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## TEST REPORT For FCC

Test Report No. : 2008010026  
Date of Issue : January 23, 2008  
FCC ID : NLMURP-SU110  
Model/Type No. : URP-SU110  
Kind of Product : UHF RFID Handheld READER  
Applicant : SAMSUNG TECHWIN CO., LTD  
Applicant Address : 145-3 Sangdaewon 1 dong, Chungwon-ku, Sunghnam City,  
Kyungki-do, Korea  
Manufacturer : SAMSUNG TECHWIN CO., LTD  
Manufacturer Address : 145-3 Sangdaewon 1 dong, Chungwon-ku, Sunghnam City,  
Kyungki-do, Korea  
Contact Person : Moon Soo - Choi / Engineer  
Telephone : +82-31-280-8073  
Received Date : December 27, 2007  
Test period : Start : January 7, 2008 End : January 18, 2008  
Test Results :  In Compliance  Not in Compliance

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

Tested by

Kyu-Chul, Shin  
Test Engineer  
Date: January 23, 2008

Reviewed by

Young-Joon, Park  
Technical Manager  
Date: January 23, 2008



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## REPORT REVISION HISTORY

Date	Revision	Page No
January 23, 2008	Issued (2008010026)	All

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## 1.0 General Product Description

Equipment model name : URP-SU110

Serial number : Prototype

EUT condition : Pre-production, not damaged

Antenna type : Patch antenna Gain 4.52dBi

Frequency Range : 902.75MHz ~ 927.25 MHz

RF power : 25.25dBm - Conducted

Number of channels : 50CH

Channel Spacing : 0.49MHz

Channel Access Protocol : Frequency Hopping

Type of Modulation : GFSK

Power Source : Li-Polymer Battery (DC 4.2V )

## 1.1 Tested Frequency

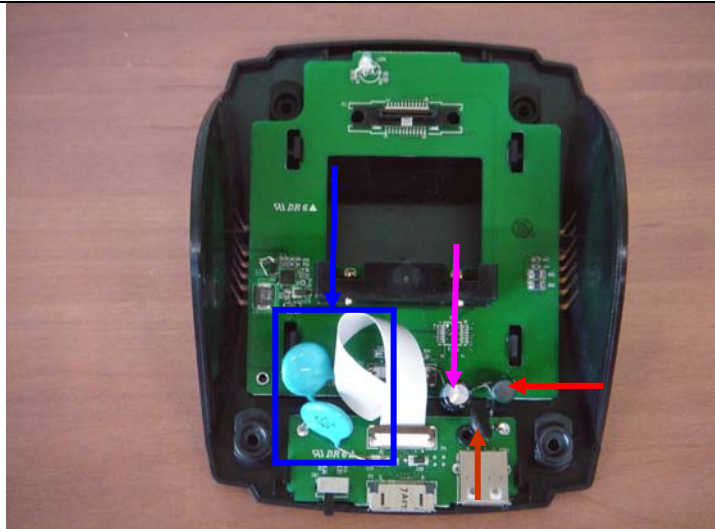
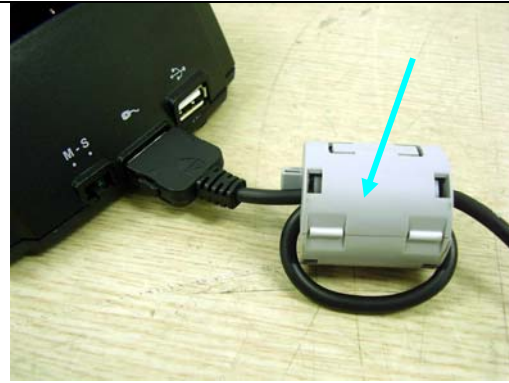
	LOW	MID	HIGH
Frequency (MHz)	902.75	914.25	927.25

## 1.2 Model Differences

Not applicable

## 1.3 Device Modifications

The following modifications were necessary for compliance:

— 0.47 uF x 2    — 22 uF  
— 0.2 uH  
— thermistor  
— Core

Location	Manufacturer	Part number	Turn number
DC IN	TDK	ZCAT3035-1330	1

\*Manufacturer does debugging directly and applied

## 1.4 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.	FCC ID or DoC
Notebook PC	DELL	LATITUDE D505	32775808960	DoC
I.T.E. POWER SUPPLY	AULT KOREA Corp.	JPW150	KA0500F51	-
Personal Computer	SAMSUNG ELECTRONICS Co., Ltd.	DM-V60	493J96BLB00311Y	DoC
USB Mouse	MICROSOFT CORPORATION	Optical Mouse: USB/PS2 Compatible	69657-492-4974533-40420	DoC
PS/2 Mouse	SYSGRATION	SAGM002	304009601	DoC
PS/2 Keyboard	HEWLETT-PACKARD COMPANY	5219	BN50702141	DoC
LCD Monitor	TIANJIN SAMSUNG ELECTRONICS DISPLAY	GH17US	N372HVEX225526	DoC
Adaptor	Anam Instruments (Shen Zhen) Co., Ltd.	AP0414-UV	-	-



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### 1.5 Calibration Details of Equipment Used for Measurement

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

### 1.6 Test Facility

The measurement facility is located at 386-1, Ho-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-100, Korea.

### 1.7 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Logo
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	 93250
JAPAN	VCCI	10 meter Open Area Test Site and one conducted site.	 R-948, C-986
KOREA	MIC	EMI (10 meter Open Area Test Site and two conducted sites) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	 No. 51, KR0025
International	KOLAS	EMC	
Europe	GLAS	EMC EN 55011, EN 55022, EN 61000-6-3, EN 61000-6-4, EN 61000-3-2, EN 61000-3-3, EN 61000-6-1, EN 61000-6-2, EN 50130-4, EN 55024, EN 61204-3, EN 60601-1-2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11	 No.13000796-02



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## 2.0 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	> 50 hops		C
15.247(a)	Occupoed Bandwidth	< 500 KHz		C
15.247	Time of Occupancy	< 0.4 seconds		C
15.247(b)	Transmitter Output Power	< 1Watt		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
15.207 /15.107	AC Conducted Emissions	EN 55022	Line Conducted	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.

The sample was tested according to the following specification:  
- FCC Part 15.247, ANSI C63.4-2003

## 2.1 Transmitter Requirements

### 2.1.1 Carrier Frequency Separation

#### Test Location

RF Test Room

#### Test Procedures

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled. After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

#### The spectrum analyzer is set to:

Span = 5 MHz

RBW = 100 kHz ( $\geq$  1% of the span) Sweep = auto

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

Trace = max hold

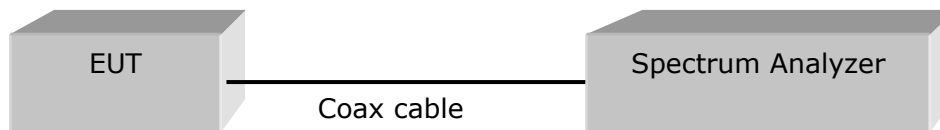


Figure 1 : Measurement setup for the carrier frequency separation

#### Limit

The EUT shall have hopping channel carrier frequencies separated minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

#### Test Results

Carrier Frequency Separation (MHz)	Result
0.5	Complies

See next pages for actual measured spectrum plots.





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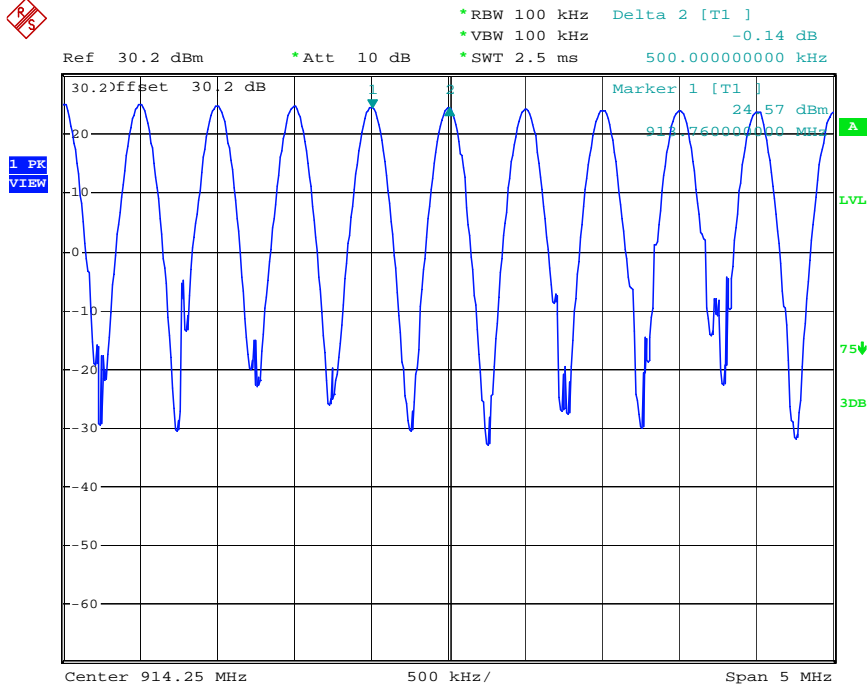
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## Carrier Frequency Separation



## 2.1.2 Number of Hopping Frequencies

### Test Location

RF Test Room

### Test Procedures

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

The spectrum analyzer is set to:

Frequency range      Start = 902 MHz,      Stop = 928 MHz

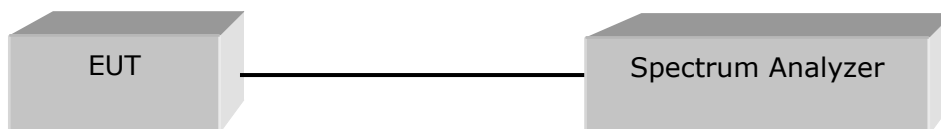
RBW = 300 kHz ( $\geq$  1% of the span)

Sweep = auto

VBW = 300 kHz ( $\geq$  RBW)

Detector function = peak

Trace = max hold



### Limit

The EUT in the 902MHz ~ 928MHz band shall use at least 50 channels.

### Test Results

Total number of Hopping Channels	Result
50	Complies

See next pages for actual measured spectrum plots.



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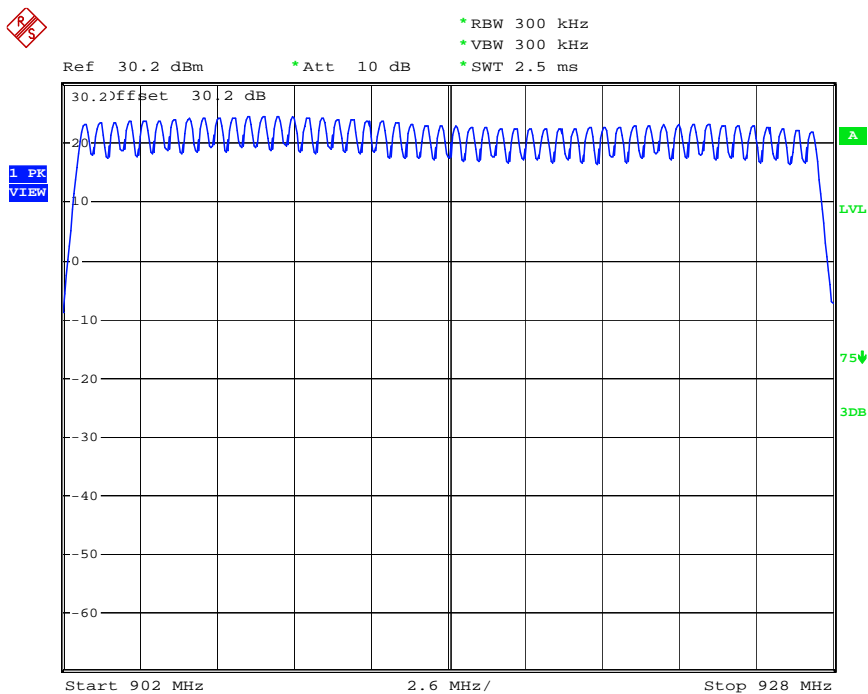
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## Number of Hopping Frequencies



## 2.1.3 Occupied Bandwidth

### Test Location

RF Test Room

### Test Procedures

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 20 dB 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 = 500kHz

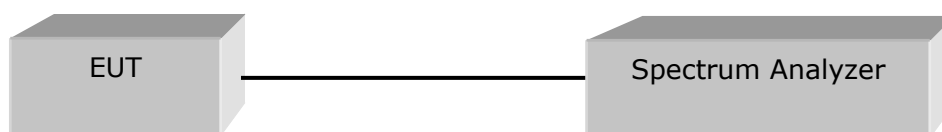
RBW = 3 kHz ( $\geq 1\%$  of the span)

Sweep = auto

VBW = 10 kHz ( $\geq$  RBW)

Detector function = peak

Trace = max hold



### Limit

The maximum allowed 20dB bandwidth of the hopping channel is 500kHz

### Test Results

Frequency (MHz)	20dB bandwidth (KHz)	99% bandwidth (KHz)	Result
902.75	52.00	63.00	Complies
914.25	52.00	63.00	Complies
927.25	53.00	64.00	Complies

See next pages for actual measured spectrum plots.



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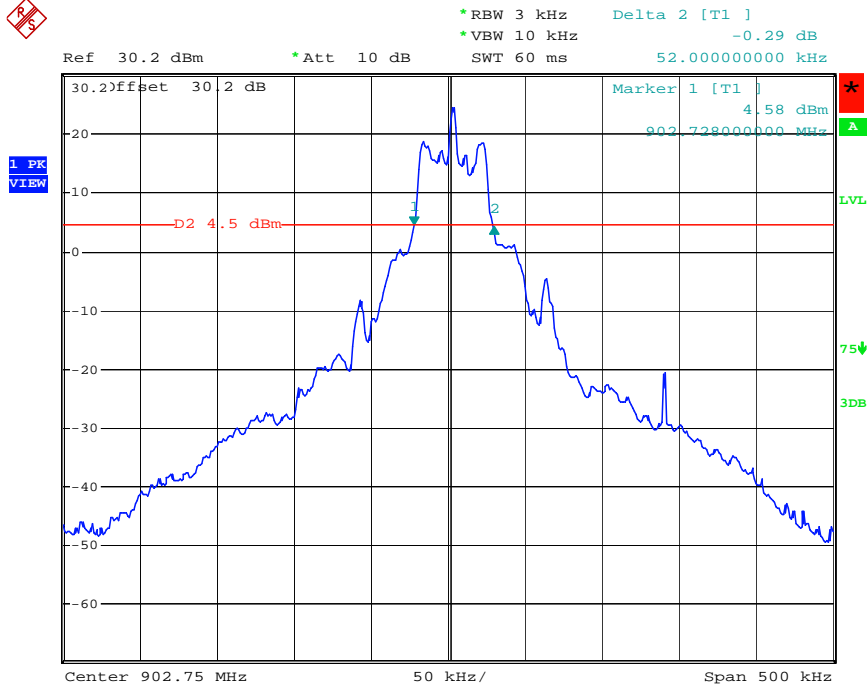
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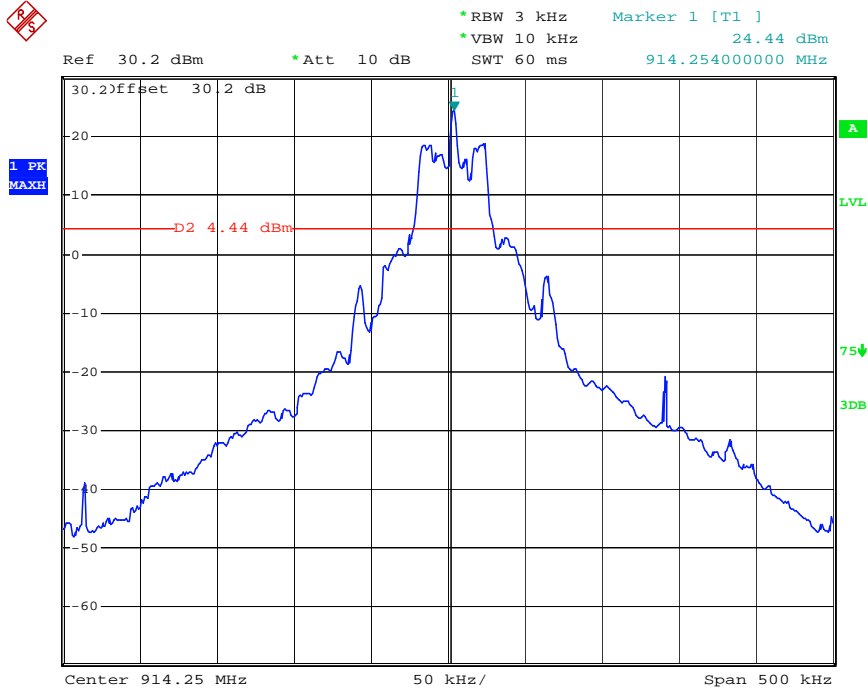
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## 20 dB Bandwidth Low Channel



## Mid Channel





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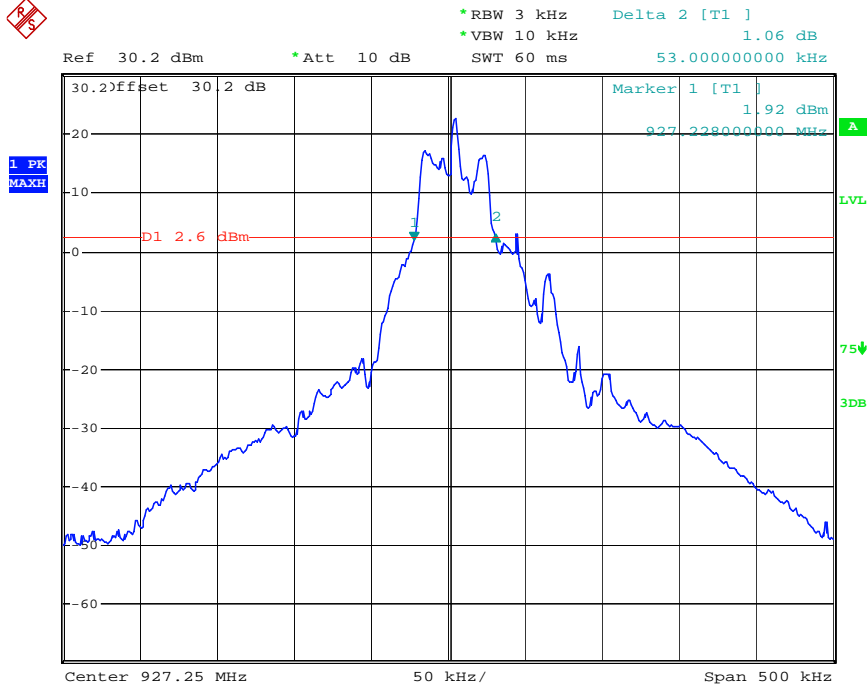
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## 20 dB Bandwidth High Channel





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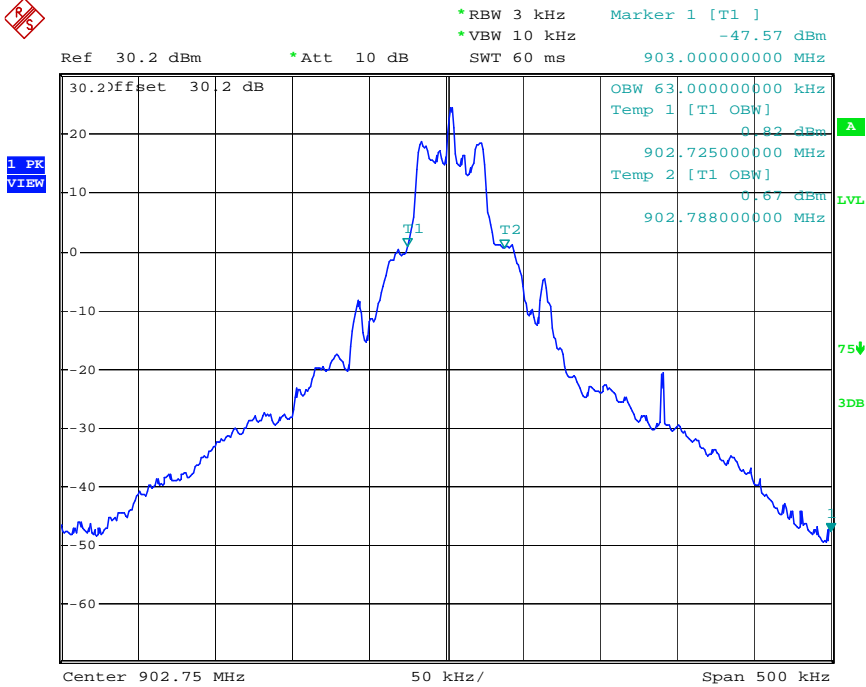
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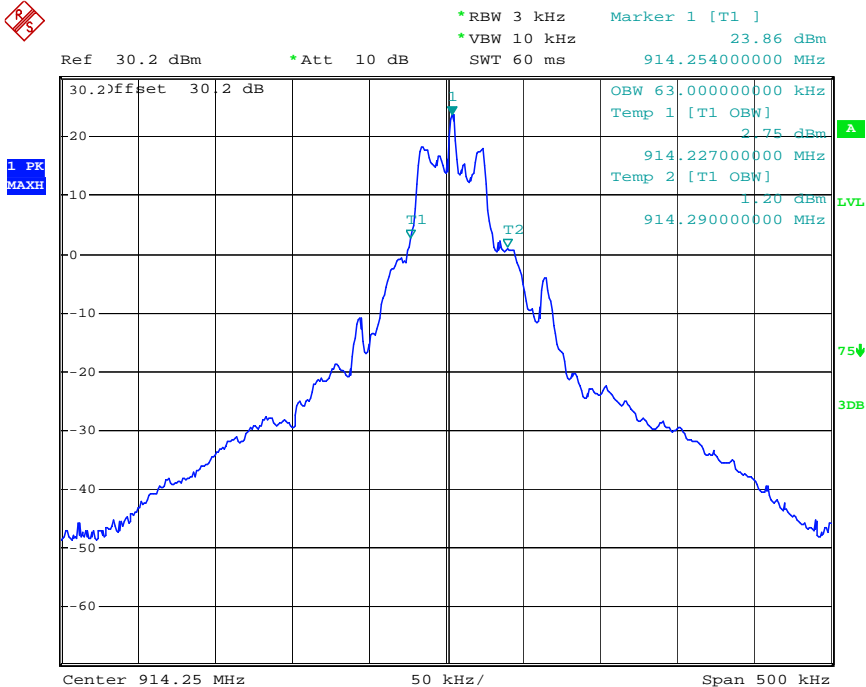
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## 99% Bandwidth Low Channel



## Mid Channel





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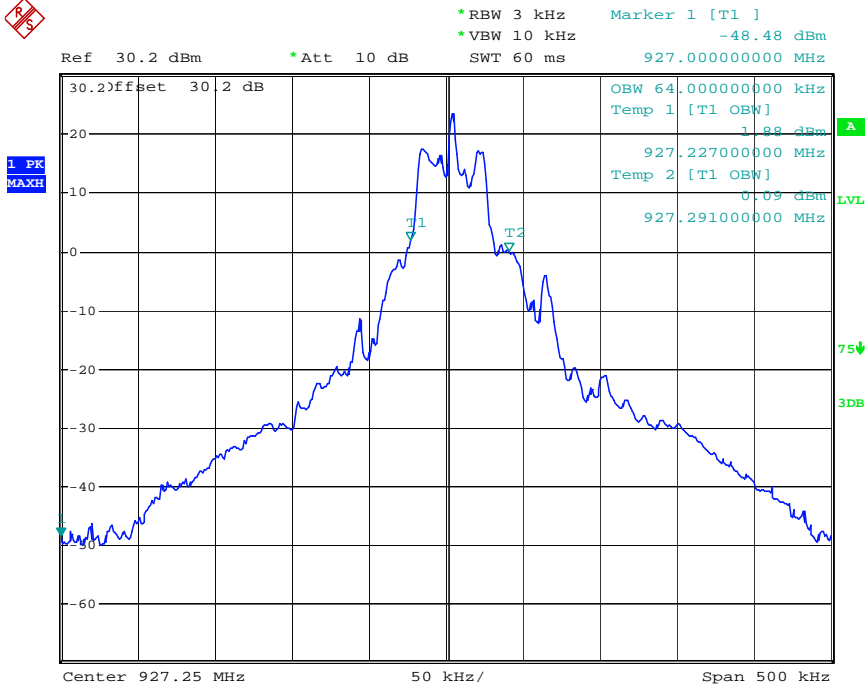
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## 99% Bandwidth High Channel





## 2.1.4 Time of Occupancy (Dwell Time)

### Test Location

RF Test Room

### Test Procedures

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

#### The spectrum analyzer is set to:

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

Span = zero

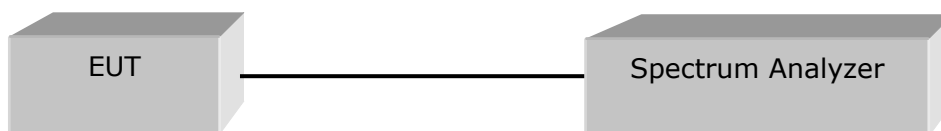
RBW = 3 kHz

Trace = max hold

VBW = 10 KHz ( $\geq$  RBW)

Detector function = peak

Sweep = as necessary to capture the entire dwell time per hopping channel



### Limit

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period .

### Test Results

**Dwell time= 0.0099sec**

**Time between occupancy = 0.54sec**

**Time of Occupancy = period / time between occupancy \* dwell time**

**Therefore ->  $(20/0.54) * 0.0099 = 0.3667\text{second} < 0.4\text{second}$**

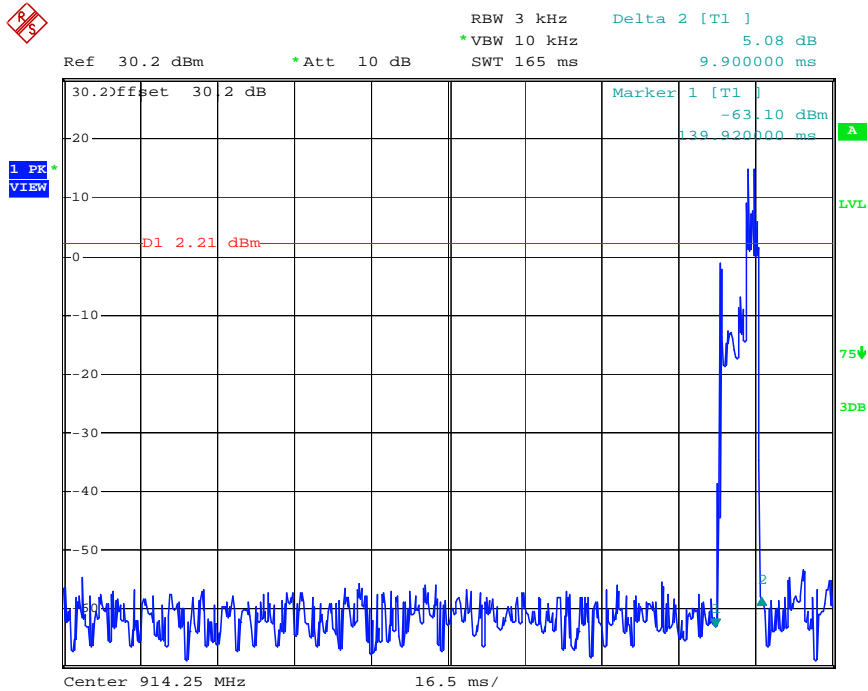


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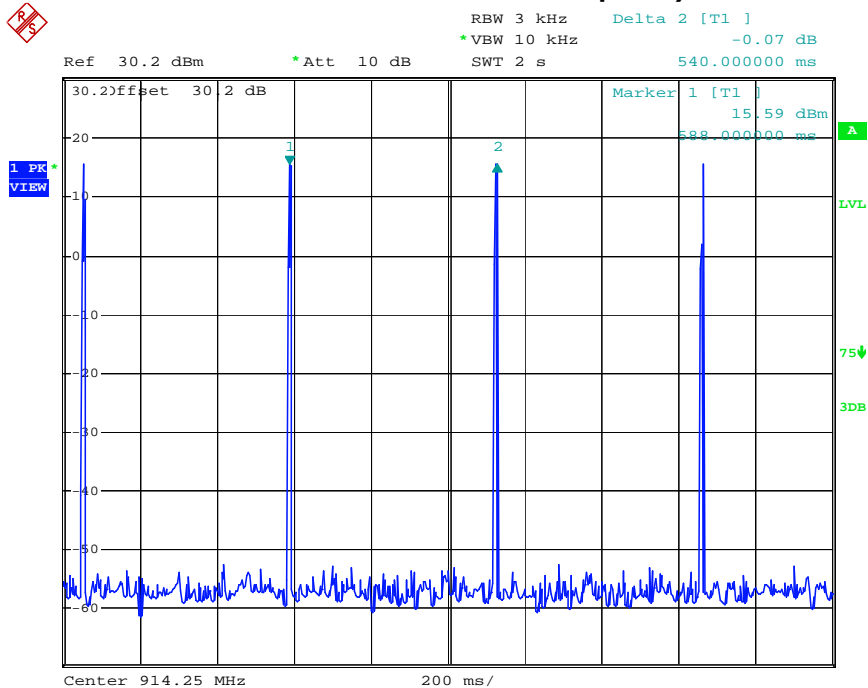
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## Dwell time



## Time between occupancy



## 2.1.5 Maximum peak Conducted Output Power

### Test Location

RF Test Room

### Test Procedures

The maximum peak conducted output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function disabled at the highest, middle and the lowest available channels.

The spectrum analyzer is set to:

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

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

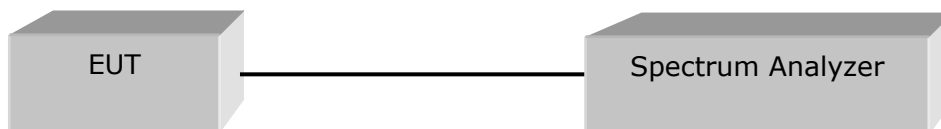
RBW = 3 MHz (greater than the 20 dB bandwidth of the EUT)

VBW = 3 MHz ( $\geq$  RBW)

Detector function = peak

Trace = max hold

Sweep = auto



### Limit

< 1 W

### Test Results

Frequency (MHz)	Peak output power(dBm)	Peak output power(mW)	Result
902.75	25.04	319.15	Complies
914.25	25.25	334.97	Complies
927.25	24.24	265.46	Complies

See next pages for actual measured spectrum plots.

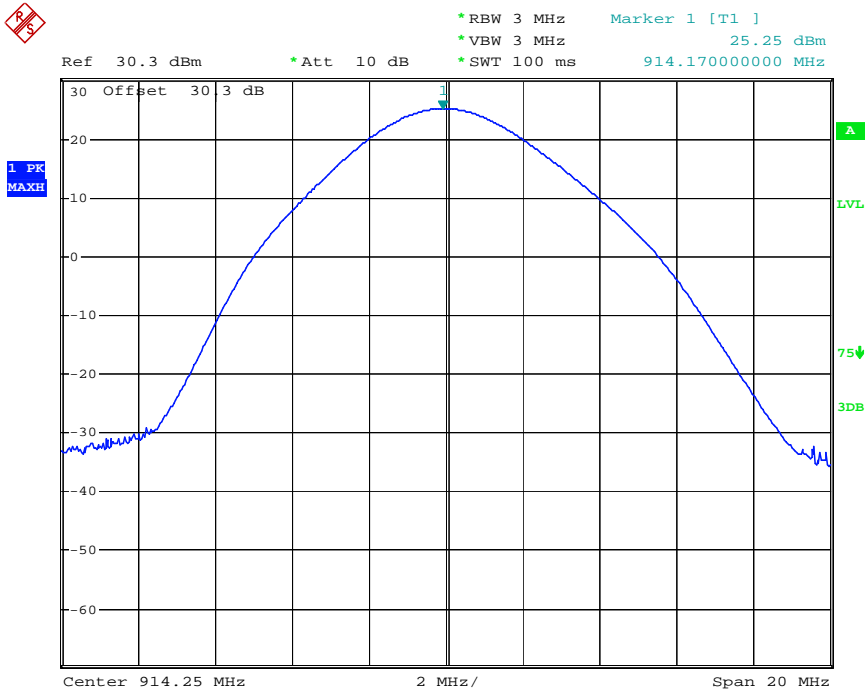
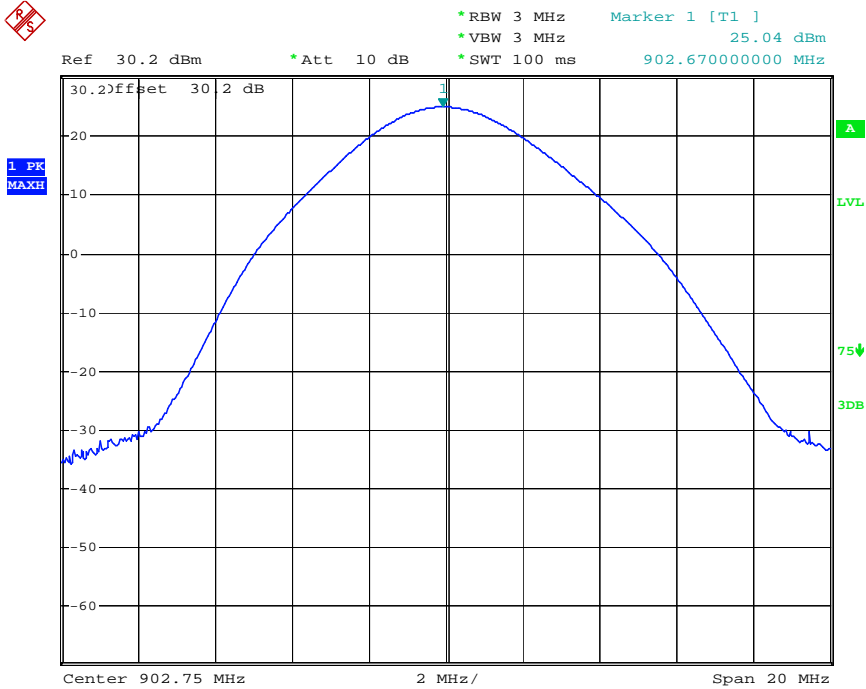


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## Maximum peak Conducted Output Power





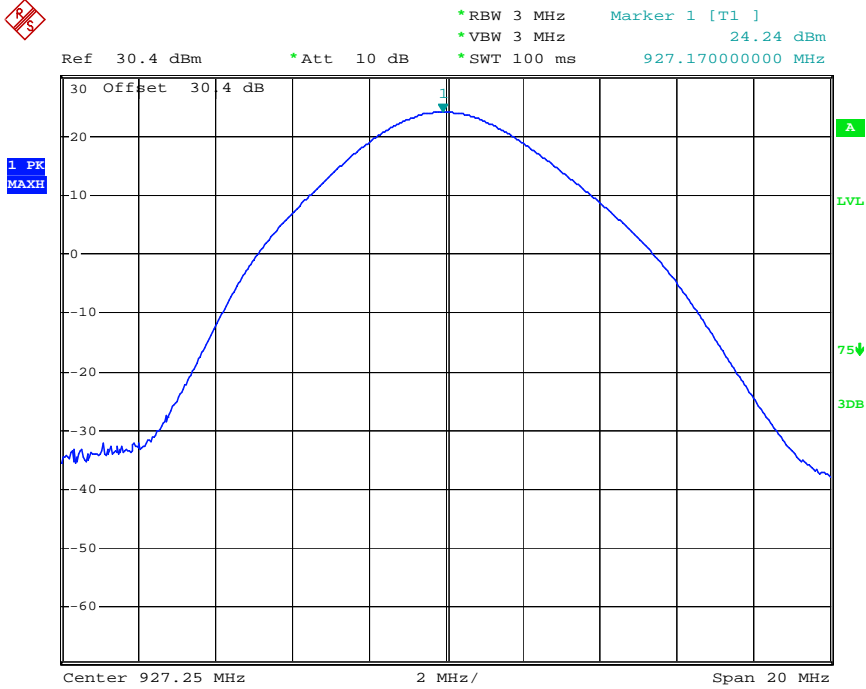
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## 2.1.6 Band-edge

### Test Location

RF Test Room

### Test Procedures

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

The spectrum analyzer is set to:

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

RBW = 100 kHz

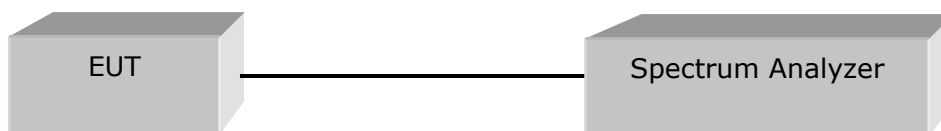
VBW = 100 kHz ( $\geq$  RBW)

Span = 100 MHz

Trace = max hold

Detector function = peak

Sweep = auto



### Limit

> 20 dBc

### Test Results

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

See next pages for actual measured spectrum plots.

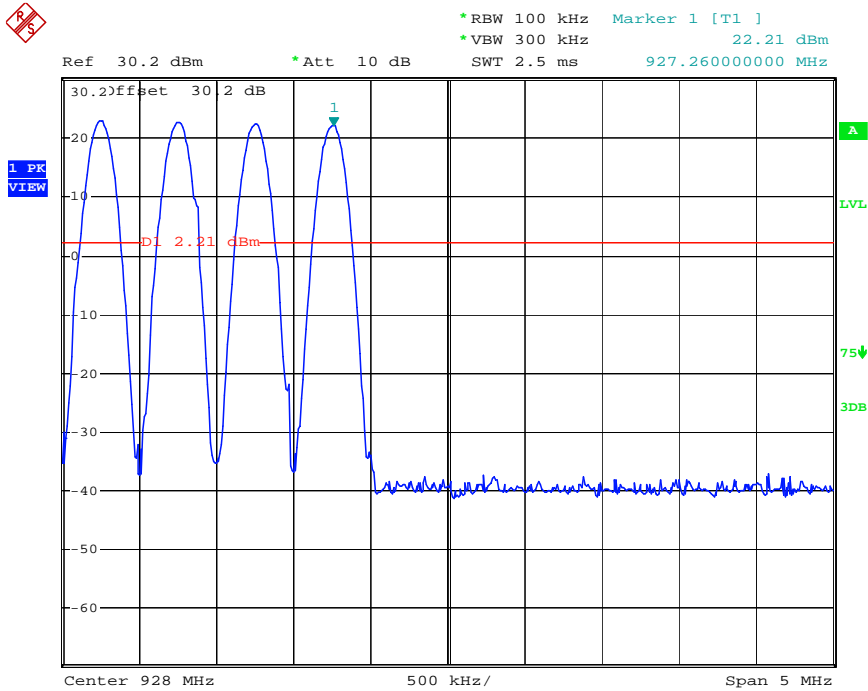


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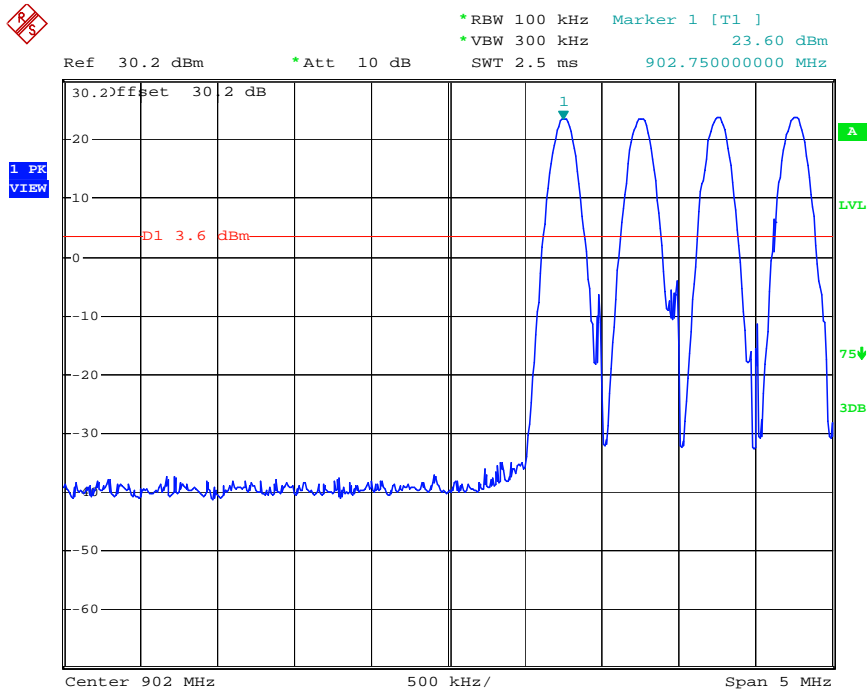
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## Band – edge (with Hopping)



Date: 30.NOV.2007 07:24:57



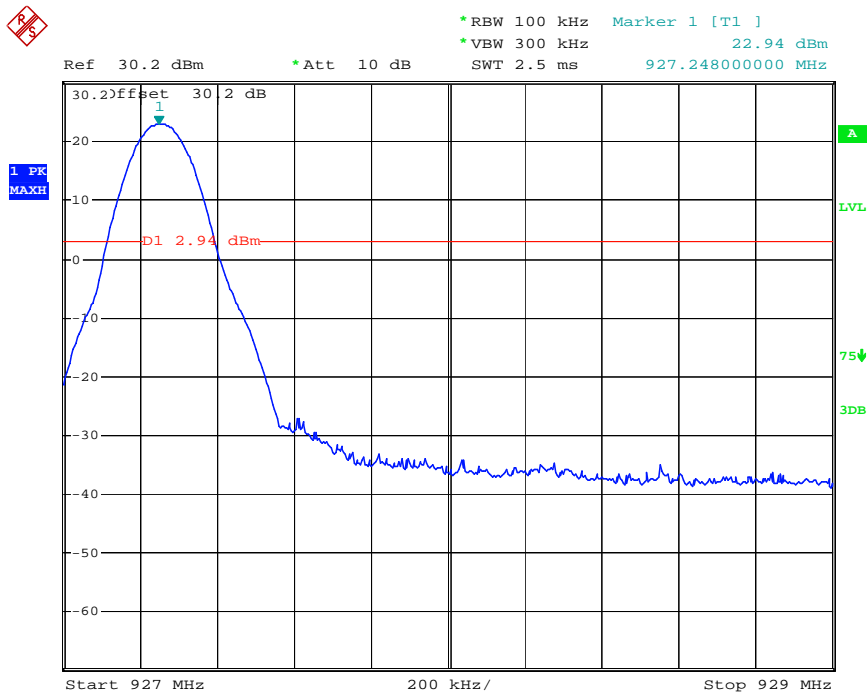
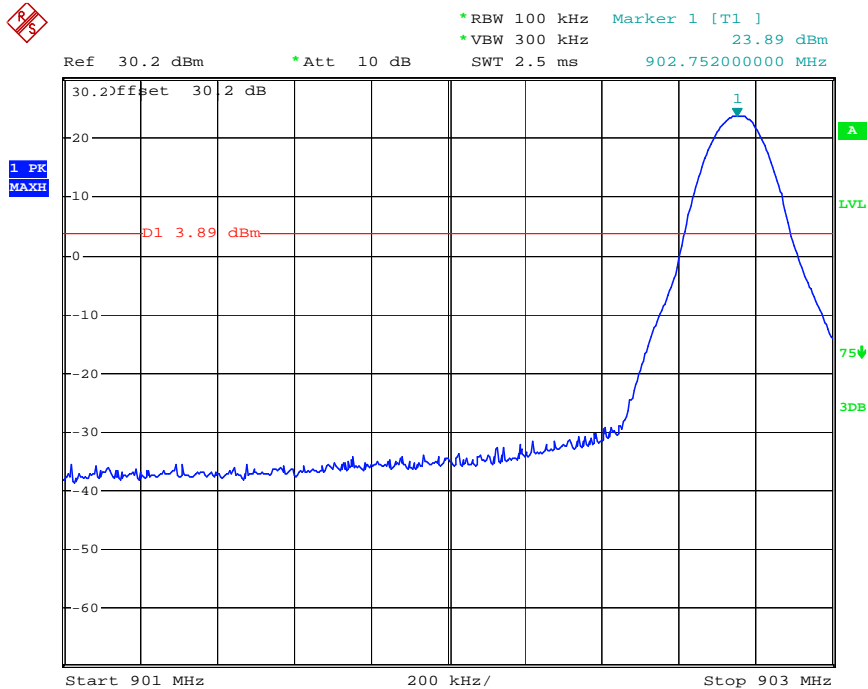


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## Band – edge (without Hopping)





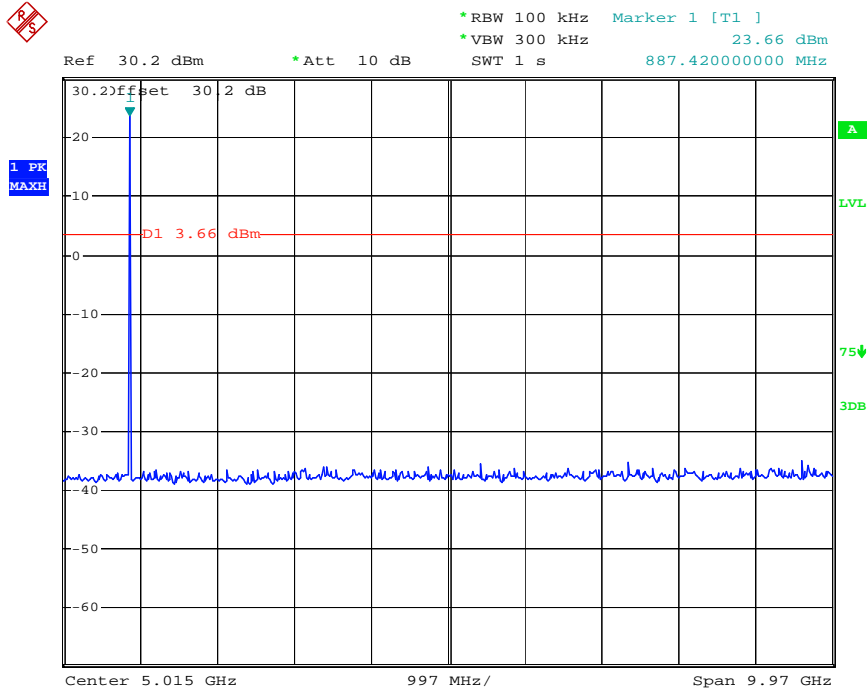


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## Band – edge (at 20 dB blow) – Low channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic





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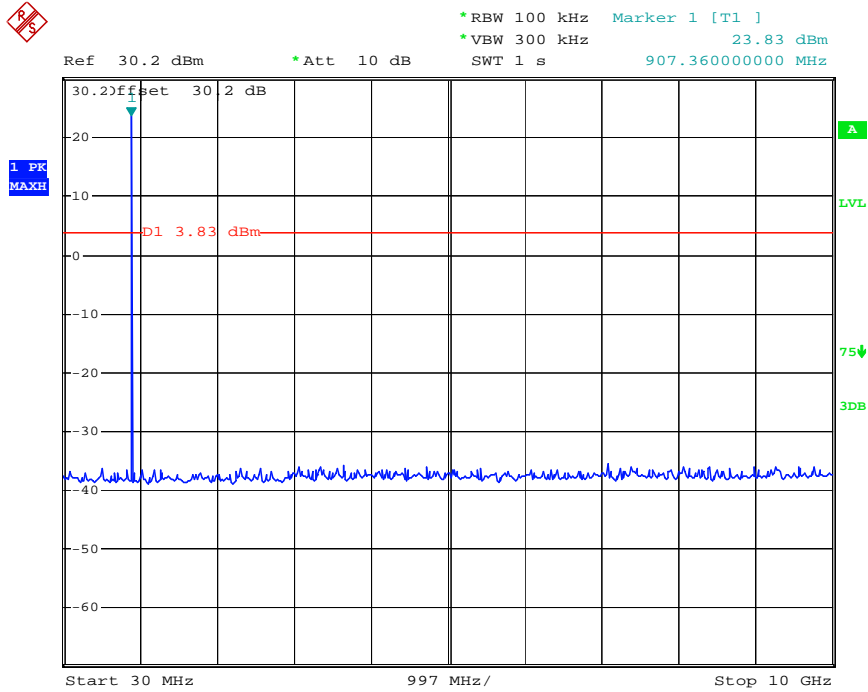
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## Band – edge (at 20 dB blow) – Mid channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic





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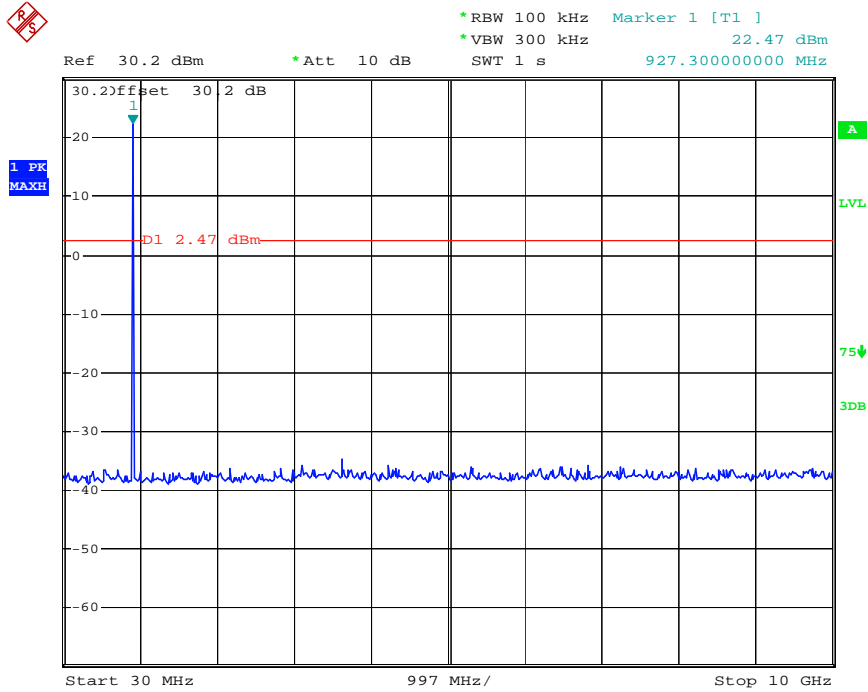
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## Band – edge (at 20 dB blow) – High channel Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic



## 2.1.7 Field Strength of Emissions

### Test Location

Testing was performed at a test distance of 3 meter Open Area Test Site

### Test Procedures

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity. The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic

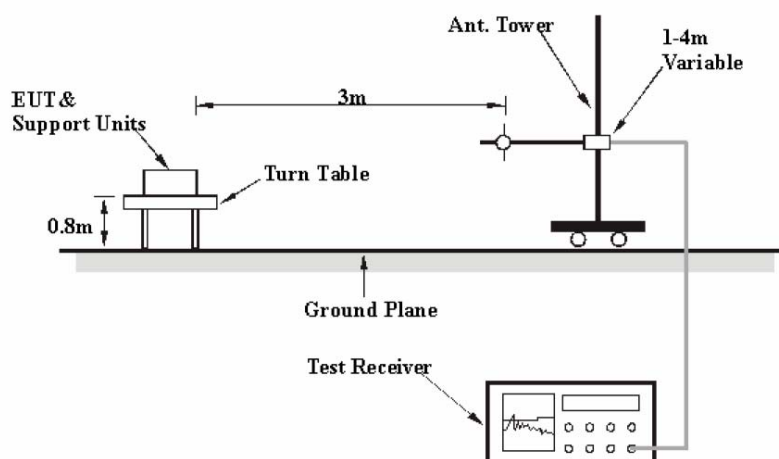
RBW = 120 kHz (30 MHz ~ 1 GHz) VBW ≥ RBW

= 1 MHz (1 GHz ~ 10<sup>th</sup> harmonic)

Span = 100 MHz

Detector function = Quasi-peak

Trace = max hold



### Limit

#### - 15.209(a)

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m
30-88	100**	40
88-216	150**	43.5
216-960	200**	46
Above 960	500	54

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



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## Test Results

EUT	UHF RFID Handheld READER	Measurement Detail	
Model	URP-SU110	Frequency Range	Below 1000MHz
Channel	-	Detector function	Quasi-Peak

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
253.10	43.0	3.0	Quasi-Peak

## Test Data

Frequency [MHz]	Reading [dBuV/m]	Pol.	Height [m]	Correction Factor		Limits [dBuV/m]	Result [dBuV/m]	Margin [dB]
				Antenna	Cable			
253.10	31.3	V	1.0	9.8	1.9	46.0	43.0	3.0
294.25	28.9	H	1.5	10.9	2.3	46.0	42.1	3.9
762.15	18.9	H	2.0	19.5	4.1	46.0	42.5	3.5
800.00	18.2	V	1.8	19.8	4.4	46.0	42.4	3.7
875.50	16.8	V	2.0	20.8	4.6	46.0	42.2	3.8
956.25	15.4	V	2.0	21.6	4.6	46.0	41.6	4.5

H : Horizontal, V : Vertical



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## Test Results

EUT	UHF RFID Handheld READER	Measurement Detail	
Model	URP-SU110	Frequency Range	1-25GHz
Frequency	902.75MHz	Detector function	Average/Peak

## Remarks

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

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
1805.54	52.43/63.29	1.57/10.71	Average/Peak

## Test Data

Frequency [MHz]	Reading A/P [dBuV/m]	Pol.	Height [m]	Correction Factor			Limits/ Detector A/P [dBuV/m]	Result A/P [dBuV/m]
				Antenna	Amp. Gain	Cable		
1805.54	56.33/67.19	V	1	28.2	35.3	3.2	54.0 /74.0	52.43/63.29

\*No emission Were detected at level greater than 20dB below limit.

## Restricted band edge test data

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



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## Test Results

EUT	UHF RFID Handheld READER	Measurement Detail	
Model	URP-SU110	Frequency Range	1-25GHz
Frequency	914.25MHz	Detector function	Average/Peak

## Remarks

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

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
1828.42	52.27/62.88	1.73/11.12	Average/Peak

## Test Data

Frequency [MHz]	Reading A/P [dBuV/m]	Pol.	Height [m]	Correction Factor			Limits/ Detector A/P [dBuV/m]	Result A/P [dBuV/m]
				Antenna	Amp. Gain	Cable		
1828.42	56.17/66.78	V	1	28.2	35.3	3.2	54.0 /74.0	52.27/62.88

\*No emission Were detected at level greater than 20dB below limit.

## Restricted band edge test data

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



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## Test Results

EUT	UHF RFID Handheld READER	Measurement Detail	
Model	URP-SU110	Frequency Range	1-25GHz
Frequency	927.25MHz	Detector function	Average/Peak

## Remarks

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

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
1854.57	52.35/60.76	1.65/13.24	Average/Peak

## Test Data

Frequency [MHz]	Reading A/P [dBuV/m]	Pol.	Height [m]	Correction Factor			Limits/ Detector A/P [dBuV/m]	Result A/P [dBuV/m]
				Antenna	Amp. Gain	Cable		
1854.57	56.25/64.66	V	1	28.2	35.3	3.2	54.0 /74.0	52.35/60.76

\*No emission Were detected at level greater than 20dB below limit.

## Restricted band edge test data

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





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### 2.1.8 AC Conducted Emissions

#### Test Location

Shielded Room

#### Frequency Range of Measurement

150 kHz to 30 MHz

#### Instrument Settings

IF Band Width: 9 kHz

#### Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

#### Limit

##### - 15.207(a)

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

\* Decreases with the logarithm of the frequency.

#### Test Results

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
16.45	48.1	11.9	Quasi-peak



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## Test Data

Frequency [MHz]	Correction Factor		Line	Quasi-peak				Average			
	LISN	Cable		Limit	Reading	Result	Margin	Limit	Reading	Result	Margin
				[dBuV]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dB]
1.78	0.2	0.2	N	56.0	35.1	35.5	20.5	46.0	25.8	26.2	19.8
2.00	0.2	0.2	N	56.0	35.2	35.6	20.4	46.0	25.6	26.0	20.0
15.60	0.6	0.2	H	60.0	41.2	42.0	18.0	50.0	26.7	27.5	22.5
16.45	0.6	0.2	N	60.0	47.3	48.1	11.9	50.0	35.3	36.1	13.9
16.49	0.6	0.2	N	60.0	47.1	47.9	12.1	50.0	35.1	35.9	14.1
16.57	0.7	0.2	H	60.0	46.9	47.8	12.2	50.0	34.7	35.6	14.4

'H': HOT, 'N': NEUTRAL



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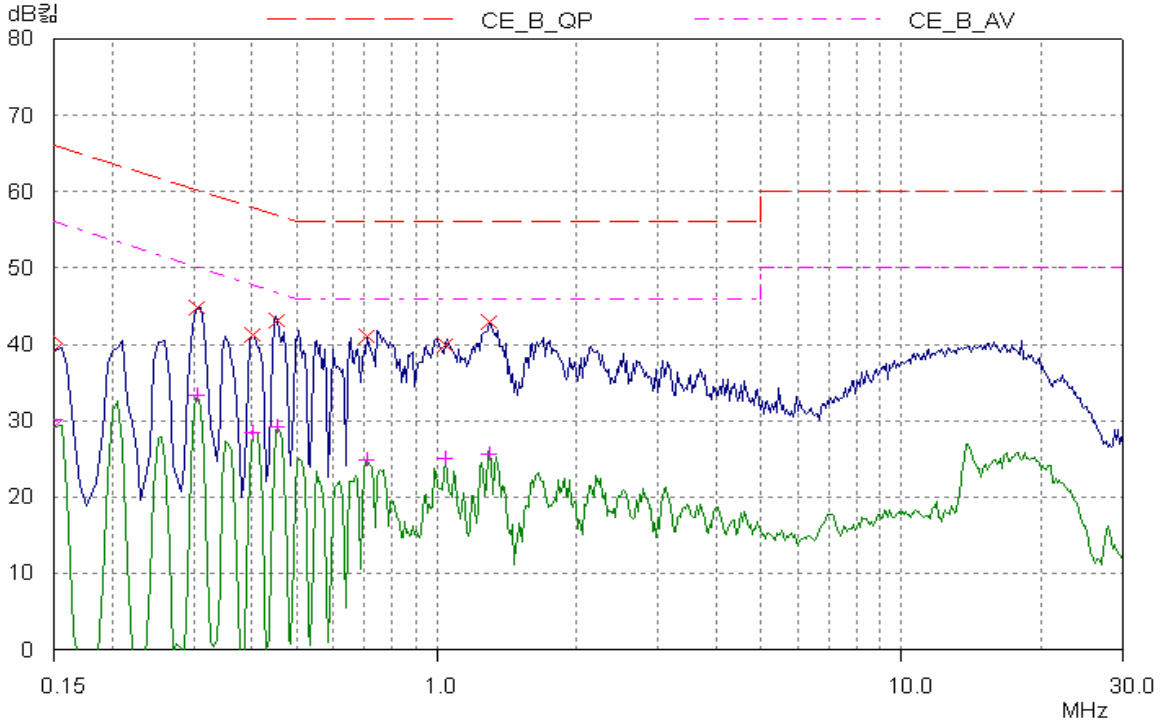
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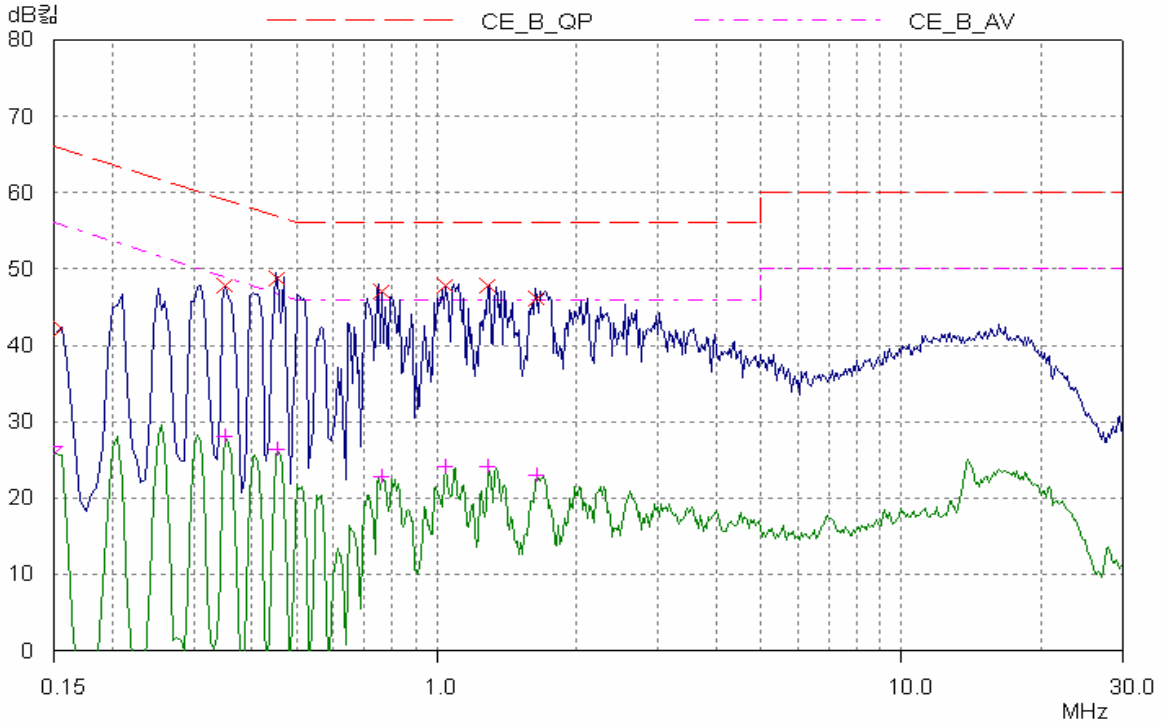
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## [Hot]



## [Neutral]





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## APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
1	Spectrum Analyzer	Agilent	8564E	3551A0041	2008-11-01
2	Spectrum Analyzer	HP	E4403B	US39440619	2008-09-03
3	Spectrum Analyzer	Rohde & Schwarz	FSP-30	100994	2008-11-19
4	EMI Test Receiver	Rohde & Schwarz	ESVS30	826638/008	2008-03-07
5	ULTRA Broadband Antenna	Rohde & Schwarz	HL562	361324/014	2008-06-12
6	LOOP ANTENNA	EMCO	6502	9107-2652	2008-10-17
7	LOOP ANTENNA	EMCO	6502	9607-3020	2008-03-06
8	System Power Supply	HP	6032A	3440A-10521	2008-07-16
9	EPM Series Power Meter	HP	E4418A	GB38272734	2008-11-03
10	Power Sensor	HP	8481A	331BA92056	2008-11-03
11	Power Sensor	HP	8482B	331BA05406	2008-11-03
12	Audio Analyzer	HP	8903B	2747A03432	2008-11-01
13	ESG-D Series Signal Generator	Agilent	E4432B	US40054094	2008-11-01
14	SYNTHESIZED SWEEPER	HP	8341B	2819A01563	2008-11-22
15	Modulation Analyzer	HP	8901B	3438A05228	2008-11-08
16	Attenuator	HP	8494A	3308A33351	2008-11-06
17	Attenuator	HP	8496A	3308A15142	2008-11-06
18	Temp&Humi Chamber	Kunpoong	KP-1000	2002KP050041	2009-01-21
19	Temp&Humi Chamber	Kunpoong	KP-RC2000	2002KP650042	2009-01-21
20	EMC Analyzer	Agilent	E7405A	MY45110859	2008-01-09
21	Horn Antenna	ETS-Lindgren	3115	00078894	2008-11-29
22	Horn Antenna	ETS-Lindgren	3115	00078895	2008-11-29
23	Horn Antenna	ETS-Lindgren	3116	00062504	2008-11-27
24	Horn Antenna	ETS-Lindgren	3116	00062916	2008-11-27
25	Dipole Antenna	SCHWARZBECK	VHA 9103	VHA91032557	2009-11-27
26	Dipole Antenna	SCHWARZBECK	UHA 9105	UHA91052417	2009-11-27
27	OPT H64 AMPLIFIER	HP	8447F	3113A06814	2008-02-28
28	PREAMPLIFIER	Agilent	8449B	3008A02307	2008-11-05
29	Radio Communication Tester	Rohde & Schwarz	CMU200	106765	2008-02-09
30	Band Reject Filter	Wainwright Instruments	WRCG824	-	2008-04-16
31	Band Reject Filter	Wainwright Instruments	WRCG1750	-	2008-04-13



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### APPENDIX B – MPE CALCULATION



## **\*\* MPE Calculations \*\***

The EUT will only be used with a separation of 20 centimeters or greater between the antenna and the body of the user. The MPE calculation for this exposure is shown below.

The peak radiated output power (EIRP) is calculated as follows:

$\text{EIRP} = P + G$ $\text{EIRP} = 29.77 \text{ dBm}$	<p>Where,</p> <p>P = Power input to the antenna (mW)</p> <p>G = Power gain of the antenna (dBi)</p>
---	---

The numeric gain(G) of the antenna with a gain specified in dB is determined by:

$$G = \text{Log}^{-1} (\text{dB antenna gain} / 10)$$

$$G = \text{Log}^{-1} (-3.07 / 10)$$

$$G = 2.83$$

### **Power density at the specific separation:**

$S = PG / (4R^2 \pi)$ $S = (334.97 * 2.83) / (4 * 20^2 * \pi)$ $S = 0.1887 \text{ mW/cm}^2$	<p>Where,</p> <p>S = Maximum power density (mW/cm<sup>2</sup>)</p> <p>P = Power input to the antenna (mW)</p> <p>G = Numeric power gain of the antenna</p> <p>R = Distance to the center of the radiation of the antenna (20cm = limit for MPE)</p>
---	---

The Maximum permissible exposure (MPE) for the general population is 1 mW/cm<sup>2</sup> .

The power density at 20cm does not exceed the 1 mW/cm<sup>2</sup> limit.

### **Estimated safe separation:**

$R = \sqrt{PG / 4 \pi}$ $R = \sqrt{(334.97 * 2.83 / 4 \pi)}$ $R = 8.69 \text{ cm}$	<p>Where,</p> <p>P = Power input to the antenna (mW)</p> <p>G = Numeric power gain of the antenna</p> <p>R = Distance to the center of the radiation of the antenna (20cm = limit for MPE)</p>
--	--