Si1142 IRSlider2EK Demo Kit User's Guide

1. Kit Contents

The Si1142 Slider Demo Kit contains the following items:

- Si1142 Slider Demo Board
- Si1142 Slider Demo Board Quick Start Guide
- USB Cable

2. Introduction

The Si1142 Slider Demo Board implements an infrared touchless slider function based around the Si1142 infrared proximity and ambient light sensor. As shown in Figure 1, the main components of the board are the Si1142 sensor (U2), the C8051F800 microcontroller (U1), and two infrared emitters (DS1 and DS2). Hardware is also provided on-board to facilitate code development for the C8051F800 and communications with software support packages over a USB interface.

The firmware running on the C8051F800 measures the infrared light energy detected by the Si1142, while each of the two infrared emitters are independently activated. The infrared light from these emitters will be reflected back to the Si1142 by any object that is placed in proximity to the board. The left-right position is then calculated from these two measurements and used to illuminate the appropriate signal LED. If no object is close enough to the board, the measured signal levels will fall below pre-determined thresholds, and no signal LEDs will be illuminated. In addition to indicating the current position, the firmware is also able to detect different gestures from the infrared sensor, as described in Table 2 on page 9. The Si1142's ambient light sensor (ALS) is also monitored by the firmware, which can determine the amount of ambient light present.

Note: The touchless infrared position and gesture detection implemented in the example is patent pending.

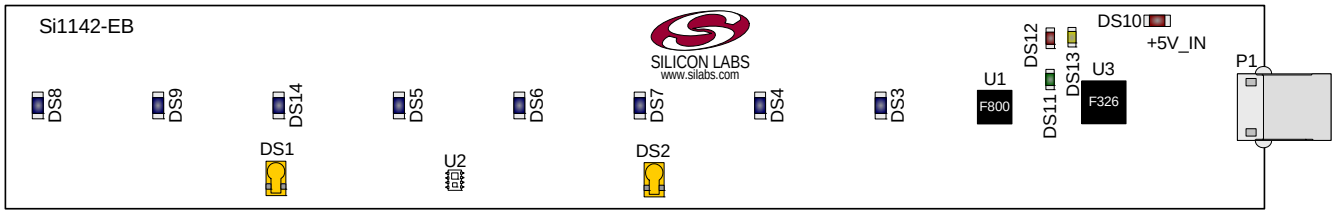

Figure 1. Si1142 Slider Demo Board

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3. Running the Pre-Loaded Slider Demo

1. The board receives its power over the USB interface. Connect one end of a USB cable to the USB connector (P1) on the Si1142 Slider Demo Board and the other end to a USB Port on the PC.
2. The red LED DS10 should light on the board, indicating that it is receiving power from the USB.
3. Position a hand about 5 to 10 cm above and perpendicular to the board. The visible blue LEDs will light according to the position of the hand above the board.
4. To initiate a “pause” gesture, hold steady for about 3/4 seconds. The current LED position indicator will blink a few times to indicate that a pause gesture has been detected.
5. To perform a “swipe” gesture, move the hand from left to right (swipe right) or right to left (swipe left) above the entire length of the board. The LEDs will briefly light in a sweeping pattern to indicate that a swipe gesture was detected.

On this board, the infrared emitters used are OSRAM part number SFH 4056. These emitters have a power rating of 40 mW and a half-angle of 22 degrees. Other emitters with different characteristics may also be used, depending on the specific application requirements.

4. Software Overview

There are several optional software packages available to support the Si1142 Slider Demo Board. QuickSense™ Studio contains the Performance Analysis Tool, which can be used to collect data from the board over the USB interface and display it graphically on screen. The Silicon Labs Integrated Development Environment (IDE) provides a means of developing code for the C8051F800 and uses the USB connection on the board to program the MCU and perform in-system debugging. For users wishing to modify the example code or download the latest version of firmware into the board, the Si1142 Slider Demo Board installation package contains board-specific materials, such as the latest version of the pre-built firmware .HEX image and the firmware example source code. All of the supporting software can be downloaded from the web at: http://www.silabs.com/quicksense.

4.1. QuickSense Studio

The QuickSense Studio software facilitates rapid code development and analysis for applications using the Silicon Labs family of QuickSense products. QuickSense Studio is comprised of multiple programs that guide users through an intuitive development flow, including graphical configuration wizards, firmware templates, and performance-monitoring tools. These programs interface with the QuickSense Firmware API, a highly configurable open-source firmware library that provides support for many different applications, from simple buttons to complex algorithms like gesture recognition. The main component of QuickSense Studio used by the Si1142 Slider Demo Board is the Performance Analysis Tool, which is described in more detail in "5. Using the Si1142 Slider Demo Board with the Performance Analysis Tool" on page 5.

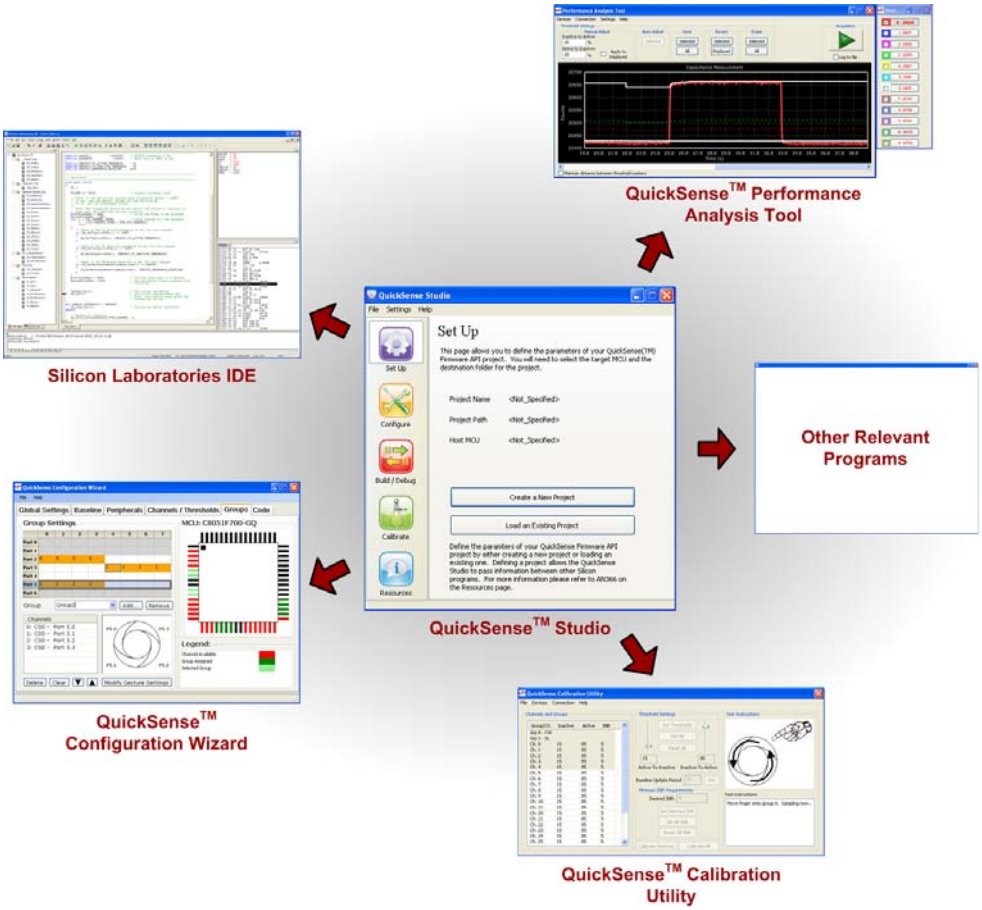

Figure 2. Silicon Labs QuickSense Studio Software

For detailed information on the QuickSense Studio software, see the QuickSense Studio User's Guide available on the Silicon Labs QuickSense webpage (http://www.silabs.com/quicksense) in the QuickSense Studio section.

4.2. Silicon Laboratories IDE

The Silicon Laboratories IDE integrates a source-code editor, a source-level debugger, and an in-system Flash programmer. This tool can be used to develop and debug code for the C8051F800 MCU, which is included on the Si1142 Slider Demo Board. The use of several third-party compilers and assemblers is supported by the IDE.

4.2.1. IDE System Requirements

The Silicon Laboratories IDE requirements are:

- Pentium-class host PC running Microsoft Windows 2000 or newer
- One available USB port

4.2.2. Third Party Toolsets

The Silicon Laboratories IDE has native support for many 8051 compilers. The full list of natively-supported tools is as follows:

- Keil
- IAR
- Raisonance
- Tasking
- SDCC

4.2.3. Downloading the Example Firmware Image

The Si1142 Slider Demo Board installer package includes the firmware source code as well as a pre-built .HEX image that can be downloaded directly into the board. The firmware source code and an example IDE project are located in the default path *C:\SiLabs\MCU\QuickSense_Studio\Kits\IRSlider2EK\Firmware*\. The pre-built .HEX image is located in the default path *C:\SiLabs\MCU\QuickSense_Studio\Kits\IRSlider2EK\Firmware\Release*\. Follow the instructions below to update or refresh the .HEX image in the Si1142 Slider Demo Board:

1. Connect the Si1142 Slider Demo Board to the PC using a USB cable.
2. Launch the Silicon Labs IDE, and click on *Options->Connection Options*.
3. Select “USB Debug Adapter”, and then select the board from the list (it should show up as “TS” followed by a serial number).
4. Select “C2” as the debug interface, and press “OK”.
5. Connect to the board by pressing the “Connect” icon, or using the keyboard shortcut Alt+C.
6. Click on the “Download” icon, or use the keyboard shortcut Alt+D.
7. In the download dialog window, click “Browse”.
8. Change to Files of Type “Intel Hex (*.hex)” and then browse to select the file **Si1142_Slider.hex** in the default path *C:\SiLabs\MCU\QuickSense_Studio\Kits\IRSlider2EK\Firmware\Release*\
9. Click “Open” then “Download”.
10. To run the new image, either press “Run” or “Disconnect” in the IDE.

Note: The IDE and the Performance Analysis Tool cannot connect to the Si1142 Slider Demo Board at the same time. Be certain to disconnect from the board in one software package before trying to connect in the other.

5. Using the Si1142 Slider Demo Board with the Performance Analysis Tool

The Si1142 Slider Demo Board is supported by the QuickSense Performance Analysis Tool. The Performance Analysis Tool allows users to see real-time infrared proximity and ambient light measurements from the Si1142 in a graphical form. The communications interface to the Si1142 Slider Demo Board is provided over the USB connection via the QuickSense Firmware API. For a more detailed description of the QuickSense Firmware API or the Serial Interface, see “AN366: QuickSense Firmware API.”

To use the Performance Analysis Tool with the Si1142 Slider Demo Board, perform the following steps:

1. Connect the Si1142 Slider Demo Board to the PC using a USB cable.
2. Launch the Performance Analysis Tool from QuickSense Studio or from the Start menu.
3. Select the board from the “Devices” menu (it should show up as “TS” followed by a serial number).
4. Select the channels you wish to display on the picture of the slider board that appears. The individual channels available are described in “5.1. Channel Selection” .
5. Click the green “Acquisition” arrow to begin collecting data.

Note: The Performance Analysis Tool and the IDE cannot connect to the Si1142 Slider Demo Board at the same time. Be certain to disconnect from the board in one software package before trying to connect in the other.

Figure 3 shows an example of the Performance Analysis Tool output when connected to the Si1142 Slider Demo Board. To generate the graph, a hand was moved above the slider board. The selected traces shown are the raw data measurements for the amount of Infrared light being reflected onto the part. The pink trace represents the readings using infrared emitter DS1, and the green trace represents the readings using infrared emitter DS2.

Figure 3. Performance Analysis Tool Main Window

5.1. Channel Selection

Selecting which channels to display is done by checking the appropriate boxes on the Board Representation window, shown in Figure 4, and the Generic Data window, shown in Figure 5. There are two different groups of measurements available from the example firmware: raw data channels and generic data channels.

5.1.1. Raw Data Channels

The raw data measurements can be seen by selecting the channels from the Board Representation window, shown in Figure 4. The two types of raw data measurements are ambient light and infrared proximity.

1. Raw ambient light measurements. The ambient light channels are Channel 0 (red) and Channel 1(blue). Channel 0 displays measurements of the ambient visible light while Channel 1 displays measurements of the ambient infrared light.
2. Raw infrared proximity measurements. The infrared proximity channels are Channel 2 (pink) readings using DS1 and Channel 3 (green) readings using DS9. Each output is proportional to the amount of infrared light being reflected onto the part by an object above the board. These outputs are 16-bit unsigned values.

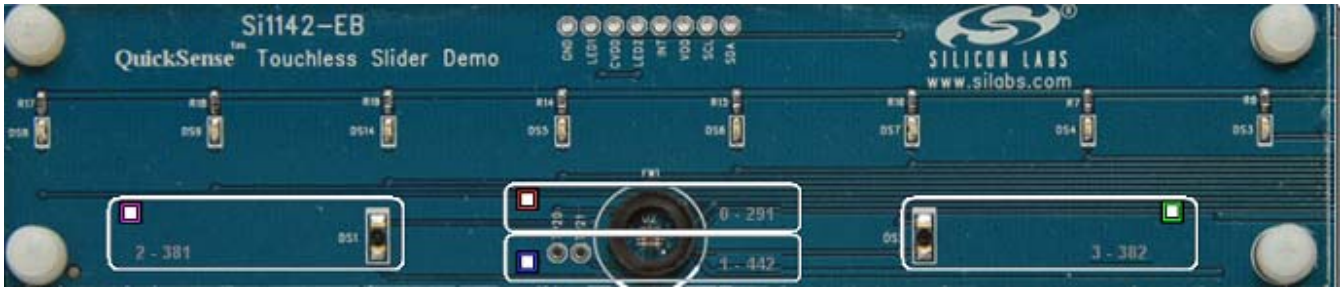

Figure 4. Raw Data Channel Selection

5.1.2. Generic Data Channels

The generic data channels contain any data generated by the host MCU. These 16-bit channels can be anything from simple debug channels to calculated position values. See Table 1 for an explanation of all the channels shown in Figure 5.

Figure 5. Generic Data Channel Selection

Table 1. Generic Data Channels

Name	Label	Type	Description
G0	Rad1	Linearized Distance Measurements	Using characterization of the PS measurements with objects at certain distances, it is possible to estimate the distance of an object based on the PS measurement value. These three channels represent the distance estimations for each LED's measurement.
G1	Rad2		
G2	X(mm)	Estimated Location Coordinates	With the approximate distance measurements above, an estimation of X and Y position can be made. These estimations are given in units of mm.
G3	Y(mm)		
G4	iLED1	LED Drive Current Levels	Each LED driver has a specific LED drive current setting for it. These values are given in units of mA.
G5	iLED2		
G6	VIS	AutoRanging Ambient Outputs	AutoRanging will automatically change the modes of the photodiodes to avoid saturation. When changing modes, the raw data output changes levels, but AutoRanging will scale the raw data so that all measurements are on the same scale. The output from this channel is the pro-
G7	IR		
G8	PS1	AutoRanging PS Outputs	These channels are the AutoRanging PS output from the device. Raw data measurements are processed by the AutoRanging firmware to make all the readings across different modes have the same magnitude. Since the device switches modes to compensate for ambient
G9	PS2		
G10	VIS s	State of Ambient Visible System	These channels help indicate what mode the sensor is in during each of their respective measurements. The four possible modes are as follows, Low Light, High Sensitivity, High Signal, and Sunlight. These modes are numbered from zero to three. For more information about each mode, please consult the data sheet.
G11	IR st	State of Ambient IR System	
G12	PS st	State of PS System	
G13	PS1bl	PS Baseline Levels	AutoRanging uses baselining to determine the no-detect threshold for readings. Any readings below the values shown on these channels will be considered no-detect readings. Any values higher than this baseline will be shown in the AutoRanging PS Outputs above.
G14	PS2bl		
G15	N/A	Unused	The unused channels are not in use by software, but they are available in firmware to use as needed.
G16	N/A		

5.2. Gesture Sensing

In addition to infrared and ambient light measurements and distance calculations, the example firmware contains algorithms for gesture recognition. When connected to the board with the Performance Analysis Tool, a group window will appear, as shown in Figure 6. When a gesture is recognized by firmware, the gesture name and parameter information will be added to the top of the 2D Gesture group. Three gestures are supported by the example code. The parameters for each gesture are listed in Table 2.

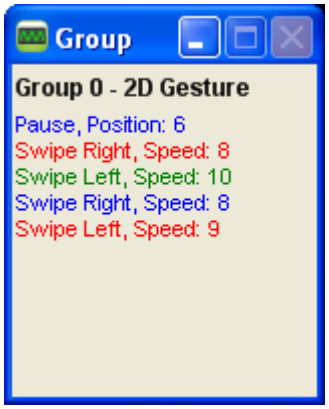

Figure 6. Performance Analysis Tool Group Window

Table 2. Recognized Gestures

Gesture Name	Parameter	Parameter Range	Description of Action and LED Indication
Pause	Position	1–8 (LED position)	Hold hand steady in a single position above the board for 3/4 second. Current position LED will blink briefly.
Swipe Left	Speed	1–18 (Slow to Fast)	Move hand rapidly from the right side to the left side of the board. LEDs will briefly indicate a leftward sweep pattern.
Swipe Right	Speed	1–18 (Slow to Fast)	Move hand rapidly from the left side to the right side of the board. LEDs will briefly indicate a rightward sweep pattern.

6. Schematic

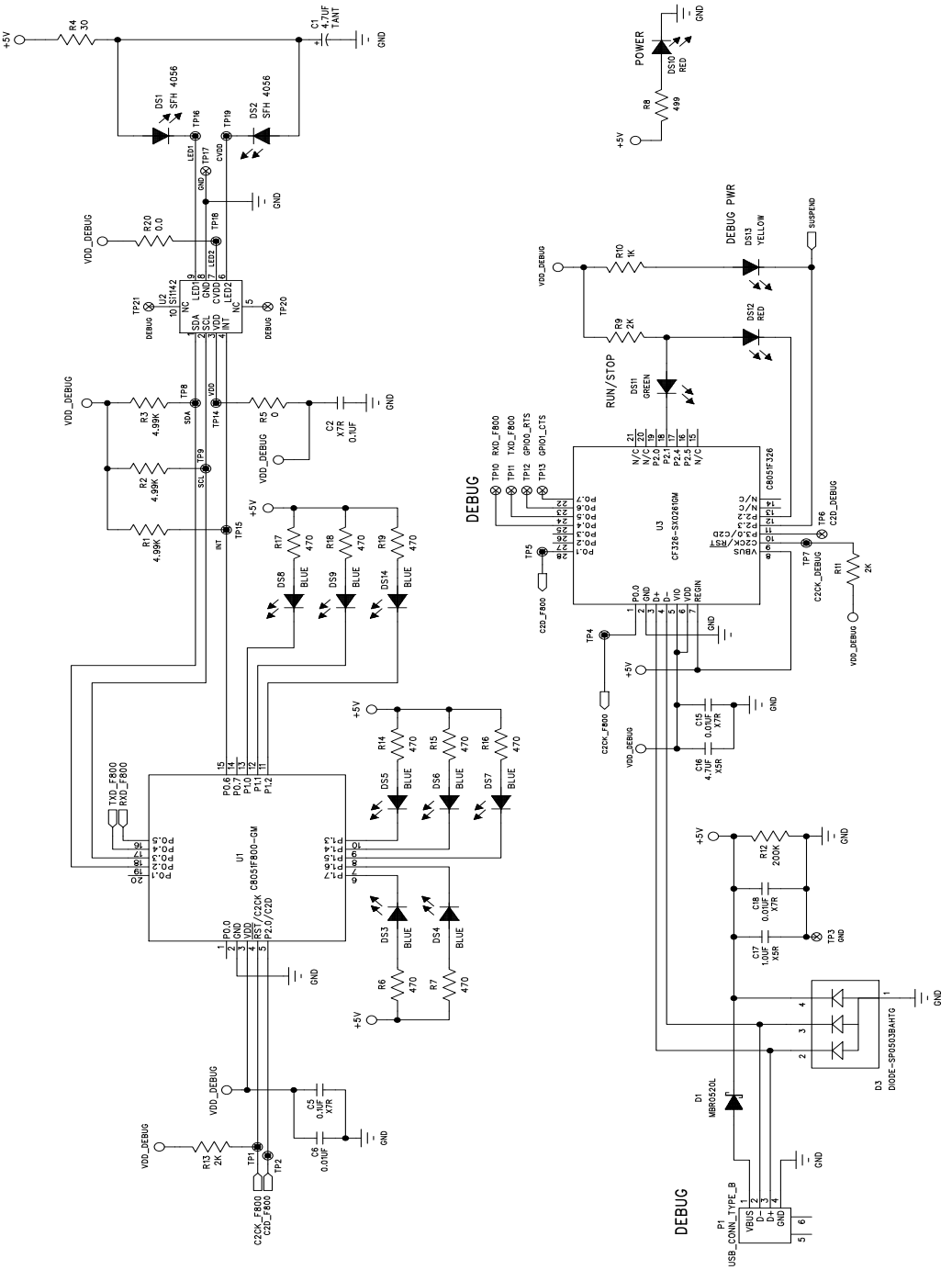

Figure 7. Si1142 Slider Demo Board Schematic

NOTES:

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