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Spec No: 002-08682

Spec Title: MB39C811-EVBSK-02 ENERGY HARVESTING WITH BLUETOOTH(R) SMART BEACON STARTER KIT OPERATION GUIDE

Replaced by: NONE

MB39C811-EVBSK-02

Energy Harvesting with Bluetooth® Smart Beacon Starter Kit Operation Guide

Doc. No. 002-08682 Rev. *C

Cypress Semiconductor
198 Champion Court
San Jose, CA 95134-1709
http://www.cypress.com

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Preface

This manual explains how to use the Starter Kit. Be sure to read this manual before using the product.
For mass production/evaluation PMICs for this product, consult with sales representatives or support representatives..

Handling and use

Handling and use of this product and notes regarding its safe use are described in the manuals for products bundled with the Starter Kit.
Follow the instructions in the manuals to use this product.
Keep this manual at hand so that you can refer to it anytime during use of this product.

Notice on this document

All information included in this document is current as of the date it is issued. Such information is subject to change without any prior notice.
Please confirm the latest relevant information with the sales representatives.

Cautions

Caution of the products described in this document

The following precautions apply to the product described in this manual.

⚠ WARNING	Indicates a potentially hazardous situation which could result in death or serious injury and/or a fault in the user's system if the product is not used correctly.

Electric shock, Damage	Before performing any operation described in this manual, turn off all the power supplies to the system. Performing such an operation with the power on may cause an electric shock or device fault.
Electric shock, Damage	Once the product has been turned on, do not touch any metal part of it. Doing so may cause an electric shock or device fault.

⚠ CAUTION	Indicates the presence of a hazard that may cause a minor or moderate injury, damages to this product or devices connected to it, or may cause to lose software resources and other properties such as data, if the device is not used appropriately.

Cuts, Damage	Before moving the product, be sure to turn off all the power supplies and unplug the cables. Watch your step when carrying the product. Do not use the product in an unstable location such as a place exposed to strong vibration or a sloping surface. Doing so may cause the product to fall, resulting in an injury or fault.
Cuts	The product contains sharp edges that are left unavoidably exposed, such as jumper plugs. Handle the product with due care not to get injured with such pointed parts.
Damage	Do not place anything on the product or expose the product to physical shocks. Do not carry the product after the power has been turned on. Doing so may cause a malfunction due to overloading or shock.
Damage	Since the product contains many electronic components, keep it away from direct sunlight, high temperature, and high humidity to prevent condensation. Do not use or store the product where it is exposed to much dust or a strong magnetic or electric field for an extended period of time. Inappropriate operating or storage environments may cause a fault.
Damage	Use the product within the ranges given in the specifications. Operation over the specified ranges may cause a fault.
Damage	To prevent electrostatic breakdown, do not let your finger or other object come into contact with the metal parts of any of the connectors. Before handling the product, touch a metal object (such as a door knob) to discharge any static electricity from your body.

Damage	When turning the power on or off, follow the relevant procedure as described in this document. Before turning the power on, in particular, be sure to finish making all the required connections. Furthermore, be sure to configure and use the product by following the instructions given in this document. Using the product incorrectly or inappropriately may cause a fault.
Damage	Always turn the power off before connecting or disconnecting any cables from the product. When unplugging a cable, unplug the cable by holding the connector part without pulling on the cable itself. Pulling the cable itself or bending it may expose or disconnect the cable core, resulting in a fault.
Damage	Because the product has no casing, it is recommended that it be stored in the original packaging. Transporting the product may cause a damage or fault. Therefore, keep the packaging materials and use them when re-shipping the product.

Contents

1.   Description

The MB39C811-EVBSK-02 is an evaluation board that contains Energy Harvesting Power Management IC, MB39C811 (Buck DC/DC converter) with Bluetooth® Smart (Low Energy), which can be used in application on the Solar and Piezoelectric Energy Harvester. The MB39C811 has a wide input range from 4V up to 23V, and the output voltages are selectable from 1.5V to 5V. The board contains a Programmable (application block only) Bluetooth® Smart module, Cypress Component: MBH7BLZ02-109004, which allows BLE (Bluetooth Low Energy) Beacon and wireless data communications.

Figure 1-1. Diagram of the Starter Kit

Transmitter
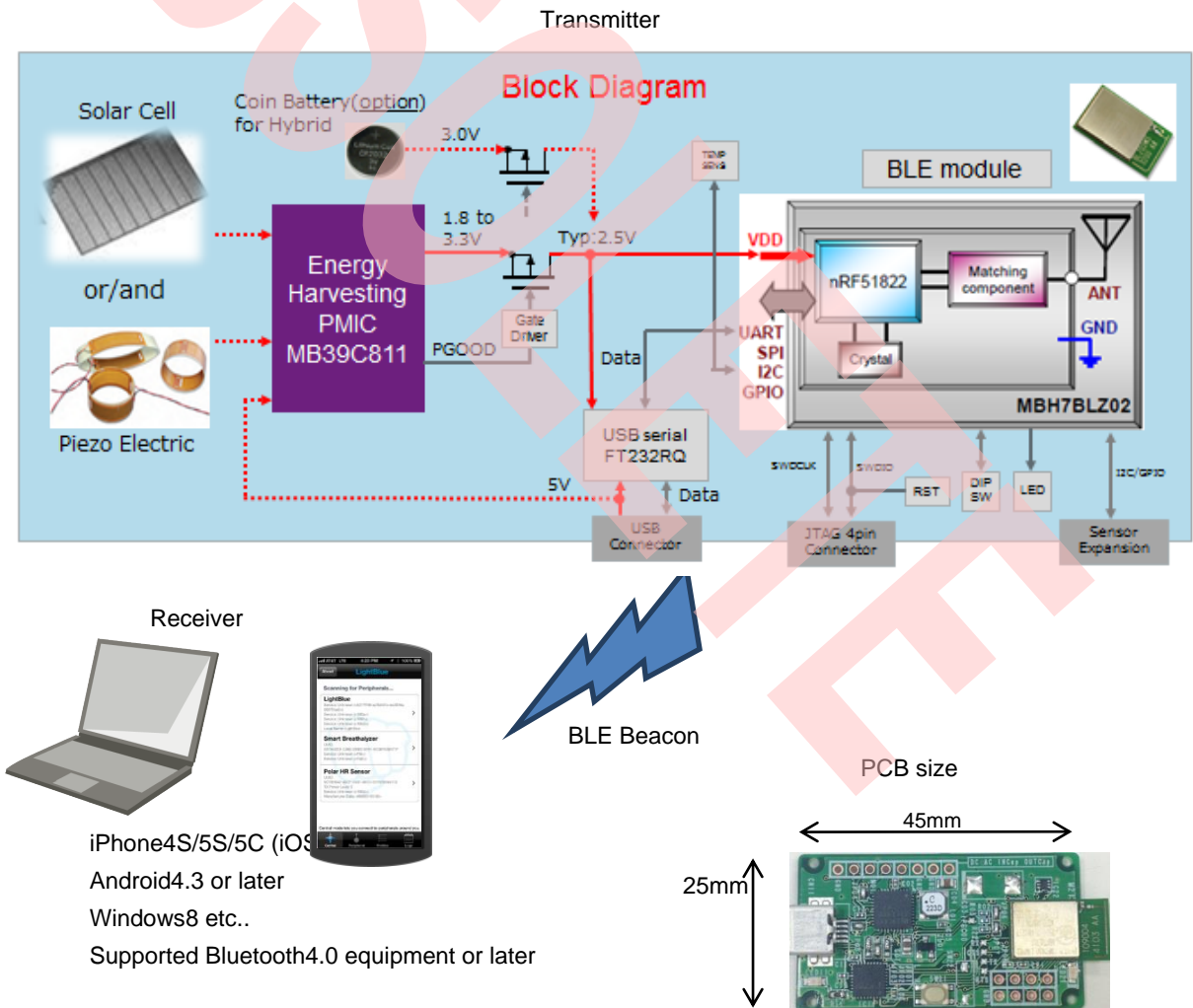
Receiver

iPhone4S/5S/5C (iOS

Android4.3 or later

Windows8 etc..

Supported Bluetooth4.0 equipment or later

BLE Beacon

PCB size

45mm

25mm
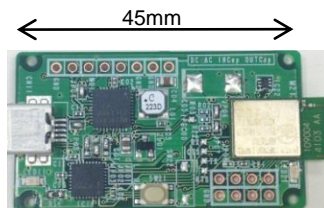
2.   Features

- Installed Energy Harvesting Power Management IC: MB39C811
- Programmable (application block only)Bluetooth® Smart Module: MBH7BLZ02-109004(*1)
- Transmit BLE Beacon using Solar energy and Vibration energy only
- Transmit about 1 second intervals under 500lx
- Support a lot of energy inputs
  - □ - Solar Cell
  - □ - Piezo Electric
  - □ - USB Bus Power
  - □ - Coin Battery (Expandable: For Hybrid)
  - □ - NFC: Near Field Communication (Expandable: Power supply only)
  - □ - Commercial Power Supply: AC85~265V (Expandable: Need additional resister)
- Installed Temperature Sensor
- Installed USB Serial Converter IC for changing Beacon IDs
- Attached Solar Cell for Evaluation
- Attached Case & USB Cable
- Schematic, BOM List, Layout Data, Sample Software
- Installed Expandable Terminal.
  - □ - Reset Button for MCU (Standard mount)
  - □ - JTAG Connector for MCU Program
  - □ - Expandable Sensor Interface (I2C/GPIO)
  - □ - DIPSW (Expandable)
  - □ - LED (Expandable)
- Small Size PCB: 45mm×25mm

*1 Need the "Software Development Kit (SDK)" of Nordic semiconductor to program the software.
To get SDK on WEB site of Nordic semiconductor, use "Product Key" including in this starter
Kit.

- Battery-less BLE Beacon
- AC Power supply BLE Beacon
- Wireless Sensor node for IoT
- BEMS/HEMS/FEMS
- Active RFID
- Solar Energy Harvesting
- Wireless Illumination Control
- Wireless HVAC Sensors
- Security System

4. Setup

4.1 Contents in a package

No.	Contents		Description	Qty	Note
1	MB39C811-EVBSK-02(*1)	PCB	Energy Harvesting with BLE Board	1	Installed
		Solar Panel (*2)	TDK: BCS4630B9 or Panasonic: AM-1801	1	Installed either one
		Case	TAKACHI: PS-65	1	Installed
2	USB Cable		USB Mini Converter Cable	1	

*1 : Check the radio law of each country to use it. Please access to Cypress Component about detail of BLE module.

*2 : The solar panel is sample for operation check. It isn't guaranteed the electrical characteristics, etc.

Please be careful because the solar panel doesn't have the guard film of surface.
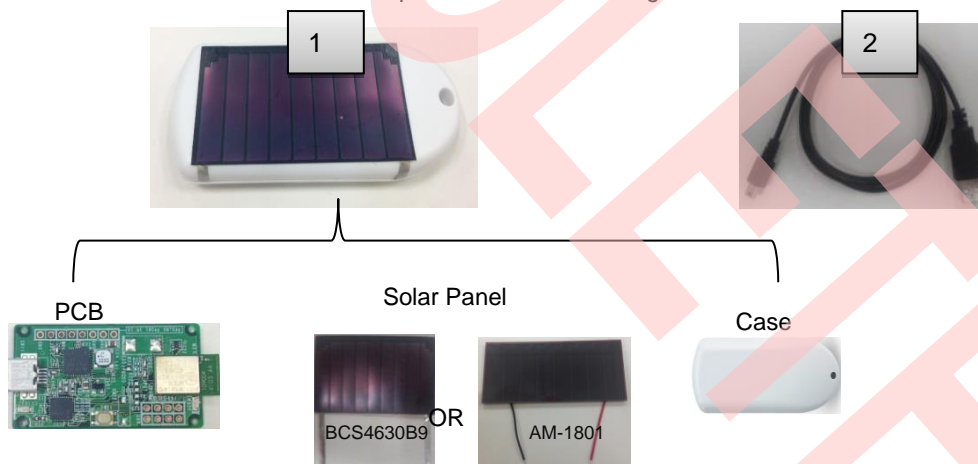
4.2 Preparation

Requirement for preparation

- MB39C811-EVBSK-02 Starter Kit   1set
- IPhone4S/5 etc. (iOS7 or later), Android4.3 or later   1device

4.2.1   Preparation of Receiver

1. Place a MB39C811-EVBSK-02 under office light about 500lx.
2. After placing, the Beacon packet is transmitted automatically. Regarding to receiver data, please refer to next step.

Place under office light about 500lx
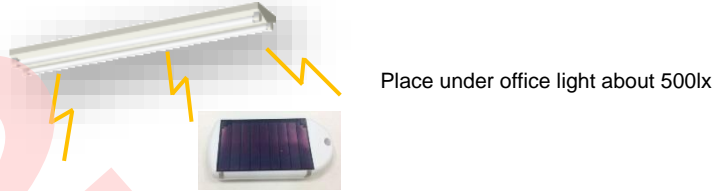
4.2.2   Setup of Receiving (iPhone or Smart Phone etc…)

Note :

Need supported Bluetooth v4.0 equipment which is iOS7 or Android 4.3 or later, to check operation.

1. The default setting is following.

- ■ UUID   11111111-1111-1111-1111-111111111111
- ■ Major   1
- ■ Minor   1
- ■ TX power   4dBm
- ■ RSSI   -61dBm
- ■ Advertise interval   100ms
- ■ Bluetooth company   0x0059 (Nordic Semiconductor ASA)

2. Set the Bluetooth setting to "ON" on your equipment.

3. Check the BLE Beacon operation using an application. The following are example of application for iOS and Android.

For iOS, install either following application on App Store.

- ■ Beecon   ©BeaconSandwich
- ■ eBeacon   ©Jaalee Inc
- ■ LightBlue   ©Punch Through Design LLC
- ■ Particle Detector   ©KS Technologies LLC

For Android, install either following application on Play Store.

- ■ iBeacon Detector   ©youten
- ■ iBeacon Finder   ©Mobisfera
- ■ iBeacon Scanner   ©ixsoft, inc.
- ■ iBeacon Maps   ©Hint Solutions

4. After installed, execute these applications.

5. Set "Proximity UUID", "Major", "Minor" while refer the default setting. To learn detail, refer to the operation manual for each application.

6. The set of receiving will be finished when can check BLE beacon data on an application.
■ If can't check the data, retry checking as shown in below.
■ Check Bluetooth setting on your equipment
■ Check "Proximity UUID", "Major" and "Minor" on an application.
■ If use iOS8 equipment or later, it can't occasionally receive BLE data, otherwise "Bluetooth Company" is 0x004C (Apple, Inc.). Refer to "4.3.1 Method of Rewriting Beacon IDs"to change "Bluetooth Company" to 0x004C.
■ Restart your receiver equipment.

4.3 Other

4.3.1 Method of Rewriting Beacon IDs

1. Prepare attached USB mini converter cable, MB39C811-EVBSK-02 and PC for rewriting ID.
2. Install a serial communication tool named "Tera Term" and so on.
3. Download the driver for "USB serial converter IC (FT232RL)", and then defreeze it to any directory on PC. FTDI maker website (FT232 Driver is available) http://www.ftdichip.com/

4. Open the case of MB39C811-EVBSK-02. Insert your fingernail to case, then open case.
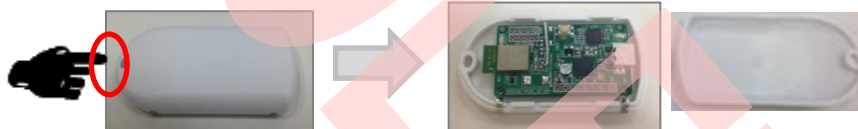
5. Connect USB cable both PC and MB39C811-EVBSK-02 board. There is no problem that connect USB cable while a solar cell is connected.
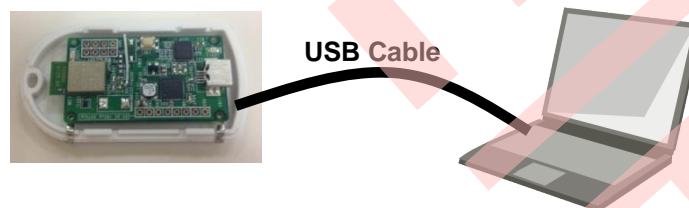
6. The driver Installation starts automatically and the message window will pop appear.

7. When the following window appears, the installation is completed.
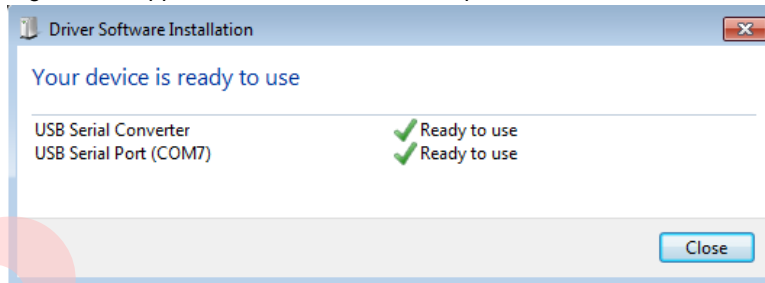
8. After the device driver installation, make sure that new COM port was added in the Windows Device Manager.

Start Menu > Control Panel> Device Manager
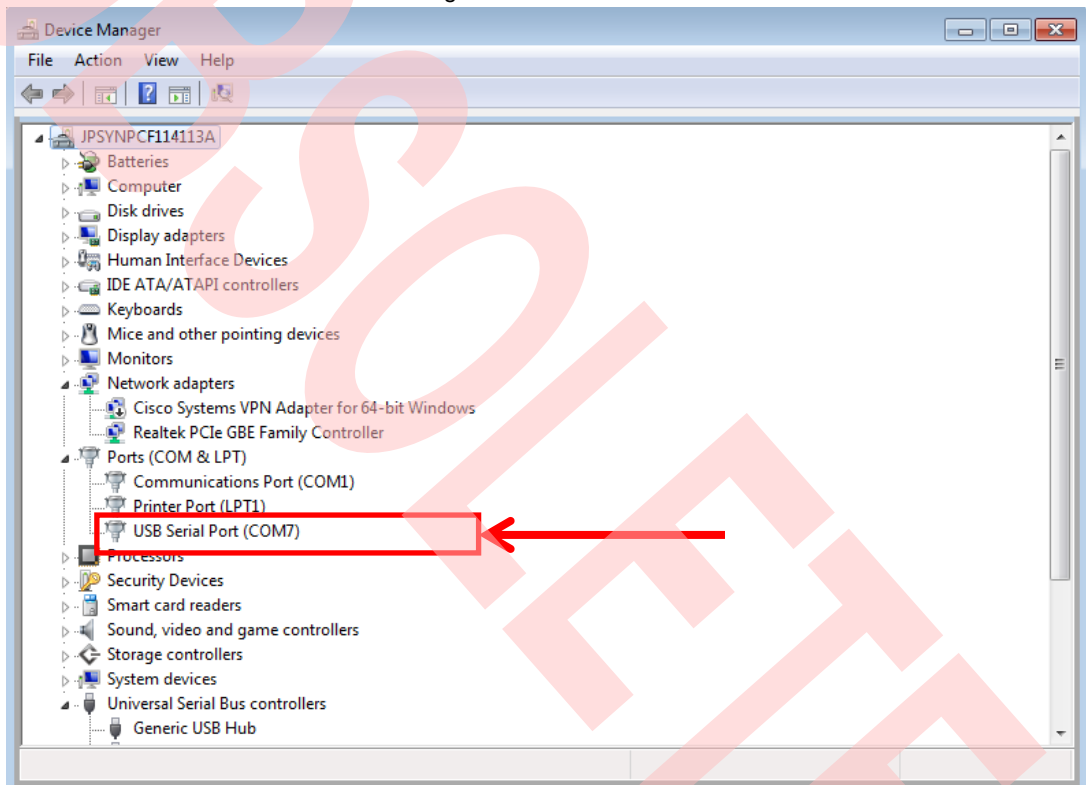
9. Execute installed serial communication tool.
   (Operation check information: Windows7 SP1 32bit, Tera Term Version 4.74)
10. Select USB serial port (COMxx) that was added in the Windows Device Manager.
11. The setting of a serial communication tool is following.

Menu>Setup>Serial Port…

Baud rate	: 9600
Data	: 8 bit
Parity	: none
Stop	: 1 bit
Flow control	: none

Menu>Setup>Terminal…
New-line

Receive	: AUTO
Transmit	: CR+LF
Local echo	: Check
Other	: Default

12. Push a MCU reset button. At this time, the mode is changed to ID rewriting mode, and then stop the BLE Beacon transmitter.

MCU Reset Button

13. The "Start…." message is appeared on a serial communication tool window, and then changes to the command waiting mode. The detail of a serial command is following.
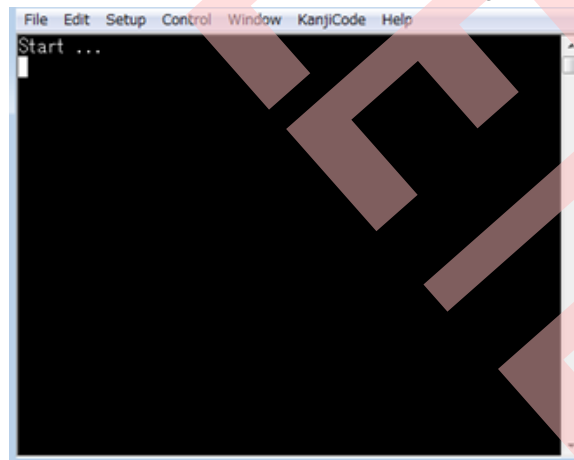
Table 4-1. Commands List

No.	Commands Name	Description	Default
[1]	UUID	Read/Write of UUID	1111111-1111-1111-1111-111111111111 [hex]
[2]	MAJOR	Read/Write of MAJOR	0x0001
[3]	MINOR	Read/Write of MINOR	0x0001
[4]	TXPWR	Read/Write of Transmitter Power Strength	+4 dBm
[5]	RSSI	Read/Write of Receiver Power Strength for distance 1m (RSSI)	-61 dBm
[6]	ITRVL	Read/Write of Advertise Interval	100ms
[7]	COID	Read/Write of Bluetooth Company	0x0059 (Nordic Semiconductor ASA)
[8]	ERASE	Default parameters	-
[9]	EXIT	Finish the command waiting mode, and then retransmit the BLE Beacon data	-
[10]	VER	Display Firmware Version	-

[1] Read/Write of UUID
   [1-1] Read
      Read UUID data. Default: 11111111-1111-1111-1111-111111111111
<Example>
UUID⏎
     (echo) UUID
     (output) -> UUID: 11111111-1111-1111-1111-111111111111

  [1-2] Write
     Write UUID data.
<Example>
UUID EEEEDDDD-CCCC-BBBB-AAAA-999988887777⏎
    (echo) UUID EEEEDDDD-CCCC-BBBB-AAAA-999988887777
    (output) -> New UUID: EEEEDDDD-CCCC-BBBB-AAAA-999988887777

[2] Read/Write of MAJOR
  [2-1] Read
     Read MAJOR. Default: 0x0001
  <Example>
  MAJOR⏎
    (echo) MAJOR
    (output) -> MAJOR: 0001

[2-2] Write
 Write MAJOR.
<Example>
MAJOR 1A2F↵   <- Input HEX data
 (echo) MAJOR 1A2F
 (output) -> New MAJOR: 1A2F

[3] Read/Write of MINOR
[3-1] Read
 Read MINOR.   Default: 0x0001
<Example>
MINOR↵
 (echo) MINOR
 (output) -> MINOR: 0001

[3-2] Write
 Write MINOR.
<Example>
MINOR 2C3D↵   <- Input HEX data
 (echo) MINOR 2C3D
 (output) -> New MINOR: 2C3D

[4] Read/Write of Transmitter Power Strength
[4-1] Read
 Read Power Strength. Default: +4dBm
<Example>
TXPWR↵
 (echo) TXPWR
 (output) -> TX power in dBm: 4

[4-2] Write
 Set Power Strength.   Set Value: -40, -30, -20, -16, -12, -8, -4, 0, 4
<Example>
TXPWR -40↵
 (echo) TXPWR -40
 (output) -> New TX power in dBm: -40

[5] Read/Write of Receiver Power Strength for distance 1m (RSSI)
[5-1] Read
   Read RSSI.   Default: -61dBm
<Example>
RSSI↵
   (echo) RSSI
   (output) -> RSSI in dBm: -61

[5-2] Write
Set RSSI.
<Example>
RSSI -90↵
   (echo) RSSI -90
   (output) -> New RSSI in dBm: -90

[6] Read/Write of Advertise Interval
[6-1] Read
   Read Advertise Interval.   Default: 100ms
<Example>
ITRVL↵
   (echo) ITRVL
   (output) -> Advertise Interval in msec: 100

[6-2] Write
Set Advertise Interval.   Set Value: 100~10240 ms
<Example>
ITRVL 10240↵
   (echo) ITRVL 10240
   (output) -> New Advertise Interval in msec: 10240

[7] Read/Write of Bluetooth Company
[7-1] Read
   Read Bluetooth Company. Default: 0x0059 (Nordic Semiconductor ASA)
<Example>
COID↵
   (echo) COID
   (output) ->Company ID: 0059

[7-2] Write
   Write Bluetooth Company.
<Example>
COID004C↵   <- Input HEX data
   (echo) COID004C
   (output) -> New Company ID: 004C

[8] ERASE

Erase the flash memory in MCU. After erase, all value will be default parameters.

<Example>

ERASE⏎

(echo) ERASE

(output) Erase completed!

[9] EXIT

Finish the command waiting mode, and then retransmit the BLE Beacon data.

<Example>

EXIT⏎

(echo) EXIT

(output) ---

[10] VER

Display Firmware Version.

<Example>

VER⏎

(echo) VER

(output) -> MB39C811-EVBSK-02 Sample Firmware, Version 1.0

[*]Input another command (Error Handling)

TEST

(echo) TEST

(output) Command format error!!

14. Enter "EXIT" command when all settings are finished, and then retransmit the BLE Beacon data.
The changed IDs are transmitted by solar energy when disconnect the USB cable.

5. Specification of Energy Harvesting PMIC (MB39C811)

The following is the specification of Energy Harvesting Power Management IC (MB39C811) on this starter kit. Regarding to newest information, refer to the datasheet of MB39C811 (DS405-00013).

5.1 Recommended Operating Conditions

Figure 5-1. Recommended Operating Conditions

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
VIN pin input voltage	VVIN	VIN pin	2.6	-	23	V
AC pin input voltage	VPV	AC1_1 pin, AC1_2 pin, AC2_1 pin, AC2_2 pin	-	-	23	V
Input voltage	VSI	S0 pin, S1 pin, S2 pin	0	-	VVB (*1)	V
	VFB	VOUT pin	0	-	5.5	V
Operating ambient temperature	Ta	-	-40	-	+85	°C

*1 : Output Voltage for internal circuit

5.2 DC Characteristics

Table 5-1. DC Characteristics

(Ta= -40°C to +85 °C, VVIN=7.0 V, L1=22 µH, C2=47 µF

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Quiescent current	IVIN	VVIN = 2.5 V (UVLO), Ta = + 25 °C	-	550	775	nA
		VVIN = 4.5 V (sleep mode), Ta = + 25 °C	-	1.5	2.25	µA
		VVIN = 18 V (sleep mode), Ta = + 25 °C	-	1.9	2.85	µA
Preset output voltage	VVOUT	S2 = L, S1 = L, S0 = L IOUT = 1mA	1.457	1.5	1.544	V
		S2 = L, S1 = L, S0 = H IOUT = 1mA	1.748	1.8	1.852	V
		S2 = L, S1 = H, S0 = L IOUT = 1mA	2.428	2.5	2.573	V
		S2 = L, S1 = H, S0 = H IOUT = 1mA	3.214	3.3	3.386	V
		S2 = H, S1 = L, S0 = L IOUT = 1mA	3.506	3.6	3.694	V
		S2 = H, S1 = L, S0 = H IOUT = 1mA	3.993	4.1	4.207	V
		S2 = H, S1 = H, S0 = L IOUT = 1mA	4.383	4.5	4.617	V
		S2 = H, S1 = H, S0 = H IOUT = 1mA	4.870	5.0	5.130	V
Peak switching current	IPEAK	-	200	250	400	mA
Maximum Output current	IOUTMAX	Ta=25°C	100*	-	-	mA
UVLO release voltage (Input Power-Good detection voltage)	VUVLOH	S2 = L, S1 = L, S0 = L	3.8	4.0	4.2	V
		S2 = L, S1 = L, S0 =H				
		S2 = L, S1 = H, S0 = L				
		S2 = L, S1 = H, S0 = H	4.94	5.2	5.46	V
		S2 = H, S1 = L, S0 = L				
		S2 = H, S1 = L, S0 = H	6.84	7.2	7.56	V
		S2 = H, S1 = H, S0 =L				
		S2 = H, S1 = H, S0 = H				
UVLO detection voltage (Input Power-Good reset voltage)	VUVLOL	S2 = L, S1 = L, S0 = L	2.6	2.8	3.0	V
		S2 = L, S1 = L, S0 =H				
		S2 = L, S1 = H, S0 = L				
		S2 = L, S1 = H, S0 = H	3.8	4.0	4.2	V
		S2 = H, S1 = L, S0 = L				
		S2 = H, S1 = L, S0 = H	5.7	6.0	6.3	V
		S2 = H, S1 = H, S0 =L				
		S2 = H, S1 = H, S0 = H				
VIN pin shunt voltage	VSHUNT	-	19	21	23	V

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
VIN pin shunt current	ISHUNT	-	100	-	-	mA
Output Power-Good detection voltage (Rising)	VOPGH	To preset voltage ratio	90	94	98	%
Output Power-Good reset voltage (Falling)	VOPGL	To preset voltage ratio	65.5	70	74.5	%
Power supply output voltage for internal circuit	VVB	VVIN = 6 V to 20 V	-	5.0*	-	V

*: This parameter is not be specified. This should be used as a reference to support designing the circuits.

5.3 Block Diagram

Figure 5-2. Block Diagram
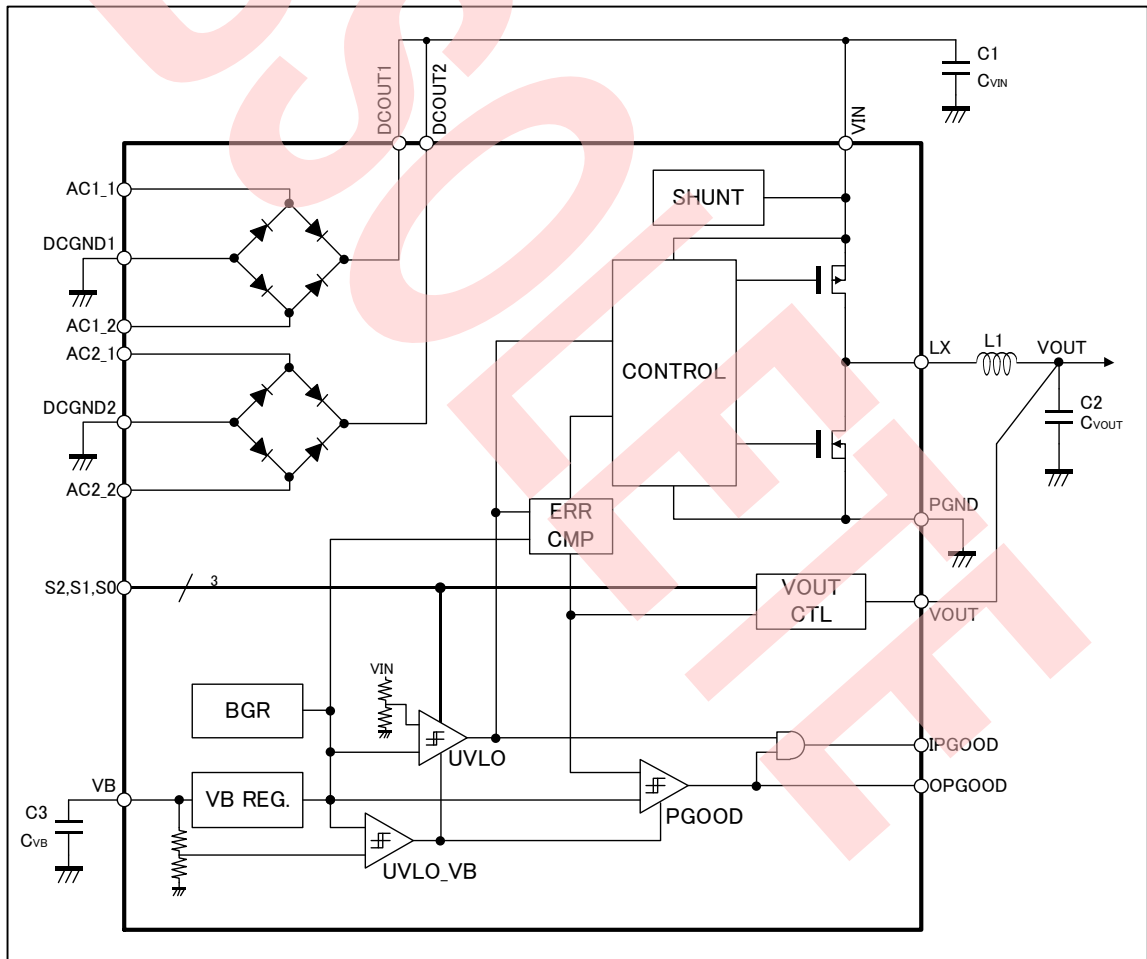
6. Specification of Starter Kit

6.1 Layout of the Board

TOP

Power IC：MB39C811

Expandable power terminal

Temp sensor

BLE module：MBH7BLZ02-109004

USB min connector

Jumper for output voltage setting (Default：2.5V)

USB Serial IC：FT232RQ

Reset button

JTAG terminal for program

Expandable sensor, I/O terminal
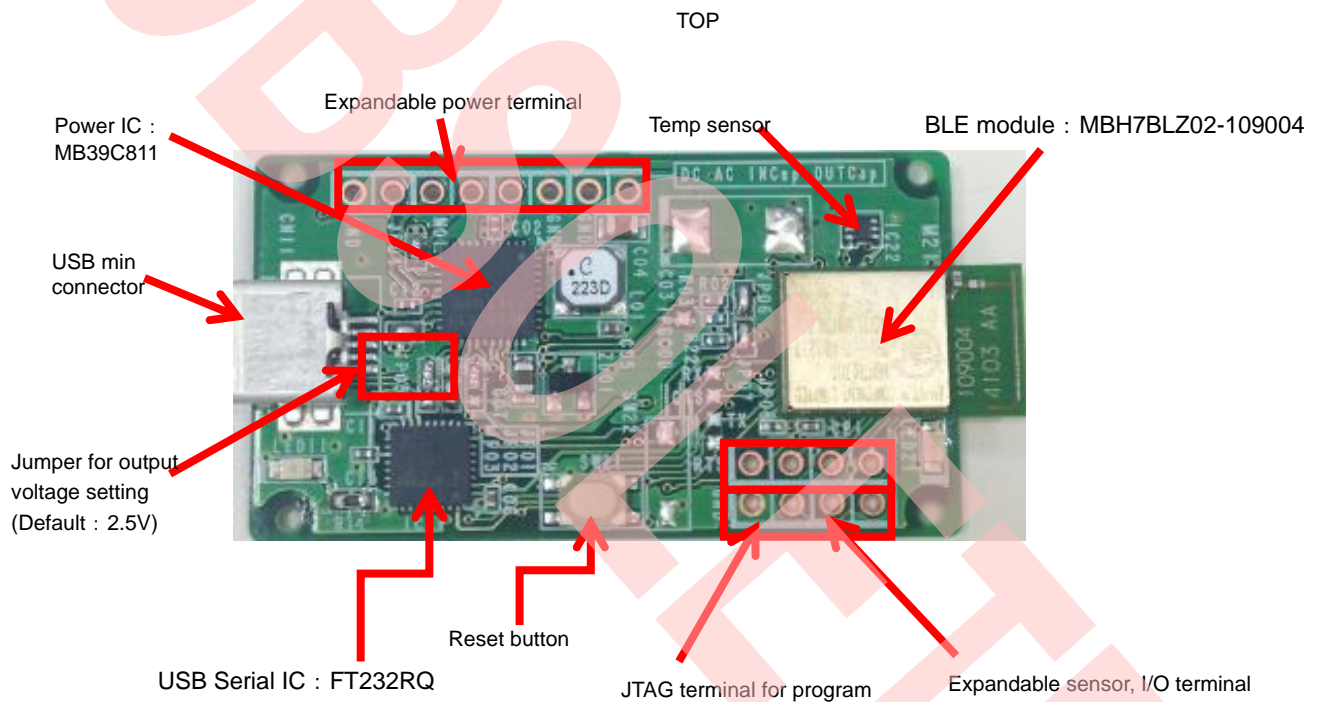
BOTTOM

Expandable coin battery folder
(For Hybrid)
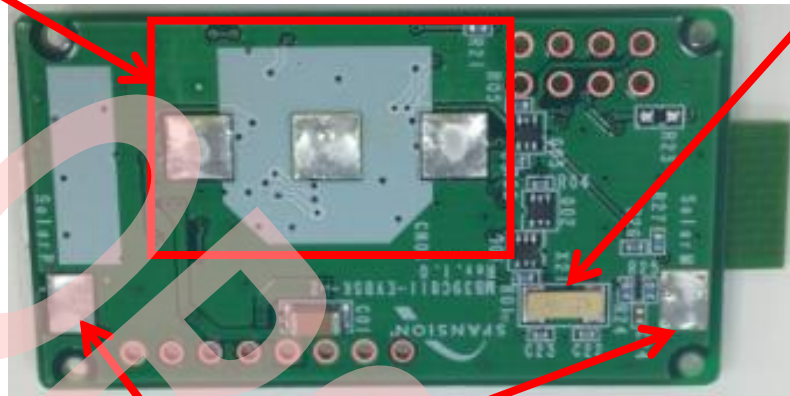
Real Time Clock

Land for TDK Solar Cell (BCS4630B9)

6.2   Input/Output Pin Description

Table 6-1. Input/Output Pin Description

Circuit Pin No.	Silk-Printed Name	I/O	Description
CN001	AC	I	Bridge Rectifier1 AC input pin1
CN002		I	Bridge Rectifier1 AC input pin2
CN003	DC	I	Solar Cell Input (Inputting to either SolarP or CN003)
AC2_G	GND	-	GNDpin
SolarP	SolarP	I	Input TDK Solar Cell (Inputting to either SolarP or CN003)
SolarN	SolarN	-	GND pin for TDK Solar Cell
INCapV	INcap	-	Expandable input capacitor +pin
INCapG	GND	-	Expandable input capacitor -pin
OUTCapV	OUTcap	-	Expandable output capacitor +pin
OUTCapG	GND	-	Expandable output capacitor -pin
PIO7	-	I/O	GPIO_7 of BLE module
PIO8	-	I/O	GPIO_8 of BLE module
PIO9	-	I/O	GPIO_9 of BLE module
PIO10	-	I/O	GPIO_10 of BLE module
JTAG1	-	-	Power Pin for JTAG
JTAG2	-	-	SWDIO pin of BLE module
JTAG3	-	-	SWDCLK pin of BLE module
JTAG4	GND	-	GND pin for JTAG

Detail of Input/Output Pin
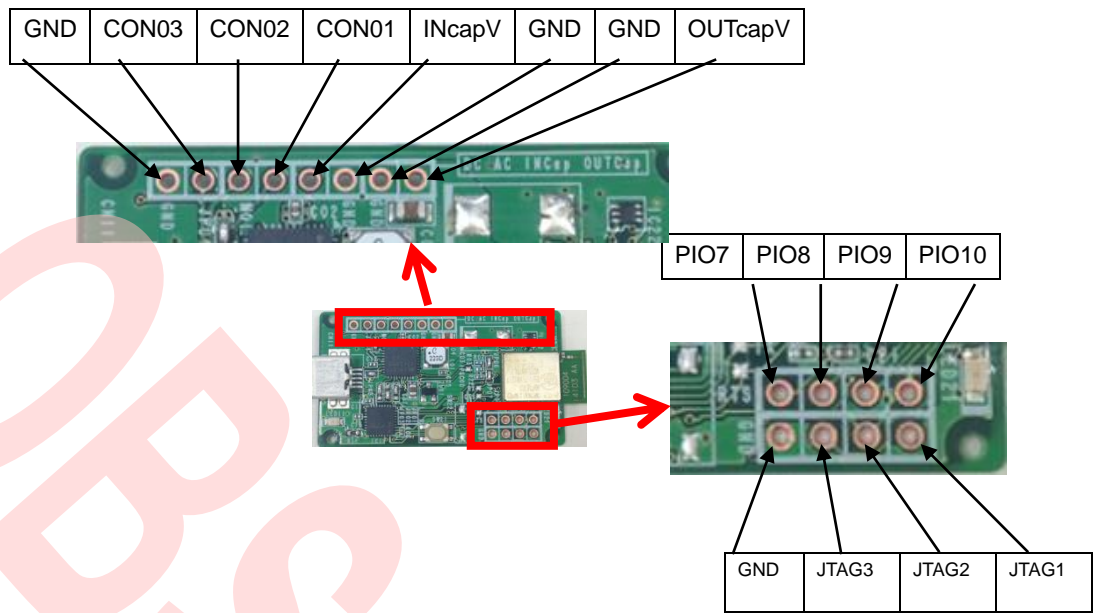
6.3   Switch Description

Table 6-2. Switch Description

Circuit Pin No.	Silk-Printed Name	Description
SW21	SW21	Reset Button for BLE module
SW22	SW22 (No mounted)	Expandable DIPSW

6.4 Jumper Description

Table 6-3. Jumper Description

Circuit Pin No.	Description	Default Settings
JP01(*2)	Output Voltage Setting Switching H/L for S0 Pin of MB39C811	L (*1)
JP02(*2)	Output Voltage Setting Switching H/L for S1 Pin of MB39C811	H(*1)
JP03(*2)	Output Voltage Setting Switching H/L for S2 Pin of MB39C811	L(*1)
JP04	Bridge Rectifier1 Select "Open" or "Short" Open : DC Output Pin (DCOUT1) Short : DC Power Input Pin (VIN)	Short(*1)
JP05	Bridge Rectifier2 Select "Open" or "Short" Open : DC Output Pin (DCOUT2) Short : DC Power Input Pin (VIN)	Short(*1)
JP06	Connect the MB39C811 output and Load	Short(*1)
JP07	Connect the Coin battery and Load	Open(*1)

*1: Set "Open/Short" and "H/L" by soldering.
*2: Set the output voltage from the "Table 6-4 Output Voltage Setting". The default value is 2.5V.

Table 6-4. Output Voltage Setting

JP03 (S2 pin)	JP02 (S1 pin)	JP01 (S0 pin)	Preset Output Voltage [V]	Note
L	L	L	1.5	Do not use(*1)
L	L	H	1.8	
L	H	L	2.5	Default
L	H	H	3.3	
H	L	L	3.6	
H	L	H	4.1	Do not use(*1)
H	L	L	4.5	Do not use(*1)
H	H	H	5.0	Do not use(*1)

*1: Do not use these voltages setting, because BLE module voltage is from 1.8V to 3.6V.

6.5 Circuit
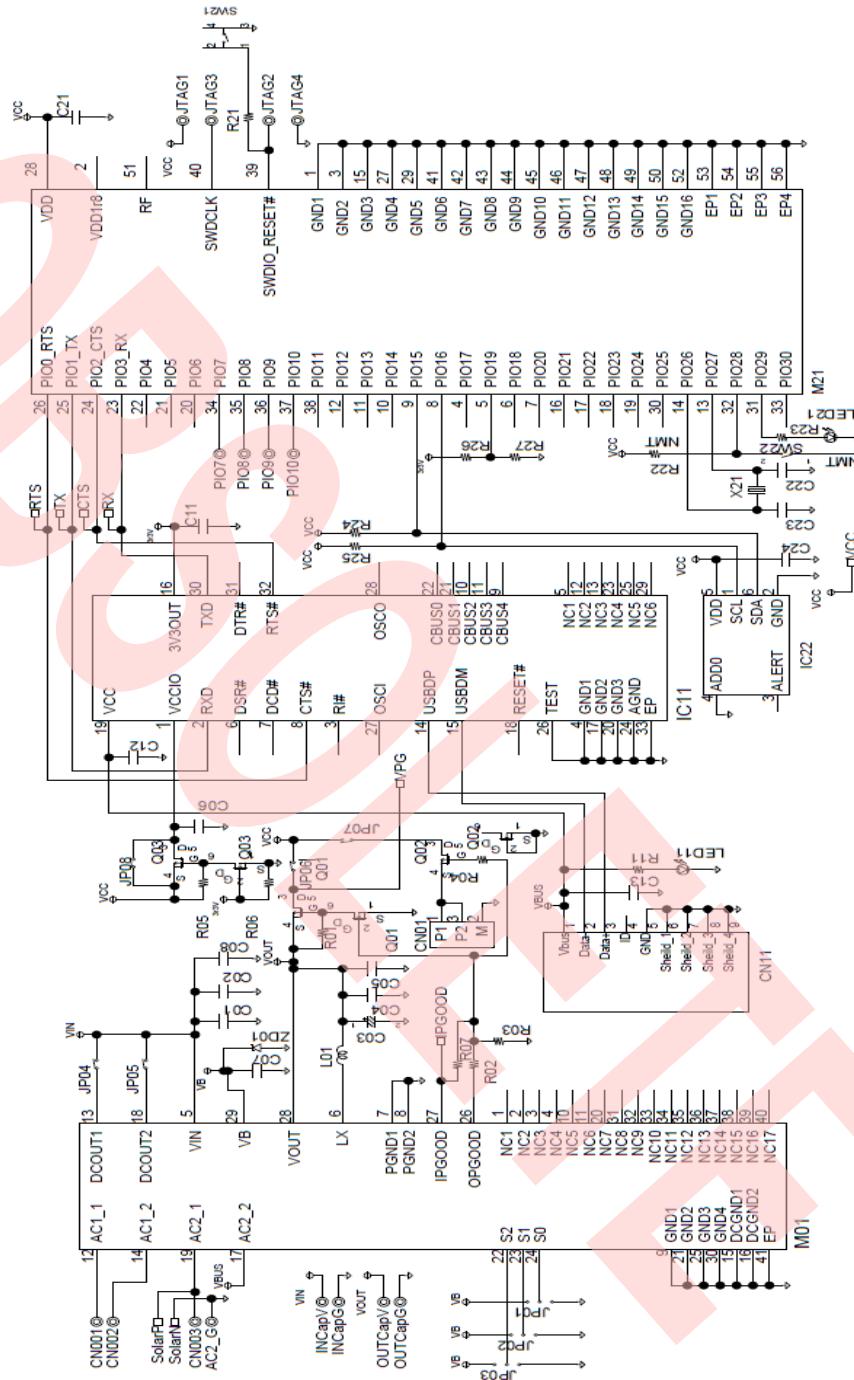
6.6 BOM List

Table 6-5. BOM List

No	Qty	Reference	Parts Number	Description	Manufacture	Note
1	1	C01	C3216X5R1E226MT	22µF/25V	TDK	
2	4	C06 C11 C21 C24	C1005JB1H104K	0.1µF/50V	TDK	
3	1	C04	C2012X5R1A226M	22µF/10V	TDK	
4	1	C07	C2012JB1C475K	4.7µF/16V	TDK	
5	1	C08	C3216X5R1E476M160AC	47µF/25V	TDK	
6	-	C02 C03 C05	Non mount	-	-	Non mount
7	2	C12 C13	C1005JB1C105K	1µF/16V	TDK	
8	2	C22 C23	C1005CH1H100J	10pF/50V	TDK	
9	-	CN01	Non mount	-	-	Non mount
10	1	CN11	UX60SC-MB-5ST	USB mini connector	Hirose	
11	1	IC11	FT232RQ	USB serial converter	FTDI	
12	1	IC22	TMP102	Temperature sensor	TI	
13	1	L01	LPS4018-223MLB	22µH	Coilcraft	
14	1	LED11	HSMG-C170	LED Green	Avago	
15	-	LED21	Non mount	-	-	Non mount
16	1	M01	MB39C811	Energy Harvesting PMIC	Cypress	
17	1	M21	MBH7BLZ02-109004	Bluetooth LE module	Cypress Component	
18	3	Q01 Q02 Q03	EM6M2	Nch+Pch MOSFET	ROHM	
19	5	R01 R03 R04 R05 R06	RK73H1ETTD1004F	1MΩ	KOA	
20	-	R02 R22 R23	Non mount	-	-	Non mount
21	1	R07	RK73H1ETTD000	0Ω	KOA	
22	1	R27	RK73H1ETTD1003F	100kΩ	KOA	
23	2	R24 R25	RK73H1ETTD2201F	2.2kΩ	KOA	
24	1	R11	RK73H1ETTD1001F	1kΩ	KOA	
25	1	R21	RK73H1ETTD1000F	100Ω	KOA	
26	1	R26	RK73H1ETTD3302F	33kΩ	KOA	
27	1	SW21	SKRPACE010	Push Switch	ALPS	
28	-	SW22	Non mount	-	-	Non mount
29	1	X21	ABS10-32.768kHz	32.768k X'tal	ABRACON	
30	1	ZD01	PLVA662A	Voltage regulator diode	NXP	

6.7 Layout

Top Silk

Bottom Silk

Layer1
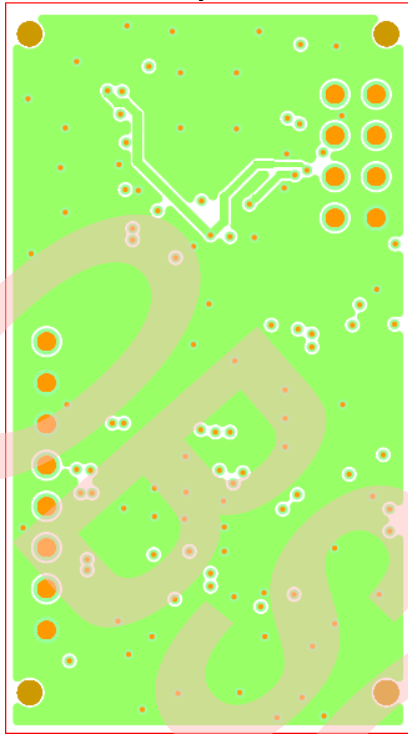
Layer2

Layer3

Layer4
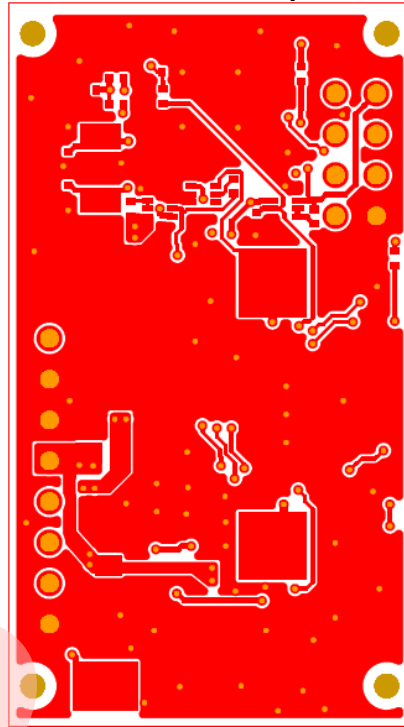
7. Sample Software for BLE Beacon

7.1 State Change Diagram of Sample Software

```
                    ┌─────────────────────┐
                    │  Power on reset     │
                    └──────────┬──────────┘
                               │
                               ▼
        ┌──────────────────────────────────┐           USB disconnect
  ┌────▶│  FLASH boot                      │◀───────────────────────────┐
  │     │  UUID/ Major /Minor etc…         │                            │
  │     └──────────┬───────────────────────┘                            │
  │                │                                                     │
  │                ▼                         ┌──────────────────────────────┐
  │         ╱──────────────╲                 │ After pushing the reset button, │◀─┐
  │        ╱  USB connection ╲ ──────────────▶│ It changes over to USB         │  │
  │        ╲  check?         ╱                │ Command mode                   │──┘
  │         ╲──────┬─────────╱                └──────────────────────────────┘
  │                │ No                                    ▲
  │                ▼                            "EXIT" command
  │     ┌──────────────────────────┐                      │
  │  ┌─▶│ Initialize BLE stack     │──────────────────────┘
  │  │  │ Initialize the Advertising│
  │  │  └──────────┬───────────────┘
  │  │             │
  │  │             ▼
  │  │  ┌──────────────────────────┐
  │  │  │ Transmit BLE Data        │
  │  │  │ Start Advertising        │
  │  │  └────┬────────────┬────────┘
  │  │ Event │            │ Energy management mode
  │  │       ▼            │
  │  │  ┌──────────────┐  │  Energy
  │  └──│ Sleep mode   │  │  shortage
  │     └──────┬───────┘  │
  │            │          │
  │ Energy     ▼          ▼ Energy shortage
  │ charging ┌──────────────┐
  └──────────│ Power off    │
             └──────────────┘
```
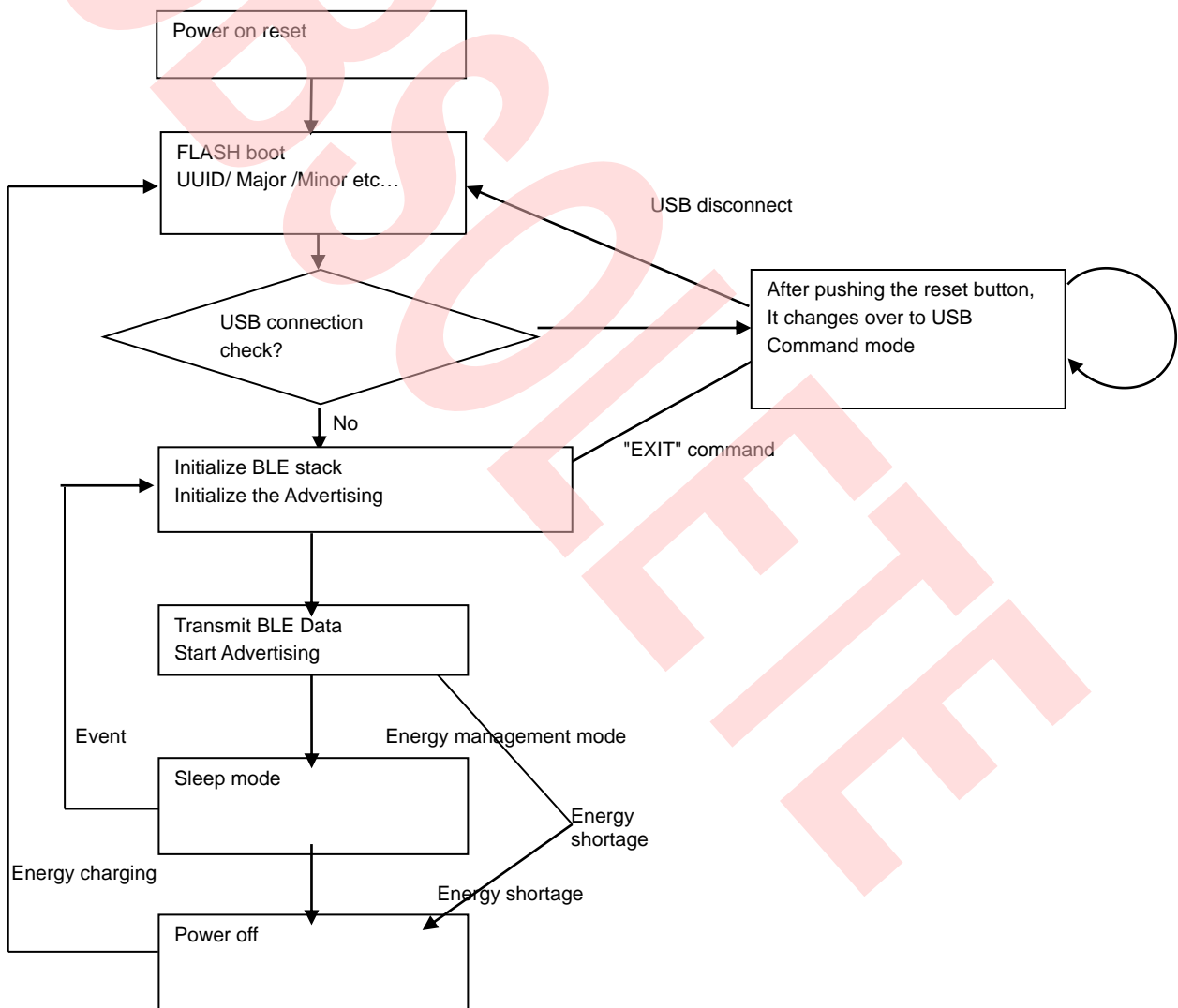
Table 6-6. Flow of sample software

No.	Items	Contents	Data branch
1	Initial	Power on reset	-
2	Boot	Initialize the ports of FLASH Read the data of BLE beacon from FLASH	-
3	Mode select	Checking the USB cable PIO19 of BLE module (H: connect, L: disconnect)	L: disconnect-> No.4 H: connect-> No.8
4	BLE setting	Initialize the BLE stack Initialize the Advertising Start the Advertising	-
5	Energy management	After transmitting the BLE beacon packets, it changes over to sleep mode. It will turn off the power by the power gating when it is in energy shortage in capacitance	Energy shortage ->No.6 Enough energy ->No.7
6	Energy charging	After turning off the power, it changes over to the charging process After finishing the charging process, it is turned on by the power gating again	After this, repeat No.1~No.6
7	Sleep <-> Transmit	Transmit the BLE beacon data by the value of Advertising interval setting Repeat this process during enough energy.	-
8	USB command mode	After resetting MCU, wait the USB command It changes over to BLE setting when inputted the "EXIT" command	Change over to No.4 by "EXIT" command

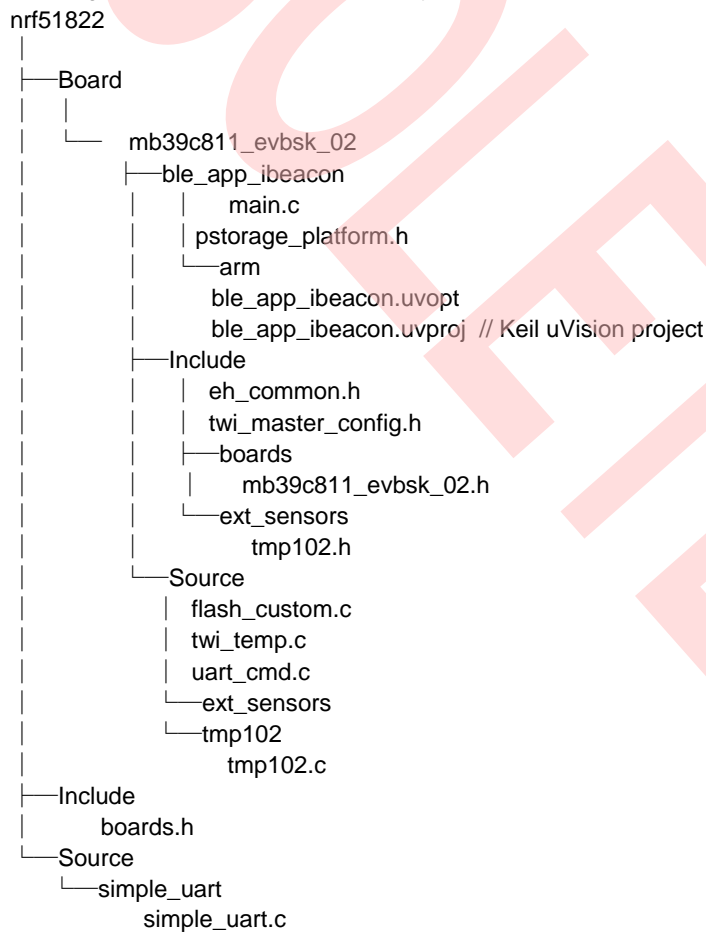# 8. Programming and Debug

8.1 Structure of Files

This program is made based on the "Software Development Kit (SDK)" of Nordic Semiconductor. It is including only difference information of SDK. To get SDK on WEB site of Nordic semiconductor, use "Product Key" including in this starter kit.

The following is structure of files for this project. Overwrite all files on SDK's folder of Nordic semiconductor.

It is based on nRF51 SDK v.6.0.0.

Note:

Don't rewrite "Soft Device (S110)" provided from WEB of Nordic Semiconductor.

If rewrote it, must re-get the radio law of each country.

```
nrf51822
│
├──Board
│   │
│   └── mb39c811_evbsk_02
│       ├──ble_app_ibeacon
│       │   │   main.c
│       │   │ pstorage_platform.h
│       │   └──arm
│       │       ble_app_ibeacon.uvopt
│       │       ble_app_ibeacon.uvproj  // Keil uVision project
│       ├──Include
│       │   │ eh_common.h
│       │   │ twi_master_config.h
│       │   ├──boards
│       │   │   mb39c811_evbsk_02.h
│       │   └──ext_sensors
│       │       tmp102.h
│       └──Source
│           │ flash_custom.c
│           │ twi_temp.c
│           │ uart_cmd.c
│           └──ext_sensors
│           └──tmp102
│               tmp102.c
├──Include
│     boards.h
└──Source
      └──simple_uart
          simple_uart.c
```

8.2 Programming and executing using JTAG Debugger

Requirement for preparation
- MB39C811-EVBSK-02Board (accessory)   1pcs
- USB Mini Converter Cable (accessory)   1pcs
- PC which is installed the KEIL integrated development tool (MDK-ARM) 1pcs
  https://www.keil.com/
- ICE for ARM programming (Recommend SEGGERJ-Link series)   1pcs
  http://www.segger.com/jlink-debug-probes.html
- JTAG Converter Cable (Need making yourself)   1pcs

Note:

The following is example for JTAG Converter Cable. Regarding to making cable, please make sure self-responsibility.
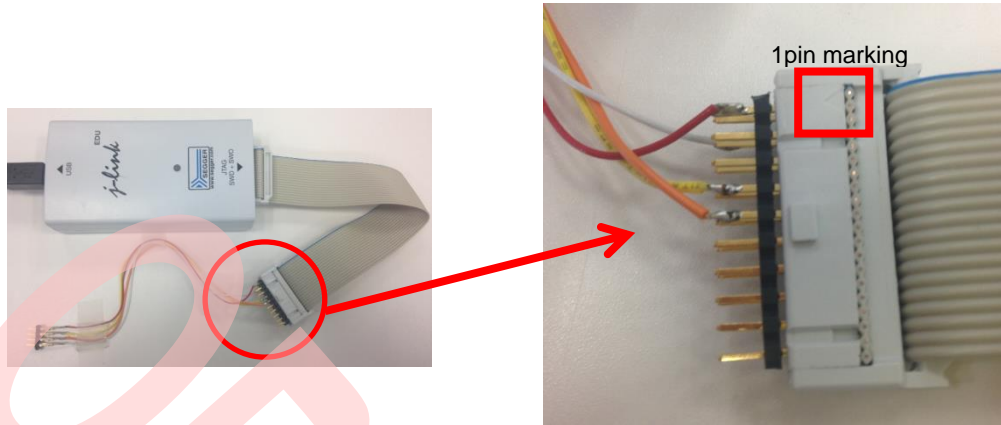
8.2.1 Example for JTAG Converter Cable

1. Make the JTAG Converter Cable as shown in below. It is example of ARM Standard 20pin JTAG.
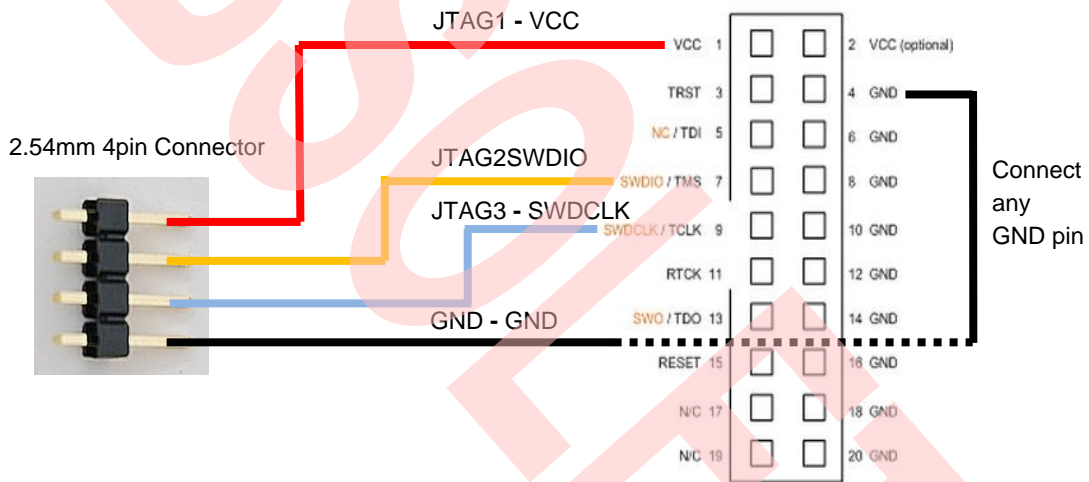
2. Example of completed cable as shown in below.
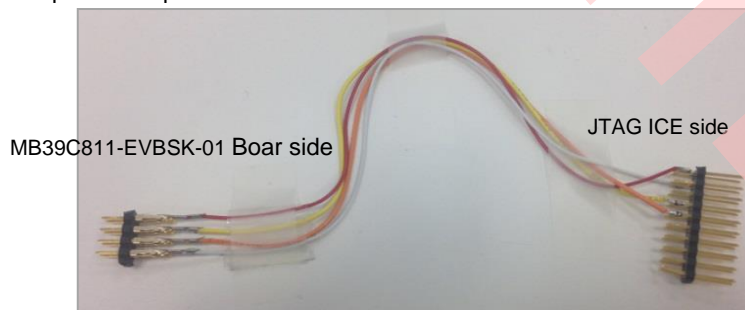
3. Connect to the ICE for ARM programming. Please be careful of 1pin position.


That's the end of making JTAG Converter Cable.

8.2.2 KEIL integrated development tool (MDK-ARM)

1. Install MDK-ARM on your PC at first,
2. Install SDK of Nordic semiconductor, as shown in "8.1 Structure of Files".
3. Connect JTAG Cable which made by "8.2.1 Example for JTAG Converter Cable". To touch JTAG Cable to the land of board, connect it little slanted.
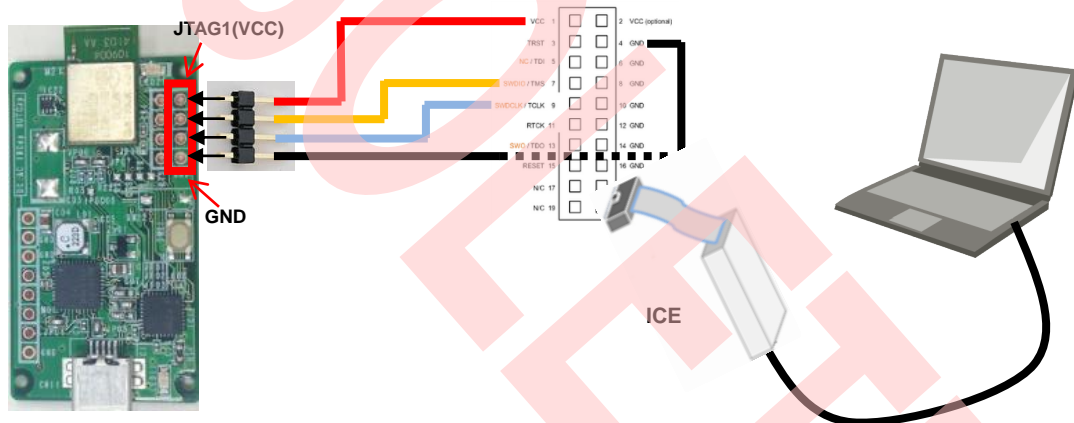
4. Connect the USB Mini Converter Cable to PC. At this time, the LED on board will be bright as shown in below.

ICE

LED

USB mini cable
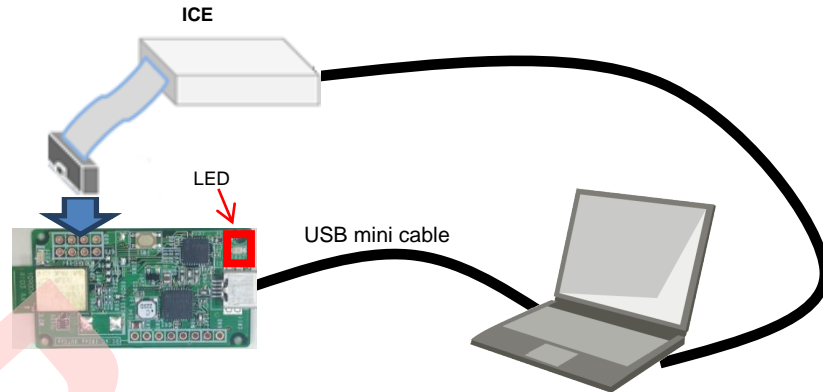
5. KEIL integrated development tool is opened when you execute the "xxxxxxxx.uvproj" file in ARM folder, nrf51822¥Board¥mb39c811_evbsk_02¥ble_app_ibeacon¥arm¥ble_app_ibeacon.uvproj
and then the program is builded when click the "Build target" or "Rebuild all target files" on "Project".

Figure 8-1. Build target

Build

Rebuild
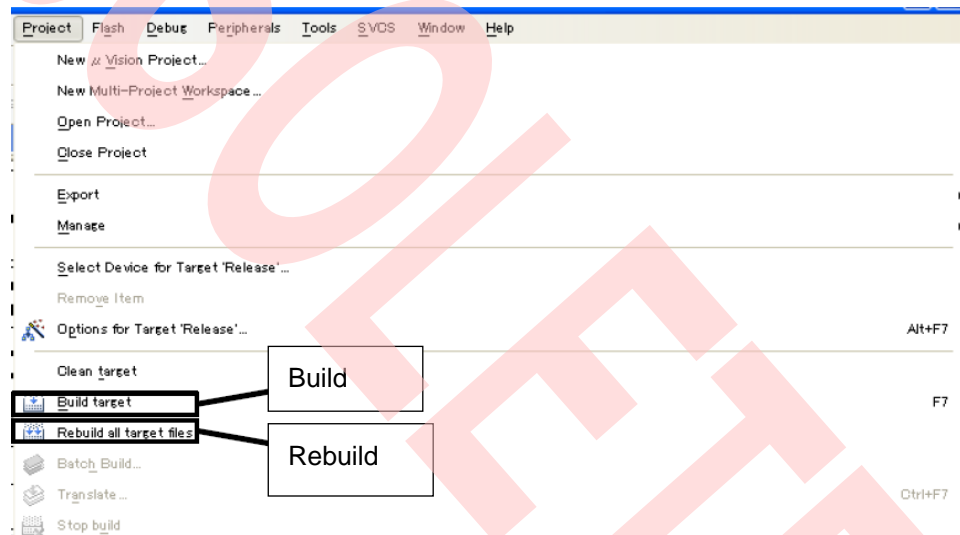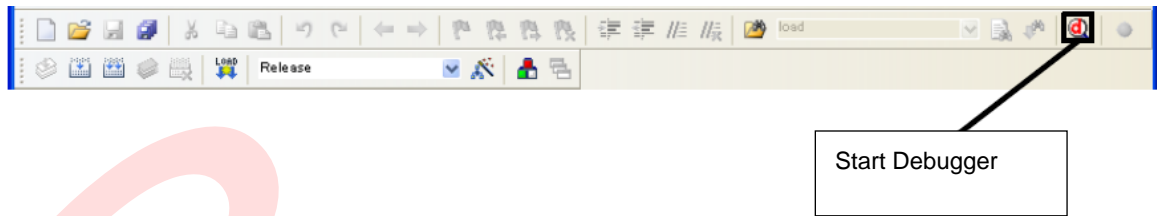
6. Write to FLASH and execute the program. To write the program to FLASH, push "LOAD" button, as shown in Figure 8-2.

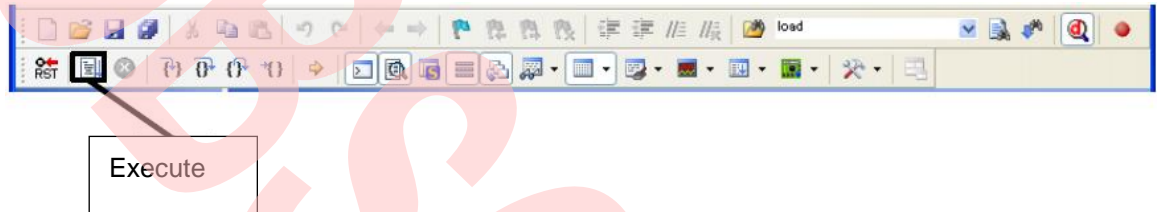Figure 8-2. Write to FLASH

Write to FLASH
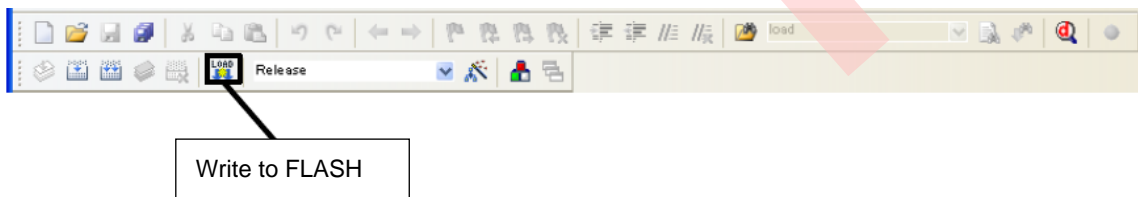
The debugger starts by clicking "d" button as shown in below.

Figure 8-3. Start Debugger

To execute the program, push "execute" button after start debugger, as shown in Figure 8-4.

Figure 8-4. Execute the program

That's the end of programming by KEIL integrated development tool.

9.   Appendix

9.1   Assemble Case

Notes:

■   The following step is already finished by initial packing. Please use it as reference information.

■   Show the method of assemble case about TDK: BCS4630B9 only.

Figure 9-1. Picture of completion case

Requirement for preparation:

■   MB39C811-EVBSK-02 Starter Kit   1set
■   Soldering iron, Solder (For connecting solar cell to board)   1set
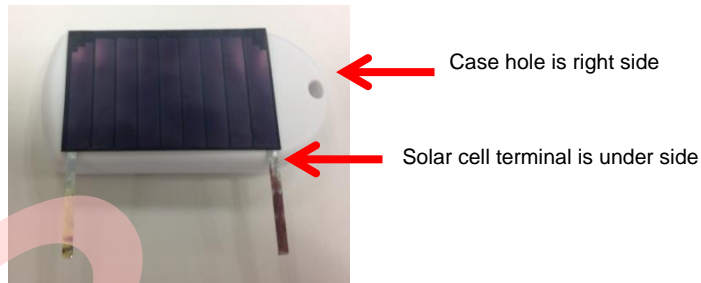■   Double sided tape (For putting solar cell on case)   1device

1.   Prepare a case (TAKACHI: PS-65) and Solar Cell (TDK: BCS4630B9
2.   Bring the flat surface of case to top.

3.   Put a double sided tape on solar cell of other side.
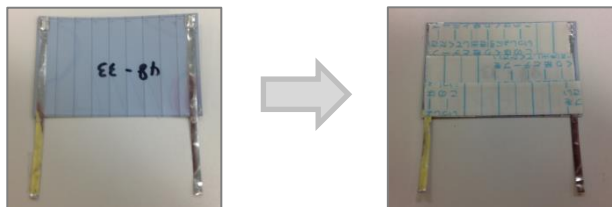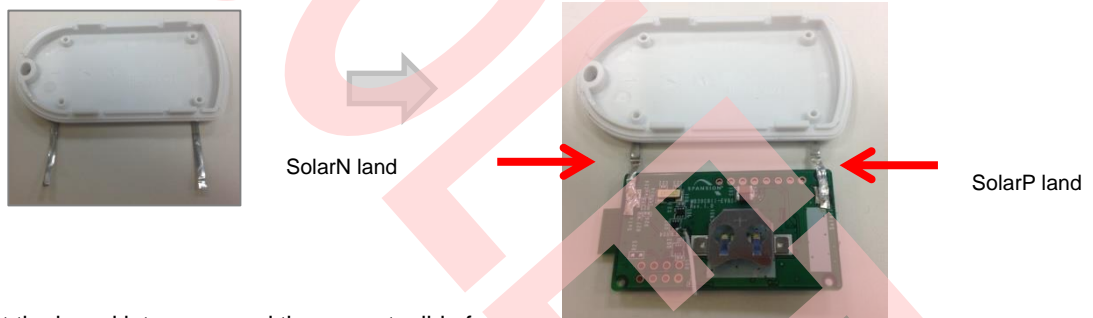
4. Put a solar cell to the flat surface of case. Please be careful about direction.

Case hole is right side

Solar cell terminal is under side

5. Remove a lid of case.

6. Bring putted solar cell to other side, and then connect it to SolarP/SolarN land on MB39C811-EVBSK-02 board using soldering iron.

SolarN land

SolarP land

7. Put the board into case, and then revert a lid of case.
   If need to fix the board to case, please use "TAKACHI: EM-1.6 (sold separately)" and so on. However it is 2 fixing holes only.

That's the end of the Assemble case.

10. Ordering Information

Table 10-1. Ordering Information

Part number	Version	Note
MB39C811-EVBSK-02	Rev 1.0	

Revision History

Document Revision History

Document Title: MB39C811-EVBSK-02 Energy Harvesting with Bluetooth® Smart Beacon Starter Kit Operation Guide Document Number: 002-08682			
Revision	**Issue Date**	**Origin of Change**	**Description of Change**
**	11/10/2014	MITK	**Revision 1**: Initial release
			Revision 2: Changed from "Bluetooth Low Energy" to "Bluetooth® Smart (Low Energy)". Section 1 " Description" - Modified the description of BLE module
			Section 2 "Features" - Modified the description of BLE module and Note.
			Section 4.1 "Contents in a package" - Added the solar cell of Panasonic:AM-1801
			Section 4.2.2 "Setup of Receiving" - Modified some recommended Application and Added the method of rechecking.
			Section 4.3.1 "Method of Rewriting Beacon IDs" - Added "Table4-1 Commands List" and Added "[7] Read/Write of Bluetooth company"
			Section 8.1 "Structure of Files" - Modified the description ,Added the Note and added "pstorage_platform.h" file
			Section 9.1 "Assemble Case"- Added the Note
*A	02/11/2016	MITK	Migrated Spansion Guide from MB39C811-EVBSK-02_SS901-00028-2v0-E to Cypress format
*B	04/26/2017	SHEA	Updated logo and copyright
*C	01/25/2019	SSAS	Obsoleted.