RF TEST REPORT for Intentional Radiator
No. 170500717SHA-001

Applicant	:	Dimplex North America Limited.
		1367 Industrial Road, Cambridge, Ontario, Canada
Manufacturer	:	Dimplex North America Limited.
		1367 Industrial Road, Cambridge, Ontario, Canada
Product Name	:	Bluetooth Speaker
Type/Model	:	3800060100
TEST RESULT	**:**	**PASS**

SUMMARY

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

47CFR Part 15 (2016): Radio Frequency Devices

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

RSS-247 Issue 2 (February 2017): 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 for Compliance of Radio Apparatus

Date of issue: Jul 22, 2017

Prepared by: Reviewed by:

Teddy Yin (*Project Engineer*)   Daniel Zhao (*Reviewer*)

Description of Test Facility

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

FCC Registration Number: 236597
IC Assigned Code: 2042B-1

Name of contact: Jonny Jing
Tel: +86 21 64956565 ext. 271
Fax: +86 21 54262335 ext. 271

Content

1. General Information

1.1 Applicant Information

Applicant	:	Dimplex North America Limited.
		1367 Industrial Road, Cambridge, Ontario, Canada
Name of contact	:	Nathan Hingston
Tel	:	519.650.3630 x475
Fax	:	
Manufacturer	:	Dimplex North America Limited.
		1367 Industrial Road, Cambridge, Ontario, Canada

1.2 Identification of the EUT

Equipment	:	Bluetooth Speaker
Type/model	:	3800060100
FCC ID	:	Z49-00009
IC	:	6592A-00009
Description of EUT	:	The EUT is a speaker which supports BT4.2 (only support BR+EDR function), and it has only one model. We tested it and listed the BT Base Rate and EDR results in this report.
Rating	:	DC 3.7-5V, MAX 600mA
Category of EUT	:	Class B
EUT type	:	☒ Table top☐ Floor standing
Sample received date	:	May 10, 2017
Sample Identification No	:	*0170510-19-001*
Date of test	:	Jun 8, 2017

1.3 Technical specification

Operation Frequency Band:	2402 - 2480 MHz
Protocol:	BT 4.2 (BR+EDR)
Modulation:	GFSK, π/4 DQPSK, 8DPSK

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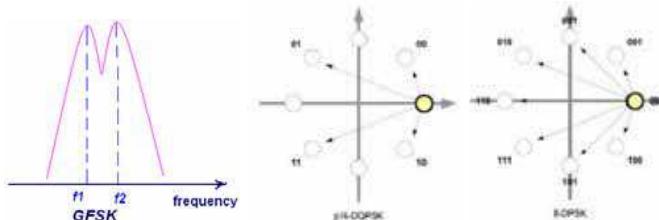
GFSK is different from π/4DQPSK and 8DPSK. 8DPSK is similar with π/4DQPSK but more complex, and with a bigger data rate. So all the tests except output power, occupied bandwidth, dwell time and number of hopping frequencies were performed with GFSK modulation and 8DPSK modulation for representative.

Antenna Designation:	PCB antenna
Gain of Antenna:	0dBi
Channel Description:	There are 79 channels in all. The designed channel spacing is 1MHz.

Channel Identifier	Frequency (MHz)
low	2402
middle	2442
high	2480

Antenna Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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.

The test setting software is offered by the manufactory. The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

Radiated test mode:
Mode 1: EUT transmitted signal with BT antenna;

Conducted test mode:
Mode 2: EUT transmitted signal from BT RF port connected to SPA directly;

The worst case modulation configuration:

Worst Modulation Used for Conformance Testing			
Bluetooth Mode	**Data Rate**	**Packet Type**	**Worst Mode**
GFSK	BR-1Mbps	DH1,DH3,DH5	BR-1Mbps DH5 EDR-2Mbps 2DH5 EDR-3Mbps 3DH5
π /4 DQPSK	EDR-2Mbps	2DH1,2DH3,2DH5	
8DPSK	EDR-3Mbps	3DH1,3DH3,3DH5	
Note: The BR-1Mbps 3DH5 mode was chosen for radiation emission bellow 1GHz and Conducted emission testing as representative in this report.			

Test Peripherals:

Equipment	Brand Name	Model	Note
Notebook	HP	6470b	
Note: The accessories are used for configuration only and not used during test.			

2. Test Specification

2.1 Instrument list

Selected	Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
☒	PXA Analyzer	N9030A	Agilent	EC5338	2017/3/4	2018/3/3
☒	Vector SG	N5182B	Agilent	EC5175	2017/3/4	2018/3/3
☒	Power sensor	U2021XA	Agilent	EC5338-1	2017/3/4	2018/3/3
☒	MXG Analog SG	N5181A	Agilent	EC5338-2	2017/3/4	2018/3/3
☒	Power meter	N1911A/N1921A	Agilent	EC4318	2017/4/10	2018/4/9
☒	EMI Receiver	ESCS 30	R&S	EC 2107	2016/10/20	2017/10/19
☒	A.M.N.	ESH2-Z5	R&S	EC 3119	2016/12/16	2017/12/15
☒	I.S.N.	FCC-TLISN-T8-02	FCC	EC3756	2017/2/16	2018/2/15
☒	EMI chamber	3m	Albatross	EC 3048	2017/5/5	2018/5/4
☒	Test Receiver	ESIB 26	R&S	EC 3045	2016/10/20	2017/10/19
☒	Test Receiver	ESCI 7	R&S	EC4501	2017/2/24	2018/2/23
☒	Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2017/5/30	2018/5/29
☒	Horn antenna	HF 906	R&S	EC 3049	2016/9/11	2017/9/10
☒	Horn antenna	HAP18-26W	TOYO	EC 4792-3	2014/6/12	2017/6/11
☒	Pre-amplifier	Pre-amp 18	R&S	EC 5262	2017/5/24	2018/5/23
☒	Pre-amplifier	Tpa0118-40	R&S	EC 4792-2	2017/4/11	2018/4/10
☒	Shielded room	-	Zhongyu	EC 2838	2017/1/9	2018/1/8

2.2 Test Standard

47CFR Part 15 (2016)
ANSI C63.10 (2013)
DA 00-705
RSS-247 Issue 2 (February 2017)
RSS-Gen Issue 4 (November 2014)

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-247 Issue 2 Clause 5	Tested
Carrier Frequency Separation	15.247(a)(1)	RSS-247 Issue 2 Clause 5	Pass
Output power	15.247(b)(1)	RSS-247 Issue 2 Clause 5	Pass
Radiated Spurious Emissions	15.205 & 15.209	RSS-247 Issue 2 Clause 5	Pass
Conducted Spurious Emissions & Band Edge	15.247(d)	RSS-247 Issue 2 Clause 5	Pass
Power line conducted emission	15.207	RSS-Gen Issue 4 Clause 8.8	NA
Number of Hopping Frequencies	15.247(a)(1)(iii)	RSS-247 Issue 2 Clause 5	Pass
Dwell time	15.247(a)(1)(iii)	RSS-247 Issue 2 Clause 5	Pass
Occupied bandwidth	-	RSS-Gen Issue 4 Clause 6.6	Tested

Notes: 1: NA =Not Applicable

2: This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

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)
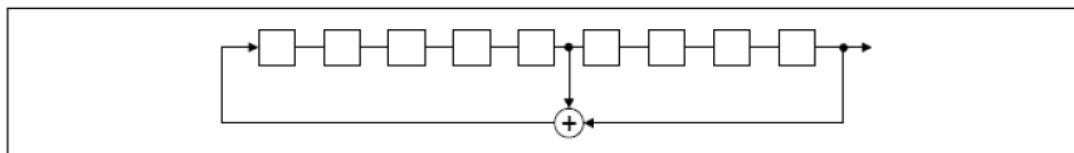
Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:
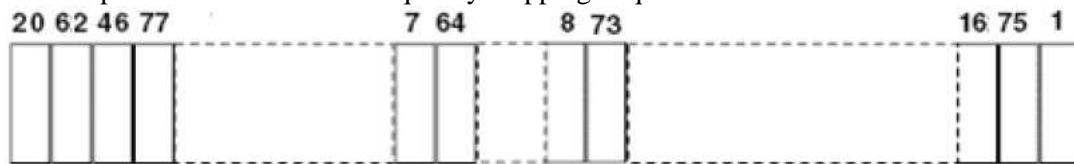
Each frequency used equally on the average by each transmitter.
According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted 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
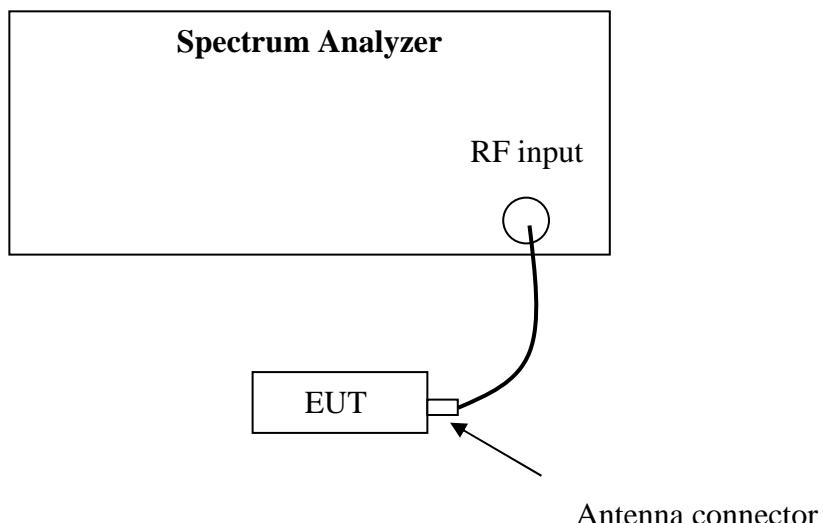
3.3 Test Procedure and test setup

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	1260	840
	M	1248	832
	H	1254	836

Channel L

Date: 1.JUN.2017 12:41:58

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Channel M

```
                              *RBW 100 kHz    Marker 1 [T1 ]
                              *VBW 300 kHz              -6.09 dBm
     Ref   0 dBm      *Att  30 dB    SWT 2.5 ms    2.441910000 GHz
     0                                       ndB [T1]   20.00 dB
                                      1       BW   1.248000000 MHz
    -10                                      Temp 1 [T1 ndB]
                                                         -26.06 dBm
    -20                                           T2    2.441442000 GHz
                                                 Temp 2 [T1 ndB]
                          T1                              -25.60 dBm
    -30                                                2.442690000 GHz

    -40
                                                          PS
    -50

    -60                                                  3DB
                                                         AC
    -70

    -80

    -90

    -100
     Center 2.442 GHz           300 kHz/           Span 3 MHz
```
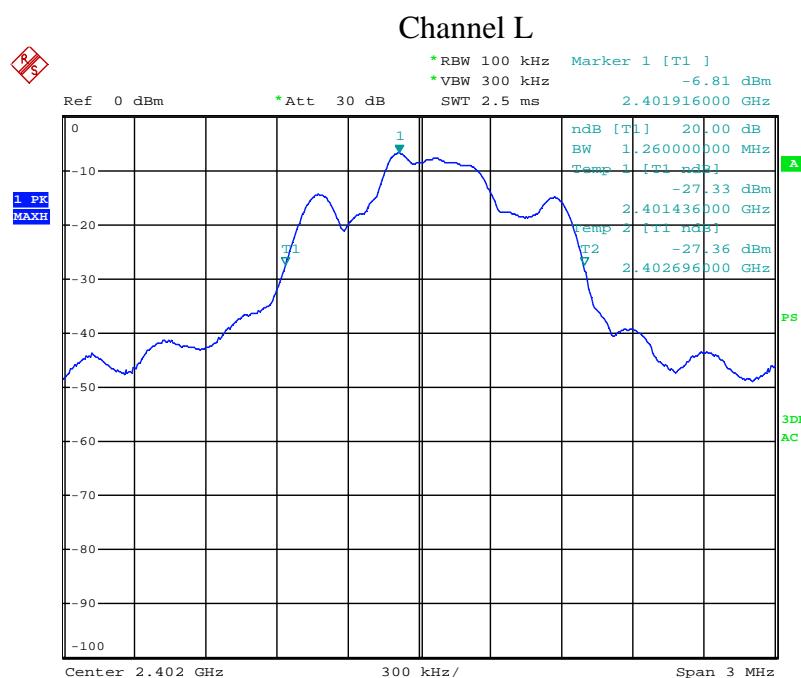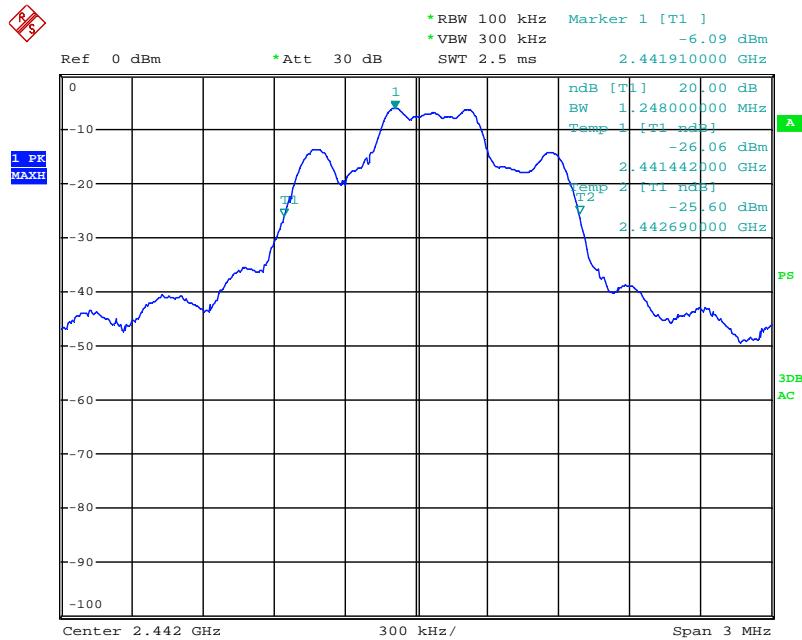
Date: 1.JUN.2017 12:46:07

Channel H
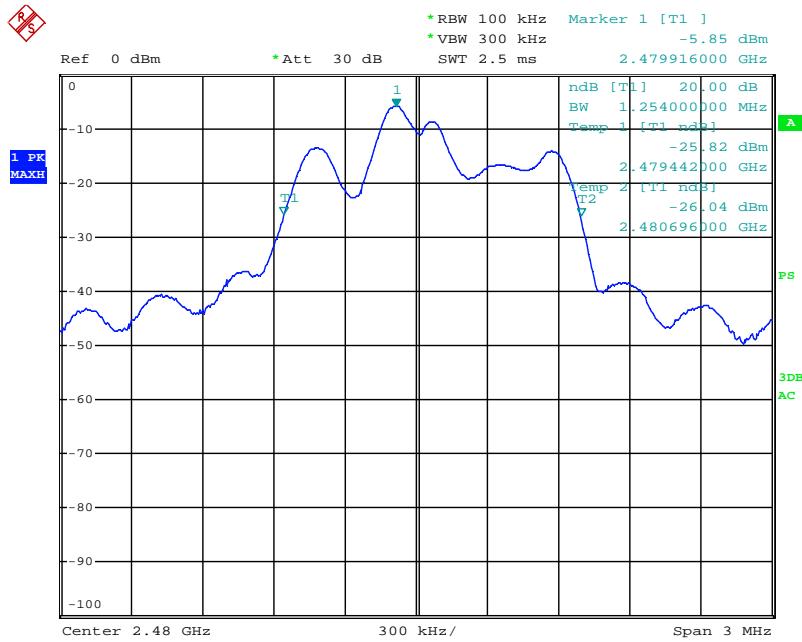
```
                              *RBW 100 kHz    Marker 1 [T1 ]
                              *VBW 300 kHz              -5.85 dBm
     Ref   0 dBm      *Att  30 dB    SWT 2.5 ms    2.479916000 GHz
     0                                       ndB [T1]   20.00 dB
                                      1       BW   1.254000000 MHz
    -10                                      Temp 1 [T1 ndB]
                                                         -25.82 dBm
    -20                                           T2    2.479442000 GHz
                                                 Temp 2 [T1 ndB]
                          T1                              -26.04 dBm
    -30                                                2.480696000 GHz

    -40
                                                          PS
    -50

    -60                                                  3DB
                                                         AC
    -70

    -80

    -90

    -100
     Center 2.48 GHz            300 kHz/           Span 3 MHz
```

Date: 1.JUN.2017 12:48:48

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Modulation	CH	Bandwidth (kHz)	Two-thirds of Bandwidth (kHz)
π /4 DQPSK	L	1326	884
	M	1338	892
	H	1326	884

Channel L

Date: 1.JUN.2017 12:52:20

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intertek
Total Quality. Assured.

Channel M

```
                              *RBW 100 kHz    Marker 1 [T1 ]
                              *VBW 300 kHz                    -6.12 dBm
    Ref   0 dBm      *Att  30 dB     SWT 2.5 ms        2.441910000 GHz
```

```
  0                          1                  ndB [T1]    20.00 dB
                                                BW   1.338000000 MHz
 -10                                            Temp 1 [T1 ndB]
                                                          -26.40 dBm
 -20                                                2.441394000 GHz
                                                Temp 2 [T1 ndB]
 -30                                                      -26.15 dBm
                                                    2.442732000 GHz

 -40
                                                              PS
 -50
 -60                                                          3DB
                                                              AC
 -70

 -80

 -90

-100
    Center 2.442 GHz        300 kHz/            Span 3 MHz
```

```
1 PK
MAXH
```

```
A
```
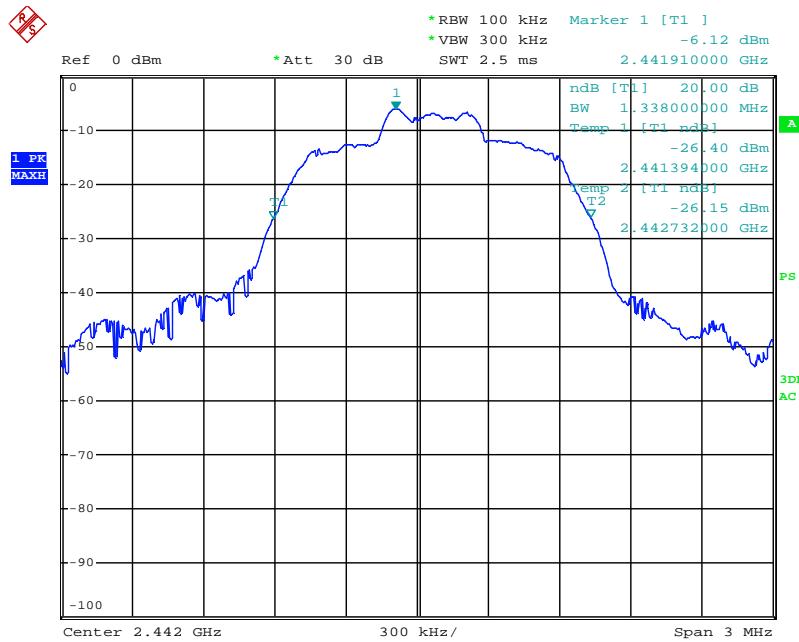
Date: 1.JUN.2017 12:54:26

Channel H

```
                              *RBW 100 kHz    Marker 1 [T1 ]
                              *VBW 300 kHz                    -5.84 dBm
    Ref   0 dBm      *Att  30 dB     SWT 2.5 ms        2.479916000 GHz
```

```
  0                          1                  ndB [T1]    20.00 dB
                                                BW   1.326000000 MHz
 -10                                            Temp 1 [T1 ndB]
                                                          -25.80 dBm
 -20                                                2.479400000 GHz
                                                Temp 2 [T1 ndB]
 -30                                                      -25.82 dBm
                                                    2.480726000 GHz

 -40
                                                              PS
 -50
 -60                                                          3DB
                                                              AC
 -70

 -80

 -90

-100
    Center 2.48 GHz        300 kHz/            Span 3 MHz
```

```
1 PK
MAXH
```

```
A
```

Date: 1.JUN.2017 12:55:47

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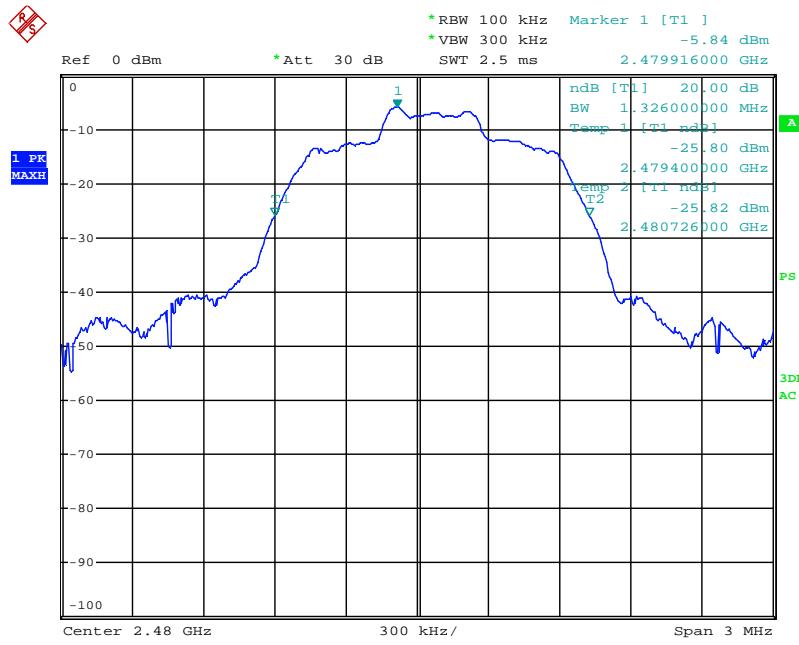
Modulation	CH	Bandwidth (kHz)	Two-thirds of Bandwidth (kHz)
8DPSK	L	1332	888
	M	1332	888
	H	1338	892

Channel L
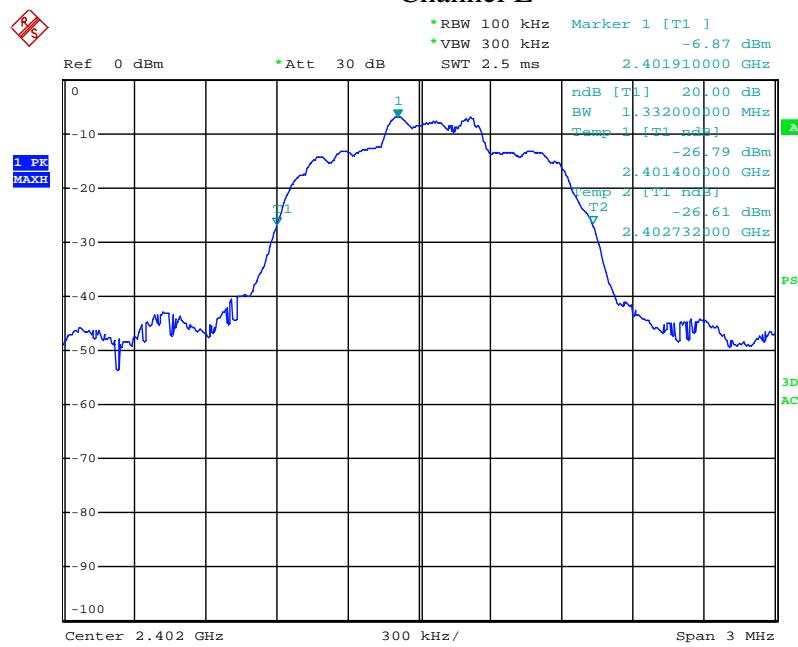
Date: 1.JUN.2017 12:57:09

Channel M

```
                                    *RBW 100 kHz    Marker 1 [T1 ]
                                    *VBW 300 kHz           -6.10 dBm
   Ref   0 dBm          *Att  30 dB   SWT 2.5 ms      2.441910000 GHz
```



```
   Center 2.442 GHz              300 kHz/              Span 3 MHz
```
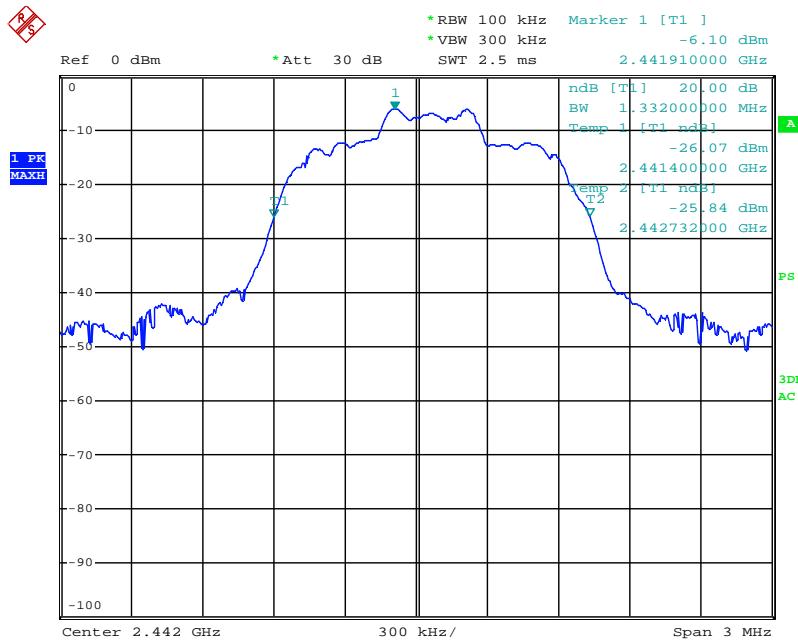
Date: 1.JUN.2017 12:58:29

Channel H

```
                                    *RBW 100 kHz    Marker 1 [T1 ]
                                    *VBW 300 kHz           -5.87 dBm
   Ref   0 dBm          *Att  30 dB   SWT 2.5 ms      2.479910000 GHz
```



```
   Center 2.48 GHz               300 kHz/              Span 3 MHz
```

Date: 1.JUN.2017 12:59:47

TTRF15.247_V1 ©2015Intertek
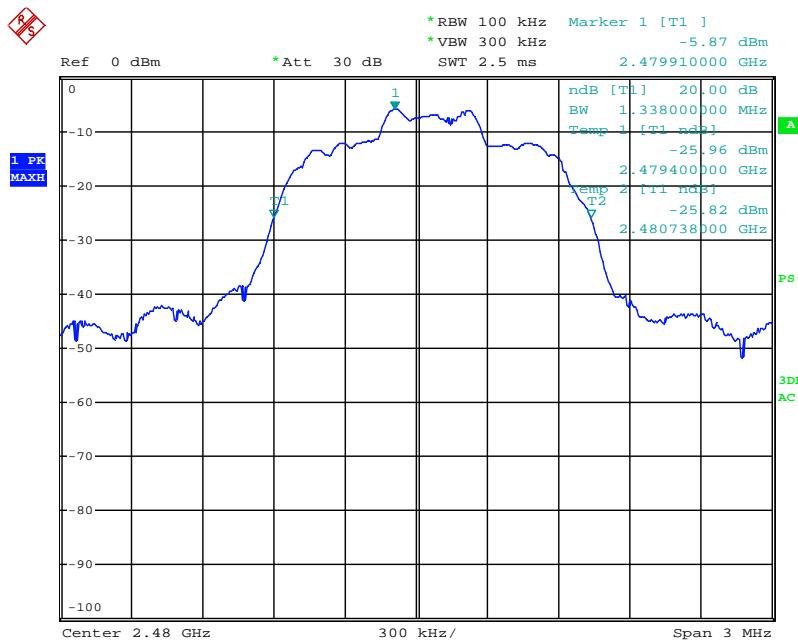
4.   Carrier Frequency Separation

   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

```
┌─────────────────────────────────────────┐
│          Spectrum Analyzer                │
│                                           │
│                             RF input      │
│                                           │
│                               ◯           │
└─────────────────────────────────────────┘
                                │
                                │
              ┌─────────┐       │
              │  EUT    │▭──────┘
              └─────────┘  ↖
                        Antenna connector
```
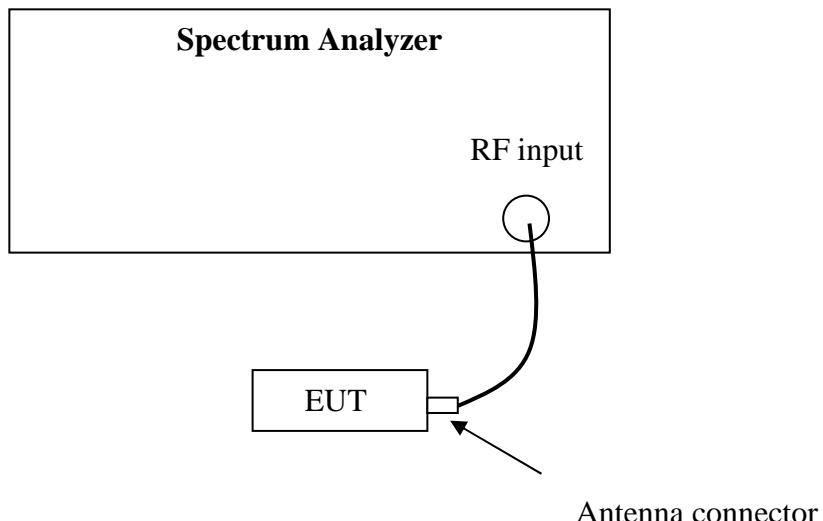
4.3 Test Procedure and test setup

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	1000	≥ 840
	M	1008	≥ 832
	H	1000	≥ 836
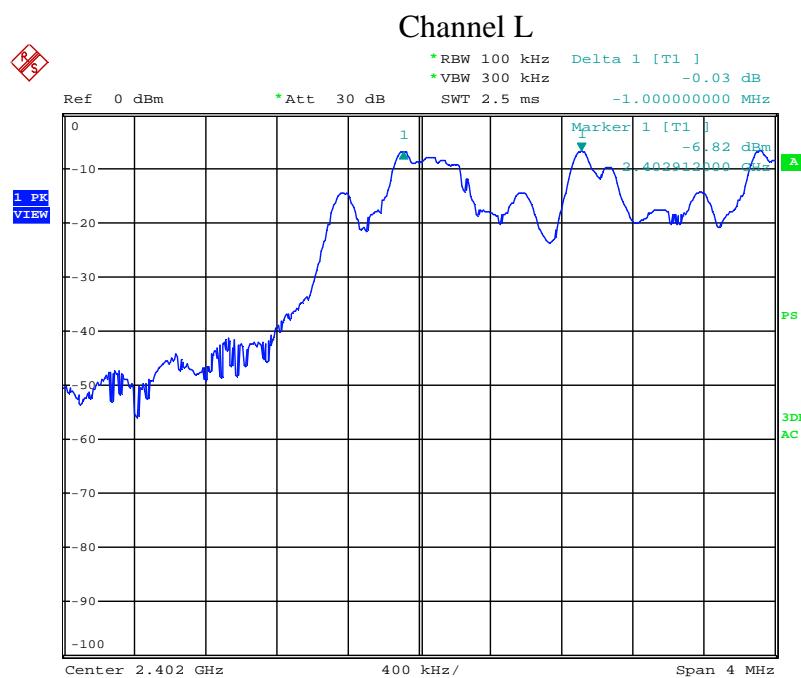
Channel L

Date: 1.JUN.2017 13:07:26

Channel M


```
                              *RBW 100 kHz    Delta 1 [T1 ]
                              *VBW 300 kHz                -0.04 dB
     Ref   0 dBm      *Att  30 dB     SWT 2.5 ms     1.008000000 MHz
```
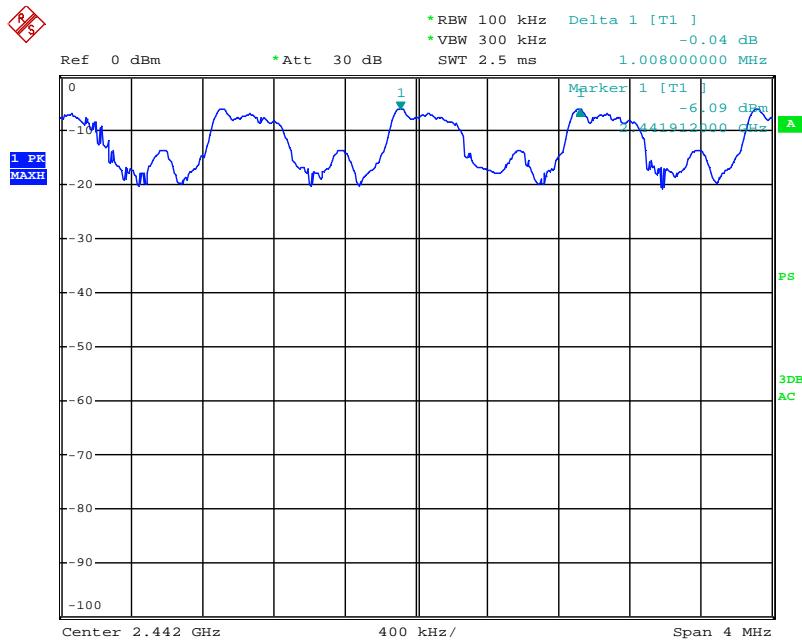
Date: 1.JUN.2017 13:12:20

Channel H


```
                              *RBW 100 kHz    Delta 1 [T1 ]
                              *VBW 300 kHz                -0.02 dB
     Ref   0 dBm      *Att  30 dB     SWT 2.5 ms    -1.000000000 MHz
```

Date: 1.JUN.2017 13:13:54

,

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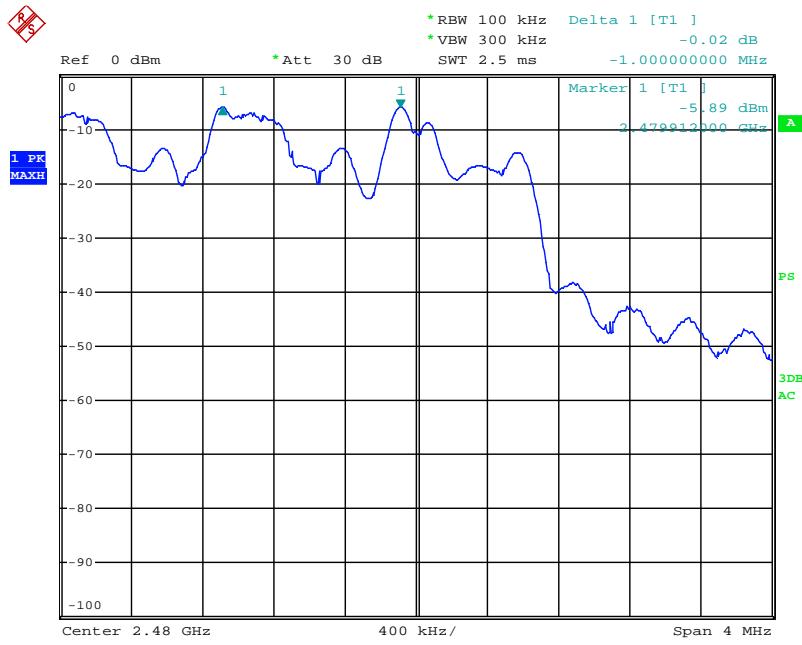
Mode	CH	Frequency Separation (kHz)	Limit (kHz)
π /4 DQPSK	L	1000	≥ 884
	M	1000	≥ 892
	H	1000	≥ 884
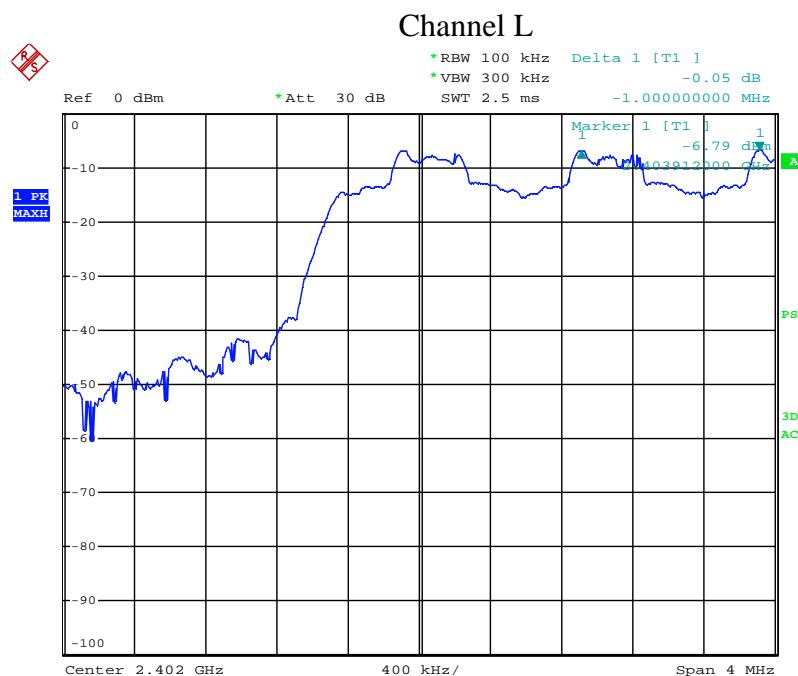
Channel L

Date: 1.JUN.2017 13:15:33

Channel M


```
                                    *RBW 100 kHz    Delta 1 [T1 ]
                                    *VBW 300 kHz              -0.02 dB
    Ref   0 dBm        *Att  30 dB  SWT 2.5 ms        1.000000000 MHz
```

```
Center 2.442 GHz              400 kHz/              Span 4 MHz
```
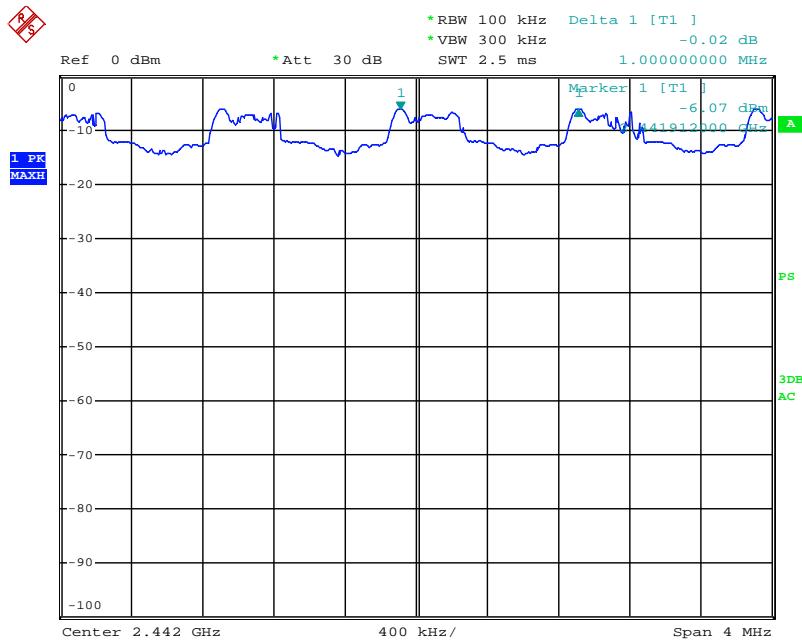
Date: 1.JUN.2017 13:17:27

Channel H


```
                                    *RBW 100 kHz    Delta 1 [T1 ]
                                    *VBW 300 kHz              -0.01 dB
    Ref   0 dBm        *Att  30 dB  SWT 2.5 ms       -1.000000000 MHz
```

```
Center 2.48 GHz               400 kHz/              Span 4 MHz
```

Date: 1.JUN.2017 13:18:26

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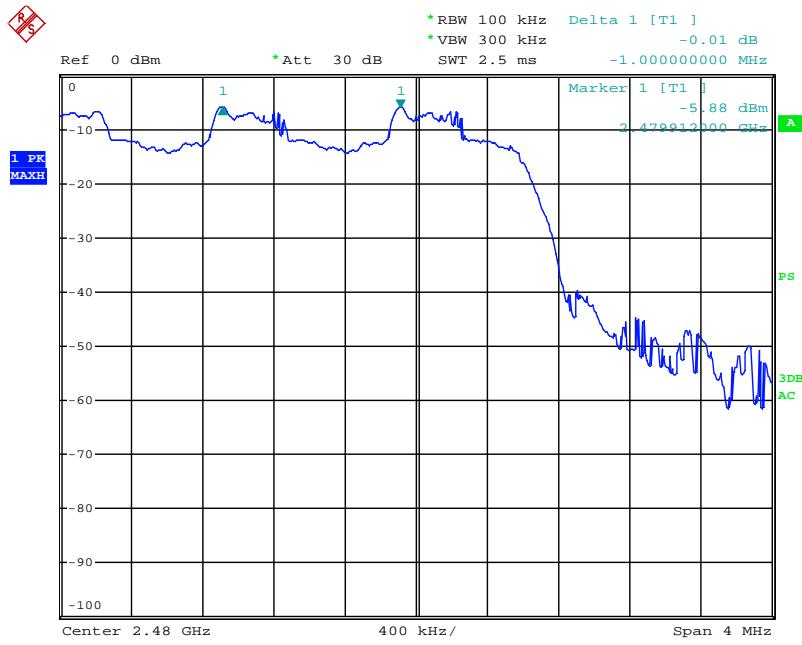
Mode	CH	Frequency Separation (kHz)	Limit (kHz)
8DPSK	L	1000	≥ 888
	M	1000	≥ 888
	H	1000	≥ 892

Channel L


```
                                *RBW 100 kHz    Delta 1 [T1 ]
                                *VBW 300 kHz              -0.07 dB
          Ref  0 dBm         *Att  30 dB     SWT 2.5 ms     -1.000000000 MHz
```
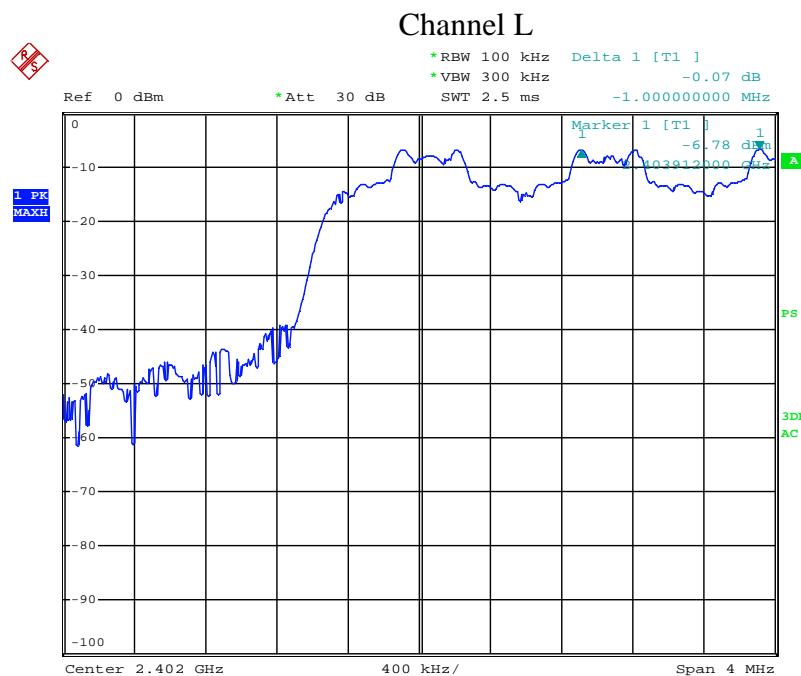
Date: 1.JUN.2017 13:19:59

Channel M


```
                                    *RBW 100 kHz    Delta 1 [T1 ]
                                    *VBW 300 kHz              -0.02 dB
     Ref   0 dBm        *Att  30 dB   SWT 2.5 ms      -1.000000000 MHz
```

Marker 1 [T1]
-6.14 dBm
2.443912000 GHz

1 PK MAXH

A
PS
3DB
AC

Center 2.442 GHz   400 kHz/   Span 4 MHz
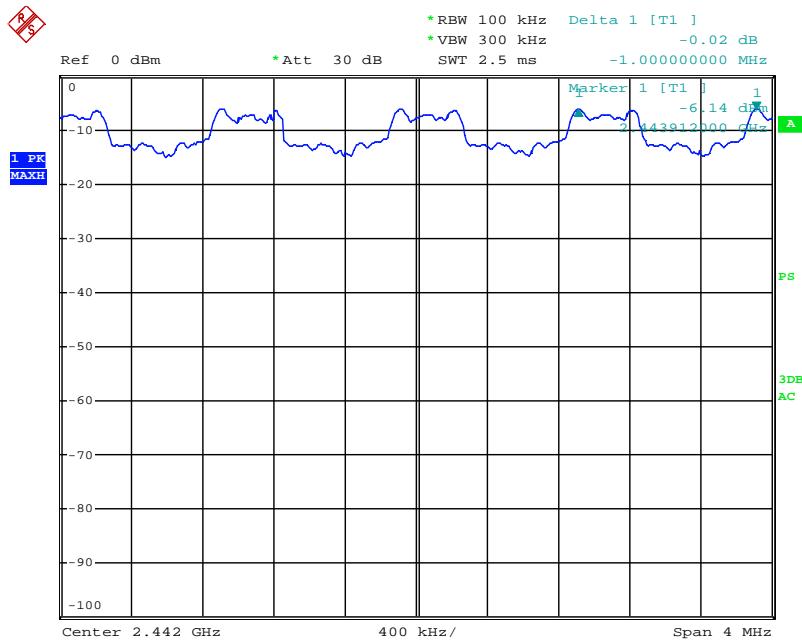
Date: 1.JUN.2017 13:29:54

Channel H


```
                                    *RBW 100 kHz    Delta 1 [T1 ]
                                    *VBW 300 kHz              -0.02 dB
     Ref   0 dBm        *Att  30 dB   SWT 2.5 ms      -1.000000000 MHz
```

Marker 1 [T1]
-5.93 dBm
2.479912000 GHz

1 PK MAXH

A
PS
3DB
AC

Center 2.48 GHz   400 kHz/   Span 4 MHz
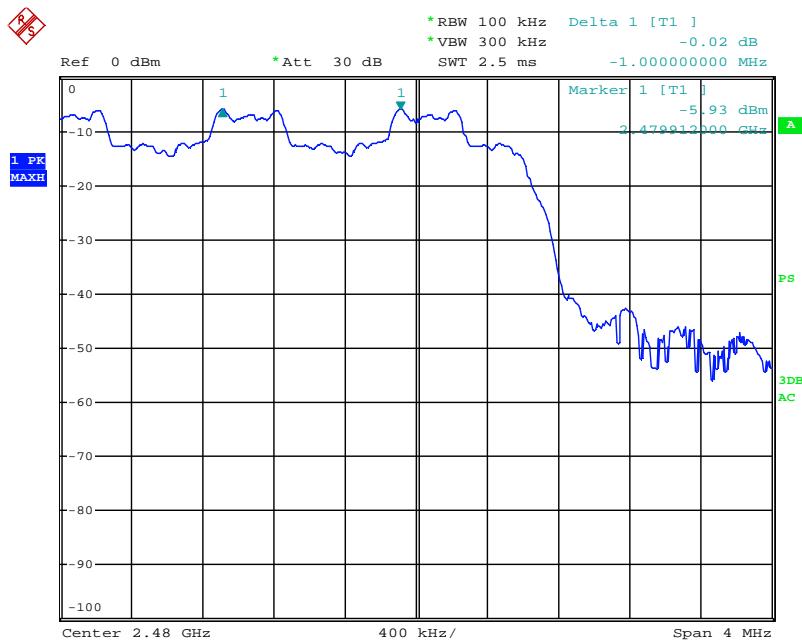
Date: 1.JUN.2017 13:31:24

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

```
┌──────────────────────────────────┐
│  Spectrum Analyzer               │
│                                  │
│                      RF input    │
│                        ◯         │
└──────────────────────────────────┘

        ┌──────────┐
        │   EUT    │─┐
        └──────────┘
                        Antenna connector
```
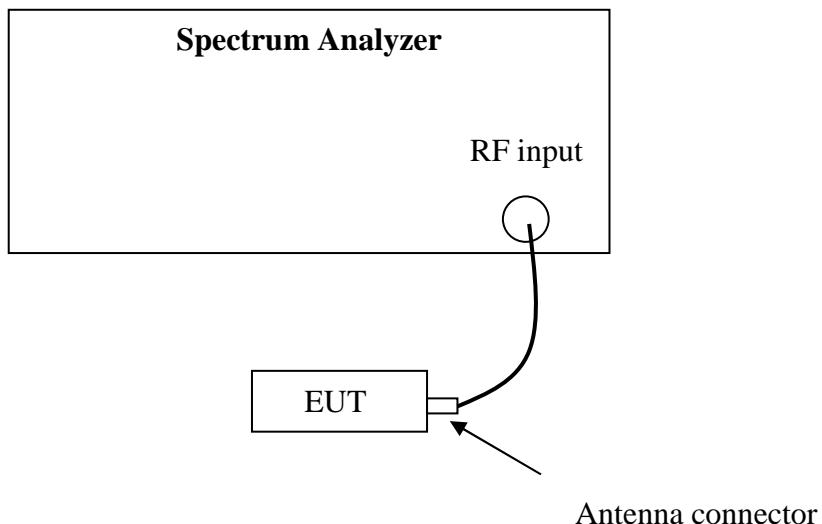
5.3 Test procedure and test setup

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 (DH5)	L	0.8	-5.96	≤21.00
	M	0.8	-5.08	
	H	0.8	-5.01	

Channel L

Date: 1.JUN.2017 14:03:53

intertek
Total Quality. Assured.

Channel M

```
                                    *RBW  3 MHz      Marker 1 [T1 ]
                                    *VBW 10 MHz                 -5.08 dBm
        Ref   9.3 dBm       *Att  30 dB    SWT 2.5 ms      2.441880000 GHz
          Offset  0.8 dB
```



```
        Center 2.442 GHz                1 MHz/              Span 10 MHz
```
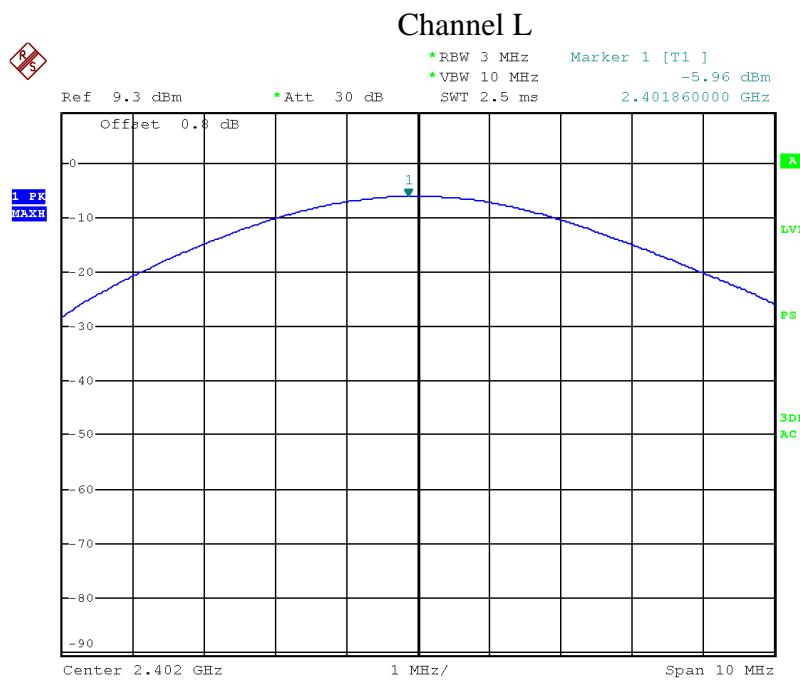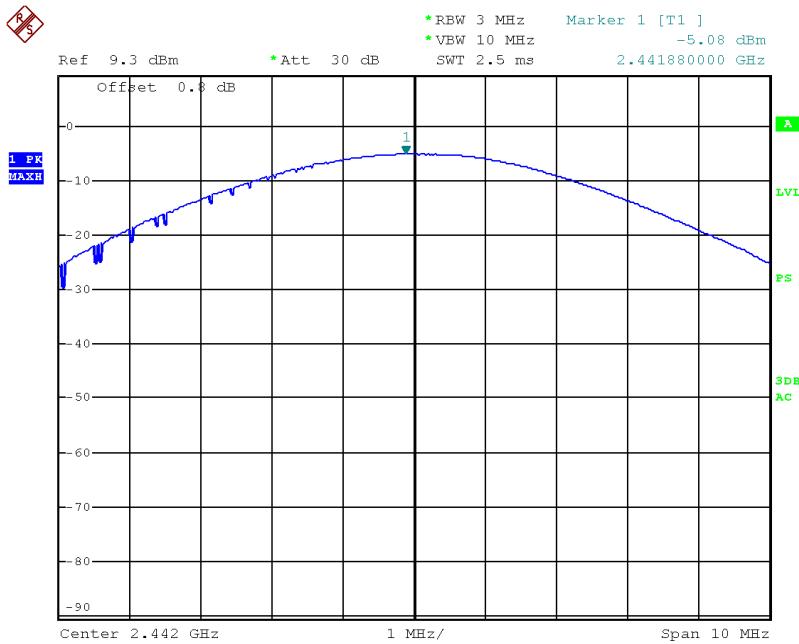
Date: 1.JUN.2017 14:04:49

Channel H

```
                                    *RBW  3 MHz      Marker 1 [T1 ]
                                    *VBW 10 MHz                 -5.01 dBm
        Ref   9.3 dBm       *Att  30 dB    SWT 2.5 ms      2.480000000 GHz
          Offset  0.8 dB
```



```
        Center 2.48 GHz                 1 MHz/              Span 10 MHz
```
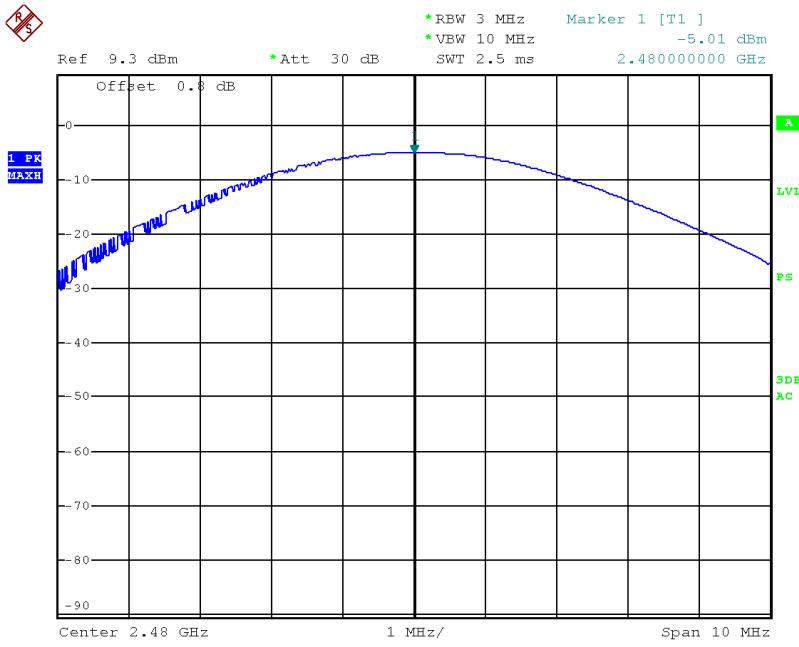
Date: 1.JUN.2017 14:05:29

Mode	CH	Cable loss (dB)	Corrected reading (dBm)	Limit (dBm)
π /4 DQPSK (2DH5)	L	0.8	-5.93	≤21.00
	M	0.8	-5.14	
	H	0.8	-5.01	
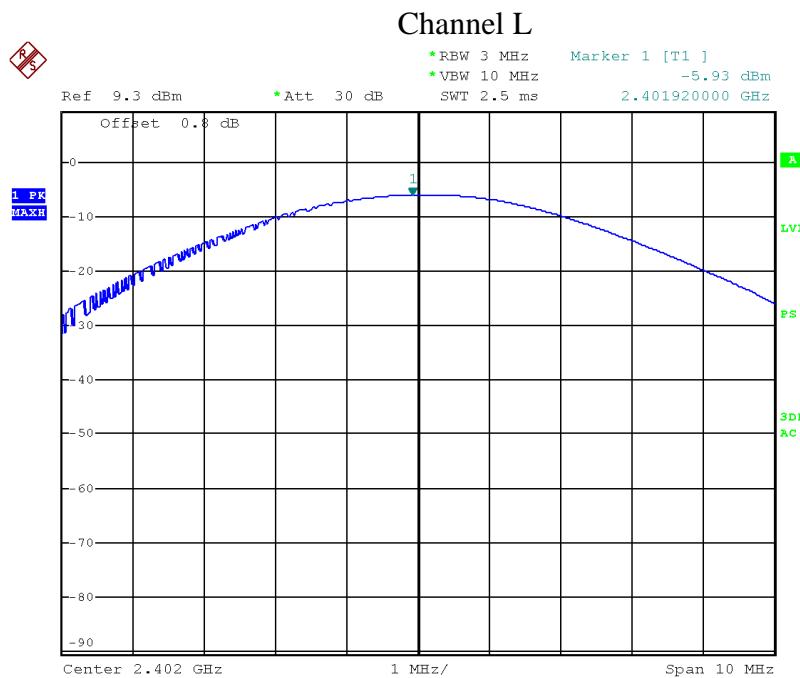
Channel L

Date: 1.JUN.2017 14:07:04

Channel M


```
                                    *RBW  3 MHz     Marker 1 [T1 ]
                                    *VBW 10 MHz                  -5.14 dBm
        Ref   9.3 dBm        *Att  30 dB    SWT 2.5 ms     2.441980000 GHz
           Offset  0.8 dB
```

Center 2.442 GHz   1 MHz/   Span 10 MHz
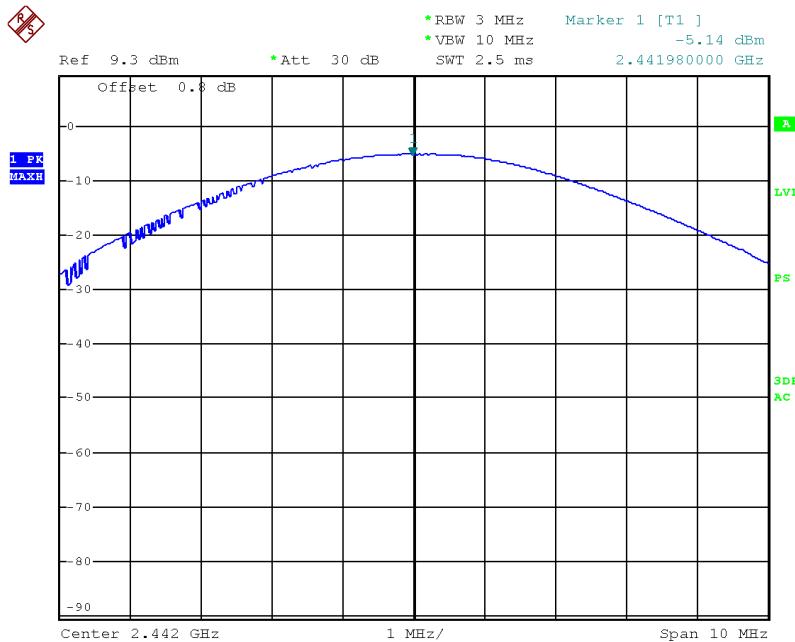
Date: 1.JUN.2017 14:07:43

Channel H


```
                                    *RBW  3 MHz     Marker 1 [T1 ]
                                    *VBW 10 MHz                  -5.01 dBm
        Ref   9.3 dBm        *Att  30 dB    SWT 2.5 ms     2.479840000 GHz
           Offset  0.8 dB
```

Center 2.48 GHz   1 MHz/   Span 10 MHz
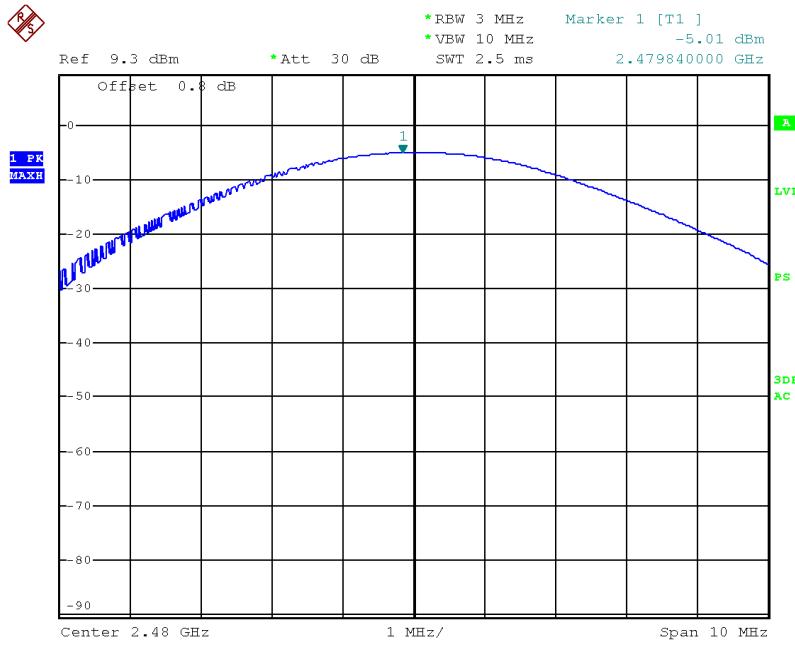
Date: 1.JUN.2017 14:08:17

Mode	CH	Cable loss (dB)	Corrected reading (dBm)	Limit (dBm)
8DPSK (3DH5)	L	0.8	-5.93	≤21.00
	M	0.8	-5.08	
	H	0.8	-4.98	
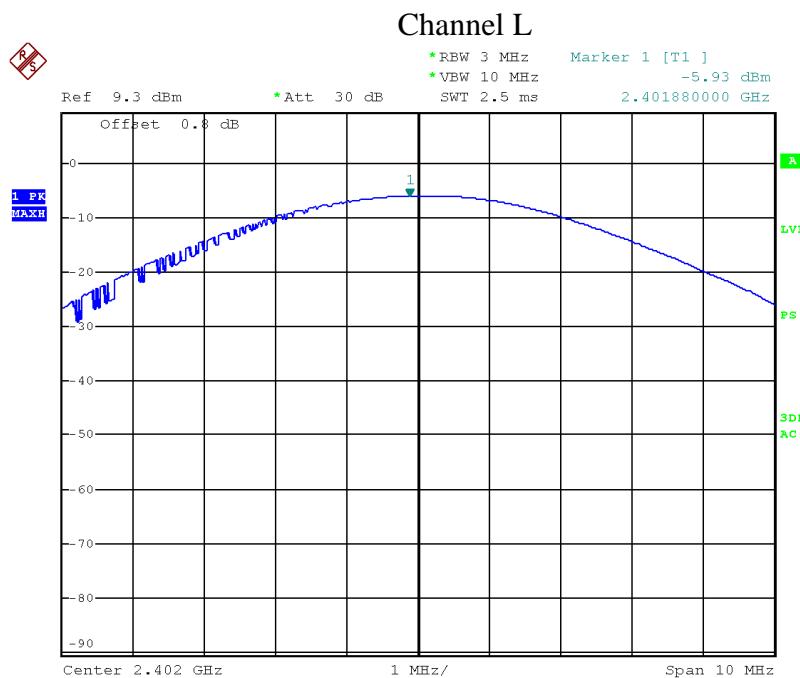
Channel L

Date: 1.JUN.2017 14:09:03

Channel M


```
                            *RBW  3 MHz      Marker 1 [T1 ]
                            *VBW 10 MHz                 -5.08 dBm
     Ref   9.3 dBm        *Att   30 dB      SWT 2.5 ms      2.441880000 GHz
        Offset   0.8 dB
1 PK
MAXH
```

Center 2.442 GHz   1 MHz/   Span 10 MHz
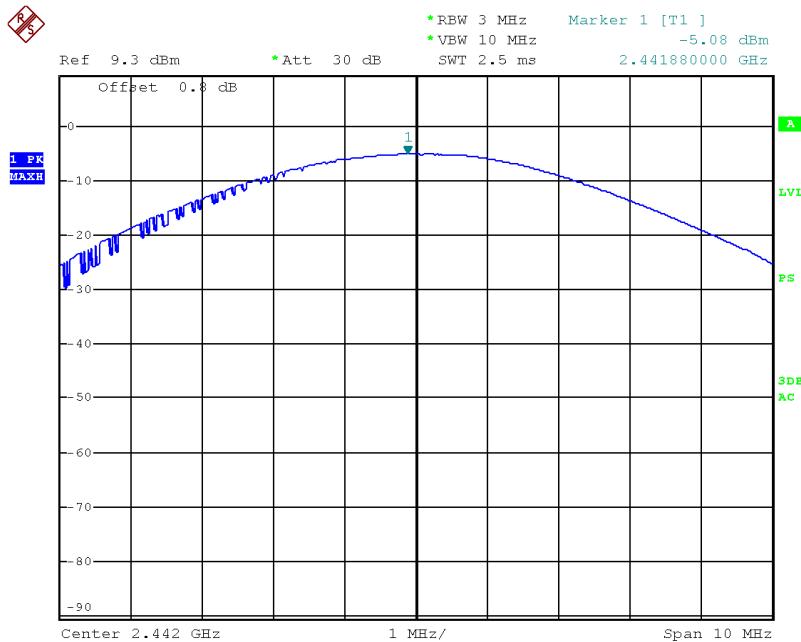
Date: 1.JUN.2017 14:09:41

Channel H


```
                            *RBW  3 MHz      Marker 1 [T1 ]
                            *VBW 10 MHz                 -4.98 dBm
     Ref   9.3 dBm        *Att   30 dB      SWT 2.5 ms      2.479900000 GHz
        Offset   0.8 dB
1 PK
MAXH
```

Center 2.48 GHz   1 MHz/   Span 10 MHz

Date: 1.JUN.2017 14:10:10

TTRF15.247_V1 ©2015Intertek
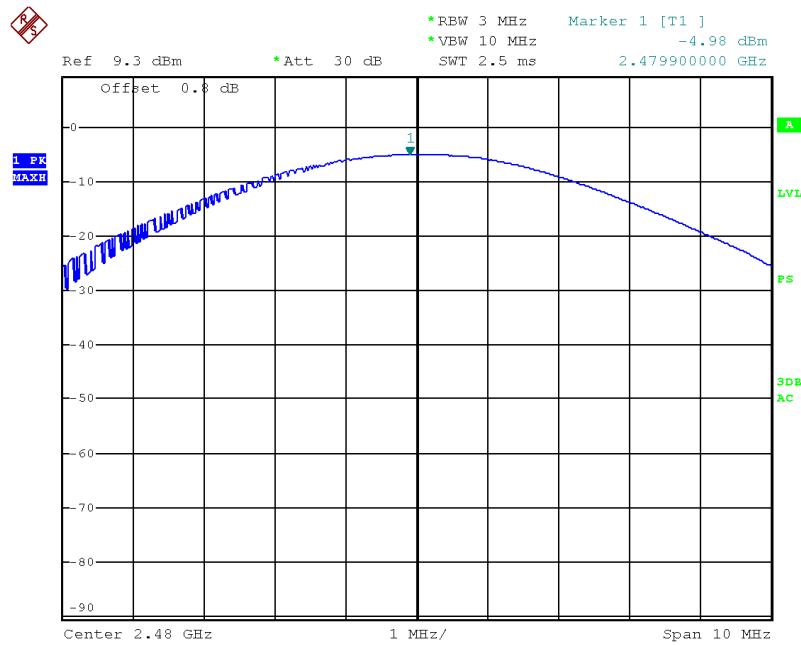
6.   Radiated Spurious Emissions

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

Antenna mast

EUT

Turn Table

Test receiver
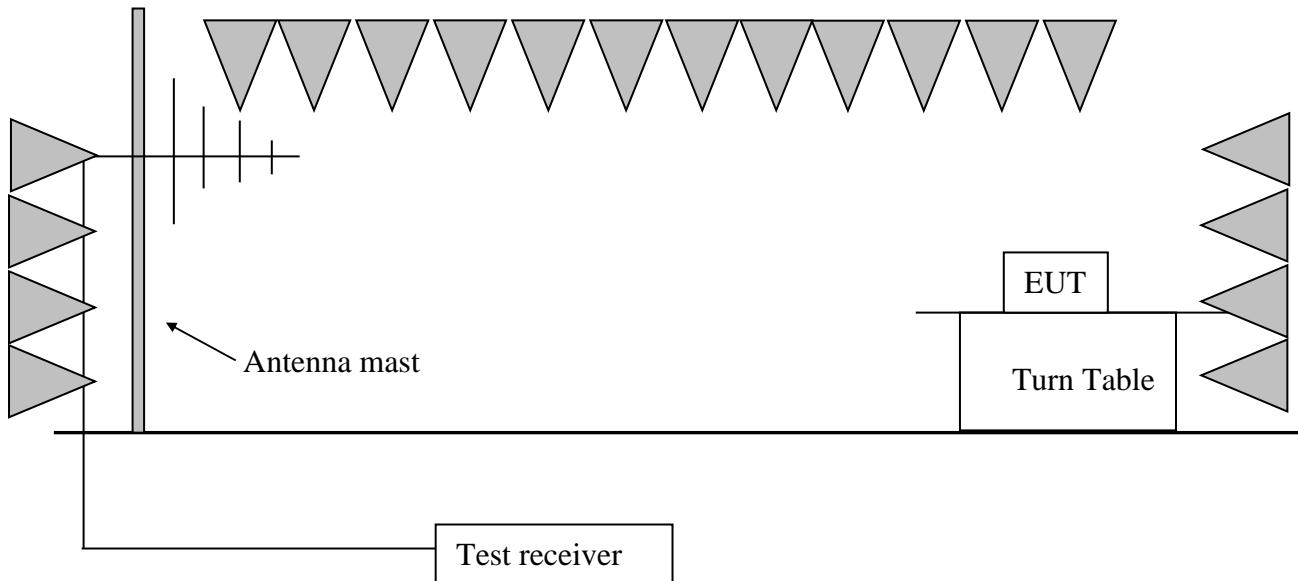
6.3 Test procedure and test setup

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.

Tabletop devices shall be placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 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);

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

6.4 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.

Horizontal

x   MES 0500717H1_red
          MES 0500717H1_pre

Vertical

x   MES 0500717V1_red
          MES 0500717V1_pre

TTRF15.247_V1 ©2015Intertek
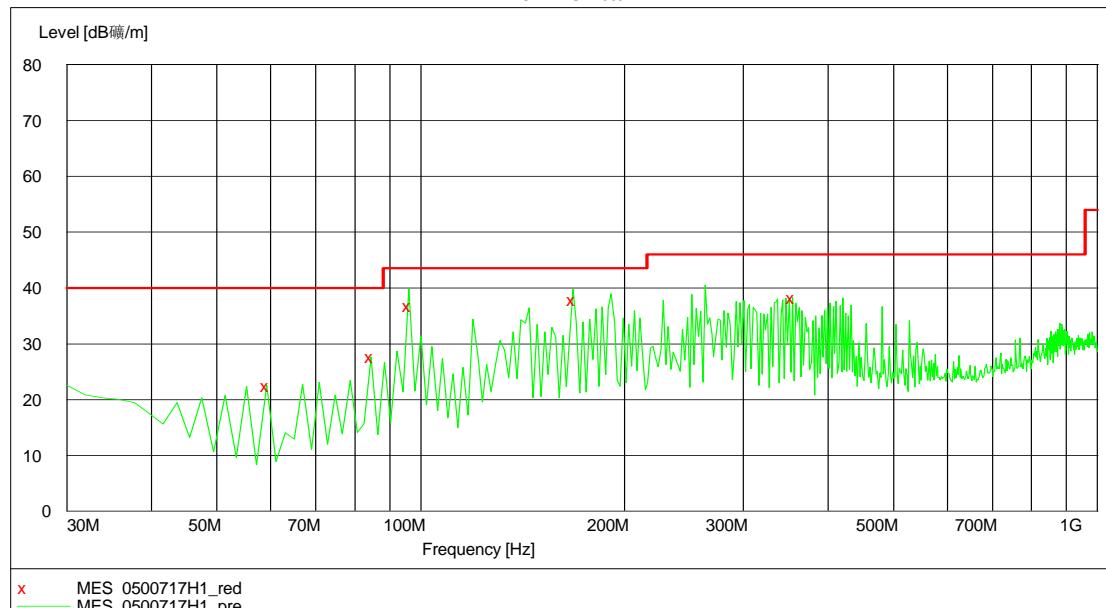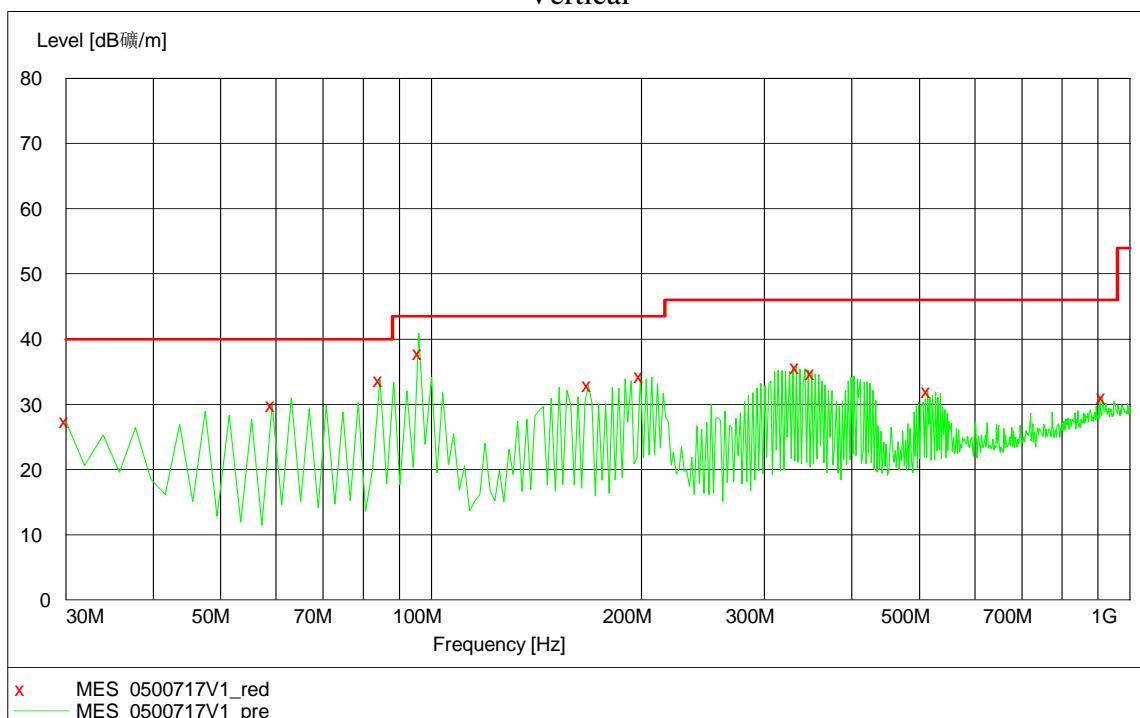
Test data (30MHz~1GHz, GFSK (DH5) Mode):

Horizontal

Frequency (MHz)	Measured level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
59.15	22.5	40.0	17.5	PK
84.42	27.6	40.0	12.4	PK
96.09	36.8	43.5	6.7	PK
168.01	37.8	43.5	5.7	PK
354.62	38.3	46.0	7.7	PK
Remark: If the margin higher than 10dB, it would be marked as *.				

Vertical

Frequency (MHz)	Measured level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
30.00	33.8	40.0	12.6	PK
59.15	29.9	40.0	10.1	PK
84.42	33.8	40.0	6.2	PK
96.09	37.9	43.5	5.6	PK
168.01	32.9	43.5	10.6	PK
199.11	34.4	43.5	9.1	PK
333.24	35.8	46.0	10.2	PK
350.74	34.9	46.0	11.1	PK
Remark: If the margin higher than 10dB, it would be marked as *.				

Test Data (>1GHz):

GFSK (DH5) 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	62.50	Fundamental	/	PK
	H	2389.90	30.20	47.50	74.00	26.50	PK
	H	2389.90	30.20	30.30	54.00	23.70	AV
	H	4804.00	-1.50	33.40	74.00	40.60	PK
M	V	2442.00	30.70	61.70	Fundamental	/	PK
	V	4882.00	-1.10	32.20	74.00	41.80	PK
H	H	2480.00	30.70	59.70	Fundamental	/	PK
	V	2483.50	31.52	43.40	74.00	30.60	PK
	V	2483.50	31.52	31.50	54.00	22.50	AV
	V	4960.00	-0.80	37.60	74.00	36.40	PK

π /4DQPSK (2DH5) 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	62.10	Fundamental	/	PK
	H	2389.98	30.20	45.90	74.00	29.10	PK
	H	2389.98	30.20	30.10	54.00	23.90	AV
	H	4804.00	-1.50	32.80	74.00	41.20	PK
M	V	2442.00	30.70	61.90	Fundamental	/	PK
	V	4882.00	-1.10	33.60	74.00	40.40	PK
H	H	2480.00	30.70	60.50	Fundamental	/	PK
	V	2483.50	31.52	42.90	74.00	31.10	PK
	V	2483.50	31.52	31.20	54.00	22.80	AV
	V	4960.00	-0.80	36.60	74.00	37.40	PK

8DPSK (3DH5) 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	64.80	Fundamental	/	PK
	H	2389.93	30.20	47.10	74.00	26.90	PK
	H	2389.93	30.20	32.70	54.00	21.30	AV
	H	4804.00	-1.50	30.20	74.00	43.80	PK
M	V	2442.00	30.70	63.40	Fundamental	/	PK
	V	4882.00	-1.10	34.30	74.00	39.70	PK
H	H	2480.00	30.70	61.10	Fundamental	/	PK
	V	2483.50	31.52	42.50	74.00	31.50	PK
	V	2483.50	31.52	30.60	54.00	23.40	AV
	V	4960.00	-0.80	36.90	74.00	37.10	PK

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

Spectrum Analyzer

RF input

EUT

Antenna connector
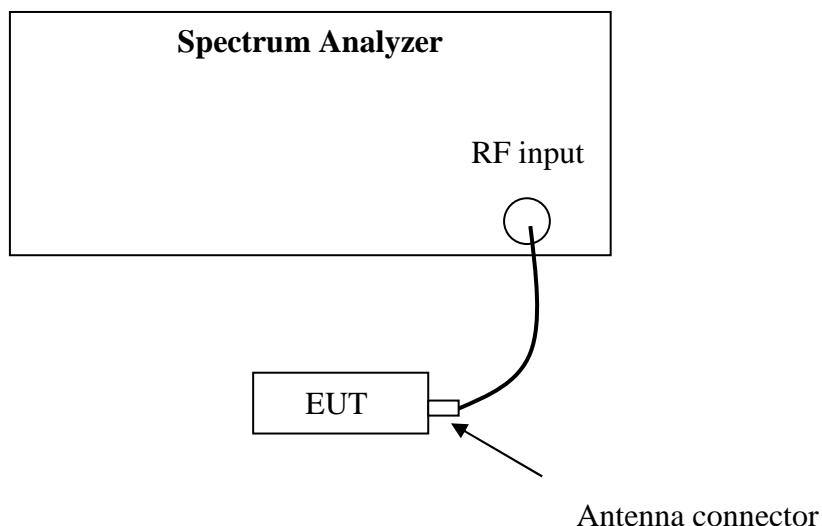
7.3 Test procedure and test setup

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 2 channels (lowest 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 %

GFSK Channel- L

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Total Quality. Assured.

GFSK Channel- H

π /4 DQPSK Channel- L

TTRF15.247_V1 ©2015Intertek
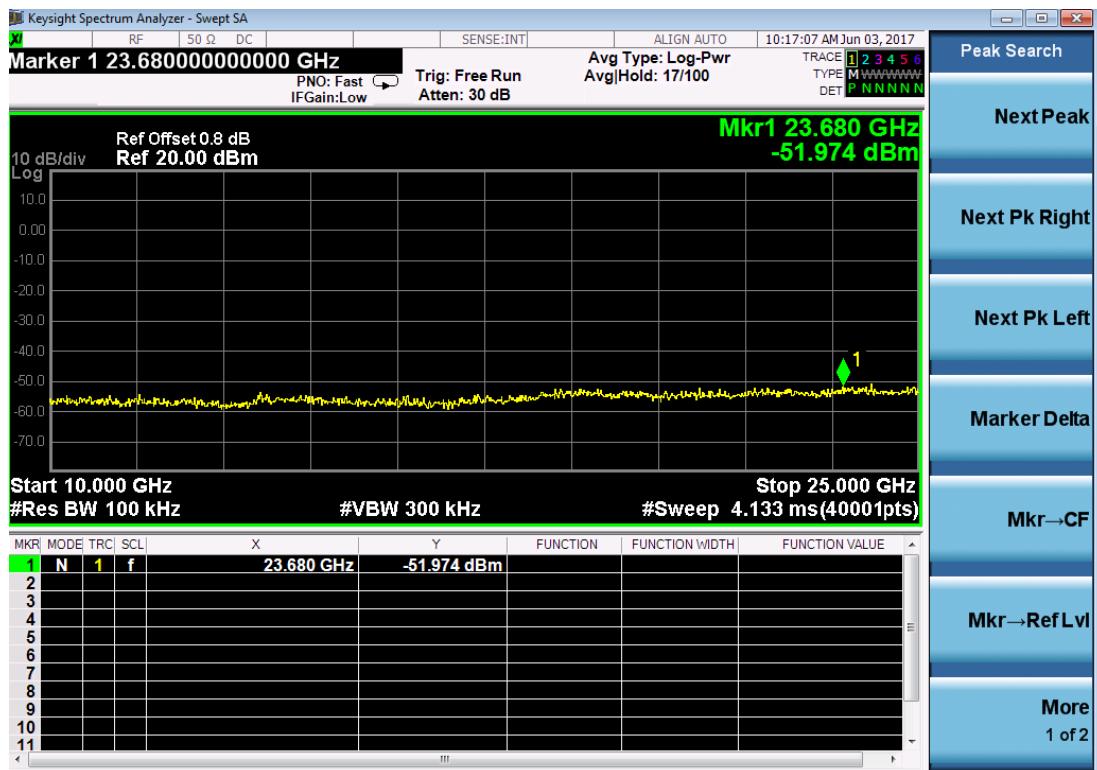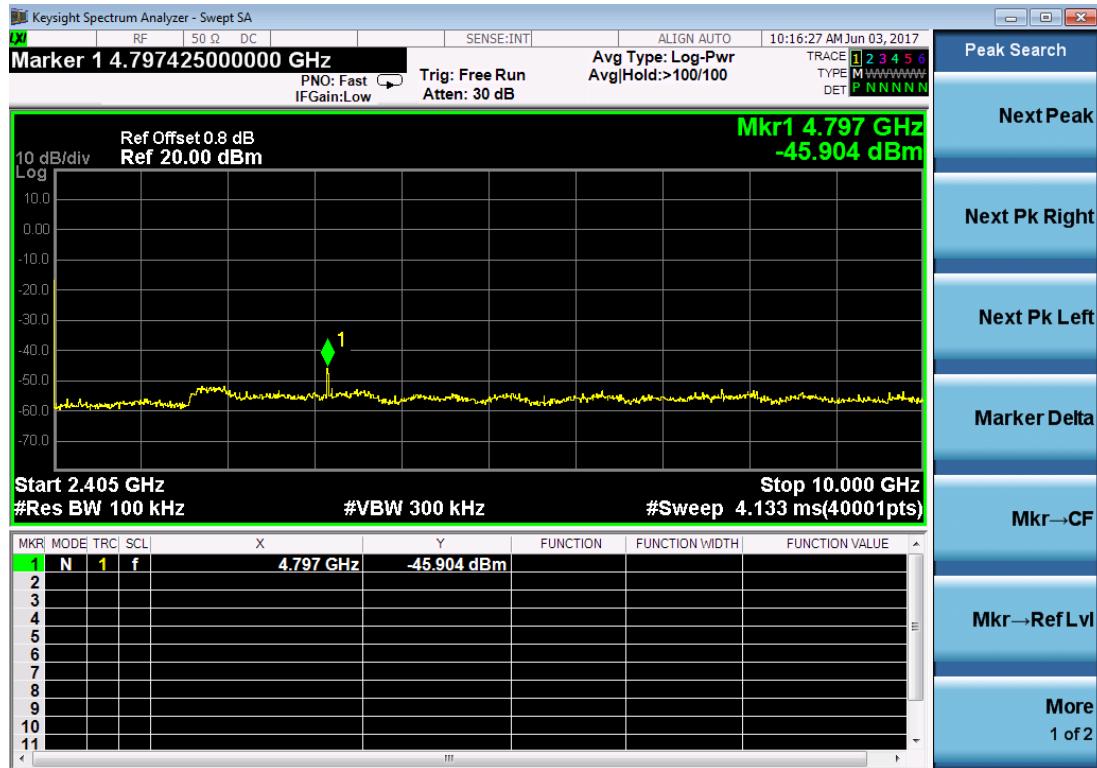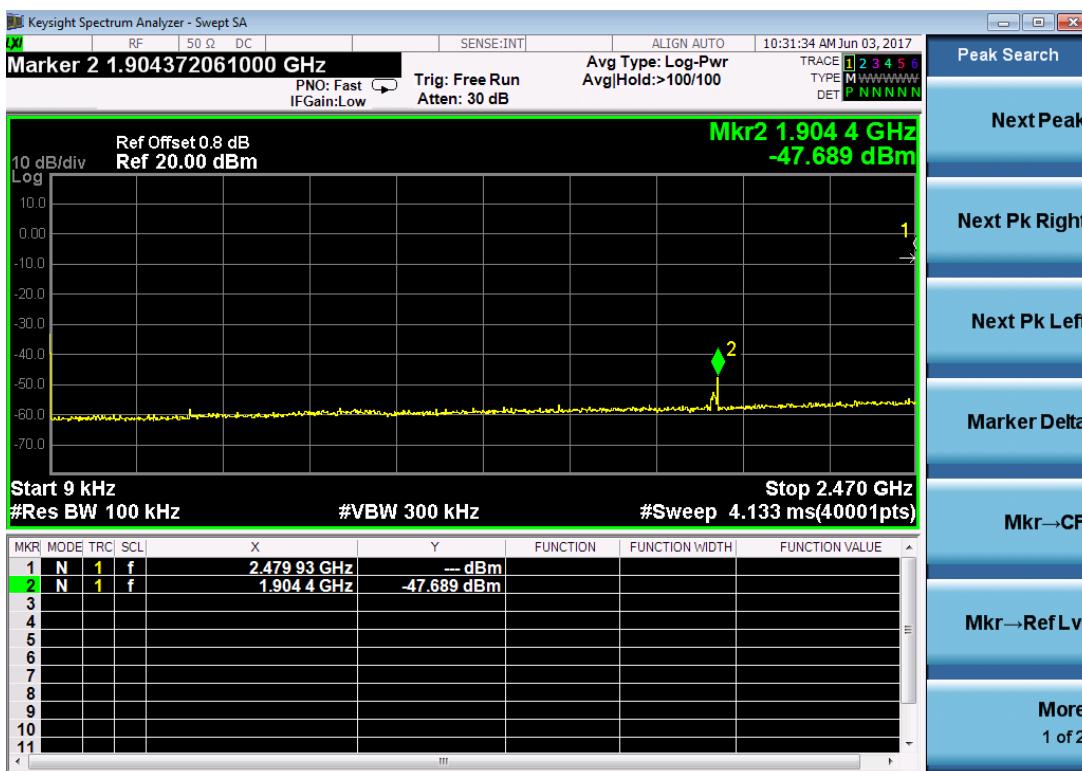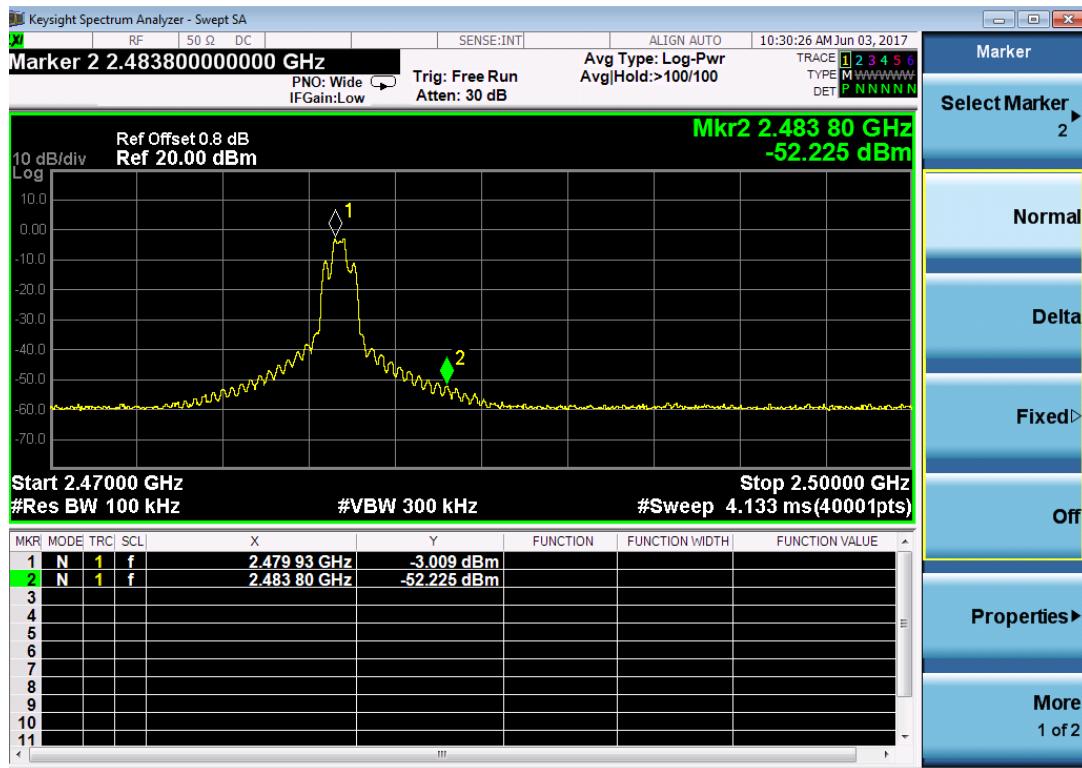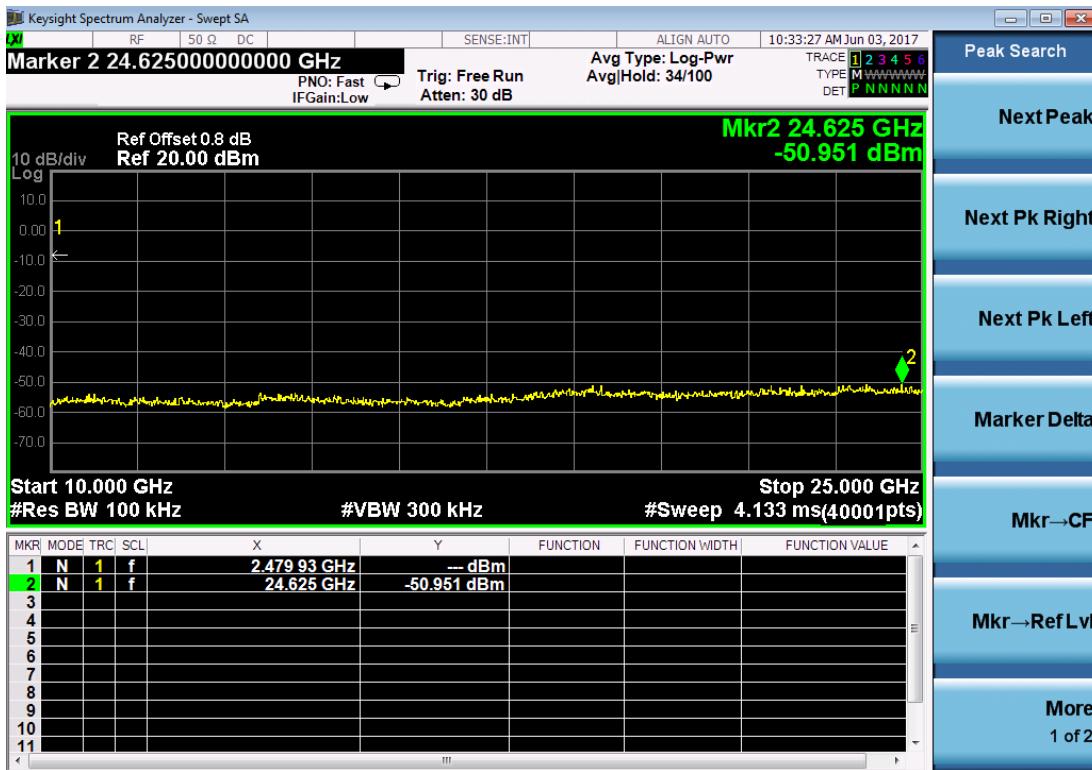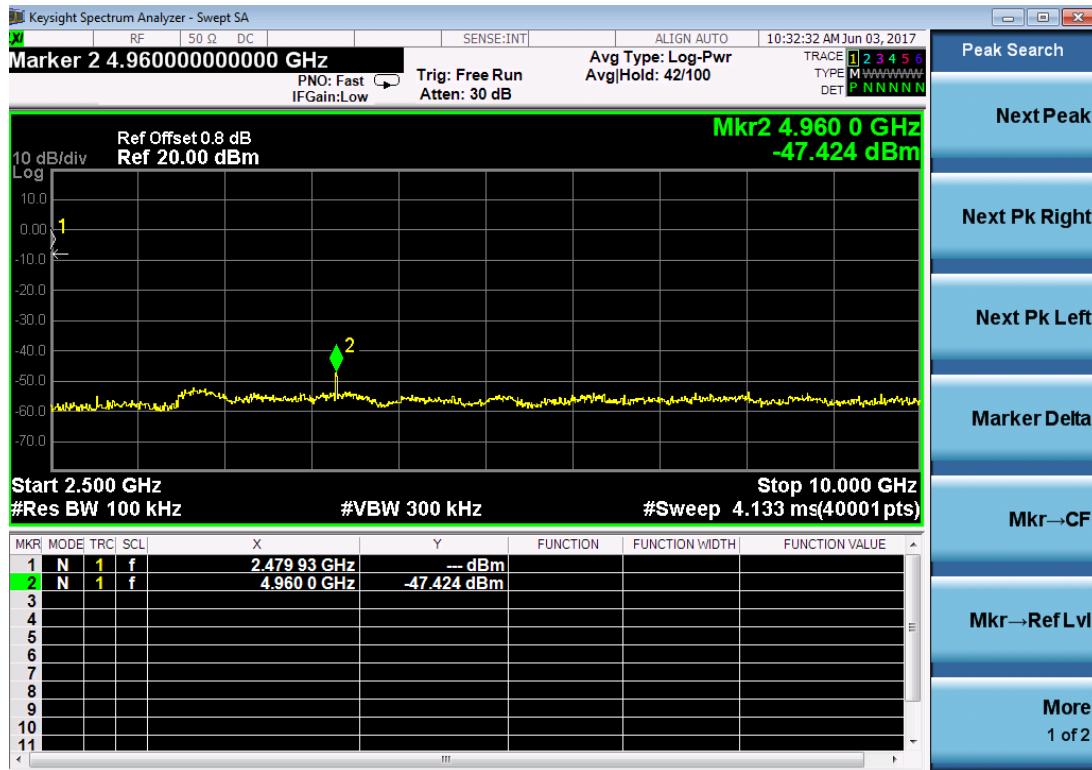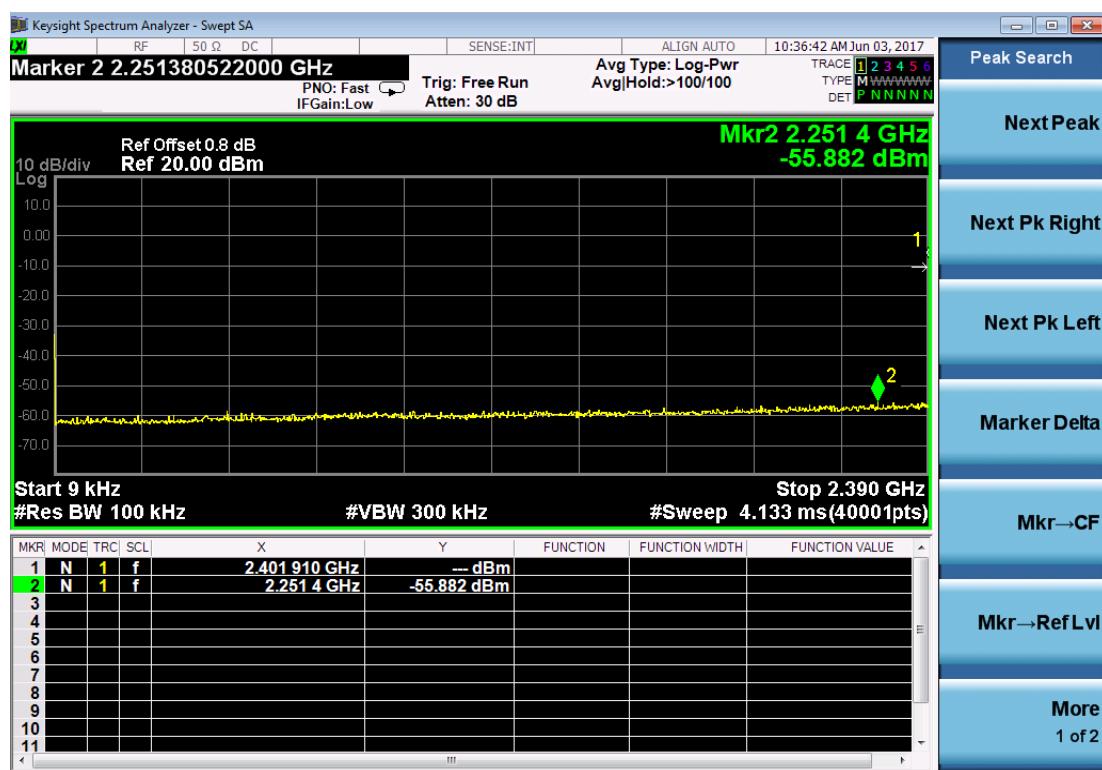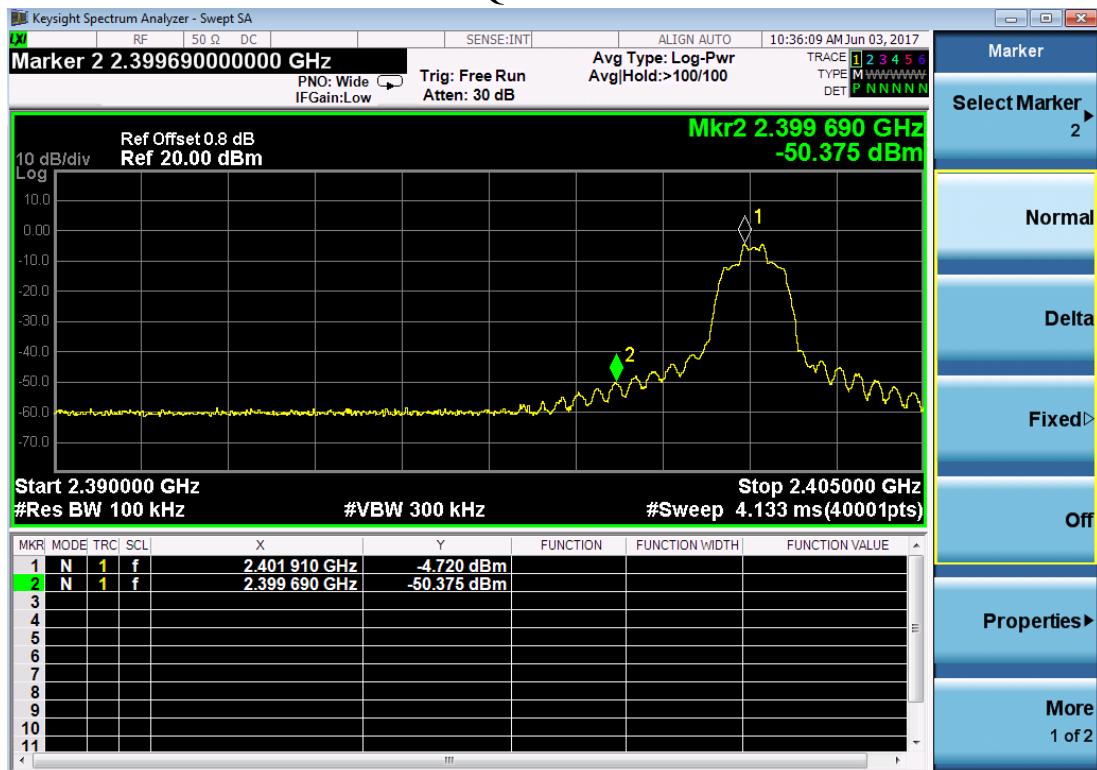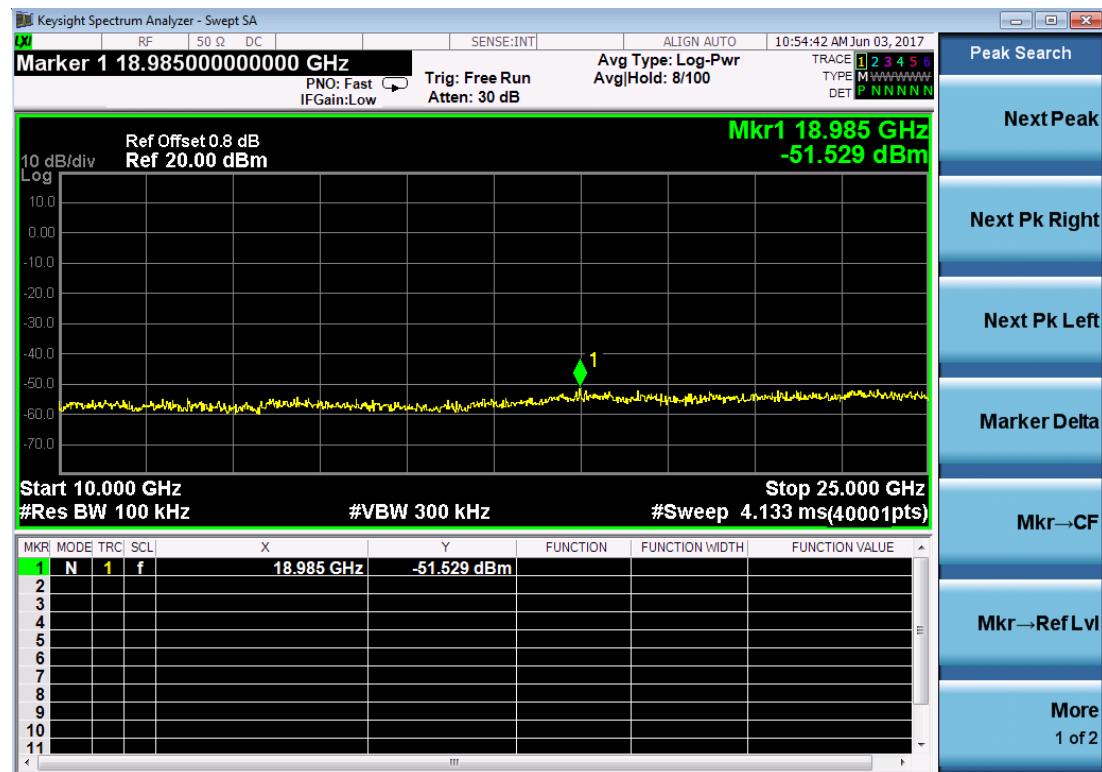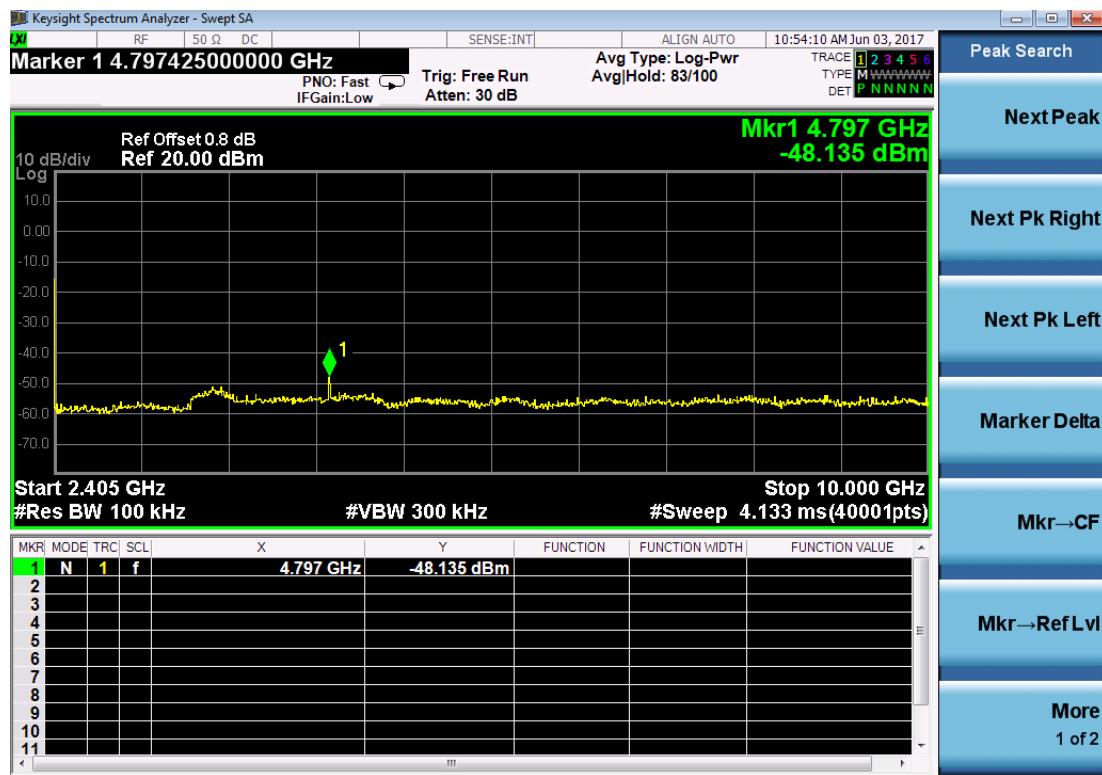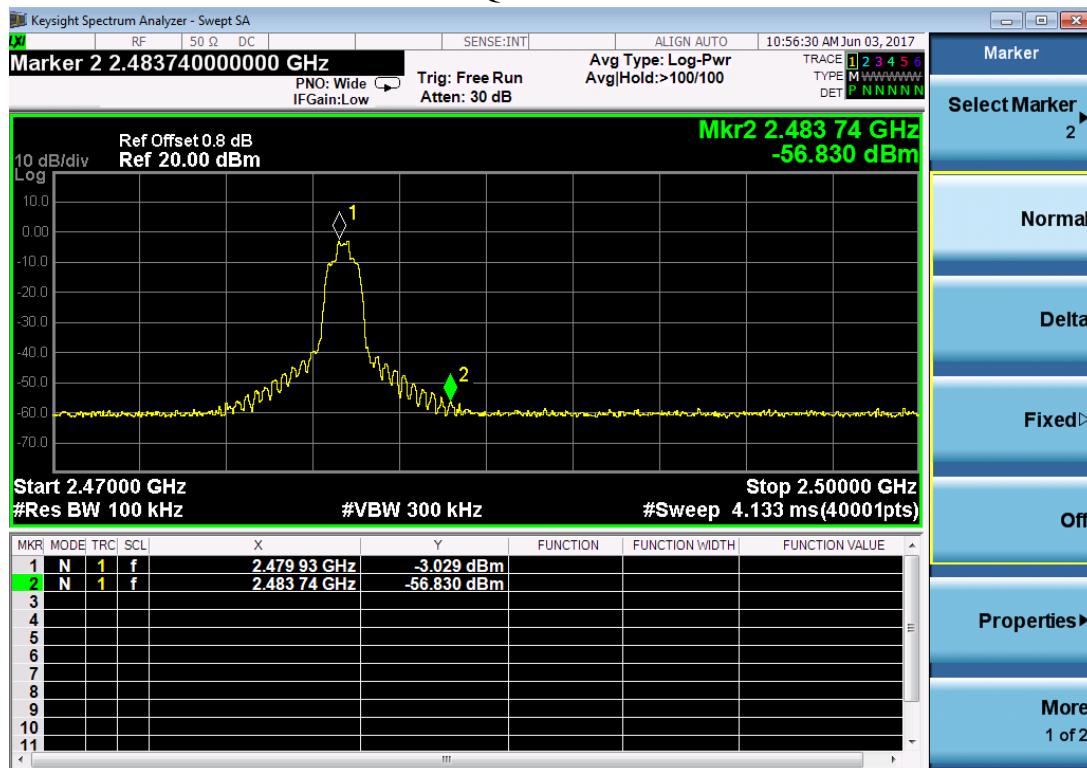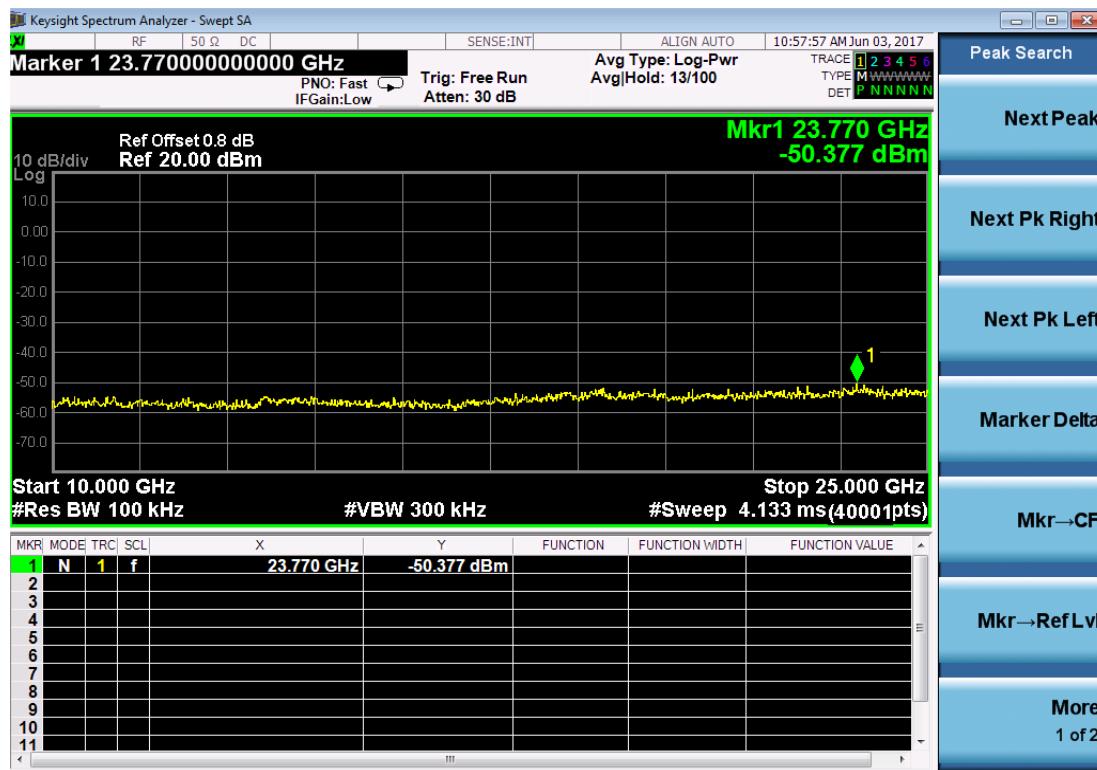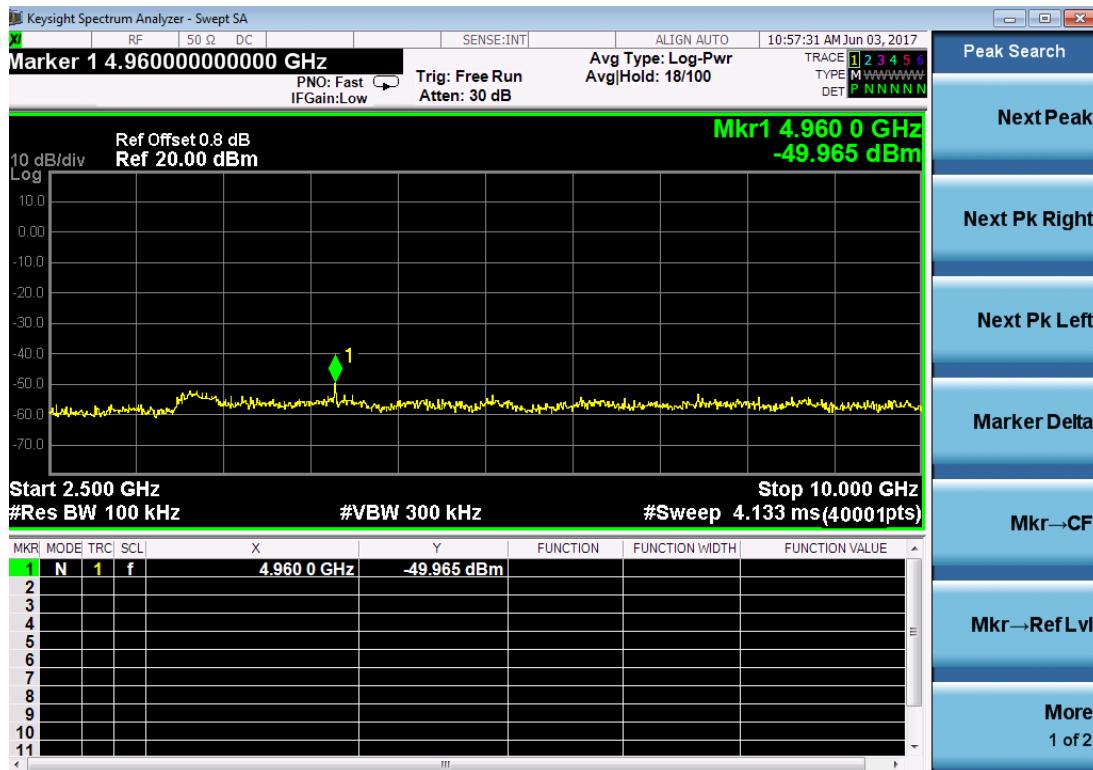
π /4 DQPSK Channel- H

8DPSK Channel- L

8DPSK Channel- H

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Total Quality. Assured.
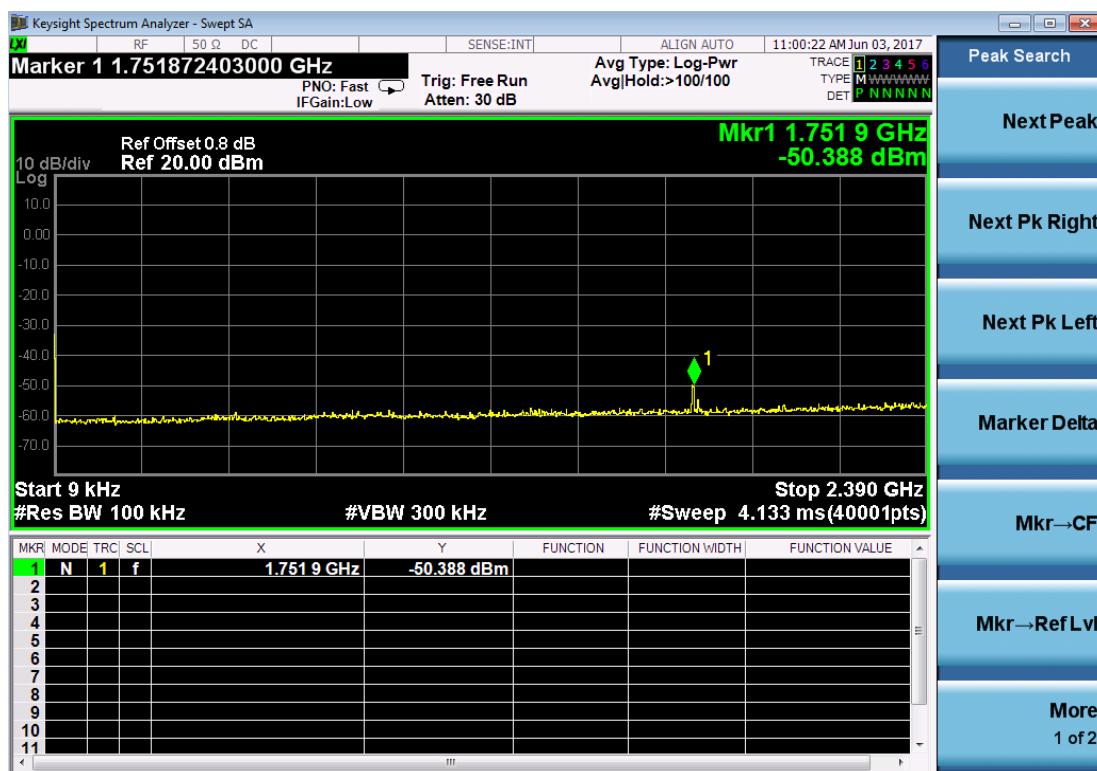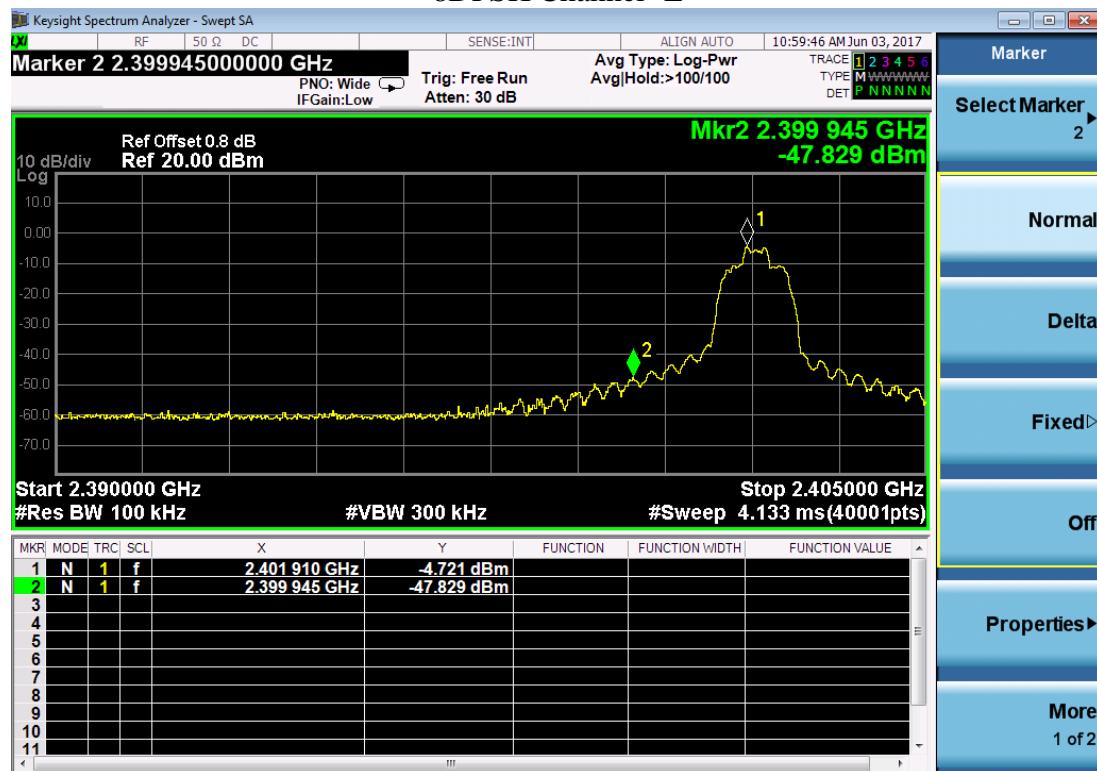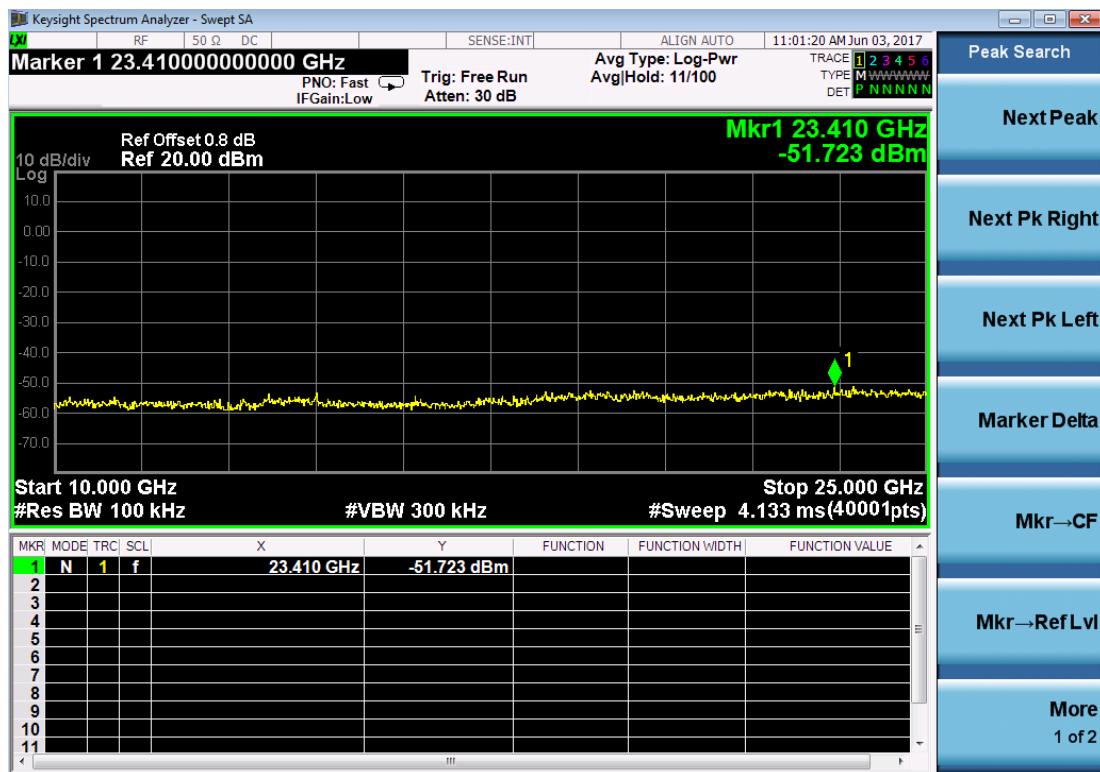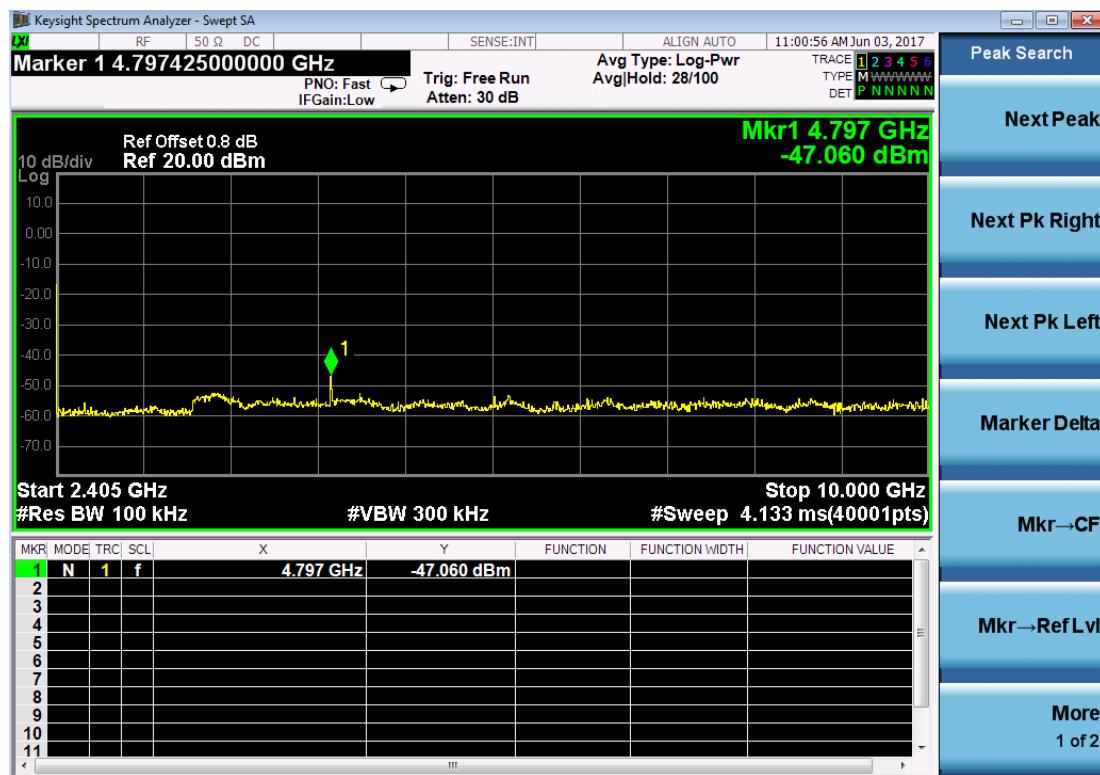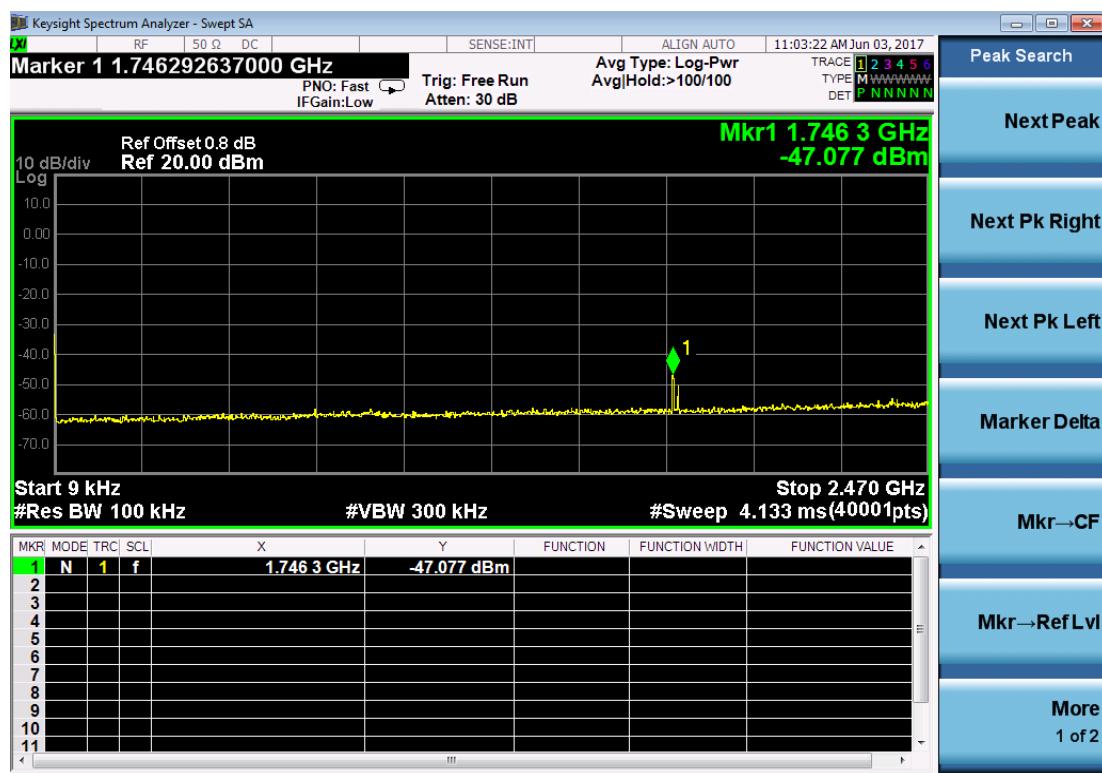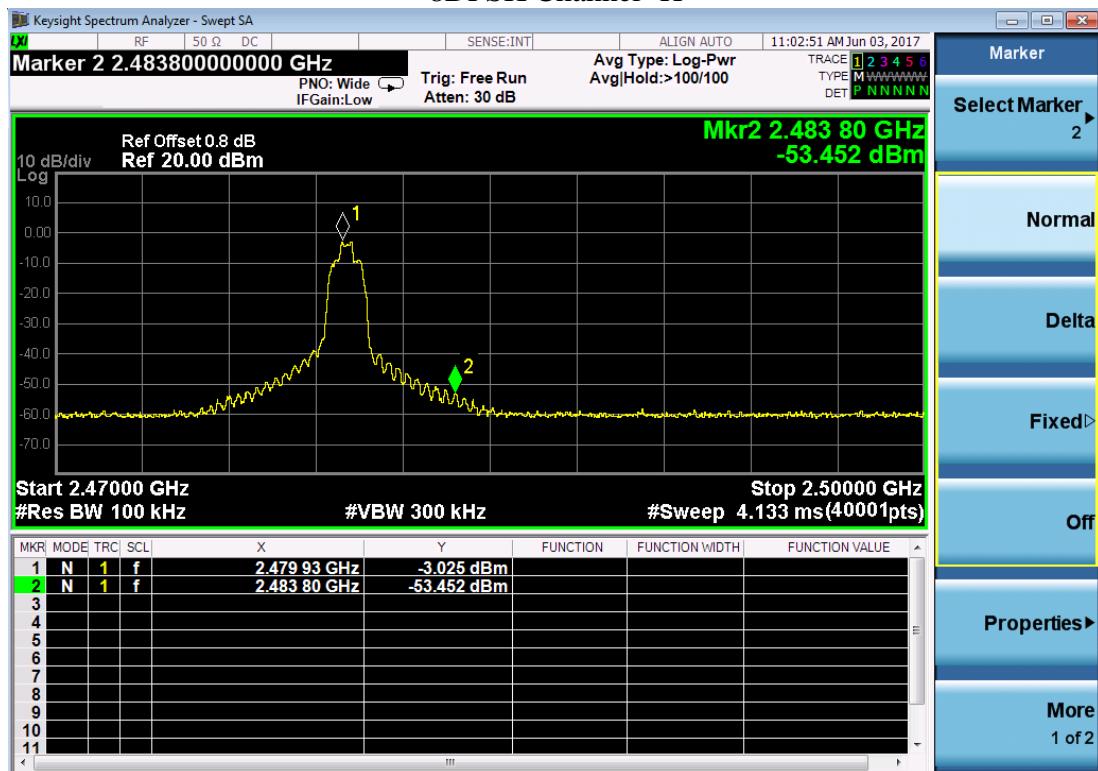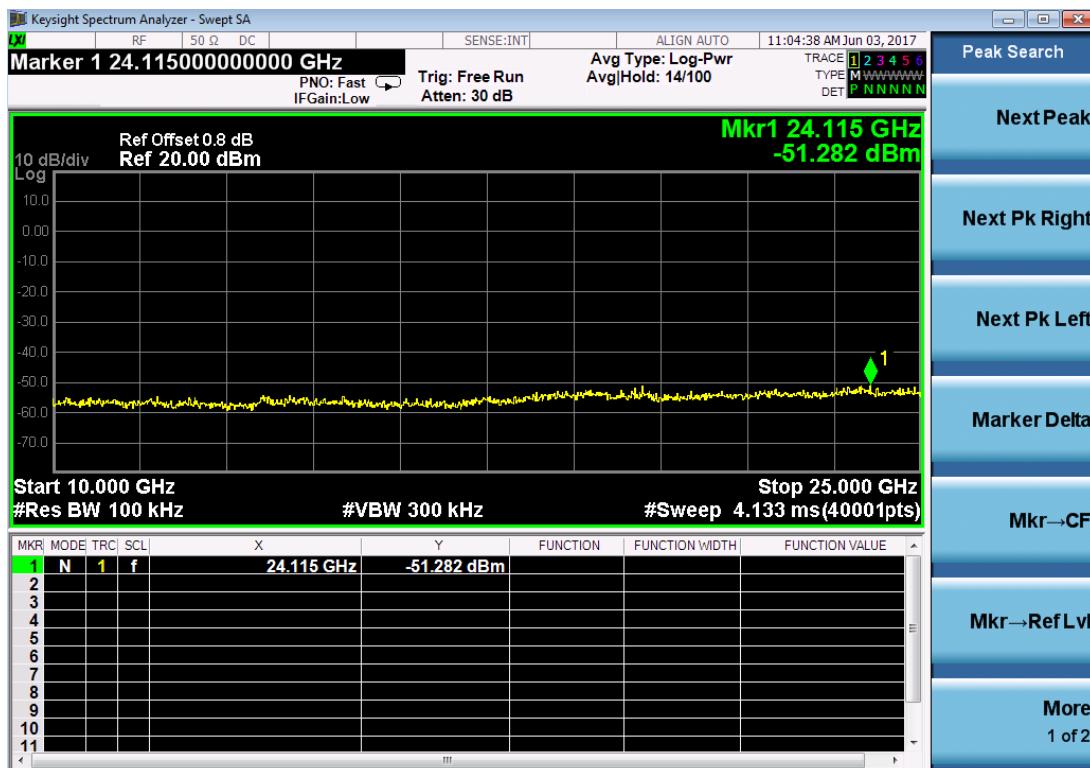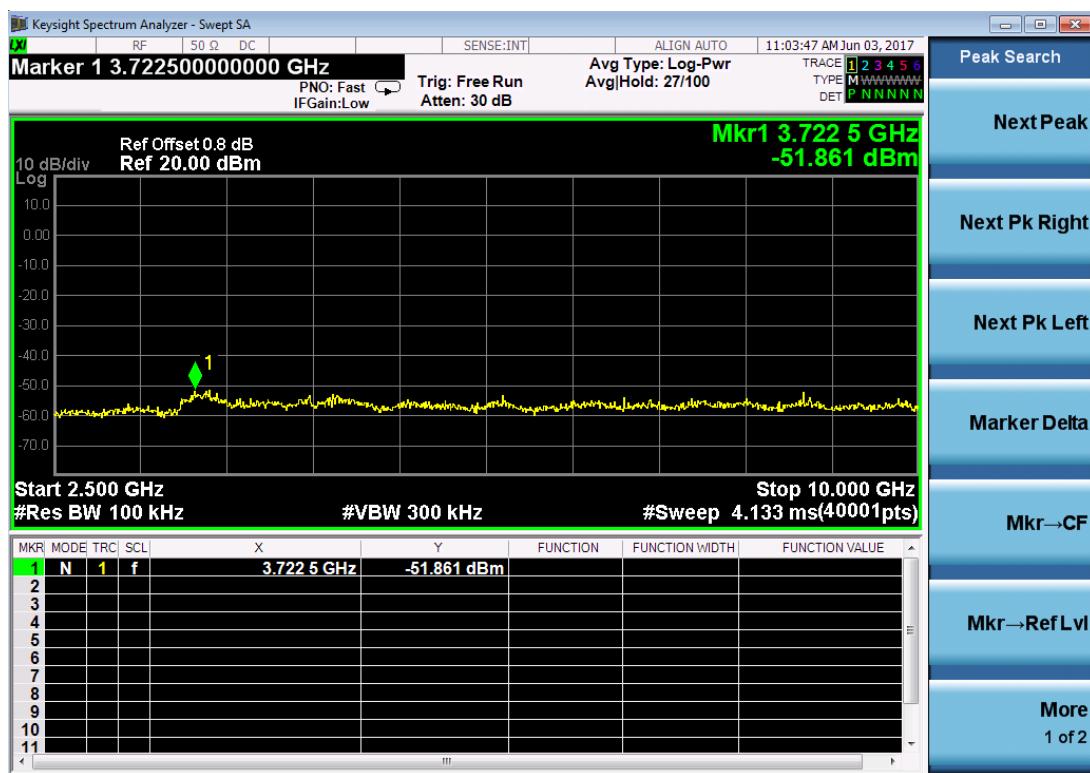
Hopping
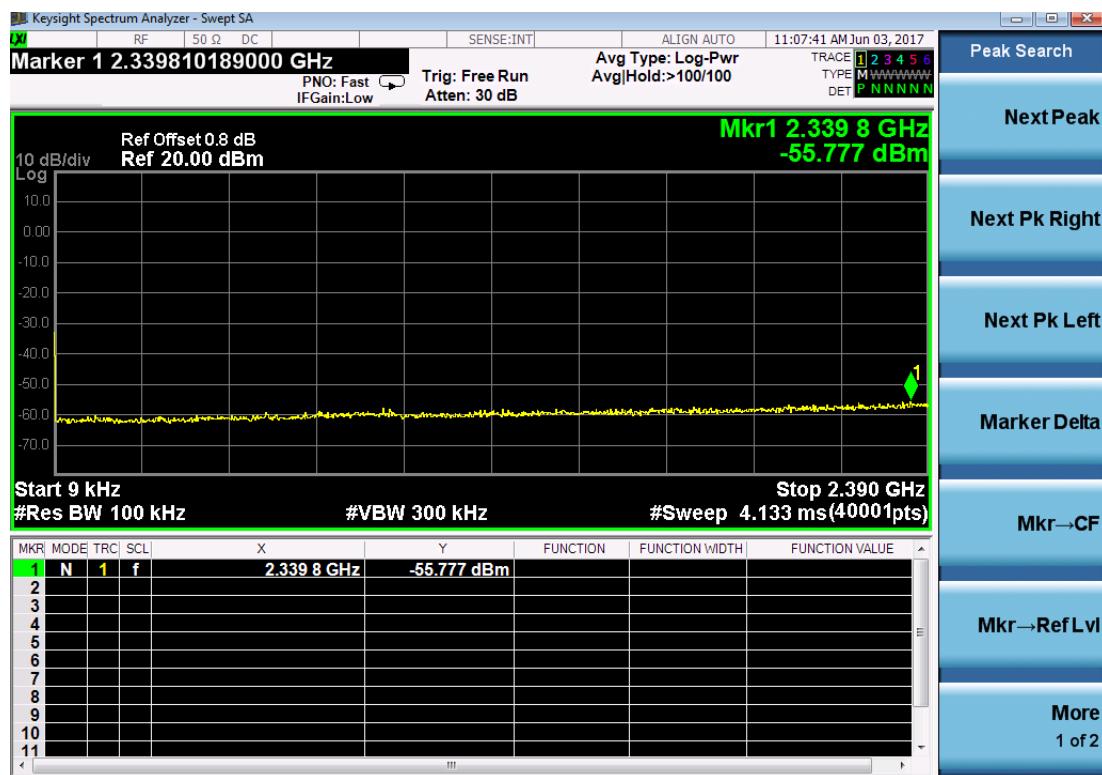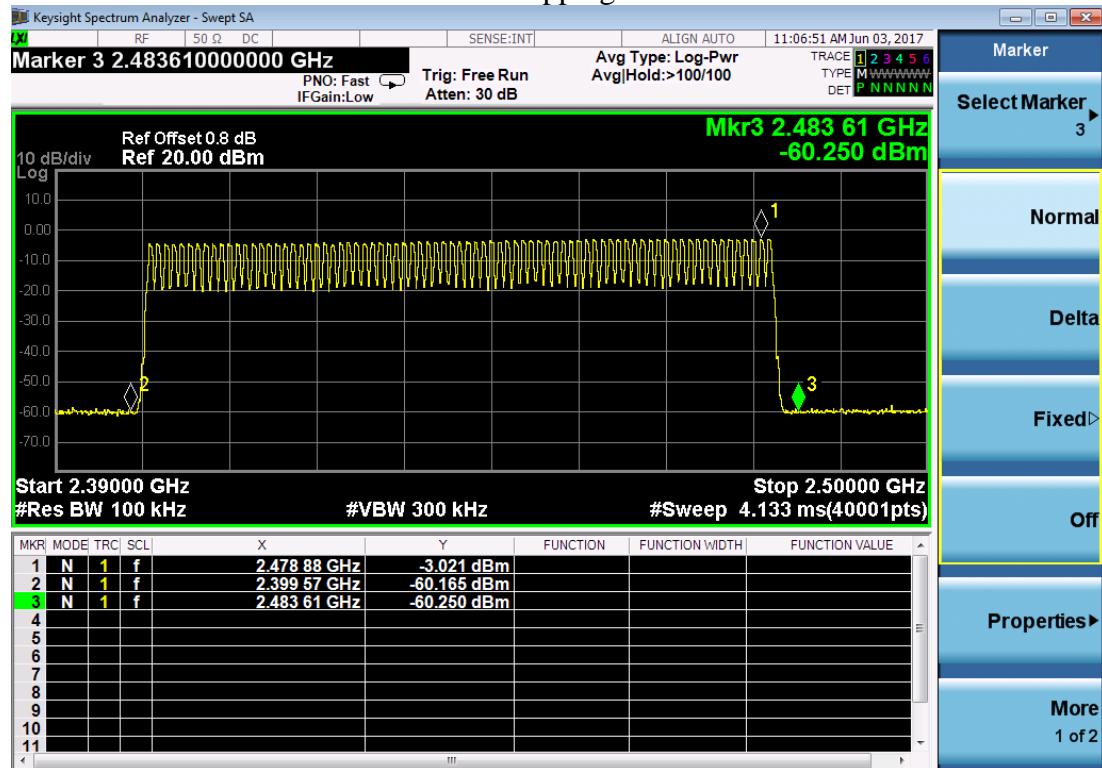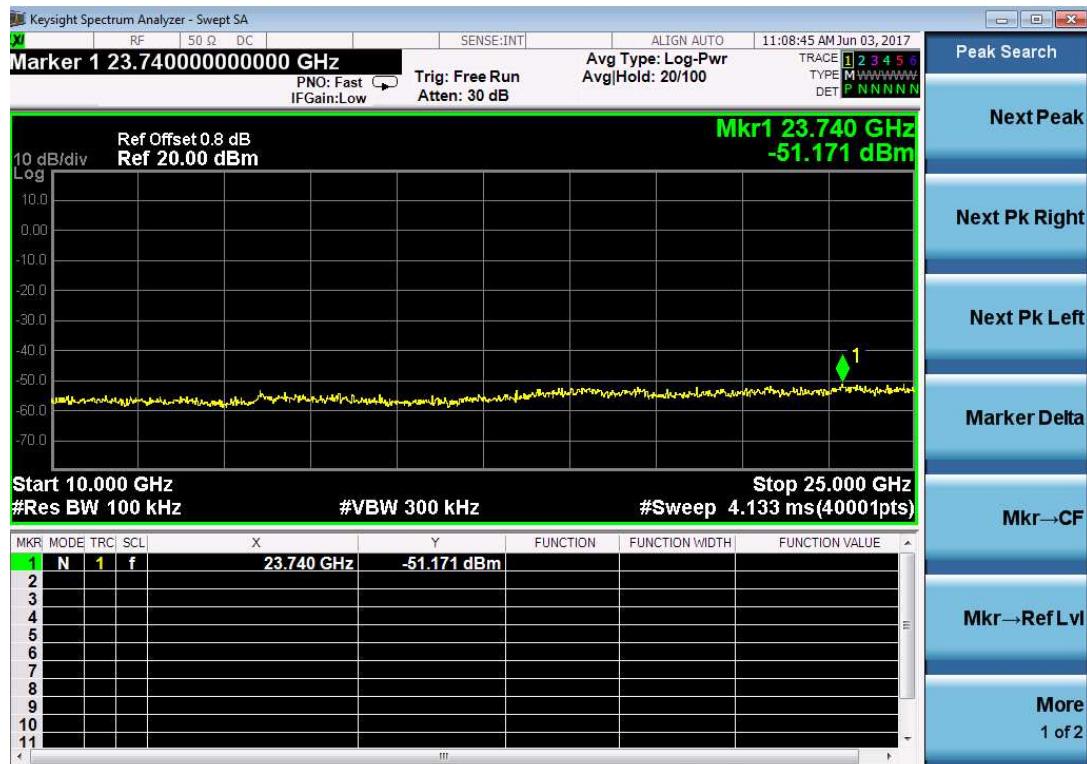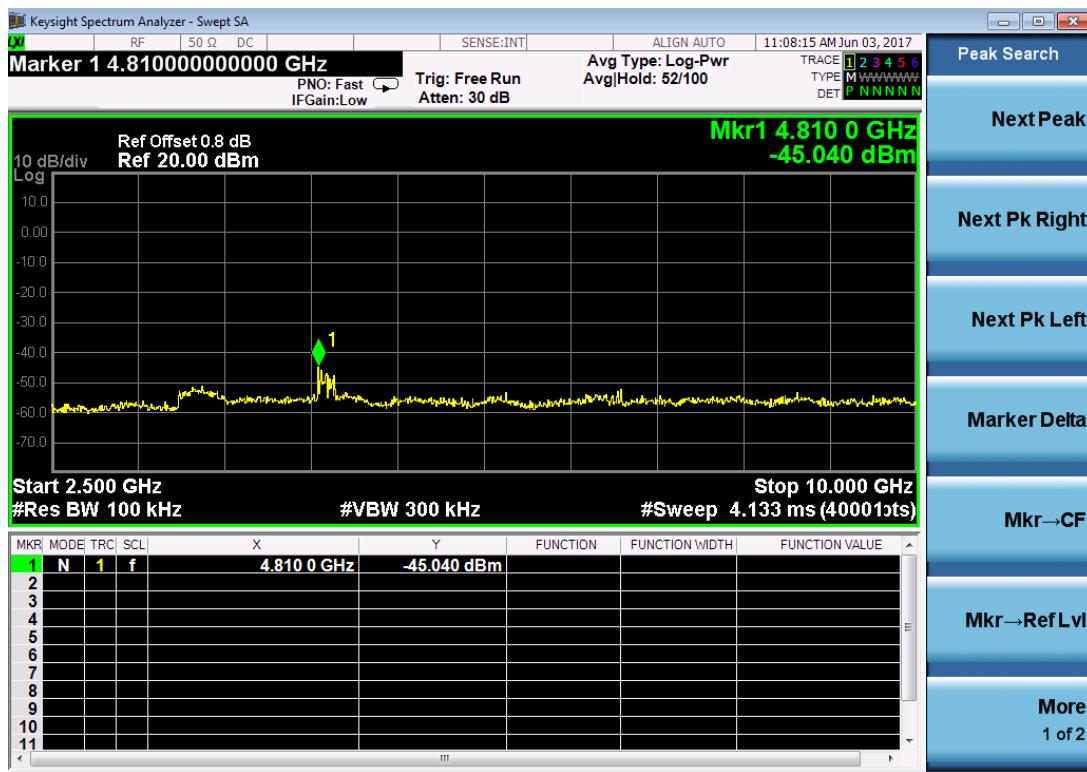
8. Power line conducted emission

Test result: **NA**

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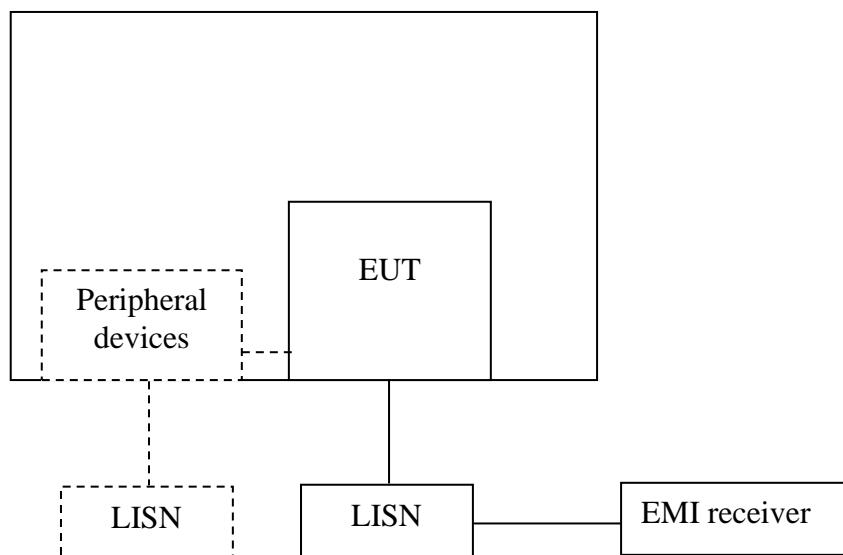
☒ For table top equipment, wooden support is 0.8m height table

☐ 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	:	°C
Relative Humidity	:	%

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
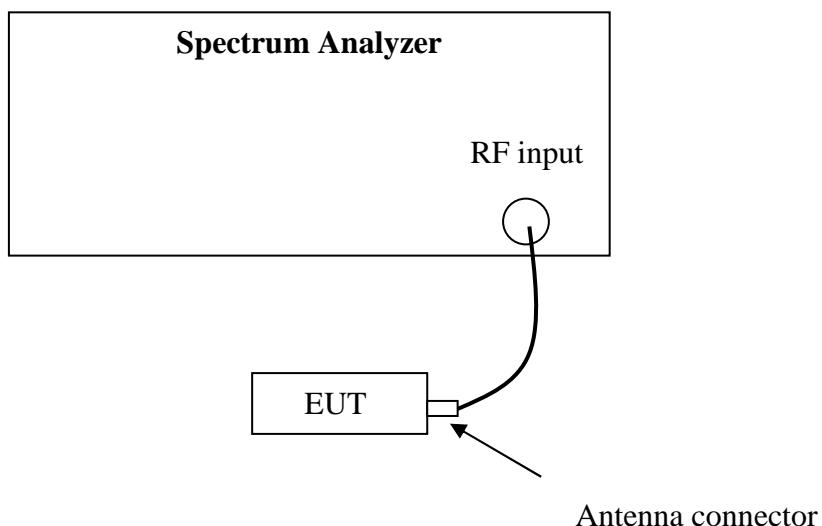
9.3 Test procedure and test setup

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

intertek
Total Quality. Assured.
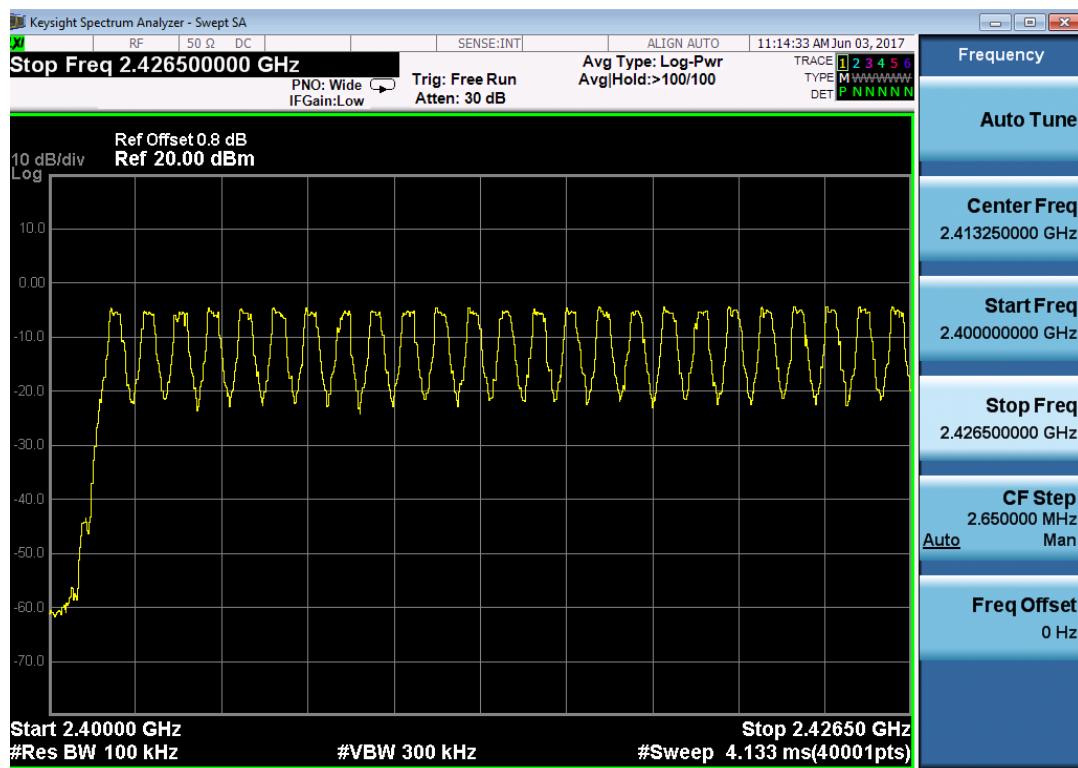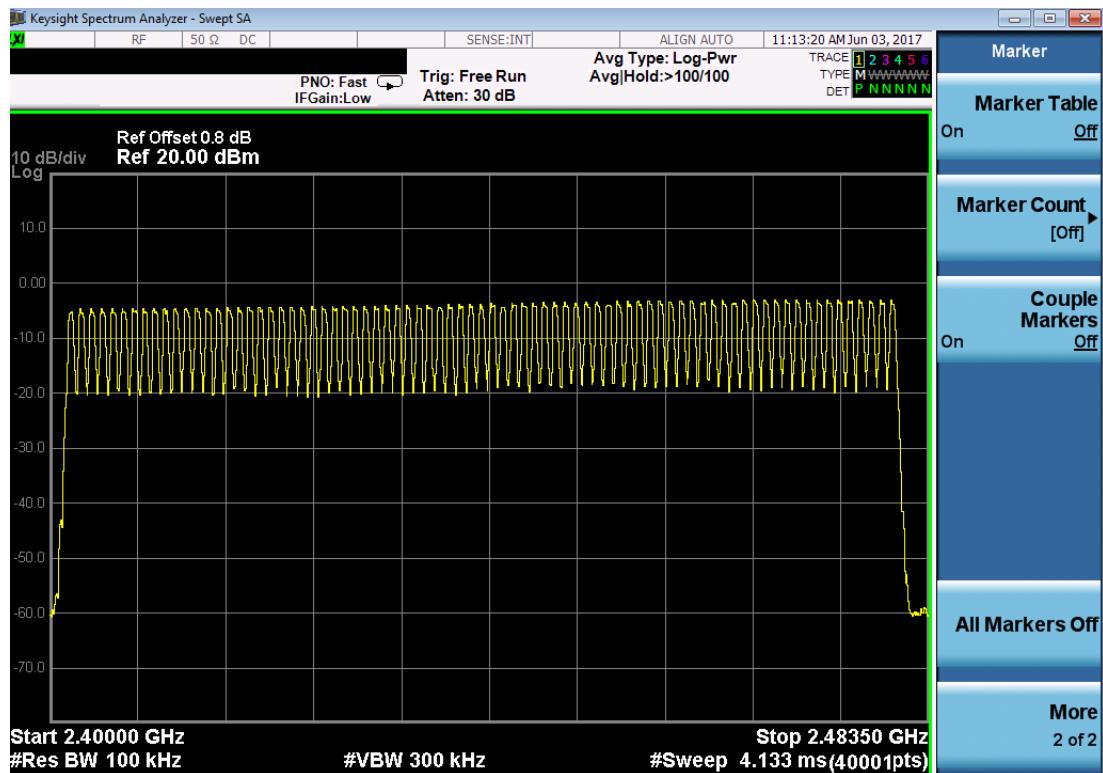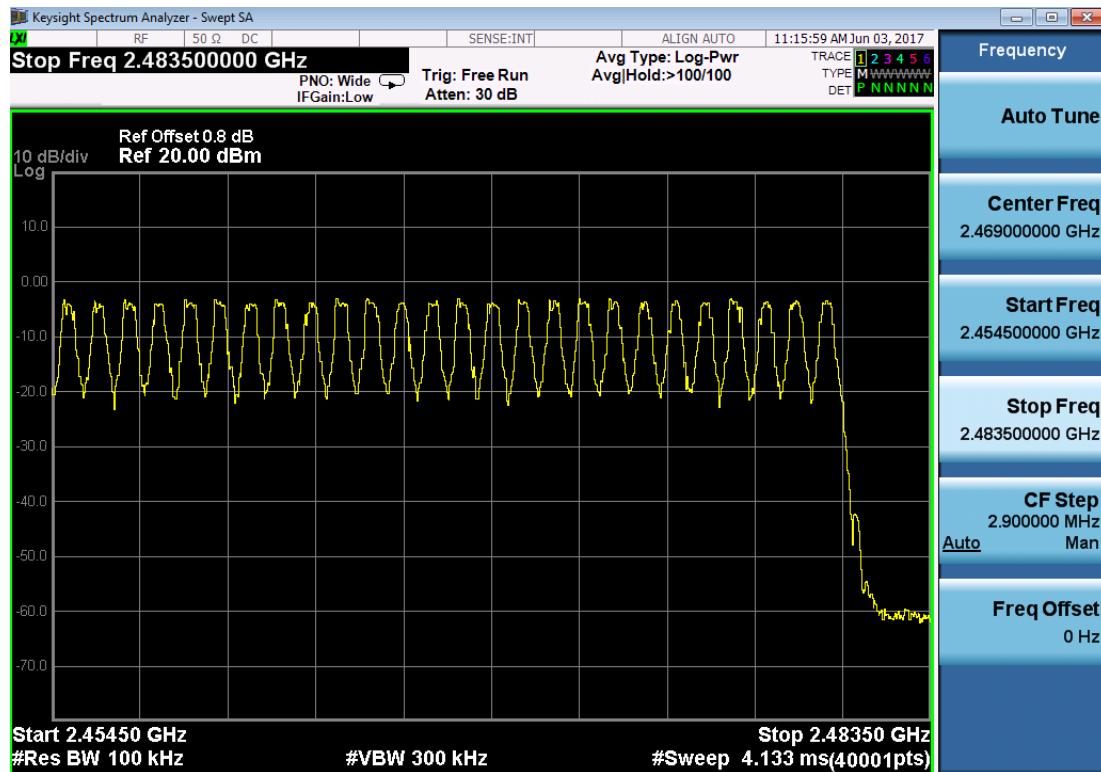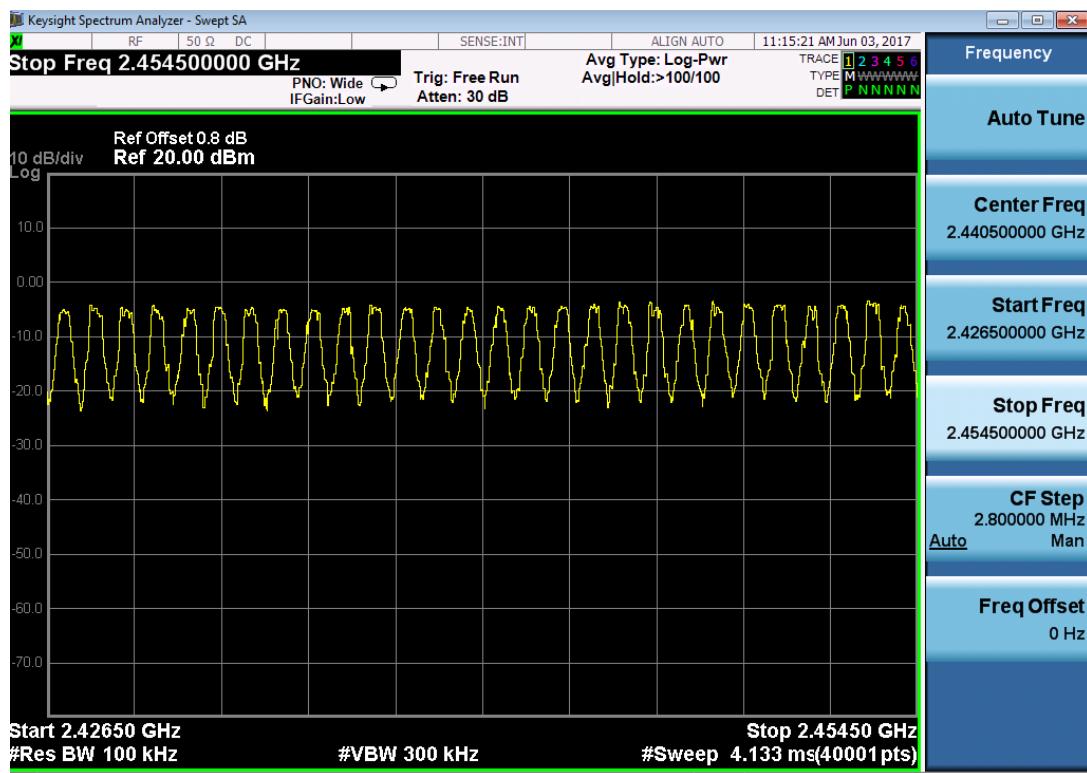
10. Dwell Time

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
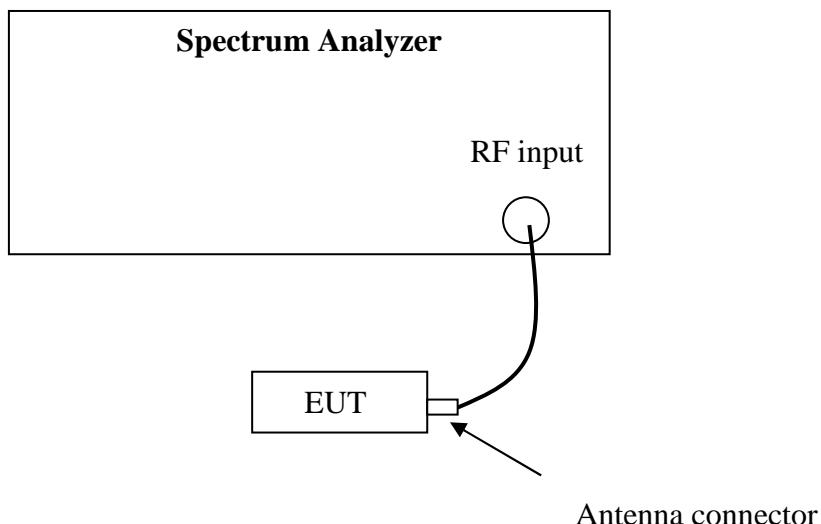
10.3 Test procedure and test setup

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 %

8DPSK Modulation:

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	0.426	L	3.16	31	132.06	
		M	3.16	31	132.06	
		H	3.16	31	132.06	
DH3	1.695	L	3.16	15	254.25	
		M	3.16	15	254.25	≤0.4
		H	3.16	15	254.25	
DH5	2.948	L	3.16	11	324.48	
		M	3.16	11	324.48	
		H	3.16	11	324.48	

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

DH3

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DH5

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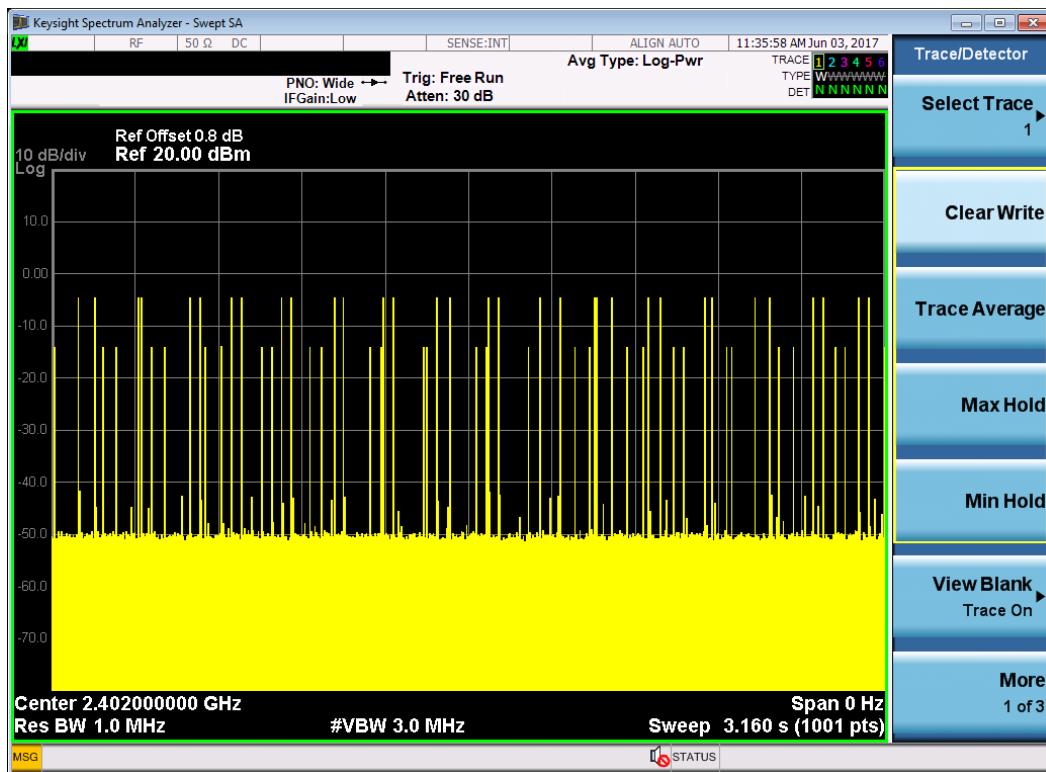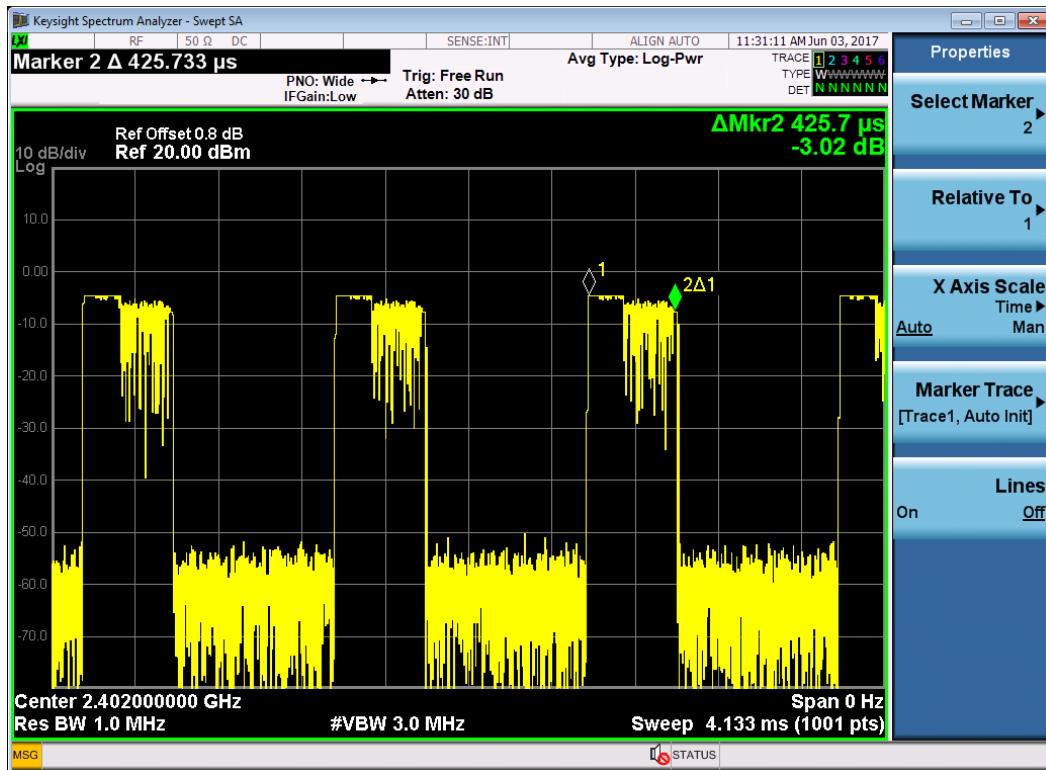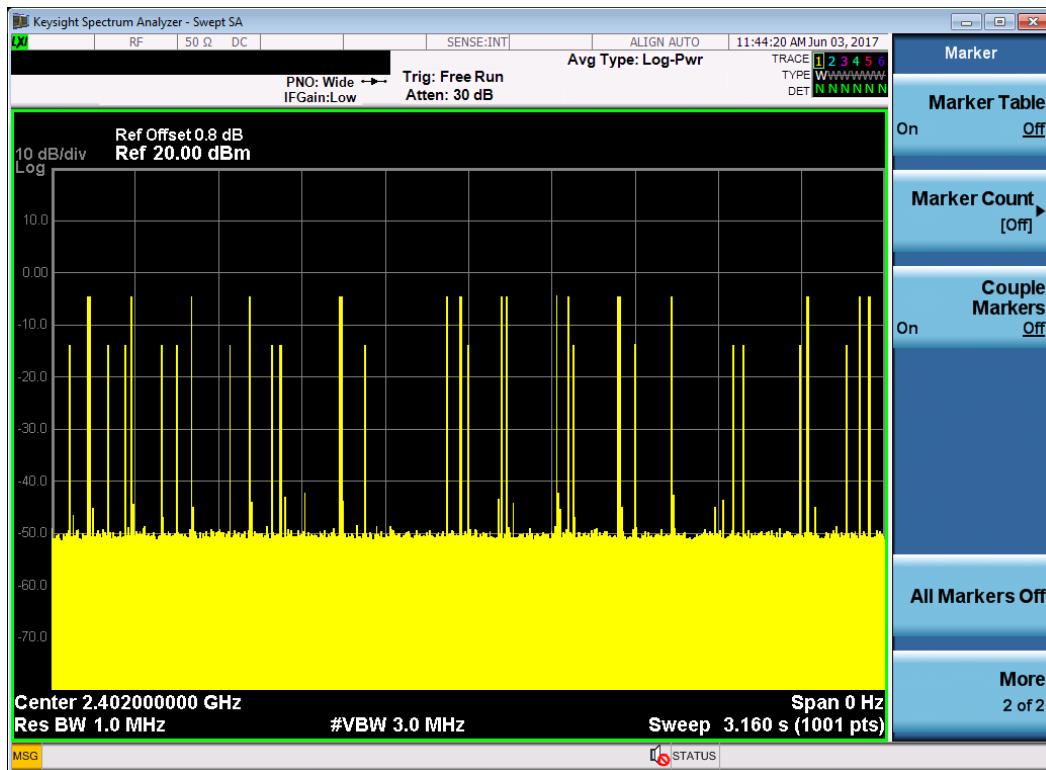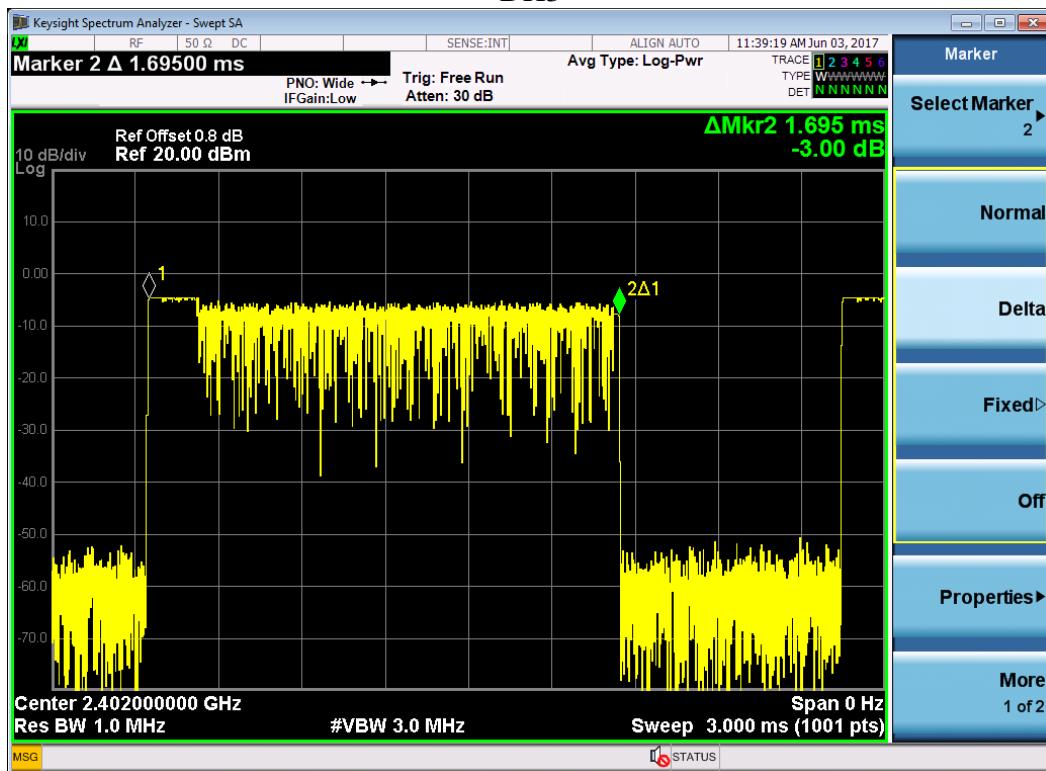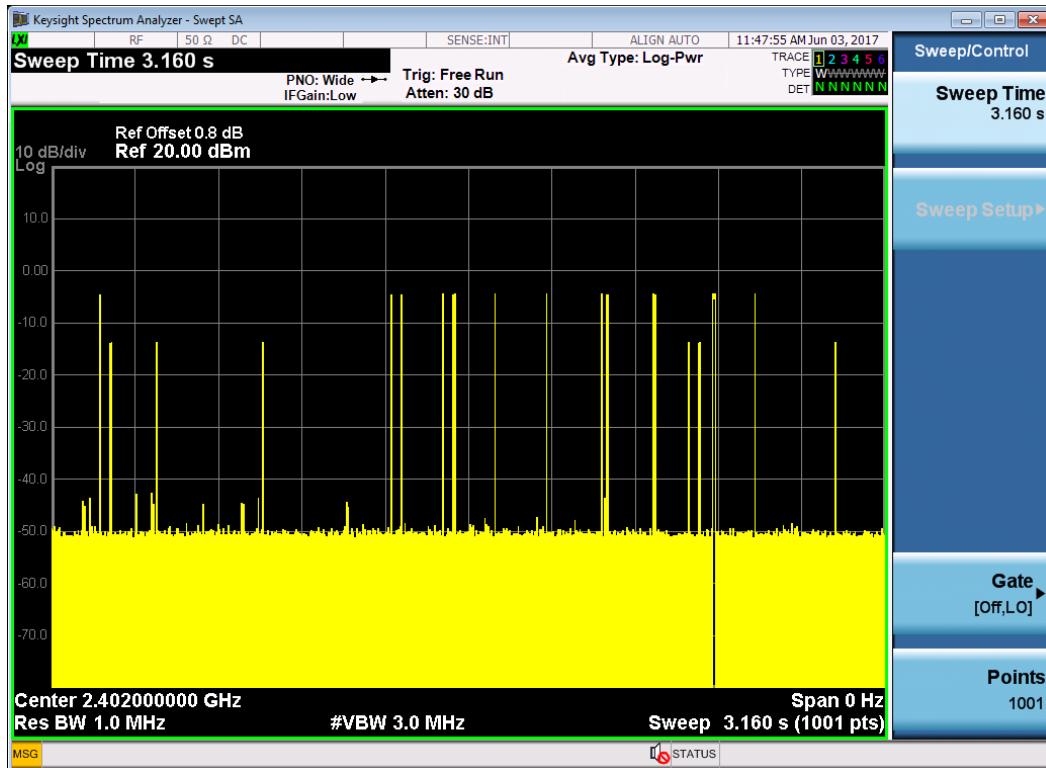
11. Occupied Bandwidth

Test result: **Tested**

11.1 Test limit

 None

11.2 Test Configuration
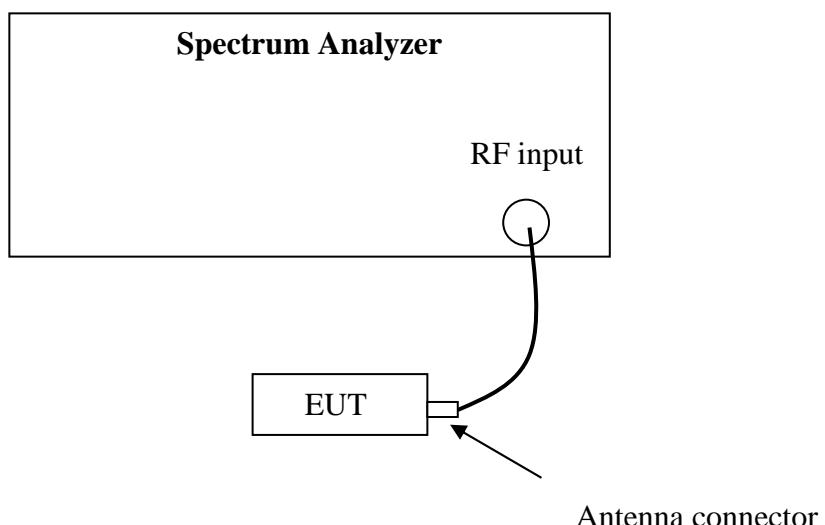
11.3 Test procedure and test setup

The occupied bandwidth per RSS-Gen Issue 4 Clause 6.6 was measured using the Spectrum Analyzer with the RBW in the range of 1% to 5% of the occupied bandwidth (OBW) , VBW = 3 * RBW Detector = peak hold.

11.4 Test protocol

Temperature   :   25 °C
Relative Humidity   :   55 %

Modulation	Channel	99% Occupied Bandwidth (kHz)
GFSK	L	1152
	M	1146
	H	1182

Channel L
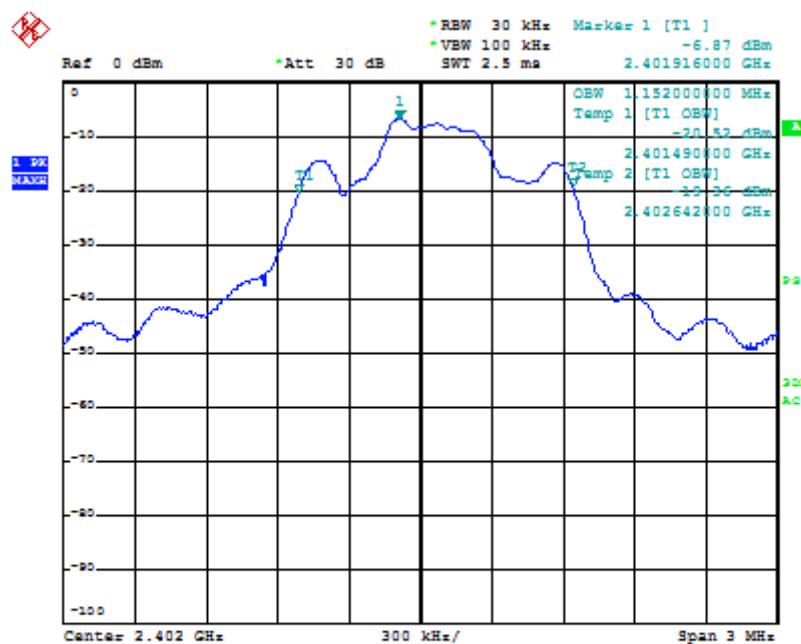
Date: 1.JUN.2017   12:44:45

Channel M
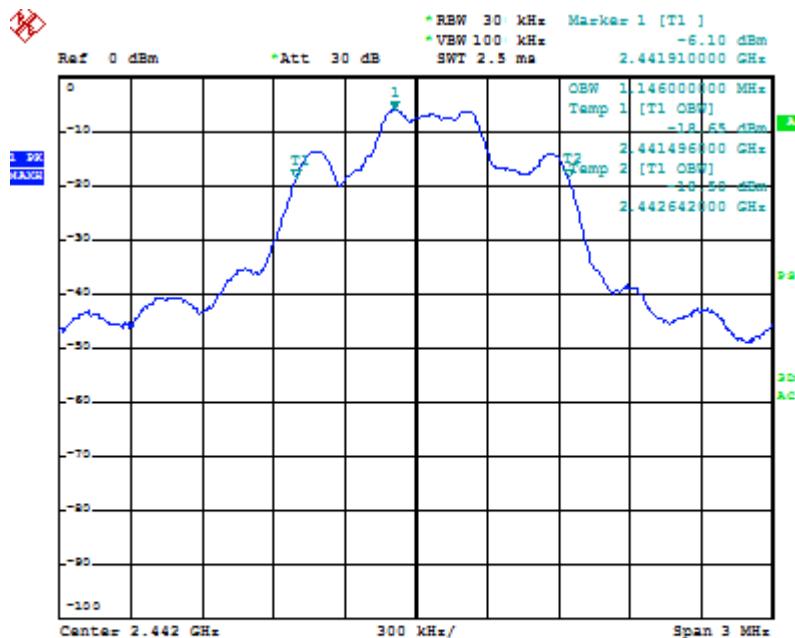
Date: 1.JUN.2017   12:47:34

Channel H
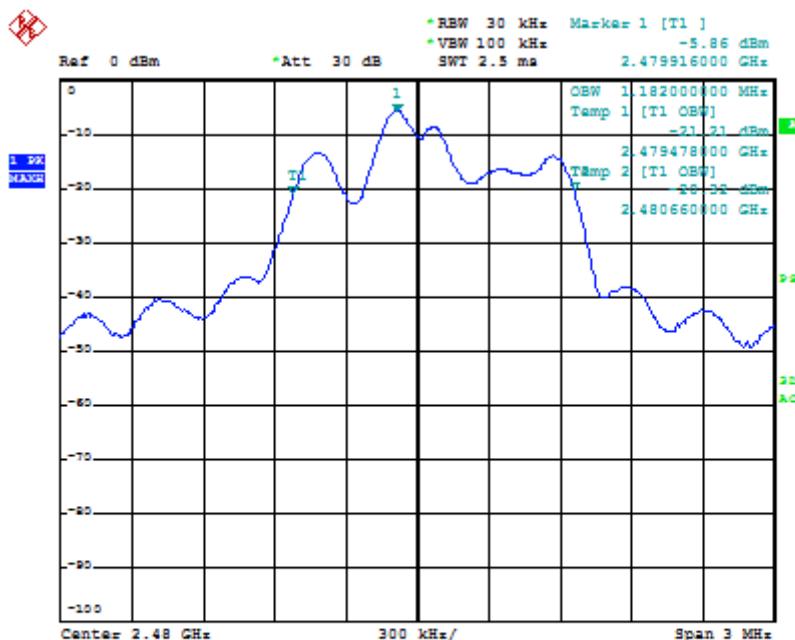
Date: 1.JUN.2017   12:49:57

Modulation	Channel	99% Occupied Bandwidth (kHz)
π /4 DQPSK	L	1182
	M	1188
	H	1182

Channel L
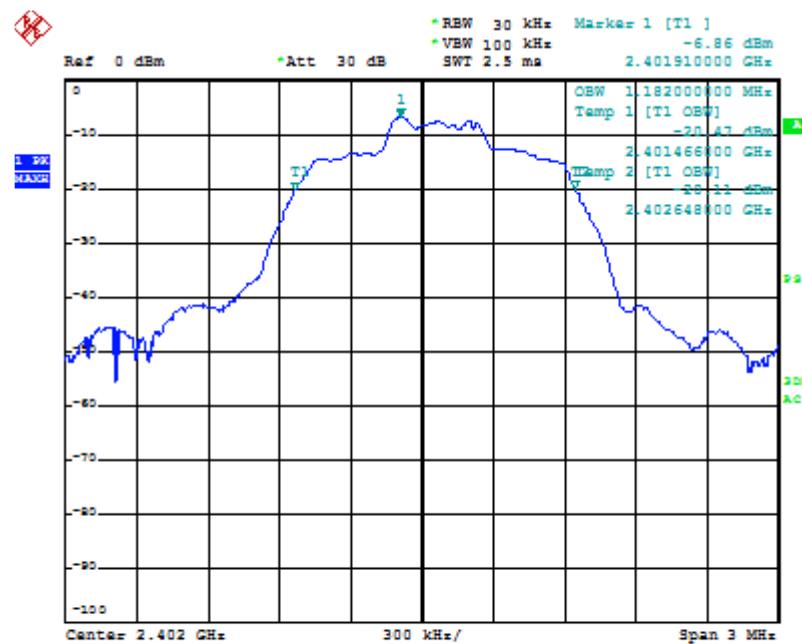
Date: 1.JUN.2017 12:53:06

Channel M
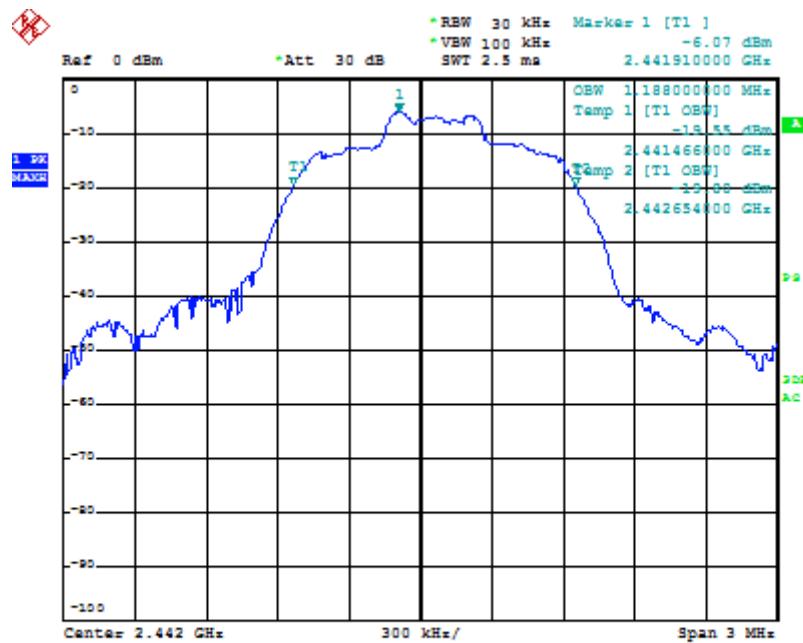
Date: 1.JUN.2017 12:54:58

Channel H
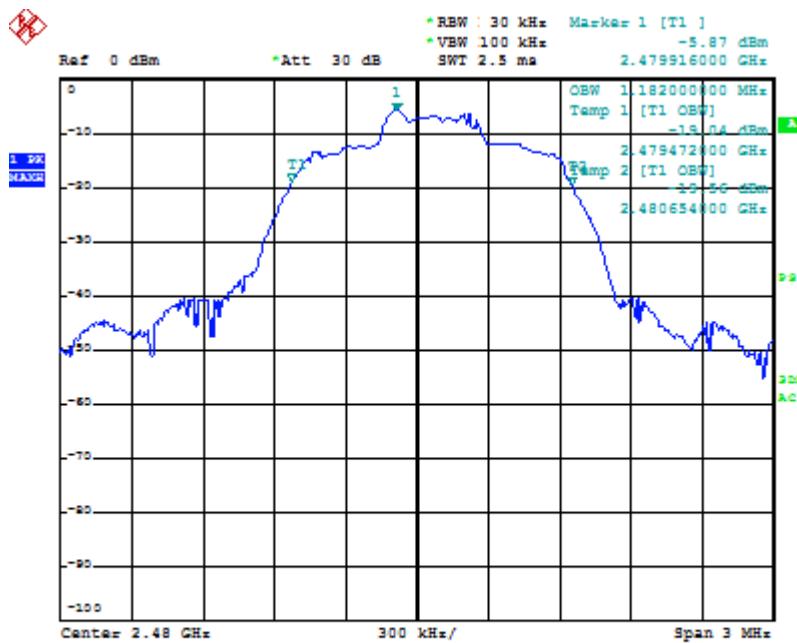
Date: 1.JUN.2017 12:56:14

| Modulation	Channel	99% Occupied Bandwidth (kHz)
8DPSK	L	1182
	M	1182
	H	1188

Channel L
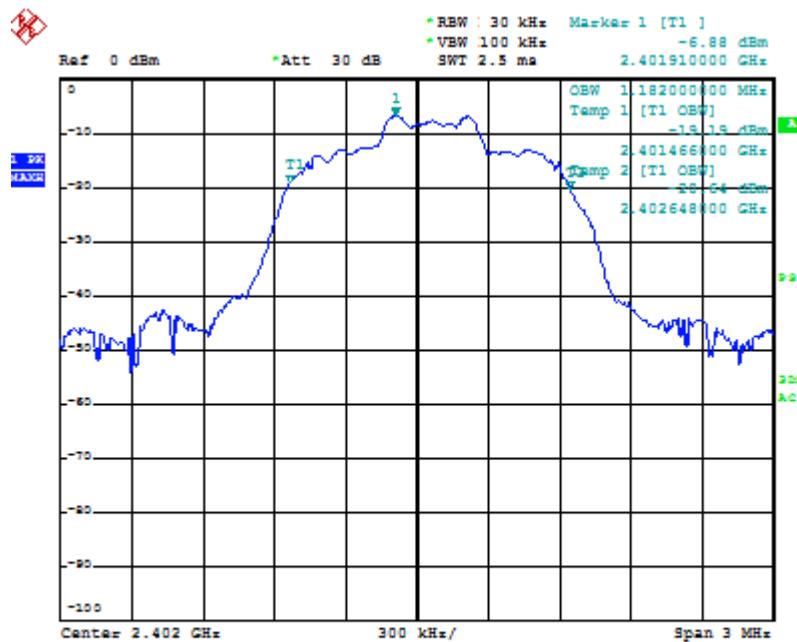
Date: 1.JUN.2017   12:57:45

Channel M

Date: 1.JUN.2017   12:59:00

Channel H

Date: 1.JUN.2017   13:00:19

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