LTA
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SENA

Dates of Tests: February 02 ~10, 2012
Test Report S/N: LR500111202A
Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID	S7AIW02
IC	8154A-IW02
APPLICANT	Sena Technologies, Inc.

Equipment Class	**:**	**Part 15 Spread Spectrum Transmitter (DSS)**
Manufacturing Description	**:**	**Bluetooth Module**
Manufacturer	**:**	**Sena Technologies, Inc.**
Model name	**:**	**Parani-BCD110DU**
Variant Model name	**:**	**Parani-BCD110DS, Parani-BCD110DC Parani-BCD110SU, Parani-BCD110SC**
Test Device Serial No.:	**:**	**Identical prototype**
Rule Part(s)	**:**	**FCC Part 15.247 Subpart C; ANSI C-63.4-2003 RSS-210 and ISSUE No. :8 Date :2010**
Frequency Range	**:**	**2402 ~ 2480MHz**
RF power	**:**	**Max 14.21 dBm - Conducted**
Data of issue	**:**	**February 16, 2012**

This test report is issued under the authority of:

Hyun-Chae You, Manager

The test was supervised by:

Ki-Hun Cho, Test Engineer

This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

NVLAP LAB Code.: 200723-0

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1. General information's

1-1 Test Performed

Company name : LTA Co., Ltd.

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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	2012-09-30	ECT accredited Lab.
RRL	KOREA	KR0049	2013-04-24	EMC accredited Lab.
FCC	U.S.A	610755	2014-04-27	FCC filing
FCC	U.S.A	649054	2013-04-13	FCC CAB
VCCI	JAPAN	R2133(10m), C2307	2014-06-21	VCCI registration
VCCI	JAPAN	T-2009	2013-12-23	VCCI registration
IC	CANADA	IC5799	2012-05-14	IC filing

2. Information's about test item

2-1 Client & Manufacturer

Company name	:	Sena Technologies, Inc.
Address	:	210 Yangjae-dong Seocho-gu Seoul 137-130 Korea
Telephone / Facsimile	:	+82-2-571-8283/ +82-2-573-7710

2-2 Equipment Under Test (EUT)

Trade name	:	Bluetooth Module
FCC ID	:	S7AIW02
Model name	:	Parani-BCD110DU
Serial number	:	Identical prototype
Date of receipt	:	January 26, 2012
EUT condition	:	Pre-production, not damaged
Antenna type	:	Dipole antenna (M/N: R-AN2400-1901RS) Max Gain 5.37 dBi Dipole antenna (M/N: R-AN2400-5801RS) Max Gain 3.27 dBi Dipole antenna (M/N: AN2400-3306RS) Max Gain 1.40 dBi Chip antenna (SENA_F0615) Max Gain: 0.2dBi
Frequency Range	:	2402 ~ 2480MHz
RF output power	:	Max.14.21 dBm - Conducted
Number of channels	:	79
Duty cycle	:	80.90 %
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	:	3.3Vdc by Main System
Firmware Version	:	V1.0.0

2-4 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	2402	2441	2480

2-5 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
Notebook	PP37L	29705283757	DELL
MOUSE	SMH-210U	M2UWTAKQ605877M	MONTEREY INTERNATIONAL CORP
PRINTER	Deskjet 600K	SG763131XX	HP
DC Power Supply	E3615A	KR72705061	HP

2-6 Model Description

M/N	Interface Type	ANT Connector Type	Type Description	
Parani-BCD110DU	DIP Type	U.FL	D	DIP(Interface)
Parani-BCD110DC	DIP Type	CHIP	S	SMD(Interface)
Parani-BCD110DS	DIP Type	RPSMA	U	U.FL Connector ANT
Parani-BCD110SC	SMD Type	CHIP	C	CHIP ANT
Parani-BCD110SU	SMD Type	U.FL	S	RPSMA Connector ANT

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	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	NC[Note3]
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.

Note3: This device is only operated by DC3.3V Main System

Note 1: Antenna Requirement

→ The Sena Technologies, Inc. FCC ID:S7AIW02 unit complies with the requirement of §15.203.

The antenna connector is the reverse polarity SMA connector. And Chip antenna

Note 2: The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2003

RSS-210 and ISSUE No.: 8 Date: 2010

3.2 Transmitter requirements

3.2.1 Carrier Frequency Separation

Procedure:

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**
1.0014	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

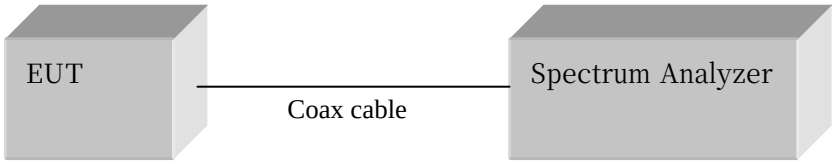
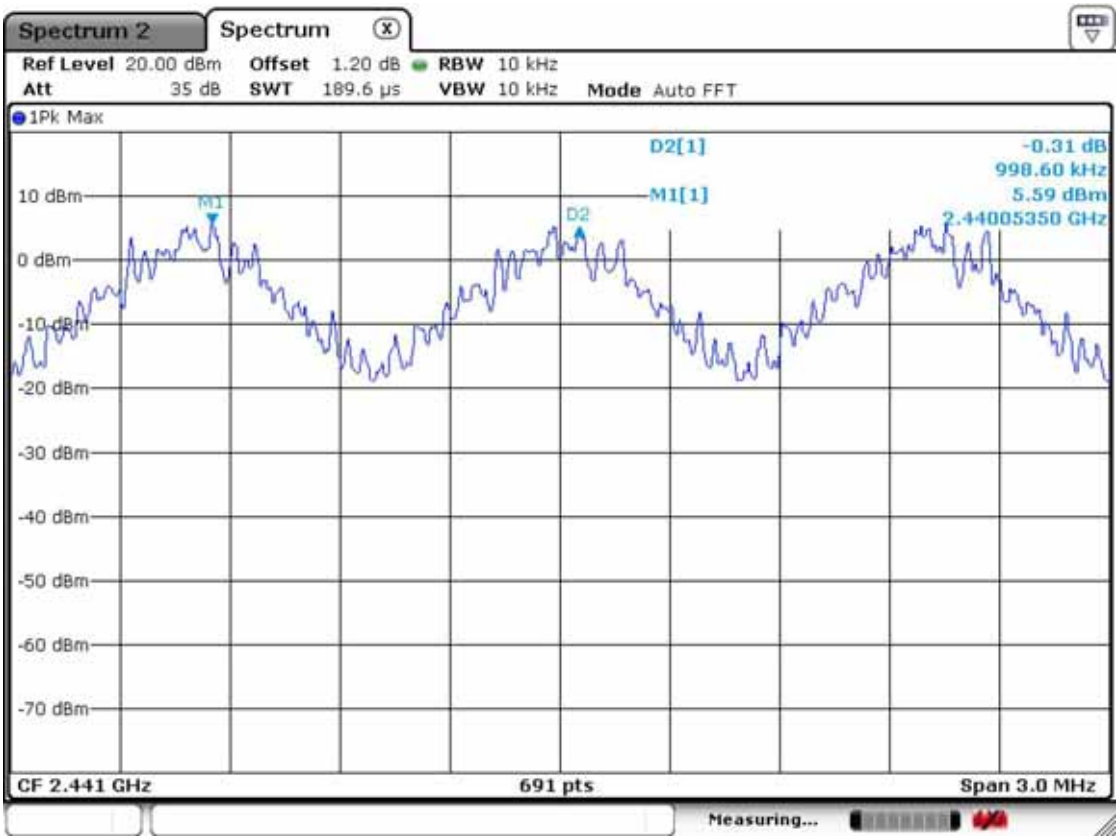


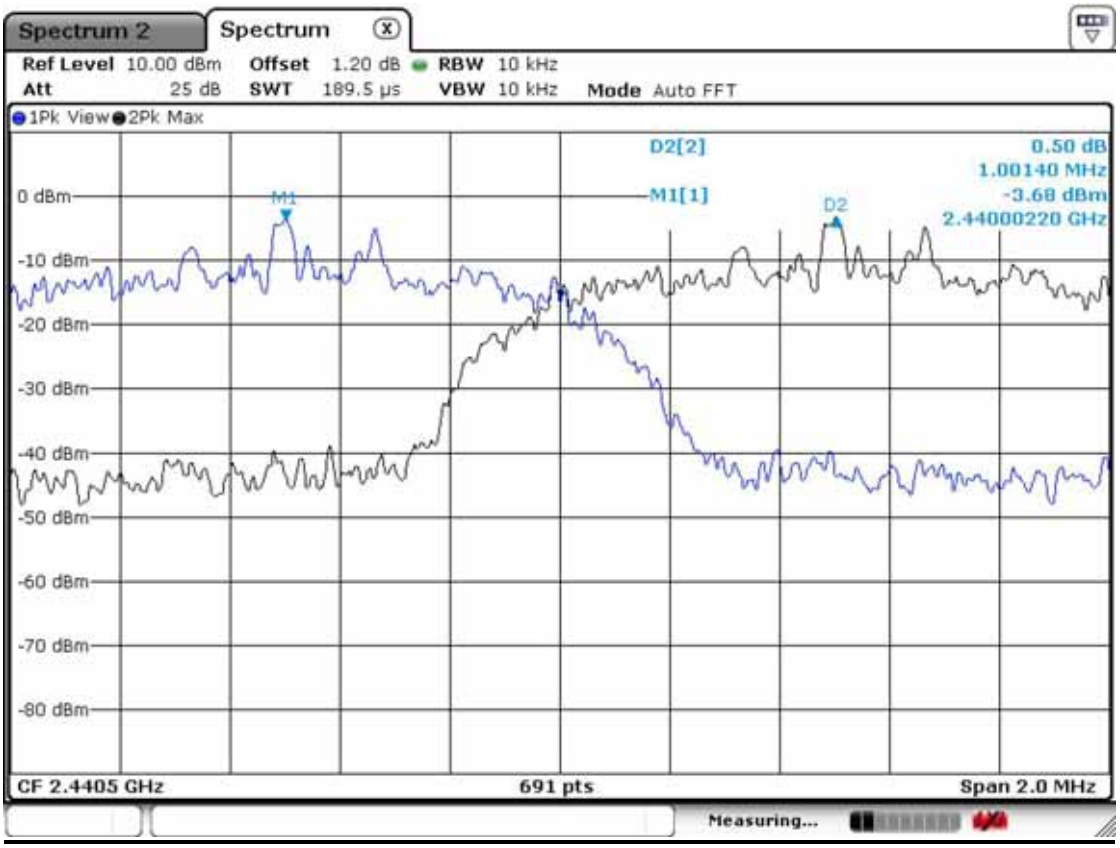
Figure 1: Measurement setup for the carrier frequency separation

Carrier Frequency Separation

Basic Mode



EDR Mode



3.2.2 Number of Hopping Frequencies

Procedure:

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:

Frequency range Start = 2400.0MHz, Stop = 2483.5 MHz

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

VBW = 100 kHz (VBW ≥ 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.

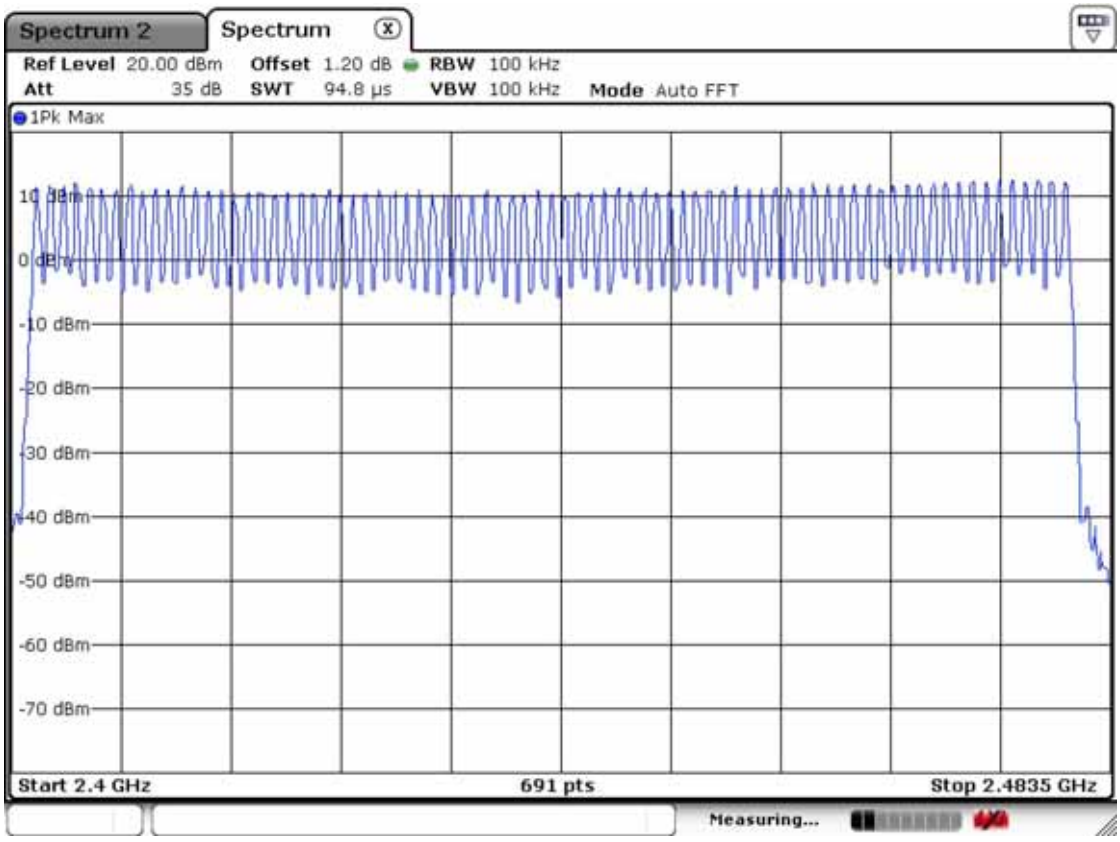
Minimum Standard:

At least 15 hopes

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Number of Hopping Frequencies



3.2.3 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:

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 ≥ RBW)

Detector function = peak

Trace = max hold

Measurement Data: Basic Mode

Frequency (MHz)	Channel No.	Test Results(MHz)	
		20dB Bandwidth	99% Bandwidth
2402	0	0.834	0.891
2441	39	0.842	0.898
2480	78	0.821	0.886

Measurement Data: EDR Mode

Frequency (MHz)	Channel No.	Test Results(MHz)	
		20dB Bandwidth	99% Bandwidth
2402	0	1.220	1.185
2441	39	1.216	1.181
2480	78	1.216	1.172

- See next pages for actual measured spectrum plots.

Minimum Standard:

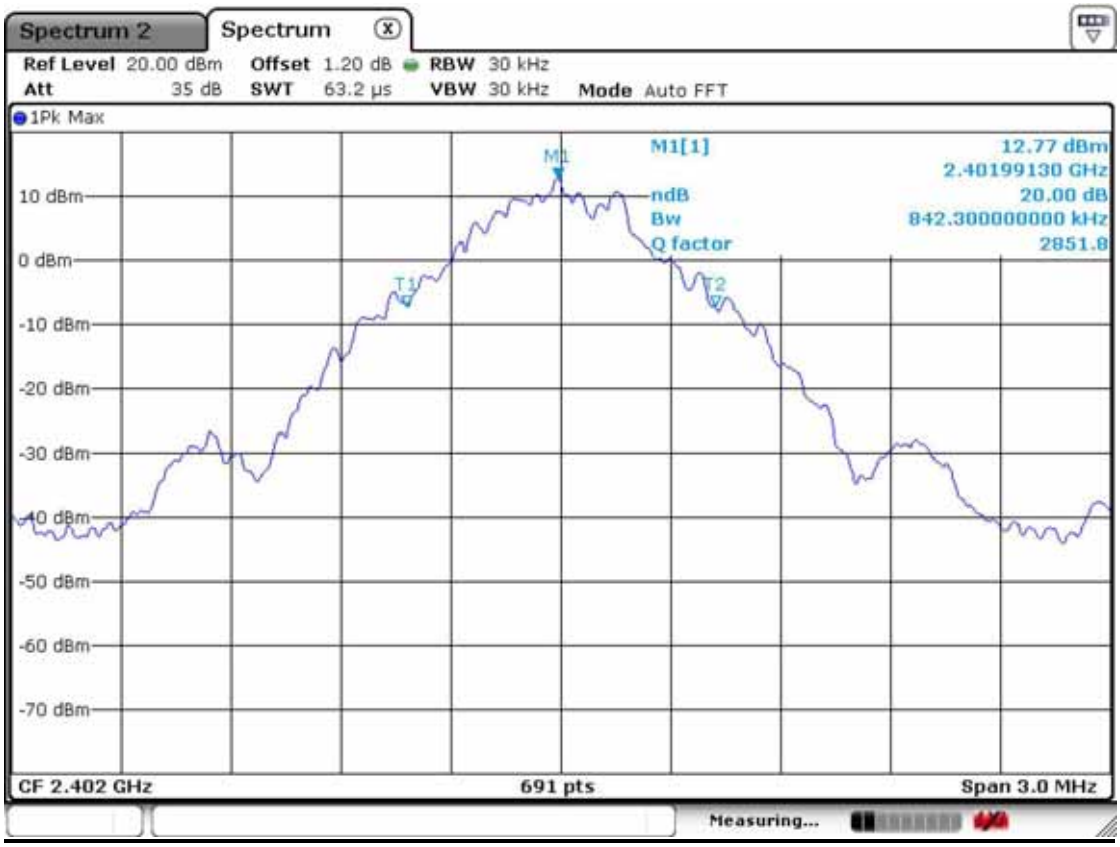
N/A

Measurement Setup

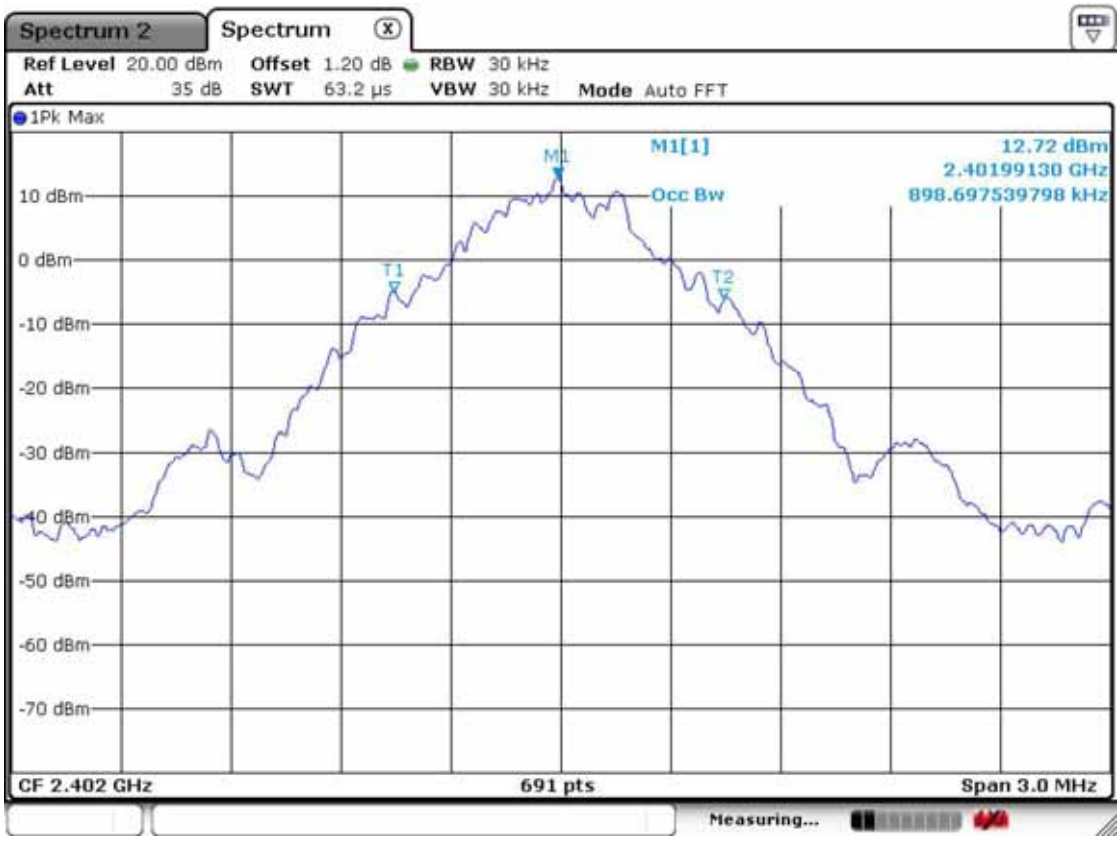
Same as the Chapter 3.2.1 (Figure 1)

Channel 1 of basic mode

20 dB Bandwidth

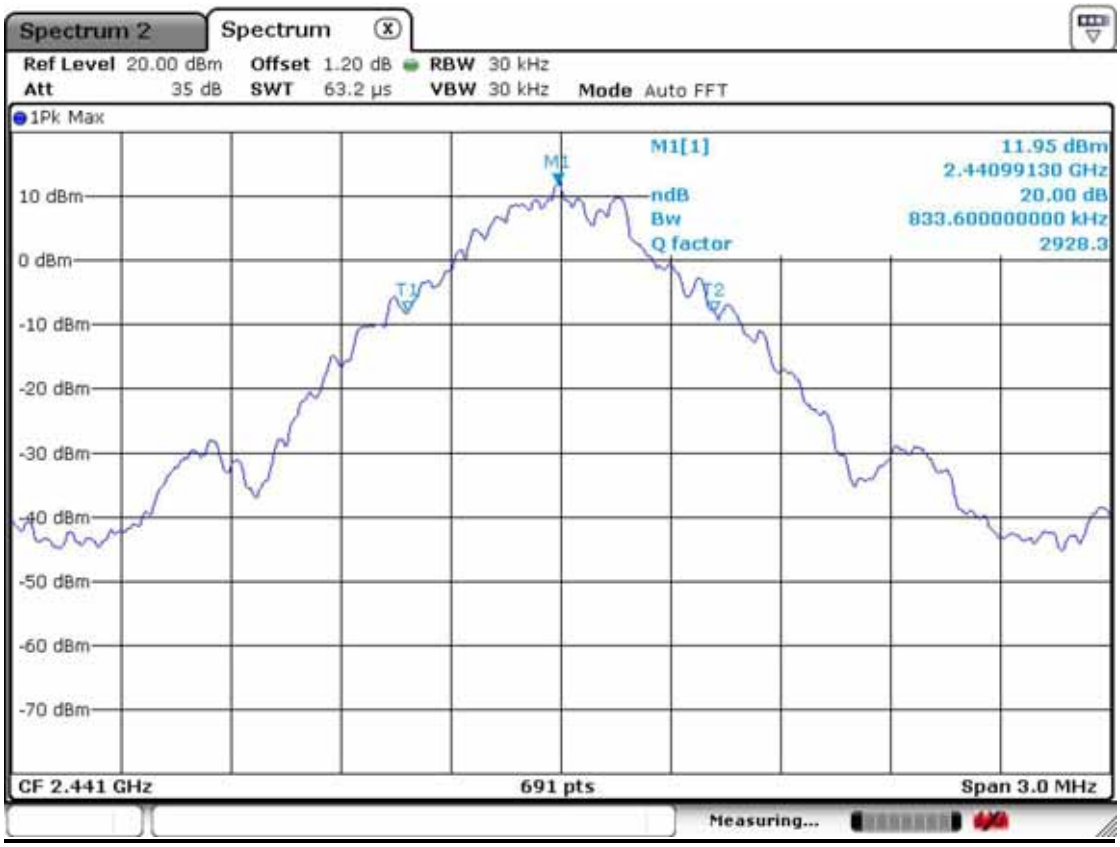


99% Bandwidth

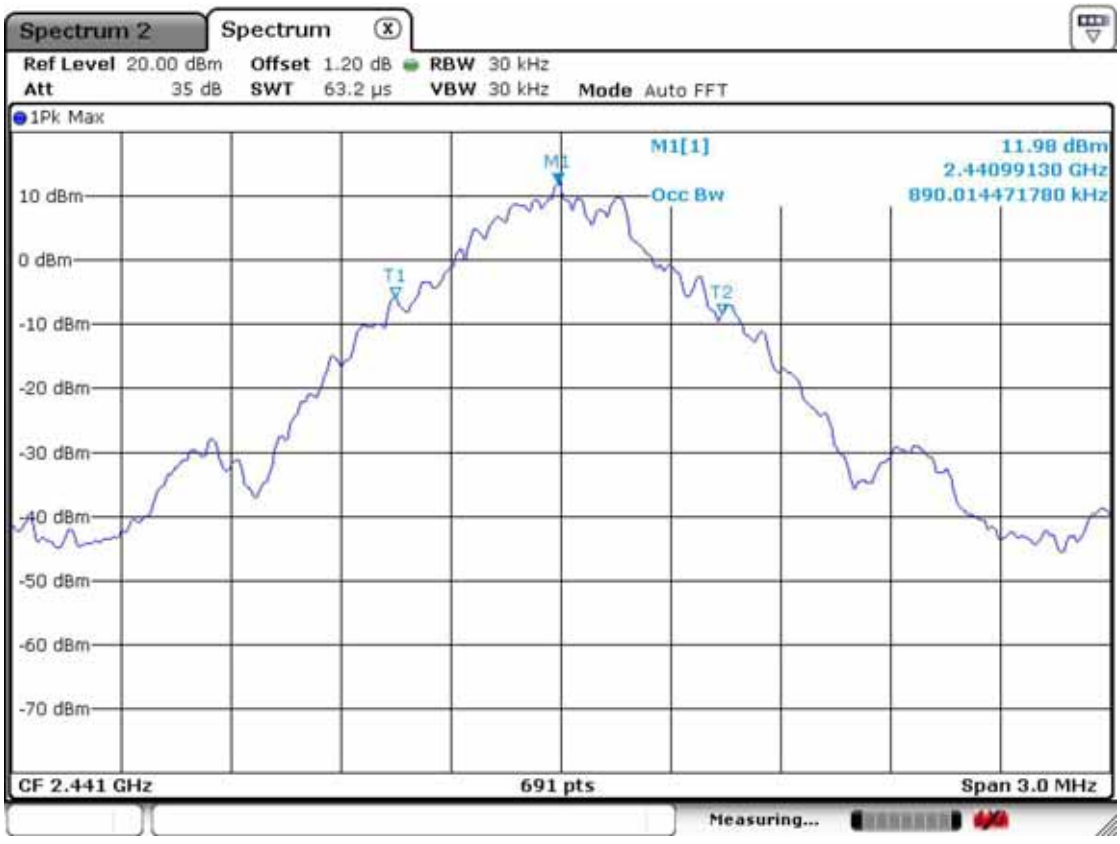


Channel 2 of basic mode

20 dB Bandwidth

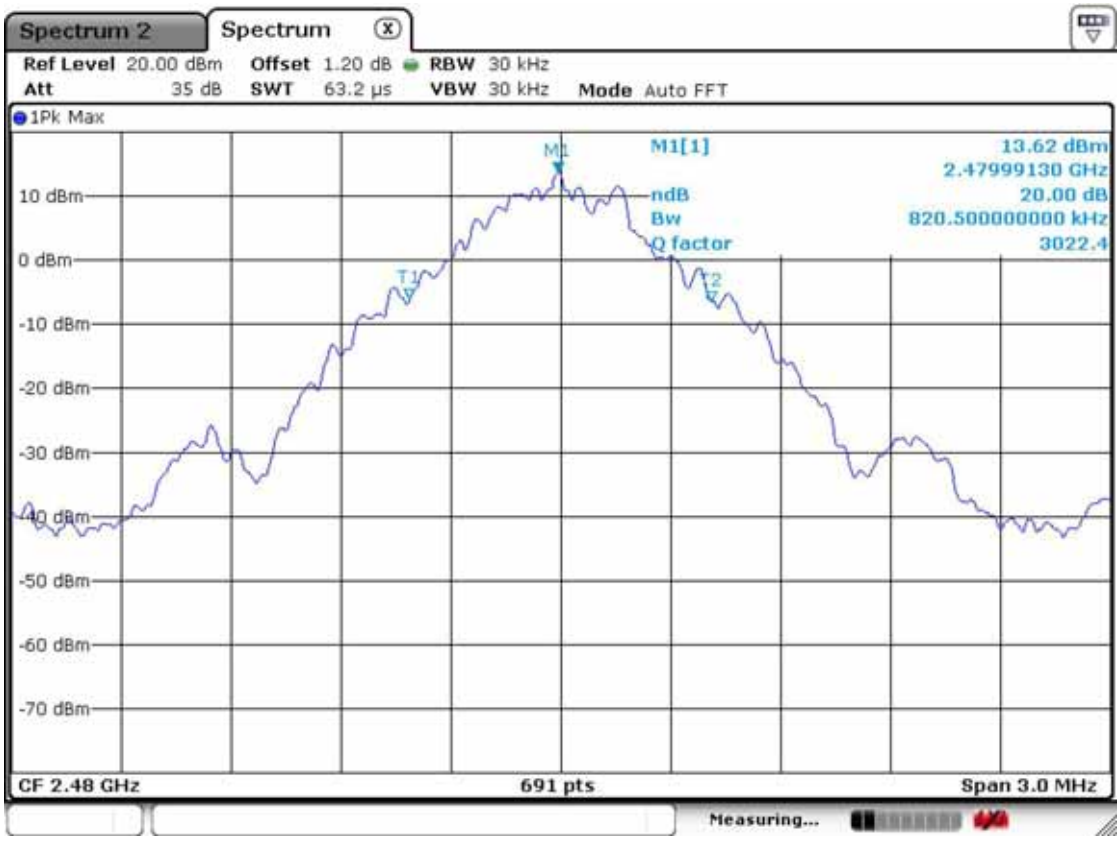


99% Bandwidth

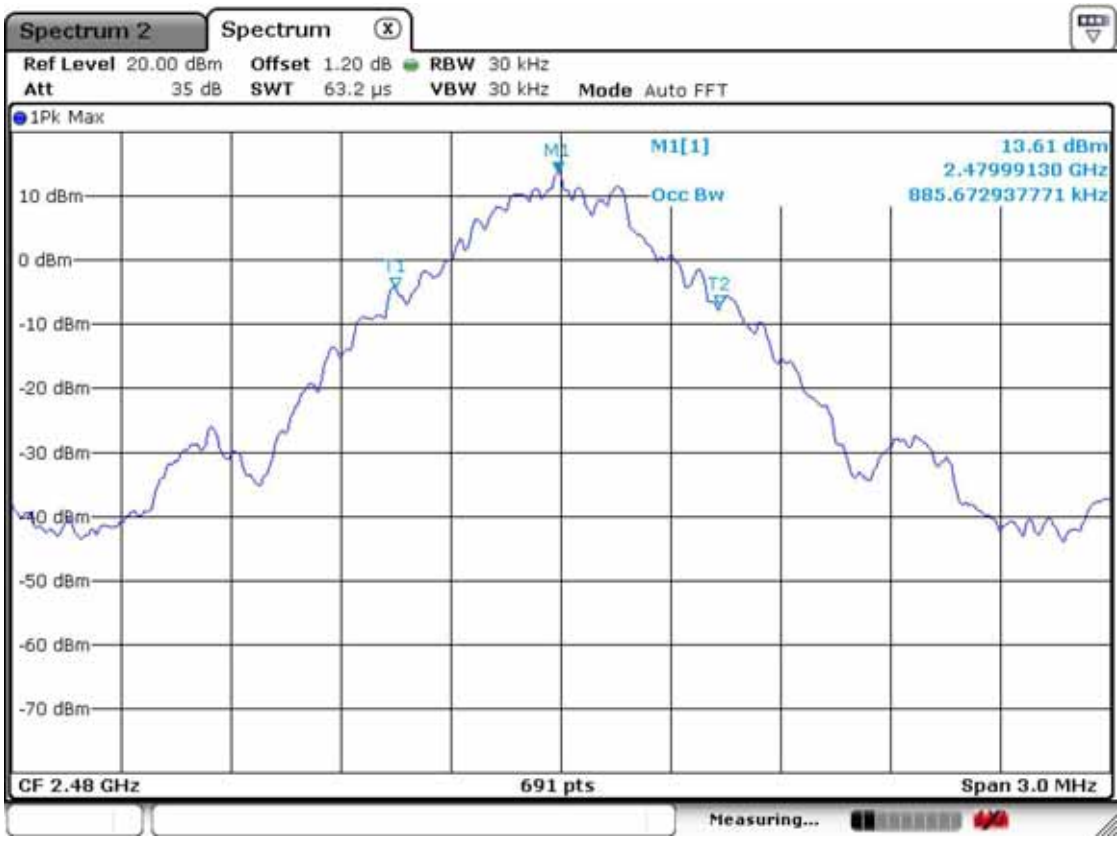


Channel 3 of basic mode

20 dB Bandwidth

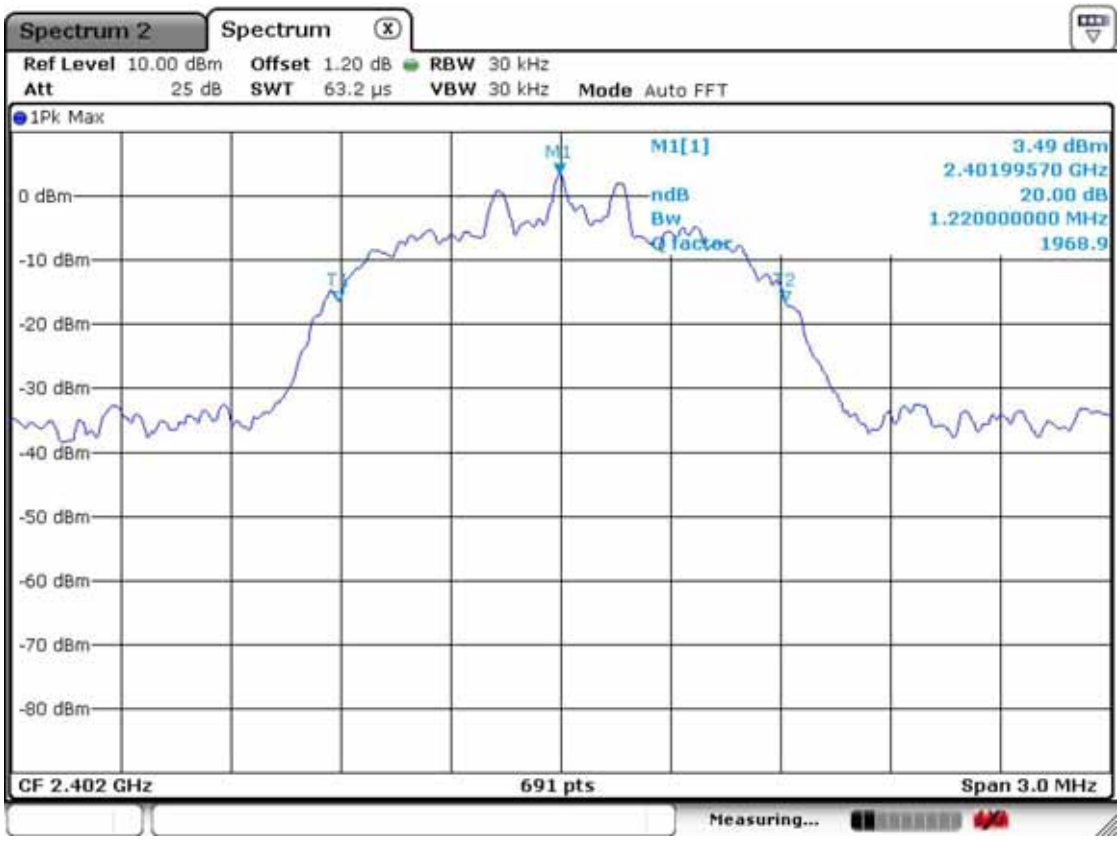


99% Bandwidth



Channel 1 at EDR mode

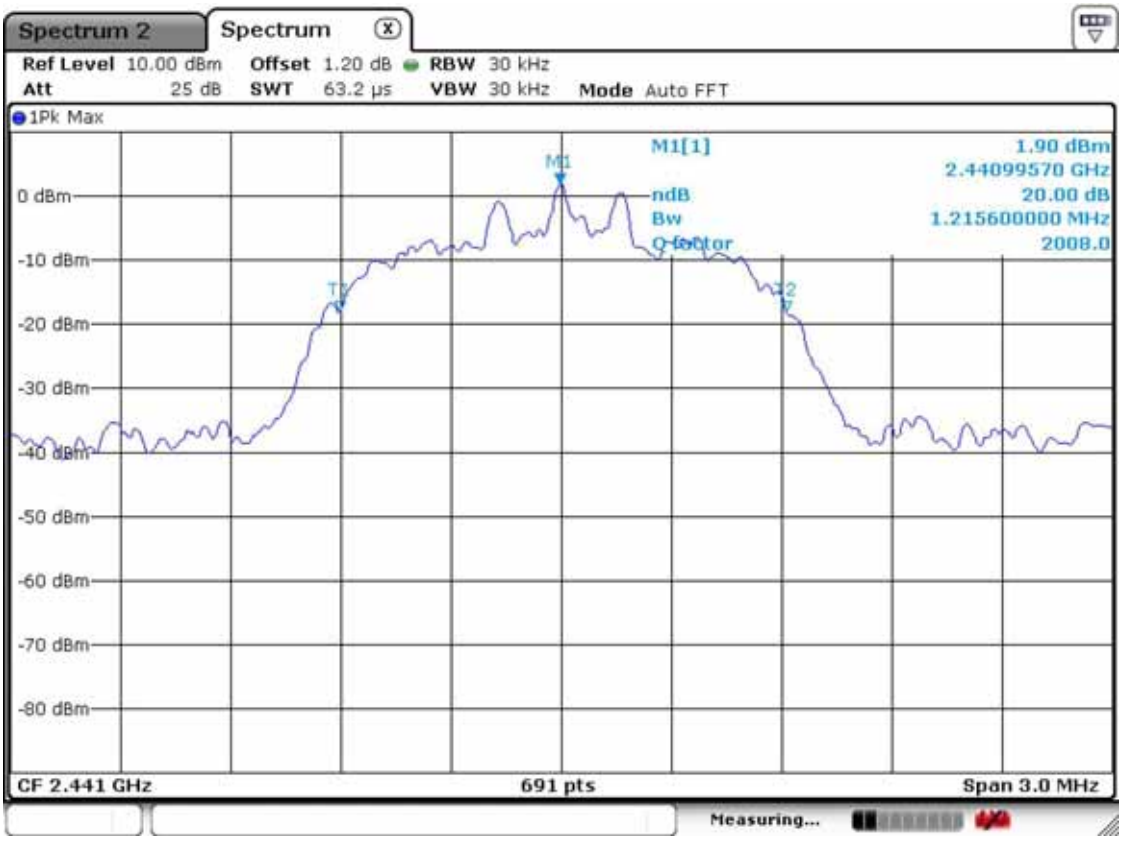
20 dB Bandwidth



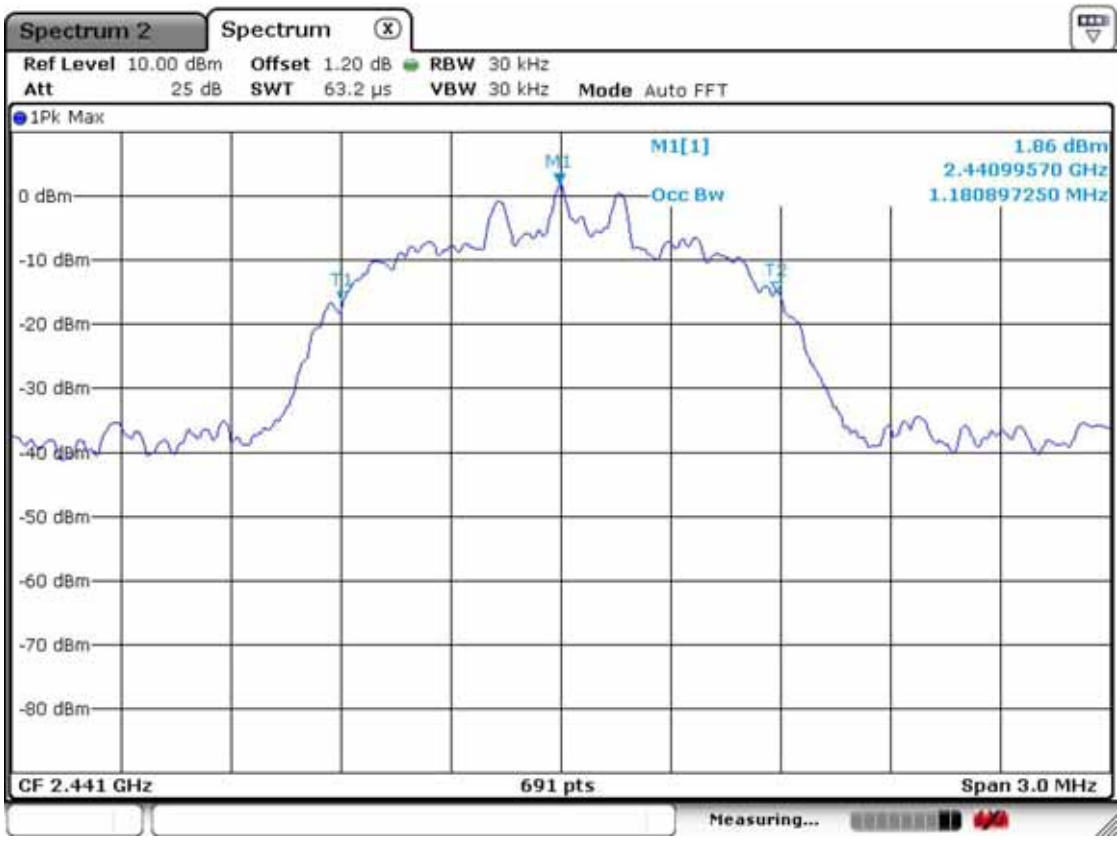
99% Bandwidth

Channel 2 at EDR mode

20 dB Bandwidth

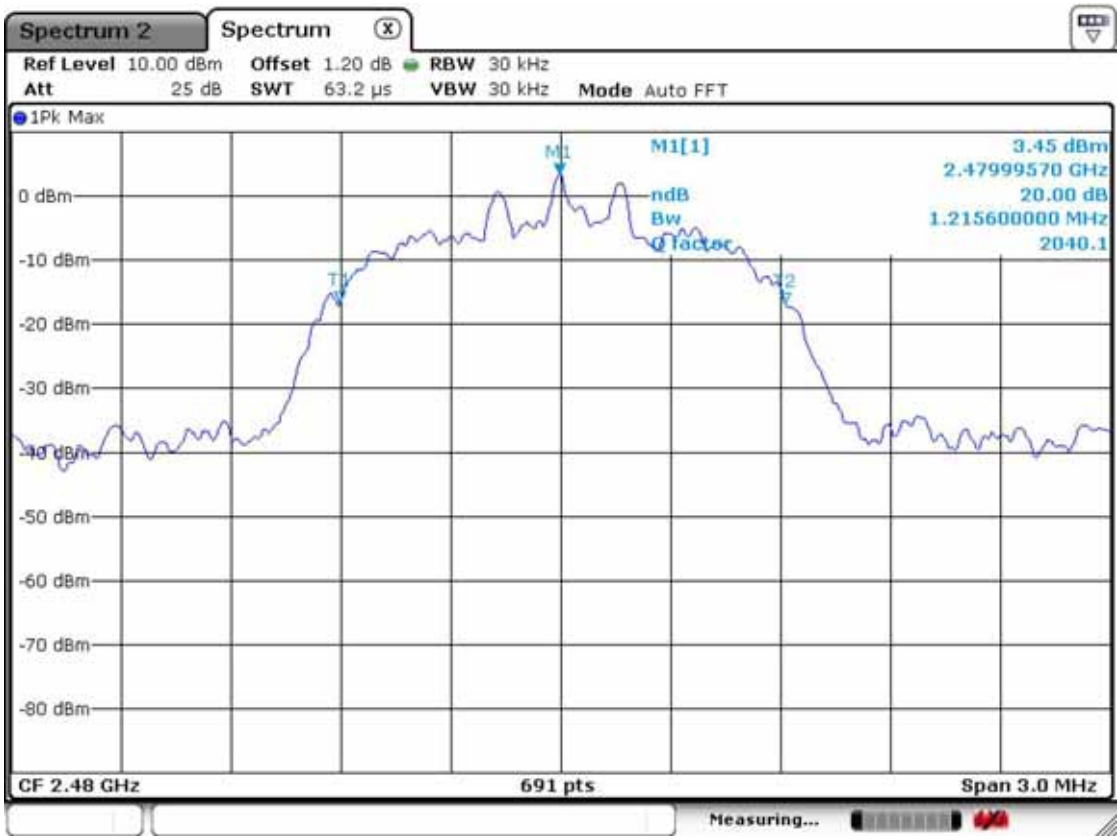


99% Bandwidth

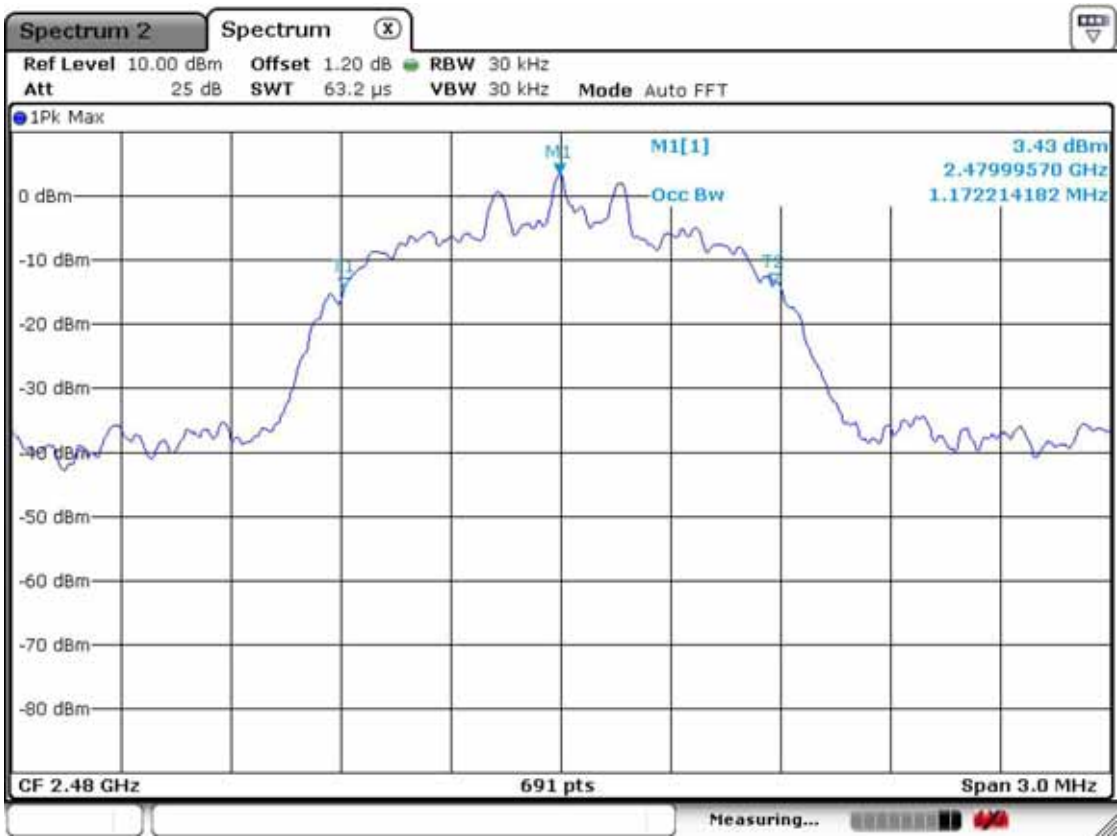


Channel 3 at EDR mode

20 dB Bandwidth



99% Bandwidth



3.2.4 Time of Occupancy (Dwell Time)

Procedure:

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 ≥ RBW)

Trace = max hold Detector function = peak

Measurement Data:

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**	**0.557**	**176.01**	**400**
DH3	**15(Times / 3sec) *10.533 = 158.00**	**1.797**	**283.92**	**400**
DH5	**10(Times / 3sec) *10.533 = 105.33**	**3.058**	**322.10**	**400**
EDR 3Mbps DH5	**10(Times / 3sec) *10.533 = 105.33**	**3.058**	**322.10**	**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

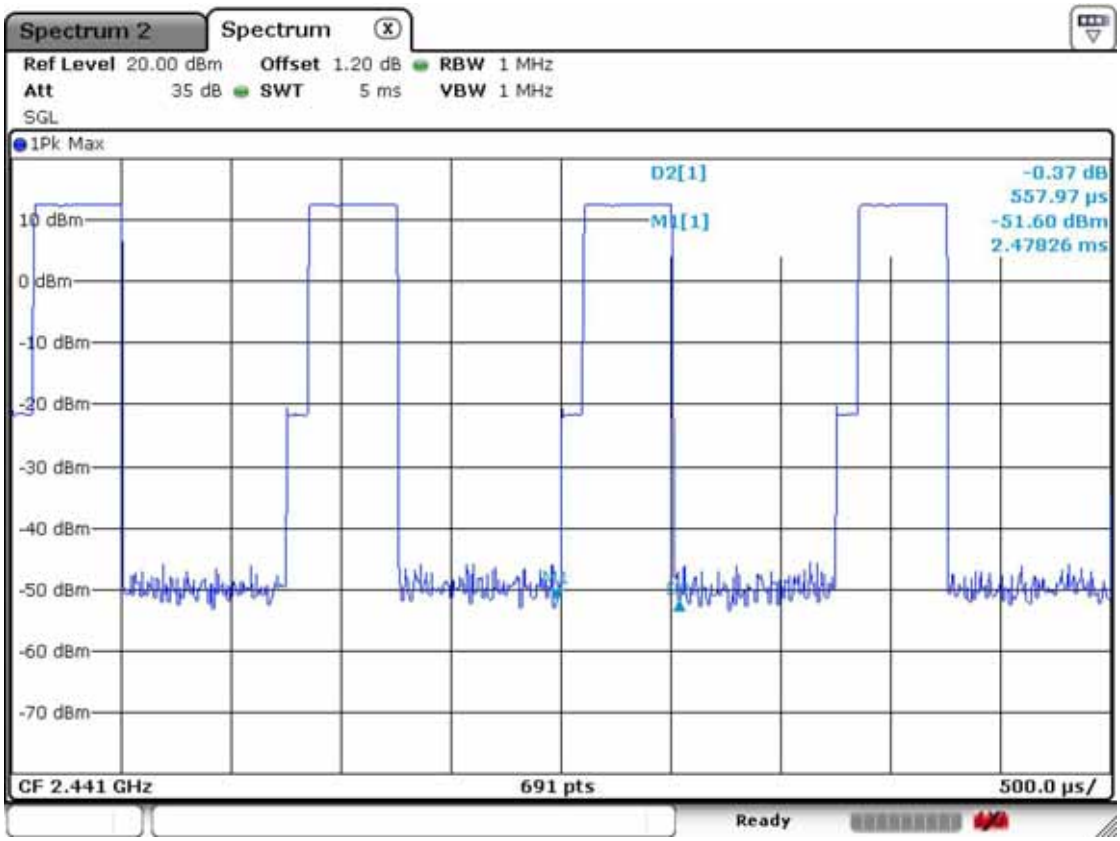
Minimum Standard:

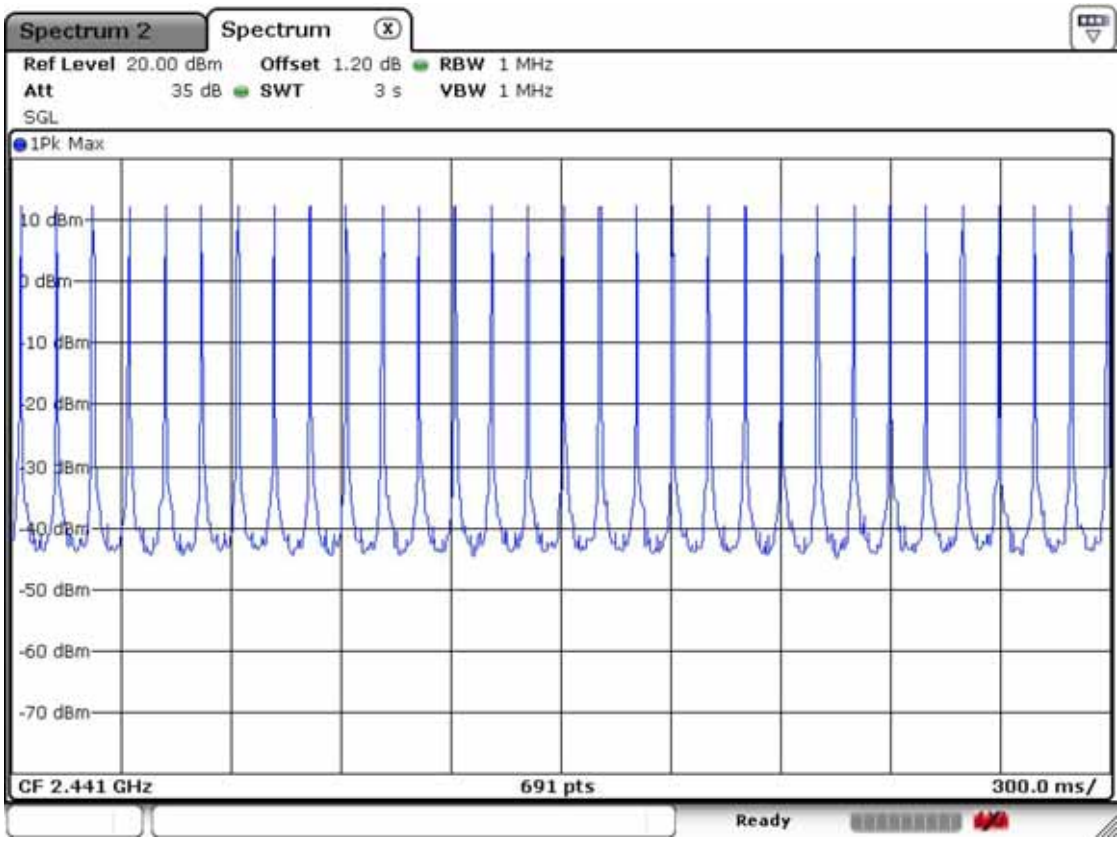
0.4 seconds within a 30 second period per any frequency

Measurement Setup

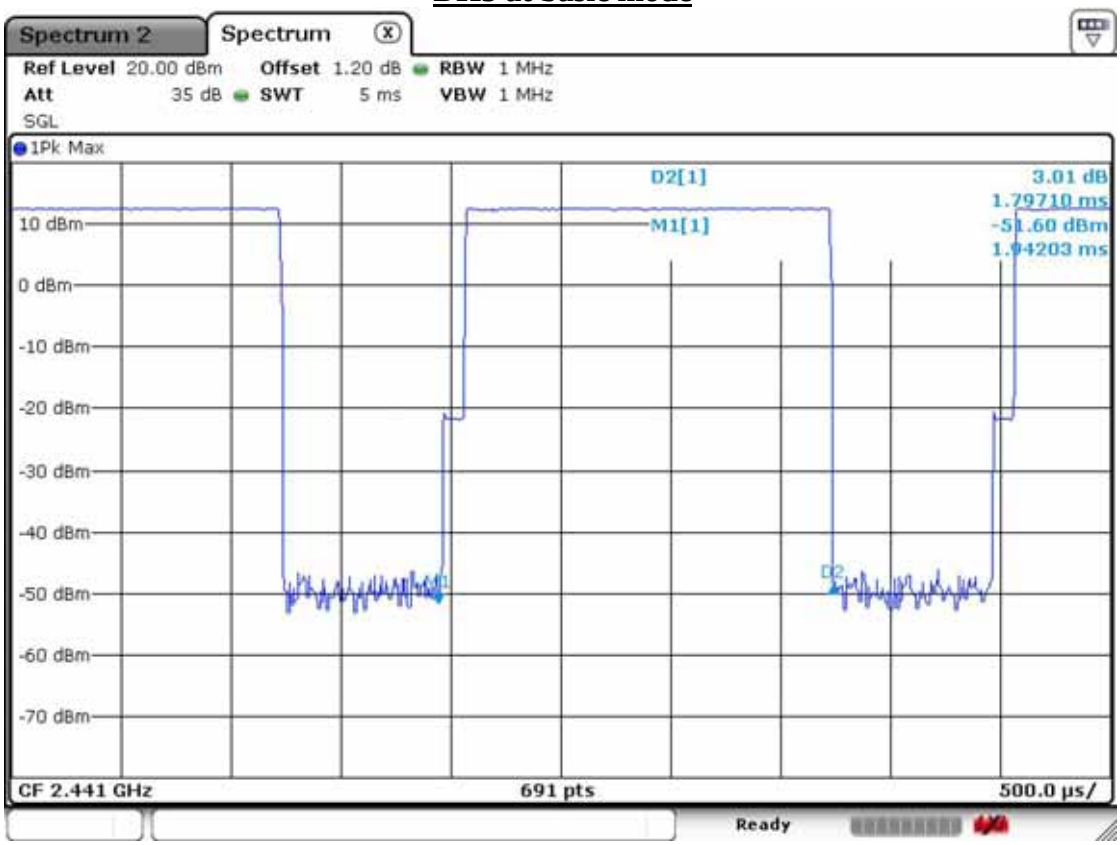
Same as the Chapter 3.2.1 (Figure 1)

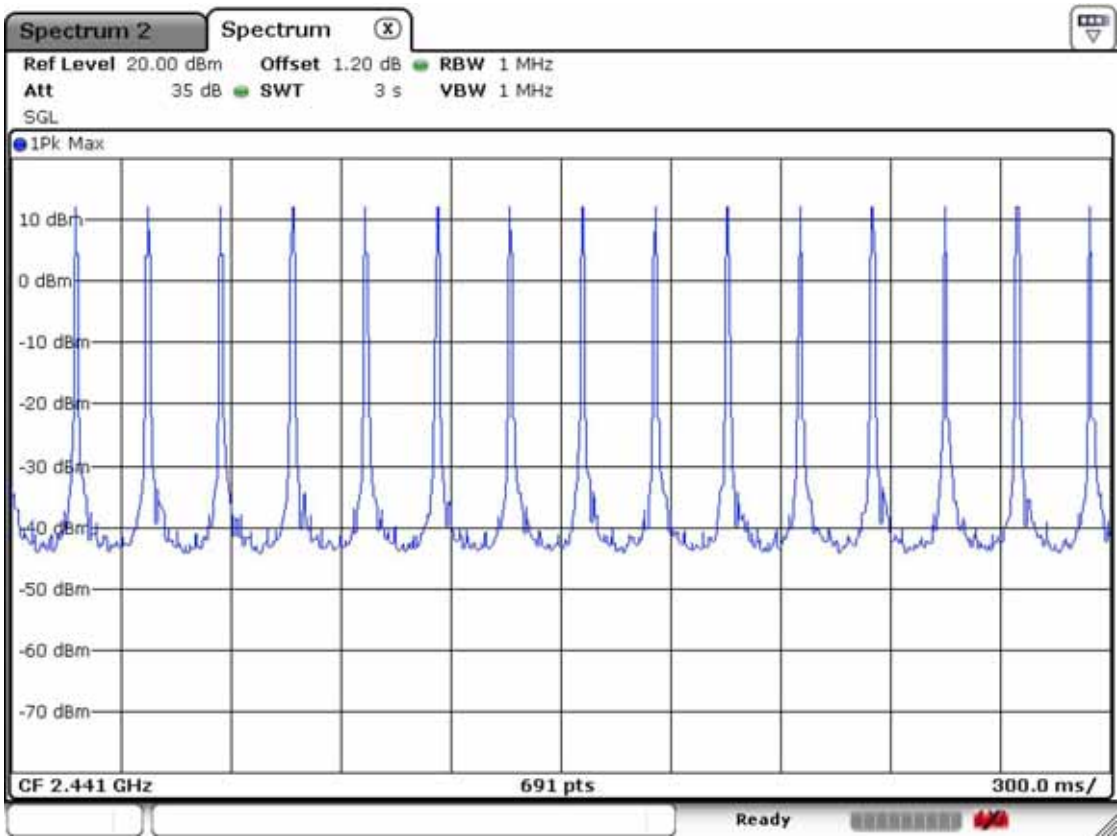
DH1 at basic mode



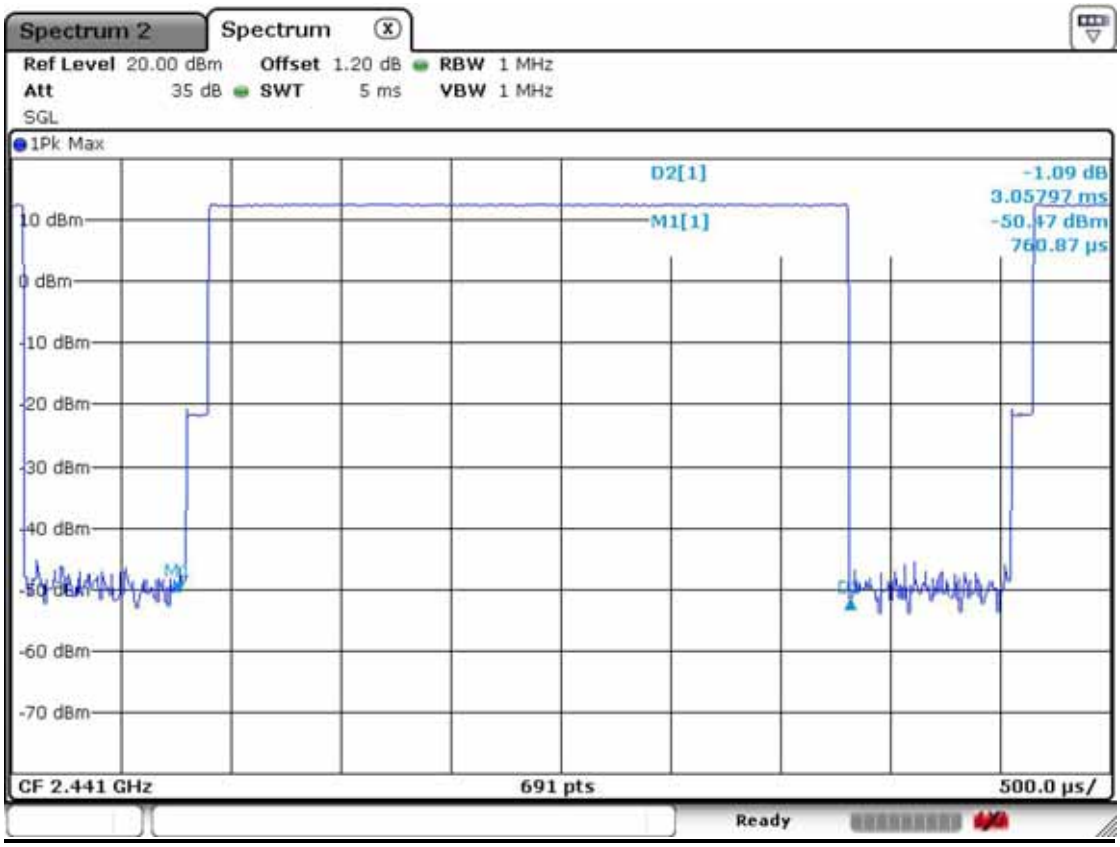


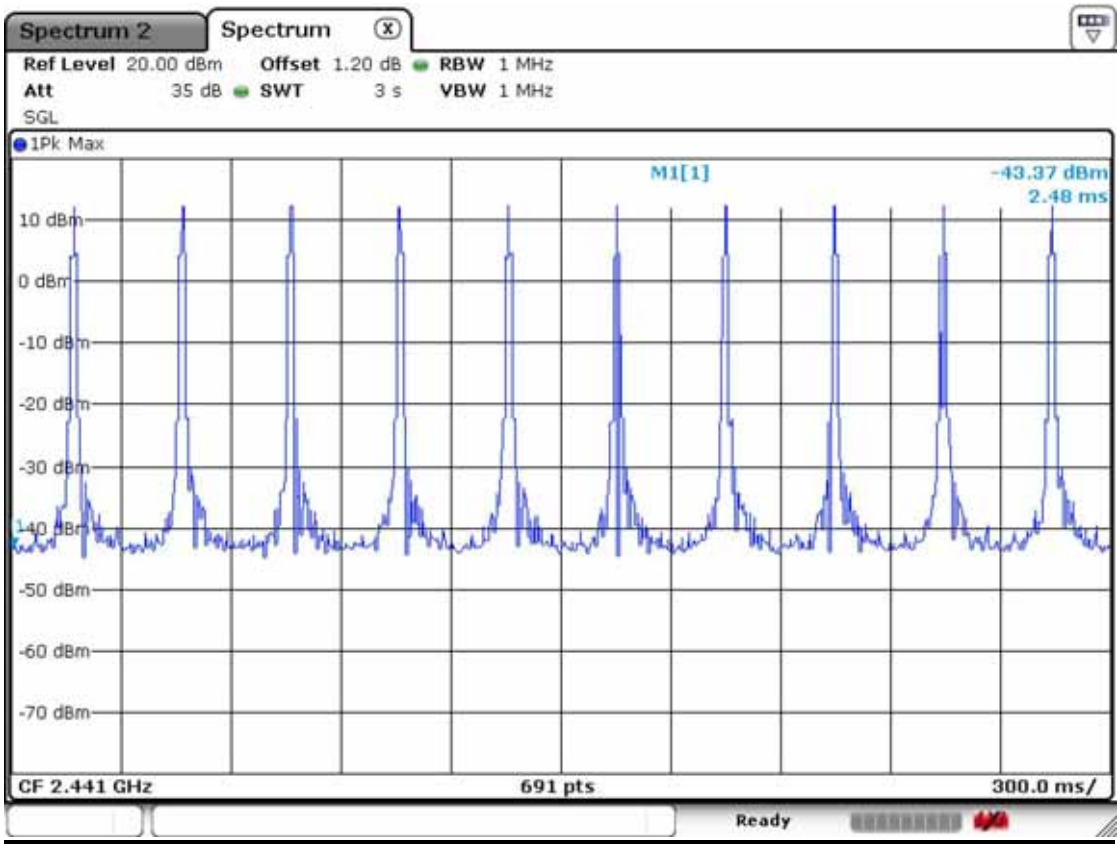
DH3 at basic mode



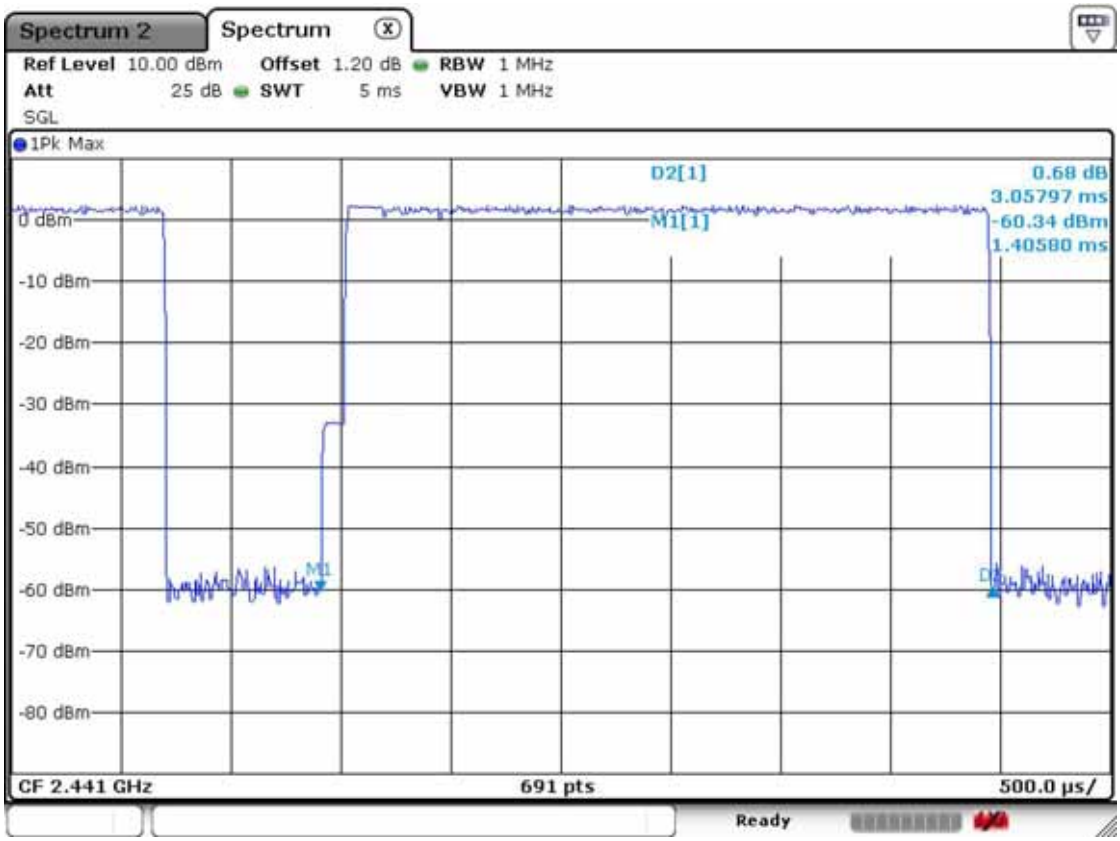


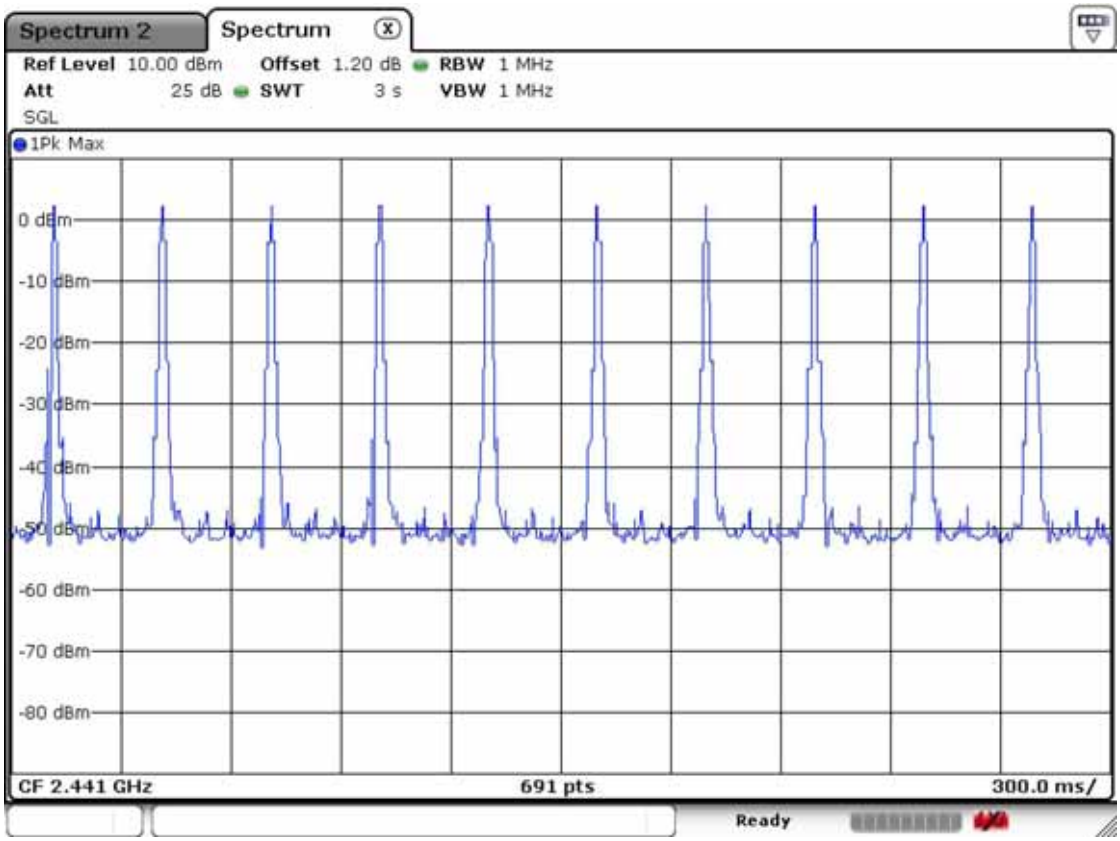
DH5 at basic mode





DH5 at EDR mode with 3Mbps





3.2.5 Transmitter Output Power

Procedure:

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 ≥ RBW) Detector function = peak

Trace = max hold Sweep = auto

Measurement Data: Basic Mode

Frequency (MHz)	Ch.	Test Results		
		dBm	mW	Result
2402	0	**13.38**	**21.78**	Complies
2441	39	**12.14**	**16.37**	Complies
2480	78	**14.21**	**26.36**	Complies

Measurement Data: EDR Mode

Frequency (MHz)	Ch.	Test Results		
		dBm	mW	Result
2402	0	**4.57**	**2.86**	Complies
2441	39	**2.97**	**1.98**	Complies
2480	78	**4.55**	**2.85**	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:	< 250 mW

Measurement Setup

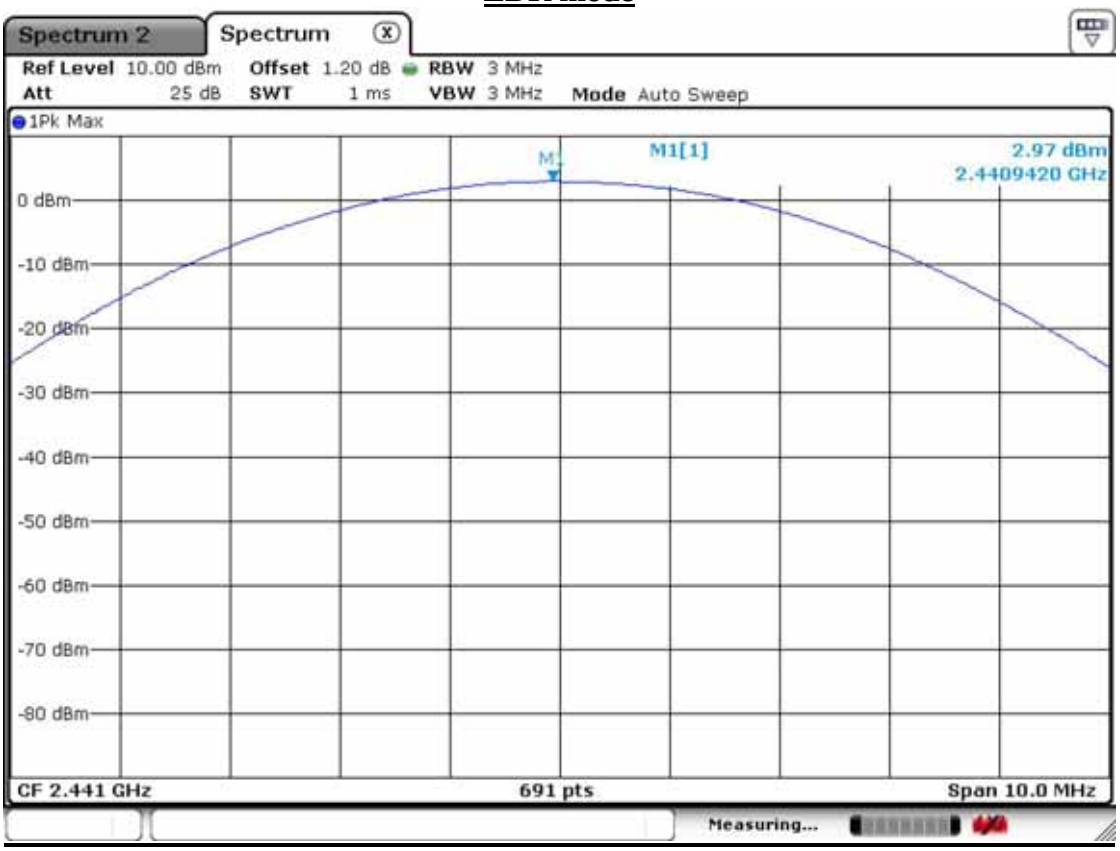
Same as the Chapter 3.2.1 (Figure 1)

Channel 1
Basic mode

EDR mode

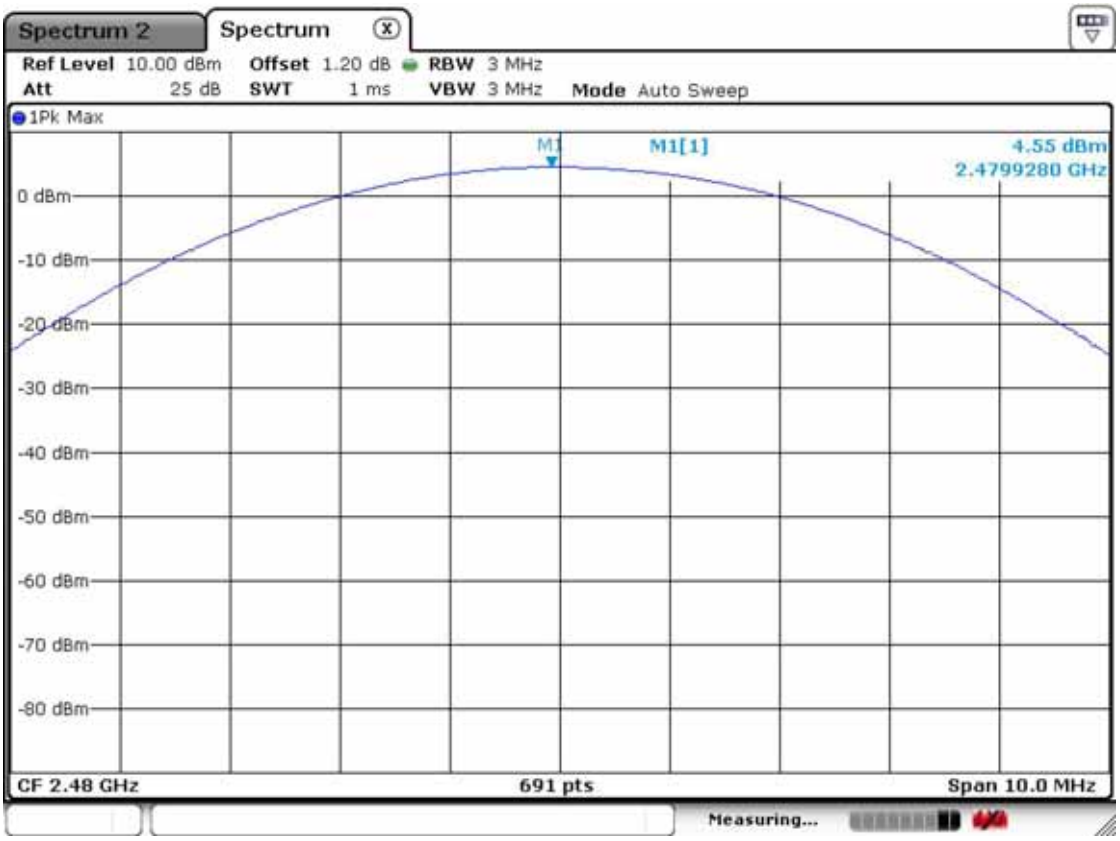
Channel 2
Basic mode

EDR mode



Channel 3
Basic mode

EDR mode



3.2.6 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 3.2.1 (Figure 1)

Band – edge

Lower edge

Upper edge

Band-edges in the restricted band 2310-2390 MHz measurement

Measurement Data: Parani-BCD110DU DIP Type & U.FL Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2386.0	50.8	62.3	V	25.4	37.1	4.0	54.0	74.0	43.1	54.6	11.0	19.5

Measurement Data: Parani-BCD110DS DIP Type & RP-SMA Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2386.0	48.3	60.5	V	25.4	37.1	4.0	54.0	74.0	40.6	52.8	13.5	21.3

Measurement Data: Parani-BCD110DC DIP Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2386.0	47.6	60.7	V	25.4	37.1	4.0	54.0	74.0	39.9	53.0	14.2	21.1

Measurement Data: Parani-BCD110SU SMD Type & U.FL Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2386.0	49.7	61.8	V	25.4	37.1	4.0	54.0	74.0	42.0	54.1	12.1	20.0

Measurement Data: Parani-BCD110SC SMD Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2386.0	48.1	61.0	V	25.4	37.1	4.0	54.0	74.0	40.4	53.3	13.7	20.8

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

Measurement Data: Parani-BCD110DU DIP Type & U.FL Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp. Gain	Cable						
2486.0	52.4	61.8	V	25.4	37.1	4.0	54.0	74.0	44.7	54.1	9.4	20.0

Measurement Data: Parani-BCD110DS DIP Type & RP-SMA Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp. Gain	Cable						
2486.0	51.6	62.0	V	25.4	37.1	4.0	54.0	74.0	43.9	54.3	10.2	19.8

Measurement Data: Parani-BCD110DC DIP Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp. Gain	Cable						
2486.0	50.3	61.7	V	25.4	37.1	4.0	54.0	74.0	42.6	54.0	11.5	20.1

Measurement Data: Parani-BCD110SU SMD Type & U.FL Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp. Gain	Cable						
2486.0	51.8	61.0	V	25.4	37.1	4.0	54.0	74.0	44.1	53.3	10.0	20.8

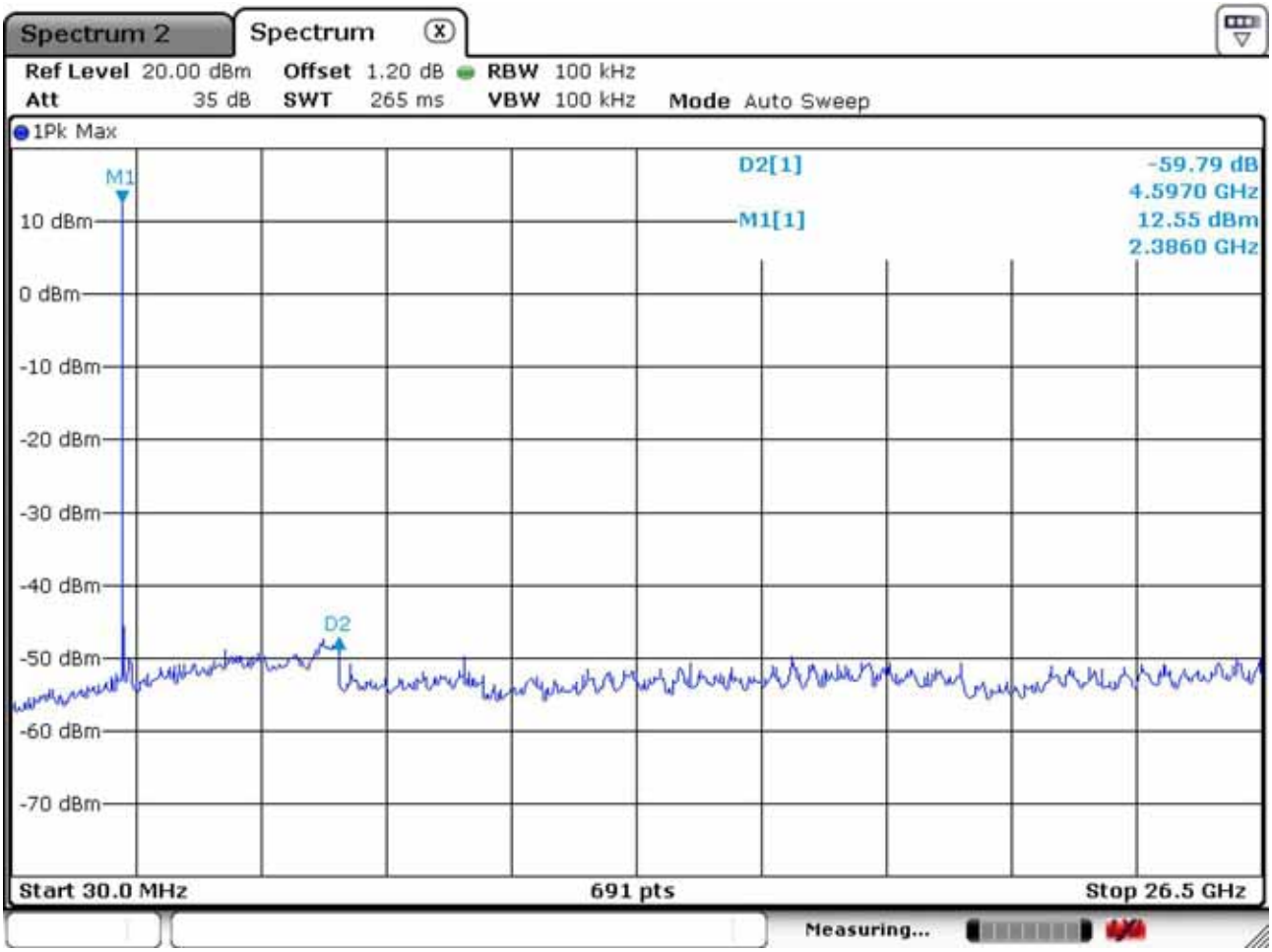
Measurement Data: Parani-BCD110SC SMD Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp. Gain	Cable						
2486.0	50.8	60.9	V	25.4	37.1	4.0	54.0	74.0	43.1	53.2	11.0	20.9

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

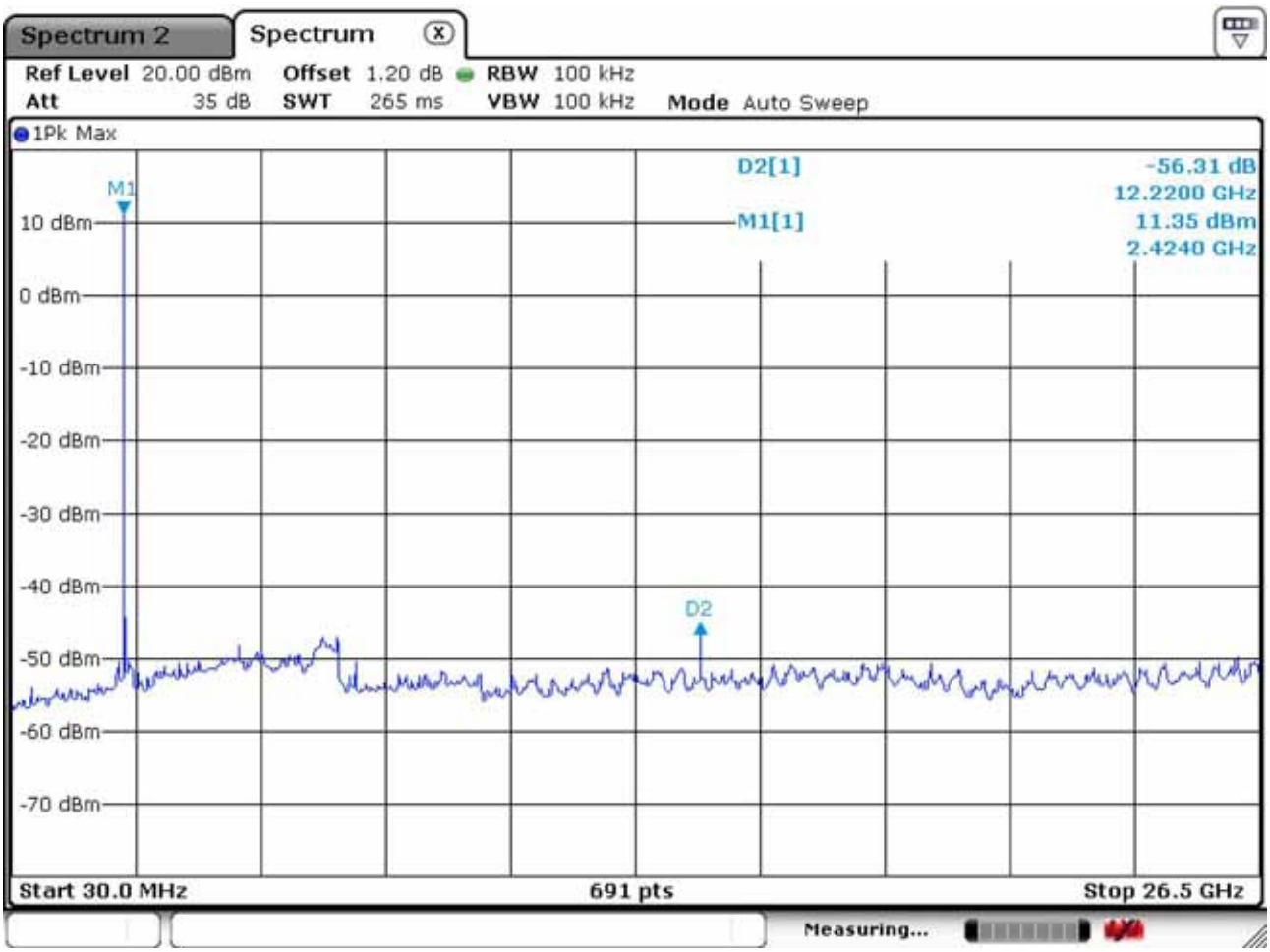
Unwanted Emission – Low channel

Frequency Range = 30 MHz ~ 26.5 GHz



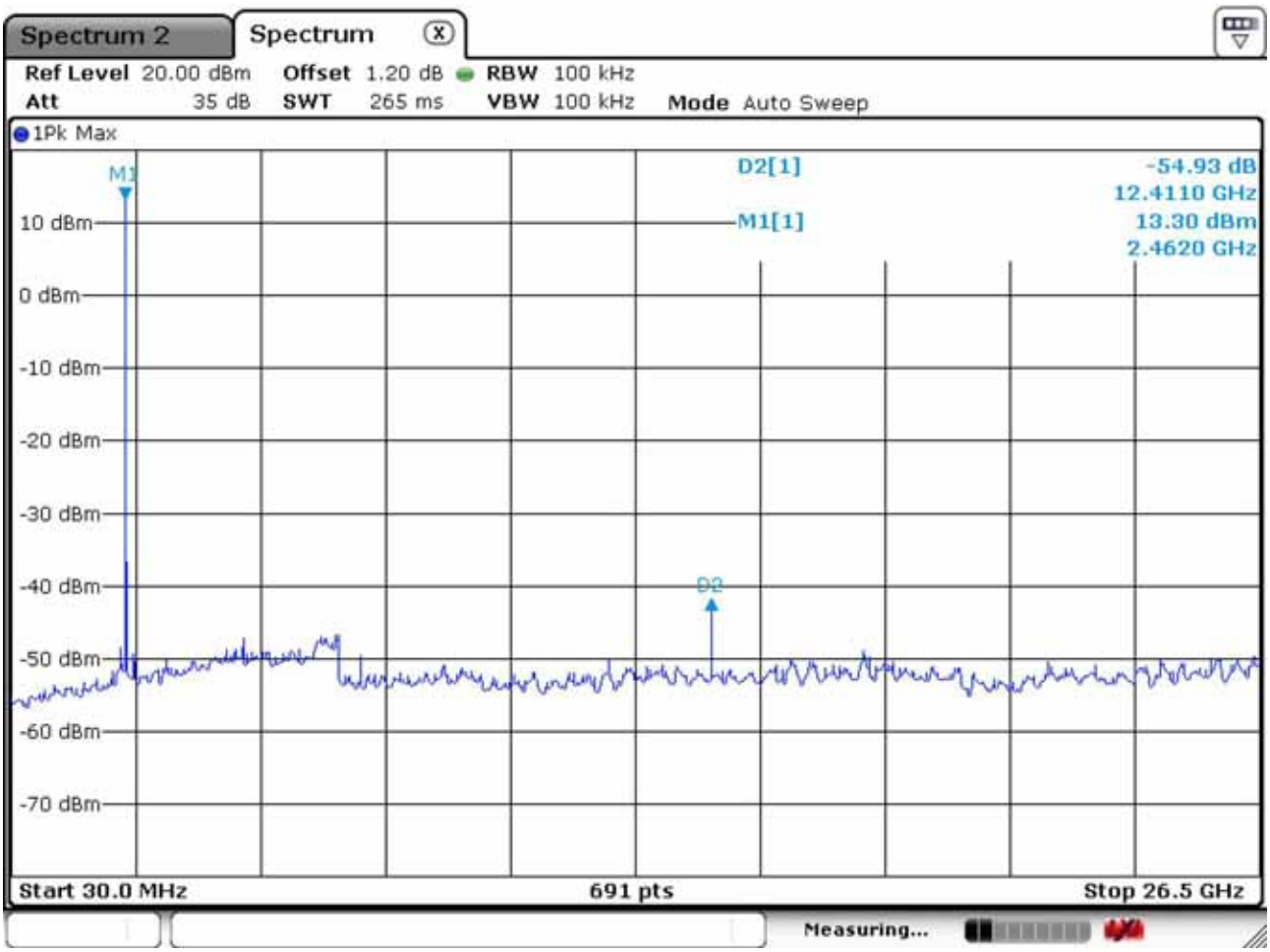
Unwanted Emission – Middle channel

Frequency Range = 30 MHz ~ 26.5 GHz



Unwanted Emission – High channel

Frequency Range = 30 MHz ~ 26.5 GHz



3.2.7 Field Strength of Harmonics - Transmitter

Procedure:

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 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.

(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 = 25 MHz ~ 10^{th} harmonic.

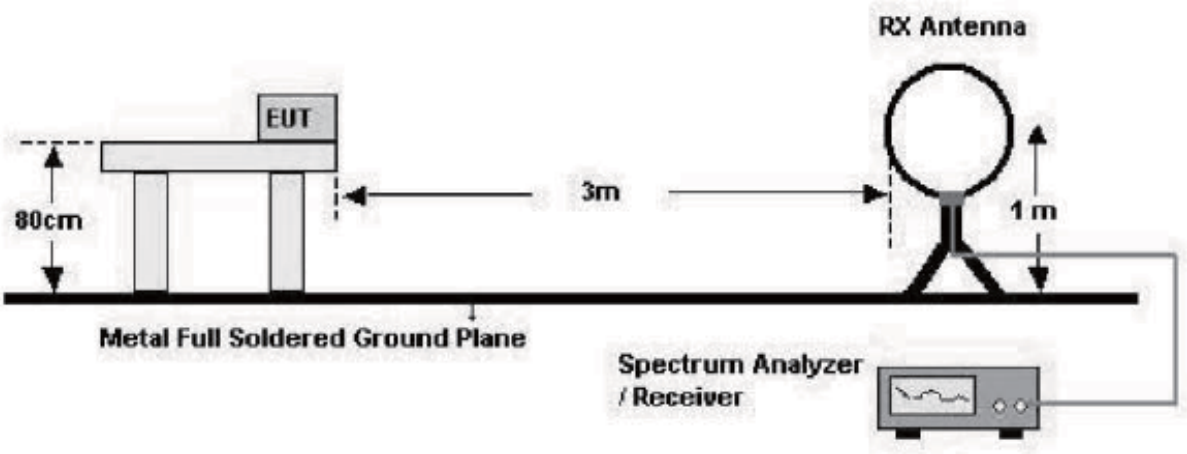
RBW = 100 kHz (10MHz ~ 1 GHz) VBW $\geq$ RBW

= 1 MHz (1 GHz ~ 10^{th} harmonic)

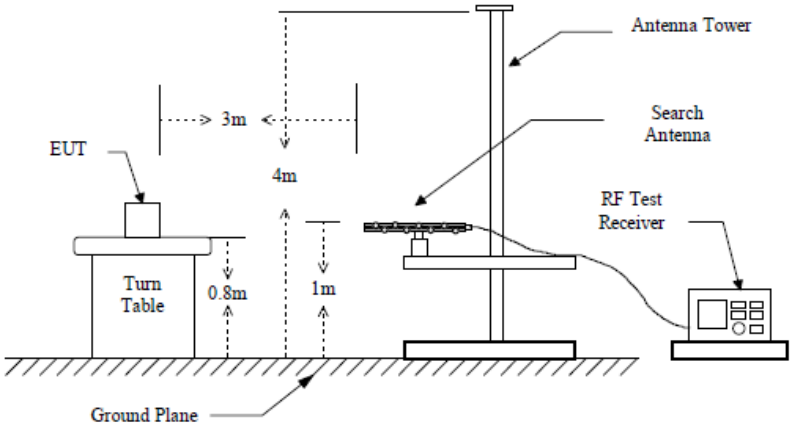
Span = 100 MHz Detector function = peak

Trace = max hold Sweep = auto

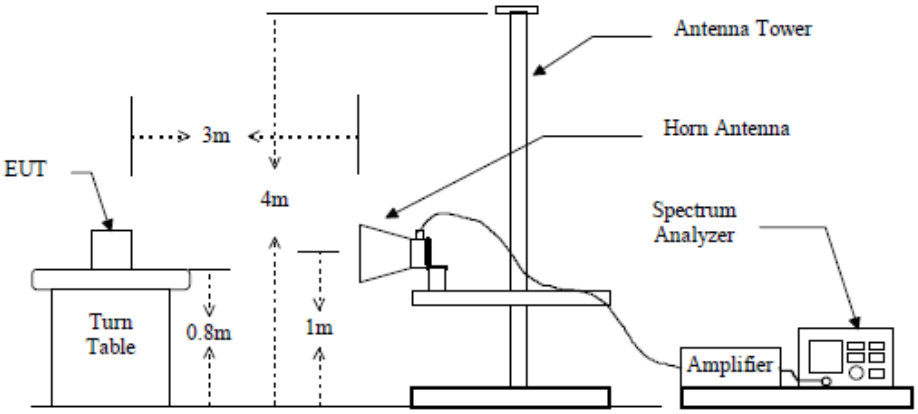
below 30MHz



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

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: **Parani-BCD110DU DIP Type & U.FL Type Connector(R-AN2400-1901RS)**

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp.Gain	Correction Factor 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
4804.0	56.7	64.3	V	31.4	36.5	5.7	-30.29	54.0	74.0	27.1	34.7	26.9	39.3
4882.0	55.9	63.3	V	31.4	36.5	5.7	-30.29	54.0	74.0	26.3	33.7	27.7	40.3
4960.0	59.1	67.3	V	31.4	36.5	5.7	-30.29	54.0	74.0	29.5	37.7	24.5	37.8

- 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)

= 20log(3.058ms/100ms) = -30.29

Measurement Data: Parani-BCD110DS DIP Type & RP-SMA Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp.Gain	Correction Factor 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
4804.0	55.6	64.0	V	31.4	36.5	5.7	-30.29	54.0	74.0	26.0	34.4	28.0	39.6

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp.Gain	Correction Factor 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
4882.0	54.6	62.9	V	31.4	36.5	5.7	-30.29	54.0	74.0	25.0	33.3	29.0	40.7

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp.Gain	Correction Factor 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
4960.0	58.1	63.1	V	31.4	36.5	5.7	-30.29	54.0	74.0	28.5	33.5	25.5	40.5

- 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)

= 20log(3.058ms/100ms) = -30.29

Measurement Data: Parani-BCD110DC DIP Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4804.0	55.3	63.6	V	31.4	36.5	5.7	-30.29	54.0	74.0	25.7	34.0	28.3	40.0
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4882.0	55.3	61.4	V	31.4	36.5	5.7	-30.29	54.0	74.0	25.7	31.8	28.3	42.2
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4960.0	56.9	64.6	V	31.4	36.5	5.7	-30.29	54.0	74.0	27.3	35.0	26.7	39.0

- 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)

= 20log(3.058ms/100ms) = -30.29

Measurement Data: **Parani-BCD110SU SMD Type & U.FL Type Connector(R-AN2400-1901RS)**

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4804.0	54.9	63.1		31.4	36.5	5.7	-30.29	54.0	74.0	25.3	33.5	28.7	40.5
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4882.0	54.2	63.7	V	31.4	36.5	5.7	-30.29	54.0	74.0	24.6	34.1	29.4	39.9
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4960.0	57.3	65.0	V	31.4	36.5	5.7	-30.29	54.0	74.0	27.7	35.4	26.3	38.6

- 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)

= 20log(3.058ms/100ms) = -30.29

Measurement Data: Parani-BCD110SC SMD Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4804.0	55.5	62.9		31.4	36.5	5.7	-30.29	54.0	74.0	25.9	33.3	28.1	40.7
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4882.0	52.7	62.5	V	31.4	36.5	5.7	-30.29	54.0	74.0	23.1	32.9	30.9	41.1
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
4960.0	57.5	63.8	V	31.4	36.5	5.7	-30.29	54.0	74.0	27.9	34.2	26.1	39.8

- 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)

= 20log(3.058ms/100ms) = -30.29

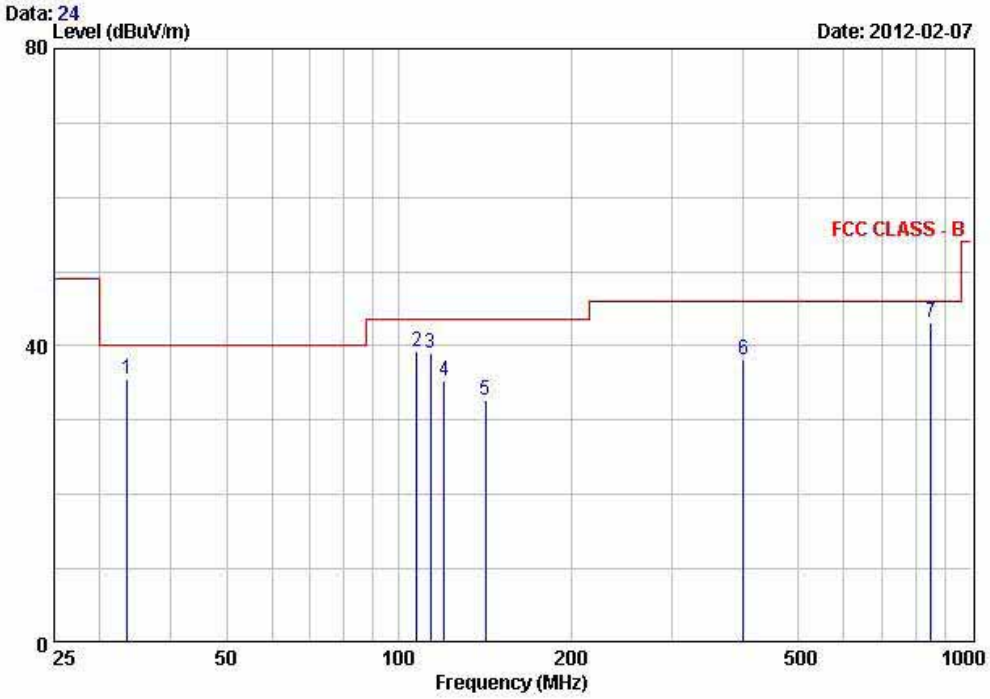
Radiated Emissions – BT Pairing

LTA
Laboratory for Test & Approval Co.,Ltd.

243 Jubug-ri, yangji-Myeon, Youngin-si,
Gyeonggi-do 449-822 Korea
Tel :+82-31-3236008,9
Fax:+82-31-3236010

EUT/Model No.: SENA(Parani-BCD110DU) TEST MODE: BT paring

Temp Humi : 8'C / 22% Tested by: CHO.K.H



	Freq	Reading	C.F	Result	Limit QP	Margin	Height	Angle	Polarity
	MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	33.60	52.30	-16.79	35.51	40.00	4.49	100	125	VERTICAL
2	107.70	56.70	-17.47	39.23	43.50	4.27	119	165	HORIZONTAL
3	113.70	56.20	-17.09	39.11	43.50	4.39	121	179	HORIZONTAL
4	120.30	52.00	-16.67	35.33	43.50	8.17	100	179	VERTICAL
5	141.80	45.90	-13.27	32.63	43.50	10.87	117	228	HORIZONTAL
6	399.60	46.80	-8.73	38.07	46.00	7.93	137	211	HORIZONTAL
7	851.30	40.90	2.15	43.05	46.00	2.95	122	194	VERTICAL

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

3.2.8 Field Strength of Harmonics - Receivers

Definition:

The field strength of emissions from intentional radiators was measured. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately

Test method	:	FCC Part 15.209
Frequency Range	:	25 MHz ~ 10th harmonic.
Bandwidth	:	120 kHz (F < 1GHz) 1 MHz (F > 1GHz)
Distance of antenna	:	3 meters
Test mode	:	Rx mode
Result	:	**Complies**

Measurement Data:

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

Field Strength Limit

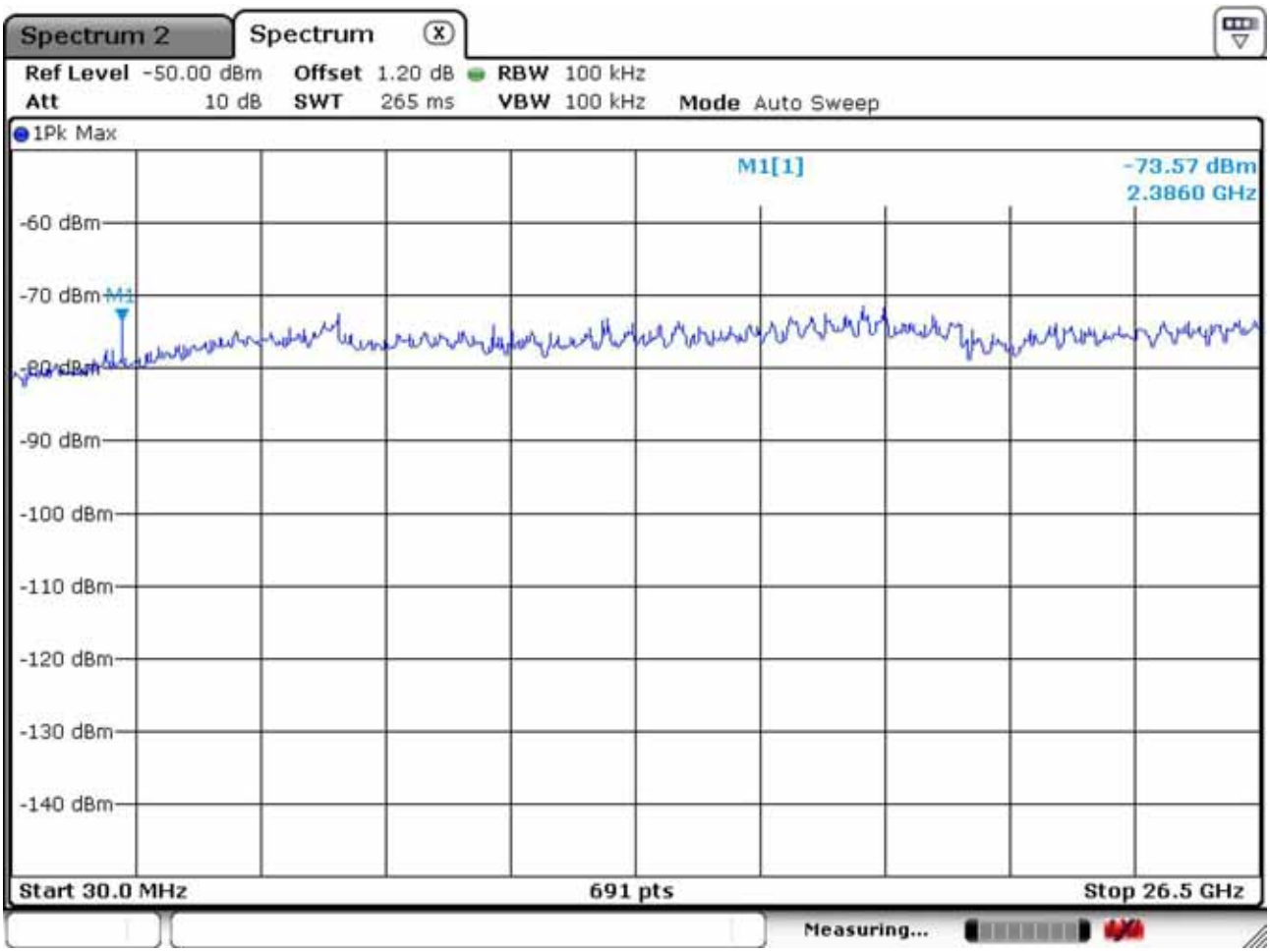
Part 15.209 LIMIT:

Frequency (MHz)	Limit (uV/m) @ 3m
0.009 ~ 0.490	2400/F(kHz)
0.490 ~ 1.705	24000/F(kHz)
1.705 ~ 30	30
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.

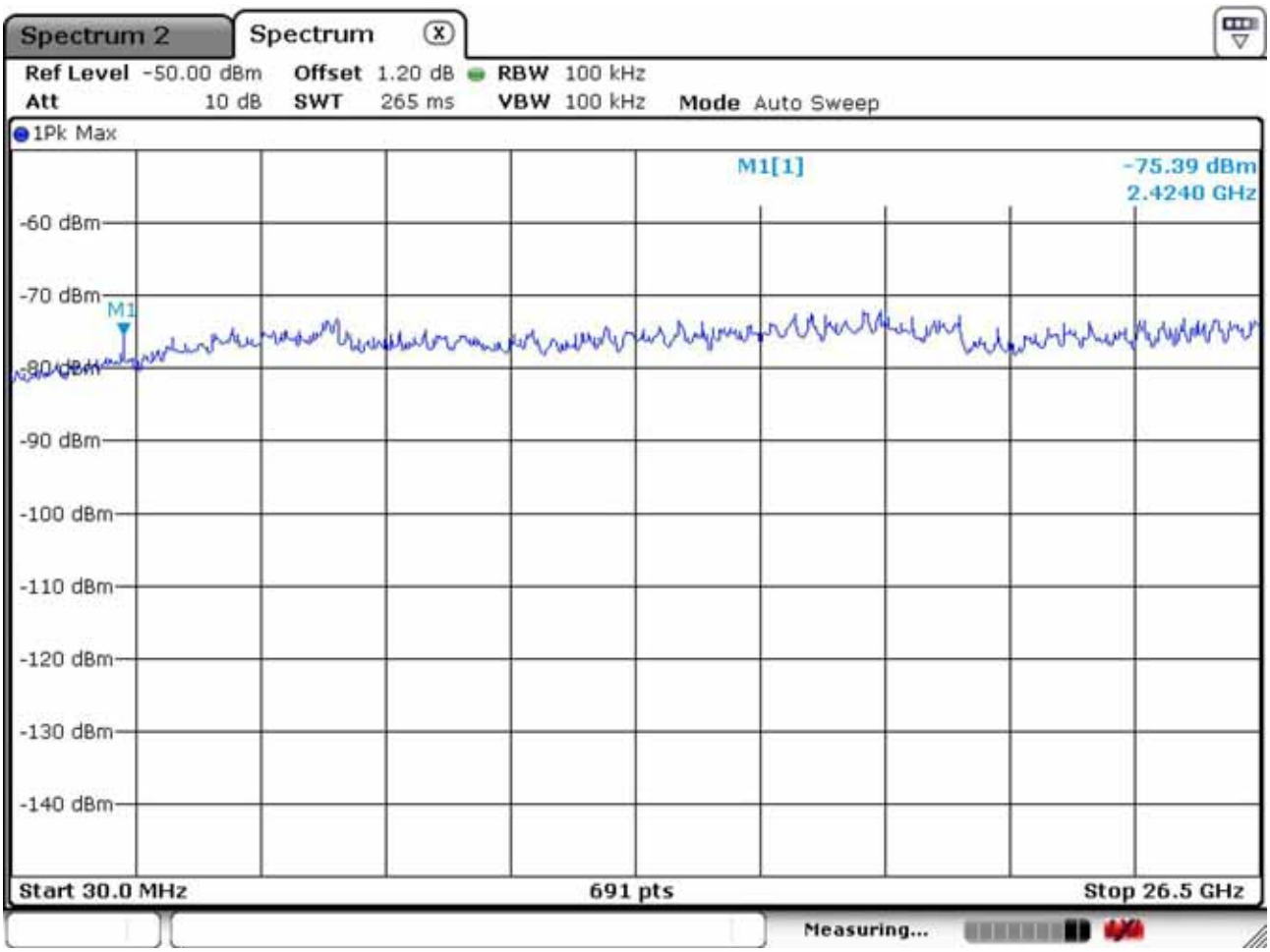
Conducted Emission – Low channel

Frequency Range = 30 MHz ~ 26.5 GHz



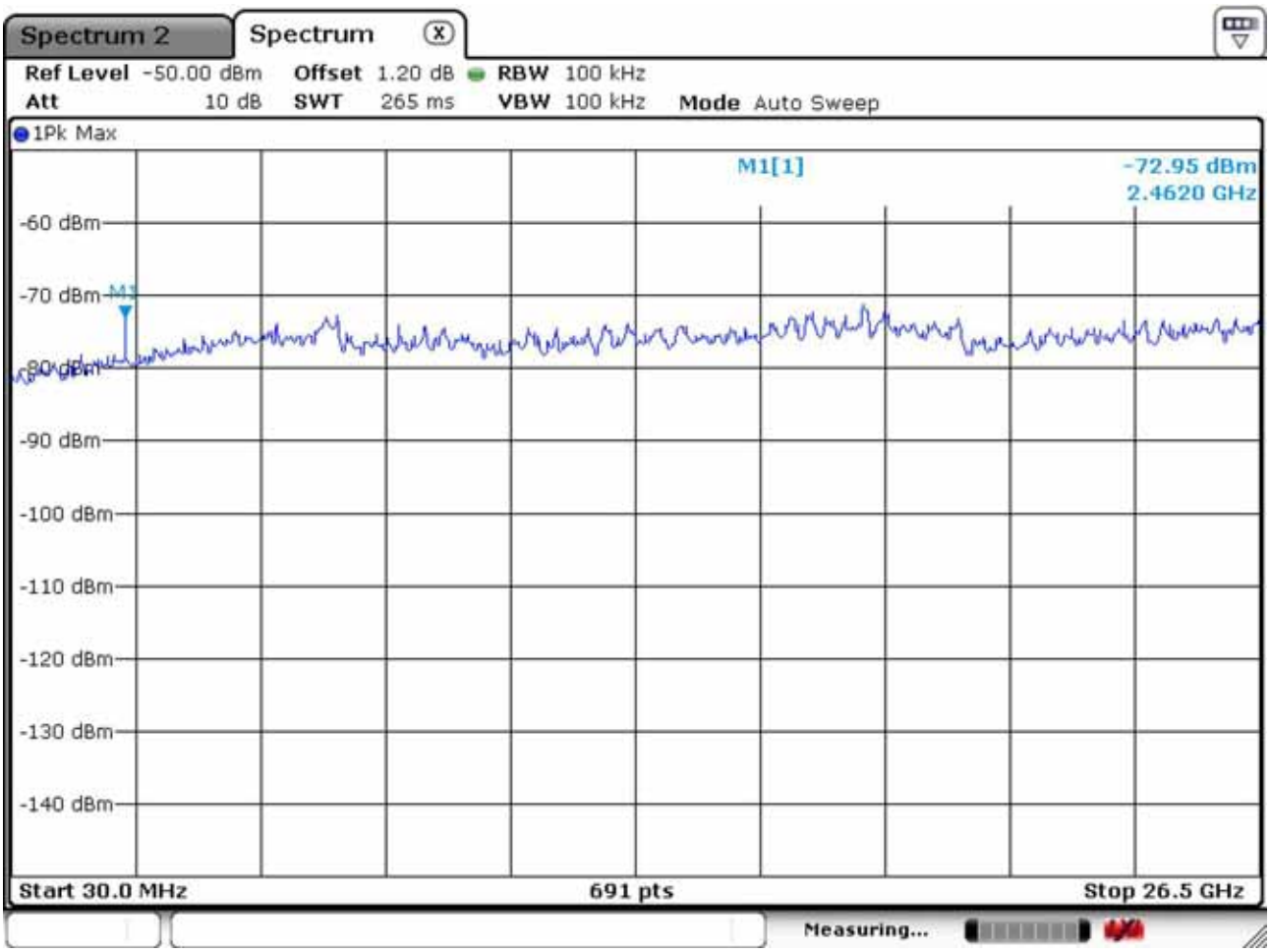
Conduceted Emission – Middle channel

Frequency Range = 30 MHz ~ 26.5 GHz



Conduceted Emission – High channel

Frequency Range = 30 MHz ~ 26.5 GHz



Measurement Data: Parani-BCD110DU DIP Type & U.FL Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2403.0	38.9	48.7	V	25.4	37.1	4.0	54.0	74.0	31.2	41.0	22.9	33.1
Frequency [MHz]	**Reading [dBuV/m] AV**	**Reading [dBuV/m] Peak**	**Pol.**	**Correction Factor Antenna**	**Correction Factor Amp. Gain**	**Correction Factor Cable**	**Limits [dBuV/m] AV**	**Limits [dBuV/m] Peak**	**Result [dBuV/m] AV**	**Result [dBuV/m] Peak**	**Margin [dB] AV**	**Margin [dB] Peak**
2442.0	39.1	48.3	V	25.4	37.1	4.0	54.0	74.0	31.4	40.6	22.7	33.5
Frequency [MHz]	**Reading [dBuV/m] AV**	**Reading [dBuV/m] Peak**	**Pol.**	**Correction Factor Antenna**	**Correction Factor Amp. Gain**	**Correction Factor Cable**	**Limits [dBuV/m] AV**	**Limits [dBuV/m] Peak**	**Result [dBuV/m] AV**	**Result [dBuV/m] Peak**	**Margin [dB] AV**	**Margin [dB] Peak**
2481.0	38.5	47.9	V	25.4	37.1	4.0	54.0	74.0	30.8	40.2	23.3	33.9

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

Measurement Data: Parani-BCD110DS DIP Type & RP-SMA Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2403.0	37.6	49.1	V	25.4	37.1	4.0	54.0	74.0	29.9	41.4	24.2	32.7
Frequency [MHz]	**Reading [dBuV/m] AV**	**Reading [dBuV/m] Peak**	**Pol.**	**Correction Factor Antenna**	**Correction Factor Amp. Gain**	**Correction Factor Cable**	**Limits [dBuV/m] AV**	**Limits [dBuV/m] Peak**	**Result [dBuV/m] AV**	**Result [dBuV/m] Peak**	**Margin [dB] AV**	**Margin [dB] Peak**
2442.0	38.2	48.0	V	25.4	37.1	4.0	54.0	74.0	30.5	40.3	23.6	33.8
Frequency [MHz]	**Reading [dBuV/m] AV**	**Reading [dBuV/m] Peak**	**Pol.**	**Correction Factor Antenna**	**Correction Factor Amp. Gain**	**Correction Factor Cable**	**Limits [dBuV/m] AV**	**Limits [dBuV/m] Peak**	**Result [dBuV/m] AV**	**Result [dBuV/m] Peak**	**Margin [dB] AV**	**Margin [dB] Peak**
2481.0	37.9	47.5	V	25.4	37.1	4.0	54.0	74.0	30.2	39.8	23.9	34.3

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

Measurement Data: Parani-BCD110DC DIP Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2403.0	37.2	47.3	V	25.4	37.1	4.0	54.0	74.0	29.5	39.6	24.6	34.5
Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2442.0	38.1	47.1	V	25.4	37.1	4.0	54.0	74.0	30.4	39.4	23.7	34.7
Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2481.0	38.4	47.6	V	25.4	37.1	4.0	54.0	74.0	30.7	39.9	23.4	34.2

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

Measurement Data: Parani-BCD110SU SMD Type & U.FL Type Connector(R-AN2400-1901RS)

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2403.0	38.5	48.1	V	25.4	37.1	4.0	54.0	74.0	30.8	40.4	23.3	33.7
2442.0	37.6	47.7	V	25.4	37.1	4.0	54.0	74.0	29.9	40.0	24.2	34.1
2481.0	38.8	47.9	V	25.4	37.1	4.0	54.0	74.0	31.1	40.2	23.0	33.9

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

Measurement Data: Parani-BCD110SC SMD Type & Chip Type Ant

Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2403.0	37.6	47.2	V	25.4	37.1	4.0	54.0	74.0	29.9	39.5	24.2	34.6
Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2442.0	37.2	47.0	V	25.4	37.1	4.0	54.0	74.0	29.5	39.3	24.6	34.8
Frequency [MHz]	Reading [dBuV/m] AV	Reading [dBuV/m] Peak	Pol.	Correction Factor Antenna	Correction Factor Amp. Gain	Correction Factor Cable	Limits [dBuV/m] AV	Limits [dBuV/m] Peak	Result [dBuV/m] AV	Result [dBuV/m] Peak	Margin [dB] AV	Margin [dB] Peak
2481.0	37.9	46.8	V	25.4	37.1	4.0	54.0	74.0	30.2	39.1	23.9	35.0

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

3.2.9 AC Conducted Emissions

Procedure:

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: **Not Complies**

- The EUT operates by DC 3.3V Main System

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

Frequency Range (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

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

APPENDIX

TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Interval	Last Cal. Date
1	Spectrum Analyzer (~30GHz)	FSV-30	100757	R&S	1 year	2012-01-10
2	Signal Generator (~3.2GHz)	8648C	3623A02597	HP	1 year	2011-03-30
3	Signal Generator (1~20GHz)	83711B	US34490456	HP	1 year	2011-03-30
4	Attenuator (3dB)	8491A	37822	HP	2 year	2010-10-08
5	Attenuator (10dB)	8491A	63196	HP	2 year	2010-10-08
6	Attenuator (30dB)	8498A	3318A10929	HP	2 year	2011-01-05
7	Test Receiver (~30MHz)	ESHS10	828404/009	R&S	1 year	2011-03-30
8	EMI Test Receiver (~1GHz)	ESCI7	100722	R&S	1 year	2011-10-07
9	RF Amplifier (~1.3GHz)	8447D	2439A09058	HP	2 year	2010-10-08
10	RF Amplifier (1~18GHz)	8449B	3008A02126	HP	2 year	2010-03-29
11	Horn Antenna (1~18GHz)	BBHA 9120D	9120D122	SCHWARZBECK	2 year	2010-12-24
12	Horn Antenna (18 ~ 40GHz)	SAS-574	154	Schwarzbeck	2 year	2010-11-25
13	Horn Antenna (18 ~ 40GHz)	SAS-574	155	Schwarzbeck	2 year	2010-11-25
14	TRILOG Antenna	VULB 9160	9160-3172	SCHWARZBECK	2 year	2010-10-07
15	Dipole Antenna	VHA9103	2116	SCHWARZBECK	2 year	2010-11-25
16	Dipole Antenna	VHA9103	2117	SCHWARZBECK	2 year	2010-11-25
17	Dipole Antenna	VHA9105	2261	SCHWARZBECK	2 year	2010-11-25
18	Dipole Antenna	VHA9105	2262	SCHWARZBECK	2 year	2010-11-25
19	Hygro-Thermograph	THB-36	0041557-01	ISUZU	2 year	2010-04-12
20	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
21	Power Divider	11636A	6243	HP	2 year	2010-10-08
22	DC Power Supply	6622A	3448A03079	HP	-	-
23	Frequency Counter	5342A	2826A12411	HP	1 year	2011-03-30
24	Power Meter	EPM-441A	GB32481702	HP	1 year	2011-03-30
25	Power Sensor	8481A	US41030291	HP	1 year	2011-10-07
26	Audio Analyzer	8903B	3729A18901	HP	1 year	2011-10-07
27	Modulation Analyzer	8901B	3749A05878	HP	1 year	2011-10-07
28	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2011-10-07
29	Stop Watch	HS-3	601Q09R	CASIO	2 year	2010-03-31
30	LISN	ENV216	100408	R&S	1 year	2011-10-07
31	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	2 year	2010-05-13
32	Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	-	-
33	Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	-	-
34	Loop Antenna	FMZB 1516	151602/94	SCHWARZBECK	2 year	2011-04-05