LTA
Laboratory for Test & Approval Co.,Ltd.

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SENA

Dates of Tests: Jan 20 ~ 29, 2010
Test Report S/N: LR500191002B
Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID. **S7AZBLINXZS10**

APPLICANT **Sena Technologies, Inc.**

Equipment Class	**:**	**Digital Transmission System (DTS)**
Manufacturing Description	**:**	**ZigBee Serial Adapter**
Manufacturer	**:**	**Sena Technologies, Inc.**
Model name	**:**	**ZBlinx-ZS10**
Test Device Serial No.:	**:**	**Identical prototype**
Rule Part(s)	**:**	**FCC Part 15.247 Subpart C; ANSI C-63.4-2003**
Frequency Range	**:**	**2410MHz ~ 2475MHz**
Max. Output Power	**:**	**Max 13.42dBm - Conducted**
Data of issue	**:**	**February 1, 2010**

This test report is issued under the authority of:

Dong –Min JUNG, Technical Manager

The test was supervised by:

Kyung-Taek LEE, 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. This report must not be used by the applicant to claim product endorsement by any agency.

NVLAP LAB Code.: 200723-0

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1. General information's

1-1 Test Performed

Company name : LTA Co., Ltd.

Address : 243, Jubug-ri,Yangji-Myeon,Youngin-Si, Kyunggi-Do, Korea. 449-822

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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	2010-09-30	ECT accredited Lab.
RRL	KOREA	KR0049	2011-06-20	EMC accredited Lab.
FCC	U.S.A	610755	2011-04-22	FCC filing
VCCI	JAPAN	R2133, C2307	2011-06-21	VCCI registration
IC	CANADA	IC5799	2010-05-03	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
Tel / Fax	:	+82-2-571-8283/ +82-2-573-7710

2-2 Equipment Under Test (EUT)

Trade name	:	ZigBee Serial Adapter
FCC ID	:	S7AZBLINXZS10
Model name	:	ZBlinx-ZS10
Serial number	:	Identical prototype
Date of receipt	:	January 20, 2010
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
Frequency Range	:	2410MHz ~ 2475MHz (DSSS)
RF output power	:	Max 13.42dBm - Conducted
Number of channels	:	14
Type of Modulation	:	O-QPSK
Channel spacing	:	5MHz
Power Source	:	3.7Vdc by Battery

2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	2410	2445	2475

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
PC	HP Compaq dx7400 Microtower	CNG8330J95	HP
MONITOR	HPL1710	CNC816QHF2	HP
KEYBOARD	SK-8115	68A-04Q6	DELL
MOUSE	MO56UO	520107013	DELL
PRINTER	STYLUS C65	N/A	EPSON

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	6 dB Bandwidth	> 500kHz	Conducted	C
15.247(b)	Transmitter Peak Output Power	< 1Watt		C
15.247(d)	Transmitter Power Spectral Density	< 8dBm @ 3kHz		C
15.247(d)	Band Edge & Spurious	> 20 dBc		C
15.209	Field Strength of Harmonics	Emission	Radiated	C
15.207	AC Conducted Emissions	Emissions	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.

→ Antenna Requirement
The Sena Technologies, Inc. FCC ID: S7AZBLINXZS10 unit complies with the requirement of §15.203.
The antenna connector is the reverse polarity SMA connector.

The sample was tested according to the following specification:
FCC Parts 15.247; ANSI C-63.4-2003

3.2 Technical Characteristics Test

3.2.1 6 dB Bandwidth

Procedure:

The bandwidth at 6dB below the highest in-band spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

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 6dB 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 6 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz — Span = 30 MHz

VBW = 100 kHz (VBW ≥ RBW) — Sweep = auto

Trace = max hold — Detector function = peak

Measurement Data:

Frequency (MHz)	Test Results	
	Measured Bandwidth (MHz)	Result
2410	**1.650**	Complies
2440	**1.577**	Complies
2475	**1.570**	Complies

- See next pages for actual measured spectrum plots.

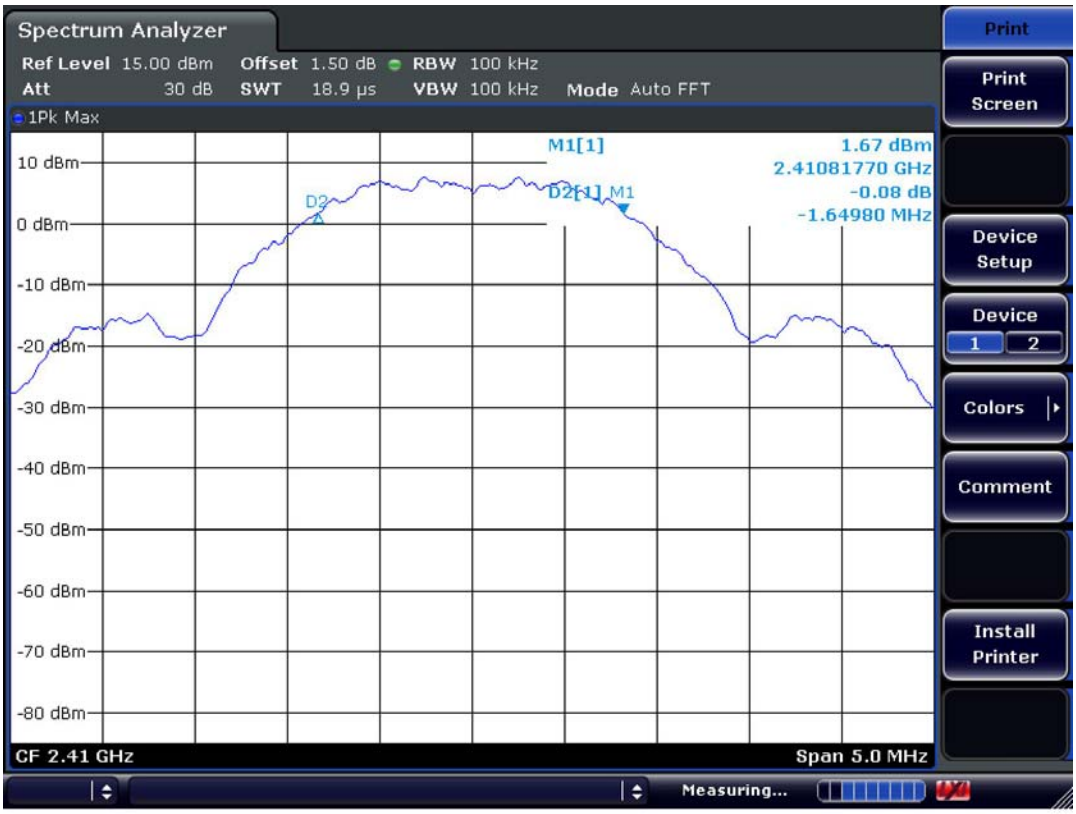
Minimum Standard:

6 dB Bandwidth > 500kHz

Measurement Setup

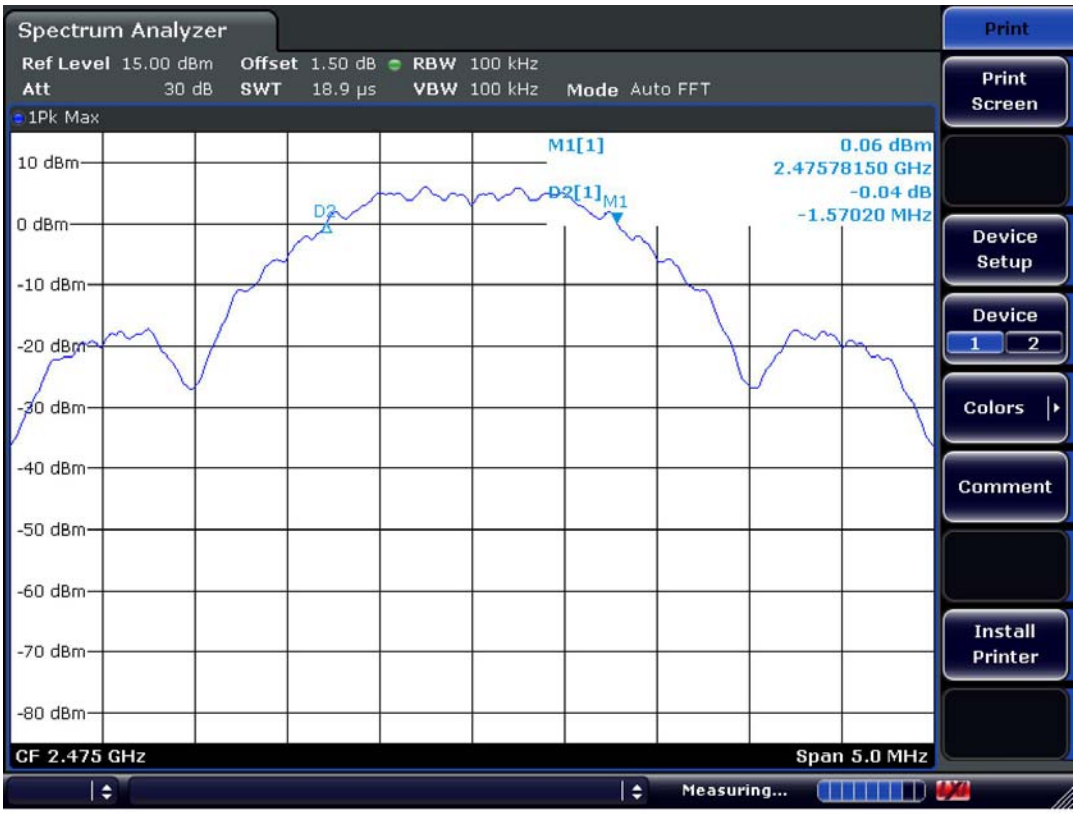
Same as the Chapter 3.2.1 (Figure 1)

Low Channel



Mid Channel

High Channel



3.2.2 Peak Output Power Measurement

Procedure:

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 1MHz Span = auto

VBW = 1MHz (VBW ≥ RBW) Sweep = auto

Detector function = peak

Measurement Data:

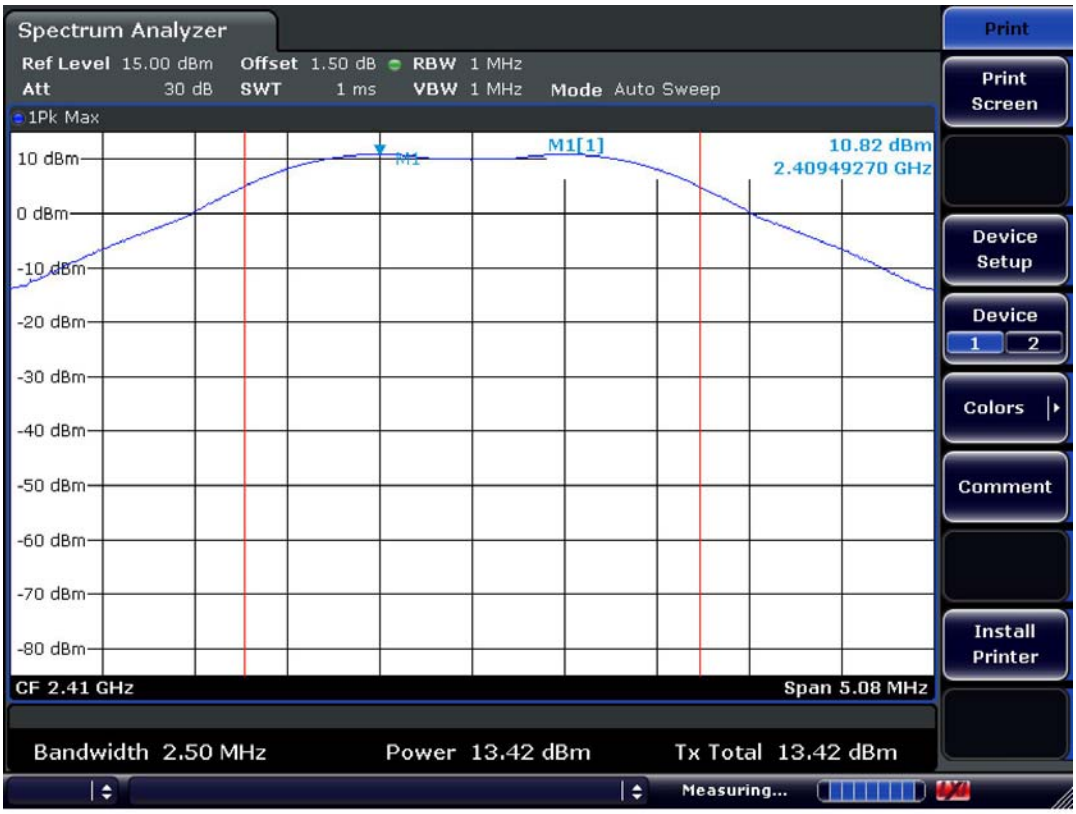
Frequency (MHz)	Test Results		
	dBm	mW	Result
2410	**13.42**	**21.98**	Complies
2440	**12.50**	**17.78**	Complies
2475	**11.59**	**14.42**	Complies

- See next pages for actual measured spectrum plots.

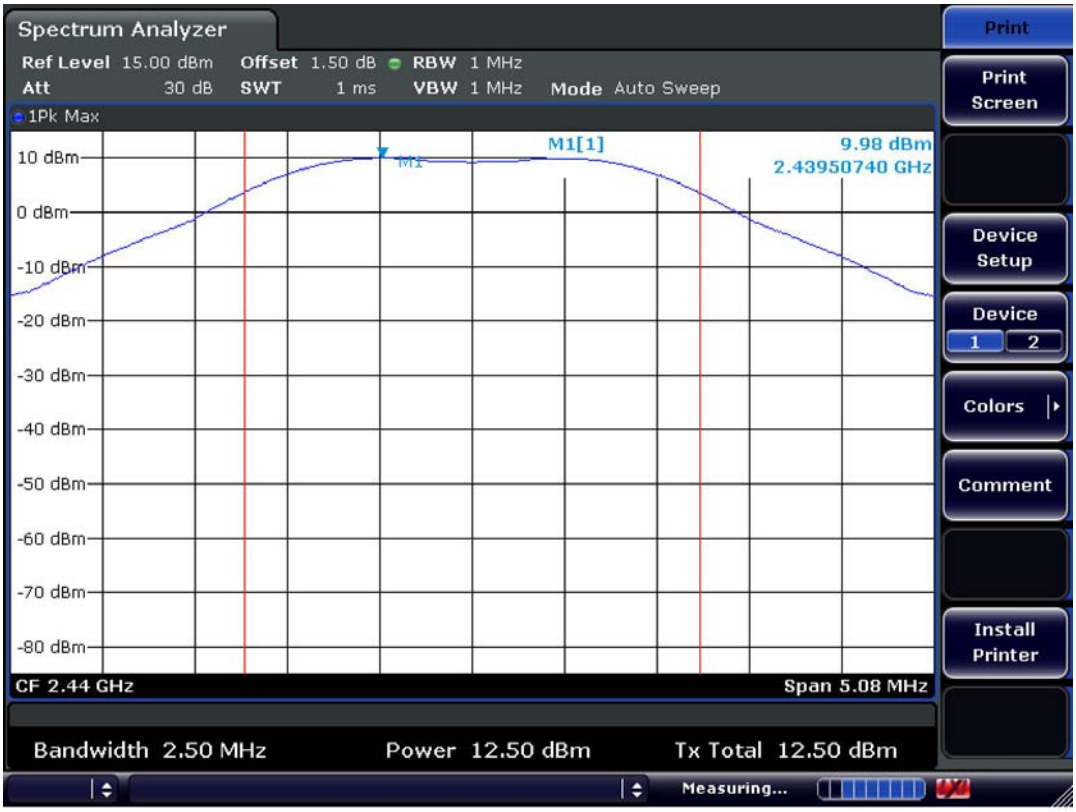
Minimum Standard:

Peak output power	< 1W

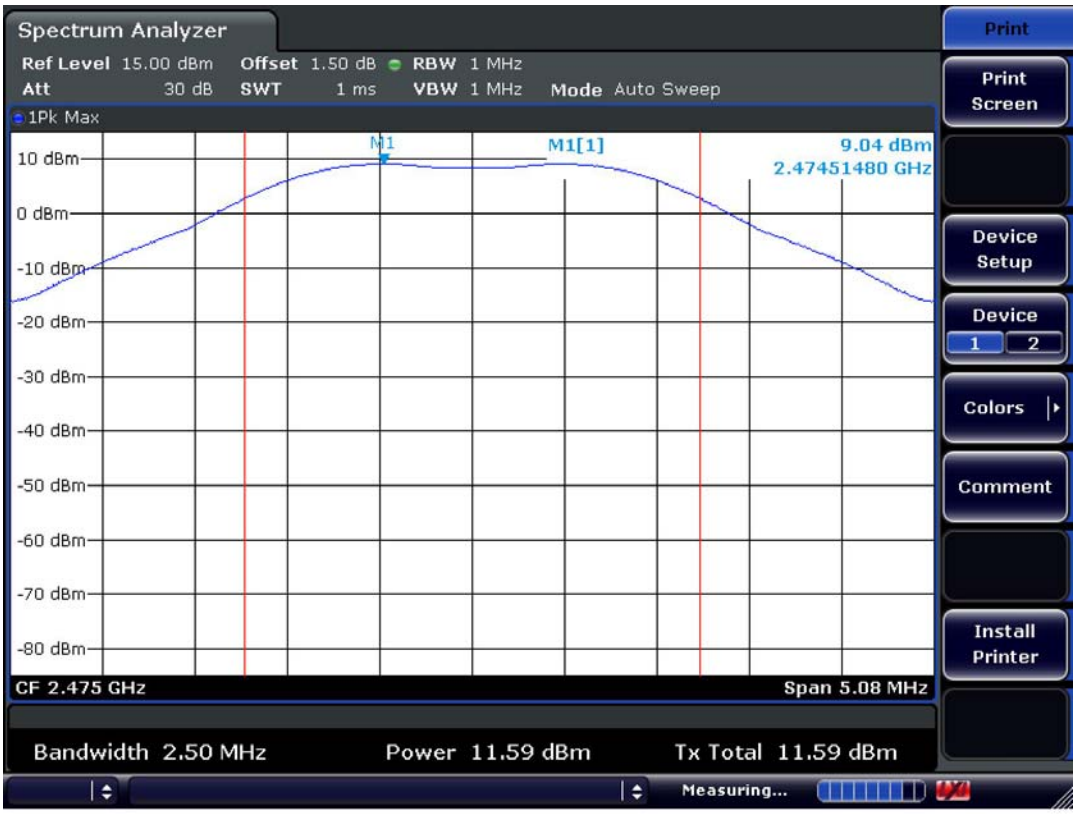
Low Channe



Mid Channel



High Channel



3.2.3 Power Spectral Density

Procedure:

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The spectrum analyzer is set to:

RBW = 3 kHz Span = 300 kHz

VBW = 3 kHz Sweep = 100 sec

Detector function = peak Trace = max hold

Measurement Data:

Frequency (MHz)	Test Results	
	dBm	Result
2410	**-4.10**	Complies
2440	**-4.55**	Complies
2475	**-5.88**	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

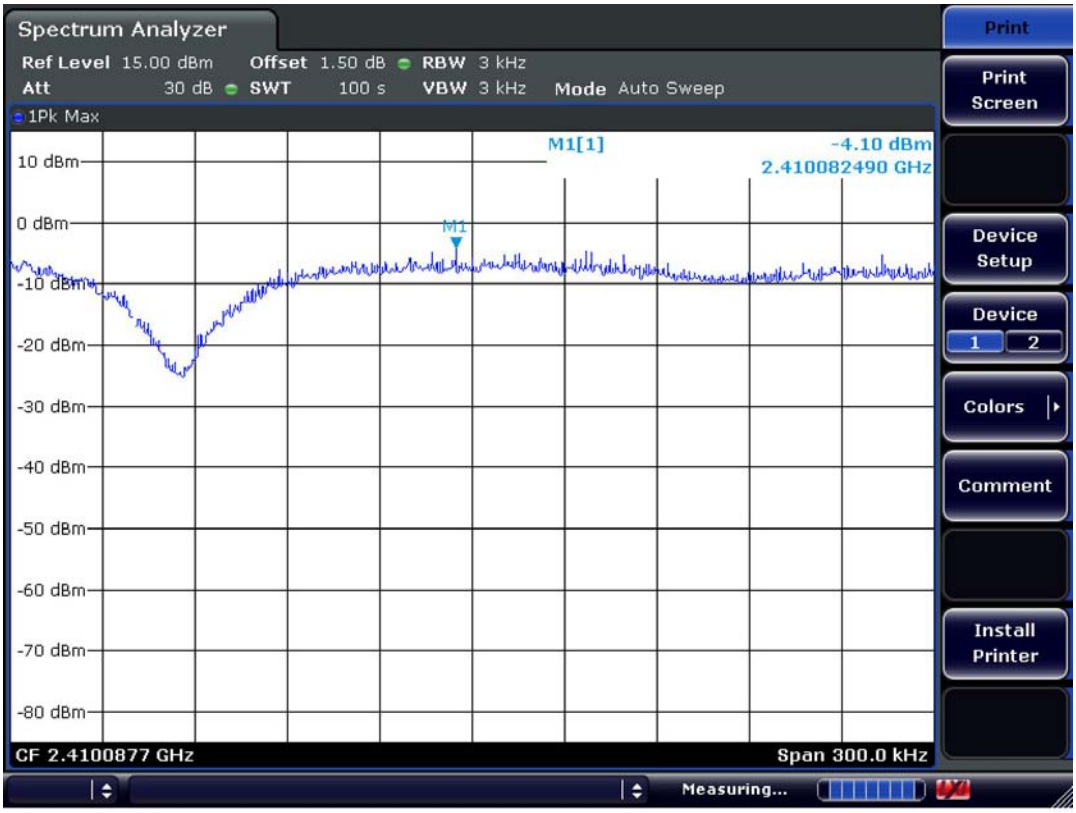
Power Spectral Density	< 8dBm @ 3kHz BW

Measurement Setup

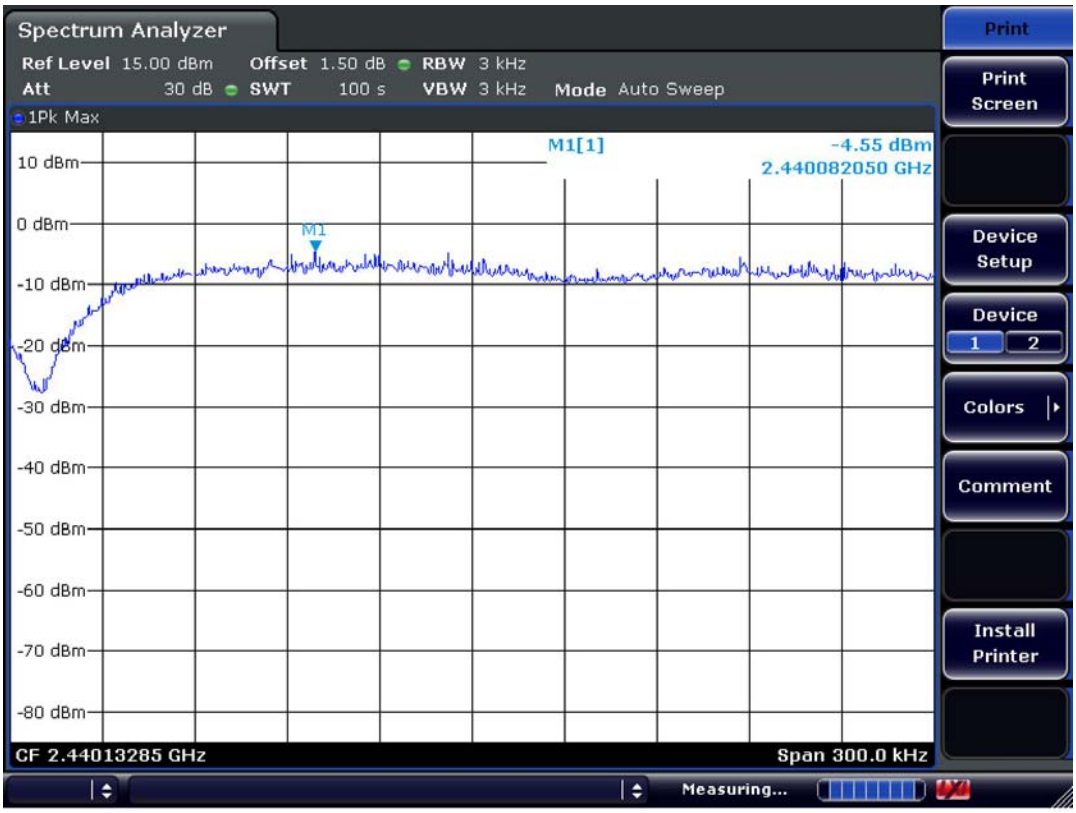
Same as the Chapter 3.2.1 (Figure 1)

Power Density Measurement

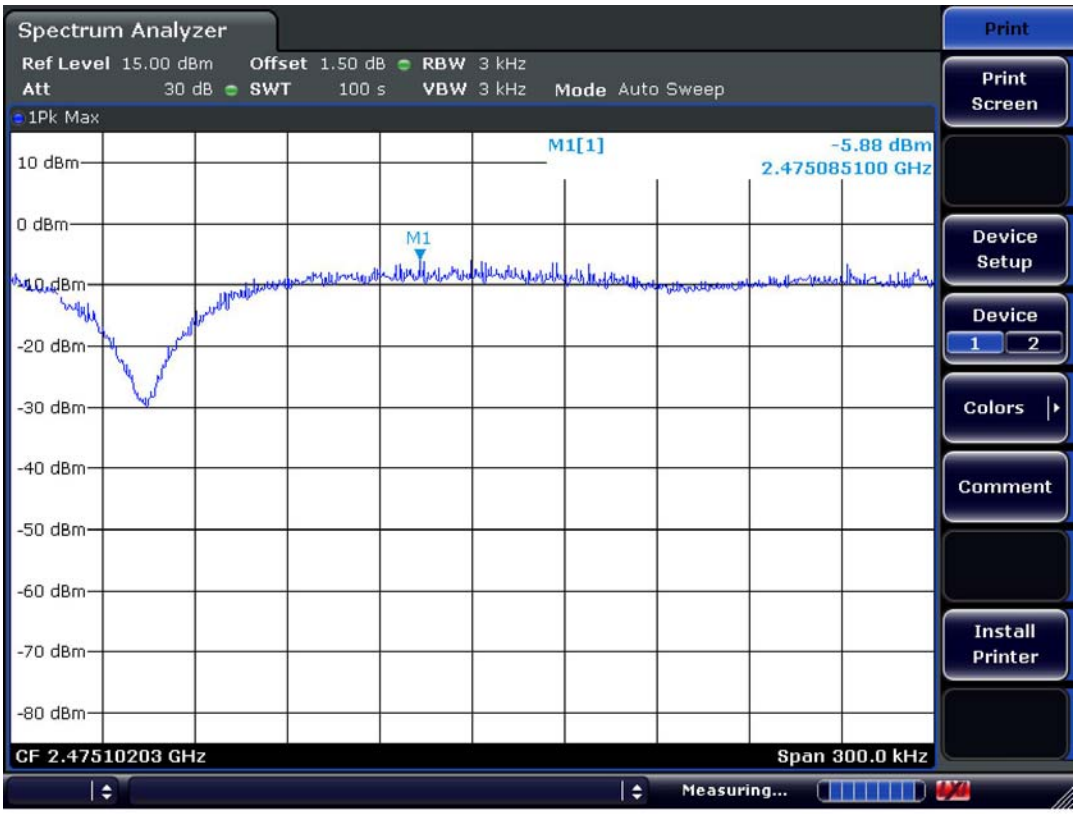
Low Channel



Mid Channel



High Channel



3.2.4 Band - edge & Spurious

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 is operating in transmission mode at the appropriate frequencies.

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 = 40 MHz Detector function = peak

Trace = max hold Sweep = auto

Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

The spectrum analyzer is set to:

Center frequency = the highest, the lowest channels

PEAK: RBW = VBW = 1MHz, Sweep=Auto

Average: RBW = 1MHz, VBW=10Hz, Sweep=Auto

Measurement Distance: 3m

Polarization: Horizontal / Vertical

Measurement Data: Complies

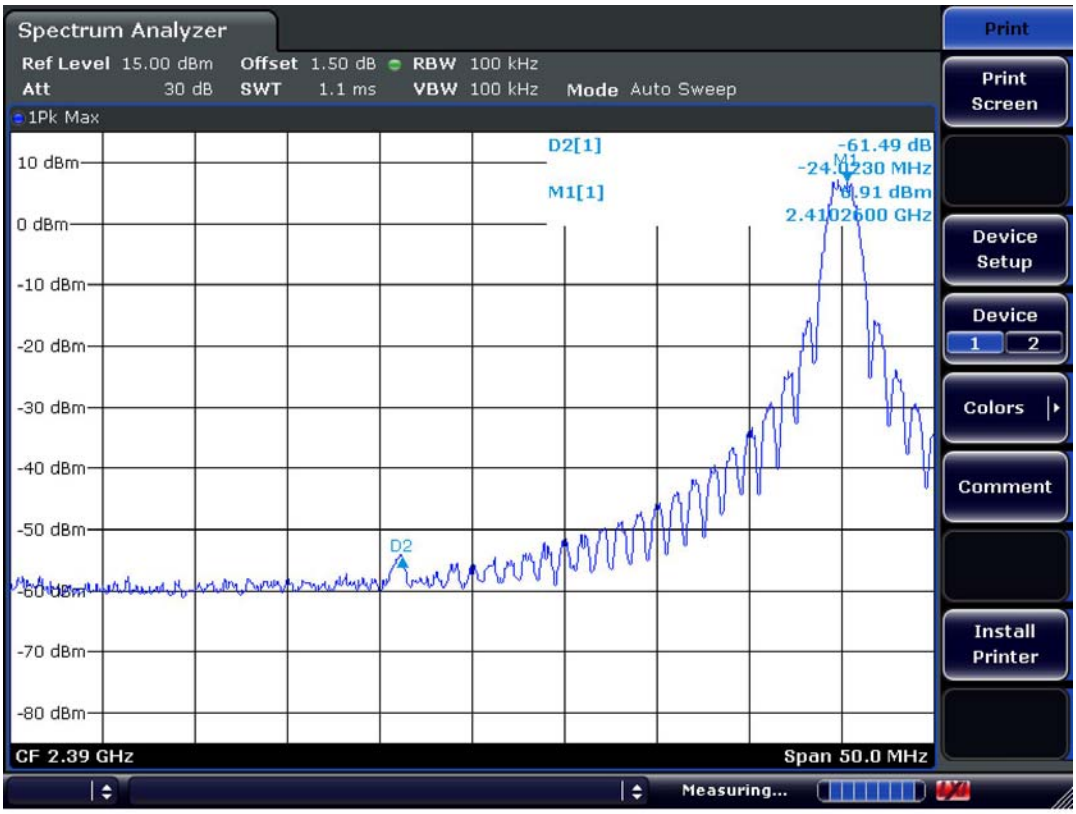
- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.
- See next pages for actual measured spectrum plots.
- The used antenna is “R-AN2400-1901RS” and it gave the worse case emissions.

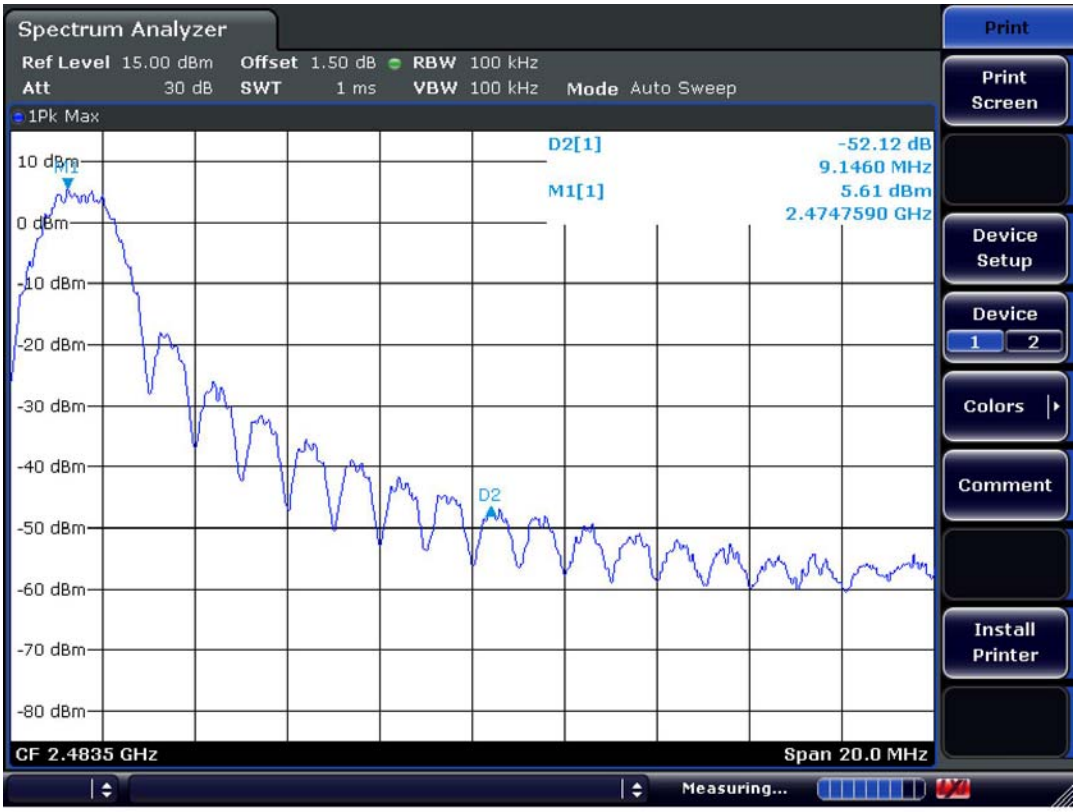
Minimum Standard:	> 20 dBc

Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

Band–edge





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

Frequency	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
[MHz]	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2390.00	49.3	60.3	H	26.0	36.5	8.2	54.0	74.0	47.1	58.0	7.0	16.0

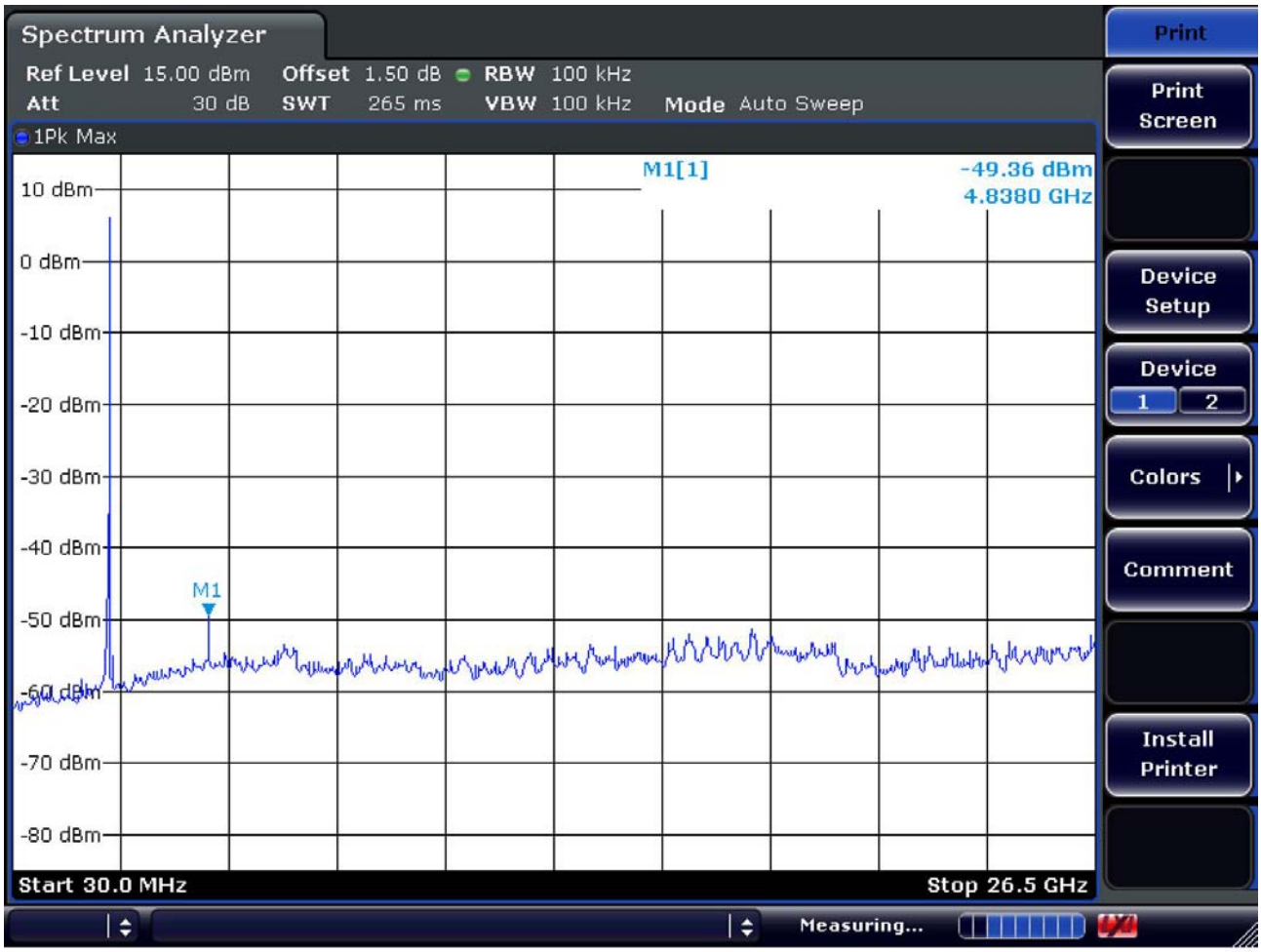
Band-edges in the restricted band 2483.5-2500 MHz measurement

Frequency	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
[MHz]	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2483.60	50.2	61.4	H	26.0	36.5	8.2	54.0	74.0	47.9	59.1	6.1	14.9

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

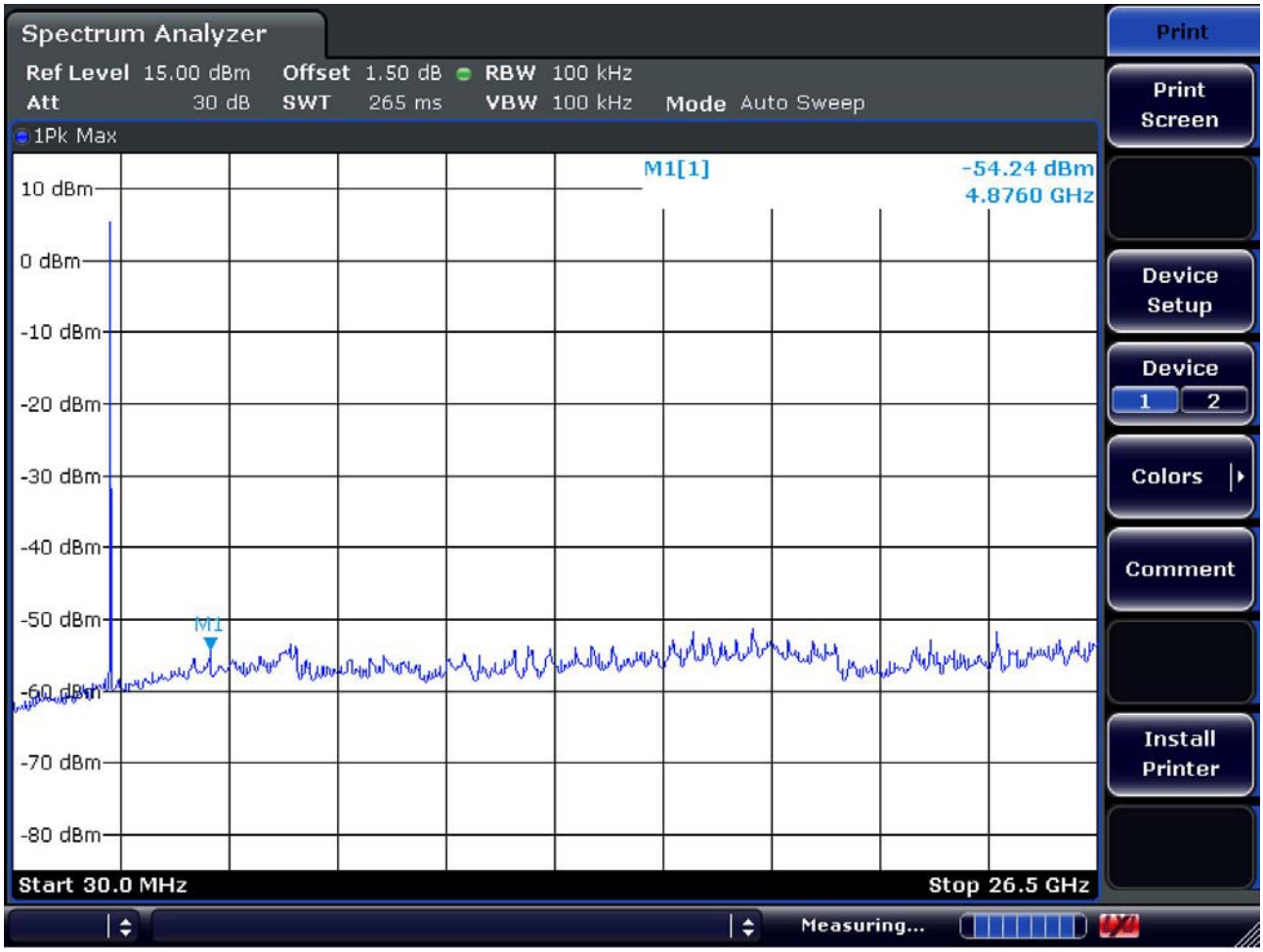
Low channel

Frequency Range = 30 MHz ~ 10th harmonic.



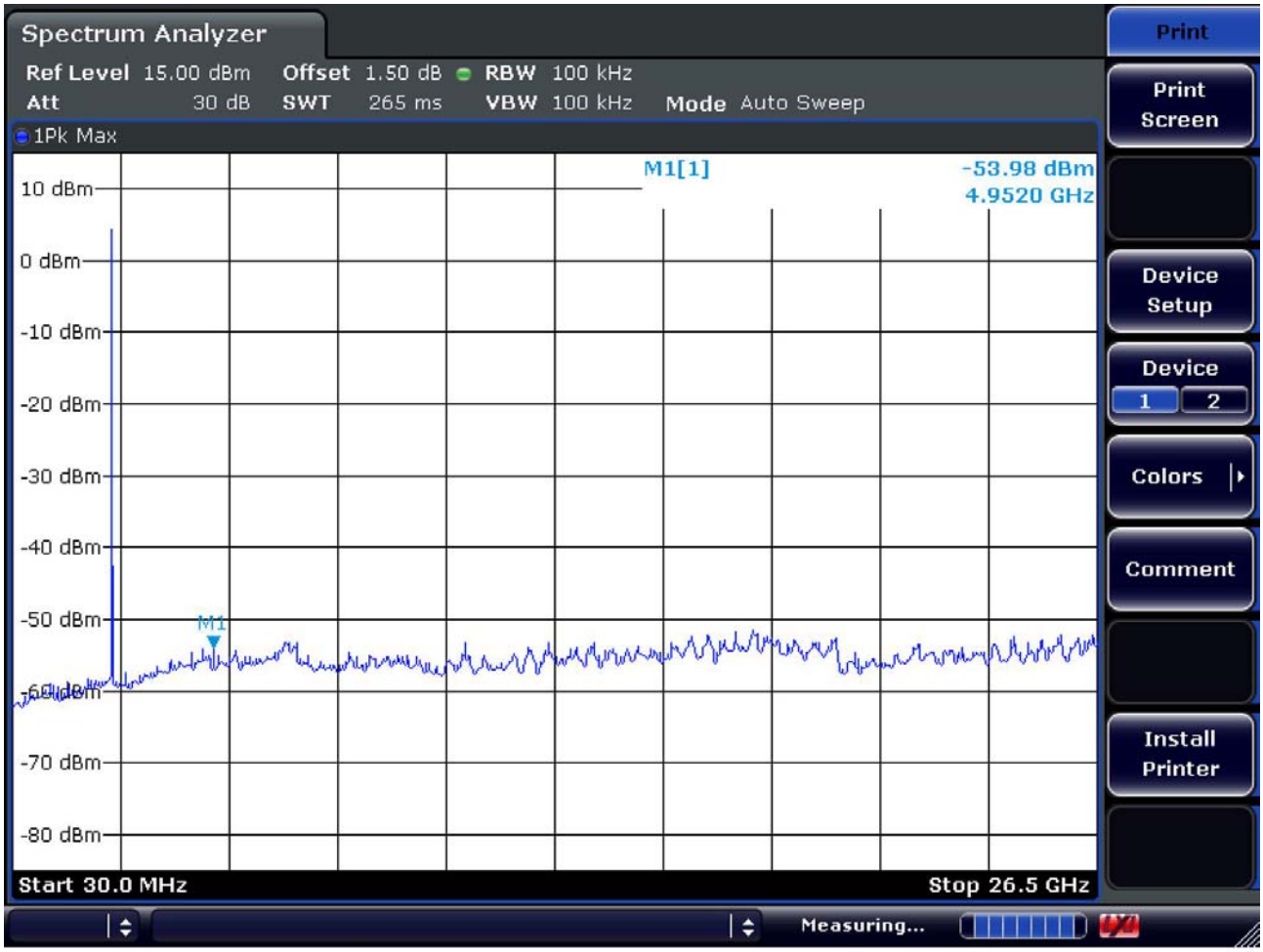
Mid channel

Frequency Range = 30 MHz ~ 10th harmonic.



High channel

Frequency Range = 30 MHz ~ 10th harmonic.



3.2.5 Field Strength of Harmonics

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.

The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 30 MHz ~ 10th harmonic.

RBW = 100 kHz (30MHz ~ 1 GHz) VBW ≥ RBW

= 1 MHz (1 GHz ~ 10th harmonic)

Span = 100 MHz Detector function = peak

Trace = max hold Sweep = auto

Measurement Data: Complies

- See next pages for actual measured data.
- The used antenna is "R-AN2400-1901RS" and it gave the worse case emissions.

Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
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.

Minimum Standard: FCC Part 15.109

Frequency (MHz)	Limit (uV/m) @ 10m
30 ~ 88	90
88 ~ 216	150
216 ~ 960	210
Above 960	300

Measurement Data:

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
4820.00	46.8	52.4	H	31.4	34.6	8.7	54.0	74.0	52.3	57.9	1.8	16.2
4880.00	42.4	48.2	H	31.4	34.6	8.7	54.0	74.0	47.9	53.7	6.2	20.4
4950	43.2	49.4	H	31.4	34.6	8.7	54.0	74.0	48.7	54.9	5.3	19.2

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

Radiated Emissions – Zigbee

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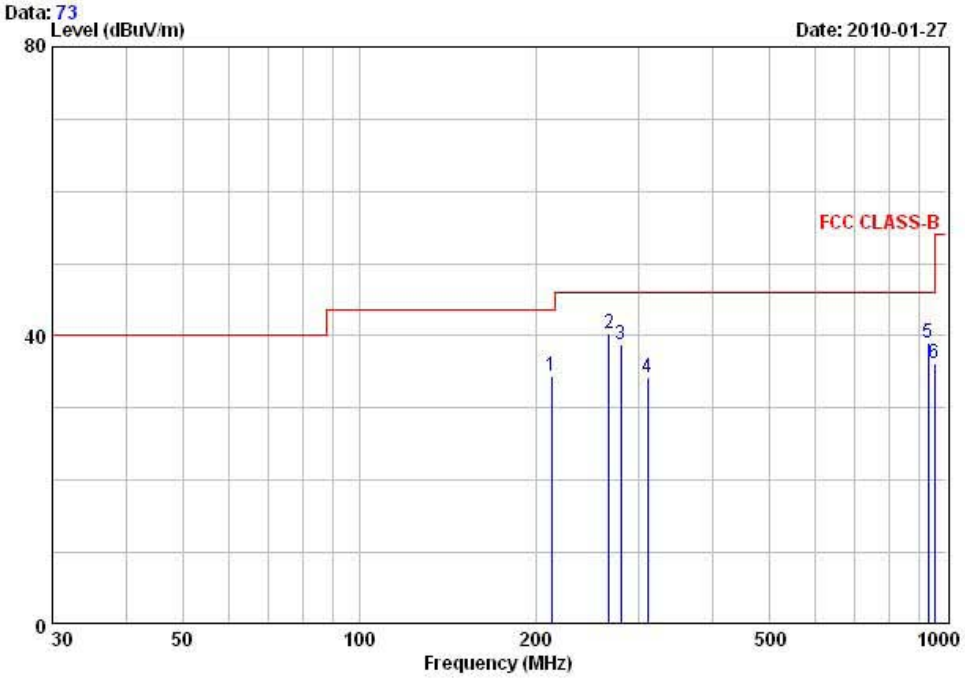
EUT/Model No.: ZBlinx-ZS10 TEST MODE: ZigBee mode

Temp Humi : 2 / 25 Tested by: PARK.H.W



	Freq	Reading	C.F	Result	Limit QP	Margin	Height	Angle	Polarity
	MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	213.02	46.40	-11.86	34.54	43.50	8.96	239	71	HORIZONTAL
2	266.61	49.90	-9.65	40.25	46.00	5.75	241	28	HORIZONTAL
3	279.04	48.00	-9.21	38.79	46.00	7.21	162	82	HORIZONTAL
4	310.00	42.60	-8.31	34.29	46.00	11.71	135	27	HORIZONTAL
5	932.66	37.00	2.04	39.04	46.00	6.96	100	136	HORIZONTAL
6	955.83	33.80	2.39	36.19	46.00	9.81	106	247	HORIZONTAL

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

3.2.6 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: Complies

- See next pages for actual measured spectrum plots.
- No emissions were detected at a level greater than 10dB below limit.
- The used antenna is "R-AN2400-1901RS" and it gave the worse case emissions.

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

Class B

Frequency Range	quasi-peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

AC Conducted Emissions – Zigbee – Line

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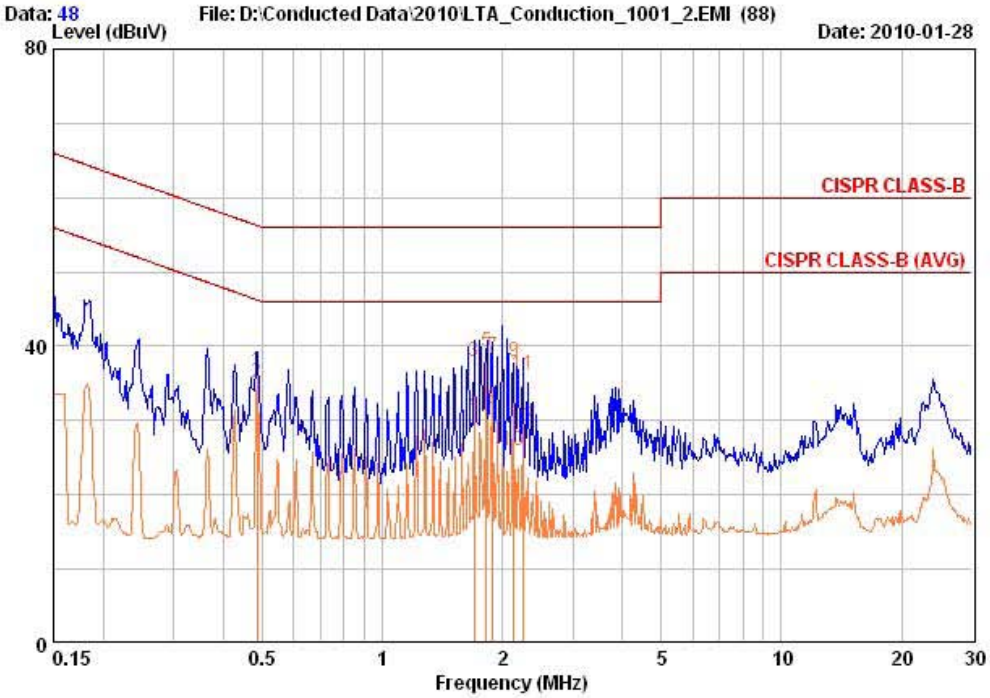
EUT / Model No.	: ZBlinx-ZS10	Phase	: LINE
Test Mode	: ZigBee mode	Test Power	: 120 / 60
Temp./Humi.	: 24 / 33	Test Engineer	: PARK.H.W



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
0.486	26.95	25.35	9.67	36.62	35.02	56.24	46.24	19.62	11.22
1.703	28.15	21.25	9.81	37.96	31.06	56.00	46.00	18.04	14.94
1.825	29.35	21.75	9.81	39.16	31.56	56.00	46.00	16.84	14.44
1.888	28.85	21.85	9.82	38.67	31.67	56.00	46.00	17.33	14.33
2.132	28.06	16.16	9.82	37.88	25.98	56.00	46.00	18.12	20.02
2.253	26.36	19.46	9.83	36.18	29.28	56.00	46.00	19.82	16.72

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

AC Conducted Emissions – Zigbee – Neutral

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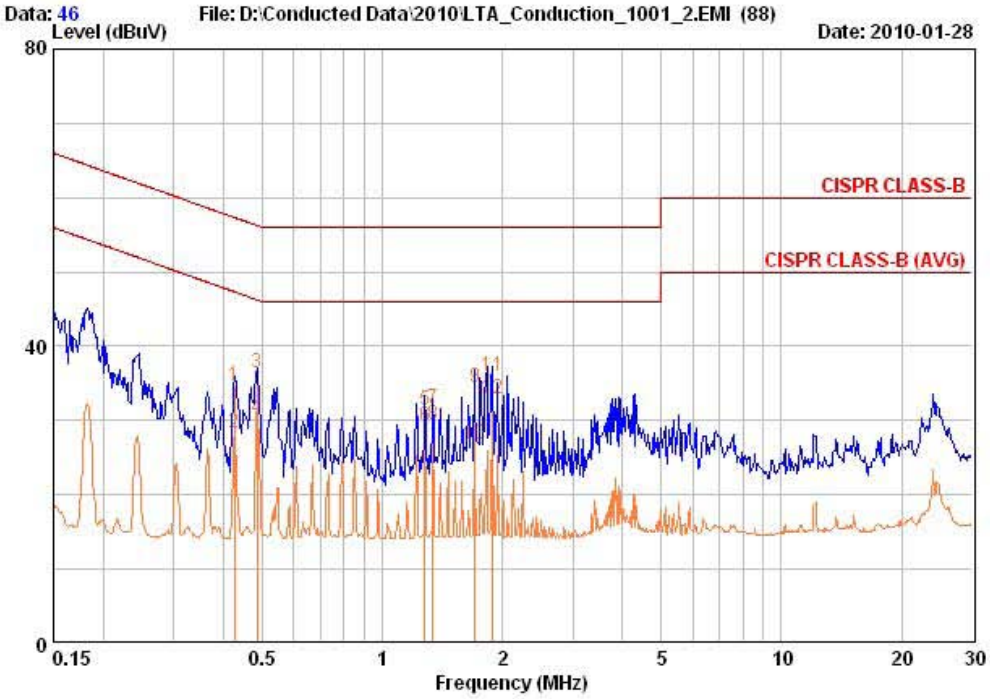
Tel :+82-31-3236008,9
Fax:+82-31-3236010

EUT / Model No.	: ZBlinx-ZS10	Phase	: NEUTRAL
Test Mode	: ZigBee mode	Test Power	: 120 / 60
Temp./Humi.	: 24 / 33	Test Engineer	: PARK.H.W



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
0.426	24.95	18.65	9.66	34.61	28.31	57.33	47.33	22.72	19.02
0.485	26.65	20.65	9.66	36.31	30.31	56.25	46.25	19.94	15.94
1.278	21.65	19.35	9.79	31.44	29.14	56.00	46.00	24.56	16.86
1.339	21.75	19.55	9.79	31.54	29.34	56.00	46.00	24.46	16.66
1.704	24.65	17.05	9.81	34.46	26.86	56.00	46.00	21.54	19.14
1.889	26.15	23.15	9.82	35.97	32.97	56.00	46.00	20.03	13.03

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

APPENDIX

TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Next Cal. Date
1	Spectrum Analyzer	FSV-30	100757	R&S	Feb-10
2	Spectrum Analyzer	8563E	3425A02505	HP	Apr-10
3	Spectrum Analyzer	8594E	3710A04074	HP	Oct-10
4	Signal Generator	8648C	3623A02597	HP	Apr-10
5	Signal Generator	83711B	US34490456	HP	Apr-10
6	Attenuator (3dB)	8491A	37822	HP	Oct-10
7	Attenuator (10dB)	8491A	63196	HP	Oct-10
8	Attenuator (30dB)	8498A	1801A06689	HP	Oct-10
9	EMI Test Receiver	ESVD	843748/001	R&S	Apr-10
10	Horn Antenna(18 ~ 40GHz)	SAS-574	154	Schwarzbeck	Nov-10
11	Horn Antenna(18 ~ 40GHz)	SAS-574	155	Schwarzbeck	Nov-10
12	RF Amplifier	8447D	2949A02670	HP	Oct-10
13	RF Amplifier	8449B	3008A02126	HP	Apr-10
14	Test Receiver	ESHS10	828404/009	R&S	Apr-10
15	TRILOG Antenna	VULB 9160	9160-3212	SCHWARZBECK	Apr-11
16	Log.-Per. Antenna	VULP 9118	9118 A 401	SCHWARZBECK	Apr-11
17	Biconical Antenna	BBA 9106	VHA 9103-2315	SCHWARZBECK	Apr-11
18	Horn Antenna	3115	00055005	ETS LINDGREN	Mar-11
19	Horn Antenna	BBHA 9120D	9120D122	SCHWARZBECK	Dec-11
20	Dipole Antenna	VHA9103	2116	SCHWARZBECK	Nov-10
21	Dipole Antenna	VHA9103	2117	SCHWARZBECK	Nov-10
22	Dipole Antenna	VHA9105	2261	SCHWARZBECK	Nov-10
23	Dipole Antenna	VHA9105	2262	SCHWARZBECK	Nov-10
24	Hygro-Thermograph	THB-36	0041557-01	ISUZU	Apr-10
25	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-
26	RF Switch	MP59B	6200414971	ANRITSU	-
27	Power Divider	11636A	6243	HP	Oct-10
28	DC Power Supply	6622A	3448A03079	HP	Oct-10
29	Frequency Counter	5342A	2826A12411	HP	Apr-10
30	Power Meter	EPM-441A	GB32481702	HP	Apr-10
31	Power Sensor	8481A	2702A64048	HP	Apr-10
32	Audio Analyzer	8903B	3729A18901	HP	Oct-10
33	Modulation Analyzer	8901B	3749A05878	HP	Oct-10
34	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	Oct-10
35	LOOP-ANTENNA	FMZB 1516	151602/94	SCHWARZBECK	Mar-11
36	Stop Watch	HS-3	601Q09R	CASIO	Apr-10
37	LISN	ENV216	100408	R&S	Oct-10