

## FCC - TEST REPORT

Report Number : **68.930.15.026.01** Date of Issue: September 15, 2015

Model : **COM-DEX**

Product Type : Wireless headset for hearing aid

Applicant : Widex A/S

Address : Nymoellevej 6, DK-3540 Lynge, Denmark

Production Facility : Widex A/S

Address : Nymoellevej 6, DK-3540 Lynge, Denmark

Test Result : ☒ **Positive** ☐ **Negative**

Total pages including  
Appendices : 38

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## 2 Details about the Test Laboratory

### Details about the Test Laboratory

#### Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch  
Building 12&13, Zhiheng Wisdomland Business Park,  
Nantou Checkpoint Road 2, Nanshan District,  
Shenzhen City, 518052,  
P. R. China

FCC Registration No.: 502708

IC Registration No: 10320A-1

Telephone: 86 755 8828 6998  
Fax: 86 755 8828 5299

### 3 Description of the Equipment Under Test

Product:	Wireless headset for hearing aid
Model no.:	COM-DEX
Brand Name:	Widex
FCC ID:	TTY-CMDEX
Options and accessories:	NIL
Rating:	DC 3.7V by Li-ion Battery
RF Transmission Frequency:	2402-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Duty Cycle:	Max 77% for DH5
Antenna Type:	Integral Antenna
Antenna Gain:	0dBi
Description of the EUT:	The Equipment Under Test (EUT) is a buletooth Module operated at 2.4GHz

## 4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2014 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to Public Notice DA 00-705 -Frequency Hopper Spread Spectrum Test Procedure released by FCC on March 30, 2000 and C63.10 (2014).

## 5 Summary of Test Results

Technical Requirements				
FCC Part 15 Subpart C				
Test Condition		Pages	Test Site	Test Result
§15.207	Conducted emission AC power port	---	---	N/A
§15.247 (b) (1)	Conducted peak output power	10	Site 1	Pass
§15.247(a)(1)	20dB bandwidth	---	---	N/A
§15.247(a)(1)	Carrier frequency separation	12	Site 1	Pass
§15.247(a)(1)(iii)	Number of hopping frequencies	18	Site 1	Pass
§15.247(a)(1)(iii)	Dwell Time	21	Site 1	Pass
§15.247(a)(2)	6dB bandwidth	---	---	Pass
§15.247(e)	Power spectral density	---	---	N/A
§15.247(d)	Spurious RF conducted emissions	26	Site 1	Pass
§15.247(d)	Band edge	30	Site 1	Pass
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	35	Site 1	Pass
§15.203	Antenna requirement	See note 2		Pass

Note 1: N/A=Not Applicable.

Note 2: The EUT uses an integral antenna, which gain is 0dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

## 6 General Remarks

### Remarks

This submittal(s) (test report) is intended for FCC ID: TTY-CMDEX complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

### SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

□ - **Does not** fulfill the general approval requirements.

Sample Received Date: August 3, 2015

Testing Start Date: August 4, 2015

Testing End Date: September 14, 2015

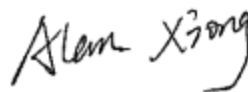
TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch

Reviewed by:

Prepared by:



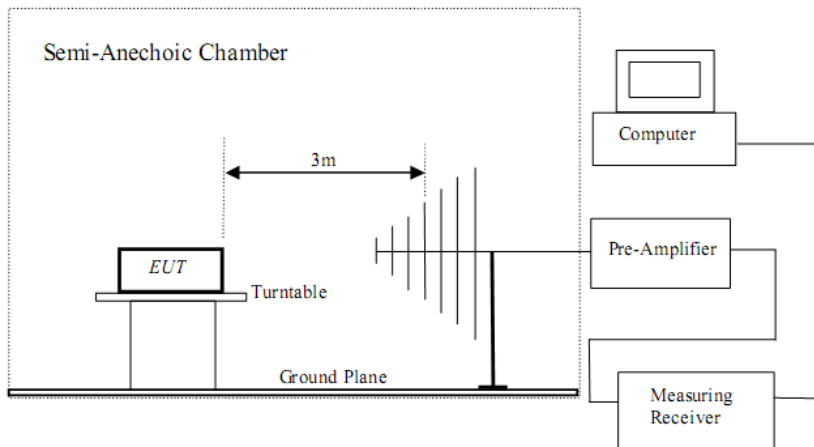
John Zhi  
EMC Project Manager



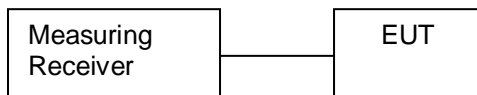
Alan Xiong  
EMC Project Engineer

## 7 Test Setups

### 7.1 Radiated test setups



### 7.2 Conducted RF test setups





## 8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenovo	X220	---

Test software: Bluetooth 3, which used to control the EUT in continues transmitting mode

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power

## 9 Technical Requirement

### 9.1 Conducted peak output power

#### Test Method

1. Use the following spectrum analyzer settings:  
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel  
RBW > the 20 dB bandwidth of the emission being measured, VBW $\geq$ RBW,  
Sweep = auto, Detector function = peak, Trace = max hold
2. Add a correction factor to the display.
3. 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

#### Limits

According to §15.247 (b) (1), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	$\leq 1$	$\leq 30$

## Conducted peak output power

### Bluetooth Mode GFSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	2.00	Pass
Middle channel 2441MHz	3.43	Pass
High channel 2480MHz	2.68	Pass

### Bluetooth Mode $\pi/4$ -DQPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-1.70	Pass
Middle channel 2441MHz	-0.01	Pass
High channel 2480MHz	-0.84	Pass

### Bluetooth Mode 8DPSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-0.67	Pass
Middle channel 2441MHz	1.02	Pass
High channel 2480MHz	0.22	Pass

## 9.2 20 dB bandwidth

### Test Method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

### Limit

Limit [kHz]

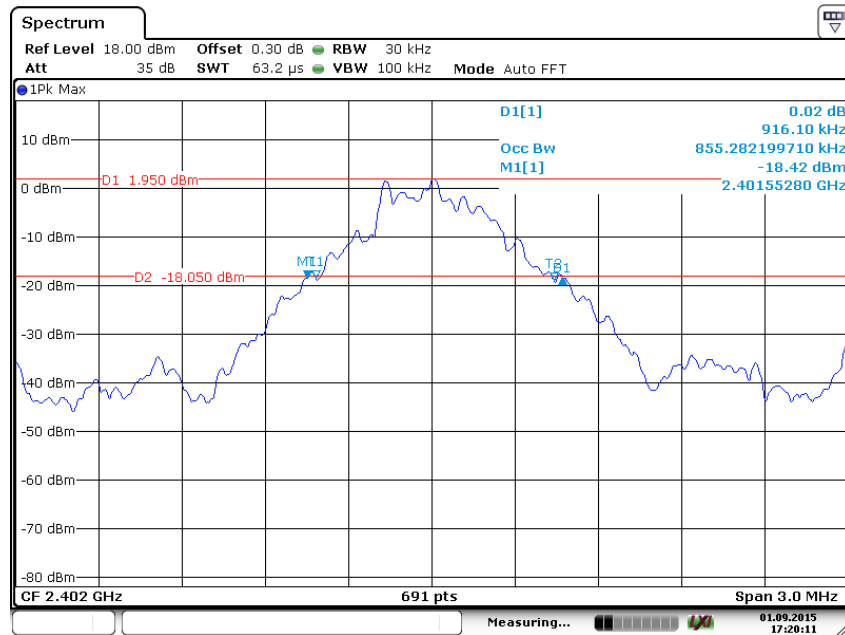
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N/A

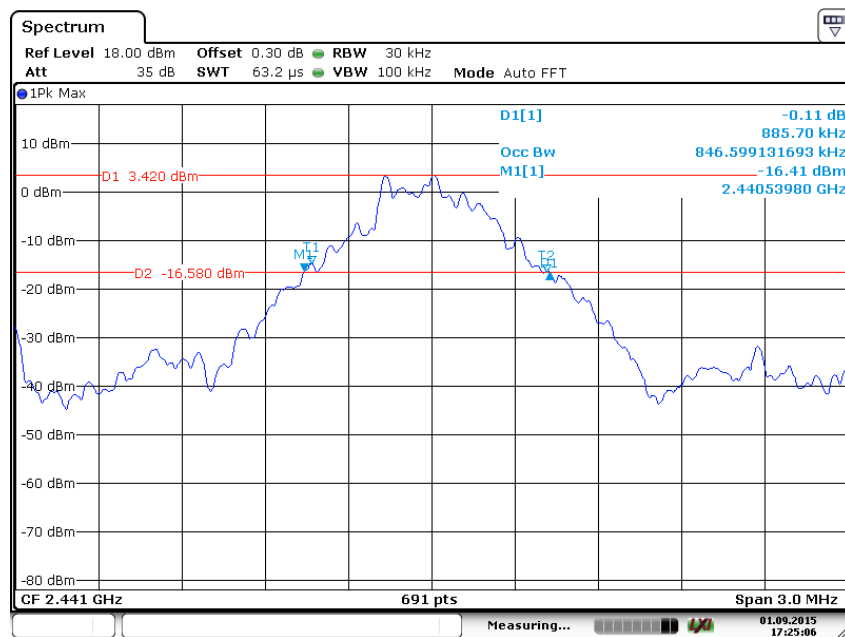
## 20 dB bandwidth

### Bluetooth Mode GFSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	Limit kHz	Result
2402	916.10	--	Pass
2441	885.70	--	Pass
2480	885.70	--	Pass

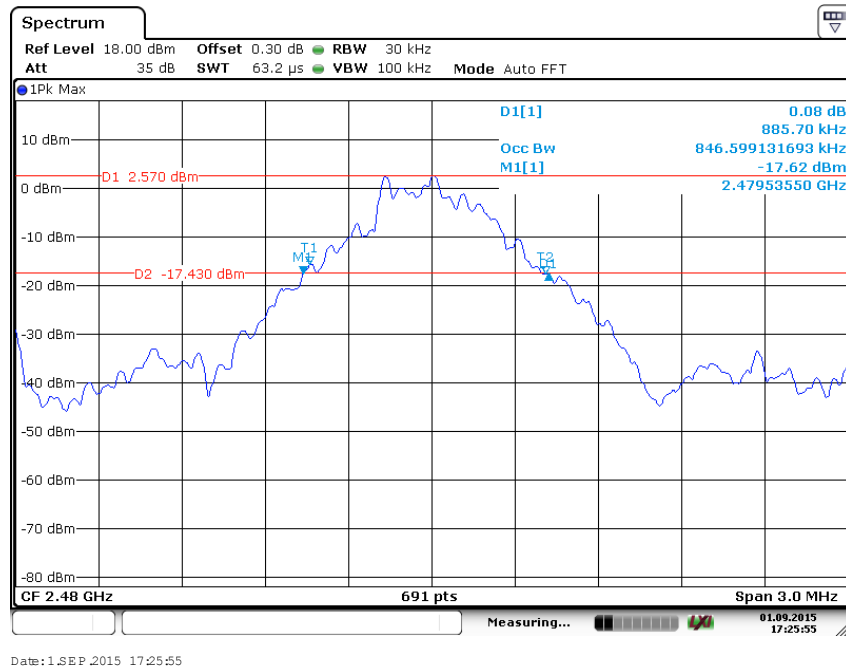


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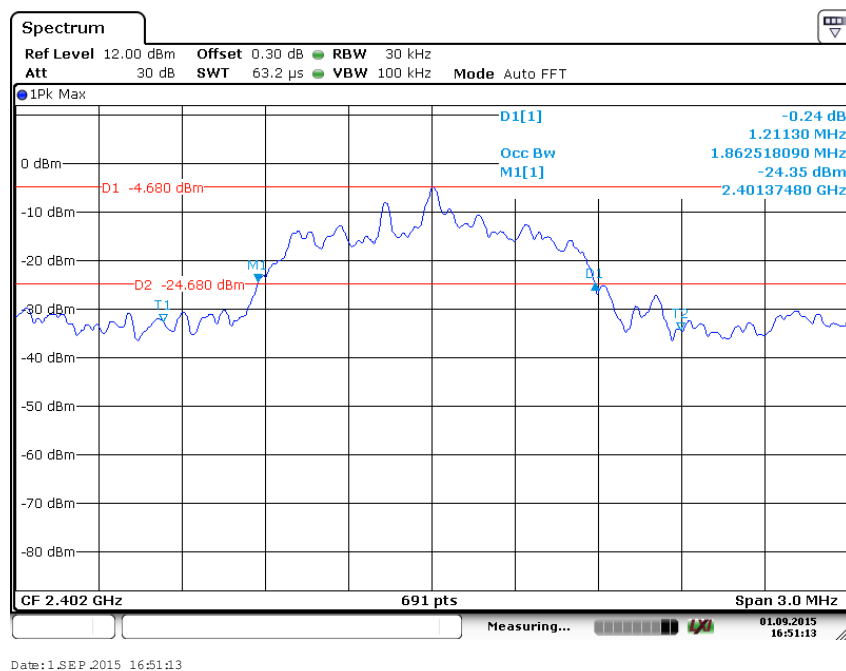
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## 20 dB bandwidth



## Bluetooth Mode $\pi/4$ -DQPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	Limit kHz	Result
2402	1211.30	--	Pass
2441	1211.30	--	Pass
2480	1211.30	--	Pass



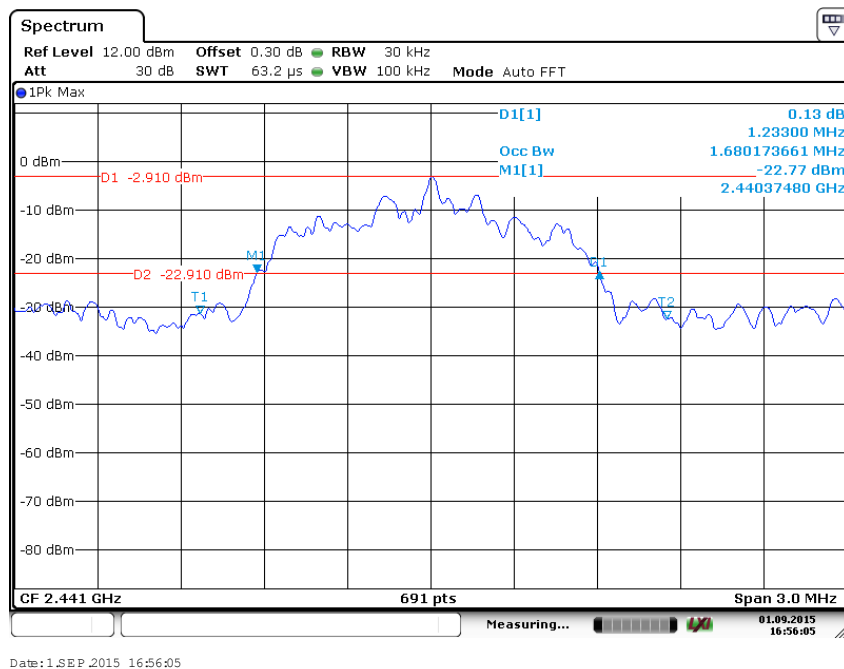
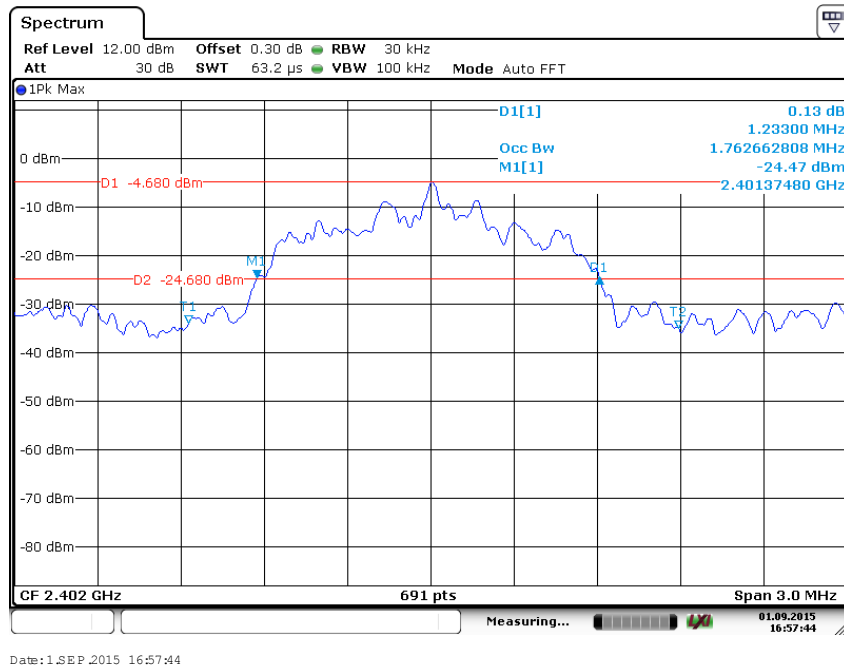
EMC\_SZ\_FR\_21.00 FCC  
Release 2014-03-20



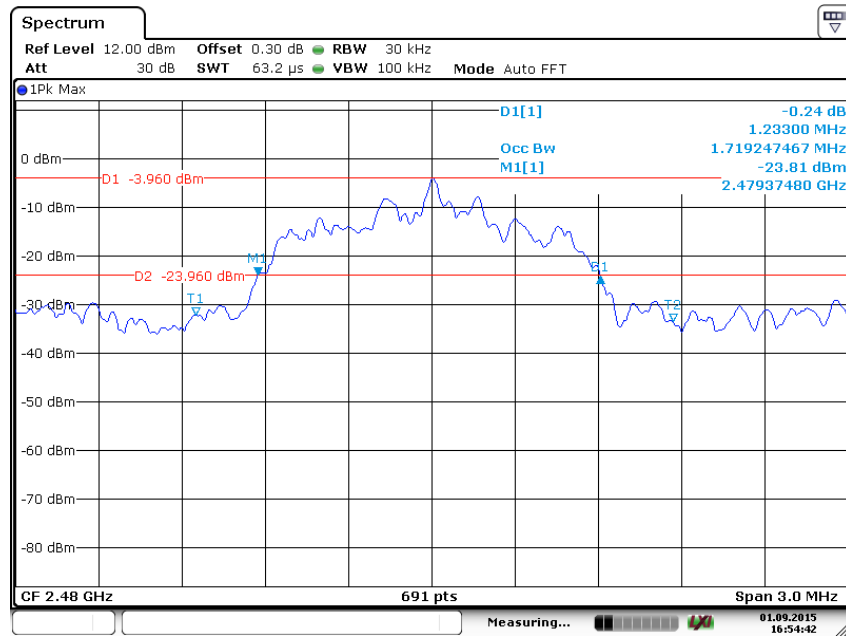
## 20 dB bandwidth

### Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	Limit kHz	Result
2402	1233.00	--	Pass
2441	1233.00	--	Pass
2480	1233.00	--	Pass





**20 dB bandwidth**

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### 9.3 Carrier Frequency Separation

#### Test Method

1. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels,  $RBW \geq 1\%$  of the span,  $VBW \geq RBW$ , Sweep = auto, Detector function = peak
2. By using the Max-Hold function record the separation of two adjacent channels.
3. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function.
4. Repeat above procedures until all frequencies measured were complete.

#### Limit

Limit kHz
$\geq 25\text{kHz}$ or $2/3$ of the 20 dB bandwidth which is greater

#### GFSK Modulation Limit

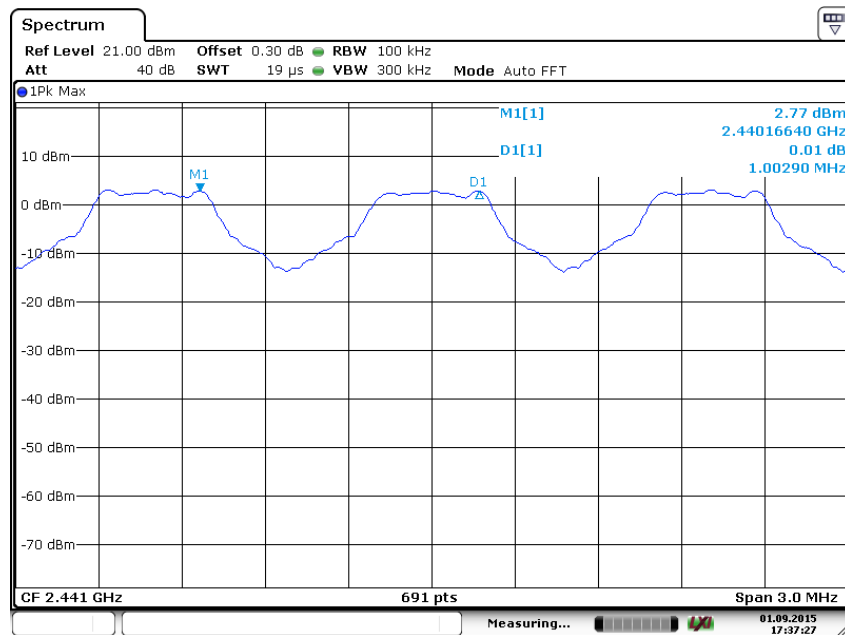
Frequency MHz	2/3 of 20 dB Bandwidth kHz
2402	610.73
2441	590.47
2480	590.47

## Carrier Frequency Separation

Test result: The measurement was performed with the typical configuration (normal hopping status), here GFSK modulation mode was used to show compliance.

### GFSK Modulation test result

Frequency MHz	Carrier Frequency Separation kHz	Result
2441	1002.9	Pass



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## 9.4 Number of hopping frequencies

### Test Method

1. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels,  $RBW \geq 1\%$  of the span,  $VBW \geq RBW$ , Sweep = auto, Detector function = peak
2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode.
3. Record all the signals from each channel until each one has been recorded.
4. Repeat above procedures until all frequencies measured were complete.

### Limit

Limit  
number

---

$\geq 15$



## 9.5 Dwell Time

### Test Method

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable.  
Equipment mode: Spectrum analyzer
2. RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
3. Adjust the center frequency of spectrum analyzer on any frequency be measured.
4. Measure the Dwell Time by spectrum analyzer Marker function.
5. Repeat above procedures until all frequencies measured were complete.

### Limit

According to §15.247(a)(1)(iii) The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

### Dwell time

The maximum dwell time shall be 0,4 s.

According to the Bluetooth Core Specification, the worse result (DH5 mode) was reported to show compliance.

The Dwell Time = Burst Width \* Total Hops. The detailed calculations are showed as follows:

The duration for dwell time calculation:  $0.4 \text{ [s]} * \text{hopping number} = 0.4 \text{ [s]} * 79 \text{ [ch]} = 31.6 \text{ [s*ch]}$ ;

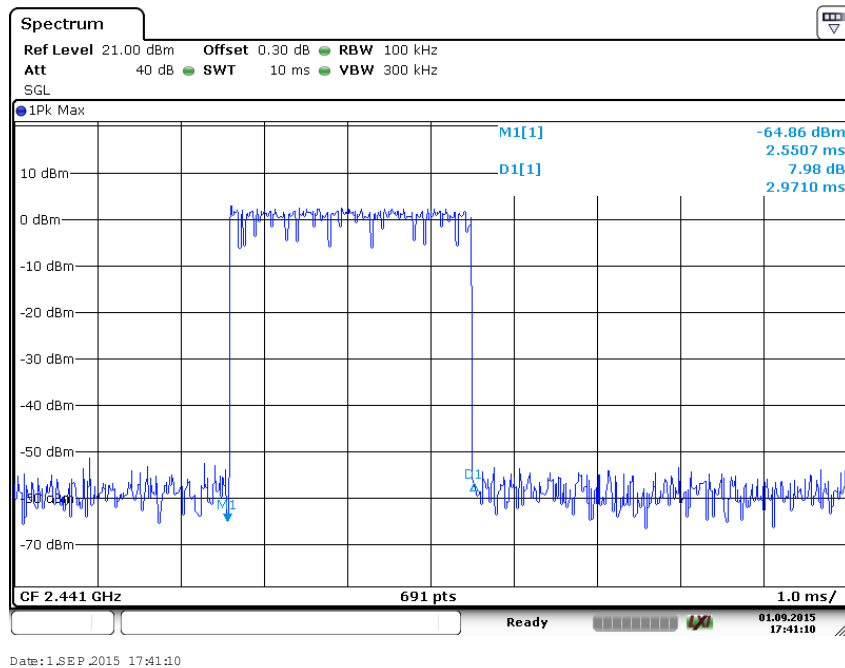
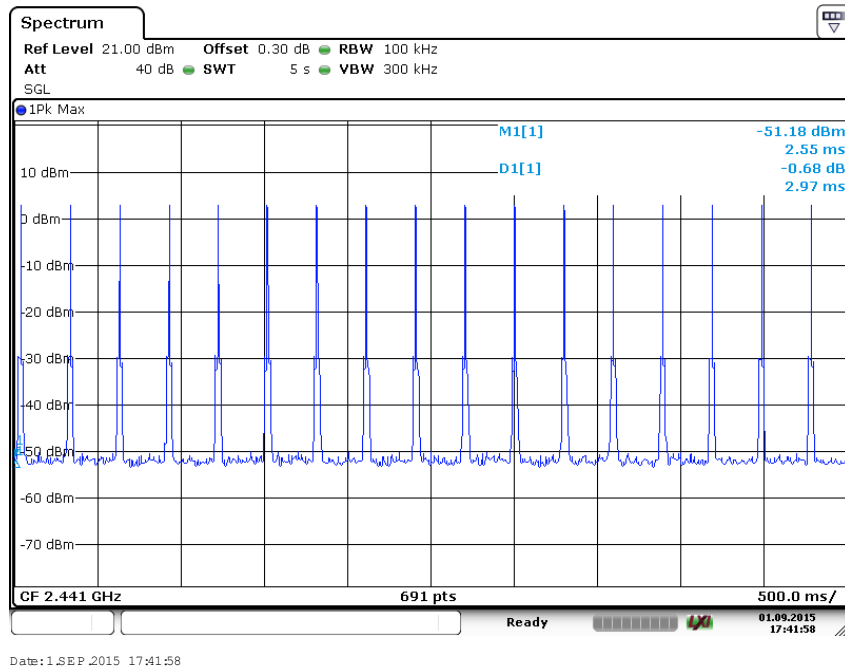
The burst width, which is directly measured, refers to the duration on one channel hop.

The maximum number of hopping channels in 31.6s for DH5= $1600 / 6 / 79 * 31.6 = 106.67$

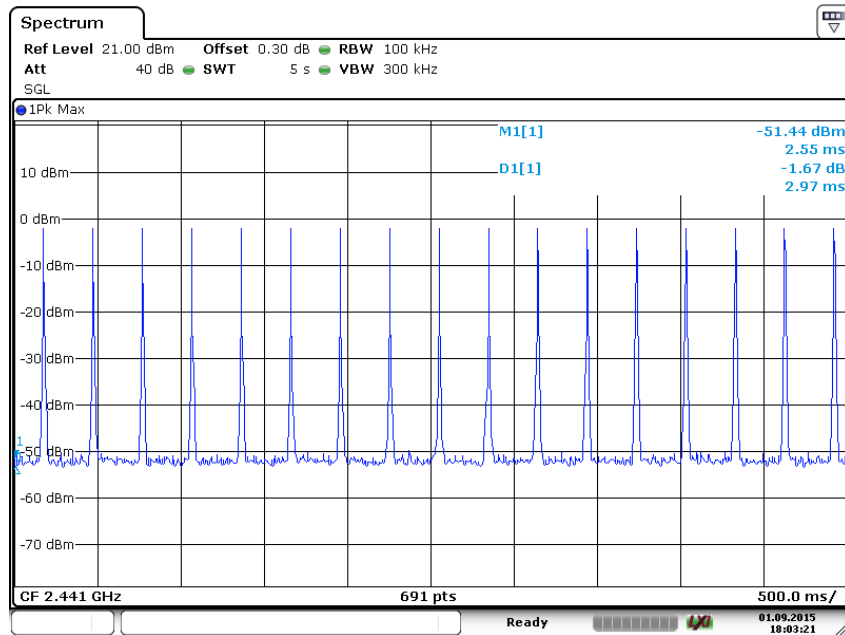
### Test Result

Modulation	Mode	Reading (μs)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	2971	107.44	319.20	< 400	Pass
π/4-DQPSK	2DH5	2957	107.44	317.70	< 400	Pass
8-DPSK	3DH5	2971	107.44	319.20	< 400	Pass

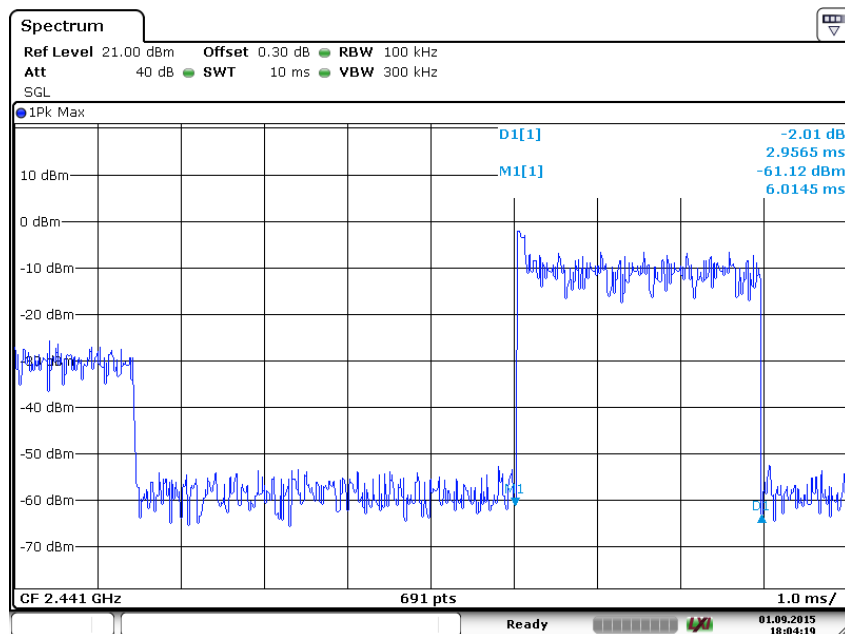
## GFSK Modulation



DH5

$\pi/4$ -DQPSK Modulation

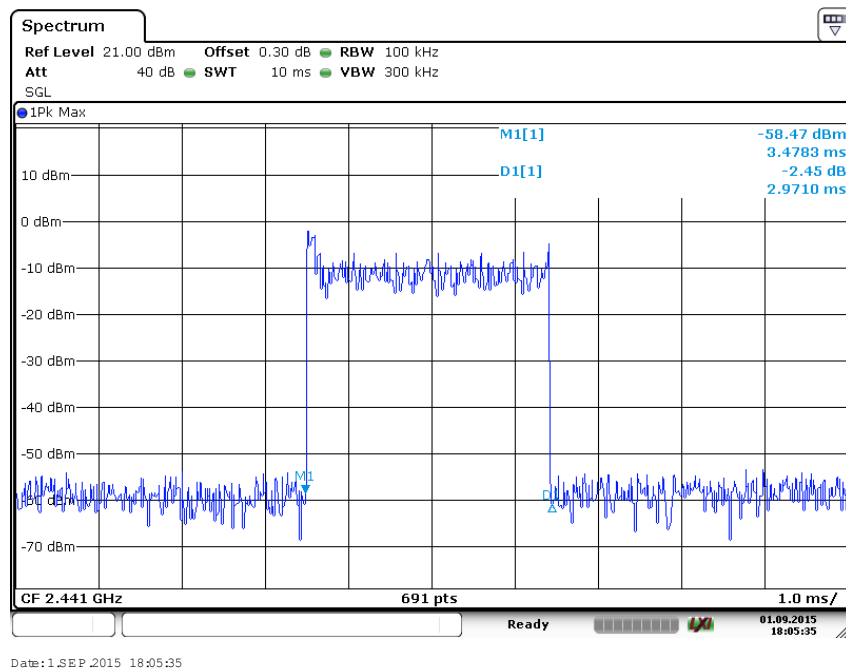
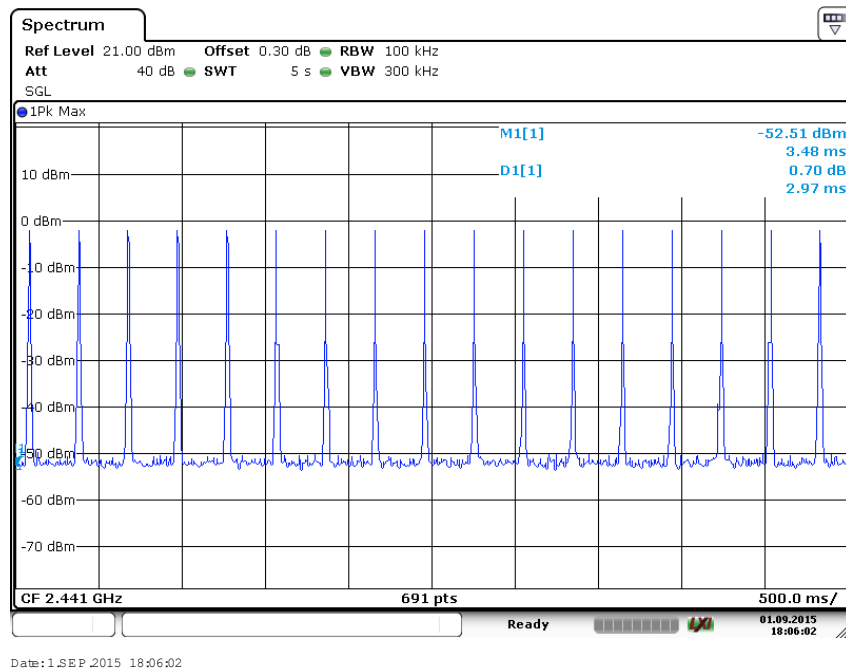
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## 8-DPSK Modulation



## 9.6 Spurious RF conducted emissions

### Test Method

1. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10<sup>th</sup> harmonic. Typically, several plots are required to cover this entire span.  
RBW = 100 kHz, VBW ≥ 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.
3. The level displayed must comply with the limit specified in this Section. Submit these plots.
4. Repeat above procedures until all frequencies measured were complete.

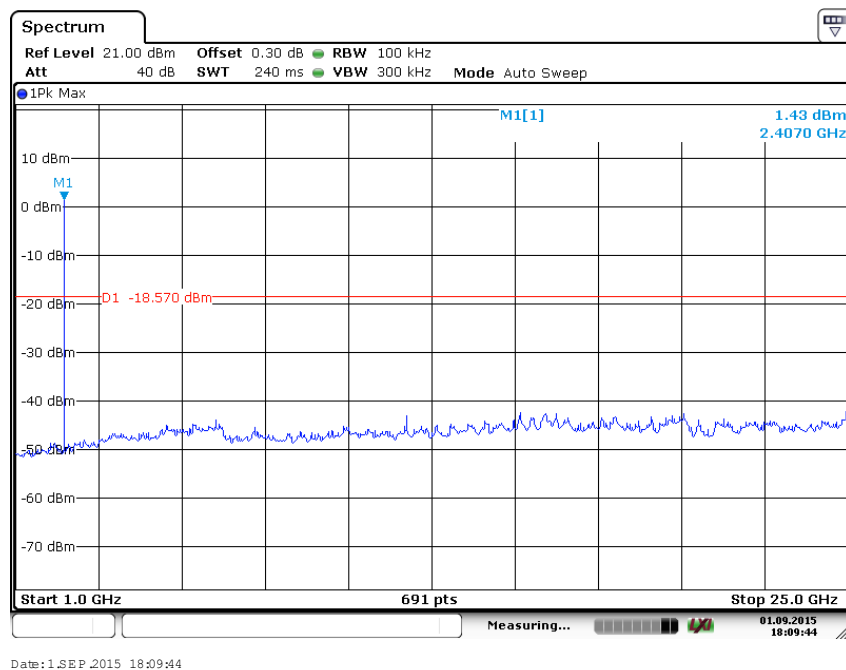
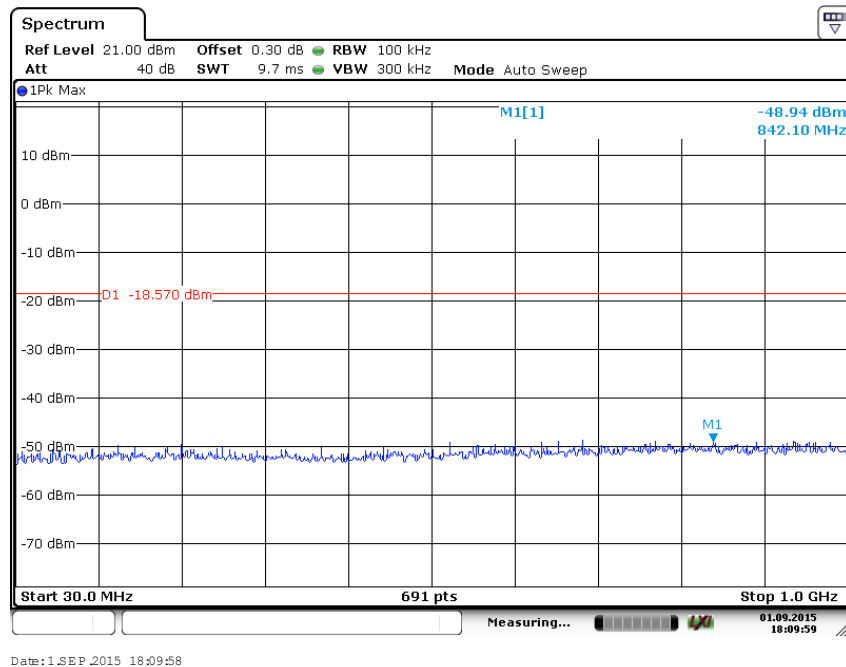
### Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

## Spurious RF conducted emissions

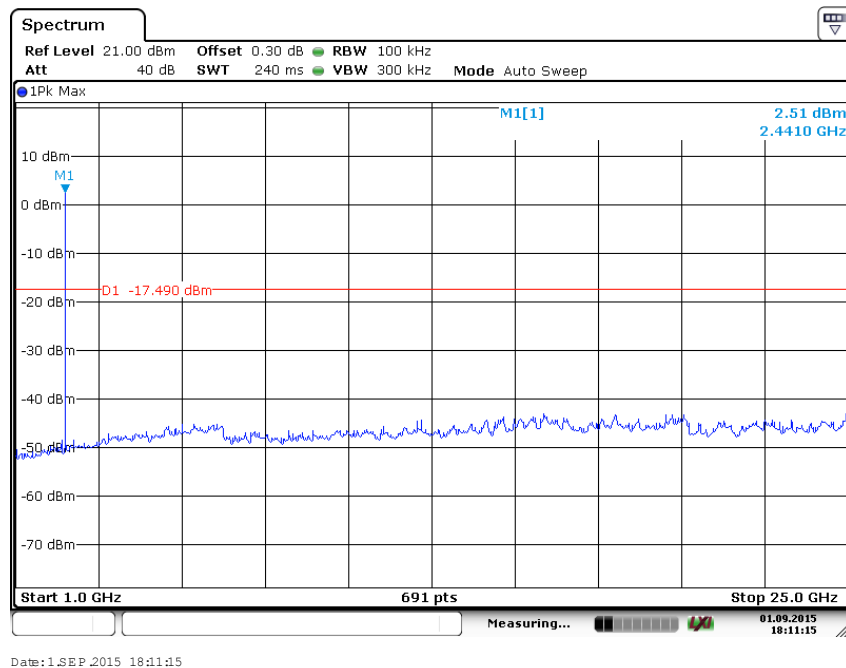
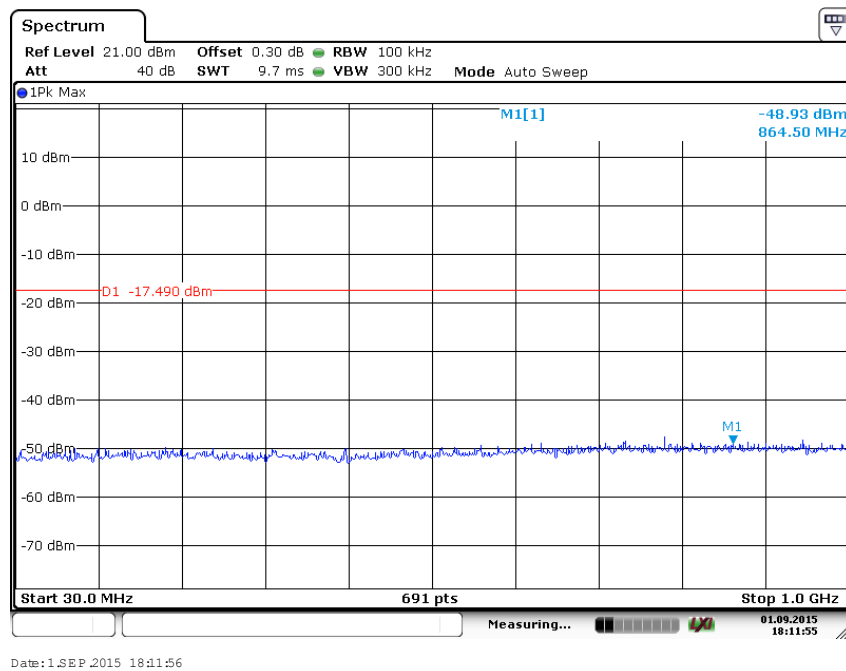
Only the worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report.

2402MHz



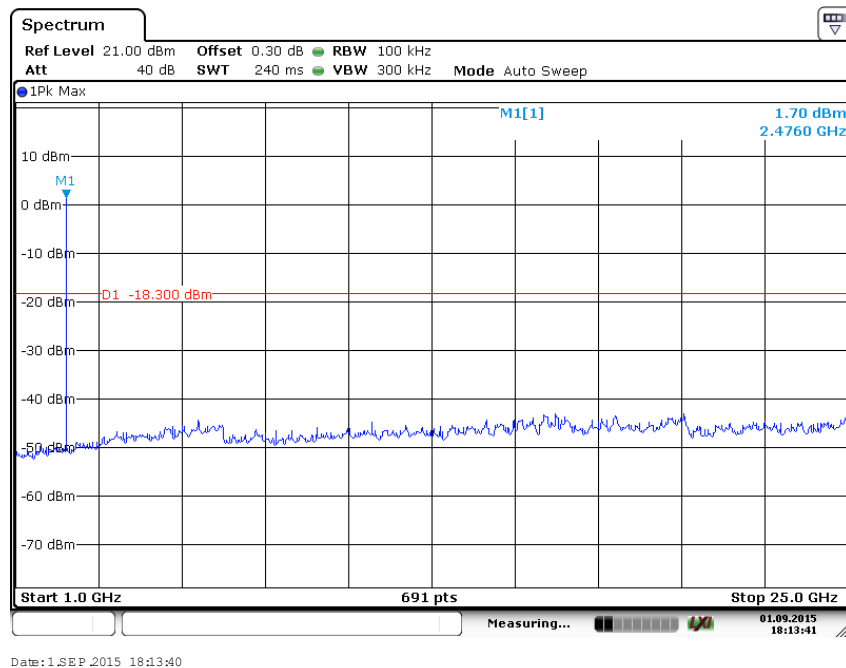
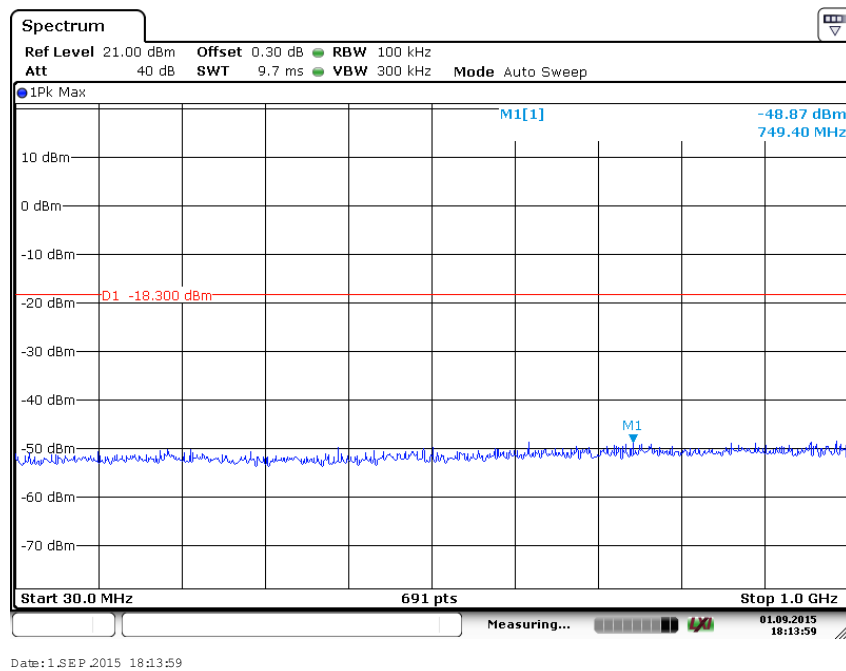
## Spurious RF conducted emissions

2441MHz



## Spurious RF conducted emissions

2480MHz



## 9.7 Band edge testing

### Test Method

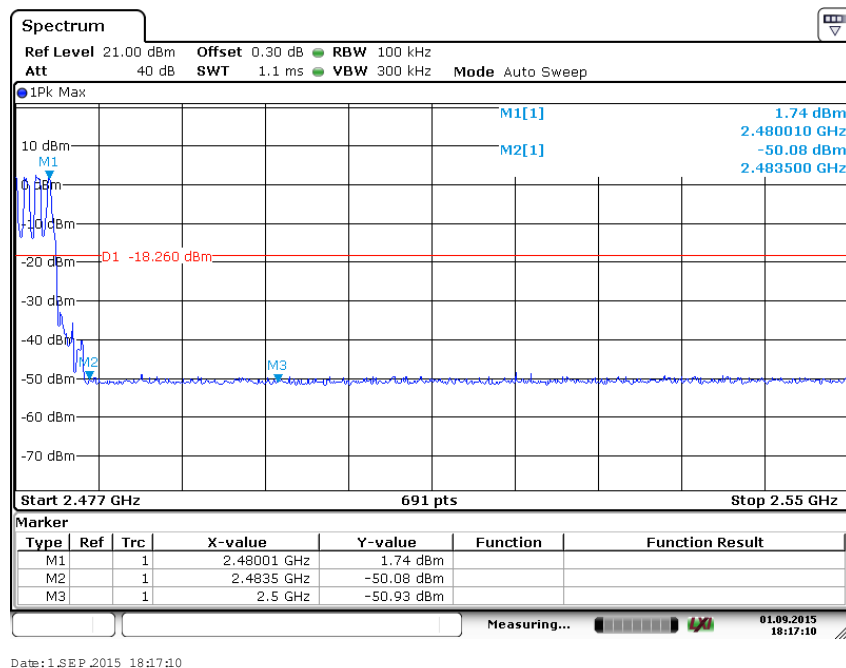
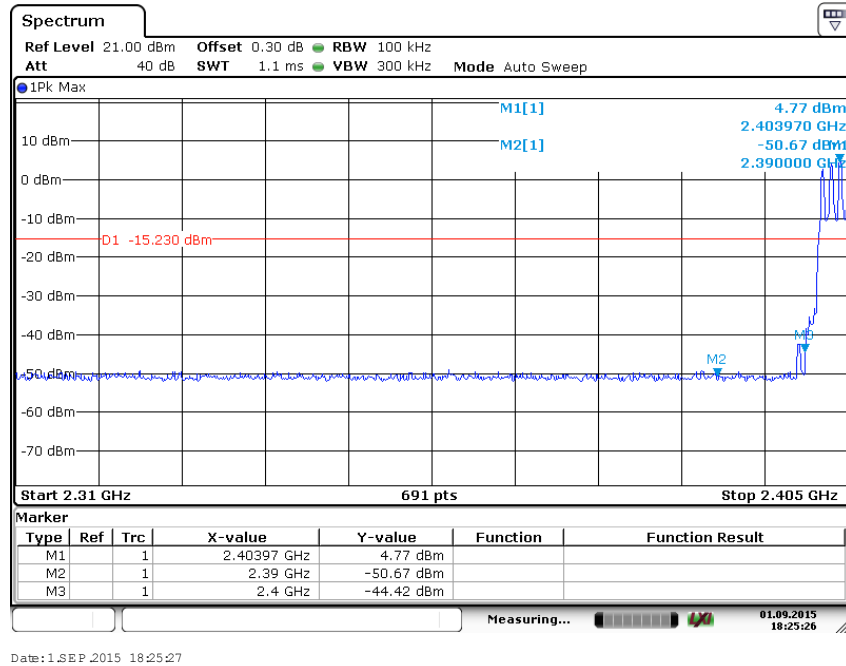
- 1 Use the following spectrum analyzer settings:  
Span = wide enough to capture the peak level of the in-band emission and all spurious  
RBW = 100 kHz, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section. .
- 4 Repeat the test at the hopping off and hopping on mode, submit all the plots.

### Limit:

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen7.2.2, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.

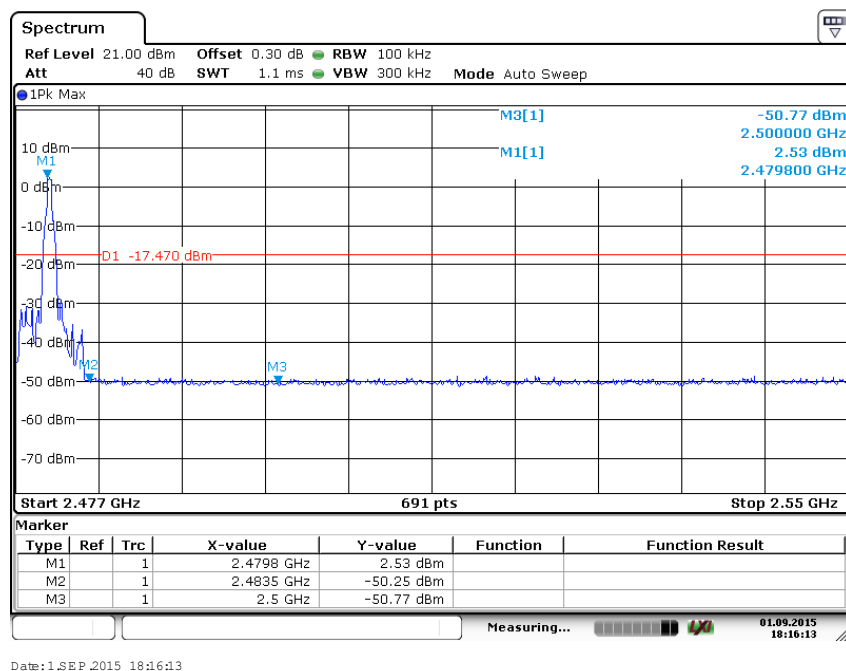
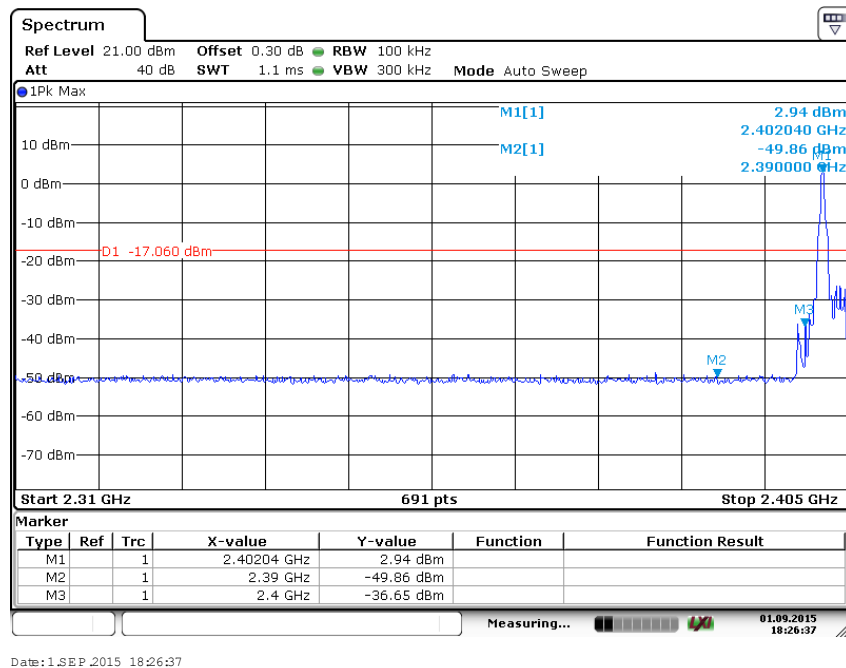
## Band edge testing

GFSK Modulation Test Result:  
Hopping on mode:



## Band edge testing

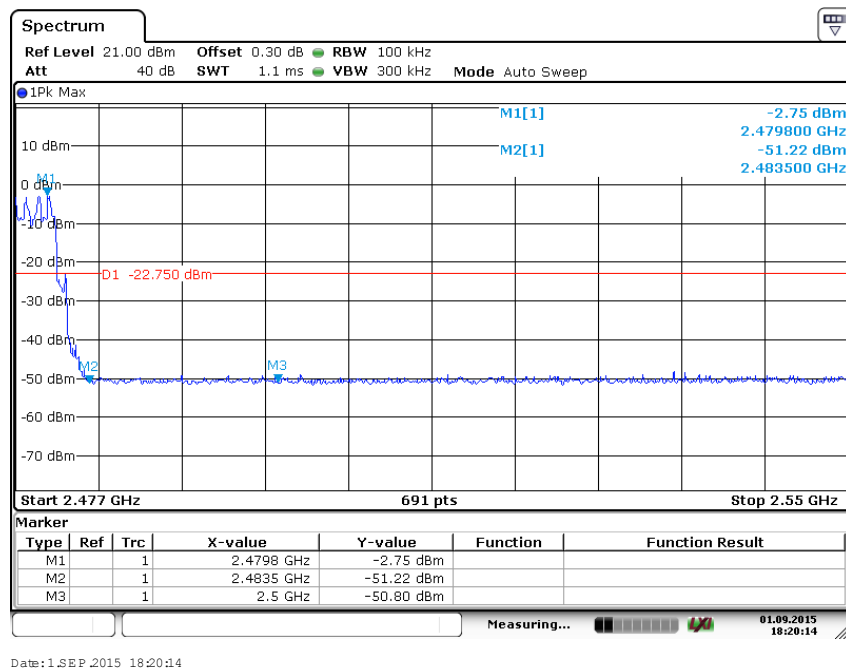
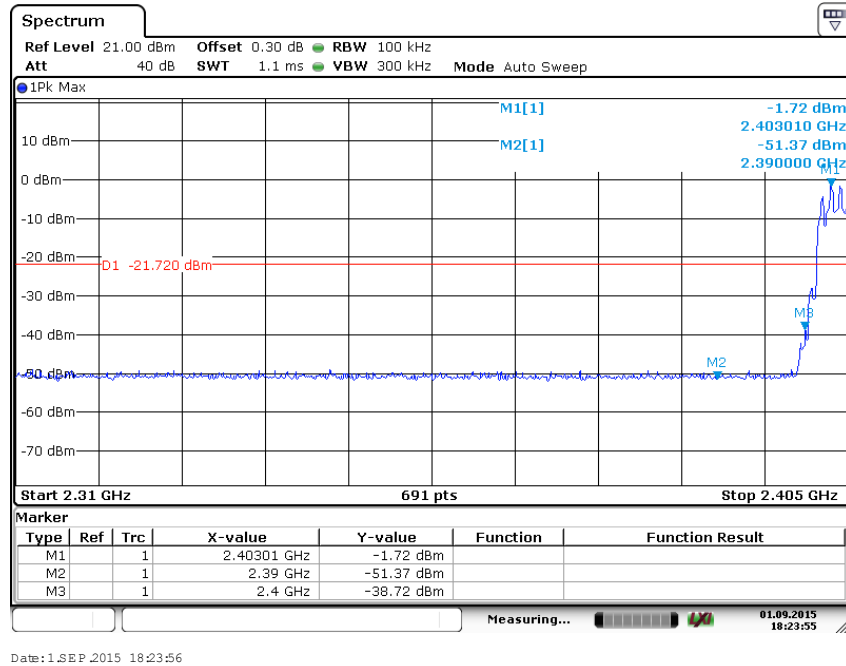
Hopping off mode:





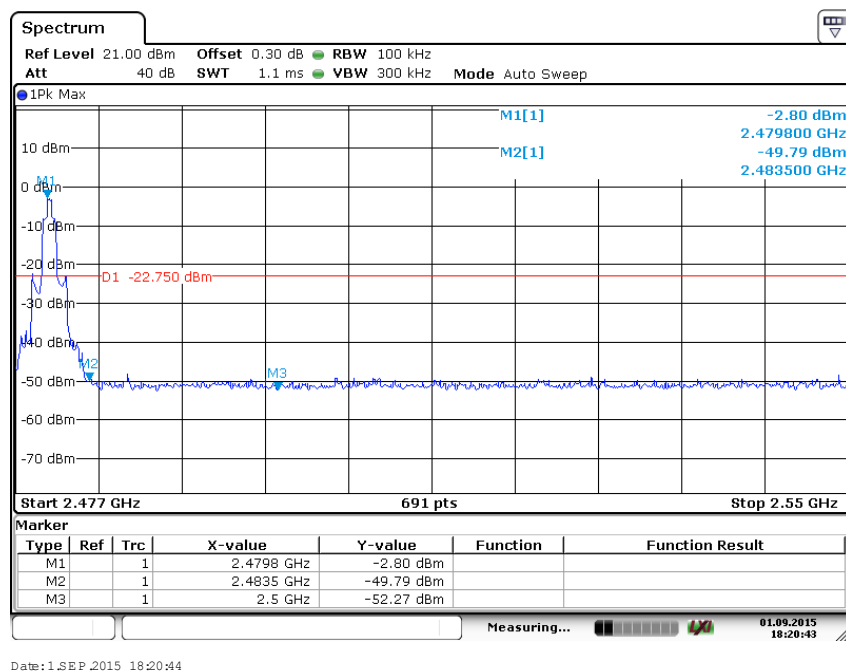
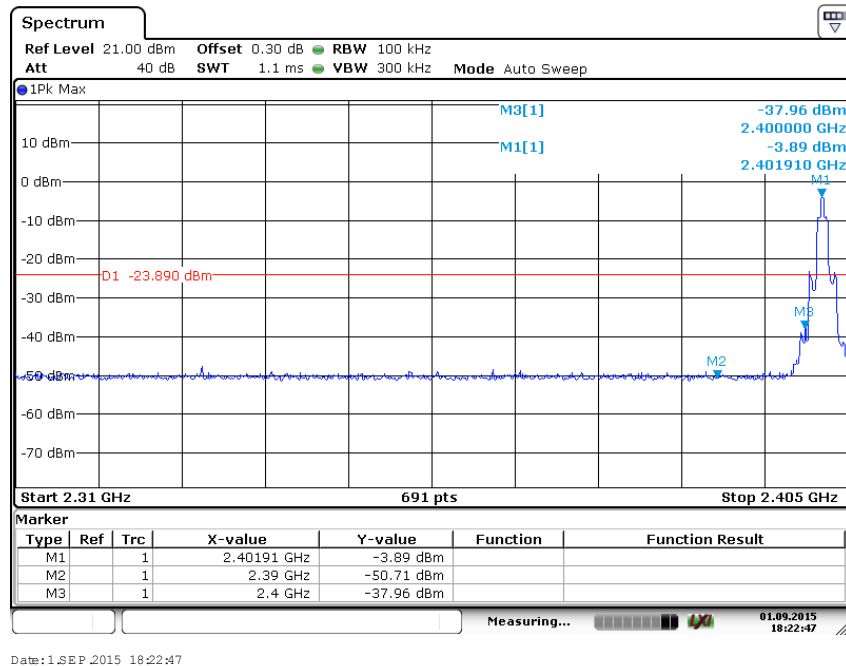
## Band edge testing

8DPSK Modulation Test Result:  
Hopping on mode:



## Band edge testing

Hopping off mode:



## 9.8 Spurious radiated emissions for transmitter

### Test Method

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
3. Use the following spectrum analyzer settings:  
Span = wide enough to fully capture the emission being measured, RBW = 1 MHz for  $f \geq 1\text{GHz}$ , 100 kHz for  $f < 1\text{GHz}$ , VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Follow the guidelines in ANSI C63.4-2009 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc.  
The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the duty cycle per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from  $20\log(\text{duty cycle}/100\text{ ms})$ , in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

### Limit

According to part 15.247(d), the radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section 15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBuV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

## Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

The only worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report.

### Transmitting spurious emission test result as below:

#### Bluetooth Mode GFSK Modulation 2402MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBuV/m		dBuV/m	
83.90	23.00	Horizontal	40.00	QP	17.00	Pass
95.96	30.27	Horizontal	43.50	QP	13.23	Pass
167.98	23.17	Horizontal	43.50	QP	20.33	Pass
260.44	25.94	Horizontal	46.00	QP	20.06	Pass
587.63	34.15	Horizontal	46.00	QP	11.85	Pass
99.42	20.66	Vertical	43.50	QP	22.84	Pass
167.98	20.70	Vertical	43.50	QP	22.80	Pass
258.07	24.62	Vertical	46.00	QP	21.38	Pass
571.99	34.91	Vertical	46.00	QP	11.09	Pass
*4804	51.02	Horizontal	74	PK	22.98	Pass
*4804	49.79	Vertical	74	PK	24.21	Pass

#### Bluetooth Mode GFSK Modulation 2441MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBuV/m		dBuV/m	
*4882	51.32	Horizontal	74	PK	22.68	Pass
*4882	55.81	Vertical	74	PK	18.19	Pass
*4882	47.51	Vertical	54	AV	6.49	Pass

#### Bluetooth Mode GFSK Modulation 2480MHz Test Result

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBuV/m		dBuV/m	
*4960	47.66	Horizontal	74	PK	26.34	Pass
*4960	54.16	Vertical	74	PK	19.84	Pass
*4960	48.61	Vertical	54	AV	5.39	Pass

#### Remark:

- (1) AV Emission Level= PK Emission Level+20log(dutycycle)
- (2) Data of measurement within this frequency range shown “-” in the table above means the reading of emissions are attenuated more than 20db below the permissible limits or the field strength is too small to be measured.
- (3) “\*” means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.

## 10 Test Equipment List

### List of Test Instruments

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2016-7-24
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2016-8-14
Horn Antenna	Rohde & Schwarz	HF907	102294	2016-7-24
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2016-7-24
3m Semi-anechoic chamber	TDK	9X6X6	----	2019-5-29

## 11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.95dB; Vertical: 5.02dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.89dB; Vertical: 4.88dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 4.93dB; Vertical: 4.92dB;
Uncertainty for Conducted RF test with TS 8997	Power level test involved: 2.04dB Frequency test involved: $1.1 \times 10^{-7}$