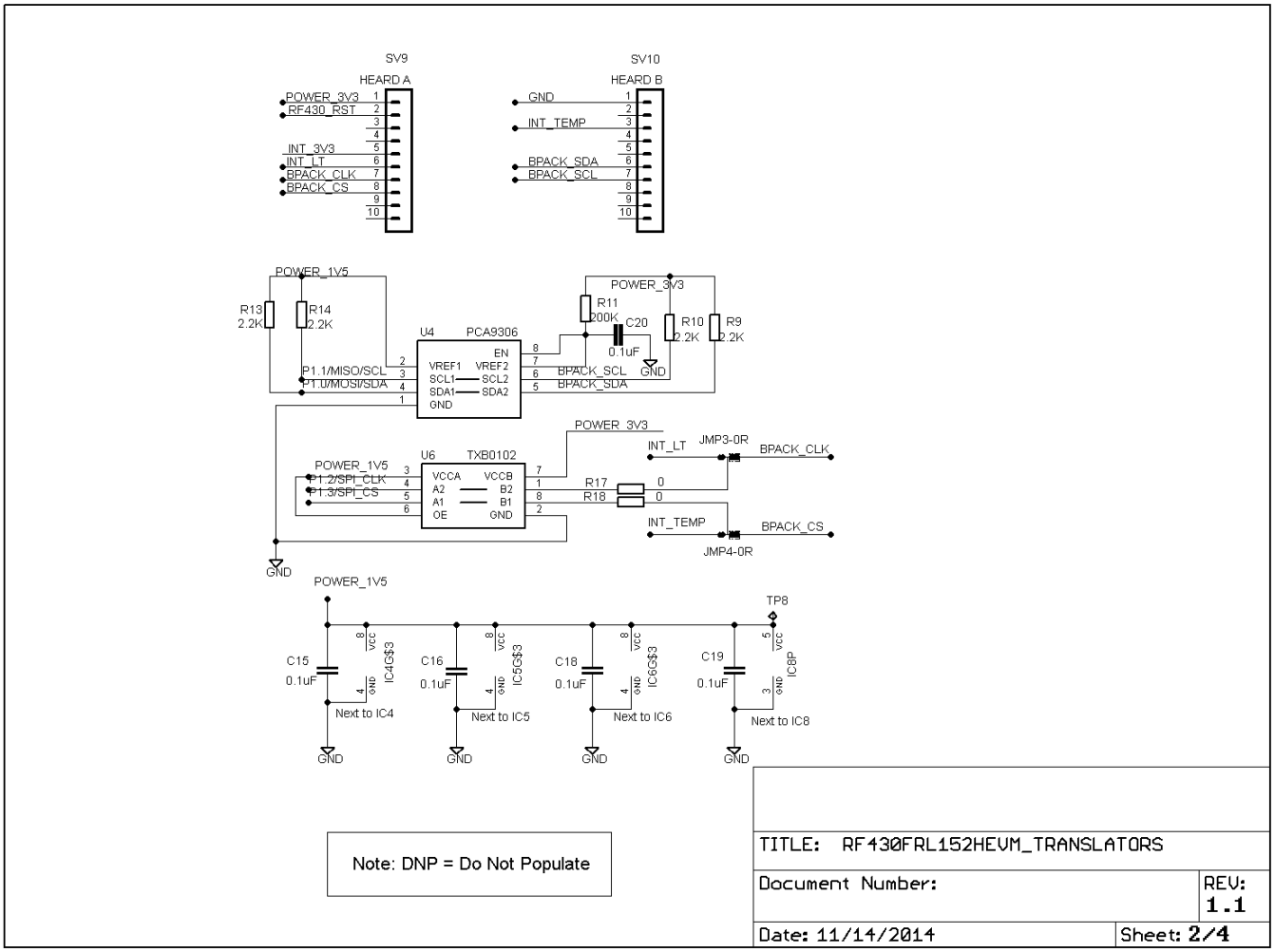


Figure 20. I²C or SPI Translators Section Schematic

Copyright © 2014, Texas Instruments Incorporated

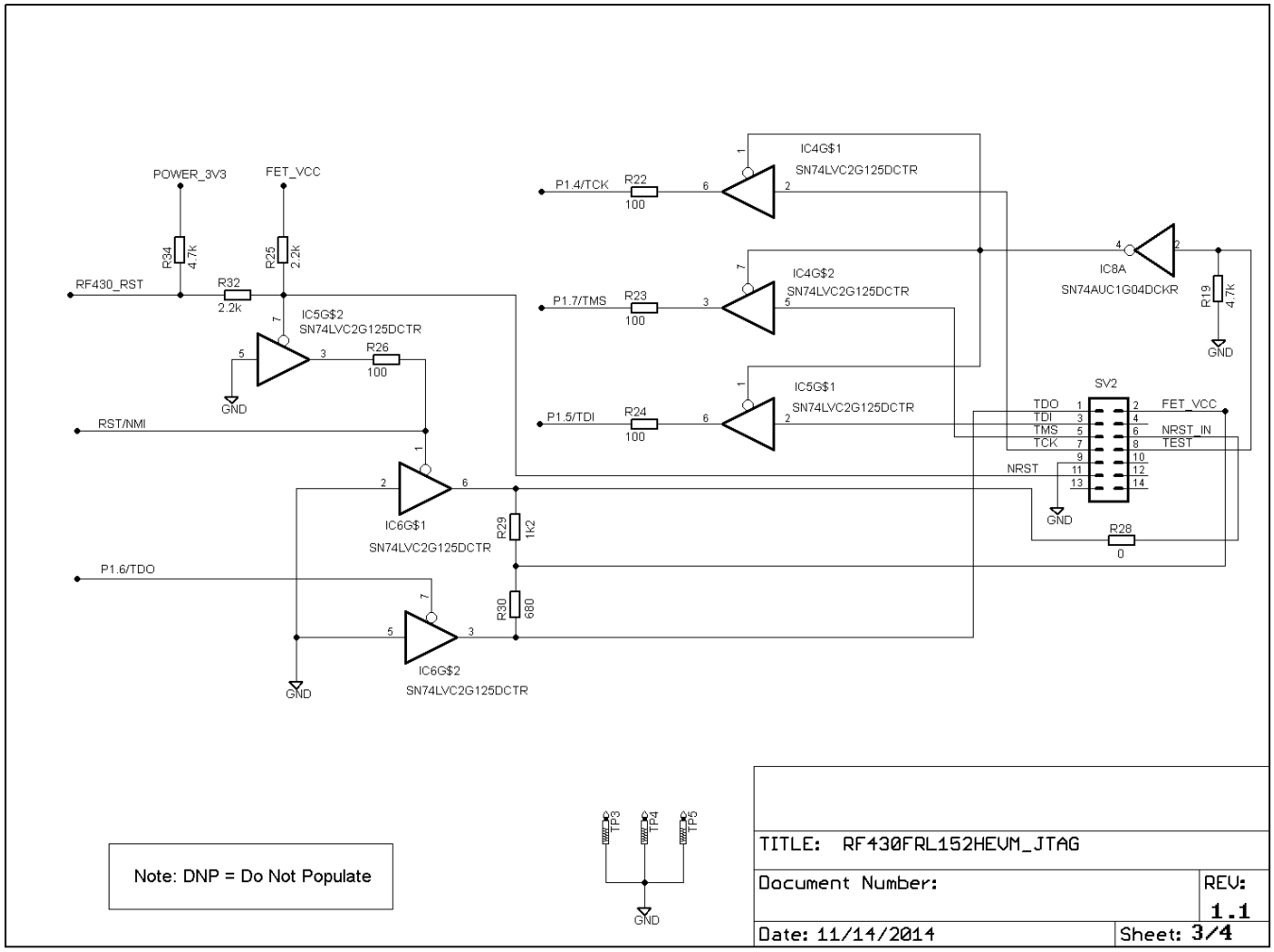


Figure 21. JTAG Section Schematic

Copyright © 2014, Texas Instruments Incorporated

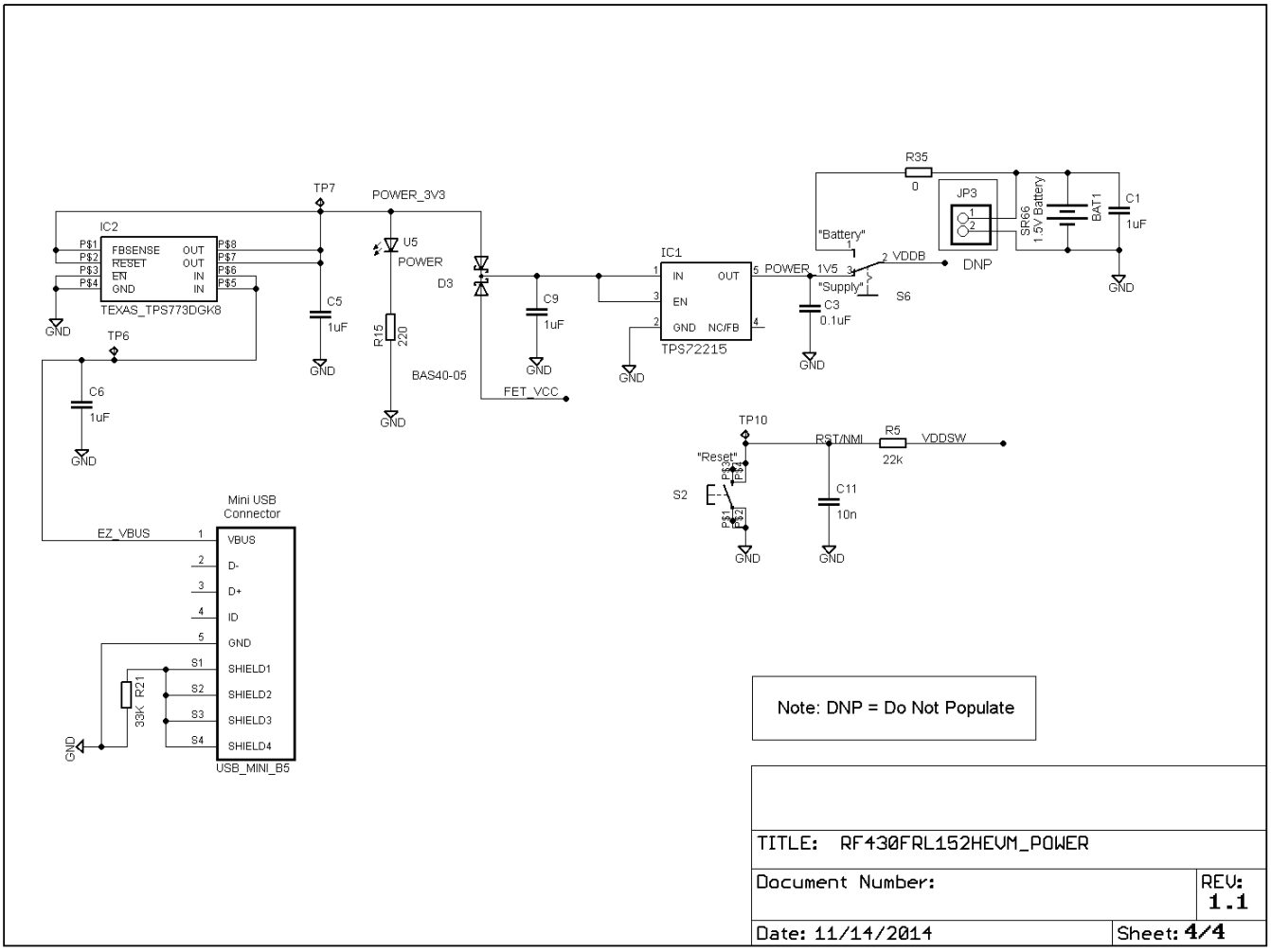


Figure 22. Power Section Schematic

Copyright © 2014, Texas Instruments Incorporated

7 References

The primary sources of RF430FRL15xH information are:

RF430FRL152H Evaluation Module (www.ti.com/tool/rf430frl152hevm)

Sensor Hub BoosterPack (www.ti.com/tool/boostxl-senshub)

TRF7970A Evaluation Module (www.ti.com/tool/trf7970aevm)

Near Field Communications Overview (www.ti.com/nfc)

Low-Power Microcontrollers Overview (www.ti.com/msp430)

Copyright © 2014, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2014, Texas Instruments Incorporated

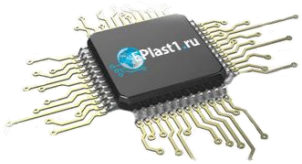
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.