SAPPHIRE-67CFSG

SAPPHIRE-67DFSG

TOSHIBA Bluetooth® IC Evaluation Board User's Manual

SENSYST

Rev 1.0

Regulatory Compliance Information

This evaluation board contains the device that transmit and receive radio signals for the 2.4-GHz unlicensed frequency range and is gained regulatory approvals to be used in Japan and United States.

FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC RF Radiation Exposure Statement.

(1) This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. (2) This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

FCC RF Exposure requirements.

This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

FCC Interference Statement for Class B devices.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: ・ Reorient or relocate the receiving antenna. ・ Increase the separation between the equipment and receiver. ・ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. ・ Consult the dealer or an experienced radio/TV technician for help.
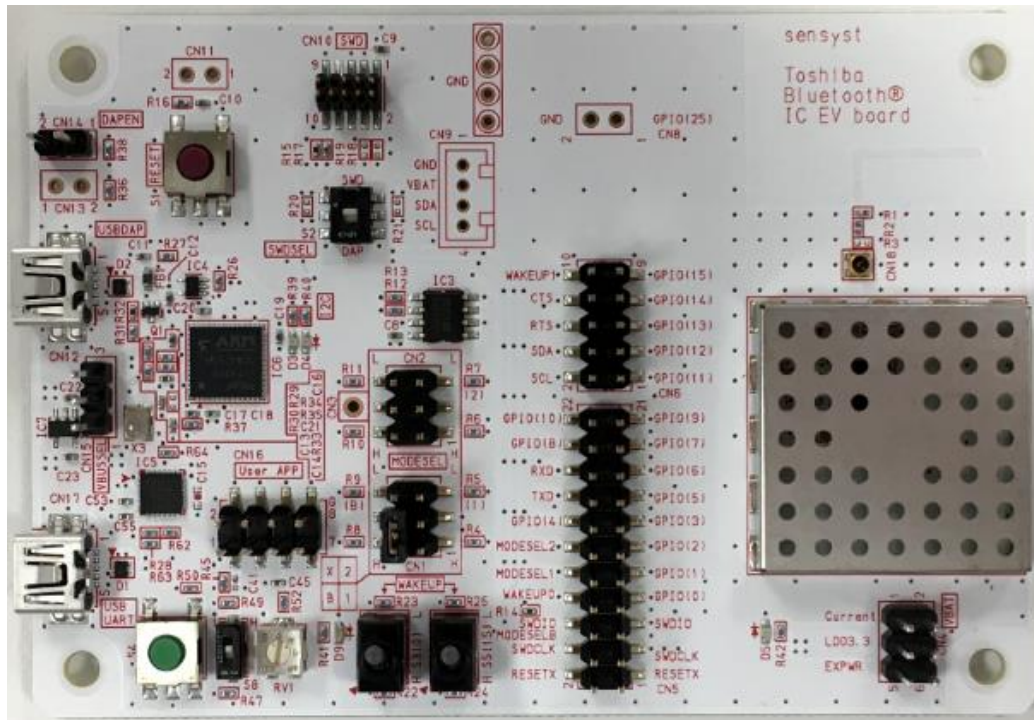
SAPPHIRE Evaluation Board KIT

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USB Type A Male to Mini B Male Cable, The coaxial RF adapters suitable for Hirose MS–156C,

and the debugger with half pitch 10 pin cable aren't included.

If need for your evaluation, please prepare yourself.

<Caution>

✧ This evaluation board is intended for use for engineering development, demonstration, or evaluation purpose only. Persons handling this product must have rich electronics knowledge and rich engineering practice. Sensyst does not consider for this product to be a finished end-product fit for general consumer use. The products incorporated this board are not appropriate for resales.

1. Introduction

The SAPPHIRE evaluation board includes Toshiba Bluetooth LE IC complies with Bluetooth v4.2, low energy single-mode radio.

Toshiba Bluetooth LE IC is

・Compliant with Bluetooth v4.2 low energy system

・Operating frequency: 2.4 GHz ISM band at 2400-2483.5 MHz (40 RF channels; f=2402+k*2 MHz, k=0, … ,39)

・Maximum output power level: 0dBm (typ.)

This time, we made following changes.

・Flash memory's capacity in the IC (BTLE IC) is changed from 256KB to 128KB <u>for cost saving</u>

・ROM in the IC (BTLE IC) is changed from 384KB to 216KB <u>for cost saving</u>

・RAM in the IC (BTLE IC) is changed from 192KB to 128KB <u>for cost saving</u>

・A random number generator <u>for security</u> is newly added in the IC(BTLE IC)

・A 32kHz silicon oscillator in the IC(BTLE IC) is deleted <u>for cost saving</u>

・Some components/parts (IC6, CN12, X3, S2) are newly added <u>for using CMSIS-DAP</u>※1

-About A Randam Number Generator-

A random number generator is used to generate the key of the encrypted protocol.

-About CMSIS-DAP-

CMSIS-DAP is the interface firmware for a Debug Unit that connects the Debug Port to USB. Debuggers, which execute on a host computer, connect via USB to the Debug Unit and to the Device that runs the application software. The Debug Unit connects via JTAG or SWD signals to the target Device. ARM Cortex processors provide the CoreSight Debug and Trace Unit. CMSIS-DAP supports target devices that contain one or more Cortex processors.

2. Overview

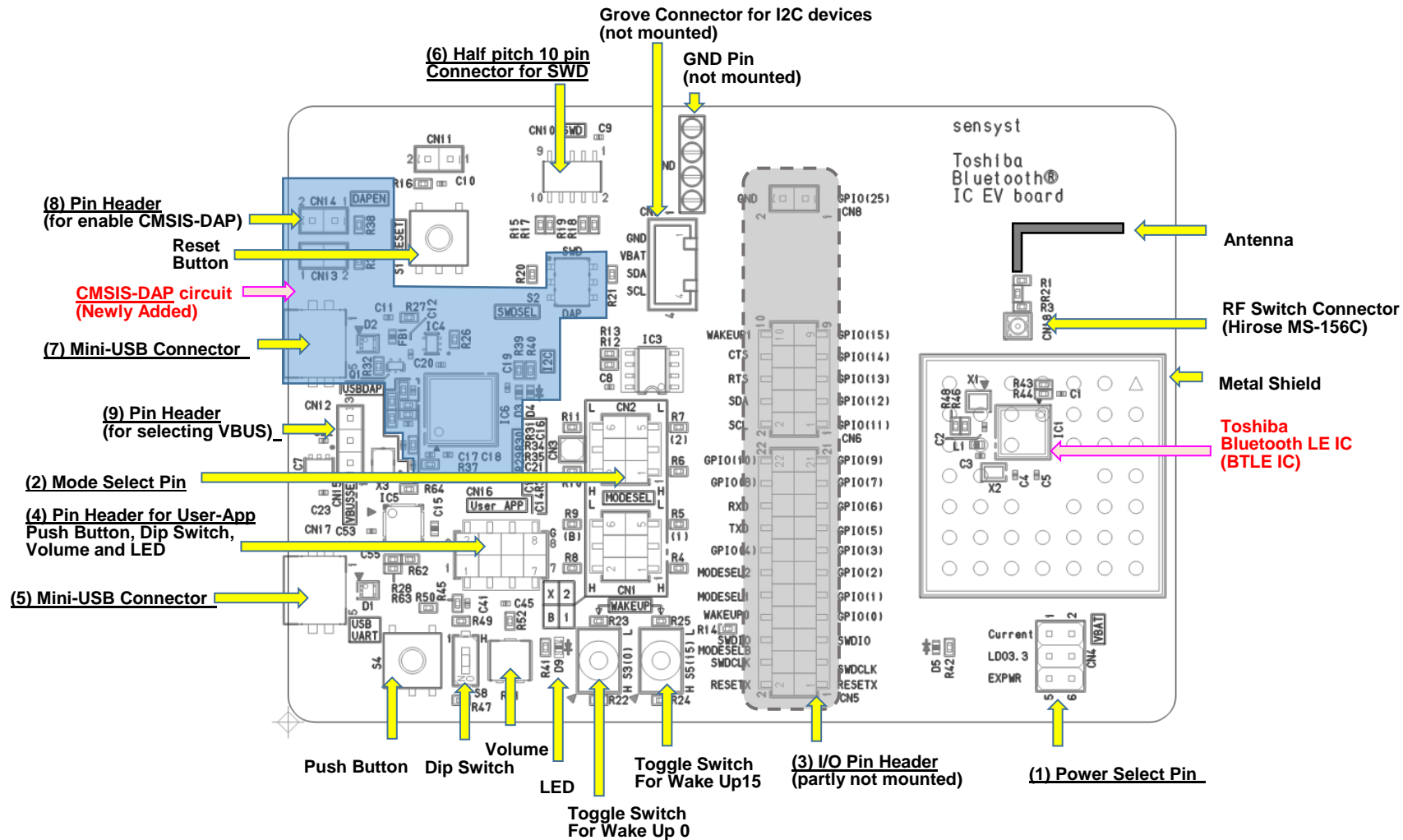The differences between each model are shown following table.

ORIGINAL

Model	Board		BTLE Chipset	BTLE Chipset						FCC ID
	Name	CMSIS-DAP		Package	Internal Flash Memory (KB)	Internal Mask ROM(KB)	Internal Work RAM(KB)	Internal Silicon OSC	Internal Randam Number Generator	
Model-1	SAPPHIRE-678FSG	No	TC35678FSG	QFN 40pin	256	384	192	Yes	No	2AKW4-678FSG
Model-2	SAPPHIRE-679FSG	No	TC35679FSG		No	384	192	Yes	No	

This model

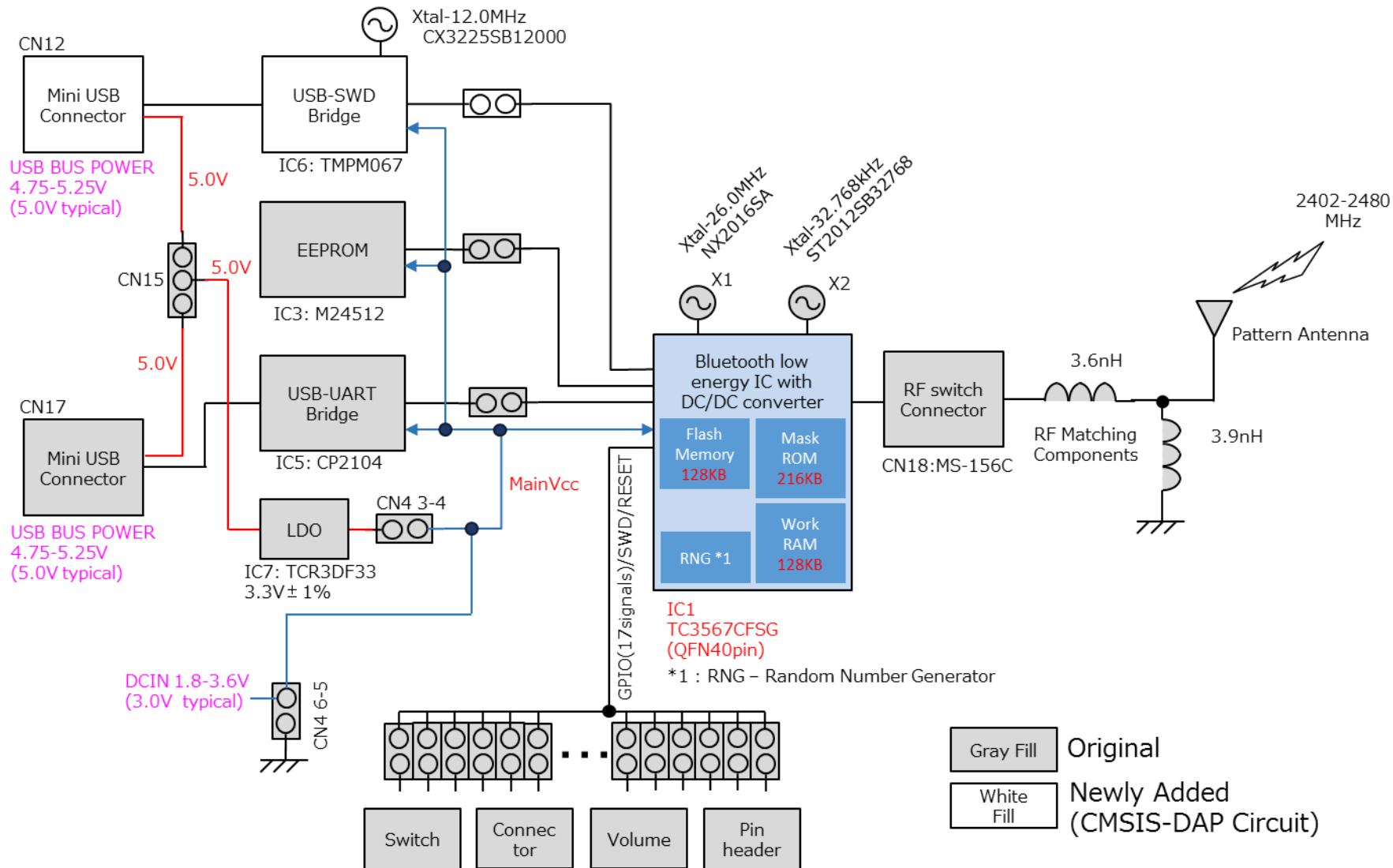| Model	Board		BTLE Chipset	BTLE Chipset						FCC ID
	Name	CMSIS-DAP		Package	Internal Flash Memory (KB)	Internal Mask ROM(KB)	Internal Work RAM(KB)	Internal Silicon OSC	Internal Randam Number Generator	
Model-1	SAPPHIRE-67CFSG	Yes	TC3567CFSG	QFN 40pin	128	216	128	No	Yes	2AKW4-678FSG
Model-2	SAPPHIRE-67DFSG	Yes	TC3567DFSG		No	216	128	No	Yes	

3. Overview Appearance

The difference in appearance between SAPPHIRE-67CFSG & SAPPHIRE-67DFSG and SAPPHIRE-678FSG & SAPPHIRE-679FSG is that we added parts for CMSIS-DAP.
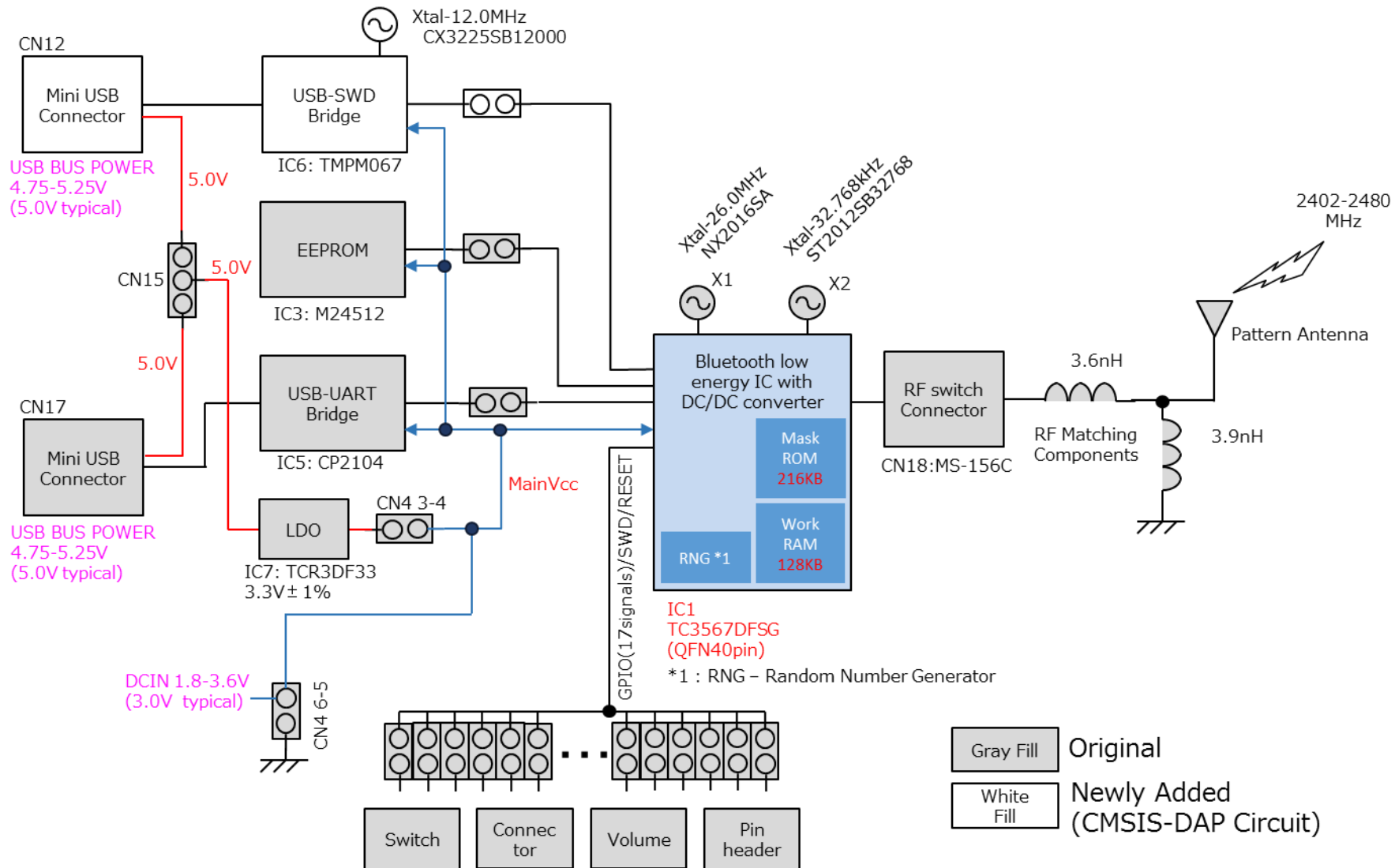
4. Block Diagram

4-1. SAPPHIRE-67CFSG (2AKW4-678FSG)

4-2. SAPPHIRE-67DFSG (2AKW4-678FSG)

Xtal-12.0MHz
CX3225SB12000

CN12
Mini USB Connector

USB BUS POWER
4.75-5.25V
(5.0V typical)

5.0V

USB-SWD Bridge

IC6: TMPM067

CN15

5.0V

5.0V

EEPROM

IC3: M24512

5.0V

CN17
Mini USB Connector

USB BUS POWER
4.75-5.25V
(5.0V typical)

USB-UART Bridge

IC5: CP2104

LDO

CN4 3-4

IC7: TCR3DF33
3.3V±1%

MainVcc

DCIN 1.8-3.6V
(3.0V typical)

CN4 6-5

Switch

Connector

Volume

Pin header

Xtal-26.0MHz
NX2016SA

Xtal-32.768kHz
ST2012SB32768

X1

X2

Bluetooth low energy IC with DC/DC converter

Mask ROM
216KB

RNG *1

Work RAM
128KB

IC1
TC3567DFSG
(QFN40pin)

*1 : RNG – Random Number Generator

GPIO(17signals)/SWD/RESET

RF switch Connector

CN18:MS-156C

3.6nH

RF Matching Components

3.9nH

2402-2480 MHz

Pattern Antenna

Gray Fill — Original

White Fill — Newly Added (CMSIS-DAP Circuit)

5. Features

The SAPPHIRE evaluation board includes Toshiba Bluetooth LE IC complies with Bluetooth v4.2, low energy single-mode radio and has the following features.

[Radio]

- Complies with Bluetooth v4.2, low energy single-mode radio operates at 2402 MHz to 2480 MHz.

- The qualified Bluetooth protocol stacks such as HCI,GATT are stored in the Bluetooth LE IC.

- Bluetooth Device Address, uniquely radio identifier is stored in the Bluetooth LE IC.

- Maximum communication distance is approximately up to 30 m with the pattern antenna on this board. (Transmit output power :0 dBm, Sensitivity:-93 dBm)

- Hirose MS-156C RF switch connector for radio evaluation is included. If needed for radio evaluation, please prepare suitable RF coaxial adapter(*) yourself.

   (*)MS-156R-HRMJ-1

[Power]

- USB bus powered is supported. Built-in LDO device produce a 3.3 V power supply   to the ICs from Vbus 5 V.

- Pin headers for external power supply such as coin battery are included.

- Pure current of the Bluetooth LE IC can be measured at the pin headers on the board.

[GPIO]

- All GPIOs of the bluetooth LE IC can be directly contacted at the pin headers on this board. (But partly headers are not mounted)

- SAPPHIRE-67CFSG and SAPPHIRE-67DFSG support GPIO 0 to 15 and GPIO 25.

[Peripheral]

- Either HCI mode or User-App mode can be selected by the configuration of Mode Select Pin.

- Silicon labs CP2104 device, USB-UART bridge IC enables UART communication with PC and Bluetooth LE IC. USB type A male to mini B male cable is not included.

- 512KB EEPROM device is on this board. The SAPPHIRE-67DFSG boots up from this EEPROM device for User-App mode.

- Toggle switch for Wake up 0 and wake up 15

- A push switch, a dip switch, a LED and a volume for user application can be connected to the any GPIOs with wire cables.

- Half pitch 10 pin connector for SWD debugging and programming.

- Grove Universal 4 pin connector can be mounted on this board for connecting the various I2C shield modules.

- Supports on-board debugging function. You do not need an another debugger. You can debug and program by connecting with PC and USB type A male to mini B male cable.

6. Transmission Operation

(1) Check the jumper position on this board so that it can be communicated with a PC via virtual COM port..
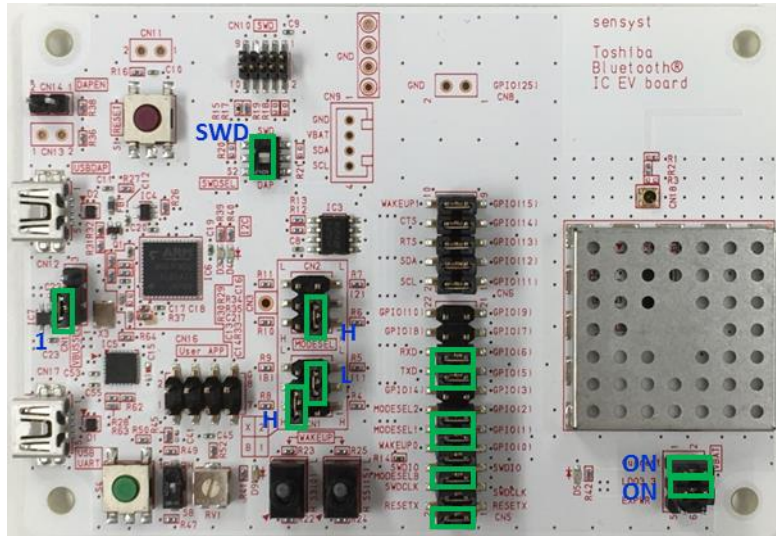
(1) Get the latest version of the CP210x USB to UART Bridge VCP Driver on the Silicon Labs website:www.silabs.com/interface-software and install this to the PC.

(2) Connect the SAPPHIRE Evaluation board to the PC using standard USB Type A Male to Mini B Male Cable.

(3) The CP210x device will be apper as a COM port in device manager in Windows. As a virtual COM port,the CP210x functions identically to a real COM port from the reference point of both the host application and the serial device.
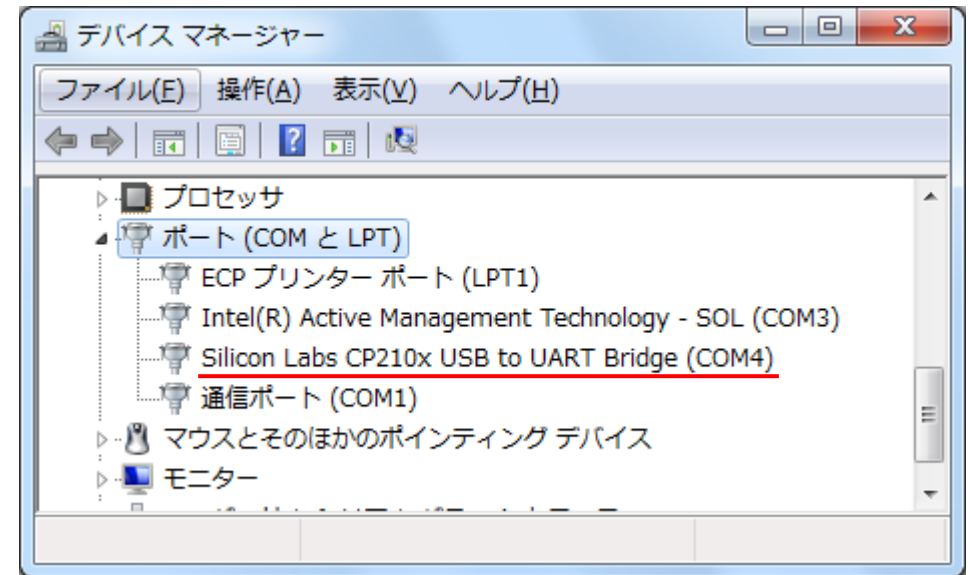
(4) Send commands using Host application such as Toshiba HCI Testers to operate the Bluetooth LE IC on this board or download a program to the NVM for user applications. Refer Toshiba website for more informations.
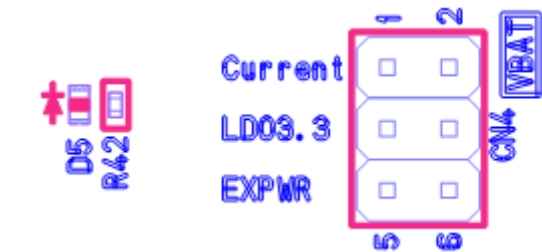
https://toshiba.semicon-storage.com/us/product/wireless-communication.html

7. Feature Description

(1) Power Select Pin(CN4)

Use this pin header when selecting the power supply for the Bluetooth LE IC.

And measuring the current consumption of the Bluetooth LE IC.



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✧ NOTE1 (Selecting Power Supply)

When using external power supply, be sure to open 3-4 pin to avoid collision with LDO output.

✧ NOTE2(Current measurement)

By connecting an ammeter to 1-2 pin, it is possible to measure consumption current of Bluetooth LE IC alone. .

(2) Mode Select (CN1-2)

Depending on the mounting of the jumper socket, you can switch between HCI mode and User-App mode. Since the mode is confirmed immediately after releasing reset, you can use it in any state after booting.
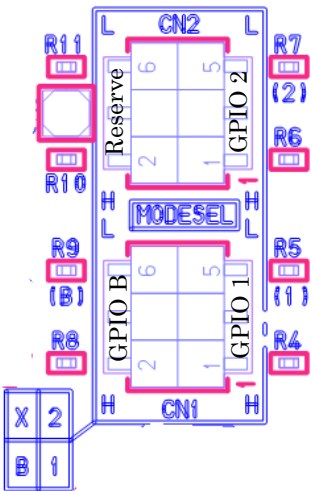

	User-App Mode	HCI Mode	
GPIO 1	H or Open	L	CN1
GPIO 2	Don't care	L	CN2
GPIO B	Don't care	H or Open	CN1

(3) I/O Pin Header (CN5-8)

To this pin header

・Reset input of Bluetooth LE IC

・SWD interface

・All GPIOs of each IC are connected

Since no other circuit is connected between IC and pin header, it can contact directly with IC terminal. CN8 is not mounted. If you use GPIO24-31, you need to install a pin header to CN8.
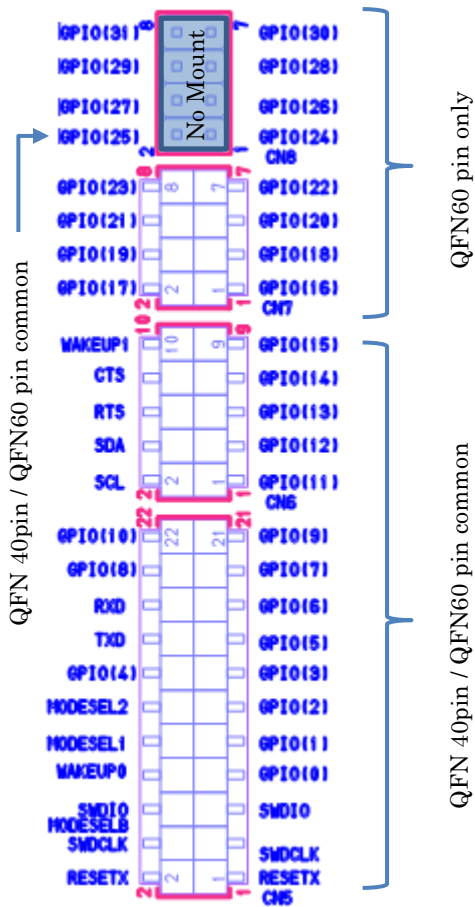
(4)　Pin Header for User-App (CN16)

This pin header is for user application evaluation.

The connection destination of each pin is shown in the table below.

Pin No.	Access Point	Descriptipn
1	Push Button	H or L Pushing is L.
2	GND	GND
3	Dip Switch	H or L
4	GND	GND
5	Volume	Separating I/O volatage
6	GND	GND
7	LED (Red)	Lighting is L.
8	GND	GND

(5)　Mini-USB Connector (CN17)

Power Select (Please show Power select pin)

By connecting a USB cable to this connector, Bluetooth LE IC
can be controlled with UART from Windows PC.

When using this function, it is necessary to download and install
the VCP driver from the Silicon labs company website in
advance.
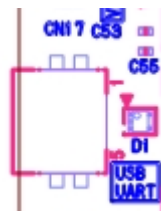
(6)　Half Pitch 10 pin Connector for SWD Connector (CN10)

It is for ARM debugger connection. You can debug the Bluetooth
LE IC with the SWD interface.

Debugging function is exclusive with CMSIS-DAP(CN12).
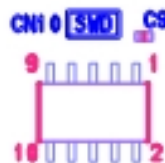
(7)　Mini-USB Connector (CN12)

It is for CMSIS-DAP. You can debug the Bluetooth LE IC without
using an external debugger.

Debugging function is exclusive with SWD Connector(CN10).
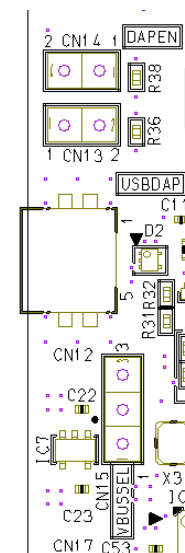
(8)　Pin Header (CN14)

Shorting this pin header enables the CMSIS-DAP function..

(9)　Pin Header (CN15)

This Pin Header is for selecting VBUS power supply.

1-2 → Power is supplied from CN17.

2-3 → Power is supplied from CN12.

8. BLE Chip Specification

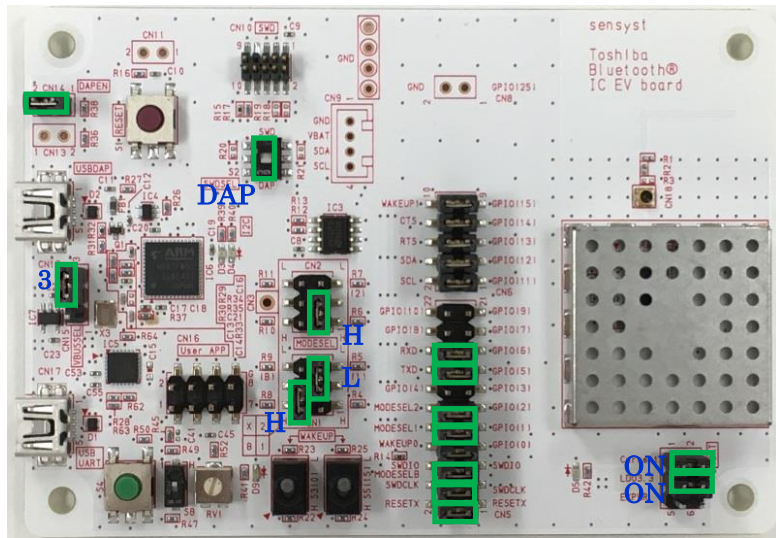Please refer to

✧ TC3567CFSG-001_SummaryCatalog_en_20170626.pdf

✧ TC3567DFSG-001_SummaryCatalog_en_20170626.pdf

https://toshiba.semicon-storage.com/us/product/wireless-communication/bluetooth/detail.TC3567CFSG-001.html

https://toshiba.semicon-storage.com/us/product/wireless-communication/bluetooth/detail.TC3567DFSG-001.html

9. Appendix

The following picture shows the setting when using CMSIS-DAP function.

It is necessary to receive the PC driver for CMSIS-DAP from Toshiba Electronic Devices & Storage Corp.

For details, refer to the following URL.

https://toshiba.semicon-storage.com/us/product/wireless-communication/bluetooth.html

For details of CMSIS-DAP, please refer to the following URL.

https://developer.arm.com/embedded/cmsis

For development tools, please refer to the following URL.

http://www.keil.com/support/man/docs/dapdebug/dapdebug_introduction.htm

https://www.iar.com/jp/iar-embedded-workbench/tools-for-arm/cmsis/