

***Bluetooth*[®] low energy Module**

Bluetooth[®] 4.2 low energy

EYSGCNAWY-VX

Data Report

By purchase of any products described in this document, the customer is deemed to understand and accept contents of this document.

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EYSGCNAWY-VX

TAIYO YUDEN CO., LTD.

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Revision History

23-Apr.-2019 > Ver.1.0 Release

10-Sep.-2020 > Ver.1.1 Update

EYSGCNAWY-VX

TAIYO YUDEN CO., LTD.

Control No. HD-AG-A181108	(1/5)	Control name General Items
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Scope

This specification ("Specification") applies to the hybrid IC "EYSGCNAWY-VX", a **Bluetooth**® 4.2 low energy module ("Product") manufactured by TAIYO YUDEN Co., Ltd. ("TAIYO YUDEN")

1. Type: EYSGCN

User Code: EYSGCNAWY-VX

*User Code may be changed for mass production or other cases.

2. Function:

Radio frequency module. **Bluetooth**® standard Ver 4.2 low energy conformity

3. Application: Health & Fitness Equipment, Sensor, Toys**4. Structure:**

Hybrid IC loaded with silicon monolithic semiconductor

Regarding the containment of hazardous substance in this Product, it conforms to RoHS Directive.

5. Outline: 12.9x 9.6 x 2.0 mm

49-pin Land Grid Array

6. Marking: Part number, Lot number, Japan ID, FCC ID, IC ID**7. Features:**

- Small outline by PCB substrate
- Low power consumption
- Integrated antenna
- Integrated system and sleep clock
- **Bluetooth**® 4.2 low energy conformity
- Slave or Master Role

8. Country of origin: Japan or Thailand**9. Packaging:**

Packaging method: Tape & reel + aluminum moisture barrier bag

Packaging unit: 1000

*It might be provided as tray at sample stage.

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EYSGCNAWY-VX

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Control No. HD-AG-A181108	(2/5)	Control name General Items
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10. Note:

- a. Any question arising from this Specification shall be solved through mutual discussion by the parties hereof.
- b. This Product is not designed to be radiation durable and should not be used under the circumstance of radiation.
- c. The operating conditions of this Product are as shown in this Specification. Please note that TAIYO YUDEN shall not be liable for a failure and/or abnormality which is caused by use under the conditions other than the operating conditions hereof.
- d. The Product mentioned in this Specification is manufactured for use in Health & Fitness Equipment, Sensor and Toys. Before using this Product in any special equipment (such as medical equipment, space equipment, air craft, disaster prevention equipment), where higher safety and reliability are duly required, the applicability and suitability of this Product must be fully evaluated by the customer at its sole risk to ensure correct and safe operation of these special equipments. Also, evaluation of the safety function of this Product even for use in general electronics equipment shall be thoroughly made and when necessary, a protective circuit shall be added during the design stage, all at the customer's sole risk.
- e. a) You are requested to fully check and confirm by the start of mass production of this Product that (1) no bug, defect or other failure is included in firmware incorporated in this Product ("Incorporated Software"), (2) no bug defect or other failure arising from installation of this Product in which is contained Incorporated Software into your products is included in Incorporated Software, and that Incorporated Software fully meets your intended use, although TAIYO YUDEN sufficiently inspects or verifies quality of Incorporated Software.
b) Please note that TAIYO YUDEN is not responsible for any failure arising out of bugs or defects in Incorporated Software.
- f. TAIYO YUDEN warrants only that this Product is in conformity with this Specification for one year after purchase and shall in no event give any other warranty.
- g. Communication between this Product and others might not be established nor maintained depending on radio environment or operating conditions of this Product and other *Bluetooth*[®] products.
- h. In order to test for Radio Law certification with a device incorporating this module, the Host Software must be able to put the module into test mode. Please contact TAIYO YUDEN for further details.
- i. This Product operates in the unlicensed ISM band at 2.4GHz. In case this Product is used around the other wireless devices which operate in same frequency band of this Product, there is a possibility that interference may occur between this Product and such other devices. If such interference occurs, please stop the operation of other devices or relocate this Product before using this Product or do not use this Product around the other wireless devices.
- j. Please thoroughly evaluate our module with your products before going mass production.
- k. User Code Modification Notice.
User Code for sample modules or part numbers in this Specification are TAIYO YUDEN standard part numbers. When any modification is made to a module to meet requested specifications, the part number will be changed. Please contact TAIYO YUDEN to confirm whether your part number needs to be modified.
Please see the following examples for cases when part numbers are modified:
 - for specific firmware version (our standard item firmware will be upgraded occasionally)
 - for other relevant cases (specific or different setting, form, sizes, or display etc..)

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Control No. HD-AG-A181108	(3/5)	Control name General Items
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- l. Alternative components may used to this module. The intended components is used within the warranty written in this document (characteristics, size, operating condition, reliability, public regulation such as radio type approval) and Taiyo Yuden confirmed there are not any problems with the replacement. The traceability of the components is secured each production lot.
- m. Caution for Export Control
This Product may be subject to governmental approvals, consents, licenses, authorizations, declarations, filings, and registrations for export or re-export of the Product, required by Japanese Foreign Exchange and Foreign Trade Law (including related laws and regulations) and/or any other country's applicable laws or regulations related to export control.
If you plan to export or re-export this Product, it is strongly recommended that you check and confirm, the necessary procedures to export or re-export of this Product as required by applicable laws and regulations, and if necessary, you have to obtain necessary and appropriate approvals or licenses from governmental authority at your own risk and expense.
- n. Japan Regulatory Information
This module is approved with the specific antenna on this module.
a) Please ensure that your product can bear a label with the following information. If the product is so small that it is not practicable to place the label, please place it in the instruction manual and package.
This product installs a radio system which has been approved as a radio station in a low power data communication system based on the Radio Law.
EYSGCN : 001-A06158
- o. Canada Regulatory Information
a) This device complies with Industry Canada license-exempt RSS standards. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
L'utilisation de ce dispositif est autorisée seulement aux conditions suivantes: (1) il ne doit pas produire de brouillage et (2) l'utilisateur du dispositif doit être prêt à accepter tout brouillage radioélectrique reçu, même si ce brouillage est susceptible de compromettre le fonctionnement du dispositif.
b) This product is certified as type of the portable device with Industry Canada Rules. To maintain compliance with RF Exposure requirement, please use within specification of this product.
Ce produit est certifié comme type de l'appareil portable avec Industrie Règles de Canada. Pour maintenir l'acquiescement avec exigence Exposition de RF, veuillez utiliser dans spécification de ce produit.
- IC: 4389B-EYSGCN
c) Please notify certified ID by either one of the following method on your product.
Spécifiez ID certifiée dans votre produit par une de méthode suivante.
-Contains Transmitter module IC : 4389B-EYSGCN
-Contains IC : 4389B-EYSGCN

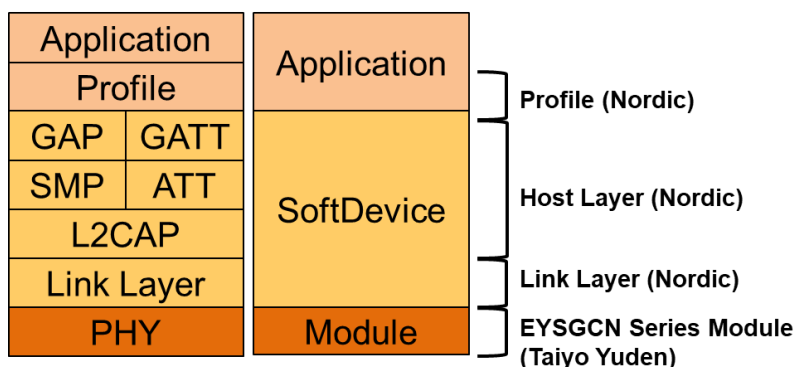
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EYSGCNAWY-VX

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Control No. HD-AG-A181108	(4/5)	Control name General Items
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- p. FCC Regulatory Information
 - a) 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.
 - b) Please notify certified ID by either one of the following method on your product.
 - Contains Transmitter Module FCC ID: RYYEYSGCN
 - Contains FCC ID: RYYEYSGCN
 - c) CAUTION: changes or modifications not expressly approved by the party responsible for compliance could void the use's authority to operate the equipment.
 - d) This product is certified as type of the portable device with FCC Rules. To maintain compliance with RF Exposure requirement, please use within specification of this product.
 - e) The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- q. CE Regulatory Information
 - a) When your end product installs this module, it is required to proceed additional certification processes before placing on the market in EU member states to make your products fully comply with relative EU standards.
 - b) TAIYO YUDEN can provide you the test reports of conducted measurement portion for the radio module. You can utilize the test reports for the certification processes of your end product as it requires radio testing.
- r. This Product is designed for use in products which comply with *Bluetooth*[®] Specifications (Ver 4.2 LE) ("Bluetooth Specifications"). TAIYO YUDEN disclaims and is not responsible for any liability concerning infringement by this Product under any intellectual property right owned by third party in case the customer uses this Product in any product which does not comply with Bluetooth Specifications (the "non-complying products"). Furthermore, TAIYO YUDEN warrants only that this Product complies with this Specification and does not grant any other warranty including warranty for application of the non-complying products.
- s. EYSGCNAWY-VX is the embedded software module including Softdevice and Profile (BAS). This module is qualified as PHY only with Component category by Bluetooth SIG. The QDID of this module is 72109. Softdevice and Profile (BAS) has each QDID, 80952 and 45222, respectively. The final product needs to get qualification as End product before selling the product. Please refer to following combination and consult with your qualification body and BQC.



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EYSGCNAWY-VX

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Control No. HD-AG-A181108	(5/5)	Control name General Items
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The use of Embedded Software
Before using this product.

Please kindly read carefully and understand the following before using the Products.

1. Taiyo Yuden Co., Ltd. (hereinafter "TY"), lawfully has copyrights and other rights to the software embedded to the memory of the Products (the "Embedded Software"). Except as otherwise expressly provided herein, your company is not permitted to disclose or offer the Embedded Software, either wholly or partly, to any third party (including uploading to your company or third party (ies)'s web sites and downloading by third parties from such sites), nor to copy, revise, reverse engineer, upgrade, make specification change, or alienate the Embedded Software.
2. Before using the Products, you need to check and confirm sufficient safety and operation of your products which incorporate the Products and interoperability and compatibility with other Bluetooth® enabled products.
3. TY have not evaluated and confirmed the interoperability, compatibility, etc. of the Products (including Embedded Software) with every kind of Bluetooth® enabled product. In addition, TY does not guarantee interoperability and compatibility of the Product with certain devices. In order to minimize the damage or harm arising out of the Potential Failure or out of combination with other devices, TY recommend your company set up interface or external pin (for detail, please refer to Specification " Pin Layout " of this document) for rewriting the Embedded Software.

EYSGCNAWY-VX

TAIYO YUDEN CO., LTD.

Control No. HD-AM-A181108	(1/1)	Control name Absolute maximum ratings
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Absolute maximum ratings

Symbol	Parameter	Min.	Max.	Units
VCC_NRF		-0.3	+3.6	V
GND			0	V
VIO		-0.3	VCC_NRF+ 0.3	V
Storage temperature		-40	+85	Deg-C
MSL	Moisture Sensitivity Level	3		
ESD HBM	Human Body Model		1	kV
ESD MM	Machine Model		100	V
Endurance	Flash Memory Endurance	20000		write/erase cycles
Retention	Flash Memory Retention	10 years		At 40 deg-C
Number of times an address can be written between erase cycles			2	times

EYSGCNAWY-VX

TAIYO YUDEN CO., LTD.

Control No. HD-AE-A181108	(1/2)	Control name Electrical characteristics
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Electrical characteristics**Recommendation operating range**

Symbol	Parameter	Min.	Typ.	Max.	Units
VCC_NRF	Supply voltage, normal mode	1.8	3.0	3.6	V
tR_VCC_NRF	Supply rise time (0V to 1.8V)*1			100	ms
TA	Operation temperature	-25	25	85	Deg-C

*1 The on-chip power-on reset circuitry may not function properly for rise times outside the specified interval. Also after power off, it must start up from below 0.3V. The on-chip power-on reset circuitry may not function properly.

DC Specifications

The Specification applies for Topr.= 25 degrees C, VCC_NRF = 3.0V

Symbol	Parameter (condition)	Min.	Typ.	Max.	Units
VIH	Input high voltage	0.7 VCC_NRF		VCC_NRF	V
VIL	Input low voltage	GND		0.3 VCC_NRF	V
VOH	Output high voltage (std. drive, 0.5 mA)	VCC_NRF-0.3		VCC_NRF	V
VOH	Output high voltage (high-drive, 5 mA)	VCC_NRF-0.3		VCC_NRF	V
VOL	Output low voltage (std. drive, 0.5 mA)	GND		0.3	V
VOL	Output low voltage (high-drive, 5 mA)	GND		0.3	V
RPU	Pull-up resistance	11	13	16	kohm
RPD	Pull-down resistance	11	13	16	kohm
ITX,+4dBm	TX only run current @ POUT =+4 dBm		16		mA
IRX	RX only run current		13		mA
IOFF	Current in SYSTEM-OFF, no RAM retention		0.6		uA
RSTR	RESET High to Module Ready		300	600	ms
RPW	RESET Pulse Width		5		ms

UART specifications

Symbol	Description	Min.	Typ.	Max.	Units
f _{UART}	Baud rate for UART	9600		921600	bps

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EYSGCNAWY-VX

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Control No. HD-AE-A181108	(2/2)	Control name Electrical characteristics
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RF Specifications

Symbol	Description	Min.	Typ.	Max.	Units
Fop	Operating frequencies	2402		2480	MHz
Df	Frequency deviation	+/-225	+/-250	+/-275	kHz
PRF	Maximum output power		4		dBm
PRFCR	RF power accuracy			+/-4	dB
PBW	20 dB bandwidth for modulated carrier		950	1100	kHz
PRF1	1st Adjacent Channel Transmit Power 1 MHz			-20	dBc
PRF2	2nd Adjacent Channel Transmit Power 2 MHz			-45	dBc
PRXMAX	Maximum received signal strength at < 0.1% PER		0		dBm
PSENS IT	Receiver sensitivity (0.1% BER) Ideal transmitter		-93		dBm
PSENS DT	Receiver sensitivity (0.1% BER) dirty transmitter		-91		dBm

Many documents of nRF51822, such as product specification and the anomaly notification, can be found at the link below. Please be sure to check these latest documents when using our module.

Product Specification

https://infocenter.nordicsemi.com/topic/struct_nrf51/struct/nrf51822_ps.html?cp=4_4_0

Product Anomaly Notification

https://infocenter.nordicsemi.com/topic/struct_nrf51/struct/nrf51822_pan.html?cp=4_4_1

SoftDevice

https://infocenter.nordicsemi.com/topic/struct_nrf51/struct/s130.html?cp=4_7_2

For more information

<https://infocenter.nordicsemi.com/index.jsp>

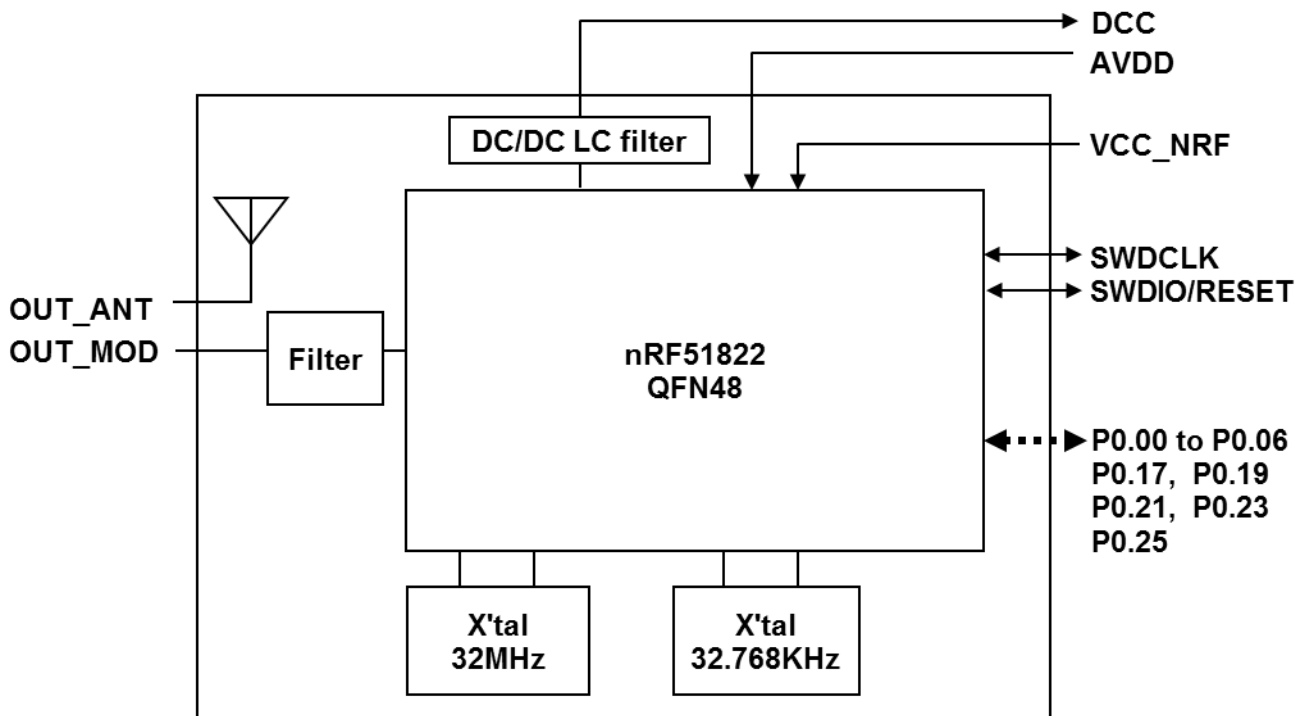
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EYSGCNAWY-VX

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Control No. HD-MC-A181108	(1/3)	Control name Circuit Schematic
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Block Diagram



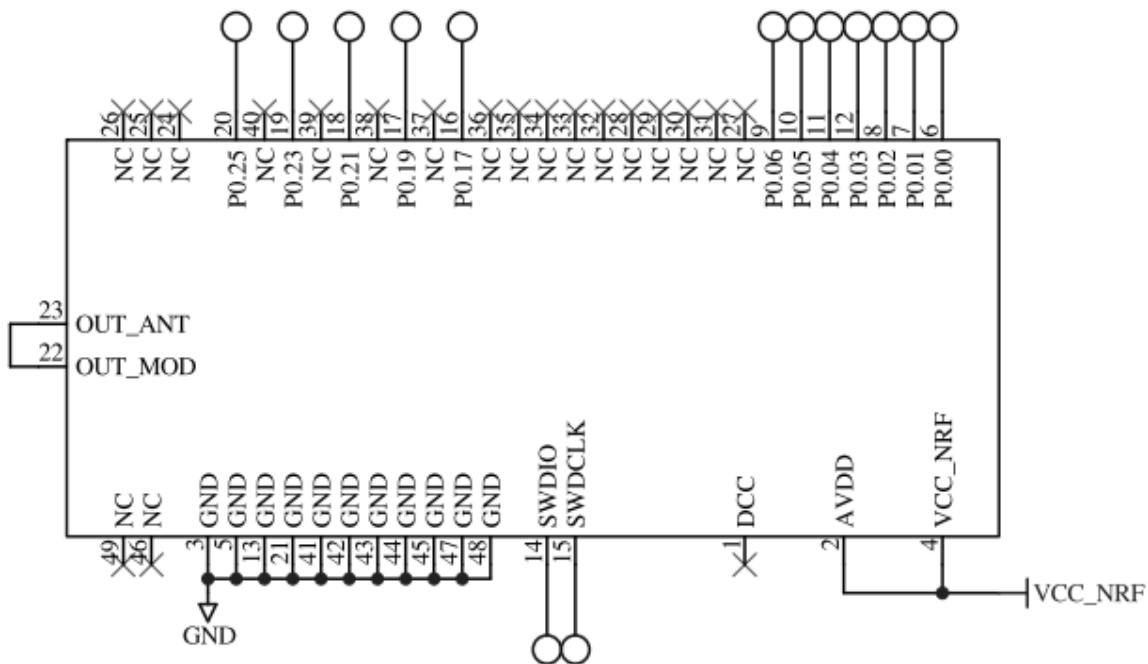
EYSGCNAWY-VX

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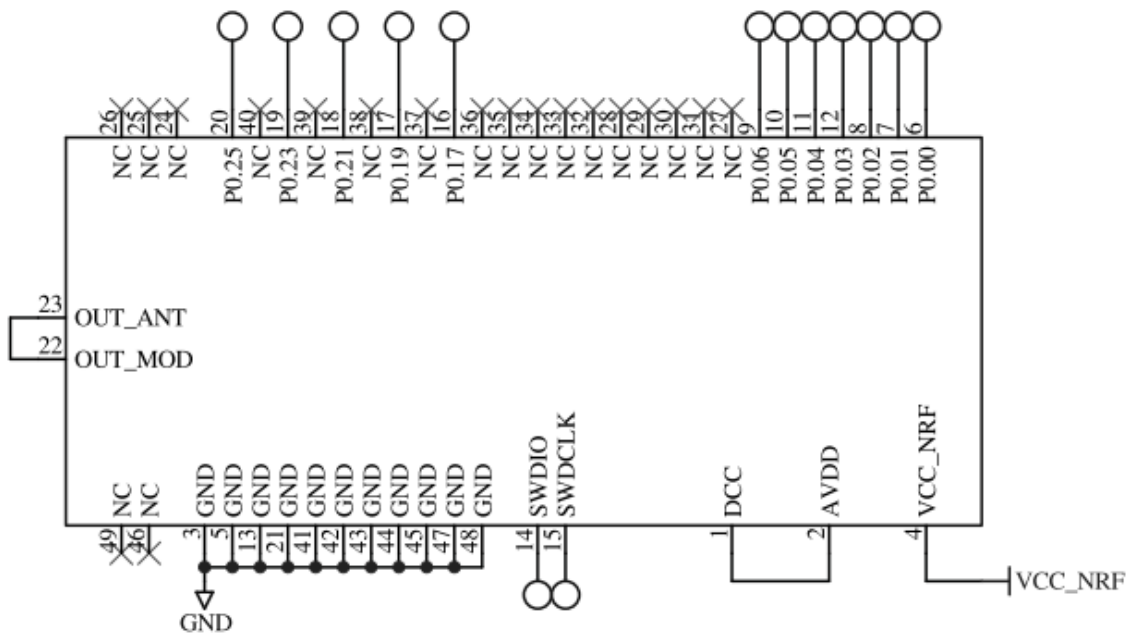
Control No. HD-MC-A181108	(2/3)	Control name Circuit Schematic
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Sample circuits

Internal LDO setup



DC/DC converter setup

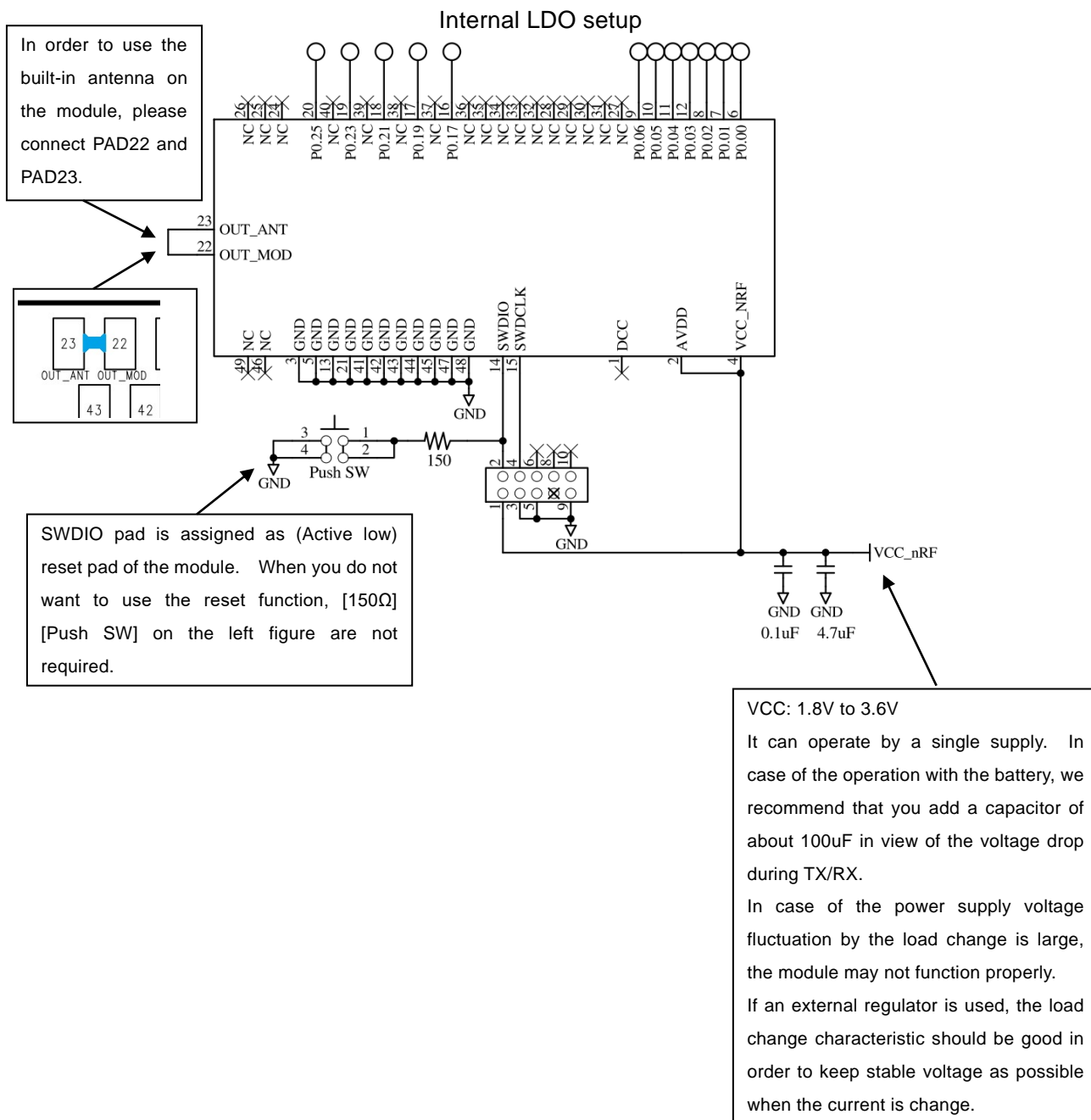


EYSGCNAWY-VX

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Control No. HD-MC-A181108	(3/3)	Control name Circuit Schematic
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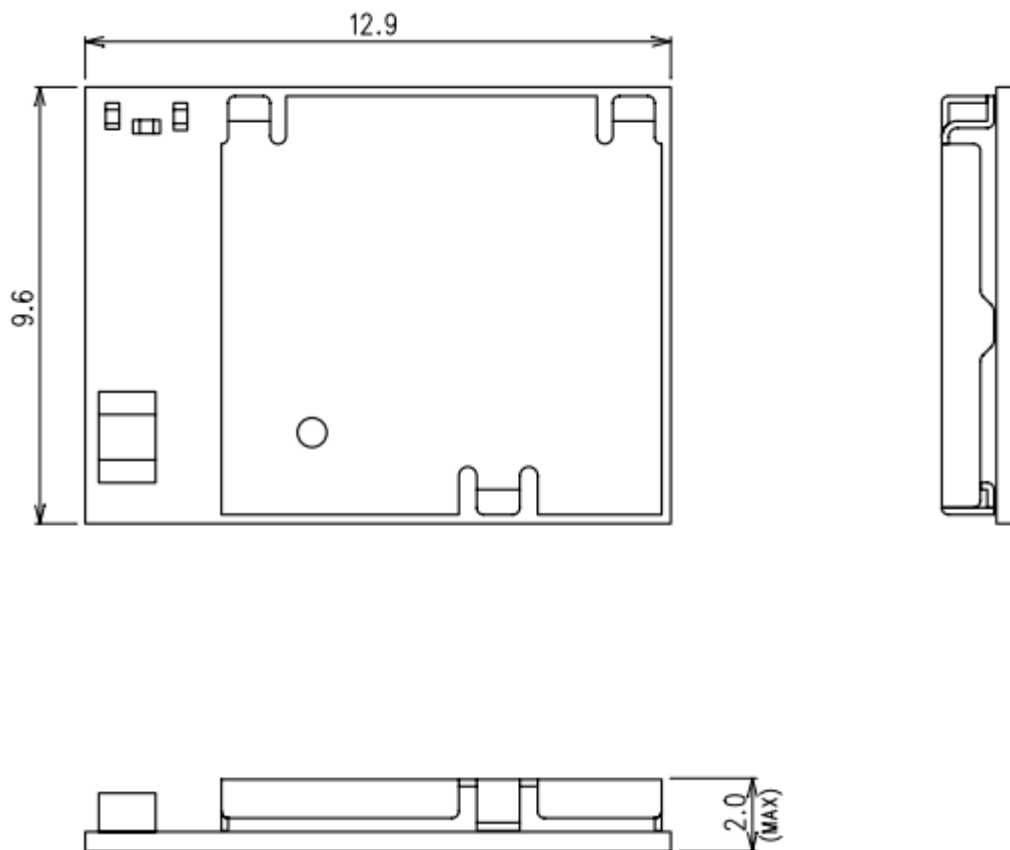
Reference Circuits



EYSGCNAWY-VX

TAIYO YUDEN CO., LTD.

Control No. HD-AD-A181108 (1/3)	Control name Outline/Appearance
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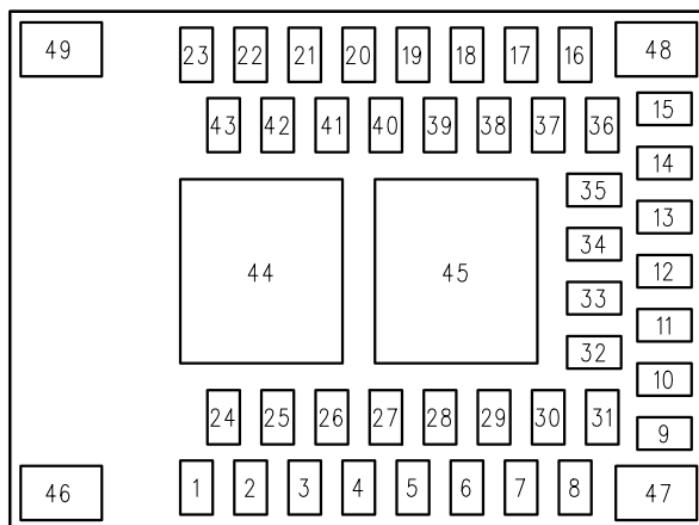
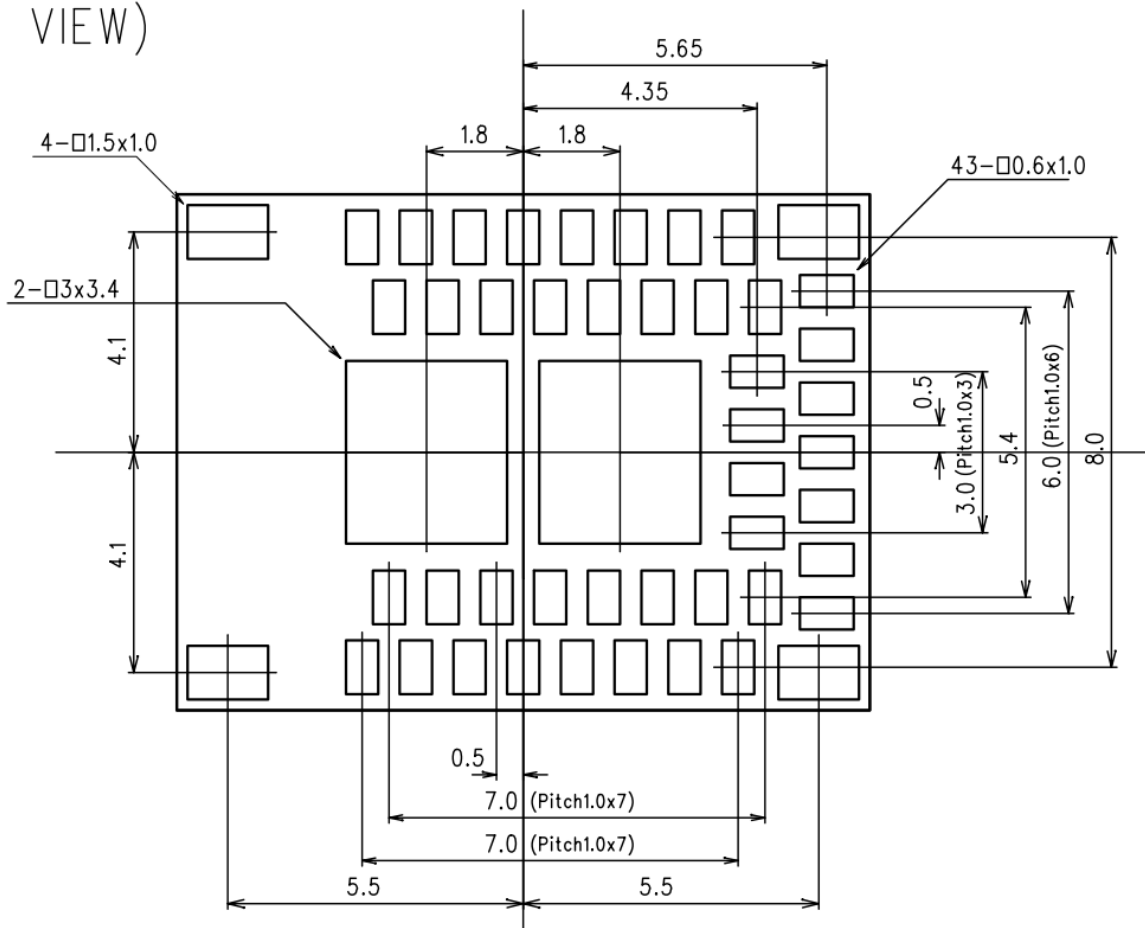
Tolerance: +/- 0.2mm
 Unit : (mm)

EYSGCNAWY-VX

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Control No. HD-AD-A181108	(2/3)	Control name Outline/Appearance
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(TOP VIEW)



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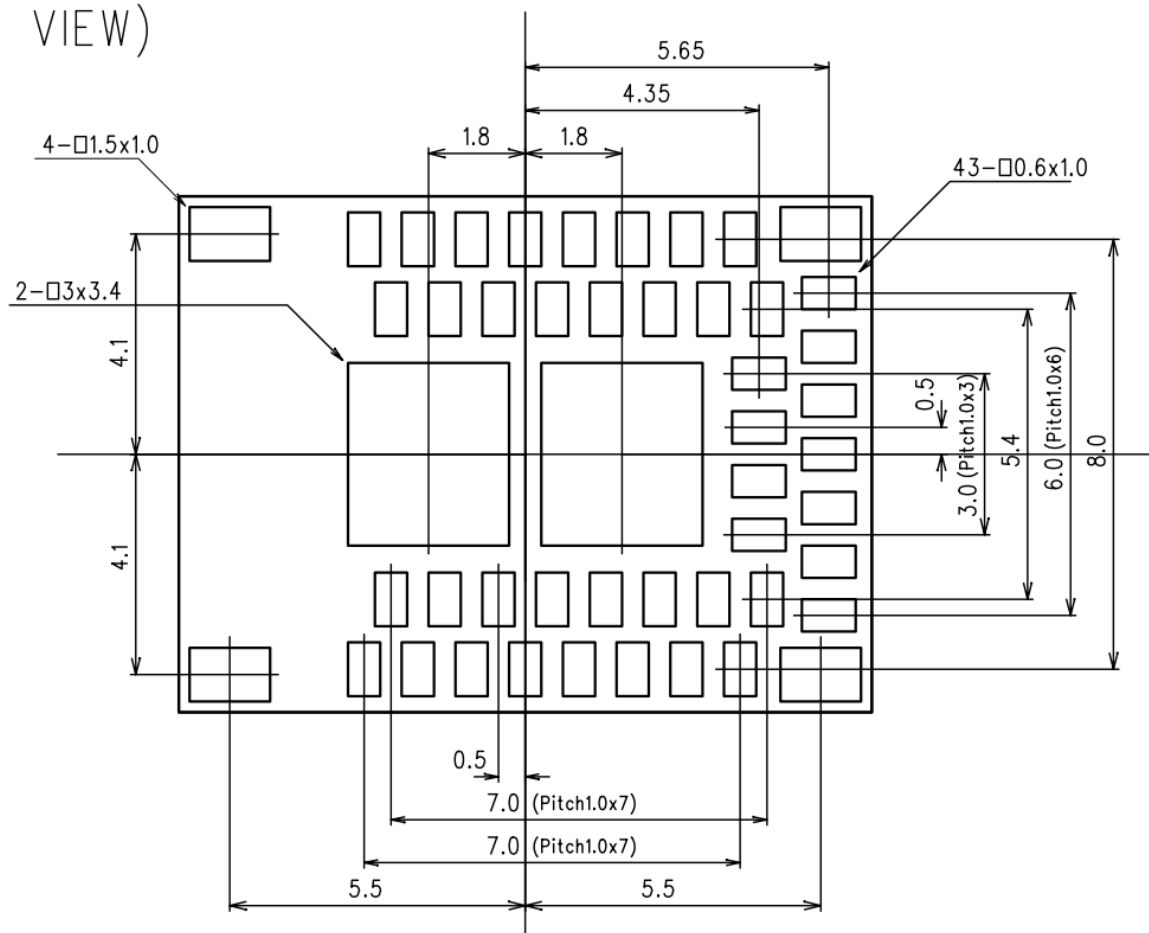
EYSGCNAWY-VX

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Control No. HD-AD-A181108	(3/3)	Control name Outline/Appearance
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LAND PATTERN EXAMPLE

(TOP VIEW)



Recommended metal mask for solder printing

Pad size	Mask opening
Signal pad 43 – 0.6 x 1.0 mm	0.5 x 0.9 mm
Corner pad 4 – 1.5 x 1.0 mm	1.0 x 0.7 mm
Center pad 2 – 3.0 x 3.4 mm	2.6 x 3.0 mm

The center of each mask opening is same as the pad center.

The metal mask thickness: t=0.1mm

The solder volume should be same by changing the mask opening if different metal mask thickness is used.

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EYSGCNAWY-VX

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Control No. HD-BA-A181108	(1/1)	Control name Pin Layout
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Pin Descriptions

Pin	Pin name	Pin function	Description
1	DCC	Power	Reserved
2	AVDD	Power	Analog Power supply
3	GND	Ground	Ground (0 V)
4	VCC_NRF	Power	Power supply
5	GND	Ground	Ground (0 V)
6	P0.00	Digital Output	UART_RTS
7	P0.01	Digital Output	UART_TX
8	P0.02	Digital Input	UART_CTS
9	P0.06	Digital Input	Disconnect request / Resume from Power saving mode
10	P0.05	Digital Output	Module active / sleep indicate
11	P0.04	Digital Input	Forced initialize / Request Sleep mode
12	P0.03	Digital Input	UART_RX
13	GND	Ground	Ground (0 V)
14	SWDIO	Digital I/O	System reset (active low). Also HW debug and flash programming I/O
15	SWDCLK	Digital input	HW debug and flash programming I/O
16	P0.17	Digital Input	Request DFU mode
17	P0.19	Digital Output	State indication of module / DFU indication
18	P0.21	Digital Input	Sleep indication of host / Resume from Power saving mode
19	P0.23	Digital Output	Mode indication of module
20	P0.25	Digital Output	Wake up request
21	GND	Ground	Ground (0 V)
22	OUT_MOD	RF In/Out	RF I/O pin. It should be connected to Pin 23 OUT_ANT for normal operation.
23	OUT_ANT	Antenna In/Out	Internal antenna. It should be connected to Pin 22 OUT_MOD for normal operation.
24 to 40	NC	Not Connected	Reserved for future use
41 to 45	GND	Ground	Ground (0 V)
46	NC	Not Connected	Isolated pad on PCB for mechanical stability
47 to 48	GND	Ground	Ground (0 V)
49	NC	Not Connected	Isolated pad on PCB for mechanical stability

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EYSGCNAWY-VX

TAIYO YUDEN CO., LTD.

Control No. HQ-BA-537	(1/2)	Control name Handling Precaution
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This specification describes desire and conditions especially for mounting.

Desire/Conditions

(1) Environment conditions for use and storage

1. Store the components in an environment of < **40deg-C/90%RH** if they are in a moisture barrier bag packed by TAIYO YUDEN.
2. Keep the factory ambient conditions at < **30deg-C/60%RH**.
3. Store the components in an environment of < **25±5deg-C/10%RH** after the bag is opened.
(The condition is also applied to a stay in the manufacture process).

(2) Conditions for handling of products

Make sure all of the moisture barrier bags have no holes, cracks or damages at receiving. If an abnormality is found on the bag, its moisture level must be checked in accordance with 2 in (2).

Refer to the label on the bag.

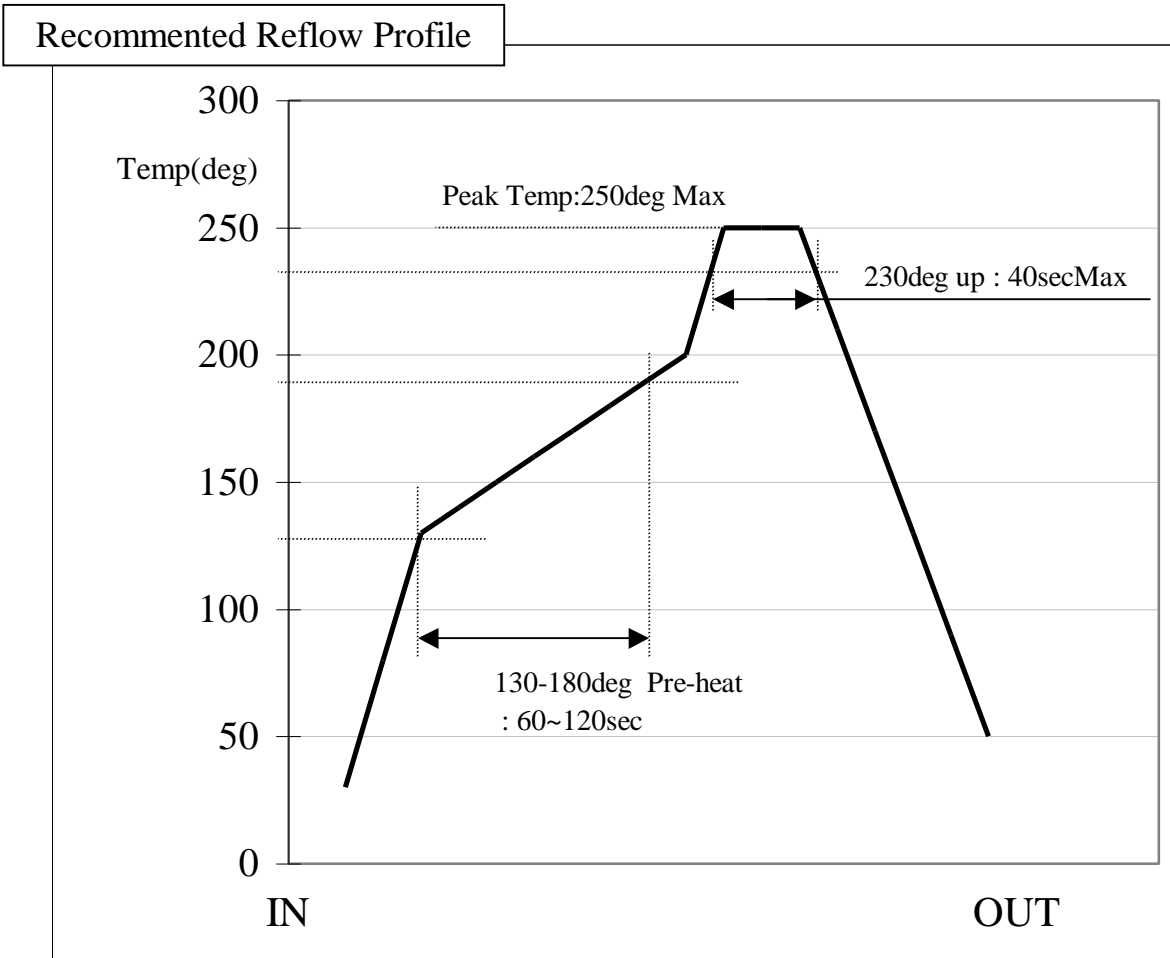
1. All of the surface mounting process (reflow process) must be completed **in 12 months** from the bag sea date.
2. Make sure humidity in the bag is less than **10%RH** immediately after open, using a humidity indicator card sealed with the components.
3. **All** of the surface mounting process (reflow process including rework process) must be completed in **168 hours** after the bag is opened (inclusive of any other processes).
4. If any conditions in (1) or condition 2 and 3 in (2) are not met, bake the components in accordance with the conditions at **125deg-C 24hours**
5. As a rule, baking the components in accordance with conditions 4 in (2) shall be once.
6. Since semi-conductors are inside of the components, they must be free from static electricity while handled.(<100V) Use ESD protective floor mats, wrist straps, ESD protective footwear, air ionizers etc. , if necessary.
7. Please make sure that there are lessen mechanical vibration and shock for this module, and do not drop it.
8. Please recognize pads of back side at surface mount.
9. Washing the module is not recommended. If washing cannot be avoided, please test module functionality and performance after thoroughly drying the module.
We cannot be held responsible for any failure due washing the module.
10. Please perform temperature conditions of module at reflow within the limits of the following.
Please give the number of times of reflow as a maximum of 2 times.

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EYSGCNAWY-VX

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Control No. HQ-BA-537	(2/2)	Control name Handling Precaution
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EYSGCNAWY-VX

TAIYO YUDEN CO., LTD.

Control No. HD-BB-A181108	(1/3)	Control name Packaging Specification
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Packaging Specification

梱包仕様

(1) Packaging Material 梱包材料

Name 部材名	Outline 概要	Materials 材質	Note 備考
Emboss エンボス	24mm wide - 12mmPitch 24mm幅 - 12mmピッチ	Conductive PS 導電性 PS	
Cover Tape カバーテープ			
Reel リール	φ 330 mm	Conductive PS 導電性 PS	
Desiccant 乾燥剤	30g×1		
Humidity indicator card 湿度インジケータ			
Aluminum moisture barrier bag アルミ防湿袋	420×460(mm)	(AS)PET/AL/NY/PE(AS)	
Label ラベル			
Corrugated cardboard box(Inner) 個装箱	339×351×74(mm)		
Corrugated cardboard box(Outer) 外装箱	369×369×277(mm)		

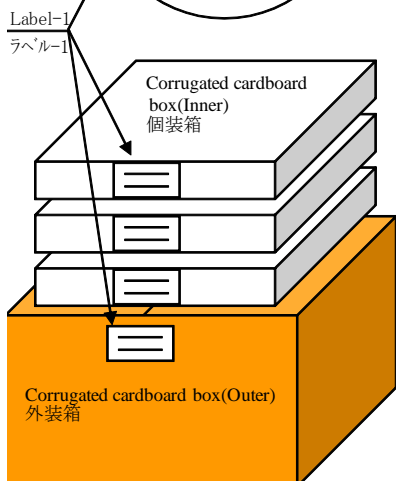
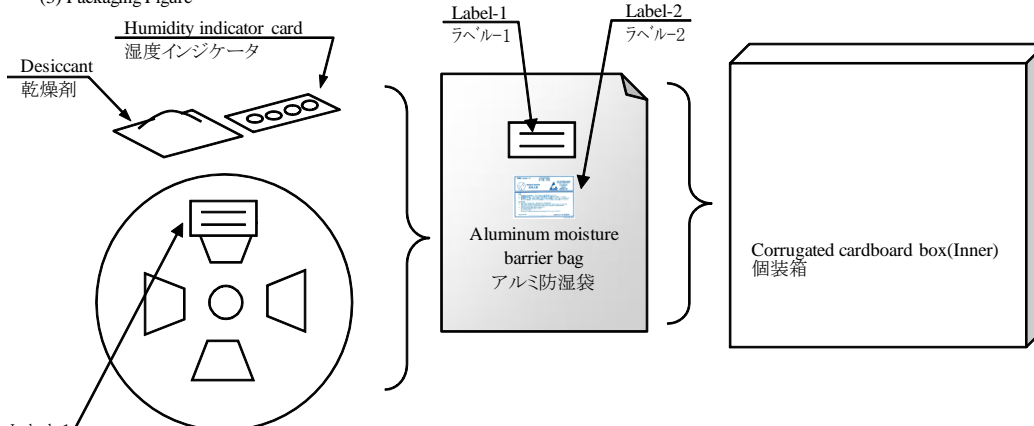
(2) Packaging Unit

梱包数量

Max 1000 pieces/Reel

Max 3000 pieces/Box(Outer)

(3) Packaging Figure



(4) Label

ラベル

Label-1

- COMPANY NAME 御社名
- PURCHASE ORDER 注文番号
- DESCRIPITON 品名
- QUANTITY 数量
- LotNo. ロット番号

Label-2

- CAUTION LABEL
注意ラベル
- MSL Level3

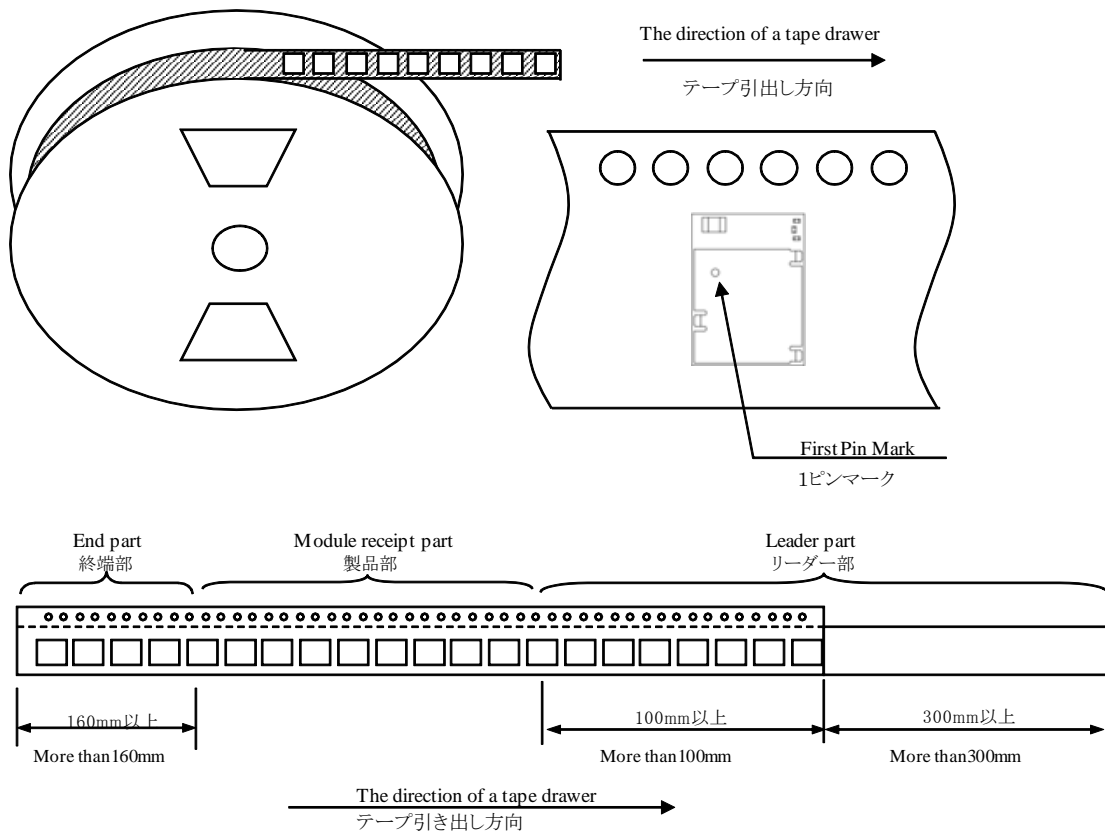
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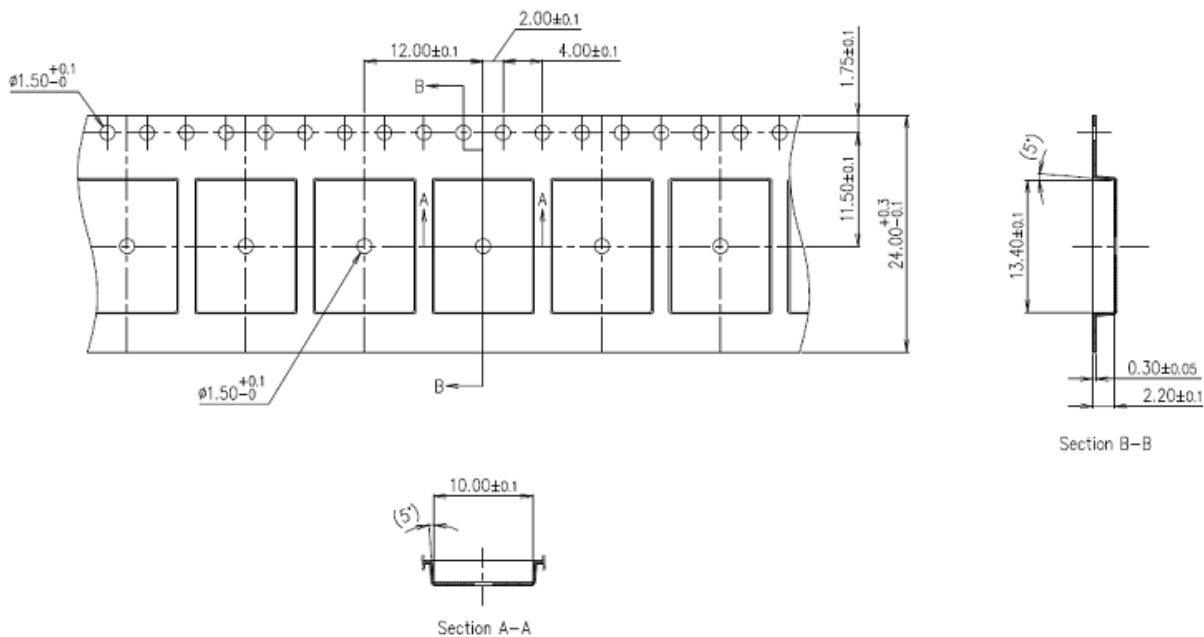
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Control No. HD-BB-A181108	(2/3)	Control name Packaging Specification
------------------------------	-------	---

Tape specification
テーピング仕様



キャリアエンボス図面



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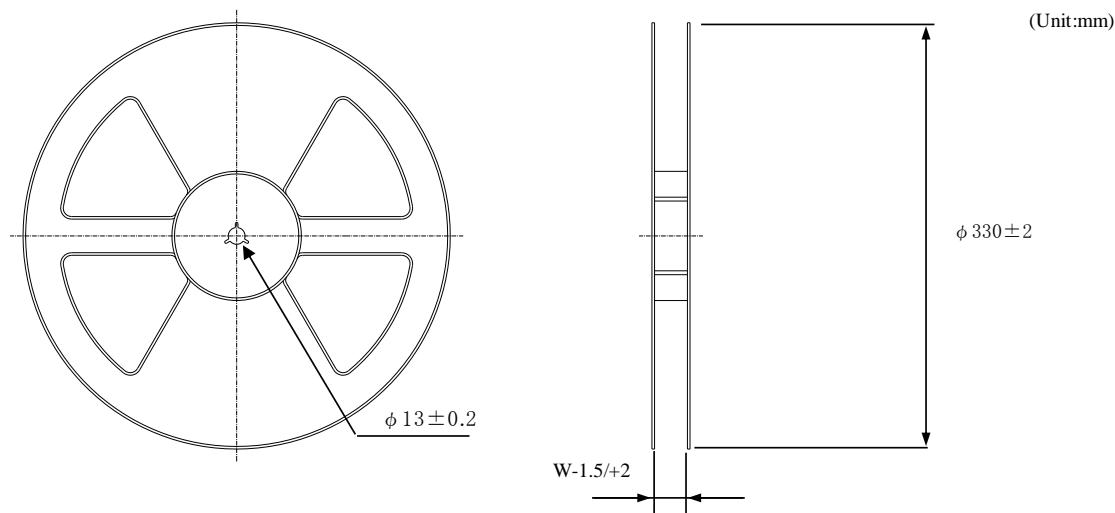
Control No.
HD-BB-A181108

(3/3)

Control name
Packaging Specification

Reel specification

リール仕様



Tape wide	8mm	12mm	16mm	24mm	32mm	44mm
W	9.4mm	13.4mm	17.4mm	25.4mm	33.4mm	45.4mm

Taping performance

テーピング性能

Both of an embossing tape top cover tape bear this, when the power of 10N is applied in the direction of a drawer.

- エンボステープ、トップカバーテープともに、引き出し方向に10Nの力を加えた場合に、これに耐えること。

The exfoliation adhesion of a top cover tape is the intensity of 0.1~1.3N.

(The angle to pull is 165~180 degrees. The speed to pull is 300 mm/min.)

- トップカバーテープの剥離強度は、角度165~180度に保ち、300mm/minのスピードでトップカバーテープを引っ張ったとき、0.1~1.3Nとする。

Note

備考

Lack of the parts in 1 reel is with two or less pieces.

1リール中の部品の欠落は2個までとします。(ラベル表示数量と梱包数は同じです。欠落とはテープ内でのモジュール抜けが2個まで許容させていただくという意味になります。)

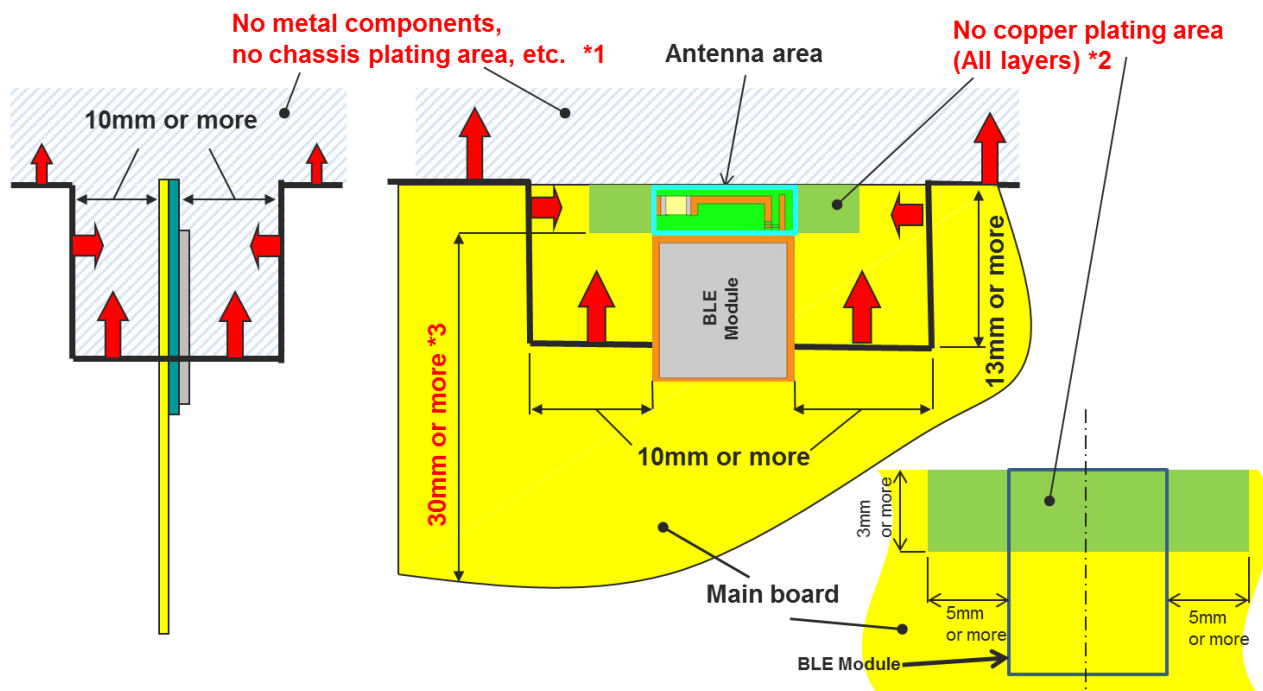
MSL Level 3 Under control

MSLはレベル3で管理しています。

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Control No. (1/3)	Control name Antenna application note
----------------------	--

Recommended module mounting example



*1 Please do not place any metal components in blue shaded space,(*1) such as signal line and metal chassis as possible except for main board while mounting the components in *1 space on the main board is allowed except for no copper plating area. (*2).

*2 This area is routing prohibited area on the main board. Please do not place copper on any layer. Please remain use of FR-4 dielectric material. The antenna is tuned with the FR-4.

*3 Characteristics may deteriorate when GND pattern length is less than 30mm. It should be 30 mm or more as possible.

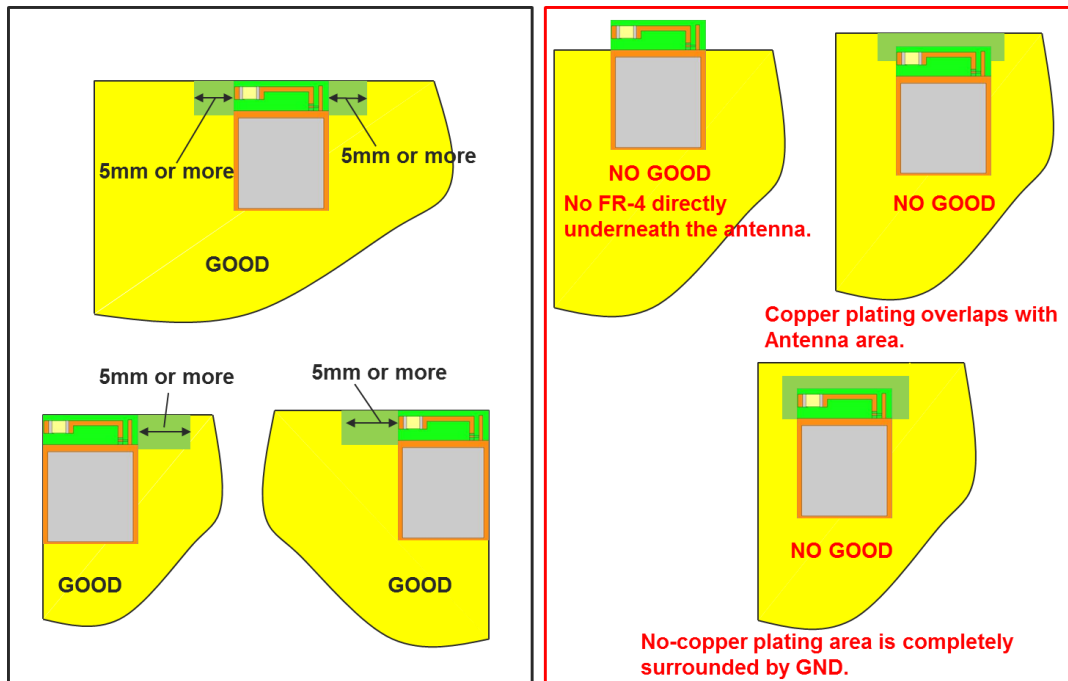
Even when above mentioned condition is satisfied, communication performance may be significantly deteriorated depending on the structure of the product.

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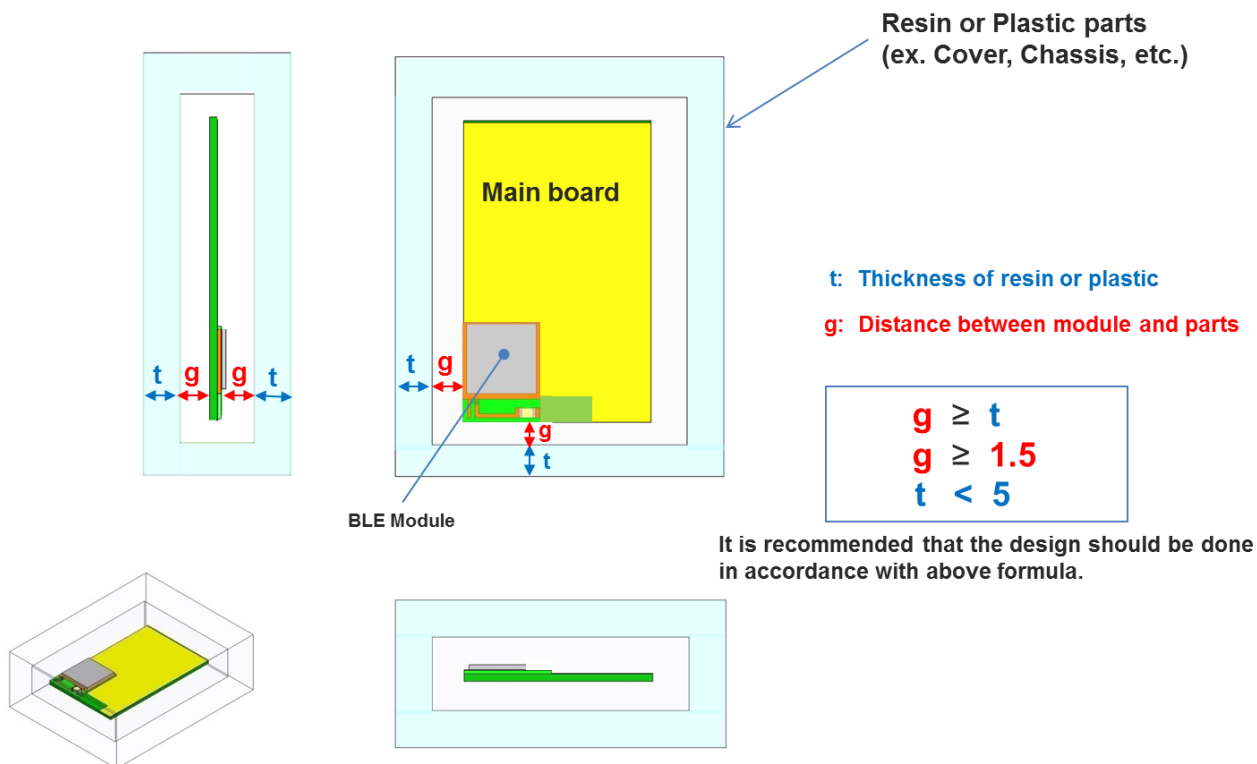
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Control No.	Control name
(2/3)	Antenna application note

Other module mounting examples



Placement of resin or plastic parts

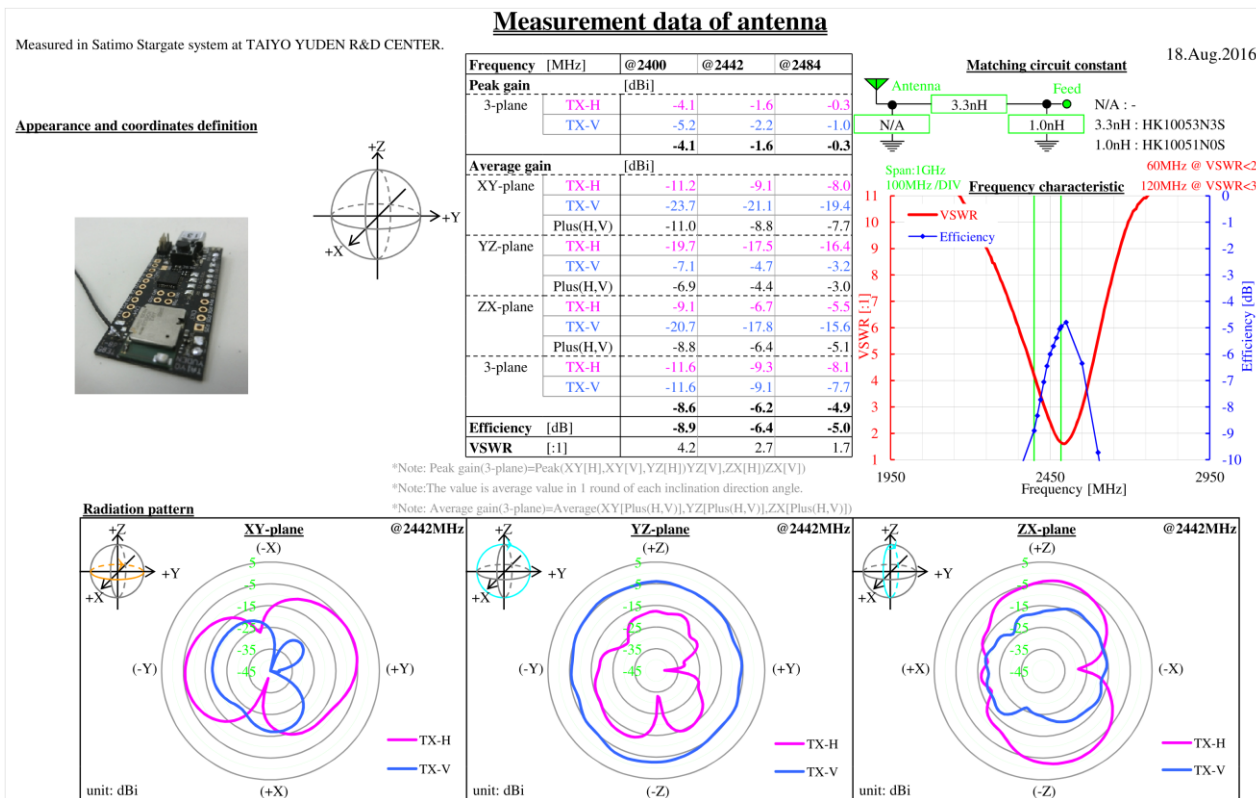


Please do not apply molding over the antenna area of BLE module.

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Control No. (3/3)	Control name Antenna application note
--------------------------	--

Directional characteristics example (when mounted on evaluation board)



About this Application Note

- This Application Note has been prepared as a reference material to help obtaining the antenna performance mounted on BLE module better while it is not guaranteed or assured to obtain better communication performance and distance.
- This product “BLE module” has been certified and matching circuit constant for antenna within module cannot be changed when ambient environment condition changes. The product must be re-certified when matching circuit constant is changed.

Control No. (1/1)	Control name Design guide
--------------------------	------------------------------

1. Power Up Sequence

VCC_NRF power supply rise time (0V to 1.8V) must not exceed 100ms.

2. Recommended Power Circuit

VCC_NRF is the main power supply (1.8 – 3.6V) for this module. The supply voltage range of VCC_NRF is 1.8V to 3.6V in LDO mode and 2.1V to 3.6V in DCDC mode. For more information of internal DC/DC converter operation, please refer to chapter 12.1.3 of "nRF51_Series_Reference_Manual v3.0" by Nordic Semiconductor. In case of the power supply voltage fluctuation by the load change is large, the module may not function properly. If an external regulator is used, the load change characteristic should be good in order to keep stable voltage as possible when the current is change.

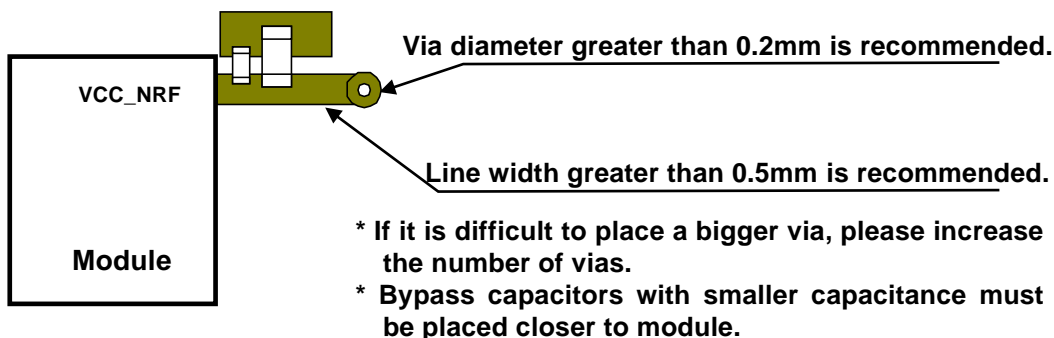
3. Battery operation

When using a small battery (e.g. CR2032), a large capacitor (e.g.100uF low leakage capacitor) should be placed near the battery. This will reduce the voltage drop especially when the module is operated at low temperatures

4. Pattern Design Guide

4-1. Power Supply System

Power supply bypass capacitors should be placed close to the VCC_NRF pin of the module. The VCC_NRF trace should be greater than 0.5mm and a bigger a via diameter is recommended.

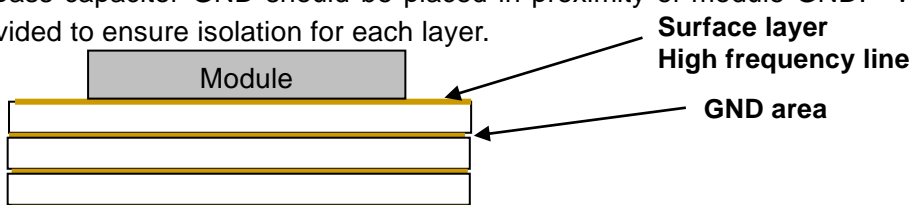


4-2. Bypass Capacitor Layout

A parallel combination of a small capacitance (about 10pF) and a large capacitance (1uF to 10uF) is recommended for bypass capacitors. The GND of the bypass capacitor should be placed close to an adjacent module GND to ensure the shortest closed loop.

4-3. GND Pattern

Power supply bypass capacitor GND should be placed in proximity of module GND. Wide GND area must be provided to ensure isolation for each layer.



GND pattern of each layer should be connected to GND area with large number of via.

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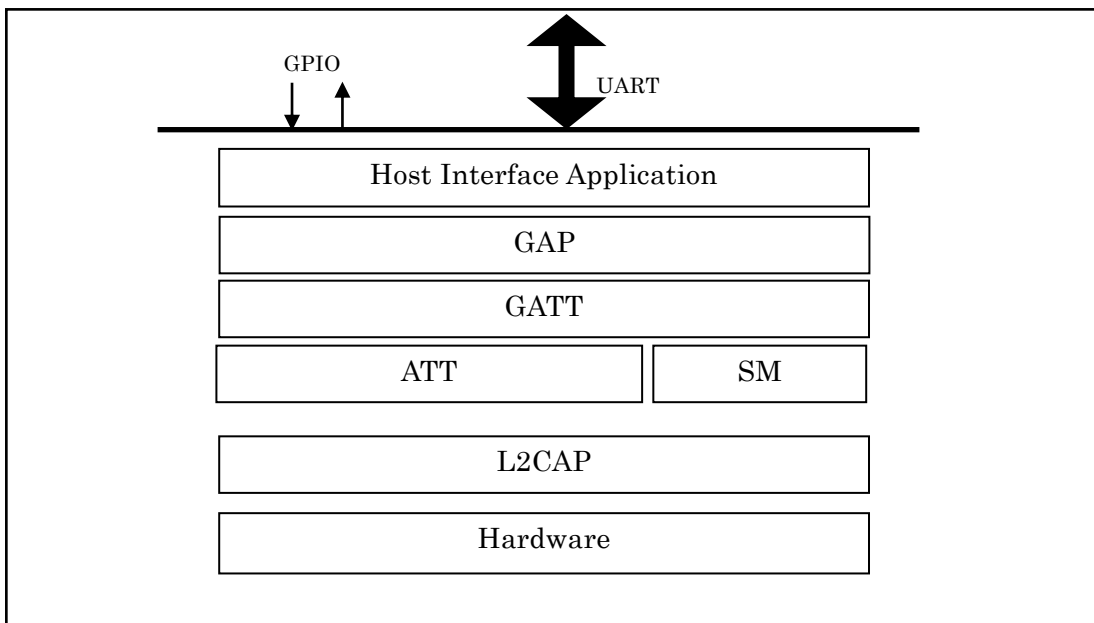
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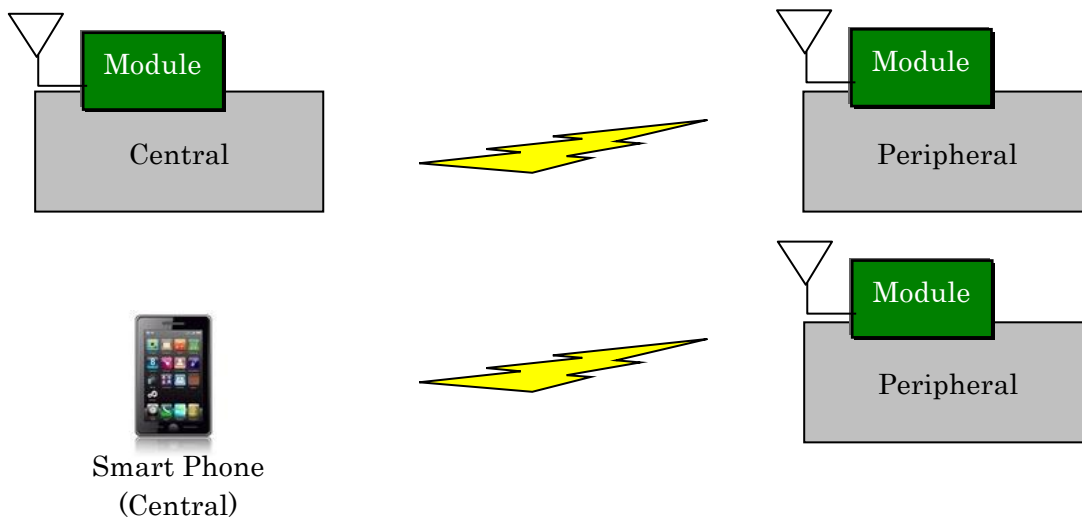
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Overview

This specification is for module based on TAIYO YUDEN original service. This specification will only define supporting point-to-point connections.



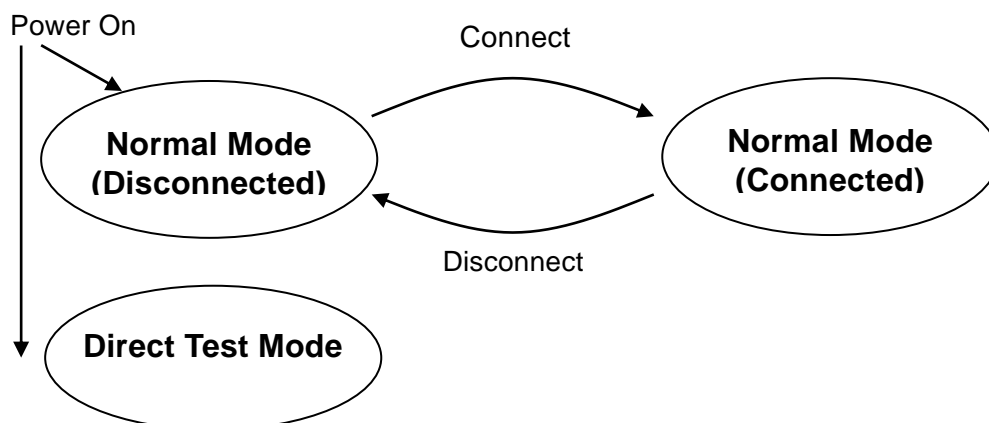
Software Block Diagram



Usage Model

* Only one-to-one connection is supported.

1. Basic software state diagram



- **Normal Mode (Disconnected) :**
Module can only accept control commands in this mode.
- **Normal Mode (Connected) :**
Module can accept control commands and data transmission command in this mode. When disconnected, it will return to Normal Mode (Disconnected).
- **Direct Test mode :**
RF PHY testing of *Bluetooth*® low energy devices.

2. Command Syntax

3.1 Control Command

Control commands which the host sends are based on character strings that start with "B"(ASCII code: 0x42, 66 decimal), and that end with <CR><LF> (ASCII code: 0x0D 0x0A) (decimal values 13, 10).

Response event which host receives are started with <CR><LF> and ended <CR><LF>. Please note that this specification / application does not allow for multiple commands to be sent to the host. The application is not responsible for parsing of packets / command sequences.

Command Mode – Control Command:

"B"{command characters}[Parameter1Parameter2:: Parameter(N)]<CR><LF>

Response Event:

<CR><LF>{event characters}[Parameter1Parameter2::Parameter(N)]<CR><LF>

3.2 Data Transmission and Reception Command

3.2.1. Transmission Command

B	SEND	,	Index	Method	Length	Data
	CMD				PARAM	

"BSEND," : 6byte - ascii

Index : 1byte - binary

0 : In Peripheral role

1 : In Central role

Method : 1byte - binary

0 : Notification, Write Command

1 : Indication, Write Request

2 : Battery Service (Peripheral only, Send first byte of data as battery level)

Length : 1byte - binary

1 - 20 (0x01 - 0x14)

Data : 1-20byte (specified at Length param) - binary

3.2.2. Transmission Response

B	SEND	,	Response code	¥r	¥n
	RES		PARAM	CR	LF

Response code : ascii

"ACK" : Successful

"NAKx" : Failed

x=01 Bad parameter

x=02 Disconnected

x=03 Service disabled

x=04 In sending

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- x=05 Send data error
- x=06 Same data (Battery Service only)

- Data transmission command shall be sent after previous command response.
- In Method = 0 and 1, Characteristic value is updated even when data is failed to be sent in error NAK02-NAK05.
- In Method = 2, Characteristic value is updated even when data is failed to be sent in error NAK05.

3.2.3. Reception Event

B	RECV	,	RSSI	Index	Method	Length	Data
	CMD				PARAM		

“BRCV,” : 6byte – ascii

RSSI : 1byte – binary

-128 - 127 (0x80 – 0x7F : two’s complement)

Index : 1byte - binary

0 : In Peripheral role

1 : In Central role

Method : 1byte - binary

0 : Notification, Write Command

1 : Indication, Write Request

Length : 1byte - binary

1 - 20 (0x01 - 0x14)

Data : 1-20byte (specified at Length param) - binary

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3. Peripheral

4.1. Control Command and Event List

4.1.1. Common Commands

Command Character	Function	Parameter	Response
Configuration These commands are available when advertising stopped.			
ST1	Set initiator's address in Direct Advertising. "BST1112233445566"	<u>Parameter:</u> BD Address	Successful: ACK Failed: NAK##
ST2	Set Local device address "BST2F01234AABBCC" It will return to the initial value when reset. PSKEY_USER10 shall be set to 0000.	<u>Parameter:</u> BD Address (Static Address)	Successful: ACK Failed: NAK##
ST3	Set Local Device Name (MAX 16CHARACTERS) Default : "TYSA-B 4.0.1" The setting will be updated after reset.	<u>Parameter:</u> Device_name	Successful: ACK Failed: NAK##
ST4	Set default value for User data The setting will be updated after reset. User data is PSKEY, Bonding information and Advertising data. Please refer section 4.2 about PSKEY. Baudrate setting is not initialized.	/	Successful: ACK Failed: NAK##
ST5	Set PSKEY Value (Note Values 0 >= are valid) Example BST5030100 (set PSKEY 03 to 0x0100) The setting will be updated after reset. Please refer section 4.2.	<u>Parameter 0:</u> PSKEY: DD (Decimal) <u>Parameter 1:</u> Value: HHHH (Hex Word)	Successful: ACK Failed: NAK##

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ST8	<p>Set Customized Advertising data (MAX 62CHARACTERS (31bytes))</p> <p>The data is stored in FLASH.</p> <p>Example BST801EFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFF (Advertising data : 0x1E,0xFF...)</p> <p>BST811EFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFF (Scan Response data : 0x1E,0xFF...)</p> <p>Please refer section 4.16 for details.</p> <p>The data will be updated in next "CD" command.</p>	<p><u>Parameter 0:</u> Advertising : 0 Scan Response : 1</p> <p><u>Parameter 1:</u> data: HHHH... (Hex ASCII)</p>	<p>Successful: ACK Failed: NAK##</p>
ST9	<p>Set Customized Advertising data (MAX 62CHARACTERS (31bytes))</p> <p>The data is not stored in FLASH.</p> <p>Example BST901EFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFF (Advertising data : 0x1E,0xFF...)</p> <p>BST911EFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFF (Scan Response data : 0x1E,0xFF...)</p> <p>Please refer section 4.16 for details.</p> <p>The data will be updated in next "CD" command.</p>	<p><u>Parameter 0:</u> Advertising : 0 Scan Response : 1</p> <p><u>Parameter 1:</u> data: HHHH... (Hex ASCII)</p>	<p>Successful: ACK Failed: NAK##</p>

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GT2	Read Local BD Address		Successful: Local BD_ADDR, ACK Failed: NAK##
GT3	Read Local Device Name		Successful: Local Device Name, ACK Failed: NAK##
GT5	Read PSKEY Value Example: BGT501 (Get PSKEY 1)		Successful: KVHHHH, ACK Failed: NAK##
GT6	Read Paired Initiator's BD Address and IRK (Initiator = Central side) From top to bottom, index 1 to 7 are assigned for DS command.		Successful: Initiator's BD Address, IRK, ACK Failed: NAK##
GT8	Get Customized Advertising data	<u>Parameter 0:</u> Advertising : 0 Scan Response : 1	Successful: HHHH... (Hex ASCII) Stored Advertising data
GT9	Get Customized Advertising data	<u>Parameter 0:</u> Advertising : 0 Scan Response : 1	Successful: HHHH... (Hex ASCII) Current Advertising data
DS	Delete a Specified Paired Central device.	<u>Parameter:</u> 1-7 : index Please refer GT6 command.	Successful: ACK Failed: NAK##
DD	Delete all Paired Central devices		Success: ACK Failed: NAK##
TT	Go to Direct Test Mode		Successful: ACK Failed: NAK##
SP	Go to Power saving mode		Failed: NAK##
RS	Reset the module		Successful: Ver. XXXX Failed: NAK##
RL	Role switch The setting will be updated after reset.	<u>Parameter:</u> 0 : Peripheral 1 : Central	Successful: ACK Failed: NAK##

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Link Control			
CD	<p>Connectable & Discoverable (Advertising Start / Stop)</p> <p>Advertising PDU type '1' - '2': ADV_IND Connectable and Scannable. Allow Scan Request from Any, Allow Connect Request only from White List.</p> <p>'3' - '4': ADV_IND Connectable, Scannable and Discoverable from any devices.</p> <p>'5' : ADV_DIRECT_IND Connectable from the device whose BD Address matches ST1 command.</p> <p>'6' : ADV_NONCONN_IND Non-Connectable, Non-Scannable and Discoverable.</p> <p>'7' : ADV_SCAN_IND Non-Connectable, Scannable and Discoverable.</p> <p>Default data Advertising : 0D09545953412D4220332E302E3 0 020105020A04</p> <p>Scan Response : 03030F181107EB532D21D4E1E1 CB 289A008A70152F44</p>	<p><u>Parameter</u></p> <p>'0' – Advertising Stop.</p> <p>'1' – Connectable from White List Advertising Start. Default data.</p> <p>'2' – Connectable from White List Advertising Start. Customized data.</p> <p>'3' – Connectable and discoverable from any devices Advertising Start. Default data.</p> <p>'4' – Connectable and discoverable from any devices Advertising Start. Customized data.</p> <p>'5' – Directed Advertising Start.</p> <p>'6' – Non-Connectable and Non-Scannable Advertising Start. Customized data.</p> <p>'7' – Non-Connectable and Scannable Advertising Start. Customized data.</p>	<p>Successful: ACK, Failed: NAK##</p>

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DC	Disconnect		Successful: ACK, DCO Failed: NAK##
IO	Local Device I/O capabilities 0: Display only. (Passkey Entry) 1: Display and enter "yes" or "no". (Numeric Comparison) 2: Keyboard only. (Passkey Entry) 3: No Input and No Display. (Just Works) 5: Out of Band (OOB) (Default is '3') The setting will be updated after reset.	<u>Parameter</u> I/O capabilities (['0','1','2','3','5'])	Successful: ACK, Failed: NAK##
YN	Answer of numeric collation	<u>Parameter</u> Yes/No '0' – Yes, Accept '1' – No, Reject	Successful: PS,CON Failed:NAK##
KY	Enter the passkey number (Six digit number) Example: BKY895361	<u>Passkey (ASCII)</u> (from "000000" to "999999")	Successful: PS,CON Failed:NAK##
OB	Read Local OOB Data		Successful: OBC 32CHARACTERS OBR 32CHARACTERS Failed: NAK##
OC	Remote OOB Data (Simple Pairing Hash C) 32CHARACTERS	<u>OOB (ASCII)</u> (from "00000000000000000000000000000000" " to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" FFF")	Successful: ACK Failed: NAK##
OR	Remote OOB Data (Simple Pairing Randomizer R) 32CHARACTERS	<u>OOB (ASCII)</u> (from "00000000000000000000000000000000" " to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" FFF")	Successful: ACK Failed: NAK##

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4.1.2. Common Response Events

Response Events	Function	Parameters
ACK	Successful	
NAK##	Failed	Failed Reason – See Error section 4.3. for further details.
CON	Connection successful	Established Remote BD_ADDR
DCO	Disconnect	<u>Parameter 0:</u> 0 : In Peripheral role 1 : In Central role <u>Parameter 1:</u> Reason in hexadecimal See section 4.3.1 for further details.
ADT	Advertising Timeout	
PAS	Pairing Success	<u>Parameter:</u> 0 : Paired device is not stored 1-7 : Index of paired device list
ESR	Enable Service	<u>Parameter:</u> 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication) 2 : Battery Service
DSR	Disable Service	<u>Parameter:</u> 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication) 2 : Battery Service
NM	Shown a six digit number (Numeric Value)	<u>Parameter:</u> From "000000" to "999999" (ASCII)
OBC	Local OOB Data (Simple Pairing Hash C)	<u>Parameter:</u> From "00000000000000000000000000000000" to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" (ASCII)
OBR	Local OOB Data (Simple Pairing Randomizer R)	<u>Parameter:</u> From "00000000000000000000000000000000" to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" (ASCII)
KEY	Request passkey number	
PK	Passkey Number indication	<u>Parameter:</u> From "000000" to "999999" (ASCII)

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4.2. Persistent Store (PS) User Key Description

All Values for "Defaults" are in HEX notation.

Name	PSKEY_USER00	Key Length:	1
Descriptive Name:	Baud rate		
Description:	Set Session Baud Rate. (bps) 0001: 9600, 0002: 19200, 0003: 38400, 0004: 57600, 0005: 115200 0006: 230400, 0007: 460800, 0008: 921600		
Default:	0001 (9600bps)		
Range	0001 - 0008		

Name	PSKEY_USER01	Key Length:	1
Descriptive Name:	Advertising Timeout (sec)		
Description:	Advertising Timeout defines the timeout for the advertising. 0000 means timeout is disabling. Advertising will continue forever.		
Default:	003C (60sec)		
Range	0000 – 00B4 (0 – 180sec)		

Name	PSKEY_USER02	Key Length:	1
Descriptive Name:	Advertising Interval (msec)		
Description:	The time between the start of two consecutive advertising events. The value in this parameter is multiplied by 0.625msec.		
Default:	0040 (40msec)		
Range	0020 – 4000 (20 – 10240msec)		

Name	PSKEY_USER03	Key Length:	1
Descriptive Name:	Connection Interval Minimum (msec)		
Description:	Defines minimum value for the connection interval. The value in this parameter is multiplied by 1.25msec.		
Default:	0050 (100msec)		
Range	0006 – 0C80 (7.5 – 4000msec)		

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Name	PSKEY_USER04	Key Length:	1
Descriptive Name:	Connection Interval Maximum (msec)		
Description:	Defines maximum value for the connection interval. The value in this parameter is multiplied by 1.25msec.		
Default:	00A0 (200msec)		
Range	0006 – 0C80 (7.5 – 4000msec)		

Name	PSKEY_USER05	Key Length:	1
Descriptive Name:	Slave latency		
Description:	Defines the slave latency for the connection in number of connection events. The Slave Latency field shall have a value in the range of 0 to ((SupervisionTimeout / connectionIntervalMax*2) -1). The Slave Latency field shall be less than 500.		
Default:	0000		
Range	0000 – 01F3 (0 – 499)		

Name	PSKEY_USER06	Key Length:	1
Descriptive Name:	Supervision Timeout (msec)		
Description:	Defines the connection supervision timeout. The value in this parameter is multiplied by 10msec.		
Default:	01F4 (5000msec)		
Range	000A– 0C80 (100 – 32000msec)		

Name	PSKEY_USER07	Key Length:	1
Descriptive Name:	Auto Advertising Start setting		
Description:	This will store Auto Advertising Start at startup or disconnected setting. The parameter is correspond to that of CD command. “0000” : Auto start OFF “0001” : Auto start, Default Advertising data, ADV_IND (white list) “0002” : Auto start, Customized Advertising data, ADV_IND (white list) “0003” : Auto start, Default Advertising data, ADV_IND “0004” : Auto start, Customized Advertising data, ADV_IND “0006” : Auto start, Customized Advertising data, ADV_NONCONN_IND “0007” : Auto start ON, Customized Advertising data, ADV_SCAN_IND		
Default:	0000		
Range	0000– 0007 (0005 is not available)		

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Name	PSKEY_USER08	Key Length:	1
Descriptive Name:	Security setting		
Description:	This will store Security setting. "0000" will disable Security setting. "0001" will enable Security setting (LE Security Mode1, Level 2). "0002" will enable Secure Connection (LE Security Mode1, Level 4)		
Default:	0000		
Range	0000– 0002		

Name	PSKEY_USER09	Key Length:	1
Descriptive Name:	Power saving mode setting at startup.		
Description:	This will store Power saving mode setting at startup. "0000" will disable Power saving mode. It does not enter Power saving mode. "0001" will enable Power saving mode. It enters Power saving mode. Regardless of the setting, module can enter the mode by BSP command.		
Default:	0000		
Range	0000– 0001		

Name	PSKEY_USER10	Key Length:	1
Descriptive Name:	BD Address type		
Description:	Set the type of BD Address "0000": Static Address "0001" – "000F" : Resolvable Private Address The value in this parameter is multiplied by 60sec and used as address update interval. (1minute – 15minutes)		
Default:	0000		
Range	0000– 000F		

Name	PSKEY_USER11	Key Length:	1
Descriptive Name:	Add the "peer device identify" to connection event.		
Description:	It can identify the peer device based on the IRK index. "0000" will disable identify. "0001" will enable identify. Please refer section 4.15 for details.		
Default:	0000		
Range	0000– 0001		

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Name	PSKEY_USER12	Key Length:	1
Descriptive Name:	TX power setting.		
Description:	<p>Set the radio's transmit power. Radio transmit power in dBm (accepted values are -30, -20, -16, -12, -8, -4, 0, and 4 dBm).</p> <p>0000: 4, 0001: 0, 0002: -4, 0003: -8, 0004: -12, 0005: -16, 0006: -20, 0007: -30</p>		
Default:	0000		
Range	0000– 0007		

Name	PSKEY_USER13	Key Length:	1
Descriptive Name:	DC/DC converter setting		
Description:	<p>DC/DC converter setting. “0000” will disable internal DC/DC converter (and use internal LDO). “0001” will enable internal DC/DC converter.</p> <p>Note: When supply voltage goes below 2.1V, DCDC is disabled, and enabled when the supply voltage goes up again. About hardware specification, please refer to “DataReport”.</p>		
Default:	0000		
Range	0000– 0001		

Name	PSKEY_USER14	Key Length:	1
Descriptive Name:	-		
Description:	Not use this user key. This value should be 0000.		
Default:	0000		
Range	0000		

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4.3. Error Codes

#	Error Name	Program Logic Cause / Action taken by Host
-1	Unknown Error	There is the possibility that the hardware is out of order.
00	Command Not Recognized	It confirms whether or not the command is correct.
01	Bad Parameter	It confirms parameter range.
02	Invalid State	Stop Advertising / Scanning or Disconnect.
04	UART Buffer full (buffer size : 128byte)	The commands shall be sent after previous command response.
05	Connection Fail (Central Only)	Please try again. If bond information exists, delete it and try again.
06	Device Full	Flash block for storing pairing information is full. (Max 7) To store new device information, delete with BDD command.
07	Pairing Failed	Please try again. If bond information exists, delete it and try again.
08	FLASH access error	Please run forced initialize (4.5.4).
11	Connection Parameter Error	It confirms connection parameter. Check PSKEY settings.
21	Advertising Parameter Error (Peripheral Only)	It confirms advertising data and parameter. Check PSKEY setting. If Advertising data is customized, check the parameter and the response of ST9 command.
22	Whitelist Error	It confirms whether or not bonded devices exist.
31	Scanning Parameter Error (Central Only)	It confirms scanning parameter. Check PSKEY setting.

4.3.1. Disconnect reason

#	Error Name	Description
08	BLE_HCI_CONNECTION_TIMEOUT	Connection Timeout.
13	BLE_HCI_REMOTE_USER_TERMINATED_CONNECTION	Remote User Terminated Connection.
16	BLE_HCI_LOCAL_HOST_TERMINATED_CONNECTION	Local Host Terminated Connection.
3D	BLE_HCI_CONN_TERMINATED_DUE_TO_MIC_FAILURE	Connection Terminated due to MIC Failure.

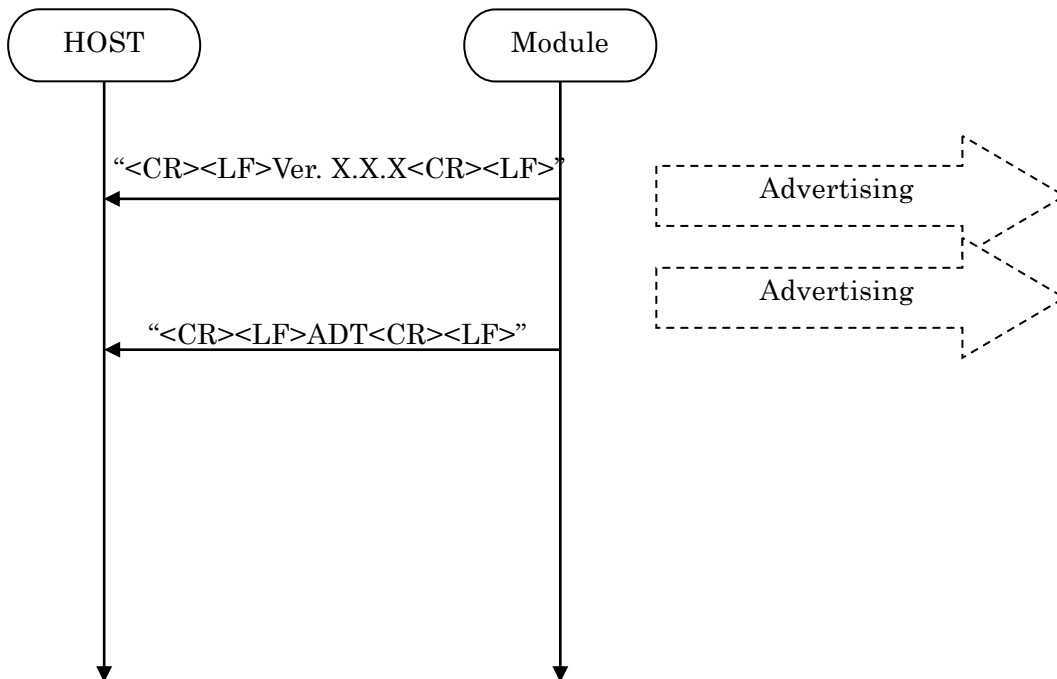
About other error codes, please see below.

https://infocenter.nordicsemi.com/index.jsp?topic=%2Fcom.nordic.infocenter.s130.api.v2.0.1%2Fgroup_ble_hci_status_codes.html

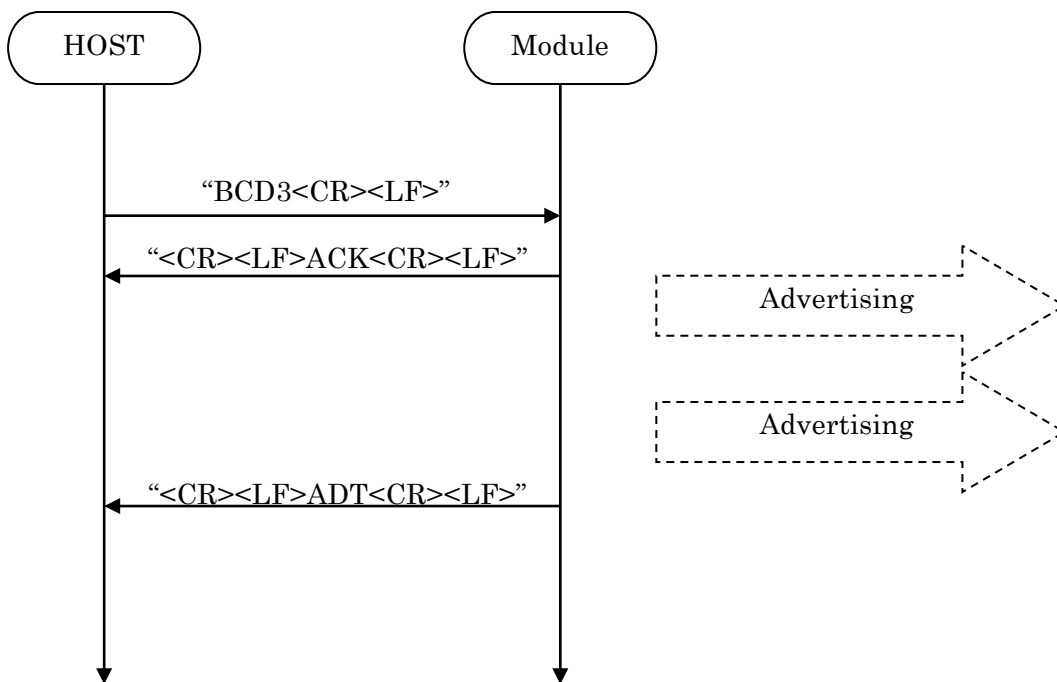
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4.4. Message Sequence Chart

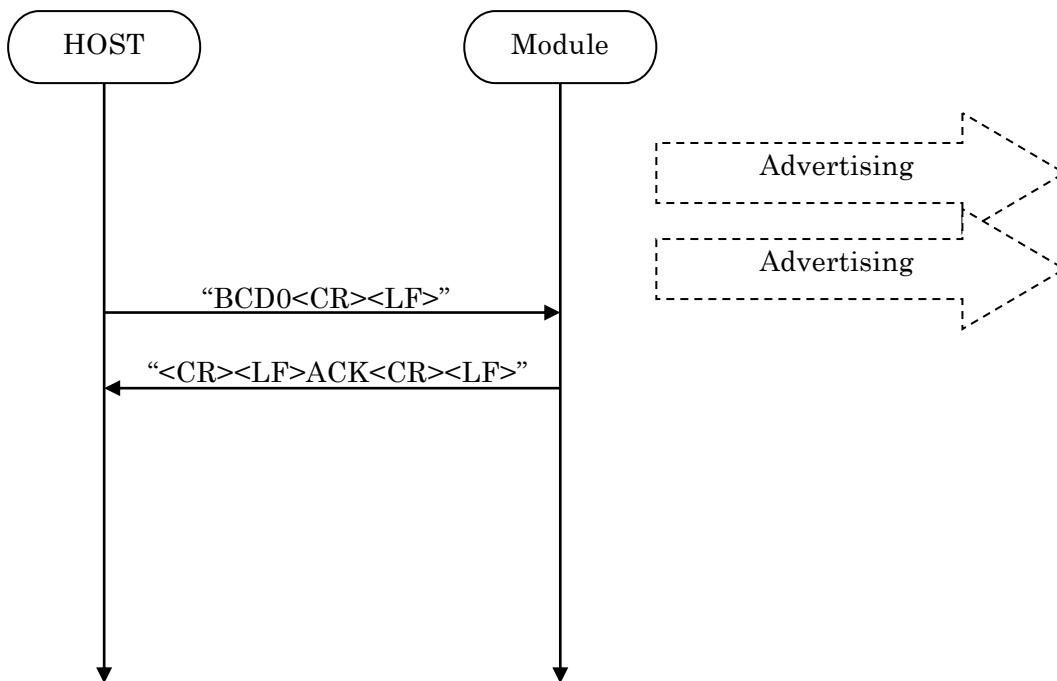
4.4.1. Power On (In case of PSKEY_USER01#'0000' and PSKEY_USER07#'0000')



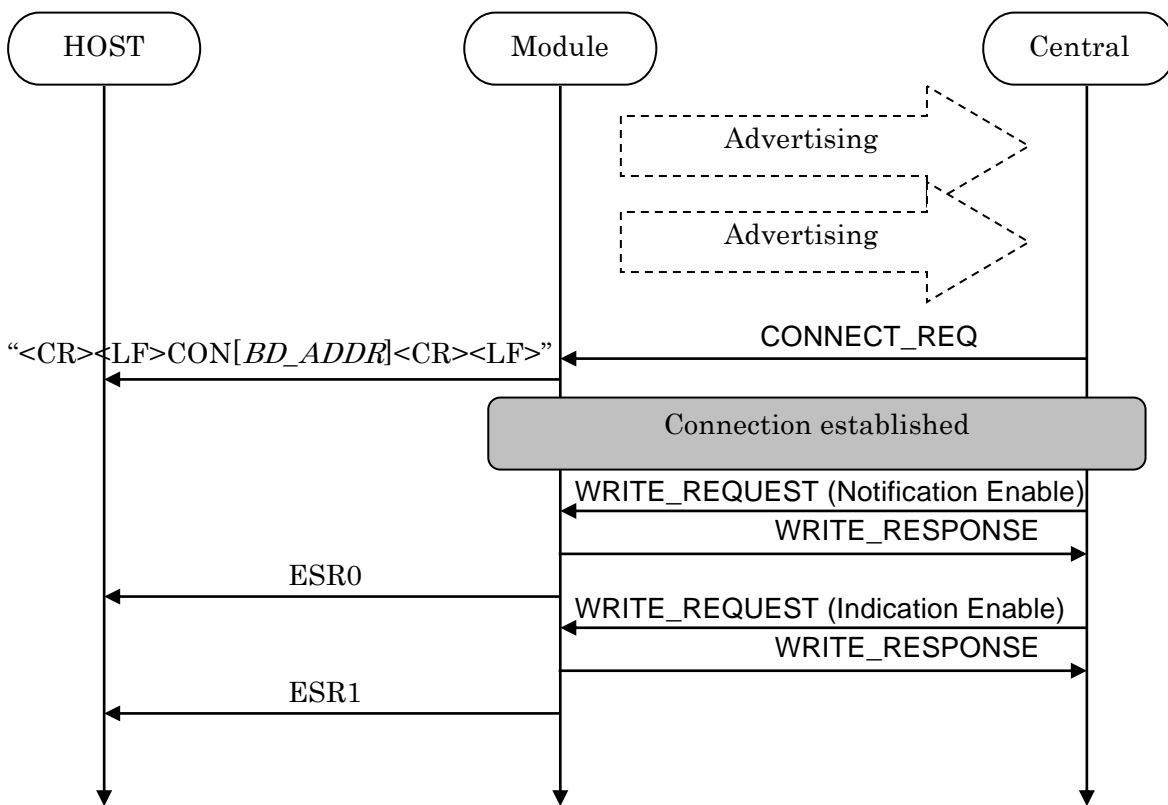
4.4.2. Advertising Start



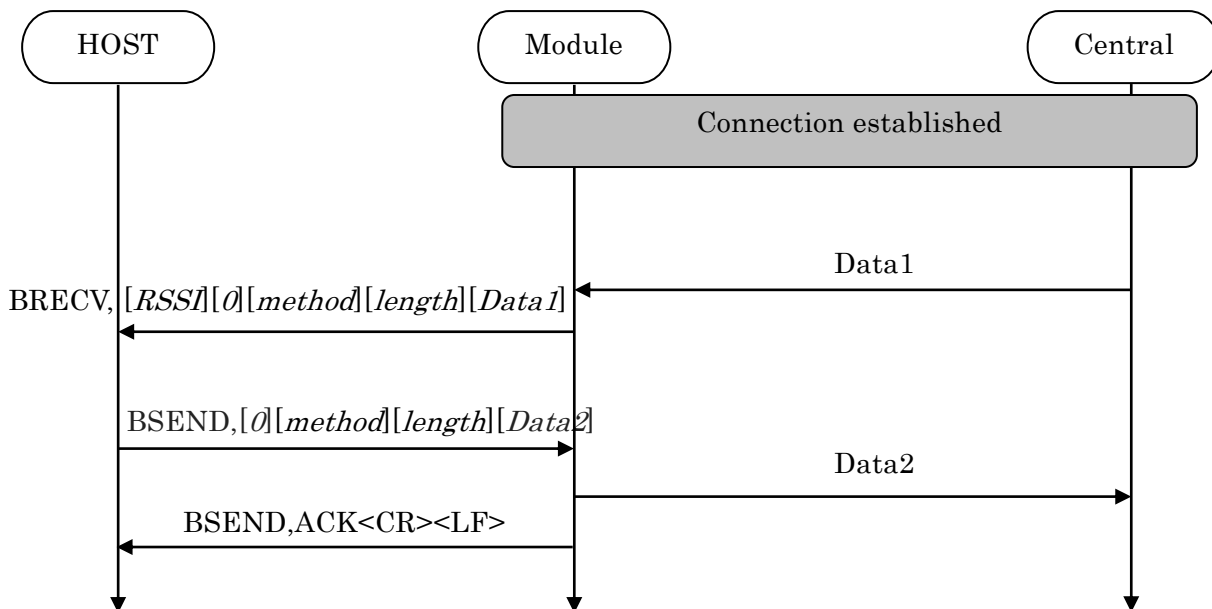
4.4.3. Advertising Stop



4.4.4. Connect

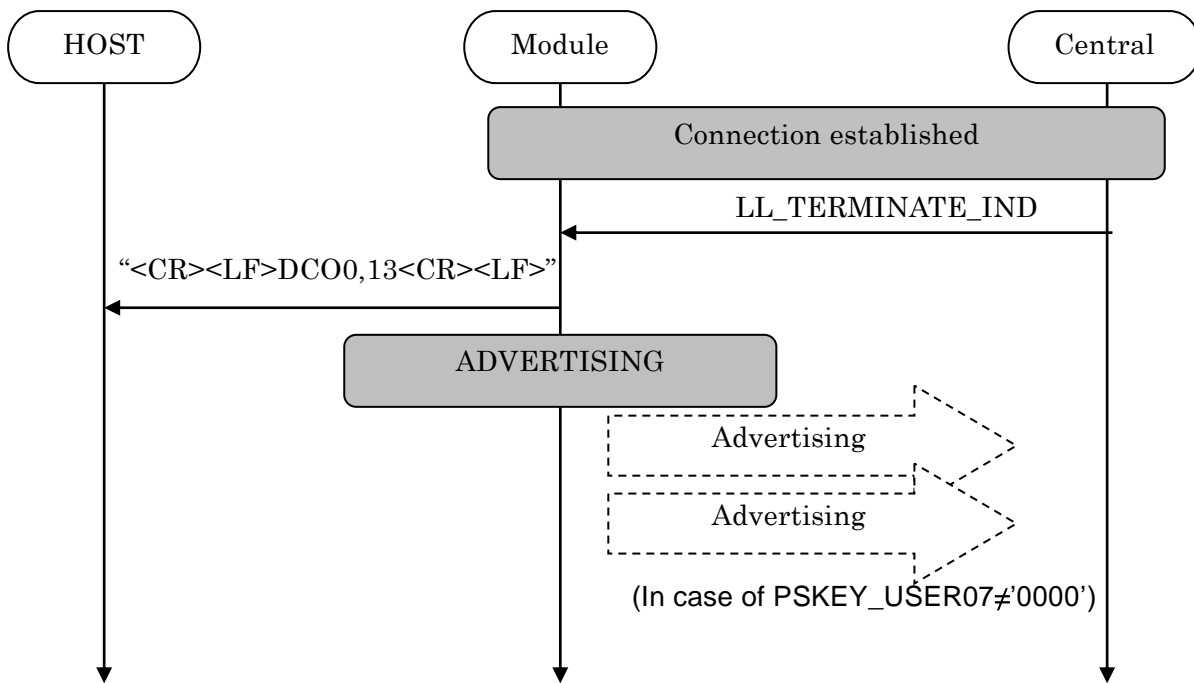


4.4.5. Sending & Receiving Data over a connected Link

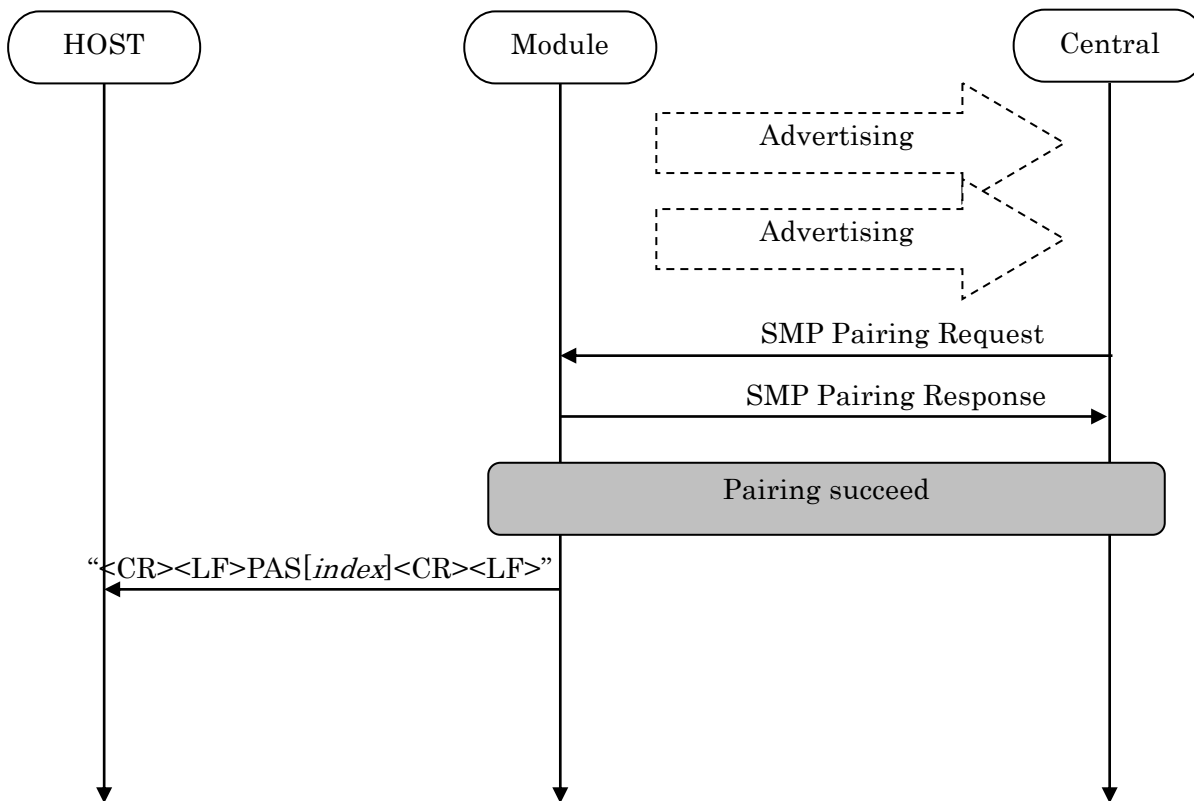


Max send a packet data size = 20bytes
 Max receive a packet data size = 20bytes

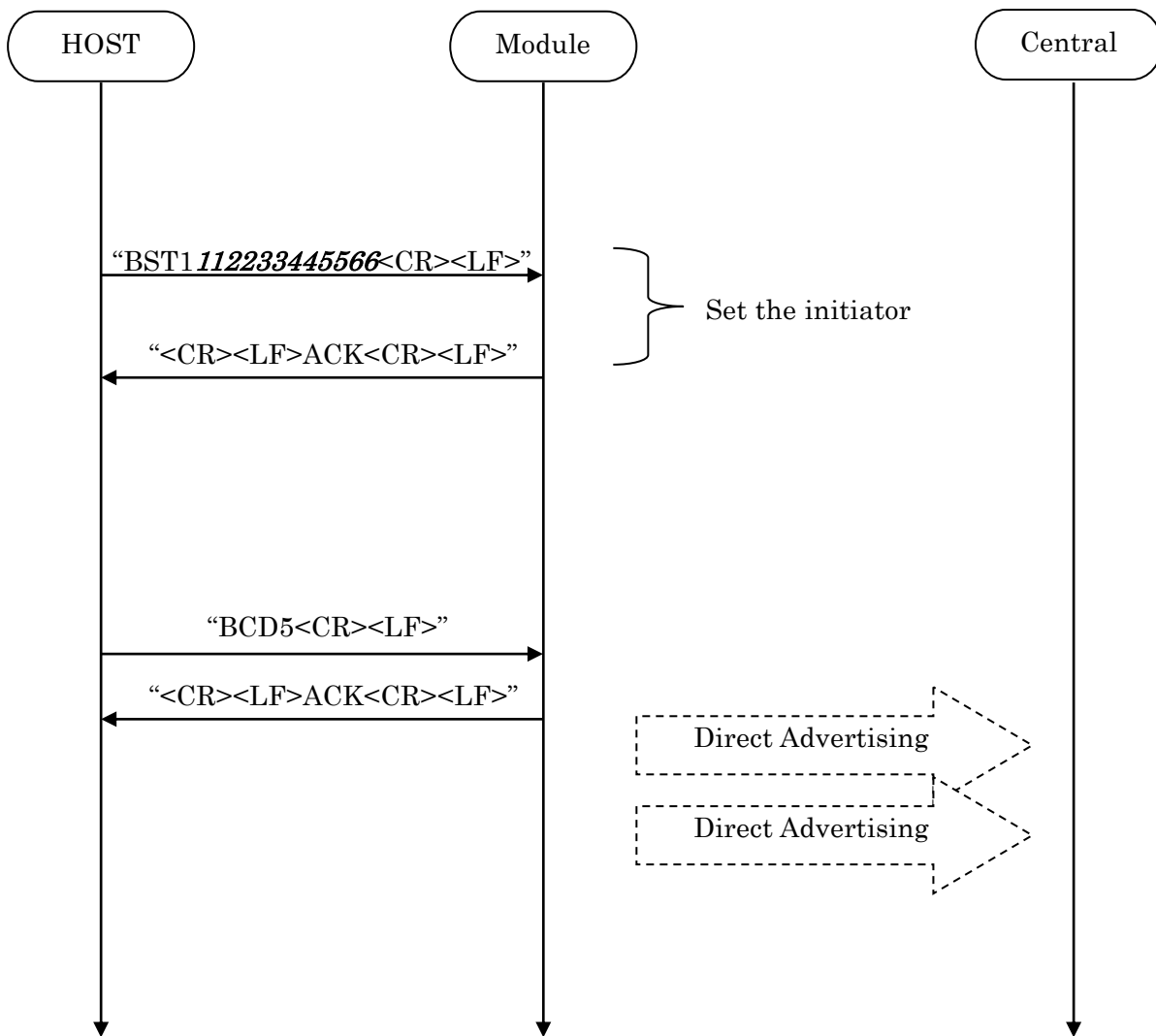
4.4.6. Disconnect



4.4.7. Pairing



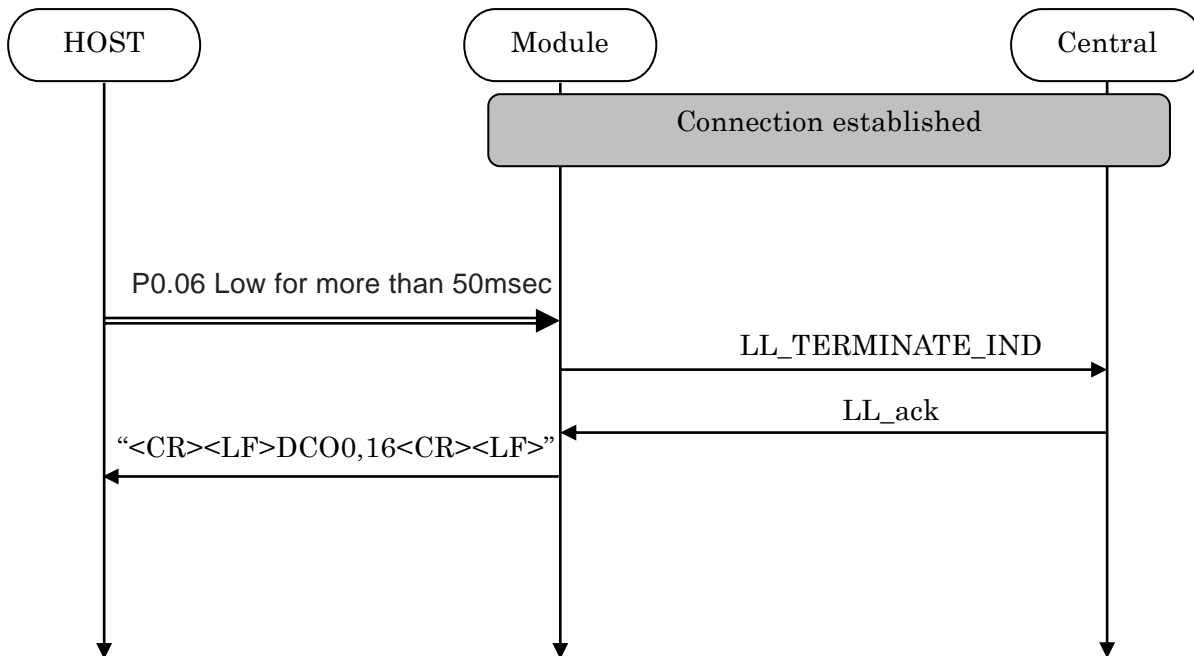
4.4.8. Directed Advertising



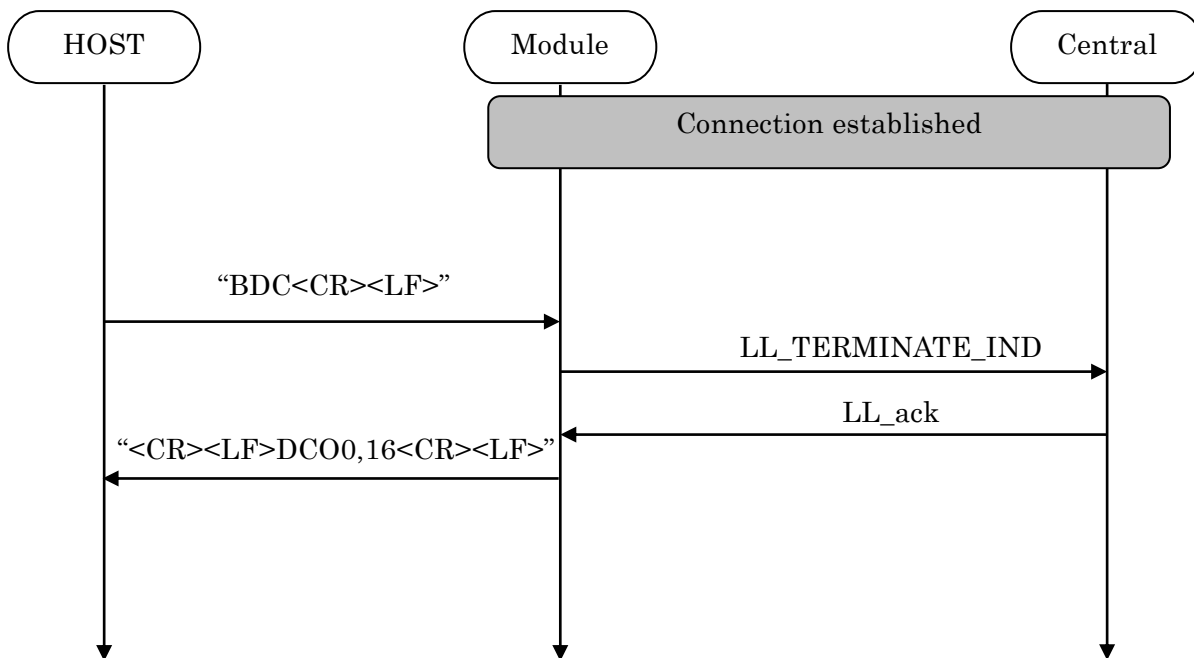
It connected only initiator at the specified address. (By BST1)

* Direct Advertising Timeout is 1.28sec regardless of Advertising Timeout setting (PSKEY_USER01).

4.4.9. Disconnect Request (GPIO)



4.4.10. Disconnect Request (Command)



4.5. GPIO state and control

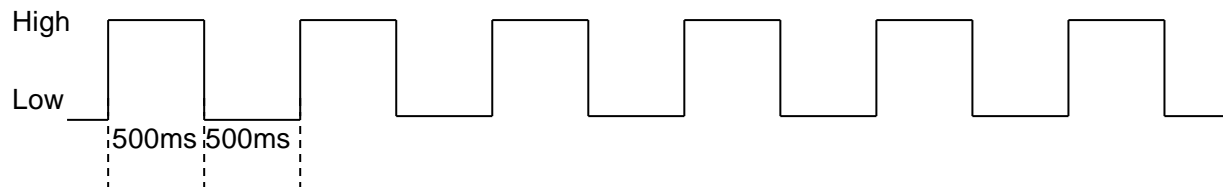
Pin Name	Input / Output	Description
P0.04	Input	Forced initialize(Peripheral's Info)
		Request Sleep mode
		Request Direct Test mode
P0.17	Input	Request DFU mode
		Request Direct Test mode
P0.05	Output	Module active/sleep indicate
P0.19	Output	State indication of module
		DFU indication
P0.06	Input	Disconnect request
		Resume from Power saving mode
		Request Direct Test mode
P0.21	Input	Sleep indication of host
		Resume from Power saving mode
P0.25	Output	Wake up request

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4.5.1. Advertising

P0.19



4.5.2. Connect

P0.19 High

4.5.3. Disconnect & Standby

P0.19 Low

4.5.4. Forced initialize

Both Central and Peripheral user setting of the module return to a default value when make P0.04 Low at module startup.

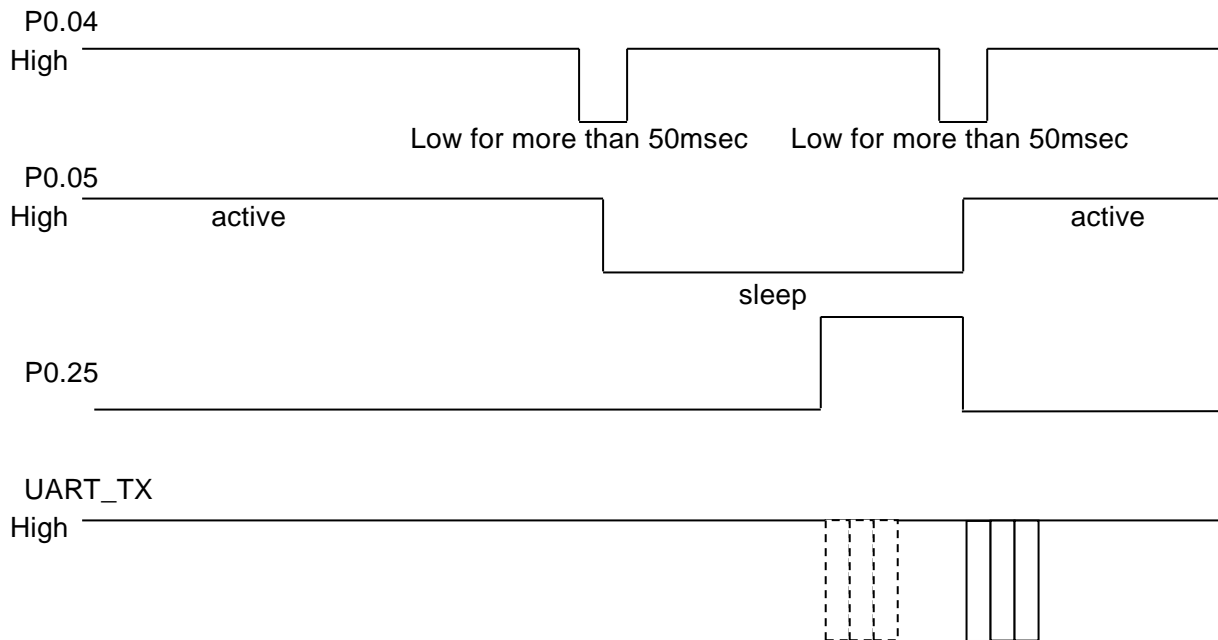
After P0.04 Low, H/W reset or power restart is necessary.

The module start as Peripheral role.

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4.5.5. Sleep mode request and indicate



* Buffer size : 128byte If the buffer is full, further data received is discarded without any events.

4.6. Service

Primary Service

TAIYO YUDEN Original Service UUID :

0x442F1570-8A00-9A28-CBE1-E1D4212D53EB

Characteristic

TAIYO YUDEN Original Characteristic UUID :

0x442F1571-8A00-9A28-CBE1-E1D4212D53EB (Read, Notification)

TAIYO YUDEN Original Characteristic UUID :

0x442F1572-8A00-9A28-CBE1-E1D4212D53EB (Write no response)

TAIYO YUDEN Original Characteristic UUID :

0x442F1573-8A00-9A28-CBE1-E1D4212D53EB (Read, Indication)

TAIYO YUDEN Original Characteristic UUID :

0x442F1574-8A00-9A28-CBE1-E1D4212D53EB (Write)

*** GATT Server is implemented in Peripheral role of this software.****4.7. UART configuration**

RX_PIN : P0.03

TX_PIN : P0.01

CTS_PIN : P0.02

RTS_PIN : P0.00

Baud rate : depend on PSKEY_USER00 (default setting: 9600)

Data : 8 bit

Parity : none

Stop : 1 bit

Hardware flow control : Enabled (In case of DTM, flow control is disabled)

4.8. SWD (Serial Wire Debug)

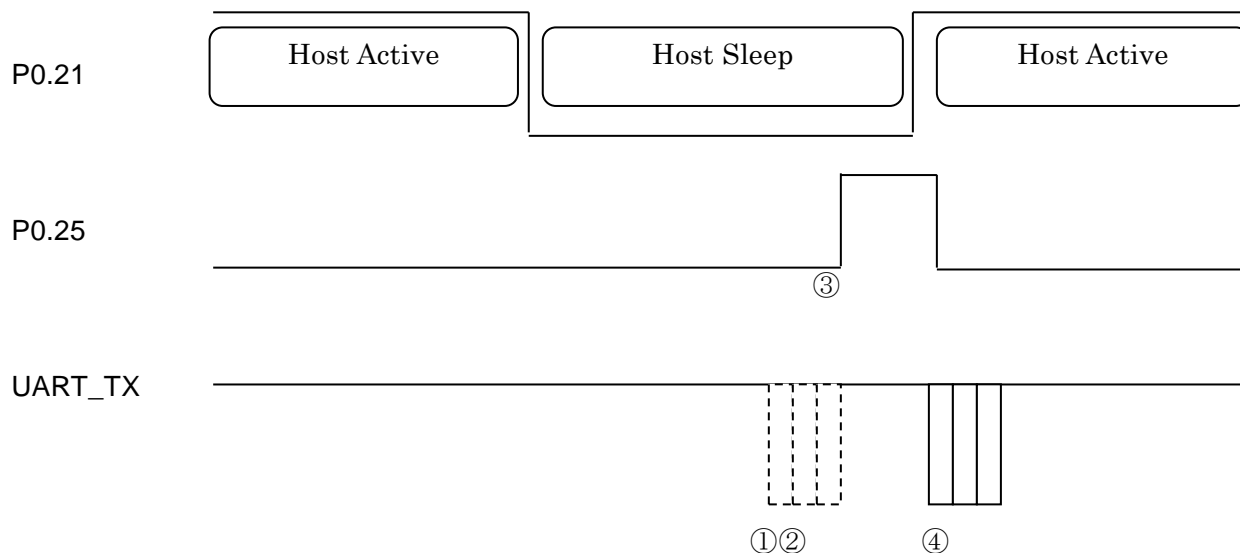
SWDIO :

SWDCLK :

These pins are for FW debug and flash programming I/O.

We recommend your company set up these pins for rewriting the firmware.

4.9. Host wake-up sequence

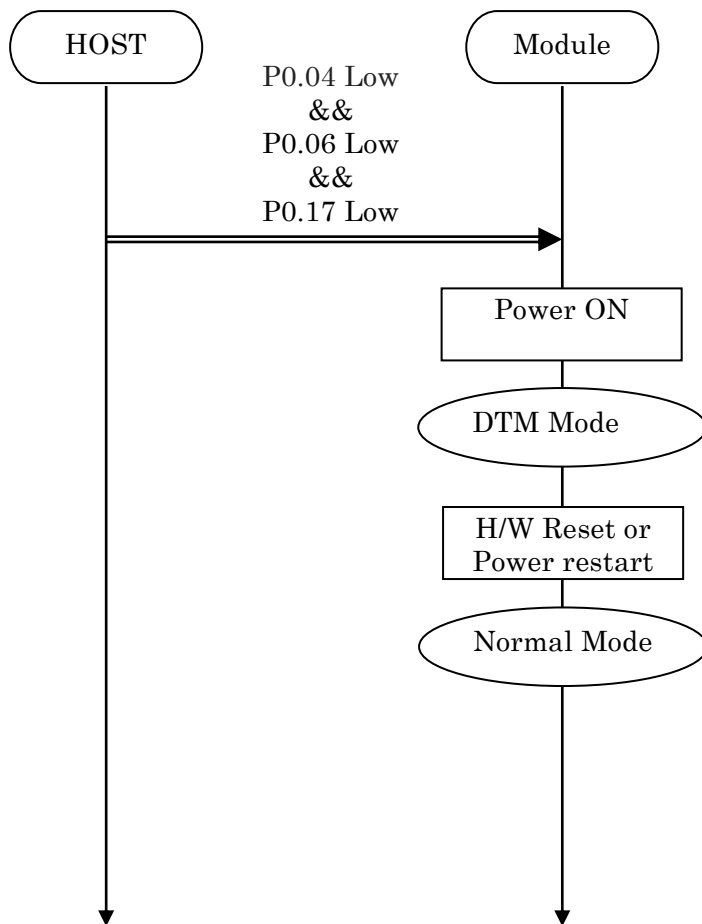


- ① Communication data or an event occurs in HOST Sleep.
- ② It waits until the host becomes active.
- ③ Module request to host wake-up via PIO.
- ④ If HOST becomes Active and Module is active (refer 4.5.5), module send communication data or event.

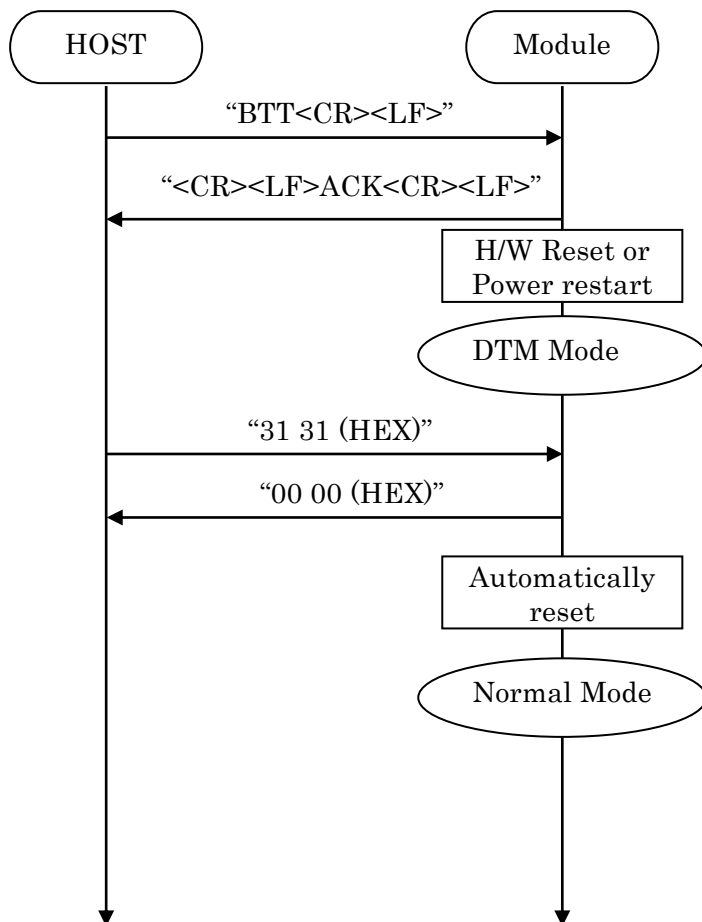
* **Buffer size : 128byte** If the buffer is full, further data received is discarded without any events.

4.10. DTM (Direct Test Mode)

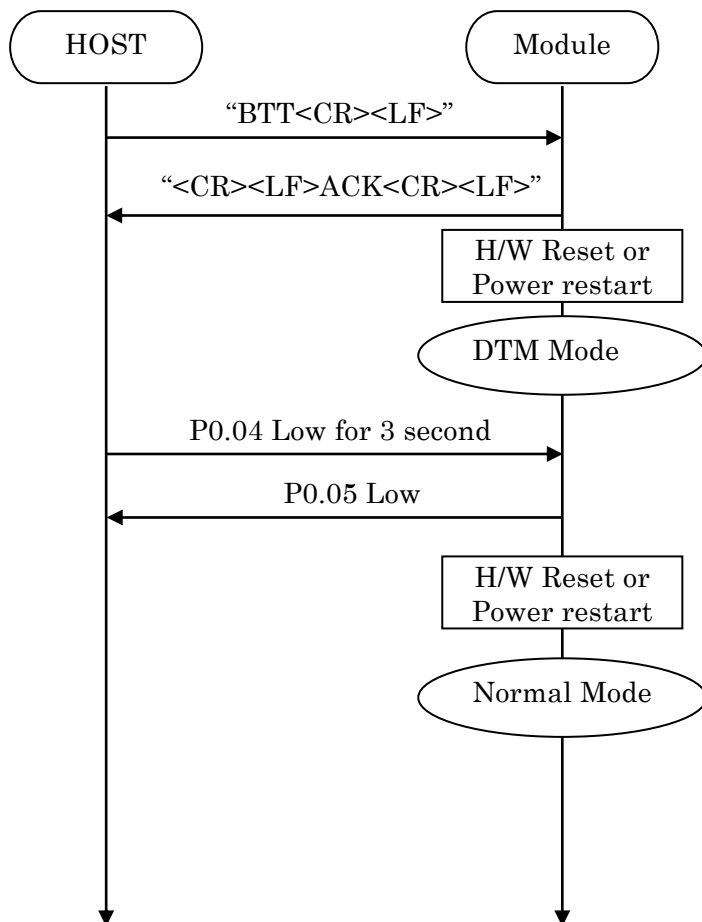
4.10.1. Enter DTM and exit DTM with GPIO



4.10.2. Enter DTM and exit DTM with UART command (permanent)



4.10.3. Enter DTM and exit DTM with Command



4.10.4. DTM Commands/Events

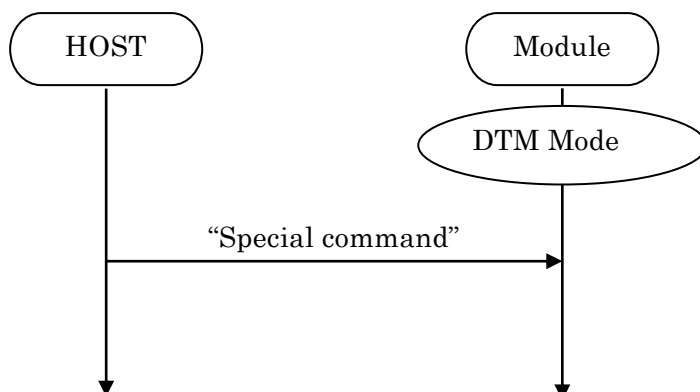
These commands/events are conforming to DTM of *Bluetooth*[®] specifications V4.0. Please refer to *Bluetooth*[®] specifications V4.0. (Core System Package [Low Energy Controller volume] Part F, Direct Test Mode)

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4.11. GPIO check

Host can inspect GPIO by special commands in DTM.

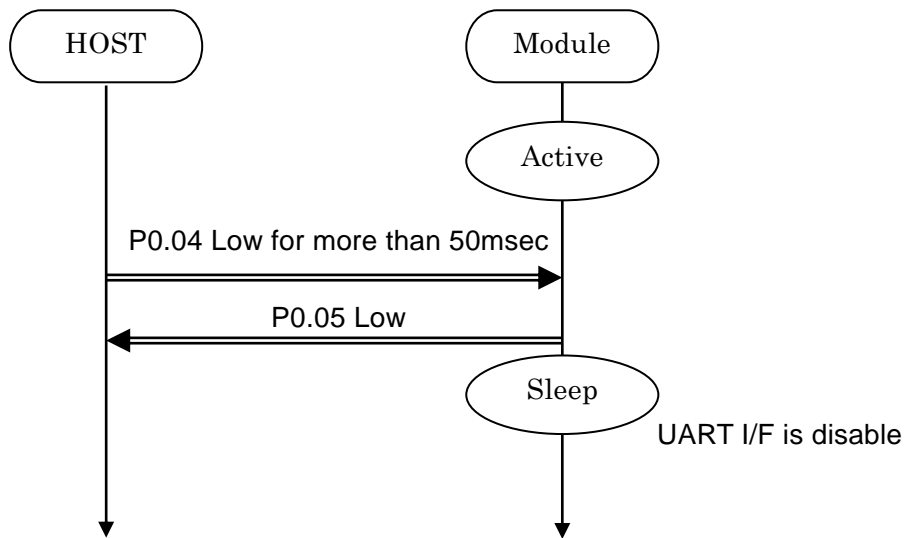


Command (Hex value)	Function	Response
32 30	It makes P0.05 Low.	00 00
32 31	It makes P0.05 High.	00 00
33 30	It makes P0.19 Low.	00 00
33 31	It makes P0.19 High.	00 00
34 30	It makes P0.25 Low.	00 00
34 31	It makes P0.25 High.	00 00
35 30	It makes P0.23 Low.	00 00
35 31	It makes P0.23 High.	00 00
39 39	It acquires state of Input Pin.	XX 00 00 XX: state Bit0: P0.04 (0:Low, 1:High) Bit1: P0.17 (0:Low, 1:High) Bit2: P0.06 (0:Low, 1:High) Bit3: P0.21 (0:Low, 1:High) Example 01 : P0.04 is High. Other Pin is Low. 0F: All Pin is High. 0B: P0.06 is Low. Other Pin is High.

4.12. Sleep Mode (SYSTEM ON)

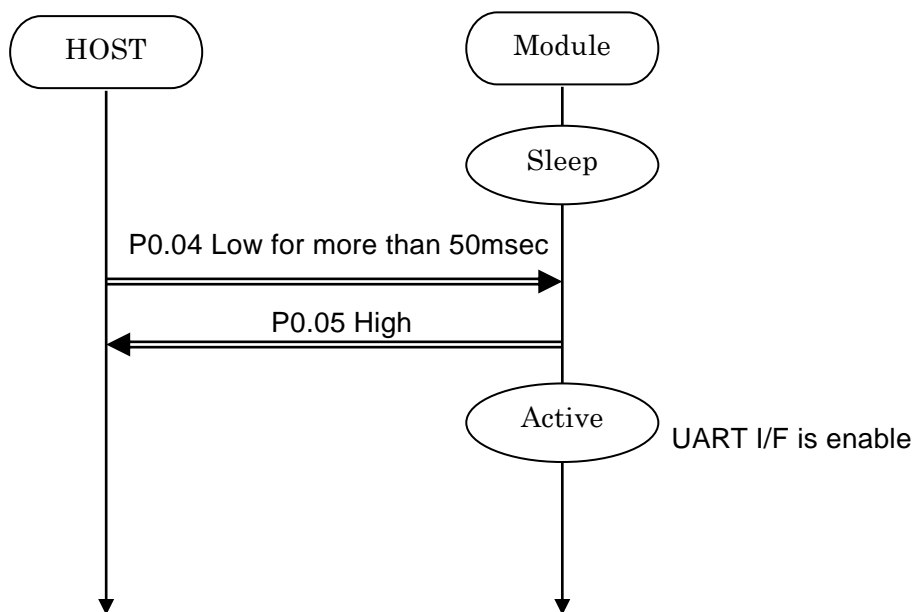
This Sleep is available in during Advertising and Connection.
 UART I/F is not usable during Sleep.

4.12.1. Enter sleep mode



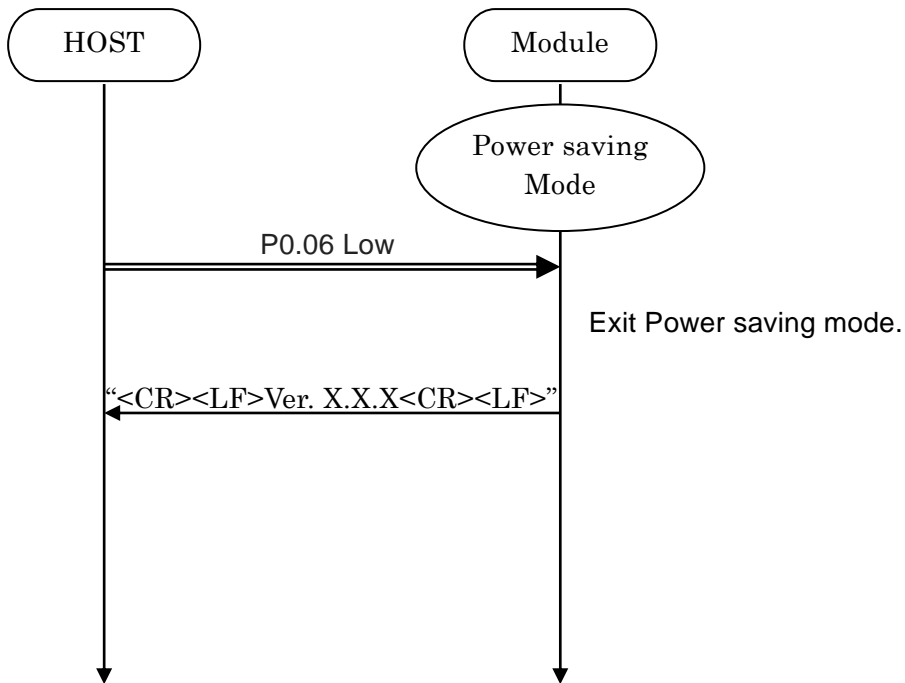
In case of UART data happen, the module notify to Host via P0.25.
 It is same as "Host wake-up".

4.12.2. Exit sleep mode

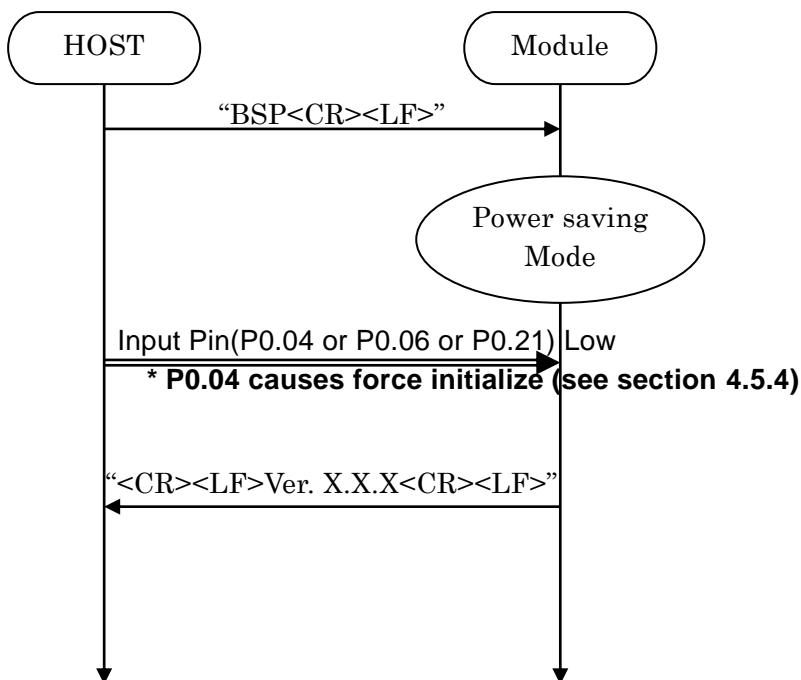


4.13. Power saving mode (SYSTEM OFF)

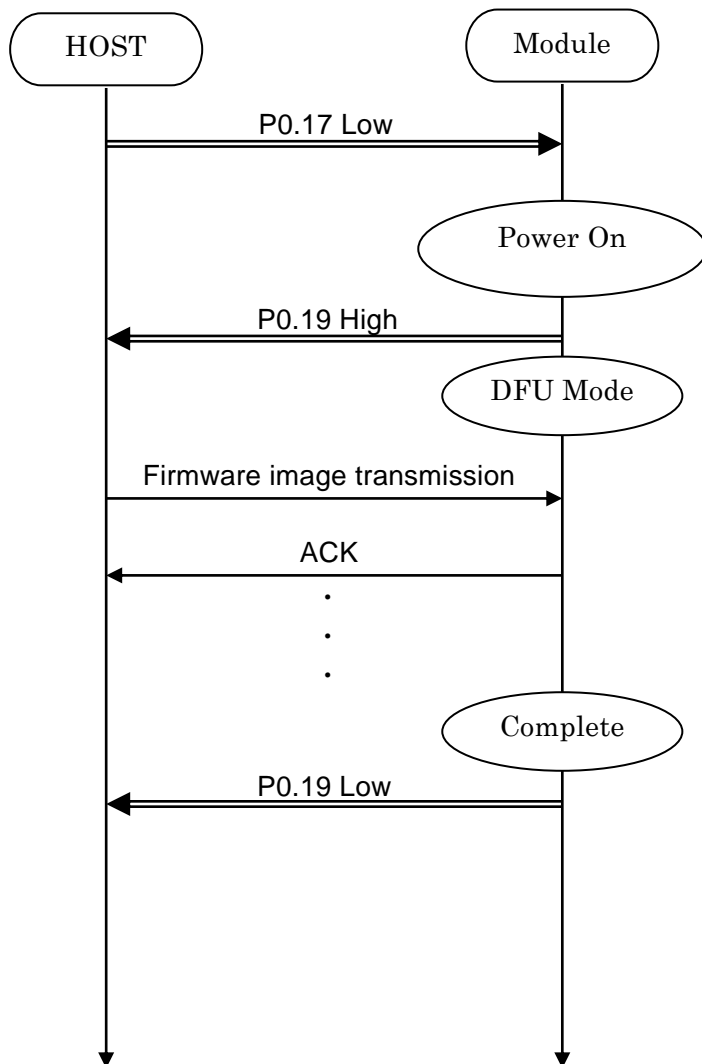
4.13.1. On startup (In case of PSKEY_USER09='0001')



4.13.2. BSP command



4.14. Device Firmware updates (DFU)



UART

Baud rate : 38400 bps
 Data : 8 bit
 Parity : none
 Stop : 1 bit
 Hardware flow control : Enabled

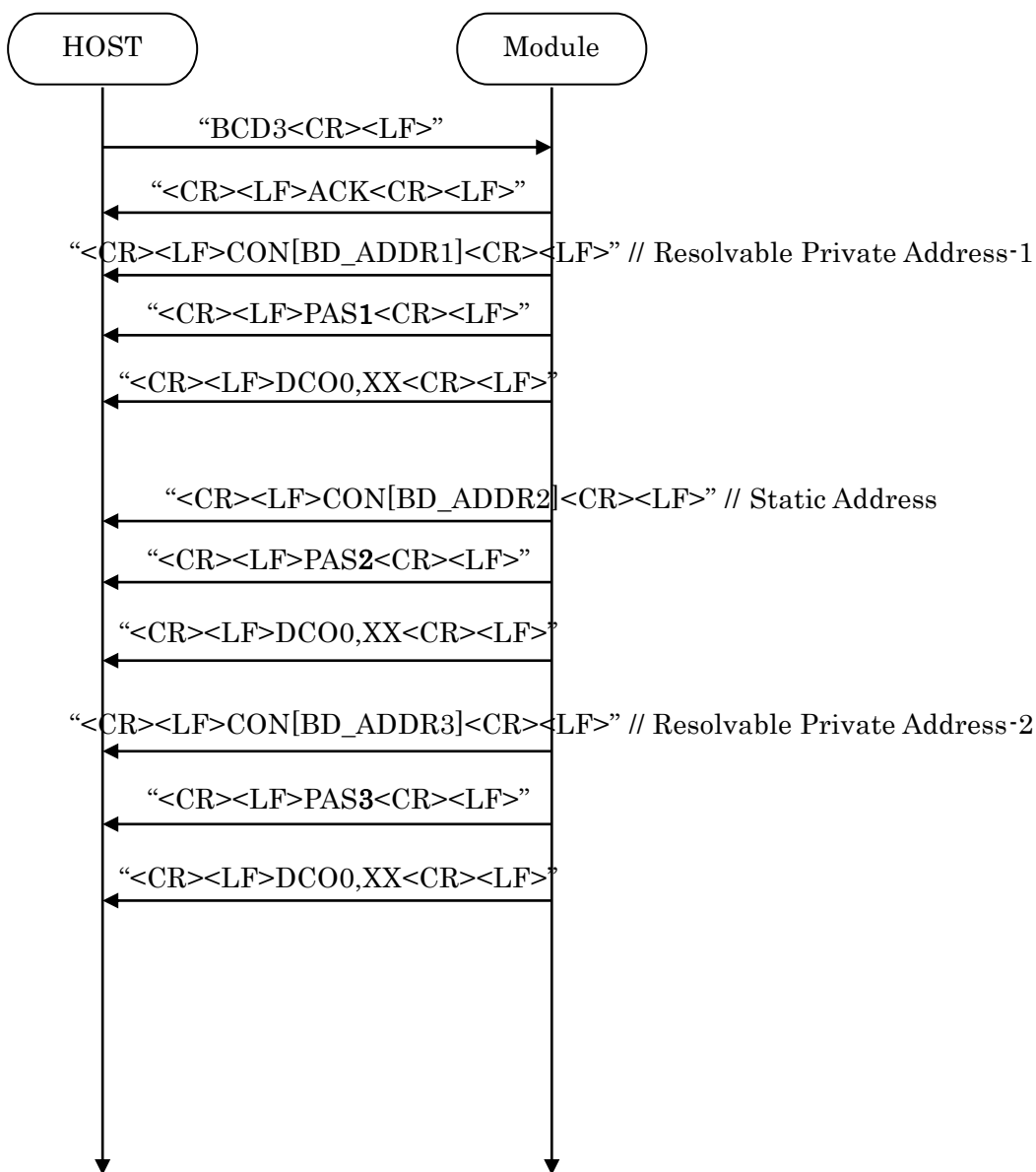
* Please contact TAIYO YUDEN when you use this function.

4.15. Identify the peer device

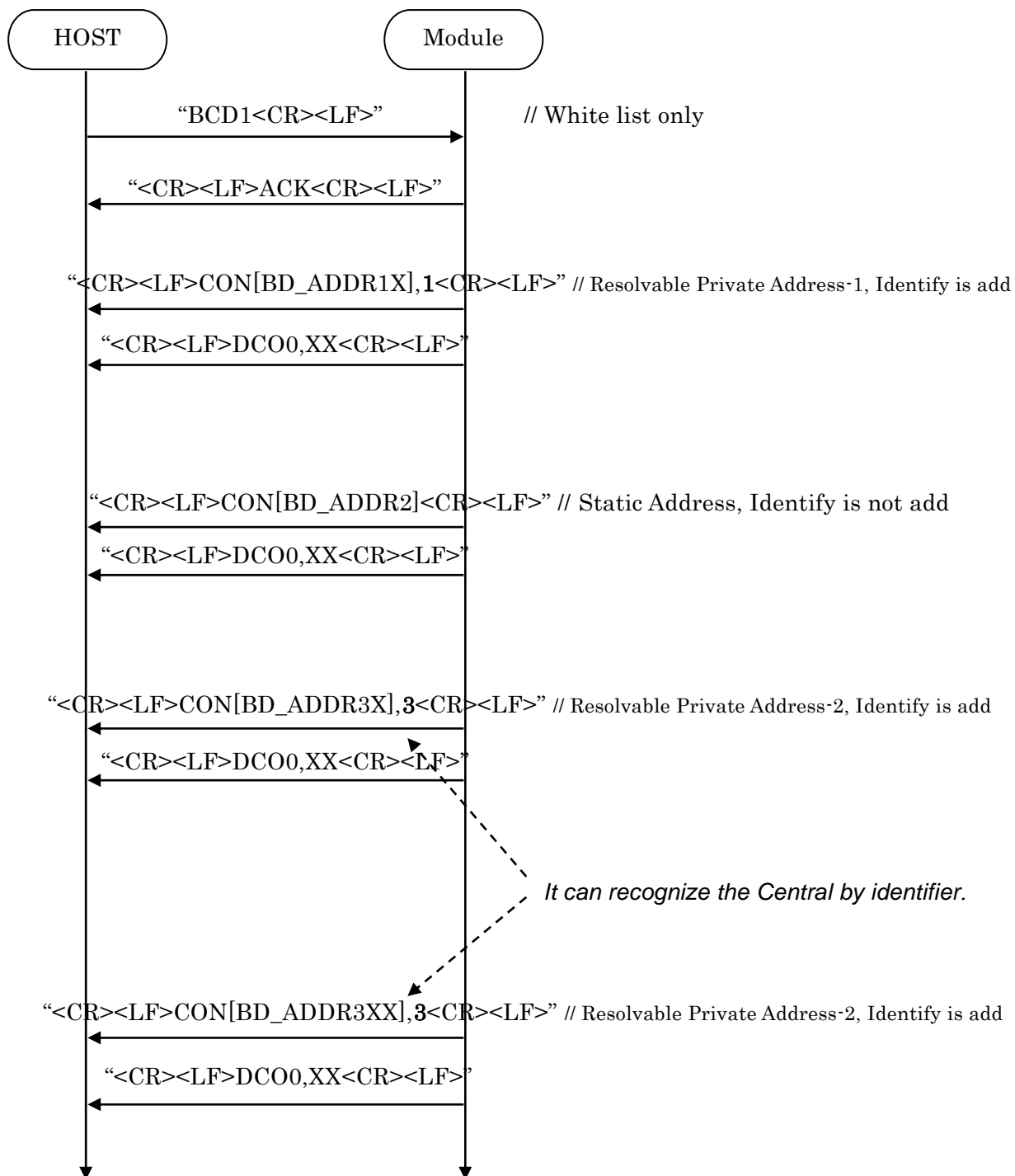
Some central devices use a Random Address and make an IRK entry. In this case, the address would change. It is unclear whether the connection with any central. You can add identify to the connection event by the setting PSKEY.

In case of PSKEY_USER08='0001' (Security On) and PSKEY_USER11='0001' (Enable Identify)

4.15.1. Pairing



4.15.2. Connection



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4.16. Customized Advertising data

Sample iBeacon data

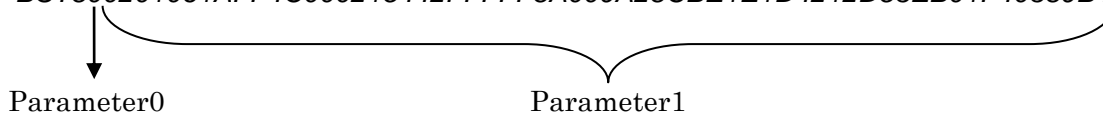
0	1	2	3	4	5	6	7	8
Size (02)	Type (01)	Flag (06)	Size (1A)	Type (FF)	Company ID (4C 00) Little endian		Beacon Type[0] (02)	Beacon Type[1] (15)

9 - 24	25	26	27	28	29
Proximity UUID (442FFFFFF8A009A28CBE1E1D4212D53EB) Big-endian 442FFFFFF-8A00-9A28-CBE1-E1D4212D53EB		Major (01 F4) Big-endian	Minor (03 89) Big-endian		Measured Power (B1)

Please refer "Supplement to the Bluetooth Core Specification" and iBeacon specification about the data format.

The following command stores above data as Customized Advertising data.

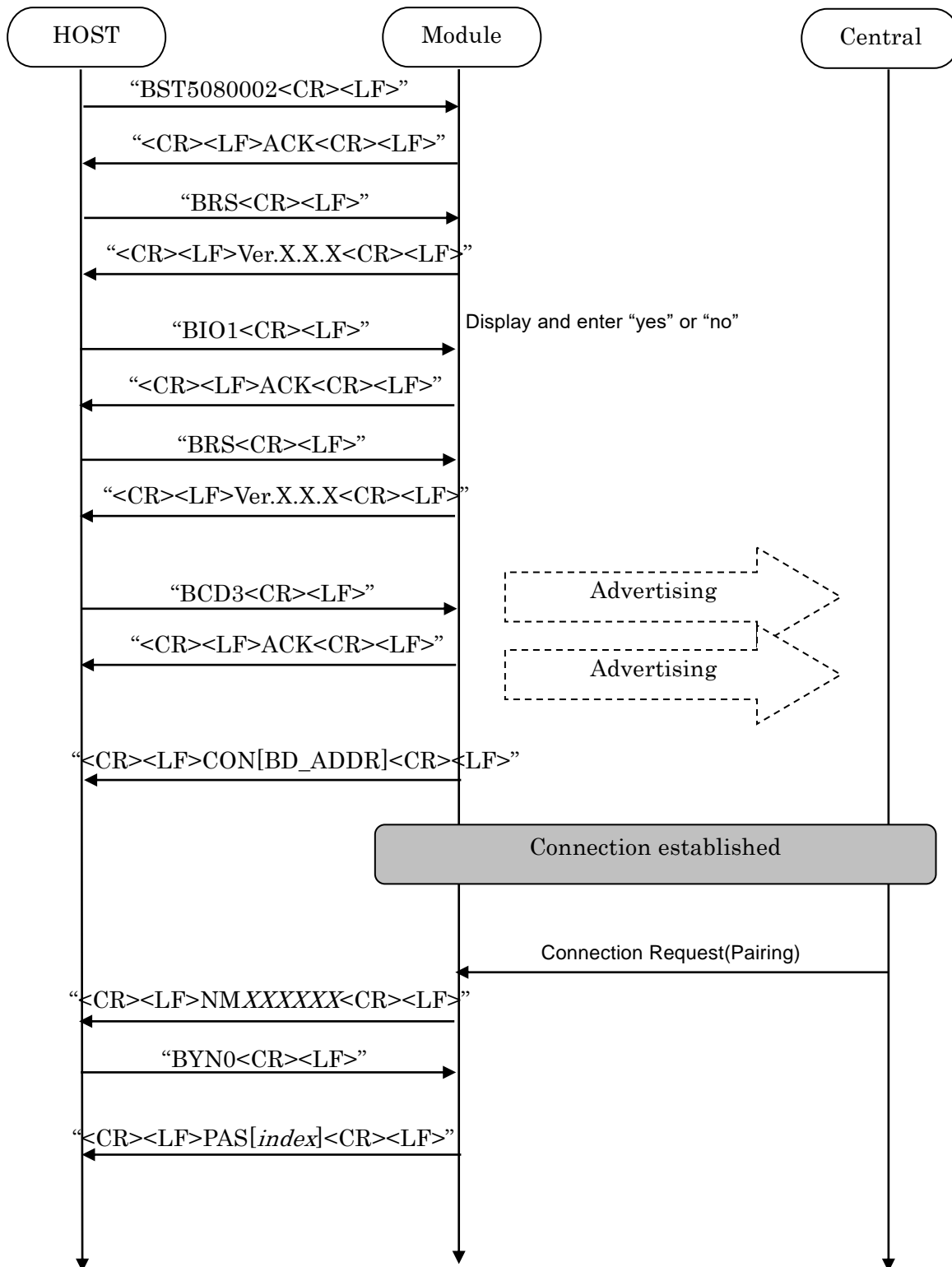
BST800201061AFF4C000215442FFFFFF8A009A28CBE1E1D4212D53EB01F40389B1<CR><LF>



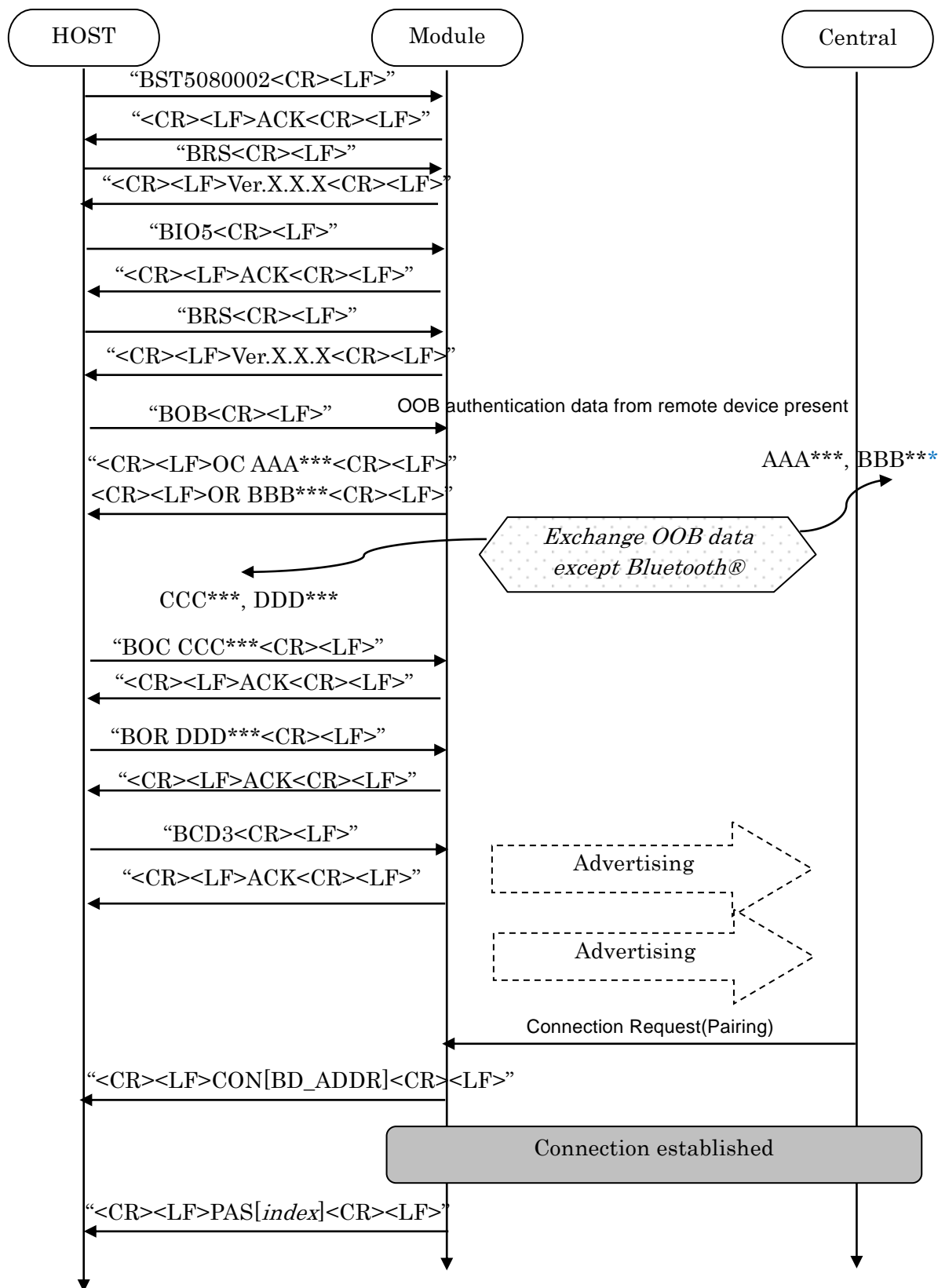
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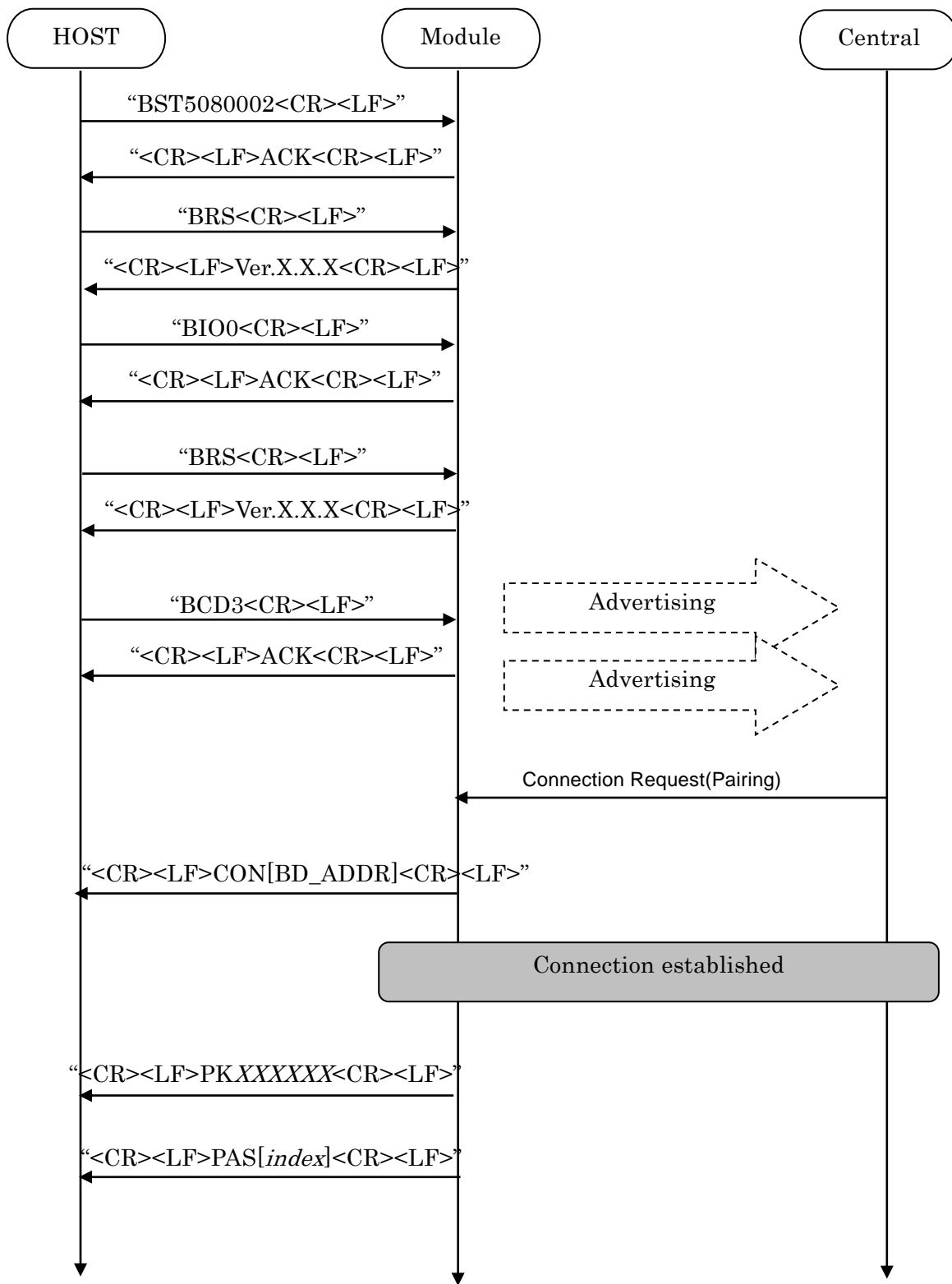
4.17. LE Secure Connection 4.17.1 Numeric Comparison



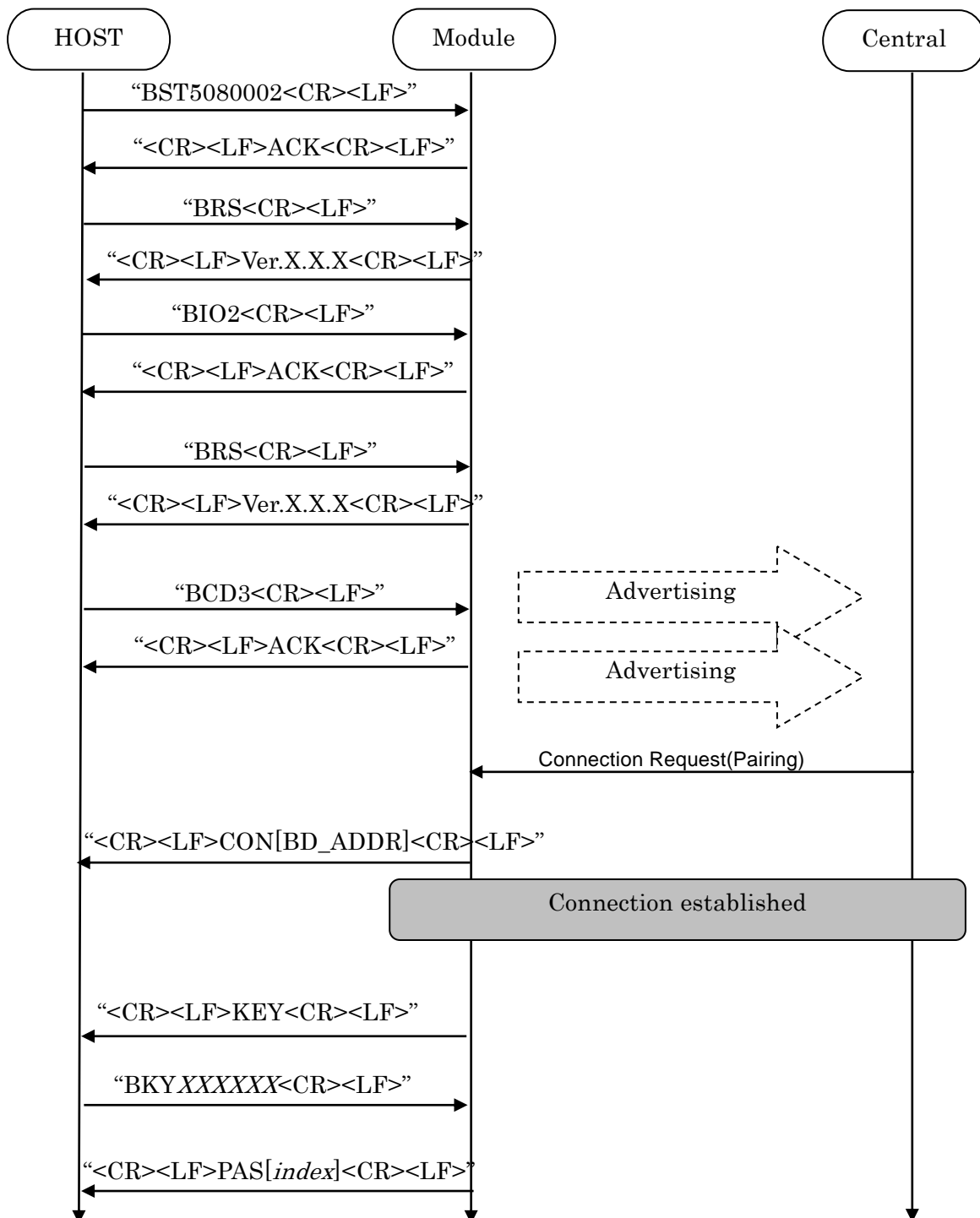
4.17.2 Out of Band



4.17.3 Passkey Entry, Peripheral Displays



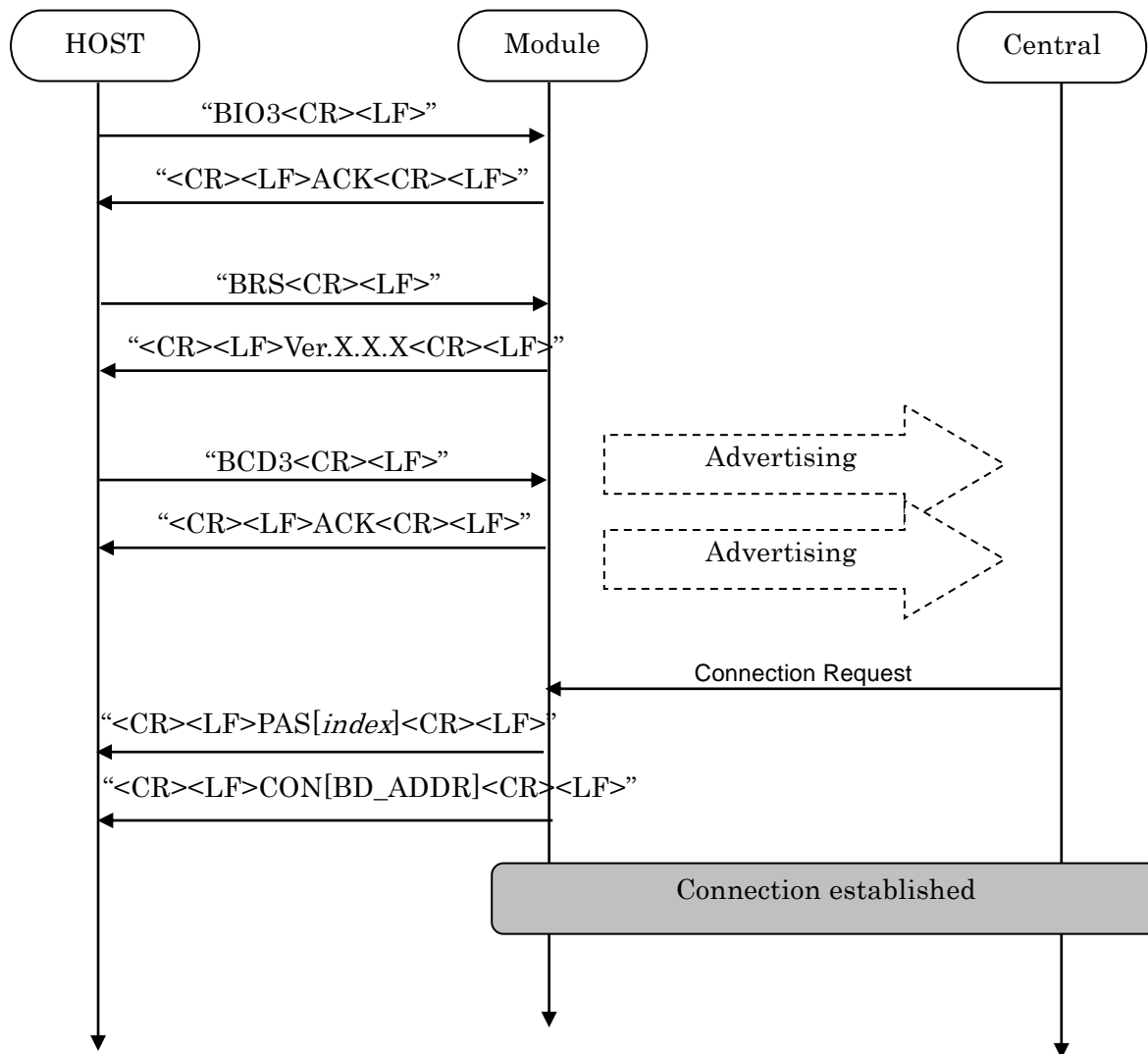
4.17.4 Passkey Entry, User Inputs on Peripheral



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4.17.5 Just Works



4.18. Notices

1. This application uses Softdevice S130 V2.0.1. for Peripheral.
2. <CR><LF> are not added to the first response for the GT3 command. After outputting the first response, <CR><LF>ACK<CR><LF> is outputted.
3. The parameter of the ST3 command is ignored on and after NULL(0x00).
4. Connection Interval may be refused. It will accept if there is a request for Connection Interval from Central side.
5. ST2 command accepts only Static Address (BLUETOOTH SPECIFICATION Version 4.2 [Vol 6 PartB] 1.3.2.1). A static address is a 48-bit randomly generated address and shall meet the following requirements.
 - The two most significant bits of the static address shall be equal to '1'.
 - All bits of the random part of the static address shall not be equal to '1'.
 - All bits of the random part of the static address shall not be equal to '0'.
6. The buffer size for Sleep (Section 4.5.5) is 128byte. If the buffer is full, further data received is discarded without any events.
7. The buffer size for Host wake-up (Section 4.9) is 128byte. If the buffer is full, further data received is discarded without any events.
8. TT command set the flag for Direct Test Mode.
To reset the flag, input "31 31(HEX)" or set GPIO P0.04 Low for 3 second. Until the flag is reset, the module keeps DTM even after system restart.
9. Do not turn the power off while the data is written to FLASH memory with ST3/ST4/ST5/ST8/DS/DD/TT command. It takes up to 500ms to complete the writing process asynchronously after ACK response.
10. For CD command with parameter 2 (White List Advertising, Customized Advertising data), do not turn on "Discoverable Mode" flag in Flags data type in Customized Advertising data.
11. If the bonding information of the same device is stored multiple times, delete with DS command except the latest stored data.
It may occurs when the bonding information in bonded peer device is deleted then the device is connected in whitelist Advertising mode (CD1 and CD2).
12. Connection parameter update request is sent 5 seconds after the connection is established if the connection parameters of Peripheral are different from the parameters Central has specified in CONNECT_REQ.
13. PSKEY_USER08 and PSKEY_USER 11 must be enabled before setting the Local Device I/O capabilities
14. It takes about 10 seconds to initialize the FLASH area when executing DFU. Please start communication after Pin0.19 goes High after completion of initialization.

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4. Central

5.1 Control Command and Event List

5.1.1. Common Commands

Command Character	Function	Parameter	Response
Configuration These commands are available when scanning stopped.			
ST2	Set Local device address "BST2F01234AABBCC" It will return to the initial value when reset. PSKEY_USER10 shall be set to 0000.	<u>Parameter:</u> BD Address (Static Address)	Successful: ACK Failed: NAK##
ST4	Set default value for User data The setting will be updated after reset. User data is PSKEY, Bonding information and filter's parameter. Please refer section 5.2 about PSKEY. Baudrate setting is not initialized.	/	Successful: ACK Failed: NAK##
ST5	Set PSKEY Value (Note Values 0 >= are valid) Example BST5030100 (set PSKEY 03 to 0x0100) The setting will be updated after reset. Please refer section 5.2.	<u>Parameter 0:</u> PSKEY: DD (Decimal) <u>Parameter 1:</u> Value: HHHH (Hex Word)	Successful: ACK Failed: NAK##
STF	Set Filter's parameter	Please refer section 5.16.	Successful: ACK Failed: NAK##
GT2	Read Local BD Address	/	Successful: Local BD_ADDR, ACK Failed: NAK##
GT5	Read PSKEY Value Example: BGT501 (Get PSKEY 1)	/	Successful: KVHHHH, ACK Failed: NAK##
GT6	Read Paired Peripheral's BD Address and IRK. From top to bottom, index 1 to 7 are assigned for DS command. * All 0xFF is set to IRK. Please refer 5.18 No.4	/	Success: Peripheral's BD Address, IRK, ACK Failed: NAK##

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GTF	Get filter's parameter	Please refer section 5.16.	Successful: Value Failed: NAK##
DS	Delete a Specified Paired Peripheral device.	<u>Parameter:</u> 1-7 : index Please refer GT6 command.	Success: ACK Failed: NAK##
DD	Delete All Paired Peripheral Devices.		Success: ACK Failed: NAK##
TT	Go to Direct Test Mode		Successful: ACK Failed: NAK##
SP	Go to Power saving mode		Failed: NAK##
RS	Reset the module		Successful: Ver. X.X.XC Failed: NAK##
RL	Role switch The setting will be updated after reset.	<u>Parameter:</u> 0 : Peripheral 1 : Central	Successful: ACK Failed: NAK##

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Link Control			
SC	Scan Start or Stop	<u>Parameter</u> '0' – Scanning Stop. '1' – Scanning Start. (Passive scan, Connectable) '2' – Scanning Start. (Active scan, Connectable) '3' – Scanning Start. (Passive scan, Non-Connectable) '4' – Scanning Start. (Active scan Non-Connectable)	Successful: ACK Failed: NAK##
DC	Disconnect		Successful: ACK, DCO Failed: NAK##

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Link Control			
IO	Local Device I/O capabilities 0: Display only. (Passkey Entry) 1: Display and enter "yes" or "no". (Numeric Comparison) 2: Keyboard only. (Passkey Entry) 3: No Input and No Display. (Just Works) 5: Out of Band (OOB) (Default is '3') The setting will be updated after reset.	<u>Parameter</u> I/O capabilities (['0','1','2','3','5'])	Successful: ACK, Failed: NAK##
YN	Answer of numeric collation	<u>Parameter</u> Yes/No '0' – Yes, Accept '1' – No, Reject	Successful: PS,CON Failed:NAK##
KY	Enter the passkey number (Six digit number) Example: BKY895361	Passkey (ASCII) (from "000000" to "999999")	Successful: PS,CON Failed:NAK##
OB	Read Local OOB Data		Successful: OBC 32CHARACTERS OBR 32CHARACTERS Failed: NAK##
OC	Remote OOB Data (Simple Pairing Hash C) 32CHARACTERS	OOB (ASCII) (from "00000000000000000000000000000000" to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF")	Successful: ACK Failed: NAK##
OR	Remote OOB Data (Simple Pairing Randomizer R) 32CHARACTERS	OOB (ASCII) (from "00000000000000000000000000000000" to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF")	Successful: ACK Failed: NAK##

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5.1.2. Common Response Events

Response Events	Function	Parameters
ACK	Successful	
NAK##	Failed	Failed Reason – See Error section 5.3. for further details.
CON	Connection successful	Established Remote BD_ADDR
DCO	Disconnect	<u>Parameter 0:</u> 0 : In Peripheral role 1 : In Central role <u>Parameter 1:</u> Reason in hexadecimal See section 5.3.1 for further details.
SCT	Scanning Timeout	
PAS	Pairing Success	<u>Parameter 0:</u> 0 : Paired device is not stored 1-7 : Index of paired device list
INT	Connection Interval	<u>Parameter0:</u> Max Connection Interval <u>Parameter1:</u> Min Connection Interval
ESR	Enable Service	<u>Parameter:</u> 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication)
DSR	Disable Service	<u>Parameter:</u> 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication)
NM	Shown a six digit number (Numeric Value)	<u>Parameter:</u> From "000000" to "999999" (ASCII)
OBC	Local OOB Data (Simple Pairing Hash C)	<u>Parameter:</u> From "00000000000000000000000000000000" to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" (ASCII)
OBR	Local OOB Data (Simple Pairing Randomizer R)	<u>Parameter:</u> From "00000000000000000000000000000000" to "FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF" (ASCII)
KEY	Request passkey number	
PK	Passkey Number indication	<u>Parameter:</u> From "000000" to "999999" (ASCII)

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5.2 Persistent Store (PS) User Key Description

All Values for "Defaults" are in HEX notation.

Name	PSKEY_USER00	Key Length:	1
Descriptive Name:	Baud rate		
Description:	Set Session Baud Rate. (bps) 0001: 9600, 0002: 19200, 0003: 38400, 0004: 57600, 0005: 115200 0006: 230400, 0007: 460800, 0008: 921600		
Default:	0001 (9600bps)		
Range	0001 - 0008		

Name	PSKEY_USER01	Key Length:	1
Descriptive Name:	Scanning Timeout (sec)		
Description:	Scanning Timeout defines the timeout for the scanning. 0000 means timeout is disabling. Scanning will continue forever.		
Default:	003C (60sec)		
Range	0000 – 3FFF (0 – 16383sec)		

Name	PSKEY_USER02	Key Length:	1
Descriptive Name:	Scanning Interval (msec)		
Description:	The time between the start of two consecutive scanning events. The value in this parameter is multiplied by 0.625msec.		
Default:	00A0 (100msec)		
Range	0004 – 4000 (2.5msec – 10.24sec)		

Name	PSKEY_USER03	Key Length:	1
Descriptive Name:	Connection Interval Minimum (msec)		
Description:	Defines minimum value for the connection interval. The value in this parameter is multiplied by 1.25msec.		
Default:	0014 (25msec)		
Range	0006 – 0C80 (7.5 – 4000msec)		

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Name	PSKEY_USER04	Key Length:	1
Descriptive Name:	Connection Interval Maximum (msec)		
Description:	Defines maximum value for the connection interval. The value in this parameter is multiplied by 1.25msec.		
Default:	0028 (50msec)		
Range	0006 – 0C80 (7.5 – 4000msec)		

Name	PSKEY_USER05	Key Length:	1
Descriptive Name:	Slave latency		
Description:	Defines the slave latency for the connection in number of connection events. The Slave Latency field shall have a value in the range of 0 to ((SupervisionTimeout / connectionIntervalMax*2) -1). The Slave Latency field shall be less than 500.		
Default:	0000		
Range	0000 – 01F3 (0 – 499)		

Name	PSKEY_USER06	Key Length:	1
Descriptive Name:	Supervision Timeout (msec)		
Description:	Defines the connection supervision timeout. The value in this parameter is multiplied by 10msec.		
Default:	01F4 (5000msec)		
Range	000A– 0C80 (100 – 32000msec)		

Name	PSKEY_USER07	Key Length:	1
Descriptive Name:	Auto Scanning Start setting		
Description:	This will store Auto Scanning Start setting. The parameter is correspond to that of SC command. “0000” : Auto start OFF “0001” : Auto start, Passive scan, Connectable “0002” : Auto start, Active scan, Connectable “0003” : Auto start, Passive scan, Non-Connectable “0004” : Auto start, Active scan, Non-Connectable		
Default:	0000		
Range	0000– 0004		

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Name	PSKEY_USER08	Key Length:	1
Descriptive Name:	Scan window setting		
Description:	This will store Scan window setting. The value in this parameter is multiplied by 0.625msec. Scan window shall be less than or equal to Scan interval.		
Default:	0032 (31.25msec)		
Range	0004 – 4000 (2.5msec – 10.24sec)		

Name	PSKEY_USER09	Key Length:	1
Descriptive Name:	Power saving mode setting at startup.		
Description:	This will store Power saving mode setting at startup. "0000" will disable Power saving mode. It does not enter Power saving mode. "0001" will enable Power saving mode. It enters Power saving mode. Regardless of the setting, module can enter the mode by BSP command.		
Default:	0000		
Range	0000– 0001		

Name	PSKEY_USER10	Key Length:	1
Descriptive Name:	BD Address type		
Description:	Set the type of BD Address "0000": Static Address "0001" – "000F" : Resolvable Private Address The value in this parameter is multiplied by 60sec and used as address update interval. (1minite – 15minites)		
Default:	0000		
Range	0000– 000F		

Name	PSKEY_USER11	Key Length:	1
Descriptive Name:	Notice of Connection Parameter Update.		
Description:	"0000": It does not notice the Connection Interval. "0001": When Connection Interval is changed, It notify via "INT" event.		
Default:	0000		
Range	0000– 0001		

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Name	PSKEY_USER12	Key Length:	1
Descriptive Name:	TX power setting.		
Description:	<p>Set the radio's transmit power. Radio transmit power in dBm (accepted values are -30, -20, -16, -12, -8, -4, 0, and 4 dBm).</p> <p>0000: 4, 0001: 0, 0002: -4, 0003: -8, 0004: -12, 0005: -16, 0006: -20, 0007: -30</p>		
Default:	0000		
Range	0000– 0007		

Name	PSKEY_USER13	Key Length:	1
Descriptive Name:	DC/DC converter setting		
Description:	<p>DC/DC converter setting. “0000” will disable internal DC/DC converter (and use internal LDO). “0001” will enable internal DC/DC converter.</p> <p>Note: When supply voltage goes below 2.1V, DCDC is disabled, and enabled when the supply voltage goes up again. About hardware specification, please refer to “DataReport”.</p>		
Default:	0000		
Range	0000– 0001		

Name	PSKEY_USER14	Key Length:	1
Descriptive Name:	RSSI and Advertising data notification setting		
Description:	<p>RSSI and Advertising data notification setting. Please refer section 5.15 for details.</p> <p>“0000” : RSSI disable and Data disable “0001” : RSSI enable and Data disable “0002” : RSSI enable and Data enable</p>		
Default:	0000		
Range	0000– 0002		

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Name	PSKEY_USER15	Key Length:	1
Descriptive Name:	Filter (Device name)		
Description:	Set the filter of Device name. "0000" will disable the filter. "0001" will enable the filter. Device name is set with STF command.		
Default:	0001		
Range	0000– 0001		

Name	PSKEY_USER16	Key Length:	1
Descriptive Name:	Filter (Advertising data)		
Description:	Set the filter of Advertising data. "0000" : disable filter "0010" : iBeacon (UUID filter OFF) "0011" : iBeacon (UUID filter ON) "0020" : iBeacon (-ish) (UUID filter OFF) "0021" : iBeacon (-ish) (UUID filter ON) UUID is set with STF command.		
Default:	0000		
Range	0000– 0021		

Name	PSKEY_USER17	Key Length:	1
Descriptive Name:	Filter (RSSI)		
Description:	Set the filter of RSSI. Parameter "00XX" XX : -128 - 127 (0x80 – 0x7F : two's complement)		
Default:	0080		
Range	0080– 007F		

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Name	PSKEY_USER18	Key Length:	1
Descriptive Name:	Filter (BD Address)		
Description:	<p>Set the filter of BD Address. The filter checks "Allow" then "Deny".</p> <p>Parameter "00XY"</p> <p>X : Allow Y : Deny</p> <p>0 Disable filter</p> <p>1 Specify in BD Address</p> <p>2 Specify in Company ID(Public BD Address)</p> <p>BD Address is set with STF command.</p>		
Default:	0000		
Range	0000– 0022		

5.3 Error Codes

#	Error Name	Program Logic Cause / Action taken by Host
-1	Unknown Error	There is the possibility that the hardware is out of order.
00	Command Not Recognized	It confirms whether or not the command is correct.
01	Bad Parameter	It confirms parameter range.
02	Invalid State	Stop Advertising / Scanning or Disconnect.
04	UART Buffer full (buffer size : 128byte)	The commands shall be sent after previous command response.
05	Connection Fail (Central Only)	Please try again. If bond information exists, delete it and try again.
06	Device Full	Flash block for storing pairing information is full. (Max 7) To store new device information, delete with BDD command.
07	Pairing Failed	Please try again. If bond information exists, delete it and try again.
08	FLASH access error	Please run forced initialize (5.5.4).
11	Connection Parameter Error	It confirms connection parameter. Check PSKEY settings.
21	Advertising Parameter Error (Peripheral Only)	It confirms advertising data and parameter. Check PSKEY setting. If Advertising data is customized, check the parameter and the response of ST9 command.
22	Whitelist Error	It confirms whether or not bonded devices exist.
31	Scanning Parameter Error (Central Only)	It confirms scanning parameter. Check PSKEY setting.

5.3.1. Disconnect reason

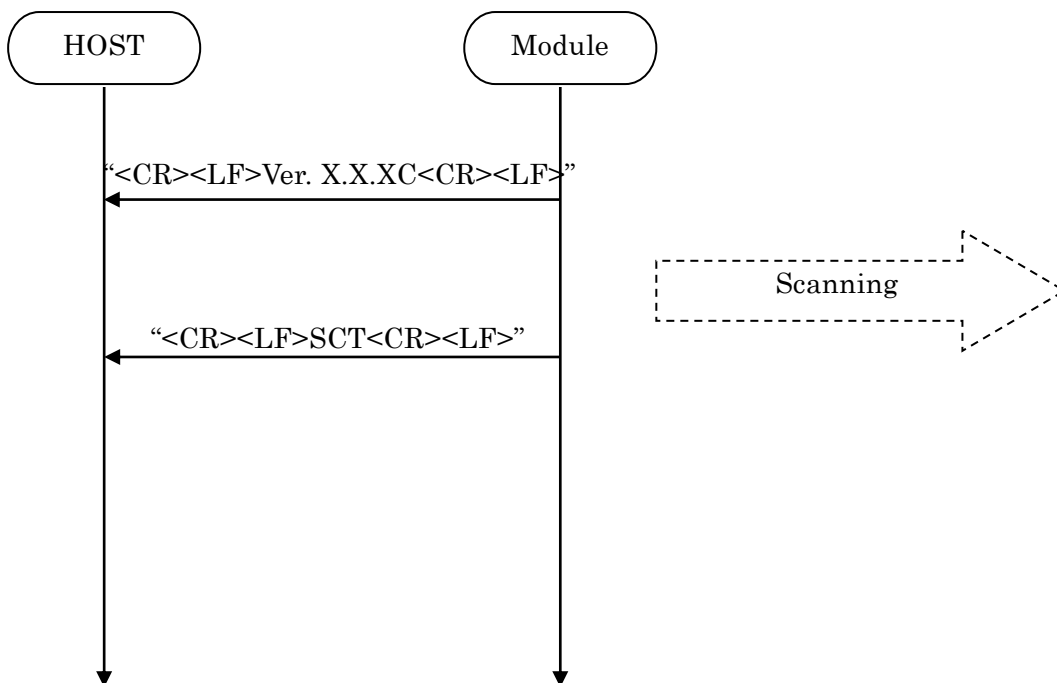
#	Error Name	Description
08	BLE_HCI_CONNECTION_TIMEOUT	Connection Timeout.
13	BLE_HCI_REMOTE_USER_TERMINATED_CONNECTION	Remote User Terminated Connection.
16	BLE_HCI_LOCAL_HOST_TERMINATED_CONNECTION	Local Host Terminated Connection.
3D	BLE_HCI_CONN_TERMINATED_DUE_TO_MIC_FAILURE	Connection Terminated due to MIC Failure.

About other error codes, please see below.

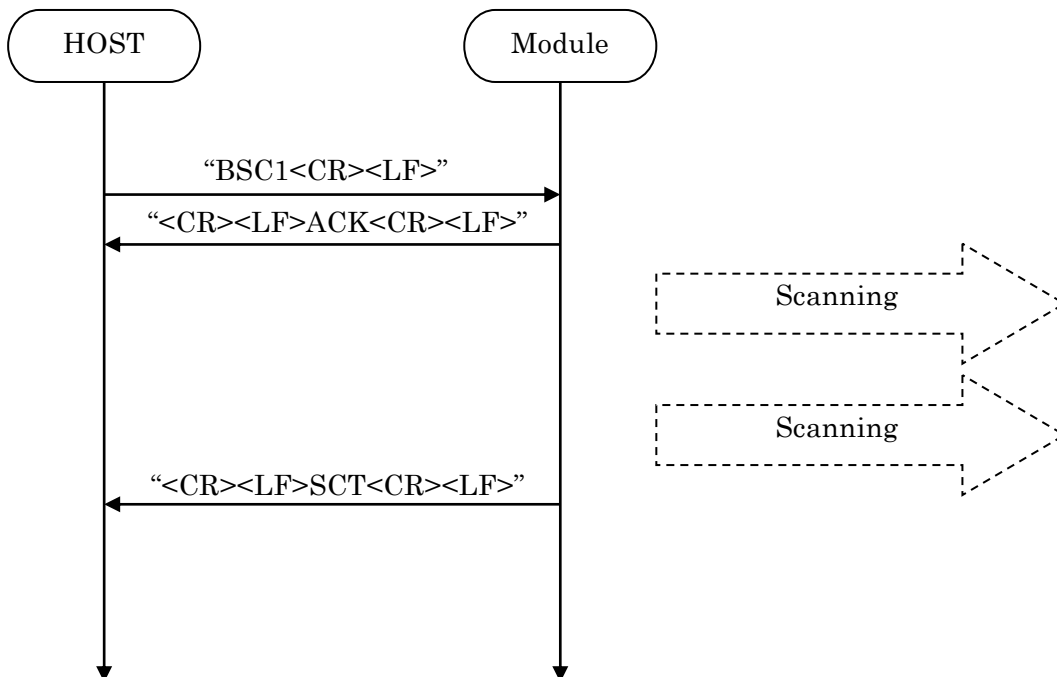
https://infocenter.nordicsemi.com/topic/com.nordic.infocenter.s130.api.v2.0.1/group_ble_hci_status_codes.html

5.4 Message Sequence Chart

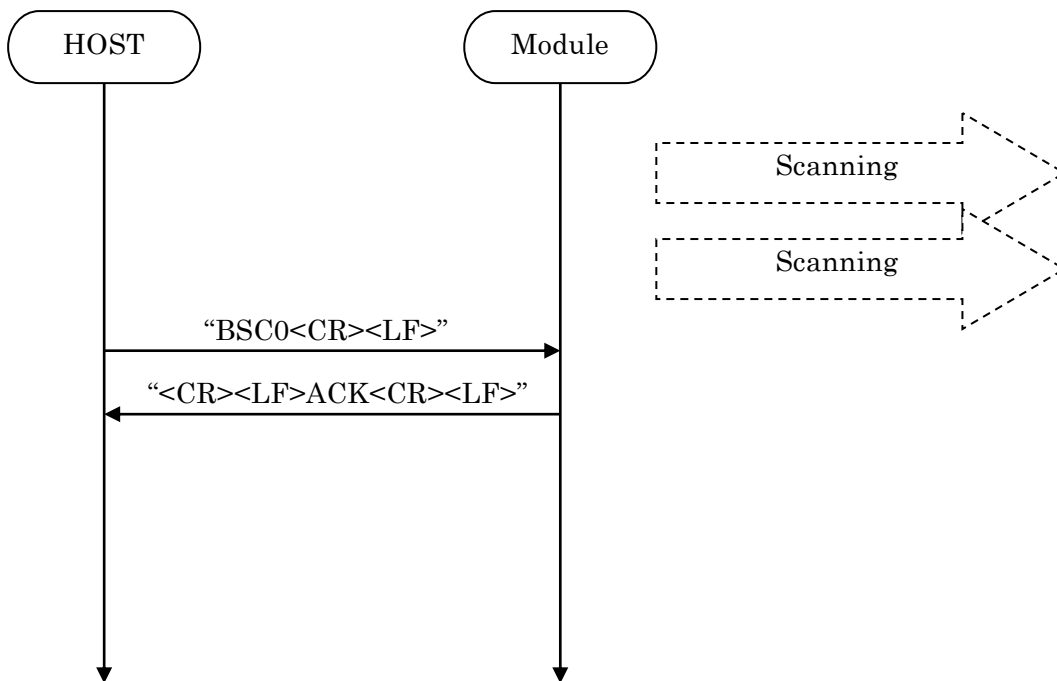
5.4.1. Power On (In case of PSKEY_USER01#'0000' and PSKEY_USER07#'0000')



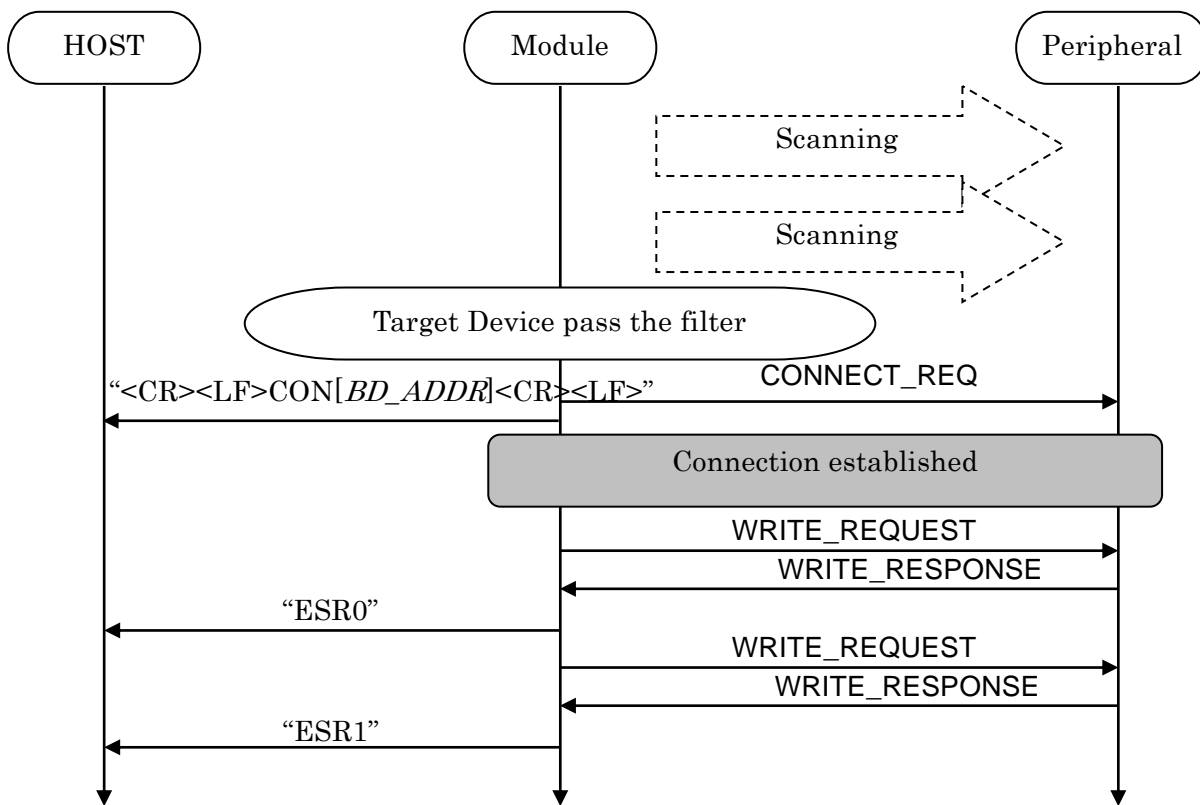
5.4.2. Scan Start



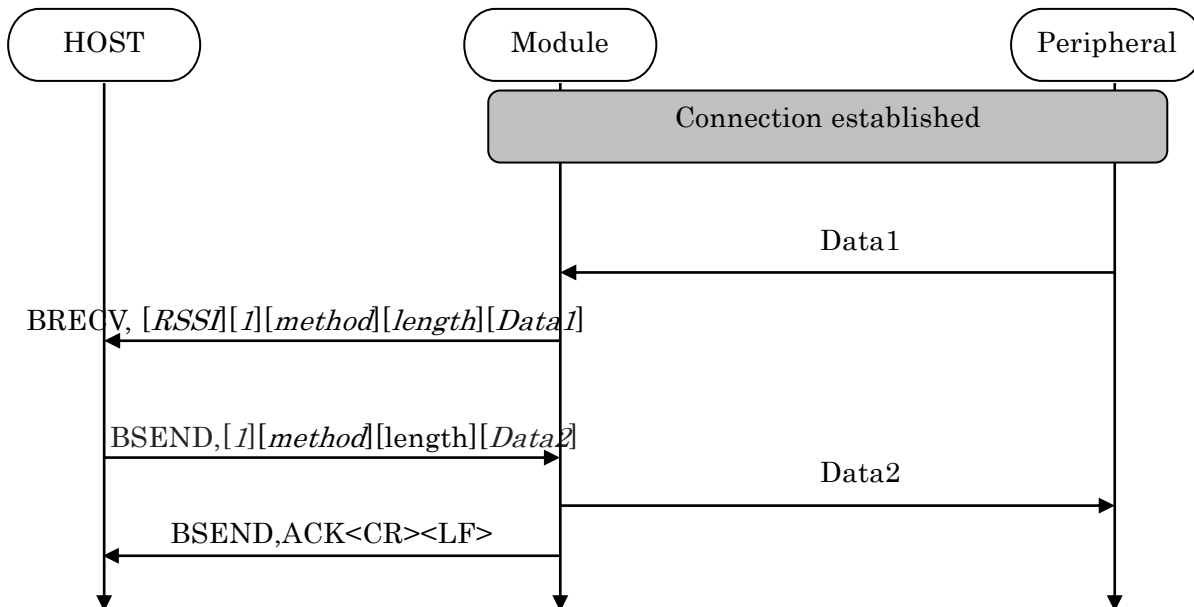
5.4.3. Scanning Stop



5.4.4. Connect

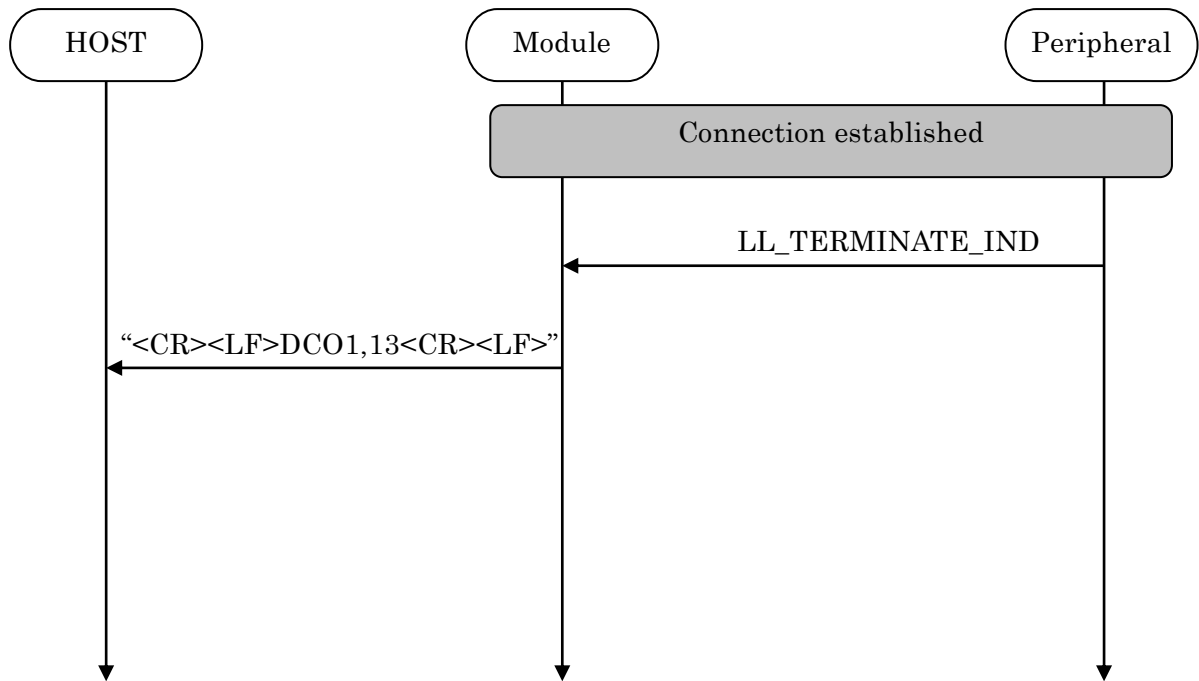


5.4.5. Sending & Receiving Data over a connected Link

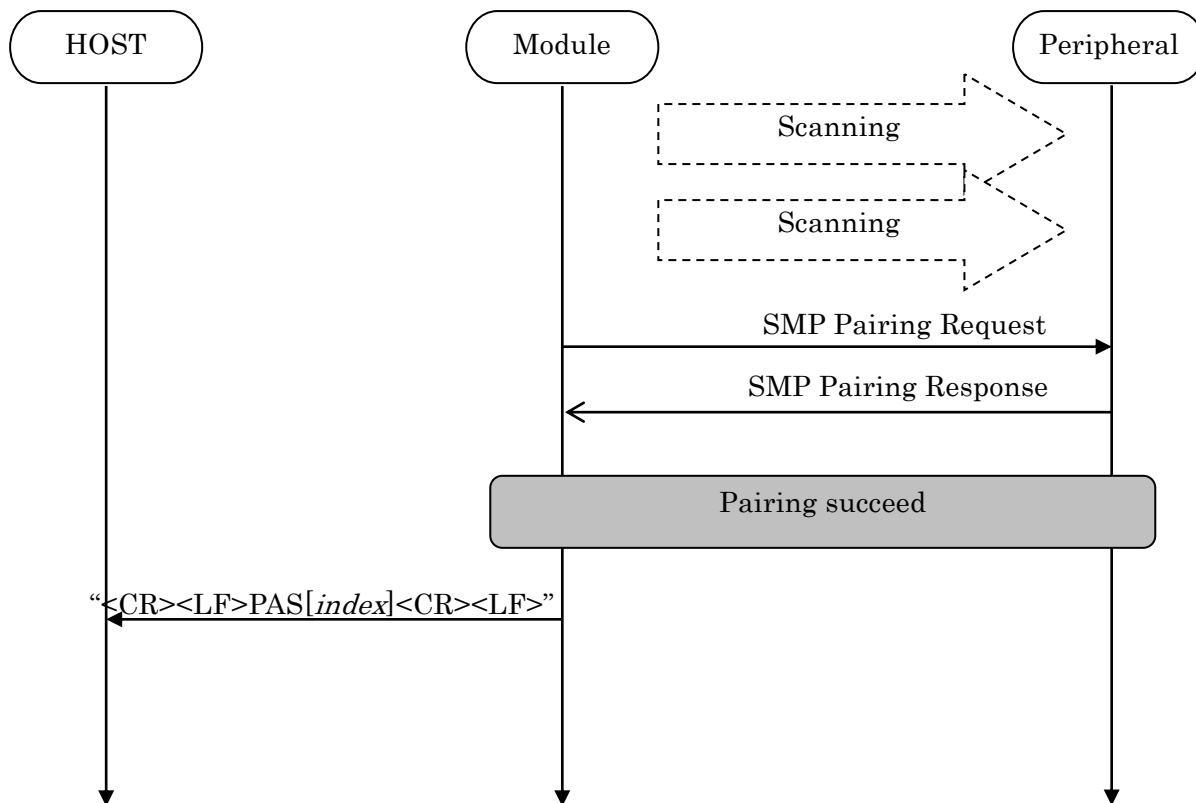


Max send a packet data size = 20bytes
 Max receive a packet data size = 20bytes

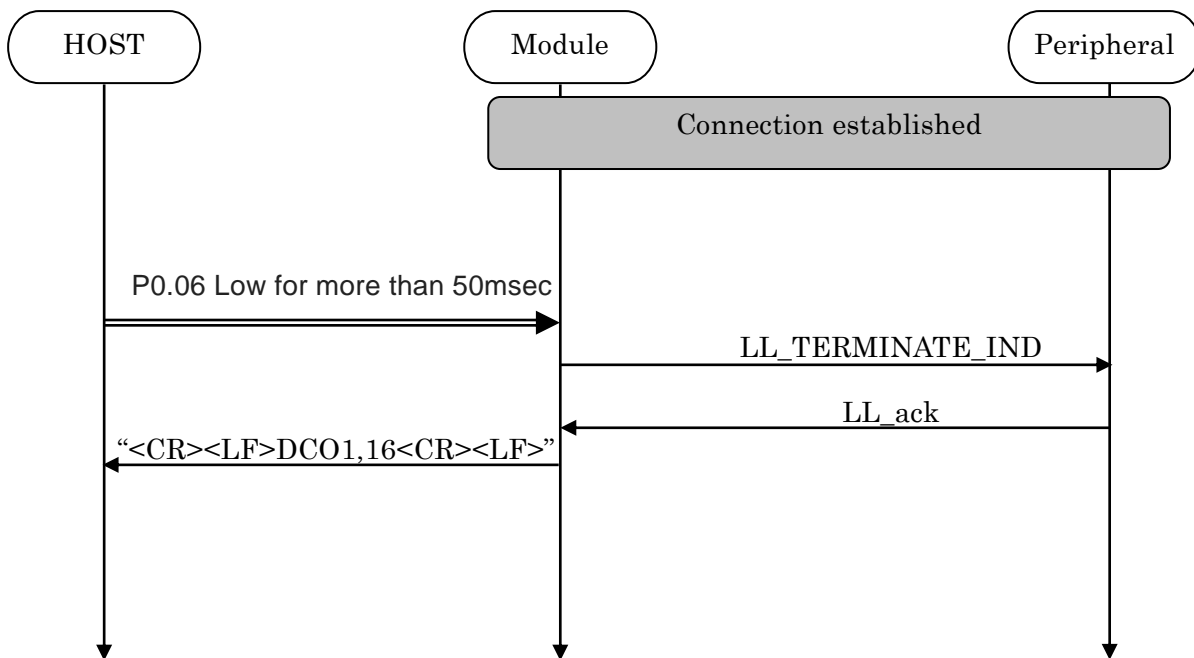
5.4.6. Disconnect



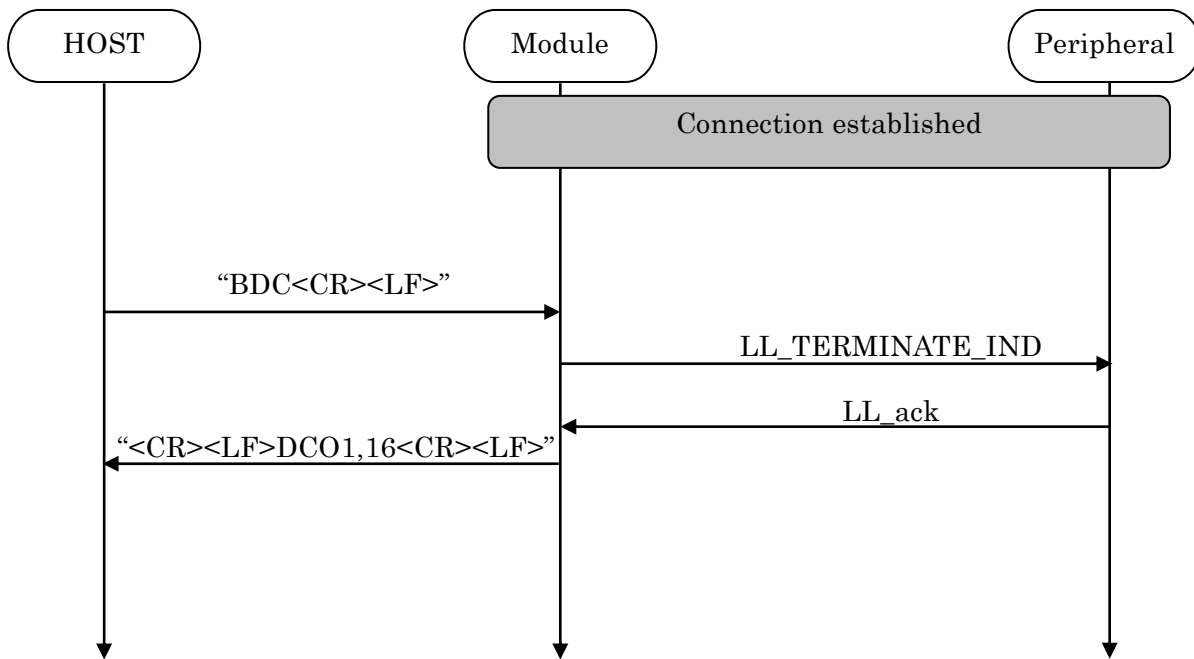
5.4.7. Pairing



5.4.8. Disconnect Request (GPIO)



5.4.9. Disconnect Request (Command)



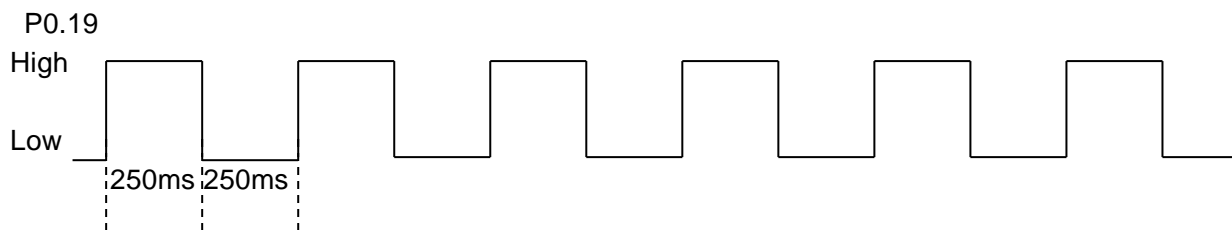
5.5 GPIO state and control

Pin Name	Input / Output	Description
P0.04	Input	Forced initialize(Central's Info)
		Request Sleep mode
		Request Direct Test mode
P0.17	Input	Request DFU mode
		Request Direct Test mode
P0.05	Output	Module active/sleep indicate
P0.19	Output	State indication of module
		DFU indication
P0.06	Input	Disconnect request
		Resume from Power saving mode
		Request Direct Test mode
P0.21	Input	Sleep indication of host
		Resume from Power saving mode
P0.25	Output	Wake up request

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5.5.1. Disconnect Request



5.5.2. CONNECTED

P0.19 High

5.5.3. Disconnect & Standby

P0.19 Low

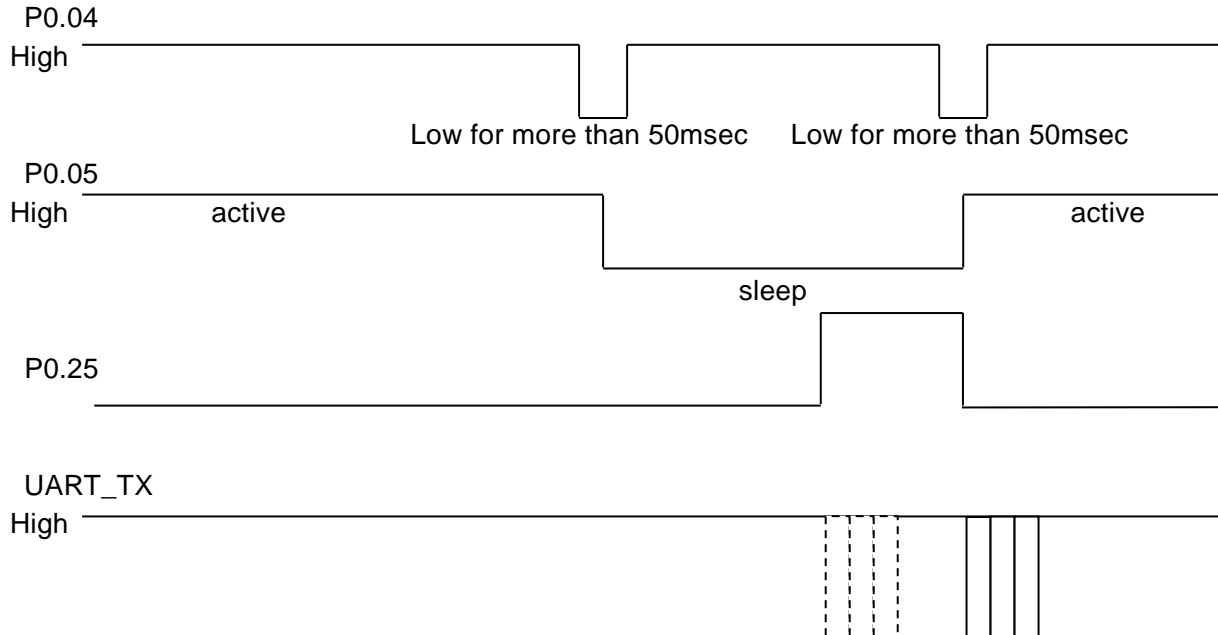
5.5.4. Forced initialize

Both Central and Peripheral user settings of the module return to a default value when make P0.04 Low at module startup.

After P0.04 Low, H/W reset or power restart is necessary.

The module start as Peripheral role.

5.5.5. Sleep mode request and indicate



* Buffer size : 128byte If the buffer is full, further data received is discarded without any events.

5.6 Service

Primary Service

TAIYO YUDEN Original Service UUID :

0x442F1570-8A00-9A28-CBE1-E1D4212D53EB

Characteristic

TAIYO YUDEN Original Characteristic UUID :

0x442F1571-8A00-9A28-CBE1-E1D4212D53EB (Read, Notification)

TAIYO YUDEN Original Characteristic UUID :

0x442F1572-8A00-9A28-CBE1-E1D4212D53EB (Write no response)

TAIYO YUDEN Original Characteristic UUID :

0x442F1573-8A00-9A28-CBE1-E1D4212D53EB (Read, Indication)

TAIYO YUDEN Original Characteristic UUID :

0x442F1574-8A00-9A28-CBE1-E1D4212D53EB (Write)

*** GATT Server is implemented in Peripheral role of this software.****5.7 UART configuration**

RX_PIN : P0.03

TX_PIN : P0.01

CTS_PIN : P0.02

RTS_PIN : P0.00

Baud rate : depend on PSKEY_USER00 (default setting: 9600)

Data : 8 bit

Parity : none

Stop : 1 bit

Hardware flow control : Enabled (In case of DTM, flow control is disabled)

5.8 SWD (Serial Wire Debug)

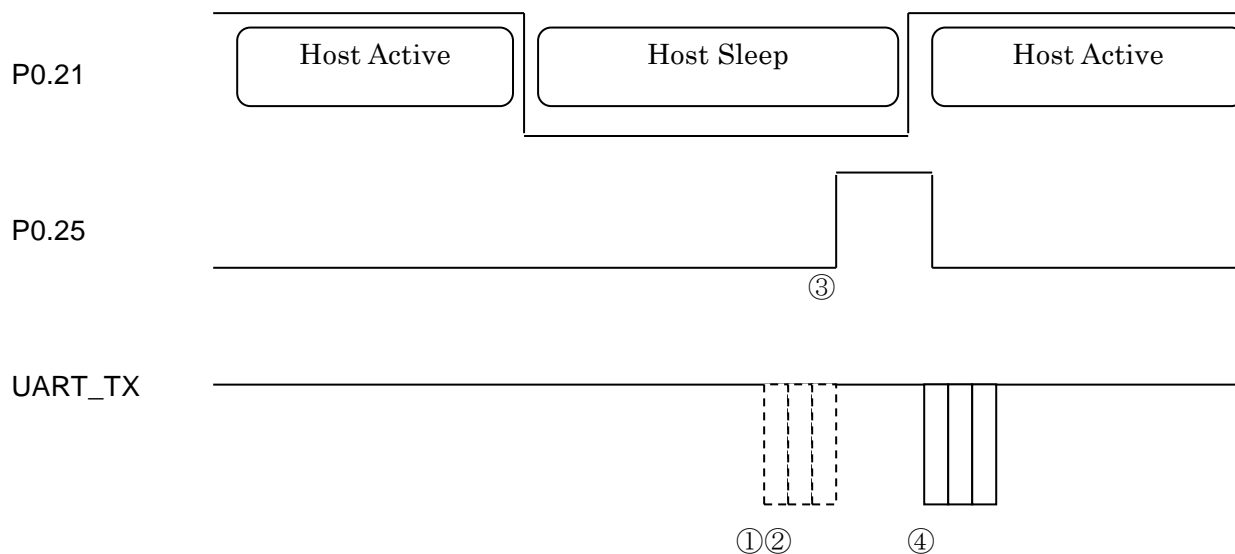
SWDIO :

SWDCLK :

These pin are for FW debug and flash programming I/O.

We recommend your company set up these pin for rewriting the firmware.

5.9 Host wake-up sequence

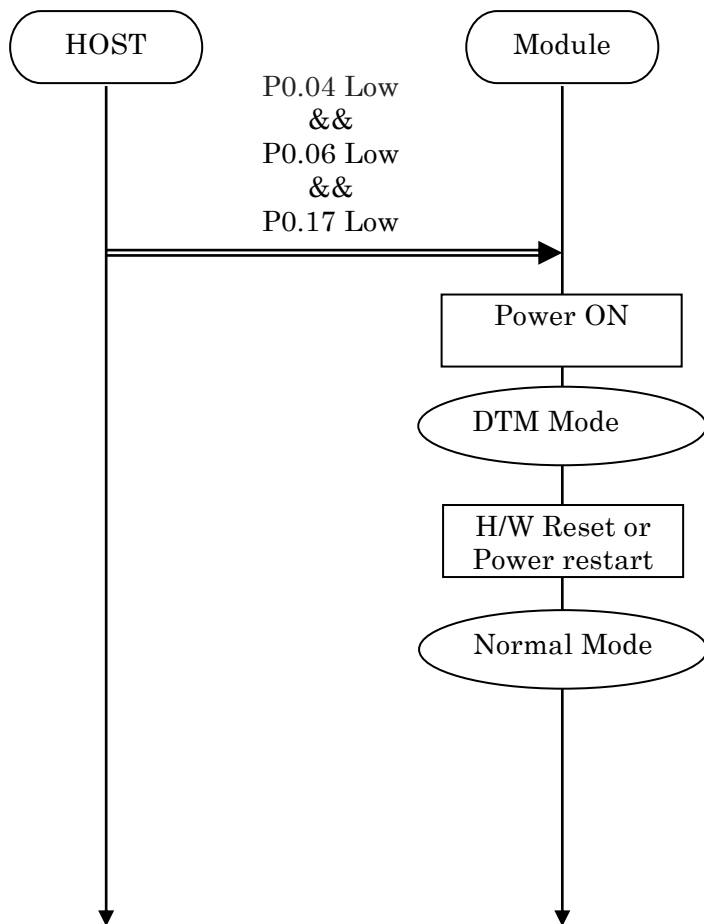


- ① Communication data or an event occurs in HOST Sleep.
- ② It waits until the host becomes active.
- ③ Module request to host wake-up via PIO.
- ④ If HOST becomes Active and Module is active (refer 5.5.5), module send communication data or event.

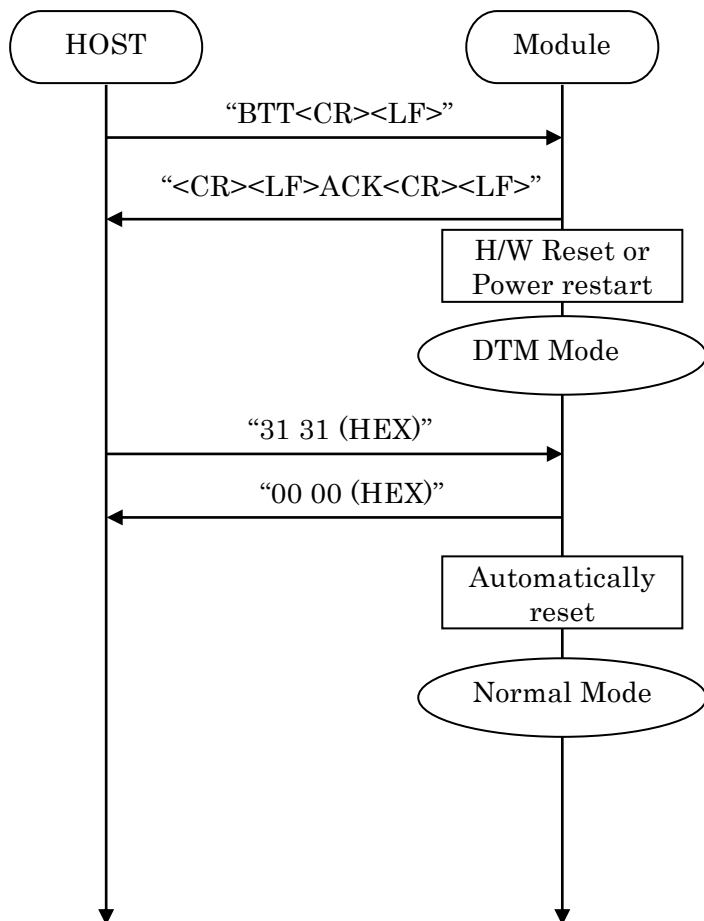
*** Buffer size : 128byte If the buffer is full, further data received is discarded without any events.**

5.10 DTM (Direct Test Mode)

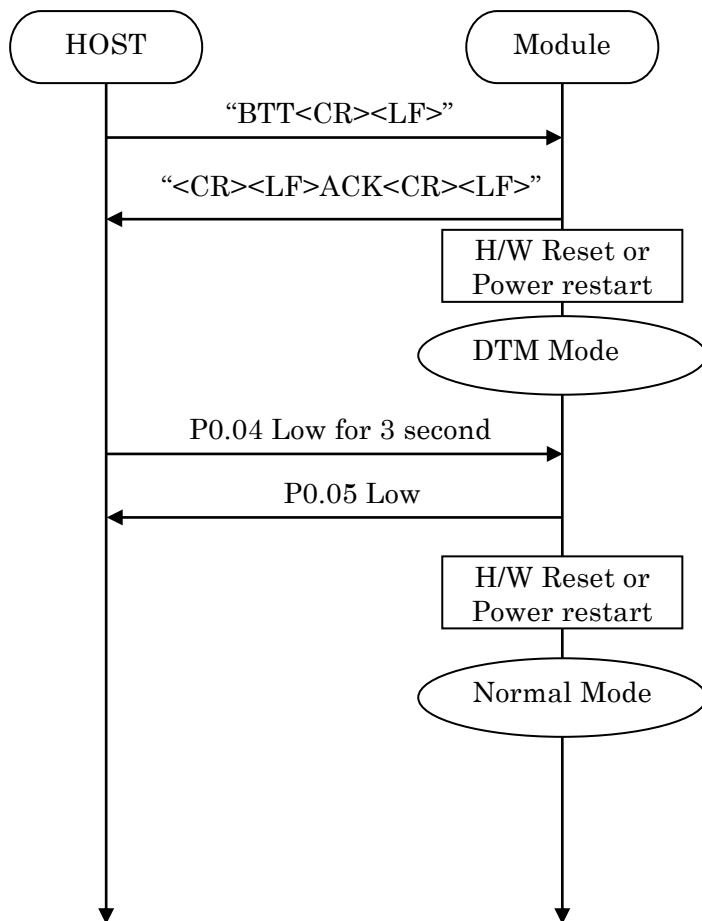
5.10.1. Enter DTM and exit DTM (one-time)



5.10.2. Enter DTM and exit DTM with UART command (permanent)



5.10.3. Enter DTM and exit DTM with GPIO command (permanent)



5.10.4. DTM Commands/Events

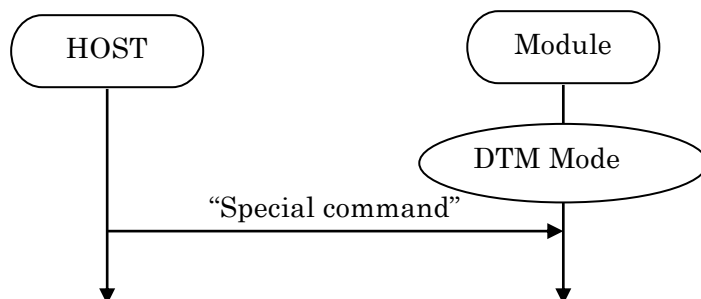
These commands/events are conforming to DTM of *Bluetooth*[®] specifications V4.0. Please refer to *Bluetooth*[®] specifications V4.0. (Core System Package [Low Energy Controller volume] Part F, Direct Test Mode)

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5.11 GPIO check

Host can inspect GPIO by special commands in DTM.

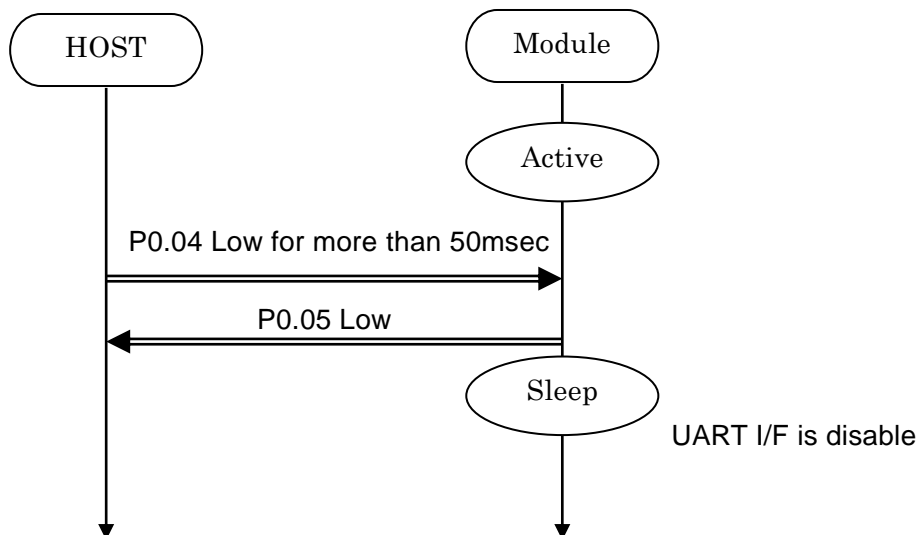


Command (Hex value)	Function	Response
32 30	It makes P0.05 Low.	00 00
32 31	It makes P0.05 High.	00 00
33 30	It makes P0.19 Low.	00 00
33 31	It makes P0.19 High.	00 00
34 30	It makes P0.25 Low.	00 00
34 31	It makes P0.25 High.	00 00
35 30	It makes P0.23 Low.	00 00
35 31	It makes P0.23 High.	00 00
39 39	It acquires state of Input Pin.	XX 00 00 XX: state Bit0: P0.04 (0:Low, 1:High) Bit1: P0.17 (0:Low, 1:High) Bit2: P0.06 (0:Low, 1:High) Bit3: P0.21 (0:Low, 1:High) Example 01 : P0.04 is High. Other Pin is Low. F: All Pin is High. B: P0.06 is Low. Other Pin is High.

5.12 Sleep Mode (SYSTEM ON)

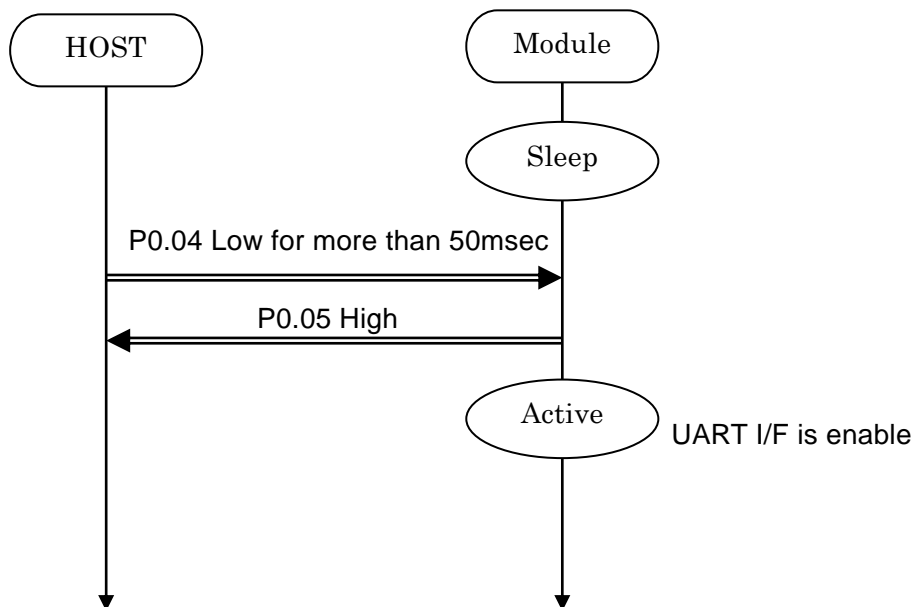
This Sleep is available in during Scanning and Connection.
 UART I/F is not usable during Sleep.

5.12.1. Enter sleep mode



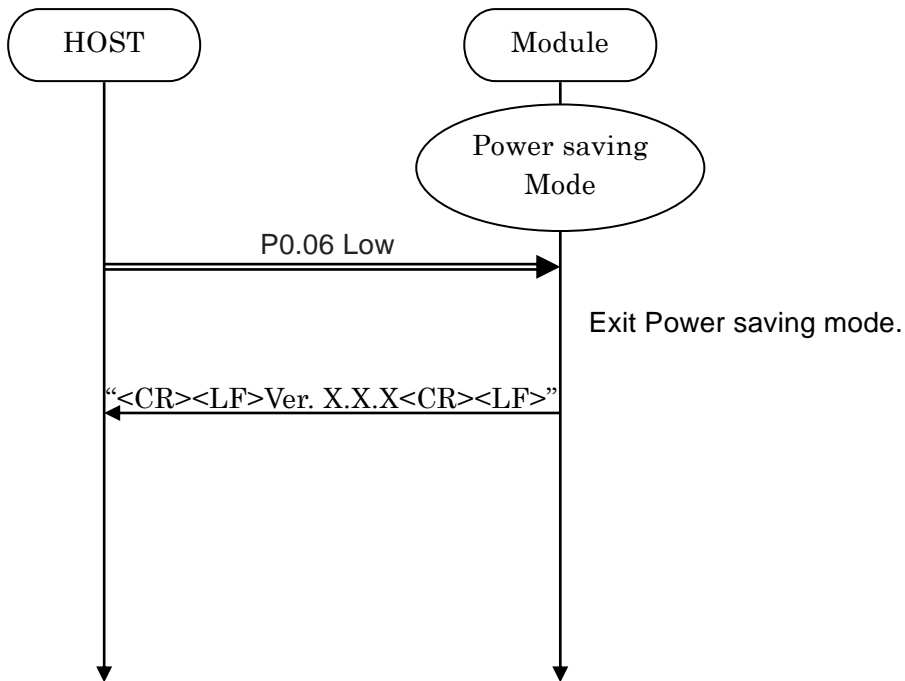
In case of UART data happen, the module notify to Host via P0.25.
 It is same as "Host wake-up".

5.12.2. Exit sleep mode

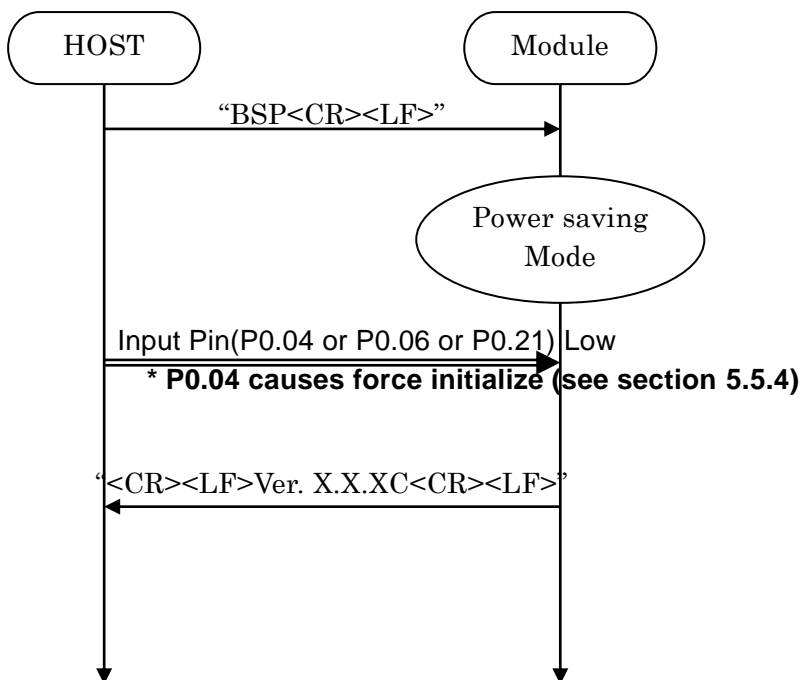


5.13 Power saving mode (SYSTEM OFF)

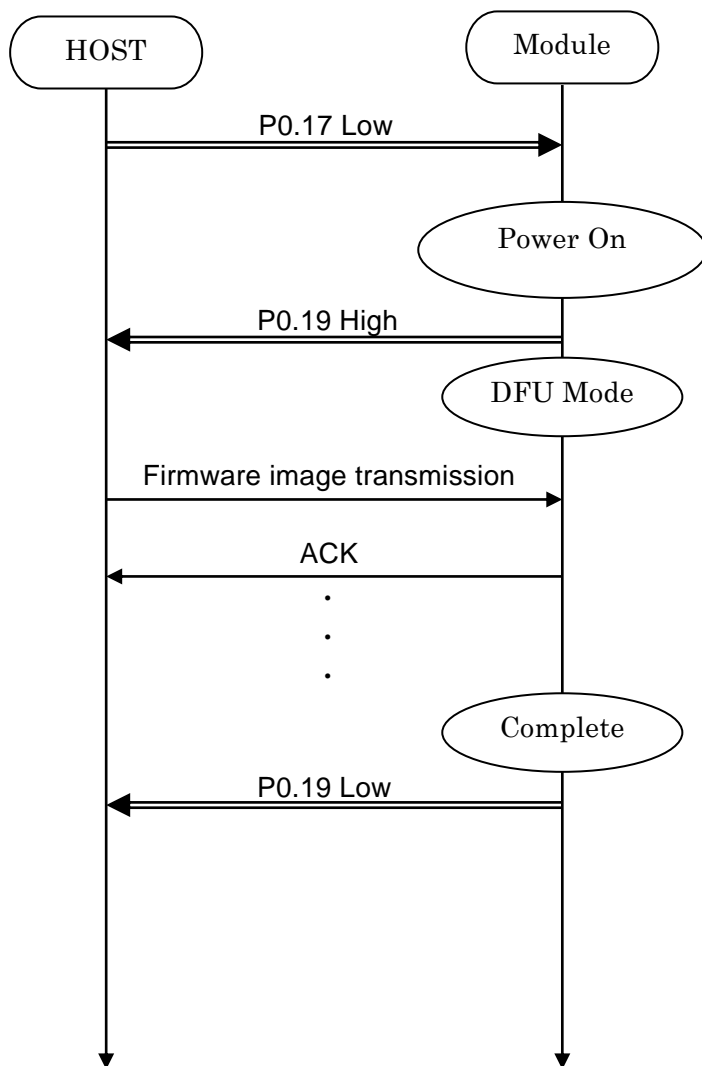
5.13.1. On startup (In case of PSKEY_USER09='0001')



5.13.2. BSP command



5.14 Device Firmware updates (DFU)



UART

- Baud rate : 38400 bps
- Data : 8 bit
- Parity : none
- Stop : 1 bit
- Hardware flow control : Enabled

* Please contact TAIYO YUDEN when you use this function.

5.15 RSSI and Advertising data notification

Output RSSI value to UART according to PSKEY_USER14.

Format

In Advertising (only Central)

```
<CR><LF><RSSI (signed 4-digit)><,><BD Address (12-digit)><,>
<Data><CR><LF>
```

Example

```
// In Advertising (only Central)
-043,DF3F7BAF76F9,0123456789ABCDEF0123456789ABCDEF
-101,E647ADD614B0,0123456789ABCDEF0123456789ABCDEF
-044,DF3F7BAF76F9,0123456789ABCDEF0123456789ABCDEF
```

When UART baudrate is too low compared to RSSI notification rate, the output data may be incomplete.

In Sleep (5.5.5) and Host Sleep (5.9), RSSI notification is suspended.

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5.16 Filter

The filter for Scan (SC command).

In Connectable Scan, the module connect to the first device that passes the filter.

When the notification is enabled in PSKEY_USER14, Advertising data that passes the filter is output to UART.

5.16.1 PSKEY

Name	Filter	Default
PSKEY_USER15	Device name	Enabled Default device name : "TYSA-B 4.0.1"
PSKEY_USER16	Advertising data	Disabled
PSKEY_USER17	RSSI	-127 (Disabled)
PSKEY_USER18	BD Address	Disabled

By default, only device name filter "TYSA-B 4.0.1" is enabled.

5.16.2 STF command

Parameter 0:

0: Initialize all filter

1: Device name : PSKEY_USER15

Parameter 1:

Device name (ASCII 16byte Complete Local Name or Shortened Local Name)

Default target device name : "TYSA-B 4.0.1"

2: UUID 16byte : PSKEY_USER16

Parameter 1:

Index (ASCII 1-5)

Parameter 2:

UUID (Hex ASCII 32byte)

"0011" : iBeacon (UUID filter ON)

: Company ID must be set to iBeacon

"0021" : iBeacon (-ish) (UUID filter ON)

: You can use filters without having to set Company ID to iBeacon

3: BD Address (Allow) : PSKEY_USER18

Parameter 1:

Index (ASCII 1-3)

Parameter 2:

BD Address (Hex ASCII 12byte)

4: BD Address (Deny) : PSKEY_USER18

Parameter 1:

Index (ASCII 1-3)

Parameter 2:

BD Address (Hex ASCII 12byte)

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5: Company ID (Public BD Address) (Allow) : PSKEY_USER18

Parameter 1:

Company ID (Hex ASCII 6byte)

Please set 6 bytes from the beginning of the address

6: Company ID (Public BD Address) (Deny) : PSKEY_USER18

Parameter 1:

Company ID (Hex ASCII 6byte)

Please set 6 bytes from the beginning of the address

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5.16.3 GTF command

Parameter 0:

1: Device name

Response value:

Device name (ASCII 16byte Complete Local Name or Shortened Local Name)

2: UUID 16byte

Parameter 1:

Index (ASCII 1-5)

Response value:

UUID (Hex ASCII 32byte)

3: BD Address (Allow)

Parameter 1:

Index (ASCII 1-3)

Response value:

BD Address (Hex ASCII 12byte)

4: BD Address (Deny)

Parameter 1:

Index (ASCII 1-3)

Response value:

BD Address (Hex ASCII 12byte)

5: Company ID (Allow)

Response value:

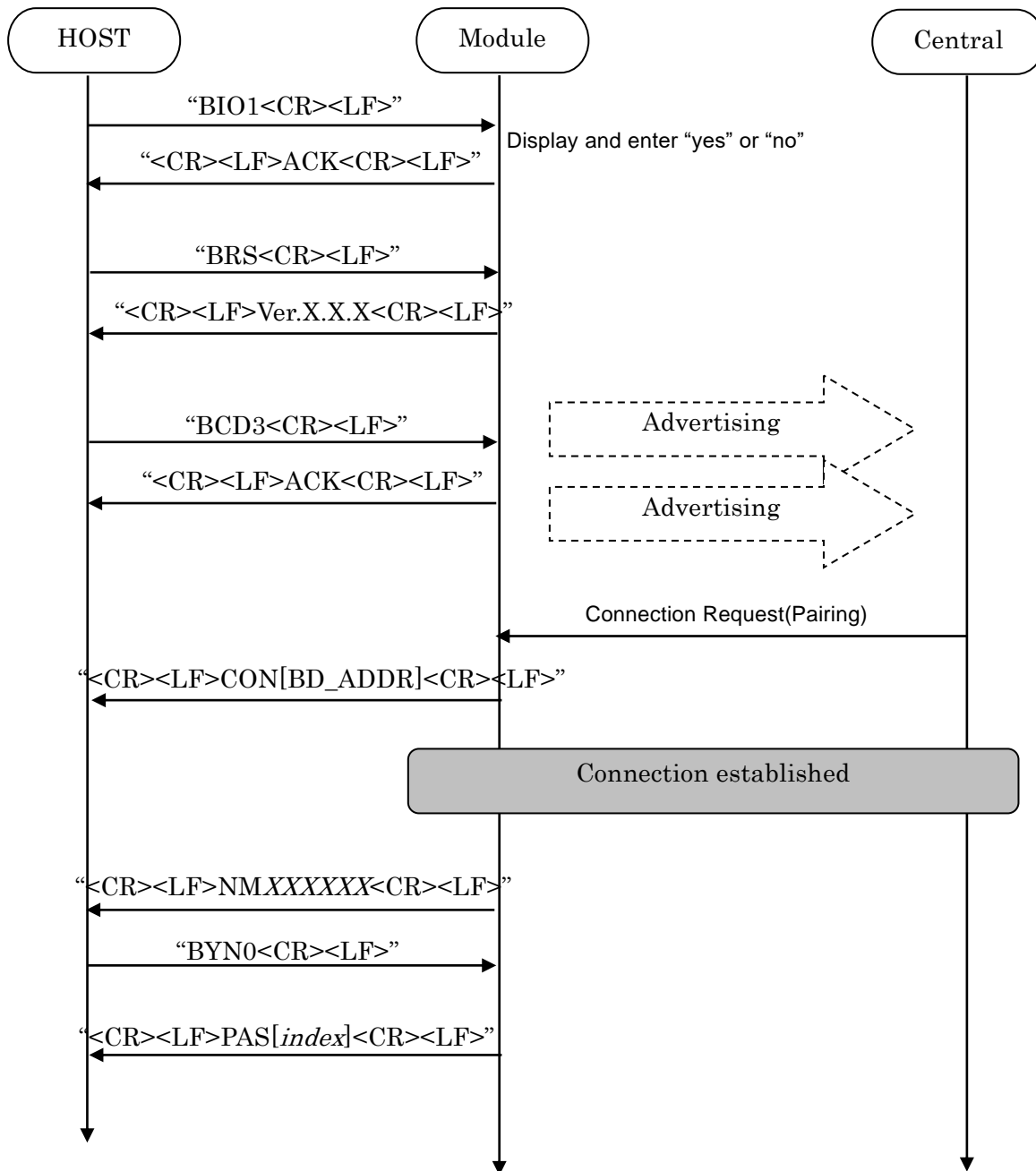
Company ID (Hex ASCII 6byte)

6: Company ID (Deny)

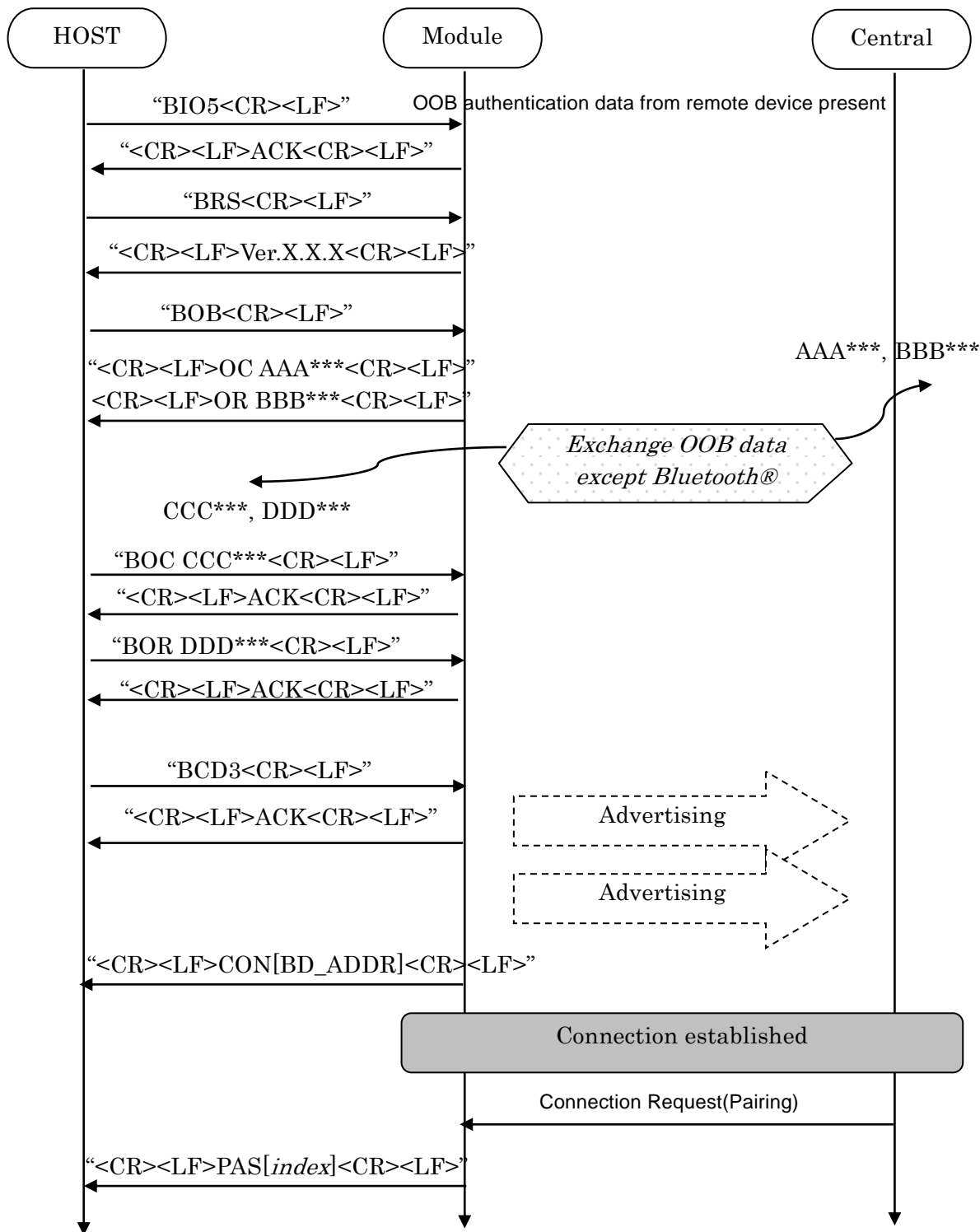
Response value:

Company ID (Hex ASCII 6byte)

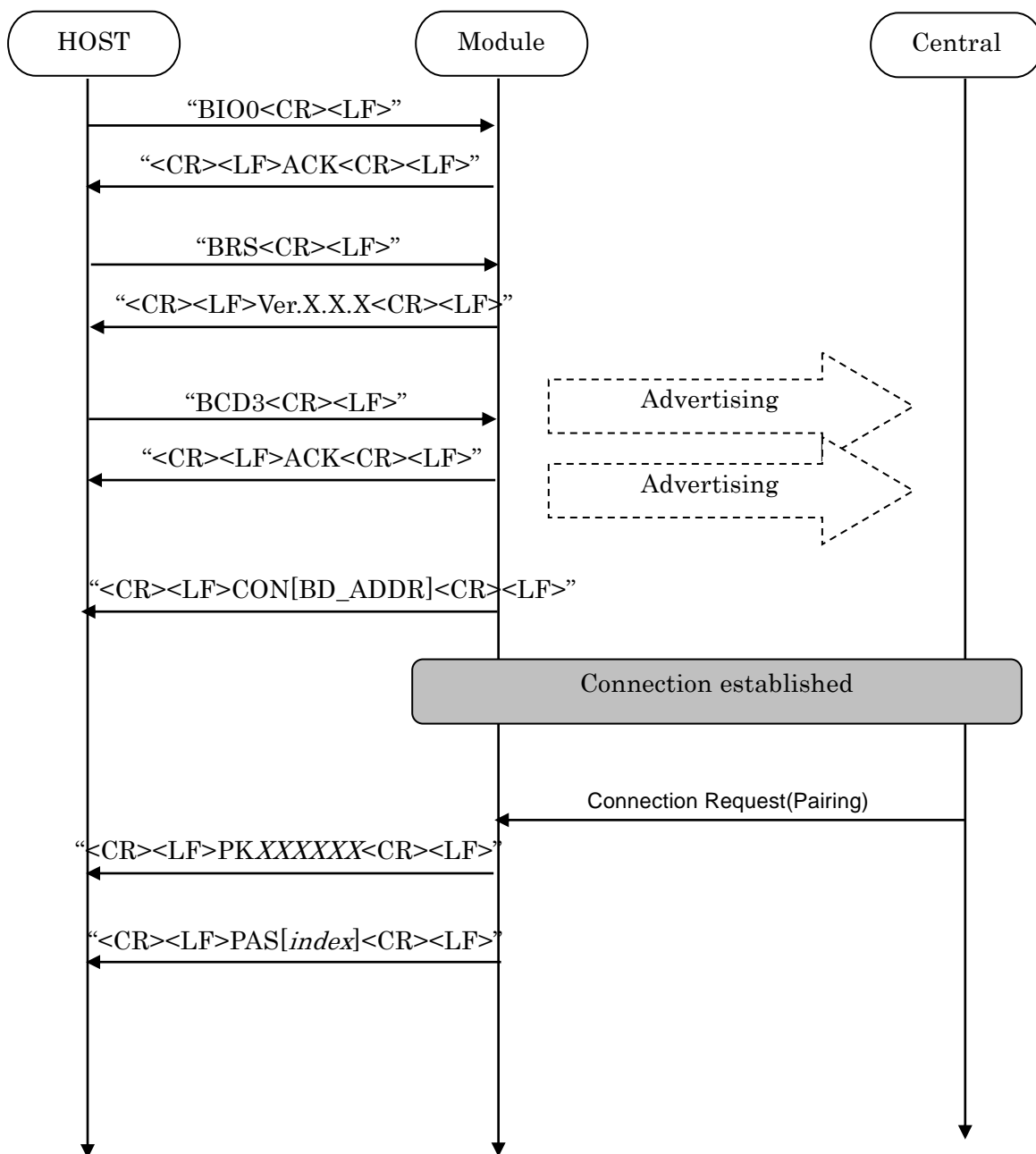
5.17 LE Secure Connection
5.17.1 Numeric Comparison



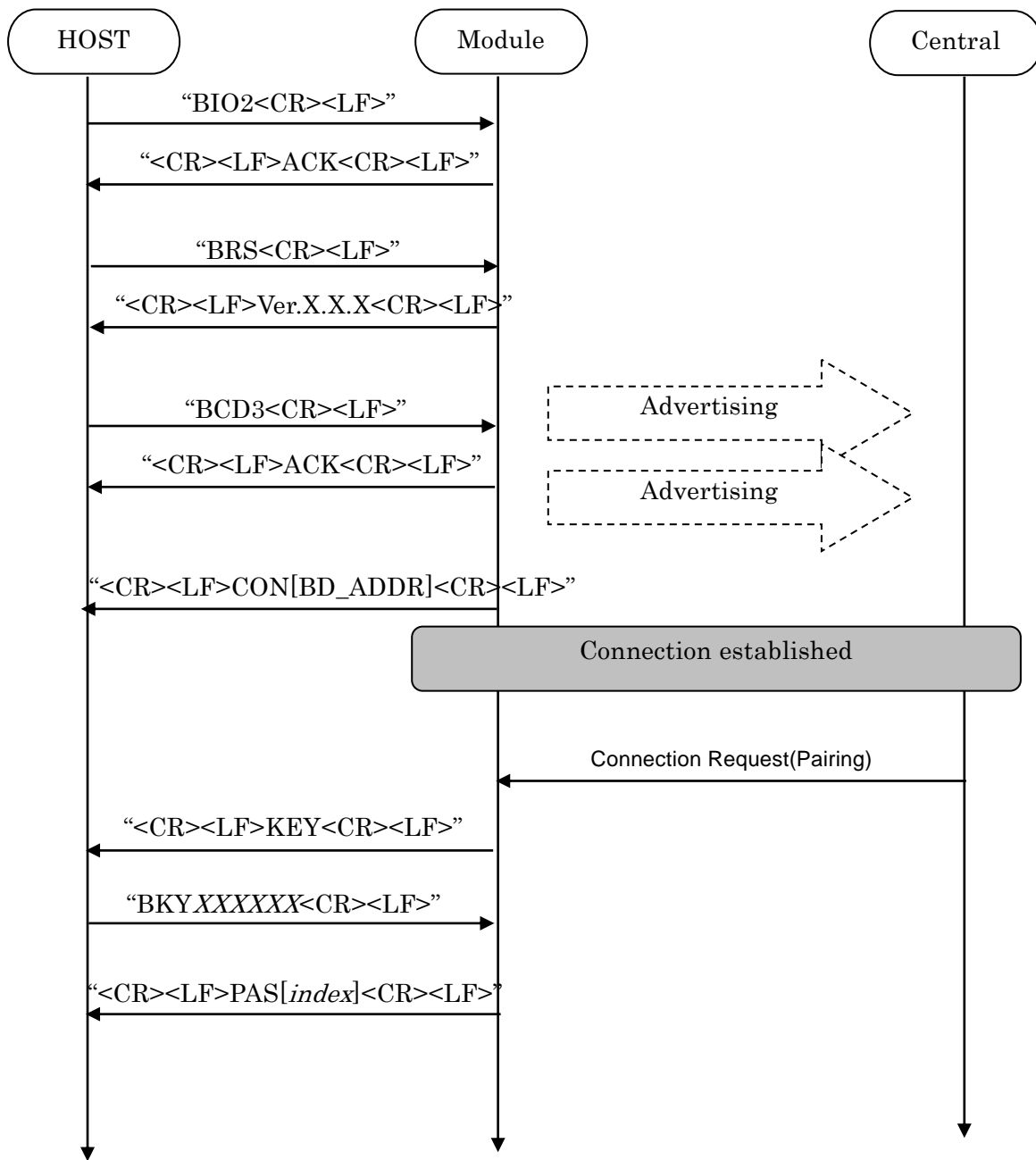
5.17.2 Out of Band



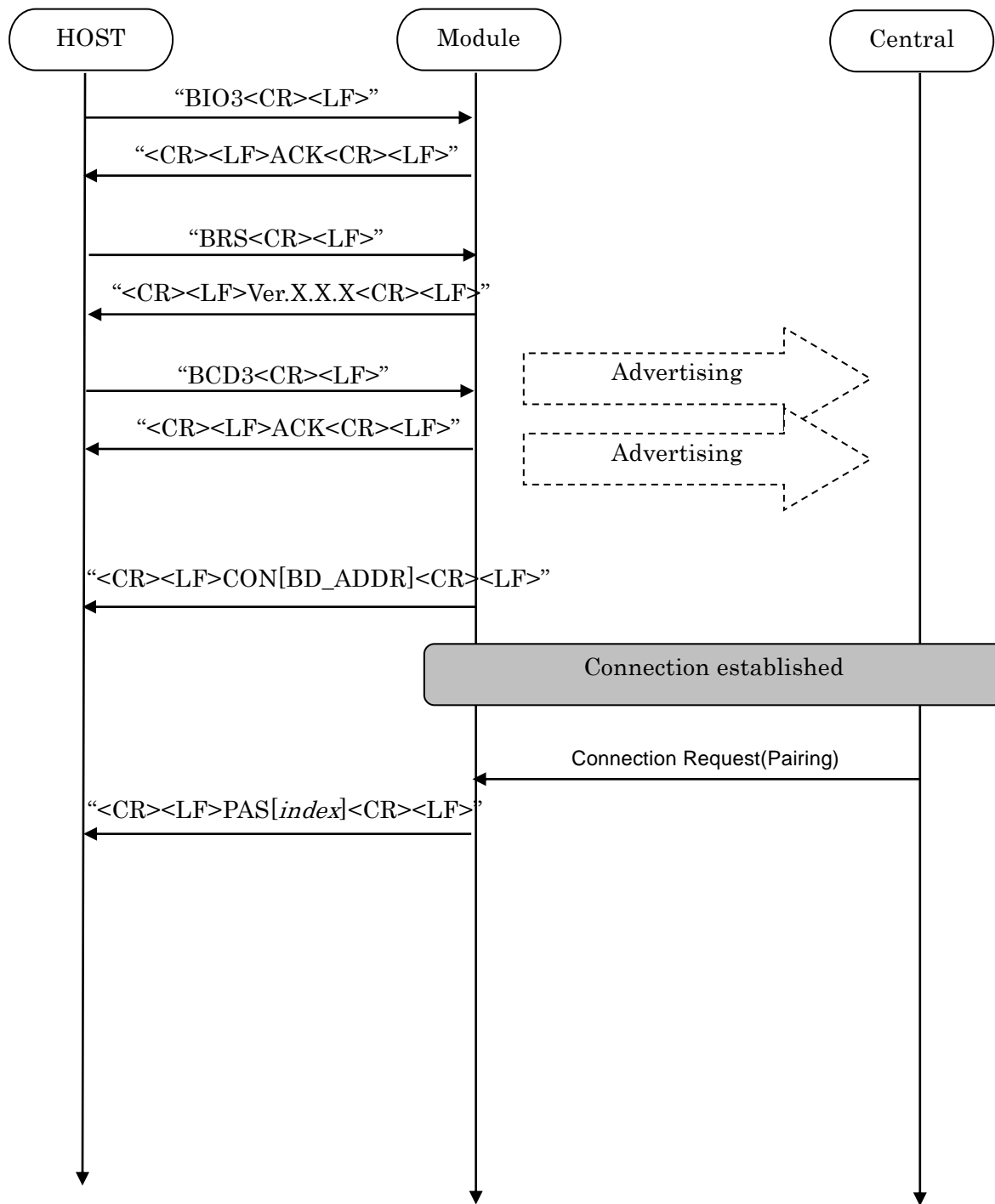
5.17.3 Passkey Entry, Peripheral Displays



5.17.4 Passkey Entry, User Inputs on Peripheral



5.17.5 Just Works



5.18 Notices

1. This application uses Softdevice S130 V2.0.1 for Central.
2. Central role of this application doesn't support IRK.
Therefore, if Peripheral uses private random address, pairing is performed every time and bonding is not performed.
3. ST2 command accepts only Static Address (BLUETOOTH SPECIFICATION Version 4.2 [Vol 6 PartB] 1.3.2.1). A static address is a 48-bit randomly generated address and shall meet the following requirements.
 - The two most significant bits of the static address shall be equal to '1'.
 - All bits of the random part of the static address shall not be equal to '1'.
 - All bits of the random part of the static address shall not be equal to '0'.
4. The buffer size for Sleep (Section 5.5.5) is 128byte.
If the buffer is full, further data received is discarded without any events.
5. The buffer size for Host wake-up (Section 5.9) is 128byte.
If the buffer is full, further data received is discarded without any events.
6. TT command set the flag for Direct Test Mode.
To reset the flag, input "31 31(HEX)" or set GPIO P0.04 Low for 3 second.
Until the flag is reset, the module keeps DTM even after system restart.
7. Do not turn the power off while the data is written to FLASH memory with ST4/ST5/STF/DS/DD/TT command. It takes up to 500ms to complete the writing process asynchronously after ACK response.
8. The connection timer is 160 seconds.
This timer starts when the module attempts to establish the connection to target device and stops when Characteristic 0x1571 (Notification) in Peripheral's GATT Server is enabled.
9. If connection interval is too long, the pairing fails and NAK07 because of SMP TIMEOUT (BLUETOOTH SPECIFICATION Version 4.2 [Vol 3, Part H] 3.4).
The connection parameters of Central is used until Connection parameter update.
To use long connection interval, set connection parameters in Peripheral side and wait Connection update request.
10. If you want to use PSKEY_USER16 filter, you need to set Advertising data(Company ID) to iBeacon. Please refer to Chapter 4.16 for the value of advertising data
11. It takes about 10 seconds to initialize the FLASH area when executing DFU. Please start communication after Pin0.19 goes High after completion of initialization.

その他、注意事項について (Precautions)

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