

TL8822CSL

DATASHEET

Customer confirmation print column		
Customer	Approve	Date

Reversion History:

Version	Date	Modification
1.0	2020.12.30	First release

1. Overview

The TL8822CSL is based on RTL8822CS , Complied with IEEE 802.11a/b/g/n/ac2T2R SDIO3.0 WLAN controller. It combines a WLAN MAC, a 2T2R capable WLANbaseband, BT Protocol Stack (LM, LL, and LE), BT Baseband, modem, and WLAN/BT RFin a single chip. The RTL8822CS provides a complete solution for a high throughputperformance intergrated wireless LAN and Bluetooth device.

2. Features

- Supports 802.11ac 2x2, Wave-2 compliant with MU-MIMO
- 802.11a/b/g/n/ac Draft 3.0 2T2R WLAN and Bluetooth single module
- Complies with SDIO3.0 for WLAN and UART/PCM interface for BT controller
- Support WLAN 2.4GHz and 5GHz band channels
- Support WLAN 20MHz, 40MHz and 80MHz bandwidth transmission
- WLAN maximum PHY data rate 54Mbps in 802.11a/g; and 300Mbps in 802.11n; and 867Mbps in 802.11ac
- Supports Bluetooth Low Energy
- Supports Bluetooth 4.2 LE Secure Connection by upper layer software upgrade

3. Block Diagram

The block diagram is a long-term confidential document and does not reflect

4. General Specification

Model	TL8822CSL
Product Name	WLAN 11a/b/g/n/ac SDIO3.0 2T2R + Bluetooth 4.2 module
Major Chipset	RTL8822CS-VL-CG
Standard	802.11a/b/g/n/ac
Modulation Method	BPSK/ QPSK/ 16-QAM/ 64-QAM/256-QAM
Frequency Band	2.4GHz and 5GHz ISM Band
WiFi Interface	SDIO3.0
BT Interface	UART
Operating Temperature	-20 C° ~ 70 C°
Storage Temperature	-40 C° ~ 85 C°
Humidity	5% to 90% maximum
Dimension	15x13x1.8 (LxWxH) ±0.3mm

5. Electrical Characteristics

5.1 WiFi Section:

A. 2.4GHz RF Specification

Feature	Description
WLAN Standard	IEEE 802.11a/b/g/n/ac WiFi complian
Frequency Range	2.400 GHz ~ 2.4835 GHz (2.4 GHz ISM Band)
Number of Channels	2.4GHz: Ch1 ~ Ch14
Modulation	802.11b : DQPSK, DBPSK, CCK 802.11 g/n : OFDM /64-QAM,16-QAM, QPSK, BPSK
Output Power	802.11b /1Mbps : 18dBm $\pm$ 1.5 dB @ EVM $\leq$ -15dB
	802.11b /11Mbps : 17dBm $\pm$ 1.5 dB @ EVM $\leq$ -15dB
	802.11g /6Mbps : 17 dBm $\pm$ 1.5 dB @ EVM $\leq$ -5dB
	802.11g /54Mbps : 15 dBm $\pm$ 1.5 dB @ EVM $\leq$ -28dB
	802.11n HT20 /MCS0 : 17 dBm $\pm$ 1.5 dB @ EVM $\leq$ -5dB
	802.11n HT20/MCS7 : 14 dBm $\pm$ 1.5 dB @ EVM $\leq$ -30dB
	802.11n HT40 /MCS0 : 17 dBm $\pm$ 1.5 dB @ EVM $\leq$ -5dB
	802.11n HT40/MCS7 : 14 dBm $\pm$ 1.5 dB @ EVM $\leq$ -30dB
Receive	- 1Mbps PER @ -93 dBm, typical
Sensitivity (11b,20MHz) @8% PER	- 2Mbps PER @ -91 dBm, typical
	- 5.5Mbps PER @ -88 dBm, typical
	- 11Mbps PER @ -86 dBm, typical
	- 6Mbps PER @ -90 dBm, typical
Receive Sensitivity (11g,20MHz) @10% PER	- 9Mbps PER @ -89 dBm, typical
	- 12Mbps PER @ -88 dBm, typical
	- 18Mbps PER @ -85 dBm, typical
	- 24Mbps PER @ -82 dBm, typical
	- 36Mbps PER @ -79 dBm, typical
	- 48Mbps PER @ -74 dBm, typical
	- 54Mbps PER @ -72 dBm, typical

	- MCS=0 PER @ -90 dBm, typical
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Receive Sensitivity (11n,20MHz) @10% PER	- MCS=1	PER @ -87 dBm, typical
	- MCS=2	PER @ -85 dBm, typical
	- MCS=3	PER @ -81 dBm, typical
	- MCS=4	PER @ -78 dBm, typical
	- MCS=5	PER @ -73 dBm, typical
	- MCS=6	PER @ -72 dBm, typical
	- MCS=7	PER @ -70 dBm, typical
Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0	PER @ -87 dBm, typical
	- MCS=1	PER @ -84 dBm, typical
	- MCS=2	PER @ -82 dBm, typical
	- MCS=3	PER @ -79 dBm, typical
	- MCS=4	PER @ -75 dBm, typical
	- MCS=5	PER @ -71 dBm, typical
	- MCS=6	PER @ -69 dBm, typical
Maximum Input Level	802.11b : -10 dBm	
	802.11g/n : -20 dBm	
Antenna Reference	Small antennas with 0~2 dBi peak gain	

B. 5GHz RF Specification

Feature	Description
WLAN Standard	IEEE 802.11a/n/ac 2x2, WiFi compliant
Frequency Range	4.900 GHz ~ 5.845 GHz (5.0 GHz ISM Band)
Number of Channels	5.0GHz: Please see the table
Modulation	802.11a : OFDM /64-QAM,16-QAM, QPSK, BPSK 802.11n : OFDM /64-QAM,16-QAM, QPSK, BPSK 802.11ac : OFDM /256-QAM
Output Power Receive Sensitivity (11a,20MHz) @10% PER	802.11a /6Mbps : 17 dBm $\pm$ 1.5dB @ EVM $\leq$ -5dB 802.11a /54Mbps : 15 dBm $\pm$ 1.5dB @ EVM $\leq$ -25dB
	802.11n HT20 /MCS0 : 17 dBm $\pm$ 1.5 dB @ EVM $\leq$ -5dB 802.11n HT20 /MCS7 : 14 dBm $\pm$ 1.5 dB @ EVM $\leq$ -28dB
	802.11n HT40 /MCS0 : 17 dBm $\pm$ 1.5 dB @ EVM $\leq$ -5dB 802.11n HT40 /MCS7 : 14 dBm $\pm$ 1.5 dB @ EVM $\leq$ -28dB
	802.11ac VHT20 /MCS0 : 17 dBm $\pm$ 1.5 dB @ EVM $\leq$ -5dB 802.11ac VHT20 /MCS8 : 14 dBm $\pm$ 1.5 dB @ EVM $\leq$ -30dB
	802.11ac VHT40 /MCS0 : 16dBm $\pm$ 1.5 dB @ EVM $\leq$ -5dB 802.11ac VHT40 /MCS9 : 13dBm $\pm$ 1.5 dB @ EVM $\leq$ -32dB
	802.11ac VHT80 /MCS0 : 16 dBm $\pm$ 1.5 dB @ EVM $\leq$ -32dB 802.11ac VHT80 /MCS9 : 13 dBm $\pm$ 1.5 dB @ EVM $\leq$ -32dB

Receive Sensitivity (11a,20MHz) @10% PER	- 6Mbps	PER @ -89 dBm, typical
	- 9Mbps	PER @ -88 dBm, typical
	- 12Mbps	PER @ -87 dBm, typical
	- 18Mbps	PER @ -84 dBm, typical
	- 24Mbps	PER @ -81 dBm, typical
	- 36Mbps	PER @ -78 dBm, typical
	- 48Mbps	PER @ -73 dBm, typical
	- 54Mbps	PER @ -72 dBm, typical
Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0	PER @ -89 dBm, typical
	- MCS=1	PER @ -86 dBm, typical
	- MCS=2	PER @ -84 dBm, typical
	- MCS=3	PER @ -81 dBm, typical
	- MCS=4	PER @ -77 dBm, typical
	- MCS=5	PER @ -72 dBm, typical
	- MCS=6	PER @ -71 dBm, typical
	- MCS=7	PER @ -68 dBm, typical
Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0	PER @ -86 dBm, typical
	- MCS=1	PER @ -83 dBm, typical
	- MCS=2	PER @ -81 dBm, typical
	- MCS=3	PER @ -78 dBm, typical
	- MCS=4	PER @ -74 dBm, typical
	- MCS=5	PER @ -70 dBm, typical
	- MCS=6	PER @ -68 dBm, typical
	- MCS=7	PER @ -67 dBm, typical
Receive Sensitivity (11ac,20MHz) @10% PER	- MCS=0, NSS1	PER @ -87 dBm, typical
	- MCS=1, NSS1	PER @ -85 dBm, typical
	- MCS=2, NSS1	PER @ -83 dBm, typical
	- MCS=3, NSS1	PER @ -80 dBm, typical
	- MCS=4, NSS1	PER @ -76 dBm, typical
	- MCS=5, NSS1	PER @ -71 dBm, typical
	- MCS=6, NSS1	PER @ -70 dBm, typical
	- MCS=7, NSS1	PER @ -69 dBm, typical
	- MCS=8, NSS1	PER @ -65 dBm, typical

Receive Sensitivity (11ac,40MHz) @10% PER	- MCS=0, NSS1 PER @ -85 dBm, typical
	- MCS=1, NSS1 PER @ -82 dBm, typical
	- MCS=2, NSS1 PER @ -80 dBm, typical
	- MCS=3, NSS1 PER @ -77 dBm, typical
	- MCS=4, NSS1 PER @ -74 dBm, typical
	- MCS=5, NSS1 PER @ -69 dBm, typical
	- MCS=6, NSS1 PER @ -68 dBm, typical
	- MCS=7, NSS1 PER @ -67 dBm, typical
	- MCS=8, NSS1 PER @ -62 dBm, typical
	- MCS=9, NSS1 PER @ -58 dBm, typical
Receive Sensitivity (11ac,80MHz) @10% PER	- MCS=0, NSS1 PER @ -82 dBm, typical
	- MCS=1, NSS1 PER @ -79 dBm, typical
	- MCS=2, NSS1 PER @ -77 dBm, typical
	- MCS=3, NSS1 PER @ -73 dBm, typical
	- MCS=4, NSS1 PER @ -70 dBm, typical
	- MCS=5, NSS1 PER @ -67 dBm, typical
	- MCS=6, NSS1 PER @ -65 dBm, typical
	- MCS=7, NSS1 PER @ -63 dBm, typical
	- MCS=8, NSS1 PER @ -59 dBm, typical
	- MCS=9, NSS1 PER @ -55 dBm, typical
Maximum Input Level	802.11a/n/ac : -20 dBm
Antenna Reference	Small antennas with 0~2 dBi peak gain

5.2 5GHz(20MHz) Channel table

Band GHz	Operating Channe Numbers	Channel center frequencies(MHz)
5.15GHz~5.25GHz	36	5180
	40	5200
	44	5220
	48	5240
5.25GHz~5.35GHz	52	5260
	56	5280
	60	5300
	64	5320
5.5GHz~5.7GHz	100	5500
	104	5520
	108	5540
	112	5560
	116	5580
	120	5600
	124	5620
	128	5640
	132	5660
	136	5680
	140	5700
5.725GHz~5.825GHz	149	5745
	153	5765
	157	5785
	161	5805
	165	5825

5.3 Bluetooth Section:

Feature	Description		
General Specification			
Bluetooth Standard	Bluetooth V4.2 of 1, 2 and 3 Mbps.		
Host Interface	UART		
Antenna Reference	Small antennas with 0~2 dBi peak gain		
Frequency Band	2402 MHz ~ 2480 MHz		
Number of Channels	79 channels		
Modulation	FHSS, GFSK, DPSK, DQPSK		
RF Specification			
	Min.	Typical.	Max.
Output Power (Class 1.5)		10 dBm	
Output Power (Class 2)		2 dBm	
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-89 dBm	
Sensitivity @ BER=0.01% for π/4-DQPSK (2Mbps)		-86 dBm	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-83 dBm	
Maximum Input Level	GFSK (1Mbps):-20dBm		
	π/4-DQPSK (2Mbps) :-20dBm		
	8DPSK (3Mbps) :-20dBm		

6. Electrical Characteristics

A. Power requirements

symbol	Parameter	Minimum	Typical	Maximum	Units
VCC	3.3V supply voltage	3.135	3.3	3.465	V
VDDIO	I/O supply voltage	1.71	1.8 or 3.3	3.46	V
Current	3.3V rating current	--	--	1000	mA

B. Power Consumption

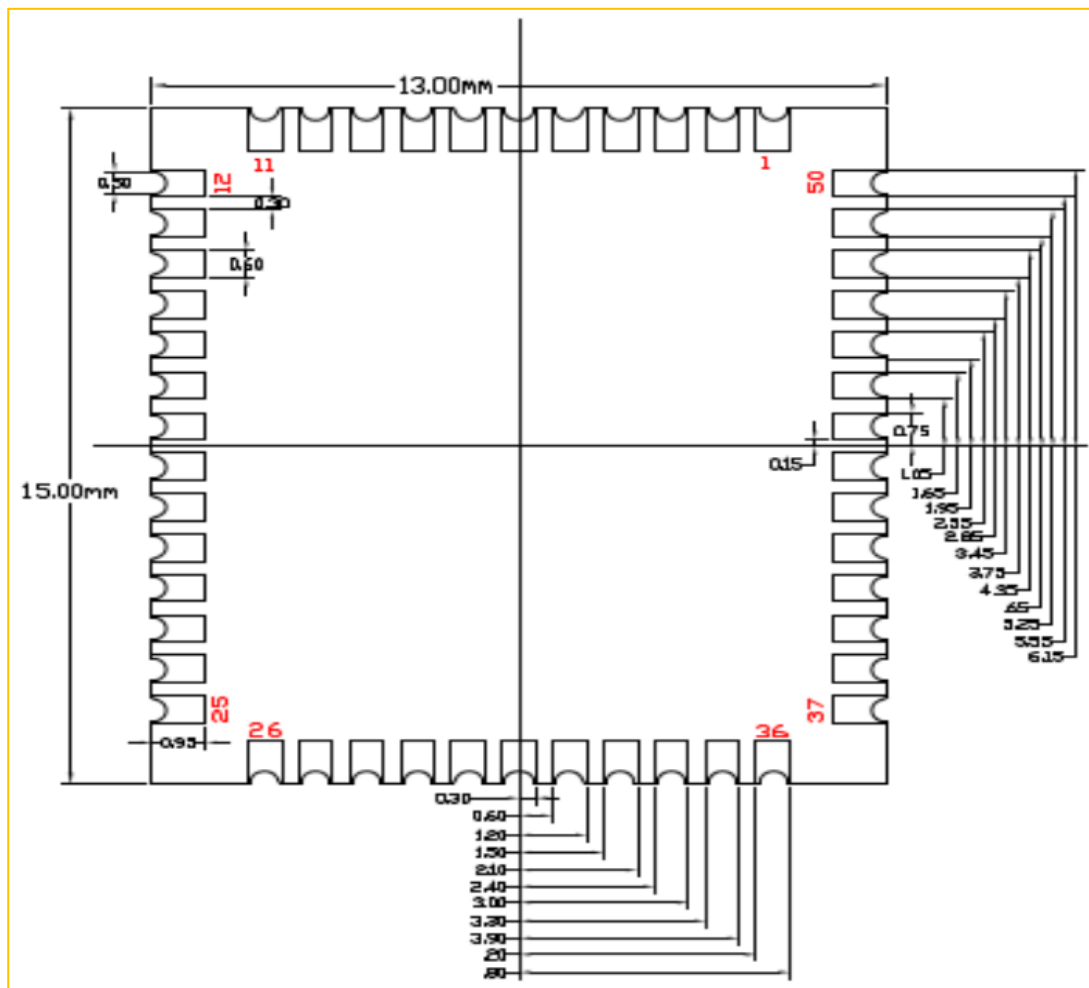
*Note1: Measurement duration condition by 10 sec

*Note2: SD_CLK=200MHz

*Note3: Non-Associated idle Scan Period=1 min

(Unit:mA@3.3V)			BT			
WLAN			Disable	Idle	FTP TX	FTP RX
Non-Associated idle			13.8			
Associated idle	DTIM=1	5GHz	4		--	--
		2.4GHz	6		--	--
WoWLAN	DTIM=1	5GHz	2.7			
		2.4GHz	4.8			
Radio off			NA		--	--
Disable			1.1		--	--
		Throughput(Mbps)				
Transmit@VHT80,11ac		514	562		--	--
Receive@VH80,11ac		550	312		--	--
Transmit@VHT40,11ac		270	570		--	--
Receive@VH40,11ac		250	248		--	--
Transmit@VHT20,11ac		129	589		--	--
Receive@VH20,11ac		127	210		--	--
Transmit@HT40,11n		214	615		--	--
Receive@H40,11n		220	235		--	--
Transmit@HT20,11n		110	578		--	--
Receive@H20,11n		107	187		--	--
Transmit@54M (g mode)		29	322		--	--
Receive@54M,11n (g mode)		26	192		--	--
Transmit@11M,11n (b mode)		5	328		--	--
Receive@11M,11n (b mode)		5	220		--	--

7. Footprint Dimension



8.Pin Description

NO.	Name	Type	Description
1	GND	—	Ground connections
2	ANT0	I/O	WL_RF I/O port chain0
3	GND	—	Ground connections
4	GND	—	Ground connections
5	GND	—	Ground connections
6	GND	—	Ground connections
7	GND	—	Ground connections
8	GND	—	Ground connections
9	ANT1	I/O	WL_RF I/O port chain1
10	GND	—	Ground connections
11	GND	—	Ground connections
12	ANT2	I/O	BT_RF_IN/OUT(NonSharedAnt-BT)
13	GND	—	Ground connections
14	NC	—	No connect
15	WL_REG_ON	I	WL_EN(GPIO15)
16	WL_WAKE_HOST	O	WLAN wake host (GPIO10)
17	SDIO_CMD	I/O	SDIO command line
18	SDIO_CLK	I/O	SDIO CLK
19	SDIO_DATA_3	I/O	SDIO DATA3
20	SDIO_DATA_2	I/O	SDIO DATA2
21	SDIO_DATA_0	I/O	SDIO DATA0
22	SDIO_DATA_1	I/O	SDIO DATA1
23	GND	—	Ground connections
24	SDIO_INTERRUPT	I	SDIO interrupt signal (GPIO10)

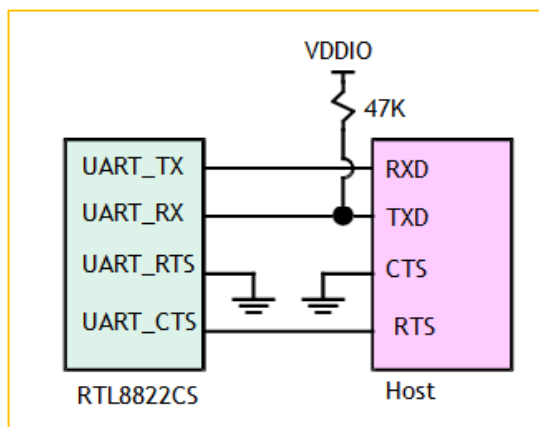
25	NC	—	No connect
26	NC	—	No connect
27	PCM_SYNC	I/O	PCM sync signal
28	PCM_IN	I	PCM DATA INPUT
29	PCM_OUT	I	PCM DATA OUTPUT
30	PCM_CLK	I/O	PCM CLK
31	LPO	—	No connect
32	GND	—	Ground connections
33	NC	—	No connect
34	VDDIO	P	I/O Voltage supply input 1.8V or 3.3V
35	NC	—	No connect
36	VCC	P	3.3V INPUT
37	NC	—	No connect
38	BT_REG_ON	—	BT_EN(GPIO11)
39	GND	—	Ground connections
40	UART_TXD	O	Bluetooth UART interface
41	UART_RXD	I	Bluetooth UART interface
42	UART_RTS_N	O	Bluetooth UART interface
43	UART_CTS_N	I	Bluetooth UART interface
44	SD_RESET	—	No connect
45	NC	—	No connect
46	GND	—	Ground connections
47	NC	—	No connect
48	GND	—	Ground connections
49	HOST_WAKE_BT	—	HOST_WAKE_BT(GPIO13)

50	BT_WAKE_HOST	O	BT_WAKE_HOST (GPIO14)
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9.Schematic design guide

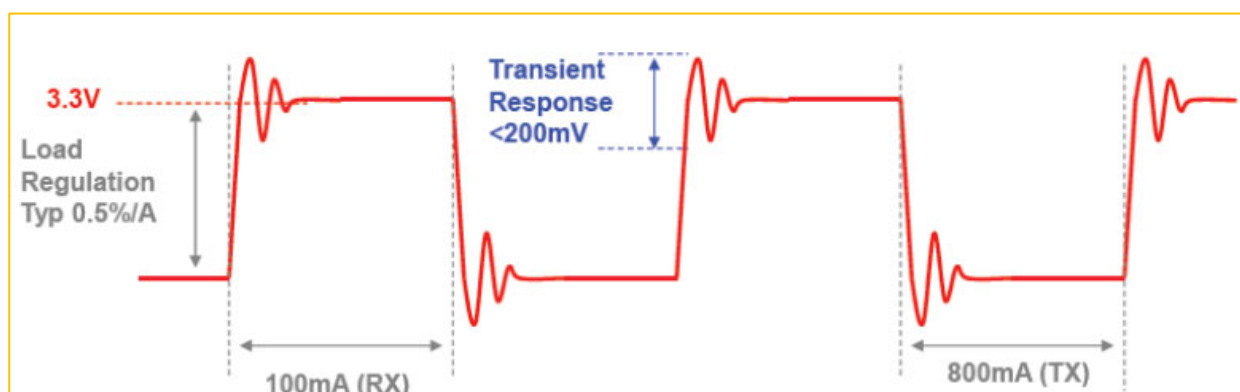
Schematics are long-term confidential information

1. RF reserves C-L-C components for impedance matching fine tuning.
2. SDIO 3.0: VDDIO connects 1.8V.
3. Pull high resistance is reserved for SDIO signal line.
4. BT HCI is the UART interface, the connection is as follows, UART_RX is recommended to add Pull High resistor.



SCH - 3.3V Source Transient Requirements

- Module 3.3V power supply requires a dedicated voltage regulator and cannot be shared with other circuits.
- Line regulation: 0.05%. Load Regulation: 0.5%
- Transient response: Transient chopping amplitude of 100/800mA step load variation should be less than 200mVpp, and transient chopping should be stable within 3 natural frequency response periods.
- Regulator noise and stability: It is necessary to confirm that the regulator has no abnormal noise or low frequency oscillation that is difficult to observe.



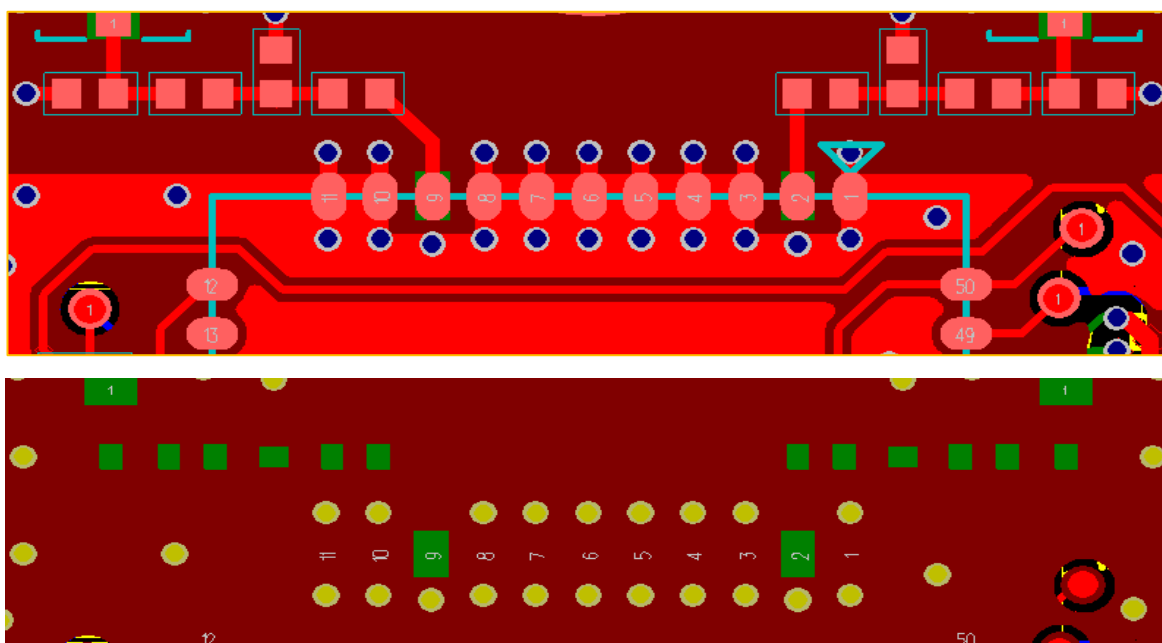
10.PCB design guide

- The following table provides recommendations for the layout of the 2-layer, 4-layer, and 6-layer PCBs.
- Except the 2-layer board, Layer 2 must be a full GND, providing a complete reference ground for the RF trace of Layer 1 and isolating noise from other layers.
- The characteristic impedance of the RF trace must be 50 +/- 10% ohms. Please ask the board supplier to provide a dicing report to confirm compliance.

Layer	Layer 2 Design Advice	Layer 4Design Advice	Layer 6 Design Advice
Layer 1	Component placement / RF signal routing	Component placement / RF signal routing	Component placement / RF signal routing
Layer 2	GND/Power supply	GND	GND

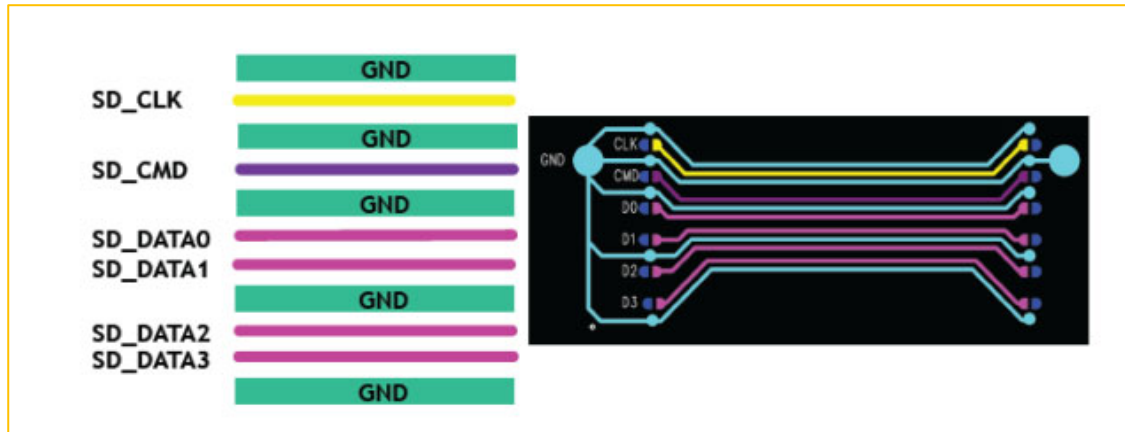
Layer 3	X	Power supply/signal routing	Analogy power supply/signal routing
Layer 4	X	Power supply/signal routing/GND	GND
Layer 5	X	X	Digital power supply/signal routing
Layer 6	X	X	GND

- The characteristic impedance of the RF signal traces must be 50 ohm.
- 4L PCB RF foot Pad must keep out $\geq 10\text{mil}$ in the TOP layer, and for Pad with larger width (≥ 1.3 times line width), the GND of L2 just under it must be hollowed out with equal area, as shown below.
- 2L PCB RF wire must be covered with copper foil, and the copper spacing is recommended to be 4mil



- 3.3V voltage regulator supply to the module, power supply pin routing should be as thick as possible and short circuit resistance should be as much as possible $< 0.05\text{ ohm}$.
- 10uF power supply capacitance must be placed close to the module pin.
- SDIO traces:
 1. Keep the characteristic impedance of SDIO traces $\sim 50\text{ ohm}$.
 2. The traces(CLK, CMD, D0~D3) difference shall be kept $\pm 100\text{ mil}$, the total length shall be < 2.5 inches.
 3. All traces shall go along with the reference GND, and there must be no shunt stubs on those traces.
 4. There must be less than 4 via on each signal trace(CLK, CMD, D0~D3).

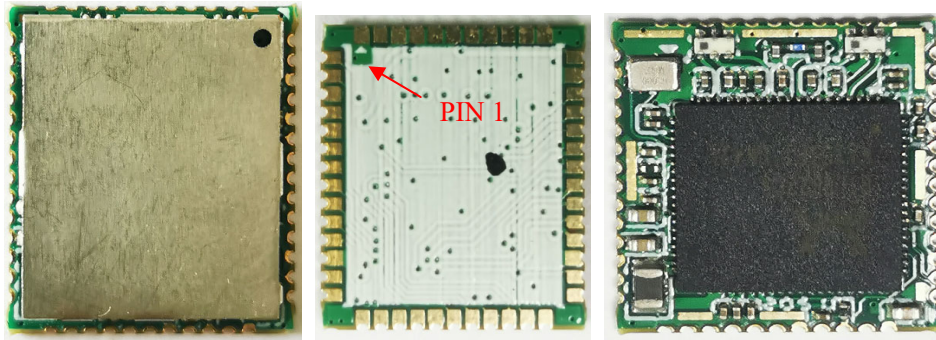
5. Keep the CLK trace away from CMD and DATA traces and have it go along (better shielded) with GND track.
6. For 2L PCB, it is better to have GND traces. The end points of both ends of this GND line must be connected directly to the GND of the module and Host.



11.Supplier

Secondary supplier list	
Material name	Supplier brand
Wifi IC	Realtek
Crystal	TKD , TXC
PCBA	A, O, S, I
Diplexer	TDK, ACX, Walsin, GLEAD, Sunlord
Power inductance	Sunlord, CHILISIN, SAMWHA
Capacitance	SAMSUNG /EYANG
Resistance	UniOhm /YAGEO/Walsin

12.Module Photo

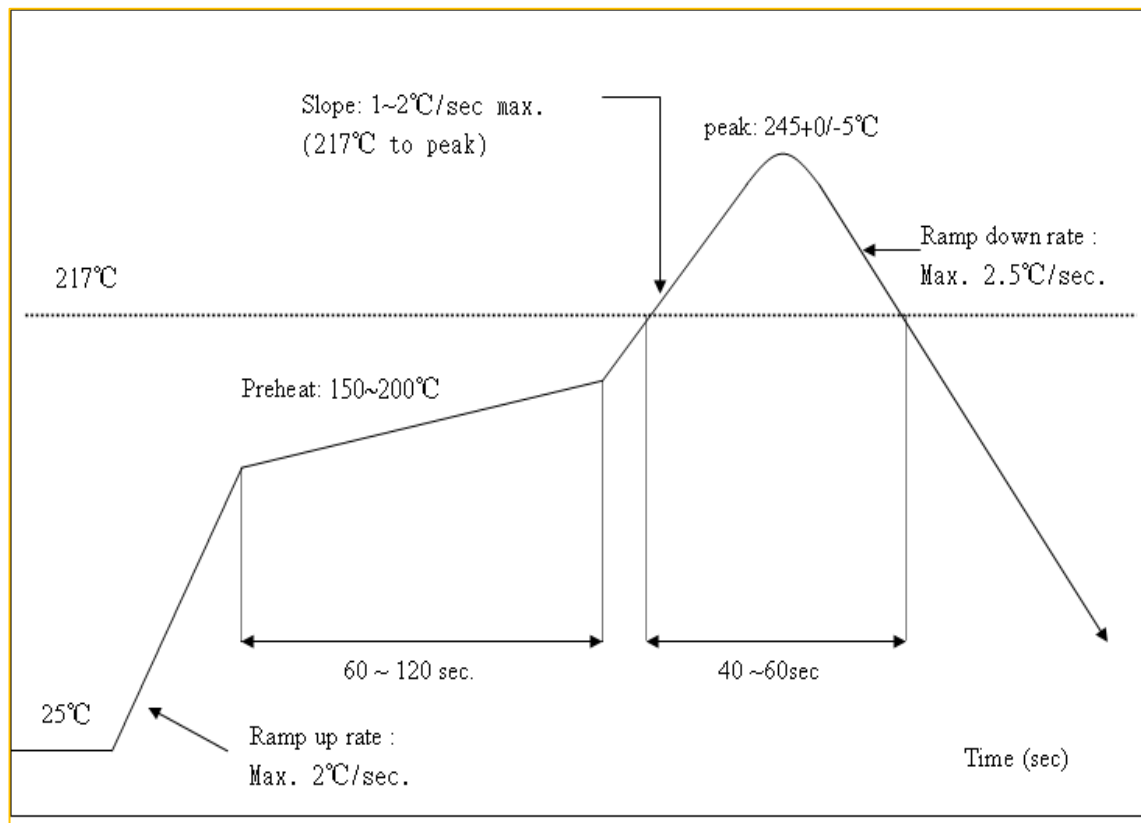


13.Recommended Reflow Profile

Referred IPC/JEDEC standard.

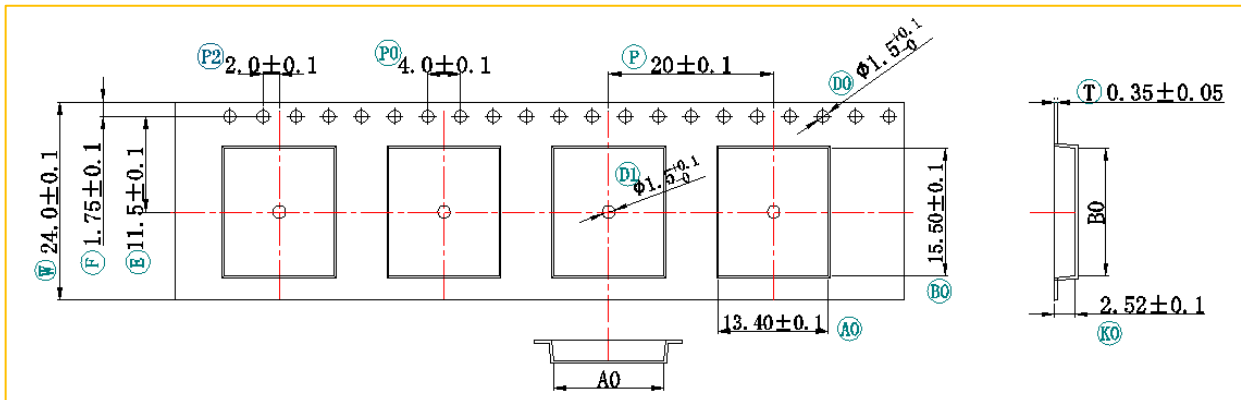
Peak Temperature : <250- C

Number of Times : 2 times

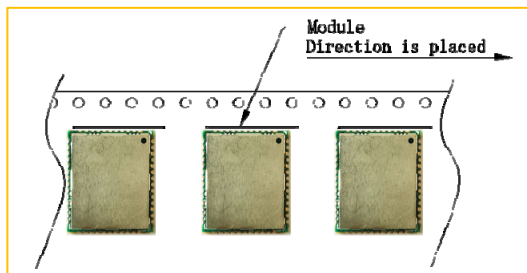


14.Packing information

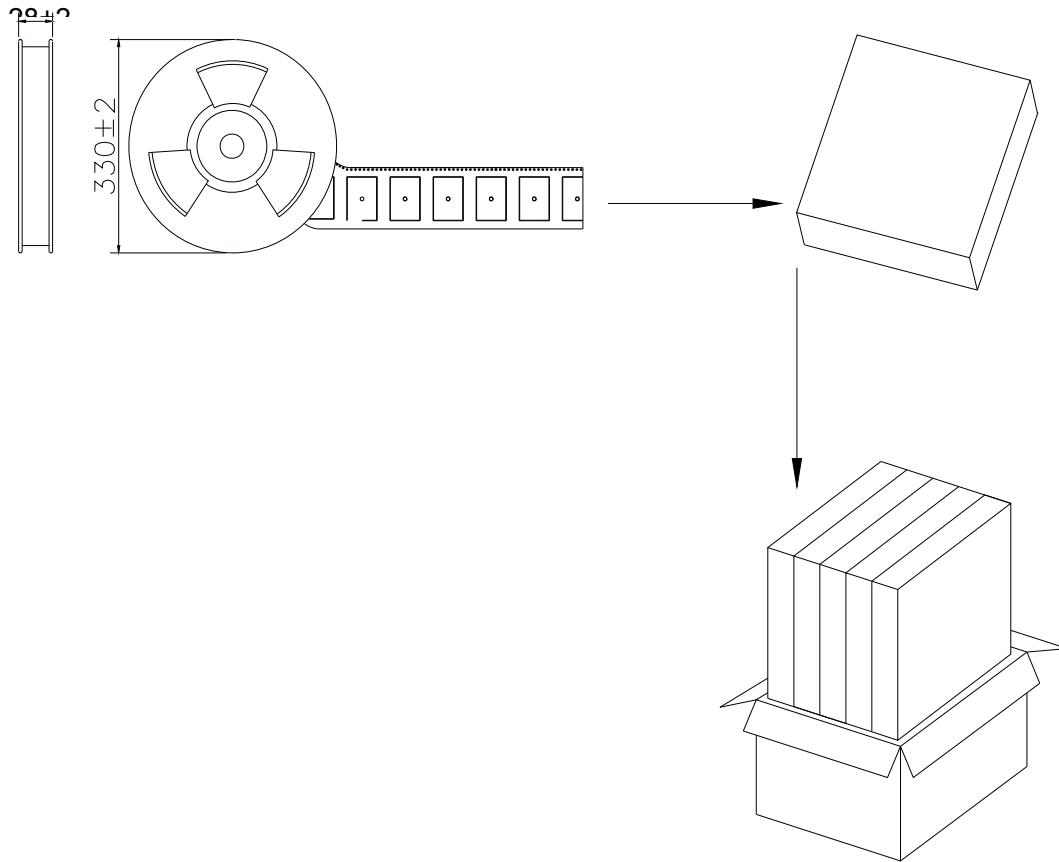
14.1 Carrier size Detail:



14.2 Packaging Detail:

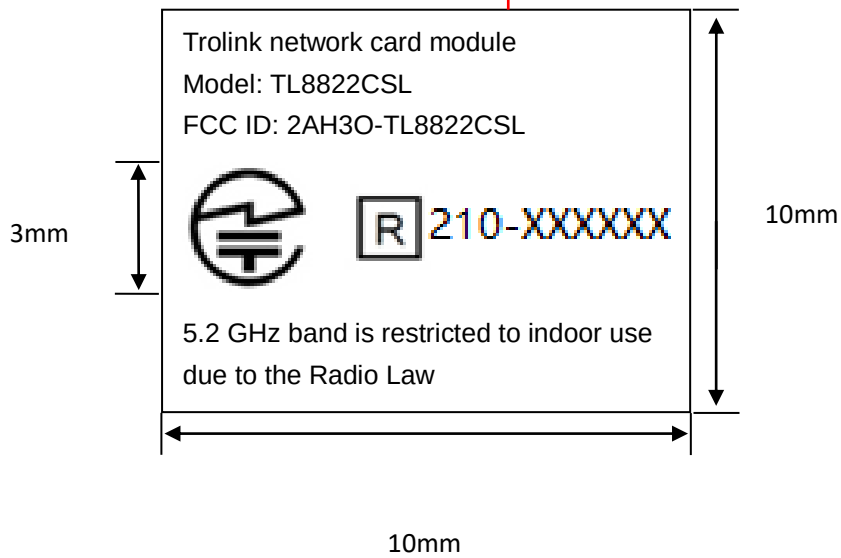
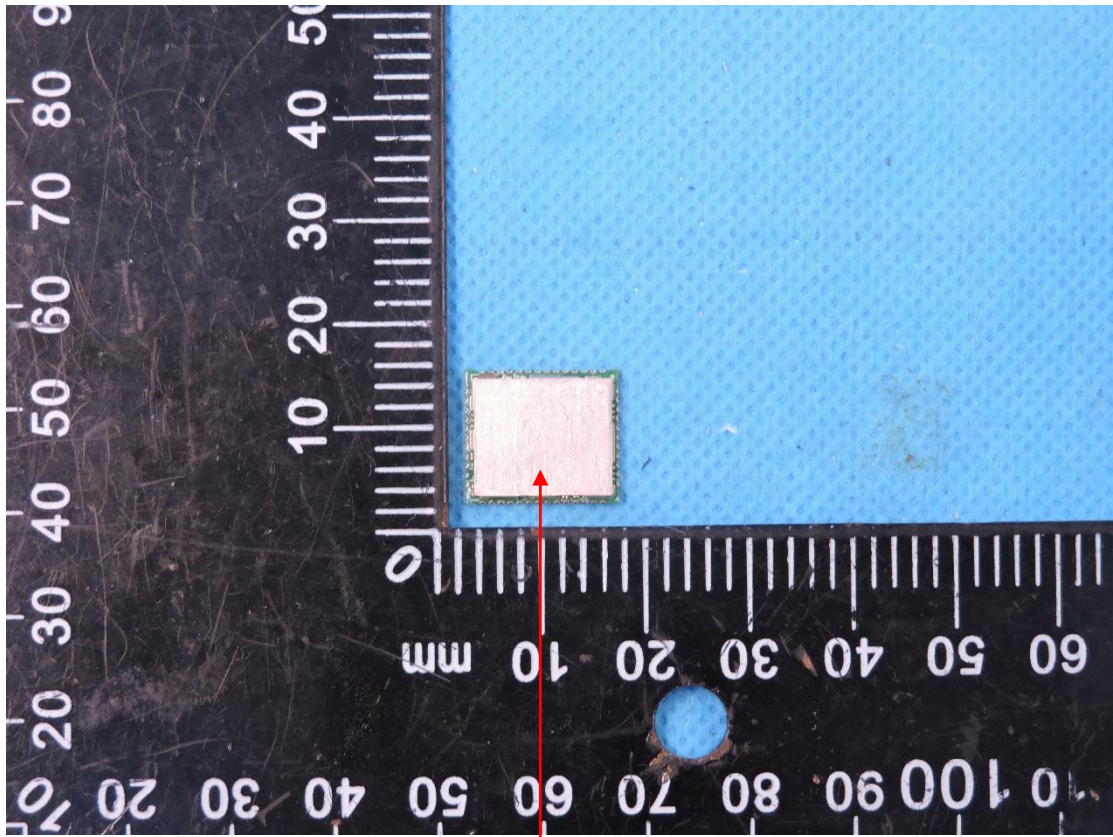


8.Package



ESD CAUTION

The D1822CS-00 is ESD (electrostatic discharge) sensitive device and may be damaged with ESD or spike voltage. Although A1_8822CS is with built-in ESD protection circuitry, please handle with care to avoid the permanent malfunction or the performance degradation.



Black font on a white label

Antenna Specification

Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
Rapsodo	TL8822CSL	Dipole	N/A	2.4G: 2dBi, 5G: 4.3dBi	WIFI/BT Antenna

FCC Statement

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.

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.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:
"Contains Transmitter Module FCC ID: 2AH3O-TL8822CSL Or Contains FCC ID: 2AH3O-TL8822CSL"

When the module is installed inside another device, the user manual of the host must contain below warning statements;

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.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

Any company of the host device which install this modular with Single modular approval should perform the test of radiated emission and 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.

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.

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) 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 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 a limited module, Refer to the manual for detailed instructions.

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

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: 2AH30-TL8822CSL.

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

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: 2AH3O-TL8822CSL."

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.