# UG548: Simplicity Link Debugger User's Guide

The Simplicity Link Debugger is a lightweight tool for debugging and programming Silicon Labs devices on custom boards.

The J-Link debugger enables programming and debugging on a target device over USB, through Silabs' Mini Simplicity interface. A virtual COM port interface (VCOM) provides an easy-to-use serial port connection over USB. The Packet Trace Interface (PTI) offers invaluable debug information about transmitted and received packets in wireless links.

A power switch gives the option to debug target boards without external power connections or batteries. The board also has 12 break out pads which can be used for probing signals to and from the connected board.
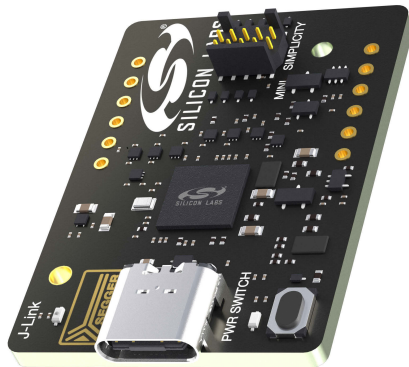
FEATURES

- SEGGER J-Link debugger
- Packet Trace Interface
- Virtual COM port
- Optional target voltage source
- Breakout pads for easy probing

SUPPORTED DEBUG PROTOCOLS

- Serial Wire Debug (SWD)
- Silicon Labs 2-Wire Interface (C2)

SOFTWARE SUPPORT

- Simplicity Studio

ORDERING INFORMATION

- Si-DBG1015A

PACKAGE CONTENT

- Simplicity Link Debugger board (BRD1015A)
- Mini Simplicity Cable

Table of Contents

1. Introduction

The Simplicity Link Debugger is a tool designed to debug and program Silicon Labs devices on boards equipped with Mini Simplicity Interface, using Simplicity Studio or Simplicity Commander software tools.

1.1 Getting Started

To start programming or debugging your own hardware, download the latest version of Simplicity Studio, and connect the flat cable to your hardware. If your hardware does not feature a suitable connector, break out pads might be alternatively used to provide connection by means of jumper wires. Segger J-Link drivers are required. These are installed by default during installation of Simplicity Studio, and they can also be downloaded directly from Segger.

1.2 Installation

Go to silabs.com/developers/simplicity-studio to download the latest version of Simplicity Studio and SDK resources, or simply update your software opening the Installation Manager dialog.

The software user guide is accessible from the Help menu or visiting the documentation pages at:

docs.silabs.com/simplicity-studio-5-users-guide/latest/ss-5-users-guide-overview

1.3 Custom Hardware Requirements

To connect and to take advantage of all debugging features offered by the Simplicity Link Debugger and Silicon Labs software tools, the Mini Simplicity interface needs to be implemented at design stage of the custom hardware. The Single Wire Debug interface is required for programming and basic debug functionality. See table Table 2.1 Mini Simplicity Connector Pin Descriptions on page 6 for connector pinout.

The cable provided with the kit is a 1.27 mm (50 mil) pitch ribbon cable, terminated with 10-pin IDC connectors. To match this and avoid mistakes when connecting the hardware, choosing a keyed connector is recommended, for example Samtec FTSH-105-01-L-DV-K.

Silicon Labs Dev kits and Explorer kits provide implementation examples for specific device packages, which allows one to see how signals are routed between the Mini Simplicity connector and the peripherals on a given target device.
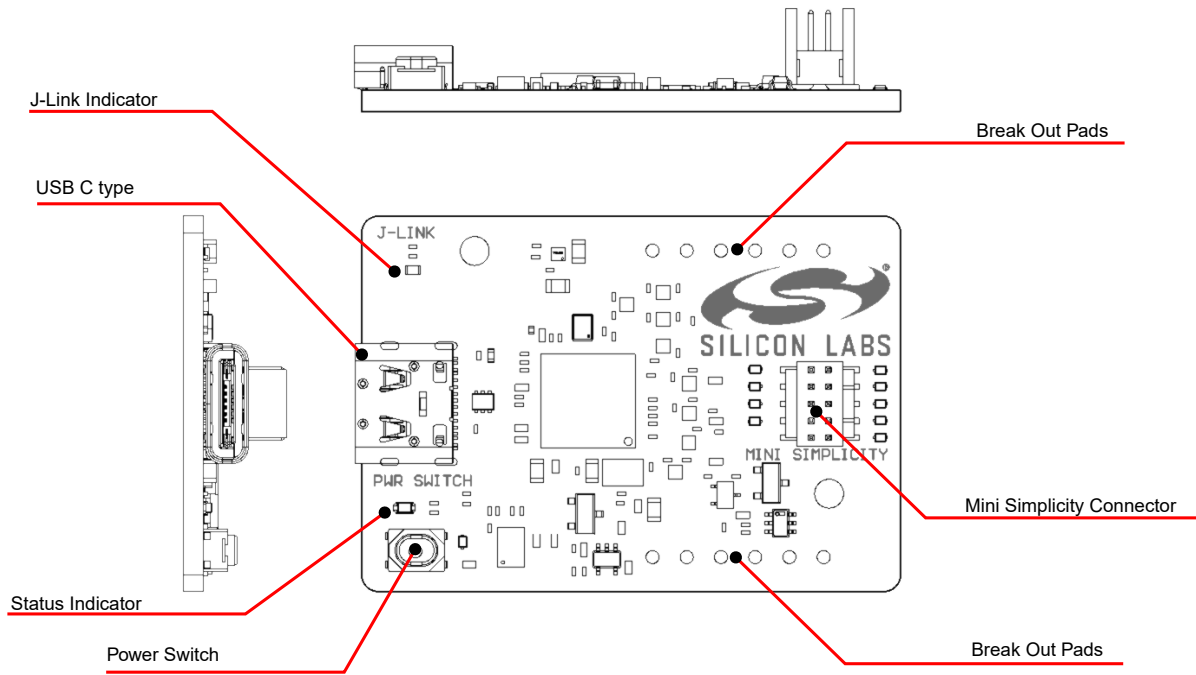
2. Hardware Overview

2.1 Hardware Layout

Figure 2.1. Hardware Layout

2.2 Block Diagram

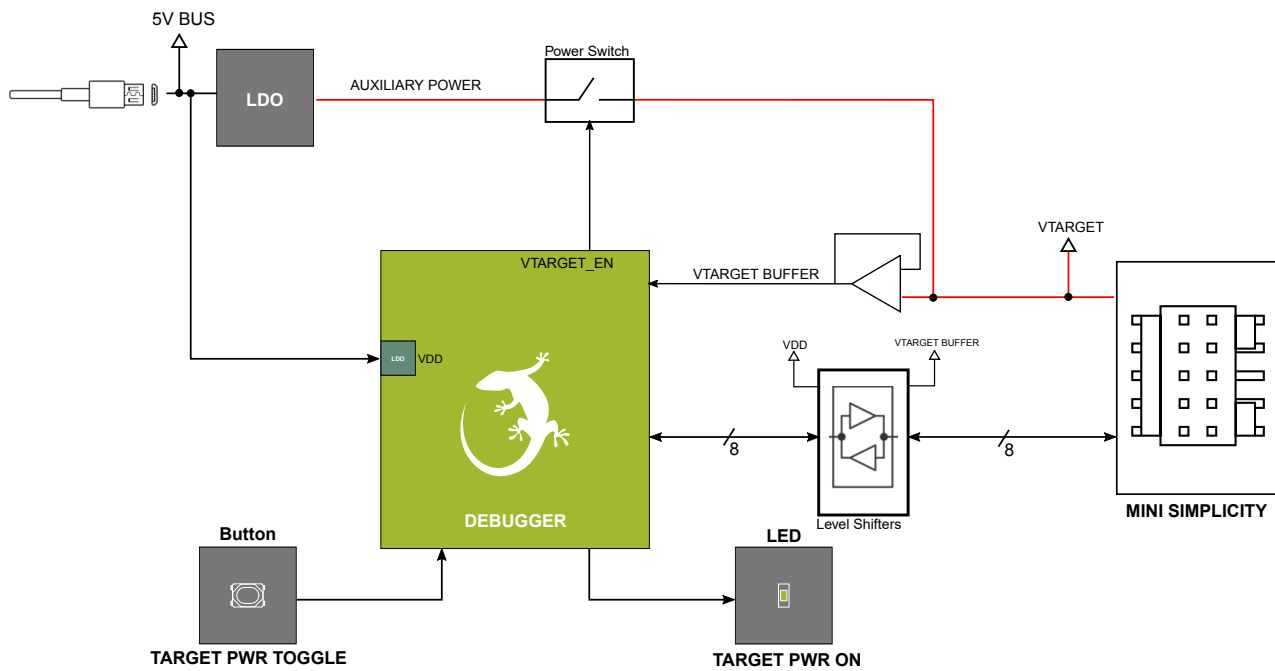An overview of the Simplicity Link Debugger is shown in the figure below.

Figure 2.2. Block Diagram

2.3 Connectors

This section gives an overview of the Simplicity Link Debugger connectivity.

2.3.1 USB Connector

The USB connector is situated on the left side of the Simplicity Link Debugger. All kit's development features are supported through this USB interface when connected to a host computer. Such features include:

- Debugging and programming of the target device using the on-board J-Link debugger
- Communication with the target device over the virtual COM port using USB-CDC
- Packet Trace

In addition to providing access to development features of the kit, this USB connector is also the main power source for the kit. USB 5V from this connector powers the debugger MCU and the auxiliary voltage regulator which supports on-demand power to the target device. When using the Simplicity Link Debugger to supply power to the target device, it is recommend that you use a USB host able to source 500 mA.

2.3.2 Breakout Pads

Break out pads are test points placed on the edges. They carry all signals of the Mini Simplicity interface, offer an easy way to probe with external measurement instruments or an alternate connection to debug boards that do not have a suitable connector. The following picture shows the layout of breakout pads in Simplicity Link Debugger:
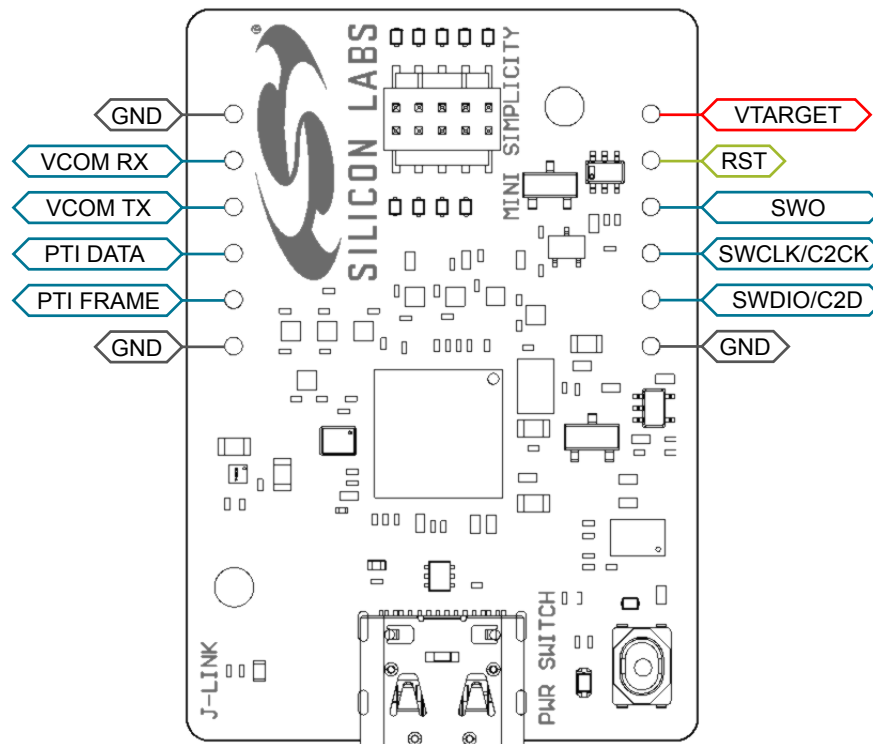

Figure 2.3. Mini Simplicity Connector

See table for descriptions of signal nets.

2.3.3 Mini Simplicity

The Mini Simplicity Connector is designed to offer advanced debug features through a small 10-pin connector:
- Serial Wire Debug interface (SWD) with SWO / Silicon Labs 2-Wire Interface (C2)
- Virtual COM port (VCOM)
- Packet Trace Interface (PTI)

If needed, the Mini Simplicity interface also support on-demand power to the connected device. This function is normally disabled and the VTARGET pin is used only for sensing.
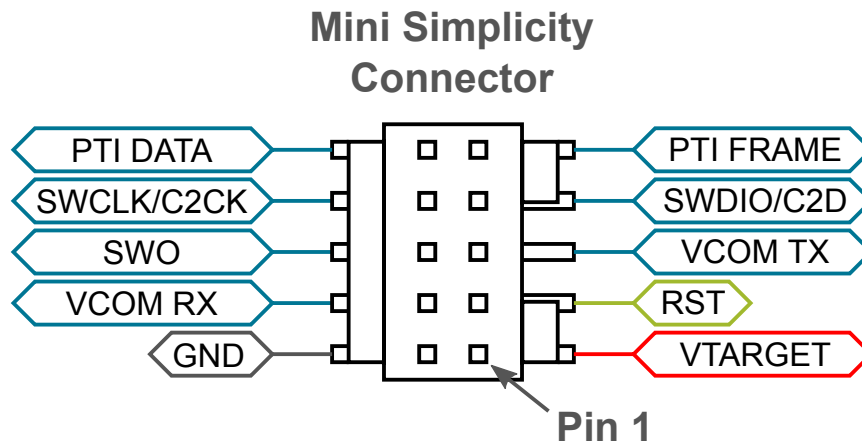
Mini Simplicity Connector

Figure 2.4. Mini Simplicity Connector

Table 2.1. Mini Simplicity Connector Pin Descriptions

Pin Number	Function	Description
1	VTARGET	Target voltage on the debugged application. Monitored or supplied when power switch is toggled
2	GND	Ground
3	RST	Reset
4	VCOM_RX	Virtual COM Rx
5	VCOM_TX	Virtual COM Tx
6	SWO	Serial Wire Output
7	SWDIO/C2D	Serial Wire Data, alternatively C2 Data
8	SWCLK/C2CK	Serial Wire Clock, alternatively C2 Clock
9	PTI_FRAME	Packet Trace Frame Signal
10	PTI_DATA	Packet Trace Data Signal

3. Specifications

3.1 Recommended Operating Conditions

The following table is intended to serve as guideline for a correct use of Simplicity Link Debugger. The table indicates typical operating conditions and some design limits.

Table 3.1. Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
USB Supply Input Voltage	V_{BUS}	4.4	5.0	5.25	V
Target Voltage[1, 3]	V_{TARGET}	1.8	-	3.6	V
Target Supply Current [2, 3]	I_{TARGET}	-	-	300	mA
Operating Temperature	T_{OP}	-	20	-	˚C

Note:
1. Sensing Mode
2. Sourcing Mode
3. See Section 4. Power Supply Modes for more details about operating modes

3.2 Absolute Maximum Ratings

Exceeding the following limits might cause permanent damage to the board.

Table 3.2. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
USB Supply Input Voltage	V_{BUS}	-0.3	5.5	V
Target Voltage	V_{TARGET}	-0.5	5.0	V
Breakout pads	*	-0.5	5.0	V

4. Power Supply Modes

The Simplicity Link Debugger is powered when connected to an host by the USB cable. When powered, the Simplicity Link Debugger can operate in two modes:

1. *Sensing mode* (default): the Simplicity Link Debugger senses the supply voltage of the connected device. In this mode, the current absorbed by the sensing circuitry of the debugger from the connected device is typically less than 1 µA
2. *Sourcing mode*: the Simplicity Link Debugger sources a fixed voltage of 3.3V to the device being debugged

At start up, the Simplicity Link Debugger operates in sensing mode (default). This mode is intended for self-powered devices , i.e. the connected board has its own power supply or battery. The Simplicity Link Debugger supports any Silicon Labs device with supply voltage ranging between 1.8V and 3.6V. In such conditions, the Simplicity Link Debugger does not require more than 100 mA and any USB 2.0 host will work.

Changing power supply mode:

If the target device has no power, it is possible to supply power from the Simplicity Link Debugger by toggling the power switch button. Pressing this button once activates the auxiliary power output connected to VTARGET, turning the green LED indicator ON and sourcing current to the target device (sourcing mode). Pressing the same button again, will deactivate the power and turn the LED OFF (sensing mode).

The Figure 2.2 Block Diagram on page 4 in Section 2. Hardware Overview might help visualizing the operating modes.

Note: To prevent accidental activations, the button needs to be pressed a little longer than one second, before it activates the power output. When operating in this mode, the Simplicity Link Debugger provides a fixed voltage of 3.3V to the target device. Depending on the custom hardware, the USB host might be required to source more than 100 mA, but no more than 500 mA.

If the indicator LED turns red when the button is pressed, it means that the Simplicity Link Debugger could not activate the power switch. Make sure that no power is present on the target device and try again.

Table 4.1. Power Supply Mode Indicator

LED Indicator	Power Supply Mode	Target Device Voltage Range	USB Host Required Current
OFF	Sensing	1.8V to 3.6V	Less than 100 mA
GREEN	Sourcing	3.3V	Less than 500 mA
RED	Sensing/Connection Error	Out of range	-

Important: Do not activate the power output when the target device is powered by other means, it might cause HW damages to either boards. Never use this function with battery powered devices.

5. Debugging

The Simplicity Link Debugger is a SEGGER J-Link Debugger that interfaces to the target device using the Serial Wire Debug (SWD) interface for Silicon Labs 32-bit (EFM32, EFR32, SiWx) devices or the C2 interface for Silicon Labs 8-bit MCUs (EFM8) devices. The debugger allows the user to download code and debug applications running on a connected custom hardware equipped with a Mini Simplicity interface. Additionally, it also provides a virtual COM (VCOM) port to the host computer that is connected to the target device's serial port* for general purpose communication between the running application and the host computer. For EFR32 devices, the Simplicity Link Debugger supports also Packet Trace Interface (PTI)*, offering invaluable debug information about transmitted and received packets in wireless links.

Note: *Assuming that the interface has been routed to the target device on custom board

When the debug USB cable is inserted, the on-board debugger is power activated and takes control of the debug and VCOM interfaces.

When the USB cable is removed, the target board might still be connected. Level shifters and the power switch prevent backpowering.

5.1 Virtual COM Port

The virtual COM port (VCOM) provides a means to connect a UART on the target device and allows a host to exchange serial data. The debugger presents this connection as a virtual COM port on the host computer that comes up when the USB cable is inserted.

Data is transferred between the host computer and the debugger through the USB connection, which emulates a serial port using the USB Communication Device Class (CDC). From the debugger, the data is passed on to the target device through a physical UART connection.

The serial format is 115200 bps, 8 bits, no parity, and 1 stop bit by default.

Note: Changing the baud rate for the COM port on the PC side does not influence the UART baud rate between the debugger and the target device. However, for target applications that require a different baud rate, it is possible to change the VCOM baud rate to match the target device's configuration. VCOM parameters in general can be configured through the kits' Admin Console available through Simplicity Studio.

5.2 Packet Trace Interface

The Packet Trace Interface (PTI) is a non-intrusive sniffer of data, radio state, and time stamp information. On EFR32 devices, starting from series 1, the PTI is provided for the user to be able to tap into the data buffers at the radio transmitter/receiver level.

From the embedded software perspective, this is available through the RAIL Utility, PTI component in Simplicity Studio.

6. Kit Configuration and Upgrades

The kit configuration dialog in Simplicity Studio allows you to change the J-Link adapter debug mode, upgrade its firmware, and change other configuration settings. To download Simplicity Studio, go to silabs.com/simplicity.

In the main window of the Simplicity Studio's Launcher perspective, the debug mode and firmware version of the selected J-Link adapter are shown. Click the [**Change**] link next to any of these settings to open the kit configuration dialog.
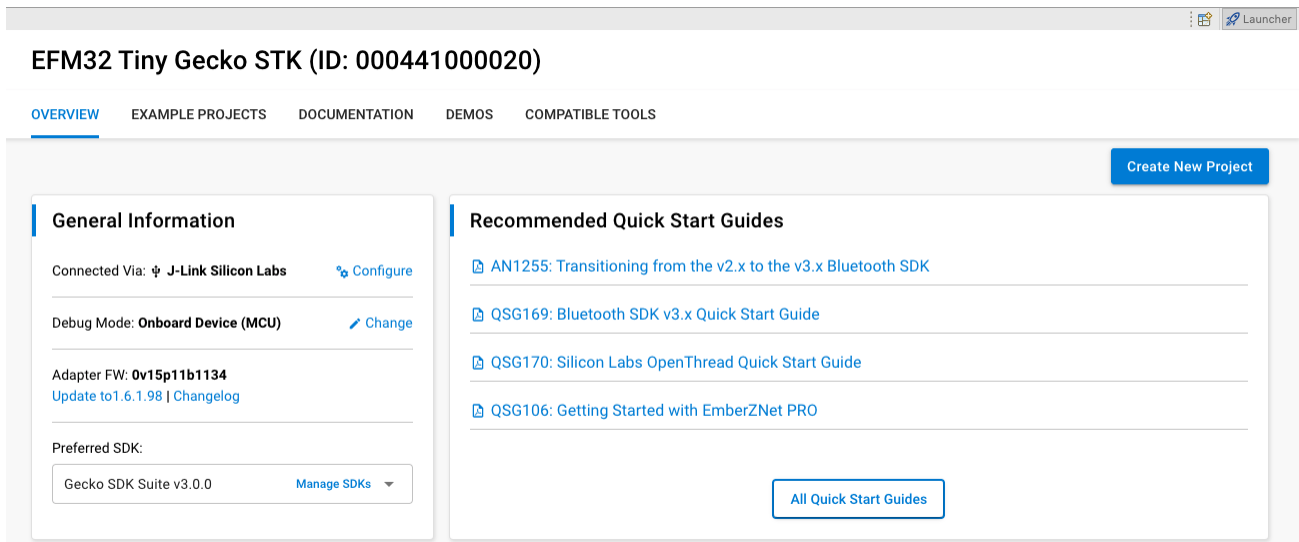

Figure 6.1. Simplicity Studio Kit Information
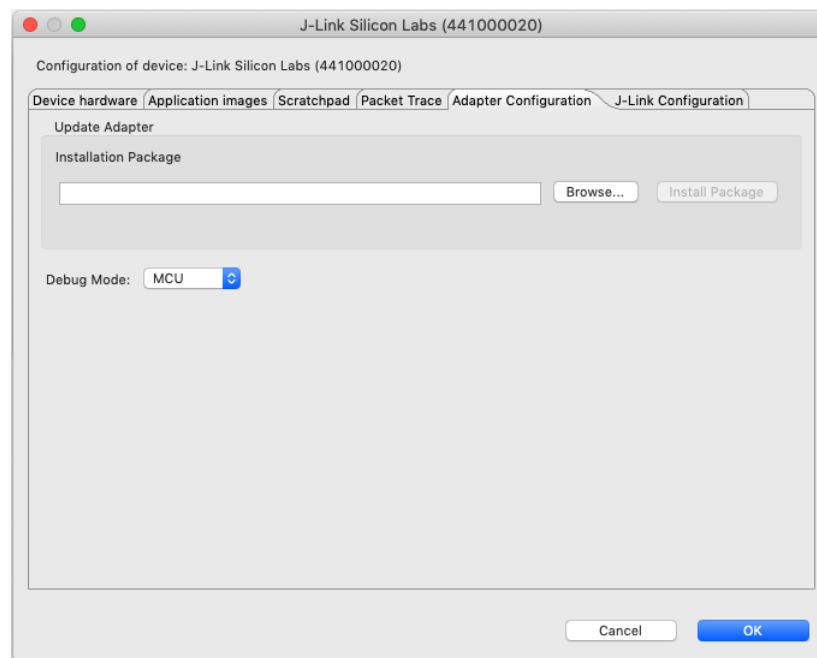
Figure 6.2. Kit Configuration Dialog

6.1 Firmware Upgrades

You can upgrade the kit firmware through Simplicity Studio. Simplicity Studio will automatically check for new updates on startup.

You can also use the kit configuration dialog for manual upgrades. Click the [**Browse**] button in the [**Update Adapter**] section to select the correct file ending in `.emz`. Then, click the [**Install Package**] button.

7. Kit Revision History

The kit revision can be found printed on the kit packaging label, as outlined in the figure below. The revision history given in this section may not list every kit revision. Revisions with minor changes may be omitted.

Figure 7.1. Kit Label

7.1 Si-DBG1015A Revision History

Kit Revision	Released	Description
A03	13 October 2022	Initial release.

8. Document Revision History

Revision 1.0

June 2023

Initial document version.

Simplicity Studio

One-click access to MCU and wireless tools, documentation, software, source code libraries & more. Available for Windows, Mac and Linux!

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