CFR 47 FCC PART 15 SUBPART C

TEST REPORT

For

WIFI+BT Module

MODEL NUMBER: WCT54M2001

FCC ID: 2AC23-WCT54

REPORT NUMBER: 4788997152-3

ISSUE DATE: June 17, 2019

Prepared for

Hui Zhou Gaoshengda Technology Co.,LTD
NO.75 Zhongkai Development Area Huizhou, Guangdong China

Prepared by

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	06/17/2019	Initial Issue	

Summary of Test Results			
Clause	**Test Items**	**FCC Rules**	**Test Results**
1	6dB Bandwidth and 99% Occupied Bandwidth	FCC Part 15.247 (a) (2)	Pass
2	Peak Conducted Output Power	FCC Part 15.247 (b) (3)	Pass
3	Power Spectral Density	FCC Part 15.247 (e)	Pass
4	Conducted Bandedge and Spurious Emission	FCC Part 15.247 (d)	Pass
5	Radiated Bandedge and Spurious Emission	FCC Part 15.247 (d) FCC Part 15.209 FCC Part 15.205	Pass
6	Conducted Emission Test For AC Power Port	FCC Part 15.207	Pass
7	Antenna Requirement	FCC Part 15.203	Pass

TABLE OF CONTENTS

UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch   FORM No: 10-SL-F0035

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1. ATTESTATION OF TEST RESULTS

Applicant Information
Company Name: Hui Zhou Gaoshengda Technology Co.,LTD
Address: NO.75 Zhongkai Development Area Huizhou, Guangdong China

Manufacturer Information
Company Name: Hui Zhou Gaoshengda Technology Co.,LTD
Address: NO.75 Zhongkai Development Area Huizhou, Guangdong China

EUT Description
EUT Name: WIFI+BT Module
Model: WCT54M2001
Brand Name: GSD
Sample Status: Normal
Sample Received Date: May 7, 2019
Date of Tested: May 10, 2019 ~ June 17, 2019

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 FCC PART 15 SUBPART C	PASS

Prepared By: Checked By:

Kebo Zhang   Shawn Wen
Engineer Project Associate   Laboratory Leader

Approved By:

Stephen Guo
Laboratory Manager

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB 558074 D01 DTS Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, KDB 662911 D01 Multiple Transmitter Output v02r01, CFR 47 FCC Part 2, CFR 47 FCC Part 15 and ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	**A2LA (Certificate No.: 4102.01)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA. **FCC (FCC Designation No.: CN1187)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Delcaration of Conformity (DoC) and Certification rules **ISED(Company No.: 21320)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with ISED. The Company Number is 21320. **VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B , the VCCI registration No. is C-20012 and T-20011

Note:
1. All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
2. The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.
3. For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30MHz had been correlated to measurements performed on an OFS.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognize national standards.

4.2. CMEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty
Conduction emission	3.62dB
Radiation Emission test(include Fundamental emission) (9KHz-30MHz)	2.2dB
Radiation Emission test(include Fundamental emission) (30MHz-1GHz)	4.00dB
Radiation Emission test (1GHz to 26GHz)(include Fundamental emission)	5.78dB (1GHz-18Gz)
	5.23dB (18GHz-26Gz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT Name	WIFI+BT Module
Model	WCT54M2001
Radio Technology	IEEE802.11b/g/n HT20/HT40
Operation frequency	IEEE 802.11b: 2412MHz—2462MHz IEEE 802.11g: 2412MHz—2462MHz IEEE 802.11n HT20: 2412MHz—2462MHz IEEE 802.11n HT40: 2422MHz—2452MHz
Modulation	IEEE 802.11b: DSSS(CCK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)
Rated Input	DC 3.3V

5.2. MAXIMUM OUTPUT POWER

Number of Transmit Chains (NTX)	IEE Std. 802.11	Frequency (MHz)	Channel Number	Max PK Conducted Power (dBm)
2	IEEE 802.11b	2412-2462	1-11[11]	20.19
2	IEEE 802.11g	2412-2462	1-11[11]	22.72
2	IEEE 802.11nHT20	2412-2462	1-11[11]	24.75
2	IEEE 802.11nHT40	2422-2452	3-9[7]	23.78

5.3. CHANNEL LIST

Channel List for 802.11b/g/n (20 MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	4	2427	7	2442	10	2457
2	2417	5	2432	8	2447	11	2462
3	2422	6	2437	9	2452	/	/

Channel List for 802.11n (40 MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	5	2432	7	2442	9	2452
4	2427	6	2437	8	2447	/	/

5.4. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
WiFi TX(802.11b)	CH 1, CH 6, CH 11	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11g)	CH 1, CH 6, CH 11	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11n HT20)	CH 1, CH 6, CH 11	2412MHz, 2437MHz, 2462MHz
WiFi TX(802.11n HT40)	CH 3, CH 6, CH 9	2422MHz, 2437MHz, 2452MHz

5.5. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band							
Test Software		QATool_Dbg					
Modulation Mode	Transmit Antenna Number	Test Channel					
		NCB: 20MHz			NCB: 40MHz		
		CH 1	CH 6	CH 11	CH 3	CH 6	CH 9
802.11b	0	default	default	default			
	1	default	default	default			
802.11g	0	default	default	default	/		
	1	default	default	default			
802.11n HT20	0	default	default	default			
	1	default	default	default			
802.11n HT40	0	/	/	/	17	17	17
	1	/	/	/	17	17	17

5.6. THE WORSE CASE CONFIGURATIONS

For SISO modes, there are two transmission antennas. The antenna used in any given time can be either ANTENNA 0 or ANTENNA 1. All antenna ports have the same power; output power measurement for SISO modes on both antennas are reported.
For 2TX MIMO modes, ANTENNA 0 and ANTENNA 1, used at the same time.

Worst-case data rates as provided by the client were:

802.11b mode: 1 Mbps
802.11g mode: 6 Mbps
802.11n HT20 mode: MCS0
802.11n HT40 mode: MCS0

Note: Only 802.11n HT20 and 802.11n HT40 support MIMO mode, for 802.11b and 802.11g , all antennas had been test ,but only the worst data for Antenna 1 was recorded.
For 802.11n HT20 and 802.11n HT40, all antennas had the same power in MIMO mode and SISO mode, so only the worst data for MIMO mode was recorded.

5.7.   DESCRIPTION OF AVAILABLE ANTENNAS

Antenna	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
0	2412-2462	PIFA Antenna	4.74
1	2412-2462	PIFA Antenna	4.74

Note: Directional gain= G_{ANT} + 10 log(N_{ANT}) dBi=7.75dBi

    G_{ANT} : Antenna Gain

    N_{ANT} : Antenna numbers

Test Mode	Transmit and Receive Mode	Description
IEEE 802.11b	☒2TX, 2RX	Antenna 0 and Antenna 1 can be used as transmitting/receiving antenna.
IEEE 802.11g	☒2TX, 2RX	Antenna 0 and Antenna 1 can be used as transmitting/receiving antenna
IEEE 802.11n HT20	☒2TX, 2RX	Antenna 0 and Antenna 1 can be used as transmitting/receiving antenna
IEEE 802.11n HT40	☒2TX, 2RX	Antenna 0 and Antenna 1 can be used as transmitting/receiving antenna

5.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	P/N
1	Laptop	ThinkPad	T460S	SL10K24796 JS
2	USB TO UART	/	/	/

I/O CABLES

Item	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	USB	/	/	0.50	/

Note: The USB cable is for debugging only.

ACCESSORIES

Item	Accessory	Brand Name	Model Name	Description
1	/	/	/	/

TEST SETUP

The EUT can work in engineering mode with a software through a Laptop.

SETUP DIAGRAM FOR TESTS

6. MEASURING INSTRUMENT AND SOFTWARE USED

	Conducted Emissions					
	Instrument					
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
☑	EMI Test Receiver	R&S	ESR3	101961	Dec.10,2018	Dec.10,2019
☑	Two-Line V-Network	R&S	ENV216	101983	Dec.10,2018	Dec.10,2019
☑	Artificial Mains Networks	Schwarzbeck	NSLK 8126	8126465	Dec.10,2018	Dec.10,2019
	Software					
Used	Description		Manufacturer		Name	Version
☑	Test Software for Conducted disturbance		Farad		EZ-EMC	Ver. UL-3A1
	Radiated Emissions					
	Instrument					
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
☑	MXE EMI Receiver	KESIGHT	N9038A	MY56400036	Dec.10,2018	Dec.10,2019
☑	Hybrid Log Periodic Antenna	TDK	HLP-3003C	130960	Sep.17, 2018	Sep.17, 2021
☑	Preamplifier	HP	8447D	2944A09099	Dec.10,2018	Dec.10,2019
☑	EMI Measurement Receiver	R&S	ESR26	101377	Dec.10,2018	Dec.10,2019
☑	Horn Antenna	TDK	HRN-0118	130939	Sep.17, 2018	Sep.17, 2021
☑	High Gain Horn Antenna	Schwarzbeck	BBHA-9170	691	Aug.11, 2018	Aug.11, 2021
☑	Preamplifier	TDK	PA-02-0118	TRS-305-00066	Dec.10,2018	Dec.10,2019
☑	Preamplifier	TDK	PA-02-2	TRS-307-00003	Dec.10,2018	Dec.10,2019
☑	Loop antenna	Schwarzbeck	1519B	00008	Jan.07, 2019	Jan.07, 2022
☑	Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	4	Dec.10,2018	Dec.10,2019
☑	High Pass Filter	Wi	WHKX10-2700-3000-18000-40SS	23	Dec.10,2018	Dec.10,2019
	Software					
Used	Description		Manufacturer		Name	Version
☑	Test Software for Radiated disturbance		Farad		EZ-EMC	Ver. UL-3A1

Other instruments						
Used	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
☑	Spectrum Analyzer	Keysight	N9030A	MY55410512	Dec.10,2018	Dec.10,2019
☑	Power Meter	Keysight	N1911A	MY55416024	Dec.10,2018	Dec.10,2019
☑	Power Sensor	Keysight	U2021XA	MY5100022	Dec.10,2018	Dec.10,2019

7. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6dB Bandwidth	KDB 558074 D01 DTS Meas Guidance v05r02	8.2
2	Peak Output Power	KDB 558074 D01 DTS Meas Guidance v05r02	8.3.1.3/8.3.2.3
3	Power Spectral Density	KDB 558074 D01 DTS Meas Guidance v05r02	8.4
4	Out-of-band emissions in non-restricted bands	KDB 558074 D01 DTS Meas Guidance v05r02	8.5
5	Out-of-band emissions in restricted bands	KDB 558074 D01 DTS Meas Guidance v05r02	8.6
6	Band-edge	KDB 558074 D01 DTS Meas Guidance v05r02	8.7
7	Conducted Emission Test For AC Power Port	ANSI C63.10-2013	6.2

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP

| EUT | — | Attenuator | — | Spectrum Analyser |

TEST ENVIRONMENT

Temperature	23.6°C	Relative Humidity	67%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

ANTENNA 1

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (KHz)	Final setting For VBW (KHz)
11b	8.382	8.415	0.996	99.61%	0.0174	0.12	0.01
11g	1.393	1.428	0.975	97.55%	0.110	0.72	1
11n20	1.301	1.336	0.974	97.38%	0.114	0.769	1
11n40	0.648	0.683	0.949	94.88%	0.227	1.54	2

Note:
Duty Cycle Correction Factor=10log (1/x).
Where: x is Duty Cycle (Linear)
Where: T is On Time
If that calculated VBW is not available on the analyzer then the next higher value should be used.
Antenna 0 and Antenna 1 has the same duty cycle, only Antenna 1 data show here.

11b ON TIME AND DUTY CYCLE MID CH

11g ON TIME AND DUTY CYCLE MID CH

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11n HT20 ON TIME AND DUTY CYCLE MID CH

11n HT40 ON TIME AND DUTY CYCLE MID CH

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8.2. 6 dB DTS BANDWIDTH AND 99% OCCUPIED BANDWIDTH

LIMITS

CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247(a)(2) ISED RSS-247 5.2 (a)	6 dB Bandwidth	≥ 500KHz	2400-2483.5
ISED RSS-Gen Clause 6.7	99% Occupied Bandwidth	For reporting purposes only.	2400-2483.5

TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 6dB Bandwidth :100K For 99% Occupied Bandwidth :1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth : ≥3 × RBW For 99% Occupied Bandwidth : approximately 3×RBW
Trace	Max hold
Sweep	Auto couple

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB and 99% relative to the maximum level measured in the fundamental emission.

TEST SETUP

TEST ENVIRONMENT

Temperature	23.6°C	Relative Humidity	67%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

8.2.1. 802.11b SISO MODE

ANTENNA 1

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	9.076	14.091	≥500	Pass
Middle	8.065	13.894	≥500	Pass
High	9.061	14.132	≥500	Pass

6 dB BANDWIDTH LOW CH

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6 dB BANDWIDTH MID CH

Keysight Spectrum Analyzer - Occupied BW

| RL | RF | 50 Ω | DC | | SENSE:INT | | ALIGN AUTO | | 10:11:41 AM May 13, 2019 |

Center Freq 2.437000000 GHz

NFE

#IFGain:Low

Center Freq: 2.437000000 GHz
Trig: Free Run   Avg|Hold: 10/10
#Atten: 40 dB

Radio Std: None
Radio Device: BTS

Ref Offset 19.29 dB
10 dB/div   Ref 30.00 dBm
Log

Mkr1 2.438 GHz
7.0406 dBm

Center 2.437 GHz   Span 40 MHz
#Res BW 100 kHz   #VBW 300 kHz   Sweep 4.267 ms

Occupied Bandwidth		Total Power	21.9 dBm
13.739 MHz			
Transmit Freq Error	-122.91 kHz	% of OBW Power	99.00 %
x dB Bandwidth	8.065 MHz	x dB	-6.00 dB

6 dB BANDWIDTH HIGH CH

Keysight Spectrum Analyzer - Occupied BW

| RL | RF | 50 Ω | DC | | SENSE:INT | | ALIGN AUTO | | 10:16:07 AM May 13, 2019 |

Center Freq 2.462000000 GHz

NFE

#IFGain:Low

Center Freq: 2.462000000 GHz
Trig: Free Run   Avg|Hold:>10/10
#Atten: 40 dB

Radio Std: None
Radio Device: BTS

Ref Offset 19.29 dB
10 dB/div   Ref 30.00 dBm
Log

Mkr1 2.46251 GHz
5.4250 dBm

Center 2.462 GHz   Span 40 MHz
#Res BW 100 kHz   #VBW 300 kHz   Sweep 4.267 ms

Occupied Bandwidth		Total Power	21.4 dBm
13.847 MHz			
Transmit Freq Error	109.64 kHz	% of OBW Power	99.00 %
x dB Bandwidth	9.061 MHz	x dB	-6.00 dB

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99%BANDWIDTH LOW CH

Keysight Spectrum Analyzer - Occupied BW

R L	RF	50 Ω	DC		SENSE:INT	ALIGN AUTO	02:19:01 PM May 10, 2019

Center Freq 2.412000000 GHz
Center Freq: 2.412000000 GHz   Radio Std: None
NFE   Trig: Free Run   Avg|Hold: 10/10
#IFGain:Low   #Atten: 30 dB   Radio Device: BTS

Ref Offset 19.29 dB
10 dB/div   Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
30.0
40.0
-50.0
-60.0
-70.0

Center 2.412 GHz   Span 40 MHz
#Res BW 200 kHz   #VBW 620 kHz   Sweep 1.067 ms

Occupied Bandwidth		Total Power	21.4 dBm
14.091 MHz			
Transmit Freq Error	-6.935 kHz	% of OBW Power	99.00 %
x dB Bandwidth	9.118 MHz	x dB	-6.00 dB

MSG   STATUS

99% BANDWIDTH MID CH

Keysight Spectrum Analyzer - Occupied BW

R L	RF	50 Ω	DC		SENSE:INT	ALIGN AUTO	02:53:22 PM May 10, 2019

Center Freq 2.437000000 GHz
Center Freq: 2.437000000 GHz   Radio Std: None
NFE   Trig: Free Run   Avg|Hold: 10/10
#IFGain:Low   #Atten: 30 dB   Radio Device: BTS

Ref Offset 19.29 dB
10 dB/div   Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
30.0
40.0
-50.0
-60.0
-70.0

Center 2.437 GHz   Span 40 MHz
#Res BW 200 kHz   #VBW 620 kHz   Sweep 1.067 ms

Occupied Bandwidth		Total Power	22.8 dBm
13.894 MHz			
Transmit Freq Error	-91.594 kHz	% of OBW Power	99.00 %
x dB Bandwidth	9.096 MHz	x dB	-6.00 dB

MSG   STATUS

99% BANDWIDTH HIGH CH

Note: All the modes and antenna ports had been tested, only the worst data recorded in the report.

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8.2.2. 802.11g SISO MODE

ANTENNA 1

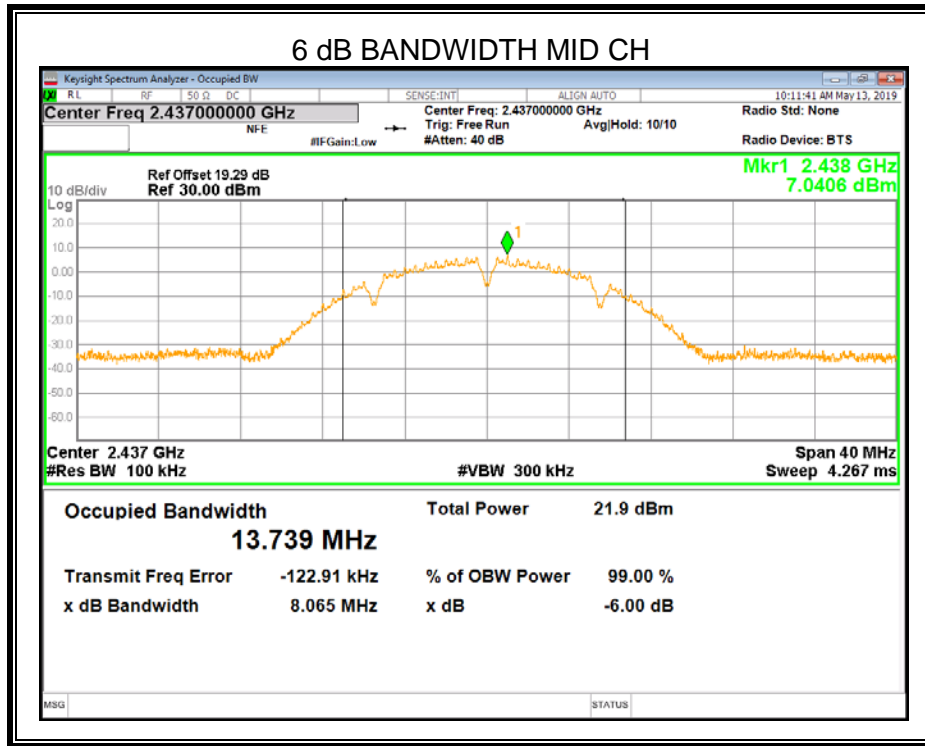| Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	15.13	16.471	≥500	Pass
Middle	15.10	16.410	≥500	Pass
High	15.11	16.430	≥500	Pass

6 dB BANDWIDTH MID CH

6 dB BANDWIDTH HIGH CH

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99% BANDWIDTH LOW CH

Occupied Bandwidth
16.471 MHz

		Total Power	20.3 dBm
Transmit Freq Error	-27.776 kHz	% of OBW Power	99.00 %
x dB Bandwidth	16.25 MHz	x dB	-6.00 dB

99%BANDWIDTH MID CH

Occupied Bandwidth
16.410 MHz

		Total Power	21.3 dBm
Transmit Freq Error	-5.561 kHz	% of OBW Power	99.00 %
x dB Bandwidth	15.57 MHz	x dB	-6.00 dB

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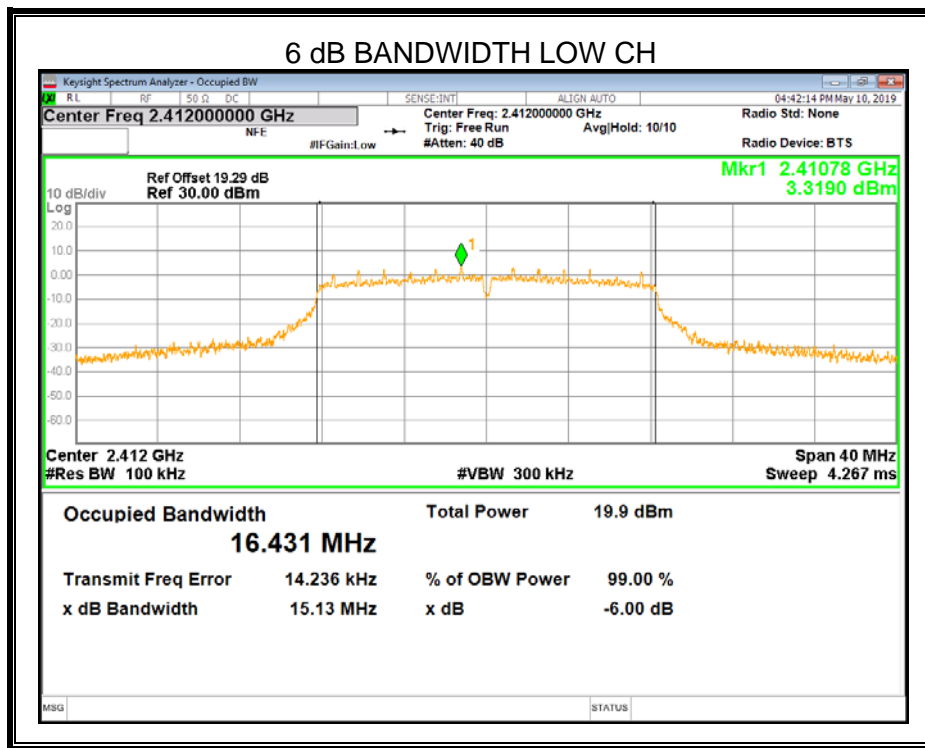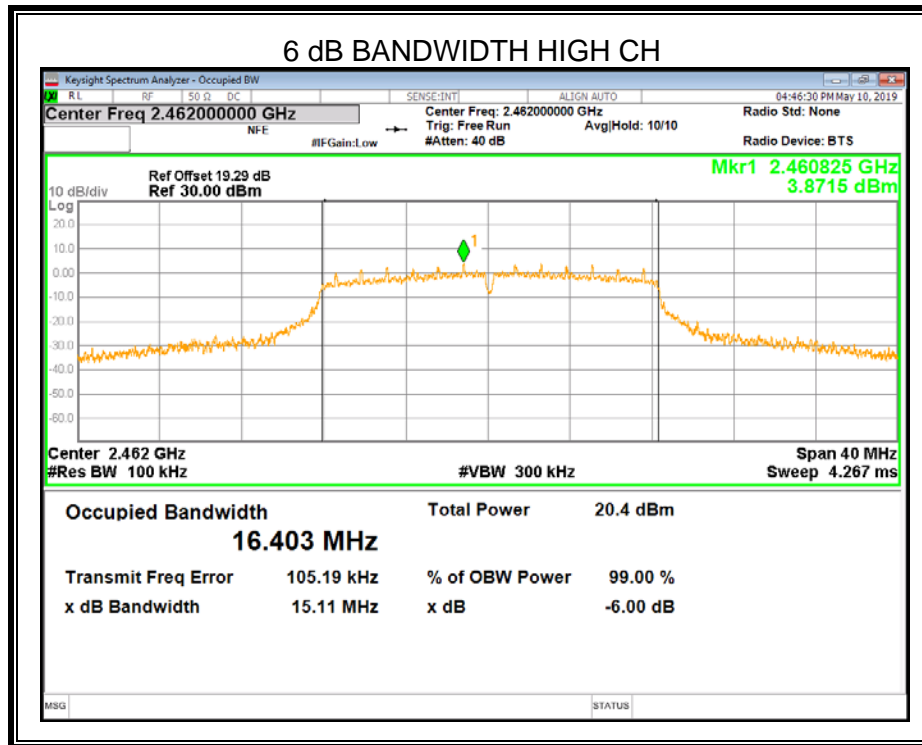
99% BANDWIDTH HIGH CH
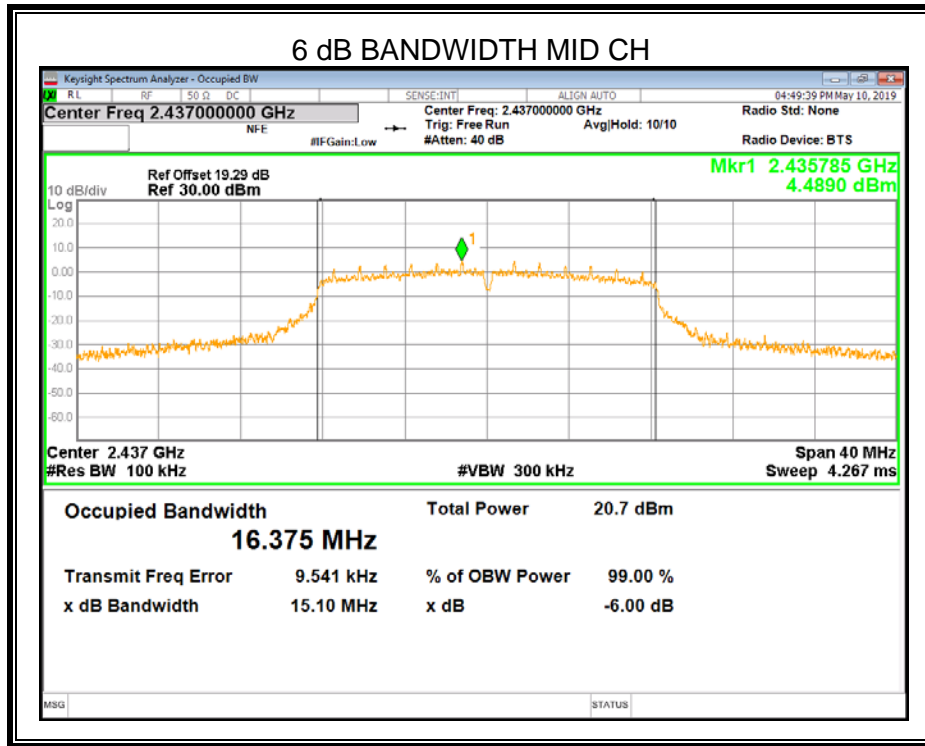

Note: All the modes and antenna ports had been tested, only the worst data recorded in the report.

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8.2.3. 802.11n HT20 MIMO MODE

ANTENNA 1

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	15.13	17.609	≥500	Pass
Middle	15.12	17.526	≥500	Pass
High	15.12	17.561	≥500	Pass

6 dB BANDWIDTH LOW CH

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6 dB BANDWIDTH MID CH

Keysight Spectrum Analyzer - Occupied BW

RL RF 50 Ω DC SENSE:INT ALIGN AUTO 09:20:34 AM May 13, 2019

Center Freq 2.437000000 GHz

NFE

Center Freq: 2.437000000 GHz Radio Std: None
Trig: Free Run Avg|Hold: 10/10
#IFGain:Low #Atten: 30 dB Radio Device: BTS

Mkr1 2.435775 GHz
3.5410 dBm

Ref Offset 19.29 dB
10 dB/div Ref 20.00 dBm
Log

Center 2.437 GHz Span 40 MHz
#Res BW 100 kHz #VBW 300 kHz Sweep 4.267 ms

Occupied Bandwidth		Total Power	19.9 dBm
17.487 MHz			
Transmit Freq Error	20.765 kHz	% of OBW Power	99.00 %
x dB Bandwidth	15.12 MHz	x dB	-6.00 dB

MSG STATUS

6 dB BANDWIDTH HIGH CH

Keysight Spectrum Analyzer - Occupied BW

RL RF 50 Ω DC SENSE:INT ALIGN AUTO 09:31:31 AM May 13, 2019

Center Freq 2.462000000 GHz

NFE

Center Freq: 2.462000000 GHz Radio Std: None
Trig: Free Run Avg|Hold:>10/10
#IFGain:Low #Atten: 30 dB Radio Device: BTS

Mkr1 2.463295 GHz
3.0992 dBm

Ref Offset 19.29 dB
10 dB/div Ref 20.00 dBm
Log

Center 2.462 GHz Span 40 MHz
#Res BW 100 kHz #VBW 300 kHz Sweep 4.267 ms

Occupied Bandwidth		Total Power	19.5 dBm
17.508 MHz			
Transmit Freq Error	66.328 kHz	% of OBW Power	99.00 %
x dB Bandwidth	15.12 MHz	x dB	-6.00 dB

MSG STATUS

99%BANDWIDTH LOW CH

Keysight Spectrum Analyzer - Occupied BW

R L | RF | 50 Ω | DC | | SENSE:INT | ALIGN AUTO | 09:13:31 AM May 13, 2019
Center Freq 2.412000000 GHz | Center Freq: 2.412000000 GHz | Radio Std: None
NF E | | Trig: Free Run | Avg|Hold:>10/10
#IFGain:Low | #Atten: 30 dB | Radio Device: BTS

Ref Offset 19.29 dB
Ref 20.00 dBm
10 dB/div
Log

Center 2.412 GHz | Span 40 MHz
#Res BW 200 kHz | #VBW 620 kHz | Sweep 1.067 ms

Occupied Bandwidth | **Total Power** | 19.3 dBm

17.609 MHz

Transmit Freq Error | 74.580 kHz | % of OBW Power | 99.00 %
x dB Bandwidth | 17.18 MHz | x dB | -6.00 dB

MSG | STATUS

99% BANDWIDTH MID CH

Keysight Spectrum Analyzer - Occupied BW

R L | RF | 50 Ω | DC | | SENSE:INT | ALIGN AUTO | 09:20:50 AM May 13, 2019
Center Freq 2.437000000 GHz | Center Freq: 2.437000000 GHz | Radio Std: None
NF E | | Trig: Free Run | Avg|Hold:>10/10
#IFGain:Low | #Atten: 30 dB | Radio Device: BTS

Ref Offset 19.29 dB
Ref 20.00 dBm
10 dB/div
Log

Center 2.437 GHz | Span 40 MHz
#Res BW 200 kHz | #VBW 620 kHz | Sweep 1.067 ms

Occupied Bandwidth | **Total Power** | 20.2 dBm

17.526 MHz

Transmit Freq Error | 42.839 kHz | % of OBW Power | 99.00 %
x dB Bandwidth | 16.13 MHz | x dB | -6.00 dB

MSG | STATUS

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99% BANDWIDTH HIGH CH

Keysight Spectrum Analyzer - Occupied BW

				SENSE:INT		ALIGN AUTO		09:31:47 AM May 13, 2019

R L   RF   50 Ω   DC

Center Freq 2.462000000 GHz

NFE

#IFGain:Low

Center Freq: 2.462000000 GHz
Trig: Free Run   Avg|Hold: 10/10
#Atten: 30 dB

Radio Std: None

Radio Device: BTS

Ref Offset 19.29 dB
Ref 20.00 dBm

10 dB/div
Log

Center 2.462 GHz   Span 40 MHz
#Res BW 200 kHz   #VBW 620 kHz   Sweep 1.067 ms

Occupied Bandwidth		**Total Power**	19.7 dBm
17.561 MHz			
Transmit Freq Error	124.23 kHz	**% of OBW Power**	99.00 %
x dB Bandwidth	16.56 MHz	**x dB**	-6.00 dB

MSG   STATUS

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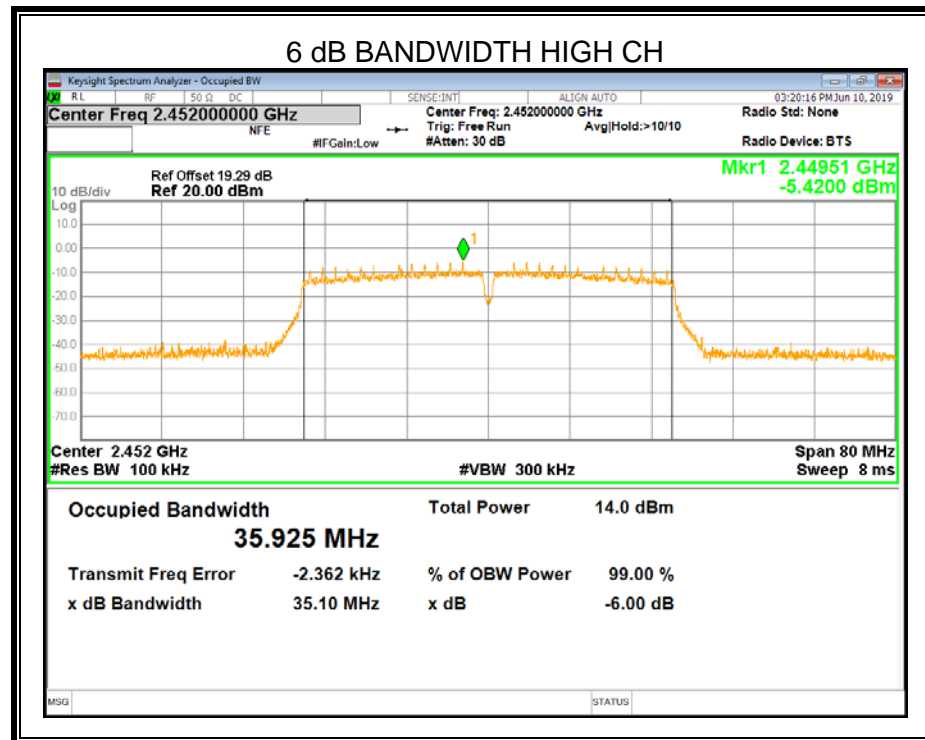*This report shall not be reproduced except in full, without the written approval of UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch.*
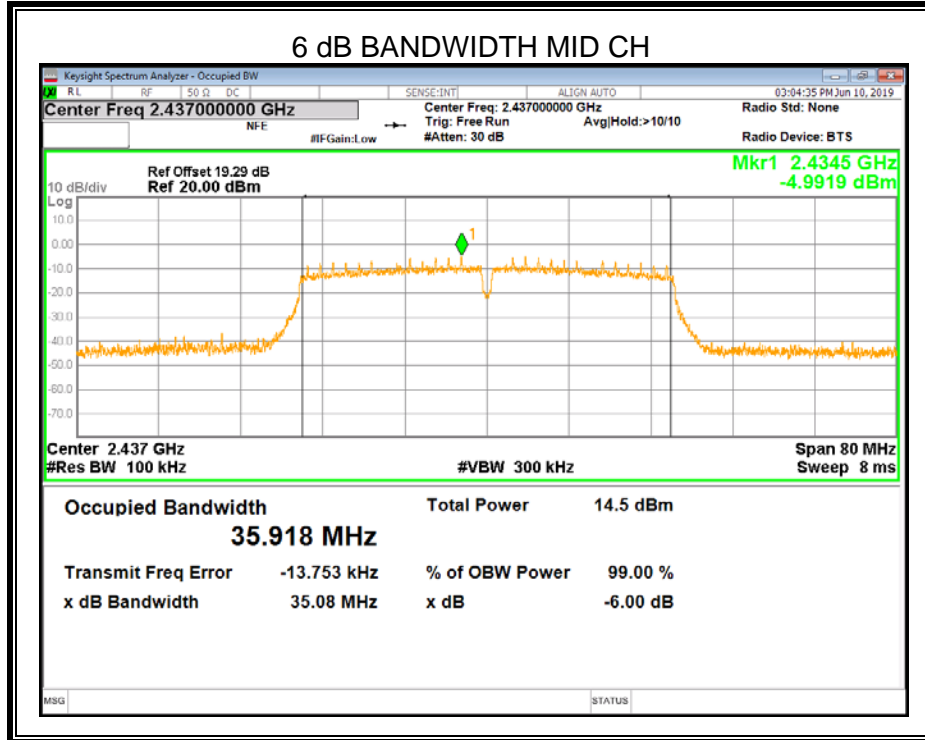
8.2.4. 802.11n HT40 MIMO MODE

ANTENNA 1

Channel	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (kHz)	Result
Low	35.11	36.112	≥500	Pass
Middle	35.08	36.088	≥500	Pass
High	35.10	36.069	≥500	Pass

6 dB BANDWIDTH LOW CH

6 dB BANDWIDTH MID CH

Keysight Spectrum Analyzer - Occupied BW

R L	RF 50 Ω DC	SENSE:INT	ALIGN AUTO	03:04:35 PM Jun 10, 2019
Center Freq 2.437000000 GHz		Center Freq: 2.437000000 GHz	Radio Std: None
	NFE	Trig: Free Run	Avg|Hold:>10/10	Radio Device: BTS
	#IFGain:Low	#Atten: 30 dB	

Ref Offset 19.29 dB
Ref 20.00 dBm

Mkr1 2.4345 GHz
-4.9919 dBm

10 dB/div
Log

10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0

Center 2.437 GHz
#Res BW 100 kHz

#VBW 300 kHz

Span 80 MHz
Sweep 8 ms

Occupied Bandwidth		Total Power	14.5 dBm
35.918 MHz			
Transmit Freq Error	-13.753 kHz	% of OBW Power	99.00 %
x dB Bandwidth	35.08 MHz	x dB	-6.00 dB

MSG | STATUS

6 dB BANDWIDTH HIGH CH

Keysight Spectrum Analyzer - Occupied BW

R L	RF 50 Ω DC	SENSE:INT	ALIGN AUTO	03:20:16 PM Jun 10, 2019
Center Freq 2.452000000 GHz		Center Freq: 2.452000000 GHz	Radio Std: None
	NFE	Trig: Free Run	Avg|Hold:>10/10	Radio Device: BTS
	#IFGain:Low	#Atten: 30 dB	

Ref Offset 19.29 dB
Ref 20.00 dBm

Mkr1 2.44951 GHz
-5.4200 dBm

10 dB/div
Log

10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0

Center 2.452 GHz
#Res BW 100 kHz

#VBW 300 kHz

Span 80 MHz
Sweep 8 ms

Occupied Bandwidth		Total Power	14.0 dBm
35.925 MHz			
Transmit Freq Error	-2.362 kHz	% of OBW Power	99.00 %
x dB Bandwidth	35.10 MHz	x dB	-6.00 dB

MSG | STATUS

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99%BANDWIDTH LOW CH

99% BANDWIDTH MID CH

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99% BANDWIDTH HIGH CH

Keysight Spectrum Analyzer - Occupied BW			
RL RF 50 Ω DC	SENSE:INT	ALIGN AUTO	03:20:33 PM Jun 10, 2019
Center Freq 2.452000000 GHz	Center Freq: 2.452000000 GHz		Radio Std: None
NF-E	Trig: Free Run	Avg|Hold: 10/10	
#IFGain:Low	#Atten: 30 dB		Radio Device: BTS

Ref Offset 19.29 dB
Ref 20.00 dBm
10 dB/div
Log

Center 2.452 GHz
#Res BW 390 kHz
#VBW 1.2 MHz
Span 80 MHz
Sweep 1.067 ms

Occupied Bandwidth		Total Power	14.9 dBm
36.069 MHz			
Transmit Freq Error	69.954 kHz	% of OBW Power	99.00 %
x dB Bandwidth	36.18 MHz	x dB	-6.00 dB

Note: All modes and antennas had been tested, but only the worst data recorded in the report.

8.3. PEAK CONDUCTED OUTPUT POWER

LIMITS

CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247(b)(3) ISED RSS-247 5.4 (d)	Peak Output Power	1 watt or 30dBm (See Note 1/2)	2400-2483.5
1. The total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi 2. Limit=30dBm – 1. Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi, where N_{ANT} is the number of outputs, G_{ANT} is the Antenna gain.			

TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
Measure peak power each channel.
Peak Detector use for Peak result.
AVG Detector use for AVG result.

TEST SETUP

TEST ENVIRONMENT

Temperature	23.6°C	Relative Humidity	67%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

8.3.1. 802.11b SISO MODE

Frequency (MHz)	ANT	Maximum PK Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	16.66			
	1	18.64			
Middle	0	17.49	/	29	PASS
	1	20.19			
High	0	17.30			
	1	20.08			

Frequency (MHz)	ANT	Maximum AV Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	14.51			
	1	16.67			
Middle	0	15.52	/	29	PASS
	1	17.81			
High	0	15.14			
	1	17.88			

8.3.2. 802.11g SISO MODE

Frequency (MHz)	ANT	Maximum PK Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	20.86			
	1	21.99			
Middle	0	21.69	/	29	PASS
	1	22.72			
High	0	21.34			
	1	22.34			

Frequency (MHz)	ANT	Maximum AV Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	14.00			
	1	14.60			
Middle	0	14.65	/	29	PASS
	1	15.12			
High	0	14.32			
	1	14.71			

8.3.3. 802.11n HT20 MIMO MODE

Frequency (MHz)	ANT	Maximum PK Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	19.71	24.12	29	PASS
	1	22.17			
Middle	0	20.47	24.75		
	1	22.72			
High	0	20.12	24.32		
	1	22.25			

Frequency (MHz)	ANT	Maximum AV Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	12.87	16.22	29	PASS
	1	13.53			
Middle	0	13.61	17.03		
	1	14.40			
High	0	13.26	16.50		
	1	13.70			

8.3.4. 802.11n HT40 MIMO MODE

Frequency (MHz)	ANT	Maximum PK Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	19.74	23.78	29	PASS
	1	21.60			
Middle	0	19.58	23.73		
	1	21.62			
High	0	19.25	23.36		
	1	21.22			

Frequency (MHz)	ANT	Maximum AV Conducted Output Power (dBm)		Limit	Result
		Single	Total		
Low	0	12.73	16.05	29	PASS
	1	13.33			
Middle	0	12.82	15.98		
	1	13.12			
High	0	12.46	15.69		
	1	12.88			

8.4. POWER SPECTRAL DENSITY

LIMITS

CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC §15.247 (e) ISED RSS-247 5.2 (b)	Power Spectral Density	8 dBm/3 kHz (See Note 1/2)	2400-2483.5
1. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. 2. Limit=8dBm – (Directional gain -6)dBi Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi, where N_{ANT} is the number of outputs, G_{ANT} is the Antenna gain.			

TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	3 kHz ≤ RBW ≤100 kHz
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.
If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST SETUP

TEST ENVIRONMENT

Temperature	24.1°C	Relative Humidity	58%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

8.4.1. 802.11b SISO MODE

Frequency (MHz)	ANT	Power Spectral Density (dBm/3kHz)		Limit (dBm/3kHz)
		Single	Total	
Low	1	6.171		
Middle	1	7.751	NA	8
High	1	7.411		

ANTENNA 1

PSD LOW CH

PSD MID CH

PSD HIGH CH

Note: All antennas had been test ,but only the worst data for Antenna 0 was recorded.

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8.4.1. 802.11g SISO MODE

Frequency (MHz)	ANT	Power Spectral Density (dBm/3kHz)		Limit (dBm/3kHz)
		Single	Total	
Low	1	-9.945		
Middle	1	-9.899	NA	8
High	1	-10.232		

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ANTENNA 1

PSD LOW CH

PSD MID CH

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PSD HIGH CH

Note: All antennas had been test ,but only the worst data for Antenna 0 was recorded.

8.4.2. 802.11n HT20 MIMO MODE

Frequency (MHz)	ANT	Power Spectral Density (dBm/3kHz)		Limit (dBm/3kHz)
		Single	Total	
Low	0	-11.031	-8.01	6.25
	1	-11.017		
Middle	0	-9.900	-5.97	
	1	-8.222		
High	0	-11.058	-6.91	
	1	-9.014		

ANTENNA 0

PSD LOW CH

PSD MID CH

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PSD HIGH CH

ANTENNA 1

PSD LOW CH

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PSD MID CH

PSD HIGH CH

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8.4.3. 802.11n HT40 MIMO MODE

Frequency (MHz)	ANT	Power Spectral Density (dBm/3kHz)		Limit (dBm/3kHz)
		Single	Total	
Low	0	-19.605	-15.74	6.25
	1	-18.042		
Middle	0	-20.779	-16.57	
	1	-18.645		
High	0	-20.037	-16.59	
	1	-19.198		

ANTENNA 0

PSD LOW CH

PSD MID CH

PSD HIGH CH

ANTENNA 1

PSD LOW CH

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PSD MID CH

PSD HIGH CH

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8.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

LIMITS

CFR 47 FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2		
Section	Test Item	Limit
CFR 47 FCC §15.247 (d) ISED RSS-247 5.5	Conducted Bandedge and Spurious Emissions	at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	100K
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum PSD level.

Span	Set the center frequency and span to encompass frequency range to be measured
Detector	Peak
RBW	100K
VBW	≥3 × RBW
measurement points	≥span/RBW
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum amplitude level**.**

TEST SETUP

```
┌──────────┐        ┌────────────┐        ┌──────────────────┐
│          │        │            │        │                  │
│   EUT    │────────│ Attenuator │────────│ Spectrum Analyser│
│          │        │            │        │                  │
└──────────┘        └────────────┘        └──────────────────┘
```

TEST ENVIRONMENT

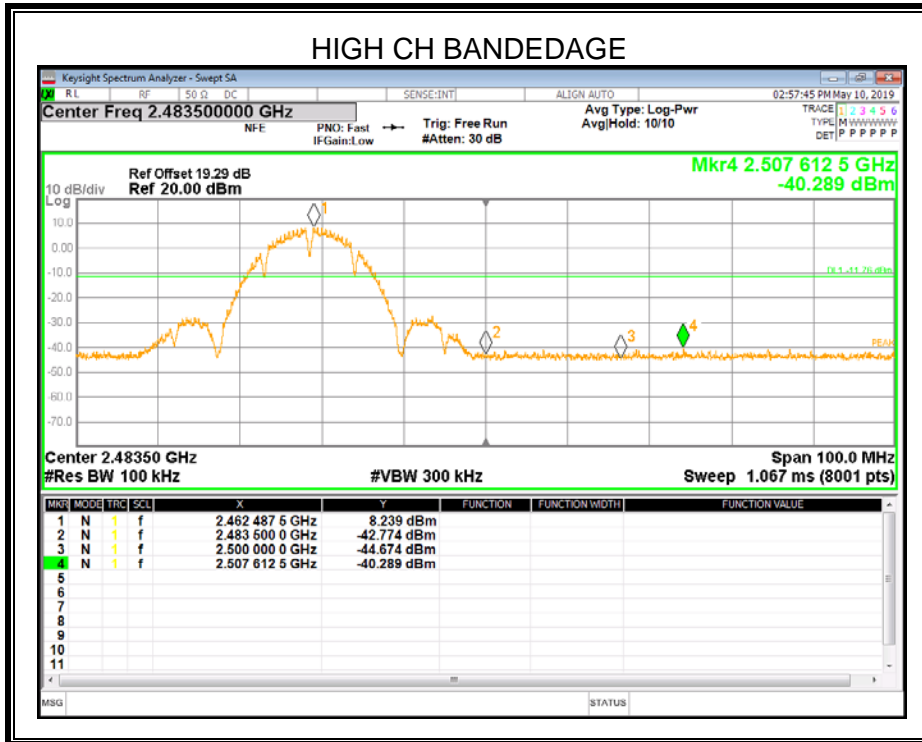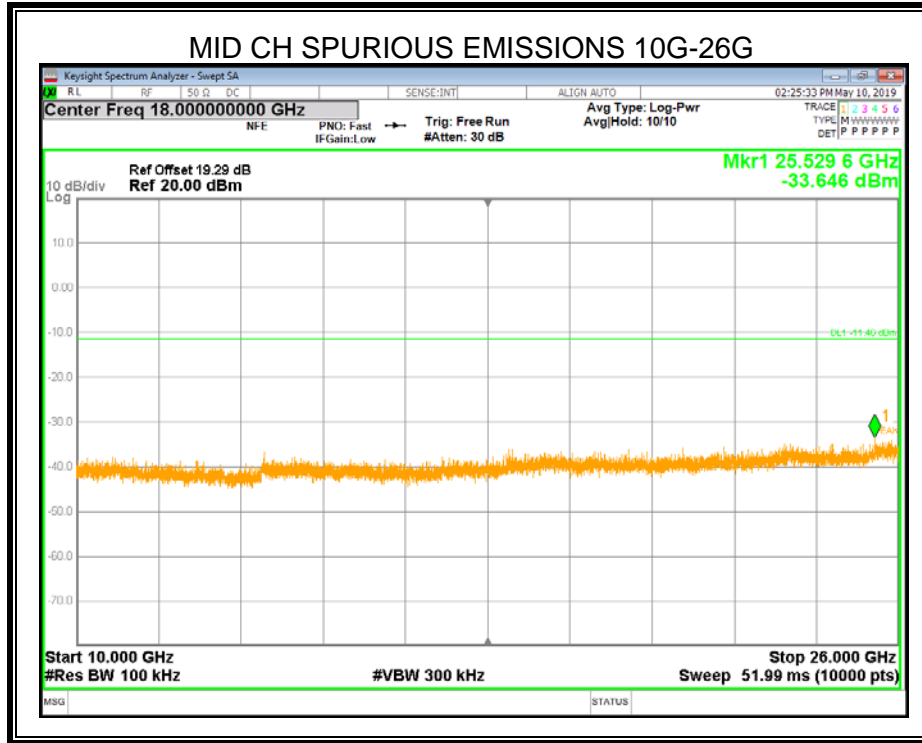| Temperature	23.8°C	Relative Humidity	54%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

RESULTS

8.5.1. 802.11b SISO MODE

ANTENNA 1

LOW CH BANDEDAGE

LOW CH REFERENCE

LOW CH SPURIOUS EMISSIONS 30M-10G

LOW CH SPURIOUS EMISSIONS 10G-26G

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MID CH REFERENCE

MID CH SPURIOUS EMISSIONS 30M-10G

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MID CH SPURIOUS EMISSIONS 10G-26G

HIGH CH BANDEDAGE

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HIGH CH REFERENCE

HIGH CH SPURIOUS EMISSIONS 30M-10G

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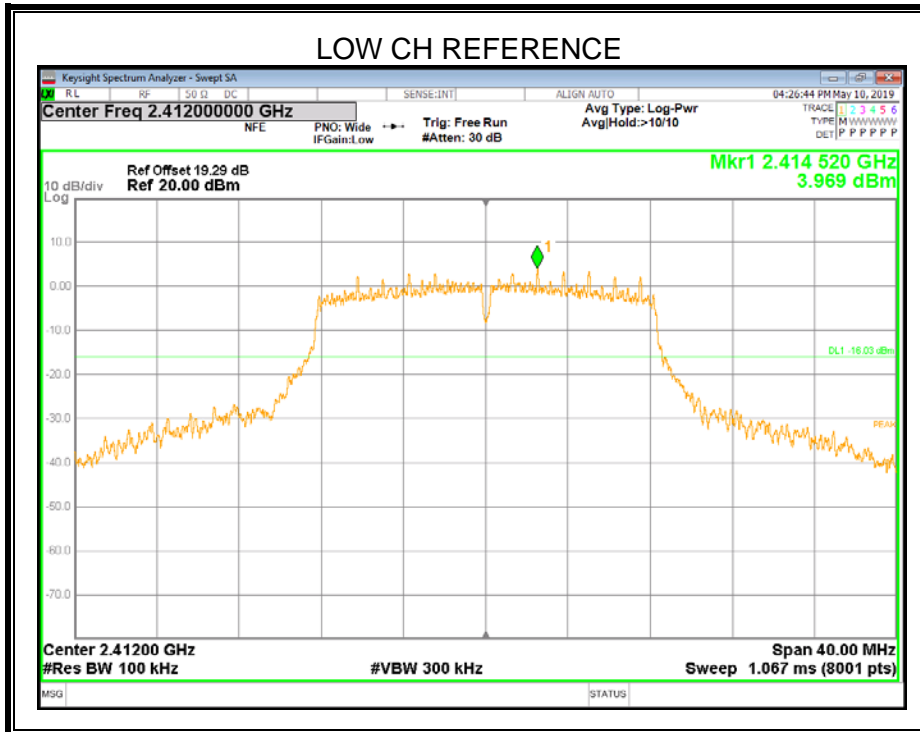
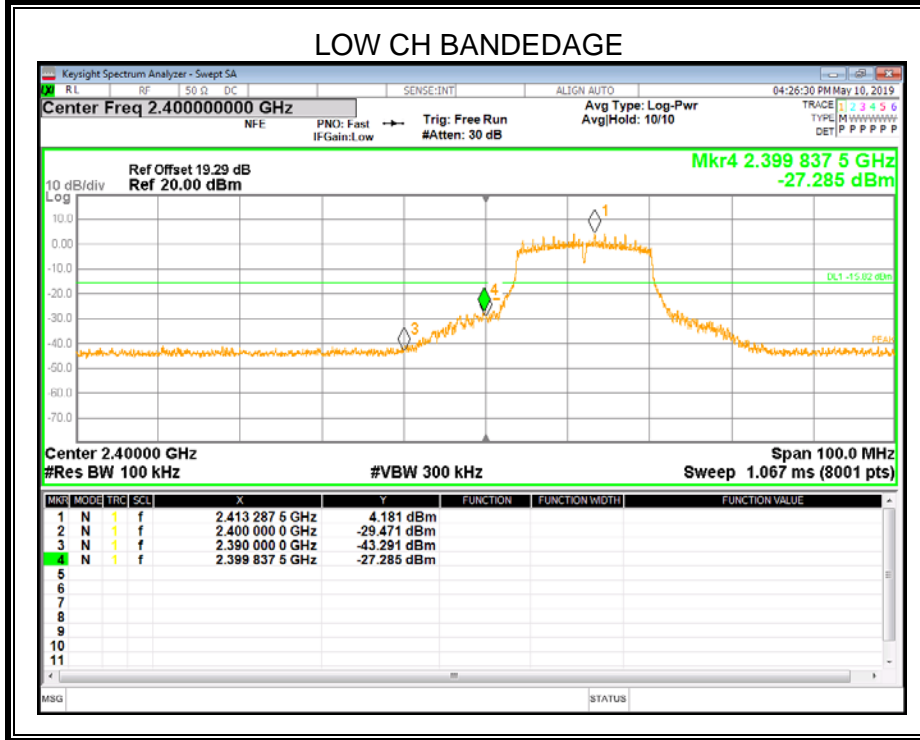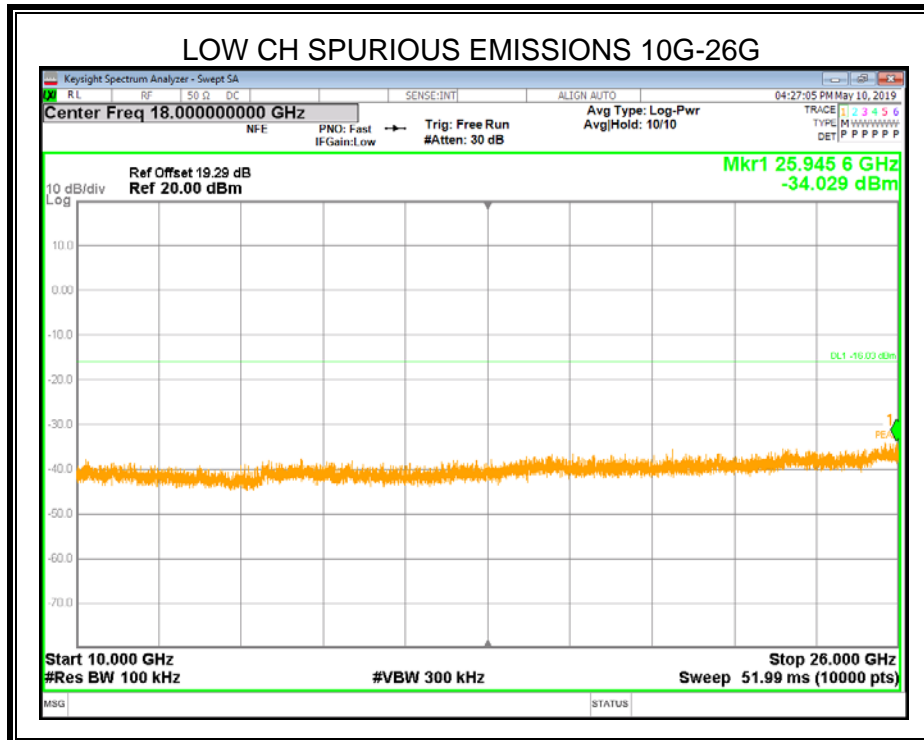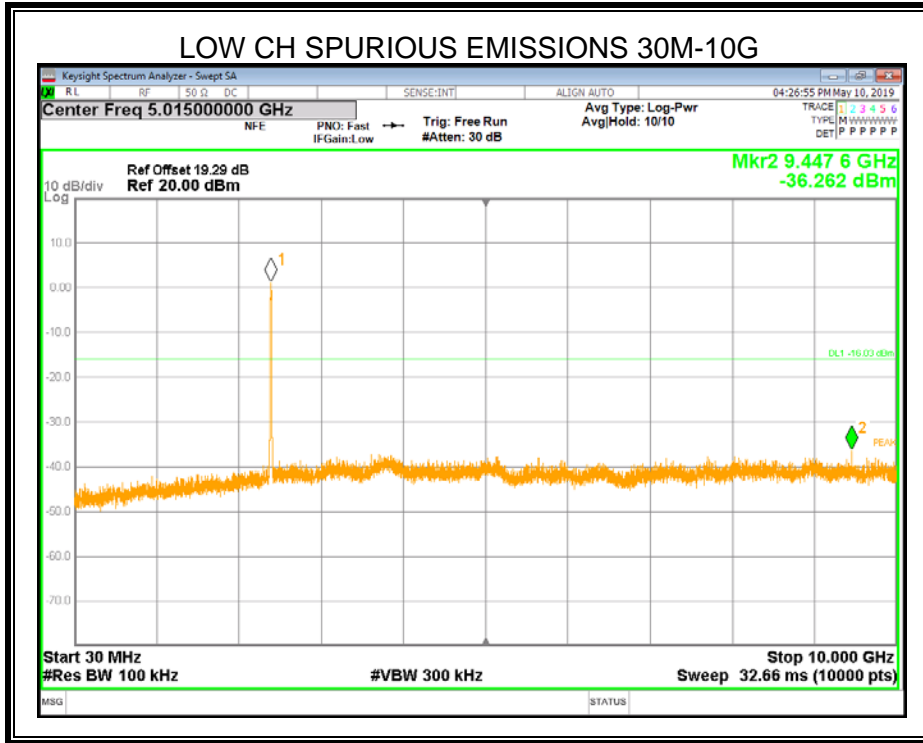## HIGH CH SPURIOUS EMISSIONS 10G-26G

Note: All the modes and antenna ports had been tested, only the worst data recorded in the report.

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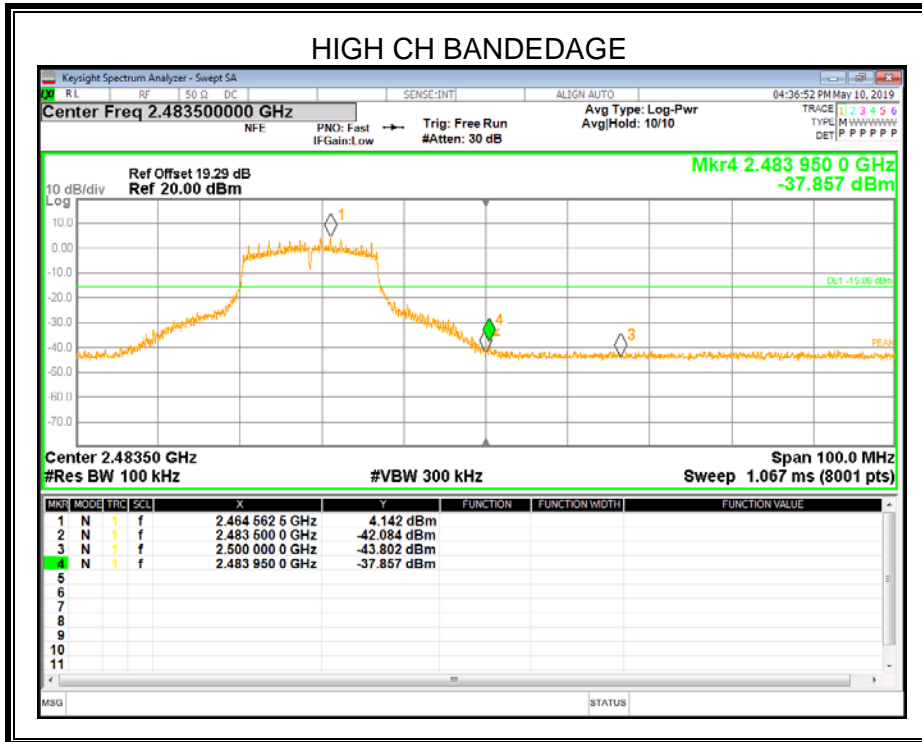
8.5.2. 802.11g SISO MODE

ANTENNA 1

LOW CH BANDEDAGE

LOW CH REFERENCE

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LOW CH SPURIOUS EMISSIONS 30M-10G

LOW CH SPURIOUS EMISSIONS 10G-26G

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MID CH REFERENCE

MID CH SPURIOUS EMISSIONS 30M-10G

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MID CH SPURIOUS EMISSIONS 10G-26G

HIGH CH BANDEDAGE

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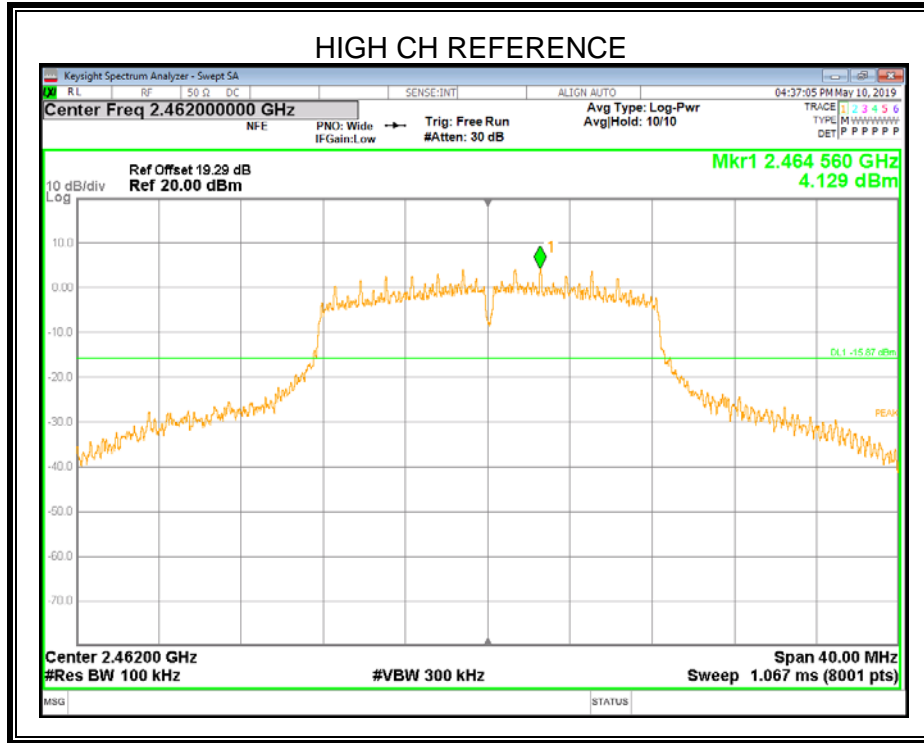
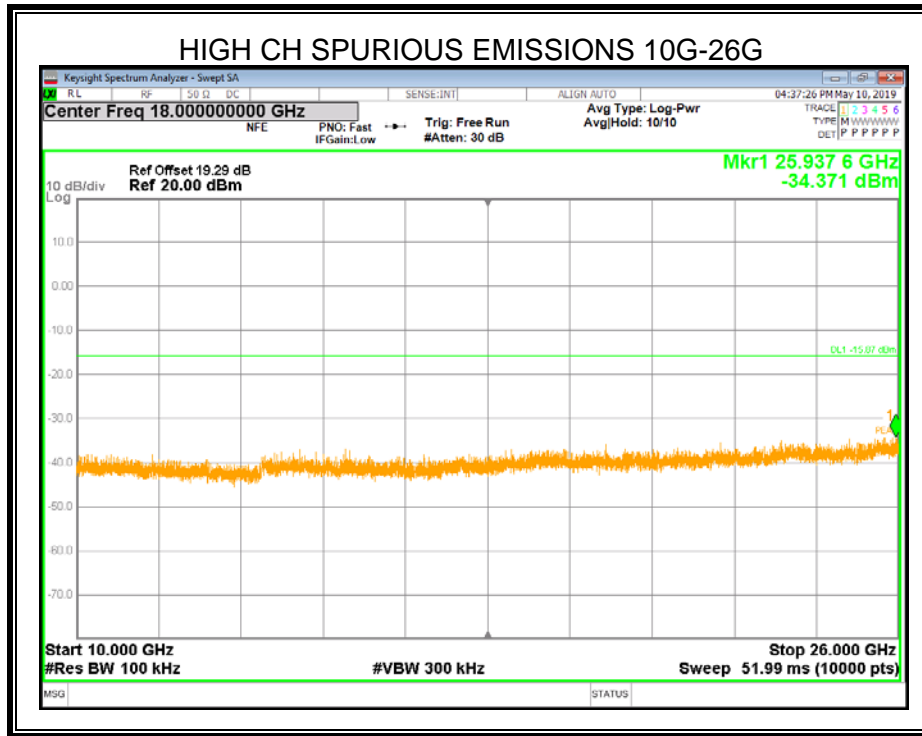## HIGH CH SPURIOUS EMISSIONS 10G-26G

Note: All the modes and antenna ports had been tested, only the worst data recorded in the report.