



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





CY3280-MBR3 Evaluation Kit User Guide

Doc. #: 001-89905 Rev. *F

Cypress Semiconductor
198 Champion Court
San Jose, CA 95134-1709
Phone (USA): +1.800.858.1810
Phone (Intl): +1.408.943.2600
www.cypress.com

Copyrights

© Cypress Semiconductor Corporation, 2014-2016. This document is the property of Cypress Semiconductor Corporation and its subsidiaries, including Spansion LLC ("Cypress"). This document, including any software or firmware included or referenced in this document ("Software"), is owned by Cypress under the intellectual property laws and treaties of the United States and other countries worldwide. Cypress reserves all rights under such laws and treaties and does not, except as specifically stated in this paragraph, grant any license under its patents, copyrights, trademarks, or other intellectual property rights. If the Software is not accompanied by a license agreement and you do not otherwise have a written agreement with Cypress governing the use of the Software, then Cypress hereby grants you a personal, non-exclusive, nontransferable license (without the right to sublicense) (1) under its copyright rights in the Software (a) for Software provided in source code form, to modify and reproduce the Software solely for use with Cypress hardware products, only internally within your organization, and (b) to distribute the Software in binary code form externally to end users (either directly or indirectly through resellers and distributors), solely for use on Cypress hardware product units, and (2) under those claims of Cypress's patents that are infringed by the Software (as provided by Cypress, unmodified) to make, use, distribute, and import the Software solely for use with Cypress hardware products. Any other use, reproduction, modification, translation, or compilation of the Software is prohibited.

TO THE EXTENT PERMITTED BY APPLICABLE LAW, CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT OR ANY SOFTWARE OR ACCOMPANYING HARDWARE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. To the extent permitted by applicable law, Cypress reserves the right to make changes to this document without further notice. Cypress does not assume any liability arising out of the application or use of any product or circuit described in this document. Any information provided in this document, including any sample design information or programming code, is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Cypress products are not designed, intended, or authorized for use as critical components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or system could cause personal injury, death, or property damage ("Unintended Uses"). A critical component is any component of a device or system whose failure to perform can be reasonably expected to cause the failure of the device or system, or to affect its safety or effectiveness. Cypress is not liable, in whole or in part, and you shall and hereby do release Cypress from any claim, damage, or other liability arising from or related to all Unintended Uses of Cypress products. You shall indemnify and hold Cypress harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of Cypress products.

Cypress, the Cypress logo, Spansion, the Spansion logo, and combinations thereof, WICED, PSoC, CapSense, EZ-USB, F-RAM, PSoC Creator, and Traveo are trademarks or registered trademarks of Cypress in the United States and other countries. For a more complete list of Cypress trademarks, visit cypress.com. Other names and brands may be claimed as property of their respective owners.

Contents



Safety Information	5
1. Introduction	7
1.1 Kit Contents	8
1.2 Getting Started.....	8
1.3 Factory Default Configuration	9
1.4 Additional Learning Resources	9
1.5 Technical Support.....	9
1.6 Acronyms	9
1.7 Document Conventions	10
2. Kit Installation	11
2.1 Before You Begin.....	11
2.2 CY3280-MBR3 EVK Software	11
2.3 Install the Software	12
2.4 Uninstall the Software.....	13
3. Kit Operation	14
3.1 Powering the Kit.....	16
3.2 Communication Between PC Host and Kit	18
3.3 Configuring the CY8CMBR3116 Controller Using EZ-Click	18
3.4 Kit Features	24
3.4.1 SmartSense Auto-Tuning Feature.....	24
4. Hardware	28
4.1 Board Details	28
4.2 Theory of Operation.....	29
4.3 Functional Description	29
4.3.1 CY8CMBR3116 CapSense Controller	29
4.3.2 PSoC 5LP	31
4.3.3 Power Supply System	32
4.3.4 Button Sensors and Proximity Loop Sensor	38
4.3.5 CY3280-MBR3 Kit LEDs	38
4.3.6 Buzzer, Shield, and Host Interrupt Multiplexing Jumper	39
4.3.7 Capacitance Variation Demonstration	41
4.3.8 Arduino-Compatible Headers.....	42
4.3.9 Push Button to Reset CY8CMBR3116.....	45
4.3.10 I2C Selection Jumpers.....	45
5. Configuration Files and Example Projects	46
5.1 Running Configuration Files and Host Projects	46

5.2	Configuration Files	46
5.2.1	LED Toggle.....	47
5.2.2	Proximity Detection	50
5.2.3	Water Tolerance	53
5.3	PSoC 4 Host Example Projects.....	57
5.3.1	Host_LED_Toggle_Buzzer_PSoC4_Pioneer_Kit.....	58
5.3.2	Host_Interrupt_LED_ON_Time_PSoC4_Pioneer_Kit.....	64
5.3.3	Configuring the MBR3 Device From the PSoC 4 Pioneer Kit	68
6.	Advanced Topics	70
6.1	Using PSoC 5LP as USB-I2C Bridge	70
6.2	Restoring to Factory Default Slave Address from 0x00.....	74
6.3	Connecting External CapSense Sensors to the CY3280-MBR3 EVK	75
A.	Appendix	76
A.1	Schematic	76
A.2	Pin Assignment Table.....	84
A.3	Bill of Materials	85
A.4	Regulatory Compliance Information	86

Safety Information



Regulatory Compliance

The CY3280-MBR3 Evaluation Kit is intended for use as a development platform for hardware or software in a laboratory environment. The board is an open system design, which does not include a shielded enclosure. This may cause interference to other electrical or electronic devices in close proximity.

In a domestic environment, this product may cause radio interference. The user may then be required to take adequate prevention measures. Also, the board should not be used near any medical equipment or RF devices.

Attaching additional wiring to this product or modifying the product operation from the factory default may affect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

The CY3280-MBR3 Evaluation Kit as shipped from the factory has been verified to meet the requirements of CE as a Class A product.



The CY3280-MBR3 Evaluation Kit contains ESD-sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused CY3280-MBR3 boards in the protective shipping package.



End-of-Life/Product Recycling

This kit has an end-of life five years from the date of manufacture mentioned on the back of the box. Contact your nearest recycler for disposing the kit.

General Safety Instructions

ESD Protection

ESD can damage boards and associated components. Cypress recommends that you perform procedures only at an ESD workstation. If an ESD workstation is not available, use appropriate ESD protection by wearing an antistatic wrist strap attached to chassis ground (any unpainted metal surface) on your board when handling parts.

Handling Boards

CY3280-MBR3 boards are sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad if available. Do not slide board over any surface.

1. Introduction



Thank you for your interest in the CY3280-MBR3 Evaluation Kit (EVK). This kit is designed to showcase the abilities of the CY8CMBR3116 register-configurable CapSense® controller. It is also designed as an Arduino™-compatible shield that supports various Arduino baseboards as well as other stackable shields available in the market. The CY3280-MBR3 EVK features four CapSense buttons, one proximity sensor loop, LEDs, a buzzer, and an onboard USB-I²C bridge to communicate with the EZ-Click™ software tool, which configures the CY8CMBR3xxx controller.

The CY8CMBR3xxx series is the latest addition to the register-configurable CapSense Mechanical Button Replacement (MBR) family of solutions. The CY8CMBR3xxx family of controllers enables you to quickly and easily add capacitive touch sensing to your user interface. See [Configuring the CY8CMBR3116 Controller Using EZ-Click on page 18](#) for information on how to configure a CY8CMBR3116 controller. CY3280-MBR3 offers the best features of Cypress' CapSense in a small package that is easy to implement and configure. Coupled with the Capacitive Sigma Delta PLUS (CSD PLUS) sensing algorithm and the patented SmartSense™ Auto-Tuning feature, the CY8CMBR3xxx controller provides a robust capacitive sensing solution, with up to 16 CapSense inputs.

SmartSense Auto-Tuning has the following advantages:

- Reduces design effort by eliminating manual tuning
- Adapts to variations in PCB, overlay, paint, and manufacturing that degrade touch-sensing performance
- Eliminates manual tuning in production
- Adapts to changes in the system environment due to noise
- Allows a platform design approach with different overlays, button shapes, and trace lengths

The MBR3 solution delivers a high signal-to-noise ratio (SNR) even in extremely noisy environments and maintains optimal sensor performance at run time. The driven shield capability offers robust proximity sensing and water tolerance, enabling its use in a wide range of applications. The MBR3 solution supports register configurability and SmartSense Auto-Tuning features, which allow customers to gain a faster time-to-market for their end product.

The CY8CMBR3xxx family of controllers is designed with multiple low-power operational states to meet the low-power requirements of battery-powered applications. These controllers have the following operational states: Boot, Active, Look-for-Touch, Look-for-Proximity, Deep Sleep, and Configuration. The CY8CMBR3xxx controllers automatically manage transitions between the four states. The Look-for-Proximity state allows ultra-low power consumption when a human body is not in close proximity. This state is entered only if the wake-on-approach feature is enabled (and toggle is disabled) in the MBR3 register configuration, which can be done using EZ-Click. Refer to the [MBR3 device datasheet](#) for more details on the CY8CMBR3xxx family of CapSense controllers.

The kit package includes EZ-Click, which is required to configure the kit. For more information and to download the tool, visit the [EZ-Click webpage](#).

1.1 Kit Contents

The CY3280-MBR3 EVK includes the following components (see [Figure 1-1](#)):

- CY3280-MBR3 EVK with a 2-mm overlay
- One additional overlay of 1-mm thickness
- A to Mini-B USB cable
- Water dropper

Figure 1-1. Kit Contents



Inspect the contents of the kit. If you find any part missing, contact your nearest Cypress sales office for help: www.cypress.com/go/support.

1.2 Getting Started

This kit guide helps to familiarize you with the CY3280-MBR3 EVK. The [Kit Installation chapter on page 11](#) describes the installation of the EVK software. The [Kit Operation chapter on page 14](#) explains how to configure the CY8CMBR3116 controller on the kit to test different features using EZ-Click. The hardware details, and configuration files and example projects are explained in their respective chapters. The configuration files and example projects require [EZ-Click](#) and [PSoC Creator™](#), respectively. The [Advanced Topics chapter on page 70](#) describes how to use the Bridge Control Panel (BCP) to configure the MBR3 device. The [Appendix on page 76](#) provides the schematics, board layout, pin assignment, and the bill of materials (BOM).

1.3 Factory Default Configuration

The kit installation folder includes three configuration files that demonstrate several features of the CY8CMBR3116 CapSense controller. See [Configuration Files on page 46](#) for more details. The CY3280-MBR3 EVK is configured with the *Water Tolerance* configuration by default. In this configuration, water tolerance, flanking sensor suppression (FSS), and auto-reset features are enabled for four CapSense buttons. The LEDs are also enabled to provide visual feedback for CapSense button touch. For more details on configuring the MBR3 device, refer to the EZ-Click User Guide, available at `<Install_Directory>\EZ-Click\<version>\Documentation`.

1.4 Additional Learning Resources

Visit the [CY8CMBR3116 CapSense Controller page](#) for additional learning resources.

Visit the [CY8CMBR3xxx CapSense Design Guide page](#) for additional Host API-based demo projects.

Visit the [CapSense Code Examples page](#) for the list of code examples using CapSense controllers.

1.5 Technical Support

For assistance, go to our [support web page](#), or contact our customer support at +1(800) 541-4736 extension 2 (in the USA), or +1 (408) 943-2600 extension 2 (International).

1.6 Acronyms

Table 1-1. Acronyms Used in the Document

Acronyms	Definition
BCP	Bridge Control Panel
BOM	bill of materials
CS	capacitive sensor
CSD	CapSense sigma delta
ESD	electrostatic discharge
EVK	evaluation kit
FSS	flanking sensor suppression
GPO	general-purpose output
GUI	graphical user interface
IIC/I ² C	inter-integrated circuit
LED	light-emitting diode
MBR	mechanical button replacement
NC	not connected
PC	personal computer
PCB	printed circuit board
PSoC [®]	Programmable System-On-Chip
SNR	signal-to-noise ratio
UART	universal asynchronous receiver/transmitter
USB	universal serial bus

1.7 Document Conventions

Table 1-2. Document Conventions for Guides

Convention	Usage
Courier New	Displays file locations, user entered text, and source code: <code>C:\...cd\icc\</code>
<i>Italics</i>	Displays file names and reference documentation: Read about the <i>sourcefile.hex</i> file in the <i>PSoC Designer User Guide</i> .
[Bracketed, Bold]	Displays keyboard commands in procedures: [Enter] or [Ctrl] [C]
File > Open	Represents menu paths: File > Open > New Project
Bold	Displays commands, menu paths, and icon names in procedures: Click the File icon and then click Open .
Times New Roman	Displays an equation: $2 + 2 = 4$
Text in gray boxes	Describes Cautions or unique functionality of the product.

2. Kit Installation



This chapter describes the CY3280-MBR3 EVK software installation and the prerequisites.

2.1 Before You Begin

All Cypress software installations require administrator privileges, but these are not required to run the software after it is installed. Close any other Cypress software that is currently running before installing the kit software.

2.2 CY3280-MBR3 EVK Software

The kit requires Cypress' proprietary software, such as PSoC Programmer (3.24.2 or later) and EZ-Click (2.0 SP2 or later), and generic software such as .NET Framework, Windows Installer, and Internet Explorer. The CY3280-MBR3 software is available on the [kit web page](#) in three formats:

Table 2-1. Kit Software Formats

Install Package	File Format	Usage
CY3280-MBR3 Kit ISO	ISO	This package can be used if the PC does not have any Cypress or non-Cypress prerequisite software installed. It first installs the prerequisites and then the kit content (firmware, hardware, and documentation files) in the specified location.
CY3280-MBR3 Kit Setup	EXE	This package can be used if the PC does not have any Cypress prerequisite software installed. If any non-Cypress prerequisites are found to be missing during installation, the installer provides links to download and install them and then installs the kit content (firmware, hardware, and documentation files) in the specified location.
CY3280-MBR3 Kit Only	EXE	This package can be used if the PC has all the Cypress and non-Cypress prerequisites installed. It installs only the kit content (firmware, hardware, and documentation files) in the specified location. If any of the prerequisites are found missing during the installation process, the installer prompts you to install all the required software before attempting to install the kit. The installer redirects to the kit web page to download and install any missing Cypress software. Similarly, it provides links to download and install the missing non-Cypress prerequisites.

Notes:

- Adobe Reader is required to view kit documents. If Adobe Reader is not installed on your PC, the installer provides the link to download and install it.
- PSoC Creator is required to execute the PSoC 4 host example projects shipped with the kit. However, it is not a mandatory prerequisite and is not installed along with the kit contents. You can download and install PSoC Creator from www.cypress.com/go/psoccreator.

2.3 Install the Software

1. Run *cyautorun.exe* in the kit ISO to start the installation process.
2. Click **Install CY3280-MBR3 EVK** to start the kit installation; see [Figure 2-1](#).

Figure 2-1. Kit Installer Startup Screen



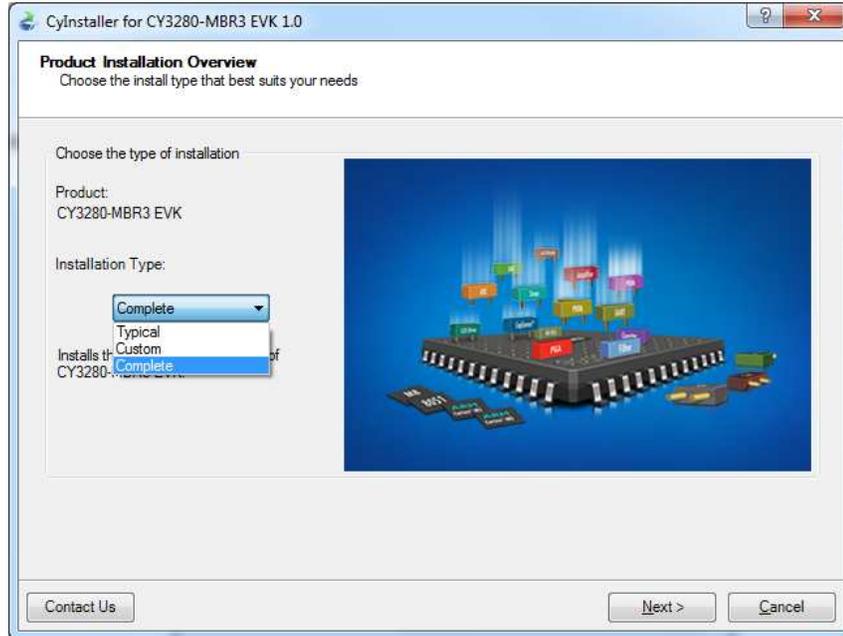
3. Select the folder to install the CY3280-MBR3 EVK files. Choose the directory and click **Next**, as shown in [Figure 2-2](#). The installation directory is referred to as `<Install_Directory>` in this document.

Figure 2-2. Default Path for EVK Installation



4. When you click **Next**, the *CY3280-MBR3 Kit ISO* installer automatically installs the required software, if it is not present on your computer.
5. Select the installation type (see [Figure 2-3](#)). The drop-down menu contains three options: **Typical** (installs all the required features), **Custom** (lets you choose the features to be installed), and **Complete** (installs all the contents). Click **Next** after you select the installation type.
Note: It is recommended that you choose the **Complete** installation type.

Figure 2-3. Installation Type Options



6. Accept the End-User License Agreement and click **Next** to proceed with the installation.
7. When the installation begins, a list of packages appears on the installation page. A green check mark appears adjacent to every package after successful installation.
8. Enter your contact information or select the **Continue Without Contact Information** check box.
9. Click **Finish** to complete the CY3280-MBR3 EVK software installation.

After the installation is complete, the kit contents are available at the following location:

<Install_Directory>\CY3280-MBR3 EVK\<version>

2.4 Uninstall the Software

You can uninstall the CY3280-MBR3 EVK software using one of the following methods:

- Go to **Start > All Programs > Cypress > Cypress Update Manager > Cypress Update Manager**; select the **Uninstall** button corresponding to the kit software.
- Go to **Start > Control Panel > Programs and Features**; select the **Uninstall/Change** button corresponding to the kit software.

3. Kit Operation



The CY8CMBR3116 CapSense controller is a register-configurable device that supports multiple features, as listed in [Kit Features on page 24](#). The CY3280-MBR3 EVK hardware includes four CapSense buttons, a proximity sensor loop, a buzzer, and LEDs; it can be used to demonstrate all the features of the MBR3 device.

The CY3280-MBR3 EVK enables you to develop applications using the CY8CMBR3116 controller. [Figure 3-1](#) and [Figure 3-2](#) illustrate the onboard components of the CY3280-MBR3 EVK.

Figure 3-1. CY3280-MBR3 EVK Top View

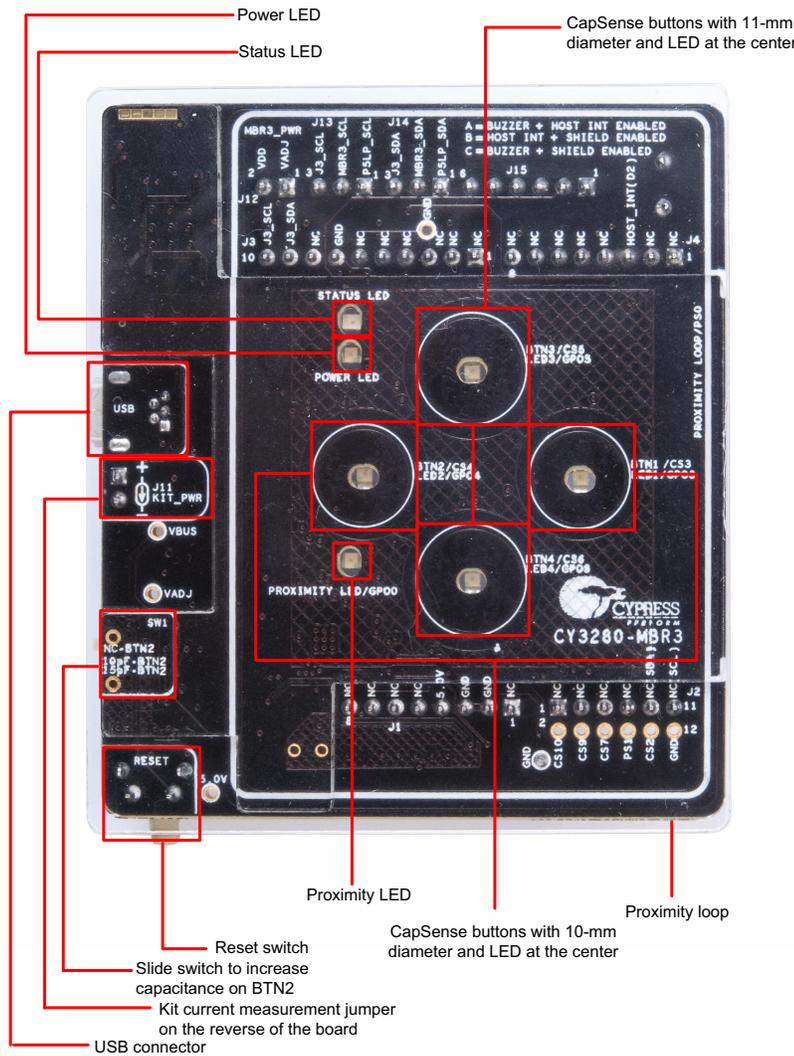
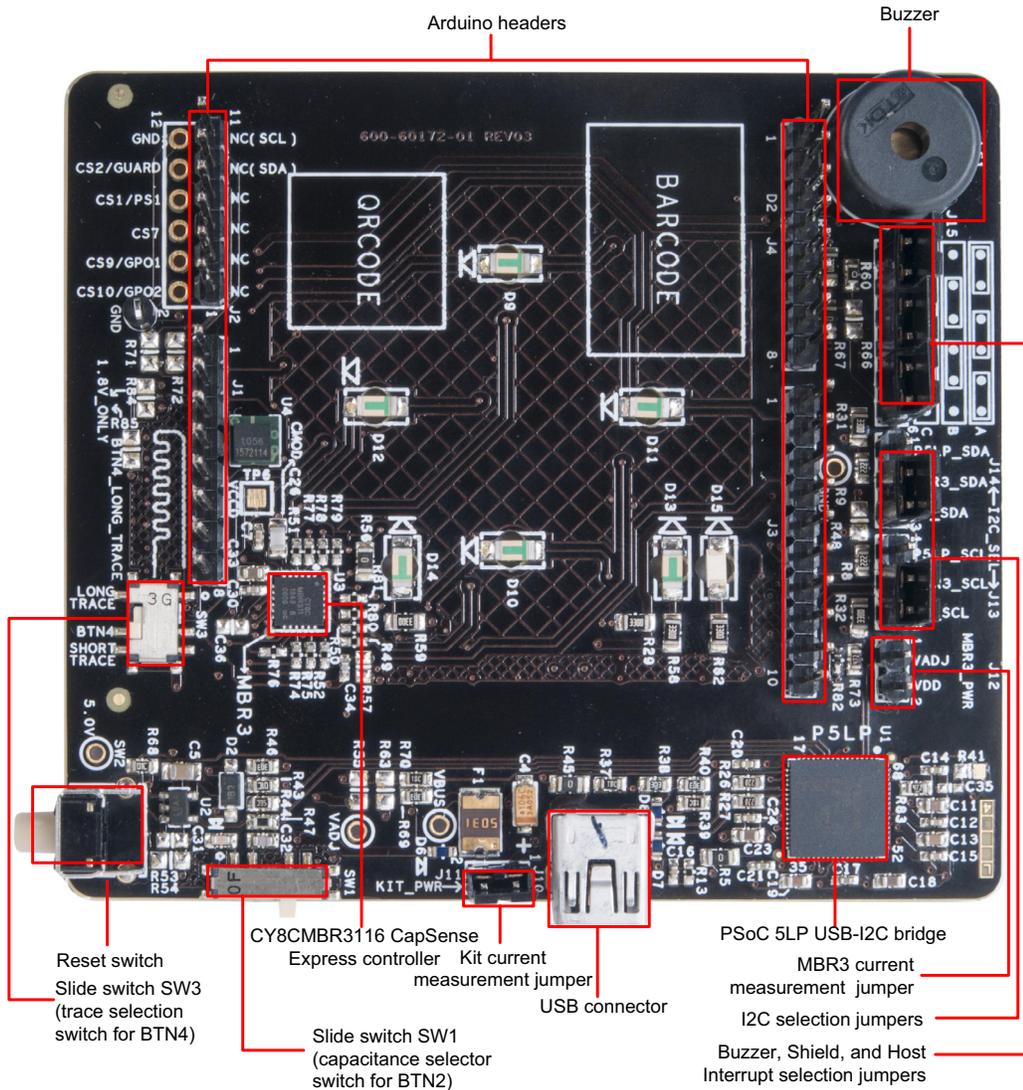


Figure 3-2. CY3280-MBR3 EVK Bottom View



3.1 Powering the Kit

To power the kit, connect the A to Mini-B USB cable, provided with the kit, to your PC or laptop. The kit enumerates as a composite device (see [Table 3-1](#)), and three separate devices appear under the Device Manager (**Start > Control Panel > Device Manager**) option of the Windows operating system, as shown in [Figure 3-5](#).

Table 3-1. CY3280-MBR3 Evaluation Kit in Device Manager after Enumeration

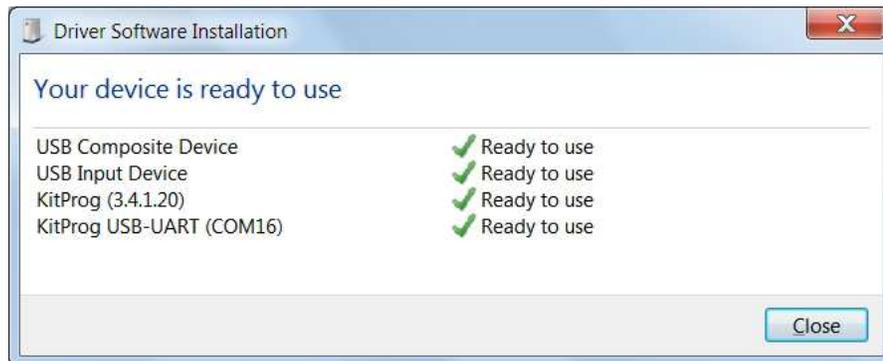
Port	Description
USB input device	USB-I ² C bridge
KitProg programmer	Programmer and debugger
KitProg USB-UART	USB-UART bridge appears as COM# port

Note: Although the kit supports a programmer and a UART bridge, these functionalities are not used with this kit. Do not use PSoC Programmer to communicate with the PSoC 5LP on the kit, as it may corrupt the kit firmware.

Figure 3-3. KitProg Driver Installation

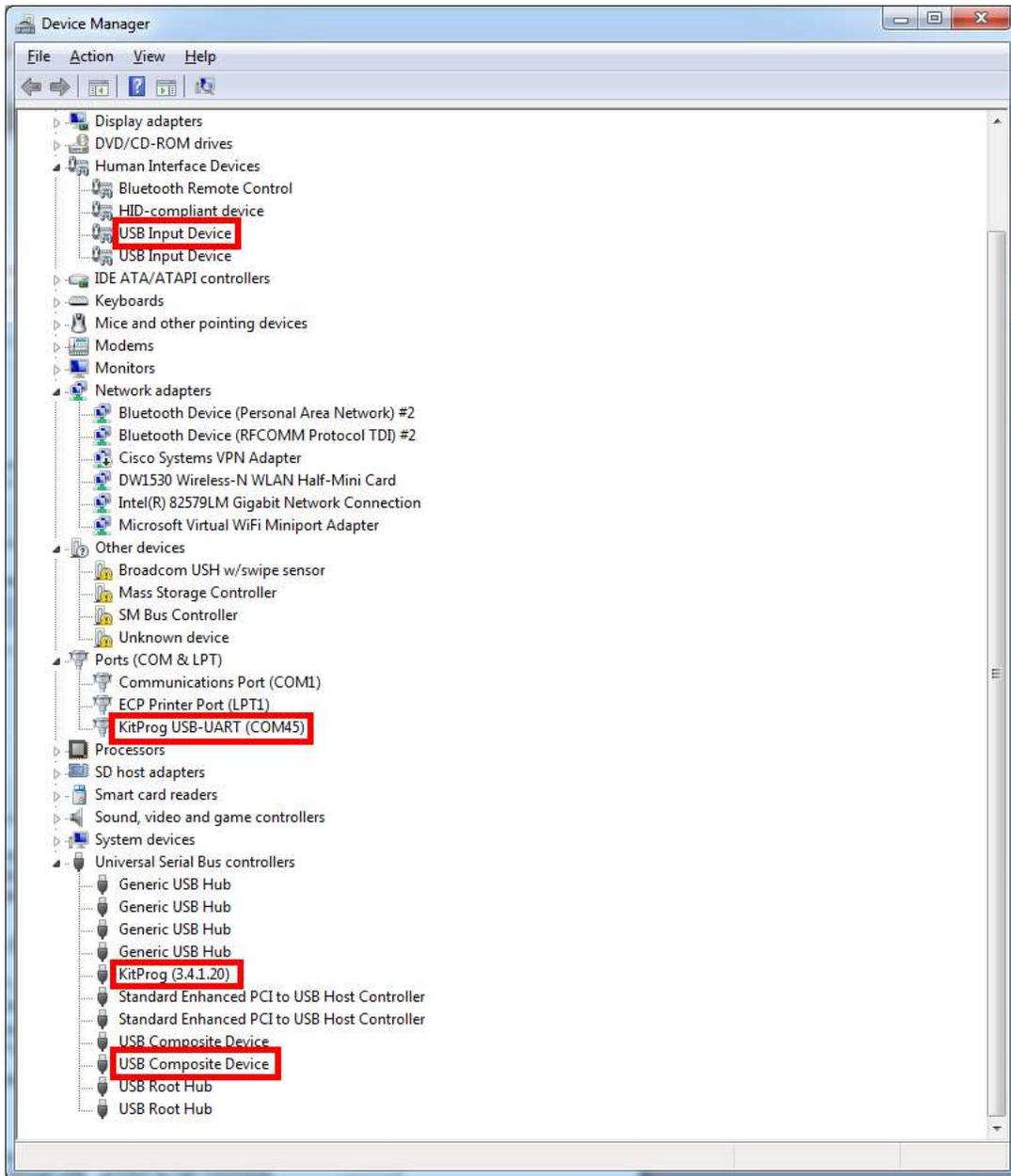


Figure 3-4. KitProg Driver Installation Complete



After the driver installation is complete, all the above devices are listed in the Device Manager, as shown in [Figure 3-5](#).

Figure 3-5. Device Manager View after KitProg is Installed



Note: The Device Manager may have more than one instance of 'USB Input Device' and 'USB Composite Device', based on the number of USB devices connected to your PC. The USB Input Device and USB Composite Device installed with KitProg can be identified by the hardware IDs (VID and PID); these devices will have hardware IDs 0x4B4 and 0xF139. To find the hardware ID, right-click on the device and select **Properties**. In the **Details** tab, select **Hardware IDs** from the **Property** field drop-down menu.

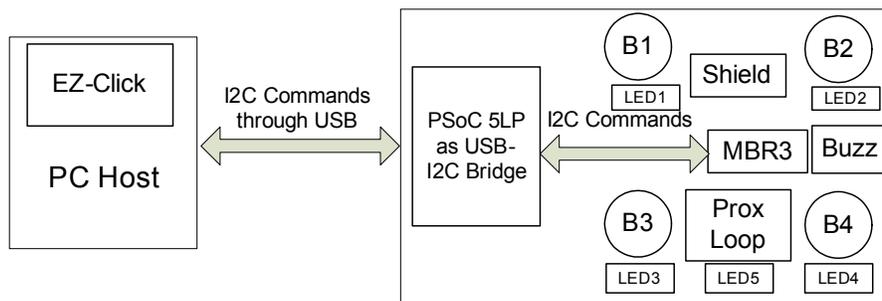
Wait until the USB enumeration completes successfully and the board is powered. When the USB enumeration is successful, both the power LED and status LED light up.

The kit is programmed with the *Water Tolerance* configuration by default. See [Water Tolerance on page 53](#) for more information.

3.2 Communication Between PC Host and Kit

The kit includes PSoC 5LP, an ARM-based PSoC that functions as a USB-I²C bridge between the CY8CMBR3116 controller and the PC host (see Figure 3-6). The CY8CMBR3116 controller communicates with PSoC 5LP using an I²C interface, and the PSoC 5LP transfers the data over USB to the PC and EZ-Click.

Figure 3-6. Block Diagram - Communication Between PC Host and Kit



Cypress provides two USB-I²C software utilities: EZ-Click and Bridge Control Panel (BCP). The CY3280-MBR3 EVK uses EZ-Click for register configuration. BCP is the software provided by Cypress that allows you to communicate over I²C, SPI, or RX8 using your PC and USB. This application currently supports CY3240, MiniProg3, FirstTouch, FirstTouchRF, TrueTouchBridge, DVKProg1, and KitProg bridges. See [Using PSoC 5LP as USB-I²C Bridge on page 70](#) for more details on using the BCP.

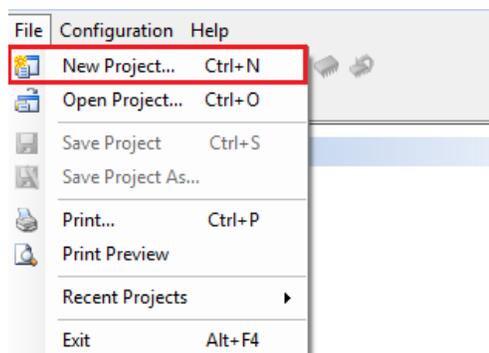
You should install EZ-Click on the PC to evaluate the kit features. This software is part of the kit installer, but it can also be downloaded from www.cypress.com/go/CY3280-MBR3. You can use EZ-Click to configure the CapSense controllers using I²C communication over the USB-I²C bridge. You can also use it to monitor raw count, baseline, SNR, and other CapSense sensor-related information directly.

3.3 Configuring the CY8CMBR3116 Controller Using EZ-Click

Follow these steps to configure the CY8CMBR3116 controller:

1. Connect the CY3280-MBR3 EVK to the PC via the USB port using the USB cable.
2. Open EZ-Click from the default location: **Start > All Programs > Cypress > EZ-Click <version> > EZ-Click <version>**.
3. Create a new project in EZ-Click by clicking **New Project...** in the File menu, as shown in [Figure 3-7](#).

Figure 3-7. Creating a New Project in EZ-Click



4. Enter an appropriate name for the project and choose a location to save your project. Select **Target Device** as 'CY8CMBR3116-LQXI' from the Product Selector. To launch the Product Selector, click the **Device Selector** button, as shown in the following figure.

Figure 3-8. New Project Details

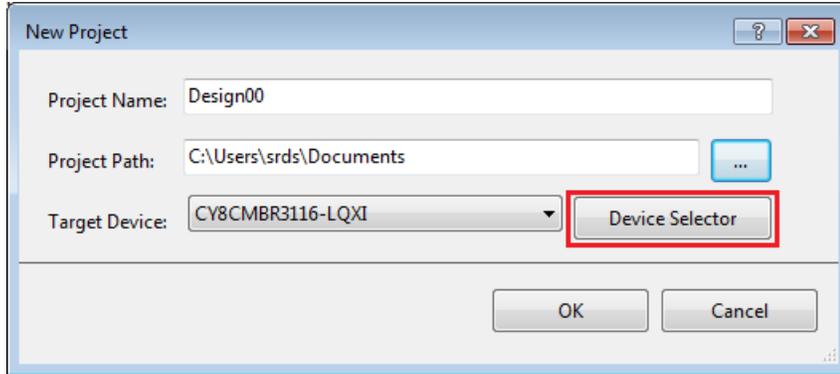
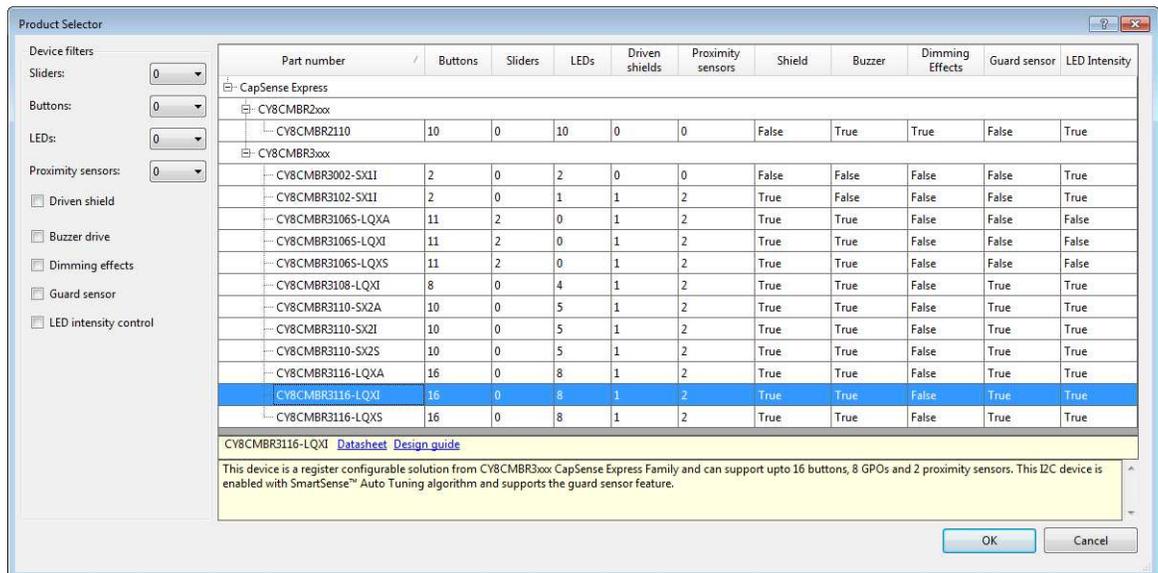
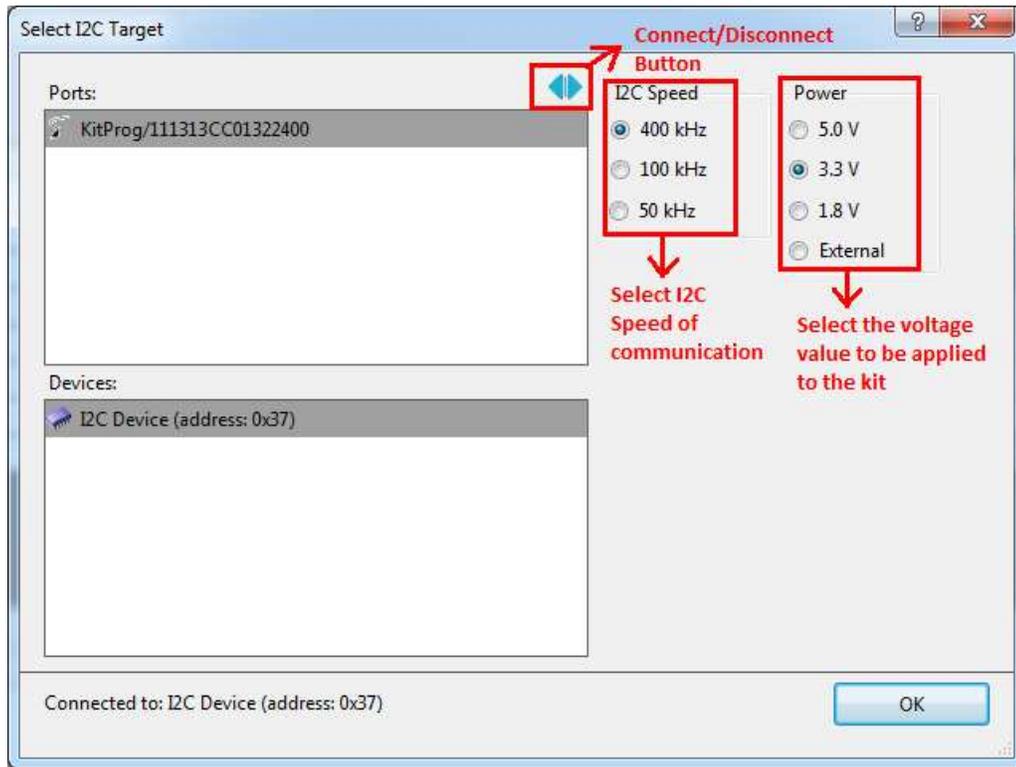


Figure 3-9. Choosing Part Number in Product Selector Guide



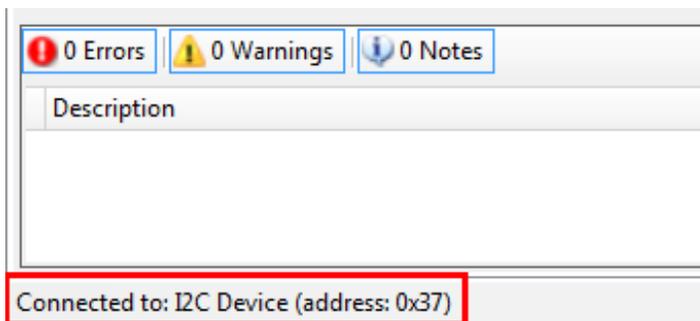
5. Ensure that the I²C selection jumpers J13 and J14 are shorted between pins 1 and 2 to allow communication with the onboard PSoC 5LP USB-I²C bridge.
6. Connect the kit to EZ-Click by clicking the **Select Target Device** button () on the EZ-Click tool bar. This opens a **Select I²C Target** window (Figure 3-10); select the following:
 - a. KitProg/<kit number> in the **Ports** window.
 - b. The I²C slave device in the **Devices** window.
Note: The CY8CMBR3116 has a slave address of 0x37 by default. If multiple slave devices are connected, you can disconnect from one slave and connect to another by using the **Connect/Disconnect** button in the **Select I²C Target** window. See Figure 3-10.
 - c. Select the speed of the I²C communication as **400 kHz**.
 - d. Choose the target device voltage by selecting the **3.3 V** radio button.

Figure 3-10. Connecting the Kit Using EZ-Click



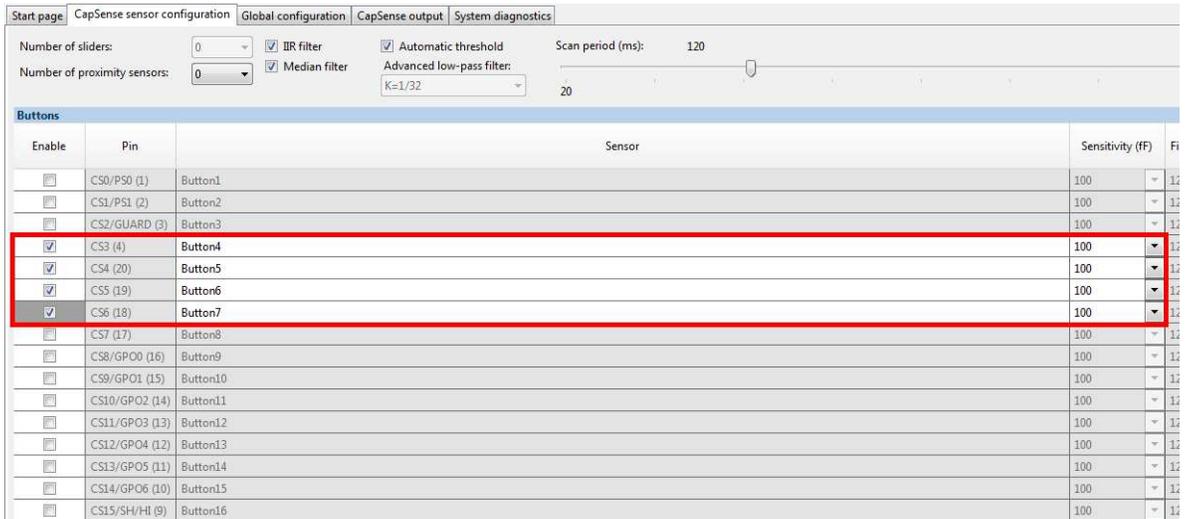
7. Click **OK**. The I²C slave address of the connected device appears on the status bar at the bottom of the EZ-Click window, as shown in [Figure 3-11](#).

Figure 3-11. I²C Slave Address Display



8. Enable the button sensors in the **CapSense sensor configuration** tab, as shown in [Figure 3-12](#). See [Pin Mapping Between CY8CMBR3116 and CY3280-MBR3 EVK on page 30](#) to learn about the available button sensors and how they are connected to the CY8CMBR3116 device. In this example, all four available button sensors on the kit are enabled.

Figure 3-12. Enabling Button Sensors Using EZ-Click



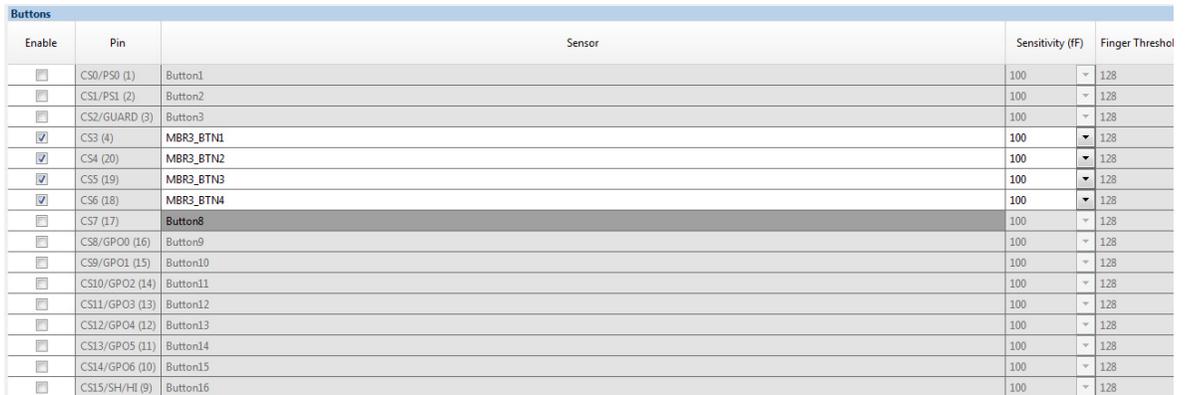
The screenshot shows the EZ-Click software interface for CapSense sensor configuration. The 'Buttons' table is highlighted with a red border. The table columns are 'Enable', 'Pin', 'Sensor', 'Sensitivity (fF)', and 'Finger Threshold'. Buttons 4 through 7 are checked in the 'Enable' column.

Enable	Pin	Sensor	Sensitivity (fF)	Finger Threshold
<input type="checkbox"/>	CS0/PS0 (1)	Button1	100	1.28
<input type="checkbox"/>	CS1/PS1 (2)	Button2	100	1.28
<input type="checkbox"/>	CS2/GUARD (3)	Button3	100	1.28
<input checked="" type="checkbox"/>	CS3 (4)	Button4	100	1.28
<input checked="" type="checkbox"/>	CS4 (20)	Button5	100	1.28
<input checked="" type="checkbox"/>	CS5 (19)	Button6	100	1.28
<input checked="" type="checkbox"/>	CS6 (18)	Button7	100	1.28
<input type="checkbox"/>	CS7 (17)	Button8	100	1.28
<input type="checkbox"/>	CS8/GPO0 (16)	Button9	100	1.28
<input type="checkbox"/>	CS9/GPO1 (15)	Button10	100	1.28
<input type="checkbox"/>	CS10/GPO2 (14)	Button11	100	1.28
<input type="checkbox"/>	CS11/GPO3 (13)	Button12	100	1.28
<input type="checkbox"/>	CS12/GPO4 (12)	Button13	100	1.28
<input type="checkbox"/>	CS13/GPO5 (11)	Button14	100	1.28
<input type="checkbox"/>	CS14/GPO6 (10)	Button15	100	1.28
<input type="checkbox"/>	CS15/SH/HL (9)	Button16	100	1.28

Note: The CapSense buttons BTN1/CS3, BTN2/CS4, BTN3/CS5, and BTN4/CS6 on the CY3280-MBR3 EVK correspond to Button4, Button5, Button6, and Button7 in EZ-Click, which map to pins CS3, CS4, CS5, and CS6 respectively on the MBR3 device. [Figure 3-14](#) shows the corresponding four buttons for reference.

9. The sensor names can be modified if desired, as shown in [Figure 3-13](#).

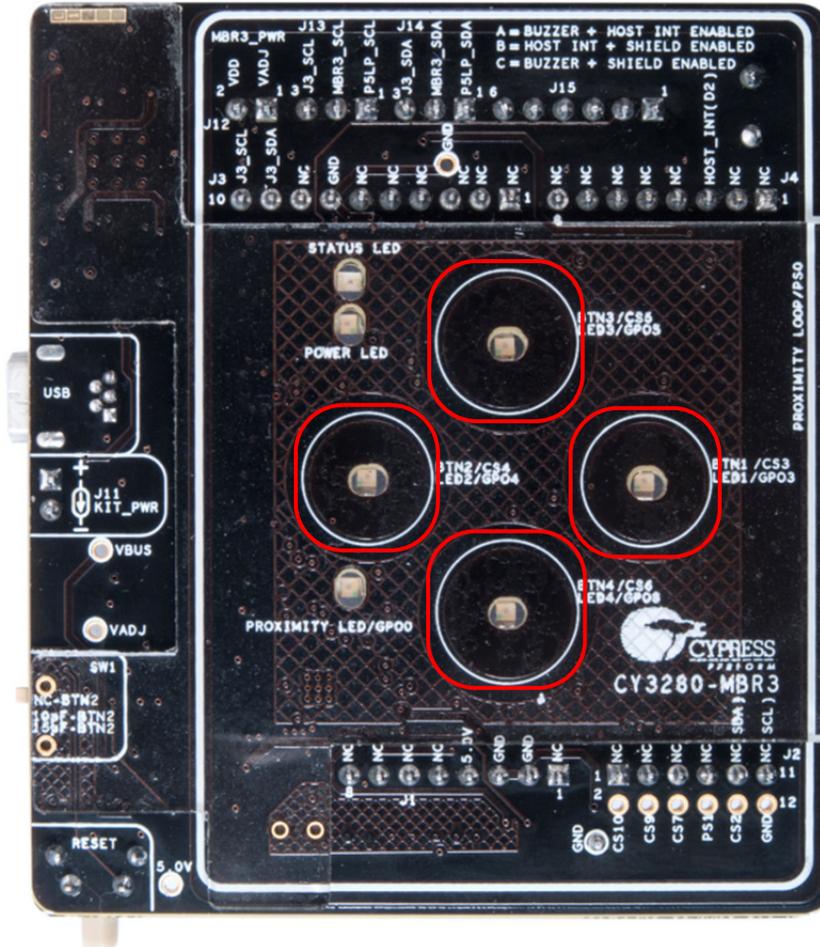
Figure 3-13. Changing Sensor Names



The screenshot shows the EZ-Click software interface for CapSense sensor configuration. The 'Buttons' table is shown with custom sensor names for buttons 4 through 7.

Enable	Pin	Sensor	Sensitivity (fF)	Finger Threshold
<input type="checkbox"/>	CS0/PS0 (1)	Button1	100	1.28
<input type="checkbox"/>	CS1/PS1 (2)	Button2	100	1.28
<input type="checkbox"/>	CS2/GUARD (3)	Button3	100	1.28
<input checked="" type="checkbox"/>	CS3 (4)	MBR3_BTN1	100	1.28
<input checked="" type="checkbox"/>	CS4 (20)	MBR3_BTN2	100	1.28
<input checked="" type="checkbox"/>	CS5 (19)	MBR3_BTN3	100	1.28
<input checked="" type="checkbox"/>	CS6 (18)	MBR3_BTN4	100	1.28
<input type="checkbox"/>	CS7 (17)	Button8	100	1.28
<input type="checkbox"/>	CS8/GPO0 (16)	Button9	100	1.28
<input type="checkbox"/>	CS9/GPO1 (15)	Button10	100	1.28
<input type="checkbox"/>	CS10/GPO2 (14)	Button11	100	1.28
<input type="checkbox"/>	CS11/GPO3 (13)	Button12	100	1.28
<input type="checkbox"/>	CS12/GPO4 (12)	Button13	100	1.28
<input type="checkbox"/>	CS13/GPO5 (11)	Button14	100	1.28
<input type="checkbox"/>	CS14/GPO6 (10)	Button15	100	1.28
<input type="checkbox"/>	CS15/SH/HL (9)	Button16	100	1.28

Figure 3-14. Kit Buttons Corresponding to CapSense Sensor Pins

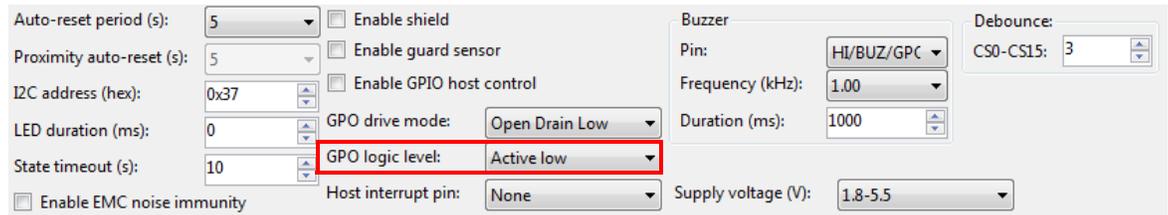


10. Enable the corresponding LEDs in the **Global configuration** tab, as shown in [Figure 3-15](#), to view the LED output for each button touch. Ensure that the GPO logic level is **Active Low** because the LEDs on the CY3280-MBR3 EVK are active low.

Note: LED1/GPO3, LED2/GPO4, LED3/GPO5, and LED4/GPO6 on the CY3280-MBR3 EVK correspond to LED4, LED5, LED6, and LED7 in EZ-Click, which map to the general-purpose output (GPO) pins CS11/GPO3, CS12/GPO4, CS13/GPO5, and CS14/GPO6 respectively on the MBR3 device.

If the ‘host control’ feature is disabled in the MBR3 device, the LEDs will be mapped to the corresponding CapSense sensors. This means, CS0 will be mapped to GPO0, CS1 will be mapped to GPO1, and so on. If a sensor is active, the corresponding LED will be turned on even if it is not enabled in EZ-Click. The Enable option in EZ-Click is used only for LED features such as duty cycle, LED duration, and toggle. To disable an LED, you need to enable the ‘host control’ feature and configure the GPO drive mode as **Strong** and GPO logic level as **Active High**.

Figure 3-15. Global Configuration Tab



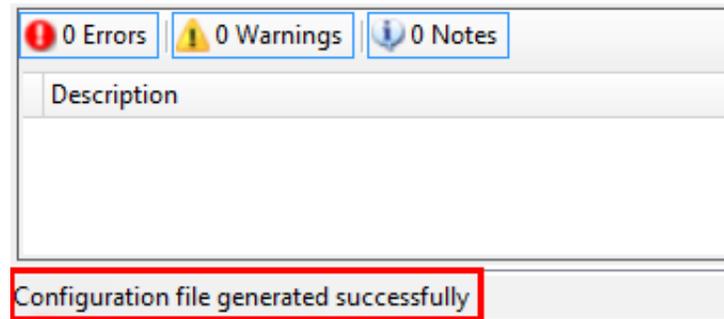
11. The LEDs can also be renamed, as shown in Figure 3-16.

Figure 3-16. Rename LEDs

Enable	Name	Pin	Active duty cycle
<input type="checkbox"/>	LED1	CS8/GPO0 (16)	100 %
<input type="checkbox"/>	LED2	CS9/GPO1 (15)	100 %
<input type="checkbox"/>	LED3	CS10/GPO2 (14)	100 %
<input checked="" type="checkbox"/>	MBR3_LED1	CS11/GPO3 (13)	100 %
<input checked="" type="checkbox"/>	MBR3_LED2	CS12/GPO4 (12)	100 %
<input checked="" type="checkbox"/>	MBR3_LED3	CS13/GPO5 (11)	100 %
<input checked="" type="checkbox"/>	MBR3_LED4	CS14/GPO6 (10)	100 %
<input type="checkbox"/>	LEDB	HI/BUZ/GPO7 (23)	100 %

12. Generate the configuration file by clicking the Generate Configuration File icon  on the tool bar or by pressing **[Ctrl] + [G]**. The status of configuration file generation is shown in the status bar at the bottom of the EZ-Click window (see Figure 3-17).

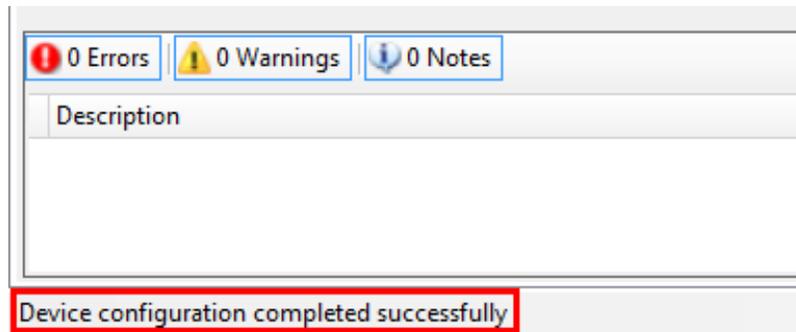
Figure 3-17. EZ-Click Status Bar Showing Configuration Generation Status



13. Click the Apply Current Configuration icon  on the tool bar in EZ-Click or press **[Ctrl] + [L]** to download the generated configuration to the MBR3 device.

14. Wait for the message “Device configuration completed successfully” to be displayed on the status bar, as illustrated in Figure 3-18.

Figure 3-18. EZ-Click Status Bar Showing Successful Device Configuration



15. Touch the buttons on the kit to observe the features as enabled in the configuration.

Note: The *Water Tolerance* configuration file is preloaded into the kit. The kit supports the features mentioned in [Water Tolerance on page 53](#) by default. To learn more about the configurations, see [Configuration Files on page 46](#).

3.4 Kit Features

The CY3280-MBR3 EVK includes the following features:

- Four CapSense buttons of two different sizes – two buttons of 10-mm diameter (BTN1 and BTN2) and two buttons of 11-mm diameter (BTN3 and BTN4)
- LEDs corresponding to sensors indicating button touch
- A buzzer
- Shield electrode pin for water tolerance
- I²C selection jumpers
- Arduino-compatible headers
- One proximity loop and a corresponding LED to indicate proximity state (on/off)
- A host interrupt pin
- Two slide switches on two CapSense buttons to vary trace capacitance and demonstrate SmartSense Auto-Tuning

Note: The CS15 pin of the MBR3 device is multiplexed for the CapSense button, host interrupt, and shield electrode. Similarly, GPO7 is multiplexed for general-purpose output, host interrupt, and buzzer output. All three features – host interrupt, buzzer, and shield electrode (water tolerance) cannot be enabled simultaneously. See [Buzzer, Shield, and Host Interrupt Multiplexing Jumper on page 39](#) for more details on CS15 and GPO7 pin connections.

3.4.1 SmartSense Auto-Tuning Feature

The CY8CMBR3116 device features SmartSense Auto-Tuning, which is the Cypress proprietary CapSense algorithm that compensates for system, manufacturing, and environmental changes while providing feature-rich CapSense solutions.

- Reduces design effort by eliminating tedious manual tuning
- Adapts to variations in PCB, overlay, paint, and manufacturing that degrade touch-sensing performance
- Eliminates production-related manual tuning
- Adapts to changes in system environment due to noise sources
- Allows a platform design approach with different overlays, button shapes, and trace lengths

The CY8CMBR3116 also supports setting manual thresholds to override the auto-tuning mechanism, if required.

SmartSense Auto-Tuning is demonstrated using three methods on the kit. See [Capacitance Variation Demonstration on page 41](#) for hardware details:

1. Using the SW1 slide switch to increase capacitance
 - a. Power on the kit using USB or an external power supply on pin 4 of the J1 header.
 - b. Touch BTN2 on the kit; the corresponding LED will turn on, providing visual feedback on each button touch.
 - c. Increase the capacitance of BTN2 by sliding SW1 to add an additional 10-pF or 15-pF external capacitance on the sensor, as shown in [Figure 3-19](#); the LED turns on as if a touch

occurred due to the increase in capacitance. Now, press the reset switch, SW2, to reset the board.

- d. Touch BTN2 on the kit; the corresponding LED works normally. This demonstrates the SmartSense Auto-Tuning algorithm, which automatically tunes for the increased CapSense button capacitance.

Note: The SW1 switch has three positions: at the NC-BTN2 position, the button is directly connected to the CS4 pin on MBR3 and no additional capacitance is added. At the 10pF-BTN2 and 15pF-BTN2 positions, an additional trace capacitance of 10 pF and 15 pF respectively are added to the CapSense button. The SW1 switch simulates changes in trace parasitic capacitance.

Figure 3-19. SW1 Slide Switch in NC-BTN2 Position



2. Using a short/long trace by adjusting the SW3 slide switch on the kit
 - a. Power on the kit using USB or an external power supply on pin 4 of the J1 header.
 - b. Touch BTN4 on the kit. The LED corresponding to BTN4 will turn on, providing visual feedback on each touch.
 - c. Increase the parasitic capacitance of BTN4 by sliding SW3 (see [Figure 3-20](#)) to add a longer trace on BTN4.
 - d. The LED turns on as if a touch occurred due to the increase in capacitance. Now, press the reset switch, SW2, to reset the board.
 - e. Touch BTN4 on the kit; the corresponding LED works normally and provides visual feedback on each touch. This demonstrates the SmartSense Auto-Tuning algorithm, which automatically tunes for the increase in CapSense button capacitance due to the long trace.