# EMC TEST REPORT for Intentional Radiator
# No. 140800005SHA-001

| | | |
|---|---|---|
| Applicant | : | Canton Elektronik GmbH & Co. KG |
| | | Neugasse 21-23, 61276 Weilrod / Niederlauken, Germany |
| Manufacturer | : | Canton Elektronik GmbH & Co. KG |
| | | Neugasse 21-23, 61276 Weilrod / Niederlauken, Germany |
| Product Name | : | Soundbar Speaker |
| Brand Name | : | CANTON |
| Type/Model | : | DM 75 SE, DM 90.3, VRA 2, BRA 2, DM 75 HD, DM 95 |
| **TEST RESULT** | **:** | **PASS** |

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

**47CFR Part 15 (2013):** Radio Frequency Devices

**ANSI C63.4 (2009):** American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

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

**RSS-Gen Issue 3 (December 2010):** General Requirements and Information for the Certification of Radio communication Equipment

Date of issue: Dec 16, 2014

Prepared by: Reviewed by:

Wade Zhang (*Project Engineer*) Daniel Zhao (*Reviewer*)

# Description of Test Facility

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# 1. General Information

## 1.1 Applicant Information

| | | |
|---|---|---|
| Applicant | : | Canton Elektronik GmbH & Co. KG<br>Neugasse 21-23, 61276 Weilrod / Niederlauken, Germany |
| Name of contact | : | Mr. Frank Goebl or Mr. Markus Brueckner |
| Tel | : | +49 6083 2870 |
| Fax | : | +49 6083 287 48 |
| Factory 1 | : | Everbright audio (Shenzhen) company limited.<br>No.19, fareast industry aera, Hsin Ho, Fuyung, Bao An, Shenzhen, China |
| Factory 2 | | Canton Elektronik GmbH & Co. KG<br>Neugasse 21-23, 61276 Weilrod / Niederlauken, Germany |

## 1.2 Identification of the EUT

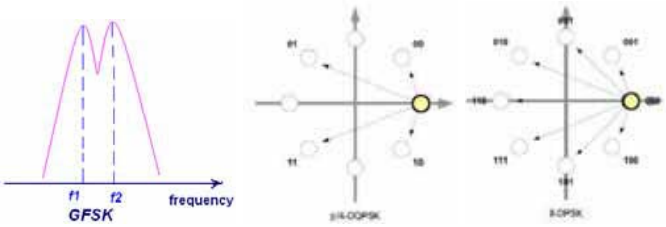
| | | |
|---|---|---|
| Equipment | : | Soundbar Speaker |
| Trade name | : | CANTON |
| Type/model | : | DM 75 SE, DM 90.3, VRA 2, BRA 2, DM 75 HD, DM 95 |
| FCC ID | : | WHZ-DM351 |
| IC | : | 7824A-DM351 |

## 1.3 Technical specification

Operation Frequency Band: 2402 - 2480 MHz

Protocol: BT 3.0 + EDR

Modulation: GFSK, π /4 DQPSK, 8DPSK




Technology:

GFSK is different from π /4DQPSK and 8DPSK. 8DPSK is similar with π /4DQPSK but more complex, and with a bigger data rate. So all the tests except output power, occupied bandwidth, dwell time and number of hopping frequencies were performed with GFSK modulation and 8DPSK modulation for representative.

Antenna Designation: Metal antenna

Gain of Antenna: 2.0dBi

Rating: AC 100-240V~, 50/60Hz, 150W

Description of EUT: The EUT is a soundbar speaker, and it has 6 models. All models are the same on schematic diagram, PCB layout and electronic construction, also have same electric parameters except its appearance. By technical analysis and evaluation, only the model of DM 75 SE was chosen to perform the full tests as representative.

Channel Description: There are 79 channels in all. The designed channel spacing is 1MHz.

| Channel Identifier | Frequency (MHz) |
|---|---|
| low | 2402 |
| middle | 2441 |
| high | 2480 |

## 1.4 Mode of operation during the test / Test peripherals used

While testing the transmitter mode of the EUT, the internal modulation is applied.
All the functions of the host device except the BT module were set on stand-by mode.

Test Peripherals:
PC: HP Compaq 6280 Pro;
iphone 5 mobile phone.

# 2. Test Specification

## 2.1 Instrument list

| Equipment | Type | Manu. | Internal no. | Cal. Date | Due date |
|---|---|---|---|---|---|
| Test Receiver | ESCS 30 | R&S | EC 2107 | 2014-10-20 | 2015-10-19 |
| Test Receiver | ESIB 26 | R&S | EC 3045 | 2014-10-19 | 2015-10-18 |
| Test Receiver | ESCI 7 | R&S | EC4501 | 2013-12-25 | 2014-12-24 |
| Test Receiver | FSP40 | R&S | / | 2014-10-20 | 2015-10-19 |
| A.M.N. | ESH2-Z5 | R&S | EC 3119 | 2014-1-9 | 2015-1-8 |
| Bilog Antenna | CBL 6112D | TESEQ | EC 4206 | 2014-4-27 | 2015-4-26 |
| Horn antenna | HF 906 | R&S | EC 3049 | 2014-4-27 | 2015-4-26 |
| Horn antenna | HAP18-26W | | EC 4792-3 | 2014-4-9 | 2015-4-8 |
| Pre-amplifier | Tpa0118-40 | R&S | EC 4792-2 | 2014-4-11 | 2015-4-10 |
| Semi-anechoic chamber | - | Albatross project | EC 3048 | 2014-5-11 | 2015-5-10 |
| Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 3323 | 2014-4-14 | 2015-4-13 |
| Pressure meter | YM3 | Shanghai Mengde | EC 3320 | 2014-6-13 | 2015-6-12 |
| Multi-meter | 179 | FLUKE | EC 3226 | 2014-9-10 | 2014-9-9 |
| Shielded room | - | Zhongyu | EC 2838 | 2014-1-12 | 2015-1-10 |
| High Pass Filter | WHKX 1.0/15G-10SS | Wainwright | EC4297-1 | 2014-1-8 | 2015-1-7 |
| High Pass Filter | WHKX 2.8/18G-12SS | Wainwright | EC4297-2 | 2014-1-8 | 2015-1-7 |
| High Pass Filter | WHKX 7.0/1.8G-8SS | Wainwright | EC4297-3 | 2014-1-8 | 2015-1-7 |
| Band Reject Filter | WRCGV 2400/2483-2390/2493-35/10SS | Wainwright | EC4297-4 | 2014-1-8 | 2015-1-7 |
| Power sensor / Power meter | N1911A/N1921A | Agilent | EC4318 | 2014-04-9 | 2015-04-8 |

## 2.2 Test Standard

47CFR Part 15 (2013)
ANSI C63.4 (2009)
RSS-210 Issue 8 (December 2010)
RSS-Gen Issue 3 (December 2010)

## 2.3 Test Summary

**This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.**

| TEST ITEM | FCC REFERANCE | IC REFERANCE | RESULT |
|---|---|---|---|
| 20 dB Bandwidth | 15.247(a)(1) | RSS-210 Issue 8 Annex 8 | Tested |
| Carrier Frequency Separation | 15.247(a)(1) | RSS-210 Issue 8 Annex 8 | Pass |
| Output power | 15.247(b)(1) | RSS-210 Issue 8 Annex 8 | Pass |
| Radiated Spurious Emissions | 15.205 & 15.209 | RSS-210 Issue 8 Clause 2 | Pass |
| Conducted Spurious Emissions & Band Edge | 15.247(d) | RSS-210 Issue 8 Annex 8 | Pass |
| Power line conducted emission | 15.207 | RSS-Gen Issue 3 Clause 7.2.4 | Pass |
| Number of Hopping Frequencies | 15.247(a)(1)(iii) | RSS-210 Issue 8 Annex 8 | Pass |
| Dwell time | 15.247(a)(1)(iii) | RSS-210 Issue 8 Annex 8 | Pass |
| Occupied bandwidth | - | RSS-Gen Issue 3 Clause 4.6.1 | Tested |
| Spurious emission for receiver | 15B | RSS-310 Issue 3 Clause 3.1 | NA |

Note: “NA” means “not applied”.

## 2.4 Frequency Hopping System Requirement

**Test Requirement: Section 15.247 (a)(1), (g), (h) requirement:**

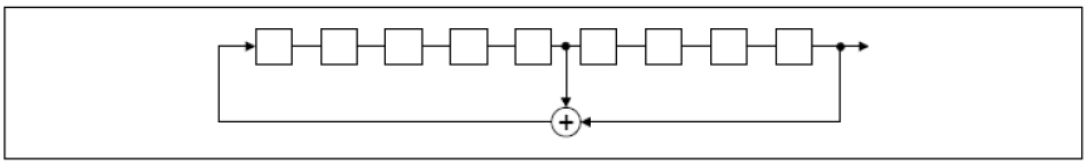
The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

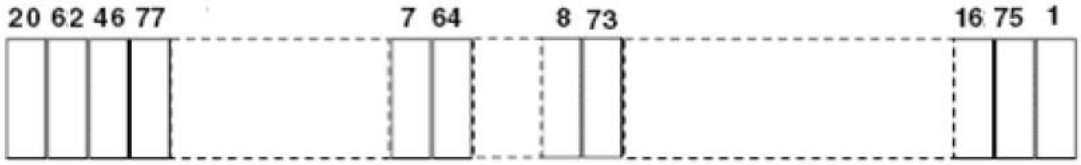
**Compliance for section 15.247(a)(1)**

According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a nine stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs;
i.e. the shift register is initialized with nine ones.
• Number of shift register stages: 9
• Length of pseudo-random sequence: $2^9$ -1 = 511 bits
• Longest sequence of zeros: 8 (non-inverted signal)



*Linear Feedback Shift Register for Generation of the PRBS sequence*

An example of Pseudorandom Frequency Hopping Sequence as follow:




Each frequency used equally on the average by each transmitter.
According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

**Compliance for section 15.247(g)**

According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

**Compliance for section 15.247(h)**

According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.
According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

# 3. 20 dB Bandwidth

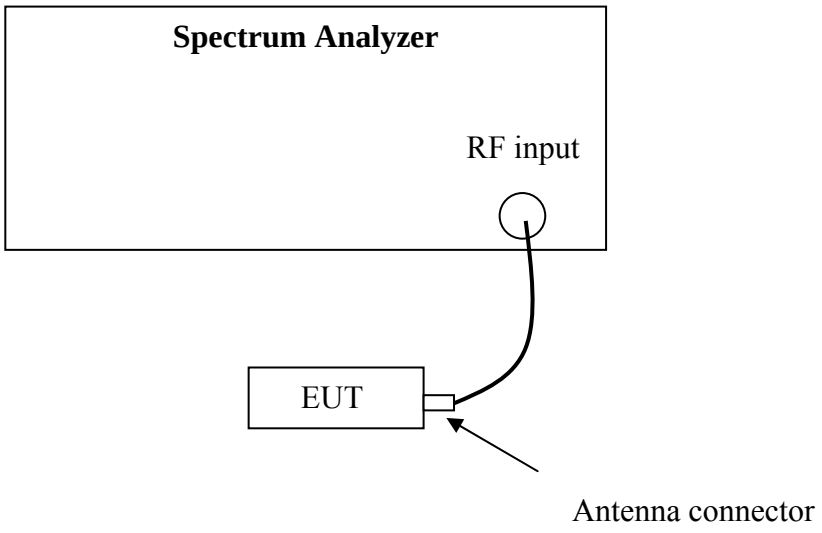
**Test result: Tested**

## 3.1 Limit

☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

## 3.2 Test Configuration




## 3.3 Test Procedure and test setup

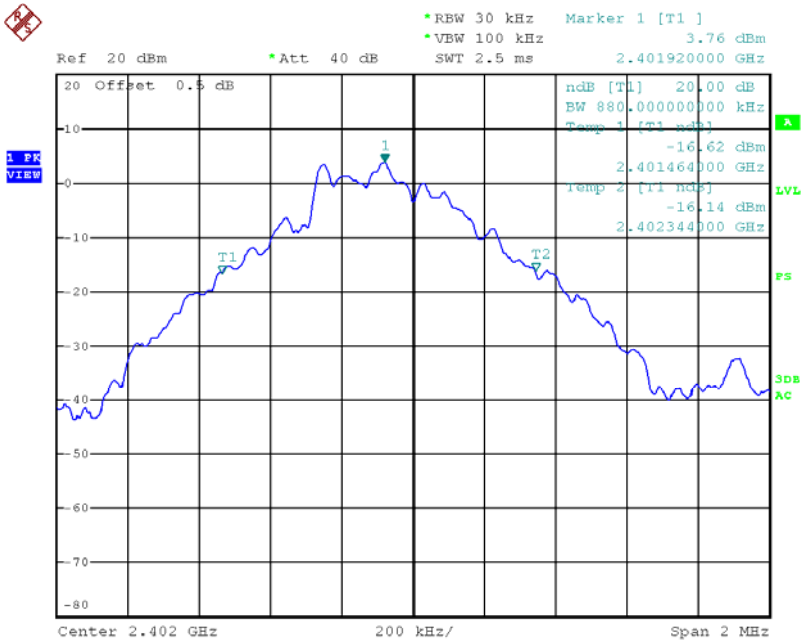
The 20 bandwidth per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span = 2 to 3 times the 20 dB bandwidth, RBW≥1% of the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

### 3.4 Test Protocol

Temperature : 25°C
Relative Humidity : 55 %

| Modulation | CH | Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|---|---|---|---|
| GFSK | L | 880.00 | 586.67 |
| | M | 876.00 | 584.00 |
| | H | 880.00 | 586.67 |

Channel L

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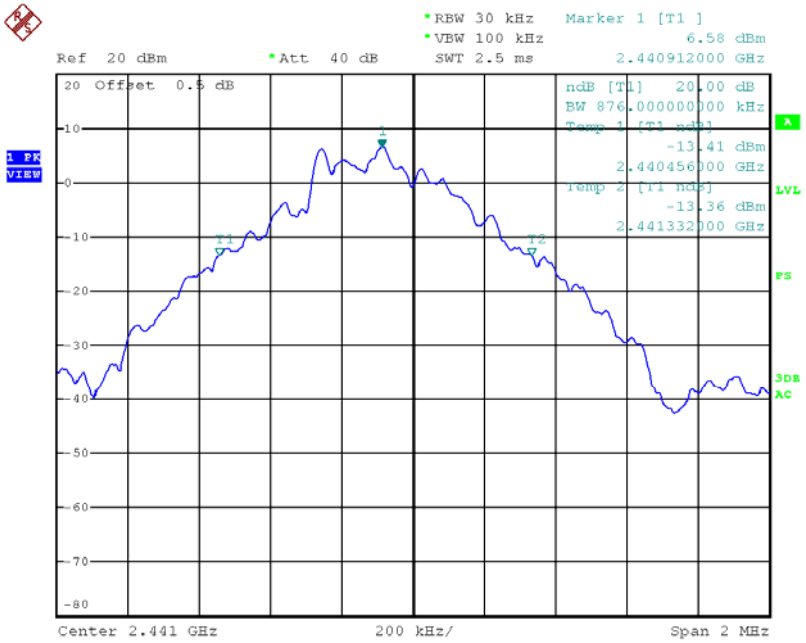
Channel M

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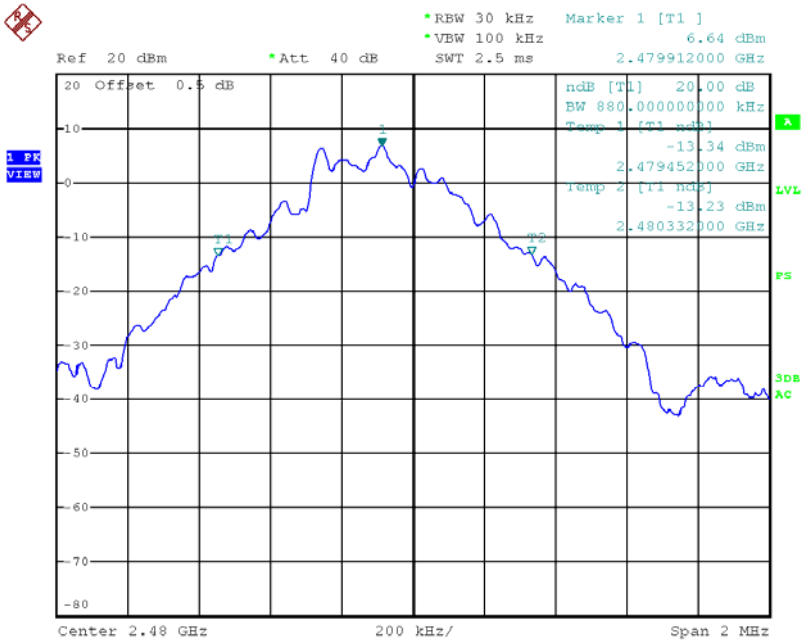
Channel H

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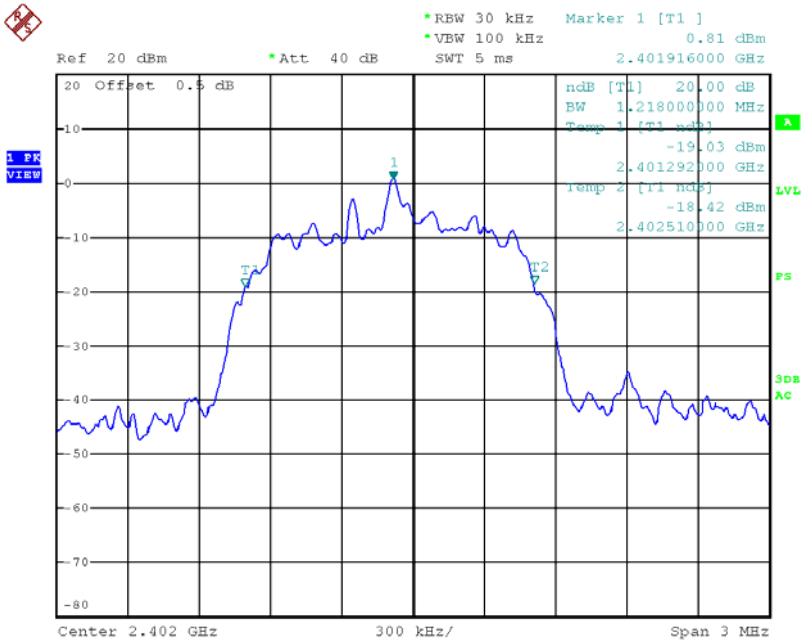
| Modulation | CH | Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|---|---|---|---|
| π /4 DQPSK | L | 1218.00 | 812.00 |
| | M | 1224.00 | 816.00 |
| | H | 1224.00 | 816.00 |

Channel L

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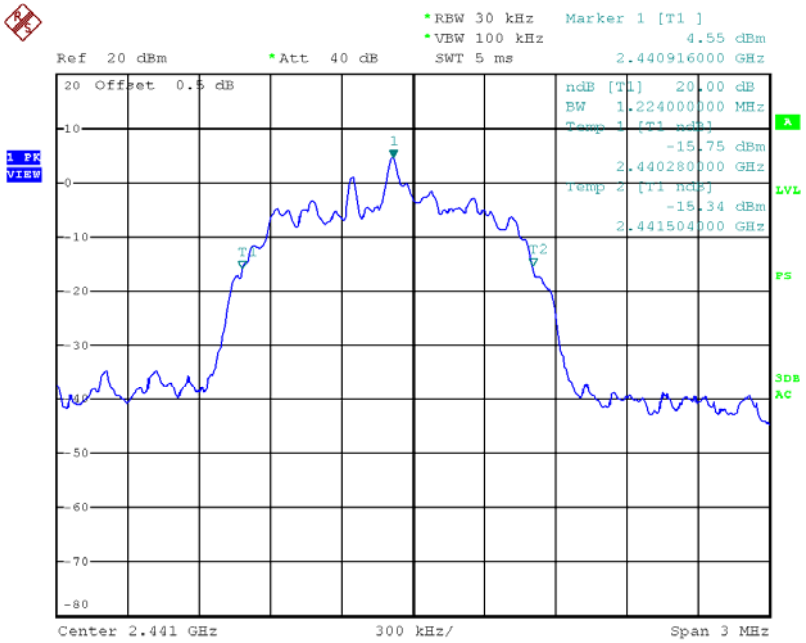


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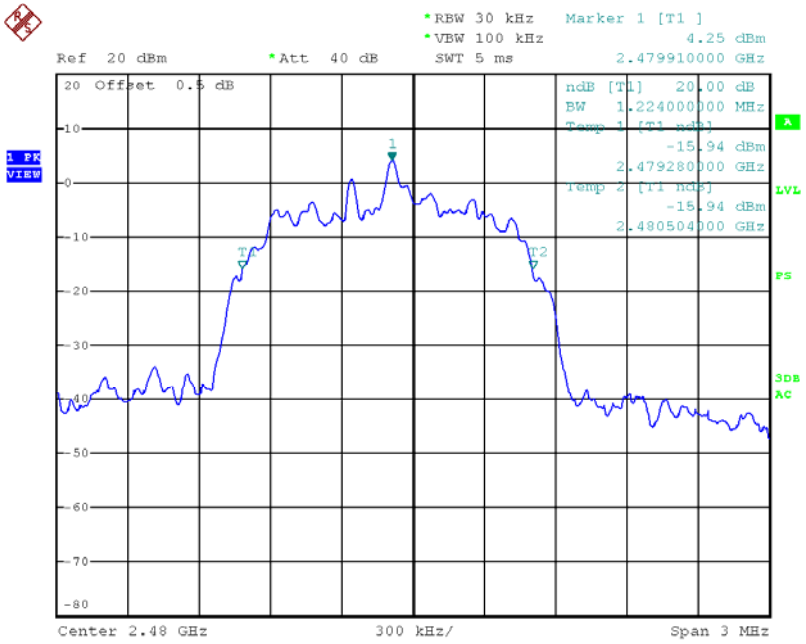
Channel H

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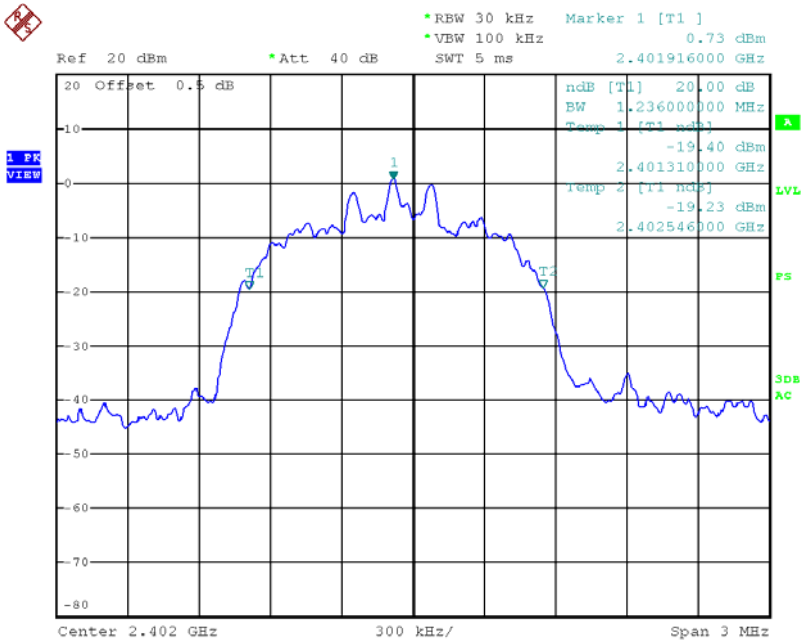
| Modulation | CH | Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|---|---|---|---|
| 8DPSK | L | 1236.00 | 824.00 |
| | M | 1266.00 | 844.00 |
| | H | 1266.00 | 844.00 |

Channel L

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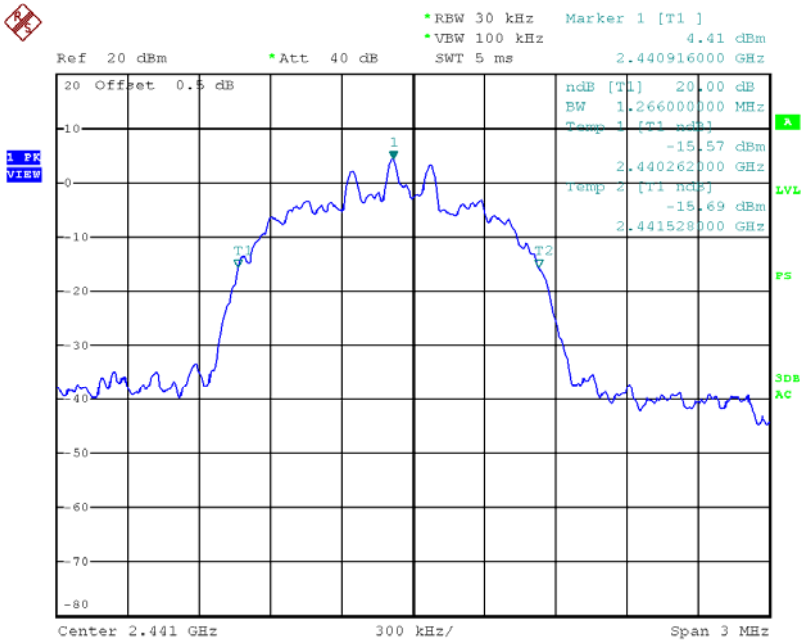
Channel M

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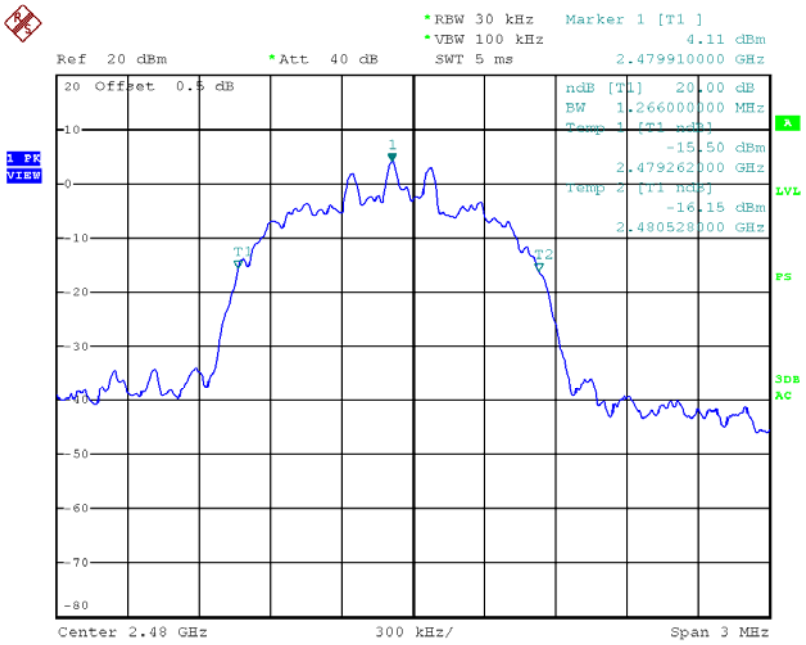
Channel H

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# 4. Carrier Frequency Separation

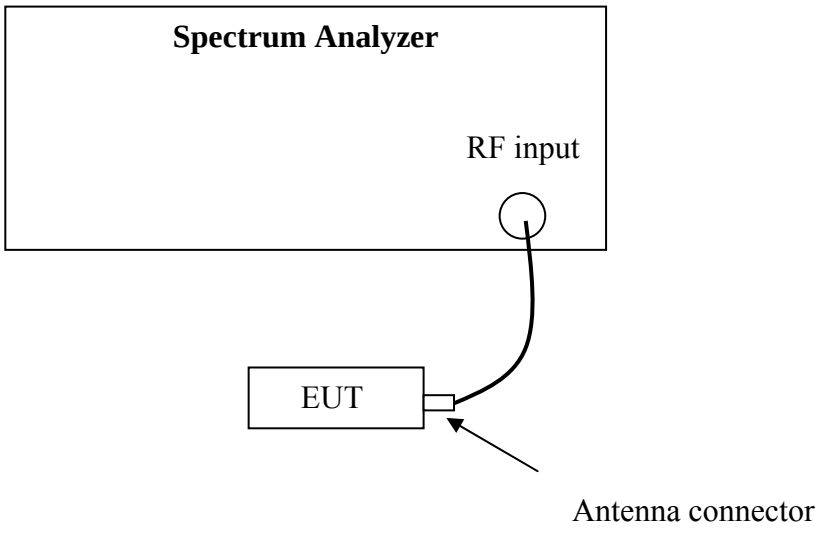
**Test result: Pass**

## 4.1 Limit

☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

## 4.2 Test Configuration




## 4.3 Test Procedure and test setup

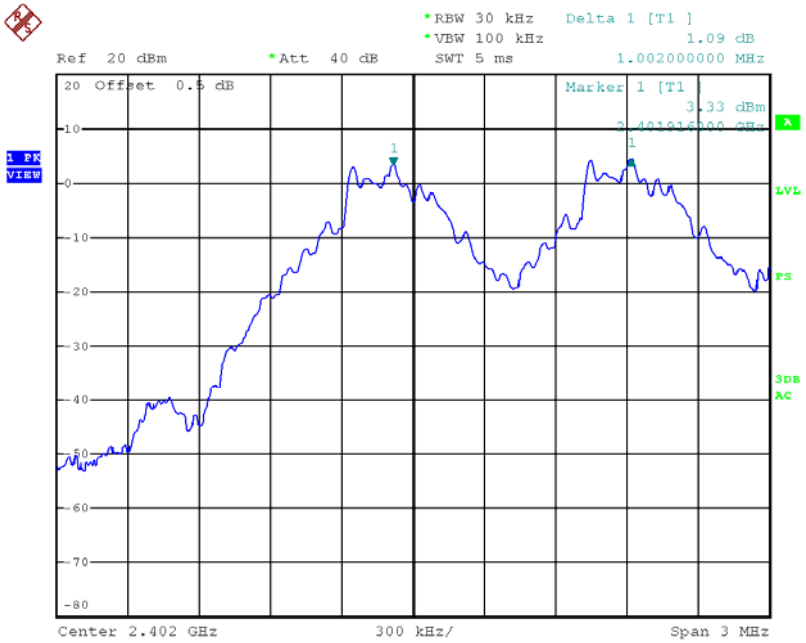
The Carrier Frequency Separation per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span can capture two adjacent channels, RBW≥1% of the span, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

## 4.4 Test Protocol

Temperature : 25°C
Relative Humidity : 55 %

| Mode | CH | Frequency Separation (kHz) | Limit (kHz) |
|---|---|---|---|
| GFSK | L | 1002.00 | ≥ 586.67 |
| | M | 1002.00 | ≥ 584.00 |
| | H | 1002.00 | ≥ 586.67 |

Channel L

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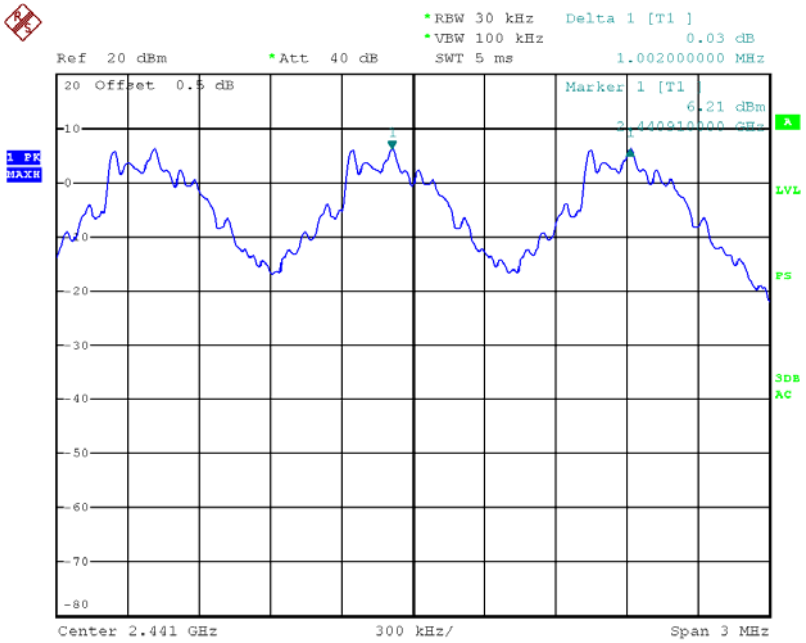
Channel M

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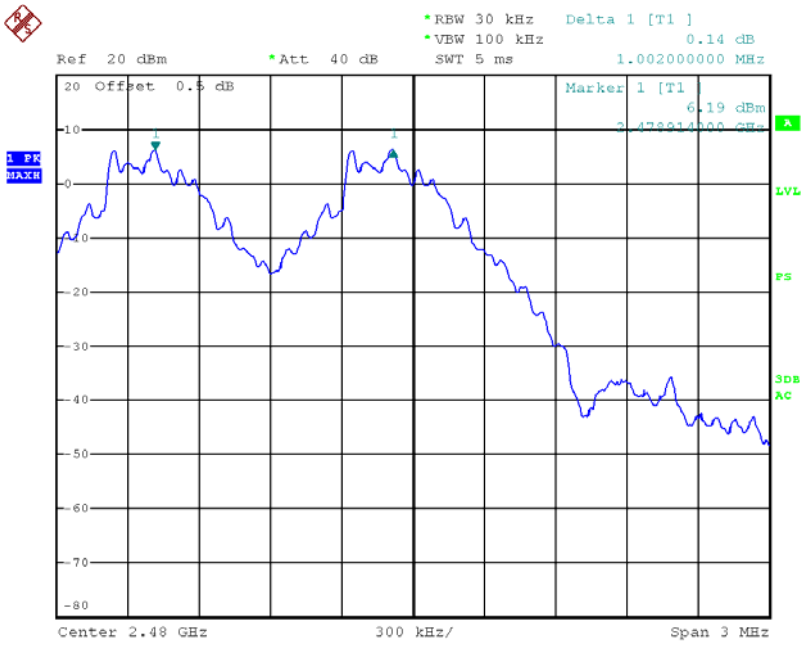
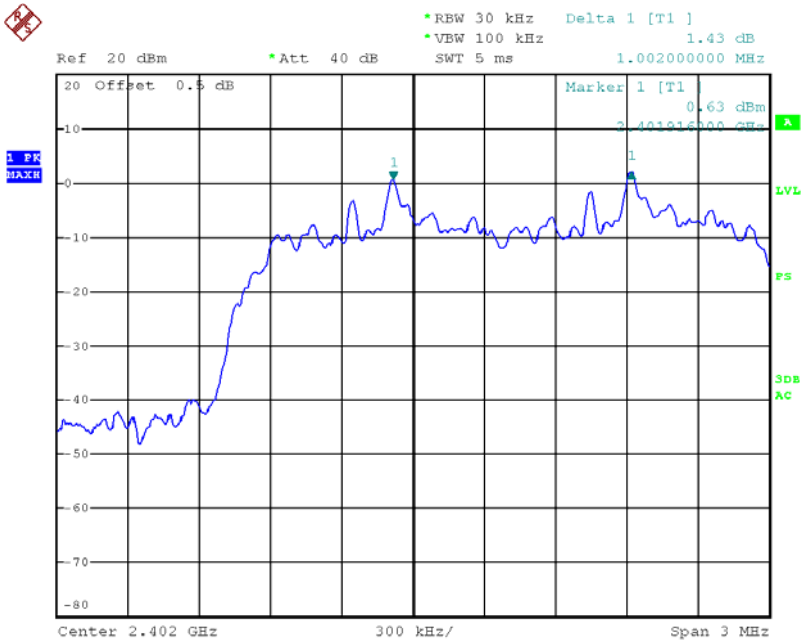
Channel H




Date: 9.SEP.2014 11:32:06

| Mode | CH | Frequency Separation (kHz) | Limit (kHz) |
|---|---|---|---|
| π /4 DQPSK | L | 1002.00 | ≥ 812.00 |
| | M | 1002.00 | ≥ 816.00 |
| | H | 1002.00 | ≥ 816.00 |

Channel L

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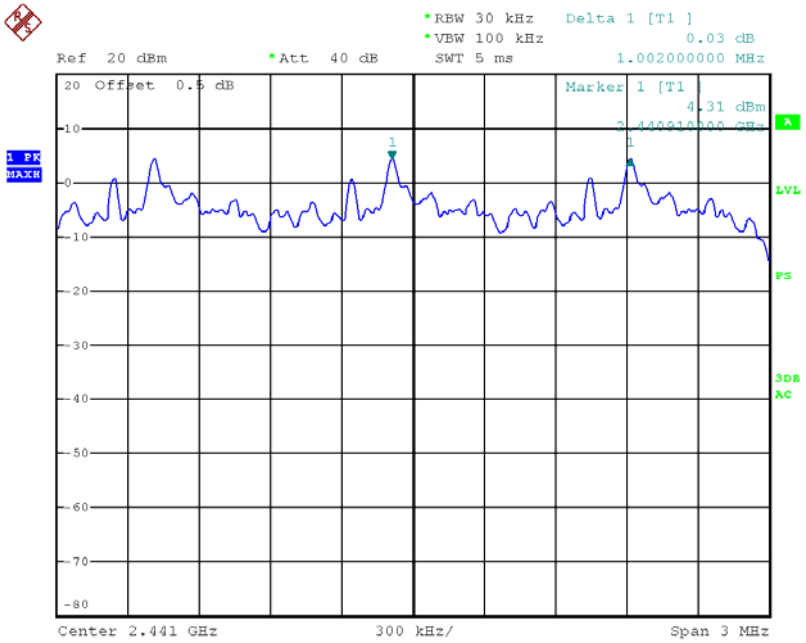
Channel M

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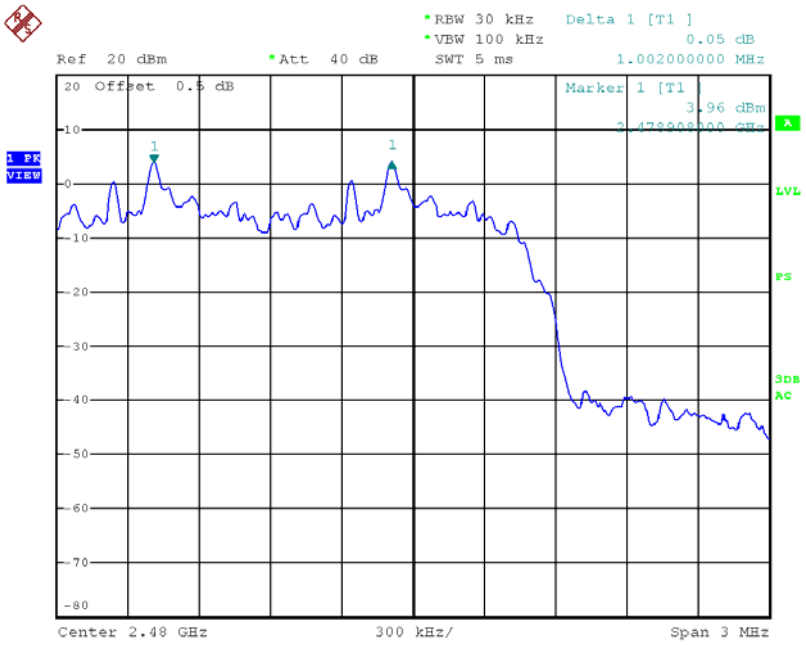
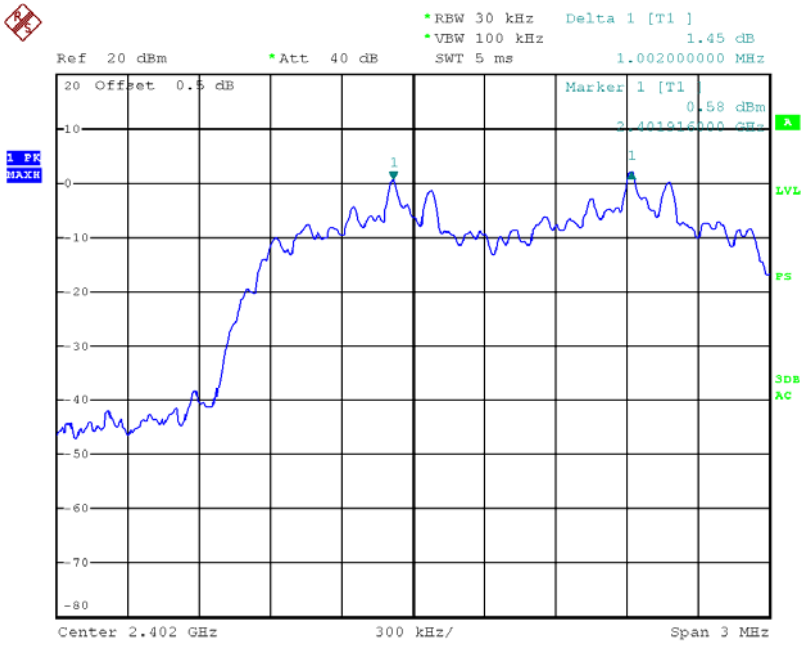
Channel H




Date: 9.SEP.2014 11:39:45

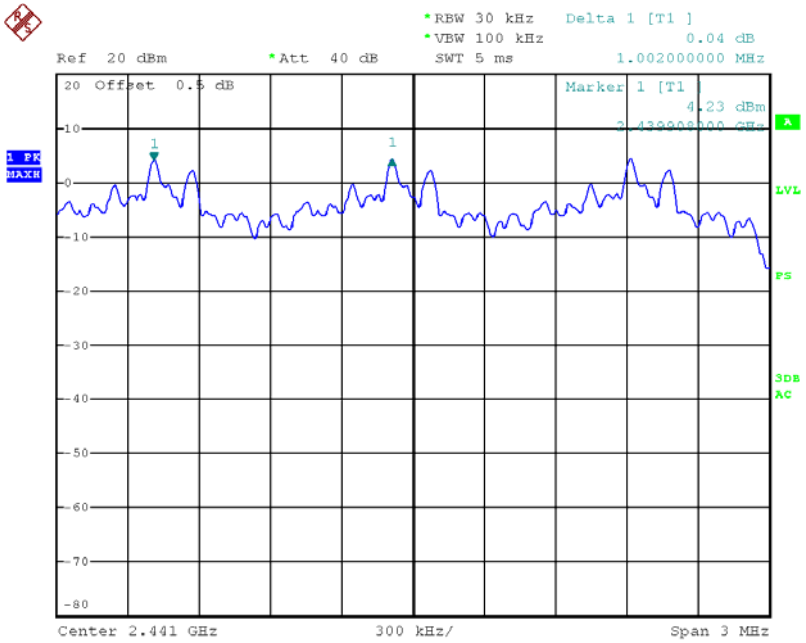
| Mode | CH | Frequency Separation (kHz) | Limit (kHz) |
|---|---|---|---|
| 8DPSK | L | 1002.00 | ≥ 824.00 |
| | M | 1002.00 | ≥ 844.00 |
| | H | 1002.00 | ≥ 844.00 |

Channel L



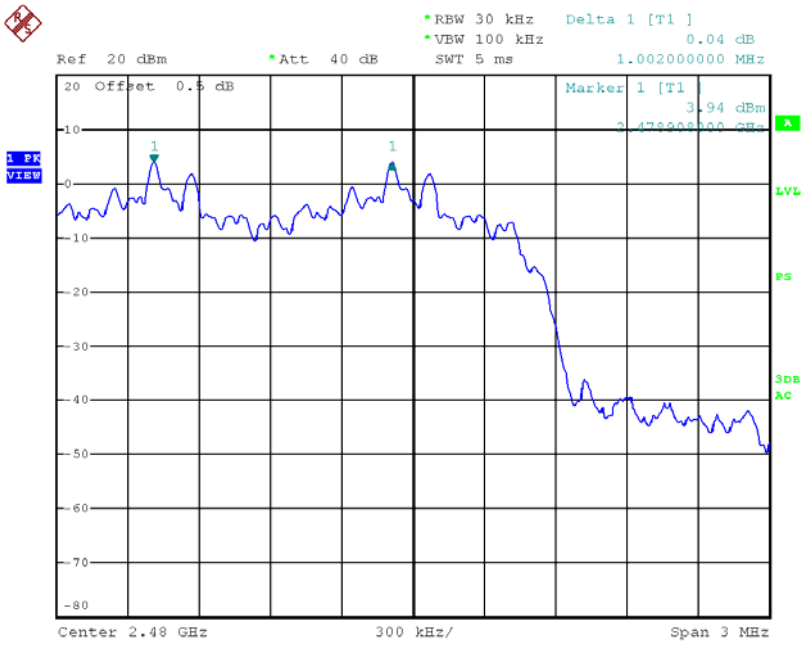

Date: 9.SEP.2014 11:44:06

Channel M




Date: 9.SEP.2014 11:45:43

Channel H




Date: 9.SEP.2014 11:47:28

# 5. Maximum peak output power

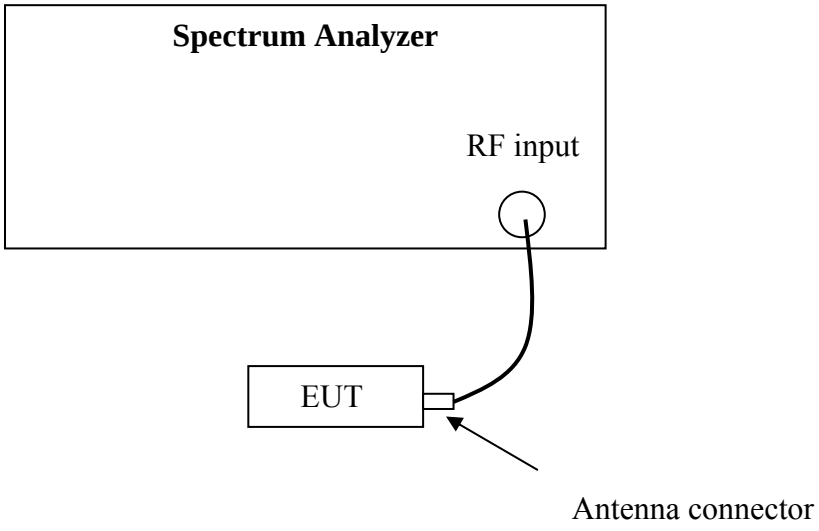
**Test result: Pass**

## 5.1 Test limit

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

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

## 5.2 Test Configuration




## 5.3 Test procedure and test setup

The power output per FCC § 15.247(b) is measured using the Spectrum Analyzer with Span = 5 times the 20 dB bandwidth, RBW≥ 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).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

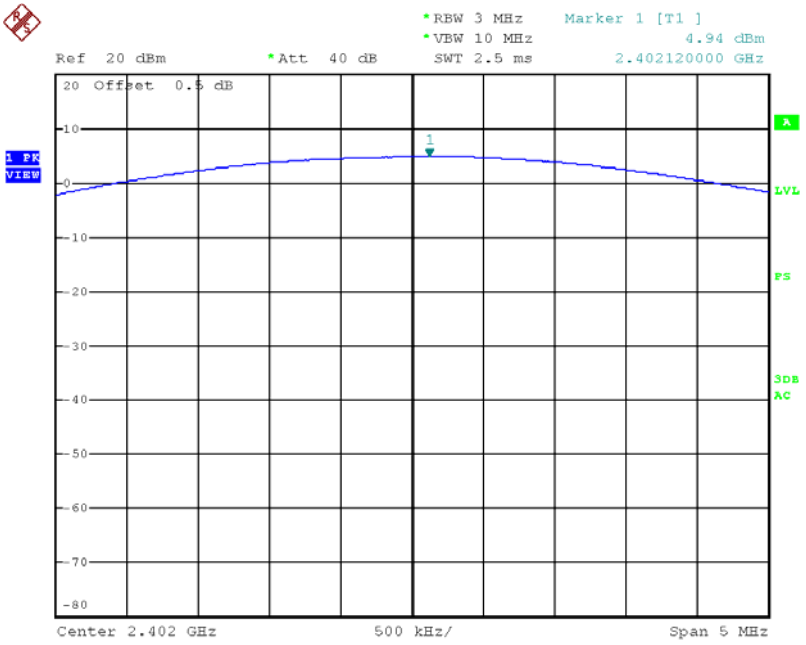
## 5.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

| Mode | CH | Cable loss (dB) | Corrected reading (dBm) | Limit (dBm) |
|---|---|---|---|---|
| GFSK | L | 0.50 | 4.94 | ≤21.00 |
| | M | 0.50 | 7.69 | |
| | H | 0.50 | 7.99 | |

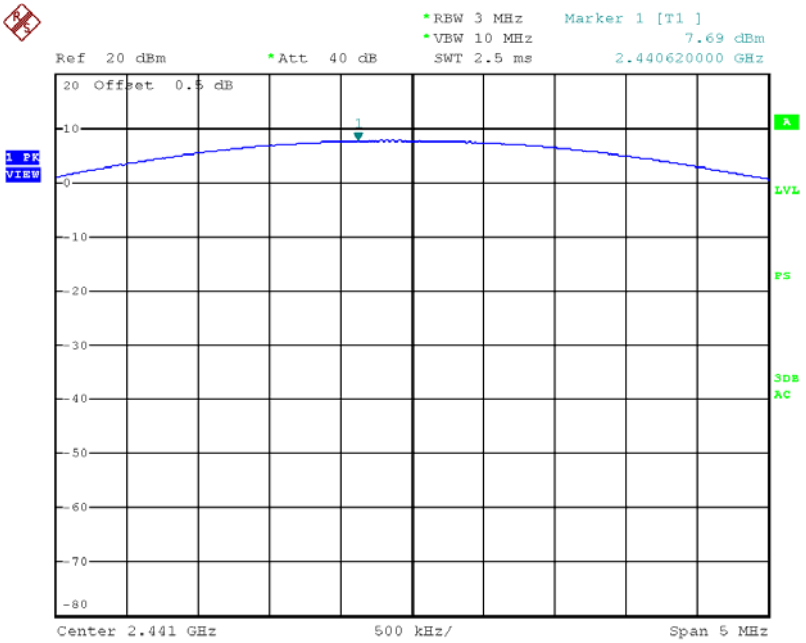
**Conclusion: The maximum EIRP = 7.99dBm+2.0dBi = 9.99dBm = 9.98mW which is lower than the limit of 4W listed in RSS-210.**

Channel L



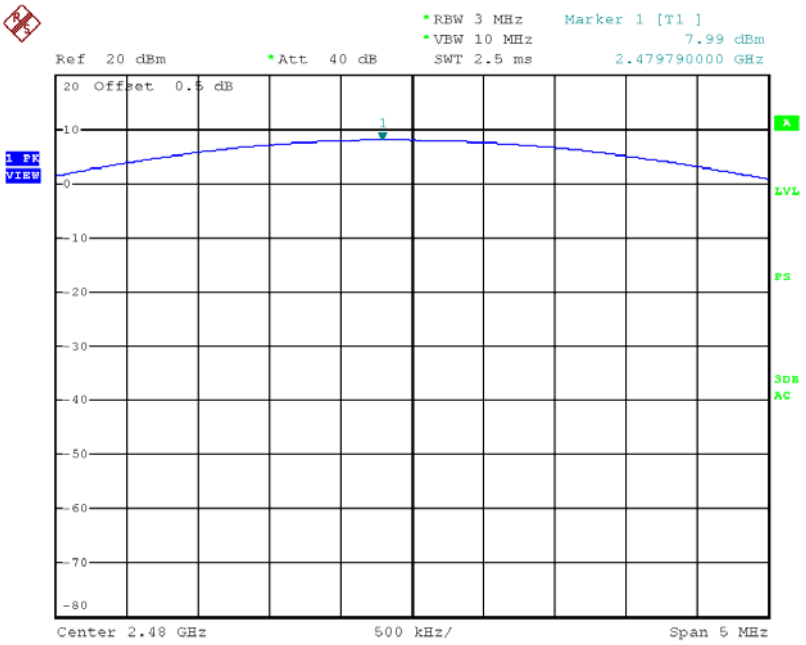

Date: 4.SEP.2014 11:32:12

Channel M




Date: 4.SEP.2014 11:33:21

Channel H

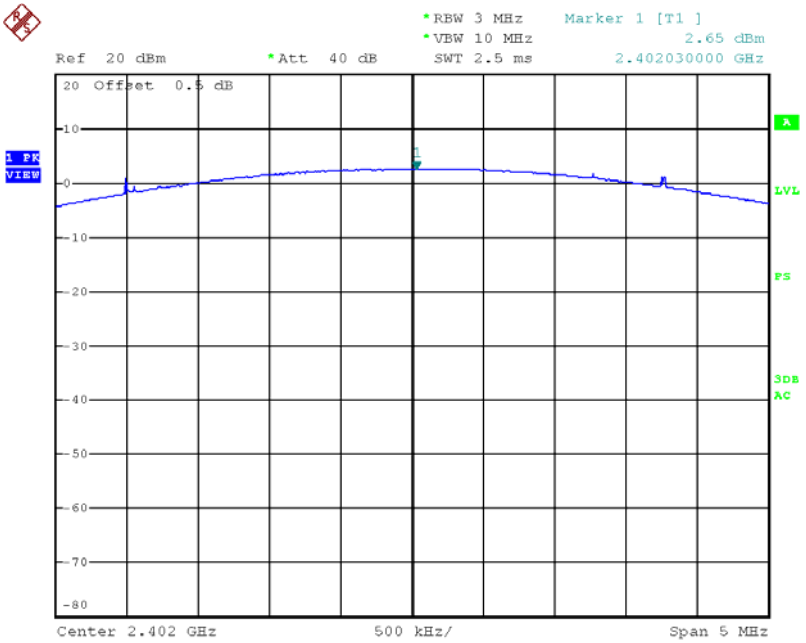



Date: 4.SEP.2014 11:34:33

| Mode | CH | Cable loss (dB) | Corrected reading (dBm) | Limit (dBm) |
|---|---|---|---|---|
| π /4 DQPSK | L | 0.50 | 2.65 | ≤21.00 |
| | M | 0.50 | 6.28 | |
| | H | 0.50 | 6.19 | |

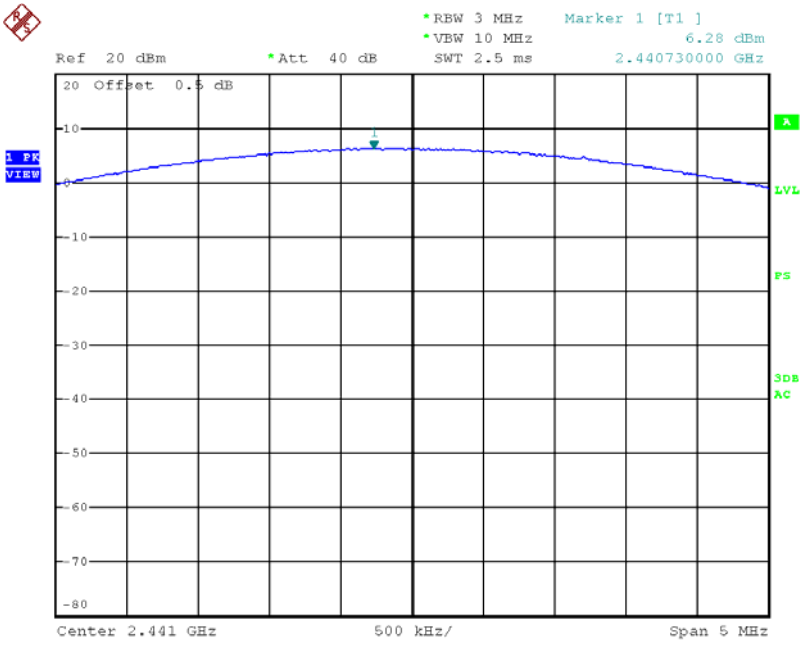
**Conclusion: The maximum EIRP = 6.28dBm+2.0dBi = 8.28dBm = 6.73mW which is lower than the limit of 4W listed in RSS-210.**

Channel L



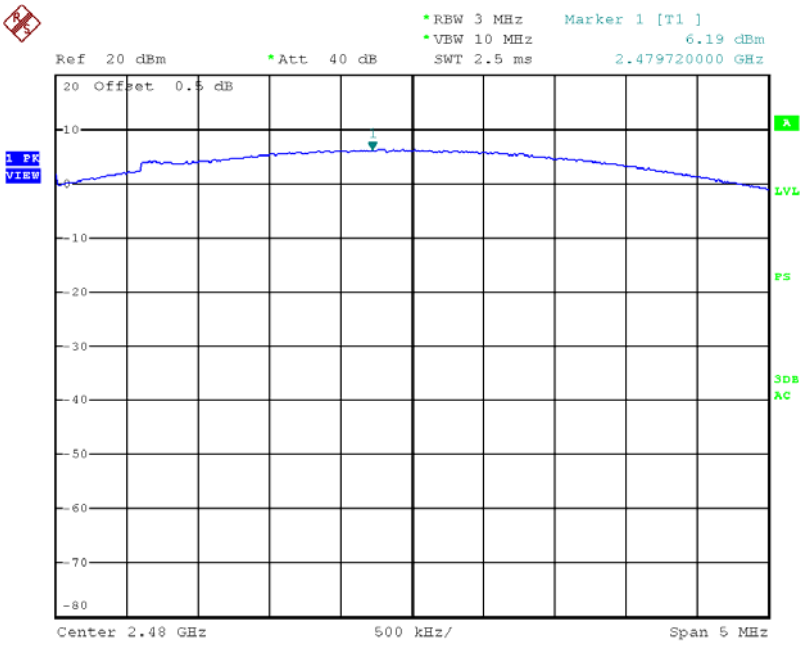

Date: 4.SEP.2014 11:36:49

Channel M




Date: 4.SEP.2014 11:37:32

Channel H

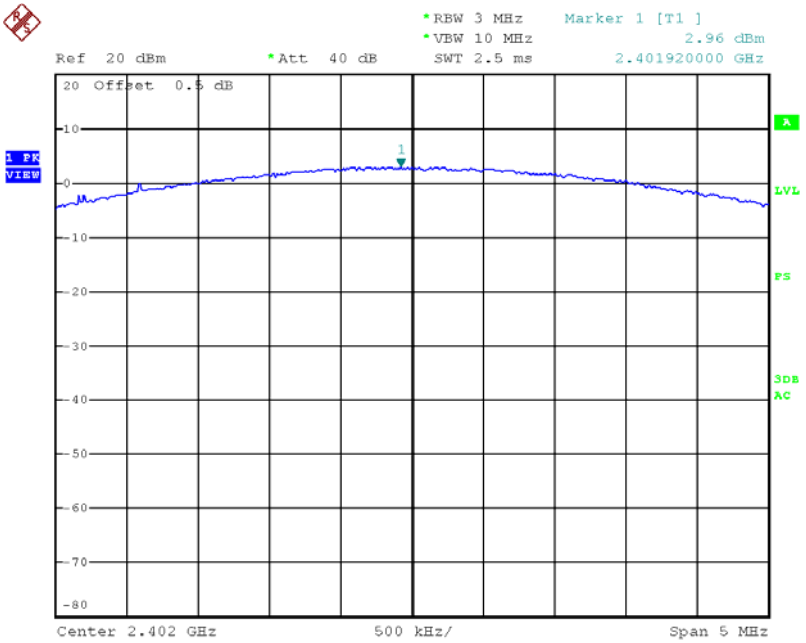



Date: 4.SEP.2014 11:38:47

| Mode | CH | Cable loss (dB) | Corrected reading (dBm) | Limit (dBm) |
|---|---|---|---|---|
| 8DPSK | L | 0.50 | 2.96 | ≤21.00 |
| | M | 0.50 | 6.68 | |
| | H | 0.50 | 6.68 | |

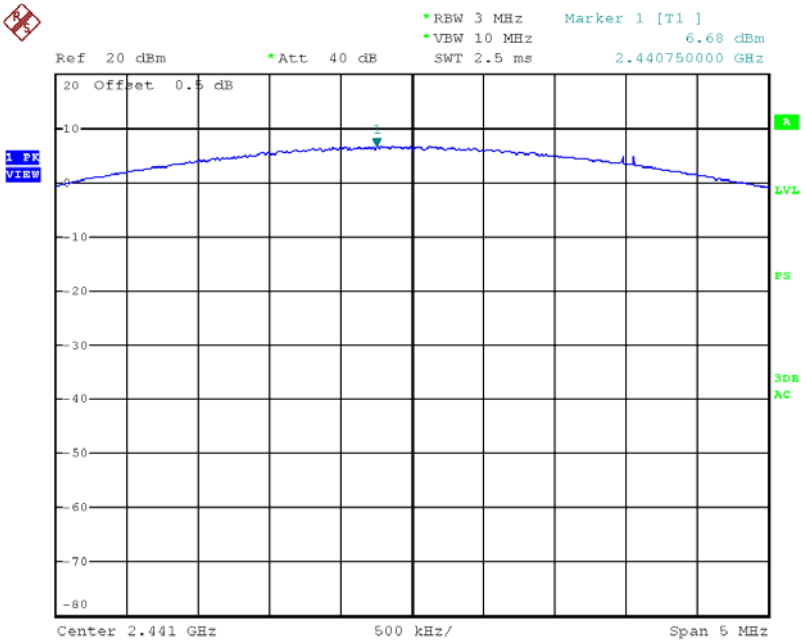
**Conclusion: The maximum EIRP = 6.68dBm+2.0dBi = 8.68dBm = 7.38mW which is lower than the limit of 4W listed in RSS-210.**

Channel L



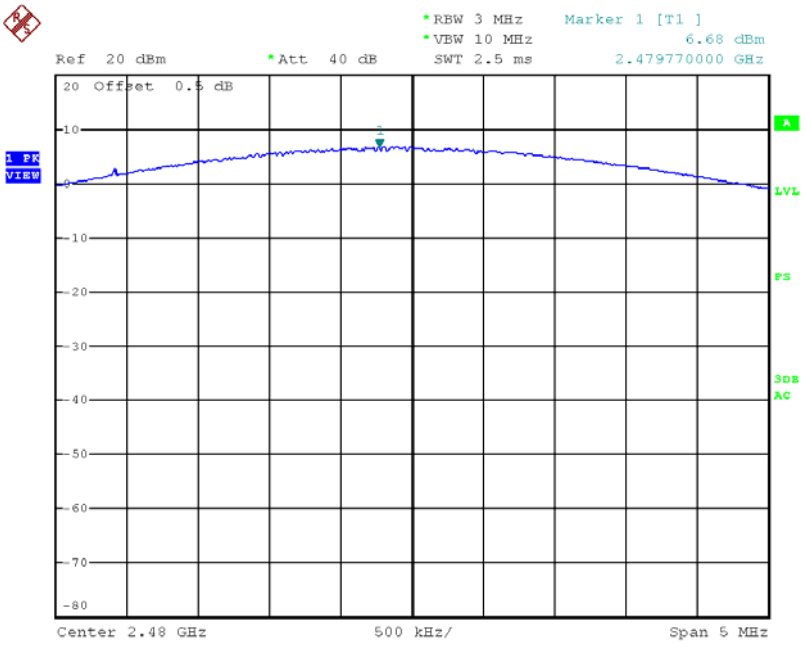

Date: 4.SEP.2014 11:39:48

Channel M




Date: 4.SEP.2014 11:40:25

Channel H




Date: 4.SEP.2014 11:41:01

# 6. Radiated Spurious Emissions

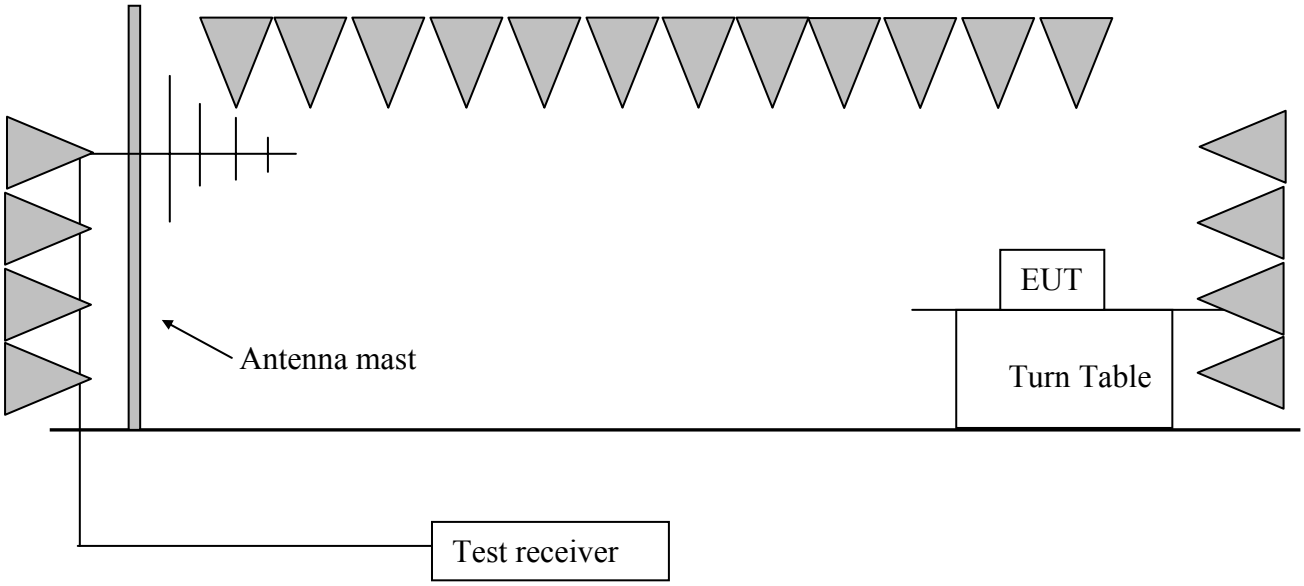
**Test result: Pass**

## 6.1 Test limit

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

| 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 |

## 6.2 Test Configuration



## 6.3 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.
The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. 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 1meter to 4 meters to find out the maximum emission level.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

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

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

If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”.

### 6.4 Test protocol

Temperature : 25 °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.

GFSK Modulation:

| H | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2402.00 | 30.70 | 96.60 | Fundamental | / | PK |
| | H | 2389.89 | 30.20 | 43.50 | 54.00 | 10.50 | AV |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4804.00 | -1.50 | 52.50 | 74.00 | 21.50 | PK |
| M | H | 2441.00 | 30.70 | 99.80 | Fundamental | / | PK |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4882.00 | -1.10 | 52.20 | 74.00 | 21.80 | PK |
| H | H | 2480.00 | 30.70 | 99.90 | Fundamental | / | PK |
| | H | 2483.56 | 31.52 | 40.50 | 54.00 | 13.50 | AV |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4960.00 | -0.80 | 51.20 | 74.00 | 22.80 | AV |

π /4DQPSK Modulation:

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2402.00 | 30.70 | 95.30 | Fundamental | / | PK |
| | H | 2389.74 | 30.20 | 43.80 | 54.00 | 10.20 | AV |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4804.00 | -1.50 | 51.70 | 74.00 | 22.30 | PK |
| M | H | 2441.00 | 30.70 | 97.50 | Fundamental | / | PK |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | QP |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | H | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4882.77 | -1.10 | 51.50 | 74.00 | 22.50 | PK |
| H | H | 2480.00 | 30.70 | 98.20 | Fundamental | / | PK |
| | H | 2483.60 | 31.52 | 41.20 | 54.00 | 12.80 | AV |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4960.00 | -0.80 | 46.80 | 74.00 | 27.20 | AV |

8DPSK Modulation:

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2402.00 | 30.70 | 95.30 | Fundamental | / | PK |
| | H | 2389.83 | 30.20 | 43.20 | 54.00 | 10.80 | AV |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4804.00 | -1.50 | 52.40 | 74.00 | 21.60 | PK |
| M | H | 2441.00 | 30.70 | 98.30 | Fundamental | / | PK |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4882.00 | -1.10 | 52.60 | 74.00 | 21.40 | PK |
| H | H | 2480.00 | 30.70 | 97.80 | Fundamental | / | PK |
| | H | 2483.68 | 31.53 | 42.30 | 54.00 | 11.70 | AV |
| | H | 80.54 | 10.40 | 37.20 | 40.00 | 2.80 | PK |
| | H | 171.90 | 12.90 | 37.30 | 43.50 | 6.20 | PK |
| | H | 173.85 | 12.70 | 37.50 | 43.50 | 6.00 | PK |
| | V | 33.89 | 19.10 | 32.60 | 40.00 | 7.40 | PK |
| | V | 76.65 | 10.00 | 28.30 | 40.00 | 11.70 | PK |
| | V | 140.80 | 15.10 | 37.50 | 43.50 | 6.00 | PK |
| | H | 4960.00 | -0.80 | 45.60 | 74.00 | 28.40 | AV |

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

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

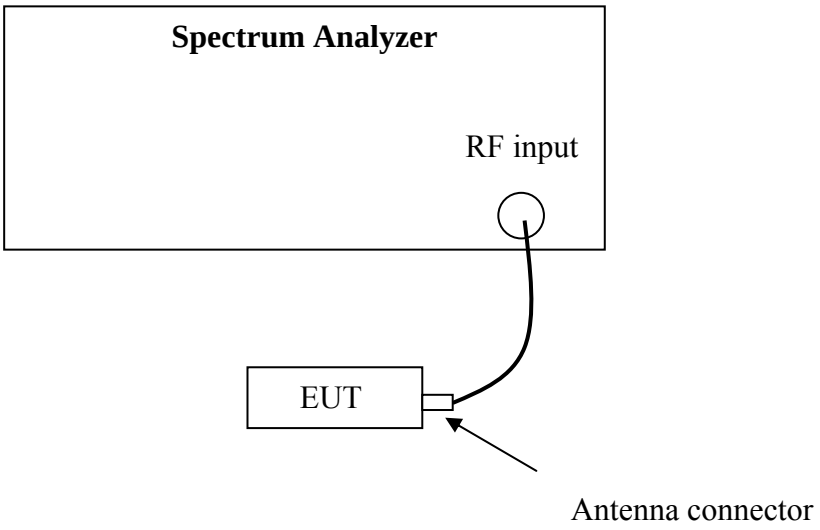
# 7. Conducted Spurious Emissions & Band Edge

**Test result: Pass**

## 7.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

## 7.2 Test Configuration




## 7.3 Test procedure and test setup

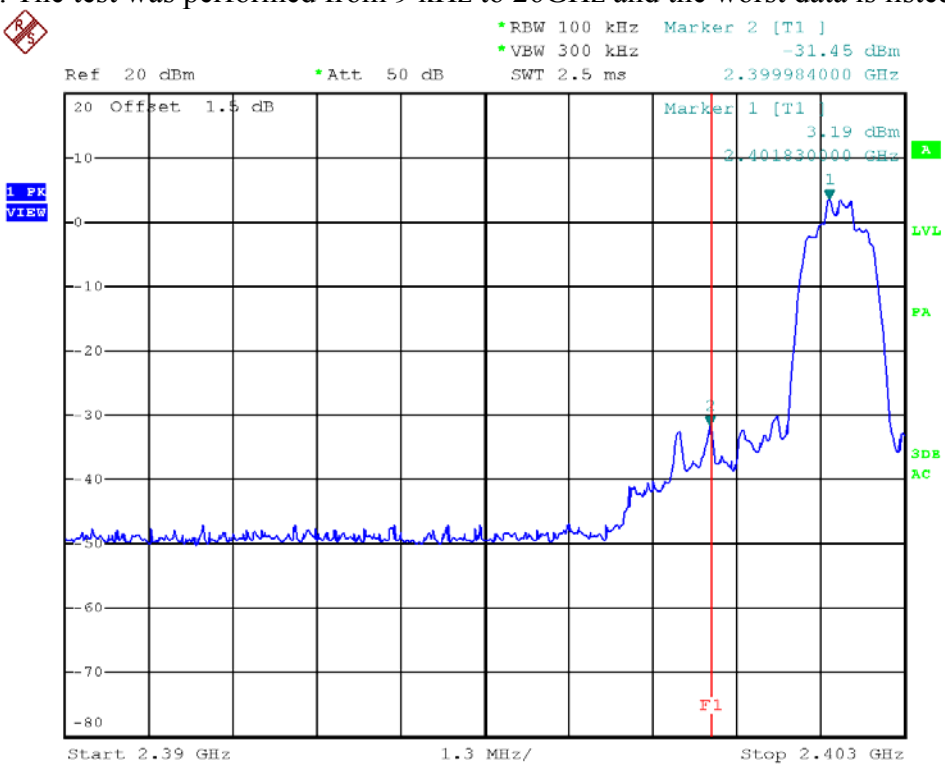
The Conducted Spurious Emissions per FCC § 15.247(d) is measured using the Spectrum Analyzer with Span wide enough capturing all spurious from the lowest emission frequency of the EUT up to 10th harmonics, RBW = 100kHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

## 7.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

| Model | CH | Max reading among band (dBm) | The most restrict Attenuation outside band (dB) | Limit (dB) |
|---|---|---|---|---|
| GFSK | L | 3.52 | 42.95 | ≥20 |
| | H | 7.47 | 46.72 | |
| π /4 DQPSK | L | 3.32 | 31.68 | ≥20 |
| | H | 6.32 | 46.93 | |
| 8DPSK | L | **3.19** | **28.26** | ≥20 |
| | H | 6.12 | 47.24 | |
| Hopping | / | 7.21 | 32.55 | ≥20 |

Note: The test was performed from 9 kHz to 26GHz and the worst data is listed here.



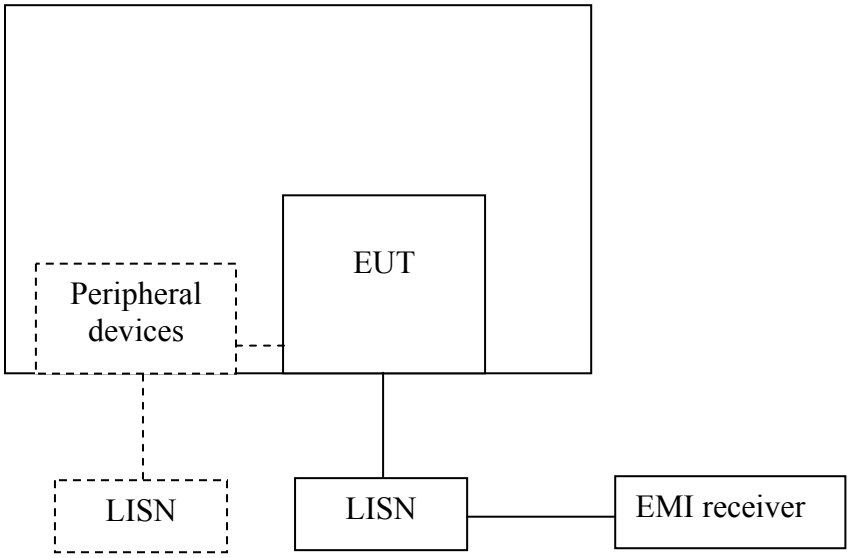
# 8. Power line conducted emission

**Test result:** **Pass**

## 8.1 Limit

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | QP | AV |
| 0.15-0.5 | 66 to 56* | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |
| * Decreases with the logarithm of the frequency. | | |

## 8.2 Test configuration




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

☒ For floor standing equipment, wooden support is 0.12m height rack.

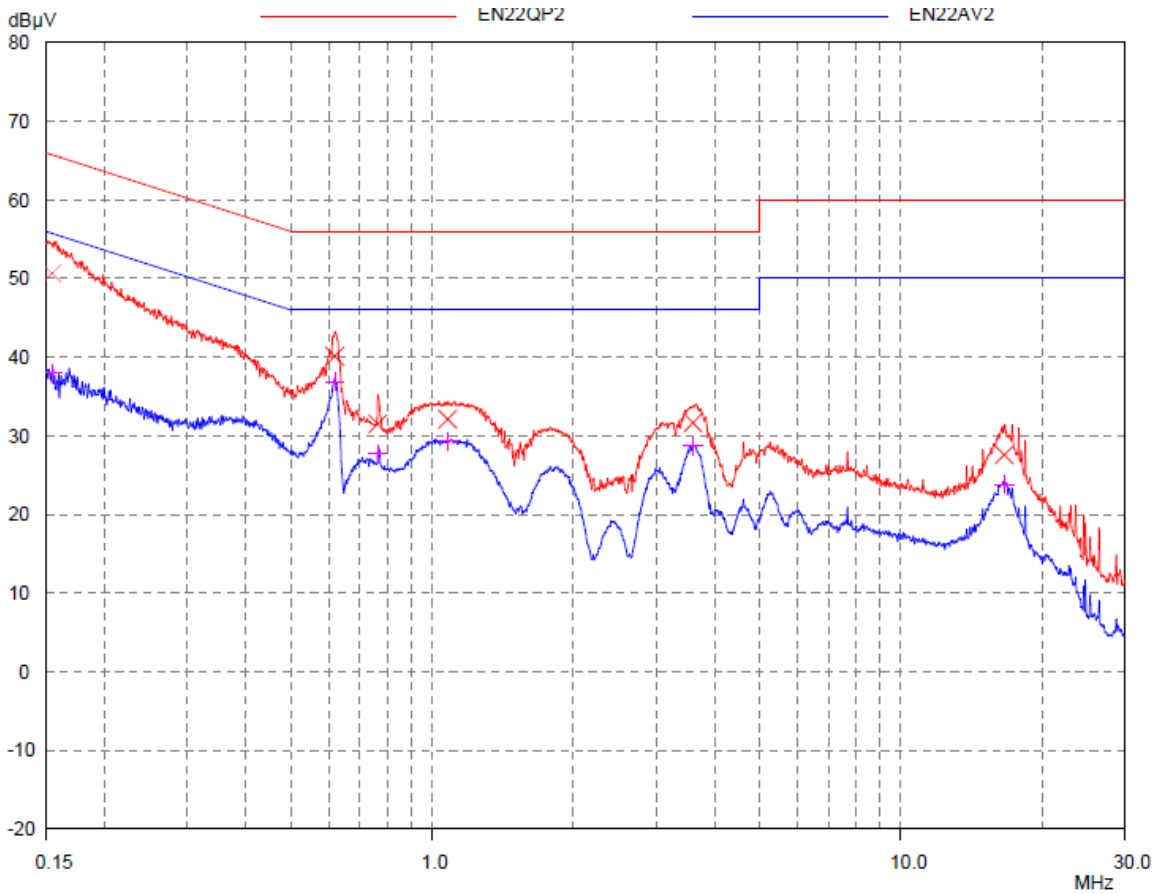
## 8.3 Test procedure and test set up

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50Ω/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50Ω/50uH coupling impedance with 50Ω termination.
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference.
In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement.
The bandwidth of the test receiver is set at 9 kHz.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

## 8.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

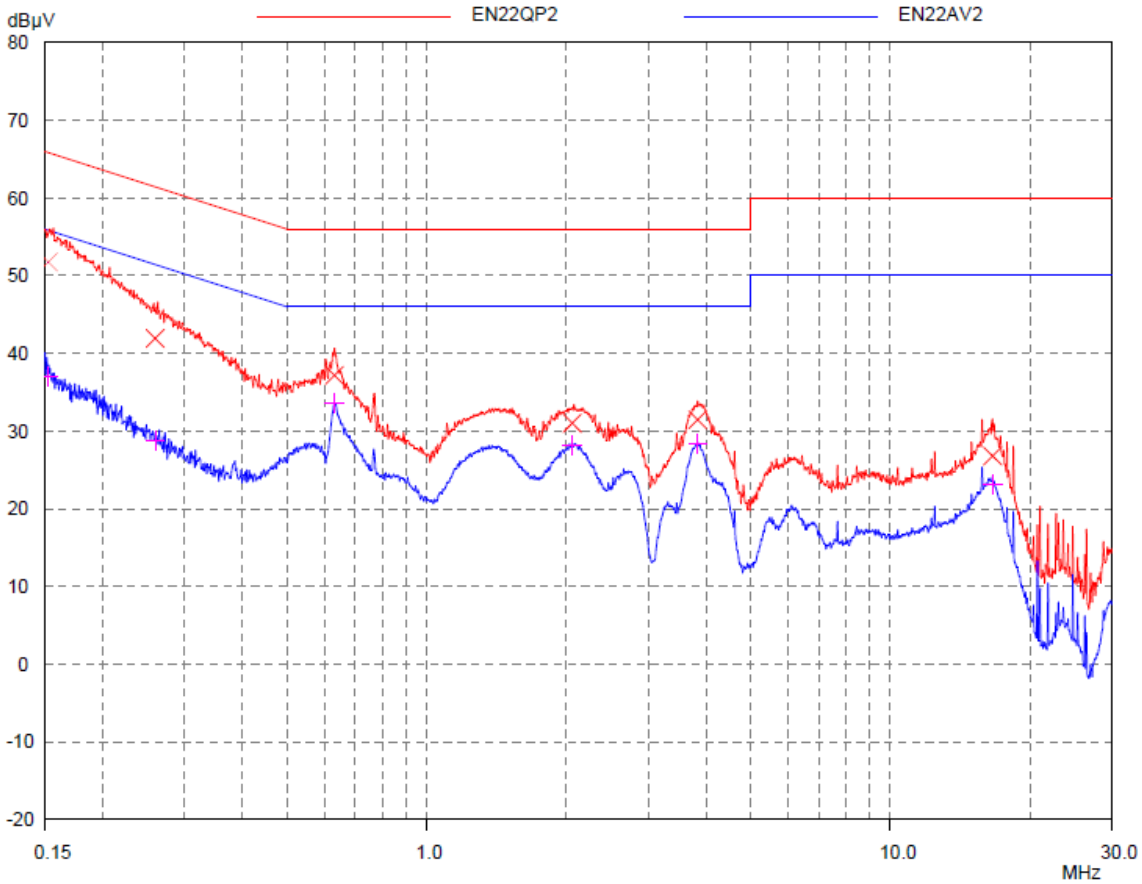
L line




**Test Data:**

| Frequency (MHz) | Quasi-peak | | | Average | | |
|---|---|---|---|---|---|---|
| | level dB(µV) | Limit dB(µV) | Margin (dB) | level dB(µV) | limit dB(µV) | Margin (dB) |
| 0.154 | 50.67 | 65.77 | 15.10 | 37.98 | 55.77 | 17.79 |
| 0.619 | 40.13 | 56.00 | 15.87 | 36.90 | 46.00 | 9.10 |
| 0.765 | 31.54 | 56.00 | 24.46 | 27.71 | 46.00 | 18.29 |
| 1.078 | 32.12 | 56.00 | 23.88 | 29.30 | 46.00 | 16.70 |
| 3.599 | 31.66 | 56.00 | 24.34 | 28.69 | 46.00 | 17.31 |
| 16.601 | 27.59 | 60.00 | 32.41 | 23.82 | 50.00 | 26.18 |

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) |
| 0.152 | 51.77 | 65.87 | 14.10 | 37.05 | 55.87 | 18.82 |
| 0.259 | 41.92 | 61.46 | 19.54 | 28.80 | 51.46 | 22.66 |
| 0.631 | 37.17 | 56.00 | 18.83 | 33.61 | 46.00 | 12.39 |
| 2.058 | 31.03 | 56.00 | 24.97 | 28.18 | 46.00 | 17.82 |
| 3.836 | 31.45 | 56.00 | 24.55 | 28.38 | 46.00 | 17.62 |
| 16.601 | 26.80 | 60.00 | 33.20 | 23.14 | 50.00 | 26.86 |

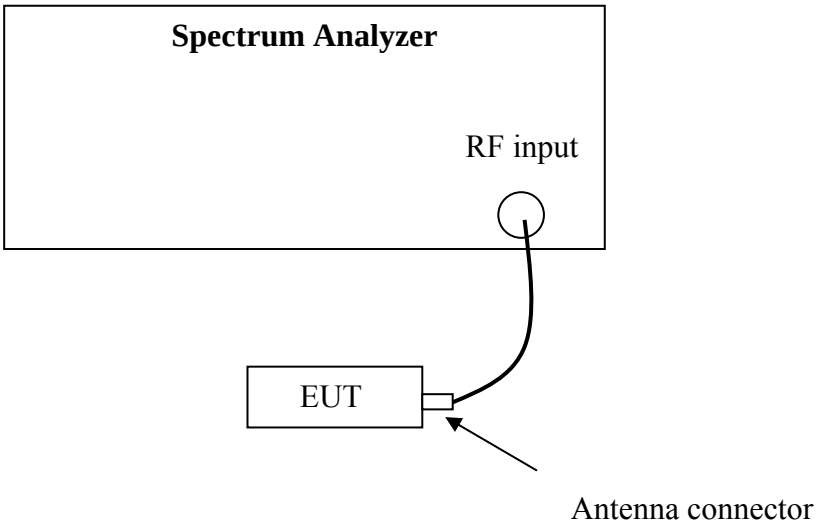
# 9. Number of Hopping Frequencies

**Test result:** **Pass**

## 9.1 Limit

Number of Hopping Frequencies in the 2400-2483.5 MHz band shall use at least 15 channels.

## 9.2 Test Configuration



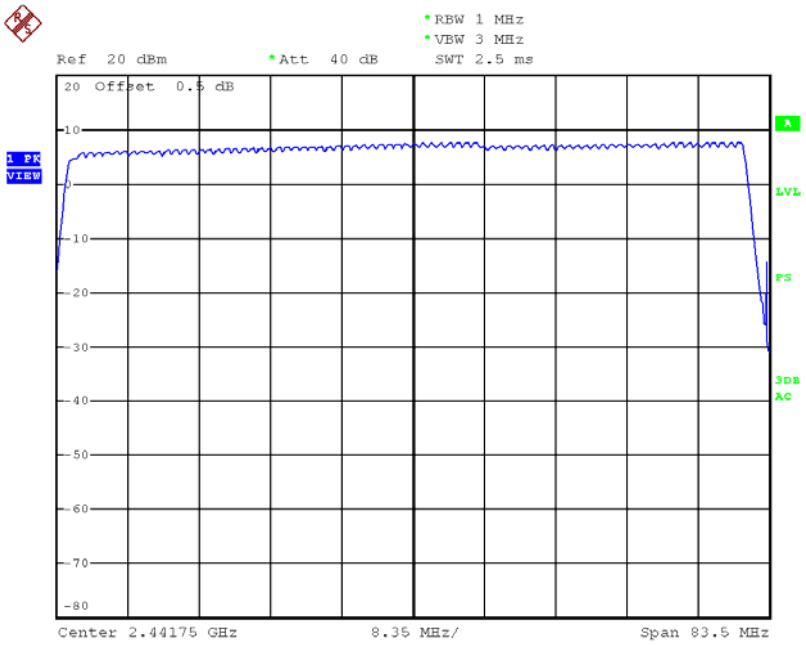

## 9.3 Test procedure and test setup

The channel number per FCC §15.247(a)(1)(iii) is measured using the Spectrum Analyzer with RBW=100kHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold. The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

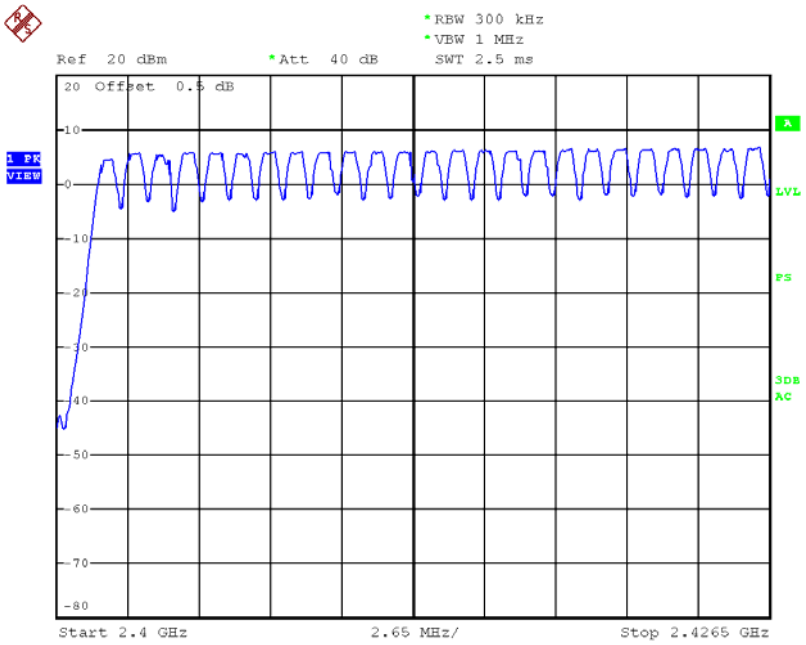
## 9.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

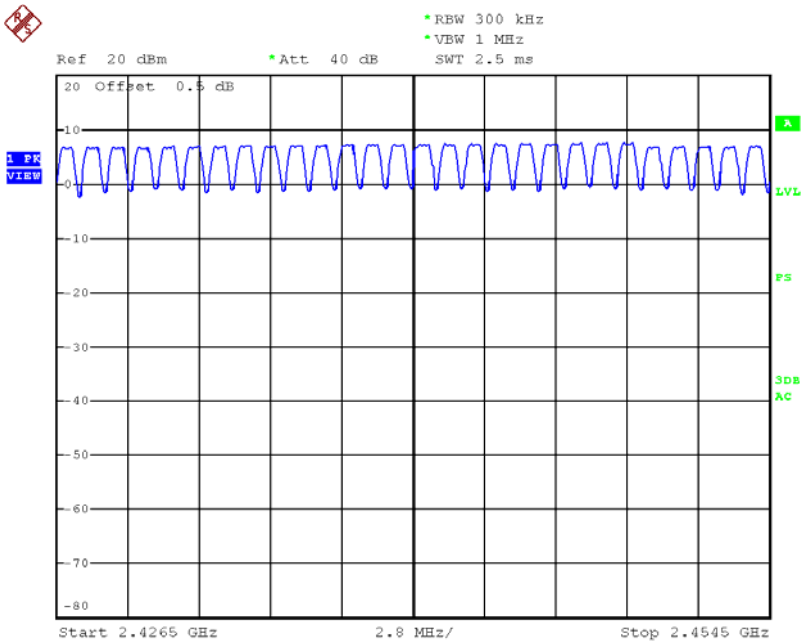
| Channel Number | Limit |
|---|---|
| 79 | ≥15 |



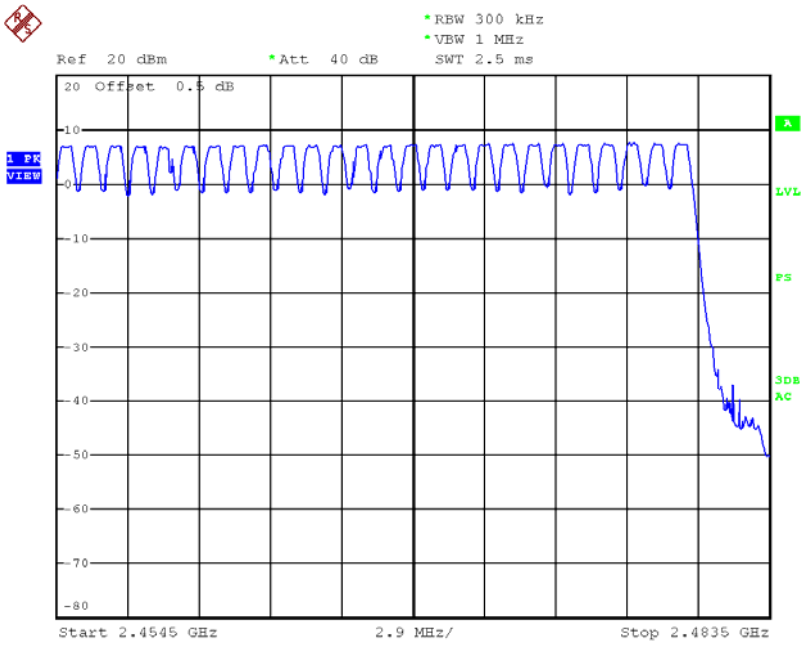

Date: 9.SEP.2014 11:55:56




Date: 9.SEP.2014 11:57:04




Date: 9.SEP.2014 11:58:33




Date: 9.SEP.2014 11:59:26

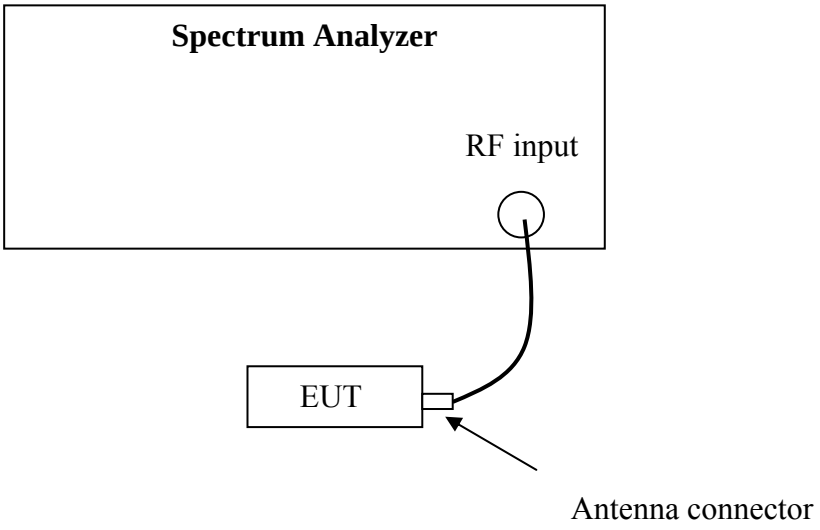
# 10. Dwell Time

**Test result:** **Pass**

## 10.1 Limit

The dwell time on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

## 10.2 Test Configuration




## 10.3 Test procedure and test setup

Dwell time per FCC § 15.247(a)(1)(iii) is measured using the Spectrum Analyzer with Span = 0, RBW=1MHz, VBW≥RBW, Sweep can capture the entire dwell time, Detector = peak, Trace = max hold.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

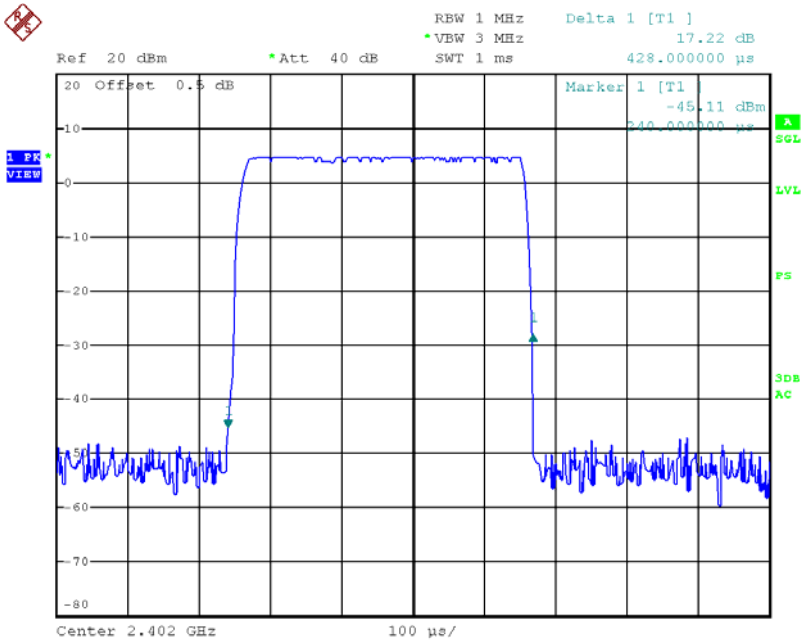
**10.4 Test protocol**

Temperature : 25 °C
Relative Humidity : 55 %

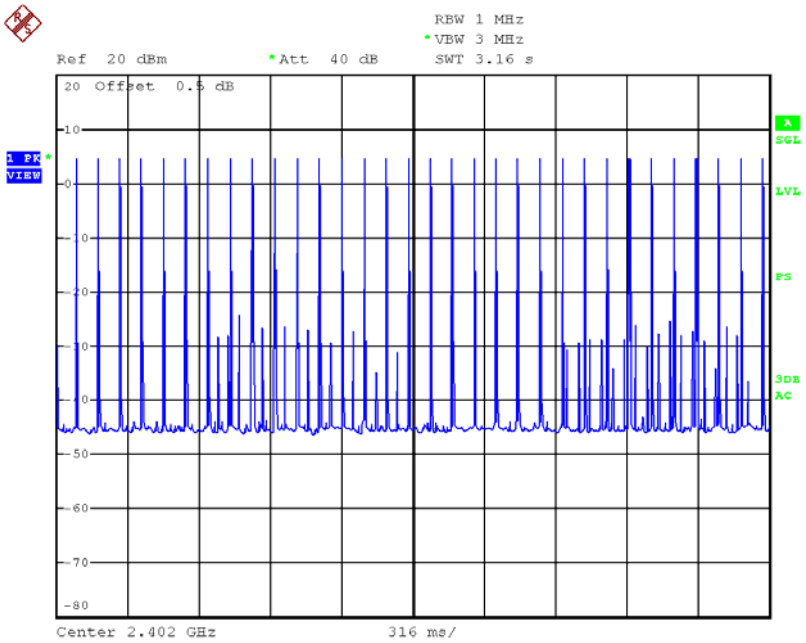
| Packet | Occupancy time for single hop (ms) **O** | CH | Real observed period (s) **P** | Hops among Observed period **I** | Dwell time (ms) **T** | Limit (s) |
|---|---|---|---|---|---|---|
| DH1 | 0.428 | L | 3.16 | 32 | 136.96 | ≤0.4 |
| | | M | 3.16 | 32 | 136.96 | |
| | | H | 3.16 | 32 | 136.96 | |
| DH3 | 1.686 | L | 3.16 | 16 | 269.76 | |
| | | M | 3.16 | 16 | 269.76 | |
| | | H | 3.16 | 16 | 269.76 | |
| DH5 | 2.936 | L | 3.16 | 11 | 322.96 | |
| | | M | 3.16 | 11 | 322.96 | |
| | | H | 3.16 | 11 | 322.96 | |

Remark: 1. There are 79 channels in all. So the complete observed period P = 0.4 * 79 = 31.6 s.
2. Average time of occupancy **T = O *I * 31.6 / P**

DH1

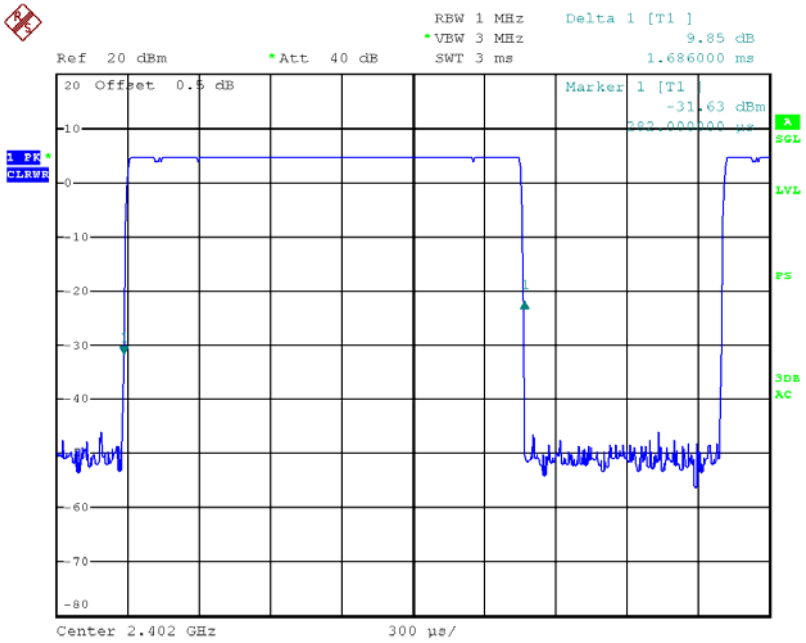



Date: 9.SEP.2014 12:03:51

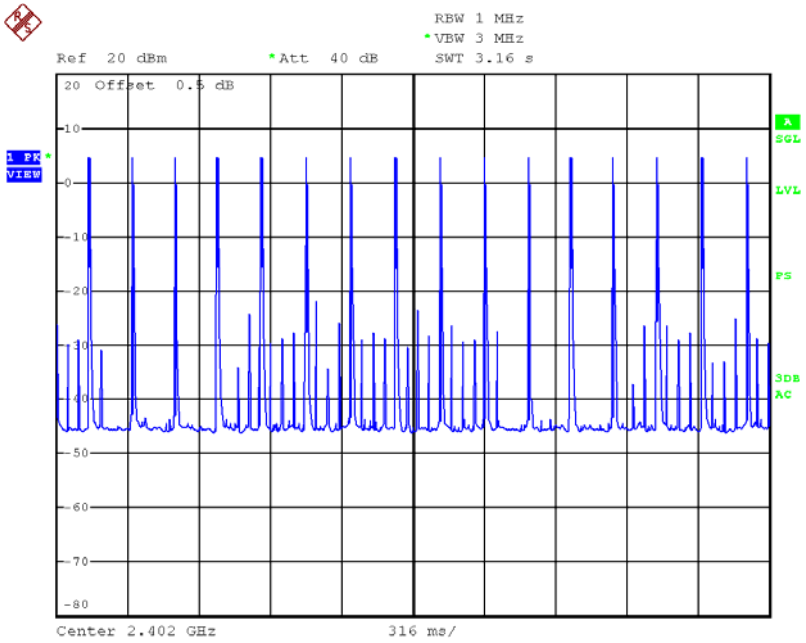



Date: 9.SEP.2014 12:06:00

DH3

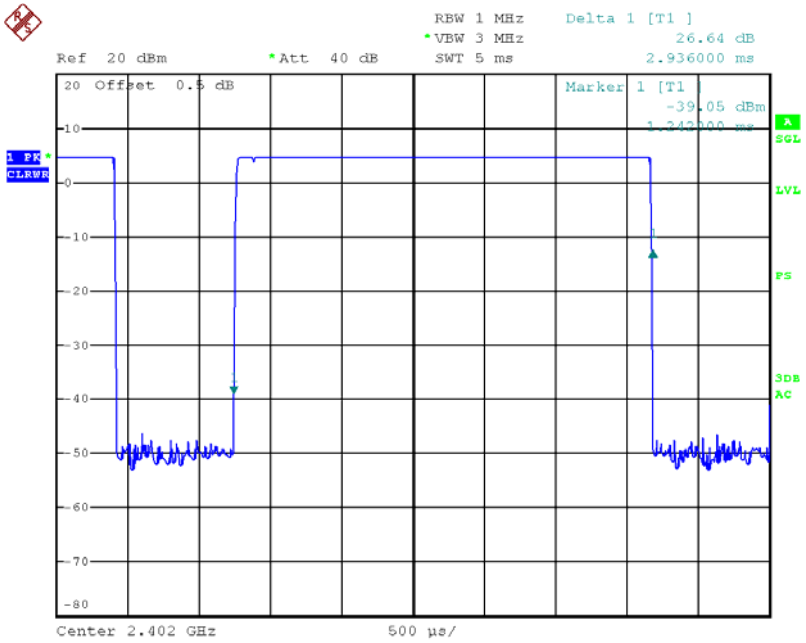



Date: 9.SEP.2014 12:08:48

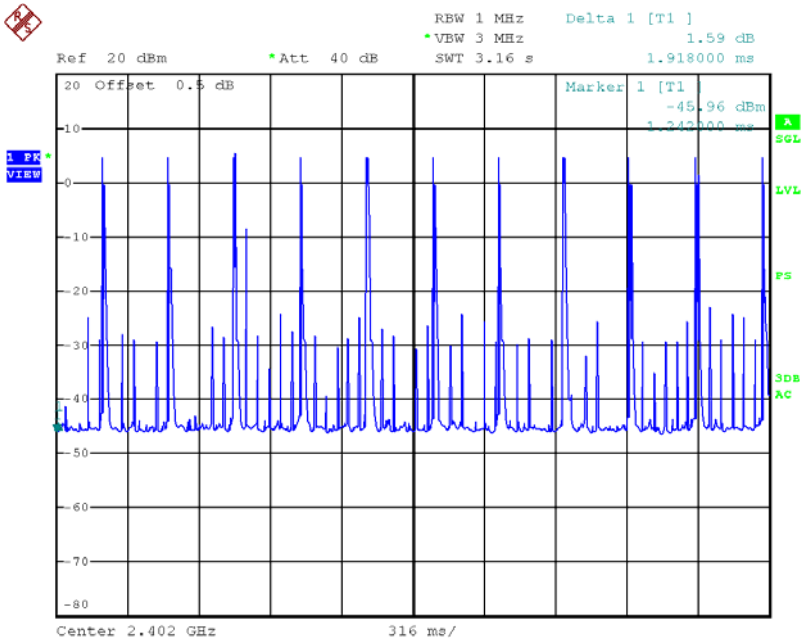



Date: 9.SEP.2014 12:07:38

DH5




Date: 9.SEP.2014 12:11:38




Date: 9.SEP.2014 12:12:18

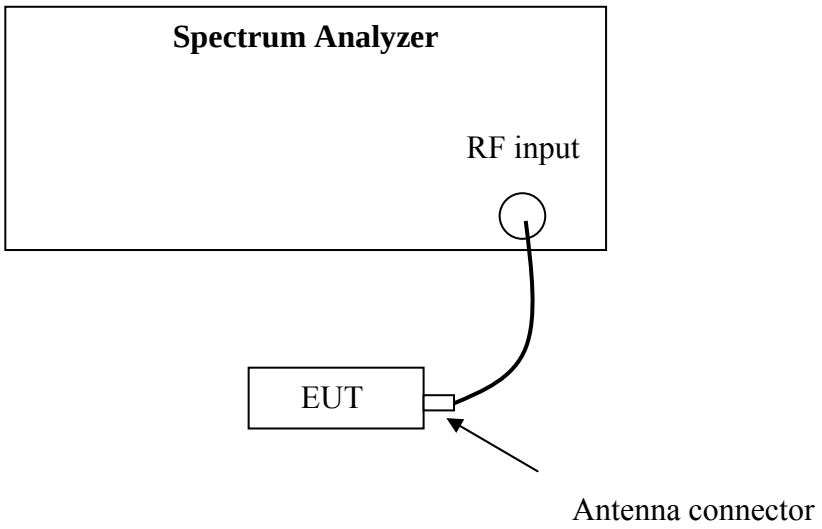
# 11. Occupied Bandwidth

**Test result:** **Tested**

## 11.1 Test limit

None

## 11.2 Test Configuration




## 11.3 Test procedure and test setup

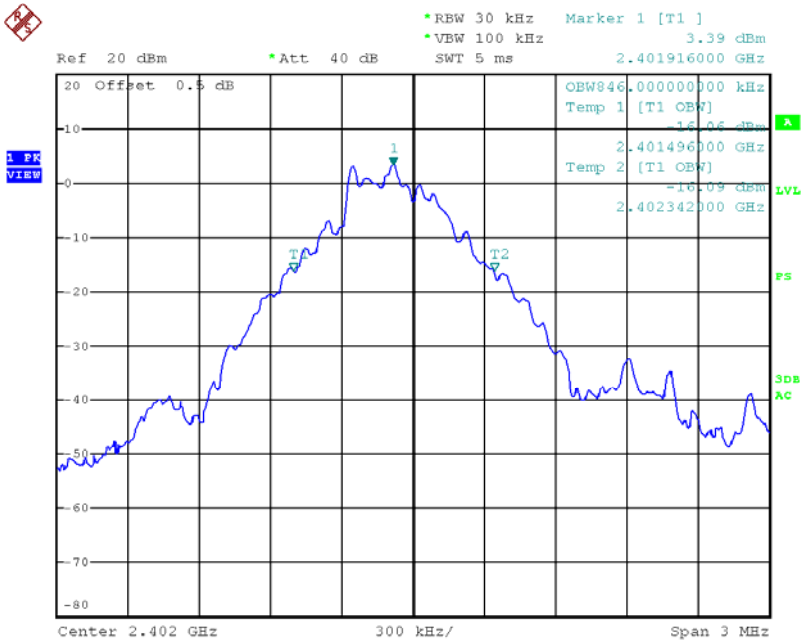
The occupied bandwidth per RSS-Gen Issue 3 Clause 4.6.1 was measured using the Spectrum Analyzer with the RBW close to 1% of the selected span, VBW = 3 * RBW Detector = Sample, Sweep = Auto.

## 11.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

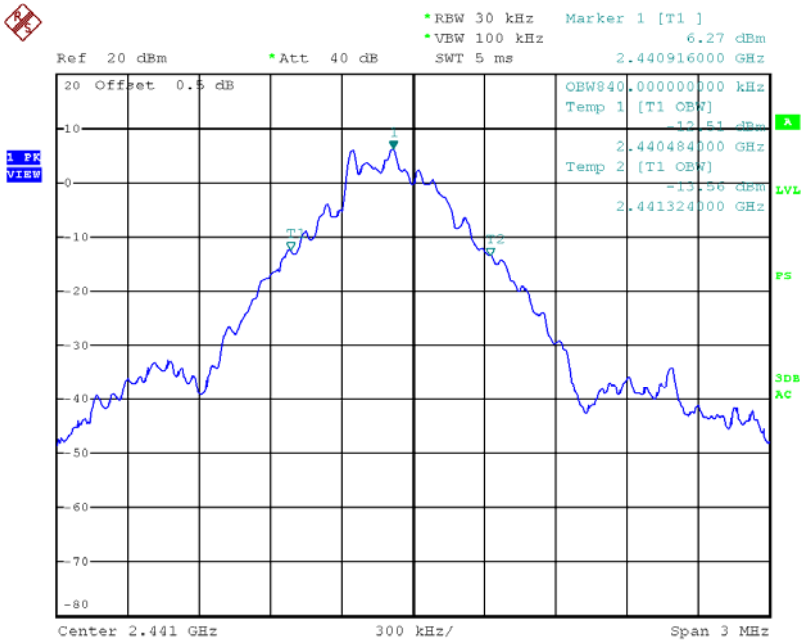
| Modulation | Channel | 99% Occupied Bandwidth (kHz) |
|---|---|---|
| GFSK | L | 846.00 |
| | M | 840.00 |
| | H | 840.00 |

Channel L



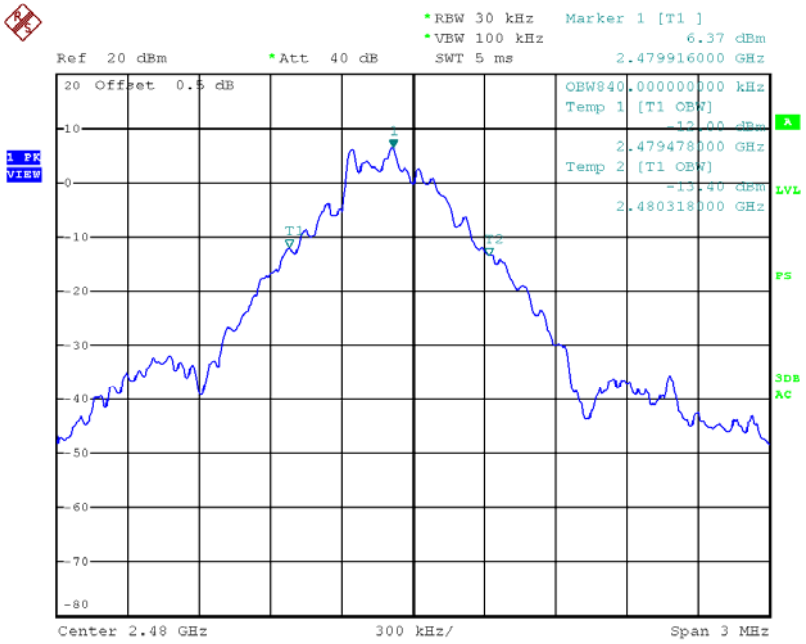

Date: 9.SEP.2014 11:12:31

Channel M




Date: 9.SEP.2014 11:13:28

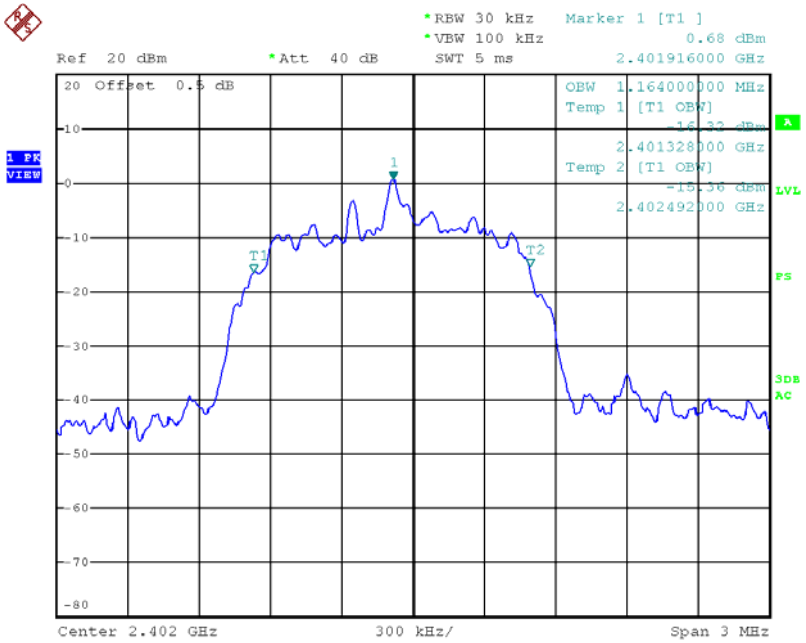
Channel H




Date: 9.SEP.2014 11:14:20

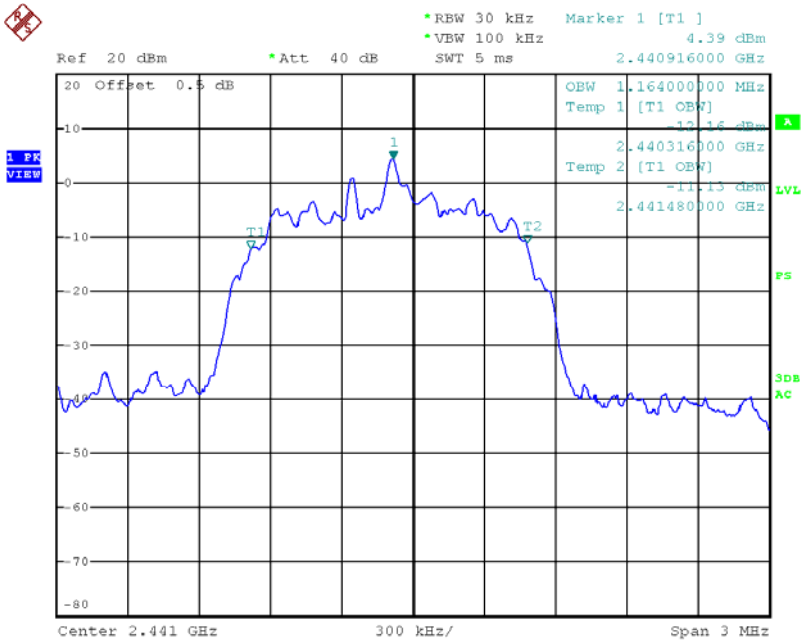
| Modulation | Channel | 99% Occupied Bandwidth (kHz) |
|---|---|---|
| π /4 DQPSK | L | 1164.00 |
| | M | 1164.00 |
| | H | 1164.00 |

Channel L



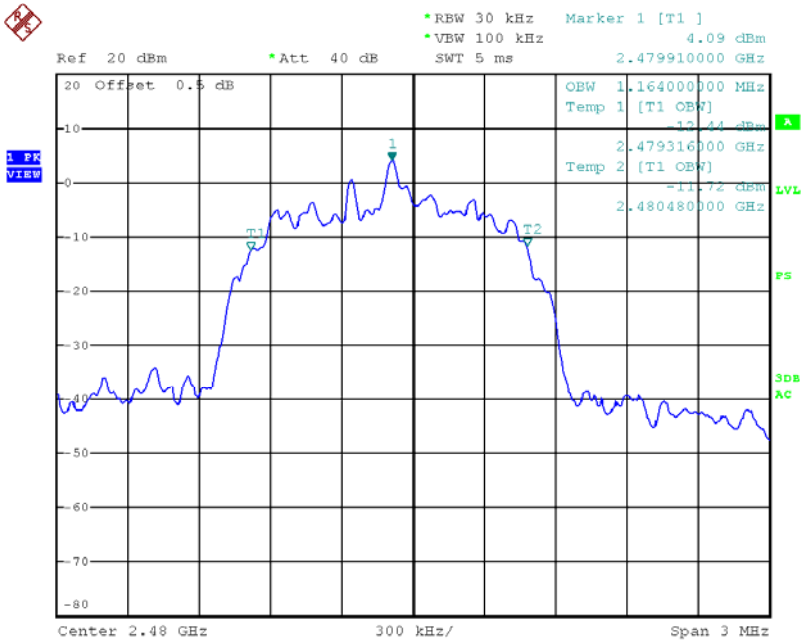

Date: 9.SEP.2014 11:15:59

Channel M




Date: 9.SEP.2014 11:17:06

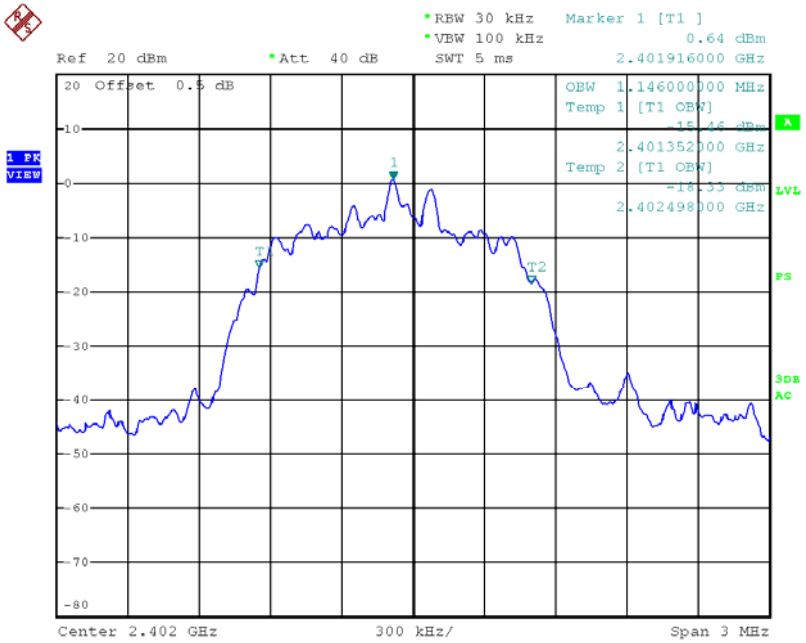
Channel H




Date: 9.SEP.2014 11:18:31

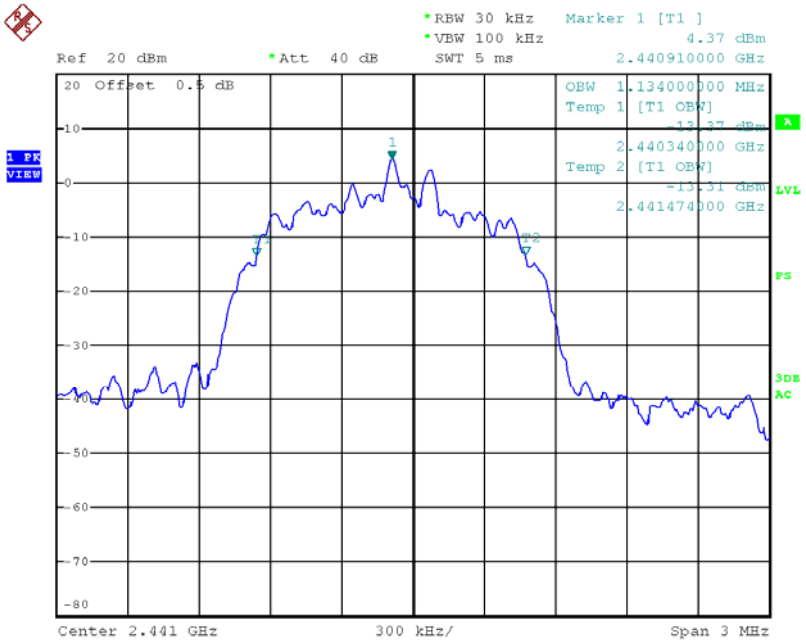
| Modulation | Channel | 99% Occupied Bandwidth (kHz) |
|---|---|---|
| 8DPSK | L | 1146.00 |
| | M | 1134.00 |
| | H | 1134.00 |

Channel L



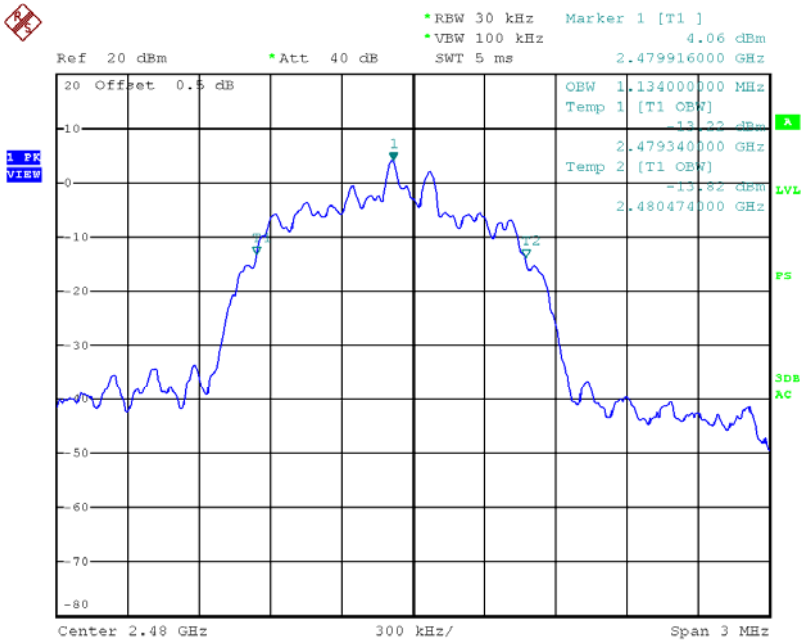

Date: 9.SEP.2014 11:20:11

Channel M




Date: 9.SEP.2014 11:20:59

Channel H




Date: 9.SEP.2014 11:22:01

# 12. Spurious emission for receiver

**Test result:** **NA**

## 12.1 Test limit

The spurious emission shall test through 3 times tuneable or local oscillator frequency whichever is the higher, without exceeding 40 GHz.

☐ If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2nW per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5nW above 1 GHz.

☐ If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 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 |

## 12.2 Test Configuration

Please refer to clause 6.2

## 12.3 Test procedure and test setup

Please refer to clause 6.3.

## 12.4 Test protocol

| Polarization | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |
| - | - | - | - | - | - | - |

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = limit – Corrected Reading

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Original Receiver Reading = 10dBuV.
Then Correct Factor = 30.20 + 2.00 = 32.20dB/m; Corrected Reading = 10dBuV + 32.20dB/m = 42.20dBuV/m
Assuming limit = 54dBuV/m, Corrected Reading = 42.20dBuV/m, then Margin = 54 -42.20 = 11.80dBuV/m