

Si1120 INFRARED SLIDER DEMO KIT USER'S GUIDE

1. Kit Contents

The Si1120 Slider Demo Kit contains the following items:

- Si1120 Slider Demo Board
- Si1120 Slider Demo Board Quick Start Guide
- USB Cable

2. Introduction

The Si1120 Slider Demo Board implements an infrared touchless slider function based around the Si1120 infrared proximity and ambient light sensor. As shown in Figure 1, the main components of the board are the Si1120 sensor (U2), the C8051F930 microcontroller (U1), and two infrared emitters (D1 and D2). User feedback is provided by the blue signal LEDs (DS0-DS7). Hardware is also provided on-board to facilitate code development for the C8051F930 and communications with software support packages over a USB interface.

The firmware running on the C8051F930 measures the infrared light energy detected by the Si1120 while each of the two infrared emitters are independently activated. The infrared light from these emitters will be reflected back to the Si1120 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 1 on page 7. The Si1120's ambient light sensor (ALS) is also monitored by the firmware, which can determine the type of ambient light present.

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

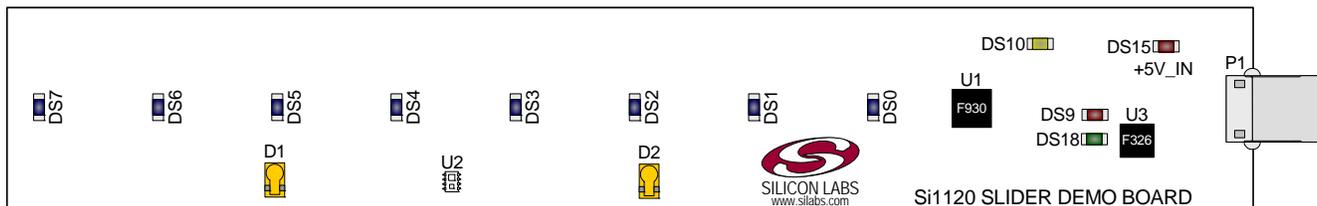


Figure 1. Si1120 Slider Demo Board

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 Si1120 Slider Demo Board, and the other end to a USB Port on the PC.
2. The red LED DS15 should light on the board, indicating that it is receiving power from USB.
3. Position a hand about 5 to 10 cm above and perpendicular to the board. The visible blue LEDs DS0-DS7 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 4650-Z. These emitters have a power rating of 45 mW and a half-angle of 20 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 Si1120 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 C8051F930, 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 Si1120 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 the URL <http://www.silabs.com/slider>.

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 Si1120 Slider Demo Board is the Performance Analysis Tool, which is described in more detail in "5. Using the Si1120 Slider Demo Board with the Performance Analysis Tool" on page 5.

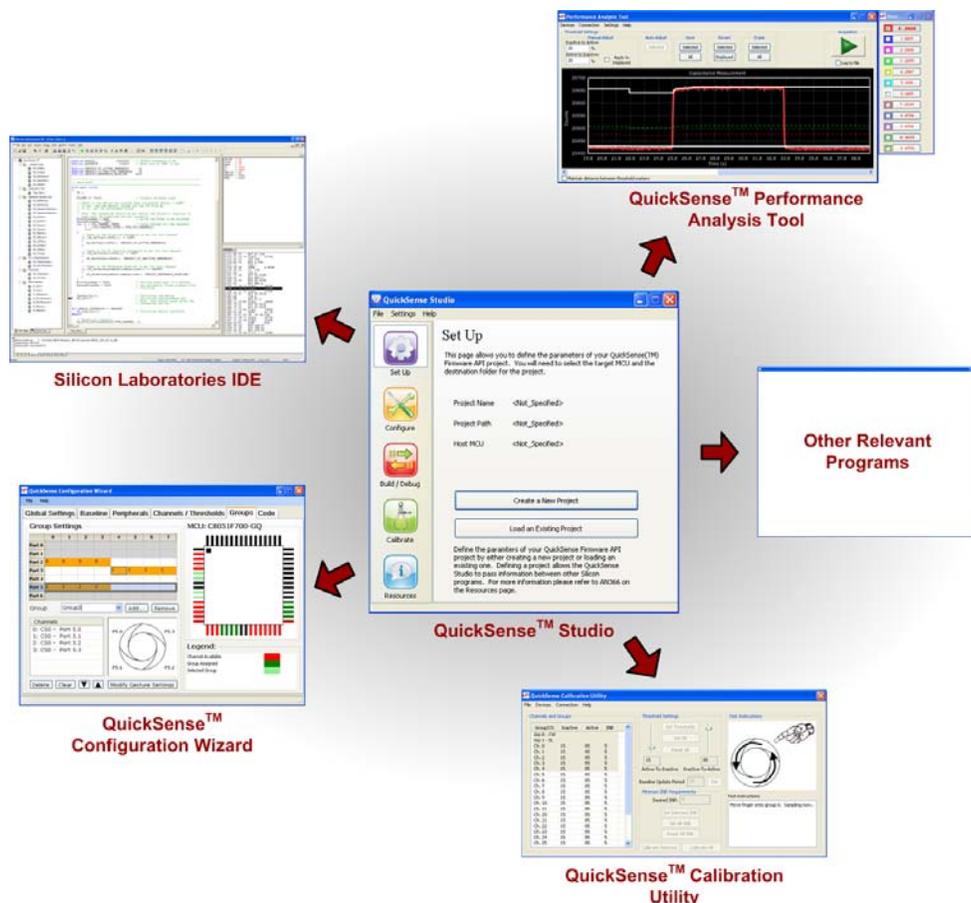


Figure 2. Silicon Labs QuickSense Studio Software

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 C8051F930 MCU which is included on the Si1120 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:

- 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 Si1120 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 is located in the default path `C:\SiLabs\MCU\QuickSense_Studio\Kits\IrSliderEK\Firmware\`. The pre-built .HEX image is located in the default path `C:\SiLabs\MCU\QuickSense_Studio\Kits\IrSliderEK\Firmware\Release\`. Follow the instructions below to update or refresh the .HEX image in the Si1120 Slider Demo Board:

1. Connect the Si1120 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 **IrSliderEK.hex** in the default path `C:\SiLabs\MCU\QuickSense_Studio\Kits\IrSliderEK\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 Si1120 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 Si1120 Slider Demo Board with the Performance Analysis Tool

The Si1120 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 Si1120 in a graphical form, as well as the calculated values for distance from each of the infrared LEDs and the X and Z positions. Additionally, recognized gestures and the ambient light conditions can be displayed in dedicated group windows. The communications interface to the Si1120 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 API.”

To use the Performance Analysis Tool with the Si1120 Slider Demo Board:

1. Connect the Si1120 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 Si1120 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 Si1120 Slider Demo Board. To generate the graph, a hand was moved above the slider board. The selected traces shown are the calculated distance from each infrared emitter and the calculated X value along the slider. The red trace represents the distance from infrared emitter D1, the blue trace represents the distance from infrared emitter D2, and the purple trace is the calculated X position of the hand above the board.

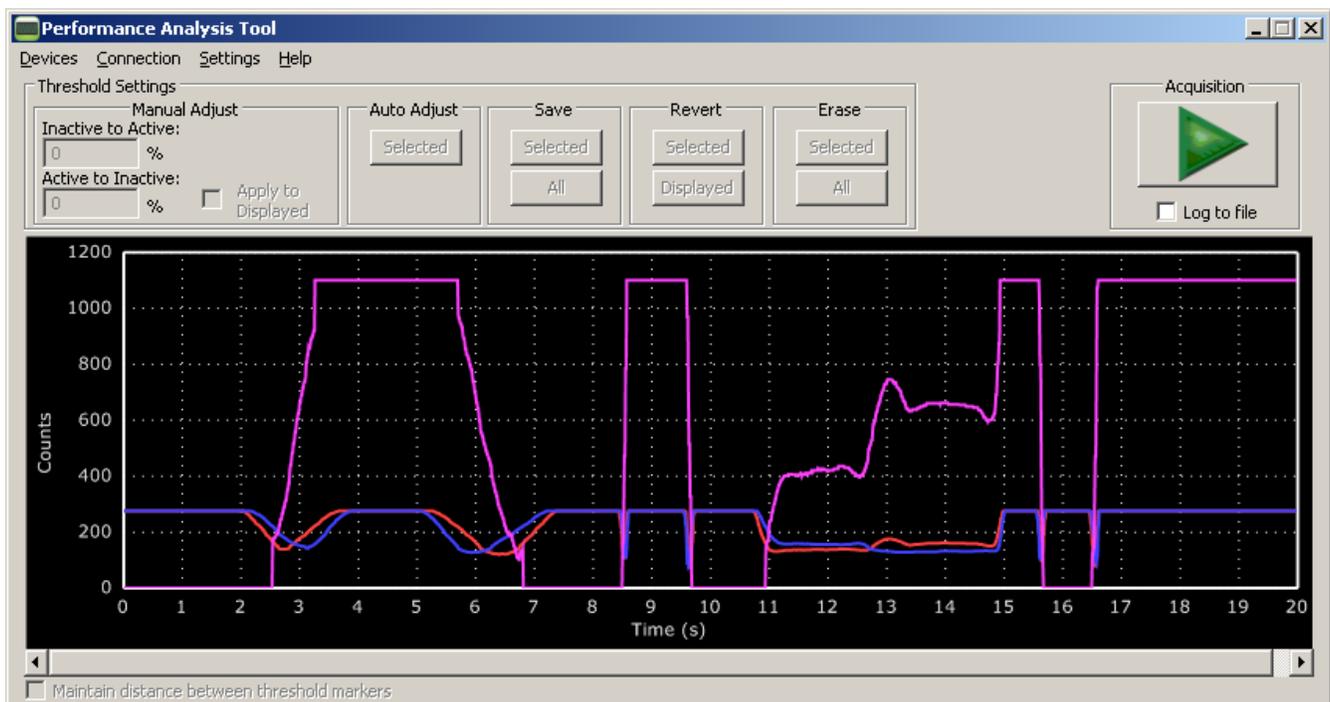


Figure 3. Performance Analysis Tool Main Window

Si1120 Infrared Slider Demo Kit

5.1. Channel Selection

Selecting which channels to display is a simple matter of checking the appropriate boxes over the board photograph, shown in Figure 4.

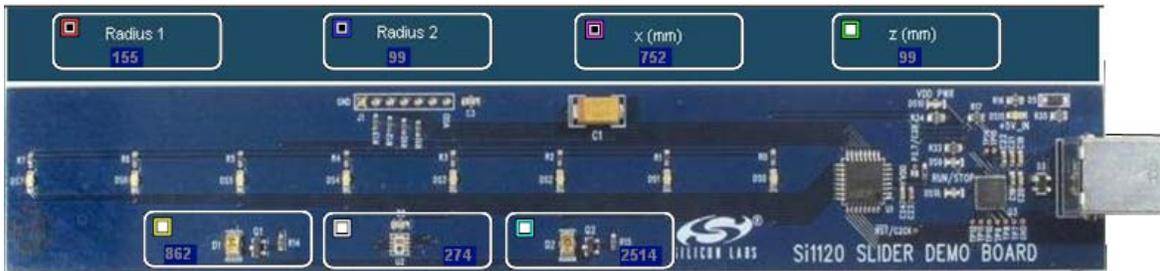


Figure 4. Channel Selection

There are three different types of measurements available from the example firmware:

1. Raw infrared proximity and ambient light measurements. The infrared channels are yellow (D1) and cyan (D2), while the ambient light channel is white. The data for these channels represents a measurement of the duration of the Si1120's PRX low time, as seen by the C8051F930 MCU. The Y axis indicates the number of 6.125 MHz clock cycles that occurred while PRX was low. The maximum output limit of the Si1120 is 2 ms, which would correspond to 12250 counts of a 6.125 MHz clock.
2. Linearized distance measurements for each IR channel. The raw proximity values output from the Si1120 will be exponentially larger the closer an object is to the sensor. The blue and red channels labeled "Radius 1" and "Radius 2" are linearizations of the raw data output from the sensor when illuminating D1 and D2, respectively.
3. Calculated coordinate measurements. The linearized D1 and D2 measurements are used to calculate both an X (left-to-right) and a Z (far-to-near) measurement, which are displayed on the purple and green channels, respectively.

Due to the nature of infrared proximity measurements, the object's size and reflectivity will have an impact on the values measured.

5.2. Gestures and Ambient Light Conditions

In addition to infrared and ambient light measurements and distance calculations, the example firmware contains algorithms for gesture recognition and ambient light condition detection. When connected to the board with the Performance Analysis Tool, two group windows will appear, as shown in Figure 5. 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 1. The detected ambient light conditions (sunlight, incandescent/halogen, or fluorescent) will be displayed in the Light Type group.

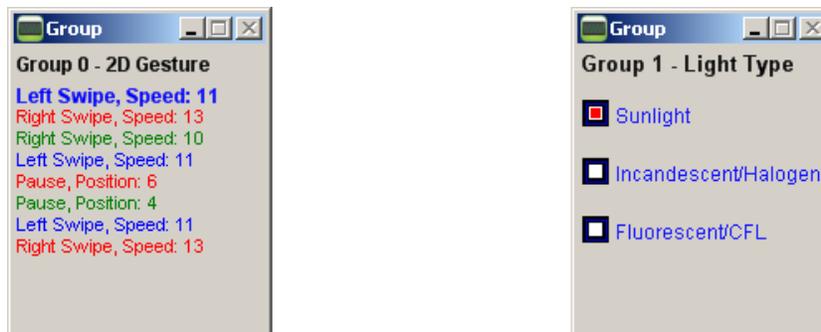


Figure 5. Performance Analysis Tool Group Windows

Table 1. 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.

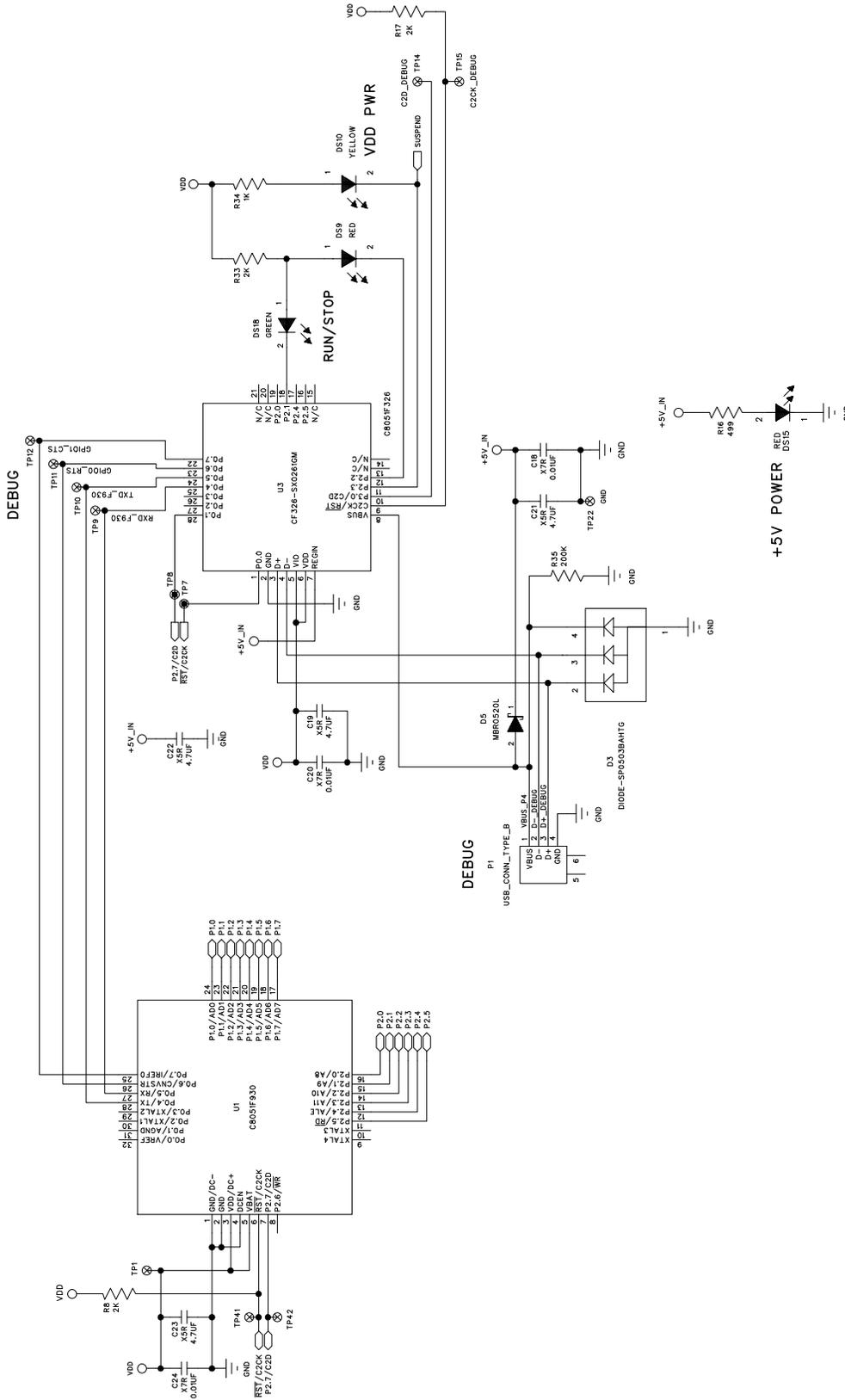


Figure 7. Si1120 Slider Demo Board Schematic (Page 2 of 2)

Si1120 Infrared Slider Demo Kit

CONTACT INFORMATION

Silicon Laboratories Inc.
400 West Cesar Chavez
Austin, TX 78701
Tel: 1+(512) 416-8500
Fax: 1+(512) 416-9669
Toll Free: 1+(877) 444-3032

Please visit the Silicon Labs Technical Support web page:
<https://www.silabs.com/support/pages/contacttechnicalsupport.aspx>
and register to submit a technical support request.

The information in this document is believed to be accurate in all respects at the time of publication but is subject to change without notice. Silicon Laboratories assumes no responsibility for errors and omissions, and disclaims responsibility for any consequences resulting from the use of information included herein. Additionally, Silicon Laboratories assumes no responsibility for the functioning of undescribed features or parameters. Silicon Laboratories reserves the right to make changes without further notice. Silicon Laboratories makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Silicon Laboratories assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. Silicon Laboratories products are not designed, intended, or authorized for use in applications intended to support or sustain life, or for any other application in which the failure of the Silicon Laboratories product could create a situation where personal injury or death may occur. Should Buyer purchase or use Silicon Laboratories products for any such unintended or unauthorized application, Buyer shall indemnify and hold Silicon Laboratories harmless against all claims and damages.

Silicon Laboratories, Silicon Labs, and QuickSense are trademarks of Silicon Laboratories Inc.

Other products or brandnames mentioned herein are trademarks or registered trademarks of their respective holders.