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SENA

Dates of Tests: December 06 ~ December 13, 2013
Test Report S/N: LR500111312K
Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID
IC
APPLICANT

S7A-SP12
8154A-SP12
Sena Technologies, Inc.

Equipment Class	:	**Part 15 Spread Spectrum Transmitter (DSS)**
Manufacturing Description	:	**BLUETOOTH STEREO MOTORCYCLE HEADSET**
Manufacturer	:	**Sena Technologies, Inc.**
Model name	:	**EXPAND**
Test Device Serial No.:	:	**Identical prototype**
Rule Part(s)	:	**FCC Part 15.247 Subpart C; ANSI C-63.4-2009**
Frequency Range	:	**2402 ~ 2480MHz**
RF power	:	**Max 5.66 dBm – Conducted**
Data of issue	:	**December 19, 2013**

This test report is issued under the authority of:

The test was supervised by:

Jae-Ho Lee, Manager

Young-Jin Lee, Test Engineer

NVLAP®

NVLAP LAB Code.: 200723-0

TABLE OF CONTENTS

1. General information

1-1 Test Performed

Company name	:	LTA Co., Ltd.
Address	:	243, Jubug-ri,Yangji-Myeon,Youngin-Si, Kyunggi-Do, Korea. 449-822
Web site	:	http://www.ltalab.com
E-mail	:	chahn@ltalab.com
Telephone	:	+82-31-323-6008
Facsimile	:	+82-31-323-6010

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the "General requirements for the competents of calibration and testing laboratory".

1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2014-09-30	ECT accredited Lab.
RRL	KOREA	KR0049	2015-03-06	EMC accredited Lab.
FCC	U.S.A	610755	2014-04-27	FCC filing
FCC	U.S.A	649054	2015-04-17	FCC CAB
VCCI	JAPAN	R2133(10m), C2307	2014-06-21	VCCI registration
VCCI	JAPAN	T-2009	2013-12-23	VCCI registration
VCCI	JAPAN	G-563	2015-05-28	VCCI registration
IC	CANADA	5799A-1	2015-06-21	IC filing

2. Information about test item

2-1 Client & Manufacturer

Company name	:	Sena Technologies, Inc.
Address	:	210 Yangjae-dong Seocho-gu Seoul 137-130 Korea
Telephone / Facsimile	:	Tel : +82-2-573-7772 / Fax : +82-2-573-7710

2-2 Equipment Under Test (EUT)

Trade name	:	SENA
Model name	:	EXPAND
Serial number	:	Identical prototype
Date of receipt	:	December 03, 2013
EUT condition	:	Pre-production, not damaged
Antenna type	:	Chip antenna (M/N:SENA_009) Max Gain 0.5 dBi
Frequency Range	:	2402 ~ 2480MHz
RF output power	:	Max. 5.66 dBm - Conducted
Number of channels	:	79
Duty cycle	:	80.69 %
Channel spacing	:	1MHz
Channel Access Protocol	:	Frequency Hopping Spread Spectrum (FHSS)
Type of Modulation	:	Basic Mode(GFSK), EDR Mode(Pi/4 DQPSK, 8DPSK)
Power Source	:	DC 3.7V by battery
Firmware Version	:	V1.0.0

2-3 Tested frequency

Bluetooth	LOW	MID	HIGH
Frequency (MHz)	2402	2441	2480

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
Smart Phone	SHV-E250S	-	Samsung-

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	Carrier Frequency Separation	> 25 kHz	Conducted	C
15.247(a)	Number of Hopping Frequencies	> 15 hops		C
15.247(a)	20 dB Bandwidth 99% Bandwidth	> 1.5 MHz		C
15.247(a)	Dwell Time	< 0.4 seconds		C
15.247(b)	Transmitter Output Power	< 250 mWatt		C
15.247(d)	Conducted Spurious emission	> 20 dBc		C
15.247(d)	Band Edge	> 20 dBc		C
15.249 / 15.209	Field Strength of Harmonics	< 54 dBuV (at 3m)	Radiated	C
15.109	Field Strength	-		C
15.207 /15.107	AC Conducted Emissions	EN 55022	Line Conducted	C
15.203	Antenna requirement	-	-	C

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

Note 2: The data in this test report are traceable to the national or international standards.

Note 1: Antenna Requirement
→ The **Sena Technologies, Inc. ,**   FCC ID: **S7A-SP12** unit complies with the requirement of §15.203.
The antenna type is chip antenna.

Note 2: The sample was tested according to the following specification:
FCC Parts 15.247; ANSI C-63.4-2009
RSS-210 and ISSUE No.:8 Date:2010

Note3: TEST METHODOLOGY
The measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices(ANSI C63.10-2009) and FCC Public Notice DA 00-705 dated March 30, 2000 entitled "**Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems**" were used in the measurement of the **Sena Technologies, Inc. ,   FCC ID: S7A-SP12**

3.2 Frequency Hopping System Requirements

3.2.1 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.

### 3.2.2 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: 29-1 = 511 bits
Longest sequence of zeros: 8 (non-inverted signal)
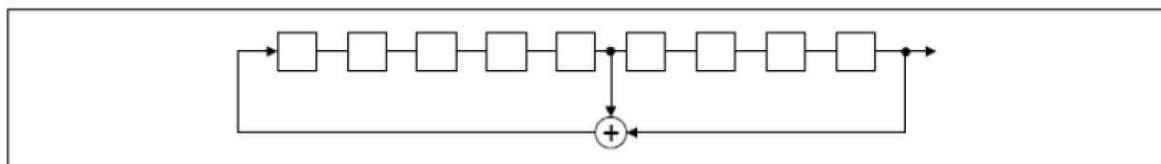
Linear Feedback Shift Register for Generation of the PRBS sequence
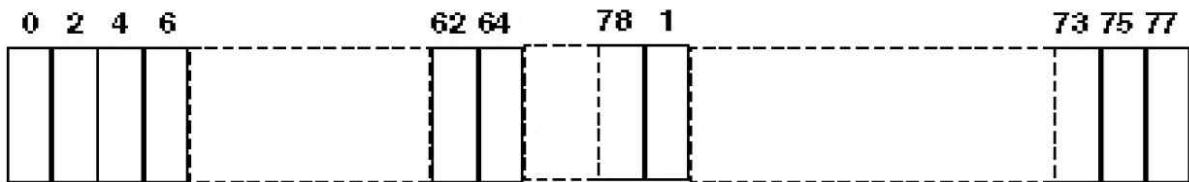
Each frequency used equally on the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

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

3.3 TECHNICAL CHARACTERISTIC TEST

3.3.1 Carrier Frequency Separation

Procedure:

The test follows DA00-705. The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had 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 = 2~ 3 MHz (wide enough to capture the peaks of two adjacent channels)

RBW = 10 kHz (1% of the span or more)   Sweep = auto

VBW = 10 kHz   Detector function = peak

Trace = max hold

Measurement Data:

Test Results	
Carrier Frequency Separation (MHz)	**Result**
0.9986	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

| The EUT shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of 20dB bandwidth of the hopping channel, whichever is greater. |
| --- |

Measurement Setup
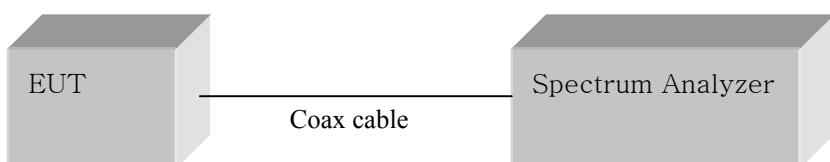
Figure 1: Measurement setup for the carrier frequency separation

Carrier Frequency Separation
Basic Mode

Spectrum	Spectrum 2 ⊗	Spectrum 3 ⊗	Spectrum 4 ⊗	
Ref Level 20.00 dBm	**Offset** 1.00 dB ⊝ **RBW** 10 kHz			
Att 35 dB	**SWT** 189.6 μs	**VBW** 10 kHz	**Mode** Auto FFT	

●1Pk Max

D2[1]   0.01 dB
            -998.60 kHz
M1[1]   -0.10 dBm
            2.44103910 GHz

10 dBm ——
0 dBm ——   D2   M1
-10 dBm ——
-20 dBm ——
-30 dBm ——
-40 dBm ——
-50 dBm ——
-60 dBm ——
-70 dBm ——

CF 2.441 GHz   691 pts   Span 3.0 MHz

Measuring...

EDR Mode

Spectrum	Spectrum 2 ⊗	Spectrum 3 ⊗	Spectrum 4 ⊗	
Ref Level 20.00 dBm	**Offset** 1.00 dB ⊝ **RBW** 10 kHz			
Att 35 dB	**SWT** 189.5 μs	**VBW** 10 kHz	**Mode** Auto FFT	

●1Pk Max ●2Pk View

D2[2]   -0.46 dB
            -998.60 kHz
M1[1]   -2.31 dBm
            2.44102390 GHz

10 dBm ——
0 dBm ——   D2   M1
-10 dBm ——
-20 dBm ——
-30 dBm ——
-40 dBm ——
-50 dBm ——
-60 dBm ——
-70 dBm ——

CF 2.4405 GHz   691 pts   Span 2.0 MHz

Measuring...

3.3.2 Number of Hopping Frequencies

Procedure:

The test follows DA00-705. The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, four frequency ranges within the 2400 ~ 2483.5 MHz FH band were examined.

The spectrum analyzer is set to (Bluetooth):

Frequency range   Start = 2400.0MHz,   Stop = 2483.5 MHz

RBW = 100 kHz (1% of the span or more)   Sweep = auto

VBW = 100 kHz (VBW $\geq$ RBW)   Detector function = peak

Trace = max hold   Span > 40MHz

Measurement Data :   Complies

Total number of Hopping Channels	79

- See next pages for actual measured spectrum plots.

Minimum Standard:

At least 15 hopes

Measurement Setup

Same as the Chapter 3.3.1 (Figure 1)

Number of Hopping Frequencies
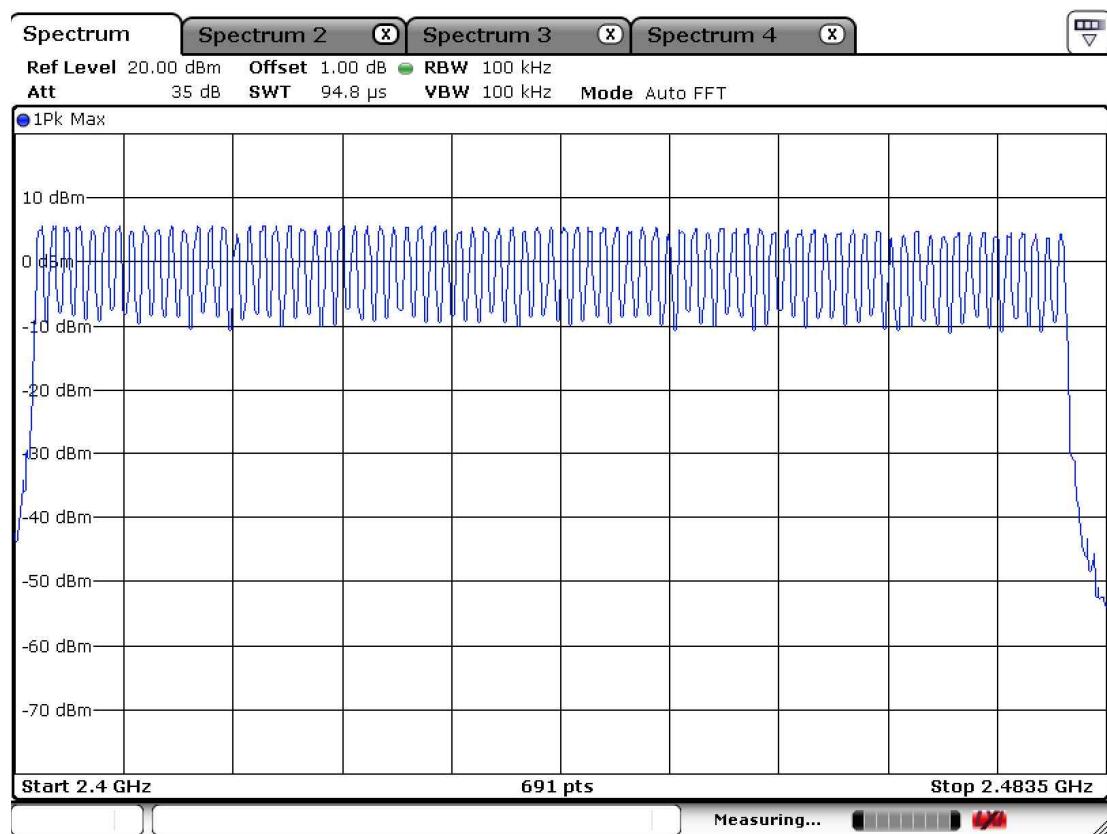
3.3.3 20 dB Bandwidth

Procedure:

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

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission.   Use the marker-delta function to measure 20dB down one 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. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

The spectrum analyzer is set to (Bluetooth):

Center frequency = the highest, middle and the lowest channels

Span = 3 MHz (approximately 2 or 3 times of the 20 dB bandwidth)

RBW = 30 kHz   Sweep = auto

VBW = 30 kHz (VBW $\geq$ RBW)   Detector function = peak

Trace = max hold

Measurement Data: Basic Mode

Frequency (MHz)	Channel No.	Test Results(MHz)	
		20dB Bandwidth	99% Bandwidth
2402	0	0.838	0.864
2441	39	0.825	0.855
2480	78	0.816	0.855

Measurement Data: EDR Mode

Frequency (MHz)	Channel No.	Test Results(MHz)	
		20dB Bandwidth	99% Bandwidth
2402	0	1.220	1.159
2441	39	1.259	1.163
2480	78	1.263	1.172

- See next pages for actual measured spectrum plots.

Minimum Standard:

N/A

**Measurement Setup**

Same as the Chapter 3.3.1 (Figure 1)

Channel 1 of basic mode
20 dB Bandwidth
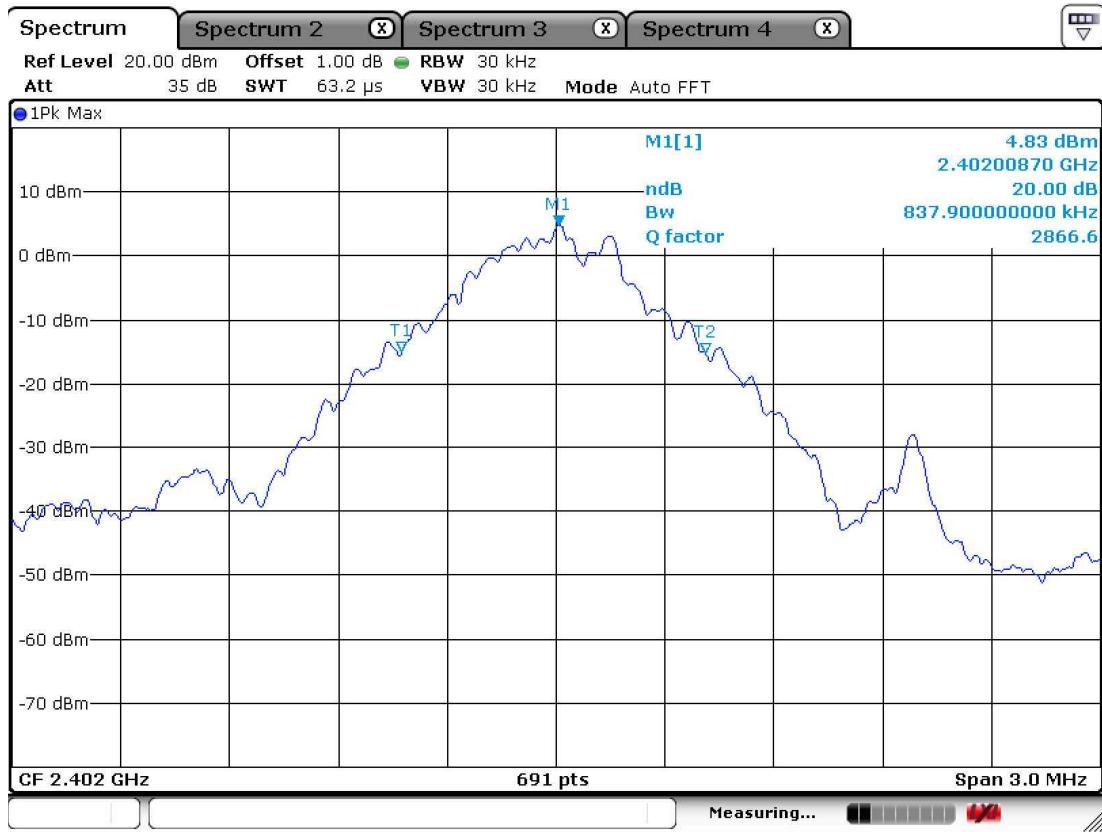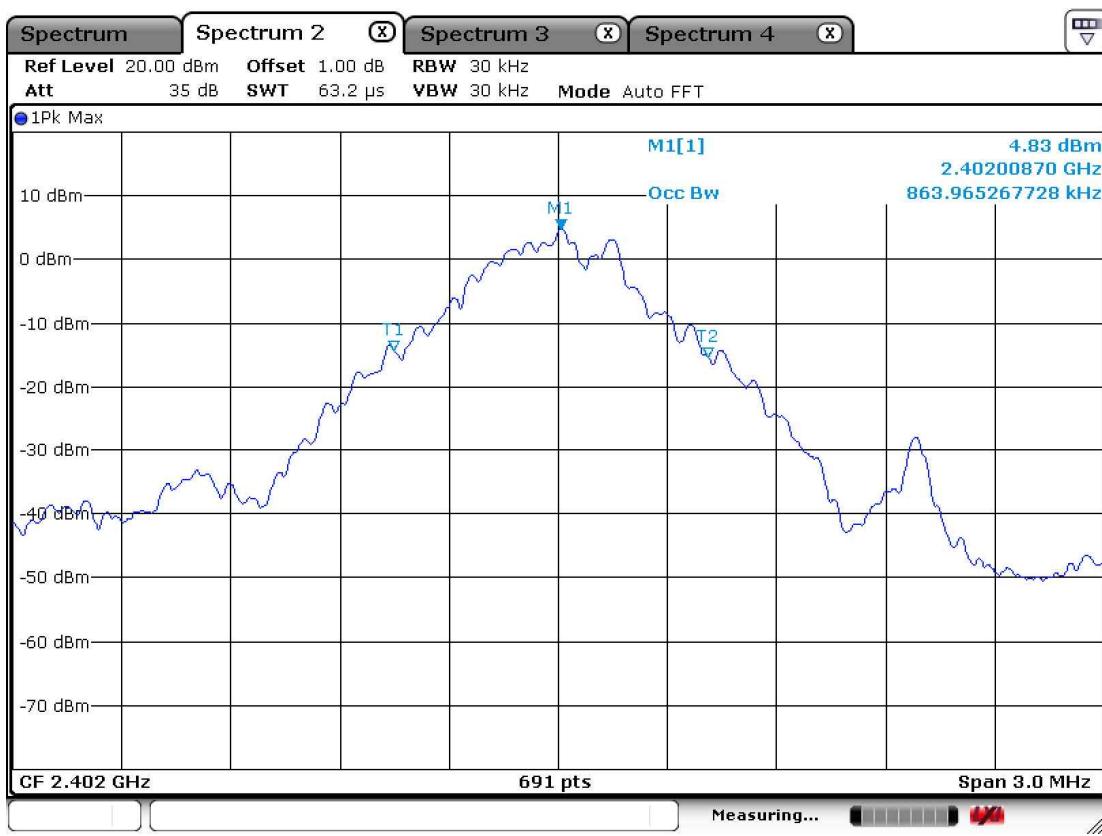
99% Bandwidth

Channel 2 of basic mode
20 dB Bandwidth

Spectrum	Spectrum 2 (X)	Spectrum 3 (X)	Spectrum 4 (X)	

Ref Level 20.00 dBm Offset 1.00 dB RBW 30 kHz
Att   35 dB SWT 63.2 µs VBW 30 kHz Mode Auto FFT
●1Pk Max

M1[1]   4.80 dBm
                    2.44100870 GHz
ndB   20.00 dB
Bw   824.900000000 kHz
Q factor   2959.2

CF 2.441 GHz   691 pts   Span 3.0 MHz
Measuring...

99% Bandwidth

Spectrum	Spectrum 2 (X)	Spectrum 3 (X)	Spectrum 4 (X)	

Ref Level 20.00 dBm Offset 1.00 dB RBW 30 kHz
Att   35 dB SWT 63.2 µs VBW 30 kHz Mode Auto FFT
●1Pk Max

M1[1]   4.68 dBm
                    2.44100430 GHz
Occ Bw   855.282199710 kHz

CF 2.441 GHz   691 pts   Span 3.0 MHz
Measuring...

Channel 3 of basic mode
20 dB Bandwidth
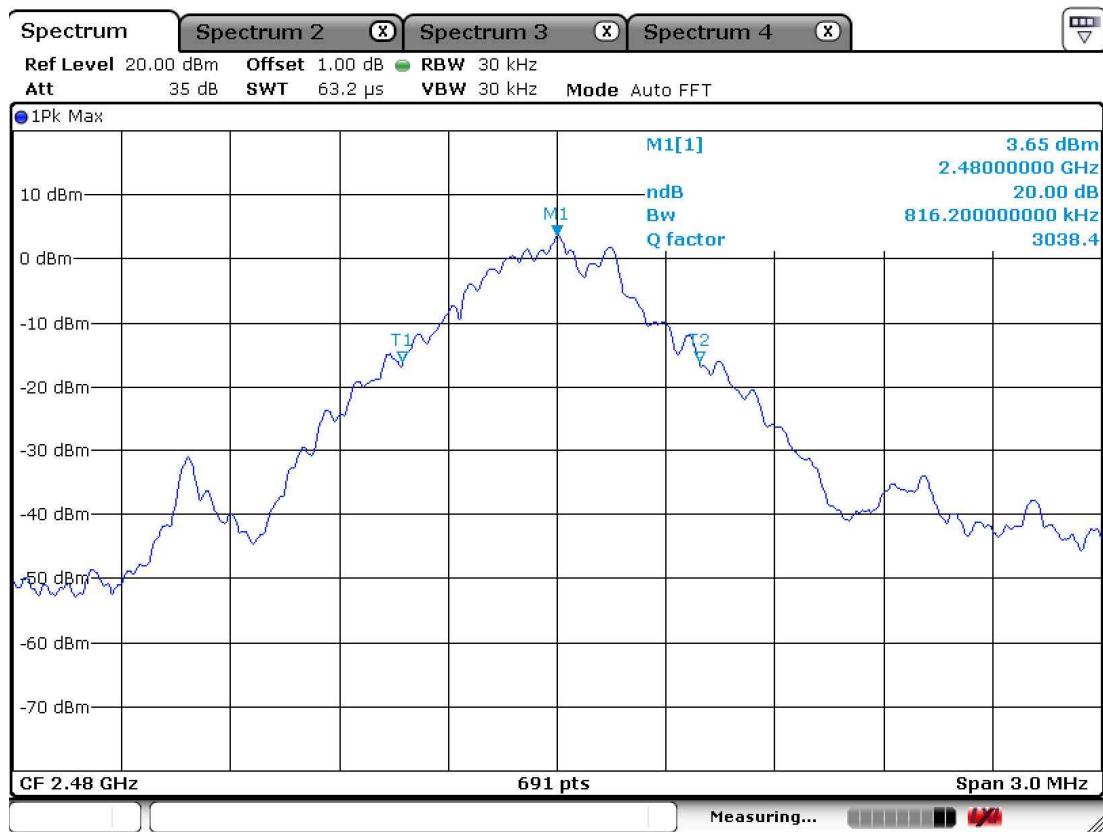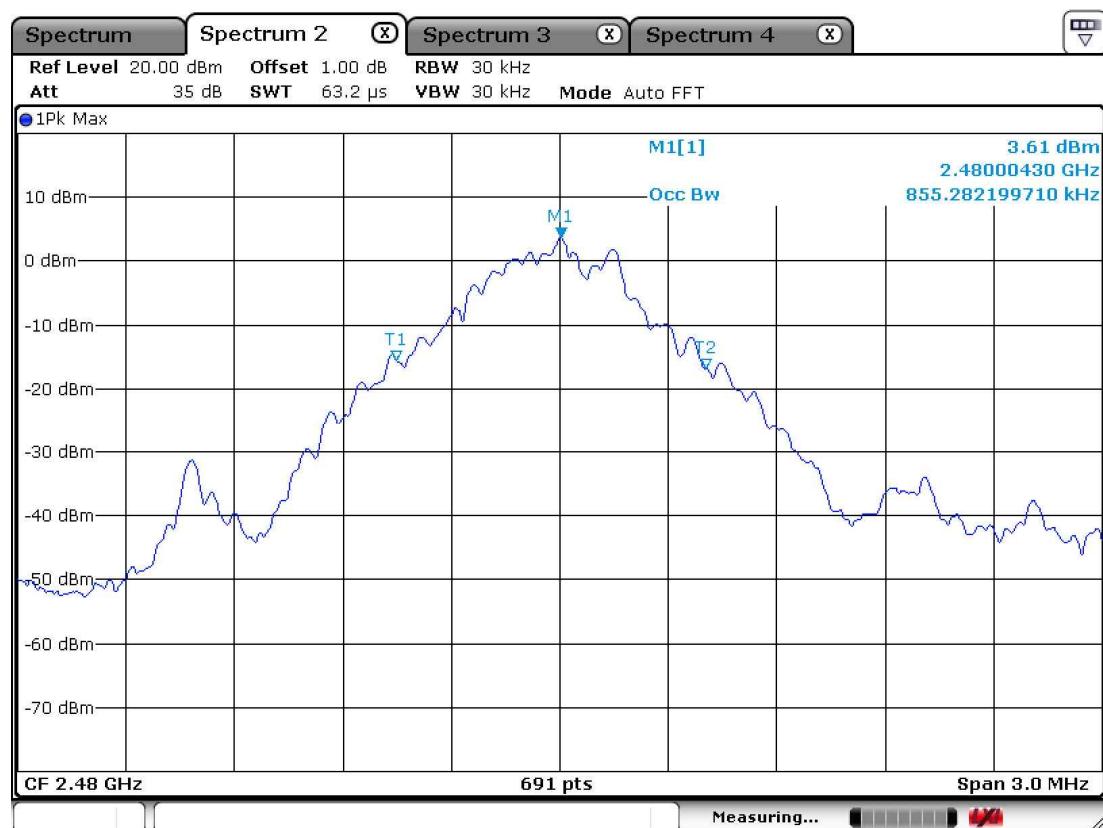
99% Bandwidth

Channel 1 at EDR mode
## 20 dB Bandwidth
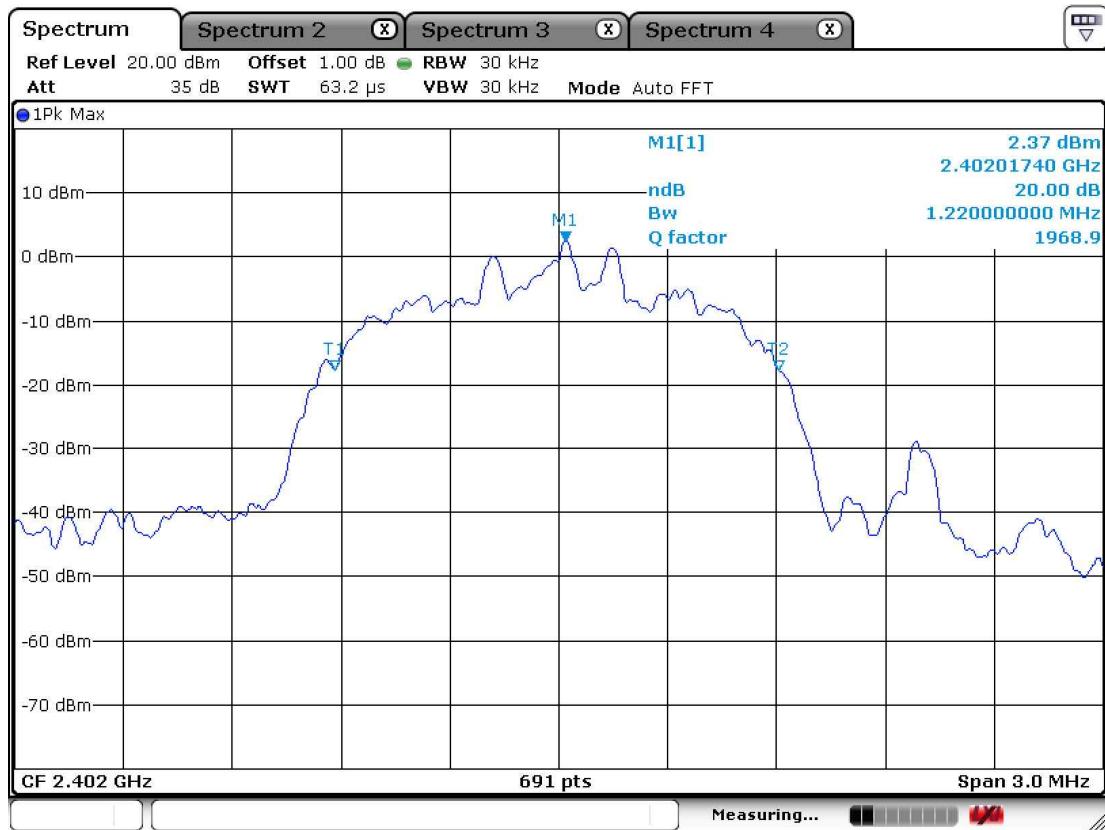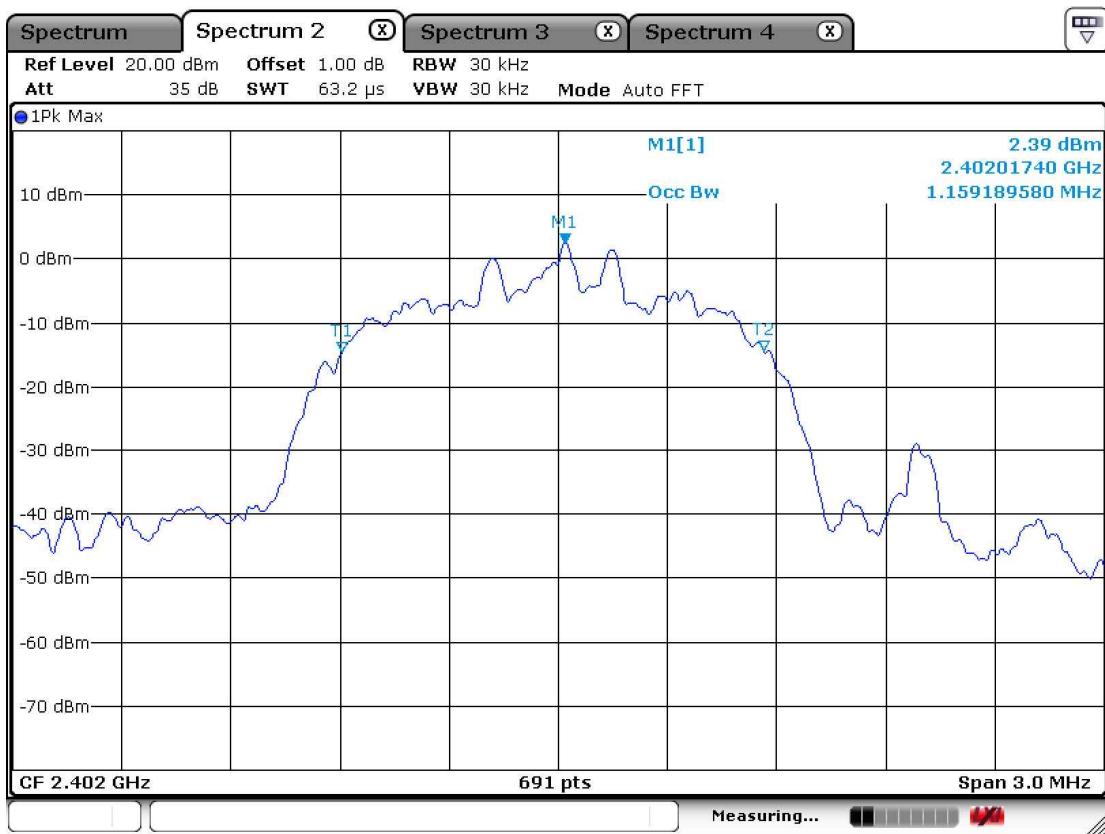
99% Bandwidth

Channel 2 at EDR mode
## 20 dB Bandwidth
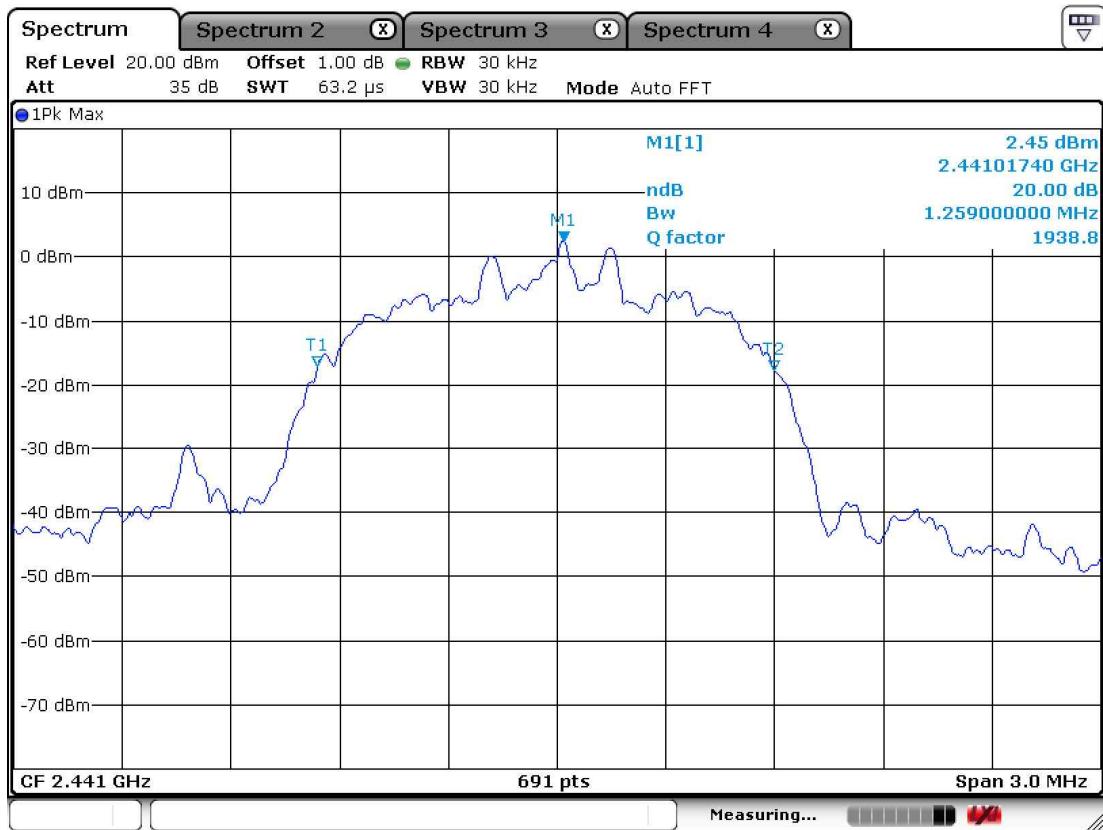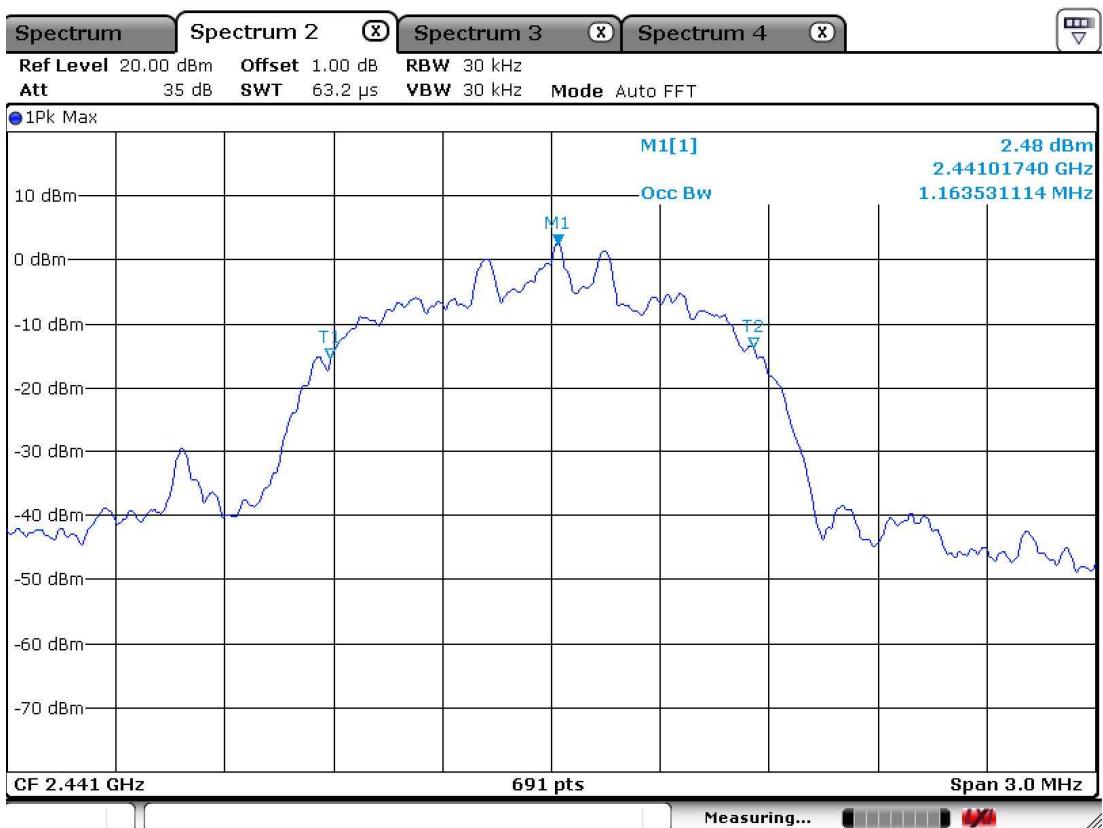
99% Bandwidth

Channel 3 at EDR mode
20 dB Bandwidth
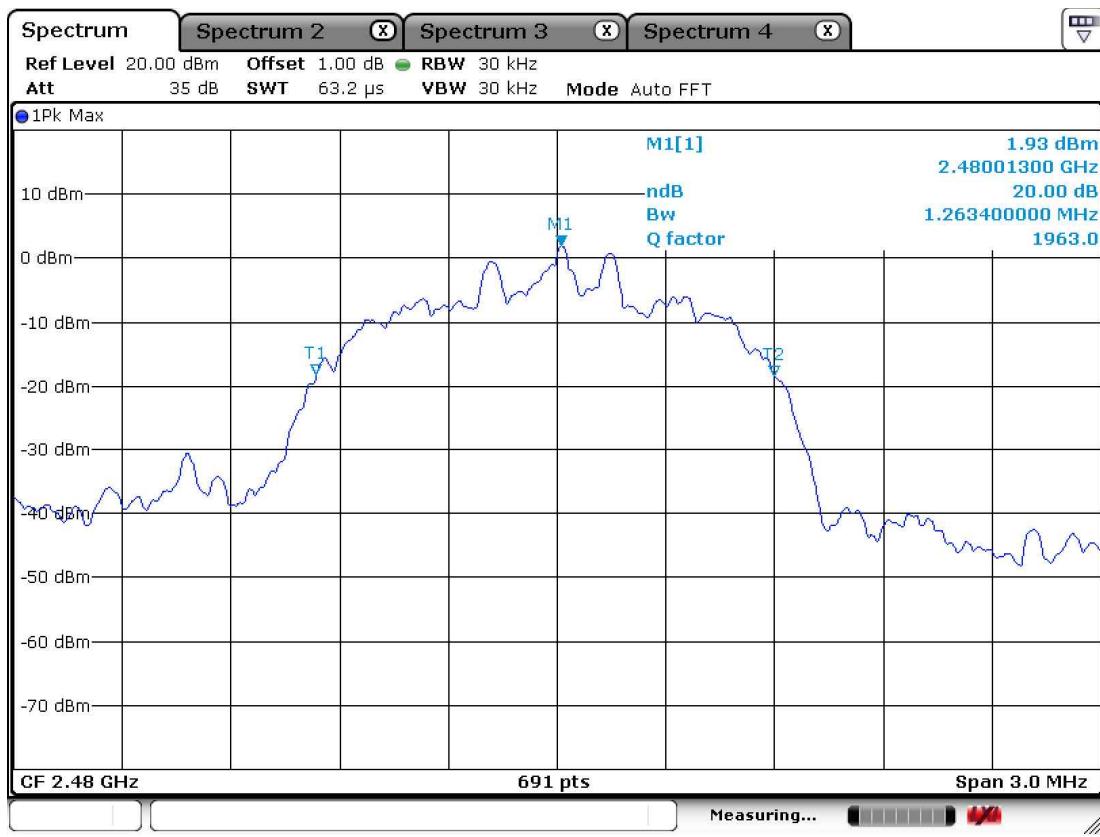
99% Bandwidth
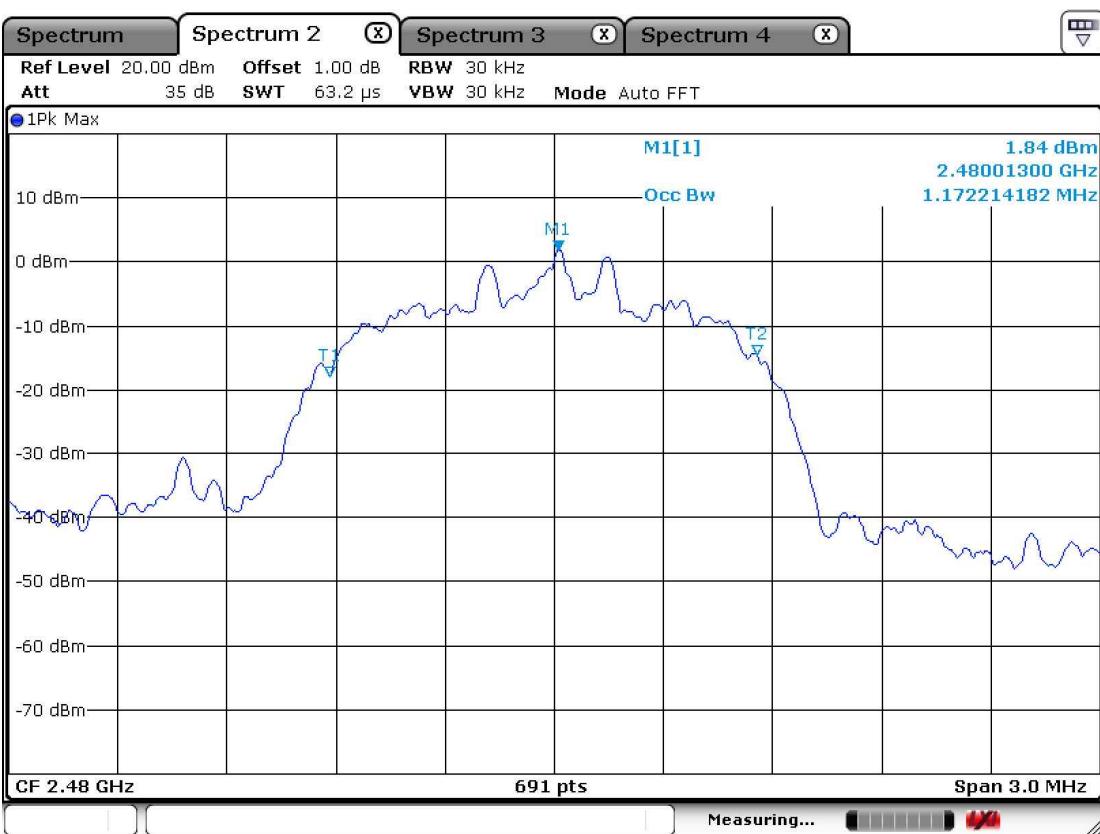
3.3.4 Time of Occupancy (Dwell Time)

Procedure:

The test follows DA00-705. The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

    The spectrum analyzer is set to :

Center frequency = 2441 MHz	Span = zero
RBW = 1 MHz	VBW = 1 MHz (VBW $\geq$ RBW)
Trace = max hold	Detector function = peak

Measurement Data (Bluetooth):

Mode	Number of transmission ina 31.6s (79Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (msec)
DH1	30(Times / 3sec) *10.533 = 315.99	0.543	171.58	400
DH3	15(Times / 3sec) *10.533 = 158.00	1.797	283.92	400
DH5	10(Times / 3sec) *10.533 = 105.33	2.956	311.35	400
EDR 3Mbps DH5	10(Times / 3sec) *10.533 = 105.33	3.050	321.25	400

- See next pages for actual measured spectrum plots.
- dwell time = {(number of hopping per second / number of slot) x duration time per channel} x 0.4 ms

Minimum Standard:

0.4 seconds within a 30 second period per any frequency

**Measurement Setup**

Same as the Chapter 3.3.1 (Figure 1)

DH1 at basic mode
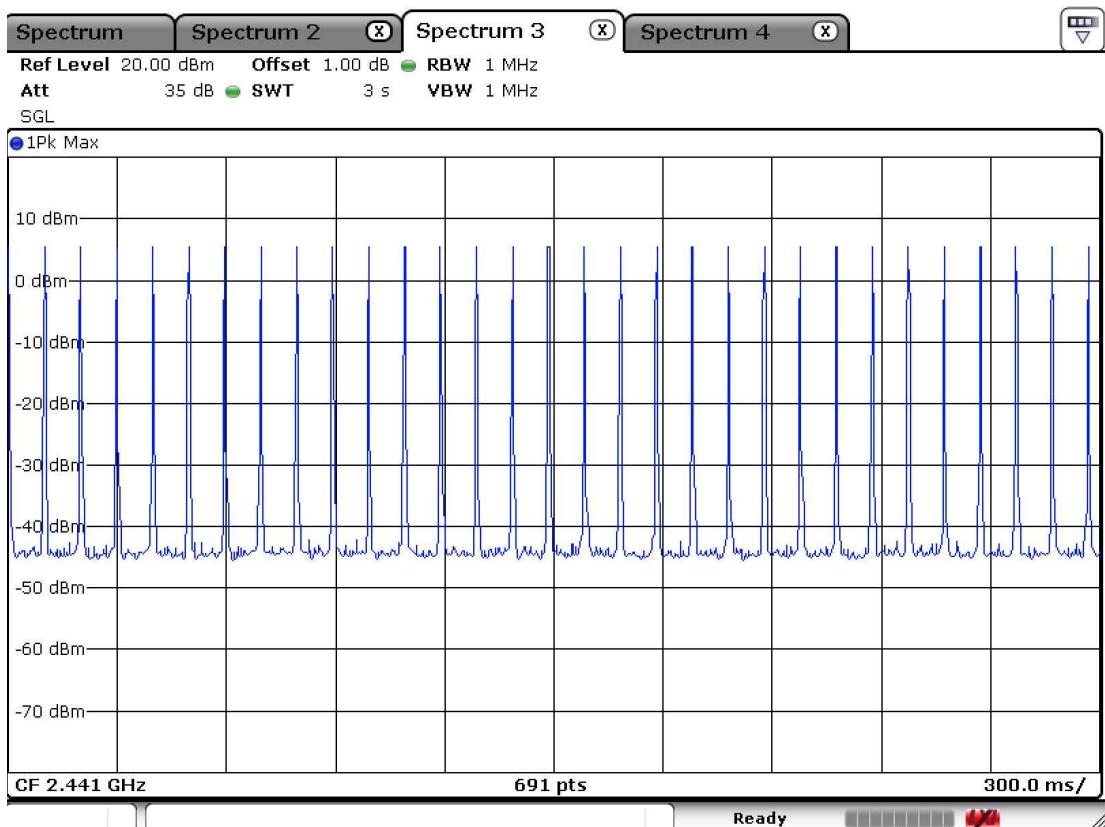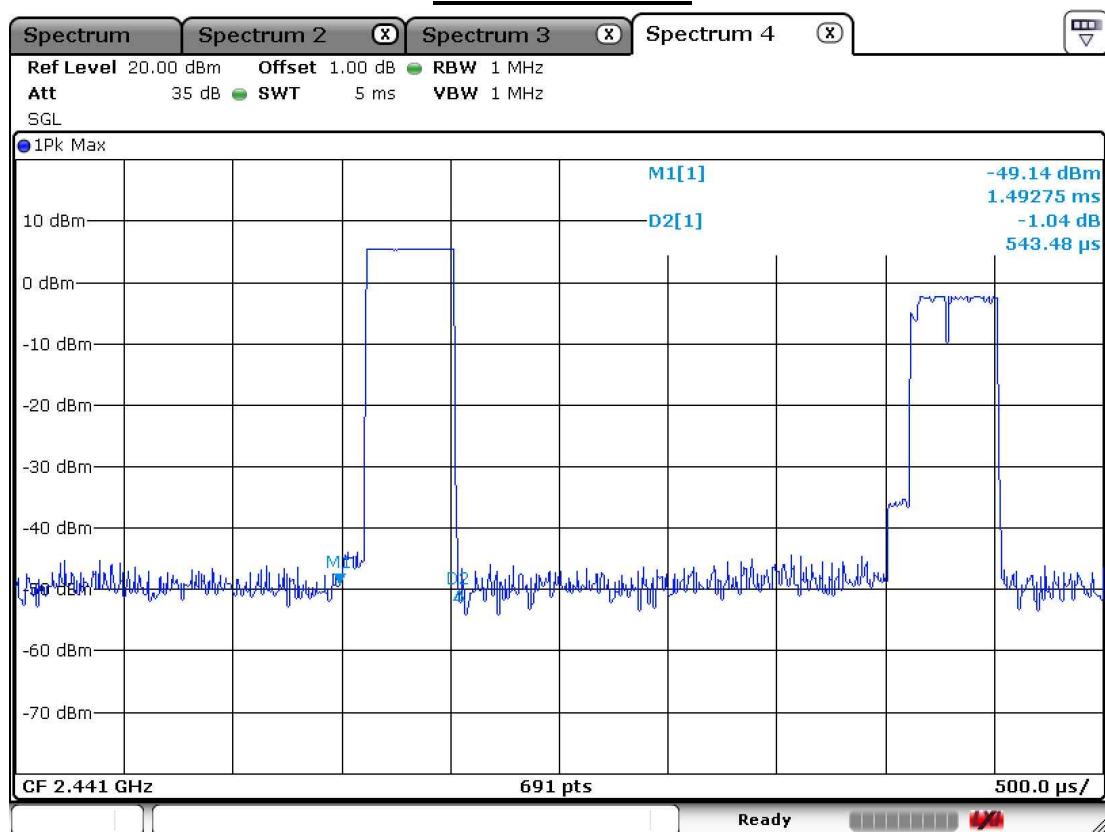
DH3 at basic mode
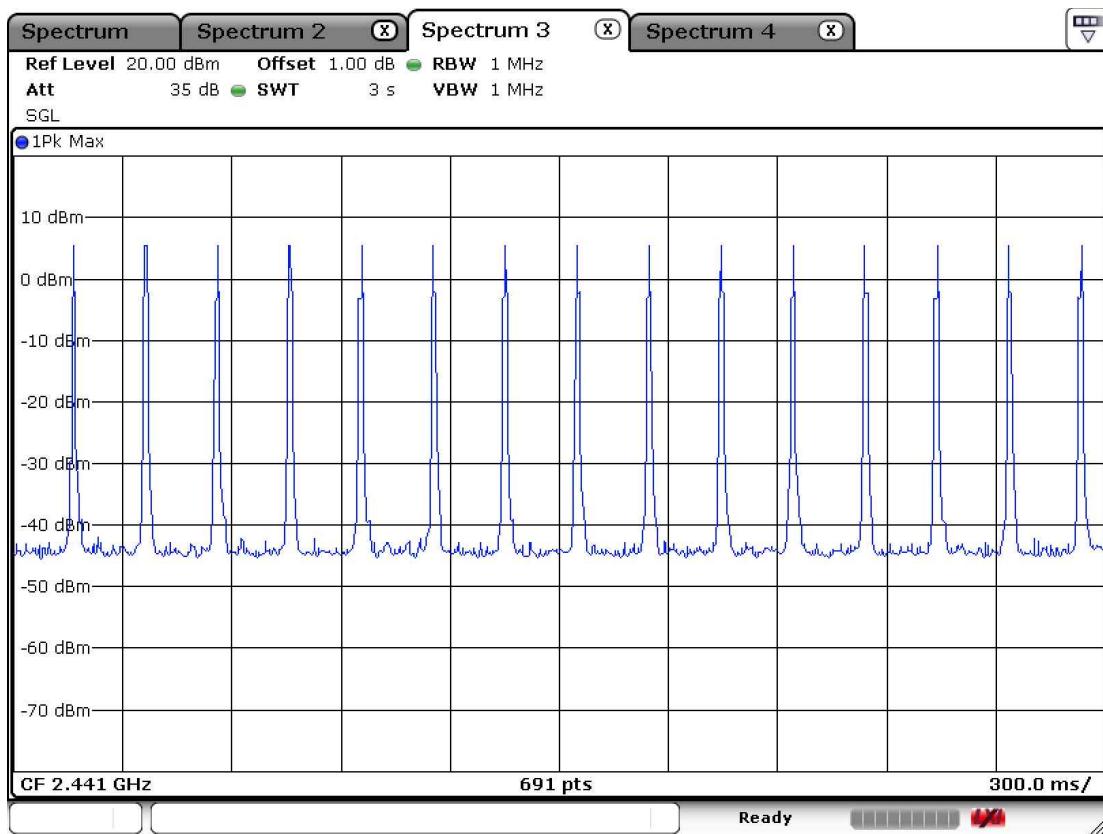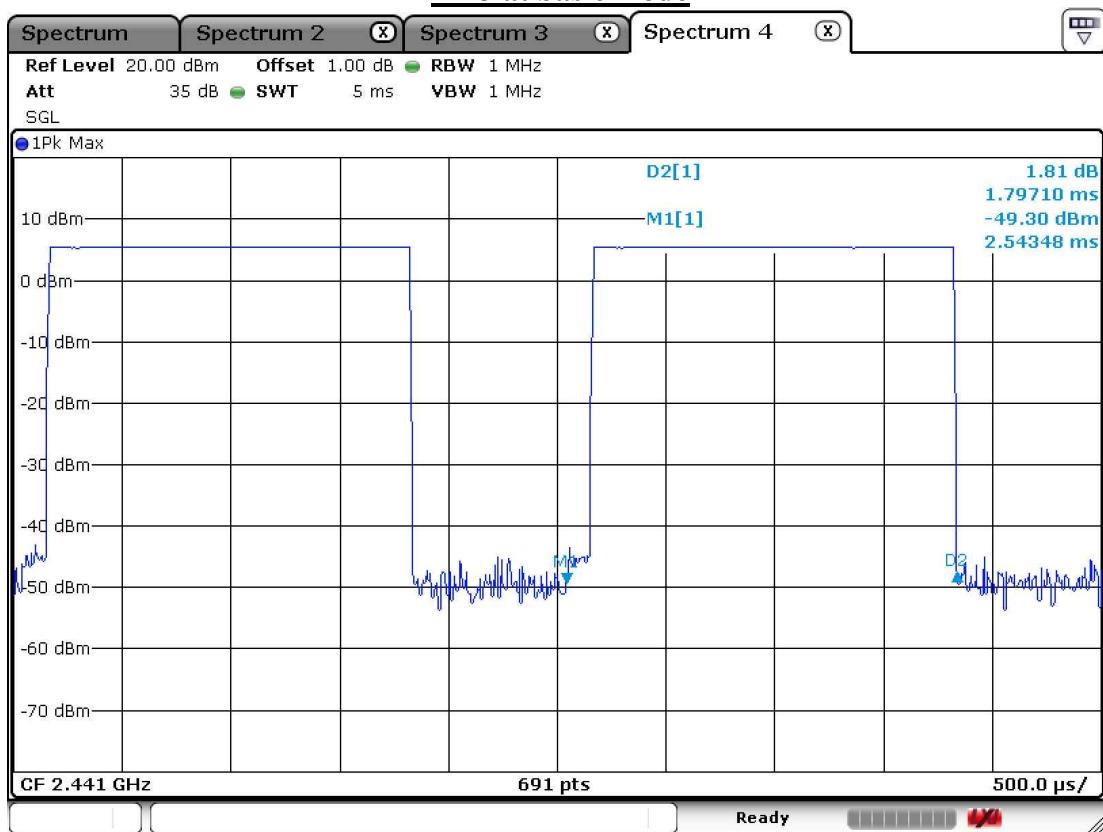
DH5 at basic mode
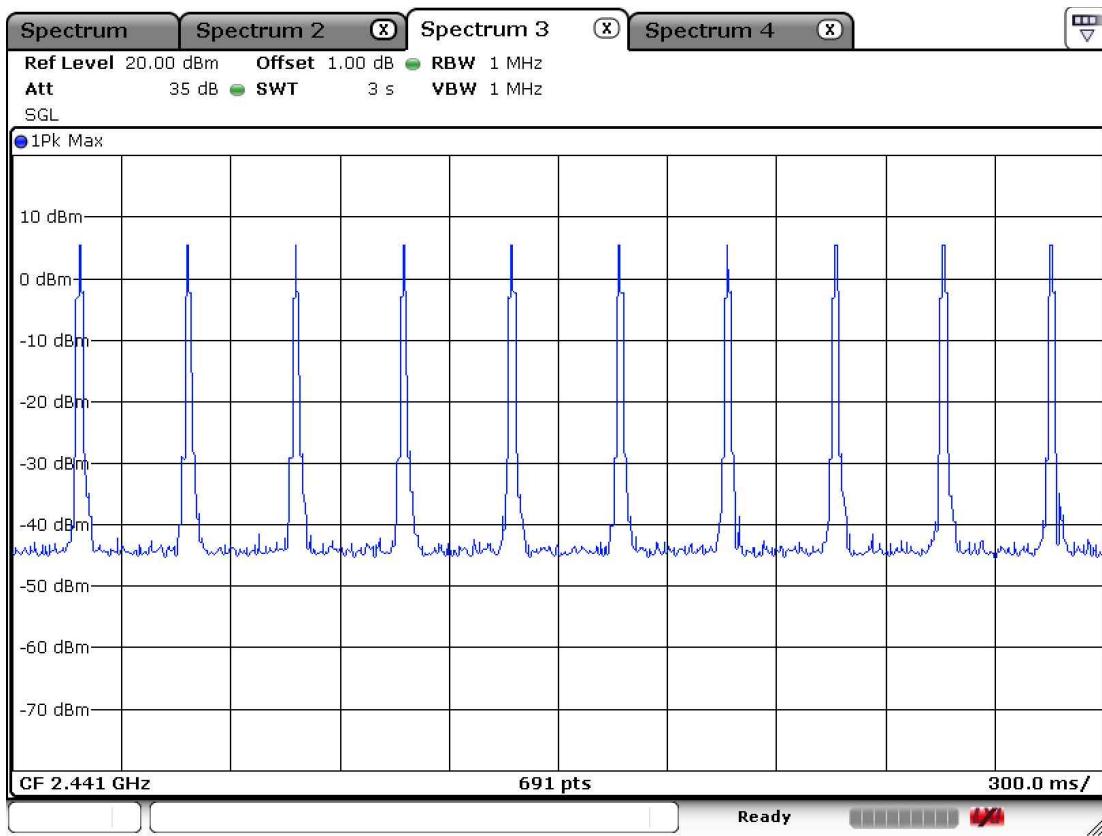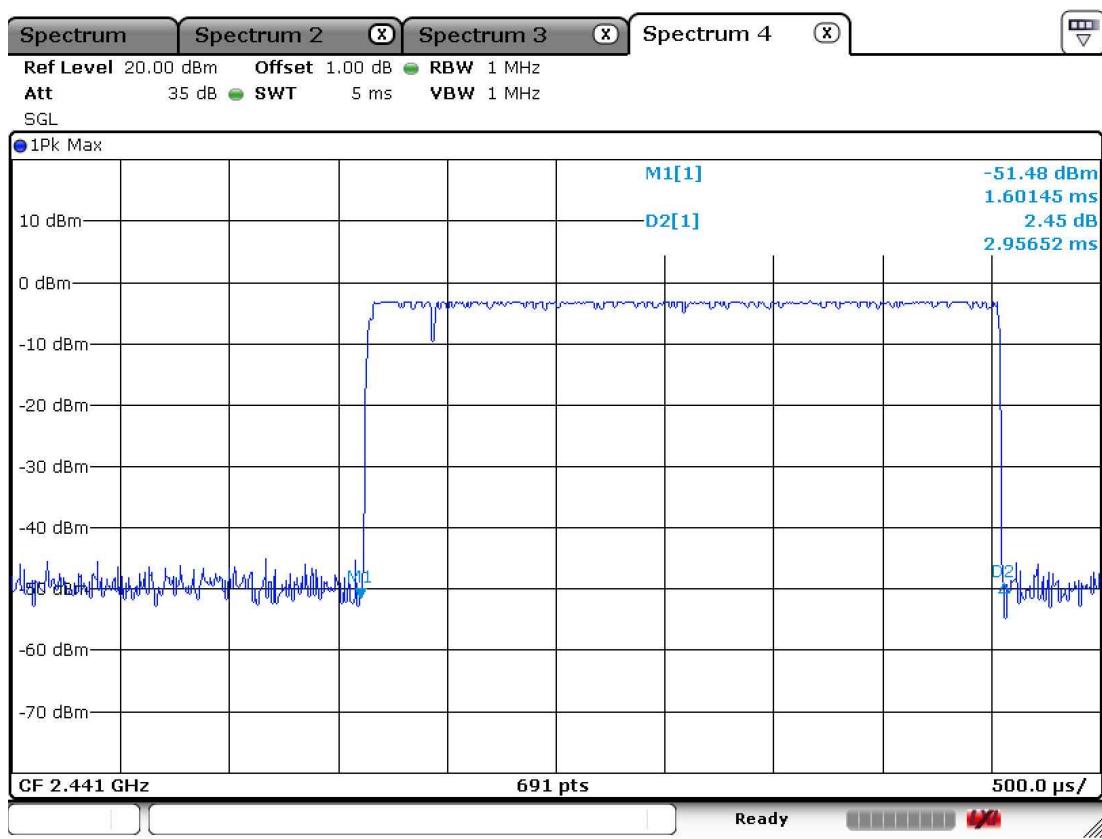
DH5 at EDR mode with 3Mbps
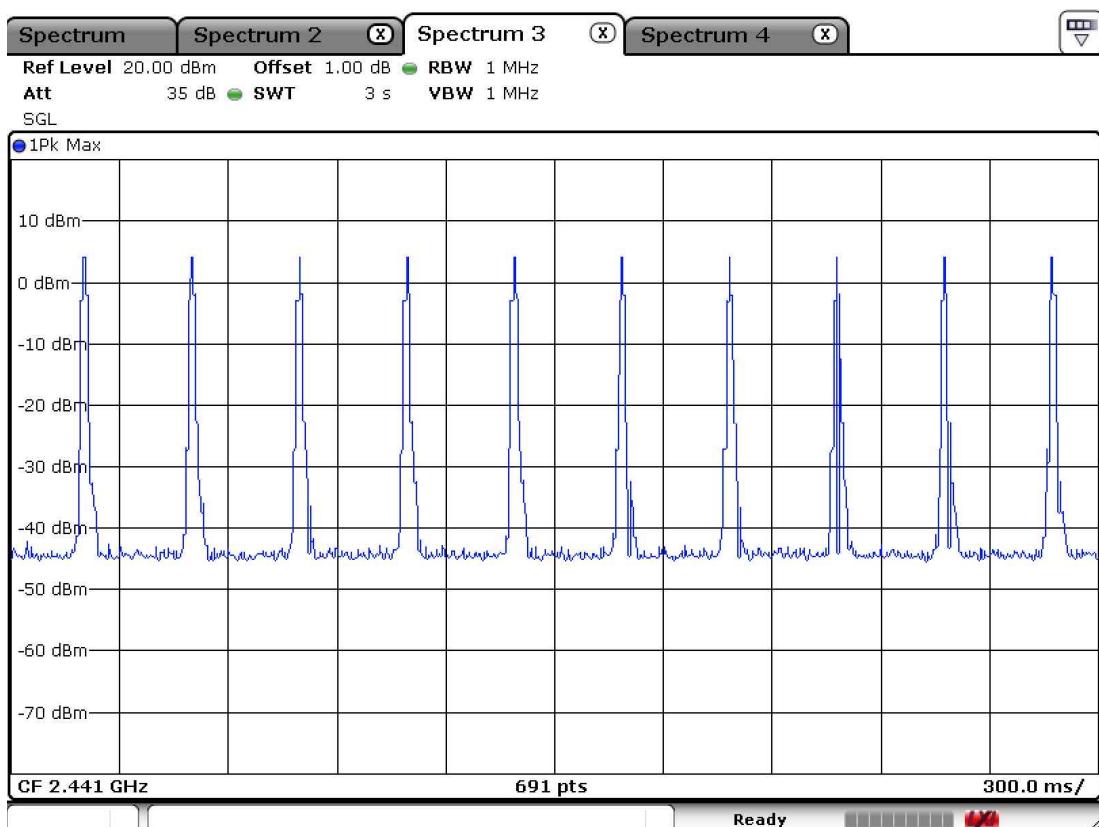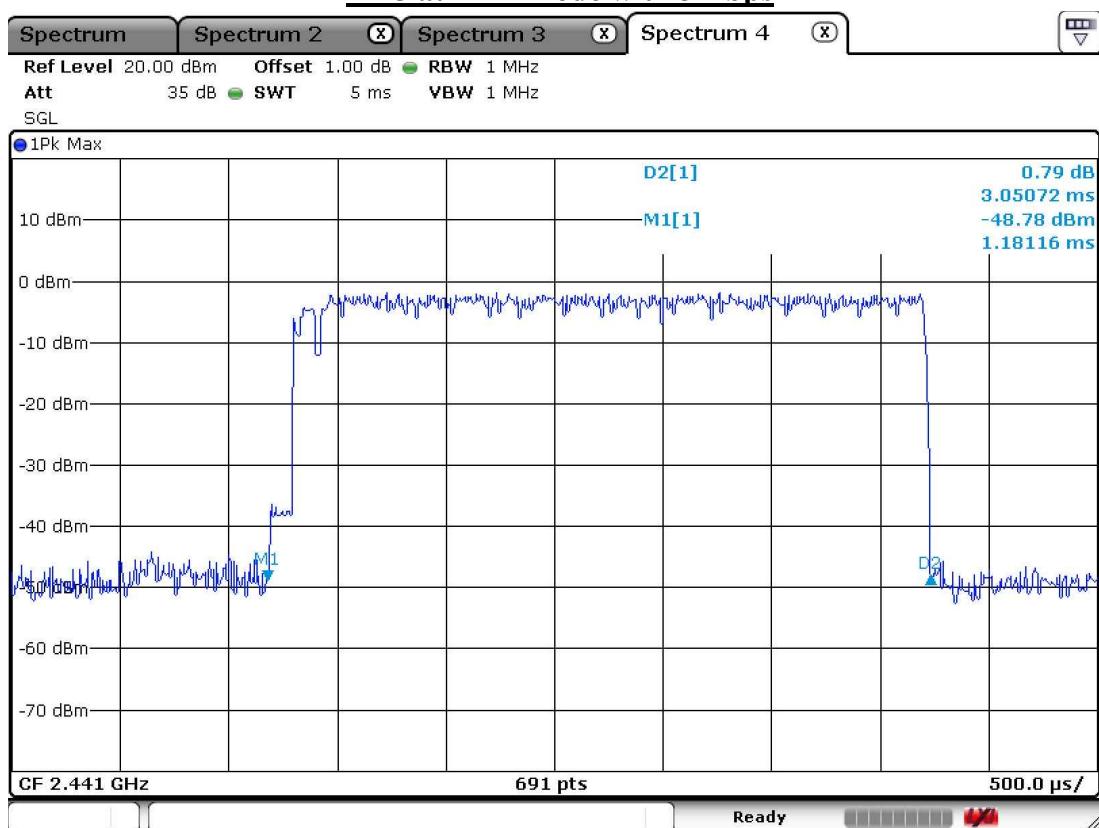
3.3.5 Transmitter Output Power

Procedure:

The test follows DA00-705. The peak output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission.   The indicated level is the peak output power.

The spectrum analyzer is set to :

Center frequency = the highest, middle and the lowest channels

Span = 10 MHz (approximately 5 times of the 20 dB bandwidth)

RBW = 3 MHz (greater than the 20dB bandwidth of the emission being measured)

VBW = 3 MHz (VBW $\geq$ RBW)   Detector function = peak

Trace = max hold   Sweep = auto

Measurement Data : Basic Mode

Frequency (MHz)	Ch.	Test Results		
		dBm	mW	Result
2402	0	**5.66**	**3.68**	Complies
2441	39	**5.56**	**3.59**	Complies
2480	78	**4.41**	**2.76**	Complies

Measurement Data : EDR Mode

Frequency (MHz)	Ch.	Test Results		
		dBm	mW	Result
2402	0	**4.32**	**2.70**	Complies
2441	39	**4.29**	**2.68**	Complies
2480	78	**3.19**	**2.08**	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:	< 250 mW

Measurement Setup

Same as the Chapter 3.3.1 (Figure 1)

Channel 1
Basic mode
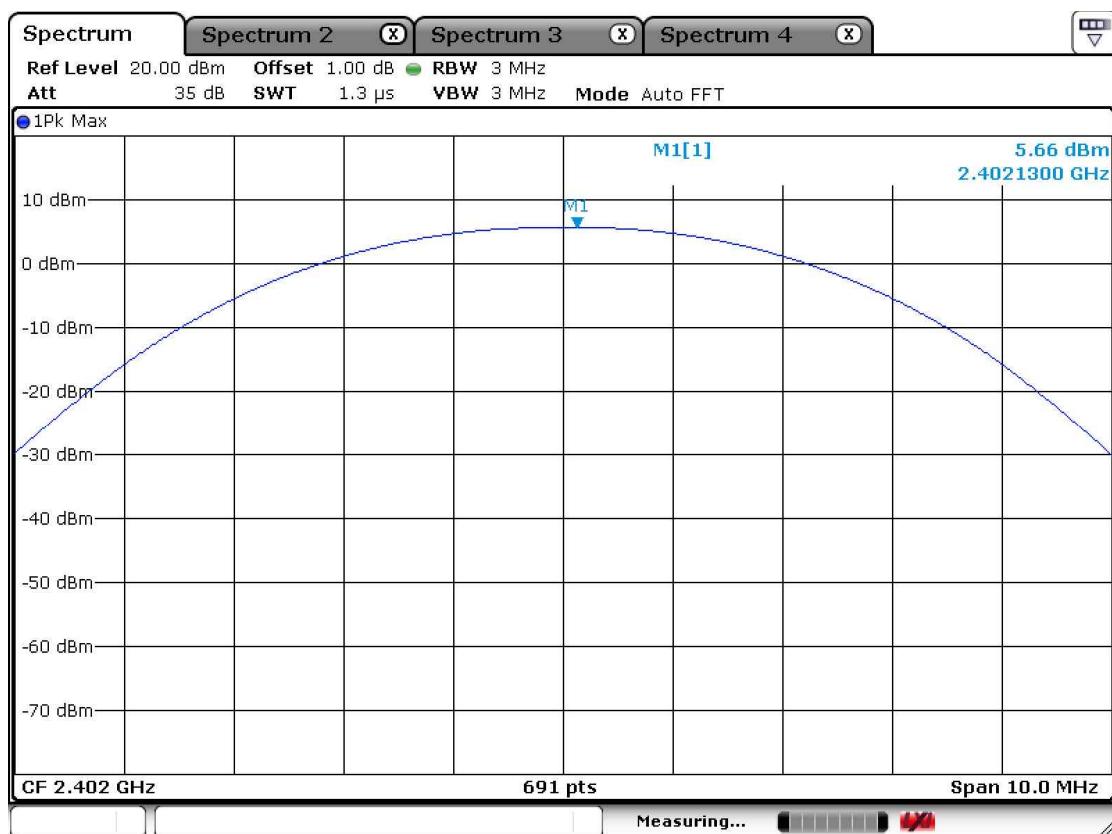
EDR mode
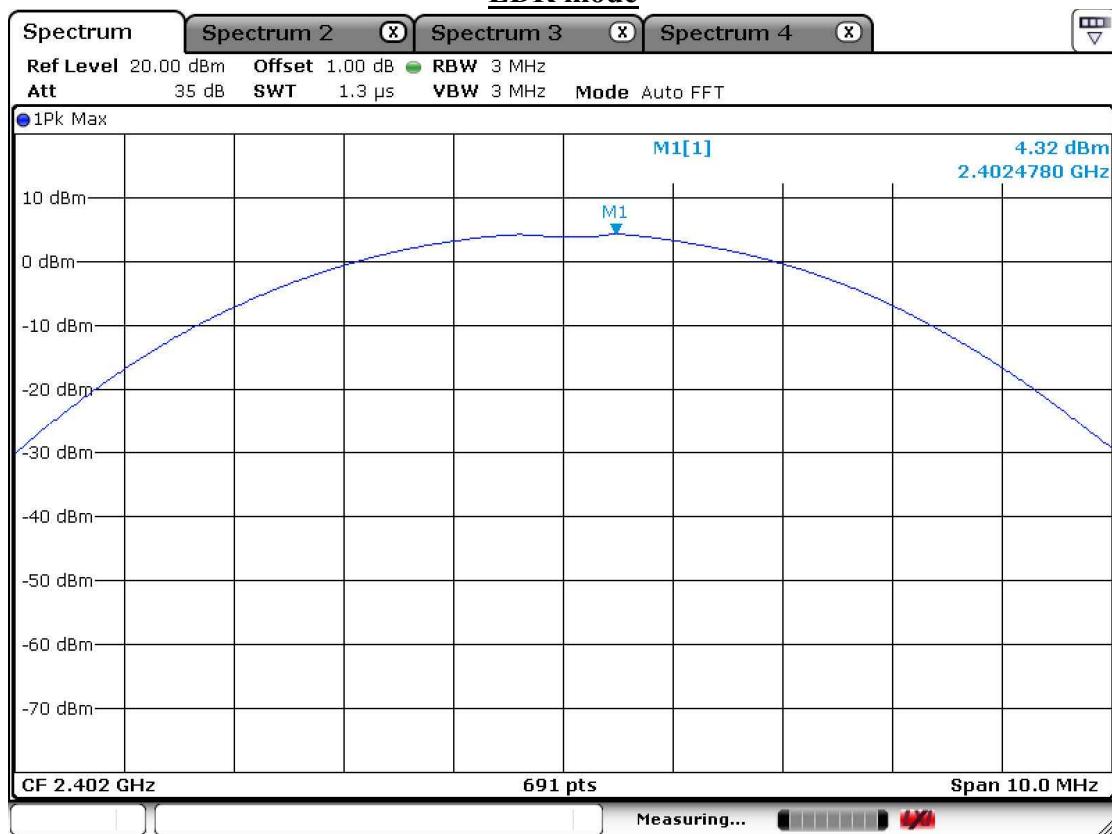
Channel 2
Basic mode
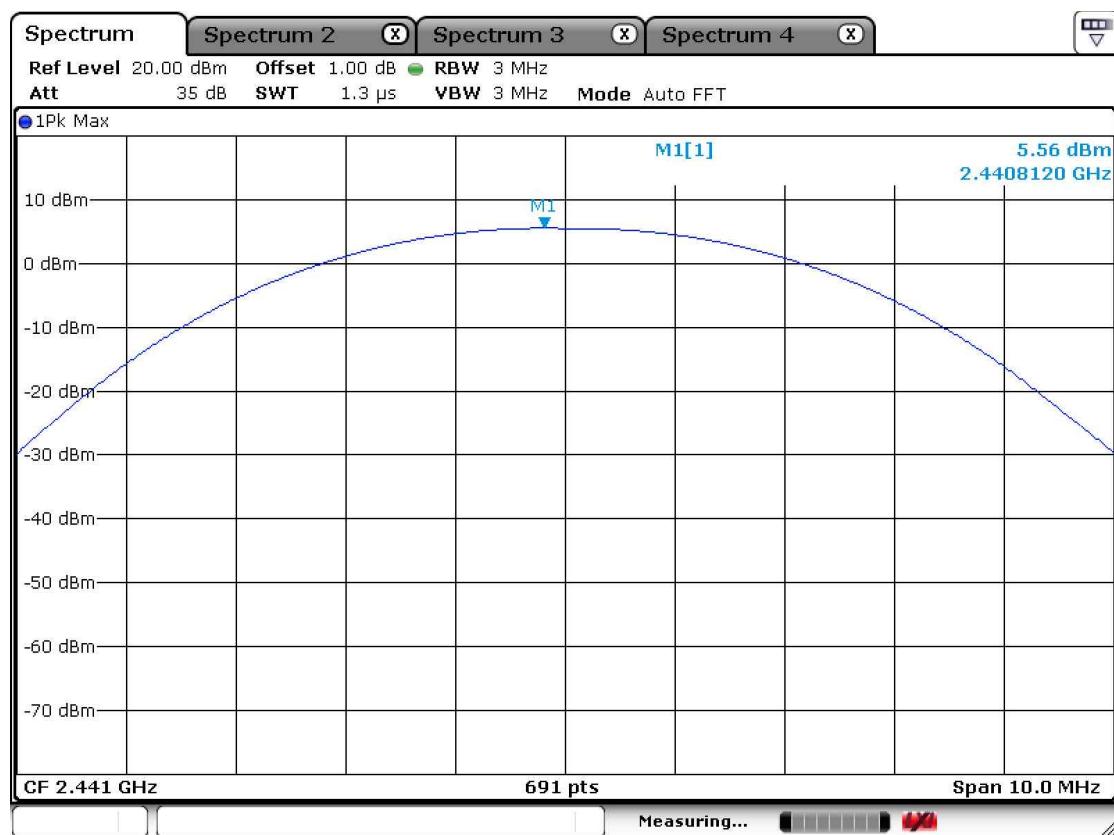
EDR mode
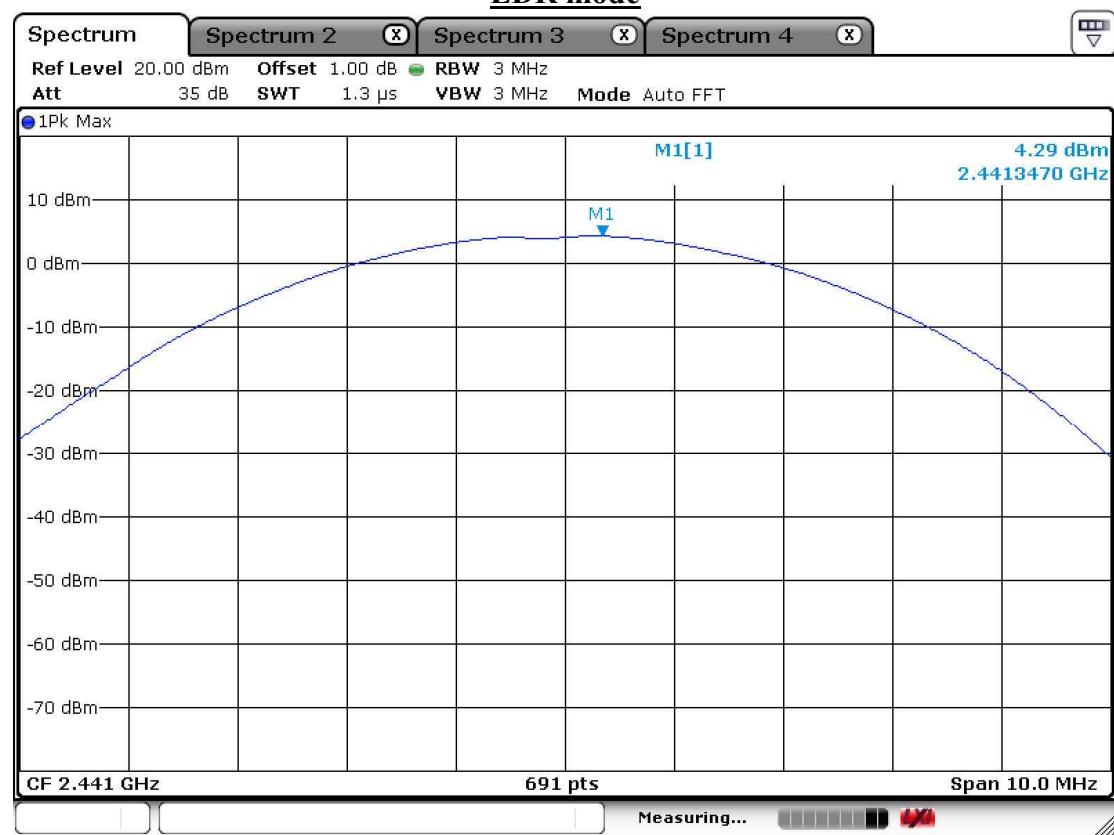
Channel 3
Basic mode
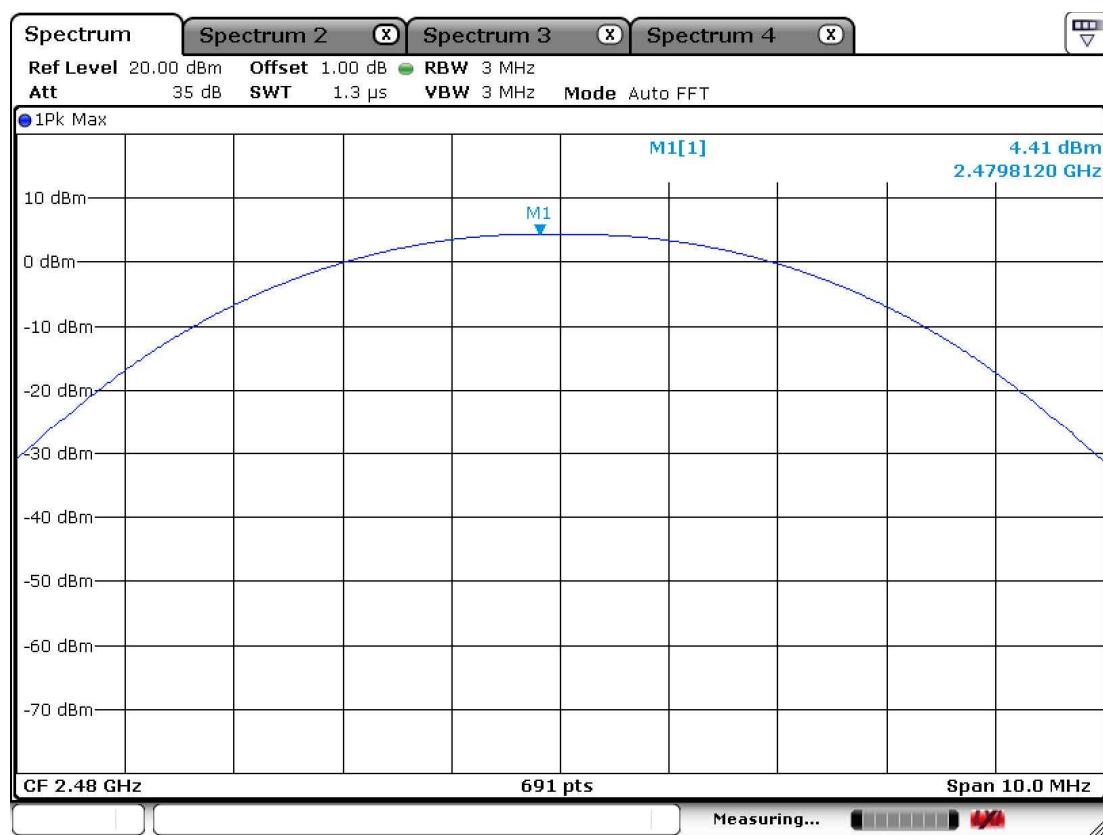
EDR mode
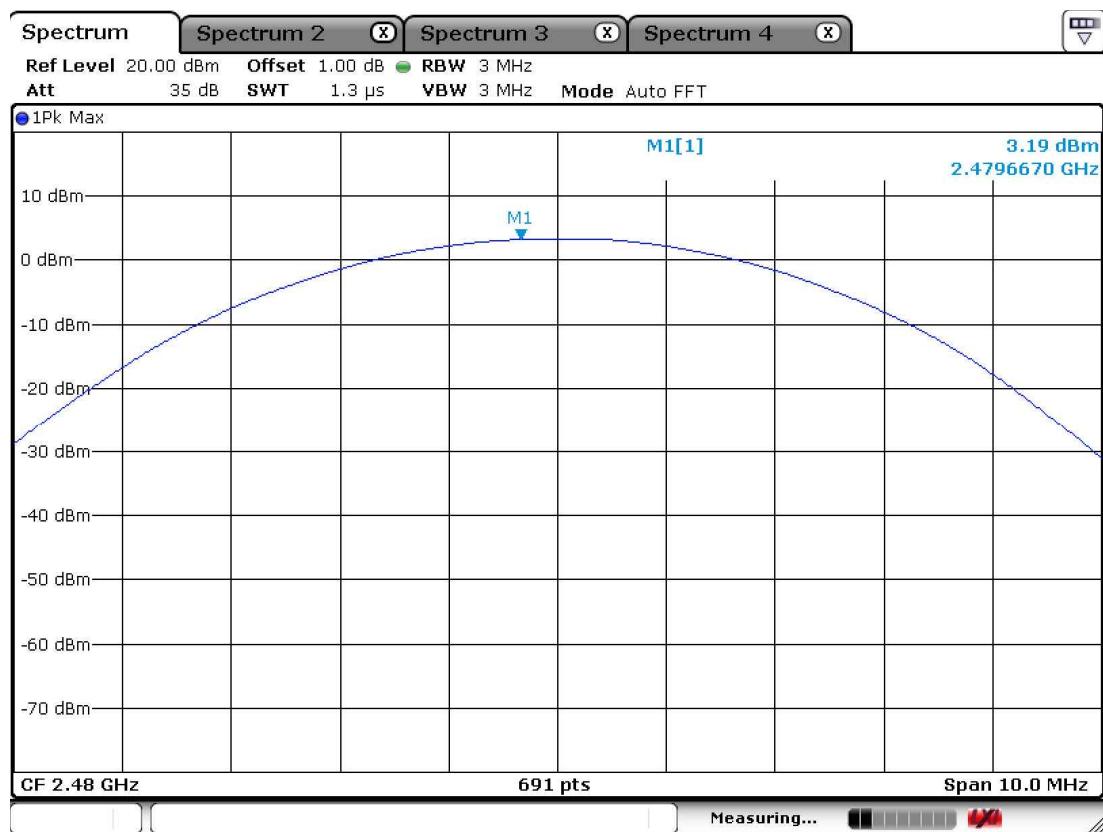
3.3.6 Band Edge

Procedure:

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

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz   VBW = 100 kHz

Span = 10~30 MHz   Detector function = peak

Trace = max hold   Sweep = auto

Measurement Data: **Complies**

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

- See next pages for actual measured spectrum plots.

Minimum Standard:	> 20 dBc

**Measurement Setup**

Same as the Chapter 3.3.1 (Figure 1)

Band Edge

Lower edge
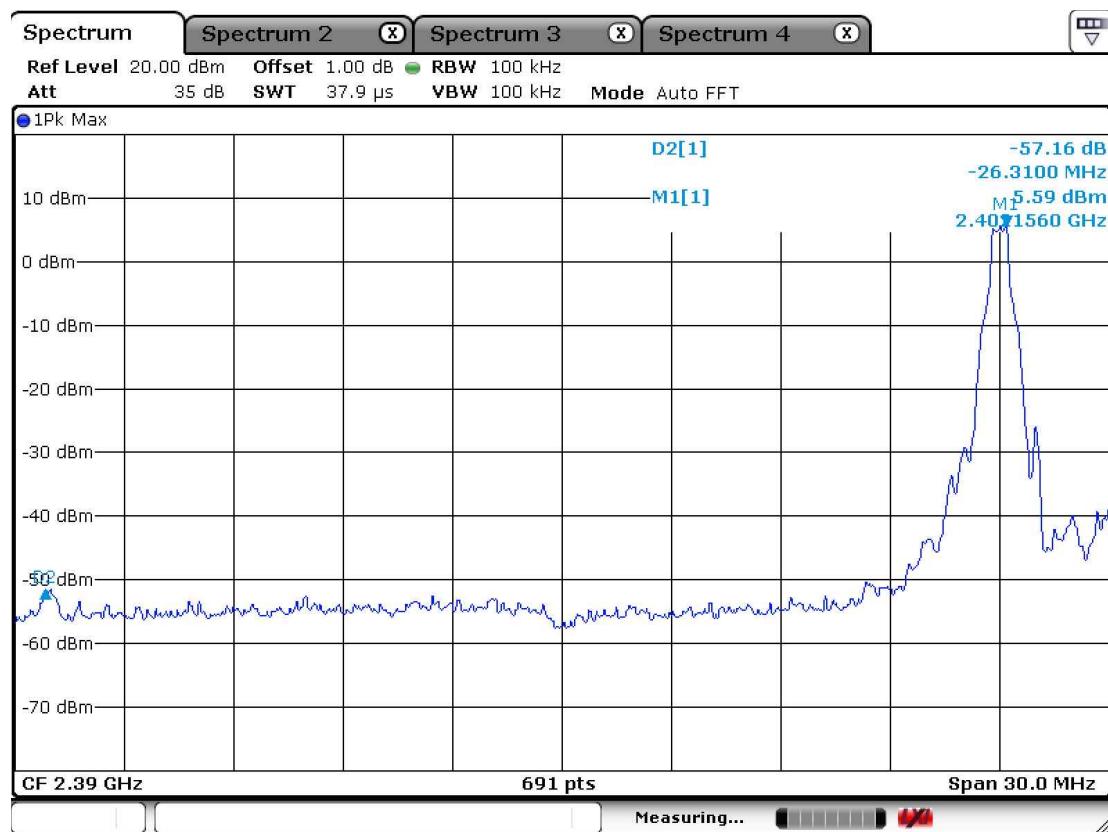
Upper edge
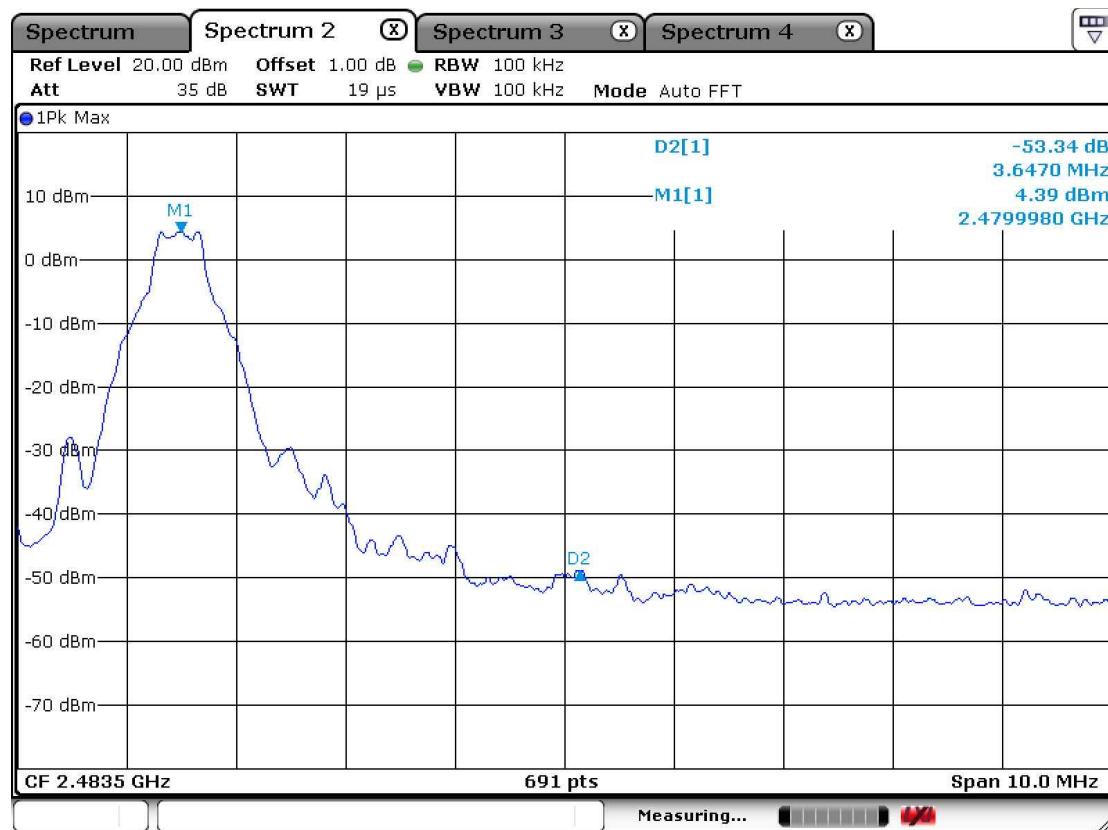
Radiated Band edges in the restricted band 2310-2390 MHz measurement

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp. Gain+CableLoss	AV / Peak		AV / Peak		AV / Peak	
2383.8	26.8	40.6	V	27.4	22.3	54	74	31.9	45.7	22.1	28.3

Radiated Band edges in the restricted band 2483.5-2500 MHz measurement

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor		Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp. Gain+CableLoss	AV / Peak		AV / Peak		[MHz]	
2483.6	26.4	41.6	V	27.4	22.3	54	74	31.5	46.7	22.5	27.3

Note : This EUT was tested in 3 orthogonal positions and the worst-case data was presented.

3.3.7 Conducted Spurious Emissions

Procedure:

The test follows DA00-705. The conducted spurious emissions were measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, set the marker on the peak of any spurious emission recorded.

The spectrum analyzer is set to:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions

RBW = 100 kHz   Sweep = auto

VBW = 100 kHz   Detector function = peak

Trace = max hold

Measurement Data: Complies

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

- See next pages for actual measured spectrum plots.

Minimum Standard:	> 20 dBc

Measurement Setup

Same as the Chapter 3.3.1 (Figure 1)

Unwanted Emission – Low channel

Frequency Range = 30 MHz ~ 26.5 GHz
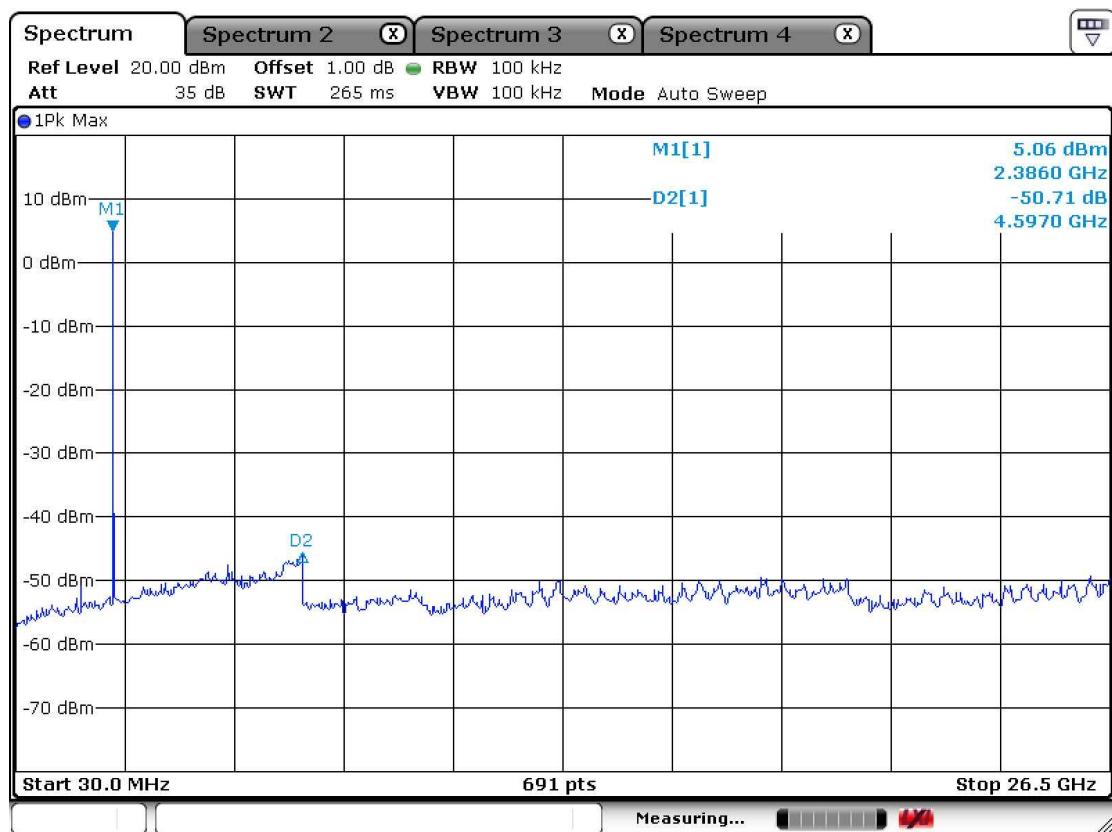
Unwanted Emission – Middle channel

Frequency Range = 30 MHz ~ 26.5 GHz
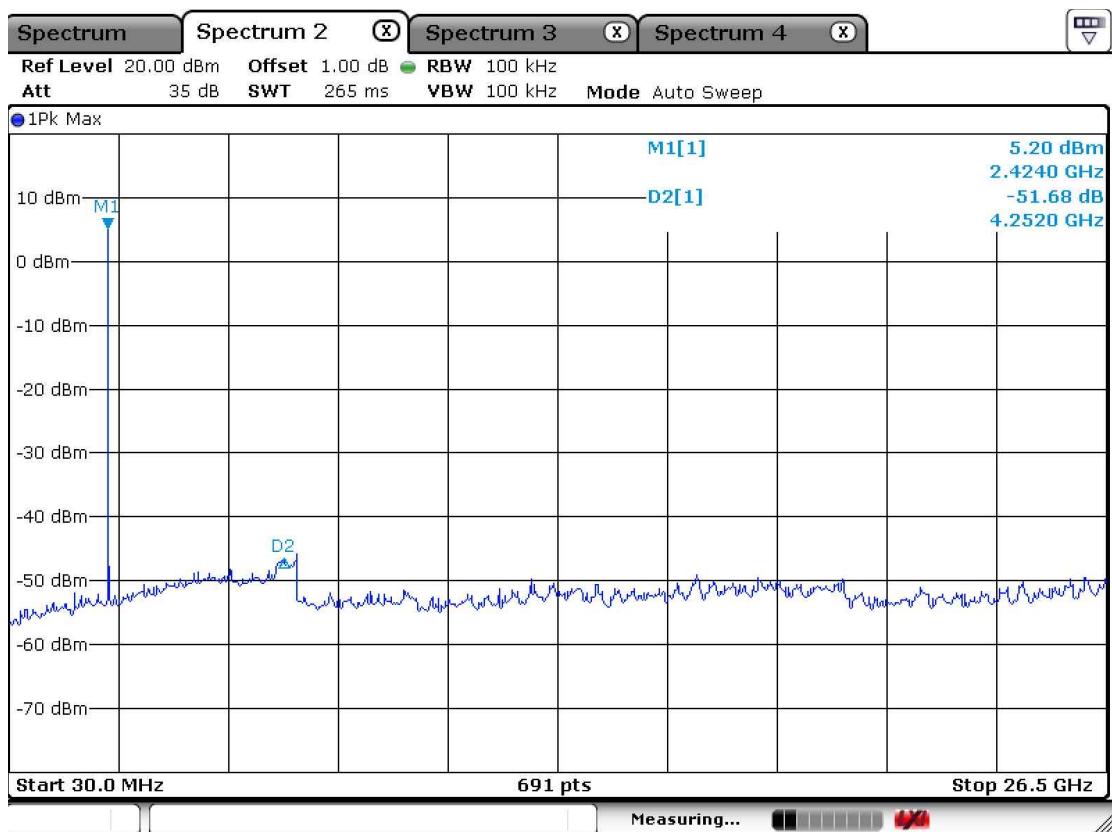
Unwanted Emission – High channel

Frequency Range = 30 MHz ~ 26.5 GHz
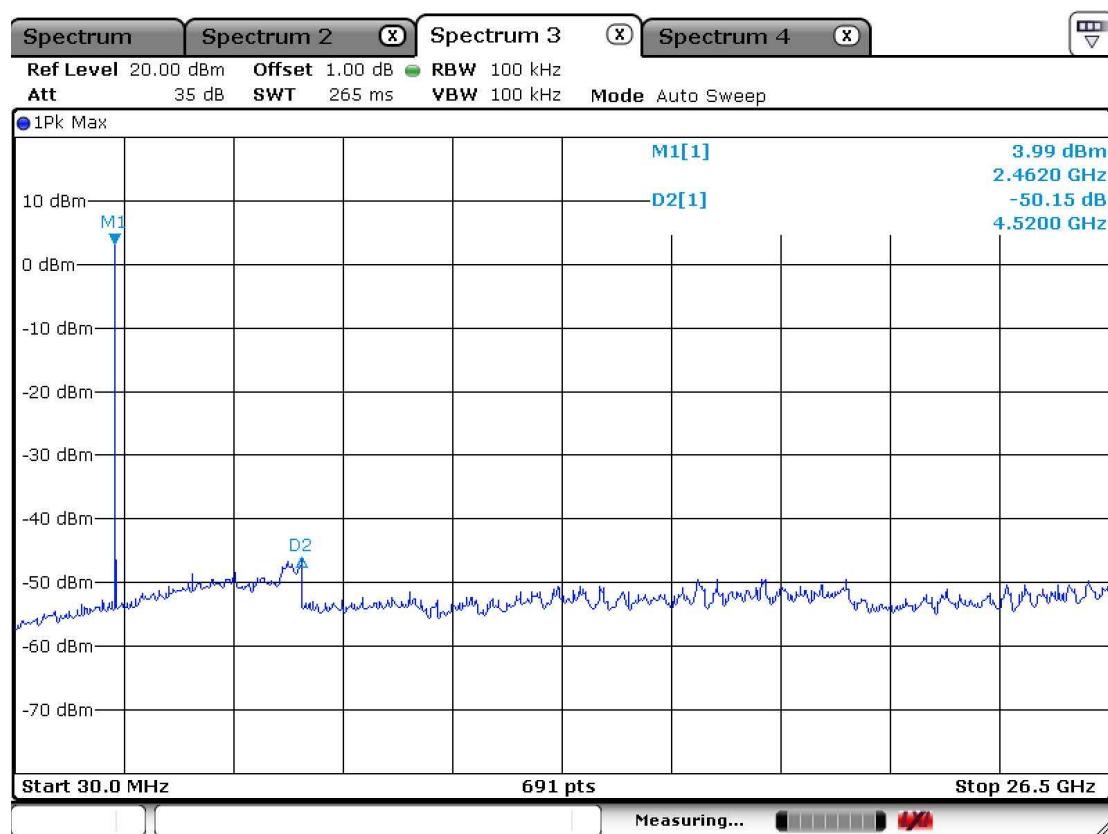
3.3.8 Radiated Spurious Emissions

Procedure:

Radiated emissions from the EUT were measured according to the dictates of DA00-705. The EUT was placed on a 0.8m high wooden table inside a shielded enclosure.   An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements.   For final radiated testing, measurements were performed in OATS.   Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

(a) In the frequency range of 9kHz to 30 MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 3m 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.

(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) 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 emission levels at both horizontal and vertical polarizations should be tested.

The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 9 kHz ~ 10th harmonic.

RBW = 120 kHz (30MHz ~ 1 GHz)   VBW $\geq$ RBW

    = 1 MHz   (1 GHz ~ 10th harmonic)

Span = 100 MHz   Detector function = peak

Trace = max hold   Sweep = auto

below 30MHz
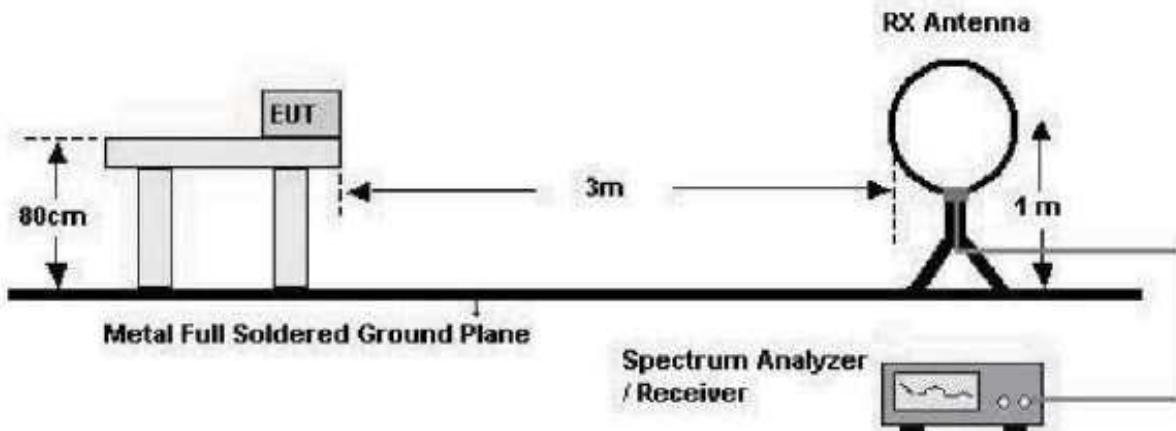
below 1GHz (30MHz to 1GHz)
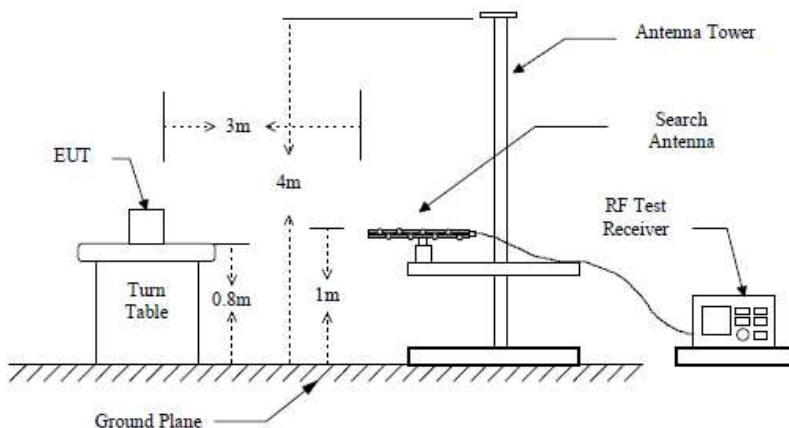
above 1GHz
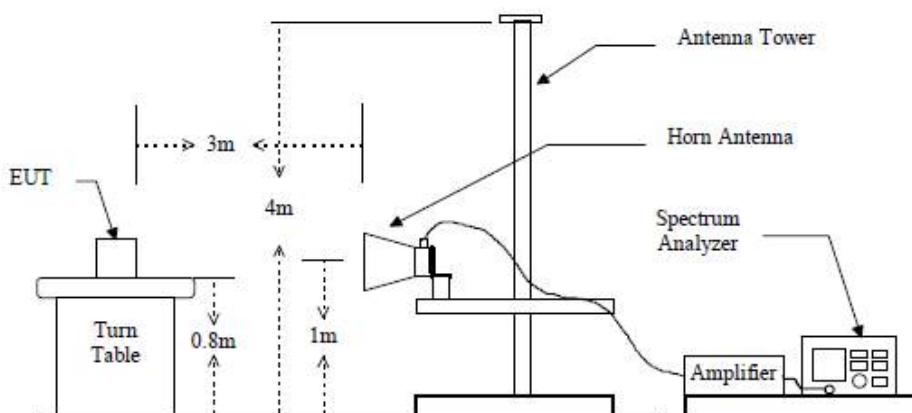
Measurement Data: **Complies**

- See next pages for actual measured data.

- No other emissions were detected at a level greater than 20dB below limit include from 9KHz to 30MHz.

Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
0.009 ~ 0.490	2400/F(kHz) **(@ 300m)**
0.490 ~ 1.705	24000/F(kHz) **(@ 30m)**
1.705 ~ 30	30**(@ 30m)**
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

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

Measurement Data :

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp.Gain+Cable	D.C.F	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
4804	40.4	54.2	H	27.4	22.3	-30.54	54.0	74.0	45.5	59.3	8.5	14.7
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
4882	39.4	55.1	H	27.4	22.3	-30.54	54.0	74.0	44.5	60.2	9.5	13.8
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
4960	40.9	54.9	H	27.4	22.3	-30.54	54.0	74.0	46.0	60.0	8.0	14.0
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-

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

- D.C.F (Duty Cycle Correction Factor) = 20log(The worst Case DWELL Time/100ms)

$$= 20\log(2.97\text{ms}/100\text{ms}) = -30.54$$

Radiated Emissions – Bluetooth mode

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Fax:+82-31-3236010

EUT/Model No.: EXPAND   TEST MODE: Bluetooth mode

Temp Humi : 17 / 43   Tested by: HA J M
-----------------------------------   ----------------

	Freq	Reading	C.F	Result	Limit QP	Margin	Height	Angle	Polarity
	MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	41.28	48.40	-16.88	31.52	40.00	8.48	100	199	VERTICAL
2	76.18	49.50	-19.90	29.60	40.00	10.40	100	234	VERTICAL
3	120.70	48.30	-16.85	31.45	43.50	12.05	400	136	HORIZONTAL
4	264.75	52.50	-15.16	37.34	46.00	8.66	400	343	HORIZONTAL
5	296.18	55.90	-13.98	41.92	46.00	4.08	400	207	HORIZONTAL
6	864.02	39.90	-0.83	39.07	46.00	6.93	400	273	HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

3.3.9 AC Conducted Emissions

Procedure:

AC power line conducted emissions from the EUT were measured according to the dictates of ANSI C63.4:2003.

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold.   While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz.   The emissions are maximized further by cable manipulation and Exerciser operation.   The highest emissions relative to the limit are listed.

Measurement Data: Complies

- Refer to the next page.
- No other emissions were detected at a level greater than 20dB below limit
- It gave the worse case emissions

Minimum Standard: FCC Part 15.207(a)/EN 55022

Frequency Range	Conducted Limit (dBuV)	
(MHz)	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

 * Note: The limits will decrease with the frequency logarithmically within 0.15MHz to 0.5MHz

Conducted Emissions – Bluetooth mode – LINE

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EUT / Model No. : EXPAND

Phase : LINE

Test Mode : Bluetooth mode
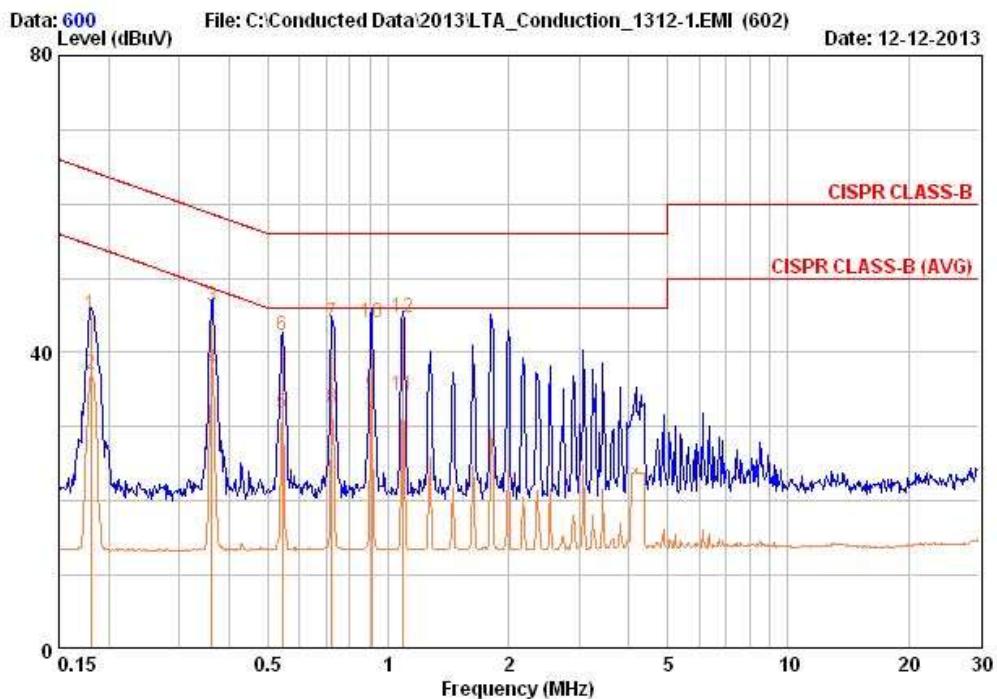
Test Power : 120 / 60

Temp./Humi. : 23 / 53

Test Engineer : HA J M

Data: 600   File: C:\Conducted Data\2013\LTA_Conduction_1312-1.EMI (602)   Date: 12-12-2013

Freq	RD QP	RD AV	C.F	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
MHz	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dBuV	dB	dB
0.180	35.55	27.45	9.56	45.11	37.01	64.49	54.49	19.38	17.48
0.362	36.65	28.25	9.57	46.22	37.82	58.68	48.68	12.46	10.86
0.544	32.65	22.15	9.60	42.25	31.75	56.00	46.00	13.75	14.25
0.724	34.35	22.75	9.68	44.03	32.43	56.00	46.00	11.97	13.57
0.908	34.45	24.65	9.64	44.09	34.29	56.00	46.00	11.91	11.71
1.088	35.15	24.65	9.62	44.77	34.27	56.00	46.00	11.23	11.73

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

Conducted Emissions Bluetooth mode – NEUTRAL

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```
EUT / Model No. : EXPAND              Phase        : NEUTRAL
                 --------------------            --------------------------
Test Mode      : Bluetooth mode       Test Power   : 120 / 60
                 --------------------            --------------------------
Temp./Humi.    : 23 / 53              Test Engineer : HA J M
                 --------------------            --------------------------
```
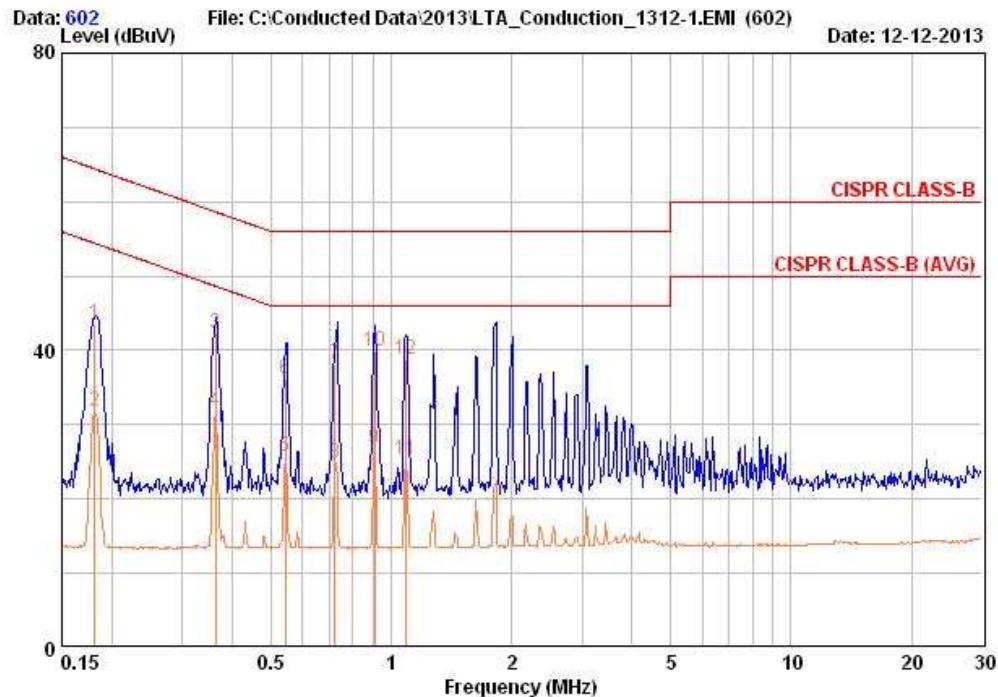
Data: 602   File: C:\Conducted Data\2013\LTA_Conduction_1312-1.EMI (602)   Date: 12-12-2013

Freq	RD QP	RD AV	C.F	Result QP	Result AV	Limit QP	Limit AV	Margin QP	Margin AV
MHz	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dBuV	dB	dB
0.181	33.95	22.15	9.58	43.53	31.73	64.44	54.44	20.91	22.71
0.363	32.75	22.25	9.60	42.35	31.85	58.66	48.66	16.31	16.81
0.543	26.55	16.05	9.61	36.16	25.66	56.00	46.00	19.84	20.34
0.723	28.55	15.35	9.57	38.12	24.92	56.00	46.00	17.88	21.08
0.907	30.35	17.15	9.58	39.93	26.73	56.00	46.00	16.07	19.27
1.087	29.25	15.75	9.59	38.84	25.34	56.00	46.00	17.16	20.66

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

APPENDIX

TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Interval	Last Cal. Date
1	Signal Analyzer (9kHz~30GHz)	FSV-30	100757	R&S	1 year	2013-01-15
2	Spectrum Analyzer (9kHz~2.9GHz)	8594E	3649A03649	HP	2 year	2012-03-26
3	Signal Generator (~3.2GHz)	8648C	3623A02597	HP	1 year	2013-03-25
4	SYNTHESIZED CW GENERATOR	83711B	US34490456	HP	1 year	2013-03-25
5	Attenuator (3dB)	8491A	37822	HP	2 year	2012-09-22
6	Attenuator (10dB)	8491A	63196	HP	2 year	2012-09-22
7	Test Receiver (~30MHz)	ESHS10	828404/009	R&S	1 year	2013-03-25
8	EMI Test Receiver (~7GHz)	ESCI7	100722	R&S	1 year	2013-09-16
9	RF Amplifier (~1.3GHz)	8447D OPT 010	2944A07684	HP	1 year	2013-09-16
10	RF Amplifier (1~26.5GHz)	8449B	3008A02126	HP	1 year	2013-03-25
11	Horn Antenna (1~18GHz)	3115	00114105	ETS	2 year	2013-05-13
12	DRG Horn (Small)	3116B	81109	ETS-Lindgren	2 year	2012-03-15
13	DRG Horn (Small)	3116B	133350	ETS-Lindgren	2 year	2012-03-15
14	TRILOG Antenna	VULB 9160	9160-3237	SCHWARZBECK	2 year	2013-05-03
15	Temp.Humidity Data Logger	SK-L200TH II A	00801	SATO	1 year	2013-03-14
16	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
17	Power Divider	11636A	06243	HP	2 year	2012-09-22
18	DC Power Supply	6674A	3637A01657	Agilent	-	-
19	Frequency Counter	5342A	2826A12411	HP	1 year	2013-03-25
20	Power Meter	EPM-441A	GB32481702	HP	1 year	2013-03-25
21	Power Sensor	8481A	US41030291	HP	1 year	2013-09-16
22	Audio Analyzer	8903B	3729A18901	HP	1 year	2013-09-16
23	Modulation Analyzer	8901B	3749A05878	HP	1 year	2013-09-16
24	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2013-09-16
25	Stop Watch	HS-3	601Q09R	CASIO	1 year	2013-03-15
26	LISN	KNW-407	8-1430-1	Kyoritsu	1 year	2013-09-16
27	Two-Lime V-Network	ESH3-Z5	893045/017	R&S	1 year	2013-04-25
28	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	1 year	2013-07-25
29	Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	-	-
30	Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	-	-
31	Active Loop Antenna	FMZB 1519	1519-031	SCHWARZBECK	1 year	2012-12-14