Bluetooth ® low energy Module

Bluetooth® 4.2 low energy

EYSGJNAWY-VX

Data Report

TAIYO YUDEN CO., LTD.

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変更履歴

23-Apr.-2019 > Ver.1.0 Release

Control No.	Control name
HD-AG-A181109 (1/5)	一般事項書

適用
本仕様書は、太陽誘電株式会社(“弊社”)により製造される ***Bluetooth***® 4.2 low energy モジュール “EYSGJNAWY-VX” (“本製品”)に適用します。

1. 認証品名: EYSGJN
   ユーザーコード: EYSGJNAWY-VX
   *ユーザーコードは量産時などに変更されることがあります。

2. 機能:
   無線モジュール ***Bluetooth***® Ver 4.2 low energy 規格準拠

3. アプリケーション: ヘルスケア、フィットネス機器、センサ、玩具等

4. 構造:
   シリコンモノリシック半導体を用いた混成集積回路
   業界標準のリフロープロファイルでの Pb フリー実装に対応
   RoHS 準拠 (Pb, Cd, Hg, Cr^{+6}, PBB, PBDE)

5. 外形: 11.3 x 5.1 x 1.3 mm
   28 ピン ランドグリッドアレイ

6. 表示: 品名, ロット番号

7. 特徴:
   - 小型プリント基板モジュール
   - 低消費電力
   - アンテナ内蔵
   - システムクロック内蔵
   - ***Bluetooth***® 4.2 low energy 規格準拠
     - Slave 側または Master 側対応

8. 梱包形態:
   テープ&リール + アルミ防湿袋
   梱包数量: 2000
   *サンプル時はトレイで提供されることがあります。

9. その他:
   a. 本仕様書に疑義の生じた場合は、打ち合わせにより解決します。
   b. 本製品は、耐放射線設計をしておりませんので、放射線のストレスを受ける環境下での使用は避けて下さい。
   c. 本保証条件以外の条件で御使用になった結果発生した不良・不具合につきましては、弊社は責任を負い兼ねますので御了承下さい。また、過電圧等本保証条件以外の条件で御使用になった場合、ショートモードで破壊する場合があります。安全性の確保のために、フューズや過電流保護回路等の追加をお願い致します。
   d. 本仕様書に記載されている本製品は、ヘルスケア、フィットネス機器、センサ、玩具用として製造されております。従って、高度の安全性や信頼性が求められる医療用機器、宇宙用機器、あるいは防災機器等にお使いになるときには、本製品の適合性をお客様の独自の責任で十分に評価、検討され、判断下さい。又、一般機器において御使用になる場合にも、お客様の独自の責任で十分な安全性評価を実施され、必要に応じて設計時に保護回路等を追加してください。
   e. a) 弊社では、本製品に内蔵されているファームウェアについて十分な品質評価・検証を行っておりますが、お客様におかれましても本製品の量産開始前までに、内蔵ファームウェアに瑕疵やその他品質上の不具合、お客様の製品への組み込み上の不具合がない事を十分に評価され、お客様での本製品の使用用途に合致するものであることをご確認頂けますようお願い申し上げます。
      b) 内蔵するソフトウェアのバグまたは不良に起因する不具合に対して弊社は一切責任を負いません。
   f. 弊社は納入後一年間、本製品が本仕様書を満足することを保証します。
   g. 本製品と他製品の通信は、周囲の電波環境及び機器環境により確立又は維持が難くなることがあります。
   h. 本製品を搭載した製品の電波法認証試験を行うためには、モジュールをテストモードに入れる必要があります。詳細は太陽誘電にお問い合わせ下さい。
   i. 本製品は 2.4GHz 帯の周波数を使用しています。本製品を本製品と同じ周波数を使用した他の無線機器の周辺でご使用になりますと、本製品とかかる他の無線機器との間で電波干渉が発生する可能性があります。電波干渉が発生した場合、他の無線機器を停止するか、本製品の使用場所を変えるなど電波干渉の生じない環境でご使用下さい。
   j. 量産以降前にお客様の製品上で十分にモジュールを評価して下さい。
   k. ユーザーコードの変更
      サンプルモジュールのユーザーコードまたは本仕様書中の品名は、太陽誘電の標準品名です。仕様の変更によりモジュールに変更がある場合には、品名が変わります。
      以下に挙げる例のような場合に品名が変わります。
      - ファームウェアバージョンの変更 (標準品のファームウェアもバージョンアップすることがあります。)
      - その他、設定の変更、外形の変更、表示の変更など

Control No.		Control name
HD-AG-A181109	(3/5)	General Items

l. 本製品を構成する部材の一部について、代替品を使用する場合があります。代替使用は、本仕様書に記載された保証範囲（特性、外形、使用条件、信頼性、公的規格（電波法等））、および品質に照らし、弊社にて代替（完全な置換え）が可能と判断致しました部材を対象とさせて頂きます。尚、使用した部材種についての追跡性は製造ロット毎に確保されます。

m. 輸出注意事項

本製品は、日本国の「外国為替及び外国貿易法」（関連法令・規則を含む）及び／又は諸外国の輸出管理関連法規に基づく輸出（再輸出を含む）申請、承認又は許可の対象となる場合があります。本製品を輸出（再輸出）する場合には、必ず事前にこれら関連法規が定める手続をご確認頂き、必要な場合には、お客様の責任と費用において適切な承認・許可をお取りください。

n. 日本規制情報

本製品は、特定アンテナとの組み合わせにおいて工事設計認証を受けた 無線設備です。

a) 御社製品に下記を明示願います。製品が小さく明示できない場合には、製品の見やすい箇所(取扱説明書および梱包又は容器を含む)に明示をお願いします。

本製品には、電波法に基づく小電力データ通信システムの無線局として、工事設計認証を受けた無線設備を内蔵しています。

EYSGJN ： 001-A05676

o. カナダ規制情報

a) 本装置は IC ライセンスを免除された RSS 標準に準じております。動作は下記の 2 条件に従います。(1) 本装置は、妨害波の原因とはなりません。 (2) 本装置は、好ましくない装置動作の原因となるどのような妨害波を受信した 場合も受け入れます。

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) 本製品は Industry Canada によりポータブルデバイスとして認証を受けています。人体暴露要求の遵守維持のため、本製品の仕様で示す範囲でご使用下さい。

This product is certified as type of the portable device with Industry Canada Riles. 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-EYSGJN
-FVIN : F1

c) 本製品を組み込む製品には、認証 ID を下記いずれかの方法で記載をお願いします。

Please notify certified ID by either one of the following method in your product.

Specifiez ID certifiée dans votre produit par une de méthode suivante.

-Contains Transmitter module IC : 4389B-EYSGJN
-Contains IC : 4389B-EYSGJN

p. FCC 規制情報

a) 本装置は FCC 規則第 15 章に準拠しています。動作は下記の 2 条件に従います。 (1) 本装置は、有害な妨害波の原因とはなりません。 (2) 本装置は、好ましくない装置動作の原因となるどのような妨害波を受信した 場合も受け入れます。
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) 本製品を組み込む製品には、認証 ID を下記いずれかの方法で記載をお願いします。
Please notify certified ID by either one of the following method.
-Contains Transmitter Module FCC ID: RYYEYSGJN
-Contains FCC ID: RYYEYSGJN

c) 適合に責任を持つ当事者によって承認されていない変更や改造は、装置運用の認定が無効となります。
CAUTION: changes or modifications not expressly approved by the party responsible for compliance could void the use's authority to operate the equipment.

d) 本製品は FCC によりポータブルデバイスとして認証を受けています。 SAR 要件遵守維持のため、本製品の仕様で示す範囲でご使用ください。
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) この無線機が使用するアンテナはいかなる他のアンテナ又は送信機と同一に配置しない、および同時に動作させないで下さい。
The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

f) このモジュールは、モジュール組み込み業者が開発するアプリケーションソフトウェアによって、状況に合わせて出力電力を設定できます。エンドユーザーは出力電力を変更することはできません。
This module can change the output power depending on the circumstances by the application software which is developed by module installer. Any end user cannot change the output power.

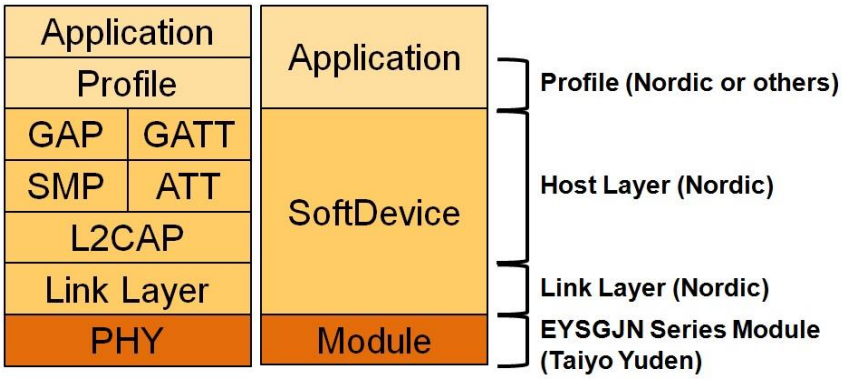
q. CE 規制情報

a) 本装置を内蔵する EU 加盟国で流通する製品は別途認証手続きが必要です。

b) 製品の認証手続きに無線部分の試験が必要となりますが、無線部分の Conducted 試験結果報告書を製品の認証の一部の資料としてご用意しています。

r. 本製品は Bluetooth® 4.2 の規格に従って製造された製品であり、本製品の用途が Bluetooth®4.2 規格以外もしくは当該規格に従わない製品(「Bluetooth®4.2 規格外製品」)への使用の場合、弊社は第三者の知的財産権の侵害に基づくいかなる責任を負いません。また、弊社は本製品が本仕様書に準拠することのみを保証するもので、上記 Bluetooth®4.2 規格外製品への応用についての保証等いかなる保証を行うものではありません。

s. EYSGJN シリーズモジュールは、PHY のみの Component カテゴリで Bluetooth SIG 認証を取得しています。このモジュールの QDID は 69825 です。最終製品は販売前に End Product として PHY (モジュール)、SoftDevice、プロファイルを組み合わせて認証を取得する必要があります。本製品の Link レイヤの QDID は 65785、また、Host レイヤの QDID は 79303 です。認証取得は以下の図をご参照頂き、お客様の認証機関、BQC にお問い合わせ下さい。



内蔵ソフトウェアについて

ご使用にあたって

本製品のご使用にあたっては、以下の事項をご理解頂き、ご了解頂いた上でご使用ください。

1. 太陽誘電株式会社(以下、「弊社」といいます)は、本製品に内蔵された記憶装置に書込まれたソフトウェア (以下、「内蔵ソフトウェア」といいます)に関する著作権その他の権利を適法に有しています。
   弊社は、内蔵ソフトウェアの全部又は一部を問わず、本製品以外での使用、第三者への開示・提供(Webサイトへの内蔵ソフトウェアの掲載やそこからの第三者によるダウンロード等を含む)及び内蔵ソフトウェアの複製・改変・バージョンアップ・仕様変更、譲渡等 (解析調査;Reverse engineering 含む)を禁止させて頂きます。

2. 本製品を使用される際には、必ず事前に充分な安全性・動作性、他の機器との接続性・適合性等の評価を行い、使用に際し支障が無い事をご確認下さい。

3. 弊社では、あらゆる機器に対して本製品(内蔵ソフトウェア含む)の動作確認を実施しているわけではありません。
   また、本仕様書は、本製品において特定の機器への接続性・適合性等を保証するものではありません。
   内蔵ソフトウェアの潜在的不具合及び各機器との組合せ等により問題が発生した場合にその損害を最小限に止める為にも、本製品を使用する製品に、内蔵ソフトウェアを書き換える為のインターフェイスや外部端子(詳細は本書“ピンレイアウト”を参照)を設けて戴くことを推奨致します。

Control No. HD-AM-A181109 (1/1)	Control name 絶対最大定格

絶対最大定格

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

Control No. HD-AE-A181109 (1/2)	Control name 電気的特性

電気的特性

推奨動作条件

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 Rise time 仕様を超えるとチップ内のパワーオンリセット回路は正しく動作しないことがあります。
また、電源を切断後、再投入する場合は必ず 0.3V 以下に落としてから立ち上げて下さい。
同様にパワーオンリセット回路が正しく動作しないことがあります。

DC 仕様

Topr.= 25 ℃, VCC_NRF = 3.0V で適用される仕様

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

RC 発振回路を使用する場合、32.768kHz 水晶振動子を使用する場合と比較して約 10uA ほど
平均電流が増加します。

UART specifications

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

Control No.	Control name
HD-AE-A181109 (2/2)	電気的特性

RF 仕様

Symbol	Description	Min.	Typ.	Max.	Units
Fop	Operating frequencies	2402		2480	MHz
Df	Frequency deviation	+/-225	+/-250	+/-275	kHz
P_{RF}	Maximum output power		4		dBm
PRFCR	RF power accuracy			+/-4	dB
P_{BW}	20 dB bandwidth for modulated carrier		950	1100	kHz
P_{RF1}	1st Adjacent Channel Transmit Power 1 MHz			-20	dBc
P_{RF2}	2nd Adjacent Channel Transmit Power 2 MHz			-45	dBc
PRX_{MAX}	Maximum received signal strength at < 0.1% PER		0		dBm
P_{SENS} IT	Receiver sensitivity (0.1% BER) Ideal transmitter		-93		dBm
P_{SENS} DT	Receiver sensitivity (0.1% BER) dirty transmitter		-91		dBm

nRF51822 の製品仕様や Product Anomaly Notification 等の多くの文書は下記リンクにあります。弊社モジュールを使用する際は、これらの最新の文書を必ずご確認ください。

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

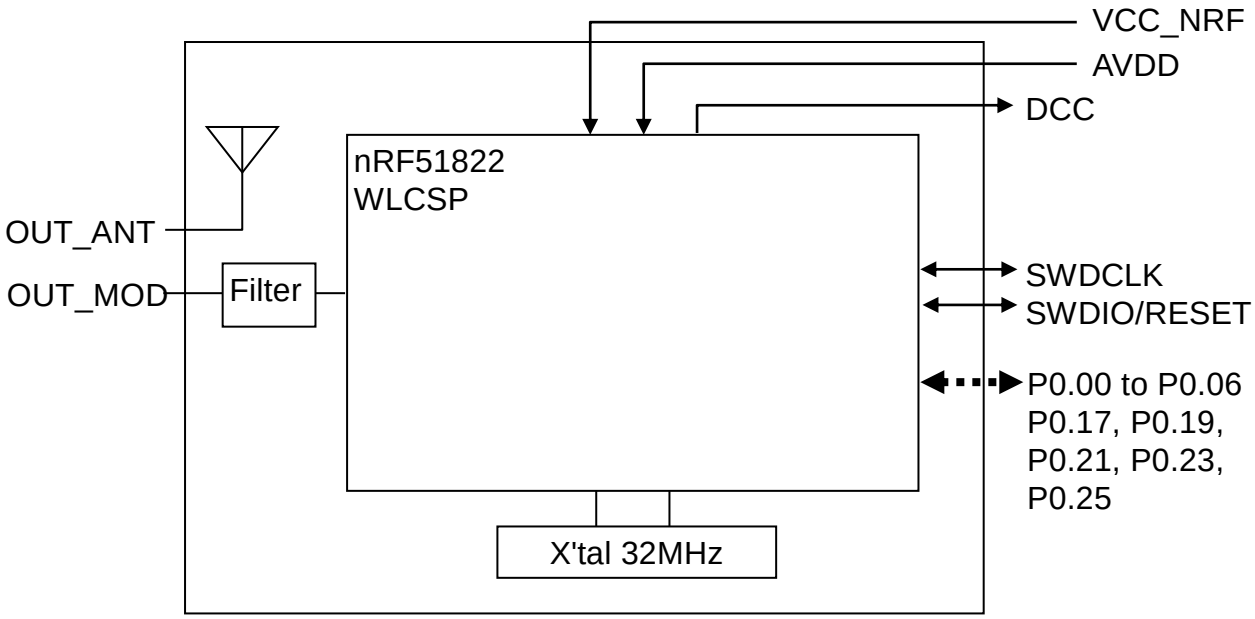
Product Anomaly Notification
https://infocenter.nordicsemi.com/topic/struct_nrf51/struct/nrf51822_pan.html?cp=4_4_1

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

For more information
https://infocenter.nordicsemi.com/index.jsp

Control No.	Control name
HD-MC-A181109 (1/3)	回路図

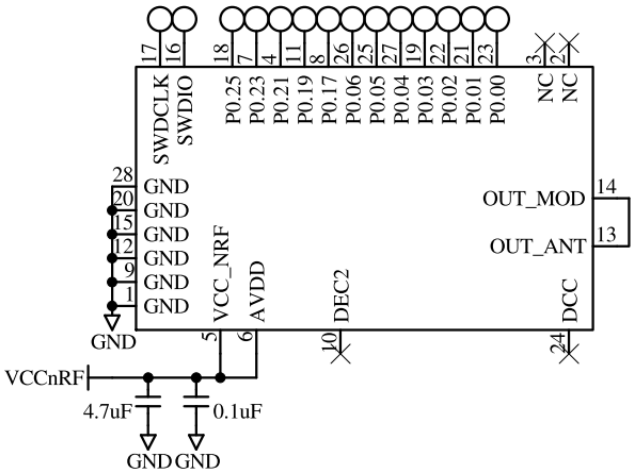
ブロックダイヤグラム



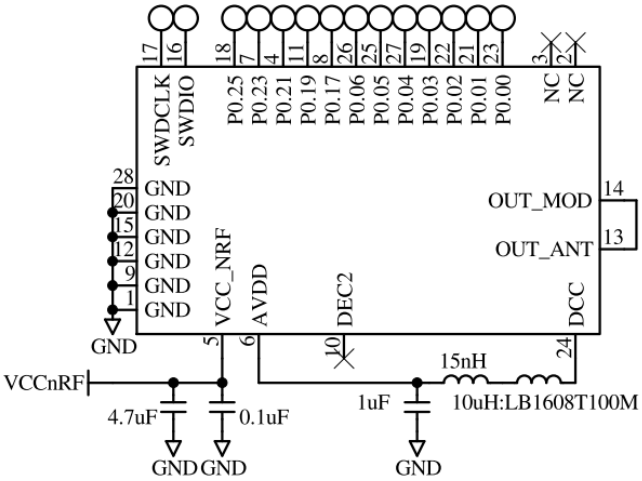
Control No.		Control name
HD-MC-A181109	(2/3)	回路図

参考回路

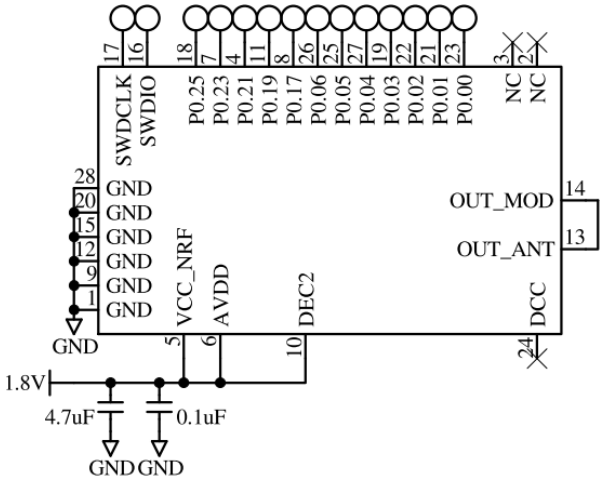
Internal LDO setup



DC/DC converter setup

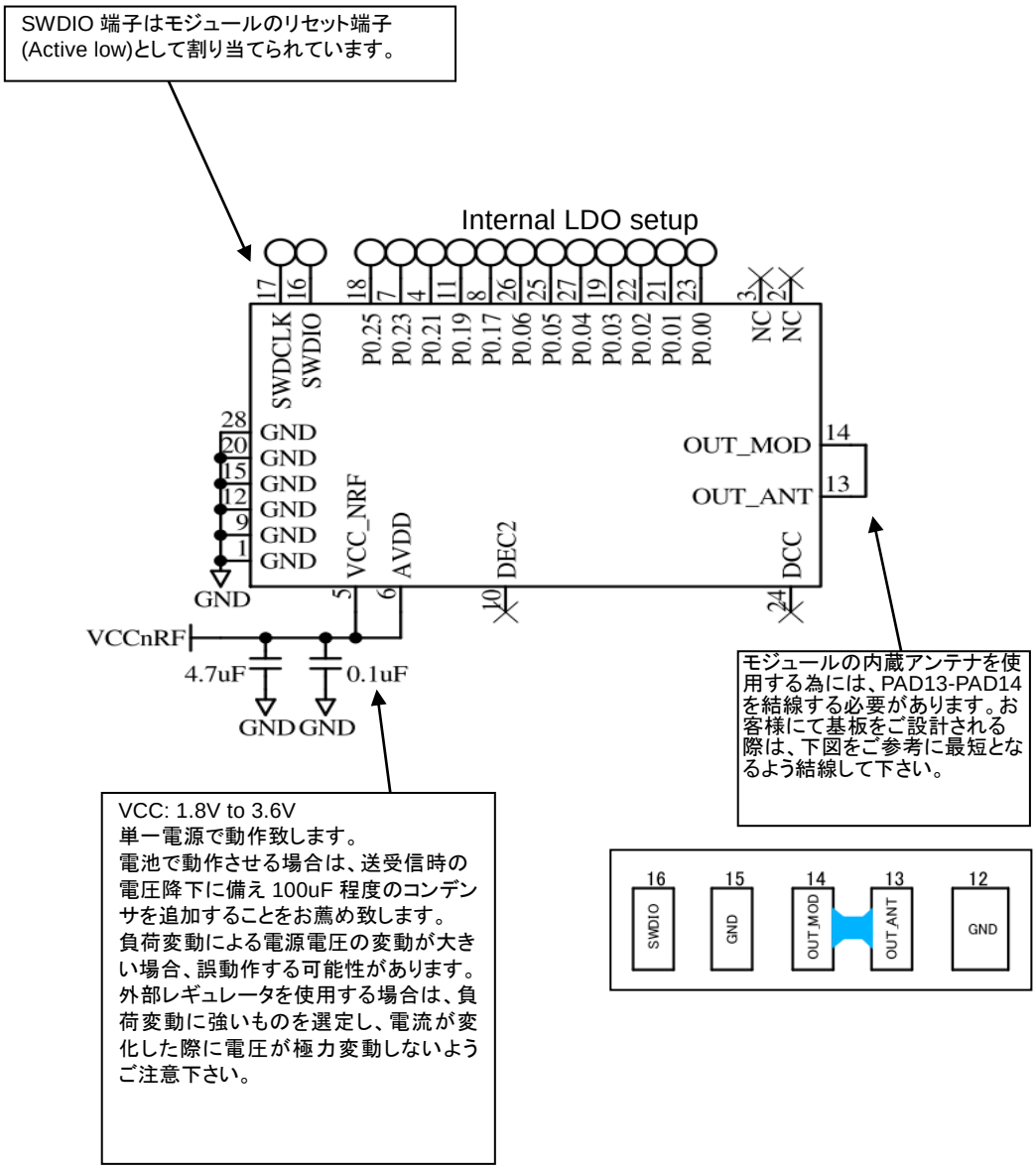


Low voltage mode setup



Control No.	Control name
HD-MC-A181109 (3/3)	回路図

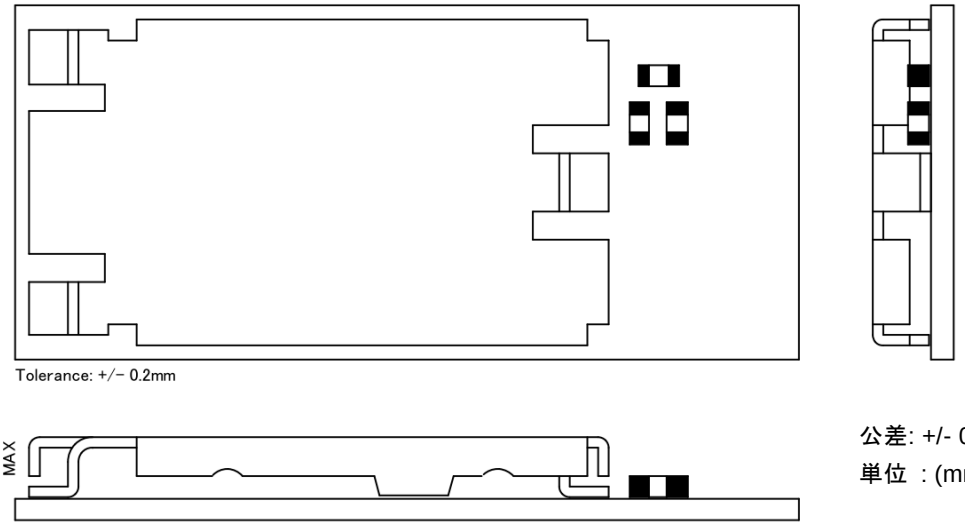
リファレンス回路



EYSGJNAWY-VX

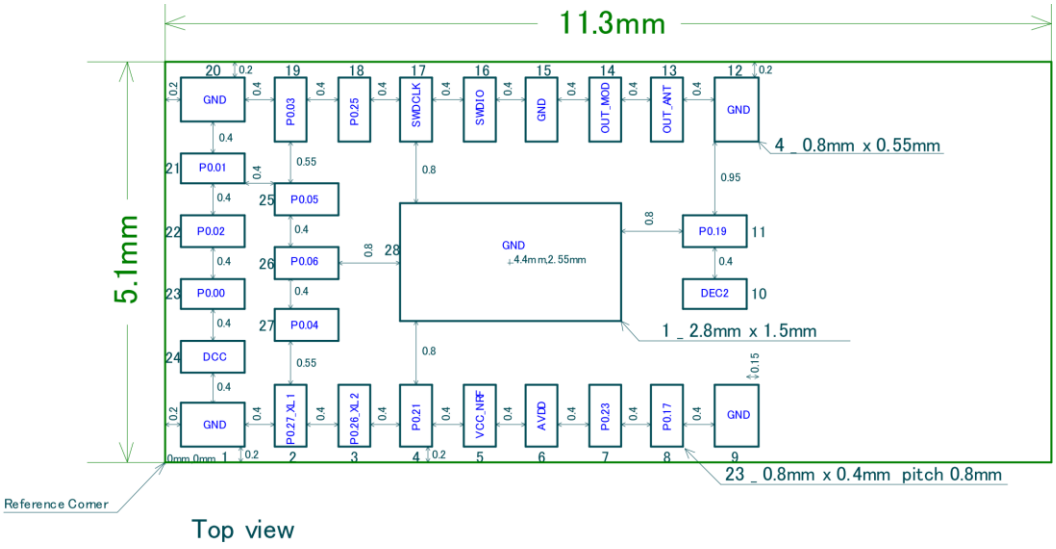
TAIYO YUDEN CO., LTD.

Control No.	Control name
HD-AD-A181109 (1/1)	外形寸法図



公差: +/- 0.2mm
単位 : (mm)

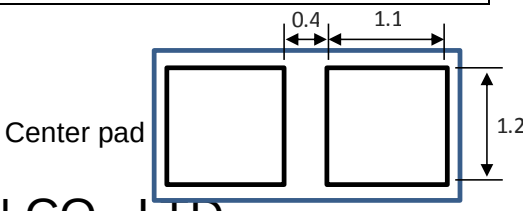
ランドパターン例



推奨ハンダ印刷メタルマスク

Pad size	Metal mask opening
Signal pad 23 – 0.4 x 0.8 mm	0.35 x 0.7 mm
Corner pad 4 – 0.55 x 0.8 mm	0.45 x 0.75 mm
Center pad 1 – 2.8 x 1.5 mm	1.1 x 1.2 mm x 2

各開口部の中心は各パッドの中心です。
メタルマスク厚 0.1mm の場合です。異なる場合は
同じ体積になるよう開口を調整して下さい



Control No.		Control name
HD-BA-A181109	(1/1)	ピンレイアウト

Pin Descriptions

Pin	Pin name	Pin function	Description
1	GND	Ground	Ground (0 V)
2	NC	Not Connected	Reserved
3	NC	Not Connected	Reserved
4	P0.21	Digital Input	Sleep indication of host / Resume from Power saving mode
5	VCC_NRF	Power	電源
6	AVDD	Power	アナログ電源
7	P0.23	Digital Output	Mode indication of module
8	P0.17	Digital Input	Request DFU mode
9	GND	Ground	Ground (0 V)
10	DEC2	Power	Reserved
11	P0.19	Digital Output	State indication of module / DFU indication
12	GND	Ground	Ground (0 V)
13	OUT_ANT	Antenna In/Out	内部アンテナ. 通常使用時は Pin 14 OUT_MOD に接続して下さい
14	OUT_MOD	RF In/Out	RF I/O pin. 通常使用時は Pin 13 OUT_ANT に接続して下さい
15	GND	Ground	Ground (0 V)
16	SWDIO	Digital I/O	システムリセット(active low). ハードウェアデバッグ、Flash プログラミング I/O
17	SWDCLK	Digital input	ハードウェアデバッグ、Flash プログラミング I/O
18	P0.25	Digital Output	Wake up request
19	P0.03	Digital input	UART_RX
20	GND	Ground	Ground (0 V)
21	P0.01	Digital Output	UART_TX
22	P0.02	Digital Input	UART_CTS
23	P0.00	Digital Output	UART_RTS
24	DCC	Power	Reserved
25	P0.05	Digital Output	Module active / sleep indicate
26	P0.06	Digital Input	Disconnect request / Resume from Power saving mode
27	P0.04	Digital Input	Forced initialize / Request Sleep mode
28	GND	Ground	Ground (0 V)

Control No.	Control name
HQ-BA-537 (1/2)	取扱注意要領

本書類では特に実装時の御願い・条件について記載します。

御願い・条件

(1) 使用・保管環境の管理

1. 弊社出荷時の防湿梱包状態で保管する場合、**40℃/90%RH** 以下の環境で保管してください。
2. 工程の環境は **30℃/60%RH** 以下に管理してください。
3. モジュールを開梱状態で保管する(工程間の滞留含む)場合、**25±5℃/10%RH** 以下の環境で保管してください。

(2) 製品取扱時の御願い・条件

防湿梱包品入庫後、防湿袋に穴、裂け、キズ等のない事を確認してください。万が一異常があった場合、(2)-2項に従い、処置をお願い致します。

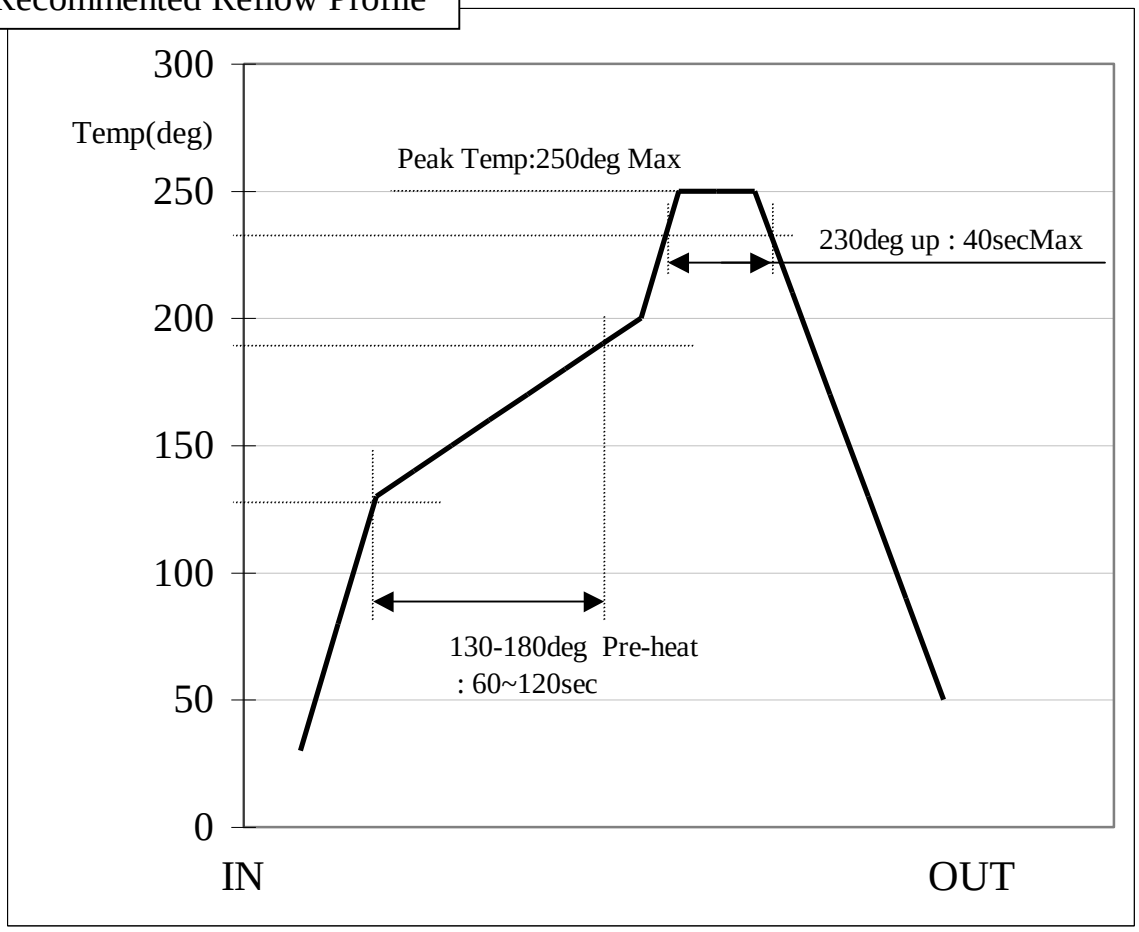
梱包に貼付のラベルをご参照ください。

1.梱包日から **12ヶ月以内**に**全て**の実装(リフロー)作業(リワーク含む)を終了してください。
2. 防湿梱包開梱後、直ちに湿度インジケーターにて梱包内の環境が**≦10%RH** であることを確認してください。
3. 開封後 **168 時間以内**に**全て**の実装作業(リワーク含むリフロー作業)を終了してください。
本モジュール以外の実装作業含みます
4. (1)項、及び(2)-2・(2)-3 の基準からはずれた場合、**125℃ 24h** にてベーキングを行ってください。
5. (2)-4 項記載の条件によるベーキングは 1 回を原則とします。
6.本モジュールは内部に半導体を有するため、取扱中には静電気に留意してください。(100V 以下)
必要に応じて、導電マット・アースバンド・静電靴・イオナイザー等を用いて、
静電気の対策を講じてください。
7. 機械的振動、衝撃を極力少なくし、落下させないでください。
8. モジュールを実装する際には、裏面の電極を認識してください。
9. 本製品の洗浄は推奨しません。洗浄を行う場合は、洗浄、乾燥後に本製品機能を十分に確認してからご使用ください。尚、本製品への洗浄における不具合に関しましては、当社は一切の責任を負いません。
10. モジュールのリフロー時温度条件は、下記の範囲内で行って下さい。

リフロー回数は最大2回として下さい。

Control No.	Control name
HQ-BA-537 (2/2)	取扱注意要領

Recommented Reflow Profile



Control No.	Control name
HD-BB-A181109 (1/3)	梱包仕様書

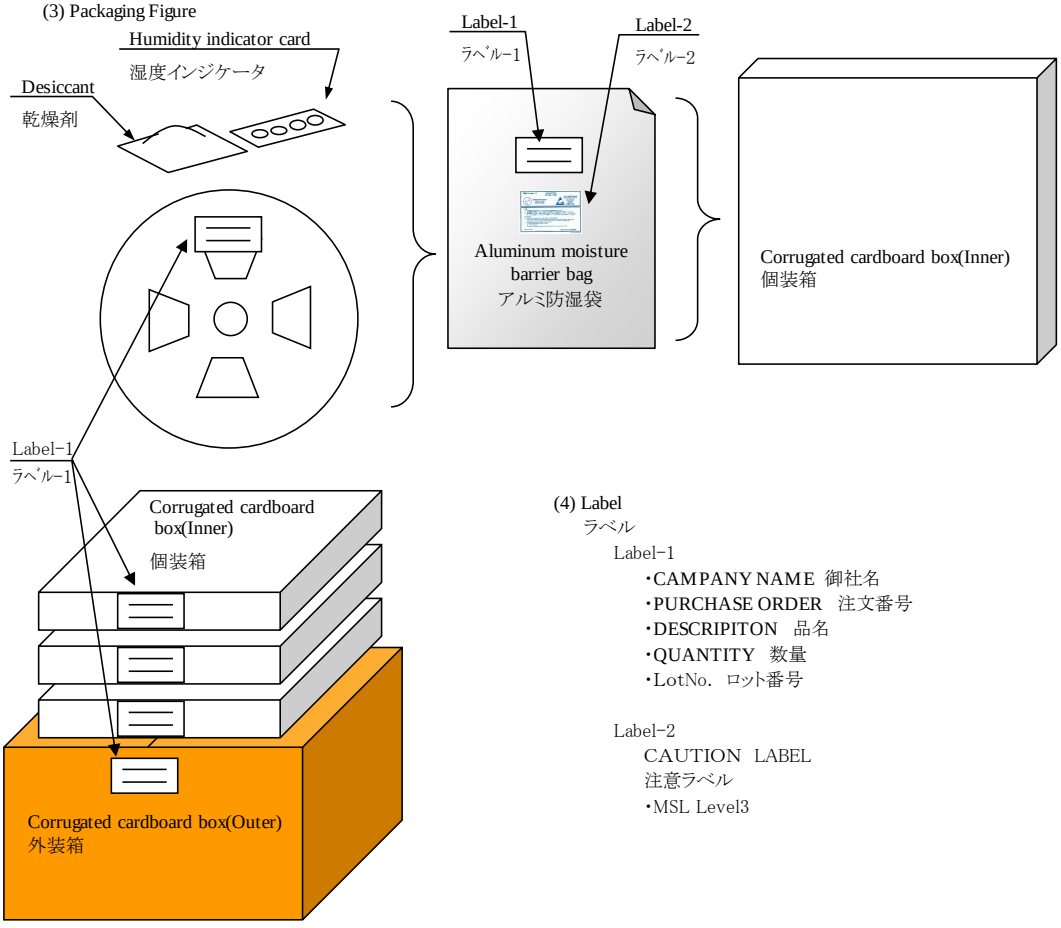
Packaging Specification
梱包仕様

(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	φ330 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 2000 pieces/Reel
Max 6000 pieces/Box(Outer)

(3) Packaging Figure

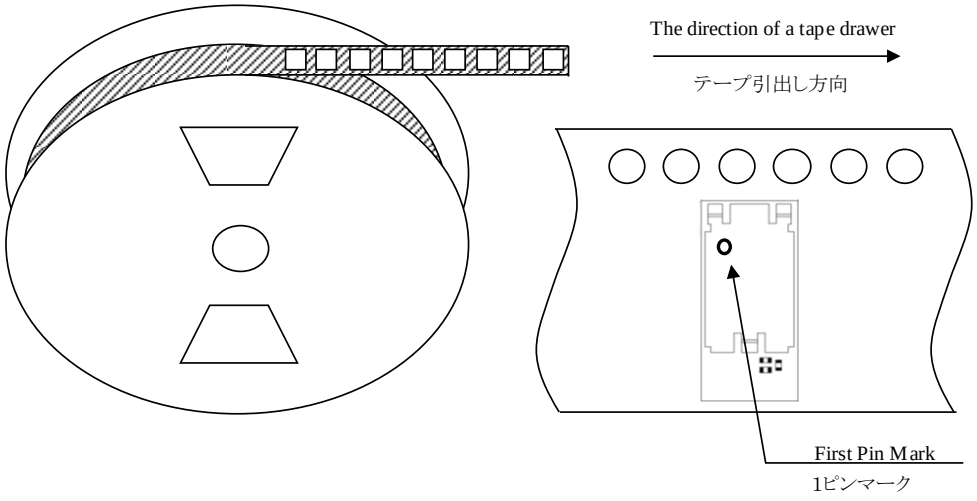


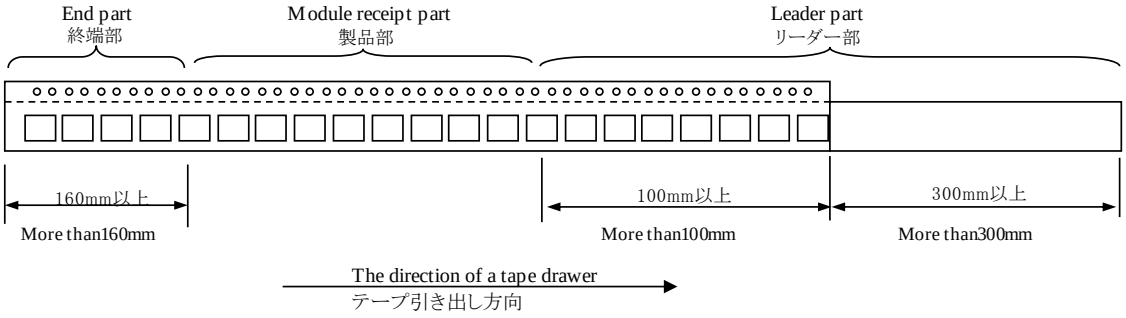
(4) Label
ラベル
Label-1
・CAMPANY NAME 御社名
・PURCHASE ORDER 注文番号
・DESCRIPITON 品名
・QUANTITY 数量
・LotNo. ロット番号

Label-2
CAUTION LABEL
注意ラベル
・MSL Level3

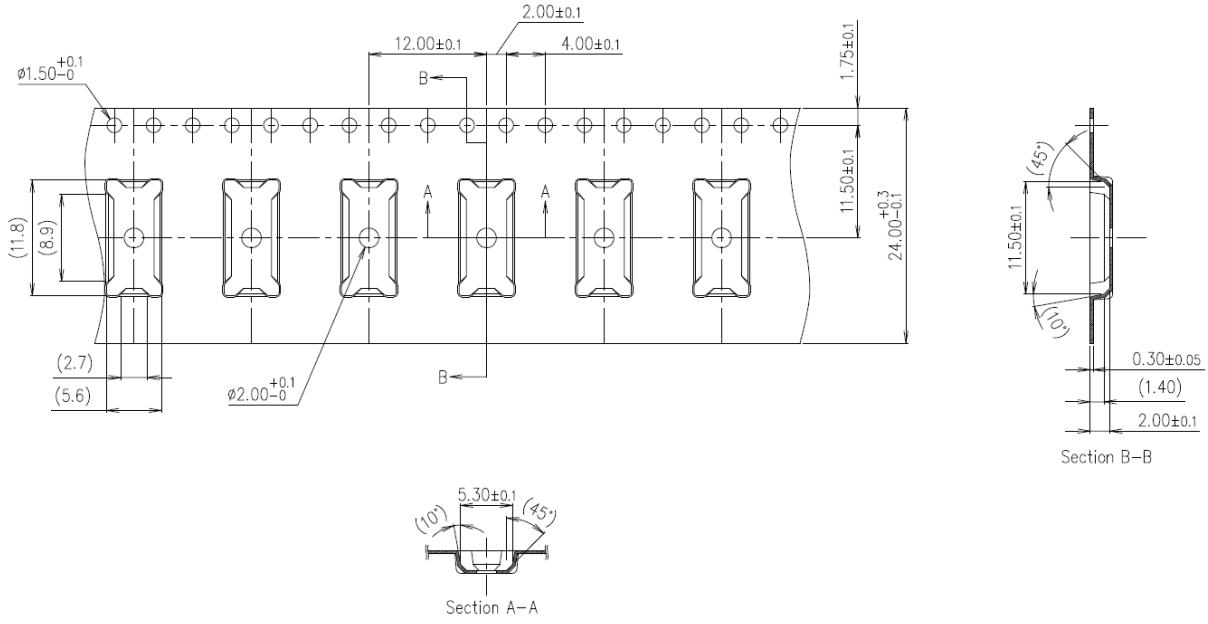
Control No.	Control name
HD-BB-A181109 (2/3)	梱包仕様書

Tape specification
テーピング仕様



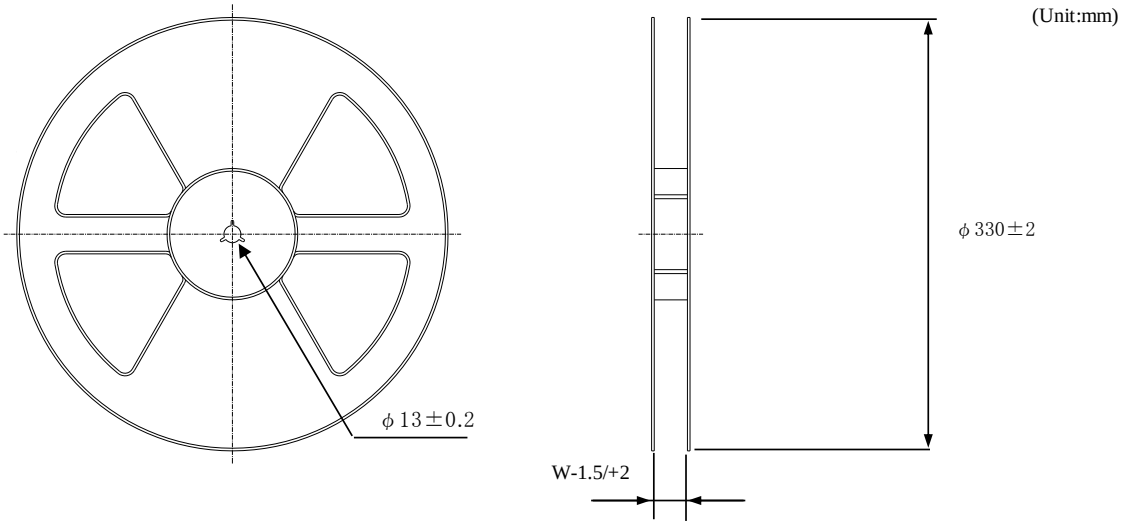


キャリアエンボス図面



Control No.	Control name
HD-BB-A181109 (3/3)	梱包仕様書

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、これに耐えうること.

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.

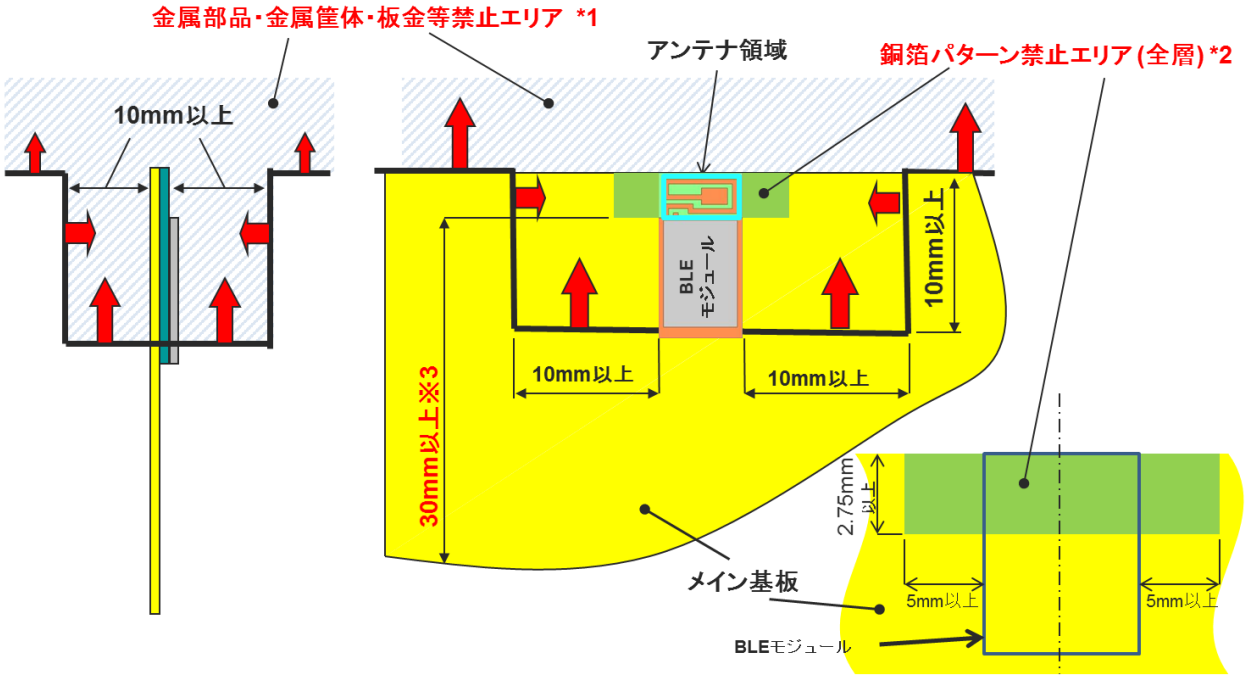
Note
備考

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。

Control No. (1/3)	Control name アンテナアプリケーションノート

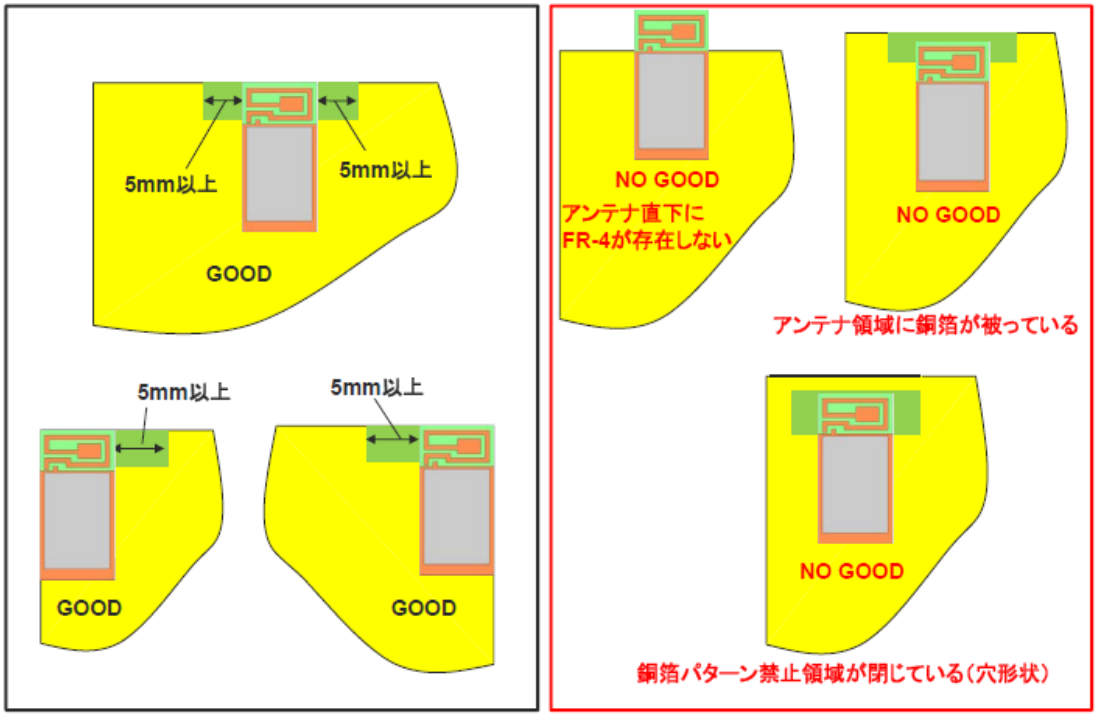
マザーボードへのモジュール実装例（当社推奨）



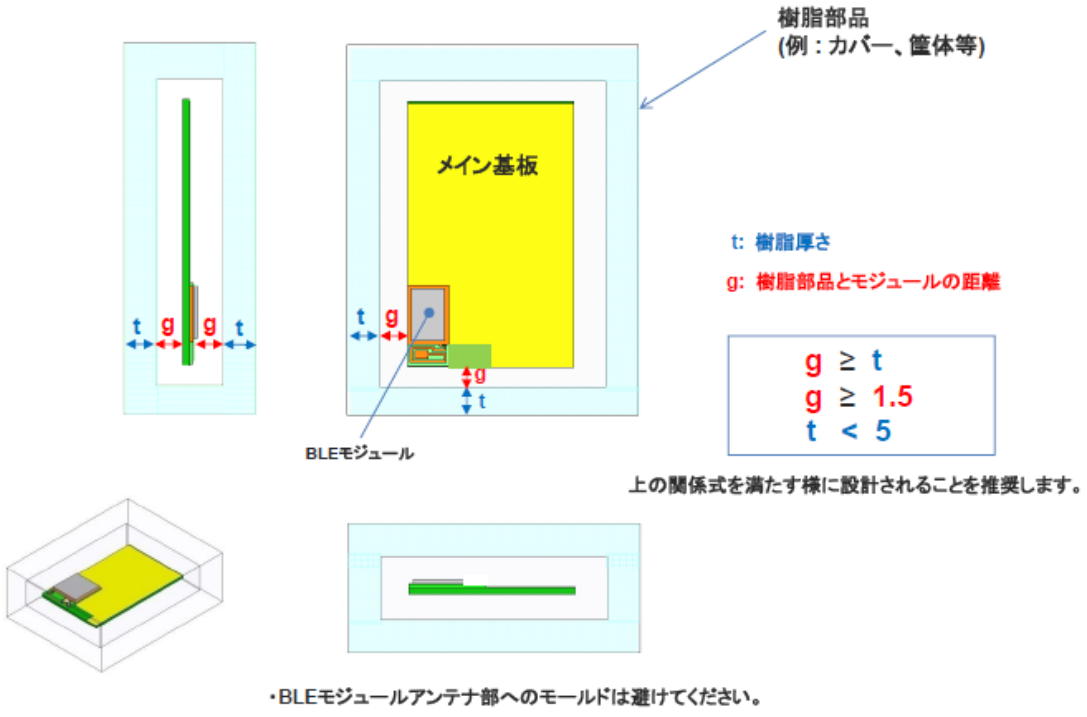
・赤矢印が指す斜線の空間内には、メイン基板以外の金属部品（配線、金属筐体、金属めっきの樹脂など）が無い様にしてください。
　但し、メイン基板上への部品実装は銅箔パターン禁止エリア(*2)を除き問題ありません。
・メイン基板上の GND パターン長（※3）が 30mm を下回るとアンテナ性能が低下しますので、できる限り 30mm 以上としてください。
・本条件を満足している場合でも、製品の構造によっては通信性能が著しく低下する場合があります。

Control No. (2/3)	Control name アンテナアプリケーションノート

その他の実装例

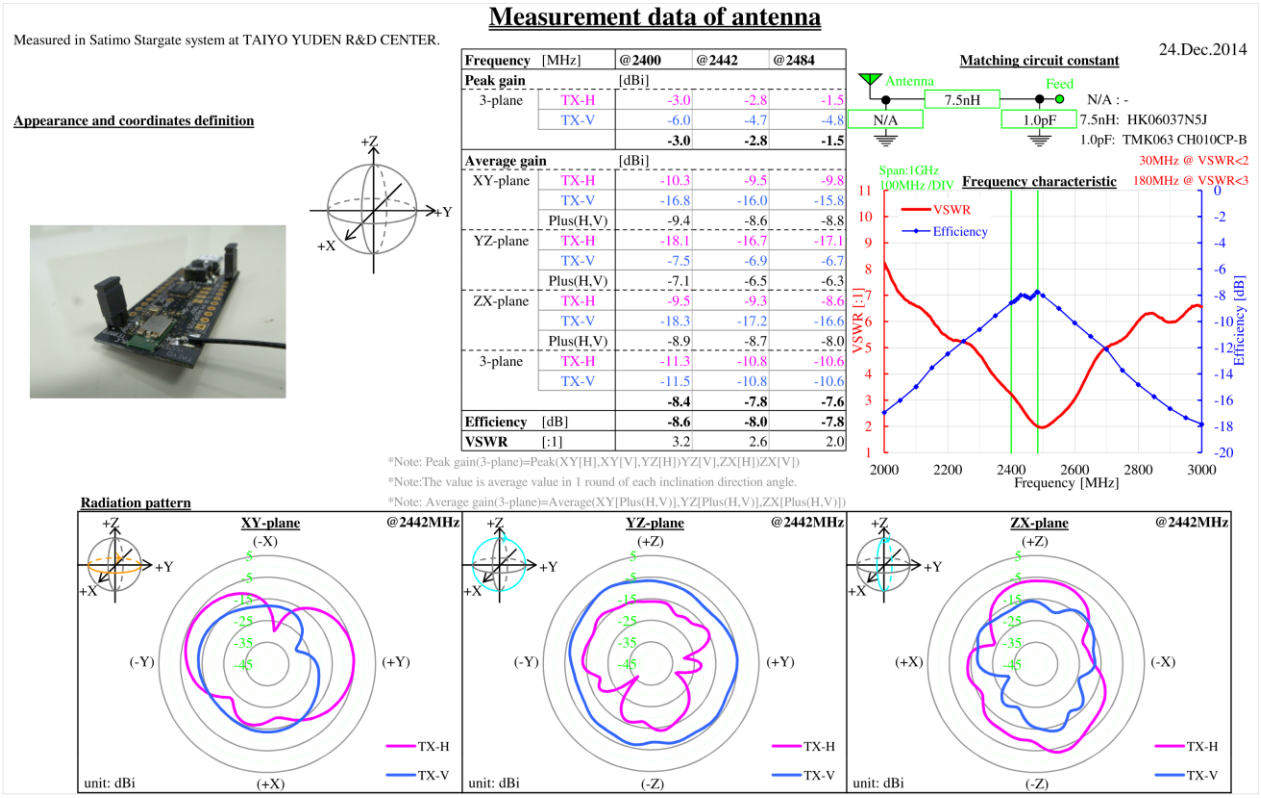


樹脂近傍のアンテナ配置



Control No. (3/3)	Control name アンテナアプリケーションノート

指向性特性例（評価基板実装時）



本資料について

・本アンテナアプリケーションノートは、BLE モジュールに搭載されているアンテナ特性をより良く確保するための参考資料です。通信性能・飛距離を確保・保証するものではありません。
・本製品は、BLE モジュールとして電波法認証を取得しておりますので、 周囲環境の影響に合わせて、モジュール内のアンテナ用マッチング回路の定数を変更することはできません。変更した場合は、電波法認証を取り直す必要があります。

Control No. (1/1)	Control name デザインガイド

1.電源起動シーケンス

VCC_NRFピンの立ち上がり時間 (0V から 1.8V) は100msを超えないで下さい。

2. 推奨電源回路

VCC_NRF はこのモジュールのメイン電源 (1.8 – 3.6V)です。 VCC_NRF の電源電圧範囲は LDO モードでは 1.8V から 3.6V、DCDC モードでは 2.1V から 3.6V です。 内蔵 DC/DC コンバータ動作に関するより詳細な情報は、Nordic Semiconductor 社発行の"nRF51 _Series_Reference_Manual v3.0"の 12.1.3 章をご参照下さい。負荷変動による電源電圧の変動が大きい場合、誤動作する可能性があります。外部レギュレータを使用する場合は、負荷変動に強いものを選定し、電流が変化した際に電圧が極力変動しないようご注意下さい。

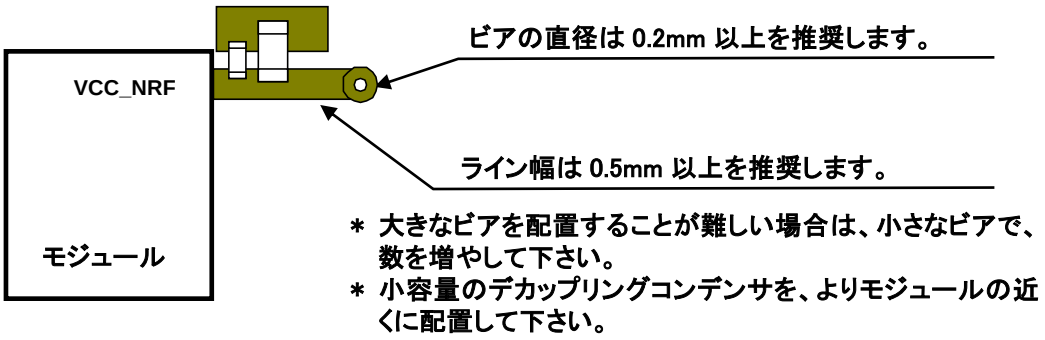
3. 電池動作

電源として小型電池 (例: CR2032)を使用する場合は、大容量コンデンサ (低漏れ電流の 100uF コンデンサなど)を電池の近くに接続して下さい。低温時にモジュールを動作させる際に、負荷による電圧降下を軽減します。

4. パターン設計ガイド

4-1. 電源系

電源のデカップリングコンデンサは、モジュールの VCC_NRF ピンの直近に配置して下さい。VCC_NRF の配線は、幅 0.5mm 以上で、より大きな直径のビアを使って接続することを推奨します。

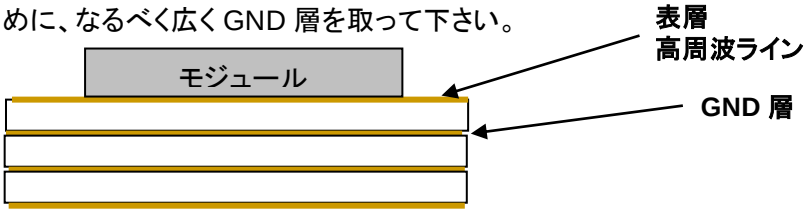


4-2. デカップリングコンデンサ配置

デカップリングコンデンサは、小容量コンデンサ (約 10pF) と大容量コンデンサ (1uF から 10uF) を組み合わせて配置することを推奨します。デカップリングコンデンサの GND はクローズドループが最小となるようにモジュールの GND の直近に配置することを推奨します。

4-3. GND パターン

電源デカップリングコンデンサの GND はモジュール GND の近くに配置して下さい。各レイヤのアイソレーションを確保するために、なるべく広く GND 層を取って下さい。



各層の GND パターンは、多くのビアで内層の GND 層に接続して下さい。

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Firmware Version is Ver. 4.0.0

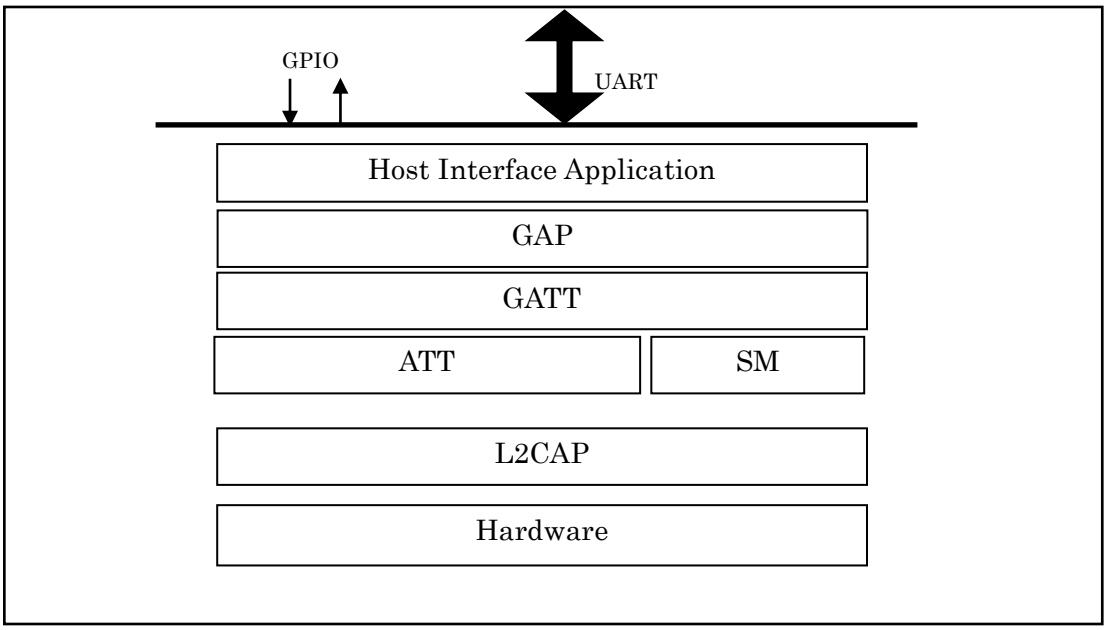
There is a possibility of changing a software specification.

Trademark:
- iBeacon is a trademark of Apple Inc.

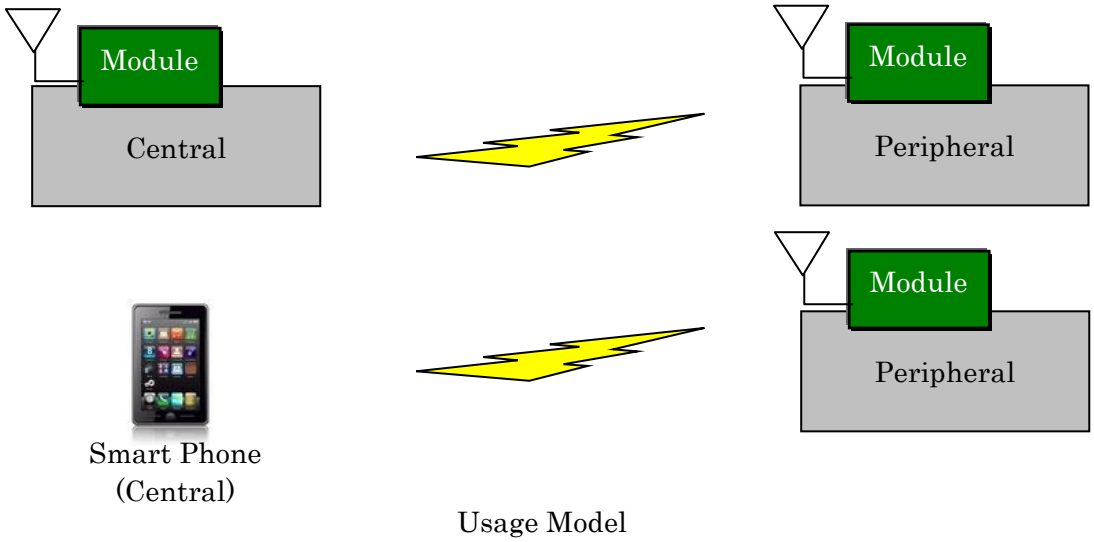
Contents

1. Overview

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



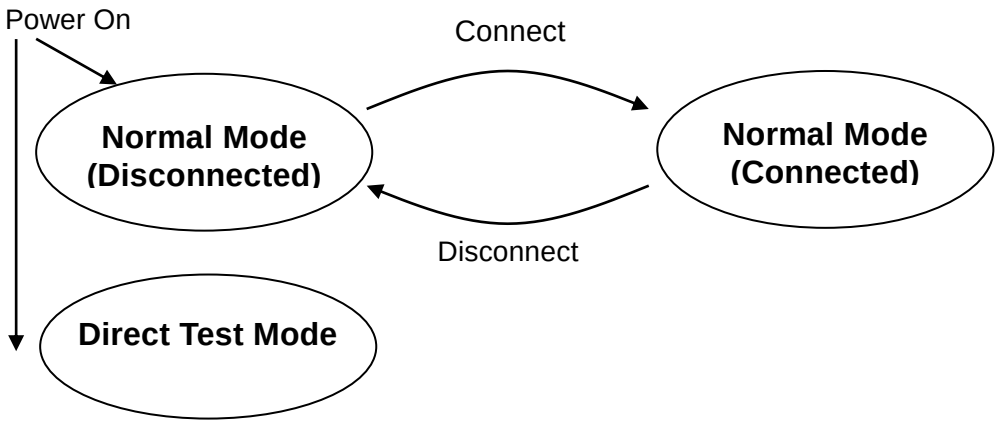
Software Block Diagram



Usage Model

*** Only one-to-one connection is supported.**

2. 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.

3. 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

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					

"BRECV," : 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

4. 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"	Parameter: **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.	Parameter: **BD Address** **(Static Address)**	Successful: ACK Failed: NAK##
ST3	Set Local Device Name (MAX 16CHARACTERS) Default : "TYSA-B 4.0.0" The setting will be updated after reset.	Parameter: **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.	Parameter 0: **PSKEY: DD** **(Decimal)** Parameter 1: **Value: HHHH** **(Hex Word)**	Successful: ACK Failed: NAK##

ST8	Set Customized Advertising data (MAX 62CHARACTERS (31bytes)) The data is stored in FLASH. Example BST801EFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFF (Advertising data : 0x1E,0xFF...) BST811EFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFF (Scan Response data : 0x1E,0xFF...) Please refer section 4.16 for details. The data will be updated in next “CD” command.	<u>Parameter 0:</u> **Advertising : 0** **Scan Response : 1** <u>Parameter 1:</u> **data: HHHH…** **(Hex ASCII)**	Successful: ACK Failed: NAK##
ST9	Set Customized Advertising data (MAX 62CHARACTERS (31bytes)) The data is **not** stored in FLASH. Example BST901EFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFF (Advertising data : 0x1E,0xFF...) BST911EFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFFFFFFFFFFFFFFFFFFF FFFFFFFFFF (Scan Response data : 0x1E,0xFF...) Please refer section 4.16 for details. The data will be updated in next “CD” command.	<u>Parameter 0:</u> **Advertising : 0** **Scan Response : 1** <u>Parameter 1:</u> **data: HHHH…** **(Hex ASCII)**	Successful: ACK Failed: NAK##

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: KV**HHHH**, 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	Parameter 0: **Advertising : 0** **Scan Response : 1**	Successful: HHHH… (Hex ASCII) Stored Advertising data
GT9	Get Customized Advertising data	Parameter 0: **Advertising : 0** **Scan Response : 1**	Successful: HHHH… (Hex ASCII) Current Advertising data
DS	Delete a Specified Paired Central device.	Parameter: **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.	Parameter: **0 : Peripheral** **1 : Central**	Successful: ACK Failed: NAK##

Link Control			
CD	Connectable & Discoverable (Advertising Start / Stop) Advertising PDU type '1' - '2': ADV_IND Connectable and Scannable. Allow Scan Request from Any, Allow Connect Request only from White List. '3' - '4': ADV_IND Connectable, Scannable and Discoverable from any devices. '5' : ADV_DIRECT_IND Connectable from the device whose BD Address matches ST1 command. '6' : ADV_NONCONN_IND Non-Connectable, Non-Scannable and Discoverable. '7' : ADV_SCAN_IND Non-Connectable, Scannable and Discoverable. **Default data** **Advertising :** 0D09545953412D4220332E302E30 020105020A04 **Scan Response :** 03030F181107EB532D21D4E1E1CB 289A008A70152F44	Parameter **'0'** – Advertising Stop. **'1'** – Connectable from White List Advertising Start. Default data. **'2'** – Connectable from White List Advertising Start. Customized data. **'3'** – Connectable and discoverable from any devices Advertising Start. Default data. **'4'** – Connectable and discoverable from any devices Advertising Start. Customized data. **'5'** – Directed Advertising Start. **'6'** – Non-Connectable and Non-Scannable Advertising Start. Customized data. **'7'** – Non-Connectable and Scannable Advertising Start. Customized data.	Successful: ACK, Failed: NAK##

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.	Parameter I/O capabilities ([**'0','1','2','3','5'**])	Successful: ACK, Failed: NAK##
YN	Answer of numeric collation	Parameter 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##

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	Parameter 0: 0 : In Peripheral role 1 : In Central role Parameter 1: Reason in hexadecimal See section 4.3.1 for further details.
ADT	Advertising Timeout	
PAS	Pairing Success	Parameter: 0 : Paired device is not stored 1-7 : Index of paired device list
ESR	Enable Service	Parameter: 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication) 2 : Battery Service
DSR	Disable Service	Parameter: 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication) 2 : Battery Service
NM	Shown a six digit number (Numeric Value)	Parameter: From "000000" to "999999" (ASCII)
OBC	Local OOB Data (Simple Pairing Hash C)	Parameter: From “00000000000000000000000000000000” to “FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF” (ASCII)
OBR	Local OOB Data (Simple Pairing Randomizer R)	Parameter: From “00000000000000000000000000000000” to “FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF” (ASCII)
KEY	Request passkey number	
PK	Passkey Number indication	Parameter: From "000000" to "999999" (ASCII)

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)		

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)		

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. (1minite – 15minites)		
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		

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

Name	PSKEY_USER13	Key Length:	1
Descriptive Name:	DC/DC converter setting		
Description:	DC/DC converter setting. “0000” will disable internal DC/DC converter (and use internal LDO). “0001” will enable internal DC/DC converter. 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”.		
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		

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.

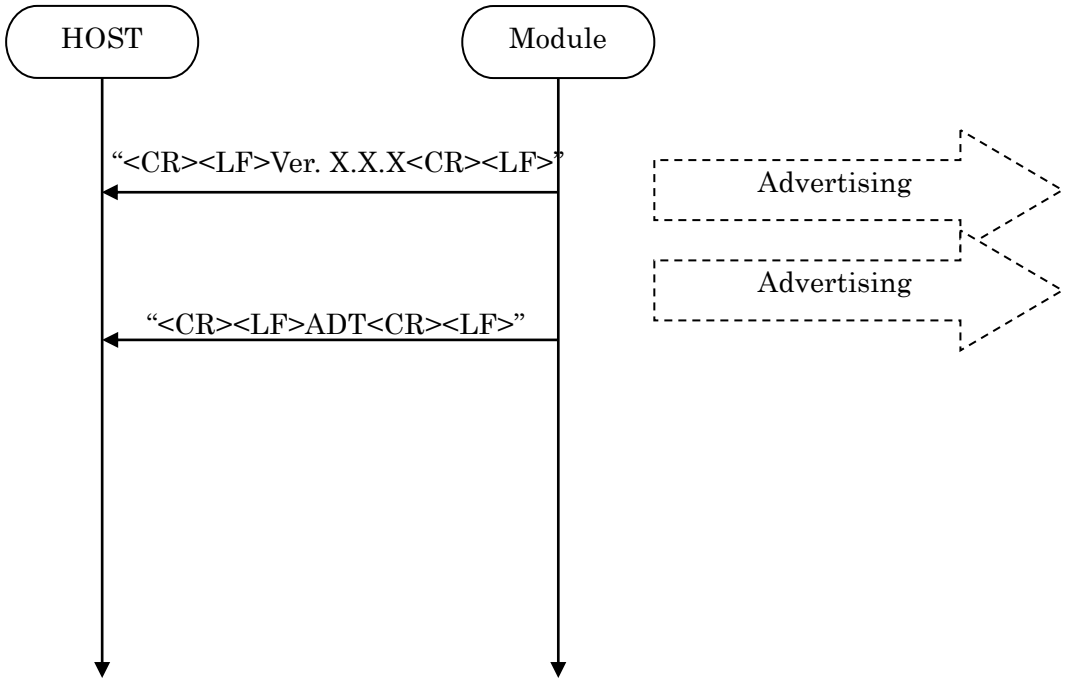
4.3.1. Disconnect reason

#	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.

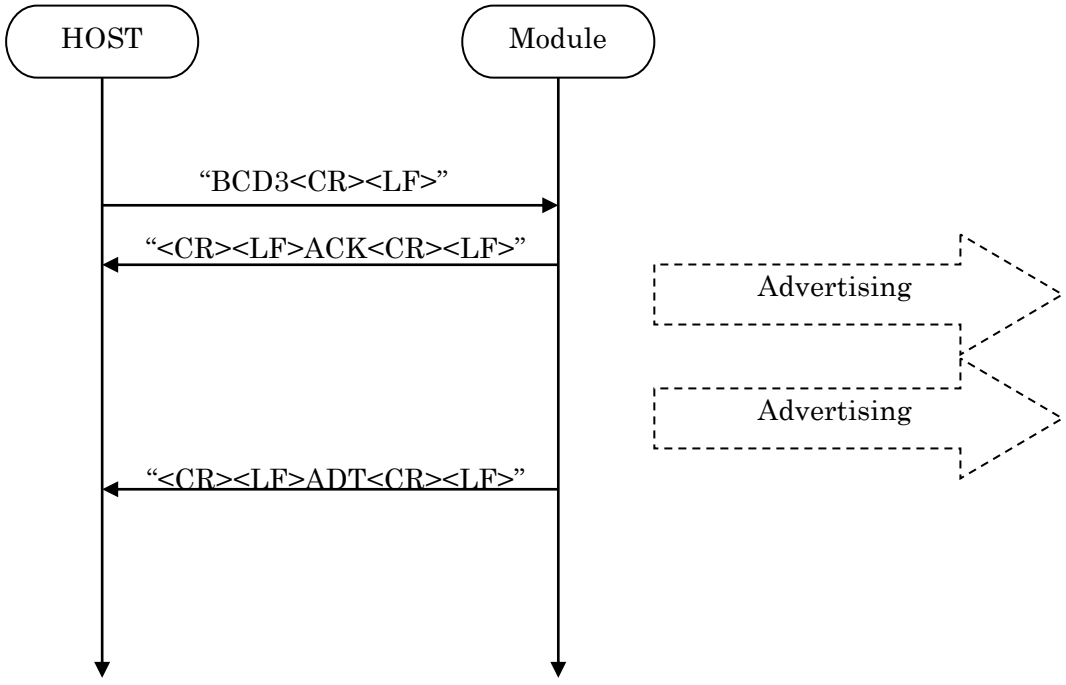
About other error codes, please see below.
https://infocenter.nordicsemi.com/topic/com.nordic.infocenter.s130.api.v2.0.1/group___b_l_e___h_c_i___s_t_a_t_u_s___c_o_d_e_s.html

4.4. Message Sequence Chart

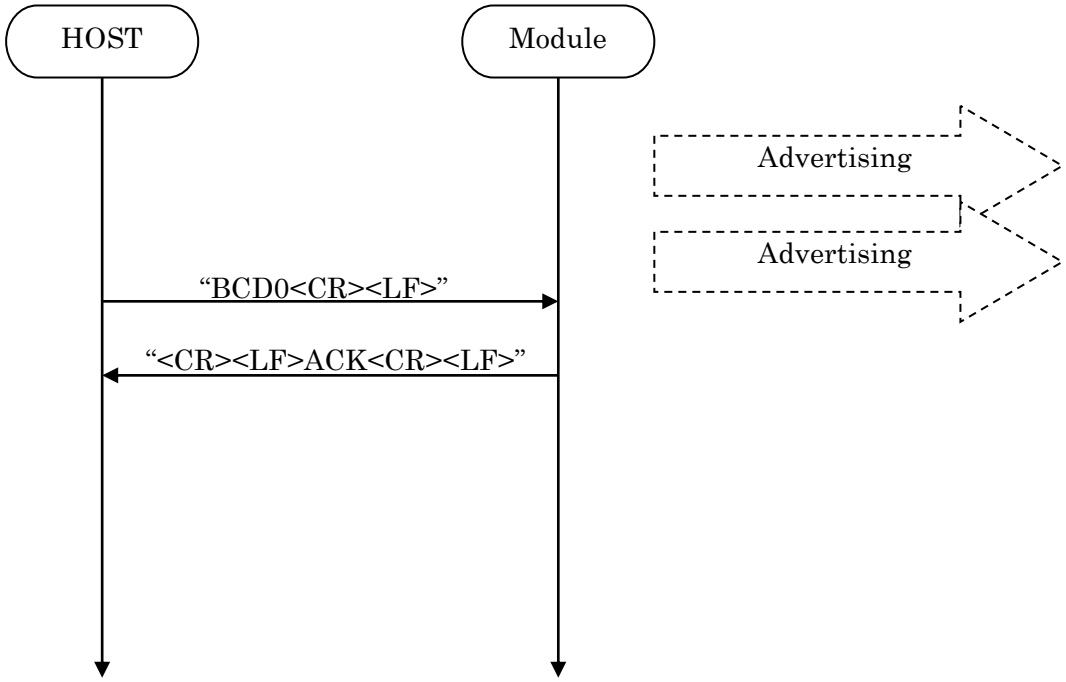
4.4.1. Power On (In case of PSKEY_USER01≠'0000' and PSKEY_USER07≠'0000')



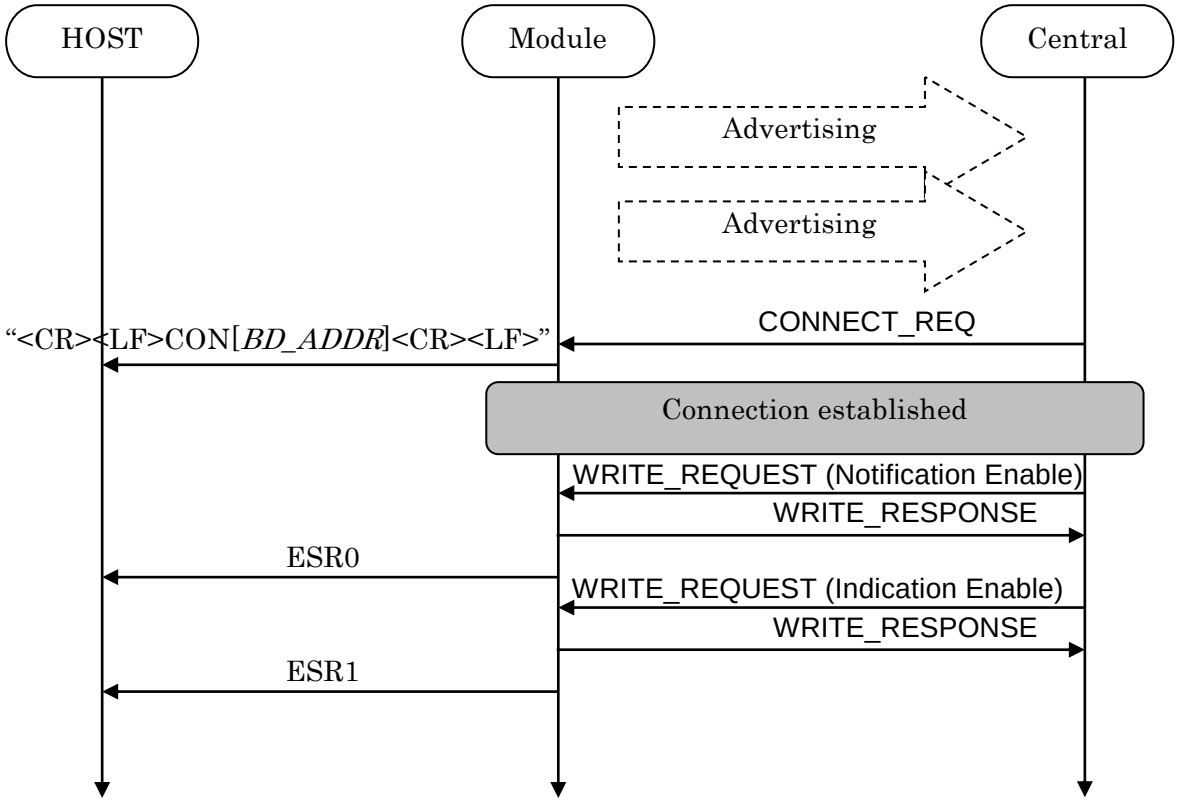
4.4.2. Advertising Start



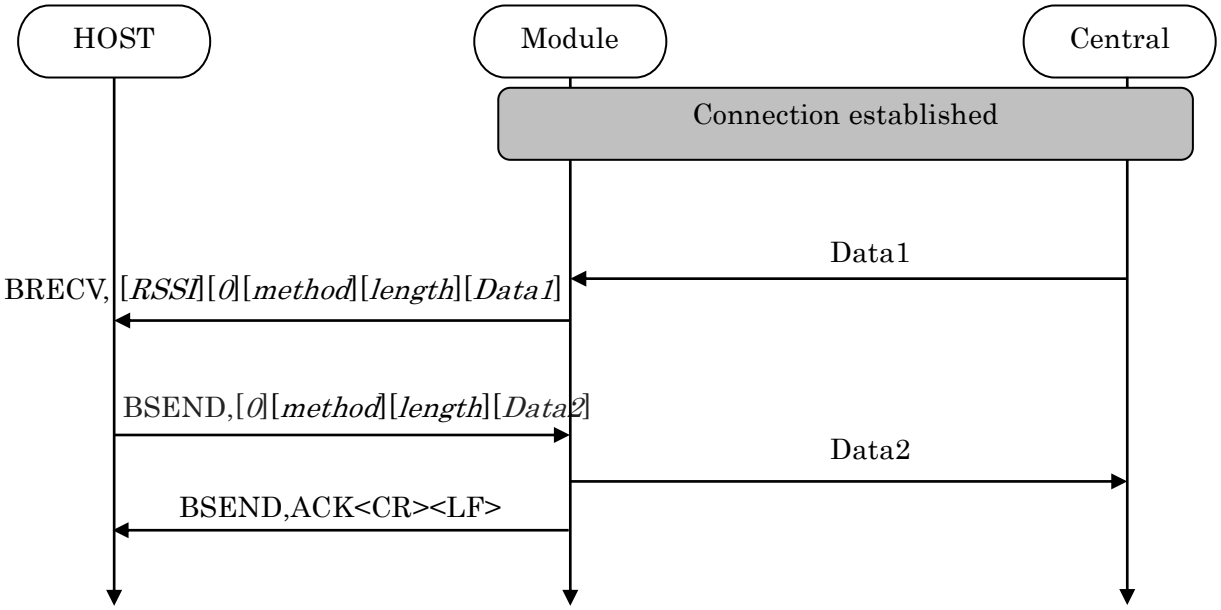
4.4.3. Advertising Stop



4.4.4. Connect

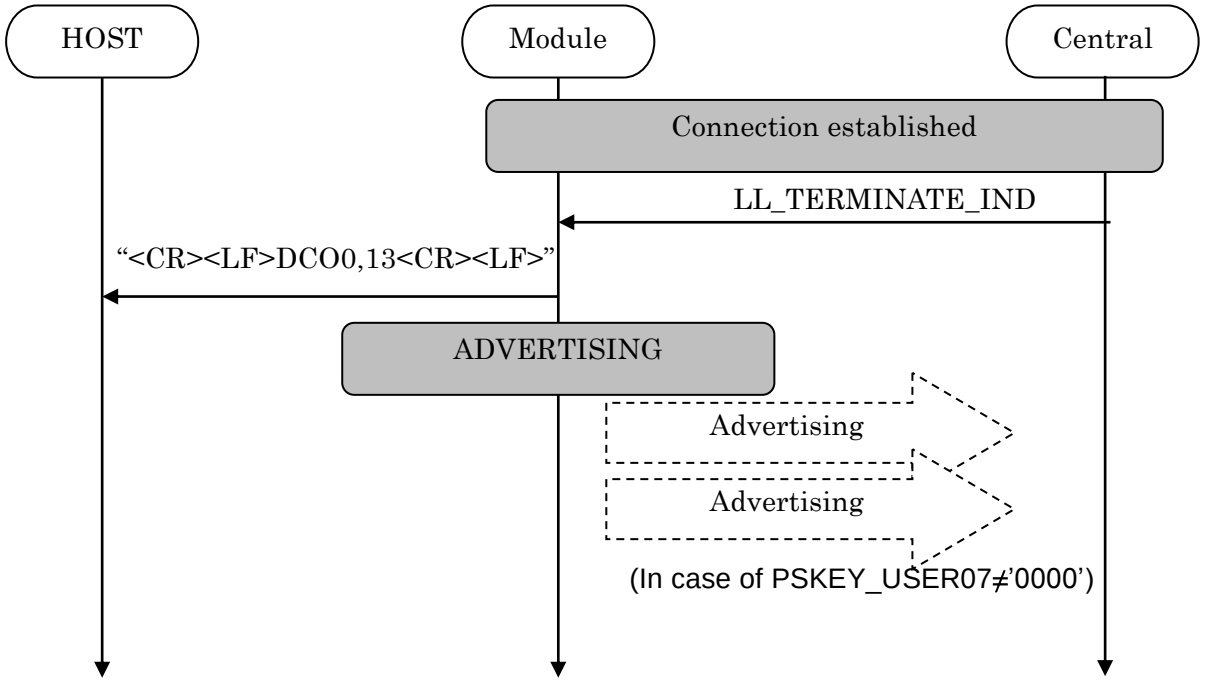


4.4.5. Sending & Receiving Data over a connected Link

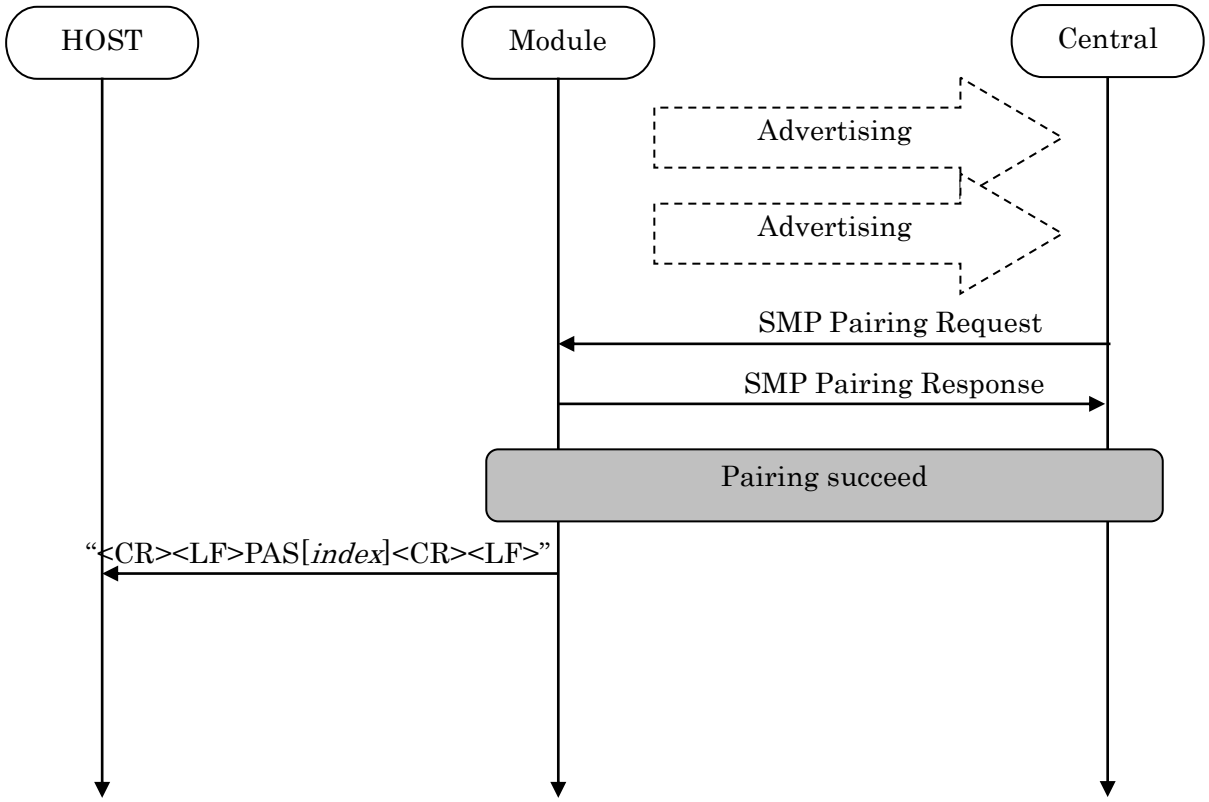


Max send a packet data size = 20bytes
Max receive a packet data size = 20bytes

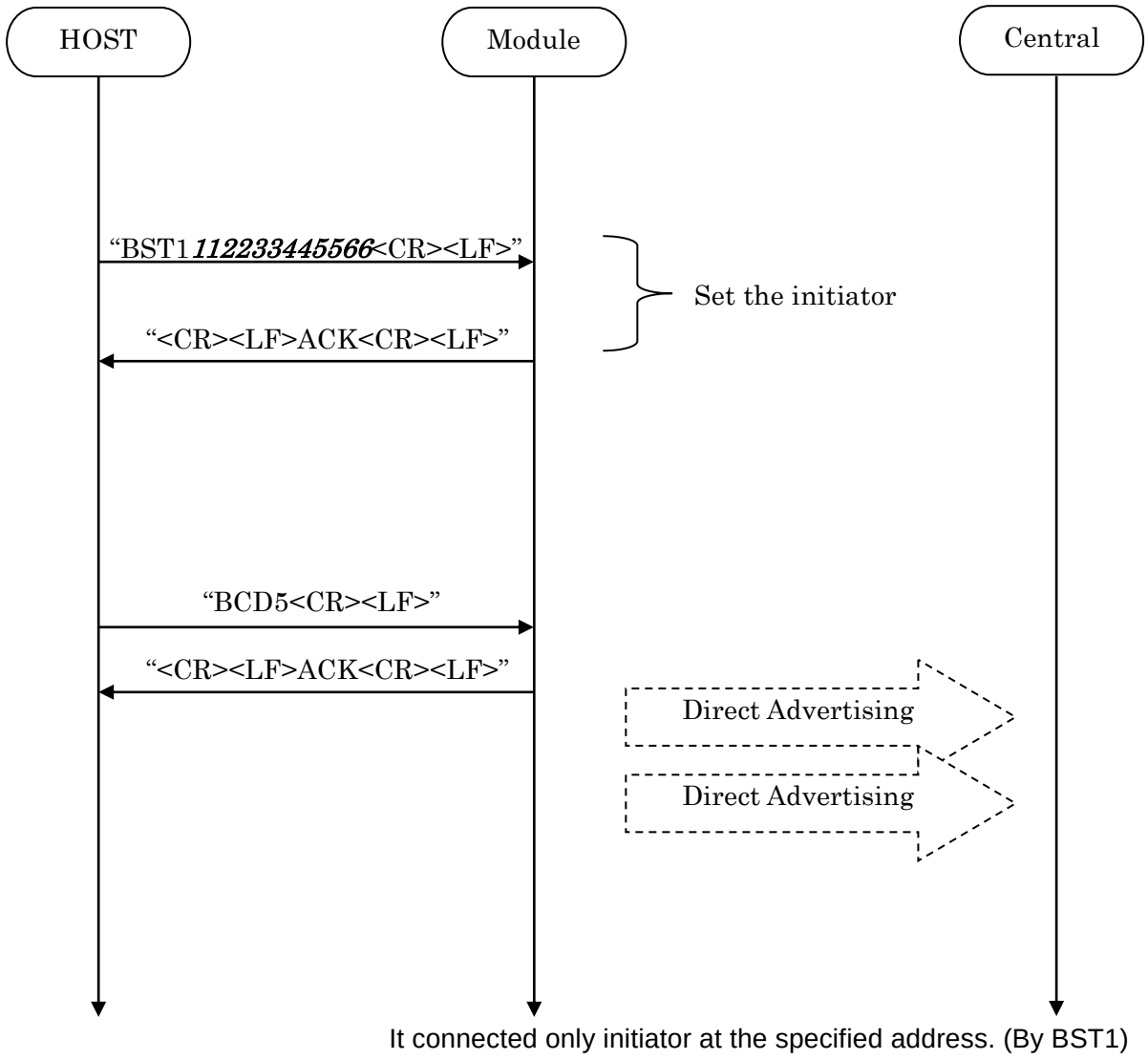
4.4.6. Disconnect



4.4.7. Pairing

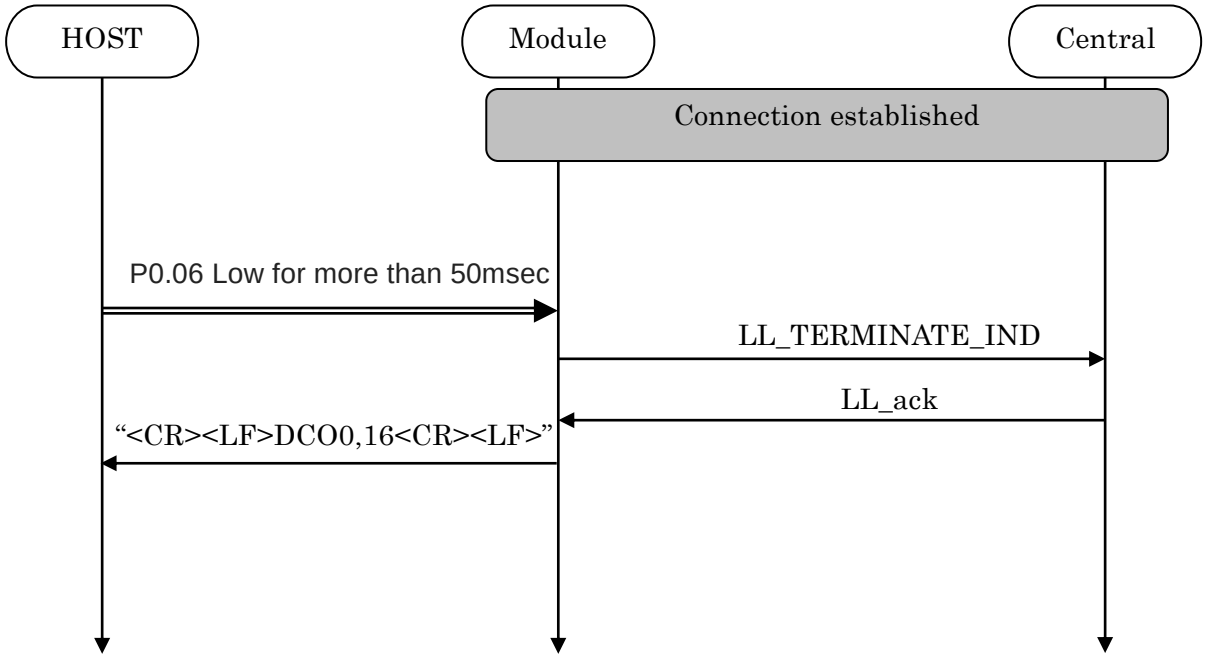


4.4.8. Directed Advertising

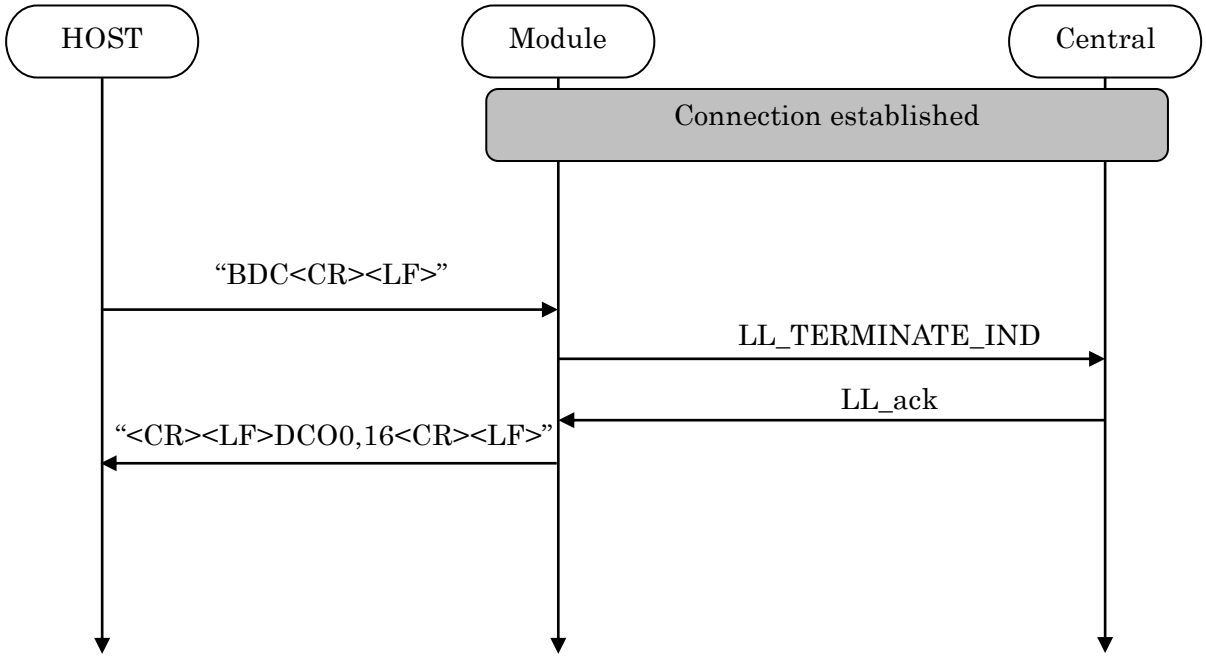


*** Direct Advertising Timeout is 1.28sec regardless of Advertising Timeout setting (PSKEY_USER01).**

4.4.9. Disconnect Request (GPIO)



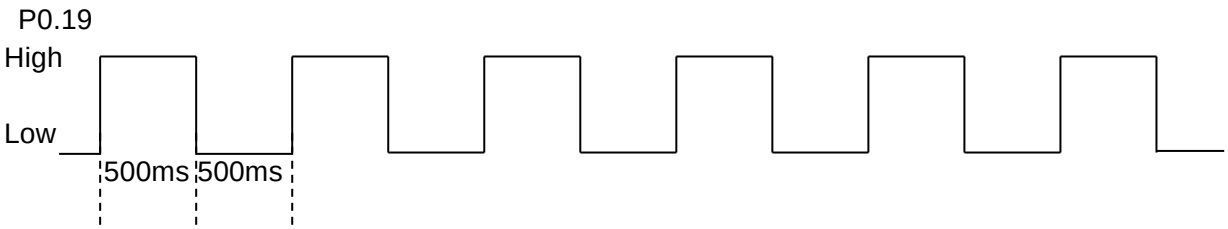
4.4.10. Disconnect Request (Command)



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

4.5.1. Advertising



4.5.2. Connect

P0.19 High

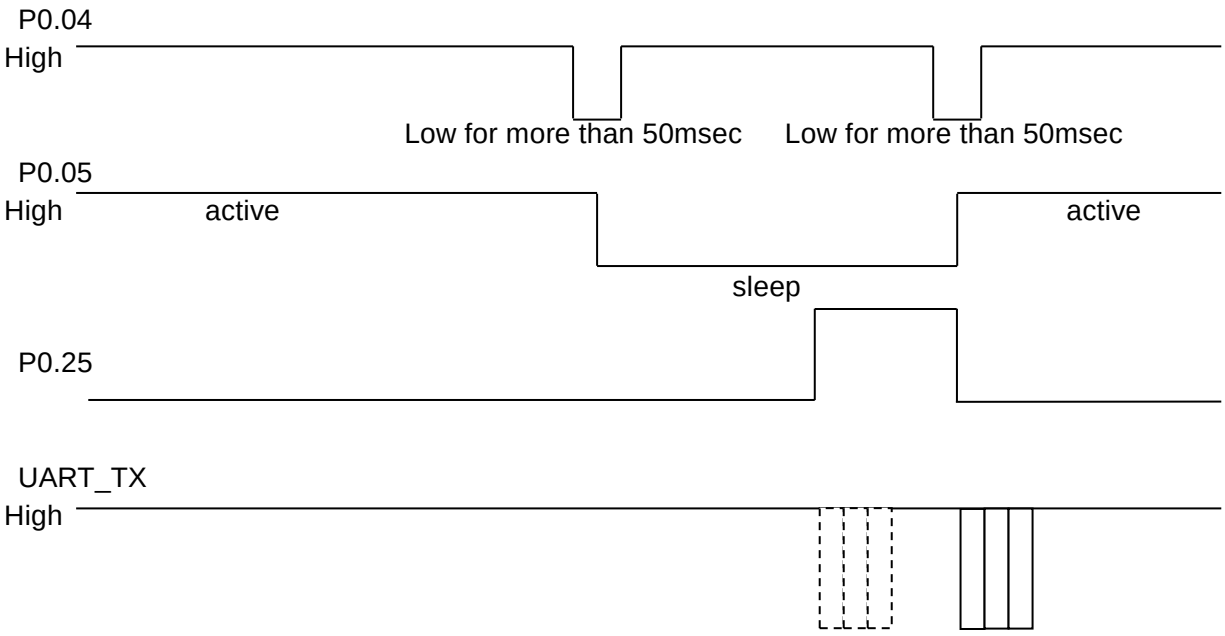
4.5.3. Disconnect & Standby

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.

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.**

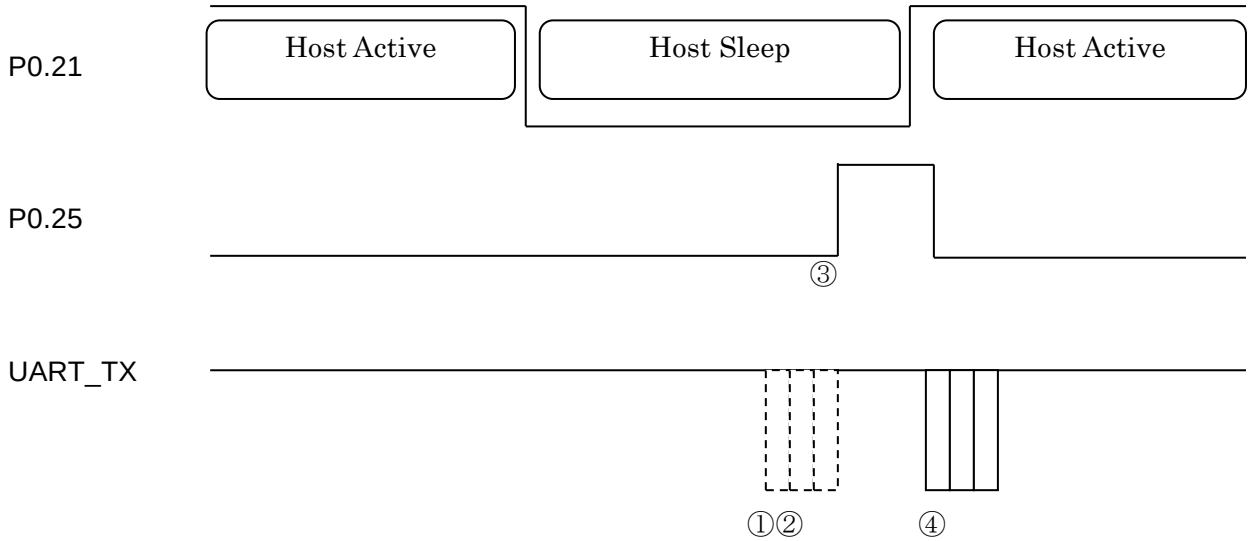
4.7. UART configuration

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

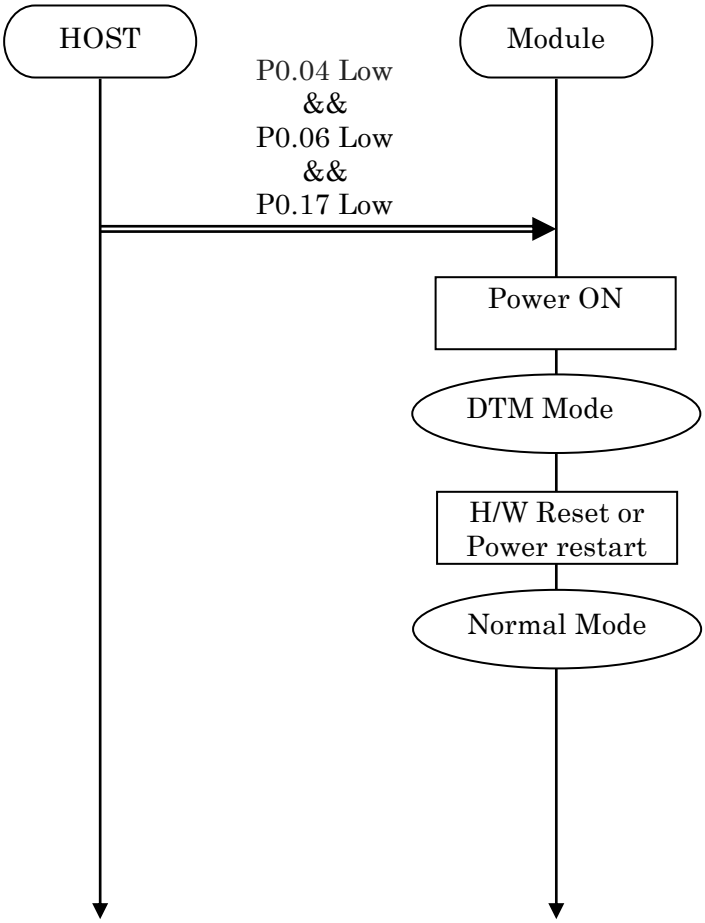


① Communication data or an event occurs in HOST Sleep.
② It waits until the host becomes active.
③ Module request to host wake-up via PIO.
④ If HOST becomes Active and Module is active (refer 4.5.5), module send communication data or event.

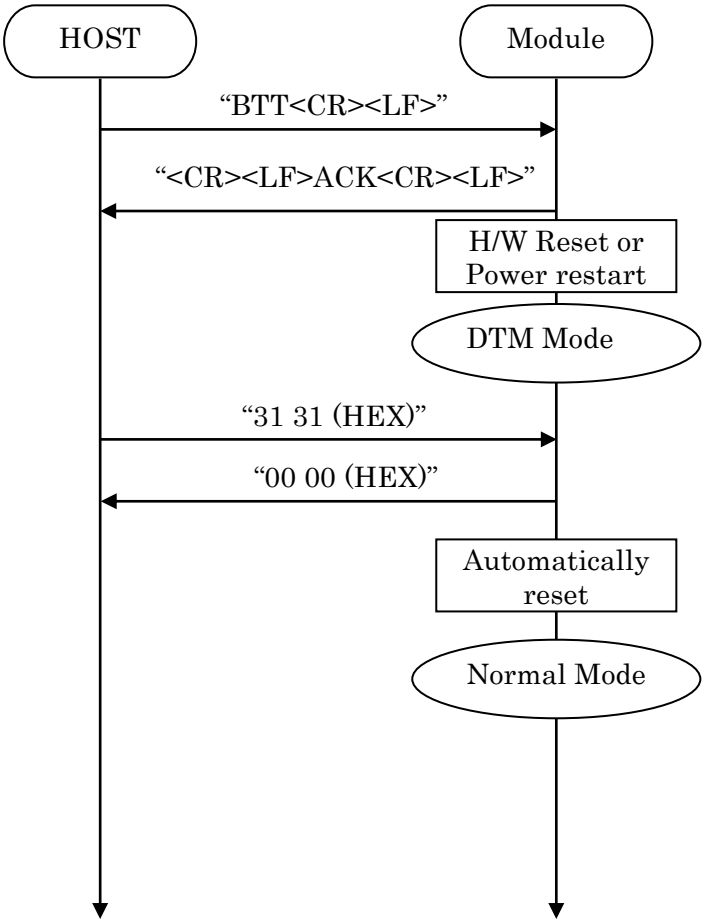
*** Buffer size : 128byte If the buffer is full, further data received is discarded without any events.**

4.10. DTM (Direct Test Mode)

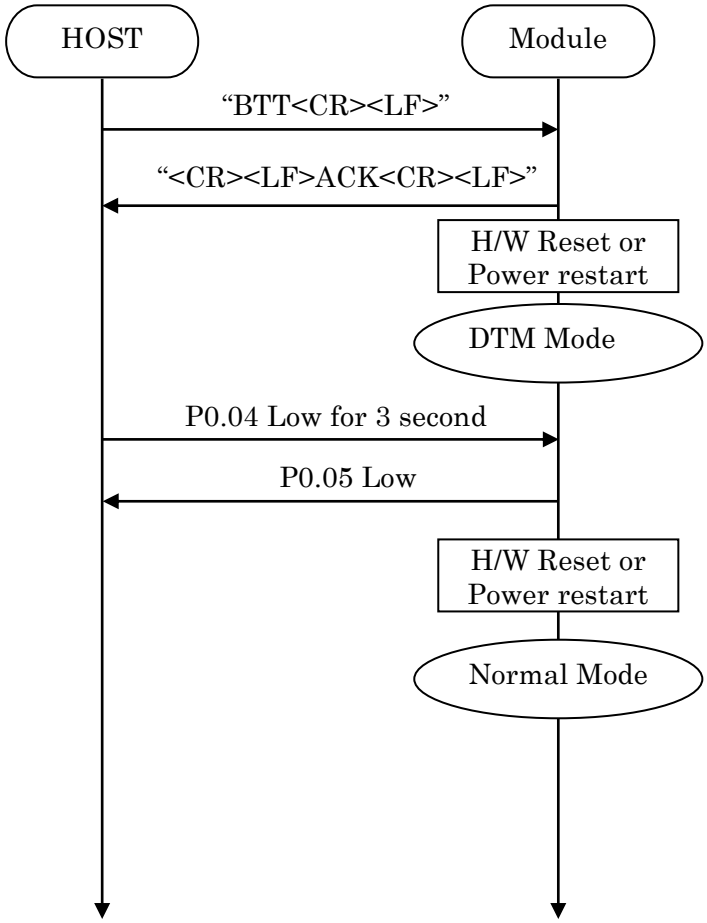
4.10.1. Enter DTM and exit DTM with GPIO



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



4.10.3. Enter DTM and exit DTM with Command

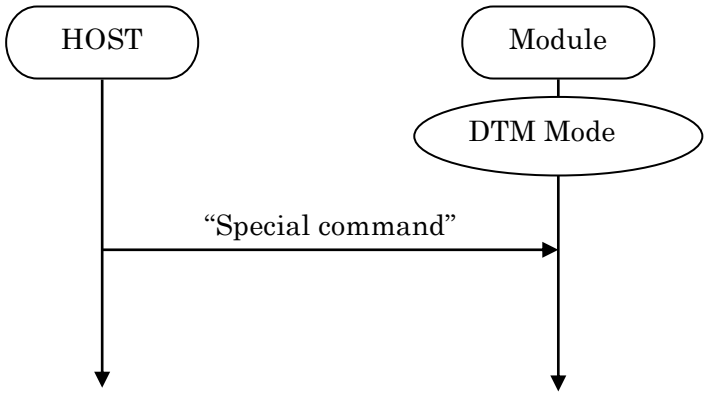


4.10.4. DTM Commands/Events

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)

4.11. GPIO check

Host can inspect GPIO by special commands in DTM.

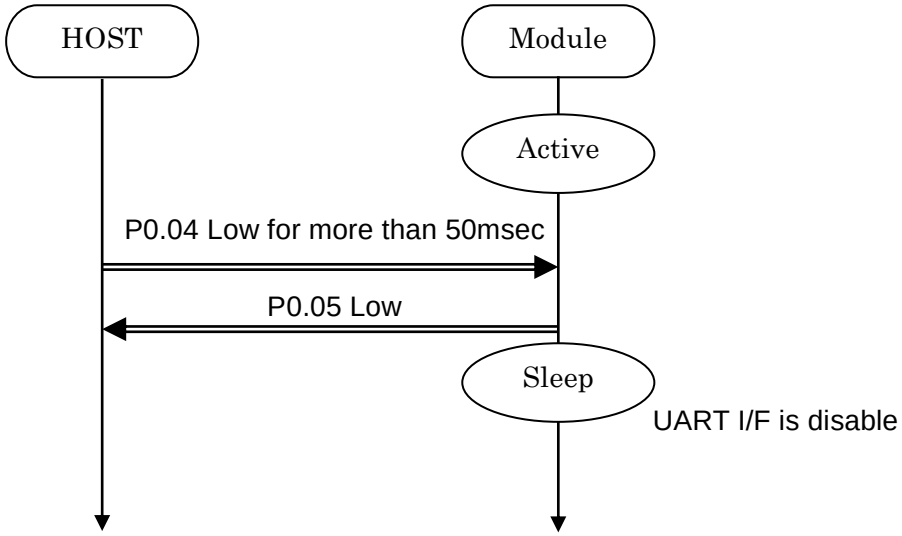


Command (Hex value)	Function	Response
32 30	It makes P0.05 Low.	00 00
32 31	It makes P0.05 High.	00 00
33 30	It makes P0.19 Low.	00 00
33 31	It makes P0.19 High.	00 00
34 30	It makes P0.25 Low.	00 00
34 31	It makes P0.25 High.	00 00
35 30	It makes P0.23 Low.	00 00
35 31	It makes P0.23 High.	00 00
39 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)

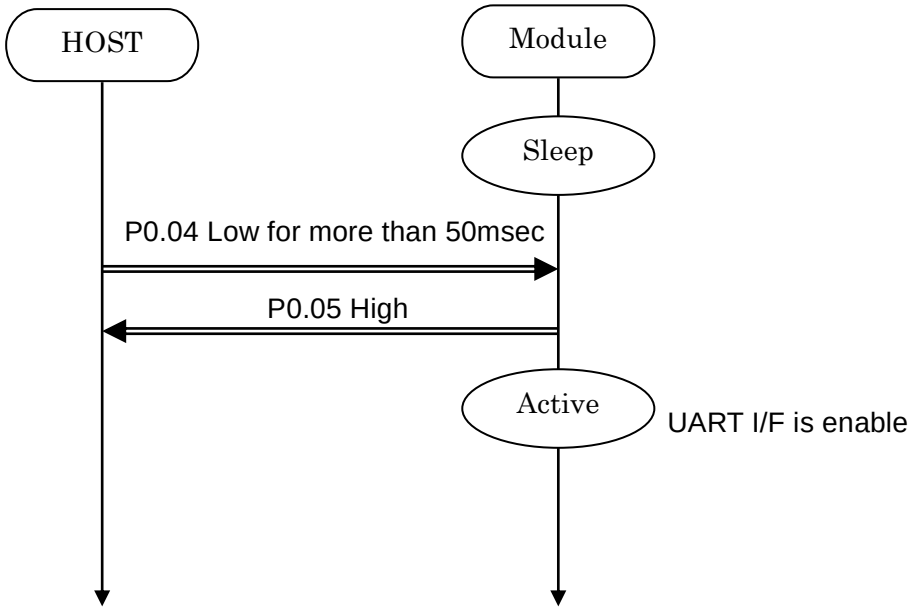
This Sleep is available in during Advertising and Connection.
UART I/F is not usable during Sleep.

4.12.1. Enter sleep mode



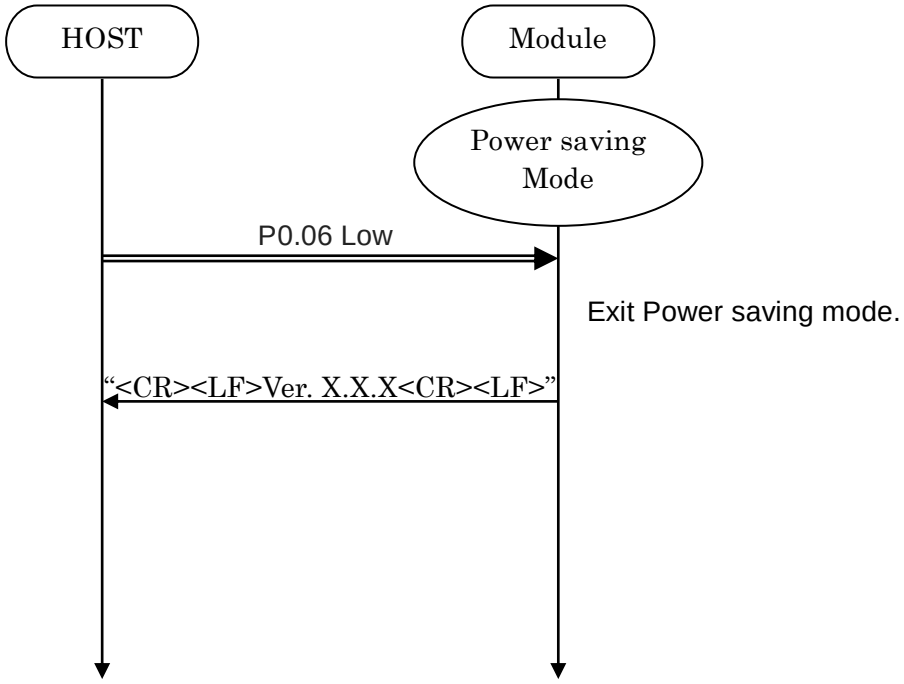
In case of UART data happen, the module notify to Host via P0.25.
It is same as “Host wake-up”.

4.12.2. Exit sleep mode

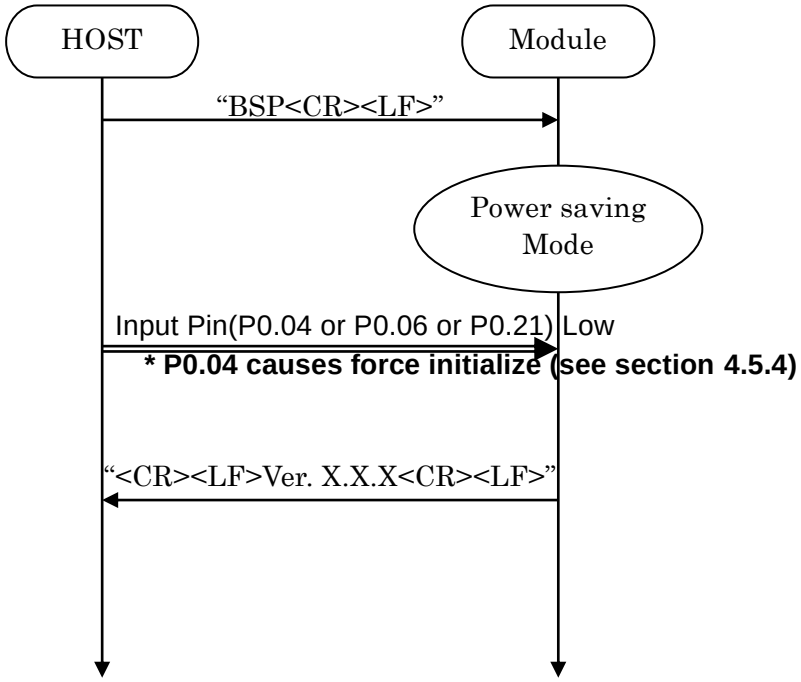


4.13. Power saving mode (SYSTEM OFF)

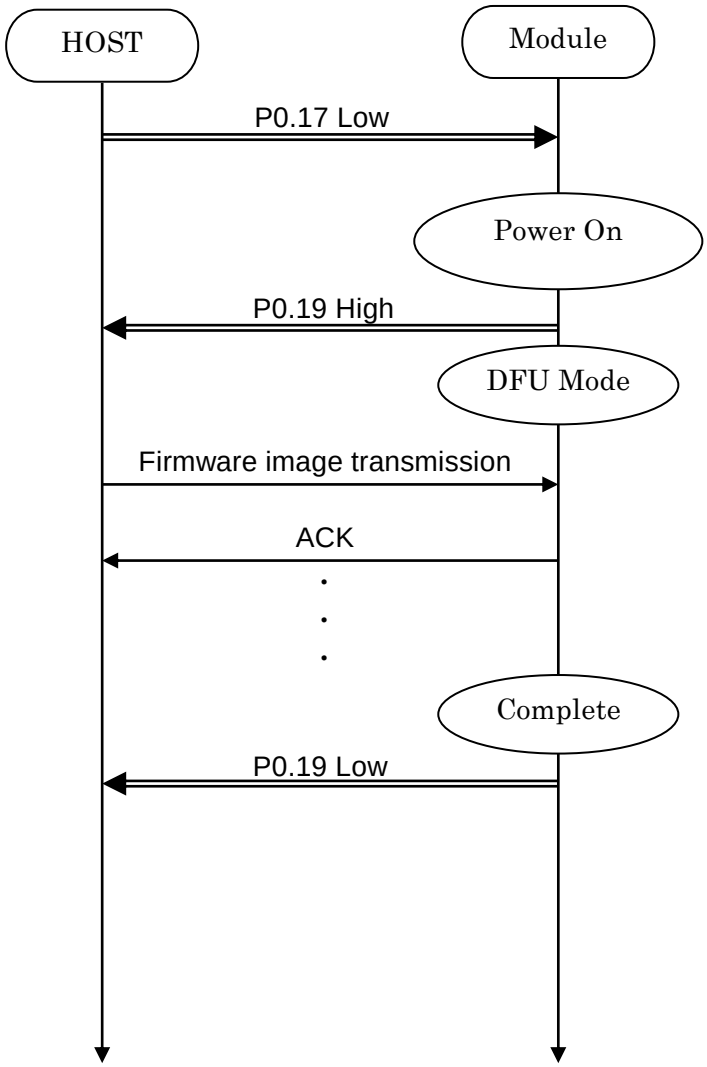
4.13.1. On startup (In case of PSKEY_USER09='0001')



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

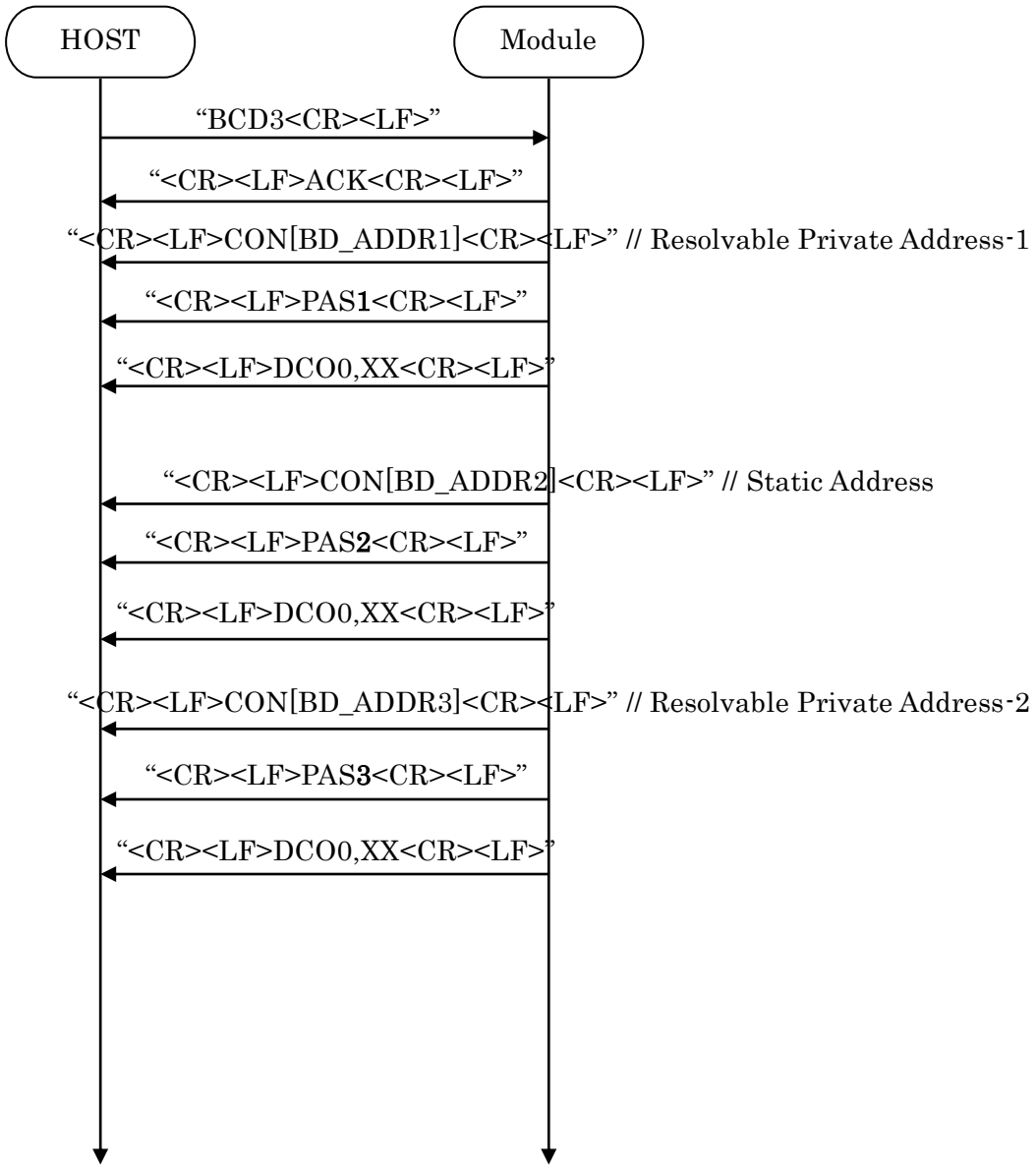
*** Please contact TAIYO YUDEN when you use this function.**

4.15. Identify the peer device

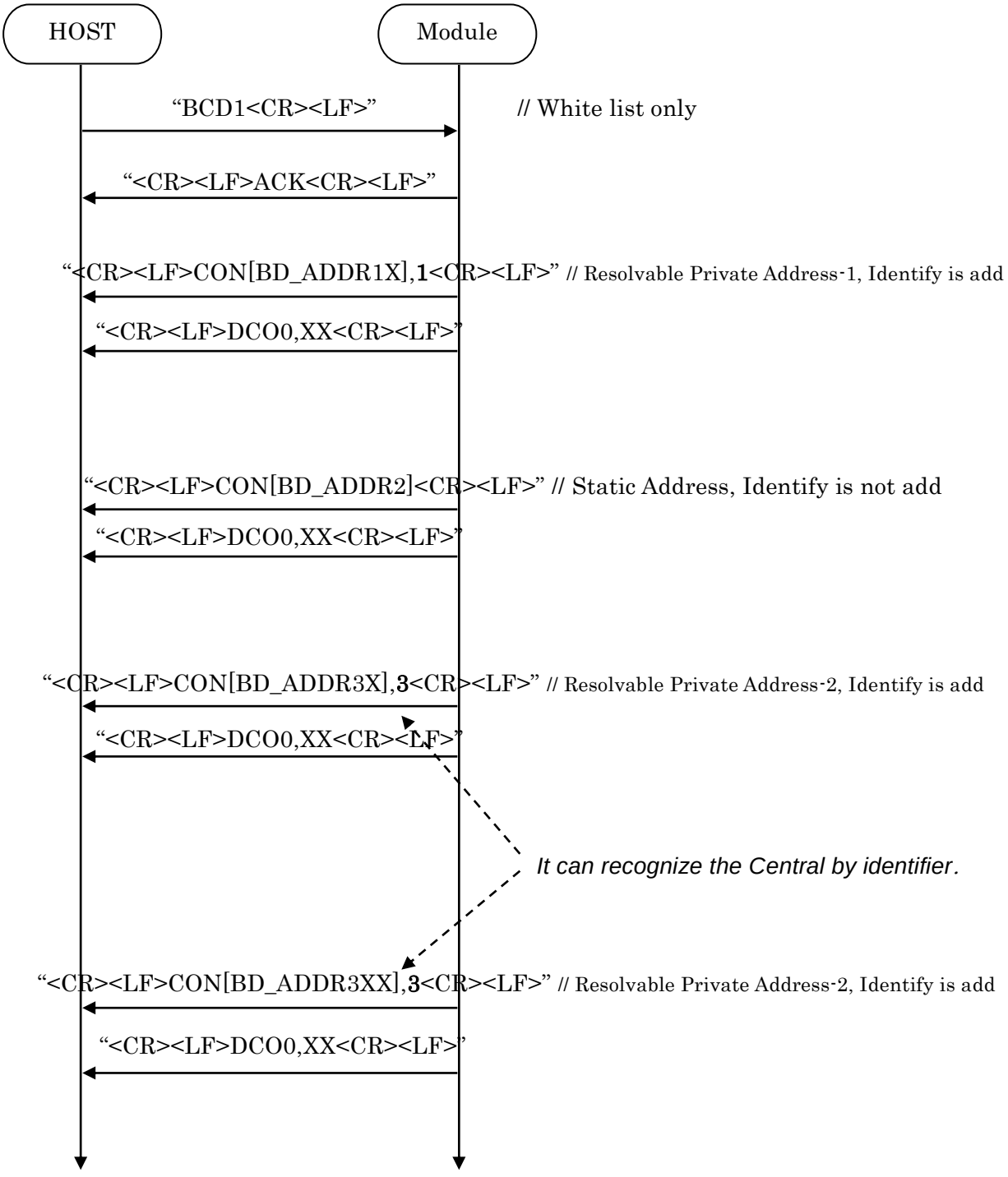
Some centrals devices uses a Random Address and makes an IRK entry. In this case, address would change. It is unclear whether the connection with any central. You can add identify to the connection event by the setting PSKEY.

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

4.15.1. Pairing



4.15.2. Connection



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 (442FFFFF8A009A28CBE1E1D4212D53EB) Big-endian 442FFFFF-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.

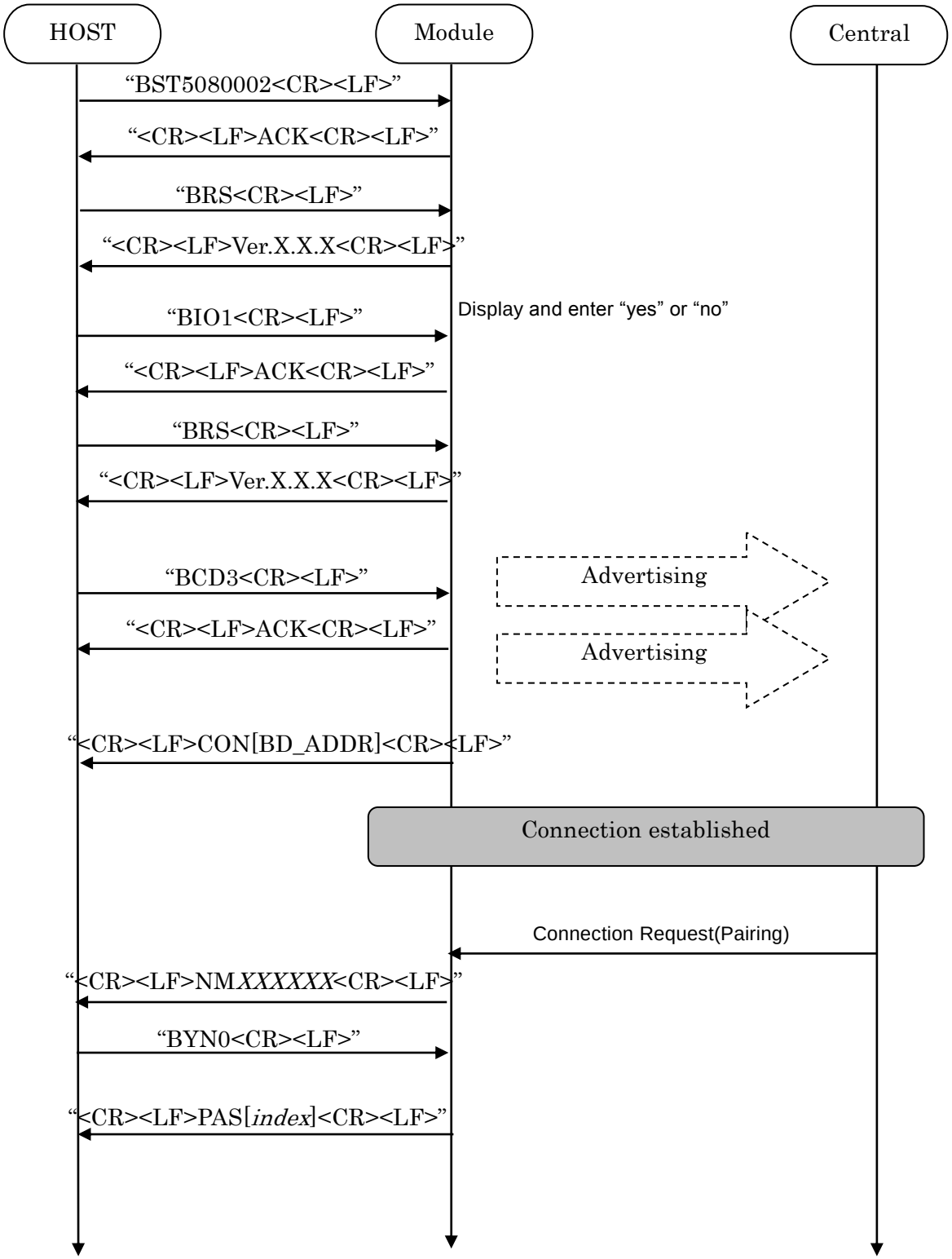
The following command stores above data as Customized Advertising data.

BST800201061AFF4C000215442FFFFF8A009A28CBE1E1D4212D53EB01F40389B1<CR><LF>

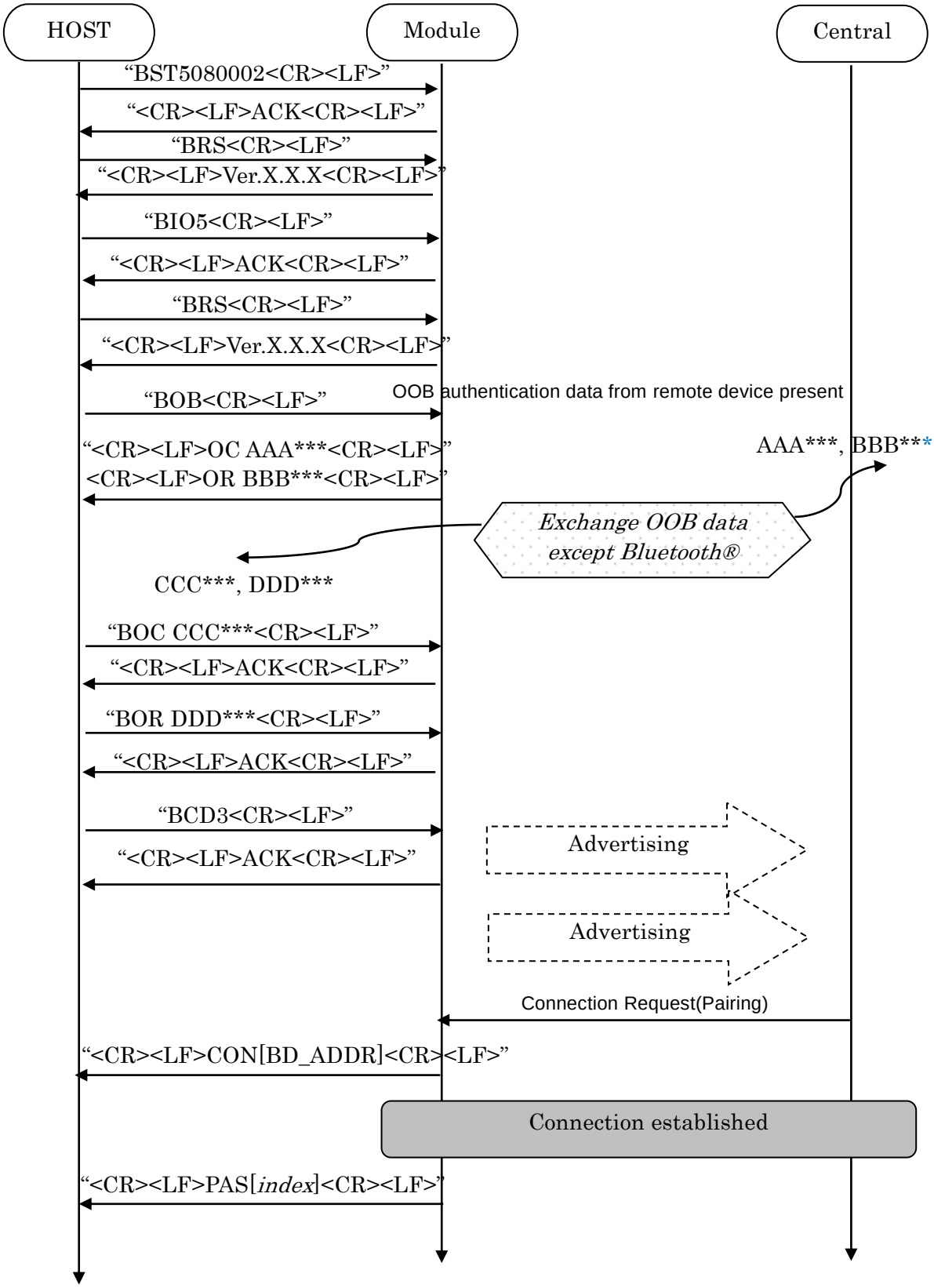
Parameter0 Parameter1

4.17. LE Secure Connection

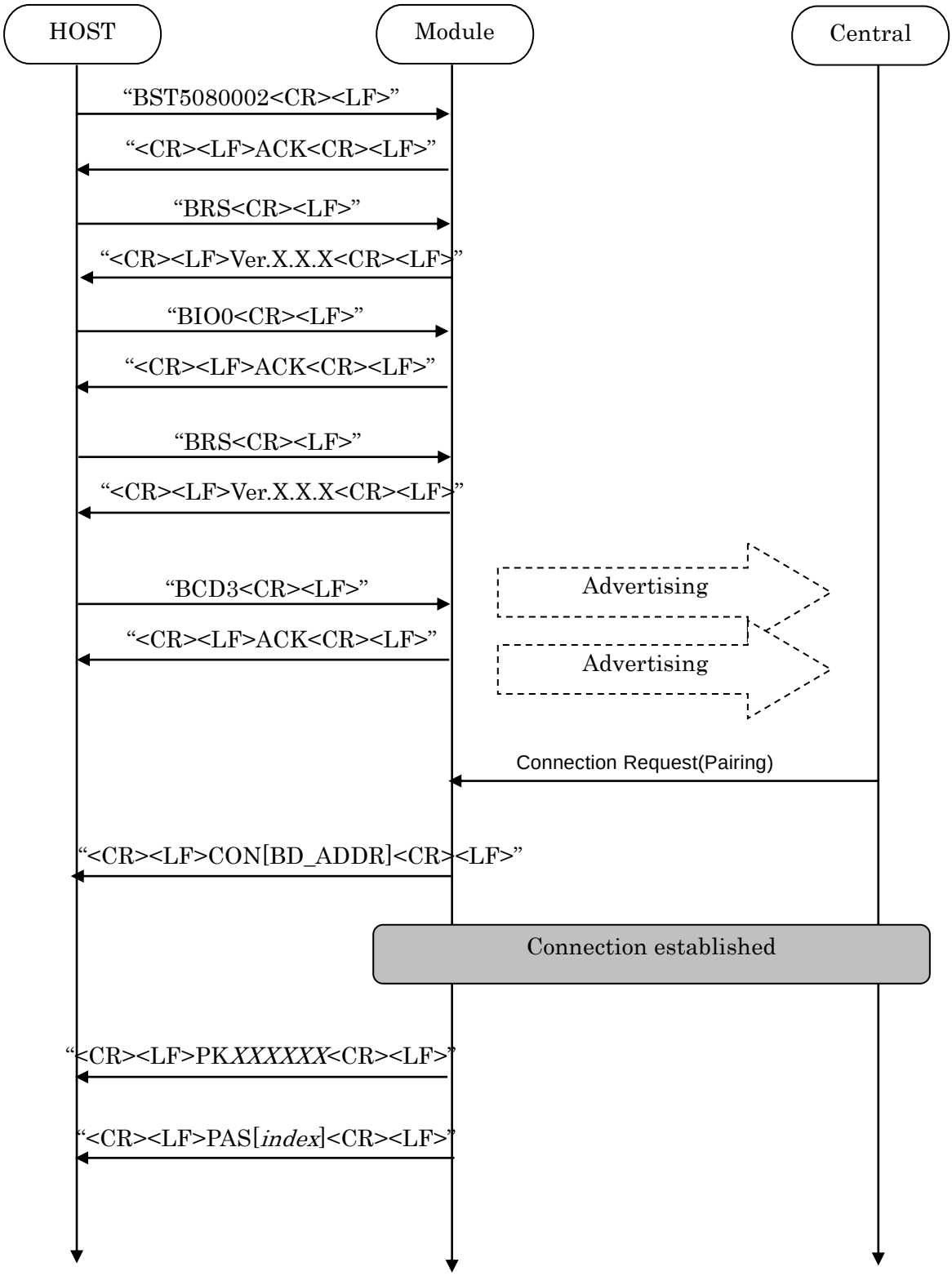
4.17.1 Numeric Comparison



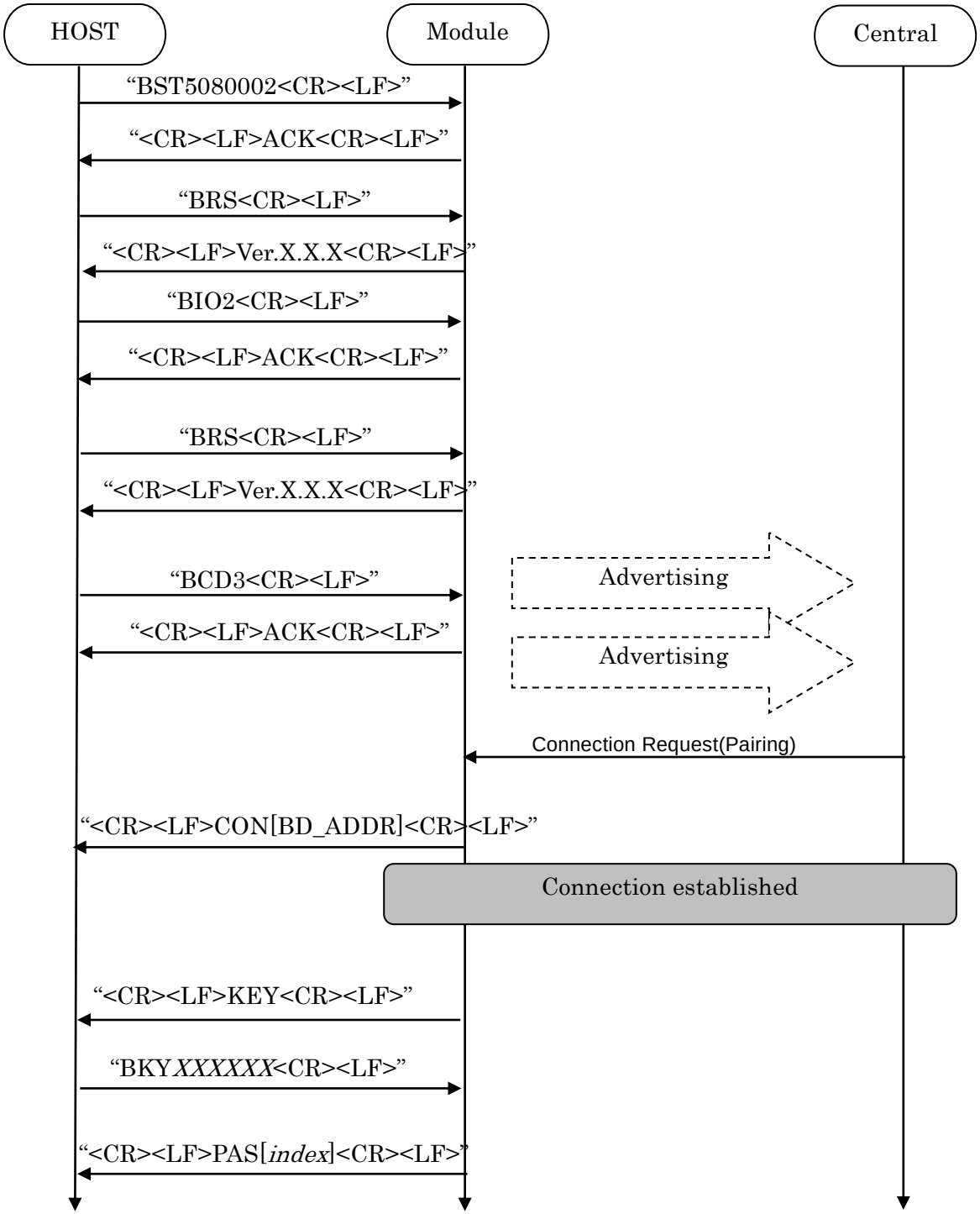
4.17.2 Out of Band



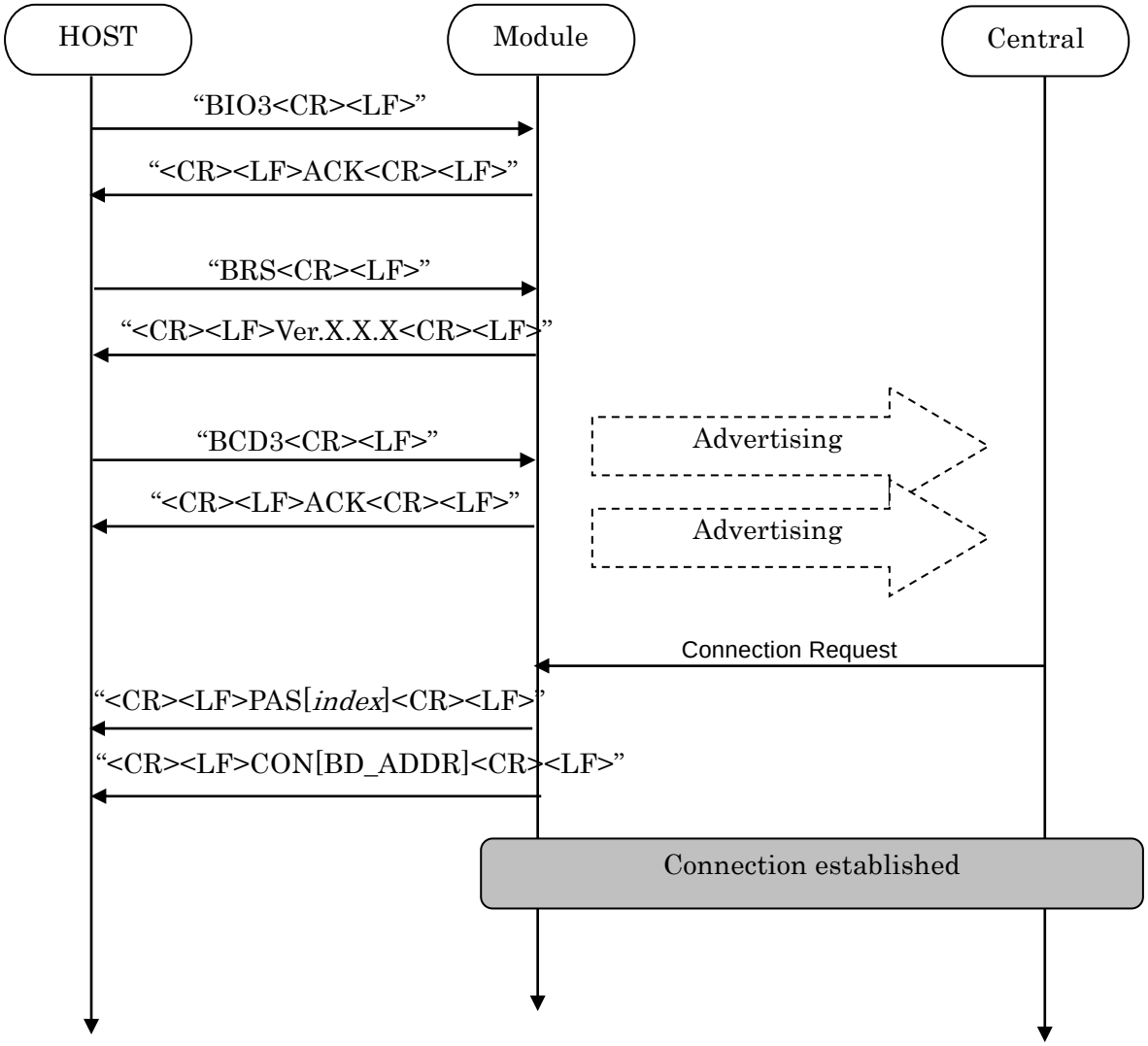
4.17.3 Passkey Entry, Peripheral Displays



4.17.4 Passkey Entry, User Inputs on Peripheral



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.

5. 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.	Parameter: **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.	Parameter 0: **PSKEY: DD (Decimal)** Parameter 1: **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: KV**HHHH**, 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##

GTF	Get filter's parameter	Please refer section 5.16.	Successful: Value Failed: NAK##
DS	Delete a Specified Paired Peripheral device.	Parameter: **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.	Parameter: **0 : Peripheral** **1 : Central**	Successful: ACK Failed: NAK##

Link Control			
SC	Scan Start or Stop	Parameter **'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##

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.	Parameter I/O capabilities ([**'0','1','2','3','5'**])	Successful: ACK, Failed: NAK##
YN	Answer of numeric collation	Parameter 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##

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	Parameter 0: 0 : In Peripheral role 1 : In Central role Parameter 1: Reason in hexadecimal See section 5.3.1 for further details.
SCT	Scanning Timeout	
PAS	Pairing Success	Parameter 0: 0 : Paired device is not stored 1-7 : Index of paired device list
INT	Connection Interval	Parameter0: Max Connection Interval Parameter1: Min Connection Interval
ESR	Enable Service	Parameter: 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication)
DSR	Disable Service	Parameter: 0 : Characteristic 0x1571 (Notification) 1 : Characteristic 0x1573 (Indication)
NM	Shown a six digit number (Numeric Value)	Parameter: From "000000" to "999999" (ASCII)
OBC	Local OOB Data (Simple Pairing Hash C)	Parameter: From “00000000000000000000000000000000” to “FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF” (ASCII)
OBR	Local OOB Data (Simple Pairing Randomizer R)	Parameter: From “00000000000000000000000000000000” to “FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF” (ASCII)
KEY	Request passkey number	
PK	Passkey Number indication	Parameter: From "000000" to "999999" (ASCII)

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)		

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		

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		

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

Name	PSKEY_USER13	Key Length:	1
Descriptive Name:	DC/DC converter setting		
Description:	DC/DC converter setting. “0000” will disable internal DC/DC converter (and use internal LDO). “0001” will enable internal DC/DC converter. 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”.		
Default:	0000		
Range	0000– 0001		

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

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		

Name	PSKEY_USER18	Key Length:	1
Descriptive Name:	Filter (BD Address)		
Description:	Set the filter of BD Address. The filter checks “Allow” then “Deny”. Parameter “00XY” X : Allow Y : Deny 0 Disable filter 1 Specify in BD Address 2 Specify in Company ID(Public BD Address) BD Address is set with STF command.		
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.

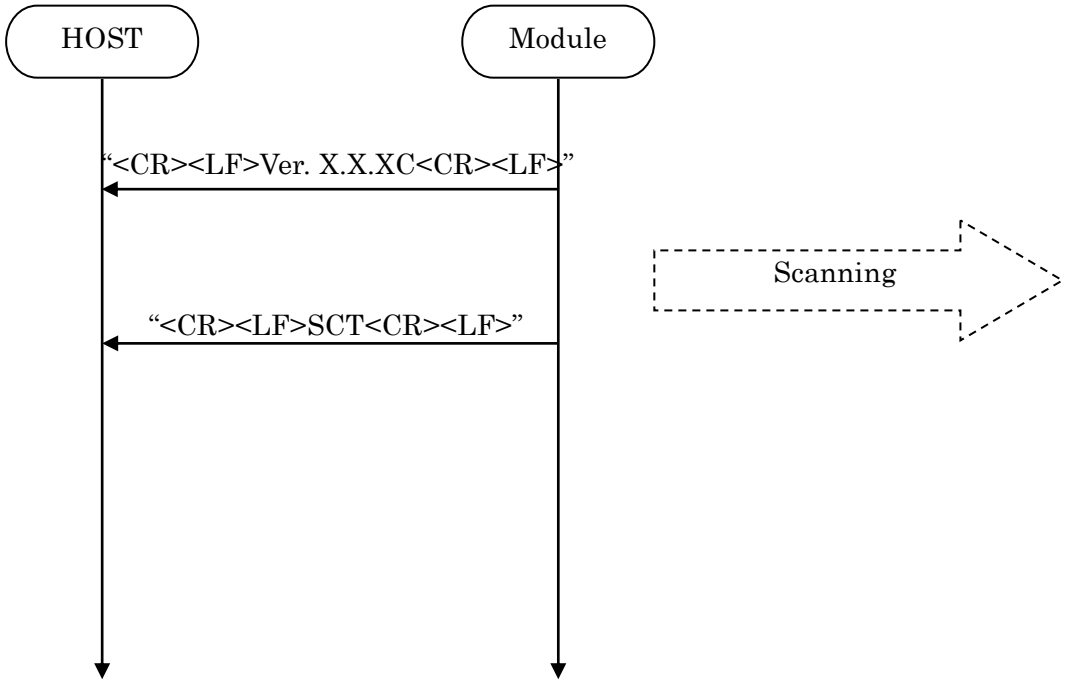
5.3.1. Disconnect reason

#	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.

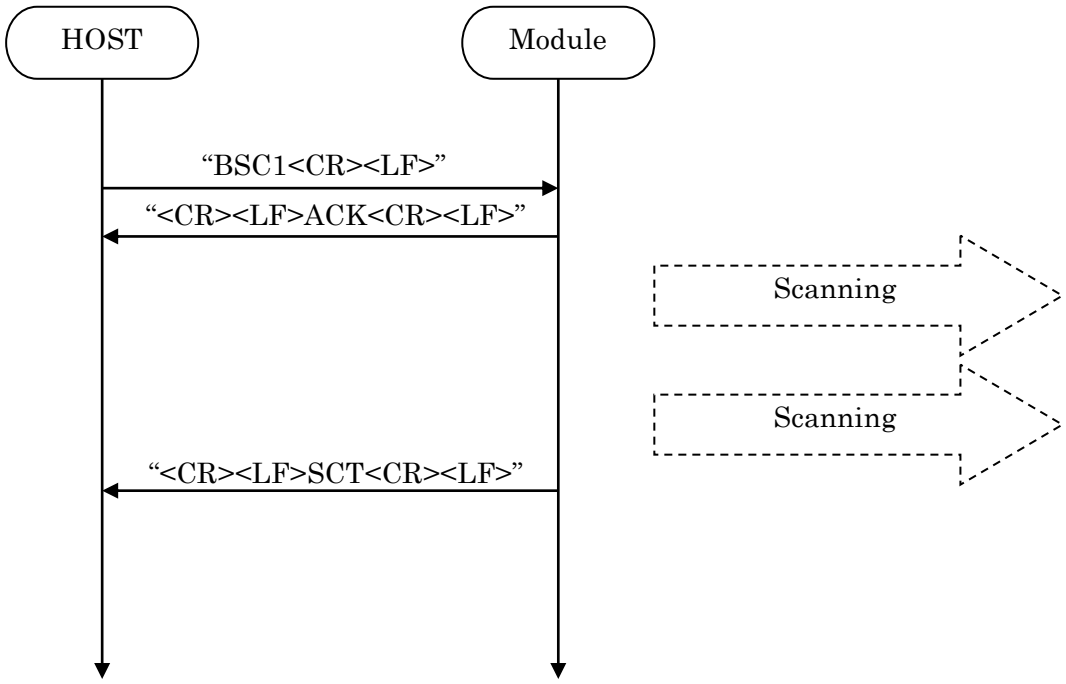
About other error codes, please see below.
https://infocenter.nordicsemi.com/topic/com.nordic.infocenter.s130.api.v2.0.1/group___b_l_e___h_c_i___s_t_a_t_u_s___c_o_d_e_s.html

5.4 Message Sequence Chart

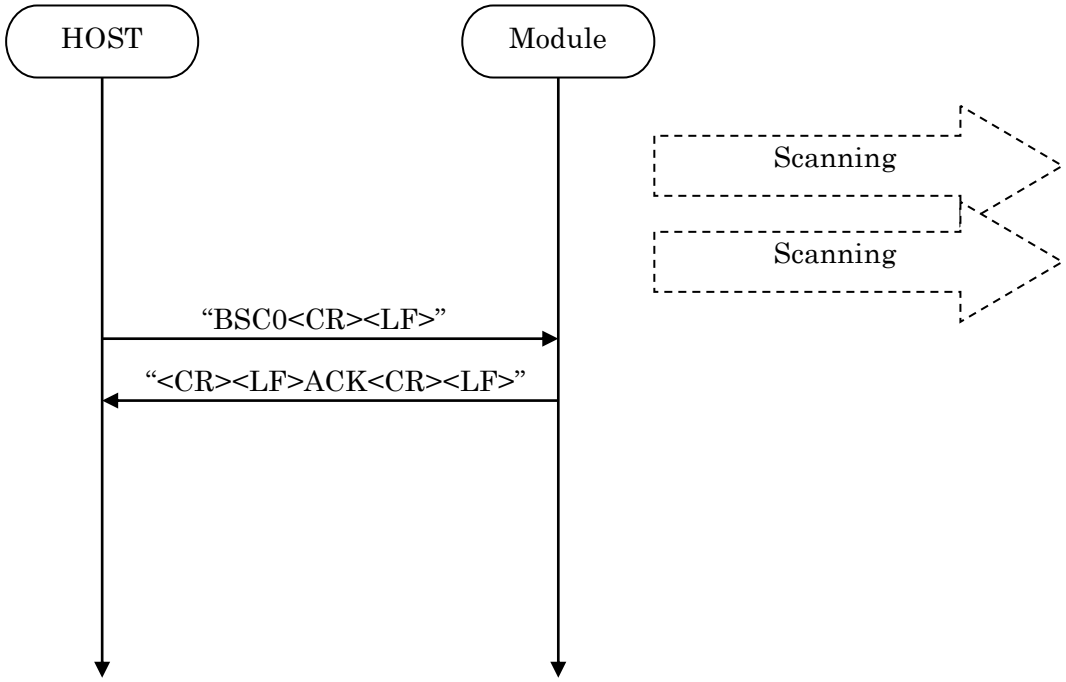
5.4.1. Power On (In case of PSKEY_USER01≠'0000' and PSKEY_USER07≠'0000')



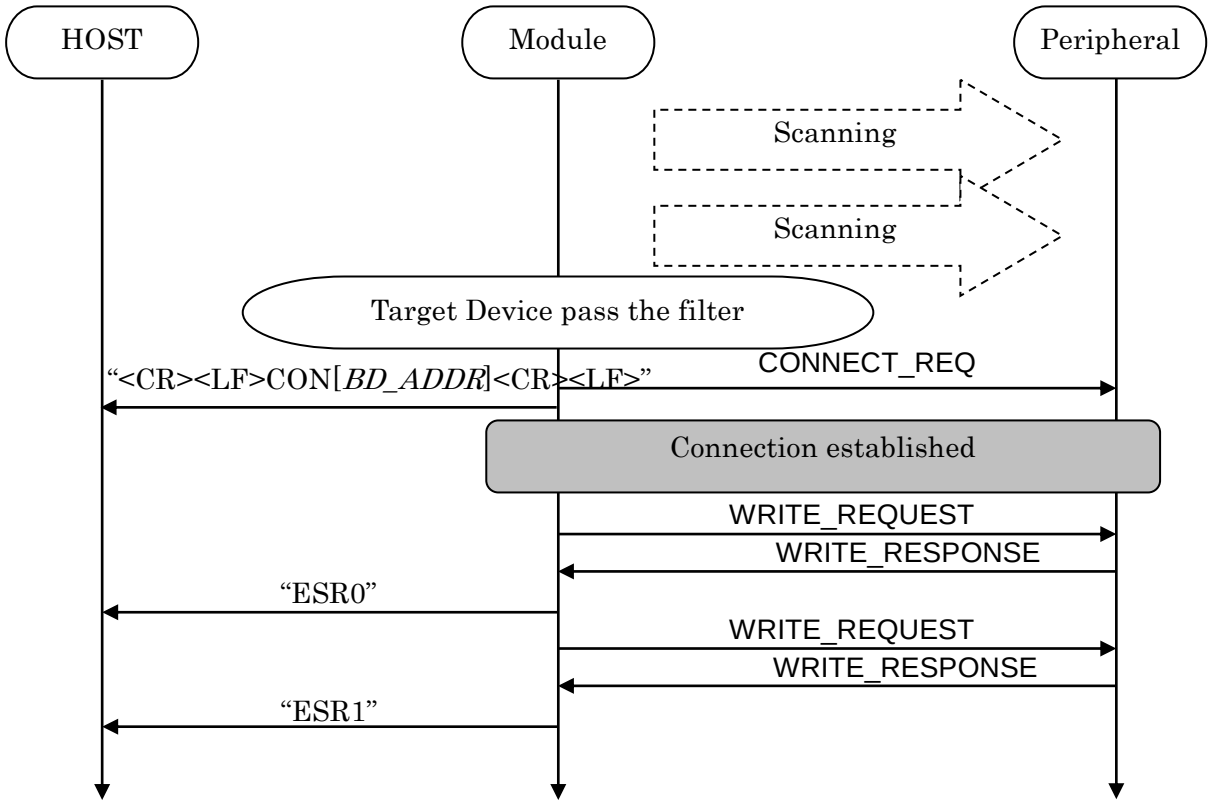
5.4.2. Scan Start



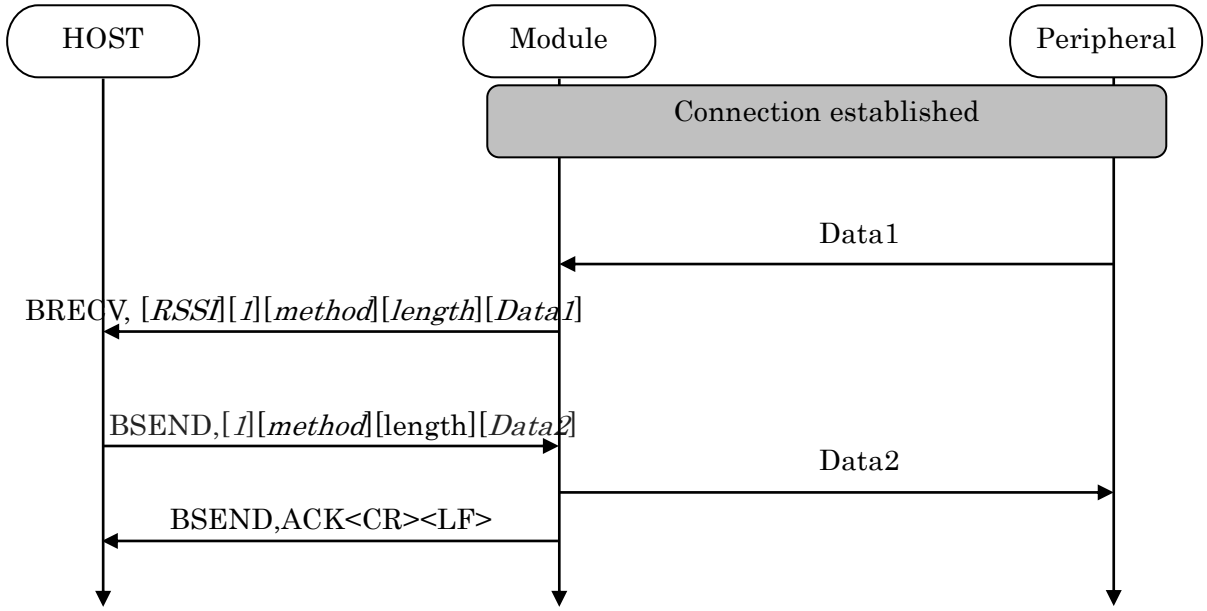
5.4.3. Scanning Stop



5.4.4. Connect

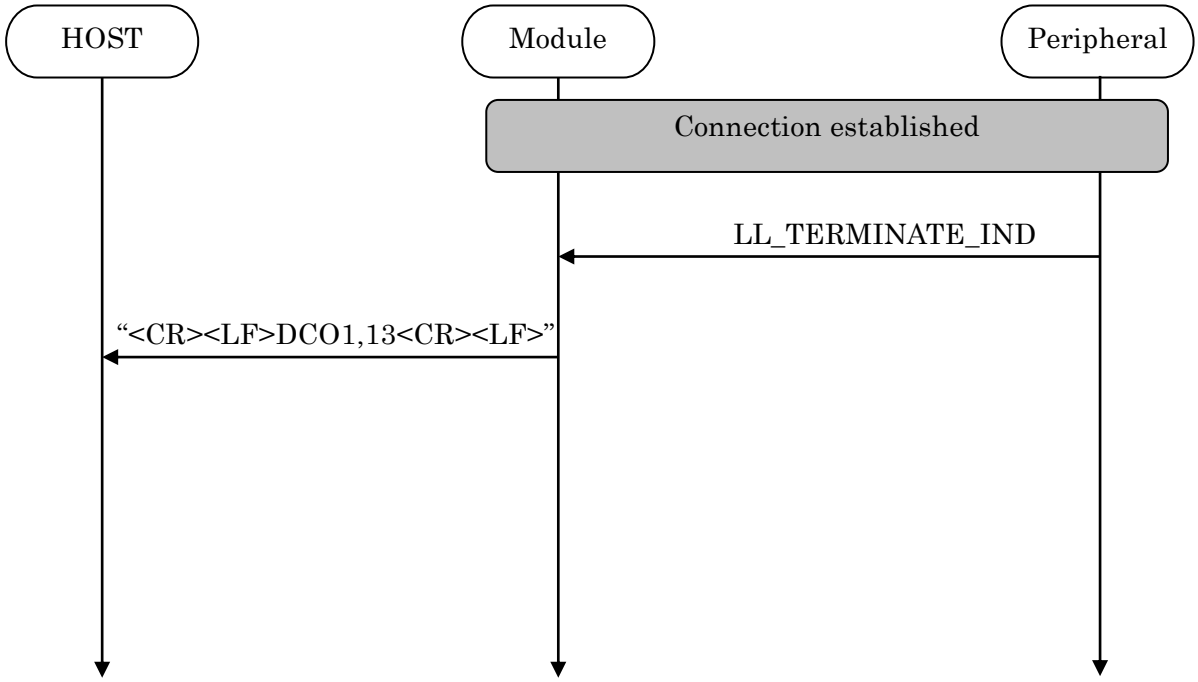


5.4.5. Sending & Receiving Data over a connected Link

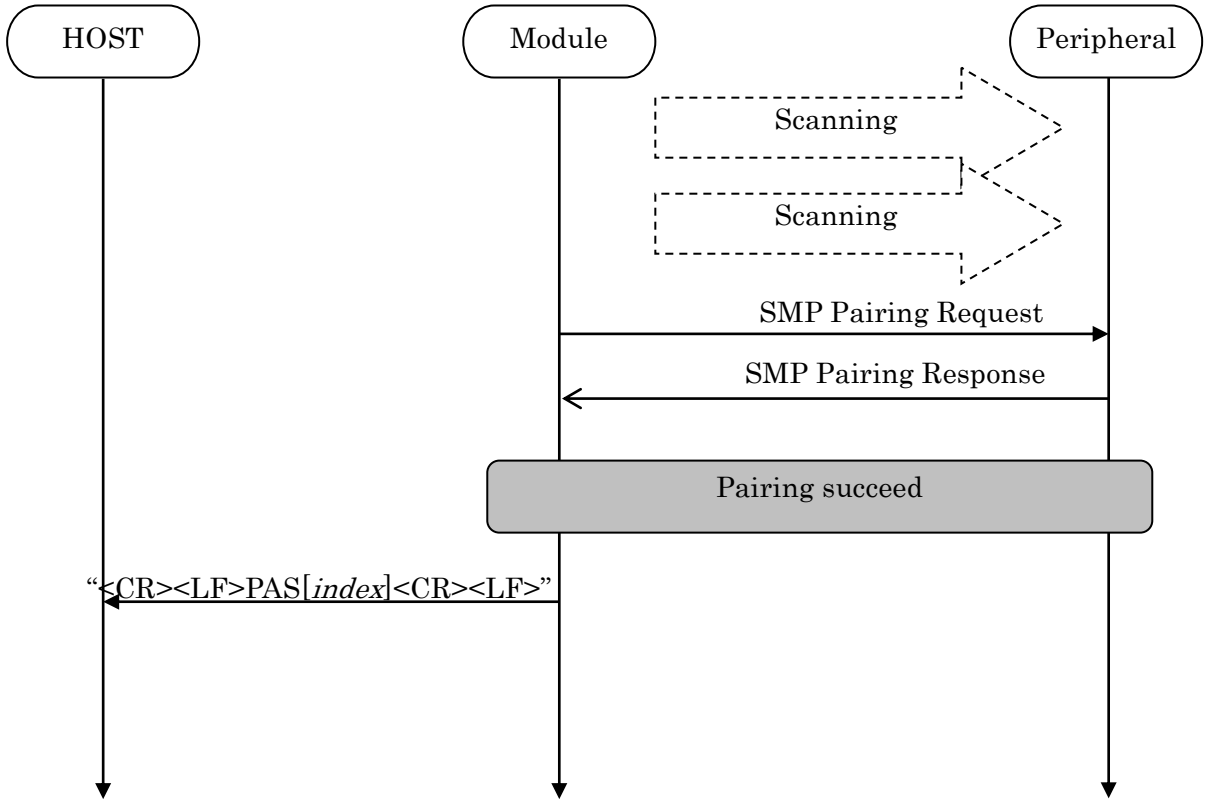


Max send a packet data size = 20bytes
Max receive a packet data size = 20bytes

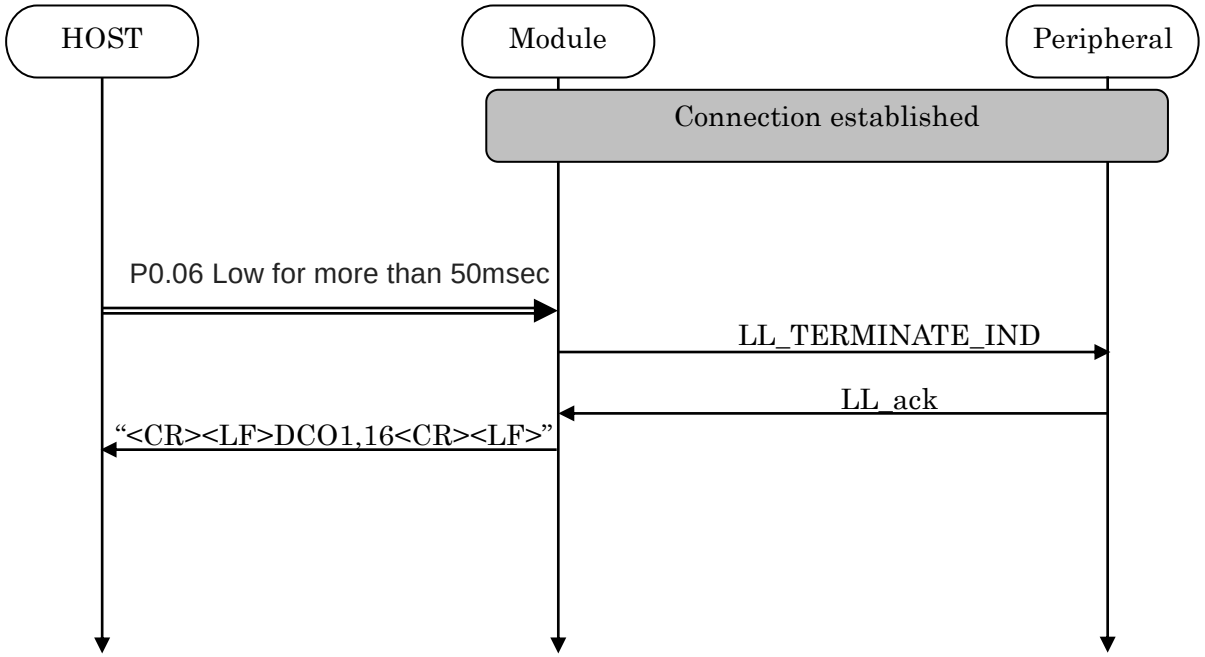
5.4.6. Disconnect



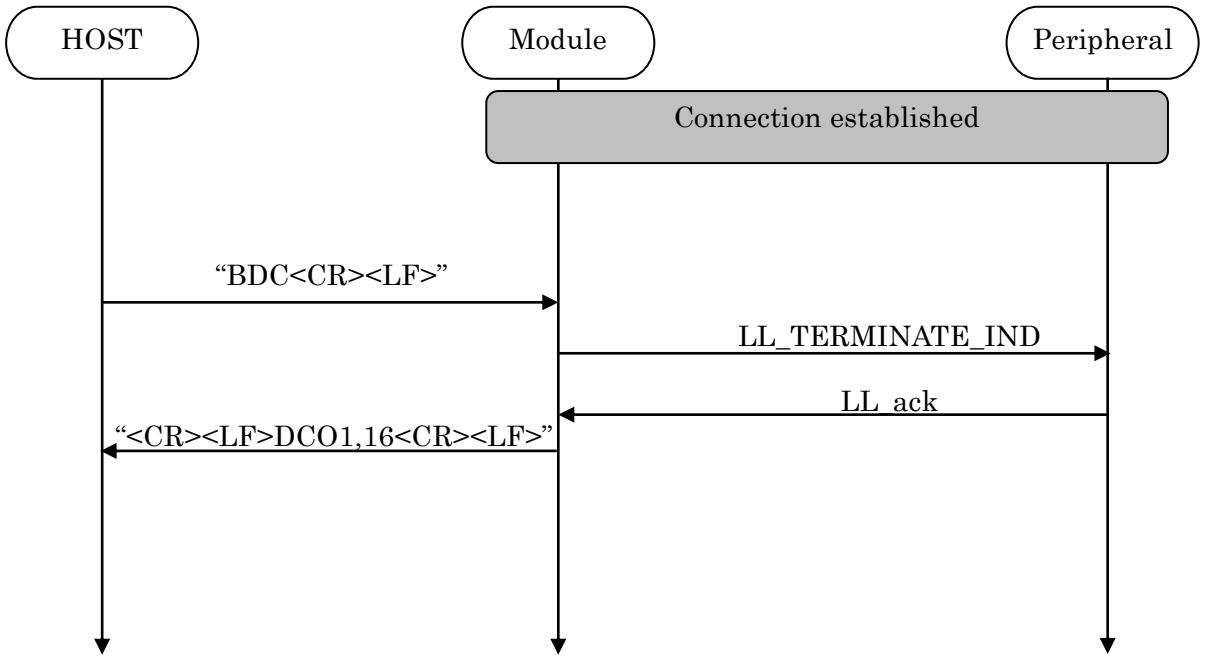
5.4.7. Pairing


HOST
Module
Peripheral
Scanning
Scanning
SMP Pairing Request
SMP Pairing Response
Pairing succeed
"<CR><LF>PAS[index]<CR><LF>"

5.4.8. Disconnect Request (GPIO)



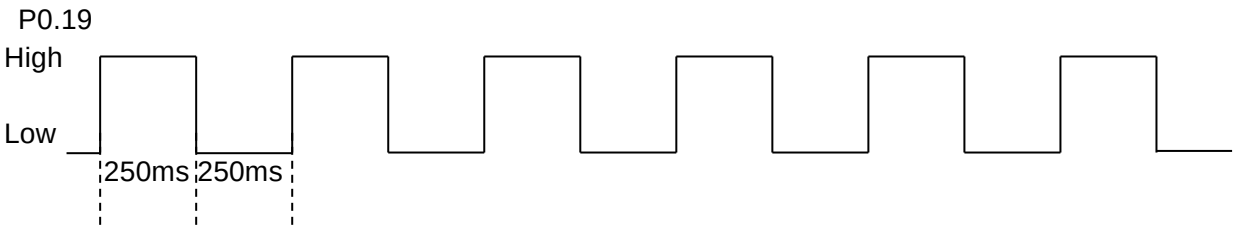
5.4.9. Disconnect Request (Command)



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

5.5.1. Disconnect Request



5.5.2. CONNECTED

P0.19 High

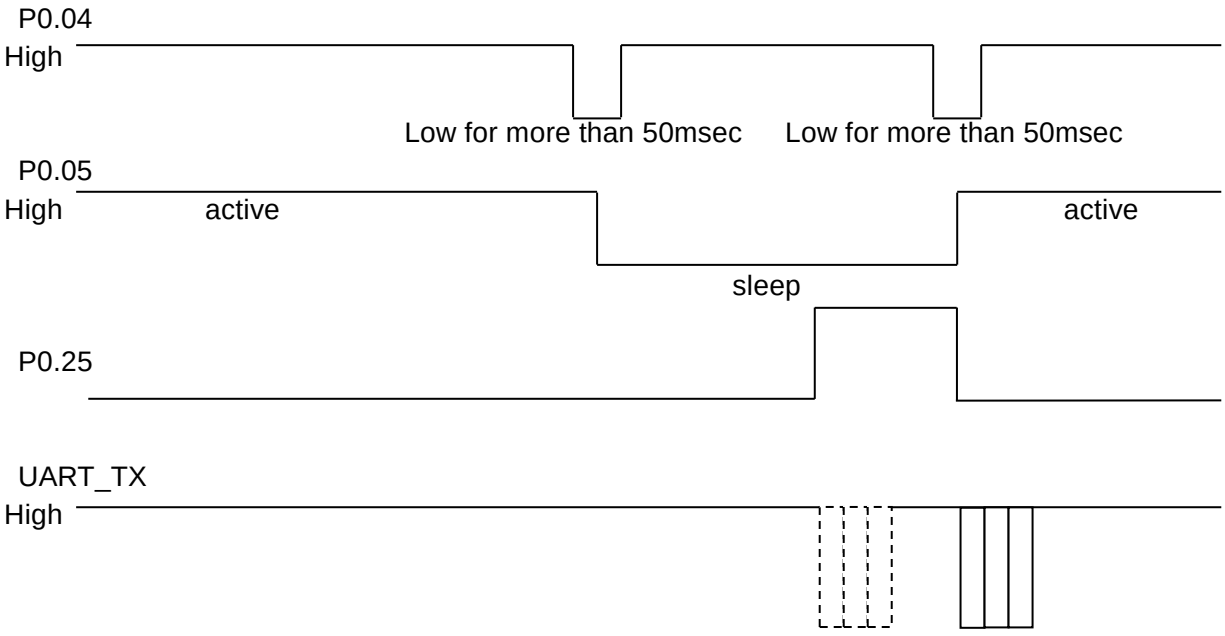
5.5.3. Disconnect & Standby

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.**

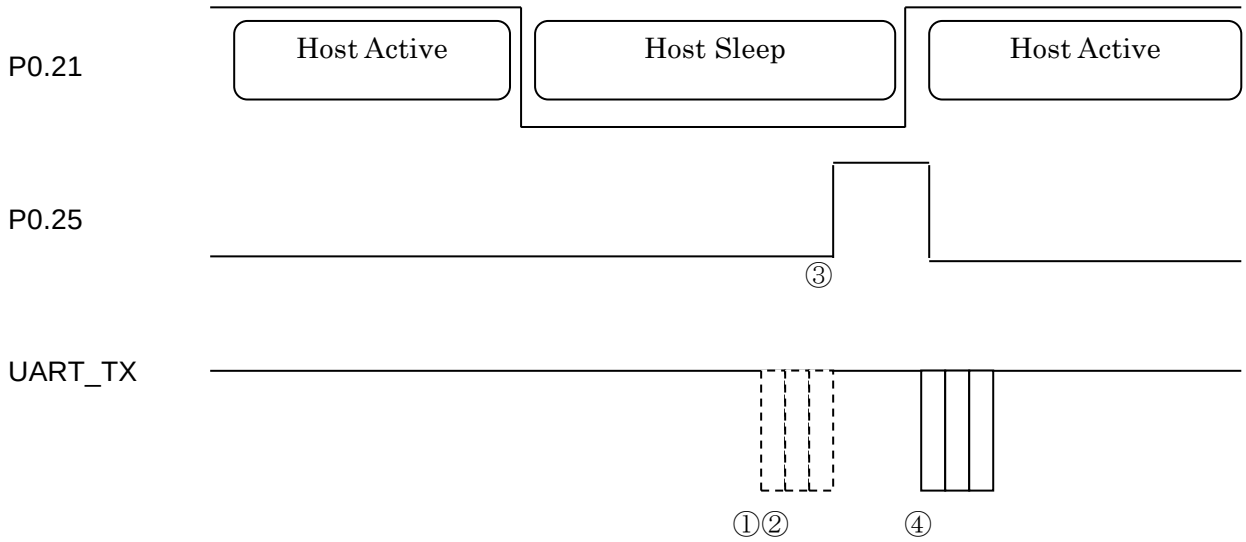
5.7 UART configuration

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

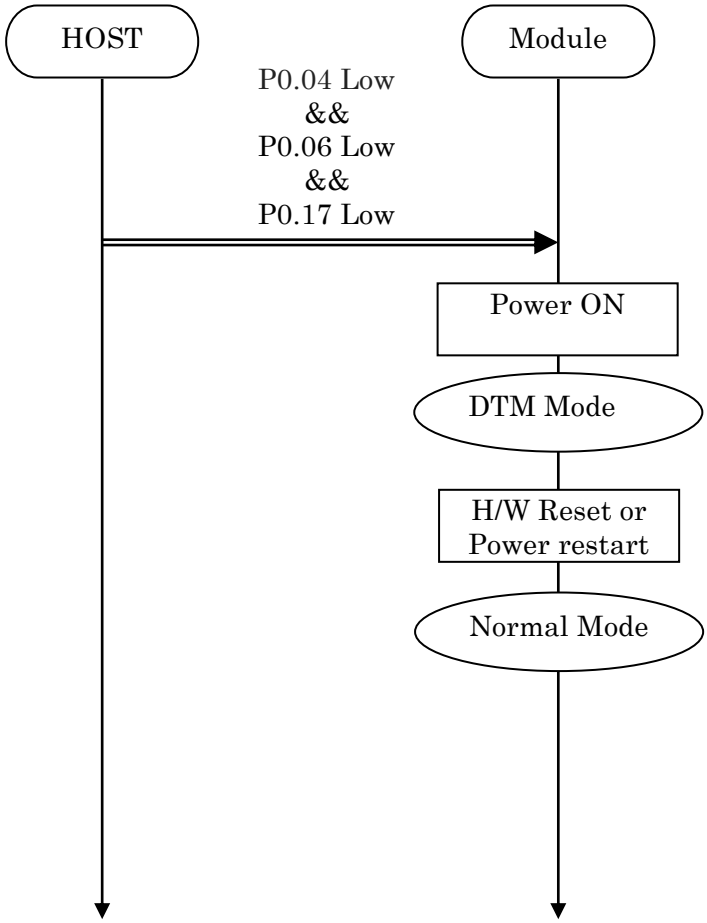


① Communication data or an event occurs in HOST Sleep.
② It waits until the host becomes active.
③ Module request to host wake-up via PIO.
④ If HOST becomes Active and Module is active (refer 5.5.5), module send communication data or event.

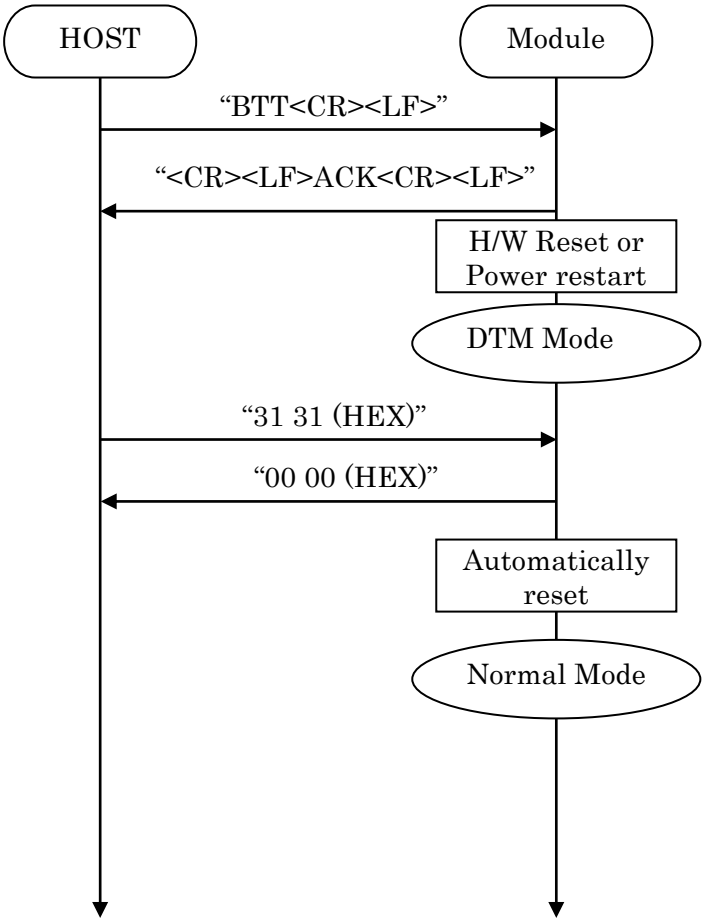
*** Buffer size : 128byte If the buffer is full, further data received is discarded without any events.**

5.10 DTM (Direct Test Mode)

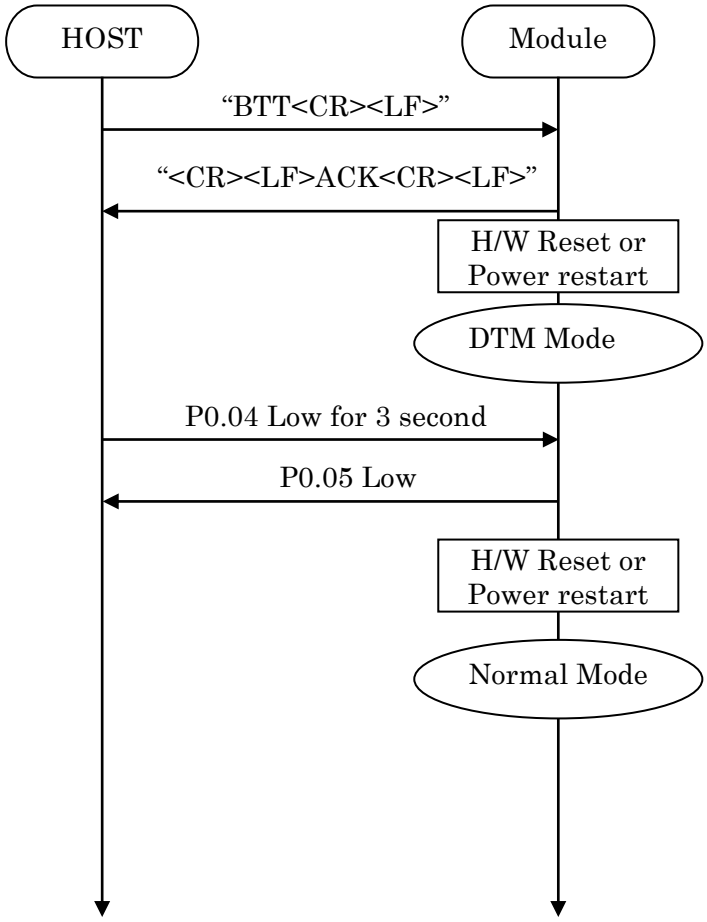
5.10.1. Enter DTM and exit DTM (one-time)



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



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

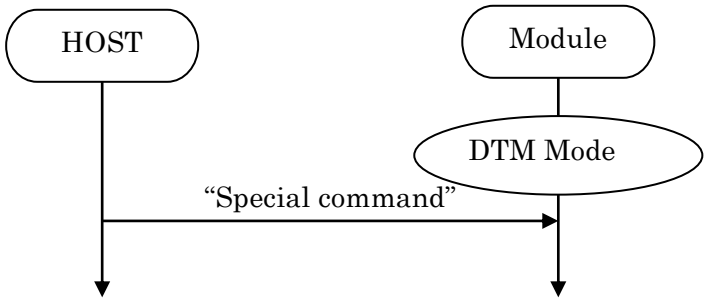


5.10.4. DTM Commands/Events

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)

5.11 GPIO check

Host can inspect GPIO by special commands in DTM.

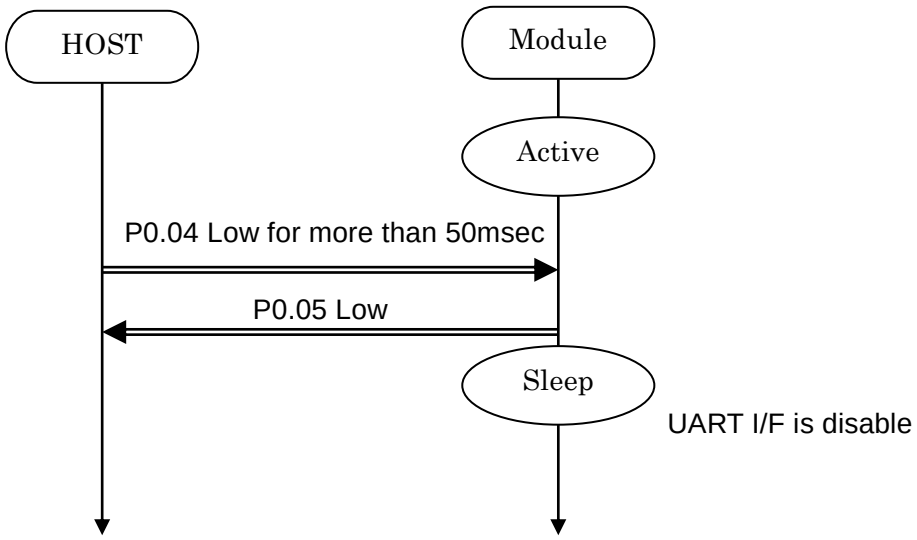


Command (Hex value)	Function	Response
32 30	It makes P0.05 Low.	00 00
32 31	It makes P0.05 High.	00 00
33 30	It makes P0.19 Low.	00 00
33 31	It makes P0.19 High.	00 00
34 30	It makes P0.25 Low.	00 00
34 31	It makes P0.25 High.	00 00
35 30	It makes P0.23 Low.	00 00
35 31	It makes P0.23 High.	00 00
39 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)

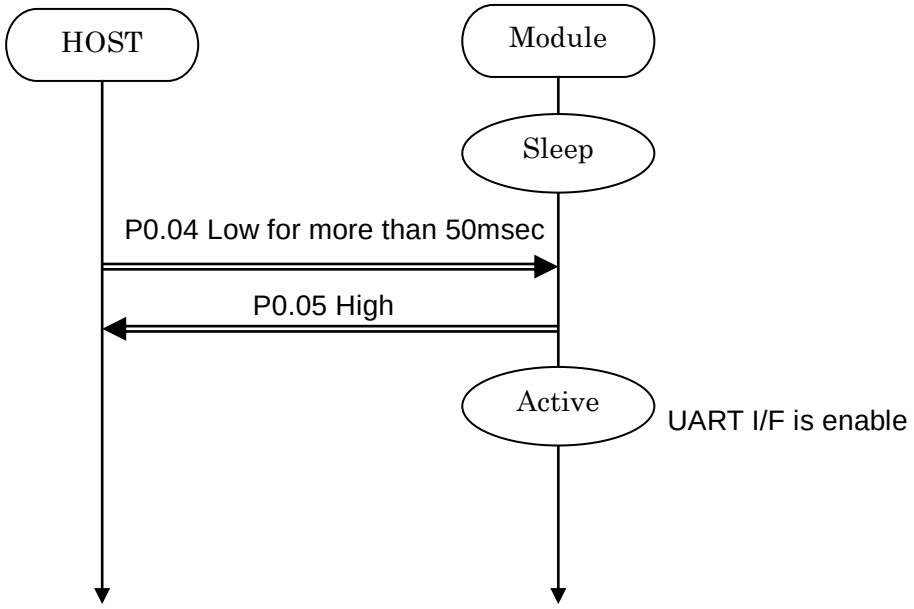
This Sleep is available in during Scanning and Connection.
UART I/F is not usable during Sleep.

5.12.1. Enter sleep mode



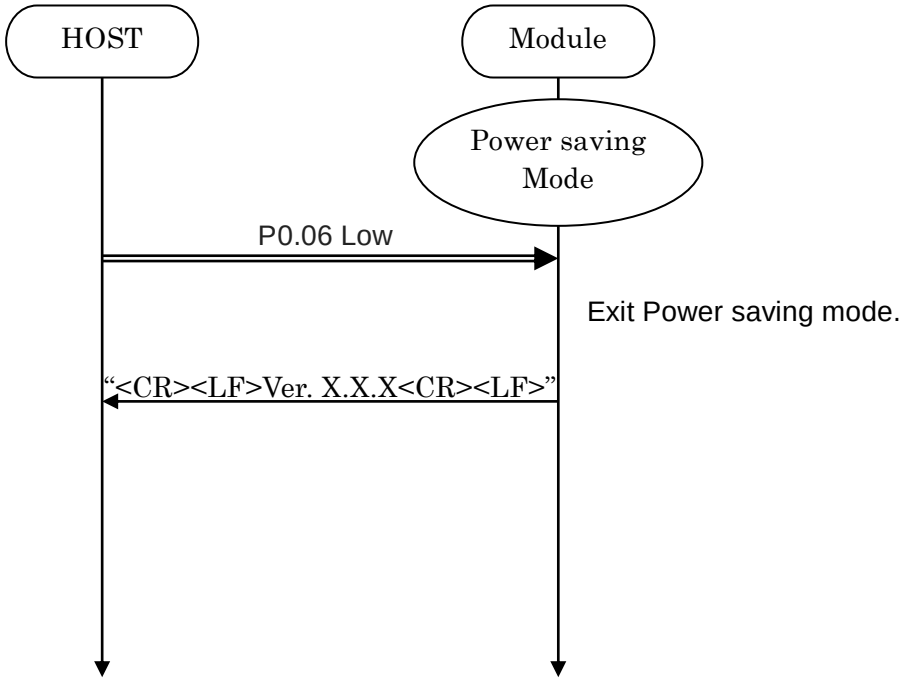
In case of UART data happen, the module notify to Host via P0.25.
It is same as “Host wake-up”.

5.12.2. Exit sleep mode

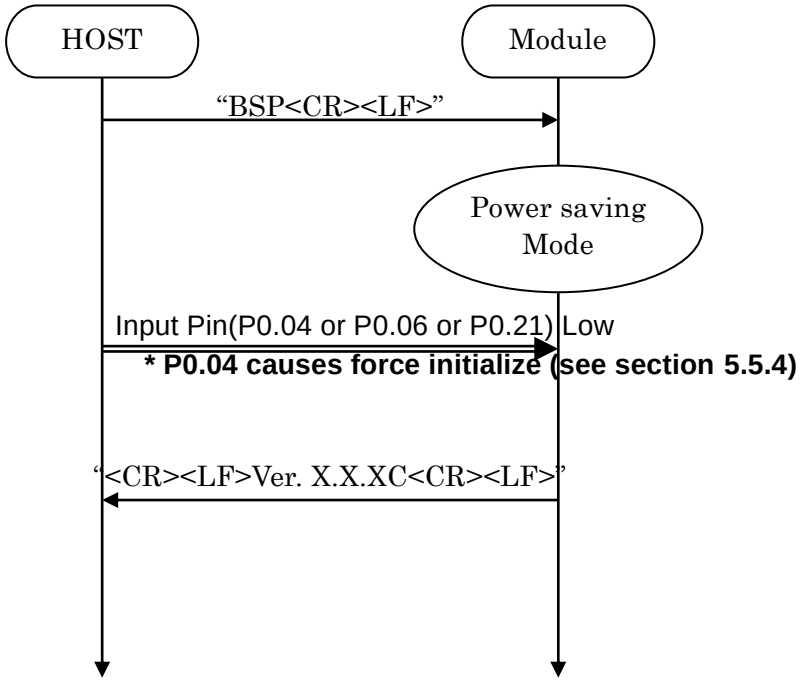


5.13 Power saving mode (SYSTEM OFF)

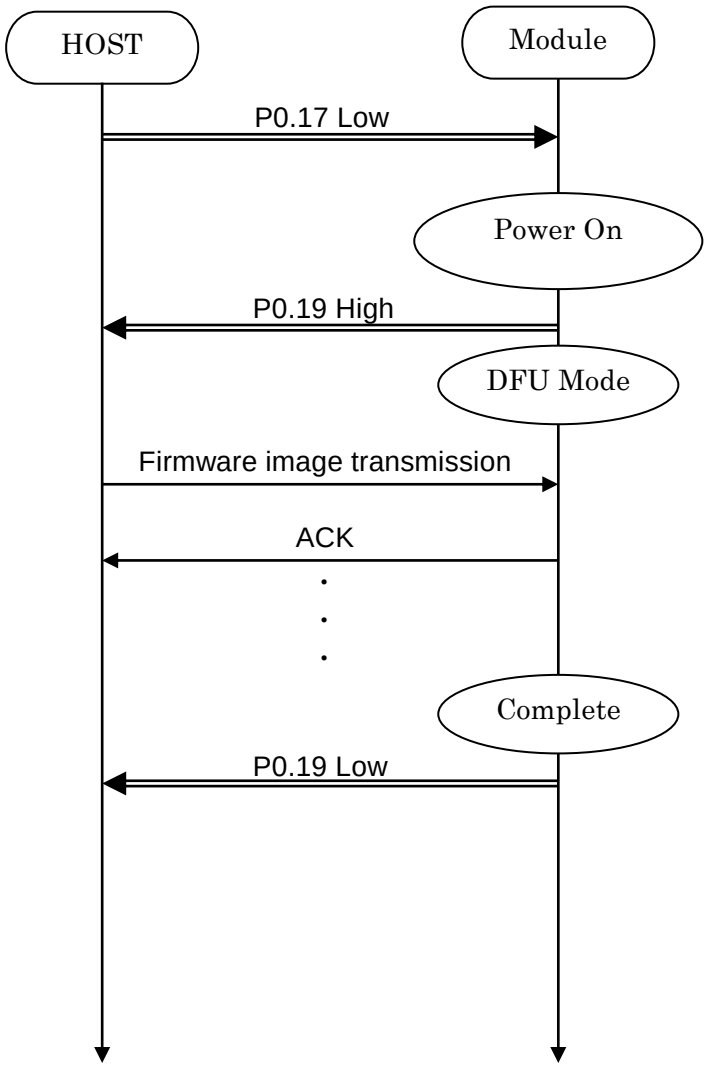
5.13.1. On startup (In case of PSKEY_USER09='0001')



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.

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 4.0.0”
PSKEY_USER16	**Advertising data**	Disabled
PSKEY_USER17	**RSSI**	-127 (Disabled)
PSKEY_USER18	**BD Address**	Disabled

By default, only device name filter “TYSA-B 4.0.0” 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 4.0.0”
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)

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

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)

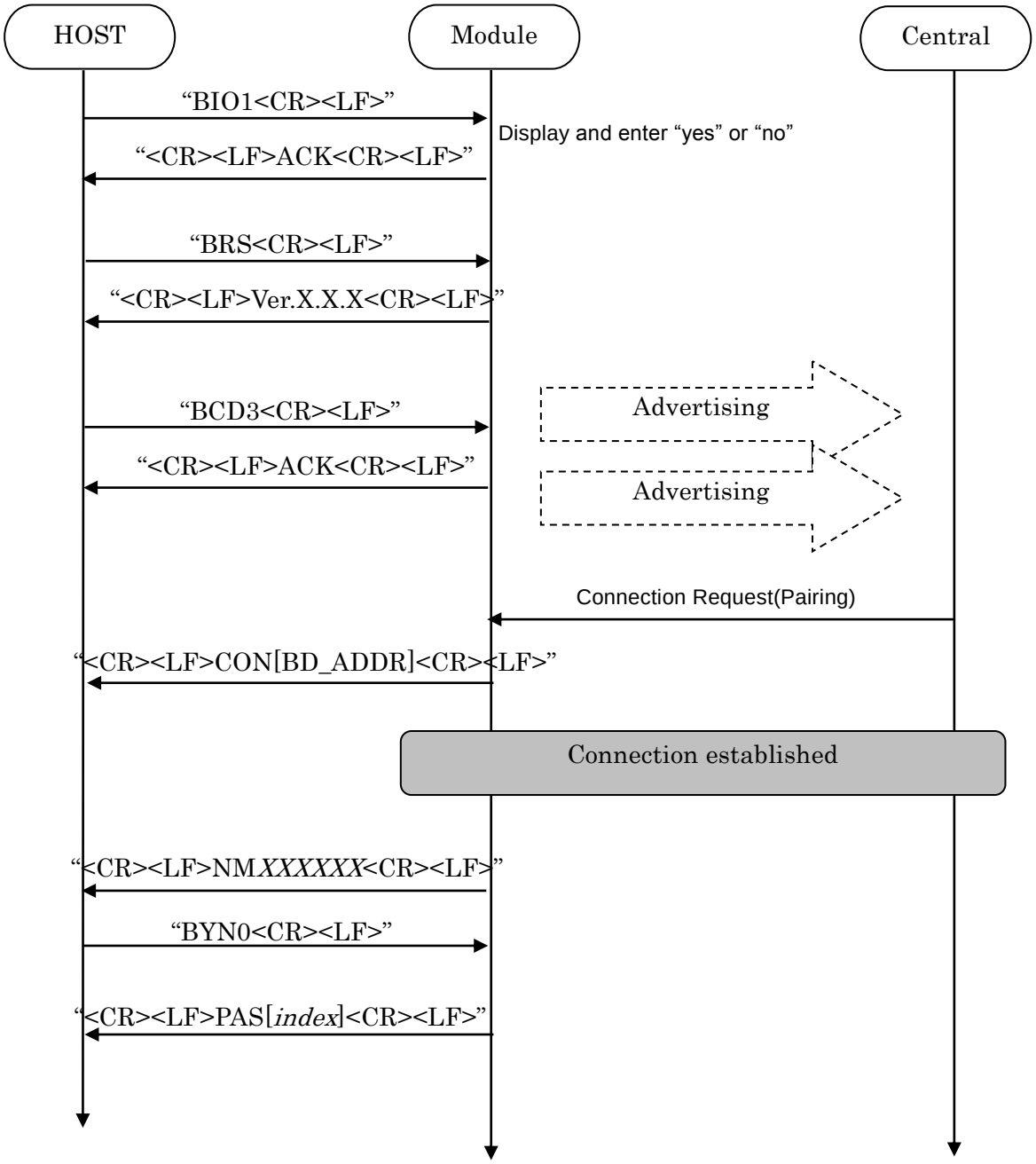
6: Company ID (Deny)

Response value:

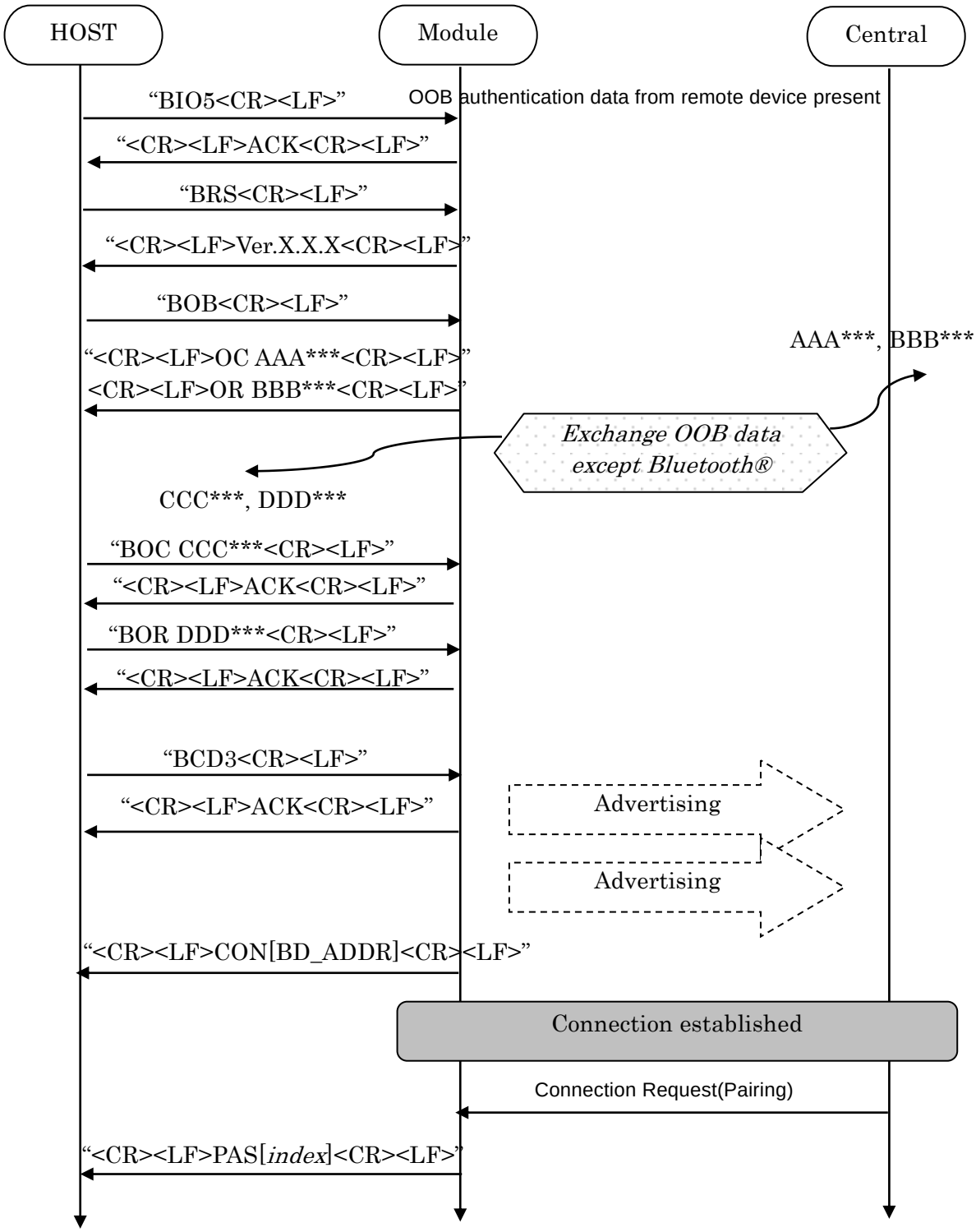
Company ID (Hex ASCII 6byte)

5.17 LE Secure Connection

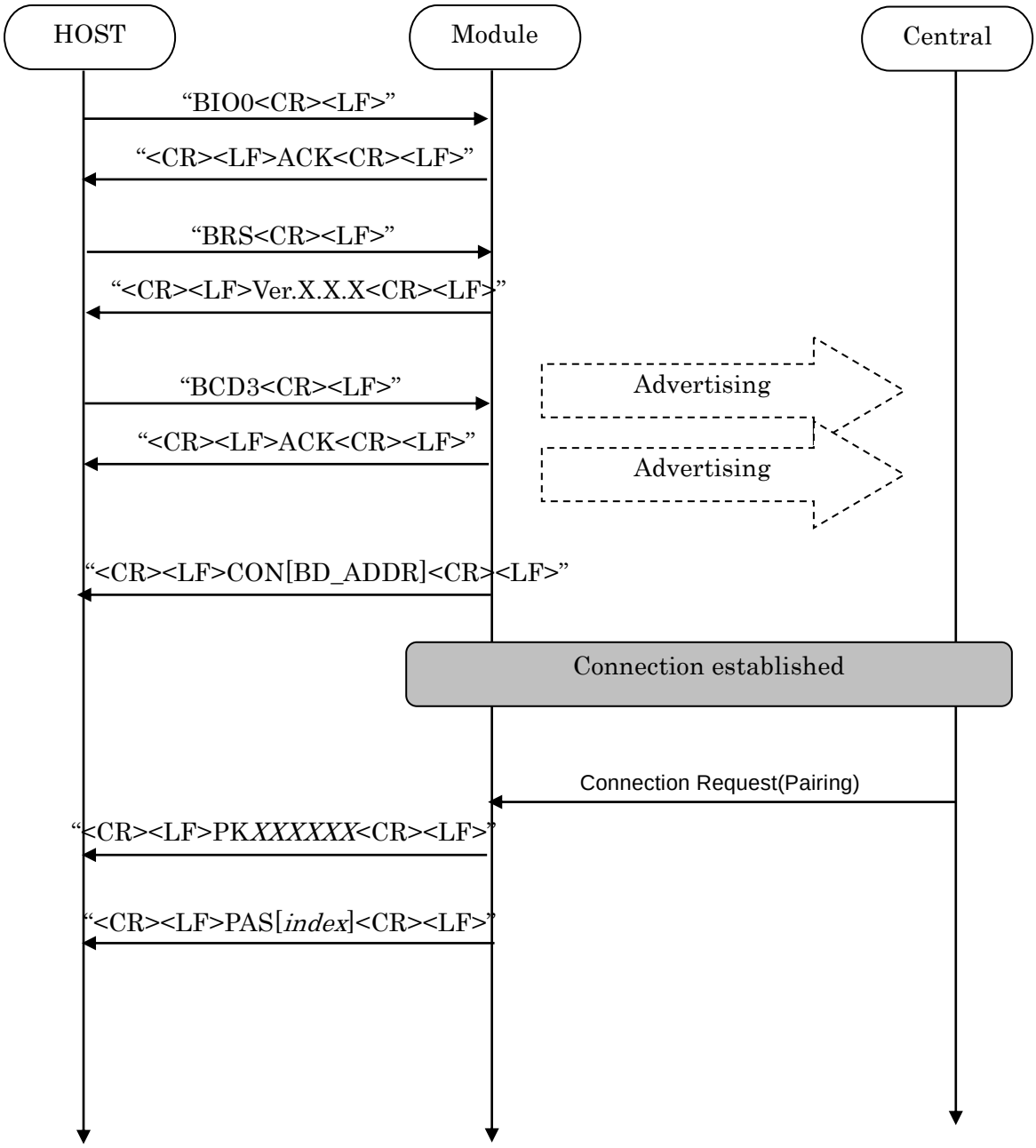
5.17.1 Numeric Comparison



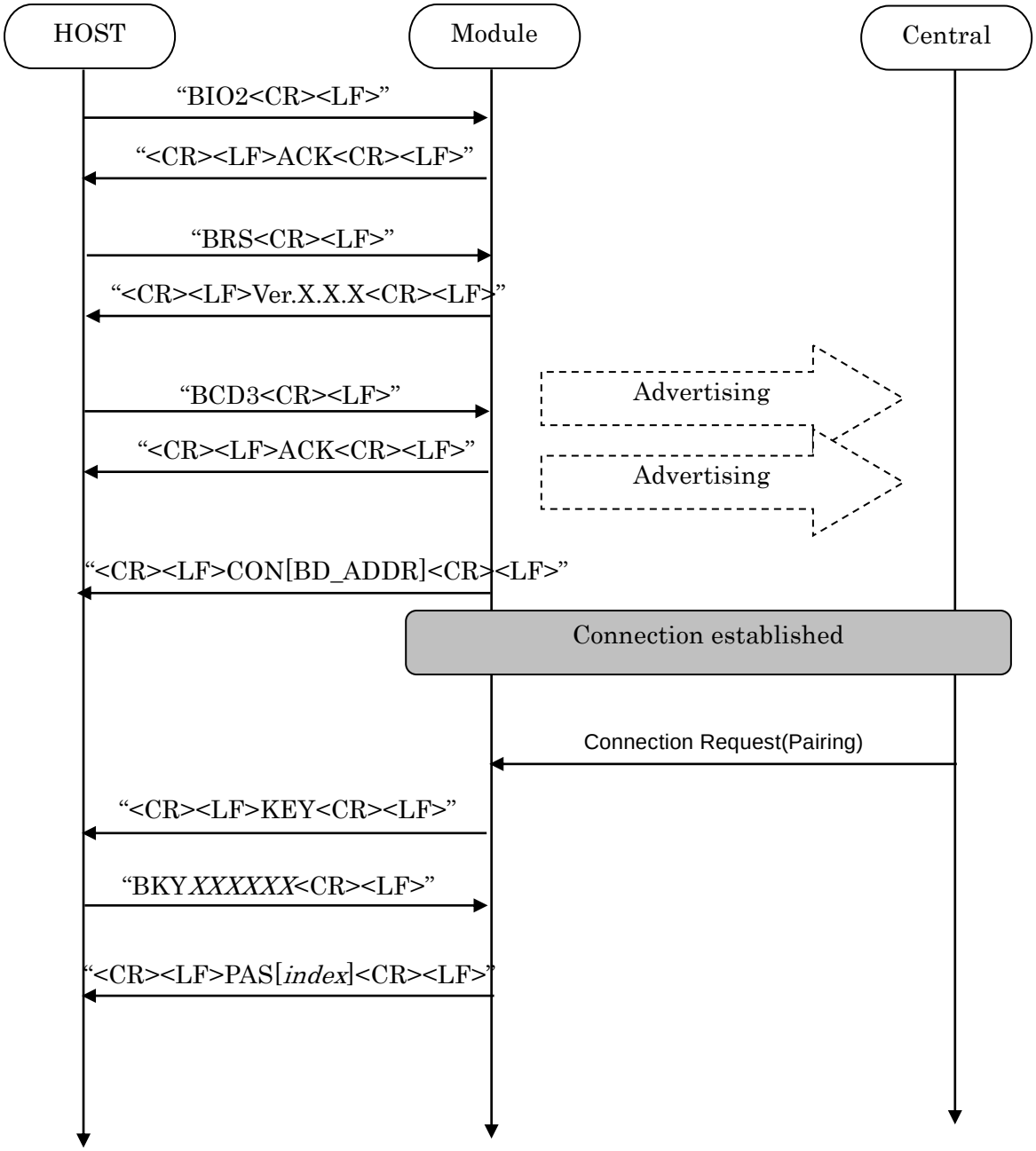
5.17.2 Out of Band



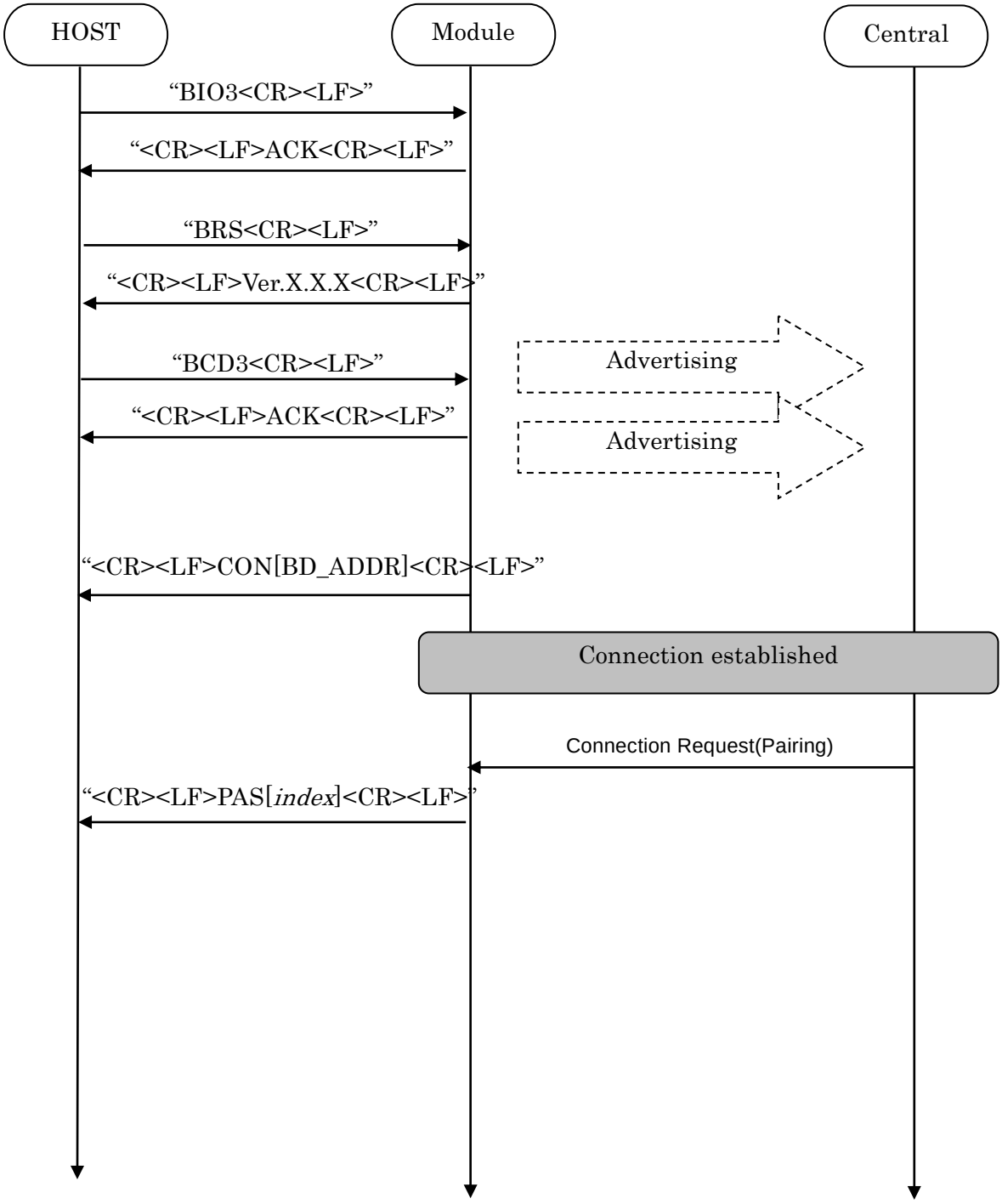
5.17.3 Passkey Entry, Peripheral Displays



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.

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