Industrial Internet Innovation Center (Shanghai) Co.,Ltd.

FCC/IC BT TEST REPORT

PRODUCT	iHelp Max 4G mobile medical device
BRAND	iHelp
MODEL	EC4WHS
APPLICANT	Wearable Health Solutions, Inc.
FCC ID	XWI-EC4WHS
IC	8730A-EC4WHS
ISSUE DATE	February 28, 2023
STANDARD(S)	FCC Part15, RSS-247 Issue 2, RSS-Gen Issue 5

Prepared by: ***Tao Lingyan*** **Reviewed by:** ***Yang Fan*** **Approved by:** ***Zheng Min***

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1. Summary of Test Report

1.1 Test Standard(s)

No.	Test Standard(s)	Title	Version
1	FCC Part15	FCC CFR 47, Part 15, Subpart C: 15.205 Restricted bands of operation; 15.209 Radiated emission limits, general requirements; 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.	2020
2	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices	2017
3	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus	2021

1.2 Reference Documents

No.	Title	Title	Version
1	ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
2	KDB 558074	Guidance for Performing Compliance Measurements on Frequency Hopping Spread Spectrum systems (DSS) Operating Under §15.247	2019

1.3 Summary of Test Results

Measurement Items	Sub-clause of Part15C	Sub-clause of IC	Verdict
Maximum Peak Output Power	15.247(b)	RSS-247 5.4	Pass
20dB Occupied Bandwidth	15.247(a)	RSS-247 5.1	Pass
99% Occupied Bandwidth	15.247(a)	RSS-Gen 6.7	Pass
Band Edges Compliance	15.247 (d)	RSS-247 5.5	Pass
Time Of Occupancy (Dwell Time)	15.247(a)	RSS-247 5.1	Pass
Carrier Frequency Separation	15.247(a)	RSS-247 5.1	Pass
Number Of Hopping Channels	15.247(a)	RSS-247 5.1	Pass
Transmitter Spurious Emission-Conducted	15.247(d)	RSS-247 5.5	Pass
Transmitter Spurious Emission-Radiated	15.247,15.209,15.205	RSS-Gen 8.9,8.10	Pass
AC Powerline Conducted Emission	15.207	RSS-Gen 8.8	Pass

Note:
The iHelp 4G, manufactured by Shenzhen Ecell Communication Technology Co.,Ltd is a new product for testing.
Industrial Internet Innovation Center (Shanghai) Co., Ltd. only performed test cases which identified with

Pass/Fail/Inc result in section 1.3. Industrial Internet Innovation Center (Shanghai) Co., Ltd. has verified that the compliance of the tested device specified in section 5.3 of this test report is successfully evaluated according to the procedure and test methods as defined in type certification requirement listed in section 6 of this test report.

Note:

a. All the test data for each data were verified, but only the worst case was reported.

b.The GFSK, π/4 DQPSK and 8DPSK were set in DH5 for GFSK, 2-DH5 for π/4 DQPSK, 3-DH5 for 8DPSK.

c.The DC and low frequency voltages' measurement uncertainty is ±2%.

1.4 Data Provided by Applicant

No.	Item(s)	Data
1	Antenna gain of EUT	1.33 dBi
Note: The data of 1.4 is provided by the customer may affect the validity of the test results in this report, and the impact and consequences of this shall be undertaken by the customer.		

2. General Information of The Laboratory

2.1 Testing Laboratory

Lab Name	Industrial Internet Innovation Center (Shanghai) Co.,Ltd.
Address	Building 4，No. 766，Jingang Road，Pudong，Shanghai，China
Telephone	021-68866880
FCC Registration No.	958356
FCC Designation No.	CN1177

2.2 Laboratory Environmental Requirements

Temperature	15℃~35℃
Relative Humidity	25%RH~75%RH
Atmospheric Pressure	101kPa

2.3 Project Information

Project Manager	Zhang Heng
Test Date	November 07, 2022 to January 31, 2023

3. General Information of The Customer

3.1 Applicant

Company	Wearable Health Solutions, Inc.
Address	2901 Pacific Coast Highway Ste. 200 Newport Beach, CA 92663
Telephone	+1 949 270 7460

3.2 Manufacturer

Company	Shenzhen Ecell Communication Technology Co.,Ltd
Address	801-803, Floor 8, West Zone, Block B, Building 7, Gaoxin Nanjiudao Science and Technology Ecological Park, Nanshan District, Shenzhen

4. General Information of The Product

4.1 Product Description for Equipment under Test (EUT)

Product	iHelp Max 4G mobile medical device
Model	EC4WHS
Date of Receipt	November 07, 2022
EUT ID*	S04aa/S10aa
SN/IMEI	NA
Supported Radio Technology and Bands	LTE Band 2/4/5/7/12/13/17/25/26/41 WLAN 802.11 b/g/n BT4.2 BR/EDR, BLE GPS/GLONASS/BDS
Hardware Version	V1.1
Software Version	iHelp 4G V1.1
FCC ID	XWI-EC4WHS
IC	8730A-EC4WHS
NOTE：EUT ID is the internal identification code of the laboratory.	

4.2 Description for Auxiliary Equipment (AE)

AE ID*	Description	Model	SN/Remark
AE1	RF Cable	N/A	N/A
NOTE：AE ID is the internal identification code of the laboratory.			

4.3 Additional Information

Bluetooth Frequency	2402MHz-2480MHz
Bluetooth Channel	Ch0-78
Bluetooth Modulation	GFSK; π/4 DQPSK; 8DPSK

5. Test Configuration Information

5.1 Laboratory Environmental Conditions

5.1.1 Permanent Facilities

Relative Humidity	Min. = 45 %, Max. = 55 %		
Atmospheric Pressure	101kPa		
Temperature	Normal	Minimum	Maximum
	25℃	-10℃	55℃
Working Voltage of EUT	Normal	Minimum	Maximum
	3.8V	3.4V	4.35V

5.2 Test Equipments Utilized

5.2.1 Conducted Test System

No.	Name	Model	S/N	Manufacturer	Cal. Date	Cal. Interval
1	Programmable Power Supply	Keithley 2303	4039070	Starpoint	July 12, 2022	1 Year
2	Temperature box	B-TF-107C	BTF107C-201804107	Boyi	June 30, 2022	1 Year
3	Signal Generator	SMF	104770	R&S	October 18, 2022	1 Year
4	Spectrum analyzer	FSVA	100924	R&S	September 9, 2022	1 Year
5	Vector Signal Generator	SMCV100B	103691	R&S	August 16, 2022	1 Year
6	Wideband Radio Communication tester	CMW500	164865	R&S	August 22, 2022	1 Year
7	Automatic control unit	JS0806-2	2218060623	Tonscend	N/A	N/A
8	Tonscend Automated test software	TS1120	10727	Tonscend	N/A	N/A

5.2.2 Radiated Emission Test System

No.	Name	Model	S/N	Manufacturer	Cal. Date	Cal. Interval
1	Universal Radio Communication Tester	CMU200	123123	R&S	October 17,2022	1Year
2	Universal Radio Communication Tester	CMW500	104178	R&S	October 17,2022	1Year
3	EMI Test Receiver	ESU40	100307	R&S	February 23, 2022	1 Year
4	TRILOG Broadband Antenna	VULB9163	VULB9163-515	Schwarzbeck	March 11, 2022	1 Year
5	Double- ridged Waveguide Antenna	ETS-3117	00135890	ETS	March 9, 2022	2 Years
6	2-Line V-Network	ENV216	101380	R&S	February 21, 2022	1 Year
7	EMI Test Software	EMC32 V9.15.00	N/A	R&S	N/A	N/A

5.2.3 Test Environment

Shielding Room1 (6.0 meters×3.0 meters×2.7 meters) did not exceed following limits along the conducted RF performance testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	> 100 dB
Ground system resistance	< 0.5 Ω
Temperature	Min. = 15 ℃, Max. = 35 ℃

Control room did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. =30 %, Max. = 60 %
Shielding effectiveness	> 100 dB
Electrical insulation	> 10 kΩ
Ground system resistance	< 0.5 Ω

Fully-anechoic chamber1 (6.9 meters×10.9 meters×5.4 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 25 %, Max. = 75 %

Shielding effectiveness	> 100 dB
Electrical insulation	> 10 kΩ
Ground system resistance	< 0.5 Ω
VSWR	Between 0 and 6 dB, from 1GHz to 18GHz
Site Attenuation Deviation	Between -4 and 4 dB,30MHz to 1GHz

5.3 Measurement Uncertainty

Measurement Items	Range	Confidence Level	Calculated Uncertainty
Peak Output Power-Conducted	2402MHz-2480MHz	95%	0.544dB
Frequency Band Edges-Conducted	2402MHz-2480MHz	95%	0.544dB
Conducted Emission	9KHz-30MHz	95%	0.89dB
Conducted Emission	30MHz-2GHz	95%	0.90dB
Conducted Emission	2GHz-3.6GHz	95%	0.88dB
Conducted Emission	3.6GHz-8GHz	95%	0.96dB
Conducted Emission	8GHz-20GHz	95%	0.94dB
Conducted Emission	20GHz-22GHz	95%	0.88dB
Conducted Emission	22GHz-26GHz	95%	0.86dB
Transmitter Spurious Emission-Radiated	9KHz-30MHz	95%	5.66dB
Transmitter Spurious Emission-Radiated	30MHz-1000MHz	95%	4.98dB
Transmitter Spurious Emission-Radiated	1000MHz -18000MHz	95%	5.06dB
Transmitter Spurious Emission-Radiated	18000MHz -40000MHz	95%	5.20dB
Dwell Time	2402MHz-2480MHz	95%	0.218ms
20dB Bandwidth	2402MHz-2480MHz	95%	62.04Hz
AC Power line Conducted Emission	0.15MHz-30MHz	95%	3.66 dB

6. Test Results

6.1 Peak Output Power-Conducted

6.1.1 Measurement Limit

Standard	Limit (dBm)	EIRP Limit (dBm)
FCC 47 Part 15.247(b)(3)	<30	<36
RSS-247 5.4(d)	<30	<36

6.1.2 Test Condition

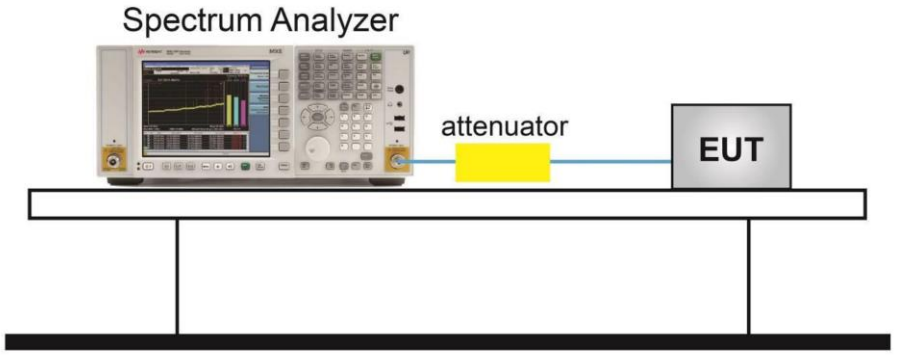
Hopping Mode	RBW	VBW	Span	Sweeptime
Hopping OFF	3MHz	10MHz	9MHz	Auto

6.1.3 Test Procedure

The measurement is according to ANSI C63.10 clause 7.8.5.

1. The output power of EUT was connected to the spectrum analyzer and CMW 270 by cable and divide. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Measure the conducted output power and record the results it

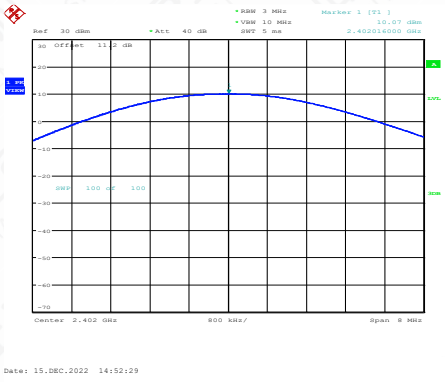
6.1.4 Test setup



Measurement Results

Test Mode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	EIRP [dBm]	Verdict
DH5	Ant1	2402	10.07	11.4	PASS
DH5	Ant1	2441	10.28	11.61	PASS
DH5	Ant1	2480	8.44	9.77	PASS
2DH5	Ant1	2402	9.44	10.77	PASS
2DH5	Ant1	2441	9.67	11	PASS
2DH5	Ant1	2480	7.67	9	PASS
3DH5	Ant1	2402	9.8	11.13	PASS
3DH5	Ant1	2441	9.99	11.32	PASS
3DH5	Ant1	2480	8.01	9.34	PASS

DH5-Ant1-2402



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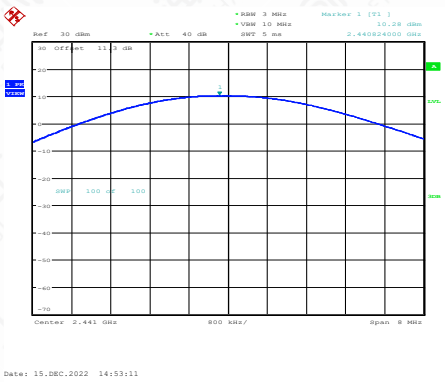

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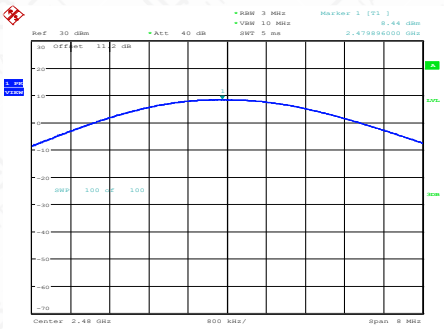

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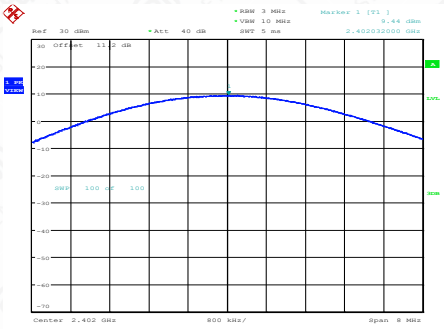

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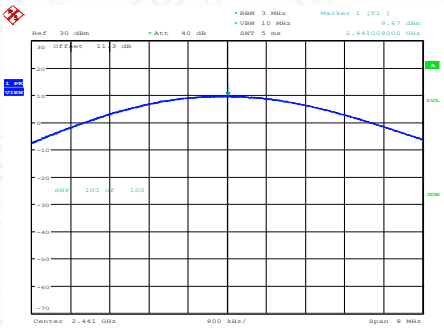

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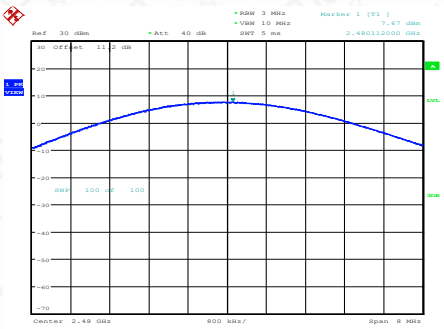

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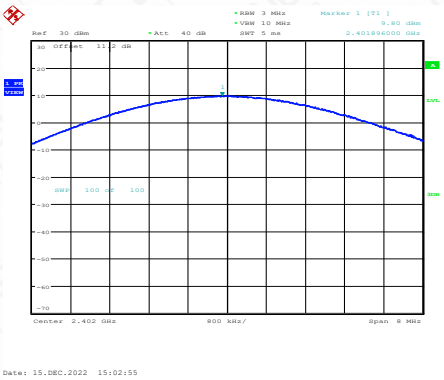

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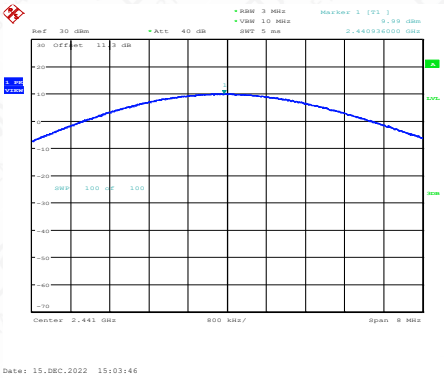

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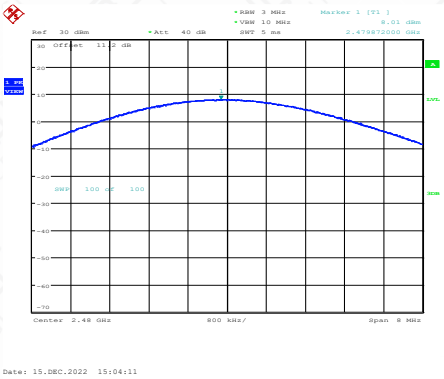


6.2 Frequency Band Edges-Conducted

6.2.1 Measurement Limit

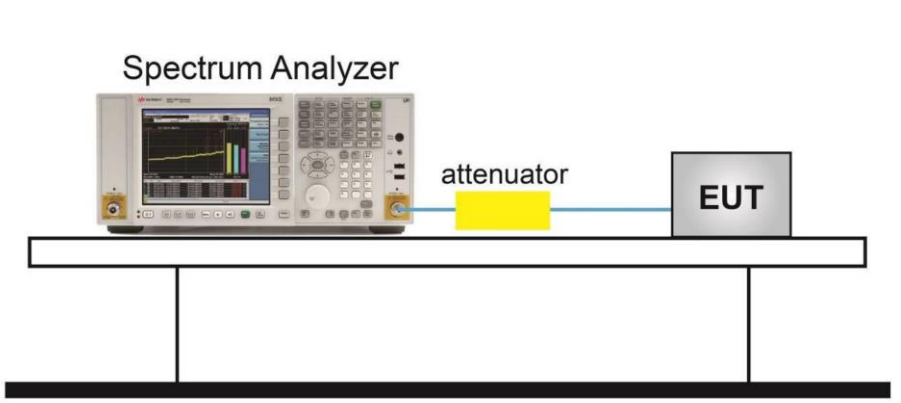
Standard	Limit(dBc)
FCC 47 CFR Part 15.247(d)	>20
RSS-247 5.5	>20

6.2.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.6.

1. Connect the EUT to spectrum analyzer.
2. Set RBW=1MHz, VBW=3MHz, span more than 1.5 times channel bandwidth (2MHz).
3. Detector =peak, sweep time=auto couple, trace mode=max hold.Allow sweep to continue until the trace stabilizes.

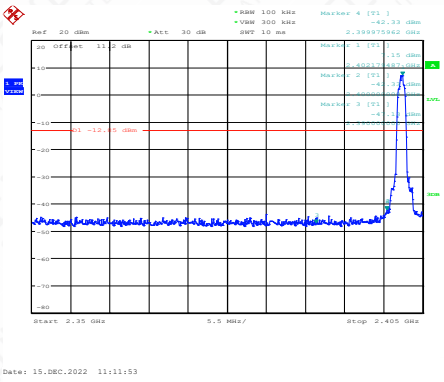
6.2.3 Test setup



Measurement Result

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	Low	2402	7.15	-42.33	≤-12.85	PASS
DH5	Ant1	High	2480	7.91	-44.11	≤-12.09	PASS
2DH5	Ant1	Low	2402	6.61	-44.49	≤-13.39	PASS
2DH5	Ant1	High	2480	5.58	-43.91	≤-14.42	PASS
3DH5	Ant1	Low	2402	6.68	-44.08	≤-13.32	PASS
3DH5	Ant1	High	2480	5.28	-43.49	≤-14.72	PASS
DH5	Ant1	High	Hop_2480	8.72	-43.43	≤-11.28	PASS
2DH5	Ant1	Low	Hop_2402	5.47	-44.04	≤-14.53	PASS
3DH5	Ant1	Low	Hop_2402	4.00	-44.4	≤-16	PASS
DH5	Ant1	Low	Hop_2402	9.24	-44.05	≤-10.76	PASS
2DH5	Ant1	High	Hop_2480	6.01	-44.24	≤-13.99	PASS
3DH5	Ant1	High	Hop_2480	4.24	-44.43	≤-15.76	PASS

DH5-Ant1-Low-2402-7.15



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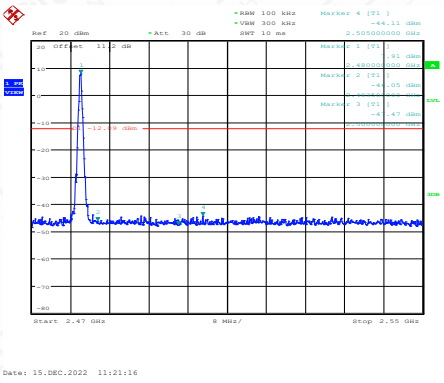

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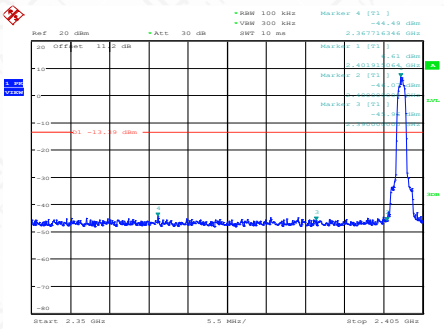

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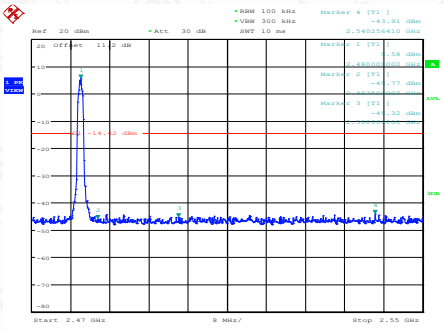

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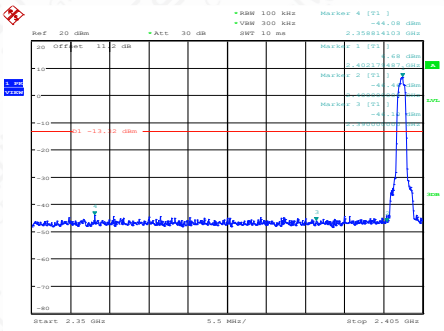

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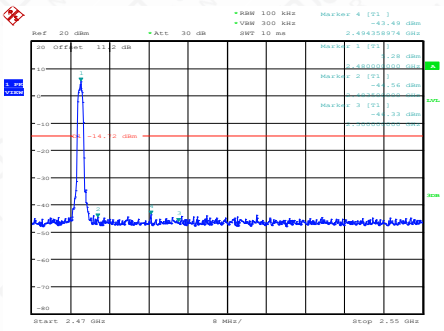

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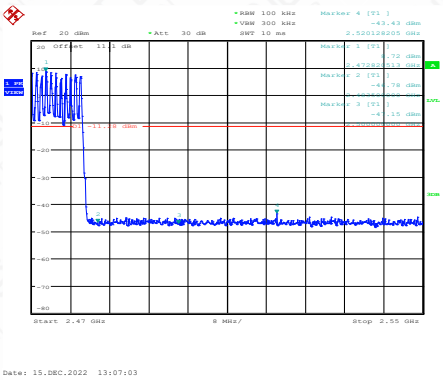

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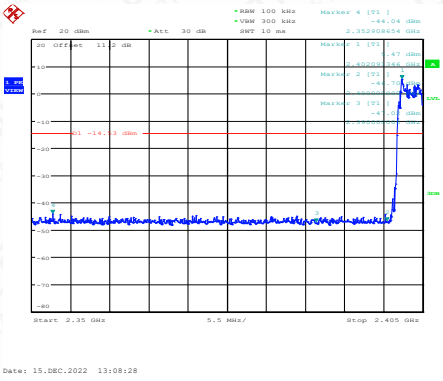

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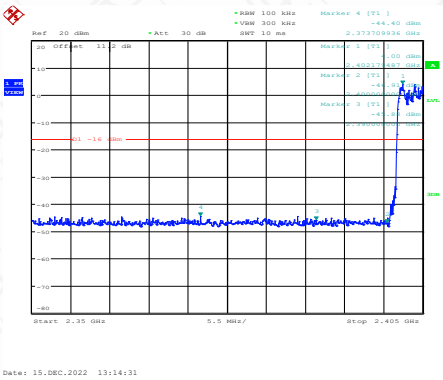

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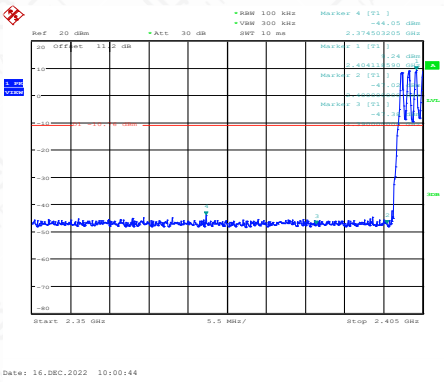

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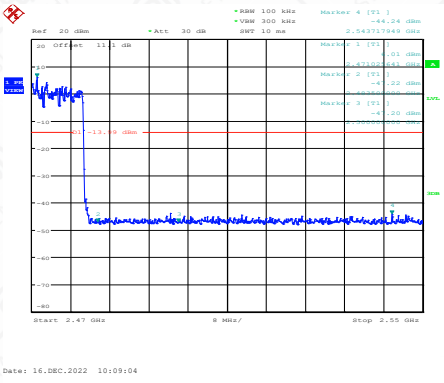

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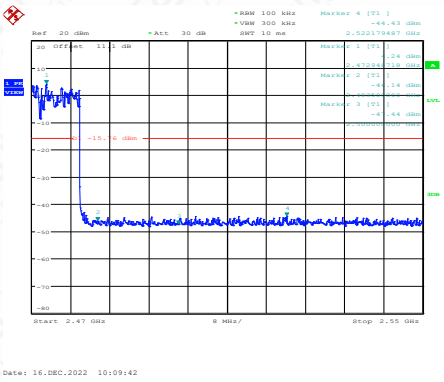


6.3 Conducted Emission

6.3.1 Measurement Limt

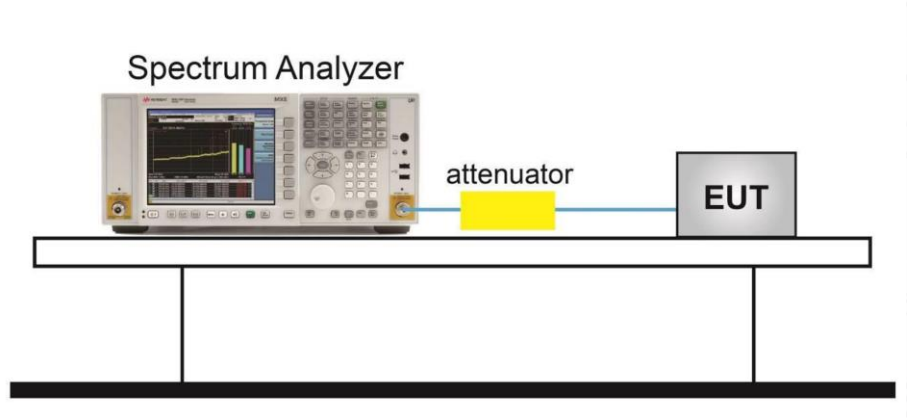
Standard	Limit
FCC 47 CFR Part15.247 (d)	20dB below peak output power in 100KHz
RSS-247 5.5	20dB below peak output power in 100KHz

6.3.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.8.

1. Connect the EUT to spectrum analyzer.
2. Set RBW=100kHz, VBW=300kHz.
3. Detector =peak, sweep time=auto couple, trace mode=max hold

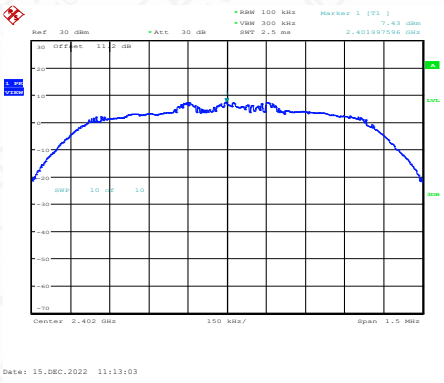
6.3.3 Test Setup



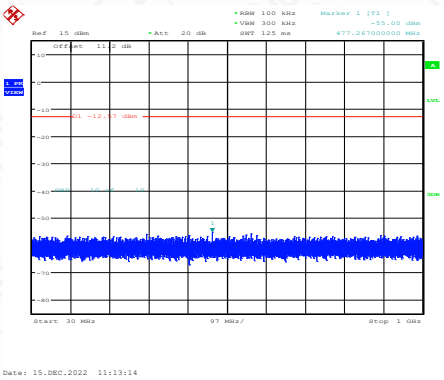
Measurement Results

TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	0~Reference	7.43	7.43	---	PASS
DH5	Ant1	2402	30~1000	7.43	-55	≤-12.57	PASS
DH5	Ant1	2402	1000~26500	7.43	-51.97	≤-12.57	PASS
DH5	Ant1	2480	0~Reference	7.97	7.97	---	PASS
DH5	Ant1	2480	30~1000	7.97	-52.97	≤-12.03	PASS
DH5	Ant1	2480	1000~26500	7.97	-48.44	≤-12.03	PASS
2DH5	Ant1	2402	0~Reference	7.54	7.54	---	PASS
2DH5	Ant1	2402	30~1000	7.54	-54.71	≤-12.46	PASS
DH5	Ant1	2441	0~Reference	9.98	9.98	---	PASS
DH5	Ant1	2441	30~1000	9.98	-54.05	≤-10.02	PASS
DH5	Ant1	2441	1000~26500	9.98	-52.3	≤-10.02	PASS
2DH5	Ant1	2402	1000~26500	7.54	-51.56	≤-12.46	PASS
2DH5	Ant1	2441	0~Reference	7.76	7.76	---	PASS
2DH5	Ant1	2441	30~1000	7.76	-55.47	≤-12.24	PASS
2DH5	Ant1	2441	1000~26500	7.76	-52.48	≤-12.24	PASS
2DH5	Ant1	2480	0~Reference	5.46	5.46	---	PASS
2DH5	Ant1	2480	30~1000	5.46	-55.28	≤-14.54	PASS
2DH5	Ant1	2480	1000~26500	5.46	-51.86	≤-14.54	PASS
3DH5	Ant1	2402	0~Reference	7.59	7.59	---	PASS
3DH5	Ant1	2402	30~1000	7.59	-56.04	≤-12.41	PASS
3DH5	Ant1	2402	1000~26500	7.59	-49.55	≤-12.41	PASS
3DH5	Ant1	2441	0~Reference	7.80	7.80	---	PASS
3DH5	Ant1	2441	30~1000	7.80	-55.06	≤-12.2	PASS
3DH5	Ant1	2441	1000~26500	7.80	-52.34	≤-12.2	PASS
3DH5	Ant1	2480	0~Reference	5.45	5.45	---	PASS
3DH5	Ant1	2480	30~1000	5.45	-55.79	≤-14.55	PASS
3DH5	Ant1	2480	1000~26500	5.45	-52.87	≤-14.55	PASS

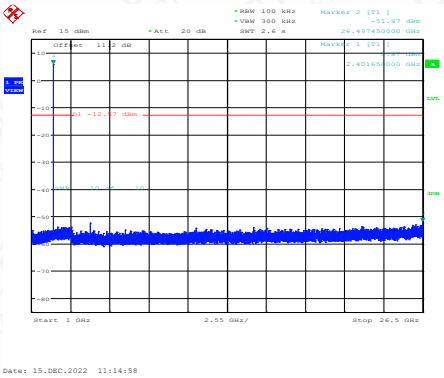
DH5-Ant1-2402-0~Reference-7.43



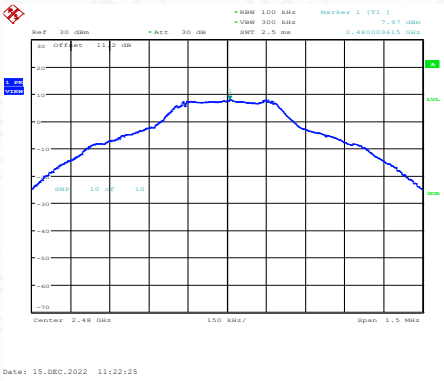
DH5-Ant1-2402-30~1000-7.43



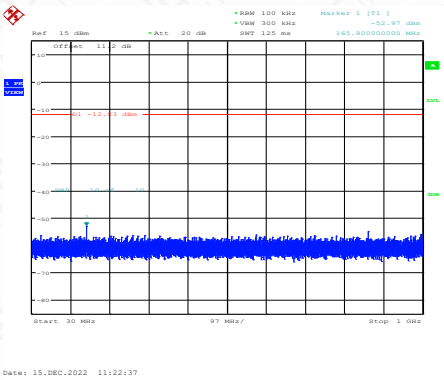
DH5-Ant1-2402-1000~26500-7.43



DH5-Ant1-2480-0~Reference-7.97



DH5-Ant1-2480-30~1000-7.97



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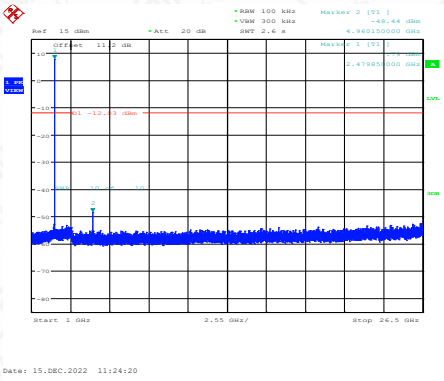

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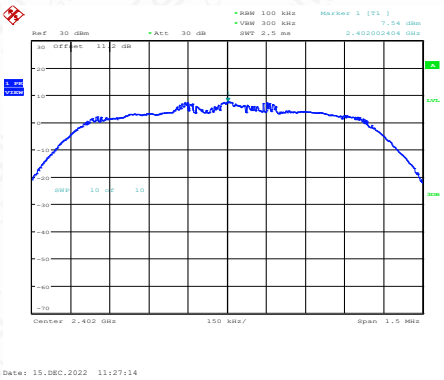
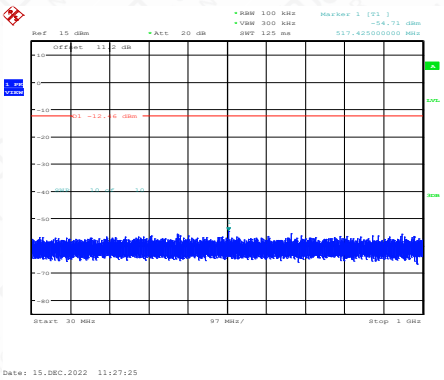
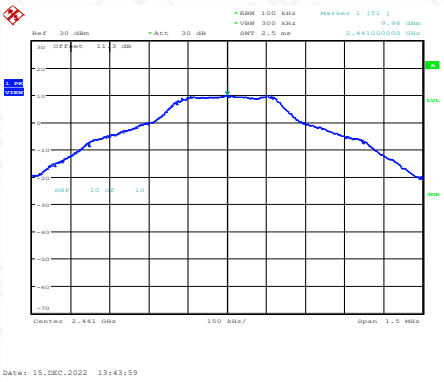


2DH5-Ant1-2402-30~1000-7.54



DH5-Ant1-2441-0~Reference-9.98



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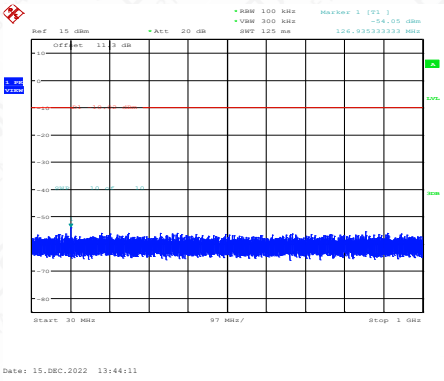
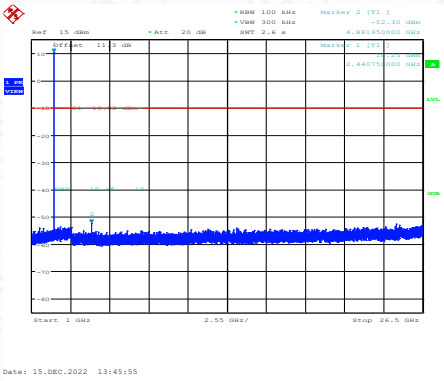
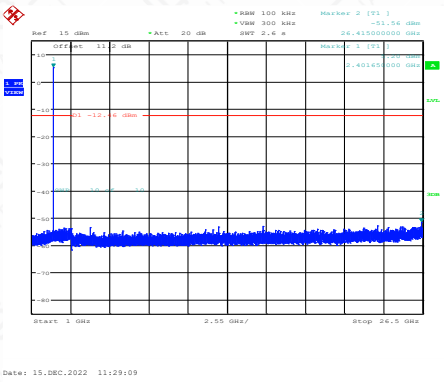


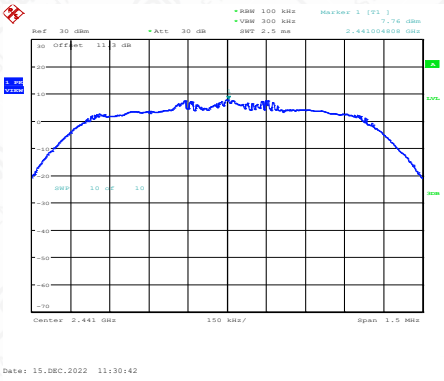
DH5-Ant1-2441-1000~26500-9.98



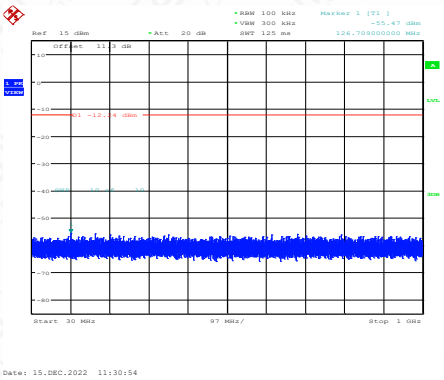
2DH5-Ant1-2402-1000~26500-7.54



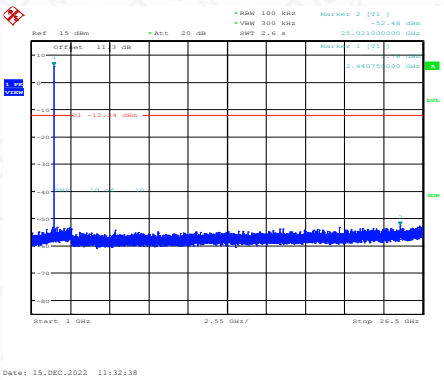
2DH5-Ant1-2441-0~Reference-7.76



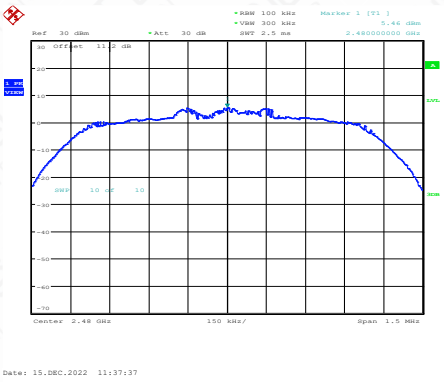
2DH5-Ant1-2441-30~1000-7.76



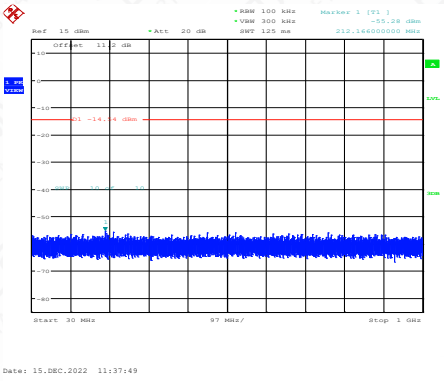
2DH5-Ant1-2441-1000~26500-7.76



2DH5-Ant1-2480-0~Reference-5.46



2DH5-Ant1-2480-30~1000-5.46



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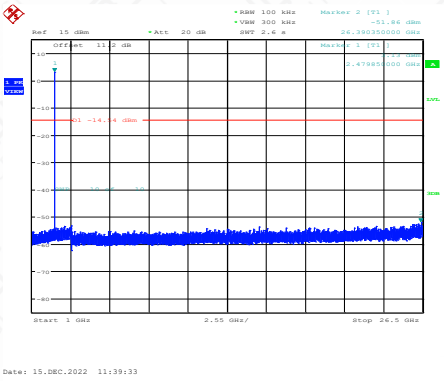

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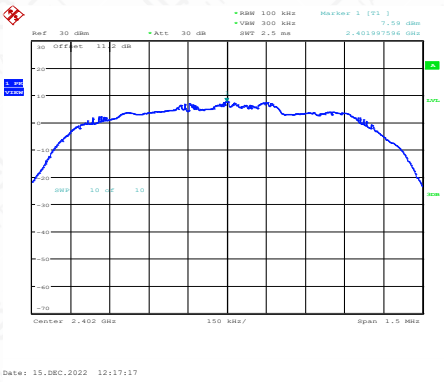

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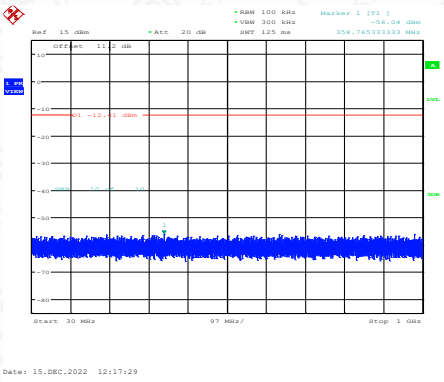
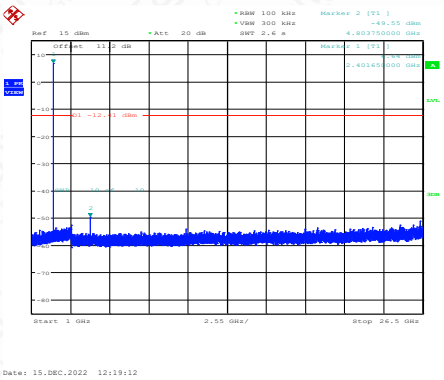
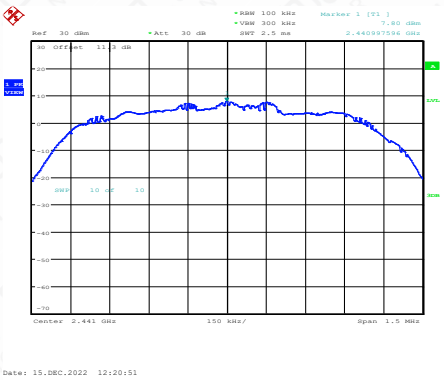


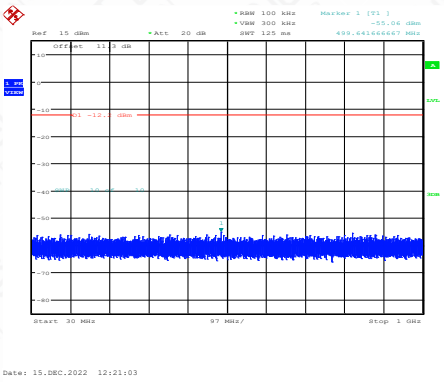
3DH5-Ant1-2402-1000~26500-7.59



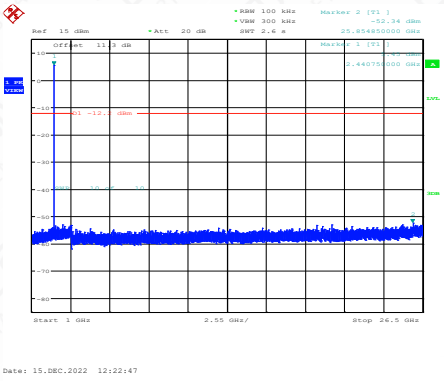
3DH5-Ant1-2441-0~Reference-7.80



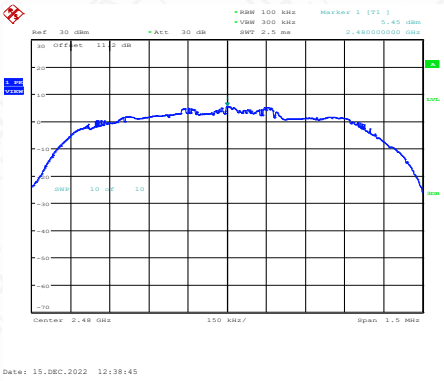
3DH5-Ant1-2441-30~1000-7.80



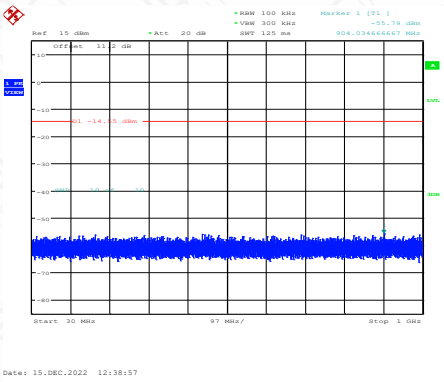
3DH5-Ant1-2441-1000~26500-7.80



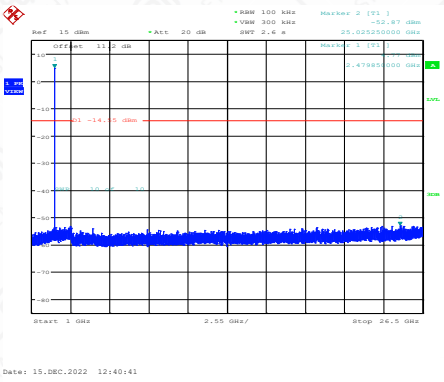
3DH5-Ant1-2480-0~Reference-5.45



3DH5-Ant1-2480-30~1000-5.45



3DH5-Ant1-2480-1000~26500-5.45



6.4 Radiated Emission

6.4.1 Measurement Limit

Standard	Limit
FCC 47 CFR Part 15.247, 15.205, 15.209	20dB below peak output power
RSS-Gen 8.9,8.10	20dB below peak output power

In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see 15.205(c)).

Limit in restricted band

Frequency of emission (MHz)	Field strength (mV/m)	Field strength (dBuV/m)
0.009~0.49	2400/F (kHz)	129-94
0.49~1.705	24000/F (kHz)	74-63
1.705~30	30	70
30~88	100	40
88~216	150	43.5
216~960	200	46
Above 960	500	54

6.4.2 Test Method

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. but it may be larger or smaller to accommodate various sized EUTs. For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also ANSI C63.10-2013 section 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

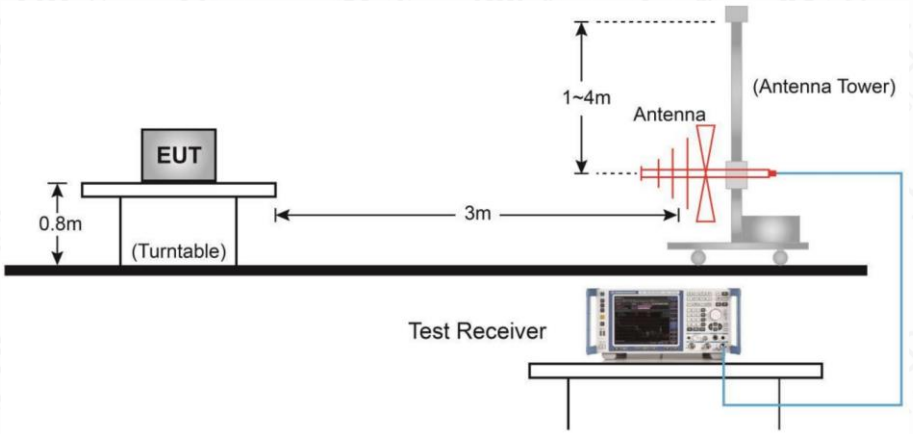
The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

Frequency of emission	RBW/VBW	Sweep Time (s)
0.009~30	9KHz/30KHz	Auto
30~1000	100KHz/300KHz	5
1000~4000	1MHz/3MHz	15
4000~18000	1MHz/3MHz	40

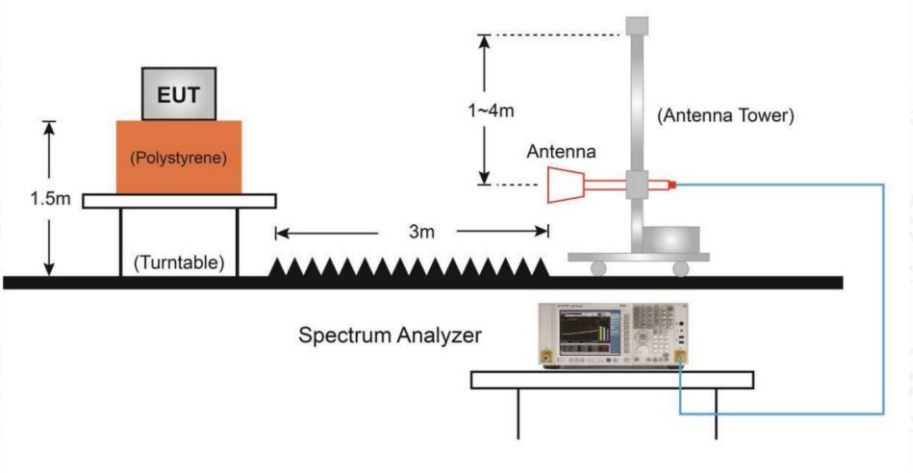
18000~26500	1MHz/3MHz	20

6.4.3 Test Setup

Below 1GHz Test Setup



Above 1GHz Test Setup



Measurement Results

A “reference path loss” is established and ARpi is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.

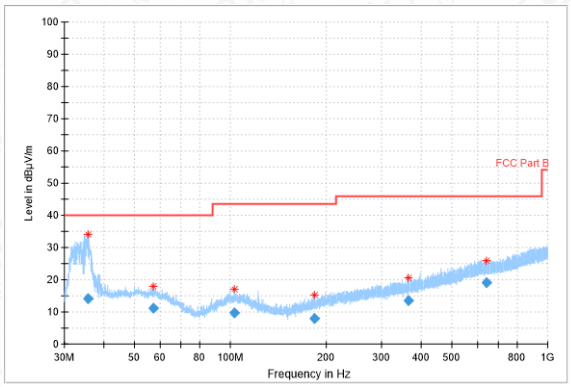
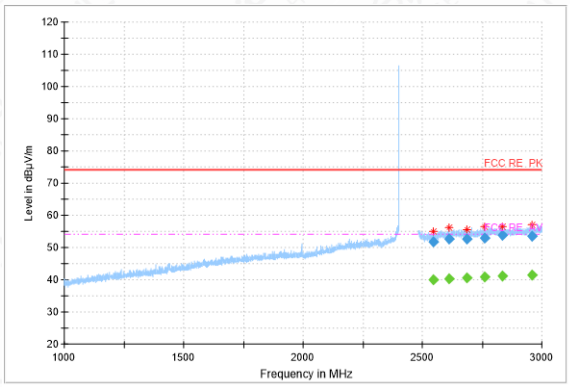
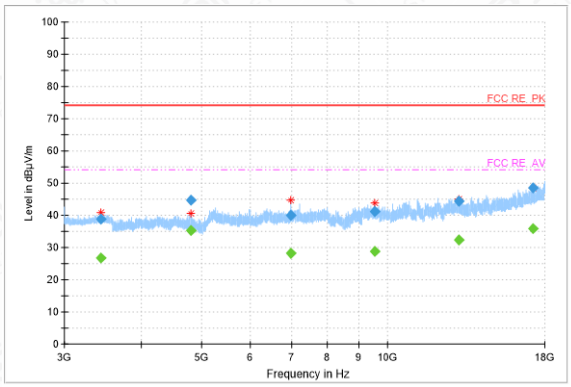
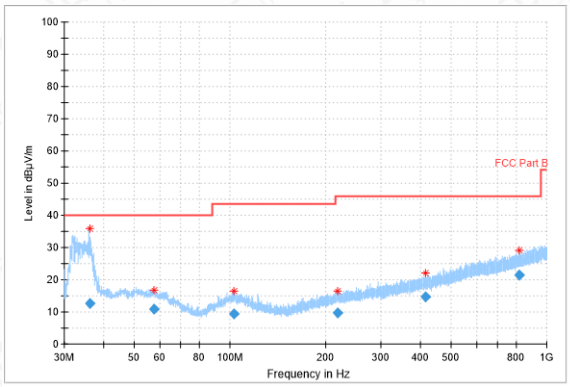
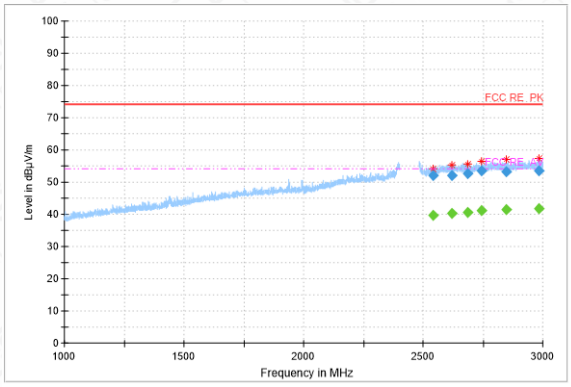
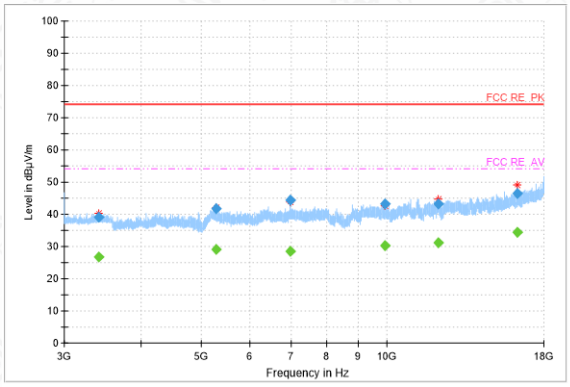
The measurement results are obtained as described below:

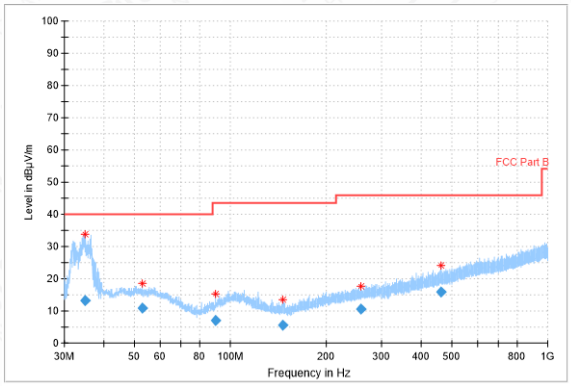
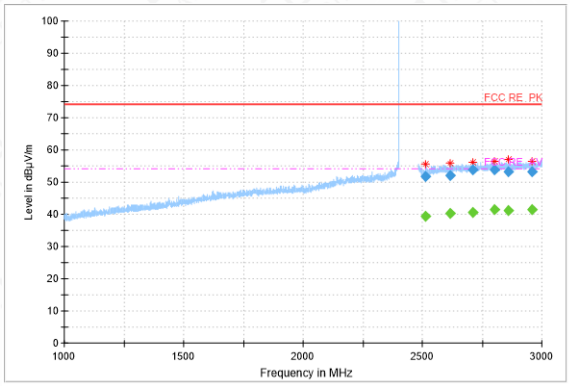
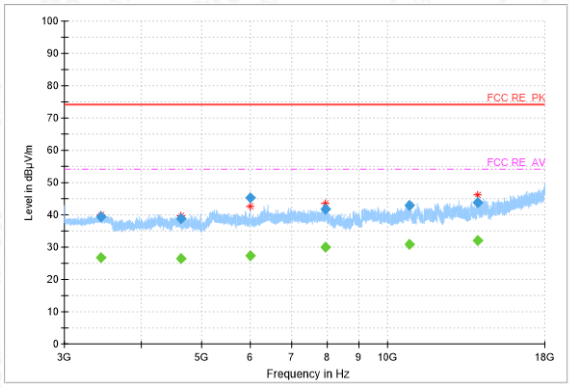
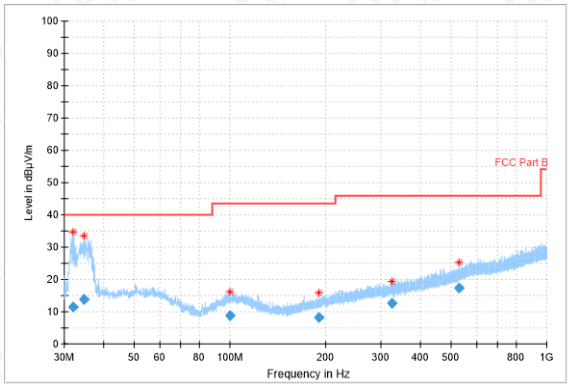
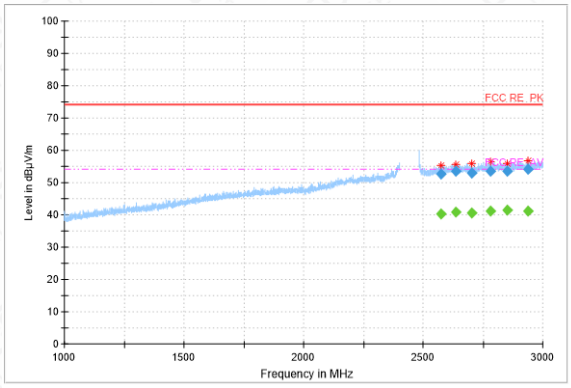
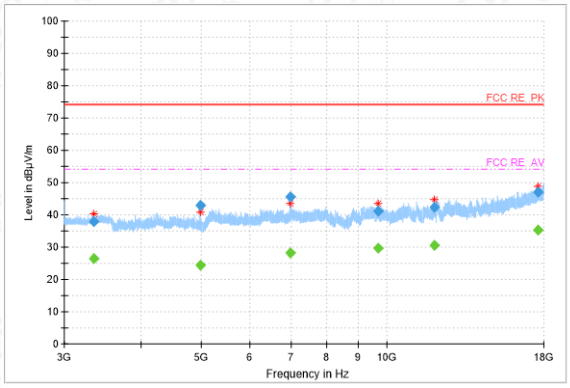
ARpi = Cable loss + Antenna Factor-Preamplifier gain

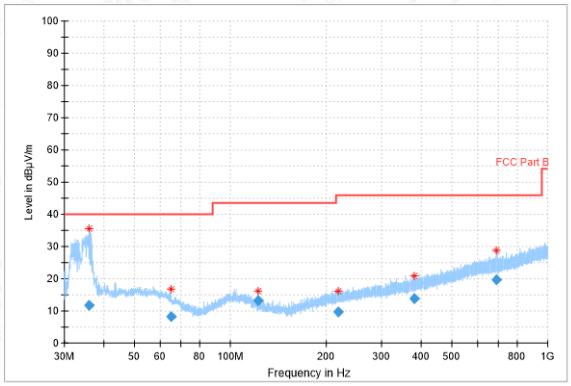
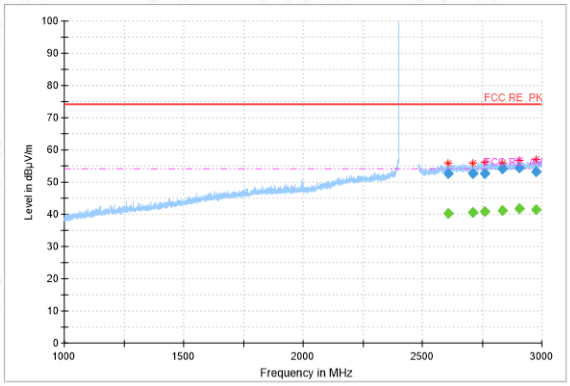
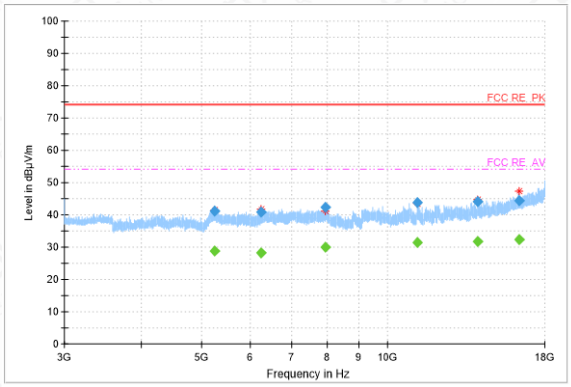
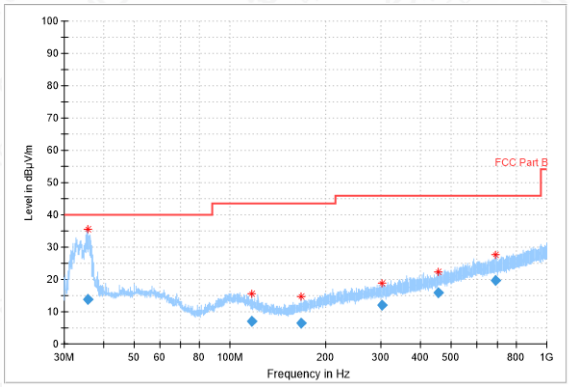
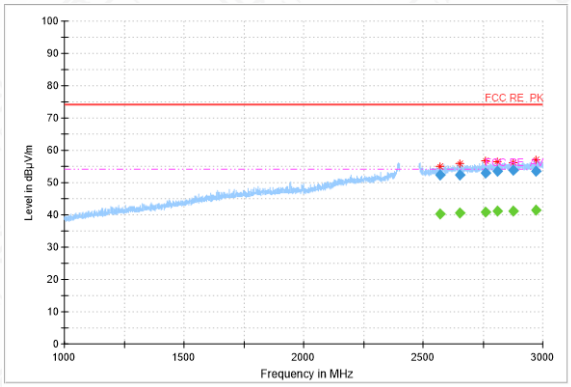
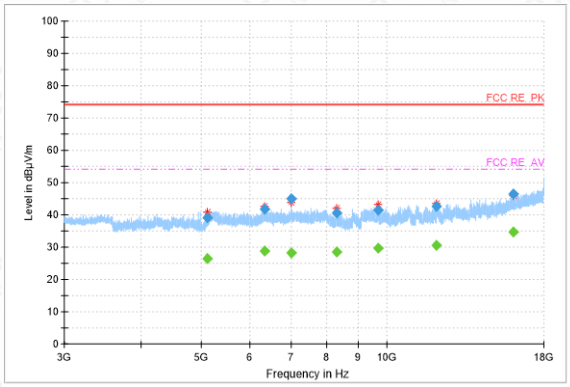
Result=PMea + ARpi

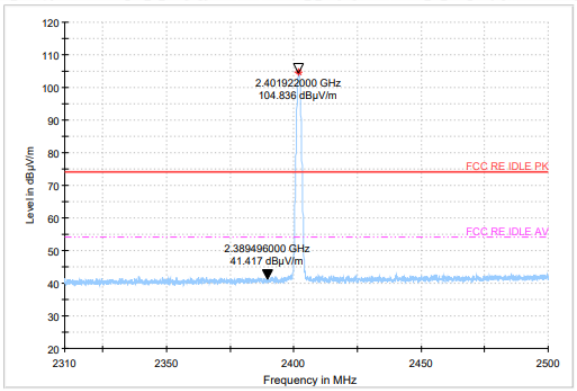
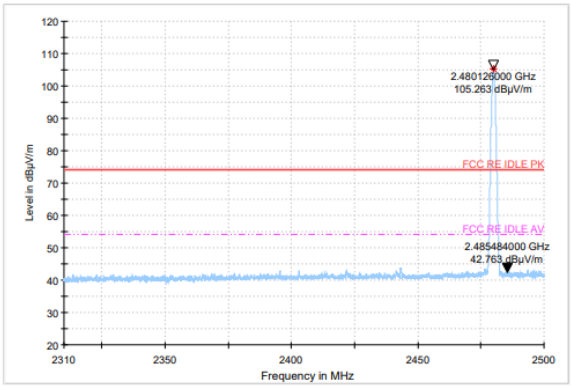
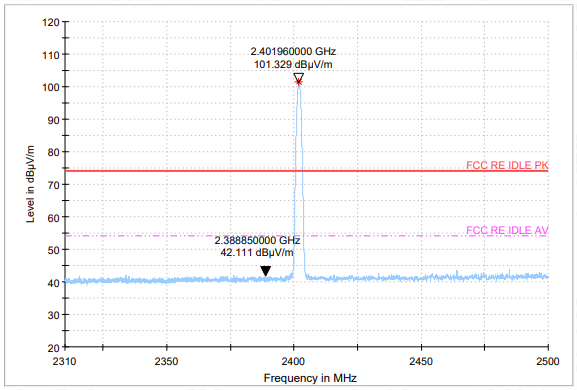
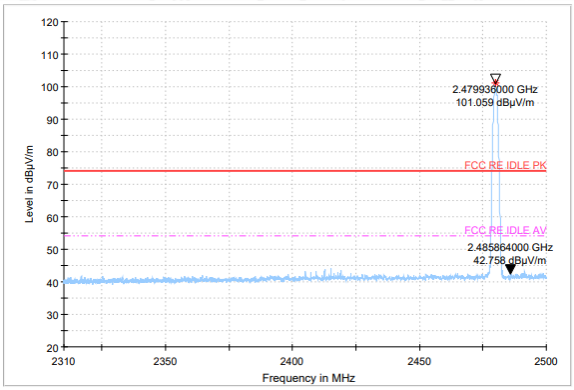
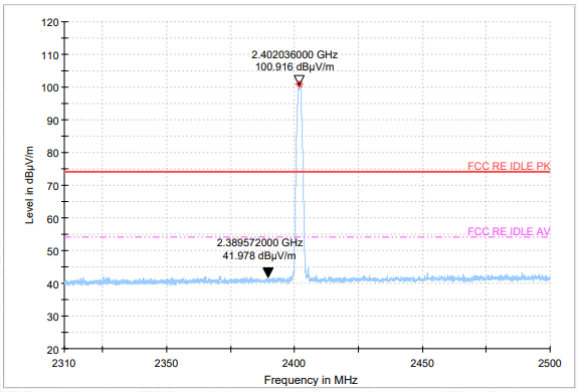
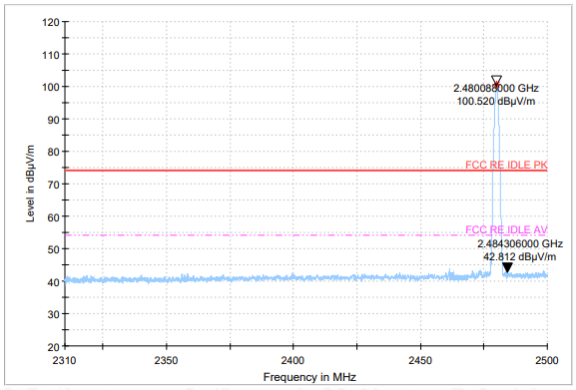
The test data below 30MHz is more than 20dB lower than the limit value, so it is not provided in the report.

Main Supply

Radiated emission: GFSK, Ch0, 30MHz~1GHz	Radiated emission: GFSK, Ch0, 1GHz~3GHz
	
Radiated emission: GFSK, Ch0, 3GHz~18GHz	**Radiated emission: GFSK, Ch78, 30MHz~1GHz**
	
Radiated emission: GFSK, Ch78, 1GHz~3GHz	**Radiated emission: GFSK, Ch78, 3GHz~18GHz**
	

Radiated emission: π/4 DQPSK, Ch0, 30MHz~1GHz	Radiated emission: π/4 DQPSK, Ch0, 1GHz~3GHz
	
Radiated emission: π/4 DQPSK, Ch0, 3GHz~18GHz	**Radiated emission: π/4 DQPSK, Ch78, 30MHz~1GHz**
	
Radiated emission: π/4 DQPSK, Ch78, 1GHz~3GHz	**Radiated emission: π/4 DQPSK, Ch78, 3GHz~18GHz**
	

Radiated emission: 8DPSK, Ch0, 30MHz~1GHz	Radiated emission: 8DPSK, Ch0, 1GHz~3GHz
	
Radiated emission: 8DPSK, Ch0, 3GHz~18GHz	**Radiated emission: 8DPSK, Ch78, 30MHz~1GHz**
	
Radiated emission: 8DPSK, Ch78, 1GHz~3GHz	**Radiated emission: 8DPSK, Ch78, 3GHz~18GHz**
	

Bandedge (Low): GFSK, low channel	Bandedge (High): GFSK, high channel
	
Bandedge (Low): π/4 DQPSK, low channel	**Bandedge (High): π/4 DQPSK, high channel**
	
Bandedge (Low): 8DPSK, low channel	**Bandedge (High): 8DPSK, high channel**
	

Note1: The out-of- limit signal in the picture is the main frequency signal.

Note2: Sweep the whole frequency band through the range from 30MHz to the 5th harmonic of the carrier, the Emissions in the frequency band 18GHz-40GHz is more than 20dB below the limit are not report.

GFSK Ch0 30MHz-1GHz

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
35.7	14.21	-13.8	28.01	V
57.1	11.08	-12.2	23.28	V
102.9	9.59	-13.3	22.89	V
184.7	7.98	-14.5	22.48	H
365.1	13.59	-9	22.59	V
638.8	19.01	-3.4	22.41	H

GFSK Ch0 1GHz-3GHz

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2545.1	51.76	15	36.76	V
2611.2	52.78	15.6	37.18	H
2685.1	52.76	15.9	36.86	V
2760.0	52.93	16.3	36.63	V
2834.1	53.9	16.6	37.3	V
2960.1	53.4	16.9	36.5	H

GFSK Ch0 3GHz-18GHz

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
3443.1	38.73	-6.7	45.43	H
4803.8	44.56	-4.9	49.46	H
6984.0	40.03	-2.3	42.33	H
9541.4	41.2	-0.6	41.8	V
13048.7	44.41	3.6	40.81	H
17229.4	48.66	9.3	39.36	H

GFSK Ch78 30MHz-1GHz

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity

36.1	12.63	-13.8	26.43	V
57.7	10.91	-12.2	23.11	H
102.8	9.52	-13.3	22.82	H
218.8	9.65	-12.6	22.25	V
413.4	14.78	-7.8	22.58	H
816.9	21.49	-1	22.49	V

GFSK Ch78 1GHz-3GHz

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2540.9	52.02	14.9	37.12	H
2619.0	52.14	15.6	36.54	V
2684.1	52.73	15.9	36.83	H
2742.9	53.51	16.2	37.31	V
2846.4	53.27	16.6	36.67	H
2982.3	53.5	17.2	36.3	V

GFSK Ch78 3GHz-18GHz

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
3414.1	39.02	-6.7	45.72	V
5288.3	41.68	-2.4	44.08	V
6976.9	44.54	-2.4	46.94	V
9951.5	43.29	-0.6	43.89	V
12112.4	43.19	1.9	41.29	H
16302.9	46.5	7.9	38.6	V

π/4 DQPSK -CH0-30M-1G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
34.8	13.09	-14.1	27.19	V
52.7	11.01	-12	23.01	V
90.1	6.97	-15.5	22.47	H

146.7	5.54	-17.1	22.64	H
258.5	10.7	-11.8	22.5	V
460.8	15.92	-6.8	22.72	H

π /4 DQPSK -CH0-1G-3G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2513.9	51.84	14.7	37.14	V
2614.8	52.11	15.6	36.51	H
2711.4	53.89	16	37.89	H
2801.7	53.71	16.6	37.11	H
2861.1	53.36	16.7	36.66	V
2957.1	53.33	16.9	36.43	V

π /4 DQPSK -CH0-3G-18G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
3439.3	39.46	-6.7	46.16	H
4643.6	38.79	-5	43.79	V
5994.0	45.24	-4	49.24	V
7938.4	41.77	-1.2	42.97	H
10859.5	42.82	1.1	41.72	H
14002.3	43.81	4.7	39.11	H

π /4 DQPSK -CH78-30M-1G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
32.1	11.48	-14.3	25.78	V
34.7	13.74	-14.1	27.84	V
100.1	8.89	-13.3	22.19	H
190.2	8.11	-14.4	22.51	V
323.5	12.58	-9.8	22.38	V
527.3	17.3	-5.5	22.8	H

π /4 DQPSK -CH78-1G-3G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2573.5	52.77	15.3	37.47	V
2636.3	53.65	15.8	37.85	H
2700.8	52.98	15.9	37.08	V
2780.5	53.59	16.4	37.19	H
2850.2	53.56	16.6	36.96	H
2936.8	54.05	16.8	37.25	H

π /4 DQPSK -CH78-1G-3G (Average)

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2936.8	41.32	16.8	24.52	H

π /4 DQPSK -CH78-3G-18G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
3346.0	38.05	-7.1	45.15	V
4996.6	42.85	-3.8	46.65	V
6989.9	45.73	-2.3	48.03	V
9696.2	41.31	-0.6	41.91	H
11972.8	42.43	2	40.43	H
17583.8	47.01	9.7	37.31	H

8DPSK -CH0-30M-1G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
36.0	11.89	-13.8	25.69	V
64.9	8.1	-14	22.1	V
122.7	13.3	-15.3	28.6	V
218.6	9.68	-12.6	22.28	V
380.8	13.88	-8.6	22.48	H

691.2	19.62	-2.9	22.52	V

8DPSK -CH0-1G-3G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2608.1	52.53	15.6	36.93	V
2711.0	52.64	16	36.64	V
2760.8	52.79	16.3	36.49	V
2834.5	54.07	16.6	37.47	V
2905.0	54.32	16.7	37.62	H
2973.6	53.3	17.1	36.2	V

8DPSK -CH0-1G-3G (Average)

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2834.5	41.27	16.6	24.67	V
2905.0	41.68	16.7	24.98	H

8DPSK -CH0-3G-18G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
5249.7	41.05	-1.6	42.65	V
6259.2	40.88	-2.6	43.48	H
7948.9	42.5	-1.1	43.6	H
11201.7	43.93	1.7	42.23	V
14001.4	44.11	4.7	39.41	H
16353.4	44.5	8	36.5	H

8DPSK -CH78-30M-1G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
35.5	13.95	-13.9	27.85	V
117.2	7.16	-14.5	21.66	H
167.7	6.6	-15.3	21.9	V

302.6	11.99	-10.8	22.79	H
454.7	15.74	-7.1	22.84	V
691.2	19.59	-2.9	22.49	V

8DPSK -CH78-1G-3G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2569.5	52.28	15.3	36.98	H
2654.3	52.41	15.9	36.51	V
2762.0	52.91	16.3	36.61	H
2808.7	53.39	16.6	36.79	V
2874.7	53.88	16.7	37.18	H
2970.4	53.44	17	36.44	V

8DPSK -CH78-3G-18G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
5112.3	39.07	-1.7	40.77	V
6347.0	41.73	-2.5	44.23	V
6998.5	45.11	-2.3	47.41	V
8289.9	40.72	-2	42.72	H
9671.4	41.37	-0.6	41.97	H
12054.3	42.55	2	40.55	H
16072.6	46.51	7.6	38.91	H

6.5 Time Of Occupancy (Dwell Time)

6.5.1 Measurement Limit

Standard	Limit(ms)
FCC 47 Part 15.247 (a) (1) (iii)	<400
RSS-247 5.5	<400

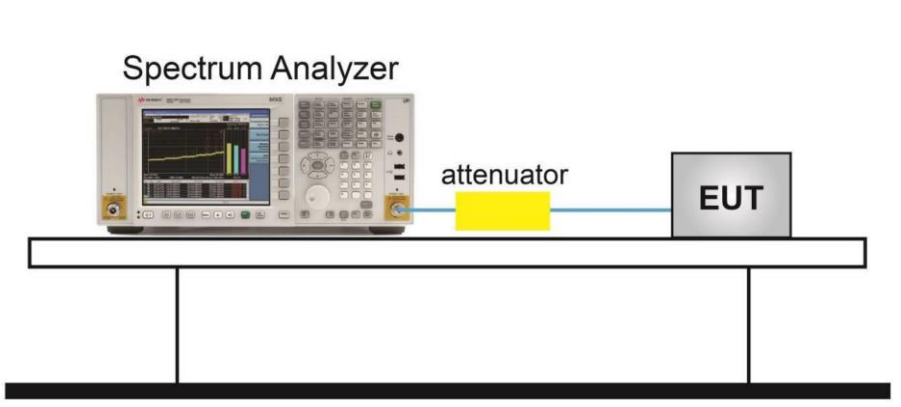
6.5.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.4

1. Connect the EUT through cable and divide with CMW 270 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 8.
4. Span: Zero span, centered on a hopping channel.
5. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
6. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to showtwo successive hops on a channel.
7. Detector function: Peak.
8. Trace: Max hold.
9. Use the marker-delta function, and record it.

Note： For AFH mode, Test Period = 0.4 (second/ channel) x 20 Channel = 8 sec,
For FHSS mode, Test Period = 0.4 (second/ channel) x 79 Channel = 31.6 sec,
So the Time of Occupancy (Dwell Time) of AFH mode= Time of Occupancy (Dwell Time) of FHSS mode / 79 Channel x 20 Channel.

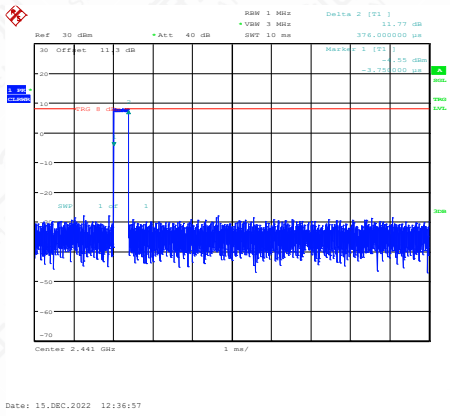
6.5.3 Test Setup



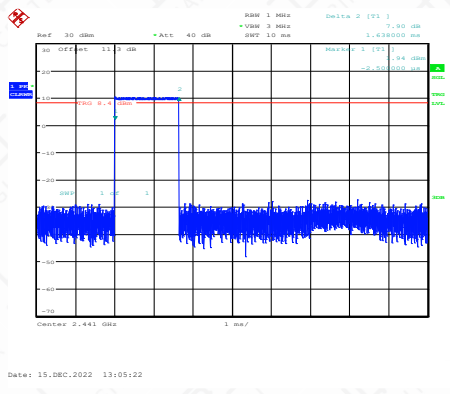
Measurement Result

TestMode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.376	320	0.12	≤0.4	PASS
DH3	Ant1	Hop	1.638	160	0.262	≤0.4	PASS
2DH5	Ant1	Hop	2.900	106.67	0.309	≤0.4	PASS
2DH1	Ant1	Hop	0.400	320	0.128	≤0.4	PASS
2DH3	Ant1	Hop	1.651	160	0.264	≤0.4	PASS
3DH5	Ant1	Hop	2.900	106.67	0.309	≤0.4	PASS
3DH1	Ant1	Hop	0.399	320	0.128	≤0.4	PASS
3DH3	Ant1	Hop	1.650	160	0.264	≤0.4	PASS
DH5	Ant1	Hop	2.884	106.67	0.308	≤0.4	PASS

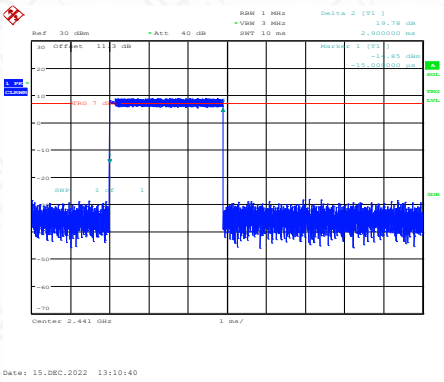
DH1-Ant1-Hop--0.376-320



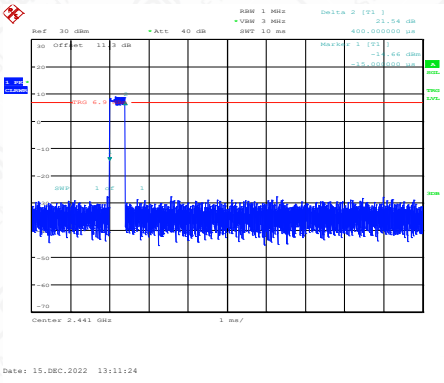
DH3-Ant1-Hop-1.638-160



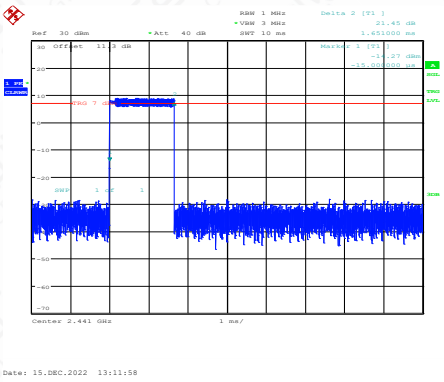
2DH5-Ant1-Hop-2.900-106.67



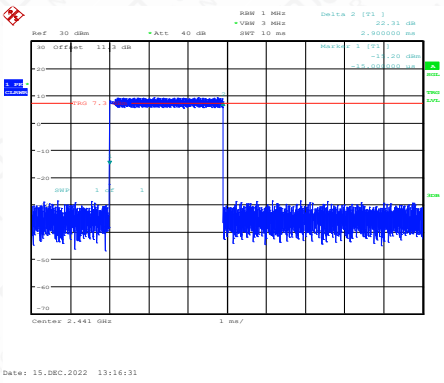
2DH1-Ant1-Hop-0.400-320

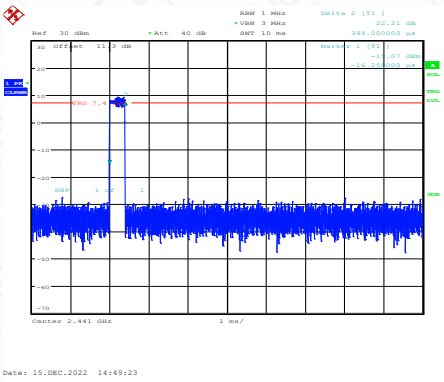


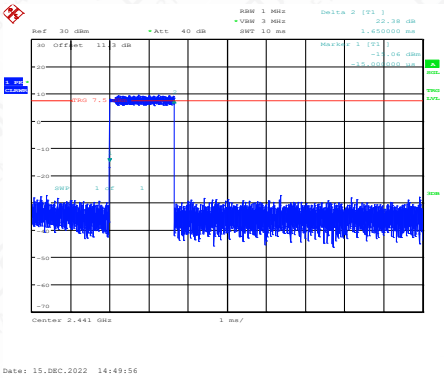
2DH3-Ant1-Hop-1.651-160

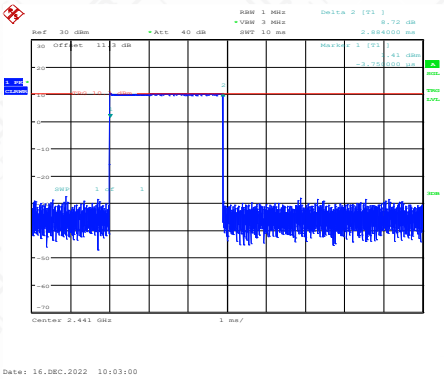


3DH5-Ant1-Hop-2.900-106.67



3DH1-Ant1-Hop-0.399-320


3DH3-Ant1-Hop-1.650-160


DH5-Ant1-Hop-2.884-106.67


6.6 20dB Bandwidth

6.6.1 Measurement Limit

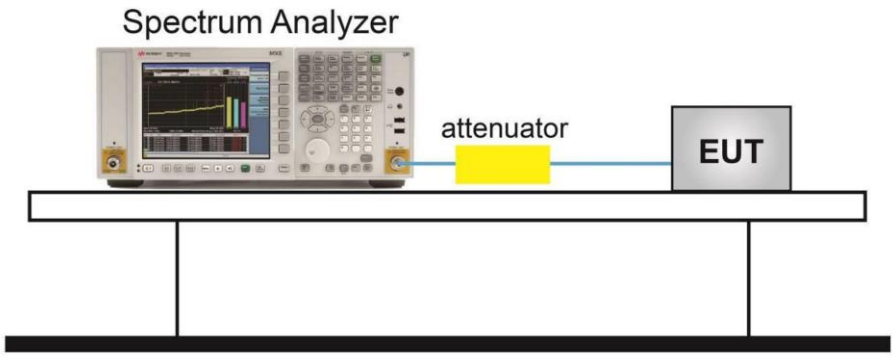
Standard	Limit
FCC 47 Part 15.247(d)	20dB below peak output power in 100KHz bandwidth
RSS-247 5.5	20dB below peak output power in 100KHz bandwidth

6.6.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.7

1. Connect the EUT through cable and divide with CMW 270 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 7.
4. Span: two or five times of OBW
5. RBW= 1% to 5% of the OBW; VBW is approximately three times of RBW; Max Hold.
6. Select the max peak, and N DB DOWN=20dB.
7. Record the results.

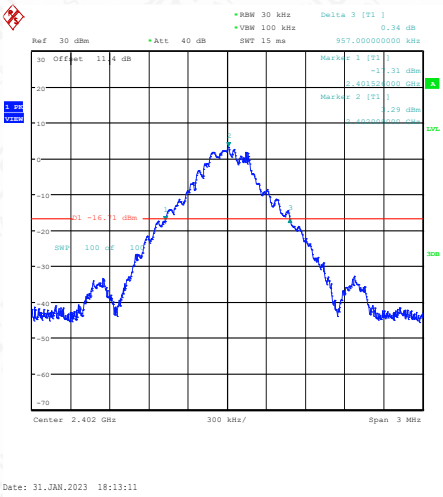
6.6.3 Test Setup



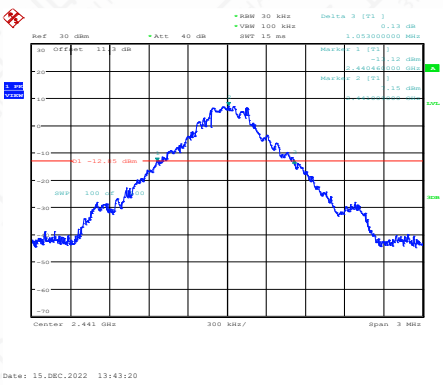
Measurement Result

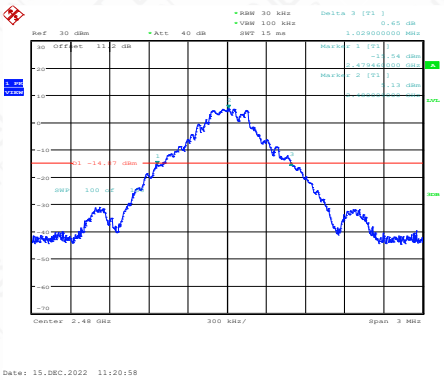
TestMode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.96	2401.53	2402.48	---	---
DH5	Ant1	2480	1.03	2479.46	2480.49	---	---
2DH5	Ant1	2402	1.29	2401.36	2402.65	---	---
2DH5	Ant1	2441	1.29	2440.36	2441.65	---	---
2DH5	Ant1	2480	1.29	2479.36	2480.65	---	---
3DH5	Ant1	2402	1.30	2401.35	2402.65	---	---
3DH5	Ant1	2441	1.31	2440.34	2441.65	---	---
3DH5	Ant1	2480	1.30	2479.35	2480.64	---	---
DH5	Ant1	2441	1.05	2440.46	2441.51	---	---

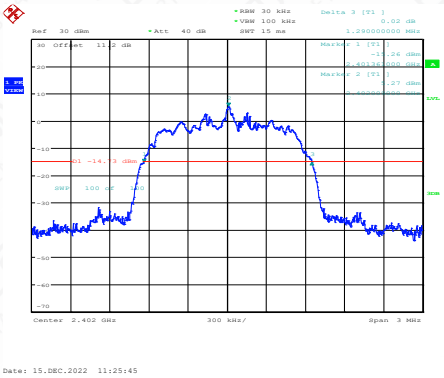
DH5-Ant1-2402

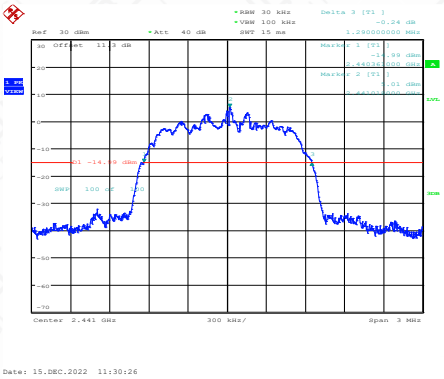


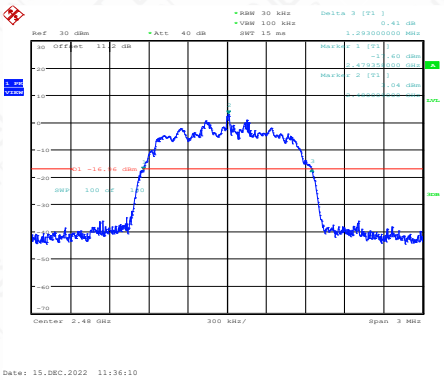
DH5-Ant1-2441

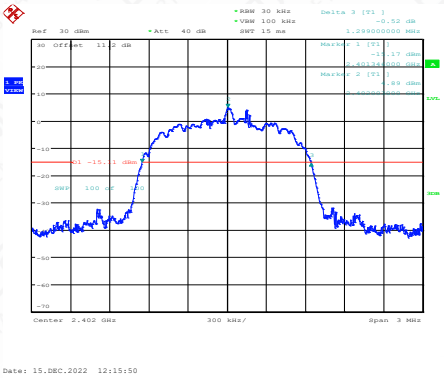


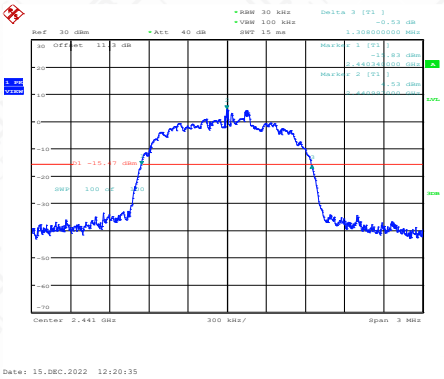
DH5-Ant1-2480


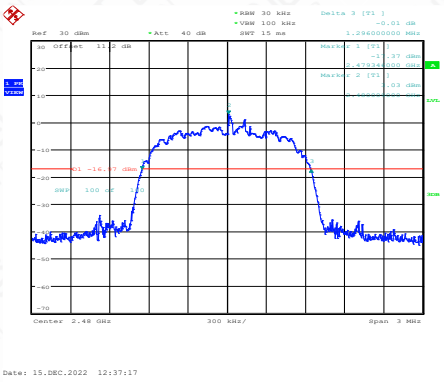
2DH5-Ant1-2402


2DH5-Ant1-2441


2DH5-Ant1-2480


3DH5-Ant1-2402


3DH5-Ant1-2441


3DH5-Ant1-2480


6.7 99% Occupied Bandwidth

6.7.1 Measurement Limit

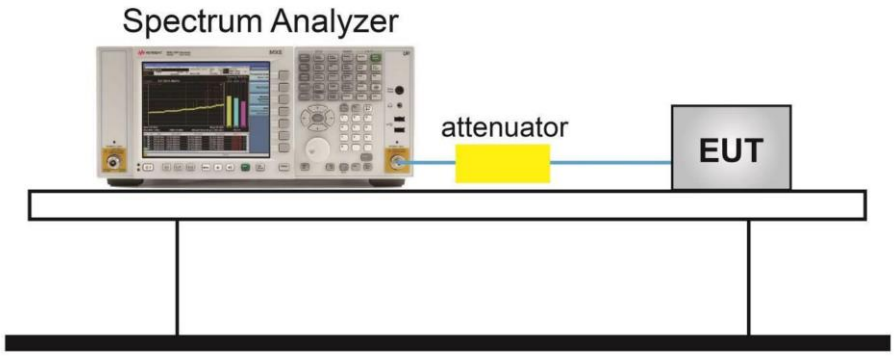
Standard	Limit
RSS-Gen 6.7	N/A

6.7.2 Test procedures

The measurement is according to ANSI C63.10 clause 6.9.3.

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Set RBW shall be in the range of 1% to 5% of the OBW.
4. Set the VBW ≥ [3 × RBW].
5. Detector = peak.
6. Trace mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize.
9. The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

6.7.3 Test setup

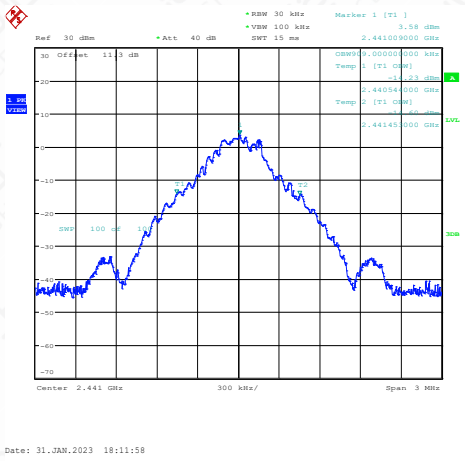


Measurement Result

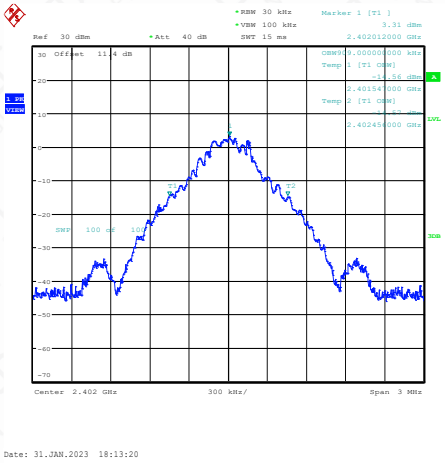
TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH5	Ant1	2402	0.909	2440.5440	2441.4530	---	---
DH5	Ant1	2441	0.909	2401.5470	2402.4560	---	---
DH5	Ant1	2480	0.918	2479.5380	2480.4560	---	---
2DH5	Ant1	2402	1.179	2401.4060	2402.5850	---	---
2DH5	Ant1	2441	1.176	2440.4060	2441.5820	---	---
2DH5	Ant1	2480	1.179	2479.4030	2480.5820	---	---
3DH5	Ant1	2402	1.182	2401.4060	2402.5880	---	---
3DH5	Ant1	2441	1.185	2440.4030	2441.5880	---	---
3DH5	Ant1	2480	1.179	2479.4060	2480.5850	---	---

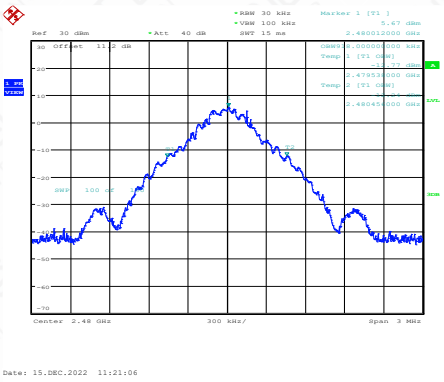
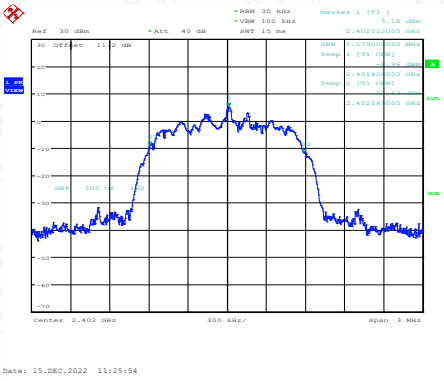
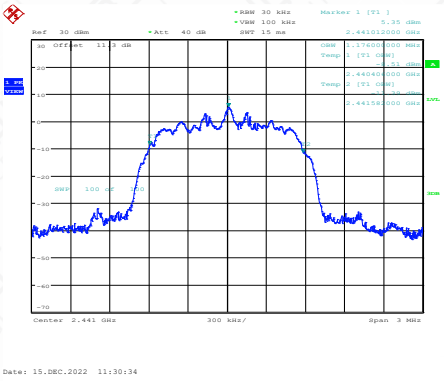
Test graphs as below

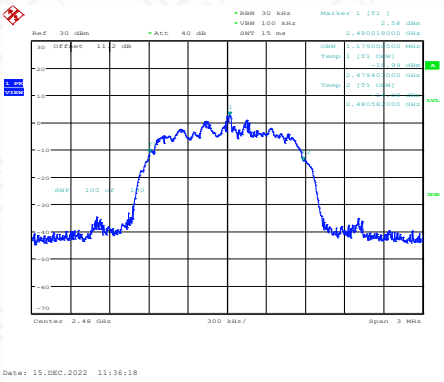
DH5-Ant1-2402



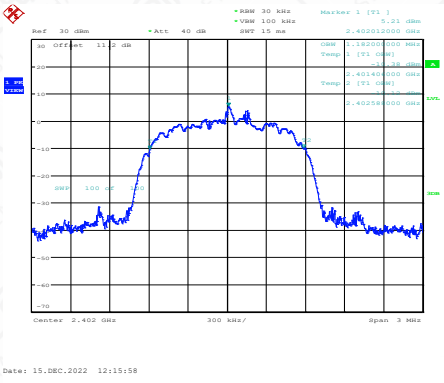
DH5-Ant1-2441



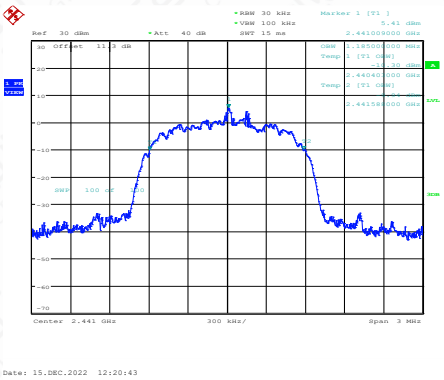
DH5-Ant1-2480

2DH5-Ant1-2402

2DH5-Ant1-2441

2DH5-Ant1-2480



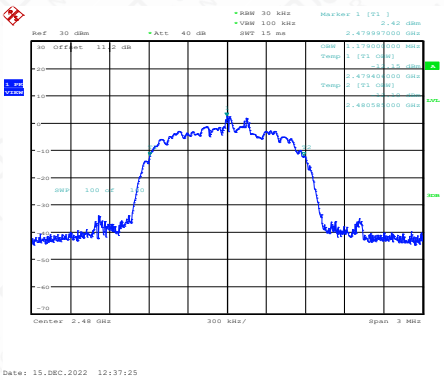
3DH5-Ant1-2402



3DH5-Ant1-2441



3DH5-Ant1-2480



6.8 Carrier Frequency Separation

6.8.1 Measurement Limit

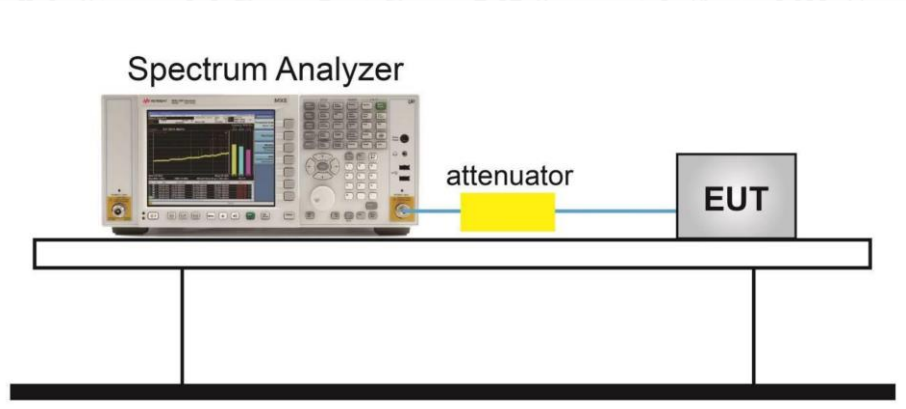
Standard	Limit(KHz)
FCC 47 Part 15.247 (a) (1)	Over 25KHz or (2/3)*20dB bandwidth
RSS-247 5.1	Over 25KHz or (2/3)*20dB bandwidth

6.8.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.2.

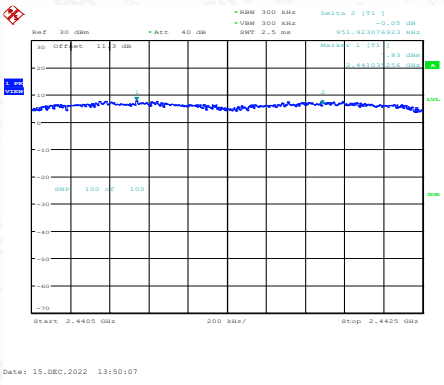
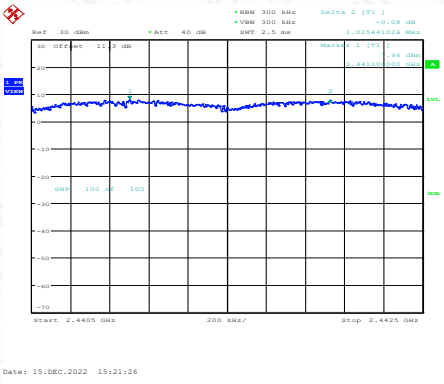
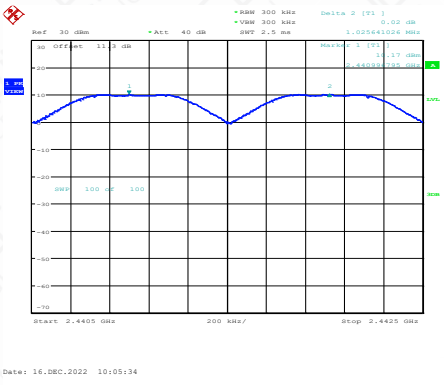
1. Connect the EUT through cable and divide with CBT32 and spectrum analyzer.
2. Enable the EUT transmit in hopping mode.
3. Span: Wide enough to capture the peaks of two adjacent channels.
4. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
5. Video (or average) bandwidth (VBW) ≥ RBW.
6. Sweep: Auto.
7. Detector function: Peak.
8. Trace: Max hold.
9. Allow the trace to stabilize.S

6.8.3 Test Setup



Measurement Result

TestMode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
2DH5	Ant1	Hop	0.952	≥0.860	PASS
3DH5	Ant1	Hop	1.026	≥0.873	PASS
DH5	Ant1	Hop	1.026	≥0.867	PASS

2DH5-Ant1-Hop

3DH5-Ant1-Hop

DH5-Ant1-Hop


6.9 Number Of Hopping Channels

6.9.1 Measurement Limit

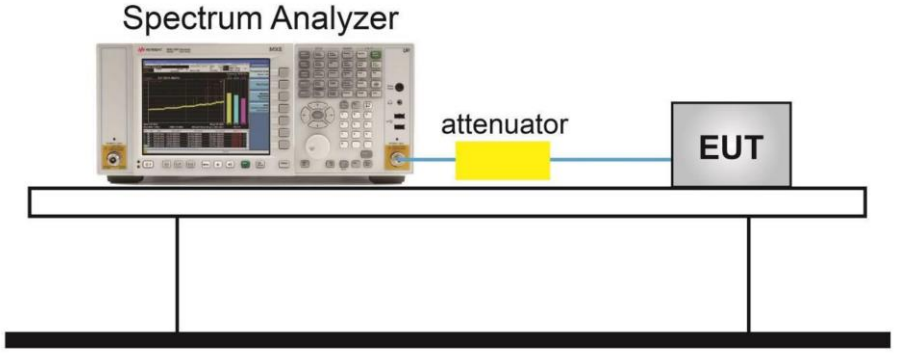
Standard	Limit
FCC 47 CFR Part 15.247 (a)(1)(iii)	At least 15 non-overlapping channels
RSS-247 5.1	At least 15 non-overlapping channels

6.9.2 Test procedure

The measurement is according to ANSI C63.10 clause 7.8.3.

1. Connect the EUT through cable and divide with CMW 270 and spectrum analyzer.
2. Enable the EUT transmit in hopping mode.
3. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
4. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
5. VBW ≥ RBW.
6. Sweep: Auto.
7. Detector function: Peak.
8. Trace: Max hold.
9. Allow the trace to stabilize.
10. Record the test results.

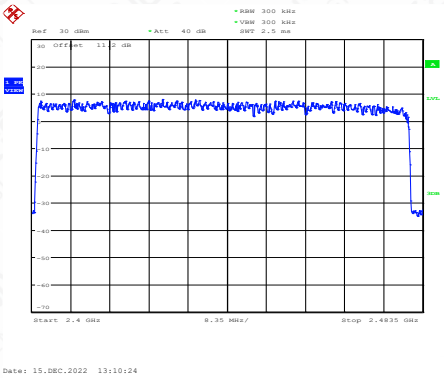
6.9.3 Test Setup



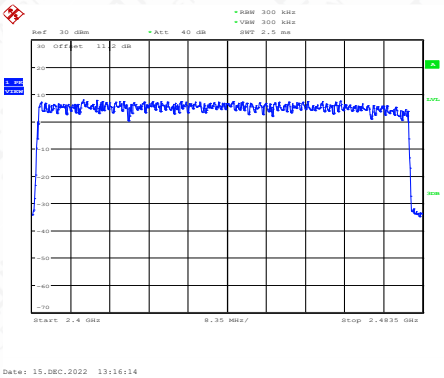
Measurement Result

TestMode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS
DH5	Ant1	Hop	79	≥15	PASS

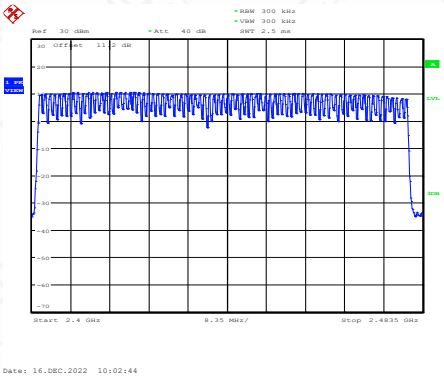
2DH5-Ant1-Hop



3DH5-Ant1-Hop



DH5-Ant1-Hop



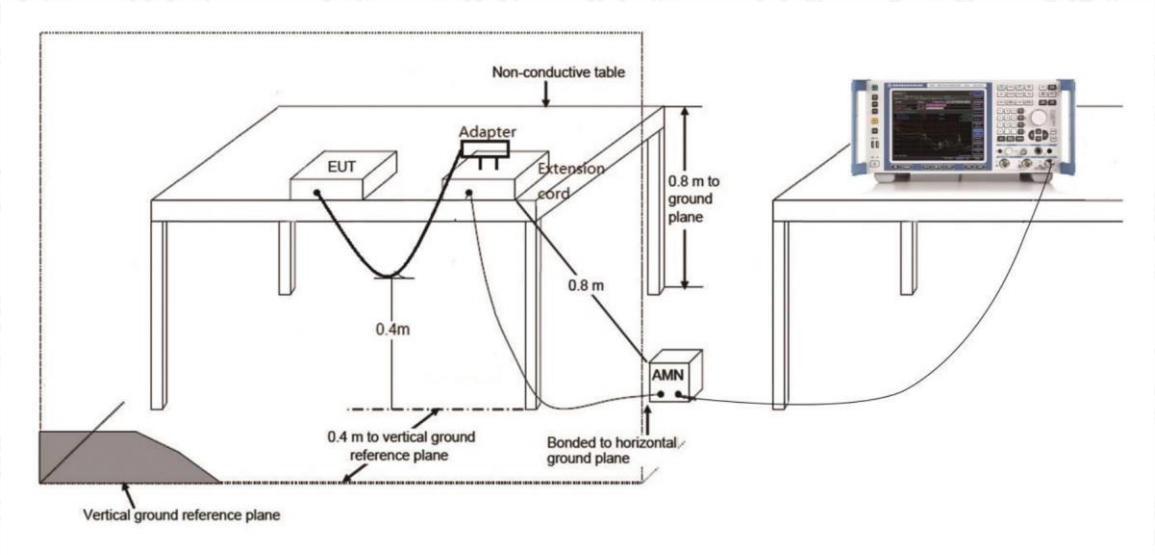
6.10 AC Powerline Conducted Emission

6.10.1 Method of Measurement: ANSI C63.10-2013-clause 6.2

1. The one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT.
2. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed.
3. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation.
4. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.36 Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

6.10.2 Test Setup



6.10.3 Test Condition

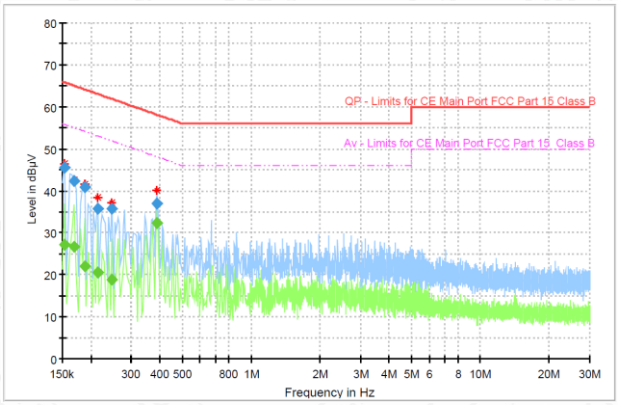
Voltage（V）	Frequency（Hz）
120	60

Measurement Result and limit

(Quasi-peak-average Limit)

Frequency range (MHz)	Quasi-peak Limit (dBμV)	Average Limit (dBμV)	Conclusion
0.15 to 0.5	66 to 56	56 to 46	P
0.5 to 5	56	46	
5 to 30	60	50	
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.			

Main Supply

CA04	/
	/

CA04

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.153731	---	27.24	55.80	28.56	15000.0	9.000	L1	ON	9.6
0.153731	45.52	---	65.80	20.27	15000.0	9.000	L1	ON	9.6
0.168656	---	26.55	55.03	28.48	15000.0	9.000	L1	ON	9.6
0.168656	42.30	---	65.03	22.73	15000.0	9.000	L1	ON	9.6
0.187313	---	22.05	54.16	32.10	15000.0	9.000	L1	ON	9.6
0.187313	40.91	---	64.16	23.25	15000.0	9.000	L1	ON	9.6
0.213431	---	20.64	53.07	32.43	15000.0	9.000	L1	ON	9.6
0.213431	35.78	---	63.07	27.29	15000.0	9.000	L1	ON	9.6
0.247013	---	18.90	51.86	32.95	15000.0	9.000	L1	ON	9.6
0.247013	35.83	---	61.86	26.02	15000.0	9.000	L1	ON	9.6
0.388800	---	32.18	48.09	15.91	15000.0	9.000	L1	ON	9.6
0.388800	36.99	---	58.09	21.10	15000.0	9.000	L1	ON	9.6

Annex A: Revised History

Version	Revised Content
V00	Initial

Annex B: Accreditation Certificate

Accredited Laboratory

A2LA has accredited

INDUSTRIAL INTERNET INNOVATION CENTER (SHANGHAI) CO., LTD.

Shanghai, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 12th day of April 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3682.01
Valid to February 28, 2023

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

END OF REPORT