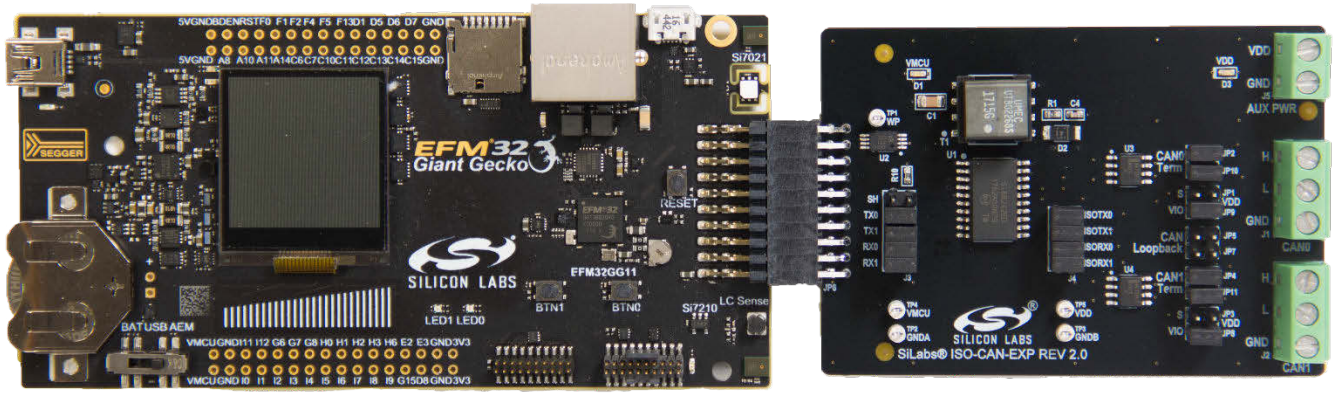
UG322: Isolated CAN Expansion Board User Guide

The Silicon Labs Isolated CAN Evaluation Board is a hardware plugin card for CAN capable EFM32 Starter Kits (STKs). The Isolated CAN EXP is intended to help demonstrate and evaluate applications for Silicon Labs isolation and MCU products. Silicon Labs isolation products create a CMOS barrier to protect components while still allowing for communication and power transfer. Silicon Labs MCU products offer broad solutions for low-power, indusrial, consumer electronics, and more. Software demos are available for connectiong the MCU to the Isolated CAN EXP and can be downloaded and run through Simplicity Studio. The demos are able to send signals across the isolation barrier and the message be seen by the user on the screen of the MCU STK. They also showcase Silicon Labs ISOVolt technology as the MCU powers components across the isolation barrier.

Note: For full use and evaluation of the Isolated CAN EXP, a CAN capable MCU STK is needed, like the EFM32GG11 STK (STK3701). Software examples are provided for the EFM32 Giant Gecko 11 Starter Kit EFM32GG-STK3701.

KEY FEATURES

- 20-pin headers for connection to EFM32 starter kits
- Software demos available in Simplicity Studio
- Power and communication over isolation barrier
- Jumpers for easy manual control of input signals



1. Kit Contents

The Isolated CAN Evaluation Kit contains the Expansion Board and a QR code card for quick access to information. Other features of the kit include:

- 20-pin header to connect to the MCU STK
- Dual CAN transceivers
- CAN0 port with High, Low, and Ground
- CAN1 port with High, Low, and Ground
- Power of the EXP board through the 20-pin header or screw terminals
- Breakout points for precise evaluation of specific systems
- Isolation barrier to separate the STK MCU from the EXP
- Easy use through Simplicity Studio

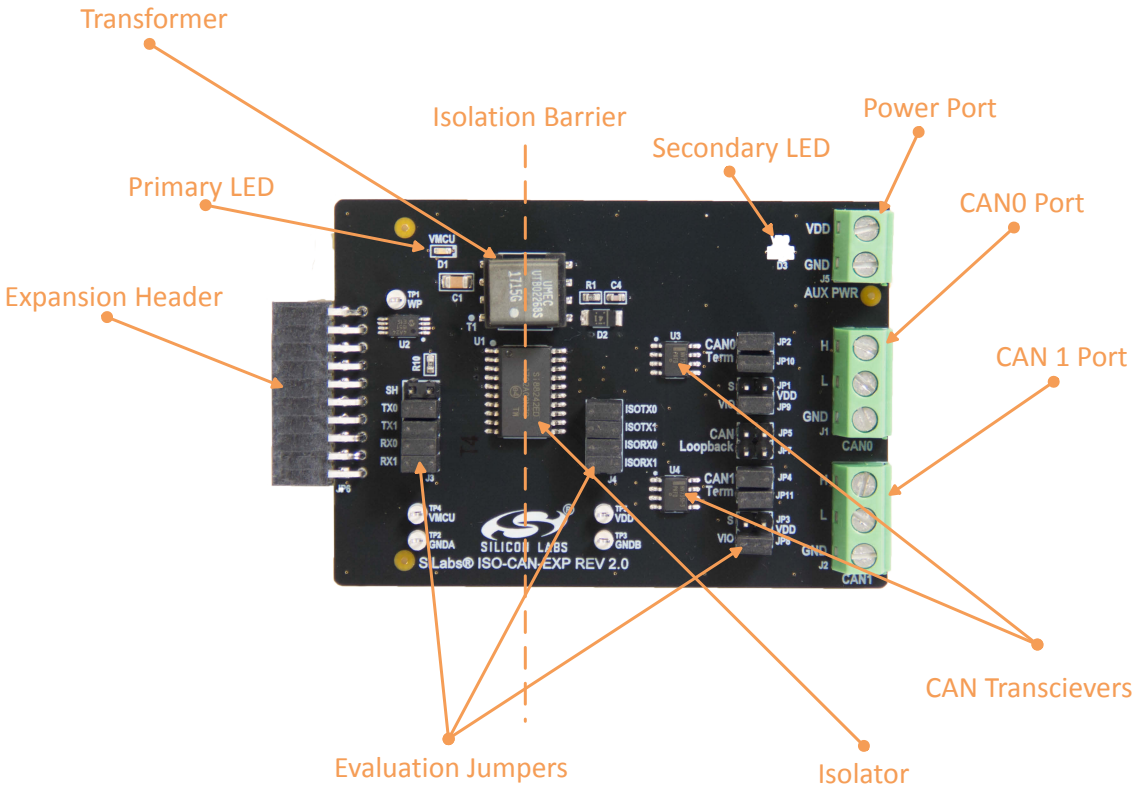


Figure 1.1. Annotated Isolated CAN EXP

2. Details and Applications

This evaluation kit and associated demos allow the MCU STK, Isolated CAN EXP, and sensors to communicate through the CAN ports on the EXP board while being isolated. The MCU acts as the protocol controller and sends the receive and transmit data to the isolator. These signals are carried through the barrier into a CAN transceiver which converts them to physical CAN bus. Then the CAN ports can be read by a host or another MCU/EXP combination. The CAN communication protocol is widely used in industrial, automotive, and commercial applications where long wires, multiple nodes, high power, or noise are common. Isolation along with CAN is widely needed in the following markets:

- Industrial automation systems
- Medical electronics
- Hybrid electric vehicles
- PLCs, distributed control systems
- Isolated switch mode supplies
- Isolated ADC and DACs
- Motor control
- Power inverters
- Communication systems

All of these market segments use various communication protocols like RS485, CAN, I2C, SPI, and UART. The combination of Silicon Labs isolators and MCU products can serve any of these segments by combining a low-power, feature-dense MCU alongside industry leading isolation.

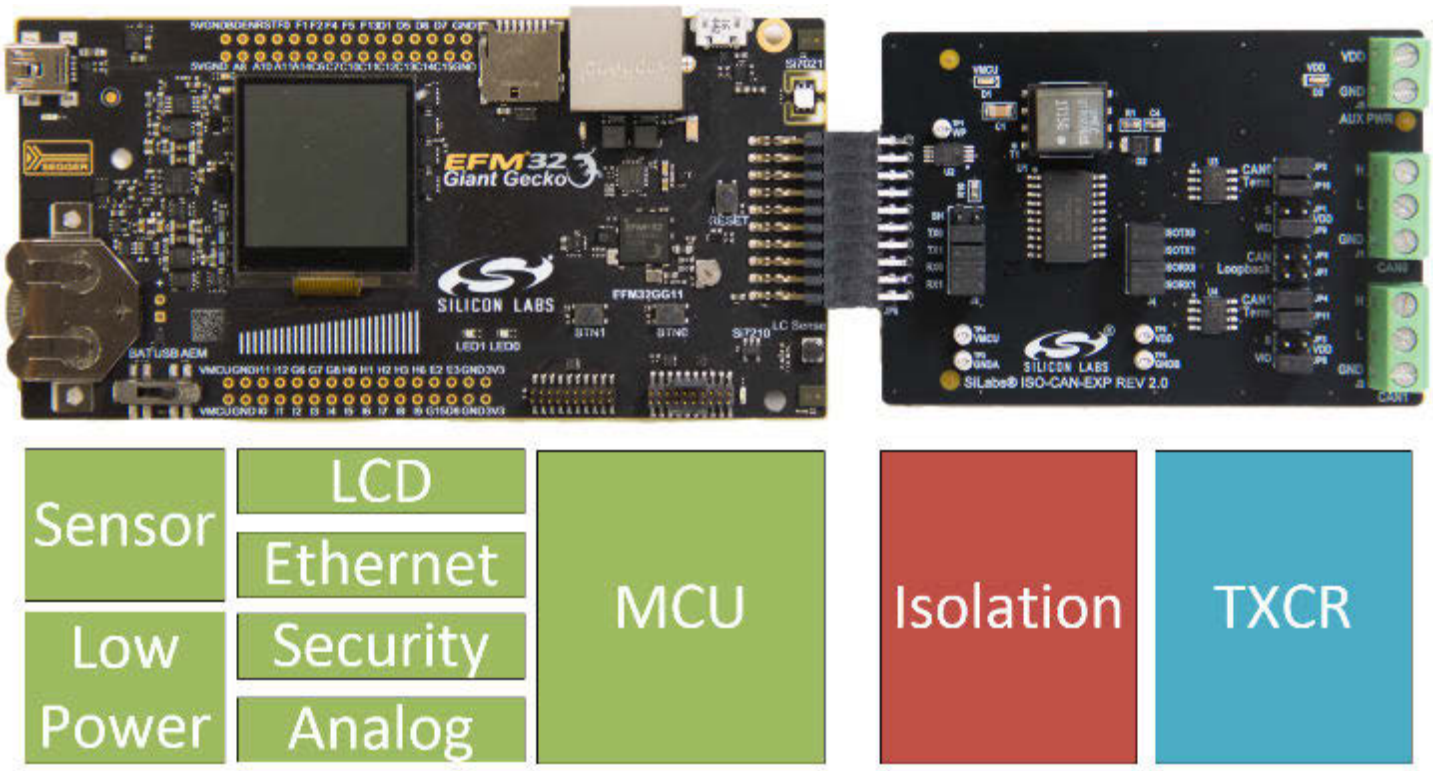


Figure 2.1. MCU + Isolated CAN EXP Block Diagram

2.1 Hardware

The Isolated CAN EXP's key components are:

- Si88242ED-IS – Digital Isolator with Integrated DC-DC Converter containing 4 unidirectional channels, Automotive, 20-pin SOIC
- 2 x NCV7351D13R2G – CAN transceiver
- UTB02268s – power inverter

The flow of the EXP board connected to an MCU Starter Kit is shown in the figure below.

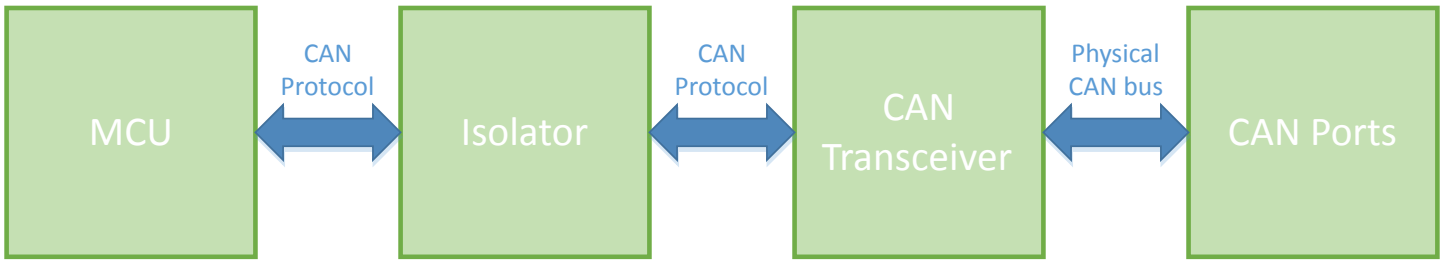


Figure 2.2. Isolated CAN EXP and MCU STK Block Diagram

2.1.1 Jumpers and Headers

The Isolated CAN EXP contains many jumpers and headers for easy debugging and added functionality.

JP1 and JP3 control the silent mode of the CAN transceivers. Populating these will silence the CAN transceivers preventing them from sending data on the CAN bus; however, they will still receive and provide the data to the MCU.

J3 contains the pre-isolated CAN data signals, as well as shutdown for the DC-DC converter. Populating the shutdown, which is the top row jumper, will prevent power from going across the isolation barrier. Note that when the shutdown is populated, auxiliary power must be provided to the other side of the isolation barrier.

J4 contains the post-isolation CAN data signals.

JP2, JP4, JP10, and JP11 control the CAN termination. Use these to either connect or disconnect the 120-Ω termination resistors that need to be on the end of the CAN bus.

JP9 and JP8 control the digital level of the CAN transceivers.

JP5 and JP7 enable or disable CAN loopback. With these two jumpers populated, the ports CAN0 and CAN1 will be connected, thereby allowing the MCU to communicate back to itself. This is intended as an evaluation and debugging mode.

The schematics for the board are found in the figure below.

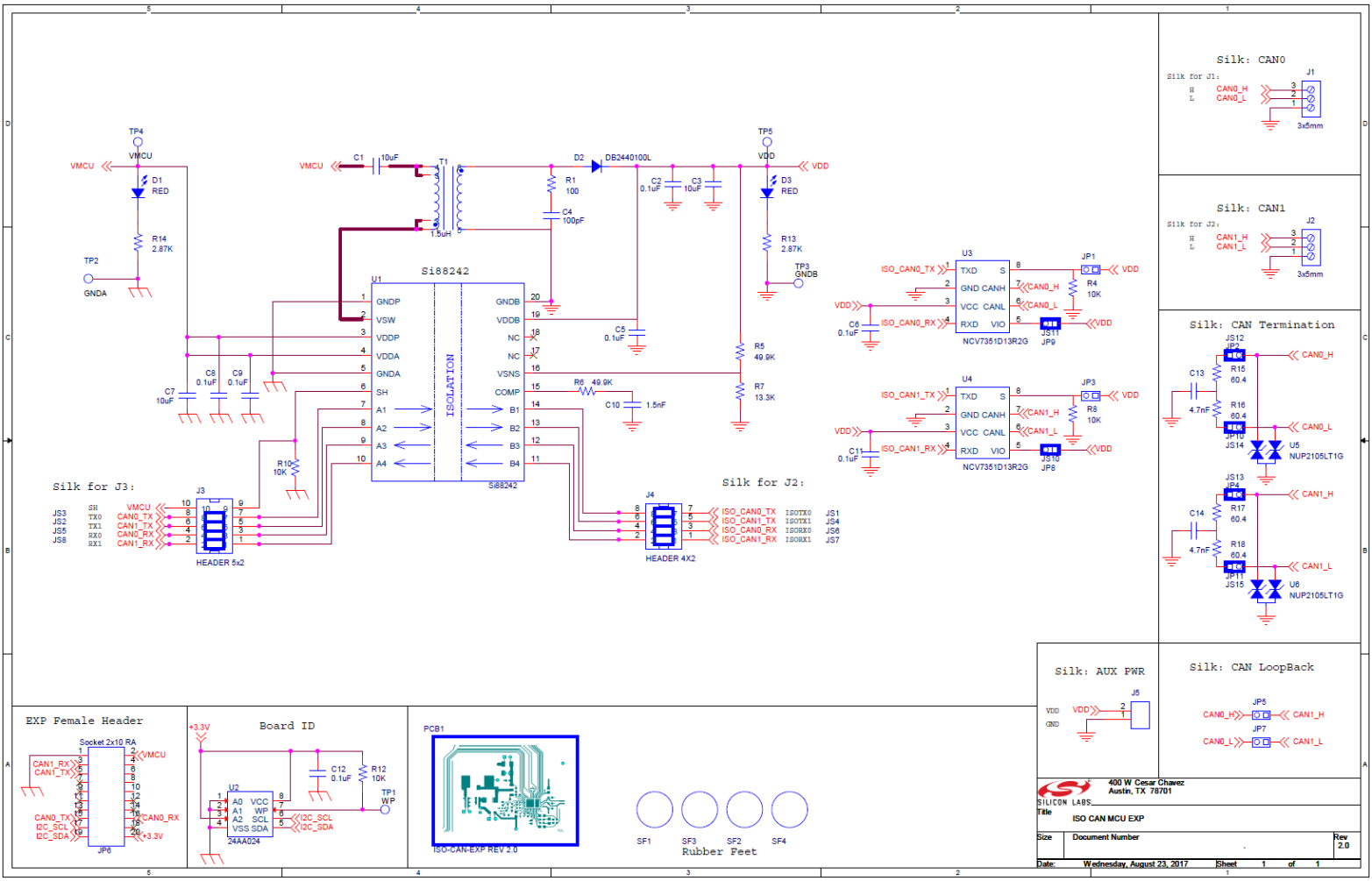


Figure 2.3. Isolated USB EXP Schematic

2.1.2 Header Connections

The Isolated CAN EXP connects to the MCU STK via a 20-pin header. The EXP board contains the receptacle, and the MCU STK contains the pins. Refer to the figure below for the exact pin out.

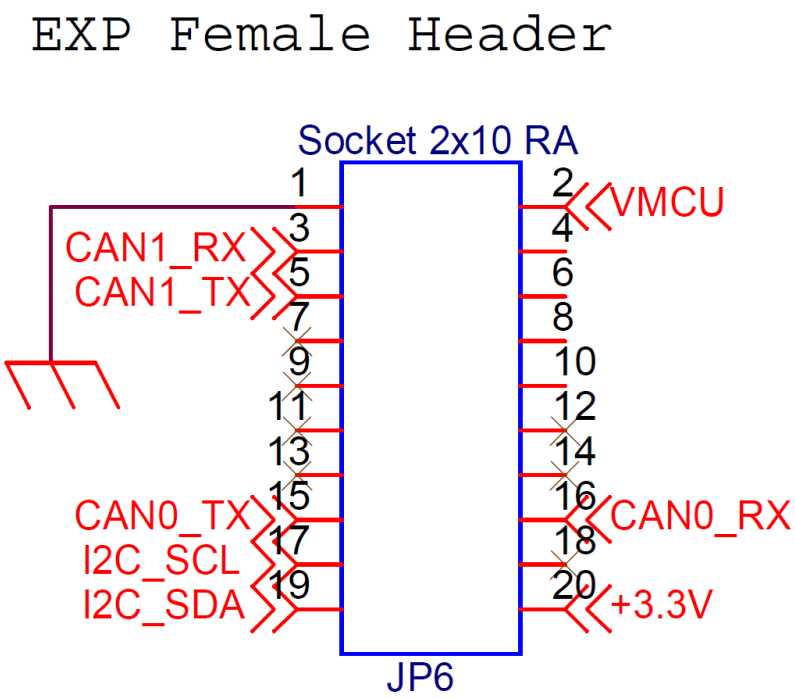


Figure 2.4. Isolated CAN EXP Receptacle Header

Refer to the individual MCU STK user guides for each specific boards pin out and pin functions. The example in the figure below is the EFM32 Giant Gecko 11 Starter Kit (SLSTK3701A) pin out.

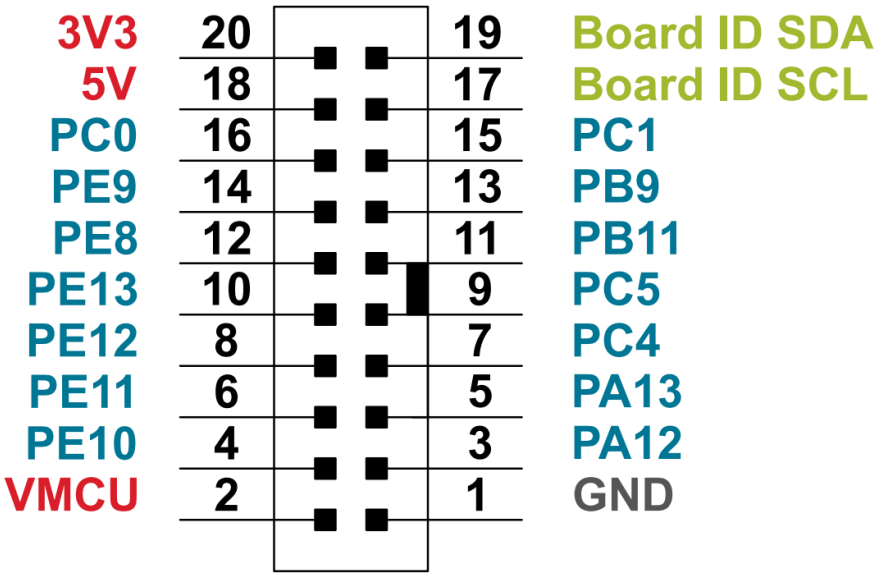


Figure 2.5. EFM32 Giant Gecko 11 STK3701A 20-pin Expansion Header

3. Getting Started

The first step to getting started with your new Isolated CAN EXP is to download Simplicity Studio from www.silabs.com/simplicity-studio. The simplicity studio software package contains all the tools, drivers, software examples, and documentation needed to use the Isolated CAN EXP. You will need to connect the Isolated CAN EXP to the EFM32GG-STK3701A Giant Gecko STK. The demo code can be loaded using the USB cable and the J-Link debug interface.

Note: This document will walk through the evaluation process assuming one Giant Gecko MCU STKs and one Isolated CAN EXP are used in CAN loopback mode, see the figure below for the final setup.

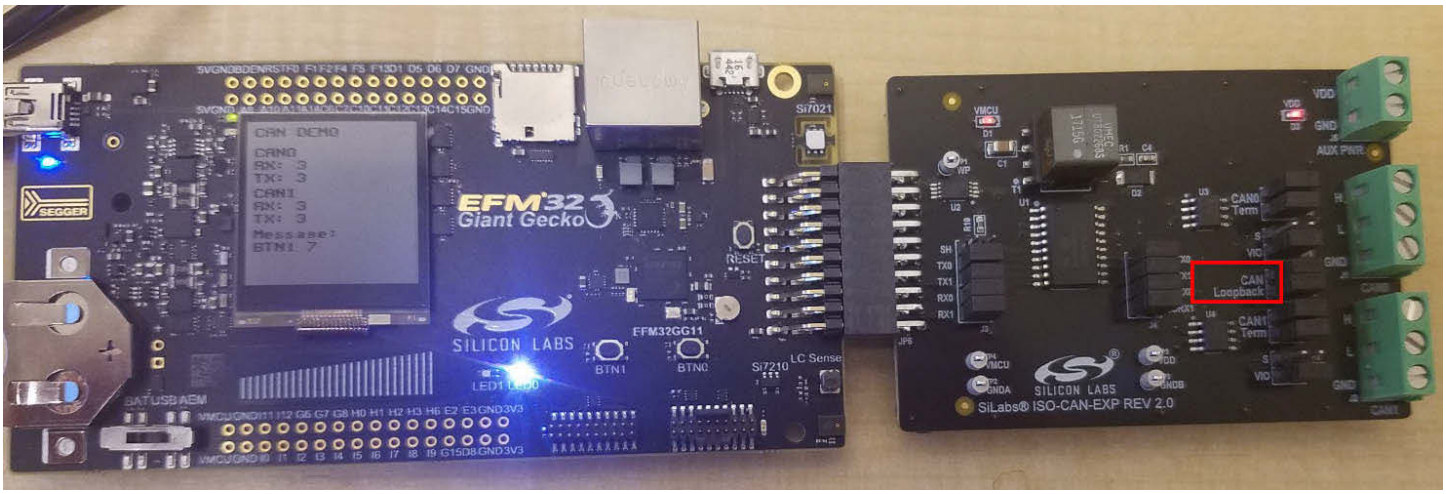


Figure 3.1. Completed CAN Demonstration Set Up

3.1 Loading CAN Software Demo

The following steps will load the demo firmware onto the Giant Gecko STK. This process requires Simplicity Studio which is available for download at www.silabs.com/simplicity-studio.

1. Use a USB mini type cable to connect the J-Link debug interface on the Giant Gecko STK to the PC, and position the power source select switch to AEM (right-most position).
2. Launch Simplicity Studio.
3. Click on [**Refresh Detected Hardware**].
4. Select the Giant Gecko STK device, under the Device tab.
5. Click on the [**New Project**] button.

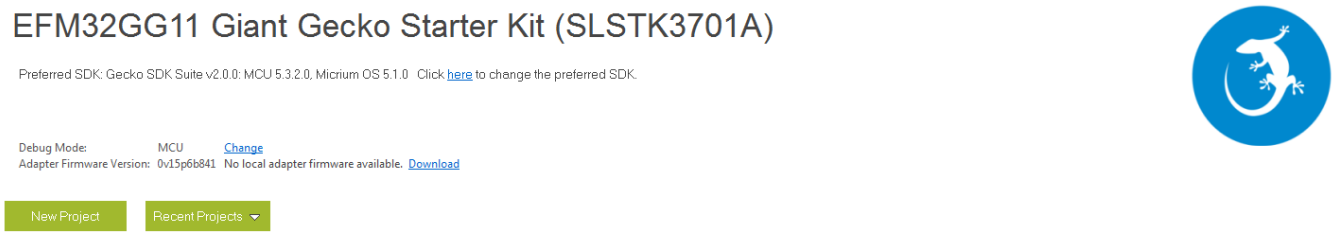


Figure 3.2. Opening a New Project with the EFM32 Giant Gecko

6. Ensure the Giant Gecko Start Kit is selected and hit [**Next**].

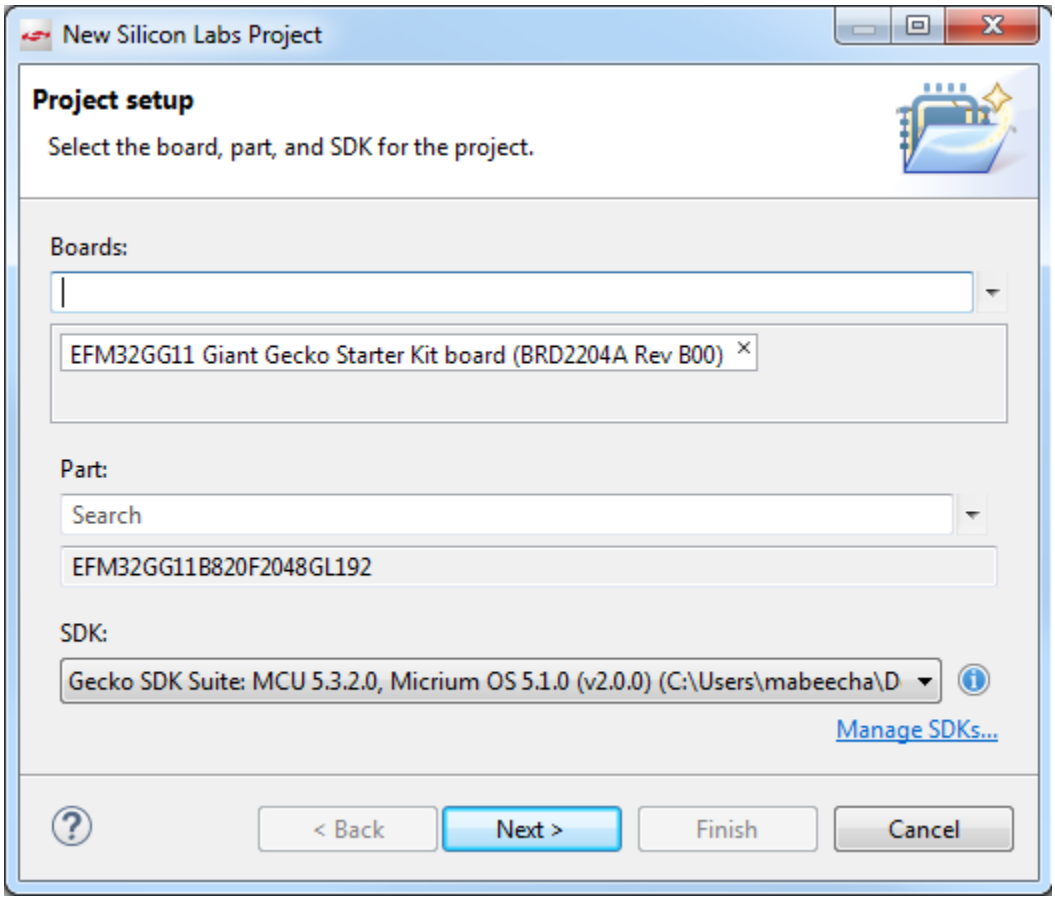


Figure 3.3. Project setup

7. Select [**Example**] and hit [**Next**].

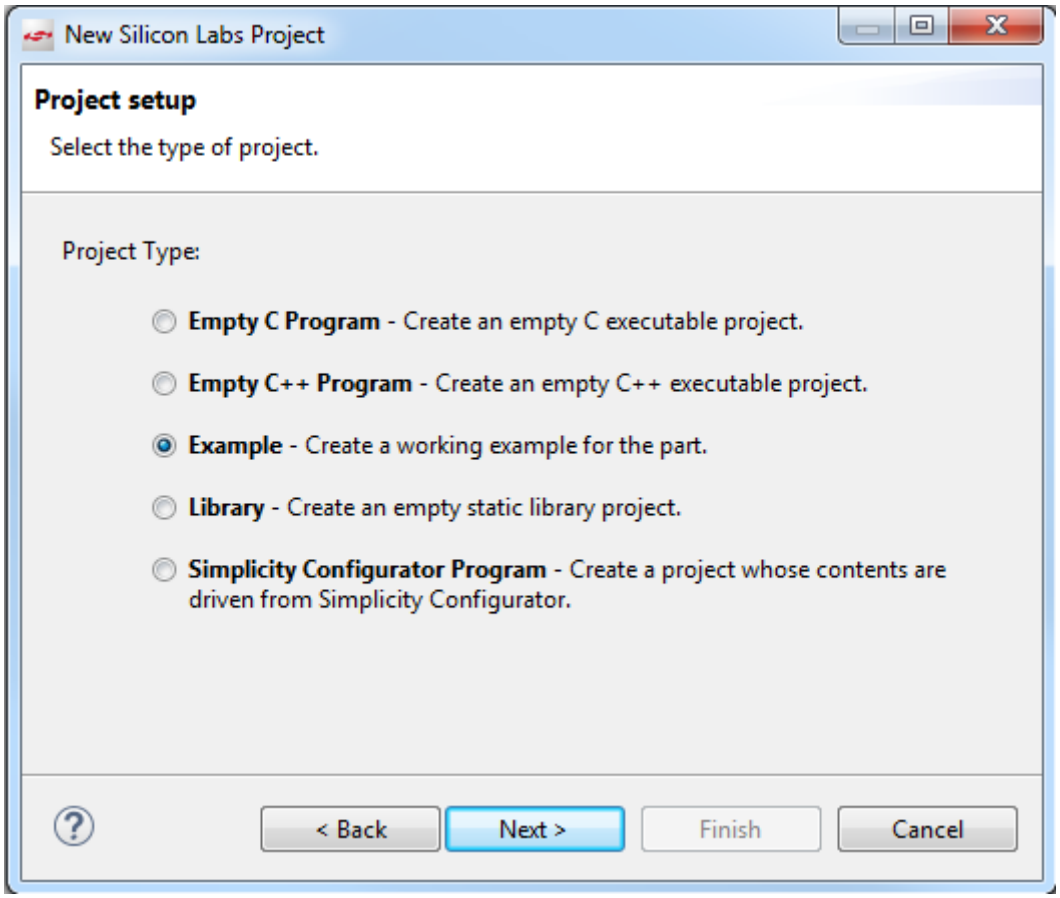


Figure 3.4. Starting from an Example

8. Locate the *can_board* example and hit [**Next**] and then [**Finish**] to complete creating a new project

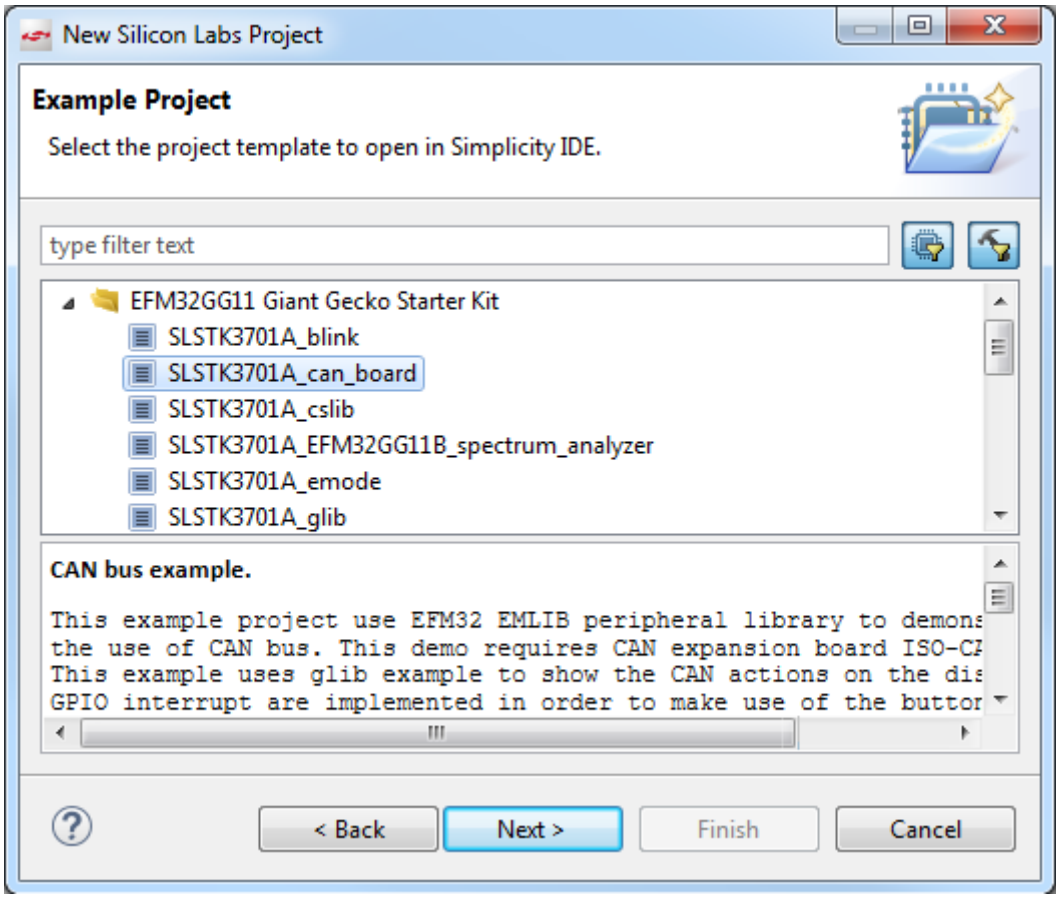


Figure 3.5. Selecting the CAN example project

9. The example and code can now be seen in the IDE perspective. From here it can be modified, debugged, and deployed to the Starter Kit. To deploy it to the board, select the [**Debug**] button outlined in red.

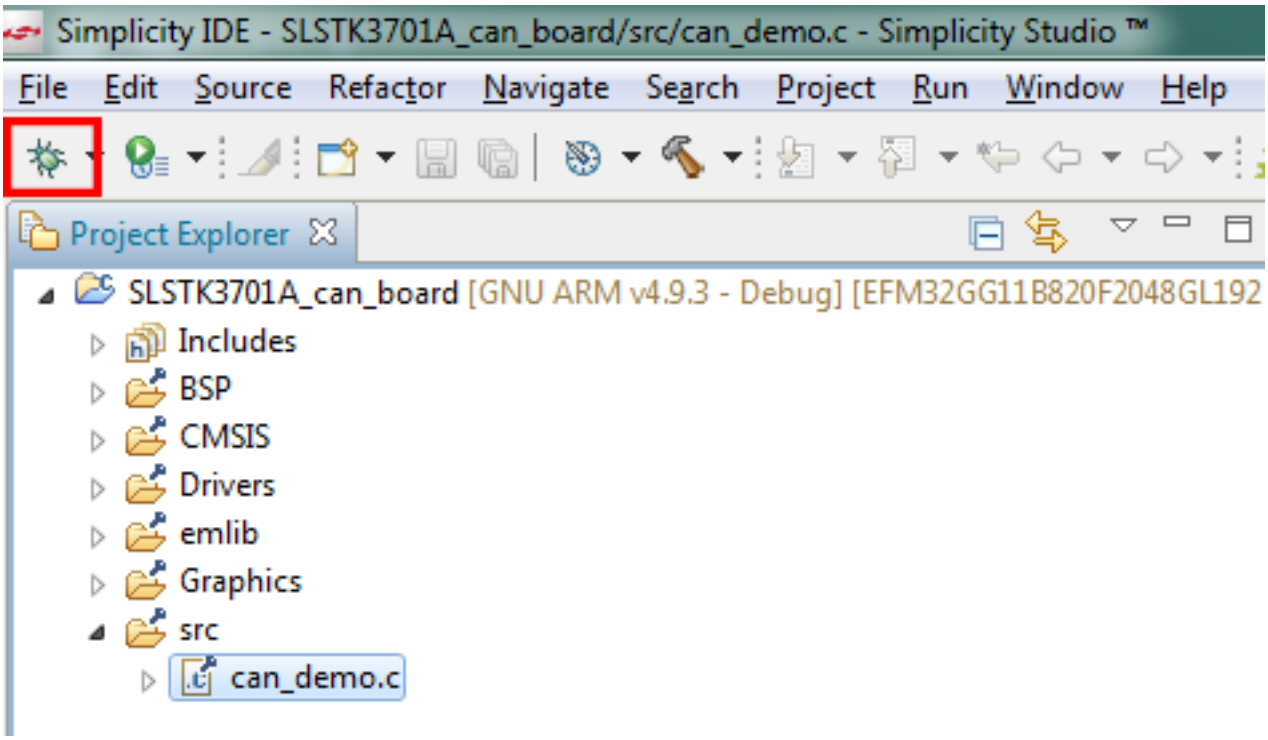


Figure 3.6. Debugging the CAN project

10. Once in debug mode, the code can be stepped through, breakpoints can be set, and more. To program the board select the [**Deploy**] button outlined in red.

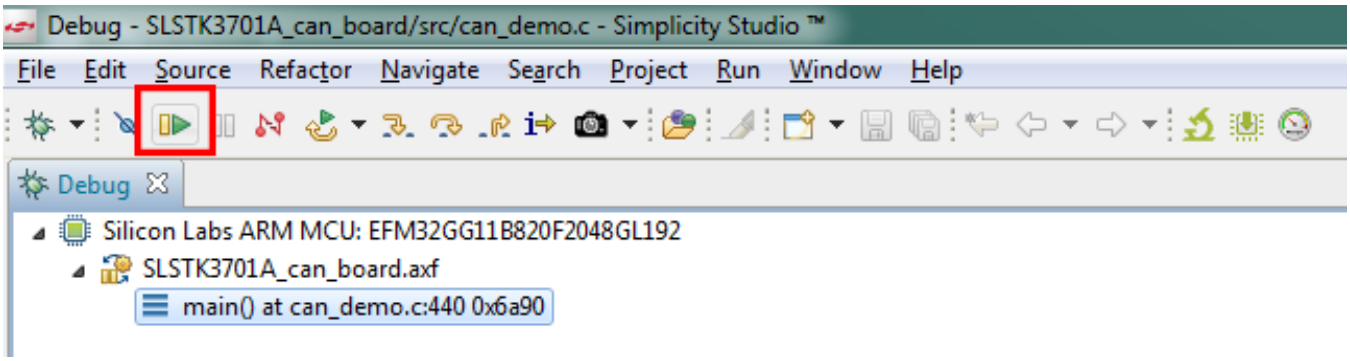


Figure 3.7. Deploying the CAN project

11. The example is now loaded onto the MCU STK.

3.2 Connecting the EXP Board

The EXP board has a 20-pin female header. This header plugs in to the STK.

- Connect the EXP board to the STK through the 20-pin header.
- Populate the CAN loopback jumpers JP5 and JP7. Alternatively you can connect wires to the screw terminals.
- With the EXP and STK connected and the MCU STK plugged in via USB, press the [**Reset**] button on the MCU STK.

The kit is now connected, the board is powered, and the demo is running on the MCU. The EXP board contains an isolation barrier where power is transferred over to the CAN transceiver.

3.3 Using and Understanding the CAN Example

The demo displays the number of received and transmitted characters on each CAN port. The MCU STK screen will increase the character count by one for each button that is pressed. In the current configuration with the loopback jumpers populated, every character sent on one CAN port will be received on the other. This way CAN0 TX and CAN1 RX should always be equal and CAN1 TX and CAN0 RX should always be equal. The screen will look like the image below after 3 presses of each button.

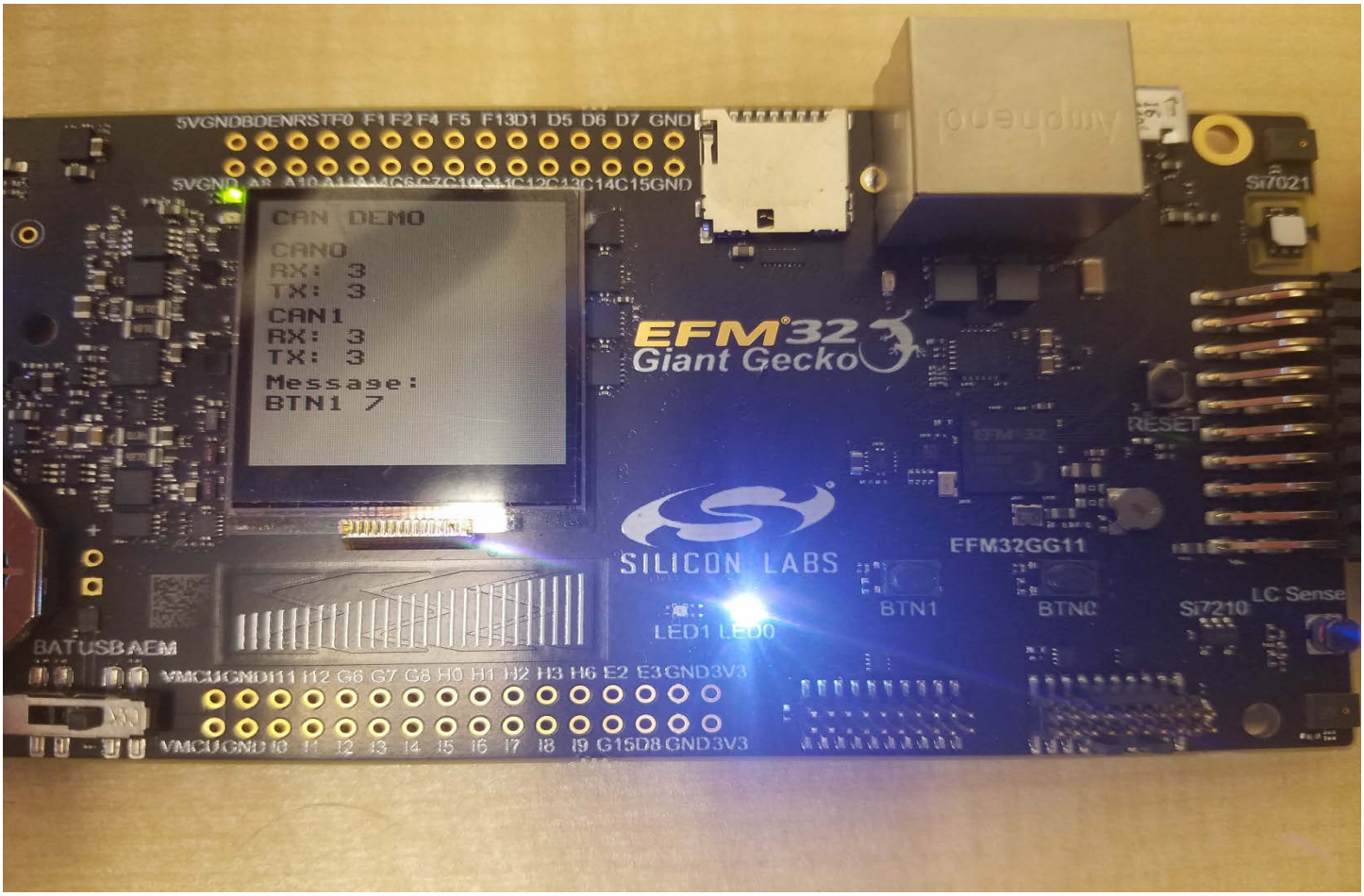


Figure 3.8. CAN Example Screen

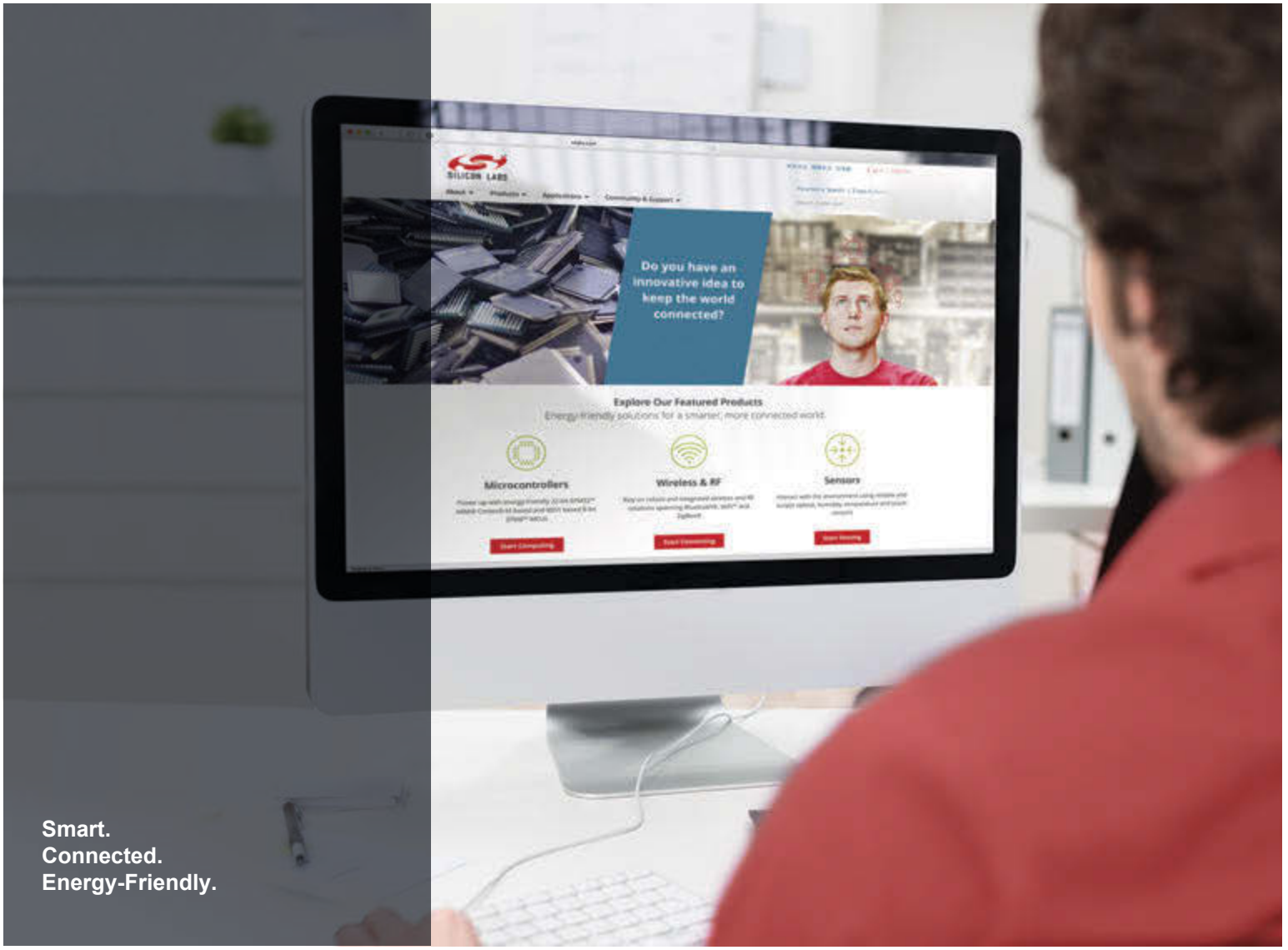
The example successfully mimicked two isolated MCU STKs from each other. If noise or a current spike occurred on either one, the other would not be affected. For more information on isolation, please see the Si88xx documentation listed at the end of this document.

4. Relevant Documentation

The following documents are available on http://www.silabs.com:

- *UG287: EFM32 Giant Gecko GG11 Starter Kit User's Guide* – User manual for the Giant Gecko 11 Starter Kit (SLSTK3701A)
- *Si88x4x Quad Digital Isolators with DC-DC Converter Datasheet* — Overview and characteristics of the Si88x4x series of isolators

Datasheet and support documentation can be accessed on the Silicon Labs website http://www.silabs.com or in Simplicity Studio under the Document Index section.



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SILICON LABS

Silicon Laboratories Inc.
400 West Cesar Chavez
Austin, TX 78701
USA

http://www.silabs.com