SPECIFICATION

TR6R851P2-M

WIFI/BT Module+5G

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1. Device Overview

1.1 Descriptions

The TR6R851P2-M is a highly integrated module that supports 1T1R 802.11 a/b/g/n/ac/ax with Wireless LAN (WLAN) PCIe interface controller and Bluetooth 5.3 HS-UART interface controller. The high speed FFT/IFFT paths, combined with BPSK, QPSK, 16QAM, 64QAM , 256QAM and 1024QAM modulation of the individual subcarriers, and compatible coding rate of 1/2, 2/3, 3/4, 5/6, provide up to 600.4Mbps for IEEE 802.11ax MIMO OFDM. The TR6R851P2-M MAC supports 802.11e for multimedia applications, 802.11i and WAPI for security.

The TR6R851P2-M provides a complete solution for a high-performance integrated wireless and Bluetooth device.

1.2 Features

1.2.1 General Features

- Supports 3.3V power supply
- Complies with PCI Express Base Specification Revision 2.1
- CMOS MAC, Baseband PHY and RF in a single module for IEEE 802.11a/b/g/n/ac/ax compatible WLAN
- IEEE 802.11i (WPA, WPA2, WPA3). Open, shared key, and pair-wise key authentication services
- Multiple BSSID feature allows the module to assume multiple MAC identities when used as a wireless bridge
- CMOS MAC, Baseband PHY and RF in a single chip for IEEE 802.11a/b/g/n/ac/ax compatible WLAN
- IEEE 802.11k Radio Resource Measurement
- WAPI(Wireless Authentication Privacy Infrastructure) certified
- Wi-Fi Direct supports wireless peer to peer application
- IEEE802.11h DFS,TPC,Spectrum Measurement

1.2.2 Wi-Fi Key Features

- IEEE 802.11a/b/g/n/ac/ax compatible WLAN
- One Transmit and One Receive paths
- CMOS single-chip fully-integrated RF, Modemand MAC
- Support 2.4GHz/5GHz Wi-Fi6
- Data rates up to 600.4Mbps with 20MHz / 40MHz / 80MHz bandwidth transmission
- In IEEE 802.11ax mode, the WLAN operation supports rates of MCS0–MCS11 (up to 1024 QAM) in 20

MHz, 40MHz, and 80 MHz channels for data rates up to 600.4 Mbps. In addition, all the IEEE 802. 11a/b/g/n/ac/ax rates are supported.

- Short Guard Interval (0.4us) for non-HE. 1xLTF and 0.8us guard interval for HE SU/ERSU. 4x LTF and 0.8us guard interval for HE MU
- WPA3-Enterprise 192-bit Security(based on AES-GCMP-256 & BIP-GMAC-256)
- OFDM with BPSK, QPSK, 16QAM, 64QAM , 256QAM and 1024QAM modulation. Convolutional Coding Rate: 1/2, 2/3, 3/4, and 5/6
- DSSS with DBPSK and DQPSK, CCK modulation with long and short preamble
- Support STBC,LDPC

1.2.3 Bluetooth Key Features

- Support BT5.3 HCI Encryption Key Size Control
- Support Bluetooth 5 system
- Compatible with Bluetooth v2.1+EDR
- Integrated MCU to execute Bluetooth protocol stack
- Supports all packet types in basic rate and enhanced data rate
- Supports Secure Simple Pairing
- Enhanced BT/WIFI Coexistence Control to improve transmission quality in different profiles
- Dual Mode support: Simultaneous LE and BR/EDR
- Supports multiple Low Energy states
- Fast AGC control to improve receiving dynamic range
- Integrated internal Class 1, Class 2, and Class 3 PA
- Supports Enhanced Power Control
- Integrated 32K oscillator for power management

1.3 Functional Block Diagram

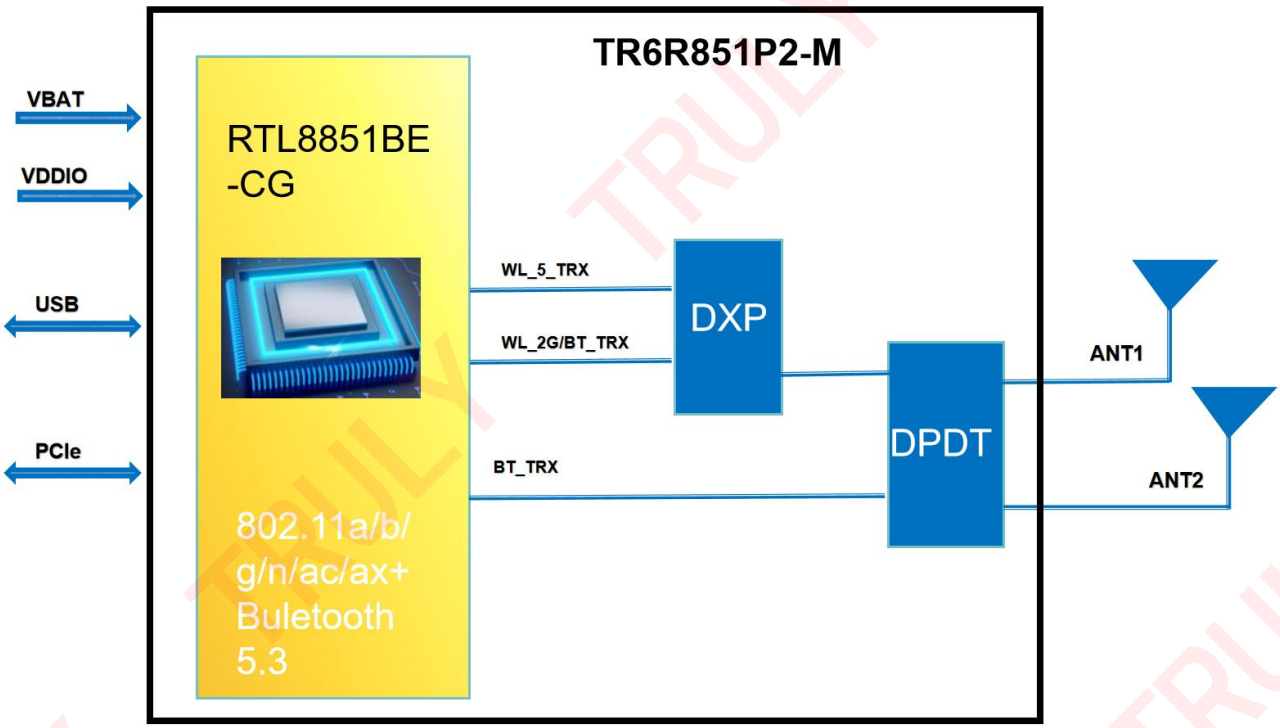


Figure 1. Block Diagram of TR6R851P2-M

2. Pin Configuration and Functions

2.1 Module Pin Diagram

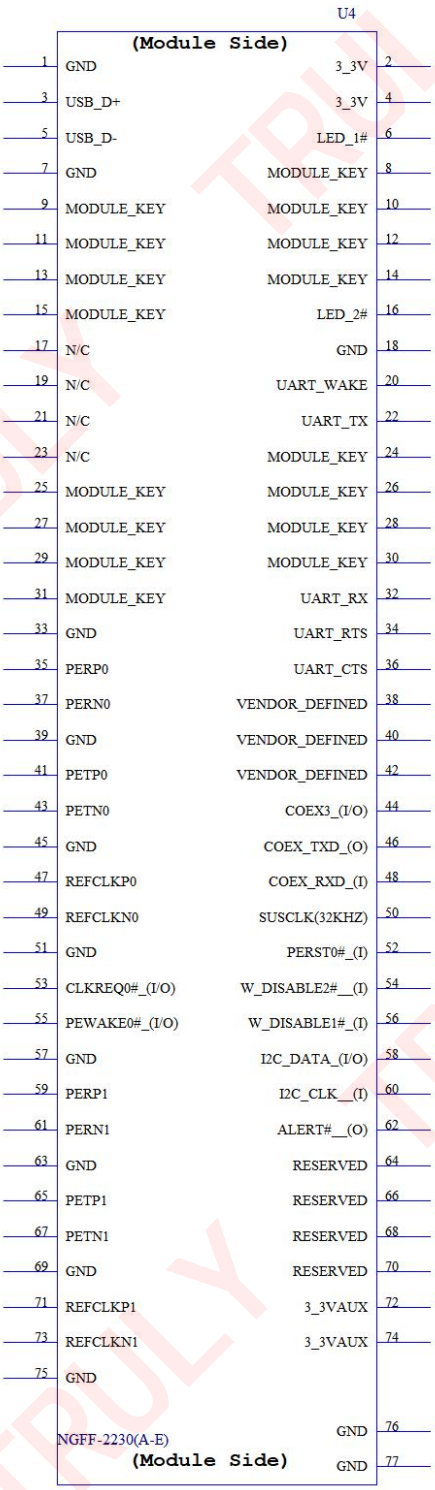


Figure 2.Pin Diagram of TR6R851P2-M

2.2 Pin Functions

Pin	Name	Description
1	GND	Ground
2	3.3V	3.3V power supply
3	USB_D+	USB_DP
4	3.3V	3.3V power supply
5	USB_D-	USB_DM
6	LED_1#	WLAN LED indicator
7	GND	Ground
16	LED_2#	BT LED indicator
18	GND	Ground
20	BT_WAKE_HOST	BT wake up Host
22	UART_TX	No connected
32	UART_RX	No connected
33	GND	Ground
34	UART_RTS	No connected
35	PERp0	PCIe differential pair RX data signal Positive
36	UART_CTS	No connected
37	PERn0	PCIe differential pair RX data signal Negative
38	HOST_WAKE_BT	Host wake up BT
39	GND	Ground
41	PETp0	PCIe differential pair TX data signal Positive
43	PETn0	PCIe differential pair TX data signal Negative
45	GND	Ground
47	REFCLKp0	PCIe differential pair clock signal Positive
49	REFCLKn0	PCIe differential pair clock signal Negative
50	SUSCLK(32kHz)	External 32K or RTC clock input

51	GND	Ground
52	PERST_N	PCIe preset signal
53	CLKREQ_N	PCIe clock request signal
54	BT_DIS_N	BT enable\disable pin.When this pin pull low,BT will disable.
55	PEWAKE_N	PCIe power management event output
56	WL_DIS_N	WiFi enable\disable pin.When this pin pull low,WiFi will disable.
57	GND	Ground
63	GND	Ground
66	RESERVED	No connected
68	RESERVED	No connected
69	GND	Ground
70	RESERVED	No connected
72	3.3V	3.3V power supply
74	3.3V	3.3V power supply
75	GND	Ground

ANT1:WIFI_BT RF Port

ANT2:WIFI_BT RF Port

Remarks: The in-use Pins are listed and defined in above table. Those missed serial numbers of Pins are not used.

3. Specifications

3.1 General Characteristics

Category	Descriptions
Dimension	L*W*H :30.0mm (±0.2mm)*22.0mm (±0.3mm)*2.2mm (±0.2mm)
Standard	IEEE 802.11a/b/g/n/ac/ax+BT 5.3
Frequency Band	2.4GHZ Band: 2412~2500MHZ
	5GHZ Band: 5150~5250MHZ@Band1 5250~5350MHZ@Band2 5470~5725MHZ@Band3 5725~5850MHZ@Band4
Bandwidth	20/40/80 MHz
Interface	WLAN:M.2 KEY.A+E (PCIe); Bluetooth: USB
PHY Rate	802.11b [11,5.5,2 and 1Mbps] 802.11g [54,48,36,24,18,12,9&6Mbps] 802.11n HT20:up to 144.4Mbps 802.11n HT40:up to 300Mbps 802.11ac VHT80:up to 866.7Mbps 802.11ax HE20:up to 286.8Mbps 802.11ax HE40:up to 573.6Mbps 802.11ax HE80:up to 1201Mbps
Data Security	WEP,WPA/WPA2/WPA3

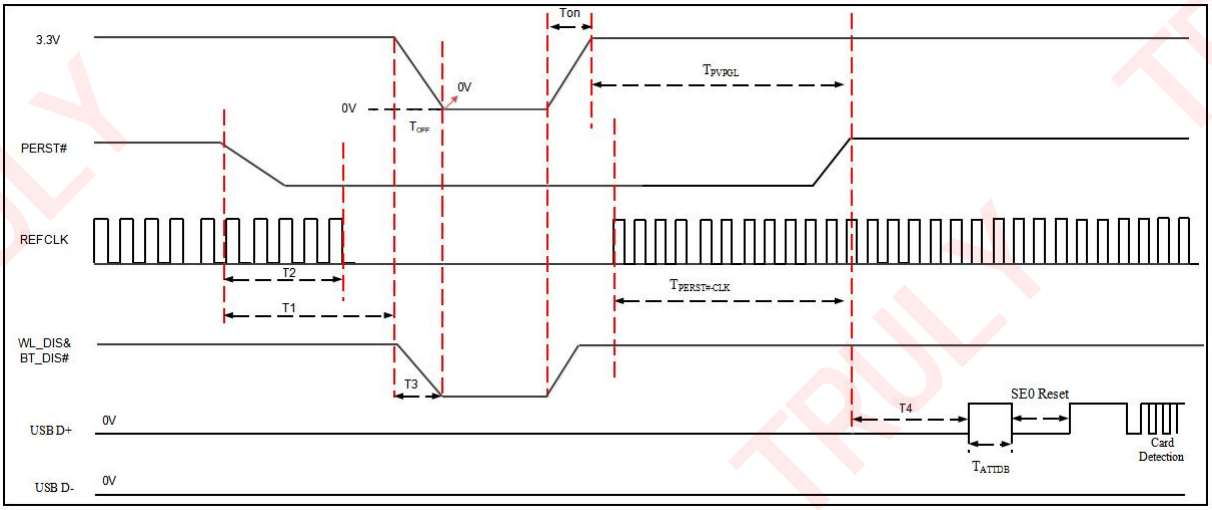
Frequency Error	<±20ppm/802.11b/g/n/a/ac
Rx Sensitivity	2.4G: 11b 11M:--89dBm@8% PER 11g 54M: -76dBm@10% PER 11n HT20 MCS7: -73dBm@10% PER 11ax HE20 MCS9: -70dBm@10% PER 5G: 11a 54M:-77dBm@10% PER 11n HT20 MCS7: -74dBm@10% PER 11n HT40 MCS7: -71dBm@10% PER 11ac VTH20 MCS8:-69dBm@10% PER 11ac VTH40 MCS9:-65dBm@10% PER 11ac VTH80 MCS9:-62dBm@10% PER 11ax HE20 MCS11:-61dBm@10% PER 11ax HE40 MCS11: -58dBm@10% PER 11ax HE80 MCS11: -55dBm@10% PER
Data Rate	802.11b [11,5.5,2 and 1Mbps] 802.11g [54,48,36,24,18,12,9&6Mbps] 802.11n HT20:up to 144.4Mbps 802.11n HT40:up to 300Mbps 802.11ac VHT80:up to 866.7Mbps 802.11ax HE20:up to 286.8Mbps 802.11ax HE40:up to 573.6Mbps 802.11ax HE80:up to 1201Mbps
Frequency Error	2.4GHz:<±25 ppm(11b),<±20 ppm(11g/n);5GHz:<±20 ppm
Ambient Temperature	-10℃~70℃
Storage Temperature	-40℃~125℃
Antenna	External RF antenna
Operating System	Windows /Linux
Operating Voltage	VBAT:3.3V

3.2 Bluetooth RF Specifications

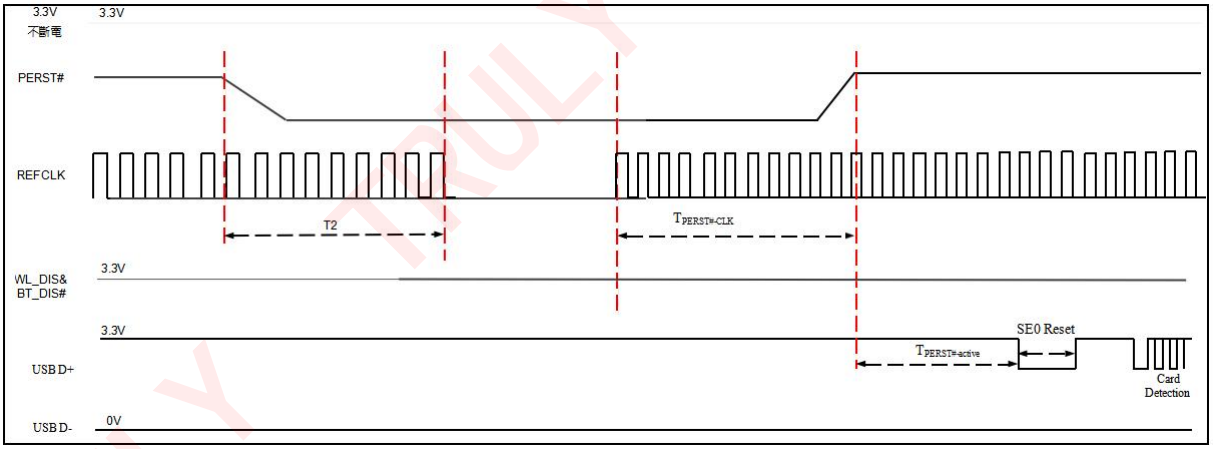
Parameter	Conditions	Minimum	Typical	Maximum	Unit
Frequency range		2402		2480	MHz
RX sensitivity	1 Mbps	-	-89	-	dBm
	2 Mbps	-	-87	-	dBm
	3 Mbps	-	-85	-	dBm
Initial carrier frequency offset		-24	5	24	KHz
Output power	BR	6	8	10	dBm
	EDR	4	6	8	dBm
	LE	4	6	8	dBm

3.3 PCIe Bus during Power On Sequence

a.*When WLAN is power off*



b.*When WLAN is NOT power off*



TPVPGL: Power valid to PERST# input inactive

TPERST#-CLK: Reference clock stable before PERST# inactive

Tattach: The interval to turn on BT after PERST# de-asserted

TATTDB: the debounce interval with a minimal duration of 100ms that provided by the USB system Software

4. Application and Implementation

4.1 Application Diagram

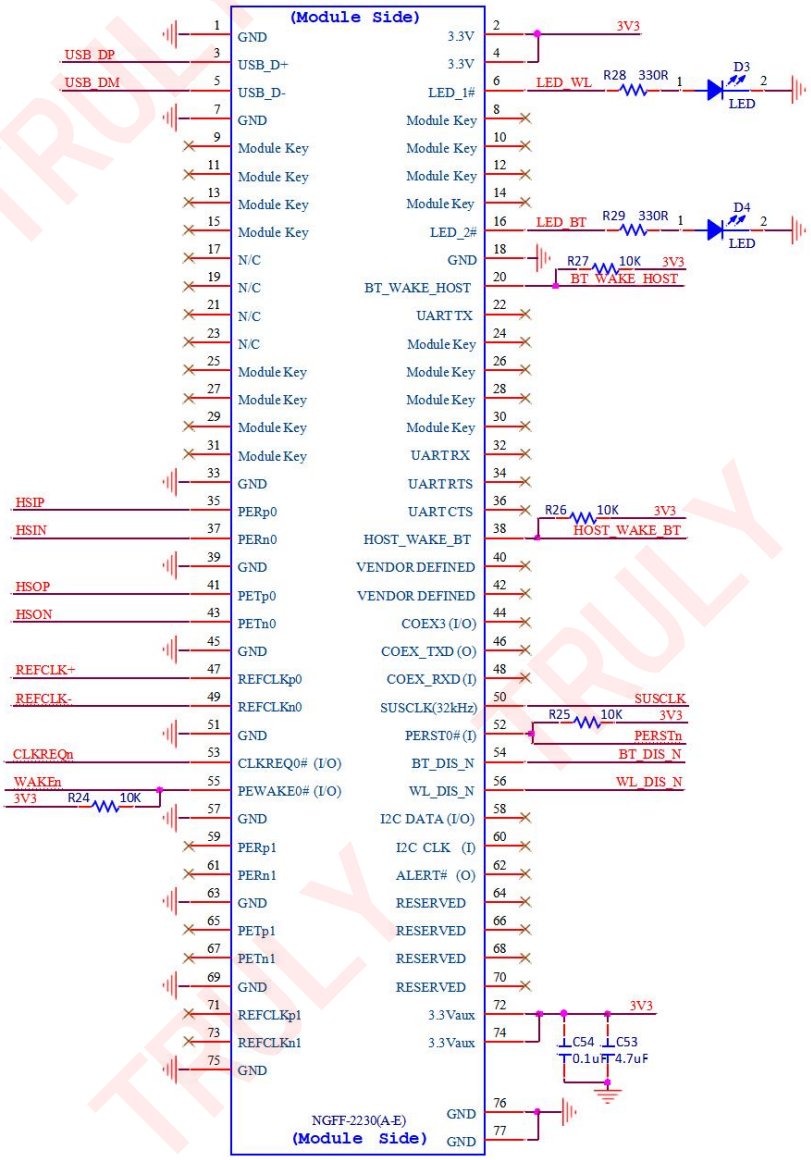
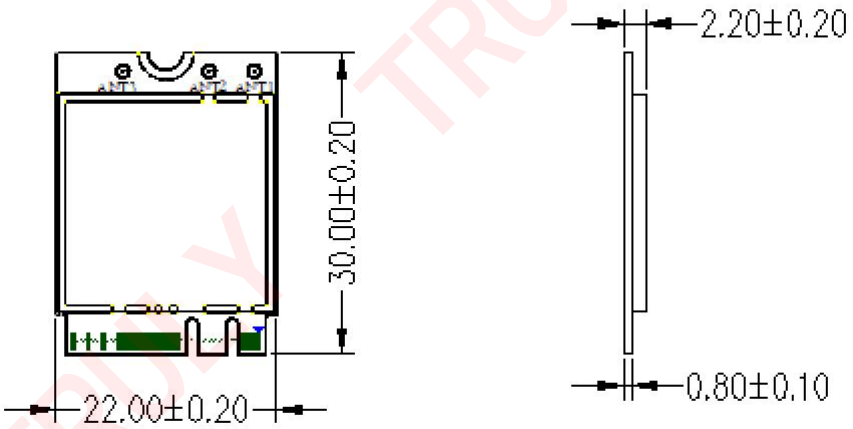


Figure 3. Application Schematic Diagram of TR6R851P2-M

5. Mechanical and Package

5.1 Mechanical Size



Note:L*W*H: 30.0mm (±0.2mm)*22.0mm (±0.2mm)*2.2mm (±0.2mm)

Figure 4. Mechanical Size of TR6R851P2-M

5.2 Package Information

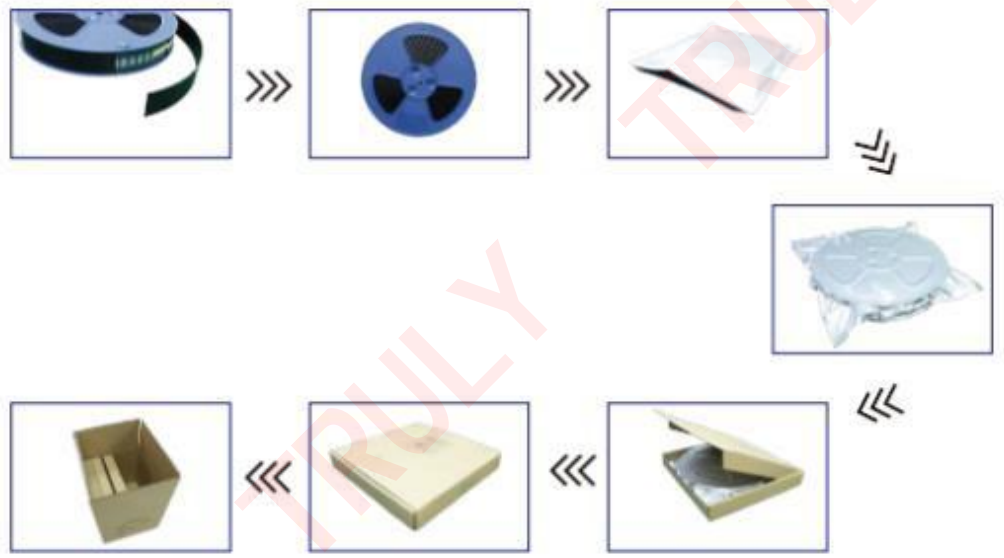


Figure 6. Brief Packaging Process of TR6R851P2-M Modules

6. Thermal Reflow

Referred to IPC/JEDEC standard.

Peak temperature: <250°C

Number of times: ≤2

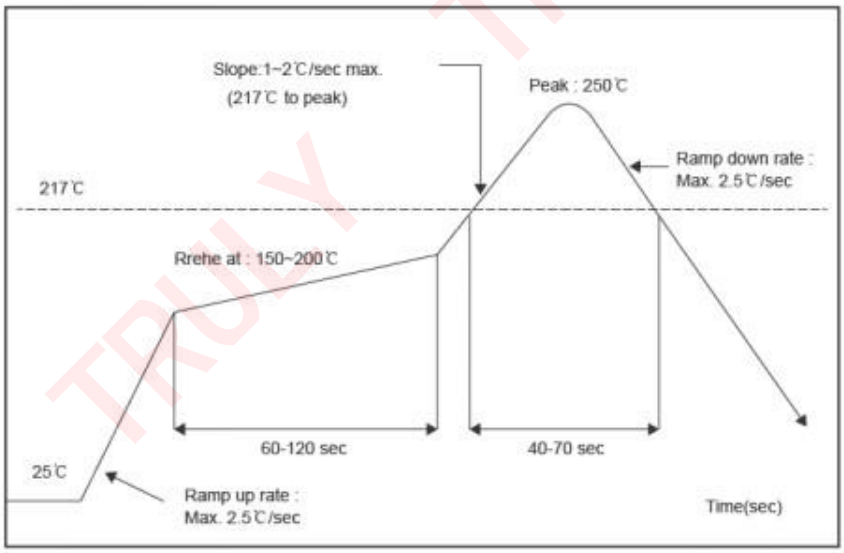


Figure 7. Recommended Reflow for Lead Free Solder

Note: The module is recommended not to go through reflow oven twice.

7. Ordering Information

Part NO.	Working Voltage	ANT	Shielding Cover	Remark
TR6R851P2-M	3.3V	2 antennas	Included	PCIe

8. Revision History

Version	Change Content	Reviser	Date
V0.1	Draft Version	Grant dou	2025.10.20

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.

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

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device.

Any company of the host which install this modular with Single modular approval should perform the test of radiated emissionand spurious emission according to FCC part 15C : 15.247 and 15.209 requirement, Only if the test result comply with FCC part 15C : 15.247 and 15.209 requirement, then the host can be sold legally.

FCC Radiation Exposure Statement

This modular complies with FCC RF 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. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

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.

OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID/IC of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. In such cases, please involve a FCC/IC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

Upgrade Firmware:

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC/IC for this module, in order to prevent compliance issues.

End product labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: 2BOHY-851P2-M”.

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

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/ICES-003) 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.
Explanation: This module meets the requirements of FCC part 15C(15.247), FCC part 15E(15.407).

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 No Antenna,The dipole antenna was used for the test.

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/IC (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, "Contains Transmitter Module FCC ID: 2BOHY-851P2-M Or Contains FCC ID: 2BOHY-851P2-M".

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 a Dipole antenna, and the antenna utilizes an RA-SMA connector, making it difficult to replace.

Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Note
TRULY	A25458102	Dipole	RA-SMA	2.4G:2.50 5G:3.50	2400-2500MHz 5150-5900MHz

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC/IC 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 Transmitter Module FCC ID: 2BOHY-851P2-M Or Contains FCC ID: 2BOHY-851P2-M".

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/IC 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/ICES-003 disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC/IC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC/IC 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/ICES-003 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/ICES-003 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.