MPR083 Proximity Evaluation Kit User's Guide

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Introduction

This guide will aid you in connecting the MPR083 Evaluation Kit Board to your PC and the installation of all necessary drivers for the board and the installation of the Graphical User Interface (GUI).

Installation

Insert the CD that is included in the contents of the kit.

Installing the PC Application and necessary drivers for the device:

1. Run the "Setup MPR08X Proximity Evaluation Kit.exe" from the contents of the evaluation kit CD. This will run the setup and installation wizard for the PC application (Figure 1).

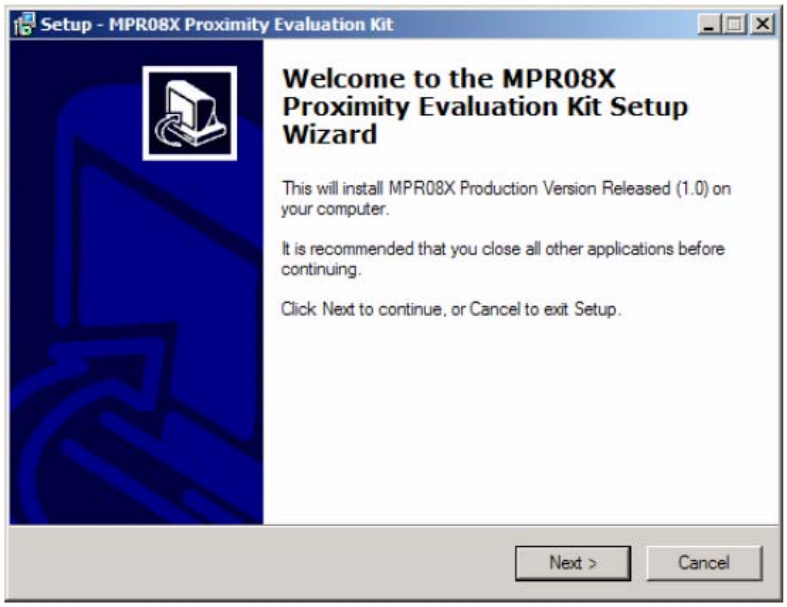

Figure 1. Setup – MPR083 Proximity Evaluation Kit

2. Read the license agreement and accept. If the user does not accept the agreement the application will not install (Figure 2).

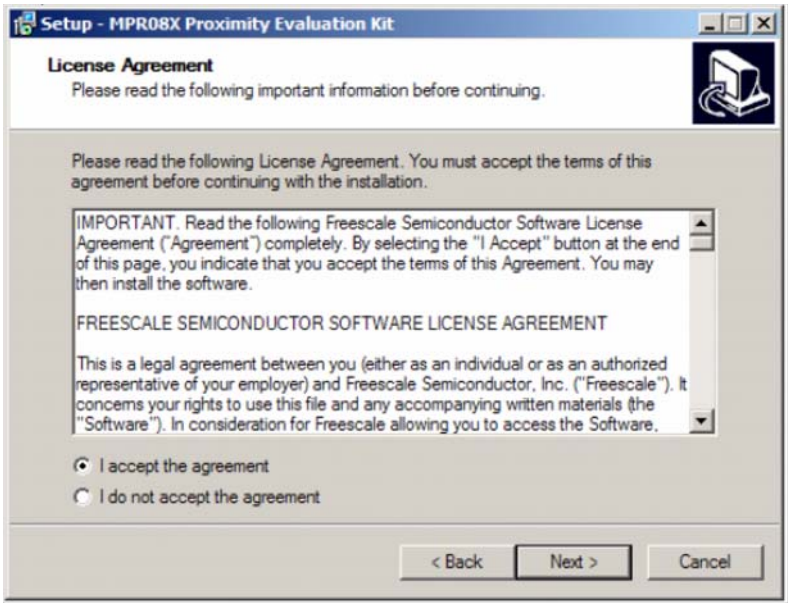

Figure 2. License Agreement

3. The user must leave the destination folder as specified. Select “Next” (Figure 3).

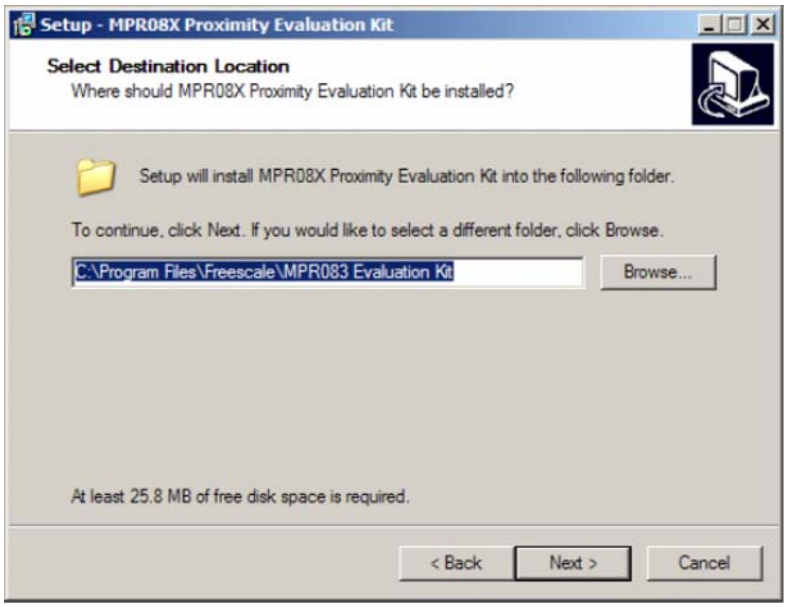

Figure 3. Destination Folder

4. In the Select Start Menu Folder, the user must specify the name that will appear in the Start Menu folder. The default name in the MPR08X Proximity Evaluation Kit (Figure 4).

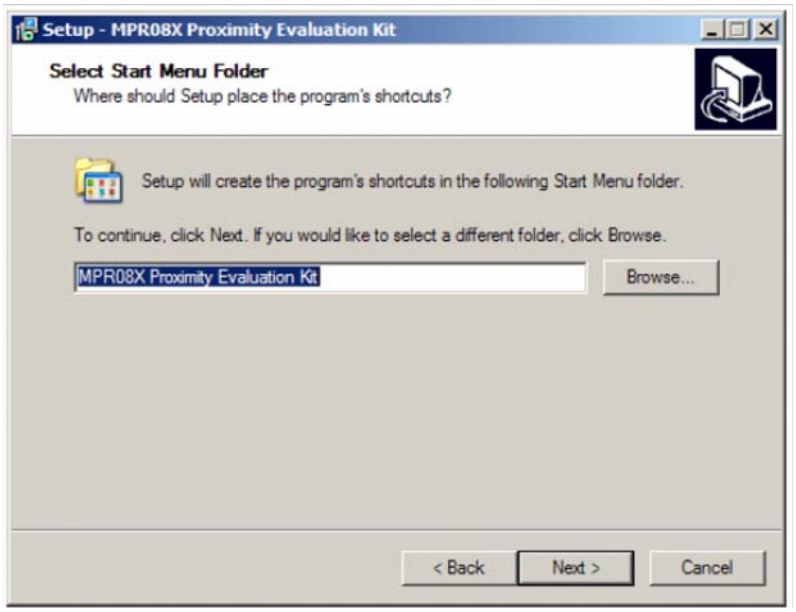

Figure 4. Start Menu Folder

5. The user needs to select whether or not they would like a desktop icon. If the user wishes to have a desktop icon, the user should select the check box for the “Create a desktop icon” (Figure 5).

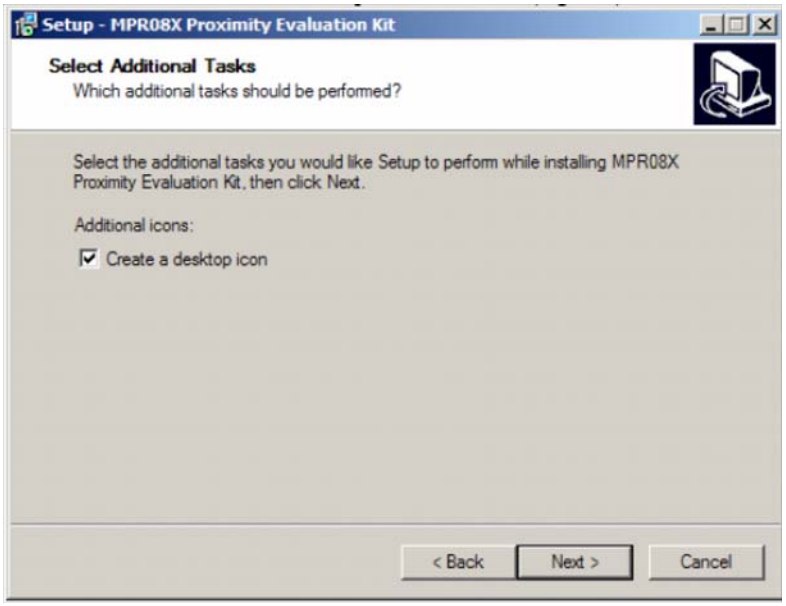

Figure 5. Create a desktop icon

6. Select “Install” if the user is satisfied with the setup. If not, select “<Back” (Figure 6).

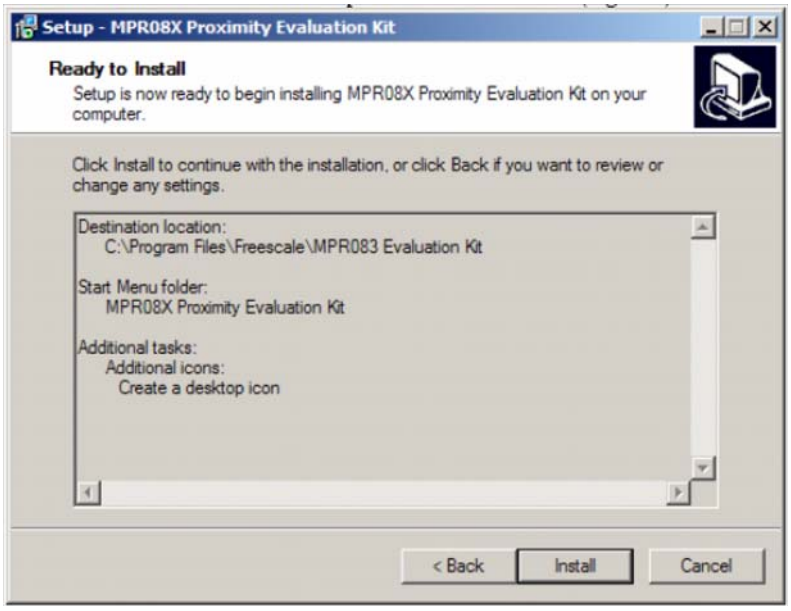

Figure 6. Install

7. The program will then install. When completed, select “Finish” (Figure 7).

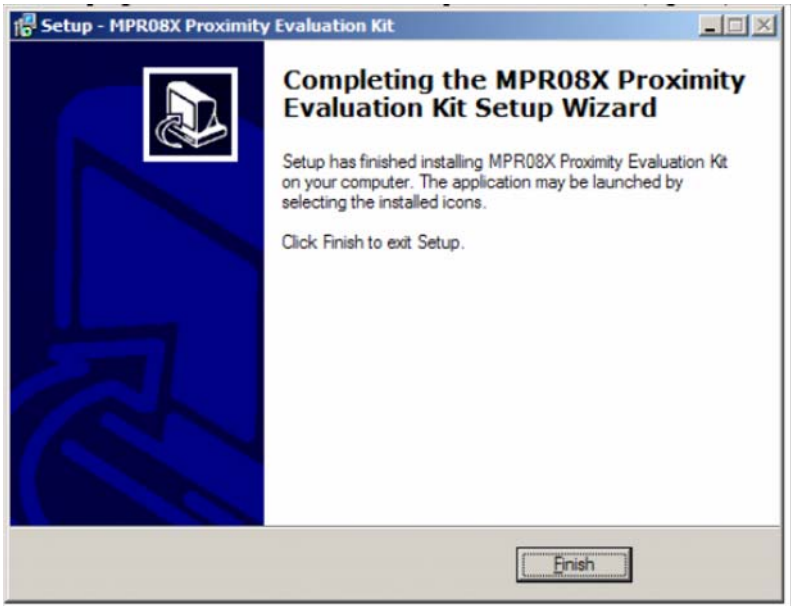

Figure 7. Install Complete

Found New Hardware Wizard

1. When the “Found New Hardware Wizard” appears, select the “Next” button (Figure 8).

Figure 8. Found New Hardware Wizard Screen 1

2. Select the radio button: “Search for the best driver in these locations.” and check box “Search removable media (floppy, CD-ROM...)”. Then select “Next” button (Figure 9).

NOTE: IF THE FILE IS NOT FOUND IN THE CD OR THE USER DOES NOT HAVE THE CD, THE NECESSARY FILES ARE LOCATED IN THE INSTALL LOCATION. IF IT IS THE DEFAULT INSTALL LOCATION, IT WILL BE IN THE C:\PROGRAM FILES\FREESCALE\MPR08X EVALUATION KIT\DRIVERS.

Figure 9. Found New Hardware Wizard Screen 2

3. The driver should automatically install (Figure 10).

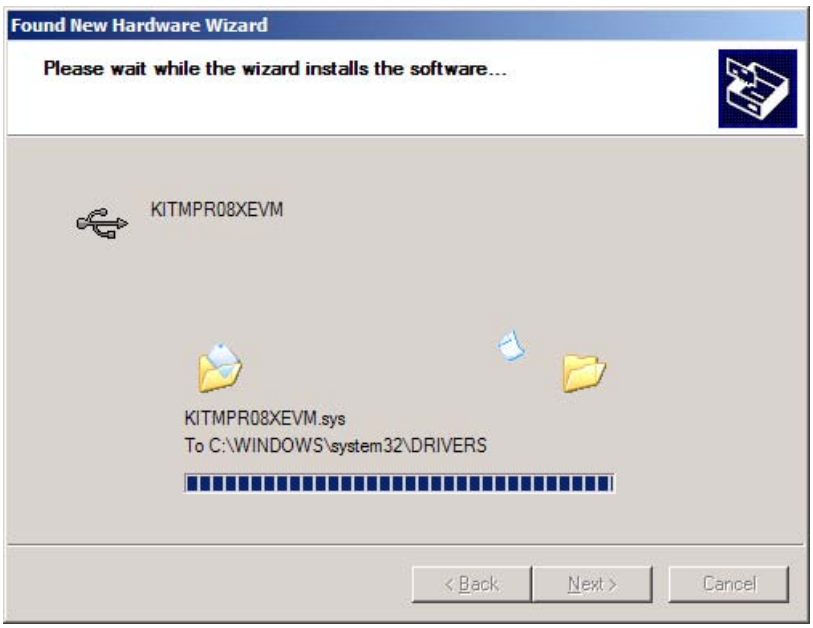

Figure 10. Found New Hardware Wizard Screen 3

4. On the final screen, select “Finish” to complete the process of installing the driver (Figure 11).

Figure 11. Found New Hardware Wizard Screen 4

USING THE PC APPLICATION

1. Start the MPR083 Evaluation Kit Application GUI by double clicking on the desktop icon or going to the Start menu → All Programs → MPR08X Proximity Evaluation Kit → MPR08X Evaluation Kit. Once the application begins, a “Select Proximity Sensor” form will appear (Figure 12). Select the “MPR083” radio button and select the “OK” button. The MPR083 application will appear (Figure 13).

Figure 12. Select Proximity Sensor

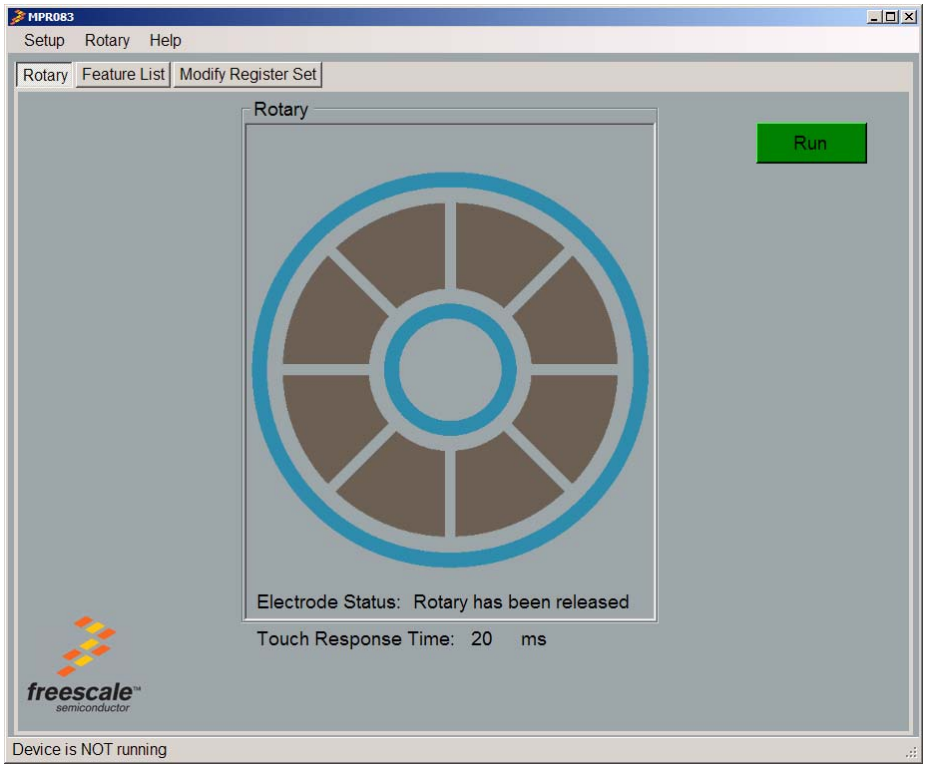

Figure 13. MPR083 Main Window

2. Calibrate your board: At the default sensitivity, the board may not be optimized for use. In order to optimize the sensitivity please follow these steps:
    1) Select “Run” on the Rotary tab of the MPR083 GUI window.
    2) The user must run their finger around the rotary while making sure that all electrodes respond.
    3) Select “Stop” on the “Rotary” tab or the “Modify Register Set” tab.
    4) Select the “Modify Register Set” tab raise the sensitivity by 2-3 and write the value using the “Write Sense” button. Verify that the value was written by reading the value with the “Read Sense” button the value should update in the “Read Value” column for sensitivity.
    5) Repeat steps **2** – 4, until one of the electrodes no longer responds.
    6) Then take 70% of that value and that should be the sensitivity value used. Write and then read the value to verify the value has been set.

NOTE: ONCE THE VALUE IS SAVED THIS VALUE WILL BE STORED EVEN WHEN CLOSING AND RE-STARTING THE APPLICATION.

7. Menu Strip Items
    A. The Setup Options
        1) Set Device Address
            a) Set Address to 0x4C – this address needs to be selected to use the off board sensor.
            b) Set Address to 0x4D – this address is used by the on board sensor and will be the default address chosen unless otherwise specified by the user.
        2) Rotary
            a) View Rotary – The user can choose to view the rotary graphic on the a floating window. To do this, select “View Rotary” and the window will pop-up (Figure 14).

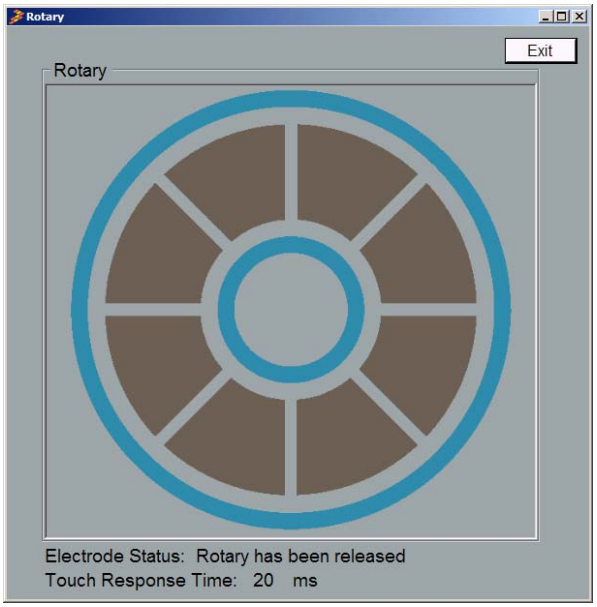

Figure 14. Rotary Floating Window

3) FIFO Log Rotary – This allows the user to view the FIFO log in a floating window. If the device is running and as the user rotates their finger around the pad, the text box will log the user's touch and releases. The log file will contain the read value, position number, date and time (Figure 15).

Figure 15. Log Rotary Window

4) Help Menu Option
   a) About MPR083 PC Application - This allows the user to view the version number of the PC Application. To check for later updates, please go to www.freescale.com/proximity.
   b) About MPR083 Sensor - To learn more about the sensor on the evaluation board, the user can check the version of the sensor. For any further questions, please contact Freescale.
   c) About JB8 Firmware - This allows the user to view the version number of the USB module.

4. Using the Rotary Tab

The Electrode Status is updated whenever a pad is touched/released, with either the "Rotary has been released" or the "Rotary is in position x", depending on the pad being touched. The Touch Response Time is the time the sensor takes to detect a touch. By default is set to 20 ms.

A. Using the Run/Stop button
   1) Select "Run" on the "Rotary" tab window. The button's text will change to "Stop". The board status label will change to "Device is running".
   2) Touch one of the rotary pads on the board. Verify that the rotary pad being touched on the GUI is black and the LED is on, on the Freescale logo (Figure 16). The user can repeat this step touching all 8 pads on the rotary. As the pads are being touched, the corresponding pad on the GUI will change to black and the LED on the board will light up.
   3) Select "Stop" button to stop the rotary from running. When stopped the board status will display the "Device is not enabled and not running". If the rotary pad is touched, the GUI will not respond.

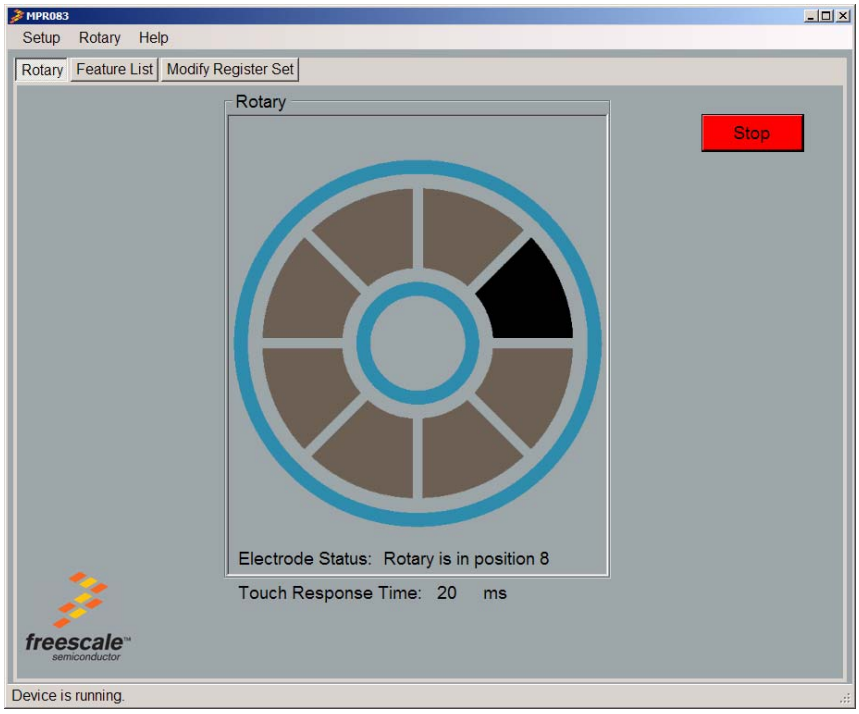

Figure 16. Pad being pressed in Main Rotary Window

5. Using the Feature List Tab

   The “Feature List” tab, gives the user the ability to change the device settings and experience some of the special features Freescale offers with proximity sensing. This feature list allows the user to change the Touch Response Time to the following: 1 s, 2 s, or 300 ms and use the Stuck Key feature (Figure 17).

NOTE: MAKE SURE APPLICATION IS IN STOP MODE BEFORE SELECTING ANY OF THESE FEATURES.

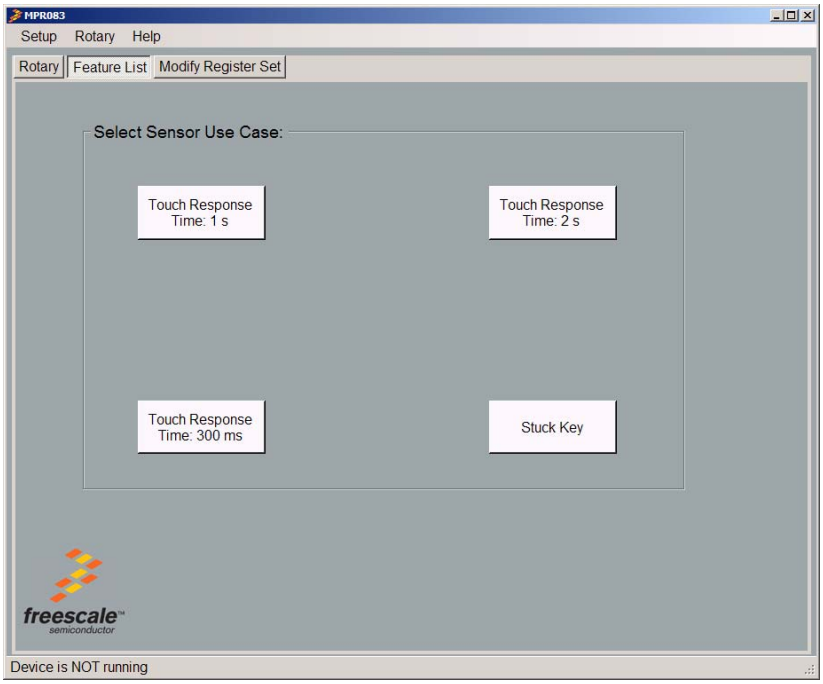

Figure 17. Feature List Form

A. Touch Response Time: 1 s

When the sample rate is changed, the following values are changed in the register set: the master tick period and the touch acquisition value. The user can check these values by going to the “Modify Register Set” tab and viewing the Master Tick Period register and the Touch Acquisition register.

1) Select the “Touch Response Time: 1 s” button, the outline of the button and the text will turn red. When the sample rate is set to 1 s, the master tick period is set to 25ms and the touch acquisition register is set to 10 master tick periods. To run the application at this touch response rate select “Run”. Then select the “Rotary” tab, the Touch Response Time will change to 1000 ms. (Figure 18).

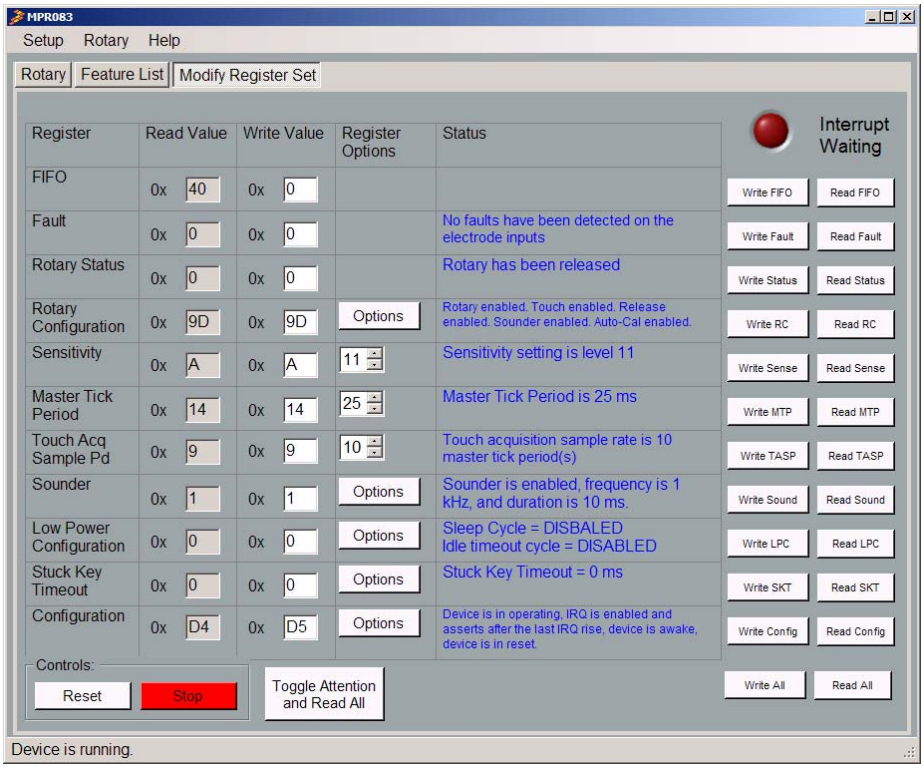

Figure 18. Modified register set after changing sampling speed to 250 ms and View Rotary

2) Go to tool bar at the top of the screen and select “Rotary” and select “View Rotary”. A form will appear with the Rotary on it (Figure 18).

3) Touch one of the rotary pads on the board. The rotary pad being touched on the GUI will be black and the corresponding LED will be on, on the Freescale logo will be on after 1 s (Figure 19). Repeat these steps for all 8 pads on the rotary.

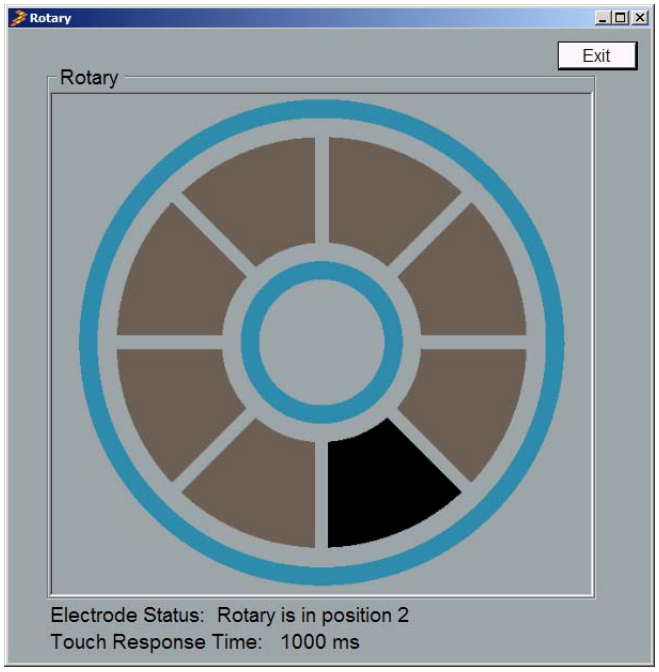

Figure 19. Rotary Form being pressed.

4) Exit the Rotary, by pressing the “Exit” button at the top of the screen. Select “Stop” button on either the Rotary form or the Modify Register Set screen

B. Touch Response Time: 2 s

1) Select the “Touch Response Time: 2 s” button, the outline of the button and the text will turn red. When the sample rate is set to 2 s, the Master Tick Period register is set to 25 ms and the Touch Acquisition register is set to 20 master tick periods. To run the application at this touch response rate, select “Run”. Then select the “Rotary” tab and the Touch Response Time will change to 2000 ms (Figure 20).
2) Go to tool bar at the top of the screen and select “Rotary” and select “View Rotary”. A form will appear with the rotary on it.
3) Touch one of the rotary pads on the board. The rotary pad being touched on the GUI will be black and the corresponding LED will be on, on the Freescale logo after 2 s (Figure 19). Repeat these steps for all 8 pads on the rotary.
4) Exit the Rotary, by pressing the “Exit” button at the top of the screen. Select “Stop” button on either the Rotary form or the Modify Register Set screen.

C. Touch Response Time: 300 ms

1) Select the “Touch Response Time: 300 ms” button, the outline of the button and the text will turn red. When the sample rate is set to 300 ms, the Master Tick Period register is set to 25 ms and the Touch Acquisition register is set to 3 master tick periods. To run the application at this touch response rate, select “Run”. Then select the “Rotary” tab and the Touch Response Time will change to 300 ms.
2) Go to tool bar at the top of the screen and select “Rotary” and select “View Rotary”. A form will appear with the Rotary on it.
3) Touch one of the rotary pads on the board. The rotary pad being touched on the GUI will be black and the corresponding LED will be on, on the Freescale logo after 300 ms (Figure 19). Repeat these steps for all 8 pads on the rotary.
4) Exit the Rotary, by pressing the “Exit” button at the top of the screen. Select “Stop” button on either the Rotary form or the Modify Register Set screen.

D. Stuck Key

1) Select the “Stuck Key” button. A “Stuck Key Feature” form will appear. Select a value between 0-255. Then select “OK”. The following is the equation used to calculate the stuck key period. The stuck key timeout period is calculated by multiplying the Stuck Key Timeout (SKT), Master Clock Period (MCP) in ms, and Touch Acquisition Sample Period (TASP) with a factor of 64.

$$StuckKeyPeriod = MCP \times TASP \times SKT \times 64$$

2) To test the Stuck Key Feature, place an object that is small enough to fit on one rotary pad, such as your finger. Once the Stuck Key period has elapsed the object will be calibrated into the baseline and the touch will be ignored.

6. Using the Modify Register Set Tab (Figure 20)

This tab allows the user the ability to configure any of the register values to perform the desired functions on the evaluation kit board. The user can read/write to any of the registers. In order to do this the user can choose to read/write from independent registers by selecting the read/write button next to the desired register or selecting the “Read All” button or “Write All” button. Please note, that if the user hits the “Run” button on the screen, the user will no longer be able to write the registers until the application is put in stop mode.

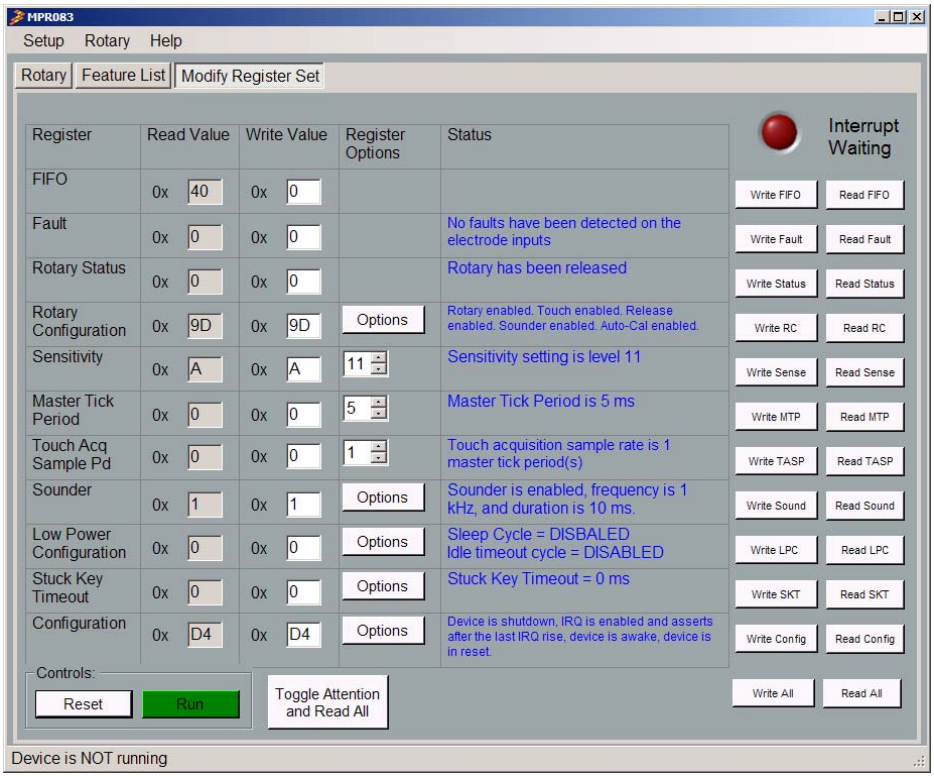

Figure 20. Modify Register Set

NOTE: IN ORDER TO READ/WRITE TO THE REGISTER, THE DEVICE MUST NOT BE RUNNING.

A. FIFO Register – The FIFO register determines the current status of the rotary. Anytime a write is issued to this register, the buffer will be cleared.

1) To read this register, the user must select either the read button next to the register or select the “Read All” button at the bottom of the screen. The user can also choose to clear the register by writing a value to it. The value must be between 0-255. The status column for the FIFO will tell the user if the FIFO is empty, FIFO has overflowed, or the FIFO still has data to process.

B. Fault Register – The fault register shows the fault number under the current sensor conditions. Any write to the fault register will clear the register.
   1) To read this register, the user must select either the read button next to the register or select the “Read All” button at the bottom of the screen. The status column for the Fault will tell the user whether a fault has been detected or has not been detected. If a fault has been detected the user will be told a fault has been detected by either a short to ground, a short to VDD, or a short to VSS. The user can clear the fault by writing a value, between 0-255 to it.

C. Rotary Status Register – The rotary status register is a read only register used to determine the current status of the rotary.
   1) When the device is in Run mode, the user can rotate around the rotary touch pad. When rotating the user will see that status label in yellow states the position for all 8 positions and if the rotary has been released. Make sure “Rotary Release Buffer Enable” and “Rotary Touch Buffer Enabled” registers are checked in the rotary configuration register options.

D. Rotary Configuration Register – The rotary configuration register configures a variety of the MPR083 features such as enabling the rotary, enabling the rotary sounder, enabling the rotary release buffer, enabling the rotary touch buffer and enabling auto calibration. In order to enable/disable any of the rotary configuration register features the user must select the “Options” button in the Rotary Configuration register. The “Options” button will show the “Rotary Configuration Options” window (Figure 21). At start up, all of the options are enabled.

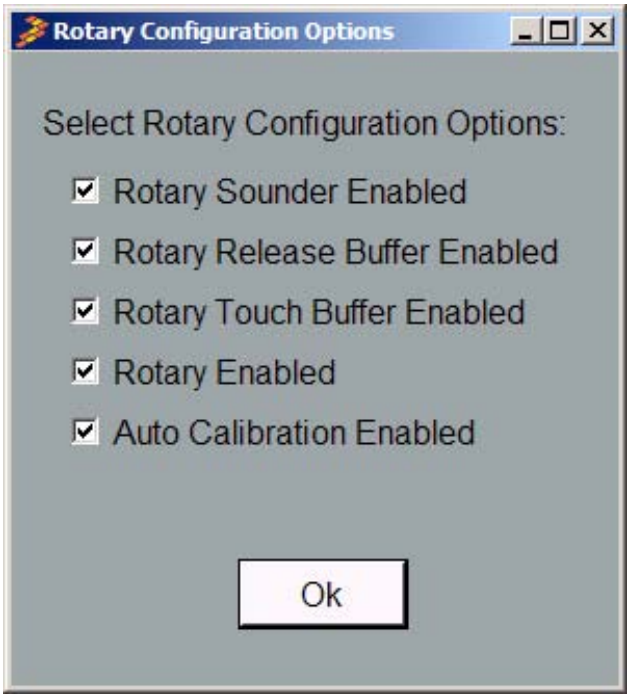

Figure 21. Rotary Configuration Options

   1) Selecting the Rotary Sounder Enabled check box, enables the rotary sounder if data is sent to the sounder. Disabling it, disables the sounder. If the sounder is not enabled the sounder register options are also disabled.
   2) Selecting the Rotary Release Buffer Enabled check box, enables the bit to determine whether not data is logged in the FIFO when the rotary transitions from a touched or untouched state. When the rotary release is enabled, the user can view the log file and view when the rotary has transitioned from a touched to untouched state by going to the menu strip at the top of the window and selecting “Rotary” and then selecting “FIFO Log of Rotary” (Figure 15). If the rotary release is disabled, the log file will not log rotary releases.

3) Selecting the Rotary Touch Buffer Enabled check box, enables the bit to determine whether or not data is logged in the FIFO anytime an electrode is pressed. When the rotary touch is enabled the user can view the log file and view when the rotary presses by going to the menu strip at the top of the window and selecting “Rotary” and then selecting “FIFO Log of Rotary” (Figure 15). If the rotary release is disabled, the log file will not log rotary releases.

4) Selecting the Rotary Enabled check box enables the bit to enable or disable the touch sensor. When it is disabled, no touches are detected.

5) Selecting the Auto Calibration Enabled check box, enables the auto calibration function. If it is not enabled the auto calibration feature is not enabled. The auto calibration feature performs a recalculation of the baseline value after 6 sample periods. The auto calibration period is calculated by multiplying the Master Clock Period (MCP) and the Touch Acquisition Sample Period (TASP) with a factor of 64.

$$AutoCalibrationPeriod = MCP \times TASP \times 64$$

E. Sensitivity Register – The Sensitivity Register allows the user to adjust the sensitivity of the MPR083 for any situation.

1) The Sensitivity Register is set by default to 0xA. The value can be changed by incrementing or decrementing the sensitivity value and then writing to the Sensitivity register. The minimum sensitivity level is 1 and the maximum is 63. To verify that the value was successfully written, read the value from that register. If the value is not successfully written, verify that the device is not running.

F. Master Tick Period Register – The Master Tick Period Register is used to set the master tick of the system. All parts of the system are synchronized to this counter. This register is overridden in all modes except for Run1. When not in Run1 mode, the value of this register is ignored and 8 ms is used for the primary clock.

1) The Master Tick period is set by default to 0, which means the master tick period is set to 5 ms. The value can be changed by incrementing or decrementing the master tick value and then writing to the Master Tick Period Register. The minimum master tick period value is 0 or 5 ms, and the maximum is 26 or 31 ms. To verify that the value was successfully written, read the value from that register. If the value is not successfully written, verify that the device is not running.

E. Touch Acquisition Sample Period Register – The Touch Acquisition Sample Period Register is used to determine the electrode scan period of the system.

1) The Touch Acquisition Sample Period is set by default to 0, which means the touch acquisition sample rate is set to 1 master tick period. The value can be changed by incrementing or decrementing the touch acquisition sample value and then writing to the Touch Acquisition Sample Period register. The minimum touch acquisition sample period value is 1 or 1 master tick period, and the maximum is 31 or 32 master tick periods. To verify that the value was successfully written, read the value from that register. If the value is not successfully written, verify that the device is not running.

F. Sounder Register – The Sounder Register is used to configure the piezo buzzer on board to give audible feedback to the user (Figure 22).

NOTE: IF THE ROTARY CLICK ENABLE IN THE ROTARY CONFIGURATION REGISTER IS NOT ENABLED, THE SOUNDER REGISTER OPTIONS ARE ALSO DISABLED.

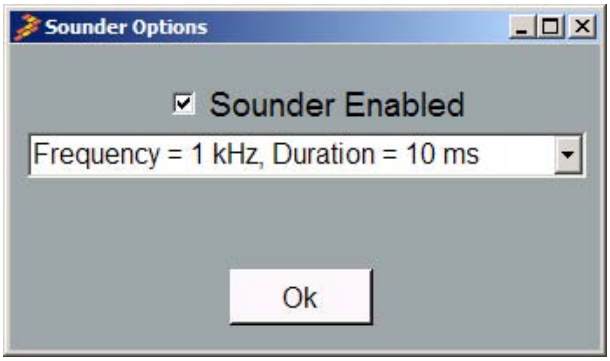

Figure 22. Sounder Options

1) The user can choose to enable or disable the sounder altogether. If the sounder is disabled, the frequency and duration options become disabled.
2) If the user chooses to enable the sounder the user can choose from the following preconfigured sounder options. To write these values to the register select “OK”, then write to the sounder register. To verify that the value was successfully written, read the value from that register. If the value is not successfully written, verify that the device is not running.
   a) Frequency = 1kHz, Duration 10ms
   b) Frequency = 1kHz, Duration 20ms
   c) Frequency = 2kHz, Duration 20ms
   d) Frequency = 2kHz, Duration 10ms

G. Low Power Configuration Register – The low power configuration register is used to configure the device to reduce power consumption by reducing the sampling rate. The Low Power Configuration register is used to set both the Idle Timeout Period and the Sleep Cycle Duration multiplication factors (Figure 23). The Low Power configuration is only active in Run2 mode. In order to put the part in Run2, deselect the Duty Cycle Enabled bit in the Configuration Register Options. The user can choose to run Low Power mode with interrupts or polling. When the sensor is successfully in Low Power, the FIFO log window will appear which will detect touch/releases. Please note, that the LEDs do not respond in Low Power Mode.

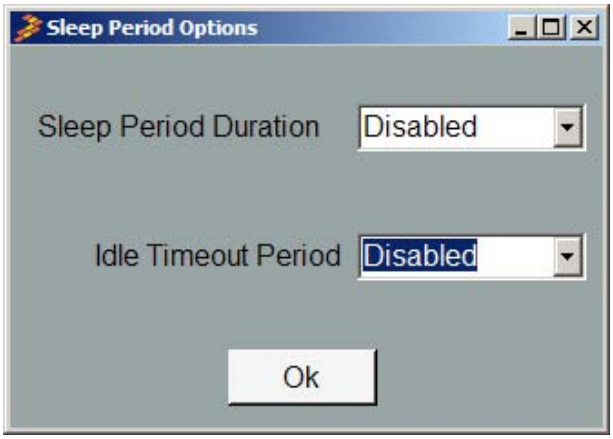

Figure 23. Sleep Period Options

1) The Sleep Period Duration selects the amount to multiply the touch acquisition sample period by to determine the sleep period of the sensor. The user can choose to have it disabled or if enabled the user can choose between a minimum of 1 and a maximum of 31.
2) The Idle Timeout Period selects the amount to multiply the touch acquisition sample period by the Idle Timeout Period to determine the idle interface timeout period of the sensor controller. The user can choose to have it disabled or if enabled the user can choose between a minimum of 1 and a maximum of 7.
3) To write these values to the register select “OK”, then write to the sleep period register. To verify that the value was successfully written, read the value from that register. If the value is not successfully written, verify that the device is not running.

NOTE: FOR FURTHER LOW POWER INFORMATION, PLEASE REFER TO APPLICATION NOTE AN3583, “USING LOW POWER MODE ON THE MPR083 AND MPR084”.

NOTE: IN ORDER TO GET OUT OF LOW POWER MODE, THE USER MUST SELECT THE “TOGGLE ATTENTION AND READ ALL” BUTTON (Figure 25).

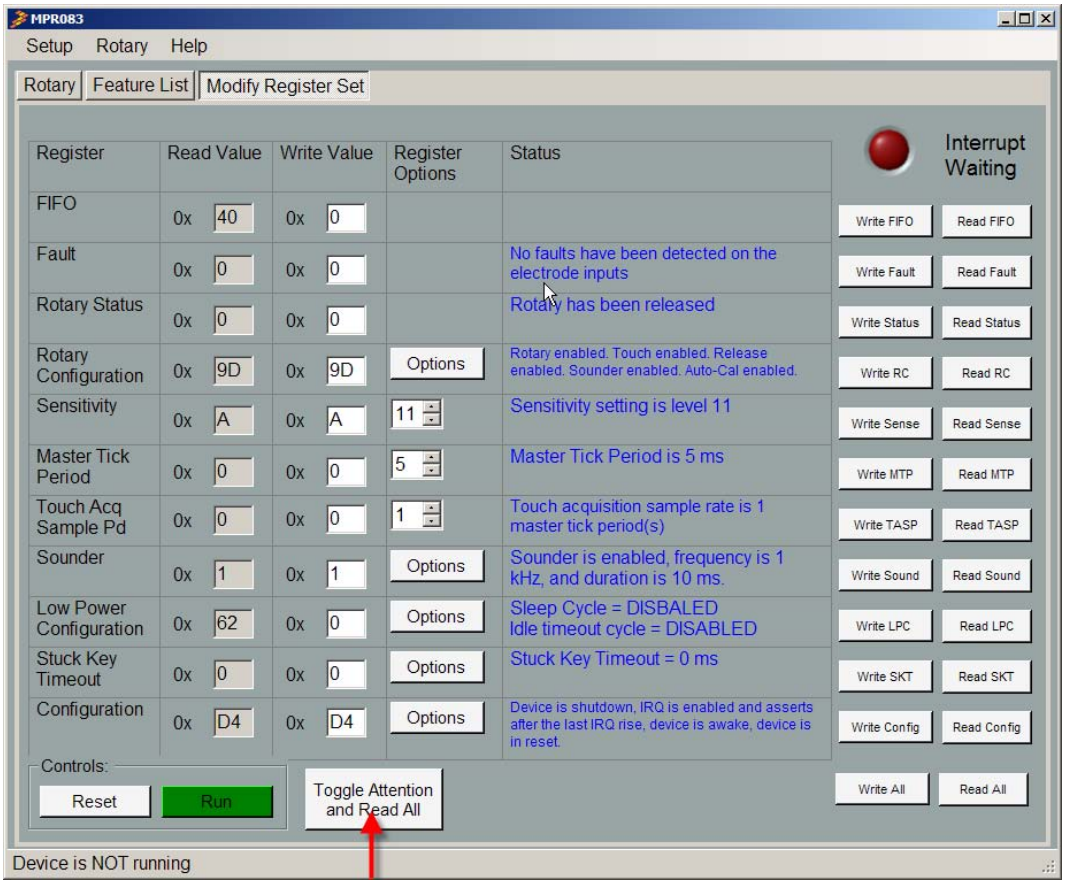

Figure 24. Toggle Attention and Read All Button

H. Stuck Key Timeout Register – The Stuck Key Timeout Register is used to determine the electrode scan period of the system (Figure 25).

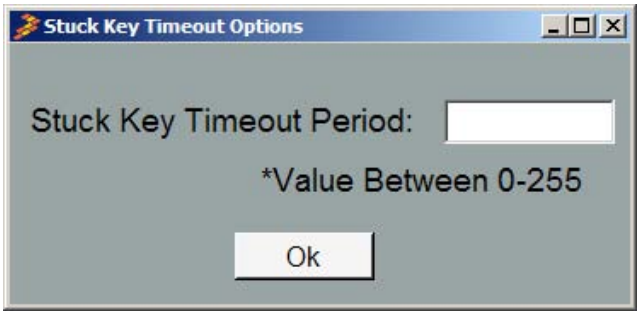

Figure 25. Stuck Key Timeout Options

1) The stuck key timeout value selects or reports the multiplication factor that is used to determine how often electrodes are calibrated while touch is being sensed. The user can choose any value between 0 and 255.
2) To write these values to the register select “OK”, then write to the Stuck Key Timeout Register. To verify that the value was successfully written, read the value from that register. If the value is not successfully written, verify that the device is not running.

I. Configuration Register – The Configuration Register allows the user to reset the part, adjust interrupt settings, and change the mode (Figure 26).

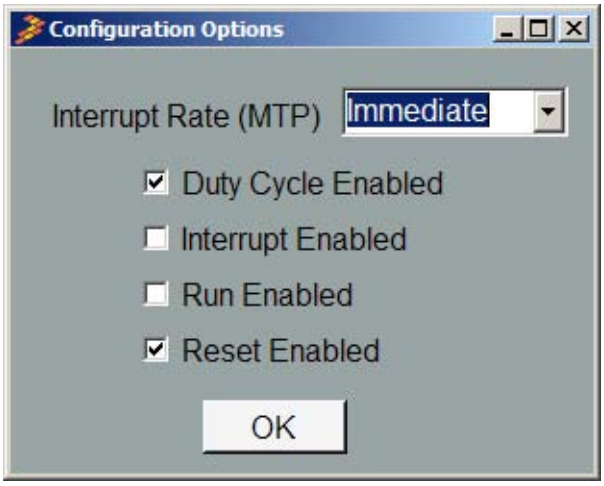

Figure 26. Configuration Options

1) The Interrupt Rate pull down allows the user to select the amount to multiply the master tick period by to determine the minimum delay between sequential interrupts. The default is set to immediate. The multiplication factor minimum is 0 or immediate and the maximum is 7 or 28.
2) If the Duty Cycle Enabled check box is selected, it enables duty cycling on the MPR083. If it is not selected, duty cycling is disabled.
3) If the Interrupt Enabled check box is selected, it will enable the IRQ. If it is disabled the IRQ is disabled.
4) If the Run Enabled check box is selected, it will enable scanning of the electrodes for touch detection. This bit field is directly tied to the Run button on both the “Rotary” tab and the “Modify Register Set” tab.
5) If the Reset Enabled check box is selected, it will assert a global reset of the sensor controller. When the user writes to the register, an information window will pop up stating that the part will be reset to start up conditions (Figure 27).

Figure 27. Reset Information

6) To write these values to the register select “OK”, then write to the sleep period register. To verify that the value was successfully written, read the value from that register. If the value is not successfully written, verify that the device is not running.

7. Reset Button
   A. To reset the part to its initial settings, select the “Reset” button. When the “Reset” button is selected, the initial start up values will be written and read from the register, so all values will be updated (Figure 28).

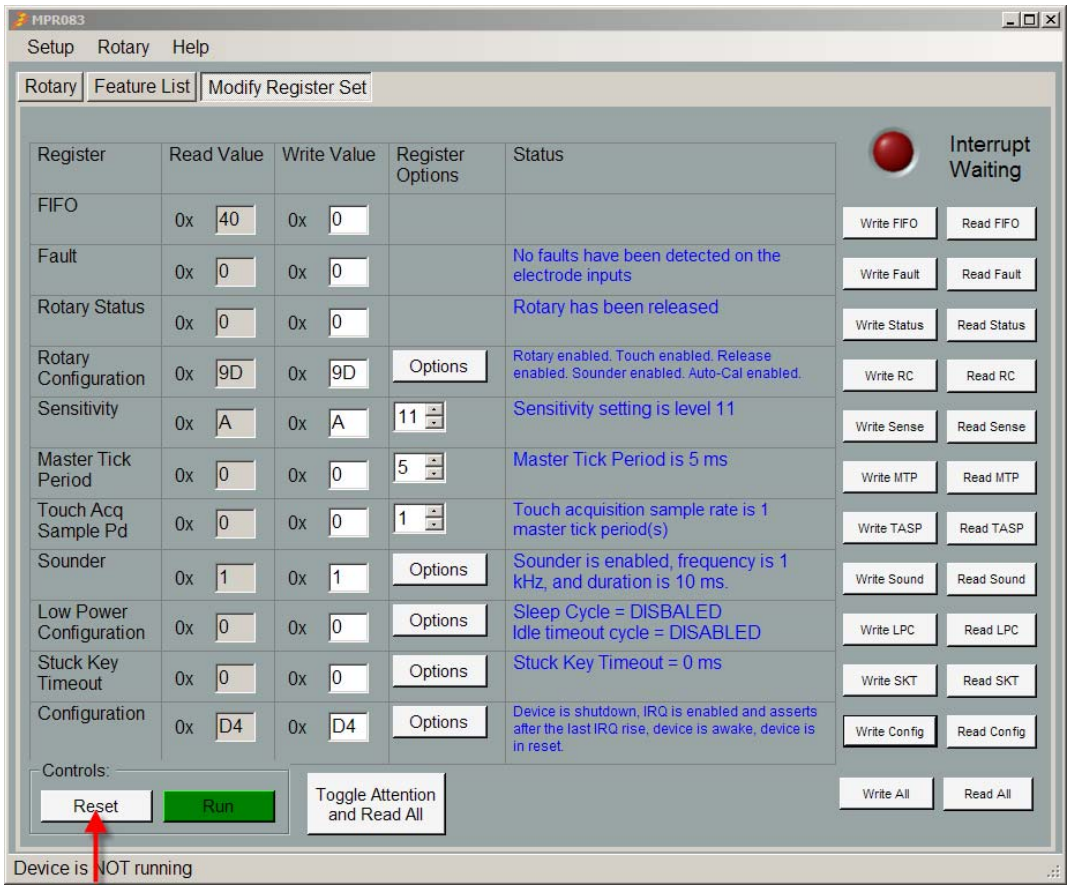

Figure 28. Reset Button

8. Run Button
   A. The “Run” button works in the same way that the run bit in the Configuration register. If the “Run” button is selected, the button will change to “Stop” and turn red (Figure 30). If the button is selected while in Stop and red, it will change to Run and green (Figure 29). This action will enable scanning of the electrodes for touch detection. If the same button is pressed while red and text saying Stop, the scanning of the electrodes will not occur.

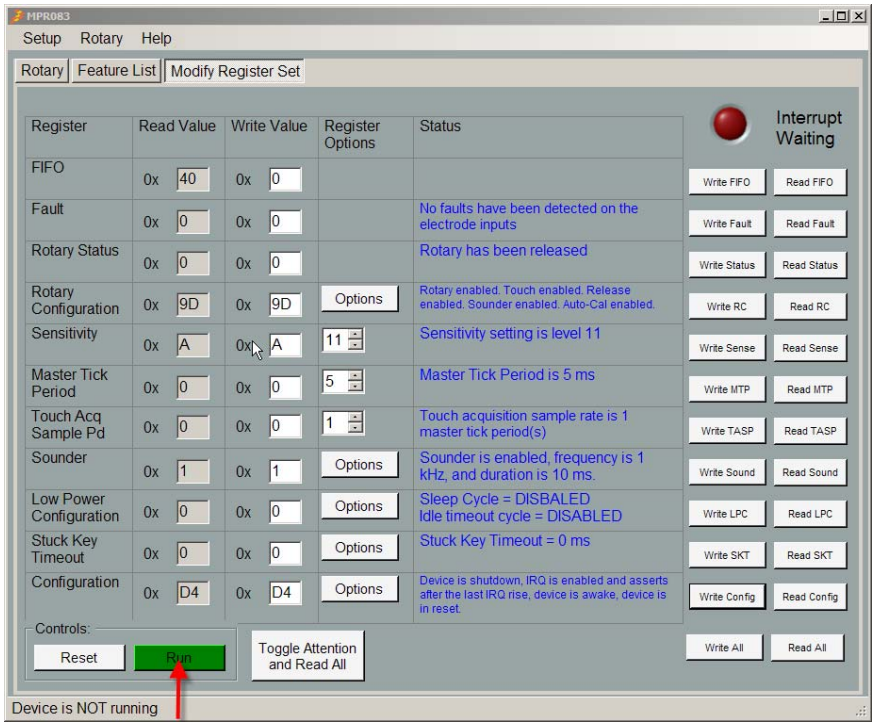

Figure 29. Run button, electrodes scanned

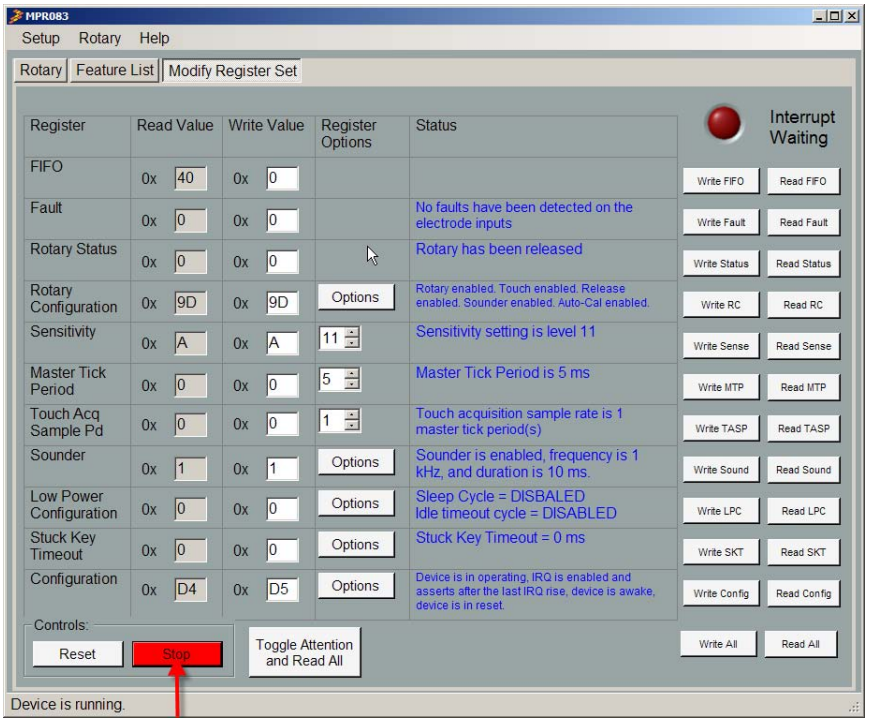

Figure 30. Stop button, electrodes not being scanned

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