CAPSTONE COMPANIES, INC.

RF TEST REPORT

Report Type:
FCC Part 15.247 RF report

Model:
Standard Mirror,
Wardrobe Mirror

REPORT NUMBER:
210601768SHA-001

ISSUE DATE:
October 18, 2021

DOCUMENT CONTROL NUMBER:
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TEST REPORT

Report no.: 210601768SHA-001

Applicant:	CAPSTONE COMPANIES, INC. 431 FAIRWAY DRIVE, SUITE 200, DEERFIELD BEACH, FL 33441 USA
Manufacturer:	PRO CONCEPT MANUFACTURER CO., LTD. 88/1 MOO 12, SOI PETCHKASEM 120,PETCHKASEM RD. OM NOI, KRATUMBAN, SAMUTSAKORN THAILAND 74130
FCC ID:	2A3GYCAP-1807

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:
47CFR Part 15 (2020): Radio Frequency Devices (Subpart C) **ANSI C63.10 (2013):** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

PREPARED BY:	**REVIEWED BY:**
	
Project Engineer Eric Li	Reviewer Daniel Zhao

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Revision History

Report No.	Version	Description	Issued Date
210601768SHA-001	Rev. 01	Initial issue of report	October 18, 2021

Measurement result summary

TEST ITEM	FCC REFERANCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	Pass
Maximum conducted output power and e.i.r.p.	15.247(b)(3)	Pass
Power spectrum density	15.247(e)	Pass
Emission outside the frequency band	15.247(d)	Pass
Radiated Emissions in restricted frequency bands	15.247(d), 15.205&15.209	Pass
Power line conducted emission	15.207(a)	Pass
Occupied bandwidth	-	Tested
Antenna requirement	15.203	Pass

Notes: 1: NA =Not Applicable

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TEST REPORT

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Thin Cast Smart Mirror
Type/Model:	Standard Mirror, Wardrobe Mirror
Description of EUT:	EUT is a Smart Mirror with WiFi function and Bluetooth function, there are two models, they are identical except for the size of mirror, so we test Wardrobe Mirror as representative and list the worst results in this report.
Rating:	12.0Vdc, 4.0A, 48.0W
EUT type:	☐ Table top ☒ Floor standing
Software Version:	/
Hardware Version:	/
Sample Identification No.:	0210919-46-001
Sample received date:	September 26, 2021
Date of test:	September 27, 2021 ~ October 15, 2021

1.2 Technical Specification

Frequency Band:	2400MHz to 2483.5MHz
Support Standards:	Bluetooth Low Energy
Operating Frequency:	2402MHz to 2480MHz
Type of Modulation:	GFSK
Channel Number:	40
Channel Separation:	2MHz
Antenna Information:	PCB Antenna, 1.0dBi

1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN1175
	IC Registration Lab CAB identifier.: CN0051
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2020)
ANSI C63.10 (2013)
KDB 558074 (v05r02)

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

Software name	Manufacturer	Version	Supplied by
QRCT	Qualcomm	-	Client

The lowest, middle and highest channel were tested as representatives.

Frequency Band (MHz)				2402 ~ 2480			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (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**

Data rate and Power setting:
The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

Frequency Band (MHz)	Mode	Data rate
2400-2483.5	BLE	1Mbps
		2Mbps

Power Setting parameter			
Mode	Channel		
	Lowest	Middle	Highest
BLE	default	default	default

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	Laptop computer	DELL 5480	-

2.5 Test environment condition:

Test items	Temperature	Humidity
Minimum 6dB Bandwidth	22°C	54%RH
Maximum conducted output power and e.i.r.p.		
Power spectrum density		
Emission outside the frequency band		
Occupied bandwidth		
Radiated Emissions in restricted frequency bands	24°C	53%RH
Power line conducted emission	23°C	53%RH

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESCS 30	EC 2107	2022-07-14
☒	A.M.N.	R&S	ESH2-Z5	EC 3119	2021-11-10
☐	A.M.N.	R&S	ENV 216	EC 3393	2022-07-14
☐	A.M.N.	R&S	ENV4200	EC 3558	2022-06-11
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESIB 26	EC 3045	2022-09-16
☒	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2022-09-24
☒	Pre-amplifier	R&S	AFS42-00101800-25-S-42	EC5262	2022-06-11
☐	Horn antenna	R&S	HF 906	EC 3049	2022-01-17
☐	Horn antenna	ETS	3117	EC 4792-1	2021-02-25
☒	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2022-07-09
☒	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2022-03-14
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2022-03-16
☐	Power sensor	Agilent	U2021XA	EC 5338-1	2022-03-16
☐	Vector Signal Generator	Agilent	N5182B	EC 5175	2022-03-16
☐	Universal Radio Communication Tester	R&S	CMW500	EC5944	2021-12-09
☐	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2022-03-16
☐	Mobile Test System	Litepoint	Iqxel	EC 5176	2022-01-16
☐	Test Receiver	R&S	ESCI 7	EC 4501	2022-09-16
☐	Climate chamber	GWS	MT3065	EC 6021	2022-07-04
☒	Spectrum Analyzer	Keysight	N9030B	EC 6078	2022-06-11
Tet Site					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Shielded room	Zhongyu	-	EC 2838	2022-01-12

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☐	Shielded room	Zhongyu	-	EC 2839	2022-01-12
☒	Semi-anechoic chamber	Albatross project	-	EC 3048	2022-07-14
☐	Fully-anechoic chamber	Albatross project	-	EC 3047	2022-07-14
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2022-03-03
☐	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3481	2022-01-05
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3442	2022-01-05
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3324	2022-09-05
☐	Pressure meter	YM3	Shanghai Mengde	EC 3320	2022-07-14

2.7 Measurement uncertainty

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

Test item	Measurement uncertainty
Maximum peak output power	± 0.74dB
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Emission outside the frequency band	± 2.89dB
Power line conducted emission	± 3.19dB

3 Minimum 6dB bandwidth

Test result: Pass

3.1 Limit

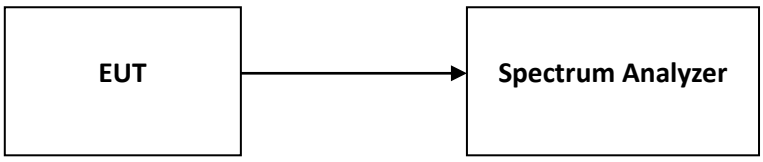
For systems using digital modulation techniques that may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands, the minimum 6 dB bandwidth shall be at least 500 kHz.

3.2 Measurement Procedure

The EUT was tested according to Subclause 11.8 of ANSI C63.10.

a) Set RBW = 100 kHz.
b) Set VBW ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) 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.

3.3 Test Configuration



3.4 Test Results of Minimum 6dB bandwidth

Please refer to Appendix A

4 Maximum conducted output power and e.i.r.p.

Test result: Pass

4.1 Limit

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 W. (The e.i.r.p. shall not exceed 4 W)

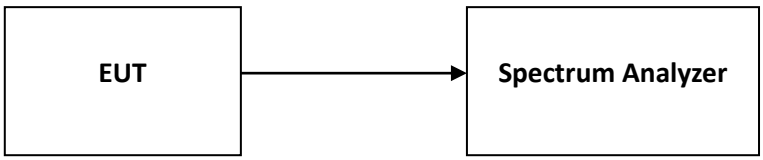
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 30dBm and 30+ (6 –antenna gain-beam forming gain).

4.2 Measurement Procedure

The EUT was tested according to Subclause 11.9.1.1 of ANSI C63.10.

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ 3 × RBW.
c) Set span ≥ 3 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

4.3 Test Configuration



4.4 Test Results of Maximum conducted output power

Please refer to Appendix A

5 Power spectrum density

Test result: **Pass**

5.1 Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

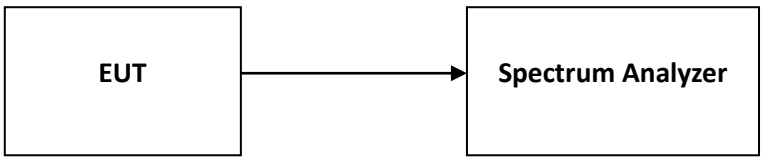
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 8dBm/MHz and 8+ (6 –antenna gain-beam forming gain).

5.2 Measurement Procedure

The EUT was tested according to Subclause 11.10 of ANSI C63.10.

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 × RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3 Test Configuration



5.4 Test Results of Power spectrum density

Please refer to Appendix A

6 Emission outside the frequency band

Test result: **Pass**

6.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

6.2 Measurement Procedure

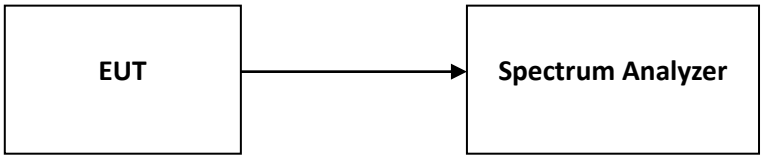
The EUT was tested according to Subclause 11.11 of ANSI C63.10.

Reference level measurement
Establish a reference level by using the following procedure:
a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 times the DTS bandwidth.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.

Emission level measurement
a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100 kHz.
c) Set the VBW ≥ 3 x RBW.
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

6.3 Test Configuration



6.4 The results of Emission outside the frequency band

Please refer to Appendix A

7 Radiated Emissions in restricted frequency bands

Test result: **Pass**

7.1 Limit

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified showed as below:

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

7.2 Measurement Procedure

The EUT was tested according to Subclause 11.12 of ANSI C63.10.

For Radiated emission below 30MHz:

a) For desk-top devices the EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz), For the floor-standing devices, the EUT was placed on the top of a rotating table 0.1 meters above the ground at 3 meters chamber room for test.. 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) Both X and Y axes of the antenna are set to make the measurement.
d) For each suspected emission, the EUT was arranged to its worst case 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 Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

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For Radiated emission above 30MHz:

a) For desk-top devices the EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz), For the floor-standing devices, the EUT was placed on the top of a rotating table 0.1 meters above the ground at 3 meters chamber room for test. 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) The height of antenna 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 quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

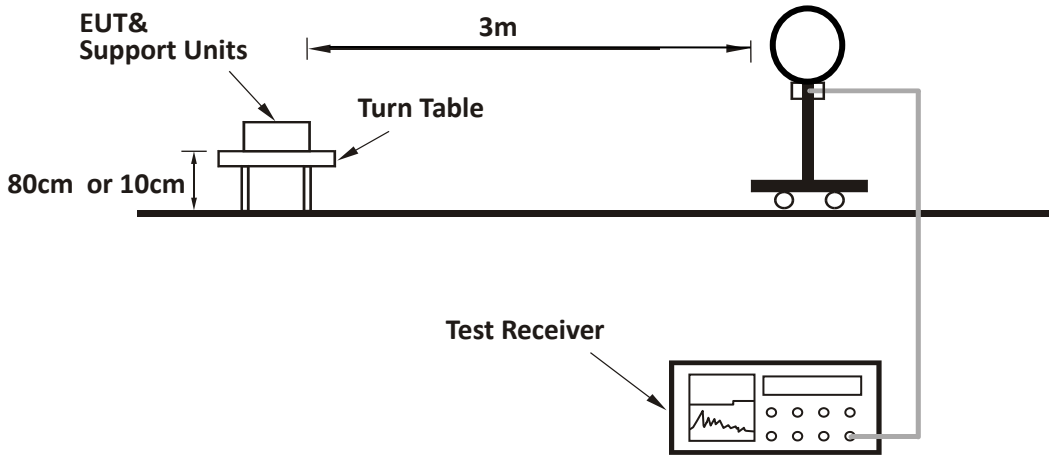
f) The test-receiver system was set to peak and average detector function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

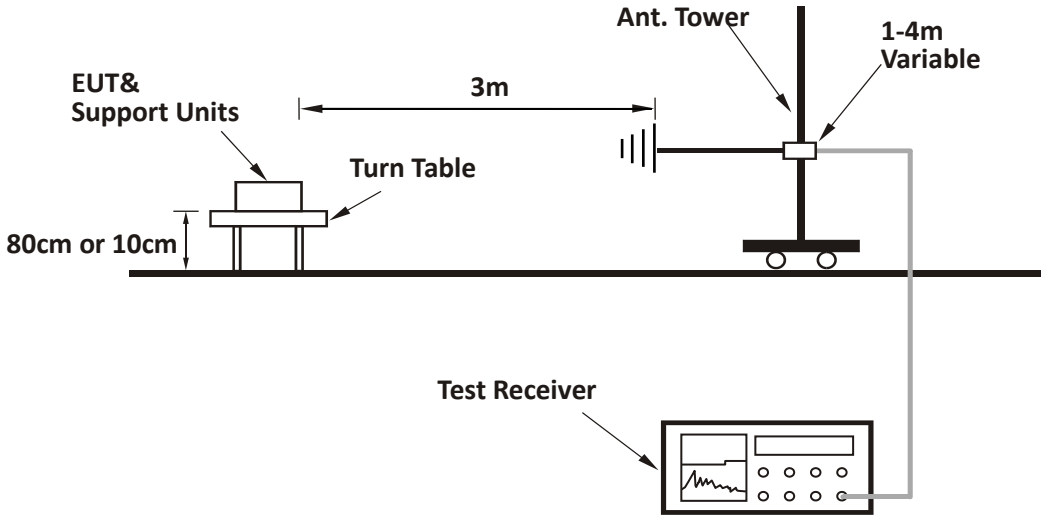
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 3 x RBW (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were and the worst-case emissions were reported.

7.3 Test Configuration

For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



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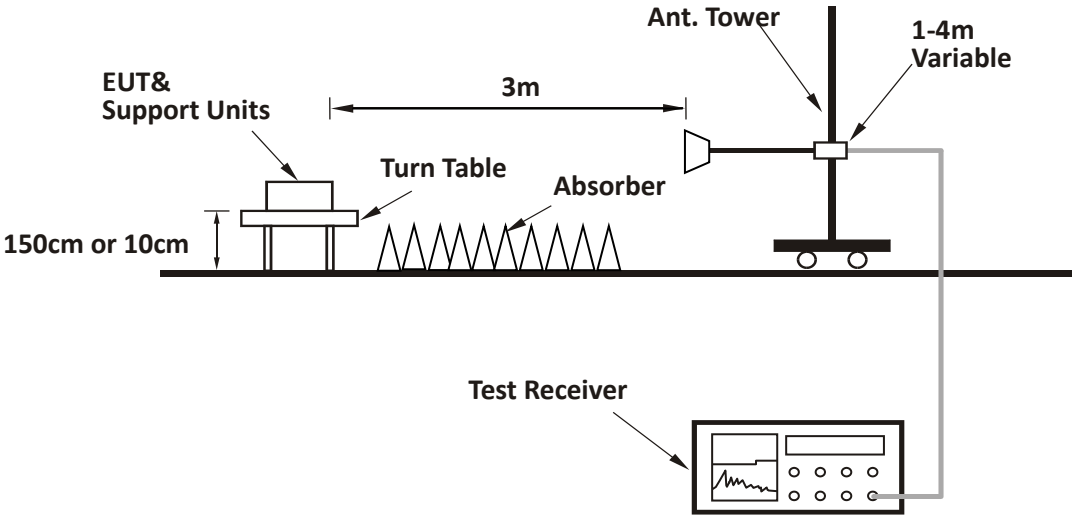
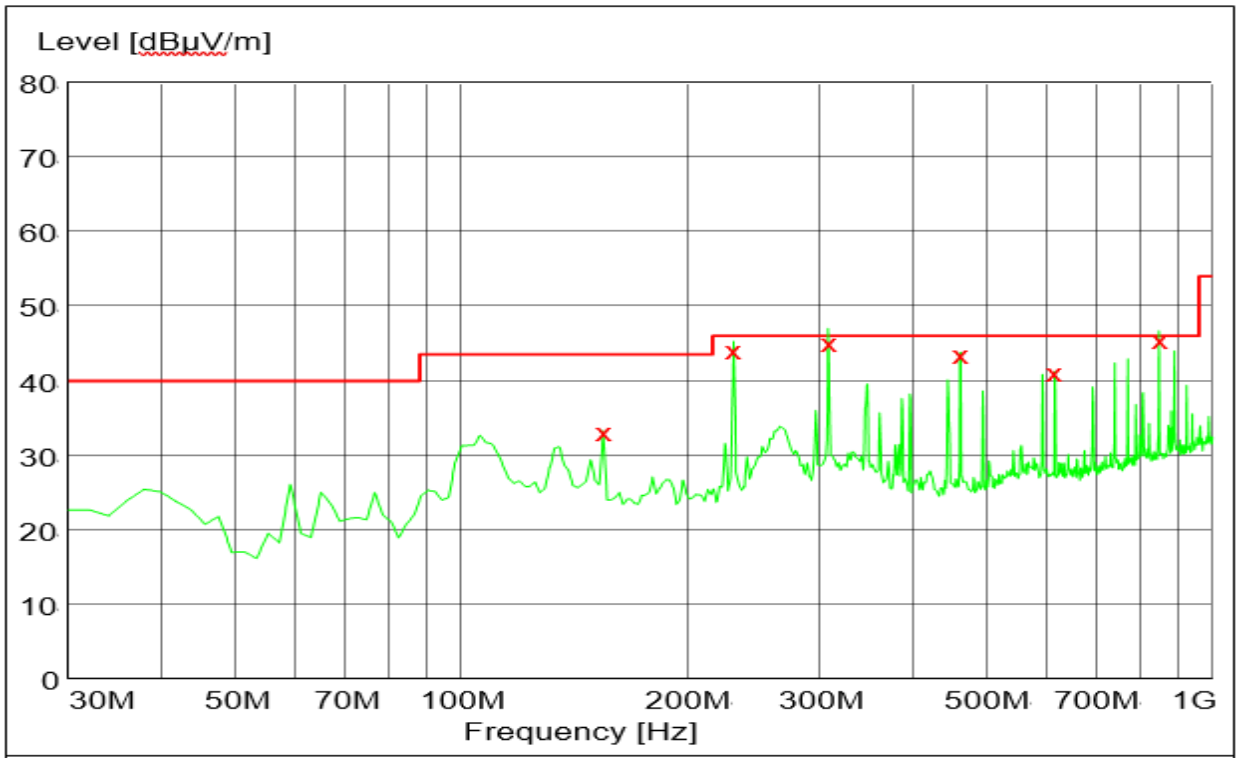
For Radiated emission above 1GHz:



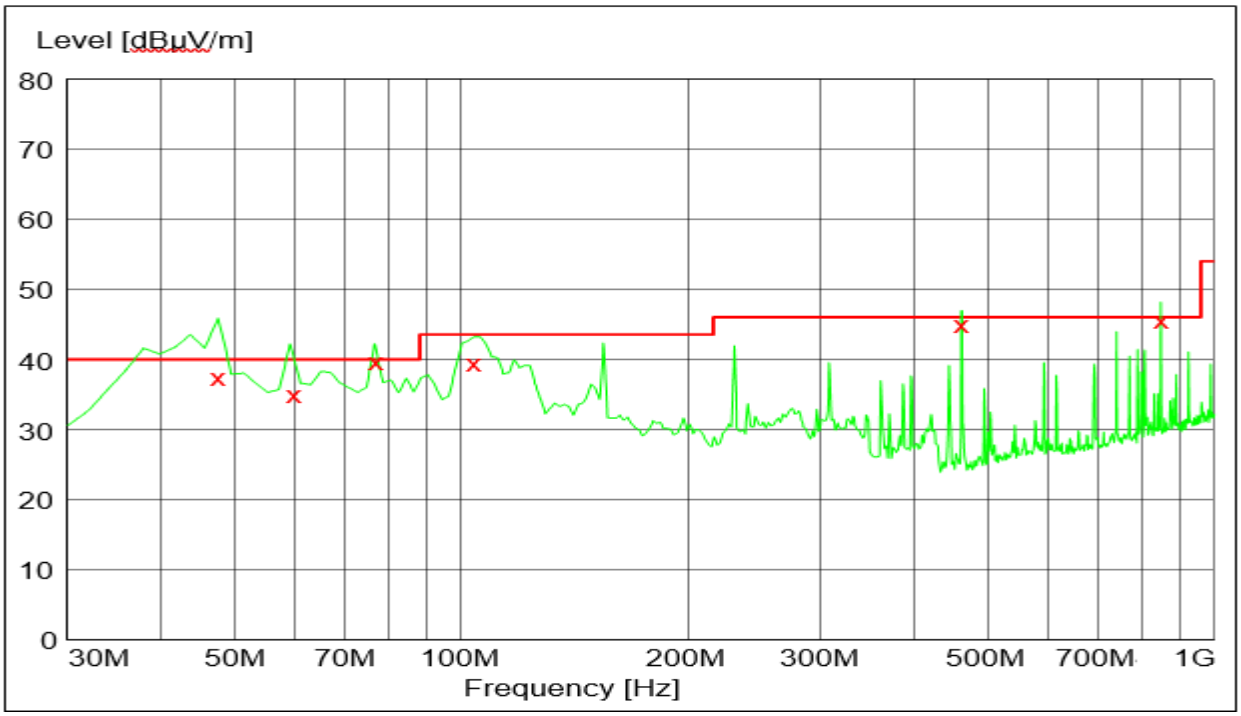
7.4 Test Results of Radiated Emissions

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported. The worst waveform from 30MHz to 1000MHz is listed as below:

Horizontal



Vertical



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Test data below 1GHz

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	154.41	33.30	43.50	10.20	PK
H	230.22	44.30	46.00	1.70	QP
H	307.98	45.40	46.00	0.60	QP
H	461.54	43.70	46.00	2.30	PK
H	617.05	41.30	46.00	4.70	PK
H	848.38	45.65	46.00	0.40	QP
V	47.49	37.60	40.00	2.40	QP
V	59.90	35.30	40.00	4.70	QP
V	76.97	39.70	40.00	0.30	QP
V	103.87	39.60	43.50	3.90	QP
V	461.54	45.20	46.00	0.80	QP
V	848.38	45.80	46.00	0.20	QP

Test result above 1GHz:

The emission was conducted from 1GHz to 25GHz for data rate 1Mbps

CH	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2390.00	51.30	74.00	22.70	PK
	V	2390.00	51.80	74.00	22.20	PK
	V	4804.00	45.30	74.00	28.70	PK
	V	7206.00	46.60	74.00	27.40	PK
M	H	4880.00	45.10	74.00	28.90	PK
	V	4880.00	46.40	74.00	27.60	PK
	H	7320.00	45.30	74.00	28.70	PK
	V	7320.00	46.50	74.00	27.50	PK
H	H	2483.50	50.70	74.00	23.30	PK
	V	2483.50	51.80	74.00	22.20	PK
	V	4960.00	45.70	74.00	28.30	PK
	V	7440.00	46.90	74.00	27.10	PK

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The emission was conducted from 1GHz to 25GHz for data rate 2Mbps

CH	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2390.00	51.80	74.00	22.80	PK
	V	2390.00	51.60	74.00	22.50	PK
	V	4804.00	45.50	74.00	29.30	PK
	V	7206.00	46.80	74.00	27.70	PK
M	H	4880.00	45.30	74.00	29.20	PK
	V	4880.00	46.60	74.00	27.90	PK
	H	7320.00	45.90	74.00	29.10	PK
	V	7320.00	46.70	74.00	27.70	PK
H	H	2483.50	51.20	74.00	22.80	PK
	V	2483.50	51.50	74.00	22.50	PK
	V	4960.00	45.30	74.00	28.70	PK
	V	7440.00	46.60	74.00	27.40	PK

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

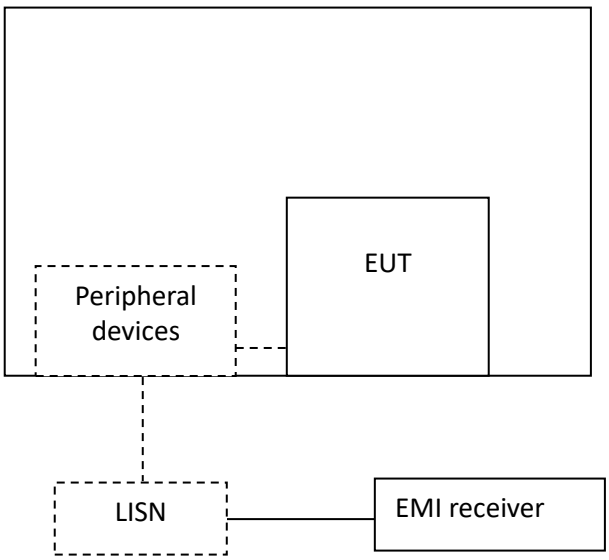
8 Power line conducted emission

Test result: **Pass**

8.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

8.2 Test Configuration



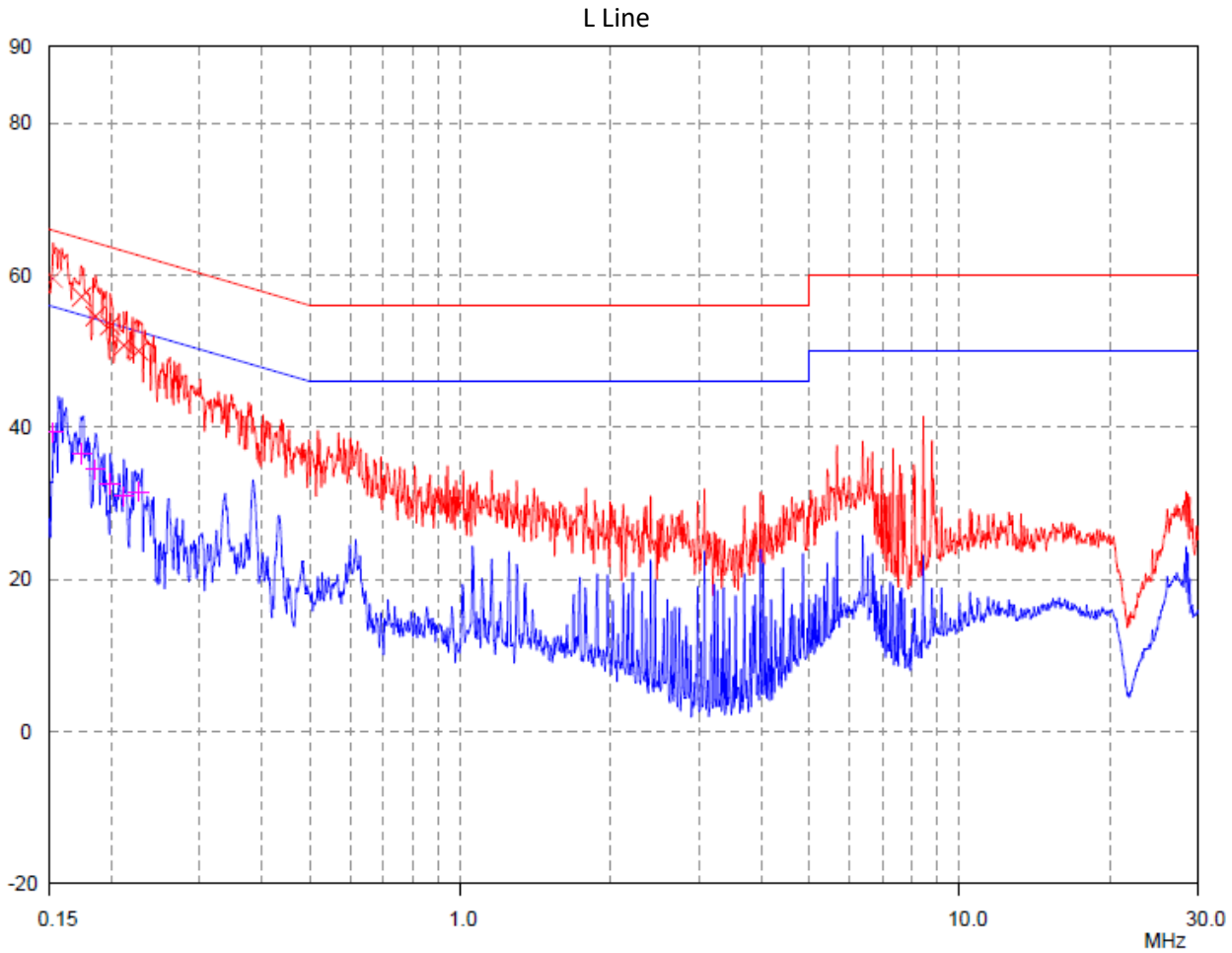
8.3 Measurement Procedure

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

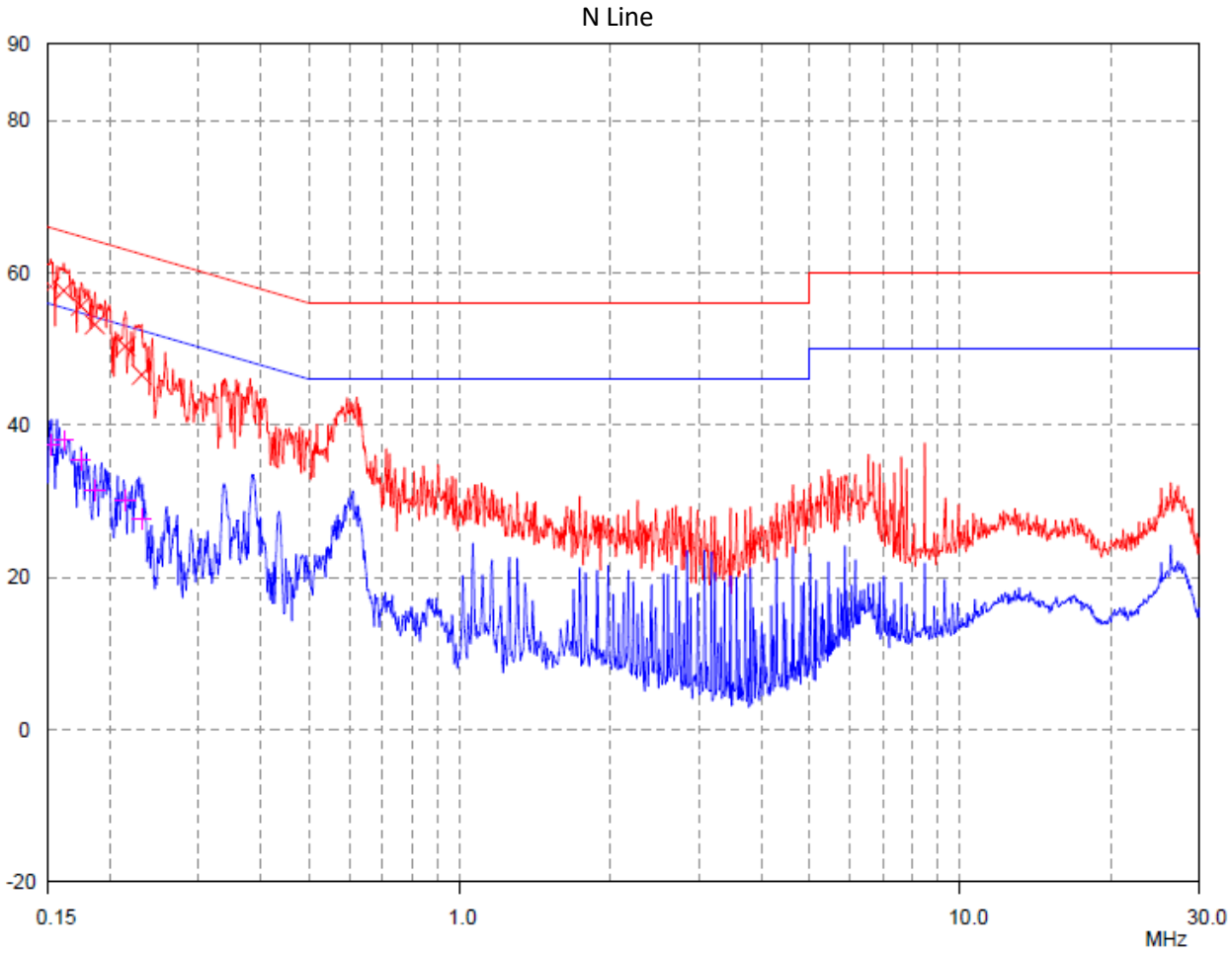
8.4 Test Results of Power line conducted emission



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.15	59.56	65.87	6.31	39.31	55.87	16.56
0.17	57.17	64.77	7.60	36.55	54.77	18.22
0.19	54.61	64.24	9.63	34.48	54.24	19.76
0.20	53.41	63.68	10.27	32.62	53.68	21.06
0.21	50.75	63.15	12.40	30.94	53.15	22.21
0.23	50.03	62.59	12.56	31.51	52.59	21.08

TEST REPORT



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.15	58.20	65.90	7.70	37.40	55.90	18.50
0.16	57.64	65.40	7.76	38.01	55.40	17.39
0.17	55.65	64.74	9.09	35.36	54.74	19.38
0.19	53.21	64.21	11.00	31.45	54.21	22.76
0.21	50.33	63.05	12.72	30.17	53.05	22.88
0.23	46.61	62.42	15.81	27.72	52.42	24.70

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

9 Occupied Bandwidth

Test result: **Tested**

9.1 Limit

None

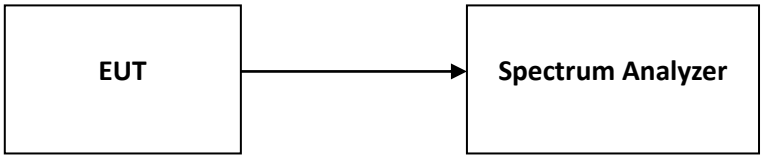
9.2 Measurement Procedure

The occupied bandwidth per RSS-Gen was measured using the Spectrum Analyzer.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

9.3 Test Configuration



9.4 The results of Occupied Bandwidth

Please refer to Appendix A

10 Antenna requirement

Requirement:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Result:
EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.

TEST REPORT

Appendix A: Test results

1. Conducted Output Power

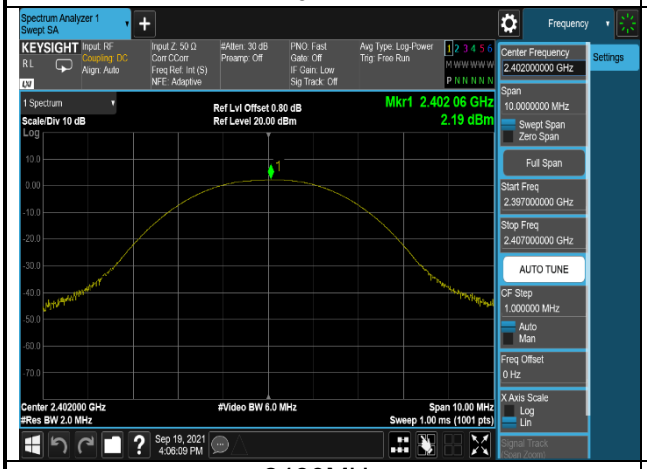
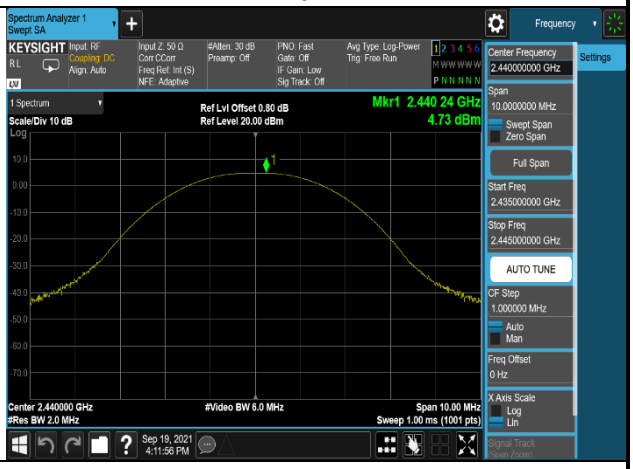
1.1 Test Data

BLE Maximum Output Power for data rate 1Mbps		
Test Frequency	Power(dBm)	Result
2402	2.19	Pass
2440	4.74	Pass
2480	5.08	Pass

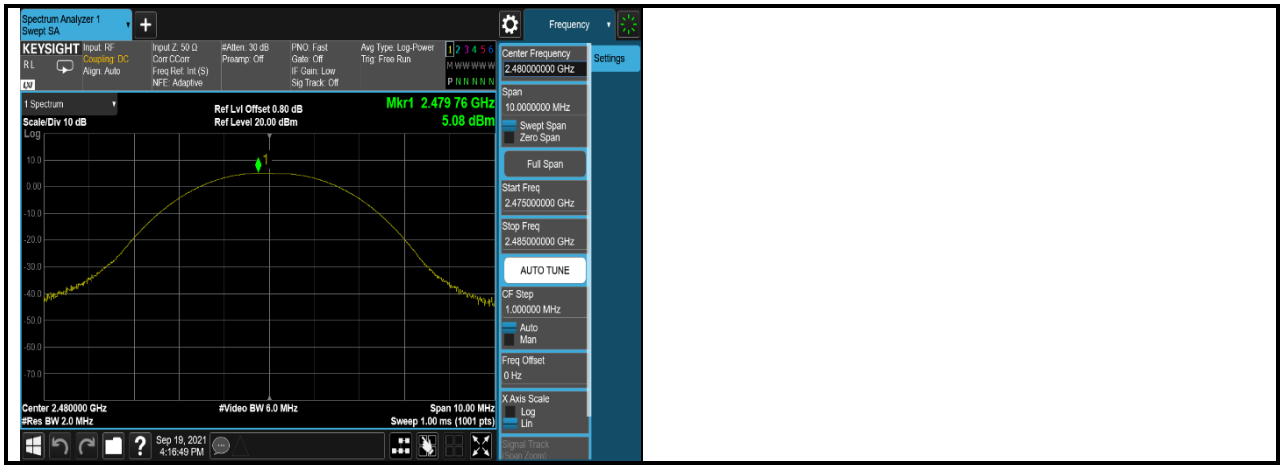
BLE Maximum Output Power for data rate 2Mbps		
Test Frequency (MHz)	Power (dBm)	Result
2402	3.45	Pass
2440	3.12	Pass
2480	2.71	Pass

1.2 Test Plots

Data rate 1Mbps

2402MHz	2440MHz
	
2480MHz	

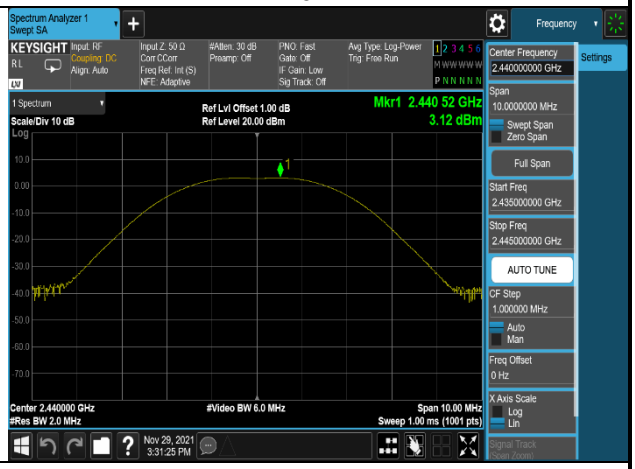
TEST REPORT



Data rate 2Mbps

2402MHz

2440MHz



2480MHz

TEST REPORT

2. Power Spectral Density

1.3 Test Data

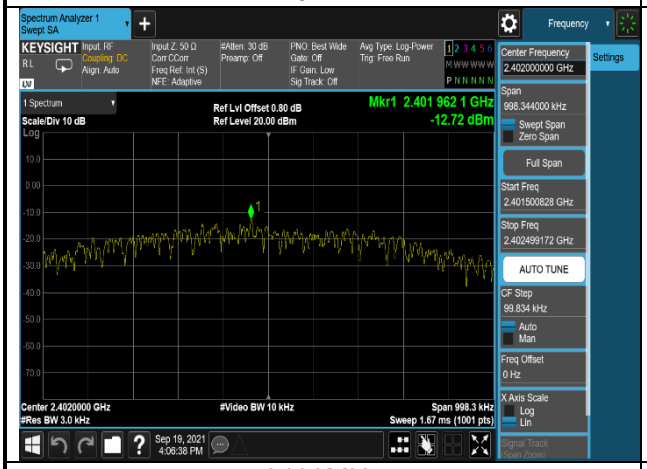
BLE Peak Power Spectral Density for data rate 1Mbps		
Test Frequency	PSD(dBm/3kHz)	Result
2402	-12.72	Pass
2440	-10.14	Pass
2480	-9.80	Pass

BLE Peak Power Spectral Density for data rate 2Mbps		
Test Frequency (MHz)	PSD (dBm/3kHz)	Result
2402	3.15	Pass
2440	2.80	Pass
2480	2.40	Pass

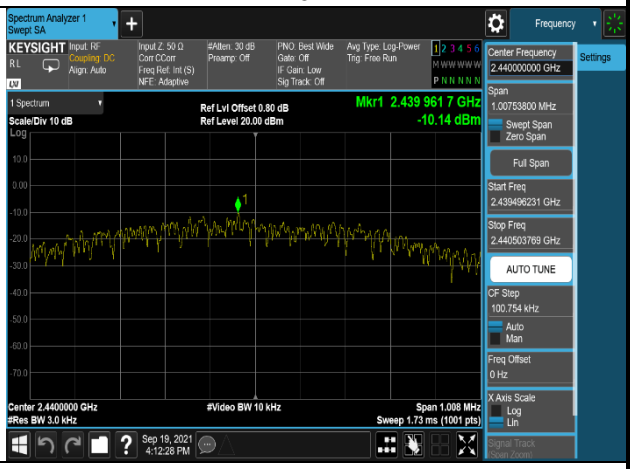
1.4 Test Plots

Data rate 1Mbps

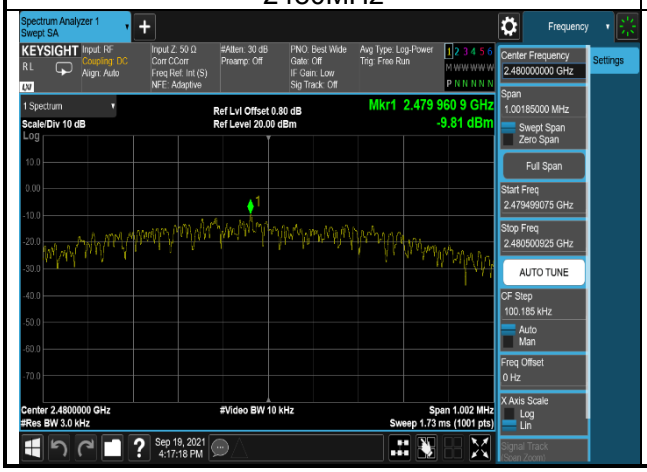
2402MHz



2440MHz

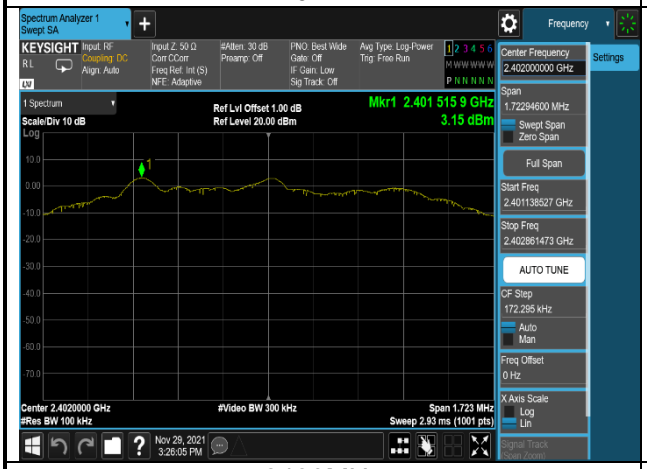


2480MHz



TEST REPORT

Data rate 2Mbps

2402MHz	2440MHz
	
2480MHz	
	

3. Minimum 6dB bandwidth

3.1 Test Data

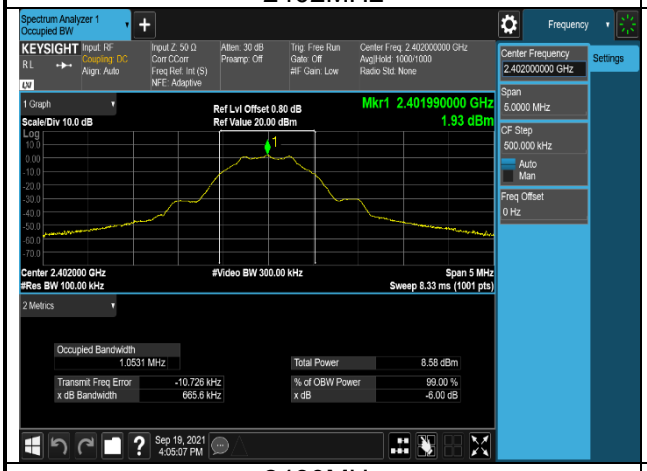
BLE Occupied 6dB Bandwidth for data rate 1Mbps			
Test Frequency (MHz)	Occupied Bandwidth (kHz)	Min Limit (kHz)	Result
2402	665.6	500	Pass
2440	671.7	500	Pass
2480	667.9	500	Pass

BLE Occupied 6dB Bandwidth for data rete 2Mbps			
Test Frequency (MHz)	Occupied Bandwidth (kHz)	Min Limit (kHz)	Result
2402	1148.6	500	Pass
2440	1141.2	500	Pass
2480	1142.0	500	Pass

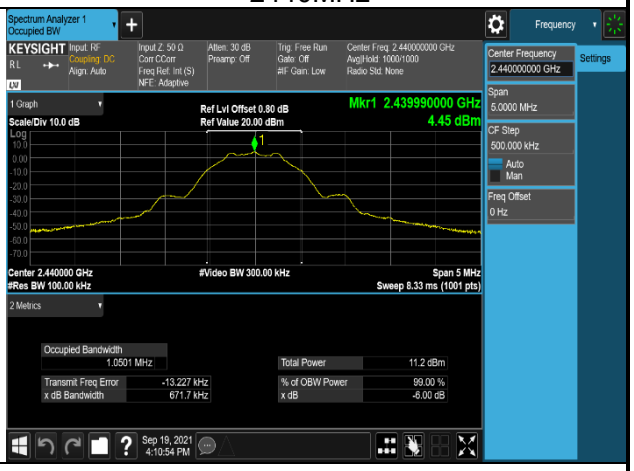
3.2 Test Plots

Data rate 1Mbps

2402MHz

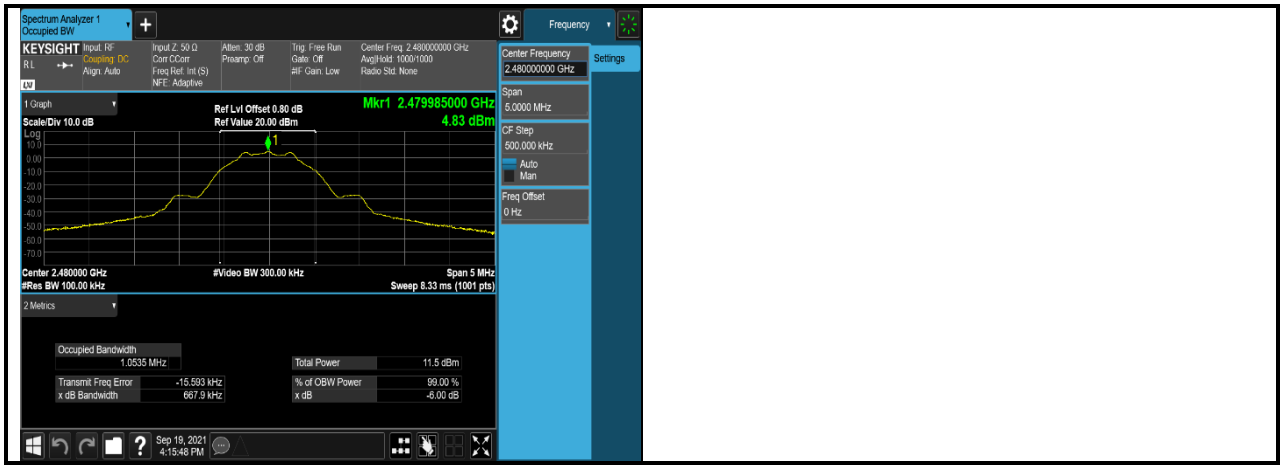


2440MHz

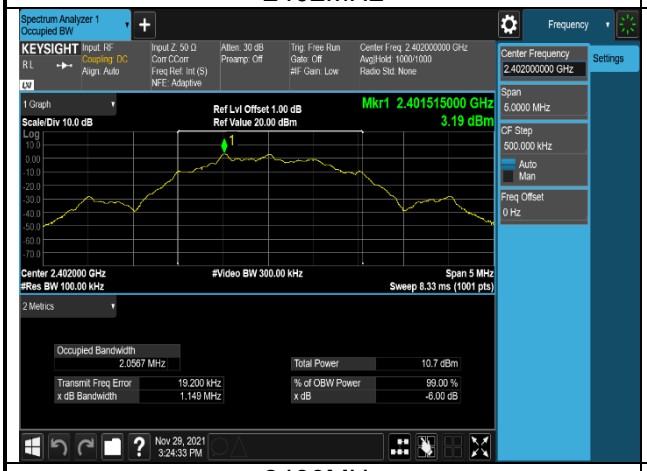
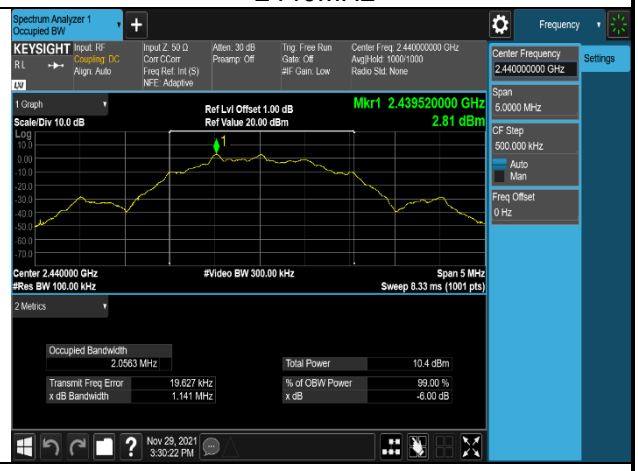
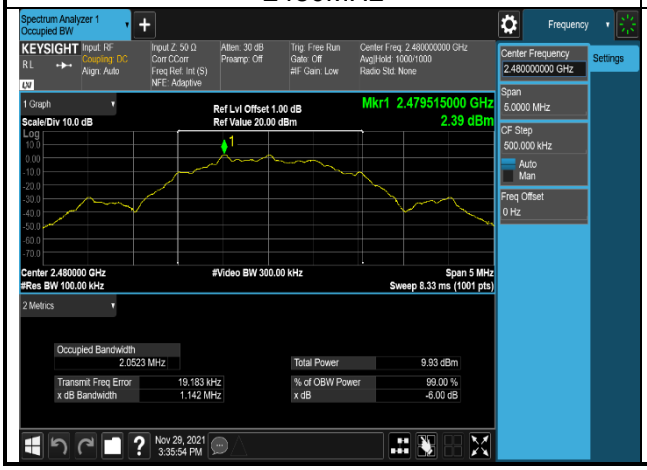


2480MHz

TEST REPORT



Data rate 2Mbps

2402MHz	2440MHz
	
2480MHz	
	

TEST REPORT

4. Occupied Bandwidth

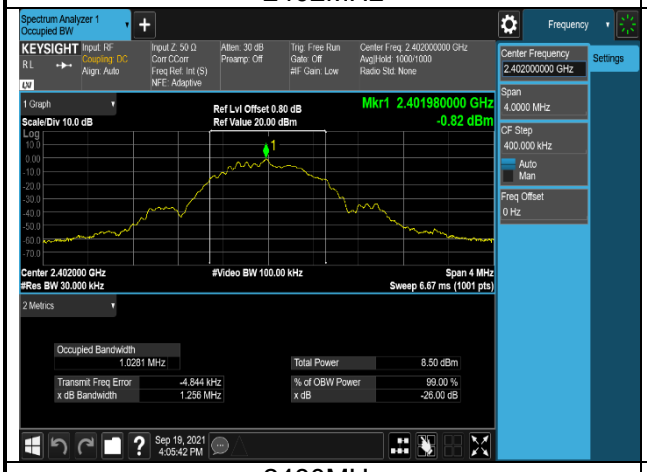
4.1 Test Data

BLE 99% Occupied Bandwidth for data rate 1Mbps		
Test Frequency (MHz)	99% Occupied Bandwidth (MHz)	Result
2402	1.0281	Pass
2440	1.0270	Pass
2480	1.0283	Pass

BLE 99% Occupied Bandwidth for data rate 2Mbps		
Test Frequency (MHz)	99% Occupied Bandwidth (MHz)	Result
2402	2.0362	Pass
2440	2.0350	Pass
2480	2.0321	Pass

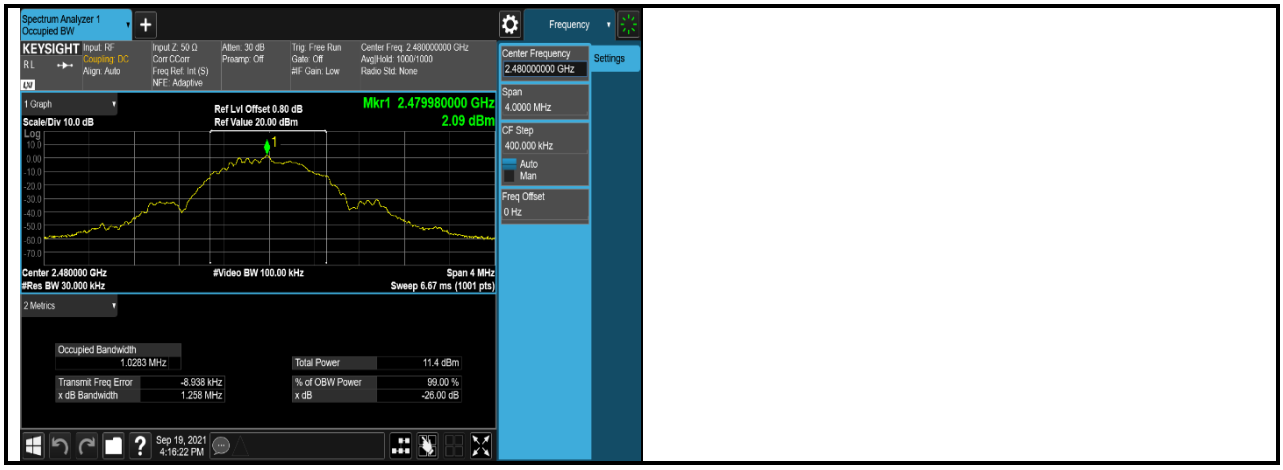
4.2 Test Plots

Data rate 1Mbps

2402MHz	2440MHz
	
2480MHz	

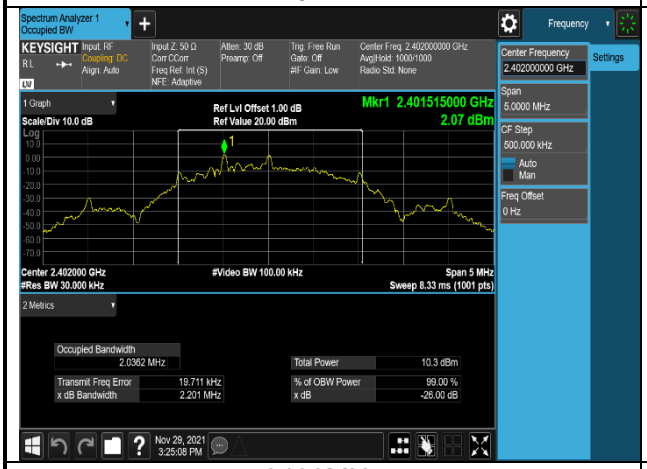
Total Quality. Assured.

TEST REPORT

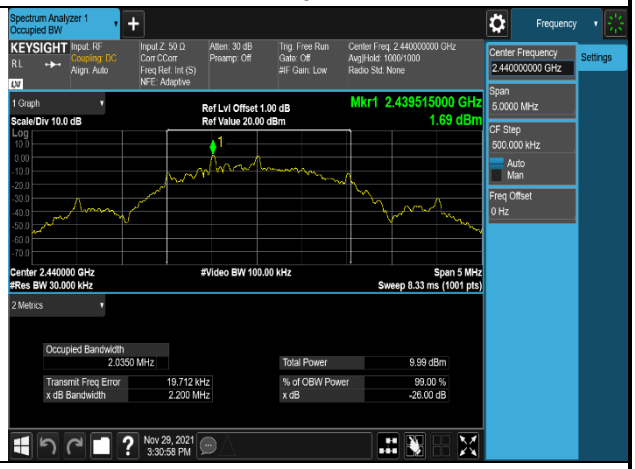


Data rate 2Mbps

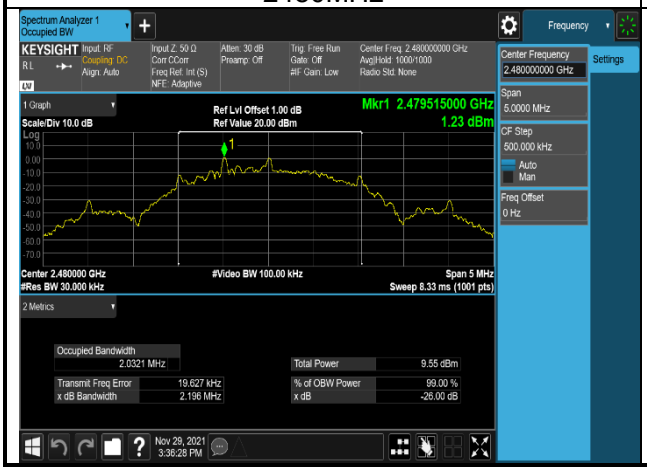
2402MHz



2440MHz



2480MHz



5. Emission outside the frequency band

5.1 Test Data

BLE Transmitter Spurious Emission for 1Mbps			
Test Frequency (MHz)	Test Range	Power (dBm)	Result
2402	1MHz~2310MHz	-57.21	Pass
2402	2500MHz~5000MHz	-54.97	Pass
2402	5000MHz~25000MHz	-40.92	Pass
2402	Band Edge	-54.10	Pass
2402	Reference Level	1.95	Pass
2440	1MHz~2310MHz	-57.61	Pass
2440	2500MHz~5000MHz	-54.29	Pass
2440	5000MHz~25000MHz	-41.32	Pass
2440	Band Edge	-58.20	Pass
2440	Reference Level	4.42	Pass
2480	1MHz~2310MHz	-57.18	Pass
2480	2500MHz~5000MHz	-54.52	Pass
2480	5000MHz~25000MHz	-41.17	Pass
2480	Band Edge	-59.39	Pass
2480	Reference Level	4.84	Pass

BLE Transmitter Spurious Emission for data rate 2Mbps			
Test Frequency (MHz)	Test Range	Power (dBm)	Result
2402	1MHz~2310MHz	-56.72	Pass
2402	2500MHz~5000MHz	-38.10	Pass
2402	5000MHz~25000MHz	-39.24	Pass
2402	Band Edge	-28.85	Pass
2402	Reference Level	3.13	Pass
2440	1MHz~2310MHz	-57.02	Pass
2440	2500MHz~5000MHz	-40.61	Pass
2440	5000MHz~25000MHz	-41.20	Pass
2440	Band Edge	-57.42	Pass
2440	Reference Level	2.80	Pass

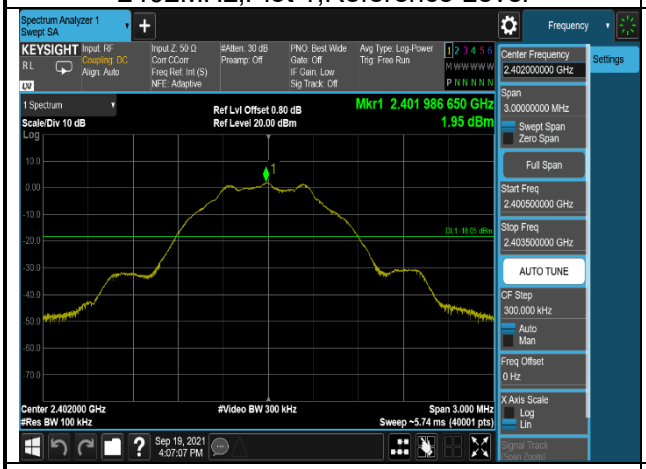
TEST REPORT

2480	1MHz~2310MHz	-57.42	Pass
2480	2500MHz~5000MHz	-40.60	Pass
2480	5000MHz~25000MHz	-41.06	Pass
2480	Band Edge	-57.90	Pass
2480	Reference Level	2.40	Pass

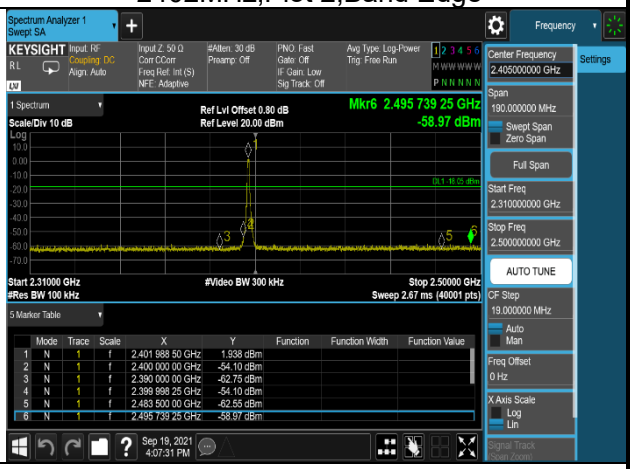
9.2 Test Plots

Data rate 1Mbps

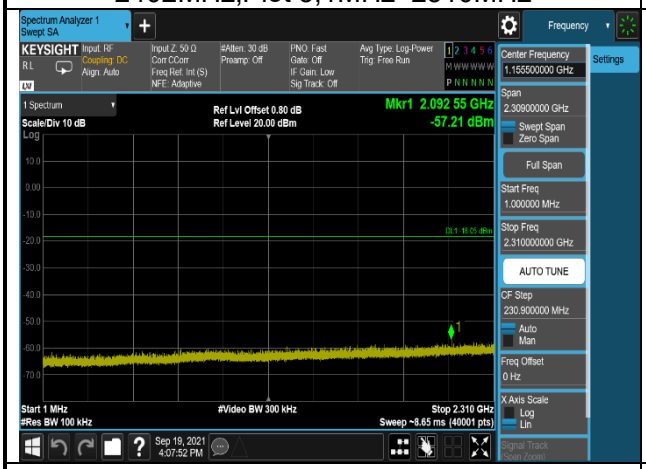
2402MHz,Plot 1,Reference Level



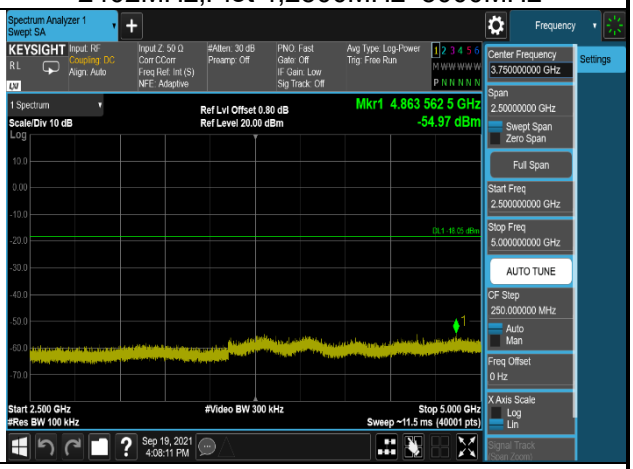
2402MHz,Plot 2,Band Edge



2402MHz,Plot 3,1MHz~2310MHz



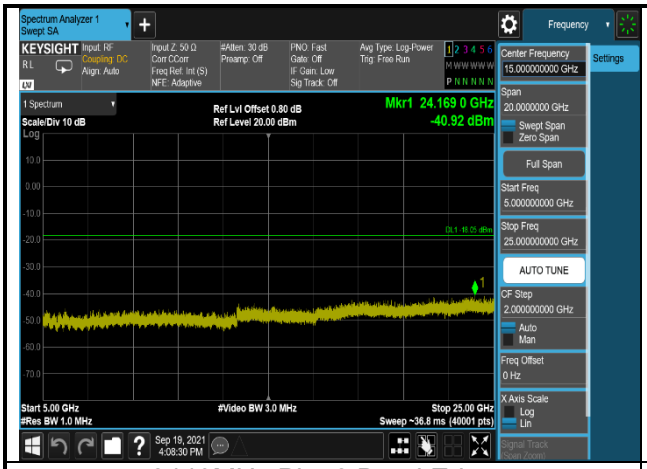
2402MHz,Plot 4,2500MHz~5000MHz



2402MHz,Plot 5,5000MHz~25000MHz

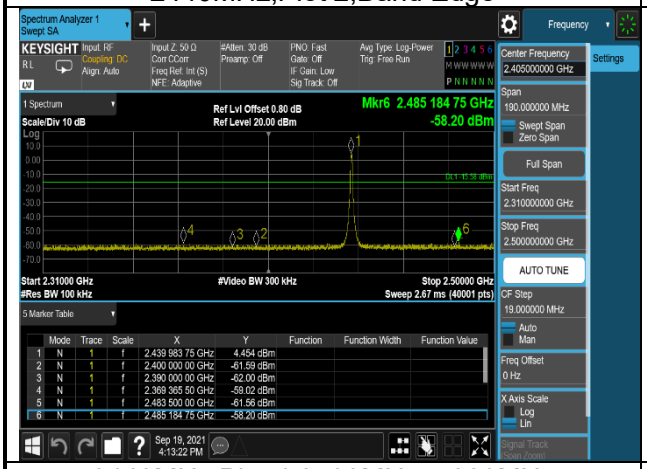
2440MHz,Plot 1,Reference Level

TEST REPORT

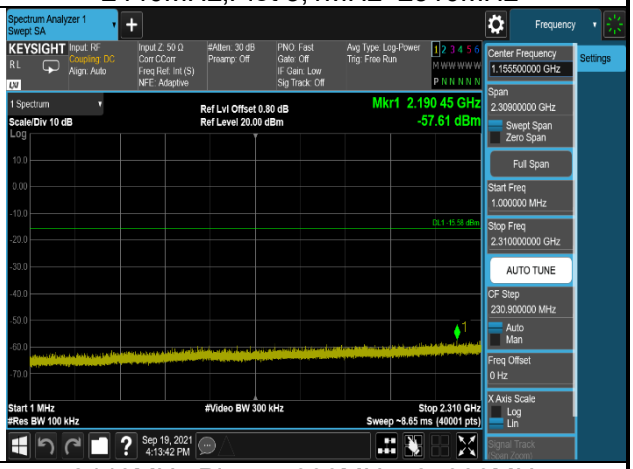


2440MHz,Plot 2,Band Edge

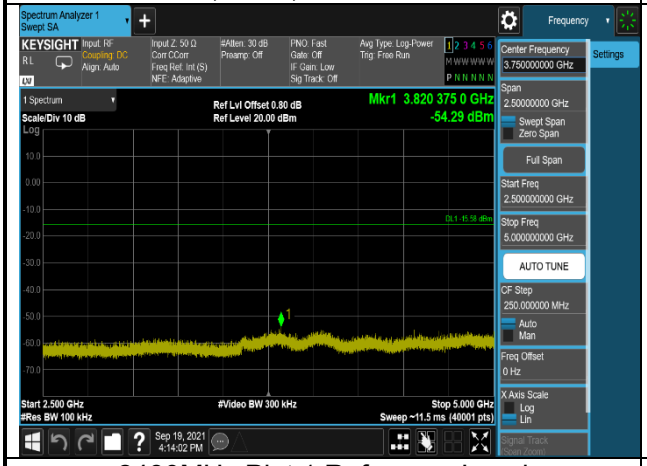
2440MHz,Plot 3,1MHz~2310MHz



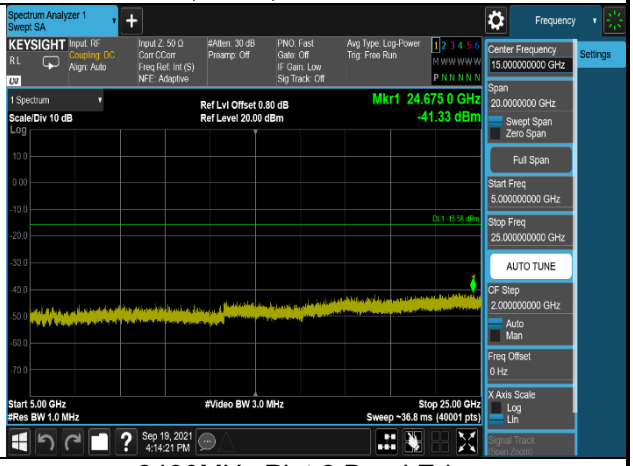
2440MHz,Plot 4,2500MHz~5000MHz



2440MHz,Plot 5,5000MHz~25000MHz



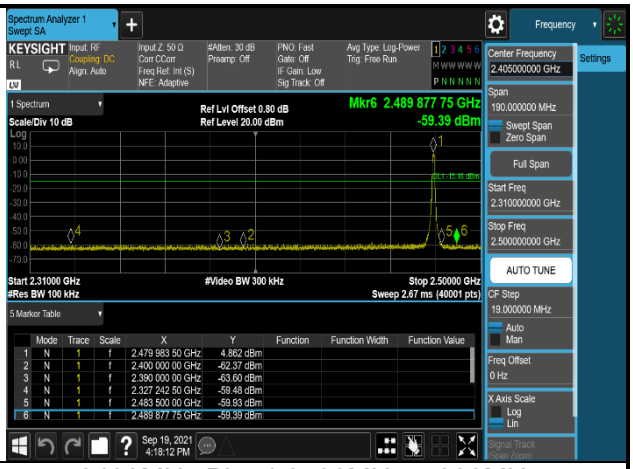
2480MHz,Plot 1,Reference Level



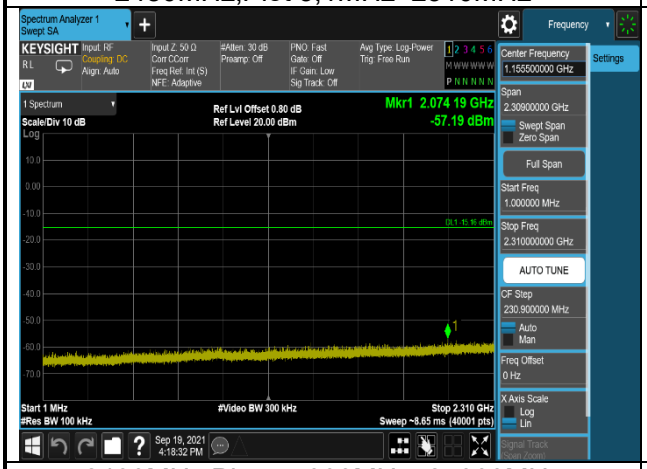
2480MHz,Plot 2,Band Edge

TEST REPORT

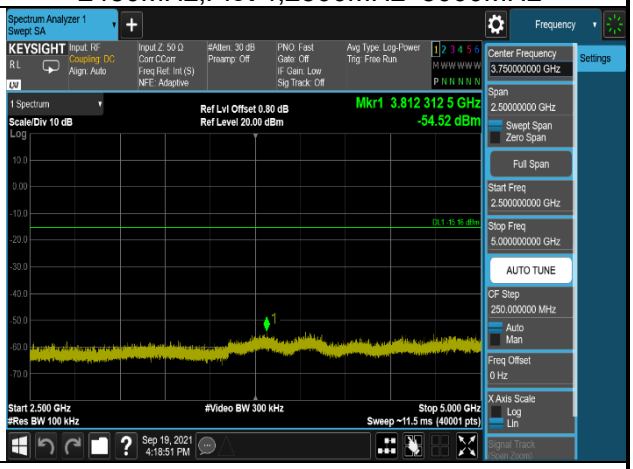
2480MHz,Plot 3,1MHz~2310MHz

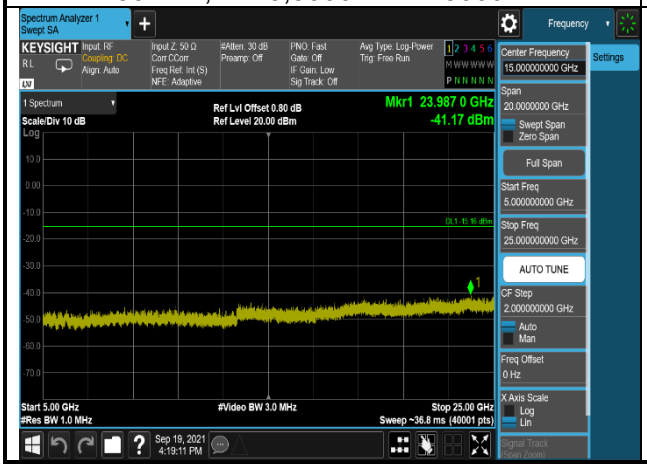


2480MHz,Plot 4,2500MHz~5000MHz



2480MHz,Plot 5,5000MHz~25000MHz



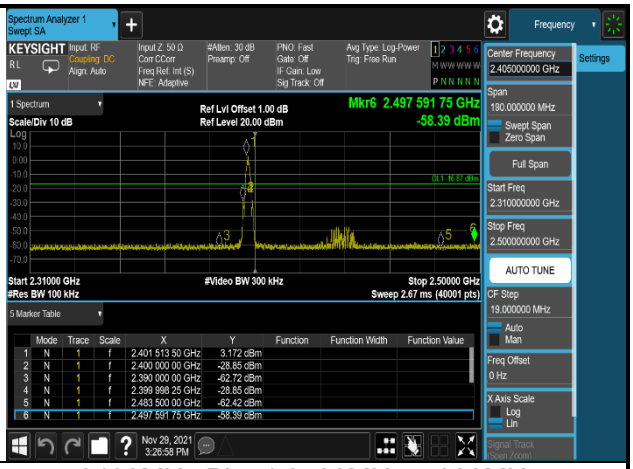


Data rate 2Mbps

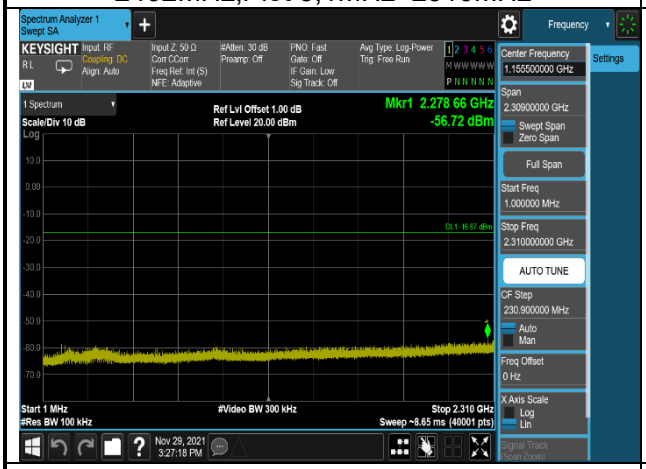
2402MHz,Plot 1,Reference Level	2402MHz,Plot 2,Band Edge

TEST REPORT

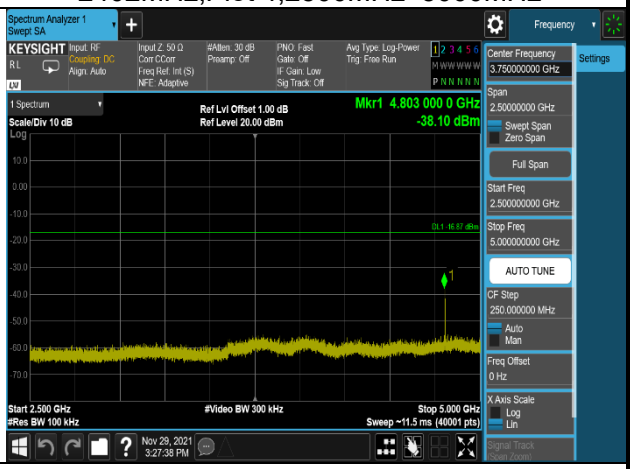
2402MHz,Plot 3,1MHz~2310MHz



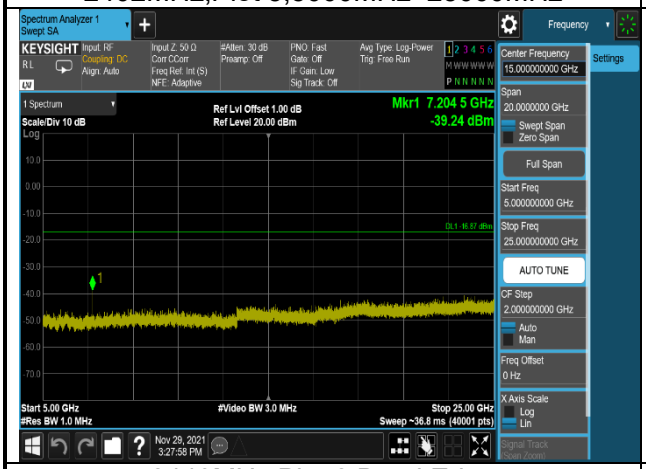
2402MHz,Plot 4,2500MHz~5000MHz



2402MHz,Plot 5,5000MHz~25000MHz



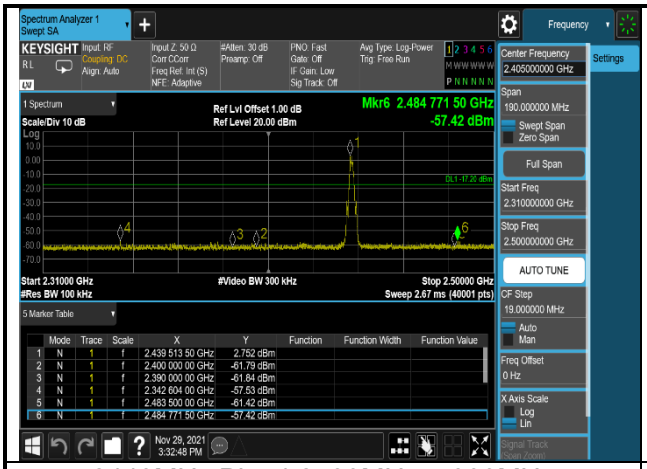
2440MHz,Plot 1,Reference Level



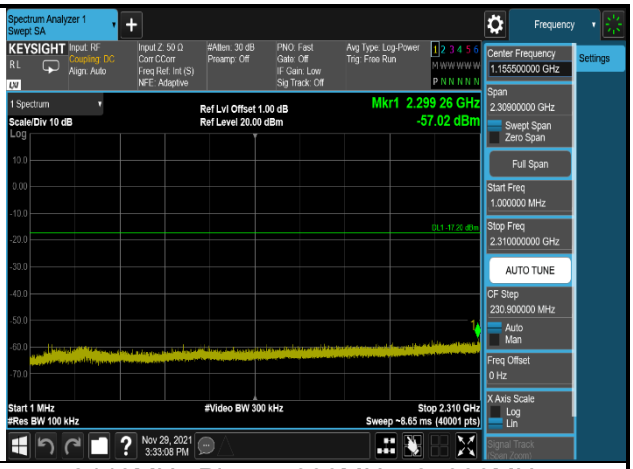
2440MHz,Plot 2,Band Edge

2440MHz,Plot 3,1MHz~2310MHz

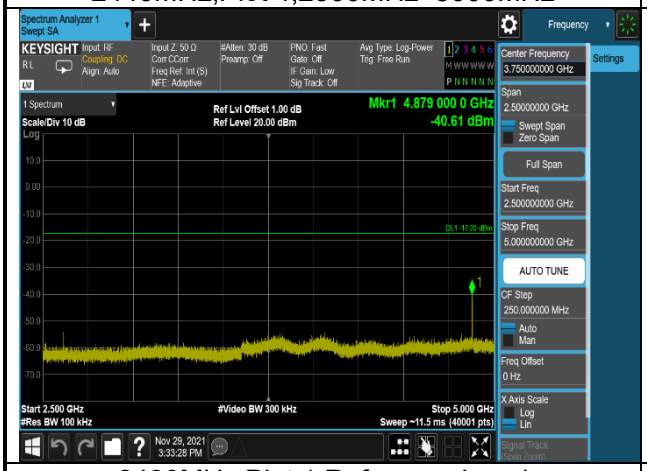
TEST REPORT



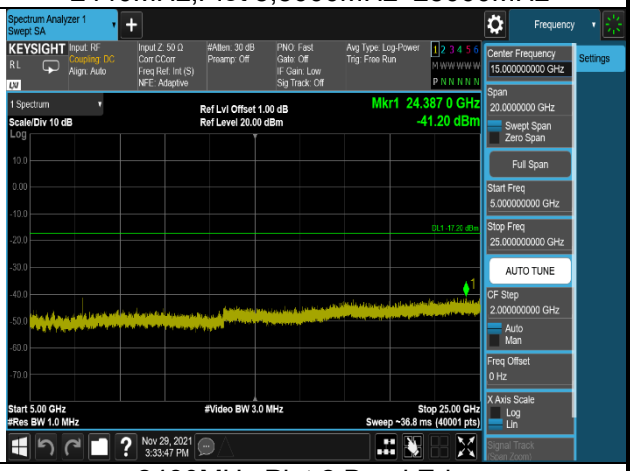
2440MHz,Plot 4,2500MHz~5000MHz



2440MHz,Plot 5,5000MHz~25000MHz

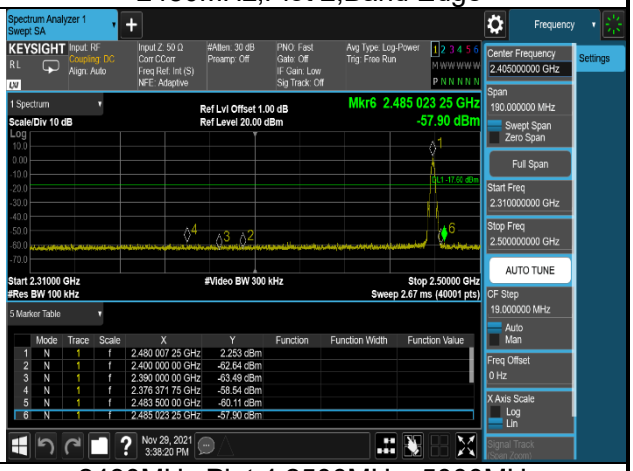


2480MHz,Plot 1,Reference Level



2480MHz,Plot 2,Band Edge

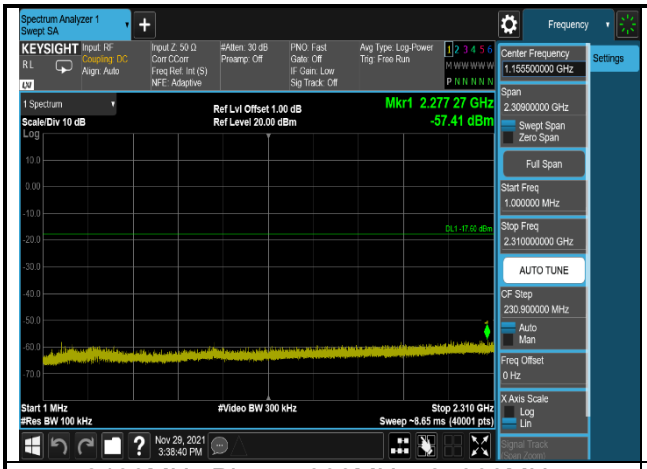
2480MHz,Plot 3,1MHz~2310MHz

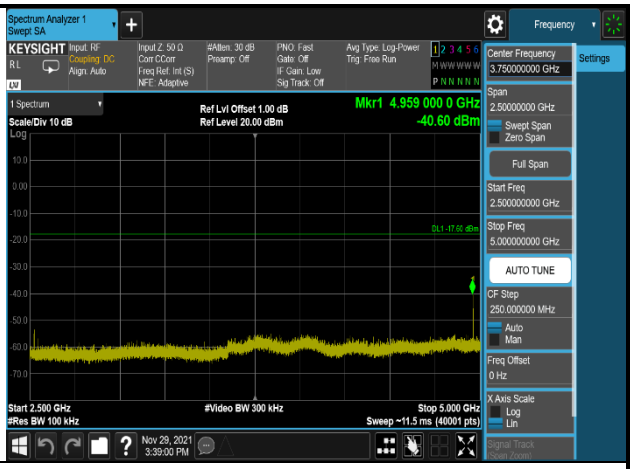


2480MHz,Plot 4,2500MHz~5000MHz

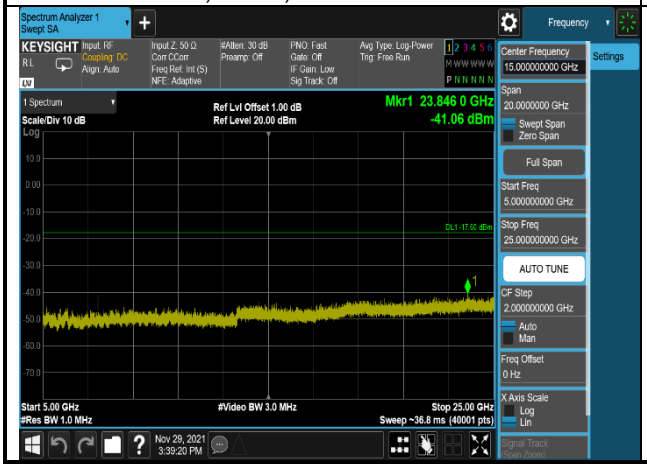
Total Quality. Assured.

TEST REPORT





2480MHz,Plot 5,5000MHz~25000MHz



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