

TEST REPORT

Applicant	Zound Industries International AB
Address	Centralplan 15 SE-111 20 Stockholm Sweden

Manufacturer or Supplier	Zound Industries International AB
Address	Centralplan 15 SE-111 20 Stockholm Sweden
Product	Portable Stereo Loudspeaker
Brand Name	<i>Marshall</i>
Model	EMBERTON
Additional Model & Model Difference	N/A
Date of tests	Jan. 07, 2020 ~ Mar. 04, 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	Approved by Glyn He Assistant Manager / EMC Department
<i>Ryan</i>	<i>Glyn He</i> Date: Apr. 13, 2020

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Test Report No.: RF200107N001-1

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Test Report No.: RF200107N001-1

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF200107N001-1	Original release	Apr. 13, 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)	Maximum Peak 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	2.90 dB
	30MHz ~ 1GMHz	3.47 dB
	1GHz ~ 18GHz	4.84 dB
	18GHz ~ 40GHz	4.62 dB

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	Portable Stereo Loudspeaker
MODEL NO.	EMBERTON
ADDITIONAL MODEL	N/A
FCC ID	2AAGF-EMBERTON
POWER SUPPLY	DC 7.27V 3300mA from Battery Charging: DC 5V from USB Host Unit
MODULATION TECHNOLOGY	FHSS
MODULATION TYPE	GFSK, $\pi/4$ DQPSK, 8DPSK
OPERATING FREQUENCY	2402MHz~2480MHz
NUMBER OF CHANNEL	79
AVERAGE OUTPUT POWER	0.774mW (Max. Measured)
ANTENNA TYPE	FPC Antenna, 3.33dBi Gain
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	USB Cable: Detachable, Shielded, 1.2m
TEST SW VERSION	BlueTest 3.2.1
RF POWER SETTING IN TEST SW	BlueTest 3.2.1
RF POWER SETTING VALUE	0

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.: 200107N001) for detailed product photo.
4. When the EUT charging that wireless function can't working. The charging mode was tested in the FCC Part 15B(sDoC) report. (Report no.: FS200107N001)

3.2 DESCRIPTION OF TEST MODES

79 channels are provided to this EUT:

CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

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	√	√	-	√	Powered By Fully Battery with BT link

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 78	39	FHSS	GFSK	DH5

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 78	0, 39, 78	FHSS	GFSK	DH5
0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

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 78	0, 39, 78	FHSS	GFSK	DH5
0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE (SYSTEM)	TESTED BY
RE<1G	25deg. C, 55%RH	DC7.27V from Fully Battery	Tank
RE≥1G	25deg. C, 55%RH	DC7.27V from Fully Battery	Tank
PLC	-		-
APCM	25deg. C, 60%RH	DC7.27V from Fully Battery	Tank

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
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

- Note:
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

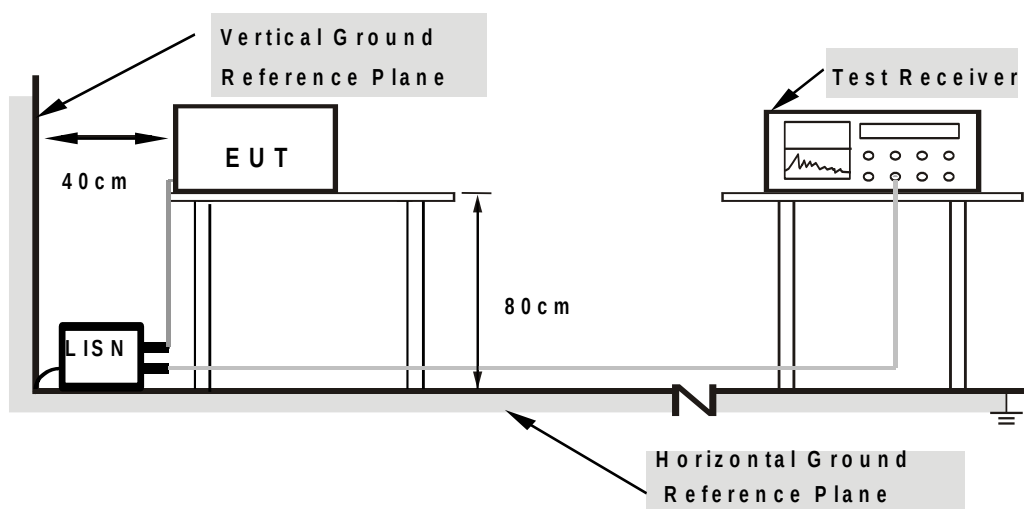
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. 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

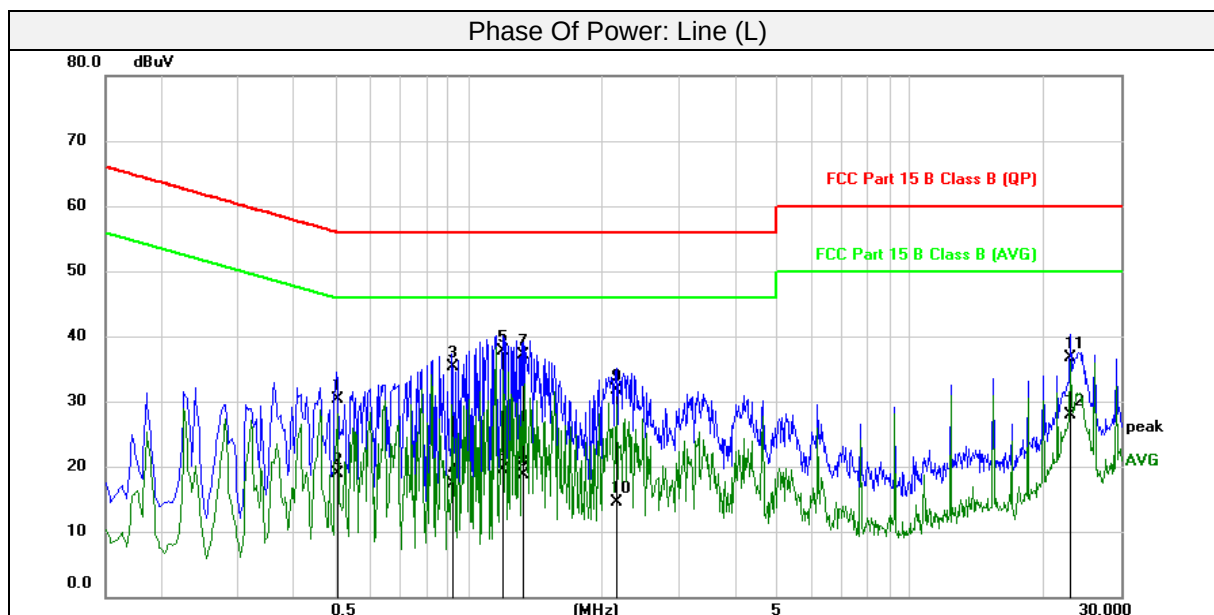
For the actual test configuration, please refer to the attached file (Test Setup Photo).

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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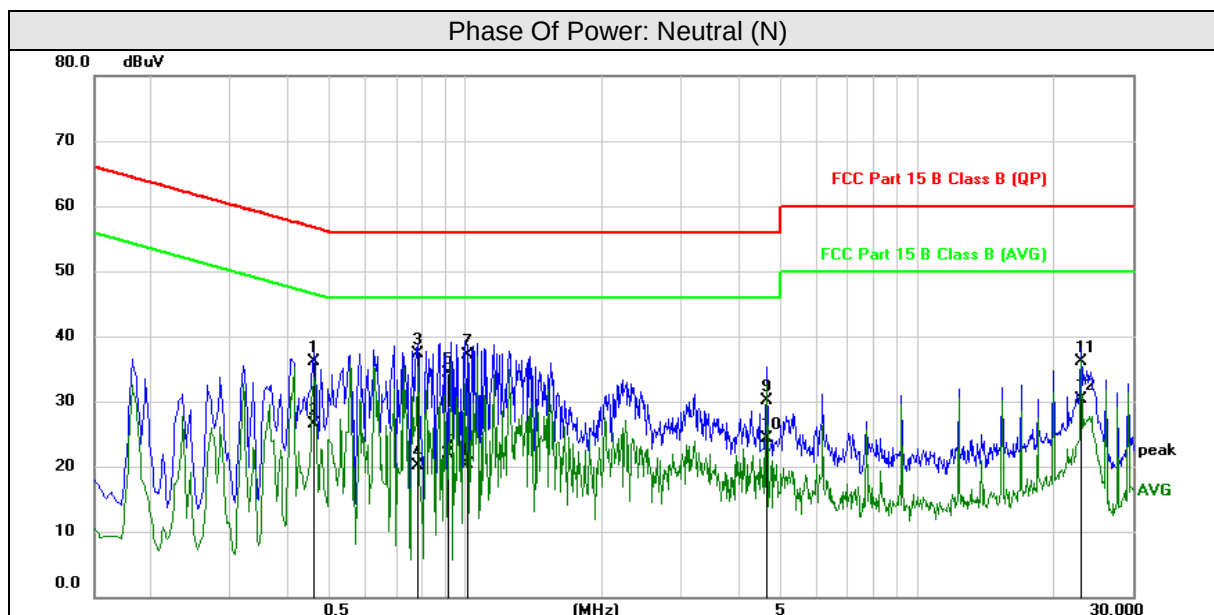


No	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.5029	20.69	9.59	30.28	56.00	-25.72	QP
2	0.5029	9.40	9.59	18.99	46.00	-27.01	AVG
3	0.9200	25.83	9.56	35.39	56.00	-20.61	QP
4	0.9200	7.65	9.56	17.21	46.00	-28.79	AVG
5	1.1930	28.25	9.55	37.80	56.00	-18.20	QP
6	1.1930	9.86	9.55	19.41	46.00	-26.59	AVG
7	1.3309	27.50	9.55	37.05	56.00	-18.95	QP
8	1.3309	9.18	9.55	18.73	46.00	-27.27	AVG
9	2.1614	22.24	9.56	31.80	56.00	-24.20	QP
10	2.1614	5.00	9.56	14.56	46.00	-31.44	AVG
11	23.1135	26.32	10.29	36.61	60.00	-23.39	QP
12	23.1135	17.69	10.29	27.98	50.00	-22.02	AVG

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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No	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.4596	26.54	9.59	36.13	56.70	-20.57	QP
2	0.4596	16.89	9.59	26.48	46.70	-20.22	AVG
3	0.7822	27.64	9.58	37.22	56.00	-18.78	QP
4	0.7822	10.48	9.58	20.06	46.00	-25.94	AVG
5	0.9107	24.83	9.56	34.39	56.00	-21.61	QP
6	0.9107	12.35	9.56	21.91	46.00	-24.09	AVG
7	1.0115	27.65	9.55	37.20	56.00	-18.80	QP
8	1.0115	10.82	9.55	20.37	46.00	-25.63	AVG
9	4.6247	20.44	9.62	30.06	56.00	-25.94	QP
10	4.6247	14.69	9.62	24.31	46.00	-21.69	AVG
11	23.1150	25.81	10.29	36.10	60.00	-23.90	QP
12	23.1150	19.92	10.29	30.21	50.00	-19.79	AVG

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

4.2.1 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.

4.2.2 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI 7	100962	2019-7-16	2020-7-15
Broadband antenna Schwarzbeck	VULB 9168	00937	2019-10-18	2020-10-17
3m Semi-anechoic Chamber MAORUI	9m*6m*6m	NSEMC003	2018-10-20	2020-10-19
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.

4.2.3 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 placed 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 performed using fresh batteries. The turntable was rotated to maximize the emission level.

NOTE:

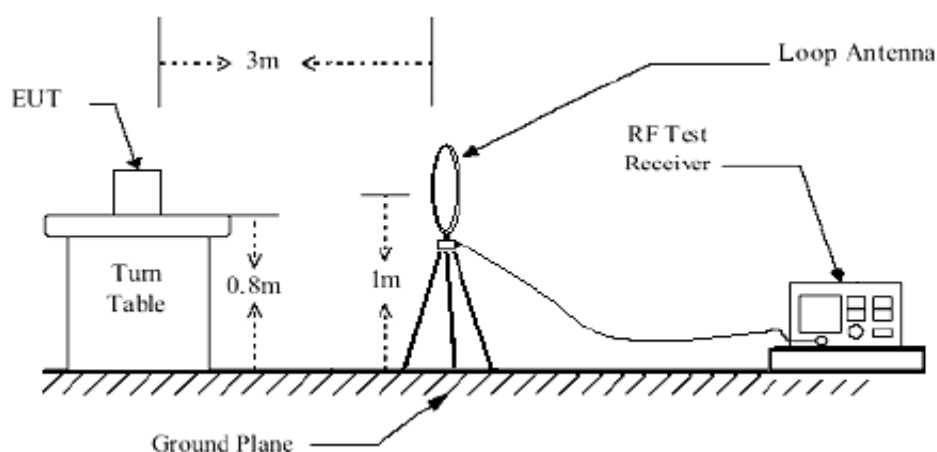
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution 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.

4.2.4 DEVIATION FROM TEST STANDARD

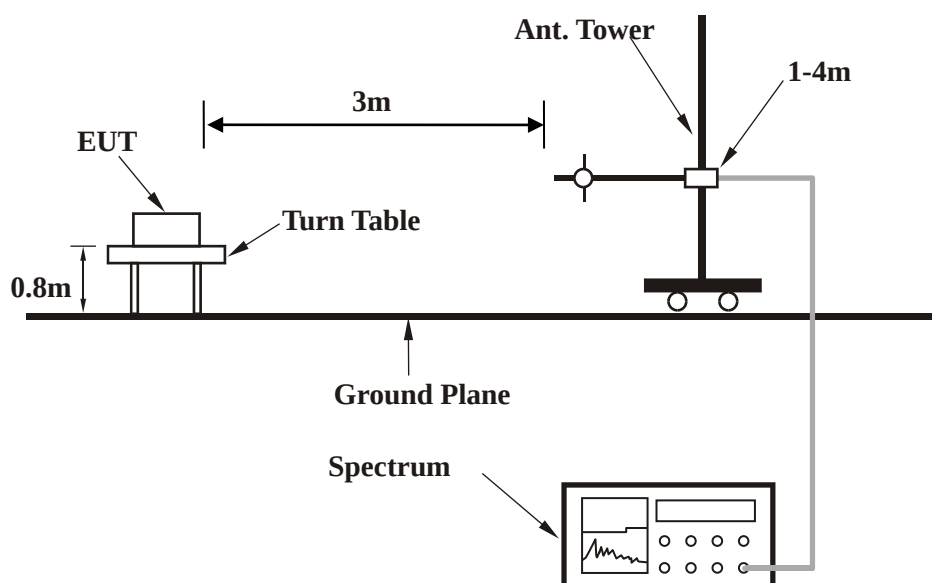
No deviation.

4.2.5 TEST SETUP

Below 30MHz test setup

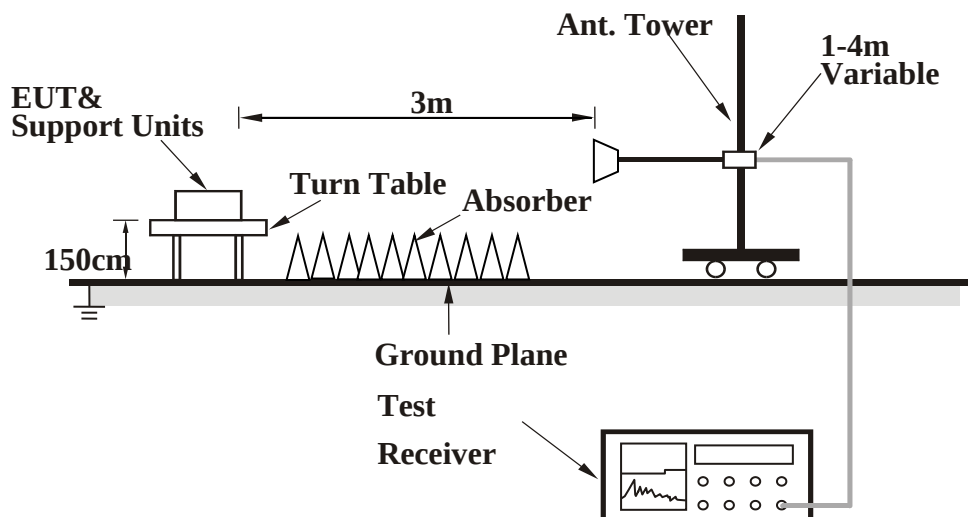


Below 1GHz test setup



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).

4.2.6 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.

4.2.7 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:

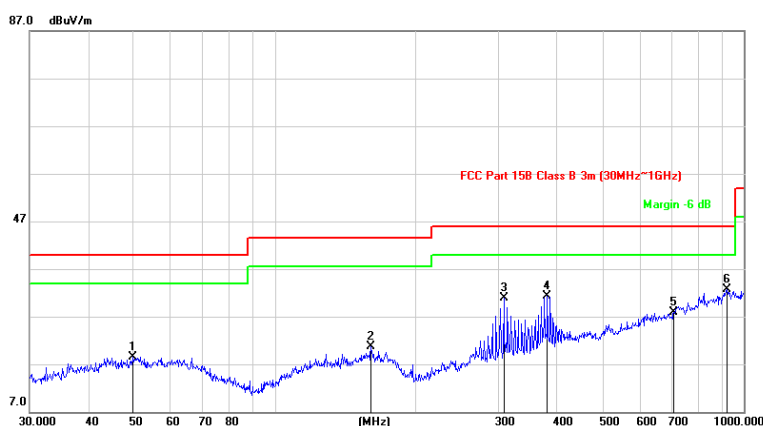
GFSK DH5

CHANNEL	Channel 39	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)	CORRECTION FACTOR (dB/m)
1	51.1208	18.90	40.00	-21.10	200	86	33.10	-14.20
2	159.2250	20.30	43.50	-23.20	200	226	32.68	-12.38
3	379.9141	22.69	46.00	-23.31	200	359	32.48	-9.79
4	517.2480	24.78	46.00	-21.22	200	184	31.60	-6.82
5	651.9416	29.01	46.00	-16.99	200	268	33.22	-4.21
6	912.8619	33.01	46.00	-12.99	200	49	31.22	1.79

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.

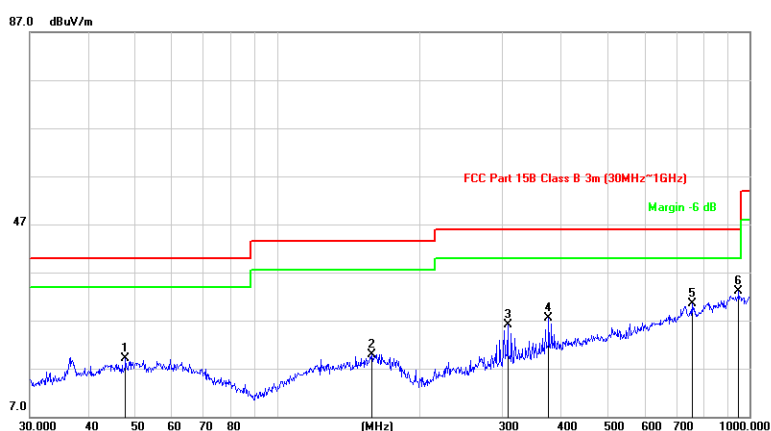


CHANNEL	Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

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)	CORRECTION FACTOR (dB/m)
1	47.8260	19.15	40.00	-20.85	100	355	33.61	-14.46
2	158.6677	19.99	43.50	-23.51	100	355	32.41	-12.42
3	307.8313	26.14	46.00	-19.86	200	4	38.96	-12.82
4	375.9385	27.54	46.00	-18.46	200	114	37.42	-9.88
5	755.3873	30.43	46.00	-15.57	100	22	32.22	-1.79
6	948.7610	33.10	46.00	-12.90	200	140	31.66	1.44

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

BT_GFSK

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

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)	CORRECTION FACTOR (dB/m)
1	2390.00	39.99	74.00	-34.01	105	265	41.19	-1.20
2	2390.00	9.89	54.00	-44.11	105	265	11.09	-1.20
3	*2402.00	89.40			105	265	90.58	-1.18
4	*2402.00	59.30			105	265	60.48	-1.18
5	4804.00	46.18	74.00	-27.82	100	147	41.50	4.68
6	4804.00	16.08	54.00	-37.92	100	147	11.40	4.68
7	#7206.00	47.93	74.00	-26.07	150	0	37.13	10.80
8	#7206.00	17.83	54.00	-36.17	150	0	7.03	10.80
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)	CORRECTION FACTOR (dB/m)
1	2390.00	37.42	74.00	-36.58	140	285	38.62	-1.20
2	2390.00	7.32	54.00	-46.68	140	285	8.52	-1.20
3	*2402.00	95.96			140	285	97.14	-1.18
4	*2402.00	65.86			140	285	67.04	-1.18
5	4804.00	46.91	74.00	-27.09	100	55	42.23	4.68
6	4804.00	16.81	54.00	-37.19	100	55	12.13	4.68
7	#7206.00	47.57	74.00	-26.43	150	172	36.77	10.80
8	#7206.00	17.47	54.00	-36.53	150	172	6.67	10.80

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.
6. " # ": The radiated frequency is out of the restricted band.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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)	CORRECTION FACTOR (dB/m)
1	*2441.00	93.93			166	265	95.00	-1.07
2	*2441.00	63.83			166	265	64.90	-1.07
3	4882.00	50.59	74.00	-23.41	150	0	45.01	5.58
4	4882.00	20.49	54.00	-33.51	150	0	14.91	5.58
5	7323.00	54.15	74.00	-19.85	150	360	42.97	11.18
6	7323.00	24.05	74.00	-49.95	150	360	12.87	11.18
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)	CORRECTION FACTOR (dB/m)
1	*2441.00	99.16			100	284	100.23	-1.07
2	*2441.00	69.06			100	284	70.13	-1.07
3	4882.00	21.84	74.00	-52.16	150	360	16.26	5.58
4	4882.00	51.94	74.00	-22.06	150	360	46.36	5.58
5	7323.00	23.89	74.00	-50.11	150	0	12.71	11.18
6	7323.00	53.99	74.00	-20.01	150	0	42.81	11.18

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 78	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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)	CORRECTION FACTOR (dB/m)
1	*2480.00	95.10			118	262	96.06	-0.96
2	*2480.00	65.00			118	262	65.96	-0.96
3	2483.50	39.84	74.00	-34.16	118	262	40.79	-0.95
4	2483.50	9.74	54.00	-44.26	118	262	10.69	-0.95
5	4960.00	49.68	74.00	-24.32	150	0	44.29	5.39
6	4960.00	19.58	54.00	-34.42	150	0	14.19	5.39
7	7440.00	54.62	74.00	-19.38	150	360	43.06	11.56
8	7440.00	24.52	54.00	-29.48	150	360	12.96	11.56
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)	CORRECTION FACTOR (dB/m)
1	*2480.00	98.26			178	283	99.22	-0.96
2	*2480.00	68.16			178	283	69.12	-0.96
3	2483.50	41.44	74.00	-32.56	178	283	42.39	-0.95
4	2483.50	11.34	54.00	-42.66	178	283	12.29	-0.95
5	4960.00	51.68	74.00	-22.32	150	360	46.29	5.39
6	4960.00	21.58	54.00	-32.42	150	360	16.19	5.39
7	7440.00	54.66	74.00	-19.34	150	0	43.10	11.56
8	7440.00	24.56	54.00	-29.44	150	0	13.00	11.56

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.
5. " * ": Fundamental frequency.



BT_8DPSK

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

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)	CORRECTION FACTOR (dB/m)
1	2390.00	37.80	74.00	-36.20	149	239	39.00	-1.20
2	2390.00	7.70	54.00	-46.30	149	239	8.90	-1.20
3	*2402.00	89.82			149	239	91.00	-1.18
4	*2402.00	59.72			149	239	60.90	-1.18
5	4804.00	49.39	74.00	-24.61	150	0	44.71	4.68
6	4804.00	19.29	54.00	-34.71	150	0	14.61	4.68
7	#7206.00	53.04	74.00	-20.96	150	360	42.24	10.80
8	#7206.00	22.94	54.00	-31.06	150	360	12.14	10.80
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)	CORRECTION FACTOR (dB/m)
1	2390.00	37.84	74.00	-36.16	100	286	39.04	-1.20
2	2390.00	7.74	54.00	-46.26	100	286	8.94	-1.20
3	*2402.00	94.76			100	286	95.94	-1.18
4	*2402.00	64.66			100	286	65.84	-1.18
5	4804.00	48.87	74.00	-25.13	150	0	44.19	4.68
6	4804.00	18.77	54.00	-35.23	150	0	14.09	4.68
7	#7206.00	53.22	74.00	-20.78	150	360	42.42	10.80
8	#7206.00	23.12	54.00	-30.88	150	360	12.32	10.80

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.
6. " # ": The radiated frequency is out of the restricted band.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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)	CORRECTION FACTOR (dB/m)
1	*2441.00	90.35			162	265	91.42	-1.07
2	*2441.00	60.25			162	265	61.32	-1.07
3	4882.00	49.24	74.00	-24.76	150	360	43.66	5.58
4	4882.00	19.14	54.00	-34.86	150	360	13.56	5.58
5	7323.00	53.16	74.00	-20.84	150	0	41.98	11.18
6	7323.00	23.06	54.00	-30.94	150	0	11.88	11.18
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)	CORRECTION FACTOR (dB/m)
1	*2441.00	95.17			100	273	96.24	-1.07
2	*2441.00	65.07			100	273	66.14	-1.07
3	4882.00	49.08	74.00	-24.92	150	360	43.50	5.58
4	4882.00	18.98	54.00	-35.02	150	360	13.40	5.58
5	7323.00	53.36	74.00	-20.64	150	0	42.18	11.18
6	7323.00	23.26	54.00	-30.74	150	0	12.08	11.18

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 78	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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)	CORRECTION FACTOR (dB/m)
1	*2480.00	94.26			118	263	95.22	-0.96
2	*2480.00	64.16			118	263	65.12	-0.96
3	2483.50	38.53	74.00	-35.47	118	263	39.48	-0.95
4	2483.50	8.43	54.00	-45.57	118	263	9.38	-0.95
5	4960.00	48.87	74.00	-25.13	150	360	43.48	5.39
6	4960.00	18.77	54.00	-35.23	150	360	13.38	5.39
7	7440.00	53.75	74.00	-20.25	150	0	42.19	11.56
8	7440.00	23.65	54.00	-30.35	150	360	12.09	11.56
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)	CORRECTION FACTOR (dB/m)
1	*2480.00	97.75			137	282	98.71	-0.96
2	*2480.00	67.65			137	282	68.61	-0.96
3	2483.50	42.46	74.00	-31.54	137	282	43.41	-0.95
4	2483.50	12.36	54.00	-41.64	137	282	13.31	-0.95
5	4960.00	49.55	74.00	-24.45	150	0	44.16	5.39
6	4960.00	19.45	54.00	-34.55	150	0	14.06	5.39
7	7440.00	53.89	74.00	-20.11	150	360	42.33	11.56
8	7440.00	23.79	54.00	-30.21	150	360	12.23	11.56

REMARKS:

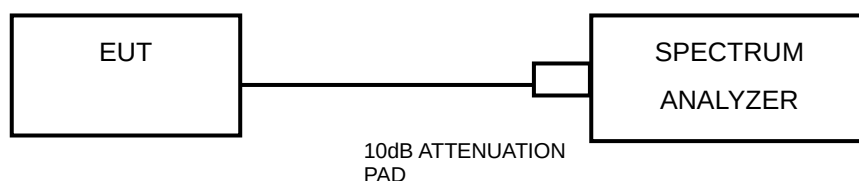
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental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

4.2 NUMBER OF HOPPING FREQUENCY USED

4.2.1 LIMIT OF HOPPING FREQUENCY USED

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

4.2.2 TEST SETUP



4.2.3 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.

4.2.4 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 MaxHold 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.

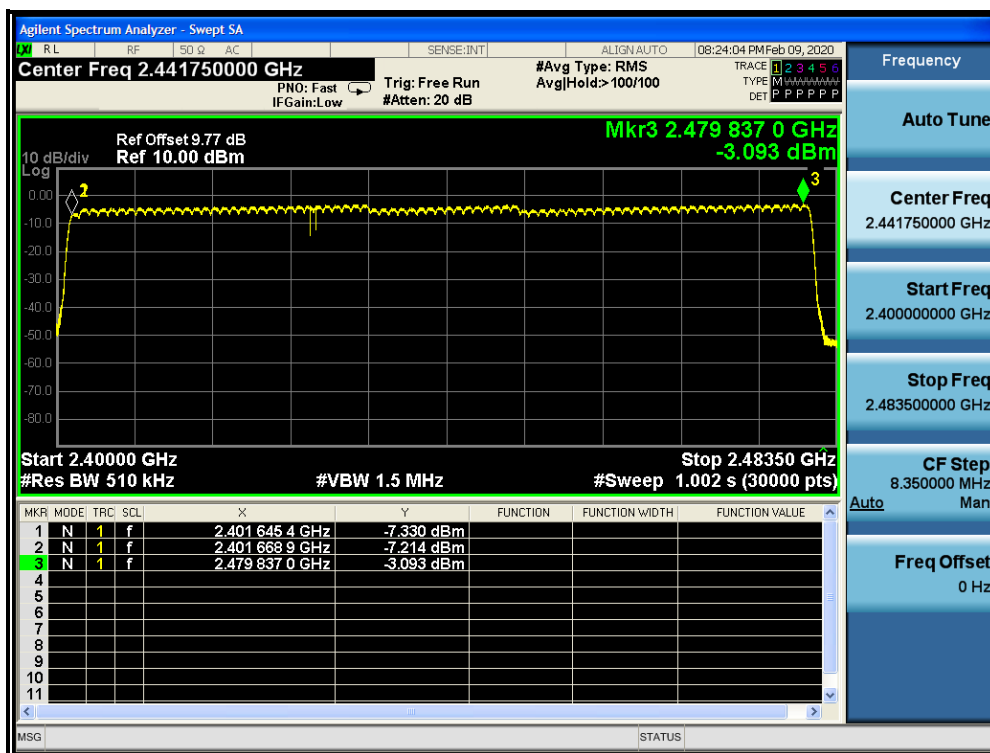
4.2.5 DEVIATION FROM TEST STANDARD

No deviation.

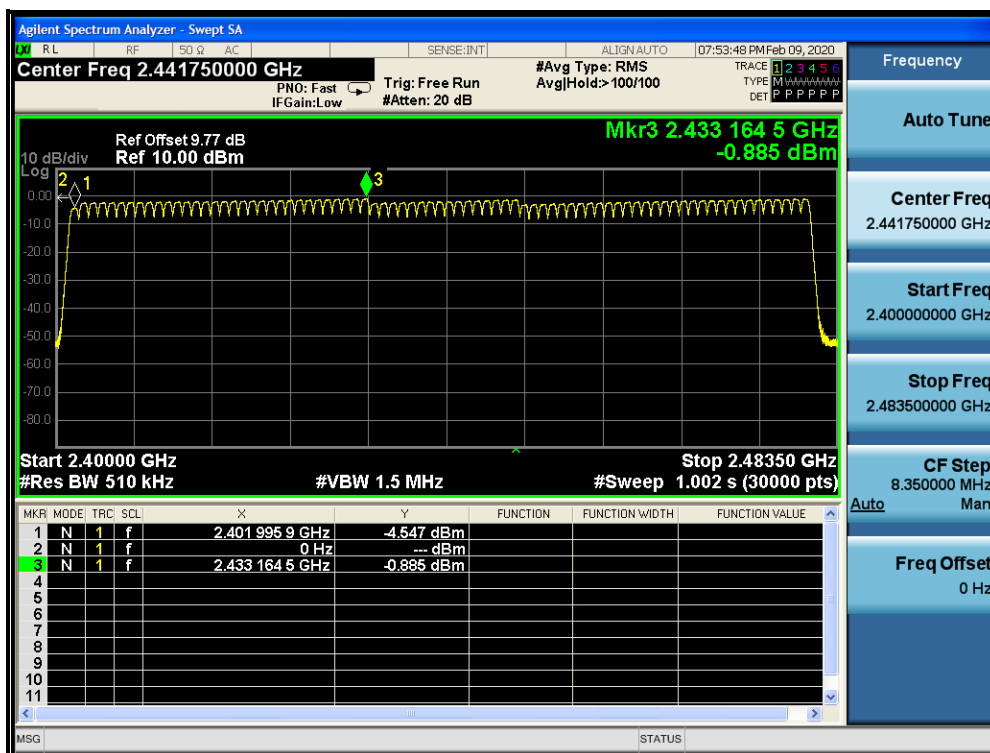
4.2.6 TEST RESULTS

There are 79 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.

GFSK



8DPSK

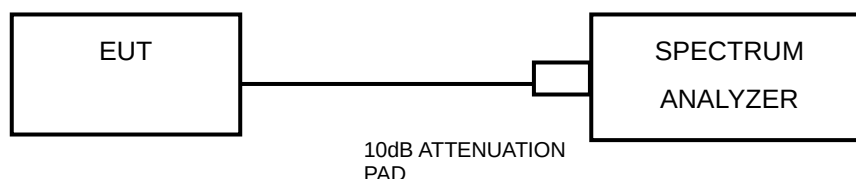


4.3 DWELL TIME ON EACH CHANNEL

4.3.1 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.

4.3.2 TEST SETUP



4.3.3 TEST INSTRUMENTS

Refer to section 4.2.3 to get information of above instrument.

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. 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.
- d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- e. Repeat above procedures until all different time-slot modes have been completed.

4.3.5 DEVIATION FROM TEST STANDARD

No deviation.

4.3.6 TEST RESULTS

GFSK:

Accumulated Transmit Time								
Mode	Number of Hopping Channel	Number of transmission in a period (channel number*0.4 sec)			Length of transmission time (ms)	Result (ms)	Limit (ms)	Pass / Fail
		Sweep time (Sec)	Number in 3.16 Sec	Total Number in 31.6 Sec				
DH1	79	3.16	32	320	0.408	130.56	400	Pass
DH3	79	3.16	16	160	1.664	266.24	400	Pass
DH5	79	3.16	11	110	2.912	320.32	400	Pass

8DPSK:

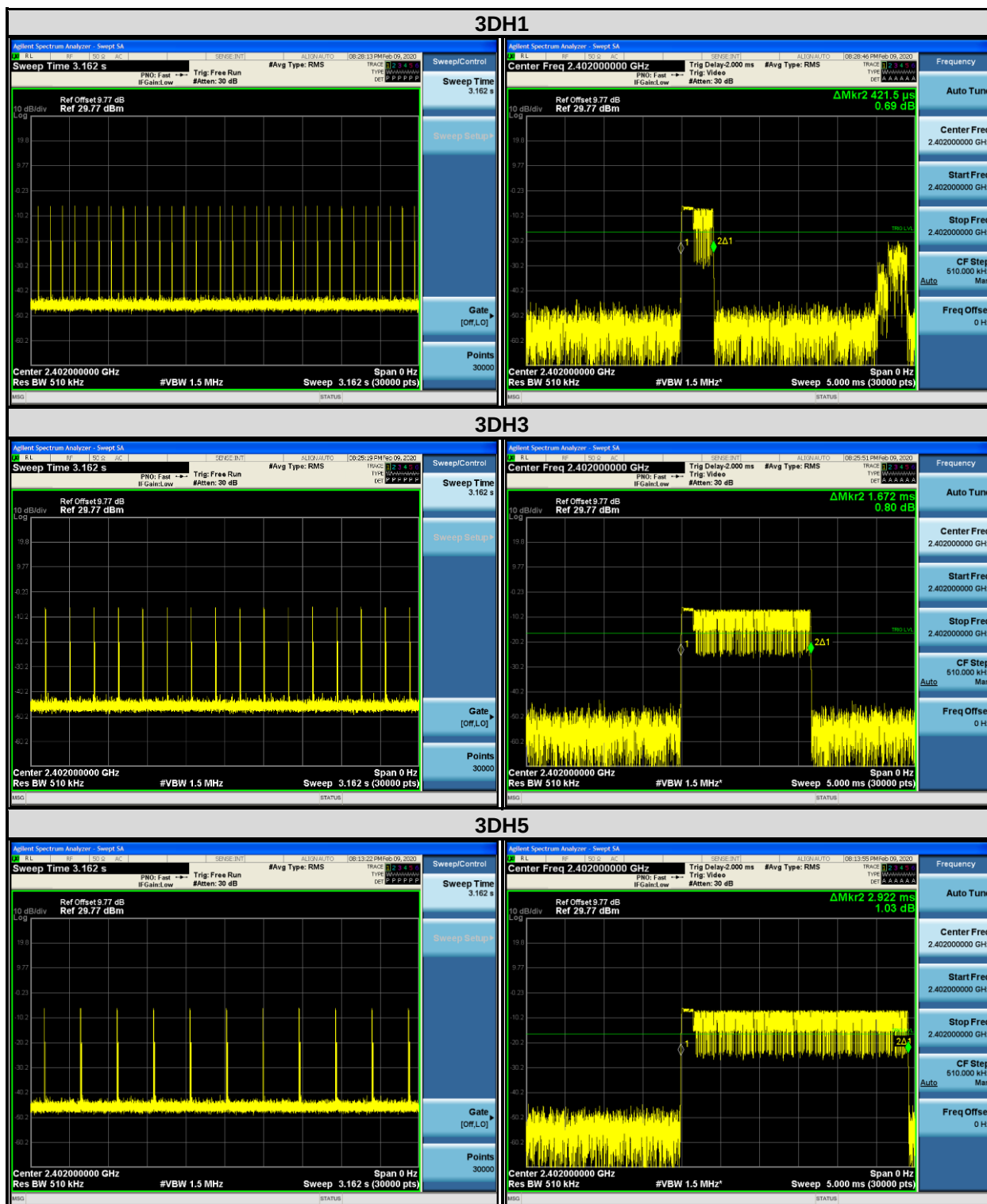
Accumulated Transmit Time								
Mode	Number of Hopping Channel	Number of transmission in a period (channel number*0.4 sec)			Length of transmission time (ms)	Result (ms)	Limit (ms)	Pass / Fail
		Sweep time (Sec)	Number in 3.16Sec	Total Number in 31.6 Sec				
3DH1	79	3.16	32	320	0.4215	134.88	400	Pass
3DH3	79	3.16	16	160	1.672	267.52	400	Pass
3DH5	79	3.16	11	110	2.922	321.42	400	Pass

NOTE: Test plots of the transmitting time slot are shown as below.

GFSK



8DPSK

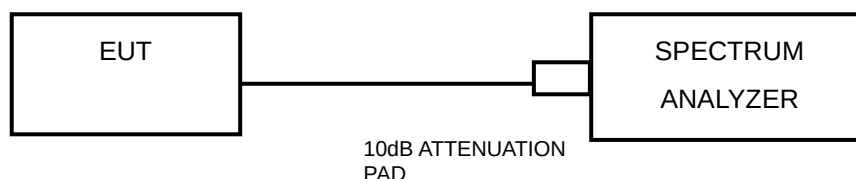


4.4 CHANNEL BANDWIDTH

4.4.1 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.

4.4.2 TEST SETUP



4.4.3 TEST INSTRUMENTS

Refer to section 4.2.3 to get information of above instrument.

4.4.4 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.

4.4.5 DEVIATION FROM TEST STANDARD

No deviation.

4.4.6 EUT OPERATING CONDITION

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

4.4.7 TEST RESULTS

GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
0	2402	1.113
39	2441	1.101
78	2480	1.089

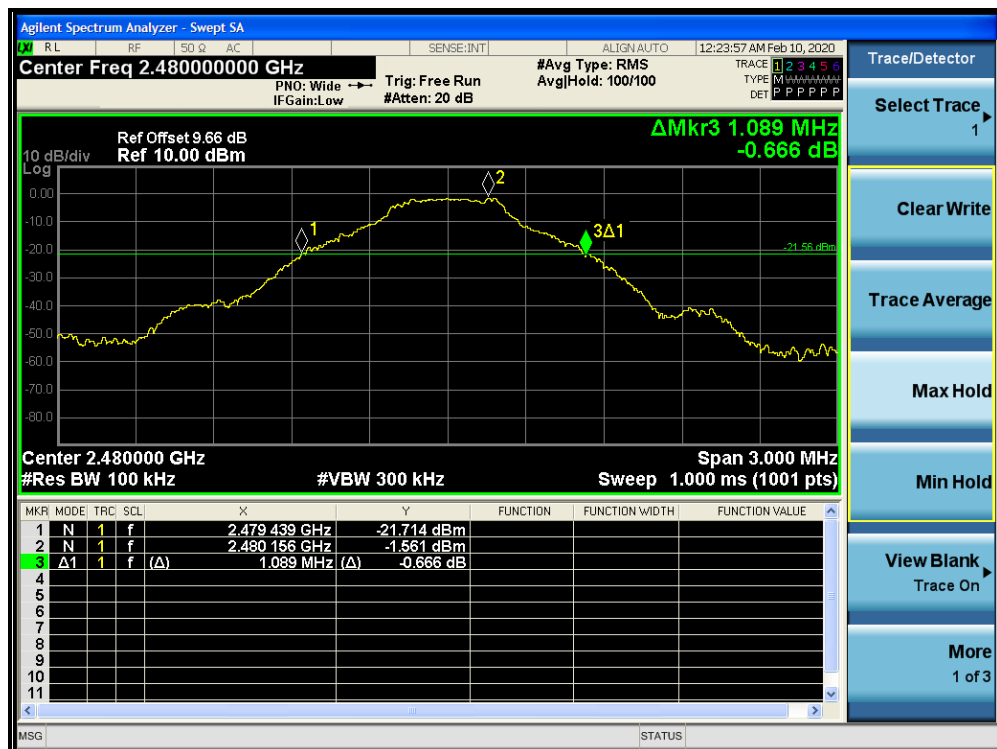
CH 0



CH 39



CH 78

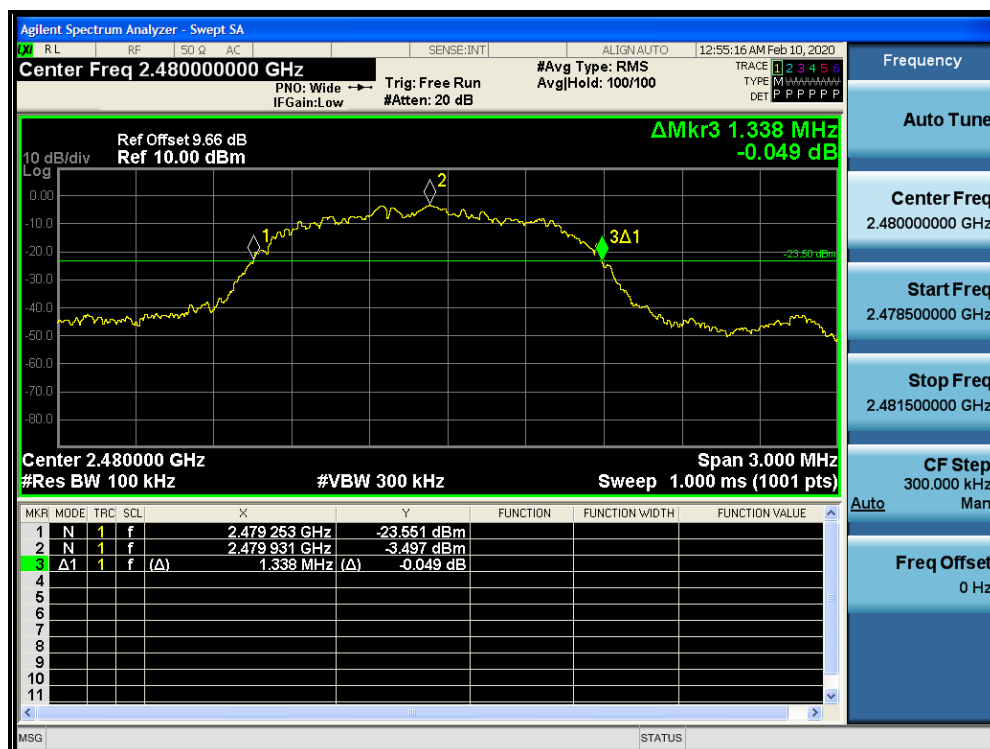


8DPSK

CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
0	2402	1.356
39	2441	1.350
78	2480	1.338

CH 0



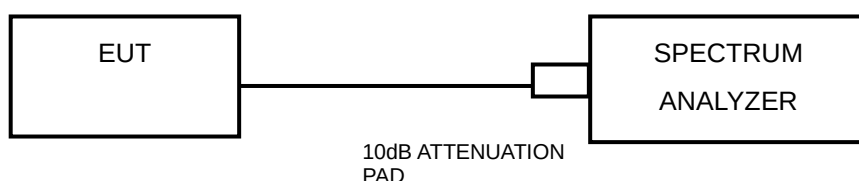


4.5 HOPPING CHANNEL SEPARATION

4.5.1 LIMIT OF HOPPING CHANNEL SEPARATION

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

4.5.2 TEST SETUP



4.5.3 TEST INSTRUMENTS

Refer to section 4.2.3 to get information of above instrument.

4.5.4 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.

4.5.5 DEVIATION FROM TEST STANDARD

No deviation.

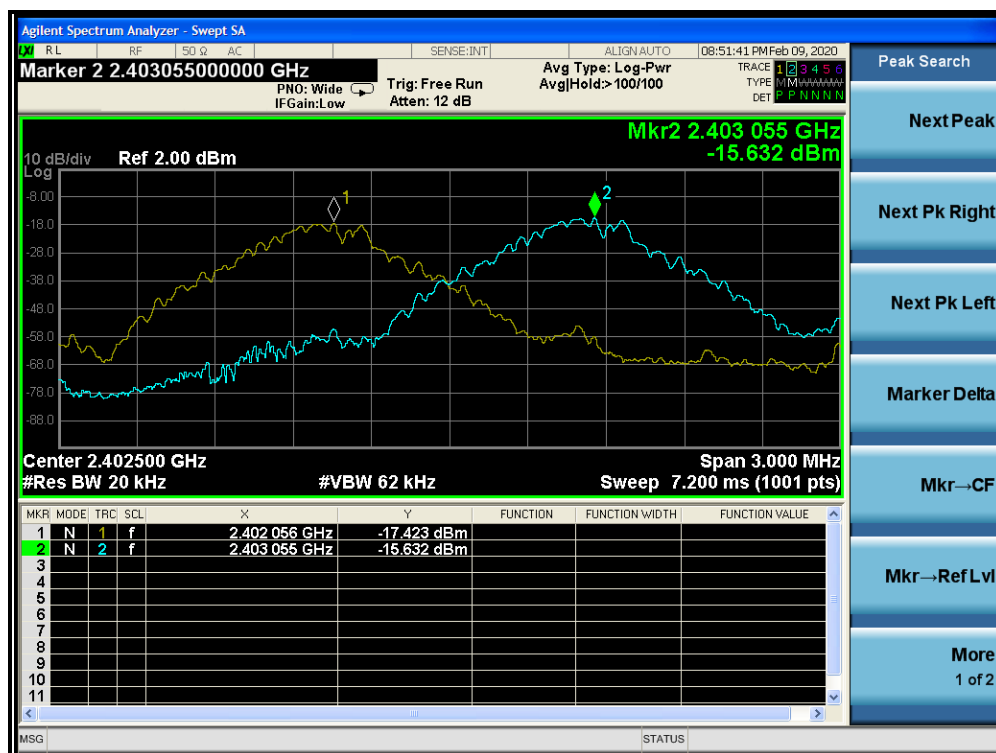
4.5.6 TEST RESULTS

GFSK

CHANNEL	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	20dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	0.999	1.113	0.742	PASS
39	2441	0.999	1.101	0.734	PASS
78	2480	0.999	1.089	0.726	PASS

NOTE: The minimum limit is two-third 20dB bandwidth.

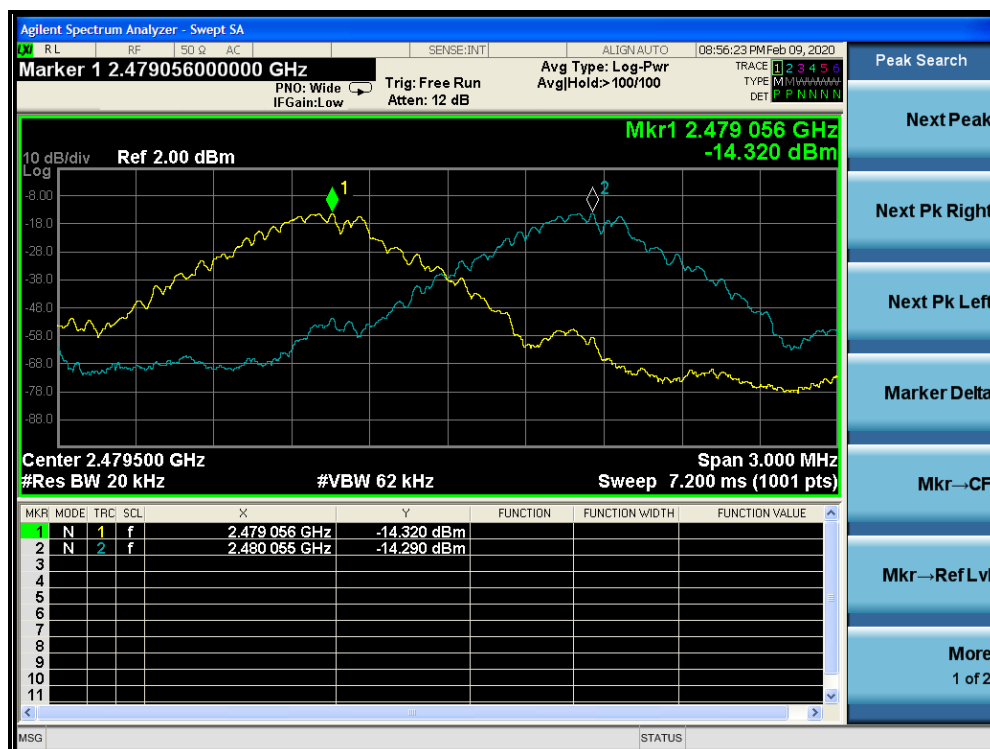
CH 0



CH 39



CH 78



8DPSK

CHANNEL	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	20dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	1.002	1.356	0.904	PASS
39	2441	1.005	1.350	0.900	PASS
78	2480	0.999	1.338	0.892	PASS

NOTE: The minimum limit is two-third 20dB bandwidth.

CH 0



CH 39



CH 78

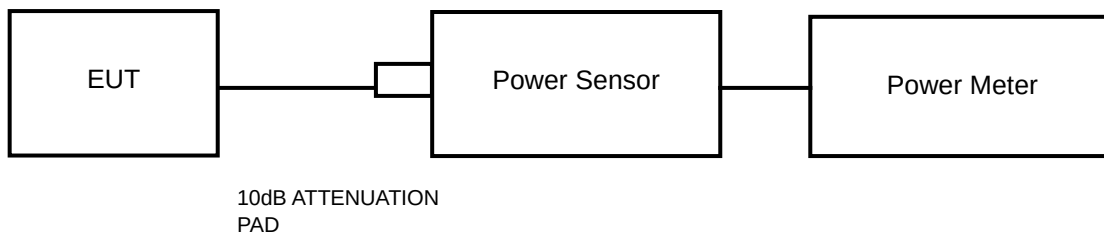


4.6 CONDUCTED OUTPUT POWER

4.6.1 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT

The Maximum Output Power Measurement is 125mW.

4.6.2 TEST SETUP



4.6.3 TEST INSTRUMENTS

Refer to section 4.2.3 to get information of above instrument.

4.6.4 TEST PROCEDURES

A average power sensor was used on the output port of the EUT. A average power meter was used to read the response of the average power sensor. Record the average power level.

4.6.5 DEVIATION FROM TEST STANDARD

No deviation.

4.6.6 EUT OPERATING CONDITION

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



4.6.7 TEST RESULTS

MAXIMUM AVERAGE OUTPUT POWER

GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)	AVERAGE POWER (mW)	AVERAGE POWER LIMIT (mW)	PASS/FAIL
0	2402	-4.80	0.331	125	PASS
39	2441	-2.11	0.615	125	PASS
78	2480	-1.11	0.774	125	PASS

8DPSK

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)	AVERAGE POWER (mW)	AVERAGE POWER LIMIT (mW)	PASS/FAIL
0	2402	-4.88	0.325	125	PASS
39	2441	-2.27	0.593	125	PASS
78	2480	-1.24	0.752	125	PASS

4.7 OUT OF BAND EMISSION MEASUREMENT

4.7.1 LIMITS OF OUT OF BAND EMISSION MEASUREMENT

Below -30dB of the highest emission level of operating band (in 100KHz RBW).

4.7.2 TEST INSTRUMENTS

Refer to section 4.2.3 to get information of above instrument.

4.7.3 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.

4.7.4 DEVIATION FROM TEST STANDARD

No deviation.

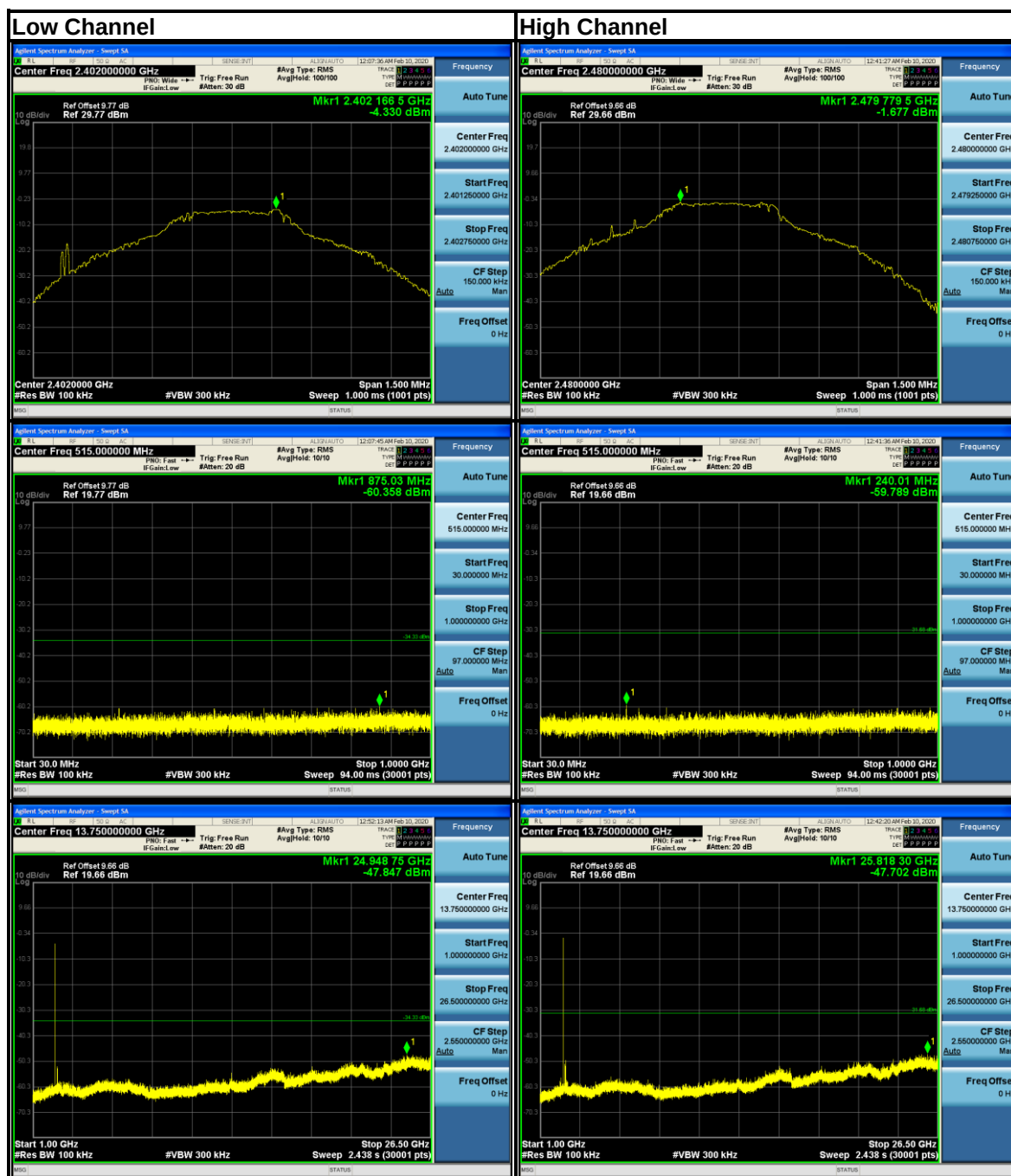
4.7.5 EUT OPERATING CONDITION

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

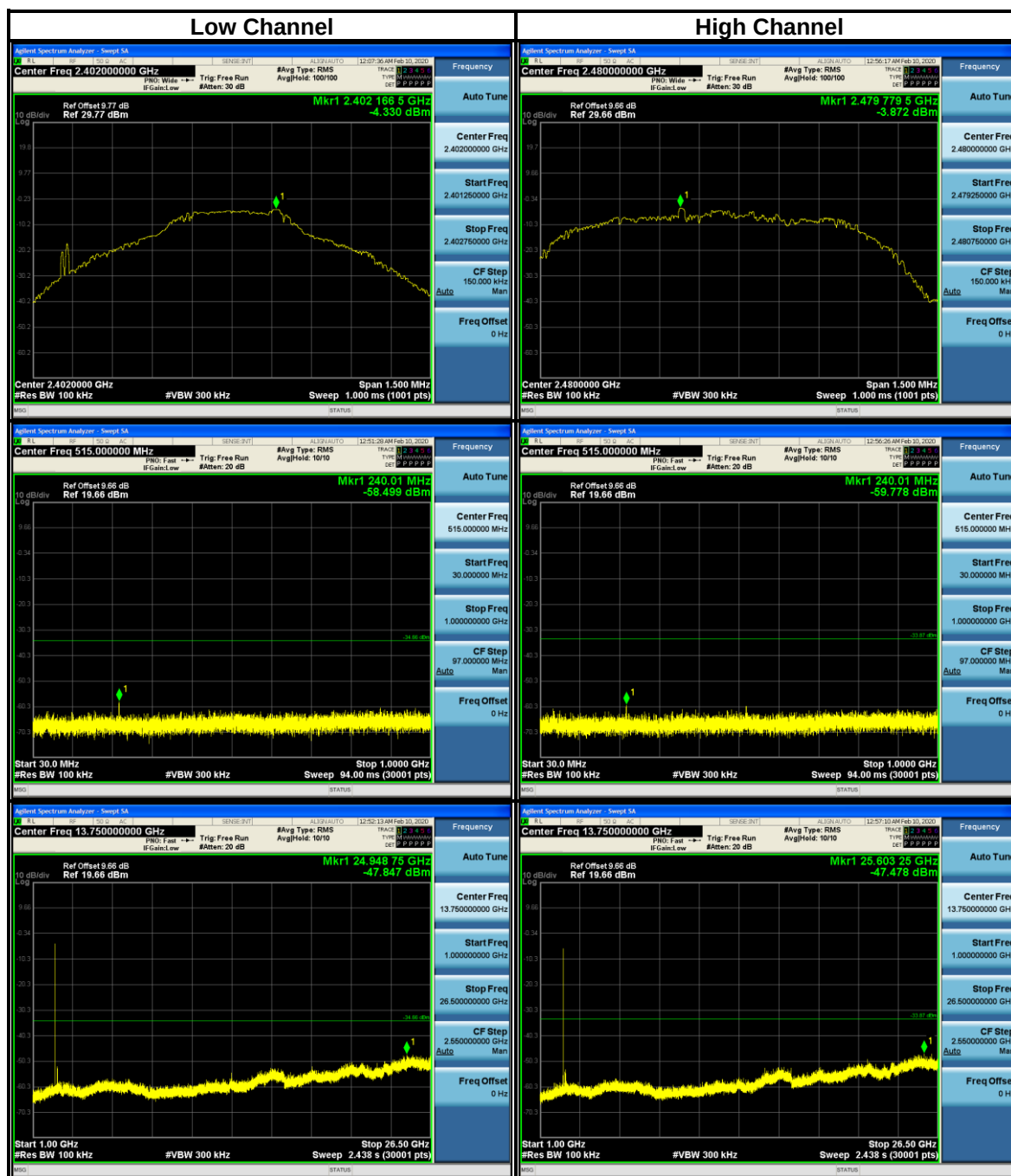
4.7.6 TEST RESULTS

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.

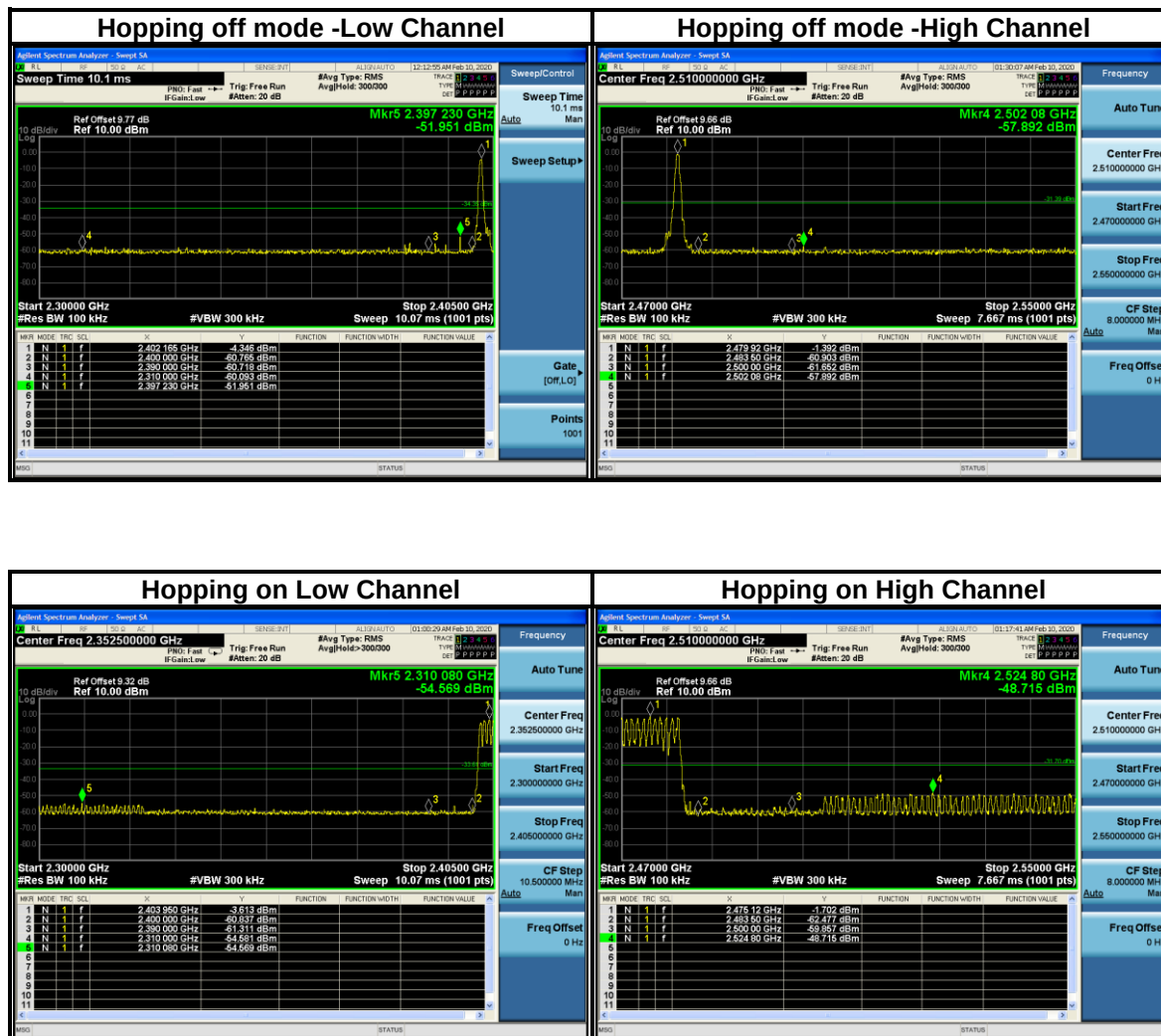
GFSK



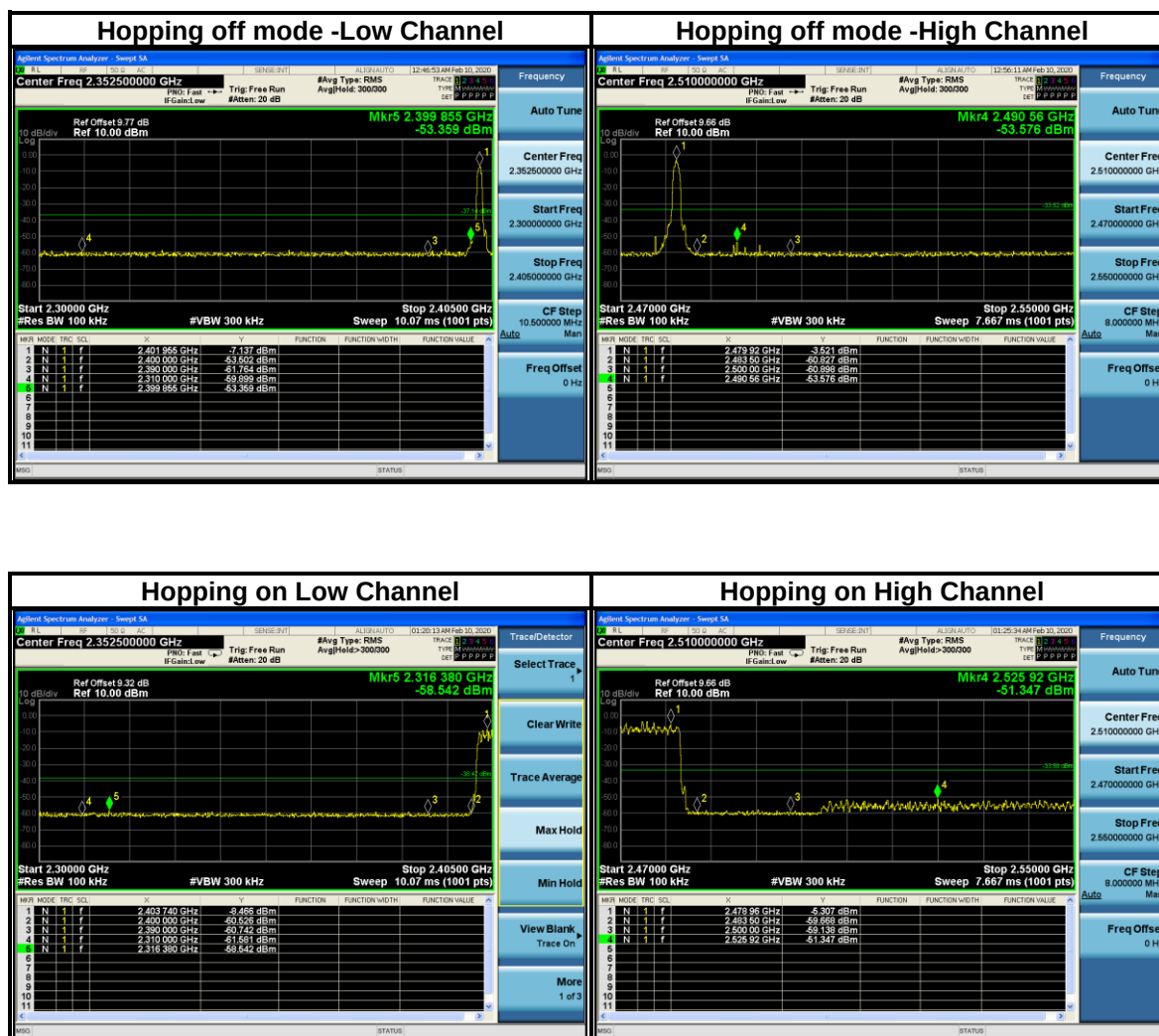
8DPSK



GFSK



8DPSK



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---