

TEST REPORT

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Manufacturer or Supplier	ARKON ELECTRONICS (HUIZHOU) CO., LIMITED
Address	NO.4 Taihao Road, High-tech Industrial Park, Sandong Town, Huicheng District, Huizhou, Guangdong, China
Product	2.4GHz Digital Wireless Headphone
Brand Name	 Avantree®
Model	WSHT-280
Additional Model & Model Difference	N/A
Date of tests	July 08, 2020 ~ July 14, 2020

the tests have been carried out according to the requirements of the following standards:

☒ **FCC Part 15, Subpart C, Section 15.247**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Tested by Ryan Lu Project Engineer / EMC Department	Tested by Glyn He Assistant Manager / EMC Department
	 Date: Aug. 14, 2020

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF200715N001	Original release	July 21, 2020
RF-BQOZ-WDG-P20080116	Basic the above original release report: 1. Change the applicant name and Brand 2. The test model name DH1000K change to WSHT-280 3. Change new FCC ID: 2AITF-WSHT-280-N	Aug. 14, 2020

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	PASS	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	PASS	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	PASS	Meet the requirement of limit.
15.247(b)	Conducted Output Power	PASS	Meet the requirement of limit.
15.247(d)& 15.209	Transmitter Radiated Emission	PASS	Meet the requirement of limit.
15.247(d)	Out of band Emission Measurement	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Radiated emissions	9KHz ~ 30MHz	+/-2.66 dB
	30MHz ~ 1GMHz	+ /-3.47 dB
	1GHz ~ 18GHz	+ /-4.84 dB
	18GHz ~ 40GHz	+ /-4.96dB

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

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	2.4GHz Digital Wireless Headphone
MODEL NO.	WSHT-280
ADDITIONAL MODEL	N/A
FCC ID	2A1TF-WSHT-280-N
POWER SUPPLY	TX: DC 5V from adapter RX: DC1.2V*2 (AAA)battery, or DC 5V Charging by TX
MODULATION TECHNOLOGY	FHSS
MODULATION TYPE	GFSK,
OPERATING FREQUENCY	2406MHz~2472MHz
NUMBER OF CHANNEL	31
PEAK OUTPUT POWER	10.25dBm (Max. Measured)
ANTENNA TYPE OF TX	PCB Antenna, 0 dBi Gain
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	N/A

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. Please refer to the EUT photo document (Reference No.: BQOZ-WDG-P20080116) for detailed product photo.
4. The EUT can be powered by adapter as below

BRAND:	N/A
MODEL:	YLJXA-T050055
INPUT:	AC ~100-240V, 50/60Hz 0.5A Max.
OUTPUT:	DC 5V, 0.55A
DC LINE:	Unshielded, Non-detachable, 1.5m without Cores

3.2 DESCRIPTION OF TEST MODES

31 channels are provided to FHSS (The total support channels)

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2406	8	2422	16	2444	24	2460
1	2408	9	2424	17	2446	25	2462
2	2410	10	2426	18	2448	26	2464
3	2412	11	2428	19	2450	27	2466
4	2414	12	2430	20	2452	28	2468
5	2416	13	2432	21	2454	29	2470
6	2418	14	2438	22	2456	30	2472
7	2420	15	2440	23	2458		

4 Frequency Hopping Sequence types:

Hopping Sequence 1 Channel list		Hopping Sequence 2 Channel list		Hopping Sequence 3 Channel list		Hopping Sequence 4 Channel list	
Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2406	0	2406	13	2432	0	2406
7	2420	1	2408	15	2440	1	2408
8	2422	2	2410	18	2448	2	2410
9	2424	3	2412	19	2450	3	2412
10	2426	4	2414	20	2452	4	2414
11	2428	5	2416	21	2454	5	2416
16	2444	6	2418	22	2456	6	2418
17	2446	7	2420	23	2458	10	2426
18	2448	8	2422	24	2460	21	2454
19	2450	9	2424	25	2462	25	2462
20	2452	10	2426	26	2464	26	2464
22	2456	11	2428	27	2466	27	2466
28	2468	12	2430	28	2468	28	2468
29	2470	14	2438	29	2470	29	2470
30	2472	17	2446	30	2472	30	2472

Note: the UUT will operation in the above four frequency hopping sequences.

3.2.1. CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photograph of the test configuration for reference.

3.2.2. TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case was found when positioned on X axis for radiated emission. Following channel(s) was (were) selected for the final test as listed below:

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
A	√	√	√	√	DC5V from adapter

Where **RE<1G**: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission

RE≥1G: Radiated Emission above 1GHz
APCM: Antenna Port Conducted Measurement

RADIATED EMISSION TEST (BELOW 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 30	hopping	FHSS	GFSK	1Mbps

For the test results, only the worst case was shown in test report.

RADIATED EMISSION TEST (ABOVE 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 30	0, 30	FHSS	GFSK	1Mbps

POWER LINE CONDUCTED EMISSION TEST:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and packet types.
- ☒ Following channels were selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 30	hopping	FHSS	GFSK	1Mbps

ANTENNA PORT CONDUCTED MEASUREMENT:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and packet types.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 30	0, 30	FHSS	GFSK	1Mbps

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE (SYSTEM)	TESTED BY
RE<1G	25deg. C, 55%RH	DC 5V from adapter	Tank Tan
RE≥1G	25deg. C, 55%RH	DC 5V from adapter	Tank Tan
PLC	25deg. C, 55%RH	DC 5V from adapter	Tank Tan
APCM	25deg. C, 60%RH	DC 5V from adapter	Tank Tan

3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C, Section 15.247

KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit without any other necessary accessory or support units.

4 TEST TYPES AND RESULTS

4.1. CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB μ V)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	60	50

- NOTES:** 1. The lower limit shall apply at the transition frequencies.
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.1.2 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI3	101418	2019-09-18	2020-09-17
Artificial Mains Network Rohde&Schwarz	ENV216	3560.6550.15	2019-10-18	2020-10-17
Test software FARAD	EZ_EMC V1.1.4.2	N/A	N/A	N/A
Hygrothermograph Yuhuaze	HTC-1	NA	2019-10-18	2020-10-17
Digital Multimeter FLUKE	15B+	43512617WS	2019-10-18	2020-10-17

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
 2. The test was performed in Hwa-Hsing(Dongguan) Testing Co., Ltd.

4.1.3 TEST PROCEDURES

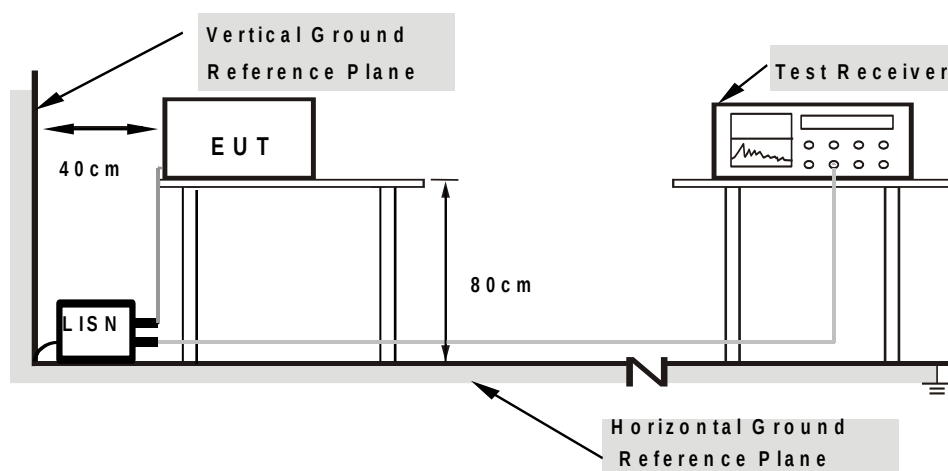
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30MHz was searched. Emission levels under Limit - 20dB was not recorded.

NOTE: All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

4.1.5 TEST SETUP



Note: 1.Support units were connected to second LISN .
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80
from other units and other metal planes

For the actual test configuration, please refer to the attached file (Test Setup Photo).



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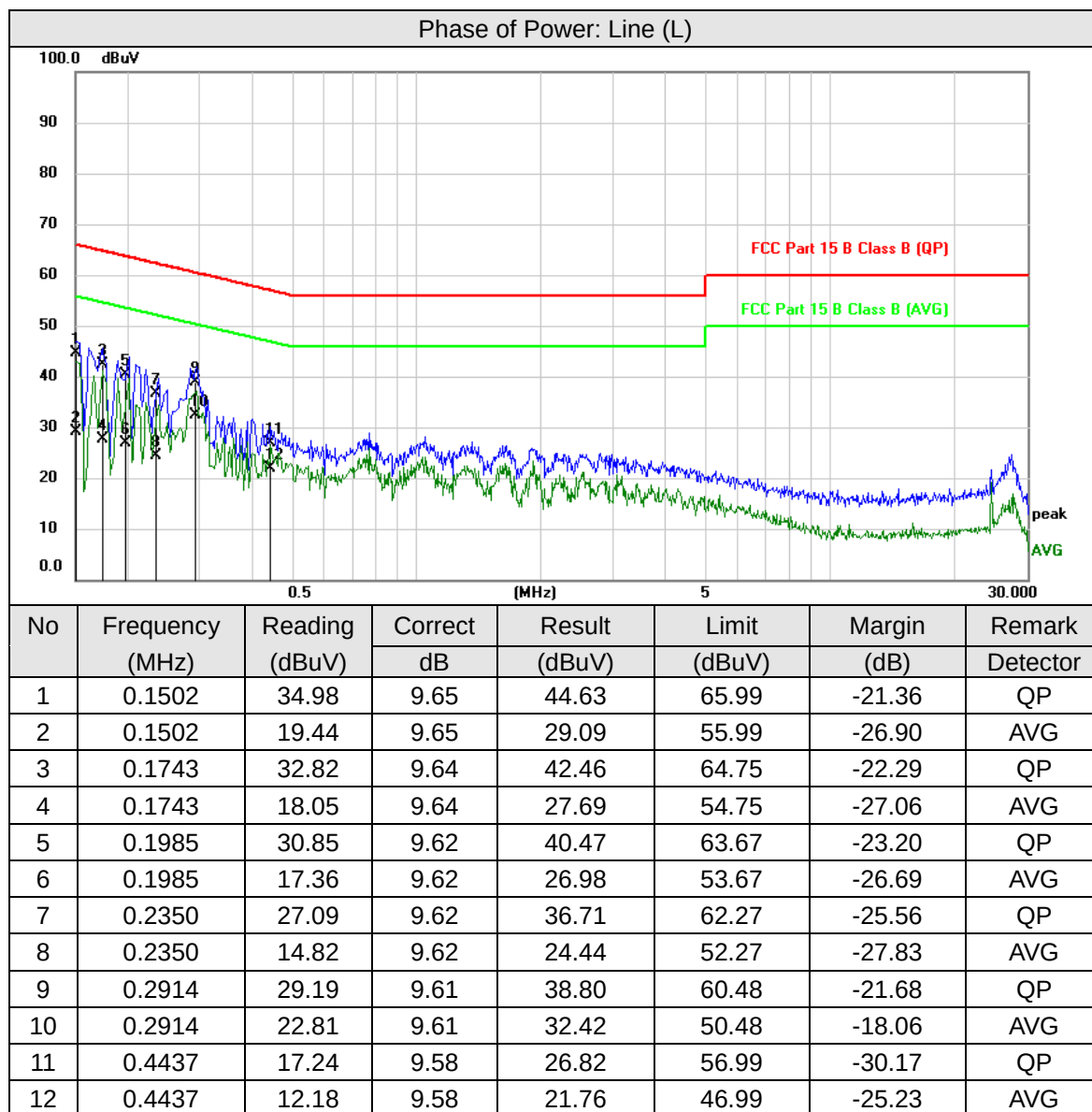
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4.1.6 EUT OPERATING CONDITIONS

- a. Turned on the power and connected of all equipment.
- b. EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

4.1.7 TEST RESULTS

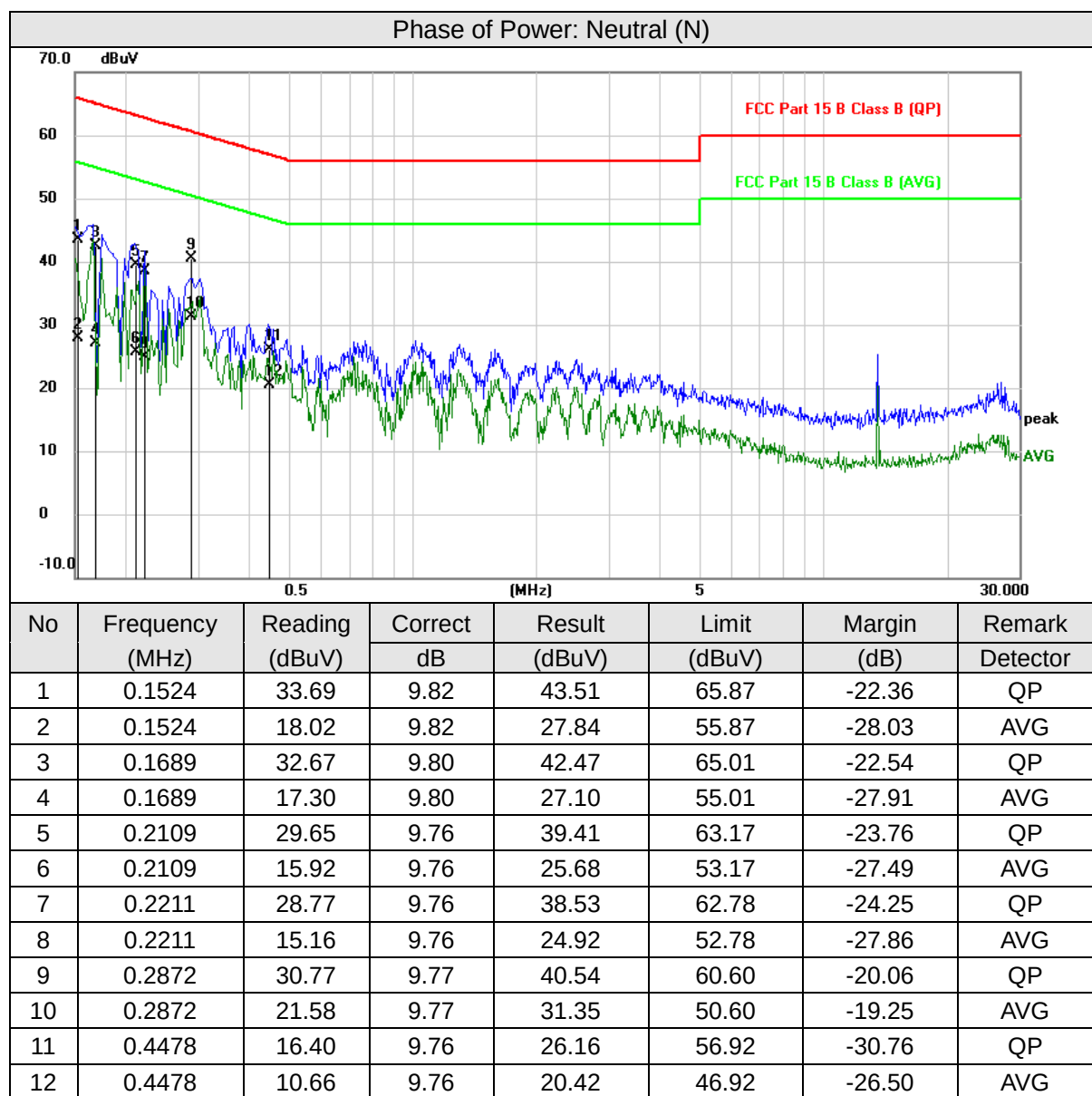
Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
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REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
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REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

4.2. RADIATED EMISSION AND BANDEDGE MEASUREMENT

4.1.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a). Other emissions shall be at least 20dB below the highest level of the desired power.

FREQUENCIES (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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.1.2 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI 7	100962	2020-5-14	2021-05-13
Broadband antenna Schwarzbeck	VULB 9168	00937	2019-10-18	2020-10-17
3m Semi-anechoic Chamber MAORUI	9m*6m*6m	NSEMC003	2020-4-14	2021-04-13
Signal Amplifier Com-power	PAM-103	18020051	2019-10-18	2020-10-17
Attenuator Rohde&Schwarz	TS2GA-6dB	18101101	N/A	N/A
Test software FARAD	FARAD	EZ_EMCV1.1.4 .2	N/A	N/A
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-0 1	2019-10-18	2020-10-17
Loop Antenna	HLA 6121	45745	2019-10-18	2020-10-17
Preamplifier EMCI	EMC001340	980201	2019-10-18	2020-10-17
Digital Multimeter FLUKE	15B+	43512617WS	2019-10-18	2020-10-17
Horn Antenna Schwarzbeck	BBHA 9170	01959	2019-10-18	2020-10-17
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2019-10-18	2020-10-17
Broadband Coaxial Preamplifier Schwarzbeck	BBV 9718	00025	2019-10-18	2020-10-17

NOTE:

1. The test was performed in 966 Chamber and was witness in Hwa-Hsing (Dongguan) Testing Co., Ltd.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.1.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 1.5 meters(above 1GHz) and 0.8 meters(below 1GHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. For below 1GHz was used bilog antenna, and above 1GHz was used horn antenna, and its 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.
- d. 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 and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. For below 30MHz, a loop antenna with its vertical plane is place 3m from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. And the centre of the loop shall be 1m above the ground.
- g. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz(Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

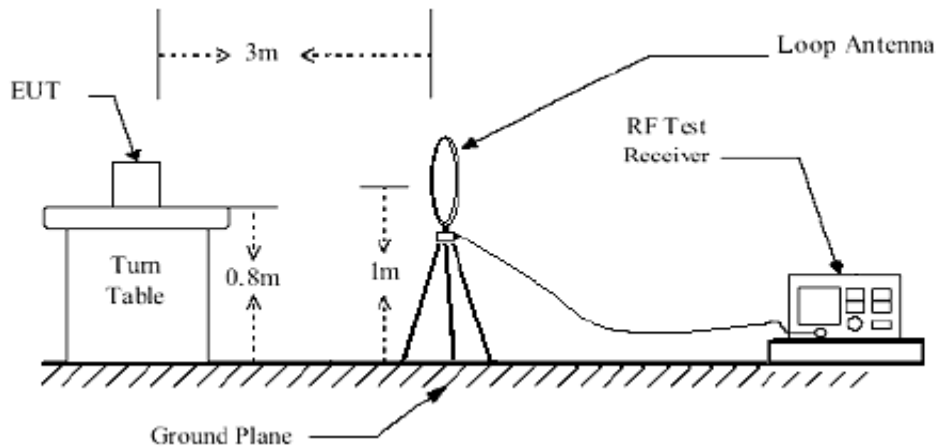


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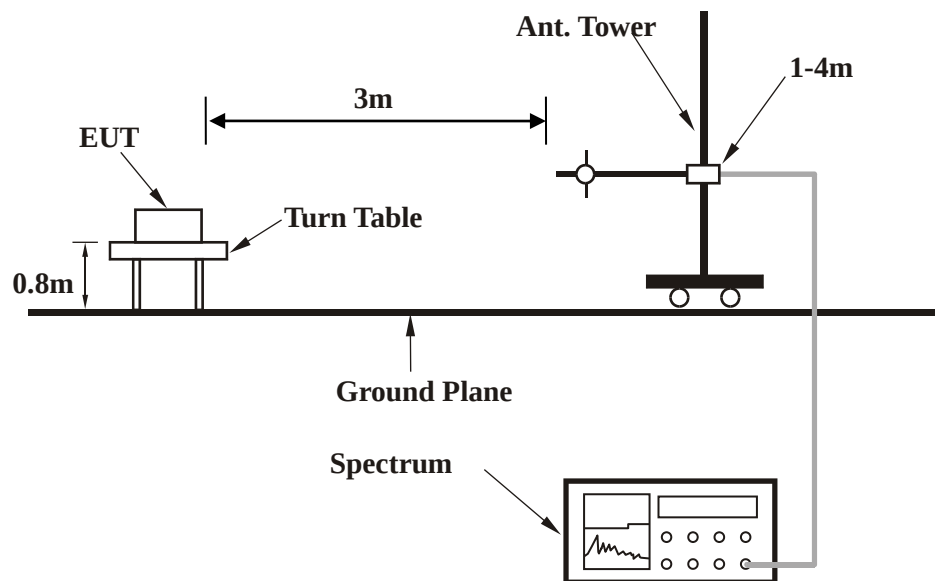
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4.1.5 TEST SETUP

Below 30MHz test setup

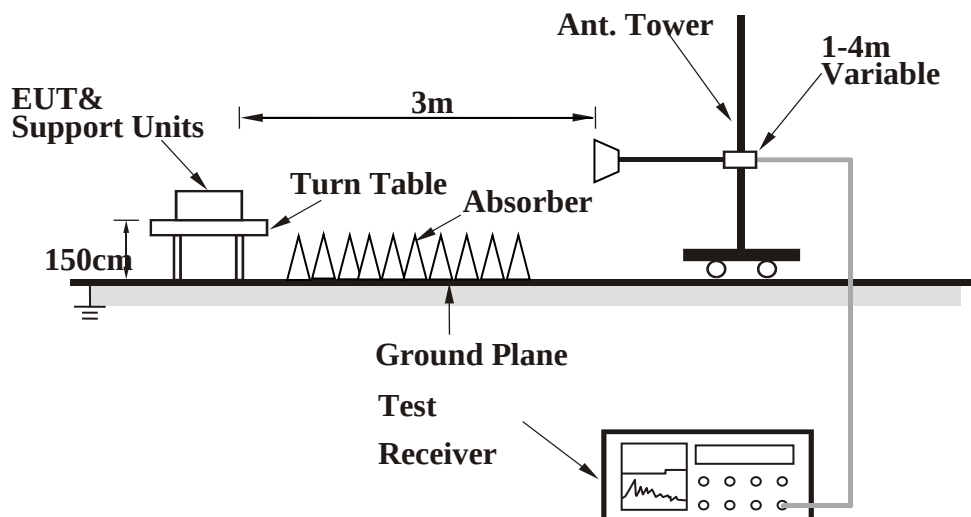


Below 1GHz test setup



Note: For the actual test configuration, please refer to the attached file (Test Setup Photo).

Above 1GHz test setup



Note: For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT OPERATING CONDITIONS

- Set the EUT under full load condition and placed them on a testing table.
- Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.
- The necessary accessories enable the EUT in full functions.

4.1.7 TEST RESULTS

9kHz ~ 30MHz Data:

The amplitude of spurious emissions attenuated more than 20dB below the permissible value is not required to be report.

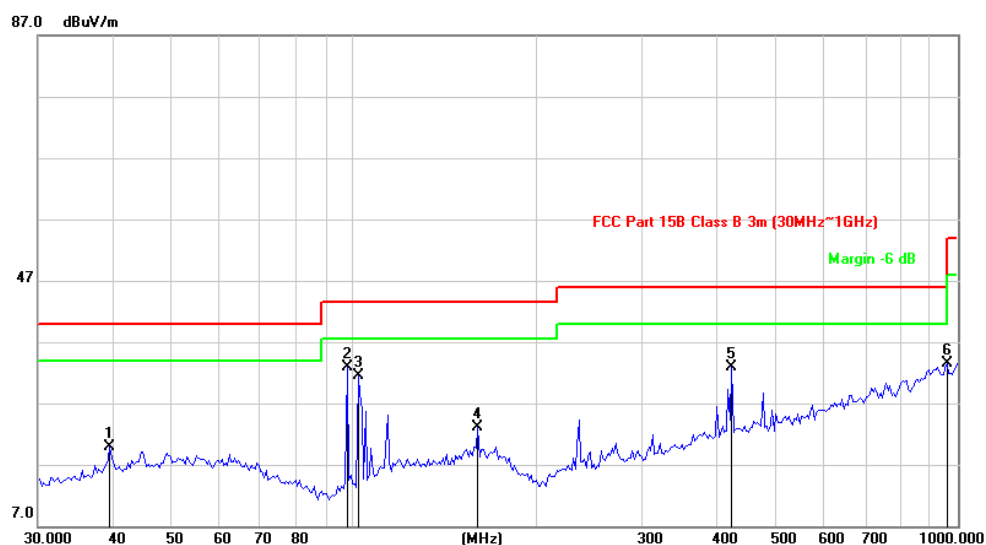
Below 1GHz worst-case data:

CHANNEL	Hopping mode	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTIO N FACTOR (dB/m)
1	39.4371	19.94	40.00	-20.06	100	210	35.62	-15.68
2	97.4560	32.85	43.50	-10.65	200	203	51.63	-18.78
3	101.6443	31.45	43.50	-12.05	200	203	49.41	-17.96
4	160.3456	23.14	43.50	-20.36	200	189	35.49	-12.35
5	422.0577	33.00	46.00	-13.00	200	215	41.75	-8.75
6	958.7943	33.49	46.00	-12.51	100	270	31.93	1.56

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

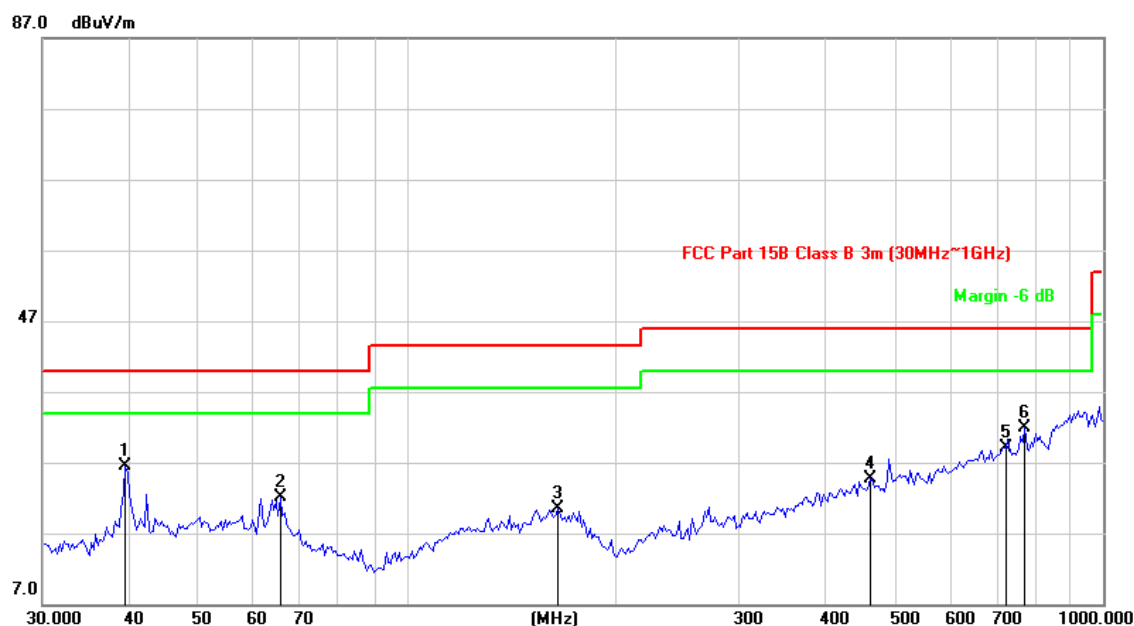


CHANNEL	Hopping mode	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTIO N FACTOR (dB/m)
1	39.4371	26.56	40.00	-13.44	100	114	42.24	-15.68
2	65.8031	22.18	40.00	-17.82	100	170	37.37	-15.19
3	164.9075	20.59	43.50	-22.91	100	320	33.62	-13.03
4	462.3455	24.65	46.00	-21.35	100	4	32.61	-7.96
5	719.1995	29.03	46.00	-16.97	200	151	30.82	-1.79
6	771.4486	31.97	46.00	-14.03	100	355	33.66	-1.69

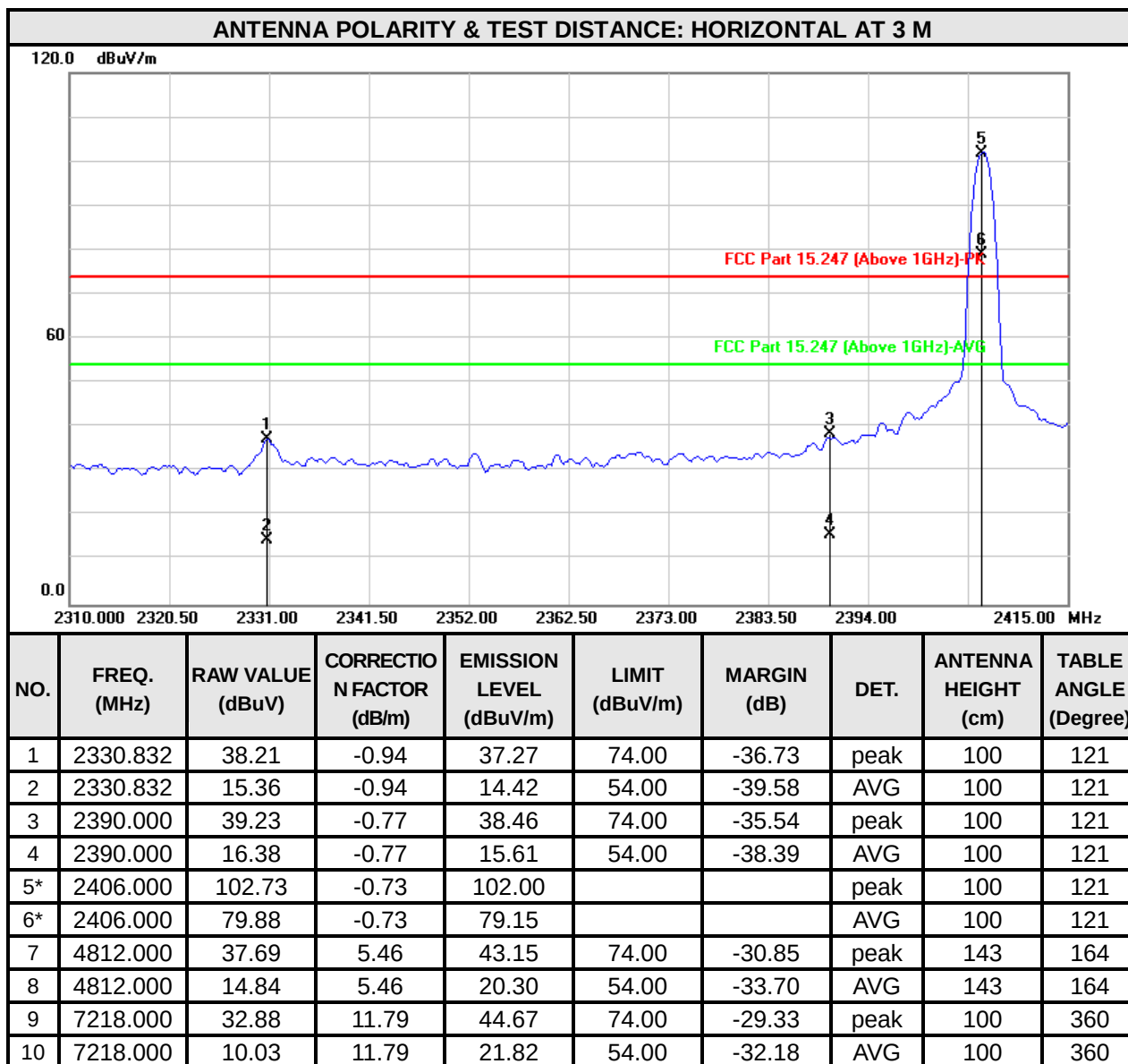
REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



ABOVE 1GHz DATA

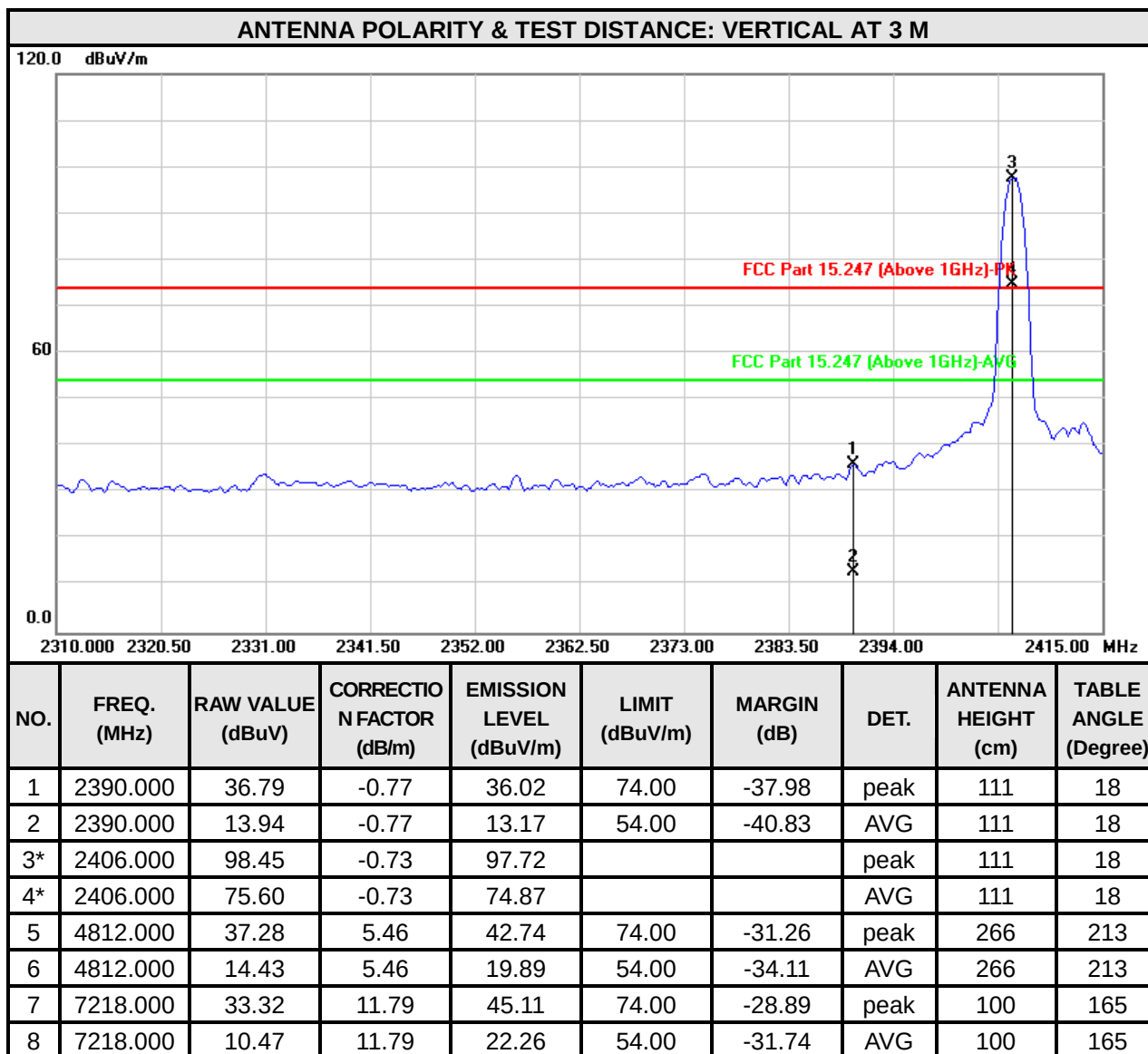
CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)



REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)



REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 16	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

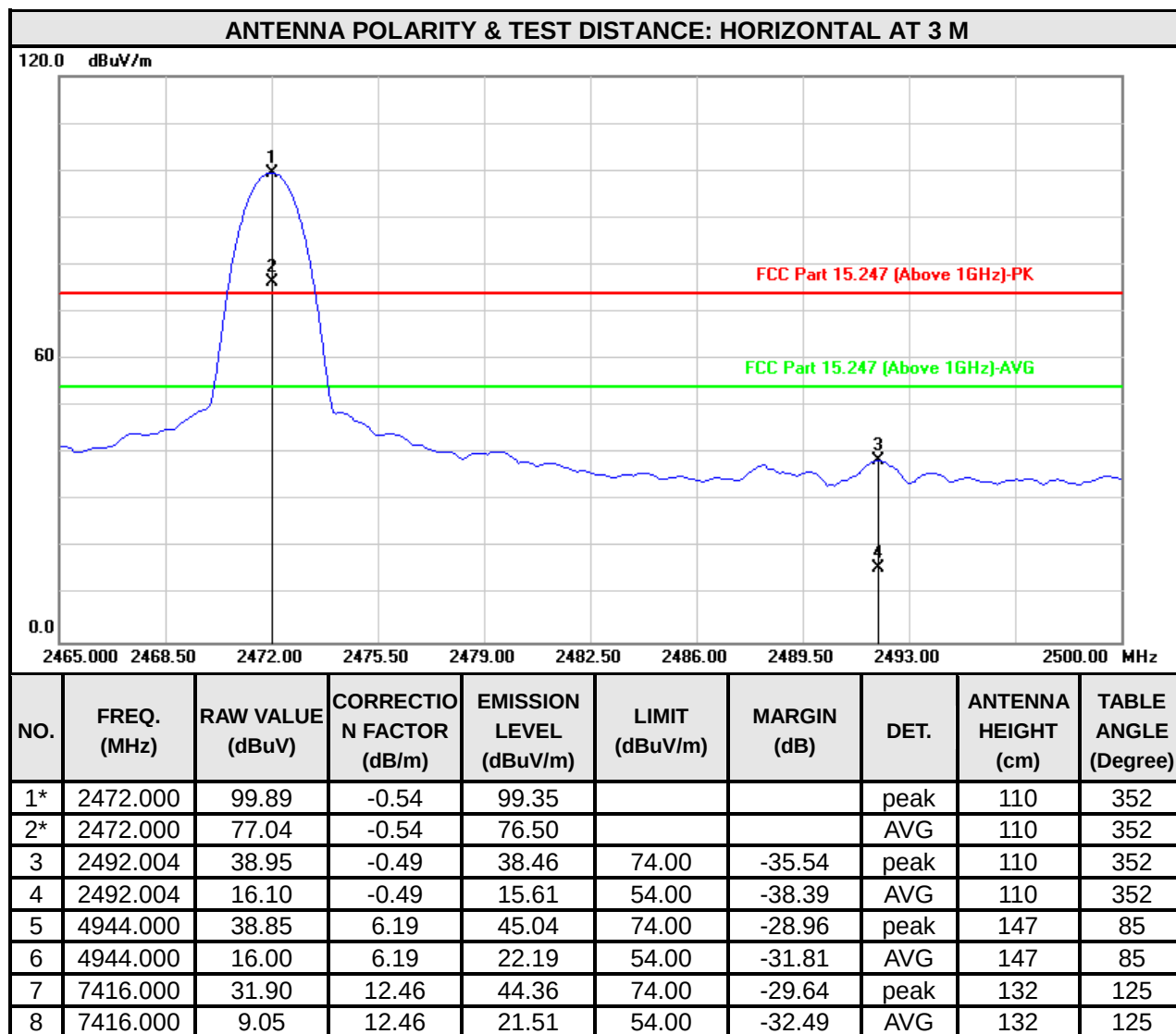
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTIO N FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	DET.	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)
1*	2440.000	102.50	-0.64	101.86			peak	100	35
2*	2440.000	79.65	-0.64	79.01			AVG	100	35
3	4880.000	37.68	6.24	43.92	74.00	-30.08	peak	103	96
4	4880.000	14.83	6.24	21.07	54.00	-32.93	AVG	103	96
5	7320.000	32.03	12.13	44.16	74.00	-29.84	peak	100	137
6	7320.000	9.18	12.13	21.31	54.00	-32.69	AVG	100	137

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTIO N FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	DET.	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)
1*	2440.000	98.89	-0.64	98.25			peak	100	35
2*	2440.000	76.04	-0.64	75.40			AVG	100	35
3	4880.000	37.43	6.24	43.67	74.00	-30.33	peak	101	211
4	4880.000	14.58	6.24	20.82	54.00	-33.18	AVG	101	211
5	7320.000	32.15	12.13	44.28	74.00	-29.72	peak	100	235
6	7320.000	9.30	12.13	21.43	54.00	-32.57	AVG	100	235

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

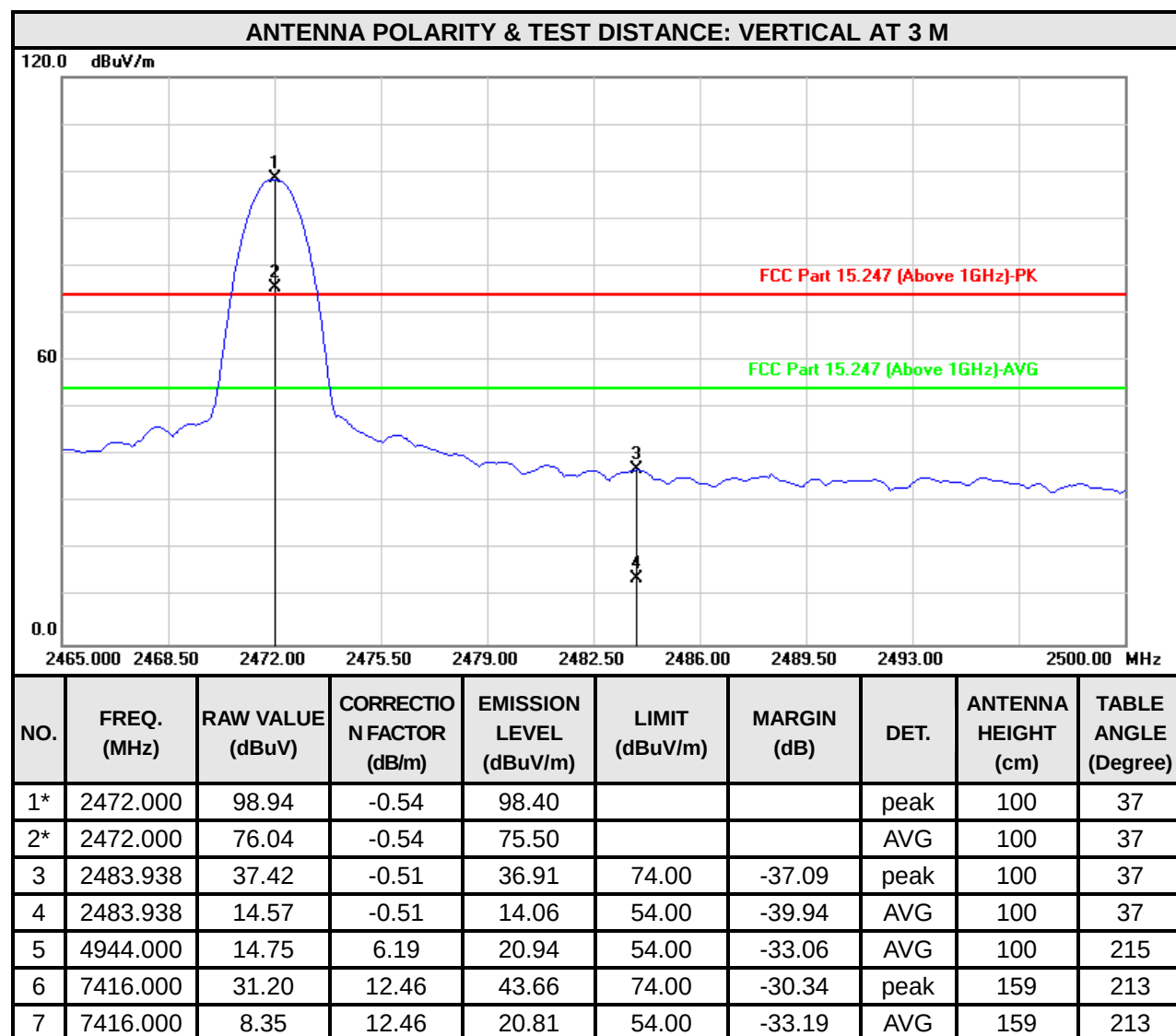
CHANNEL	TX Channel 30	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)



REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 30	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)



REMARKS:

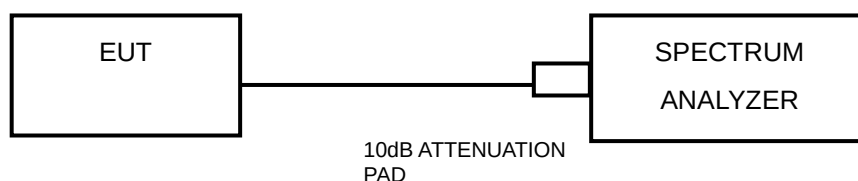
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

4.3 NUMBER OF HOPPING FREQUENCY USED

4.3.1 LIMIT OF HOPPING FREQUENCY USED

At least 15 channels frequencies, and should be equally spaced.

4.3.2 TEST SETUP



4.3.3 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Spectrum Keysight	N9020A	MY51240612	2019/10/18	2020/10/17
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2019/10/18	2020/10/17
Power Meter10Hz~18GHz Tonscend	JS0806-2	188060126	2019/10/18	2020/10/17
Signal generator Keysight	N5182A	GB40051020	2019/10/18	2020/10/17
Signal generator Keysight	N5182A	MY47420944	2019/10/18	2020/10/17
Test Software Tonscend	JS0806-2	NA	NA	NA
Hygrothermograph Yuhuaze	HTC-1	NA	2019/10/18	2020/10/17

NOTES:

1. The test was performed in RF Oven room in Hwa-Hsing (Dongguan) Testing Co., Ltd..
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.3.4 TEST PROCEDURES

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. Set the SA on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- d. Set the SA on View mode and then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were completed.

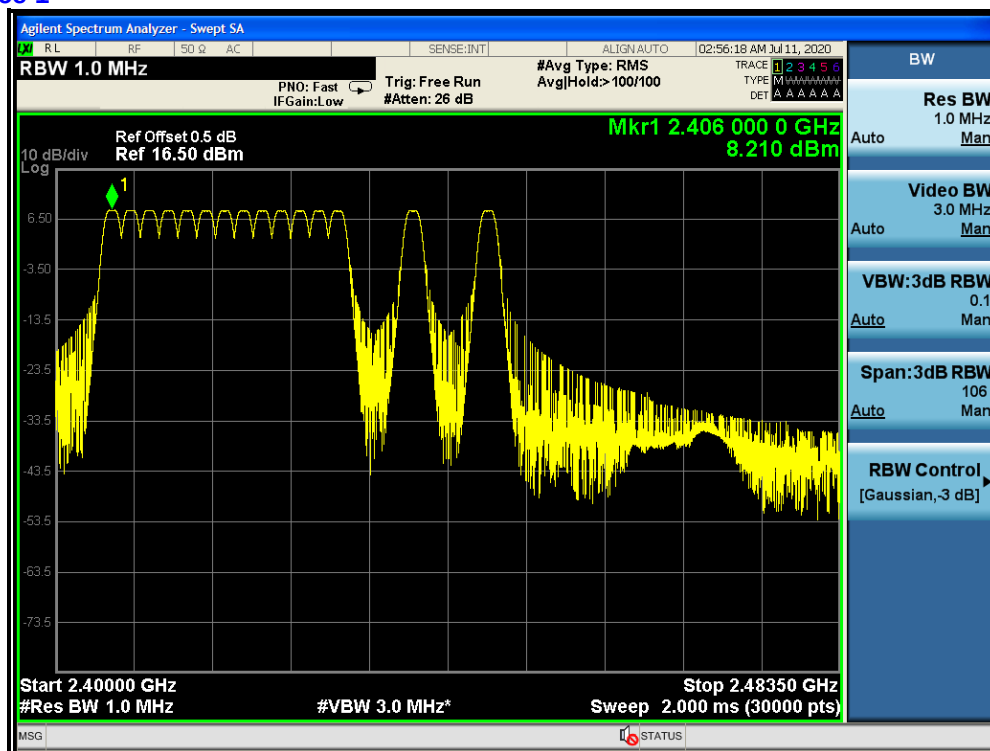
4.3.5 DEVIATION FROM TEST STANDARD

No deviation.

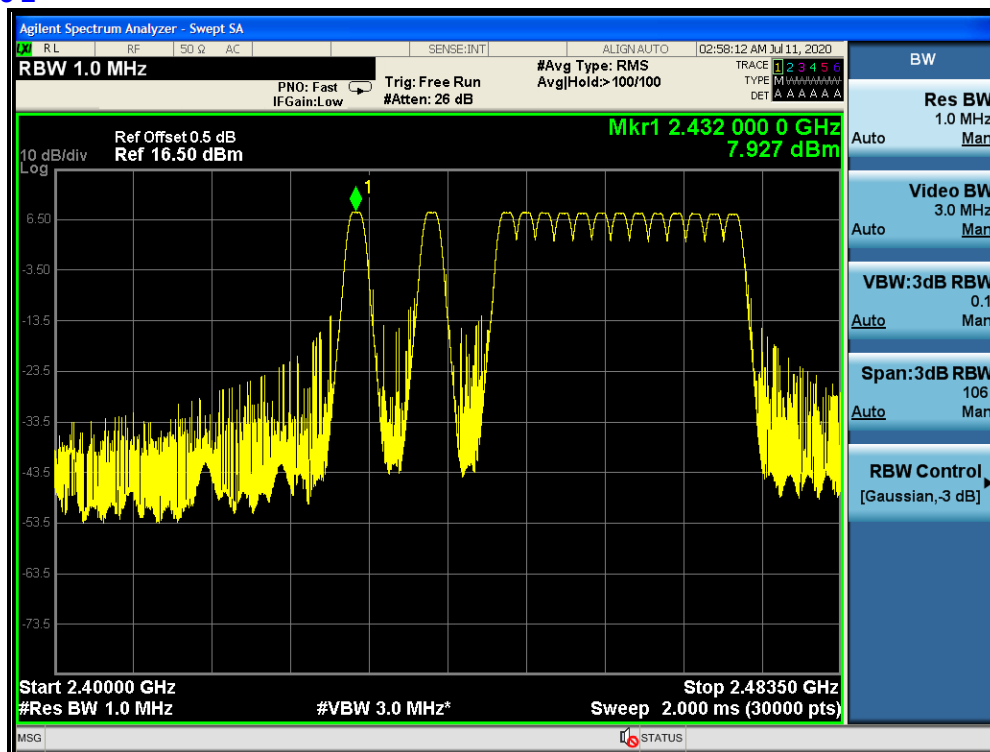
4.3.6 TEST RESULTS

There are 15 hopping frequencies in the hopping mode. Please refer to next two pages for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

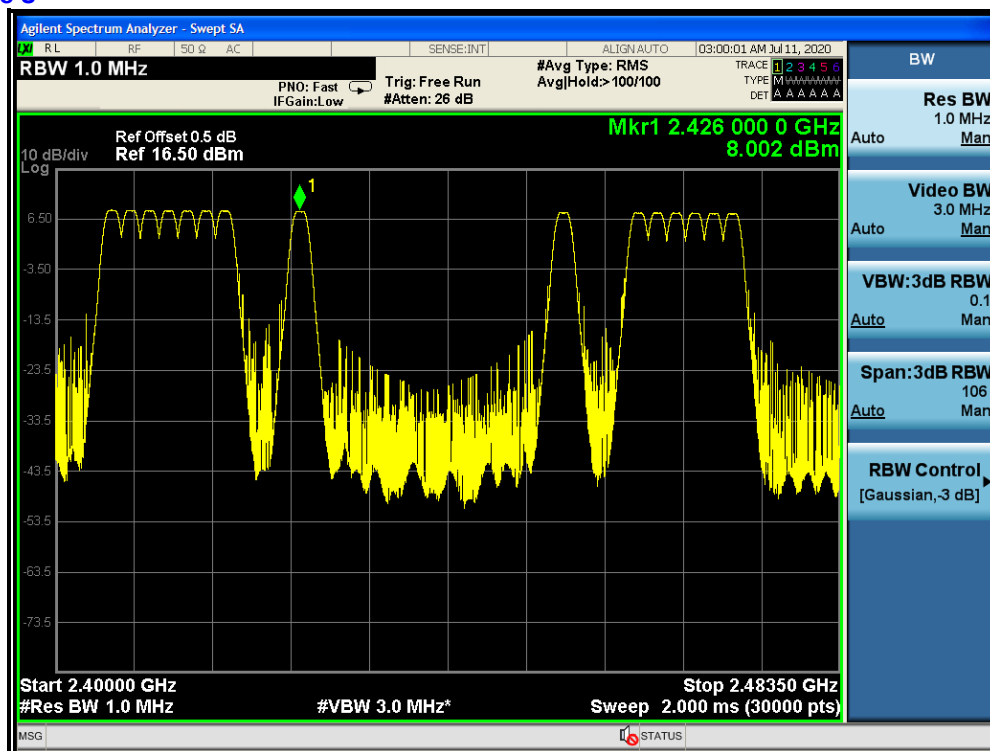
Sequence 1



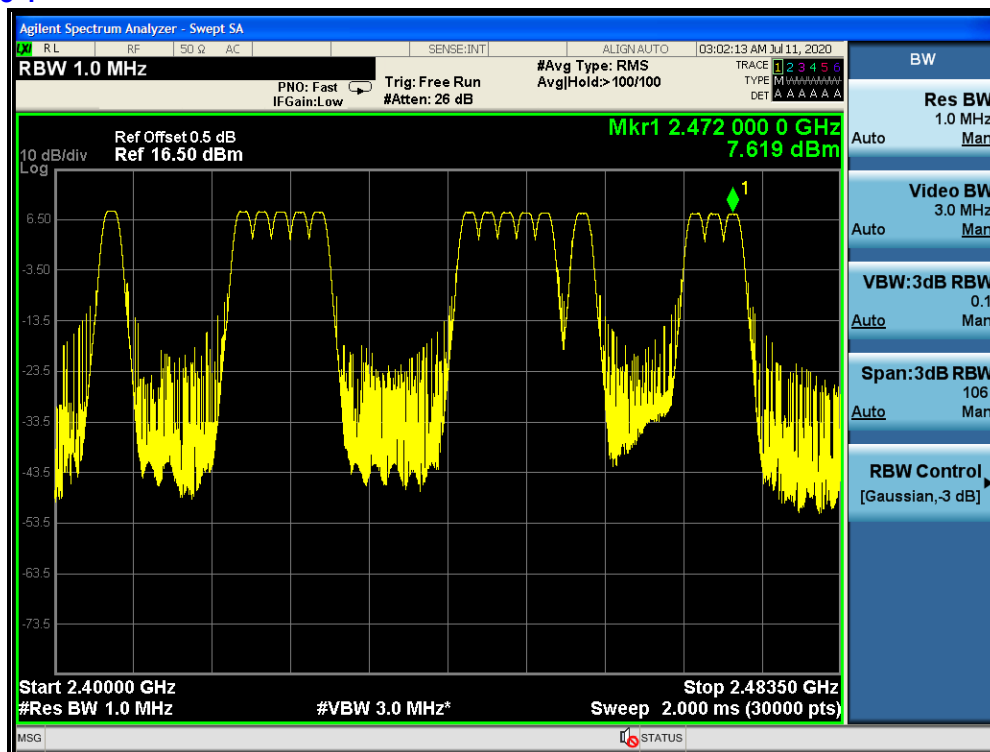
Sequence 2



Sequence 3



Sequence 4

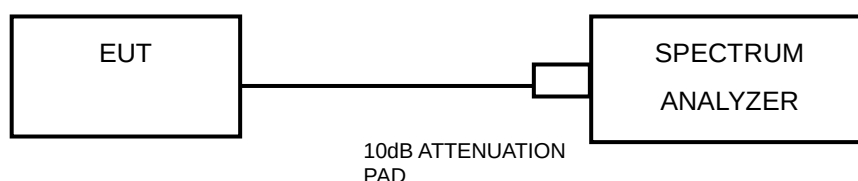


4.4 DWELL TIME ON EACH CHANNEL

4.4.1 LIMIT OF DWELL TIME USED

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

4.4.2 TEST SETUP



4.4.3 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.4.4 TEST PROCEDURES

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- Repeat above procedures until all different time-slot modes have been completed.

4.4.5 DEVIATION FROM TEST STANDARD

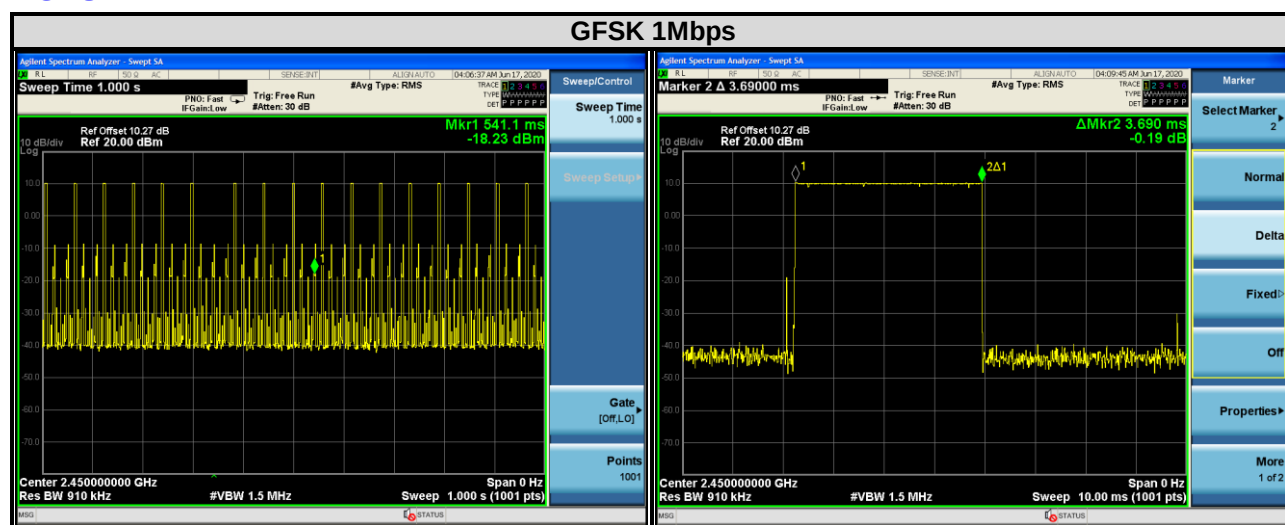
No deviation.

4.4.6 TEST RESULTS

GFSK

Accumulated Transmit Time									
Mode	Number of Hopping Channel	Number of transmission in a period (channel number*0.015 sec)				Length of transmission time (ms)	Result (ms)	Limit (ms)	Pass / Fail
		Period (Sec)	Sweep time (Sec)	Times in a sweep	Number in a period				
1Mbps	15	0.225	1	17	3.825	3.69	14.114	15	Pass

GFSK

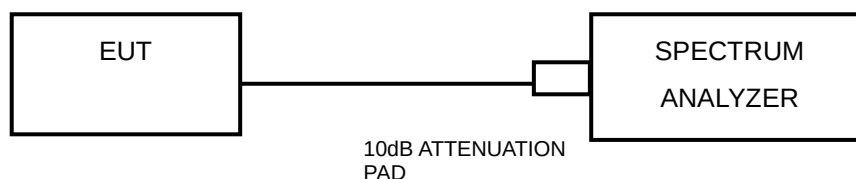


4.5 CHANNEL BANDWIDTH

4.5.1 LIMITS OF CHANNEL BANDWIDTH

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

4.5.2 TEST SETUP



4.5.3 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.5.4 TEST PROCEDURE

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- Repeat above procedures until all frequencies measured were complete.

4.5.5 DEVIATION FROM TEST STANDARD

No deviation.

4.5.6 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.5.7 TEST RESULTS

GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
0	2406	1.4084
16	2444	1.4345
30	2472	1.4035

CH 0



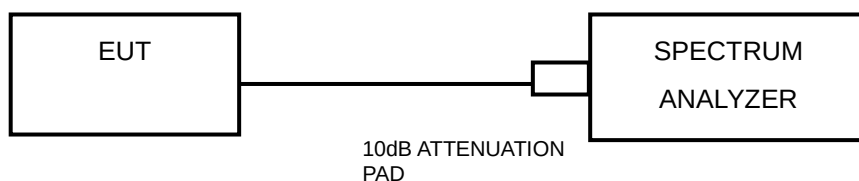


4.6 HOPPING CHANNEL SEPARATION

4.6.1 LIMIT OF HOPPING CHANNEL SEPARATION

At least 25kHz or two-third of 20dB hopping channel bandwidth (whichever is greater).

4.6.2 TEST SETUP



4.6.3 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.6.4 TEST PROCEDURES

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the MaxHold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

4.6.5 DEVIATION FROM TEST STANDARD

No deviation.

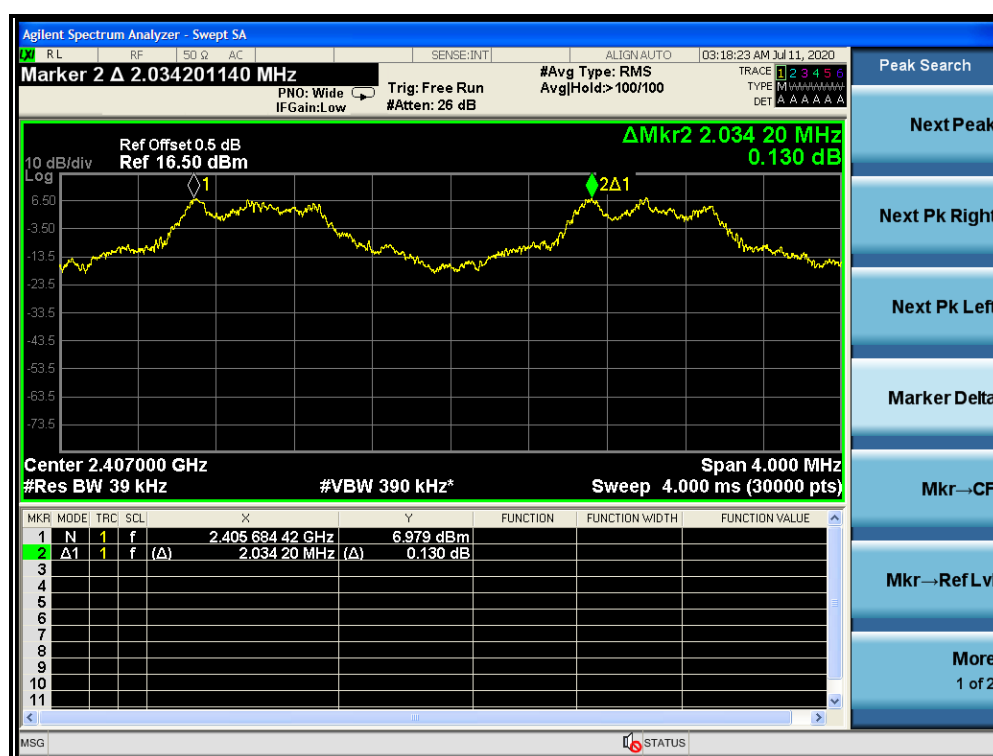
4.6.6 TEST RESULTS

GFSK

CHANNEL	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	20dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	2.0342	1.4084	1.4084	PASS
16	2444	2.0068	1.4345	1.4345	PASS
30	2472	2.0048	1.4035	1.4035	PASS

NOTE: The minimum limit is 20dB bandwidth.

CH 0



CH 16



CH 30

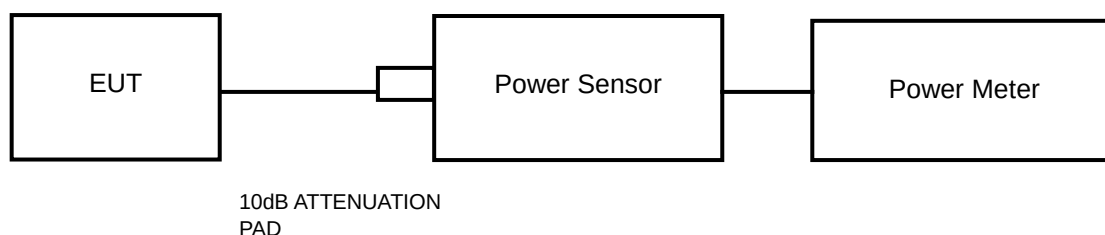


4.7 CONDUCTED OUTPUT POWER

4.7.1 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT

The Maximum Output Power Measurement is 1W.

4.7.2 TEST SETUP



4.7.3 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.7.4 TEST PROCEDURES

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor and set the detector to PEAK. Record the power level.

An average power sensor was used on the output port of the EUT. A power meter was used to read the response of the average power sensor and set the detector to AVERAGE. Record the power level.

4.7.5 DEVIATION FROM TEST STANDARD

No deviation.

4.7.6 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.7.7 TEST RESULTS

MAXIMUM PEAK OUTPUT POWER

GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (mW)	PEAK POWER LIMIT (dBm)	PASS/FAIL
0	2406	10.10	10.23	30	PASS
16	2444	10.13	10.30	30	PASS
30	2472	10.25	10.59	30	PASS

AVERAGE OUTPUT POWER(FOR REFERENCE)

GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)	AVERAGE POWER (mW)
0	2406	9.81	9.57
16	2444	9.97	9.93
30	2472	9.89	9.75

4.8 OUT OF BAND EMISSION MEASUREMENT

4.8.1 LIMITS OF OUT OF BAND EMISSION MEASUREMENT

Below -20dB of the highest emission level of operating band (in 100KHz RBW).

4.8.2 TEST INSTRUMENTS

Refer to section 4.3.3 to get information of above instrument.

4.8.3 TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer via a low loss cable. of Spectrum Analyzer was set RBW to 100 kHz and VBW to 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. Detector = PEAK and Trace mode = Max Hold. The band edges was measured and recorded.

4.8.4 DEVIATION FROM TEST STANDARD

No deviation.

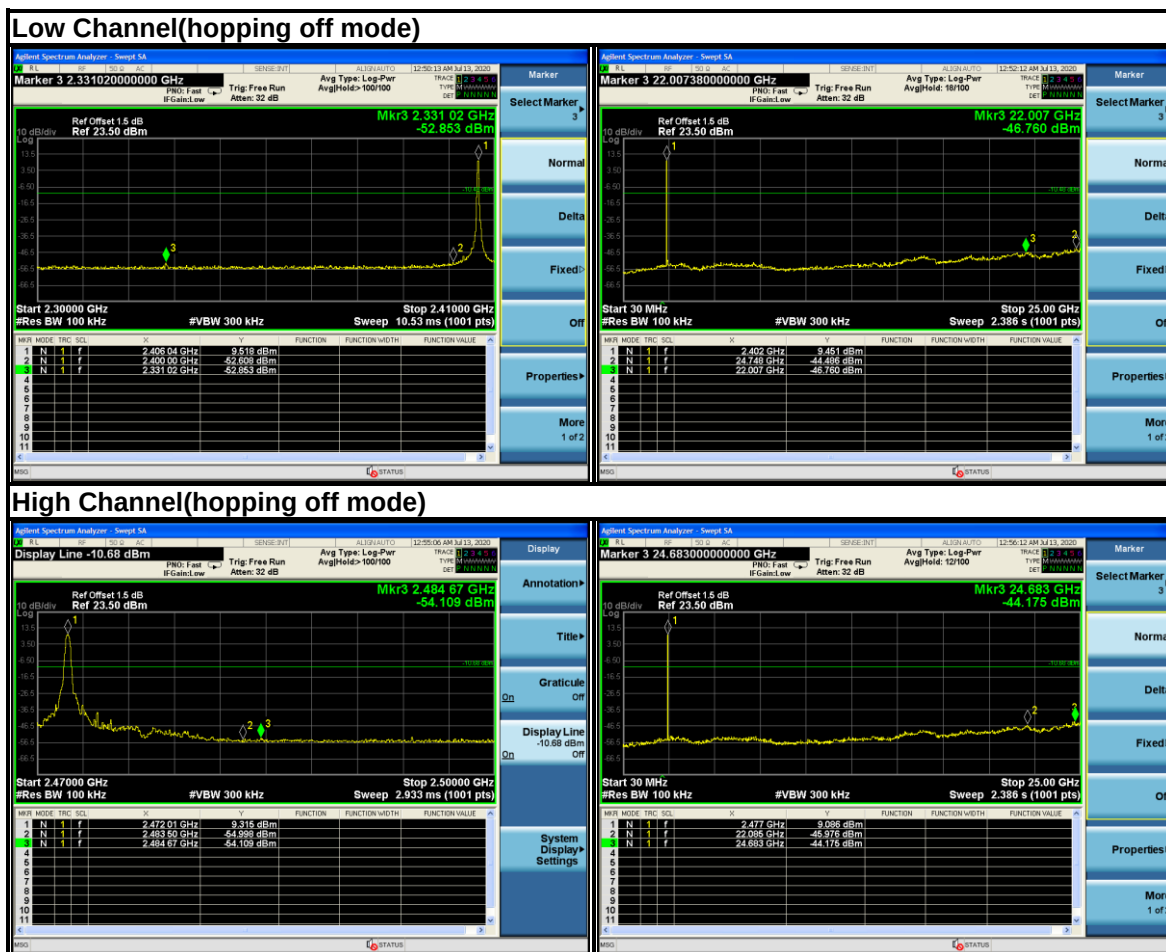
4.8.5 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.8.6 TEST RESULTS

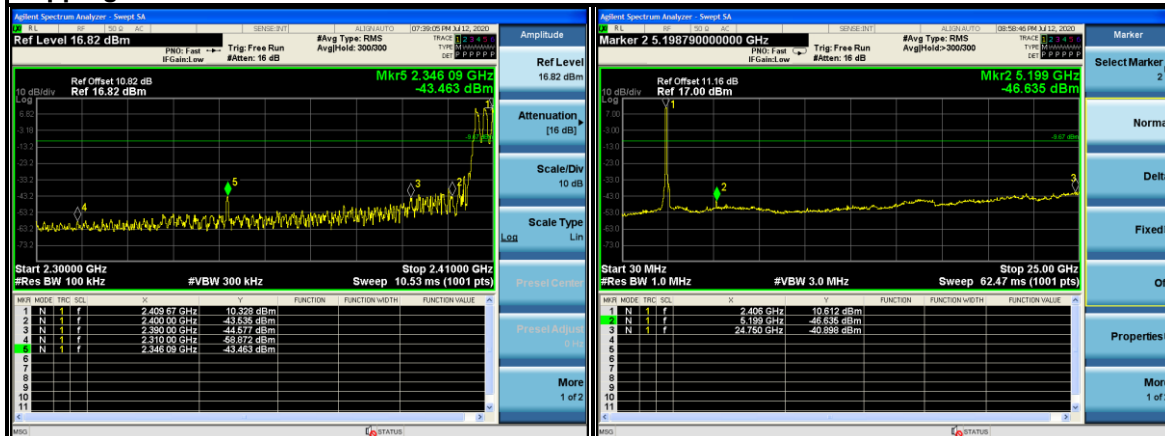
The spectrum plots are attached on the following images. D1 line indicates the highest level. D2 line indicates the 20dB offset below D1. It shows compliance to the requirement.

GFSK

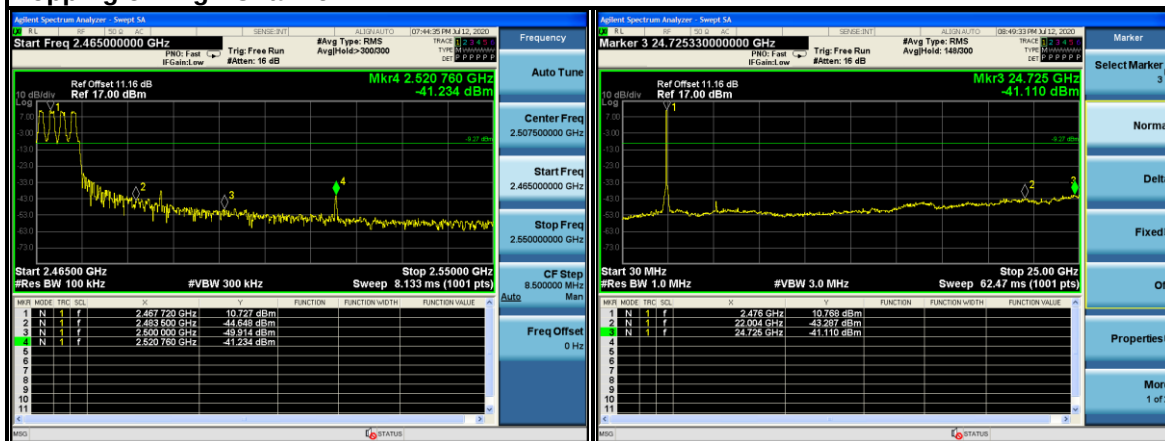


GFSK

Hopping on Low Channel



Hopping on High Channel





Test Report No.: RF-BQOZ-WDG-P20080116

5 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).

6 APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---