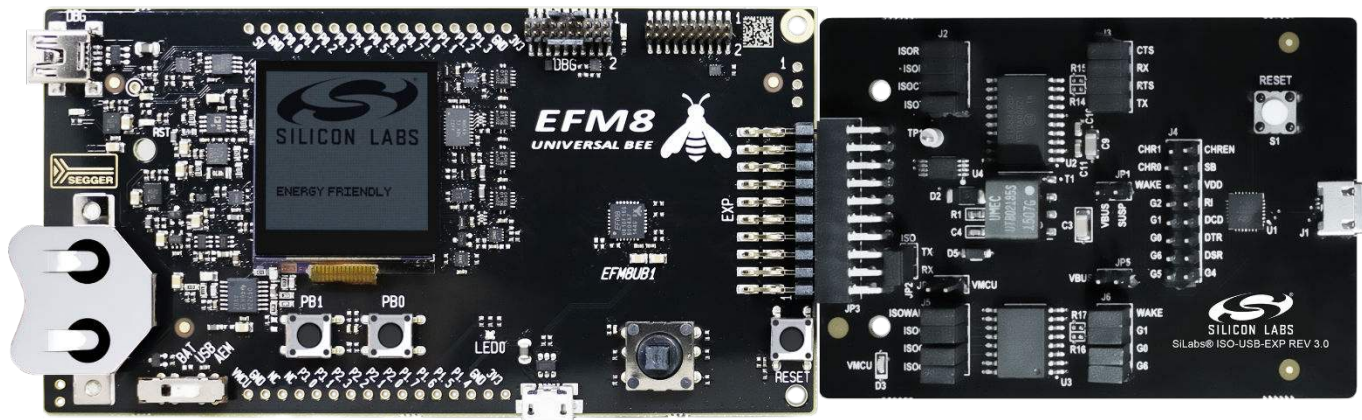# UG274: Isolated USB Expansion Board User Guide

The Silicon Labs Isolated USB Evaluation Board is a hardware plugin card for EFM8 and EFM32 Starter Kits (STKs). The Isolated USB EXP is intended to help demonstrate and evaluate applications for Silicon Labs isolation, interface, and MCU products. Silicon Labs isolation products create a CMOS barrier to protect components while still allowing for communication and power transfer. Silicon Labs interface products offer various turn-key solutions for interfacing between different protocols. Software demos are available 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 a ter-minal. They also showcase Silicon Labs ISOVolt technology as the MCU is powered across the isolation barrier.

Note: For full use and evaluation of the Isolated USB EXP a MCU STK is needed. Soft-ware examples are provided for two MCU STKs, the EFM32 Wonder Gecko Starter Kit EFM32WG-STK3800 and the EFM8 Universal Bee 1 Starter Kit SLSTK2000A.

KEY FEATURES OR KEY POINTS

- 20-pin headers for connection to EFM8 and 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 USB EXP kit contains the Expansion Board, USB cable, 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
- Power of the EXP board through USB port
- Breakout points for precise evaluation of specific systems
- Isolation barrier to separate the STK MCU from the EXP
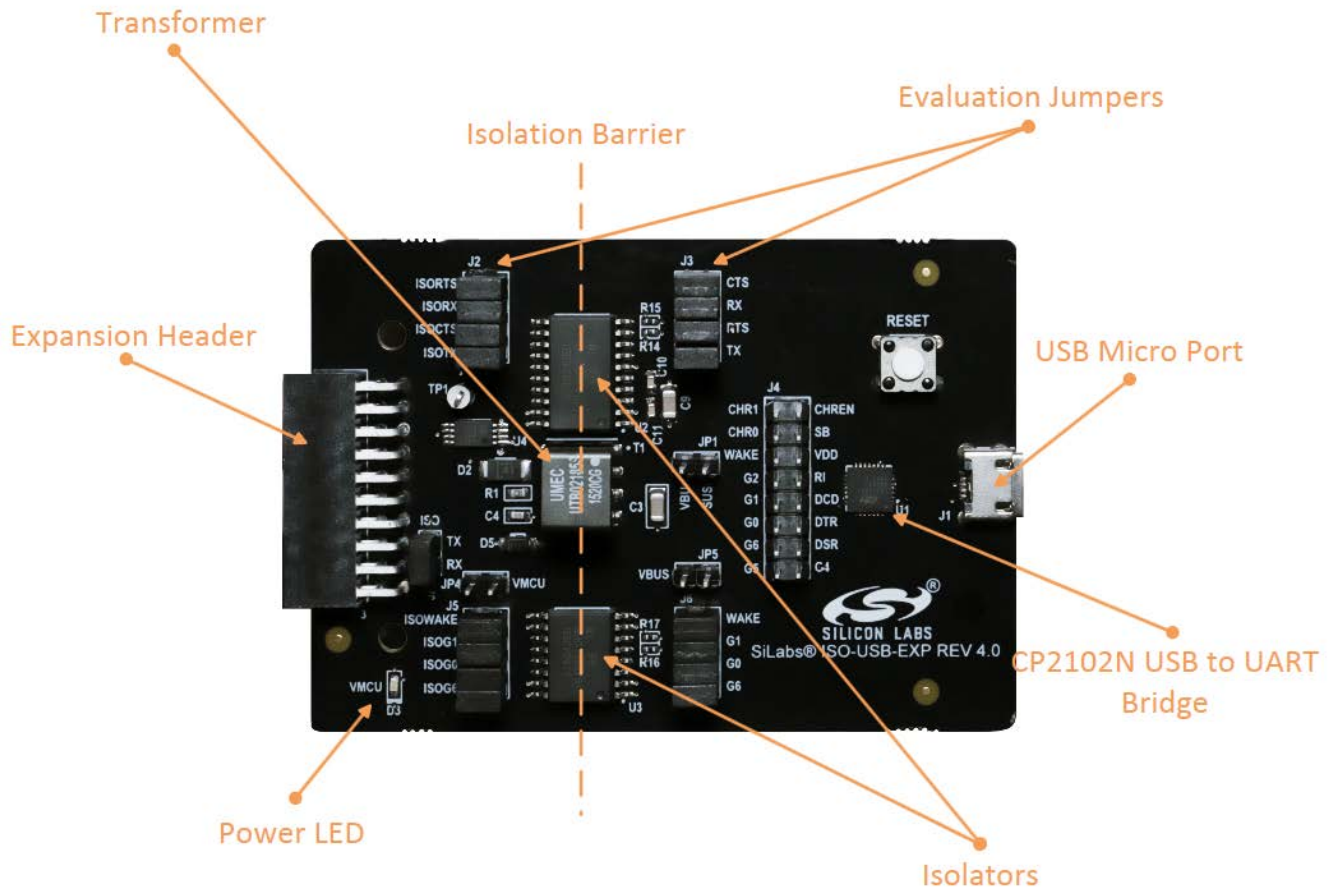- Easy use through Simplicity Studio

Figure 1.1. Annotated Isolated USB EXP

2. Details and Applications

This evaluation kit and associated demos allow the MCU STK, Isolated USB EXP, and sensors to communicate through the USB port on the EXP board while being isolated. The MCU communicates through UART to the isolation devices. These signals are carried through the barrier and an interface device, which converts the UART signals into USB D+ and D-. From the USB port the user can use a USB cable with a host and view the messages coming from the MCU. Isolation 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, such as CAN, I2C, SPI, UART. The combination of Silicon Labs isolators and interface products can serve any of these segments.

2.1 Hardware

The Isolated USB EXP key components are:

- Si88242ED-IS – Digital Isolator with Integrated DC-DC Converter containing 4 unidirectional channels, Automotive, 20-pin SOIC
- Si8642ED-B-IS - Digital CMOS Isolator with 4 channels, up to 150Mbps, Automotive, 16-Pin SOIC
- CP2102N - USB to UART Bridge
- IND-UTB00569S – Power inverter

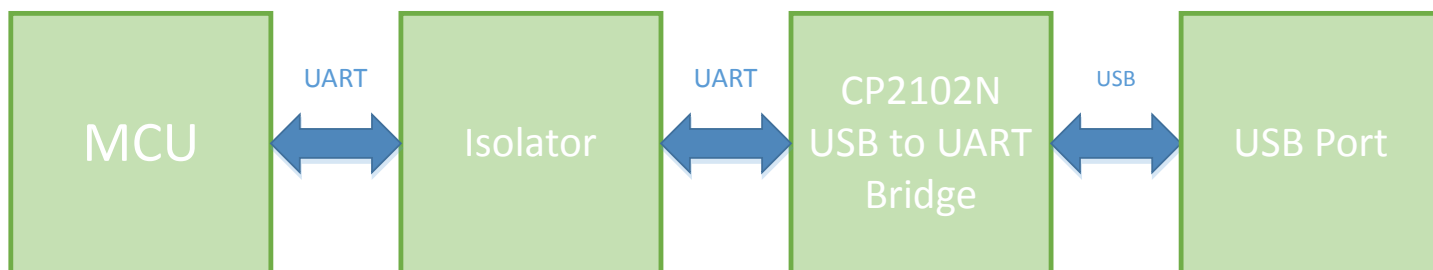The schematics for the board are found in the figure below.

Figure 2.1. Isolated USB EXP Schematic

2.1.1 Jumpers and Headers

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

J2 and J3 are the 4 wire UART signals with J2 coming from the MCU and J3 coming from the USB to UART bridge.

J5 and J6 are GPIOs with J5 coming from the MCU and J6 coming from the USB to UART bridge.

J4 gives access to all of the functions on the USB to UART Bridge and allows MCU signals to connect to them. For example the USB to UART Bridge can be put in a low power mode by connecting Wake to GND.

JP2 connects the UART TX and UART RX together enabling loopback.

JP4 and JP5 control the type of input/output of the GPIOs. Please refer to the Si864x datasheet for exact input/output specifications.

JP1 controls whether power is sent across the isolation barrier. With this populated the DC-DC converter will be disabled and both sides of the isolator must have separate power lines for full functionality. With it un-populated, power will propagate across the barrier providing power to both the CP2102N and the MCU Starter Kit. With it un-populated, be sure not to have both the MCU Starter Kit and Isolated USB EXP plugged in via USB

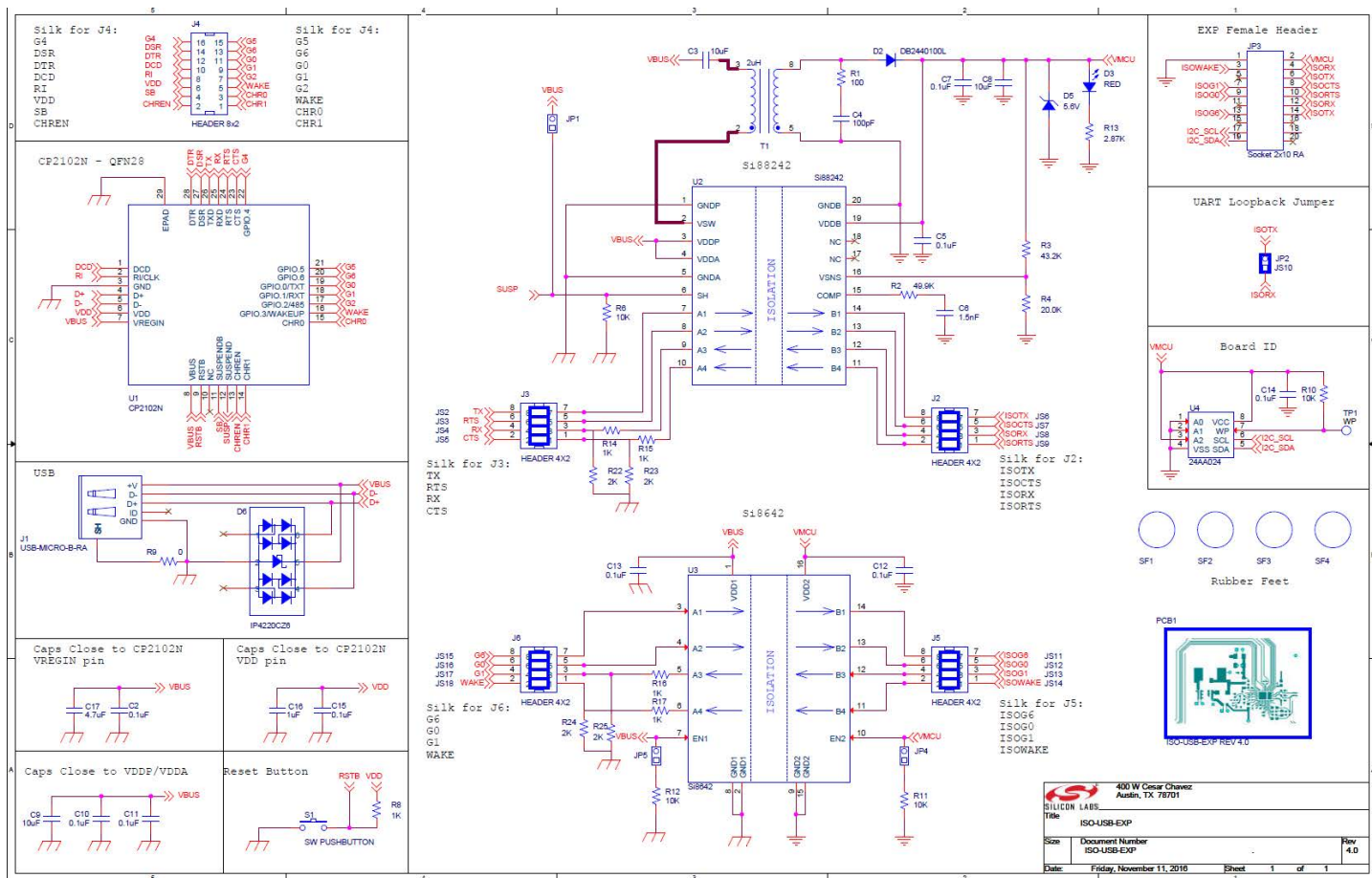The schematics for the board are found in the figure below.

Figure 2.2. Isolated USB EXP Schematic

2.1.2 Header Connections

The Isolated USB EXP connects to the MCU STK via a 20-pin header. On the EXP board is the receptacle and the MCU STK has the pins. They align in such a way to take advantage of certain MCU peripherals like UART and GPIOs. Refer to the figure below for the exact pin out. Refer to the individual MCU STK user guides for each specific board. The one in the figure is the EFM32 Wonder Gecko Starter Kit pin out.
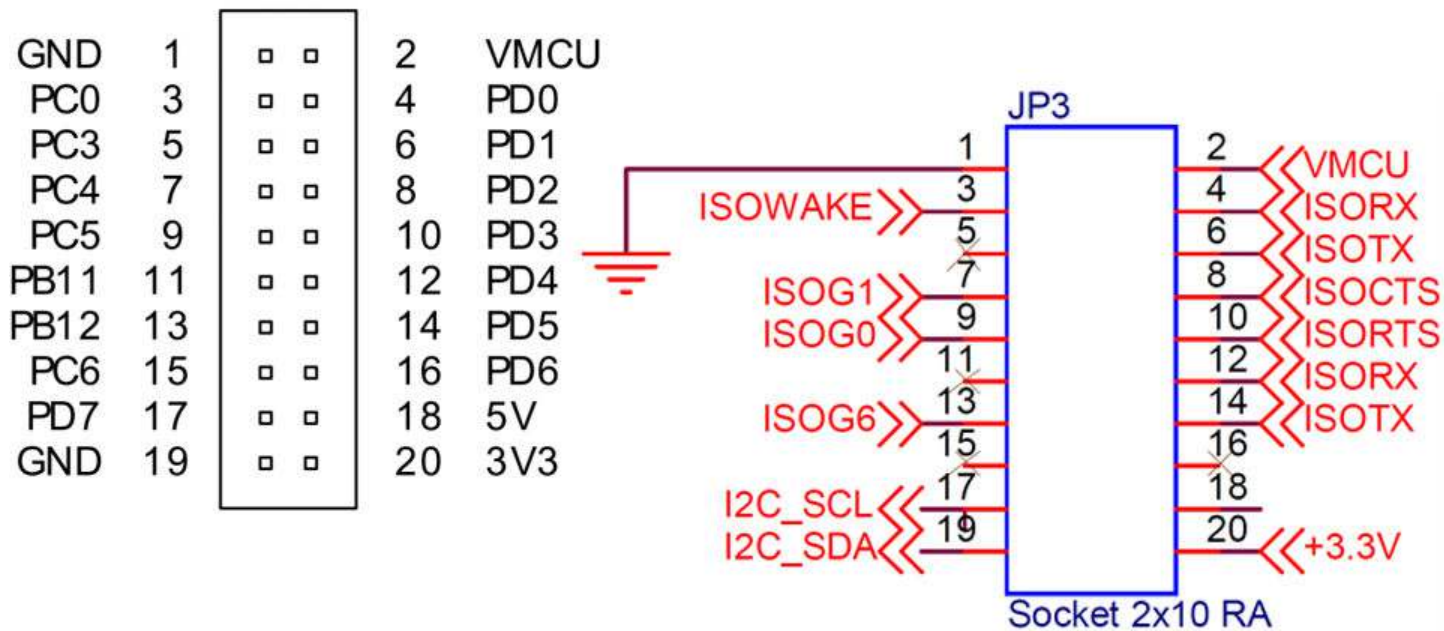

Figure 2.3. EFM32 WG STK 20-pin header (left) and the Isolated USB EXP receptacle header (right)

3. Getting Started

The first step to getting started with your new Isolated-USB-EXP is to download Simplicity Studio from http://www.silabs.com/simplicity-studio. The simplicity studio software package contains all tools, drivers, software examples, and documentation needed to use the Isolated-USB-EXP. Connect the Isolated-USB-EXP to the EFM32WG-STK3800 Wonder Gecko STK or the EFM8UB1 STK. The demo code can be loaded using the USB cable and the J-Link debug interface.
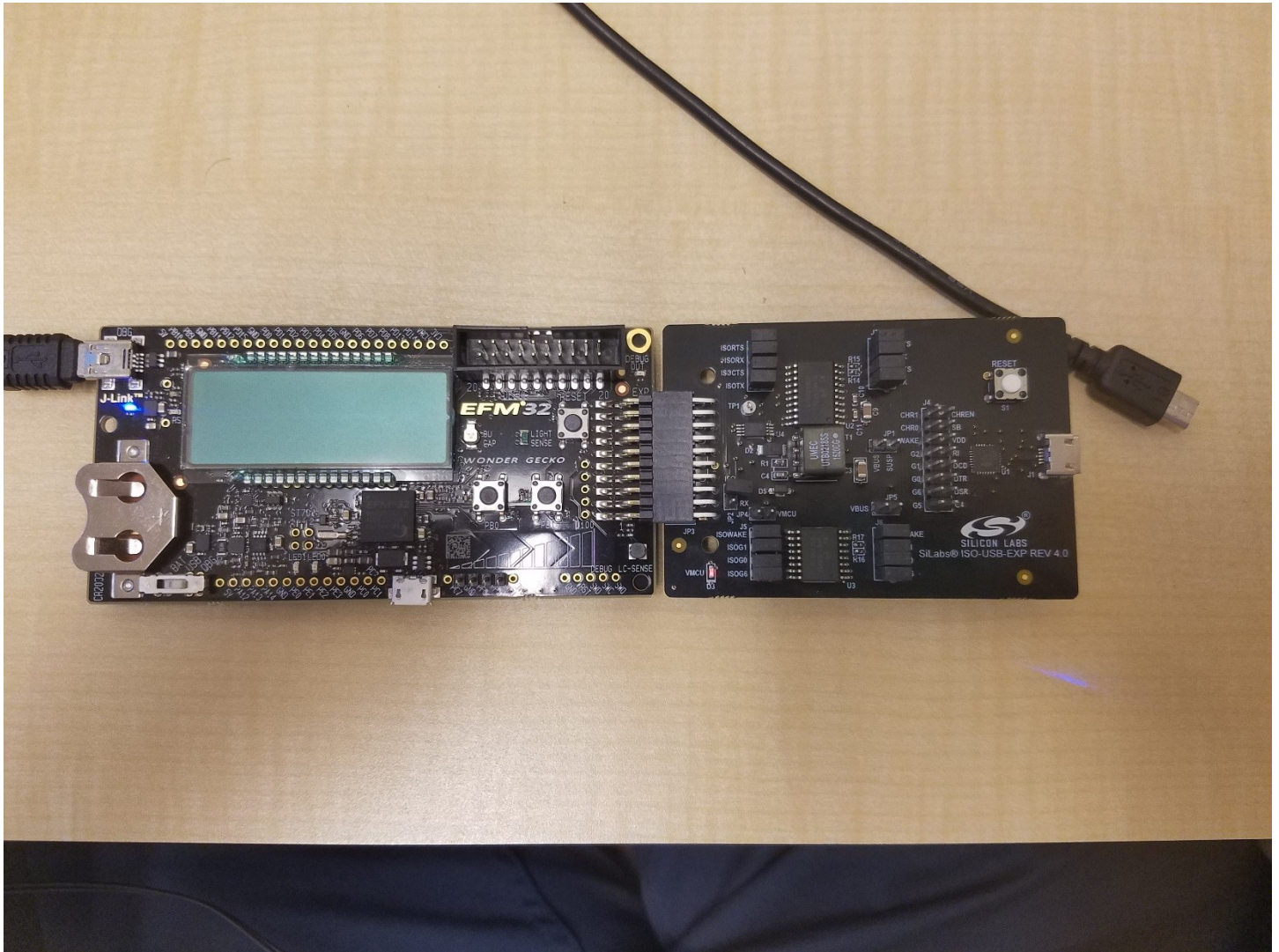
Figure 3.1. Completed isolated USB set up

3.1 Loading Software Demos

The following steps load the demo firmware onto the Wonder Gecko STK. This process requires Simplicity Studio which is available for download at http://www.silabs.com/simplicity-studio. The process is very similar for the Universal Bee 1 STK.

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

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

- Ensure the Wonder Gecko Start Kit is Selected and click next.
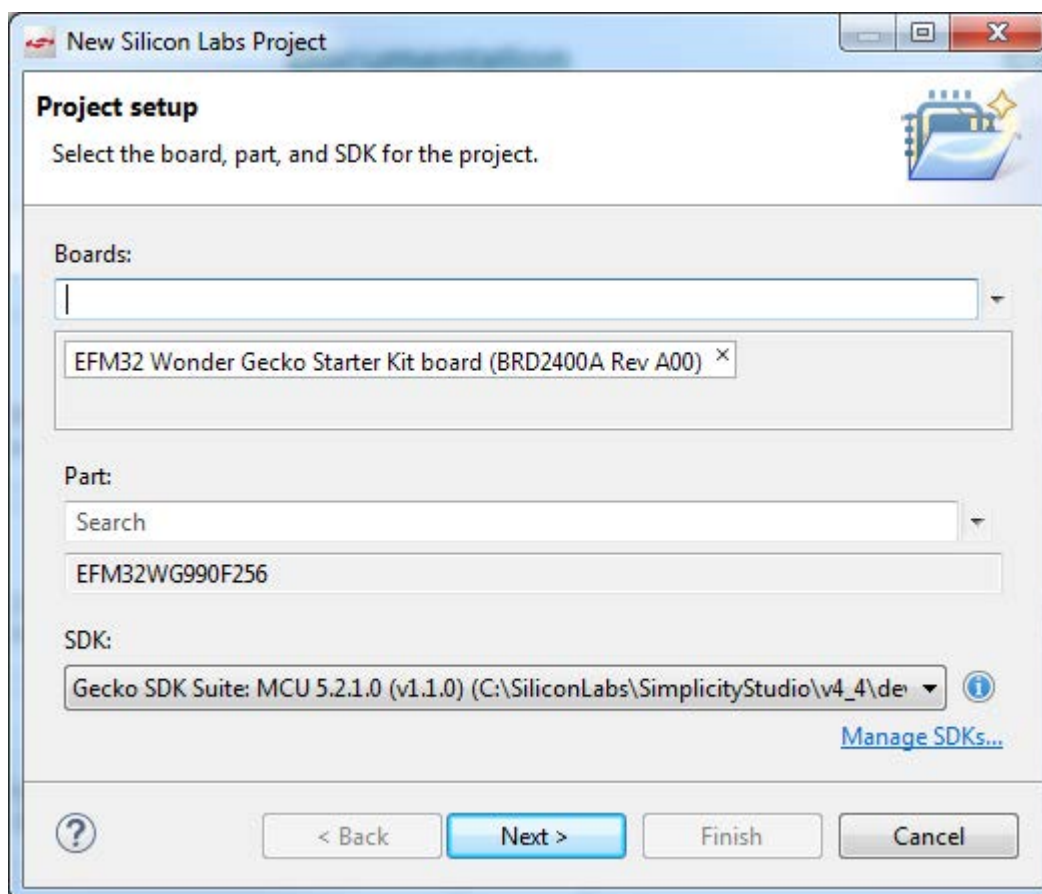
Figure 3.3. Project setup

- Select example and click next.
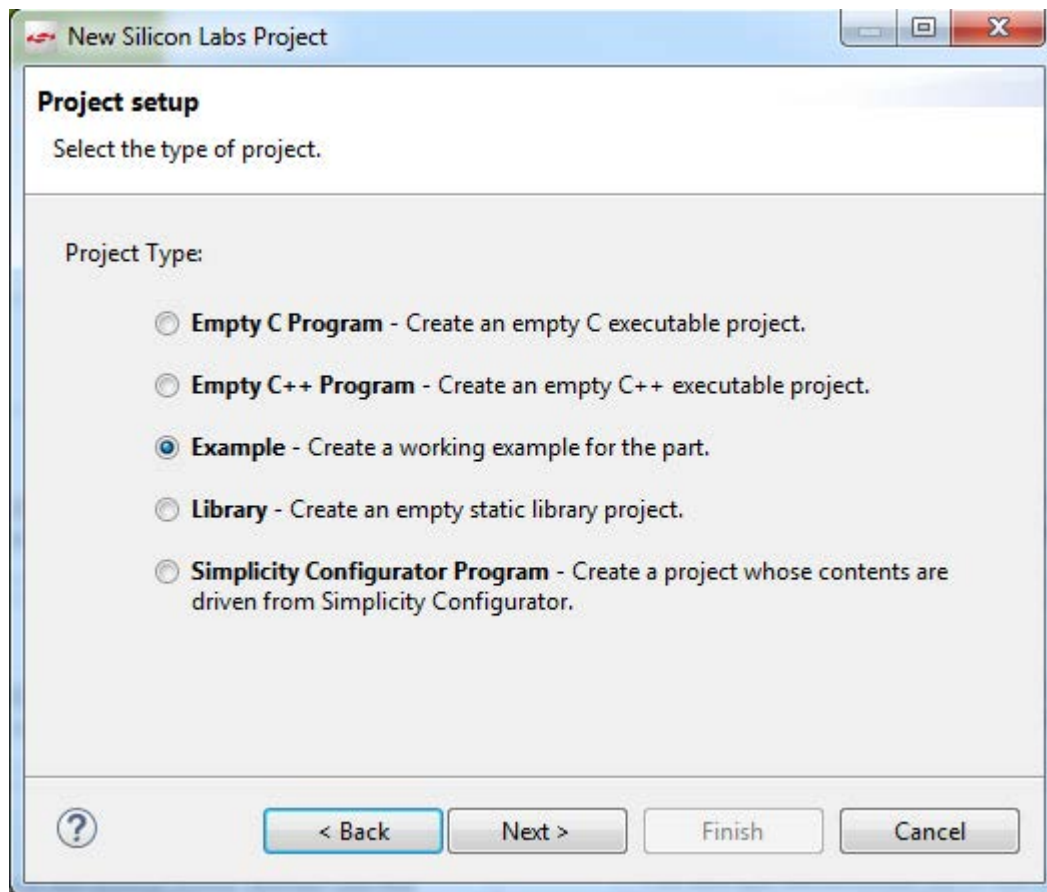
Figure 3.4. Starting from an Example

- Locate the usb_isolated example and click next and then finish to complete creating a new project.
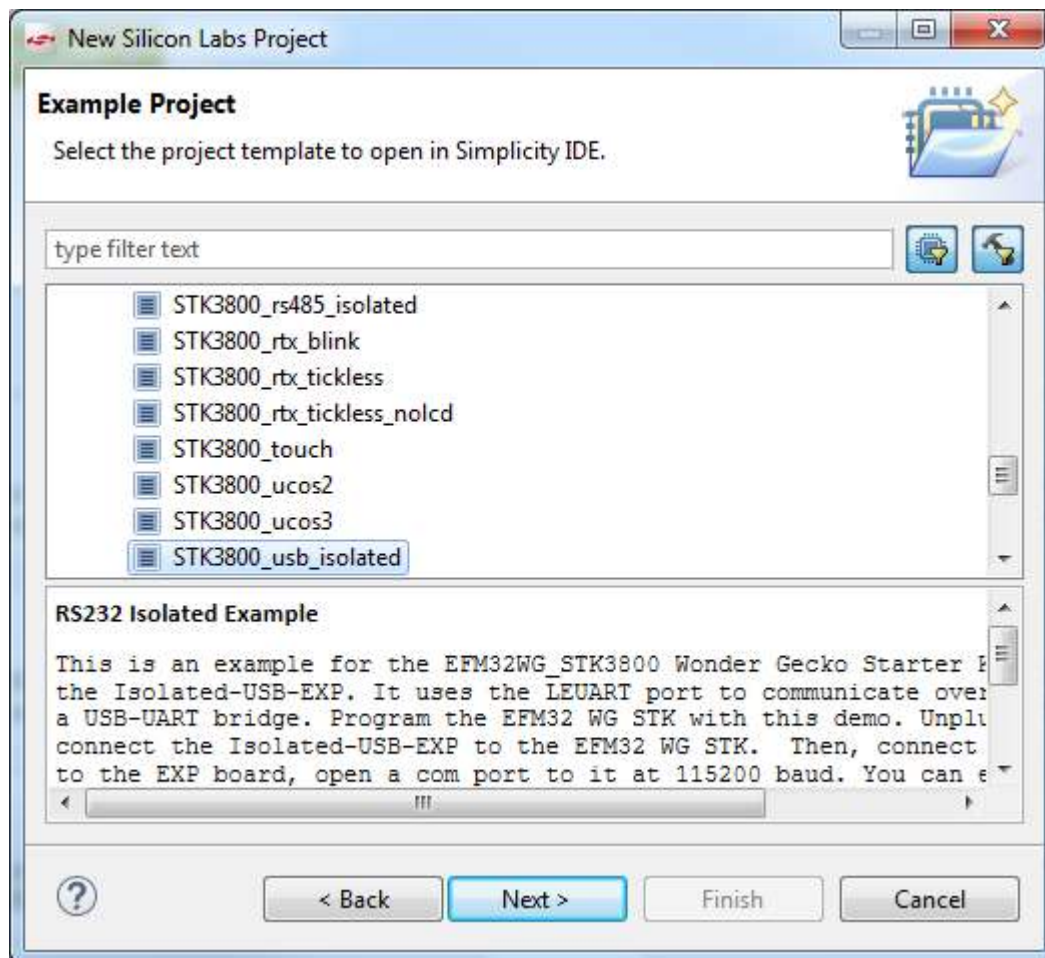
Figure 3.5. Selecting the usb_isolated example project

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.
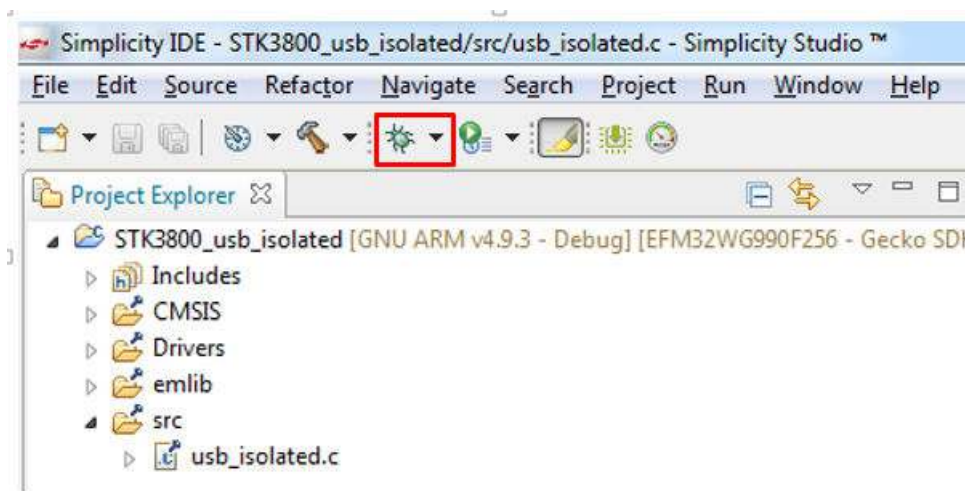

Figure 3.6. Debugging the usb_isolated project

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.
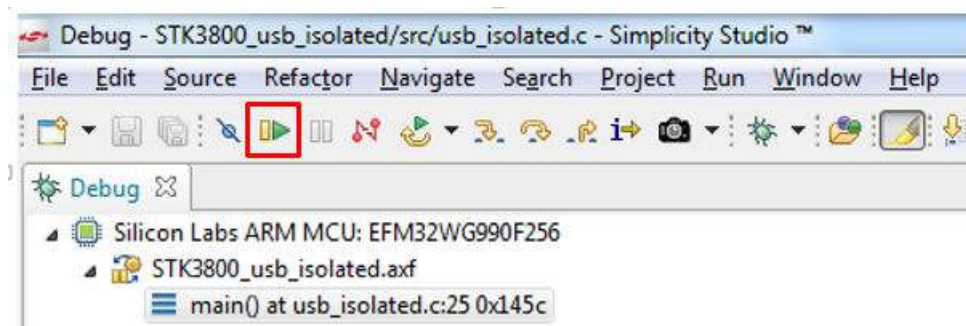
Figure 3.7. Deploying the usb_isolated project

3.2 Connecting the EXP Board

The EXP board has a 20-pin female header, which plugs into the STK. The EXP also comes with a Micro USB port and the associated cable to connect it to a host computer.

To connect the EXP board, do the following:

- Plug in the USB cable to the Micro USB slot in the Expansion Board.
- Connect the other end of the USB cable to a host like a laptop or PC.
- Wait for the necessary drivers to be installed.
- Open your terminal program of choice.
- Connect to the port that the EXP is assigned to with a baud rate of 9600.
- With the demo running on the STK MCU, disconnect the USB cable from the STK.
- Connect the EXP board to the STK through the 20-pin header (ensure the EXP is still plugged in via USB).
- With the EXP and STK connected and the EXP 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 is built to provide power to the STK. Therefore, the USB cable connected to the STK is not needed.

Note: Don't have both the MCU Starter Kit and EXP board USB ports connected. The both feed power to the same rail and will cause issues if they are both plugged in. Once the MCU Starter Kit has been programmed, disconnect its USB cable and plug into the EXP board USB port.

3.3 Using and Understanding the Example

With the MCU and EXP board setup, a connection to it is needed.

- Disconnect the USB cable from the MCU Starter Kit.
- Connect the USB Micro port on the EXP board to a host.
- On the host open a terminal program and connect to COM port associated with EXP board at a baud rate of 115200.
- By typing in the terminal program opened and then pressing the Enter key or sending a return character you will see the message you typed display on the screen.

The communication flow is as follows:

User types & host sends to EXP -> EXP bridges the USB data converting it to UART and passes it over an isolation barrier -> MCU on the STK reads the isolated UART data, buffers it, and waits to see a return character -> Return character entered by user -> MCU returns all buffered characters entered by the user via UART to the EXP -> EXP isolates UART data and sends it to the USB bridge -> Host receives USB data and displays in terminal.
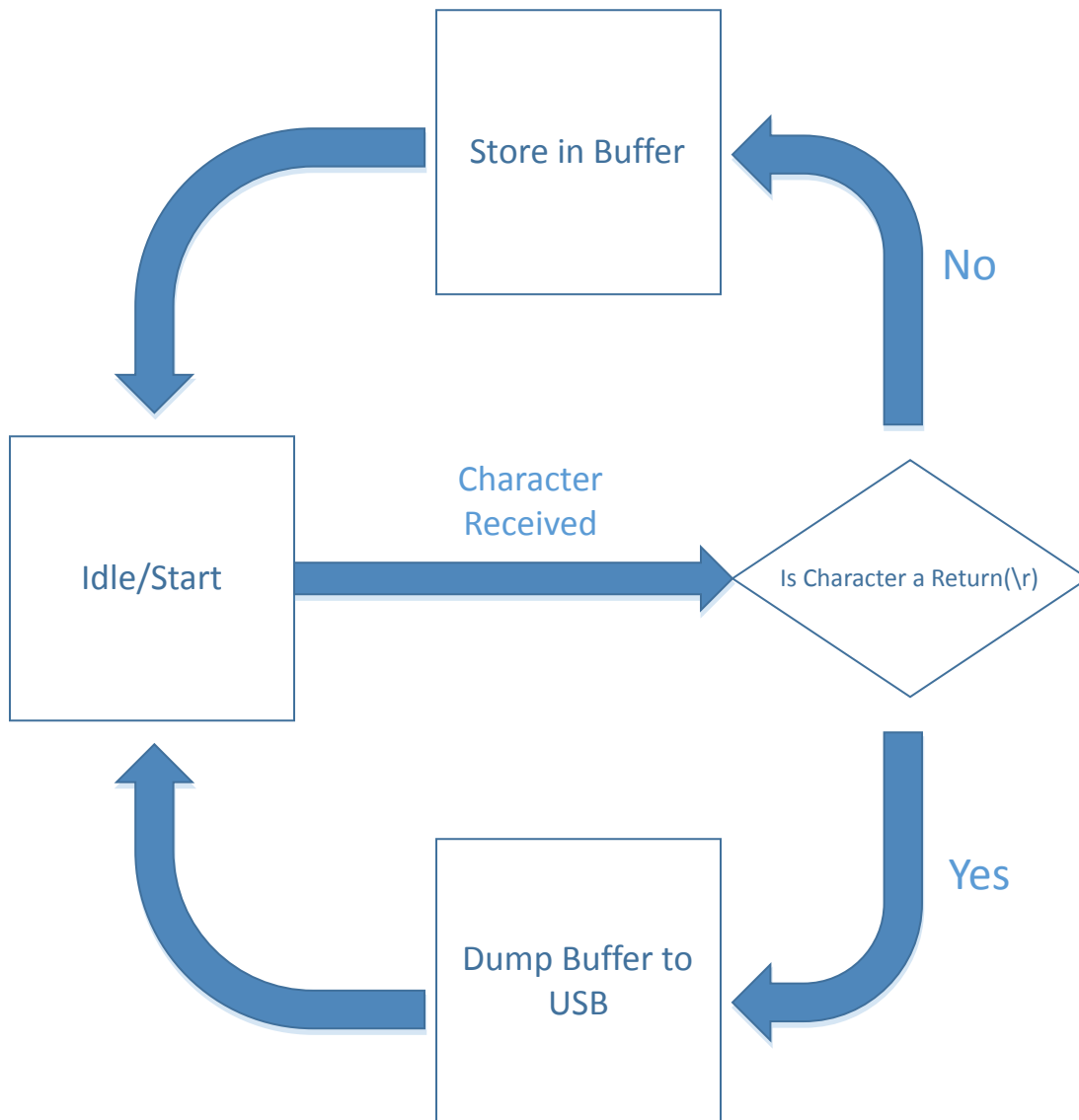
Figure 3.8. usb_isolation example flow

The Example shows how to successfully isolates the MCU STK from the host. If a noise or a current spike occurs on either one, the other is not affected. For more information on isolation, see the SI88xx documentation listed at the end of this document.
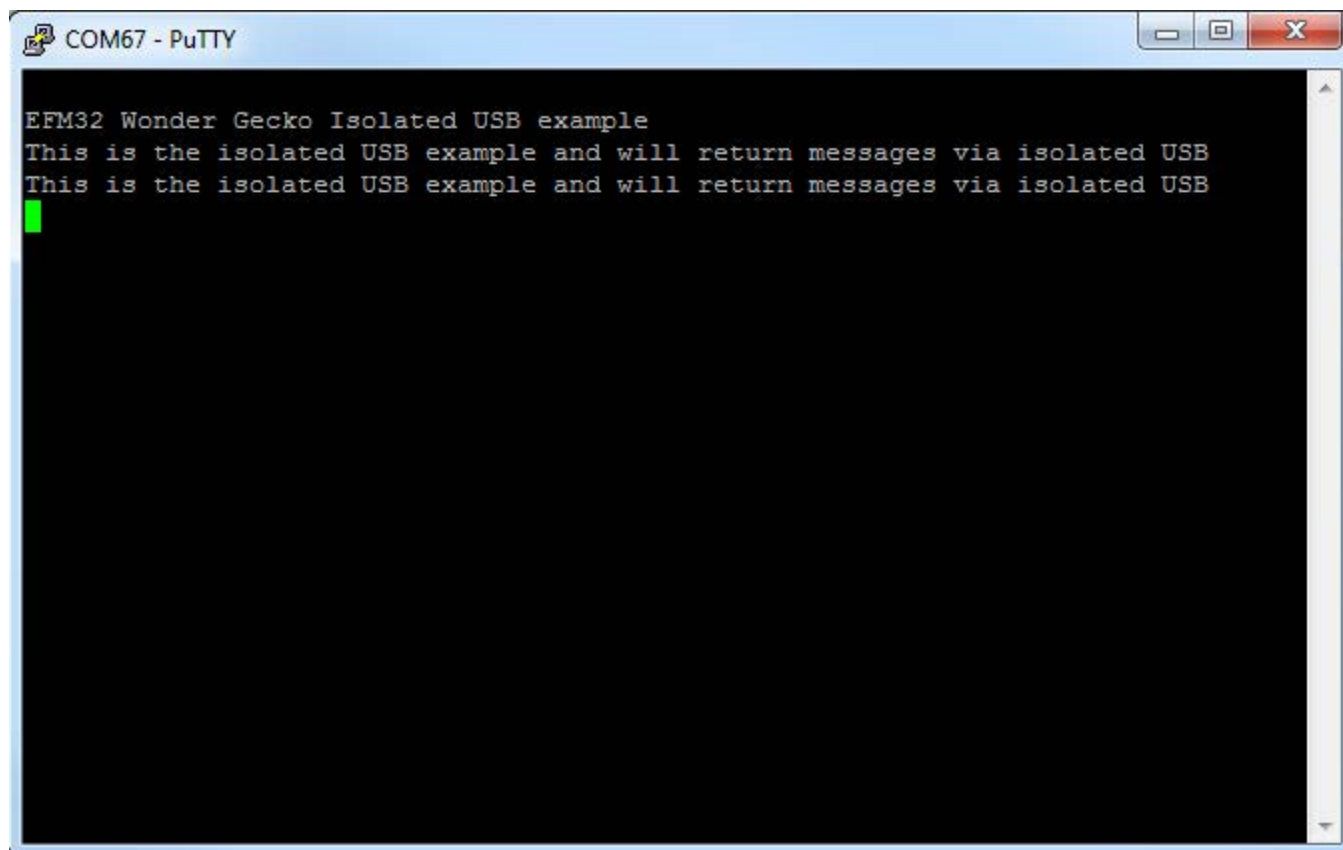
Figure 3.9. Terminal example of Isolated USB demo

4. Relevant Documentation

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

- *CP2102N Datasheet* — Overview and characteristics of the USB to UART interface bridge.
- *EFM32 Wonder Gecko STK User Guide* – User manual for the Wonder Gecko Starter Kit.
- *Si88x4x Quad Digital Isolators with DC-DC Converter Datasheet* — Overview and characteristics of the Si88x4x series of isolators.
- *Si8640/Si8641/Si8642/Si8645 Low-Power Quad-Channel Digital Isolators Datasheet* — Overview and characteristics of the Si864x series of isolators.

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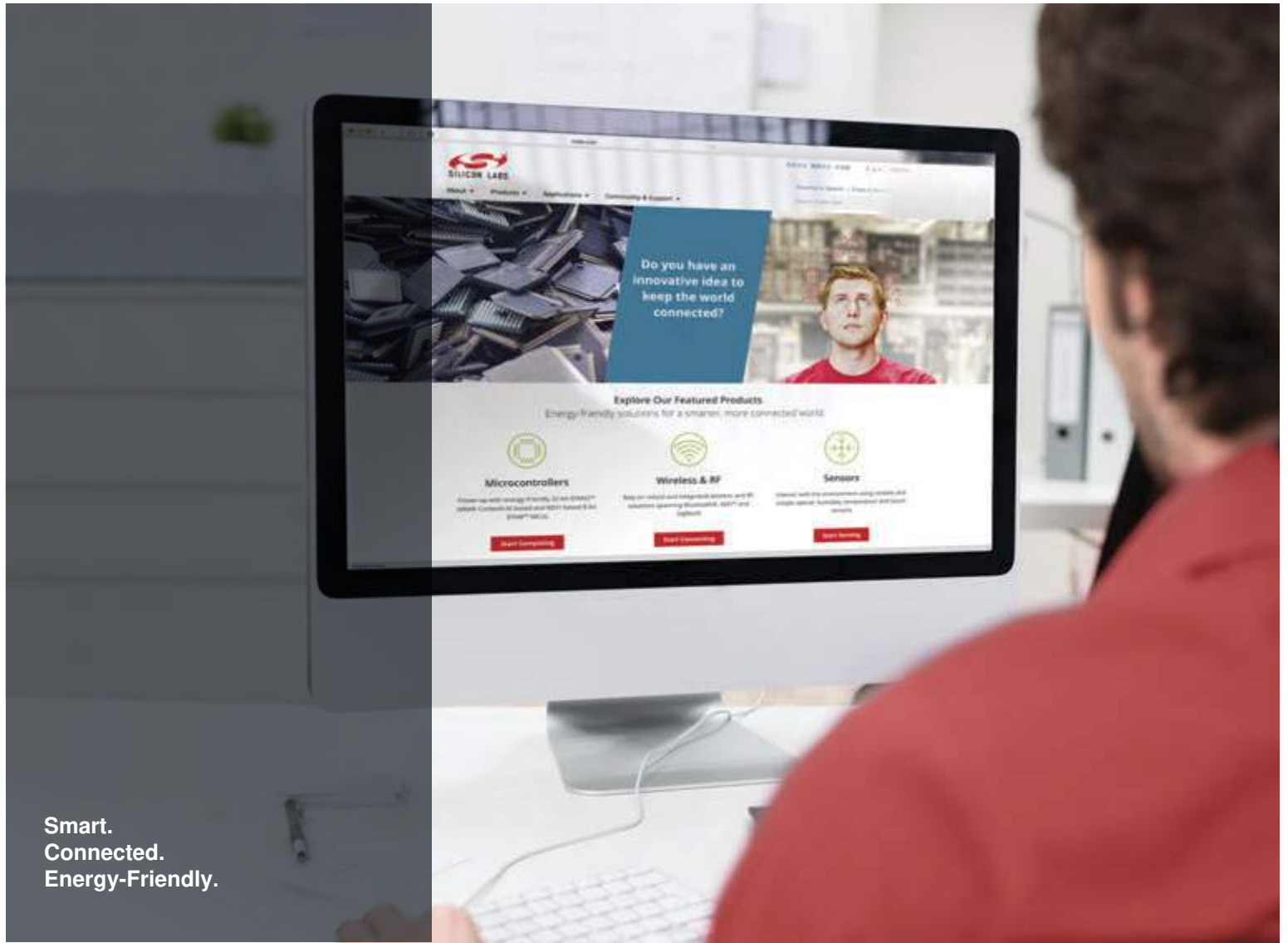
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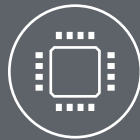
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