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## TEST REPORT

According to : FCC 47CFR part 15 subpart C

Test Report No. : CTK-2016-00990

Date of Issue : 2016-08-01

FCC ID : 2AALG-NWP-F50

Basic Model/Type No. : NWP-F50

Kind of Product : Neo smartpen N2

Applicant : NeoLAB Convergence

Applicant Address : #1501, Mario Tower, 28, Digital-ro 30-gil, Guro-gu, Seoul, Korea 08389

Manufacturer : NeoLAB Convergence

Manufacturer Address : #1501, Mario Tower, 28, Digital-ro 30-gil, Guro-gu, Seoul, Korea 08389

Contact Person : Bongki Park

Telephone : +82-70-4377-0740

Received Date : 2016-07-06

Test period : Start : 2016-07-15 End : 2016-07-21

Test Results :  In Compliance  Not in Compliance

The test results presented in this report relate only to the object tested.

Tested by

*Y. T. Lee*

Young-taek Lee  
Test Engineer  
Date: 2016-08-01

Reviewed by

*Y. J. Park*

Young-Joon, Park  
Technical Manager  
Date: 2016-08-01



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## REPORT REVISION HISTORY

Date	Revision	Page No
2016-08-01	Issued (CTK-2016-00990)	All

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## 1.0 General Product Description

Kind of product	Neo smartpen N2
FCC ID	2AALG-NWP-F50
Model name	NWP-F50
Variant Model name	-
Test SW Version	MARBELL 88MB300 Ver. 1.0.0.03
RF Power setting in Test SW	Initial value
Antenna type	Chip antenna
Antenna Gain	Peak 2.9 dBi
Frequency Range	2 402 MHz - 2 480 MHz
RF power	7.78 dBm Peak Conducted (GFSK) 8.81 dBm Peak Conducted ( $\pi/4$ DQPSK) 8.74 dBm Peak Conducted (8-DPSK)
Number of channels	79
Channel Spacing	1 MHz
Type of Modulation	GFSK(1Mbps), DQPSK(2Mbps), 8-DPSK(3Mbps)
Power Source	DC 3.9 V
Test Site Registration Number	8737A-2

## 1.1 Tested Frequency

	LOW	MID	HIGH
Frequency (MHz)	2 402	2 441	2 480



## 1.2 Tested Mode

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

Tested Ch	Modulation Technology	Modulation Type	Packet Type
Low, Mid, High	FHSS	GFSK	DH5
Low, Mid, High	FHSS	8-DPSK	3-DH5



### 1.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable

### 1.4 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Notebook Computer	HP	HP ProBook 650 G1	5CG5114KD2
AC/DC ADAPTER	HP	PPP012D-S	WCNXF0AAR7S2XX

### 1.5 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

### 1.6 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea.







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## 1.7 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
CANADA	IC	IC EMI (3/10m test site)	8737A-2	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	



## 2.0 Summary of tests

FCC Part Section(s)	Parameter	Status (note)
15.247(a)	Carrier Frequency Separation	C
15.247(a)	Number of Hopping Frequencies	C
15.247(a)	20 dB Bandwidth	C
15.247(a)	Time of occupancy (Dwell Time)	C
15.247(b)	Transmitter Output Power	C
15.247(d)	Unwanted Emission (Conducted)	C
15.209	Unwanted Emission (Radiated)	C
NA	Receiver Emission	NA
15.207	AC Power Line Conducted Emissions	C
2.1091	RF exposure evaluation	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

The sample was tested according to the following specification:  
- FCC Part 15.247, ANSI C63.10-2013

The tests were performed according to the method of measurements prescribed in DA 00-705.



## 2.1 Requirements

### 2.1.1 Carrier Frequency Separation

#### Test Procedures(ANSI C63.10-2013 7.8.2)

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span : wide enough to capture the peaks of two adjacent channels

RBW : approximately 30% of the channel spacing;

adjust as necessary to best indentify the center of each individual channel.

VBW  $\geq$  RBW

Sweep : auto

Detector function = peak

Trace = max hold

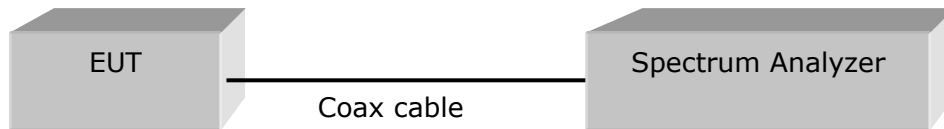


Figure 1 : Measurement setup for the carrier frequency separation

#### Limit

FHSS operating in the band 2400-2483.5 MHz 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.

#### Test Results

##### Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Channel	Adjacent Hopping Channel Separation (kHz)	Two-third of 20dB bandwidth (kHz)	Minimum Bandwidth (kHz)	Result
2 441MHz	1000	640	25	Complies

##### Test mode : 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)

Channel	Adjacent Hopping Channel Separation (kHz)	Two-third of 20dB bandwidth (kHz)	Minimum Bandwidth (kHz)	Result
2 441MHz	960	880	25	Complies

See next pages for actual measured spectrum plots.



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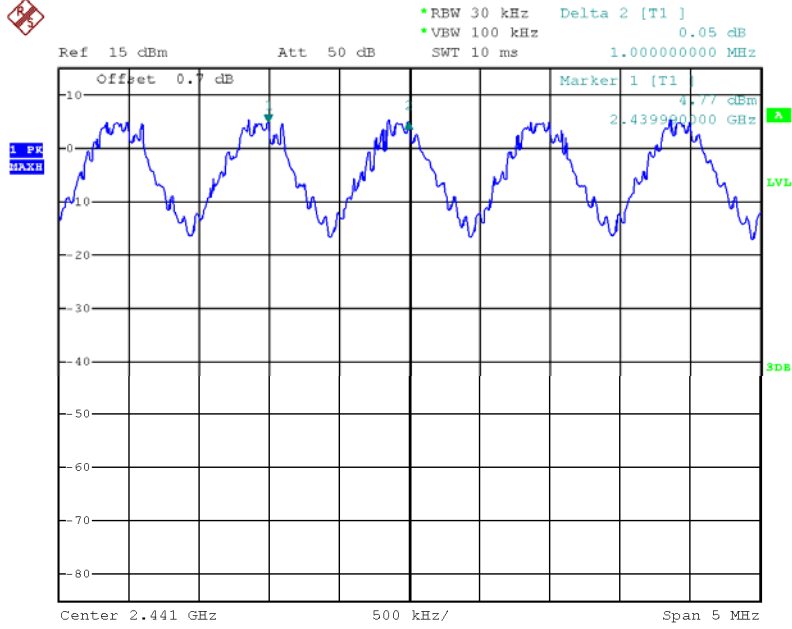
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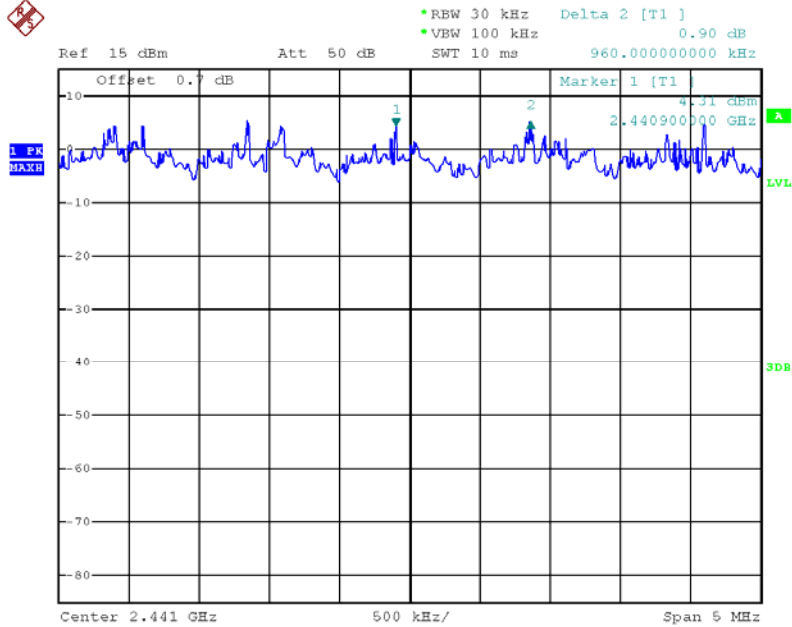
## Carrier Frequency Separation

Test mode : GFSK



Date: 20.JUL.2016 09:32:04

Test mode : 8-DPSK



Date: 20.JUL.2016 09:47:44

## 2.1.2 Number of Hopping Frequencies

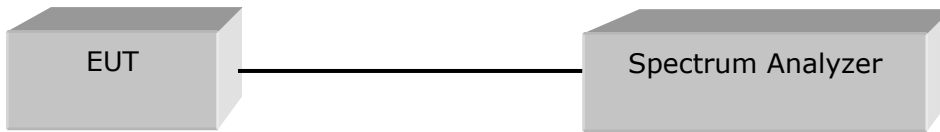
### Test Procedures(ANSI C63.10-2013 7.8.3)

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Frequency range	1: Start = 2389.5 MHz, Stop = 2439.5 MHz
	2: Start = 2439.5 MHz, Stop = 2489.5 MHz

RBW : To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.  
 VBW ≥ RBW Sweep = auto  
 Detector function = peak  
 Trace = max hold



### Limit

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

### Test Results

**Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)**

Total number of Hopping Channels	Result
79	Complies

See next pages for actual measured spectrum plots.

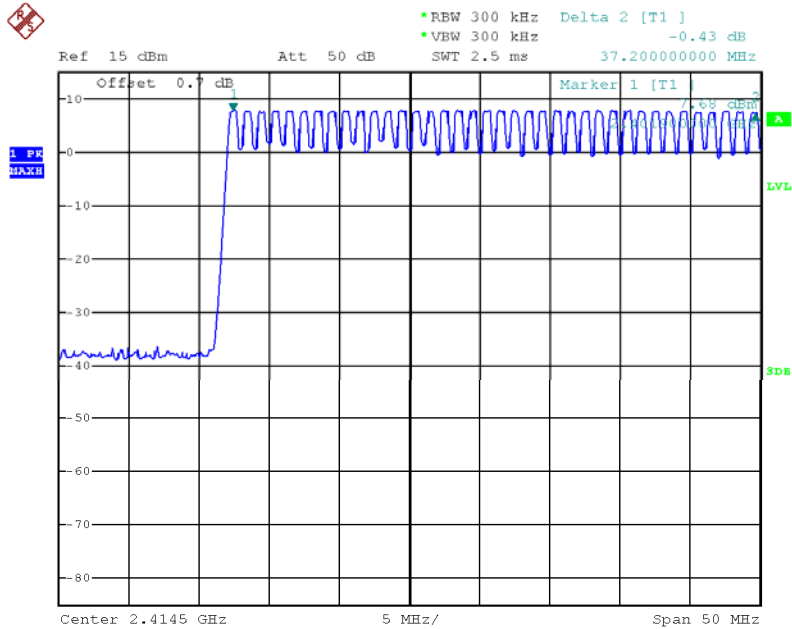


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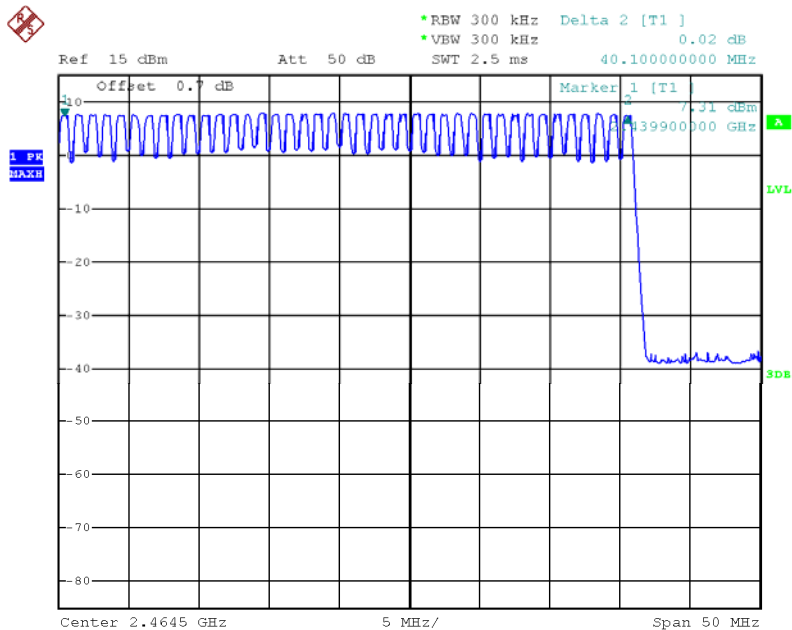
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## Number of Hopping Frequencies(GFSK)



Date: 20.JUL.2016 09:50:06



Date: 20.JUL.2016 09:50:58

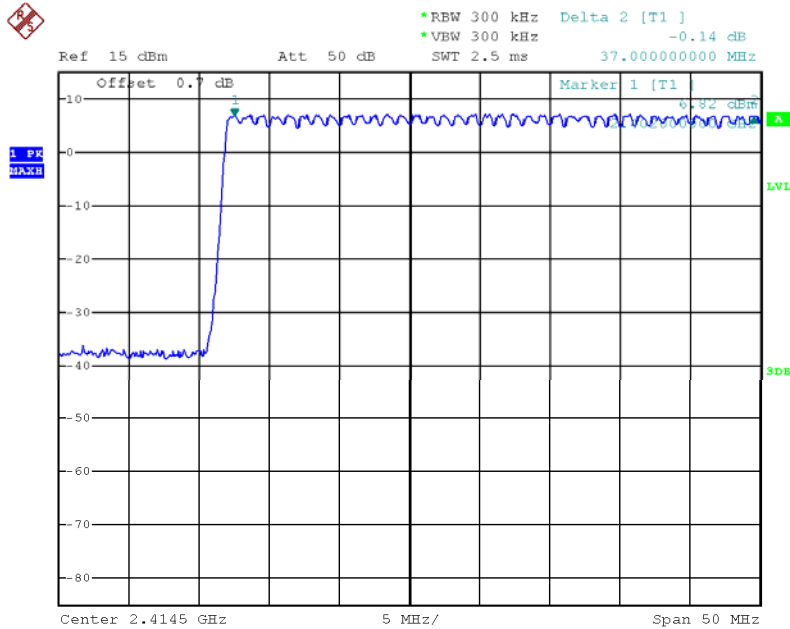


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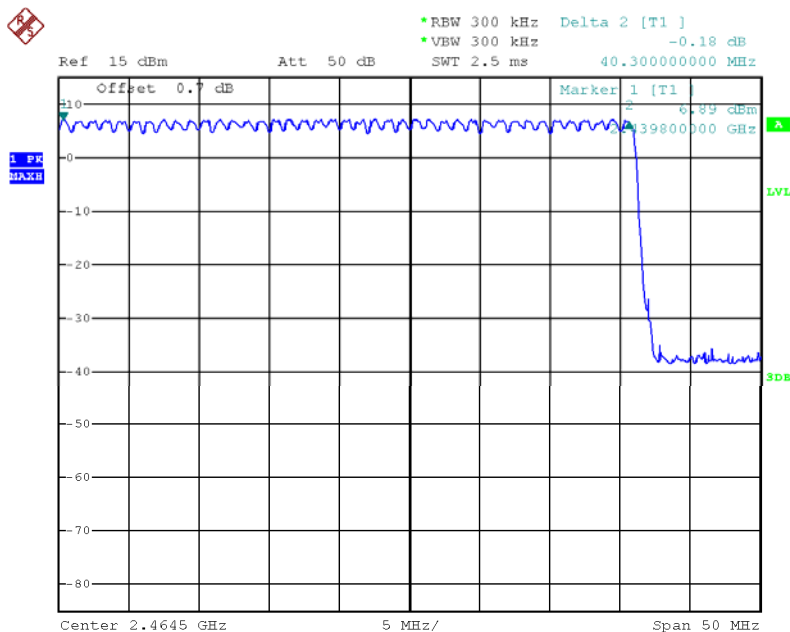
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## Number of Hopping Frequencies(8-DPSK)



Date: 20.JUL.2016 09:55:33



Date: 20.JUL.2016 09:53:25

## 2.1.3 20 dB bandwidth

### Test Procedures(ANSI C63.10-2013 6.9.2)

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

The spectrum analyzer is set to:

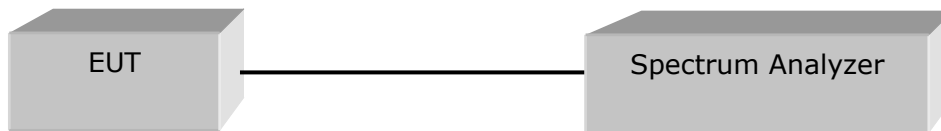
Center frequency = the highest, middle and the lowest channels

Span = between 2 times and 5 times the OBW

RBW = 1% to 5% of the OBW Sweep = auto

VBW : approximately 3 times RBW Detector function = peak

Trace = max hold



### Limit

Limit : N/A



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### Test Results

**Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)**

Frequency (MHz)	Channel Number.	Measured Bandwidth (MHz)	Result
2 402	0	0.960	Complies
2 441	39	0.960	Complies
2 480	78	0.960	Complies

**Test mode : 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)**

Frequency (MHz)	Channel Number.	Measured Bandwidth (MHz)	Result
2402	0	1.310	Complies
2441	39	1.320	Complies
2480	78	1.320	Complies

See next pages for actual measured spectrum plots.



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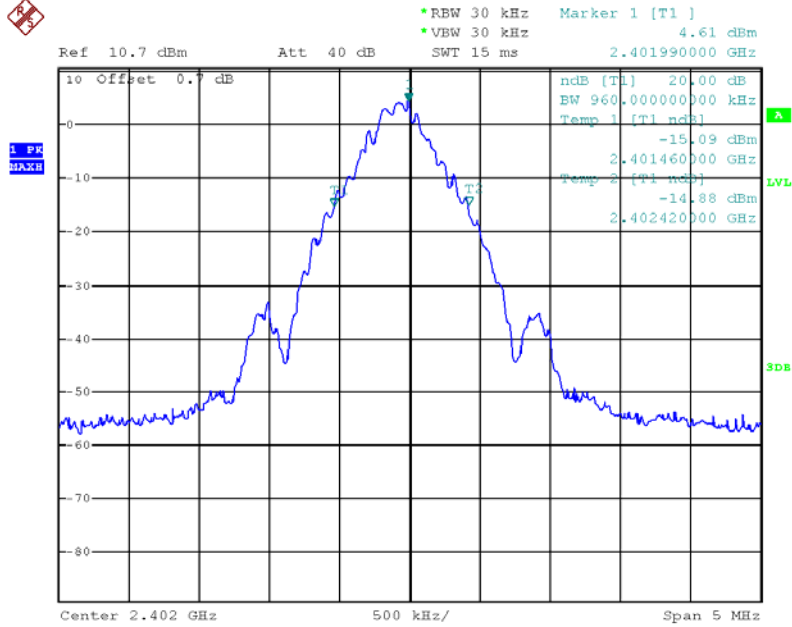
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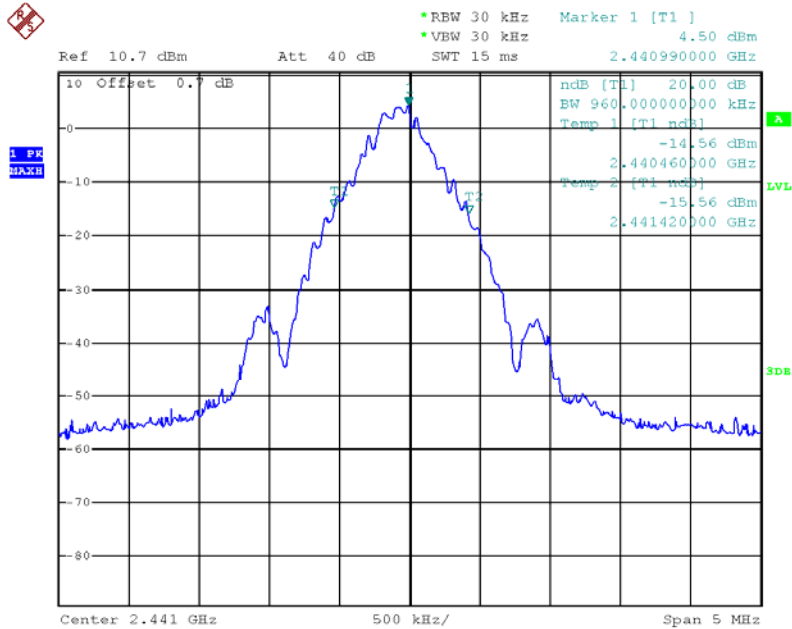
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## 20 dB Bandwidth - GFSK [Low channel]



Date: 20.JUL.2016 09:59:58

## [Middle channel]



Date: 20.JUL.2016 10:00:34





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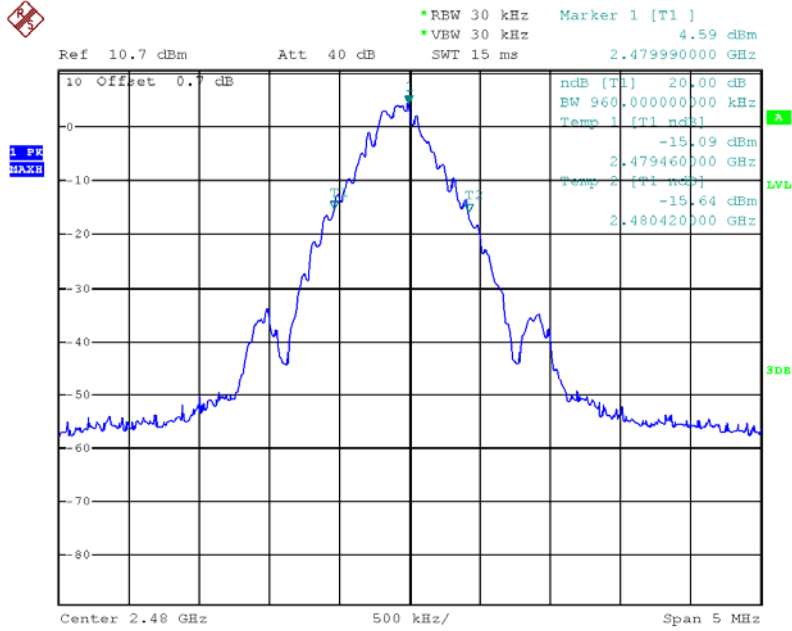
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## [High channel]



Date: 20.JUL.2016 10:01:16



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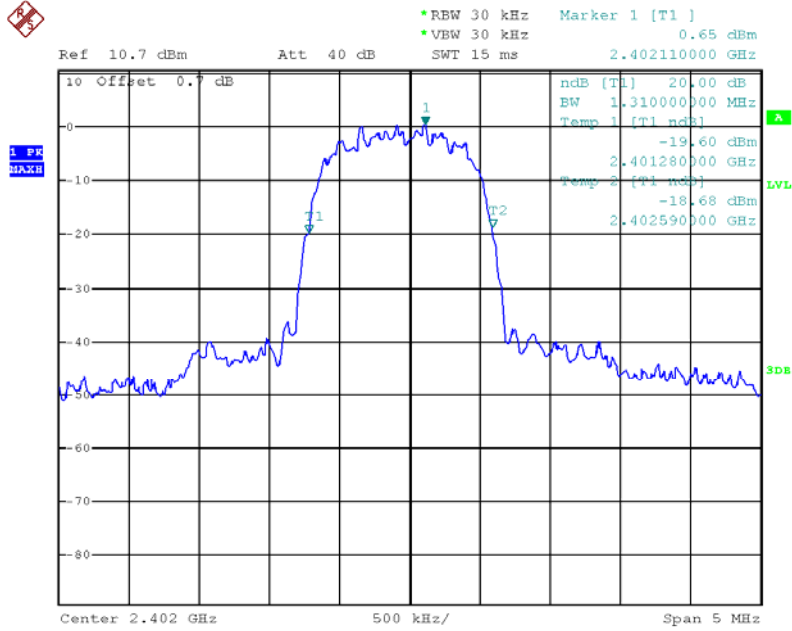
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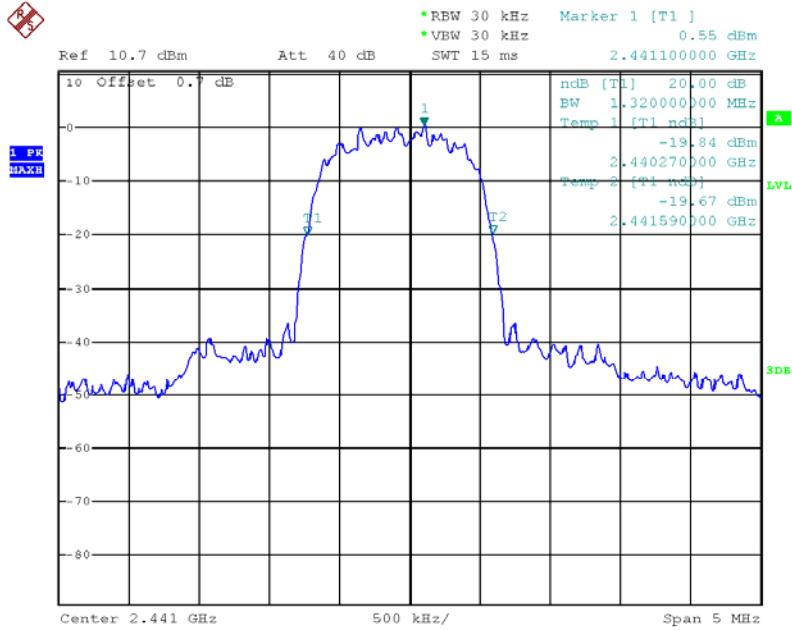
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## 20 dB Bandwidth - 8-DPSK [Low channel]



Date: 20.JUL.2016 10:02:58

## [Middle channel]



Date: 20.JUL.2016 10:03:41



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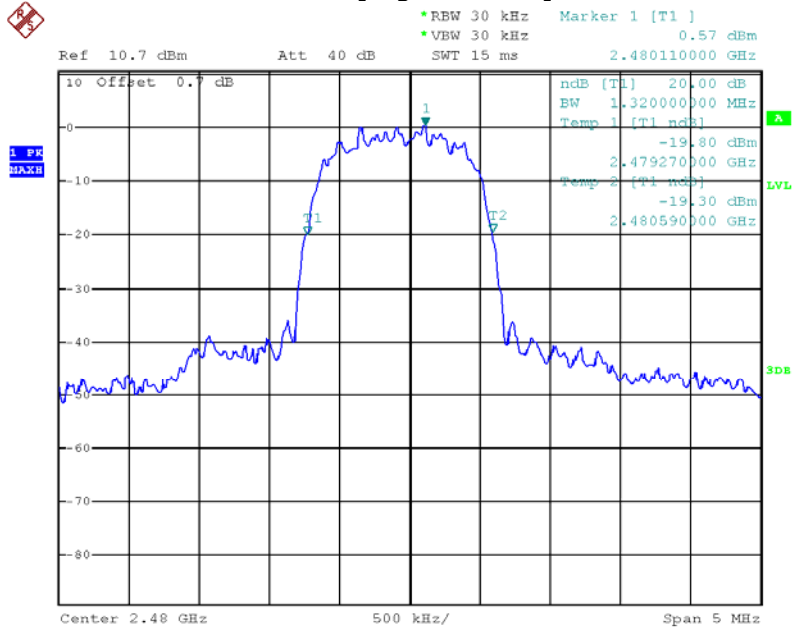
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## [High channel]



Date: 20.JUL.2016 10:04:18

## 2.1.4 Time of Occupancy (Dwell Time)

### Test Procedures(ANSI C63.10-2013 7.8.4)

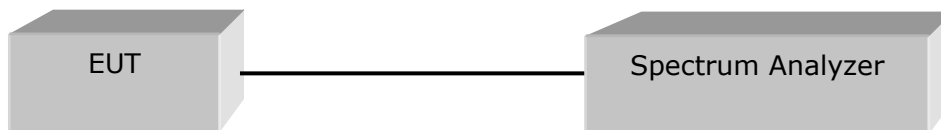
The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled.

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where T is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

$$\text{(Number of hops in the period specified in the requirements)} = \text{(number of hops on spectrum analyzer)} \times \text{(period specified in the requirements / analyzer sweep time)}$$



### Limit

The average time of occupancy 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.



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## Test Results

### Test mode : GFSK

Mode	Number of hops Channels	Length of Transmission Time(msec)	Result (msec)	Limit (msec)
DH1	79	0.390	<b>124.80</b>	400
DH3	79	1.640	<b>262.40</b>	400
DH5	79	2.900	<b>309.33</b>	400

※ Remark:

$\text{dwell time} = \{ (\text{hopping rate} / \text{time slots}) / \text{hopping channel} \} \times \text{Hopping channel} \times \text{Burst ON time} \times 0.4$

- Time slots for DH1 = 2 slots(TX=1 slot / RX 1slot)
- Time slots for DH3 = 4 slots(TX=3 slot / RX 1slot)
- Time slots for DH5 = 6 slots(TX=5 slot / RX 1slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

### Test mode : 8-DPSK

Mode	Number of hops Channels	Length of Transmission Time(msec)	Result (msec)	Limit (msec)
3DH1	79	0.390	<b>124.80</b>	400
3DH3	79	1.640	<b>262.40</b>	400
3DH5	79	2.900	<b>309.33</b>	400

※ Remark:

$\text{dwell time} = \{ (\text{hopping rate} / \text{time slots}) / \text{hopping channel} \} \times \text{Hopping channel} \times \text{Burst ON time} \times 0.4$

- Time slots for DH1 = 2 slots(TX=1 slot / RX 1slot)
- Time slots for DH3 = 4 slots(TX=3 slot / RX 1slot)
- Time slots for DH5 = 6 slots(TX=5 slot / RX 1slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

See next pages for actual measured spectrum plots.



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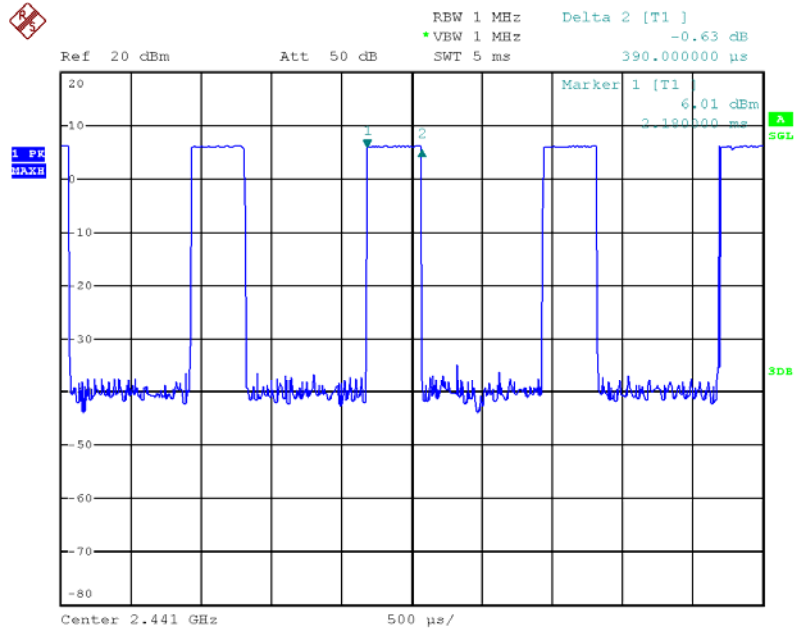
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## Time of Occupancy for PACKET Type DH1(GFSK)



Date: 15.JUL.2016 17:27:21



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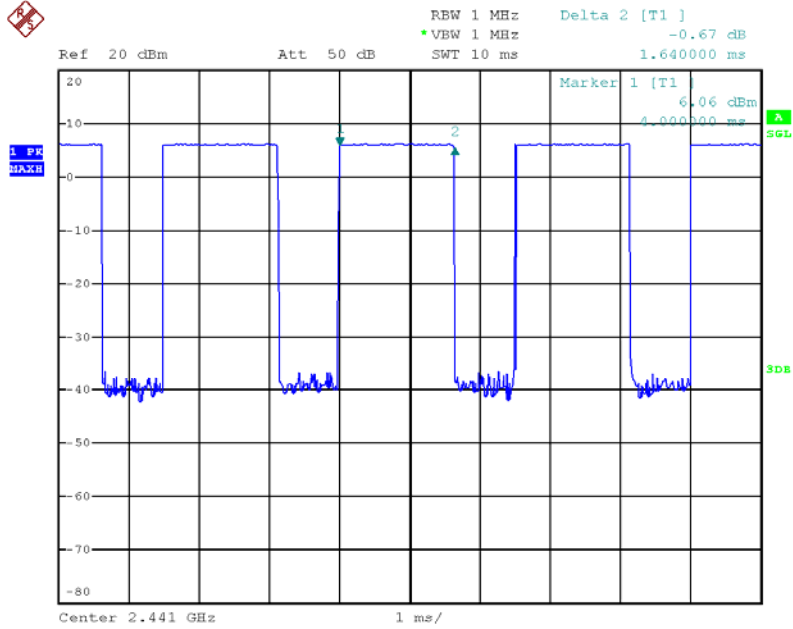
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## Time of Occupancy for PACKET Type DH3(GFSK)



Date: 15.JUL.2016 17:28:35



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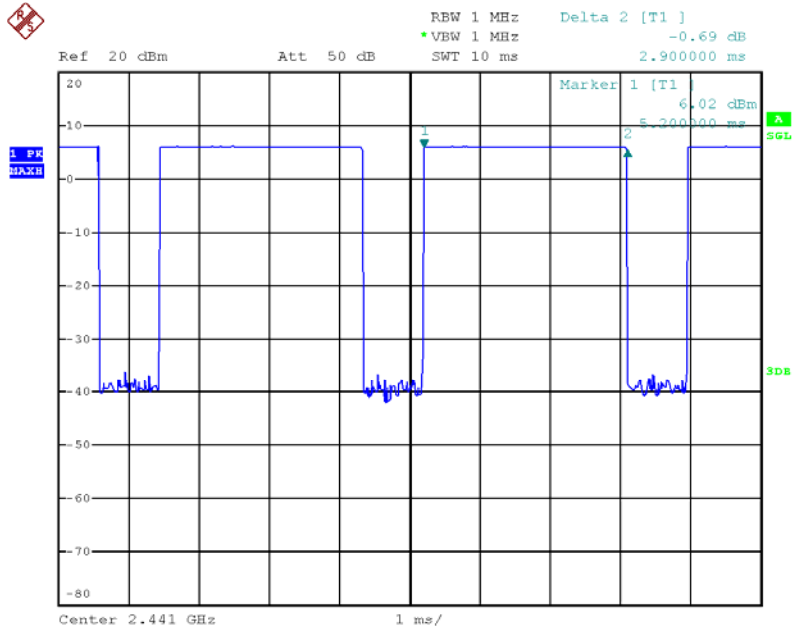
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## Time of Occupancy for PACKET Type DH5(GFSK)



Date: 15.JUL.2016 17:31:05



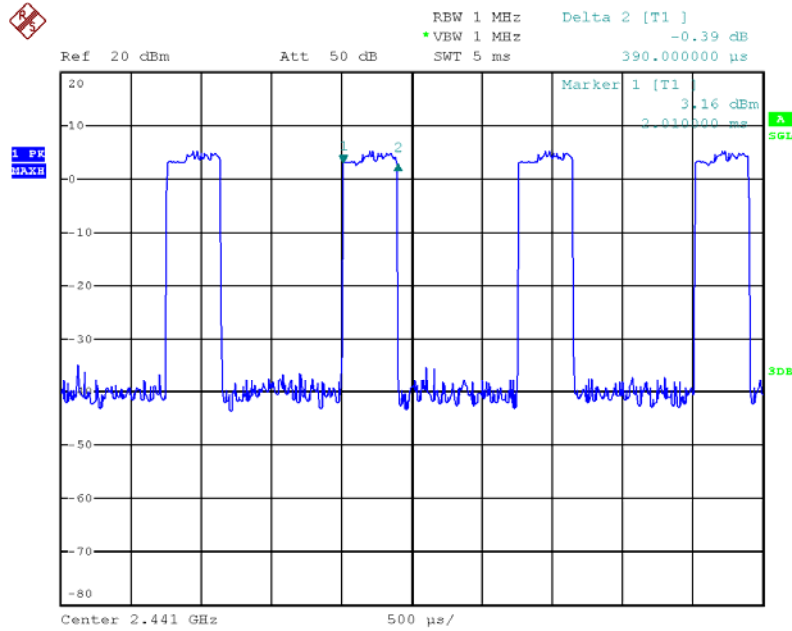


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## Time of Occupancy for PACKET Type 3DH1 (8-DPSK)



Date: 15.JUL.2016 17:41:23



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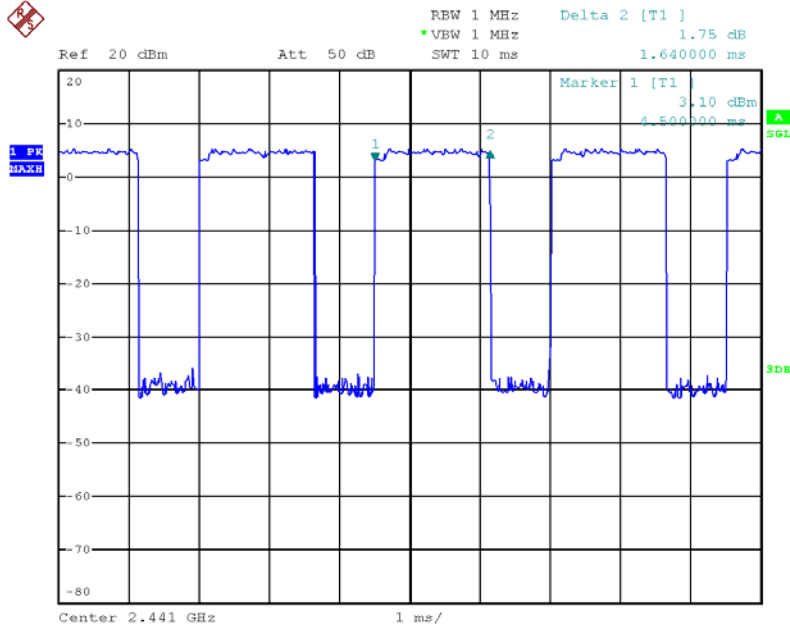
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## Time of Occupancy for PACKET Type 3DH3(8-DPSK)



Date: 15.JUL.2016 17:42:38



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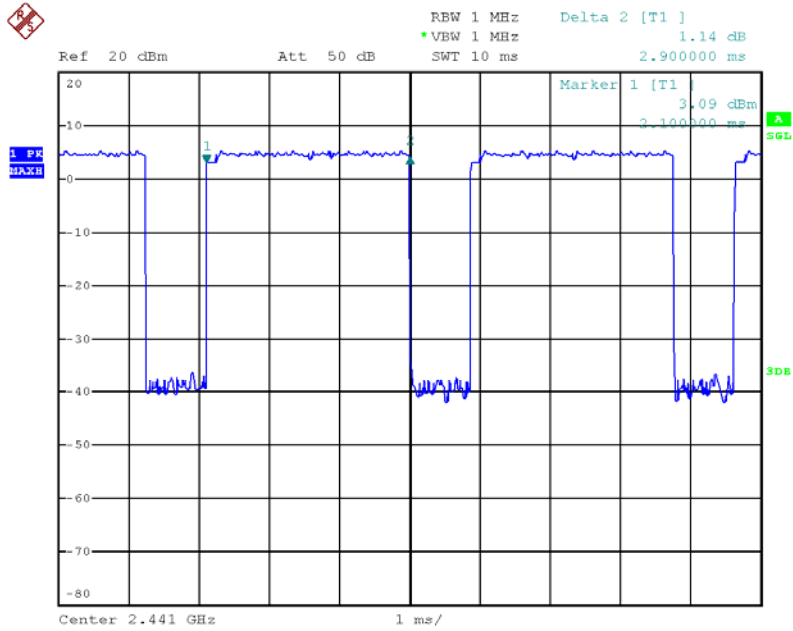
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## Time of Occupancy for PACKET Type 3DH5(8-DPSK)



Date: 15.JUL.2016 17:43:15

## 2.1.5 Maximum peak Conducted Output Power

### Test Procedures(ANSI C63.10-2013 7.8.5)

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test.

The spectrum analyzer is set to:

Center frequency = the highest, middle, and the lowest channels

Span = approximately 5 times of the 20 dB bandwidth

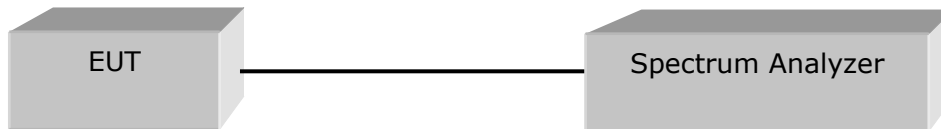
RBW > 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Detector function = peak

Trace = max hold

Sweep = auto



### Limit

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels.



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## Test Results

**Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)**

Frequency (MHz)	Channel No.	Peak output power(dBm)	Peak output power(mW)	Result
2 402	0	7.78	5.99	Complies
2 441	39	7.68	5.86	Complies
2 480	78	7.72	5.91	Complies

**Test mode :  $\pi/4$  DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)**

Frequency (MHz)	Channel No.	Peak output power(dBm)	Peak output power(mW)	Result
2402	0	8.80	7.58	Complies
2441	39	8.71	7.43	Complies
2480	78	8.81	7.60	Complies

**Test mode : 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)**

Frequency (MHz)	Channel No.	Peak output power(dBm)	Peak output power(mW)	Result
2402	0	8.74	7.48	Complies
2441	39	8.65	7.32	Complies
2480	78	8.65	7.32	Complies

See next pages for actual measured spectrum plots.

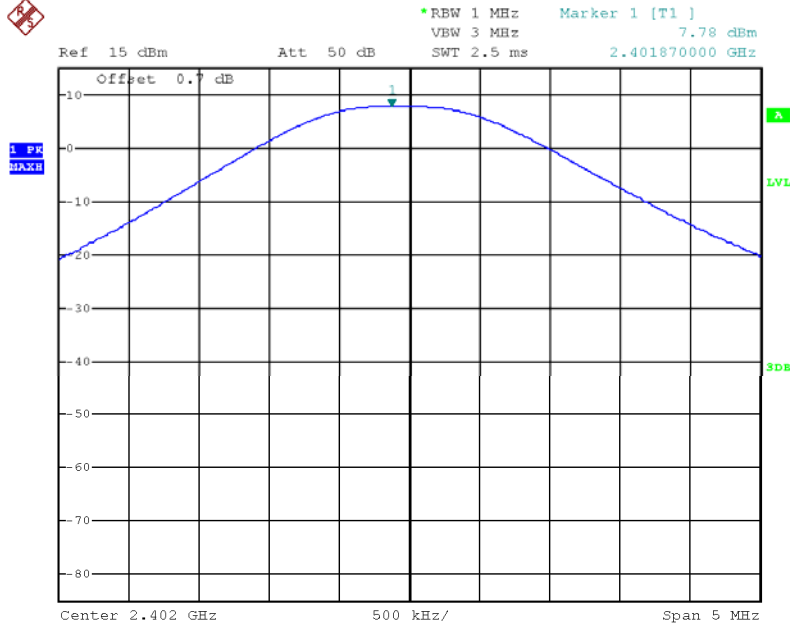


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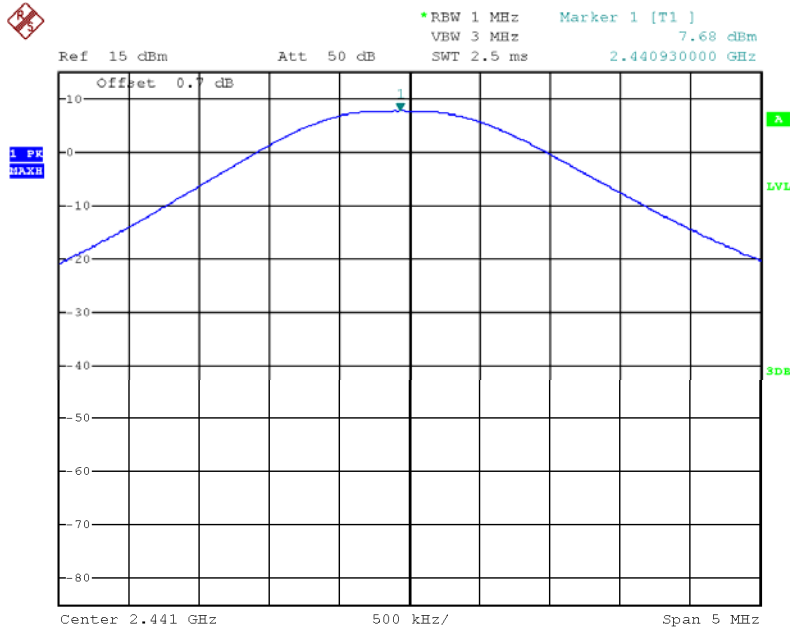
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## Maximum peak Conducted Output Power - GFSK [Low channel]



Date: 20.JUL.2016 11:11:50

## [Middle channel]



Date: 20.JUL.2016 11:14:25



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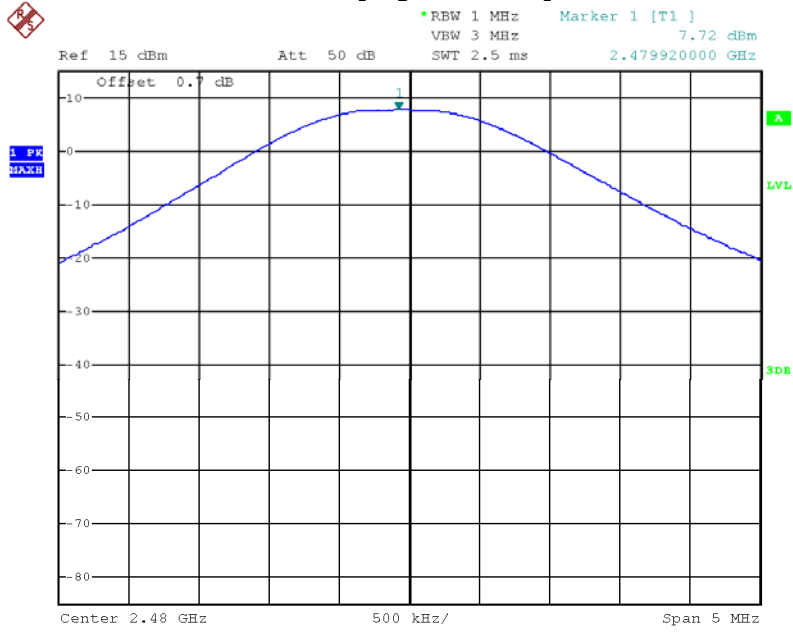
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## [High channel]



Date: 20.JUL.2016 11:14:58

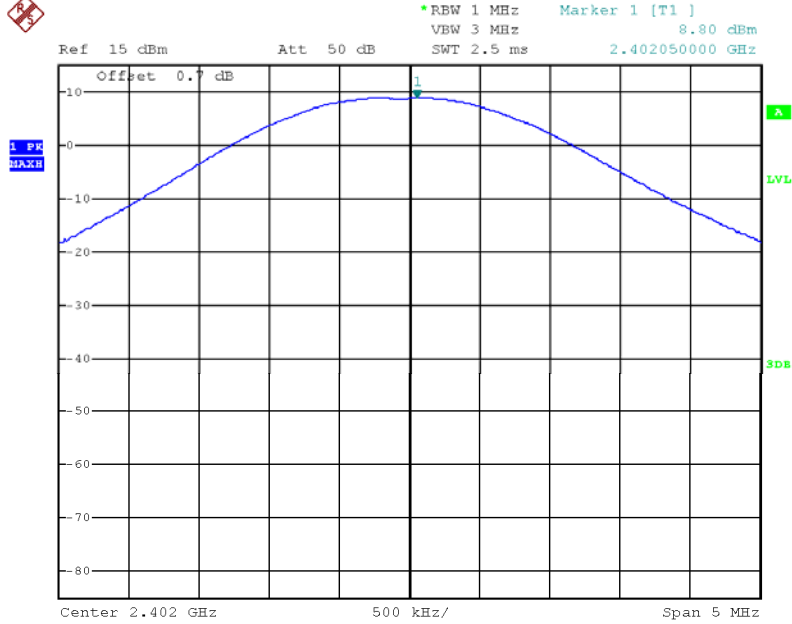


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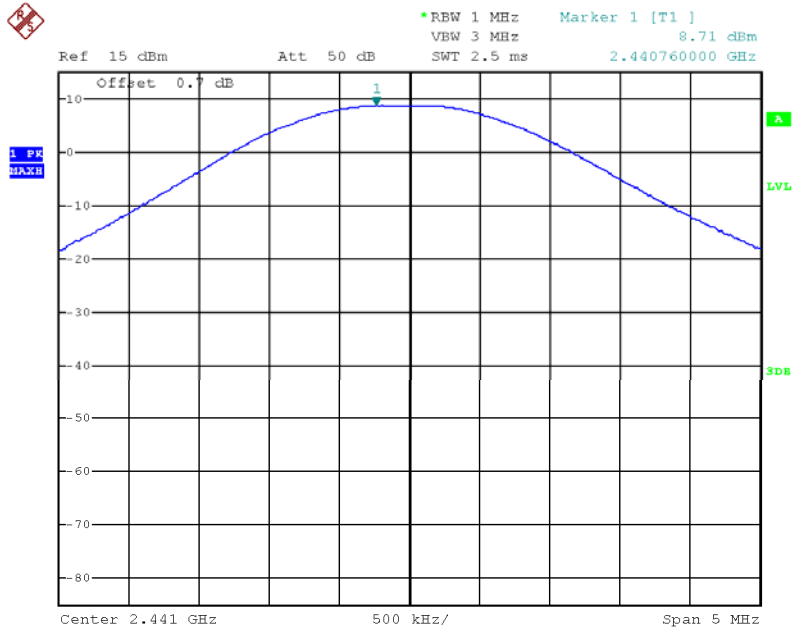
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## Maximum peak Conducted Output Power - $\pi/4$ DQPSK [Low channel]



Date: 20.JUL.2016 11:19:00

## [Middle channel]



Date: 20.JUL.2016 11:19:36





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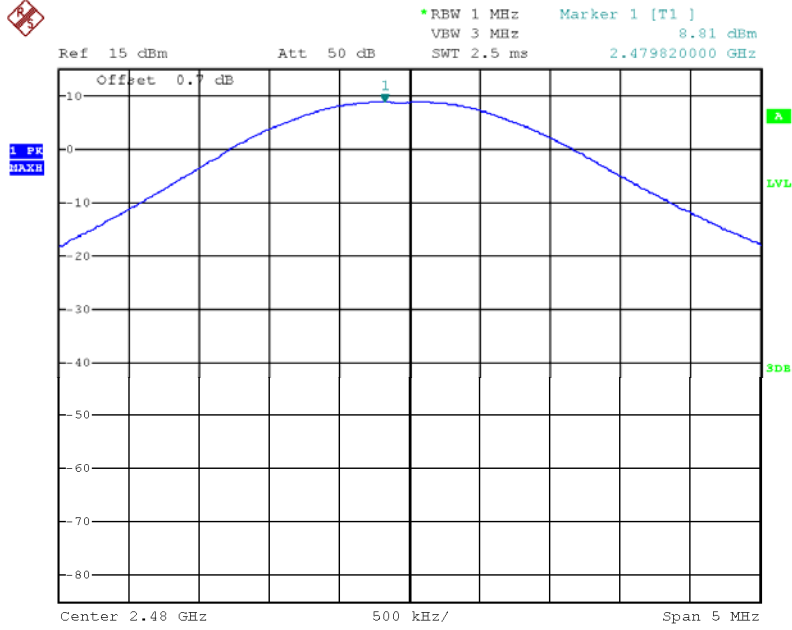
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## [High channel]



Date: 20.JUL.2016 11:33:01

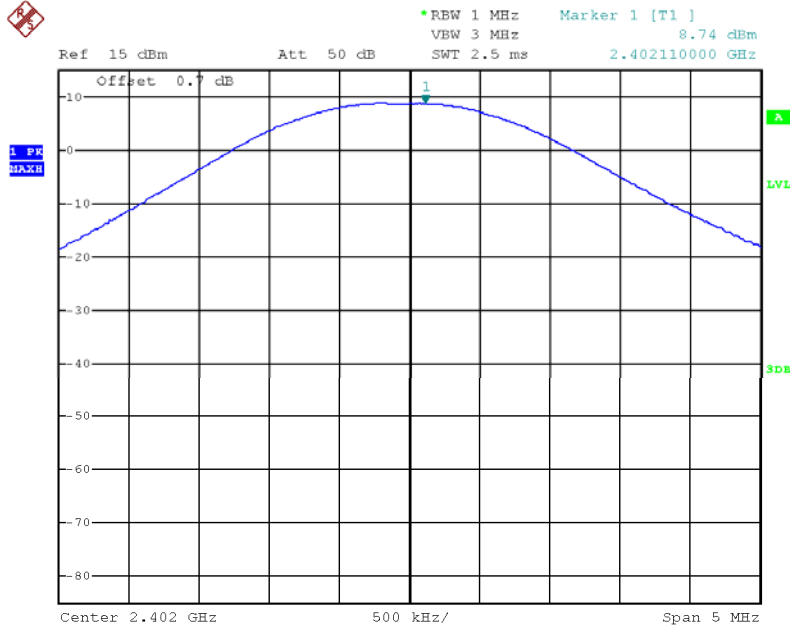


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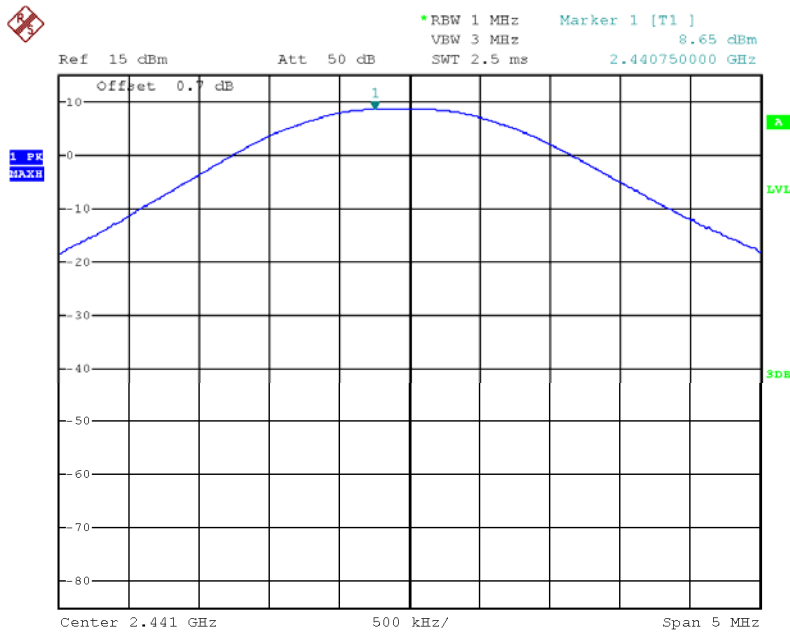
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea  
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## Maximum peak Conducted Output Power - 8-DPSK [Low channel]



Date: 20.JUL.2016 11:15:55

## [Middle channel]



Date: 20.JUL.2016 11:16:39



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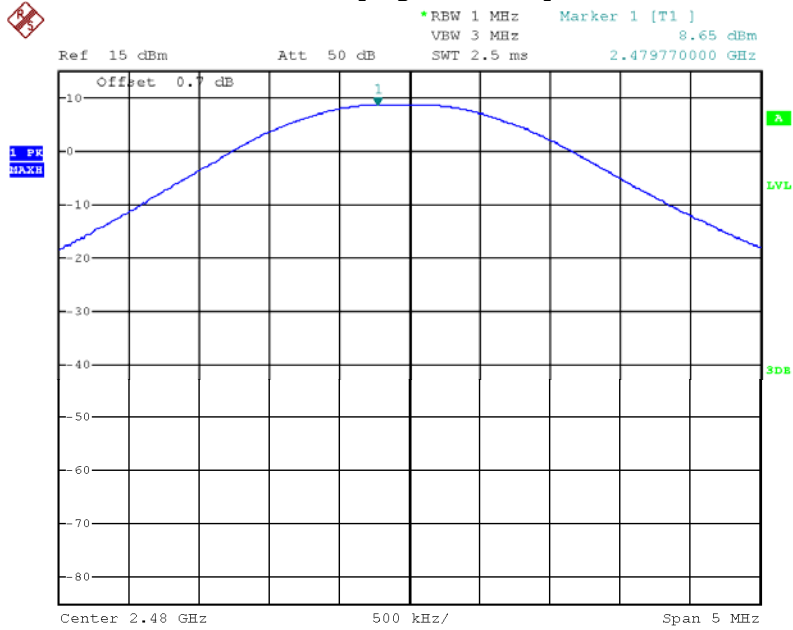
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## [High channel]



Date: 20.JUL.2016 11:17:07

## 2.1.6 Unwanted Emissions (Conducted)

### Test Procedures(ANSI C63.10-2013 7.8.6 / ANSI C63.10-2013 7.8.8)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen Issue 4 is not required.

The bandwidth at 20 dB down from the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function disabled at the highest, middle and the lowest available channels.

The spectrum analyzer is set to:

RBW : 100 kHz

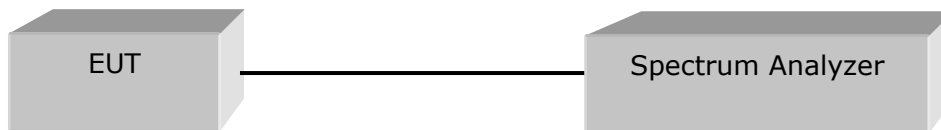
VBW : 300 kHz

Span : 30 MHz to 10 times the operating frequency in GHz

Detector function = peak

Trace : max hold

Sweep = auto



### Limit

> 20 dBc

### Test Results

All conducted emission in any 100 kHz bandwidth outside of the spectrum band was at least 20 dB lower than the highest level of the in-band spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.

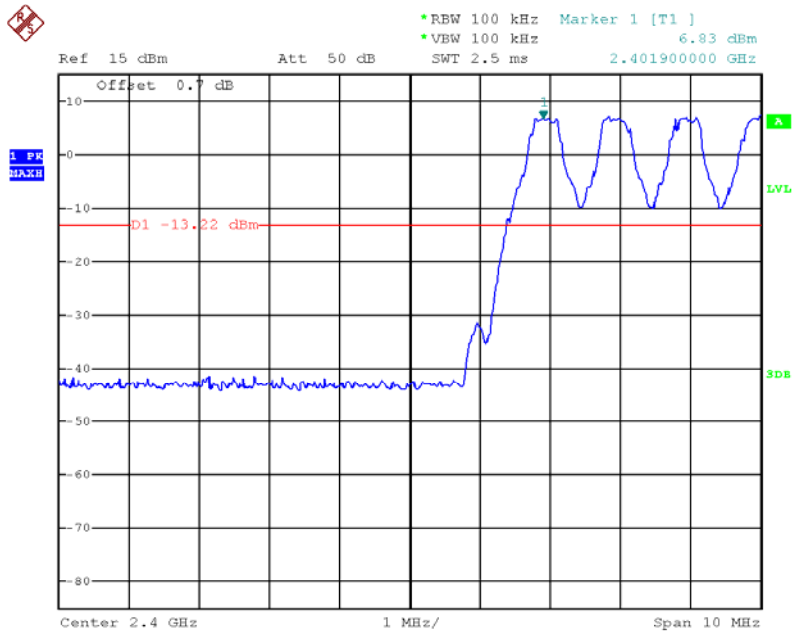


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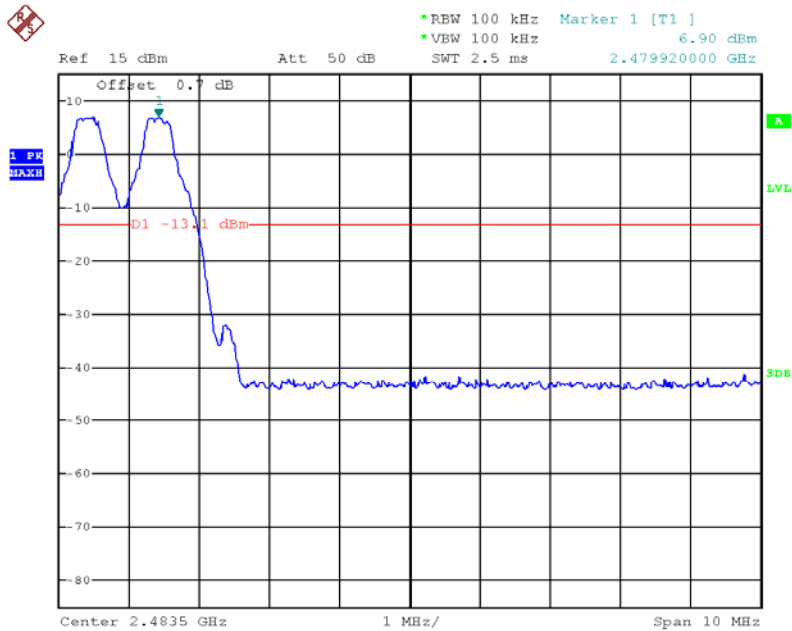
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## Band – edge (Hopping mode) - GFSK



Date: 20.JUL.2016 11:38:04



Date: 20.JUL.2016 11:39:47



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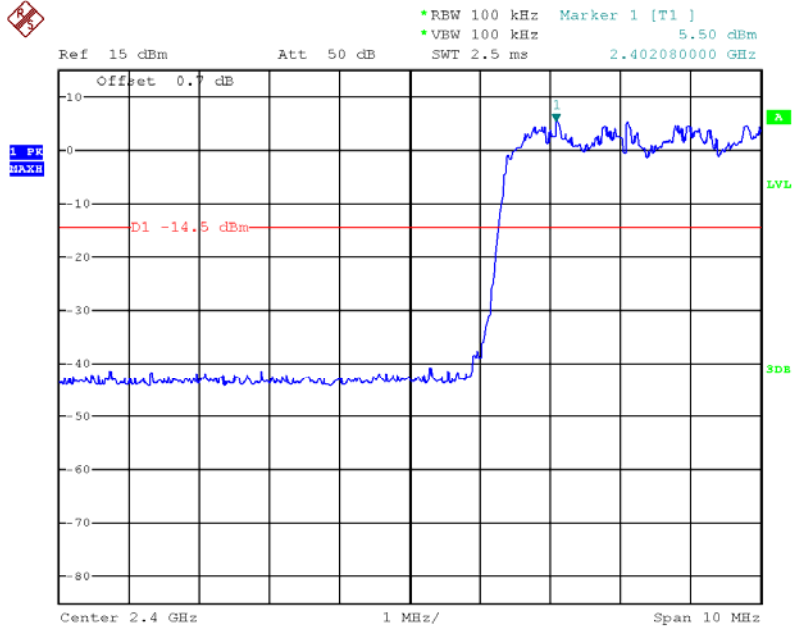
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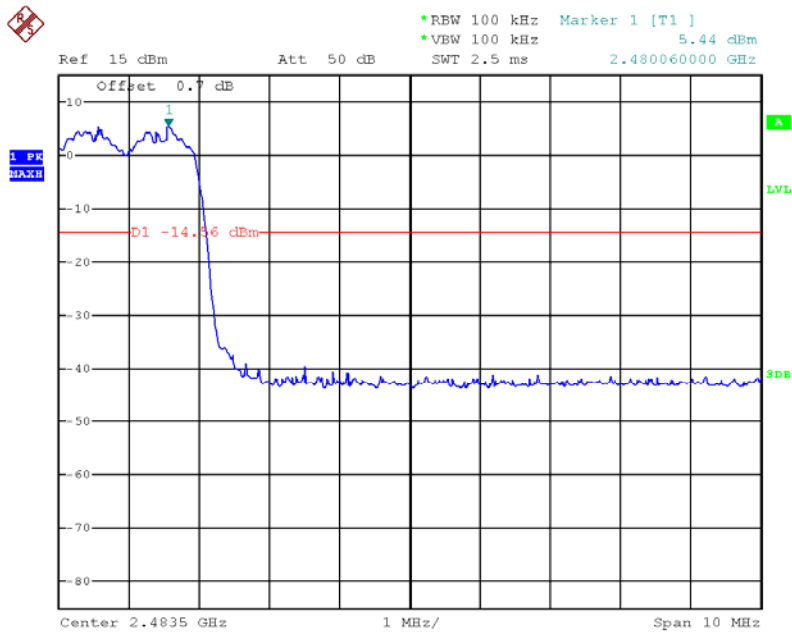
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## Band – edge (Hopping mode) - 8-DPSK



Date: 20.JUL.2016 11:50:42



Date: 20.JUL.2016 11:45:33



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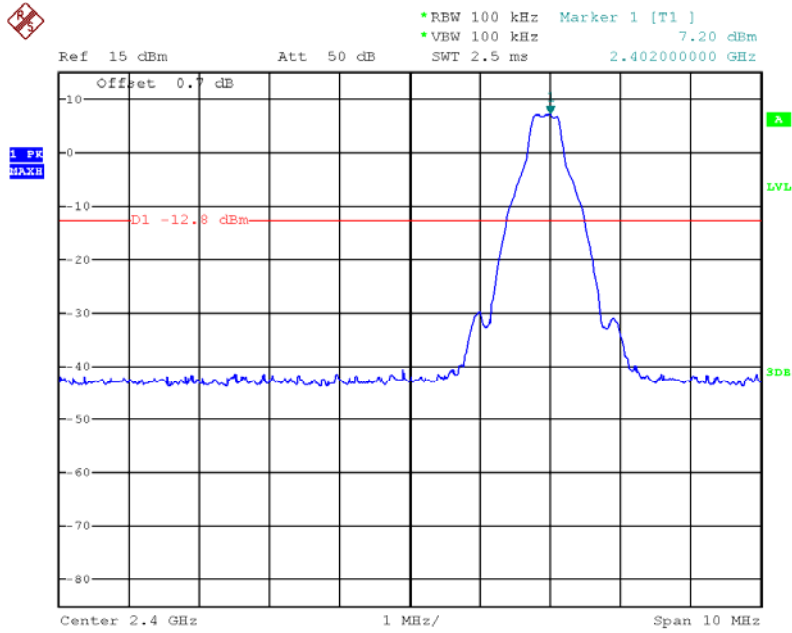
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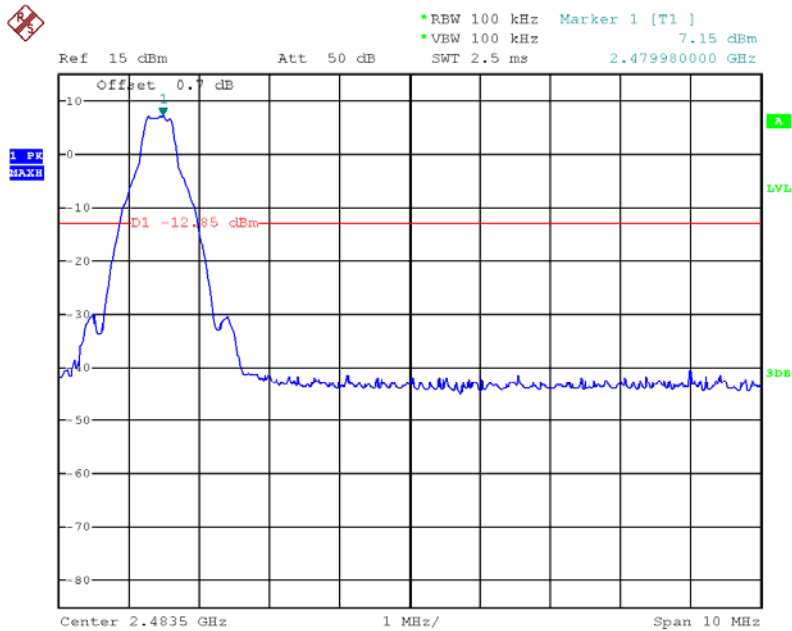
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## Band – edge (Non-Hopping mode) - GFSK



Date: 20.JUL.2016 11:56:35



Date: 20.JUL.2016 11:58:34



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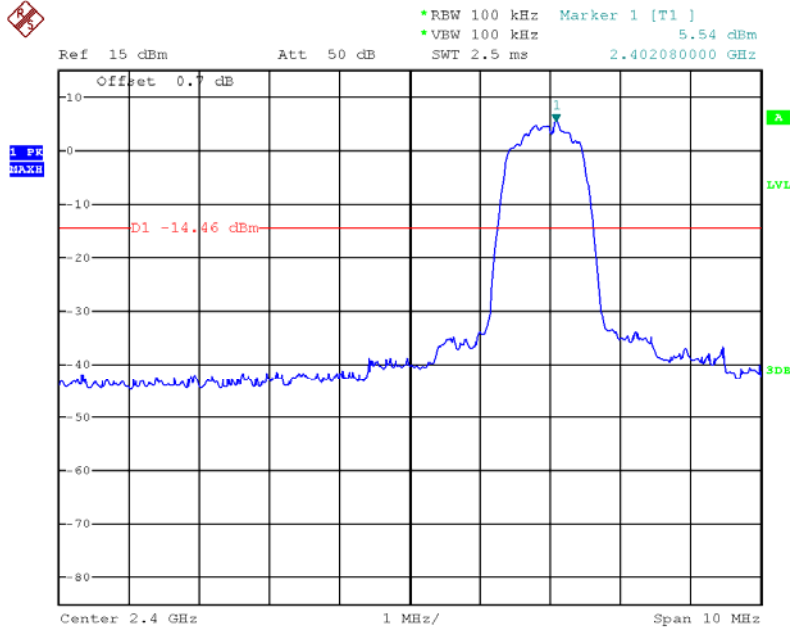
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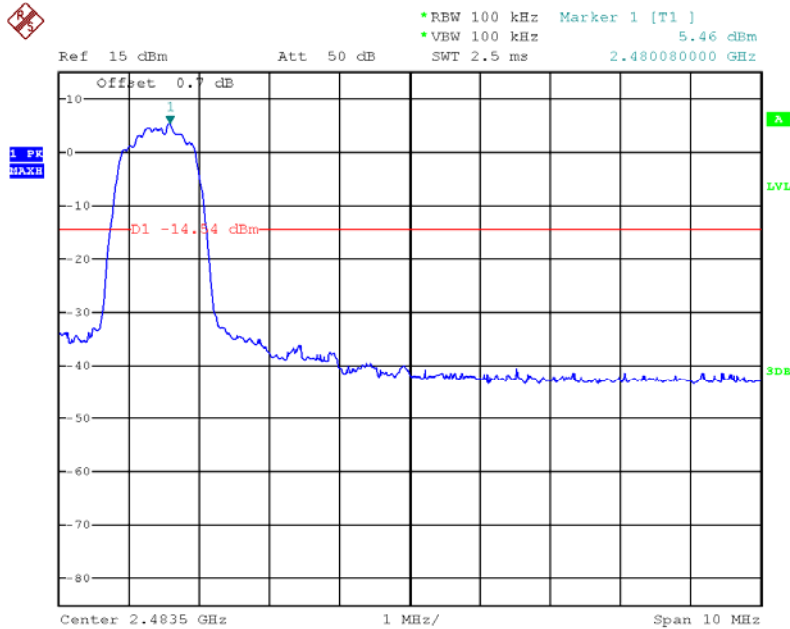
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## Band – edge (Non-Hopping mode) - 8-DPSK



Date: 20.JUL.2016 12:05:35



Date: 20.JUL.2016 12:04:07





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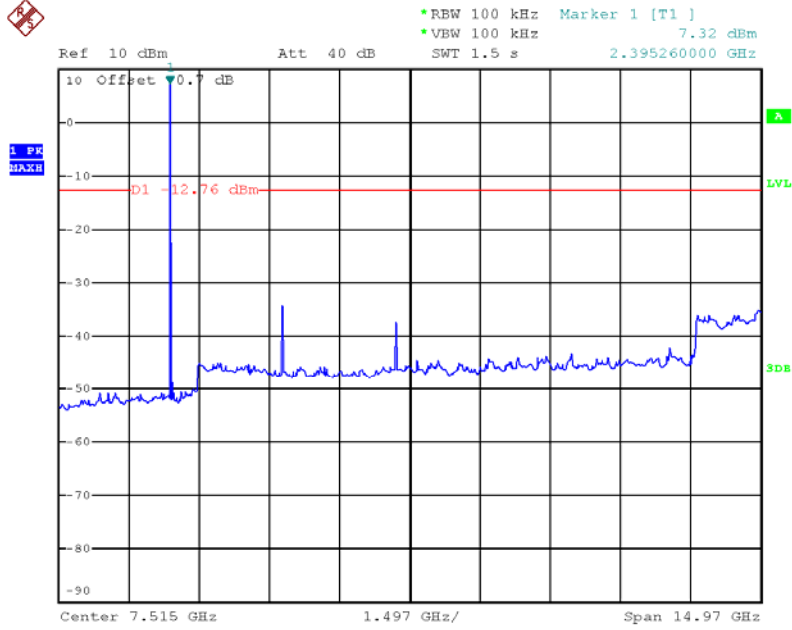
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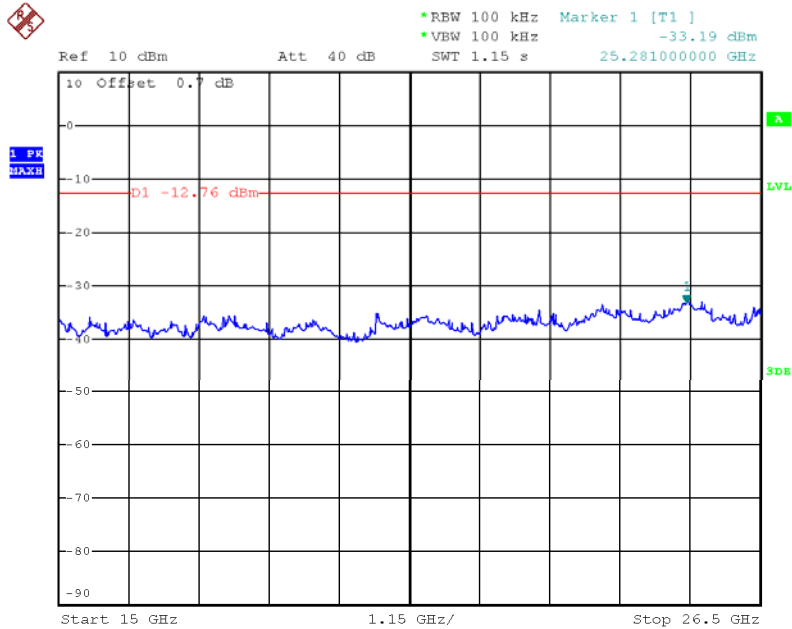
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## Spurious (at 20 dB blow) – Low channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic (Test mode : GFSK)



Date: 20.JUL.2016 14:06:44



Date: 20.JUL.2016 14:08:50



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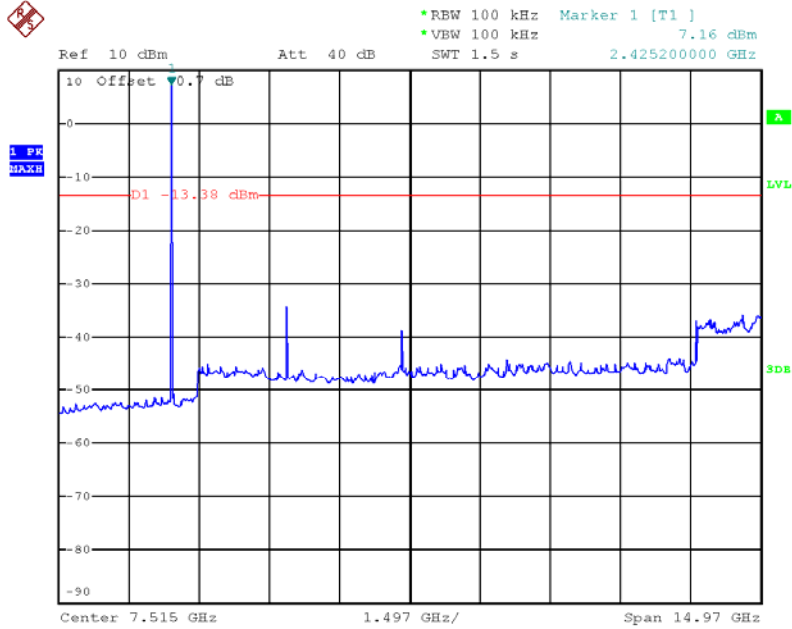
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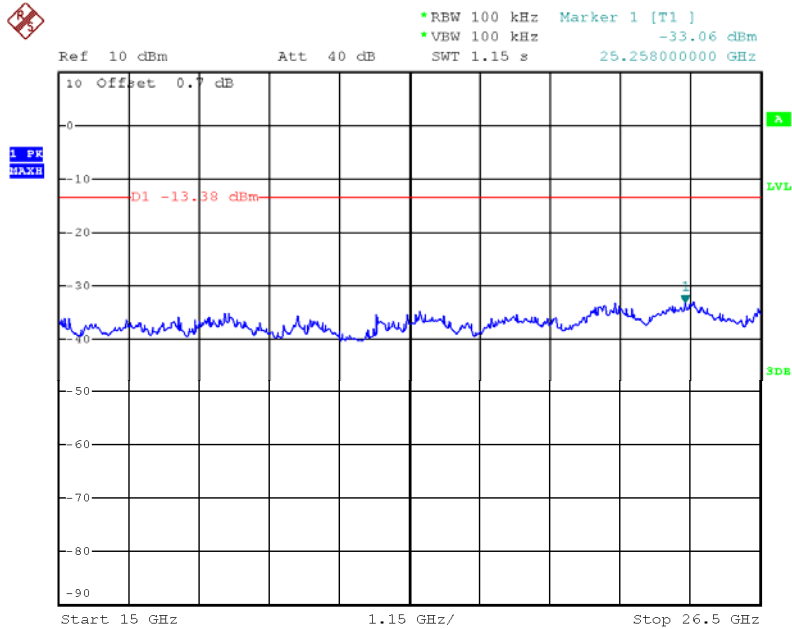
Tel: +82-31-339-9970 Fax: +82-31-624-9501

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## Spurious (at 20 dB blow) – Mid channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic (Test mode : GFSK)



Date: 20.JUL.2016 14:11:34



Date: 20.JUL.2016 14:12:15

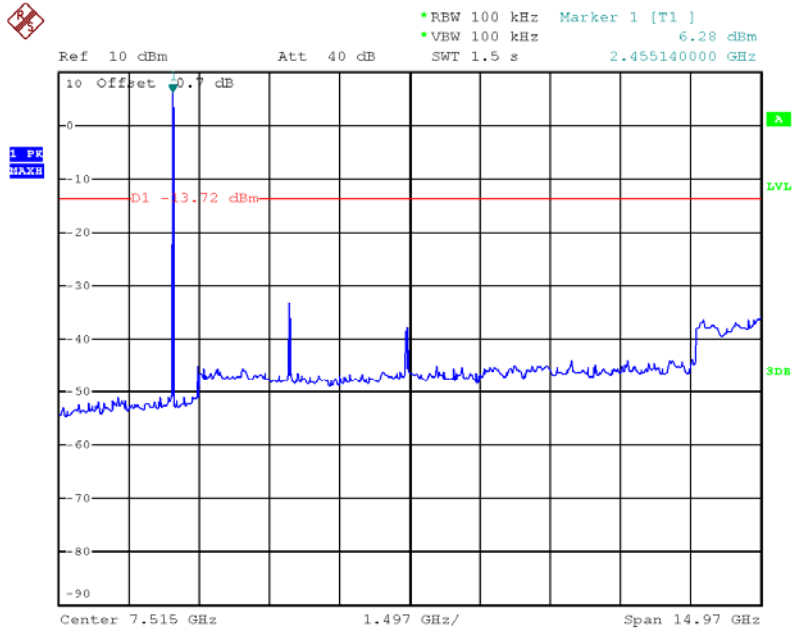


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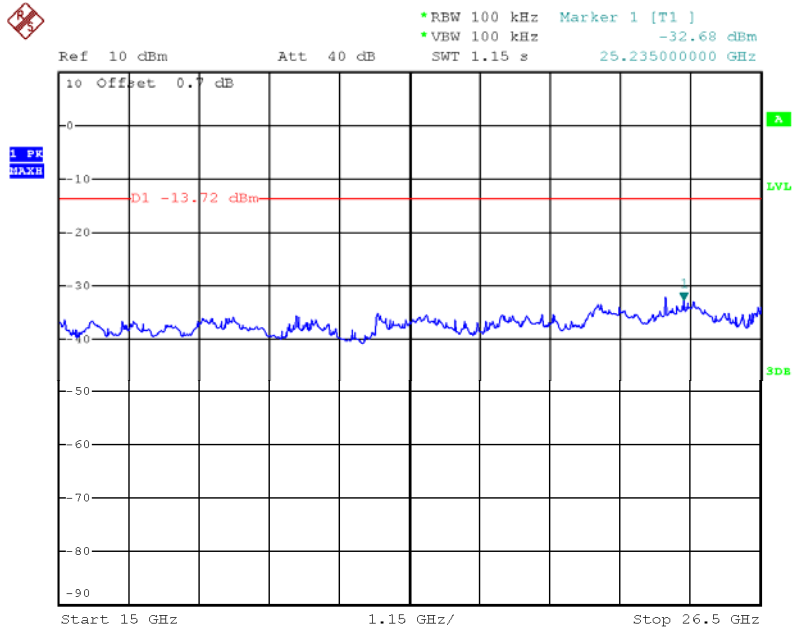
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## Spurious (at 20 dB blow) – High channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic (Test mode : GFSK)



Date: 20.JUL.2016 14:14:26



Date: 20.JUL.2016 14:15:01

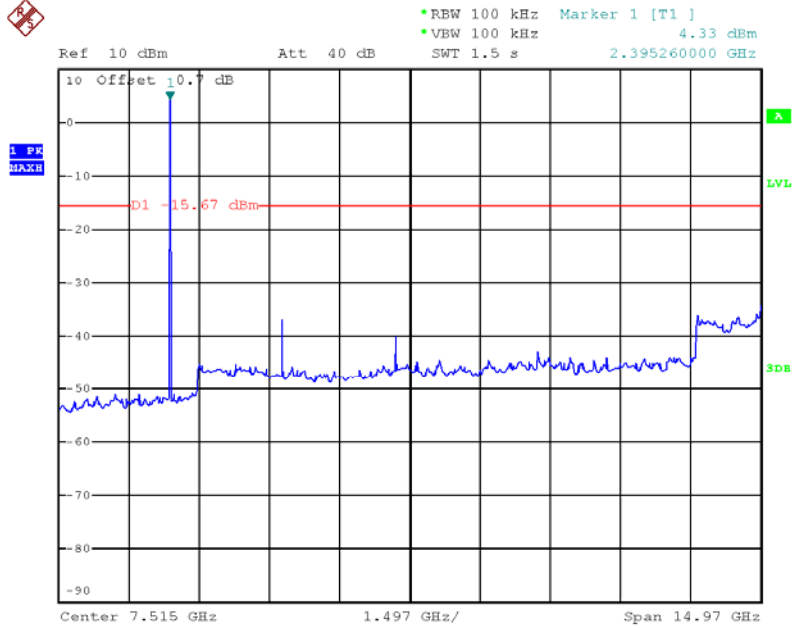


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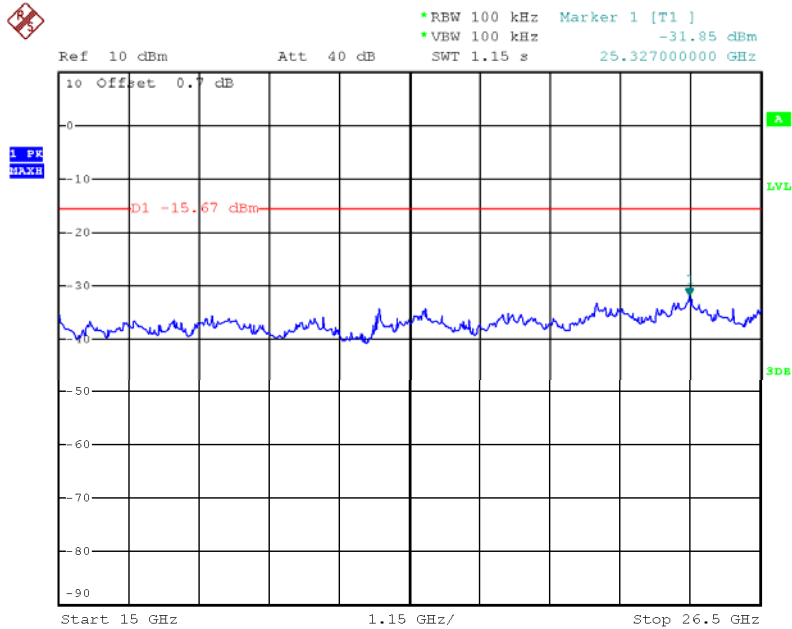
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## Spurious (at 20 dB blow) – Low channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic (Test mode : 8-DPSK)



Date: 20.JUL.2016 14:17:41



Date: 20.JUL.2016 14:18:17

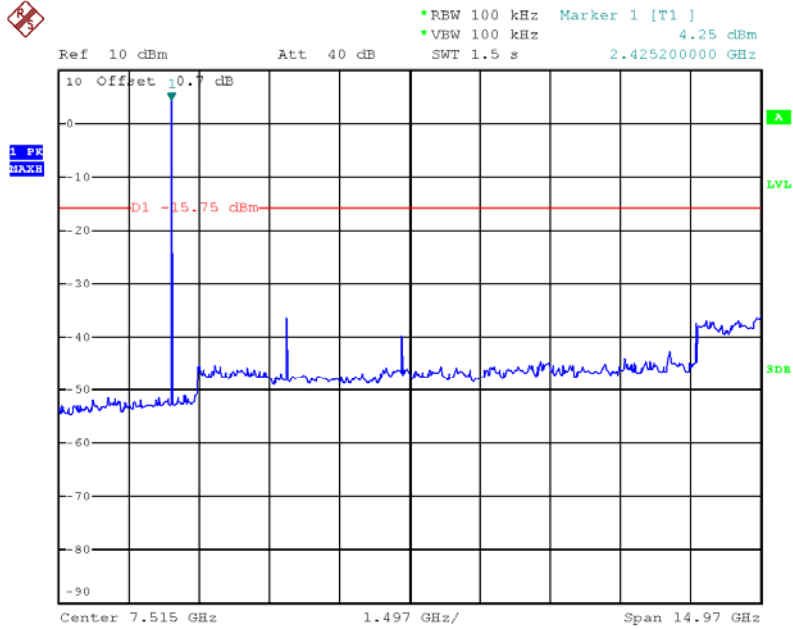


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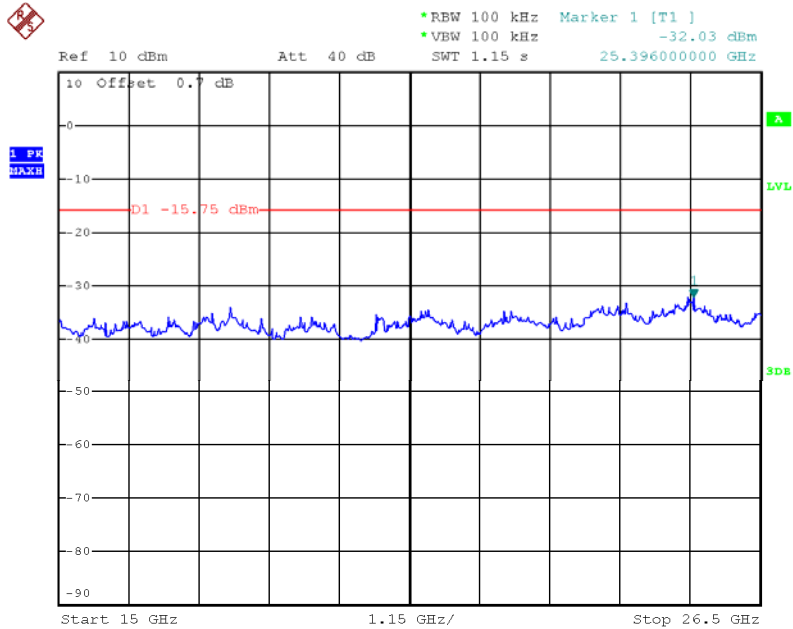
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## Spurious (at 20 dB blow) – Mid channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic (Test mode : 8-DPSK)



Date: 20.JUL.2016 14:19:59



Date: 20.JUL.2016 14:20:37

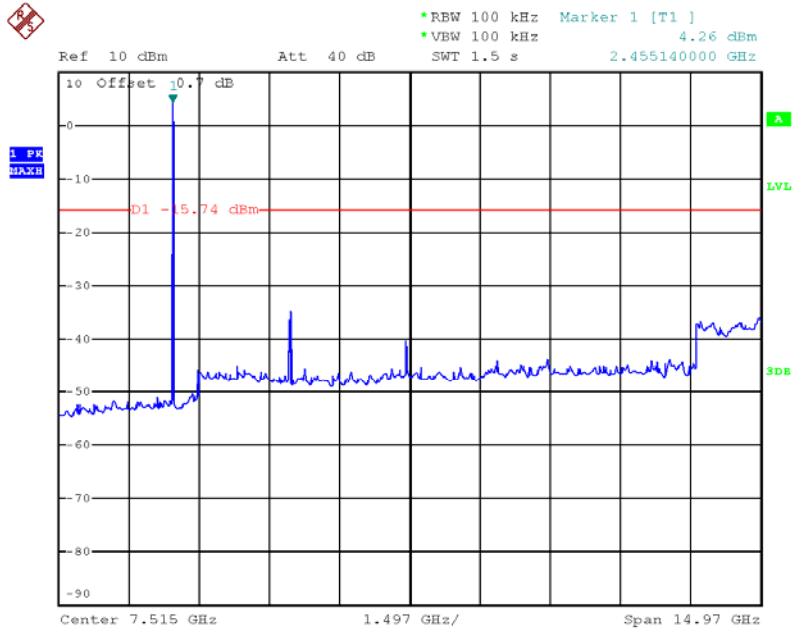


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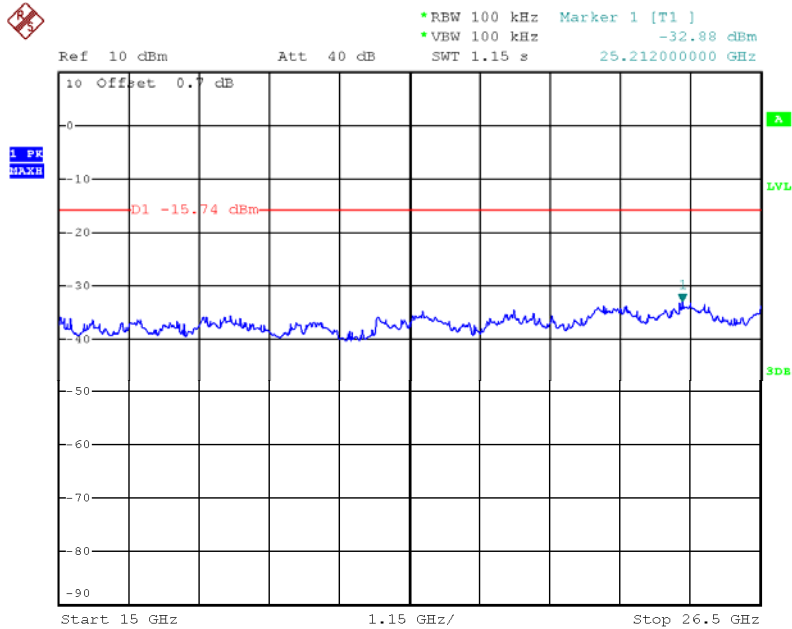
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## Spurious (at 20 dB blow) – High channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic (Test mode : 8-DPSK)



Date: 20.JUL.2016 14:22:11



Date: 20.JUL.2016 14:22:56



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### 2.1.7 Unwanted emissions (Radiated)

#### Test Location

- 10 m SAC (test distance :  10 m,  3 m)  
 3 m SAC (test distance : 3 m)

#### Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

The spectrum analyzer is set to:

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10<sup>th</sup> harmonic)

RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz, 9 kHz for  $f < 30$  MHz

VBW  $\geq$  RBW

Sweep = auto



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## Limit

§ 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
<sup>1</sup> 0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475-156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	<sup>2</sup> Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.





§ 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Deasurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

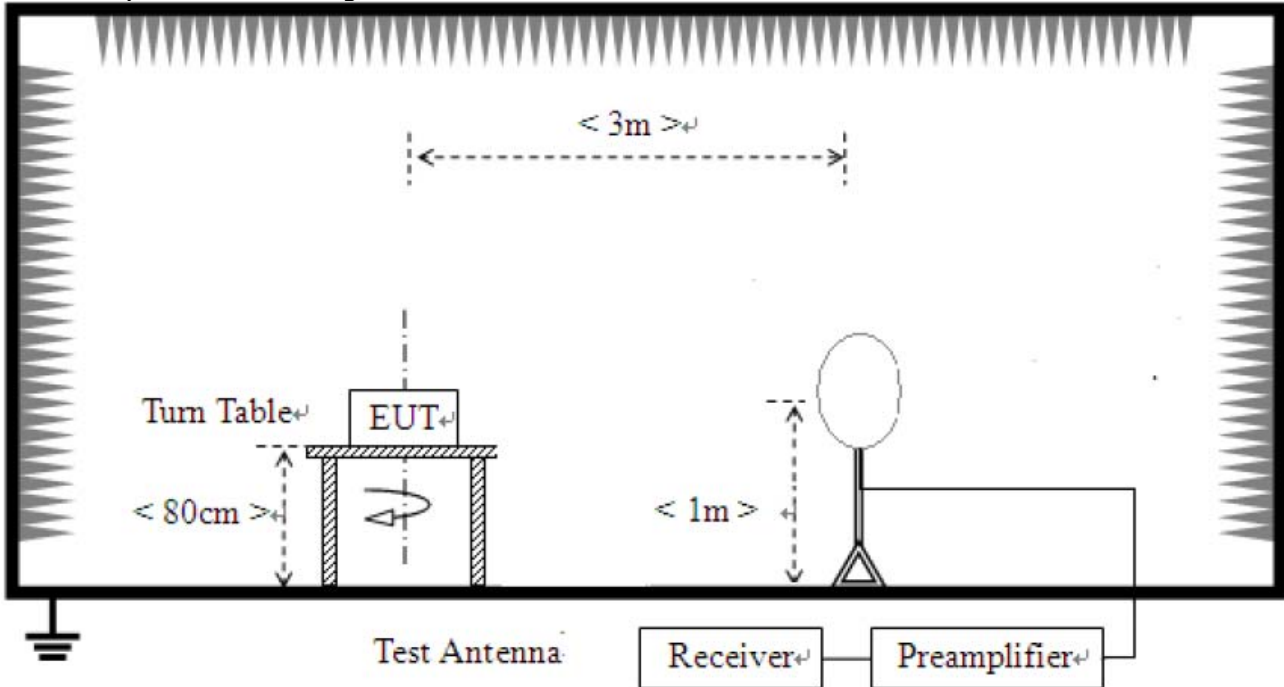
\*\* Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

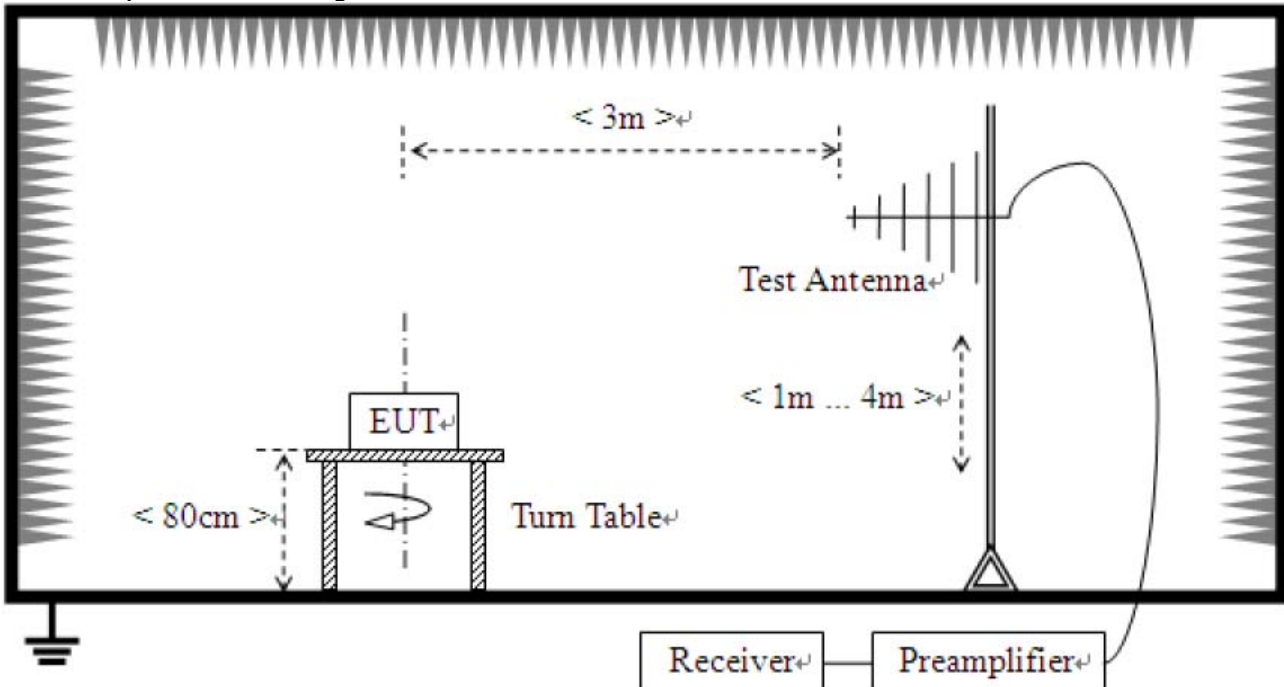
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
- 3) For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement.

### Test Setup:

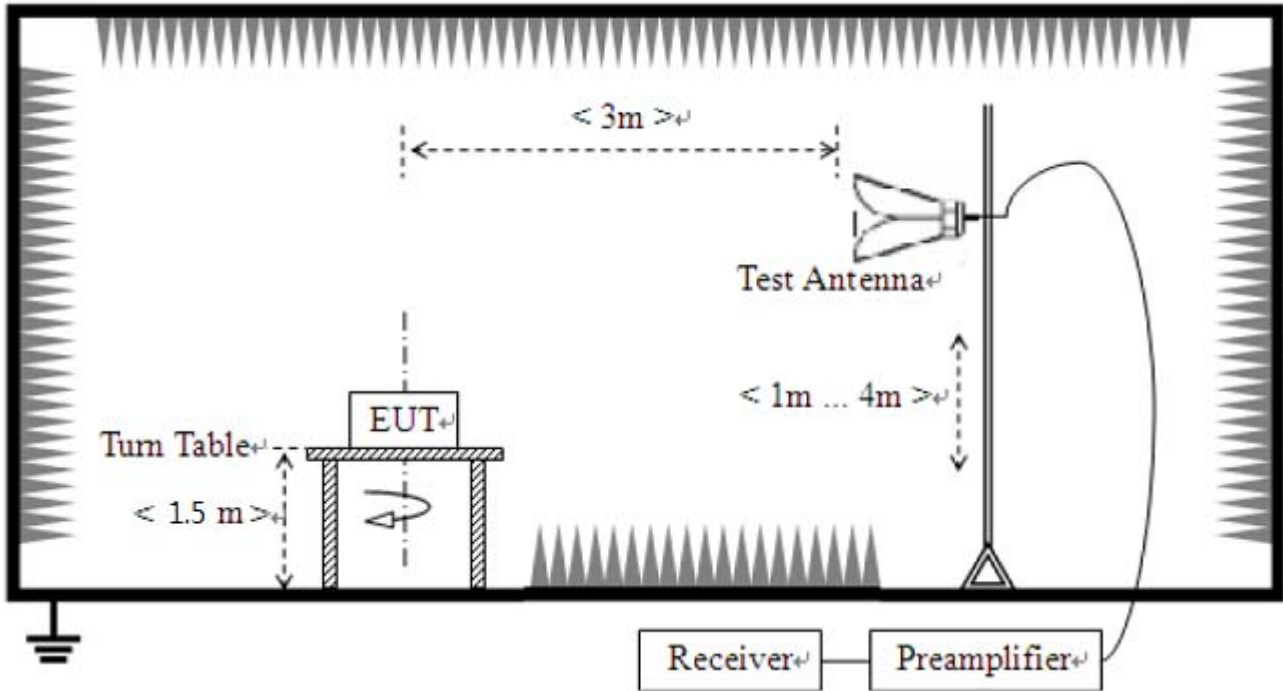
1) For field strength of emissions from 9 kHz to 30 MHz



2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



**Test Results**

**1) 9 kHz to 30 MHz**

EUT	Neo smartpen N2	Measurement Detail	
Frequency Range		9 kHz - 30 MHz	
Test mode	GFSK(Worst case)	Detector function	Quasi-Peak

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

**Note :**

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB)



## 2) 30 MHz to 1 GHz

Test mode : Hopping(GFSK), CFG PKT Packet Type : 15 Packet Size : 339(DH5)

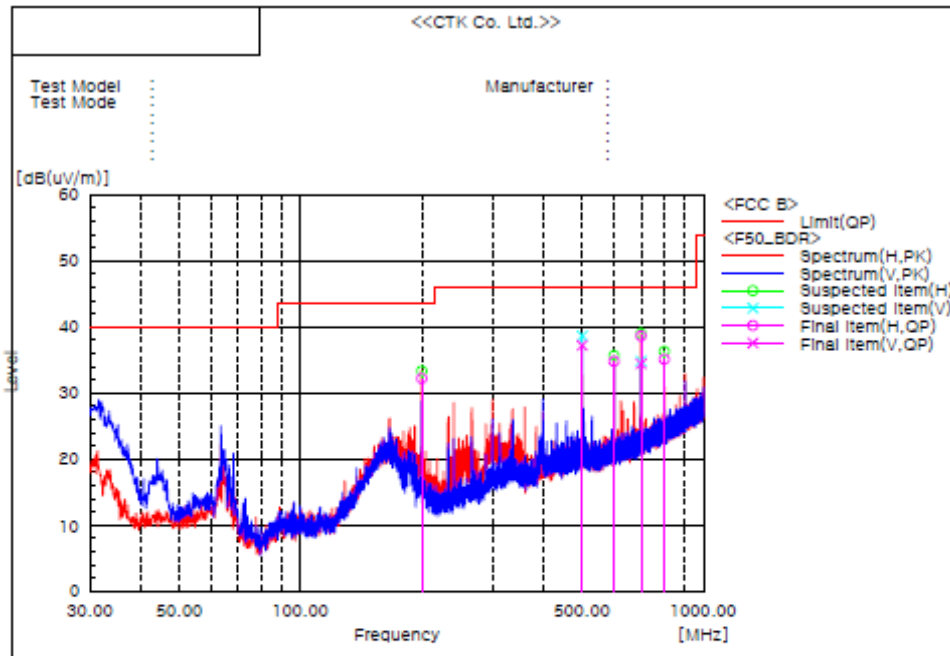
EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F50	Frequency Range	Below 1 000MHz
Mode	GFSK, Hopping	Detector function	Quasi-Peak

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
700.028	38.6	7.4	-

### Test Data



#### Final Result

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]	Angle [deg]
1	199.998	H	46.6	-14.4	32.2	43.6	11.3	213.1
2	600.086	V	45.0	-7.8	37.2	46.0	8.8	344.9
3	699.996	H	40.8	-6.0	34.8	46.0	11.2	182.3
4	700.028	H	42.8	-4.2	38.6	46.0	7.4	0.4
5	700.028	V	38.6	-4.2	34.4	46.0	11.6	49.7
6	800.069	H	37.6	-2.6	35.1	46.0	10.9	13.3

#### Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Result = Reading + Correction factor
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain



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**Test mode : Hopping(8-DPSK), CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)**

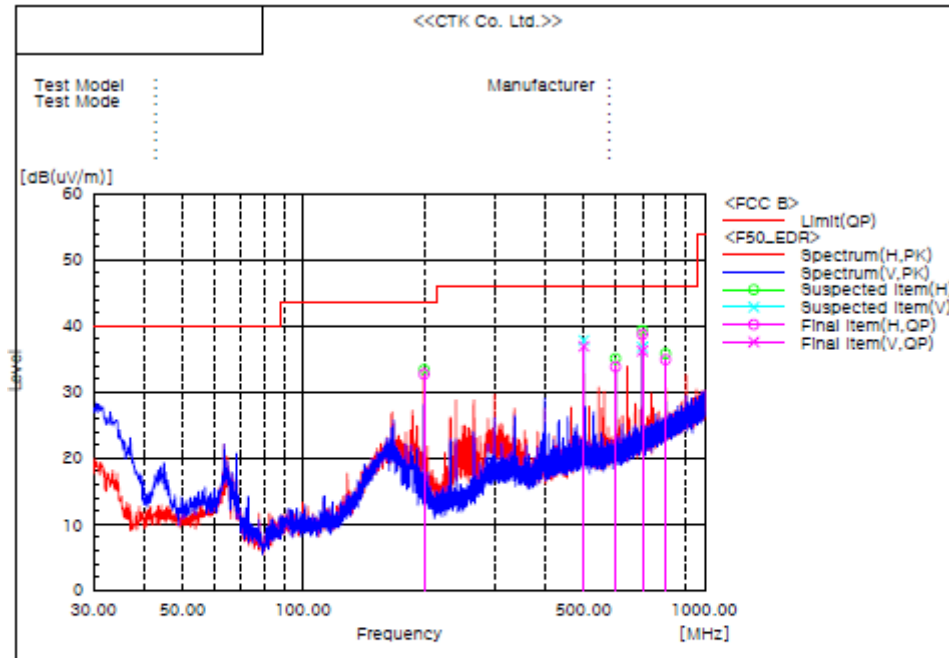
EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F50	Frequency Range	Below 1 000MHz
Mode	8-DPSK, Hopping	Detector function	Quasi-Peak

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
700.028	38.7	7.3	-

### Test Data



#### Final Result

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f. [dB(1/m)]	Result [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]	Angle [deg]
1	199.993	H	47.1	-14.4	32.7	43.5	10.8	215.4
2	499.965	V	44.7	-7.8	36.9	45.0	9.1	356.2
3	600.118	H	39.8	-6.0	33.8	45.0	12.2	200.0
4	700.028	H	42.9	-4.2	38.7	45.0	7.3	2.7
5	700.028	V	40.4	-4.2	36.2	45.0	9.8	38.7
6	800.059	H	37.4	-2.5	34.9	45.0	11.1	200.0

#### Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Result = Reading + Correction factor
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain



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### Test mode : Receive(Worst case)

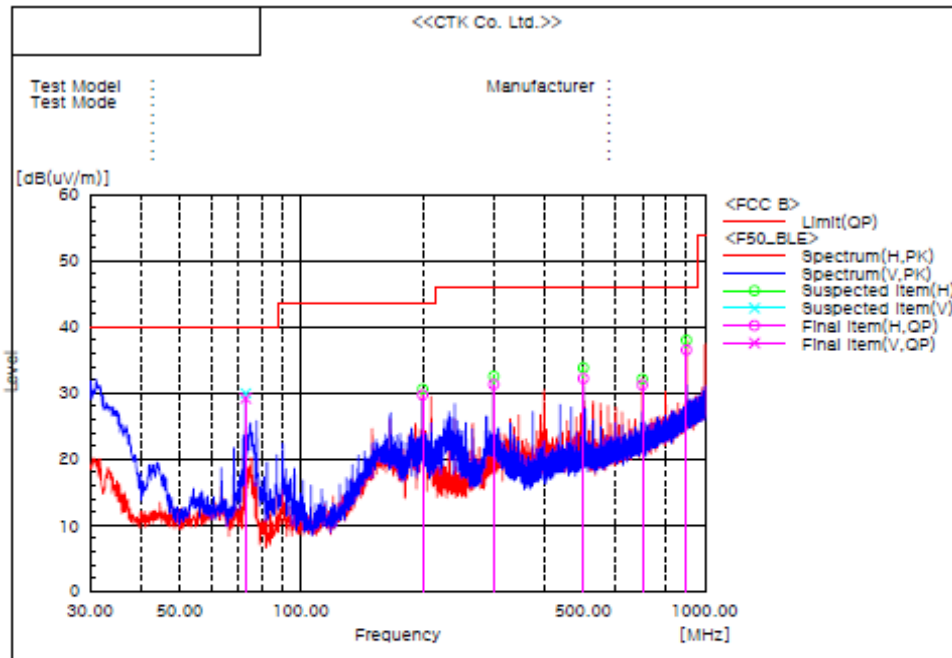
EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F50	Frequency Range	Below 1 000MHz
Mode	Receive(Worst case)	Detector function	Quasi-Peak

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
900.090	36.5	9.5	-

### Test Data



#### Final Result

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]	Angle [deg]
1	72.923	V	48.4	-19.2	29.2	40.0	10.8	121.4
2	199.993	H	44.1	-14.4	29.7	43.6	13.8	195.7
3	300.024	H	42.7	-11.4	31.3	46.0	14.7	67.9
4	499.966	H	40.0	-7.8	32.2	46.0	13.8	180.4
5	700.028	H	36.4	-4.2	31.2	46.0	14.8	42.6
6	900.090	H	37.2	-0.7	36.5	46.0	9.5	195.7

#### Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
2. Result = Reading + Correction factor
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain



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### 3) above 1 GHz

#### [Low Channel]

EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F50	Frequency Range	1-25GHz
Channel	Channel 0	Detector function	Peak / Average

#### Remarks

We have tested three mode (X, Y, Z). The worst mode (Z axis) for final test.

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4803	51.0	3.0	Average

#### Test Data

Test mode : Transmit, GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor		Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	
4803.00	47.3   54.4	H	1.5	3.7		54.0   74.0	51.0   58.1	3.0   15.9			

Test mode : Receive, GFSK

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor		Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	

No other emissions were detected at a level greater than 20dB below limit.

Test mode : Transmit, 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor		Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	
4803.00	41.1   53.1	H	1.5	3.7		54.0   74.0	44.8   56.8	9.2   17.2			

Test mode : Receive, 8-DPSK

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor		Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	

No other emissions were detected at a level greater than 20dB below limit.



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## Restricted band edge test data

Measured frequency range : 2310-2390 MHz, 2483.5-2500 MHz

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	
2351.00	34.1	48.1	H	1.5	-2.6		54.0	74.0	31.5	45.5	22.5	28.5

Test mode : Receive, GFSK

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	

No other emissions were detected at a level greater than 20dB below limit.

Test mode : 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	
2350.00	36.4	51.4	H	1.5	-2.6		54.0	74.0	33.8	48.8	20.2	25.2

Test mode : Receive, 8-DPSK

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak				Antenna + Amp. Gain + Cable		AV / Peak		AV / Peak		AV / Peak	

No other emissions were detected at a level greater than 20dB below limit.





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## [Middle Channel]

EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F50	Frequency Range	1-25GHz
Channel	Channel 39	Detector function	Peak

### Remarks

We have tested three mode (X, Y, Z). The worst mode (Z axis) for final test.

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4882	51.0	3.0	Average

### Test Data

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
4882.00	47.3	55.6	H	1.5	3.7		54.0	74.0	51.0	59.3	3.0	14.7

Test mode : Receive, GFSK

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
No other emissions were detected at a level greater than 20dB below limit.												

Test mode : Transmit, 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
4959.00	44.4	53.0	H	1.5	3.8		54.0	74.0	48.2	56.8	5.8	17.2

Test mode : Receive, 8-DPSK

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
No other emissions were detected at a level greater than 20dB below limit.												



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## Restricted band edge test data

Measured frequency range : 2310-2390 MHz, 2483.5-2500 MHz

Test mode : GPSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency [MHz]	Reading [dBuV/m]	Pol.	Height [m]	Correction Factor	Limits [dBuV/m]	Result [dBuV/m]	Margin [dB]
	AV / Peak			Antenna + Amp. Gain + Cable	AV / Peak	AV / Peak	AV / Peak

No other emissions were detected at a level greater than 20dB below limit.

Test mode : Receive, GFSK

Frequency [MHz]	Reading [dBuV/m]	Pol.	Height [m]	Correction Factor	Limits [dBuV/m]	Result [dBuV/m]	Margin [dB]
	AV / Peak			Antenna + Amp. Gain + Cable	AV / Peak	AV / Peak	AV / Peak

No other emissions were detected at a level greater than 20dB below limit.

Test mode : 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)

Frequency [MHz]	Reading [dBuV/m]	Pol.	Height [m]	Correction Factor	Limits [dBuV/m]	Result [dBuV/m]	Margin [dB]
	AV / Peak			Antenna + Amp. Gain + Cable	AV / Peak	AV / Peak	AV / Peak

No other emissions were detected at a level greater than 20dB below limit.

Test mode : Receive, 8-DPSK

Frequency [MHz]	Reading [dBuV/m]	Pol.	Height [m]	Correction Factor	Limits [dBuV/m]	Result [dBuV/m]	Margin [dB]
	AV / Peak			Antenna + Amp. Gain + Cable	AV / Peak	AV / Peak	AV / Peak

No other emissions were detected at a level greater than 20dB below limit.



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## [High channel]

EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F50	Frequency Range	1-25GHz
Channel	Channel 78	Detector function	Peak

### Remarks

We have tested three mode (X, Y, Z). The worst mode (Z axis) for final test.

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4960	49.6	4.5	Average

### Test Data

Test mode : Transmit, GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
4960.00	45.7	55.1	H	1.5	3.8		54.0	74.0	49.6	58.9	4.5	15.1

Test mode : Receive, GFSK

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
No other emissions were detected at a level greater than 20dB below limit.												

Test mode : Transmit, 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
4960.00	44.6	52.8	H	1.5	3.8		54.0	74.0	48.4	56.7	5.6	17.3

Test mode : Receive, 8-DPSK

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV	Peak			Antenna + Amp. Gain + Cable	AV	Peak	AV	Peak	AV	Peak	
No other emissions were detected at a level greater than 20dB below limit.												



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## Restricted band edge test data

Measured frequency range : 2310-2390 MHz, 2483.5-2500 MHz

Test mode : GPSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak	Result [dBuV/m] AV / Peak	Margin [dB] AV / Peak
				Antenna + Amp. Gain + Cable			
2483.50	45.5 : 50.7	H	1.5	-2.5	54.0 : 74.0	43.0 : 48.2	11.1 : 25.8

Test mode : Receive, GFSK

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak	Result [dBuV/m] AV / Peak	Margin [dB] AV / Peak
				Antenna + Amp. Gain + Cable			

No other emissions were detected at a level greater than 20dB below limit.

Test mode : 8-DPSK, CFG PKT Packet Type : 31 Packet Size : 1021(3DH5)

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak	Result [dBuV/m] AV / Peak	Margin [dB] AV / Peak
				Antenna + Amp. Gain + Cable			
2483.50	47.2 : 55.5	H	1.5	-2.5	54.0 : 74.0	44.7 : 53.0	9.3 : 21.1

Test mode : Receive, 8-DPSK

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak	Result [dBuV/m] AV / Peak	Margin [dB] AV / Peak
				Antenna + Amp. Gain + Cable			

No other emissions were detected at a level greater than 20dB below limit.



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## 2.1.8 AC Power Line 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

- 15.207(a)

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
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.

### Test Results

The requirements are:

Complies

Test mode : Charging mode

Frequency (MHz)	Measured Data (dBuV)	Margin (dB)	Remark
0.492	32.8	13.3	CAverage



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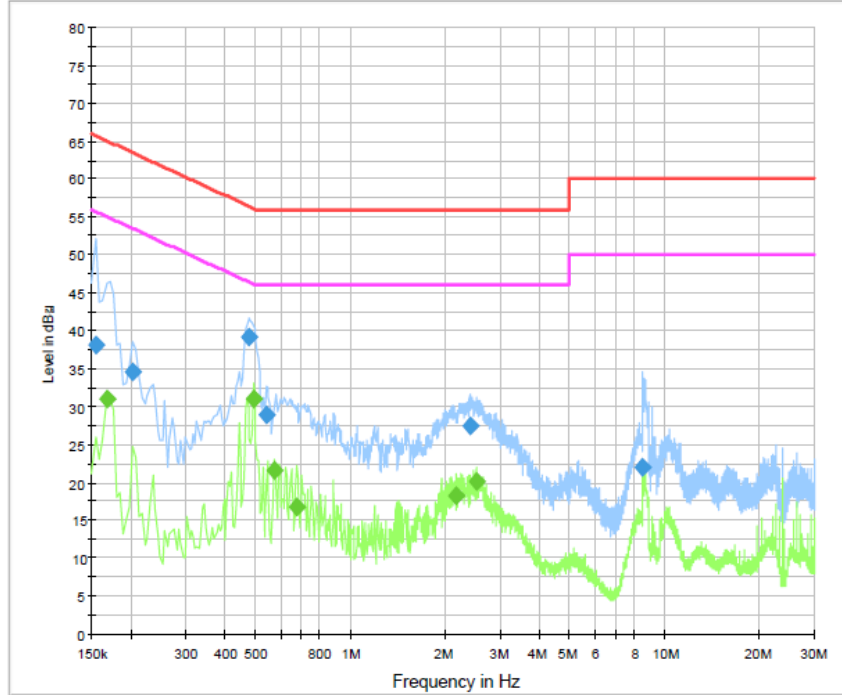
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## Test Data

[L1]

CISPR 22 Class B\_L1



### Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154500	38.2	1000.0	9.000	On	L1	9.7	27.6	65.8
0.204000	34.5	1000.0	9.000	On	L1	9.8	29.0	63.4
0.478500	39.1	1000.0	9.000	On	L1	9.9	17.3	56.4
0.541500	29.0	1000.0	9.000	On	L1	9.9	27.0	56.0
2.400000	27.4	1000.0	9.000	On	L1	9.7	28.6	56.0
8.511000	22.0	1000.0	9.000	On	L1	9.8	38.0	60.0

### Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.168000	31.1	1000.0	9.000	On	L1	9.8	24.0	55.1
0.492000	31.1	1000.0	9.000	On	L1	9.9	15.0	46.1
0.573000	21.6	1000.0	9.000	On	L1	9.9	24.4	46.0
0.676500	16.7	1000.0	9.000	On	L1	9.9	29.3	46.0
2.179500	18.2	1000.0	9.000	On	L1	9.7	27.8	46.0
2.512500	20.1	1000.0	9.000	On	L1	9.7	25.9	46.0



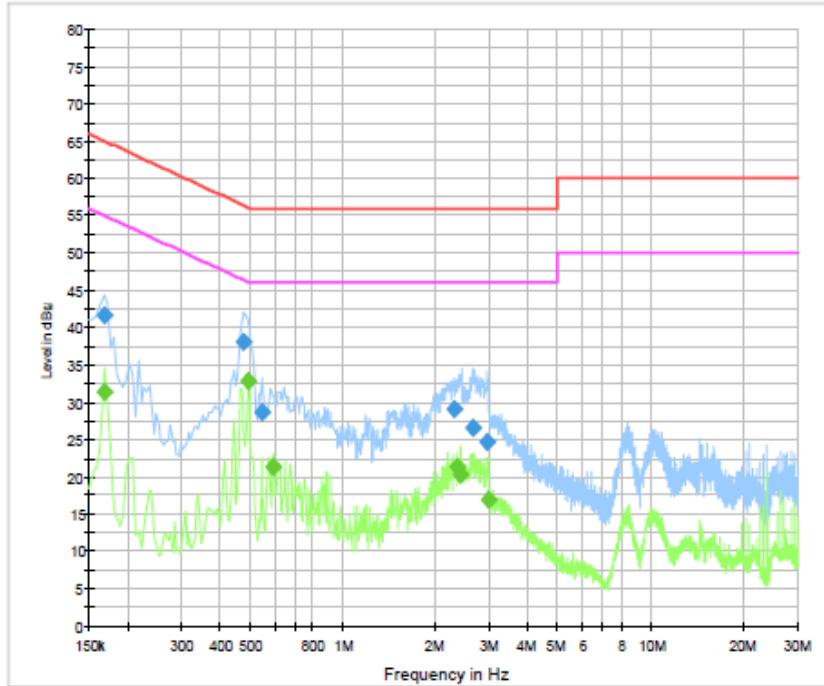
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## [NEUTRAL]

CISPR 22 Class B\_N



### Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.168000	41.7	1000.0	9.000	On	N	9.8	23.3	65.1
0.478500	38.2	1000.0	9.000	On	N	9.9	18.2	56.4
0.550500	28.6	1000.0	9.000	On	N	9.9	27.4	56.0
2.305500	29.1	1000.0	9.000	On	N	9.7	26.9	56.0
2.634000	26.7	1000.0	9.000	On	N	9.7	29.3	56.0
2.931000	24.7	1000.0	9.000	On	N	9.7	31.3	56.0

### Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.168000	31.4	1000.0	9.000	On	N	9.8	23.6	55.1
0.492000	32.8	1000.0	9.000	On	N	9.9	13.3	46.1
0.595500	21.3	1000.0	9.000	On	N	9.9	24.7	46.0
2.350500	21.4	1000.0	9.000	On	N	9.7	24.6	46.0
2.409000	20.2	1000.0	9.000	On	N	9.7	25.8	46.0
2.962500	17.0	1000.0	9.000	On	N	9.7	29.0	46.0

### 2.1.9 Frequency Hopping System Requirements Standard Applicable

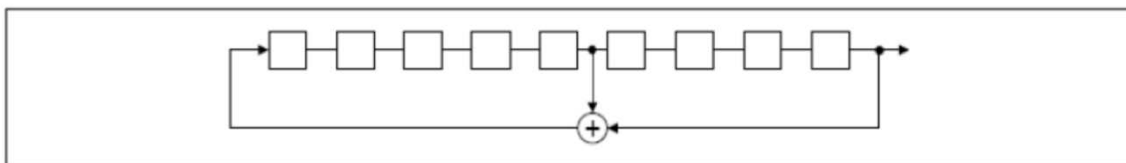
According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) 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.

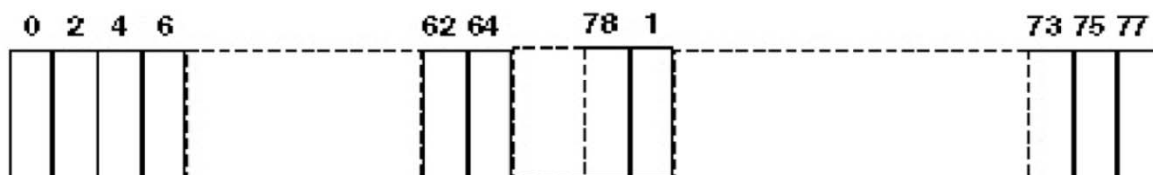
(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination 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.

#### EUT Pseudorandom Frequency Hopping Sequence

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*



Each frequency used equally on the average by each transmitter. The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.





## Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule. This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

\*Example for a Bluetooth device using channel numbers would be :

Ch 44, 35, 78, 03, 15, 21, 76, 40, 56, 13, 02, 19, 67, 39, 78, 20, 21, 64, 75 etc.



## 2.1.10 RF Exposure evaluation

### Standard Requirement

According to FCC KDB 447498D01 General RF Exposure Guidance v05  
(IC RSS-102 Issue 5)

#### 4.3.1. Standalone SAR test exclusion considerations

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

### Limits

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR, where

$f(\text{GHz})$  is the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation

The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is  $\leq 50$  mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion

### EUT RF Exposure

The Max Conducted Peak Output Power is **8.81** dBm in High channel(2.480 GHz) :  
**8.81** dBm logarithmic terms convert to numeric result is nearly **7.603** mW  
According to the formula.

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}]$

General RF Exposure =  $(7.603 \text{ mW} / 5 \text{ mm}) \times \sqrt{2.480 \text{ GHz}} = \mathbf{2.394}$  ①;

SAR requirement:

S = **3.0**

②;

① < ②.

So the SAR report is not required.



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## APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	SPECTRUM ANALYZER	Rohde & Schwarz	FSP-30	100994	2015-11-02	2016-11-02
2	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2015-11-02	2016-11-02
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100816	2015-11-02	2016-11-02
4	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2016-05-14	2017-05-14
5	Bilog Antenna	Schaffner	CBL6111C	2551	2015-04-24	2017-04-24
6	Double Ridged Guide Antenna	ETS-Lindgren	3117	00154525	2015-09-02	2017-09-02
7	Double Ridged Guide Antenna	ETS-Lindgren	3116	00062916	2015-09-04	2017-09-04
8	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2016-05-25	2017-05-25
9	Attenuator	Rohde & Schwarz	DNF	272.4110.50-2	2015-11-03	2016-11-03
10	PREAMPLIFIER	Agilent	8449B	3008A02011	2015-12-08	2016-12-08
11	AMPLIFIER	Sonoma Instrument Co.	310	291721	2016-02-02	2017-02-02
12	Signal Generator	Rohde & Schwarz	SMB100A	175528	2016-01-20	2017-01-20
13	DC POWER SUPPLY	HP	E3632A	MY40011638	2015-11-02	2016-11-02
14	LISN	Rohde & Schwarz	ENV216	101760	2016-02-05	2017-02-05