CUSTOMER :

DATE :

SPECIFICATIONS FOR APPROVAL

PRODUCT NAME : Bluetooth v5.1 / Wi-Fi 6 MIMO Module

MODEL NAME : ATC6NPL002

CUSTOMER P/N :

APPROVAL	REMARK

APPENDIX

Designed	Checked	Approved	LG Innotek Co., Ltd.	
			DOCUMENT No.	ATC6NPL002 (6-3)
			PAGE	1 / 20

TITLE : Specifications for approval (ATC6NPL002)	REV 1.0(2 / 17)
(CUSTOMER P/N :)	

1. Application

This specification is applied to LG Innotek Bluetooth v5.1 and Wi-Fi 6 (IEEE 802.11a/b/g/n/ac/ax) Combo Module ATC6NPL002 which includes chipset NXP 88Q9098.

2. Quality

Quality should meet each condition which mentioned on this specification. However, the items which are not mentioned on this specification follow the inspection agreements and standards which are agree with both companies.

3. Appearance and Characteristics

1) Appearance

Appearance should not contaminated by harmful materials and should not have cracks etc. Mechanical dimensions should meet the contents of clause 8.

2) Characteristics

Electrical characteristics should meet the contents of clause 10.

4. Application of Bluetooth v5.1 and Wi-Fi 6 (IEEE 802.11a/b/g/n/ac/ax) Module

1) Automotive

5. Operating Condition

1) Maximum Rating

No.	ITEM	Min.	Typ.	Max.	UNIT
1	Operating Temperature Range	-40	+25	+85	℃
2	Storage Temperature Range	-40	+25	+105	℃
3	VDD_3V3 Voltage Range(3.3V)	-0.3	+3.3	3.63	V
4	VDVD_1V8 Voltage Range(1.8V)	-0.3	+1.8	2.16	V
5	VIO (1.8V)	-0.3	+1.8	1.98	V
	VIO (3.3V)	-0.3	+1.8	3.63	V
6	Max. Current consumption (1.8V)		-	930	mA
	Max. Current consumption (3.3V)		-	1,140	mA

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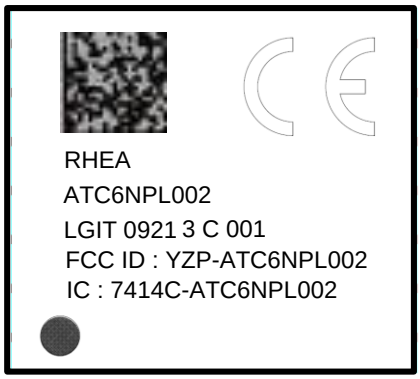
2) Recommended Operating Condition

No.	ITEM	Min.	Typ.	Max.	UNIT
1	Operating Temperature Range	-40	-	+85	℃
2	Storage Temperature Range	-	-	+105	℃
3	VDD_3V3 Voltage Range(3.3V)	+3.14	+3.3	+3.46	V
4	VDVD_1V8 Voltage Range(1.8V)	+1.71	+1.8	+1.89	V

6. Test

Electrical characteristics are tested for every products. However, if there are any objection in judgments, it should be treated with agreements of companies.

7. Labeling Information



RHEA
①
ATC6NPL002
②
LGIT x x xx
③ ④ ⑤ ⑥
x x xxx
⑦ ⑧ ⑨
⑩

No.	Index
①	PRODUCT FAMILY
②	MODEL PART NO.
③	COMPANY
④	MANUFACTURED YEAR (0~9)
⑤	MANUFACTURED MONTH(1,2, …9, A,B,C)
⑥	MANUFACTURED DATE (1~31)
⑦	Manufactured Serial Number : SMT Line no
⑧	Manufactured Serial Number : Shift no(A,B,C)
⑨	Manufactured Serial Number : (001~999)
⑩	B C6NPL002 0921 3C001 2001-0001 B: BT/WLAN Module C6NPL002: Model Part No. 0921: Manufactured Date 3C001: Manufactured Serial Number 2001 : LGIT Management Number 0001: Marking Serial Number

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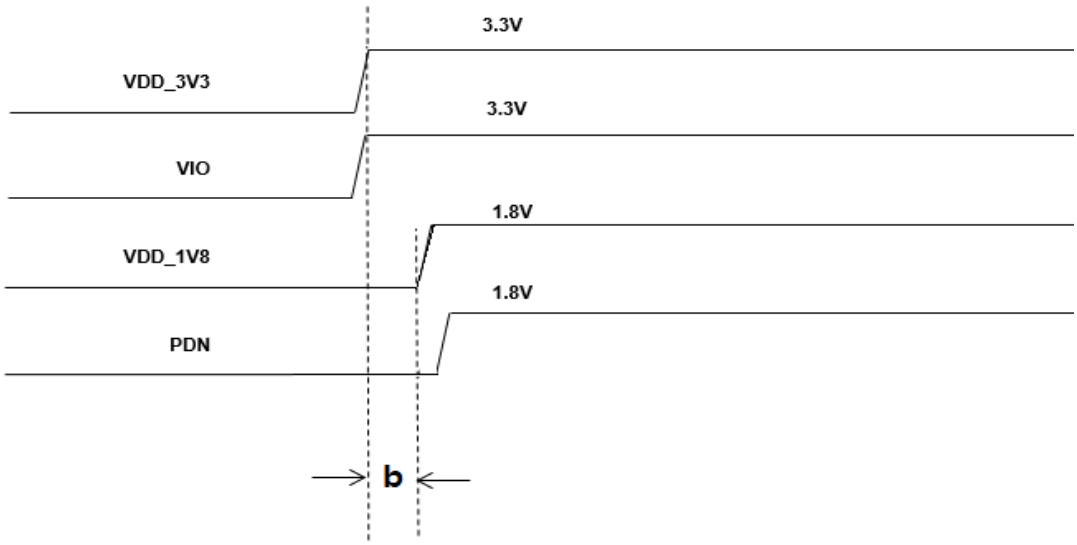
8. General Features

- Operation voltage is 3.3V and 1.8V
- Automotive module (All components are qualified for AEC-Q100/200)
- Support 2 Antenna port with 2x2 MIMO
- Use on-chip OTP(One-Time Programmable)
- Compliant with Wi-Fi 6 (IEEE 802.11a/b/g/n/ac/ax)
- Supports 2x2 Multi-User Multiple-Input Multiple-Output (MU-MIMO)
- Dual Band Simultaneous with dual MAC, 5 GHz PHY data rates up to 1.2 Gbps & 2.4 GHz PHY data rates up to 458 Mbps
- 20/40 MHz channel bandwidth for 2.4 GHz and 20/40/80 MHz for 5 GHz
- Dynamic Frequency Selection (DFS, radar detection).
- Offloading traffic for minimal host utilization.
- Low power PCIe v2.0 interface
- Compliant with BT v5.1
- Supports 2 Mbps Bluetooth Low Energy (BLE) and BLE long range
- Simultaneous active ACL connection support
- Backward-compatible with previous BT standards.
- Flexible interface PCM/I2S for BT audio.
- Supports Bluetooth-WLAN coexistence and ISM-LTE coexistence..
- RoHS Compliant

9. Electrical Specification

9.1 Power On/Off Sequence and Reset

1) Power On Sequence



b: Should be delayed from VDD_3V3 high(at least 90%) to start of VDD_1V8 ramp-up, it is 100msec typical(Min 0ms).
Note: Before boot up or any Reset, BT_HOST_WAKE, WLAN_HOST_WAKE should be kept as high status.
After reset these pins definition change immediately.

9. Electrical Specification

9.2 Power On/Off Sequence and Reset

2) Power Off Sequence

To reduce leakage, ramp down VDD_1V8 before VDD_3V3/VIO. Required minimum falling time is 0ms

9. Electrical Specification

9.3 UART Interface

1) Overview

The 88Q9098 supports the High-Speed UART interface

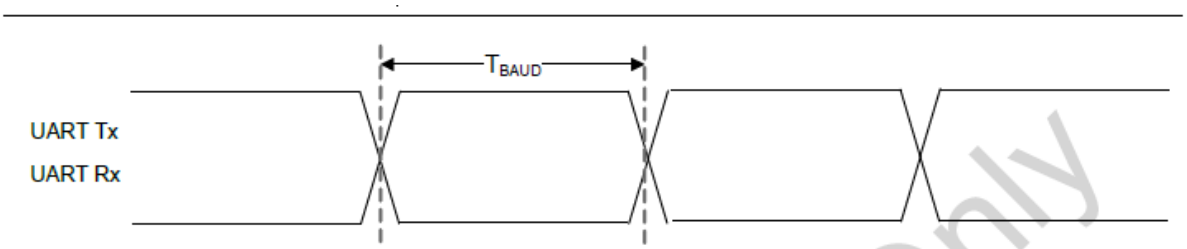


Table 47: UART Timing Data[1]

NOTE: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

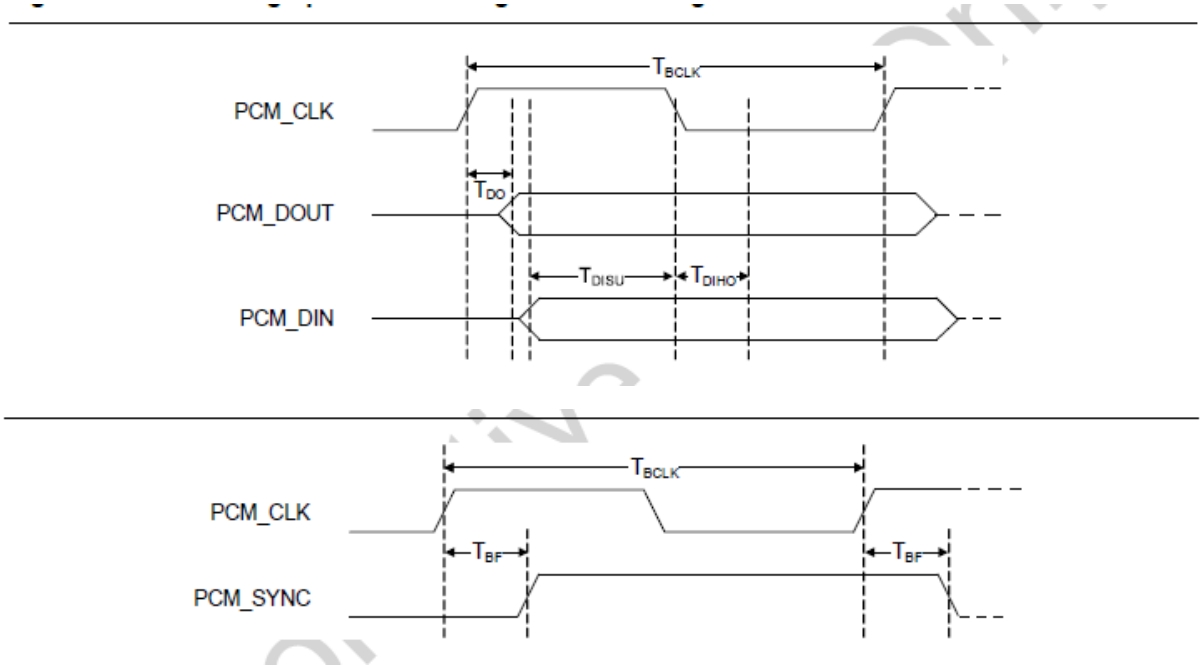
Symbol	Parameter	Condition	Min	Typ	Max	Units
T_{BAUD}	Baud rate	40 MHz input clock	250	--	--	ns

1. The acceptable deviation from the UART Rx target baud rate is ±3%.

9. Electrical Specification

9.4 PCM Interface

1) Master mode timing diagram

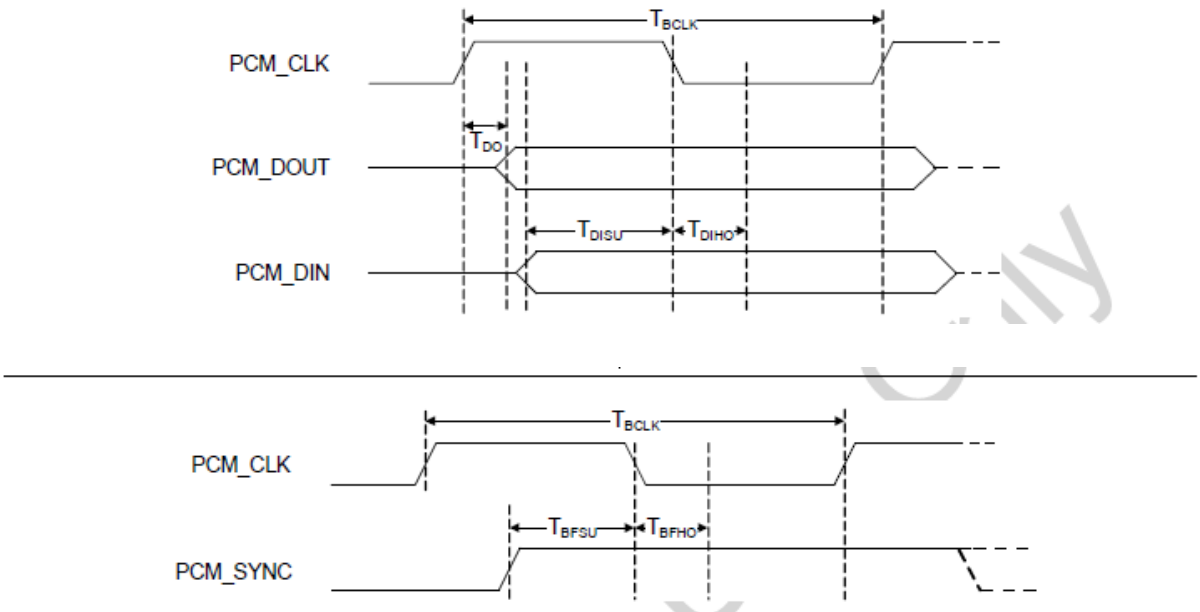


Parameter	Min.	Typ.	Max.	Units
PCM bit clock frequency (F_{BCLK})	-	2 / 2.048	-	MHz
Duty Cycle $_{BCLK}$	0.4	0.5	0.6	-
T_{BCLK} Rise/fall	-	3	-	ns
T_{DO}	-	-	15	ns
T_{DISU}	20	-	-	ns
T_{DIHO}	15	-	-	ns
T_{BF}	-	-	15	ns

9. Electrical Specification

9.5 PCM Interface

1) Slave Mode



Parameter	Min.	Typ.	Max.	Units
PCM bit clock frequency (F_{BCLK})	-	2 / 2.048	-	MHz
Duty Cycle $_{BCLK}$	0.4	0.5	0.6	-
T_{BCLK} Rise/fall	-	3	-	ns
T_{DO}	-	-	30	ns
T_{DISU}	15	-	-	ns
T_{DIHO}	10	-	-	ns
T_{BFSU}	15	-	-	ns
T_{BFHO}	10	-	-	ns

9. Electrical Specification

9.6 Recommend Operating Voltage

No.	ITEM	Min.	Typ.	Max.	UNIT
1	VDD_3V3	3.14	3.3	3.46	V
2	VDD_1V8	1.71	1.8	1.89	V
3	VIO	1.71 3.14	1.8 3.3	1.89 3.46	V

9.7 Moisture Sensitivity Level

MSL 3 Level (Floor Life Time : 168Hrs. / Condition : ≤30℃, 60% RH)

Standard : IPC / JEDEC J-STD-020C

Reflow Total MAX Three Times (LGIT : Used 1 Times / 2 times remaining)

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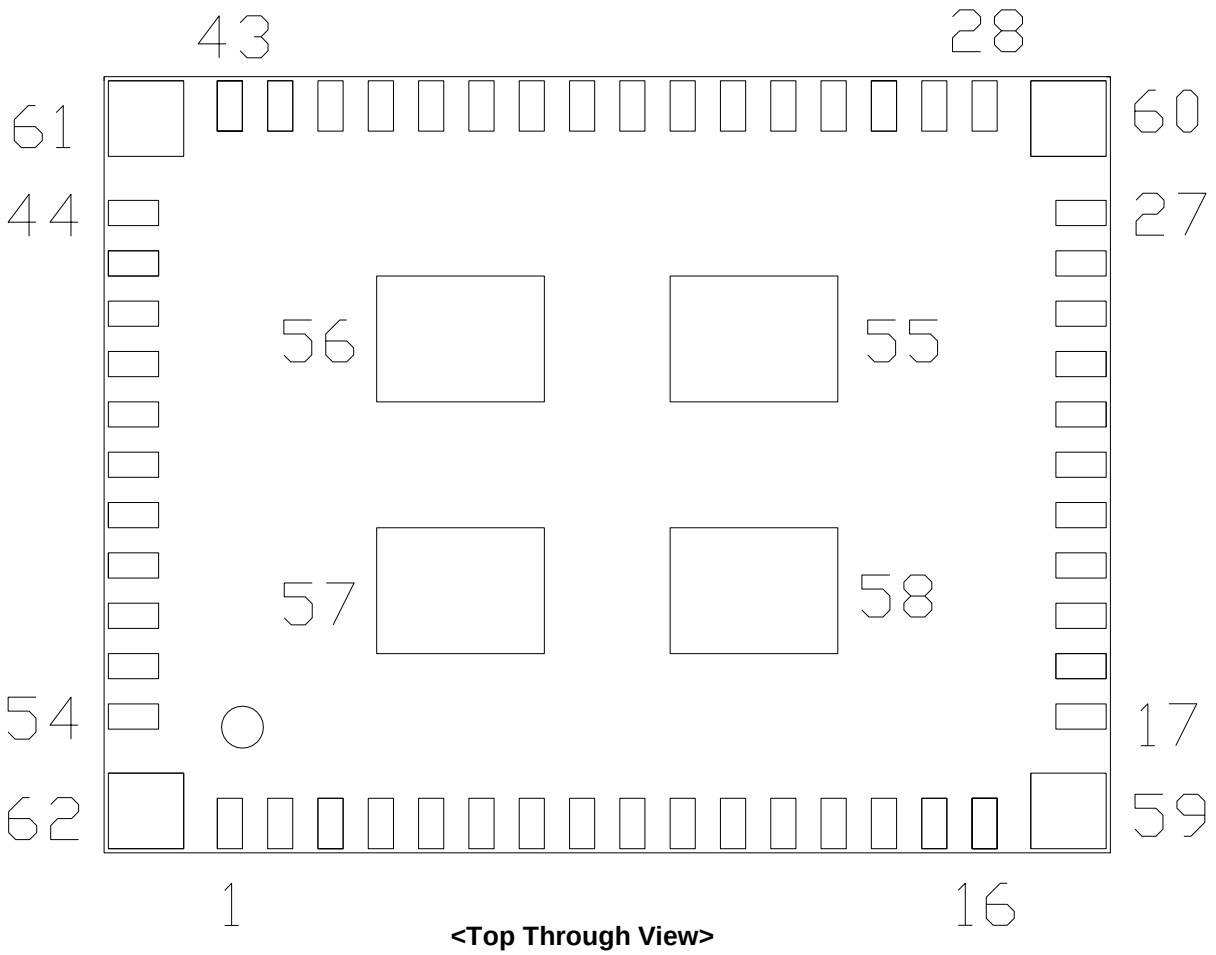
10. Pin Configuration



<Top Through View>

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10. Pin Configuration[1)]

No	Pin Name	I/O	Power Domain	Description
1	NC	-	-	Reserved
2	GPIO_0	I/O	VIO	GPIO for Host control
3	CONFIG_HOST2	-	1.8V	Boot configuration.
4	PDn	I	1.8V	Full power down (active low)
5	N/C	-	-	Reserved
6	VDD_3V3	I	3.3V	Supply Voltage for VDD 3.3V
7	VDD_3V3	I	3.3V	Supply Voltage for VDD 3.3V
8	GND	-	-	Ground
9	VIO	I	VIO	Supply Voltage for I/O. Select 3.3V or 1.8V
10	N/C	-	-	Reserved
11	GND	-	-	Ground
12	WLAN_HOST_WAKE	I/O	VIO	WLAN device to wake up host
13	BT_HOST_WAKE	I/O	VIO	BT device to wake up host
14	WL_RESET	I/O	VIO	WLAN reset. Active high / Low in reset.
15	BT_RESET	I/O	VIO	Bluetooth reset. Active high / Low in reset.
16	N/C	-		Reserved
17	BT_DEV_WAKE	I/O	VIO	Host wake up to BT device
18	PCIE_CLKREQ_L	I/O	VIO	PCI express Reference Clock Request
19	PCIE_RX_N	I	1.8V	PCI express Differential Receive Negative
20	PCIE_RX_P	I	1.8V	PCI express Differential Receive Positive
21	PCIE_CLK_N	I	1.8V	PCI express Differential Reference Clock Negative
22	PCIE_CLK_P	I	1.8V	PCI express Differential Reference Clock Positive
23	PCIE_TX_P	O	1.8V	PCI express Differential Transmit Positive
24	PCIE_TX_N	O	1.8V	PCI express Differential Transmit Negative
25	PCIE_WAKE_L	I/O	VIO	Request to service a function-initiated wake event
26	PCIE_RST_L	I/O	VIO	PCI express reset with weak pull-down
27	N/C	-	-	Reserved
28	LTE_Co-ex_TX	I/O	VIO	LTE co-existence UART Transmit
29	LTE_Co-ex_RX	I/O	VIO	LTE co-existence UART Receive
30	GPIO_21	I/O	VIO	LTE co-existence interface arbiter
31	GPIO_23	I/O	VIO	LTE co-existence interface arbiter
32	VDD_1V8	I	1.8V	Supply Voltage for VDD 1.8V

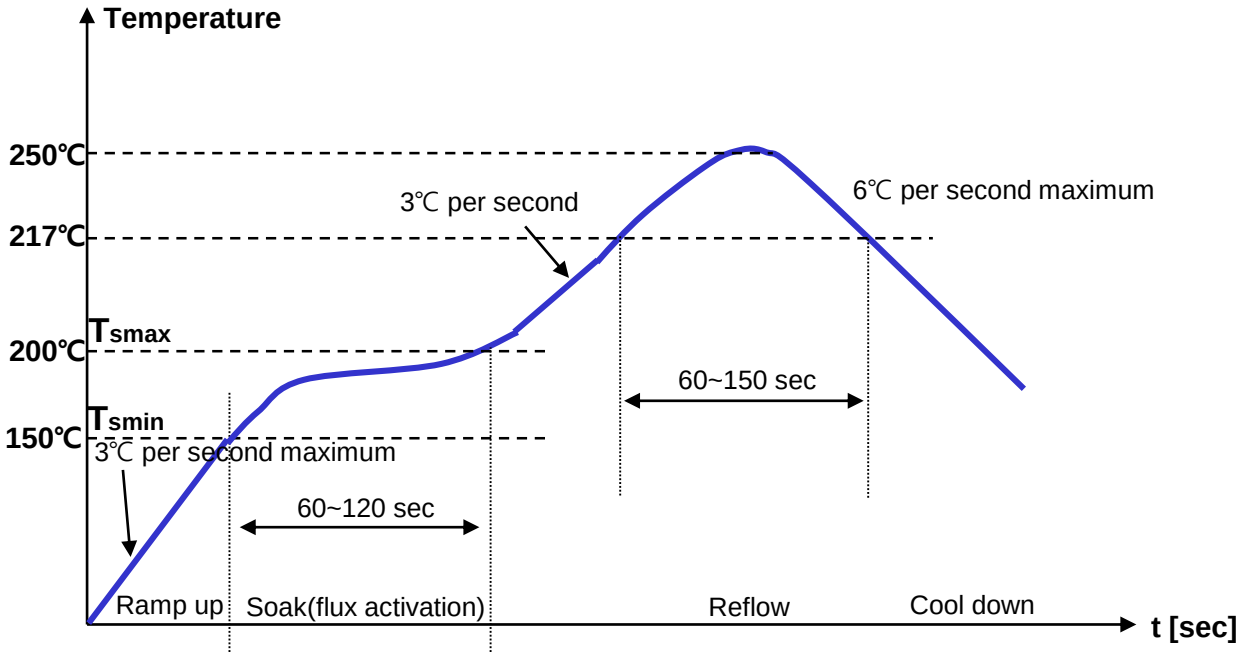
1) Pin configuration can be changed

10. Pin Configuration[1)]

No	Pin Name	I/O	Power Domain	Description
33	VDD_1V8	I	1.8V	Supply Voltage for VDD 1.8V
34	PCM_SYNC	I	VIO	Bluetooth PCM synchronization signal / I2S word select
35	PCM_OUT	O	VIO	Bluetooth PCM output signal / I2S serial data output
36	PCM_CLK	I	VIO	Bluetooth PCM clock signal / I2S serial clock
37	PCM_IN	I	VIO	Bluetooth PCM input signal / I2S serial data input
38	UART_CTS	I	VIO	Bluetooth UART Clear to Send
39	UART_RTS	O	VIO	Bluetooth UART Ready to Send
40	UART_RXD	I	VIO	Bluetooth UART Receive
41	UART_TXD	O	VIO	Bluetooth UART Transmit
42	GND	-	-	Ground
43	GPIO_22	I	VIO	GPIO for Host control
44	GND	-	-	Ground
45	N/C	-	-	Reserved
46	GND	-	-	Ground
47	ANT2	I/O	-	BT/ WiFi 2.4G & 5G RF
48	GND	-	-	Ground
49	N/C	-	-	Reserved
50	N/C	-	-	Reserved
51	N/C	-	-	Reserved
52	N/C	-	-	Reserved
53	GND	-	-	Ground
54	ANT1	I/O	-	WiFi 2.4G & 5G RF
55	GND	-	-	Ground
56	GND	-	-	Ground
57	GND	-	-	Ground
58	GND	-	-	Ground
59	GND	-	-	Ground
60	GND	-	-	Ground
61	GND	-	-	Ground
62	GND	-	-	Ground

1) Pin configuration can be changed

12. Reflow Profile



Profile Feature	Pb-free Assembly
Initial ramp-up rate	3℃ per second maximum
Preheat Temperature minimum(Tsmin) Temperature maximum(Tsmax) Time(minimum to maximum)	 150℃ 200℃ 60-120s
Ramp-up rate Tsmax to T_L	3℃ per second maximum
Liquidus Temperature(T_L)	217℃
Time above T_L	60-150s
Peak temperature	250℃ maximum
Time within 5℃ of actual peak	10s
Ramp-down rate	6℃ per second maximum

13. Certification information

13.1 FCC information

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.
(2) This device must accept any interference received, including interference that may cause undesired operation.

CAUTION: 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.

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.

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.

13. Certification information

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).

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 dipole antenna and a external unique connector.

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.

13. Certification information

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: YZP-ATC6NPL002.

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 a external unique connector.

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: YZP-ATC6NPL002.

13. Certification information

Information on test modes and additional testing requirements[5]

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.

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.

13. Certification information

13.2 IC information

This device complies with Industry Canada license-exempt RSS standard(s). 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.
Cet appareil est conforme avec Industrie Canada exempts de licence standard RSS (s). L'opération est soumise aux deux conditions suivantes:
(1) cet appareil ne peut causer d'interférences, et
(2) cet appareil doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.
The end product must be labeled to display the Industry Canada certification number of the module.
Contains transmitter module IC: 7414C-ATC6NPL002
Le dispositif d'accueil doivent être étiquetés pour afficher le numéro de certification d'Industrie Canada du module.
Contient module émetteur IC : 7414C-ATC6NPL002

*** This device is going to be operated in 5 150 MHz ~ 5 250 MHz frequency range, it is restricted in indoor environment only.**

Information for OEM Integrator
This device is intended only for OEM integrators under the following conditions:
1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.

End product labelling
The label for end product must include
"Contains FCC ID: YZP-ATC6NPL002, Contains IC: 7414C-ATC6NPL002".

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