



Test Report No.: (8822)312-0040(A)

TEST REPORT

Applicant	Crossrope LLC
Address	1639 Green St Ste D Raleigh, NC, 27603 USA

Manufacturer or Supplier	Crossrope LLC
Address	1639 Green St Ste D Raleigh, NC, 27603 USA
Product	AMP HANDLE
Brand Name	N/A
Model	1.0 AMP HANDLE
Additional Model & Model Difference	N/A
Date of tests	Oct. 25, 2022 ~ Nov. 07, 2022

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

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

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

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Date: Nov. 07, 2022

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TABLE OF CONTENTS

RELEASE CONTROL RECORD	4
1 SUMMARY OF TEST RESULTS.....	5
2 MEASUREMENT UNCERTAINTY	5
3 GENERAL INFORMATION	6
3.1 GENERAL DESCRIPTION OF EUT.....	6
3.2 DESCRIPTION OF TEST MODES.....	7
3.2.1. CONFIGURATION OF SYSTEM UNDER TEST	7
3.2.2. TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL.....	7
3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS.....	9
3.4 DESCRIPTION OF SUPPORT UNITS.....	9
4 TEST TYPES AND RESULTS.....	10
4.1 RADIATED EMISSION MEASUREMENT	10
4.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT	10
4.1.2 TEST INSTRUMENTS.....	11
4.1.3 TEST PROCEDURES	12
4.1.4 DEVIATION FROM TEST STANDARD	13
4.1.5 TEST SETUP	13
4.1.6 EUT OPERATING CONDITIONS	14
4.1.7 TEST RESULTS	15
4.2 6DB BANDWIDTH MEASUREMENT.....	23
4.2.1 LIMITS OF 6DB BANDWIDTH MEASUREMENT	23
4.2.2 TEST INSTRUMENTS.....	23
4.2.3 TEST PROCEDURE.....	24
4.2.4 DEVIATION FROM TEST STANDARD	24
4.2.5 TEST SETUP.....	25
4.2.6 EUT OPERATING CONDITIONS	25
4.2.7 TEST RESULTS	26
4.3 CONDUCTED OUTPUT POWER	30
4.3.1 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT	30
4.3.2 TEST SETUP.....	30
4.3.3 TEST INSTRUMENTS.....	30
4.3.4 TEST PROCEDURES	31
4.3.5 DEVIATION FROM TEST STANDARD	31
4.3.6 EUT OPERATING CONDITIONS	31
4.3.7 TEST RESULTS	32



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VERITAS**

Test Report No.: (8822)312-0040(A)

4.3.7.1	MAXIMUM PEAK OUTPUT POWER	32
4.3.7.2	AVERAGE OUTPUT POWER (FOR REFERENCE)	33
4.4	POWER SPECTRAL DENSITY MEASUREMENT	34
4.4.1	LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT	34
4.4.2	TEST SETUP	34
4.4.3	TEST INSTRUMENTS	34
4.4.4	TEST PROCEDURE	34
4.4.5	DEVIATION FROM TEST STANDARD	34
4.4.6	EUT OPERATING CONDITION	34
4.4.7	TEST RESULTS	35
4.5	OUT OF BAND EMISSION MEASUREMENT	37
4.5.1	LIMITS OF OUT OF BAND EMISSION MEASUREMENT	37
4.5.2	TEST SETUP	37
4.5.3	TEST INSTRUMENTS	37
4.5.4	TEST PROCEDURE	37
4.5.5	DEVIATION FROM TEST STANDARD	38
4.5.6	EUT OPERATING CONDITION	38
4.5.7	TEST RESULTS	39
5	PHOTOGRAPHS OF THE TEST CONFIGURATION	43
6	APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB	44



Test Report No.: (8822)312-0040(A)

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
(8822)312-0040(A)	Original release	Nov. 07, 2022

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC PART 15, SUBPART C (SECTION 15.247)			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
15.207	AC Power Conducted Emission	N/A	Powered from battery
15.205 15.209	Radiated Emission	PASS	Meet the requirement of limit.
15.247(d)	Out of band Emission Measurement	PASS	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted Output power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	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	5.04dB
	30MHz ~ 1GMHz	5.04dB
	1GHz ~ 18GHz	5.23dB
	18GHz ~ 40GHz	5.23dB

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	AMP HANDLE
MODEL NO.	1.0 AMP HANDLE
ADDITIONAL MODELS	N/A
FCC ID	2A89Z-AMP-HANDLE
NOMINAL VOLTAGE	3.7VDC From Li-ion battery
MODULATION TECHNOLOGY	DTS
MODULATION TYPE	BT-LE GFSK(1, 2 Mbps)
OPERATING FREQUENCY	2402-2480MHz
PEAK OUTPUT POWER	0.317mW (Max. Measured)
ANTENNA TYPE	PCB Antenna, -0.58dBi 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.: (8822)312-0040) for detailed product photo.
4. When the EUT in the charging mode that RF function no working.

3.2 DESCRIPTION OF TEST MODES

40 channels are provided for BT-LE (1, 2 Mbps):

CHANNEL	FREQ. (MHZ)	CHANNEL	FREQ. (MHZ)	CHANNEL	FREQ. (MHZ)	CHANNEL	FREQ. (MHZ)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

3.2.1. CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photographs 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, power supply voltage range and antenna ports. The worst case was found when positioned on X axis for radiated emission. Following test modes were selected for the final test, and the final worst case is marked in boldface and recorded in the report:

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
A	√	√	-	√	Powered by Fully Battery with Bluetooth link

Where **RE<1G**: Radiated Emission below 1GHz **RE≥1G**: Radiated Emission above 1GHz
PLC: Power Line Conducted Emission **APCM**: Antenna Port Conducted Measurement

NOTE: No need to concern of Conducted Emission due to the EUT is powered by battery.

RADIATED EMISSION TEST (BELOW 1GHz):

- ☒ 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 (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
BT-LE	0 to 39	39	DTS	GFSK	1
BT-LE	0 to 39	39	DTS	GFSK	2

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

RADIATED EMISSION TEST (ABOVE 1GHz):

- ☒ 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 (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
BT-LE	0 to 39	0,19, 39	DTS	GFSK	1
BT-LE	0 to 39	0,19, 39	DTS	GFSK	2

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, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
BT-LE	0 to 39	0, 19, 39	DTS	GFSK	1
BT-LE	0 to 39	0, 19, 39	DTS	GFSK	2

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE	TESTED BY
RE<1G	25deg. C, 55%RH	Powered by Full Battery	Sean Yuan
RE≥1G	25deg. C, 55%RH	Powered by Full Battery	Sean Yuan
PLC	N/A	N/A	N/A
APCM	25deg. C, 60%RH	Powered by Full Battery	Sean Yuan

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

KDB558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2013

Note: 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 together without any other necessary accessories or support units.

4 TEST TYPES AND RESULTS

4.1 RADIATED EMISSION MEASUREMENT

4.1.1 LIMITS OF RADIATED EMISSION 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).

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

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 13, 2022	Mar. 13, 2023
Antenna	Schwarzbeck	VULB9162	9162-010	Mar. 23, 2022	Mar. 23, 2024
Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Keysight	N9020A	MY54200831	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Rohde & Schwarz	FSV40	101094	Mar. 13, 2022	Mar. 13, 2023
Horn Antenna	Schwarzbeck	BBHA9170	9170-172	Mar. 23, 2022	Mar. 23, 2024
Horn Antenna	COM-Power	AH-118	071078	Mar. 23, 2022	Mar. 23, 2024
Pre-Amplifier	HP	HP 8449B	3008A00964	Mar. 13, 2022	Mar. 13, 2023
Pre-Amplifier	HP	HP 8447D	1145A00203	Mar. 13, 2022	Mar. 13, 2023
Loop Antenna	Schwarzbeck	FMZB 1513	1513-272	Mar. 23, 2022	Mar. 23, 2023
Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 13, 2022	Mar. 13, 2023
L.I.S.N	Rohde & Schwarz	ENV 216	101317	Mar. 13, 2022	Mar. 13, 2023
Test Software	EZ	EZ_EMC	N/A	N/A	N/A

NOTE:

1. The test was performed at Dongguan NTC Co., Ltd.
2. The calibration interval of the above test instruments is 12 or 24 months and the calibrations are traceable to LISAI/CHINA.
3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Site Registration No. is 749762.

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:

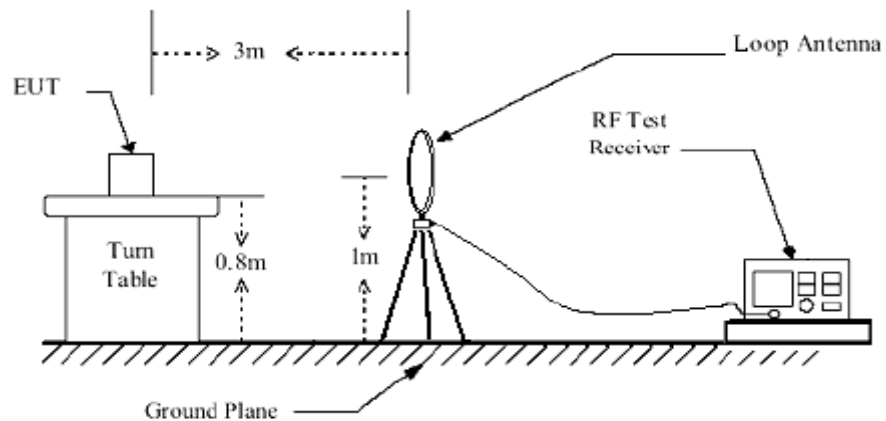
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution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

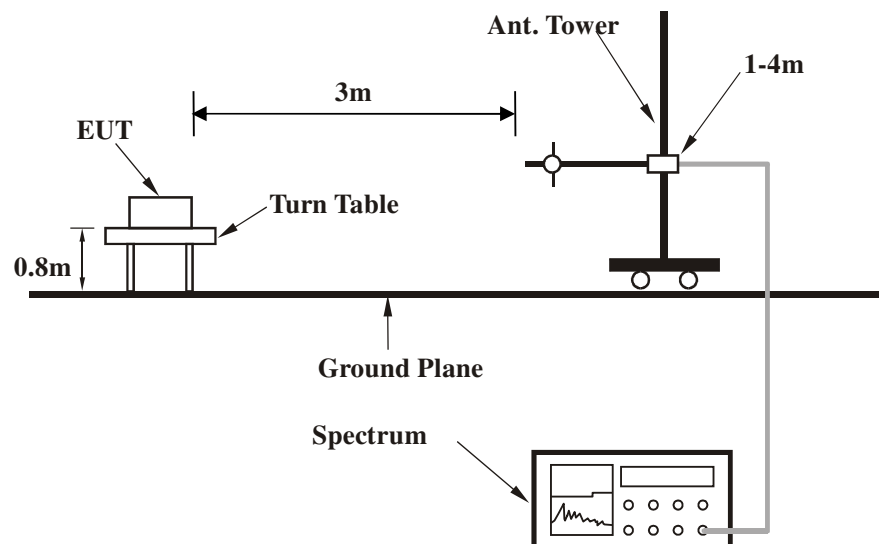
No deviation.

4.1.5 TEST SETUP

Below 30MHz test setup



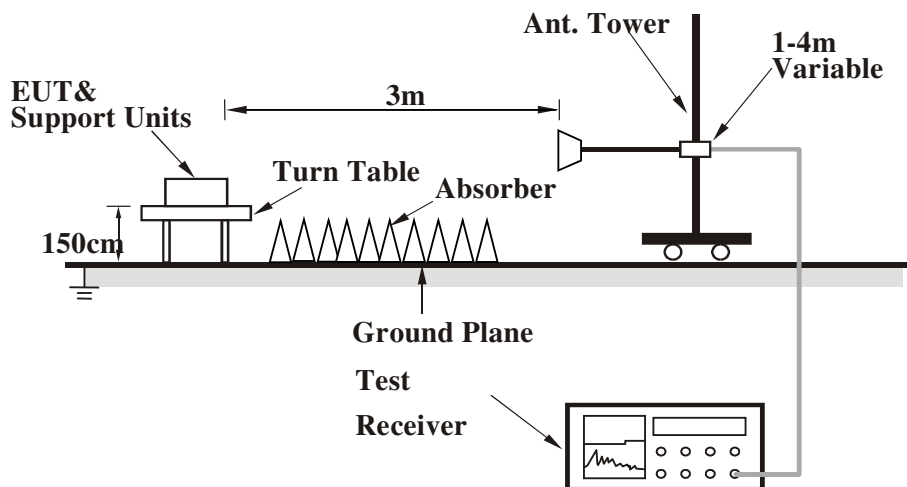
Below 1GHz test setup



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

BELOW 1GHz WORST-CASE DATA:

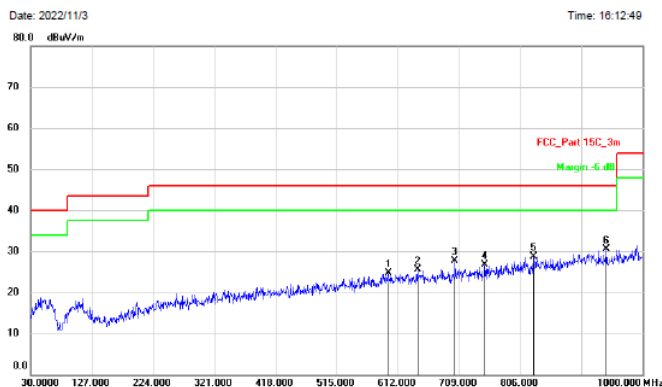
BT-LE GFSK (1Mbps)

CHANNEL	TX 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 (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	596.4800	24.63 QP	46.00	-21.37	2.00 V	137	24.05	0.58
2	643.0400	25.55 QP	46.00	-20.45	2.00 V	57	24.37	1.18
3	702.2100	27.69 QP	46.00	-18.31	2.00 V	175	25.48	2.21
4	749.7400	26.69 QP	46.00	-19.31	2.00 V	156	23.66	3.03
5	827.3400	28.72 QP	46.00	-17.28	2.00 V	195	24.29	4.43
6	942.7700	30.44 QP	46.00	-15.56	2.00 V	147	24.19	6.25

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 greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value

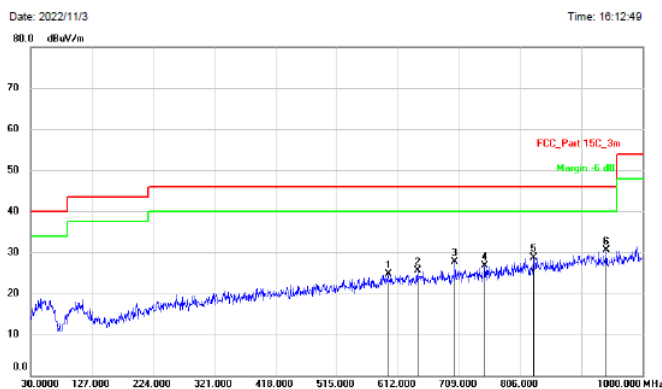


CHANNEL	TX Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	699.3000	27.44 QP	46.00	-18.56	2.00 V	137	25.29	2.15
2	741.0100	27.07 QP	46.00	-18.93	2.00 V	57	24.19	2.88
3	805.0300	28.09 QP	46.00	-17.91	2.00 V	175	24.04	4.05
4	839.9500	29.04 QP	46.00	-16.96	2.00 V	156	24.41	4.63
5	900.0900	29.68 QP	46.00	-16.32	2.00 V	195	24.72	4.96
6	945.6800	29.13 QP	46.00	-16.87	2.00 V	147	24.07	5.06

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 greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value



ABOVE 1GHz TEST DATA:

BT-LE GFSK (1Mbps)

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 (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	48.35 PK	74.00	-25.65	1.98 H	154	51.55	-3.20
2	2390.00	33.12 AV	54.00	-20.88	1.98 H	154	36.32	-3.20
3	*2402.00	89.80 PK			1.92 H	173	92.97	-3.17
4	*2402.00	51.23 AV			1.92 H	173	54.40	-3.17
5	4804.00	48.36 PK	74.00	-25.64	1.32 H	96	44.80	3.56
6	4804.00	41.25 AV	54.00	-12.75	1.32 H	96	37.69	3.56
7	#7206.00	52.96 PK	74.00	-21.04	1.90 H	53	42.52	10.44
8	#7206.00	41.89 AV	54.00	-12.11	1.90 H	53	31.45	10.44
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	50.85 PK	74.00	-23.15	2.21 V	135	54.05	-3.20
2	2390.00	33.45 AV	54.00	-20.55	2.21 V	135	36.65	-3.20
3	*2402.00	91.33 PK			2.48 V	131	94.50	-3.17
4	*2402.00	53.45 AV			2.48 V	131	56.62	-3.17
5	4804.00	48.63 PK	74.00	-25.37	1.32 V	258	45.07	3.56
6	4804.00	37.05 AV	54.00	-16.95	1.32 V	258	33.49	3.56
7	#7206.00	51.63 PK	74.00	-22.37	1.00 V	25	41.19	10.44
8	#7206.00	40.96 AV	54.00	-13.04	1.00 V	25	30.52	10.44

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 greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

CHANNEL	TX Channel 19	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 (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	91.22 PK			1.42 H	193	94.30	-3.08
2	*2440.00	51.24 AV			1.42 H	193	54.32	-3.08
3	4880.00	48.96 PK	74.00	-25.04	1.15 H	218	44.96	4.00
4	4880.00	37.22 AV	54.00	-16.78	1.15 H	218	33.22	4.00
5	7320.00	52.57 PK	74.00	-21.43	1.58 H	38	42.02	10.55
6	7320.00	41.89 AV	54.00	-12.11	1.58 H	38	31.34	10.55
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	93.44PK			1.30 V	219	96.52	-3.08
2	*2440.00	53.14 AV			1.30 V	219	56.22	-3.08
3	4880.00	48.63 PK	74.00	-25.37	1.10 V	224	44.63	4.00
4	4880.00	37.01 AV	54.00	-16.99	1.10 V	224	33.01	4.00
5	7320.00	52.48 PK	74.00	-21.52	1.13 V	28	41.93	10.55
6	7320.00	41.85 AV	54.00	-12.15	1.13 V	28	31.30	10.55

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 greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

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 (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	88.77 PK			1.30 H	163	91.79	-3.02
2	*2480.00	49.35 AV			1.30 H	163	52.37	-3.02
3	2483.50	49.63 PK	74.00	-24.37	1.10 H	128	52.65	-3.02
4	2483.50	34.62 AV	54.00	-19.38	1.10 H	128	37.64	-3.02
5	4960.00	48.25 PK	74.00	-25.75	1.00 H	152	44.24	4.01
6	4960.00	37.15 AV	54.00	-16.85	1.00 H	152	33.14	4.01
7	7440.00	53.55 PK	74.00	-20.45	1.68 H	29	42.95	10.60
8	7440.00	41.85 AV	54.00	-12.15	1.68 H	29	31.25	10.60
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	91.25PK			1.53 V	183	94.27	-3.02
2	*2480.00	53.40 AV			1.53 V	183	56.42	-3.02
3	2483.50	47.63 PK	74.00	-26.37	1.25 V	133	50.62	-3.02
4	2483.50	32.41 AV	54.00	-21.59	1.25 V	133	35.43	-3.02
5	4960.00	48.63 PK	74.00	-25.37	1.00 V	13	44.62	4.01
6	4960.00	37.01 AV	54.00	-16.99	1.00 V	13	33.00	4.01
7	7440.00	52.08 PK	74.00	-21.92	1.20 V	84	41.48	10.60
8	7440.00	41.58 AV	54.00	-12.42	1.20 V	84	30.98	10.60

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 greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

BT-LE GFSK (2Mbps)

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 (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	48.67 PK	74.00	-25.33	1.87 H	149	51.87	-3.20
2	2390.00	33.20 AV	54.00	-20.80	1.87 H	149	36.40	-3.20
3	*2402.00	88.46 PK			1.79 H	171	91.63	-3.17
4	*2402.00	50.34 AV			1.79 H	171	53.51	-3.17
5	4804.00	48.82 PK	74.00	-25.18	1.42 H	103	45.26	3.56
6	4804.00	41.56 AV	54.00	-12.44	1.42 H	103	38.00	3.56
7	#7206.00	53.73 PK	74.00	-20.27	1.84 H	63	43.29	10.44
8	#7206.00	42.39 AV	54.00	-11.61	1.84 H	63	31.95	10.44
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	51.02 PK	74.00	-22.98	2.11 V	131	54.22	-3.20
2	2390.00	33.87 AV	54.00	-20.13	2.11 V	131	37.07	-3.20
3	*2402.00	92.44 PK			2.39 V	127	95.61	-3.17
4	*2402.00	53.76 AV			2.39 V	127	56.93	-3.17
5	4804.00	48.87 PK	74.00	-25.13	1.22 V	241	45.31	3.56
6	4804.00	36.98 AV	54.00	-17.02	1.22 V	241	33.42	3.56
7	#7206.00	52.58 PK	74.00	-21.42	1.00 V	19	42.14	10.44
8	#7206.00	41.56 AV	54.00	-12.44	1.00 V	19	31.12	10.44

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 greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

CHANNEL	TX Channel 19	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 (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	90.37 PK			1.45 H	198	93.45	-3.08
2	*2440.00	53.12 AV			1.45 H	198	56.20	-3.08
3	4880.00	49.48 PK	74.00	-24.52	1.10 H	213	45.48	4.00
4	4880.00	37.38 AV	54.00	-16.62	1.10 H	213	33.38	4.00
5	7320.00	53.16 PK	74.00	-20.84	1.53 H	35	42.66	10.55
6	7320.00	42.04 AV	54.00	-11.96	1.53 H	35	31.49	10.55
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	92.15PK			1.38 V	232	95.23	-3.08
2	*2440.00	52.46 AV			1.38 V	232	55.54	-3.08
3	4880.00	48.81 PK	74.00	-25.19	1.10 V	211	44.81	4.00
4	4880.00	37.24 AV	54.00	-16.76	1.10 V	211	33.24	4.00
5	7320.00	53.02 PK	74.00	-20.98	1.20 V	62	42.47	10.55
6	7320.00	42.05 AV	54.00	-11.95	1.20 V	62	31.50	10.55

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 greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

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 (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	89.36 PK			1.20 H	169	92.38	-3.02
2	*2480.00	52.48 AV			1.20 H	169	55.50	-3.02
3	2483.50	49.95 PK	74.00	-24.05	1.00 H	124	52.97	-3.02
4	2483.50	34.64 AV	54.00	-19.36	1.00 H	124	37.66	-3.02
5	4960.00	48.70 PK	74.00	-25.30	1.00 H	150	44.69	4.01
6	4960.00	37.57 AV	54.00	-16.43	1.00 H	1502	33.56	4.01
7	7440.00	53.89 PK	74.00	-20.11	1.53 H	53	43.29	10.60
8	7440.00	42.09 AV	54.00	-11.91	1.53 H	53	41.49	10.60
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	91.33 PK			1.52 V	181	94.35	-3.02
2	*2480.00	52.47 AV			1.52 V	181	55.49	-3.02
3	2483.50	47.86 PK	74.00	-26.14	1.28 V	135	50.88	-3.02
4	2483.50	33.08 AV	54.00	-20.92	1.28 V	135	36.10	-3.02
5	4960.00	49.03 PK	74.00	-24.97	1.00 V	23	45.02	4.01
6	4960.00	37.26 AV	54.00	-16.74	1.00 V	23	33.25	4.01
7	7440.00	53.02 PK	74.00	-20.98	1.30 V	82	42.42	10.60
8	7440.00	42.10 AV	54.00	-11.90	1.30 V	82	31.50	10.60

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 greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

4.2 6dB BANDWIDTH MEASUREMENT

4.2.1 LIMITS OF 6dB BANDWIDTH MEASUREMENT

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Keysight	N9020A	MY54200831	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Rohde & Schwarz	FSV40	101094	Mar. 13, 2022	Mar. 13, 2023
Power Sensor	DARE	RPR3006W	15I00041SNO64	Mar. 13, 2022	Mar. 13, 2023
Power Meter	Agilent	E4419B	GB40201469	Mar. 13, 2022	Mar. 13, 2023
Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 13, 2022	Mar. 13, 2023
RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	Mar.13, 2022	Mar.13, 2023
Temporary antenna connector	TESCOM	SS402	N/A	N/A	N/A
Test Software	EZ	EZ_EMC	N/A	N/A	N/A

NOTE:

1. The test was performed at Dongguan NTC Co., Ltd.
2. The calibration interval of the above test instruments is 12 or 24 months and the calibrations are traceable to LISAI/CHINA.



**BUREAU
VERITAS**

Test Report No.: (8822)312-0040(A)

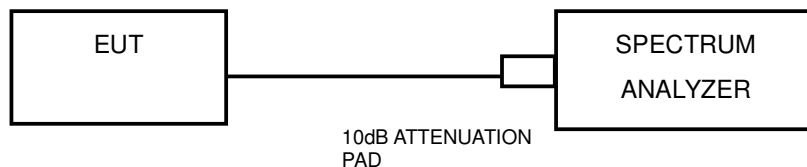
4.2.3 TEST PROCEDURE

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

4.2.4 DEVIATION FROM TEST STANDARD

No deviation.

4.2.5 TEST SETUP



4.2.6 EUT OPERATING CONDITIONS

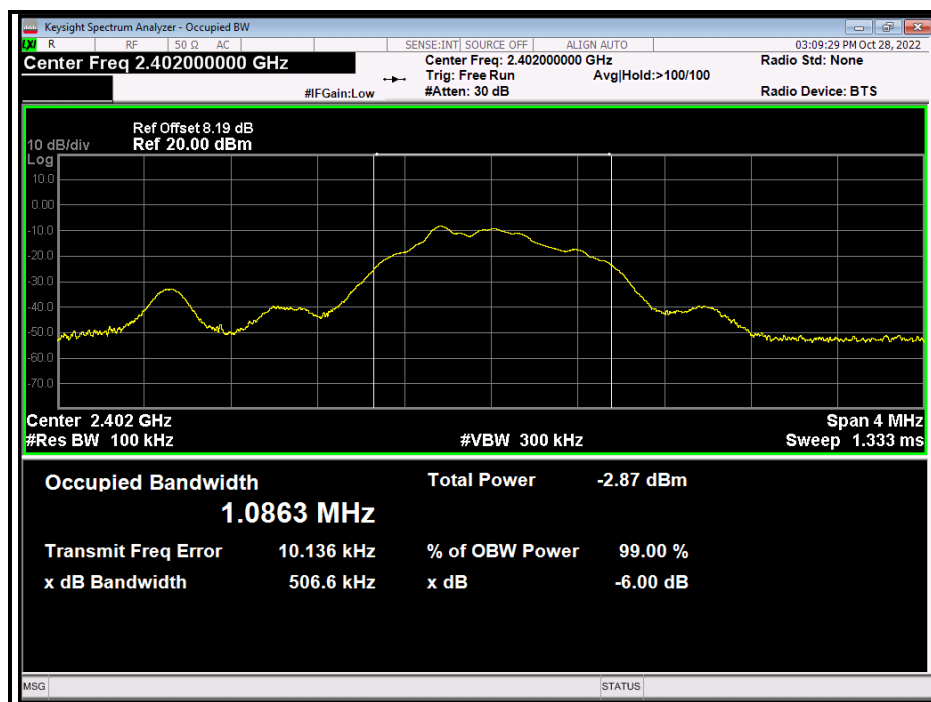
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.2.7 TEST RESULTS

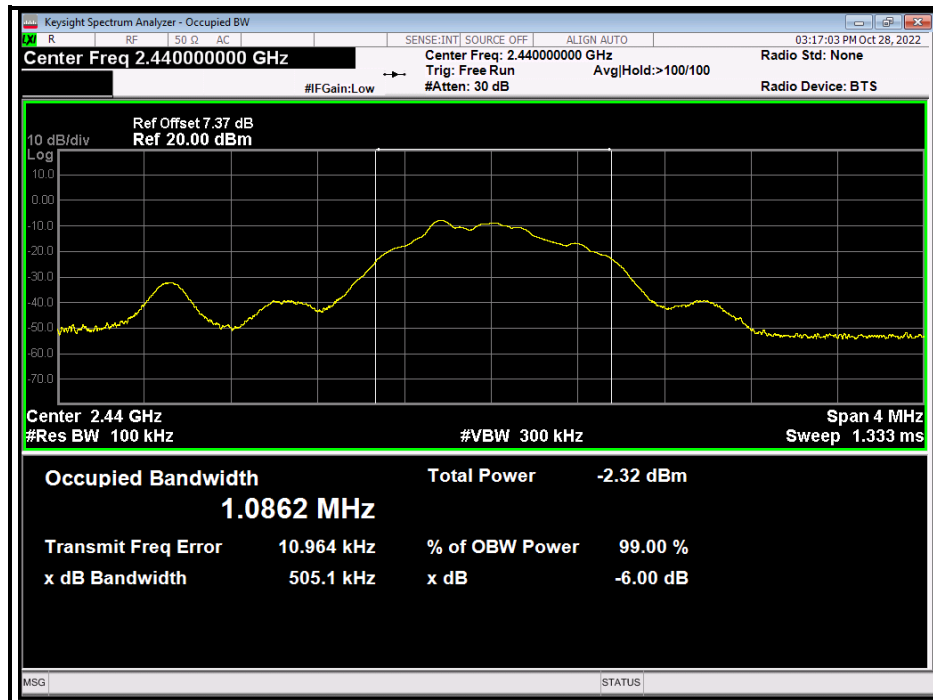
BT-LE GFSK (1Mbps)

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	0.5066	0.5	PASS
19	2440	0.5051	0.5	PASS
39	2480	0.5047	0.5	PASS

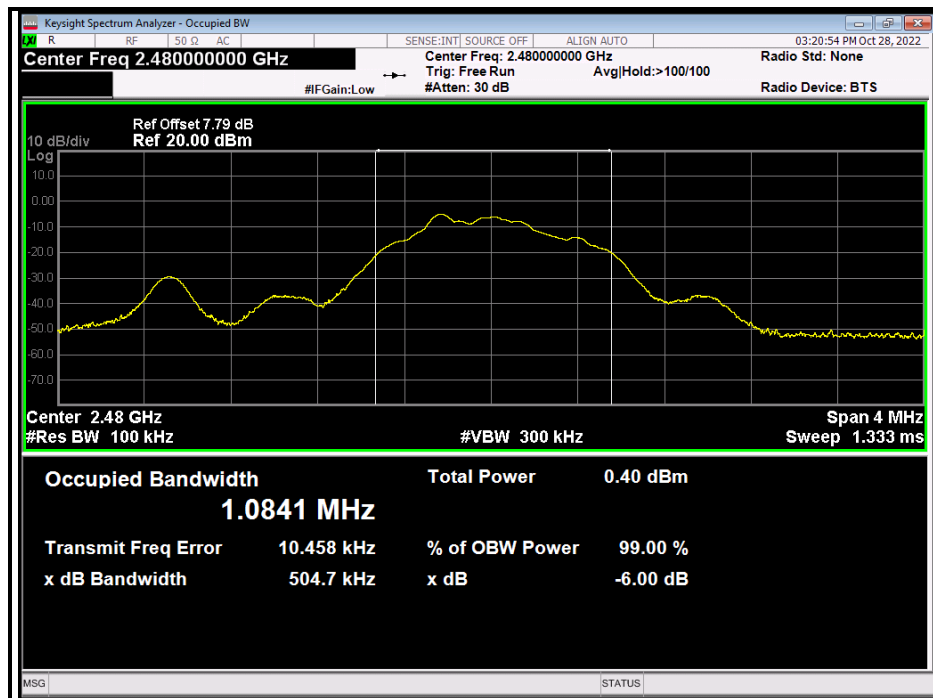
CH 0



CH 19



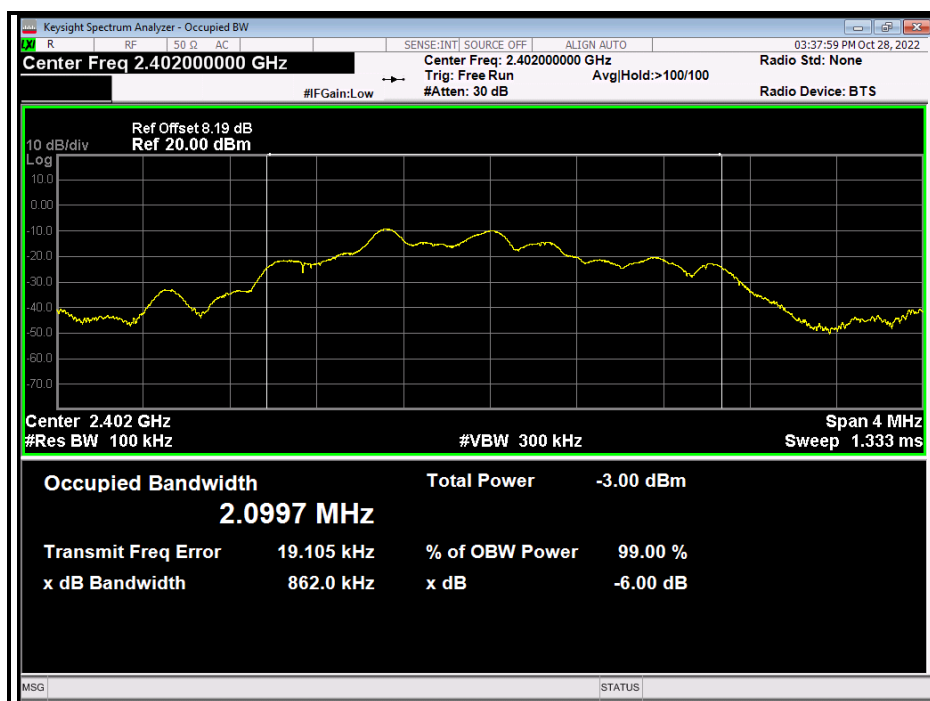
CH 39



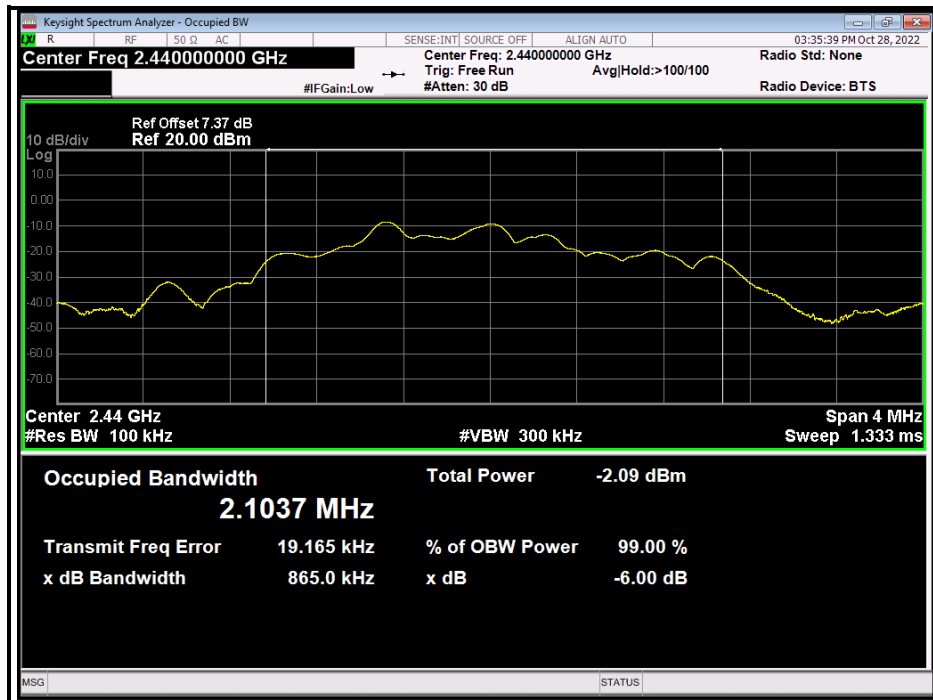
BT-LE GFSK (2Mbps)

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	0.8620	0.5	PASS
19	2440	0.8650	0.5	PASS
39	2480	0.8658	0.5	PASS

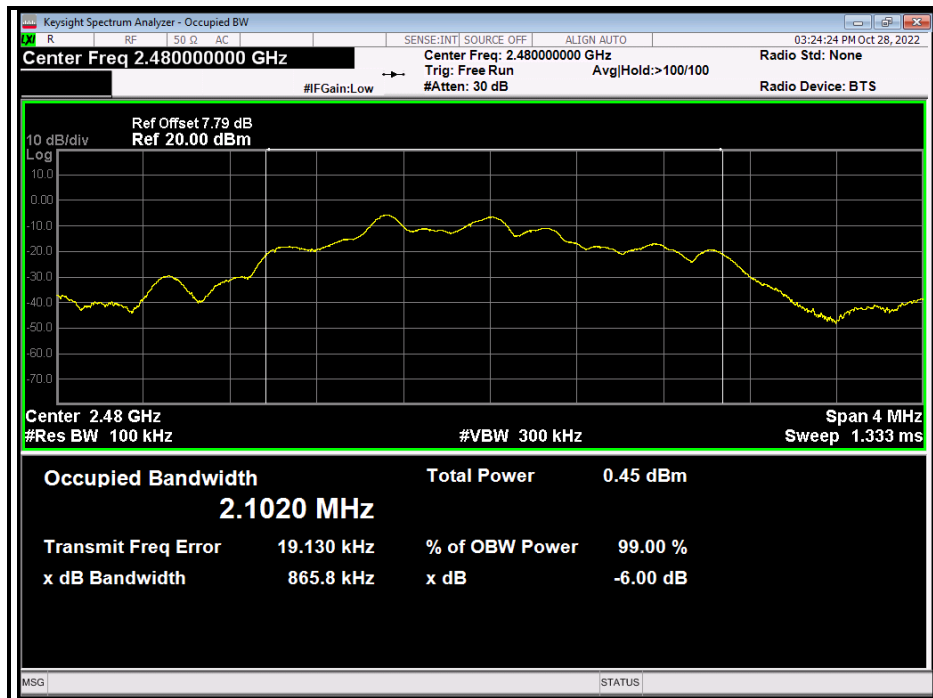
CH 0



CH 19



CH 39

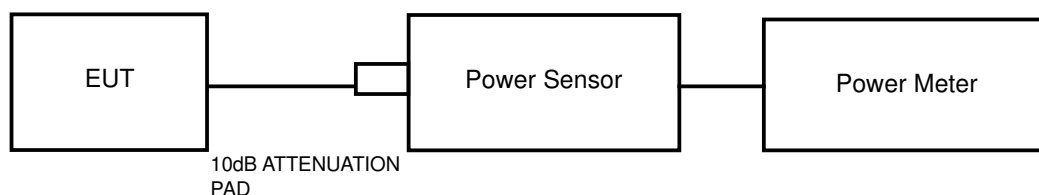


4.3 CONDUCTED OUTPUT POWER

4.3.1 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT

For systems using digital modulation in the 2400–2483.5 MHz band: 1 Watt (30dBm)

4.3.2 TEST SETUP



4.3.3 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Keysight	N9020A	MY54200831	Mar. 13, 2022	Mar. 13, 2023
Spectrum Analyzer	Rohde & Schwarz	FSV40	101094	Mar. 13, 2022	Mar. 13, 2023
Power Sensor	DARE	RPR3006W	15I00041SNO64	Mar. 13, 2022	Mar. 13, 2023
Power Meter	Agilent	E4419B	GB40201469	Mar. 13, 2022	Mar. 13, 2023
Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 13, 2022	Mar. 13, 2023
RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	Mar.13, 2022	Mar.13, 2023
Temporary antenna connector	TESCOM	SS402	N/A	N/A	N/A
Test Software	EZ	EZ EMC	N/A	N/A	N/A

NOTE:

1. The test was performed at Dongguan NTC Co., Ltd.
2. The calibration interval of the above test instruments is 12 or 24 months and the calibrations are traceable to LISAI/CHINA.

4.3.4 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.

4.3.5 DEVIATION FROM TEST STANDARD

No deviation.

4.3.6 EUT OPERATING CONDITIONS

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

4.3.7 TEST RESULTS

4.3.7.1 MAXIMUM PEAK OUTPUT POWER

BT-LE GFSK (1Mbps)

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (mW)	PEAK POWER LIMIT (W)	PASS/FAIL
0	2402	-7.04	0.198	1	PASS
19	2440	-5.99	0.252	1	PASS
39	2480	-5.08	0.310	1	PASS

BT-LE GFSK (2Mbps)

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (mW)	PEAK POWER LIMIT (W)	PASS/FAIL
0	2402	-7.06	0.197	1	PASS
19	2440	-5.94	0.255	1	PASS
39	2480	-4.99	0.317	1	PASS

4.3.7.2 AVERAGE OUTPUT POWER (FOR REFERENCE)

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

BT-LE GFSK (1Mbps)

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)	AVERAGE POWER (mW)
0	2402	-12.70	0.054
19	2440	-11.60	0.069
39	2480	-10.70	0.085

BT-LE GFSK (2Mbps)

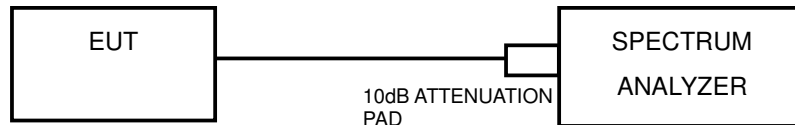
CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)	AVERAGE POWER (mW)
0	2402	-12.50	0.056
19	2440	-11.40	0.072
39	2480	-10.54	0.088

4.4 POWER SPECTRAL DENSITY MEASUREMENT

4.4.1 LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT

The Maximum of Power Spectral Density Measurement is 8dBm/3KHz.

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 PROCEDURE

1. Set the span to 1.5 times the DTS bandwidth
2. Set the RBW = 3 kHz, VBW $\geq 3 \times$ RBW, Detector = peak.
3. Sweep time = auto couple, Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

4.4.5 DEVIATION FROM TEST STANDARD

No deviation.

4.4.6 EUT OPERATING CONDITION

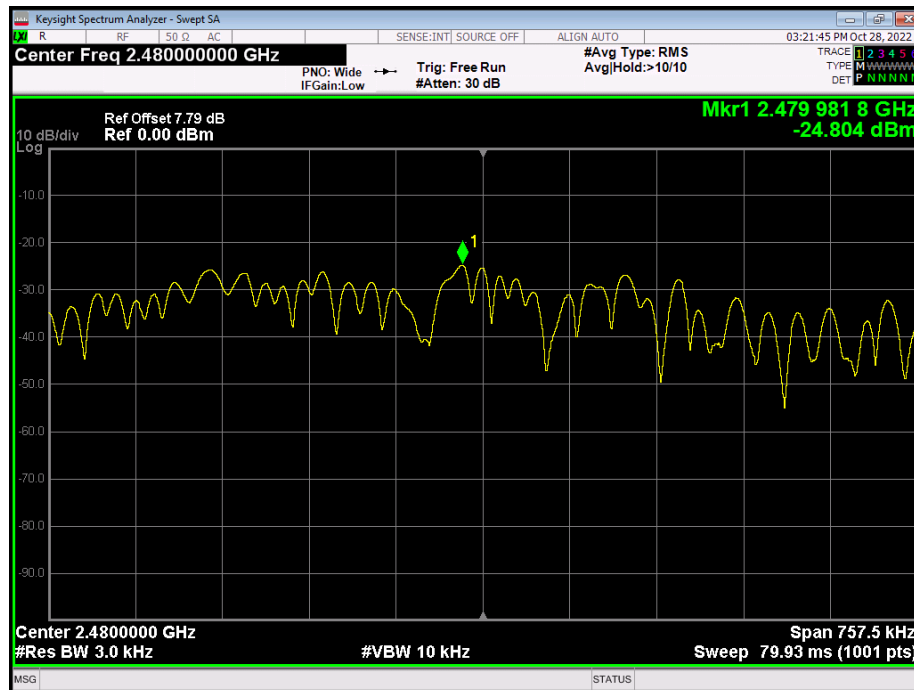
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.4.7 TEST RESULTS

BT-LE GFSK (1Mbps)

Channel	FREQ. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	PASS /FAIL
0	2402	-28.330	8	PASS
19	2440	-27.562	8	PASS
39	2480	-24.804	8	PASS

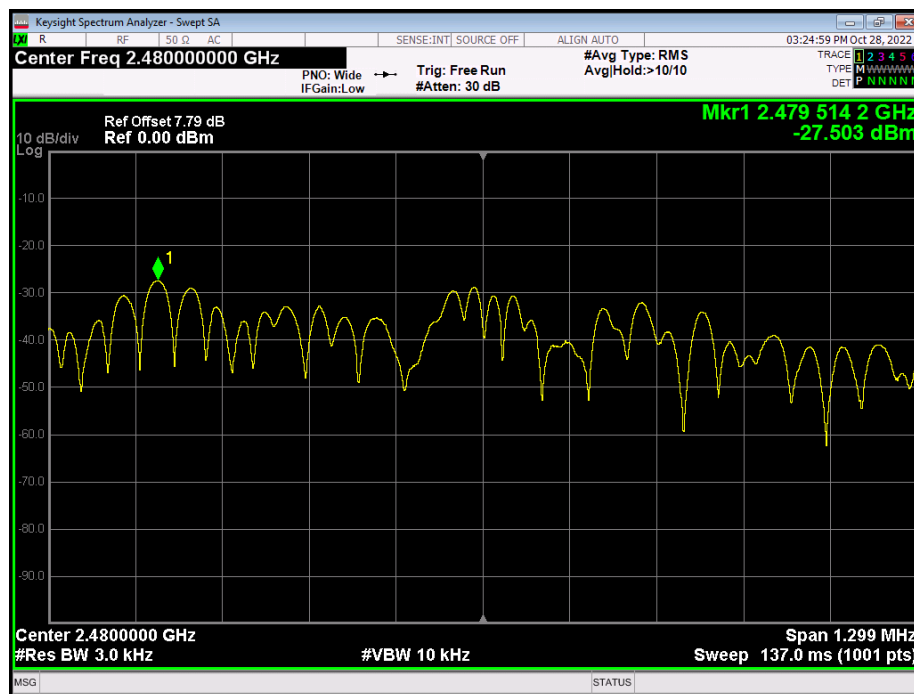
WORSE PLOT



BT-LE GFSK (2Mbps)

Channel	FREQ. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	PASS /FAIL
0	2402	-30.819	8	PASS
19	2440	-30.078	8	PASS
39	2480	-27.503	8	PASS

WORSE PLOT

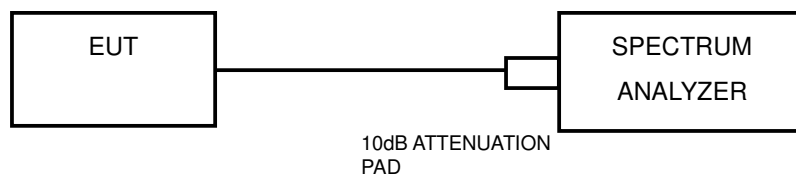


4.5 OUT OF BAND EMISSION MEASUREMENT

4.5.1 LIMITS OF OUT OF BAND EMISSION MEASUREMENT

Below -20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

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

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW $\geq$ 300 kHz.
3. Set span to encompass the spectrum to be examined
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.

4.5.5 DEVIATION FROM TEST STANDARD

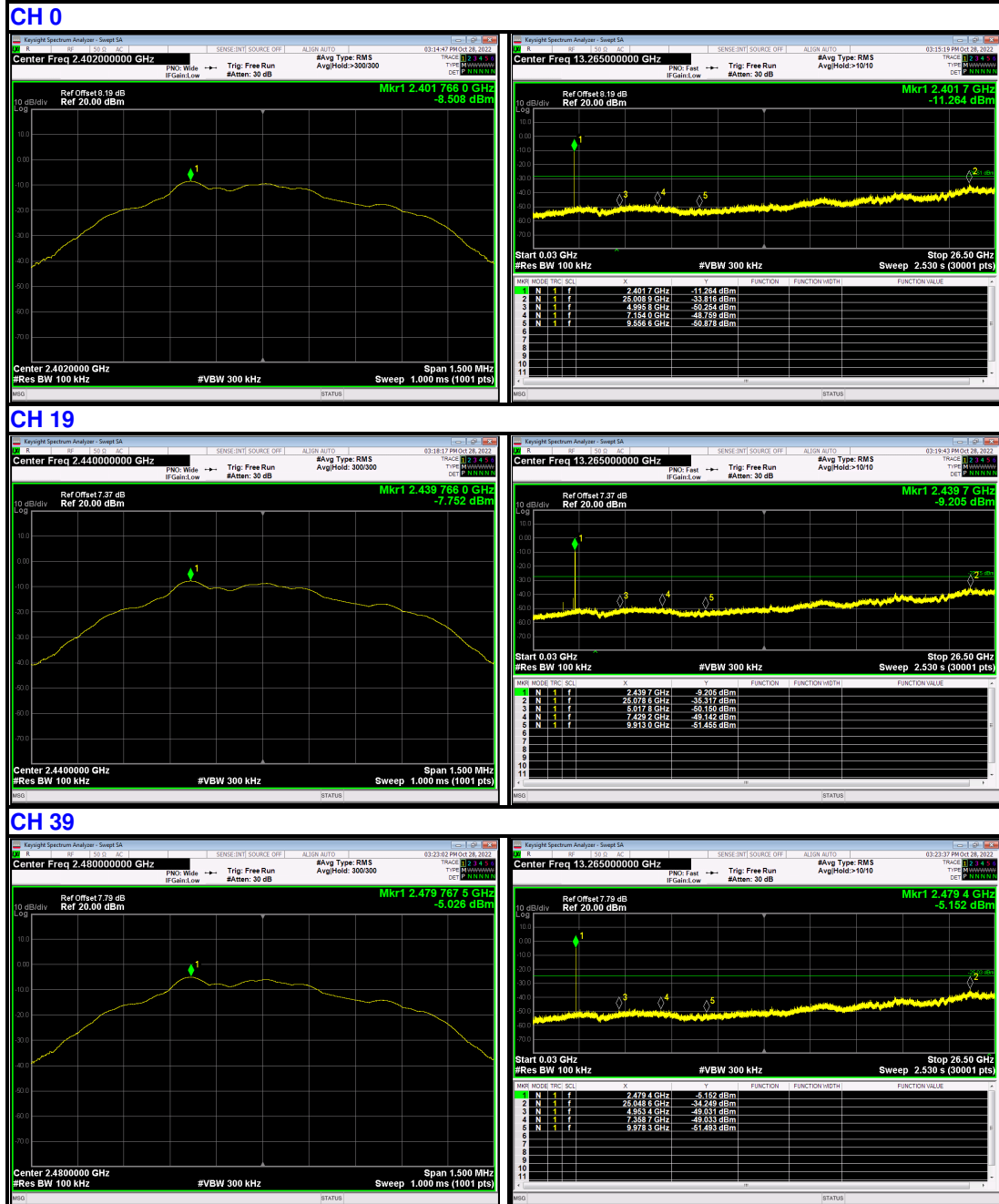
No deviation.

4.5.6 EUT OPERATING CONDITION

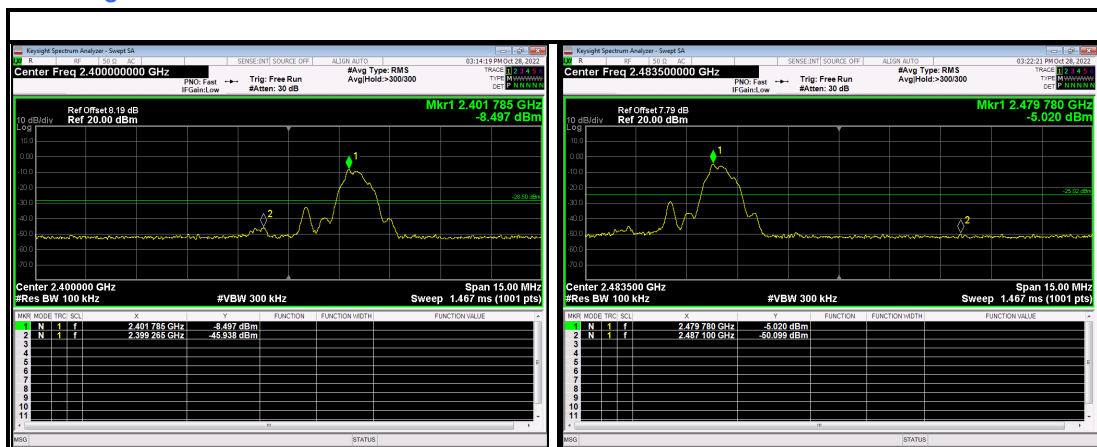
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.5.7 TEST RESULTS

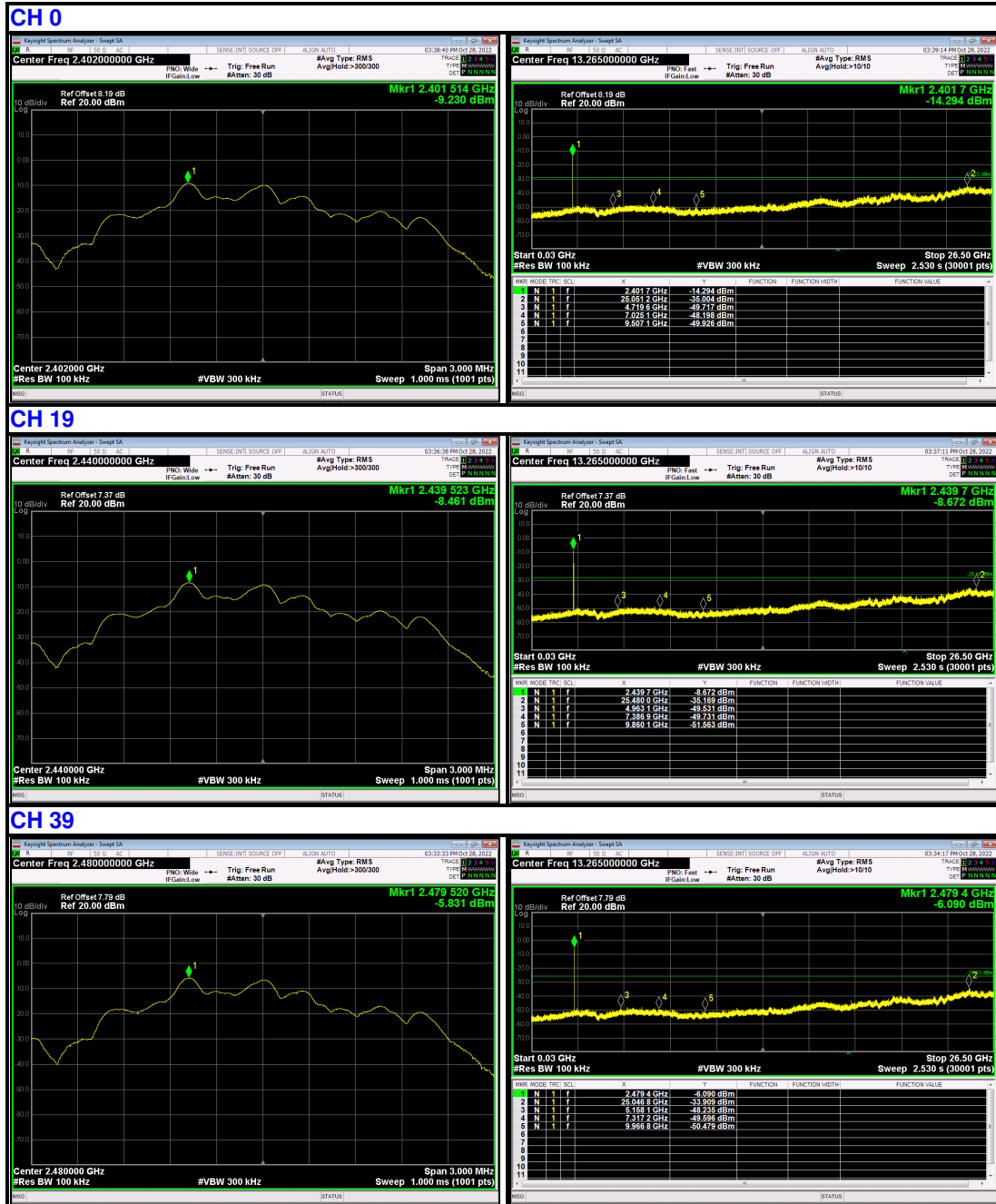
BT-LE GFSK (1Mbps)



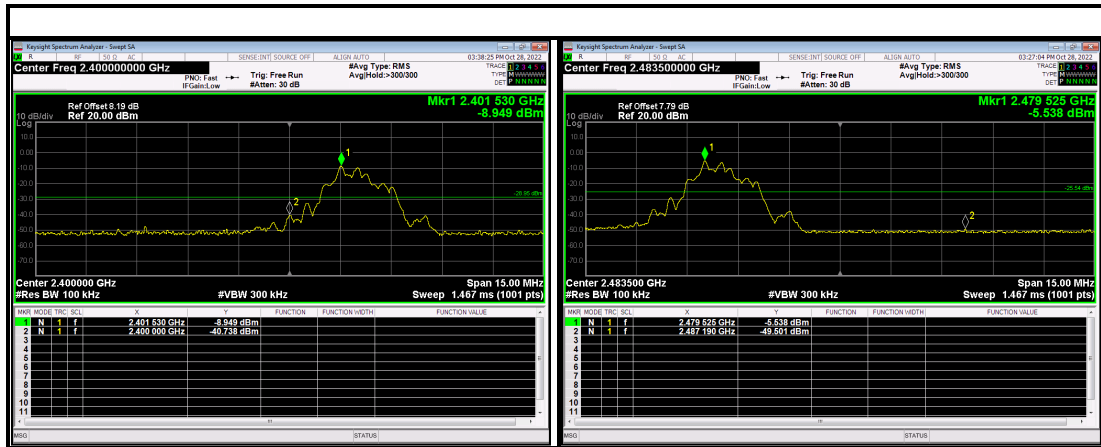
Band Edge:



BT-LE GFSK (2Mbps)



Band Edge:





Test Report No.: (8822)312-0040(A)

5 PHOTOGRAPHS OF THE TEST CONFIGURATION

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



Test Report No.: (8822)312-0040(A)

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---