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Therefore, all references to "LAPIS Technology Co., Ltd.", "LAPIS Technology"
and/or "LAPIS" in this document shall be replaced with "ROHM Co., Ltd."
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the company name, the company trademark, logo, etc.

Thank you for your understanding.

ROHM Co., Ltd.
April 1, 2024

ROHM GROUP
LAPIS TECHNOLOGY

MK715x1 Evaluation Kit（MK715x1EK1A）
MK715x1 Evaluation Kit Plus（MK715x1EK1AP）
Hardware Manual

Issue Date: Dec. 1, 2020

ROHM SEMICONDUCTOR

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   [h] Use of the Products in places subject to dew condensation.
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   (Example: IH cooking heaters, industrial robots, FA equipment, infrastructure equipment, etc.)

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6) The Products are not radiation resistant.

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11) This product is a specification to radiate the radio wave. It is necessary to acquire the attestation of decided Radio Law of each region used to use the equipment that radiates the radio wave.
Please inquire about the attestation of Radio Law that this product acquires.

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1) If change is made to the constant of an external circuit, allow a sufficient margin due to variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2) The reference circuit examples, their constants, and other types of information contained herein are applicable only when the Products are used in accordance with standard methods. Therefore, if mass production is intended, sufficient consideration to external conditions must be made.

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This product is Electrostatic sensitive product, which may be damaged due to Electrostatic discharge. Please take proper caution during manufacturing and storing so that voltage exceeding Product maximum rating won't be applied to the Products. Please take special care under dry condition (Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control etc.)

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   [b] Where the temperature or humidity exceeds those recommended by LAPIS Technology Temperature: 5°C to 40°C, Humidity 40% to 60%
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   [d] Storage in high Electrostatic.

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It might contain internal products information that is inconsistent with product information.

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● The other precautions

1) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. LAPIS Technology shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.

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Yokohama 222-8575, Japan
http://www.lapis-tech.com/en/

Preface

This document outlines the hardware of the MK715x1 evaluation kit [MK715x1EK1A] and MK715x1 evaluation kit Plus [MK715XxEK1AP] equipped with Bluetooth® 5 compatible Bluetooth low energy module MK715x1 [MK71521 or MK71511] made by Lapis Technology.

This evaluation kit is pre-installed with the AT command application that easily realizes Bluetooth® Low Energy communication by using a simple AT command via UART.

The following related documents are available, so please refer to them if necessary.

- MK71511 Data Sheet
- MK71521 Data Sheet
- MK715x1 Software Development Startup Guide
- BLE Tool User's Manual
- MK715x1 AT command application Quick Reference Guide
- MK715x1 AT command application User's Manual

Note: In this document, MK715x1 refers to both MK71511 and MK71521.

Table of Contents

1. Overview

1.1 Handling precautions

・MK715x1EK1A/MK715x1EK1AP can be used only for evaluating MK715x1. We do not take any responsibility for any direct or indirect damage caused by installing this product in your product.

・We are not responsible for any modification or illegal use of this development kit.

1.2 Main features of MK715x1EK1A/MK715x1EK1AP

This evalution kit has access to all I/O and interface via connectors, and has user programmable 4 LEDs and 4 buttons. This evalution kit is compatible with Arduino Uno R3(Rev.3) and alllows the use of third paty Arduino Uno R3 compatible shields. This evaluation kit is a great strating point for developing almost any Bluetooth® 5.X Low Energy application.

- Easy power supply by USB connection
- Coin battery(CR2032) holder
- Arduino Uno R3 compatible connector that can use a third party shield
- All I/O and interfaces can be accessed via connectors
- 4 LEDs, 4 push buttons, 4 bit DIP-SW and reset button can be used
- Current measurement pin
- Connector for high frequency(RF) measurement
- External NFC antenna terminal(valid for MK71521EK1A/MK71521EK1AP only)
- Virtual COM port

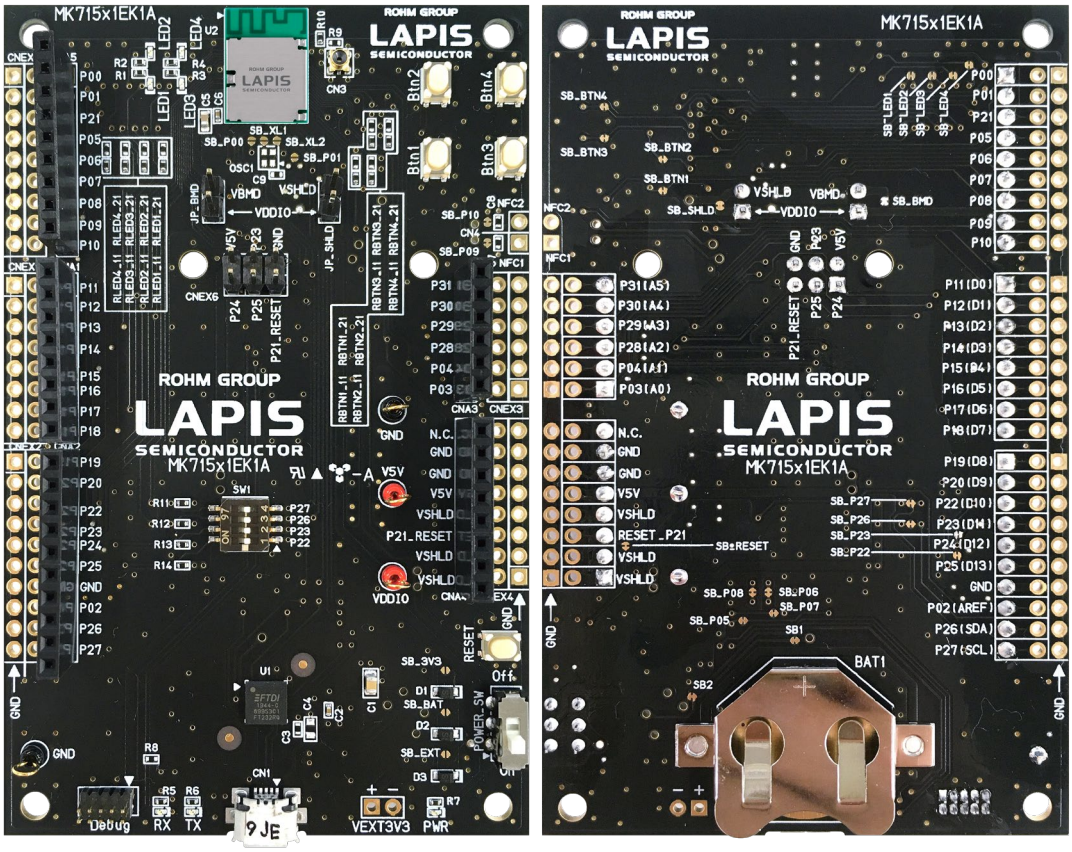


Fig. 1-1 : MK715x1EK1A appearance

1.3 MK715x1EK1A/MK715x1EK1APconfiguration

When you receive the MK715x1EK1A/MK715x1EK1AP, make sure that the following items are all included in the kit. If you find any broken or missing items, please contact the distributor where you purchased the product or the ROHM sales office.

MK715x1EK1A configuration

Component	Quantity
MK715x1 evaluation board	1

MK715x1EK1AP configuration

Component	Quantity
MK715x1 evaluation board	1
USB cable	1
J-Link LITE	1

1.4 Lineup

The MK715x1 evaluation kit has the following lineup depending on the installed modules and accessories.

Product name	Module	Accessories
MK71511 evaluation kit (MK71511EK1A)	MK71511	-
MK71521 evaluation kit (MK71521EK1A)	MK71521	-
MK71511 evaluation kit Plus (MK71511EK1AP)	MK71511	USB cable、J-Link LITE
MK71521 evaluation kit Plus (MK71521EK1AP)	MK71521	USB cable、J-Link LITE

※J-Link LITE is licensed for MK71511EK1/MK71521EK1.
※Use of MK71511EK1/ MK71521EK1 for purposes other than evaluation is prohibited.

MK71511 evaluation kit (MK71511EK1A)

MK71521 evaluation kit (MK71521EK1A)

MK71511 evaluation kit Plus (MK71511EK1AP)

MK71521 evaluation kit Plus (MK71521EK1AP)

Fig. 1-2 : MK715x1EK1A/MK715x1EK1AP Lineup

2. Hardware specifications

If you need the schematic/BOM list for this evaluation kit, please contact your distributor or ROHM sales representative.

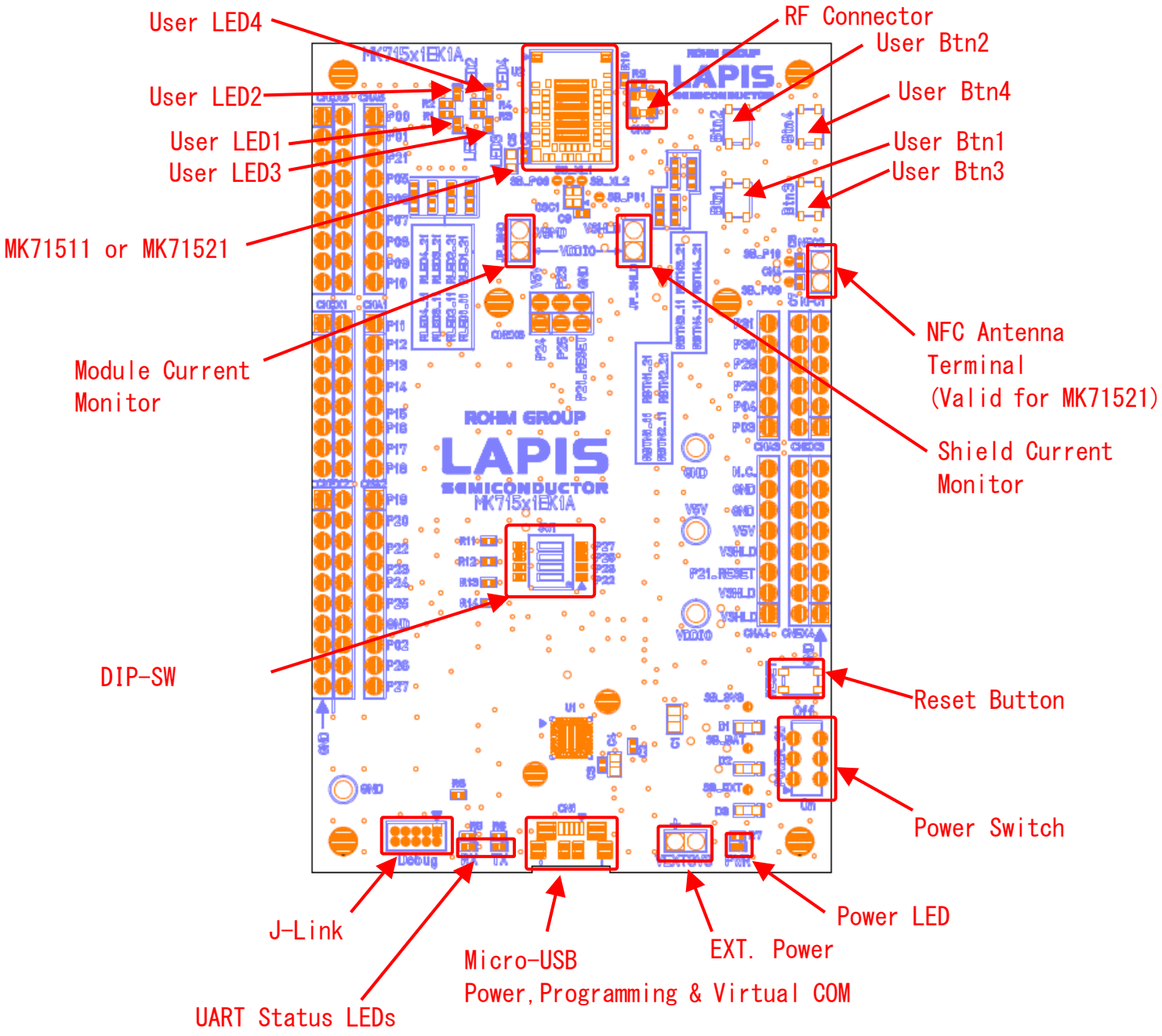


Fig. 2-1: Layout of MK715x1EK1A (Top View)

2.1 Power supply

This evalution kit can operate with three types of power supplies.

- USB
- Coin battery(CR2032)
- External power supply via 2.54mm pitch through hole connector (1.7V~3.6V)

These power supplies can coexist because the reverse current does not flow in the protection diode. If the voltage drop due to the protection diode can not be ignored, short the protection diode with a solder bridge(SB_3V3, SB_BAT, SB_EXT).

Normally, it is used by 5V power supply from USB and supplied to the 3.3V LDO regulator in FT232RQ and Arduino Uno R3 compatible Shield. VDDIO, VSHLD, and VBMD are supplied from the 3.3V LDO regulator.
※When powering from USB, avoid turning off the Power SW for a long time.
※USB, Coin battery, External power can be safely connected simultaneously only if the protection diode is not shorted.
※Take care not to damage the power supply if the protection diode is short-circuited.

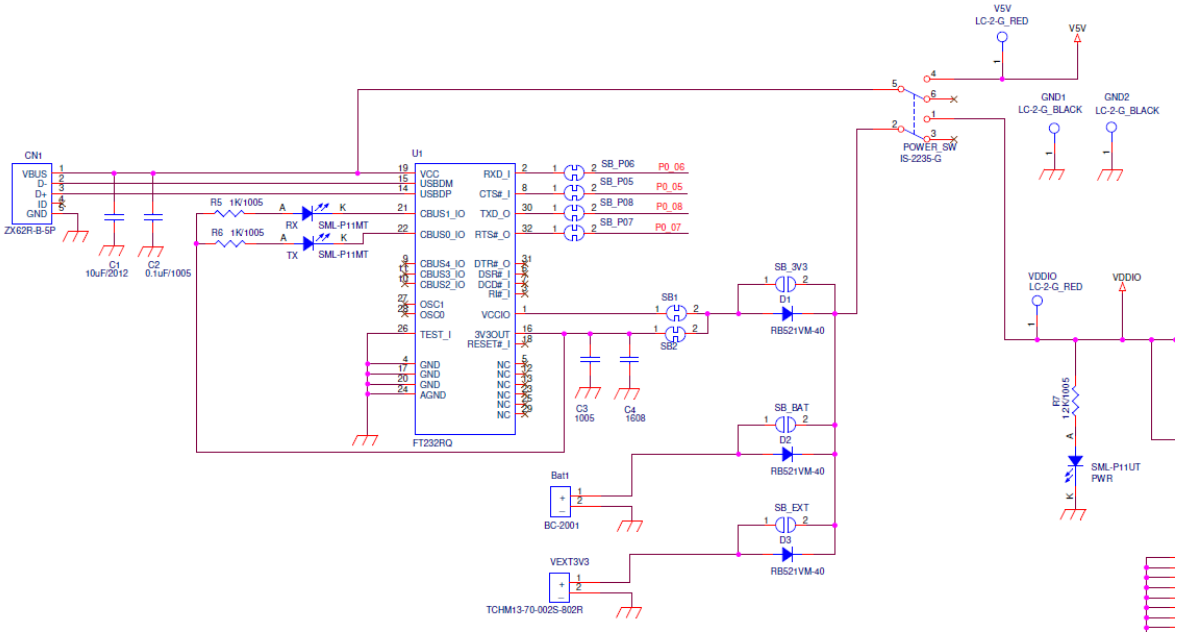


Fig. 2-2 : Power supply

2.2 Switch

2.2.1 Reset Button

The P0.21 port of MK715x1 is assigned to the hardware reset function. In this evaluation kit, the reset button is connected to P0.21. P0.21 (P0_21_RESET in Figure 2-3) is also connected to the Arduino Uno R3 compatible shield connector.

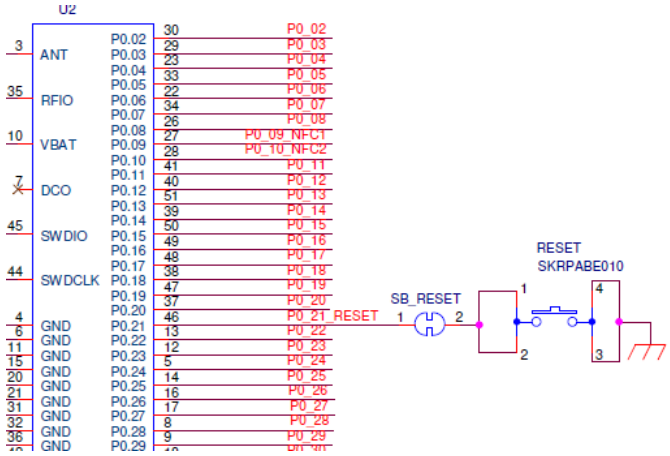


Fig. 2-3: Reset Button

Pushing the reset button puts MK715x1and Arduino Uno R3 compatible shield in reset.
P0.21 and reset button can be completely separated by cutting the solder bridge(SB_RESET).

2.2.2 User buttons

With this evaluation kit, 4 user buttons (Btn1, Btn2, Btn3, Btn4) are available. All buttons are active low (press the button to connect to GND). In order for the user button to work properly, enable the internal pull-up resistor of the GPIO port assigned to the user button. GPIO ports and push buttons can be completely separated by cutting the solder bridge(SB_Btn1, SB_Btn2, SB_Btn3, SB_Btn4). The circuit configuration and port assignment are shown below.

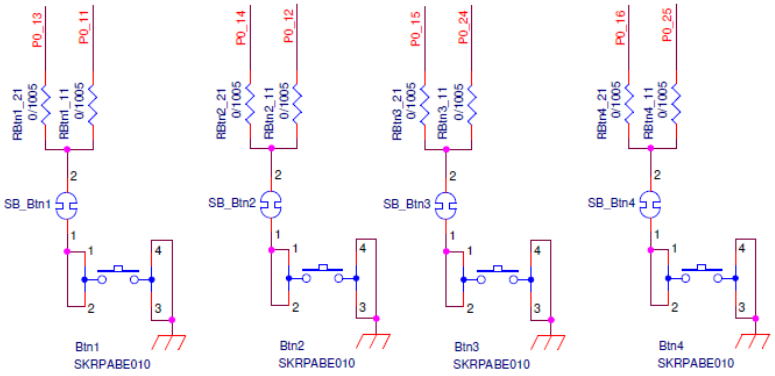


Fig. 2-4 : User buttons

Button	GPIO Port
Btn1	P0.13
Btn2	P0.14
Btn3	P0.15
Btn4	P0.16

Table. 2-1 : User button GPIO port assignment

2.2.3 DIP-SW

4-bit DIP-SW connected to GPIO is available. Each bit is pulled up to VDDIO. GPIO and DIP-SW can be completely separated by cutting the solder bridge(SB_P22, SB_P23, SB_P26, SB_P27). The circuit configuration, port assignment for each bit, and initial settings are shown below.

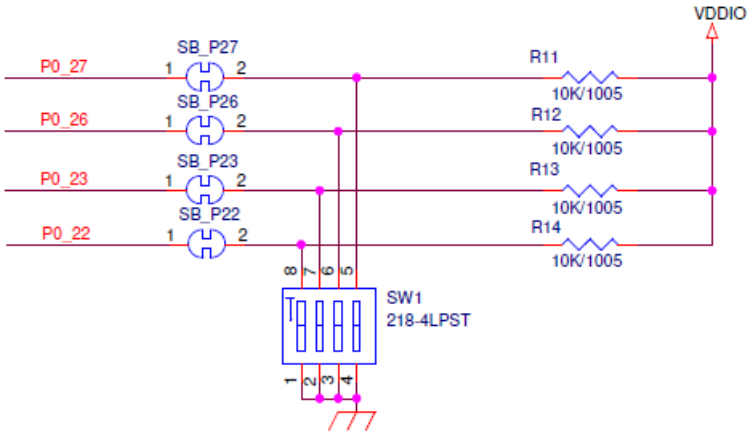


Fig. 2-5 : DIP-SW

Symbol	Pin No.	GPIO Port	Initial setting
SW1	1	P0.22	On
	2	P0.23	Off
	3	P0.26	Off
	4	P0.27	Off

Table. 2-2 : port assignment for each bit, and initial settings

2.3 LED

4 User LEDs, 1 Power LED, 2 UART status LEDs are available in this evaluation kit.

2.3.1 User LEDs

4 User LEDs (green) are connected to GPIO port. The LEDs are active low driven. GPIO port should be in high drive mode. GPIO and LED can be completely separated by cutting the solder bridge(SB_LED1, SB_LED2, SB_LED3, SB_LED4). The circuit configuration and port assignment are shown below.

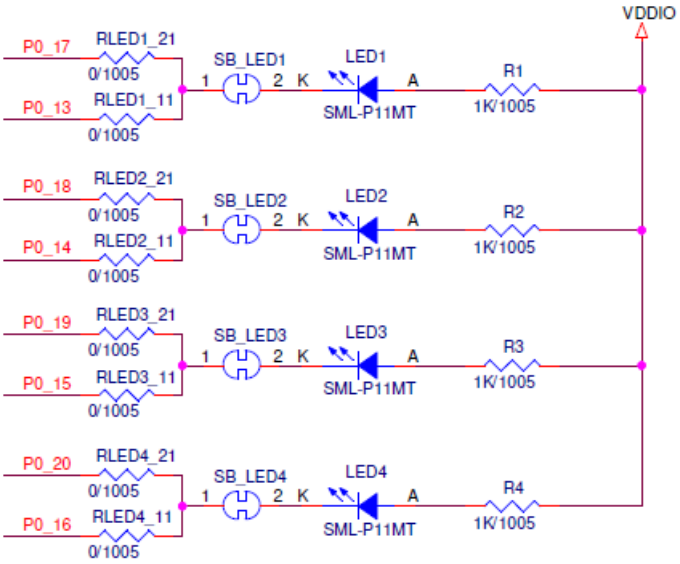


Fig. 2-6 : User LEDs

LED	GPIO Port
LED1	P0.17
LED2	P0.18
LED3	P0.19
LED4	P0.20

Table. 2-3 : LED GPIO port assignment

2.3.2 Power LED

The Power LED (red) lights on when the power (VDDIO) to the MK715x1 is turned on.

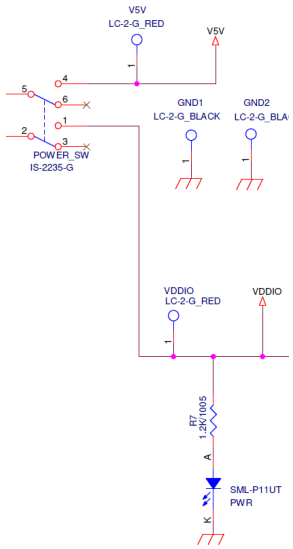


Fig. 2-7 : Power LED

2.3.3 UART status LED

The UART status LED (green) flashes during UART transmission and reception.

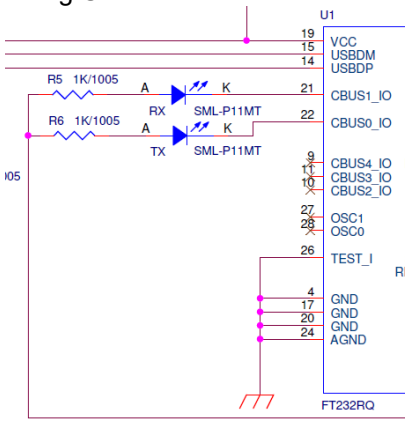


Fig. 2-8 : UART status LED

2.4 Virtual COM port

Serial communication is easily possible between the MK715x1 and PC. A virtual COM USB device connected to four GPIO ports allows UART communication with or without hardware flow control. GPIO and UART line can be completely separated by cutting the solder bridge(SB_P05, SB_P06, SB_P07, SB_P08).

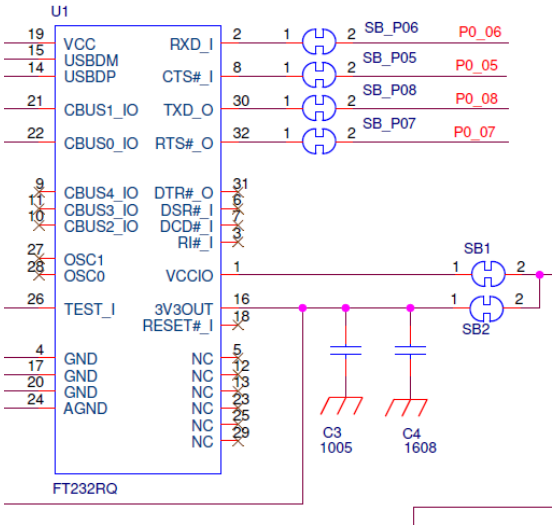


Fig. 2-9 : Virtual COM Port

MK715x1 Port Name	MK715x1Function	Solder Bridge	FT232RQ Function
P0.05	RTS	SB_P05	CTS
P0.06	TXD	SB_P06	RXD
P0.07	CTS	SB_P07	RTS
P0.08	RXD	SB_P08	TXD

Table. 2-4 : Virtual COM Port assignment

2.5 Current measurement pin

The evaluation kit has two sets(JP_BMD, JP_SHLD) of current measurement pins. JP_BMD is for MK715x1 current measurement, JP_SHLD is for Arduino Uno R3 compatible shields current measurement(VSHLD only). For current measurement, remove the solder bridge(SB_BMD or SB_SHDL) and insert an ammeter between JP_BMD or JP_SHLD.

※Only the current flowing into MK715x1 via VBMD can be measured. The current sunk through the GPIO port cannot be measured.

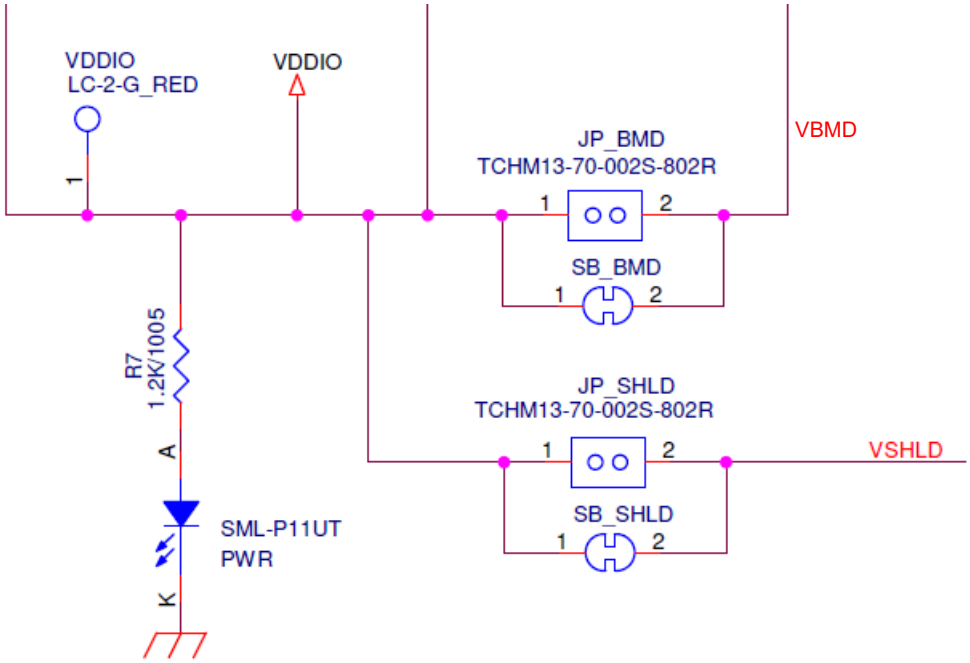


Fig. 2-10 : Current measurement pin

2.6 Solder bridge

The evaluation kit has many solder bridges. Most solder bridges are used to disconnect components on the board from GPIO ports. GPIO port with separated components can be used to interface with external circuits connected to the connector. At shipment, all GPIO ports except for P0.00 and P0.01 are connected to the external interface connector.

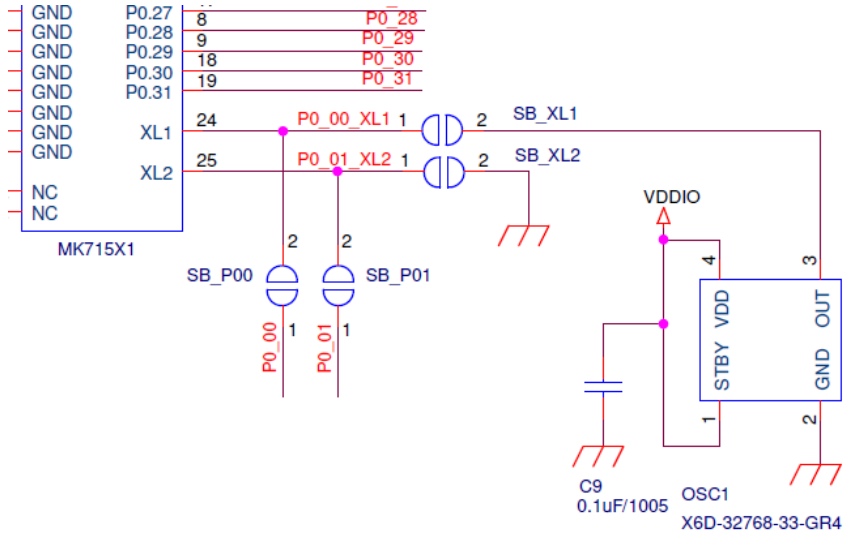


Fig. 2-11 : GPIO port separated from external interface connector

Solder Bridge	Default	Function
SB_P00	Open	Separate P0.00 from P00 in CNA5
SB_P01	Open	Separate P0.01 from P01 in CNA5
SB_XL1	Open	Separate P0.00 from 32.768kHz-SPXO
SB_XL2	Open	Separate P0.01 from 32.768kHz-SPXO
SB_P09	Closed	Separate P0.09 from P09 in CNA5(using NFC)
SB_P10	Closed	Separate P0.10 from P10 in CNA5(using NFC)
SB_LED1	Closed	Separate P0.17 from LED1
SB_LED2	Closed	Separate P0.18 from LED2
SB_LED3	Closed	Separate P0.19 from LED3
SB_LED4	Closed	Separate P0.20 from LED4
SB_BTN1	Closed	Separate P0.13 from Btn1
SB_BTN2	Closed	Separate P0.14 from Btn2
SB_BTN3	Closed	Separate P0.15 from Btn3
SB_BTN4	Closed	Separate P0.16 from Btn4
SB_RESET	Closed	Separate P0.21 from RESET Button
SB_BMD	Closed	To enable JP_BMD for current measurement
SB_SHLD	Closed	To enable JP_SHLD for current measurement
SB_3V3	Open	To short the diode for 3.3V output protection from UART Interface IC
SB_BAT	Open	To short the CR2032 coin battery protection diode
SB_EXT	Open	To short the diode for external power supply protection
SB_P05	Closed	Separate P0.05 from UART Interface
SB_P06	Closed	Separate P0.06 from UART Interface
SB_P07	Closed	Separate P0.07 from UART Interface
SB_P08	Closed	Separate P0.08 from UART Interface
SB1	Closed	Separate UART Interface IC from IO power supply
SB2	Closed	Separate 3.3V output from UART Interface IC
SB_P22	Closed	Separate P0.22 from DIP-SW
SB_P23	Closed	Separate P0.23 from DIP-SW
SB_P26	Closed	Separate P0.26 from DIP-SW
SB_P27	Closed	Separate P0.27 from DIP-SW

Table. 2-5 : Solder bridge shipping condition

2.7 The pin assignment for External interface

Equipped with 2.54mm pitch connector as external interface for IO signal from MK715x1.

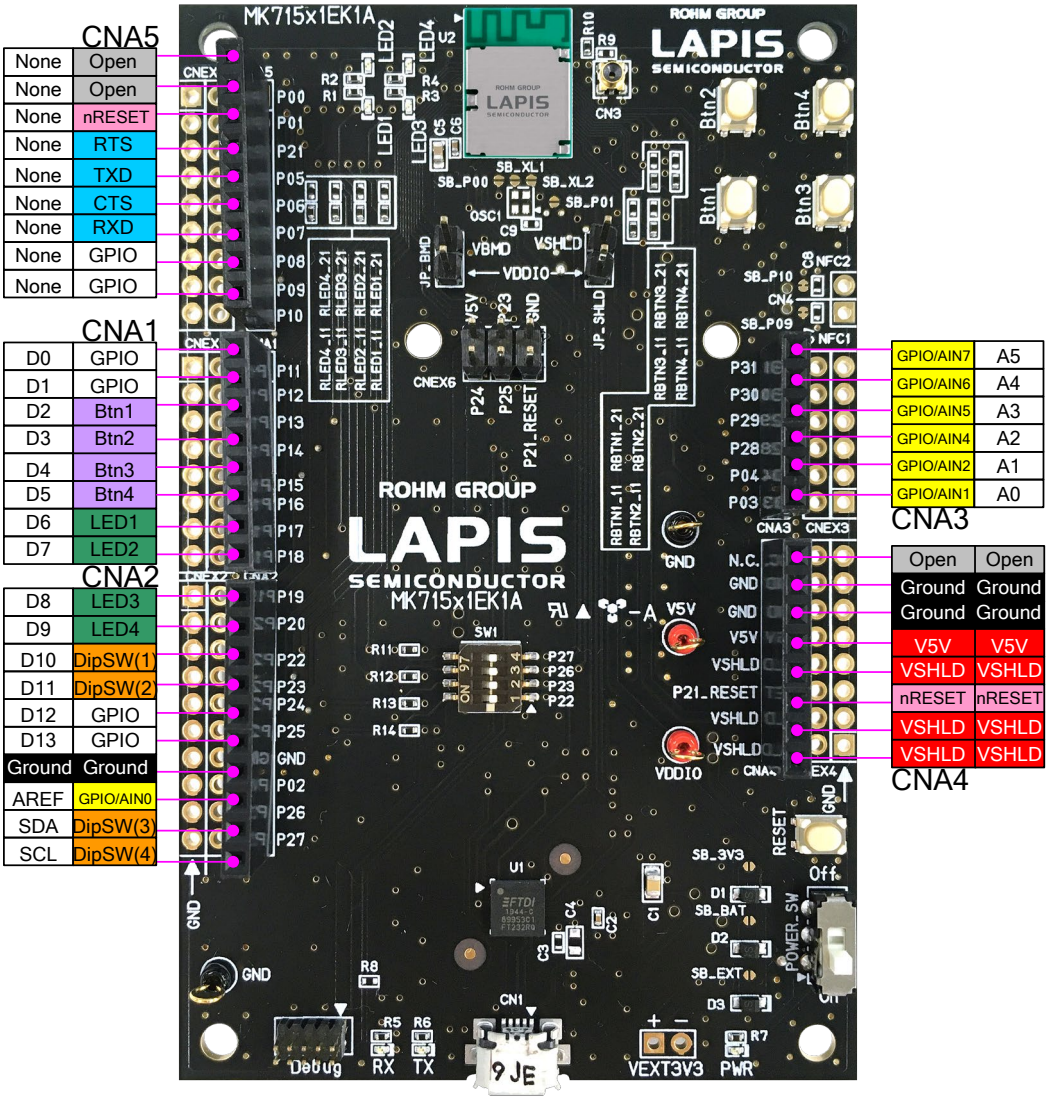


Fig. 2-12 : pin assignment table for External interface

Pin No.	Pin Name	MK715x1EK1A Assign	Arduino Function	nRF52 Port	nRF52 Function
1	P11	GPIO	D0	P0.11	GPIO
2	P12	GPIO	D1	P0.12	GPIO
3	P13	Btn1	D2	P0.13	GPIO
4	P14	Btn2	D3	P0.14	GPIO
5	P15	Btn3	D4	P0.15	GPIO
6	P16	Btn4	D5	P0.16	GPIO
7	P17	LED1	D6	P0.17	GPIO
8	P18	LED2	D7	P0.18	GPIO

Table. 2-6 : CNA1

Pin No.	Pin Name	MK715x1EK1A Assign	Arduino Function	nRF52 Port	nRF52 Function
1	P19	LED3	D8	P0.19	GPIO
2	P20	LED4	D9	P0.20	GPIO
3	P22	DIP-SW (1)	D10	P0.22	GPIO
4	P23	DIP-SW (2)	D11	P0.23	GPIO
5	P24	GPIO	D12	P0.24	GPIO
6	P25	GPIO	D13	P0.25	GPIO
7	GND	Ground	Ground	GND	Ground
8	P02	GPIO/AIN0	AREF	P0.02	GPIO/AIN0
9	P26	DIP-SW (3)	SDA	P0.26	GPIO
10	P27	DIP-SW (4)	SCL	P0.27	GPIO

Table. 2-7 : CNA2

Pin No.	Pin Name	MK715x1EK1A Assign	Arduino Function	nRF52 Port	nRF52 Function
6	P31	GPIO/AIN7	A5	P0.31	GPIO/AIN7
5	P30	GPIO/AIN6	A4	P0.30	GPIO/AIN6
4	P29	GPIO/AIN5	A3	P0.29	GPIO/AIN5
3	P28	GPIO/AIN4	A2	P0.28	GPIO/AIN4
2	P04	GPIO/AIN2	A1	P0.04	GPIO/AIN2
1	P03	GPIO/AIN1	A0	P0.03	GPIO/AIN1

Table. 2-8 : CNA3

Pin No.	Pin Name	MK715x1EK1A Assign	Arduino Function	nRF52 Port	nRF52 Function
8	N.C.	None	None	None	None
7	GND	Ground	Ground	GND	Ground
6	GND	Ground	Ground	GND	Ground
5	V5V	+5.0V Shield Power	+5.0V Shield Power	None	None
4	VSHLD	+3.3V Shield Power	+3.3V Shield Power	None	None
3	P21_RESET	nRESET	nRESET	P0.21	GPIO/nRESET
2	VSHLD	+3.3V Shield Power	+3.3V Shield Power	None	None
1	VSHLD	+3.3V Shield Power	+3.3V Shield Power	None	None

Table. 2-9 : CNA4

Pin No.	Pin Name	MK715x1EK1A Assign	Arduino Function	nRF52 Port	nRF52 Function
1	P00	Open	None	P0.00	GPIO/XL1
2	P01	Open	None	P0.01	GPIO/XL2
3	P21	nRESET	None	P0.21	GPIO/nRESET
4	P05	UART RTS	None	P0.05	GPIO/AIN3
5	P06	UART TXD	None	P0.06	GPIO
6	P07	UART CTS	None	P0.07	GPIO
7	P08	UART RXD	None	P0.08	GPIO
8	P09	GPIO	None	P0.09	GPIO/NFC1
9	P10	GPIO	None	P0.10	GPIO/NFC2

Table. 2-10 : CNA5

Pin No.	Pin Name	MK715x1EK1A Assign	Arduino Function	nRF52 Port	nRF52 Function
1	P24	GPIO	None	P0.24	GPIO
2	P25	GPIO	None	P0.25	GPIO
3	P21_RESET	nRESET	None	P0.21	GPIO/nRESET
4	GND	Ground	None	GND	Ground
5	P23	Dip Switch	None	P0.23	GPIO
6	V5V	+5.0V USB Power	None	None	None

Table. 2-11 : CNEX

3. How to use sample software

The AT command application software is installed in this kit. Please prepare MK715x1 evaluation kit and smartphone application "BLE Tool". This section briefly describes the operation of the AT command application, using the MK715x1 side as a peripheral device and connecting to a central device such as a smartphone as an example.

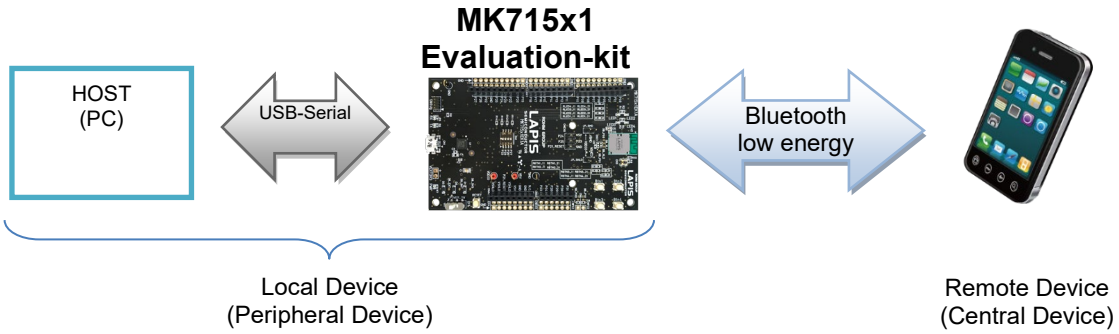


Fig. 3−1 : System configuration (when connecting to a smartphone, etc.)

Refer to "MK715x1 AT Command Application User's Manual" for detailed specifications of AT command application for MK715x1.

3.1 PC set up

1) Connect MK715x1EK1 and the USB port of your PC with USB cable(A-microB type).
When using it for the first time, USB serial conversion IC driver should be installed.
Download driver software from the following site, if necessary.
https://www.ftdichip.com/Drivers/VCP.htm

2) Start up terminal software such as Tera Term, and set the serial port as follows:

Port:	COM port number used
Baud Rate:	57,600 bps
Data:	8 bit
Parity:	None
Stop:	1 bit
Flow Control:	Hardware

3.2 Smartphone Set up

The application on the smartphone uses BLE Tool. Please download and install from the following.

Google Play : https://play.google.com/store/apps/details?id=com.lapis_semi.bleapp
App Store : https://itunes.apple.com/jp/app/ble-tool/id915714158?mt=8&ign-mpt=uo%3D4

3.3 Terminal Software Operation

With the Dip Switch on the MK715x1 evaluation kit as the initial setting, pushing the reset button executes the AT command application. If you input "at<CR>" which is AT command for command acceptance confirmation from the terminal and then the result code string is output as shown below, UART communication between the PC and MK715x1 evaluation kit is normal. Input of "at" command is not output because echo back from MK715x1 is disabled.

Fig. 3-2 : Result code string output screen for command reception confirmation

Then, when you start the peripheral operation, type "atd <CR>" and the MK715x1 Evaluation Kit will start the advertisement transmission. Alternatively, to initiate a central operation, type "ata <CR>" and the MK715x1 Evaluation Kit will initiate a scan and search for peripheral devices. The preparation for the MK715x1 side is now complete.

3.4 BLE Tool operation

3.4.1 Application start

Tap the "BLE Tool" icon to start the application. (Fig. 3-3)

Fig. 3-3: BLE Tool

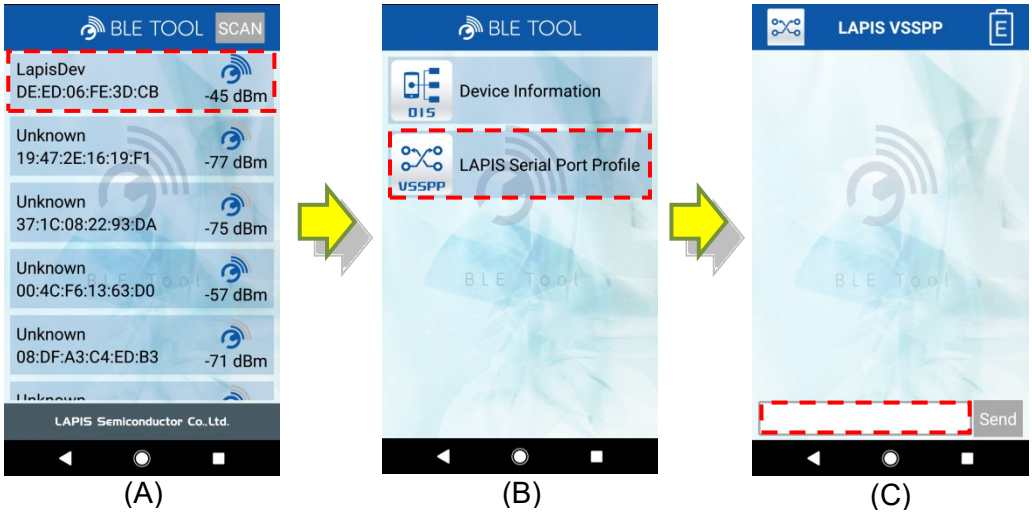
3.4.2 Data communication

Bluetooth® Low Energy communication can be performed by the following steps.
For details on how to use "BLE Tool", refer to the related document "BLE Tool User's Manual".

A) When "BLE Tool" is started, the screen in Fig. 3-4 (A) is displayed. In this screen, the central side scans and displays Bluetooth® low energy devices from the detected advertisement packets. The AT command application for MK715x1 is displayed with the device name "LapisDev" by default, so tap this.

B) The Bluetooth® Low Energy connection procedure is executed, and the service search screen shown in Fig. 3-4 (B) is displayed. At this time, "CONNECT" is output to the terminal screen on the peripheral side. In the screen in Fig. 3-4 (B), the central side executes the service search and displays the detected services. In case of AT command application for MK715x1, two services of "Device Information" and "LAPIS Serial Port Profile" are displayed. The latter is the service used for data communication in AT command applications. Tap the "LAPIS Serial Port Profile" icon.

C) The screen shown in Fig. 3-4 (C) is displayed. You can send and receive data on this screen. When you tap the text box displayed at the bottom of the screen, the soft keyboard is displayed, so if you input a character string from the soft keyboard and tap the "Send" button, the character string you input to the peripheral will be sent. Similarly, if you enter characters from the terminal screen on the peripheral side, it will be sent to the central side.



(A) (B) (C)

Fig. 3-4 : BLE Tool operation screen example

The figure below shows an example of performing data communication using the above procedure. The character string input from “BLE Tool” is output in black characters as shown in Fig. 3-5 (a), and the same character string is also output to the terminal on the peripheral side (Fig. 3-5 (b)). The character string input from the terminal on the peripheral side as shown in Fig. 3-5 (c) is output in red on the “BLE Tool” screen (Fig. 3-5 (d)).

Central
（Smartphone screen）

Peripheral
（MK715x1 Terminal software screen）

Fig. 3-5 : Example of data communication screen

3.4.3 Read device information

The AT command application for MK715x1 also provides Bluetooth SIG standard device information service (DIS). As shown in Fig. 3-6, tap the “DIS” icon on the service search screen to read the device information of the peripheral. Fig. 3-6 shows the default settings for the AT command application for MK715x1. It is necessary to change the device information according to the customer system used. For correction of device information, refer to "MK715x1 AT Command Application User's Manual".

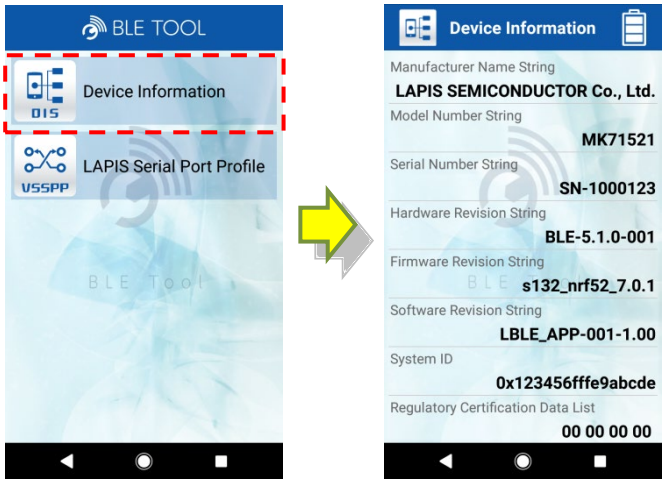


Fig. 3-6 : Device information screen example

This concludes the brief explanation of how to use the AT command application for the MK715x1. For other AT command operations, refer to "3. AT Command" in "AT Command Application for MK715x1 Quick Reference Guide".

A. Appendix

A.1 Correspondence between each evaluation kit and Nordic SDK Example Project

If you use the Nordic SDK v16.0.0 Example Project, follow the table below.

Eval. Kit Name	Applicable Nordic DK Board Type	Preferable Nordic SoftDevice	Note
MK71511EK1A	PCA10056e	S112	Some modifications are required (See A.2)
MK71521EK1A	PCA10040	S132	

Table. A-1 : Correspondence between each evaluation kit and Nordic SDK Example Project

A.2 Example Project modification steps required for MK71511EK1

MK71511EK1's GPIO interface assignment is subjected to Nordic's PCA10040 board, so when using the Nordic SDK's Example Project with MK71511EK1, it is necessary to change the assignment of reset buttons and LEDs. The procedure is described below using the Example Project for the SEGGER Embedded Studio IDE of Blood Pressure Service of nRF SDK v16.0.0 as an example.

1) Open the following project file with SEGGER Embedded Studio IDE.
<unzipped location>¥nRF5_SDK_16.0.0_98a08e2¥examples¥
ble_peripheral¥ble_app_bps¥pca10056e¥s112¥ses¥ble_app_bps_pca10056e_s112.emProject

2) Select Project>Options from the Menu Bar.

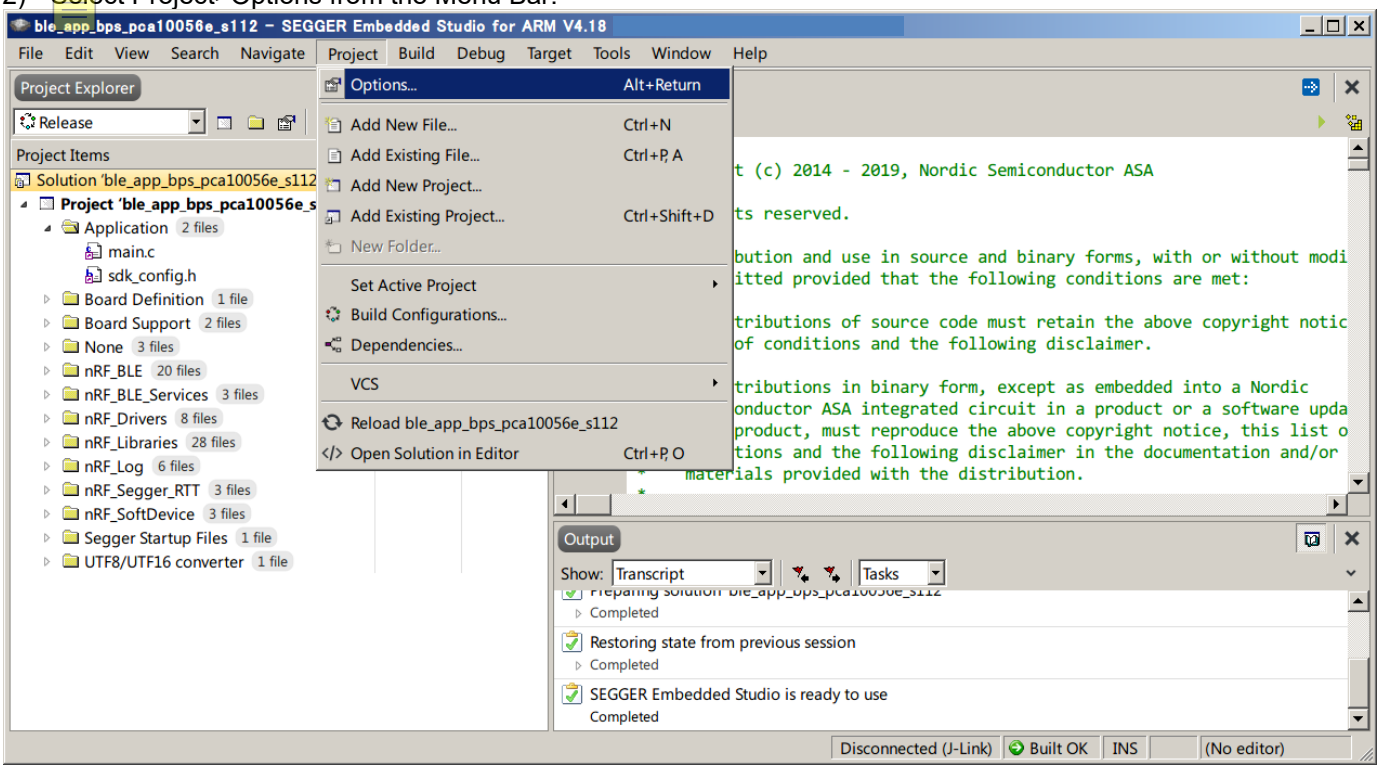


Fig. A-1 : Project "Option" settings

3) Select "Common" setting.

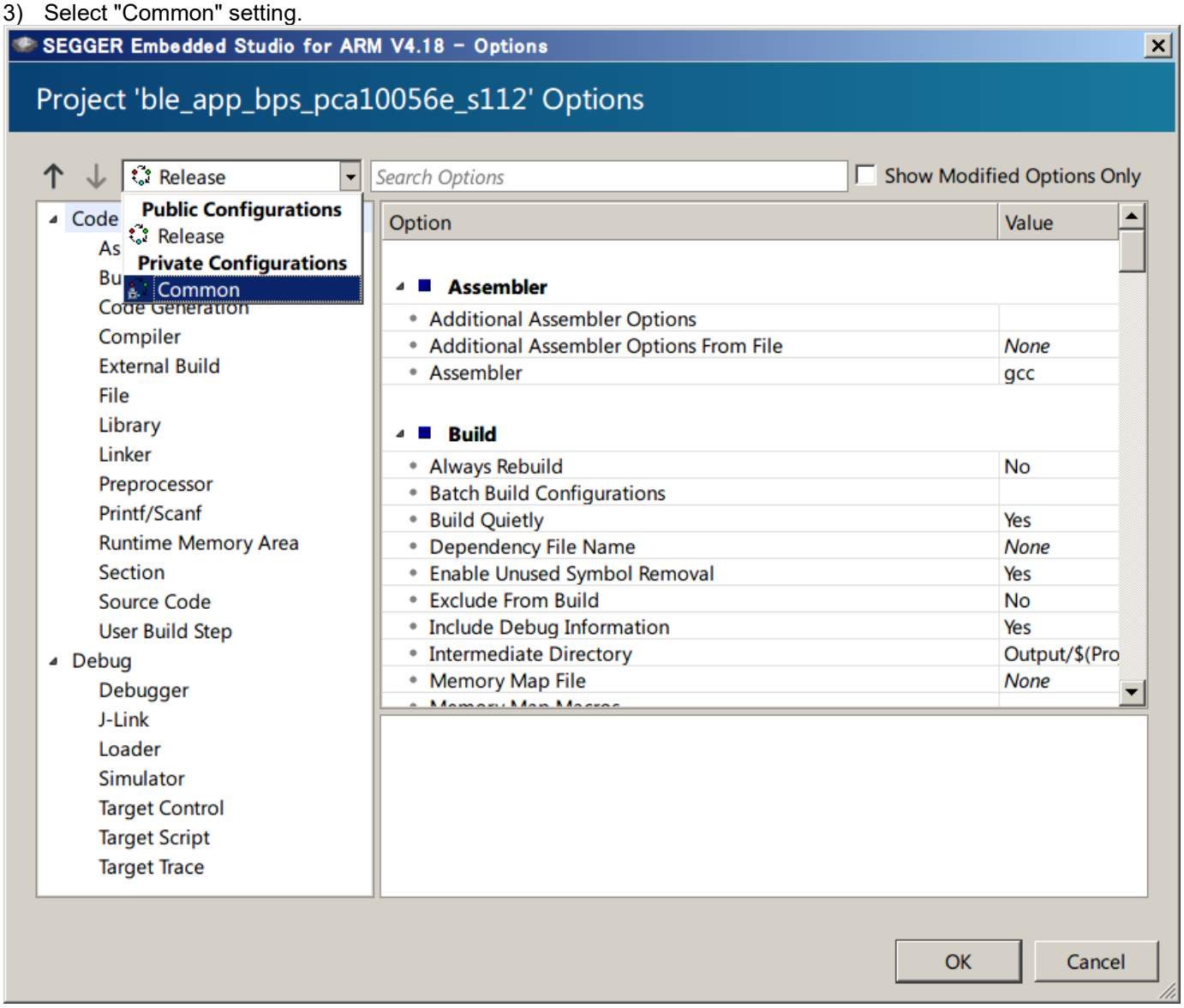


Fig. A-2 : "Common" setting

4) Select "Preprocessor" in "Code list"

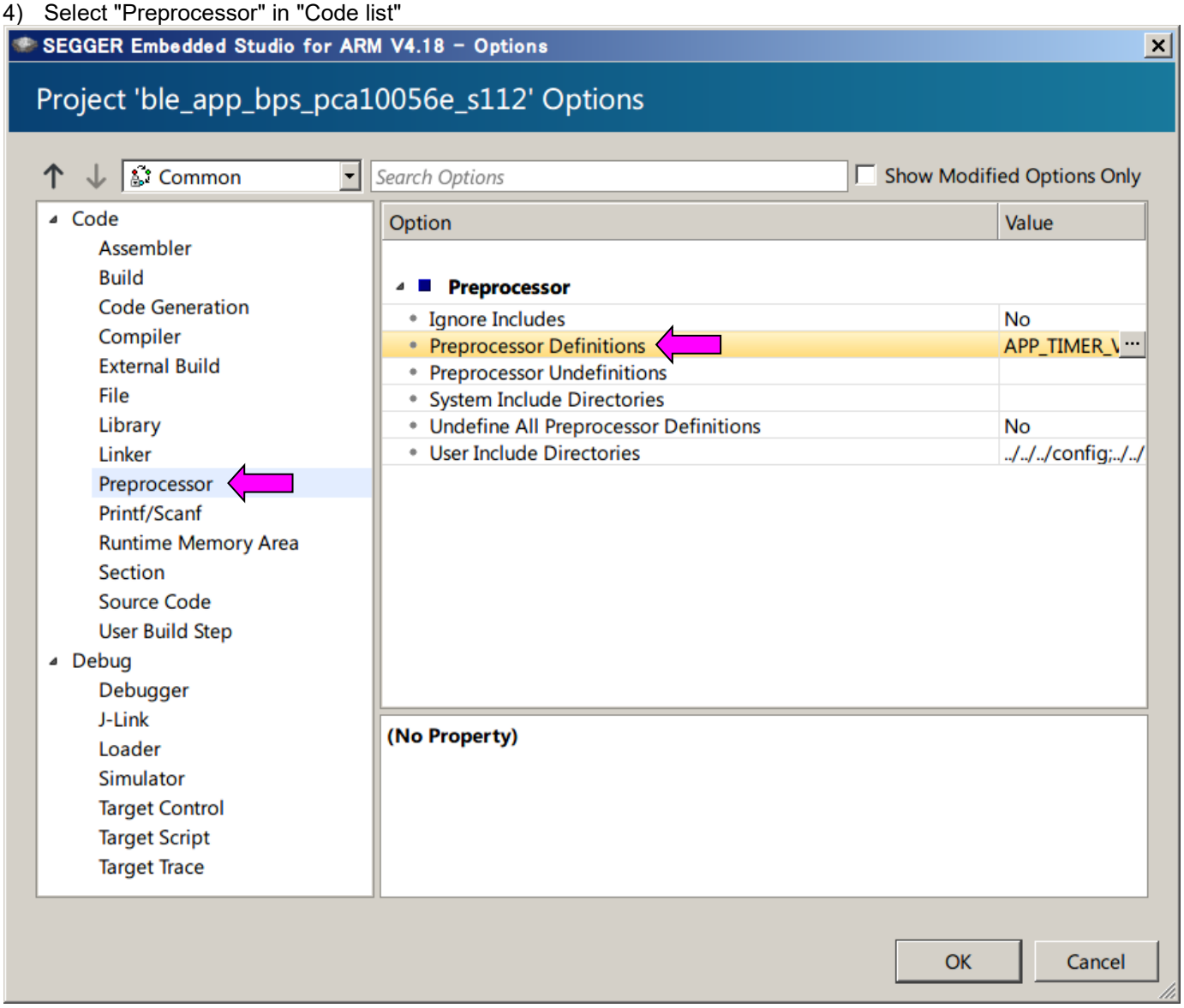


Fig. A-3: "Preprocessor" setting

5) Double-click "Preprocessor Definitions" to display the setting screen.

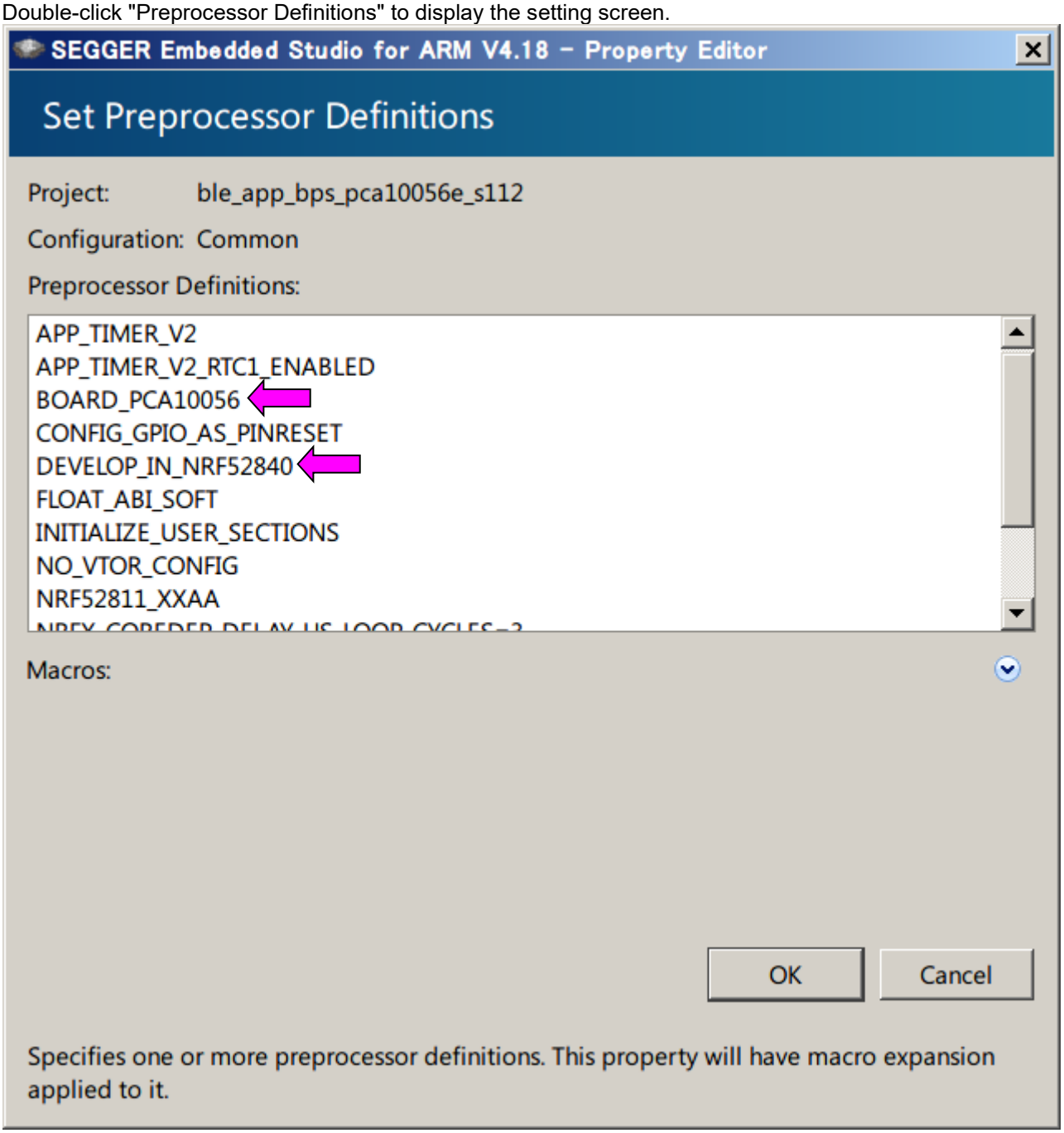


Fig. A-4: Changes to "Preprocessor Definitions"

6) Change "BOARD_PCA10056" to "BOARD_PCA10040".
7) Delete "DEVELOP_IN_NRF52840".

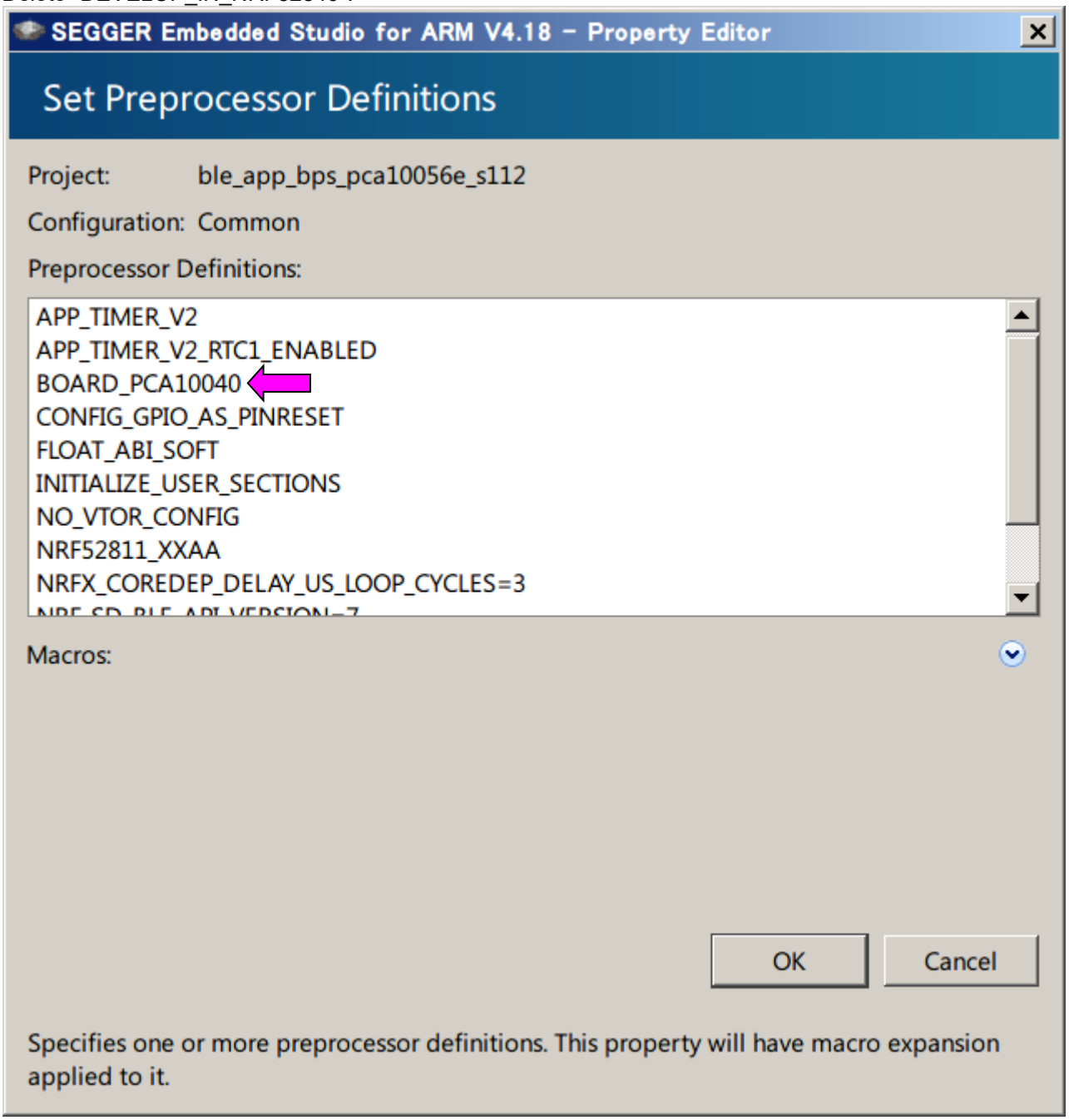


Fig. A-5: Modified "Preprocessor Definitions"

8) Click the "OK" button to close the screen.

Revision History

Document No.	Issue date	Page		Revision description
		Before revision	After revision	
FEXK715x1EK1A_HardManual-01	Dec. 1, 2020	–	–	Final first edition

(Caution) This does not include typographical errors, changes in expressions, or corrections.