

RF TEST REPORT for Intentional Radiator
No. 171000532SHA-001

Applicant : Stanley Black & Decker, Inc.
400 Executive Blvd S, Southington, CT 06489 USA
Manufacturer : Stanley Black & Decker, Inc.
400 Executive Blvd S, Southington, CT 06489 USA
Product Name : Spot Light
Type/Model : DWHT81423
TEST RESULT : PASS

SUMMARY

The equipment complies with the requirements according to the following standard(s) or specification:

47CFR Part 15 (2017): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-247 Issue 2 (February 2017): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5 (November 2018): General Requirements for Compliance of Radio Apparatus

Date of issue: Jun 28, 2018

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1 GENERAL INFORMATION

1.1 Description of Client

Applicant : Stanley Black & Decker, Inc.
400 Executive Blvd S, Southington, CT 06489 USA
Name of contact : Adam Rolfe
Tel :
Fax :
Manufacturer : Stanley Black & Decker, Inc.
400 Executive Blvd S, Southington, CT 06489 USA

1.2 Identification of the EUT

Product Name : Spot Light
Type/model : DWHT81423
Rating : 120V~, 60Hz, 0.3A

FCC ID : 2ANWFDWHT81423
IC ID : 23237-DWHT81423

1.3 Technical Specification

Operation Frequency : 2402~2480 MHz;
Band

Type of Modulation : GFSK

Protocol : Bluetooth BLE

Description of EUT : The EUT is a wireless device with Bluetooth BLE mode.
We tested the 2402CH , 2440CH and 2480CH and listed
the worst data in this report.

Antenna : Cable Antenna, 2.0dBi

Category of EUT : Class B

EUT type : ☒ Table top
☐ Floor standing

Sample received date : Oct 30, 2017

Date of test : Nov 7, 2017

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2017)

ANSI C63.10 (2013)

DA 00-705

RSS-247 Issue 2 (February 2017)

RSS-Gen Issue 5 (November 2018)

2.2 Mode of operation during the test

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

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 Measurement uncertainty

TEST ITEM	MEASUREMENT UNCERTAINTY
Maximum peak output power	$\pm 0.74\text{dB}$
Radiated Emissions in restricted frequency bands below 1GHz	$\pm 4.90\text{dB}$
Radiated Emissions in restricted frequency bands above 1GHz	$\pm 5.02\text{dB}$
Power line conducted emission	$\pm 3.19\text{dB}$

2.5 Test peripherals list

Item No.	Name	Band and Model	Description
PC	HP ProBook 6450b	HP	-

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESCS 30	EC 2107	2018-09-12
☒	A.M.N.	R&S	ESH2-Z5	EC 3119	2017-12-01
☒	Shielded room	Zhongyu	-	EC 2838	2018-01-08
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Test Receiver	R&S	ESIB 26	EC 3045	2018-09-12
☒	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2018-05-30
☒	Horn antenna	R&S	HF 906	EC 3049	2018-09-23
☒	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2018-07-09
☒	Pre-amplifier	R&S	Pre-amp 18	EC5881	2018-06-19
☒	Semi-anechoic chamber	Albatross project	-	EC 3048	2018-03-09
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2018-09-10
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 2323	2018-06-14
☒	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3325	2018-03-23

2.7 Test Summary

This report applies to tested sample only. The test results have been compared directly with the limits, and the measurement uncertainty is recorded. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

Test Items	FCC Reference	IC Reference	Result
Minimum 6dB Bandwidth& Occupied bandwidth	15.247(a)(2)	RSS-247 Issue 2 Clause 5	Pass
Output power	15.247(b)	RSS-247 Issue 2 Clause 5	Pass
Power spectrum density	15.247(e)	RSS-247 Issue 2 Clause 5	Pass
Emissions in non-restricted frequency bands	15.247(d)	RSS-247 Issue 2 Clause 5	Pass
Emissions in restricted frequency bands	15.247(d) & 15.205 & 15.209	RSS-247 Issue 2 Clause 5	Pass
Power line conducted emission	15.207	RSS-Gen Issue 5 Clause 8.8	Pass

Notes: 1: NA =Not Applicable

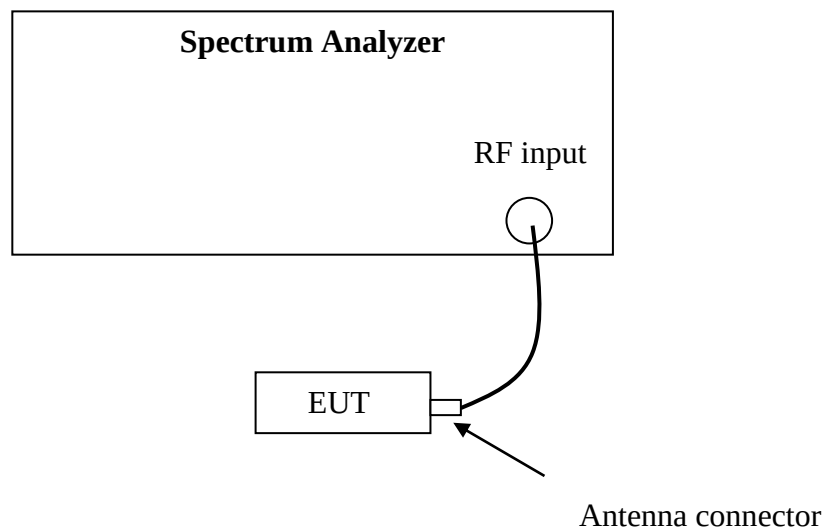
3 Minimum 6dB Bandwidth& Occupied bandwidth

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 Test Configuration



3.3 Test Procedure and test setup

The minimum 6dB bandwidth per FCC §15.247(a)(2) is measured using the Spectrum Analyzer according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance v04” for compliance to FCC 47CFR 15.247 requirements (clause 8.2).

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times$ 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.

3.4 Test Protocol

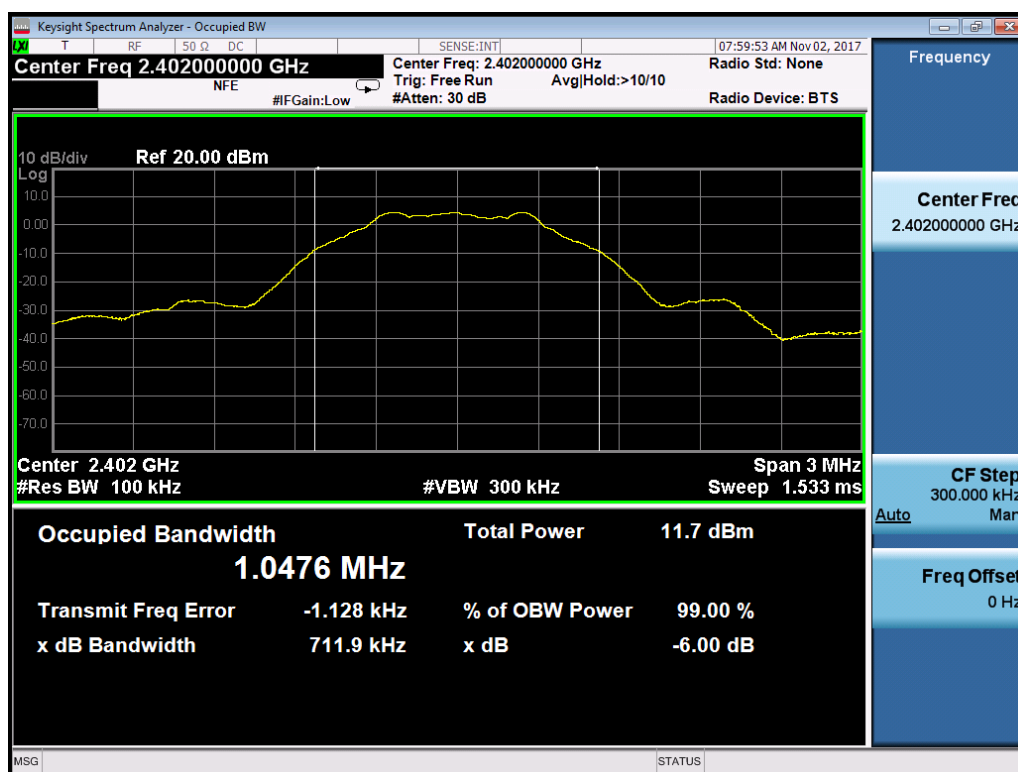
Temperature: 24 °C

Relative Humidity: 52 %

Modulation	Frequency (MHz)	Minimum 6dB Bandwidth (KHz)	Limits (KHz)
BLE	2402	711.9	> 500
	2442	700.9	> 500
	2480	711.5	> 500

Modulation	Frequency (MHz)	99% Occupied Bandwidth (MHz)
BLE	2402	1.0287
	2440	1.0283
	2480	1.0315

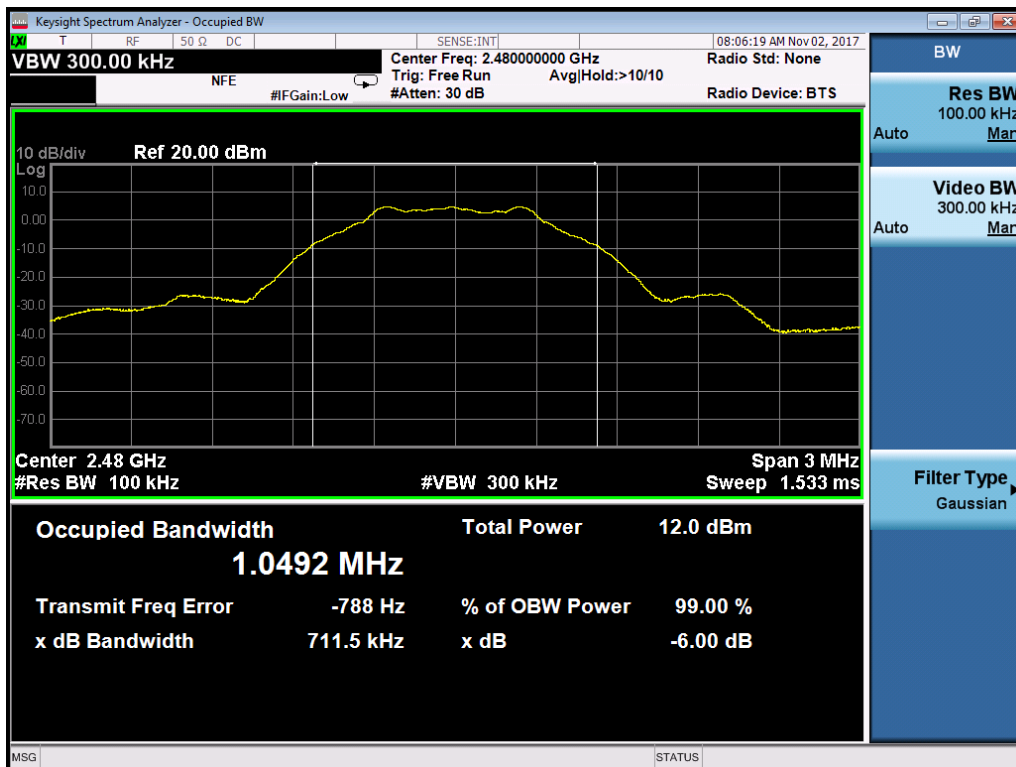
Channel L



Channel M



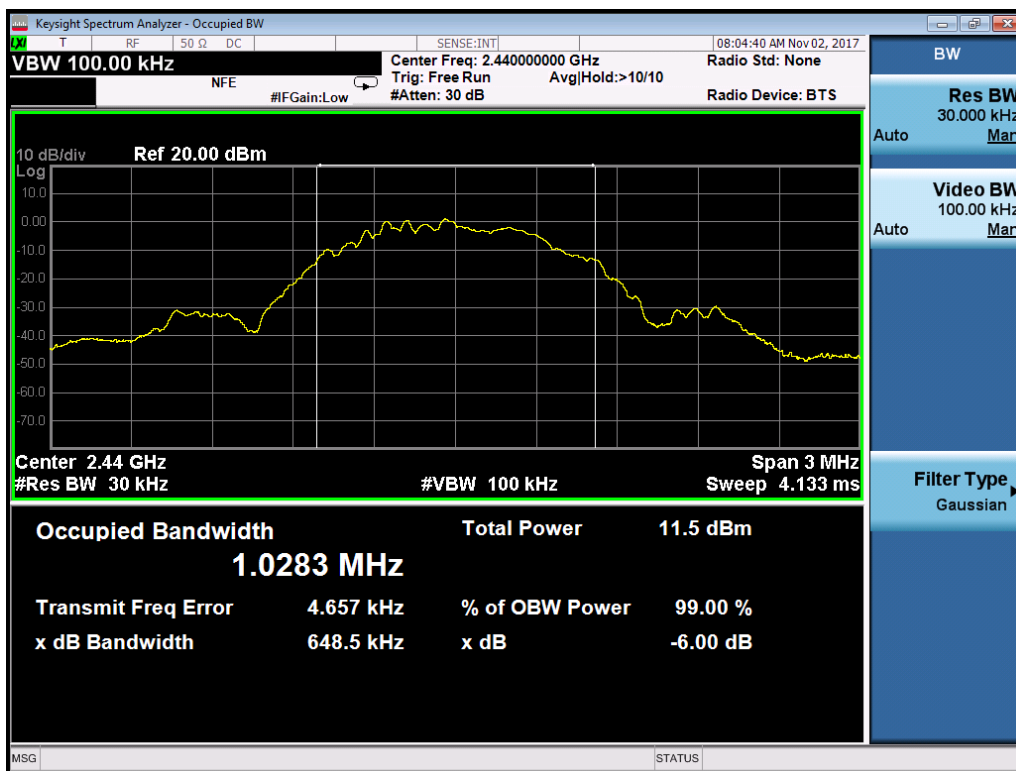
Channel H



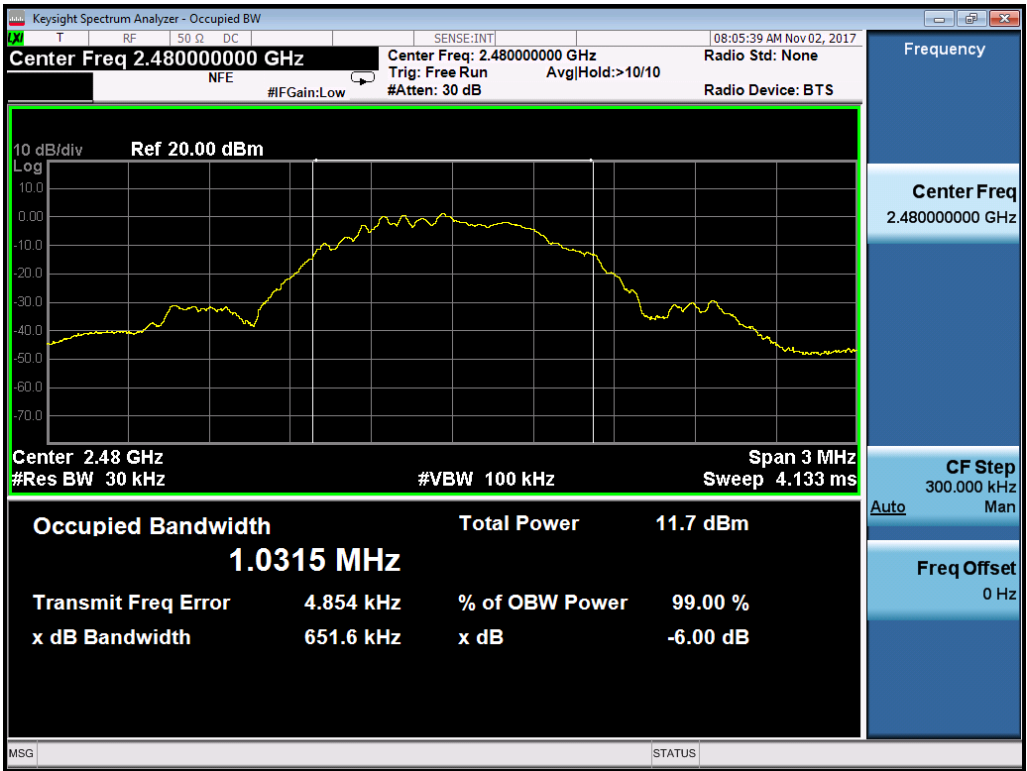
Channel L



Channel M



Channel H



4 Maximum Conducted Output power

Test result: Pass

4.1 Test limit

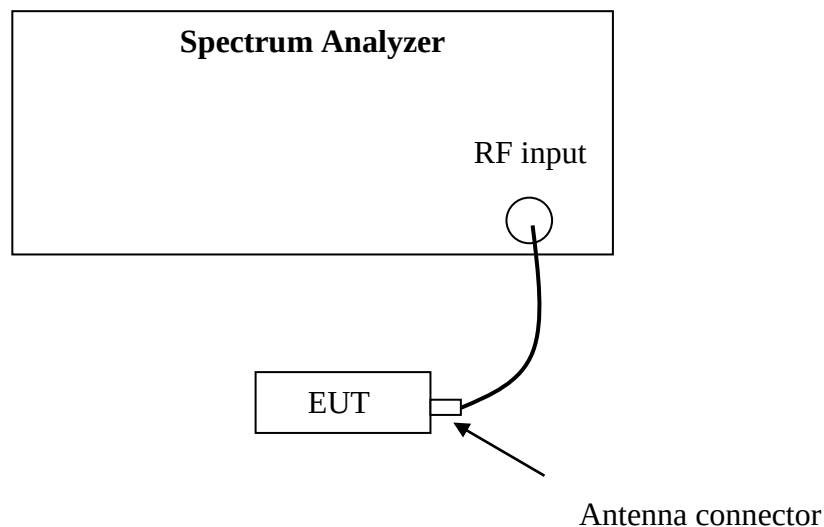
☐ For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

☐ For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

☒ For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt (EIRP: 4 watt).

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 Test Configuration



4.3 Test procedure and test setup

- a) Set the $RBW \geq$ DTS bandwidth.
- b) Set $VBW \geq 3 \times RBW$.
- c) Set span $\geq 3 \times RBW$
- 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.

4.4 Test protocol

Temperature: 24 °C

Relative Humidity: 52 %

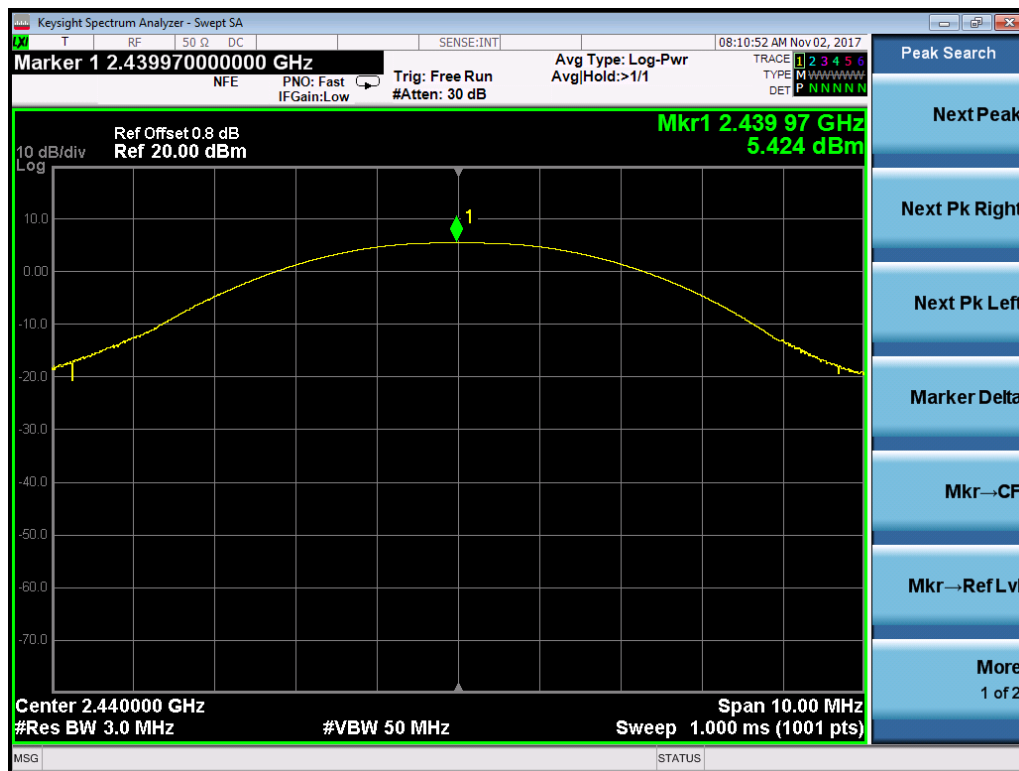
Modulation	Frequency (MHz)	MaxConducted Power (dBm)	Limit (dBm)
BLE	2402	5.307	30
	2440	5.424	30
	2480	5.472	30

Conclusion: The maximum EIRP = 5.472 dBm+2.0dBi = 7.472dBm = 0.0056W which is lower than the limit of 4W listed in RSS-247.

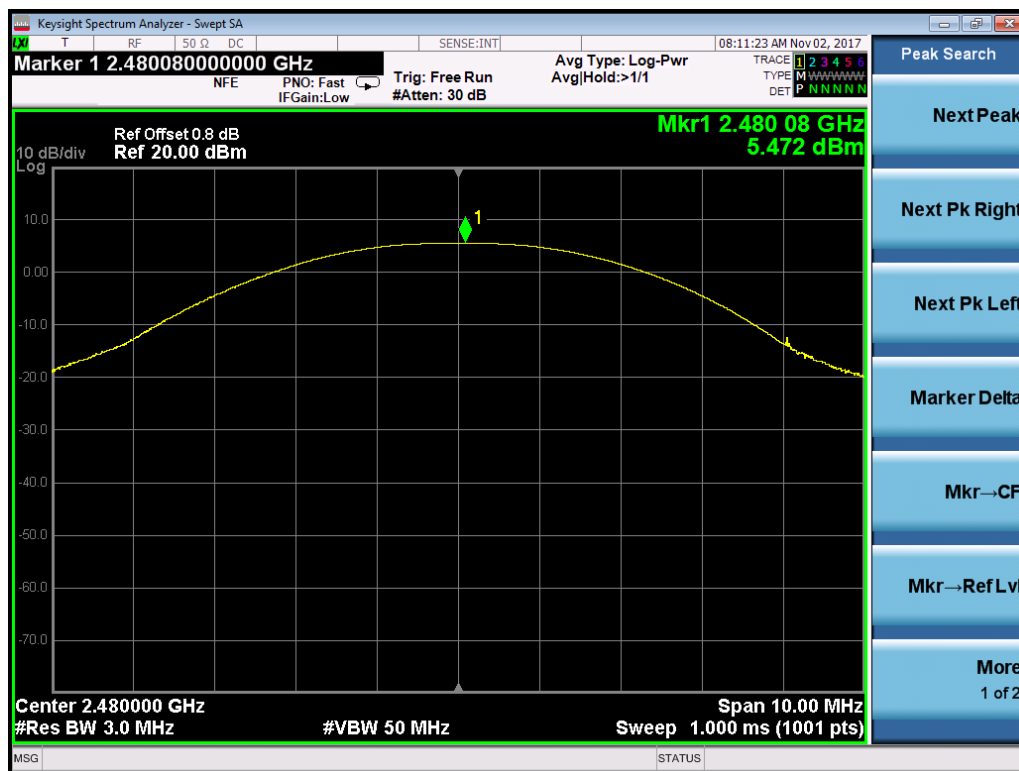
Channel L



Channel M



Channel H



5 Power spectrum density

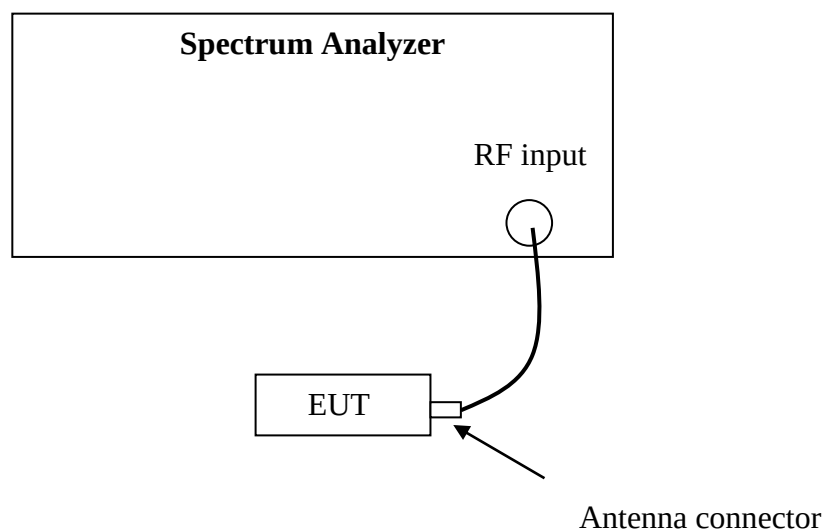
Test result: Pass

5.1 Test 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 $8 + (6 - \text{antenna gain-beam forming gain})$.

5.2 Test Configuration



5.3 Test procedure and test setup

The power output per FCC §15.247(e) was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance v04” (clause 10.2) for compliance to FCC 47CFR 15.247 requirements.

- 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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- 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.

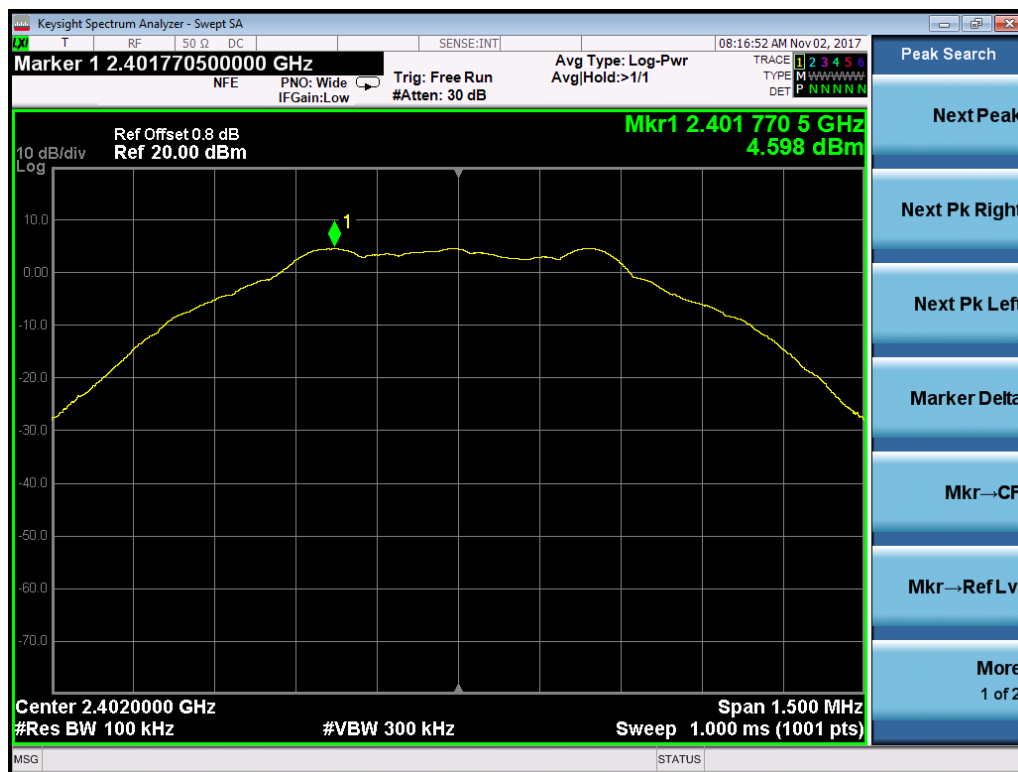
5.4 Test Protocol

Temperature: 24 °C

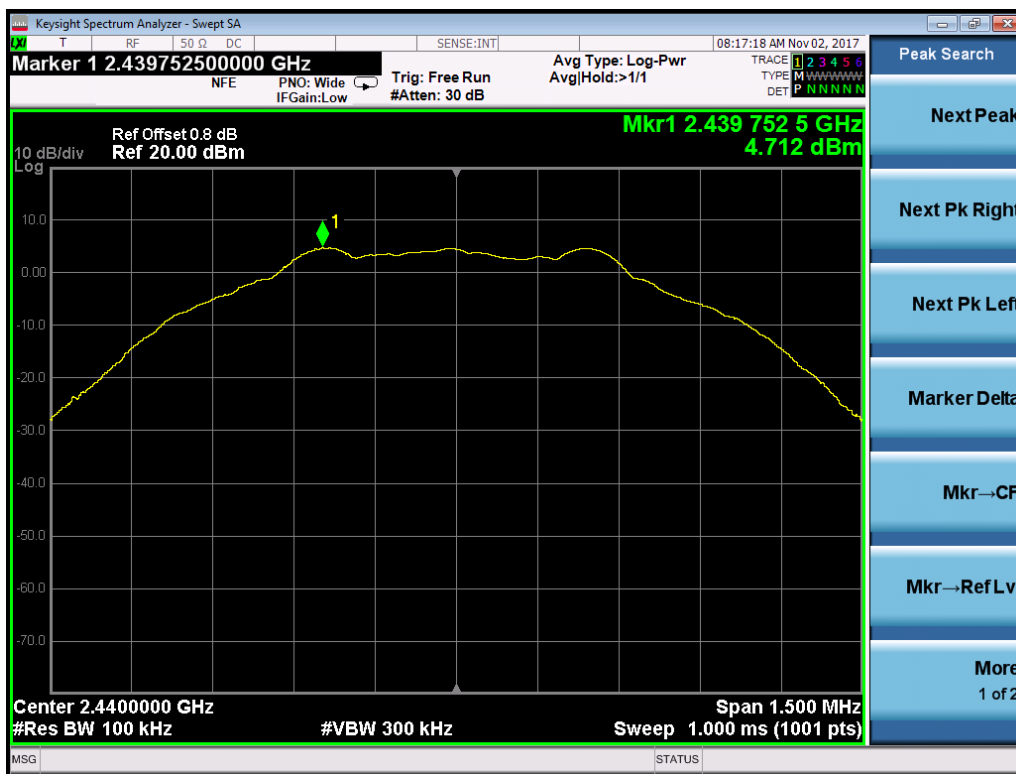
Relative Humidity: 52 %

Modulation	Frequency (MHz)	Maximum Power spectrum density (dBm/100KHz)	Limit (dBm/3KHz)
BLE	2402	4.598	8
	2440	4.712	8
	2480	4.740	8

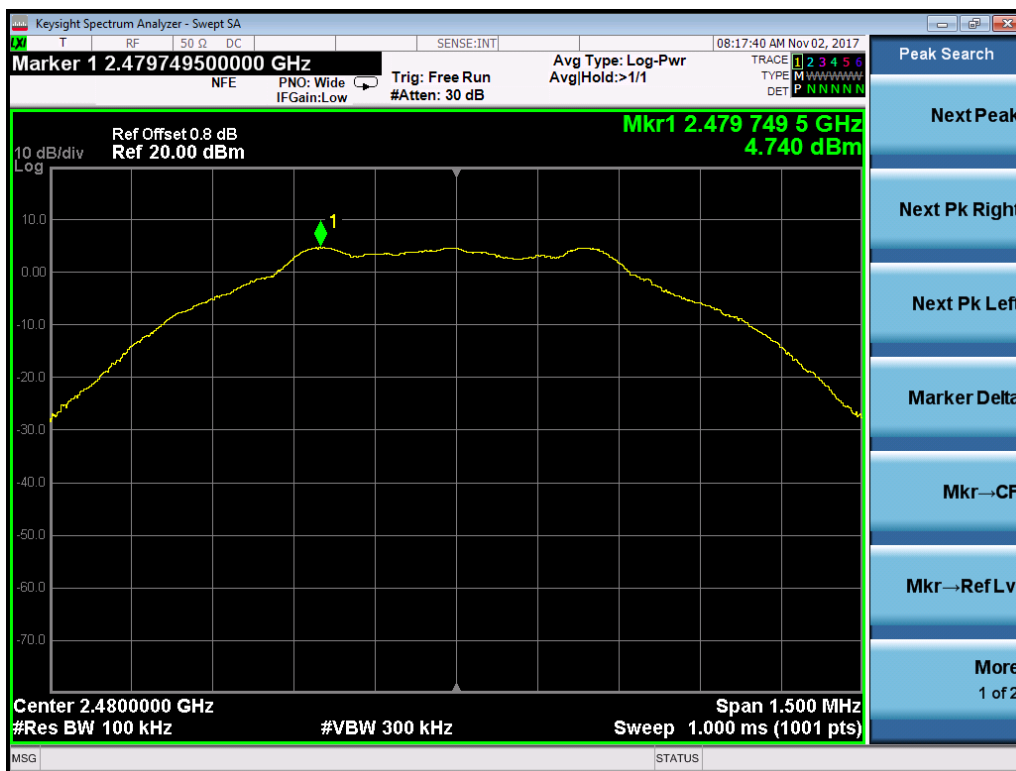
Channel L



Channel M



Channel H



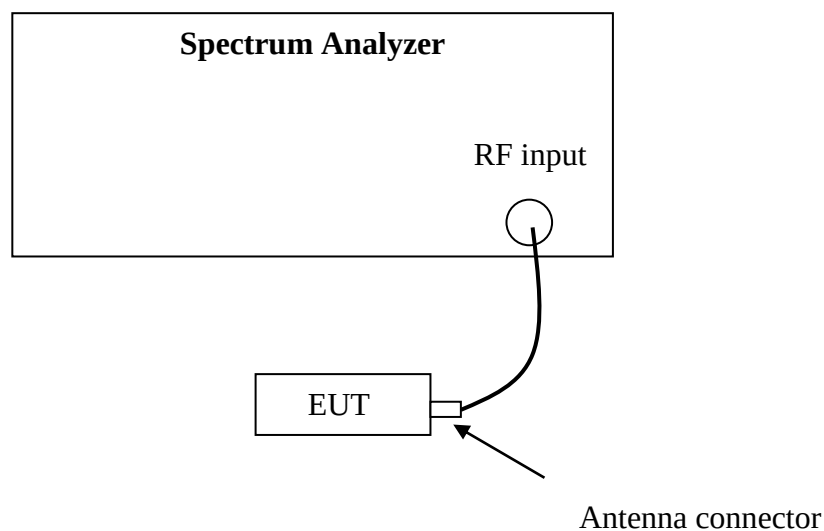
6 Emissions in non-restricted frequency bands

Test result: Pass

6.1 Test 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 Test Configuration



6.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance v04” (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

Reference level measurement

Establish a reference level by using the following procedure:

- Set instrument center frequency to DTS channel center frequency.
- Set the span to ≥ 1.5 times the *DTS bandwidth*.
- Set the RBW = 100 kHz.
- Set the VBW $\geq 3 \times$ RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.

- i) Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference 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 $\geq 3 \times$ 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.

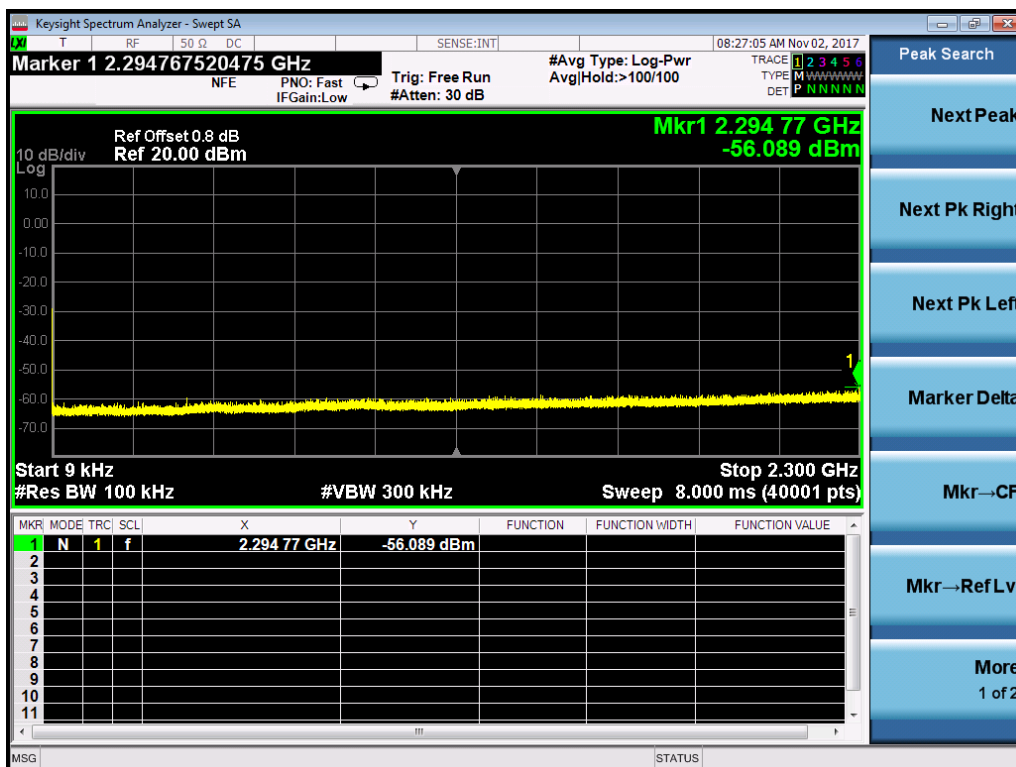
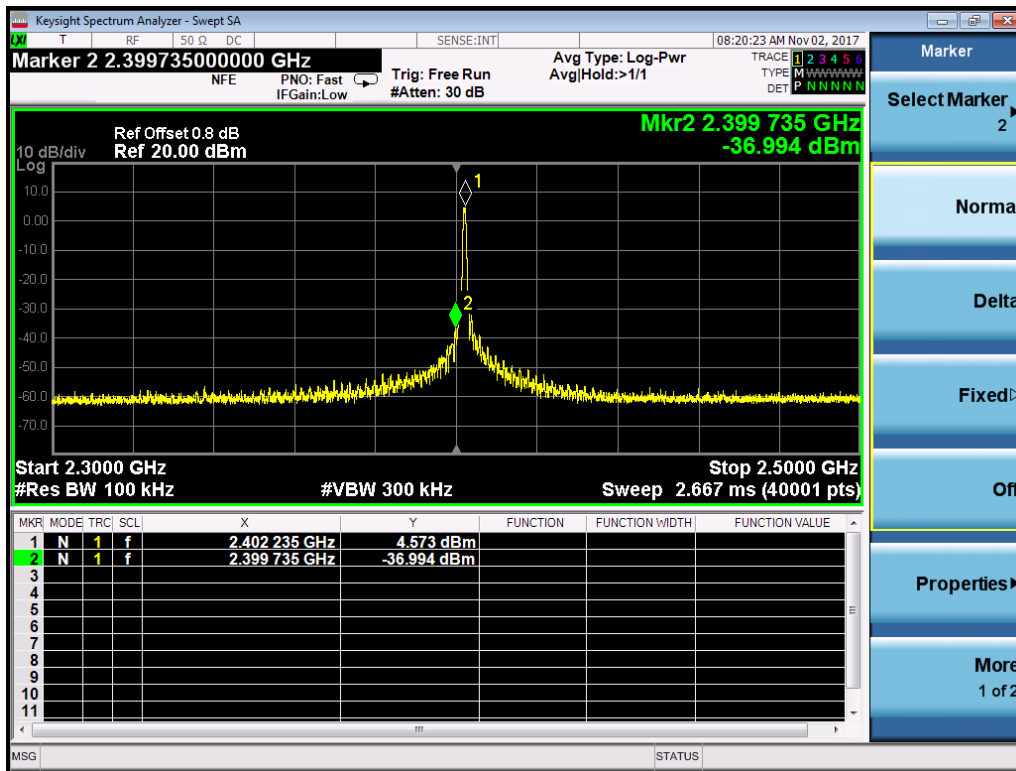
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

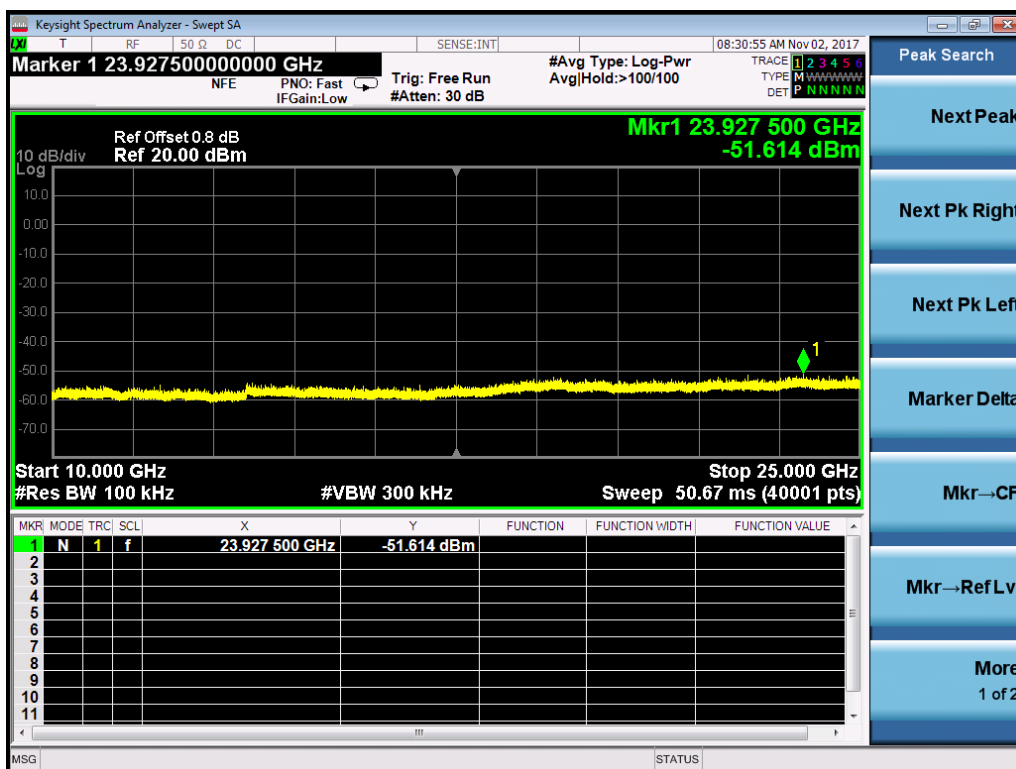
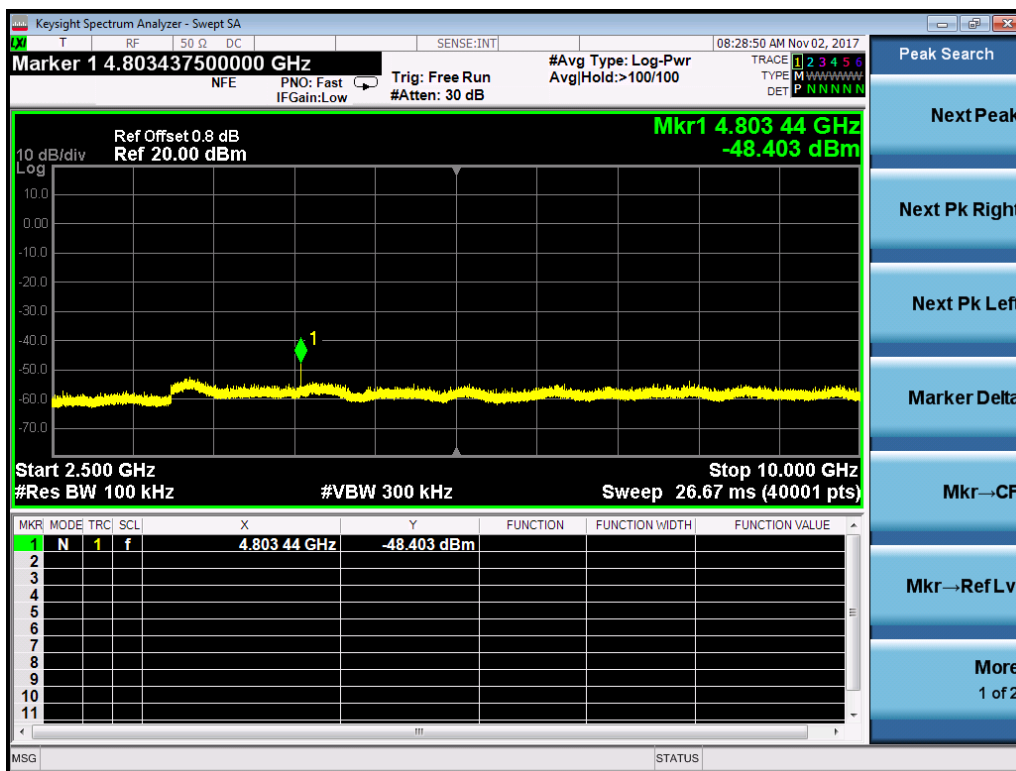
6.4 Test Protocol

Temperature: 24 °C

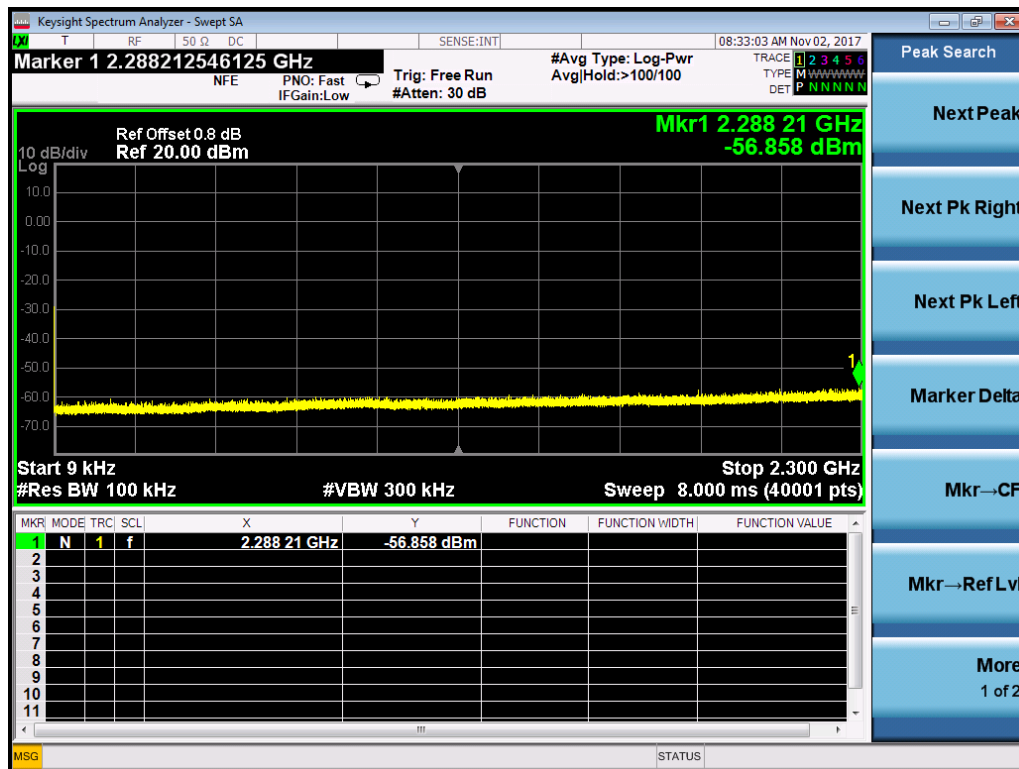
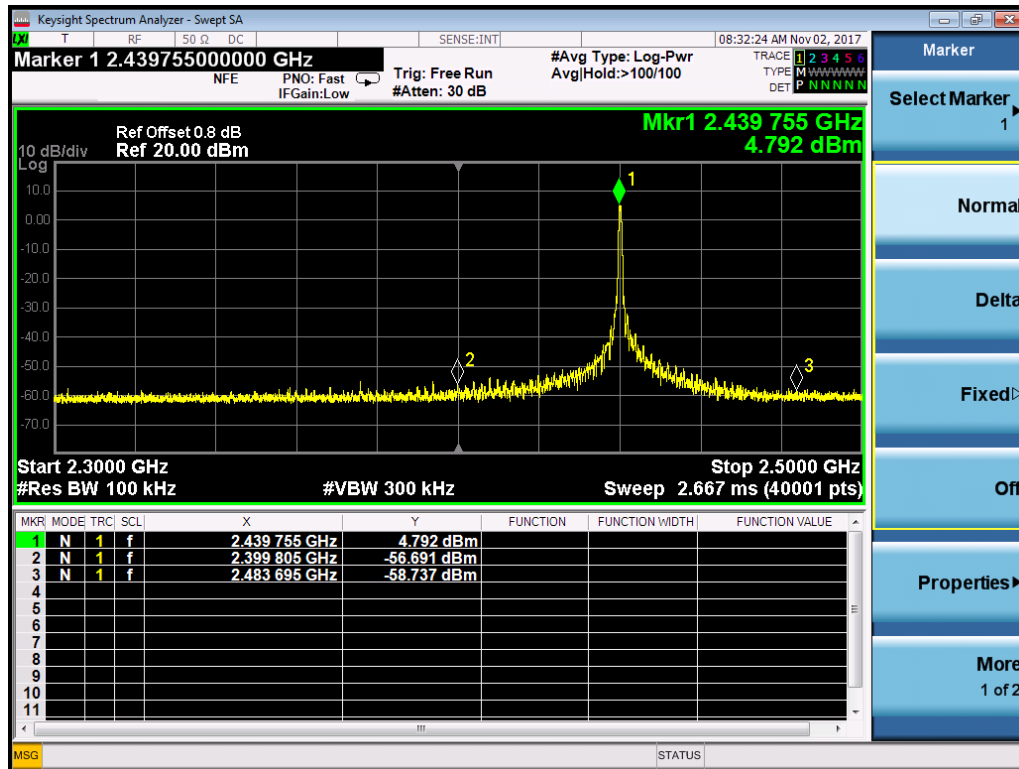
Relative Humidity: 52 %

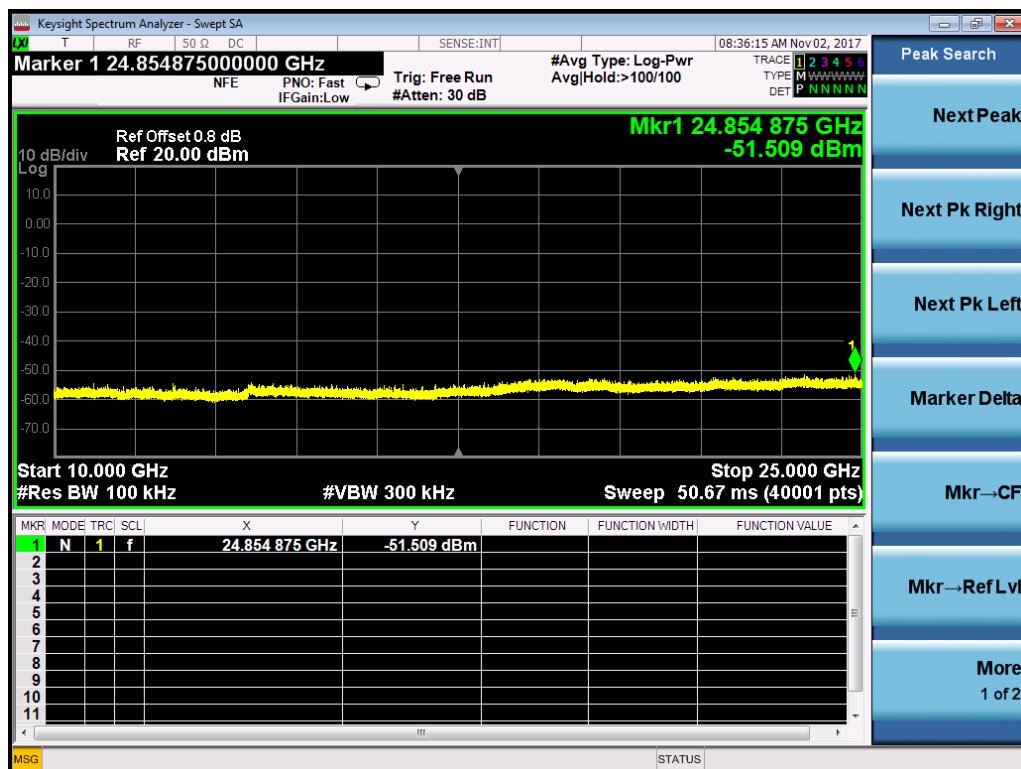
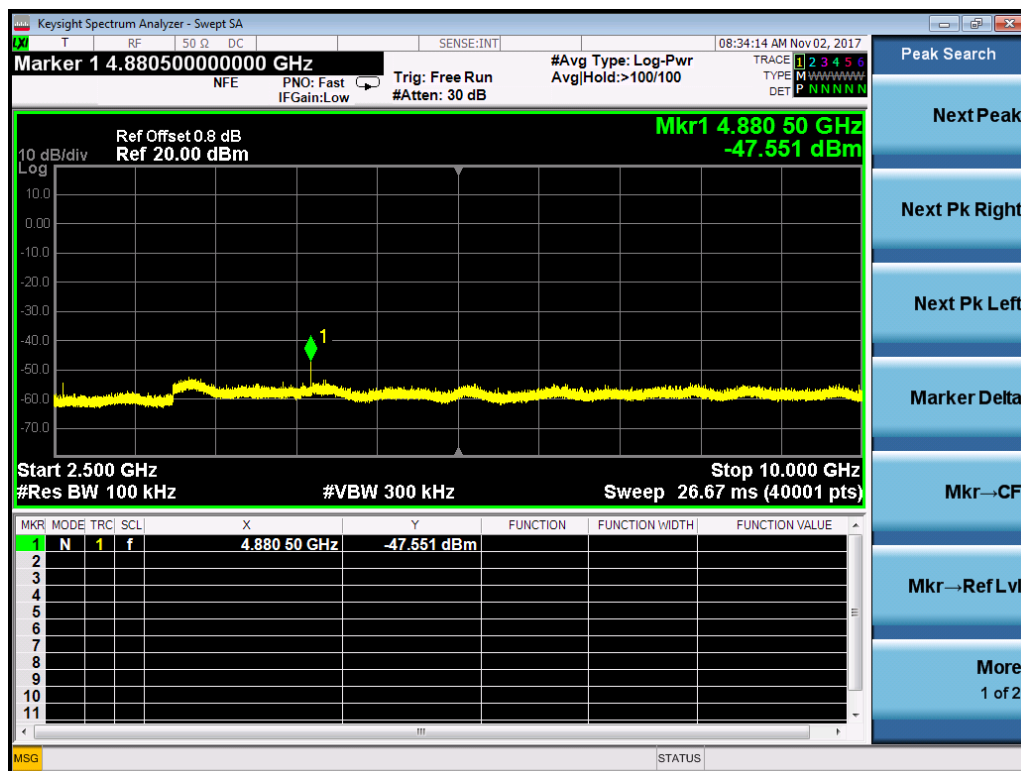
Channel L



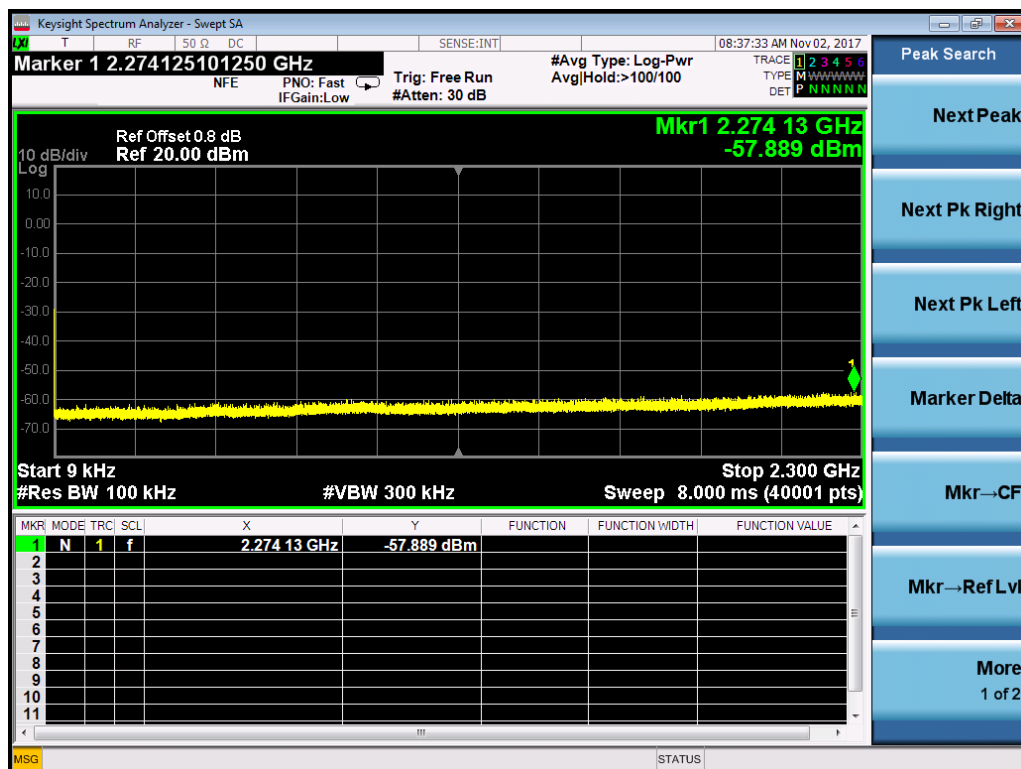
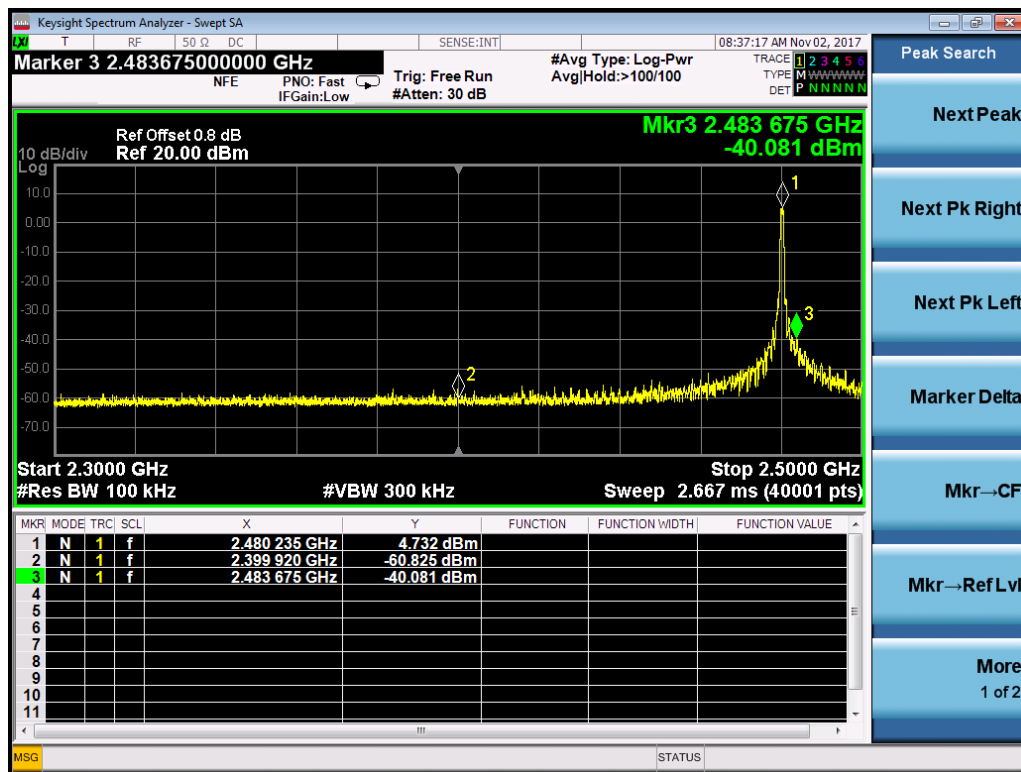


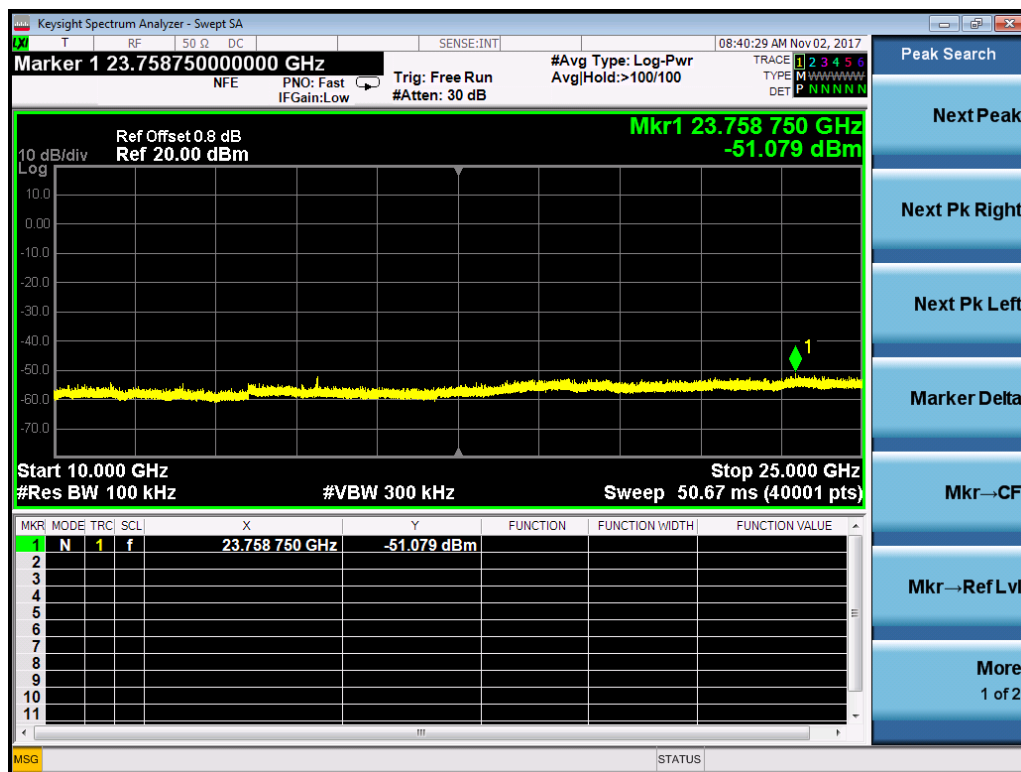
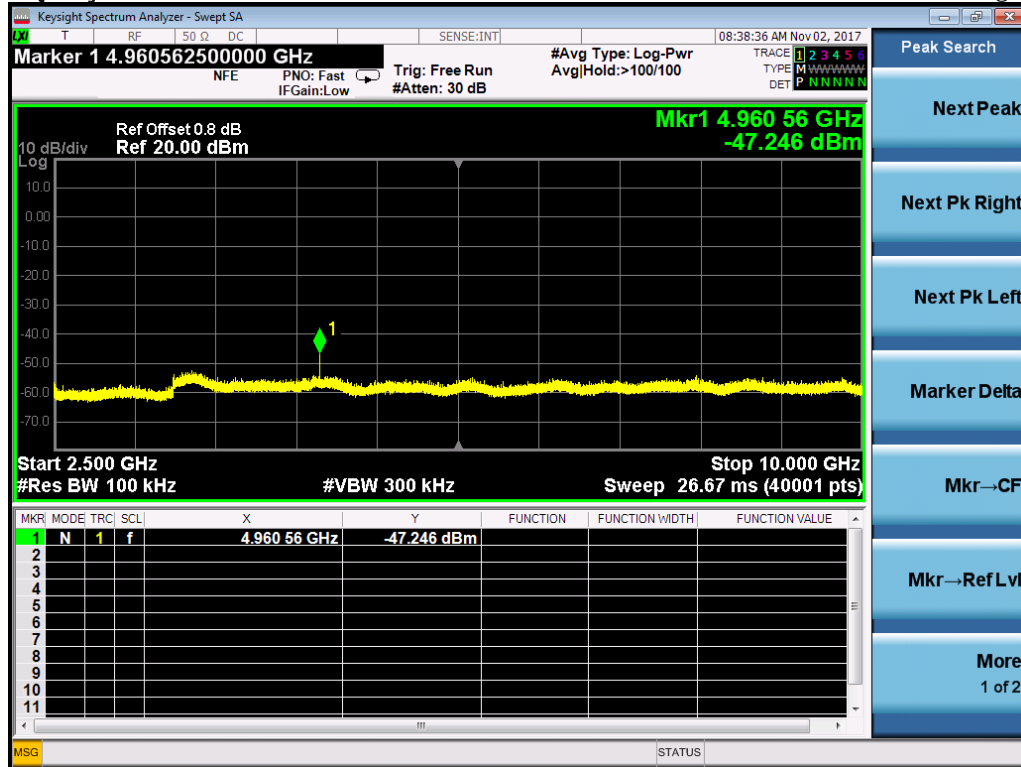
Channel M





Channel H





7 Radiated Emissions in restricted frequency bands

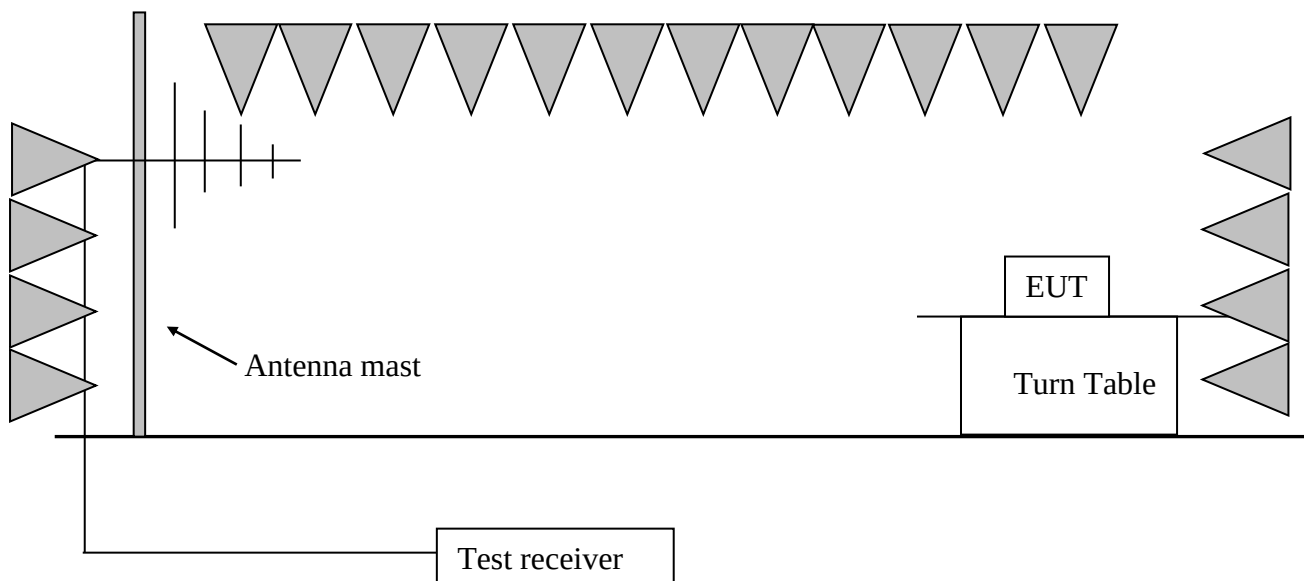
Test result: Pass

7.1 Test limit

The radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) 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 Test Configuration



7.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

Tabletop devices shall be placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The EUT was tested according to DTS test procedure of KDB558074 D01 DTS “Meas Guidance v04” for compliance to FCC 47CFR 15.247 requirements.

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 300 Hz, VBW = 1 kHz (9 kHz~150 kHz);
RBW = 10 kHz, VBW = 30 kHz (150 kHz~30MHz);
RBW = 100 kHz, VBW = 300 kHz (30MHz~1GHz for PK)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);

Remark:

1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. If the PK measured level is lower than AV limit, the AV test can be elided.

Example:

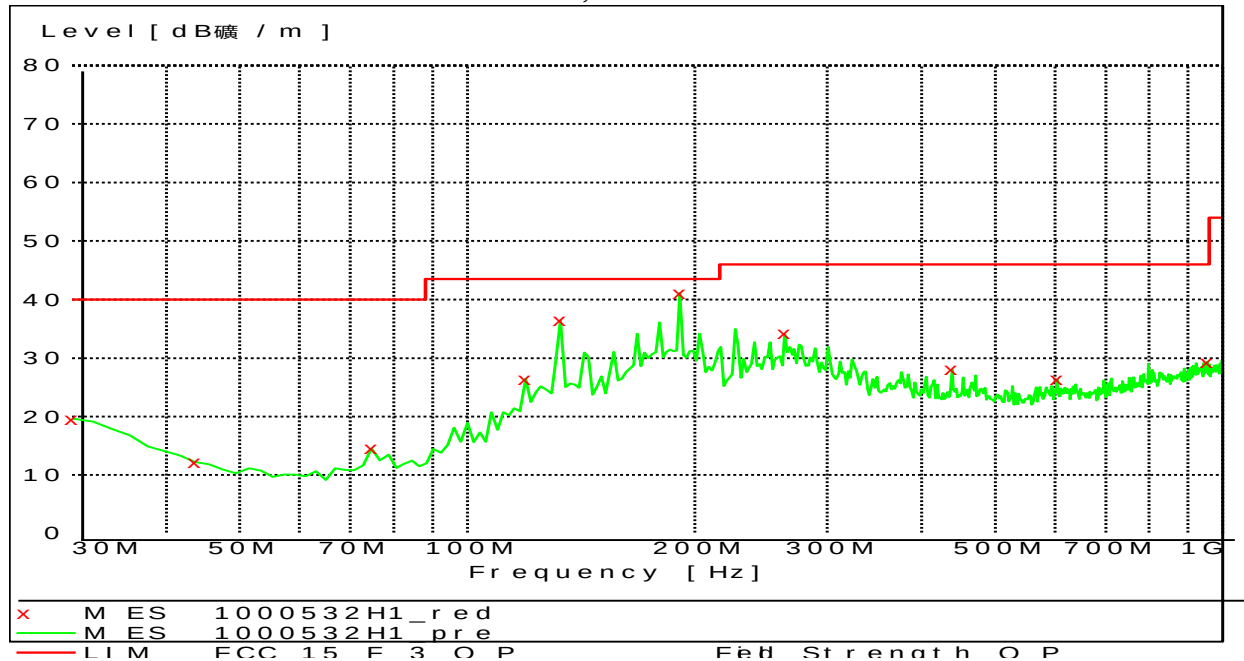
Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Measured level = 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m,
Measured level = 10.20dBuV/m, then Margin = 54 - 10.20 = 43.80dBuV/m.

Temperature: 24 °C

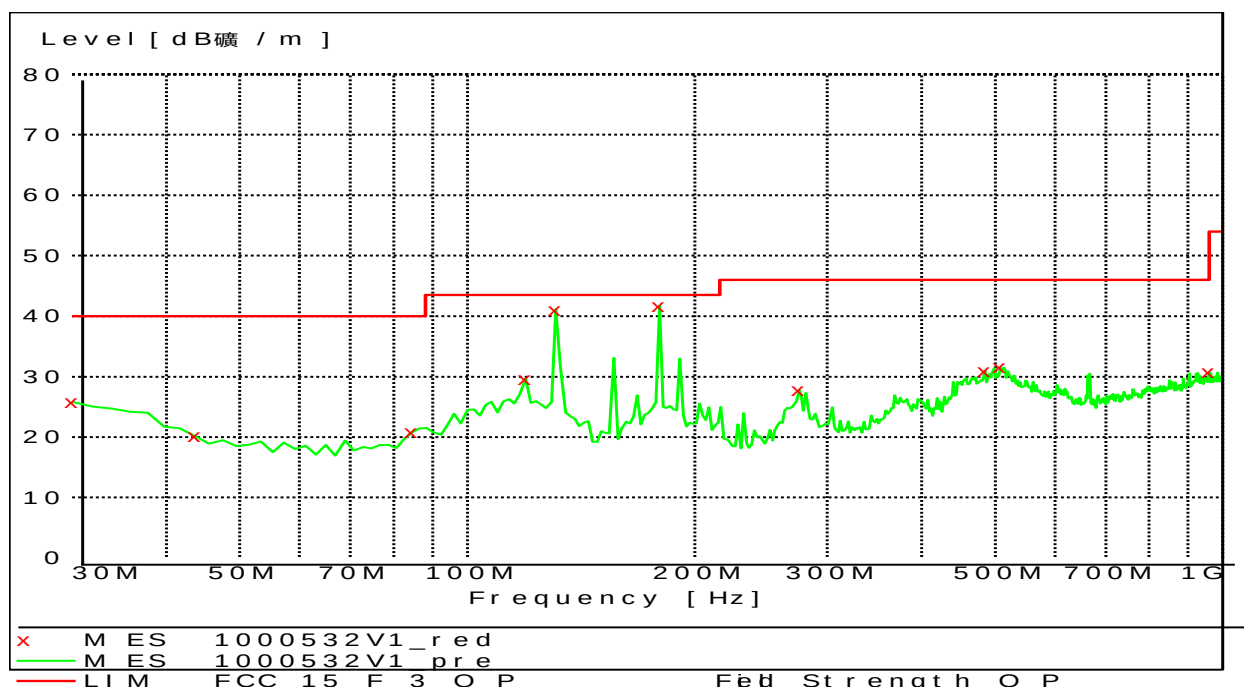
Relative Humidity: 52 %

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.

30MHz~1GHz, Horizontal



30MHz~1GHz, Vertical



Test data at 30MHz~1GHz (Channel L):

Polarization	Frequency (MHz)	Measured level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector
H	133.02	36.5	43.5	7.0	PK
	191.34	41.1	43.5	2.4	PK
	263.26	34.2	46.0	11.8	PK
V	131.08	41.8	43.5	1.7	PK
	179.67	41.7	43.5	1.8	PK
	508.19	31.5	46.0	14.5	PK

Note: The test result(30MHz to 1GHz) of channel L (2402MHz) chosen to list in the report as representative.

Test result above 1GHz:

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2402.00	30.70	99.10	Fundamental	/	PK
	H	2390.00	30.30	45.30	74.00	28.7	PK
	H	2390.00	30.30	35.70	54.00	18.3	AV
	H	4804.00	-1.50	50.90	74.00	23.1	PK
	H	4804.00	-1.50	41.30	54.00	12.7	AV
	H	7206.00	3.50	58.30	74.00	15.7	PK
	H	7206.00	3.50	49.50	54.00	4.5	AV
M	H	2442.00	30.70	98.60	Fundamental	/	PK
	V	4880.00	-1.10	48.40	74.00	25.6	PK
	H	7320.00	3.60	57.30	74.00	16.7	PK
	H	7320.00	3.60	48.50	54.00	5.5	AV
H	H	2480.00	30.70	97.40	Fundamental	/	PK
	V	2483.50	30.80	44.70	74.00	29.3	PK
	V	2483.50	30.80	35.10	54.00	18.9	AV
	V	4960.00	-0.80	49.80	74.00	24.2	PK
	H	7440.00	3.80	56.90	74.00	17.1	PK
	H	7440.00	3.80	47.70	54.00	6.3	AV

- Remark: 1. For fundamental emission, no amplifier is employed.
2. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
3. Corrected Reading = Original Receiver Reading + Correct Factor
4. Margin = limit – Corrected Reading
5. If the PK reading is lower than AV limit, the AV test can be elided.
6. The emission was conducted from 30MHz to 25GHz.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading
= 10dBuV + 0.20dB/m = 10.20dBuV/m
Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then Margin
= 54 -10.20 = 43.80dBuV/m

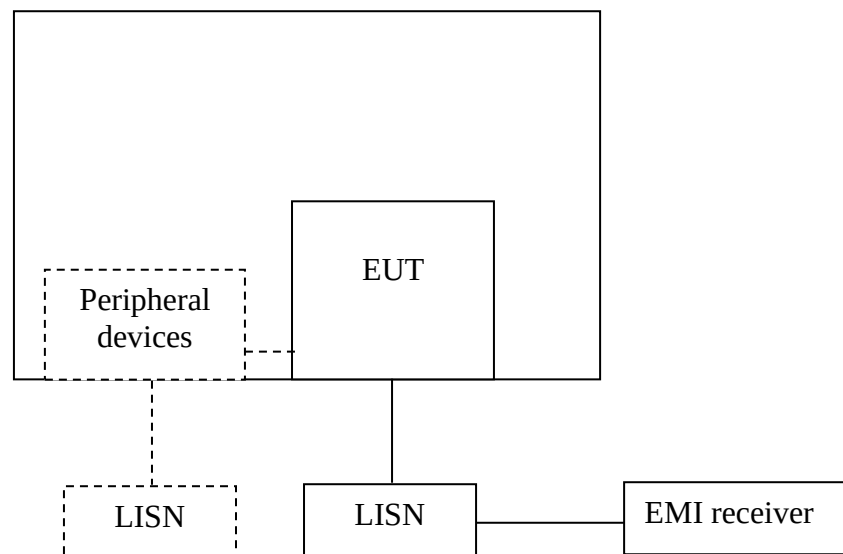
8 Power line conducted emission

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



☒ For table top equipment, wooden support is 0.8m height table

☐ For floor standing equipment, wooden support is 0.1m height rack.

8.3 Test procedure and test set up

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.

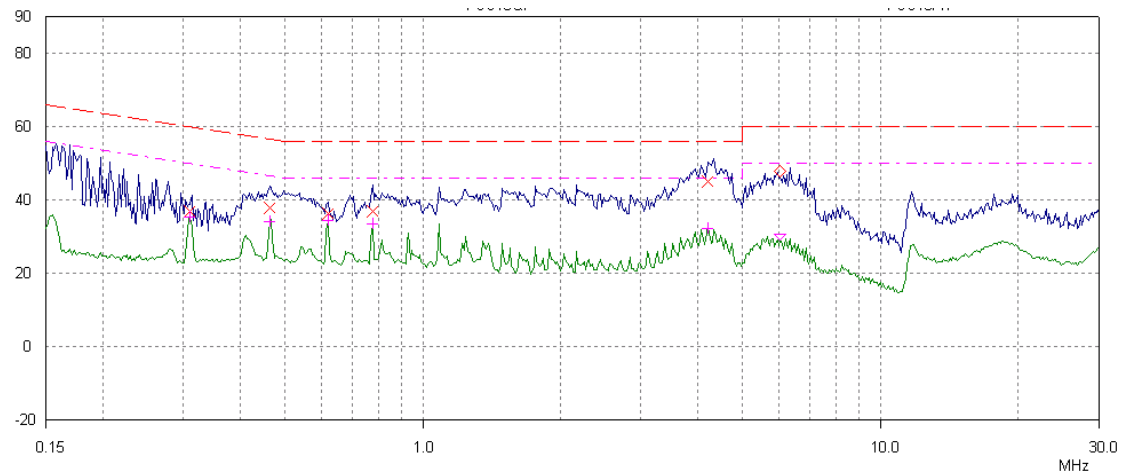
The bandwidth of the test receiver is set at 9 kHz.

8.4 Test protocol

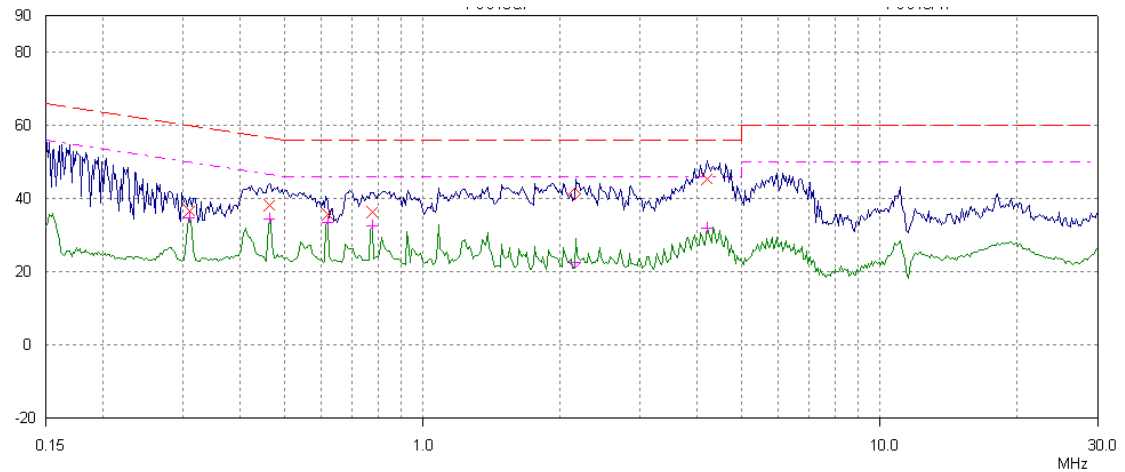
Temperature: 24 °C

Relative Humidity: 52 %

L Line



N Line



Test Data:

Frequency (MHz)	Quasi-peak			Average			Line
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)	
0.36	*	58.72	*	*	48.72	*	L
0.46	*	56.60	*	*	46.60	*	L
4.19	*	56.00	*	*	46.00	*	L
0.36	*	58.72	*	*	48.72	*	N
0.46	*	56.60	*	*	46.60	*	N
4.19	*	56.00	*	*	46.00	*	N

Note: * means the emission level 10dB lower than the relevant limit.

9. Antenna 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The manufacturer used a cable antenna with IPEX connector, so fulfill this requirement.