

TEST REPORT

of

FCC Part 2, 27
FCC ID : STE-QUADCOMM-700

Equipment Under Test : RV-Quadcomm
Model Name : Quadcomm-700
Serial No. : N/A
Applicant : R-tron Inc.
Manufacturer : R-tron Inc.
Date of Test(s) : 2010-07-14 ~ 2010-08-23
Date of Issue : 2010-08-23

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Feel Jeong

Date

2010-08-23

Approved By



Charles Kim

Date

2010-08-23

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1. General information

1.1. Testing laboratory

SGS Testing Korea Co., Ltd.

- 705, Dongchun-Dong Sooji-Gu, Yongin-Shi, Kyungki-Do, South Korea.
- Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

www.electrolab.kr.sgs.com

Telephone : +82 +31 428 5700

FAX : +82 +31 427 2371

1.2. Details of applicant

Applicant : R-tron Inc.
Address : Jisan IT Venture Center 3F, 1004-9 Doksna-Dong, Gumchon-Gu, Seoul, Korea
Contact Person : You-Sik, Choi
Phone No. : 82-2-6343-1023

1.3. Description of EUT

Kind of Product	RV-Quadcomm
Model Name	Quadcomm-700
Serial Number	N/A
Power Supply	110 ~ 220 Vac
Rated Power	30 dBm (Uplink, Downlink)
Frequency Range	776 MHz ~787 MHz(Uplink), 746 MHz ~757 MHz(Downlink)
Antenna Gain	3 dB i(Yagi_Uplink), 3 dB i(Patch_Downlink)

1.4. Description of EUT

Test modes are summarized in Table 1, Table per technical descriptions of the EUT. Tests within the present test report were performed under test modes.

Table 1 Test modes list

Test Mode	Description
DL	E-TM3.1 from 3GPP TS 36.141 V8.2.0 (2009-03)
UL	Table A.2.2.1.2-1 of 3GPP TS 36.521-1 V8.2.0 (2009-06)

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1.5. Test equipment list

Equipment	Manufacturer	Model	Cal Due.
Signal Generator	Agilent	E4438C	Mar. 31, 2011
Signal Generator	Rohde & Schwarz	SMR40	Sep. 25, 2010
Spectrum Analyzer	Rohde & Schwarz	FSV30	Mar. 31, 2011
Power Divider	Agilent	87302C	Jan. 07, 2011
Attenuator	Agilent	8498A	Apr. 01, 2011
High Pass Filter	Wainwright	WHK3.0/18G-10SS	Sep. 29, 2010
High Pass Filter	Wainwright	WHKX1.5/15G-6SS	Apr. 01, 2011
AC power Supply	Deakwang	Slidas	Sep. 25, 2010
Preamplifier	H.P.	8447F	Jun. 05, 2011
Preamplifier	Empower RF Systems, Inc	2002-BBSC4AEL	Mar. 31, 2011
Test Receiver	R & S	ESU26	Apr. 15, 2011
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	Jun. 22, 2011
Horn Antenna	Rohde & Schwarz	HF 906	Oct. 08, 2011
Horn Antenna	SCHWARZBECK	BBH 9120D	Nov. 09, 2011
Dipole Antenna	VHAP/UHAP	975/958	Oct. 10, 2011
Antenna Master	EMCO	1050	N.C.R
Turn Table	Daeil EMC	DI-1500	N.C.R
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	Jan. 27, 2011

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1.6. Summary of Test Results

APPLIED STANDARD : FCC Part 27		
Section in FCC part	Test Item	Result
§2.1046 §27.50	Maximum Channel Power	Complied
§27.53(c),§27.53(f)	Field Strength of Spurious Radiation	Complied
§2.1049	Occupied Bandwidth 26dB	Complied
§27.53(c),§27.53(f)	Spurious Emission at Antenna Terminal	Complied
§27.54	Frequency Stability	Complied
§27.53(f)	Band Edge	Complied
§1.1307(b)(1)	Maximum Permissible Exposure (Exposure of Humans to RF Fields)	Complied

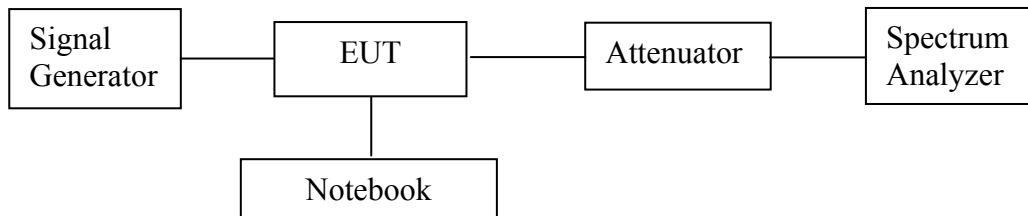
1.7. Test Report Revision

Revision	Report number	Description
0	F690501/RF-RTL004067	Initial
1	F690501/RF-RTL004067-1	Revised FCC ID
2	F690501/RF-RTL004067-2	Addition test

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2. Maximum Channel Power

2.1. Set up



2.2. Limit

Fixed and base stations transmitting a signal in the 746-757 MHz, 758-763 MHz, 776-787 MHz and 788-793 MHz bands with an emissions bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/ MHz and an antenna height of 305 m HAAT.

2.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. RF power output was measured with an RF input level at the point just before the compression point of the amplifier.
4. This is the point of maximum RF output power. If the RF input level is increased beyond this point, the amplifier gain (and consequently output power) is automatically reduced.

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2.4. Test Results

Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

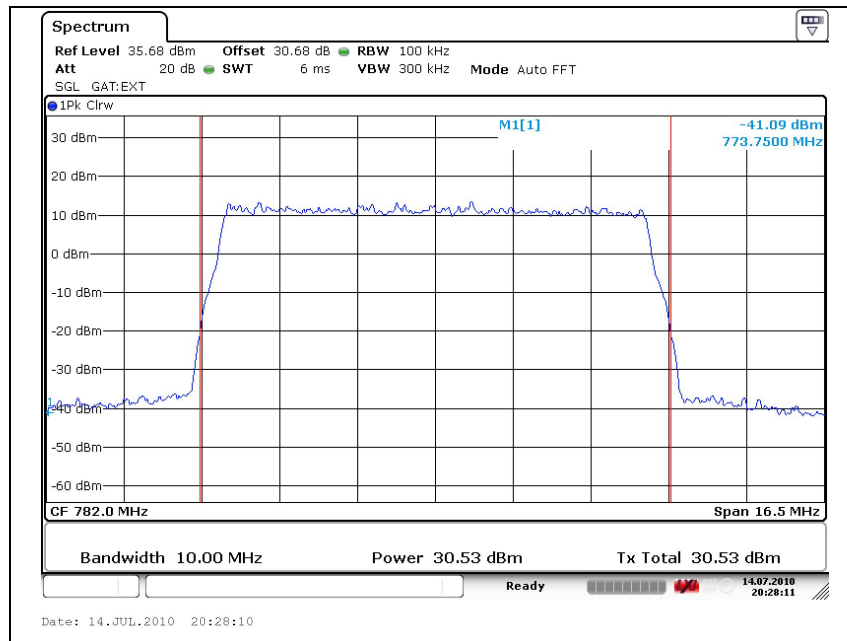
Test mode	Frequency (MHz)	Measured Channel Power	
		dB m	mW
Uplink	782.00	30.53	1 130
Downlink	751.00	29.78	951

Please refer to the following plots.

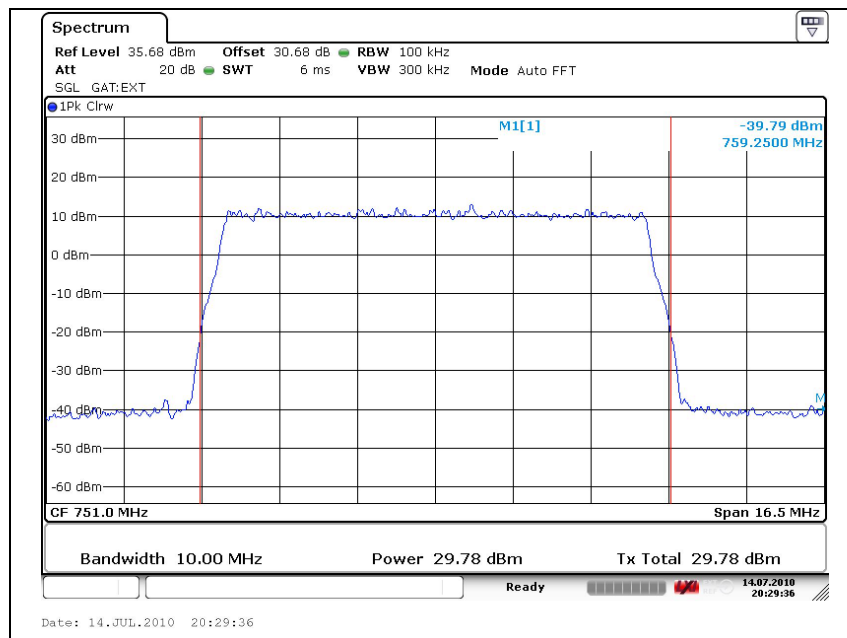
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LTE band

Uplink



Downlink

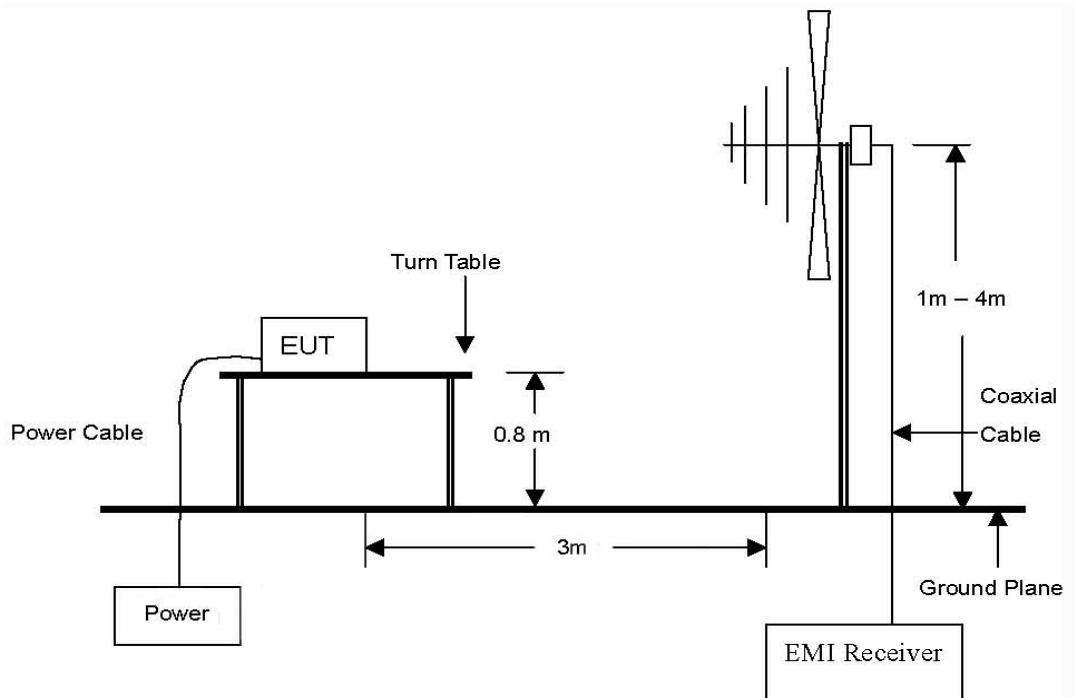


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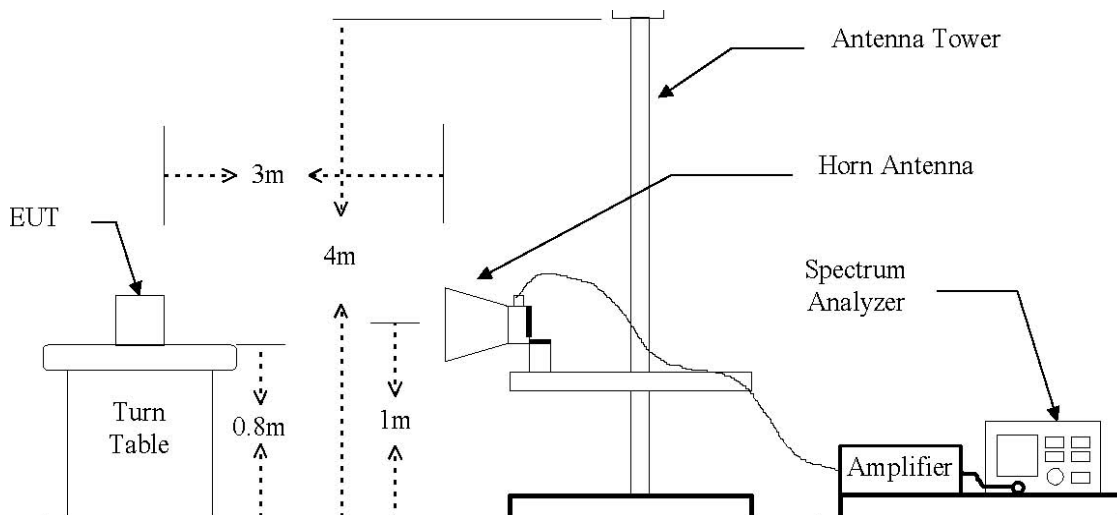
3. Field Strength of Spurious Radiation

3.1. Set up

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 40 GHz Emissions.



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3.2. Limit

For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside of the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside of the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB;

(2) On any frequency outside of the 776-787 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB;

For operations in the 746-758 MHz, 775-793 MHz and the 805- 806 MHz bands, emissions in the band 1 559-1 610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth

3.3. Test Procedure: Based on ANSI/TIA 603C: 2004

1. On a test site, the EUT shall be placed at 0.8cm height on a turn table, and in the position closest to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3m from EUT to correspond to the frequency of the transmitter.
3. The output of the test antenna shall be connected to the measuring receiver and the peak detector is used for the measurement.
4. The transmitter shall be switched on, the measuring receiver shall be tuned to the frequency of the transmitter under test.
5. The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.
6. The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
7. The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.
8. The maximum signal level detected by the measuring receiver shall be noted.
9. The transmitter shall be replaced by a horn (substitution antenna).
10. The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.
11. The substitution antenna shall be connected to a calibrated signal generator.
12. In necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
13. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
14. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, which is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.
15. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
16. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.
17. The measure of the effective radiated power is the large of the two levels recorded, at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary

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3.4. Test Result

Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

Uplink

Frequency (MHz)	Ant. Pol. (H/V)	S.G level (dB m)	Cable loss (dB)	Ant. gain (dB d)	E.R.P. (dB m)	Margin (dB)
89.414	H	-50.87	0.96	-10.09	-61.92	48.92
103.562	H	-50.14	1.01	-10.00	-61.15	48.15
750.052	H	-49.52	3.16	-10.20	-62.88	49.88
1 559.592	H	-46.53	4.40	6.21	-44.72	2.57

Downlink

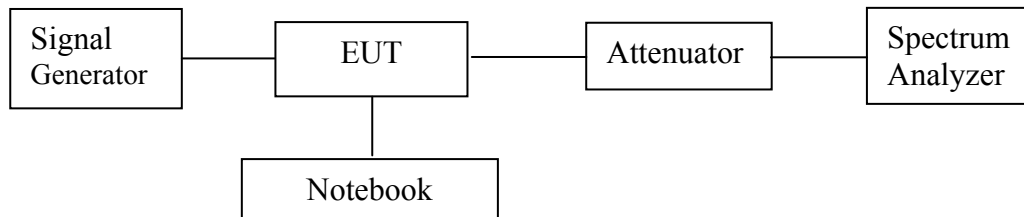
Frequency (MHz)	Ant. Pol. (H/V)	S.G level (dB m)	Cable loss (dB)	Ant. gain (dB d)	E.R.P. (dB m)	Margin (dB)
89.412	H	-50.64	0.96	-10.09	-61.69	48.69
103.559	H	-49.80	1.01	-10.00	-60.81	47.81
750.051	H	-48.88	3.16	-10.20	-62.24	49.24
1 500.160	H	-46.28	4.32	6.05	-44.55	31.55

Remake: 1. No more spurious emissions above 1 600 MHz for all channel.
2.. E.R.P. & E.I.R.P. = S.G level (dB m) - Cable loss (dB) + Ant. gain (dB d/dBi)

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4. Occupied Bandwidth 26 dB

4.1. Set up



4.2. Limit

47 CFR Part 2 section § 2.1049 and Part 27, no specific modulation characteristics requirement limits is applicable.

The occupied bandwidth is defined in section § 2.1049: the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. The occupied bandwidth is normally called 99% bandwidth.

According to section § 27.53(l)(6), the emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. The emission bandwidth is normally called 26 dB bandwidth.

4.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. The resolution bandwidth of the spectrum analyzer was set at 30 kHz.

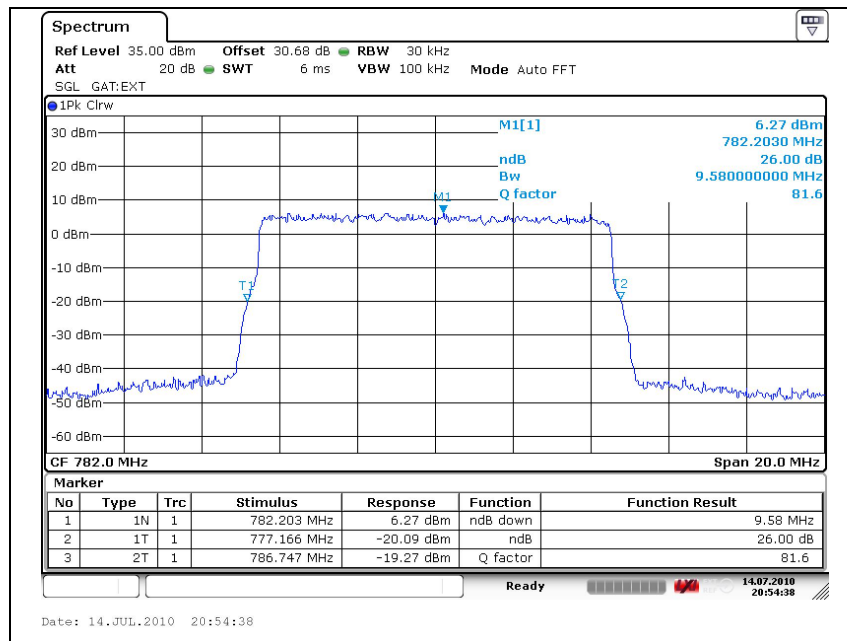
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4.4 Test Results

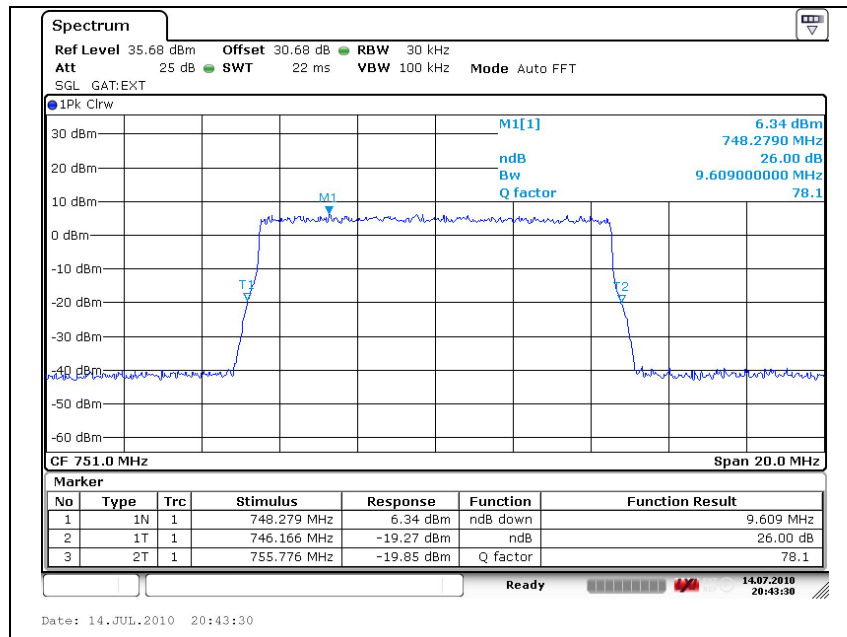
Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

Output 26 dB Occupied Bandwidth

Uplink



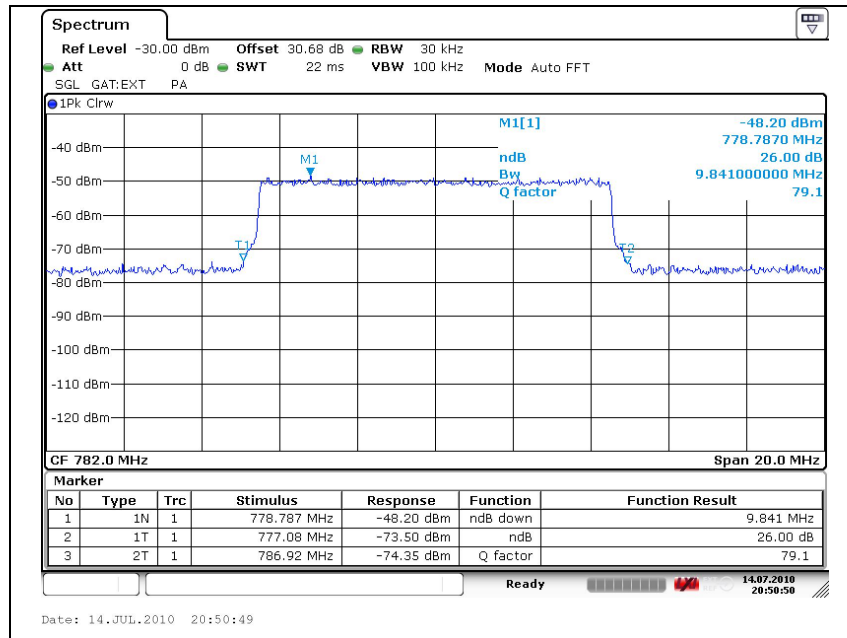
Downlink



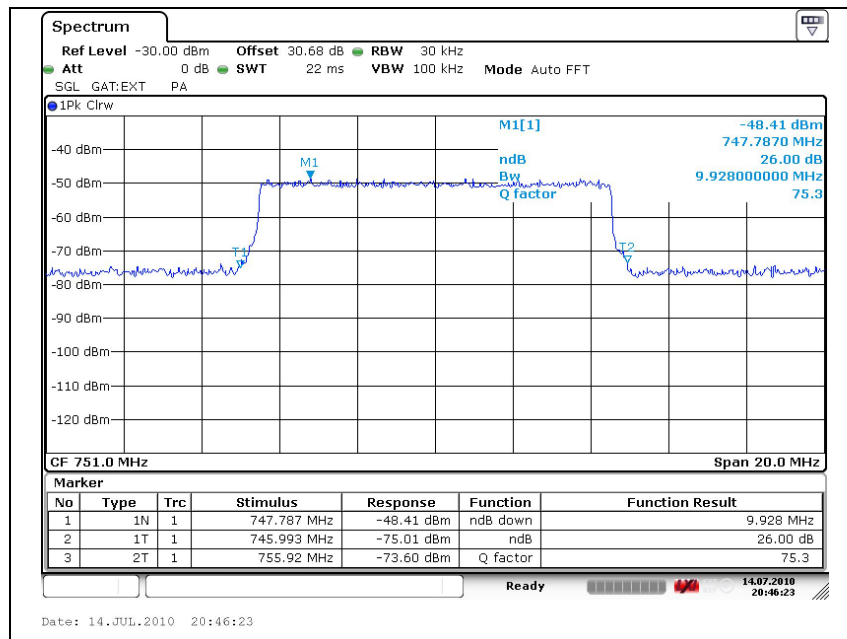
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Input 26 dB Occupied Bandwidth

Uplink



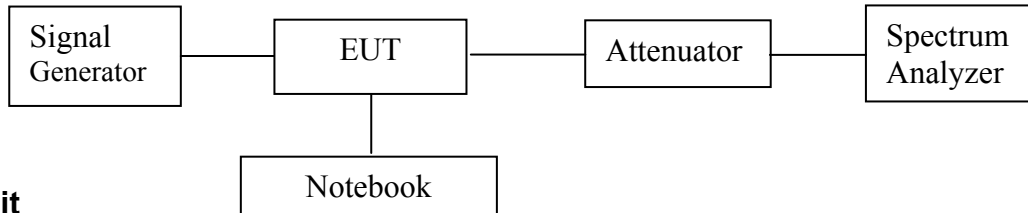
Downlink



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5. Spurious Emissions at Antenna Terminal

5.1. Set up



5.2. Limit

For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside of the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On any frequency outside of the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB;
- (2) On any frequency outside of the 776-787 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB;
- (3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log (P)$ in a 6.25 KHz band segment for base and fixed stations;
- (5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based upon the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater.

However, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of 30 kHz may be employed.

For operations in the 746-758 MHz, 775-793 MHz and the 805- 806 MHz bands, emissions in the band 1 559-1 610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

5.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. The resolution bandwidth of the spectrum analyzer was set at 1 MHz.

5.4. Test Results

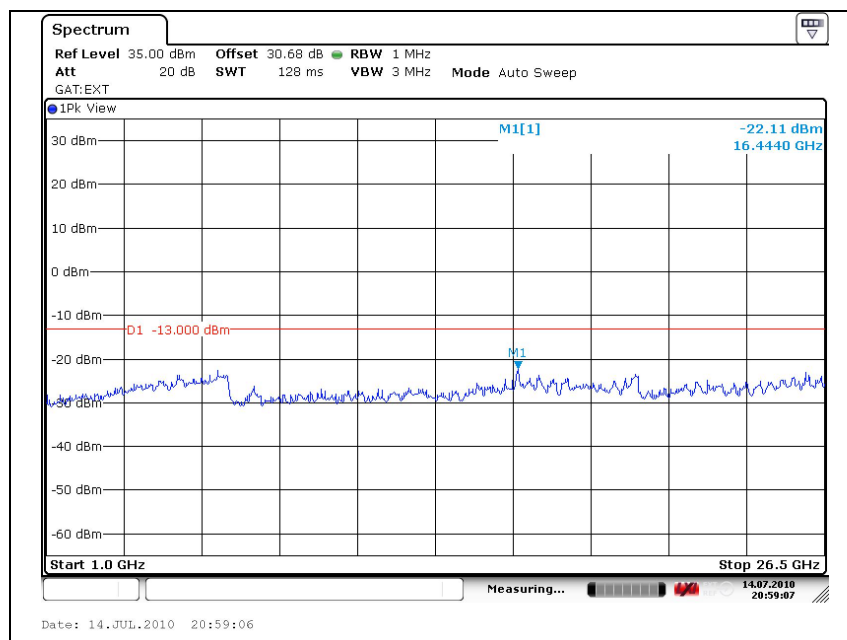
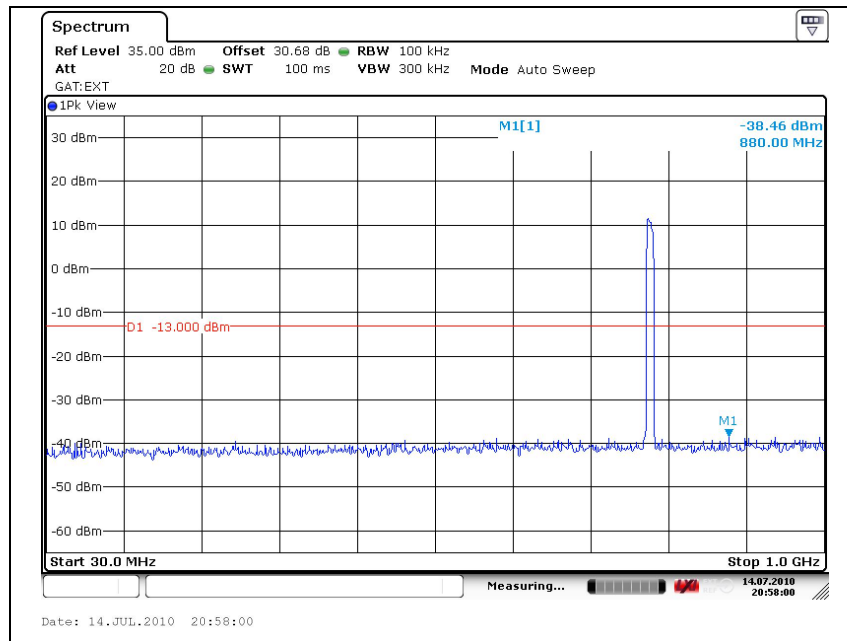
Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

Please refer to the following plots.

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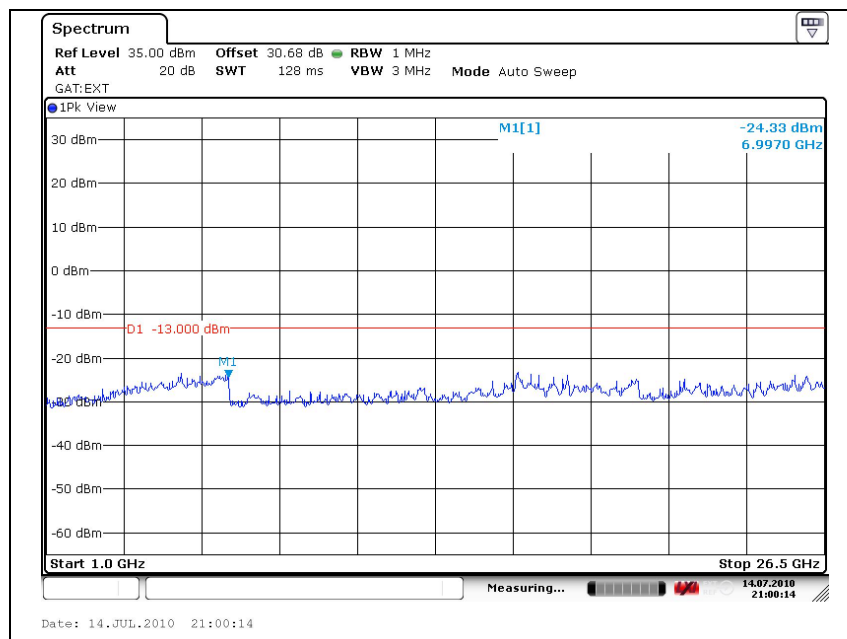
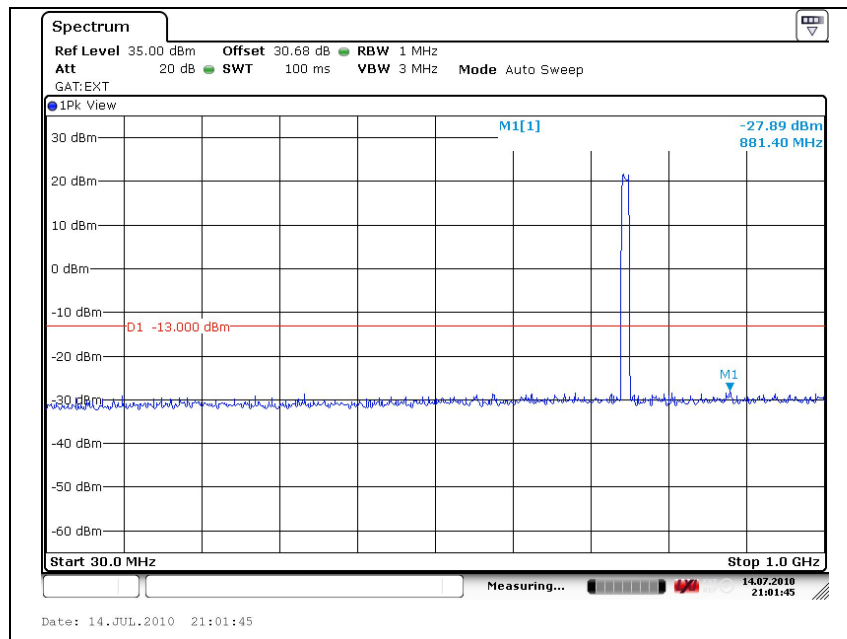
LTE band

Uplink



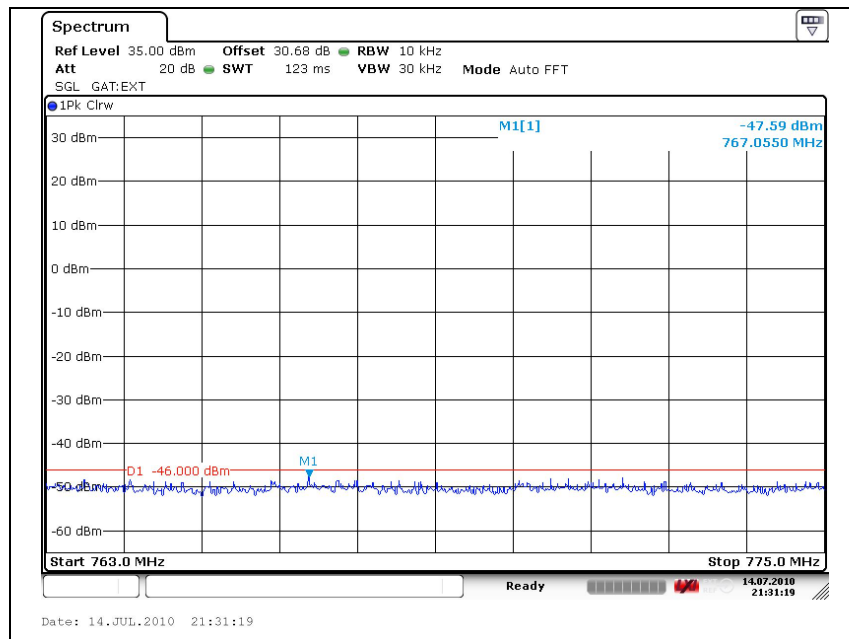
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Downlink

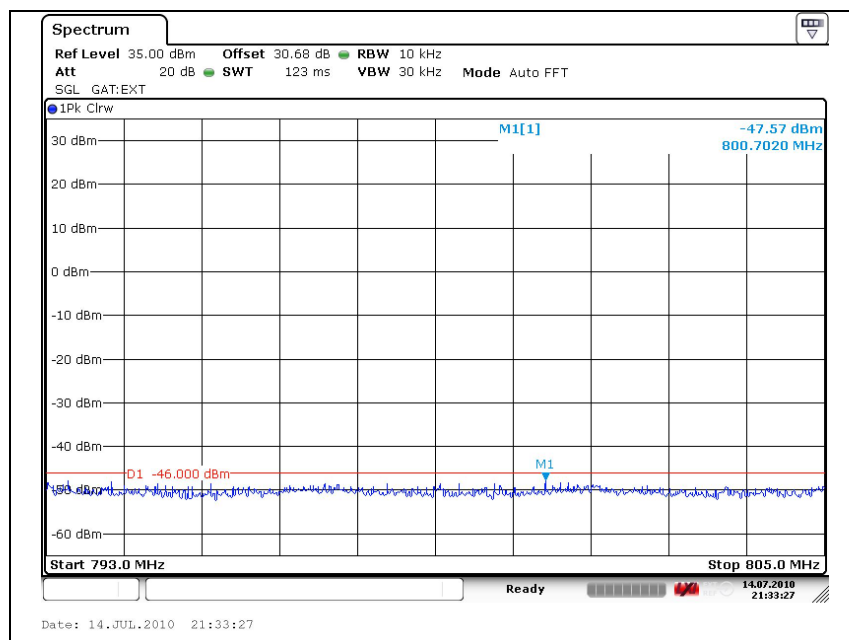


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763 MHz - 775 MHz

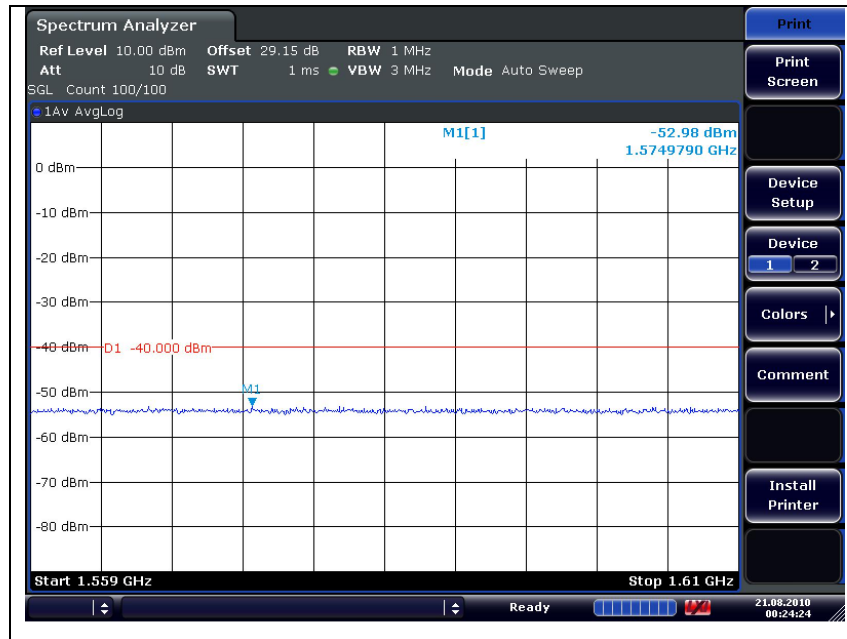


793 MHz - 805 MHz



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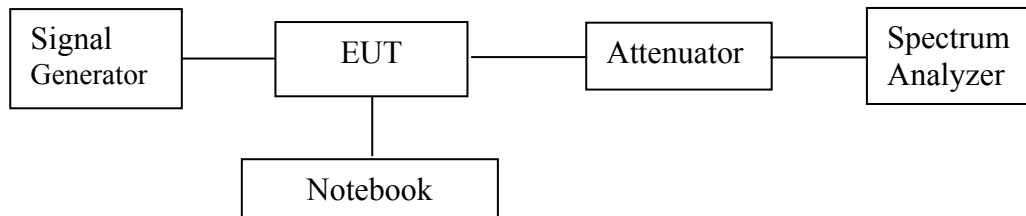
1 559 MHz – 1 610 MHz



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6. Band Edge

6.1. Set up



6.2. Limit

(1) On any frequency outside of the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB;

(2) On any frequency outside of the 776-787 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB;

6.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. The resolution bandwidth of the spectrum analyzer was set at 100 kHz.

6.4. Test Results

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

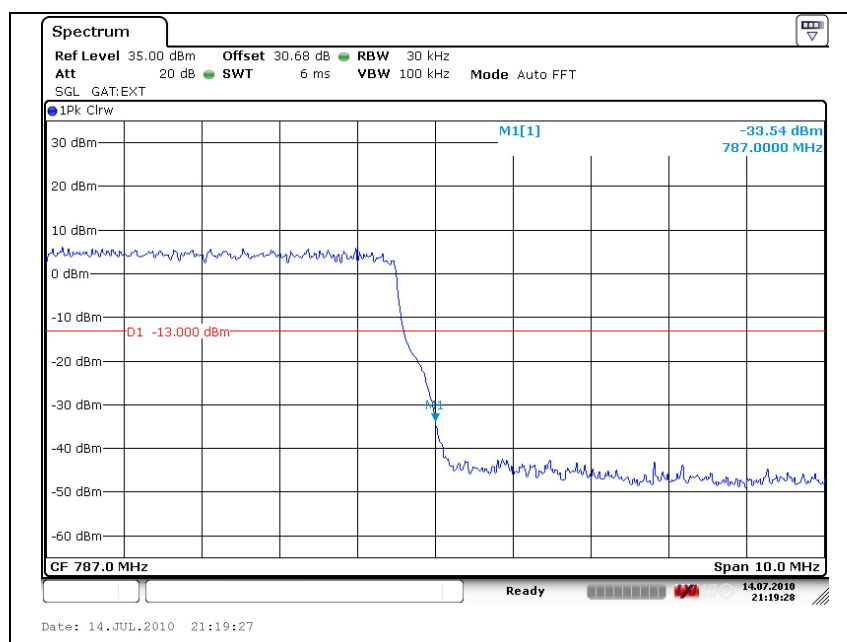
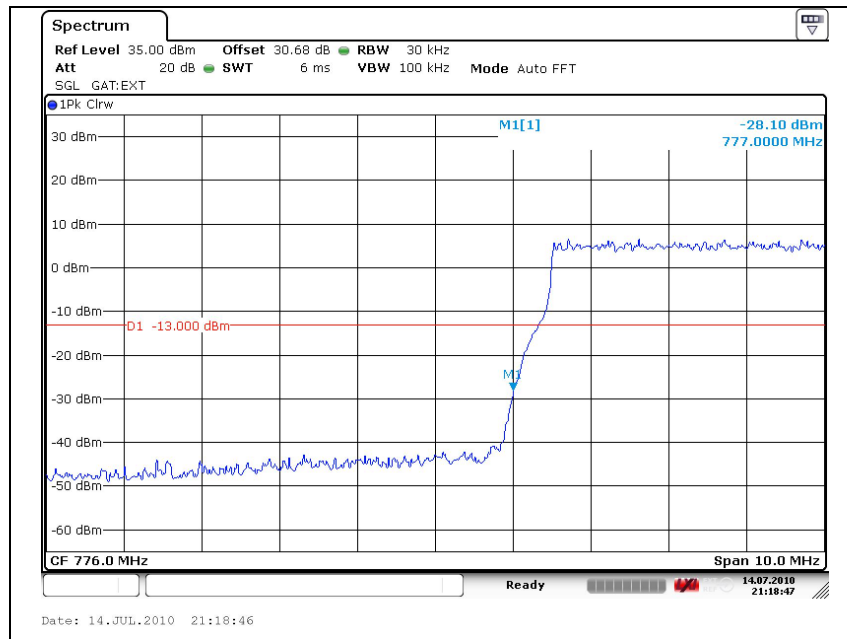
Please refer to the following plots.

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Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

LTE band

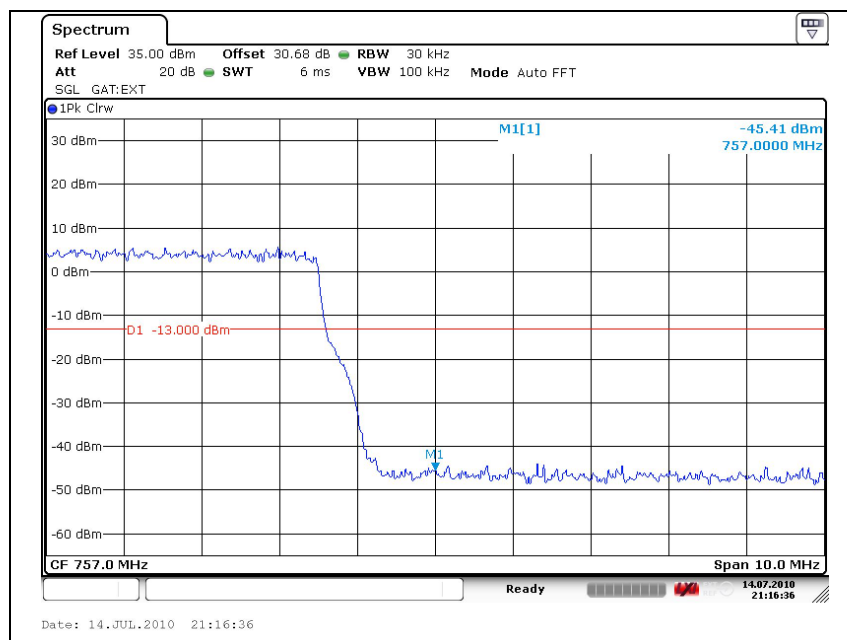
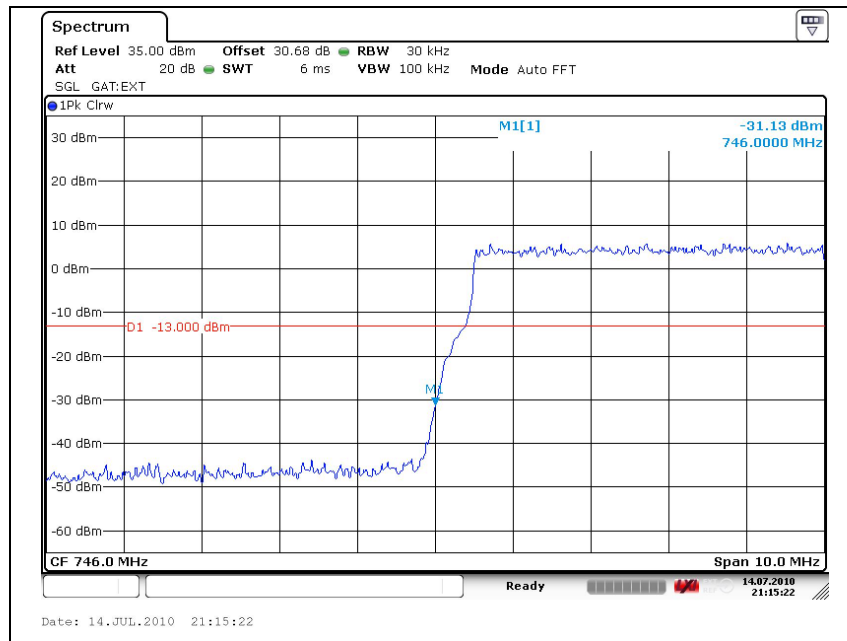
Uplink



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LTE band

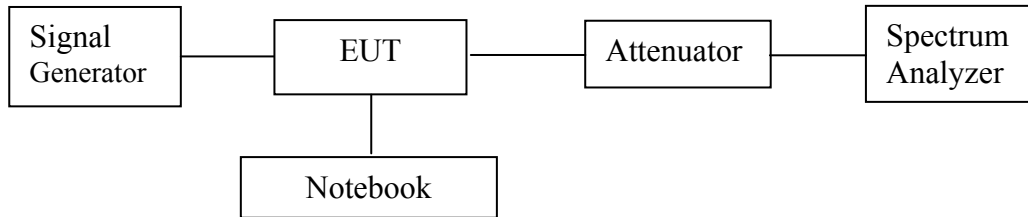
Downlink



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7. Frequency Stability

7.1. Set up



7.2. Limit

According to 47 CFR Part 2 section § 2.1055 and Part 27 section § 27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

7.3. Test Procedure

1. Frequency Stability vs. Temperature: The equipment under test was connected to an external AC power supply and the RF output was connected to a frequency counter via feed-through attenuators.
2. The EUT was placed inside the temperature chamber. The AC leads and RF output cable exited the chamber through an opening made for the purpose.
3. After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.
4. Frequency Stability vs. Voltage: An external variable AC power supply was connected to the battery terminals of the equipment under test. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the AC end point. The output frequency was recorded for each AC.

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7.4. Test Results

Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

Uplink

Reference Frequency: 782.00 MHz, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
50	110	-23	-0.029
40		-19	-0.024
30		-11	-0.014
24		-3	-0.004
10		2	0.003
0		4	0.005
-10		6	0.008
-20		11	0.014
-30		15	0.019
Frequency Stability versus power Supply			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
24	126.5	-3	-0.004
	93.5	-4	-0.005
	85(End point)	-3	-0.004

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Downlink

Reference Frequency: 751.00 MHz, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
50	110	-25	-0.033
40		-22	-0.029
30		-15	-0.020
24		-5	-0.007
10		6	0.008
0		9	0.012
-10		10	0.013
-20		14	0.019
-30		19	0.025
Frequency Stability versus power Supply			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
24	126.5	-5	-0.007
	93.5	-4	-0.005
	85(End point)	-4	-0.005

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8. RF Exposure Evaluation

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in § 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time
(A) Limits for Occupational /Control Exposures				
300 – 1 500	--	--	F/300	6
1 500 – 100 000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1500	--	--	F/1500	6
1 500 – 100 000	--	--	1	30

8.1 Friis transmission formula : $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot R^2)$

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

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8.2 Test Result of RF Exposure Evaluation

Test Item : RF Exposure Evaluation Data

Test Mode : Normal Operation

8.2.1 Output Power into Antenna & RF Exposure Evaluation Distance

Test mode	Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20cm (mW/cm ²)	LIMITS (mW/cm ²)
Uplink(Yagi)	782.00	30.53	3	0.449	0.521
Downlink(Patch)	751.00	29.78	3	0.378	0.501

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