

TEST REPORT

Product : Wireless Vibration Temperature
Smart Sensor
Trade mark : MHCC™
Model/Type reference : WS500
Serial Number : N/A
Report Number : EED32K00269601
FCC ID : 2ARK7WS001
Date of Issue : Dec. 20, 2018
Test Standards : 47 CFR Part 15Subpart C
Test result : PASS

Prepared for:

Guanwei Monitoring Technology Wuxi Co., Ltd.
Level 6 Building A Jingyuzuo iPark III, Xinwu District,
Wuxi, Jiangsu, China

Prepared by:

Centre Testing International Group Co., Ltd.
Hongwei Industrial Zone, Bao'an 70 District,
Shenzhen, Guangdong, China
TEL: +86-755-3368 3668
FAX: +86-755-3368 3385

Tested by:

Peter

Compiled by:

Kevin Lan

Reviewed by:

Tom - chen

Approved by:

Kevin Yang

Date:

Dec. 20, 2018



Check No.:2447632439

2 Version

Version No.	Date	Description
00	Dec. 20, 2018	Original

3 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	N/A
Conducted Peak Output Power	47 CFR Part 15 Subpart C Section 15.247 (b)(3)	ANSI C63.10-2013	PASS
6dB Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.247 (a)(2)	ANSI C63.10-2013	PASS
Power Spectral Density	47 CFR Part 15 Subpart C Section 15.247 (e)	ANSI C63.10-2013	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15 Subpart C Section 15.247(d)	ANSI C63.10-2013	PASS
RF Conducted Spurious Emissions	47 CFR Part 15 Subpart C Section 15.247(d)	ANSI C63.10-2013	PASS
Radiated Spurious Emissions	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS

Remark:

Test according to ANSI C63.4-2014 & ANSI C63.10-2013.

The tested sample(s) and the sample information are provided by the client.

N/A:The device is only battery operated, the test related AC mains is not applicable.

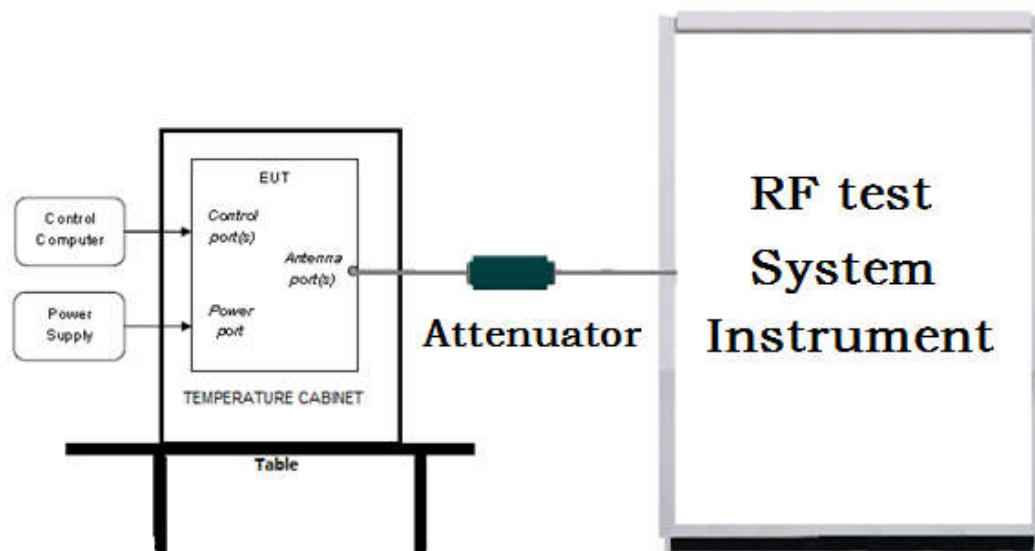
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5 Test Requirement

5.1 Test setup

5.1.1 For Conducted test setup



5.1.2 For Radiated Emissions test setup

Radiated Emissions setup:

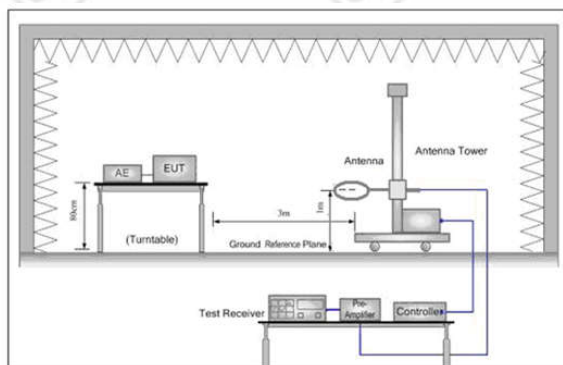


Figure 1. Below 30MHz

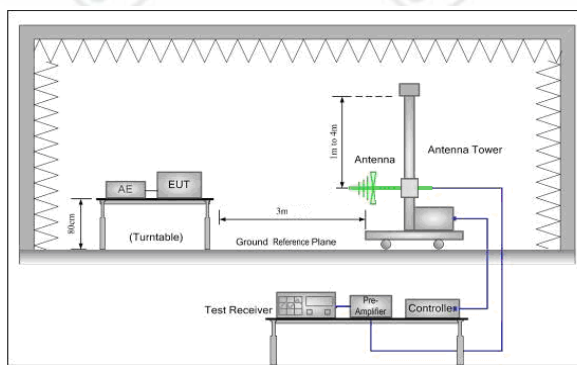


Figure 2. 30MHz to 1GHz

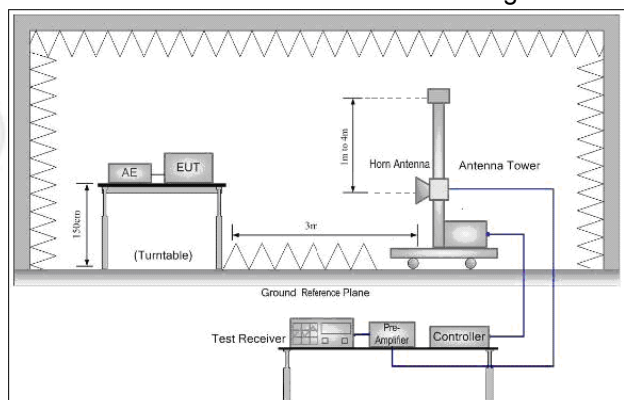
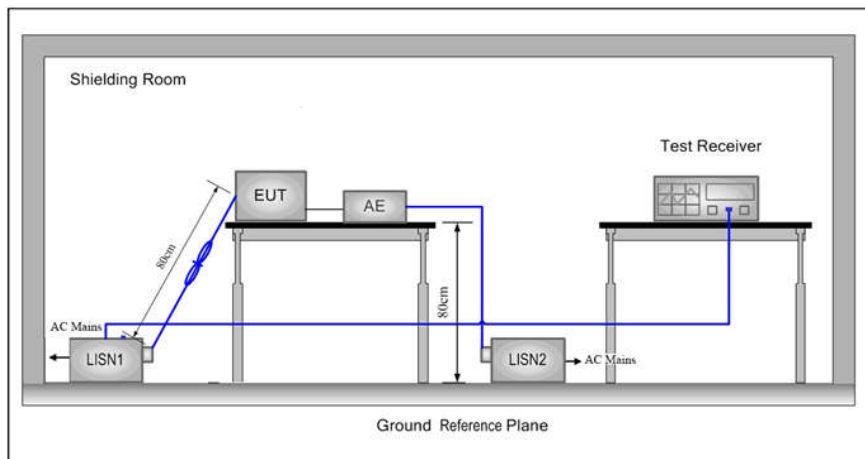


Figure 3. Above 1GHz

5.1.3 For Conducted Emissions test setup

Conducted Emissions setup



5.2 Test Environment

Operating Environment:	
Temperature:	25°C
Humidity:	55% RH
Atmospheric Pressure:	1010mbar

5.3 Test Condition

Test channel:

Test Mode	Tx/Rx	RF Channel		
		Low(L)	Middle(M)	High(H)
802.11b/g/n(HT20)	2412MHz ~2462 MHz	Channel 1	Channel 6	Channel11
		2412MHz	2437MHz	2462MHz
TX mode:	The EUT transmitted the continuous signal at the specific channel(s).			

Test mode:

Pre-scan under all rate at lowest channel 1

Mode	802.11b							
Data Rate	1Mbps	2Mbps	5.5Mbps	11Mbps				
Power(dBm)	15.87	16.07	16.24	16.58				
Mode	802.11g							
Data Rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
Power(dBm)	11.37	11.11	10.89	10.65	10.42	10.22	10.07	9.85
Mode	802.11n (HT20)							
Data Rate	6.5Mbps	13Mbps	19.5Mbps	26Mbps	39Mbps	52Mbps	58.5Mbps	65Mbps
Power(dBm)	10.38	10.27	10.12	10.05	9.91	9.77	9.62	9.44

Through Pre-scan, 11Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20).

6 General Information

6.1 Client Information

Applicant:	Guanwei Monitoring Technology Wuxi Co., Ltd.
Address of Applicant:	Level 6 Building A Jingyuzuo iPark III, Xinwu District, Wuxi, Jiangsu, China
Manufacturer:	Guanwei Monitoring Technology Wuxi Co., Ltd.
Address of Manufacturer:	Level 6 Building A Jingyuzuo iPark III, Xinwu District, Wuxi, Jiangsu, China
Factory:	Guanwei Monitoring Technology Wuxi Co., Ltd.
Address of Factory:	Level 6 Building A Jingyuzuo iPark III, Xinwu District, Wuxi, Jiangsu, China

6.2 General Description of EUT

Product Name:	Wireless Vibration Temperature Smart Sensor
Model No.(EUT):	WS500
Trade Mark:	MHCC™
EUT Supports Radios application:	WiFi 802.11b/g/n(HT20): 2412MHz to 2462MHz
Power Supply:	Battery: 3.6V 4800mAh
Sample Received Date:	Oct. 08, 2018
Sample tested Date:	Nov. 07, 2018 to Dec. 03, 2018

6.3 Product Specification subjective to this standard

Operation Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz
Channel Numbers:	IEEE 802.11b/g, IEEE 802.11n HT20: 11 Channels
Channel Separation:	5MHz
Type of Modulation:	IEEE for 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE for 802.11g :OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE for 802.11n(HT20) : OFDM (64QAM, 16QAM, QPSK, BPSK)
Sample Type:	Fixed production
Test Power Grade:	N/A
Test Software of EUT:	CC3100/CC3200 Radio Tool v1.2.5942.19689(manufacturer declare)
Antenna Type:	PCB Antenna
Antenna Gain:	1dBi
Software version:	WS500: Ver 62.04(manufacturer declare)
Hardware version:	RevG(manufacturer declare)
Test Voltage:	Battery: 3.6V 4800mAh

Operation Frequency each of channel(802.11b/g/n HT20)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz		

6.4 Description of Support Units

The EUT has been tested independently.

6.5 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd

Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China

Telephone: +86 (0) 755 33683668 Fax: +86 (0) 755 33683385

No tests were sub-contracted.

FCC Designation No.: CN1164

6.6 Deviation from Standards

None.

6.7 Abnormalities from Standard Conditions

None.

6.8 Other Information Requested by the Customer

None.

6.9 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.9×10^{-8}
2	RF power, conducted	0.46dB (30MHz-1GHz)
		0.55dB (1GHz-18GHz)
3	Radiated Spurious emission test	4.3dB (30MHz-1GHz)
		4.5dB (1GHz-12.75GHz)
4	Conduction emission	3.5dB (9kHz to 150kHz)
		3.1dB (150kHz to 30MHz)
5	Temperature test	0.64°C
6	Humidity test	3.8%
7	DC power voltages	0.026%

7 Equipment List

RF test system					
Equipment	Manufacturer	Model No.	Serial Number	Cal. Date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
Signal Generator	Keysight	E8257D	MY53401106	03-13-2018	03-12-2019
Spectrum Analyzer	Keysight	N9010A	MY54510339	03-13-2018	03-12-2019
Signal Generator	Keysight	N5182B	MY53051549	03-13-2018	03-12-2019
High-pass filter	Sinoscite	FL3CX03WG1 8NM12-0398-002	---	01-10-2018	01-09-2019
High-pass filter	MICRO-TRONICS	SPA-F-63029-4	---	01-10-2018	01-09-2019
DC Power	Keysight	E3642A	MY54426035	03-13-2018	03-12-2019
PC-1	Lenovo	R4960d	---	03-13-2018	03-12-2019
BT&WI-FI Automatic control	R&S	OSP120	101374	03-13-2018	03-12-2019
RF control unit	JS Tonscend	JS0806-2	15860006	03-13-2018	03-12-2019
RF control unit	JS Tonscend	JS0806-1	15860004	03-13-2018	03-12-2019
RF control unit	JS Tonscend	JS0806-4	158060007	03-13-2018	03-12-2019
BT&WI-FI Automatic test software	JS Tonscend	JS1120-2	---	03-13-2018	03-12-2019
Temperature/Humidity Indicator	biaozhi	HM10	1804186	10-12-2018	10-11-2019

3M Semi/full-anechoic Chamber					
Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
3M Chamber & Accessory Equipment	TDK	SAC-3	---	06-04-2016	06-03-2019
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-401	10-28-2018	10-27-2019
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-618	07-30-2018	07-29-2019
Microwave Preamplifier	Agilent	8449B	3008A02425	08-21-2018	08-20-2019
Microwave Preamplifier	Tonscend	EMC051845SE	980380	01-19-2018	01-18-2019
Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-1869	04-25-2018	04-23-2021
Horn Antenna	ETS-LINDGREN	3117	00057410	06-05-2018	06-03-2021
Double ridge horn antenna	A.H.SYSTEMS	SAS-574	6042	06-05-2018	06-04-2021
Pre-amplifier	A.H.SYSTEMS	PAP-1840-60	6041	06-05-2018	06-04-2021
Loop Antenna	ETS	6502	00071730	06-22-2017	06-21-2019
Spectrum Analyzer	R&S	FSP40	100416	05-11-2018	05-10-2019
Receiver	R&S	ESCI	100435	05-25-2018	05-24-2019
Receiver	R&S	ESCI7	100938-003	11-22-2017	11-23-2018
Receiver	R&S	ESCI7	100938-003	11-23-2018	11-22-2019
Multi device Controller	maturo	NCD/070/10711112	---	01-10-2018	01-09-2019
LISN	schwarzbeck	NNBM8125	81251547	05-11-2018	05-10-2019
LISN	schwarzbeck	NNBM8125	81251548	05-11-2018	05-10-2019
Signal Generator	Agilent	E4438C	MY45095744	03-13-2018	03-12-2019
Signal Generator	Keysight	E8257D	MY53401106	03-13-2018	03-12-2019
Temperature/Humidity Indicator	Shanghai qixiang	HM10	1804298	10-11-2017	10-12-2018
Temperature/Humidity Indicator	Shanghai qixiang	HM10	1804298	10-12-2018	10-11-2019
Communication test set	Agilent	E5515C	GB47050534	03-16-2018	03-15-2019
Cable line	Fulai(7M)	SF106	5219/6A	01-10-2018	01-09-2019
Cable line	Fulai(6M)	SF106	5220/6A	01-10-2018	01-09-2019
Cable line	Fulai(3M)	SF106	5216/6A	01-10-2018	01-09-2019
Cable line	Fulai(3M)	SF106	5217/6A	01-10-2018	01-09-2019
Communication test set	R&S	CMW500	104466	02-05-2018	02-04-2019
High-pass filter	Sinoscite	FL3CX03WG18 NM12-0398-002	---	01-10-2018	01-09-2019
High-pass filter	MICRO-TRONICS	SPA-F-63029-4	---	01-10-2018	01-09-2019
band rejection filter	Sinoscite	FL5CX01CA09C L12-0395-001	---	01-10-2018	01-09-2019
band rejection filter	Sinoscite	FL5CX01CA08C L12-0393-001	---	01-10-2018	01-09-2019
band rejection filter	Sinoscite	FL5CX02CA04C L12-0396-002	---	01-10-2018	01-09-2019
band rejection filter	Sinoscite	FL5CX02CA03C L12-0394-001	---	01-10-2018	01-09-2019

8 Radio Technical Requirements Specification

Reference documents for testing:

No.	Identity	Document Title
1	FCC Part15C	Subpart C-Intentional Radiators
2	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Test Results List:

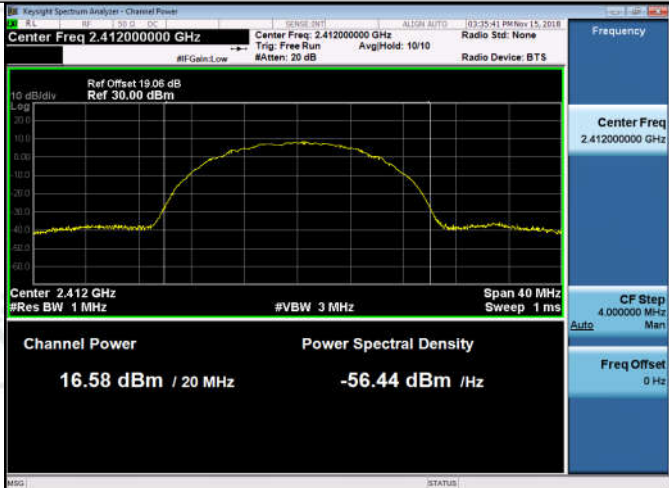
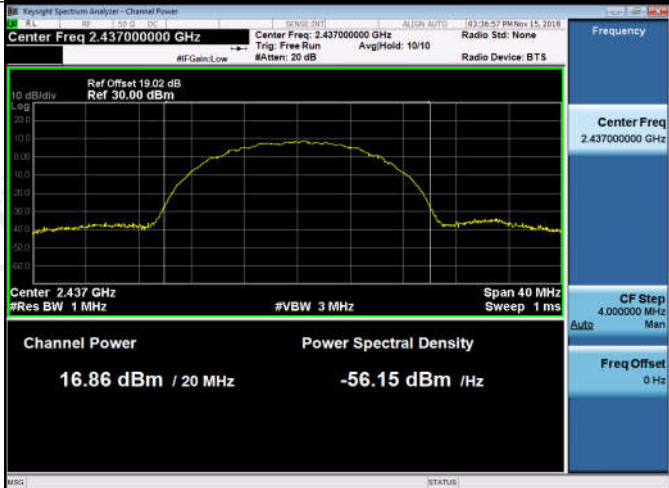
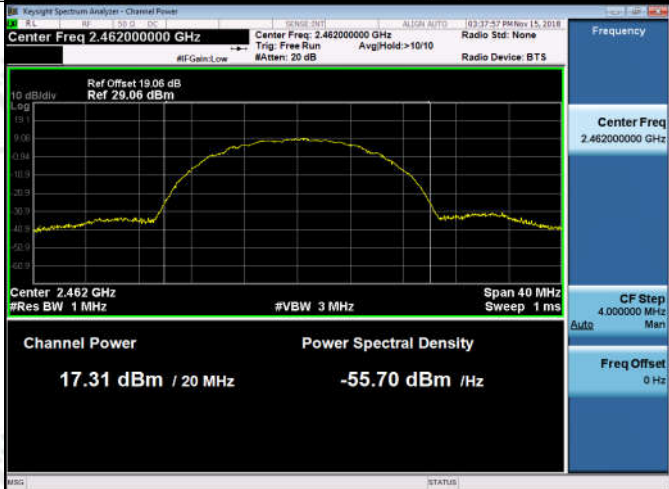
Test Requirement	Test method	Test item	Verdict	Note
Part15C Section 15.247 (b)(3)	ANSI C63.10	Conducted Peak Output Power	PASS	Appendix A)
Part15C Section 15.247 (a)(2)	ANSI C63.10	6dB Occupied Bandwidth	PASS	Appendix B)
Part15C Section 15.247(d)	ANSI C63.10	Band-edge for RF Conducted Emissions	PASS	Appendix C)
Part15C Section 15.247(d)	ANSI C63.10	RF Conducted Spurious Emissions	PASS	Appendix D)
Part15C Section 15.247 (e)	ANSI C63.10	Power Spectral Density	PASS	Appendix E)
Part15C Section 15.203/15.247 (c)	ANSI C63.10	Antenna Requirement	PASS	Appendix F)
Part15C Section 15.207	ANSI C63.10	AC Power Line Conducted Emission	N/A	N/A
Part15C Section 15.205/15.209	ANSI C63.10	Restricted bands around fundamental frequency (Radiated Emission)	PASS	Appendix G)
Part15C Section 15.205/15.209	ANSI C63.10	Radiated Spurious Emissions	PASS	Appendix H)

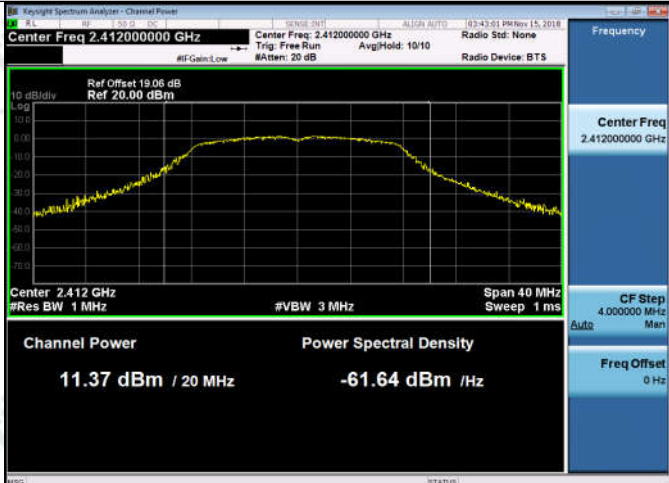
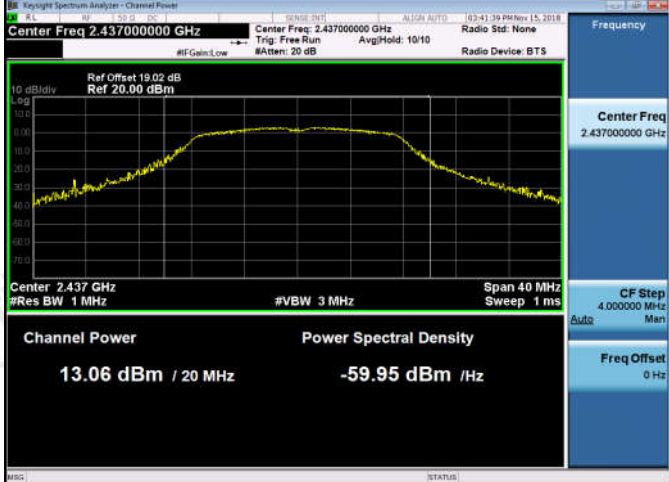
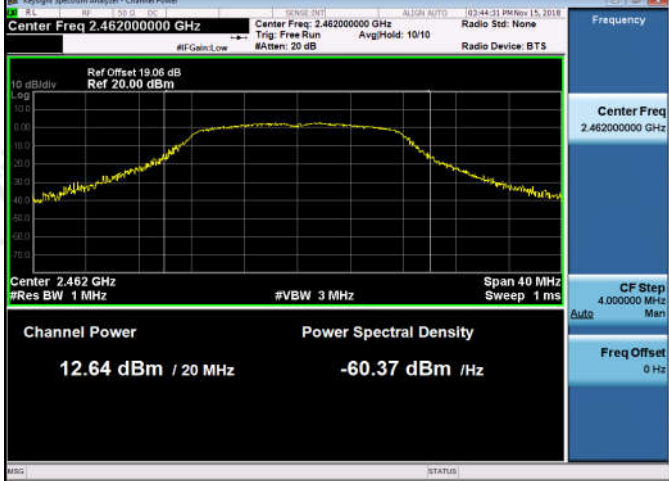
Appendix A): Conducted Peak Output Power

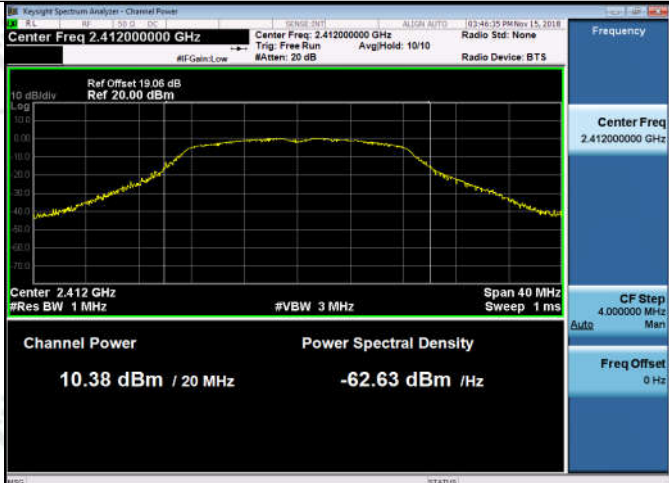
Result Table

Mode	Channel	Conducted Peak Output Power [dBm]	Verdict
11B	LCH	16.58	PASS
11B	MCH	16.86	PASS
11B	HCH	17.31	PASS
11G	LCH	11.37	PASS
11G	MCH	13.06	PASS
11G	HCH	12.64	PASS
11N20SISO	LCH	10.38	PASS
11N20SISO	MCH	12.09	PASS
11N20SISO	HCH	11.53	PASS

Test Graph

Graphs	
11B/LCH	 Keygraph Spectrum Analyzer - Channel Power Center Freq 2.412000000 GHz Center Freq: 2.412000000 GHz Radio Std: None Trig: Free Run Avg/Hold: 10/10 #IF Gain: Low #Atten: 20 dB Radio Device: BTS Ref Offset 19.06 dB Ref 30.00 dBm 10 dB/div Center 2.412 GHz Span 40 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 1 ms Channel Power Power Spectral Density 16.58 dBm / 20 MHz -56.44 dBm / Hz Frequency Center Freq 2.412000000 GHz CF Step 4.000000 MHz Freq Offset 0 Hz
11B/MCH	 Keygraph Spectrum Analyzer - Channel Power Center Freq 2.437000000 GHz Center Freq: 2.437000000 GHz Radio Std: None Trig: Free Run Avg/Hold: 10/10 #IF Gain: Low #Atten: 20 dB Radio Device: BTS Ref Offset 19.02 dB Ref 30.00 dBm 10 dB/div Center 2.437 GHz Span 40 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 1 ms Channel Power Power Spectral Density 16.86 dBm / 20 MHz -56.15 dBm / Hz Frequency Center Freq 2.437000000 GHz CF Step 4.000000 MHz Freq Offset 0 Hz
11B/HCH	 Keygraph Spectrum Analyzer - Channel Power Center Freq 2.462000000 GHz Center Freq: 2.462000000 GHz Radio Std: None Trig: Free Run Avg/Hold: >10/10 #IF Gain: Low #Atten: 20 dB Radio Device: BTS Ref Offset 19.06 dB Ref 29.06 dBm 10 dB/div Center 2.462 GHz Span 40 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 1 ms Channel Power Power Spectral Density 17.31 dBm / 20 MHz -55.70 dBm / Hz Frequency Center Freq 2.462000000 GHz CF Step 4.000000 MHz Freq Offset 0 Hz

11G/LCH	 Keynote Spectrum Analyzer - Channel Power Center Freq 2.412000000 GHz Ref Offset 19.06 dB Ref 20.00 dBm Center 2.412 GHz #Res BW 1 MHz #VBW 3 MHz Span 40 MHz Sweep 1 ms Channel Power 11.37 dBm / 20 MHz Power Spectral Density -61.64 dBm / Hz Center Freq 2.412000000 GHz CF Step 4.000000 MHz Auto Man Freq Offset 0 Hz
11G/MCH	 Keynote Spectrum Analyzer - Channel Power Center Freq 2.437000000 GHz Ref Offset 19.02 dB Ref 20.00 dBm Center 2.437 GHz #Res BW 1 MHz #VBW 3 MHz Span 40 MHz Sweep 1 ms Channel Power 13.06 dBm / 20 MHz Power Spectral Density -59.95 dBm / Hz Center Freq 2.437000000 GHz CF Step 4.000000 MHz Auto Man Freq Offset 0 Hz
11G/HCH	 Keynote Spectrum Analyzer - Channel Power Center Freq 2.462000000 GHz Ref Offset 19.06 dB Ref 20.00 dBm Center 2.462 GHz #Res BW 1 MHz #VBW 3 MHz Span 40 MHz Sweep 1 ms Channel Power 12.64 dBm / 20 MHz Power Spectral Density -60.37 dBm / Hz Center Freq 2.462000000 GHz CF Step 4.000000 MHz Auto Man Freq Offset 0 Hz

11N20SISO/LCH	 Keyight Spectrum Analyzer - Channel Power Center Freq 2.412000000 GHz Ref Offset 19.06 dB Ref 20.00 dBm Center 2.412 GHz #Res BW 1 MHz #VBW 3 MHz Span 40 MHz Sweep 1 ms Channel Power 10.38 dBm / 20 MHz Power Spectral Density -62.63 dBm / Hz
11N20SISO/MCH	 Keyight Spectrum Analyzer - Channel Power Center Freq 2.437000000 GHz Ref Offset 19.02 dB Ref 20.00 dBm Center 2.437 GHz #Res BW 1 MHz #VBW 3 MHz Span 40 MHz Sweep 1 ms Channel Power 12.09 dBm / 20 MHz Power Spectral Density -60.92 dBm / Hz
11N20SISO/HCH	 Keyight Spectrum Analyzer - Channel Power Center Freq 2.462000000 GHz Ref Offset 19.06 dB Ref 20.00 dBm Center 2.462 GHz #Res BW 1 MHz #VBW 3 MHz Span 40 MHz Sweep 1 ms Channel Power 11.53 dBm / 20 MHz Power Spectral Density -61.48 dBm / Hz

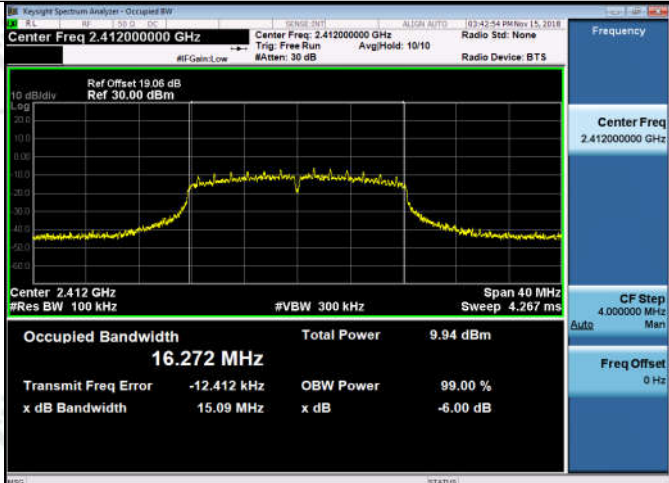
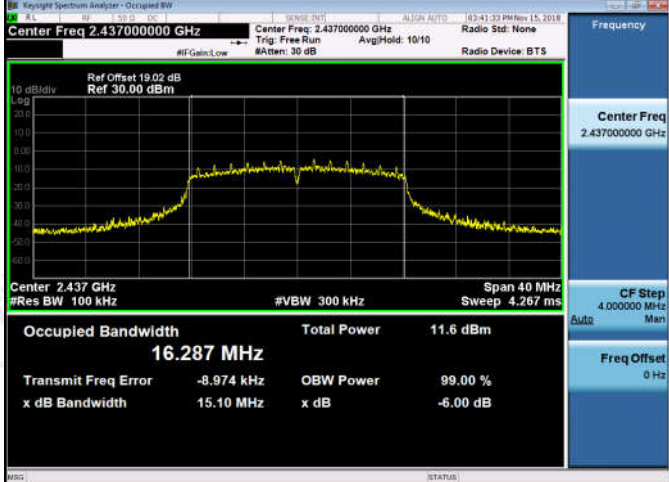
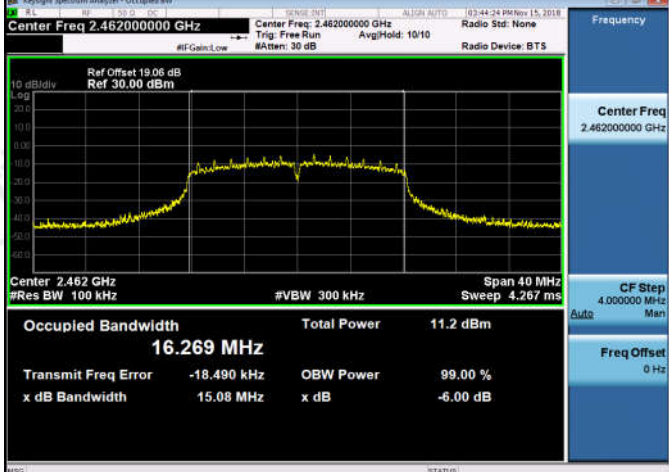
Appendix B): 6dB Occupied Bandwidth

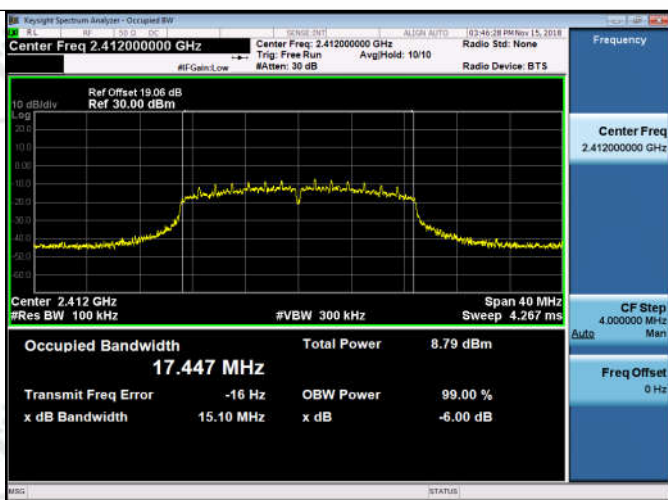
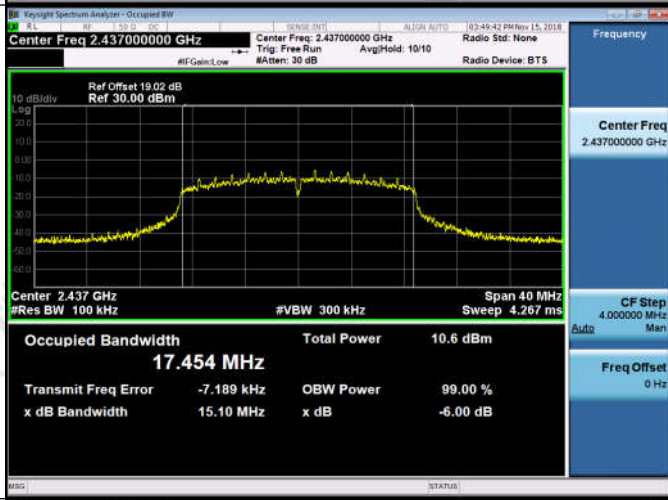
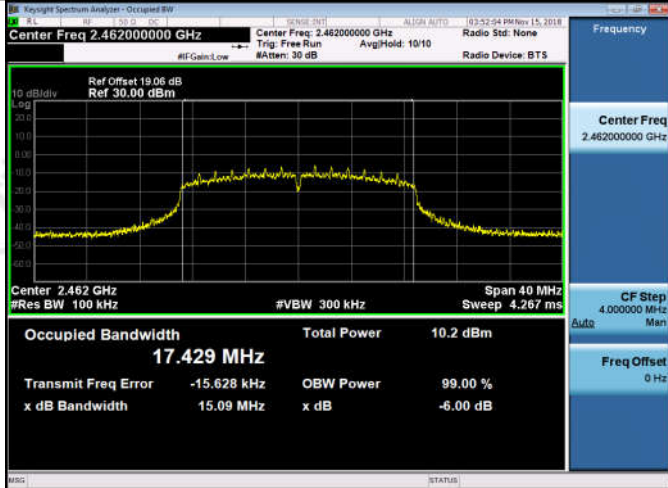
Result Table

Mode	Channel	6dB Bandwidth [MHz]	99% OBW [MHz]	Verdict	Remark
11B	LCH	10.08	14.401	PASS	Peak detector
11B	MCH	10.07	14.401	PASS	
11B	HCH	10.06	14.407	PASS	
11G	LCH	15.09	16.272	PASS	
11G	MCH	15.10	16.287	PASS	
11G	HCH	15.08	16.269	PASS	
11N20SISO	LCH	15.10	17.447	PASS	
11N20SISO	MCH	15.10	17.454	PASS	
11N20SISO	HCH	15.09	17.429	PASS	

Test Graph



11G/LCH	 Center Freq 2.41200000 GHz Ref Offset 19.06 dB Ref 30.00 dBm Center Freq 2.41200000 GHz Trig: Free Run Avg/Hold: 10/10 Radio Std: None Radio Device: BTS Center 2.412 GHz #Res BW 100 kHz #VBW 300 kHz Span 40 MHz Sweep 4.267 ms Occupied Bandwidth 16.272 MHz Total Power 9.94 dBm Transmit Freq Error -12.412 kHz OBW Power 99.00 % x dB Bandwidth 15.09 MHz x dB -6.00 dB
11G/MCH	 Center Freq 2.43700000 GHz Ref Offset 19.02 dB Ref 30.00 dBm Center Freq 2.43700000 GHz Trig: Free Run Avg/Hold: 10/10 Radio Std: None Radio Device: BTS Center 2.437 GHz #Res BW 100 kHz #VBW 300 kHz Span 40 MHz Sweep 4.267 ms Occupied Bandwidth 16.287 MHz Total Power 11.6 dBm Transmit Freq Error -8.974 kHz OBW Power 99.00 % x dB Bandwidth 15.10 MHz x dB -6.00 dB
11G/HCH	 Center Freq 2.46200000 GHz Ref Offset 19.06 dB Ref 30.00 dBm Center Freq 2.46200000 GHz Trig: Free Run Avg/Hold: 10/10 Radio Std: None Radio Device: BTS Center 2.462 GHz #Res BW 100 kHz #VBW 300 kHz Span 40 MHz Sweep 4.267 ms Occupied Bandwidth 16.269 MHz Total Power 11.2 dBm Transmit Freq Error -18.490 kHz OBW Power 99.00 % x dB Bandwidth 15.08 MHz x dB -6.00 dB

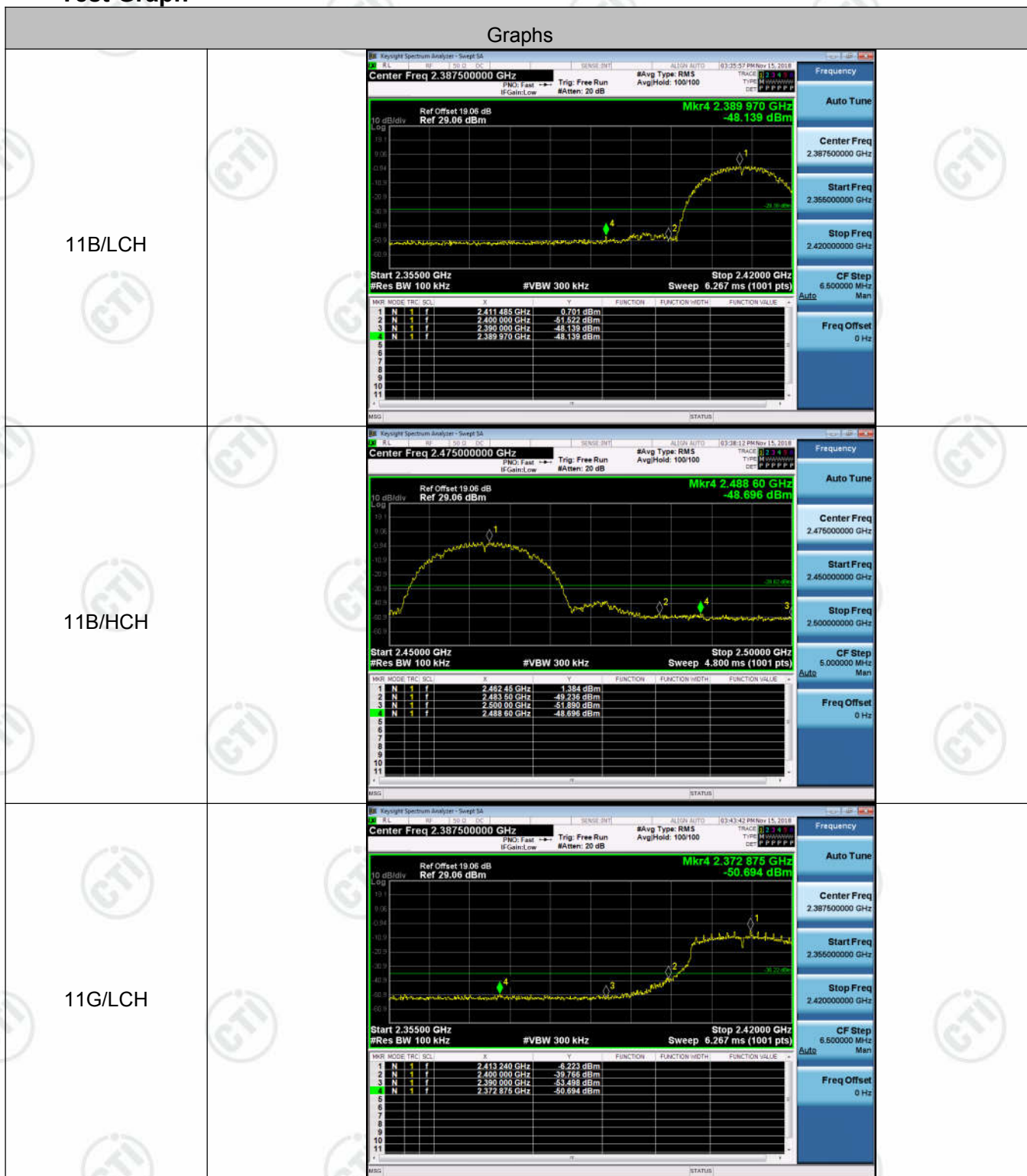
11N20SISO/LCH	
11N20SISO/MCH	
11N20SISO/HCH	

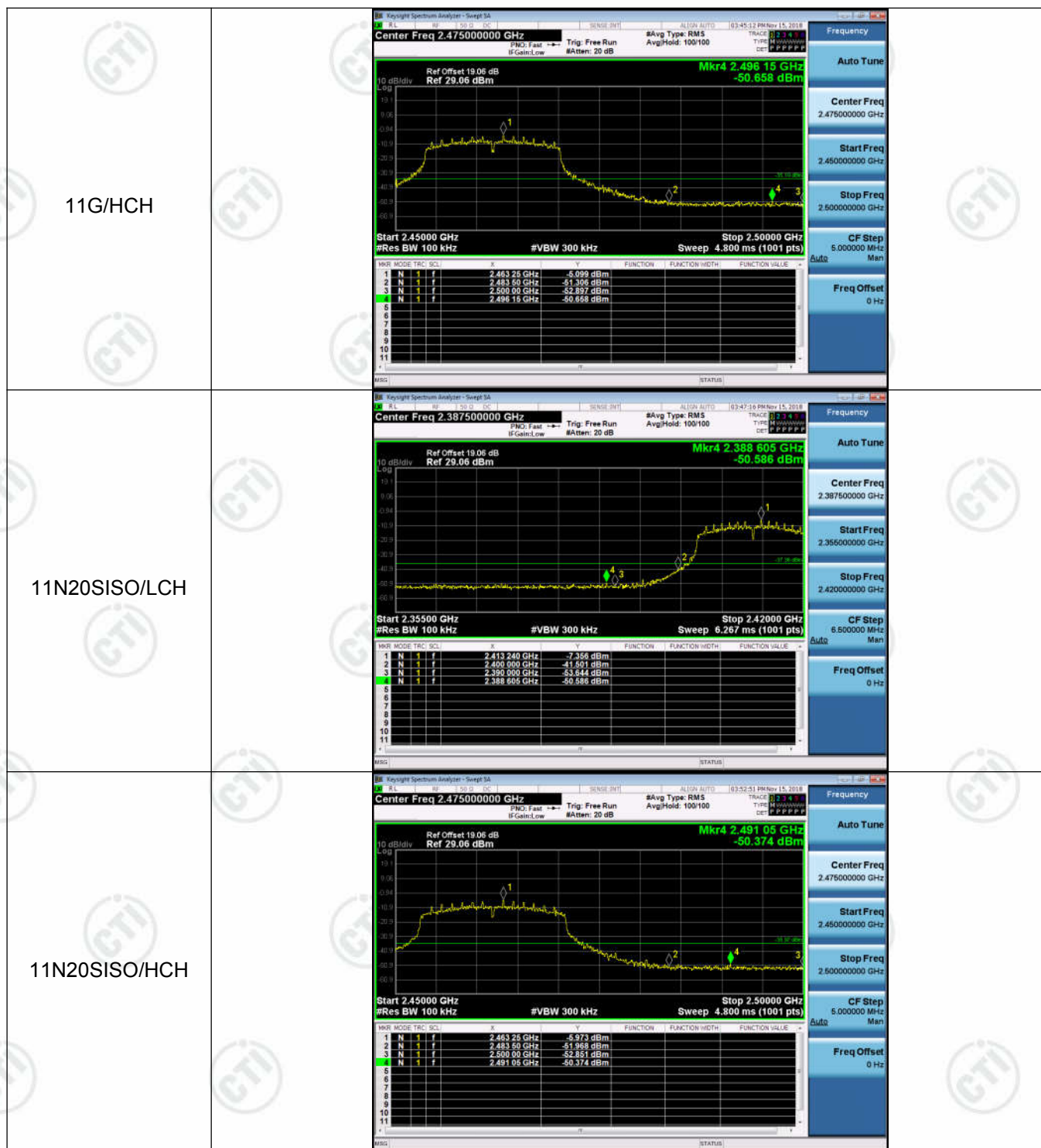
Appendix C): Band-edge for RF Conducted Emissions

Result Table

Mode	Channel	Carrier Power[dBm]	Max.Spurious Level [dBm]	Limit [dBm]	Verdict
11B	LCH	0.701	-48.139	-29.30	PASS
11B	HCH	1.384	-48.696	-28.62	PASS
11G	LCH	-6.223	-50.694	-36.22	PASS
11G	HCH	-5.099	-50.658	-35.10	PASS
11N20SISO	LCH	-7.356	-50.586	-37.36	PASS
11N20SISO	HCH	-5.973	-50.374	-35.97	PASS

Test Graph





Appendix D): RF Conducted Spurious Emissions

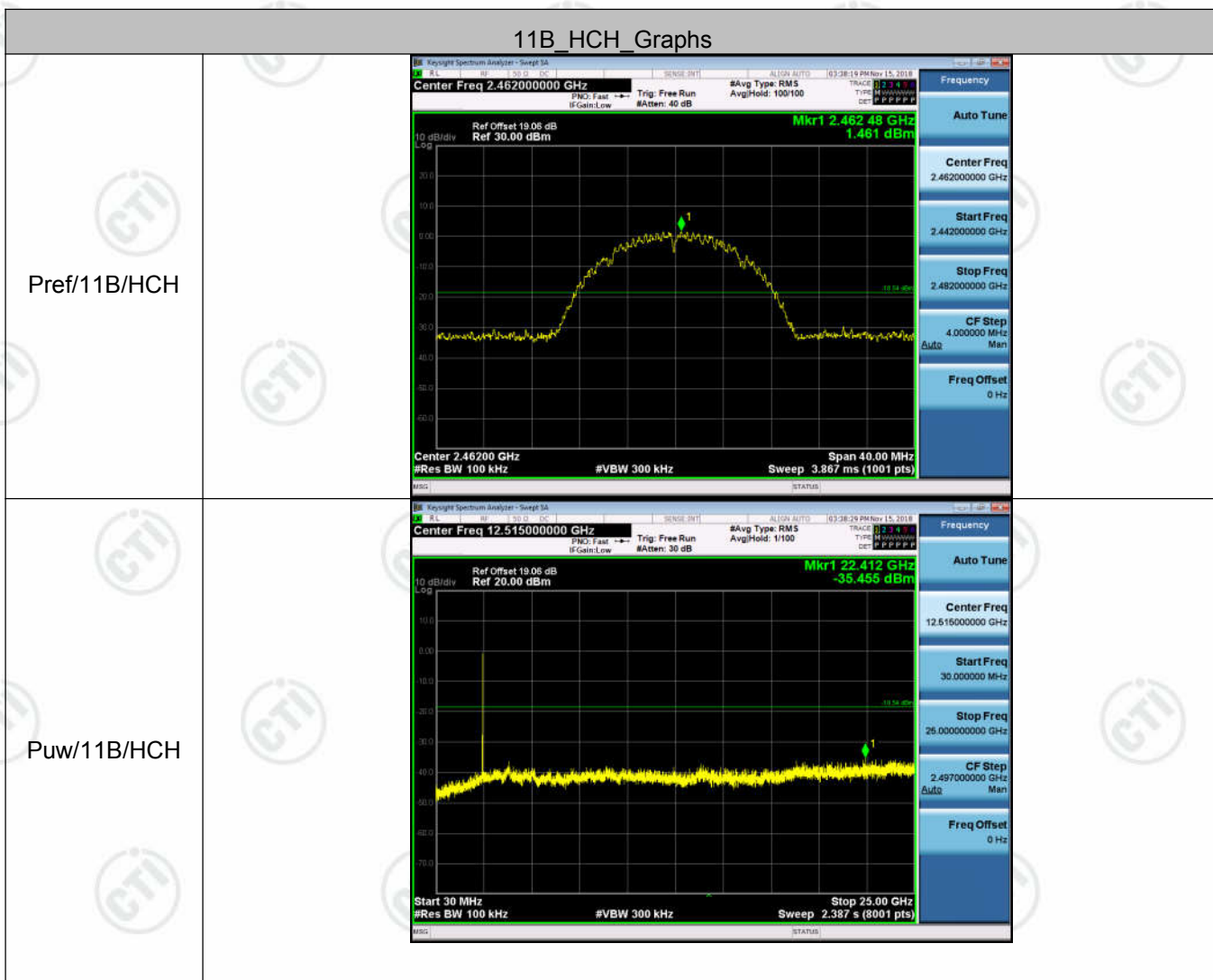
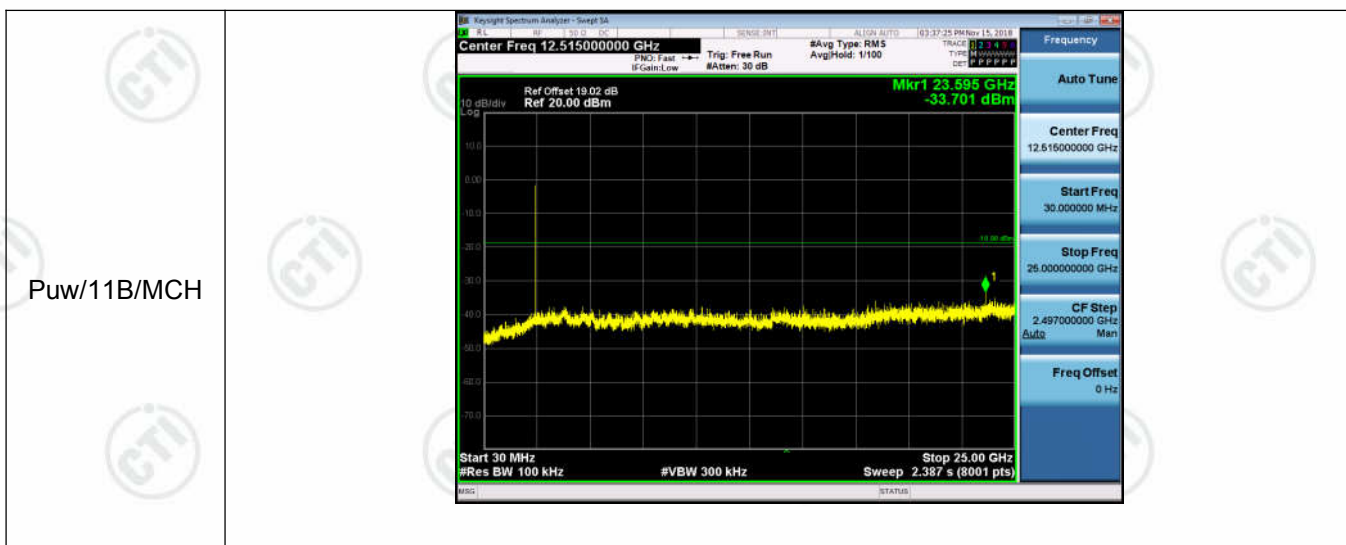
Result Table

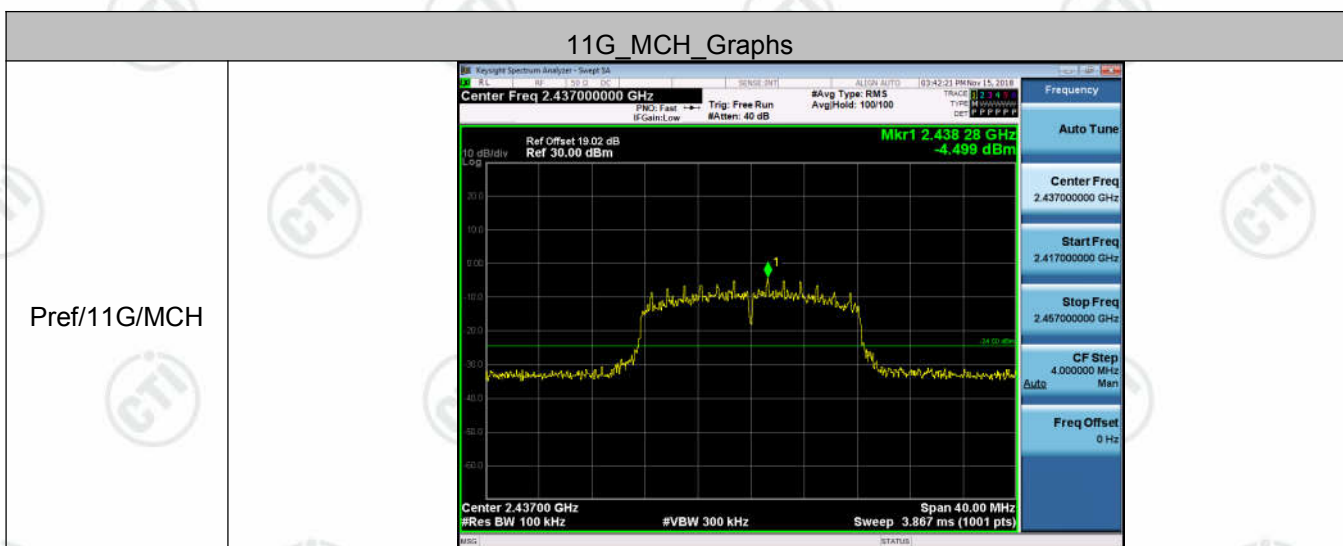
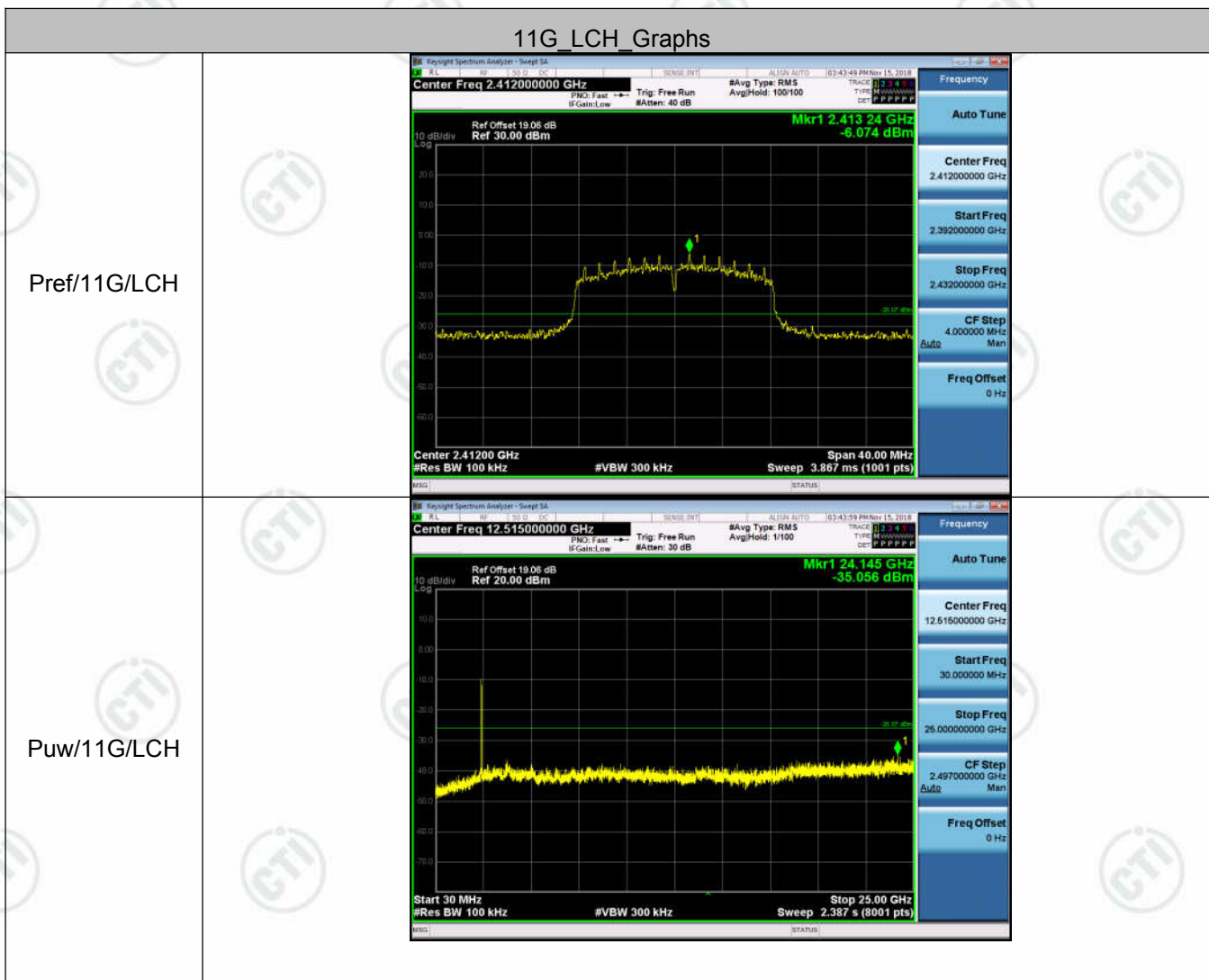
Mode	Channel	Pref [dBm]	Puw[dBm]	Verdict
11B	LCH	0.797	<Limit	PASS
11B	MCH	1.019	<Limit	PASS
11B	HCH	1.461	<Limit	PASS
11G	LCH	-6.074	<Limit	PASS
11G	MCH	-4.499	<Limit	PASS
11G	HCH	-4.925	<Limit	PASS
11N20SISO	LCH	-7.171	<Limit	PASS
11N20SISO	MCH	-5.279	<Limit	PASS
11N20SISO	HCH	-5.953	<Limit	PASS

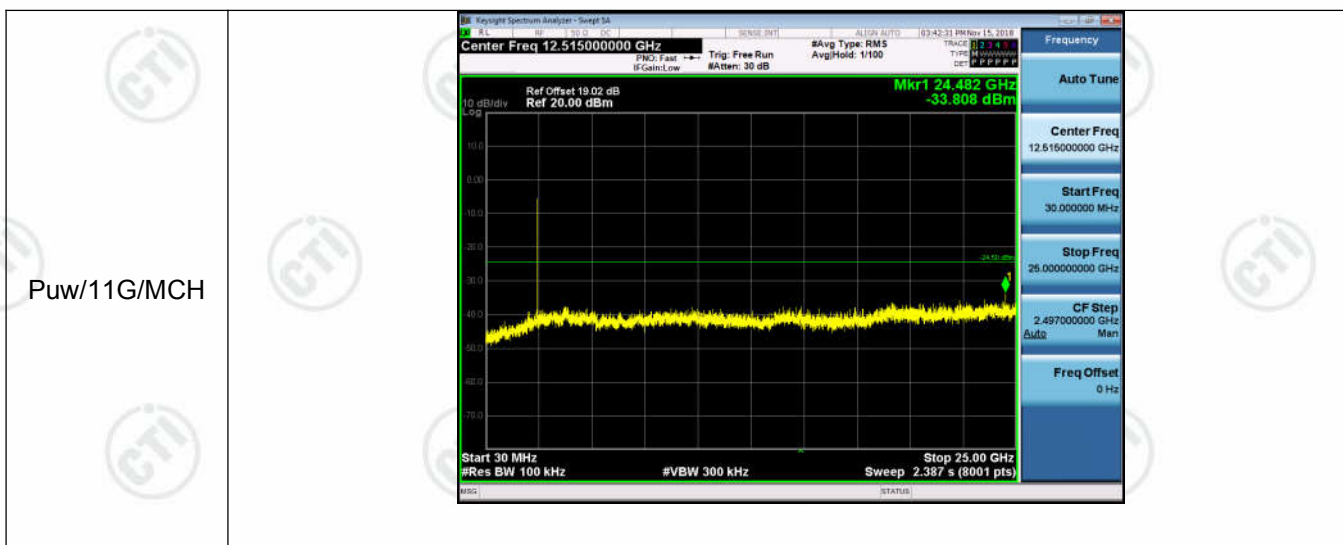
Test Graph

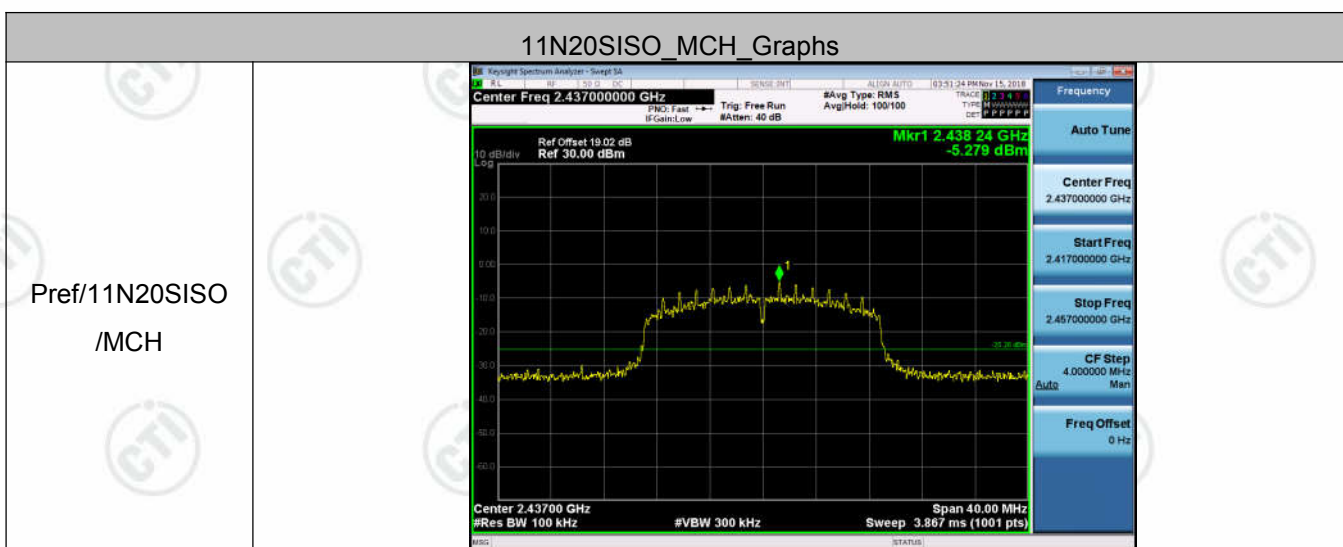
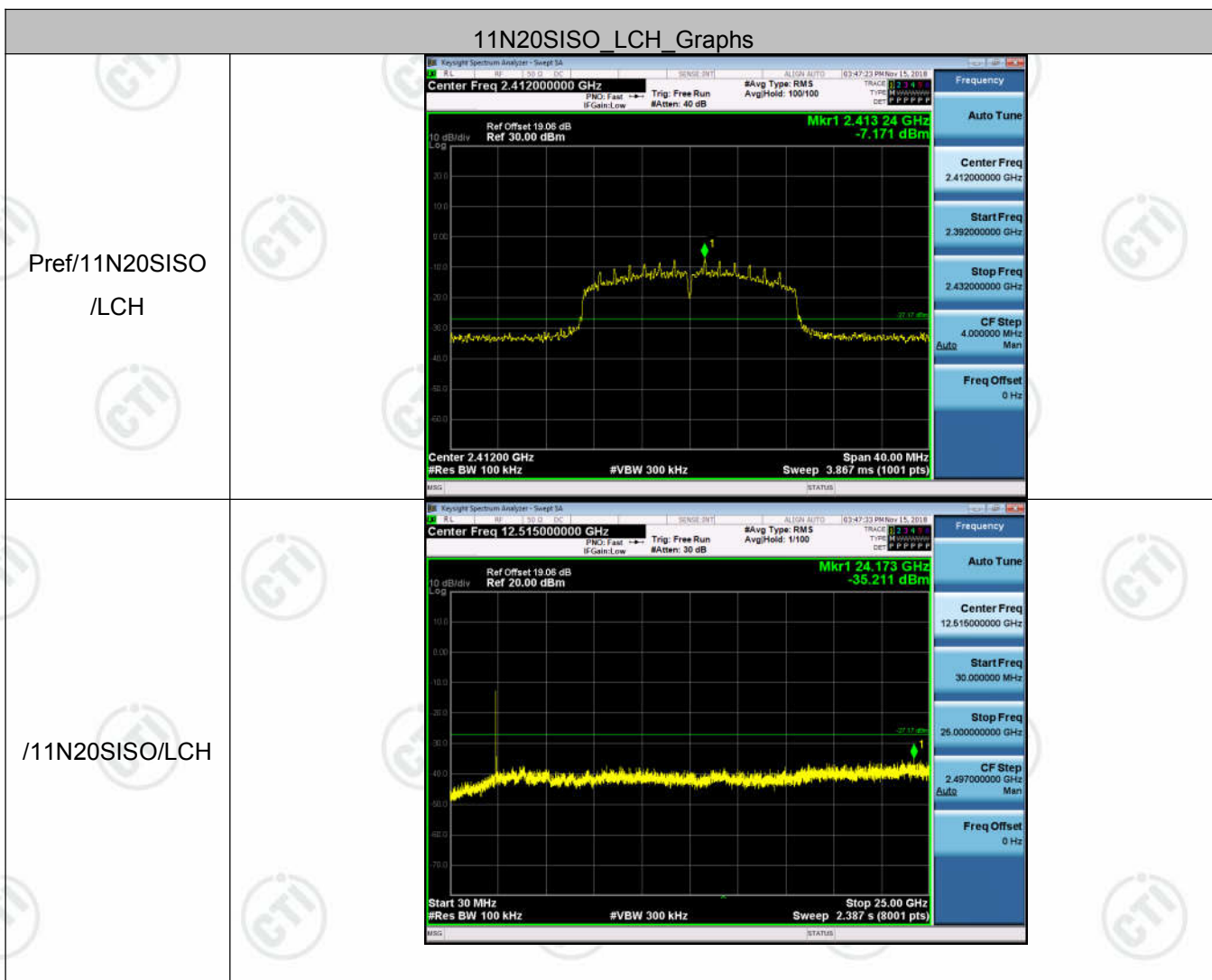
11B_LCH_Graphs	
Pref/11B/LCH	
Puw/11B/LCH	

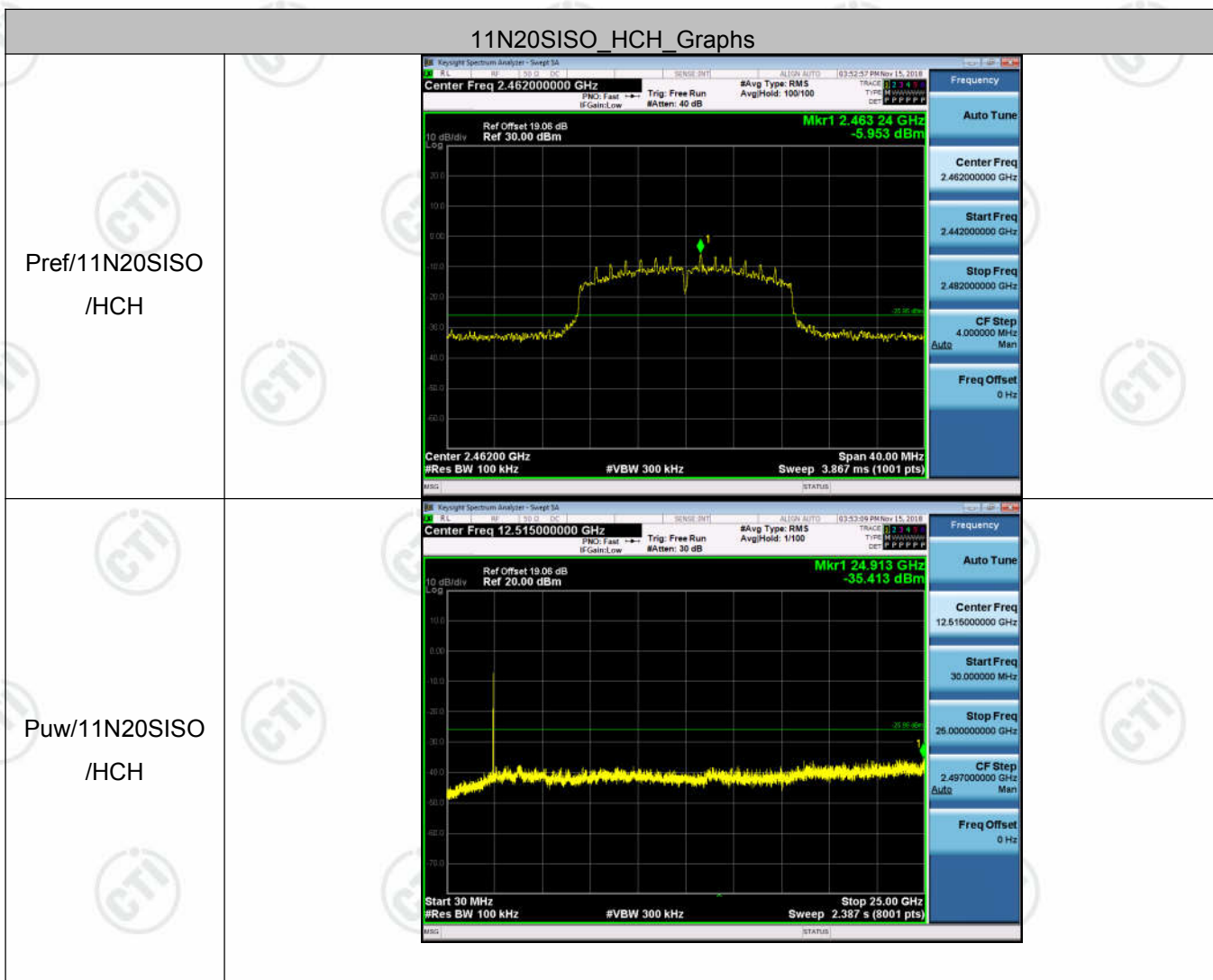
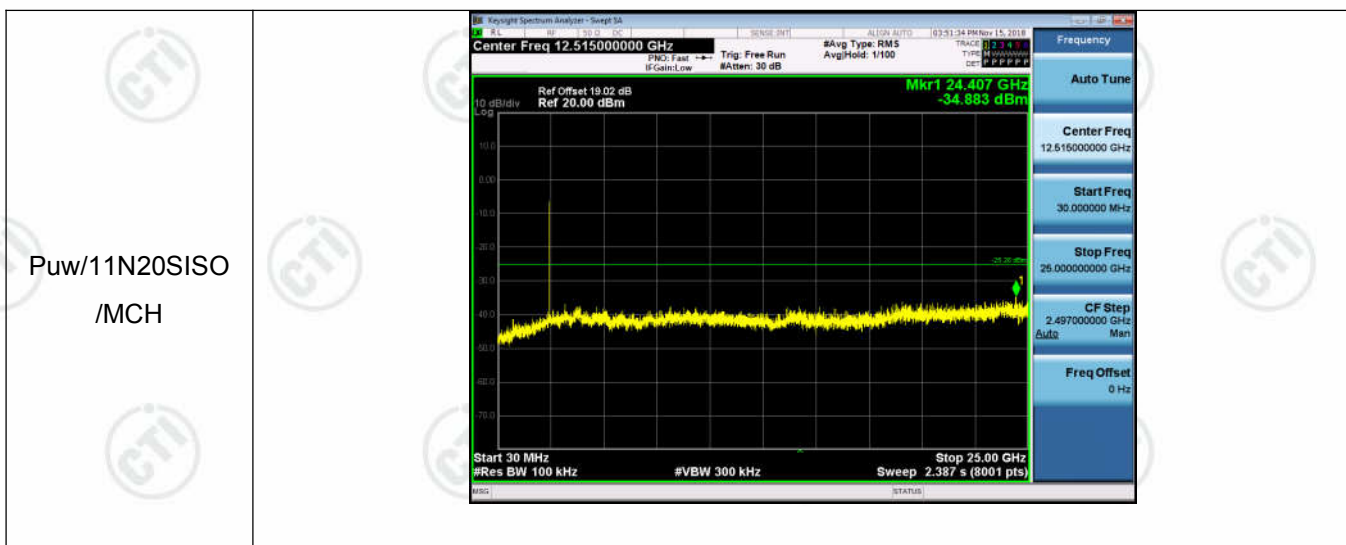
11B_MCH_Graphs	
Pref/11B/MCH	











Appendix E): Power Spectral Density

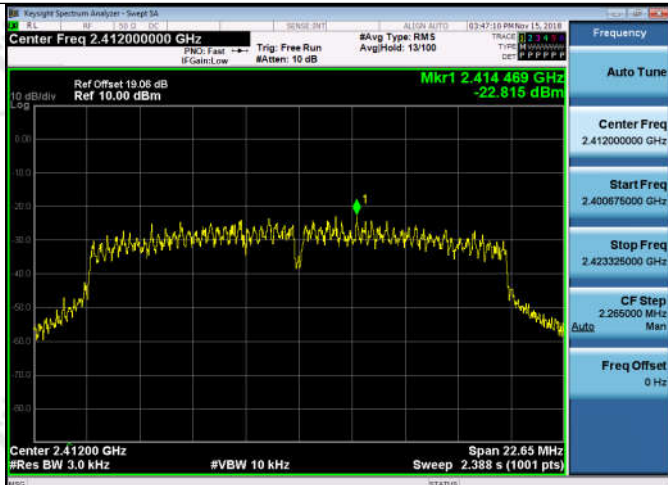
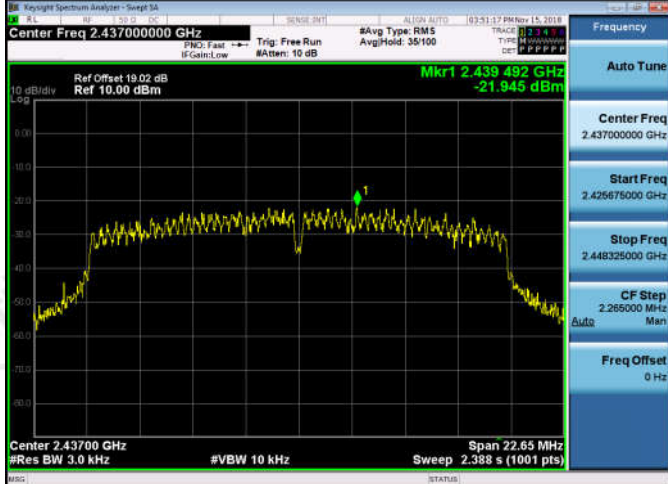
Result Table

Mode	Channel	Power Spectral Density[dBm/3kHz]	Limit [dBm/3kHz]	Verdict
11B	LCH	-13.081	8	PASS
11B	MCH	-12.883	8	PASS
11B	HCH	-12.939	8	PASS
11G	LCH	-22.541	8	PASS
11G	MCH	-20.588	8	PASS
11G	HCH	-20.942	8	PASS
11N20SISO	LCH	-22.815	8	PASS
11N20SISO	MCH	-21.945	8	PASS
11N20SISO	HCH	-22.467	8	PASS

Test Graph

Graphs	
11B/LCH	
11B/MCH	
11B/HCH	



11N20SISO/LCH	
11N20SISO/MCH	
11N20SISO/HCH	