SIQORE DIGITAL KEY DEMO KIT
User Guide

Introduction

SIQORE's Digital Key Evaluation Kit is designed for demonstrating the application concept of Ultra-Wideband (UWB) and Bluetooth Low Energy (BLE) based on Car Connectivity Consortium (CCC) 3.0 specifications. It includes a UWB module (SMK100), a BLE module (SSL100), and a CAN BUS module (TD3USPCAN).

This evaluation kit provides a practical concept of the CCC Digital Key from the UWB and BLE wireless application perspective. Please contact us so we can further introduce our solution and help to accelerate the development of your next Digital Key.
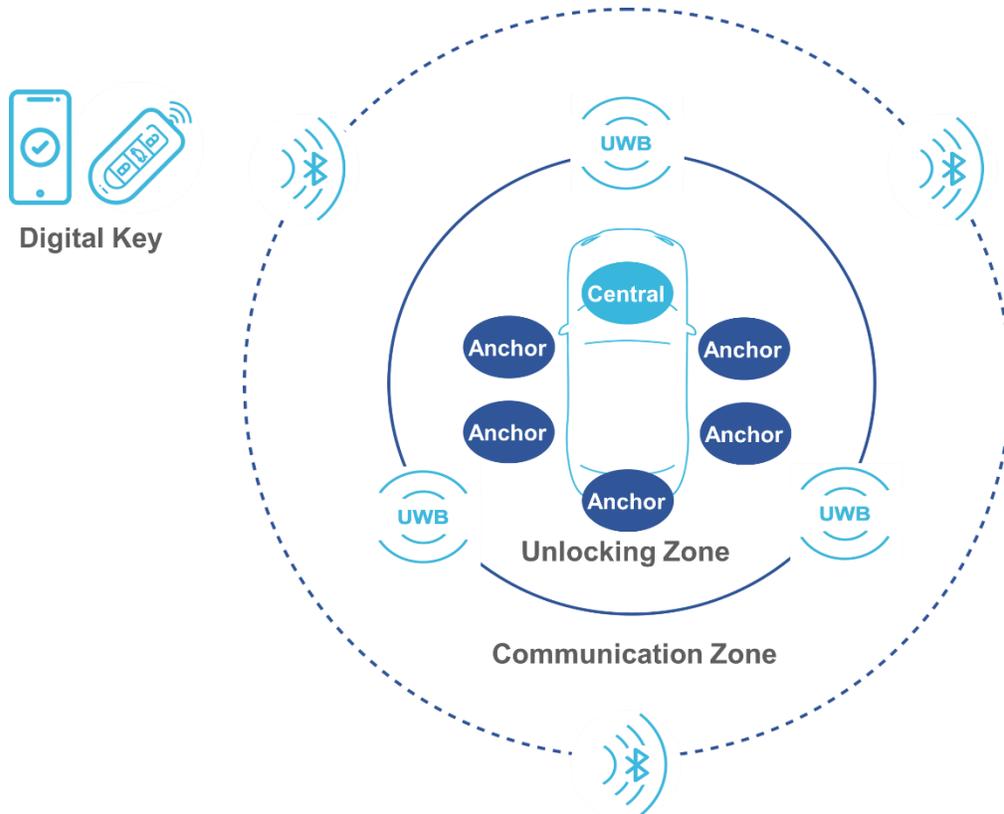
Revision History

| Revision	Date	Description	Author
V1	2023/6/27	Initial version	Yuri
V1.1	2023/7/17	Corrected the name of pins in 2.2.2 MK8000 Firmware Programming and Debugging Setup section.	Yuri, Evie

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1. Recognizing Demo Board

The following is the connection diagram of the whole set of equipment using CAN bus.
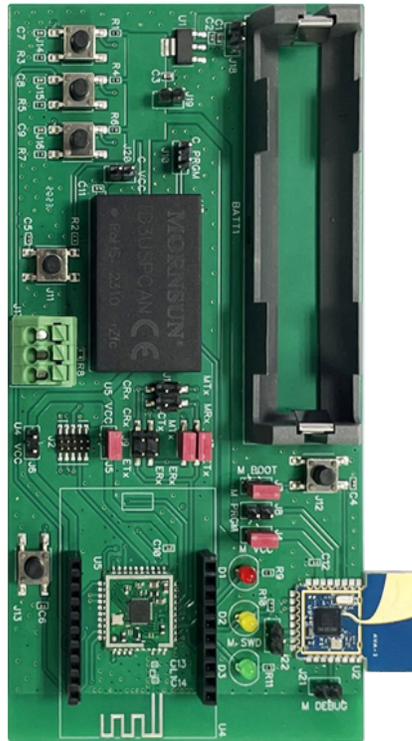

It is composed of a Digital Key (tag), a central and five anchors. The following introduces each device.
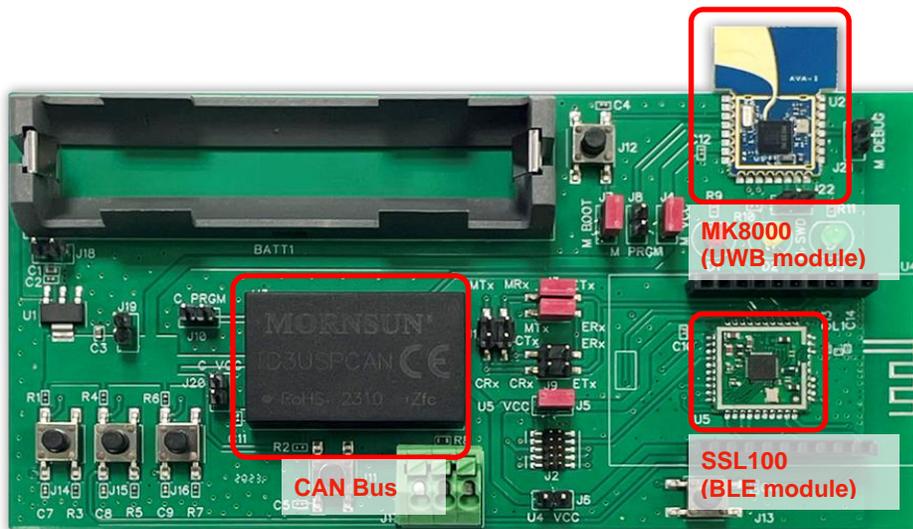
Top view of SIQORE Digital Key Demo Kit v1.

1.1 Digital Key (tag)
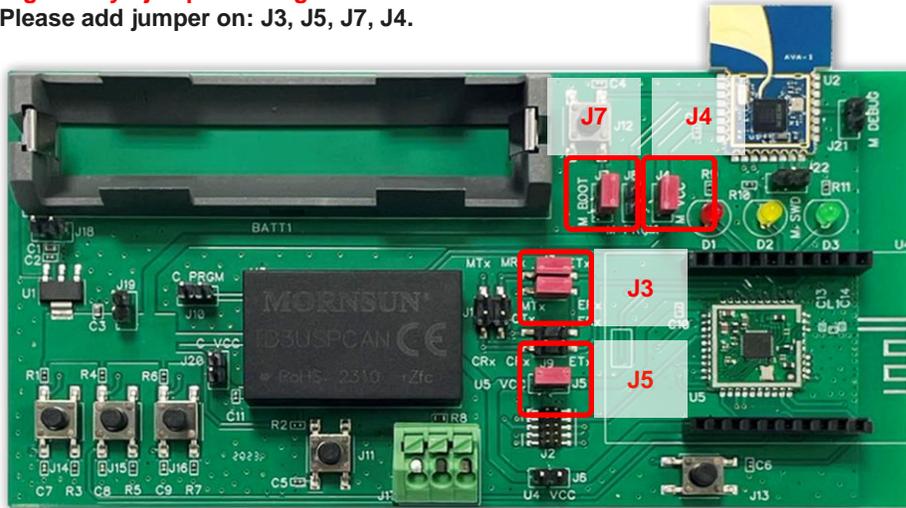

Digital Key (tag) top view.
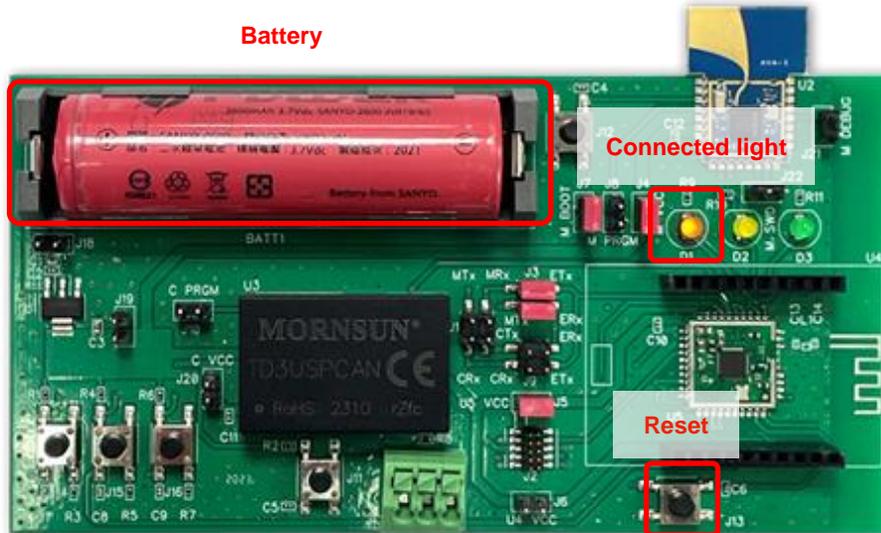
Digital Key (tag) bottom view.

1.1.1 Description of Digital Key (tag)

Digital Key - jumper setting
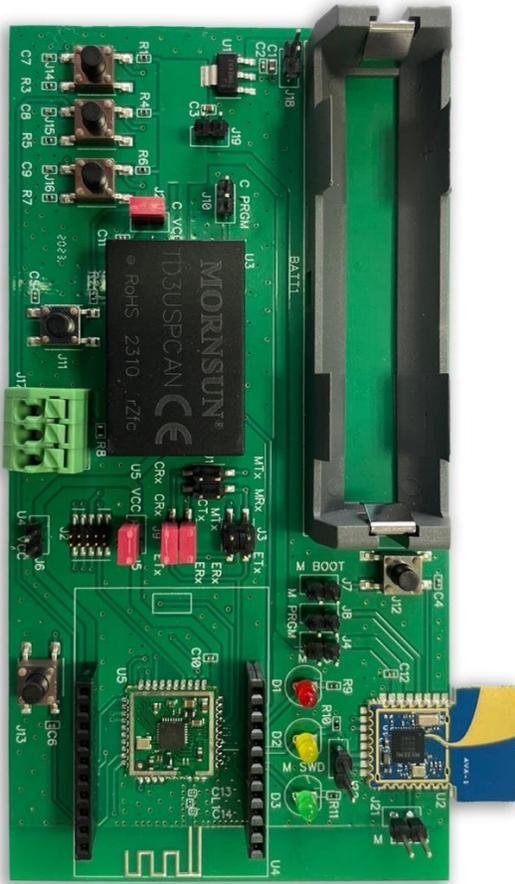**Please add jumper on: J3, J5, J7, J4.**

Jumper setting of the Digital Key (tag).

It is location of reset button, LED, and the battery on the demo kit.

When the jumper setting is in Digital Key (Key-fob), there is 1 reset button (J13) and 1 red LED (D1) indicating connection status. Users can reset key-fob board by pressing button J13 after plugging in battery (J13 only resets the SSL100 without resetting the CAN or MK8000 module). Key-fob can connect with vehicle central when BLE RSSI > -65dBm and disconnect when UWB range > 10m. Red LED (D1) will be turned on when the key-fob is connected to the vehicle.
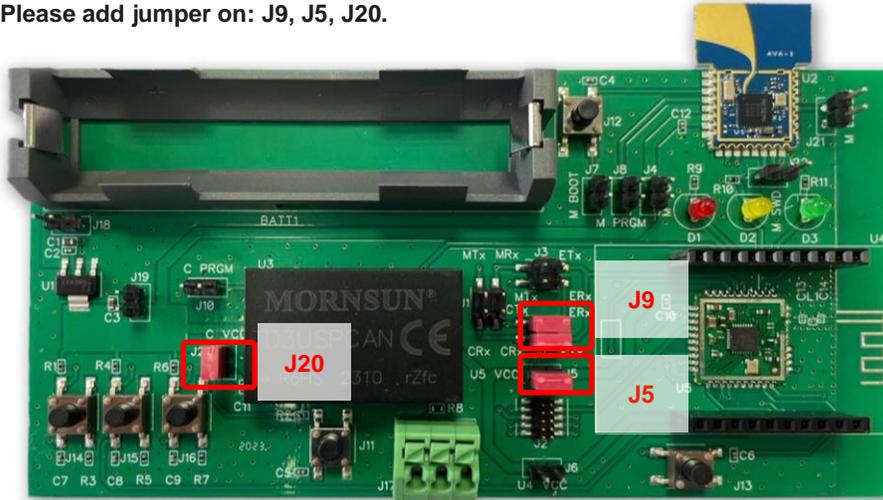
1.2. Vehicle Central

Vehicle Central top view.

Vehicle Central bottom view.
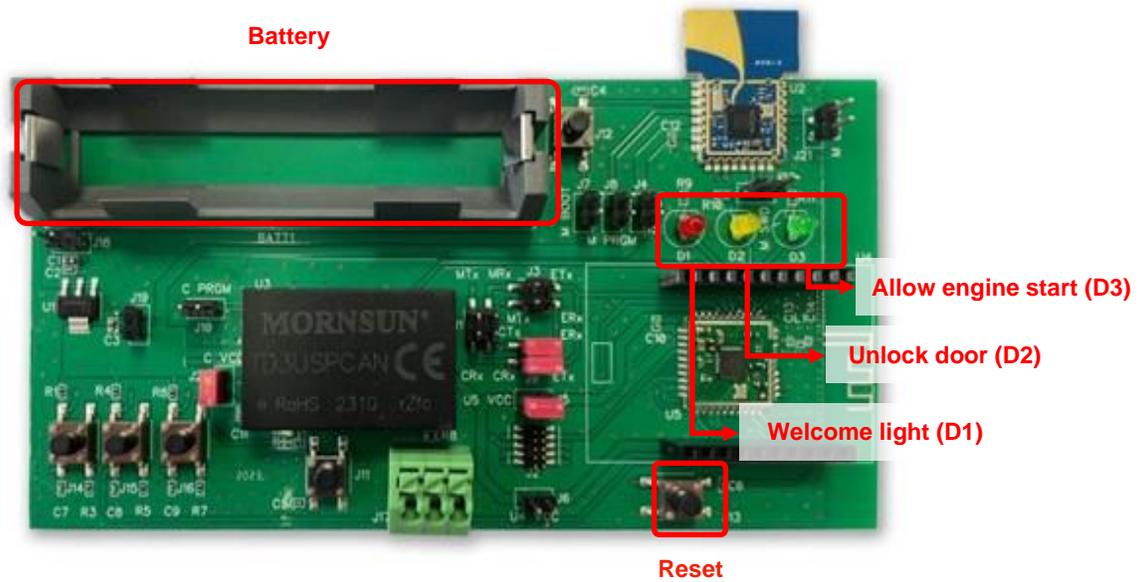
1.2.1 Description of Vehicle Central

Vehicle Central - jumper setting
Please add jumper on: J9, J5, J20.

Jumper setting of the Vehicle Central.

The following is the location of the reset button, LEDs, and battery on the demo kit.

When the jumper setting is in Central, there is 1 reset button (J13) and 3 LEDs to indicate different statuses. Users can reset the vehicle board by pressing button J13 after plugging in the battery (J13 only resets the SSL100 without resetting the CAN or MK8000 module). Key-fob can connect with vehicle central when BLE RSSI > -65dBm and disconnect when UWB range > 10m. When the central connects to the key-fob and the distance in between is within the setting range, the corresponding LED will be turned on. Different LEDs also represent different statuses of the vehicle.

The default settings are as follows:

• Red LED (D1): vehicle welcome light, turns on between 0.5m to 5m range.

• Yellow LED (D2): unlock the vehicle door and turn on between 0.5m to 3m range.

• Green LED (D3): allows vehicle engine to start and turns on when the range is less than 0.5m.

Users can change the distance to connect or disconnect BLE and UWB, as well as the corresponding LEDs.

The following picture shows that the red LED (D1) of the key-fob turns on when it is connected to the vehicle. At the vehicle side, the green LED (D3) turns on because the distance between the key-fob and the vehicle is less than 0.5m.

1.3. Vehicle Anchor

Vehicle Anchor top view.

Vehicle Anchor bottom view.
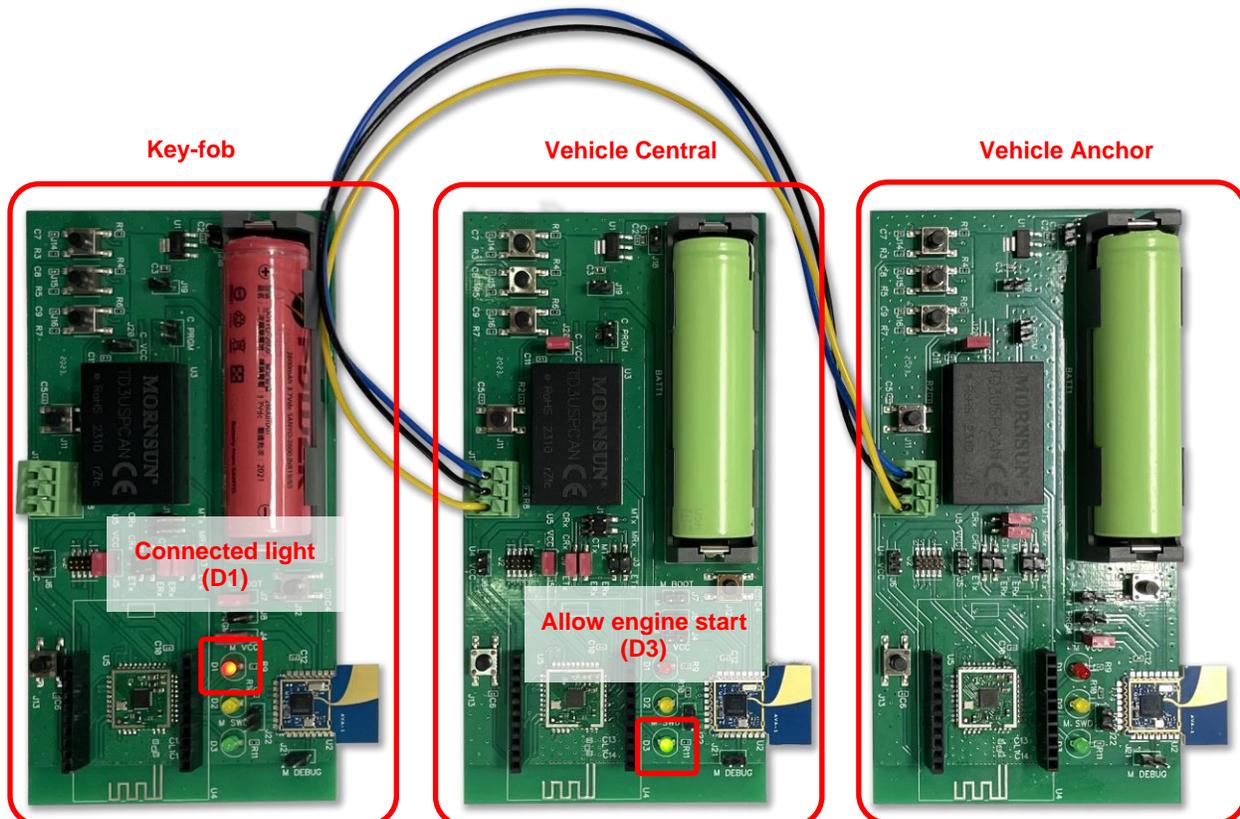
1.3.1. Description of Vehicle Anchor

Vehicle Anchor - jumper setting
Please add jumper on: J1, J4, J20.
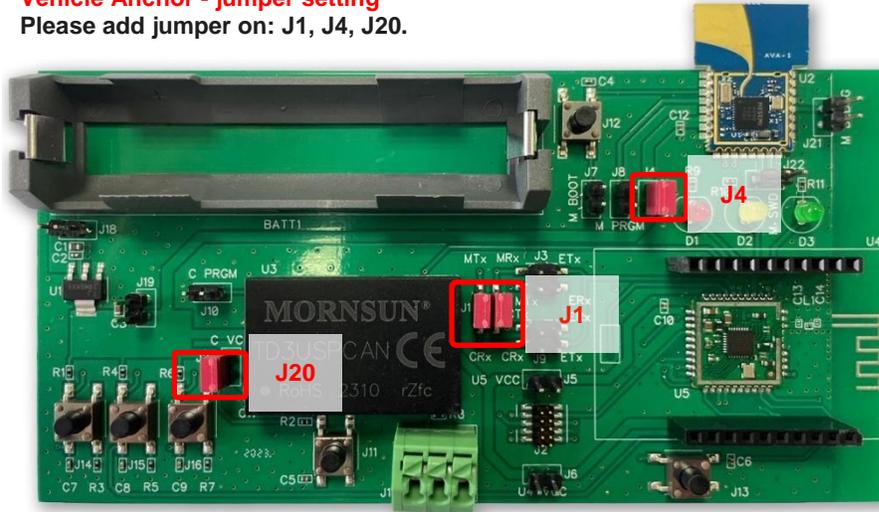
2. Programing and Debugging

(If the MK8000 and SSL100 have been programmed, this step can be ignored)

2.1. Firmware Programing

Firmware programming involves two modules: SSL100 and MK8000. The generation of MK8000 firmware depends on the MK8000 SDK. For details, please refer to the MK8000 SDK.

2.2. Debugging

User can check the debug log of SSL100 and MK8000 by connect cable to their debug port.

### 2.2.1. SSL100 Firmware Programming and Debugging Setup

For SSL100 programming and debugging, please connect a STK/WSTK debug adapter to Silicon Lab's development mainboard. Then, please use an IDC 10 pin female-female cable to connect between debug adapter's "MINI" port and J2 of CCC Demo Kit. Users need to configure mainboard debugging to "OUT" option. Users can reset SSL100 by pressing button J13 after powering on (J13 only resets the SSL100 without resetting the CAN or MK8000 module).
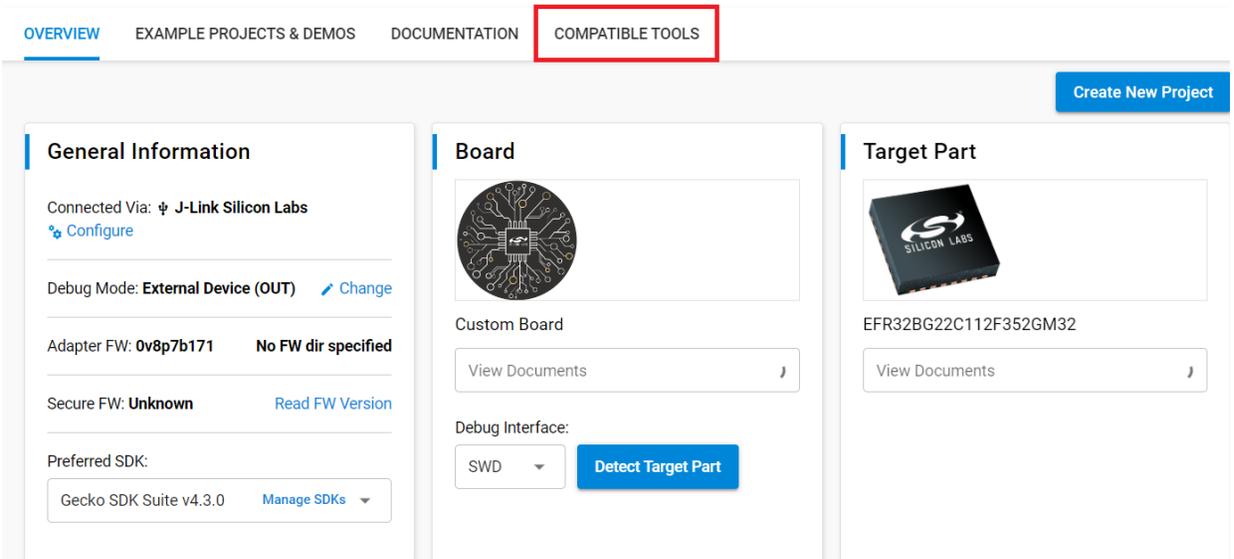
Details are shown in the picture below:
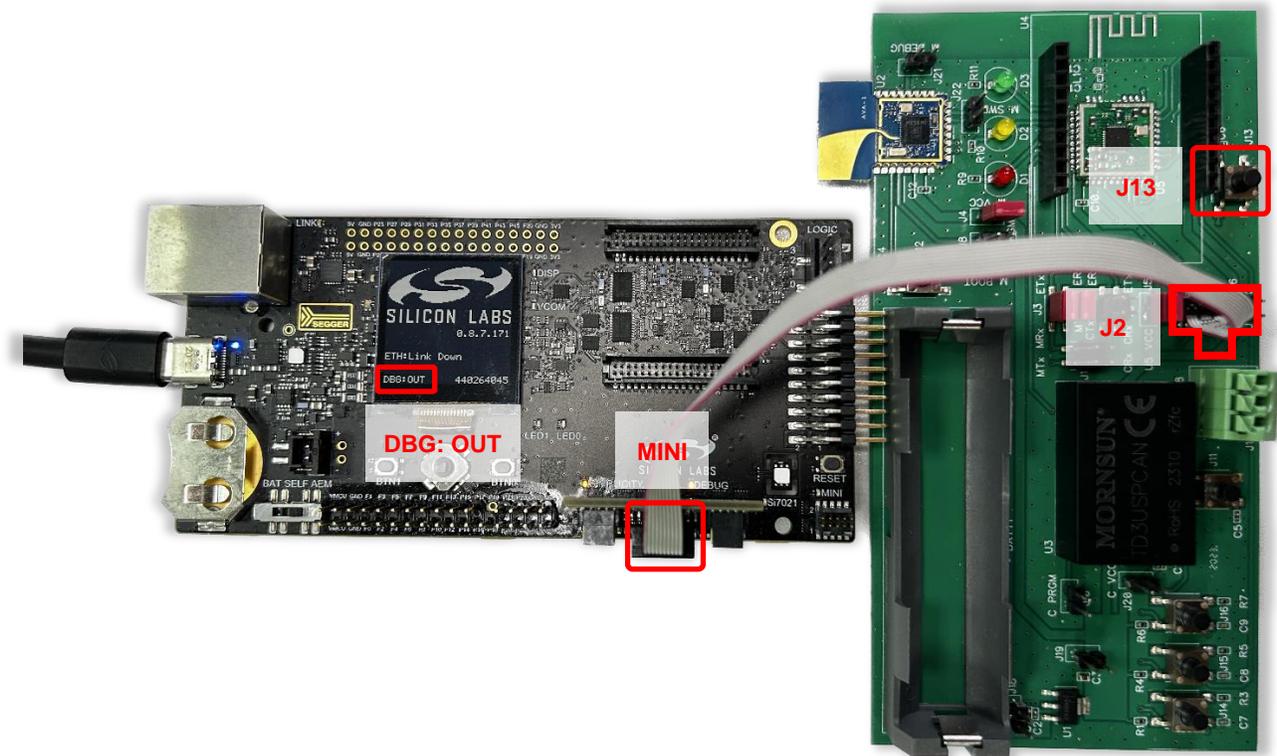
To program SSL100, user can follow the steps below:

1. Plug in Silab Mainboard connected with device to be programmed.
2. Start Simplicity Studio.
3. Verify JLink is detected and click "Start" button (as red frame below).
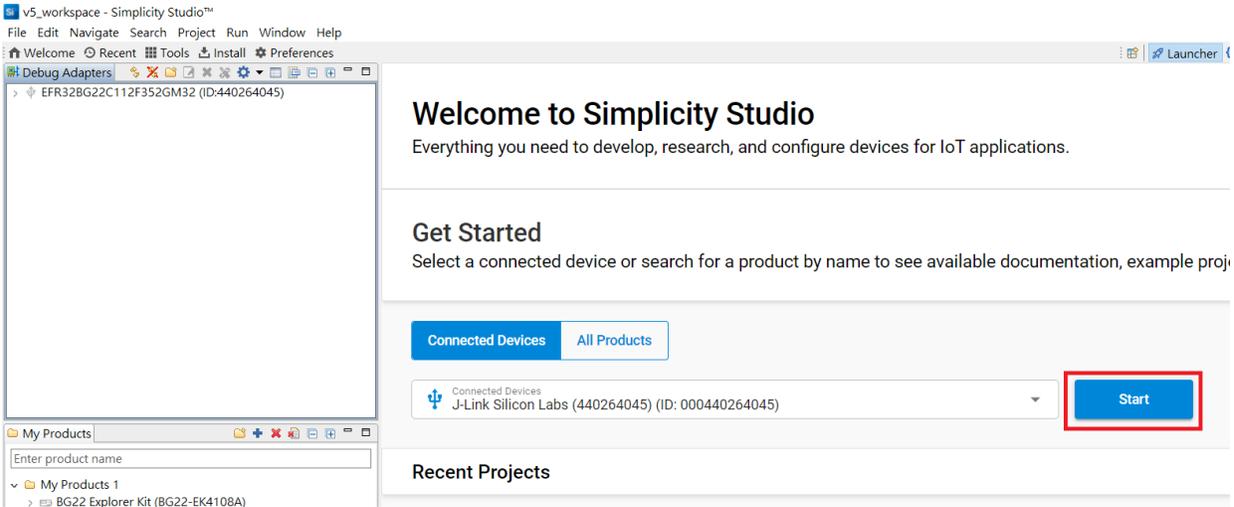
4. Click compatible tools tab.

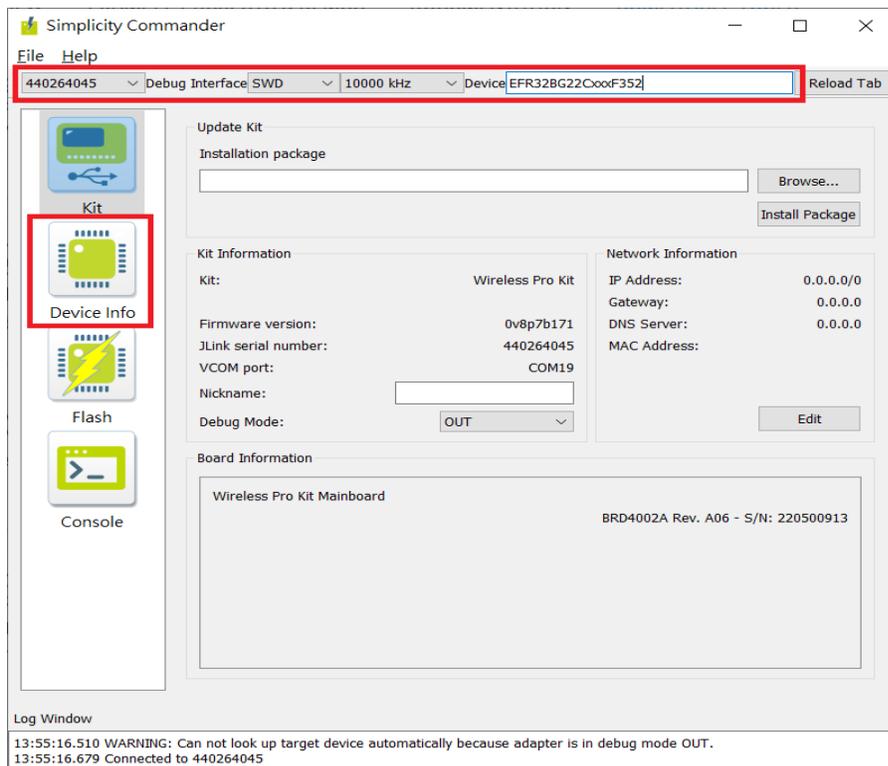5. Click "Launch" button under Simplicity Commander.

J-Link Silicon Labs (440264045) (ID: 000440264045)

OVERVIEW   EXAMPLE PROJECTS & DEMOS   DOCUMENTATION   **COMPATIBLE TOOLS**

Device Console
Development kit serial and admin command-line console utility
[LAUNCH]

Network Analyzer
Wireless packet capture and analysis tools
[LAUNCH]

Application Builder
Embedded software framework application builder for Zigbee and Gecko Bootloader
[LAUNCH]

AoA Analyzer
Graphical tool for analyzing Angle of Arrival calculation in a Bluetooth Direction Finding setup
[LAUNCH]

Positioning Tool
Interactive tool for AoA Locator boards
[LAUNCH]

Bluetooth NCP Commander
Interactive tool for sending BGAPI commands to a Bluetooth device
[LAUNCH]

Migrate Projects
Migrate projects from version 4 workspace to version 5 workspace
[LAUNCH]

Simplicity Commander
Graphical and command-line utility to manage flash and security of EFM and EFR devices in development and production environments
[LAUNCH]

6. Select debug interface to Silab Mainboard. Change device to EFR32BG22CxxxF352.
7. Click "Device Info" tab.

8. If device is properly detected, under MCU Information data will show up.
9. Click "Flash" tab.
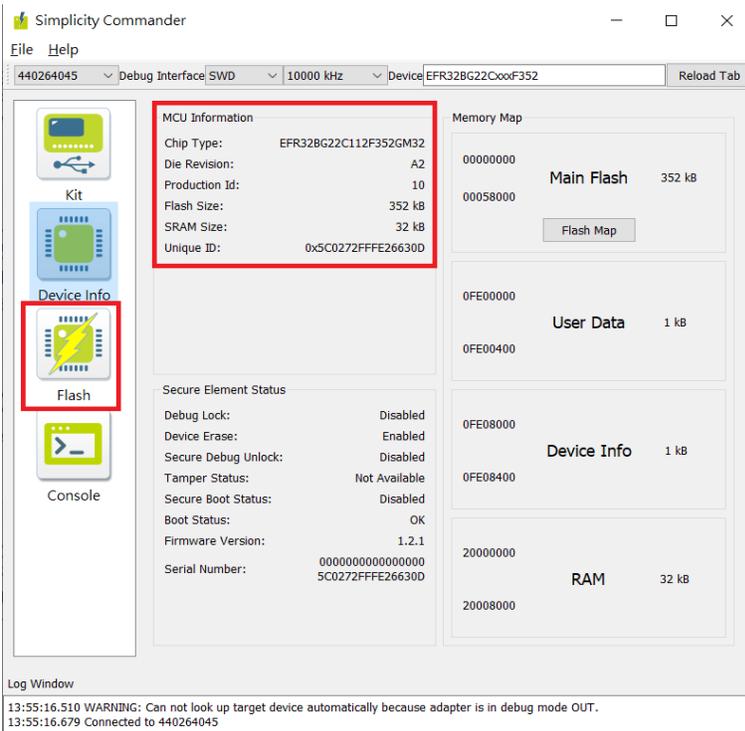
10. Select hex file to program.
11. Click "Flash" button. Wait until programming is complete.
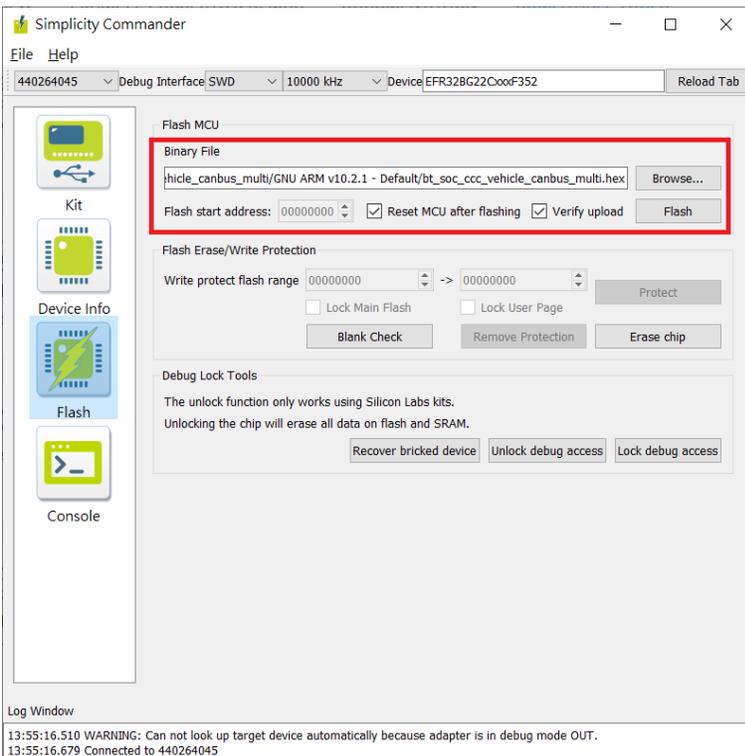
On PC side, the baud rate of COMPORT for debug log serial port is 115200. User can use terminal programs such as Putty or TeraTerm to read the debug log outputs from SSL100. Once key-fob and vehicle central are connected, users can see distance measurements between key-fob and vehicle in the debug log. Please note that this debug log may change for different firmware version, but main data should still be the same.

The output results of sample distance are shown below:

```
[I] drv_ucan_read: 0
[I] CANID 1 - Distance: 85 cm
[I] CANID 1 - AVG Distance: 82 cm
[I] CANID 2 - AVG Distance: 0 cm
[I] drv_ucan_read: 0
[I] CANID 1 - Distance: 62 cm
[I] CANID 1 - AVG Distance: 75 cm
[I] CANID 2 - AVG Distance: 0 cm
[I] drv_ucan_read: 0
[I] CANID 2 - Distance: 43 cm
[I] CANID 1 - AVG Distance: 75 cm
[I] CANID 2 - AVG Distance: 43 cm
[I] drv_ucan_read: 0
[I] CANID 2 - Distance: 6 cm
[I] CANID 1 - AVG Distance: 75 cm
[I] CANID 2 - AVG Distance: 24 cm
[I] drv_ucan_read: 0
[I] CANID 2 - Distance: 83 cm
[I] CANID 1 - AVG Distance: 75 cm
[I] CANID 2 - AVG Distance: 44 cm
[I] drv_ucan_read: 0
[I] CANID 2 - Distance: 75 cm
[I] CANID 1 - AVG Distance: 75 cm
[I] CANID 2 - AVG Distance: 54 cm
[I] drv_gpio_write GPIO Write
[I] Light ON
[I] drv_gpio_write GPIO Write
[I] Door UNLOCKED
```
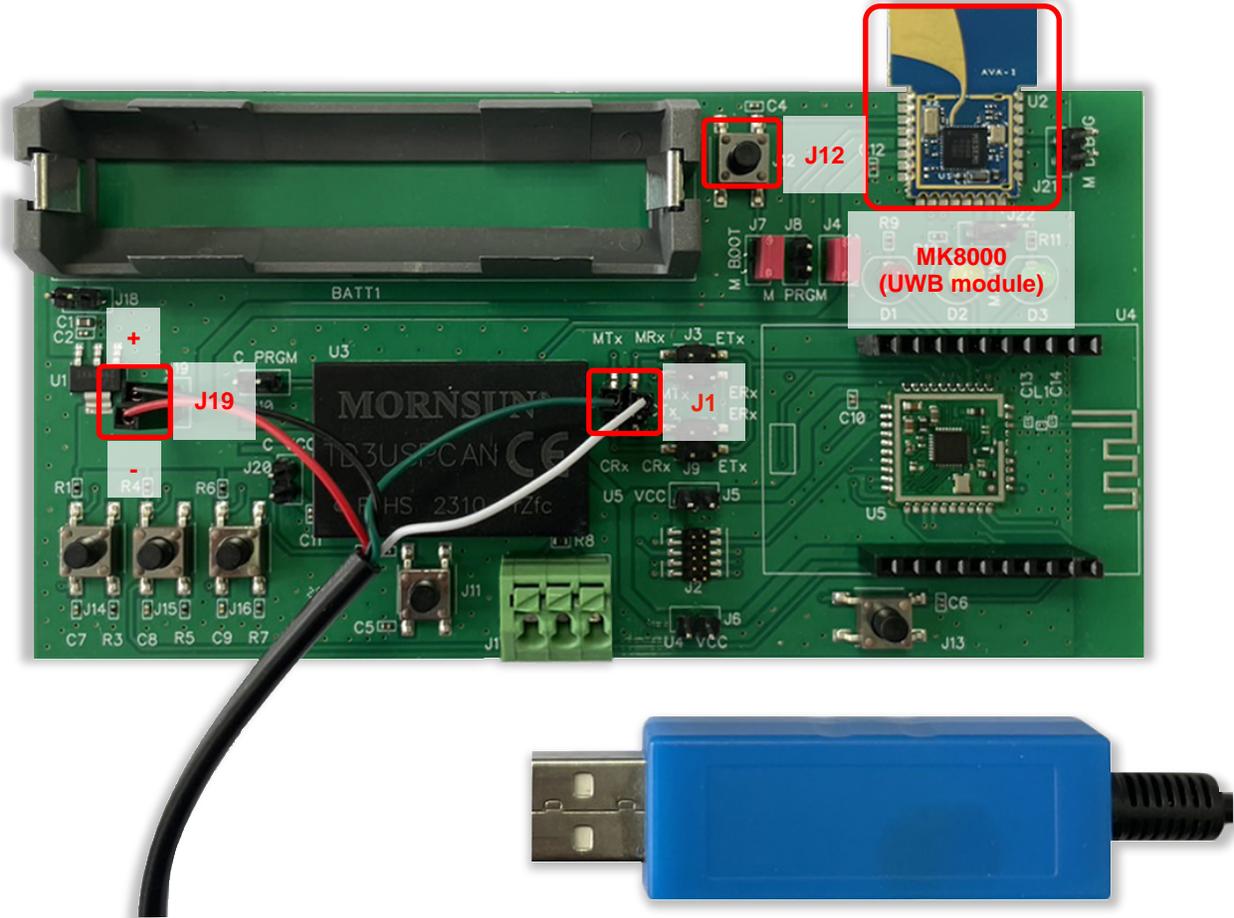
2.2.2 MK8000 Firmware Programming and Debugging Setup

For MK8000 programming, please use a USB to UART cable and connect Power and Ground at jumper pin J19 (the upper jumper pin close to "J19" is GND), Tx, and Rx at jumper pin J1 (Connect MRx of J1 jumper pin to USB Tx, contact MTx to USB Rx). See the following photo for more details.

Users can reset MK8000 by pressing button J12 after plugging in the battery (J12 only resets the MK8000 without resetting the CAN or SSL100 module). When the cable setup is correct, user can start to program MK8000 module. Please refer to   MK8000_EVB_Quick_Start_Guide" for more information.

For MK8000 debugging, please use a USB to UART cable to connect Ground and debug output at jumper pin J21 of CCC Demo Kit (Debug output is the upper pin). Please make sure the battery is plugged in.
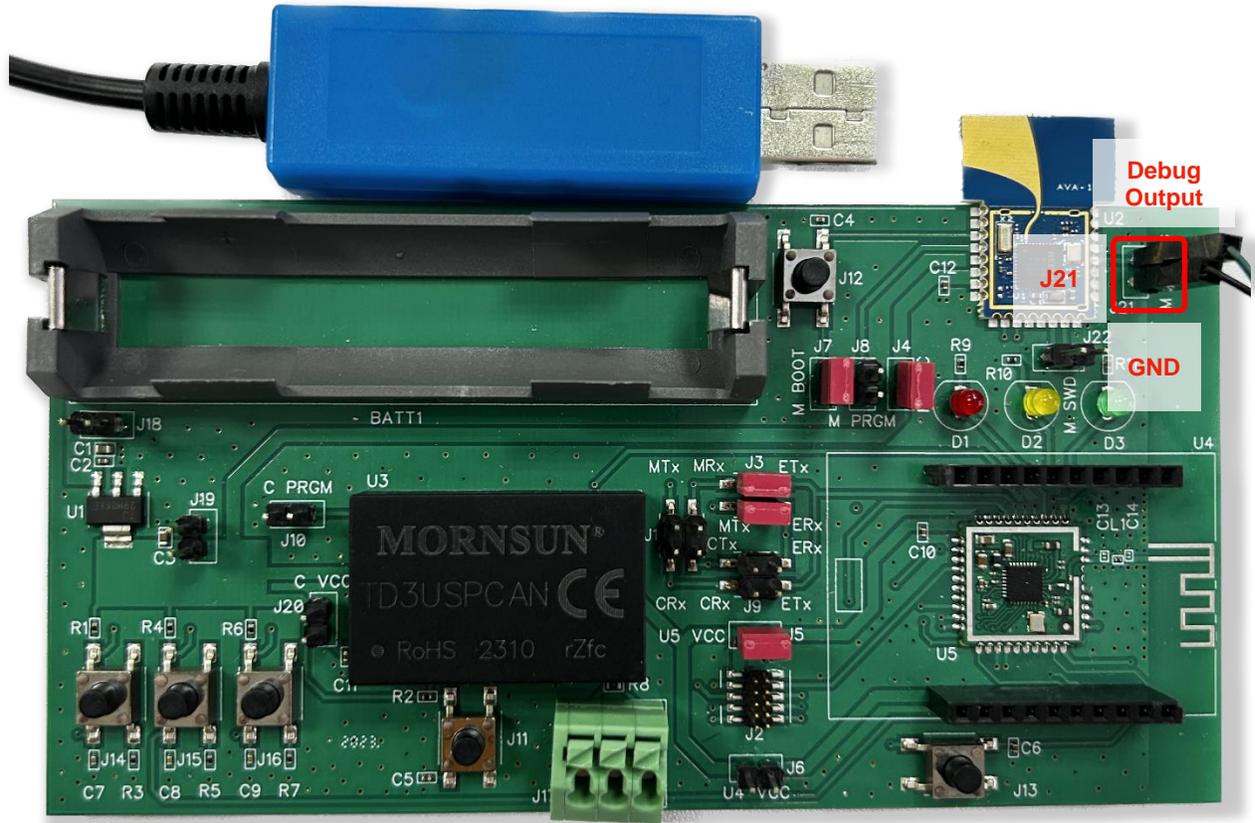
After connecting USB to PC, check the COM port and open the debug tool such as Putty or TeraTerm. The baud rate of the serial port is 921600. Sample debug log is shown as follows:

```
COM33 - PuTTY                                                                    —

   60 | [APP][INFO]Hello from MKSEMI!
  180 | [APP][INFO]Build information
                              Vendor      : MKSEMI
                                    Chip    : MK8000
                                        Date    : Apr 26 2023
                                                    Version   : V0.4.0
  450 | [DRV][INFO]jedec_id C86513
 2100 | [DRV][INFO]load_cap : 00000050
 2250 | [APP][INFO]WDT close
 4020 | [MAC][INFO]2080000 - Exchange Table
 4230 | [MAC][INFO]2080018 - Control Structure
 4410 | [MAC][INFO]20800A8 - Link Descriptor
 4590 | [MAC][INFO]20800D0 - RX Descriptor
 4800 | [MAC][INFO]20801C0 - TX Descriptor
 4980 | [MAC][INFO]20801F0 - RX Buffer
 5160 | [MAC][INFO]2080DF0 - TX Buffer
 5370 | [DRV][INFO]uwb_open
 5490 | [APP][INFO]Ranging lib version: 0.8.2.0
 5640 | [APP][INFO]AoA lib version: 0.7.7.1
```
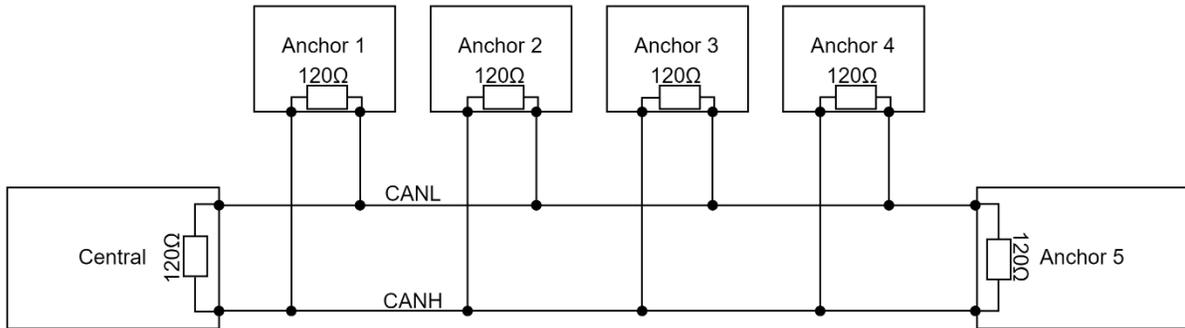
3. CAN BUS Connection
3.1 CAN BUS Networking Mode

The CAN BUS network connection is shown as follows:

CANL of all CAN devices are all connected together, and CANH of all CAN devices are connected together. There is a 120 OHM resistor on each board already, so no external resistor is required. Users can reset CAN bus by pressing button J11 after plugging in the battery (J11 only resets the CAN BUS without resetting MK8000 or SSL100 module).
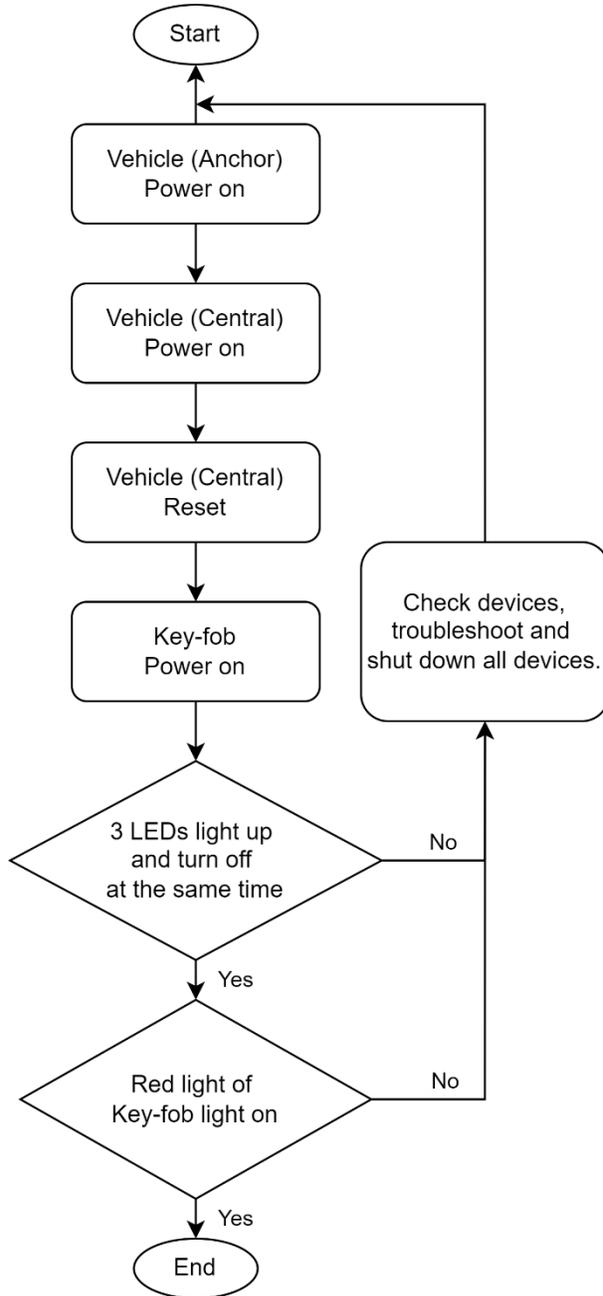
3.2. CAN bus connector
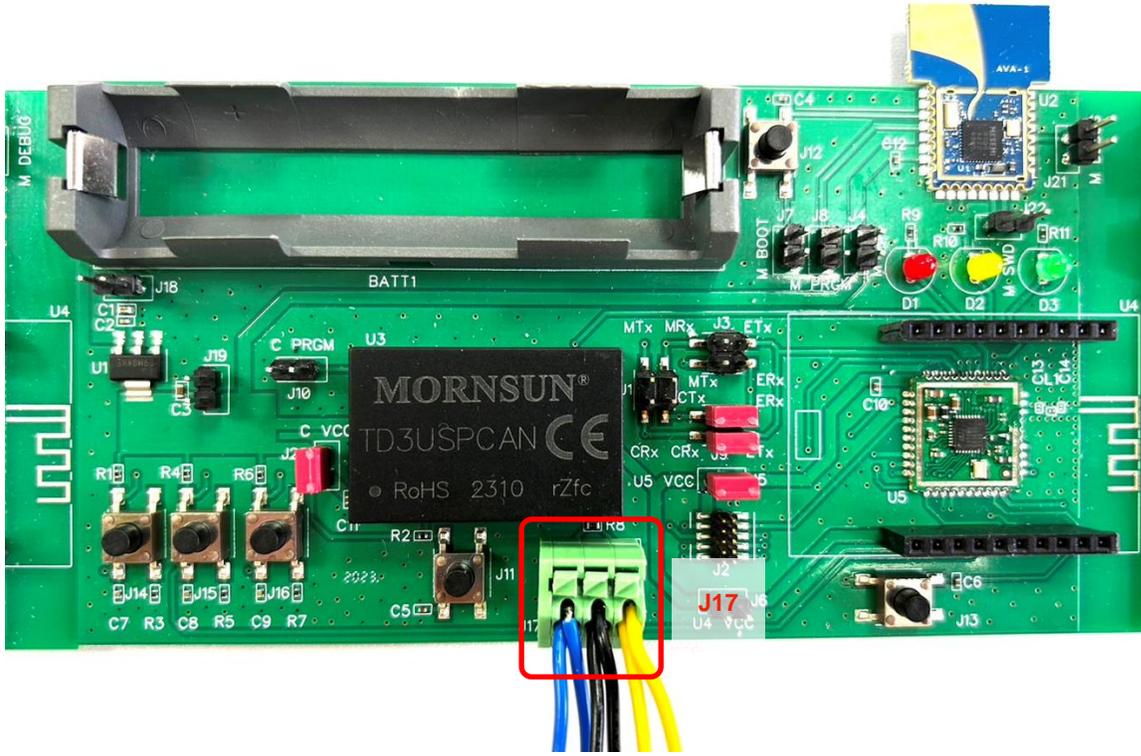
Vehicle Central connection diagram. User can connect Vehicle Central and Anchor through J17.
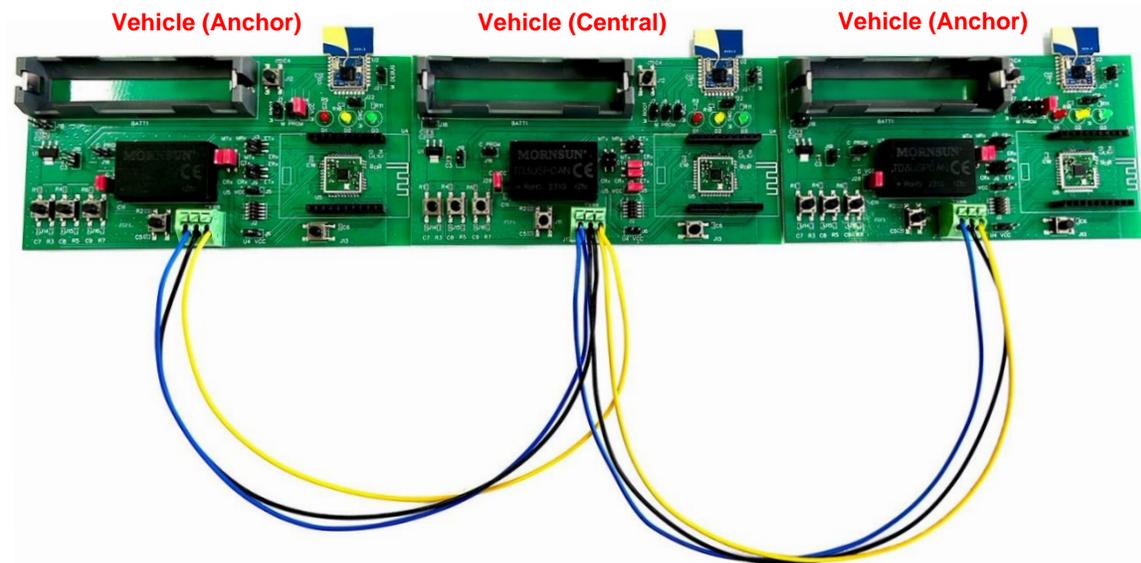
1 Vehicle Central and 2 Vehicle Anchor connection example.

4. Power On Order
4.1. Power on procedure of Digital Key

1. Power on all vehicle anchors.
2. Power on vehicle central.
3. Reset vehicle central.
4. Power on key-fob.
5. Verify if device is working. If user see that all LEDs light up at the same time then turn off, this means that system is ready. If the LEDs light up but did not turn off, this means that there is something wrong with the system.
6. Once key-fob is sufficiently close to vehicle central, its red LED will light up. This means that both are connected via BLE and UWB ranging should be starting.

SIQORE Contact Information

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