


FCC MEASUREMENT REPORT

CERTIFICATION OF COMPLIANCE

PRODUCT : UHF READER
MODEL/TYPE NO : SST-US-URFR01A
FCC ID : P4YSST-US-URFR01A
TRADE NAME : 
APPLICANT : Samsung SDS Co., Ltd.
707-19, Yeoksam-dong, Gangnam-gu, Seoul, 135-080, Korea
RULE PART(S) : FCC Part 15C
FCC PROCEDURE : Certification
DATES OF TEST : November 1 to December 14, 2010
DATES OF ISSUE : December 15, 2010
TEST REPORT No. : BWS-10-RF-0004
TEST LAB. : BWS TECH Inc. (Registration No. : 553281)

This UHF READER SST-US-URFR01A has been tested in accordance with the measurement procedures specified in ANSI C63.4-2003 and ANSI/TIA-603-C-2004 at the BWS TECH/EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part 15.

I attest to the accuracy of data. All measurement herein was performed by me or were made under my supervision. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. The results of testing in this report apply to the product/system, which was tested only. Other similar equipment may not necessarily produce the same results due to production tolerance and measurement uncertainties.

December 15, 2010

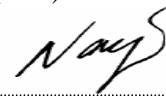
(Date)



Tested by **HyunSup, Jin**

December 15, 2010

(Date)



Reviewed by **TaeHyun, Nam**

BWS TECH Inc.

www.bws.co.kr

#611-1 Maesan-Ri, Mohyeon-Myeon, Yongin-Si, Gyeonggi-Do, 449-853 Korea

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FCC TEST REPORT

Scope - Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)

1. General Information

Applicant

Company Name Samsung SDS Co., Ltd.
Company Address 707-19, Yeoksam-dong, Gangnam-gu, Seoul, 135-080, Korea
Phone/Fax Phone : 82-2-6484-0646 Fax :82-2-6484-0688

Manufacturer

Company Name U-Pass Co., Ltd.
Company Address Daeryung Post Tower III 509, 138-4 Guro-dong, Guro-gu, Seoul
Phone/Fax Phone : 82-2-488-8807 Fax :82-2-488-8277

- **EUT Type** UHF READER
- **Model Number** SST-US-URFR01A
- **FCC Identifier** P4YSST-US-URFR01A
- **S/N** Prototype
- **FCC Rule Part(s)** FCC Part 15.247C
- **Frequency** 902-928 MHz
- **Modulation Method** PR-ASK
- **Emission Designator** N/A
- **RF Power Output** 27.94 dBm
- **Channel** 50
- **Dates of Tests** Noveember 1 to December 14, 2010
- **Place of Tests** BWS TECH Inc.(FCC Registration Number : 553281)
#611-1 Maesan-Ri, Mohyeon-Myeon, Yongin-Si, Gyeonggi-Do, 449-853 Korea
TEL: +82 31 333 5997 FAX: +82 31 333 0017
- **Test Report No.** BWS-10-RF-0004

2. Description of Test Facility

The measurement for radiated and conducted emission test were conducted at the open area test site of BWS TECH Inc. facility located at #611-1 Maesan-Ri, Mohyeon-Myeon, Yongin-Si, Gyeonggi-Do, 449-853 Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-2009 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission with the FCC for 3 and 10-meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-2009 and registered to the Federal Communications Commission (Registration Number : 553281).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2009) was used in determining radiated and conducted emissions from the Samsung SDS Co., Ltd. UHF READER Model : **SST-US-URFR01A**.

3. Product Information

3.1 General Specification

Reader Specifications	
Operation Frequency	902 ~ 928 MHz
Main Board	<ul style="list-style-type: none"> ● 32bit ARM CPU ● 64M RAM ● 256M NAND Flash
RF Output	27.94 dBm
Channel bandwidth	250 kHz
Recognition Distance	< 10m
Hopping Channel	50 Channel
Indicators	<ul style="list-style-type: none"> ● LED : RUN, Tag, Ant1, Ant2, Ant3, Ant4 ● Beep
Protocols	<ul style="list-style-type: none"> ● ISO 18000-6B ● ISO 18000-6C (EPC Class1 Gen2)
Communication Interfaces	RS-232 or RS-485, RS-422, 100M LAN, Synchronization Port
IO	<ul style="list-style-type: none"> ● GPIO(1 digital input lines) ● Relay
Operating Temperature	-30 ~ 70°C
Operation Voltage	DC 24V
Power Consumption	17W
Power Adaptor	110~250VAC, 50/0Hz, 1.3A
Size	275x220x55 (mm)

4. Summary of The Test Result

No.	Test case	FCC reference	Verdict
1	RF Output Power	15.247(b)(2)	Pass
2	E.R.P.	15.247(b)(2)	Pass
3	20dB Bandwidth	15.247(a)(1)(i)	Pass
4	Spurious RF conducted emissions	15.247	Pass
5	900MHz Band Edge	15.247(d)	Pass
6	Number of hopping channels	15.247(a)(1)(i)	Pass
7	Channel Spacing	15.247(a)(1)	Pass
8	Channel Dwell Time	15.247(a)(1)	Pass
9	Radiated Spurious emissions	15.247(d),15.35(b), 15.209	Pass
10	Line Conducted Emissions	15.207	Pass
11	Antenna Requirement	15.203	Pass

5. TEST DATA

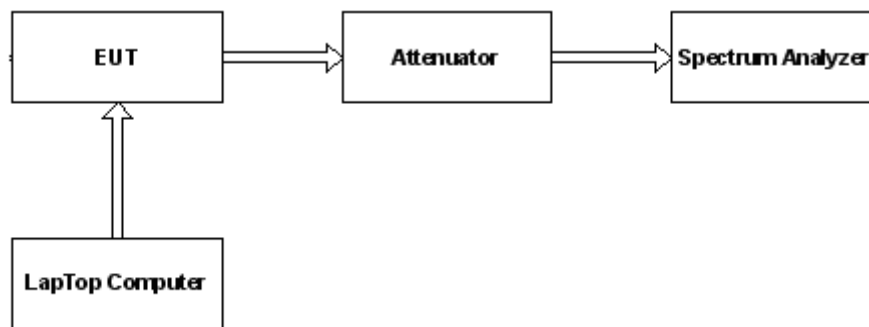
5.1 RF Output Power

5.1.1 Method of Measurement

The test was configured as shown in the RF conducted bench top test setup. The unit was sequentially tuned to the test channels(Low, Mid and High)and configured to transmit random data. The RF transmit power was then measured on the spectrum analyzer.

Given that the channel BW is approximately 20MHz, the RBW and VBW was set to encompass the entire bandwidth of the channel and thus measure the total channel power. The RBW and VBW were set as follows: RBW 1MHz, VBW 1MHz, and the detector is PK model.

5.1.2 Measurement Set-Up



5.1.3 Test Result

Channel	Frequency(MHz)	RF output Power(dBm)
Low	902.75	27.50
Mid	914.75	26.87
High	927.25	27.09

5.1.4 Limit

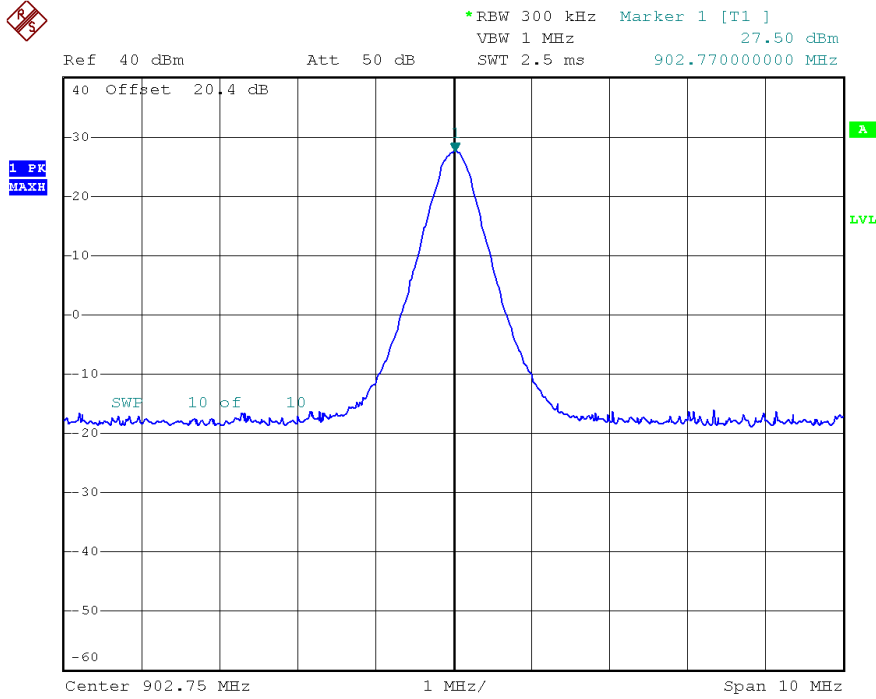
≤ 27.94dBm *

*antenna gain is 2.06dBi over than 6dBi.

This limit is reduce over gain.

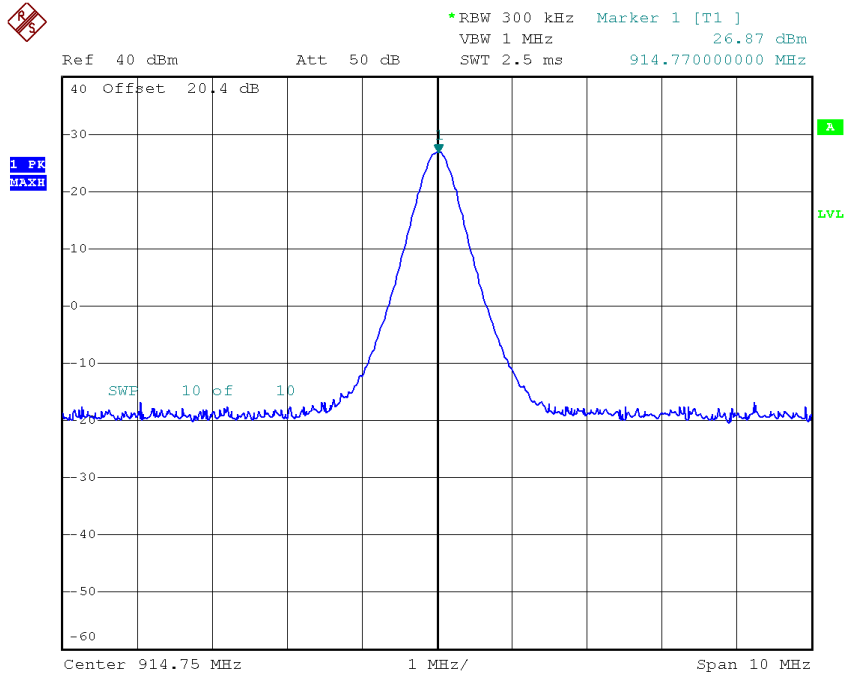
Plots of RF Output Power

1. Low Channel



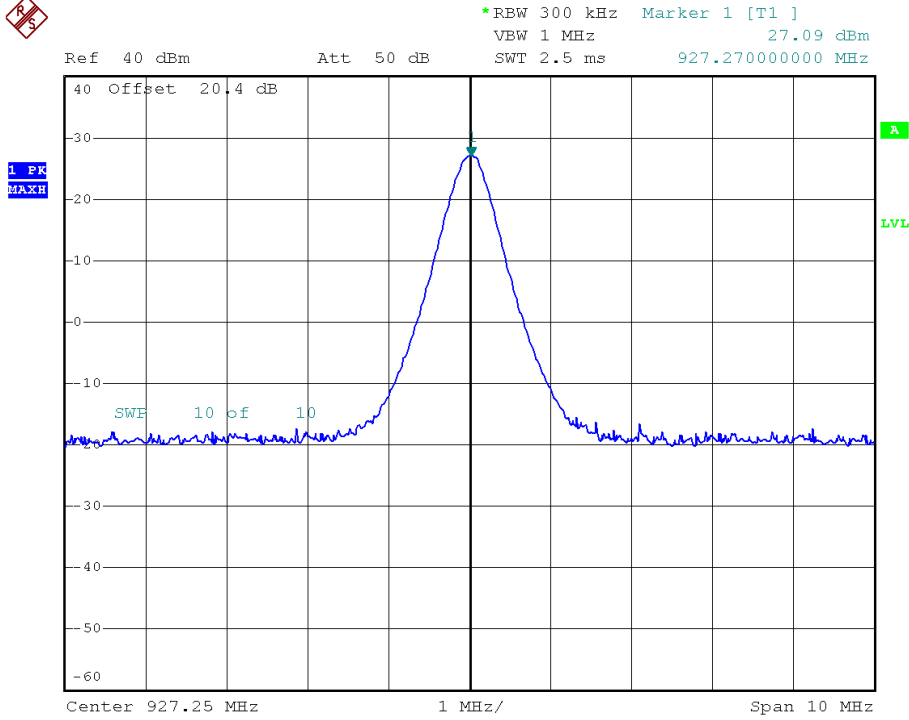
Date: 21.DEC.2010 12:54:59

2. Middle Channel



Date: 21.DEC.2010 12:55:33

3.high Channel



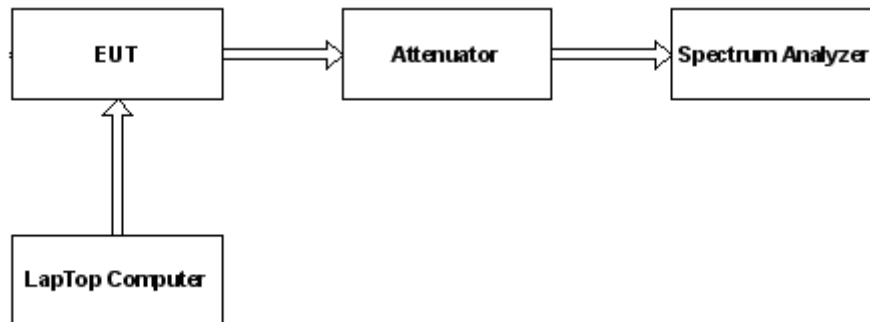
Date: 21.DEC.2010 12:56:02

5.2 20dB Bandwidth

5.2.1 Method of Measurement

The 20dB bandwidth was measured on the low middle and high channels of the 900 MHz band using the conducted RF test setup. The spectrum analyzer was configured for MAX HOLD and the trace allowed to stabilize. A peak search with the frequency and the level was performed, then we got the “Delta 2” and “Delta 3”, and they were both located the points at -20dB below the peak. With these we tested the “20dB Bandwidth”.

5.2.2 Measurement Set-Up



5.2.3 Test Result

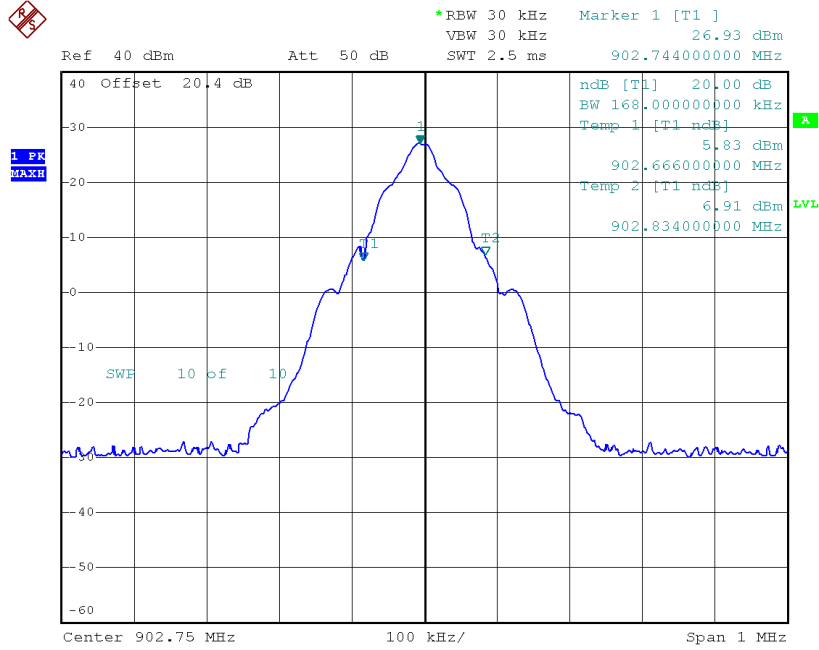
Channel	Frequency (MHz)	Delta 2 (kHz)	Delta 3 (kHz)	20dB BW (kHz)
Low	902.75	84	84	168
Mid	914.75	92	88	180
High	927.25	92	88	180

5.2.4 Limits

≤ 250kHz

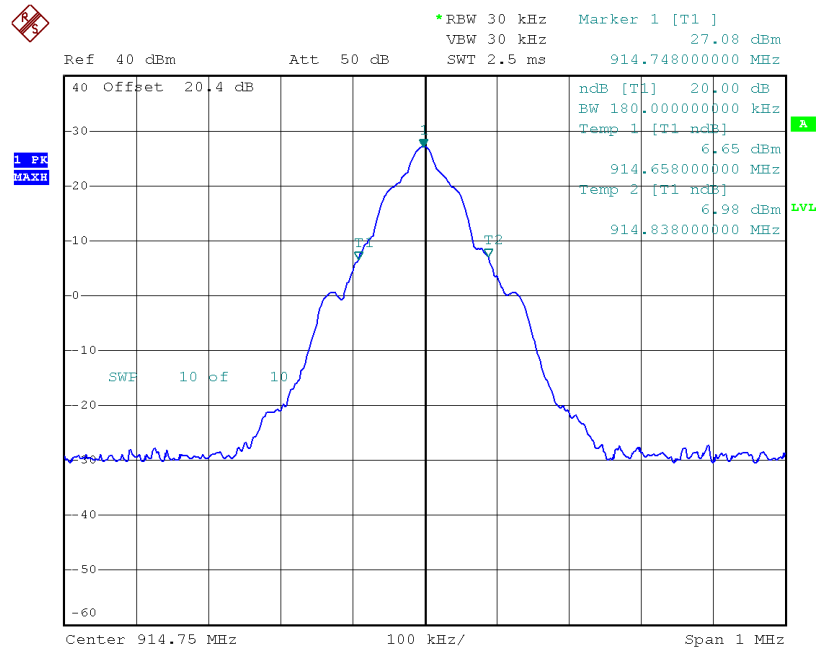
Plots of 20dB Bandwidth

1. Low Channel



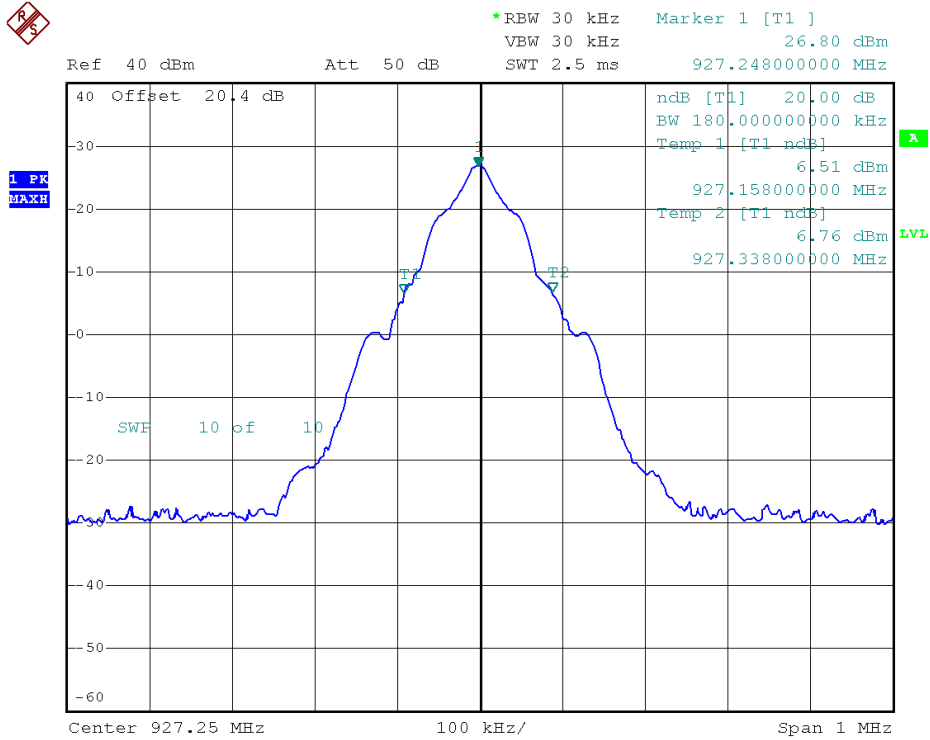
Date: 10.DEC.2010 09:13:46

2. Middle Channel



Date: 10.DEC.2010 09:14:38

3. High Channel



Date: 10.DEC.2010 09:15:38

5.3 Spurious RF conducted emissions

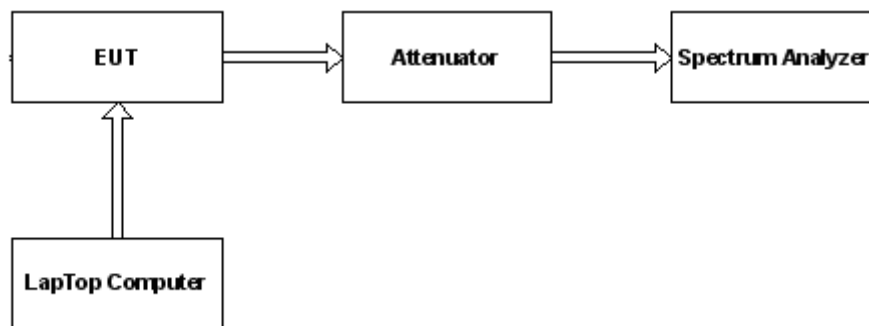
5.3.1 Method of Measurement

The test was configured as shown in the RF conducted bench top test setup.

The units was sequentially tuned to the test channels (Low, Mid, and High) and configured to transmit random data. The measurement is carried out using a spectrum analyzer. The spectrum analyzer scans from 30MHz to 10GHz (higher than the 10th harmonic of the carrier). The peak detector is used on spectrum analyzer.

The spurious Emissions at antenna terminals was measured on the low middle and high channels of the 900 MHz band using the conducted RF test setup.

5.3.2 Measurement Set-Up



5.3.3 Test Results

Refer to the following next pages figures

5.3.4 Limits

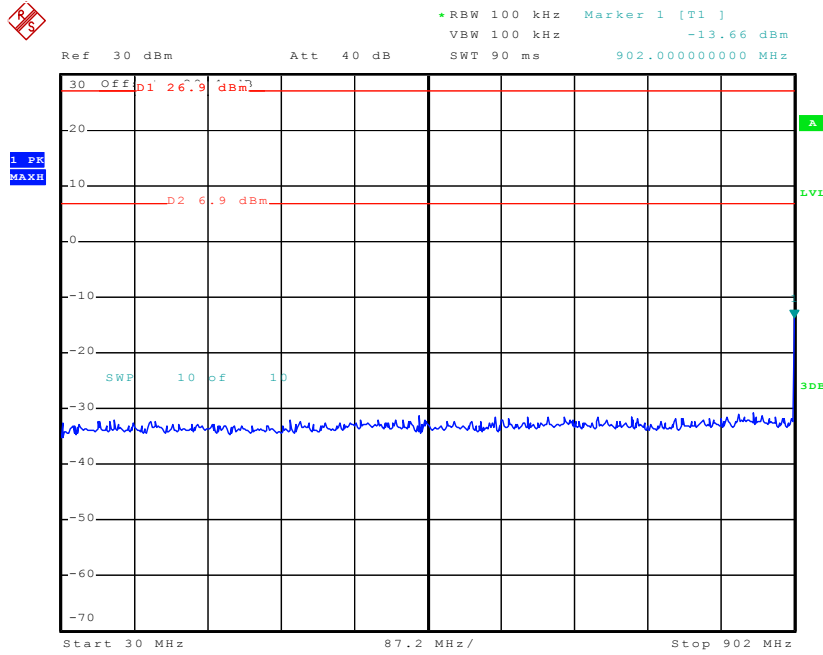
FCC Specification: Part 15.247

In any 500 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 500kHz bandwidth within the band that contains the highest level of the desired power.

Plots of Spurious Emissions

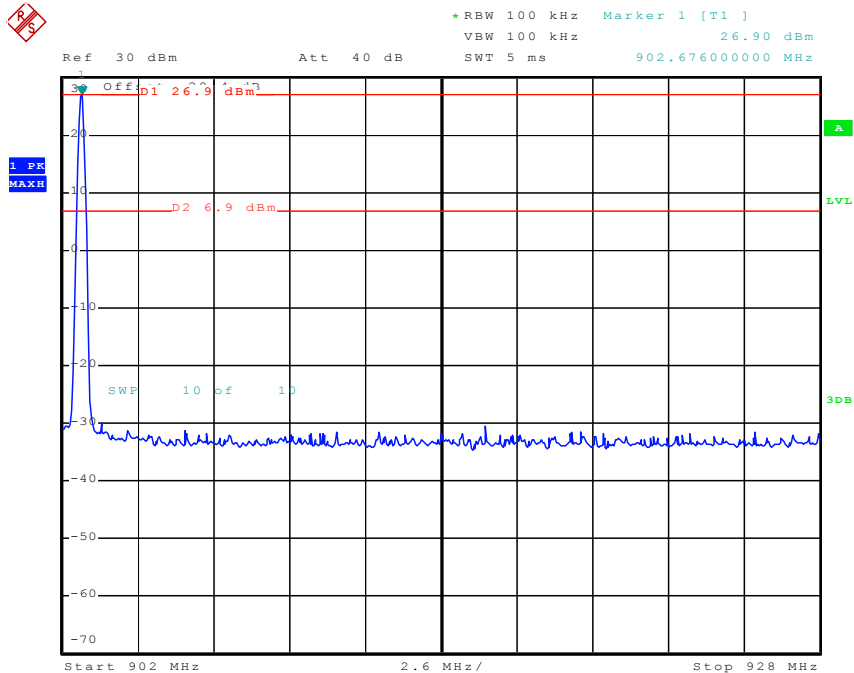
1. Low Channel

1.1 30MHz~902MHz



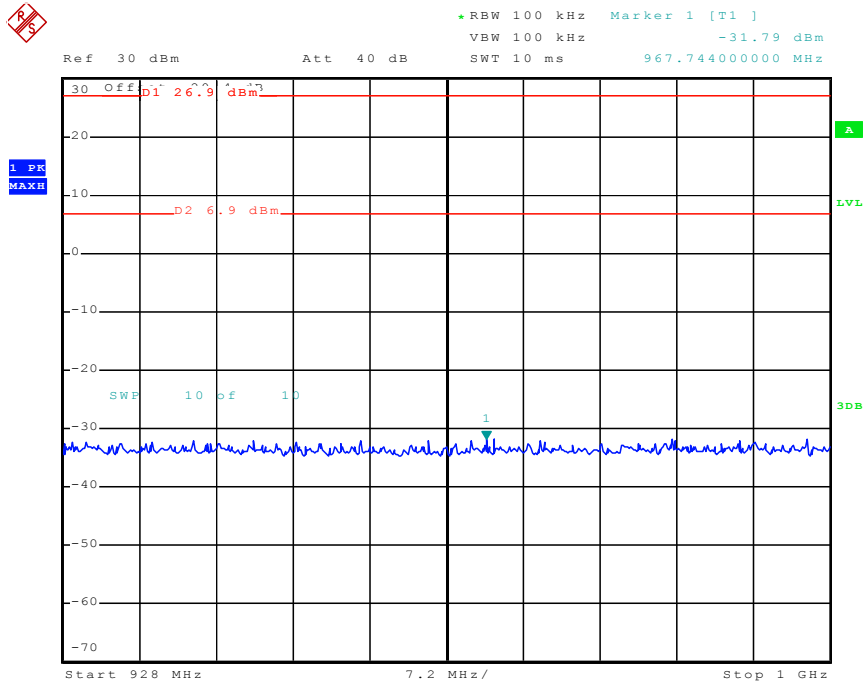
Date: 6.DEC.2010 23:18:46

1.2 902MHz~928MHz



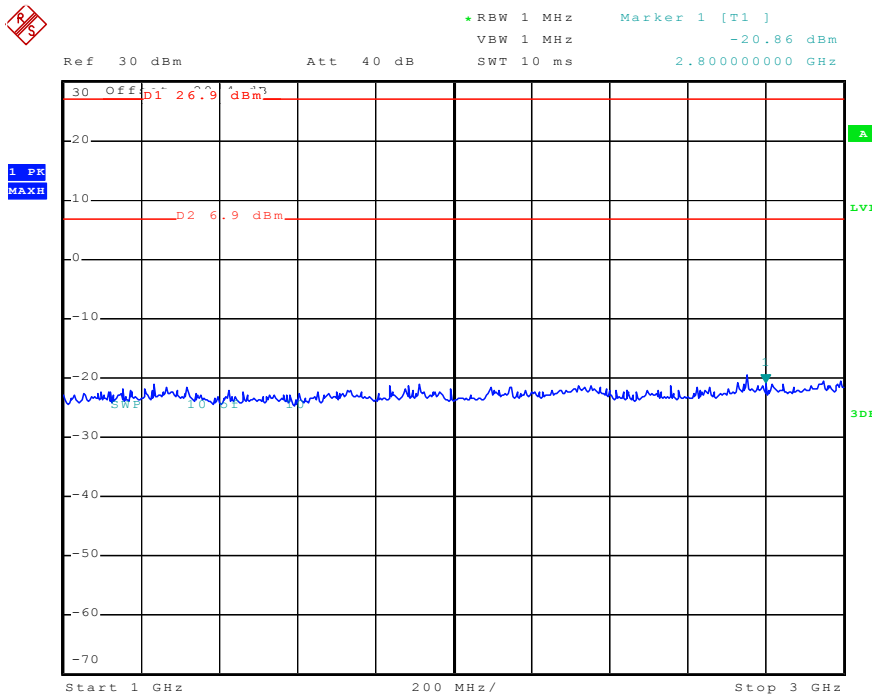
Date: 6.DEC.2010 23:17:36

1.3 928MHz~1GHz



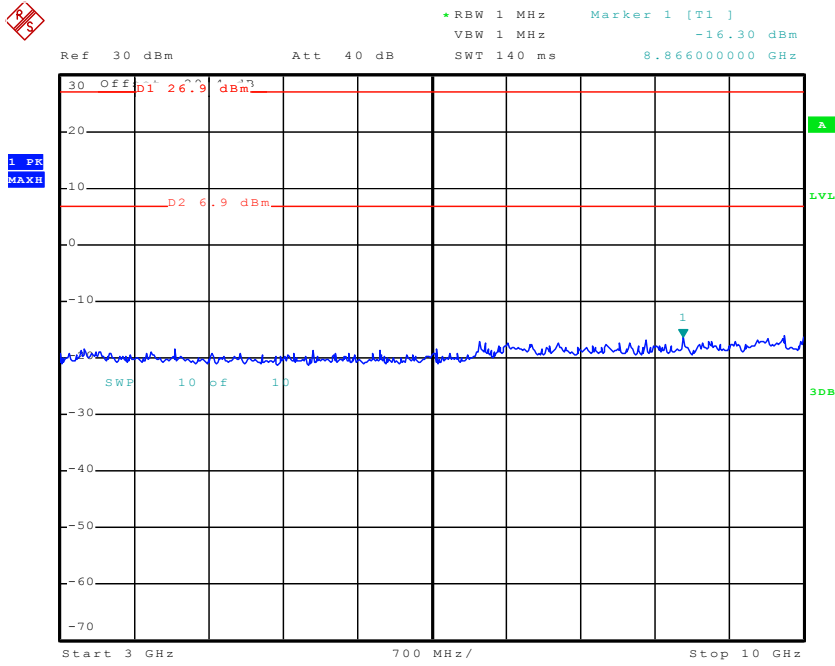
Date: 6.DEC.2010 23:19:26

1.4 1GHz~3GHz



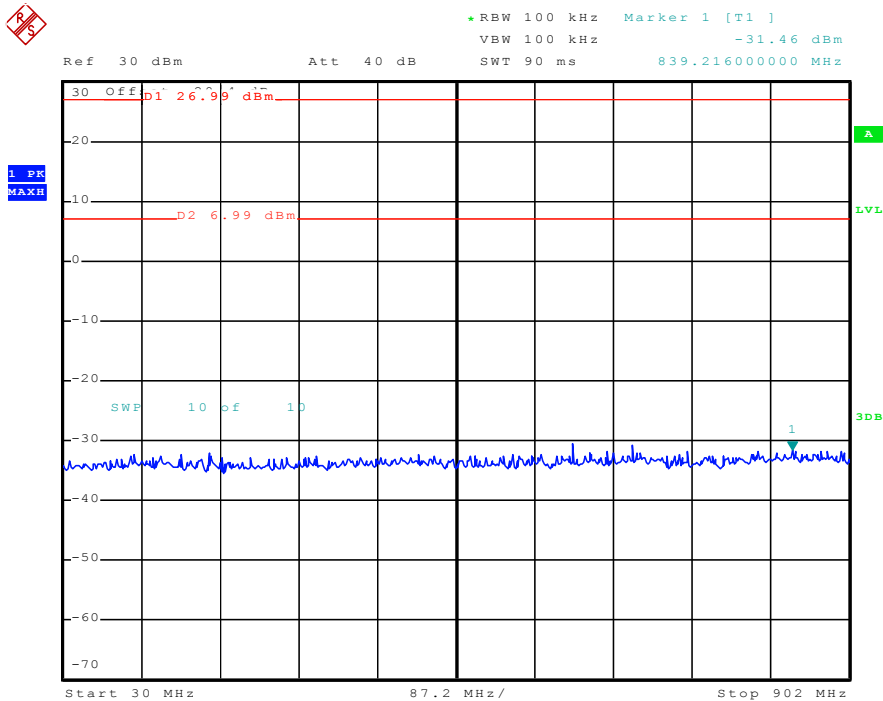
Date: 6.DEC.2010 23:20:07

1.5 3GHz~10GHz



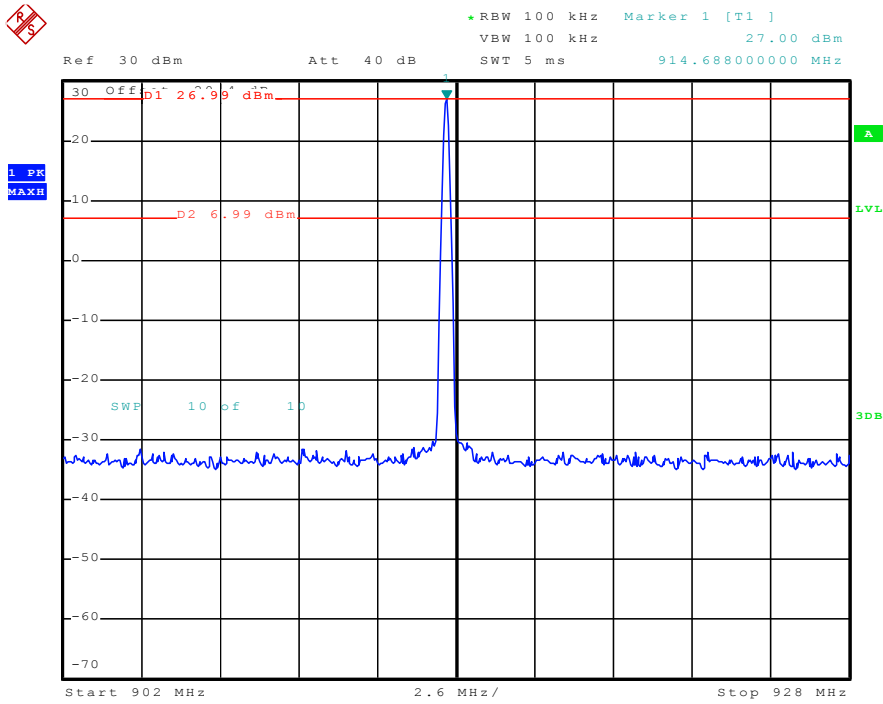
Date: 6.DEC.2010 23:20:34

2. Middle Channel
2.1 30MHz~902MHz



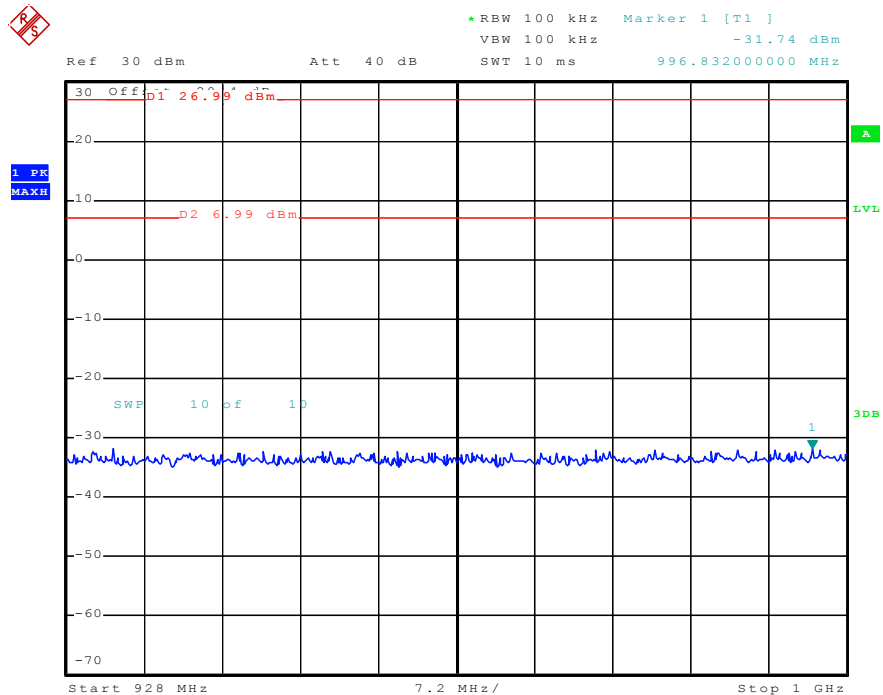
Date: 6.DEC.2010 23:22:15

2.2 902MHz~928MHz



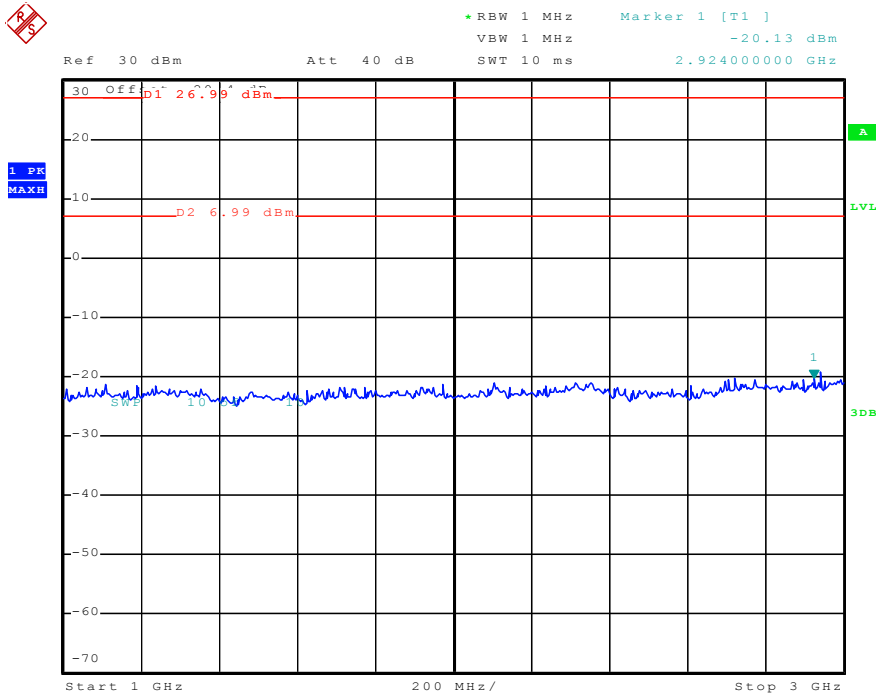
Date: 6 DEC 2010 23:21:45

2.3 928MHz~1GHz



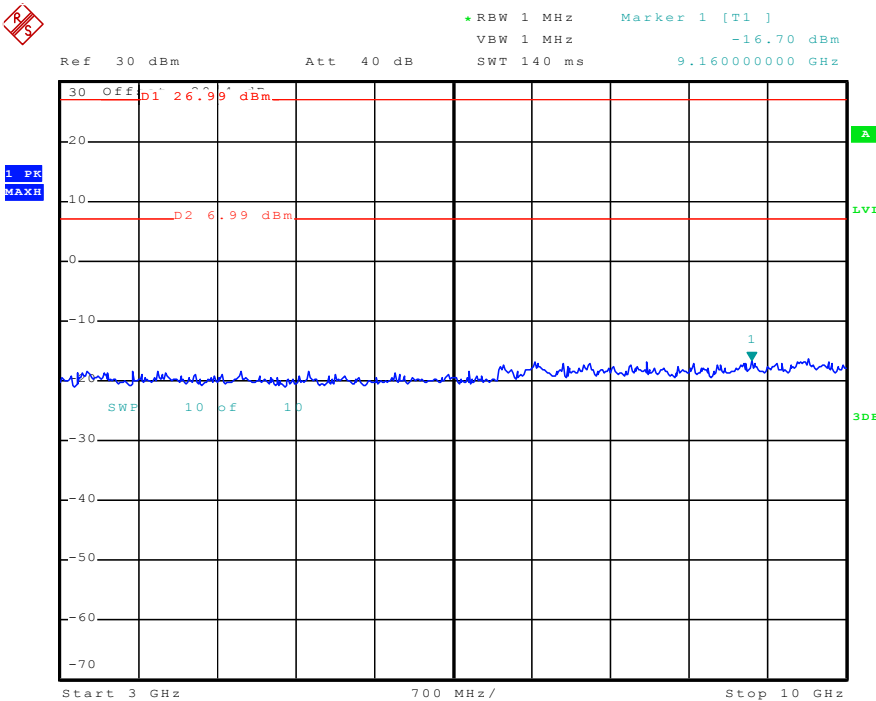
Date: 6 DEC 2010 23:22:52

2.4 1GHz~3GHz



Date: 6. DEC. 2010 23:23:30

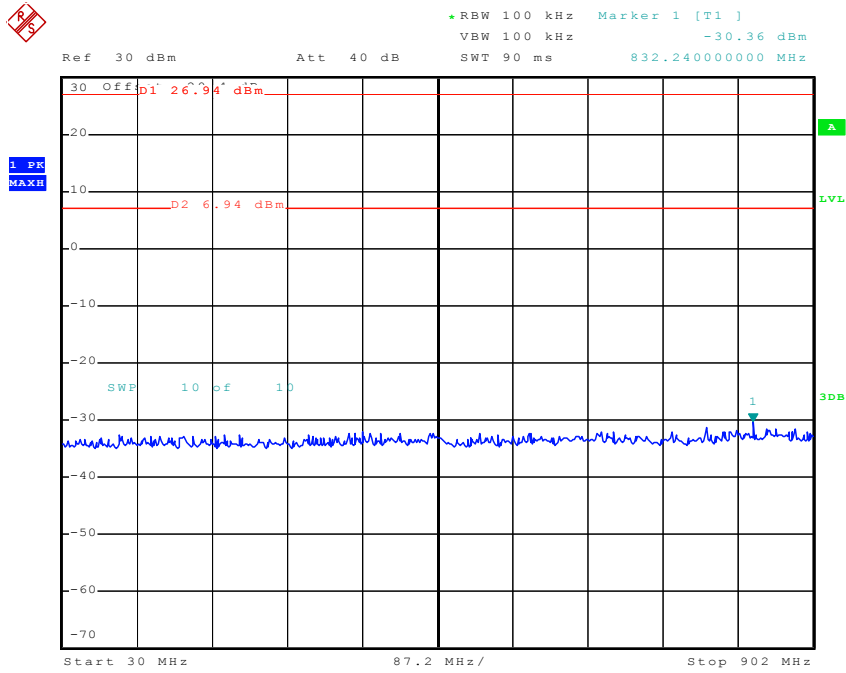
2.5 3GHz~10GHz



Date: 6. DEC. 2010 23:24:12

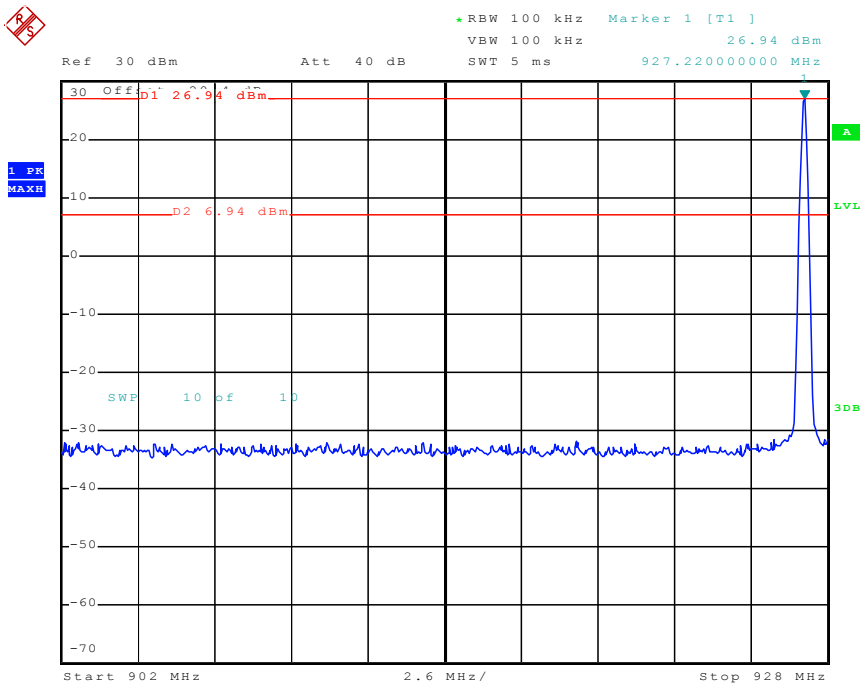
3. High Channel

3.1 30MHz~902MHz



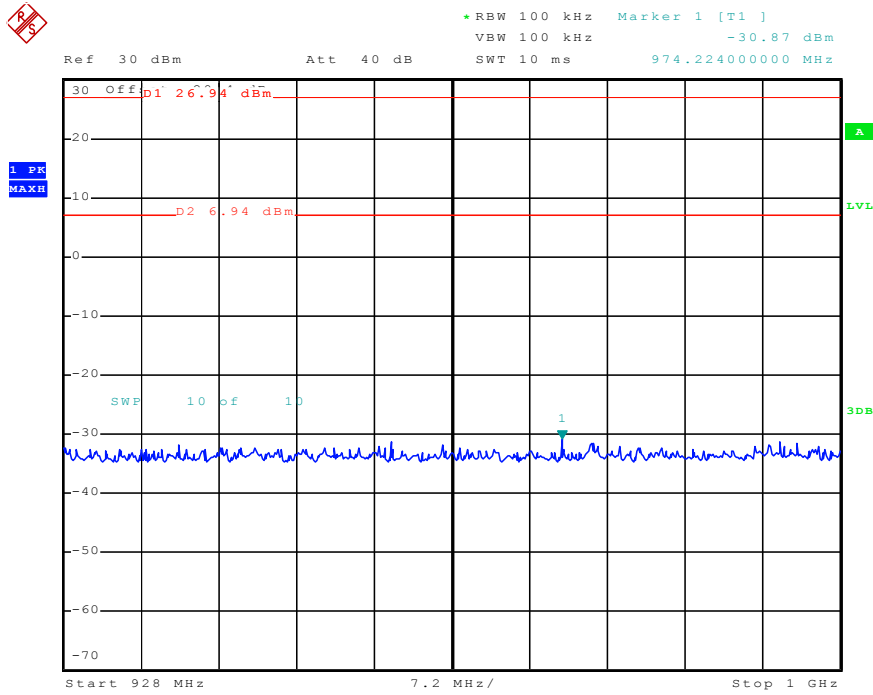
Date: 6.DEC.2010 23:26:08

3.2 902MHz~928MHz



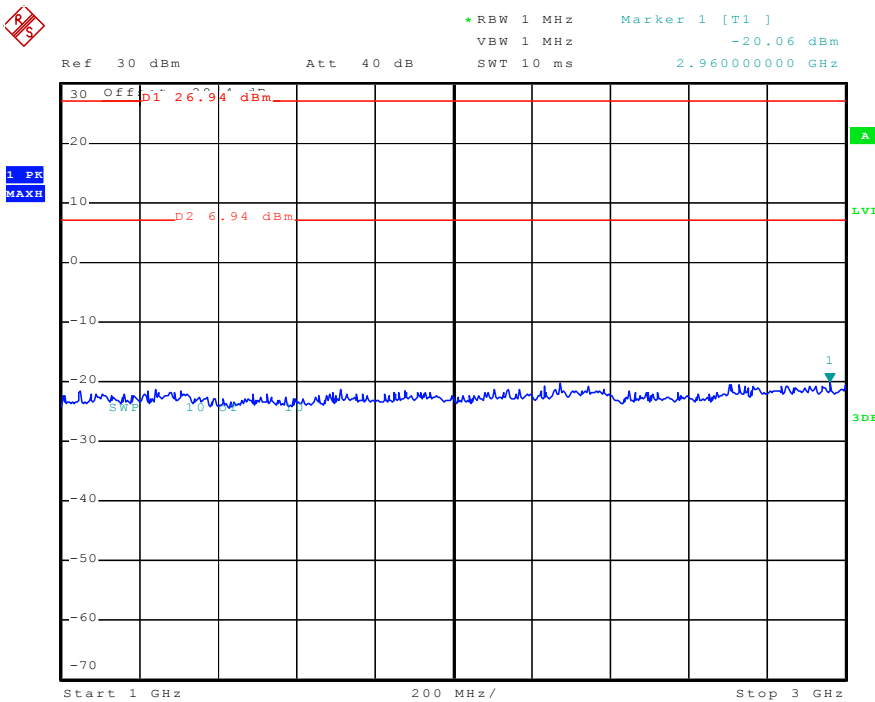
Date: 6.DEC.2010 23:25:22

3.3 928MHz~1GHz



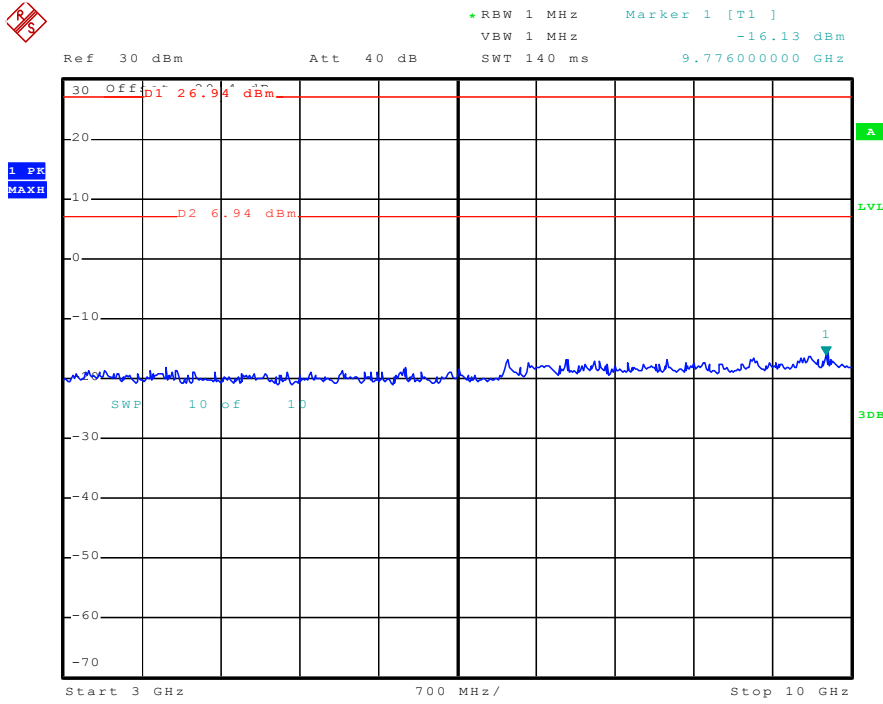
Date: 6.DEC.2010 23:26:39

3.4 1GHz~3GHz



Date: 6.DEC.2010 23:27:35

3.5 3GHz~10GHz



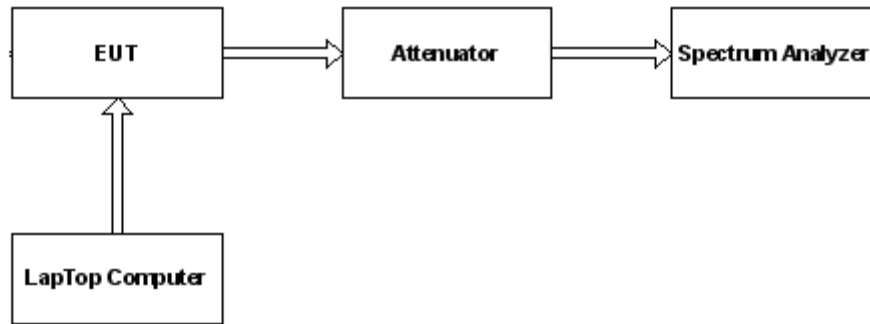
Date: 6.DEC.2010 23:28:14

5.4 900 MHz Band Edge

5.4.1 Method of Measurement

The test setup was configured as shown in the conducted test setup. The EUT was configured to continuously transmit random data on the low, and then the high test channel. The span of the analyzer was centered on the 902 and 928 MHz band edge respectively. The RBW & VBW were set to 100 kHz. The trace was allowed to stabilize then a Peak-search and a marker delta measurement to the band edge was performed to verify that the RF power at the band edge was at least 20 dB below the peak of the fundamental level.

5.4.2 Measurement Set-Up

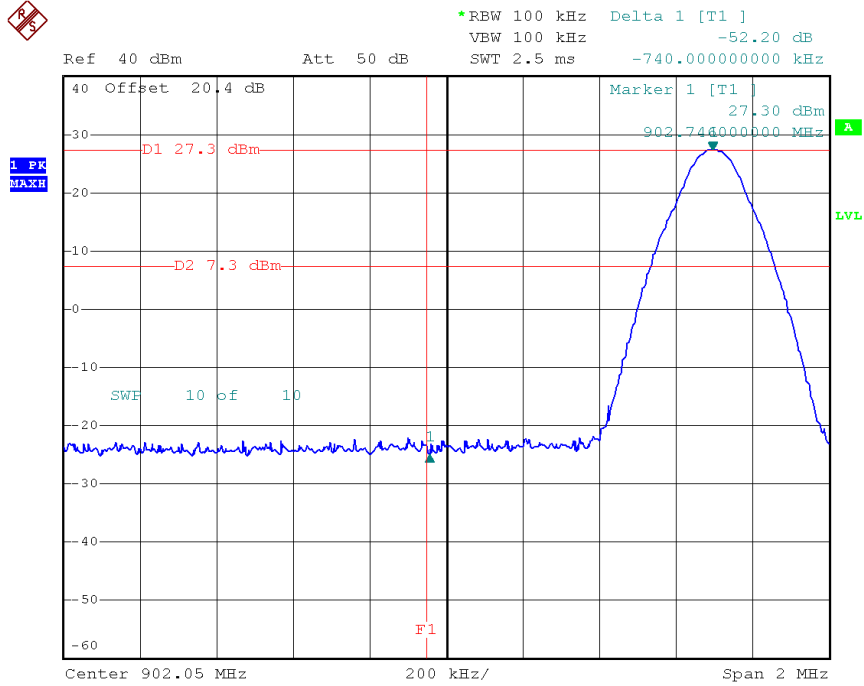


5.4.3 Test Results

Frequency (MHz)	Level (dBc)	Limits (dBc)
902	-52.20	-20.00
928	-49.48	-20.00

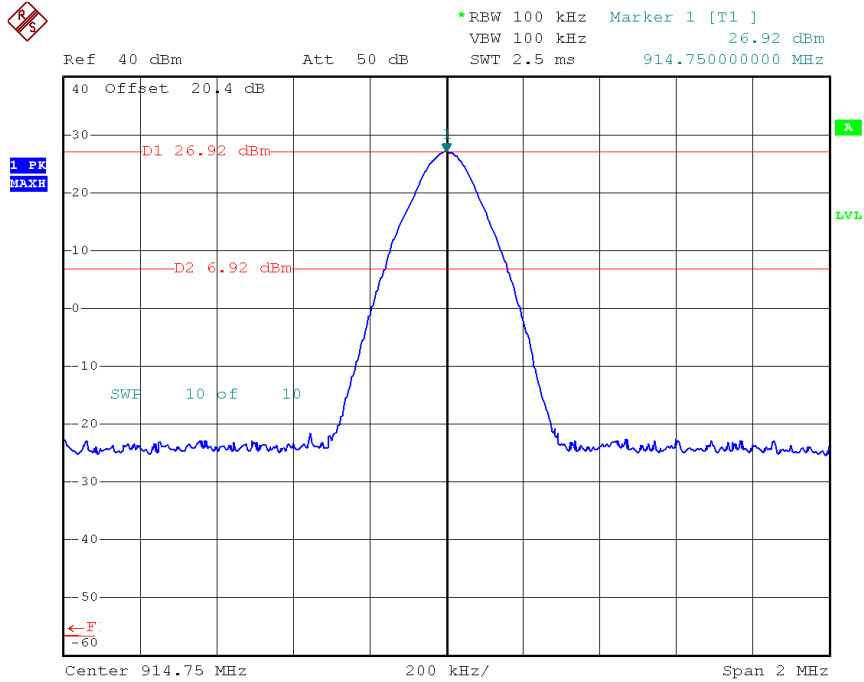
Plots of Band Edge

1. Low Channel



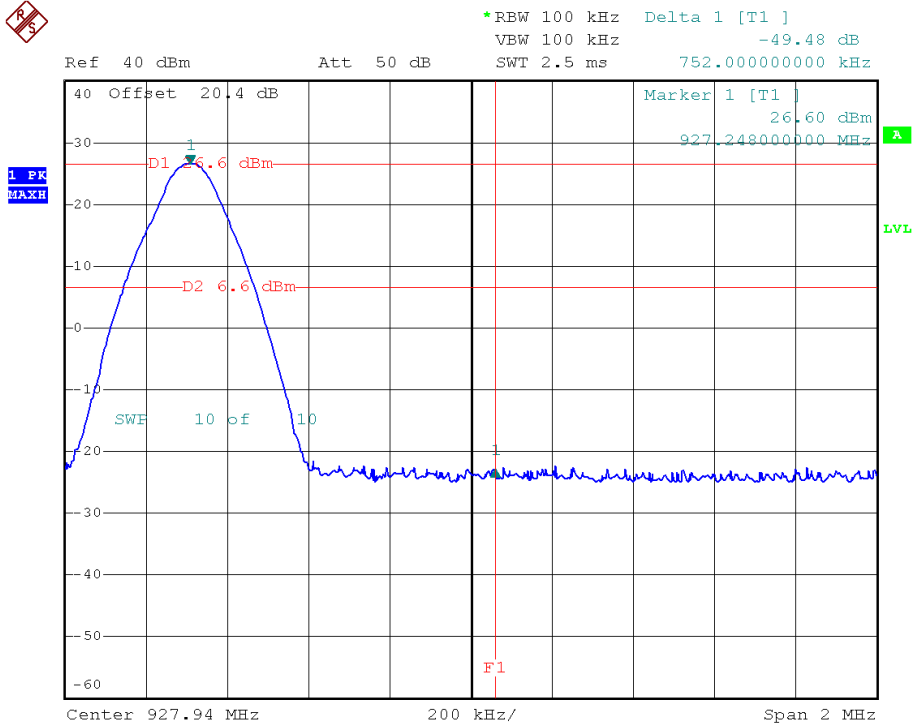
Date: 10.DEC.2010 09:17:50

2. Middle Channel



Date: 10.DEC.2010 09:18:46

3.High Channel



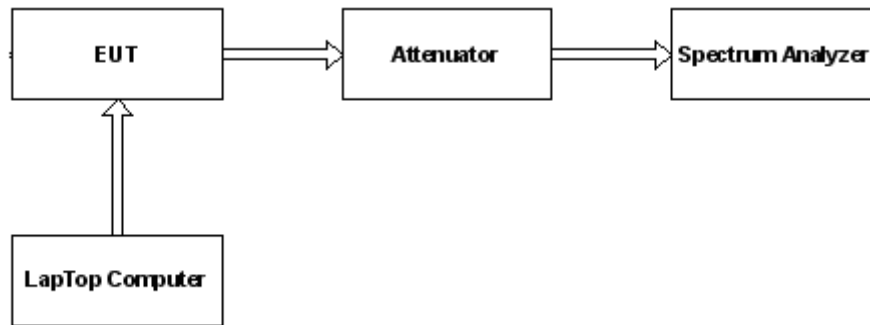
Date: 10.DEC.2010 09:20:11

5.5 Number of hopping Channels

5.5.1 Method of Measurement

The test setup is as shown in the Conducted RF bench setup. The EUT was configured to hop Sequentially through all of its channels. The spectrum analyzer was set to MAX HOLD to capture the number of hopping channels. The entire 902~928 MHz band was examined in three sub-bands, 902~910 MHz, 910~920MHz and 920~928MHz.

5.5.2 Measurement Set-Up



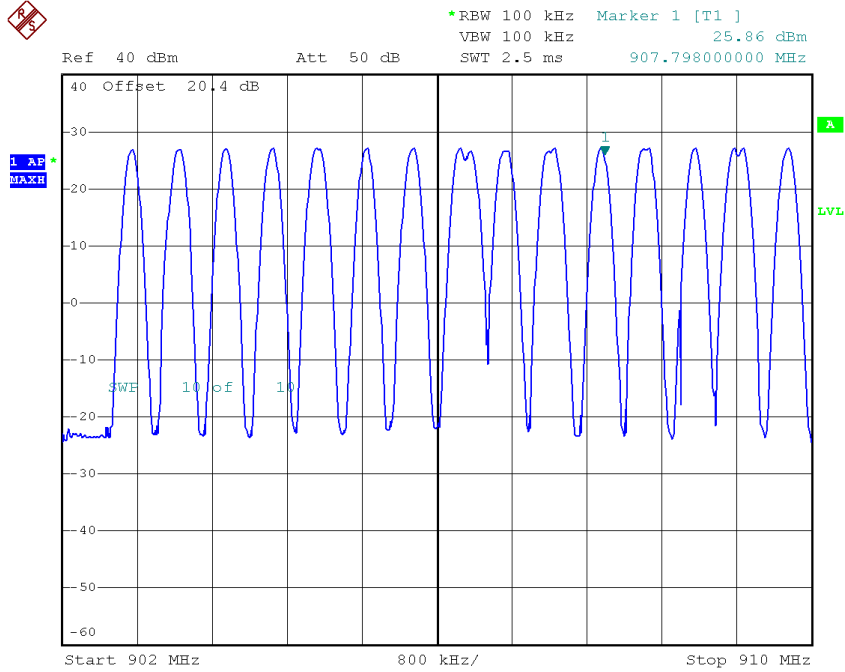
5.5.3 Test Results

All 50 hopping channels were recorded.

Frequency range (MHz)	Num of Channels
902~910	14
910.2~920	20
920.2~928	16

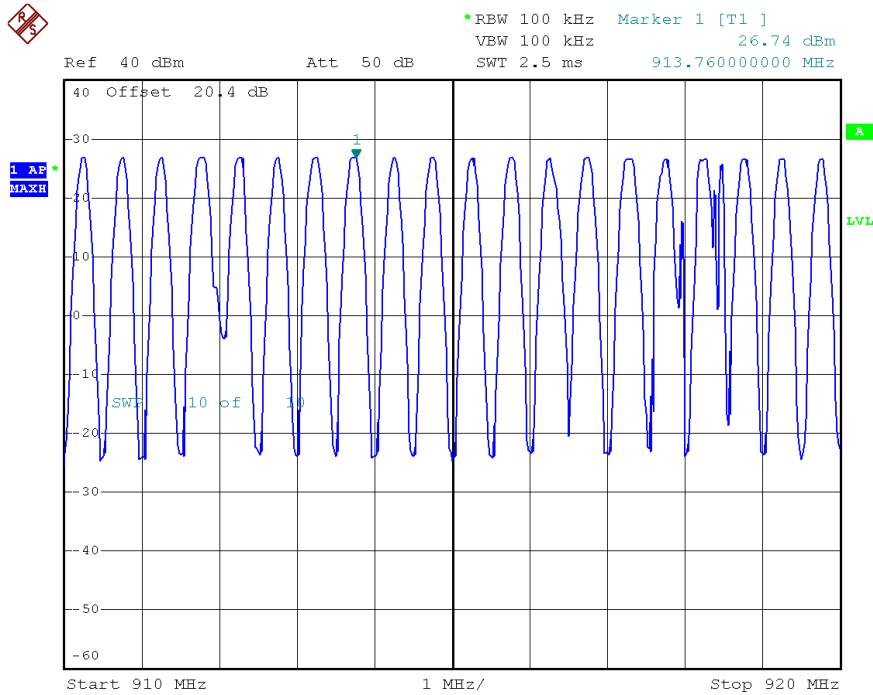
Plots of Hopping Channel

1. 902~910MHz



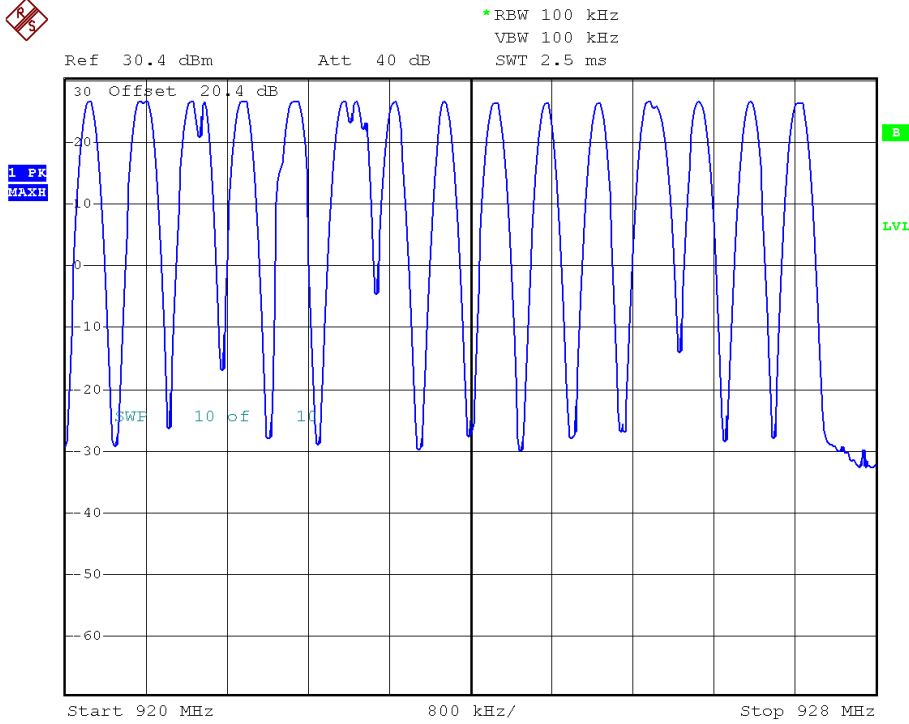
Date: 10.DEC.2010 10:02:35

2. 910~920MHz



Date: 10.DEC.2010 10:11:55

3. 920~928MHz



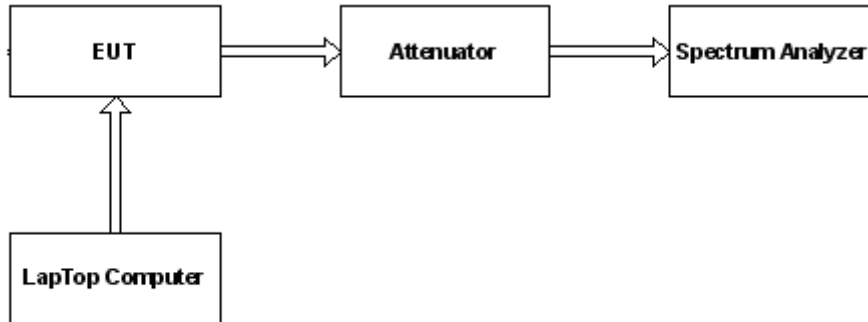
Date: 10.DEC.2010 12:42:44

5.6 Channel Spacing

5.6.1 Method of Measurement

The test setup is as shown in the Conducted RF bench setup. The EUT was configured to hop sequentially through all of its channels. The spectrum analyzer was set to MAX HOLD to capture a few of the sequential channel frequencies. The spectrum analyzer markers were used to determine the channel spacing.

5.6.2 Measurement Set-Up

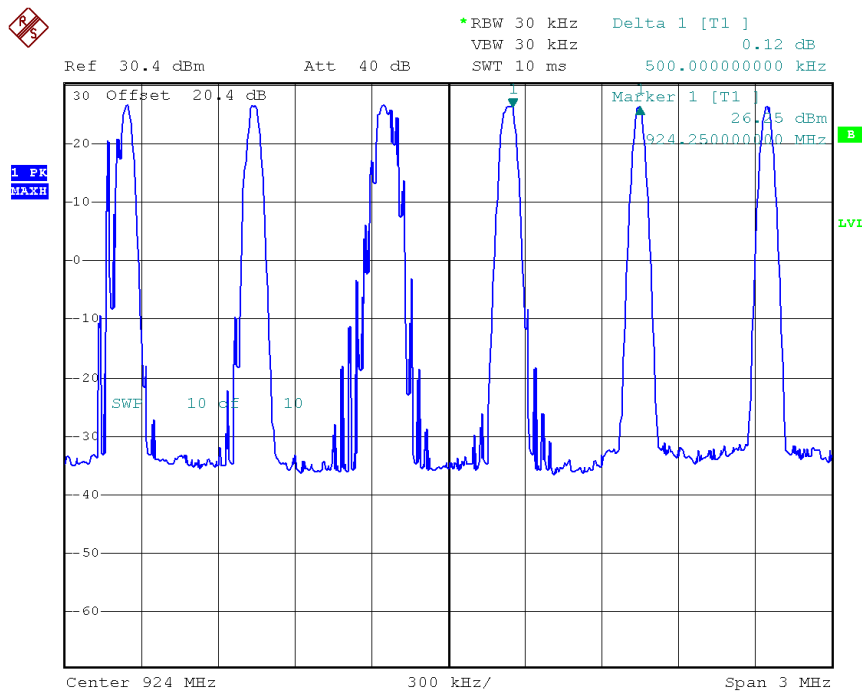


5.6.3 Test Results

The specification requires that the channel spacing be greater than the measured 20dB BW. The 20dB BW was measured at a maximum of 180 kHz.

Channel spacing result measured was 500kHz.

Plots of Channel Spacing



Date: 10.DEC.2010 12:51:38

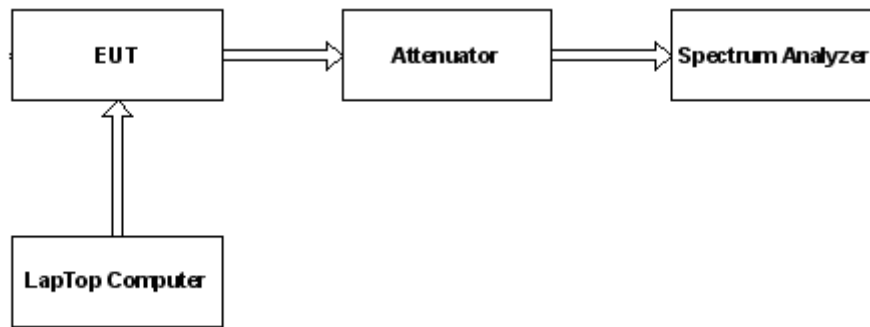
5.7 Channel Dwell Time

5.7.1 Method of Measurement

The test setup is as shown in the Conducted RF bench setup. The EUT was configured to hop Sequentially through all of its channels. Random data packets were transmitted over the link at a fixed packet size.

The spectrum analyzer was used to determine the transmission time for each packet firstly, And then the LOW, MID and High channel were monitored with the spectrum analyzer on zero Span and set to 20s sweep time. RBW was set to 1MHz to prevent hits on adjacent channels appearing as hits on the test channel.

5.7.2 Measurement Set-Up



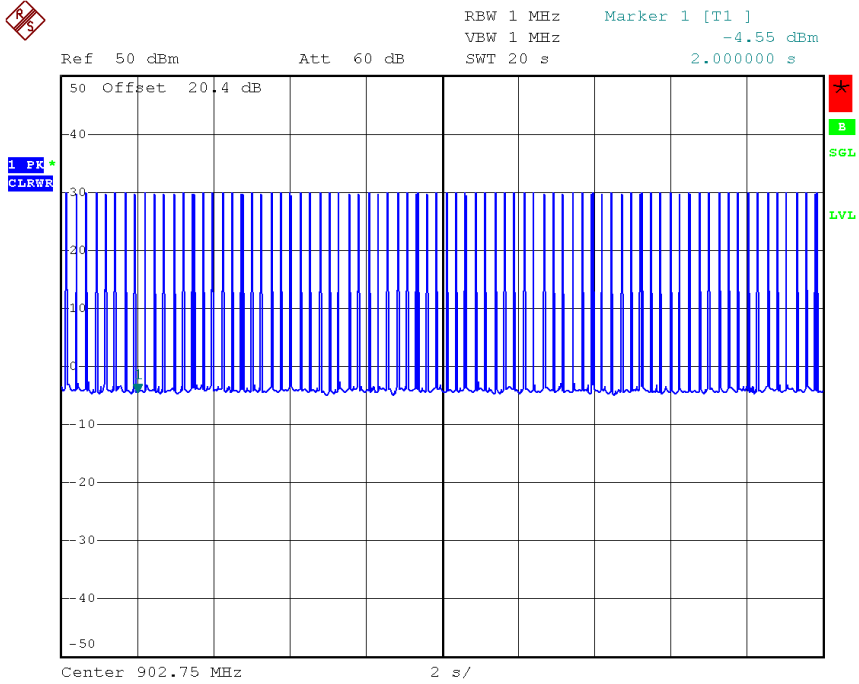
5.7.3 Test Results

There was only 80 packets in 20s on each channel (LOW, MID and HIGH), So we get the results. $0.00454 \times 80 \times 10 = 0.363\text{s}$

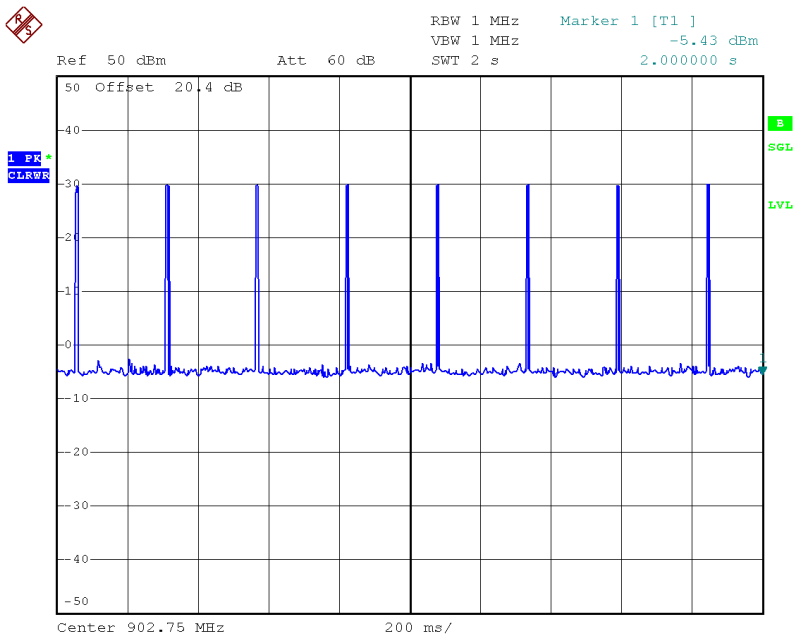
Limits(s)	Frequency(MHz)	Channel Dwell Time(s)	Result
0.400	902.75	0.363	Pass
0.400	914.75	0.379	Pass
0.400	927.25	0.376	Pass

Plots of Dwell Time

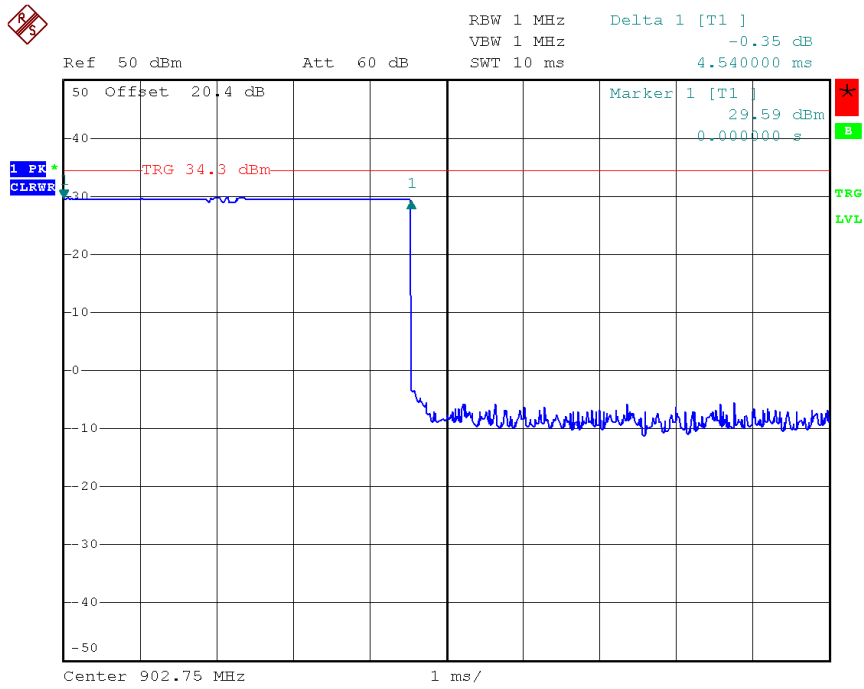
1. Low Channel



Date: 13.DEC.2010 15:22:03

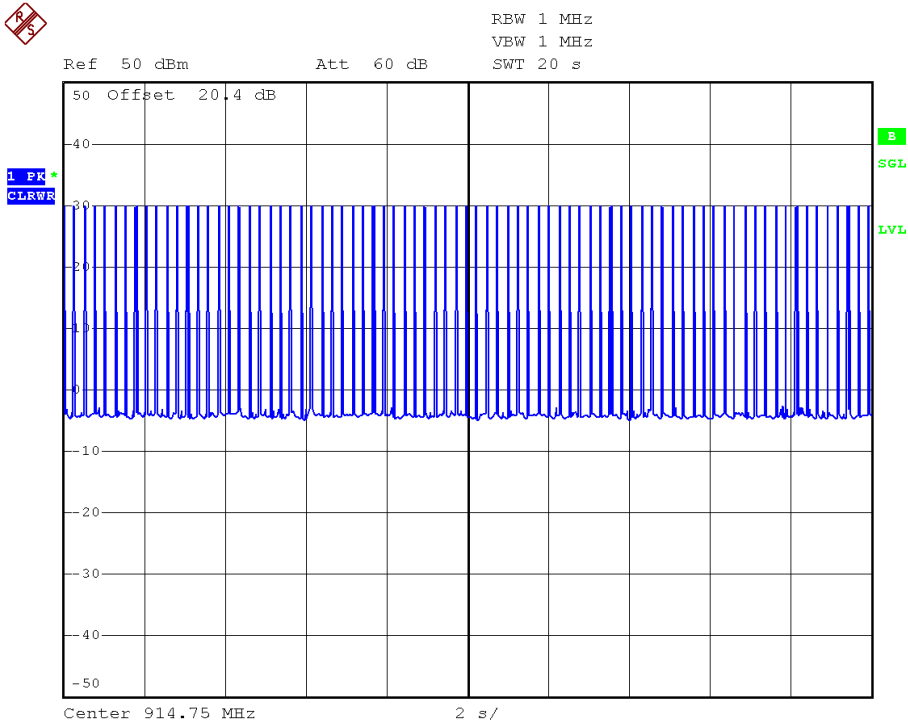


Date: 13.DEC.2010 15:22:27

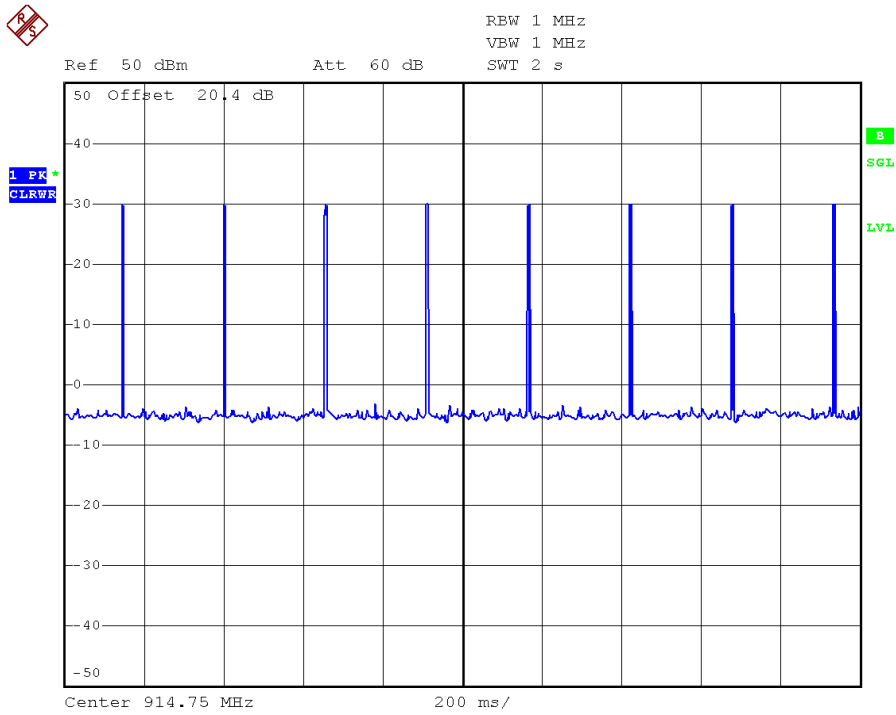


Date: 13.DEC.2010 15:23:53

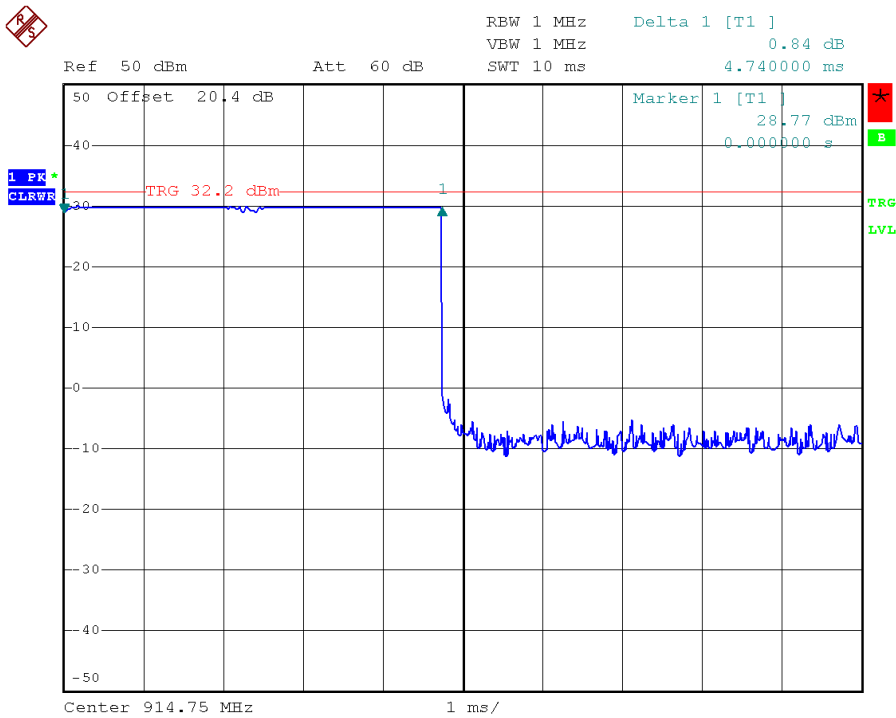
2. Middle Channel



Date: 13.DEC.2010 15:31:48

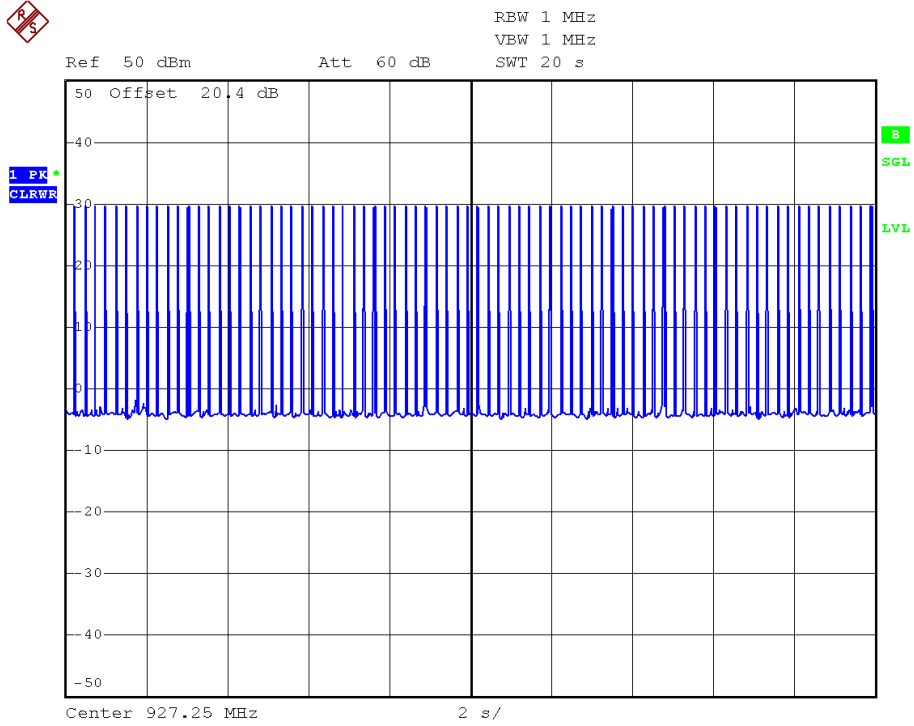


Date: 13.DEC.2010 15:31:15

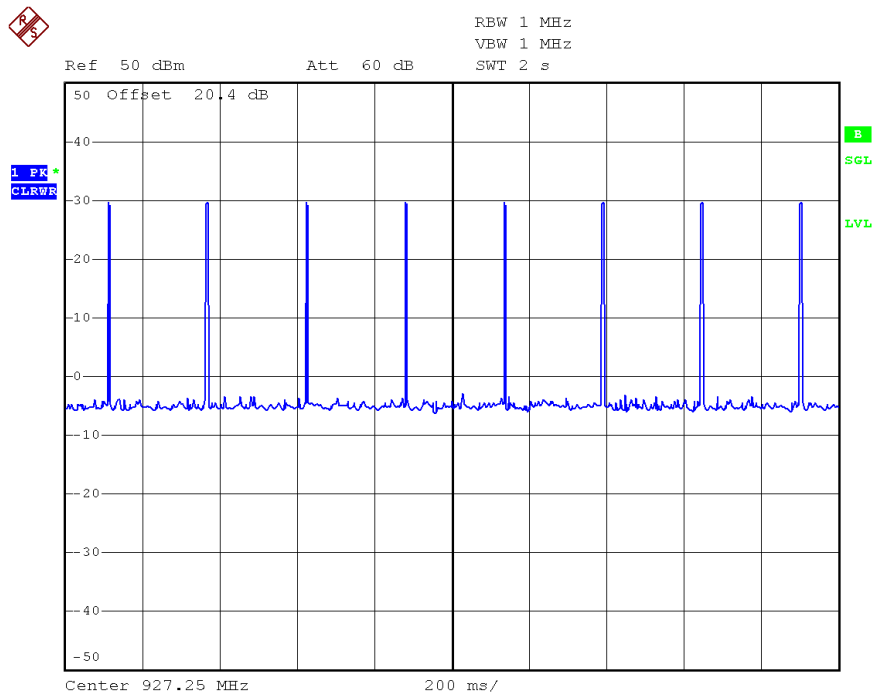


Date: 13.DEC.2010 15:30:52

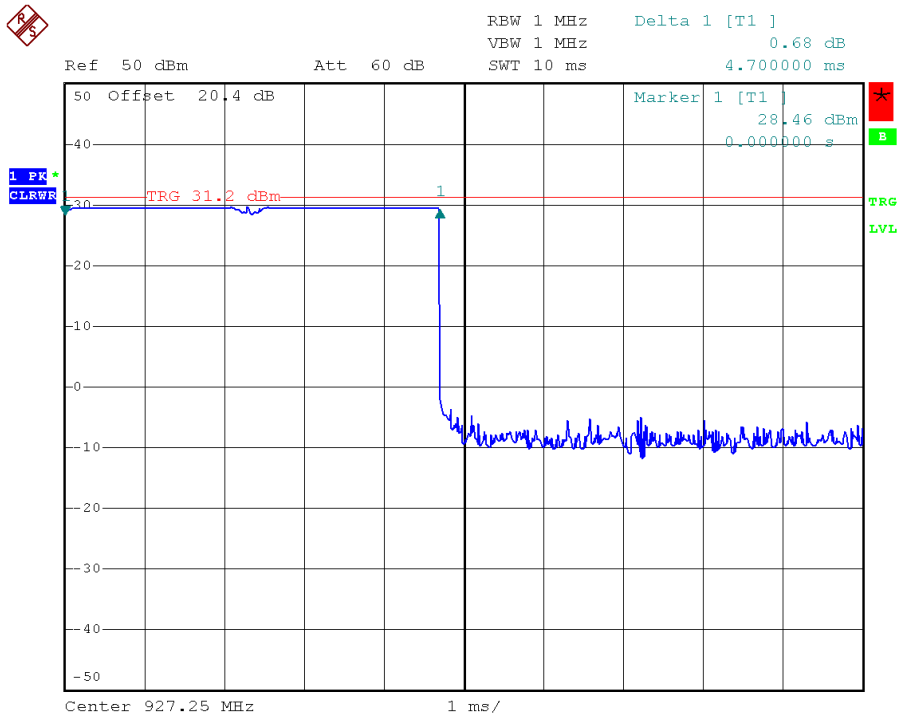
3. High Channel



Date: 13.DEC.2010 15:32:40



Date: 13.DEC.2010 15:32:59



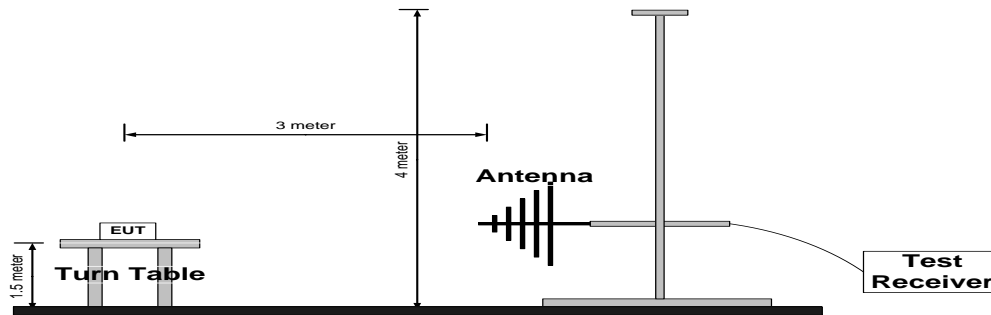
Date: 13.DEC.2010 15:33:31

5.8 Spurious radiated emissions

5.8.1 Method of Measurement

The test set-up was made in accordance to the general provisions of ANSI C63.4-2009. The equipment Under Test(EUT) was set up on a non-conductive table in the semi-anechoic Chamber. The test was performed at the distance of 3m between the EUT and receiving antenna. The radiated emissions measurements were made in a typical installation configuration. Then start the test software. Sweep the whole frequency band through the range from 30MHz to 1GHz or above, using receive bilog antenna or horn antenna. During the test, the height of receive antenna shall be moved from 1 to 4 meters, and the antenna shall be performed under horizontal and vertical polarization. The turn table shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna. The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing.

5.8.2 Measurement Set-Up



5.8.3 Test Results

There was only one packets in 20s on each channel (LOW,MID and HIGH), So we get the results.

Channel	Frequency [MHz]	Reading [dB μ V]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dB μ V/m]	Emission Level [dB μ V/m]
902.75MHz	110.57	10.71	V	10.78	2.31	43.50	23.80
	111.74	9.86	H	10.88	2.32	43.50	23.06
	112.75	9.01	H	10.97	2.32	43.50	22.31
	116.13	8.22	H	11.28	2.36	46.00	21.85
	198.63	27.86	H	10.25	3.14	43.50	41.25
	972.14	4.74	V	24.39	7.53	54.00	36.65

Channel	Frequency [MHz]	Reading [dB μ V]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dB μ V/m]	Emission Level [dB μ V/m]
914.75MHz	71.83	22.55	H	10.18	1.86	40.00	34.60
	73.88	21.68	H	9.73	1.89	40.00	33.30
	110.86	14.29	V	10.81	2.31	43.50	27.40
	121.53	9.67	V	11.72	2.41	43.50	23.80
	154.82	11.73	V	13.35	2.76	43.50	27.83
	198.59	26.56	V	10.25	3.14	43.50	39.95
	480.53	17.51	V	17.38	4.97	46.00	39.86
Channel	Frequency [MHz]	Reading [dB μ V]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dB μ V/m]	Emission Level [dB μ V/m]
927.25MHz	71.83	21.79	H	10.18	1.86	40.00	33.84
	73.88	21.07	H	9.73	1.89	40.00	32.69
	110.67	19.54	V	10.79	2.31	43.50	32.64
	116.01	12.88	V	11.26	2.35	43.50	26.50
	177.19	7.16	H	12.23	2.96	43.50	22.35
	198.59	25.57	V	10.25	3.14	43.50	38.96
	232.53	9.47	V	10.84	3.38	46.00	23.70

5.8.4 Limits

FCC Part 15, Subpart C, 15.247(d)

...In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, 15.209, Radiated Emission Limits

Frequency Range (MHz)	Class B Limits (dBuV/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
above 960	54.0

15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....
Used conversion factor: Limit (dBuV/m) = 20 log(Limit(uV/m)1uV/m)

5.9 Power Line Conducted Emission

5.9.1 Specification

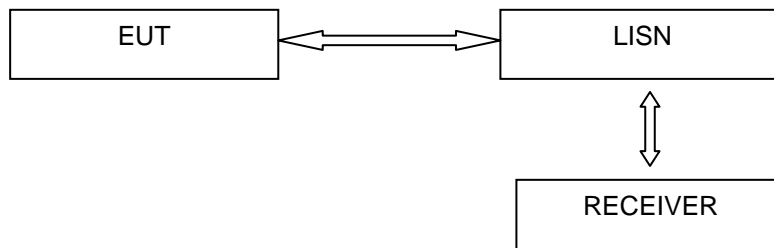
Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 kHz on the 24 DC power and return leads of the EUT according to the methods defined in FCC Part 15.207.

The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane as shown in section 3.1.5. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position producing maximum conducted emissions.

5.9.2 Method of Measurement

The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane as shown in section 3.1.5. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position producing maximum conducted emissions

5.9.3 Measurement Set-Up



5.9.4 Limit

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

5.9.5 Test Result

Frequency Range of Test : 150 kHz to 30 MHz
 Test Standard : FCC Part 15.207
 Test Date : December 21, 2010
 Temperature/Humidity : 24 °C/ 57 %

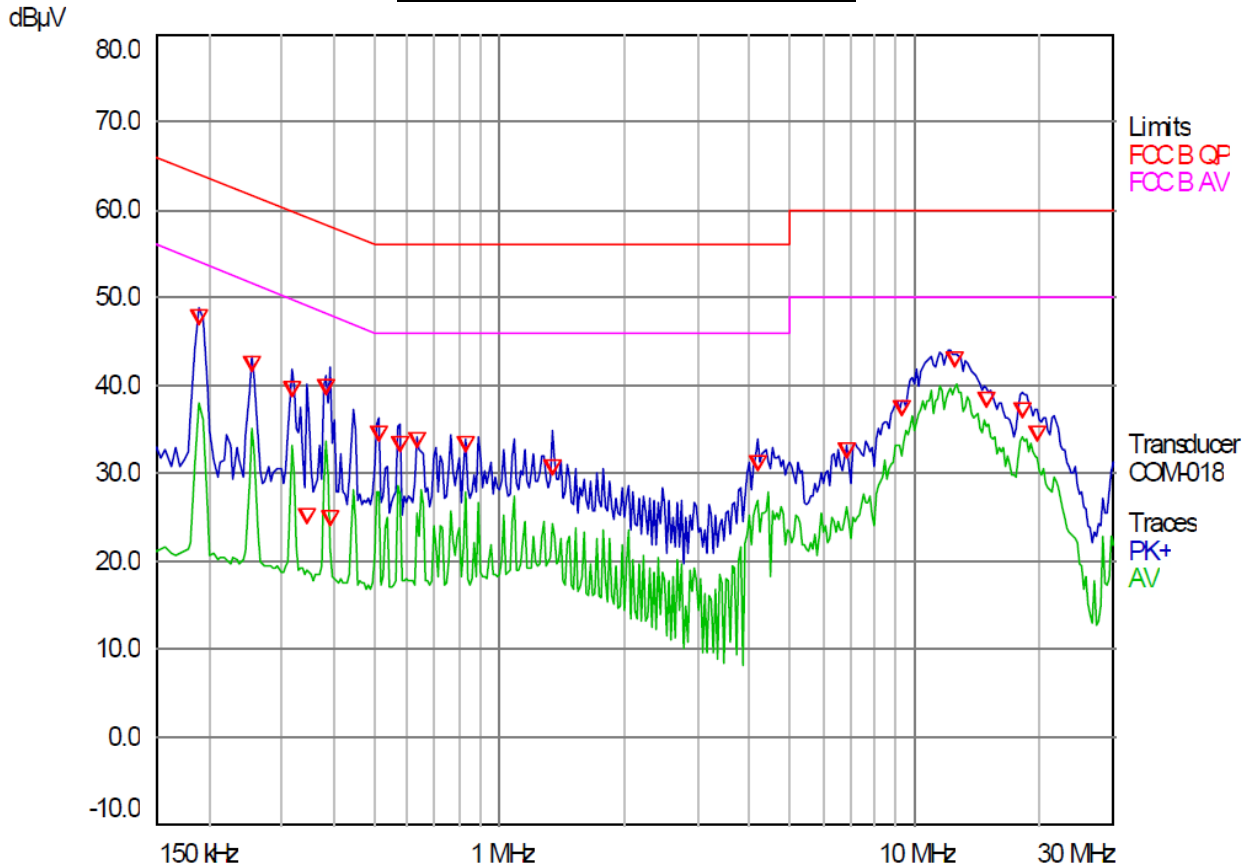
5.9.6 Conducted Emission Test Data

Freq [MHz]	Correcton		Phase [H/N]	Quasi-Peak Mode				Average Mode			
	AMN	C.L		Limit	Reading	Emission	Margin	Limit	Reading	Emission Level	Margin
				[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]
0.190	0.06	0.03	N	64.90	47.43	47.52	-17.38	54.90			
0.254	0.07	0.16	N	63.10	41.69	41.92	-21.18	53.10			
0.318	0.08	0.22	N	61.30	39.05	39.35	-21.95	51.30			
0.366	0.08	0.24	N	59.90	25.98	26.30	-33.60	49.90			
0.382	0.08	0.24	H	59.40	38.67	38.99	-20.41	49.40			
0.394	0.08	0.24	H	59.10	23.70	24.02	-35.08	49.10			
0.512	0.07	0.30	H	56.00	33.21	33.58	-22.42	46.00			
0.576	0.07	0.30	N		32.32	32.69	-23.31				
0.636	0.07	0.30	N		32.67	33.04	-22.96				
0.828	0.08	0.30	N		32.10	32.48	-23.52				
1.348	0.03	0.45	H		29.40	29.88	-26.12				
4.208	0.03	0.79	H		29.39	30.21	-25.79				
6.820	0.04	0.96	H	60.00	30.70	31.70	-28.30	50.00			
9.244	0.06	1.01	H		35.52	36.59	-23.41				
12.492	0.04	1.16	N		40.99	42.19	-17.81				
14.852	0.06	1.22	N		36.49	37.77	-22.23				
18.100	0.07	1.28	H		34.94	36.29	-23.71				
19.564	0.05	1.35	H		32.30	33.70	-26.30				

Notes:

- All modes of operation were investigated and the worst-case emissions are reported. See the plots in next 2 pages.
- Line N = (Neutral), Line H = (Hot)
- Measurement uncertainty estimated at ± 3.736 dB.
The measurement uncertainty is given with a confidence of 95.00 % with the coverage factor, $k=2$
- The detail plot data is refer to 6.1.

Plots of Conducted Emission Test

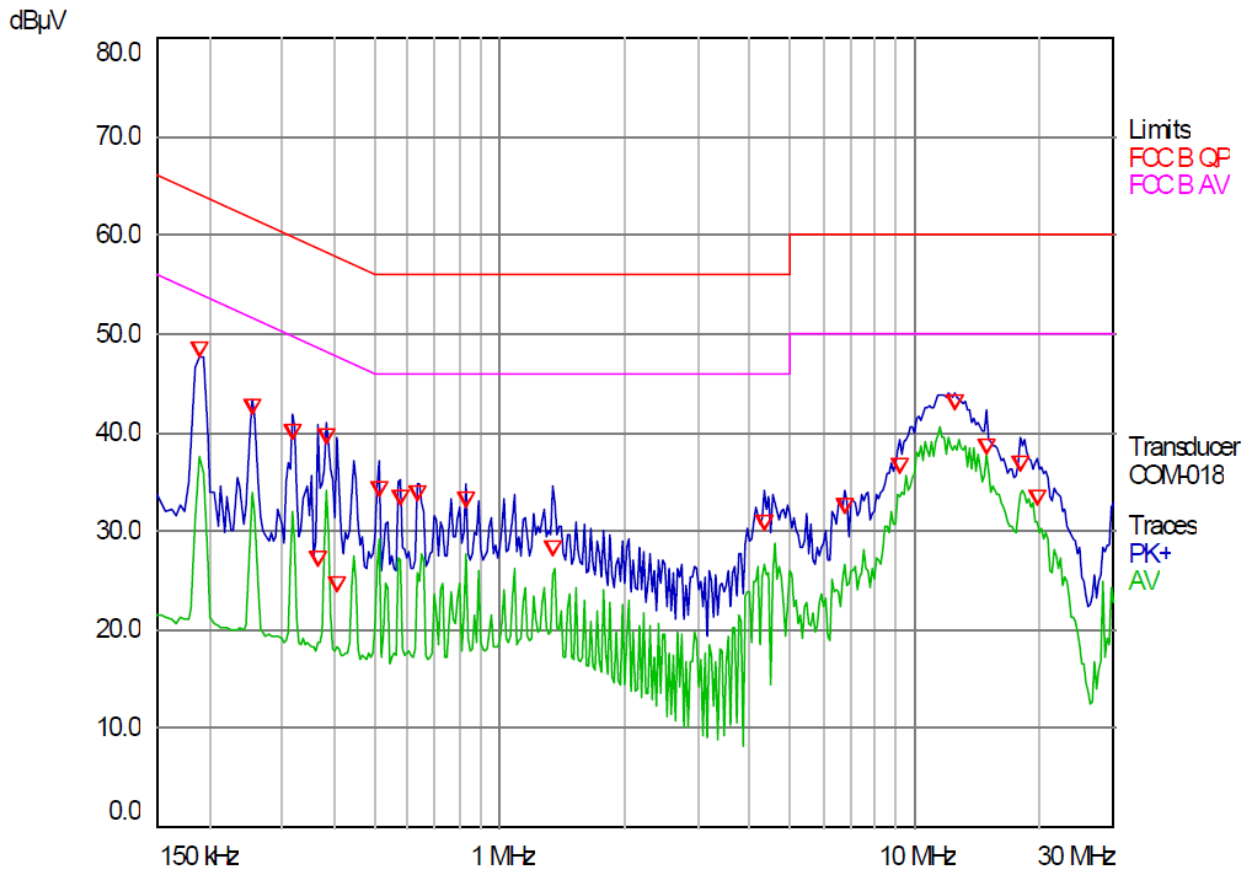


Test Model: SST-US-URFR01A

Test Mode: HOT

Classification: FCC Part15 Subpart B Section 15.207(a) Class B

Plots of Conducted Emission Test



Test Model: SST-US-URFR01A

Test Mode: NEUTRAL

Classification: FCC Part15 Subpart B Section 15.207(a) Class B

5.10 Antenna Requirement

Type	Patch Antenna
Gain	8.06 dBi
Polarity	Circular Polarized
Connector	TNC Female
Model Name / Company	SST-KS-URFA01A / Samsung SDS
Impedance	50 ohm
Size	610 x 290 x 50 (mm)
Beam Width	60 degree



Structure

6. TEST EQUIPMENTS LIST

The listing below denotes the test equipments utilized for the test(s).

	EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date
1	Receiver	ESVS30	Rohde & Schwarz	832854/010	11/01/28
2	Spectrum analyzer	FSP13SE	Rohde & Schwarz	100278	11/10/12
3	Spectrum analyzer	N9020A	Agilent	US46220101	11//09/25
4	Signal Generator	GT9000	Gigatronics	9604010	11/10/15
5	Frequency Counter	R5372	Advantest	41855204	11/10/14
6	Shield Room (7m x 4m x 3m)	N/A	SJEMC	0004	N/A
7	Turn Table	OSC-30	N/A	BWS-01	N/A
8	Antenna Mast	JAC-3	Dail EMC	N/A	N/A
9	Temperature & Humidity chanber	EN-GLMP-54	Enex	N/A	11/10/14
10	Bilog Antenna	VULB9160	Schwarzbeck	VULB9160-3122	12/02/10
11	Bilog Antenna	VULB9161	Schwarzbeck	VULB9161-4067	11/12/01
12	Bilog Antenna	VULB9161	Schwarzbeck	VULB9161-4068	11/11/12
13	Horn Antenna	BBHA 9120 D	Schwarzbeck	BBHA 9120 D 234	12/10/04
14	Horn Antenna	BBHA 9170	Schwarzbeck	BBHA9170157	11/03/16
15	Power Meter	E4418A	Agilent	GB38272621	11/10/14
16	Power Sensor	E9301B	Agilent	US40010238	11/10/14
17	Power supply	IPS-30B03DD	Interact	42052	11/10/15
18	Bandreject filter	3TNF-800/1000-0.2 N/N	K&L Microwave	441	11/10/14
19	Attenuator	34-20-34	WEINSCHL	BP8714	11/10/12