

# TEST REPORT

## Part 15 Subpart C 15.247

**Equipment under test** Watchdog

**Model name** BTSW-100

**Variant model** Watchdog

**FCC ID** S4KBTSW-100

**Applicant** EDAM Information & Communications Co., Ltd.

**Manufacturer** EDAM Information & Communications Co., Ltd.

**Date of test(s)** 2013.02.27 ~ 2013.03.20

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**Issued to**

**EDAM Information & Communications Co., Ltd.**

(Geumjeong-dong, Hanlim Venture Town, 689-6), 601, 284, Gongdan-ro, Gunpo-si,  
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### Revision history

Revision	Date of issue	Test report No.	Description
-	2013.03.26	KES-RF-F130003	Initial

## TABLE OF CONTENTS

1.0	General product description .....	4
1.1	Test frequency .....	4
1.2	Information about variant model .....	4
1.3	Device modifications .....	4
1.4	Device Information .....	4
1.4	Test facility .....	4
1.5	Laboratory accreditations and listings .....	4
2.0	Summary of tests .....	5
2.1	Test data .....	6
2.1.1	Pre-scanned output power .....	6
2.1.2	Peak power output power .....	6
2.1.3	Conducted spurious emission & band edge .....	11
2.1.4	20 dB bandwidth .....	21
2.1.5	Frequency separation .....	26
2.1.6	Number of hopping frequency .....	28
2.1.7	Time of occupancy (Dwell time) .....	31
2.1.8	Radiated spurious emission & band edge .....	36
2.1.9	AC conducted emissions .....	49
Appendix A.	Test equipment used for test .....	52
Appendix B.	Test setup photo .....	53



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### 1.0 General product description

Equipment under test	Watchdog
Model name	BTSW-100(Variant model : Watchdog)
Serial number	N/A
Frequency Range	2 402 MHz ~ 2 480 MHz(Bluetooth BDR & EDR)
Modulation technique	GFSK, 8DPSK
Number of channels	79(Bluetooth BDR & EDR)
Antenna type & gain	Fixed type(FPCB antenna) // -1.141 dBi
Power source	DC 3.7 V

### 1.1 Test frequency

	Low channel	Middle channel	High channel
Frequency (MHz)	2 402	2 441	2 480

### 1.2 Information about variant model

Variant model (Watchdog) is same as basic model (BTSW-100) for hardware, software and mechanical.

### 1.3 Device modifications

N/A

### 1.4 Test facility

C3701 Dongil Techno Town, 889-1, Gwanyang 2-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea  
477-6, Hageo-ri, Yeoju-eup, Yeoju-gun, Gyeonggi-do, 469-803, Korea

The open area test site is constructed in conformance with the requirements ANSI C63.4-2003.

### 1.5 Laboratory accreditations and listings

Country	Agency	Scope of accreditation	Certificate No.
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	KC	EMI (10 meter Open Area Test Site and two conducted sites) Radio (3 & 10 meter Open Area Test Sites and one conducted site)	KR0100
CANADA	IC	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1



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### 2.0 Summary of tests

Section in FCC Part 15	Parameter	Status
15.247(b)(1)	Peak output power	C
15.247(d)	Conducted spurious emission and band edge	C
15.247(a)(1)	20 dB bandwidth	C
15.247(a)(1)	Frequency separation	C
15.247(a)(1)(iii)	Number of hopping frequency	C
15.247(a)(1)(iii)	Time of occupancy(Dwell time)	C
15.205 15.209	Radiated spurious emission and band edge	C
15.207	AC conducted emission	C

Note 1: C=Complies    NC=Not complies    NT=Not tested    NA=Not applicable

### Statement:

The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) and the guidance provided in FCC OET Public notice DA 00-705 were used in the measurement of the DUT.

## 2.1 Test data

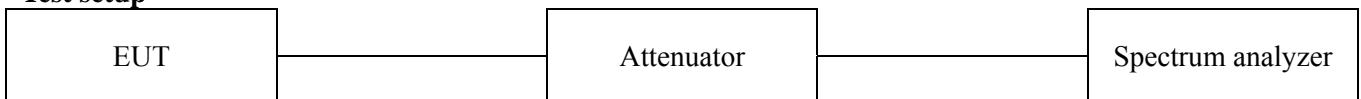
### 2.1.1 Pre-scanned output power

Preliminary tests were performed in different data rate as below table and the highest power data rates(1 Mbps, 2 Mbps, 3Mbps) were chosen for full test in the following section to demonstrate compliance to the FCC limit line.

Data rate	1 Mbps(GFSK)	2 Mbps( $\pi/4$ -DQPSK)	3 Mbps(8DPSK)
Output power(dBm)	<b>5.74</b>	4.24	<b>4.54</b>

### 2.1.2 Peak power output power

#### Test setup



#### Test procedure

1. Use the following spectrum analyzer setting

Center frequency: Lowest, middle and highest channels

Span = 25 MHz

RBW = 3 MHz

VBW = 3 MHz ( $\geq$  RBW)

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.

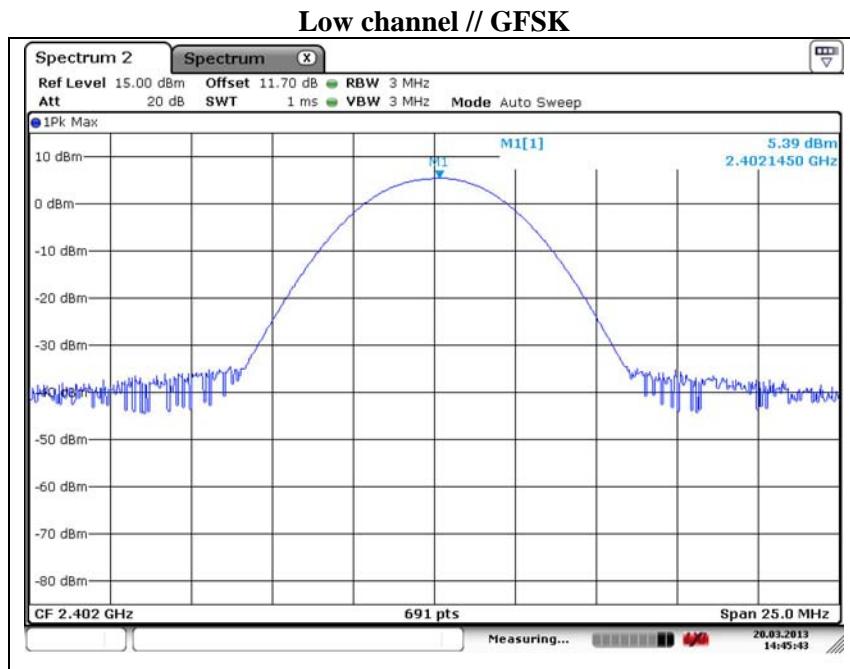
The indicated level is the peak output power.

#### Limit

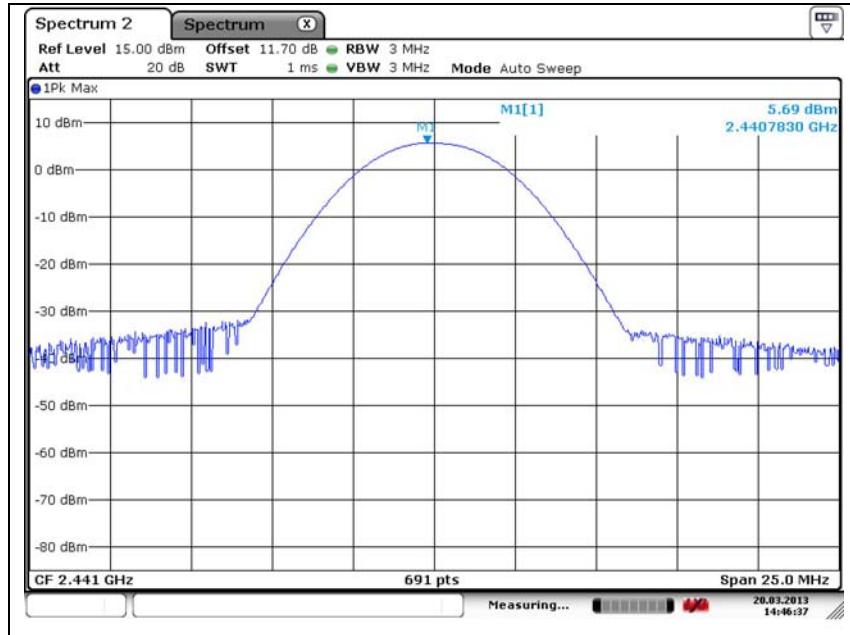
According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz band: 1 Watt.

### Test results

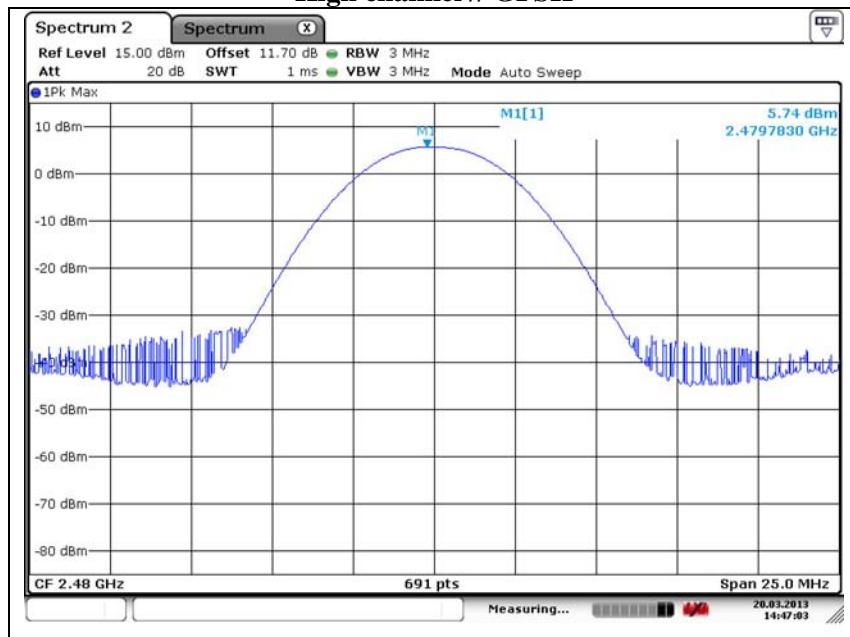
Operation mode	Frequency(MHz)	Output power (dBm)	Limit (dBm)
GFSK	2 402	5.39	30
	2 441	5.69	30
	2 480	5.74	30
8DPSK	2 402	3.80	30
	2 441	4.45	30
	2 480	4.54	30



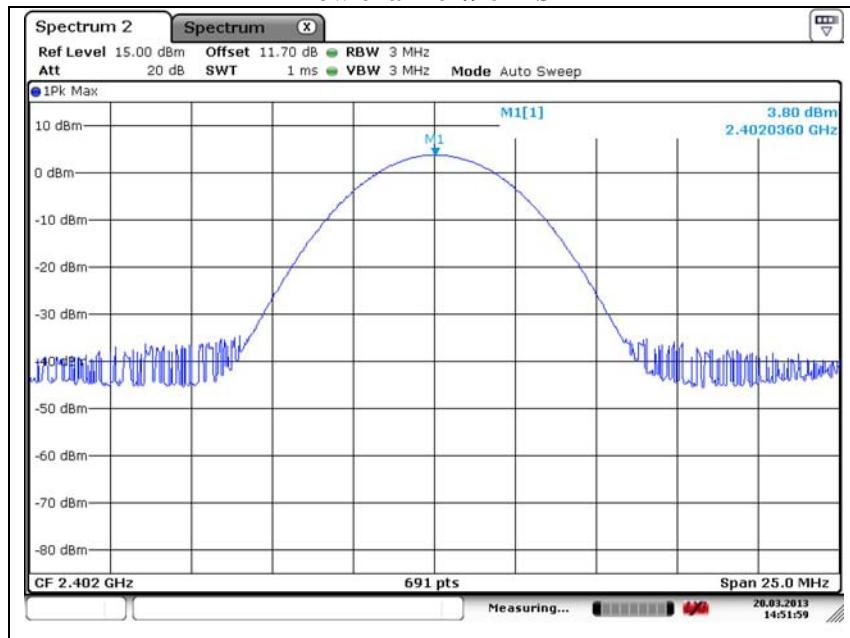
### Middle channel // GFSK



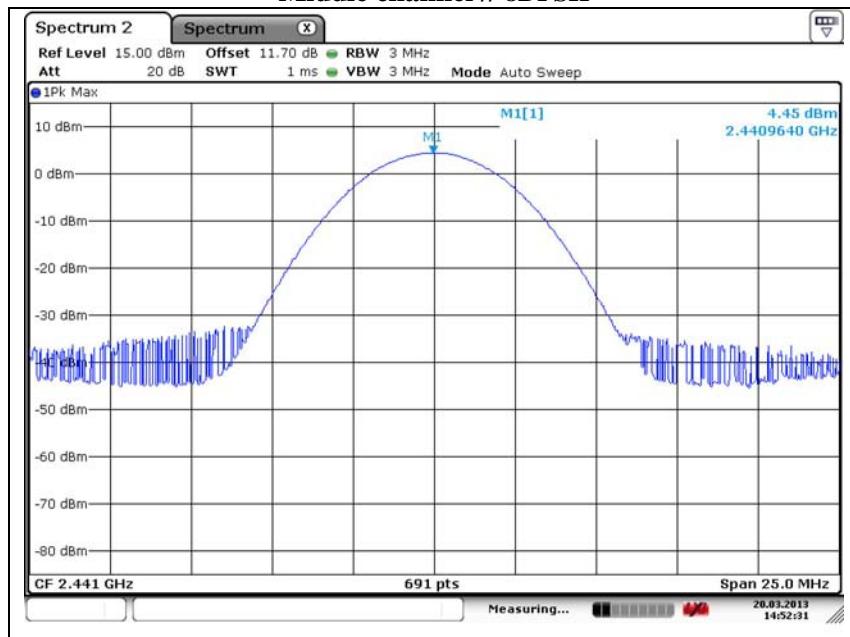
### High channel // GFSK



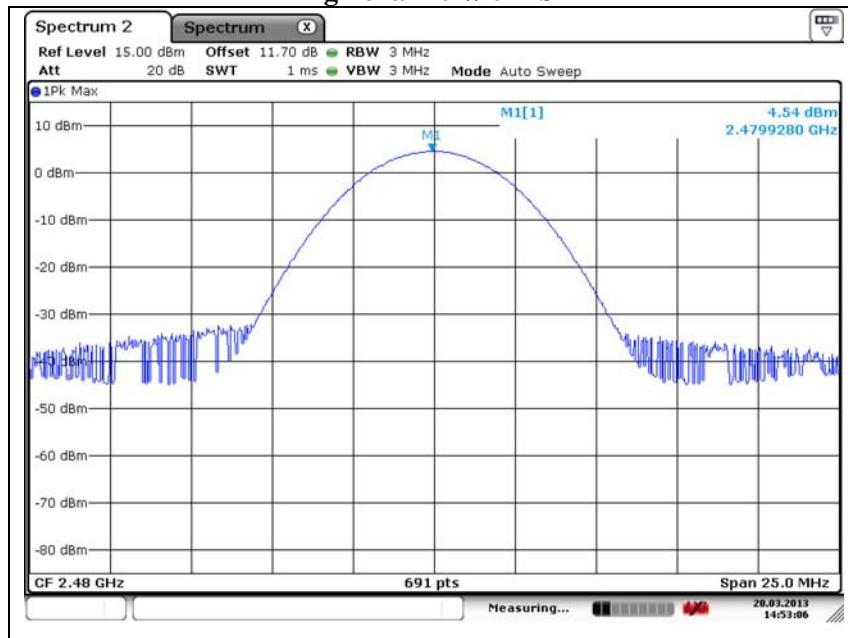
### Low channel // 8DPSK



### Middle channel // 8DPSK

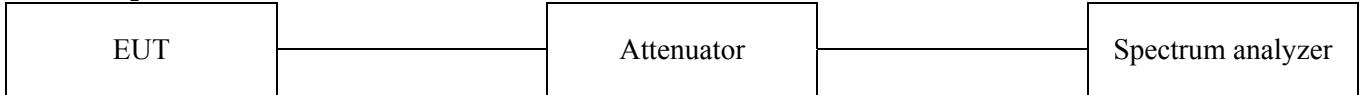


### High channel // 8DPSK



### 2.1.3 Conducted spurious emission & band edge

#### Test setup



#### Test procedure for band edge

1. Use the following spectrum analyzer setting  
 Center frequency: Low, middle and high channel.  
 Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.  
 RBW = 100 kHz  
 VBW = 100 kHz ( $\geq$  RBW)  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold
2. Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation on product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission

#### Test procedure for spurious emission

1. Use the following spectrum analyzer setting  
 Center frequency: Low, middle and high channel.  
 Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.  
 RBW = 100 kHz  
 VBW = 100 kHz ( $\geq$  RBW)  
 Sweep = auto  
 Detector function = peak  
 Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.



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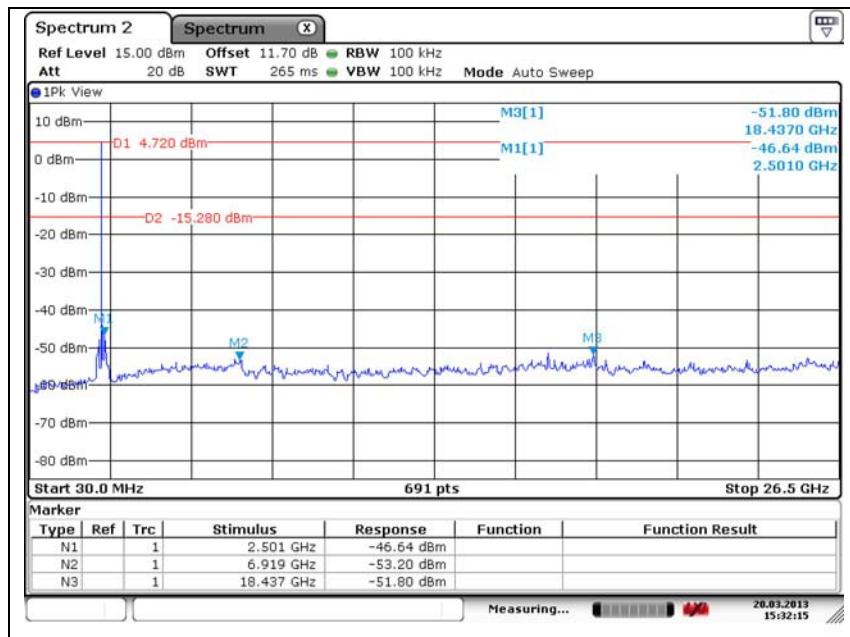
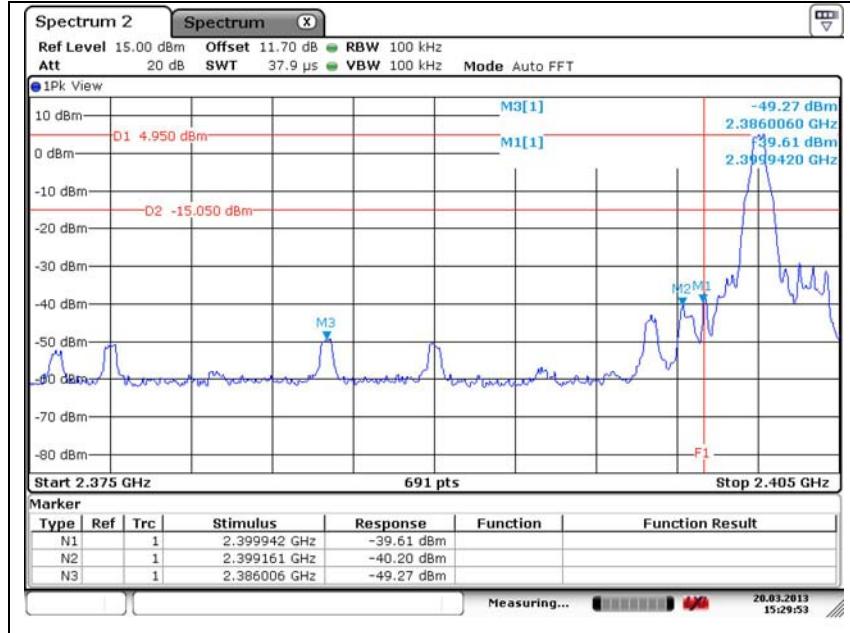
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### Limit

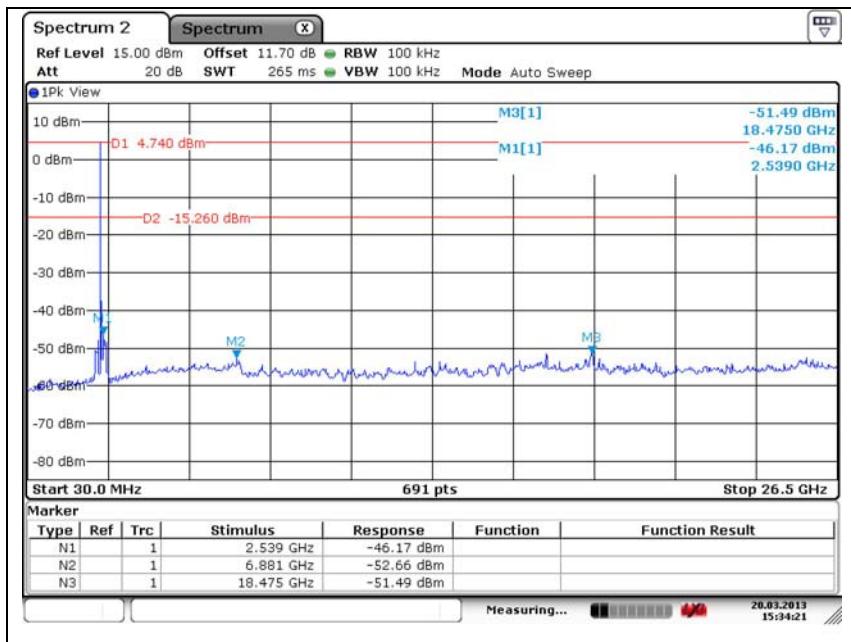
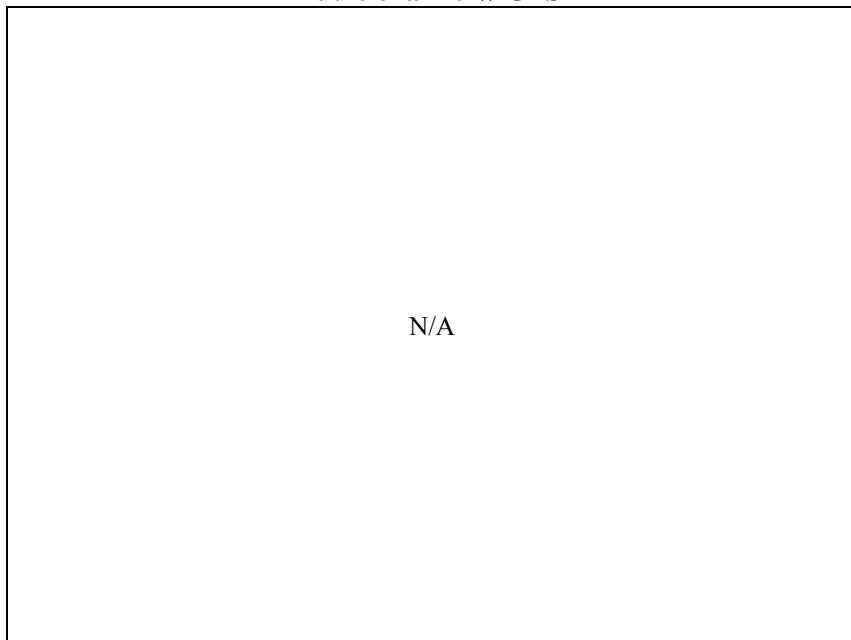
According to 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval , as permitted under paragraph(b)(3) of this section , the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))

## Test results

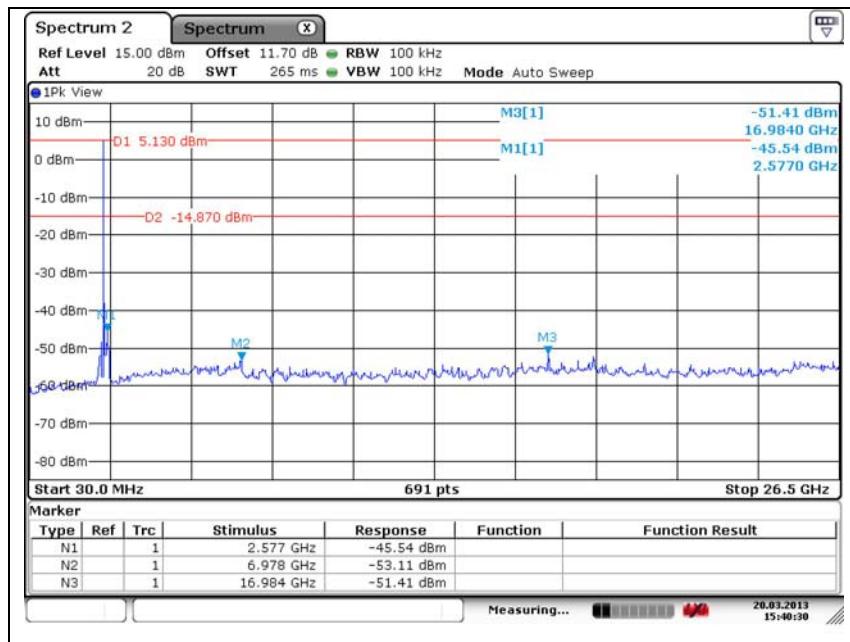
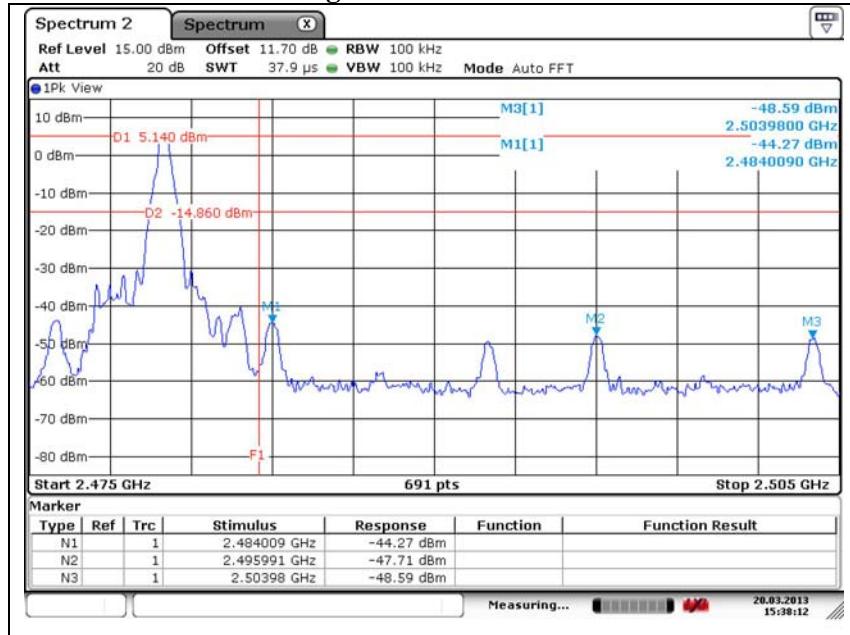
### Low channel // GFSK



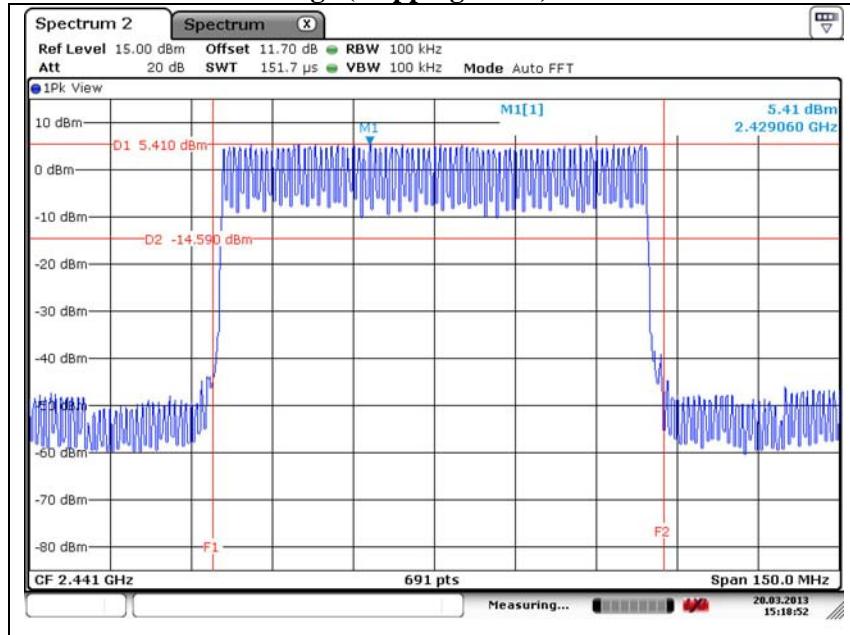
**Middle channel // GFSK**



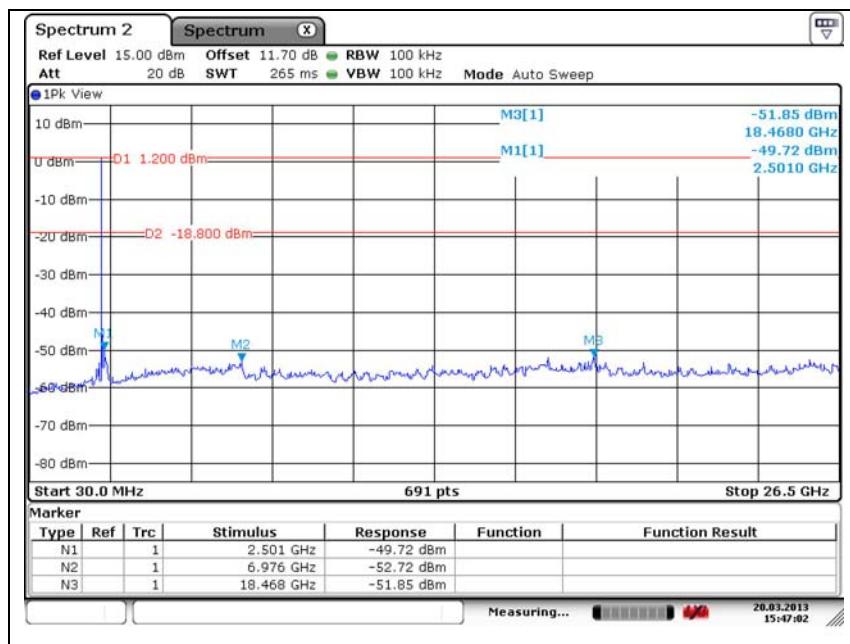
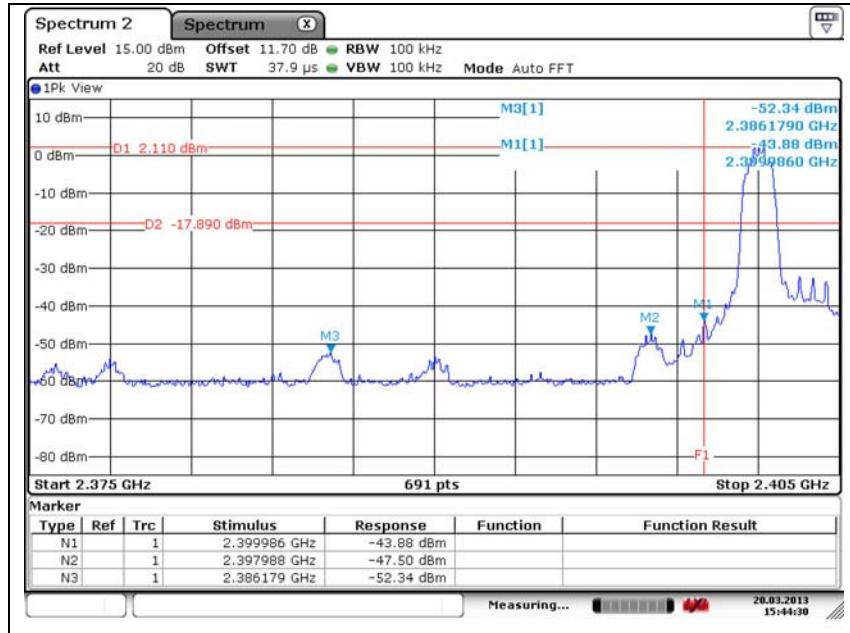
### High channel // GFSK



**Band edge (Hopping mode) // GFSK**

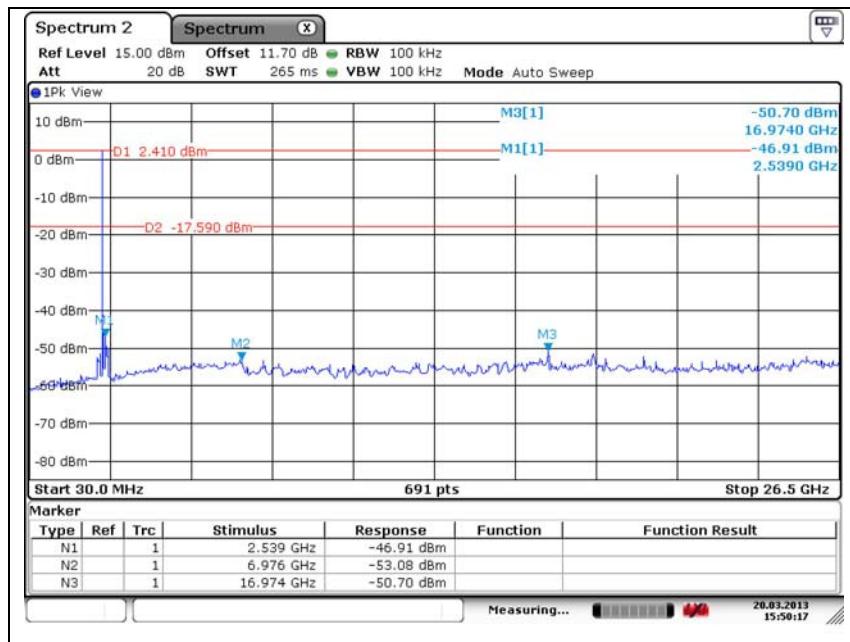


**Low channel // 8DPSK**

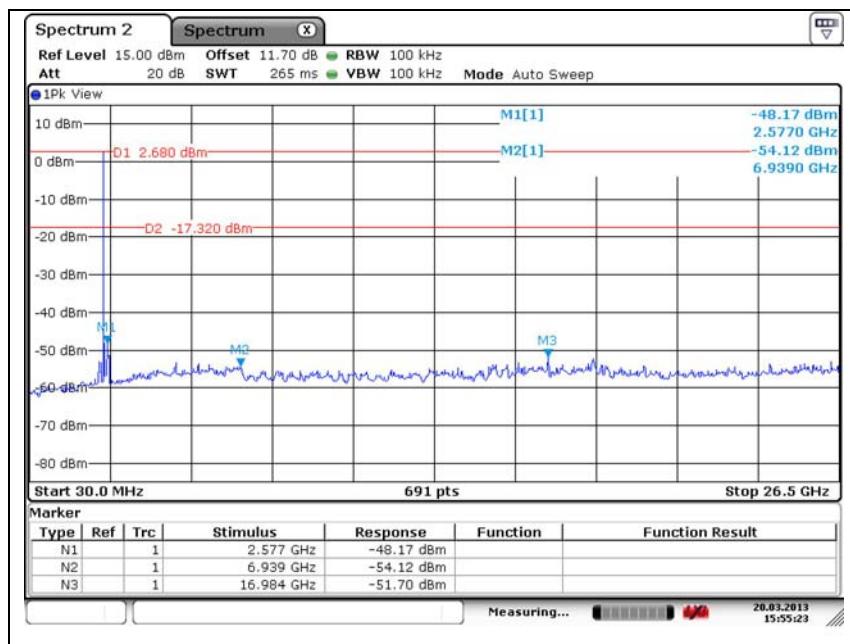
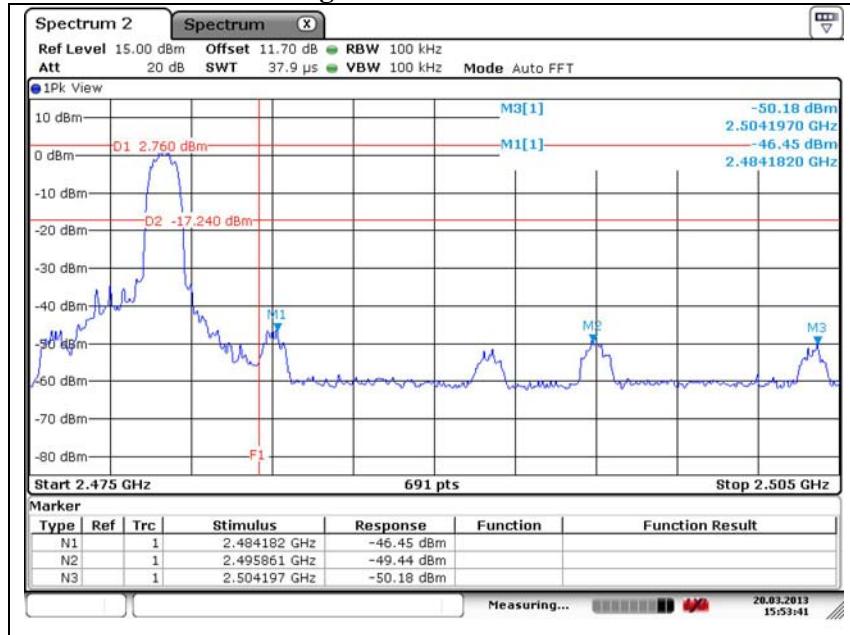


**Middle channel // 8DPSK**

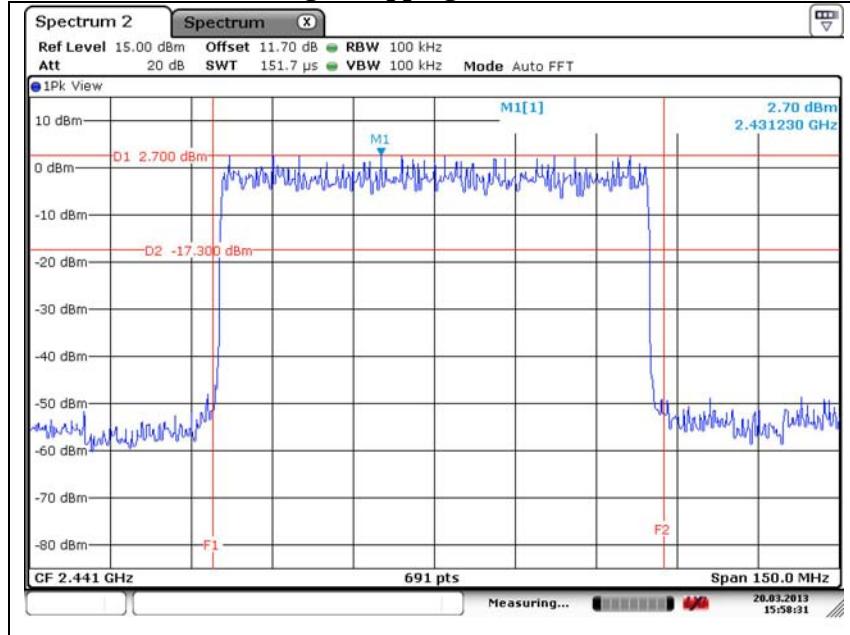
N/A



### High channel // 8DPSK

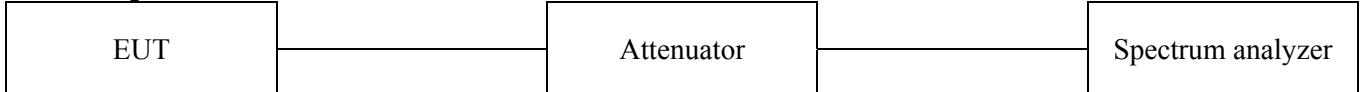


**Band edge (Hopping mode) // 8DPSK**



## 2.1.4 20 dB bandwidth

### Test setup



### Test procedure

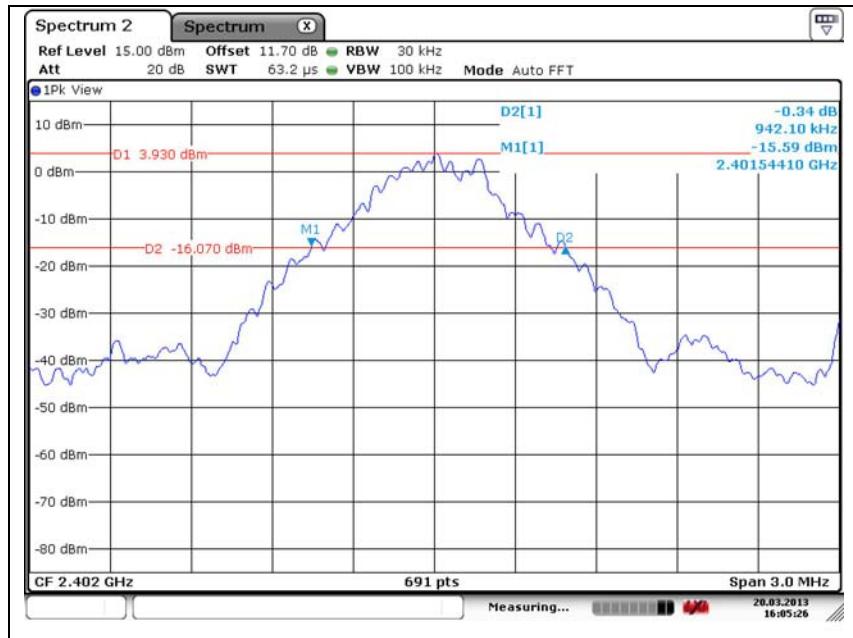
1. Use the following spectrum analyzer setting
  - Center frequency: Lowest, middle and highest channels
  - Span = 3 MHz (Approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel)
  - RBW = 30 kHz ( $\geq$  1% of the span)
  - VBW = 100 kHz ( $\geq$  RBW)
  - Sweep = auto
  - Detector function = peak
  - Trace = max hold
2. The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down on side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level.

### Limit

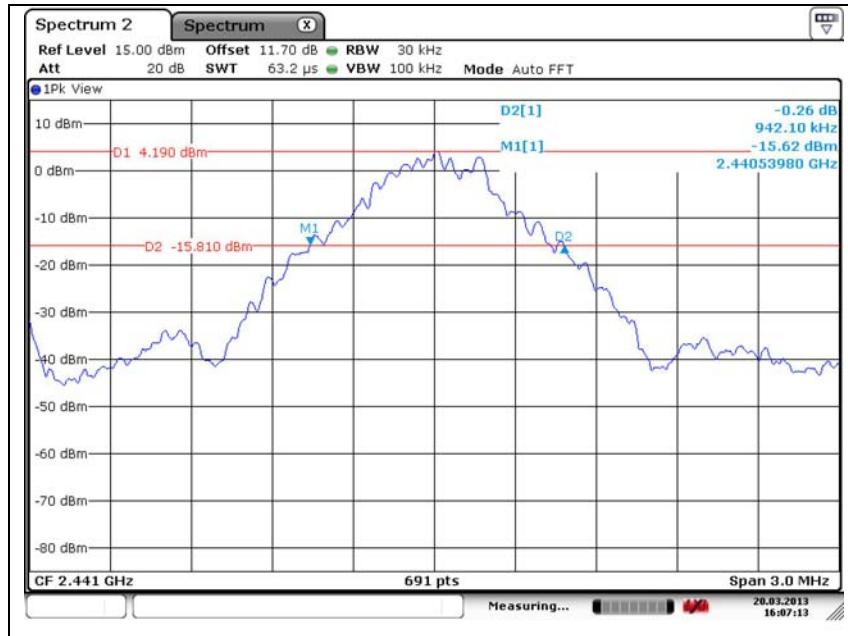
Not applicable

**Test results**

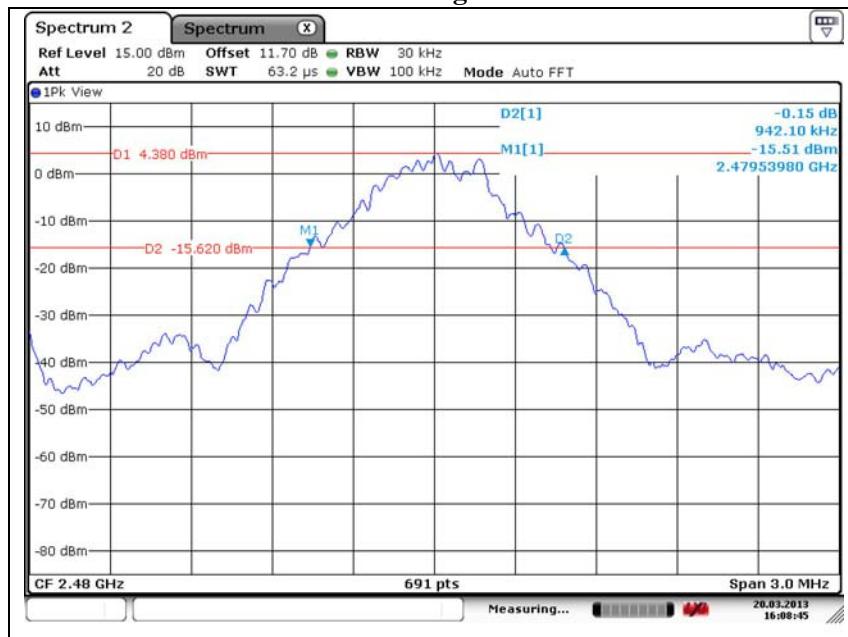
Operation mode	Frequency(MHz)	20 dB bandwidth(MHz)
GFSK	2 402	0.942
	2 441	0.942
	2 480	0.942
8DPSK	2 402	1.263
	2 441	1.259
	2 480	1.254

**20 dB bandwidth // Low channel // GFSK**


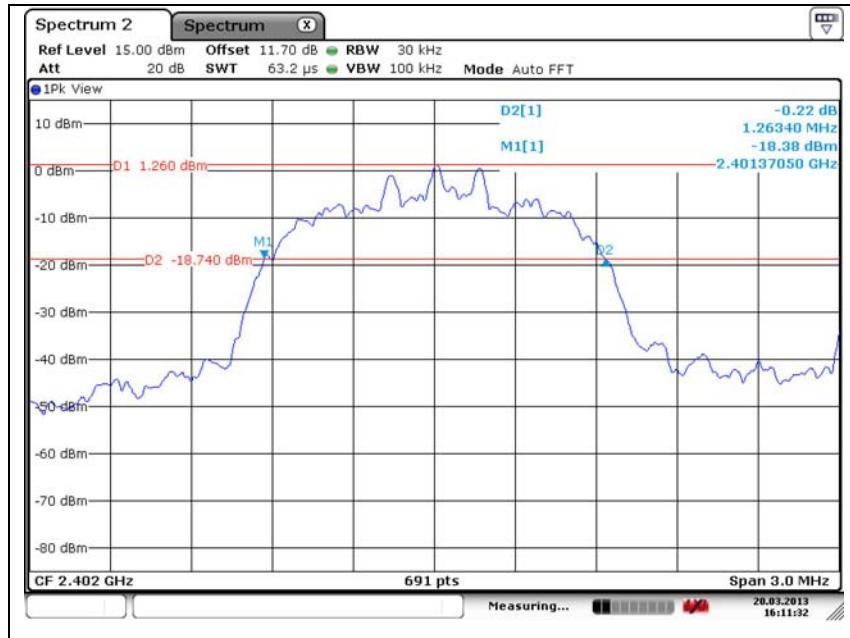
### 20 dB bandwidth // Middle channel // GFSK



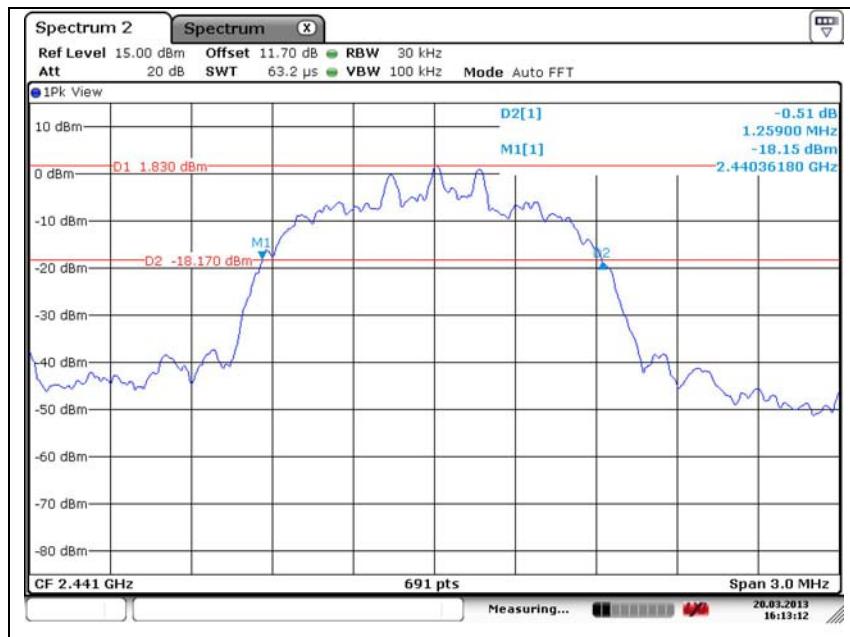
### 20 dB bandwidth // High channel // GFSK

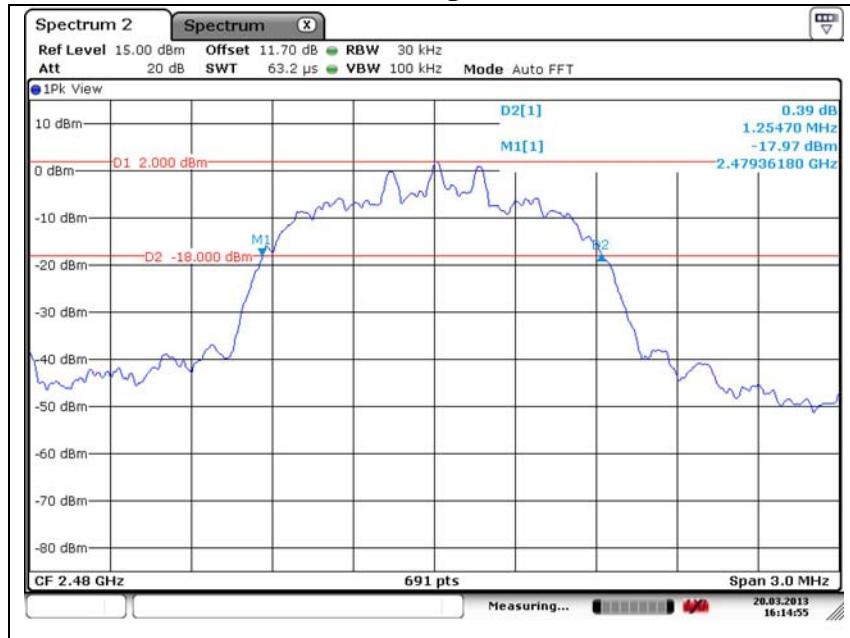


**20 dB bandwidth // Low channel // 8DPSK**



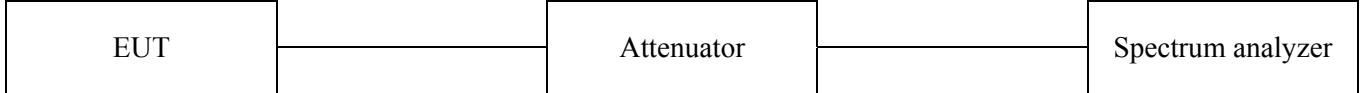
## 20 dB bandwidth // Middle channel // 8DPSK



**20 dB bandwidth // High channel // 8DPSK**


## 2.1.5 Frequency separation

### Test setup



### Test procedure

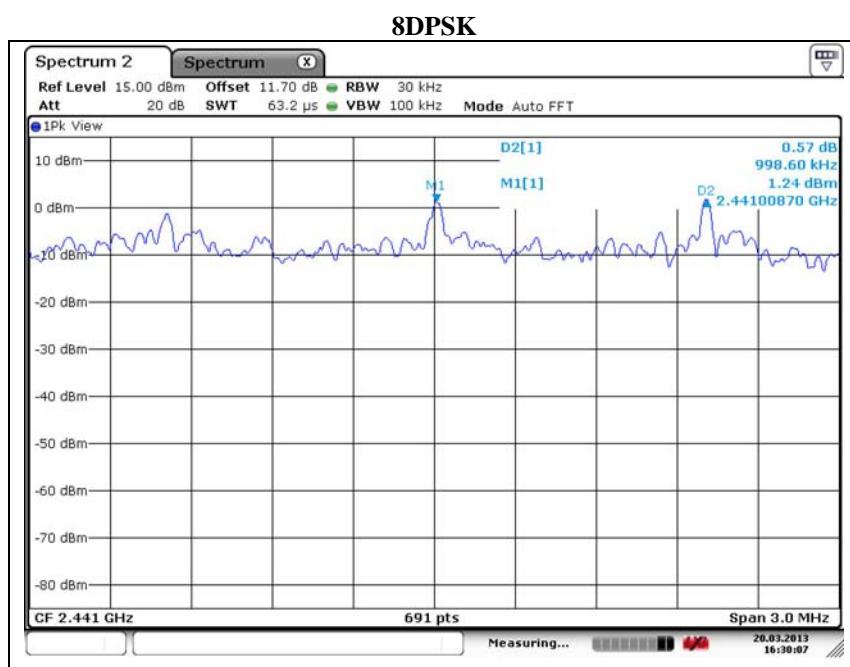
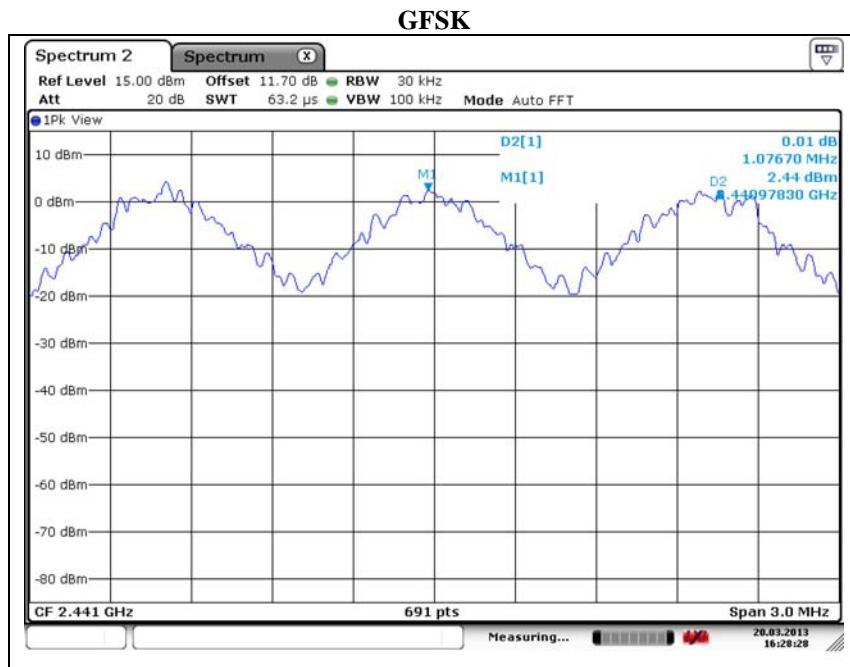
1. The EUT must have its hopping function enabled.
2. Use the following spectrum analyzer setting
  - Span = 3 MHz (wide enough to capture the peaks of two adjacent channels)
  - RBW = 30 kHz ( $\geq$  1% of the span)
  - VBW = 100 kHz ( $\geq$  RBW)
  - Sweep = auto
  - Detector function = peak
  - Trace = max hold
3. All the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

### Limit

According to 15.247(a)(1), frequency hopping system operating in 2 400 ~ 2 483.5 MHz. Band may have hopping channel carrier frequencies that are separated by 25 kHz or two-third of 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

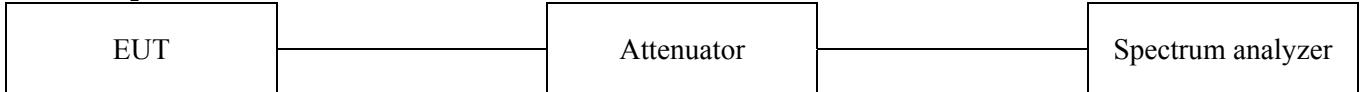
### Test results

Operation mode	Frequency (MHz)	Adjacent hopping channel separation(kHz)	Two-third of 20 dB bandwidth (kHz)	Minimum bandwidth (kHz)
GFSK	2 441	1.076	0.628	25
8DPSK	2 441	0.998	0.8742	25



### 2.1.6 Number of hopping frequency

#### Test setup



#### Test procedure

1. The EUT must have its hopping function enabled.

2. Use the following spectrum analyzer setting

Frequency range: 2 400 MHz ~ 2 441.5 MHz, 2 441.5 MHz ~ 2 483.5 MHz

Span = the frequency band of operation

RBW = 1 MHz ( $\geq 1\%$  of the span)

VBW = 1 MHz ( $\geq$  RBW)

Sweep = auto

Detector function = peak

Trace = max hold

3. All the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

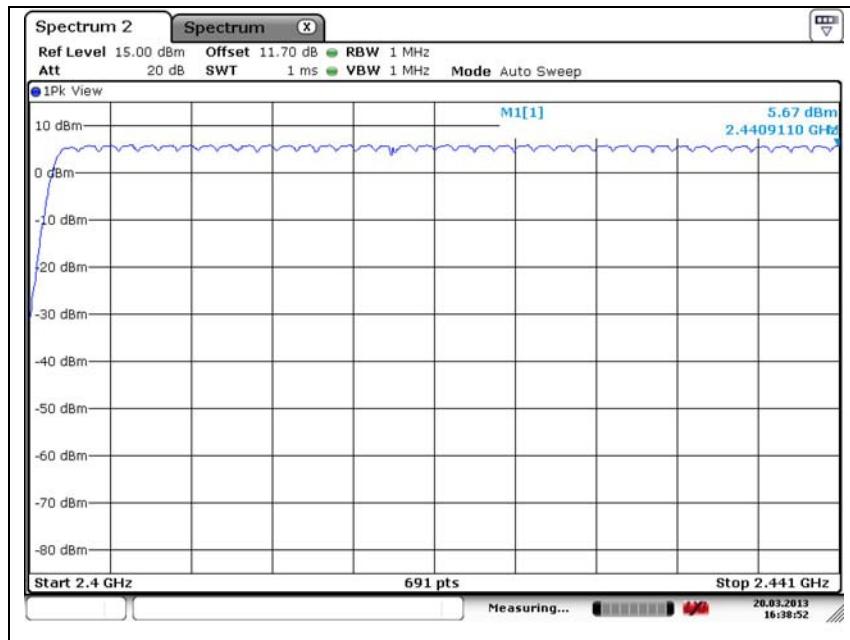
#### Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 MHz bands shall use at least 15 hopping frequencies.

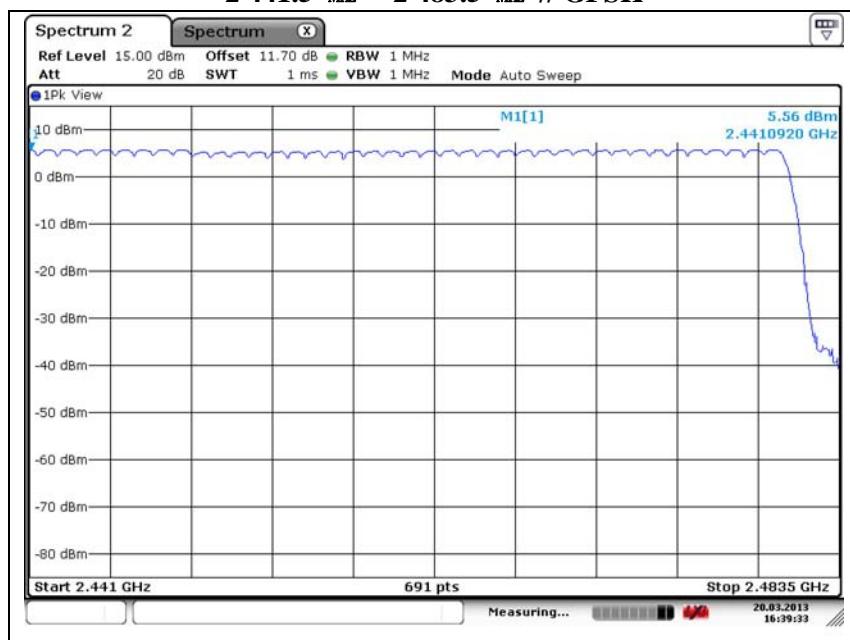
#### Test results

Operation mode	Number of hopping frequency	Limit
GFSK	79	$\geq 15$
8DPSK	79	$\geq 15$

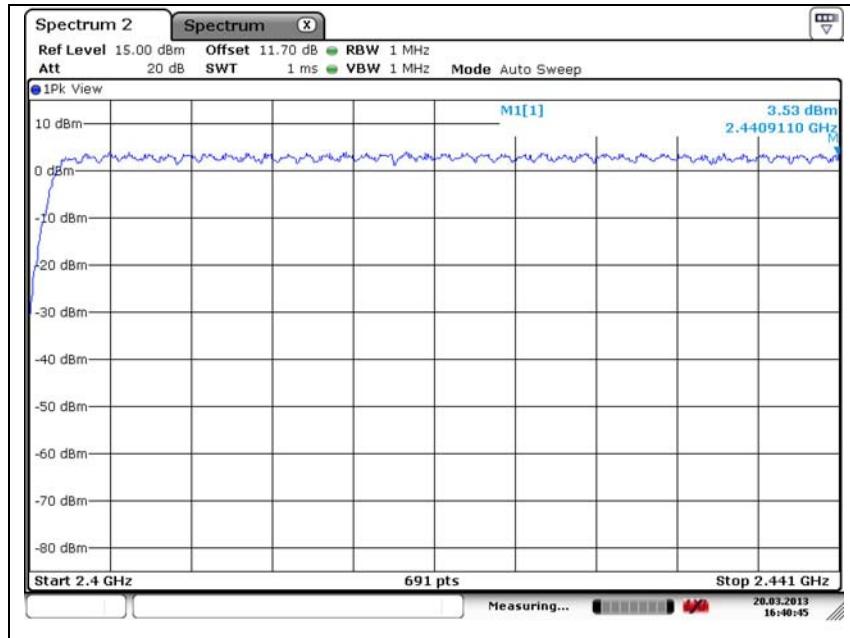
**2 400 MHz ~ 2 441.5 MHz // GFSK**



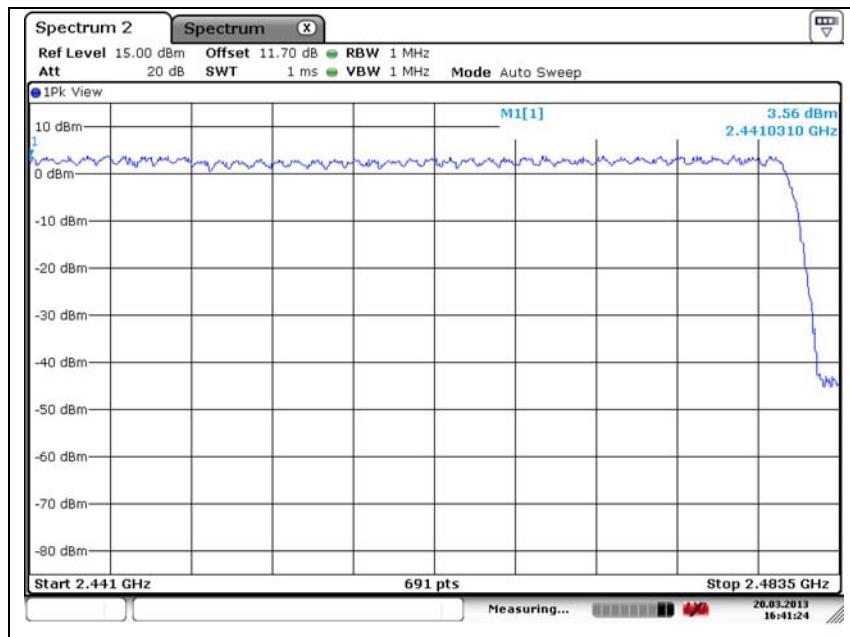
**2 441.5 MHz ~ 2 483.5 MHz // GFSK**



**2 400 MHz ~ 2 441.5 MHz // 8DPSK**

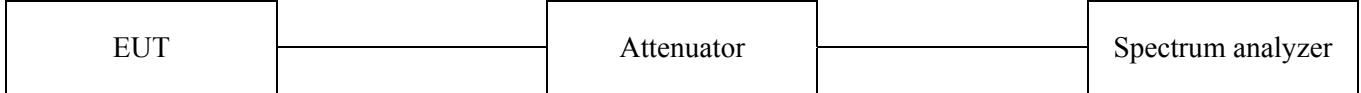


**2 441.5 MHz ~ 2 483.5 MHz // 8DPSK**



### 2.1.7 Time of occupancy (Dwell time)

#### Test setup



#### Test procedure

1. Use the following spectrum analyzer setting

Center frequency: 2 441 MHz

Span = Zero span, centered on a hopping channel

RBW = 1 MHz

VBW = 3 MHz ( $\geq$  RBW)

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

2. If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., date rate, modulation format, etc.), repeat this test for each variation.

3. The Bluetooth has 3 type of payload DH1, DH3, DH5. The hopping rate is 1 600 per second.

#### Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

A period time =  $0.4(s) \times 79 = 31.6(s)$

### Test results

Time of occupancy on the TX channel in 31.6 sec

= time domain slot length  $\times$  (hop rate  $\div$  number of hop per channel)  $\times$  31.6

### Operation mode: GFSK , 8DPSK

Packet type	Frequency (MHz)	Dwell time (ms)	Time of occupancy on the Tx channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx channel in 31.6 sec (ms)
DH1	2 441	0.391	125.12	400
DH3	2 441	1.637	261.92	400
DH5	2 441	2.898	310.08	400
3-DH1	2 441	0.398	127.36	400
3-DH3	2 441	1.644	263.04	400
3-DH5	2 441	2.891	309.33	400

#### ※ Remark:

DH1: Dwell time (ms)  $\times$  [(1 600  $\div$  2)  $\div$  79]  $\times$  31.6(s) = 125.12 (ms)

DH3: Dwell time (ms)  $\times$  [(1 600  $\div$  4)  $\div$  79]  $\times$  31.6(s) = 261.92 (ms)

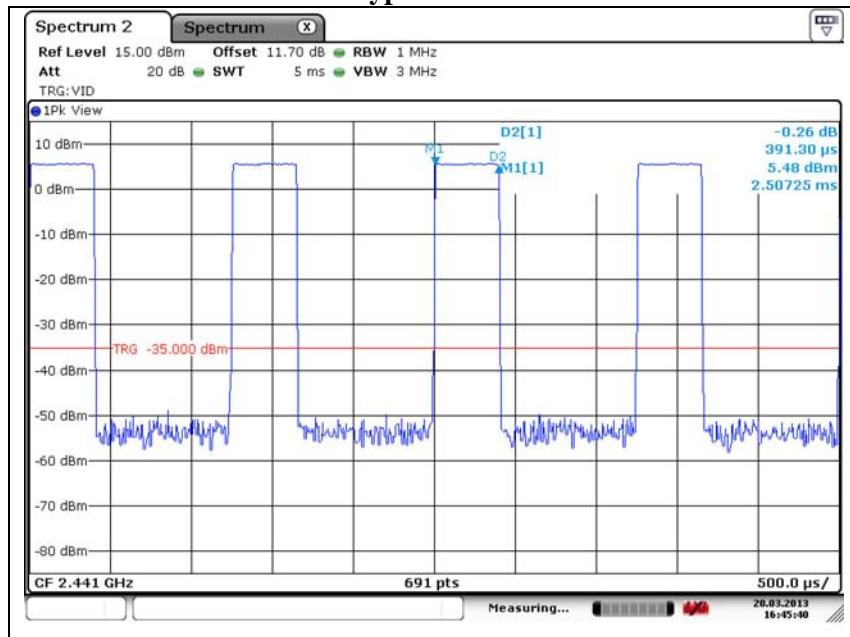
DH5: Dwell time (ms)  $\times$  [(1 600  $\div$  6)  $\div$  79]  $\times$  31.6(s) = 310.08 (ms)

3-DH1: Dwell time (ms)  $\times$  [(1 600  $\div$  2)  $\div$  79]  $\times$  31.6(s) = 127.36 (ms)

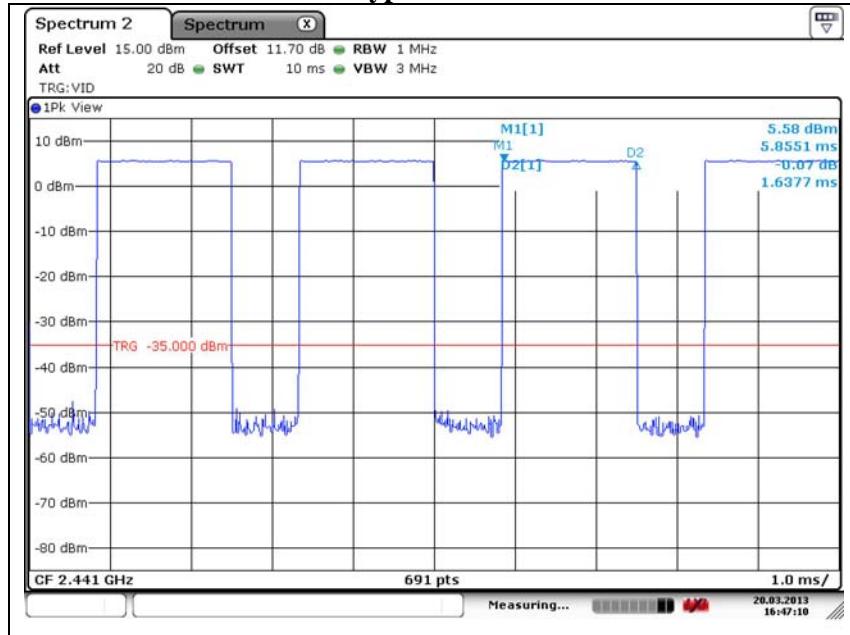
3-DH3: Dwell time (ms)  $\times$  [(1 600  $\div$  4)  $\div$  79]  $\times$  31.6(s) = 263.04 (ms)

3-DH5: Dwell time (ms)  $\times$  [(1 600  $\div$  6)  $\div$  79]  $\times$  31.6(s) = 309.33 (ms)

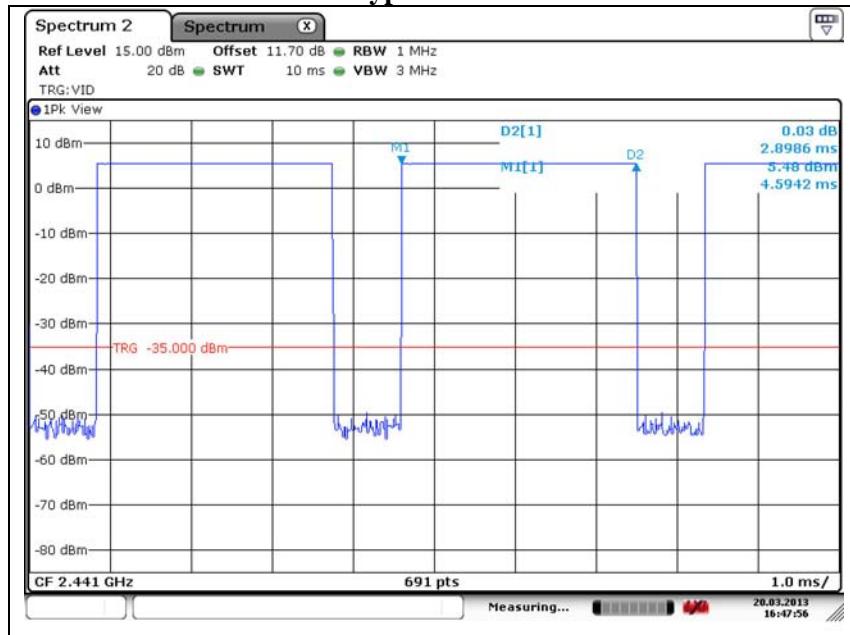
### Packet type: DH1 // GFSK



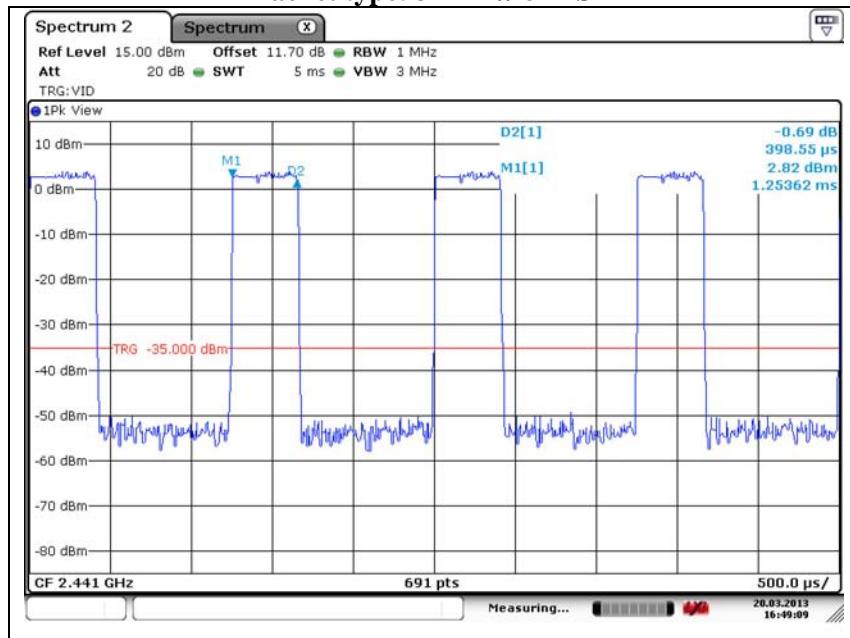
**Packet type: DH3 // GFSK**



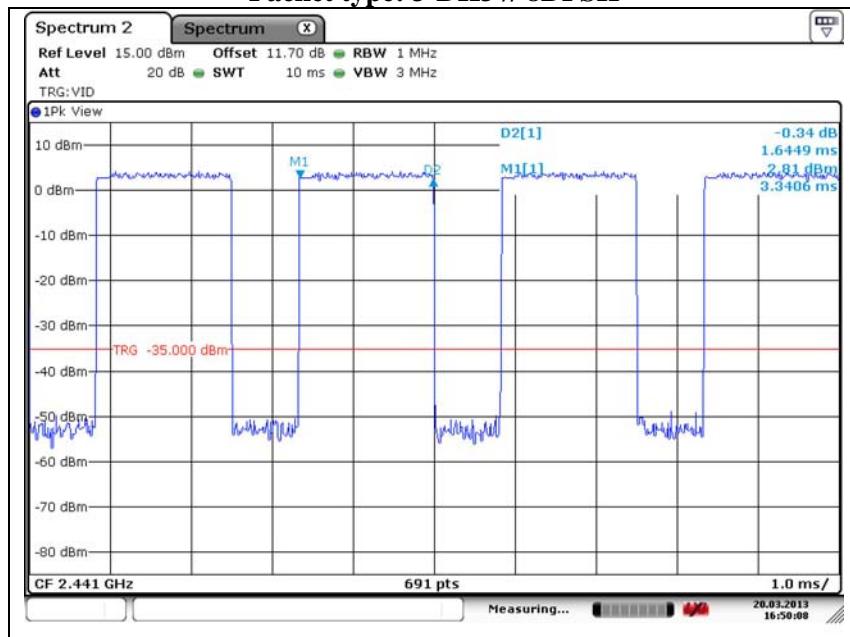
**Packet type: DH5 // GFSK**



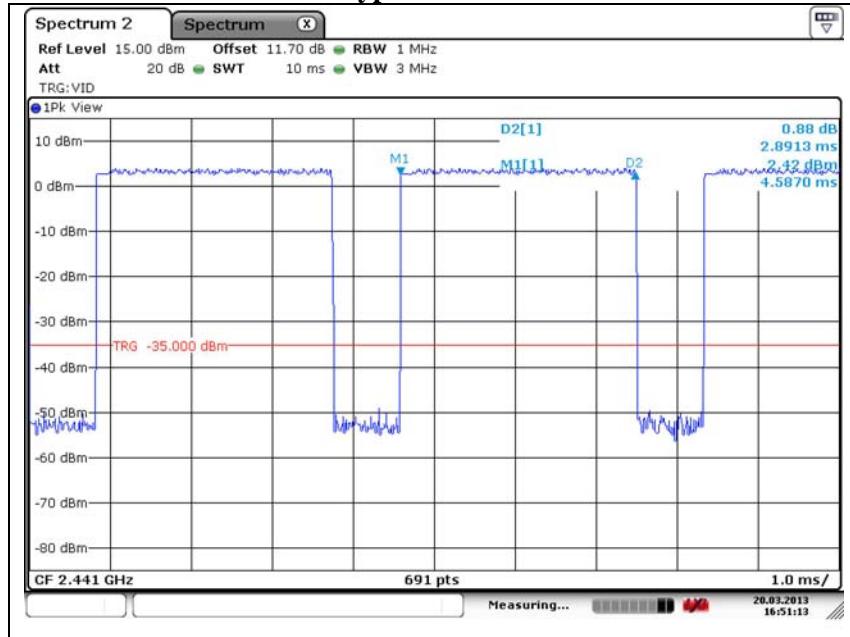
**Packet type: 3-DH1// 8DPSK**



**Packet type: 3-DH3 // 8DPSK**



**Packet type: 3-DH5 // 8DPSK**



## 2.1.8 Radiated spurious emission & band edge

### Test location

Testing was performed at a test distance of 3 meter Open Area Test Site

### Test procedures

[9 kHz to 30 MHz]

The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 Hz for Quasi-peak detection (QP) at frequency below 9 kHz~ 150 kHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 kHz for Quasi-peak detection (QP) at frequency below 150 kHz~ 30 MHz.

[30 MHz to 1 GHz and 1 GHz to 24 GHz]

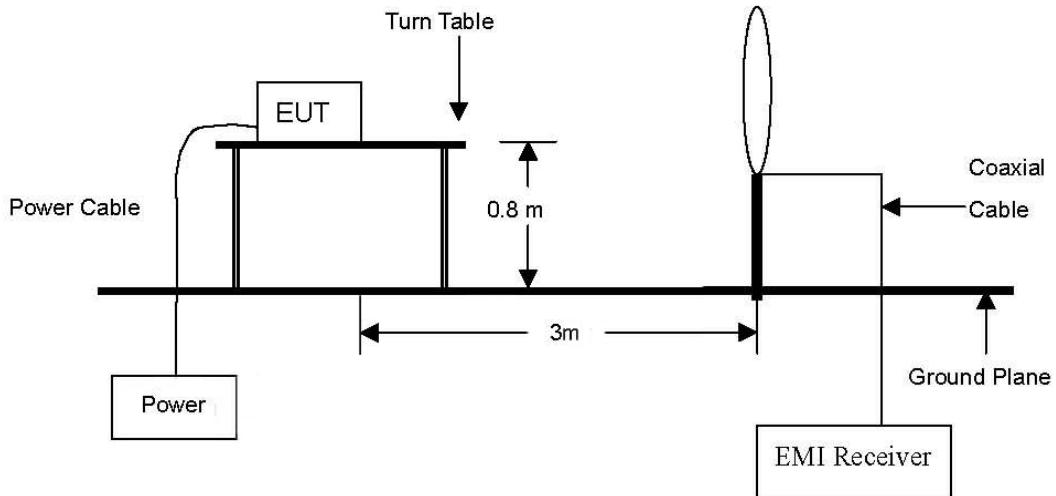
The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.

The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

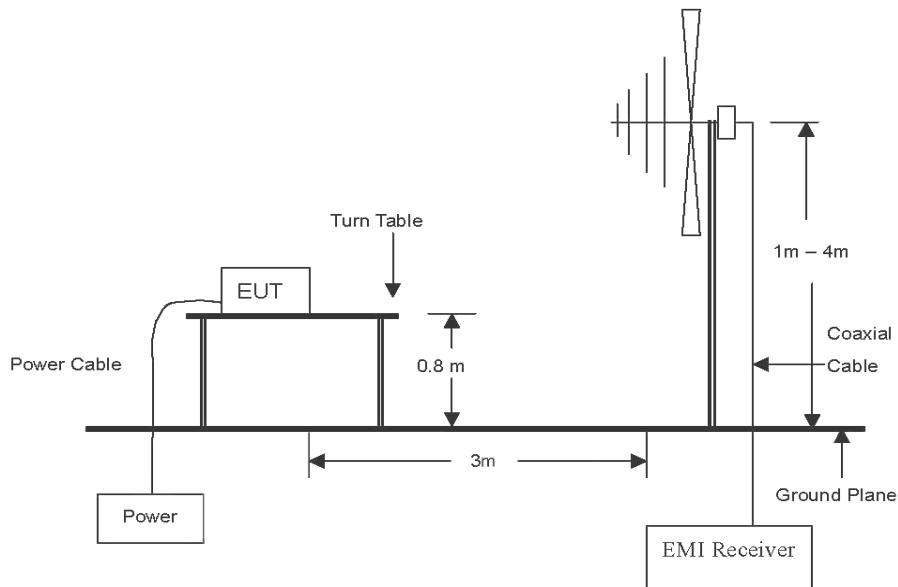
The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz for Average detection (AV) at frequency above 1 GHz.

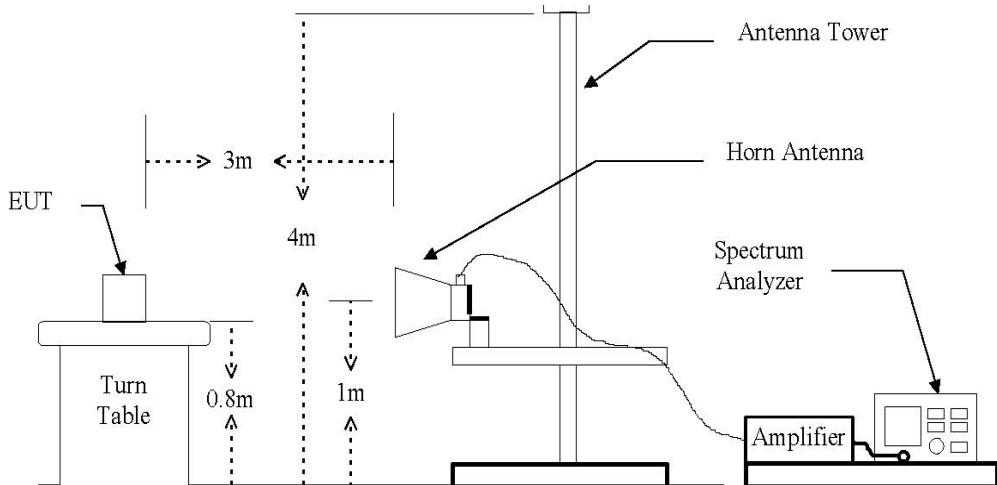
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz emissions.



### Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated ( $\mu$ V/m)
0.009 ~ 0.490	300	2400 / F(kHz)
0.490 ~ 1.705	30	24000 / F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.



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### Test results (Below 30 MHz) – Worst case configuration: GFSK

The frequency spectrum from 9 kHz to 30 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ V)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	F <sub>d</sub> (dB)	Actual (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
Below 30	Not detected							

#### ※ Remark

1. All spurious emission at channels are almost the same below 30 MHz, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss + F<sub>d</sub>
3. F<sub>d</sub> = 40log(D<sub>m</sub> / D<sub>s</sub>)

Where:

F<sub>d</sub> = Distance factor in dB  
D<sub>m</sub> = Measurement distance in meters  
D<sub>s</sub> = Specification distance in meters

**Test results (Below 1 000 MHz) – Worst case configuration: GFSK**

The frequency spectrum from 30 MHz to 1 000 MHz was investigated.

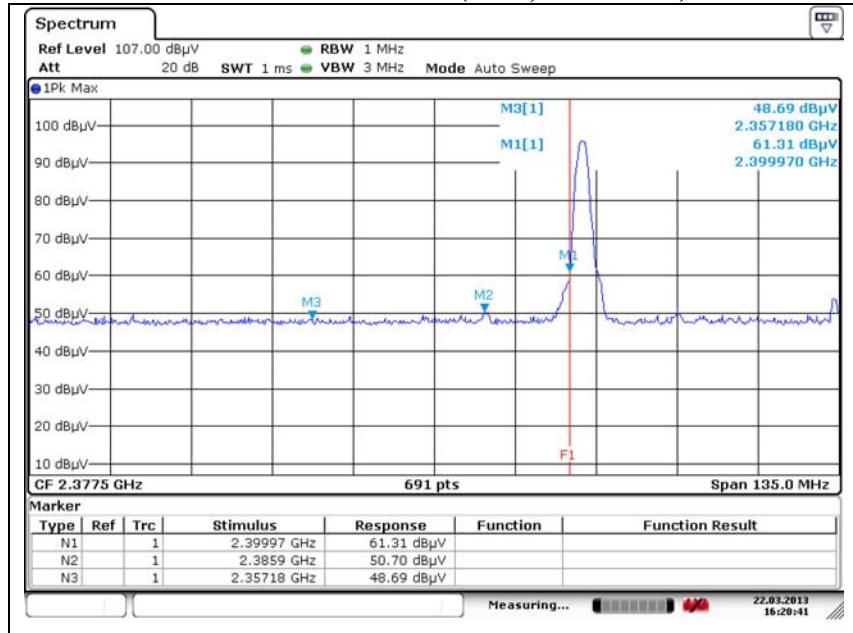
Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ N)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
139.0	8.60	H	12.61	2.25	23.46	43.50	20.04
141.6	8.10	V	12.73	2.28	23.11	43.50	20.39
241.0	6.40	H	11.36	3.22	20.98	46.02	25.04
272.5	9.10	H	12.43	3.43	24.96	46.02	21.06
301.5	6.60	H	13.40	3.62	23.62	46.02	22.40
340.3	8.80	H	14.27	3.88	26.95	46.02	19.07
381.6	6.90	H	15.20	4.12	26.22	46.02	19.80

**\* Remark**

1. All spurious emission at channels are almost the same below 1 GHz, so that middle channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
3. Detector mode: Quasi peak
4. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

## Test results (Above 1 000 MHz)

### Low channel // GFSK (Peak, Horizontal)



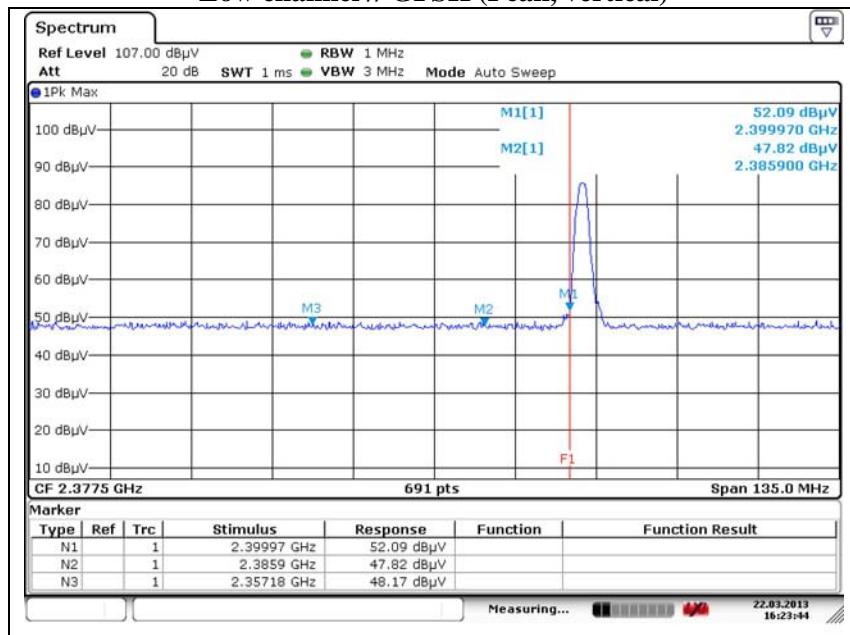
### Low channel // GFSK (Peak, Horizontal)\_Expand Span



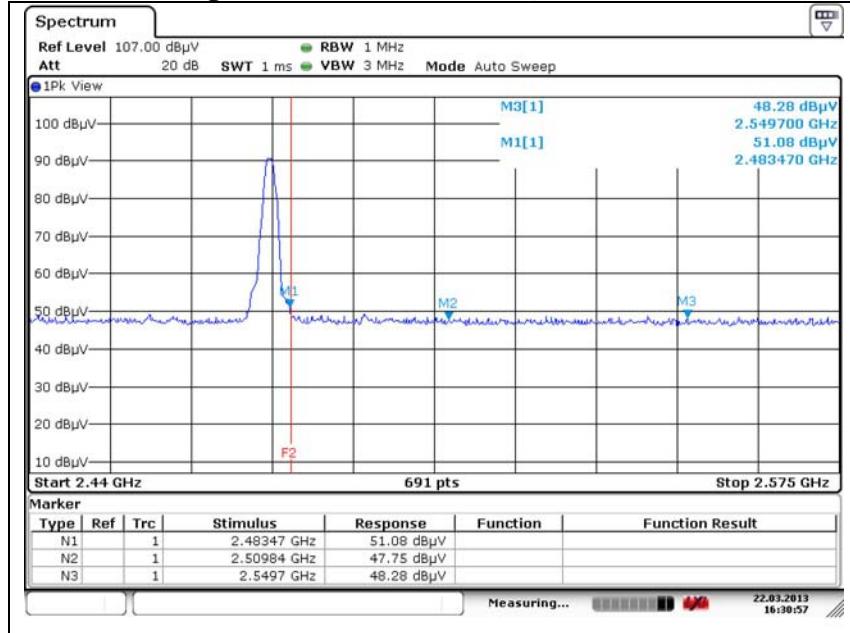
**Low channel // GFSK (Average, Horizontal) \_Expand Span**



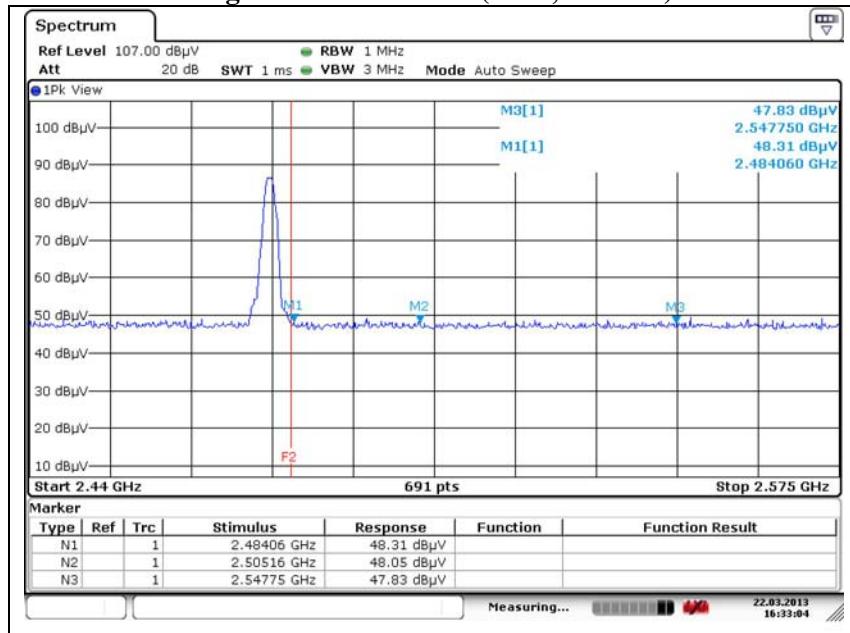
**Low channel // GFSK (Peak, vertical)**



### High channel // GFSK (Peak, Horizontal)



### High channel // GFSK (Peak, Vertical)





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The frequency spectrum from 1 GHz to 25 GHz was investigated. No Emissions were found above 20 dB below the limit.

### Low channel // GFSK

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ N)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
2357.180	48.69	Peak	H	2.42	0.00	51.11	74.00	22.89
2357.180	48.17	Peak	V	2.42	0.00	50.59	74.00	23.41
2385.900	50.70	Peak	H	2.42	0.00	53.12	74.00	20.88
2385.900	47.82	Peak	V	2.42	0.00	50.24	74.00	23.76
2399.970	52.09	Peak	V	2.42	0.00	53.97	74.00	19.49
2399.986	59.70	Peak	H	2.42	0.00	62.12	74.00	11.88
2399.986	50.20	Average	H	2.42	-30.77	21.85	54.00	32.15

### Middle channel // GFSK

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
Above 1 000	Not detected							

### High channel // GFSK

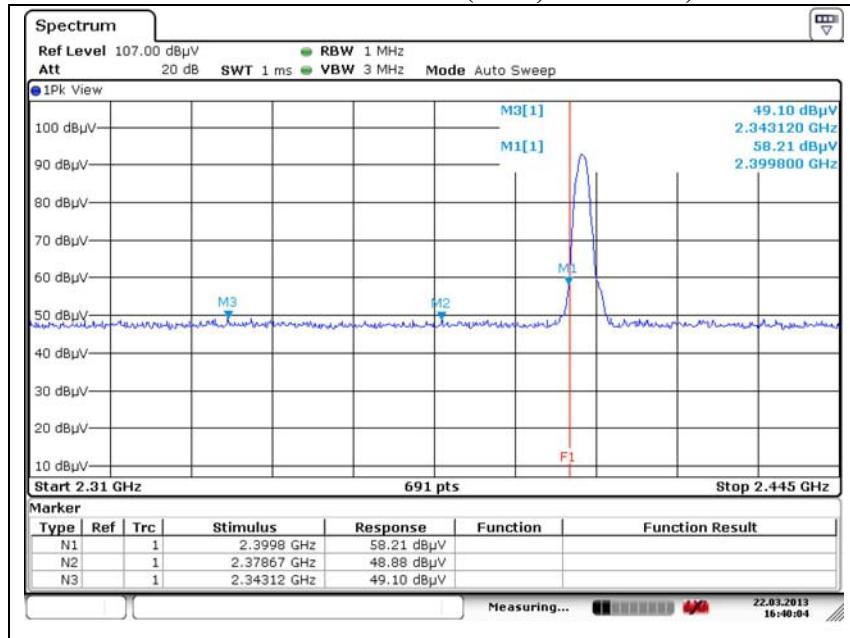
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ N)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
2483.470	51.08	Peak	H	3.28	0.00	53.96	74.00	19.64
2484.060	48.31	Peak	V	3.29	0.00	51.60	74.00	22.40
2505.160	48.05	Peak	V	3.51	0.00	51.56	74.00	22.44
2509.840	47.75	Peak	H	3.56	0.00	51.31	74.00	22.69
2547.750	47.83	Peak	V	3.95	0.00	51.78	74.00	22.22
2549.700	48.28	Peak	H	3.97	0.00	52.25	74.00	21.75

#### \* Remark

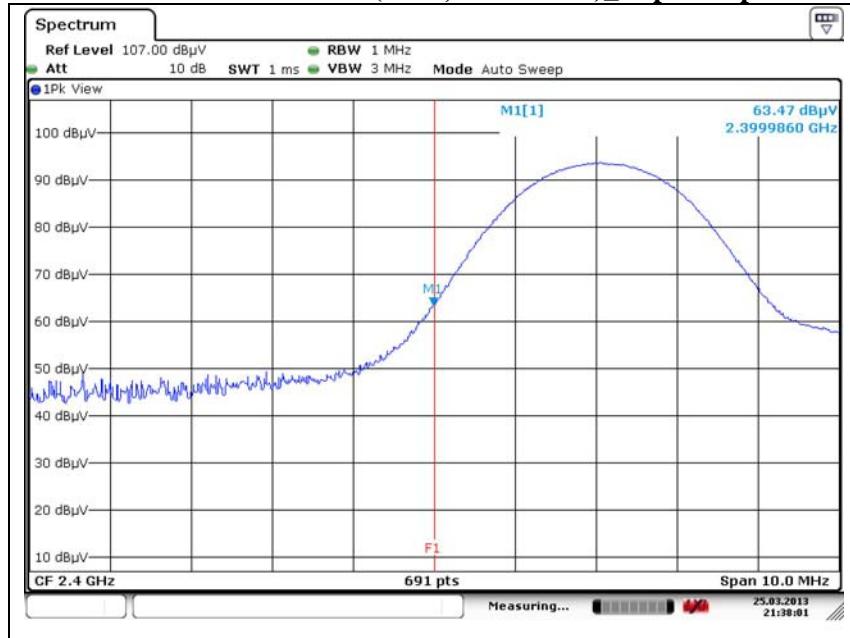
1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + AFCL(Ant. factor – Amp. gain + Cable loss) + DCF(If measurement is average detector)  

$$\text{DCF (Duty cycle correction factor)} = 20\log(\text{Worst Dwell Time}(2.89 \text{ ms}) / 100 \text{ ms}) [\text{dB}] = -30.77 \text{ dB}$$
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

### Low channel // 8DPSK (Peak, Horizontal)



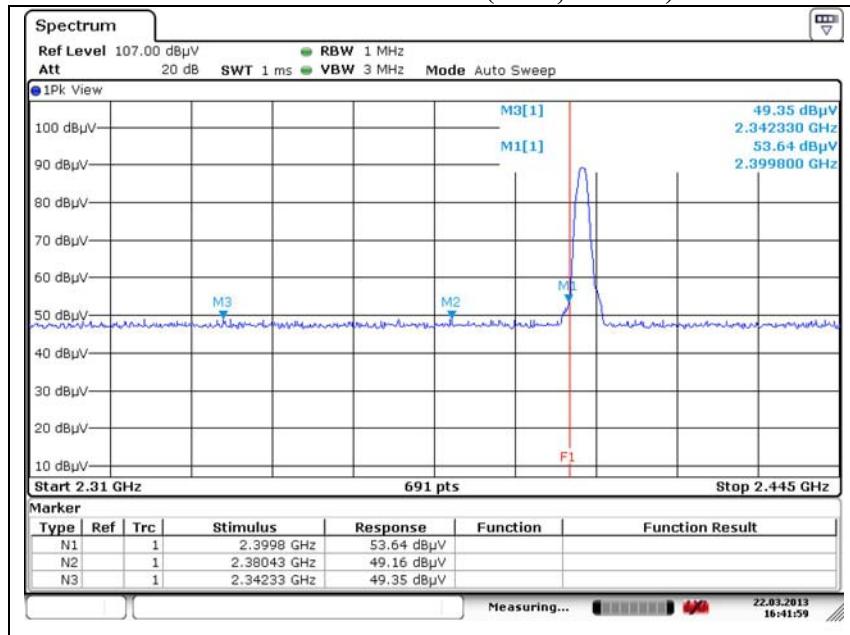
### Low channel // 8DPSK (Peak, Horizontal)\_Expand Span



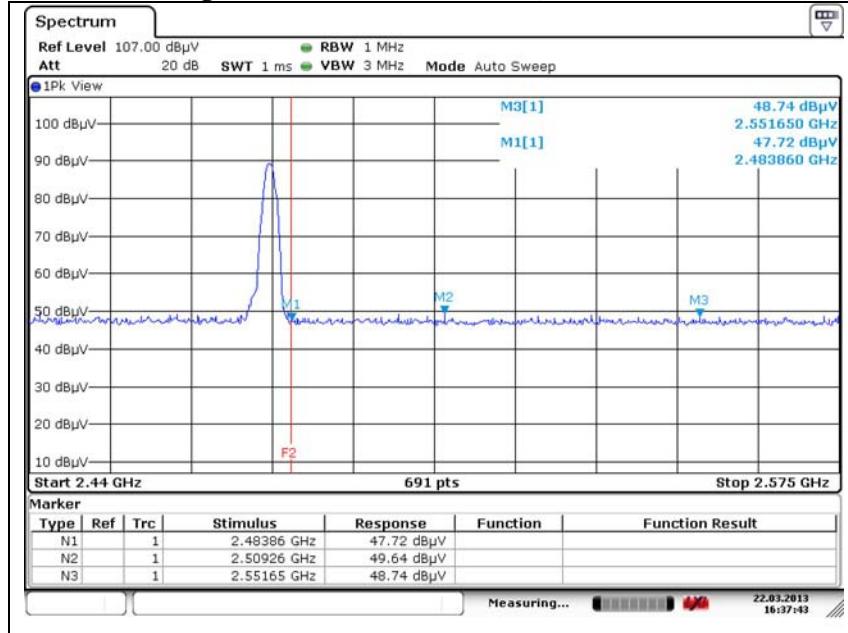
**Low channel // 8DPSK (Average, Horizontal) \_Expand Span**



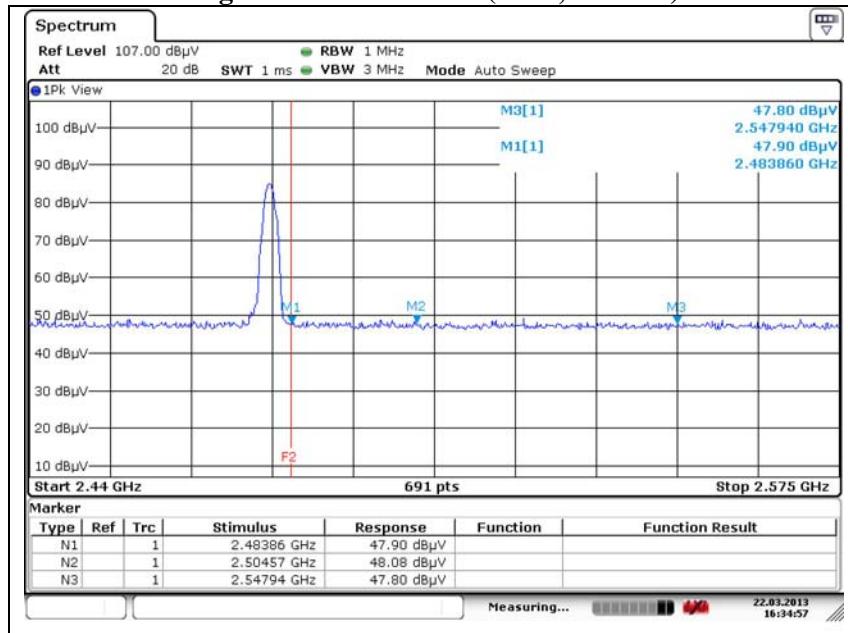
**Low channel // 8DPSK (Peak, vertical)**



### High channel // 8DPSK (Peak, Horizontal)



### High channel // 8DPSK (Peak, Vertical)





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The frequency spectrum from 1 GHz to 25 GHz was investigated. No Emissions were found above 20 dB below the limit.

### Low channel // 8DPSK

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ N)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
2343.120	49.10	Peak	H	0.98	0.00	50.08	74.00	23.92
2342.330	49.35	Peak	V	0.99	0.00	50.34	74.00	23.66
2378.670	48.88	Peak	H	0.63	0.00	49.51	74.00	24.49
2380.430	49.16	Peak	V	0.61	0.00	49.77	74.00	24.23
2399.800	53.64	Peak	V	0.42	0.00	53.96	74.00	19.94
2399.986	63.47	Peak	H	0.42	0.00	63.89	74.00	10.11
2399.986	52.06	Average	H	0.42	-30.77	21.71	54.00	32.29

### Middle channel // 8DPSK

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ N)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
Above 1 000	Not detected							

### High channel // 8DPSK

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB $\mu$ N)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
2483.860	47.72	Peak	H	2.13	0.00	49.85	74.00	24.15
2509.260	49.64	Peak	H	2.64	0.00	52.28	74.00	21.72
2551.650	48.74	Peak	H	3.51	0.00	52.25	74.00	21.75
2483.860	47.90	Peak	V	2.13	0.00	50.03	74.00	23.97
2504.570	48.08	Peak	V	2.55	0.00	50.63	74.00	23.37
2547.940	47.80	Peak	V	3.43	0.00	51.23	74.00	22.77

#### \* Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + AFCL(Ant. factor – Amp. gain + Cable loss) + DCF(If measurement is average detector)  

$$\text{DCF (Duty cycle correction factor)} = 20\log(\text{Worst Dwell Time}(2.89 \text{ ms}) / 100 \text{ ms}) [\text{dB}] = -30.77 \text{ dB}$$
5. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

## 2.1.9 AC conducted emissions

### Frequency range of measurement

150 kHz to 30 MHz

### Instrument settings

IF Band Width: 9 kHz

### Test procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m. Amplitude measurements were performed with a quasi-peak detector and an average detector.

### Limit

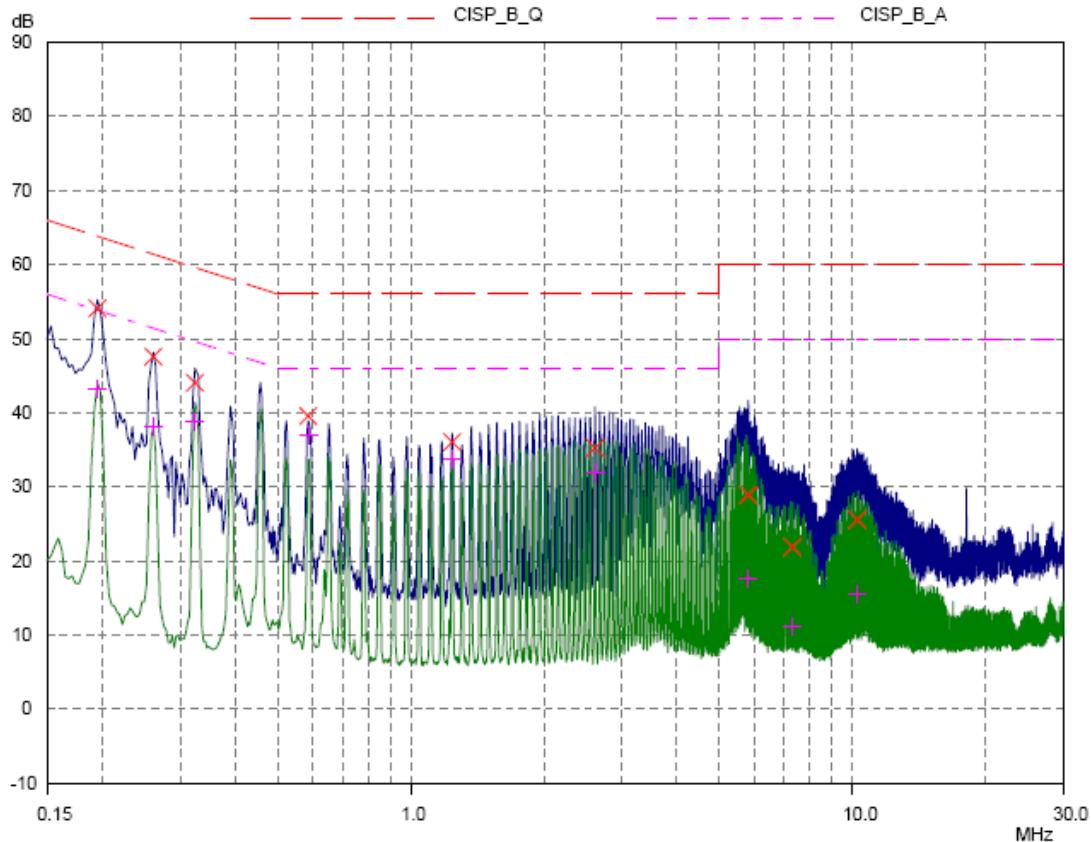
According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted limit (dB $\mu$ V/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

### \* Remark

Decreases with the logarithm of the frequency.

## Test results

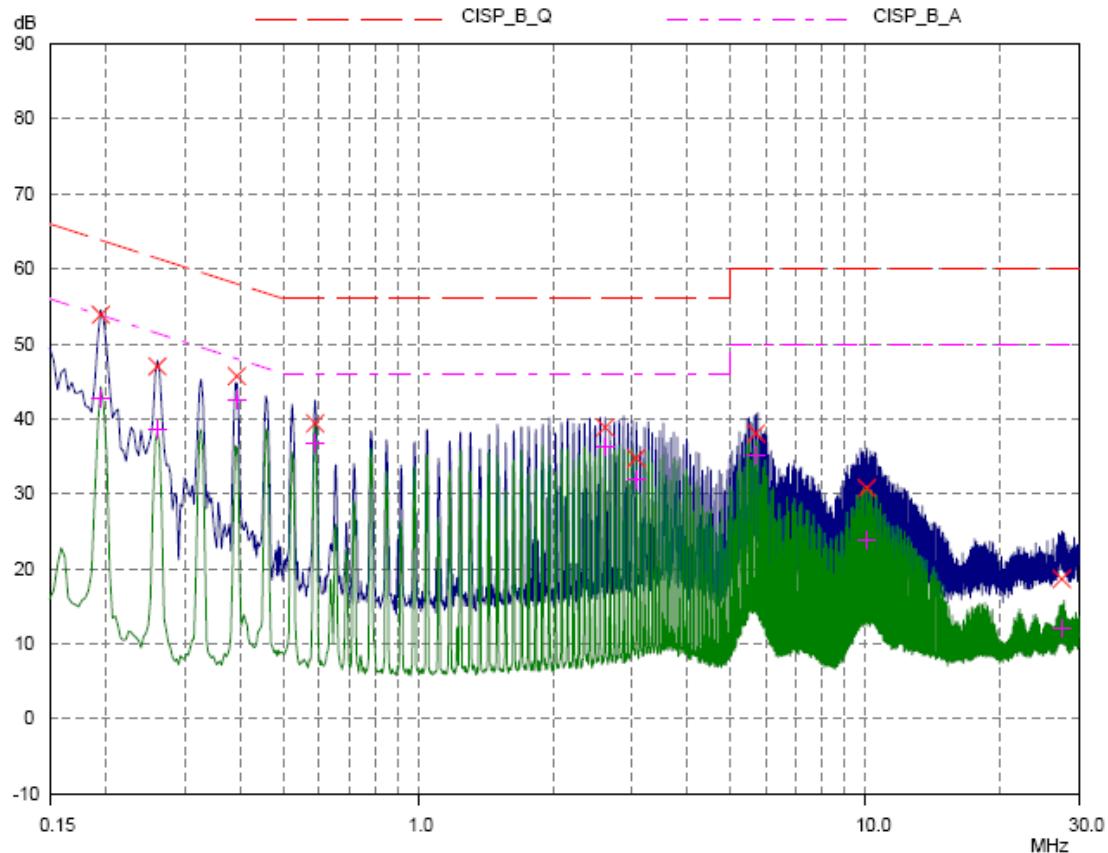


Frequency MHz	QP Level dB	QP Limit dB	QP Delta dB
0.195	54.09	63.82	9.73
0.261	47.56	61.40	13.84
0.324	44.05	59.60	15.55
0.585	39.55	56.00	16.45
1.239	36.04	56.00	19.96
2.61	35.24	56.00	20.76
5.808	28.91	60.00	31.09
7.311	21.84	60.00	38.16
10.254	25.54	60.00	34.46

Frequency MHz	AV Level dB	AV Limit dB	AV Delta dB
0.195	43.24	53.82	10.58
0.261	38.15	51.40	13.25
0.324	38.80	49.60	10.80
0.585	37.00	46.00	9.00
1.239	33.63	46.00	12.37
2.61	31.99	46.00	14.01
5.808	17.66	50.00	32.34
7.311	11.07	50.00	38.93
10.254	15.59	50.00	34.41

Note; Hot Line,

Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).



Frequency MHz	QP Level dB	QP Limit dB	QP Delta dB
------------------	----------------	----------------	----------------

0.195	53.87	63.82	9.95
0.261	46.97	61.40	14.43
0.393	45.68	58.00	12.32
0.588	39.39	56.00	16.61
2.616	38.84	56.00	17.16
3.072	34.71	56.00	21.29
5.691	38.03	60.00	21.97
10.074	30.74	60.00	29.26
27.489	18.63	60.00	41.37

Frequency MHz	AV Level dB	AV Limit dB	AV Delta dB
------------------	----------------	----------------	----------------

0.195	42.70	53.82	11.12
0.261	38.48	51.40	12.92
0.393	42.56	48.00	5.44
0.588	36.80	46.00	9.20
2.616	36.23	46.00	9.77
3.072	31.96	46.00	14.04
5.691	35.04	50.00	14.96
10.074	23.85	50.00	26.15
27.489	12.16	50.00	37.84

Note; Neutral Line

Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).



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### Appendix A. Test equipment used for test

Equipment	Manufacturer	Model	Calibration due.
Spectrum Analyzer	R&S	FSV30	2014.01.09
8360B Series Swept Signal Generator	HP	83630B	2013.06.06
Attenuator	HP	8495B	2013.05.04
Attenuator	HP	8494B	2013.05.04
DC Power Supply	HP	6674A	2013.12.07
Loop Antenna	R&S	HFH2-Z2.335.4711.52	2013.03.10
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	2013.10.25
Horn Antenna	A.H. System	SAS-571	2015.02.28
High Pass Filter	Wainwright Instrument	WHJS3000-10TT	2014.01.10
Preamplifier	HP	8449B	2013.08.02
EMI Test Receiver	R & S	ESV10	2013.05.04
EMI Test Receiver	R & S	ESHS10	2013.05.04
LISN	R & S	ENV216	2014.02.27

### Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook(Laptop)	Samsung Electronics	NT-R519	ZLT393BSB00204H

**Appendix B. Test setup photo****Radiated field emissions**

**AC conducted emission**