

FCC 47 CFR PART 15 SUBPART C ISED RSS 247 ISSUE 2

CERTIFICATION TEST REPORT

For

Smart Cordless Hard Floor Cleaner

MODEL NUMBER: FW05US0001

ADDITIONAL MODEL NUMBER: FW05CA0001, FW05US0201

PROJECT NUMBER: 4789256329

REPORT NUMBER: 4789256329-1

FCC ID: 2ASWB-FS3

IC: 24918-FS3

ISSUE DATE: Jan. 14, 2020

Prepared for

Ecovacs Robotics Co Ltd

Prepared by

UL-CCIC COMPANY LIMITED

No. 2, Chengwan Road, Suzhou Industrial Park, People's Republic of China

Tel: +86 769 22038881 Fax: +86 769 33244054 Website: www.ul.com



Page 2 of 104

Revision History

Rev.	Issue Date	Revisions	Revised By
V0	01/14/2020	Initial Issue	



TABLE OF CONTENTS

1. AT	TESTATION OF TEST RESULTS	4
2. TE	ST METHODOLOGY	6
3. FA	CILITIES AND ACCREDITATION	6
4. CA	ALIBRATION AND UNCERTAINTY	7
4.1.	MEASURING INSTRUMENT CALIBRATION	7
4.2.	MEASUREMENT UNCERTAINTY	7
5. EG	QUIPMENT UNDER TEST	8
5.1.	DESCRIPTION OF EUT	8
5.2.	MAXIMUM OUTPUT POWER	9
5.3.	CHANNEL LIST	9
5.4.	TEST CHANNEL CONFIGURATION	10
5.5.	THE WORSE CASE POWER SETTING PARAMETER	10
5.6.	DESCRIPTION OF AVAILABLE ANTENNAS	11
5.7.	THE WORSE CASE CONFIGURATIONS	11
5.8.	TEST ENVIRONMENT	12
5.9.	DESCRIPTION OF TEST SETUP	13
5.10.	MEASURING INSTRUMENT AND SOFTWARE USED	14
6. ME	EASUREMENT METHODS	15
7. AN	ITENNA PORT TEST RESULTS	16
7.1.	ON TIME AND DUTY CYCLE	16
7.2.	6 dB BANDWIDTH AND 99% BANDWIDTH	19
7.3.	PEAK CONDUCTED OUTPUT POWER	26
7.4.	POWER SPECTRAL DENSITY	28
7.5.	CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS	35
7.6.		
	6.1. LIMITS AND PROCEDURE	
	S.3. RESTRICTED BANDEDGE	65
7.6	S.4. SPURIOUS EMISSIONS	78
8. AN	ITENNA REQUIREMENTS	104



Page 4 of 104

1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name: Ecovacs Robotics Co Ltd

Address: No. 108 Shihu Road West, Wuzhong Zone, Suzhou, 215128

P.R.China

Manufacturer Information

Company Name: Ecovacs Robotics Co Ltd

Address: No. 108 Shihu Road West, Wuzhong Zone, Suzhou, 215128

P.R.China

Factory Information

Company Name: Ecovacs Robotics Co Ltd

Address: No. 108 Shihu Road West, Wuzhong Zone, Suzhou, 215128

P.R.China

EUT Description

Product Name Smart Cordless Hard Floor Cleaner

Model Name FW05US0001

Additional No. FW05CA0001, FW05US0201

Sample Number 2695885
Data of Receipt Sample Dec. 11, 2019

Date Tested Dec. 11, 2019~ Jan. 14, 2020

APPLICABLE STANDARDS				
STANDARD	TEST RESULTS			
CFR 47 Part 15 Subpart C	PASS			
ISED RSS-247 Issue 2	PASS			
ISED RSS-GEN Issue 5	PASS			



Page 5 of 104

	Summary of Test Results					
Clause	Test Items	FCC/IC Rules	Test Results			
1	6db DTS Bandwidth and 99% Bandwidth	FCC 15.247 (a) (2) RSS-247 Clause 5.2 (a)	Complied			
2	Peak Conducted Power	FCC 15.247 (b) (3) RSS-247 Clause 5.4 (e)	Complied			
3	Power Spectral Density	FCC 15.247 (e) RSS-247 Clause 5.2 (b)	Complied			
4	Conducted Band edge And Spurious emission	FCC 15.247 (d) RSS-247 Clause 5.5	Complied			
5	Radiated Band edges and Spurious emission	FCC 15.247 (d) FCC 15.209 FCC 15.205 RSS-247 Clause 5.5 RSS-GEN Clause 8.9	Complied			
6	Conducted Emission Test For AC Power Port	FCC 15.207 RSS-GEN Clause 8.8	NA			
7	Antenna Requirement	FCC 15.203 RSS-GEN Clause 8.3	Complied			

Remark:

Laboratory Leader

2) The EUT can't work during the AC charging mode.

Tom Tang	Cluris Zhong
Tom Tang Engineer Project Associate	Chris Zhong Senior Project Engineer
Authorized By:	
Scholl Zhang	
Scholl Zhang	

¹⁾ The measurement result for the sample received is <Pass> according to < ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15C, ISED RSS-GEN Issue5, ISED RSS-247 Issue2> > when <Accuracy Method> decision rule is applied.



Page 6 of 104

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15 ISED RSS-GEN ISSUE5 and ISED RSS-247 ISSUE5.

3. FACILITIES AND ACCREDITATION

Test Location	UL-CCIC Company Limited, EMC&RF Lab
Address	No. 2, Chengwan Road, Suzhou Industrial Park, Suzhou 215122 ,China
Accreditation Certificate	CNAS (Certificate No.: L2065) The Laboratory has been assessed and proved to be in compliance with CNAS, The Certificate Registration Number is L2065. A2LA (Certificate No.: 4829.01) UL-CCIC COMPANY LIMITED has been assessed and proved to be in compliance with A2LA. FCC (FCC Designation No.: CN1247) UL-CCIC COMPANY LIMITED has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules. IC (IC Designation No.: 25056) UL-CCIC COMPANY LIMITED has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules.

Note 1: All tests measurement facilities use to collect the measurement data are located at No. 2, Chengwan Road, Suzhou Industrial Park, Suzhou 215122, People's Republic of China

Note 2: For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. These measurements below 30MHz had been correlated to measurements performed on an OFS.

Note 3: The test anechoic chamber in UL-CCIC COMPANY LIMITED 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.



Page 7 of 104

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 recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

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

Test Item	Uncertainty
Conduction emission	3.00dB
Radiation Emission test(include Fundamental emission) (9KHz-30MHz)	3.32dB
Radiation Emission test(include Fundamental emission) (30MHz-1GHz)	3.27dB
Radiation Emission test (1GHz to 26GHz)(include Fundamental emission)	3.80dB (1GHz-18Gz)
Notes This was estaintenance and a manifestal and a second of the second	4.11dB (18GHz-26.5Gz)

Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



Page 8 of 104

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

Product Name:	Smart Cordless Hard Floor Cleaner			
Model No.:	FW05US0001			
Operating Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz			
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)			
Channels Step:	Channels with 5MHz step			
Test power grade:	NA (manufacturer declare)			
Test software of EUT:	EspRFtestTool_2.0 (manufacturer declare)			
Antenna Type:	PCB Antenna			
Antenna Gain:	2.3 dBi			
Battery	NAME: Rechargeable Li-ion Battery MODEL: Floor one S3-01 OUTPUT: 4000mAh 21.6V DC 86.4Wh			
Adapter	MODEL:YLJXIIBY-T260100 INPUT:100-240V~50/60Hz 1.0A OUTPUT:26.0V 1.0A			

Model No.:

Number:	Name:	Number:	Name:	Number:	Name:
1	FW05US0001	2	FW05CA0001	3	FW05US0201

Remark: Only the main model **FW05US0001** was tested and only the data of this model is shown in this test report. Since Their electrical circuit design, layout, components used and internal wiring are identical, only the model name, product color, marketing channel and sale country.



Page 9 of 104

5.2. MAXIMUM OUTPUT POWER

Number of Transmit Chains IEEE Std. 802.11 (NTX)		Channel Number	Max PK Conducted Power (dBm)
1	IEEE 802.11B	1-11[11]	14.44
1	IEEE 802.11G	1-11[11]	19.94
1	IEEE 802.11n HT20	1-11[11]	19.88

5.3. CHANNEL LIST

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



Page 10 of 104

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

5.5. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band								
Test Softw	vare		EspRFtestTool_2.0					
	Transmit			Test C	Channel			
Modulation Mode	Antenna		NCB: 20MH	lz	NCB: 40MHz			
Mode	Number	CH 1	CH 6	CH 11	CH 3	CH 6	CH 9	
802.11b	1	NA NA NA						
802.11g	1	NA NA NA]			
802.11n HT20	1	NA NA NA						

Remark: The att in the software is setting 24.



Page 11 of 104

5.6. DESCRIPTION OF AVAILABLE ANTENNAS

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
1	2400-2483.5	PCB Antenna	2.3

Test Mode Transmit at Receive Mo		Description	
IEEE 802.11b ⊠1TX, 1RX		Antenna1 can be used as transmitting/receiving antenna independently.	
IEEE 802.11g ⊠1TX, 1RX		Antenna1 can be used as transmitting/receiving antenna independently.	
IEEE 802.11N (HT20)	⊠1TX, 1RX	Antenna1 can be used as transmitting/receiving antenna independently.	

5.7. THE WORSE CASE CONFIGURATIONS

For the product, there two transmission antennas, and pre-testing both of them, only the worse data for the antenna is recorded in the report.

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

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



Page 12 of 104

5.8. **TEST ENVIRONMENT**

Environment Parameter	Selected Values During Tests				
Relative Humidity	55 ~ 65%				
Atmospheric Pressure:	1025Pa				
Temperature	TN	23 ~ 28°C			
	VL	N/A			
Voltage :	VN	DC 21.6V			
	VH	N/A			

Note: VL= Lower Extreme Test Voltage

VN= Nominal Voltage

VH= Upper Extreme Test Voltage TN= Normal Temperature

Page 13 of 104

5.9. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	Description
1	Laptop	ThinkPad	E550c	N/A
2	Fixed Frequency Board	N/A	N/A	Supply by Customer

I/O PORT

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	N/A	N/A	N/A	N/A	N/A

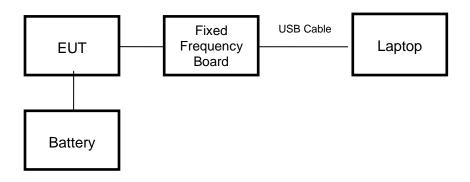
ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
2	USB Cable	N/A	N/A	Supply by UL Lab

TEST SETUP

The EUT can work in an engineer mode with a software through a table PC.

SETUP DIAGRAM FOR TESTS





Page 14 of 104

5.10. MEASURING INSTRUMENT AND SOFTWARE USED

Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Cal.		5.10. MEASURING INSTRUMENT AND SOFTWARE USED									
Serial No. Cal. Last Cal. Next Cal.		Conducted Emissions (Instrument)									
Two-Line V-Network	Used	Equipment	Manufacturer	Model No.		Serial No.		Last Cal.	Next Cal.		
Software	\checkmark	EMI Test Receiver	R&S	ESR:	3	126700	2018-12-13	2019-12-07	2020-12-06		
Software Software		Two-Line V-Network	R&S	ENV2	16	126701	2018-12-13	2019-12-07	2020-12-06		
Used Description	V		R&S	ENY8	31	126711	2018-12-13	2019-12-07	2020-12-06		
Radiated Emissions (Instrument) Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Last Cal. Next Cal. ☑ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28 ☑ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28 ☑ EMI test receiver R&S ESR26 1267603 2018-12-13 2019-12-07 2020-12-06 ☑ Receiver Antenna (gkHz-30MHz) Schwarzbeck FMZB 1513 513-265 2018-06-17 2019-06-16 2022-06-15 ☑ Receiver Antenna (1GHz-18GHz) SunAR RF Motion JB1 126704 N/A 2019-01-28 2022-01-27 ☑ Receiver Antenna (1GHz-18GHz) Schwarzbeck BBHA9170 126705 2018-01-27 2019-01-26 2022-01-26 ☑ Receiver Antenna (18GHz-2.6.3GHz) Schwarzbeck BBHA9170 126706 2018-07-25 2019-07-23 2020-07-22 ☑ Pre-ampli		Software									
Spectrum Analyzer	Used	Des	cription		Ма	nufacturer	Name	Version			
Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Cal. Cal.	V	Test Software for 0	Conducted distur	bance		R&S	EMC32	Ver. 9.25			
Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28 Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 201			Ra	diated E	miss	ions (Instrum	ent)				
☑ EMI test receiver Antenna (Receiver Antenna Receiver Antenna (Receiver Antena	Used	Equipment	Manufacturer	Model	No.	Serial No.		Last Cal.	Next Cal.		
✓ Receiver Antenna (gkHz-30MHz) Schwarzbeck (gkHz-30MHz) FMZB 1513 513-265 2018-06-17 2019-06-16 2022-06-15 ✓ Receiver Antenna (30MHz-1GHz) SunAR RF Motion JB1 126704 N/A 2019-01-28 2022-01-27 ✓ Receiver Antenna (1GHz-18GHz) Reseiver Antenna (1(GHz-26.5GHz) Schwarzbeck BBHA9170 126706 2018-01-27 2019-01-26 2022-01-26 ✓ Receiver Antenna (18GHz-26.5GHz) Schwarzbeck BBHA9170 126706 2018-02-07 2019-02-06 2022-02-05 ✓ Receiver Antenna (18GHz-26.5GHz) TOYO HAP 26-40W 00000012 2018-07-25 2019-07-23 2020-07-22 ✓ Pre-amplification (To 18GHz) Compliance Direction System Inc. PAP-1G18-50 14140-13467 2018-04-10 2019-04-09 2020-04-08 ✓ Pre-amplification (To 26.5GHz) R&S SCU-26D 134668 N/A 2019-03-18 2020-03-17 ✓ Band Reject Filter Wainwright Wilk X10-20-20 2018-02-07 2019-03-18 2020-03-28	$\overline{\mathbf{A}}$	Spectrum Analyzer	Keysight	N9010)B	MY57110128	2018-05-30	2019-05-29	2020-05-28		
	$\overline{\checkmark}$	EMI test receiver	R&S	ESR2	26	1267603	2018-12-13	2019-12-07	2020-12-06		
	V			FMZB 1	513	513-265	2018-06-17	2019-06-16	2022-06-15		
	V			JB1		126704	N/A	2019-01-28	2022-01-27		
Manufacturer Model No. Serial No. Schwarzbeck BBHA91/0 126/06 2018-02-07 2019-02-06 2022-02-05	V		R&S	HF90)7	126705	2018-01-27	2019-01-26	2022-01-26		
			Schwarzbeck	BBHA9	170	126706	2018-02-07	2019-02-06	2022-02-05		
✓ Fre-amplification (To 18GHz) Direction System Inc. PAP-1G18-50 14140-13467 2018-04-10 2019-04-09 2020-04-08 ✓ Pre-amplification (To 26.5GHz) R&S SCU-26D 134668 N/A 2019-03-18 2020-03-17 ✓ Band Reject Filter Wainwright WRCJV8-2350-2400-2483.5-2533.5-40SS 1 2018-02-07 2019-02-06 2020-02-05 ✓ Highpass Filter Wainwright WHKX10-2700-3000-18000-40SS 2 2018-05-30 2019-05-29 2020-05-28 Software Used Description Manufacturer Name Version ✓ Test Software for Radiated disturbance Tonscend JS32 V1.0 Other instruments Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Last Cal. Next Cal. ✓ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28			TOYO	HAP 26-	40W	00000012	2018-07-25	2019-07-23	2020-07-22		
Wainwright Wainwright Wainwright Wainwright Wainwright Wainwright Wainwright 2350-2400-2483.5-2533.5-40SS WHKX10-2700-3000-18000-40SS Wainwright Wainwr	V		Direction	PAP-1G1	18-50	14140-13467	2018-04-10	2019-04-09	2020-04-08		
☑ Band Reject Filter Wainwright 2350-2400-2483.5-2533.5-40SS 1 2018-02-07 2019-02-06 2020-02-05 ☑ Highpass Filter Wainwright WHKX10-2700-3000-18000-40SS 2 2018-05-30 2019-05-29 2020-05-28 Software Used Description Manufacturer Name Version ☑ Test Software for Radiated disturbance Tonscend JS32 V1.0 Other instruments Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Cal. Last Cal. Next Cal. ☑ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28	V	•	R&S	SCU-2	6D	134668	N/A	2019-03-18	2020-03-17		
✓ Highpass Filter Wainwright 2700-3000-18000-40SS 2 2018-05-30 2019-05-29 2020-05-28 Software Used Description Manufacturer Name Version ✓ Test Software for Radiated disturbance Tonscend JS32 V1.0 Other instruments Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Last Cal. Next Cal. ✓ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28		Band Reject Filter	Wainwright	2350-24 2483.5-25	400- 533.5-	1	2018-02-07	2019-02-06	2020-02-05		
Used Description Manufacturer Name Version ✓ Test Software for Radiated disturbance Tonscend JS32 V1.0 Other instruments Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Last Cal. Next Cal. ✓ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28		Highpass Filter	Wainwright	WHKX10- 2700-3000-		2	2018-05-30	2019-05-29	2020-05-28		
✓ Test Software for Radiated disturbance Tonscend JS32 V1.0 Other instruments Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Last Cal. Next Cal. ✓ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28		Software									
Other instruments Used Equipment Manufacturer Model No. Serial No. Upper Last Cal. Last Cal. Next Cal. ☑ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28	Used	Desci	ription	Manufac		turer	Name	Version			
UsedEquipmentManufacturerModel No.Serial No.Upper Last Cal.Last Cal.Next Cal.☑Spectrum AnalyzerKeysightN9010BMY571101282018-05-302019-05-292020-05-28	V	Test Software for R	adiated disturbar	nce Tonsce		end	JS32	V1.0			
Osed Equipment Manufacturer Model No. Serial No. Cal. Last Cal. Next Cal. ✓ Spectrum Analyzer Keysight N9010B MY57110128 2018-05-30 2019-05-29 2020-05-28				Oth	er ins	truments					
	Used	Equipment	Manufacturer	Model No.		Serial No.		Last Cal.	Next Cal.		
	$\overline{\checkmark}$	Spectrum Analyzer	Keysight	N9010	OB	MY57110128	2018-05-30	2019-05-29	2020-05-28		
Power Meter Keysight U2021XA MY57110002 2018-06-13 2019-06-12 2020-06-11	$\overline{\checkmark}$	Power Meter	Keysight	U2021	XA	MY57110002	2018-06-13	2019-06-12	2020-06-11		



Page 15 of 104

6. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6dB Bandwidth and 99% Bandwidth	KDB 558074 D01 15.247 Meas Guidance v05r02	8.2
2	Peak Output Power	KDB 558074 D01 15.247 Meas Guidance v05r02	8.3.1.3/8.3.2.3
3	Power Spectral Density	KDB 558074 D01 15.247 Meas Guidance v05r02	8.4
4	Out-of-band emissions in non-restricted bands	KDB 558074 D01 15.247 Meas Guidance v05r02	8.5
5	Out-of-band emissions in restricted bands	KDB 558074 D01 15.247 Meas Guidance v05r02	8.6
6	Band-edge	KDB 558074 D01 15.247 Meas Guidance v05r02	8.7

Page 16 of 104

7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

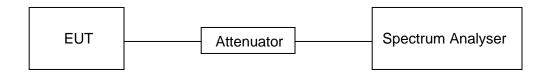
LIMITS

None; for reporting purposes only

PROCEDURE

FCC KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP



TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 21.6V

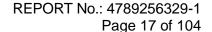
RESULTS

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (db)	1/T Minimum VBW (KHz)	Final VBW (KHz)
11B	4.188	4.712	0.89	89	0.50	0.24	1
11G	0.6911	0.794	0.87	87	0.60	1.45	2
11N20 HT20	0.6551	0.7594	0.86	86	0.65	1.53	2

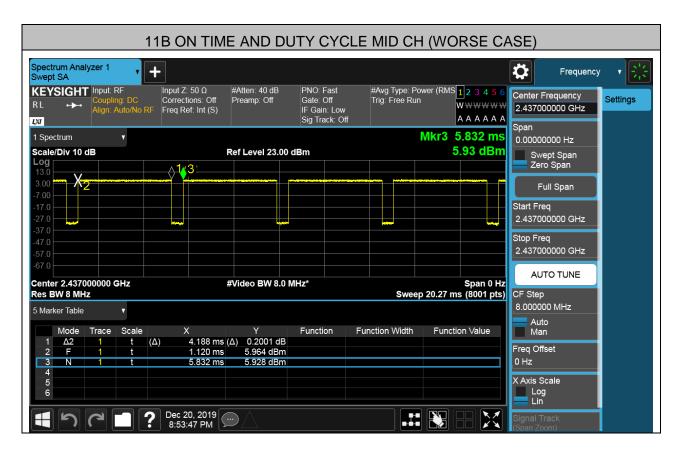
Note: 1) Duty Cycle Correction Factor=10log(1/x).

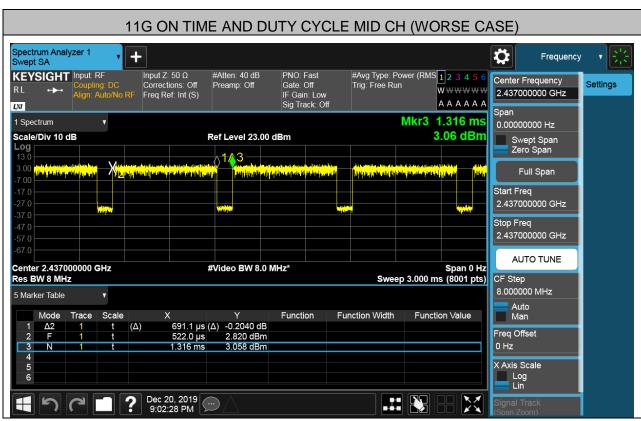
2) Where: x is Duty Cycle(Linear)

3) Where: T is On Time (transmit duration)

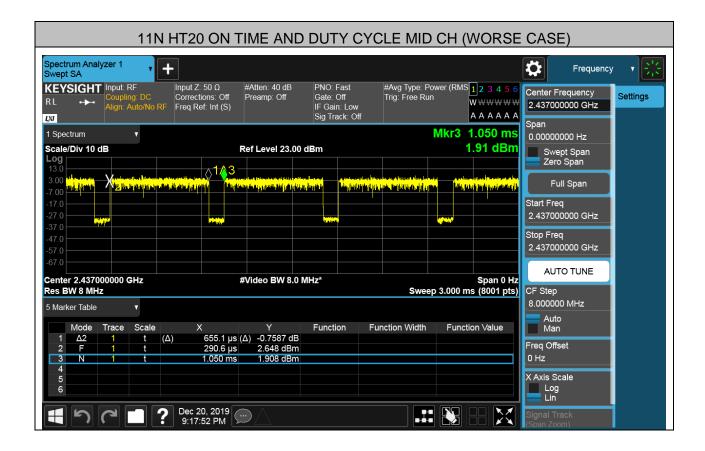












Page 19 of 104

7.2. 6 dB BANDWIDTH AND 99% BANDWIDTH

LIMITS

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

TEST PROCEDURE

Refer to FCC KDB 558074, connect the UUT to the spectrum analyser and use the following settings:

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

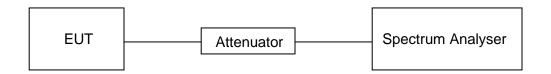
Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 21.6V



TEST SETUP

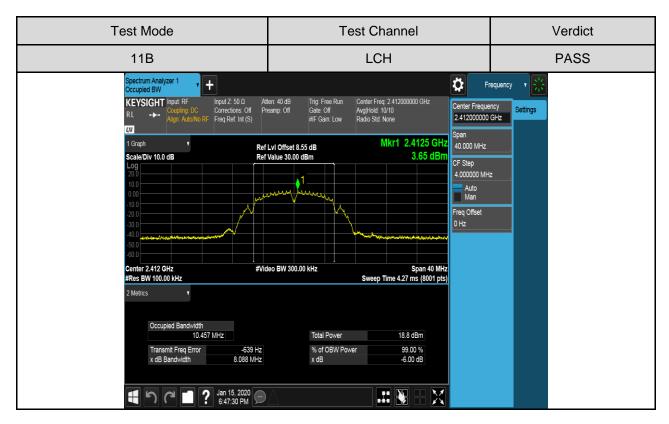


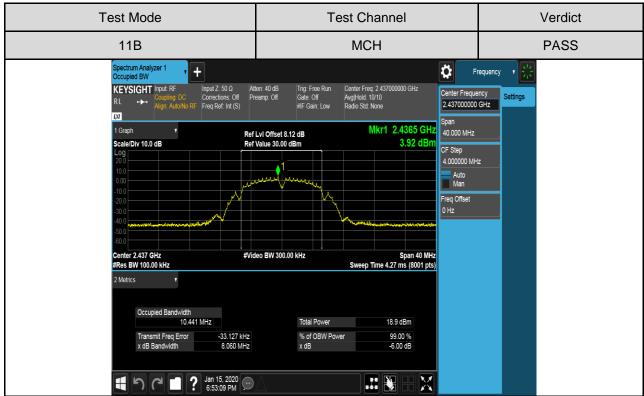
RESULTS TABLE

Test Mode	Test Channel	6dB bandwidth(MHz)	99% bandwidth(MHz)	Verdict
11B	LCH	8.088	10.457	PASS
11B	MCH	8.060	10.441	PASS
11B	HCH	8.090	10.403	PASS
11G	LCH	16.32	16.363	PASS
11G	MCH	16.26	16.362	PASS
11G	HCH	16.30	16.370	PASS
11N HT20	LCH	16.62	17.435	PASS
11N HT20	MCH	16.63	17.429	PASS
11N HT20	HCH	16.60	17.441	PASS



Test Graphs

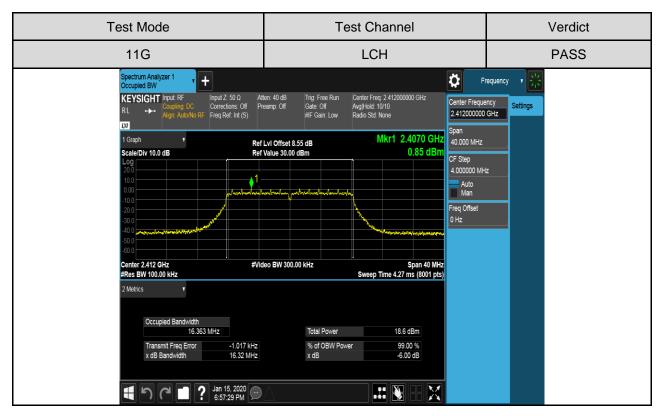






Page 22 of 104





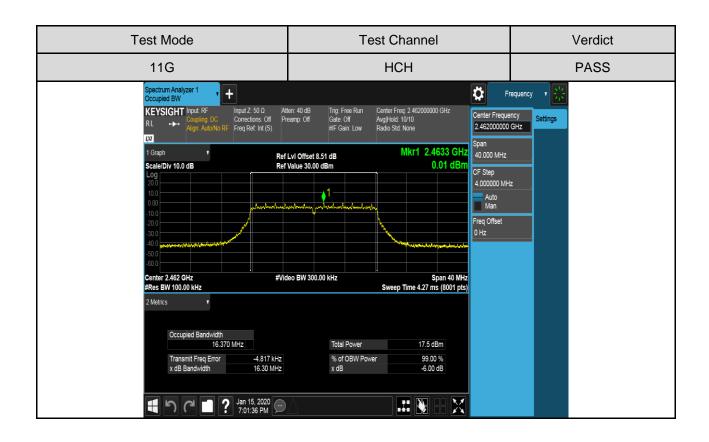


Test Mode Test Channel Verdict **PASS** 11G **MCH** Spectrum Analyzer 1 Occupied BW Ö Frequency Atten: 40 dB Preamp: Off Center Freq: 2.437000000 GHz Avg|Hold:>10/10 Radio Std: None Input Z: 50 Ω Corrections: Off Freq Ref: Int (S) Trig: Free Run Gate: Off #IF Gain: Low KEYSIGHT Input RF Settings 2.437000000 GHz L)XI 1 Graph Ref Lvl Offset 8.12 dB Ref Value 30.00 dBm Mkr1 2.4383 GHz 40.000 MHz 0.29 dBr Scale/Div 10.0 dB CF Step 4.000000 MHz Auto Man Freq Offset 0 Hz Span 40 MHz Sweep Time 4.27 ms (8001 pts) Center 2.437 GHz #Res BW 100.00 kHz #Video BW 300.00 kHz 2 Metrics Occupied Bandwidth 16.362 MHz Total Power 17.7 dBm % of OBW Power -8.858 kHz 16.26 MHz 99.00 % -6.00 dB Transmit Freq Error x dB

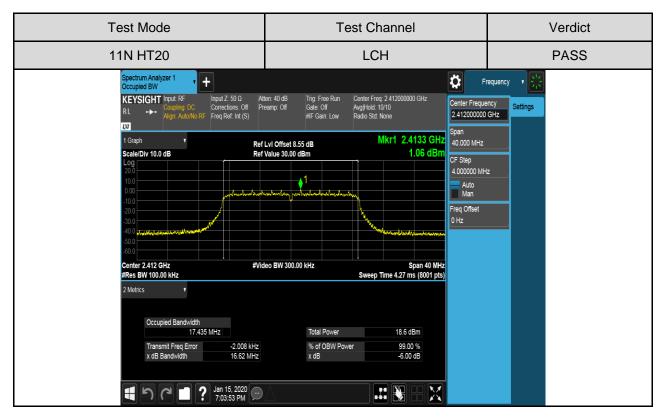
X

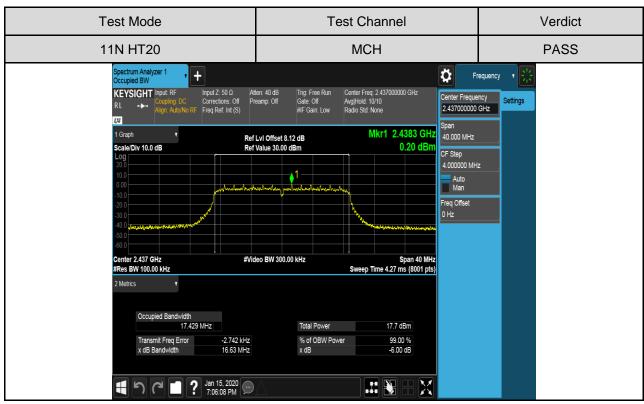
👫

1 5 C 2 2020 5 Jan 15, 2020 5 6:59:38 PM



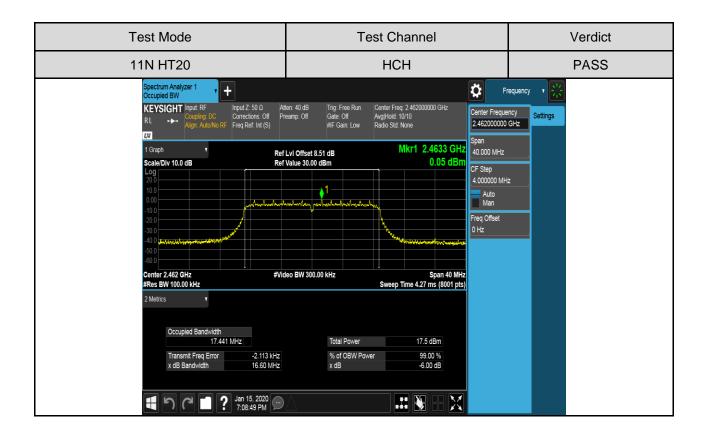








Page 25 of 104





REPORT No.: 4789256329-1 Page 26 of 104

7.3. PEAK CONDUCTED OUTPUT POWER

LIMITS

FCC Part15 (15.247) Subpart C, ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(b)(3) ISED RSS-247 5.4 (d) RSS-Gen Clause 6.12	Peak Output Power	1 watt or 30dBm	2400-2483.5

TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.

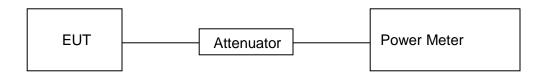
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.

Measure the power of each channel.

Peak Detector use for Peak result.

AVG Detector use for AVG result.

TEST SETUP



TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 21.6V



Page 27 of 104

RESULTS

Maximum Peak Conducted Output Power(dBm)

Test Mode	Test Channel	Maximum Peak Conducted Output Power(dBm)	EIRP (dBm)	Result
	LCH	14.44	16.74	Pass
11B	MCH	14.42	16.72	Pass
	HCH	14.10	16.40	Pass
	LCH	19.94	22.24	Pass
11G	MCH	19.01	21.31	Pass
	HCH	18.79	21.09	Pass
	LCH	19.88	22.18	Pass
11N HT20	MCH	19.02	21.32	Pass
	HCH	18.84	21.14	Pass

Page 28 of 104

7.4. POWER SPECTRAL DENSITY

LIMITS

FCC Part15 (15.247) Subpart C, ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
FCC §15.247 (e) ISED RSS-247 5.2 (b)	Power Spectral Density	8 dBm in any 3 kHz band	2400-2483.5

TEST PROCEDURE

Refer to FCC KDB 558074, 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.

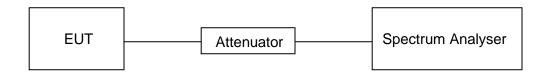
Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 21.6V

TEST SETUP



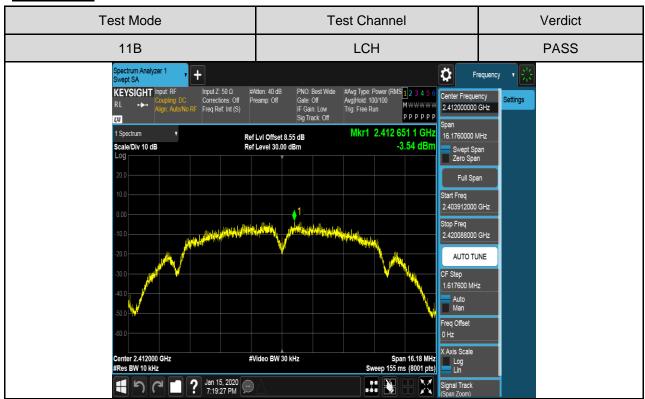


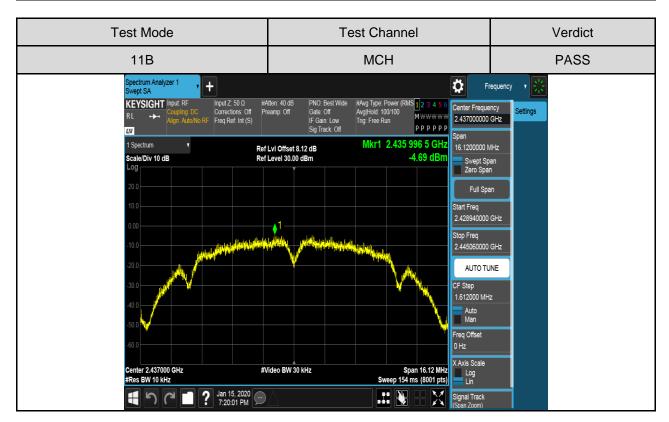
Page 29 of 104

Test Mode	Test Channel	Maximum Peak power spectral density (dBm/3KHz)	Result
	LCH	-3.54	Pass
11B	MCH	-4.69	Pass
	HCH	-4.76	Pass
	LCH	-7.80	Pass
11G	MCH	-8.83	Pass
	HCH	-9.00	Pass
	LCH	-7.56	Pass
11N HT20	MCH	-8.33	Pass
	HCH	-8.60	Pass



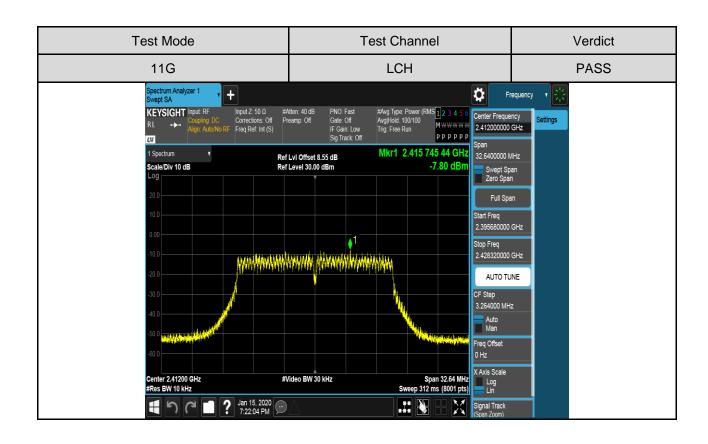
Test Graphs:





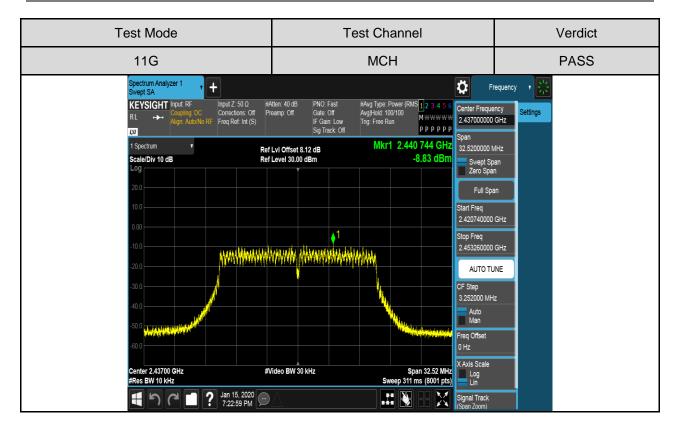


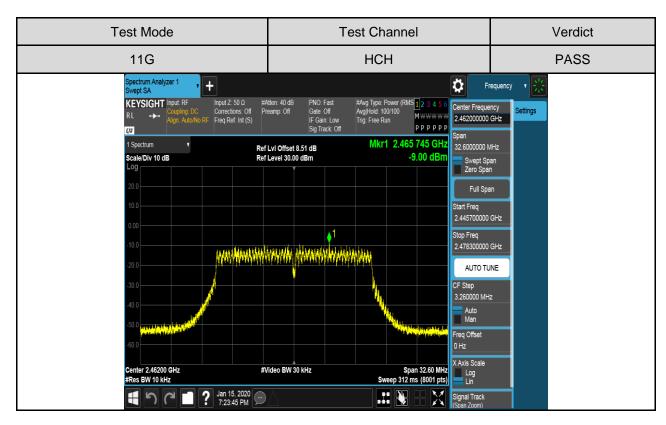
Test Mode Test Channel Verdict **HCH PASS** 11B pectrum Analyzer 1 wept SA Ö Input Z: 50 Ω Corrections: Off Freq Ref: Int (S) PNO: Best Wide Gate: Off IF Gain: Low Sig Track: Off #Atten: 40 dB Preamp: Off #Avg Type: Power (RMS 1 2 3 4 5 Avg|Hold: 100/100 Trig: Free Run KEYSIGHT Input RF Settings 2.462000000 GHz PPPPPP ĻΧΙ 1 Spectrum Mkr1 2.462 651 2 GHz Ref Lvl Offset 8.51 dB 16.1800000 MHz -4.76 dBn Swept Span Zero Span Full Span 2.453910000 GHz Stop Freq 2.470090000 GHz AUTO TUNE 1.618000 MHz Auto Man req Offset 0 Hz X Axis Scale #Video BW 30 kHz Span 16.18 MHz Log Lin Res BW 10 kHz Sweep 155 ms (8001 pts) ? Jan 15, 2020 ... 7:20:42 PM

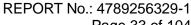




Page 32 of 104

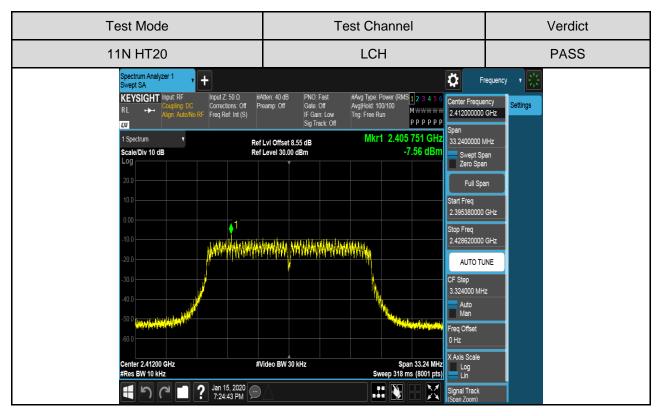


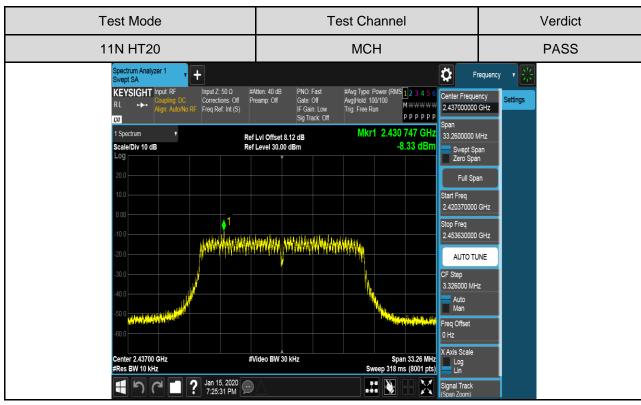






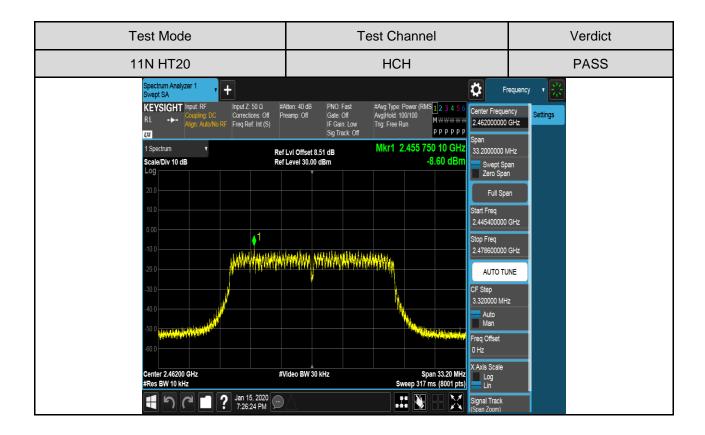
Page 33 of 104







Page 34 of 104



Page 35 of 104

7.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

LIMITS

FCC Part15 (15.247) Subpart C, ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	
FCC §15.247 (d) RSS-247 Clause 5.5 RSS-GEN Clause 6.13	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

Refer to FCC KDB 558074, connect the UUT to the spectrum analyser and use the following

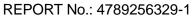
Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	100K
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

settings:

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.

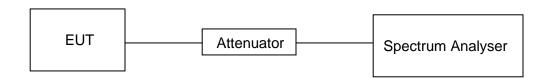
Use the peak marker function to determine the maximum amplitude level.





Page 36 of 104

TEST SETUP



TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 21.6V



Page 37 of 104

Part I: Conducted Bandedge

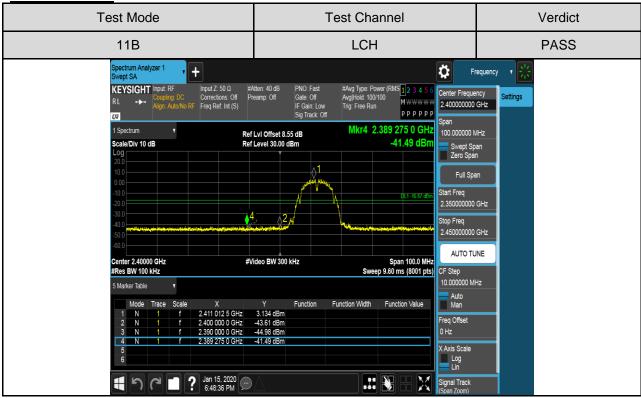
RESULTS TABLE

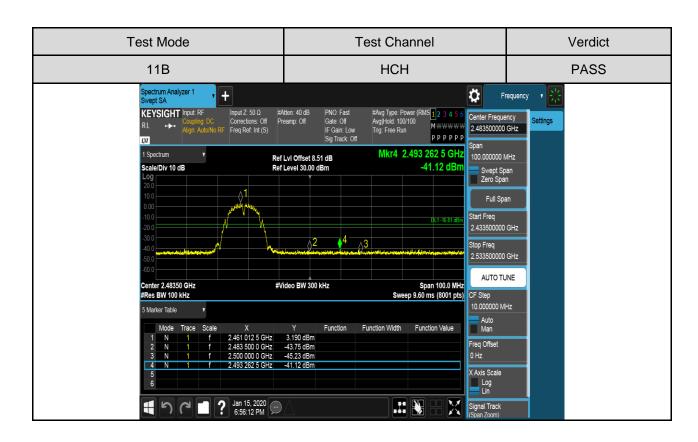
Test Mode	Test Antenna	Test Channel	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit [dBm]	Verdict
11B Antenna 1	Antonno 1	LCH	3.134	-41.495	-16.87	PASS
	Antenna i	HCH	3.190	-41.123	-16.81	PASS
11G A	Antonno 1	LCH	0.710	-41.327	-19.29	PASS
	Antenna 1	HCH	-0.031	-40.948	-20.03	0.03 PASS
11N HT20	Antonno 1	LCH	1.018	-41.431	-18.98	B PASS
	Antenna 1	HCH	0.066	-41.206	-19.93	PASS



Page 38 of 104

TEST GRAPHS





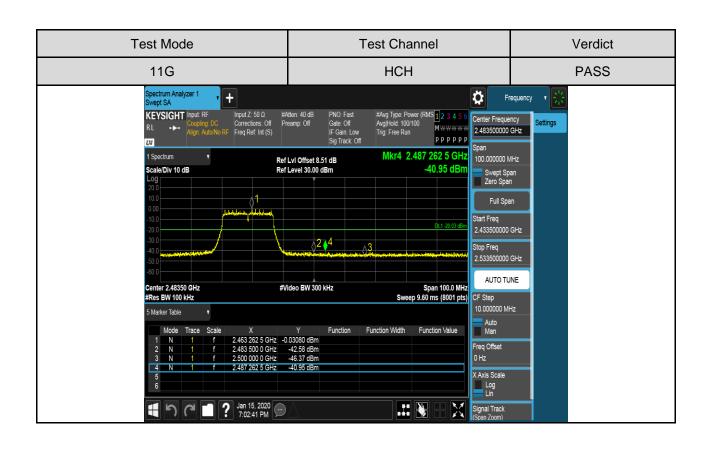
Freq Offset

X Axis Scale Log Lin

Signal Track (Span Zoom)



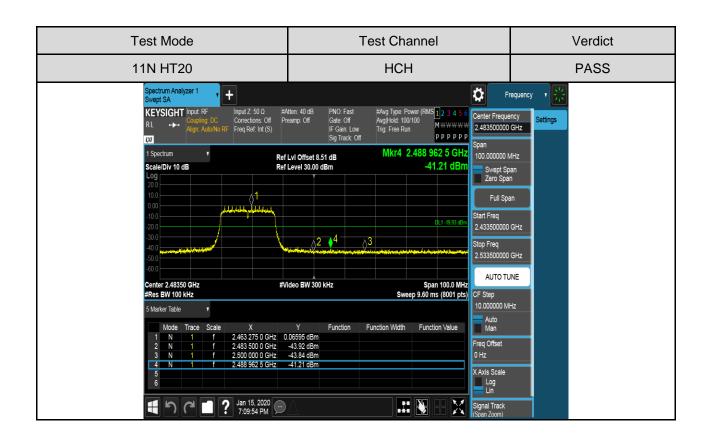
Test Channel Test Mode Verdict LCH **PASS** 11G pectrum Analyzer : wept SA Ö Frequency KEYSIGHT Input RF Center Frequency Corrections: Off Freq Ref: Int (S) Settings 2.400000000 GHz PPPPPP Mkr4 2.363 400 0 GHz Ref LvI Offset 8.55 dB Ref Level 30.00 dBm 100.000000 MHz -41.33 dBr Scale/Div 10 dB Swept Span Zero Span Full Span Start Freq 2.350000000 GHz Stop Freq 2.450000000 GHz AUTO TUNE Span 100.0 MHz Sweep 9.60 ms (8001 pts) #Video BW 300 kHz Res BW 100 kHz Auto Man Function Function Width Function Value 2.415 762 5 GHz 2.400 000 0 GHz 2.390 000 0 GHz 0.7101 dBm -39.32 dBm -42.88 dBm



9 Jan 15, 2020 5:58:36 PM



Test Mode **Test Channel** Verdict LCH **PASS** 11N HT20 pectrum Analyzer 1 wept SA Ö Frequency KEYSIGHT Input RF Center Frequency Settings M₩₩₩₩ 2.400000000 GHz PPPPPP Mkr4 2.361 262 5 GHz Ref LvI Offset 8.55 dB Ref Level 30.00 dBm 100.000000 MHz -41.43 dBi Scale/Div 10 dB Swept Span Zero Span Full Span Start Freq 2.350000000 GHz Stop Freq 2.450000000 GHz AUTO TUNE nter 2.40000 GHz #Video BW 300 kHz Span 100.0 MH Res BW 100 kHz Sweep 9.60 ms (8001 pts) Auto Man Function Function Width Function Value 1.018 dBm -39.19 dBm -45.39 dBm Freq Offset 2.400 000 0 GHz 2.390 000 0 GHz X Axis Scale Log Lin 4 5 C 7 3an 15, 2020 7:04:59 PM # 🐉 Signal Track (Span Zoom)





Page 41 of 104

Part II :Conducted Emission

Test Result Table

Test Mode	Channel	Pref(dBm)	Puw(dBm)	Verdict
	LCH	3.76	<limit< td=""><td>PASS</td></limit<>	PASS
11B	MCH	3.54	<limit< td=""><td>PASS</td></limit<>	PASS
	HCH	3.34	<limit< td=""><td>PASS</td></limit<>	PASS
	LCH	0.81	<limit< td=""><td>PASS</td></limit<>	PASS
11G	MCH	-0.03	<limit< td=""><td>PASS</td></limit<>	PASS
	HCH	-0.34	<limit< td=""><td>PASS</td></limit<>	PASS
11N HT20	LCH	0.95	<limit< td=""><td>PASS</td></limit<>	PASS
	MCH	-0.04	<limit< td=""><td>PASS</td></limit<>	PASS
	HCH	0.03	<limit< td=""><td>PASS</td></limit<>	PASS



Page 42 of 104

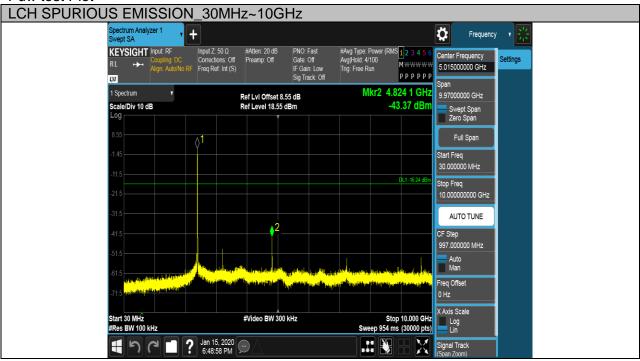
Test Plots

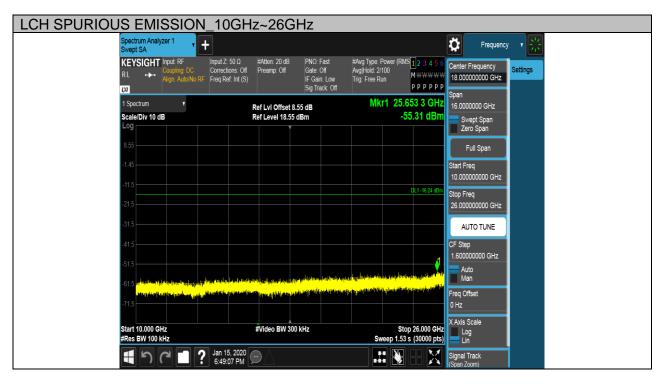
Test Mode	Channel	Verdict
11B	LCH	PASS





Page 43 of 104







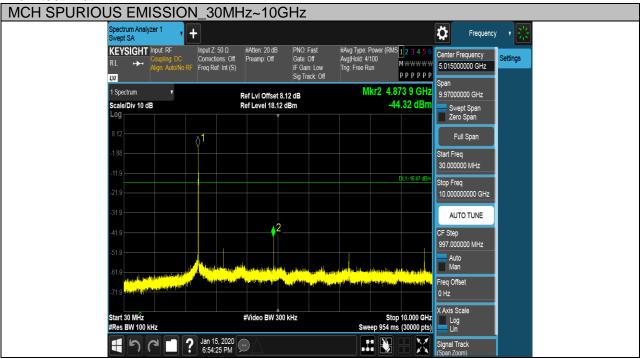
Page 44 of 104

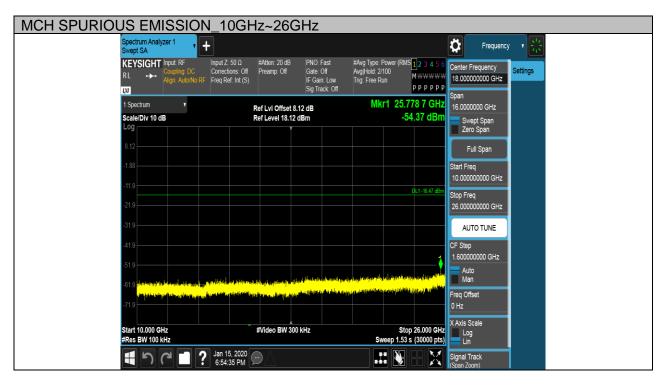
Test Mode	Channel	Verdict
11B	MCH	PASS





Page 45 of 104







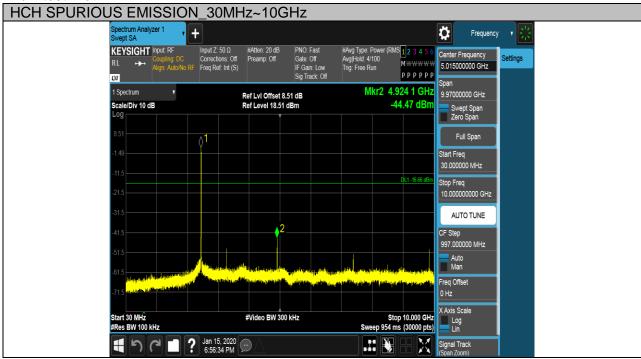
Page 46 of 104

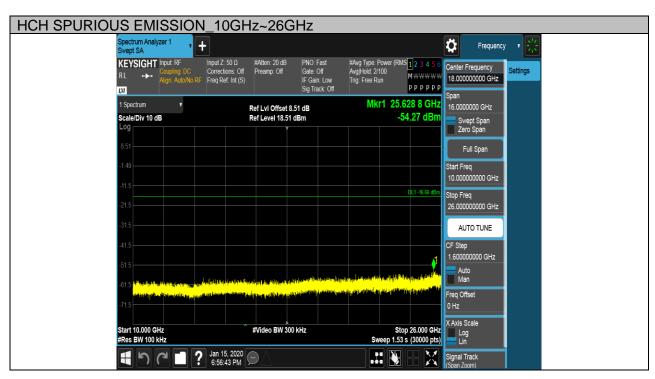
Test Mode	Channel	Verdict
11B	HCH	PASS





Page 47 of 104

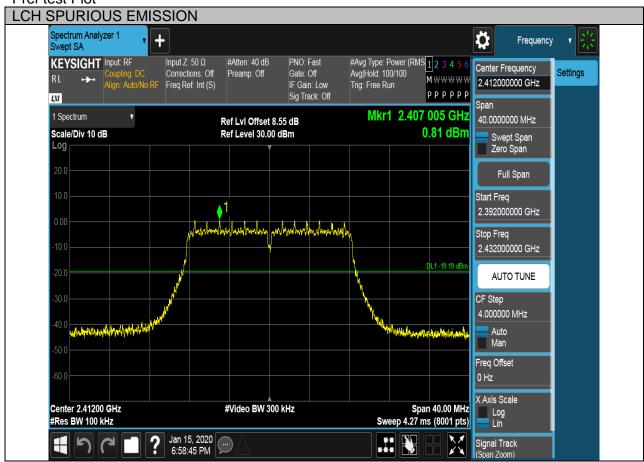






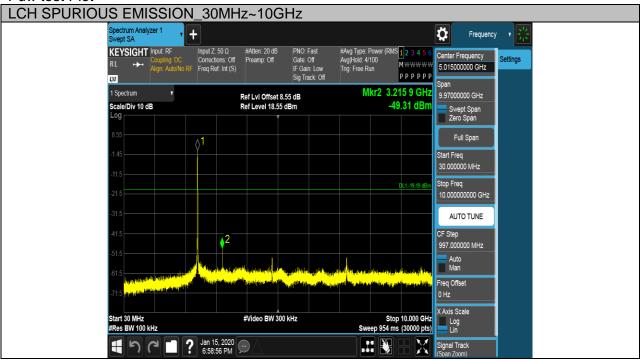
Page 48 of 104

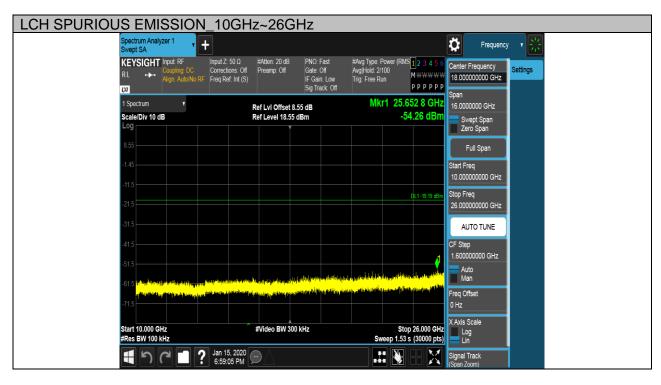
Test Mode	Channel	Verdict
11G	LCH	PASS





Page 49 of 104

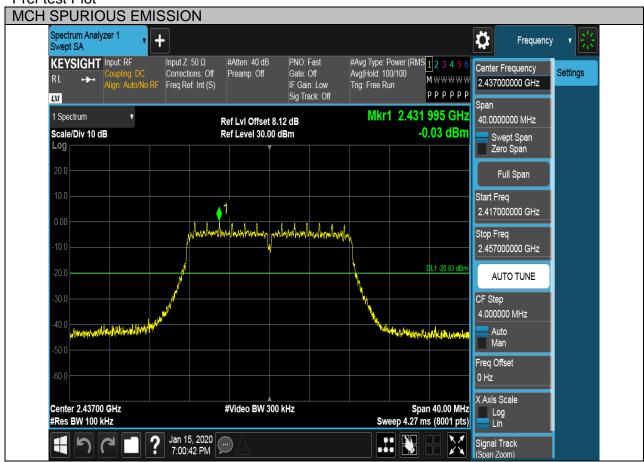






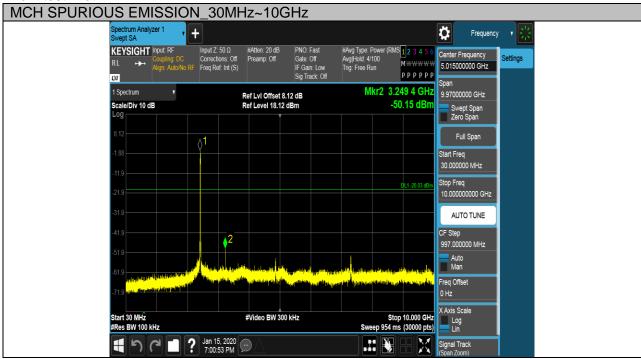
Page 50 of 104

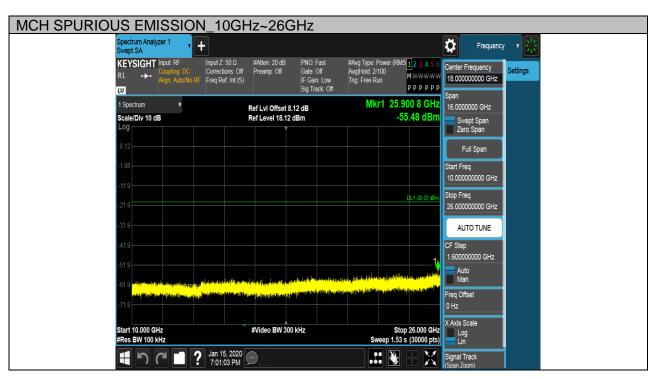
Test Mode	Channel	Verdict
11G	MCH	PASS





Page 51 of 104







Page 52 of 104

Test Mode	Channel	Verdict
11G	HCH	PASS

