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Version: 1
Issued Date: 2024/02/27

Datasheet

产品名称 (Product): BT 6.0 module

产品型号 (Model No.): HOLYIOT-24005 -nRF54L15

1. Description

NRF54L15 is the first system level chip (SoC) in the nRF54L series. It is an ultra-low power Bluetooth 5.4 SoC with the best in class new multi protocol radio and advanced security features. The nRF54L series takes the popular nRF52 series to a new level with a more compact packaging, featuring excellent processing power and efficiency, expanded memory, and new peripherals. Main advantages Taking the nRF52 series to the next level: achieving significant leaps in performance, efficiency, and security. Resisting security threats: Advanced security features, including secure boot, secure firmware updates, secure storage, and physical attack protection.Providing long-distance: the best in class multi protocol radio with low power consumption for 1 Mbps Bluetooth, with a transmission power of up to 8 dBm and a reception sensitivity of -98 dBm.Extending battery life or reducing battery size: efficient processing, ultra-low power radio, and minimum sleep current.

Hardware :

SWD programmer (SWDIO,SWCLK,VDD,GND)

nRF54L15 -QFAA-QFN48

Size : 24mm*15.6mm

BLE stack & RF 2.4Ghz

Features :

Excellent processing ability and efficiency

The nRF54L15 SoC integrates an Arm Cortex-M33 processor with a operating frequency of 128 MHz, which has twice the processing power of the nRF52840 and reduces power consumption. It has 1.5 MB of non-volatile memory and 256 KB of RAM, which is sufficient to run multiple wireless protocols simultaneously.

Advanced Security

NRF54L15 is designed specifically for PSA certification level 3, which is the highest level of PSA certified IoT security standard. It provides security services such as secure boot, secure firmware updates, and secure storage. The integrated tampering sensor can detect attacks and take appropriate measures, while the encryption accelerator can be reinforced to resist side channel attacks.

A first-class multi protocol radio

This best in class multi protocol RF product has higher robustness and longer transmission distance. For 1 Mbps Bluetooth with low power consumption, the transmission power can reach 8 dBm (with a step of 1 dB), and the receiving sensitivity is -98 dBm. This radio includes a new 4 Mbps data rate option for 2.4 GHz proprietary protocols, with improved throughput,

efficiency, and latency. It supports low-power Bluetooth and all Bluetooth 5.4 features, and is specifically designed to support the upcoming Bluetooth specifications. In addition, it also supports protocols such as Bluetooth grid, Thread, and Matter.

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New Global RTC peripherals that can extend battery life

The new global RTC peripherals can wake up SoC from the deepest sleep mode, eliminating the need for external RTC, greatly reducing energy consumption for long-term sleep applications and extending battery life.

Ultra compact packaging suitable for size limited designs

NRF54L15 samples are now available in QFN packaging. It will also adopt two ultra compact WLCSP packages. These packages will be 50% smaller than nRF52840 and are suitable for designs with strict size limitations.
6x6 mm QFN48 with 31 GPIOs
2.4x2.2 mm WLCSP with 32 GPIOs (300 um pitch)
2.4x2.2 mm WLCSP with 14 GPIOs (350 um pitch)

Application:

Computer accessories, game controllers, and remote controllers
Virtual reality and augmented reality
Smart Home and Materials
Medical equipment
Industrial Internet of Things

2. Introduction

2.1 Programmer

HOLYIOT-24005- NRF54L15 module use the Serial Wire Debug(SWD port), the module which layout the SWDIO, SWCLK, VDD, GND for debug and flash your own firmware, more info about the SWD, please visit https://www.silabs.com/community/mcu/32-bit/knowledge-base.entry.html/2014/10/21/serial_wire_debugs-qKCT
You can using the Jlink or Jtag for programmer.

2.2 Software development Tool

It supports the standard Nordic Software Development Tool-chain using Segger Embedded Studio, Keil, IAR and GCC. More info please visit https://www.nordicsemi.com/Software-and-Tools/Development-Tools

2.3 Protocols

This module support Bluetooth 5, Bluetooth Low Energy,Bluetooth mesh,Thread,802.15.4,ANT, 2.4GHz proprietary. So we can use different protocols for different situations.

Software Development Kit
Nordic Semiconductor's Software Development Kits (SDK) are your starting point for software development on the nRF51 and nRF52 Series. It contains source code libraries and example applications covering wireless functions, libraries for all peripherals, bootloaders, wired and OTA FW upgrades, RTOS examples, serialization libraries.
More info please visit https://www.nordicsemi.com/Software-and-Tools/Software/nRF5-SDK
You can also download the SDK for coding development .

2.4 SoftDevices

Nordic Semiconductor protocol stacks are known as SoftDevices. SoftDevices are pre-compiled, pre-linked binary files. SoftDevices can be programmed in nRF5 series devices, and are freely downloadable from the Nordic website. Please download that here:

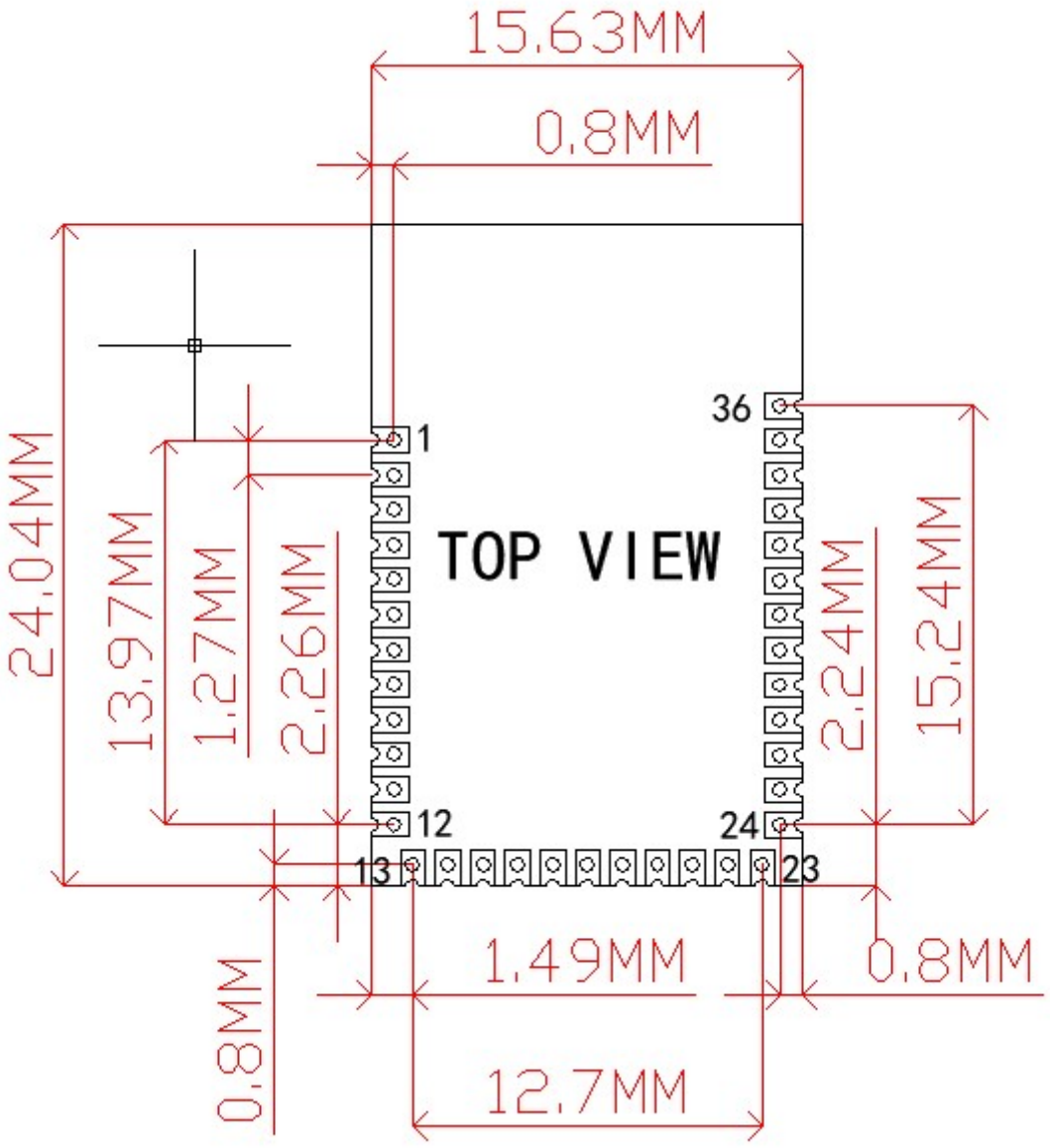
https://www.nordicsemi.com/Software-and-Tools/Software/S132

Over-The-Air DFU

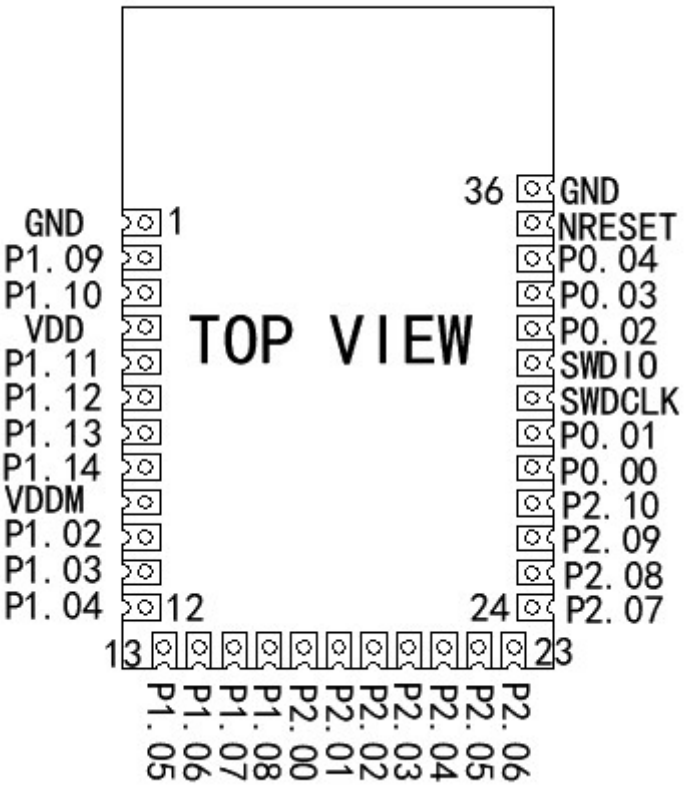
The SoC is supported by an Over-The-Air Device Firmware Upgrade (OTA DFU) feature. This allows for in the field updates of application software and SoftDevice.

3. Product Descriptions

3.1 Mechanical drawings



3.2 Pin assignments



PIN No.	PIN define	Functions
1	GND	Ground
2	P1.09 TAMPC.ASO[2]	Digital I/O Digital I/O
3	P1.10 TAMP.ASI[2]	Digital I/O Digital I/O
4	VDD	power
5	P1.11 TAMPC.ASO[3] AIN4	Digital I/O Digital I/O Analog input
6	P1.12 TAMPC.ASI[3] AIN5	Digital I/O Digital I/O Analog input
7	P1.13 AIN6	Digital I/O Analog input

8	P1.14 AIN7	Digital I/O Analog input
9	VDDM	power
10	P1.02 NFC1	Digital I/O NFC input
11	P1.03 NFC2	Digital I/O NFC input
12	P1.04 AIN0 ASO[0]	Digital I/O Analog input Digital I/O
13	P1.05 AIN1 ASI[0]	Digital I/O Analog input Digital I/O
14	P1.06 AIN2 ASO[1]	Digital I/O Analog input Digital I/O
15	P1.07 AIN3 ASI[1]	Digital I/O Analog input Digital I/O
16	P1.08 GRTCHFOUT TAMPC.EXT EXTREF	Digital I/O Digital I/O Digital I/O Analog input
17	P2.00	Digital I/O
18	P2.01	Digital I/O
19	P2.02 SWO	Digital I/O Digital I/O
20	P2.03	Digital I/O
21	P2.04	Digital I/O
22	P2.05	Digital I/O
23	P2.06 TRACECLK	Digital I/O Digital I/O
24	P2.07 TRACEDATA[0] SWO	Digital I/O Digital I/O Digital I/O
25	P2.08	Digital I/O

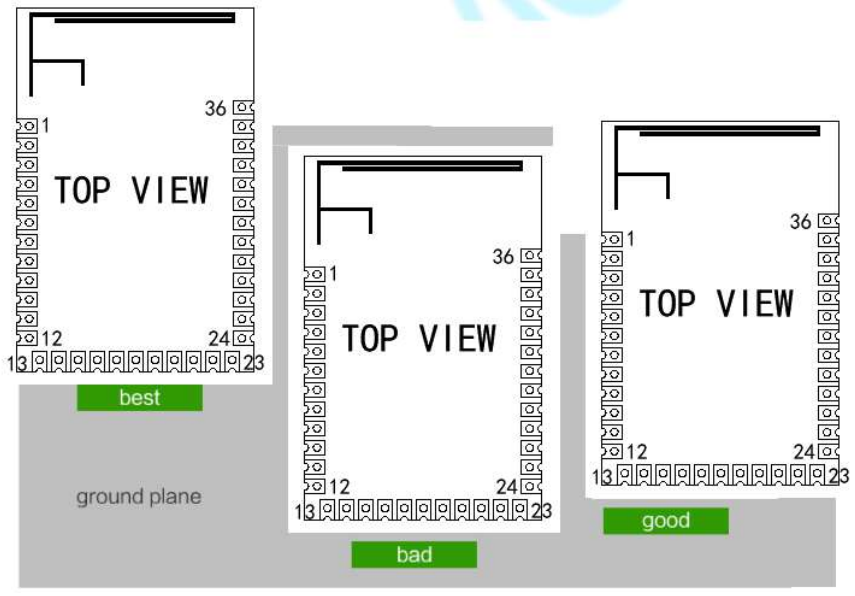
	TRACEDATA[1]	Digital I/O
26	P2.09 TRACEDATA[2]	Digital I/O Digital I/O
27	P2.10 TRACEDATA[3]	Digital I/O Digital I/O
28	P0.00	Digital I/O
29	P0.01	Digital I/O
30	SWDCLK	Debug
31	SWDIO	Debug
32	P0.02	Digital I/O(general purpose I/O)
33	P0.03 GRTCPWM	Digital I/O(general purpose I/O Trace port clock output)
34	P0.04 GRTCLFCLKOUT	Digital I/O Digital I/O
35	nRESET	Reset
36	GND	Ground

4. Mounting our board on the host PCBA

We suggest that you mount our RF board(HOLYIOT-24005 -nRF54L15) on the board like that:

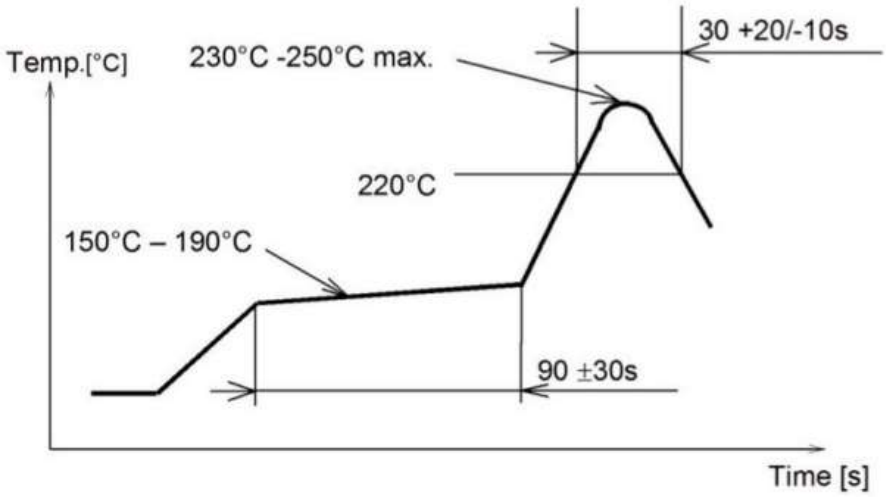
For the best Bluetooth performance, the antenna of the area need to extend about several mm without ground under the antenna of the edge of the host PCB.

The second choice is that place our board at the corner of host PCB, the antenna of board need to extend several mm outside of the Ground plane of the host PCB.



5. Miscellaneous

Soldering Temperature-Time Profile for Re-Flow Soldering. Maximum number of cycles for re-flow is 2. No opposite side re-flow is allowed due to module weight.



6. Recommended operating conditions

The operating conditions are the physical parameters that nRF54L15 can operate with.

Symbol	Parameter	Min.	Nom.	Max.	Units
VDD	VDD supply voltage	1.7		2.7	V
VDDM	VDDM supply voltage	1.8	3.0	3.6	V
TA	Operating temperature	-40	25	105	°C

Table 88: Recommended operating conditions

FCC WARNING

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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.

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

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other

antenna or transmitter.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user.

The final end product must be labelled in a visible area with the following:

“Contains Transmitter Module “FCC ID:2ALGY-24005”

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See alsoSection

2.10 below concerning the need to notify host manufacturers that further testing is required.3

Explanation: This module meets the requirements of FCC part 15C (15.247).it Specifically identified AC Power Line Conducted Emission, Radiated Spurious emissions, Band edge and RF Conducted Spurious Emissions, Conducted Peak Output Power, Bandwidth, Power Spectral Density, Antenna Requirement.

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The product antenna uses an irreplaceable antenna with a gain of 3dBi

2.4 Single Modular

If a modular transmitter is approved as a "Single Modular ," then the module manufacturer isresponsible for approving the host environment that the Single Modular is used with. The manufacturer of a Single Modular must describe, both in the filing and in the installation instructions, the alternative means that the Single Modular manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A Single Modular manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could

include that the limited

module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This Single Modular procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is a single module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna); b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered); c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout; d) Appropriate parts by manufacturer and specifications; e) Test procedures for design verification; and f) Production test procedures for ensuring compliance

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions

(mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product

manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: The module complies with FCC radiofrequency radiation exposure limits for uncontrolled environments. The device is installed and operated with a distance of more than 20 cm between the radiator and your body." This module follows FCC statement design, FCC ID :2ALGY-24005

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product.

The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The product antenna uses an irreplaceable antenna with a gain of

3dBi

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This

includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2ALGY-24005

2.9 **Information on test modes and additional testing requirements5** Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

Explanation: Shenzhen holyiot technology Co.,LTD can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for

compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product

as being Part 15
Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.