SX9310/11 Evaluation Kit

User's Guide

Table of Contents

Table of Figures

1 Introduction

The SX9310 and SX9311 are capacitive sensing controllers mainly targeted at SAR applications. Both devices are covered by a single EVK based on the SX9310 superset device. The scope of this document is to describe this EVK.

The GUI requires a PC running minimum Windows XP with at least one USB available for connecting to the EVK.

1.1 SX9310 Main Features

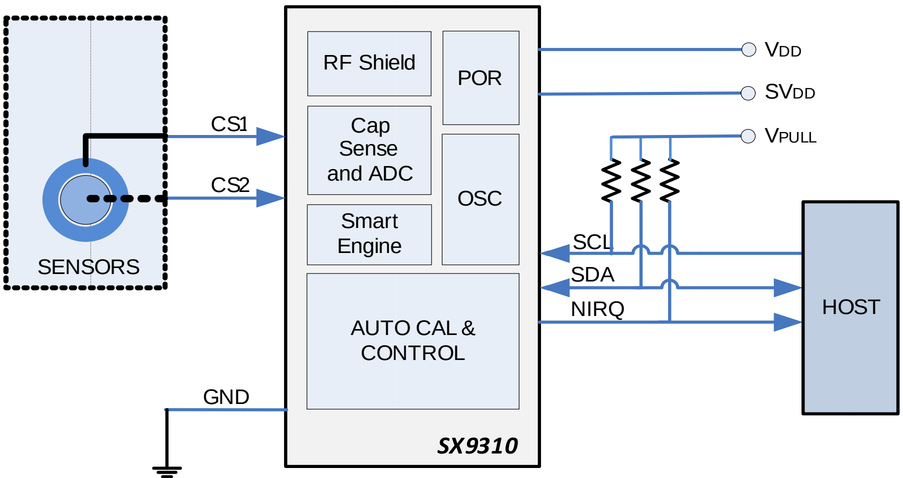


Figure 1 – SX9310 Overview

- 2.7 – 5.5V Core Supply (VDD)
  - 1.65 – 2V Host Interface Supply (SVDD)
  - 1.65 – 5.5V Compliant Host Interface (VPULL)
- Up to 3 SAR Capacitive Sensor Inputs
  - Patented On-Chip Smart Engine For SAR (Body versus Inanimate Object Detection)
  - Capacitance Resolution down to 0.08 fF
  - Capacitance Offset Compensation up to 100 pF
  - Integrated RF Shield
  - Advanced Temperature Compensation
- Automatic Calibration
- Built-in Start-up Proximity Detection
- Ultra Low Power Consumption
  - Active Mode: 70 uA
  - Doze Mode: 8 uA
  - Sleep Mode: 2.5 uA
- 400kHz I2C Serial Interface
- Programmable Interrupt or Real-Time Status Pin
- User NVM for Custom Default Registers Values (Standalone Mode)
- Two Reset Sources: POR, Soft Reset
- -40°C to +85°C Operation

1.2 Kit Content

The SX9310/11 Evaluation Kit consists of:

- SX9310EVKA board
- SX9310EVKA CDROM including all necessary PC software and documentation
- Mini USB cable to connect the SX9310EVKA board to the PC

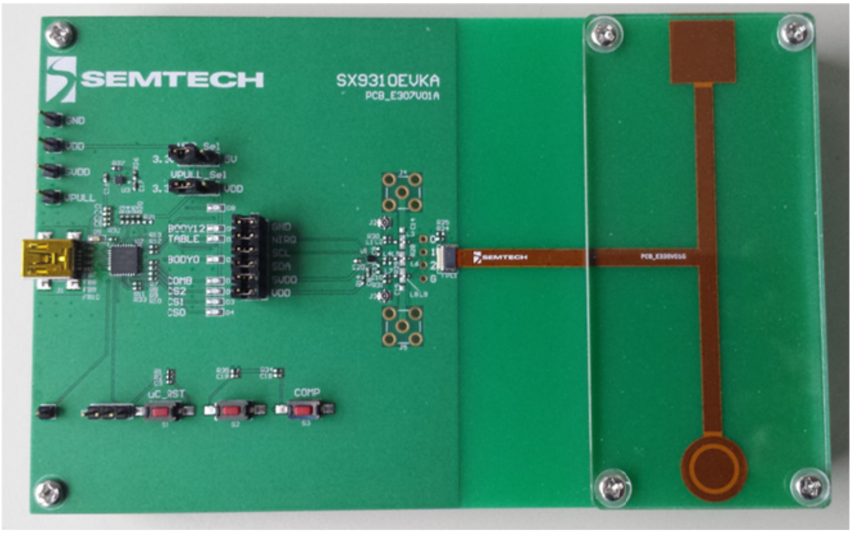


Figure 2 – SX9310EVKA Board

1.3 Installation

Stand-Alone Demo

1. Connect the SX9310EVKA board to a USB port/supply via the cable provided.
2. Wait for a few seconds.
3. SX9310EVKA is now ready to be used!

PC Software

1. Run the "SX9310EvaluationKit Setup.exe" file contained in the included CDROM.
2. After installation is completed, connect the SX9310EVKA board to the PC via the mini USB cable.
3. Launch "Semtech->SX9310Evaluation->SX9310Evaluation" from Start menu.
4. The SX9310EVKA and GUI are now ready to use!

2 Hardware Description

2.1 Overview

The following picture shows an overview of the SX9310EVKA's Top:

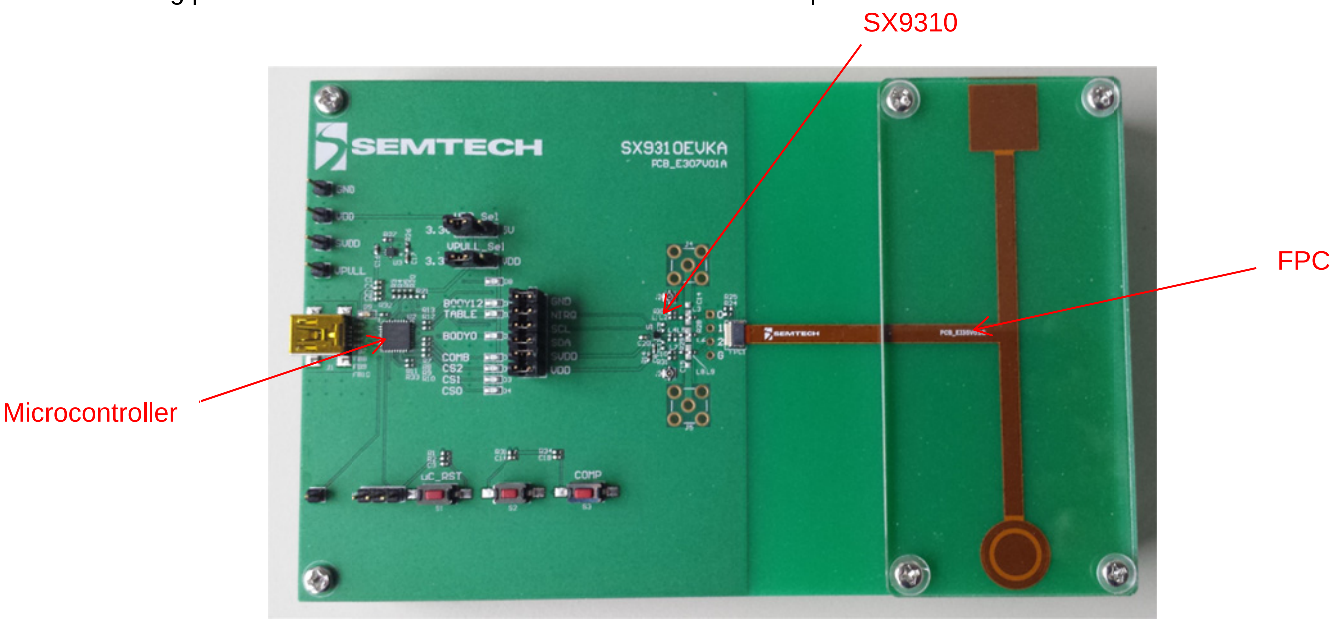


Figure 3 – Hardware Overview

2.2 USB Connector

The USB connector provides the power supply to the EVK and the communication to the GUI for evaluation.

Figure 4 – USB Connector

2.3 LDO

The SC560C low noise LDO linear regulator is used to provide 1.8V digital power supply to the SX9310 (SV_{DD}).

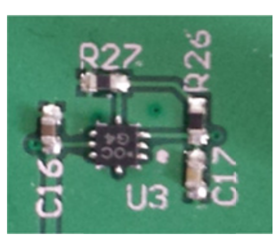


Figure 5 – LDO Linear Regulator

2.4 Microcontroller (µC)

The microcontroller (C8051F387) implements the firmware that provides the USB communication with the SX9310 (through I2C) and drives the different LEDs.

2.5 LEDs

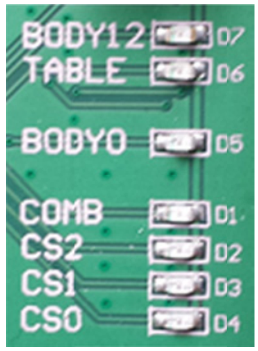


Figure 6 – Proximity/Touch LEDs on EVK

The table below describes the behavior of the LEDs:

Name	Color	LED is ON when a '1' is in the variables:
BODY12	Red	BODYSTAT12 and SAREN
TABLE	Green	TABLESTAT12 and SAREN
BODY0	Red	BODYSTAT0
COMB	Blue	PROXSTATCOMB
CS2	Orange	PROXSTAT2
CS1	Orange	PROXSTAT1
CS0	Orange	PROXSTAT0

Please refer to the SX9310 datasheet to know the conditions in which these different variables are set to 1.

2.6 Sensors FPC

There is one individual sensor CS0 and a pair of sensors for the Smart Engine for SAR (CS1/CS2):

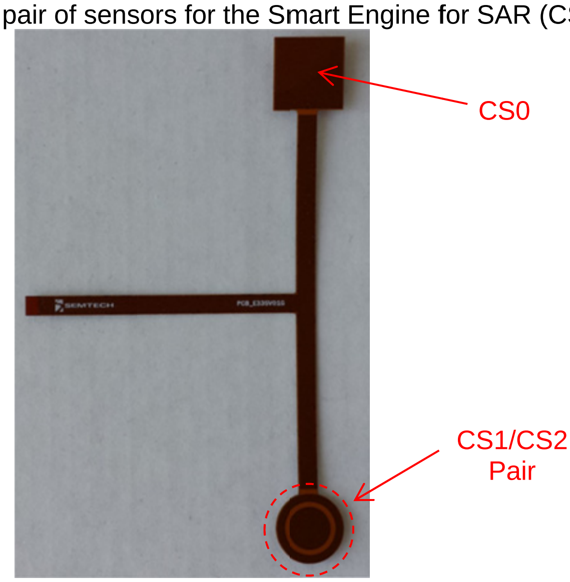


Figure 7 – Sensors FPC, PCB_E335V01G

2.7 *Jumpers*

2.7.1 V_{DD} and V_{PULL} Selection

VDD_Sel and VPULL_Sel jumpers are used to select the on board voltage sources. V_{DD} can be set to 3.3V or 5V. VPULL_Sel determines the voltage used as pull-up for the I2C communication signals. V_{PULL} can be set to 3.3V or VDD (please note that in real application, V_{PULL} could go down to 1.65V).

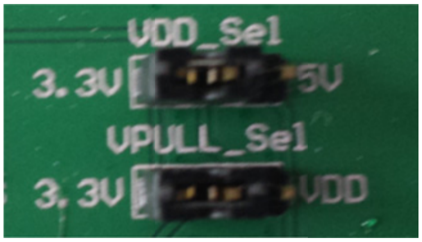


Figure 8 – Power Supply Jumpers

In order to supply V_{DD} and/or V_{PULL} externally, one MUST first remove the corresponding jumper(s) and then connect external supply to the chip. It may cause permanent damage to the board if these jumpers are in and external supplies are connected.

2.7.2 Host Interface

Figure 9 – Host Interface Jumpers

There are three jumpers needed for communications between the microcontroller and the SX9310.

- NIRQ, interrupt
- SCL, I2C clock
- SDA, I2C data

There are three jumpers to supply the SX9310:

- V_{DD}
- SV_{DD}
- GND

3 Graphical User Interface (GUI)

3.1 Overview

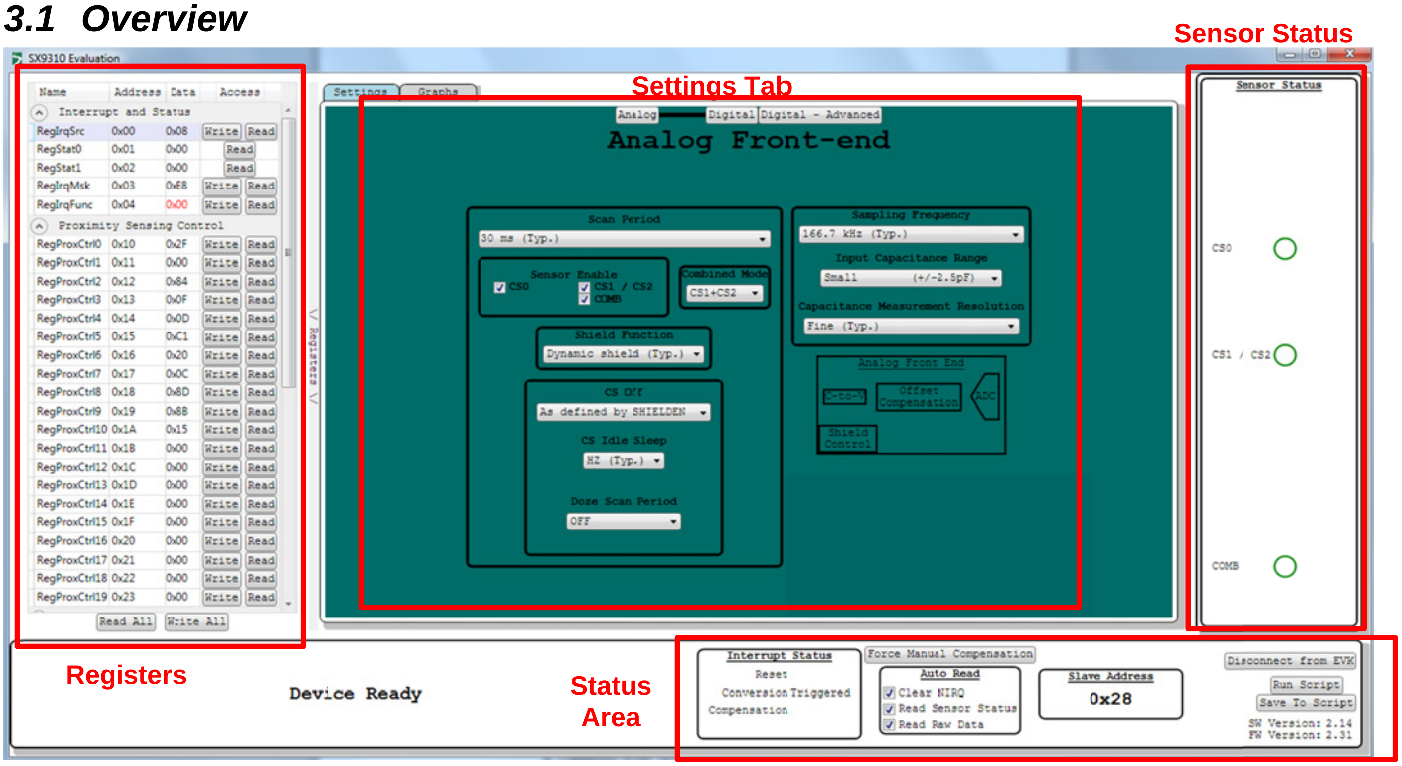
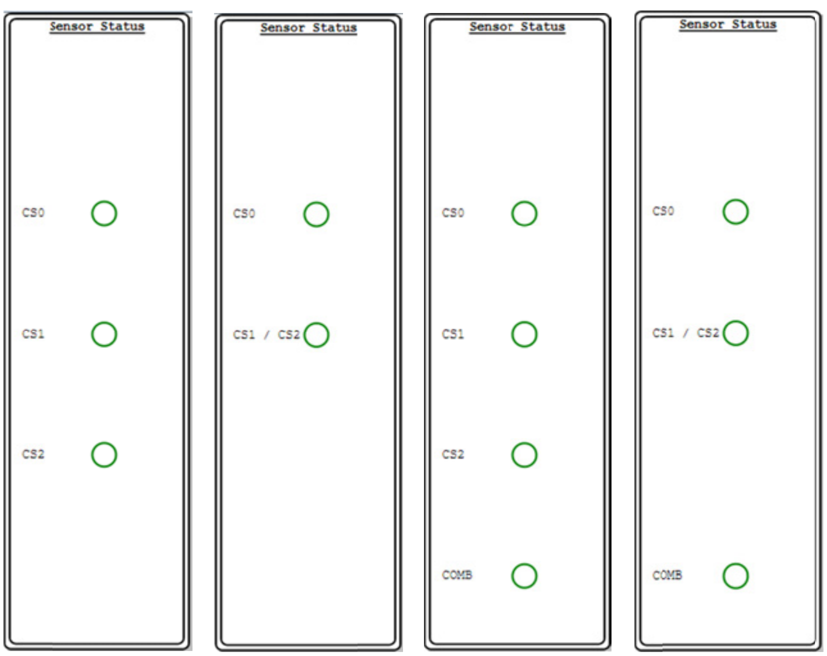


Figure 10 – GUI Overview

3.2 Sensor Status



a. b. c. d.

Figure 11 – Sensor Status

The previous figure shows the different configurations of the Sensor Status section:

a. Combined mode OFF, Smart Engine for SAR OFF
b. Combined mode OFF, Smart Engine for SAR ON
c. Combined mode ON, Smart Engine for SAR OFF
d. Combined mode ON, Smart Engine for SAR ON

When a touch is detected, the corresponding channel is set to green:

Figure 12 – Proximity Detected

When the combined mode is enabled, the corresponding channel appears as a single sensor labelled "COMB". If the Smart Engine for SAR is enabled, there are 3 possible detection statuses for the CS1/CS2 pair:

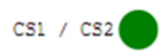


Figure 13 – Proximity Detected (No Discrimination)

Figure 14 – Human Body Detected

Figure 15 – Table Detected

With the individual sensors, if the signal is above the Body Detection Threshold, the detected object can also be reported as human body (the figure below shows CS0 as an example but the other channels also have this function):

Figure 16 – Individual Sensor, Human Body Detected

3.3 Registers

To write a register, one has to perform the following steps:

1. Double-click on the data to change
2. Enter the wanted value and validate with enter, the data field turns red
3. Click on the "Write" button, the data field turns black again

To read a register, one only has to press the "Read" button next to the wanted register address.

3.4 *Settings Tab*

The scope of this paragraph is to describe the different parameters that can be changed by the user during evaluation. We recommend forcing a manual compensation of the sensors offset after changing one of these parameters:

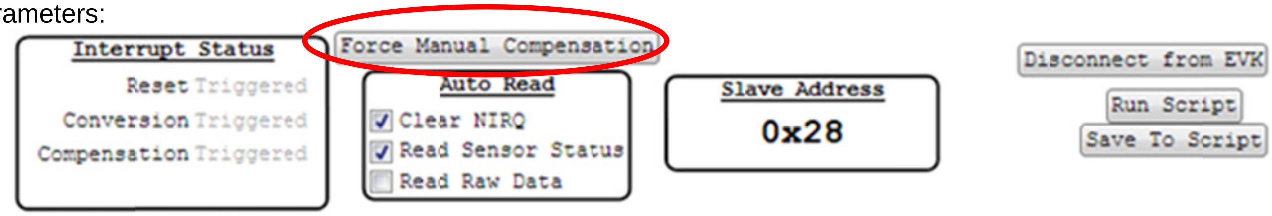


Figure 17 – Force Manual Compensation

3.4.1 Analog

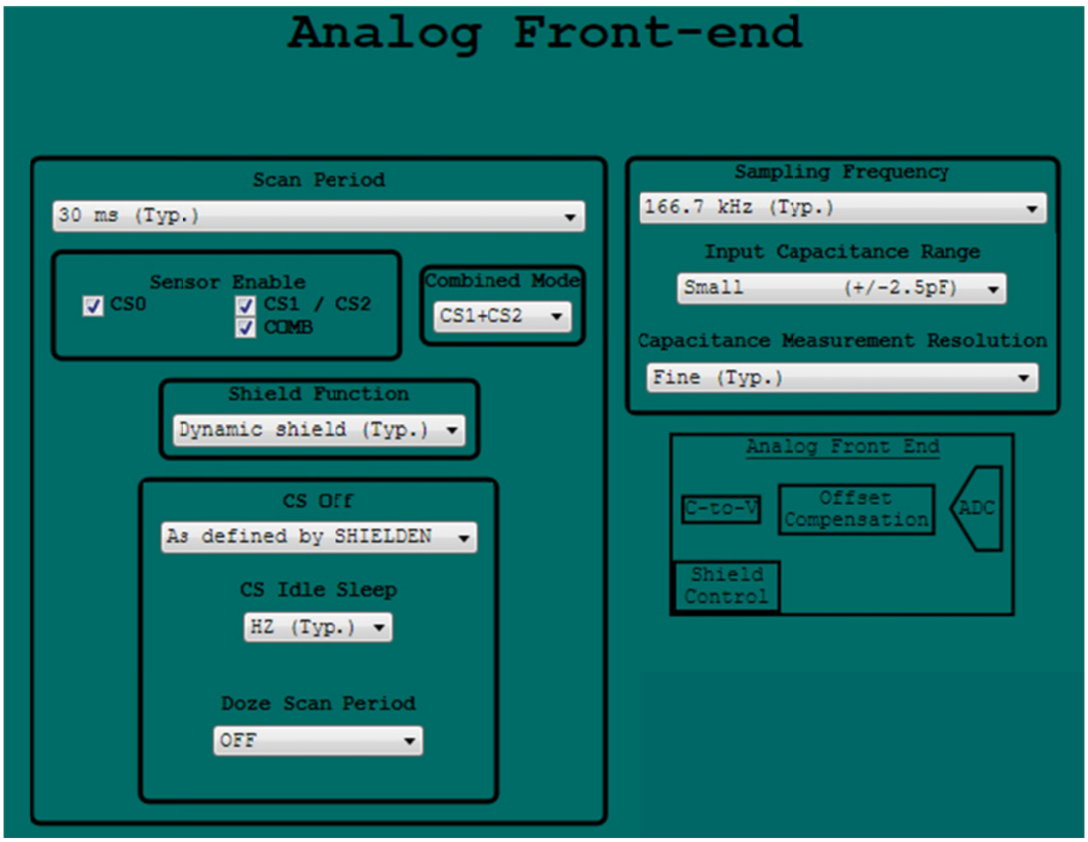


Figure 18 – Analog Section

The Analog settings can be changed here. In this section one can
- Set Scan period
- Turn On or Off the Cap sensors.
- Select the sensors used in combined mode.
- Set the Sampling Frequency
- Adjust Input Capacitance Range
- Tune Capacitance Measurement Resolution
- Enable the doze mode with different doze scan period
- Change the capacitive sensing channels levels when OFF or during idle time
- Set the shield function

3.4.2 Digital

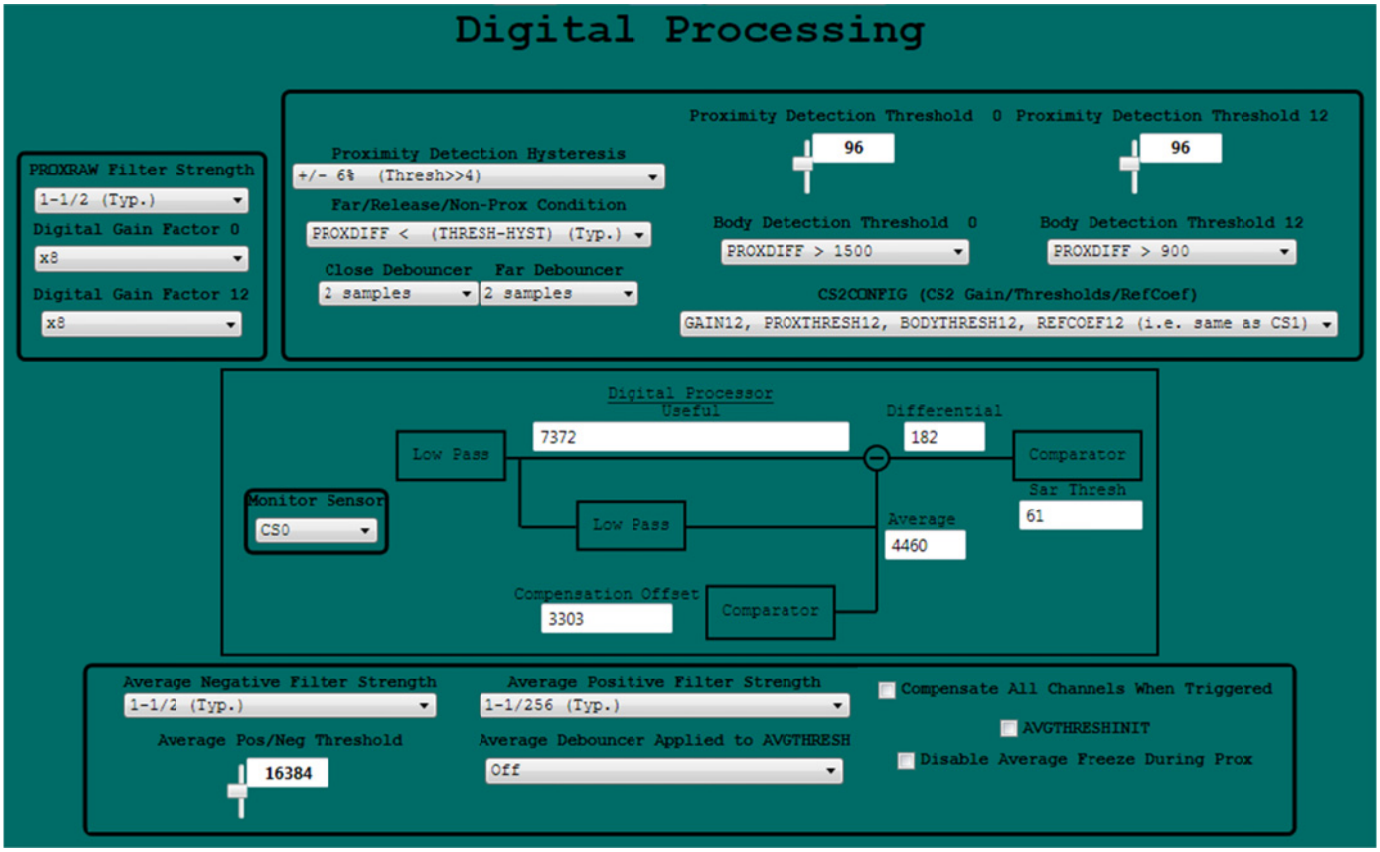


Figure 19 – Digital Section

In the digital section, one can set the following variables:

- PROXRAW filter Strength
- Digital Gain Factors
- Proximity Detection Hysteresis
- Far/Release/Non-Prox condition
- Proximity Detection Debouncers
- Proximity Detection Threshold
- Body Detection Threshold
- Sensor data (useful, average, differential, offset)
- Average parameters

3.4.3 Digital – Advanced

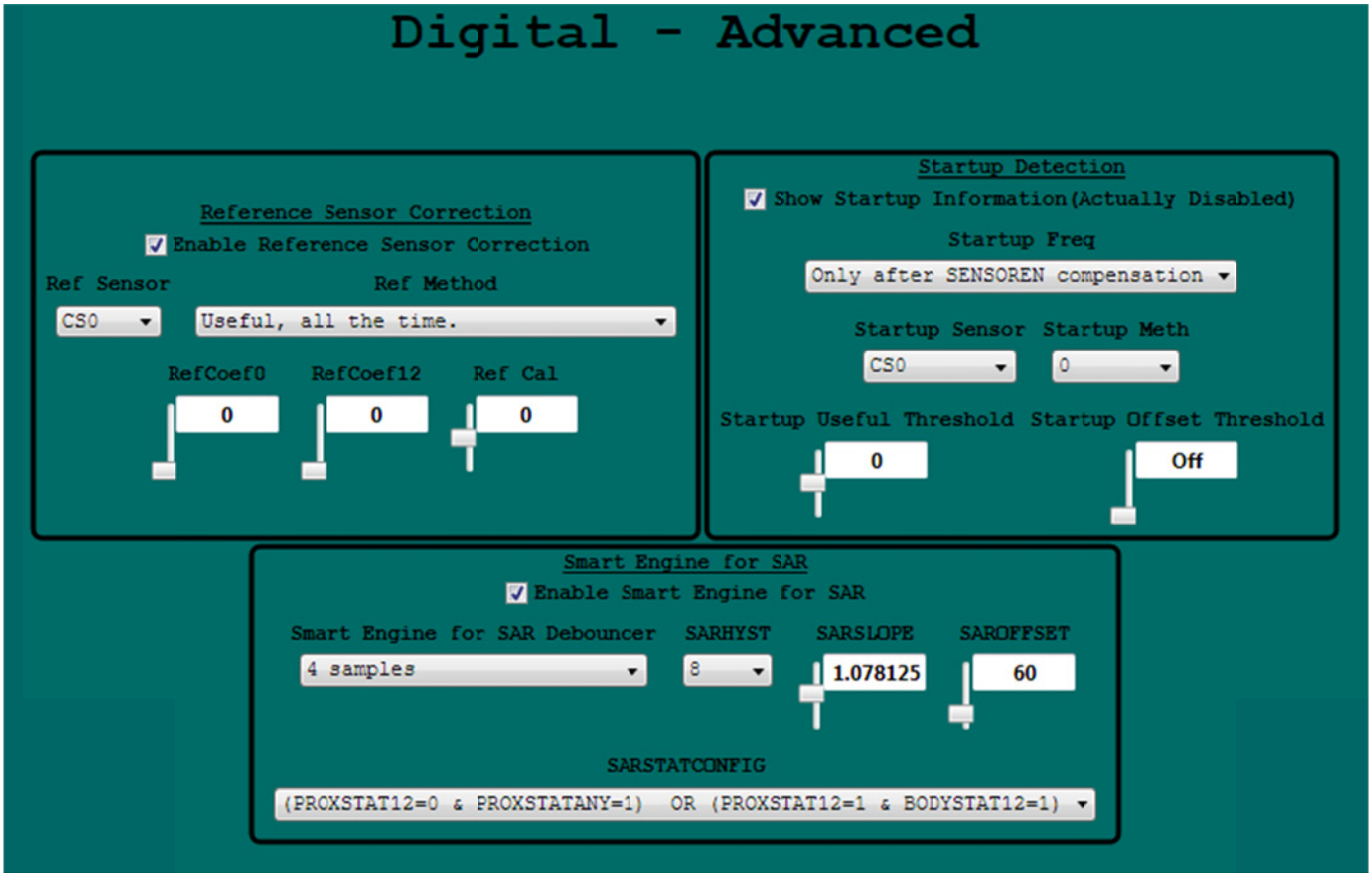


Figure 20 – Digital Advanced Section

In the digital advanced section, one can set the following parameters:
- Reference Sensor Correction
- Startup Detection
- Smart Engine for SAR

3.5 Graphs Tab

In this section, one can monitor the different sensors data:
- Useful
- Average
- Differential
- Smart SAR

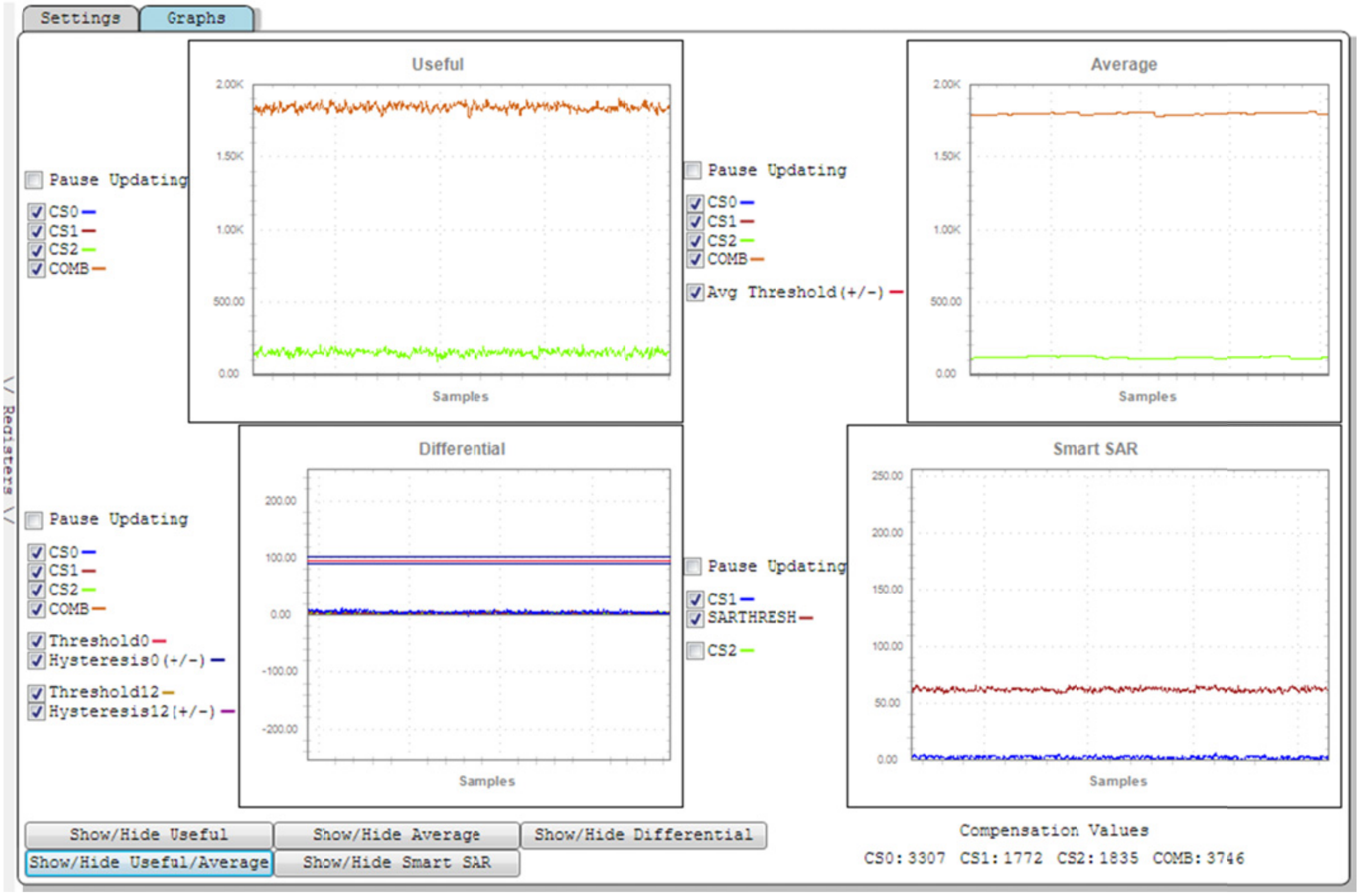


Figure 21 – Graphs Tab

Data graphs allow observing the progress of the proximity sensing's parameters in real time. Each graph has the ability to hide individual sensors from being displayed. Note that all sensors can be displayed, as well as the programmed thresholds. It is possible to zoom in a specific graph area by selection it with the mouse (left click). Right clicking on the graph provides other options such as the ability to zoom out.

3.6 Status Area

The status area provides a way to view various status items and controls:

- The Interrupt Status box shows when reset, conversion or compensation are triggered
- The Auto Read box allows:
  - Clearing automatically NIRQ events (Clear NIRQ)
  - Reading the sensors statuses in the corresponding GUI section (Read Sensor Status)
  - Reading continuously the sensors data (Read Raw Data)
- The "Run Script" button allows executing a script (see section 4)
- The "Save To Script" button allows saving the current registers settings

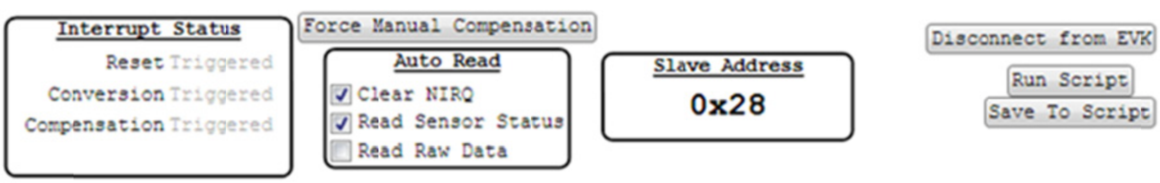


Figure 22 – Status Area

4 Scripts

4.1 Introduction to Scripting

The GUI provides a way to automate tasks by implementing a script language. Scripts are run by using the "Run Script" button. A startup script is also used to initialize registers to a default working setup once the EVK is connected. This script is described more in detail later in this document. It can be used as a reference.

4.2 Scripting Language

The following sections describe briefly some common functions that can be used in the scripting language.

4.2.1 Necessary Header Information

The very first line must only contain the string "-3-" without any quotes. This tells the scripting language that it is a version 3 script.

```
-3-
```

Figure 23 – Header Information

4.2.2 Variables

Variables are defined when a "$" (without the quotes) prefixes a string. The scripting language will automatically decode the type used so there is no need to specify a type. The following pictures show a variable called $test being assigned a value of 4.

```
$test = 4;
```

Figure 24 – Variables

4.2.3 Register Write and Read

The device uses an object oriented like method for the register access. First, the EVK BASE device is written, then i2c signifying it is for i2c and then write or read. The write command consists of an address and value to set. The read command consists of an address and a variable of where to save the value. Variables can be used for address or setting the register if needed.

```
sx9310evk.i2c.write(0x10,0x2F);
sx9310evk.i2c.read(0x11,$test);
```

Figure 25 – Register Write and Read Commands

4.2.4 Display Command

Another useful core command is display. This will display a string to the screen.

```
display $test;
```

Figure 26 – Display Command

5 Schematics and Layout

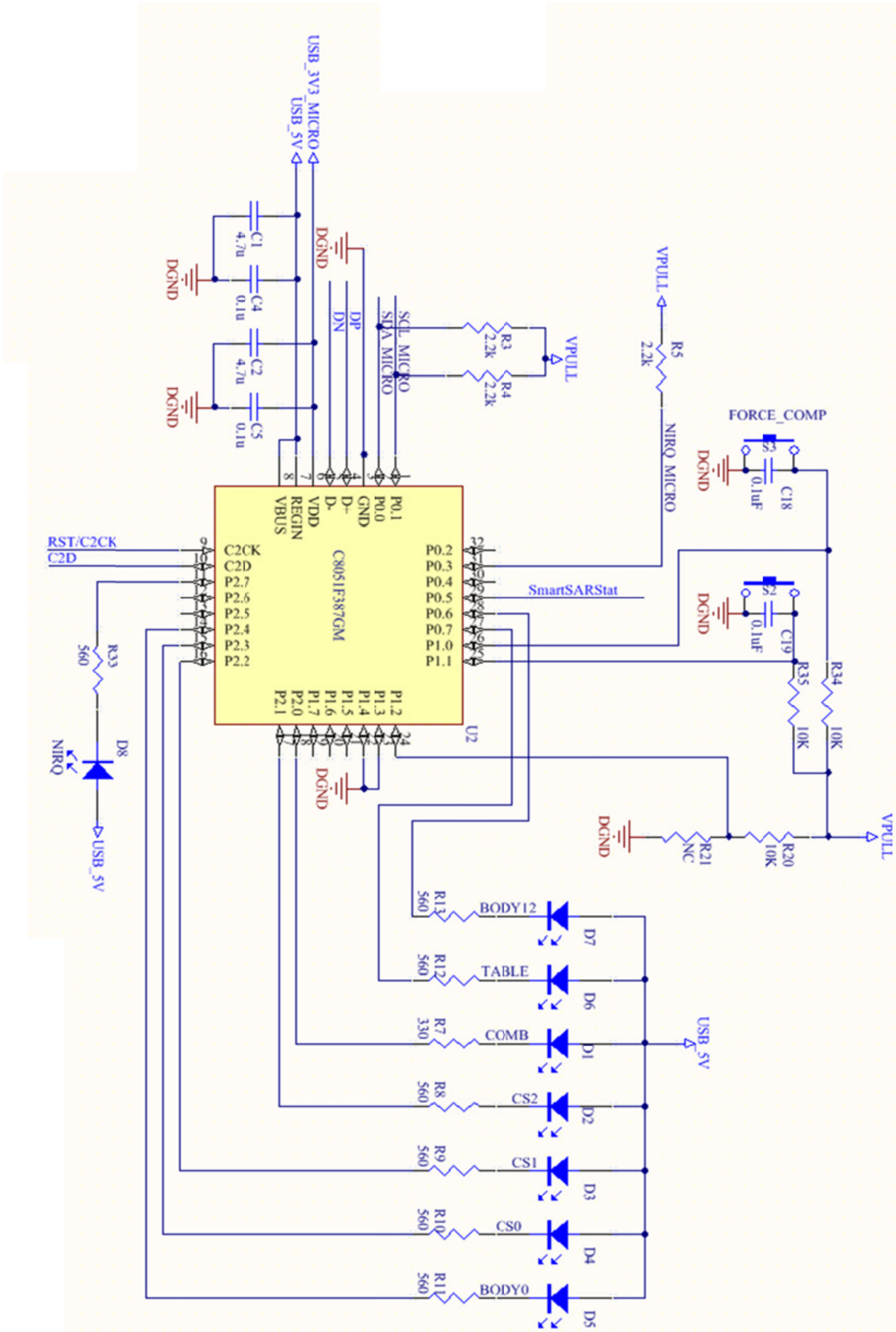


Figure 27 – **Microcontroller Section**

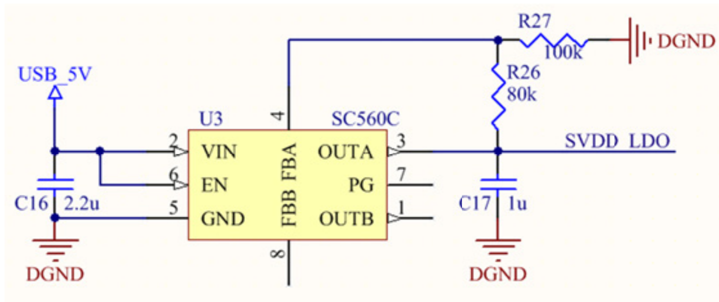


Figure 28 – LDO Section

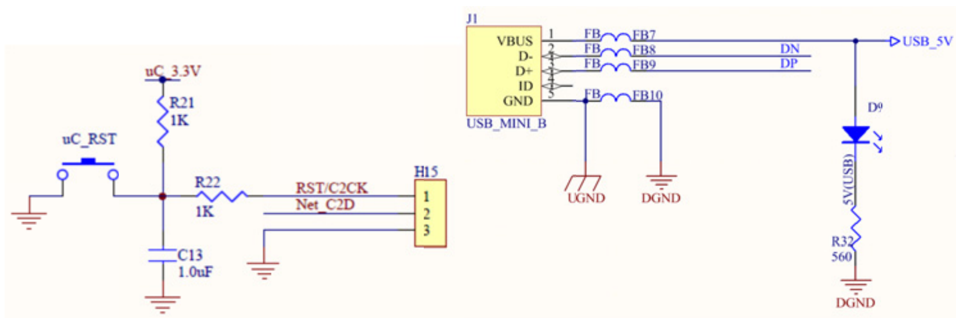


Figure 29 – USB Power Supply and Programming Connector

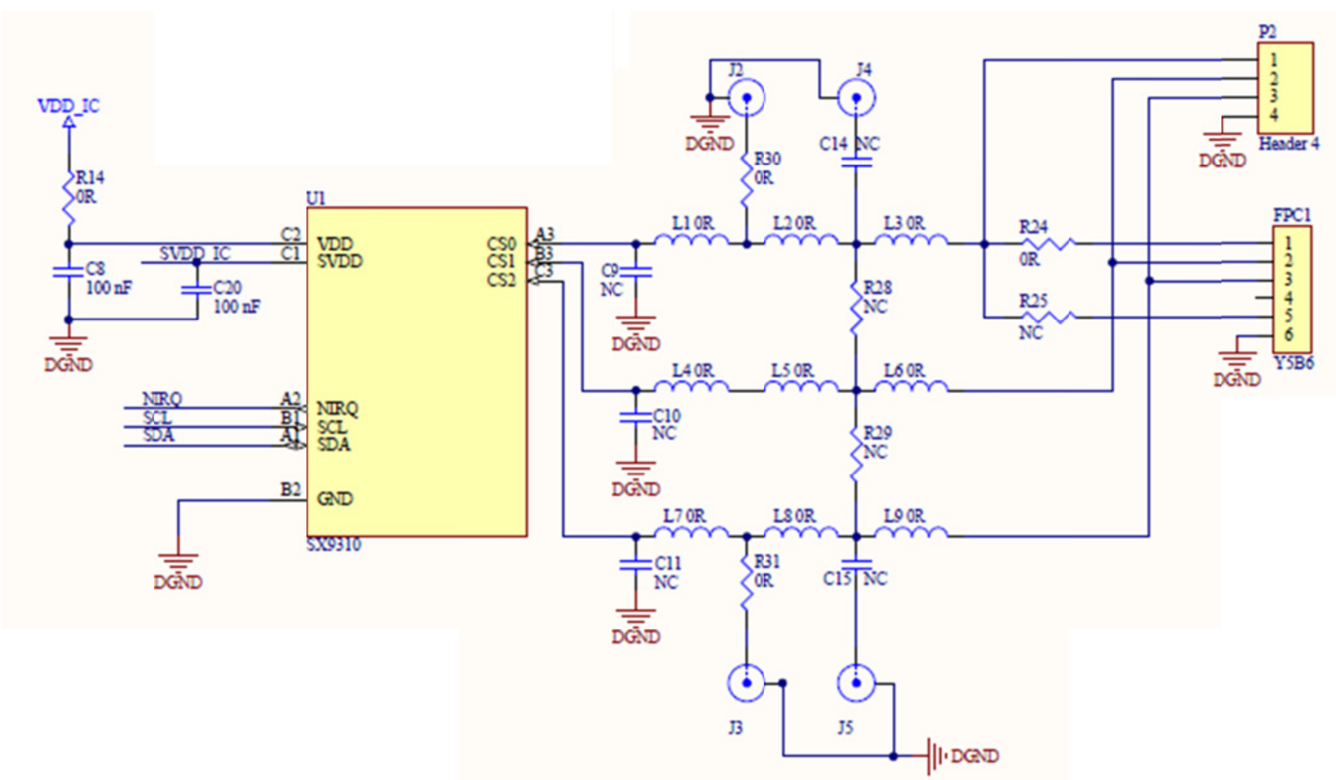


Figure 30 – SX9310 Section

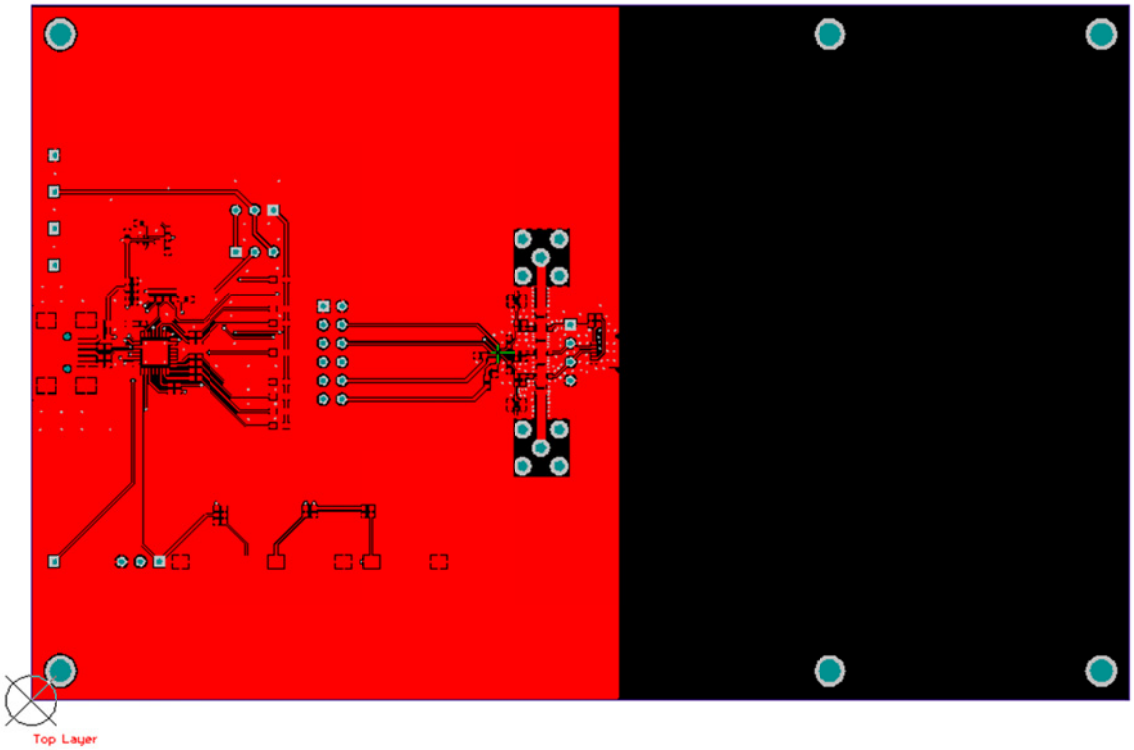


Figure 31 – PCB Top Layer

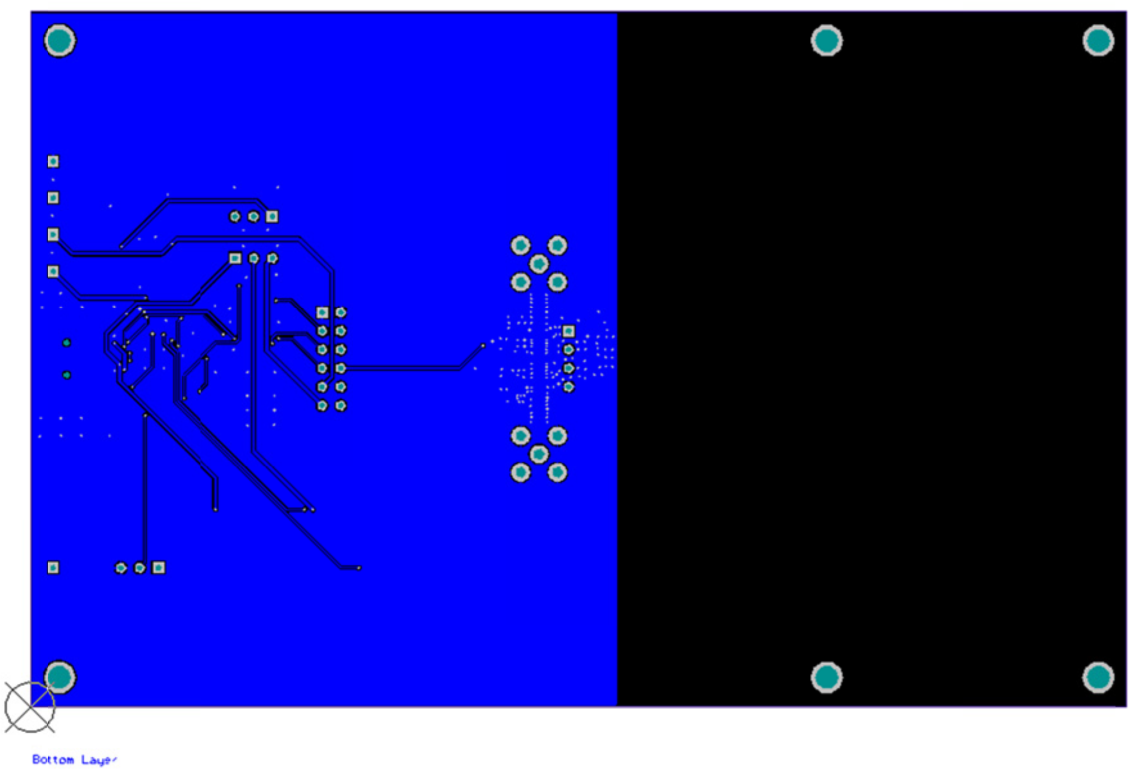


Figure 32 – PCB Bottom Layer

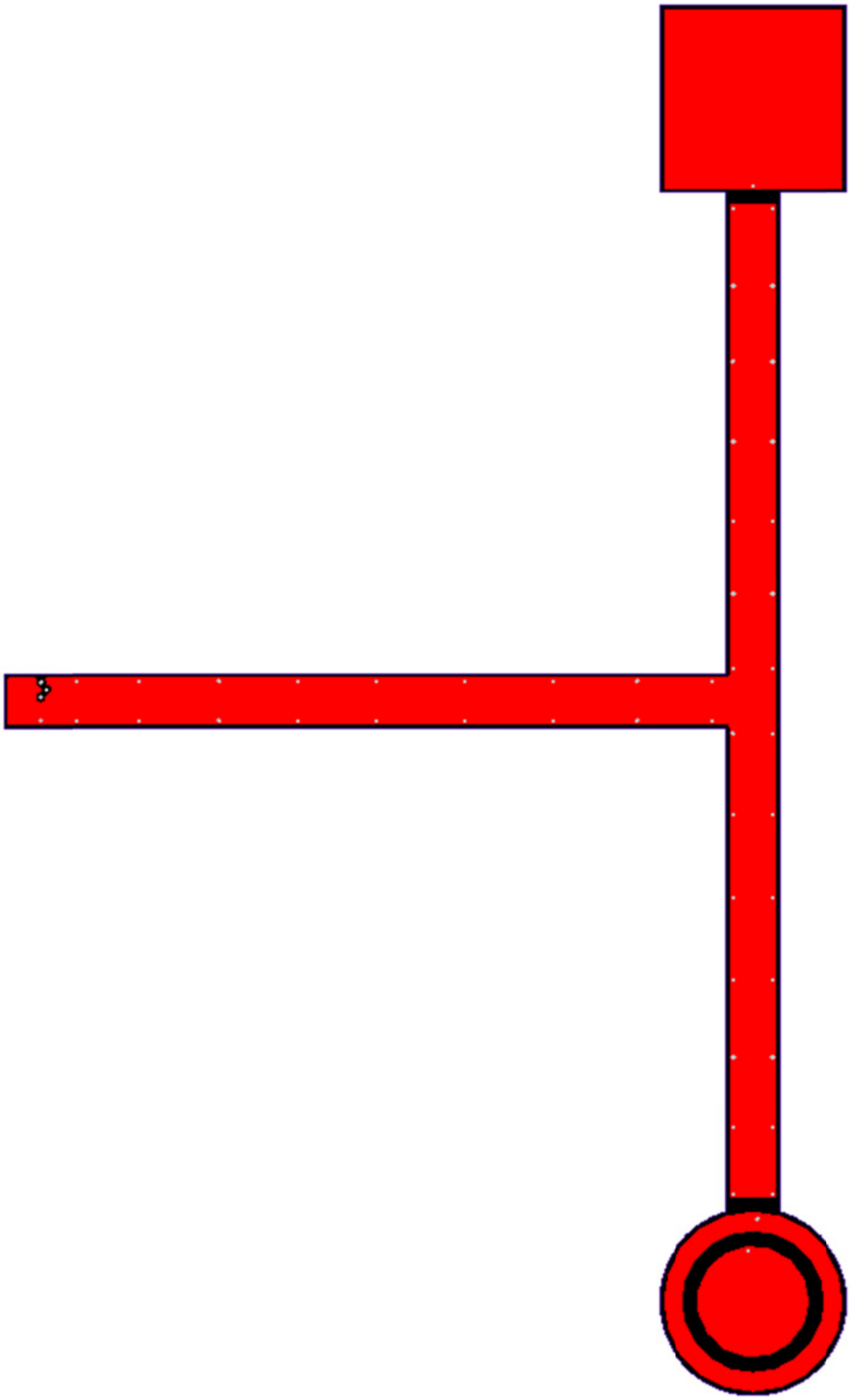


Figure 33 – FPC Top Layer

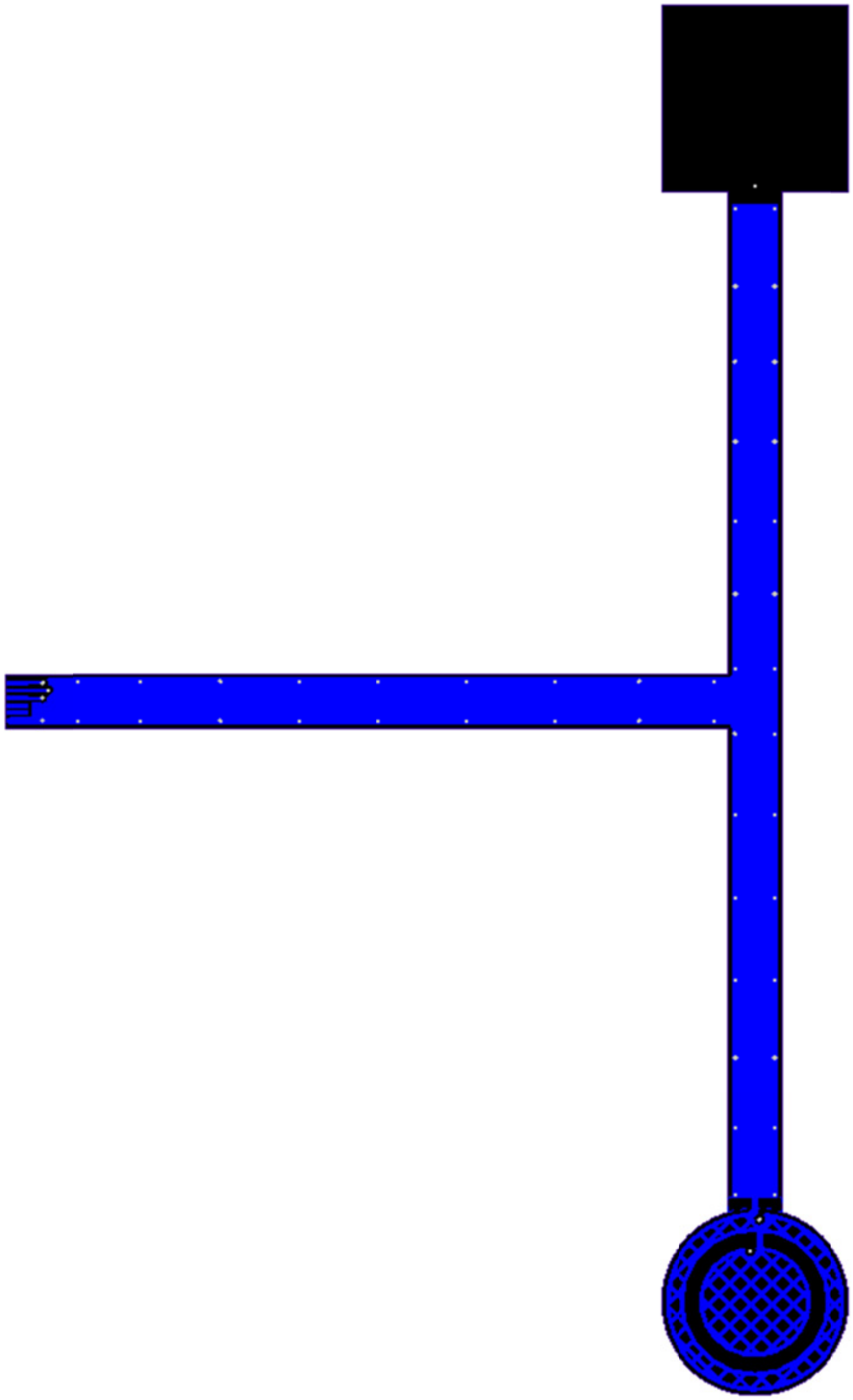


Figure 34 – FPC Bottom Layer

6 References

- [1] SX9310 Datasheet
- [2] SX9311 Datasheet

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