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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
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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.

<table>
<thead>
<tr>
<th>WARNING</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric shock, Damage</td>
<td>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.</td>
</tr>
<tr>
<td>Electric shock, Damage</td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuts, Damage</td>
<td>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.</td>
</tr>
<tr>
<td>Cuts</td>
<td>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.</td>
</tr>
<tr>
<td>Damage</td>
<td>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.</td>
</tr>
<tr>
<td>Damage</td>
<td>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.</td>
</tr>
<tr>
<td>Damage</td>
<td>Use the product within the ranges given in the specifications. Operation over the specified ranges may cause a fault.</td>
</tr>
<tr>
<td>Damage</td>
<td>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.</td>
</tr>
<tr>
<td>Damage</td>
<td>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.</td>
</tr>
<tr>
<td>Damage</td>
<td>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.</td>
</tr>
<tr>
<td>Damage</td>
<td>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.</td>
</tr>
</tbody>
</table>
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

Solar Cell

Coin Battery (optional) for Hybrid

1.8 to 3.3V

Typ. 2.5V

Energy Harvesting PMIC MB39C811

3.0V

BLE module

UART, SPI, I2C, GPIO

USB serial FT232RC

BLE Beacon

PCB size

iPhone4S/5S/5C (iOS7 or later)

Android4.3 or later

Windows8 etc..

Supported Bluetooth4.0 equipment or later

Receiver
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.
3. Applications

- 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

<table>
<thead>
<tr>
<th>No.</th>
<th>Contents</th>
<th>Description</th>
<th>Qty</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MB39C811-EVBSK-02(*1)</td>
<td>PCB</td>
<td>1</td>
<td>Installed</td>
</tr>
<tr>
<td></td>
<td>Solar Panel (*2)</td>
<td>TDK: BCS4630B9 or Panasonic: AM-1801</td>
<td>1</td>
<td>Installed</td>
</tr>
<tr>
<td></td>
<td>Case</td>
<td>TAKACHI: PS-65</td>
<td>1</td>
<td>Installed</td>
</tr>
<tr>
<td>2</td>
<td>USB Cable</td>
<td>USB Mini Converter Cable</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

*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.

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.
Setup

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

![Device Manager Window]
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.

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

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

[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.
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

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

*1 : Output Voltage for internal circuit
# 5.2 DC Characteristics

Table 5-1. DC Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
</tr>
<tr>
<td>Quiescent current</td>
<td>IVIN</td>
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<tr>
<td>Preset output voltage</td>
<td>VVOUT</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Peak switching current</td>
<td>IPEAK</td>
<td>-</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>Maximum Output current</td>
<td>IOUTMAX</td>
<td>Ta=25°C</td>
<td>100°</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<tr>
<td>UVLO release voltage</td>
<td>VUVLOH</td>
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<tr>
<td>UVLO detection voltage</td>
<td>VUVLO</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIN pin shunt voltage</td>
<td>VSHUNT</td>
<td>-</td>
<td>19</td>
<td>23</td>
</tr>
</tbody>
</table>
### Specification of Energy Harvesting PMIC (MB39C811)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIN pin shunt current</td>
<td>ISHUNT</td>
<td>-</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Output Power-Good detection</td>
<td>VOPGH</td>
<td>To preset voltage ratio</td>
<td>90 94 98</td>
<td>%</td>
</tr>
<tr>
<td>voltage (Rising)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Power-Good reset</td>
<td>VOPGL</td>
<td>To preset voltage ratio</td>
<td>65.5 70 74.5</td>
<td>%</td>
</tr>
<tr>
<td>voltage (Falling)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply output voltage for</td>
<td>VVB</td>
<td>VVIN = 6 V to 20 V</td>
<td>- 5.0’</td>
<td>V</td>
</tr>
<tr>
<td>internal circuit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*: 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

![Block Diagram Diagram](image-url)
6. Specification of Starter Kit

6.1 Layout of the Board

TOP

- Power IC: MB39C811
- BL module: MBH7BLZ02-109004
- Power IC: MB39C811
- 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
- Expandable power terminal
- Temp sensor
### 6.2 Input/Output Pin Description

Table 6-1. Input/Output Pin Description

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

Detail of Input/Output Pin
6.3 Switch Description

Table 6-2. Switch Description

<table>
<thead>
<tr>
<th>Circuit Pin No.</th>
<th>Silk-Printed Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW21</td>
<td>SW21</td>
<td>Reset Button for BLE module</td>
</tr>
<tr>
<td>SW22</td>
<td>SW22 (No mounted)</td>
<td>Expandable DIPSW</td>
</tr>
</tbody>
</table>
6.4 Jumper Description

Table 6-3. Jumper Description

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

*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

<table>
<thead>
<tr>
<th>JP03 (S2 pin)</th>
<th>JP02 (S1 pin)</th>
<th>JP01 (S0 pin)</th>
<th>Preset Output Voltage [V]</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>1.5</td>
<td>Do not use(*1)</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>H</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>L</td>
<td>2.5</td>
<td>Default</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>H</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>L</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>H</td>
<td>4.1</td>
<td>Do not use(*1)</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>L</td>
<td>4.5</td>
<td>Do not use(*1)</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
<td>H</td>
<td>5.0</td>
<td>Do not use(*1)</td>
</tr>
</tbody>
</table>

*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

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

Top Silk

Bottom Silk

Layer1

Layer2
7. Sample Software for BLE Beacon

7.1 State Change Diagram of Sample Software

1. Power on reset
2. FLASH boot
3. UUID/ Major/Minor etc...
4. USB connection check?
   - No
   - Yes
5. After pushing the reset button, it changes over to USB Command mode
6. "EXIT" command
7. Initialize BLE stack
8. Initialize the Advertising
9. Transmit BLE Data
   - Start Advertising
10. Event
11. Sleep mode
   - Energy management mode
   - Energy shortage
12. Energy charging
13. Power off
   - Energy shortage
Table 6-6. Flow of sample software

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

![Connection Diagram]

5. KEIL integrated development tool is opened when you execute the "xxxxxxxxx.uvproj" file in ARM folder, nrf51822\Board\Mobo39c811_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 Target]

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.

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.

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

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