



Test Report No. 9312320320

Applicant: RADWIN Ltd

***Broadband Wireless Access UTRA FDD
Base Station***

***Model: RADWIN-6000
FCC ID: Q3KRW6000-B5***

***From The Standards Institution
Of Israel
Industry Division
Electronics & Telematics Laboratory
EMC Branch***



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Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

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Model: RADWIN-6000

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1. Applicant information

Applicant:	RADWIN Ltd
Address:	27 Habarzel str, Tel-Aviv, 69710, Israel
Sample for test selected by:	The customer
The date of tests:	9, 22 April 2013

Equipment under test information

Description of Equipment Under Test (EUT):	Broadband Wireless Access UTRA FDD Base Station.
Model:	RADWIN-6000
Serial Number:	NA
Manufactured by:	RADWIN Ltd

2. Test performance:

Location:	SII EMC Section
Purpose of test:	Apparatus compliance verification in accordance with emission requirements
Test specifications:	47CFR part 22 Subpart H; Part 1 §1.1310

This Test Report contains 31 pages and may be used only in full.

This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.



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3. Summary of test

The EUT was found to be in compliance with requirements of:
47 CFR Part 22 H § 22.913, 22.917.

Transmitter characteristics	Subclasses
ERP transmit power	22.913(a)
Occupied Bandwidth	2.1049
Transmitter spurious emissions at antenna terminal	22.917
Transmitter spurious emissions radiated	22.917
Frequency stability over temperature variation	2.1055

Electronics and Telematics Laboratory		22 July 2013
<u>Test performed by:</u>	Mr. Michael Feldman Test technician	
<u>Test report approved by:</u>	Mr. Yuri Rozenberg. Head of EMC Branch	

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4. Equipment under test description.

*The customer provided description.

4.1 General description

RW-6000 is a small cell solution that provides HSPA+ services for cellular operators and Broadband Wireless Access (BWA) Services for Internet Service Providers.

This compact, carrier grade and fully outdoor unit supports high capacity and high transmission power with remarkably low power consumption.

Offering an intelligent and cost effective solution, RW-6000 extends remote rural area coverage and expands capacity in dense urban outdoor hotspots.

EUT technical characteristics

Transmitter technical characteristics.		Note	
Stand-alone/fixed use			
Assigned frequency ranges	869 MHz – 880 MHz	Block A	
	890 MHz – 891.5 MHz	Block A	
	880 MHz – 890 MHz	Block B	
	891.5 MHz – 894 MHz	Block B	
Operating frequency range	871.4 MHz – 891.6 MHz		
Emission bandwidth	5 MHz		
Rated output power	37 dBm		
Antenna connection	N-type connector.	Professional installation	
Type of modulation	QPSK, 16QAM, 64QAM (WCDMA)		
Type of duplexing	FDD		
Modulating test signal (baseband)	PRBS		
Antenna information			
Antenna Type	Manufacturer	Model	Gain, dBi
Double-Polarization Panel	KATHREIN	80010309v01	15
Double-Polarization Panel	RADWIN Ltd.	RW-9462-0821	13
Double-Polarization Panel	RADWIN Ltd.	RW-9462-0825	8
Omni Antenna	KATHREIN	738192	11
Omni Antenna	RADWIN Ltd.	RW-9463-0821	4
Omni Antenna	RADWIN Ltd.	RW-9461-0825	2
Omni Antenna	RADWIN Ltd.	RW-9461-1825	2
Omni Antenna	RADWIN Ltd.	RW-9462-2825	7

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Measurement uncertainty.

Were relevant, the following measurement uncertainty level have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Test description	Expanded uncertainty
<u>Radiated emissions</u> in the open field test site at 3 m measuring distance: 30 MHz – 1.0 GHz 1.0 GHz – 18 GHz	2 U _c (E) = ± 4.32 dB 2 U _c (E) = ± 4.47 dB

5. Environmental evaluation and exposure limit according to FCC CFR 47 part 1, §1.1307, §1.1310.

Power density limit in 869- 894 MHz frequency band for general population/uncontrolled exposure is 0.6 (mW/cm²) or 6 (W/m²).

The power density calculation $S = [Pt / (4\pi r 0.6)^2]$.

Where:

Pt - The transmitted power (EIRP) (mW)

r - The distance from the unit. (cm)

The 0.6 (mW/cm²) limit can be calculated from the above based on the following data:

Pt- the transmitted power which calculated for antenna 15 dBi gain is equal to the maximum EIRP = 51.8 dBm = 151356 mW.

Minimum allowed distance r from the antenna main lobe were RF exposure limit may not be exceeded = $SQRT(151356/4\pi 0.6) > 1.42$ m.

Pt- the transmitted power which calculated for antenna 11 dBi is equal to the maximum EIRP = 47.8 dBm = 60256 mW.

Minimum allowed distance r from the antenna main lobe were RF exposure limit may not be exceeded = $SQRT(60256/(4\pi 0.6)) > 0.9$ m.

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6. EUT block diagram and test configuration.

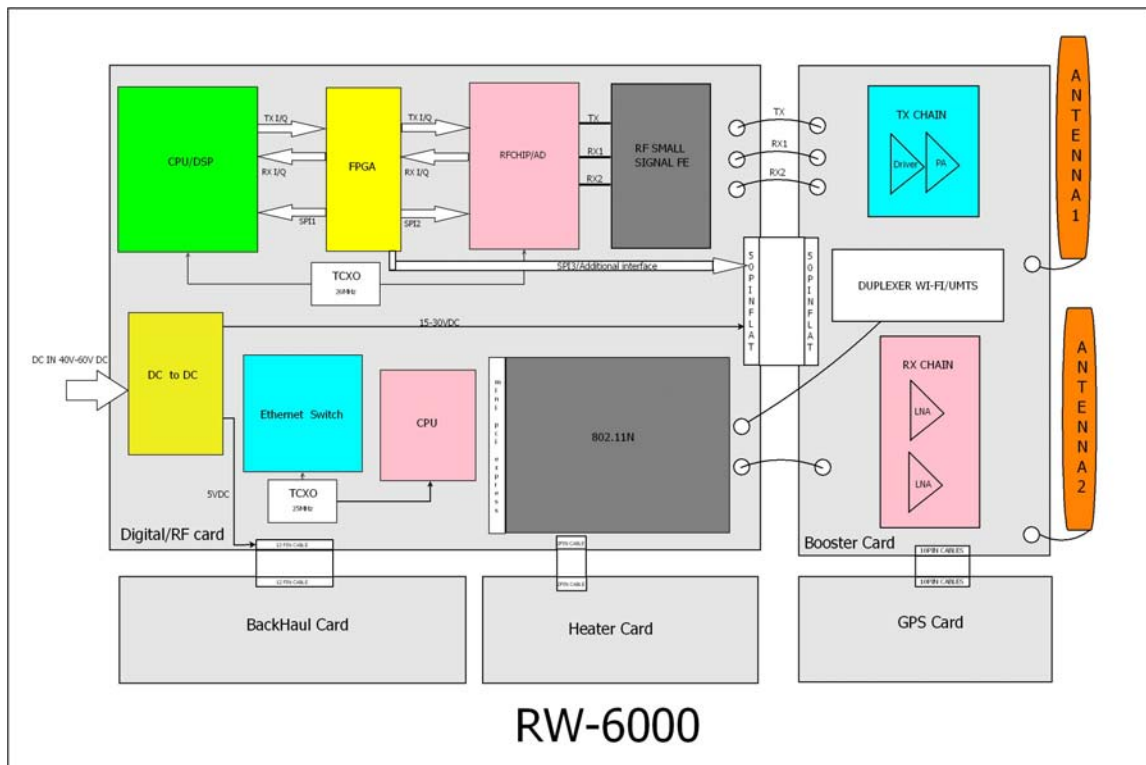


Fig. 1. EUT block diagram.

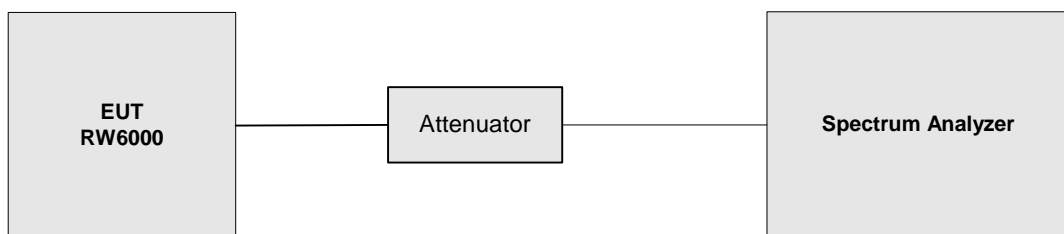


Fig. 2. RF conducted test diagram.



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7. Test results

7.1 Transmitter characteristics

7.1.1 Base Station maximum transmit power test.

Method of measurement 971168 D01 Power Meas License Digital Systems v01
 Operating Frequency Range 871.4 – 891.6 MHz
 Ambient Temperature 23⁰ C Relative Humidity 49% Air Pressure 1011 hPa

Carrier frequency MHz	Output power, dBm	*ERP power, dBm	ERP limit dBm	Margin dB	Reference to plot #
871.4	36.68	45.2	57.0	11.8	1
882.0	36.79	45.3	57.0	11.7	2
891.6	36.68	45.2	57.0	11.8	3

*Calculation of ERP (P) performed as follow: P = Output power + Antenna gain (dBi)-2.5.

*Calculation of ERP performed for Omni antenna 11 dBi gain.

Carrier frequency MHz	Output power, dBm	*ERP power, dBm	ERP limit dBm	Margin dB	Reference to plot #
871.4	36.68	49.2	57.0	7.8	1
882.0	36.79	49.3	57.0	7.7	2
891.6	36.68	49.2	57.0	7.8	3

*Calculation of ERP performed as follow: P = Output power (dBm) + Antenna gain (dBi)-2.5.

*Calculation of ERP performed for Double polarization panel antenna 15 dBi gain.

TEST REQUIREMENTS

In general, the effective radiated power (ERP) of base transmitters must not exceed 500 Watts (57 dBm).

TEST PROCEDURE

The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at bottom, middle and the top of the 869 – 894 MHz frequency band. The test was performed in 64QAM modulation mode as worst case. The EUT RF output was connected to the Spectrum Analyzer via appropriate attenuator and accounted with cable loss in SA settings.

TEST EQUIPMENT USED:

2	4	5	14			
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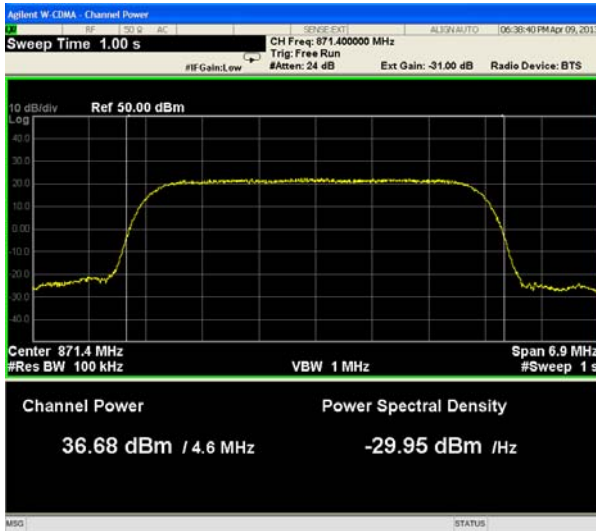
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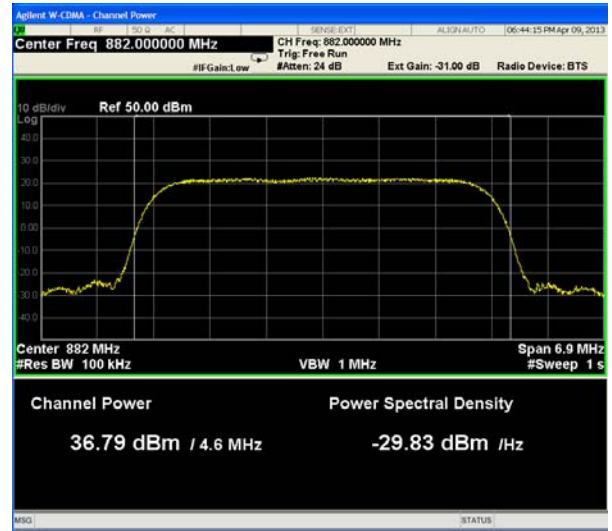
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Model: RADWIN-6000

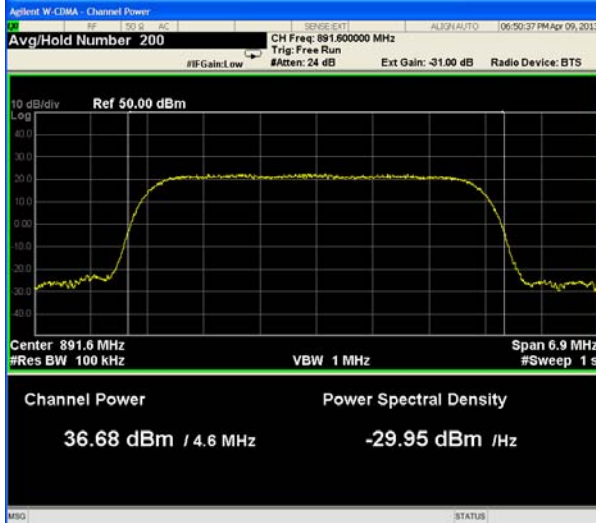
FCC ID: Q3KRW6000-B5



Plot # 1



Plot # 2



Plot # 3

Insertion loss of external attenuator and cables = 31.0 dB.



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7.1.2 Occupied bandwidth test.

Method of measurement	FCC §2.1049			
Operating Frequency Range	871.4 – 891.6 MHz			
Ambient Temperature	23 ^o C	Relative Humidity	49%	Air Pressure 1011 hPa

Carrier frequency MHz	99% power bandwidth MHz	26 dB emission bandwidth MHz	Reference to plots #
871.4	4.0	4.58	4
882.0	4.0	4.54	5
891.6	4.0	4.58	6

TEST PROCEDURE

The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at bottom, middle and the top of the 869 – 894 MHz frequency band. Test was performed in 64QAM modulation mode as worst case. The EUT RF output was connected to the Spectrum Analyzer via appropriate attenuator and accounted with cable loss in SA settings.

TEST EQUIPMENT USED:

2	4	5	14			
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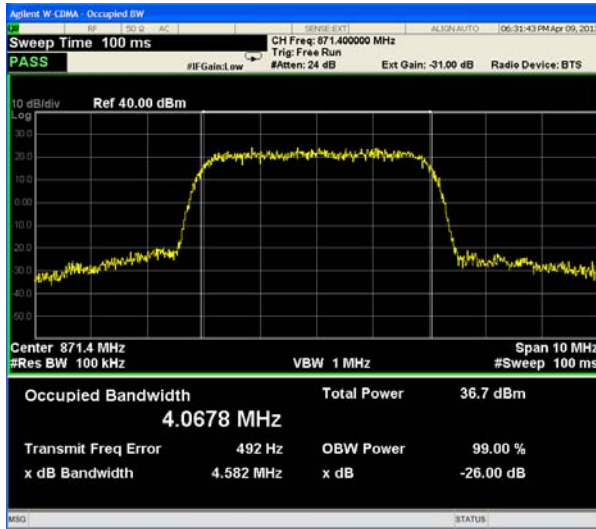
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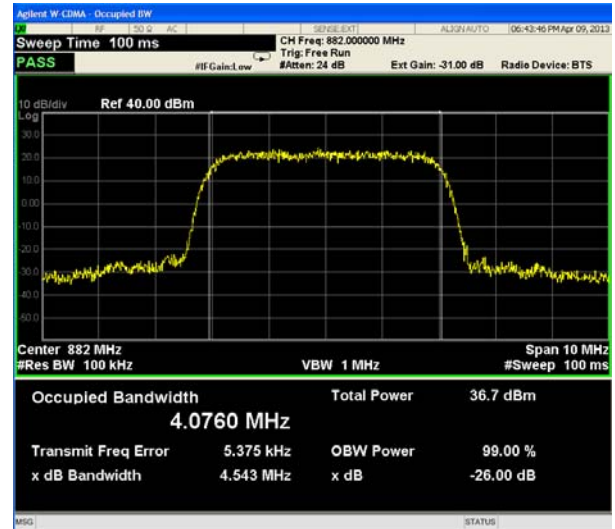
Title: Broadband Wireless Access UTRA FDD Base Station

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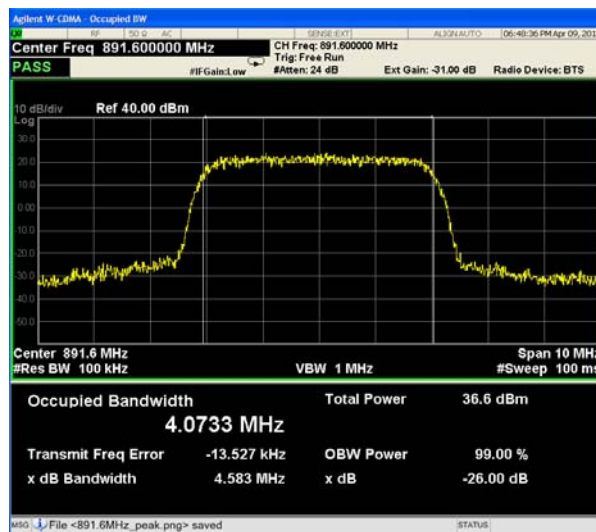
FCC ID: Q3KRW6000-B5



Plot # 4



Plot # 5



Plot # 6

Insertion loss of external attenuator and cables = 31.0 dB.



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7.1.3 Harmonic and band edge emissions test at antenna terminal.

Method of measurement	FCC §22.917 (b), §2.1051
Operating Frequency Range	871.4 – 891.6 MHz
Ambient Temperature	23 ⁰ C
Relative Humidity	49%
Air Pressure	1009 hPa

The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment up to 10 GHz. The emissions with level more than 20 dB lower than the specified limit were not recorded in the table. For the test results refer to plots in this section.

No harmonic emissions were found close than 20 dB below the limit. The worst case results were found at band edge of the frequency blocks and noted in table below:

Measured Block		Carrier frequency, MHz	Measured frequency, MHz	Measured level, dBm	Specified limit, dBm	Verdict.	Reference to plot #
A	Low edge	871.4	869.0	-15.0	-13.0	Comply	13
B	High edge	891.6	894.0	-19.5	-13.0	Comply	18

LIMIT

The power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43+10 \log (P)$ dB = -13 dBm.

TEST PROCEDURE

The test was performed with RBW = 1 MHz or 1% of emission bandwidth at available frequency blocks band edges integrated over 1 MHz. The measurements were performed in normal (transmitting) mode of operation for carrier (channel) frequency at bottom, middle, top and at band edges of frequency Blocks A and B. The EUT RF output was connected to the Spectrum Analyzer via appropriate attenuator and accounted with cable loss in SA settings.

TEST EQUIPMENT USED:

2	3	4	5	14		
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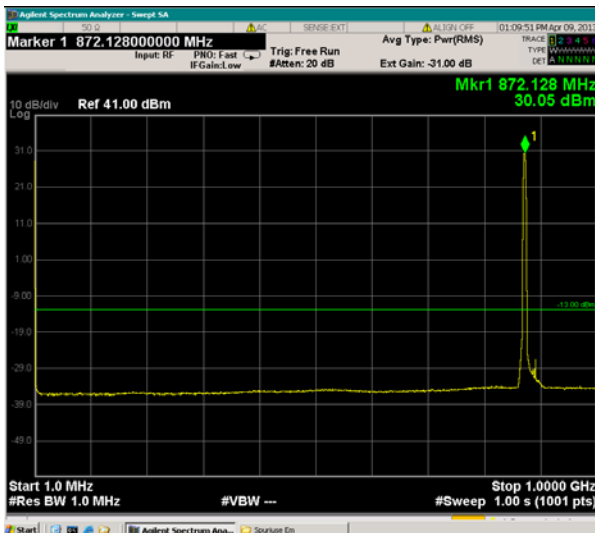
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Title: Broadband Wireless Access UTRA FDD Base Station

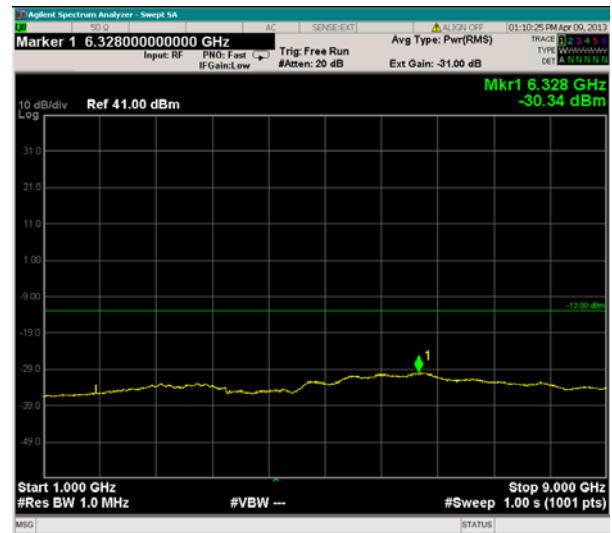
Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

Carrier frequency 871.4 MHz.

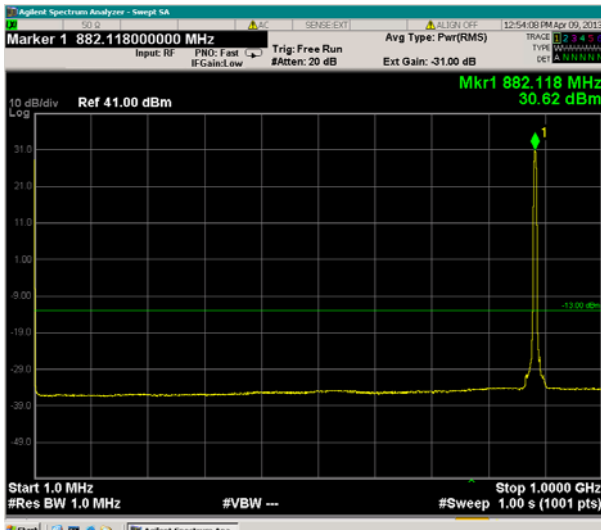


Plot # 7.

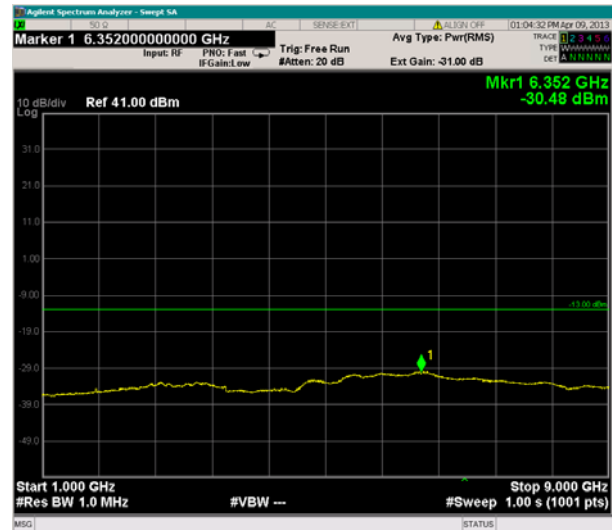


Plot # 8.

Carrier frequency 882 MHz.



Plot # 9.



Plot # 10.



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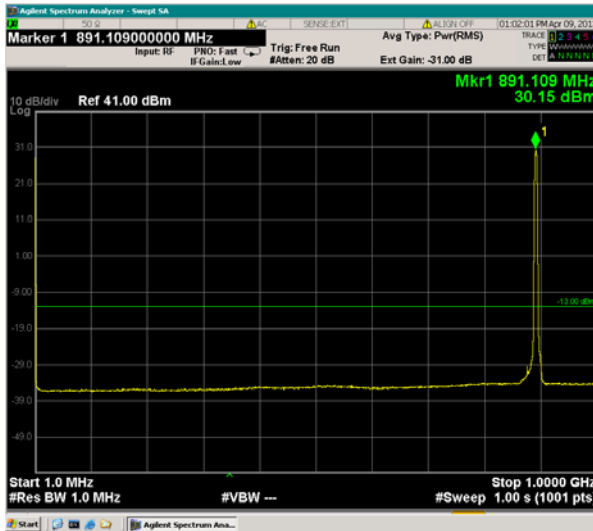
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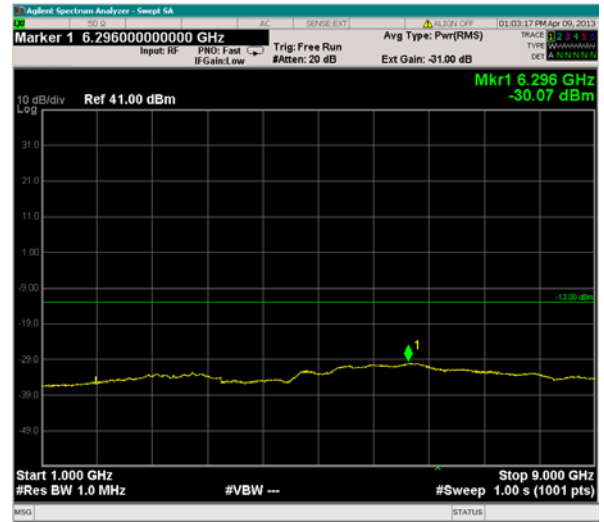
Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

Carrier frequency 891.6 MHz.



Plot # 11.



Plot # 12.



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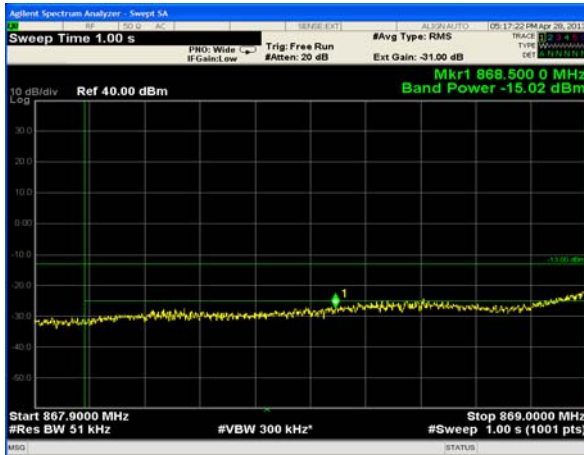
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Title: Broadband Wireless Access UTRA FDD Base Station

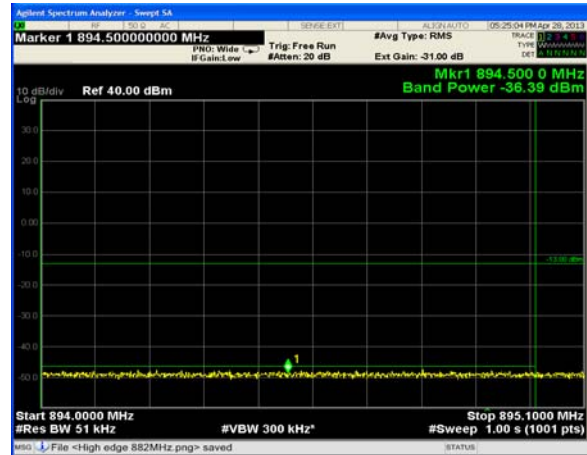
Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

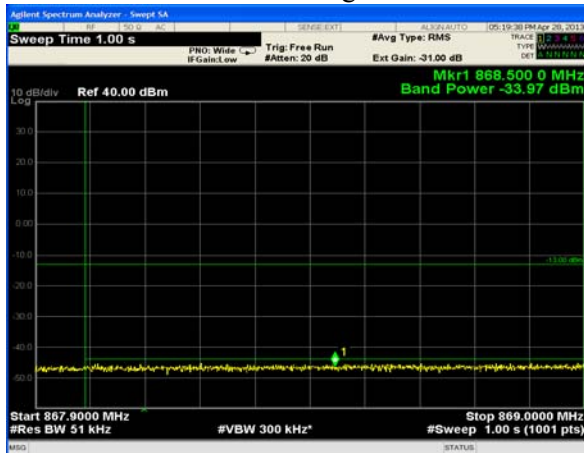
Band edge emissions test.



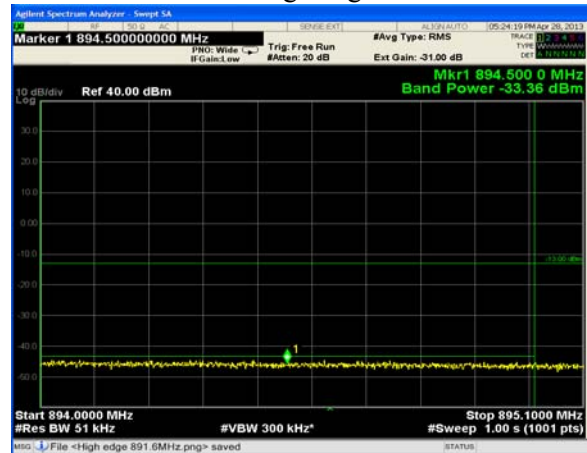
Plot # 13. Block A low edge. Fc-871.4 MHz



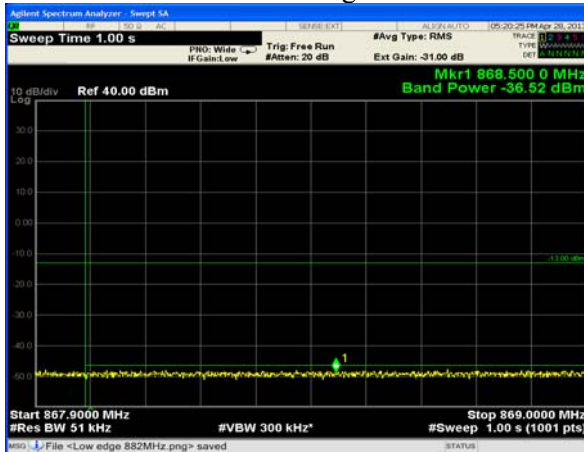
Plot # 14. Block B high edge. Fc-871.4 MHz



Plot # 15. Block A low edge. Fc-882.0 MHz



Plot # 16. Block B high edge. Fc-882 MHz



Plot # 17. Block A low edge. Fc-891.6 MHz



Plot # 18. Block B high edge. Fc-891.6 MHz



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7.1.4 Undesired radiated emissions test.

Method of measurement	FCC §22.917 (b), §2.1053
Operating Frequency Range	871.4 – 891.6 MHz
Ambient Temperature	23 ⁰ C
Relative Humidity	56%
Air Pressure	1011 hPa

The enclosure spurious emissions test was performed up to 10 GHz. The emission levels of the EUT more than 20 dB lower than the specified limit were not recorded in the table below. For the test results refer to plots in this section.

LIMIT

The power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43+10 \log (P)$ dB = -13 dBm.

TEST PROCEDURE

The measurements were performed at three transmitted carrier (channel) frequencies at bottom, middle and top of the 869 – 894 MHz frequency band. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antenna polarization was changed from vertical to horizontal. The measurements were performed with RBW 1MHz and VBW ≥ RBW. The result was previously verified according to ANSI/TIA-603-C-2004 section 2.2.12 substitution test method. Investigation of transmitter spurious emissions was performed. EUT was replaced by generator and substitution antenna. Level calculated from generator output level, substitution antenna gain and connected cable loss was compared with the limit.

TEST SUMMARY

EUT comply with standard requirements.

TEST EQUIPMENT USED:

5	6	9	13	17		
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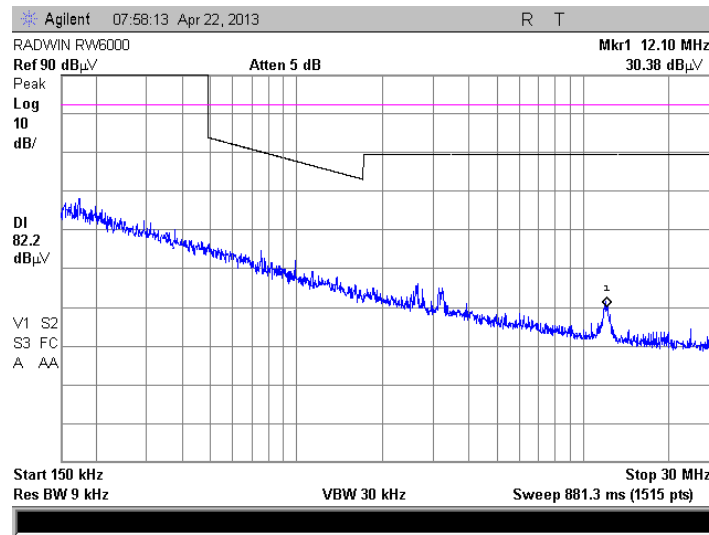
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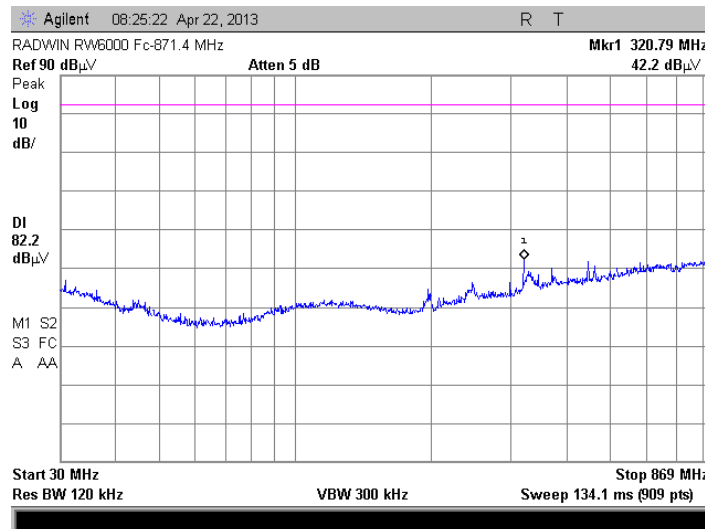
Model: RADWIN-6000

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Plot # 19. Common and worst case result for all transmitter frequencies.

Carrier frequency – 871.4 MHz



Plot # 20.



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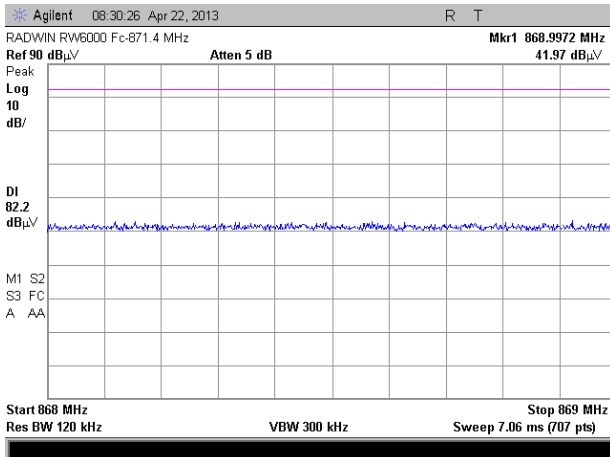
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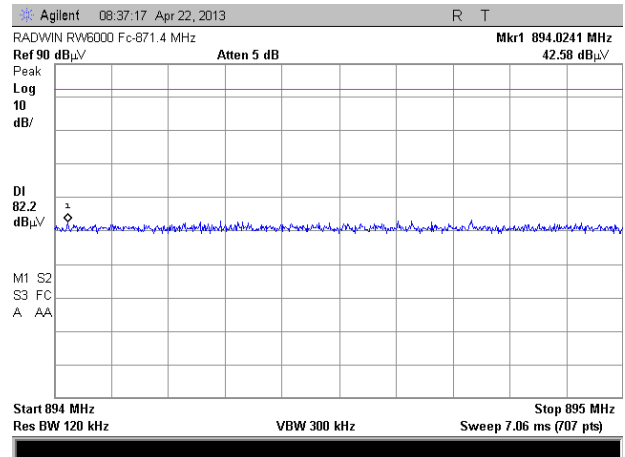
Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

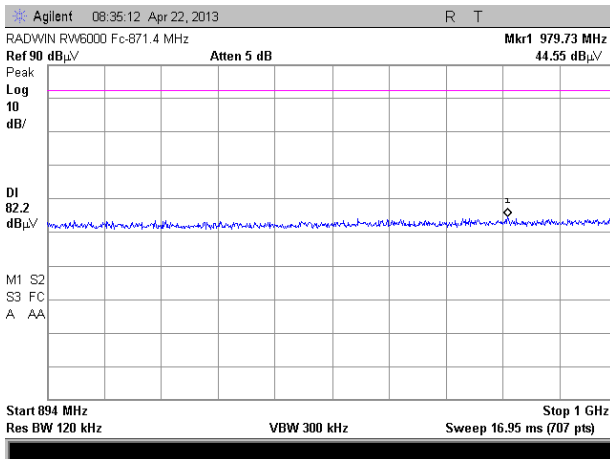
Carrier frequency – 871.4 MHz



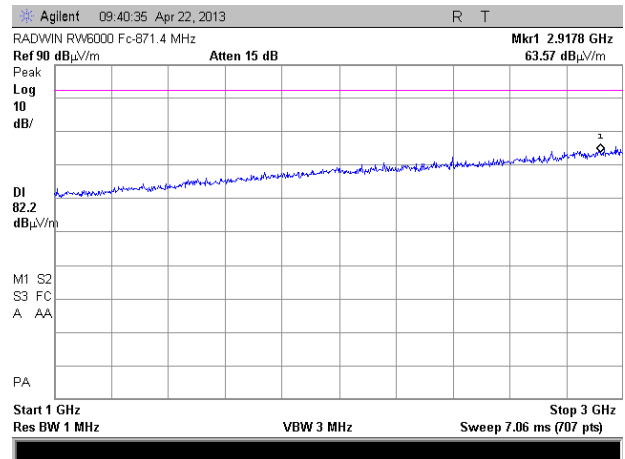
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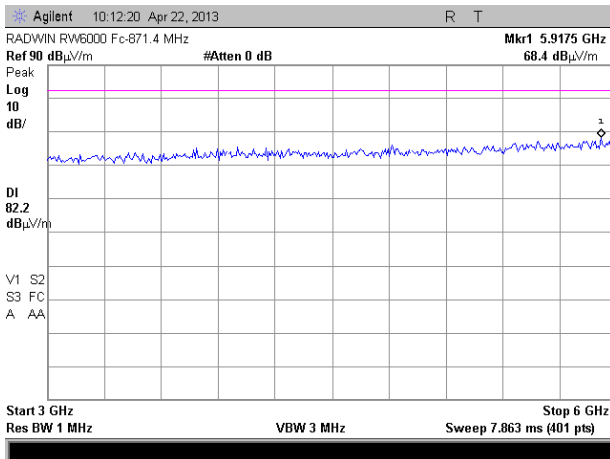
Plot # 22.



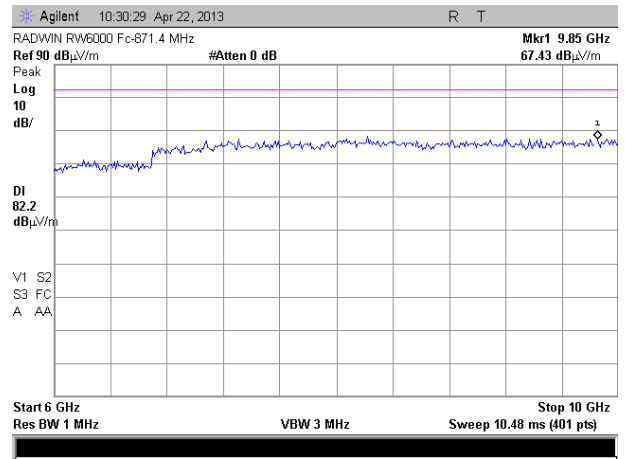
Plot # 23.



Plot # 24.



Plot # 25.



Plot # 26.



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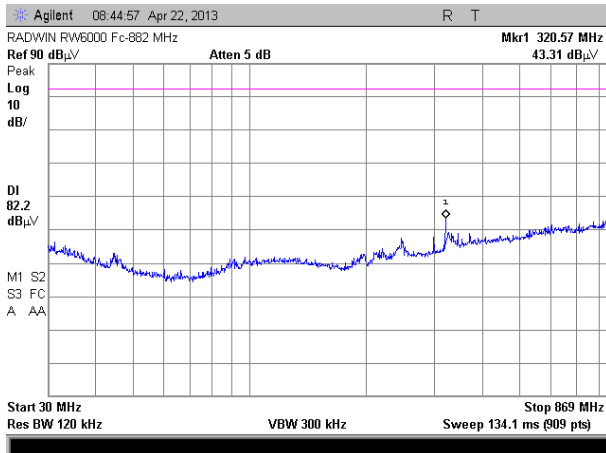
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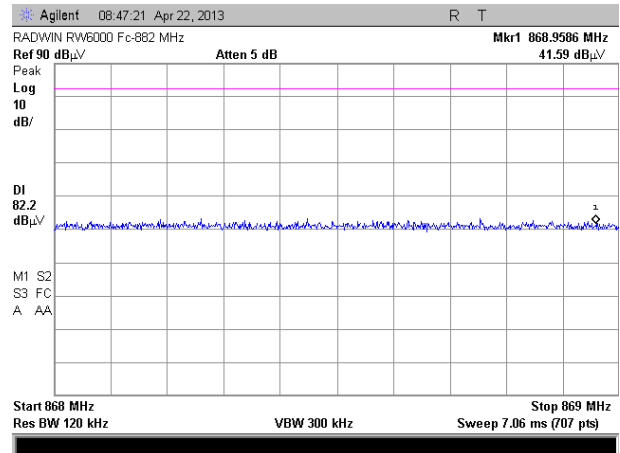
Model: RADWIN-6000

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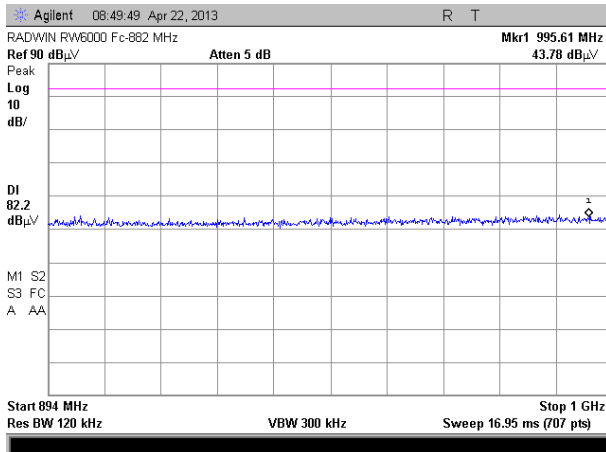
Carrier frequency – 882.0 MHz



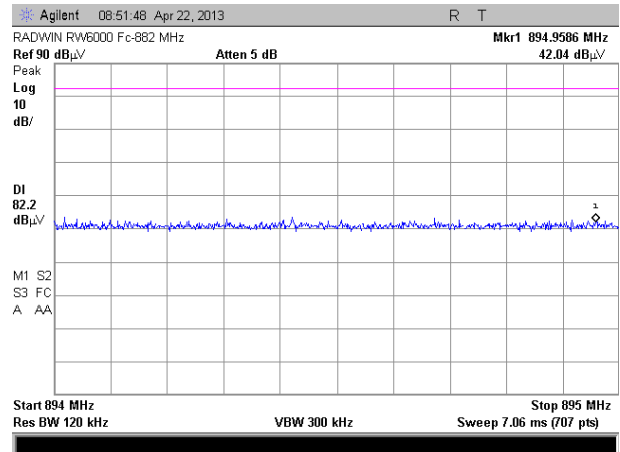
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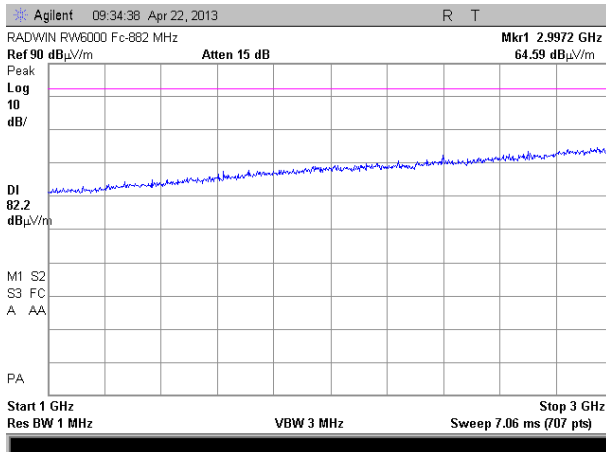
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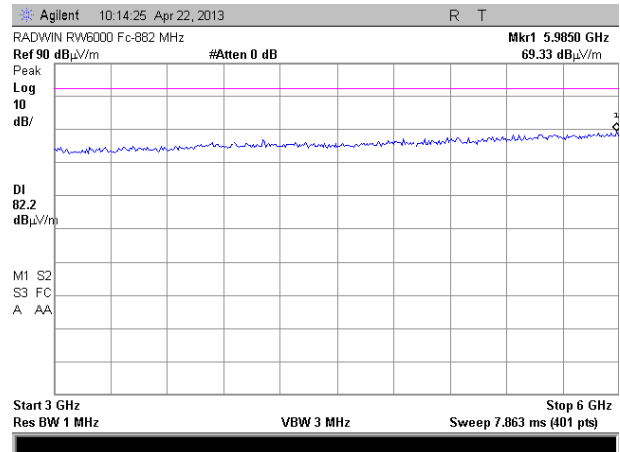
Plot # 29.



Plot # 30.



Plot # 31.



Plot # 32.



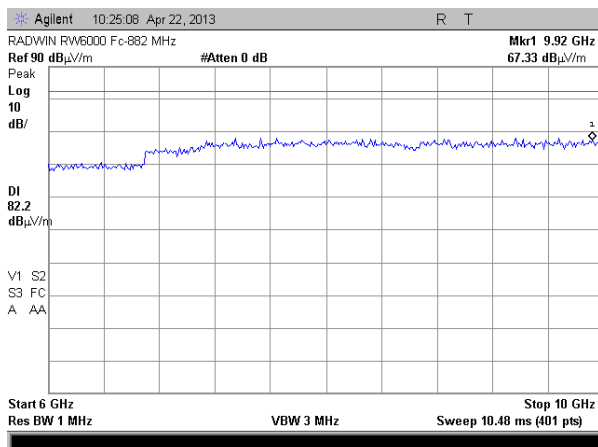
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Plot # 33.



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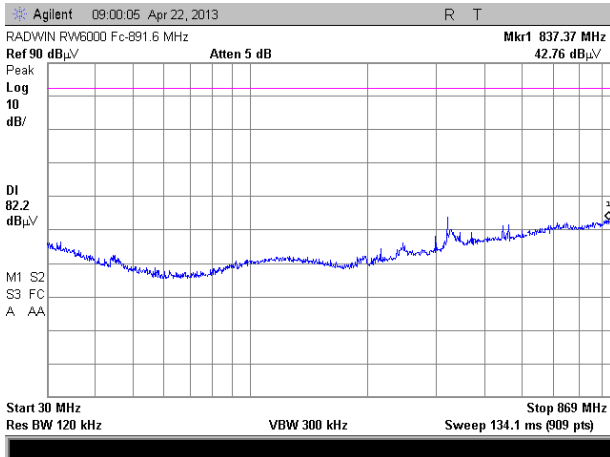
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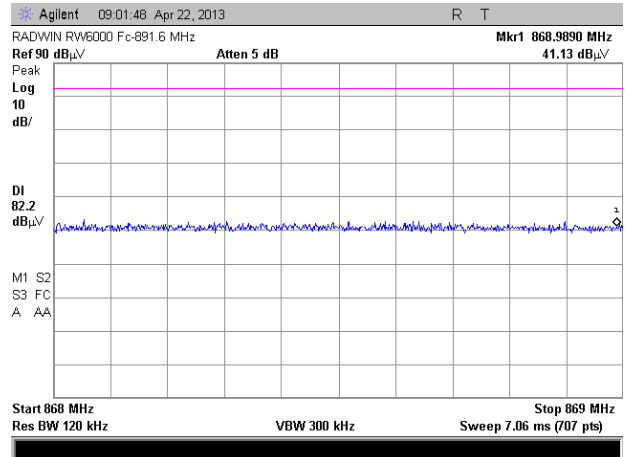
Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

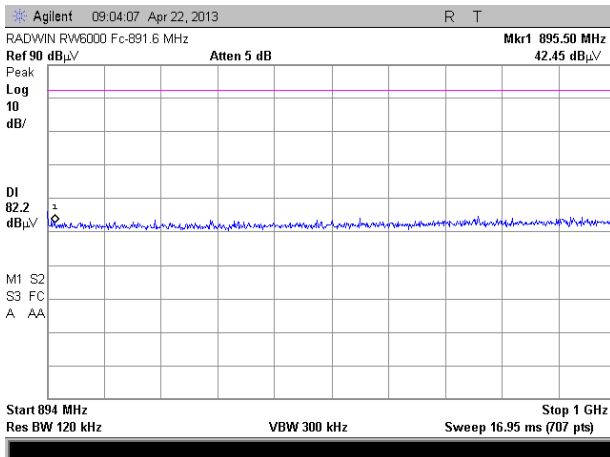
Carrier frequency – 891.6 MHz



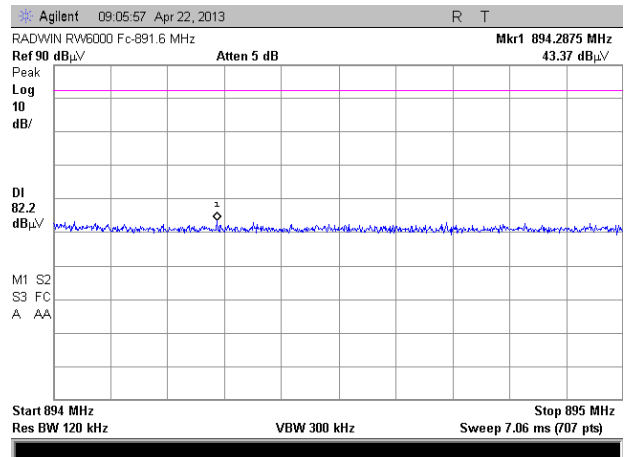
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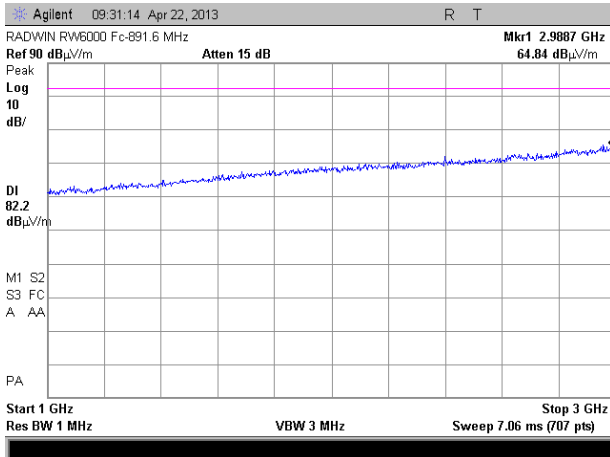
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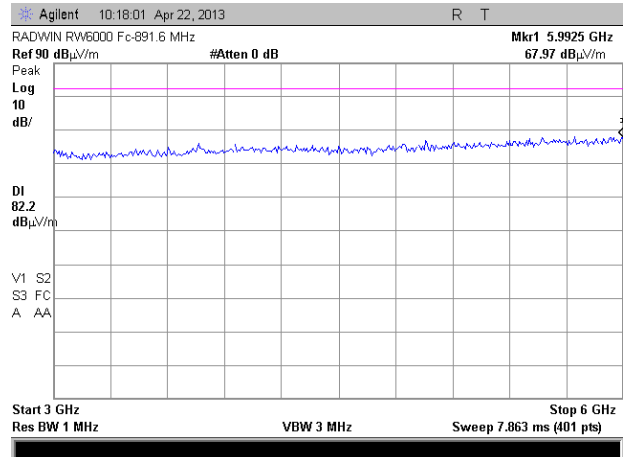
Plot # 36.



Plot # 37.



Plot # 38.



Plot # 39.



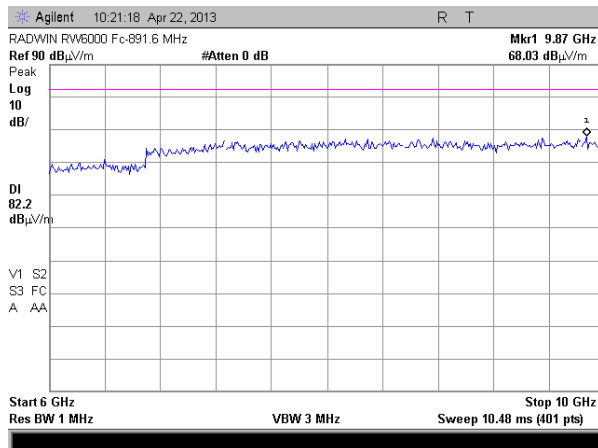
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Plot # 40.



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8. APPENDIX A. Photo

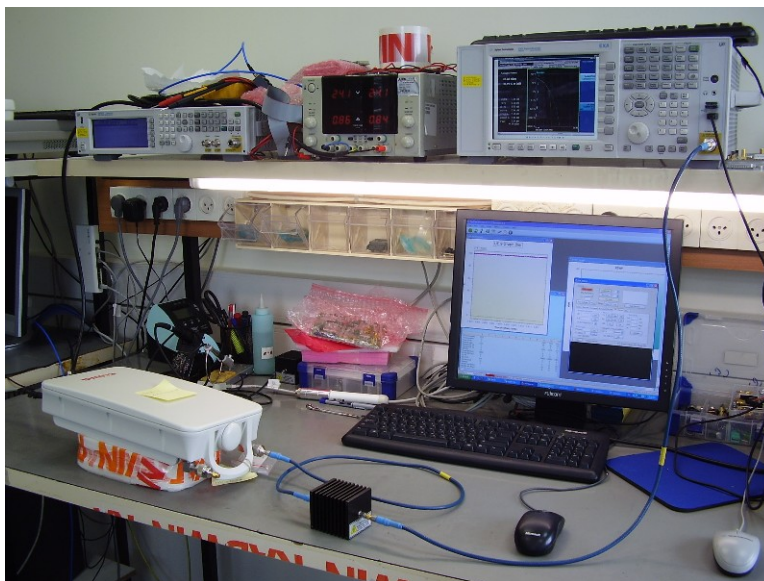


Photo #1. RF conducted emissions test setup.



Photo #2. Radiated emissions test setup in anechoic chamber.



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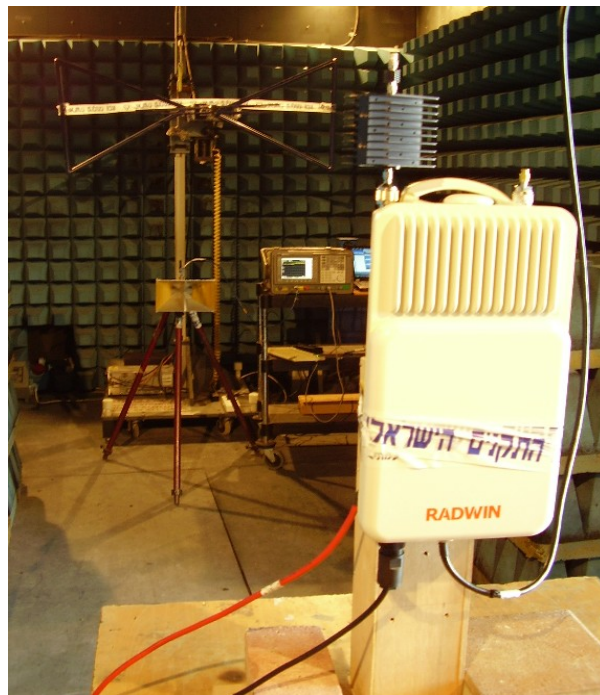


Photo #3. Radiated emissions test setup in anechoic chamber.

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Title: Broadband Wireless Access UTRA FDD Base Station**Model:** RADWIN-6000**FCC ID:** Q3KRW6000-B5**9. APPENDIX B. Test equipment used.**

No	Description	Manufacturer information			Due calibration date
		Name	Model No	Serial No	
1	Vector Signal Generator 100 kHz - 3 GHz	Agilent	N5182A	MY50141786	May 2013
2	Spectrum Analyzer EXA 9 kHz - 13.6 GHz	Agilent	N9010A	MY47191283	May 2013
3	Spectrum Analyzer EXA 10 Hz – 26.5 GHz	Agilent	N9010A	MY51250920	May 2013
4	Bi-Directional attenuator 30 dB, DC – 6.0 GHz	XMA-Omni Spectra	3082-7525-06-30	NA	Aug 2013
5	Cable RF 1m	Huber-Suhner	Sucoflex 104	85820/4PE	October 2013
6	Double Ridged Guide Antenna 1 – 18 GHz	EMCO	3115	5802	Aug 2013
7	Broadband Horn antenna 15 – 40 GHz	Schwarzbeck Mess-Electronik	BBHA 9170	9170-341	Aug 2013
8	Antenna Biconilog 30 – 2000 MHz	Schaffner-Chase	CBL6112B	S/N 23181	Aug 2013
9	Spectrum analyzer 10 KHz-26.5 GHz	HP	E7405A	SII 4944	April 2014
10	EMI Receiver 9 kHz-6.5 GHz	HP	8546A+85460A	SII 4068	April 2014
11	LISN 9 kHz – 30 MHz	FCC	LISN 250-32-4-16	SII5023	October 2013
12	Transient limiter 0.009-200 MHz	HP	11947A	3107105	October 2013
13	Cable RF 4m	Huber-Suhner	Sucoflex 104PE	21329/4PE	October 2013
14	Cable RF 0.5m	Huber-Suhner	Sucoflex 104PE	500448/4PE	October 2013
15	Cable RF 1.0m	ENP Connectivity Solutions	X116LCX10040	10-11-002	October 2013
16	Attenuator 20 dB, 25W DC- 18 GHz	Pasternak Enterprises	PE7018	NA	Aug 2013
17	Active Loop antenna 10 kHz – 30 MHz	EMCO	6502	SII 4874	October 2013

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Title: Broadband Wireless Access UTRA FDD Base Station**Model:** RADWIN-6000**FCC ID:** Q3KRW6000-B5**Cable Loss (10m cable + Mast)**

Point	Frequency (MHz)	Cable Loss (dB)	Point	Frequency (MHz)	Cable Loss (dB)
1	30	0.53	21	1000	3.68
2	50	0.75	22	1100	3.82
3	100	1.08	23	1200	4.07
4	150	1.39	24	1300	4.24
5	200	1.61	25	1400	4.43
6	250	1.752	26	1500	4.6
7	300	2.00	27	1600	4.7
8	350	2.15	28	1700	4.85
9	400	2.26	29	1800	4.98
10	450	2.383	30	1900	5.19
11	500	2.52	31	2000	5.34
12	550	2.606	32	2100	5.51
13	600	2.75	33	2200	5.69
14	650	2.856	34	2300	5.89
15	700	3.06	35	2400	6.07
16	750	3.201	36	2500	6.22
17	800	3.27	37	2600	6.28
18	850	3.38	38	2700	6.41
19	900	3.46	39	2800	6.53
20	950	3.55	40	2900	6.84

**Test report N: 9312320320****Page 28 of 31****Title: Broadband Wireless Access UTRA FDD Base Station****Model: RADWIN-6000****FCC ID: Q3KRW6000-B5****Biconilog Antenna, Model Number: CBL-6112D, S/N: 23181.**

No.	f / MHz)	AF / dB/m	f / MHz)	AF / dB/m	f / MHz)	AF / dB/m	f / MHz)	AF / dB/m
1	30	17.90	170	9.40	530	17.70	1040	22.20
2	32	16.70	175	9.00	540	18.25	1060	22.50
3	34	15.55	180	8.50	550	18.60	1080	22.50
4	36	14.35	185	8.45	560	14.45	1100	22.40
5	38	13.30	190	8.60	570	18.40	1120	22.60
6	40	12.20	195	8.85	580	18.50	1140	22.45
7	42	11.05	200	8.95	590	18.60	1160	22.50
8	44	9.95	205	8.80	600	18.60	1180	22.40
9	46	8.90	210	8.50	610	18.80	1200	22.80
10	48	8.05	215	8.20	620	18.99	1220	22.95
11	50	7.30	220	8.50	630	19.05	1240	23.10
12	52	6.80	225	9.00	640	19.23	1260	23.40
13	54	6.45	230	9.65	650	19.10	1280	23.35
14	56	6.00	235	10.30	660	19.13	1300	23.62
15	58	5.70	240	11.00	670	19.04	1320	23.64
16	60	5.45	245	11.60	680	19.00	1340	23.86
17	62	5.30	250	12.00	690	19.17	1360	23.95
18	64	5.20	255	12.45	700	19.28	1380	23.90
19	66	5.30	260	12.85	710	19.25	1400	24.45
20	68	5.30	265	12.50	720	19.45	1420	24.74
21	70	5.35	270	12.45	730	19.75	1440	24.93
22	72	5.50	275	12.40	740	19.95	1460	25.03
23	74	5.80	280	12.55	750	20.07	1480	25.45
24	76	6.00	285	12.65	760	19.85	1500	25.30
25	78	6.60	290	12.75	770	19.80	1520	25.25
26	80	6.70	295	12.95	780	19.85	1540	25.36
27	82	7.15	300	13.00	790	19.95	1560	25.58
28	84	7.60	310	13.35	800	20.05	1580	25.50
29	86	8.10	320	13.75	810	20.10	1600	25.65
30	88	8.50	330	13.85	820	20.35	1620	25.60
31	90	8.90	340	14.10	830	20.40	1640	25.70
32	92	9.20	350	14.50	840	20.35	1660	25.83
33	94	9.75	360	14.70	850	20.46	1680	25.97
34	96	9.95	370	14.90	860	20.39	1700	26.10
35	98	10.20	380	15.10	870	20.29	1720	26.25
36	100	10.50	390	15.45	880	20.24	1740	26.04
37	105	11.25	400	16.00	890	20.35	1760	26.14
38	110	11.70	410	16.40	900	20.55	1780	26.20
39	115	11.70	420	16.70	910	20.45	1800	26.40
40	120	11.80	430	16.35	920	20.60	1820	26.64
41	125	11.80	440	16.30	930	20.60	1840	26.86
42	130	11.70	450	16.30	940	20.66	1860	27.12
43	135	11.35	460	16.70	950	20.88	1880	27.00
44	140	10.95	470	17.05	960	21.11	1900	27.25
45	145	10.35	480	17.20	970	20.93	1920	27.36
46	150	10.05	490	17.30	980	21.03	1940	27.68
47	155	9.70	500	17.40	990	21.05	1960	27.10
48	160	9.70	510	17.50	1000	21.10	1980	27.06
49	165	9.45	520	17.60	1020	21.40	2000	27.25

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Title: Broadband Wireless Access UTRA FDD Base Station**Model:** RADWIN-6000**FCC ID:** Q3KRW6000-B5**Antenna Factor****Double Ridged Guide Antenna mfr EMCO model 3115 1m calibration**

Point	Frequency (MHz)	Antenna Factor (dB/m)
1	1000	23.9
2	2000	28.3
3	3000	31.0
4	4000	33.1
5	4500	32.5
6	5000	32.4
7	6000	53.7
8	6500	35.6
9	7000	36.4
10	7500	36.9
11	8000	37.0
12	8500	38.0
13	9000	38.6
14	9500	38.4
15	10000	38.4
16	10500	38.4
17	11000	38.9
18	11500	39.6
19	12000	39.4
20	12500	39.2
21	13000	40.3
22	13500	41.0
23	14000	41.2
24	14500	41.3
25	15000	40.0
26	15500	38.0
27	16000	38.1
28	16500	40.3
29	17000	42.2
30	17500	44.6
31	18000	46.2

Cable Loss**Type: Sucoflex 104PE; Ser.No.21329/4PE; 4 m length**

Point	Frequency (GHz)	Cable Loss (dB)
1	0.0-1.0	1.7
2	1.0- 3.5	3.2
3	3.5- 5.5	4.0
4	5.5 - 7.5	4.7
5	7.5 - 9.5	5.3
6	9.5 - 10.5	5.6
7	10.5 - 12.5	6.2
8	12.5 - 14.5	6.8
9	14.5 - 16.5	7.5
10	16.5 - 18.0	8.1



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Title: Broadband Wireless Access UTRA FDD Base Station

Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

Antenna Factor
Broadband Horn Antenna model BBHA 9170 1m calibration

Point	Frequency (GHz)	Antenna Factor (dB/m)
1	15.0	38.5
2	16.0	37.7
3	17.0	38.1
4	18.0	37.9
5	19.0	38.0
6	20.0	38.0
7	21.0	37.9
8	22.0	38.2
9	23.0	39.6
10	24.0	39.6
11	25.0	39.3
12	26.0	39.5
13	27.0	39.6
14	28.0	39.6
15	30.0	40.1
16	32.0	41.2
17	34.0	41.5
18	35.0	41.9
19	36.0	42.2
20	38.0	43.8
21	40.0	43.2



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Title: Broadband Wireless Access UTRA FDD Base Station

Model: RADWIN-6000

FCC ID: Q3KRW6000-B5

10. APPENDIX C. Abbreviation and acronyms.

The following abbreviations and acronyms are applicable to this test report:

AC	alternating current
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
EMC	electromagnetic compatibility
EUT	equipment under test
GHz	gigahertz
H	height
Hz	hertz
kHz	kilohertz
L	length
LNA	low noise amplifier
m	meter
Mbps	megabit per second
MHz	megahertz
NA	not applicable
OFDM	Orthogonal Frequency Division Multiple Access
PRBS	pseudo random binary sequence
QP	quasi-peak
RF	radio frequency
RE	radiated emission
SA	spectrum analyzer
rms	root mean square
W	width