

IEEE 802.11 a/b/g/n/ac/ax 1T/1R USB2.0 Combo Module Integrated Bluetooth V4.2/5.3

Model Number: WXT0HR1101
(REALTEK : RTL8851BU)

(MAC address from GSD)

Customer Approval Section		
Customer Name		
Department		
Approval		Date:

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Contents

1.General Description	4
2.Features	4
3. Application Diagrams	5
3.1 Functional Block Diagram	5
3.2 General Requirements	6
3.2.1 IEEE 802.11b Section	6
3.2.2 IEEE 802.11g Section	6
3.2.3 IEEE 802.11a Section	7
3.2.4 IEEE 802.11n Section	7
3.2.5 IEEE 802.11ac Section	8
3.2.6 IEEE 802.11ax Section	8
3.2.7 Bluetooth Section	9
4.Electrical and Thermal Characteristics	9
4.1 Temperature Limit Ratings	9
4.2 General Section	9
4.3 Software	10
4.4 Mechanical Dimensions	10
5.Mechanical Dimensions	11
6. Connector Definition	12
7. Interface Timing Specification	12



1. General Description

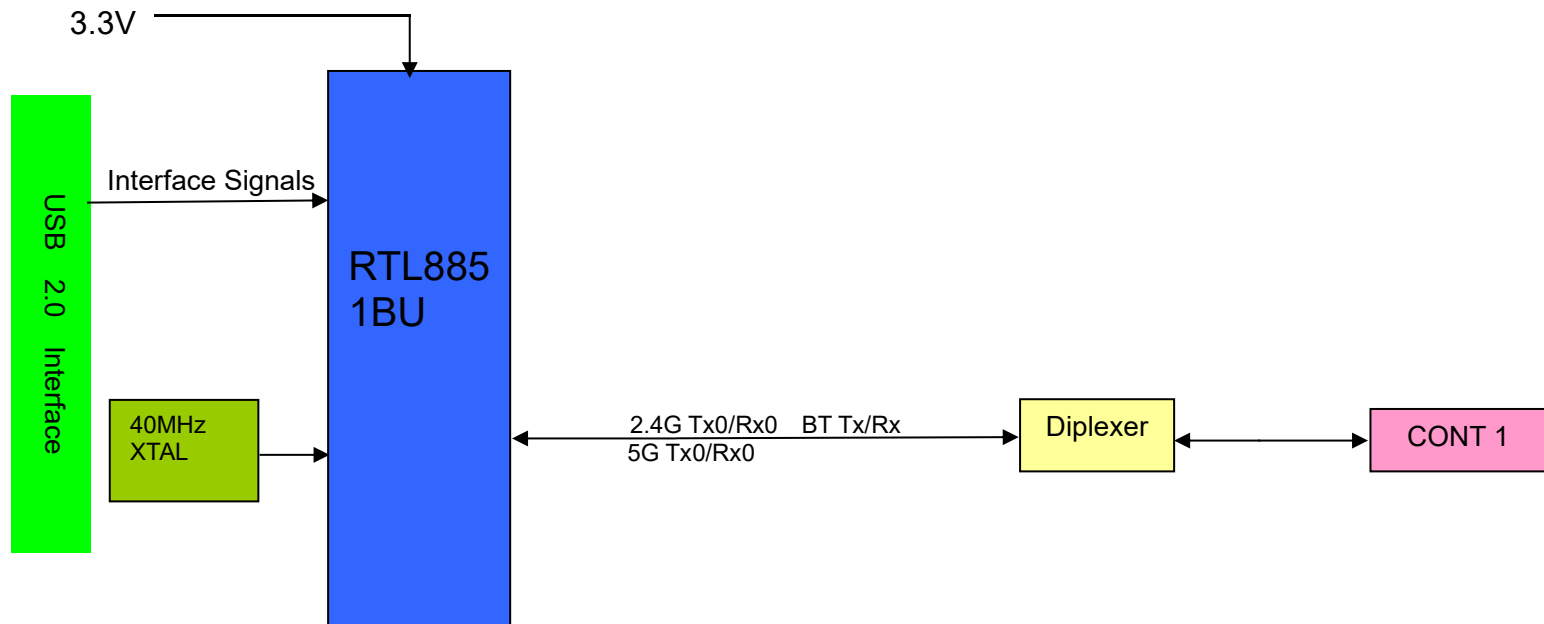
The Realtek RTL8851BU is a highly integrated single-chip that support 1-stream 802.11ax solutions with Wireless LAN (WLAN) USB interface controller. It combines a WLAN MAC, a 1T1R capable WLAN baseband, and RF in a single chip. The RTL8851BU provides a complete solution for a high-performance integrated wireless and Bluetooth device.

2. Features

- Compatible with IEEE 802.11a standard, providing wireless data rate up to 54Mbps.
- Compatible with IEEE 802.11b standard, providing wireless data rate up to 11Mbps.
- Compatible with IEEE 802.11g standard, providing wireless data rate up to 54Mbps.
- Compatible with IEEE 802.11n standard, providing wireless data rate up to 150Mbps.
- Compatible with IEEE 802.11ac standard, providing wireless data rate up to 433.3Mbps.
- Compatible with IEEE 802.11ax standard to provide wireless 286Mbps data rate in 2.4GHz band.
- Compatible with IEEE 802.11ax standard to provide wireless 600Mbps data rate in 5GHz band.
- Support 20MHz, 40MHz bandwidth in 2.4GHz band.
- Support 20MHz, 40MHz, 80Mhz bandwidth in 5GHz band.
- Support STBC, LDPC
- support QoS Enhancement (WMM)
- Security support for WPA/WPA2/WPA3
- Operation at 2.4~2.5GHz and 5.15~5.825GHz frequency band to meet worldwide regulations
- Bluetooth specification 4.2
- Bluetooth 5.3
- High speed USB 2.0 interface
- HSF compliant

3. Application Diagrams

3.1 Functional Block Diagram



3.2 General Requirements

3.2.1 IEEE 802.11b Section

	Feature	Detailed Description
3.2.1.1	Standard	IEEE 802.11b
3.2.1.2	Radio and Modulation Schemes	DQPSK , DBPSK and CCK with DSSS
3.2.1.3	Operating Frequency	2400 ~ 2483.5MHz ISM band
3.2.1.4	Channel Numbers	13 channels for Worldwide
3.2.1.5	Data Rate	at most 11Mbps
3.2.1.6	Media Access Protocol	CSMA/CA with ACK
3.2.1.7	Transmitter Output Power at Antenna Connector	- Typical RF Output Power at each RF chain, and at room Temp. 25°C 16±2 dBm at 11Mbps
3.2.1.8	Receiver Sensitivity at Antenna Connector	- Typical Sensitivity at each RF chain. @Frame (1000-byte PDUs) Error Rate≤8% at room Temp 25°C -83 dBm for 11Mbps

3.2.2 IEEE 802.11g Section

	Feature	Detailed Description
3.2.2.1	Standard	IEEE 802.11g
3.2.2.2	Radio and Modulation Type	QPSK , BPSK , 16QAM , 64QAM with OFDM
3.2.2.3	Operating Frequency	2400 ~ 2483.5MHz ISM band
3.2.2.4	Channel Numbers	13 channels for Worldwide
3.2.2.5	Data Rate	at most 54Mbps
3.2.2.6	Media Access Protocol	CSMA/CA with ACK
3.2.2.7	Transmitter Output Power at Antenna Connector	- Typical RF Output Power at each RF chain, at room Temp. 25°C 15±2 dBm at 54Mbps
3.2.2.8	Receiver Sensitivity at Antenna Connector	- Typical Sensitivity at each RF chain. @Frame (1000-byte PDUs) Error Rate≤10% at room Temp 25°C -71 dBm for 54Mbps

3.2.3 IEEE 802.11a Section

	Feature	Detailed Description
3.2.3.1	Standard	IEEE 802.11a
3.2.3.2	Radio and Modulation Type	QPSK , BPSK , 16QAM ,64QAM with OFDM
3.2.3.3	Operating Frequency	5.15~5.25GHz 5.25~5.35GHz 5.47~5.725GHz 5.725~5.85GHz
3.2.3.4	Data Rate	at most 54Mbps
3.2.3.5	Media Access Protocol	CSMA/CA with ACK
3.2.3.6	Transmitter Output Power at Antenna Connector	- Typical RF Output Power at each RF chain, at room Temp. 25°C 15±2 dBm at 54Mbps
3.2.3.7	Receiver Sensitivity at Antenna Connector	- Typical Sensitivity at each RF chain. @Frame (1000-byte PDUs) Error Rate≤10% at room Temp 25°C -71 dBm for 54Mbps

3.2.4 IEEE 802.11n Section

	Feature	Detailed Description
3.2.4.1	Standard	IEEE 802.11n
3.2.4.2	Radio and Modulation Type	BPSK , QPSK , 16QAM ,64QAM with OFDM
3.2.4.3	Operating Frequency	2.4GHz :2400 ~ 2483.5MHz for ISM band 5GHz : 5.15~5.25GHz; 5.25~5.35GHz; 5.47~5.725GHz; 5.725~5.85GHz;
3.2.4.4	Data Rate	at most 150 Mbps
3.2.4.5	Media Access Protocol	CSMA/CA with ACK
3.2.4.6	Transmitter Output Power at Antenna Connector	- Typical RF Output Power at each RF chain,and at roomTemp. 25°C 2GHZ Band: 15±2dBm at HT20 MCS7 15±2dBm at HT40 MCS7 5GHZ Band: 15±2dBm at HT20 MCS7 15±2dBm at HT40 MCS7
3.2.4.7	Receiver Sensitivity at Antenna Connector	- Typical Sensitivity at each RF chain. @Frame(1000-byte PDUs)Error Rate≤10% and at room Temp. 25°C 2GHZ Band: -69dBm at HT20 MCS7 -66dBm at HT40 MCS7 5GHZ Band: -69dBm at HT20 MCS7 -66dBm at HT40 MCS7

3.2.5 IEEE 802.11ac Section

	Feature	Detailed Description
3.2.5.1	Standard	IEEE 802.11ac
3.2.5.2	Radio and Modulation Type	QPSK , BPSK , 16QAM ,64QAM,256QAM with OFDM
3.2.5.3	Operating Frequency	5GHz : 5.15~5.25GHz; 5.25~5.35GHz; 5.47~5.725GHz; 5.725~5.85GHz;
3.2.5.4	Data Rate	at most 433.3Mbps
3.2.5.5	Media Access Protocol	CSMA/CA with ACK
3.2.5.6	Transmitter Output Power at Antenna Connector	Typical RF Output Power at each RF chain, at room Temp. 25°C 5GHZ Band: 13±2dBm at VHT80 MCS9
3.2.5.7	Receiver Sensitivity at Antenna Connector	Typical Sensitivity at each RF chain. @Frame(1000-byte PDUs)Error Rate≤10% at room Temp 25°C 5GHZ Band: -55 dBm at VHT80 MCS9

3.2.6 IEEE 802.11ax Section

	Feature	Detailed Description
3.2.6.1	Standard	IEEE 802.11ax
3.2.6.2	Radio and Modulation Type	QPSK , BPSK , 16QAM ,64QAM,256QAM, 1024QAM with OFDMA
3.2.6.3	Operating Frequency	2G: 2400 ~ 2483.5MHz ISM band 5GHz : 5.15~5.25GHz; 5.25~5.35GHz; 5.47~5.725GHz; 5.725~5.85GHz;
3.2.6.4	Data Rate	2G: at most 286Mbps 5G: at most 600Mbps
3.2.6.5	Media Access Protocol	CSMA/CA with ACK
3.2.6.6	Transmitter Output Power at Antenna Connector	Typical RF Output Power at each RF chain, at room Temp. 25°C 2GHZ Band: 12±2dBm at HE40 MCS11 5GHZ Band: 11±2dBm at HE80 MCS11
3.2.6.7	Receiver Sensitivity at Antenna Connector	Typical Sensitivity at each RF chain. @Frame(1000-byte PDUs)Error Rate≤10% at room Temp 25°C 2GHZ Band: -55 dBm at HE40 MCS11 5GHZ Band: -50 dBm at HE80 MCS11

3.2.7 Bluetooth Section

Feather		Description	
General specification			
Bluetooth standard	Bluetooth V 4.2/5.3		
Frequency band	2402MHz-2480MHz		
Channel Numbers	40 channels for BLE		
Modulation	GFSK		
RF specification			
	Min（dBm）	Type（dBm）	Max（dBm）
BLE Output Power		6	
Sensitive @BER=0.1% FOR GFSK(1Mbps)		-86	
Maximum input level	GFSK(1Mbps) -20dBm		
Sensitive @PER=30.8% FOR BLE		-90	

4. Electrical and Thermal Characteristics

4.1 Temperature Limit Ratings

Parameter	Minimum	Maximum	Units
Storage Temperature	-40	+80	°C
Ambient Operating Temperature	0	70	°C
Junction Temperature	0	125	°C

4.2 General Section

	Feature	Detailed Description
4.2.1	Antenna Type	• WIFI&BT :IPEX&PIFA Antenna
4.2.2	Operating Voltage	• 3.3V±0.3V
4.2.3	Current Consumption	• <2A
4.2.4	Form Factor and Interface	• High Speed USB2.0 Interface



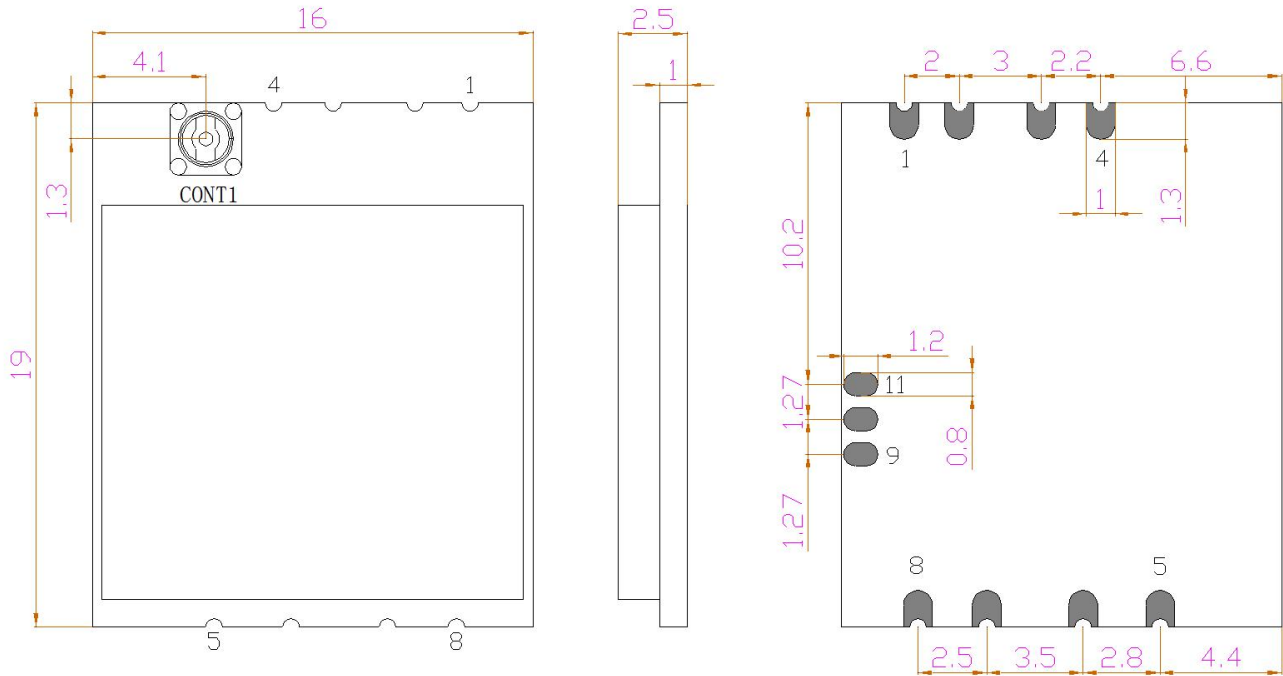
4.3 Software

Driver	Windows, Android, Linux
Security	WPA,WPA2,WPA3

4.4 Mechanical Dimensions

Feature	Detailed Description
Length	• 16mm
Width	• 19mm
Height	• PCB1.0mm

5.Mechanical Dimensions



CONT1: WIFI/BT

Tolerance:

Length(mm)	Tolerance(mm)
0-5	±0.15
5-10	±0.20
10-50	±0.30
>50	±0.40



6. Connector Definition

Pin	Definition	Remark	I/O
1	GND	GND	
2	NC	NC	
3	NC	NC	
4	GND	GND	
5	VDD3.3	3.3V	
6	DM	USB D-	
7	DP	USB D+	
8	GND	GND	
9	Reset	RESERT	I
10	WL FW log	WL FW log	
11	WL_WAKE_HOST	WIFI Wake Host	O
	CONT1	WIFI/BT	

备注： WIFI和BT共用一个地址段，但不会发生共用一个地址的情况。

Pin 9. RESET 模组内部已上拉到3.3V，端口状态应配置低电平有效

Pin 10. WL FW log: 整机NC就行

Pin 11. WL_WAKE_HOST: 模组内部已上拉到3.3V，端口状态应配置低电平有效

7. Interface Timing Specification

USB Bus during Power On Sequence

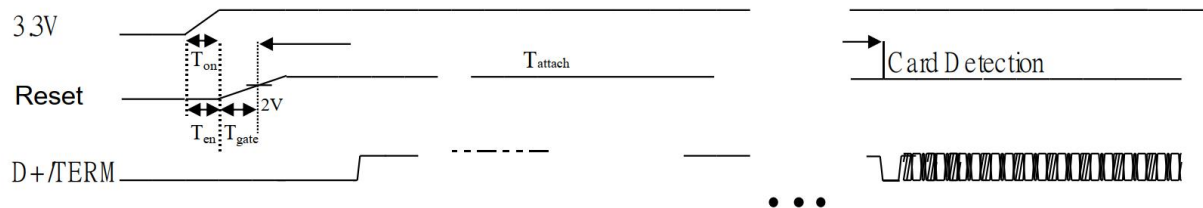


Figure 3 RTL8851BU-CG USB Bus Power On Sequence

T_{on}: The main power ramp up duration

T_{en}: Interval between the rising point of 3.3V and chip_en

T_{gate}: Interval of 3.3V to be gated when chip_en voltage level < 2V

T_{attach}: USB attach state. The duration from resistor attached to USB host starting card detection procedure

Table 15. Typical Timing Range

	Unit	Min.	Typical	Max.
T _{on}	ms	-	1.5	5
T _{en}	ms	0	0	5
T _{gate}	ms	0	1.5	8
T _{attach}	ms	100	250	-

RTL8851BU-CG Power off Sequence

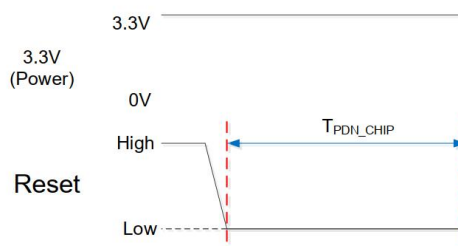


Figure 4 RTL8851BU-CG Power Off Sequence

Table 16 RTL8851BU-CG Power Off Timing Parameters

	Min.	Typical	Max.	Unit	Description
T _{PDN_CHIP}	10	100	X	ms	CHIP_EN keep low duration

Reset can externally shutdown the RTL8851BU-CG when Reset is pulled low. The keeping low duration must be more than T_{PDN_CHIP}

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 also Section 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).

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 EUT has a FPC Antenna, and the antenna use a permanently attached antenna which is not replaceable.

2.4 Limited module procedures

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

A limited module 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 limited module 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 not a limited 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.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

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: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is:

2AYHE-2406C

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 EUT has FPC Antenna, and the antenna use a permanently attached antenna which is unique.

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: 2AYHE-2406C”

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: Top band 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 circuitry), 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 circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

FCC STATEMENT :

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.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

FCC Radiation Exposure Statement:

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 & your body.

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2AYHE-2402A". Additionally, the following statement should be included on the label and in the final product's user manual:

"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 interferences, and
- (2) this device must accept any interference received, including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations.

When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application.

When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.

Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user