

TEST REPORT

Product Name : Bluetooth Headset
Brand Mark : QCY
Model No. : In2028,In2028R
Report Number : BLA-EMC-202009-A2901
FCC ID : RDR-IN2028R
Date of Sample Receipt : 2020/9/8
Date of Test : 2020/9/8 to 2020/9/16
Date of Issue : 2020/9/18
Test Standard : 47 CFR Part 15, Subpart C 15.247
Test Result : Pass

Prepared for:

Dongguan Hele Electronics Co.,Ltd

Dalingya Industrial Zone,Daojiao Town,Dongguan City,Guangdong,China

Prepared by:

BlueAsia of Technical Services(Shenzhen) Co.,Ltd.

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Date:

2020/9/18



REPORT REVISE RECORD

Version No.	Date	Description
00	2020/9/18	Original

BlueAsia

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1 TEST SUMMARY

Test item	Test Requirement	Test Method	Class/Severity	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.6 & Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	Pass
Hopping Channel Number	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.3	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
Carrier Frequencies Separation	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.2	47 CFR Part 15, Subpart C 15.247a(1)	Pass
20dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.7	47 CFR Part 15, Subpart C 15.247(a)(1)	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Dwell Time	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.4	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass

2 GENERAL INFORMATION

Applicant	Dongguan Hele Electronics Co.,Ltd
Address	Dalingya Industrial Zone,Daojiao Town,Dongguan City,Guangdong,China
Manufacturer	Dongguan Hele Electronics Co.,Ltd
Address	Dalingya Industrial Zone,Daojiao Town,Dongguan City,Guangdong,China
Factory	Dongguan Hele Electronics Co.,Ltd
Address	Dalingya Industrial Zone,Daojiao Town,Dongguan City,Guangdong,China
Product Name	Bluetooth Headset
Test Model No.	In2028

3 GENERAL DESCRIPTION OF E.U.T.

Hardware Version	V5.2
Software Version	v5.2
Operation Frequency:	2402MHz-2480MHz
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK
Channel Spacing:	1MHz
Number of Channels:	79
Antenna Type:	Internal Antenna
Antenna Gain:	1.6(Provided by the customer)

4 TEST ENVIRONMENT

Environment	Temperature	Voltage
Normal	25°C	3.7Vdc

5 TEST MODE

TEST MODE	TEST MODE DESCRIPTION
Transmitting mode	Keep the EUT in continuously transmitting mode with modulation. (hopping and non hopping mode all have been tested, non hopping mode is worse case for RE)
Remark: Full battery is used during all test except ac conducted emission, DH1,DH3, DH5 all have been tested, during the test, GFSK, Pi/4QPSK, 8-DPSK modulation were all pre-scanned only worse case is reported.	

6 MEASUREMENT UNCERTAINTY

Parameter	Expanded Uncertainty (Confidence of 95%)
Radiated Emission	±4.34dB
Radiated Emission	±4.24dB
Radiated Emission	±4.68dB
AC Power Line Conducted Emission	±3.45dB

Parameter	Expanded Uncertainty (Confidence of 95%)
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3.0 dB
Unwanted Emissions, conducted	±3.0 dB
Temperature	±3 °C
Supply voltages	±3 %
Time	±5 %
Radiated Emission (30MHz ~ 1000MHz)	±4.35 dB
Radiated Emission (1GHz ~ 18GHz)	±4.44 dB

7 DESCRIPTION OF SUPPORT UNIT

Device Type	Manufacturer	Model Name	Serial No.	Remark
AC Adapter	UGREEN	CD112	N/A	N/A
PC	HASEE	K610D	N/A	N/A

8 LABORATORY LOCATION

All tests were performed at:
BlueAsia of Technical Services(Shenzhen) Co., Ltd.
IOT Test Centre of BlueAsia
No. 448 Bulong Road, Bantian Street, Longgang District, Shenzhen, China
Telephone: TEL: +86-755-28682673 FAX: +86-755-28682673
Tests were sub-contracted:
Radiation test is conducted by Global United Technology Services Co., Ltd.
No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, sBaoan District, Shenzhen, Guangdong, China 518102
FCC —Registration No.: 381383
Job No.: GTS202009000066

9 TEST INSTRUMENTS LIST

Test Equipment Of Conducted Spurious Emissions					
Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/1/2020	6/30/2021
Spectrum	Agilent	N9020A	MY49100060	12/17/2019	12/16/2020
Signal Generator	Agilent	N5182A	MY49060650	12/17/2019	12/16/2020
Signal Generator	Agilent	E8257D	MY44320250	4/20/2020	4/19/2021

Test Equipment Of Hopping Channel Number					
Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/1/2020	6/30/2021
Spectrum	Agilent	N9020A	MY49100060	12/17/2019	12/16/2020
Signal Generator	Agilent	N5182A	MY49060650	12/17/2019	12/16/2020
Signal Generator	Agilent	E8257D	MY44320250	4/20/2020	4/19/2021

Test Equipment Of Carrier Frequencies Separation					
Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/1/2020	6/30/2021
Spectrum	Agilent	N9020A	MY49100060	12/17/2019	12/16/2020
Signal Generator	Agilent	N5182A	MY49060650	12/17/2019	12/16/2020
Signal Generator	Agilent	E8257D	MY44320250	4/20/2020	4/19/2021

Test Equipment Of 20dB Bandwidth					
Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due

Spectrum	R&S	FSP40	100817	7/1/2020	6/30/2021
Spectrum	Agilent	N9020A	MY49100060	12/17/2019	12/16/2020
Signal Generator	Agilent	N5182A	MY49060650	12/17/2019	12/16/2020
Signal Generator	Agilent	E8257D	MY44320250	4/20/2020	4/19/2021

Test Equipment Of Conducted Peak Output Power

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/1/2020	6/30/2021
Spectrum	Agilent	N9020A	MY49100060	12/17/2019	12/16/2020
Signal Generator	Agilent	N5182A	MY49060650	12/17/2019	12/16/2020
Signal Generator	Agilent	E8257D	MY44320250	4/20/2020	4/19/2021

Test Equipment Of Conducted Emissions at AC Power Line (150kHz-30MHz)

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Shield room	SKET	833	N/A	6/10/2018	6/9/2021
Receiver	R&S	ESPI3	101082	4/20/2020	4/19/2021
LISN	R&S	ENV216	3560.6550.15	7/1/2020	6/30/2021
LISN	AT	AT166-2	AKK1806000003	12/17/2019	12/16/2020
EMI software	EZ	EZ-EMC	N/A	N/A	N/A

Radiated Emission:

Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 02 2020	July. 01 2025
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 25 2020	June. 24 2021
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 25 2020	June. 24 2021

5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 25 2020	June. 24 2021
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 25 2020	June. 24 2021
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 25 2020	June. 24 2021
9	Coaxial Cable	GTS	N/A	GTS211	June. 25 2020	June. 24 2021
10	Coaxial cable	GTS	N/A	GTS210	June. 25 2020	June. 24 2021
11	Coaxial Cable	GTS	N/A	GTS212	June. 25 2020	June. 24 2021
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 25 2020	June. 24 2021
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 25 2020	June. 24 2021
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 25 2020	June. 24 2021
15	Band filter	Amindeon	82346	GTS219	June. 25 2020	June. 24 2021
16	Power Meter	Anritsu	ML2495A	GTS540	June. 25 2020	June. 24 2021
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 25 2020	June. 24 2021
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 25 2020	June. 24 2021
19	Splitter	Agilent	11636B	GTS237	June. 25 2020	June. 24 2021
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 25 2020	June. 24 2021
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 19 2019	Oct. 18 2020
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 19 2019	Oct. 18 2020
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 19 2019	Oct. 18 2020
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 25 2020	June. 24 2021

Test Equipment Of Conducted Band Edges Measurement

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/1/2020	6/30/2021
Spectrum	Agilent	N9020A	MY49100060	12/17/2019	12/16/2020
Signal Generator	Agilent	N5182A	MY49060650	12/17/2019	12/16/2020
Signal Generator	Agilent	E8257D	MY44320250	4/20/2020	4/19/2021

Test Equipment Of Dwell Time

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/1/2020	6/30/2021
Spectrum	Agilent	N9020A	MY49100060	12/17/2019	12/16/2020
Signal Generator	Agilent	N5182A	MY49060650	12/17/2019	12/16/2020

Signal Generator	Agilent	E8257D	MY44320250	4/20/2020	4/19/2021
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ANTENNA REQUIREMENT

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	N/A

CONCLUSION

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of an so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 1.60 dBi.



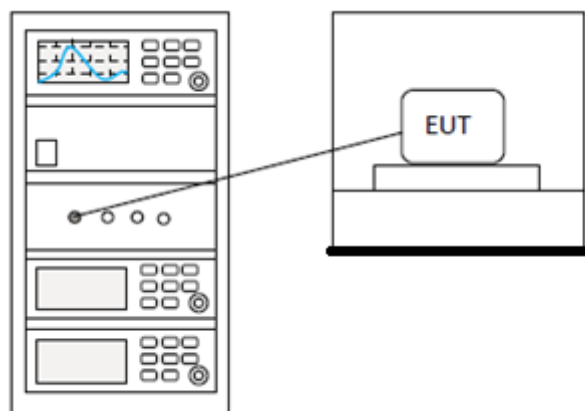
CONDUCTED SPURIOUS EMISSIONS

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.6 & Section 11.11
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	26°C
Humidity	54%

LIMITS

Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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)).
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BLOCK DIAGRAM OF TEST SETUP



TEST DATA**Pass: Please Refer To Appendix: Appendix1 For Details**

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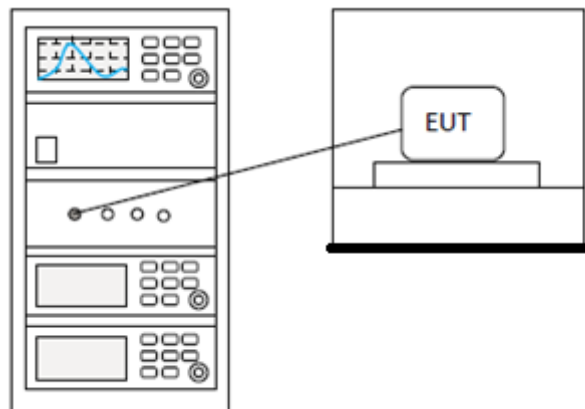
HOPPING CHANNEL NUMBER

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.3
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	26℃
Humidity	54%

LIMITS

Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth ≥250kHz
2400-2483.5	15
5725-5850	75

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

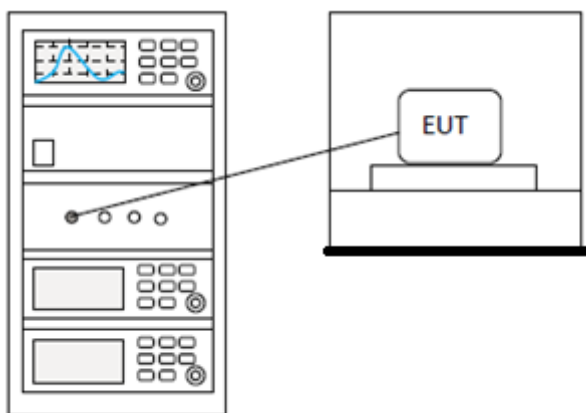
CARRIER FREQUENCIES SEPARATION

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	26°C
Humidity	54%

LIMITS

Limit:	2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W
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BLOCK DIAGRAM OF TEST SETUP



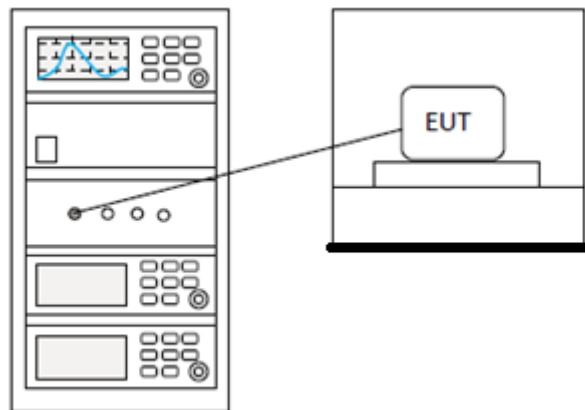
TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

20DB BANDWIDTH

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.7
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	26°C
Humidity	54%

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

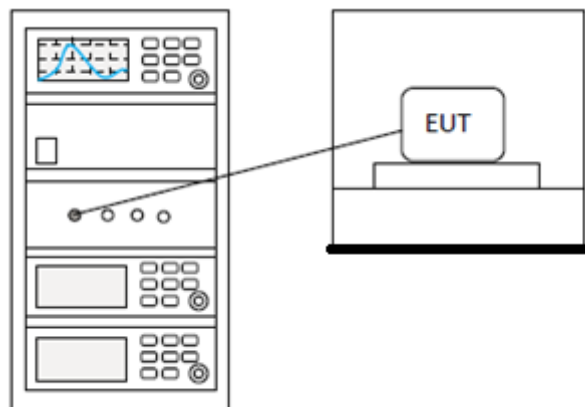
CONDUCTED PEAK OUTPUT POWER

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	26°C
Humidity	54%

LIMITS

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq \text{hopping channels} < 50$
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

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CONDUCTED EMISSIONS AT AC POWER LINE (150KHZ-30MHZ)

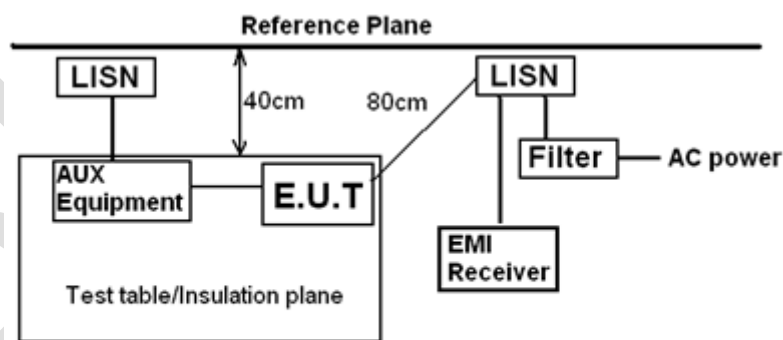
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	23℃
Humidity	54%

LIMITS

Frequency of emission(MHz)	Conducted limit(dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

BLOCK DIAGRAM OF TEST SETUP



Remark
E.U.T: Equipment Under Test
LISN: Line Impedance Stabilization Network
Test table height=0.8m

PROCEDURE

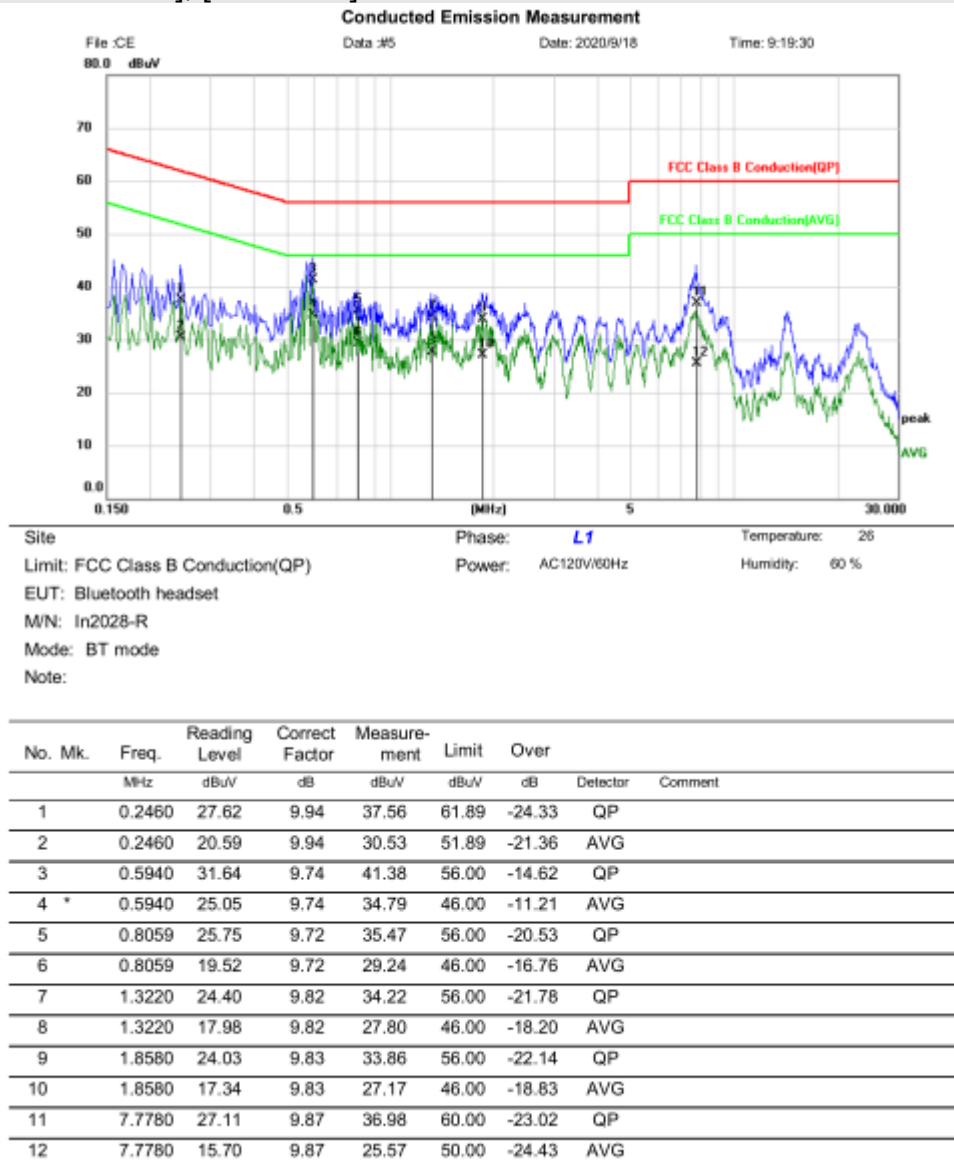
- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50?H + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.

- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: $LISN = Read\ Level + Cable\ Loss + LISN\ Factor$

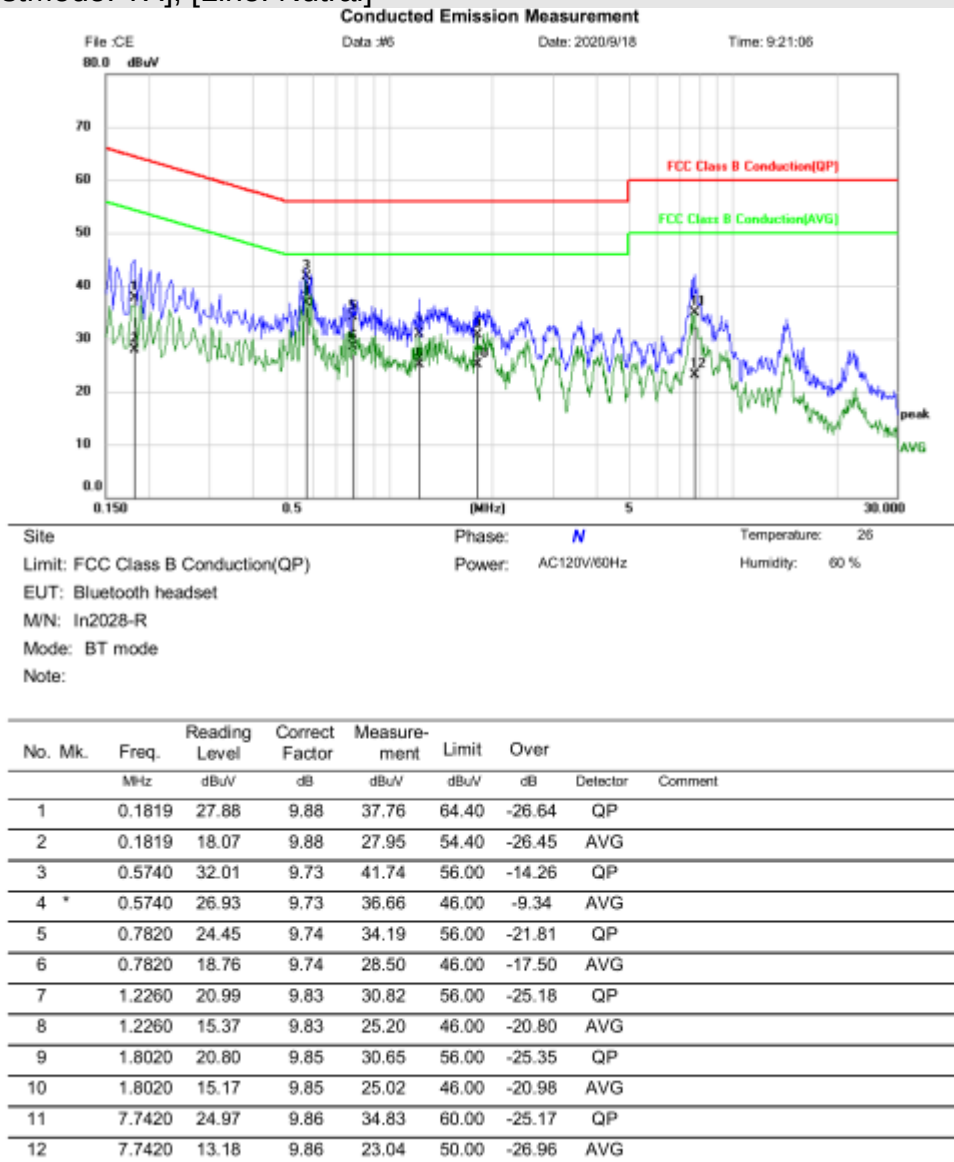
TEST DATA

[TestMode: TX]; [Line: Line]



Test Result: Pass

[TestMode: TX]; [Line: Nutral]



Test Result: Pass

RADIATED SPURIOUS EMISSIONS

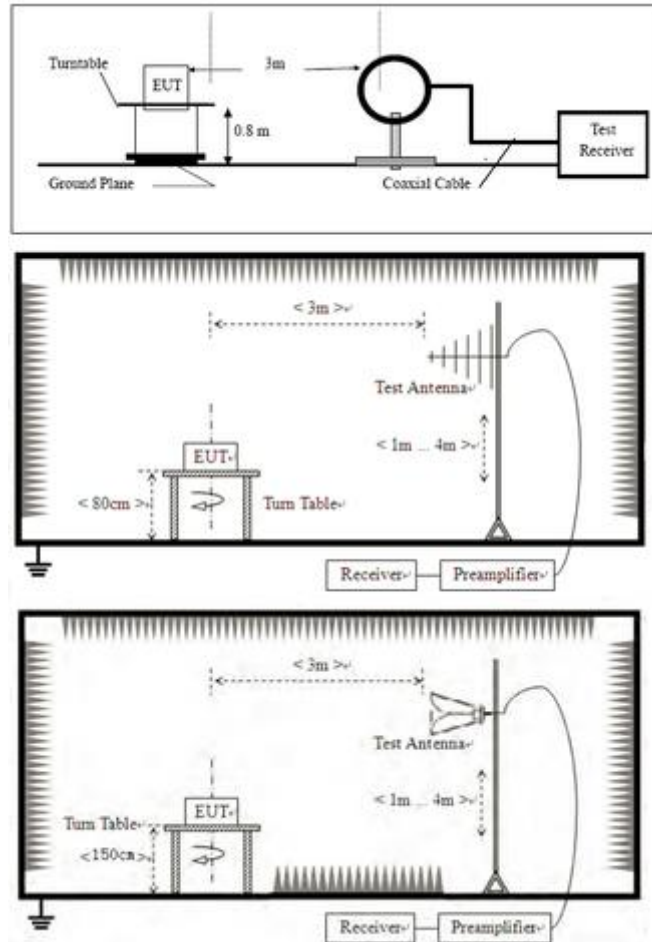
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.4,6.5,6.6
Test Mode (Pre-Scan)	TX mode (SE) below 1G; TX mode (SE) above 1G
Test Mode (Final Test)	TX mode (SE) below 1G; TX mode (SE) above 1G
Tester	Eason
Temperature	24℃
Humidity	53%

LIMITS

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

BLOCK DIAGRAM OF TEST SETUP



PROCEDURE

- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

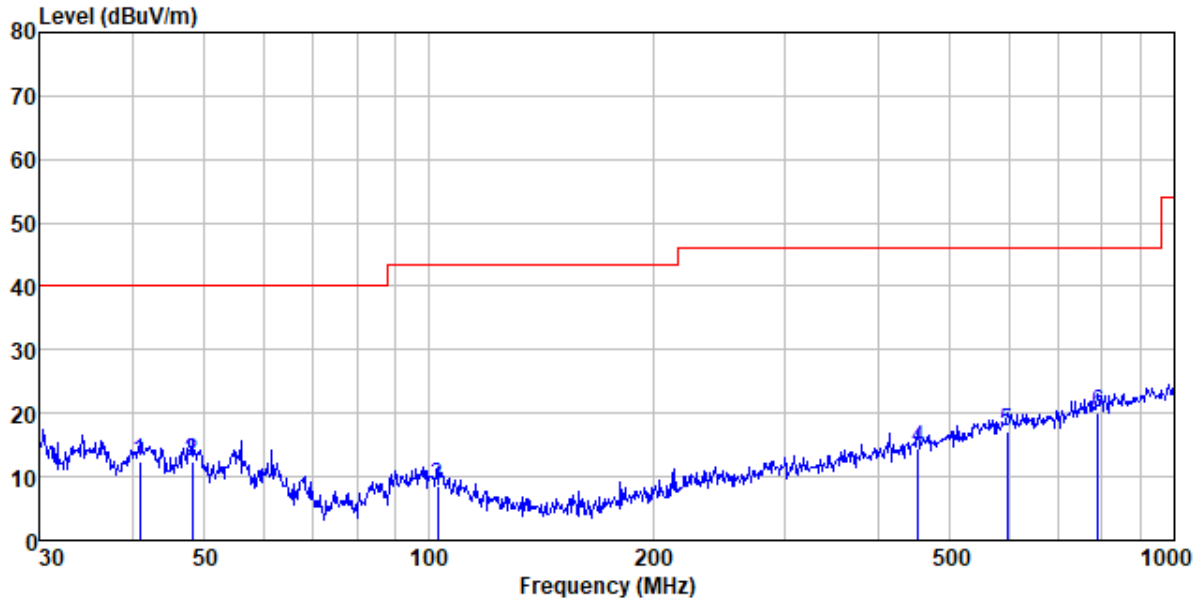
Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor + Preamplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

TEST DATA

[TestMode: TX mode (SE) below 1G]; [Polarity: Horizontal]

Power: AC120V/60Hz



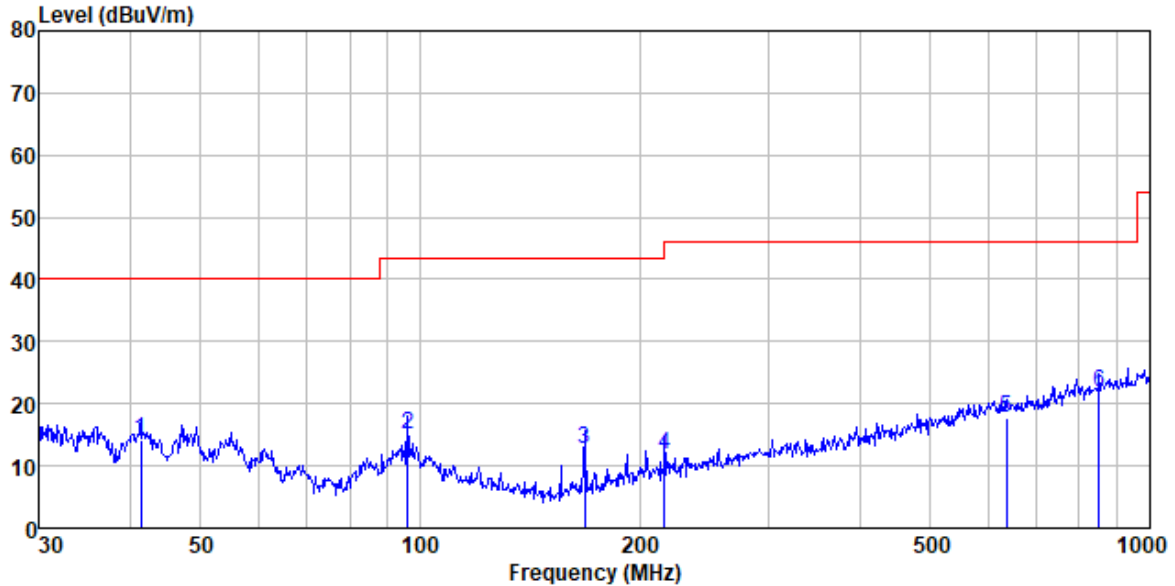
Condition : FCC PART15 CLASS B 3m HORIZONTAL
Job.No : GTS2020090000066
Test Mode : TX 2402MHz
Test Engineer: Hans
Remark :

	Freq	ReadAntenna	Preamp	Cable	Limit	Over	
	Level	Factor	Factor	Loss	Line	Limit	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB
1	40.988	35.33	12.21	35.72	0.67	12.49	40.00 -27.51 QP
2	48.163	35.59	12.28	36.09	0.75	12.53	40.00 -27.47 QP
3	102.719	32.23	11.89	36.74	1.22	8.60	43.50 -34.90 QP
4	452.720	32.36	16.40	37.51	3.10	14.35	46.00 -31.65 QP
5	597.223	31.57	19.44	37.54	3.71	17.18	46.00 -28.82 QP
6	790.619	31.95	21.21	37.62	4.42	19.96	46.00 -26.04 QP

Test Result: Pass

[TestMode: TX mode (SE) below 1G]; [Polarity: Vertical]

Power:AC120V/60Hz



Condition : FCC PART15 CLASS B 3m VERTICAL
Job.No : GTS2020090000066
Test Mode : TX 2402MHz
Test Engineer: Hans
Remark :

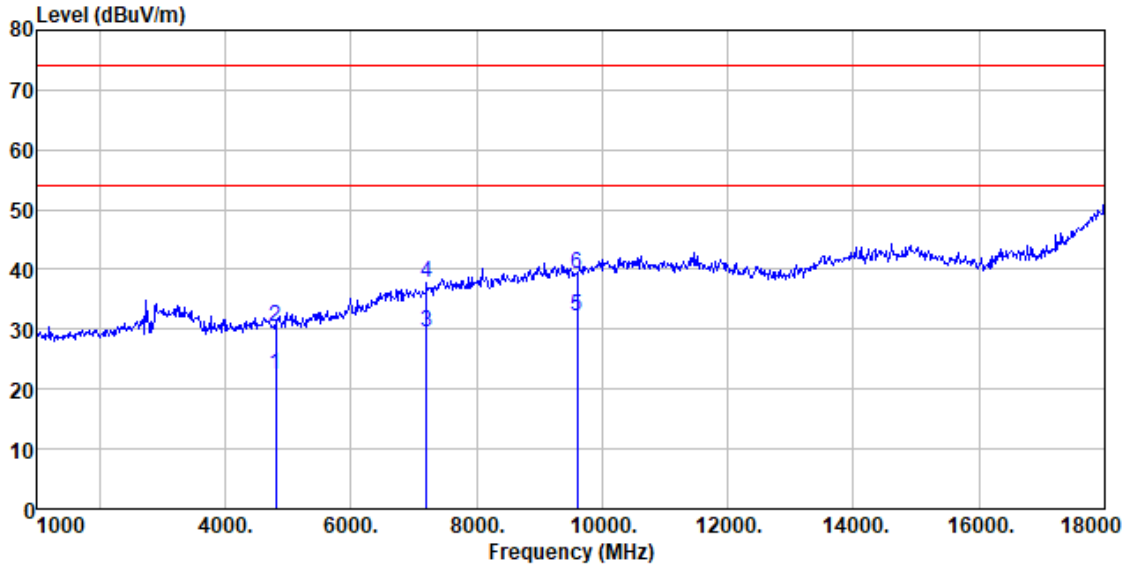
	Freq	Read	Antenna	Preamp	Cable	Limit	Over	
	MHz	Level	Factor	Factor	Loss	Line	Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	41.422	37.15	12.22	35.75	0.68	14.30	40.00	-25.70 QP
2	96.099	38.93	11.65	36.69	1.16	15.05	43.50	-28.45 QP
3	167.824	39.71	8.46	37.18	1.67	12.66	43.50	-30.84 QP
4	216.024	36.09	11.02	37.35	1.93	11.69	46.00	-34.31 QP
5	636.134	31.76	19.54	37.57	3.86	17.59	46.00	-28.41 QP
6	851.035	32.92	21.85	37.61	4.66	21.82	46.00	-24.18 QP

Test Result: Pass

[TestMode: GFSK]

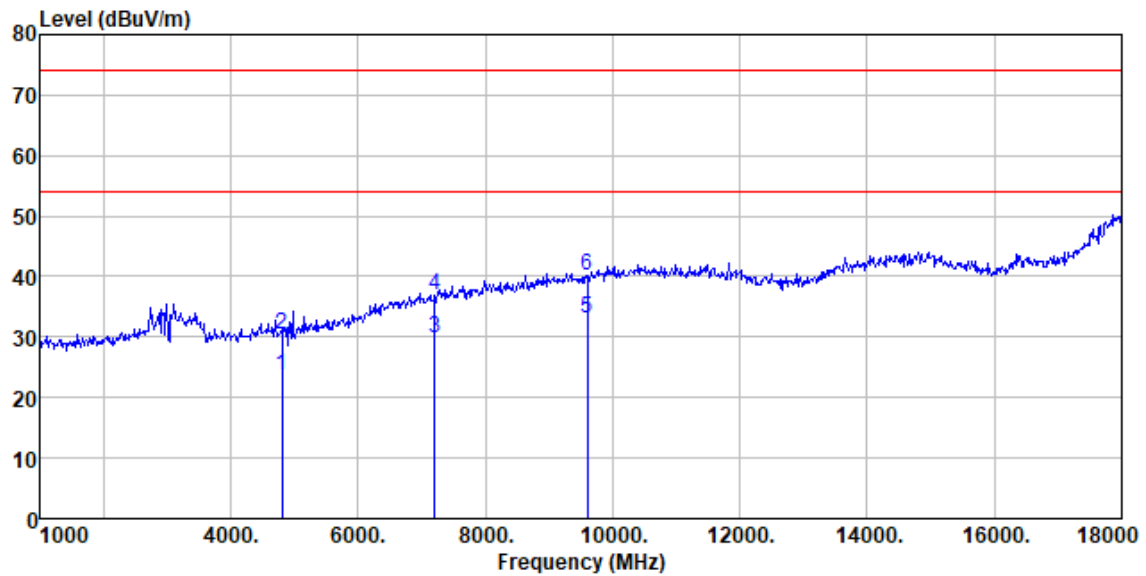
Remark: During the test, pre-scan the GFSK, Pi/4QPSK, 8-DPSK modulation, and found the GFSK modulation which it is worse case.

Test channel:lowest



Condition : FCC PART 15 (PK) 3m VERTICAL
Job No. : GTS202009000066
Test Mode : TX 2402MHz
Test Engineer: Hans
Remark :

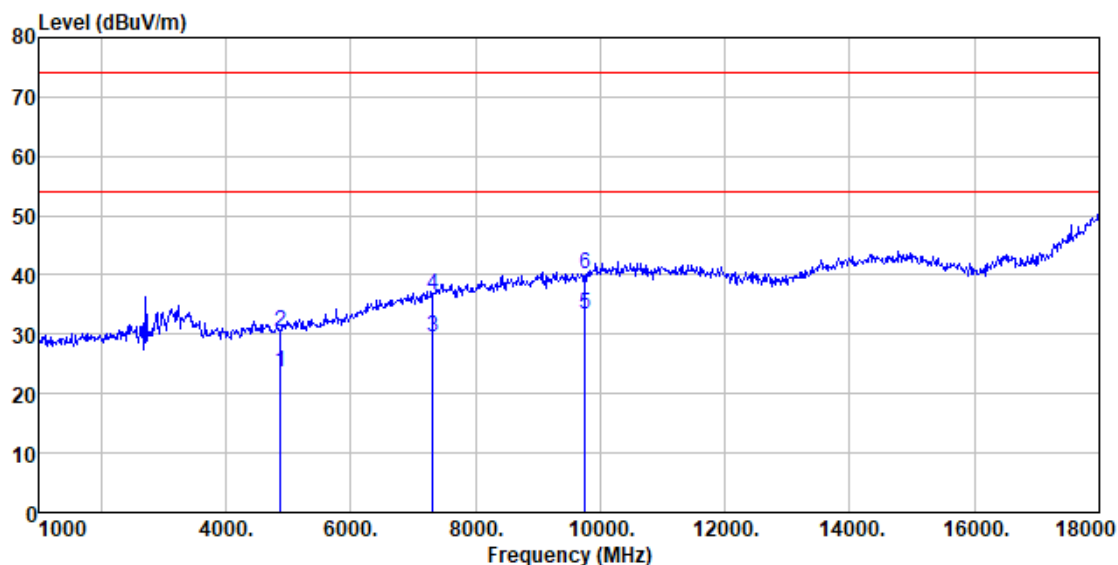
	Freq	ReadAntenna	Preamp	Cable	Limit	Over	
	Level	Factor	Factor	Loss	Level	Line	Limit Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB
1	4804.000	24.21	31.35	37.73	4.61	22.44	54.00 -31.56 Average
2	4804.000	32.30	31.35	37.73	4.61	30.53	74.00 -43.47 Peak
3	7206.000	22.81	35.89	35.63	6.48	29.55	54.00 -24.45 Average
4	7206.000	30.91	35.89	35.63	6.48	37.65	74.00 -36.35 Peak
5	9608.000	21.51	37.74	34.94	7.97	32.28	54.00 -21.72 Average
6	9608.000	28.60	37.74	34.94	7.97	39.37	74.00 -34.63 Peak



Condition : FCC PART 15 (PK) 3m HORIZONTAL
Job No. : GTS202009000066
Test Mode : TX 2402MHz
Test Engineer: Hans
Remark :

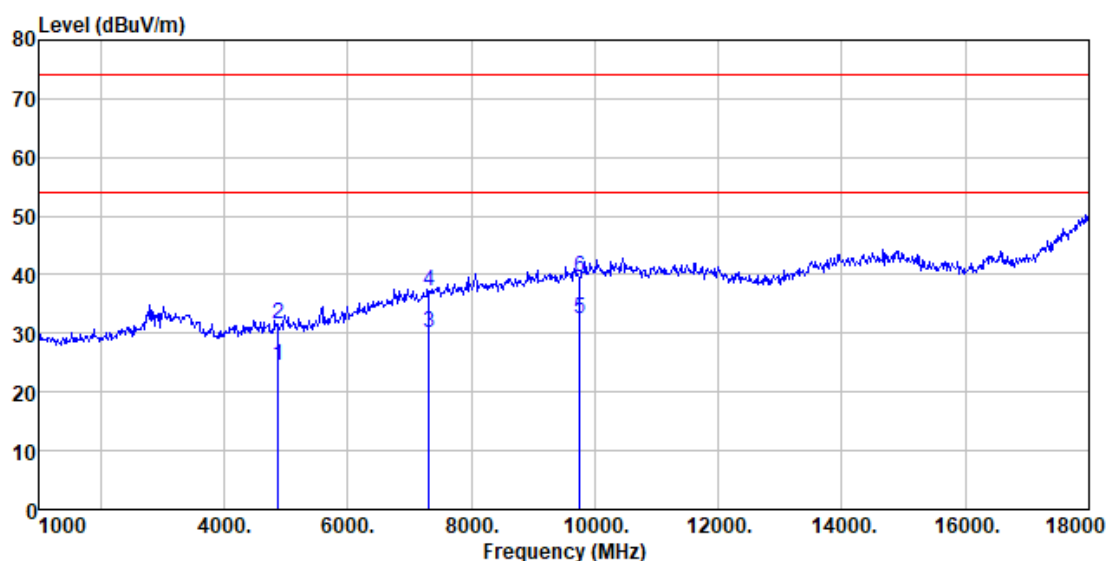
	Freq	Read Level	Antenna Factor	Preamp Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	4804.000	25.30	31.35	37.73	4.61	23.53	54.00	-30.47	Average
2	4804.000	32.28	31.35	37.73	4.61	30.51	74.00	-43.49	Peak
3	7206.000	23.03	35.89	35.63	6.48	29.77	54.00	-24.23	Average
4	7206.000	30.05	35.89	35.63	6.48	36.79	74.00	-37.21	Peak
5	9608.000	22.39	37.74	34.94	7.97	33.16	54.00	-20.84	Average
6	9608.000	29.39	37.74	34.94	7.97	40.16	74.00	-33.84	Peak

Test channel: Middle



Condition : FCC PART 15 (PK) 3m HORIZONTAL
Job No. : GTS202009000066
Test Mode : TX 2441MHz
Test Engineer: Hans
Remark :

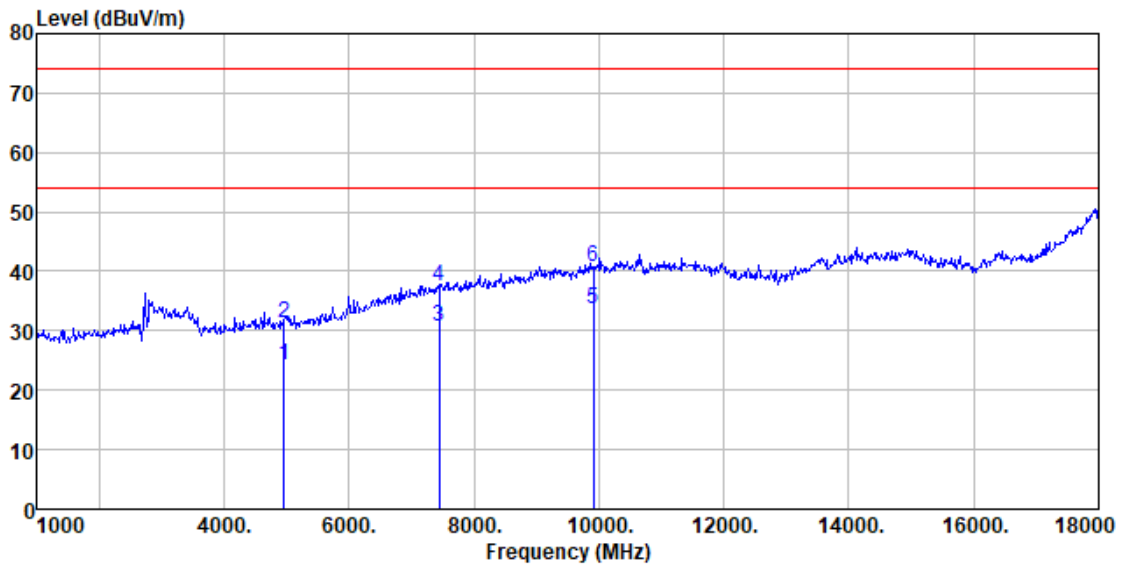
	Freq	ReadAntenna	Preamp	Cable	Level	Limit	Over	
	MHz	Level	Factor	Loss	dBuV/m	Line	Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dB	
1	4882.000	25.12	31.49	37.76	4.69	23.54	54.00	Average
2	4882.000	32.12	31.49	37.76	4.69	30.54	74.00	Peak
3	7323.000	22.33	36.18	35.60	6.63	29.54	54.00	Average
4	7323.000	29.41	36.18	35.60	6.63	36.62	74.00	Peak
5	9764.000	22.14	38.08	35.03	8.03	33.22	54.00	Average
6	9764.000	29.03	38.08	35.03	8.03	40.11	74.00	Peak



Condition : FCC PART 15 (PK) 3m VERTICAL
 Job No. : GTS202009000066
 Test Mode : TX 2441MHz
 Test Engineer: Hans
 Remark :

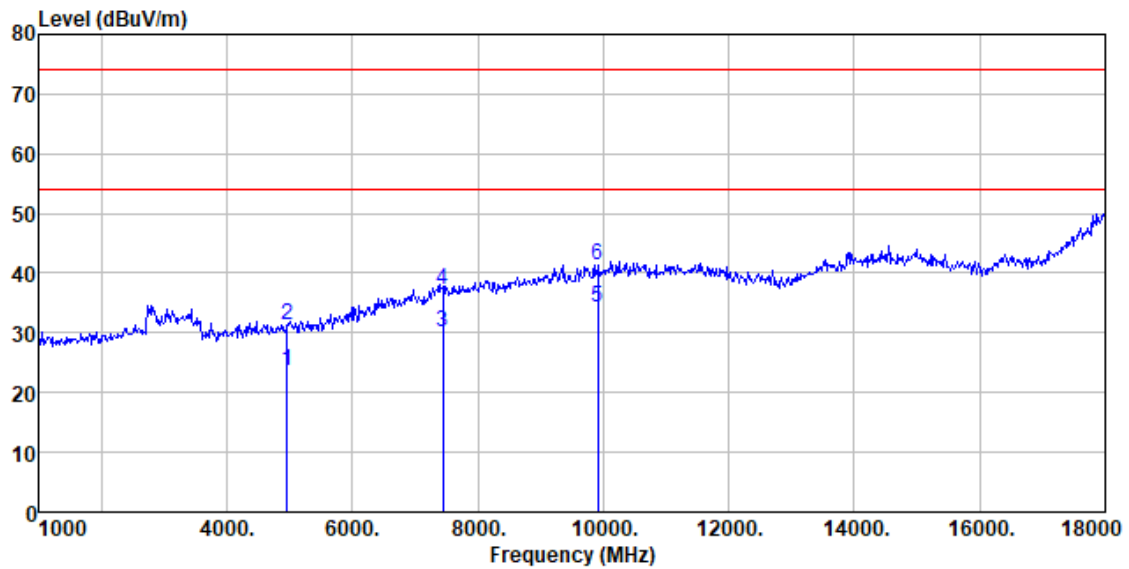
	Freq	ReadAntenna	Preamp	Cable	Limit	Over	
	Level	Factor	Factor	Loss	Line	Limit	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB
1	4882.000	26.02	31.49	37.76	4.69	24.44	54.00 -29.56 Average
2	4882.000	33.03	31.49	37.76	4.69	31.45	74.00 -42.55 Peak
3	7323.000	22.82	36.18	35.60	6.63	30.03	54.00 -23.97 Average
4	7323.000	29.96	36.18	35.60	6.63	37.17	74.00 -36.83 Peak
5	9764.000	21.33	38.08	35.03	8.03	32.41	54.00 -21.59 Average
6	9764.000	28.50	38.08	35.03	8.03	39.58	74.00 -34.42 Peak

Test channel: Highest



Condition : FCC PART 15 (PK) 3m VERTICAL
Job No. : GTS202009000066
Test Mode : TX 2480MHz
Test Engineer: Hans
Remark :

	Freq	Level	ReadAntenna	Preamp	Cable	Limit	Over	
	MHz	dBuV	Factor	Factor	Loss	Line	Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	4960.000	25.51	31.63	37.78	4.79	24.15	54.00	-29.85 Average
2	4960.000	32.50	31.63	37.78	4.79	31.14	74.00	-42.86 Peak
3	7440.000	22.90	36.46	35.56	6.77	30.57	54.00	-23.43 Average
4	7440.000	29.93	36.46	35.56	6.77	37.60	74.00	-36.40 Peak
5	9920.000	22.21	38.42	35.14	8.09	33.58	54.00	-20.42 Average
6	9920.000	29.24	38.42	35.14	8.09	40.61	74.00	-33.39 Peak



Condition : FCC PART 15 (PK) 3m HORIZONTAL
 Job No. : GTS202009000066
 Test Mode : TX 2480MHz
 Test Engineer: Hans
 Remark :

	Read	Antenna	Preamp	Cable		Limit	Over	
Freq	Level	Factor	Factor	Loss	Level	Line	Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	4960.000	25.12	31.63	37.78	4.79	23.76	54.00	-30.24 Average
2	4960.000	32.58	31.63	37.78	4.79	31.22	74.00	-42.78 Peak
3	7440.000	22.31	36.46	35.56	6.77	29.98	54.00	-24.02 Average
4	7440.000	29.40	36.46	35.56	6.77	37.07	74.00	-36.93 Peak
5	9920.000	22.85	38.42	35.14	8.09	34.22	54.00	-19.78 Average
6	9920.000	29.93	38.42	35.14	8.09	41.30	74.00	-32.70 Peak

Test Result: Pass

RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS

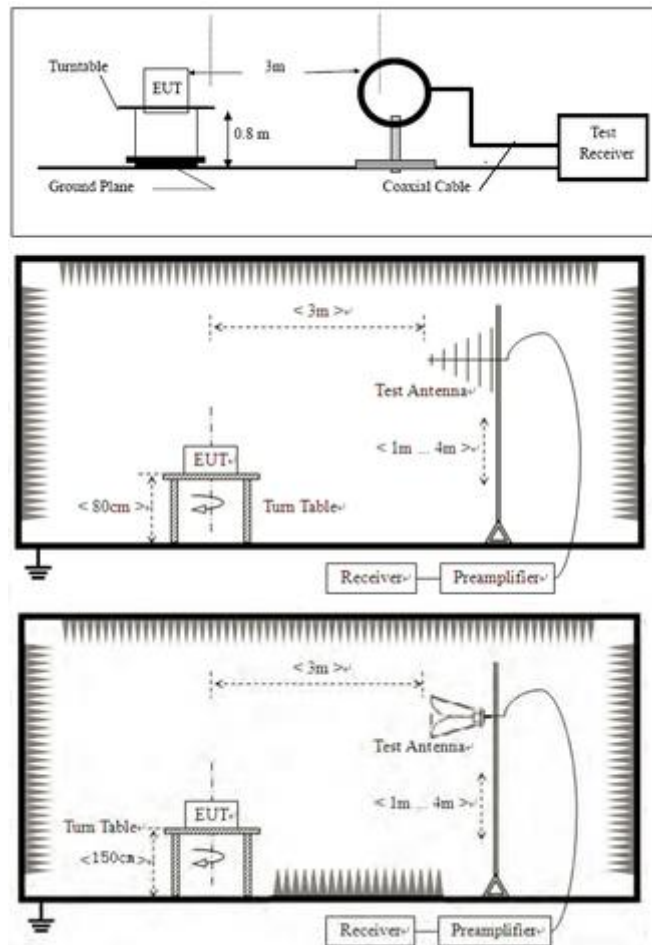
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.10.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	24°C
Humidity	53%

LIMITS

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

BLOCK DIAGRAM OF TEST SETUP



PROCEDURE

- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamplifier Factor}$

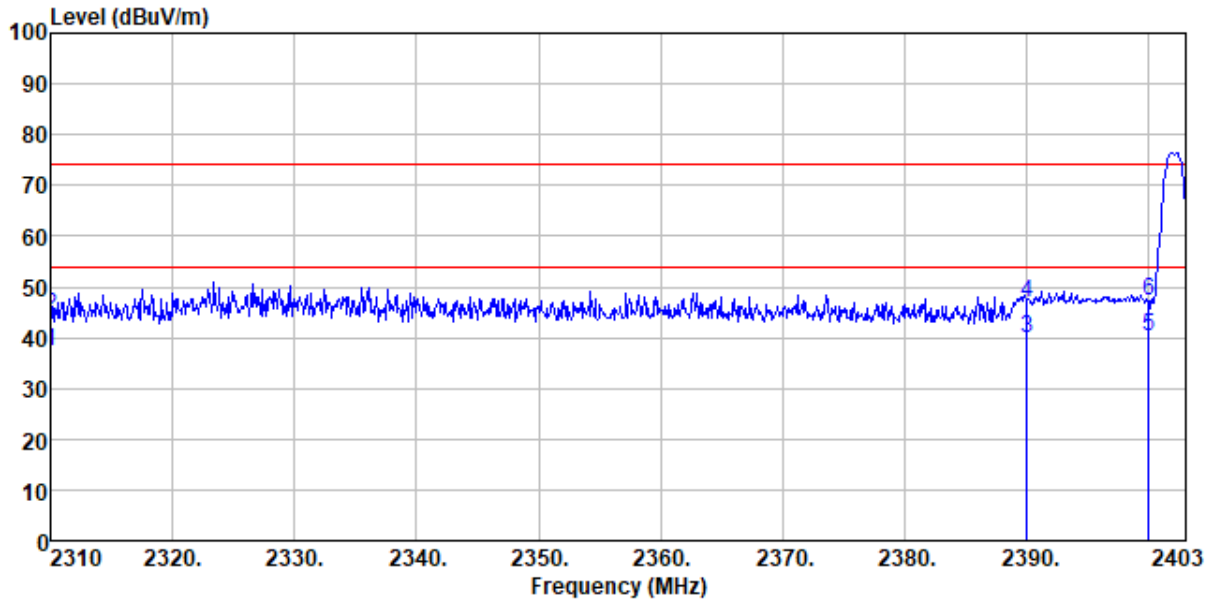
Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

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TEST DATA

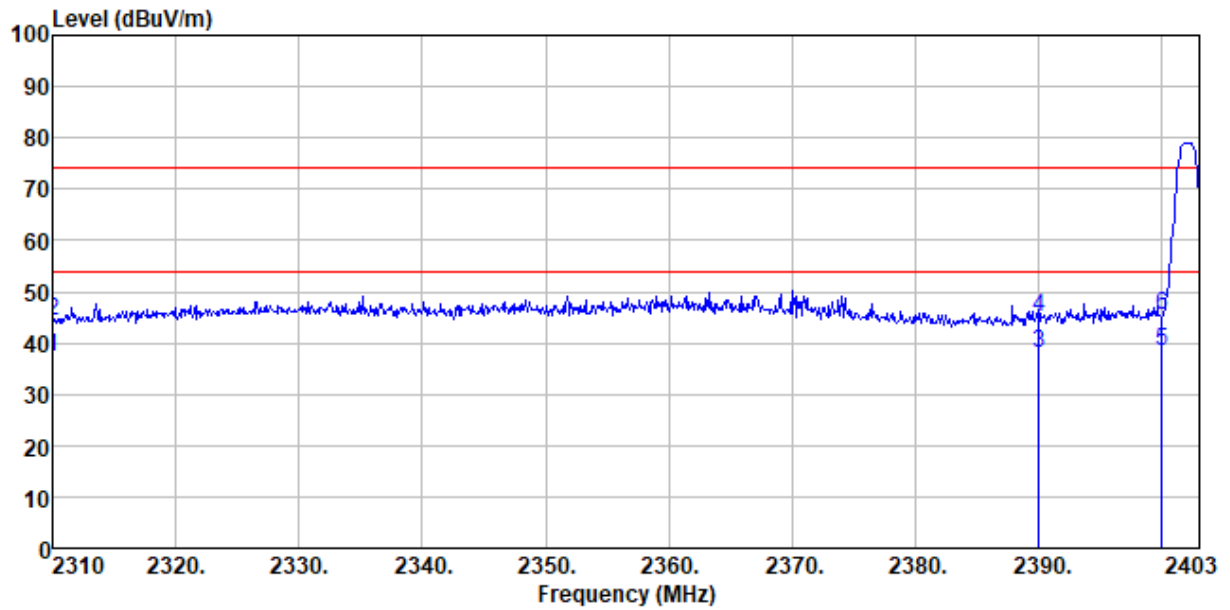
Remark: During the test, pre-scan the GFSK, Pi/4QPSK, 8-DPSK modulation, and found the GFSK modulation which it is worse case.

Lowest channel



Condition : FCC PART 15 (PK) 3m VERTICAL
Job No. : GTS202009000066
Test Mode : TX 2402MHz
Test Engineer: Hans
Remark :

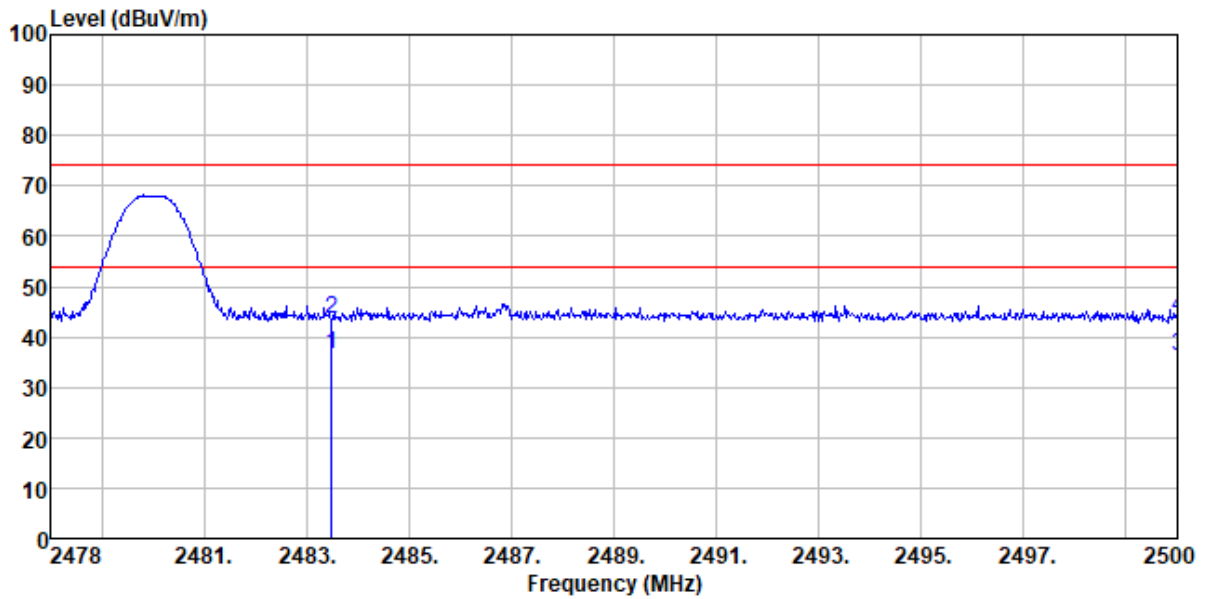
	Freq	ReadAntenna	Preamp	Cable	Limit	Over	
	Level	Factor	Factor	Loss	Level	Limit	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB
1	2310.000	37.62	27.14	30.43	2.81	37.14	54.00 -16.86 Average
2	2310.000	44.75	27.14	30.43	2.81	44.27	74.00 -29.73 Peak
3	2390.000	39.84	27.37	30.24	2.91	39.88	54.00 -14.12 Average
4	2390.000	46.94	27.37	30.24	2.91	46.98	74.00 -27.02 Peak
5	2400.000	40.02	27.41	30.26	2.91	40.08	54.00 -13.92 Average
6	2400.000	47.17	27.41	30.26	2.91	47.23	74.00 -26.77 Peak



Condition : FCC PART 15 (PK) 3m HORIZONTAL
 Job No. : GTS202009000066
 Test Mode : TX 2402MHz
 Test Engineer: Hans
 Remark :

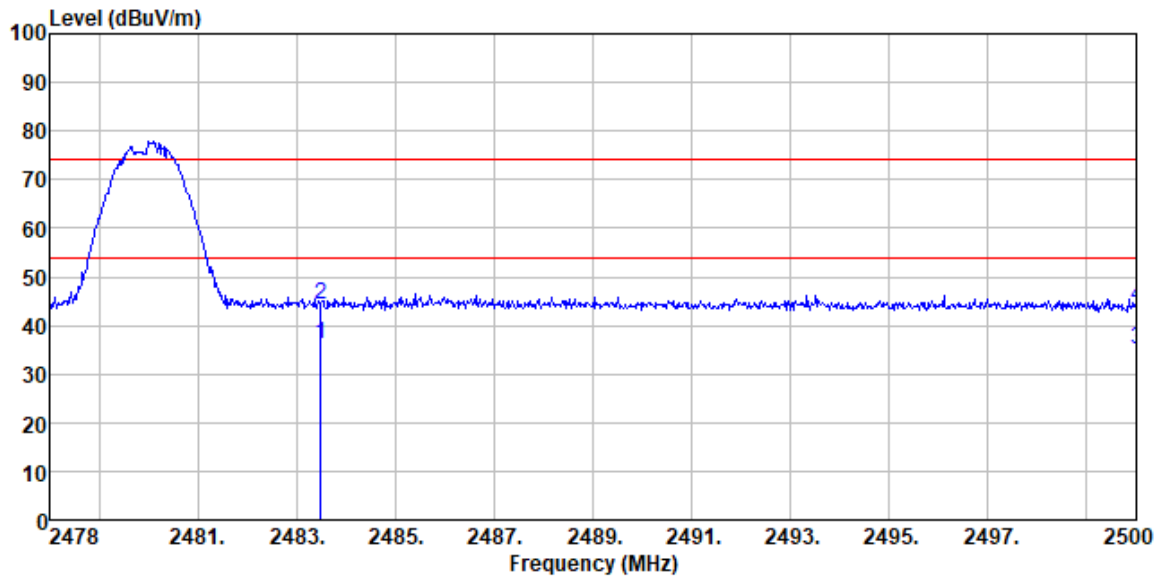
	Freq	Read	Antenna	Preamp	Cable	Level	Limit	Over	
	MHz	Level	Factor	Factor	Loss	dBuV/m	Line	Limit	Remark
	MHz	dBuV		dB/m	dB		dBuV/m	dB	
1	2310.000	37.73	27.14	30.43	2.81	37.25	54.00	-16.75	Average
2	2310.000	44.73	27.14	30.43	2.81	44.25	74.00	-29.75	Peak
3	2390.000	37.96	27.37	30.24	2.91	38.00	54.00	-16.00	Average
4	2390.000	44.96	27.37	30.24	2.91	45.00	74.00	-29.00	Peak
5	2400.000	38.22	27.41	30.26	2.91	38.28	54.00	-15.72	Average
6	2400.000	45.22	27.41	30.26	2.91	45.28	74.00	-28.72	Peak

Highest channel



Condition : FCC PART 15 (PK) 3m VERTICAL
 Job No. : GTS202009000066
 Test Mode : TX 2480MHz
 Test Engineer: Hans
 Remark :

	Freq	ReadAntenna	Preamp	Cable		Limit	Over	
	MHz	Level	Factor	Factor	Loss	Level	Line	Limit Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2483.500	36.10	27.66	30.12	2.99	36.63	54.00	-17.37 Average
2	2483.500	43.11	27.66	30.12	2.99	43.64	74.00	-30.36 Peak
3	2500.000	35.42	27.70	30.13	3.01	36.00	54.00	-18.00 Average
4	2500.000	43.46	27.70	30.13	3.01	44.04	74.00	-29.96 Peak



Condition : FCC PART 15 (PK) 3m HORIZONTAL
Job No. : GTS202009000066
Test Mode : TX 2480MHz
Test Engineer: Hans
Remark :

	Read	Antenna	Preamp	Cable	Limit	Over	
Freq	Level	Factor	Factor	Loss	Line	Limit	Remark
-----	-----	-----	-----	-----	-----	-----	-----
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1 2483.500	35.68	27.66	30.12	2.99	36.21	54.00	-17.79 Average
2 2483.500	43.71	27.66	30.12	2.99	44.24	74.00	-29.76 Peak
3 2500.000	34.41	27.70	30.13	3.01	34.99	54.00	-19.01 Average
4 2500.000	43.46	27.70	30.13	3.01	44.04	74.00	-29.96 Peak

Test Result: Pass

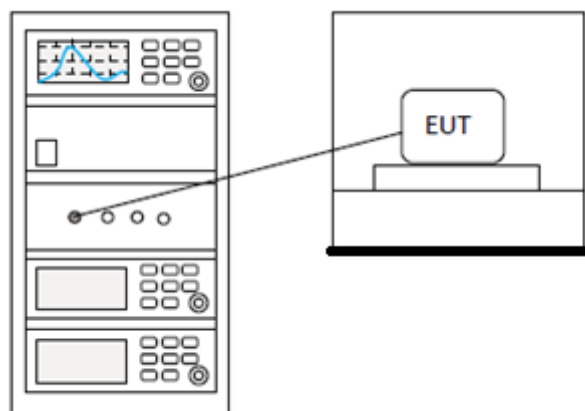
CONDUCTED BAND EDGES MEASUREMENT

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	26°C
Humidity	54%

LIMITS

Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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)).
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BLOCK DIAGRAM OF TEST SETUP



TEST DATA**Pass: Please Refer To Appendix: Appendix1 For Details**

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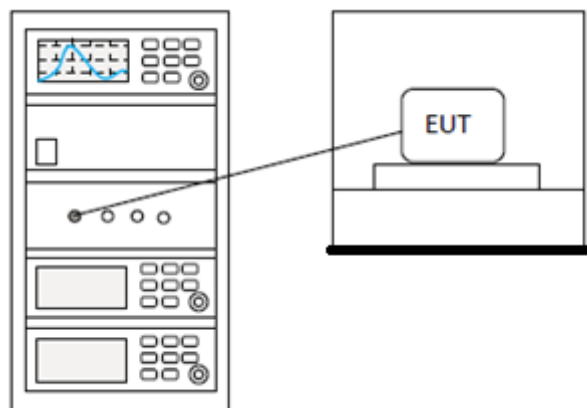
DWELL TIME

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.4
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Eason
Temperature	26°C
Humidity	54%

LIMITS

Frequency(MHz)	Limit
902-928	0.4S within a 20S period(20dB bandwidth<250kHz)
	0.4S within a 10S period(20dB bandwidth≥250kHz)
2400-2483.5	0.4S within a period of 0.4S multiplied by the number of hopping channels
5725-5850	0.4S within a 30S period

BLOCK DIAGRAM OF TEST SETUP



TEST DATA**Pass: Please Refer To Appendix: Appendix1 For Details**

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10 APPENDIX

Appendix1

10.1 APPENDIX: 20DBEMISSION BANDWIDTH

Test Result

TestMode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	1.092	2401.442	2402.534	---	PASS
		2441	1.098	2440.442	2441.540	---	PASS
		2480	1.098	2479.442	2480.540	---	PASS
2DH1	Ant1	2402	1.401	2401.289	2402.690	---	PASS
		2441	1.395	2440.295	2441.690	---	PASS
		2480	1.398	2479.292	2480.690	---	PASS
3DH1	Ant1	2402	1.392	2401.301	2402.693	---	PASS
		2441	1.395	2440.301	2441.696	---	PASS
		2480	1.392	2479.301	2480.693	---	PASS

Test Graphs





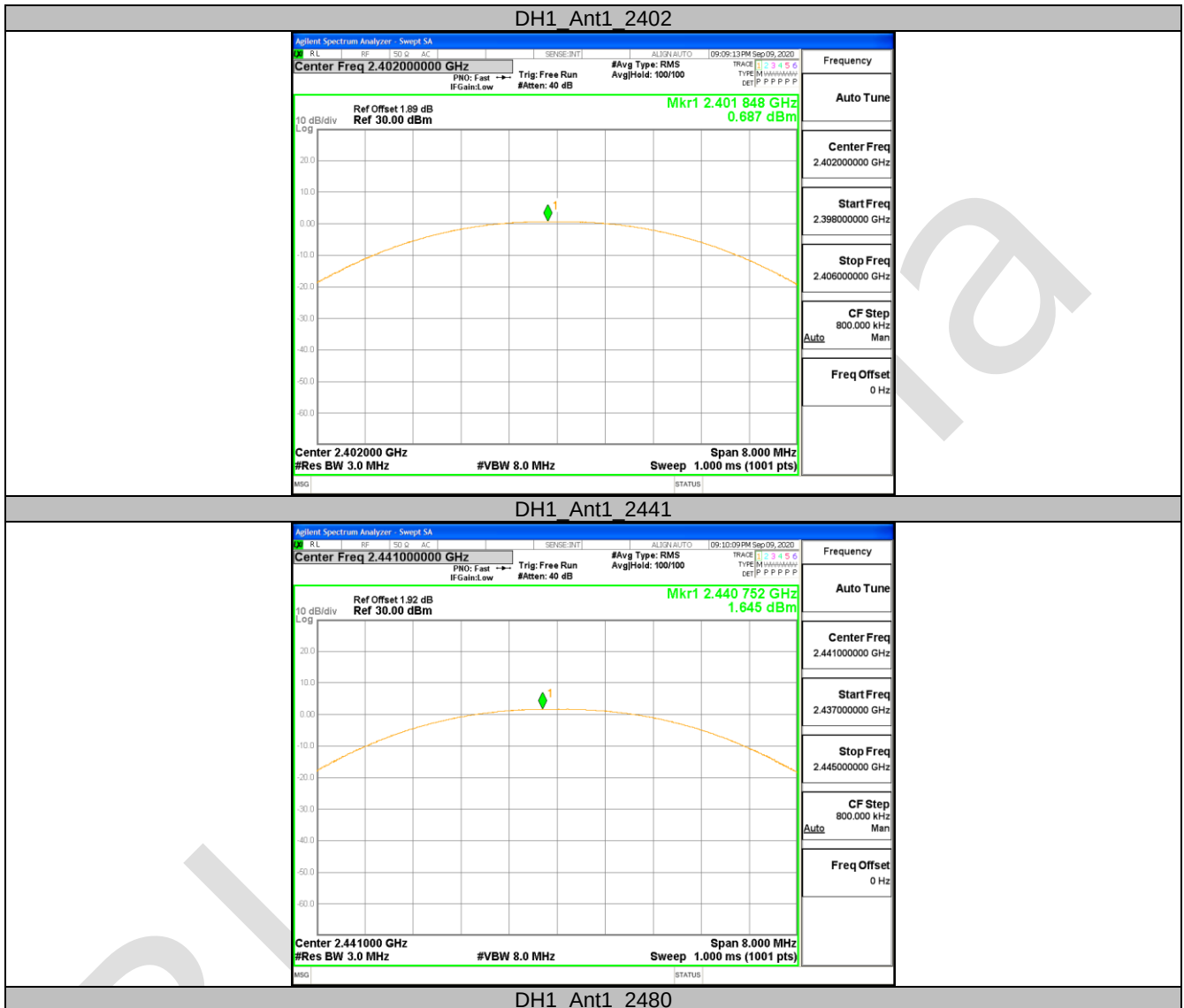


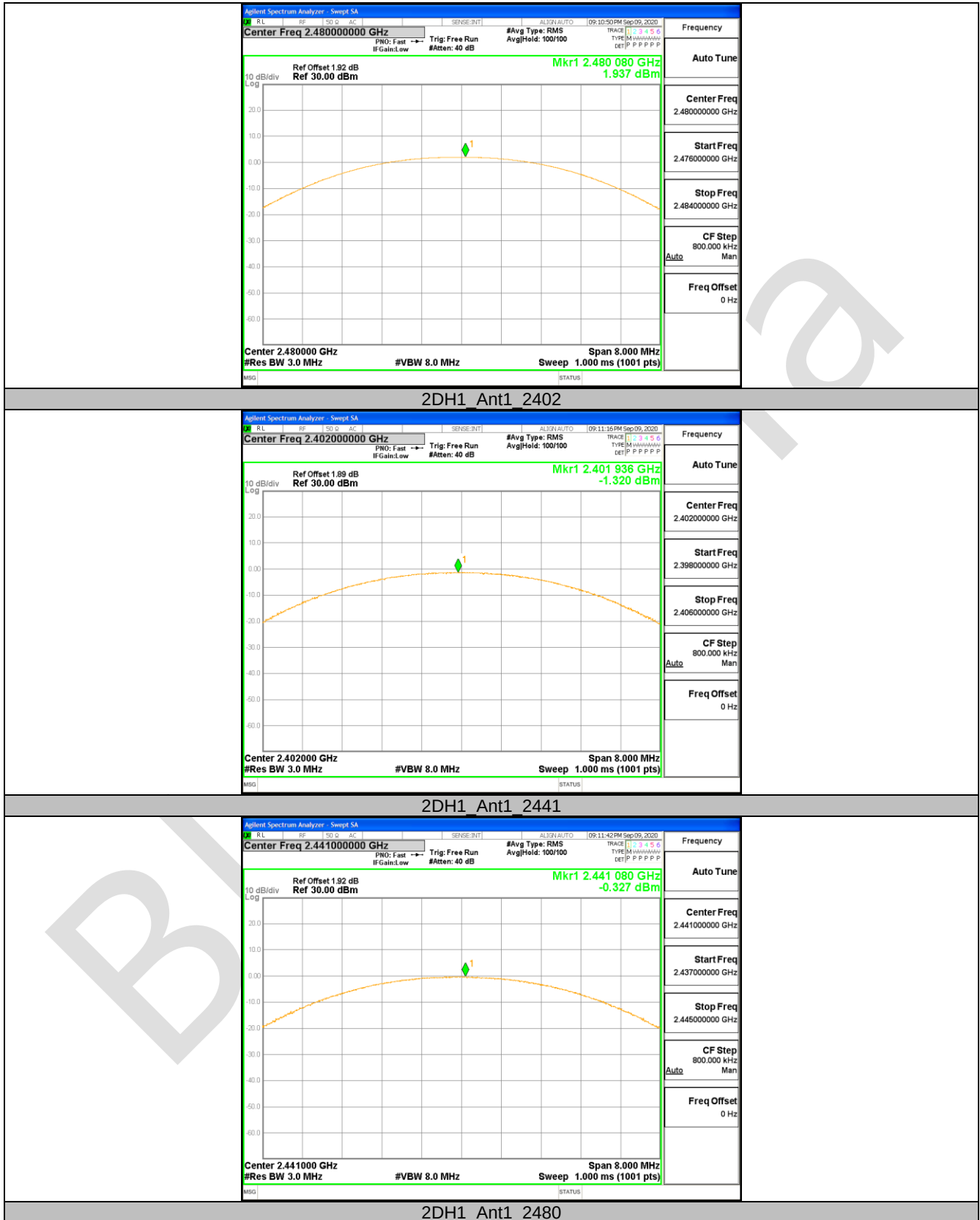
10.2 APPENDIX: MAXIMUM CONDUCTED OUTPUT POWER

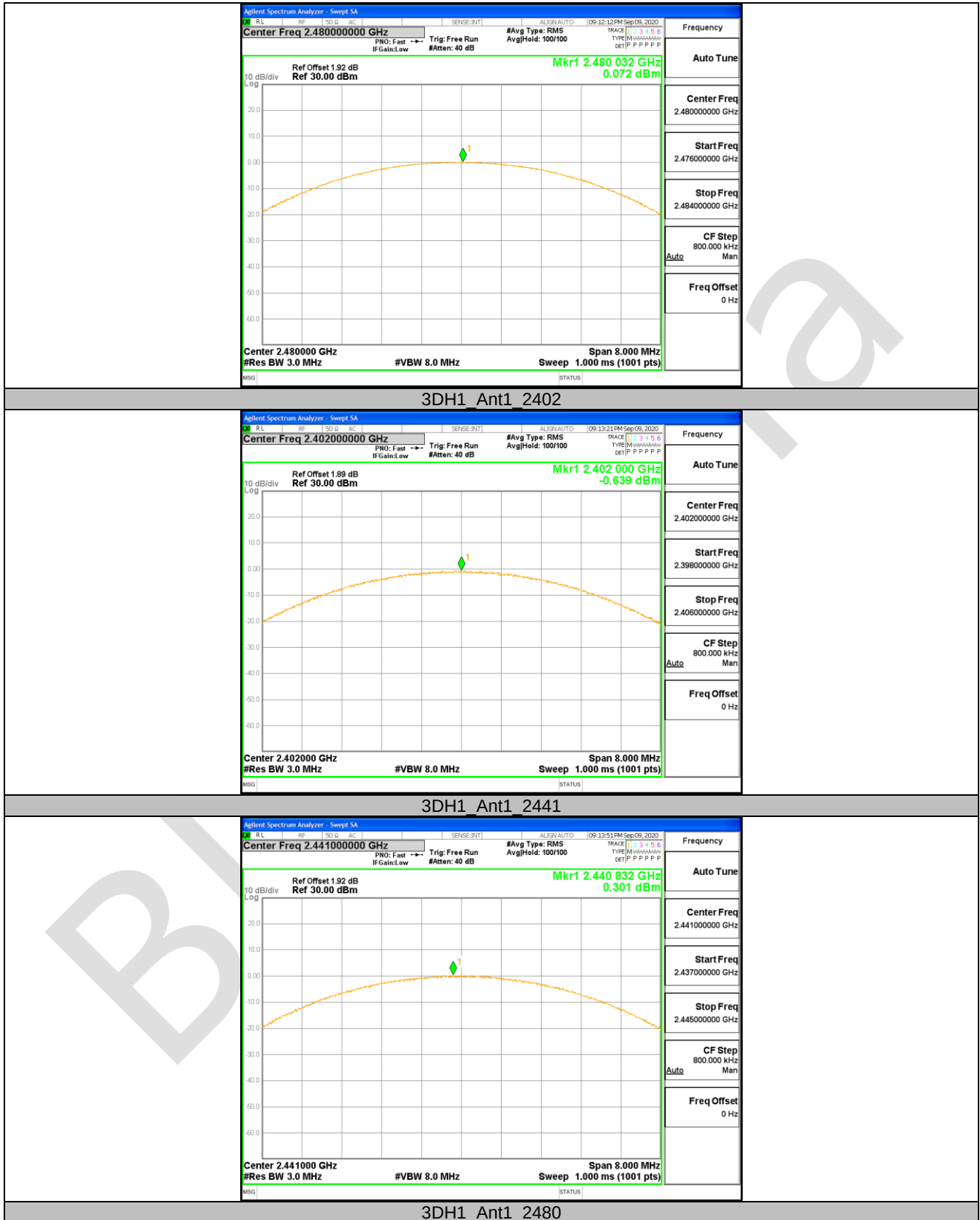
Test Result

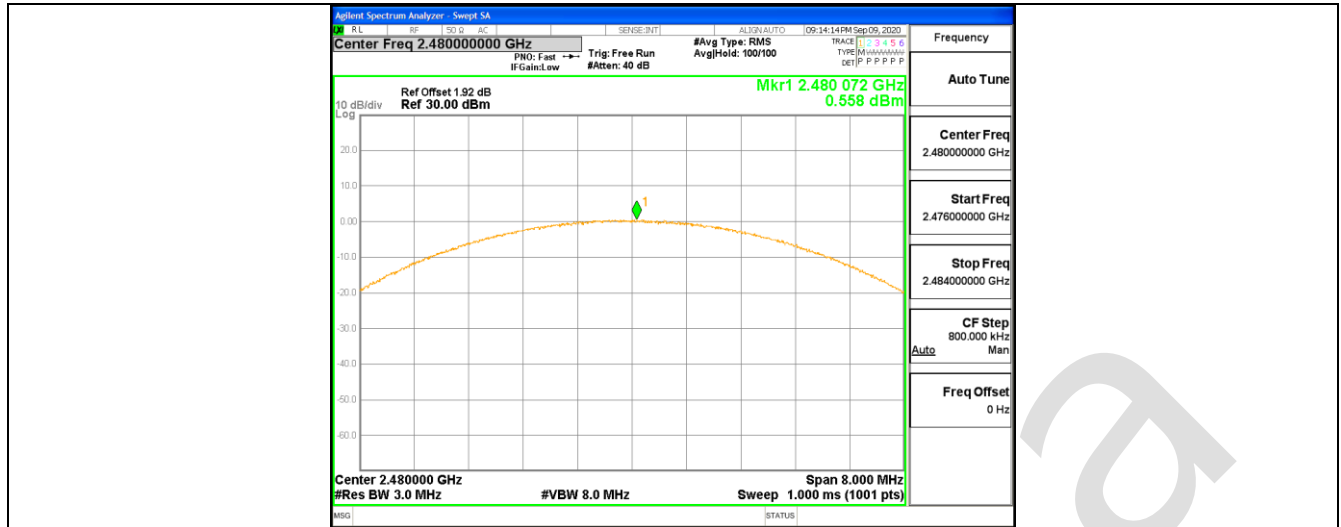
TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	2402	0.69	<=30	PASS
		2441	1.65	<=30	PASS
		2480	1.94	<=30	PASS
2DH1	Ant1	2402	-1.32	<=30	PASS
		2441	-0.33	<=30	PASS
		2480	0.07	<=30	PASS
3DH1	Ant1	2402	-0.64	<=30	PASS
		2441	0.3	<=30	PASS
		2480	0.56	<=30	PASS

Test Graphs









10.3 APPENDIX: CARRIER FREQUENCY SEPARATION

Test Result

TestMode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.326	≥ 1.098	PASS
2DH1	Ant1	Hop	0.998	≥ 0.934	PASS
3DH1	Ant1	Hop	1	≥ 0.930	PASS

Test Graphs

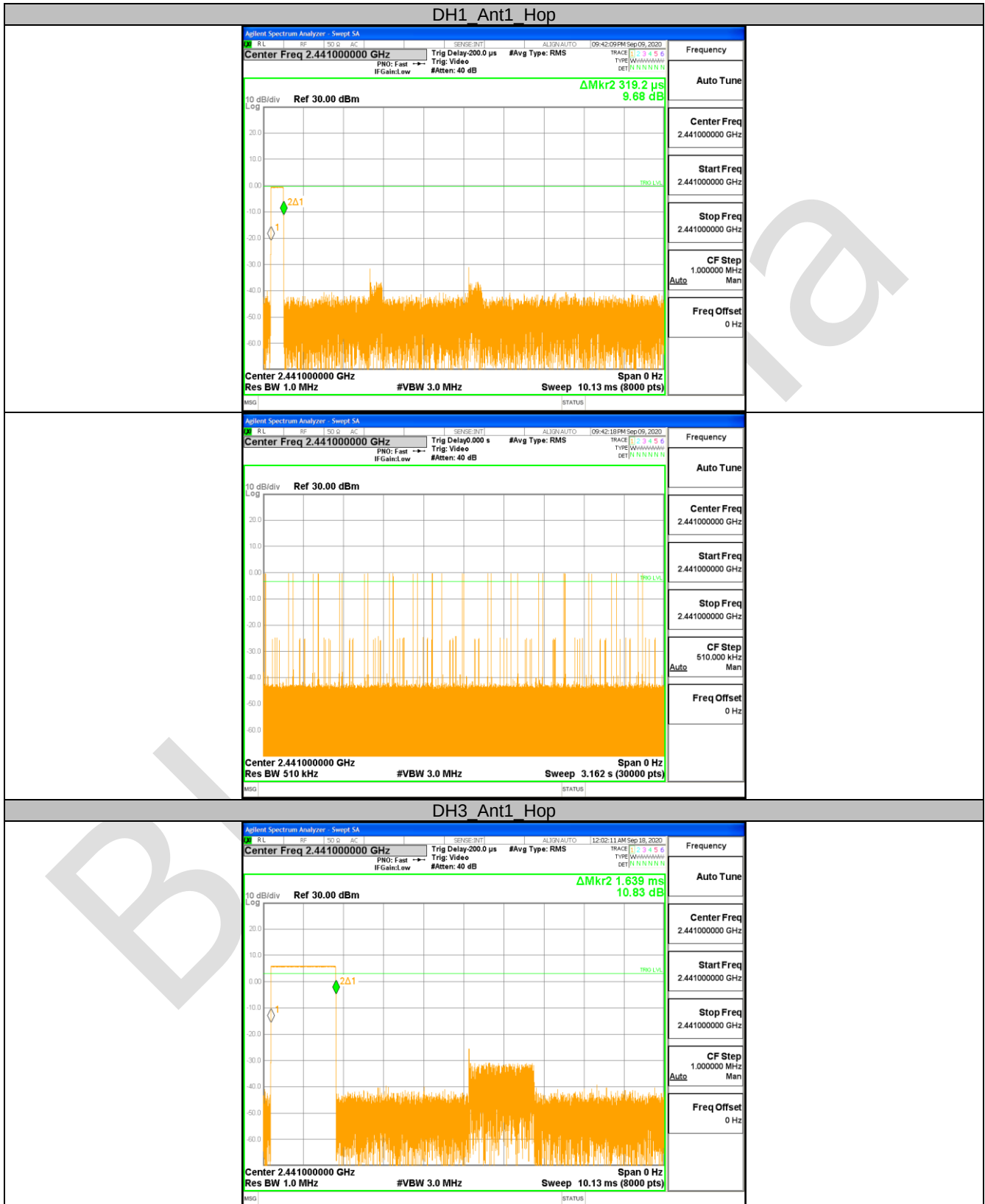


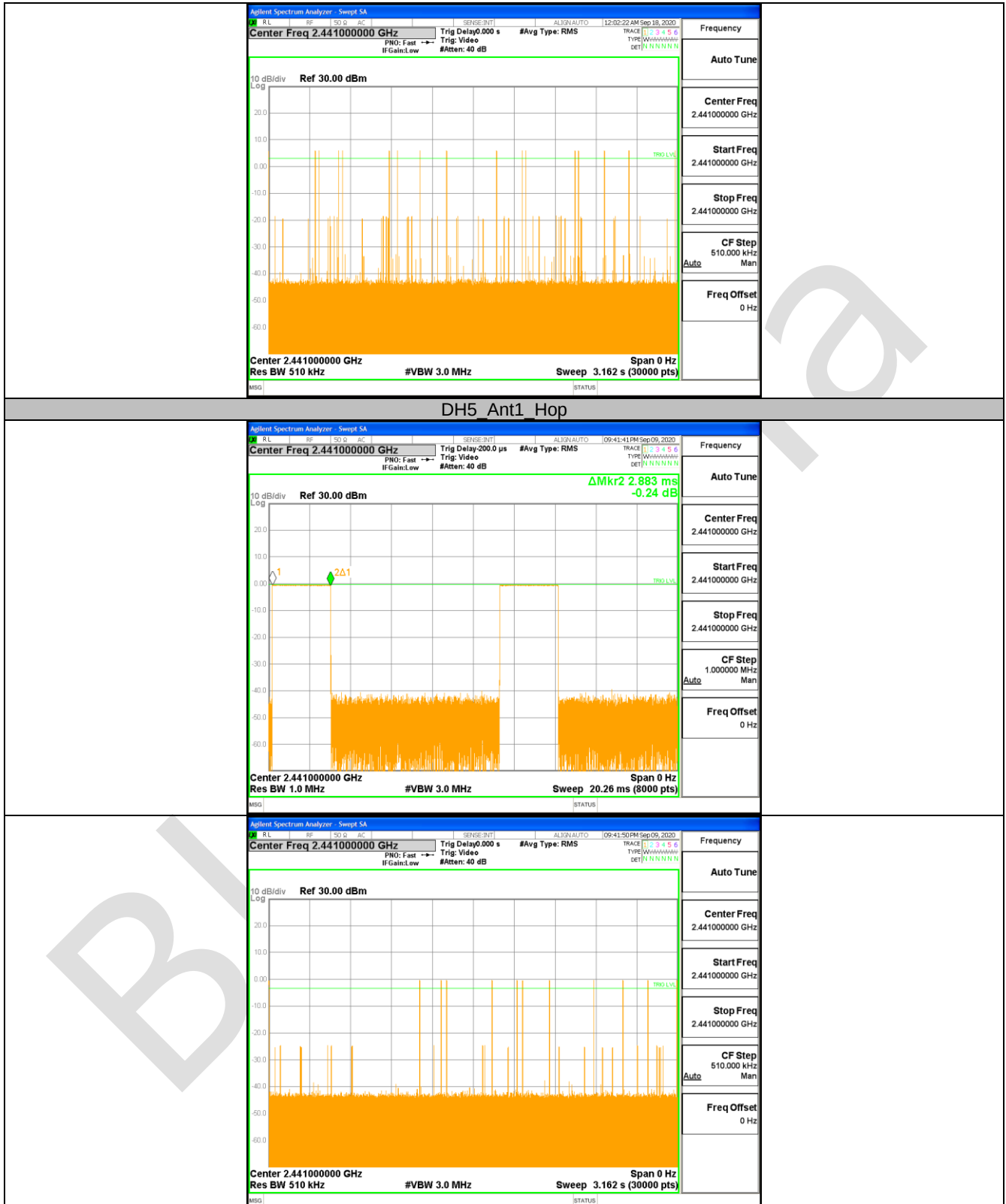
10.4 APPENDIX: TIME OF OCCUPANCY

Test Result

TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.32	330	0.105	<=0.4	PASS
DH3	Ant1	Hop	1.64	160	0.262	<=0.4	PASS
DH5	Ant1	Hop	2.88	120	0.346	<=0.4	PASS

Test Graphs





10.5 APPENDIX: NUMBER OF HOPPING CHANNELS**Test Result**

TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	≥ 15	PASS
2DH1	Ant1	Hop	79	≥ 15	PASS
3DH1	Ant1	Hop	79	≥ 15	PASS

Test Graphs



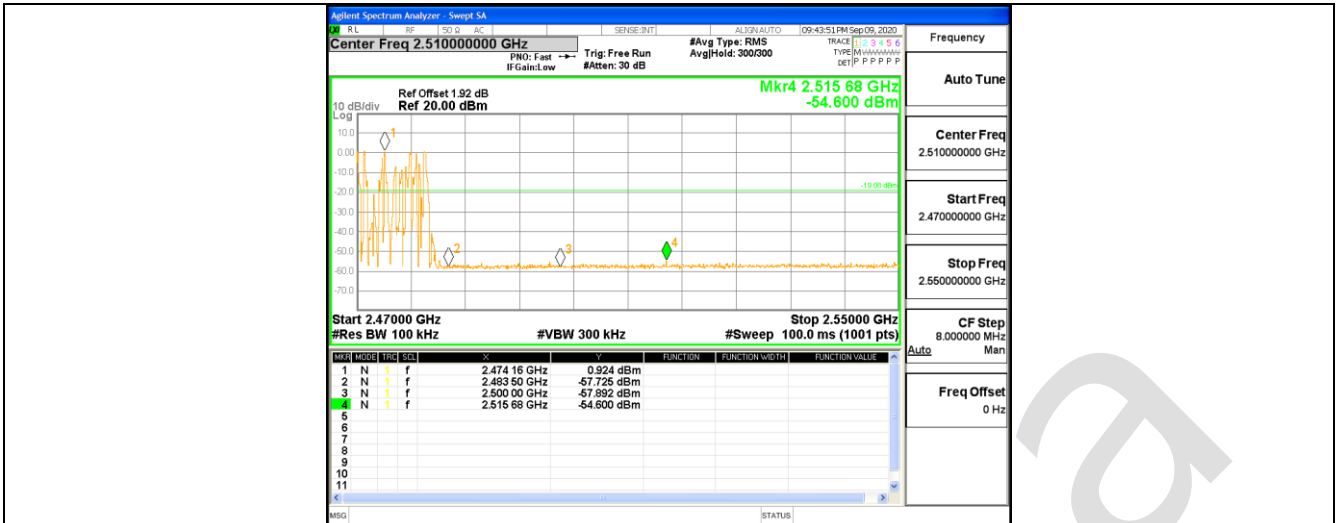
10.6 APPENDIX: BAND EDGE MEASUREMENTS

Test Result

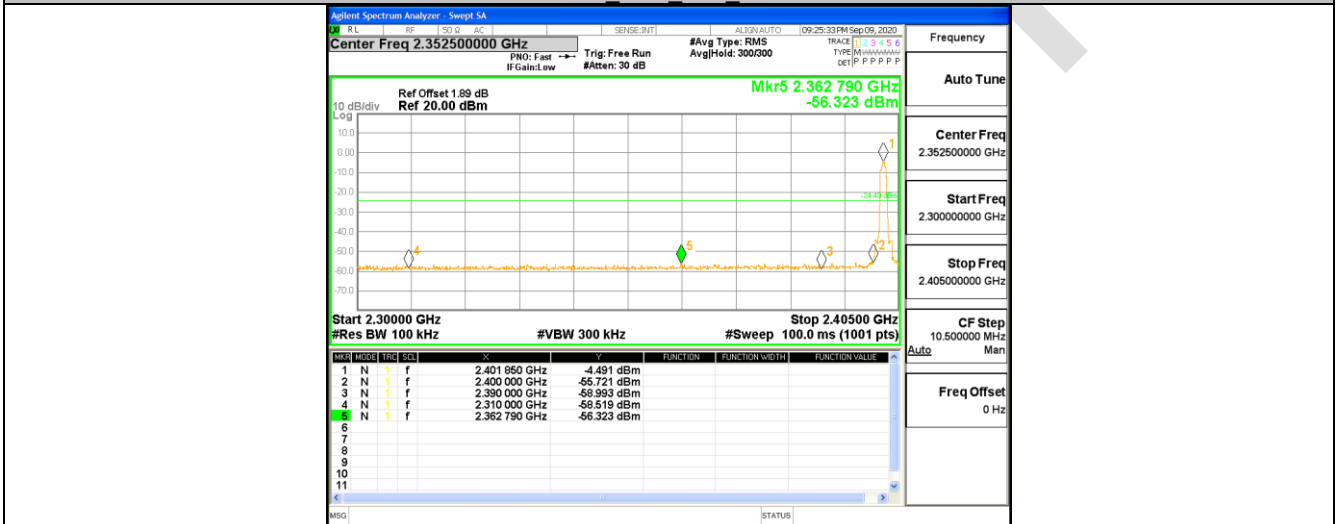
TestMode	Antenna	ChName	Channel	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH1	Ant1	Low	2402	0.28	-55.42	<=-19.72	PASS
		High	2480	1.57	-55.7	<=-18.43	PASS
		Low	Hop_2402	0.12	-56.2	-19.88	PASS
		High	Hop_2480	0.92	-54.6	-19.08	PASS
2DH1	Ant1	Low	2402	-4.49	-56.32	<=-24.49	PASS
		High	2480	-2.85	-54.46	<=-22.85	PASS
		Low	Hop_2402	-4.97	-55.23	-24.97	PASS
		High	Hop_2480	-3.25	-55.48	-23.25	PASS
3DH1	Ant1	Low	2402	-4.04	-55.17	<=-24.04	PASS
		High	2480	-2.63	-55.66	<=-22.63	PASS
		Low	Hop_2402	-5.16	-55.9	-25.16	PASS
		High	Hop_2480	-3.24	-55.57	-23.24	PASS

Test Graphs

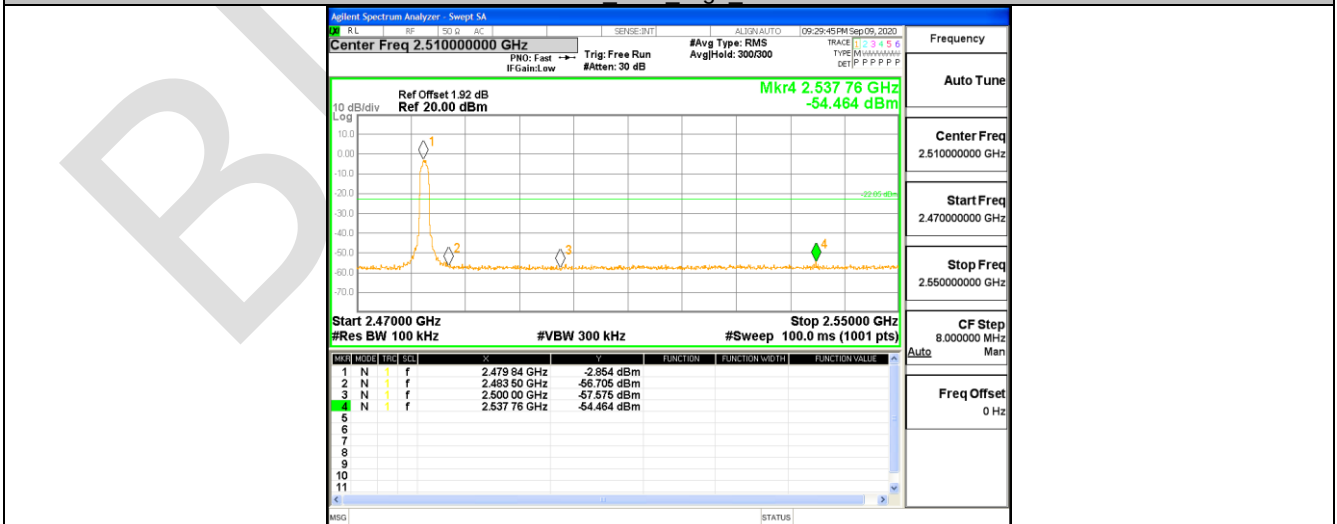




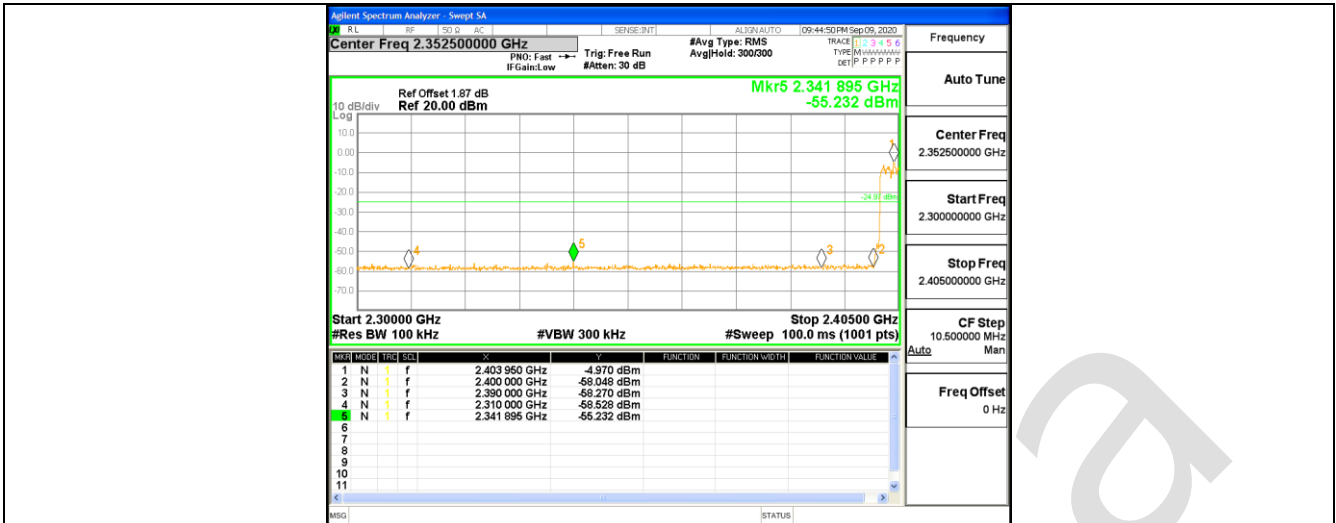
2DH1 Ant1 Low 2402



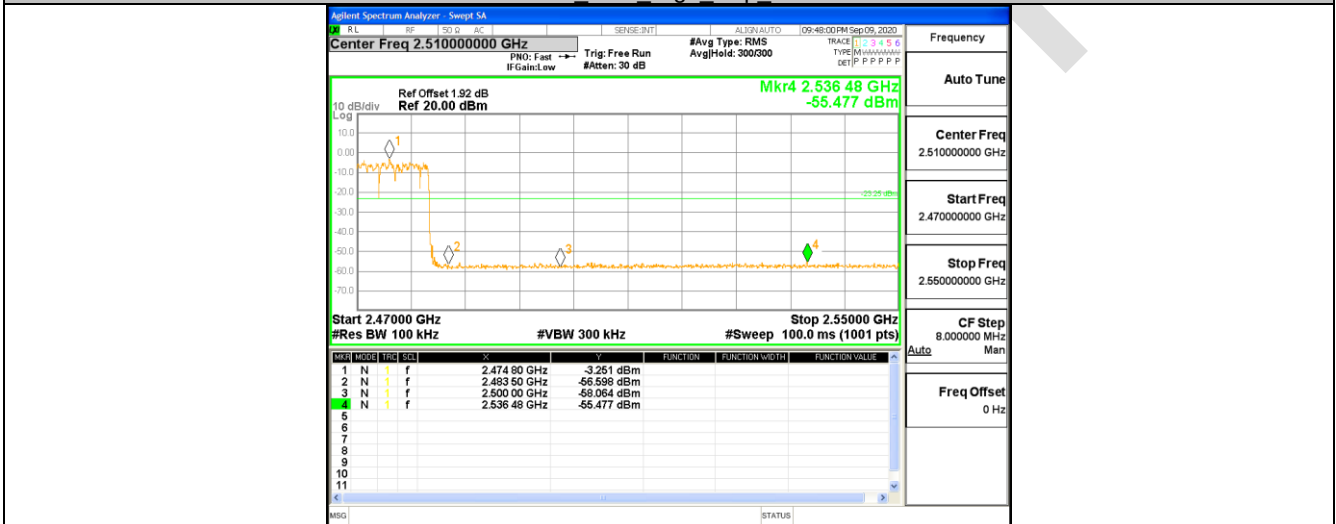
2DH1 Ant1 High 2402



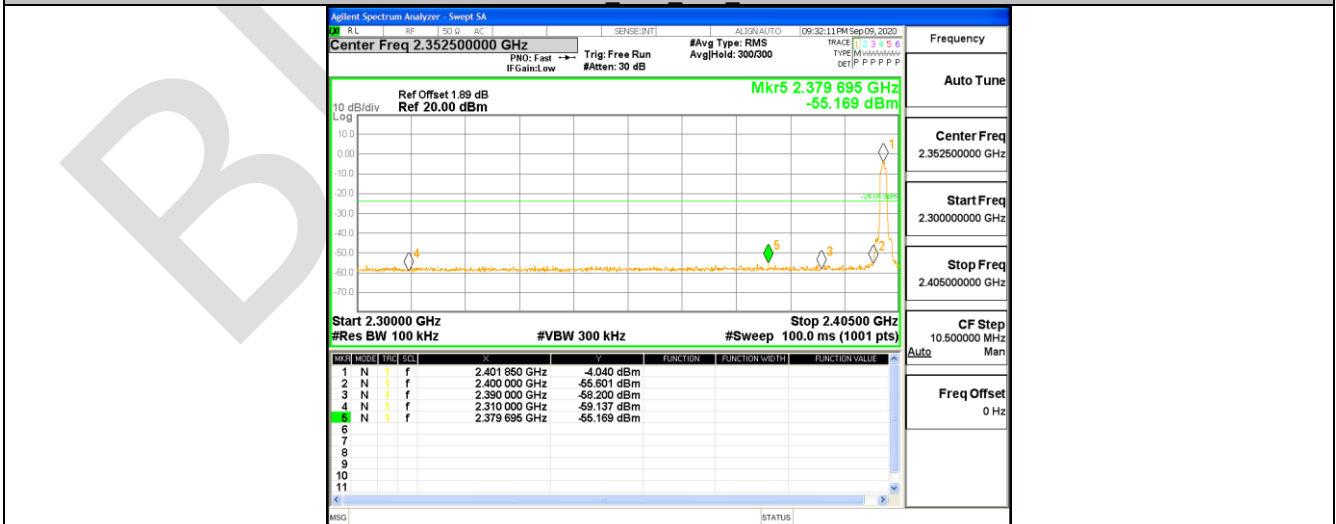
2DH1 Ant1 Low Hop 2402



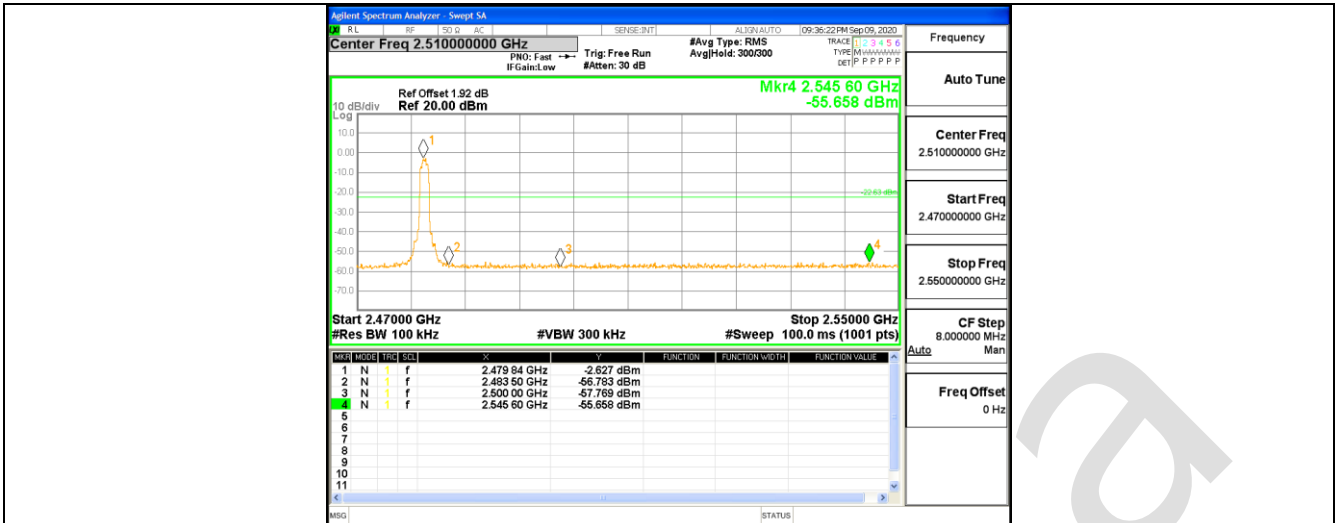
2DH1 Ant1 High Hop 2480



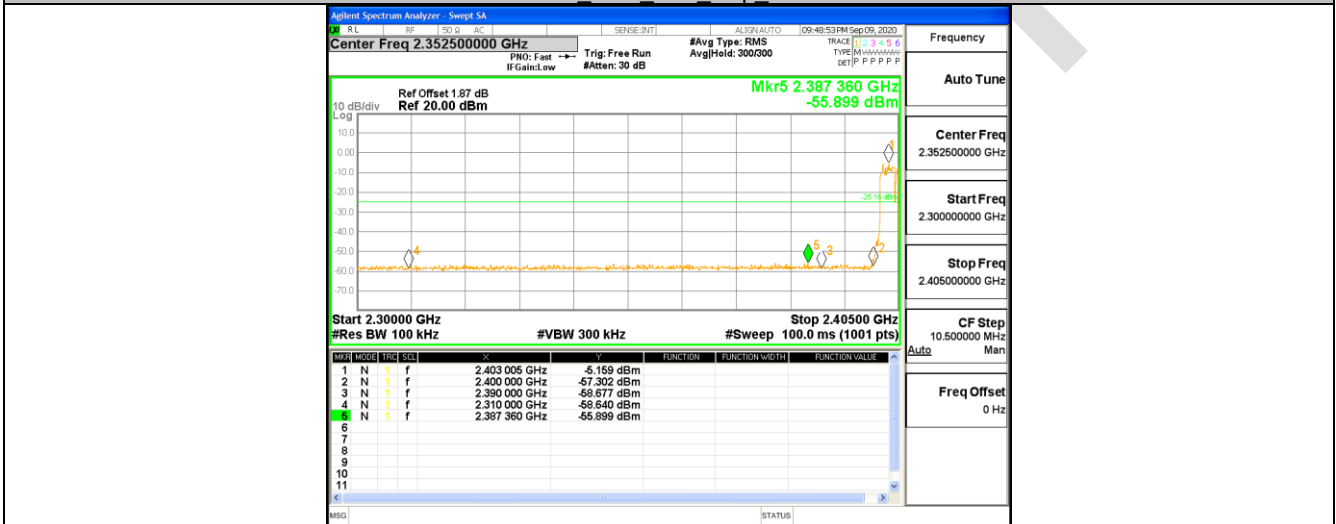
3DH1 Ant1 Low 2402



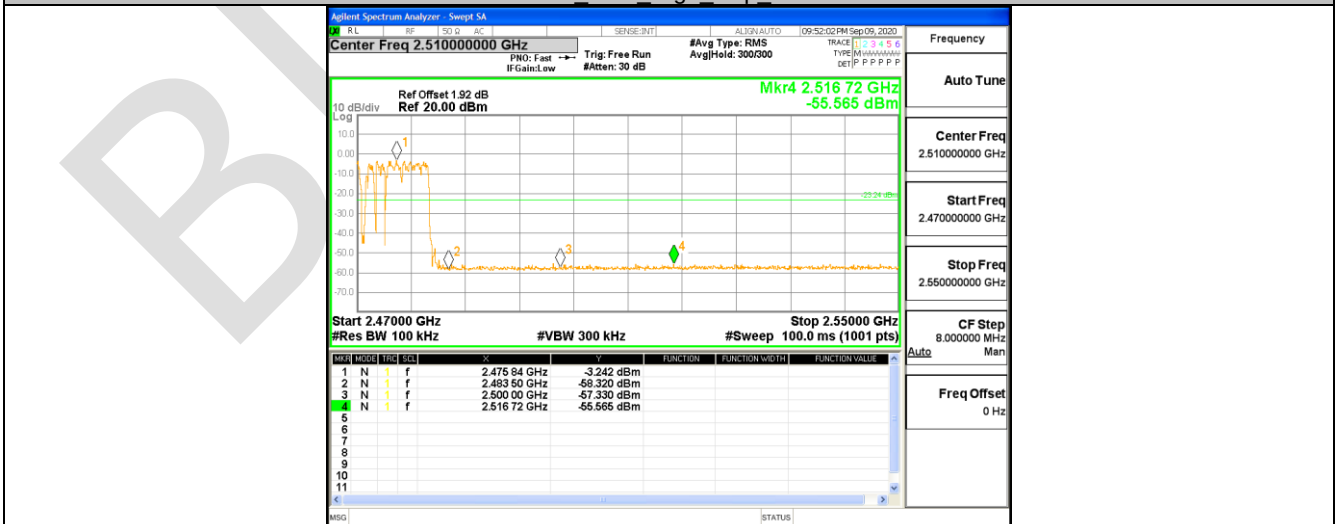
3DH1 Ant1 High 2480



3DH1 Ant1 Low Hop 2402



3DH1 Ant1 High Hop 2480



10.7 APPENDIX: CONDUCTED SPURIOUS EMISSION

Test Result

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH1	Ant1	2402	Reference	0.28	0.28	---	PASS
			30~1000	30~1000	-46.269	<=-19.725	PASS
			1000~26500	1000~26500	-52.885	<=-19.725	PASS
		2441	Reference	1.23	1.23	---	PASS
			30~1000	30~1000	-46.133	<=-18.771	PASS
			1000~26500	1000~26500	-52.429	<=-18.771	PASS
		2480	Reference	1.17	1.17	---	PASS
			30~1000	30~1000	-46.202	<=-18.831	PASS
			1000~26500	1000~26500	-53.236	<=-18.831	PASS
2DH1	Ant1	2402	Reference	-4.27	-4.27	---	PASS
			30~1000	30~1000	-46.28	<=-24.27	PASS
			1000~26500	1000~26500	-53.08	<=-24.27	PASS
		2441	Reference	-3.61	-3.61	---	PASS
			30~1000	30~1000	-46.459	<=-23.606	PASS
			1000~26500	1000~26500	-53.714	<=-23.606	PASS
		2480	Reference	-2.97	-2.97	---	PASS
			30~1000	30~1000	-46.081	<=-22.97	PASS
			1000~26500	1000~26500	-53.461	<=-22.97	PASS
3DH1	Ant1	2402	Reference	-4.08	-4.08	---	PASS
			30~1000	30~1000	-46.219	<=-24.084	PASS
			1000~26500	1000~26500	-53.824	<=-24.084	PASS
		2441	Reference	-3.29	-3.29	---	PASS
			30~1000	30~1000	-46.321	<=-23.294	PASS
			1000~26500	1000~26500	-53.301	<=-23.294	PASS
		2480	Reference	-3.28	-3.28	---	PASS
			30~1000	30~1000	-46.063	<=-23.284	PASS
			1000~26500	1000~26500	-52.416	<=-23.284	PASS

Test Graphs

