1. Level 1 Environment-related Substances should NEVER be used.
2. Purchase ink, paint, wire rods, and molding resins only from the business partners
   that Sony approves as Green Partners.
3. Recycled Resin and Coated Wire should be procured from Green Partners

Draft Approval Sheet

IEEE802.11a/b/g/n/ac (1x1)+BT 5.0 Combo Module

Project Name	CYW4373 Wi-Fi & BT Combo module
Customer Part No.	TBD
Approval Sheet Rev.	0.3
Foxconn Part No.	T99H209

Prepared by	Reviewed by	Approved by
Rachel Wu	Robin Xu	Changfu Lin

Revision History

Date	Revision	Description
2020/05/29	0.1	Initial release (draft version)
2020/09/02	0.2	1. Add module country of origin and manufacturing plant information. 2. Update BT from BT4.2 to BT5.0 3. Update temperature and humidity define and Logic Characteristics4. Add section 2.4 for current consumption 5. Add indicate description for access timing of SDIO in section 2.6 6. Update schematic design (add 10pF for SDIO CMD&DATA line, change XTAL series RES R13 from 0ohm to 220ohm, change C84 from 10uF to 22uF). 7. Update layout (V025 layout only change C4,C5 from 0603 to 0402 size to avoid material shortage). 8. Update Module Laser Marking Information (use T99H209 as part number instead of specific nameT99H209.03) 9. Update NVRAM content for PA parameters in section 6 10. Update reliability test condition based on customer's new requirement for temperature and humidity in section 9.
2020/09/12	0.3	1.Remove hatched area from BTB connector (page31)

Content

1. Introduction

The T99H209.00 WLAN/BT module is IEEE802.11a/b/g/n/ac compatible, Bluetooth 5.0 compatible ,This module is based on Broadcom CYW4373IUBGT solution that integrated single-stream IEEE 802.11a/b/g/n/ac MAC/baseband/radio and Bluetooth5.0 (Basic Rate, Enhanced Data Rate and Bluetooth Low Energy) , it is designed with SDIO2.0 for WLAN and a high-speed 4-wire UART for BT as host interface. It supports below function:

1. WLAN 1x1 IEEE802.11a/b/g/n/ac supported

    - BW for 2.4GHz:

        11b/g/n: 20MHz, 40MHz

    - BW for 5GHz:

        11a/n: 20MHz, 40MHz
        11ac: 20MHz, 40MHZ, 80MHz

    - Data rate
        802.11b is up to 11Mbps
        802.11g is up to 54Mbps
        802.11n HT20 is up to 65Mbps with 800ns GI and up to 72.2Mbps with 400ns GI
        802.11n HT40 is up to 135Mbps with 800ns GI and up to150Mbps with 400ns GI
        802.11ac VHT20 is up to 78Mbps with 800ns GI and up to 86.7Mbps with 400ns GI
        802.11ac VHT40 is up to 180Mbps with 800ns GI and up to 200Mbps with 400ns GI
        802.11ac VHT80 is up to 390Mbps with 800ns GI and up to 433.3Mbps with 400ns GI

2. Bluetooth 5.0 (Low Energy support)

    - BR/EDR/BLE supported

    - HS not supported

    - Bluetooth Class 1.5

    - BT5.0 features

        - LE Secure Connections to enable secure connection establishment using the Elliptic-Curve
          Diffie-Hellman algorithm
        - LE Privacy 1.2 to enable low-power private address resolution
        - LE Data Length Extension to support longer Bluetooth Low Energy packets

    - Only support BT5.0 LE data rate , Not support 2LE,500KLE,125KLE data rate.

3. Functional block diagram of module

    This module is designed to BTB host connect (2x8pin) with Cypress CYW4373IUBGT chipset. It's a highly integrated single chip which features IEEE802.11a/b/g/n/ac (1x1) dual-band Wi-Fi subsystem and Bluetooth 5.0 subsystem(BT share same front-end path as Wi-Fi 2.4 GHz), one PCB printing antenna for WiFi 2.4GHz & 5GHz and BT. The module typical dimension is 23mm x32mm x 3mm (NOT including BTB host connector height)

2. Electrical Specification

2.1 Absolute Maximum Rating

These specifications indicate levels where permanent damage to the device can occur. Functional operation is not guaranteed under these conditions. Operation at absolute maximum conditions for extended can adversely affect long-term reliability of the device.

Symbol	Condition	Min.	Typ.	Max	Unit
3.3V	Respect to GND	-0.5	3.3	3.9	V
Max Ripple on Supplied Voltage	3.3V	--	--	330[1]	mVpp
ESD Limit Level	HBM	--	--	+/-2000	V
	CDM	--	--	+/-200	V
Operating Temperature	--	-15	25	60	℃
Operating Humidity	--	0		90	%
Storage Temperature	--	-20	25	85	℃
Storage Humidity	--	0		90	%

*[1] with AC noise 350KHz/500KHz/535KHz/2.2MHz/24MHz/33MHz/41MHz and increase the Vpp till module performance degrade, however the module performance still not degrade even increase the Vpp over 10%,so define the max spec. for Vpp is 10% @operation voltage.

2.2 Recommended Operating Condition

Function operation is not guaranteed outside this limit, and operation outside this limit for extended period can adversely affect long-term reliability of the device.

Symbol	Condition	Min.	Typ.	Max	Unit
3.3V	Respect to GND	3.135	3.3	3.465	V

2.3 Logic Characteristics

Digital I/O Pins –VDDIO_3.3V

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IH}	Input high voltage	2	--	3.465	V
V_{IL}	Input Low voltage	--	--	0.8	V
V_{OH}	Output high voltage	VDDIO-0.4	--	3.465	V
V_{OL}	Output Low voltage	--	--	0.4	V

DC Electricals - VDDIO_RF_3.3V

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{OH}	Output high voltage	VDDIO-0.4	--	3.465	V
V_{OL}	Output Low voltage	--	--	0.4	V

2.4 Current Consumption

Testing condition:
 1.The current testing is just measured by 3.3V @ 25° C.
 2. The current measured by KEYSIGHT 6705C

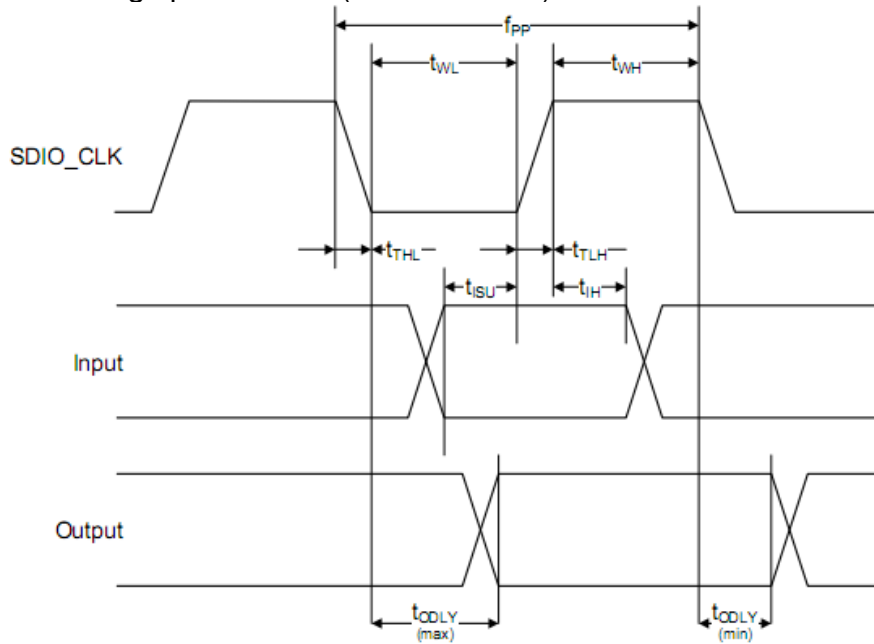| Condition		Voltage	Current consumption		Unit
			RMS	Peak	
WiFi 2.4G +BT current 2.4G TX: CCK-11Mbps_17dBm 2.4G RX:11n HT40 MCS7 BT load FW only	WLAN 2.4G-TX	3.3V	TBD	800	mA
	WLAN 2.4G-RX	3.3V	TBD	800	
WiFi 5G +BT current 5G TX: VHT80_MCS0_14dBm 5G RX:11ac VHT80 MCS9 BT TX: DH5_4dBm BT RX: 3DH5	WLAN 5G-TX + BT TX	3.3V	TBD	800	
	WLAN 5G-RX + BT RX	3.3V	TBD	800	
	WLAN 5G-TX + BT RX	3.3V	TBD	800	
	WLAN 5G-RX + BT TX	3.3V	TBD	800	

2.5 Host Interface Specification

2.5.1 SDIO 2.0 Characteristics

The SDIO interface supports all of the SDIO version 2.0 modes:

DS: Default speed (DS) up to 25 MHz, including 1- and 4-bit modes (3.3 V signaling).

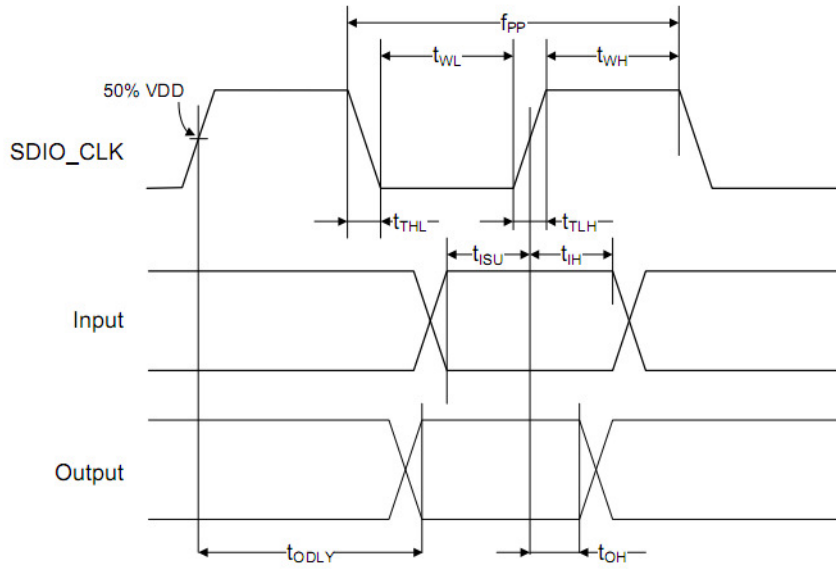HS: High speed up to 50 MHz (3.3 V signaling)

2.5.1.1 SDIO bus timing specification (Default Mode)

Parameter	Symbol	Min	Typ	Max	Unit
SDIO CLK (All values are referred to minimum VIH and maximum VIL[2])					
Frequency – Data Transfer mode	f_{PP}	0	–	25	MHz
Frequency – Identification mode	f_{OD}	0	–	400	kHz
Clock low time	t_{WL}	10	–	–	ns
Clock high time	t_{WH}	10	–	–	ns
Clock rise time	t_{TLH}	–	–	10	ns
Clock low time	t_{THL}	–	–	10	ns
Inputs: CMD, DAT (referenced to CLK)					
Input setup time	t_{ISU}	5	–	–	ns
Input hold time	t_{IH}	5	–	–	ns
Outputs: CMD, DAT (referenced to CLK)					
Output delay time – Data Transfer mode	t_{ODLY}	0	–	14	ns
Output delay time – Identification mode	t_{ODLY}	0	–	50	ns

1. Timing is based on CL ≤ 40 pF load on CMD and Data.
2. Min (VIH) = 0.7 × VDDIO and max (VIL) = 0.2 × VDDIO.
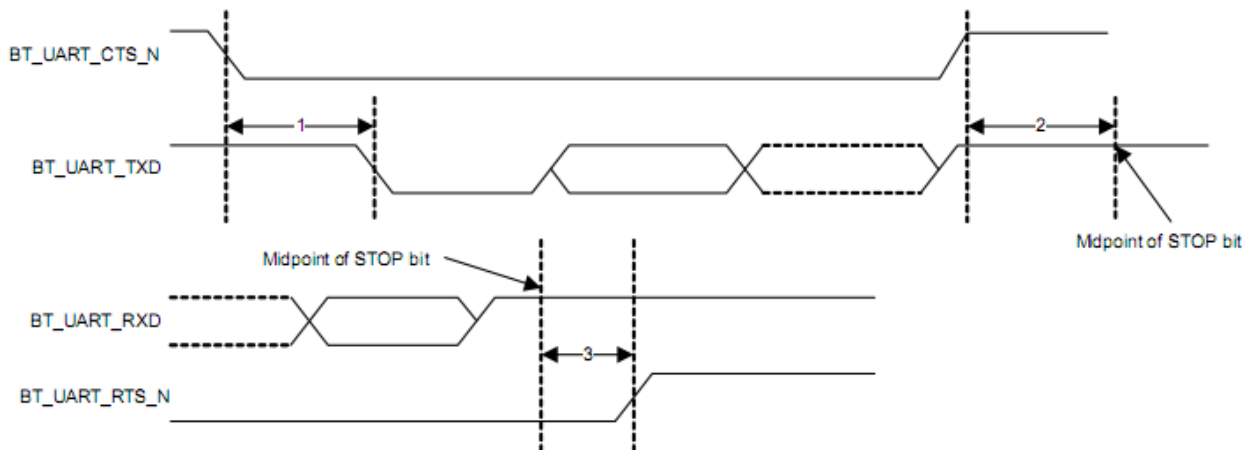
2.5.1.2 SDIO bus timing specification (High-Speed Mode)

Parameter	Symbol	Min	Typ	Max	Unit
SDIO CLK (all values are referred to minimum VIH and maximum VIL[2])					
Frequency – Data Transfer Mode	f_{PP}	0	–	50	MHz
Frequency – Identification Mode	f_{OD}	0	–	400	kHz
Clock low time	t_{WL}	7	–	–	ns
Clock high time	t_{WH}	7	–	–	ns
Clock rise time	t_{TLH}	–	–	3	ns
Clock low time	t_{THL}	–	–	3	ns
Inputs: CMD, DAT (referenced to CLK)	–	–	–	–	–
Input setup Time	t_{ISU}	6	–	–	ns
Input hold Time	t_{IH}	2	–	–	ns
Outputs: CMD, DAT (referenced to CLK)	–	–	–	–	–
Output delay time – Data Transfer Mode	t_{ODLY}	–	–	14	ns
Output hold time	t_{OH}	2.5	–	–	ns
Total system capacitance (each line)	CL	–	–	40	pF

1. Timing is based on CL ≤ 40 pF load on CMD and Data.
2. Min (VIH) = 0.7 × VDDIO and max (VIL) = 0.2 × VDDIO.

2.5.2 UART Characteristics

The UART is a standard 4-wire interface (RX, TX, RTS, and CTS) with adjustable baud rates from 9600 bps to 4.0 Mbps. The interface features an automatic baud rate detection capability that returns a baud rate selection.
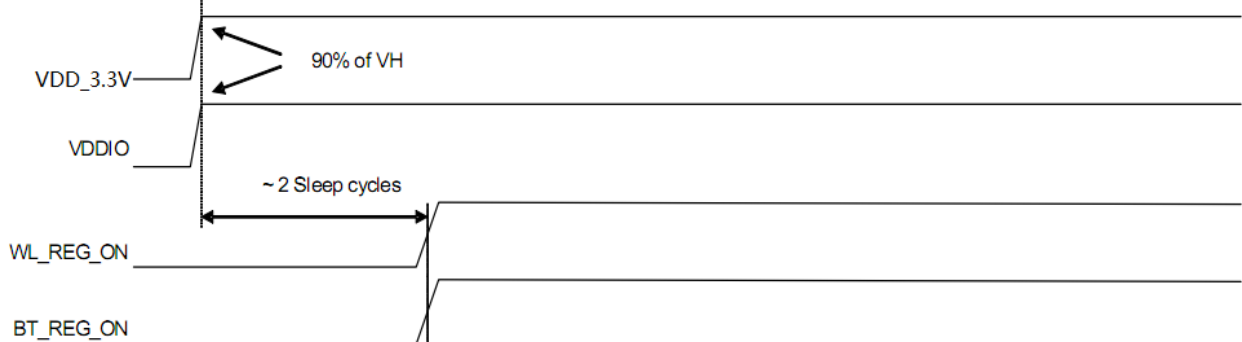
UART timing specification:

Ref	Characteristics	Min	Typ	Max	Unit
1	Delay time, BT_UART_CTS_N low to BT_UART_TXD valid	–	–	1.5	Bit periods
2	Setup time, BT_UART_CTS_N high before midpoint of stop bit	–	–	0.5	Bit periods
3	Delay time, midpoint of stop bit to BT_UART_RTS_N high	–	–	0.5	Bit periods

2.6 Power up sequence

- VDD_3.3V should not rise 10%–90% faster than 40 microseconds.
- VDd_3.3V should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high
- The CYW4373 has an internal POR circuit. The device will be held in reset for a maximum of 110 ms after VDDC and VDDIO have both passed the POR threshold. Wait at least 150 ms after VDDC and VDDIO are available before initiating SDIO accesses.

2.7 WiFi RF Specification

2.7.1 IEEE802.11b Mode

Radio Technology	Direct Sequence Spread Spectrum (DSSS)
Operating Frequency	2412 ~ 2462MHz
Modulation Schemes	DQPSK, DBPSK and CCK
Channel Numbers	13 channels
Data Rate	1Mbps , 2Mbps, 5.5Mbps and 11Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	17 +/-1.5dBm for all data rate.
Frequency Accuracy	+/-25ppm
Minimum Receiver Sensitivity Level (*1)	1Mbps ≤ -91dBm @ 8% PER 2Mbps ≤ -88dBm @ 8% PER 5.5Mbps≤ -85dBm @ 8% PER 11Mbps ≤ -83dBm @ 8% PER
Maximum Receiver Sensitivity Level	1Mbps, 2Mbps ≥ -4 dBm @ 8% PER 5.5Mbps, 11Mbps ≥ -10 dBm @ 8% PER
EVM(peak)	1Mbps ≤ -9.11dB 2Mbps ≤ -9.11dB 5.5Mbps ≤ -9.11dB 11Mbps ≤ -9.11dB

2.7.2 IEEE802.11g Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	2412 ~ 2462MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM
Channel Numbers	13 channels
Data Rate	6 , 9, 12, 18, 24, 36, 48, and 54Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	15+/-1.5dBm for all data rate.
Frequency Accuracy	+/-25ppm
Minimum Receiver Sensitivity Level (*1)	6Mbps≤ -88dBm@ 10% PER 9Mbps≤ -86dBm@ 10% PER 12Mbps≤ -84dBm@ 10% PER 18Mbps≤ -82dBm@ 10% PER 24Mbps≤ -79dBm@ 10% PER 36Mbps≤ -75dBm@ 10% PER 48Mbps≤ -71dBm@ 10% PER 54Mbps ≤ -70dBm@ 10% PER

Maximum Receiver Sensitivity Level	≥ –20dBm @ 10% PER
EVM	6Mbps ≤ –5dB
	9Mbps ≤ –8dB
	12Mbps ≤ –10dB
	18Mbps ≤ –13dB
	24Mbps ≤ –16dB
	36Mbps ≤ –19dB
	48Mbps ≤ –22dB
	54Mbps ≤ –25dB

2.7.3 IEEE802.11n (HT20) Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	2412 ~ 2462MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM
Channel Numbers	13 channels
Data Rate	HT20 MCS0~MCS7
	800ns GI: 6.5, 13, 19.5, 26, 39, 52, 58.5 and 65Mbps
	400ns GI: 7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65.0 and 72.2Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	14 +/-1.5dBm for all data rate
Frequency Accuracy	+/-25ppm
Minimum Receiver Sensitivity Level (*1)	MCS0 ≤ -88dBm@ 10% PER
	MCS1 ≤ -85dBm@ 10% PER
	MCS2 ≤ -83dBm@ 10% PER
	MCS3 ≤ -80dBm@ 10% PER
	MCS4 ≤ -76dBm@ 10% PER
	MCS5 ≤ -72dBm@ 10% PER
	MCS6 ≤ -71dBm@ 10% PER
	MCS7 ≤ -70dBm@ 10% PER
Maximum Receiver Sensitivity Level	≥ –20dBm @ 10% PER
EVM	MCS0 ≤ -5dB
	MCS1 ≤ -10dB
	MCS2 ≤ -13dB
	MCS3 ≤ -16dB
	MCS4≤ -19dB
	MCS5 ≤ -22dB
	MCS6 ≤ -25dB
	MCS7 ≤ -27dB

2.7.4 IEEE802.11n (HT40) Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	2422 ~ 2462MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM
Channel Numbers	9 channels
Data Rate	HT40 MCS0~MCS7 800ns GI: 13.5, 27, 40.5, 54, 81, 108, 121.5 and 135Mbps 400ns GI: 15, 30, 45, 60, 90, 120, 135 and 150Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	13 +/-1.5dBm for all data rate
Frequency Accuracy	+/-25ppm
Minimum Receiver Sensitivity Level (*1)	MCS0 ≤ -85dBm@ 10% PER MCS1 ≤ -82dBm@ 10% PER MCS2 ≤ -80dBm@ 10% PER MCS3 ≤ -77dBm@ 10% PER MCS4 ≤ -73dBm@ 10% PER MCS5 ≤ -69dBm@ 10% PER MCS6 ≤ -68dBm@ 10% PER MCS7 ≤ -67dBm@ 10% PER
Maximum Receiver Sensitivity Level	≥ –20dBm @ 10% PER
EVM (Test condition: Enable full packet channel estimate)	MCS0≤ -5dB MCS1≤ -10dB MCS2≤ -13dB MCS3 ≤ -16dB MCS4≤ -19dB MCS5≤ -22dB MCS6 ≤ -25dB MCS7≤ -27dB

2.7.5 IEEE802.11a Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	5180 ~ 5825MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM
Channel Numbers	25 channels
Data Rate	6 ,9, 12, 18, 24, 36, 48, and 54Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	14+/-1.5dBm for 6~48Mbps 13+/-1.5dBm for 54Mbps
Frequency Accuracy	+/-20ppm
Minimum Receiver Sensitivity Level (*1)	6Mbps≤ -87dBm@ 10% PER 9Mbps≤ -86dBm@ 10% PER 12Mbps≤ -84dBm@ 10% PER 18Mbps ≤ -82dBm@ 10% PER 24Mbps ≤ -79dBm@ 10% PER 36Mbps≤ -75dBm@ 10% PER 48Mbps ≤ -71dBm@ 10% PER 54Mbps ≤ -70dBm@ 10% PER
Maximum Receiver Sensitivity Level	≥ –30dBm @ 10% PER
EVM	6Mbps ≤ –5dB 9Mbps ≤ –8dB 12Mbps ≤ –10dB 18Mbps ≤ –13dB 24Mbps ≤ –16dB 36Mbps ≤ –19dB 48Mbps ≤ –22dB 54Mbps ≤ –25dB

2.7.6 IEEE802.11n (HT20) Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	5180~5825MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM
Channel Numbers	25 channels
Data Rate	HT20 MCS0~MS7 800ns GI: 6.5, 13, 19.5, 26, 39, 52, 58.5 and 65Mbps 400ns GI: 7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65.0 and 72.2Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	14 +/-1.5dBm for MCS0~MCS5 13+/-1.5dBm for MCS6 12+/-1.5dbm for MCS7

Frequency Accuracy	+/-20ppm
Minimum Receiver Sensitivity Level (*1)	MCS0 ≤ -87dBm@ 10% PER
	MCS1 ≤ -84dBm@ 10% PER
	MCS2 ≤ -82dBm@ 10% PER
	MCS3 ≤ -79dBm@ 10% PER
	MCS4 ≤ -75dBm@ 10% PER
	MCS5 ≤ -72dBm@ 10% PER
	MCS6 ≤ -71dBm@ 10% PER
	MCS7 ≤ -70dBm@ 10% PER
Maximum Receiver Sensitivity Level	≥ –30dBm @ 10% PER
EVM	MCS0 ≤ -5dB
	MCS1 ≤ -10dB
	MCS2 ≤ -13dB
	MCS3 ≤ -16dB
	MCS4 ≤ -19dB
	MCS5 ≤ -22dB
	MCS6 ≤ -25dB
	MCS7 ≤ -27dB

2.7.7 IEEE802.11n (HT40) Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	5190~5795MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM
Channel Numbers	18channels for all countries
Data Rate	HT40 MCS0~MS7
	800ns GI: 13.5, 27, 40.5, 54, 81, 108, 121.5 and 135Mbps
	400ns GI: 15, 30, 45, 60, 90, 120, 135 and 150Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	13 +/-1.5dBm for MCS0~MCS6
	12+/-1.5dBm for MCS7
Frequency Accuracy	+/-20ppm
Minimum Receiver Sensitivity Level (*1)	MCS0 ≤ -85dBm@ 10% PER
	MCS1 ≤ -82dBm@ 10% PER
	MCS2 ≤ -80dBm@ 10% PER
	MCS3 ≤ -77dBm@ 10% PER
	MCS4 ≤ -73dBm@ 10% PER
	MCS5 ≤ -69dBm@ 10% PER
	MCS6 ≤ -68dBm@ 10% PER
	MCS7 ≤ -67dBm@ 10% PER

Maximum Receiver Sensitivity Level	≥ –30dBm @ 10% PER
EVM (Test condition: Enable full packet channel estimate)	MCS0≤ -5dB
	MCS1≤ -10dB
	MCS2 ≤ -13dB
	MCS3 ≤ -16dB
	MCS4≤ -19dB
	MCS5 ≤ -22dB
	MCS6 ≤ -25dB
	MCS7 ≤ -27dB

2.7.8 IEEE802.11ac (VHT20) Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	5180~5825MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
Channel Numbers	25 channels
Data Rate	VHT20 MCS0~MS8
	800ns GI: 6.5, 13, 19.5, 26, 39, 52, 58.5 ,65 and 78Mbps
	400ns GI: 7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65.0 ,72.2 and 86.7Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	14 +/-1.5dBm for MCS0~MCS5
	13+/-1.5dBm for MCS6
	12+/-1.5dbm for MCS7
	11+/-1.5dbm for MCS8
Frequency Accuracy	+/-20ppm
Minimum Receiver Sensitivity Level (*1)	MCS0 ≤ -87dBm@ 10% PER
	MCS1 ≤ -84dBm@ 10% PER
	MCS2 ≤ -82dBm@ 10% PER
	MCS3 ≤ -79dBm@ 10% PER
	MCS4 ≤ -75dBm@ 10% PER
	MCS5 ≤ -72dBm@ 10% PER
	MCS6 ≤ -71dBm@ 10% PER
	MCS7 ≤ -70dBm@ 10% PER
	MCS8 ≤ -65dBm@ 10% PER
Maximum Receiver Sensitivity Level	≥ –30dBm @ 10% PER
EVM (Test condition: Enable full packet channel estimate)	MCS0≤ -5dB
	MCS1≤ -10dB
	MCS2 ≤ -13dB
	MCS3 ≤ -16dB
	MCS4≤ -19dB

	MCS5≤ -22dB
	MCS6 ≤ -25dB
	MCS7≤ -27dB
	MCS8≤ -30dB

2.7.6 IEEE802.11ac (VHT40) Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	5190~5795MHz ISM band
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
Channel Numbers	18 channels
Data Rate	VHT40 MCS0~MCS9 800ns GI: 13.5, 27, 40.5, 54, 81, 108, 121.5 ,135,162 and 180Mbps 400ns GI: 15, 30, 45, 60, 90, 120, 135 ,150,180 and 200Mbps
Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	13 +/-1.5dBm for MCS0~MCS6 12+/-1.5dBm for MCS7 11+/-1.5dbm for MCS8 10+/-1.5dbm for MCS9
Frequency Accuracy	+/-20ppm
Minimum Receiver Sensitivity Level (*1)	MCS0 ≤ -85dBm@ 10% PER MCS1 ≤ -82dBm@ 10% PER MCS2 ≤ -80dBm@ 10% PER MCS3 ≤ -77dBm@ 10% PER MCS4 ≤ -73dBm@ 10% PER MCS5 ≤ -69dBm@ 10% PER MCS6 ≤ -68dBm@ 10% PER MCS7 ≤ -67dBm@ 10% PER MCS8 ≤ -62dBm@ 10% PER MCS9 ≤ -60dBm@ 10% PER
Maximum Receiver Sensitivity Level	≥ –30dBm @ 10% PER
EVM (Test condition: Enable full packet channel estimate)	MCS0≤ -5dB MCS1≤ -10dB MCS2≤ -13dB MCS3≤ -16dB MCS4≤ -19dB MCS5 ≤ -22dB MCS6≤ -25dB MCS7≤ -27dB MCS8≤ -30dB MCS9 ≤ -32dB

2.7.7 IEEE802.11ac VHT80 Mode

Radio Technology	Orthogonal Frequency Division Multiplexing (OFDM)
Operating Frequency	5210~5775 MHz
Modulation Schemes	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
Channel Numbers	9 channels

Data Rate	VHT80 MCS0~MCS9
	
	800ns GI: 29.3, 58.5, 87.8, 117, 175.5, 234, 263.3 and
	
	        292.5, 351 and 390Mbps
	
	400ns GI: 32.5, 65, 97.5, 130, 195, 260, 292.5, 325, 390,
	        433.3Mbps

Media Access Protocol (MAC)	CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)
Transmitter Output Power	12 +/-1.5dBm for MCS0~MCS7 11 +/-1.5dBm for MCS8 10 +/-1.5dBm for MCS9
Frequency Accuracy	+/-20ppm
Minimum Receiver Sensitivity Level (*1)	MCS0≤ -82dBm@ 10% PER MCS1≤ -79dBm@ 10% PER MCS2≤ -77dBm@ 10% PER MCS3≤ -74dBm@ 10% PER MCS4 ≤ -70dBm@ 10% PER MCS5≤ -66dBm@ 10% PER MCS6 ≤ -65dBm@ 10% PER MCS7 ≤ -64dBm@ 10% PER MCS8 ≤ -59dBm@ 10% PER MCS9≤ -57dBm@ 10% PER
Maximum Receiver Sensitivity Level	≥ –30dBm @ 10% PER
EVM (Test condition: Enable full packet channel estimate)	MCS0≤ -5dB MCS1≤ -10dB MCS2 ≤ -13dB MCS3 ≤ -16dB MCS4≤ -19dB MCS5≤ -22dB MCS6≤ -25dB MCS7≤ -27dB MCS8≤ -30dB MCS9 ≤ -32dB

*1 max spec. for RX SEN include conductive and AIR

2.8 BT RF Specification

BT	Radio Modulation	FHSS
	Operating Frequency	2.402GHz ~ 2.480GHz
	Channel Numbers	79 channels with 1MHz BW
	BDR Transmitter Output Power	4+/-2 dBm
	BDR Power Control	2dB≤Power Control Step≤8dB
	BDR Initial Carrier Freq. Tolerance	≤ ± 75 kHz
	BDR Carrier Frequency Drift	Drift Rate/50us <±20kHz DH1: +/- 25kHz,DH3: +/- 40kHz,DH5: +/- 40kHz
	BDR Modulation Characteristics	140kHz ≤ Δf1avg ≤175kHz Δf2max ≥115kHz Δf2avg/Δf1avg ≥0.8
	BDR Maximum Receiver Signal	>=-20dBm@ BER <= 0.1% at 1Mbps
	BDR Sensitivity(*2)	≤ -85dBm @ BER <= 0.1% at 1Mbps
	EDR Transmitter Output Power	4+/-2 dBm
	EDR Stability and Mod Accuracy	-75 kHz <ωi < 75 kHz -10kHz<ω0 <10kHz RMS DEVM<=0.13 for all 8DPSK @3Mbps Peak DEVM<=0.25 for all 8DPSK @3Mbps 99% DEVM<=0.2 for 99% 8DPSK @3Mbps
	BDR Frequency Range	FL>2.4GHz,FH<2.4835GHz
	EDR Sensitivity (*2)	≤ -85dBm @BER <= 0.01% at 2Mbps ≤ -81dBm @BER <= 0.01% at 3Mbps
	BDR TX Output Spectrum - 20dB Bandwidth	≤1MHz
	LE Transmitter Output Power	4+/-2 dBm
	LE Modulation Characteristics	225kHz ≤ Δf1avg ≤275kHz; Δf2max ≥185kHz for at least 99.9% test packets; Δf2avg/Δf1avg ≥0.8
	LE Carrier frequency offset and drift	Carrier frequency offset: ±150kHz Carrier Drift: ≤50kHz Drift rate: ≤20kHz/50us
	LE Receiver Sensitivity(*2)	≤ -89dBm @PER <= 30.8%,GFSK,1Mbps

*2 the max RX SEN spec. include conductive and AIR

3.0 Host integration instructions
Install module through golden finger.

Federal Communication Commission Interference 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.

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

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

Operations in the 5.15-5.25GHz band are restricted to indoor usage only.

This device meets all the other requirements specified in Part 15E, Section 15.407 of the FCC Rules.

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.

KDB 996369 D03 OEM Manual v01 rule sections:

2.2 List of applicable FCC rules

This module has been tested for compliance to FCC Part 15.247 and Part 15.407

2.3 Summarize the specific operational use conditions

The module is tested for standalone mobile RF exposure use condition. Any other usage conditions such as co-location with other transmitter(s) or being used in a portable condition will need a separate reassessment through a class II permissive change application or new certification.

2.4 Limited module procedures

Not applicable.

2.5 Trace antenna designs

Not applicable.

2.6 RF exposure considerations

This equipment complies with FCC mobile radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body. If the module is installed in a portable host, a separate SAR evaluation is required to confirm compliance with relevant FCC portable RF exposure rules.

2.7 Antennas

The following antennas have been certified for use with this module; antennas of the same type with equal or lower gain may also be used with this module. The antenna must be installed such that 20 cm can be maintained between the antenna and users.

Antenna Type	PCB
Antenna connector	NA
Antenna peak gain	3.65dBi/2.4GHz 3.98dBi/5GHz

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following: "Contains FCC ID: B3QT99H209". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

2.9 Information on test modes and additional testing requirements

This transmitter is tested in a standalone mobile RF exposure condition and any co-located or simultaneous transmission with other transmitter(s) or portable use will require a separate class II permissive change re-evaluation or new certification.

2.10 Additional testing, Part 15 Subpart B disclaimer

This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B (unintentional radiator) rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable.

As long as all 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.

IMPORTANT NOTE: In the event that these conditions <u>can not be met</u> (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID <u>can not</u> 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.

Manual Information To the End User

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.

OEM/Host manufacturer responsibilities

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment

Industry Canada statement:

This device complies with ISED's licence-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d' ISED applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

Radiation Exposure Statement:

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with greater than 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé à plus de 20 cm entre le radiateur et votre corps.

This device is intended only for OEM integrators under the following conditions: (For module device use)

The antenna must be installed and operated with greater than 20cm between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as **2** 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.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

L'antenne doit être installé et exploité avec plus de 20 cm entre l'antenne et les utilisateurs, et

2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les **2** conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop

configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not 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 Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed and operated with greater than 20cm between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC: 1112C-T99H209".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un appareil où l'antenne peut être installée et utilisée à plus de 20 cm entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 1112C-T99H209 ".

Manual Information To the End User

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.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

Caution :

(i) the device for operation in the band 5150-5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

(iv) where applicable, antenna type(s), antenna models(s), and worst-case tilt angle(s) necessary to remain compliant with the e.i.r.p. elevation mask requirement set forth

in section 6.2.2.3 shall be clearly indicated.

Avertissement:

Le guide d'utilisation des dispositifs pour réseaux locaux doit inclure des instructions précises sur les restrictions susmentionnées, notamment :

(i) les dispositifs fonctionnant dans la bande 5150-5250 MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux;

(iv) lorsqu'il y a lieu, les types d'antennes (s'il y en a plusieurs), les numéros de modèle de l'antenne et les pires angles d'inclinaison nécessaires pour rester conforme à l'exigence de la p.i.r.e. applicable au masque d'élévation, énoncée à la section 6.2.2.3, doivent être clairement indiqués