

## FCC & IC Test Report

### No. 160100634SHA-001

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)

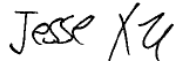
**ANSI C63.10 (2013):** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

**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 06, 2016

Prepared by:



Jesse Xu (*Project Engineer*)

Reviewed by:



Daniel Zhao (*Reviewer*)



## Description of Test Facility

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## 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)

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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 : 906-924MHz  
 Band  
 Type of Modulation : O-QPSK  
 Description of EUT : Here is one model with BLE and Mesh mode. Among only mesh function was assessed. We tested the 906CH , 916CH and 924CH and listed the worst data in this report.

Antenna Designation : PCB antenna  
 Gain of Antenna : -5dBi

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 :

| Channel Identifier | Frequency (MHz) | Channel Identifier | Frequency (MHz) |
|--------------------|-----------------|--------------------|-----------------|
| 1                  | 906             | 6                  | 916             |
| 2                  | 908             | 7                  | 918             |
| 3                  | 910             | 8                  | 920             |
| 4                  | 912             | 9                  | 922             |
| 5                  | 914             | 10                 | 924             |

Software applied : SSCOM3.2, Set the power level:6  
 :

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)  
ANSI C63.10 (2013)  
RSS-210 Issue 8 (December 2010):  
RSS-Gen Issue 4 (December 2014):

### 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<br>Annex A2.9<br>&Clause 2.2 | Pass   |
| Assigned bandwidth<br>(20dB bandwidth) | 15.215(c)       | -  | Pass   |
| Occupied bandwidth                     | -               | RSS-Gen Issue 4<br>Clause 6.6                | Tested |
| Power line conducted emission          | 15.207          | RSS-Gen Issue 4<br>Clause 8.8                | Pass   |

Notes: 1: NA =Not Applicable

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### 3 Radiated emission

**Test result: Pass**

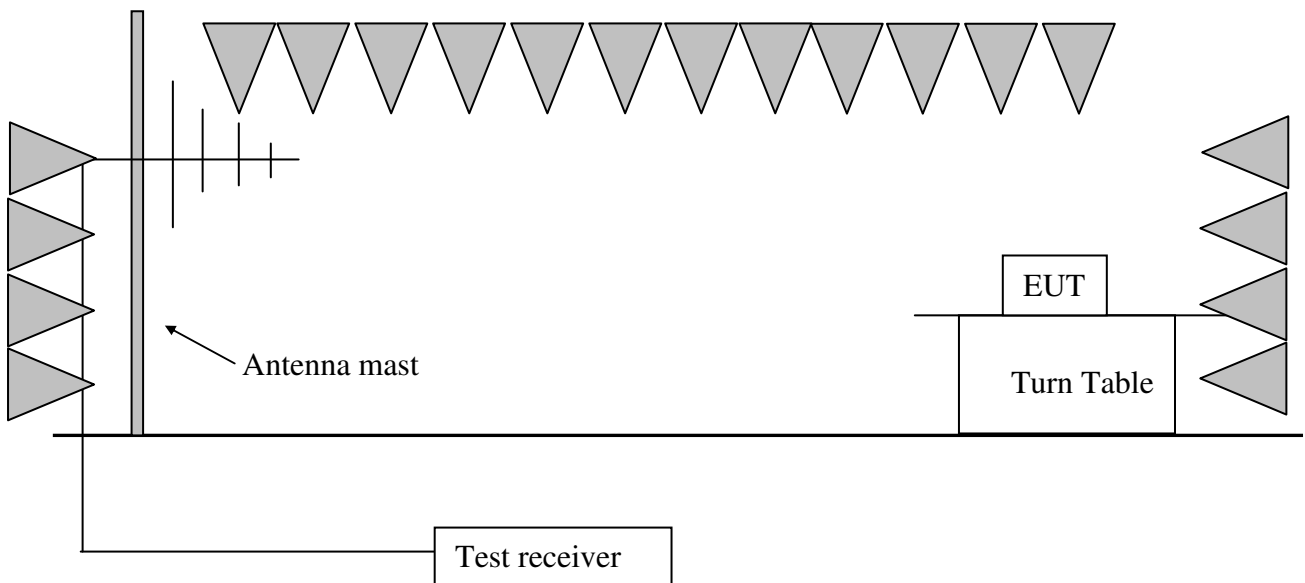
#### 3.1 Test limit

| Fundamental Frequency (MHz)                   | Fundamental limit (dBuV/m) | Harmonic limit (dBuV/m) |
|---|----------------------------|-------------------------|
| <input checked="" type="checkbox"/> 902 - 928 | 94                         | 54                      |
| <input 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 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:

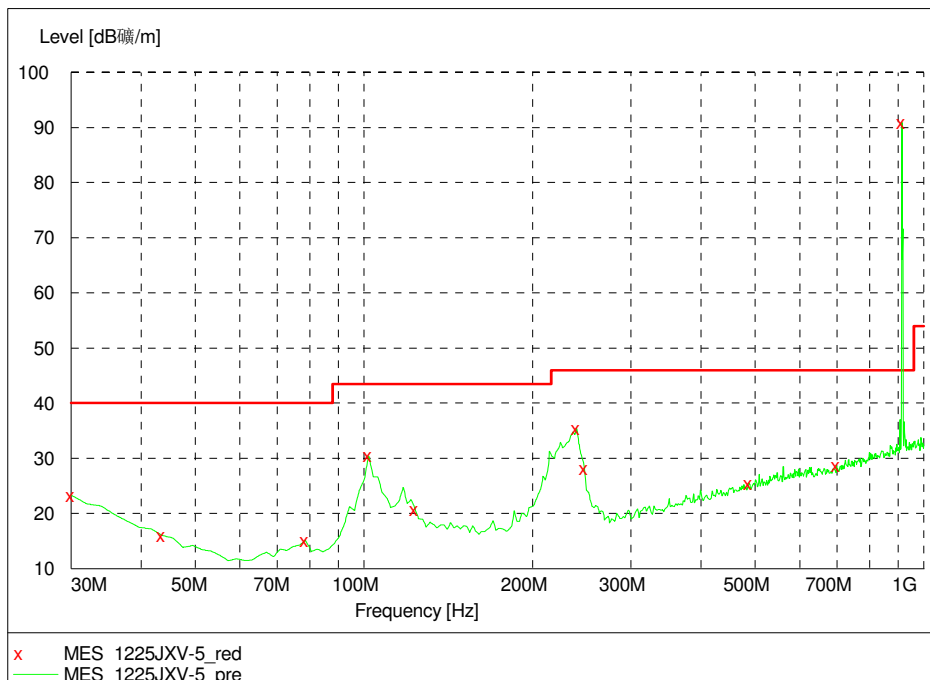
RBW = 300 Hz, VBW = 1 kHz (9 kHz~150 kHz);  
RBW = 10 kHz, VBW = 30 kHz (150 kHz~30MHz);  
RBW = 100 kHz, VBW = 300 kHz (30MHz~1GHz for PK)  
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);  
RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

### 3.4 Test protocol

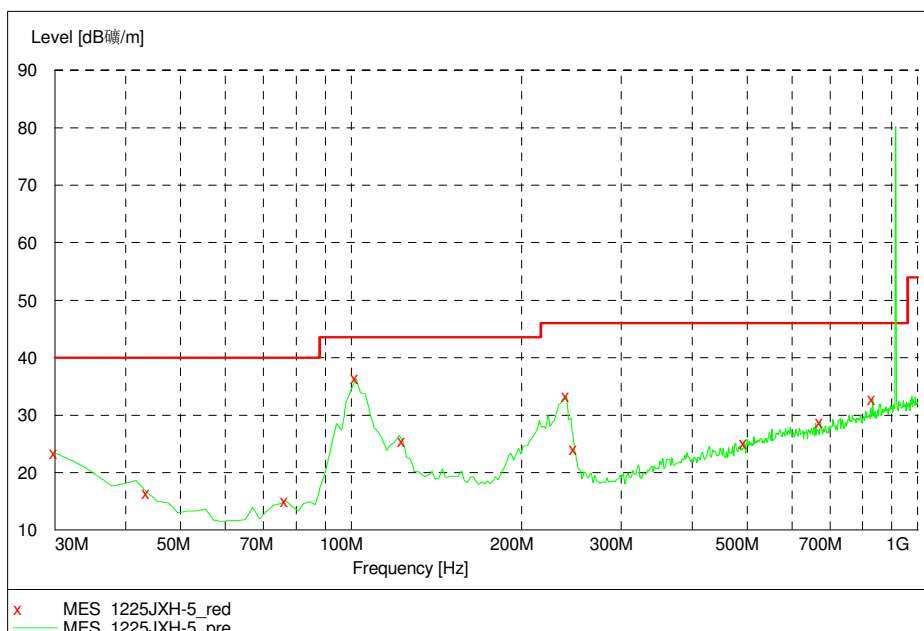
Temperature : 23 °C  
Relative Humidity : 55 %

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



Vertical



| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|----|---------|-----------------|-----------------------|----------------------------|----------------|-------------|----------|
| L  | H       | 906.69          | 25.10                 | 85.70                      | 94.00          | 8.30        | PK       |
|    | H       | 1783.56         | -15.10                | 49.20                      | 54.00          | 4.80        | PK       |
|    | H       | 3623.24         | -6.60                 | 38.60                      | 54.00          | 15.40       | PK       |
|    | H       | 226.33          | 13.20                 | 39.20                      | 46.00          | 6.80        | PK       |
|    | V       | 906.69          | 25.70                 | 78.80                      | 94.00          | 15.20       | PK       |
|    | V       | 1783.56         | -15.10                | 55.10                      | 74.00          | 18.90       | PK       |
|    | V       | 1783.56         | -15.10                | 52.10                      | 54.00          | 1.90        | AV       |
|    | V       | 2635.27         | -10.80                | 42.40                      | 54.00          | 11.60       | PK       |
|    | V       | 226.33          | 13.20                 | 29.80                      | 46.00          | 16.20       | PK       |
| M  | H       | 916.47          | 25.10                 | 86.93                      | 94.00          | 7.07        | PK       |
|    | H       | 1833.24         | -14.25                | 51.20                      | 54.00          | 2.80        | PK       |
|    | H       | 3665.11         | -6.02                 | 37.67                      | 54.00          | 16.33       | PK       |
|    | V       | 916.47          | 25.10                 | 79.45                      | 94.00          | 14.55       | PK       |
|    | V       | 1833.24         | -14.25                | 54.98                      | 74.00          | 19.02       | PK       |
|    | V       | 1833.24         | -14.25                | 51.69                      | 54.00          | 2.31        | AV       |
|    | V       | 3665.11         | -6.02                 | 43.11                      | 54.00          | 10.89       | PK       |
| H  | H       | 924.19          | 25.20                 | 84.70                      | 94.00          | 9.30        | PK       |
|    | H       | 1849.32         | -13.10                | 50.25                      | 54.00          | 3.75        | PK       |
|    | H       | 3670.21         | -5.87                 | 39.45                      | 54.00          | 14.55       | PK       |
|    | V       | 924.19          | 25.20                 | 79.11                      | 94.00          | 14.89       | PK       |
|    | V       | 1849.32         | -13.10                | 55.24                      | 74.00          | 18.76       | PK       |
|    | V       | 1849.32         | -13.10                | 52.24                      | 54.00          | 1.76        | PK       |
|    | V       | 3670.21         | -5.87                 | 38.11                      | 54.00          | 15.89       | 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.

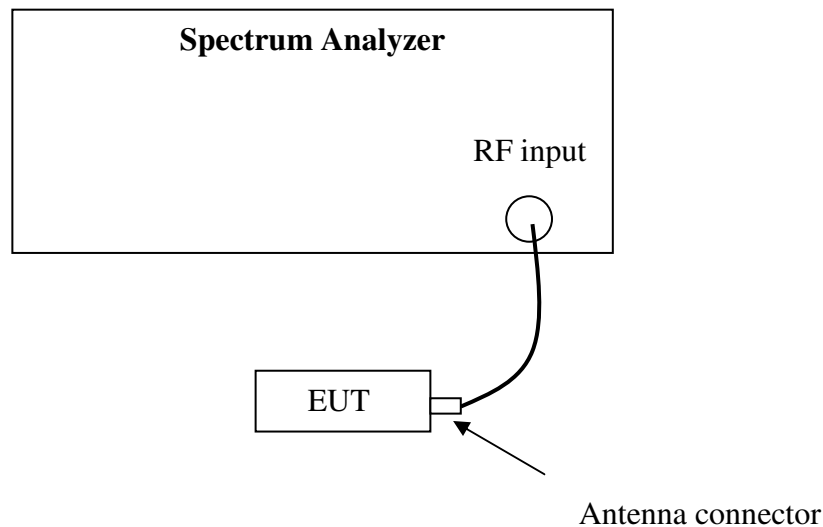
## 4 Assigned bandwidth (20dB bandwidth)

**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



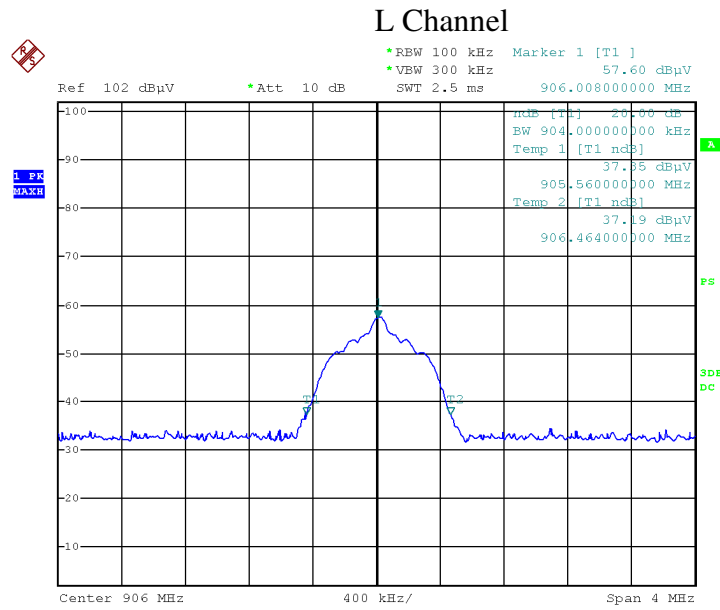
### 4.3 Test procedure and test setup

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).

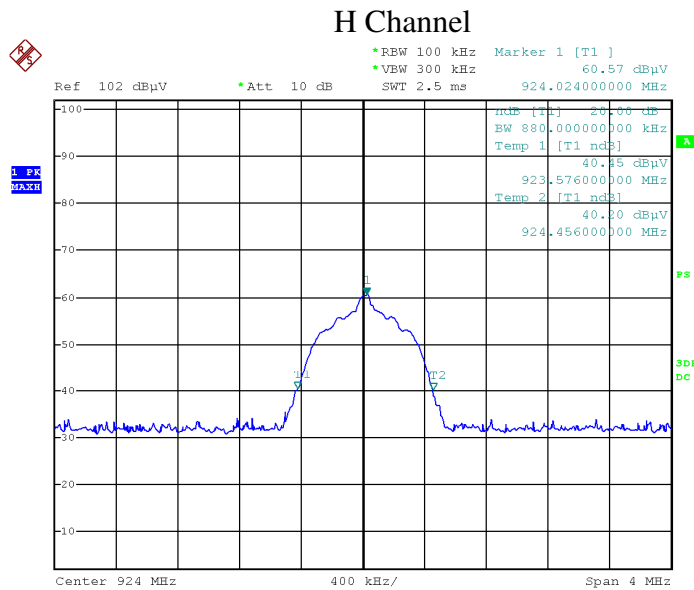
#### 4.4 Test protocol

Temperature : 23 °C  
Relative Humidity : 55 %

| 20dB bandwidth (MHz) | 80% of permitted band (MHz) | Result |
|----------------------|-----------------------------|--------|
| 905.56 ~ 924.45      | 904.60 ~ 925.40             | Pass   |



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## 5 Power line conducted emission

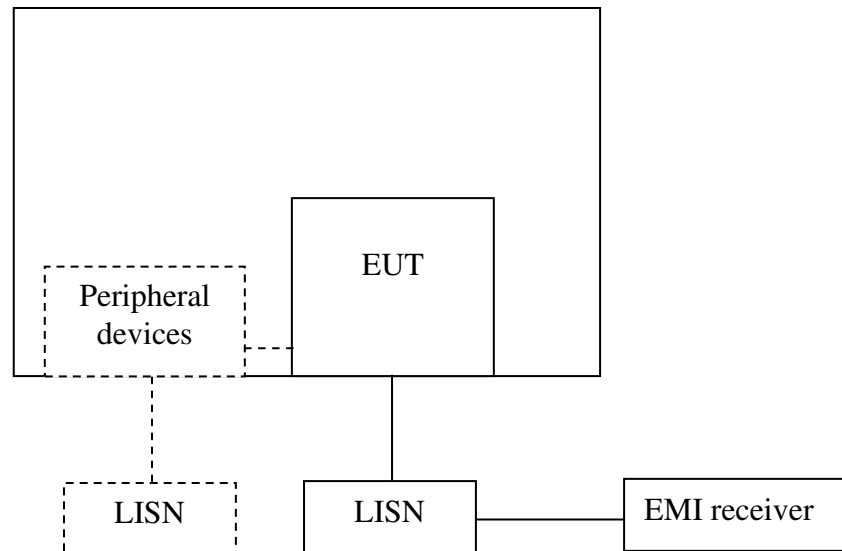
**Test result:** Pass

### 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  $\Omega$  LISN port (to which the EUT is connected), where permitted, terminated into a 50  $\Omega$  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  $\Omega$  measuring port is terminated by a measuring instrument having 50  $\Omega$  input impedance. All other ports are terminated in 50  $\Omega$  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.

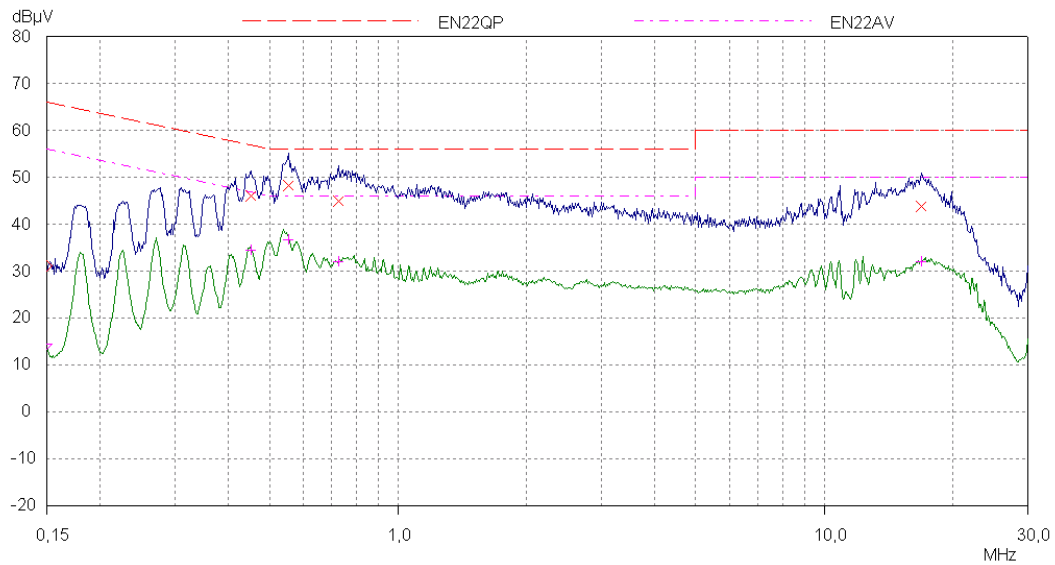
The bandwidth of the test receiver is set at 9 kHz.



### 5.4 Test protocol

Temperature : 23 °C  
Relative Humidity : 56 %

#### L line

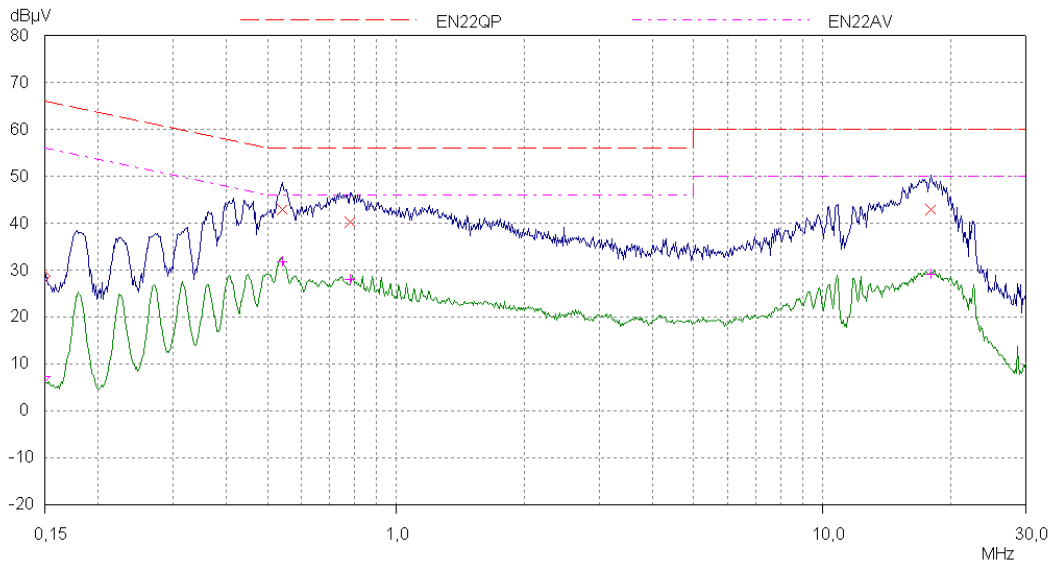


#### Test Data:

| 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) |
|---------|--------------------------|------------------|
| 906     | 821.04                   | 821.04           |
| 916     | 822.43                   | 822.43           |
| 924     | 830.20                   | 830.20           |

**Remark: "Max. Value" is the maximum test result of all the measured occupied bandwidth.**

