

RAE Systems, Inc

RF TEST REPORT

Report Type:

FCC Part 15.249 & ISSED RSS-210 RF report

Model:

PGM-2602

REPORT NUMBER:

180600757SHA-001

ISSUE DATE:

July 20, 2018

DOCUMENT CONTROL NUMBER:

TTRF15.249_V1 © 2018 Intertek



Applicant: RAE Systems, Inc
3775 N. 1st St. San Jose, California USA 95134

Manufacturer: RAE Systems, Inc
3775 N. 1st St. San Jose, California USA 95134

Manufacturing site: RAE Systems (Shanghai) Inc.
No. 990, East Huiwang Road, Jiading District, Shanghai, China, 201815

FCC ID: SU3-2602A

IC: 20969-2602A

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-210 Issue 9 (August 2016): Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

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

PREPARED BY:

Project Engineer
Nemo Li

REVIEWED BY:

Reviewer
Daniel Zhao

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

TEST REPORT

Content

REVISION HISTORY.....	4
MEASUREMENT RESULT SUMMARY.....	5
1 GENERAL INFORMATION	6
1.1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)	6
1.2 TECHNICAL SPECIFICATION	6
1.3 DESCRIPTION OF TEST FACILITY	7
2 TEST SPECIFICATIONS.....	8
2.1 STANDARDS OR SPECIFICATION	8
2.2 MODE OF OPERATION DURING THE TEST.....	8
2.3 TEST SOFTWARE LIST	9
2.4 TEST PERIPHERALS LIST	9
2.5 TEST ENVIRONMENT CONDITION:.....	9
2.6 INSTRUMENT LIST	10
2.7 MEASUREMENT UNCERTAINTY	12
3 RADIATED EMISSION	13
3.1 LIMIT	13
3.2 MEASUREMENT PROCEDURE	13
3.3 TEST CONFIGURATION	15
3.4 TEST RESULTS OF RADIATED EMISSIONS	17
4 POWER LINE CONDUCTED EMISSION.....	19
4.1 LIMIT	19
4.2 TEST CONFIGURATION	19
4.3 MEASUREMENT PROCEDURE	20
4.4 TEST RESULTS OF POWER LINE CONDUCTED EMISSION.....	21
5 ASSIGNED BANDWIDTH (20DB BANDWIDTH)	23
5.1 LIMIT	23
5.2 MEASUREMENT PROCEDURE	23
5.3 TEST CONFIGURATION	23
5.4 THE RESULTS.....	24
6 ANTENNA REQUIREMENT	26

Revision History

Report No.	Version	Description	Issued Date
180600757SHA-001	Rev. 01	Initial issue of report	July 20, 2018

Measurement result summary

TEST ITEM	FCC REFERENCE	IC REFERENCE	RESULT
Radiated emission	15.249 & 15.209	RSS-210 Issue 9 Clause B.10	Pass
Power line conducted emission	15.207	RSS-Gen Issue 5 Clause 8.8	Pass
Assigned bandwidth (20dB bandwidth)	15.215(c)	RSS-Gen Issue 5 Clause 6.7	Pass
Antenna requirement	15.203	-	Pass

Notes: 1: NA =Not Applicable

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	MICRORAE
Type/Model:	PGM-2602
Description of EUT:	EUT is a product with Bluetooth and WiFi function. It has only one model.
Rating:	Internal battery: 3.7V Switch-mode power supply: Model: 6A-061WP12 Input: 100-240V~ Output: 12VDC 0.5A
EUT type:	<input checked="" type="checkbox"/> Table top <input type="checkbox"/> Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	June 8, 2018
Date of test:	June 8, 2018 ~ July 10, 2018

1.2 Technical Specification

Frequency Range:	2400MHz ~ 2483.5MHz
Support Standards:	Bluetooth LE
Type of Modulation:	GFSK
Channel Number:	40
Data Rate:	1Mbps
Channel Separation:	2 MHz
Antenna Information:	PCB antenna, -5.3dBi Peak gain

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 Registration code No.: 2042B-1
	VCCI Registration Lab Registration No.: R-4243, G-845, C-4723, T-2252
	NVLAP Accreditation Lab NVLAP LAB CODE: 200849-0
	A2LA Accreditation Lab Certificate Number: 3309.02

TEST REPORT

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2017)

ANSI C63.10 (2013)

RSS-210 Issue 9 (August 2016)

RSS-Gen Issue 5 (April 2018)

2.2 Mode of operation during the test

The EUT is a handheld device, so three axes (X, Y, Z) were observed and the worst data was listed in the report.

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

The test setting software is offered by the manufactory. 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.

Test software and Power Setting parameter			
Test Software	mbt		
Working Mode	BLE		
Test Channel	2402MHz	2440MHz	2480MHz

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	HP 5480	-

2.5 Test environment condition:

Test items	Temperature	Humidity
Radiated emission	24°C	56% RH
Assigned bandwidth (20dB bandwidth)	22°C	52% RH
Power line conducted emission	24°C	56% RH

2.6 Instrument list

Conducted Emission / Disturbance Power / Tri-loop Test / CDN method					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESCS 30	EC 2107	2018-09-12
<input checked="" type="checkbox"/>	A.M.N.	R&S	ESH2-Z5	EC 3119	2018-12-07
<input type="checkbox"/>	A.M.N.	R&S	ENV 216	EC 3393	2018-07-30
<input type="checkbox"/>	A.M.N.	R&S	ENV4200	EC 3558	2019-06-20
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESIB 26	EC 3045	2018-09-12
<input checked="" type="checkbox"/>	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2019-05-30
<input checked="" type="checkbox"/>	Pre-amplifier	R&S	Pre-amp 18	EC5262	2019-06-20
<input checked="" type="checkbox"/>	Horn antenna	R&S	HF 906	EC 3049	2018-11-17
<input type="checkbox"/>	Horn antenna	ETS	3117	EC 4792-1	2019-01-09
<input checked="" type="checkbox"/>	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2020-07-09
<input checked="" type="checkbox"/>	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2019-03-07
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input type="checkbox"/>	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2019-03-05
<input type="checkbox"/>	Power sensor	Agilent	U2021XA	EC 5338-1	2019-03-05
<input type="checkbox"/>	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2019-03-05
<input type="checkbox"/>	Vector Signal Generator	Agilent	N5182B	EC 5175	2019-03-05
<input type="checkbox"/>	Power meter	Keysight	N1911A	EC 4318	2019-05-12
<input type="checkbox"/>	Wideband Radio Communication Tester	R&S	CMW500	EC 5944	2018-12-07
<input type="checkbox"/>	Mobile Test System	LitePoint	IQxel	EC 5176	2019-01-09
<input type="checkbox"/>	Test Receiver	R&S	ESCI 7	EC 4501	2018-09-12
<input type="checkbox"/>	Spectrum analyzer	Agilent	E7402A	EC 2254	2018-09-12
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3323	2019-06-14
<input type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3324	2019-04-09

TEST REPORT

<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3325	2019-03-23
<input type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3326	2019-03-28
<input type="checkbox"/>	Pressure meter	YM3	Shanghai Mengde	EC 3320	2019-06-28

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	$\pm 0.74\text{dB}$
Radiated Emissions in restricted frequency bands below 1GHz	$\pm 4.90\text{dB}$
Radiated Emissions in restricted frequency bands above 1GHz	$\pm 5.02\text{dB}$
Emission outside the frequency band	$\pm 2.89\text{dB}$
Power line conducted emission	$\pm 3.19\text{dB}$

3 Radiated emission

Test result: Pass

3.1 Limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
<input type="checkbox"/> 902 - 928	94	54
<input checked="" type="checkbox"/> 2400 - 2483.5	94	54
<input type="checkbox"/> 5725 - 5875	94	54
<input type="checkbox"/> 24000 - 24250	108	68

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

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

3.2 Measurement Procedure

For Radiated emission below 30MHz:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- Both X and Y axes of the antenna are set to make the measurement.
- 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.
- The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

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

TEST REPORT**For Radiated emission above 30MHz:**

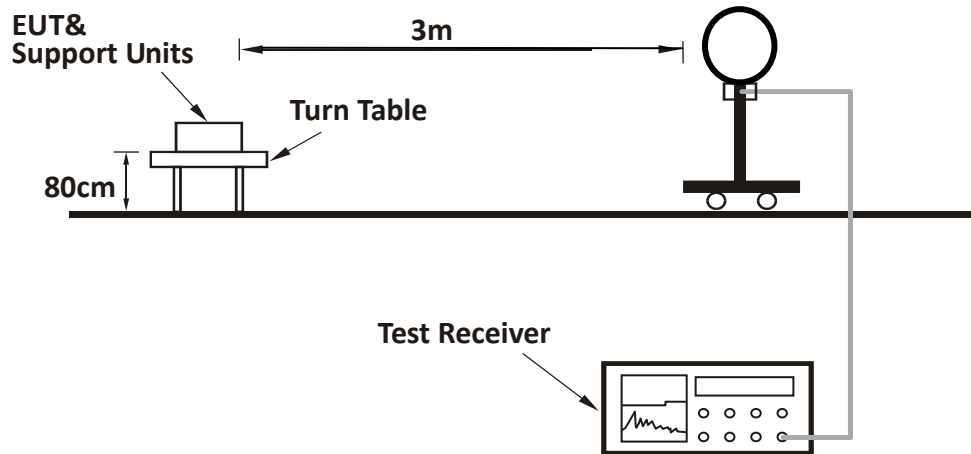
- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving 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 detect 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:

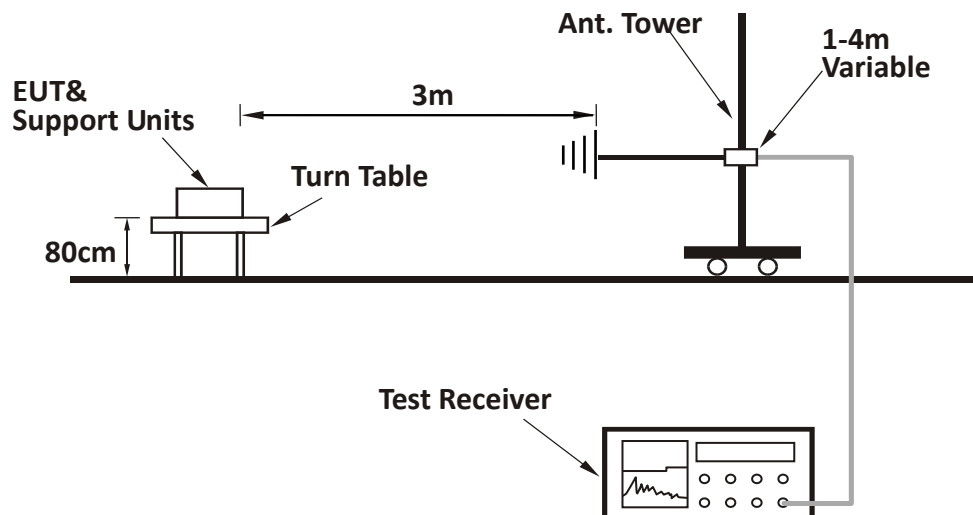
- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

3.3 Test Configuration

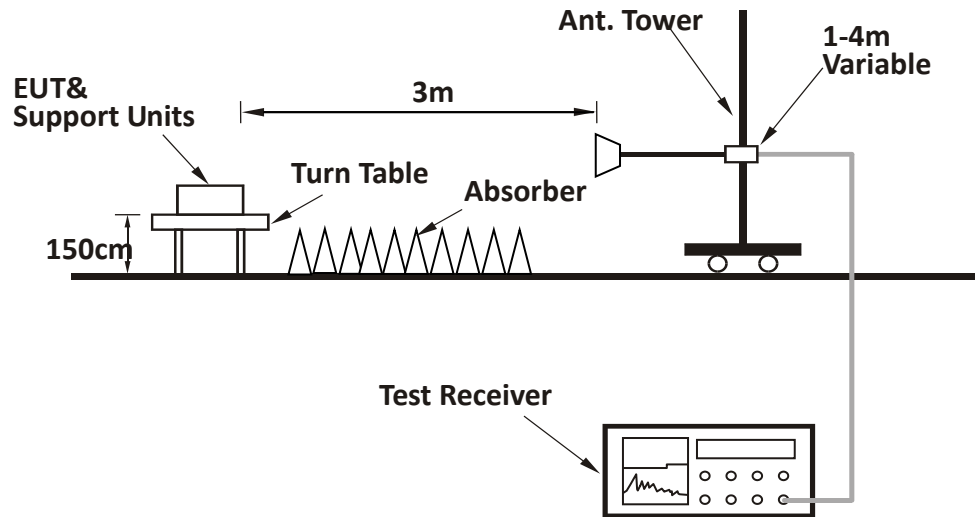
For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



For Radiated emission above 1GHz:



TEST REPORT

3.4 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.

EUT was tested with WiFi transmitting on and off, and the worst data was listed in the report.

Test data below 1GHz

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	47.49	37.40	9.90	40.00	2.60	PK
H	59.16	26.80	7.10	40.00	13.20	PK
H	166.07	30.70	10.90	43.50	12.80	PK
H	191.34	32.10	10.60	43.50	11.40	PK
H	383.79	25.20	16.90	46.00	20.80	PK
H	900.86	31.10	23.00	46.00	14.90	PK
V	47.49	35.80	9.90	40.00	4.20	PK
V	61.10	26.20	7.00	40.00	13.80	PK
V	166.07	25.20	10.90	43.50	18.30	PK
V	191.34	25.10	10.60	43.50	18.40	PK
V	512.08	24.40	19.40	46.00	21.60	PK
V	959.18	30.00	23.60	46.00	16.00	PK

Test result above 1GHz:

The emission was conducted from 1GHz to 25GHz

CH	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2402.00	76.80	34.10	114.00	37.20	PK
	V	2402.00	79.80	34.10	114.00	34.20	PK
	H	2399.94	48.50	34.10	74.00	25.50	PK
	V	2399.94	50.50	34.10	74.00	23.50	PK
M	H	2440.00	77.50	34.20	114.00	36.50	PK
	V	2440.00	79.50	34.20	114.00	34.50	PK

TEST REPORT

H	H	2480.00	76.50	34.80	114.00	37.50	PK
	V	2480.00	79.00	34.80	114.00	35.00	PK
	H	2484.14	50.50	34.80	74.00	23.50	PK
	V	2484.14	49.50	34.80	74.00	24.50	PK
	H	2492.00	51.00	34.80	74.00	23.00	PK
	V	2492.00	52.00	34.80	74.00	22.00	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 = $30.20 + 2.00 - 32.00 = 0.20\text{dB/m}$;
Corrected Reading = $10\text{dBuV} + 0.20\text{dB/m} = 10.20\text{dBuV/m}$;
Margin = $40.00\text{dBuV/m} - 10.20\text{dBuV/m} = 29.80\text{dB}$.

4 Power line conducted emission

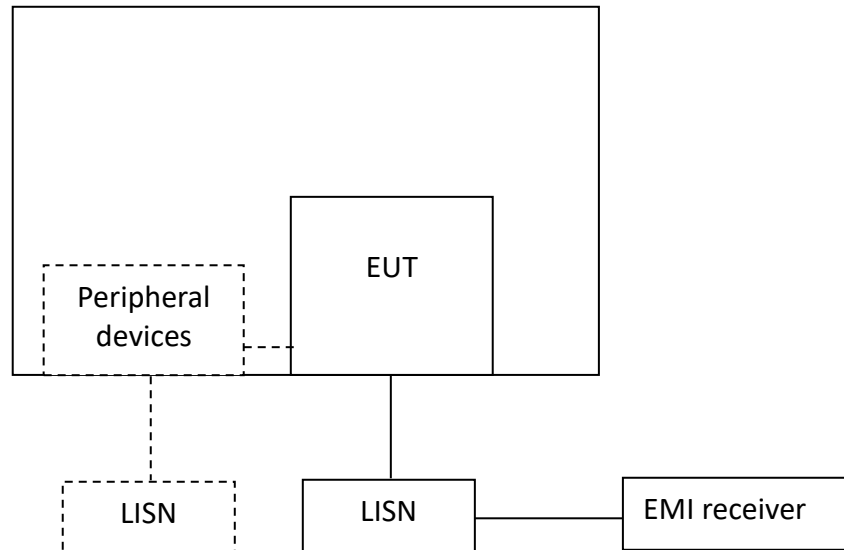
Test result: Pass

4.1 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.

4.2 Test Configuration



4.3 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.

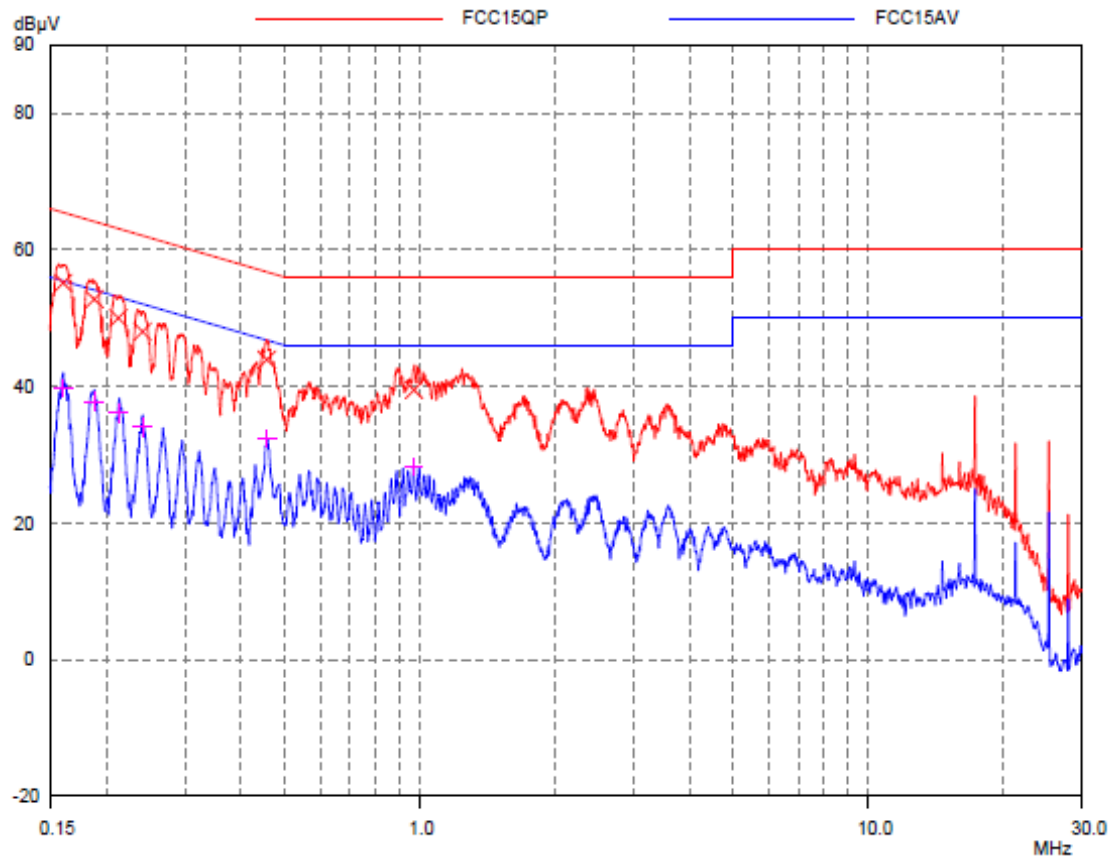
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on 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.

4.4 Test Results of Power line conducted emission

Test Curve:

L Line

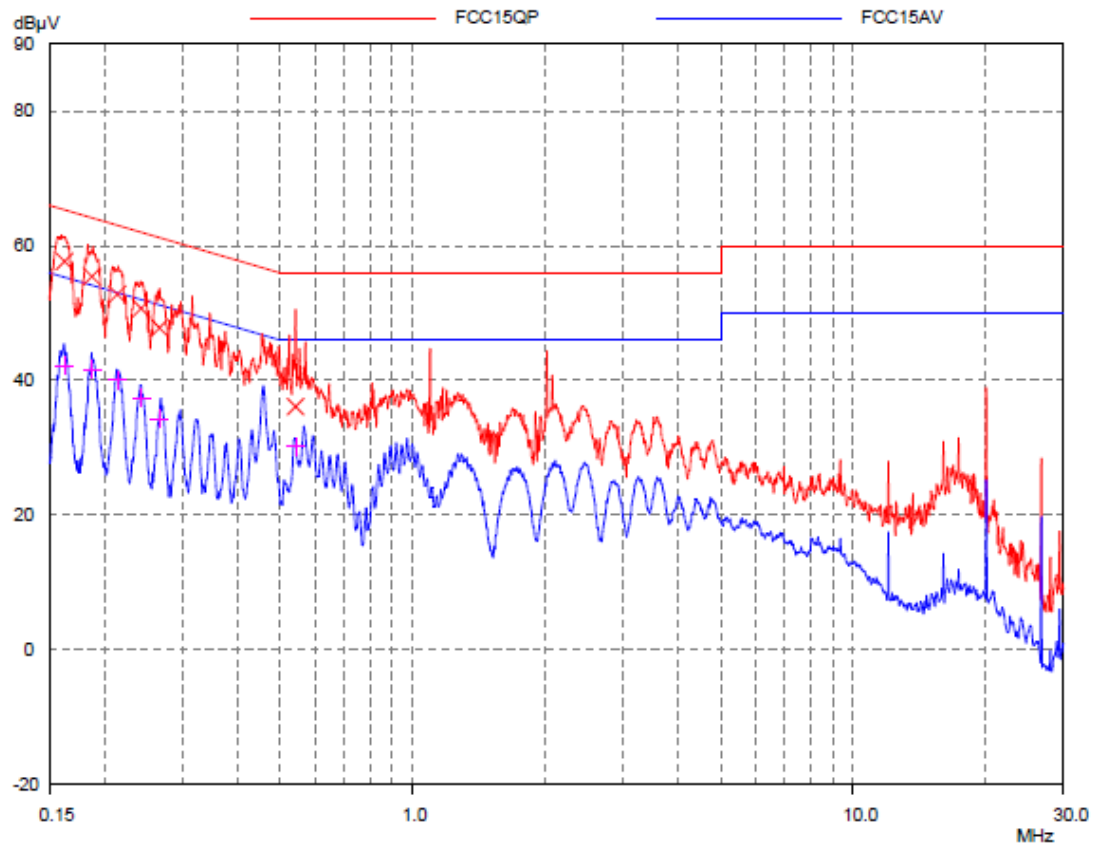


Test Data:

Frequency (MHz)	Quasi-peak			Average		
	Level dB(μV)	Limit dB(μV)	Margin (dB)	Level dB(μV)	Limit dB(μV)	Margin (dB)
0.16	55.15	65.44	10.29	39.80	55.14	15.64
0.19	52.75	64.11	11.36	37.82	54.11	16.29
0.21	50.02	63.08	13.06	36.13	53.08	16.95
0.2	48.00	62.05	14.05	34.05	52.05	18.00
0.46	43.90	56.75	12.85	32.30	46.75	14.45
0.97	39.48	56.00	16.52	28.21	46.00	17.79

Test Curve:

N Line



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	Level dB(μV)	Limit dB(μV)	Margin (dB)	Level dB(μV)	Limit dB(μV)	Margin (dB)
0.16	57.71	65.34	7.63	42.16	55.34	13.18
0.19	55.45	64.14	8.69	41.57	54.14	12.57
0.21	52.82	63.05	10.23	40.02	53.05	13.03
0.24	50.70	62.02	11.32	37.45	52.02	14.57
0.27	47.82	61.23	13.41	34.27	51.23	16.96
0.54	36.12	56.00	19.88	30.18	46.00	15.82

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

2. Level = Original Receiver Reading + Correct Factor

3. Margin = Limit - Level

4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

5 Assigned bandwidth (20dB bandwidth)

Test result: Pass

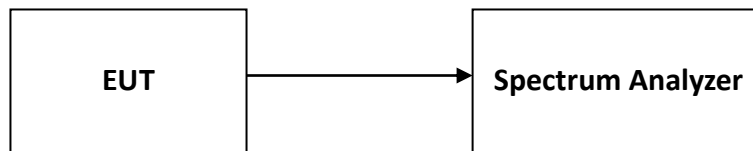
5.1 Limit

Intentional radiators must be designed to ensure that the 20dB bandwidth of the emission is contained within the allocated frequency band.

5.2 Measurement Procedure

The 20dB Bandwidth is measured using the Spectrum Analyzer.
Set Span = 2 to 3 times the 20 dB bandwidth, RBW = approximately 1% of the 20 dB bandwidth, VBW>RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 2 channels (lowest and highest channel).

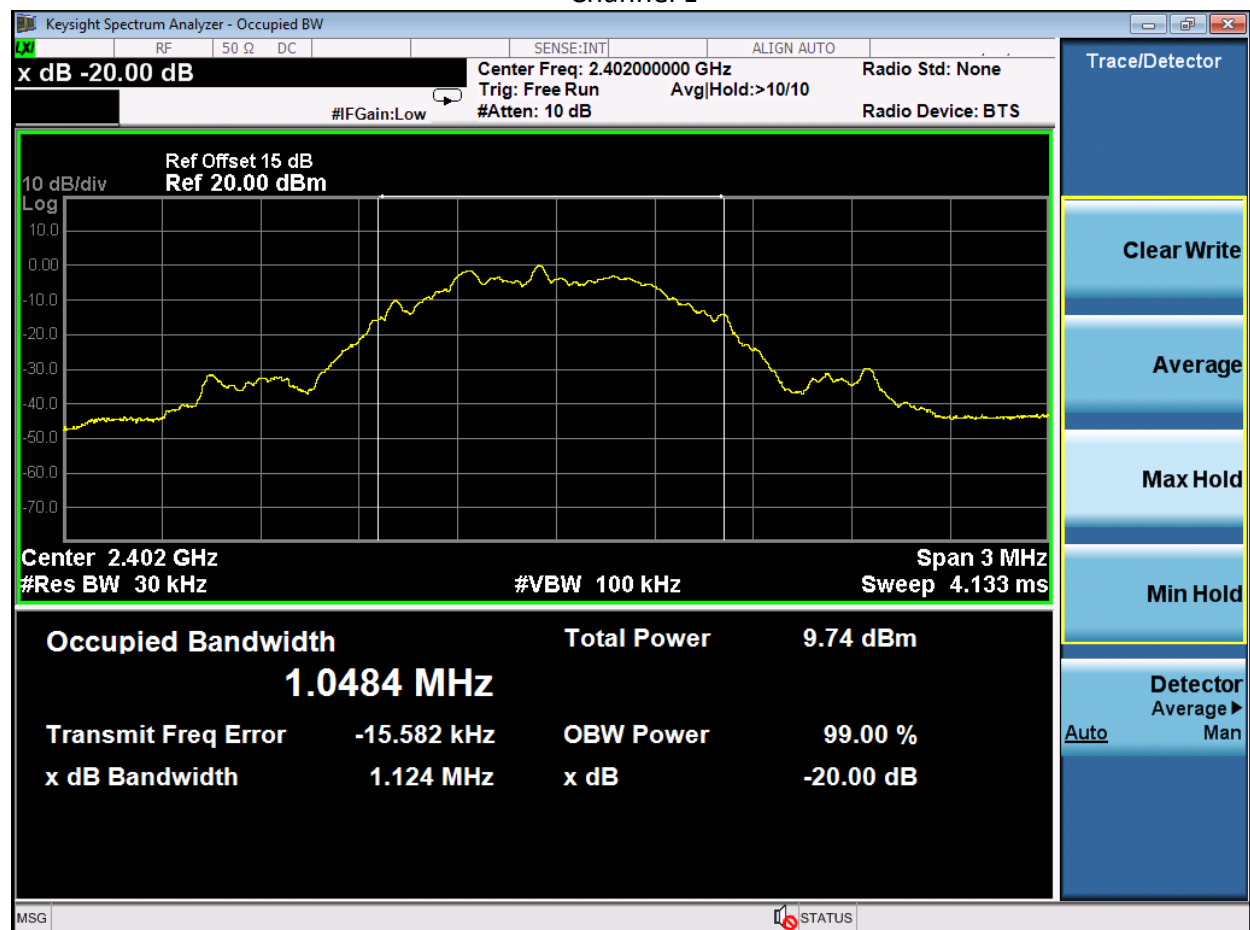
5.3 Test Configuration



5.4 The results

Test Mode	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	F _L at 20dB BW (MHz)	F _H at 20dB BW (MHz)
BLE	2402	1.124	1.0484	>2400	/
	2480	1.138	1.0598	/	<2483.5
Limit		N/A	N/A	F _L >2400	F _H <2483.5
Result		Complied			

Channel L



Channel H



6 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.

***** END *****