

FCC & IC Test Report

No. 160100634SHA-004

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.

Product Name : MICRORAE

Type/Model : PGM-2601

TEST RESULT : PASS

SUMMARY

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

47CFR Part 15 (2014): Radio Frequency Devices (Subpart C)

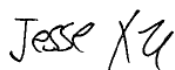
ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-210 Issue 8 (December 2010): Low-power Licence-exempt Radio communication Devices (All Frequency Bands): Category I Equipment

RSS-Gen Issue 4 (December 2014): General Requirements for Compliance of Radio Apparatus

Date of issue: Jan 08, 2016

Prepared by:



Jesse Xu (*Project Engineer*)

Reviewed by:



Daniel Zhao (*Reviewer*)

Description of Test Facility

Name: Intertek Testing Service Limited Shanghai
Address: Building No.86, 1198 Qinzhou Road(North), Shanghai 200233, P.R.
China

FCC Registration Number: 236597
IC Assigned Code: 2402B-1

Name of contact: Jonny Jing
Tel: 86 21 61278271
Fax: 86 21 54262353

Content

SUMMARY.....	1
1 GENERAL INFORMATION	4
1.1 Description of Client.....	4
1.2 Identification of the EUT	4
1.3 Technical Specification.....	5
2 TEST SPECIFICATIONS.....	6
2.1 Standards or specification	6
2.2 Mode of operation during the test.....	6
2.3 Test software list	6
2.4 Test peripherals list	6
2.5 Instrument list	7
2.6 Test Summary	8
3 RADIATED EMISSION	9
3.1 Test limit	9
3.2 Test Configuration	9
3.3 Test procedure and test setup	10
3.4 Test protocol	11
4 ASSIGNED BANDWIDTH (20dB BANDWIDTH)	13
4.1 Limit.....	13
4.2 Test Configuration	13
4.3 Test procedure and test setup	13
4.4 Test protocol	14
5 POWER LINE CONDUCTED EMISSION	16
5.1 Limit.....	16
5.2 Test configuration	16
5.3 Test procedure and test set up	17
5.4 Test protocol	18

1 GENERAL INFORMATION

1.1 Description of Client

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

Name of contact : James Pan (IC)
James Liu (FCC)

Tel : 408-952-8217; 408-9528200

Fax : 408-952-8480; 408-952-8487

Email : james.liu@honeywell.com
Jungsyng.Pan@Honeywell.com

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

1.2 Identification of the EUT

Product Name : MICRORAE

Type/model : PGM-2601

FCC ID : SU3-2601

IC : 20969-2601

1.3 Technical Specification

Operation Frequency	: 2402~2480 MHz;
Band	
Type of Modulation	: GFSK
Protocol	: Bluetooth BLE
Description of EUT	: Here is one model with BLE and Merish mode. Among only BLE function was assessed. We tested the 2402CH , 2442CH and 2480CH and listed the worst data in this report.
Antenna Designation	: PCB antenna
Gain of Antenna	: -5.3dBi
Rating	: Switching Adapter supply: Model: 3A-066WP12 Input: AC 100-240V, 50/60Hz, 0.3A Output: DC 12V, 0.5A Internal battery: 1900mAH, 3.7V
EUT type	: ☒ Table top ☐ Floor standing
Channel Description	: 40 channels
Software applied	: mbt, Set the power level:3
Sample received date	: Nov 08, 2015
Date of test	: Nov 10, 2015 ~Dec 28, 2015

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2014)
RSS-210 Issue 8 (December 2010):
RSS-Gen Issue 4 (December 2014)
ANSI C63.10 (2013)
KDB 558074 (v03r03)

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 Test peripherals list

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

2.5 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2015-10-21	2016-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2015-10-20	2016-10-19
A.M.N.	ESH2-Z5	R&S	EC 3119	2015-1-9	2016-1-8
A.M.N.	ENV 216	R&S	EC 3393	2015-8-9	2016-8-8
A.M.N.	ENV 216	R&S	EC 3394	2015-8-9	2016-8-8
A.M.N.	ENV4200	R&S	EC3558	2015-8-9	2016-8-8
Ultra-broadband antenna	HL 562	R&S	EC 3046-1	2015-5-16	2016-5-14
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2015-4-28	2017-4-27
Horn antenna	HF 906	R&S	EC 3049	2015-4-28	2017-4-27
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2015-4-12	2016-4-11
Semi-anechoic chamber	-	Albatross project	EC 3048	2015-5-12	2016-5-11
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2015-1-8	2016-1-7
Power sensor / Power meter	N1911A/N1921A	Agilent	EC4318	2015-04-12	2016-04-11

2.6 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 ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Radiated emission	15.249 & 15.205	RSS-210 Issue 8 Annex A2.9 &Clause 2.2	Pass
Assigned bandwidth (20dB bandwidth)	15.215(c)	-	Pass
Occupied bandwidth	-	RSS-Gen Issue 4 Clause 6.6	Tested
Power line conducted emission	15.207	RSS-Gen Issue 4 Clause 8.8	Pass

Notes: 1: NA =Not Applicable

2: 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.

3 Radiated emission

Test result: Pass

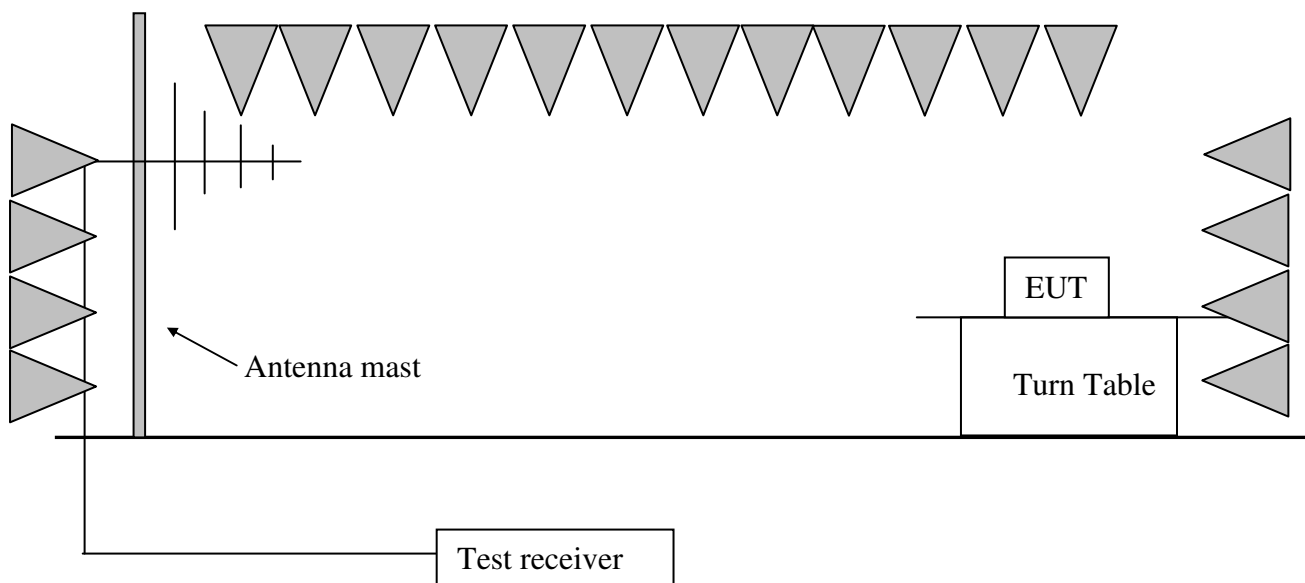
3.1 Test limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
☐ 902 - 928	94	54
☒ 2400 - 2483.5	94	54
☐ 5725 - 5875	94	54
☐ 24000 - 24250	108	68

The radiated emissions which fall outside allocated band (2400-2483.5MHz), must also comply with the radiated emission limits specified in §15.209(a) showed as below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

3.2 Test Configuration



3.3 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 turn table 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 1 meter to 4 meters to find out the maximum emission level.

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

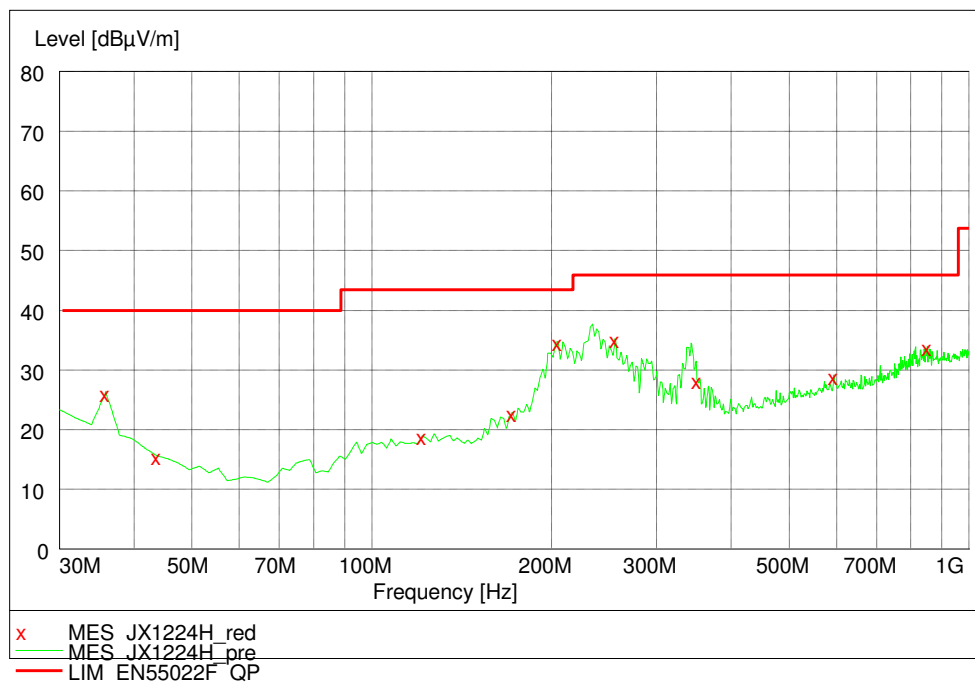
RBW = 300 Hz, VBW = 1 kHz (9 kHz~150 kHz);
RBW = 10 kHz, VBW = 30 kHz (150 kHz~30MHz);
RBW = 100 kHz, VBW = 300 kHz (30MHz~1GHz for PK)
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);
RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

3.4 Test protocol

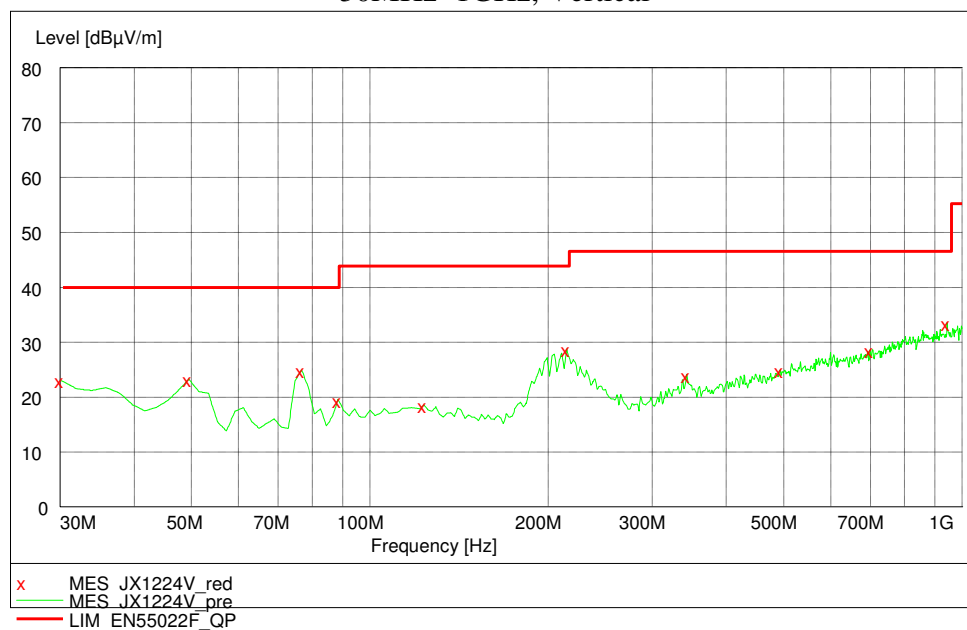
Temperature : 23 °C
Relative Humidity : 55 %

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



CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	2401.79	34.30	72.80	94.00	21.20	PK
	H	203.04	15.10	32.80	43.50	10.70	PK
	H	261.98	19.70	33.20	46.00	12.80	PK
	H	2389.83	-10.89	40.20	54.00	13.80	PK
	H	1597.19	29.70	51.50	54.00	2.50	PK
	V	2401.79	34.30	78.40	94.00	15.60	PK
	V	76.65	8.40	24.90	40.00	15.10	PK
	V	214.66	12.50	28.80	40.00	11.20	PK
	V	1360.72	-13.40	48.60	54.00	5.40	PK
	V	2483.89	-9.20	43.00	54.00	31.00	PK
M	H	2442.86	35.10	71.93	94.00	22.07	PK
	H	1921.84	-15.10	46.88	54.00	4.90	PK
	H	3665.11	-6.02	37.67	54.00	16.33	PK
	V	2442.86	35.10	78.69	94.00	15.31	PK
	V	1360.72	-13.40	43.15	54.00	8.40	PK
H	H	2480.92	25.88	73.70	94.00	20.30	PK
	H	1849.32	-12.10	45.32	54.00	8.68	PK
	V	2480.92	25.88	76.70	94.00	17.30	PK
	V	924.19	25.20	79.11	94.00	14.89	PK
	V	1360.72	-13.40	48.00	54.00	6.00	PK

Remark:

1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed);
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 = 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.

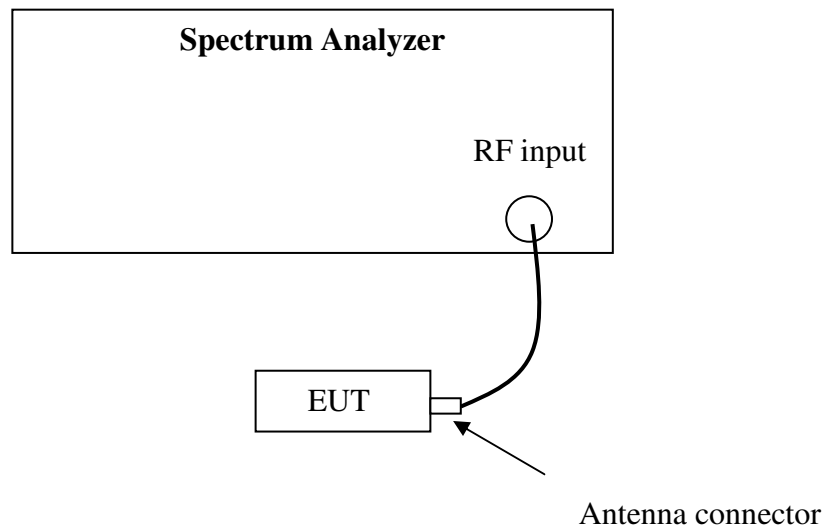
4 Assigned bandwidth (20dB bandwidth)

Test result: Pass

4.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band as clause 3.1 shows. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.2 Test Configuration



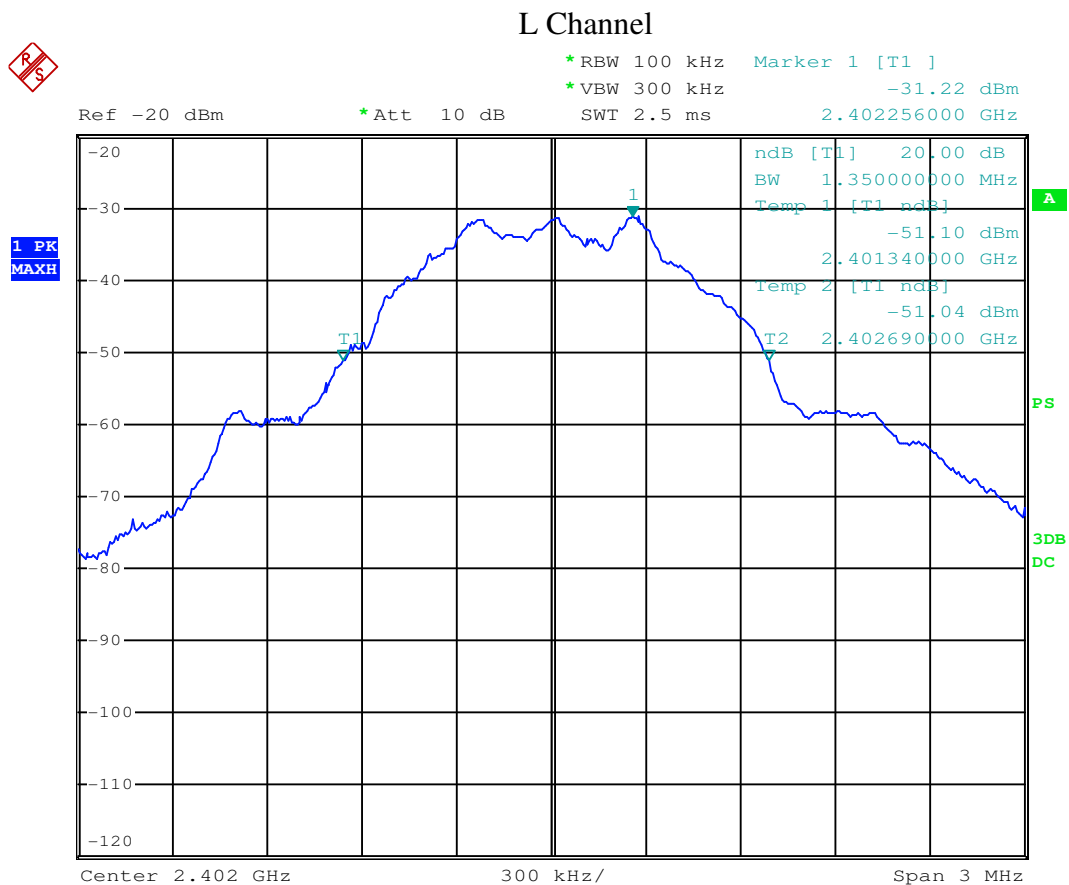
4.3 Test procedure and test setup

The 20dB Bandwidth per FCC § 15.215(c) 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 3 channels (lowest, middle and highest channel).

4.4 Test protocol

Temperature : 23 °C
Relative Humidity : 55 %

20dB bandwidth (MHz)	permitted band (MHz)	Result
2401.34 ~ 2480.64	2400 ~ 2483.5	Pass

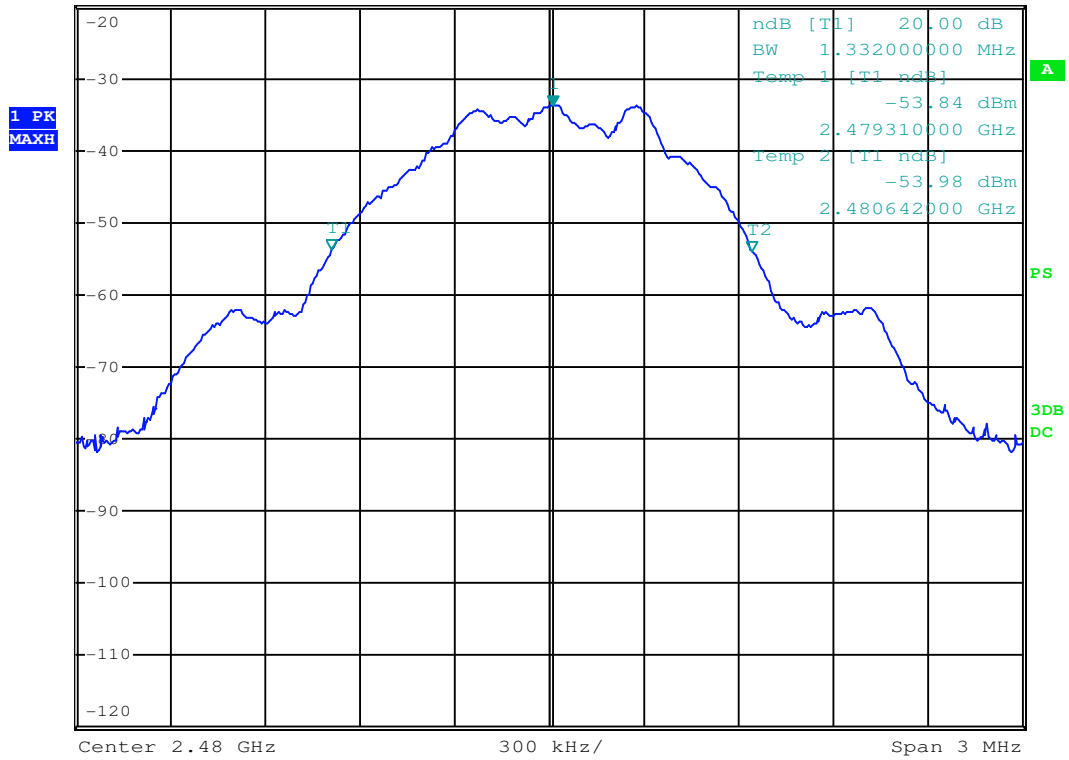


Date: 7.JAN.2016 12:36:23

H Channel



*RBW 100 kHz Marker 1 [T1] -33.68 dBm
 *VBW 300 kHz
 Ref -20 dBm *Att 10 dB SWT 2.5 ms 2.480012000 GHz



Date: 7.JAN.2016 12:43:50

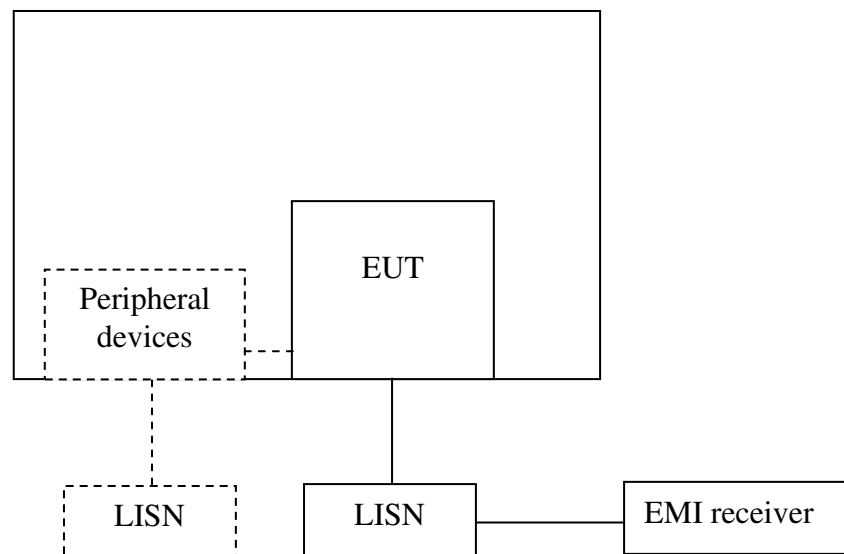
5 Power line conducted emission

Test result: Pass

5.1 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.		

5.2 Test configuration



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

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

5.3 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.

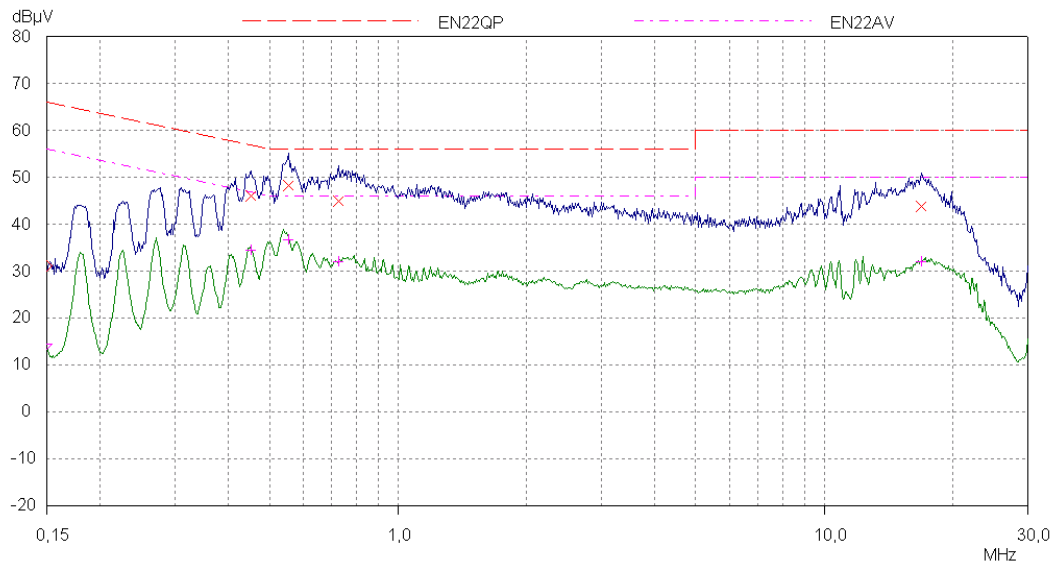
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on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

5.4 Test protocol

Temperature : 23 °C
Relative Humidity : 56 %

L line

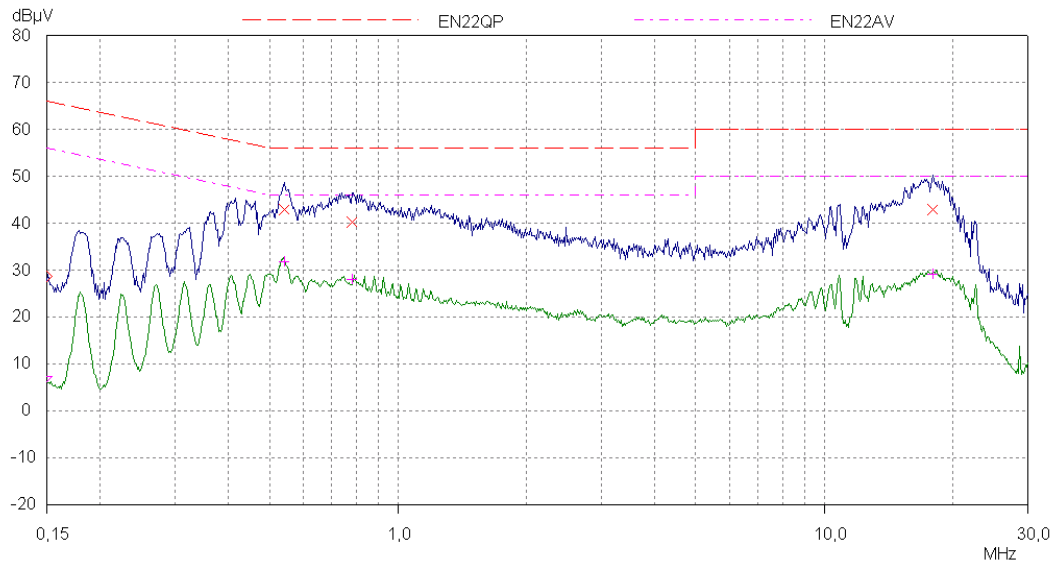


Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.45	45.97	56.85	10.88	34.45	46.85	12.40
0.55	48.16	56.00	7.84	36.62	46.00	9.38
0.72	44.92	56.00	11.08	31.96	46.00	14.04
16.86	43.79	60.00	16.21	31.94	50.00	18.06
*	*	*	*	*	*	*
*	*	*	*	*	*	*

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

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)
0.54	42.93	56.00	13.07	31.74	46.00	14.26
0.78	40.29	56.00	15.71	27.94	46.00	18.06
17.90	42.97	60.00	17.03	29.08	50.00	20.92
*	*	*	*	*	*	*
*	*	*	*	*	*	*
*	*	*	*	*	*	*

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

6 Occupied Bandwidth

Test Status: Tested

6.1 Test limit

None

6.2 Test Configuration

See clause 3.2.

6.3 Test procedure and test setup

The occupied bandwidth per RSS-Gen Issue 4 Clause 4.6.1 was measured using the Spectrum Analyzer.

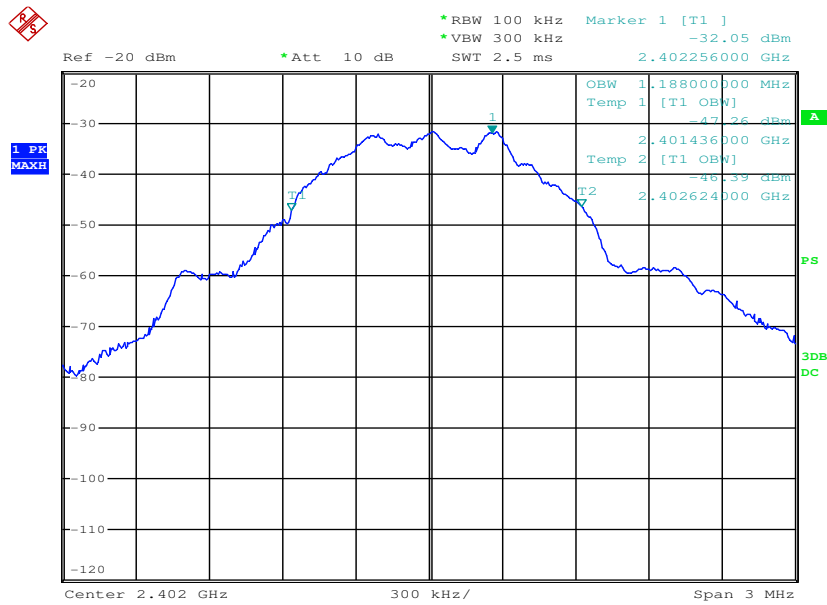
6.4 Test protocol

Temperature :23 °C
Relative Humidity :55 %

Channel	Occupied Bandwidth (KHz)	Max. Value (KHz)
L	1188	1188
M	1254	1254
H	1170	1170

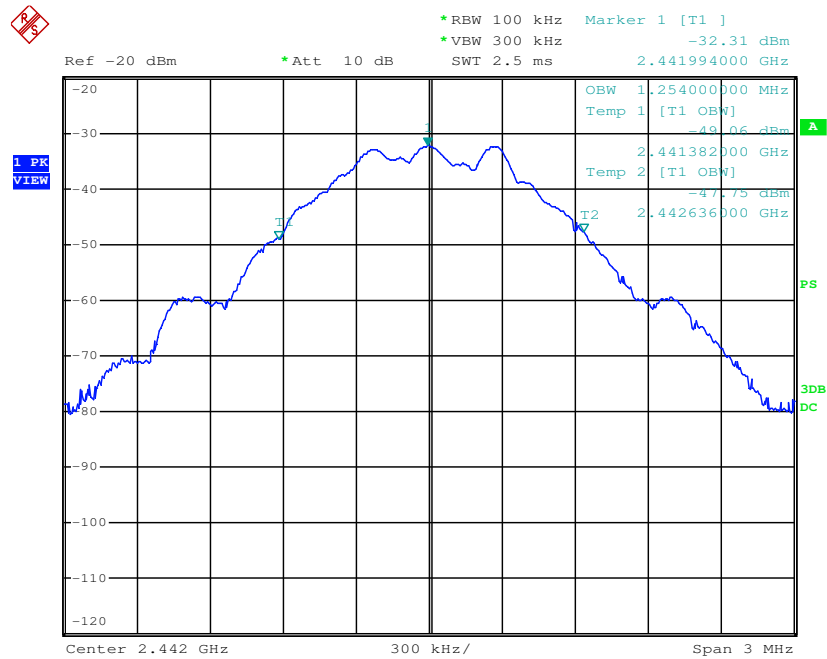
Remark: “Max. Value” is the maximum test result of all the measured occupied bandwidth.

L Channel



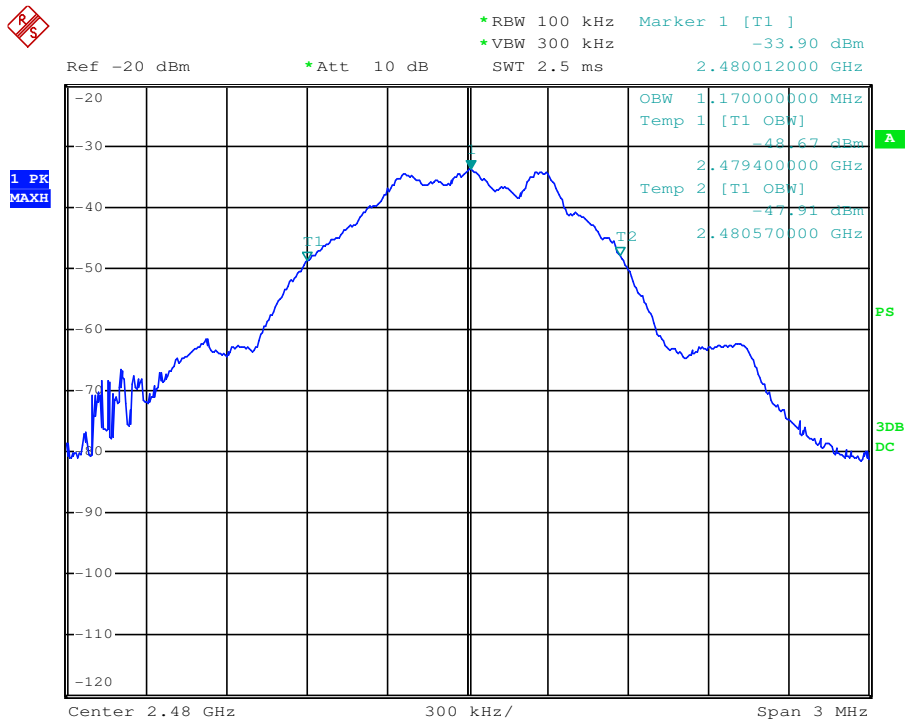
Date: 7.JAN.2016 12:36:44

M Channel



Date: 7.JAN.2016 12:45:39

H Channel



Date: 7.JAN.2016 12:44:09