# FCC TEST REPORT for Bluetooth Device

# No. 160600522SHA-001

| | | |
|---|---|---|
| Applicant | : | Chongqing Zongshen General Power Machine Co., Ltd.<br>Zongshen Industry Zone Chaoyouchang<br>Banan District, Chongqing, China |
| Manufacturer | : | Chongqing Zongshen General Power Machine Co., Ltd.<br>Zongshen Industry Zone Chaoyouchang<br>Banan District, Chongqing, China |
| Product Name | : | APP Controller |
| Type/Model | : | RG-BLE-12 |
| **TEST RESULT** | **:** | **PASS** |

SUMMARY

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

**47CFR Part 15 (2015):** Radio Frequency Devices

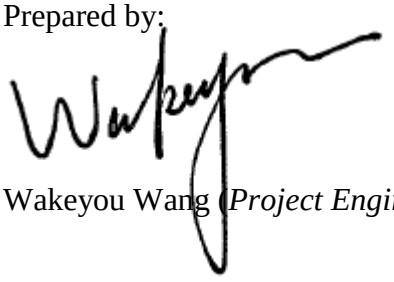
**RSS-247 (Issue 1, 2015):** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

**RSS-Gen Issue 4 (November 2014):** General Requirements and Information for the Certification of Radiocommunication Equipment

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

Date of issue: Aug 4, 2016

Prepared by: Reviewed by:



Wakeyou Wang (*Project Engineer*) Daniel Zhao (*Reviewer*)

# Description of Test Facility

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# Content

# 1. General Information

## 1.1 Applicant Information

| | | |
|---|---|---|
| Applicant | : | Chongqing Zongshen General Power Machine Co., Ltd.<br>Zongshen Industry Zone Chaoyouchang<br>Banan District, Chongqing, China |
| Name of contact | : | Rong Luo |
| Tel | : | +86-13983885759 |
| Fax | : | / |
| Email | : | luorong@zsengine.com |
| Manufacturer | : | Chongqing Zongshen General Power Machine Co., Ltd.<br>Zongshen Industry Zone Chaoyouchang<br>Banan District, Chongqing, China |

## 1.2 Identification of the EUT

| | | |
|---|---|---|
| Product Name | : | APP Controller |
| Type/model | : | RG-BLE-12 |
| FCC ID | : | 2AIRGBTC01 |
| IC | : | / |

## 1.3 Technical specification

| | | |
|---|---|---|
| Operation Frequency Band | : | 2402 - 2480 MHz |
| Type of Modulation | : | FHSS |
| EUT Modes of Modulation | : | GFSK, Pi/4 DQPSK, 8DQPSK |
| Channel Number | : | 79 channels with spacing of 1MHz. |
| Description of EUT | : | There is one model only. |
| Port identification | : | N/A |
| Antenna | : | PCB antenna, 0dBi |
| Rating | : | DC 12V |

| | | |
|---|---|---|
| Declared Temperature | : | / |
| Category of EUT | : | Class B |
| EUT type | : | ☒ Table top<br>☐ Floor standing |
| Sample received date | : | June 6, 2016 |
| Sample Identification | : | / |
| Date of test | : | June 6, 2016 – Aug 4, 2016 |

# 2. TEST SPECIFICATIONS

## 2.1 Test Standard

47CFR Part 15 (2015)
RSS-247 (Issue 1, 2015)
RSS-Gen Issue 4 (November 2014)
ANSI C63.10 (2013)
DA 00-705 (March 30, 2000)

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

While testing transmitting mode of EUT, the internal modulation was applied. The EUT is powered by external DC power supply.

**Test software setting:** Highest power 0 among the software *BlueTool.*

**Test mode:**
Mode 1: Hopping off, GFSK_DH5
Mode 2: Hopping off, 8DQPSK_DH5
Mode 3: Hopping on, GFSK_DH5
Mode 4: Hopping on, 8DQPSK_DH5

**Test Channel:**

| Channel | Frequency (MHz) |
|---|---|
| L | 2402 |
| M | 2441 |
| H | 2480 |

**Frequency Hopping System Requirement**

☒**Compliance for 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.

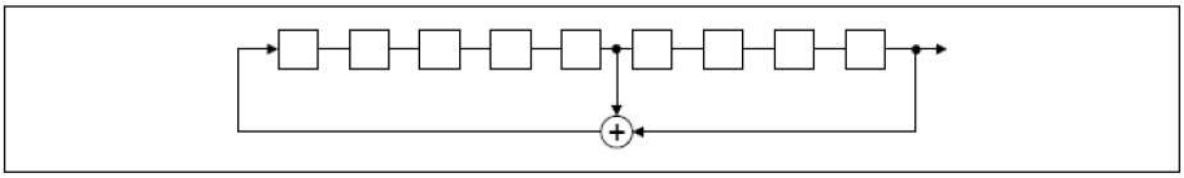
Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented 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)**

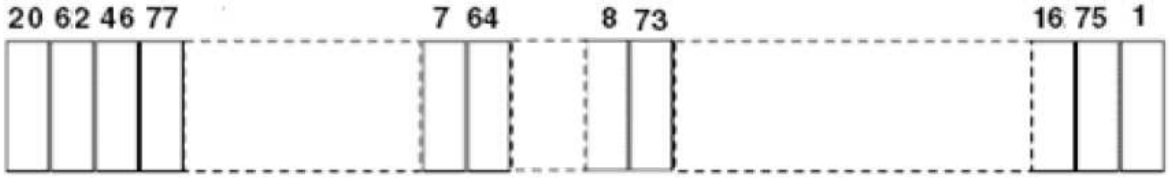
According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a ninestage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive 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.

**2.3 Test software list**

| Test Items | Software | Manufacturer | Version |
|---|---|---|---|
| Conducted emission | ESxS-K1 | R&S | V2.1.0 |
| Radiated emission | ES-K1 | R&S | V1.71 |

**2.4 Test peripherals list**

| Item No. | Name | Band and Model | Description |
|---|---|---|---|
| 1 | DC power supply | Chroma, 62024P-100-50 | NA |

## 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 | 2016-1-9 | 2017-1-8 |
| Bilog Antenna | CBL 6112D | TESEQ | EC 4206 | 2016-4-28 | 2017-4-27 |
| Horn antenna | HF 906 | R&S | EC 3049 | 2016-4-28 | 2017-4-27 |
| Pre-amplifier | Pre-amp 18 | R&S | EC 3222 | 2016-4-12 | 2017-4-11 |
| Semi-anechoic chamber | - | Albatross project | EC 3048 | 2016-5-12 | 2017-5-11 |
| High Pass Filter | WHKX 1.0/15G-10SS | Wainwright | EC4297-1 | 2016-1-8 | 2017-1-7 |
| Power sensor / Power meter | N1911A/N1921A | Agilent | EC4318 | 2016-04-12 | 2017-04-11 |
| Temperature Camber | SETH-E | tayasaf | EC4315 | 2016-4-9 | 2017-4-8 |
| Spectrum analyzer | E7402A | Agilent | EC2254 | 2015-08-16 | 2016-08-15 |

## 2.6 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-247 Issue 1 Annex 5.1 | Tested |
| Carrier Frequency Separation | 15.247(a)(1) | RSS-247 Issue 1 Annex 5.1 | Pass |
| Output power | 15.247(b)(1) | RSS-247 Issue 1 Annex 5.4 | Pass |
| Radiated Spurious Emissions | 15.205 & 15.209 | RSS-Gen Issue 4 Clause 8.10 | Pass |
| Band Edge Emission | 15.247(d) | RSS-247 Issue 1 Annex 5.5 | Pass |
| Power line conducted emission | 15.207 | RSS-Gen Issue 4 Clause 8.8 | Pass |
| Number of Hopping Frequencies | 15.247(a)(1)(iii) | RSS-247 Issue 1 Annex 5.1 | Pass |
| Dwell time | 15.247(a)(1)(iii) | RSS-247 Issue 1 Annex 5.1 | Pass |

Note: “NA” means “not applied”.

# 3. 20 dB Bandwidth

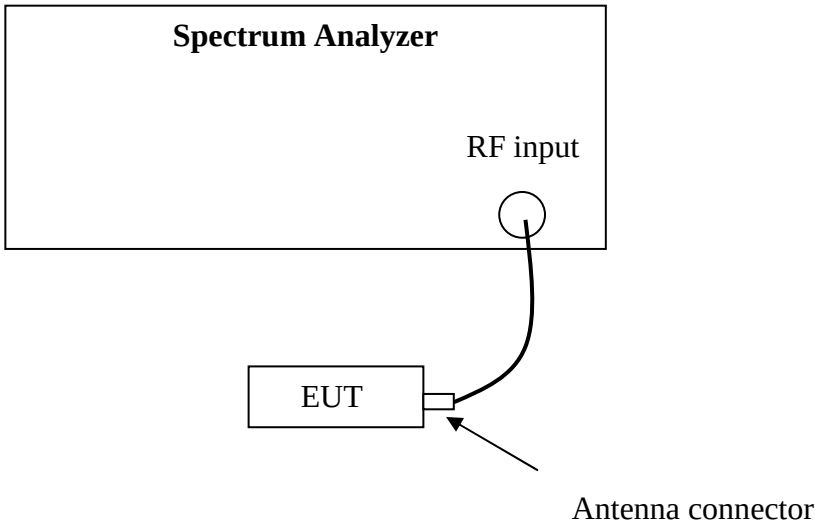
**Test result: Tested**

## 3.1 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.

## 3.2 Test Configuration




## 3.3 Test Procedure and test setup

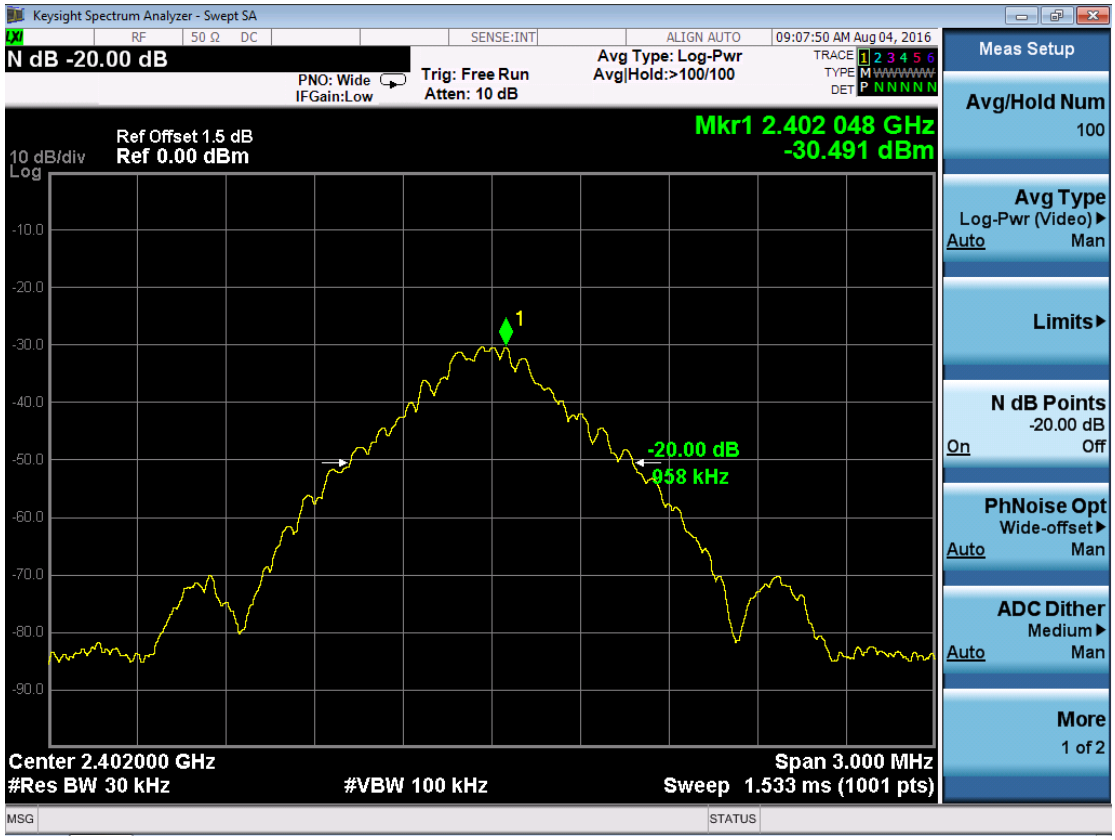
The 20 bandwidth per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span = approximately 2 to 3 times the 20 dB bandwidth, RBW≥1% of the 20 dB bandwidth, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).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

### 3.4 Test Protocol

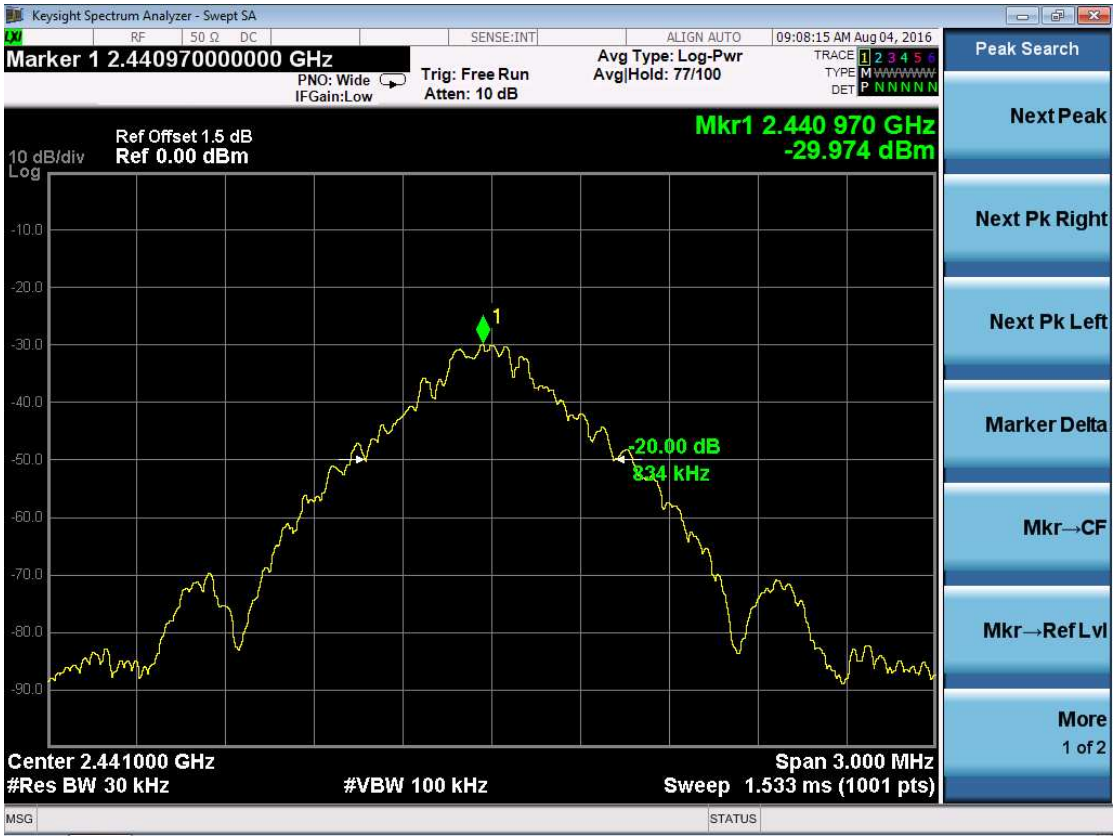
Temperature : 25°C
Relative Humidity : 55 %

| Mode | CH | Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|---|---|---|---|
| 1 | L | 958 | 639 |
| | M | 834 | 556 |
| | H | 887 | 591 |

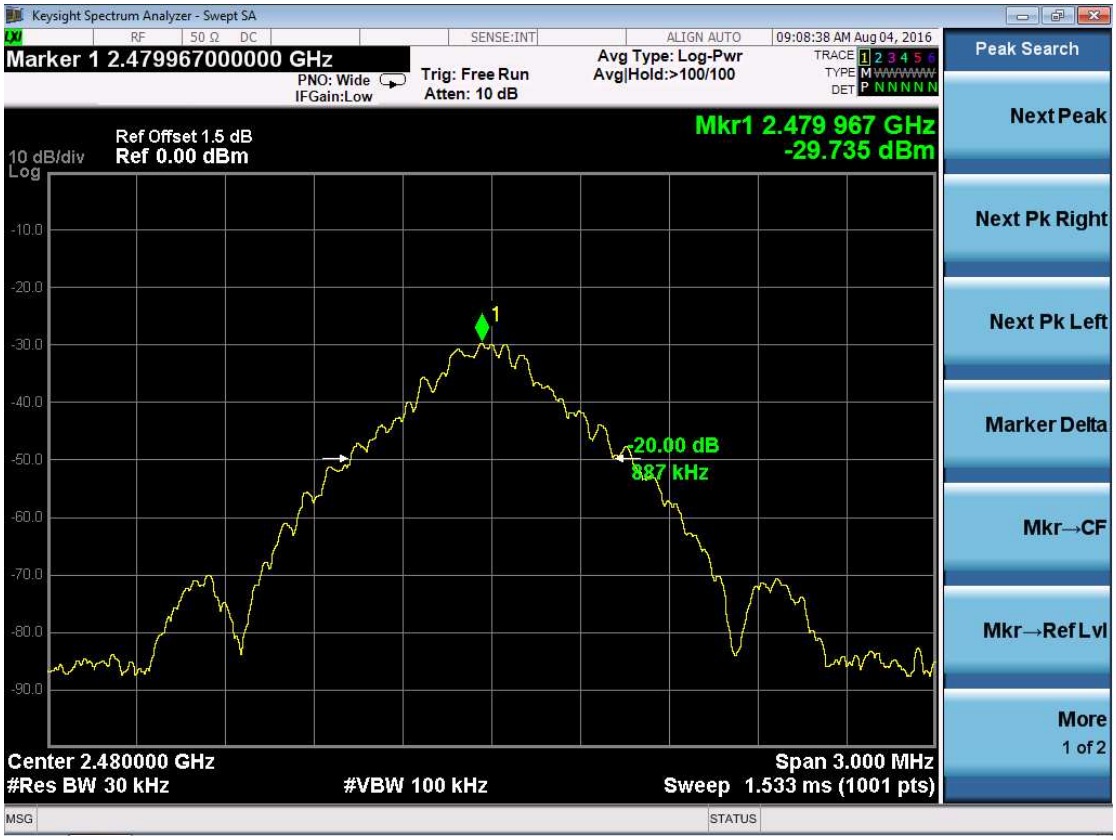
Channel L



Channel M

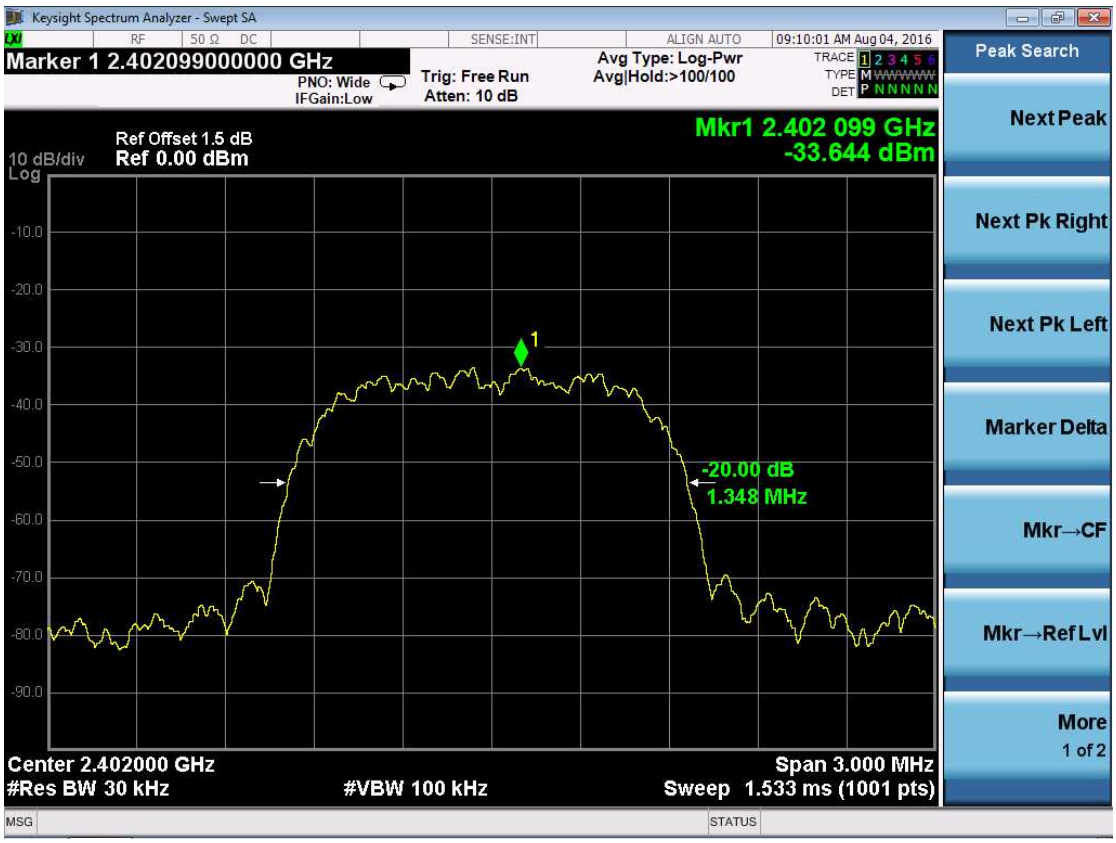



Channel H

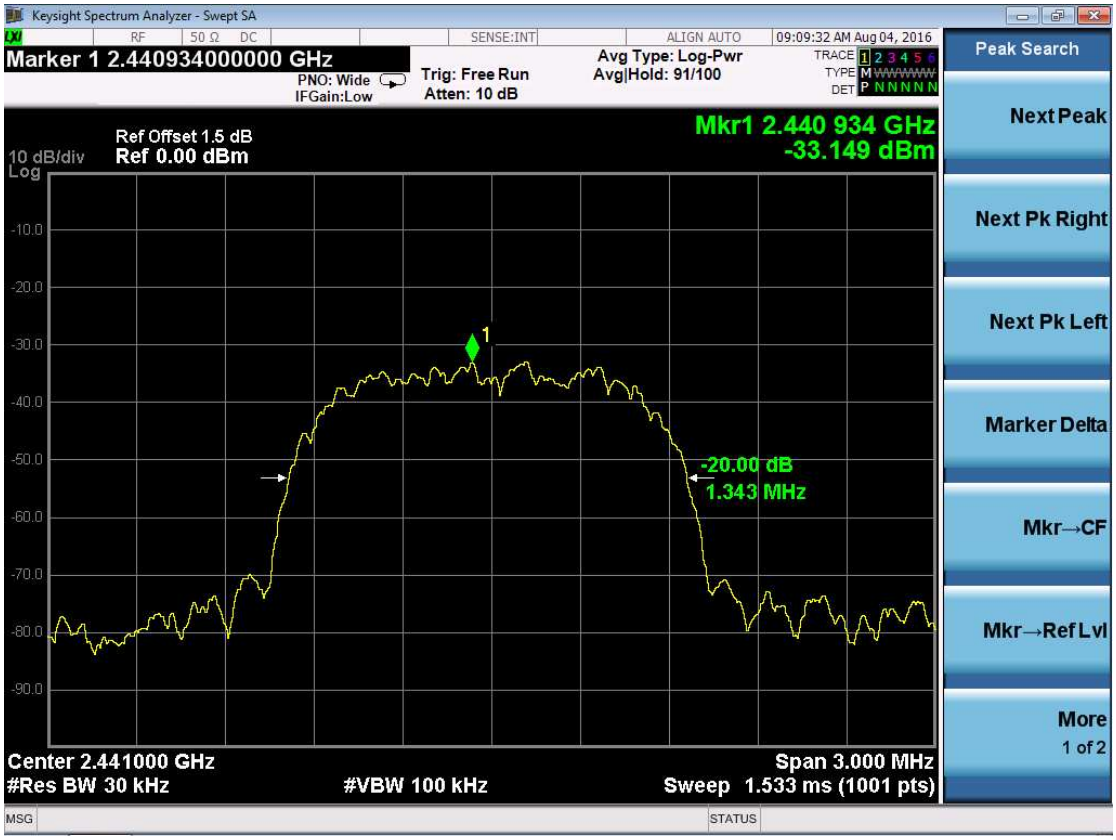


| Mode | CH | Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|---|---|---|---|
| 2 | L | 1348 | 899 |
| | M | 1343 | 895 |
| | H | 1311 | 874 |

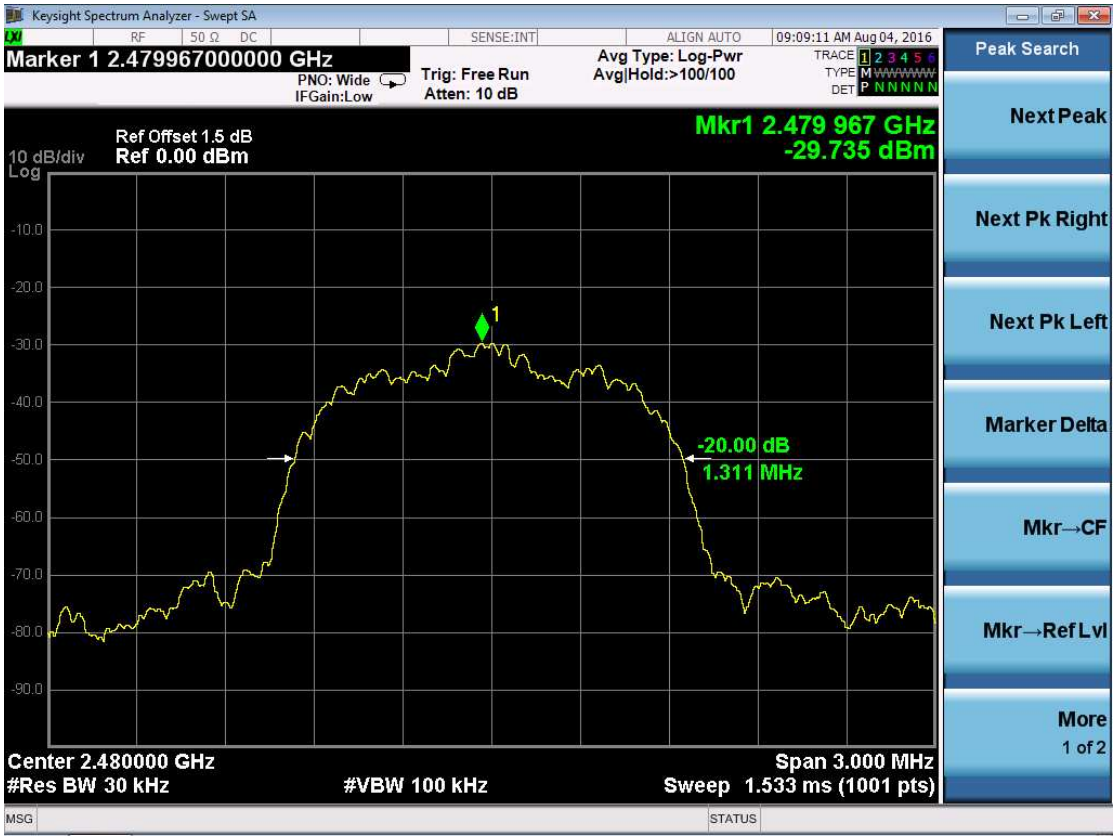
Channel L



Channel M




Channel H



### 3.5 Measurement uncertainty

Measurement uncertainty: ± 3 %
The measurement uncertainty is given with a confidence of 95%, k=2.

# 4. Carrier Frequency Separation

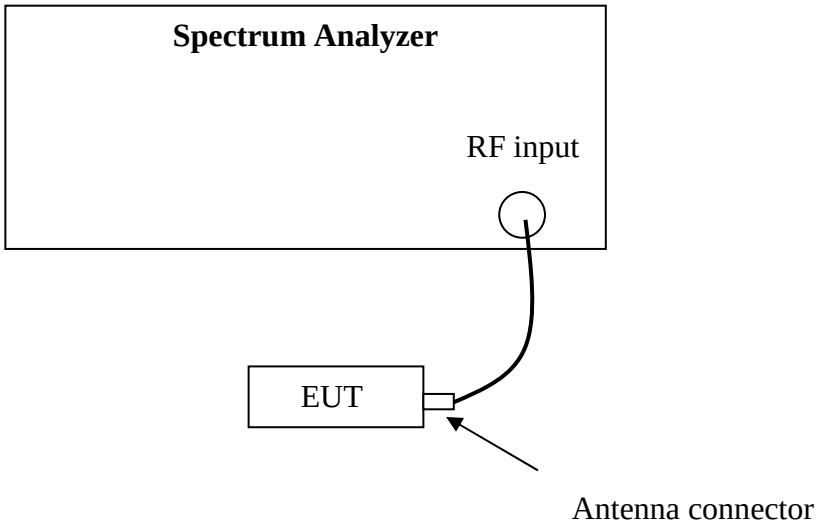
**Test result: Pass**

## 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

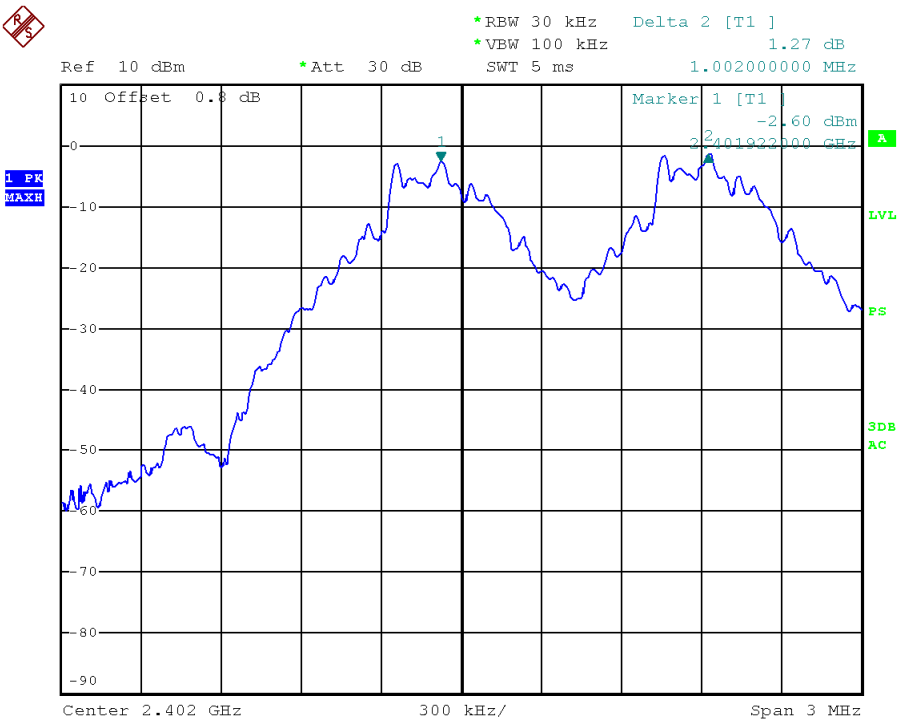
The Carrier Frequency Separation per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span can capture two adjacent channels, RBW≥1% of the span, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT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

## 4.4 Test Protocol

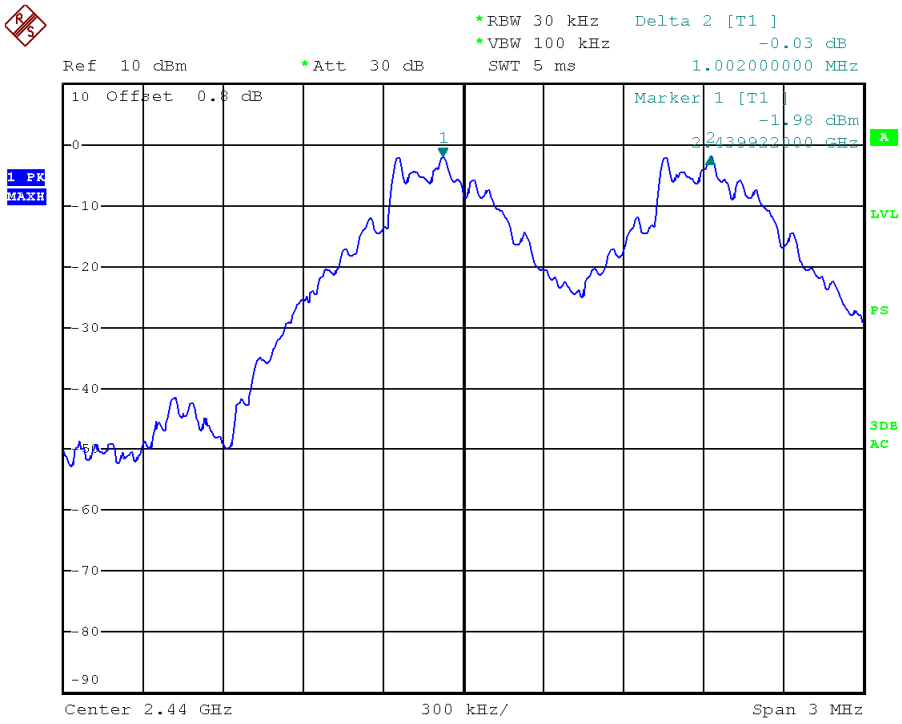
Temperature : 25°C
Relative Humidity : 55 %

| Mode | CH | Frequency Separation (kHz) | Limit (kHz) |
|---|---|---|---|
| 1 | L | 1002.00 | ≥ 2/3 of 20dB BW |
| | M | 1002.00 | ≥ 2/3 of 20dB BW |
| | H | 1002.00 | ≥ 2/3 of 20dB BW |

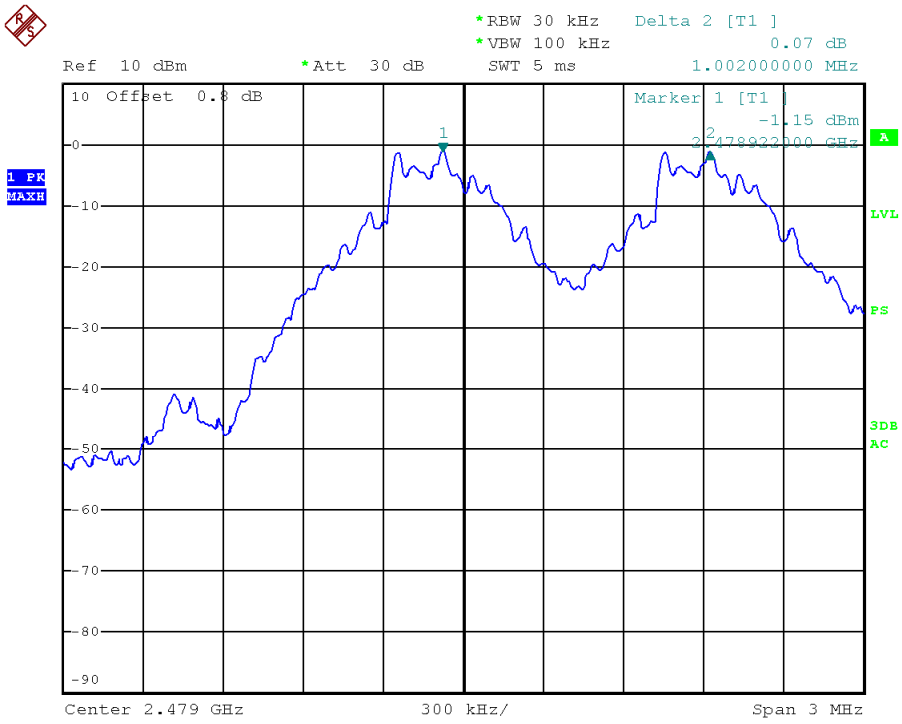
Channel L



## Channel M

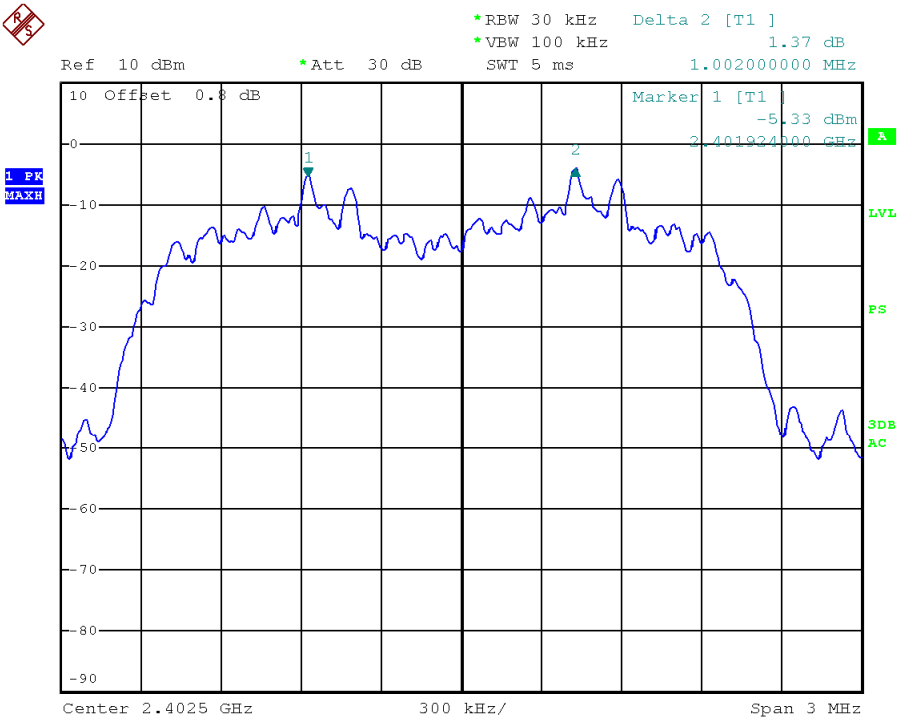



## Channel H

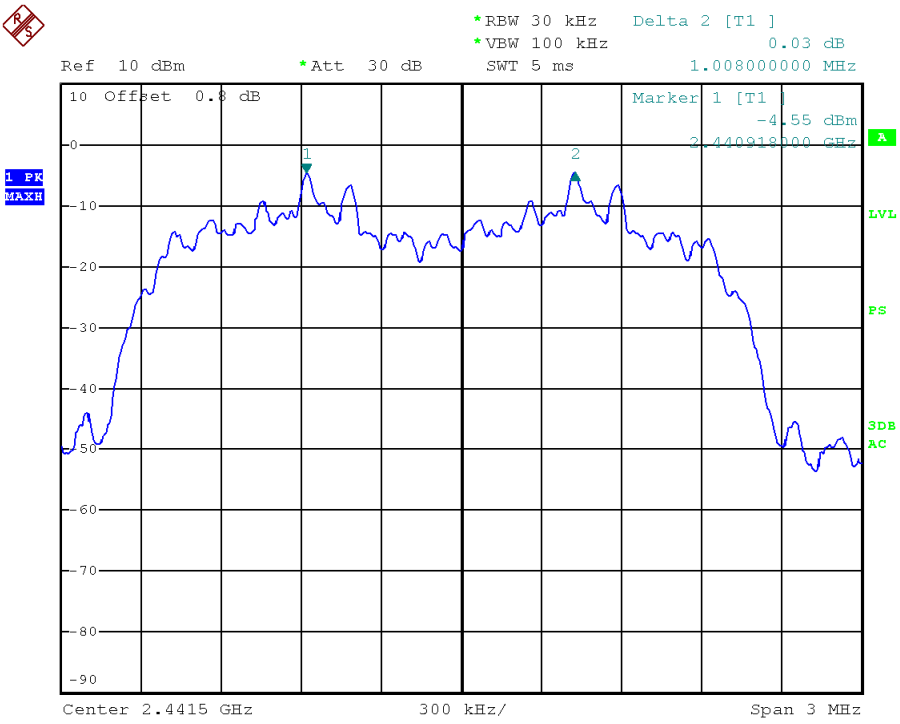


| Mode | CH | Frequency Separation (kHz) | Limit (kHz) |
|---|---|---|---|
| 2 | L | 1002.00 | ≥ 2/3 of 20dB BW |
| | M | 1008.00 | ≥ 2/3 of 20dB BW |
| | H | 1002.00 | ≥ 2/3 of 20dB BW |

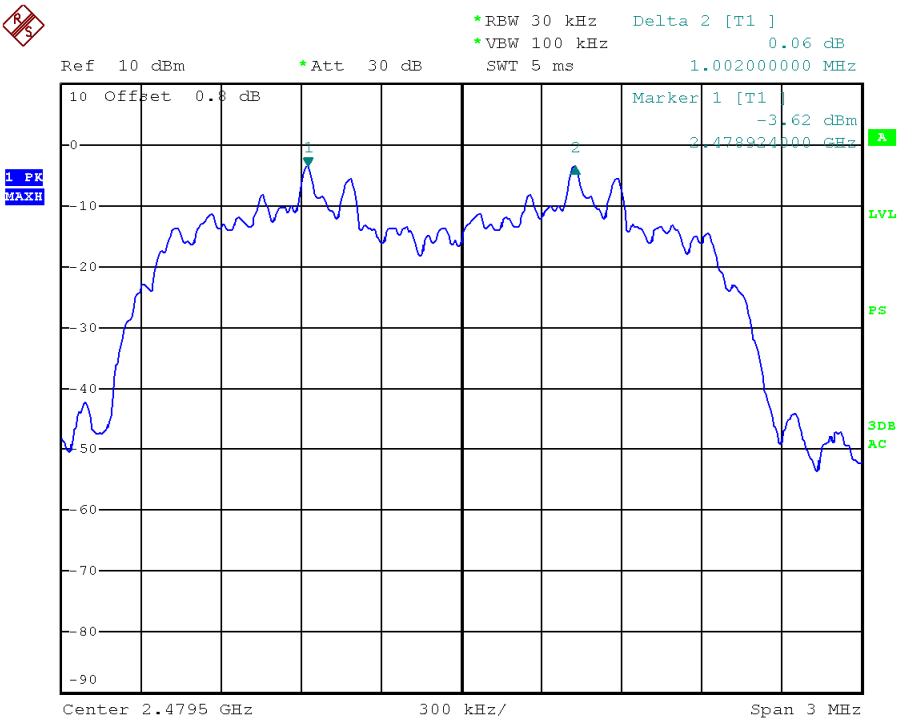
Channel L



## Channel M




## Channel H



## 4.5 Measurement uncertainty

Measurement uncertainty: ± 3 %
The measurement uncertainty is given with a confidence of 95%, k=2.

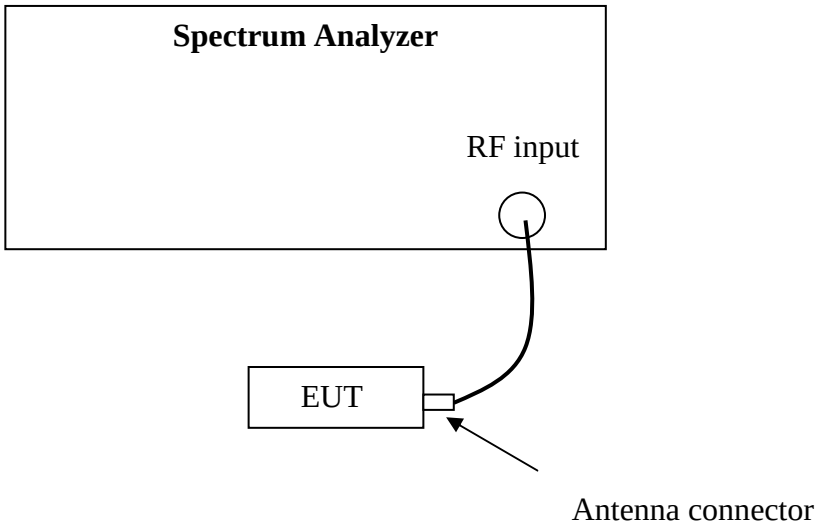
# 5. Maximum peak output power

**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 by setting the Spectrum Analyzer as RBW = 1MHz, VBW = 3MHz, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The test method is following 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) | Conducted Power (dBm) | Limit (dBm) |
|---|---|---|---|---|
| 1 | L | 0.80 | -2.30 | 21 |
| | M | 0.80 | -2.80 | 21 |
| | H | 0.80 | -3.40 | 21 |

| Mode | CH | Cable loss (dB) | Conducted Power (dBm) | Limit (dBm) |
|---|---|---|---|---|
| 2 | L | 0.80 | -0.30 | 21 |
| | M | 0.80 | -0.70 | 21 |
| | H | 0.80 | -1.10 | 21 |

## 5.5 Measurement uncertainty

Measurement uncertainty: ± 0.74dB
The measurement uncertainty is given with a confidence of 95%, k=2.

# 6. Radiated Spurious Emissions

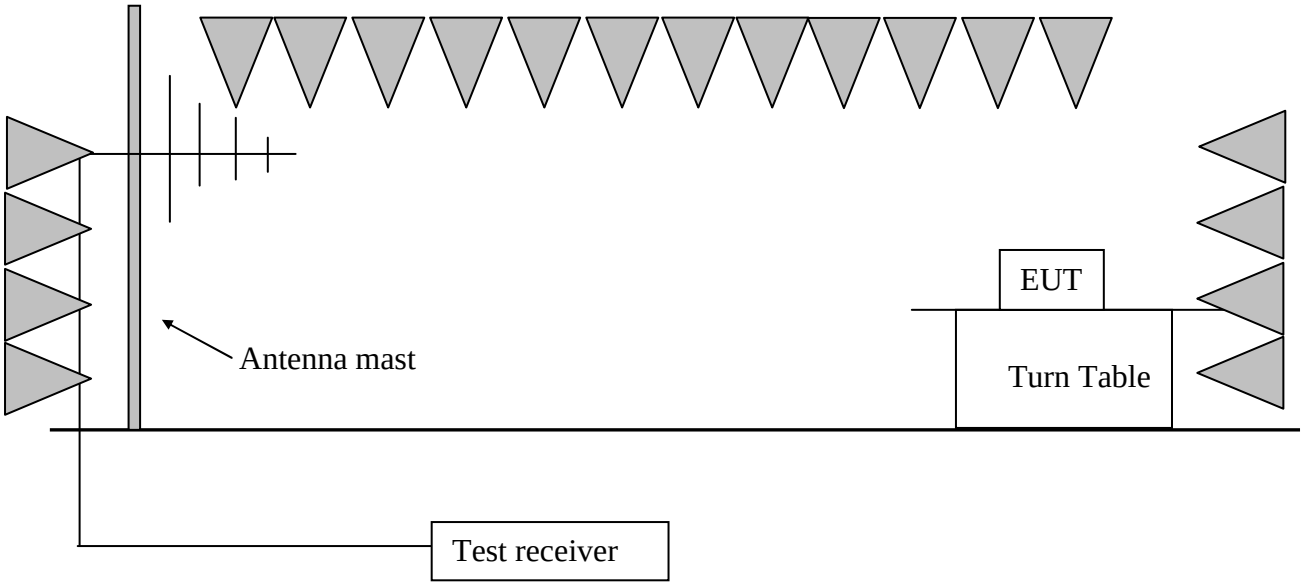
**Test result: PASS**

## 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 and the EUT was placed on a 1.5m height.
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 radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 100kHz, VBW = 300kHz (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

Mode 1

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2402.20 | 30.70 | 90.30 | Fundamental | / | PK |
| | H | 61.10 | 7.80 | 33.00 | 40.00 | 7.00 | PK |
| | V | 168.01 | 12.00 | 35.20 | 43.50 | 8.30 | PK |
| | V | 239.93 | 14.20 | 39.70 | 46.00 | 6.30 | PK |
| | V | 335.19 | 17.40 | 40.90 | 46.00 | 5.10 | PK |
| | H | 797.83 | 24.40 | 31.60 | 46.00 | 14.40 | PK |
| | H | 2389.15 | 34.30 | 52.20 | 54.00 | 1.80 | PK |
| | H | 4804.59 | -3.60 | 39.40 | 54.00 | 14.60 | PK |
| M | H | 2441.07 | 30.70 | 89.60 | Fundamental | / | PK |
| | H | 61.10 | 7.80 | 33.00 | 40.00 | 7.00 | PK |
| | V | 168.01 | 12.00 | 35.20 | 43.50 | 8.30 | PK |
| | V | 239.93 | 14.20 | 39.70 | 46.00 | 6.30 | PK |
| | V | 335.19 | 17.40 | 40.90 | 46.00 | 5.10 | PK |
| | H | 797.83 | 24.40 | 31.60 | 46.00 | 14.40 | PK |
| | H | 4882.23 | -3.40 | 39.20 | 54.00 | 14.80 | PK |
| H | H | 2479.83 | 30.70 | 88.70 | Fundamental | / | PK |
| | H | 61.10 | 7.80 | 33.00 | 40.00 | 7.00 | PK |
| | V | 168.01 | 12.00 | 35.20 | 43.50 | 8.30 | PK |
| | V | 239.93 | 14.20 | 39.70 | 46.00 | 6.30 | PK |
| | V | 335.19 | 17.40 | 40.90 | 46.00 | 5.10 | PK |
| | H | 797.83 | 24.40 | 31.60 | 46.00 | 14.40 | PK |
| | H | 2485.39 | 34.60 | 51.60 | 54.00 | 2.40 | PK |
| | H | 4963.92 | -3.20 | 42.80 | 54.00 | 11.20 | PK |

Mode 2

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2401.98 | 30.70 | 92.40 | Fundamental | / | PK |
| | H | 61.10 | 7.80 | 33.00 | 40.00 | 7.00 | PK |
| | V | 168.01 | 12.00 | 35.20 | 43.50 | 8.30 | PK |
| | V | 239.93 | 14.20 | 39.70 | 46.00 | 6.30 | PK |
| | V | 335.19 | 17.40 | 40.90 | 46.00 | 5.10 | PK |
| | H | 797.83 | 24.40 | 31.60 | 46.00 | 14.40 | PK |
| | H | 2379.73 | 34.30 | 51.00 | 54.00 | 3.00 | PK |
| | H | 4804.59 | -3.60 | 41.20 | 54.00 | 12.80 | PK |
| M | H | 2441.07 | 30.70 | 92.00 | Fundamental | / | PK |
| | H | 61.10 | 7.80 | 33.00 | 40.00 | 7.00 | PK |
| | V | 168.01 | 12.00 | 35.20 | 43.50 | 8.30 | PK |
| | V | 239.93 | 14.20 | 39.70 | 46.00 | 6.30 | PK |
| | V | 335.19 | 17.40 | 40.90 | 46.00 | 5.10 | PK |
| | H | 797.83 | 24.40 | 31.60 | 46.00 | 14.40 | PK |
| | H | 4882.23 | -3.40 | 40.90 | 54.00 | 13.10 | PK |
| H | H | 2480.28 | 30.70 | 91.10 | Fundamental | / | PK |
| | H | 61.10 | 7.80 | 33.00 | 40.00 | 7.00 | PK |
| | V | 168.01 | 12.00 | 35.20 | 43.50 | 8.30 | PK |
| | V | 239.93 | 14.20 | 39.70 | 46.00 | 6.30 | PK |
| | V | 335.19 | 17.40 | 40.90 | 46.00 | 5.10 | PK |
| | H | 797.83 | 24.40 | 31.60 | 46.00 | 14.40 | PK |
| | H | 2487.91 | 34.60 | 51.10 | 54.00 | 2.90 | PK |
| | H | 4963.92 | -3.20 | 43.10 | 54.00 | 10.90 | PK |

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

## 6.5 Measurement uncertainty

Measurement uncertainty of radiated emission (30MHz-1000MHz) is: ± 4.90dB
Measurement uncertainty of radiated emission (1000MHz-6000MHz) is: ± 5.02dB
The measurement uncertainty is given with a confidence of 95%, k=2.

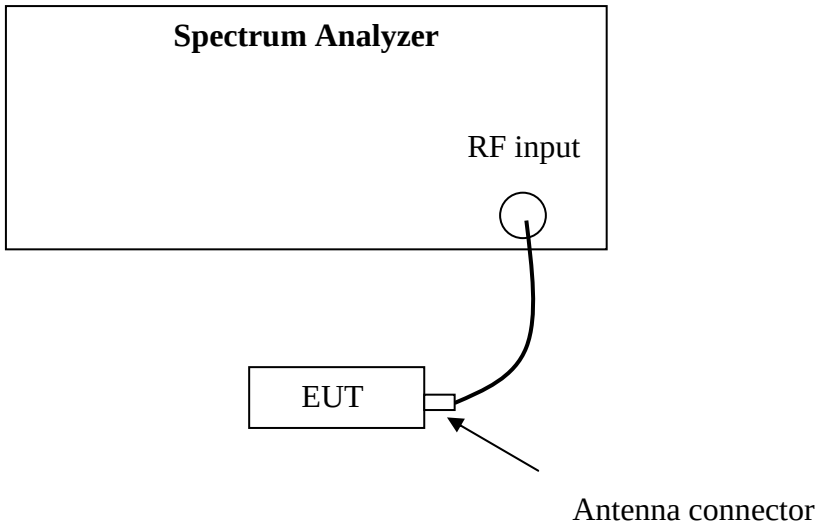
# 7. Band Edge Emission

**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

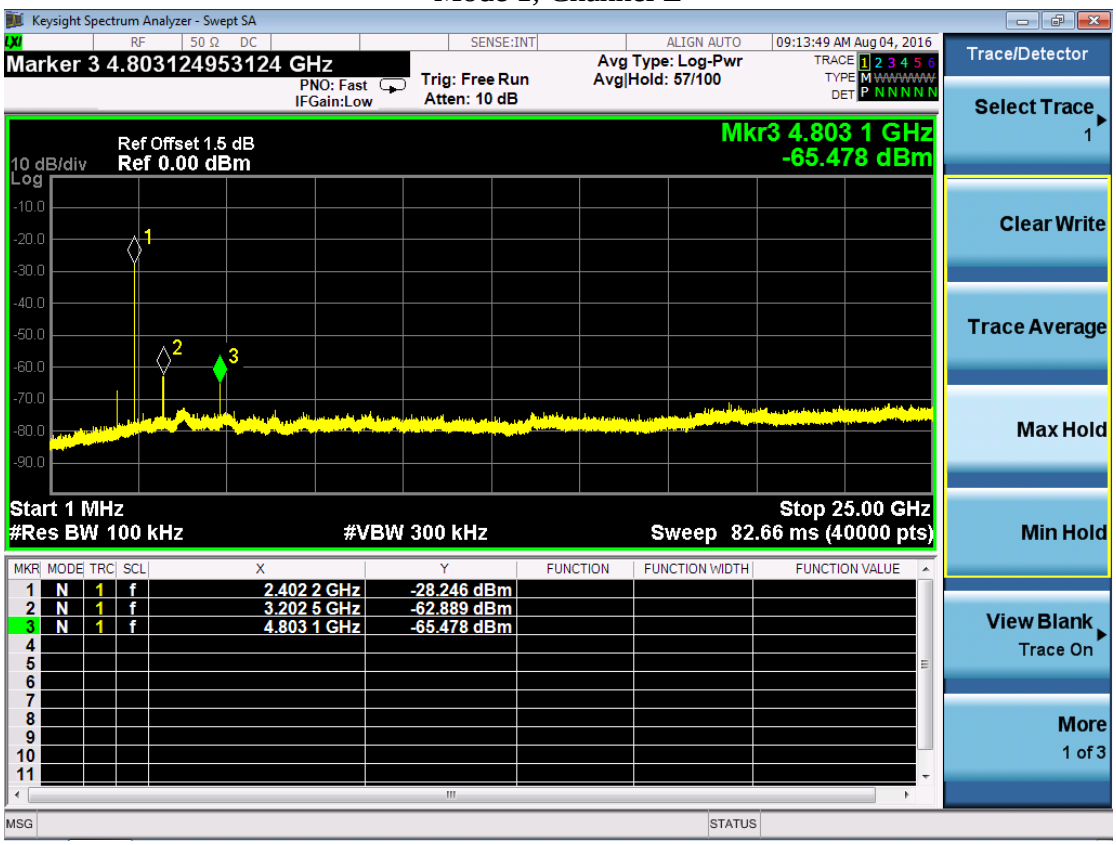


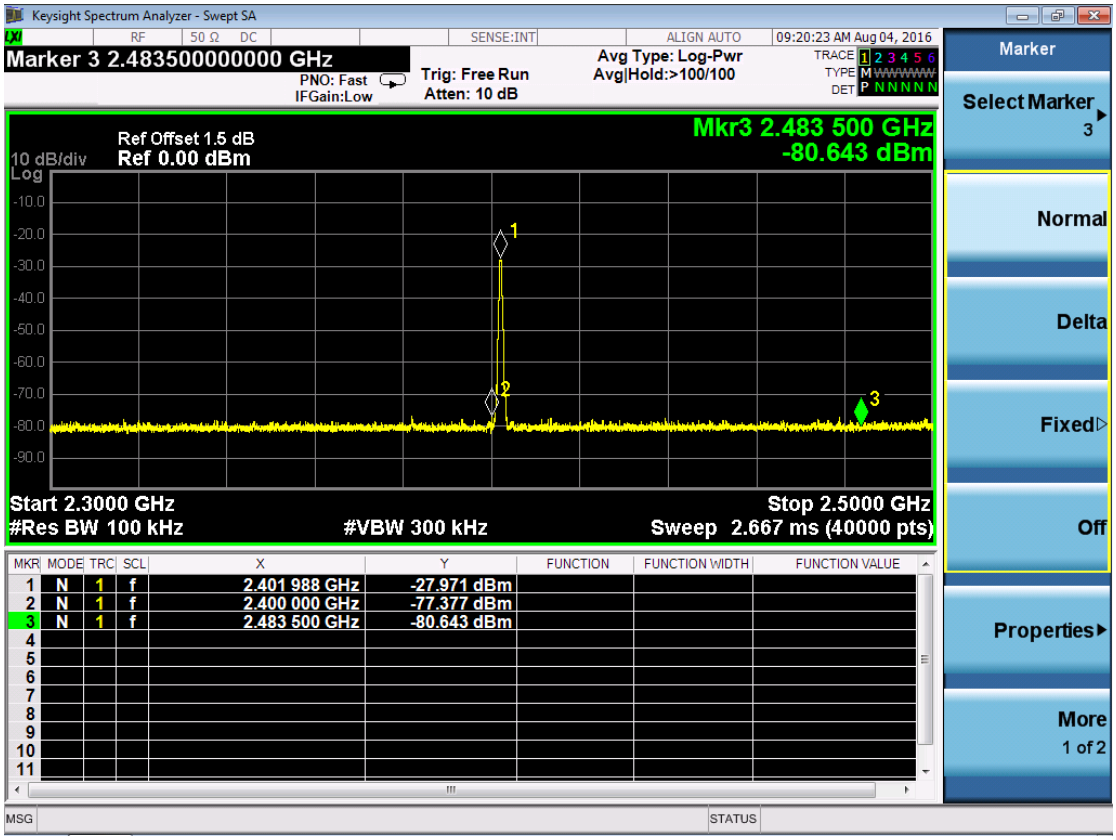

## 7.3 Test procedure and test setup

The Band Edge 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)

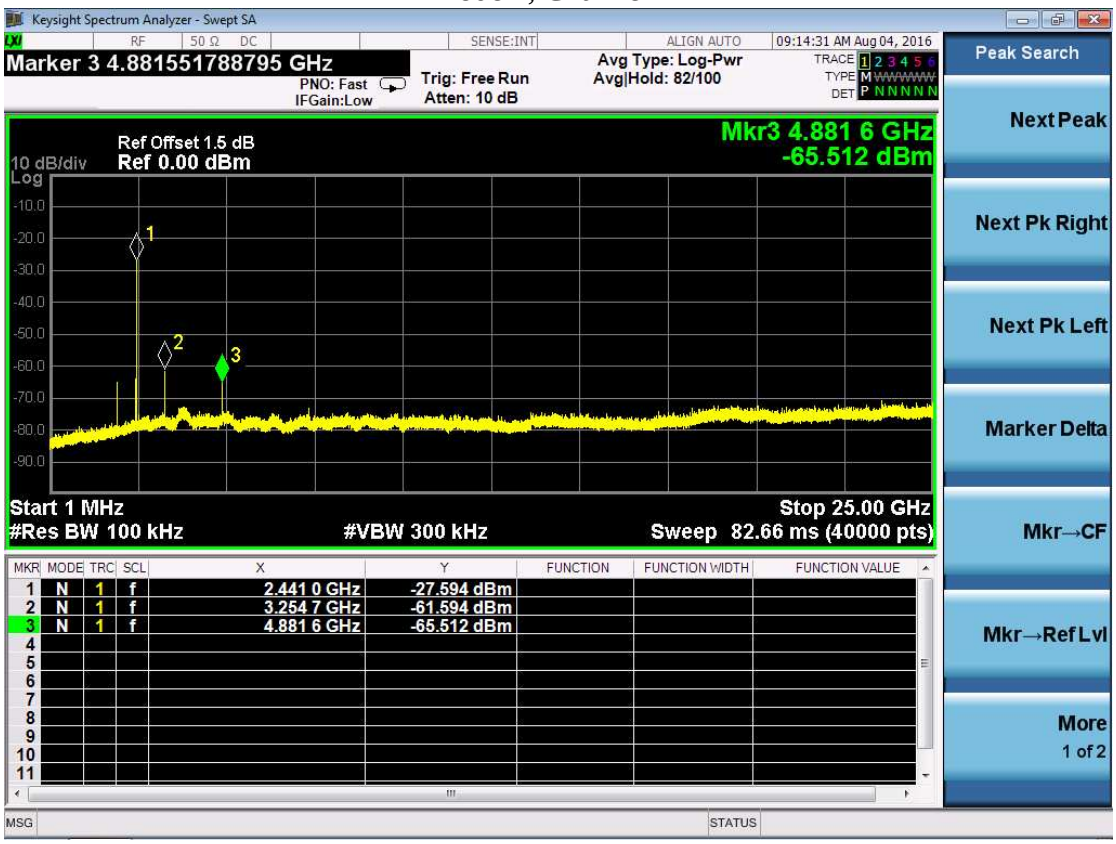
## 7.4 Test protocol

Mode 1, Channel L

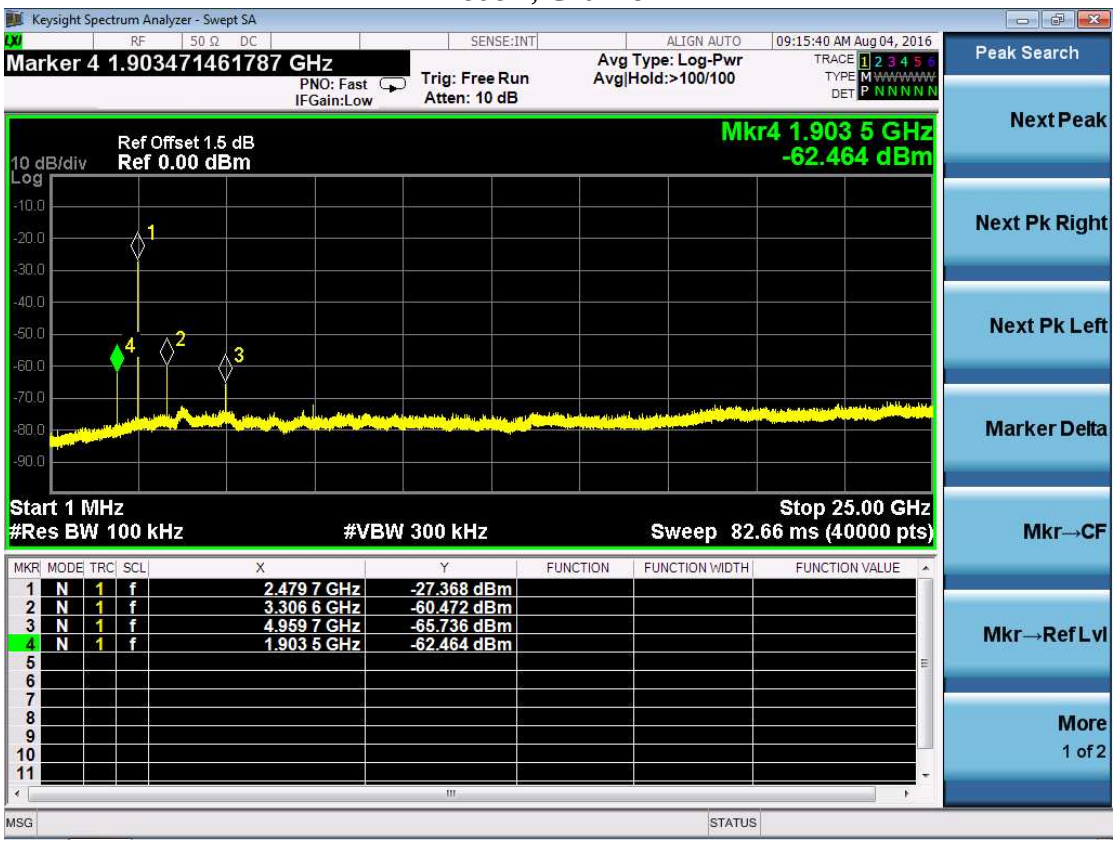


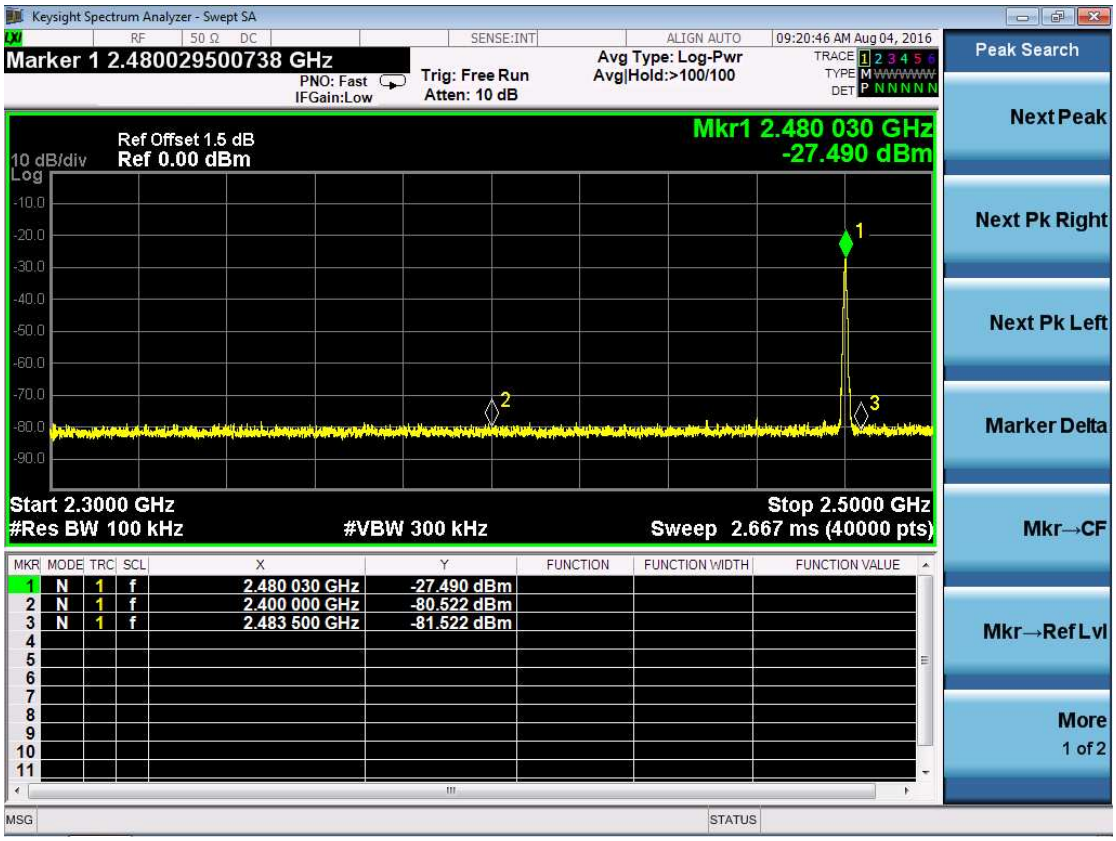



Mode 1, Channel M

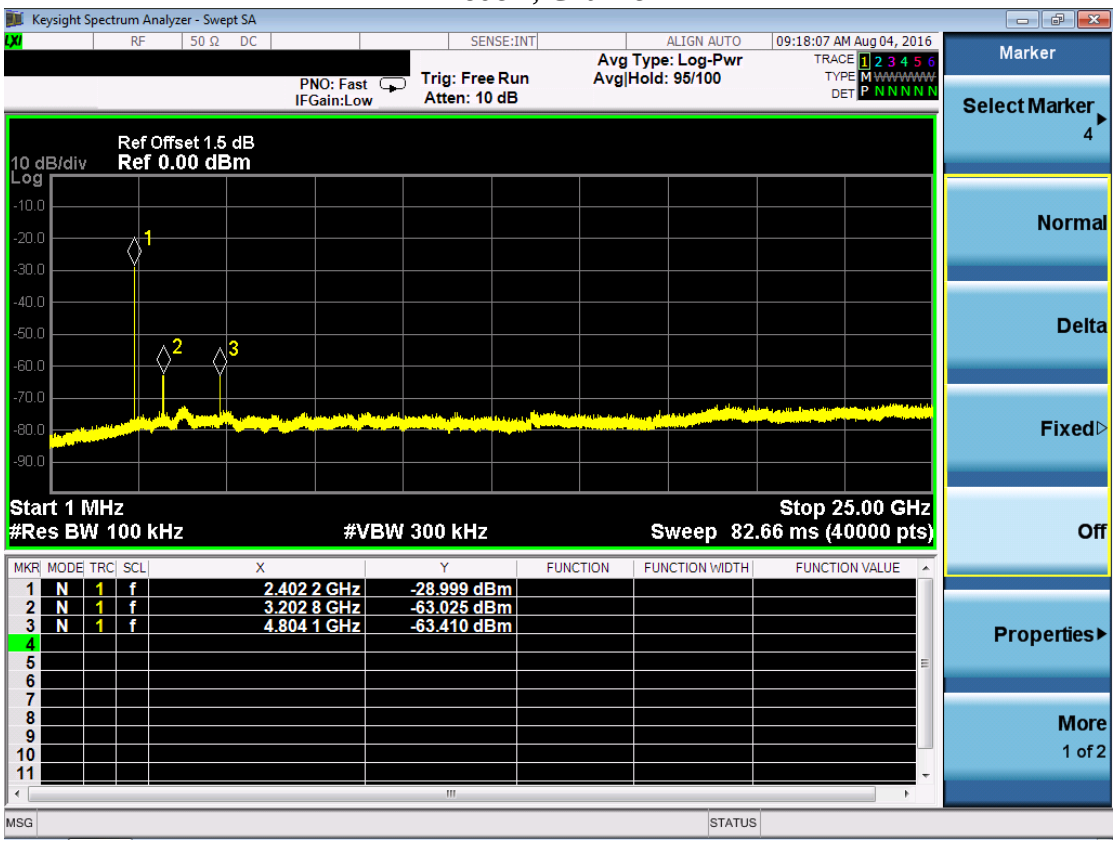


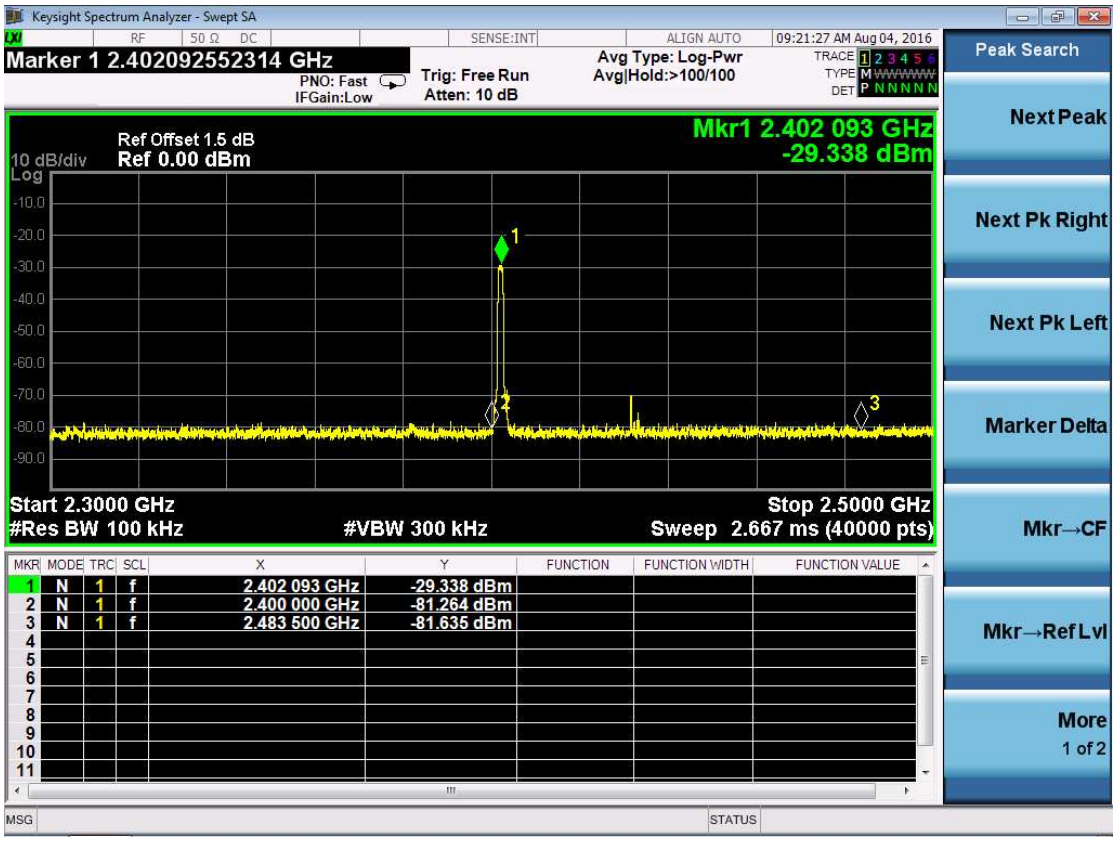

Mode 1, Channel H



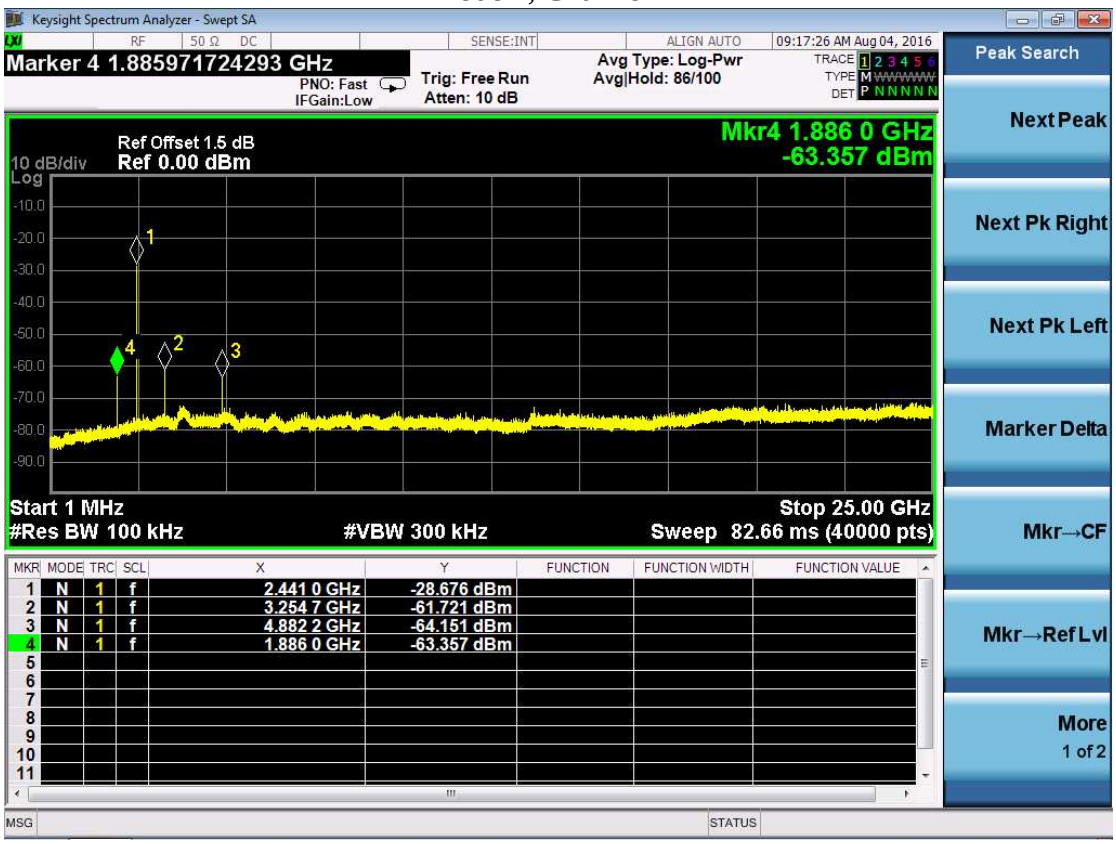



Mode 2, Channel L

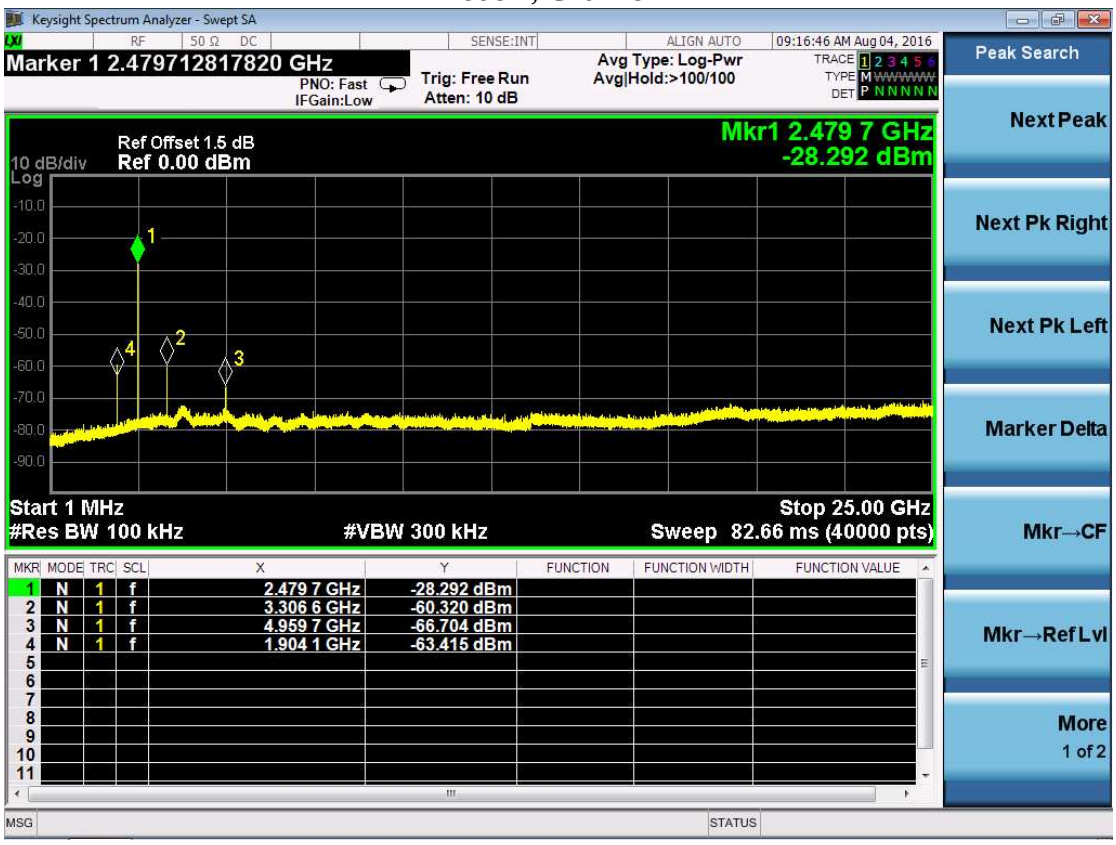


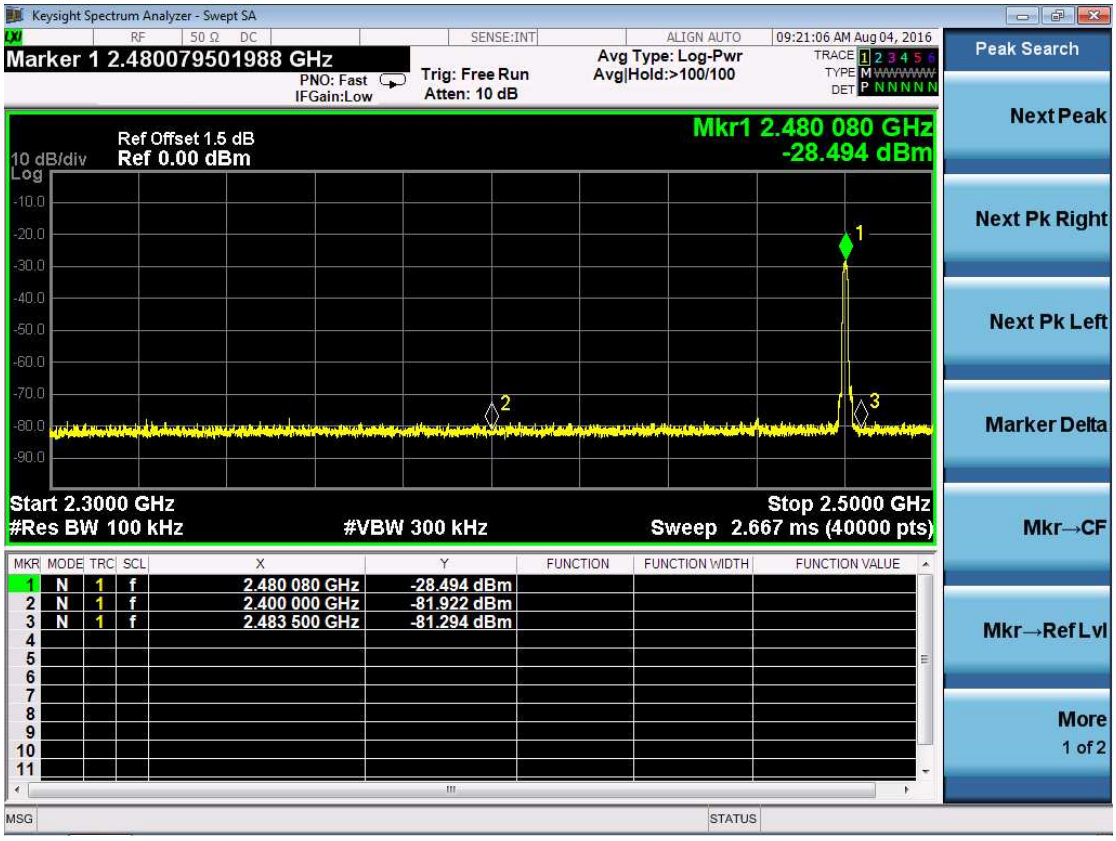



Mode 2, Channel M

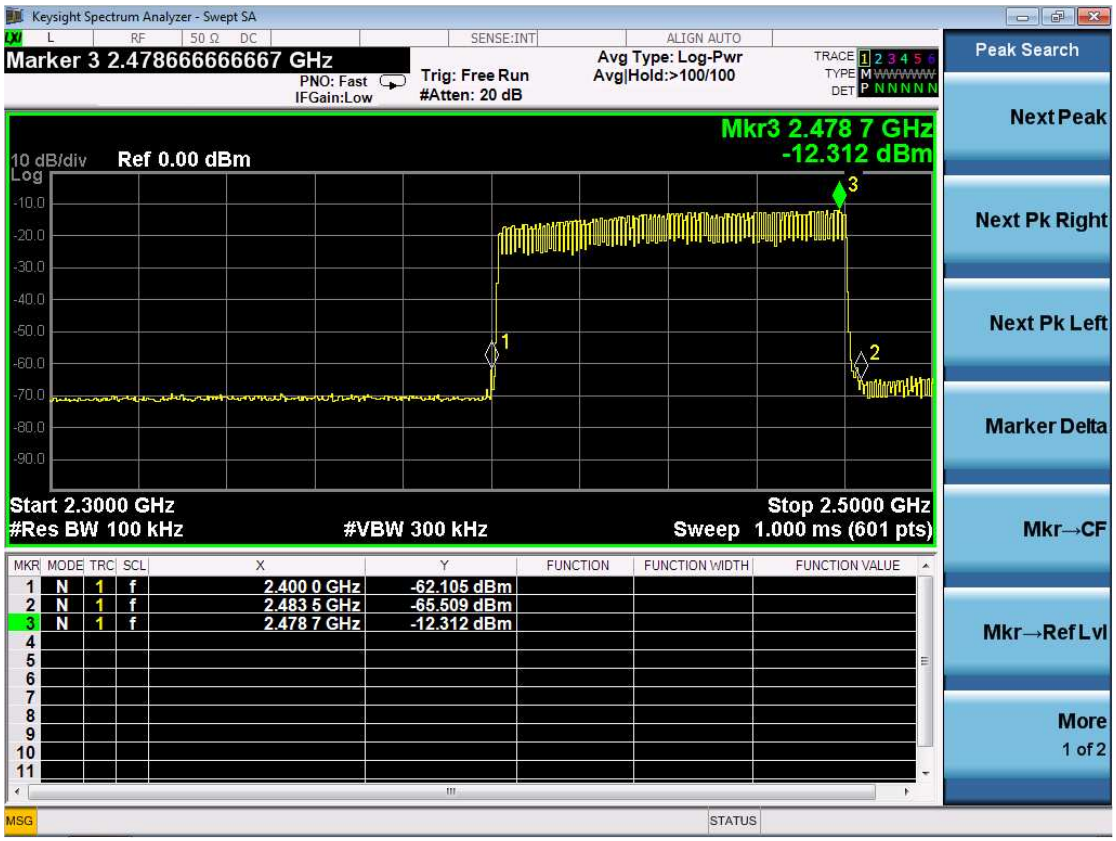


Mode 2, Channel H

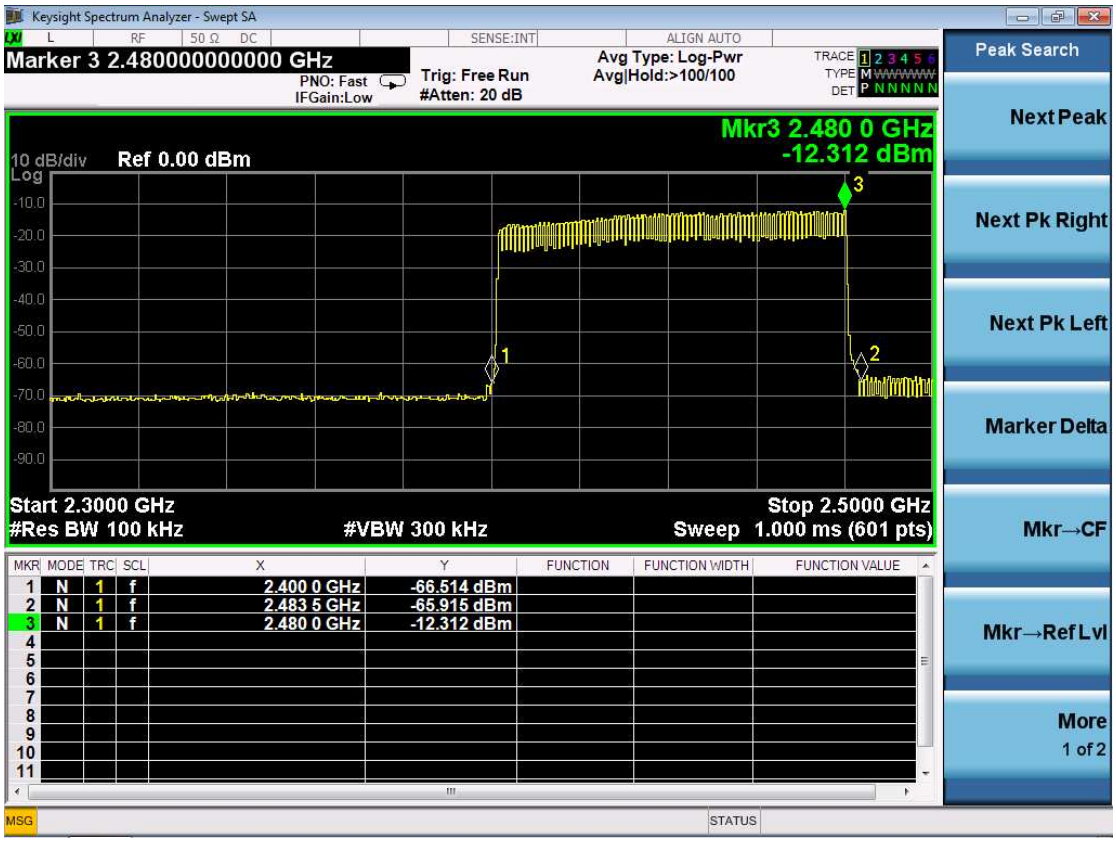


Mode 3


Keysight Spectrum Analyzer - Swept SA
Marker 3 2.478666666667 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
Mkr3 2.478 7 GHz
-12.312 dBm
10 dB/div
Log
Ref 0.00 dBm
Start 2.3000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.5000 GHz
Sweep 1.000 ms (601 pts)
1 N 1 f 2.400 0 GHz -62.105 dBm
2 N 1 f 2.483 5 GHz -65.509 dBm
3 N 1 f 2.478 7 GHz -12.312 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

Mode 4


Keysight Spectrum Analyzer - Swept SA
Marker 3 2.480000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
Mkr3 2.480 0 GHz
-12.312 dBm
10 dB/div
Log
Ref 0.00 dBm
Start 2.3000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.5000 GHz
Sweep 1.000 ms (601 pts)
1 N 1 f 2.400 0 GHz -66.514 dBm
2 N 1 f 2.483 5 GHz -65.915 dBm
3 N 1 f 2.480 0 GHz -12.312 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

## 7.5 Measurement uncertainty

Measurement uncertainty: ± 0.74dB
The measurement uncertainty is given with a confidence of 95%, k=2.

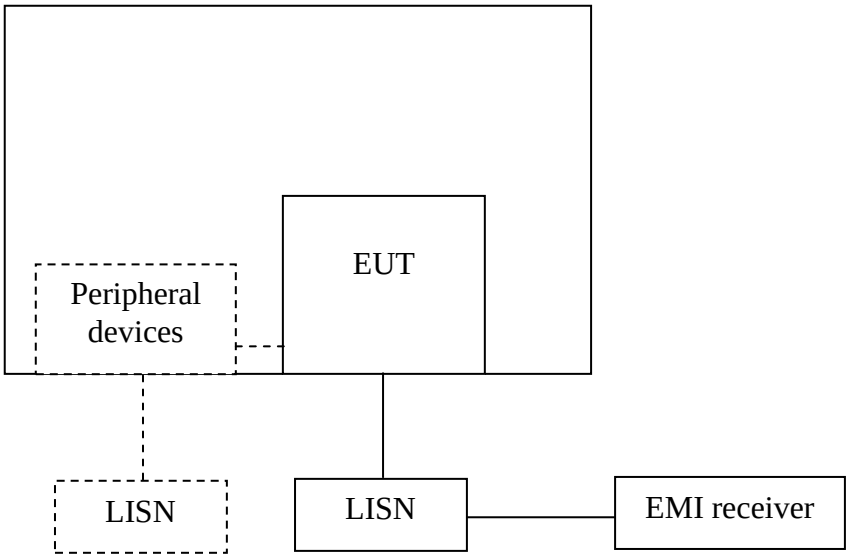
# 8. Power line conducted emission

**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



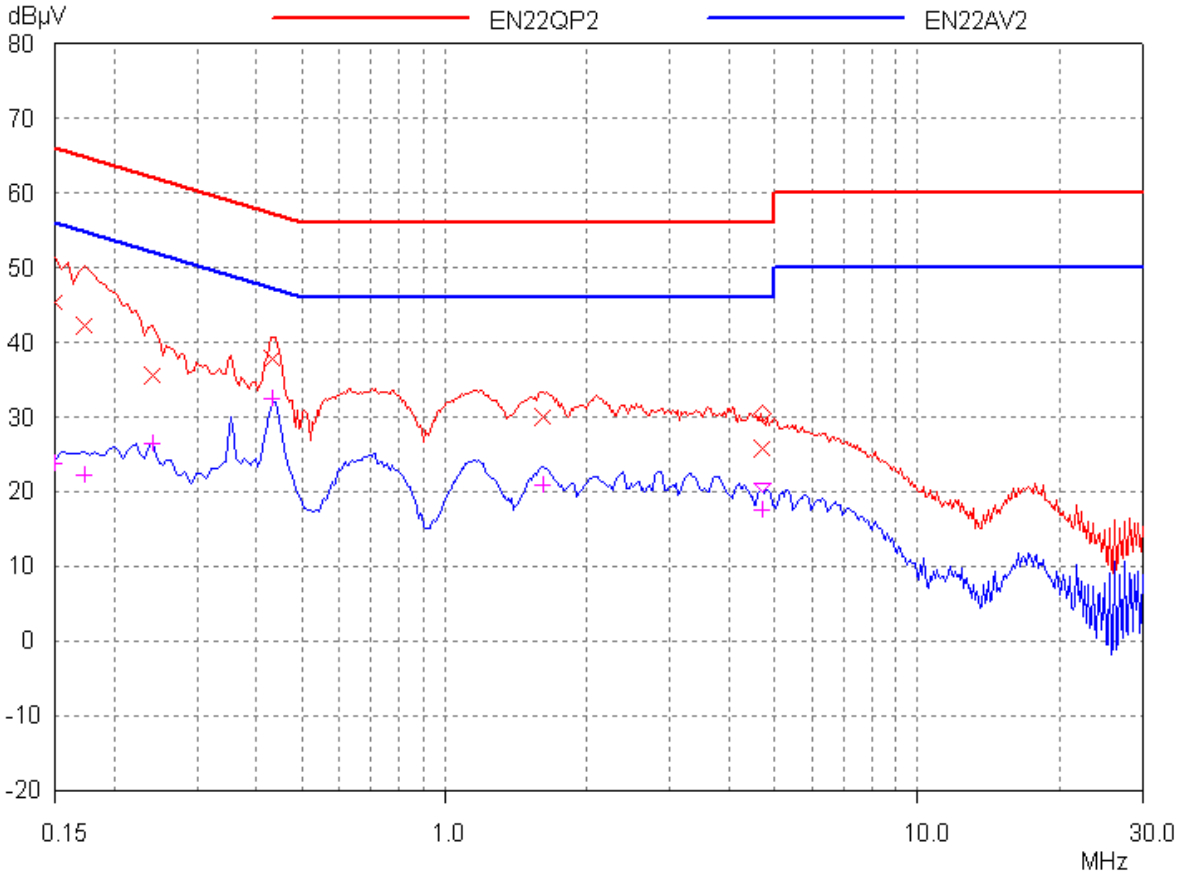

☒ For table top equipment, wooden support is 0.8m height table

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

## 8.4 Test protocol




| Frequency | Correct Factor (dB) | Corrected Reading (dBuV) | | Limit (dBuV) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|
| | | QP | AV | QP | AV | QP | AV |
| 0.15 (N) | 3.00 | 45.36 | 23.75 | 66.00 | 56.00 | 20.64 | 32.25 |
| 0.17 (L) | 3.00 | 42.13 | 22.21 | 64.84 | 54.84 | 22.71 | 32.63 |
| 0.24 (N) | 3.00 | 35.47 | 26.34 | 62.10 | 52.10 | 26.63 | 25.76 |
| 0.43 (N) | 3.00 | 37.89 | 32.52 | 57.19 | 47.19 | 19.30 | 14.67 |
| 1.61 (N) | 3.00 | 30.01 | 20.92 | 56.00 | 46.00 | 25.99 | 25.08 |
| 4.67 (L) | 3.00 | 25.73 | 17.50 | 56.00 | 46.00 | 30.27 | 28.50 |
| Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB).<br>2. Margin (dB) = Limit - Corrected Reading. | | | | | | | |

## 8.5 Measurement uncertainty

Measurement uncertainty: ± 3.19dB
The measurement uncertainty is given with a confidence of 95%, k=2.

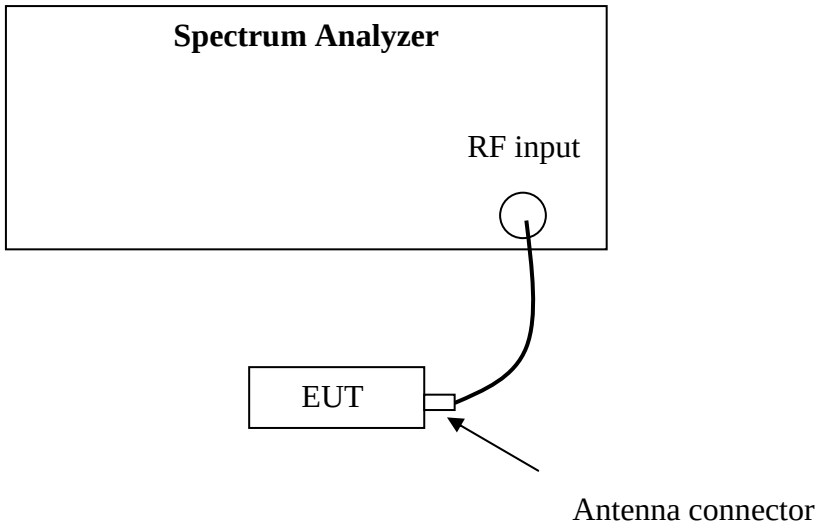
# 9. Number of Hopping Frequencies

**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

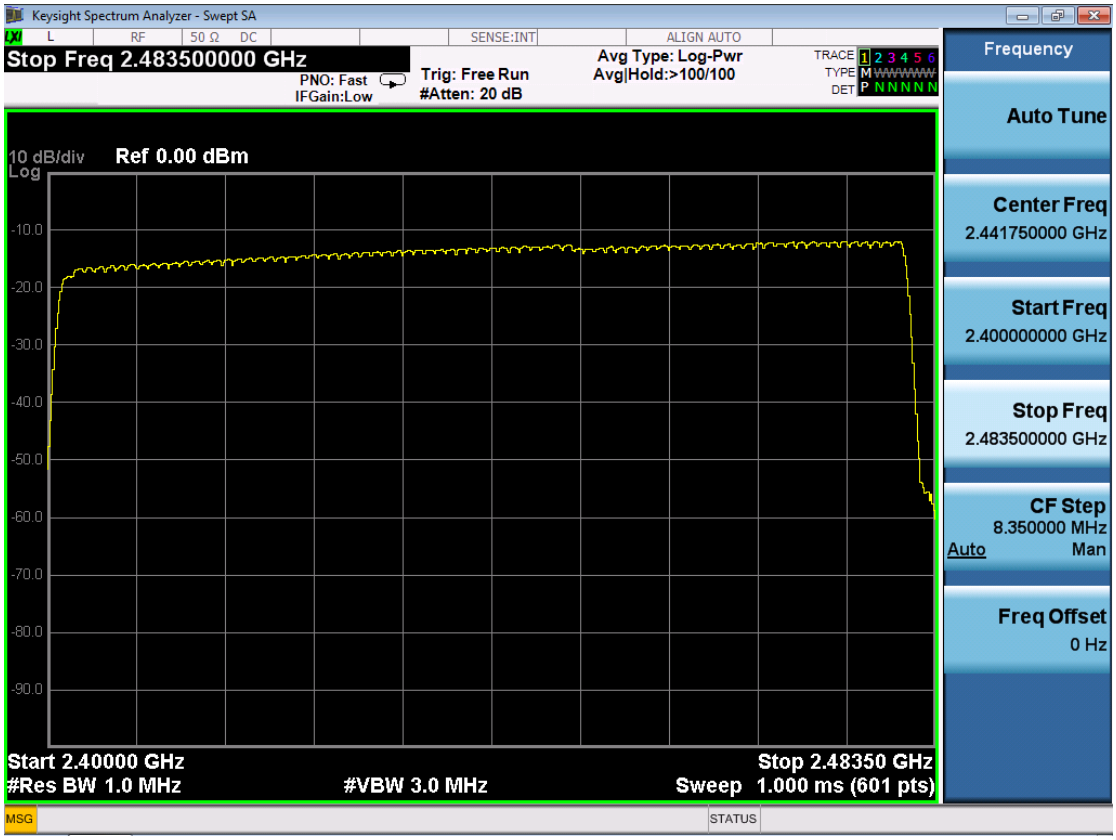



## 9.3 Test procedure and test setup

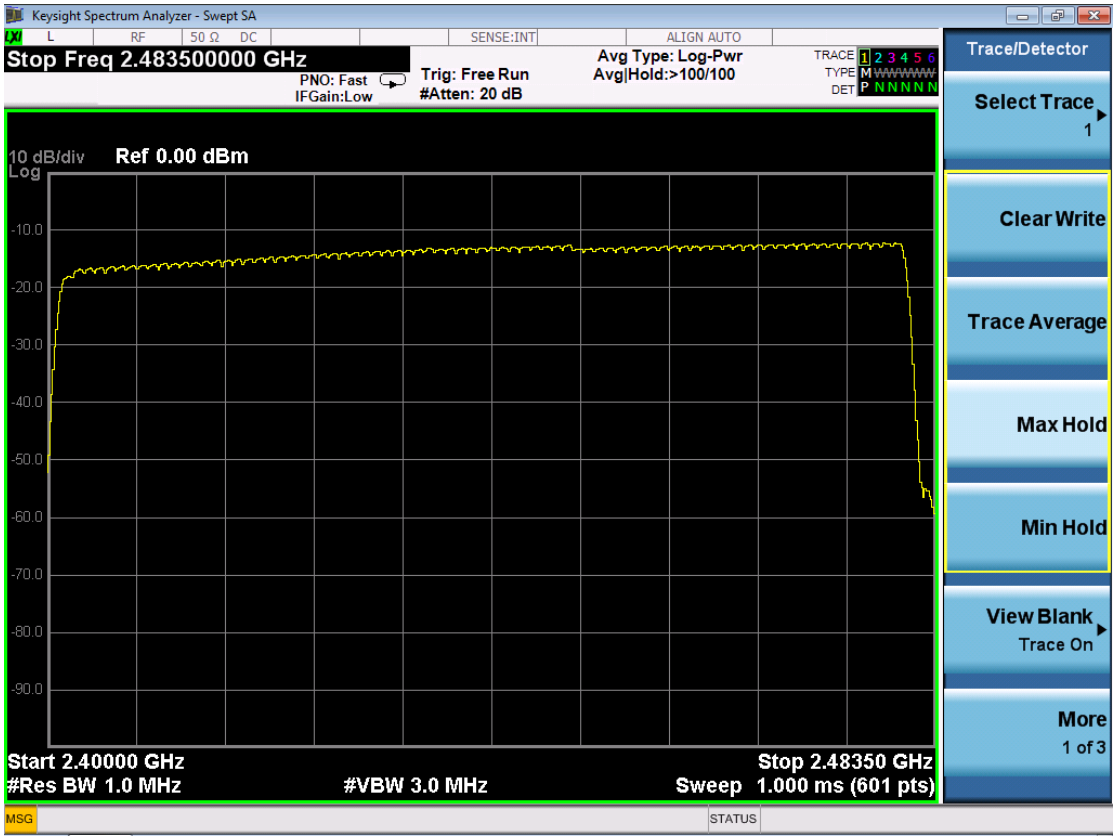
The channel number per FCC §15.247(a)(1)(iii) is measured using the Spectrum Analyzer with RBW=1MHz, VBW≥RBW, Sweep = auto, Detector = peak, Trace = max hold.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

## 9.4 Test protocol

| Mode | Channel Number | Limit |
|---|---|---|
| 3 | 79 | ≥15 |



| Mode | Channel Number | Limit |
|---|---|---|
| 4 | 79 | ≥15 |




## 9.5 Measurement uncertainty

Measurement uncertainty: ± 3%
The measurement uncertainty is given with a confidence of 95%, k=2.

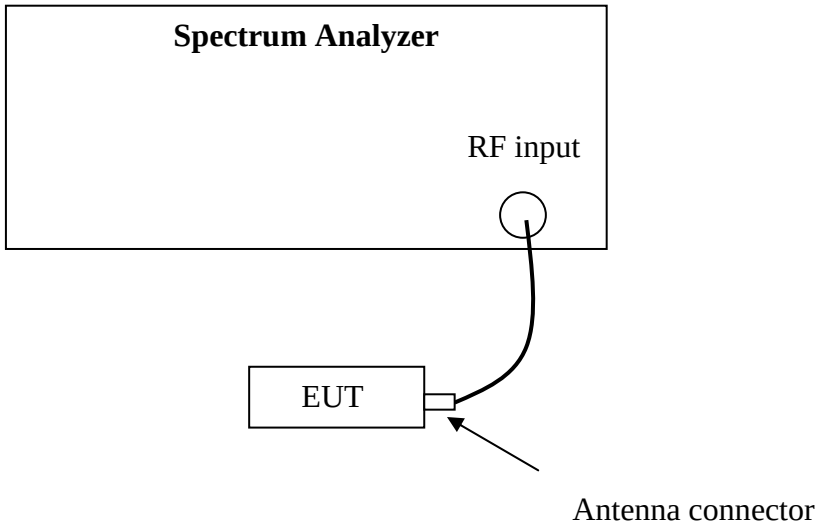
# 10. Dwell Time

**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

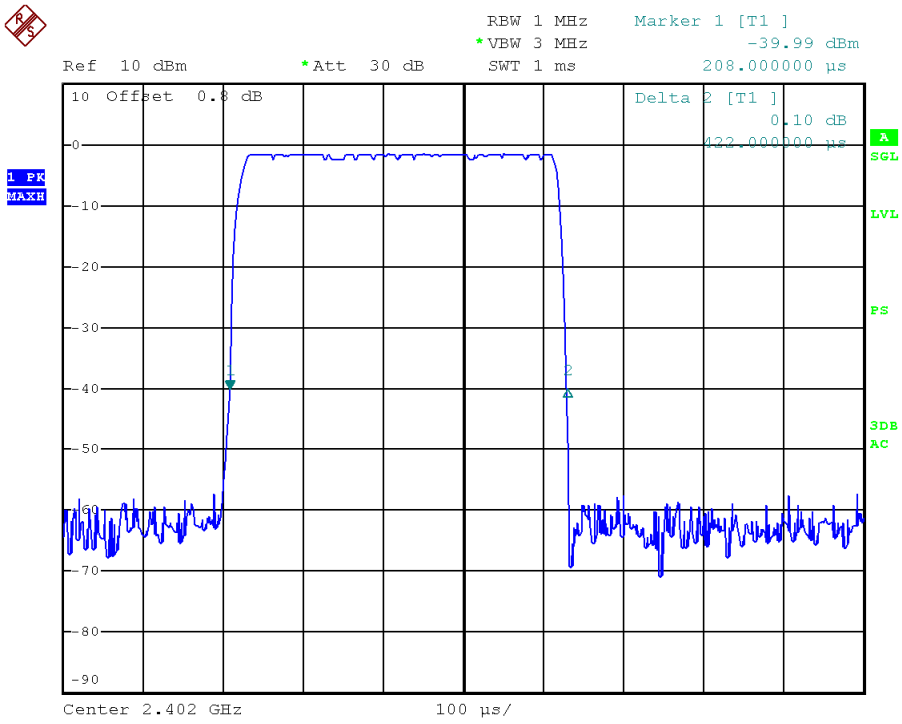
Dwell time per FCC § 15.247(a)(1)(iii) is measured using the Spectrum Analyzer with Span = 0, RBW=1MHz, VBW≥RBW, Sweep can capture the entire dwell time, Detector = peak, Trace = max hold.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum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

**10.4 Test protocol**

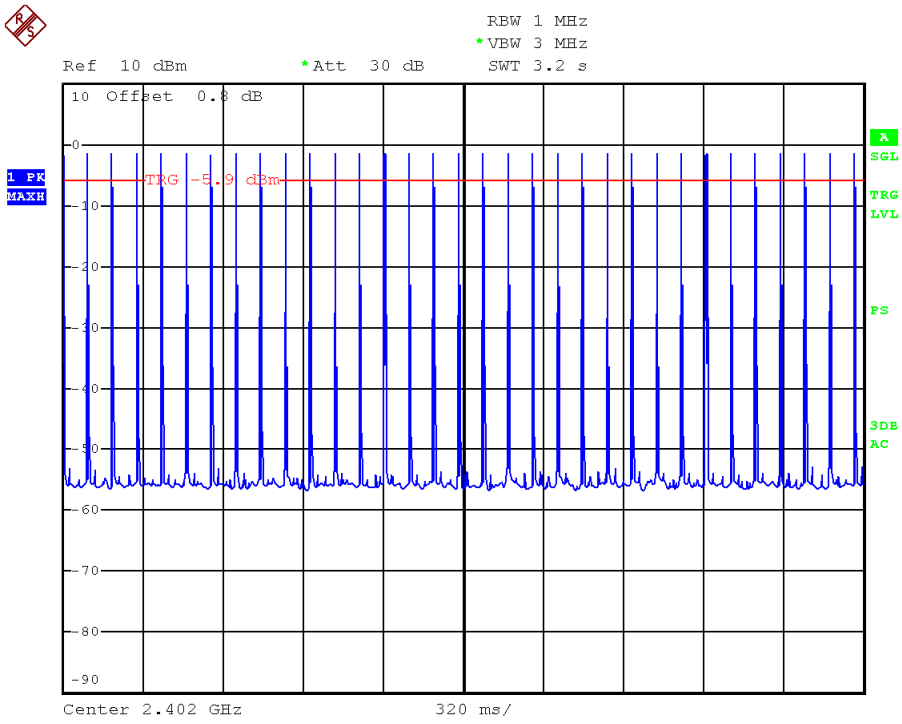
| Packet | Occupancy time for single hop (ms) **O** | CH | Real observed period (s) **P** | Hops among Observed period **I** | Dwell time (s) **T** | Limit (s) |
|---|---|---|---|---|---|---|
| 3DH1 | 0.422 | L | 3.16 | 33 | 0.14 | ≤0.4 |
| | | M | 3.16 | 33 | 0.14 | |
| | | H | 3.16 | 33 | 0.14 | |
| 3DH3 | 1.688 | L | 3.16 | 17 | 0.29 | |
| | | M | 3.16 | 17 | 0.29 | |
| | | H | 3.16 | 17 | 0.29 | |
| 3DH5 | 2.924 | L | 3.16 | 11 | 0.32 | |
| | | M | 3.16 | 11 | 0.32 | |
| | | H | 3.16 | 11 | 0.32 | |

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**

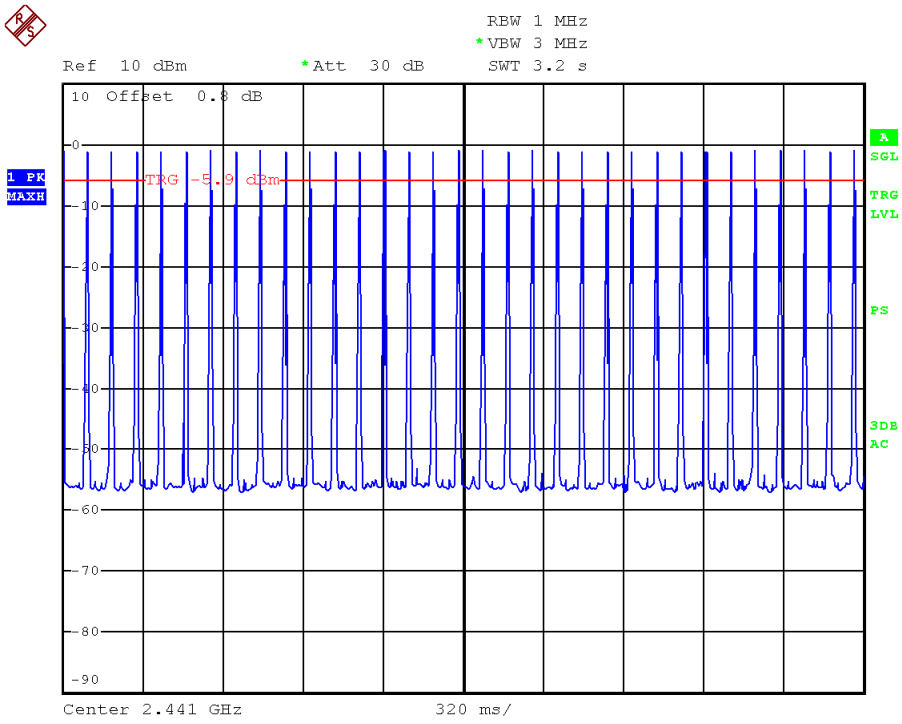
3DH1



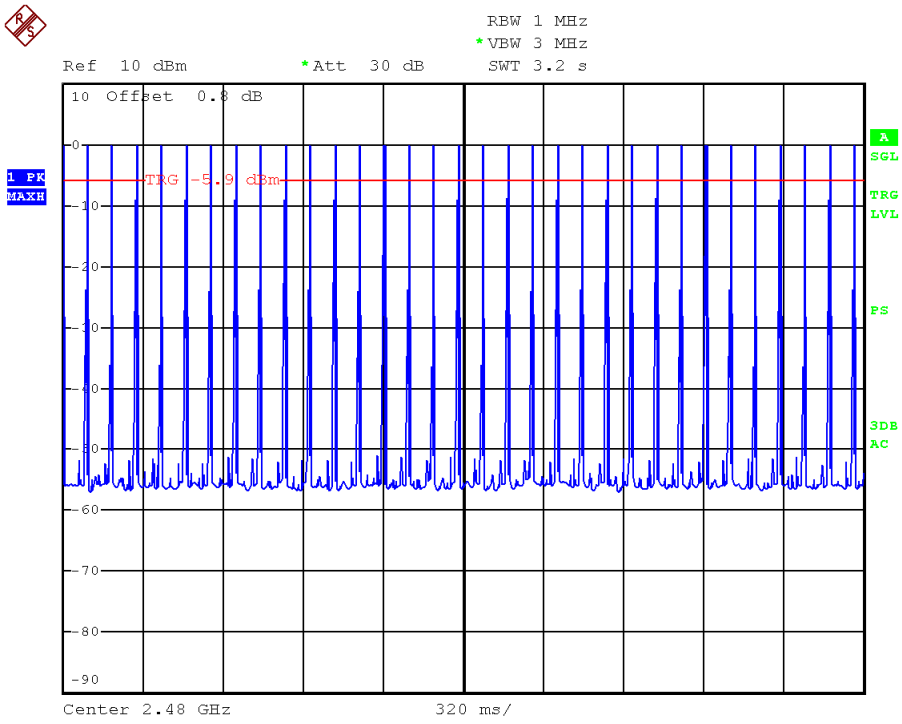

Channel L



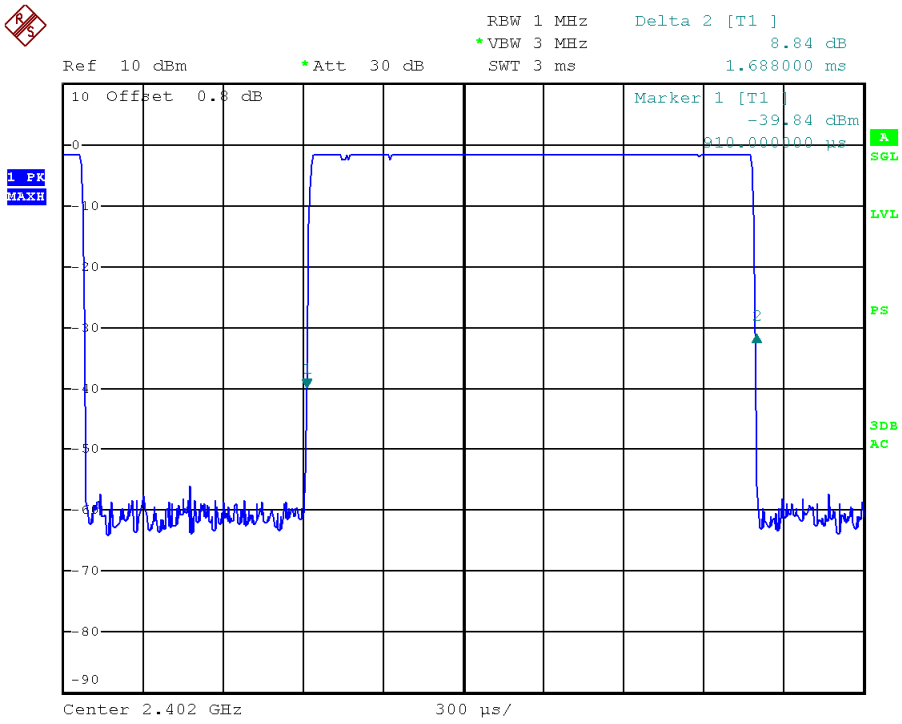
## Channel M



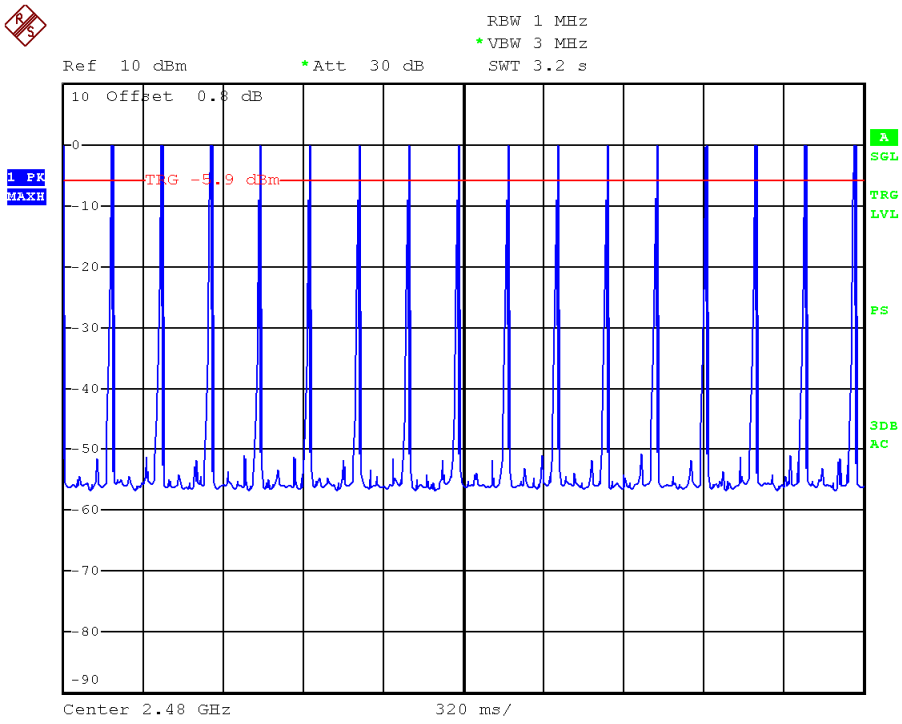

## Channel H



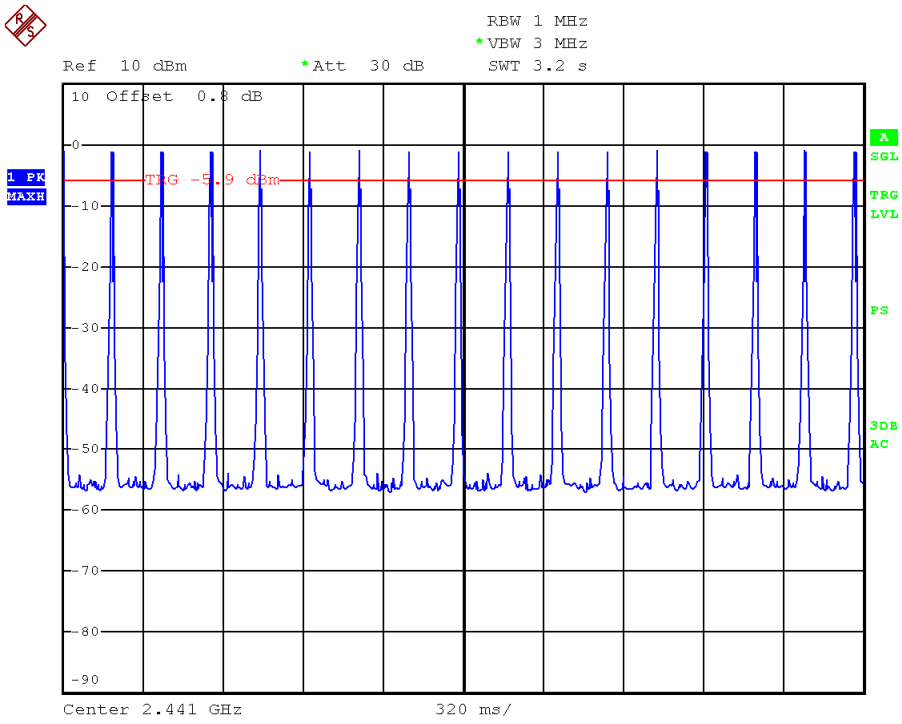
3DH3



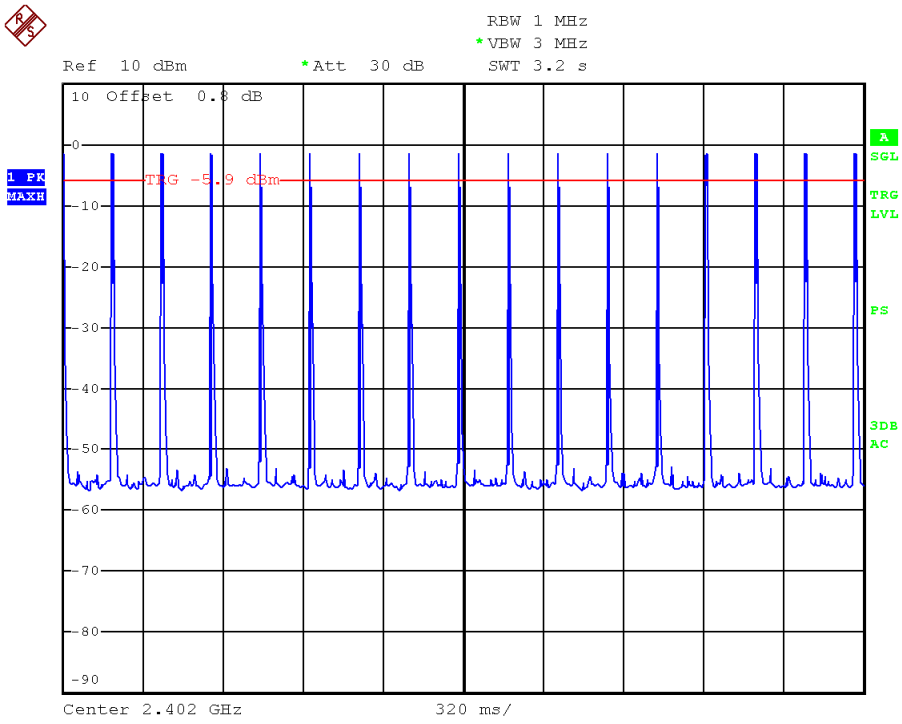

Channel L



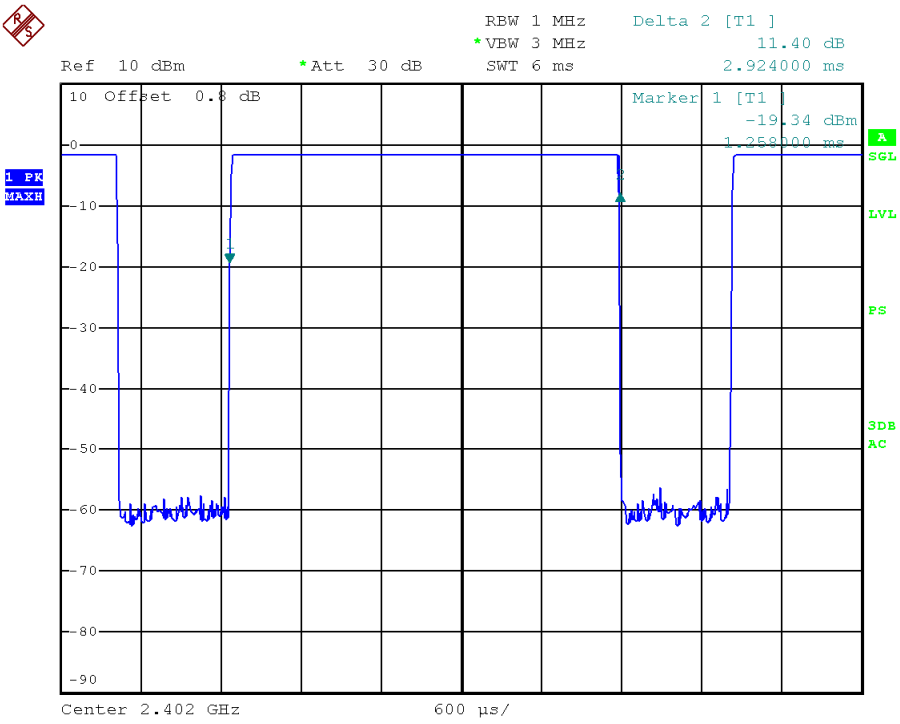
## Channel M



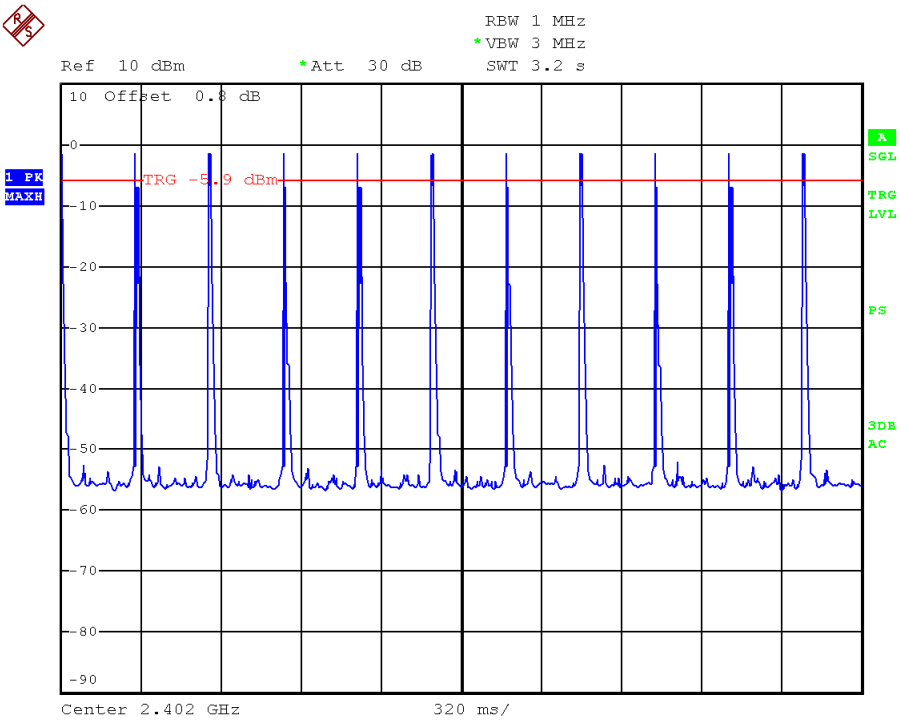

## Channel H



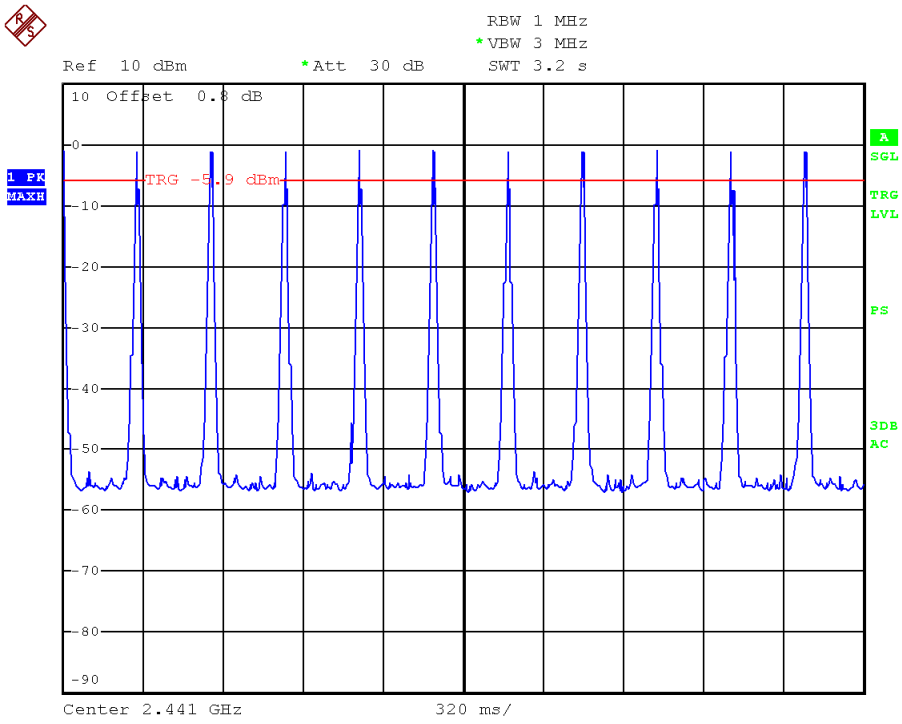
3DH5



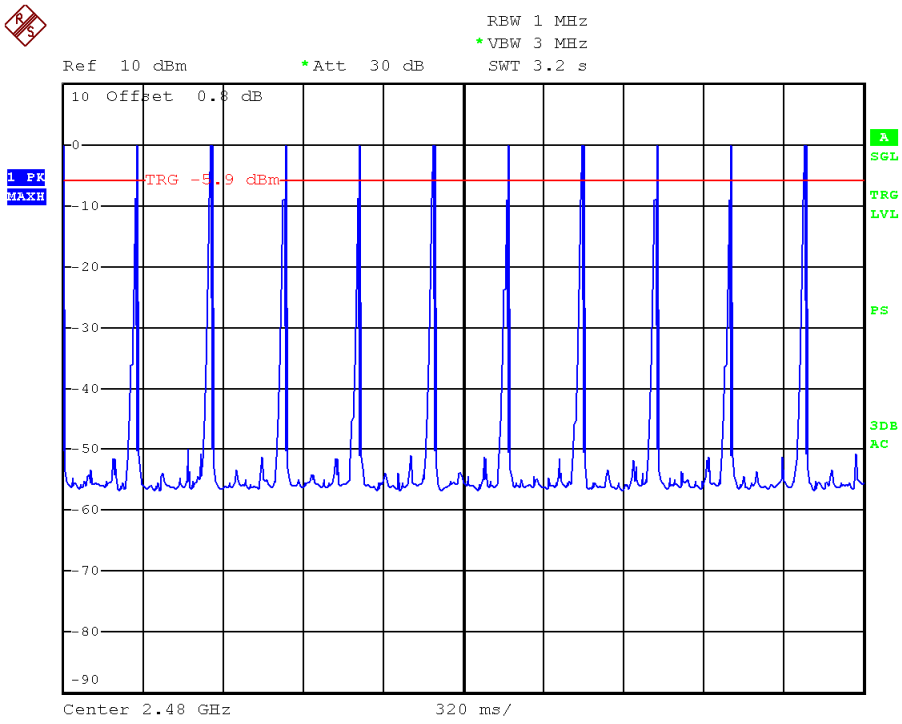

Channel L



## Channel M




## Channel H



**10.5 Measurement uncertainty**

Measurement uncertainty: ± 3%
The measurement uncertainty is given with a confidence of 95%, k=2.