# FCC/IC - TEST REPORT

| | | | | |
|---|---|---|---|---|
| Report Number | : | 68.950.18.0568.01 | Date of Issue: | November 28, 2018 |
| Model | : | G1023E, G1018E, M610 | | |
| Product Type | : | Wireless Receiver | | |
| Applicant | : | Shenzhen Loyal Electronics Co., Ltd | | |
| Address | : | No.5 The First Industrial Area of Shanmen, Songgang, Baoan, Shenzhen,China | | |
| Manufacturer | : | Shenzhen Loyal Electronics Co., Ltd | | |
| Address | : | No.5 The First Industrial Area of Shanmen, Songgang, Baoan, Shenzhen,China | | |
| Test Result | : | ■ **Positive** ☐ **Negative** | | |
| Total pages including Appendices | : | 40 | | |

# 1 Table of Contents





TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

# 2 Details about the Test Laboratory

**Details about the Test Laboratory**
Test Site 1

| | |
|---|---|
| Company name: | TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch<br>Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District<br>Shenzhen 518052<br>P.R. China |
| Telephone: | 86 755 8828 6998 |
| Fax: | 86 755 828 5299 |
| FCC Registration No.: | 514049 |
| IC Registration No.: | 10320A -1 |

# 3 Description of the Equipment Under Test

| | |
|---|---|
| Product: | Wireless Receiver |
| Model no.: | G1023E, G1018E, M610 |
| FCC ID: | 2AAVD-R1018 |
| IC: | 23918-R1018 |
| Options and accessories: | N/A |
| Rating: | 5VDC, 100mA, powered by USB port. |
| RF Transmission Frequency: | 2408MHz-2474MHz |
| No. of Operated Channel: | 34 |
| Modulation: | FSK, |
| Antenna Type: | Integrated antenna |
| Antenna Gain: | -0.61dBi |
| Description of the EUT: | The Equipment Under Test (EUT) is a Wireless Receiver operated at 2.4GHz |

# 4 Summary of Test Standards

| Test Standards | |
|---|---|
| FCC Part 15 Subpart C<br>10-1-2017 Edition | PART 15 - RADIO FREQUENCY DEVICES<br>Subpart C - Intentional Radiators |
| RSS-Gen Issue 5<br>April 2018 | General Requirements for the Certification of Radio Apparatus |
| RSS-247 Issue 2<br>February 2017 | Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices |

All the test methods were according to KDB558074 D01 15.247 Meas Guidance v05 and ANSI C63.10 (2013).

# 5 Summary of Test Results

| Technical Requirements | | | | | |
|---|---|---|---|---|---|
| **FCC Part 15 Subpart C/RSS-247 Issue 2/RSS-Gen Issue 5** | | | | | |
| Test Condition | | | Pages | Test Result | Test Site |
| §15.207 | RSS-GEN 8.8 | Conducted emission AC power port | 10 | Pass | Site 1 |
| §15.247(b)(1) | RSS-247 Clause 5.4(d) | Conducted peak output power | 13 | Pass | Site 1 |
| §15.247(e) | RSS-247 Clause 5.2(b) | Power spectral density* | -- | N/A | -- |
| §15.247(a)(2) | RSS-247 Clause 5.2(a) | 6dB bandwidth | -- | N/A | -- |
| §15.247(a)(1) | RSS-247 Clause 5.1(a) & RSS-Gen 6.7 | 20dB bandwidth and 99% Occupied Bandwidth | 16 | Pass | Site 1 |
| §15.247(a)(1) | RSS-247 Clause 5.1(b) | Carrier frequency separation | 20 | Pass | Site 1 |
| §15.247(a)(1)(iii) | RSS-247 Clause 5.1(d) | Number of hopping frequencies | 22 | Pass | Site 1 |
| §15.247(a)(1)(iii) | RSS-247 Clause 5.1(d) | Dwell Time | 24 | Pass | Site 1 |
| §15.247(d) | RSS-247 Clause 5.5 | Spurious RF conducted emissions | 26 | Pass | Site 1 |
| §15.247(d) | RSS-247 Clause 5.5 | Band edge | 32 | Pass | Site 1 |
| §15.247(d) & §15.209 & | RSS-247 Clause 5.5 & RSS-GEN 6.13 | Spurious radiated emissions for transmitter and receiver | 35 | Pass | Site 1 |
| §15.203 | RSS-GEN 6.8 | Antenna requirement | See note 2 | Pass | -- |

Note 1: N/A=Not Applicable.
Note 2: The EUT uses a Integrated antenna, which gain is -0.61dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

# 6 General Remarks

**Remarks**

This submittal(s) (test report) is intended for FCC ID: 2AAVD-R1018, IC: 23918-R1018 complies with Section 15.207,15.209, 15.247 of the FCC Part 15, Subpart C, RSS-247Issue 2 February 2017 and RSS-Gen Issue 5 April 2018 rules.

G1023E, G1018E, M610 is a Wireless Receiver with 2.4G. The TX and RX range is 2408MHz-2474MHz.

Note: The report is for FSK only.

**SUMMARY:**

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date: September 10, 2018

Testing Start Date: September 10, 2018

Testing End Date: November 28, 2018

| Reviewed by: | Prepared by: | Tested by: |
|---|---|---|
| Phoebe Hu | Vincent Zheng | Tree Zhan |
| EMC Section Manager | EMC Project Engineer | EMC Test Engineer |

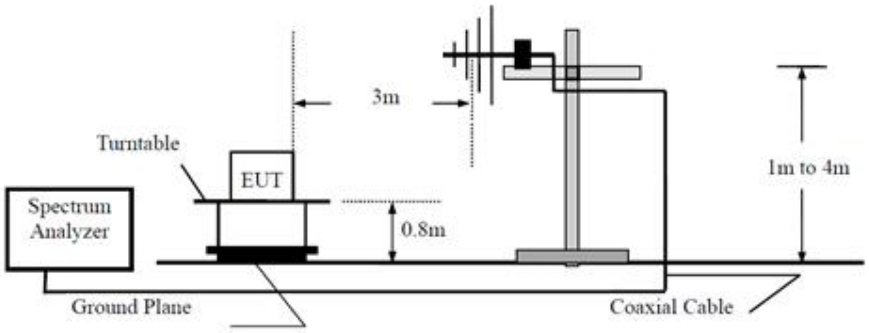


TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

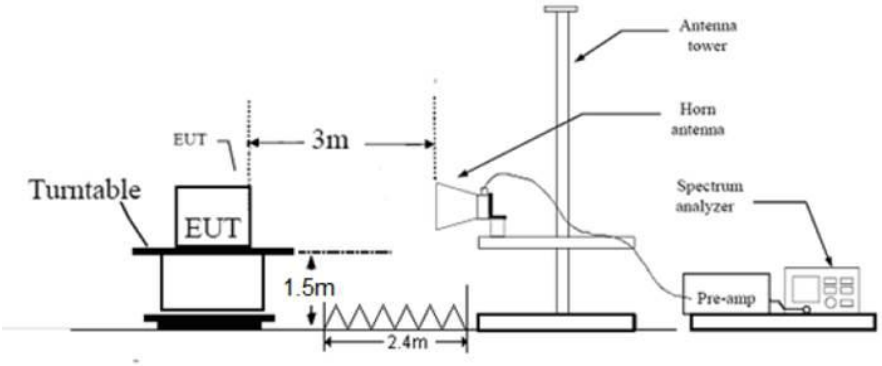
# 7 Test Setups

## 7.1 Radiated test setups

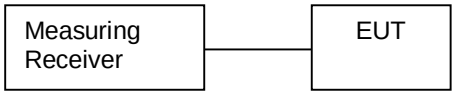
Below 1GHz



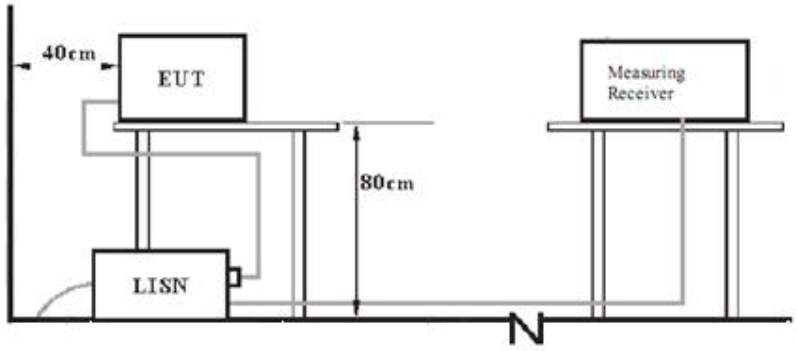

Above 1GHz




## 7.2 Conducted RF test setups




## 7.3 AC Power Line Conducted Emission test setups



# 8 Systems test configuration

Auxiliary Equipment Used during Test:

| DESCRIPTION | MANUFACTURER | MODEL NO. | S/N |
|---|---|---|---|
| Notebook | Lenovo | X220 | --- |

Test software: USB test tool, which used to control the EUT in continues transmitting mode

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

# 9 Technical Requirement

## 9.1 Conducted Emission

**Test Method**

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

**Limit**

| Frequency MHz | QP Limit dBµV | AV Limit dBµV |
|---|---|---|
| 0.150-0.500 | 66-56* | 56-46* |
| 0.500-5 | 56 | 46 |
| 5-30 | 60 | 50 |

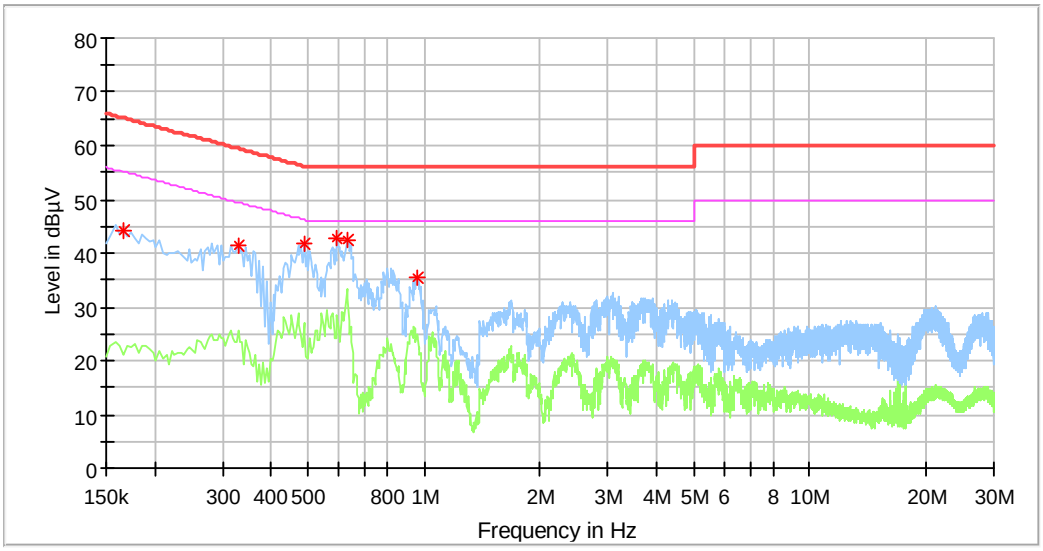
Decreasing linea



TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

## Conducted emission AC power port

| | |
|---|---|
| Model: | G1018E |
| Test mode: | Transmitting |
| Test Voltage: | AC 120V/60Hz |
| Test Specification | Power Line, Live |



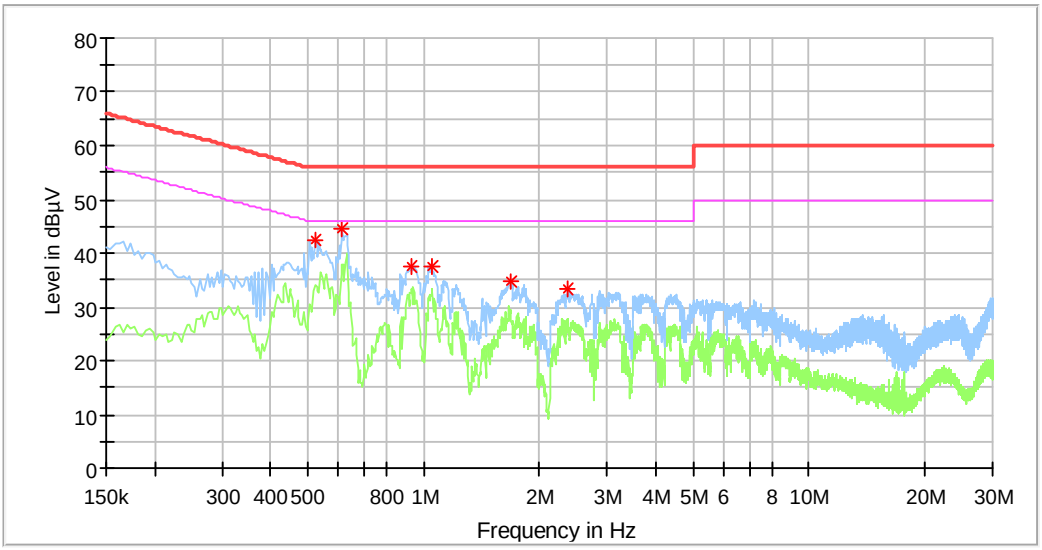

## Critical_Freqs

| Frequency (MHz) | MaxPeak (dBµV) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|
| 0.166000 | 44.21 | --- | 65.16 | 20.95 | L1 | 10.2 |
| 0.330000 | 41.46 | --- | 59.45 | 17.99 | L1 | 10.2 |
| 0.486000 | 41.66 | --- | 56.24 | 14.57 | L1 | 10.3 |
| 0.594000 | 42.65 | --- | 56.00 | 13.35 | L1 | 10.3 |
| 0.630000 | 42.41 | --- | 56.00 | 13.59 | L1 | 10.3 |
| 0.962000 | 35.43 | --- | 56.00 | 20.57 | L1 | 10.3 |

Remark： “*” Correct factor=cable loss + LISN factor

## Conducted emission AC power port

| | |
|---|---|
| Model: | G1018E |
| Test mode: | Transmitting |
| Test Voltage: | AC 120V/60Hz |
| Test Specification | Power Line, Neutral |




## Critical_Freqs

| Frequency (MHz) | MaxPeak (dBµV) | Average (dBµV) | Limit (dBµV) | Margin (dB) | Line | Corr. (dB) |
|---|---|---|---|---|---|---|
| 0.522000 | 42.38 | --- | 56.00 | 13.62 | N | 10.3 |
| 0.614000 | 44.52 | --- | 56.00 | 11.48 | N | 10.3 |
| 0.930000 | 37.49 | --- | 56.00 | 18.51 | N | 10.3 |
| 1.050000 | 37.61 | --- | 56.00 | 18.39 | N | 10.3 |
| 1.682000 | 34.73 | --- | 56.00 | 21.27 | N | 10.3 |
| 2.362000 | 33.45 | --- | 56.00 | 22.55 | N | 10.3 |

Remark： “*” Correct factor=cable loss + LISN factor

## 9.2 Conducted peak output power

**Test Method**

1. Use the following spectrum analyzer settings:
   Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
   RBW > the 20dB bandwidth of the emission being measured, VBW≥RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power

**Limits**

| Frequency Range MHz | Limit W | FCC Limit dBm | IC Limit dBm |
|---|---|---|---|
| 2400-2483.5 | ≤1 | ≤30/1W | ≤21/0.125W |

**For e.i.r.p**

| Frequency Range MHz | Limit W | Limit dBm |
|---|---|---|
| 2400-2483.5 | ≤4W | ≤36 |

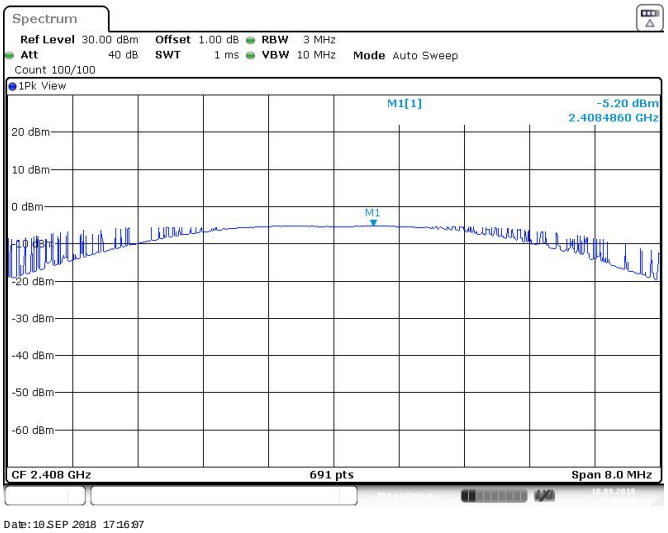

TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

## Conducted peak output power

FSK modulation Test Result

| Frequency MHz | Conducted Peak Output Power dBm | E.I.R.P dBm | Result |
|---|---|---|---|
| Low channel 2408MHz | -5.20 | -5.81 | Pass |
| Middle channel 2440MHz | -5.81 | -6.42 | Pass |
| High channel 2474MHz | -5.58 | -6.19 | Pass |

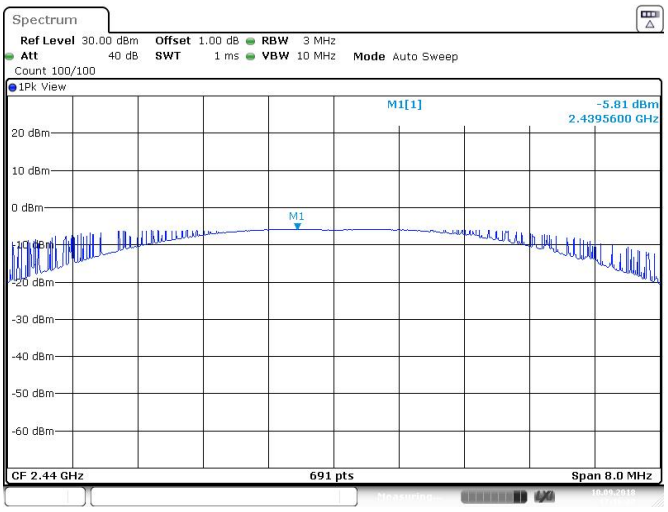
Low channel 2408MHz



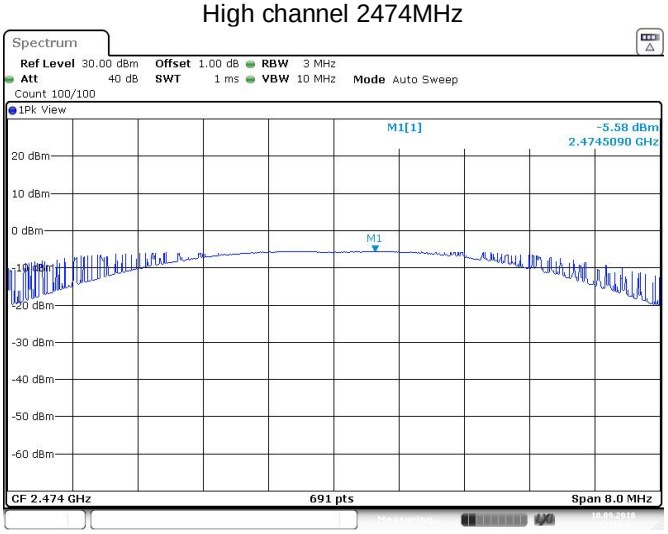



TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

Middle channel 2440MHz




High channel 2474MHz



## 9.3 20 dB bandwidth and 99% Occupied Bandwidth

**Test Method**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

**Limit**

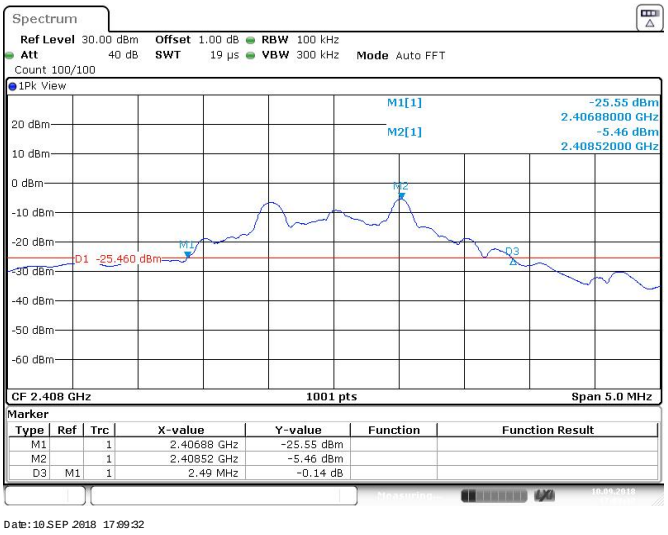
| Limit [kHz] |
|---|
| N/A |

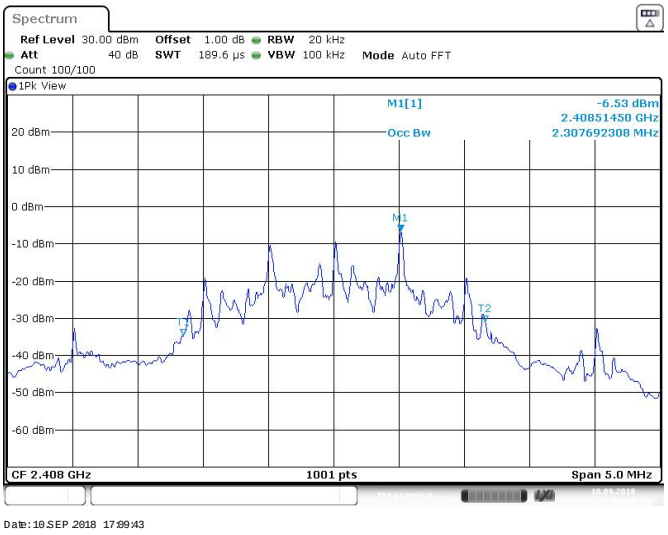
## 20 dB bandwidth and 99% Occupied Bandwidth

FSK Modulation test result

| Frequency MHz | 20 dB Bandwidth MHz | 99% Bandwidth MHz | Limit kHz | Result |
|---|---|---|---|---|
| 2408 | 2.490 | 2.263 | -- | Pass |
| 2440 | 2.530 | 2.248 | -- | Pass |
| 2474 | 2.510 | 2.263 | -- | Pass |

Low channel 2408MHz

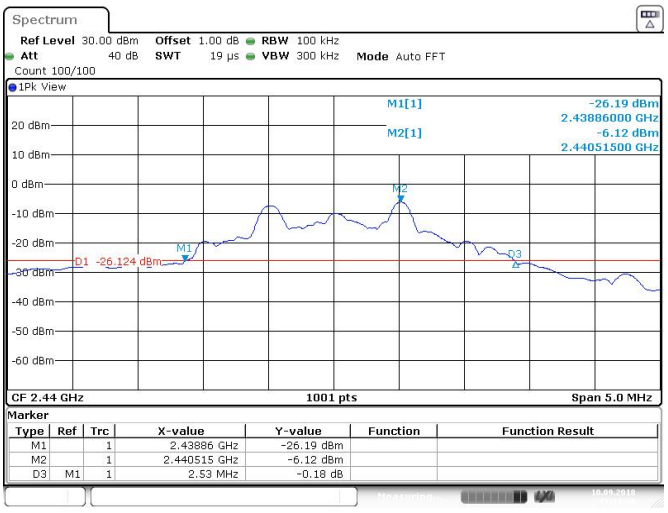


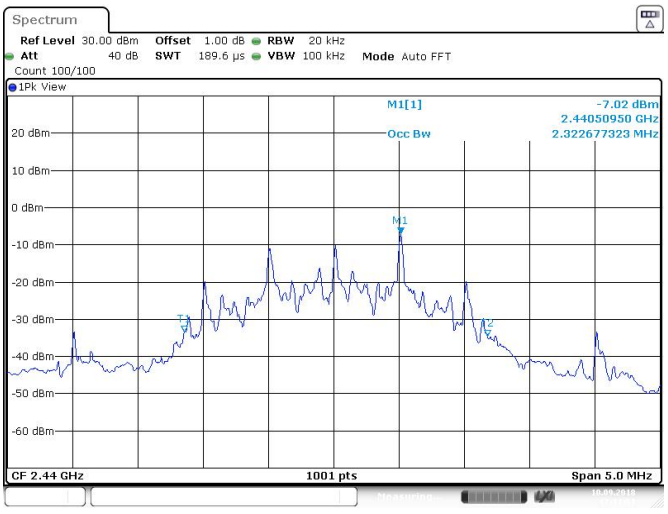





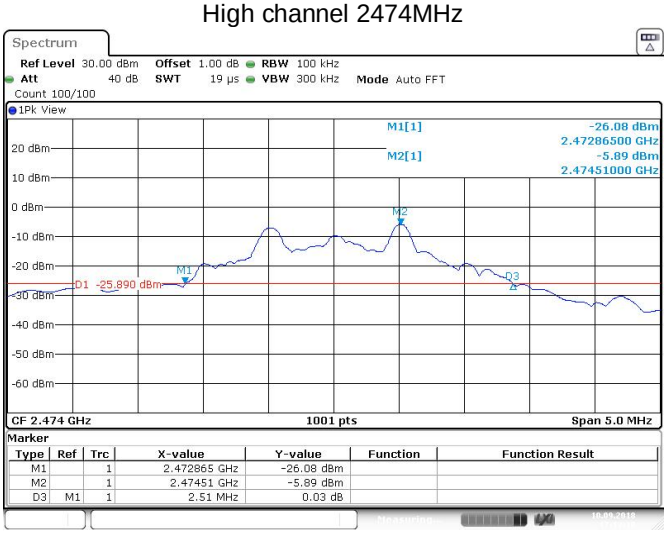

TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

Middle channel 2440MHz

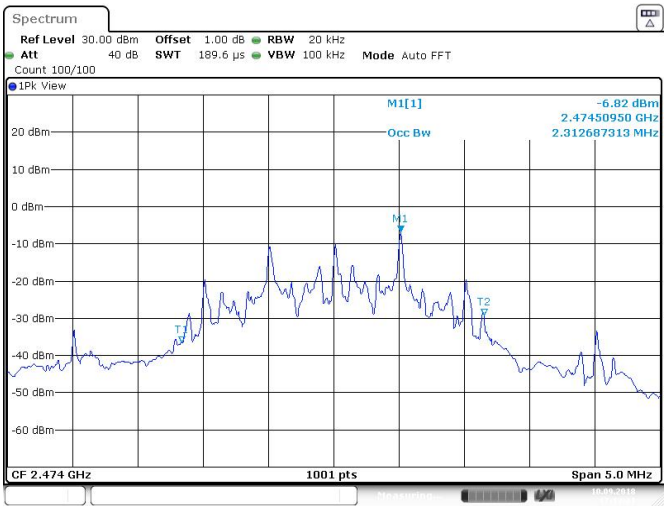


High channel 2474MHz




Date: 10.SEP.2018 17:13:10




Date: 10.SEP.2018 17:13:22

## 9.4 Carrier Frequency Separation

**Test Method**

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
2. By using the Max-Hold function record the separation of two adjacent channels.
3. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function.
4. Repeat above procedures until all frequencies measured were complete.

**Limit**

| Limit<br>kHz |
|---|
| ≥25KHz or 2/3 of the 20 dB bandwidth which is greater |

FSK Modulation Limit

| Frequency<br>MHz | 2/3 of 20 dB Bandwidth<br>kHz |
|---|---|
| 2408 | 628.07 |
| 2440 | 633.87 |
| 2474 | 631.0 |

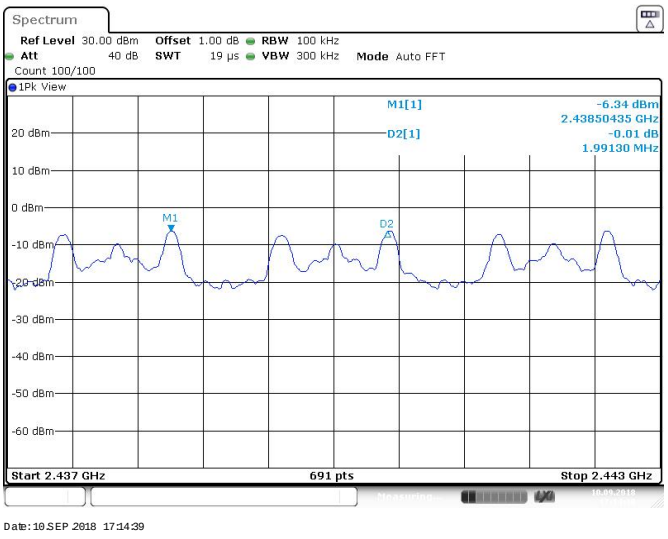
## Carrier Frequency Separation

Test result: The measurement was performed with the typical configuration (normal hopping status), here FSK modulation mode was used to show compliance.

FSK Modulation test result

| Frequency MHz | Carrier Frequency Separation kHz | Result |
|---|---|---|
| 2408 | -- | Pass |
| 2440 | 1991 | Pass |
| 2474 | -- | Pass |

Middle channel 2440MHz






TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

## 9.5 Number of hopping frequencies

**Test Method**

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode.
3. Record all the signals from each channel until each one has been recorded.
4. Repeat above procedures until all frequencies measured were complete.

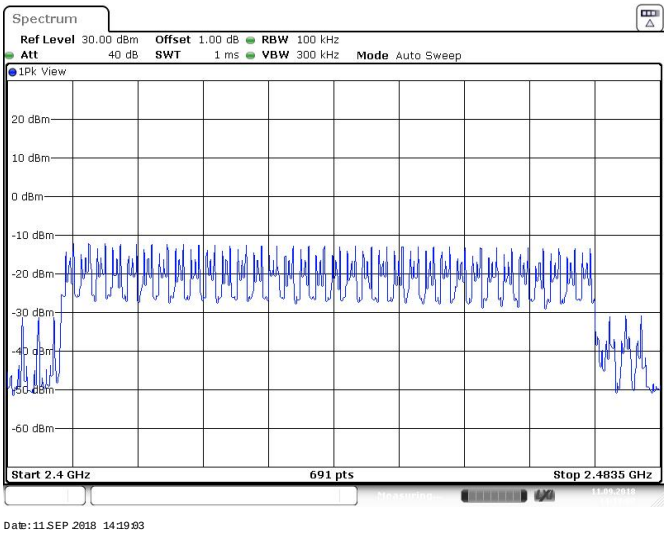
**Limit**

| Limit number |
|---|
| ≥ 15 |

## Number of hopping frequencies

Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification. Here FSK modulation mode was used to show compliance.

| Number of hopping frequencies | Result |
|---|---|
| 34 | Pass |






TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

## 9.6 Dwell Time

**Test Method**

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable. Equipment mode: Spectrum analyzer
2. RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
3. Adjust the center frequency of spectrum analyzer on any frequency be measured.
4. Measure the Dwell Time by spectrum analyzer Marker function.
5. Repeat above procedures until all frequencies measured were complete.

**Limit**

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

## Dwell Time

### Dwell time

The maximum dwell time shall be 0.4 s.
The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] *34 [ch] = 31.6 [s*ch];

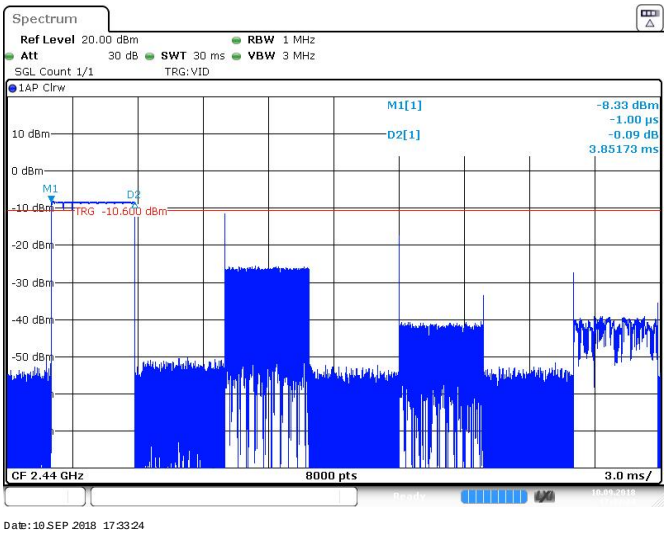
The burst width, which is directly measured, refers to the duration on one channel hop.

The maximum number of hopping channels in 13.6s for FSK=1600 / 6 / 34 *13.6=106.67

Test Result

| Modulation | Mode | Reading (ms) | Total Hops | Test Result (ms) | Limit (ms) | Result |
|---|---|---|---|---|---|---|
| FSK | -- | 3.85 | 46 | 177.1 | < 400 | Pass |

FSK Modulation






TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

## 9.7 Spurious RF conducted emissions

**Test Method**

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10$^{th}$ harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
3. The level displayed must comply with the limit specified in this Section. Submit these plots.
4. Repeat above procedures until all frequencies measured were complete.

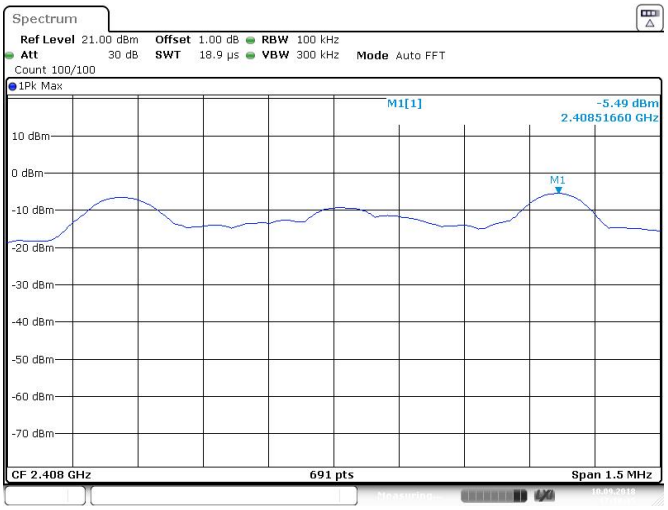
**Limit**

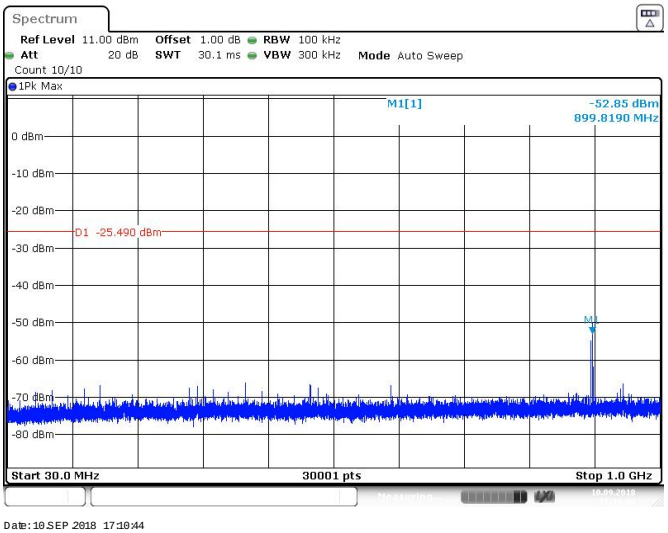
| Frequency Range MHz | Limit (dBc) |
|---|---|
| 30-25000 | -20 |

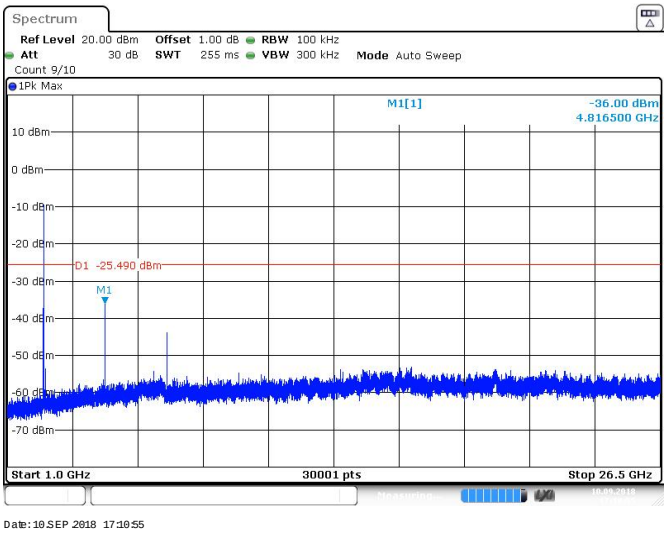
## Spurious RF conducted emissions

FSK Modulation:

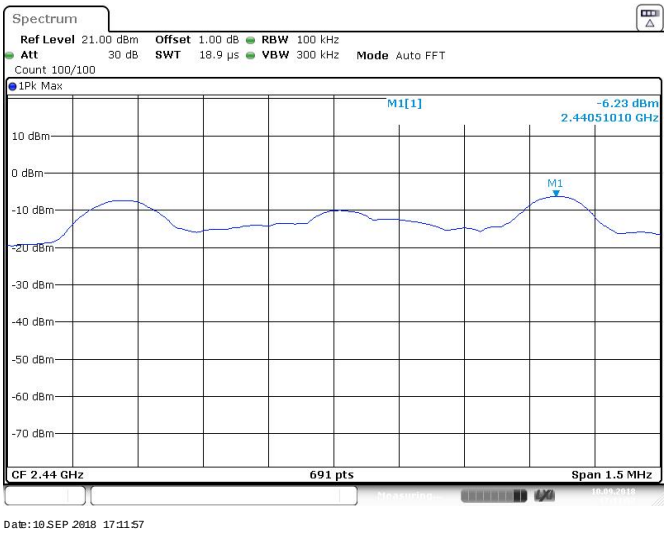
Low channel 2408MHz

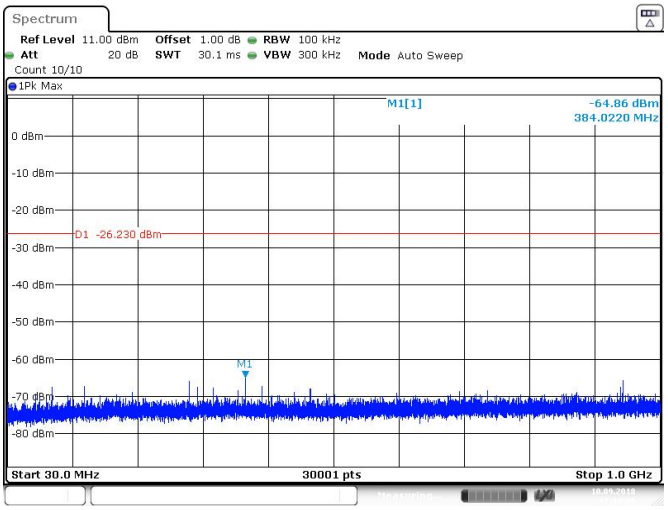


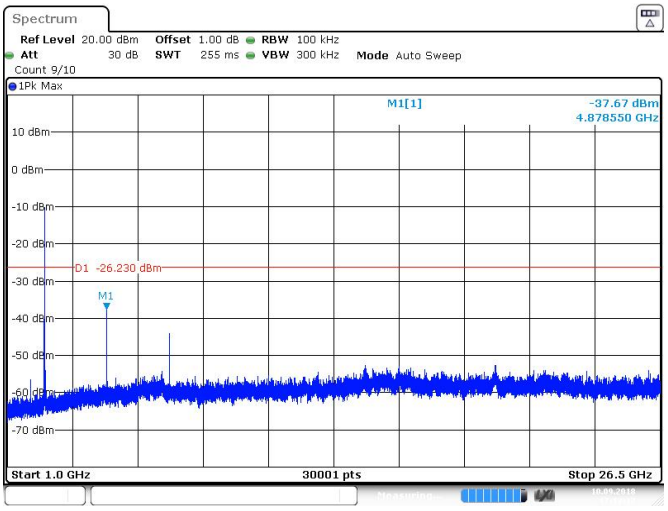





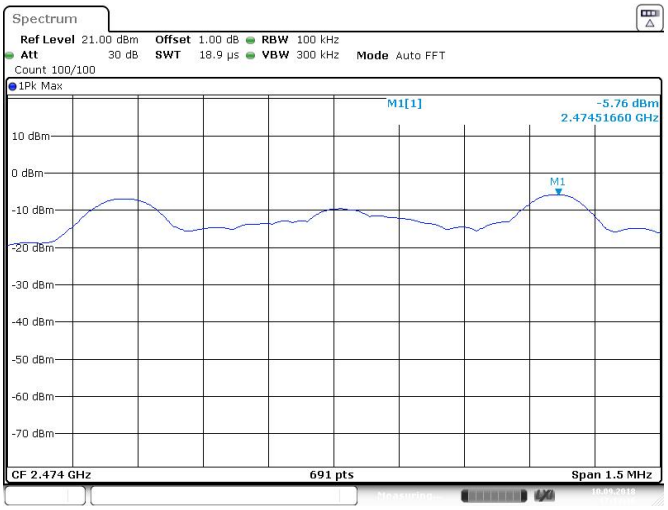

Middle channel 2440MHz

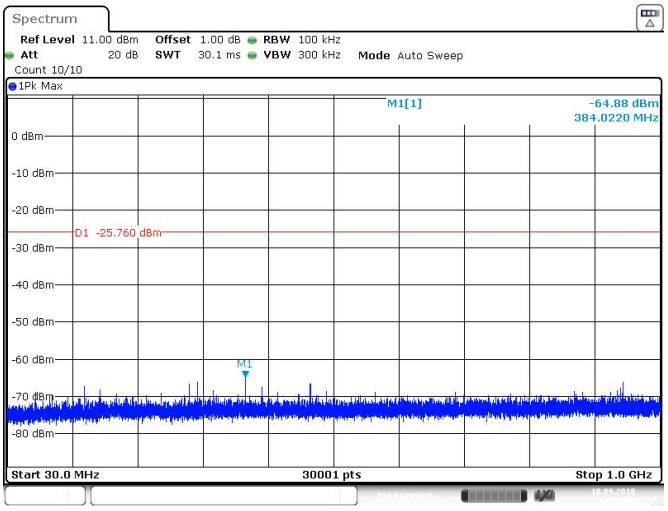



Spectrum
Ref Level 11.00 dBm Offset 1.00 dB RBW 100 kHz
Att 20 dB SWT 30.1 ms VBW 300 kHz Mode Auto Sweep
Count 10/10
1Pk Max
M1[1] -64.86 dBm
384.0220 MHz
0 dBm
-10 dBm
-20 dBm
D1 -26.230 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
-70 dBm
-80 dBm
Start 30.0 MHz
30001 pts
Stop 1.0 GHz
Date: 10.SEP.2018 17:12:06


Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 255 ms VBW 300 kHz Mode Auto Sweep
Count 9/10
1Pk Max
M1[1] -37.67 dBm
4.878550 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
D1 -26.230 dBm
-30 dBm
M1
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 GHz
30001 pts
Stop 26.5 GHz
Date: 10.SEP.2018 17:12:18

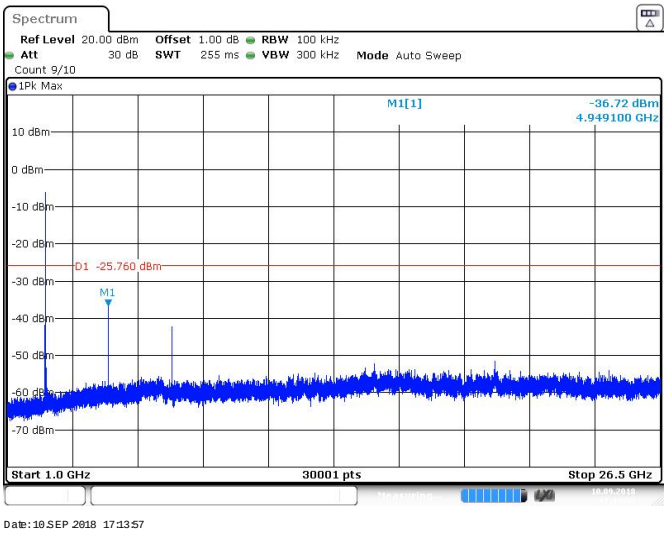
High channel 2474MHz






TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China






TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

## 9.8 Band edge testing

**Test Method**

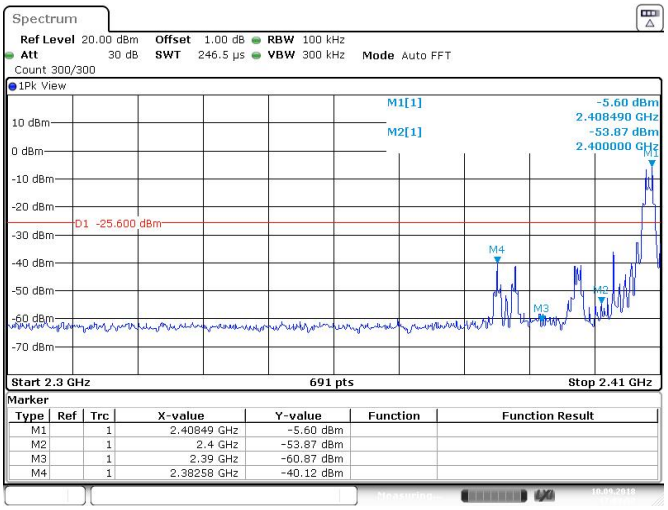
1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
3 The level displayed must comply with the limit specified in this Section. .
4 Repeat the test at the hopping off and hopping on mode, submit all the plots.

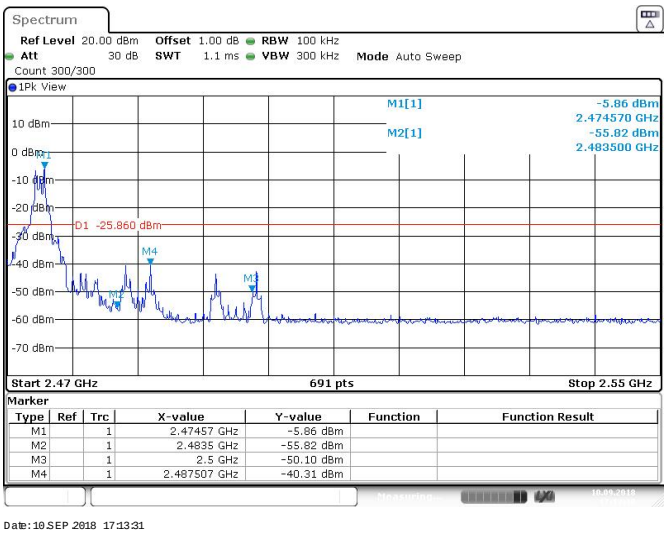
**Limit:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

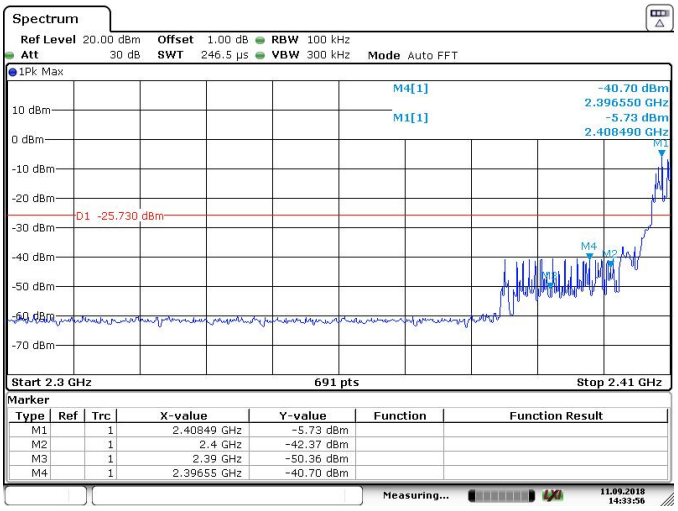

TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District
Shenzhen 518052, P.R. China

## FSK mode: Hopping off

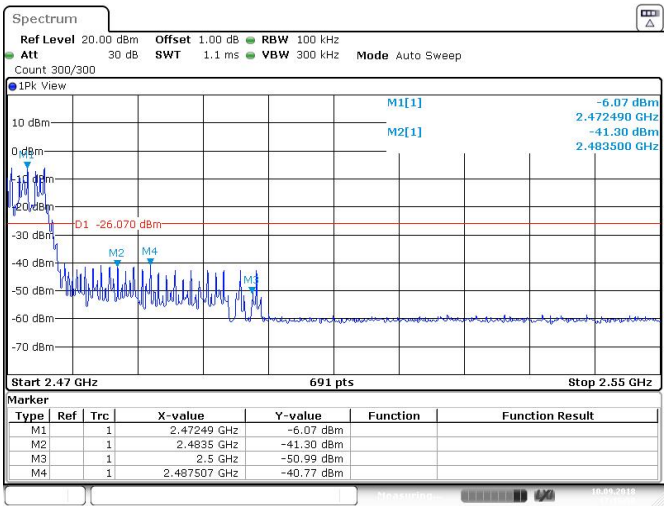


## FSK mode: Hopping on




Date: 11.SEP.2018 14:33:56




Date: 10.SEP.2018 17:15:50

## 9.9 Spurious radiated emissions for transmitter

**Test Method**

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.

3: 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.

4: 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.

5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement and VBW = 10Hz for average measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 KHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

**Note:**

1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.

2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.

3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log(1/duty cycle)).

4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.

## Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

| Frequency MHz | Field Strength uV/m | Field Strength dBµV/m | Detector |
|---|---|---|---|
| 30-88 | 100 | 40 | QP |
| 88-216 | 150 | 43.5 | QP |
| 216-960 | 200 | 46 | QP |
| 960-1000 | 500 | 54 | QP |
| Above 1000 | 500 | 54 | AV |
| Above 1000 | 5000 | 74 | PK |

## Spurious radiated emissions for transmitter

**Transmitting spurious emission test result as below:**

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

FSK Modulation 2408MHz Test Result

| Frequency Band | Frequency | Emission Level | Polarization | Limit | Detector | Margin | Correct factor | Result |
|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | | dBµV/m | | dBuV/m | (dB) | |
| 30-1000MHz | 625.36 | 28.99 | H | 46 | QP | 17.01 | -19.5 | Pass |
| | 794.85 | 31.26 | V | 46 | QP | 14.74 | -14.6 | Pass |
| 1000-25000MHz | 4816.10* | 51.06 | H | 74 | PK | 22.94 | -8.4 | Pass |
| | 4816.93* | 49.86 | V | 74 | PK | 24.14 | -8.4 | Pass |
| | 7223.95* | 52.05 | H | 74 | PK | 21.95 | -6.8 | Pass |
| | 7223.56* | 48.76 | V | 74 | PK | 25.24 | -6.8 | Pass |

FSK Modulation 2440MHz Test Result

| Frequency Band | Frequency | Emission Level | Polarization | Limit | Detector | Margin | Correct factor | Result |
|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | | dBµV/m | | dBuV/m | (dB) | |
| 30-1000MHz | -- | -- | H | 43.5 | QP | -- | -- | Pass |
| | -- | -- | V | 46 | QP | -- | -- | Pass |
| 1000-25000MHz | 4879.87* | 51.06 | H | 74 | PK | 22.94 | -8.5 | Pass |
| | 4879.70* | 49.86 | V | 74 | PK | 24.14 | -8.5 | Pass |
| | 7319.82* | 52.05 | H | 74 | PK | 21.95 | -7.2 | Pass |
| | 7319.24* | 48.76 | V | 74 | PK | 25.24 | -7.2 | Pass |

FSK Modulation 2474MHz Test Result

| Frequency Band | Frequency | Emission Level | Polarization | Limit | Detector | Margin | Correct factor | Result |
|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | | dBµV/m | | dBuV/m | (dB) | |
| 30-1000MHz | -- | -- | H | 43.5 | QP | -- | -- | Pass |
| | -- | -- | V | 46 | QP | -- | -- | Pass |
| 1000-25000MHz | 4960.49* | 51.06 | H | 74 | PK | 22.94 | -8.4 | Pass |
| | 4959.94* | 49.86 | V | 74 | PK | 24.14 | -8.4 | Pass |
| | 7440.13* | 52.05 | H | 74 | PK | 21.95 | -7.1 | Pass |
| | 7440.26* | 48.76 | V | 74 | PK | 25.24 | -7.1 | Pass |

Remark:

(1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.

(2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.

(3) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss

# 10 Test Equipment List

## List of Test Instruments

Radiated Emission Test

| DESCRIPTION | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DUE DATE |
|---|---|---|---|---|
| EMI Test Receiver | Rohde & Schwarz | ESR 26 | 101269 | 2019-7-6 |
| Trilog Super Broadband Test Antenna | Schwarzbeck | VULB 9163 | 707 | 2019-7-14 |
| Horn Antenna | Rohde & Schwarz | HF907 | 102294 | 2019-7-14 |
| Pre-amplifier | Rohde & Schwarz | SCU 18 | 102230 | 2019-7-6 |
| Signal Generator | Rohde & Schwarz | SMY01 | 839369/005 | 2019-7-6 |
| Attenuator | Agilent | 8491A | MY39264334 | 2019-7-6 |
| 3m Semi-anechoic chamber | TDK | 9X6X6 | ---- | 2020-7-7 |
| Test software | Rohde & Schwarz | EMC32 | Version 9.15.00 | N/A |

Conducted Emission Test

| DESCRIPTION | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DUE DATE |
|---|---|---|---|---|
| EMI Test Receiver | Rohde & Schwarz | ESR 3 | 101782 | 2019-7-6 |
| LISN | Rohde & Schwarz | ENV4200 | 100249 | 2019-7-6 |
| LISN | Rohde & Schwarz | ENV432 | 101318 | 2019-7-6 |
| LISN | Rohde & Schwarz | ENV216 | 100326 | 2019-7-6 |
| ISN | Rohde & Schwarz | ENY81 | 100177 | 2019-7-6 |
| ISN | Rohde & Schwarz | ENY81-CA6 | 101664 | 2019-7-6 |
| High Voltage Probe | Rohde & Schwarz | TK9420(VT9420) | 9420-584 | 2019-6-30 |
| RF Current Probe | Rohde & Schwarz | EZ-17 | 100816 | 2019-6-30 |
| Attenuator | Shanghai Huaxiang | TS2-26-3 | 080928189 | 2019-7-6 |
| Test software | Rohde & Schwarz | EMC32 | Version9.15.00 | N/A |

TS8997 Test System

| DESCRIPTION | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DUE DATE |
|---|---|---|---|---|
| Signal Generator | Rohde & Schwarz | SMB100A | 108272 | 2019-7-6 |
| Vector Signal Generator | Rohde & Schwarz | SMBV100A | 262825 | 2019-7-6 |
| Communication Synthetical Test Instrument | Rohde & Schwarz | CMW 270 | 101251 | 2019-5-31 |
| Signal Analyzer | Rohde & Schwarz | FSV40 | 101030 | 2019-7-6 |
| Vector Signal Generator | Rohde & Schwarz | SMU 200A | 105324 | 2019-7-6 |
| RF Switch Module | Rohde & Schwarz | OSP120/OSP-B157 | 101226/100851 | 2019-7-6 |
| Power Splitter | Weinschel | 1580 | SC319 | 2019-7-5 |
| 10dB Attenuator | Weinschel | 4M-10 | 43152 | 2019-7-6 |
| 10dB Attenuator | R&S | DNF | DNF-001 | 2019-7-6 |
| 10dB Attenuator | R&S | DNF | DNF-002 | 2019-7-6 |
| 10dB Attenuator | R&S | DNF | DNF-003 | 2019-7-6 |
| 10dB Attenuator | R&S | DNF | DNF-004 | 2019-7-6 |
| Test software | Rohde & Schwarz | EMC32 | Version 10.38.00 | N/A |
| Test software | Tonscend | System for BT/WIFI | Version 2.6 | N/A |

## 11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

| System Measurement Uncertainty | |
|---|---|
| Test Items | Extended Uncertainty |
| Uncertainty for Conducted Emission 150kHz-30MHz (for test using AMN ENV432 or ENV4200) | 3.21dB |
| Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz | Horizontal: 4.91dB;<br>Vertical: 4.89dB; |
| Uncertainty for Radiated Emission in 3m chamber 1000MHz-18000MHz | Horizontal: 4.80dB;<br>Vertical: 4.79dB; |
| Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz | Horizontal: 5.05dB;<br>Vertical: 5.04dB; |
| Uncertainty for Conducted RF test with TS 8997 | Power level test involved: 1.16dB<br>Frequency test involved:<br>$0.6\times10^{-7}$ |