

Test of RADWIN 2000 2.5 GHz BAND

To: FCC 47 CFR Part 27, Subpart M

Test Report Serial No.: RDWN04-U1 Rev A



TEST REPORT

From



Test of: Radwin 2000 2.5 GHz BAND

To: FCC 47 CFR Part 27 Subpart M

Test Report Serial No.: RDWN04-U1 Rev A

This report supersedes: None

Applicant: Radwin Ltd
27 Habarzel Street
Tel Aviv 69710
Israel

Product Function: Dual Antenna Port 2.5 GHz BAND
PtP Wireless Communication

Copy No: pdf **Issue Date:** 28th February 2011

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com



TESTING CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



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1 ACCREDITATION, LISTINGS & RECOGNITION

1.1 TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



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1.2 RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	Listing #: 4143A
Japan	VCCI	-	-	No. 2959
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

**NB – Notified Body

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1.3 PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-02.pdf>



The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence as a

Product Certification Body

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC Guide 65:1996 *General requirements for bodies operating product certification systems*. This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system for a Telecommunications Certification Body (TCB) meeting FCC (U.S.), and IC (Canada) requirements.



Presented this 24th day of June 2010.



President & CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2011

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)

TCB Identifier – US0159

Industry Canada – Certification Body

CAB Identifier – US0159

Europe – Notified Body

Notified Body Identifier - 2280

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2 DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	28 th February 2011	Initial Release

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3 TEST RESULT CERTIFICATE

Applicant:	Radwin Ltd 27 Habarzel Street Tel Aviv 69710 Israel	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
Product:	Outdoor radio unit operating in the 2.5 GHz band.	Telephone:	+1 925 462 0304
Model No.:	RADWIN 2000 2.5 GHz BAND	Fax:	+1 925 462 0306
S/No's:	PBR250E000Z99999		
Date(s) Tested:	8 th – 11 th February 2011	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 27, Subpart M	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested complies with the requirements as documented in this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

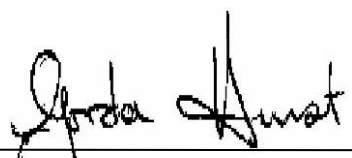
Approved & Released for MiCOM Labs, Inc. by:



TESTING CERTIFICATE #2381.01



Graeme Grieve
Quality Manager MiCOM Labs, Inc.



Gordon Hurst
President & CEO MiCOM Labs, Inc.

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4 REFERENCES AND MEASUREMENT UNCERTAINTY

4.1 Normative References

Ref.	Publication	Year	Title
i.	FCC 47 CFR Part 27, Subpart M	2009	Title 47: Part 27, Subpart M Miscellaneous Wireless Communication Services
ii.	47 CFR Part 15, Subpart B	2010	47 CFR Part 15, Subpart B; Unintentional Radiators
iii.	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
iv.	CISPR 22/ EN 55022	2008 2006+A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
v.	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
vi.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
vii.	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
viii.	A2LA	9th June 2010	Reference to A2LA Accreditation Status – A2LA Advertising Policy

4.2 Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.



5 TEST SUMMARY

List of Measurements: The following table represents the list of measurements required under FCC 47 CFR Part 27, Subpart M.

Standard Section(s)	Test Description	Measurement Condition	Result	Notes	Test Report Section
§2.1049 §27.53	Occupied Bandwidth (99% & 26 dB)	Conducted	PASS	Note 1,2,3	7.1
§2.1033 (C)(4) §2.1033 (C)(6) §2.1033 (C)(7) §2.1046 §2.1047 §27.50 (h)(1) §27.53 (m)(6)	RF Output Power, Emission Mask, EIRP at the Antenna Terminals	Conducted	PASS	Note 1,2,3	7.2
§27.50 (h)(4)	Power Spectral Density	Conducted	PASS	Note 1,2,3	7.3
§2.1055 §27.54	Frequency Stability	Conducted	PASS	Note 1,2,3	7.4
§2.1093	Maximum Permissible Exposure	Calculation	PASS	Note 1,2,3	7.5
§2.1051 §2.1053 §2.1057 §27.53 (m)(2)	Conducted Spurious Emissions	Conducted	PASS	Note 1,2,3	7.6
§2.1051 §2.1053 §2.1057 §27.53 (m)(2) 15.109	Radiated Spurious Emissions				7.7
	- Transmitter >1GHz	Radiated	PASS	Note 1,2,3	7.7.1
	- Radiated (Digital) Emissions <1GHz	Radiated	PASS	Note 1,2,3	7.7.2
15.107	AC Wireline Emissions 0.15 – 30 MHz	Conducted	PASS	Note 1,2,3	7.8

Note 1: Test results reported in this document relate only to the items tested

Note 2: The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

Note 3: Section 6.10 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

6 PRODUCT DETAILS AND TEST CONFIGURATIONS

6.1 Test Program Scope

The scope of the test program was to test the RADWIN 2000 2.5 GHz BAND transmitter for compliance against FCC 47 CFR Part 27, SubPart M.

Note: The RADWIN 2000 2.5 GHz BAND can further be configured as the RADWIN 1000 2.5 GHz BAND and RADWIN 5000 2.5 GHz BAND. These two configurations were not tested by MiCOM Labs.

APPLICANT: Radwin Ltd **PRODUCT:** RADWIN 2000 2.5 GHz BAND



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APPLICANT: Radwin Ltd **PRODUCT:** RADWIN 2000 2.5 GHz BAND Label





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6.2 EUT Details

Detail	Description
Purpose:	Test of the RADWIN 2000 2.5 GHz BAND for compliance against FCC 47 CFR Part 27, Subpart M
Applicant:	Radwin Ltd 27 Habarzel Street Tel Aviv 69710 Israel
Manufacturer:	Same as Applicant
Test Laboratory:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	RDWN04-U1
Date EUT received:	8 th February 2011
Dates of test (from - to):	8th – 11th February 2011
Unit Tested:	PBR250E000Z99999
Product Name:	Outdoor unit operating in the 2.5 GHz band.
Manufacturers Trade Name:	Radwin Ltd.
Model No.:	RADWIN 2000 2.5 GHz BAND
Equipment Primary Function:	2.5 GHz BAND Outdoor Radio Unit for transmitting and receiving data.
Equipment Secondary Function(s):	N/A
Installation type:	Fixed Station
Construction/Location for Use:	Outdoor
Hardware Version:	Prototype
Software/Firmware Release:	Not Applicable
Test Software Release:	ART Ver. 0.9
Rated Input Voltage and Current DC:	Nominal: 55Vdc, current: 1A
Operating Temperature Range °C:	Min: -35 °C Max: 60 °C
Equipment Dimensions:	7.1" x 2.2" x 10.6"
Weight:	3 lbs
Long Term Frequency Stability:	1.7 p.p.m.
Transmit/Receive Operation:	Full Duplex
Output Power Type	Variable 1 dB steps

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6.3 External A.C. / D.C. Power Adaptor

Model	Description
ET0061040	AC power adaptor: Input: 100 - 240V AC; 50-60 Hz; 1.5 Amp Output: 55V DC; 1 Amp

6.4 Types of Modulation Supported

Modulation / Mode	Bandwidth (MHz)
BPSK, QPSK, 16 QAM, 64 QAM	5
BPSK, QPSK, 16 QAM, 64 QAM	10
BPSK, QPSK, 16 QAM, 64 QAM	20

6.5 Antenna Details

The following is a description of the EUT antennas, no antennas were used for test purposes.

Antenna Type	Manufacturer	Model	Beamwidth	Gain (dBi)	Frequency Range (MHz)
Integrated Flat Panel	Radwin Ltd	RW-9612-2327INT	16°	17.5	2300-2700
External Flat Panel	Radwin Ltd	RW-9612-2427	16°	20	2400-2700
Grid	Radwin Ltd	RW-9820-2001	8°	24	2300-2900

6.6 Cabling and I/O Ports

The following is a description of the cable and input, output ports available on the EUT.

Type of I/O Ports	Description	Screened (Y/N)	Length	Qty	Tested (Y/N)
Ethernet/POE	Ethernet cable to provide communication and power	Y	>3 meters	1	Y
Antenna	Connection to external antennas	Y	< 3 meters	2	Y

6.7 EUT Configurations

Channel plan and spacing

Band (GHz)	Mode	Freq Band (MHz)	Freq Range (MHz)	Low Ch	Mid Ch	High Ch	Chan Spacing (MHz)
2.5	64QAM	2496 - 2690	2504.75 – 2687.25	2504.75	--	2687.25	5.5
			2499 - 2593	2499	2593	--	6.0
			2507.5 – 2684.5	2507.5	2590	2684.5	11/12
			2513 - 2679	2513	2590	2679	22/24

6.8 Support Equipment Details

The following is a description of supporting equipment used during the test program.

Equipment	Equipment Description	Manufacturer	Model No.	Serial No (s).	Tested
POE Injector	PoE device with AC power feeding	LI SHIN	ET0061040	L21032009463	Y



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6.9 Test Configurations

Operational Mode(s)	Mode/Data Rate Tested	Duty Cycle
5.0	64QAM/32.5 Mbps	100 %
10.0	64QAM/65 Mbps	100 %
20.0	64QAM/130 Mbps	100 %

6.10 Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

6.11 Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

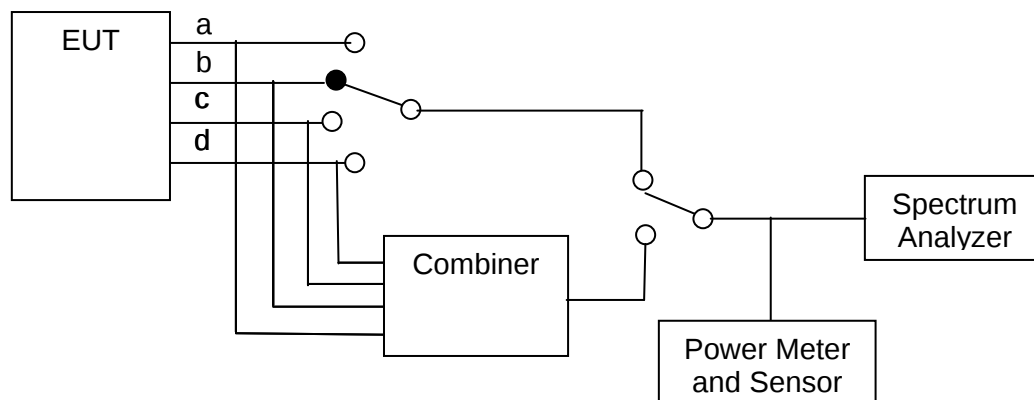
7 TEST RESULTS

7.1 26 dB and 99 % Occupied Bandwidth

Test Procedure

The bandwidth at 26 dB and 99 % is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

Test Measurement Set up



Measurement set up for 26 dB and 99 % bandwidth test



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Measurement Results for 26 dB & 99% Occupied Bandwidth

Ambient conditions.

Temperature: 20.5 °C

Relative humidity: 39 %

Pressure: 1005 mbar

EUT parameters

Power Level: Maximum

Duty Cycle: 100%

Temperature: Ambient

7.1.1 Measurement results for 5.5 MHz

TABLE OF RESULTS – 5.5 MHz Channel Spacing

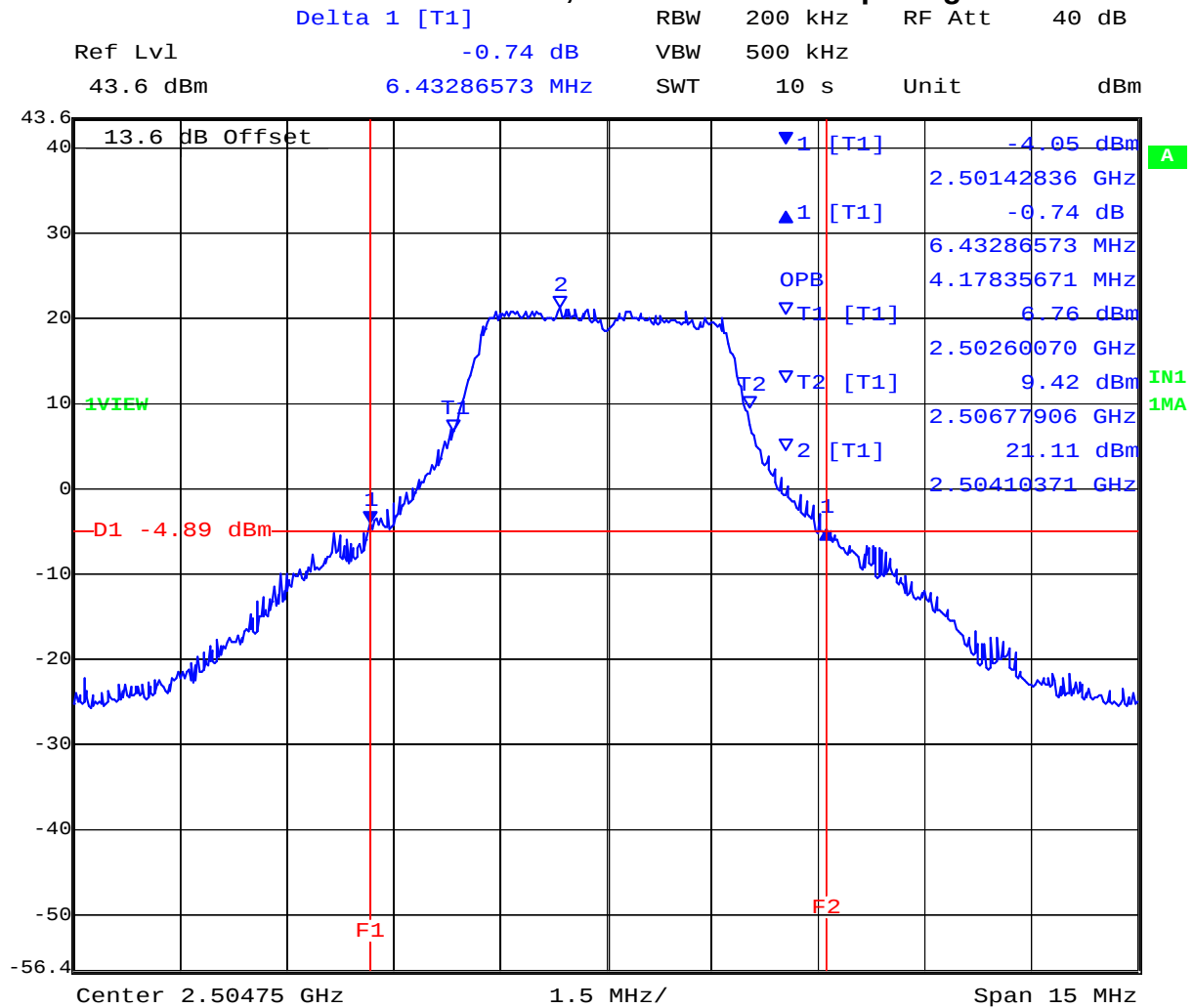
Center Frequency (MHz)	26 dB Bandwidth (MHz)	99 % BW (MHz)
2504.75	6.433	4.178
2687.25	6.162	4.118

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**26 dB & 99% Occupied Bandwidth,
Channel 2504.75 MHz, 5.5 MHz Channel Spacing**



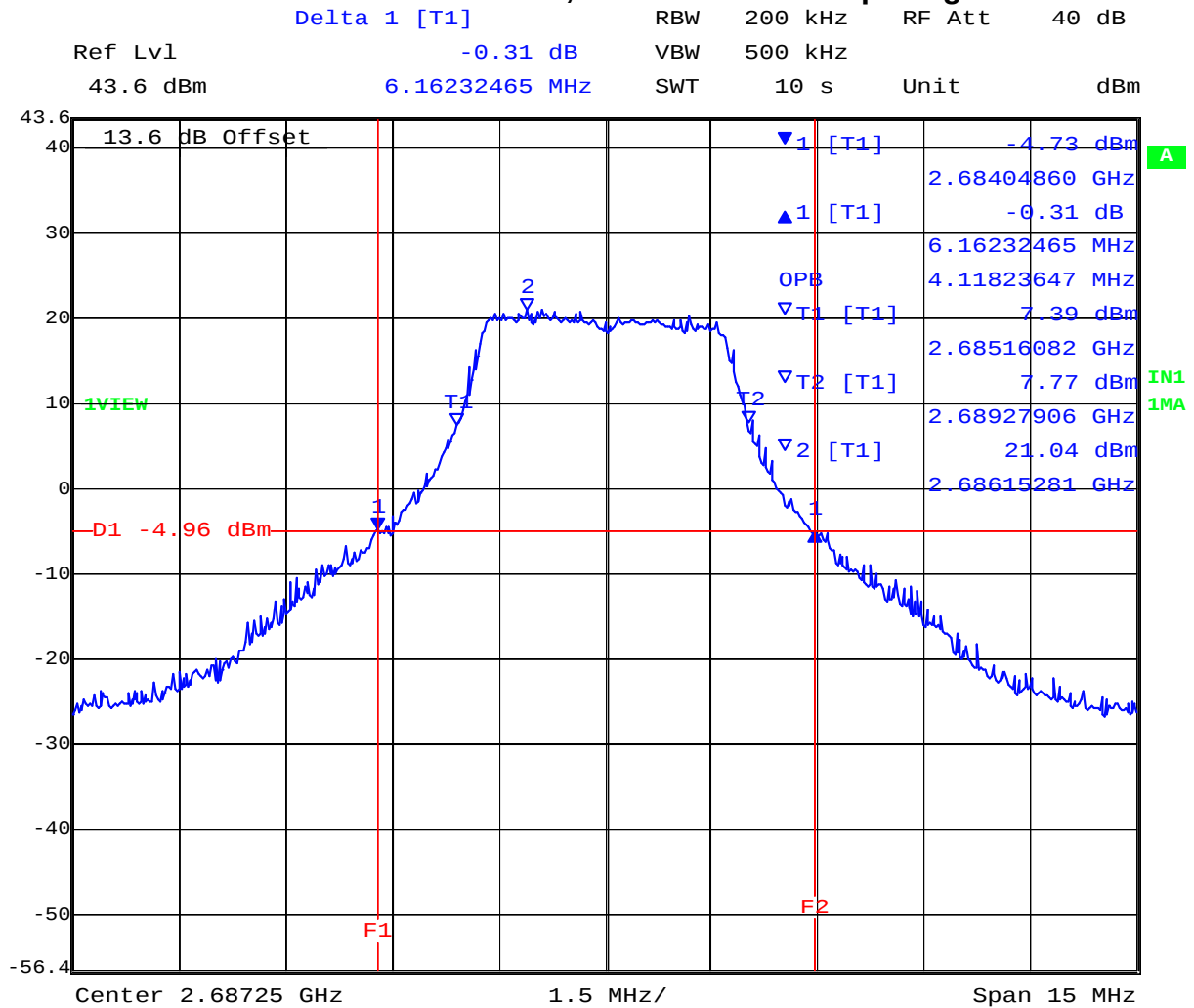
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**26 dB & 99% Occupied Bandwidth,
Channel 2687.25 MHz, 5.5 MHz Channel Spacing**



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7.1.2 Measurement results for 6.0 MHz

TABLE OF RESULTS – 6 MHz Channel Spacing

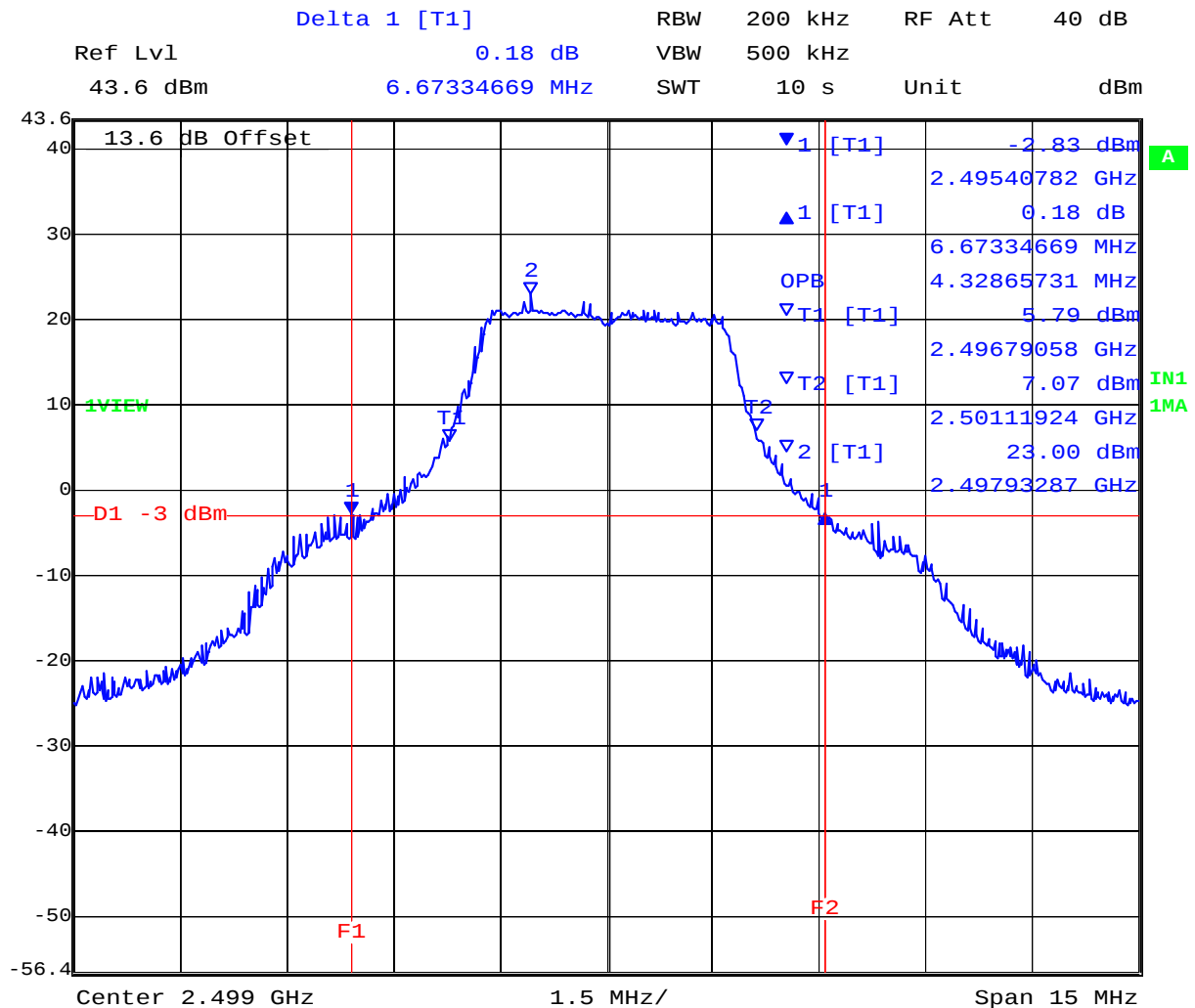
Center Frequency (MHz)	26 dB Bandwidth (MHz)	99 % BW (MHz)
2499.00	6.673	4.329
2593.00	6.102	4.148

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**26 dB & 99% Occupied Bandwidth,
Channel 2499.00 MHz, 6.0 MHz Channel Spacing**



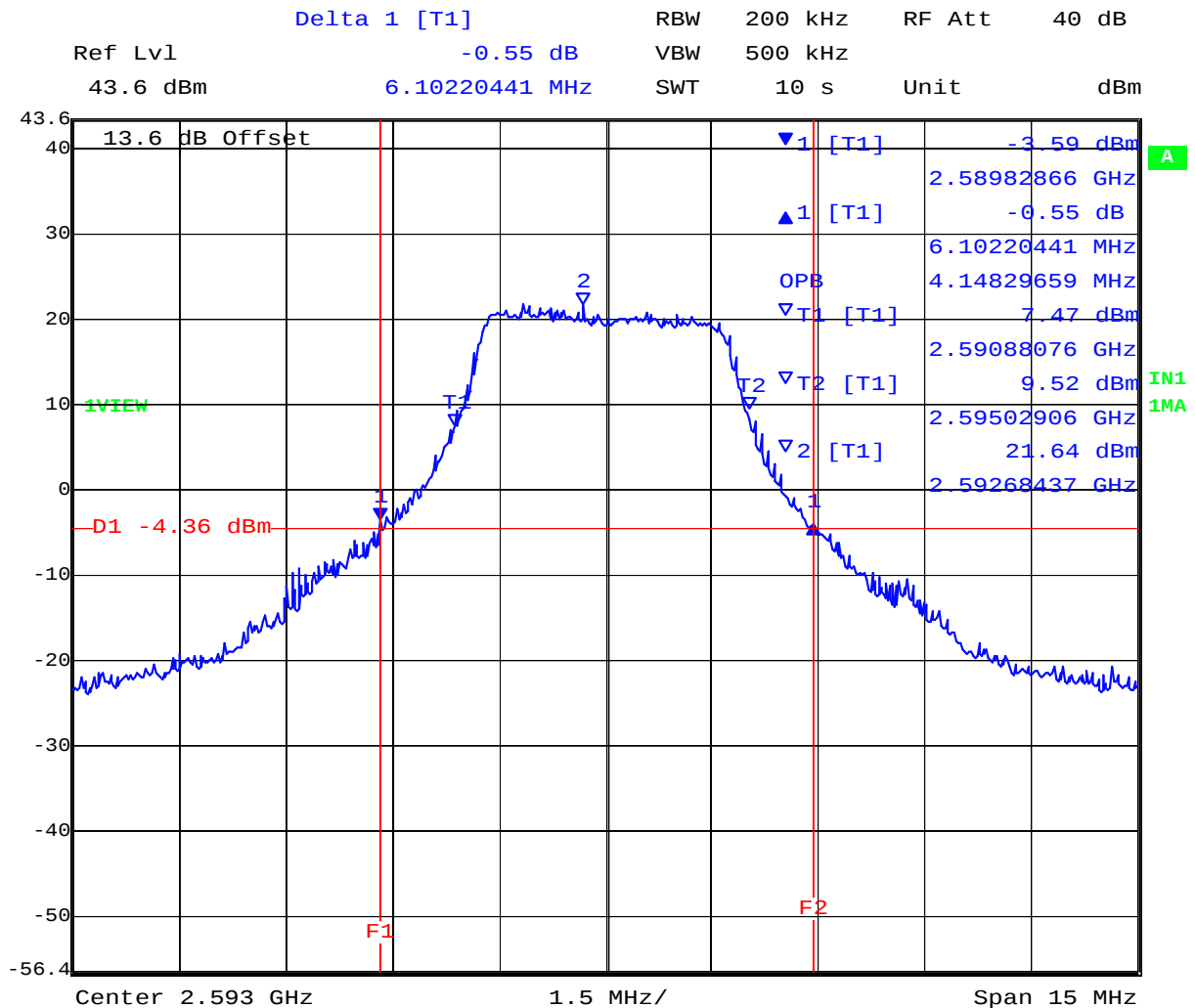
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26 dB & 99% Occupied Bandwidth,
Channel 2593.00 MHz, 6.0 MHz Channel Spacing



Date: 9.FEB.2011 10:10:05

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7.1.3 Measurement results for 11 and 12.0 MHz

TABLE OF RESULTS – 11 MHz and 12 MHz Dual Channel Spacing

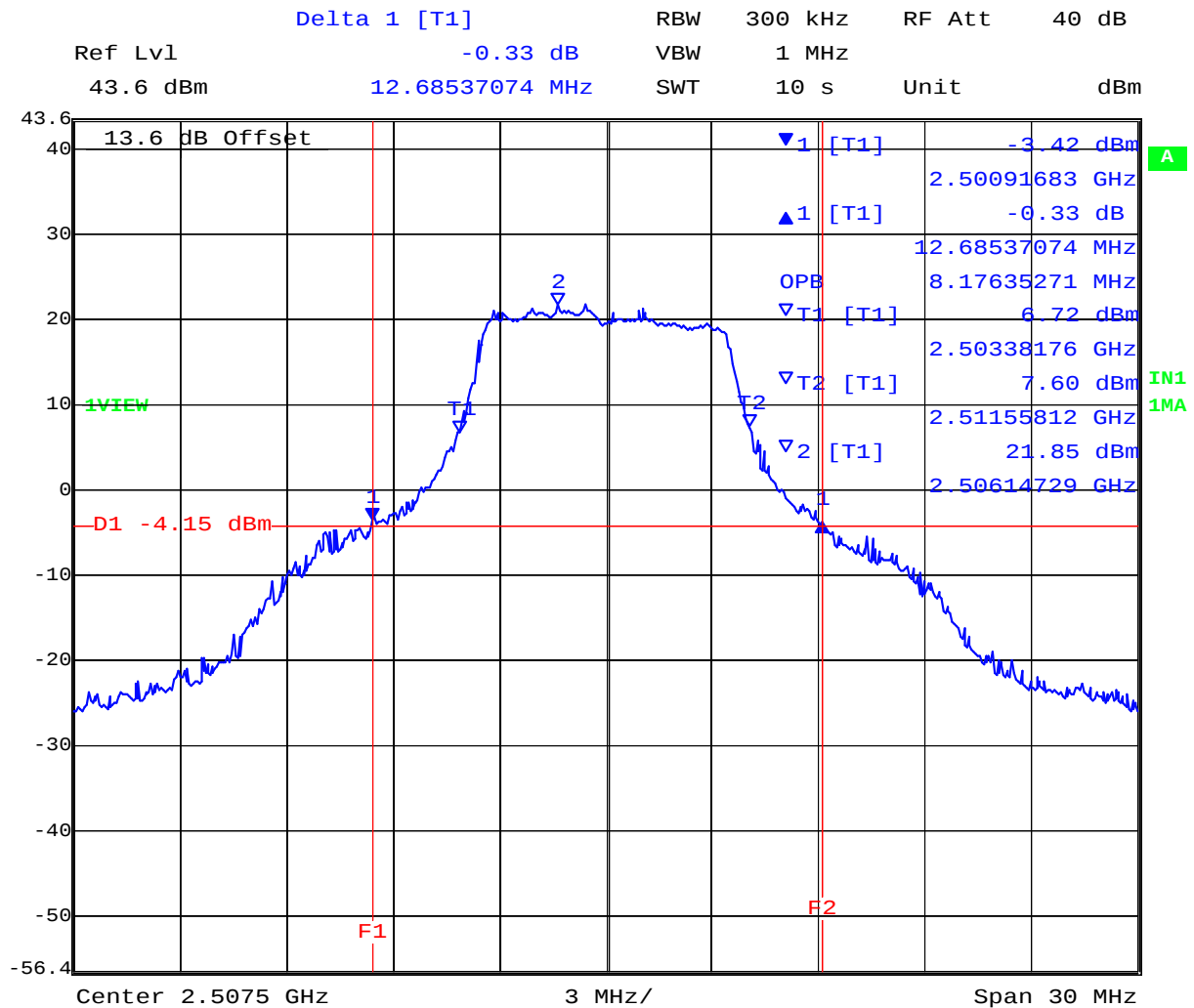
Center Frequency (MHz)	26 dB Bandwidth (MHz)	99 % BW (MHz)
2507.50	12.685	8.176
2590.00	11.964	7.936
2684.50	12.745	8.116

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**26 dB & 99% Occupied Bandwidth,
Channel 2507.50 MHz, 11 MHz Dual Channel Spacing**



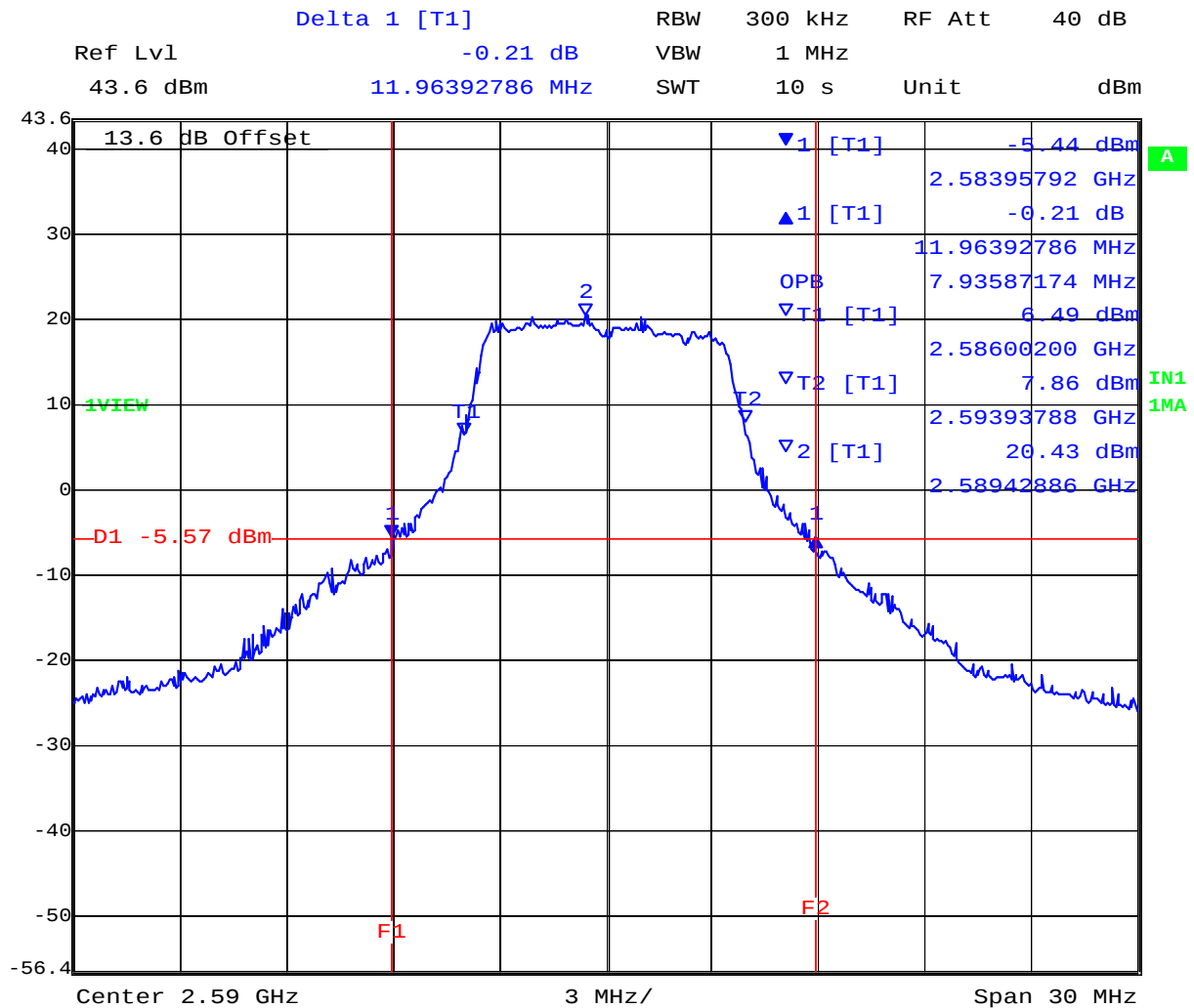
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**26 dB & 99% Occupied Bandwidth,
Channel 2590.00 MHz, 12 MHz Dual Channel Spacing**

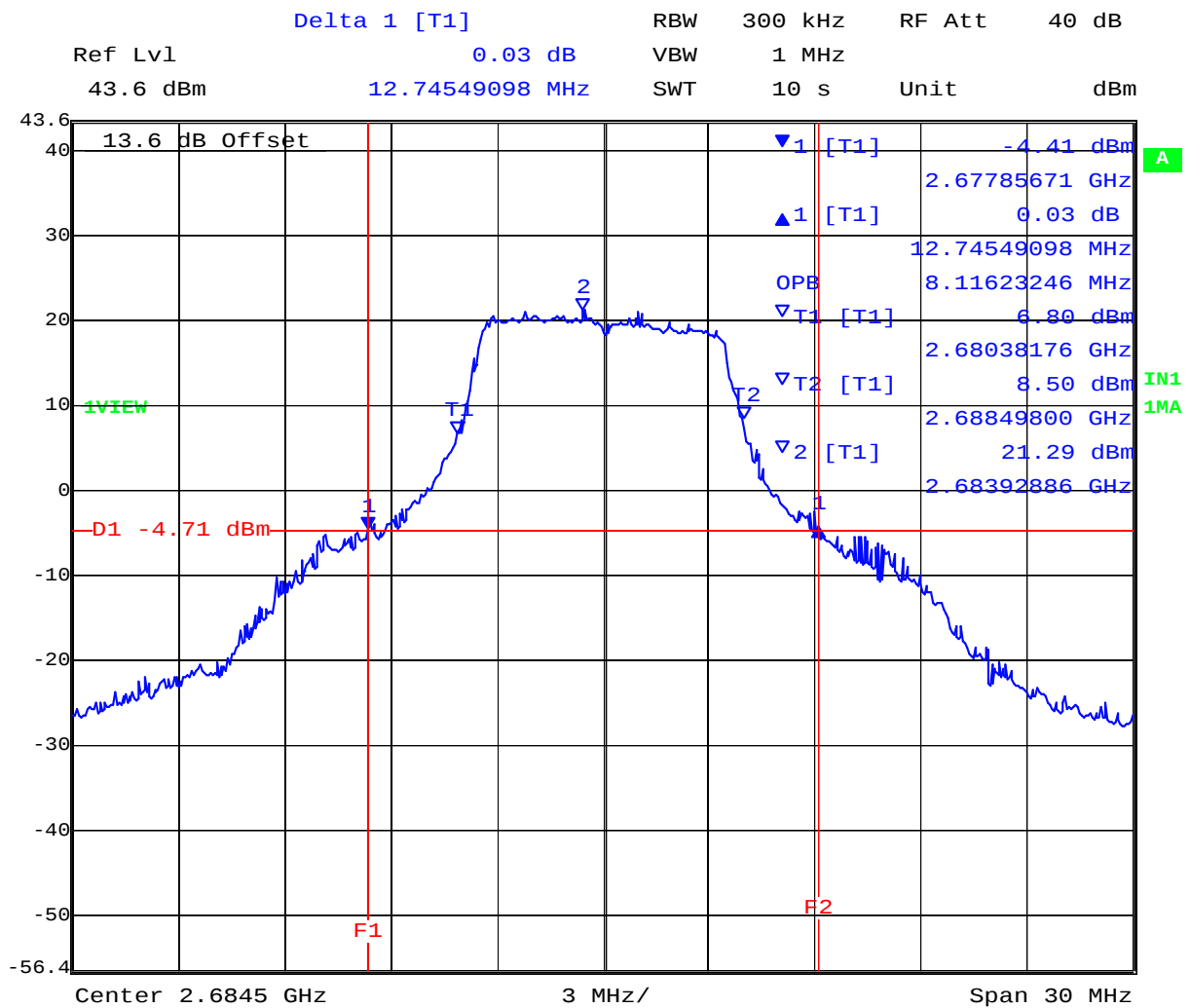


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26 dB & 99% Occupied Bandwidth,
Channel 2684.50 MHz, 11 MHz Dual Channel Spacing



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7.1.4 Measurement results for 22 and 24 MHz

TABLE OF RESULTS – 22 MHz and 24 MHz Quad Channel Spacing

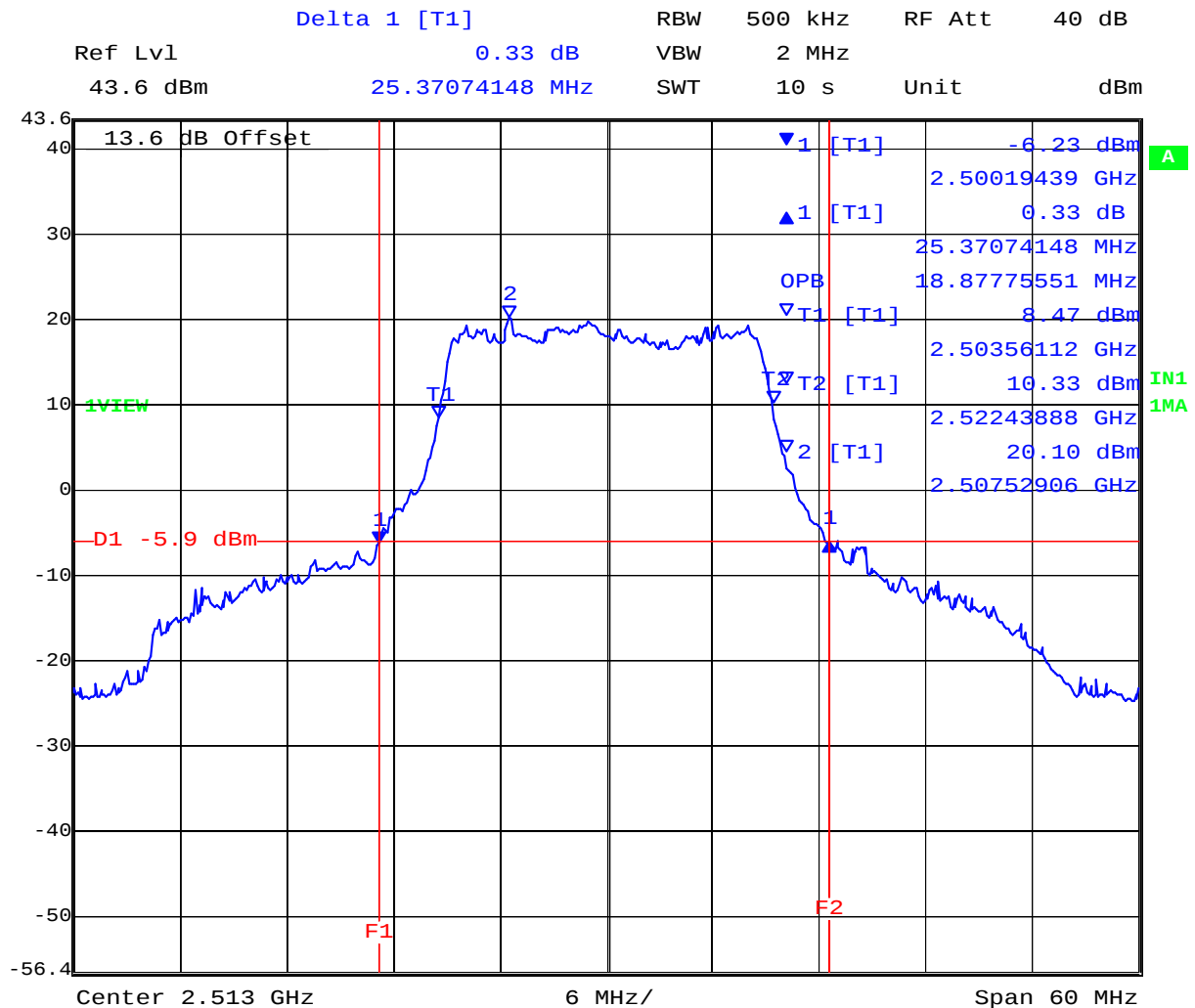
Center Frequency (MHz)	26 dB Bandwidth (MHz)	99 % BW (MHz)
2513.00	25.371	18.878
2590.00	25.851	18.878
2679.00	25.010	18.878

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**26 dB & 99% Occupied Bandwidth,
Channel 2513.00 MHz, 22 MHz Quad Channel Spacing**

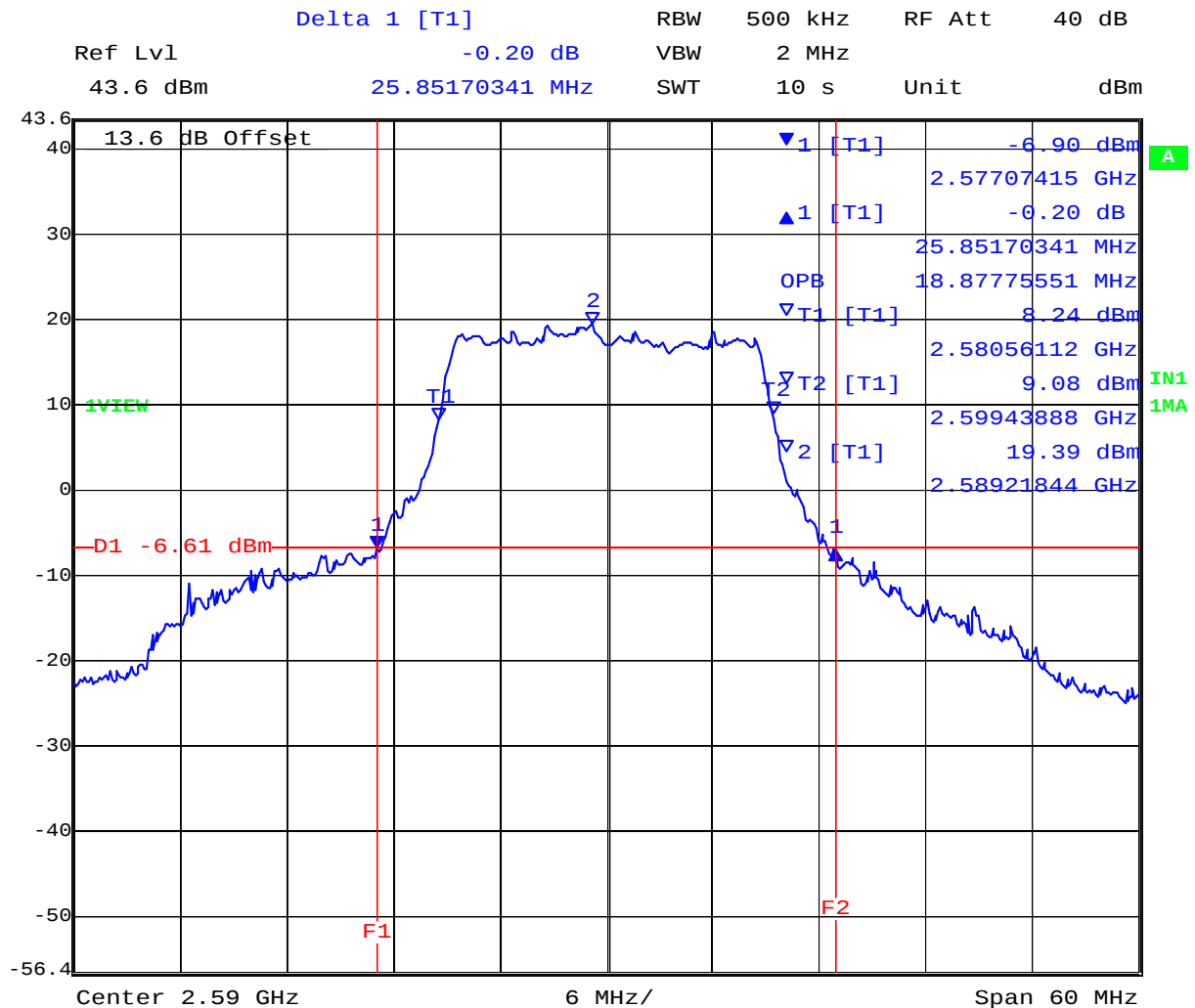


Date: 9.FEB.2011 10:33:30

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26 dB & 99% Occupied Bandwidth,
Channel 2590.00 MHz, 24 MHz Quad Channel Spacing



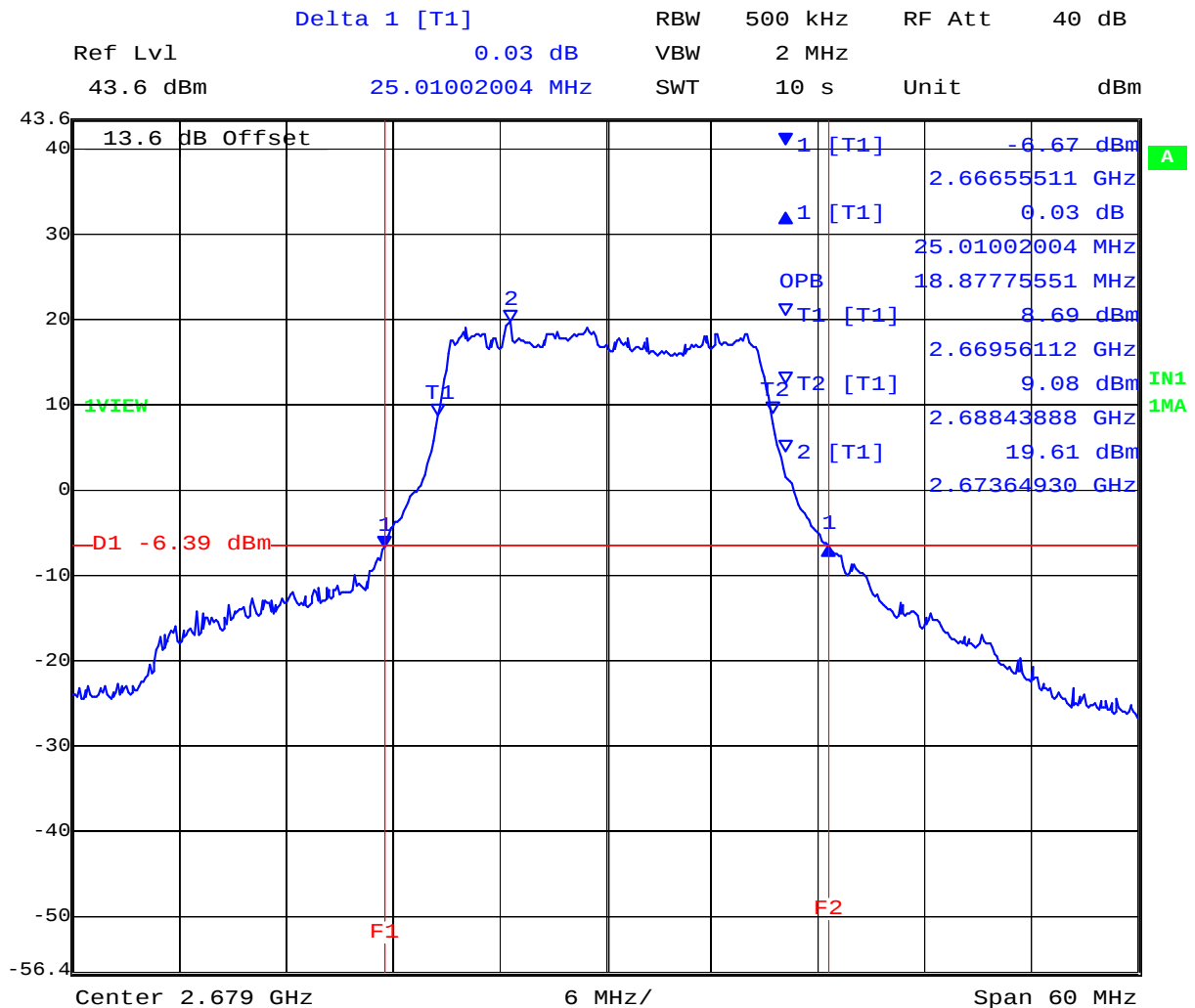
Date: 9.FEB.2011 10:35:40

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**26 dB & 99% Occupied Bandwidth,
Channel 2679.00 MHz, 22 MHz Quad Channel Spacing**



Date: 9.FEB.2011 10:37:35

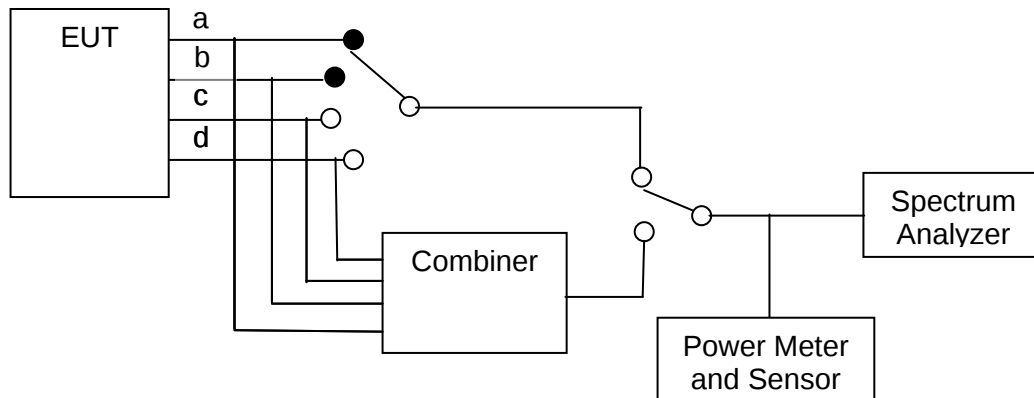
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7.2 RF Output Power, Emission Mask, EIRP at the Antenna Terminals

Test Procedure

The test methodology and conditions utilized for each measurement is referenced in the test results matrix. The output power was measured by the spectrum analyzer per the test configuration below. Per the standard measurements were taken at ambient conditions, nominal voltage.

Test Configuration



Measurement setup for RF Output Power



Specification

Power and antenna height limits.

§ 27.50 (h) The following power limits shall apply in the BRS and EBS:

(1) Main, booster and base stations.

(i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

(ii) If a main or booster station sectorizes or otherwise uses one or more transmitting antennas with a non-omni-directional horizontal plane radiation pattern, the maximum EIRP in dBW in a given direction shall be determined by the following formula: $EIRP = 33 \text{ dBW} + 10 \log(X/Y) \text{ dBW} + 10 \log(360/\text{beam width}) \text{ dBW}$, where X is the actual channel width in MHz, Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, and beam width is the total horizontal plane beam width of the individual transmitting antenna for the station or any sector measured at the half-power points.

EIRP Calculation –

Channel Spacing (MHz)	Antenna Beam width	EIRP Limit (dBm)	Measured BW (MHz)
5.5	16°	77.20	6.433
6	16°	76.98	6.673
11	16°	77.16	12.745
12	16°	76.51	11.964
22	16°	77.14	25.371
24	16°	76.84	25.851
5.5	8°	80.21	6.433
6	8°	79.99	6.673
11	8°	80.17	12.745
12	8°	79.52	11.964
22	8°	80.15	25.371
24	8°	79.85	25.851

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Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363

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Measurement Results for Transmit Output Power

Ambient conditions.

Temperature: 20.5 °C

Relative humidity: 39 %

Pressure: 1005 mbar

EUT parameters.

Power Level: Maximum

Duty Cycle: 100%

Temperature: Ambient

7.2.1 Measurement results for 5.5 MHz

TABLE OF RESULTS – 5.5 MHz Channel Spacing

Center Frequency (MHz)	Maximum Conducted Power (dBm)	
	Port A	Port B
2504.75	+23.77	+22.72
2687.25	+21.96	+22.43

Band-Edge Power (Power Integrated over 1 MHz @ 100 kHz Bandwidth)

Center Frequency (MHz)	Plot Reference	Band-Edge Power (dBm)		Limit (dBm)
		Port A	Port B	
2504.75	ACP Low (cl1-cl1)	-17.25	-15.23	-13.00
2687.25	ACP Up (cu1-cu1)	-14.97	-14.19	

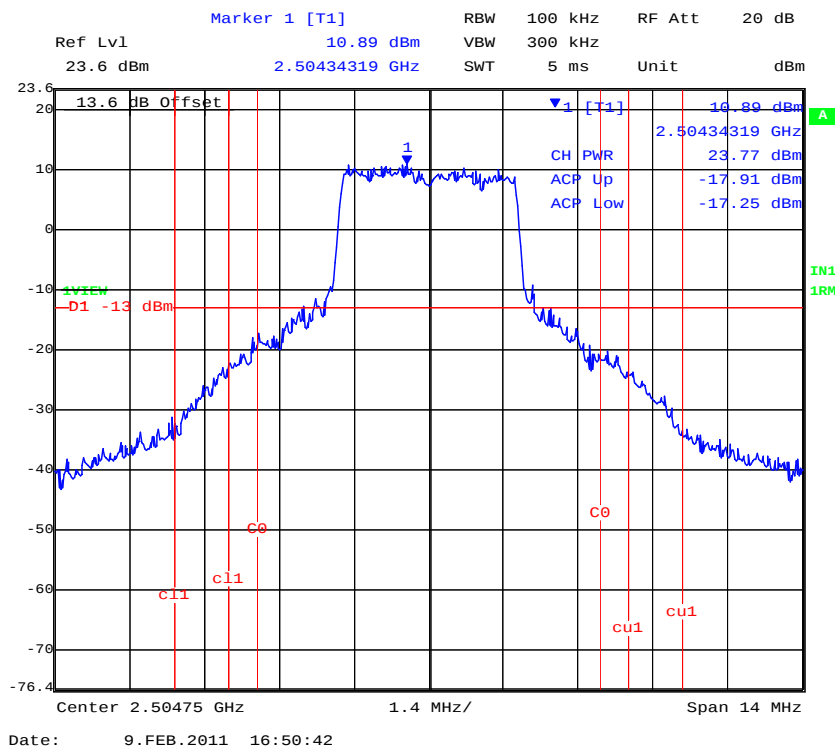
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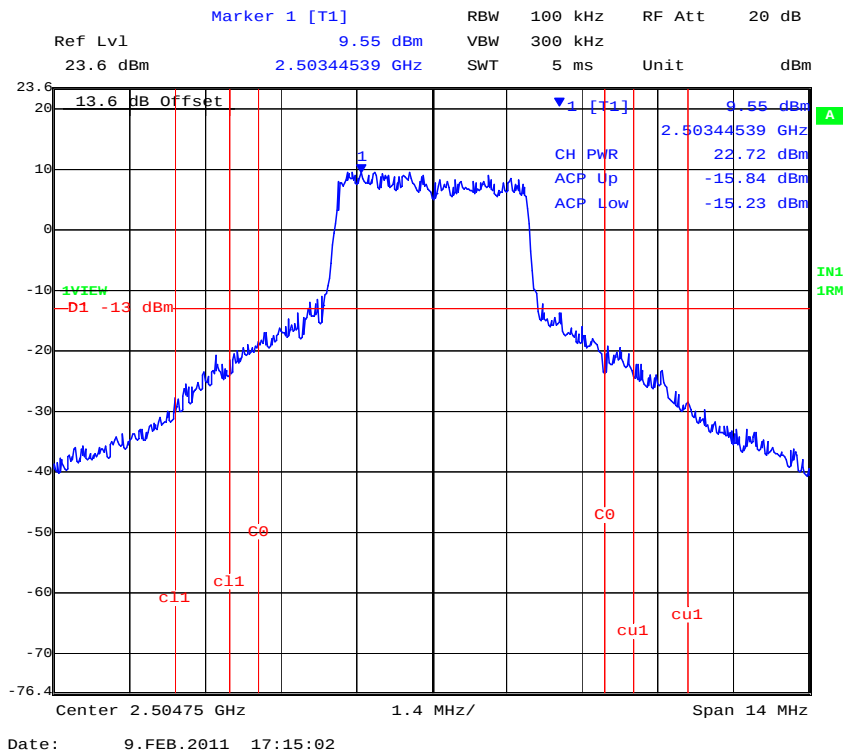
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Output Power, Channel 2504.75 MHz, 5.5 MHz Channel Spacing

Port A



Port B

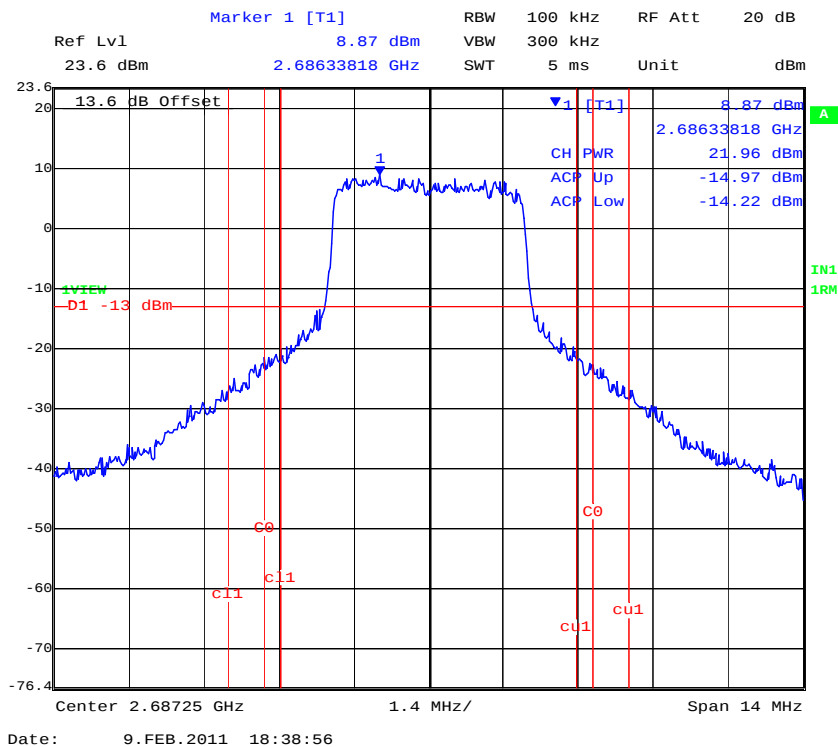


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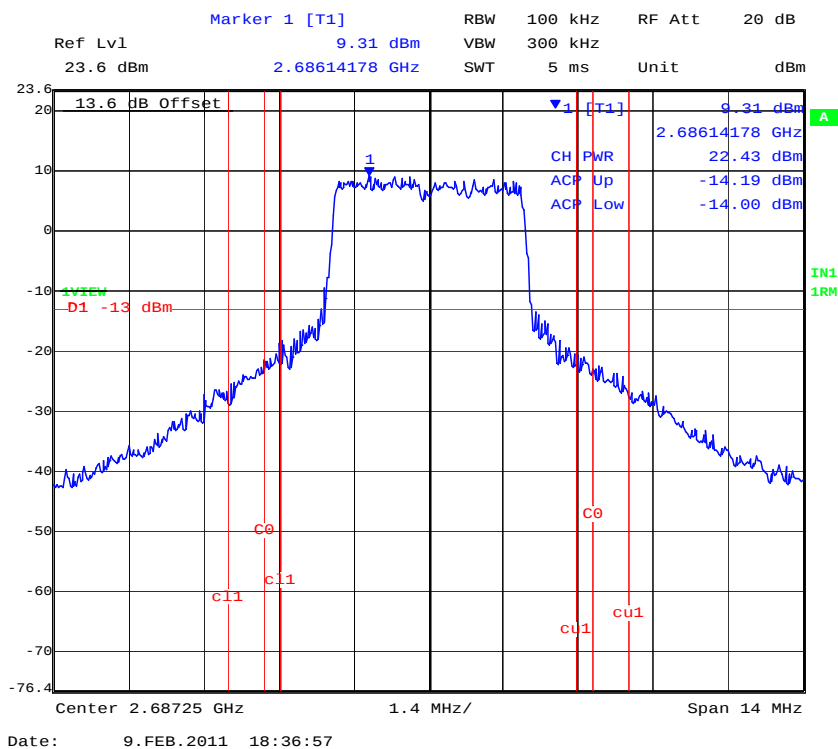


Output Power, Channel 2687.25 MHz, 5.5 MHz Channel Spacing

Port A



Port B



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7.2.2 Measurement results for 6.0 MHz

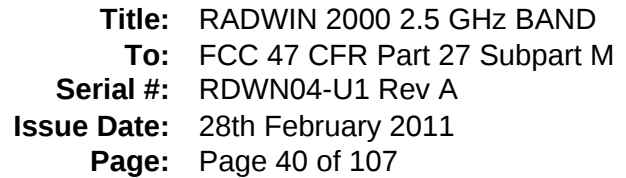
TABLE OF RESULTS – 6 MHz Channel Spacing

Center Frequency (MHz)	Maximum Conducted Power (dBm)	
	Port A	Port B
2499.00	+22.63	+22.19
2593.00	+22.85	+22.84

Band-Edge Power (Power Integrated over 1 MHz @ 100 kHz Bandwidth)

Center Frequency (MHz)	Plot Reference	Band-Edge Power (dBm)		Limit (dBm)
		Port A	Port B	
2499.00	ACP Low (cl1-cl1)	-17.50	-15.80	-13.00

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Ref Lvl 23.6 dBm RBW 100 kHz VBW 300 kHz SWT 5 ms RF Att 20 dB

Marker 1 [T1] 9.48 dBm 2.49735872 GHz

CH PWR 22.63 dBm

ACP Up -18.00 dBm

ACP Low -17.50 dBm

Center 2.499 GHz 1.4 MHz/ Span 14 MHz

Date: 9.FEB.2011 17:11:01

Ref Lvl 23.6 dBm

Marker 1 [T1] 9.70 dBm

RBW 100 kHz

VBW 300 kHz

RF Att 20 dB

SWT 5 ms

Unit dBm

13.6 dB Offset

1 [T1] 9.70 dBm

CH PWR 22.19 dBm

ACP Up -16.78 dBm

ACP Low -15.80 dBm

D1 -13 dBm

C0

C11

cu1

cu1

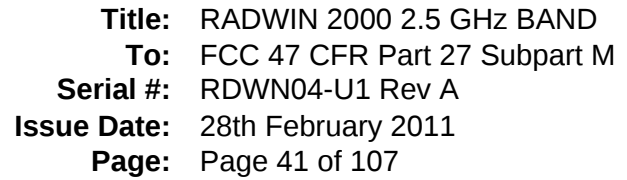
Center 2.499 GHz

1.4 MHz/

Span 14 MHz

Date: 9.FEB.2011 17:08:34

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Ref Lvl 23.6 dBm

Marker 1 [T1] 9.58 dBm

RBW 100 kHz

VBW 300 kHz

SWT 5 ms

Unit dBm

23.6 dB Offset

13.6 dB Offset

1 [T1] 9.58 dBm

CH PWR 2.59290180 GHz 22.85 dBm

CH BW 6.10200000 MHz

VIEW

IN1 1RM

Center 2.593 GHz

1.4 MHz/

Span 14 MHz

Date: 10.FEB.2011 10:12:46

[illegible]

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7.2.3 Measurement results for 11 and 12 MHz

TABLE OF RESULTS – 11 and 12 MHz Dual Channel Spacing

Center Frequency (MHz)	Maximum Conducted Power (dBm)	
	Port A	Port B
2507.50	+23.34	+23.55
2590.00	+22.97	+23.36
2684.50	+22.26	+23.32

Band-Edge Power (Power Integrated over 1 MHz @ 100 kHz Bandwidth)

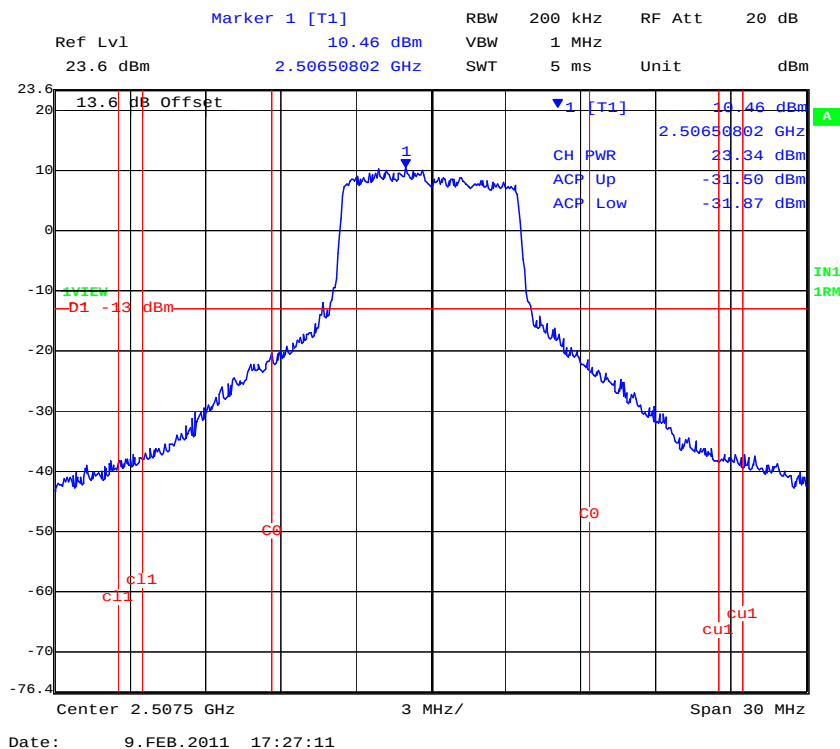
Center Frequency (MHz)	Plot Reference	Band-Edge Power (dBm)		Limit (dBm)
		Port A	Port B	
2507.50	ACP Low (cl1-cl1)	-31.87	-27.84	-13.00
2684.50	ACP Up (cu1-cu1)	-16.97	-13.94	



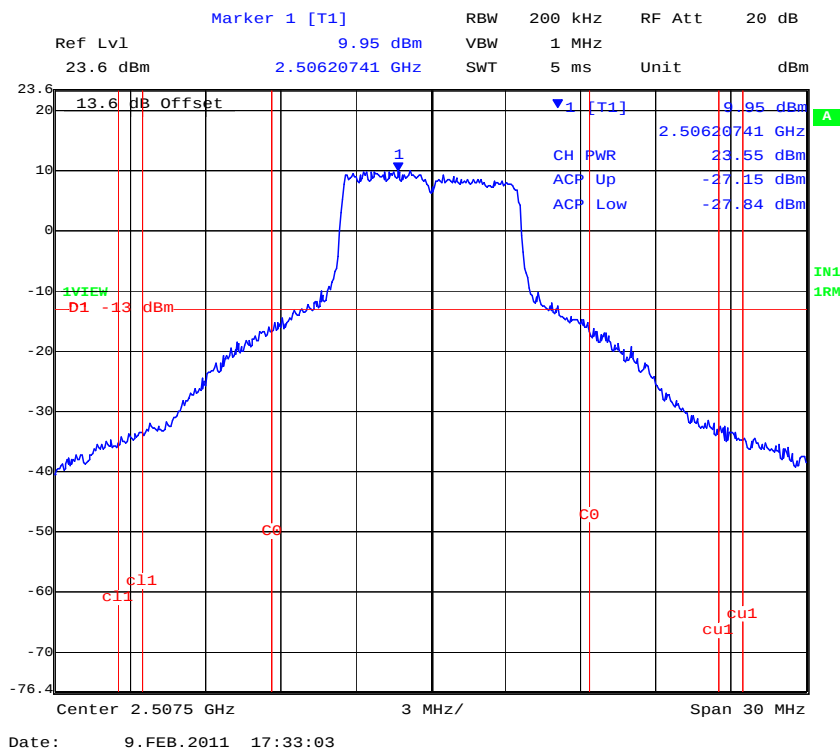
Title: RADWIN 2000 2.5 GHz BAND
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Output Power, Channel 2507.50 MHz, 11 MHz Dual Channel Spacing

Port A



Port B



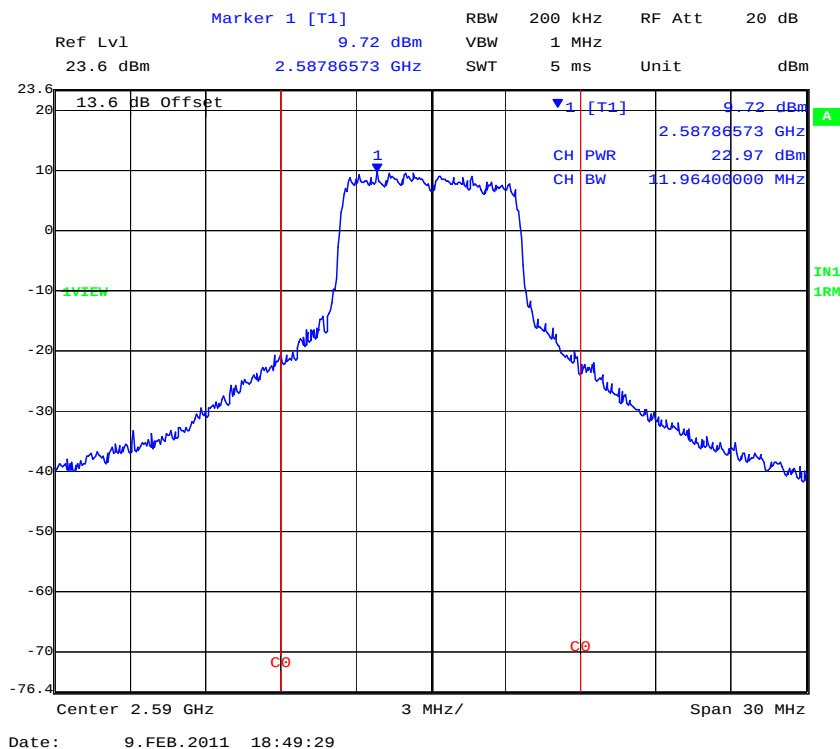
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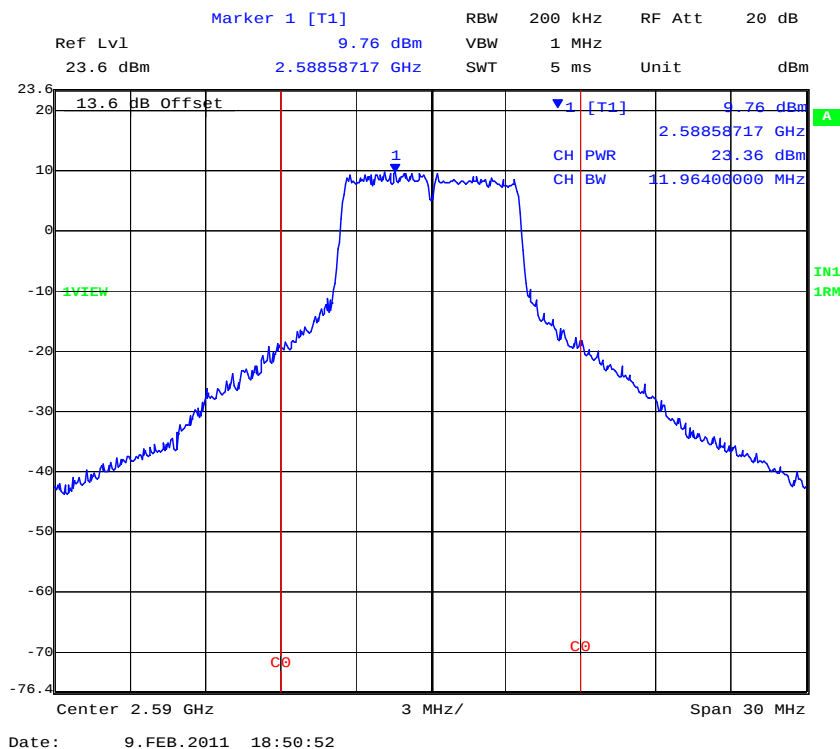
Title: RADWIN 2000 2.5 GHz BAND
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Output Power, Channel 2590.00 MHz, 12 MHz Dual Channel Spacing

Port A



Port B



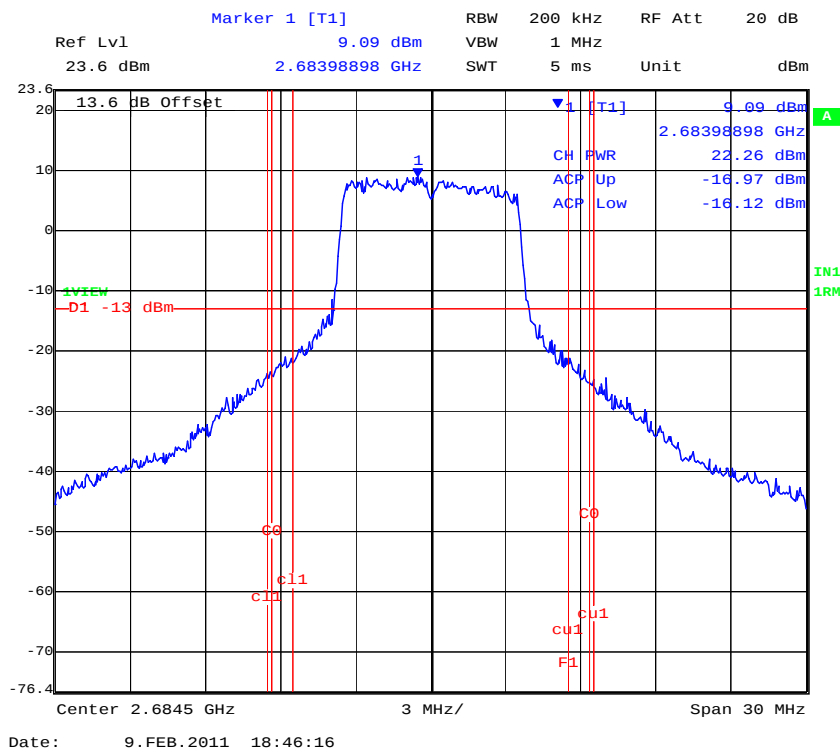
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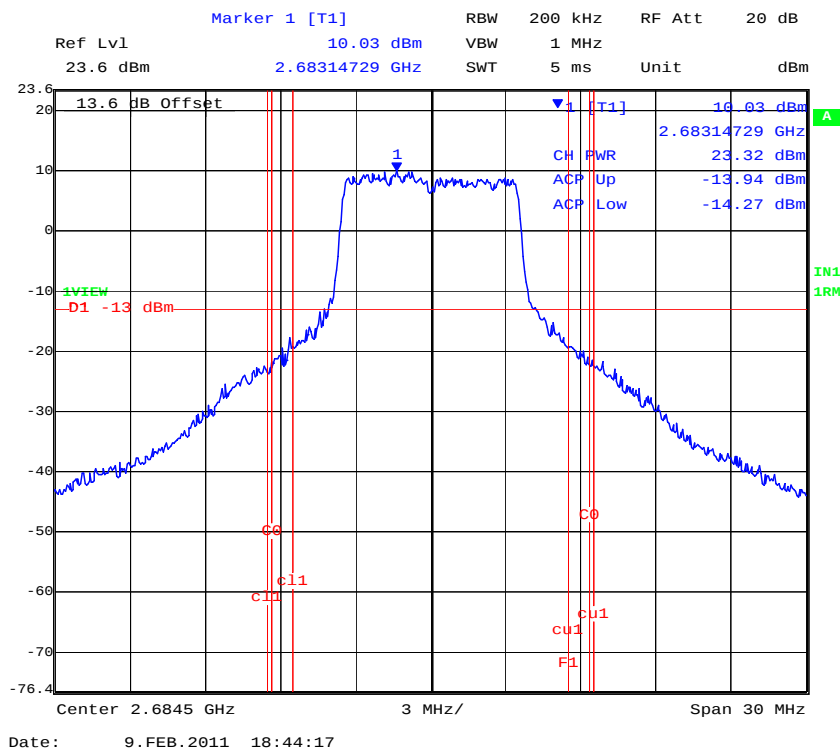
Title: RADWIN 2000 2.5 GHz BAND
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Output Power, Channel 2684.50 MHz, 11 MHz Dual Channel Spacing

Port A



Port B



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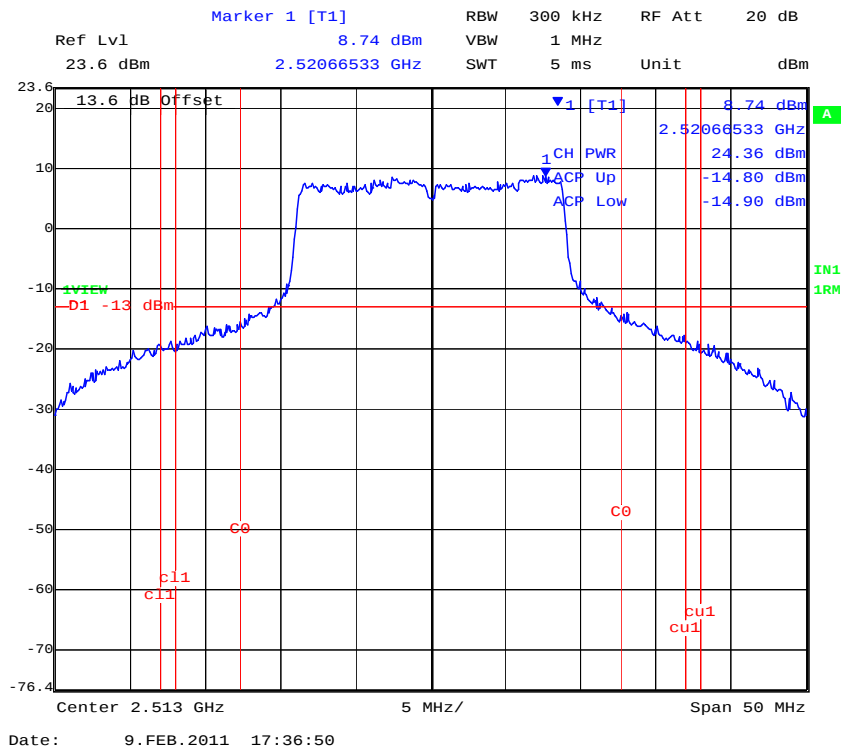
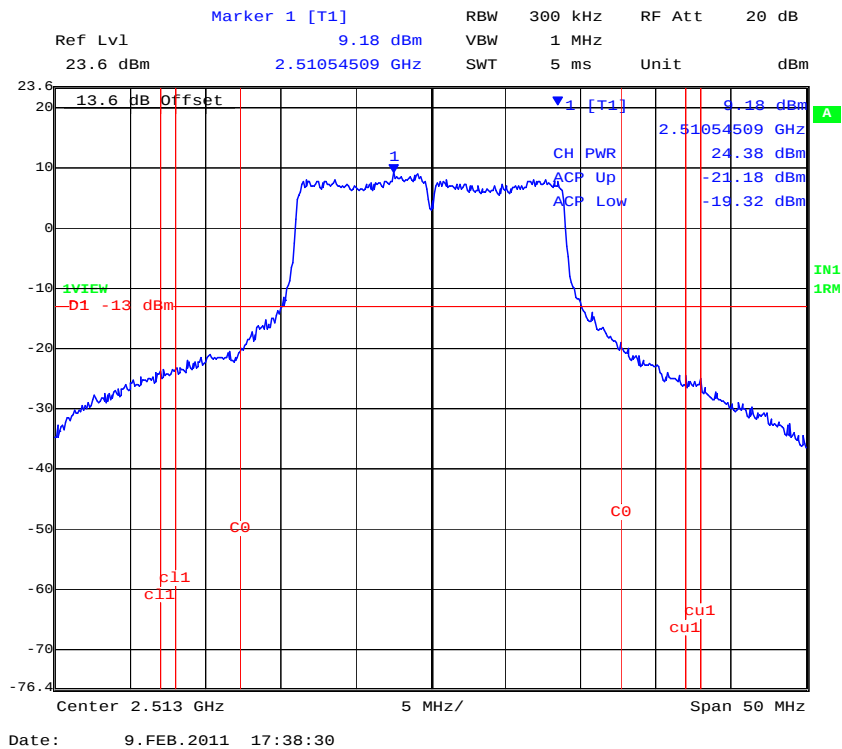
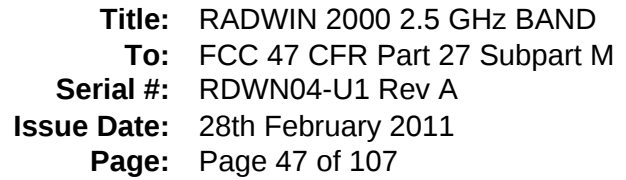
7.2.4 Measurement results for 22 and 24 MHz

TABLE OF RESULTS – 22 and 24 MHz Quad Channel Spacing

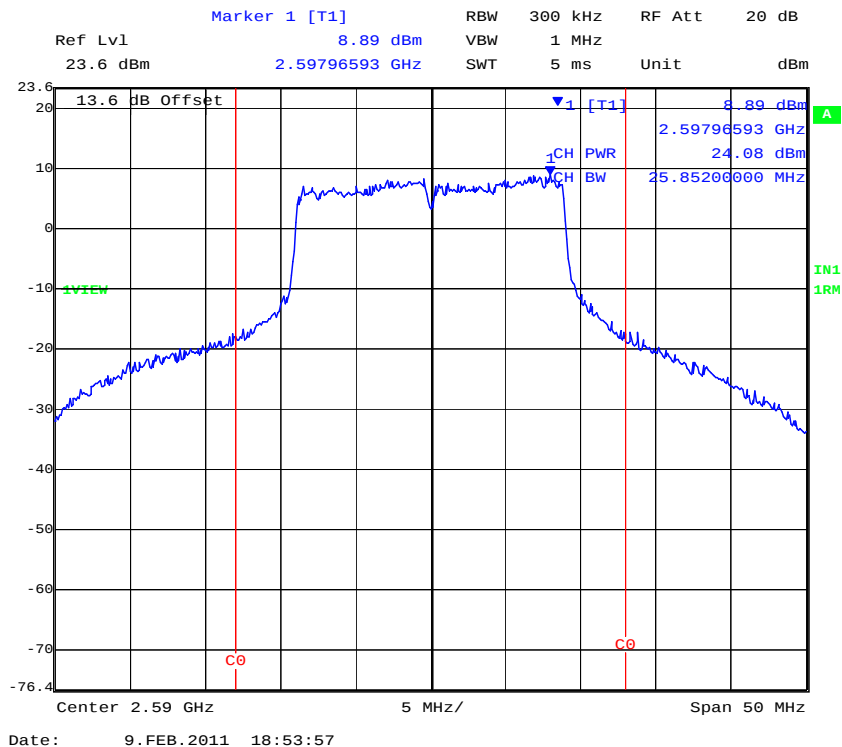
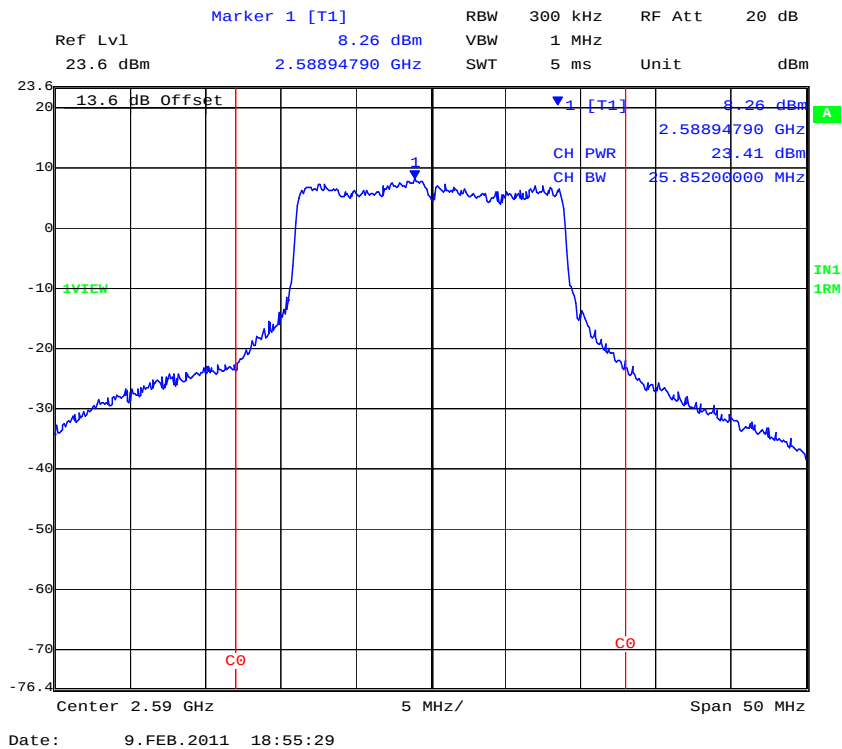
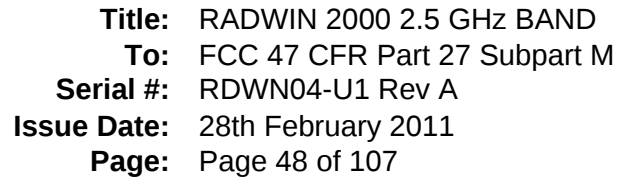
Center Frequency (MHz)	Maximum Conducted Power (dBm)	
	Port A	Port B
2513.00	+24.38	+24.36
2590.00	+23.41	+24.08
2679.00	+22.17	+23.15

Band-Edge Power (Power Integrated over 1 MHz @ 100 kHz Bandwidth)

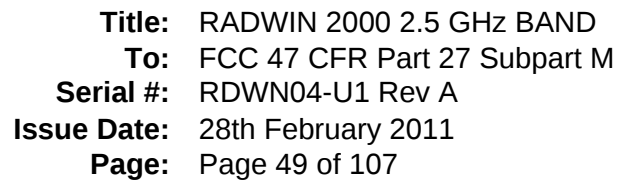
Center Frequency (MHz)	Plot Reference	Band-Edge Power (dBm)		Limit (dBm)
		Port A	Port B	
2513.00	ACP Low (cl1-cl1)	-19.32	-14.90	-13.00
2697.00	ACP Up (cu1-cu1)	-15.77	-13.59	



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Ref Lvl 23.6 dBm
 Marker 1 [T1] 6.63 dBm
 2.67213627 GHz
 RBW 300 kHz
 VBW 1 MHz
 SWT 5 ms
 RF Att 20 dB
 Unit dBm

13.6 dB Offset
 1 [T1] 6.63 dBm
 2.67213627 GHz
 CH PWR 22.17 dBm
 ACP Up -15.77 dBm
 ACP Low -15.81 dBm

D1 -13 dBm
 D11
 C0
 C0
 C01
 C01

Center 2.679 GHz
 5 MHz/
 Span 50 MHz

Date: 9.FEB.2011 18:21:32

[illegible]

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7.2.5 Output Power V's Antenna Gain (EIRP)

Channel Spacing (MHz)	Antenna	Antenna Gain (dBi)	Maximum Measured Conducted Power (dBm)	EIRP (dBm)
5.5	Integrated Flat Panel	17.5	+23.77	+41.27
	External Flat Panel	20		+43.77
	Grid	24		+47.77
6.0	Integrated Flat Panel	17.5	+22.85	+40.35
	External Flat Panel	20		+42.85
	Grid	24		+46.85
11.0/12.0	Integrated Flat Panel	17.5	+23.55	+41.05
	External Flat Panel	20		+43.55
	Grid	24		+47.55
22.0/24.0	Integrated Flat Panel	17.5	+24.38	+41.88
	External Flat Panel	20		+44.38
	Grid	24		+48.38

7.3 Power Spectral Density

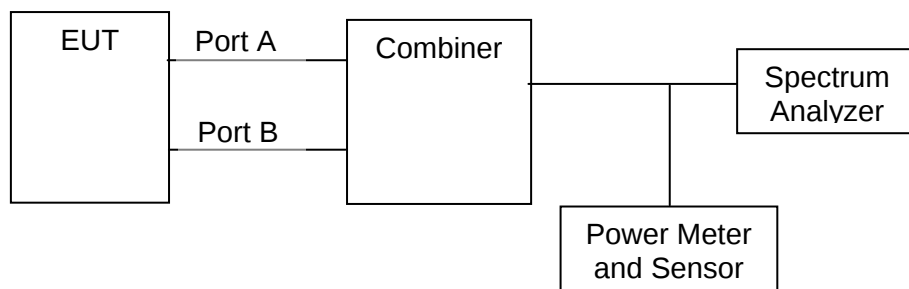
Test Procedure

The test methodology and conditions utilized for each measurement is referenced in the following test results matrix. RF output power, transmit power control and power density were measured per the Test Configuration identified below.

Testing was performed on the highest and lowest power settings of the equipment.

Per the standard measurements were taken at ambient and nominal and voltage.

Test Configuration



Measurement setup for Power Spectral Density



Specification

Power and antenna height limits.

§ 27.50 (h) The following power limits shall apply in the BRS and EBS:

- (4) For main, booster and response stations utilizing digital emissions with non-uniform power spectral density (e.g. unfiltered QPSK), the power measured within any 100 kHz resolution bandwidth within the 6 MHz channel occupied by the non-uniform emission cannot exceed the power permitted within any 100 kHz resolution bandwidth within the 6 MHz channel if it were occupied by an emission with uniform power spectral density, i.e., if the maximum permissible power of a station utilizing a perfectly uniform power spectral density across a 6 MHz channel were 2000 watts EIRP, this would result in a maximum permissible power flux density for the station of $2000/60 = 33.3$ watts EIRP per 100 kHz bandwidth. If a non-uniform emission were substituted at the station, station power would still be limited to a maximum of 33.3 watts EIRP within any 100 kHz segment of the 6 MHz channel, irrespective of the fact that this would result in a total 6 MHz channel power of less than 2000 watts EIRP.

Power Density Calculation –

Channel Spacing (MHz)	Antenna Beam width	EIRP Limit (dBm)	Power Density Limit (dBm/100KHz)
5.5	16°	77.20	59.80
6	16°	76.98	59.20
11	16°	77.16	56.75
12	16°	76.51	55.72
22	16°	77.14	53.72
24	16°	76.84	53.04
5.5	8°	80.21	62.81
6	8°	79.99	62.21
11	8°	80.17	59.76
12	8°	79.52	58.73
22	8°	80.15	56.73
24	8°	79.85	56.05



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Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363

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Measurement Results for Power Spectral Density

Ambient conditions.

Temperature: 20.5 °C

Relative humidity: 39 %

Pressure: 1005 mbar

EUT parameters

Power Level: Maximum

Duty Cycle: 100%

Temperature: Ambient

7.3.1 Measurement results for 5.5 MHz

TABLE OF RESULTS – 5.5 MHz Channel Spacing

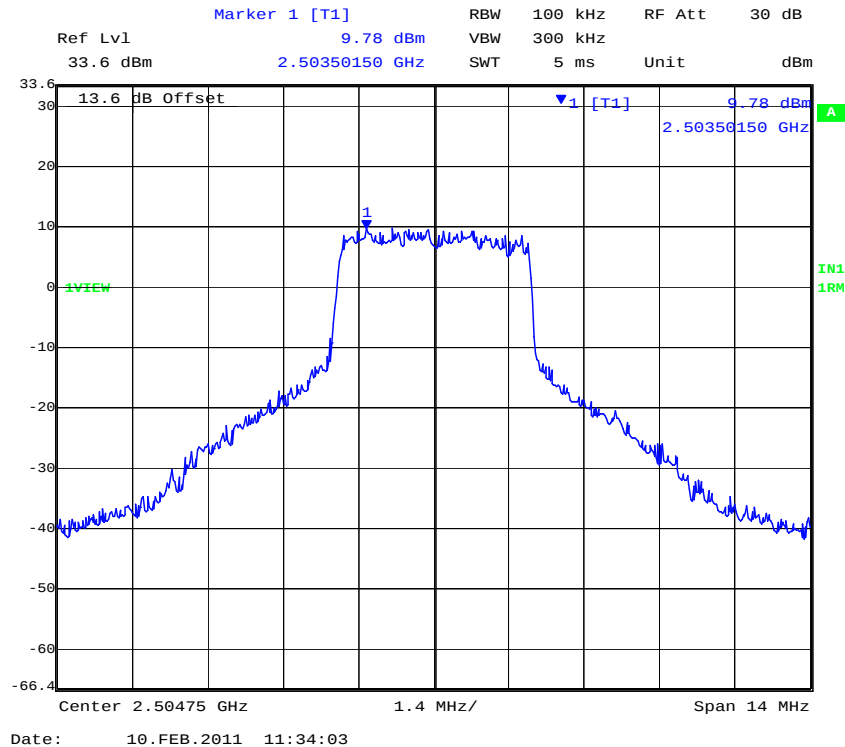
Center Frequency (MHz)	Measured Power Spectral Density (dBm/100 kHz)	
	Port A	Port B
2504.75	+9.78	+10.60
2687.25	+9.91	+9.49

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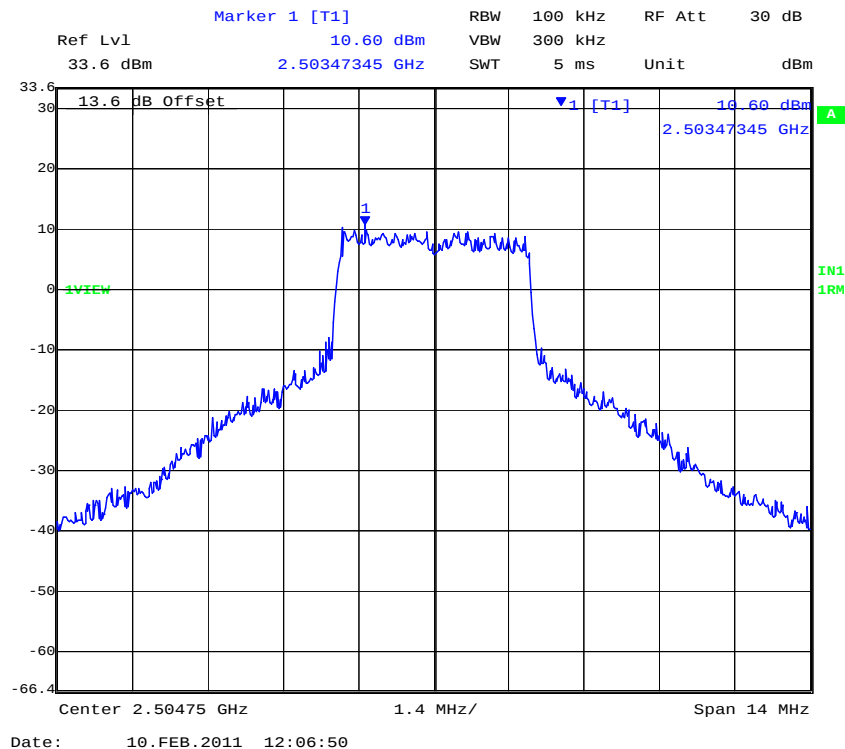


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Power Spectral Density, Channel 2504.75 MHz, 5.5 MHz Channel Spacing Port A



Port B

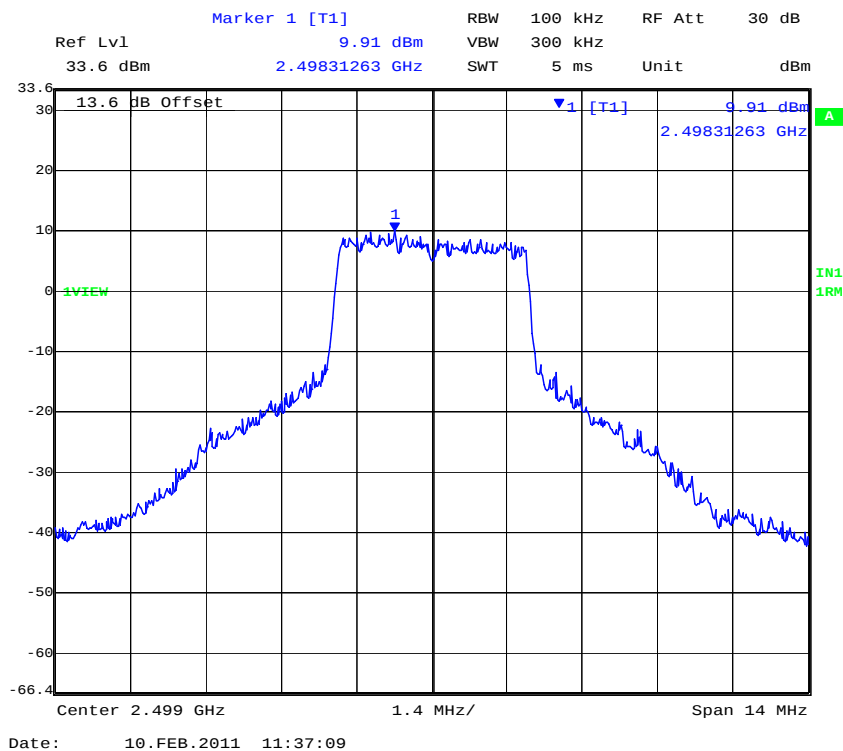


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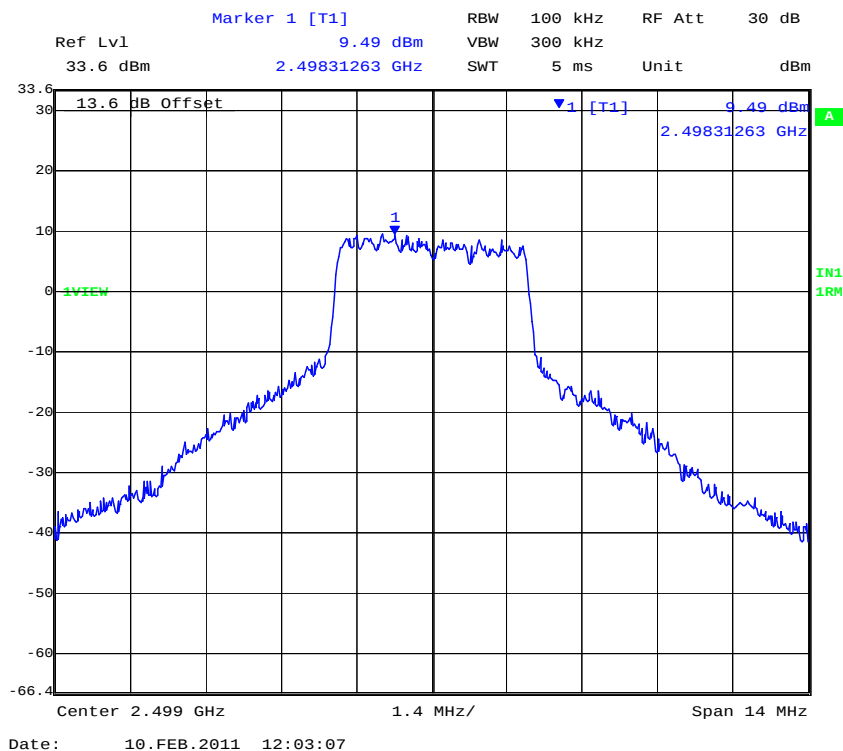


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Power Spectral Density, Channel 2687.25 MHz, 5.5 MHz Channel Spacing Port A



Port B



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7.3.2 Measurement results for 6.0 MHz

TABLE OF RESULTS – 6 MHz Channel Spacing

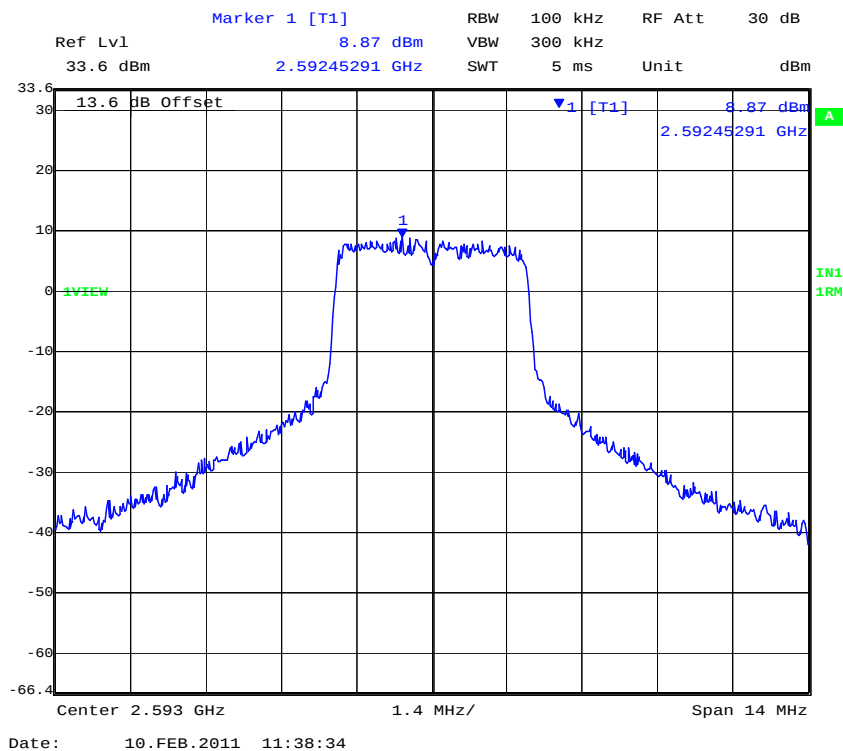
Center Frequency (MHz)	Measured Power Spectral Density (dBm/100kHz)	
	Port A	Port B
2499.00	+8.87	+9.49
2593.00	+8.87	+9.25

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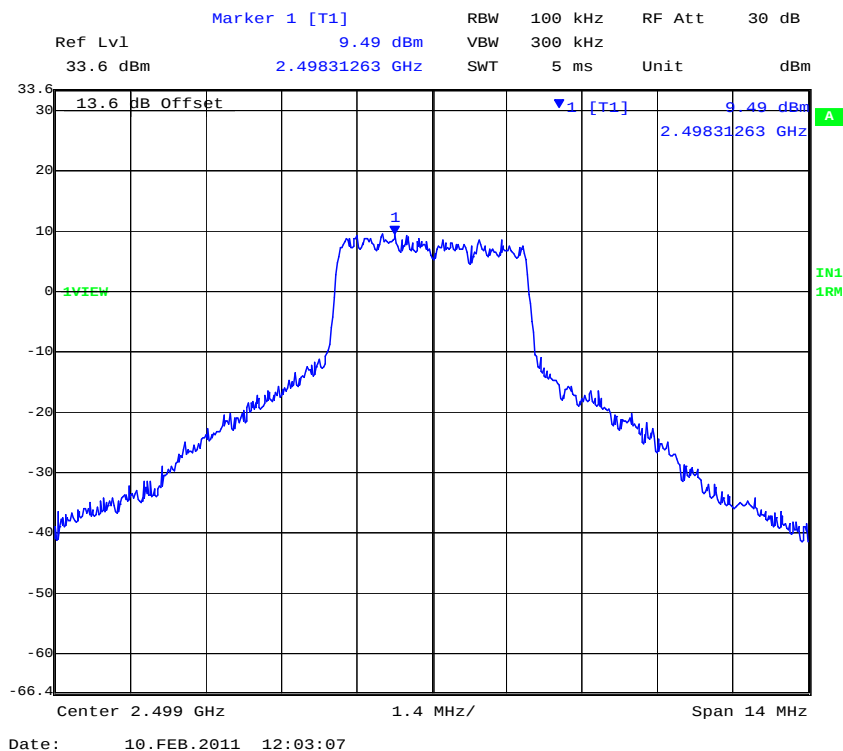


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Power Spectral Density, Channel 2499.00 MHz, 6.0 MHz Channel Spacing Port A



Port B

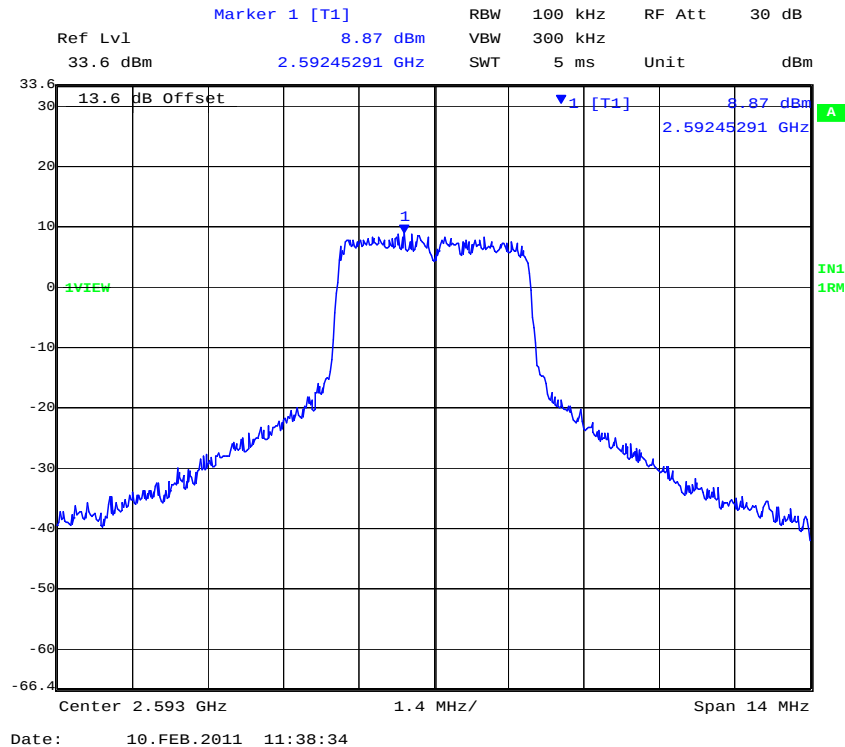


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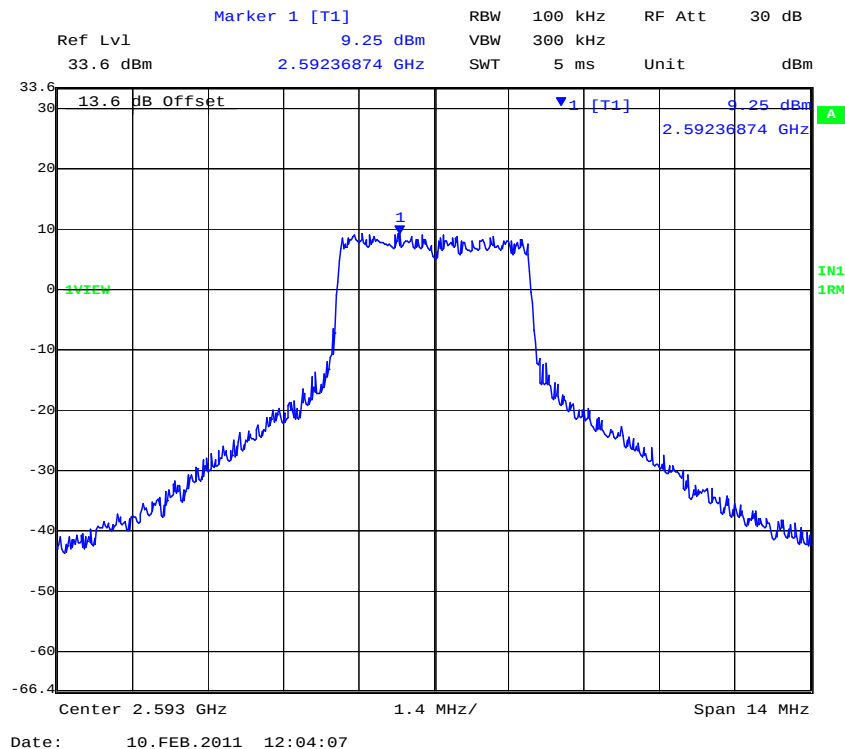


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Power Spectral Density, Channel 2593.00 MHz, 6.0 MHz Channel Spacing Port A



Port B



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7.3.3 Measurement results for 11 and 12 MHz

TABLE OF RESULTS – 11 and 12 MHz Dual Channel Spacing

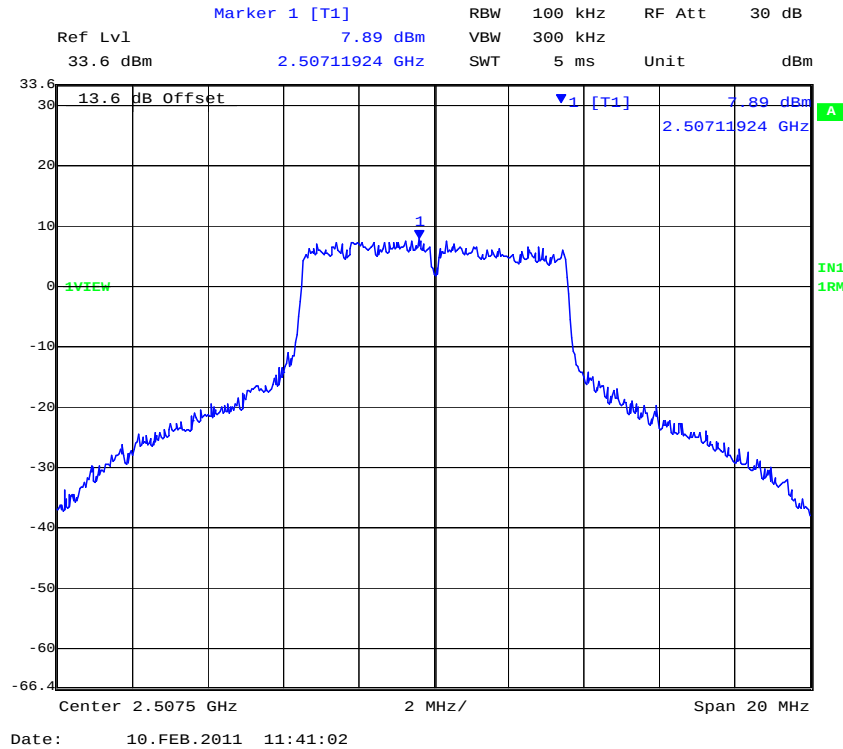
Center Frequency (MHz)	Measured Power Spectral Density (dBm/100 kHz)	
	Port A	Port B
2507.50	+7.89	+7.62
2590.00	+7.59	+6.97
2684.50	+6.09	+7.79

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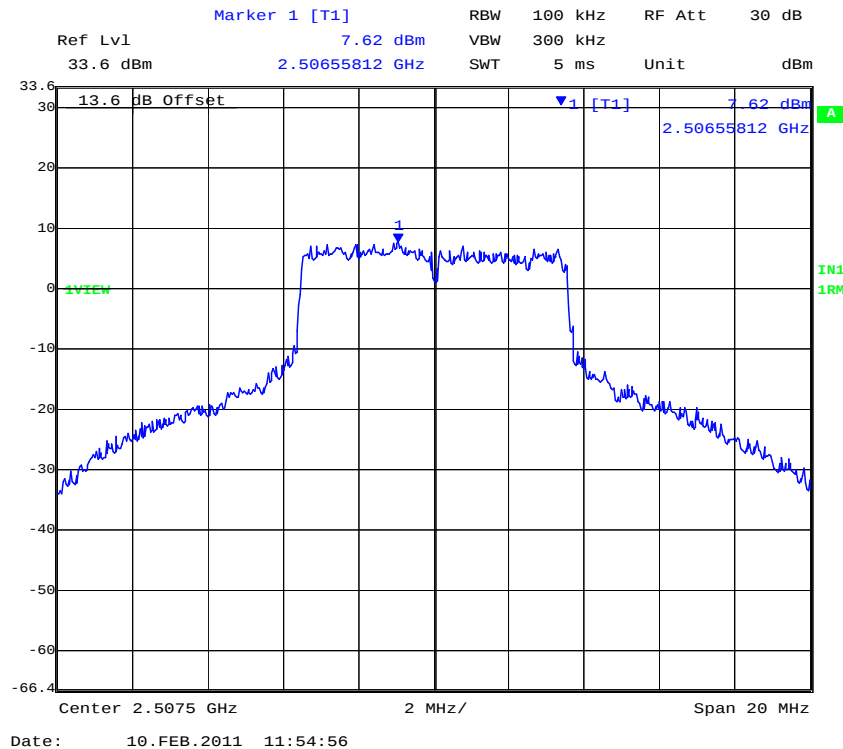


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Power Spectral Density, Channel 2507.50 MHz, 11 MHz Dual Channel Spacing Port A



Port B

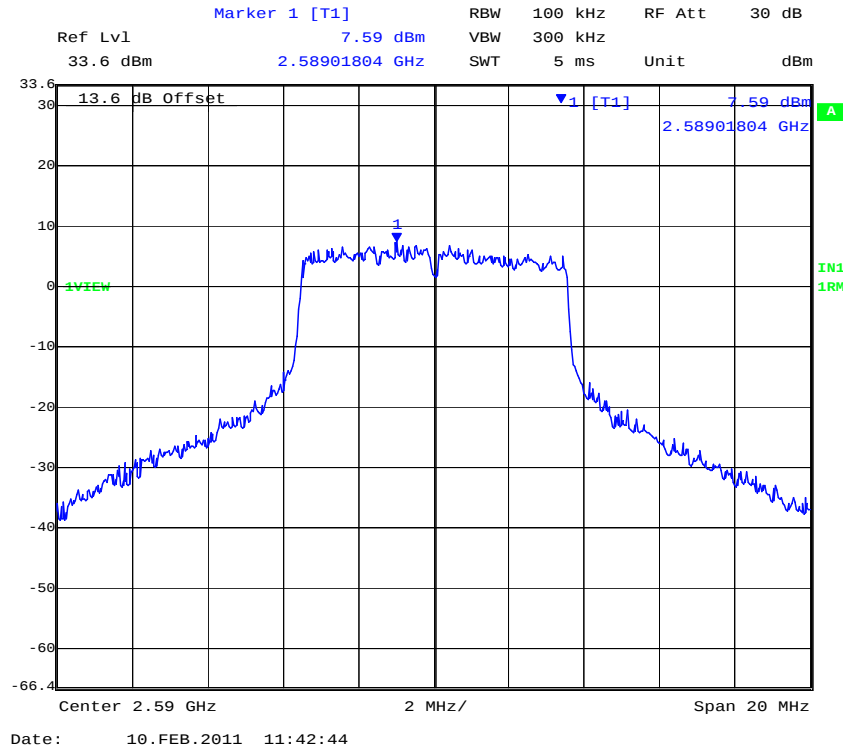


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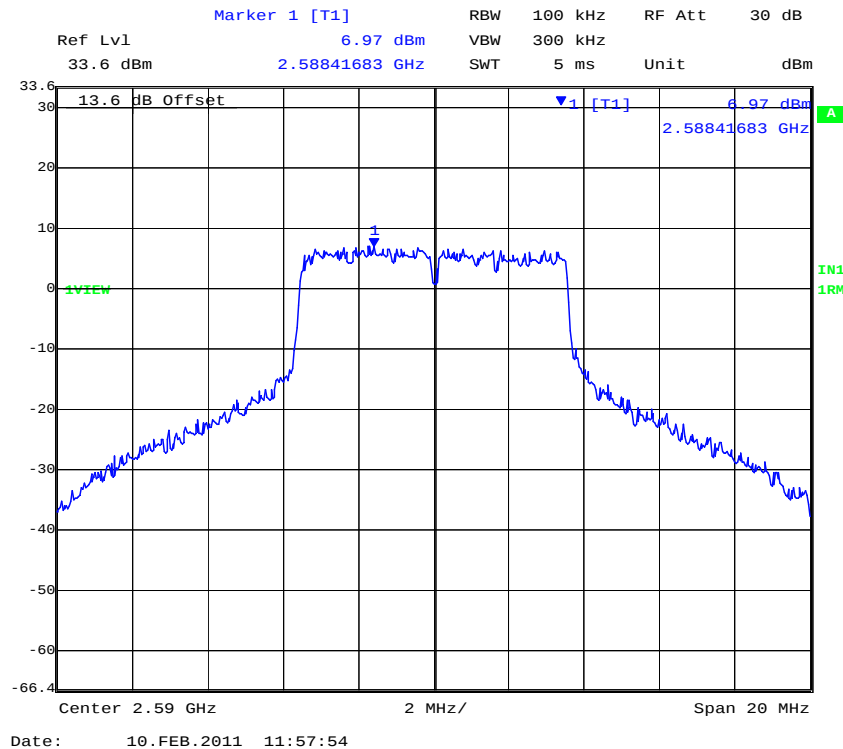


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Power Spectral Density, Channel 2590.00 MHz, 12 MHz Dual Channel Spacing Port A



Port B

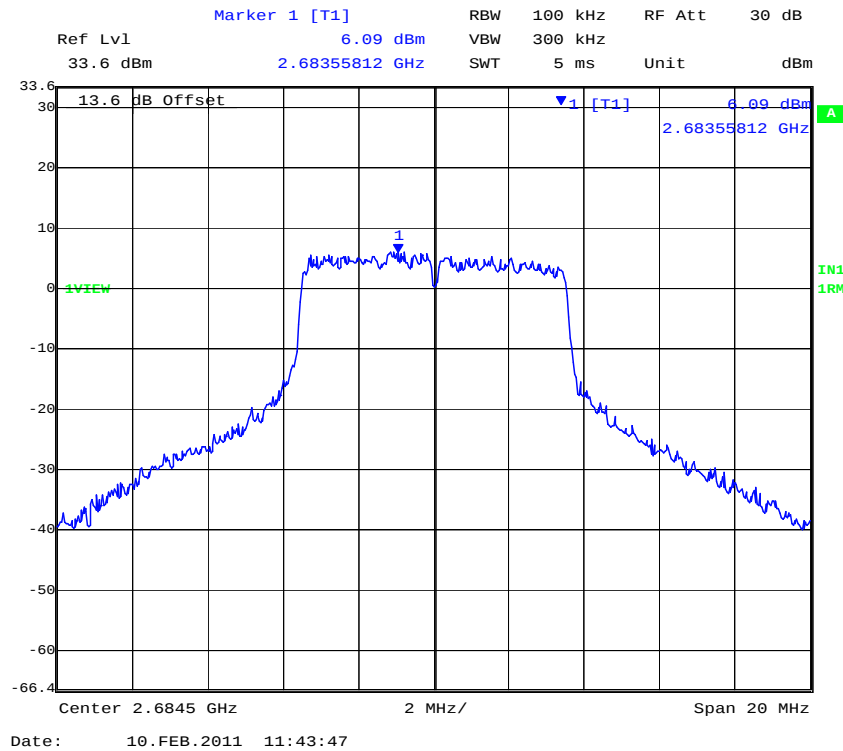


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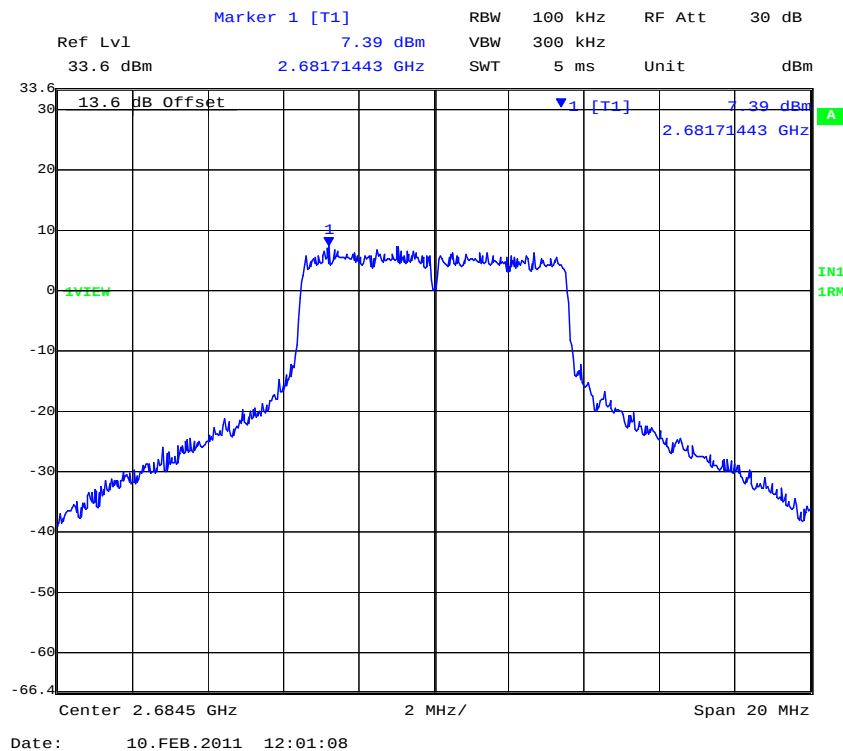


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Power Spectral Density, Channel 2684.50 MHz, 11 MHz Dual Channel Spacing Port A



Port B



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7.3.4 Measurement results for 22 and 24 MHz

TABLE OF RESULTS – 22 and 24 MHz Quad Channel Spacing

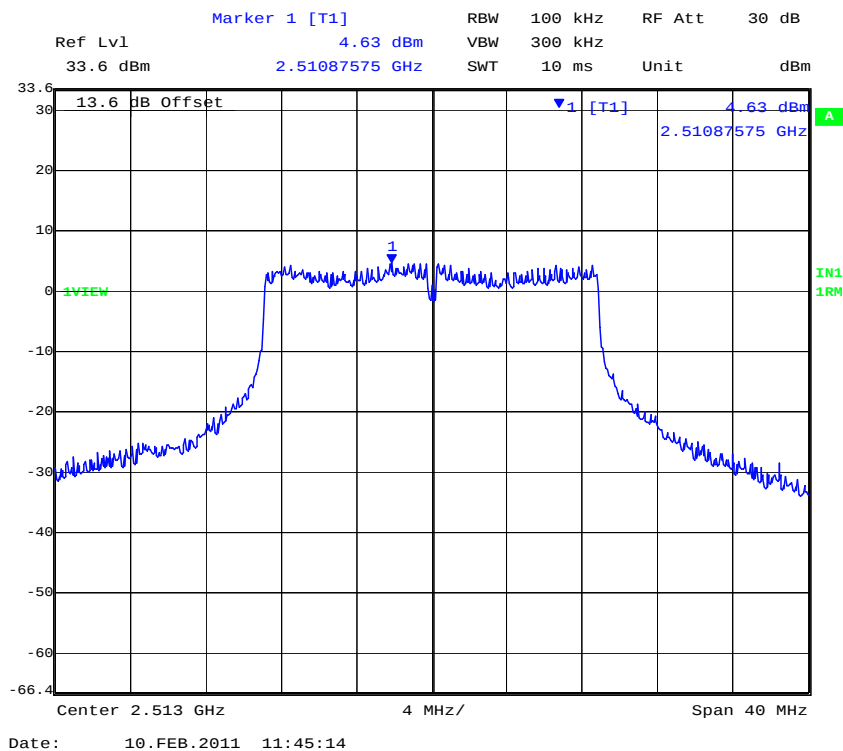
Center Frequency (MHz)	Measured Power Spectral Density/100 kHz (dBm)	
	Port A	Port B
2513.00	+4.63	+4.24
2590.00	+4.41	+4.19
2679.00	+3.60	+4.67

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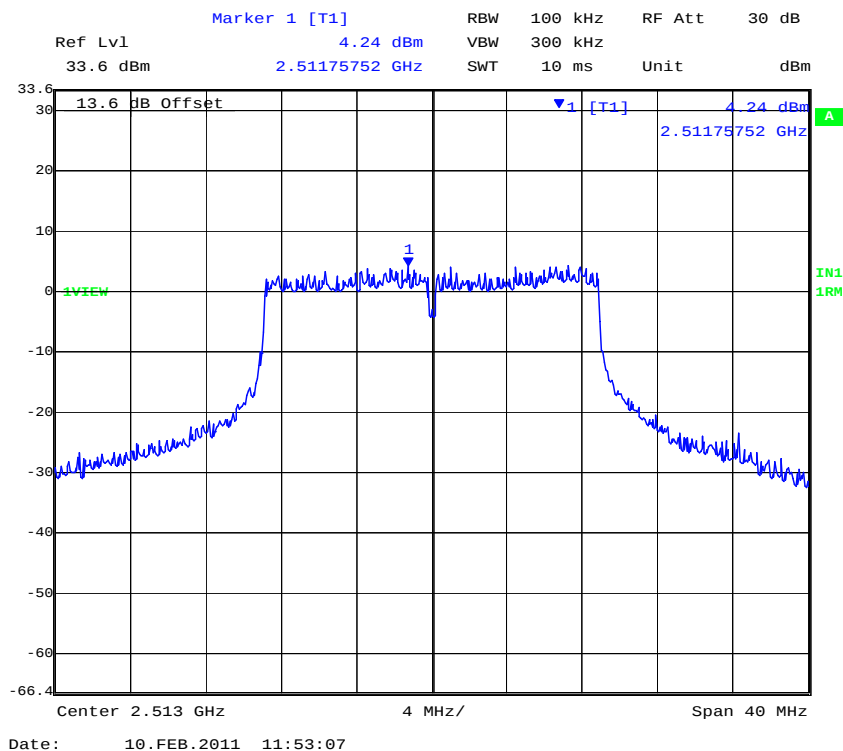


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Power Spectral Density, Channel 2513.00 MHz, 22 MHz Quad Channel Spacing Port A



Port B

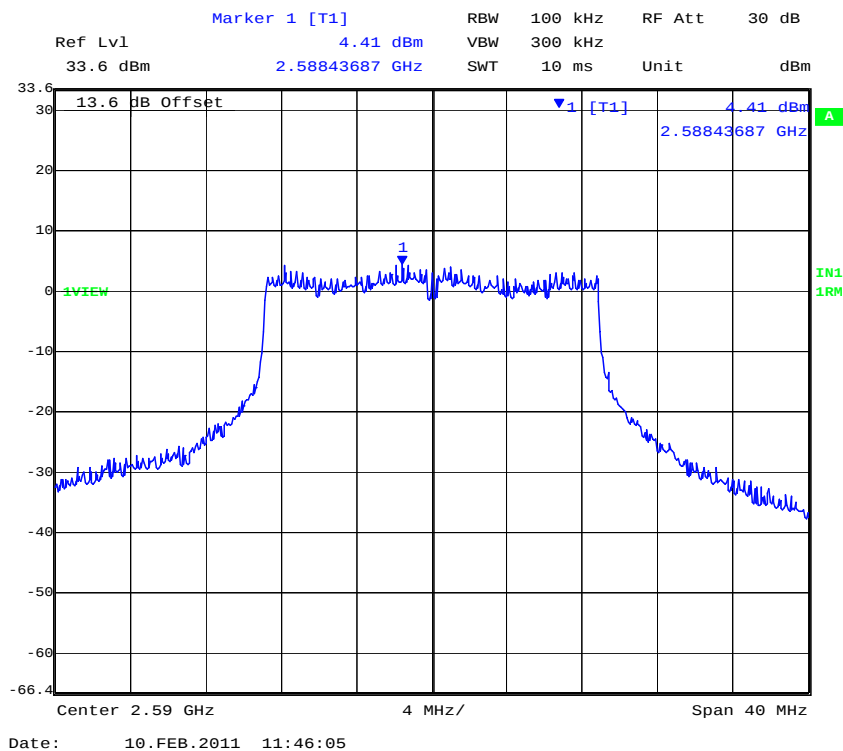


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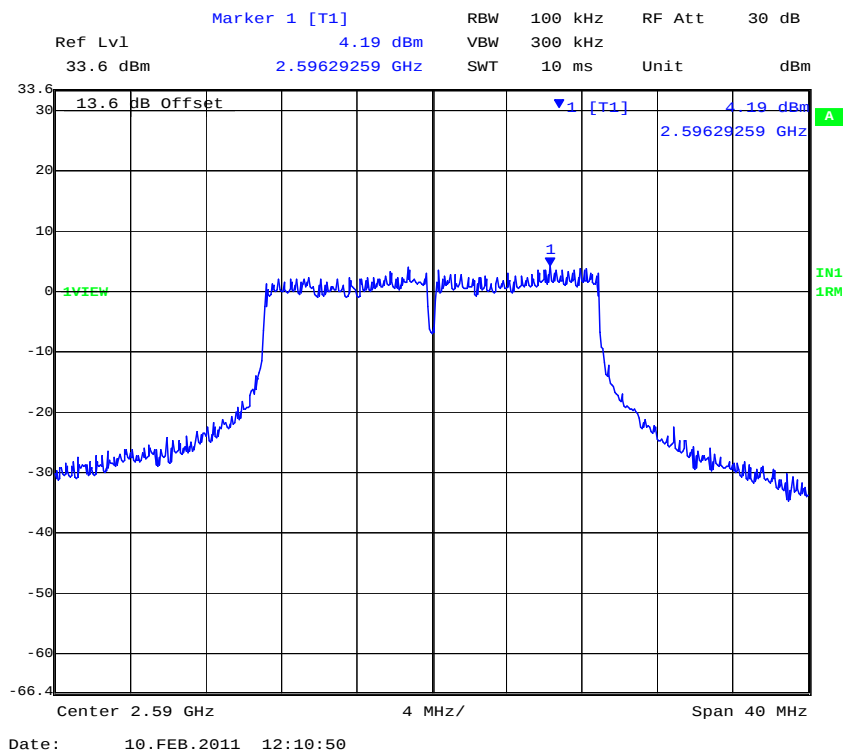


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Power Spectral Density, Channel 2590.00 MHz, 24 MHz Quad Channel Spacing Port A



Port B

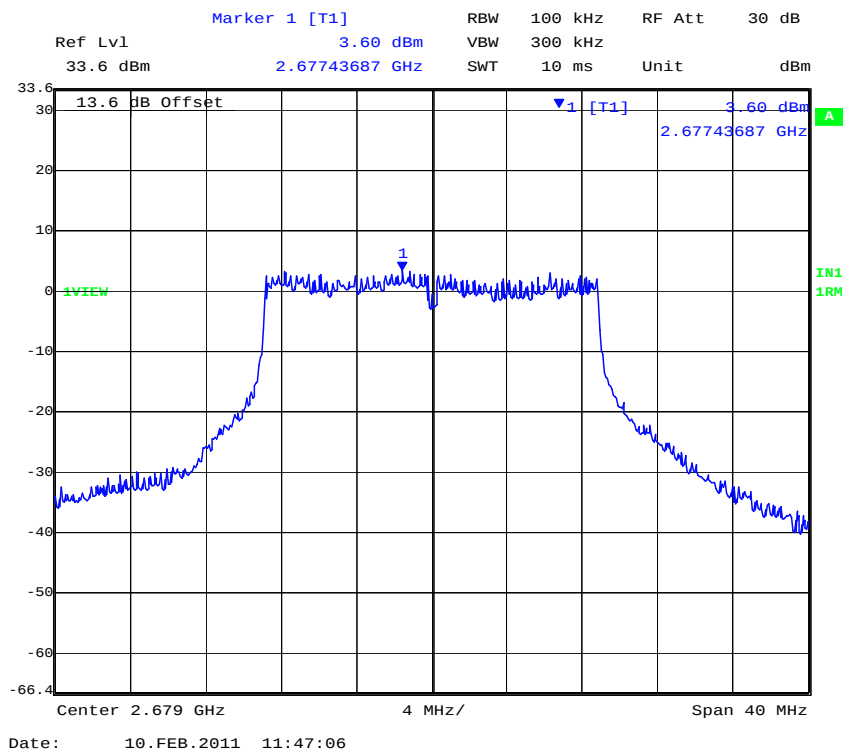


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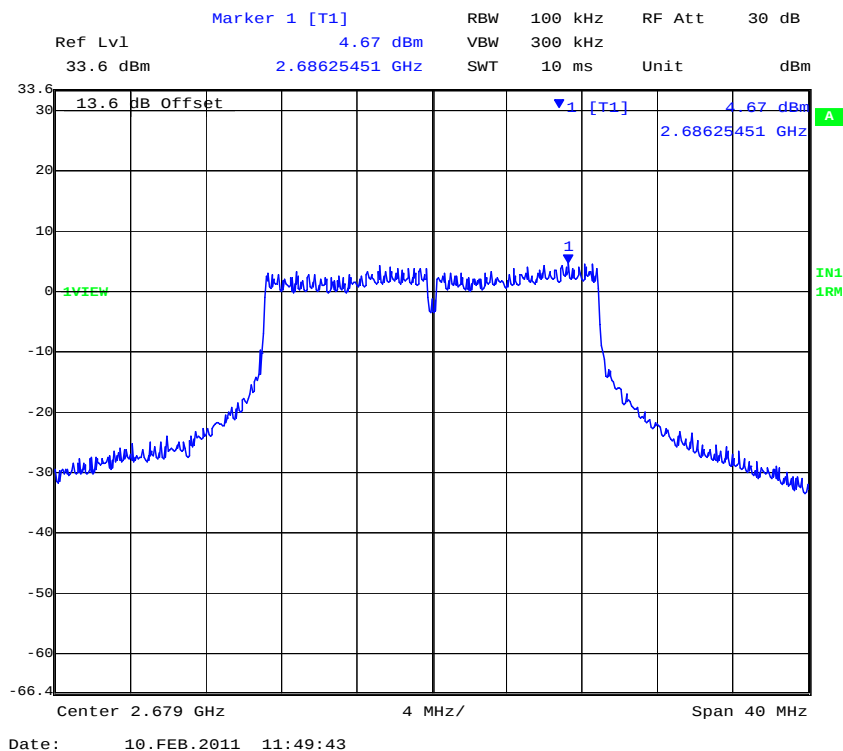


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Power Spectral Density, Channel 2679.00 MHz, 22 MHz Quad Channel Spacing Port A



Port B



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7.4 Frequency Stability

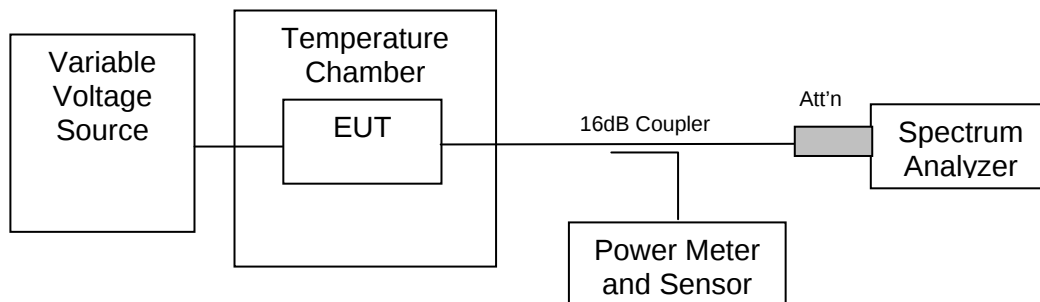
Test Procedure

The Frequency Stability of the device was measured with a spectrum analyzer connected to the antenna terminal, while EUT was operating in transmission mode at the appropriate center frequency.

The low, mid and high channels were measured over extremes of temperature. Frequency stability was further monitored at ambient conditions with a variation of input voltage.

The EUT transmitter output was connected to a spectrum analyzer and frequency monitored over temperature and voltage variations. The EUT was set in an operational mode in which allowed carrier breakthrough to be used to monitor stability.

Test Measurement Set up



Measurement set up for Frequency Stability

Specification Limits

§ 27.54 Frequency Stability.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.



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Measurement Results for Frequency Stability

Ambient conditions.

Temperature: 20.5 °C

Relative humidity: 39 %

Pressure: 1005 mbar

Radio Parameters

Duty Cycle: 100%

Output: Modulated (Carrier Breakthrough)

7.4.1 Measurement results for Extremes of Temperature

Temperature	Channels								
	Low Channel 2499 MHz			Mid Channel 2593 MHz			High Channel 2687.25 MHz		
	Frequency	kHz	ppm	Frequency	kHz	ppm	Frequency	kHz	ppm
-35	2499.00131	1.31	0.524	2593.00160	1.6	0.617	2687.25152	1.52	0.566
-25	2499.00167	1.67	0.668	2593.00178	1.78	0.686	2687.25187	1.87	0.696
-15	2499.00351	3.51	1.405	2593.00264	2.64	1.018	2687.25266	2.66	0.990
-5	2499.00368	3.68	1.473	2593.00384	3.84	1.481	2687.25399	3.99	1.485
5	2499.00427	4.27	1.709	2593.00441	4.41	1.701	2687.25456	4.56	1.697
15	2499.00385	3.85	1.541	2593.00401	4.01	1.546	2687.25416	4.16	1.548
25	2499.00258	2.58	1.032	2593.00265	2.65	1.022	2687.25273	2.73	1.016
35	2499.00215	2.15	0.860	2593.00222	2.22	0.856	2687.25231	2.31	0.860
45	2499.00189	1.89	0.756	2593.00195	1.95	0.752	2687.25206	2.06	0.767
55	2499.00252	2.52	1.008	2593.00263	2.63	1.014	2687.25277	2.77	1.031
60	2499.00345	3.45	1.381	2593.00358	3.58	1.381	2687.25372	3.72	1.384

Maximum Drift from nominal frequency: 1.709 ppm

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7.4.2 Measurement results for Ambient Temperature V's Voltage Variation

		Channels								
Temp	Voltage	Low Channel 2499 MHz			Mid Channel 2593 MHz			High Channel 2687.25MHz		
°C	Vdc	Frequency	kHz	ppm	Frequency	kHz	ppm	Frequency	kHz	ppm
18	48.0	2499.00334	3.34	1.337	2593.00331	3.31	1.277	2687.25318	3.18	1.183
18	43.2	2499.00325	3.25	1.301	2593.00321	3.21	1.238	2687.25321	3.21	1.195
18	53.8	2499.00319	3.19	1.277	2593.00318	3.18	1.226	2687.25326	3.26	1.213

Maximum Drift from nominal frequency: 1.337 ppm



7.5 Maximum Permissible Exposure

Calculations for Maximum Permissible Exposure Levels

Power Density = P_d (mW/cm²) = $EIRP / (4\pi d^2)$

$EIRP = P * G * 2$

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = $10^{(G \text{ (dBi)}/10)}$

The RADWIN 2000 2.5 GHz BAND has two transmitters. The peak power in the table below is calculated by assuming a worst case scenario where the two transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum conducted power measured in each band and multiplying by 2.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm²

Freq. Band (MHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power x 2 (mW)	Calculated Safe Distance @ 1mW/cm ² Limit(cm)	Minimum Separation Distance (cm)
2500	24.0	251.2	+24.38	548.3	104.6	20.00

Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

Specification

Maximum Permissible Exposure Limits

FCC §1.1310 Limit = 1mW / cm² from 1.310 Table 1

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB
-------------------------	----------

7.6 Conducted Spurious Emissions

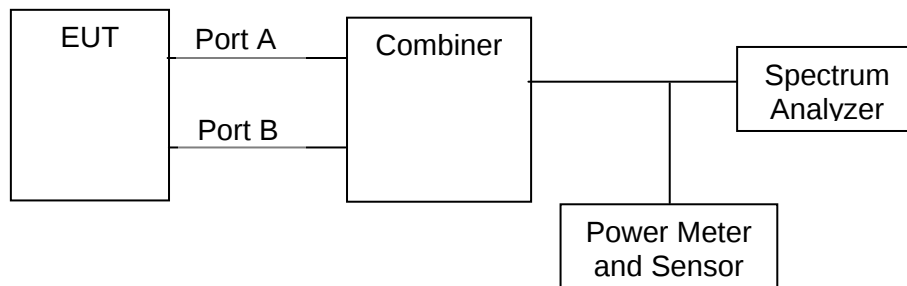
Test Procedure

As detailed in ANSI TIA-603-C 2004 Section 2.2.12 referencing FCC Part 2.1053

Conducted emissions were measured at a limit of -13 dBm from 30 MHz to the 10th harmonic of the carrier frequency. Both antenna ports were combined and emissions were measured via the spectrum analyzer. Emissions at the band edge were measured and recorded in Section 7.1 RF Output Power, Emission Mask, EIRP at the Antenna Terminal.

Measurements were made while EUT was operating in the modulated mode at the appropriate center frequency.

Test Configuration



Measurement setup for Conducted Spurious Emission

Specification Limits

§ 27.53 (m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(2) For digital base stations, the attenuation shall be not less than $43 + 10 \log (P)$ dB = -13 dBm

Traceability

Method	Test Equipment Used
WI-05	0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363.



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7.6.1 Measurement results for 5.5 MHz

TABLE OF RESULTS – 5.5 MHz Channel Spacing

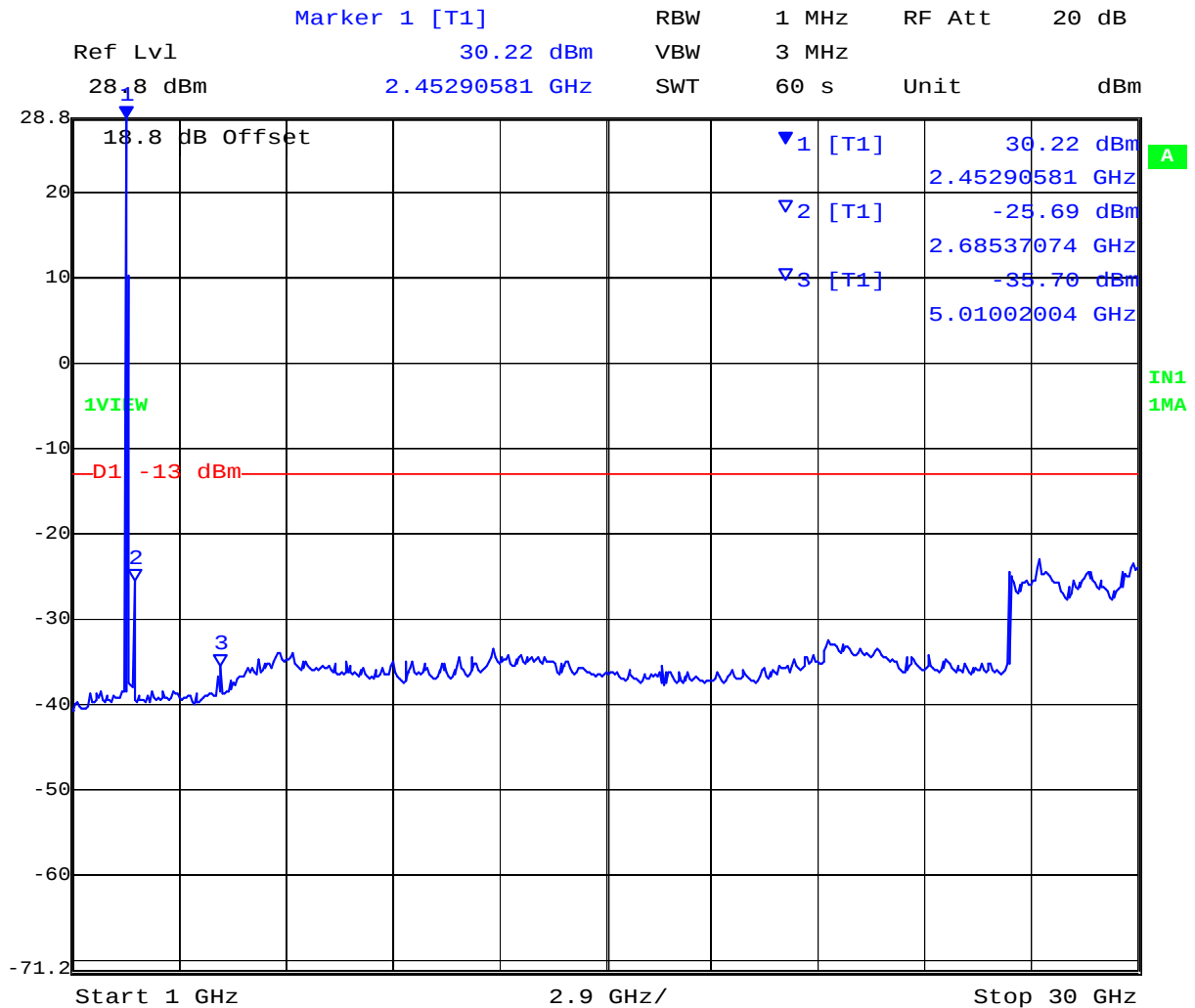
Channel Centre Frequency (GHz)	Start Frequency (GHz)	Stop Frequency (GHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2504.75	1	30	-25.69	-13.00	-12.69
2687.25			-29.58		-16.58

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Conducted Spurious Emissions, Channel 2504.75 MHz, 5.5 MHz Channel Spacing



Date: 9.FEB.2011 12:37:16

The emission breaking the limit line is the fundamental emission

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Conducted Spurious Emissions, Channel 2687.25 MHz, 5.5 MHz Channel Spacing



Date: 9.FEB.2011 12:40:31

The emission breaking the limit line is the fundamental emission

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7.6.2 Measurement results for 6.0 MHz

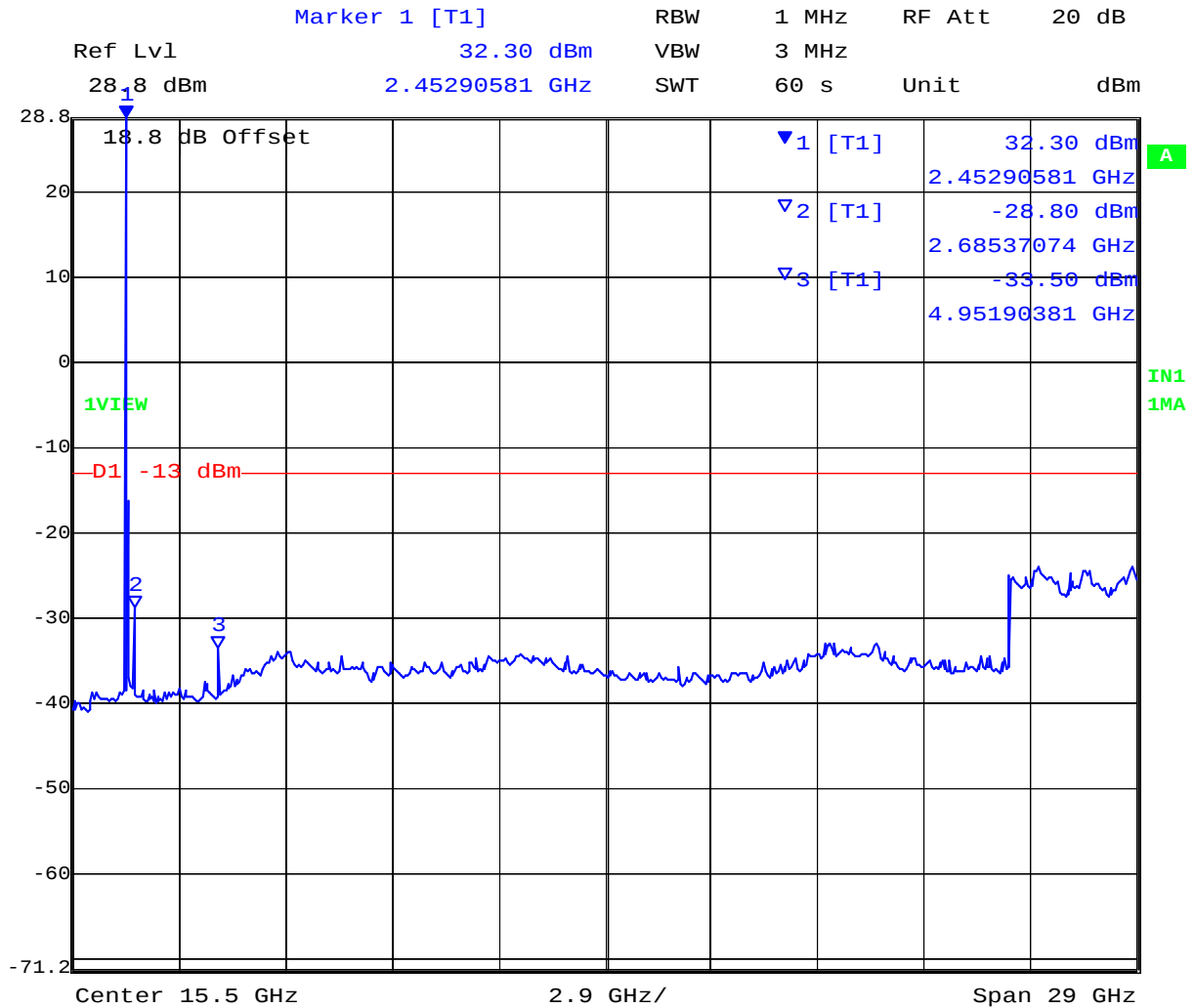
TABLE OF RESULTS – 6.0 MHz Channel Spacing

Channel Centre Frequency (GHz)	Start Frequency (GHz)	Stop Frequency (GHz)	Maximum Emission Observed (dBm/MHz)	Limit (dBm)	Margin (dB)
2499.00	1	30	-28.80	-13.00	-15.80
2593.00			-24.52		-11.52

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Conducted Spurious Emissions,
Channel 2499.00 MHz, 6.0 MHz Channel Spacing



Date: 9.FEB.2011 12:47:24

The emission breaking the limit line is the fundamental emission



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Conducted Spurious Emissions, Channel 2593.00 MHz, 6.0 MHz Channel Spacing



Date: 9.FEB.2011 12:50:44

The emission breaking the limit line is the fundamental emission

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7.6.3 Measurement results for 11 and 12 MHz

TABLE OF RESULTS – 11 and 12 MHz Dual Channel Spacing

Channel Centre Frequency (GHz)	Start Frequency (GHz)	Stop Frequency (GHz)	Maximum Emission Observed (dBm/MHz)	Limit (dBm)	Margin (dB)
2507.50	1	30	-23.64	-13.00	-10.64
2590.00			-23.64		-10.64
2684.50			-23.22		-10.22

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Conducted Spurious Emissions, Channel 2507.50 MHz, 11 MHz Dual Channel Spacing



Date: 9.FEB.2011 12:53:59

The emission breaking the limit line is the fundamental emission



Conducted Spurious Emissions,
Channel 2590.00 MHz, 12 MHz Dual Channel Spacing

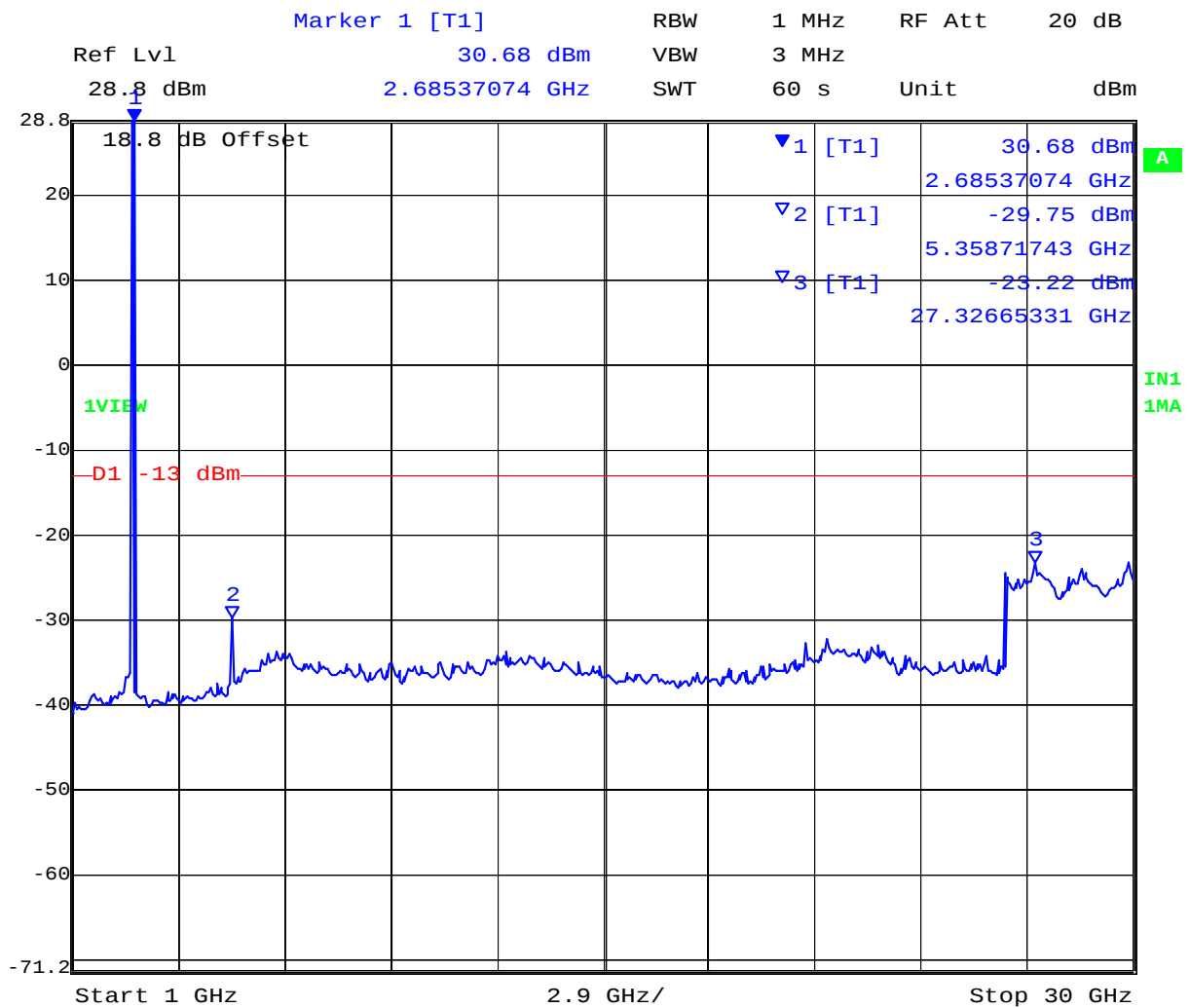


Date: 9.FEB.2011 12:58:36

The emission breaking the limit line is the fundamental emission



Conducted Spurious Emissions,
Channel 2684.50 MHz, 11 MHz Dual Channel Spacing



Date: 9.FEB.2011 13:00:53

The emission breaking the limit line is the fundamental emission



7.6.4 Measurement results for 22 and 24 MHz

TABLE OF RESULTS – 22 and 24 MHz Quad Channel Spacing

Channel Centre Frequency (GHz)	Start Frequency (GHz)	Stop Frequency (GHz)	Maximum Emission Observed (dBm/MHz)	Limit (dBm)	Margin (dB)
2513.00	1	30	-22.88	-13.00	-9.88
2590.00			-23.94		-10.94
2679.00			-23.04		-10.04



Conducted Spurious Emissions,
Channel 2513.00 MHz, 22 MHz Quad Channel Spacing



Date: 9.FEB.2011 13:03:47

The emission breaking the limit line is the fundamental emission



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Conducted Spurious Emissions, Channel 2590.00 MHz, 24 MHz Quad Channel Spacing



Date: 9.FEB.2011 13:06:47

The emission breaking the limit line is the fundamental emission

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Conducted Spurious Emissions,
Channel 2670.00 MHz, 22 MHz Quad Channel Spacing



Date: 9.FEB.2011 13:10:16

The emission breaking the limit line is the fundamental emission



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7.7 Radiated Spurious Emissions

Test Procedure

Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

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Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

$$CORR = \text{Correction Factor} = CL - AG + NFL$$

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss

Field Strength Calculation Example:

Given receiver input reading of 51.5 dB μ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log (level (\mu V/m))}$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement Uncertainty	+5.6/ -4.5 dB
--------------------------------	---------------

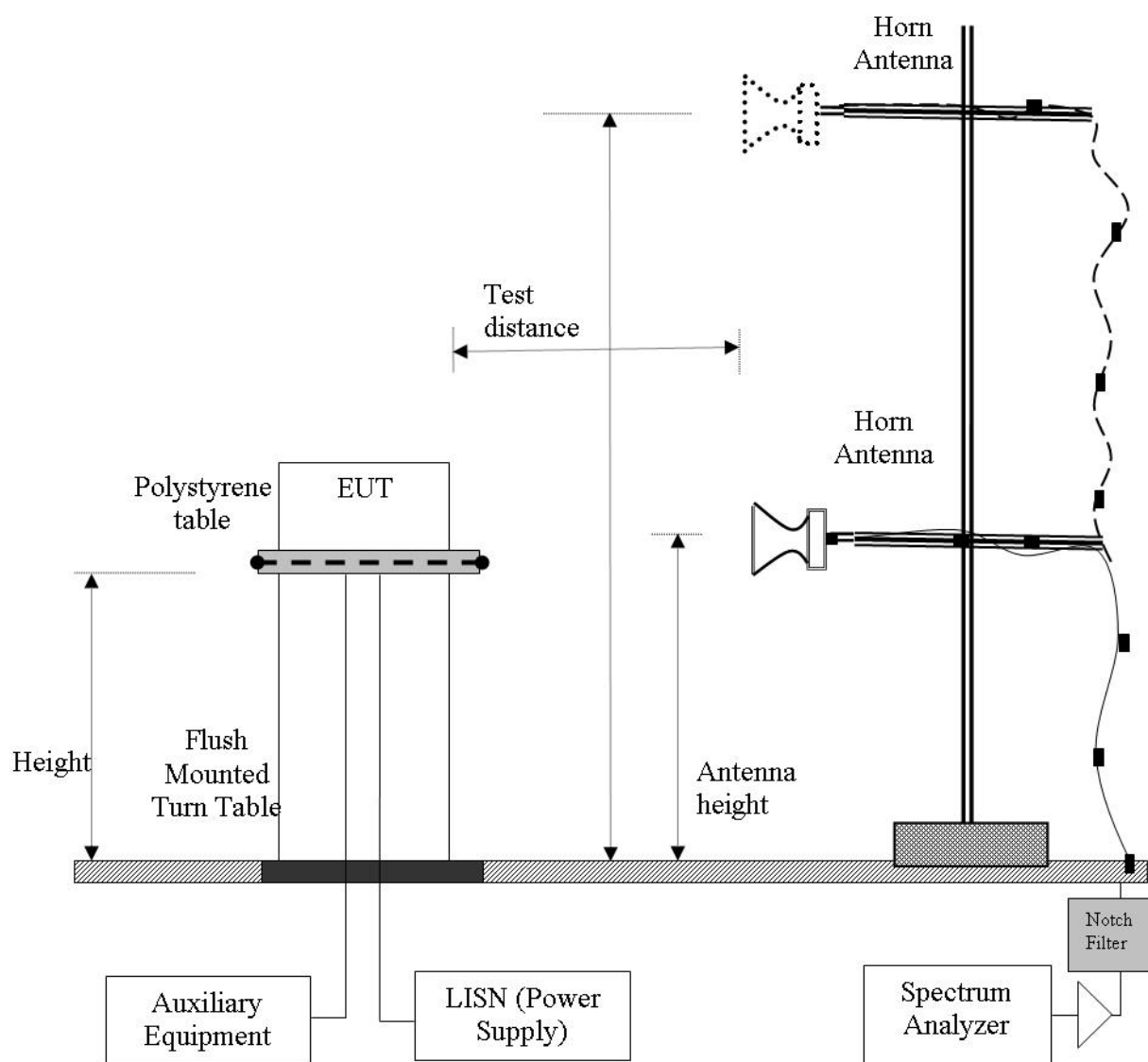
Traceability:

Method	Test Equipment Used
Work instruction WI-03	0287, 0193, 0342, 0158, 0303, 0304, 0134, 0310, 0312

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7.7.1 Transmitter Radiated Spurious Emission above 1 GHz

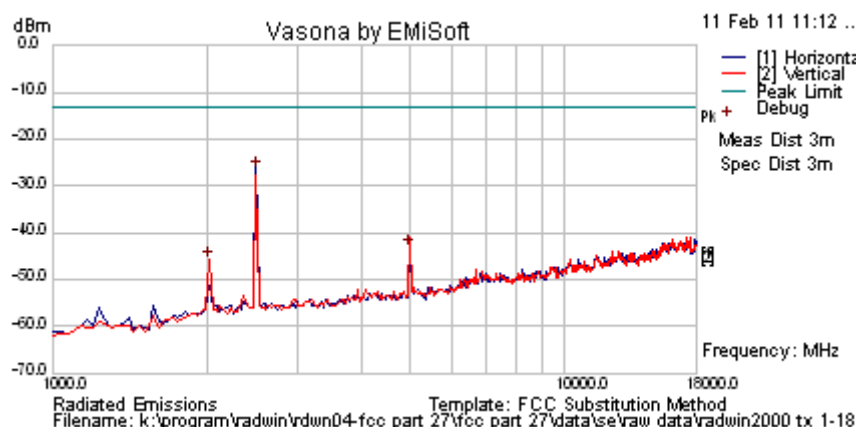
Radiated Emission Measurement Setup – Above 1 GHz





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Test Freq.	2504.75 MHz	Engineer	EVF
Variant	5.5 MHz Channel Spacing, Modulation 64 QAM	Temp (°C)	19
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	30
Power Setting	max	Press. (mBars)	1011
Antenna	3 feet long N-type cable with 50Ohm termination x2	Duty Cycle (%)	100
Test Notes 1	Model: RADWIN2000 2.5GHz BAND; transmitting at 2504.75MHz (Channel Spacing 5.5MHz)		
Test Notes 2	POE power supply (model: ET0061040) was placed on the table and connected to UUT through shielded ethernet cable; second ethernet cable was connected to PC in order to make the unit operational; UUT was placed 1.5 m above the ground reference plane.		



Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
2023.388	-50.9	2.8	2.0	-46.1	Peak [Scan]	V	152	360	-13	-33.1	Pass	
4979.965	-51.9	4.6	3.8	-43.5	Peak [Scan]	V	152	360	-13	-30.5	Pass	HAR
2496.102	-31.3	3.0	1.9	-26.5	Peak [Scan]	H						FUND
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; HAR = Harmonics RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

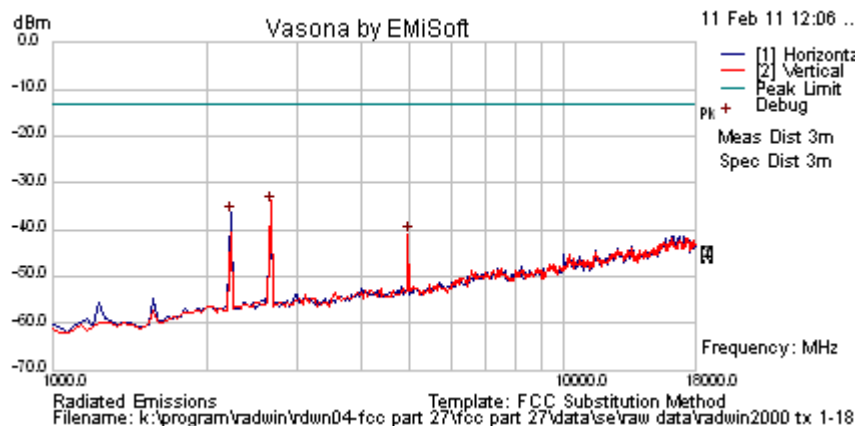
The emission closest to the limit is the fundamental

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Test Freq.	2687.25 MHz	Engineer	EVF
Variant	5.5 MHz Channel Spacing, Modulation 64 QAM	Temp (°C)	19
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	30
Power Setting	max	Press. (mBars)	1011
Antenna	3' long N-type cable with 50Ohm termination x2	Duty Cycle (%)	100
Test Notes 1	Model: RADWIN2000 2.5GHz BAND; transmitting at 2687.25MHz (Channel Spacing 5.5MHz)		
Test Notes 2	POE power supply (model: ET0061040) was placed on the table and connected to UUT through shielded ethernet cable; second ethernet cable was connected to PC in order to make the unit operational; UUT was placed 1.5 m above the ground reference plane.		



Formally measured emission peaks

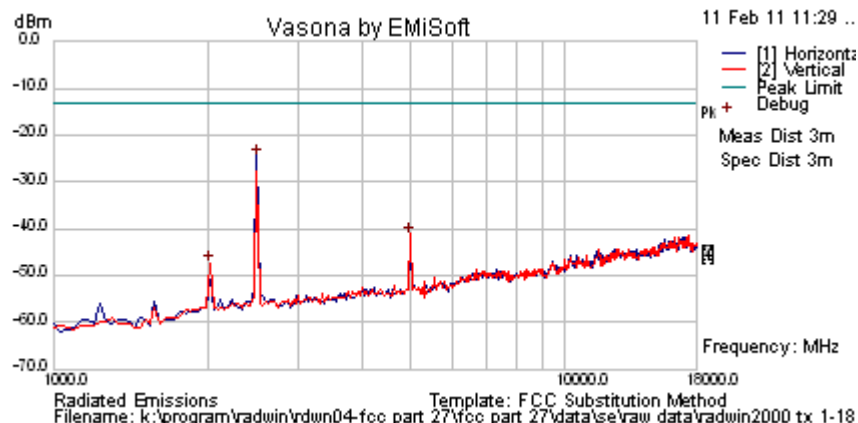
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
2225.386	-41.4	2.9	1.6	-36.9	Peak [Scan]	H	152	360	-13	-23.9	Pass	
4950.389	-50.0	4.6	3.8	-41.6	Peak [Scan]	V	152	360	-13	-28.6	Pass	HAR
2671.514	-40.4	3.1	1.9	-35.4	Peak [Scan]	V						FUND
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; HAR = Harmonics												
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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Test Freq.	2499 MHz	Engineer	EVF
Variant	6 MHz Channel Spacing; Modulation 64 QAM	Temp (°C)	18.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum. (%)	31
Power Setting	max	Press. (mBars)	1011
Antenna	3 feet long N-type cable with 50Ohm termination x2	Duty Cycle (%)	100
Test Notes 1	Model: RADWIN2000 2.5GHz BAND; transmitting at 2499 MHz (Channel Spacing 6MHz)		
Test Notes 2	POE power supply (model: ET0061040) was placed on the table and connected to UUT through shielded ethernet cable; second ethernet cable was connected to PC in order to make the unit operational; UUT was placed 1.5 m above the ground reference plane.		



Formally measured emission peaks

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
2022.623	-52.6	2.8	2.0	-47.8	Peak [Scan]	V	152	360	-13	-34.8	Pass	
4980.065	-49.9	4.6	3.8	-41.5	Peak [Scan]	V	152	360	-13	-28.5	Pass	HAR
2496.866	-29.8	3.0	1.9	-24.9	Peak [Scan]	H						FUND
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; HAR = Harmonics												
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

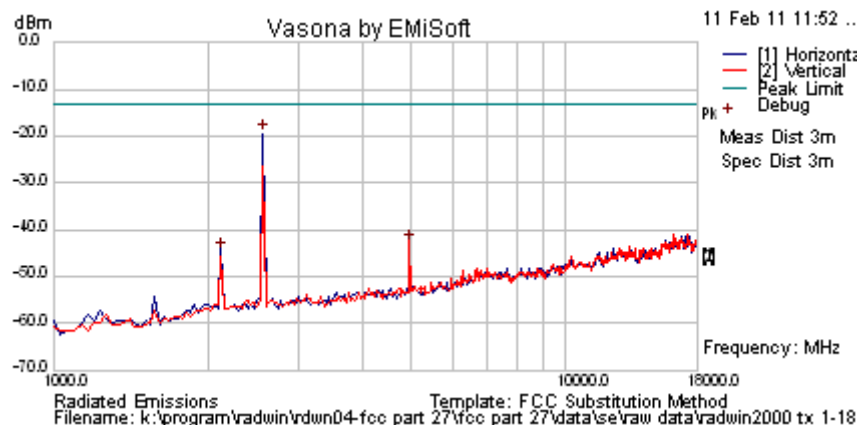
The emission closest to the limit is the fundamental

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Test Freq.	2593 MHz	Engineer	EVF
Variant	6 MHz Channel Spacing; Modulation 64 QAM	Temp (°C)	18.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum. (%)	31
Power Setting	max	Press. (mBars)	1011
Antenna	3 feet long N-type cable with 50Ohm termination x2	Duty Cycle (%)	100
Test Notes 1	Model: RADWIN2000 2.5GHz BAND; transmitting at 2593 MHz (Channel Spacing 6MHz)		
Test Notes 2	POE power supply (model: ET0061040) was placed on the table and connected to UUT through shielded ethernet cable; second ethernet cable was connected to PC in order to make the unit operational; UUT was placed 1.5 m above the ground reference plane.		



Formally measured emission peaks

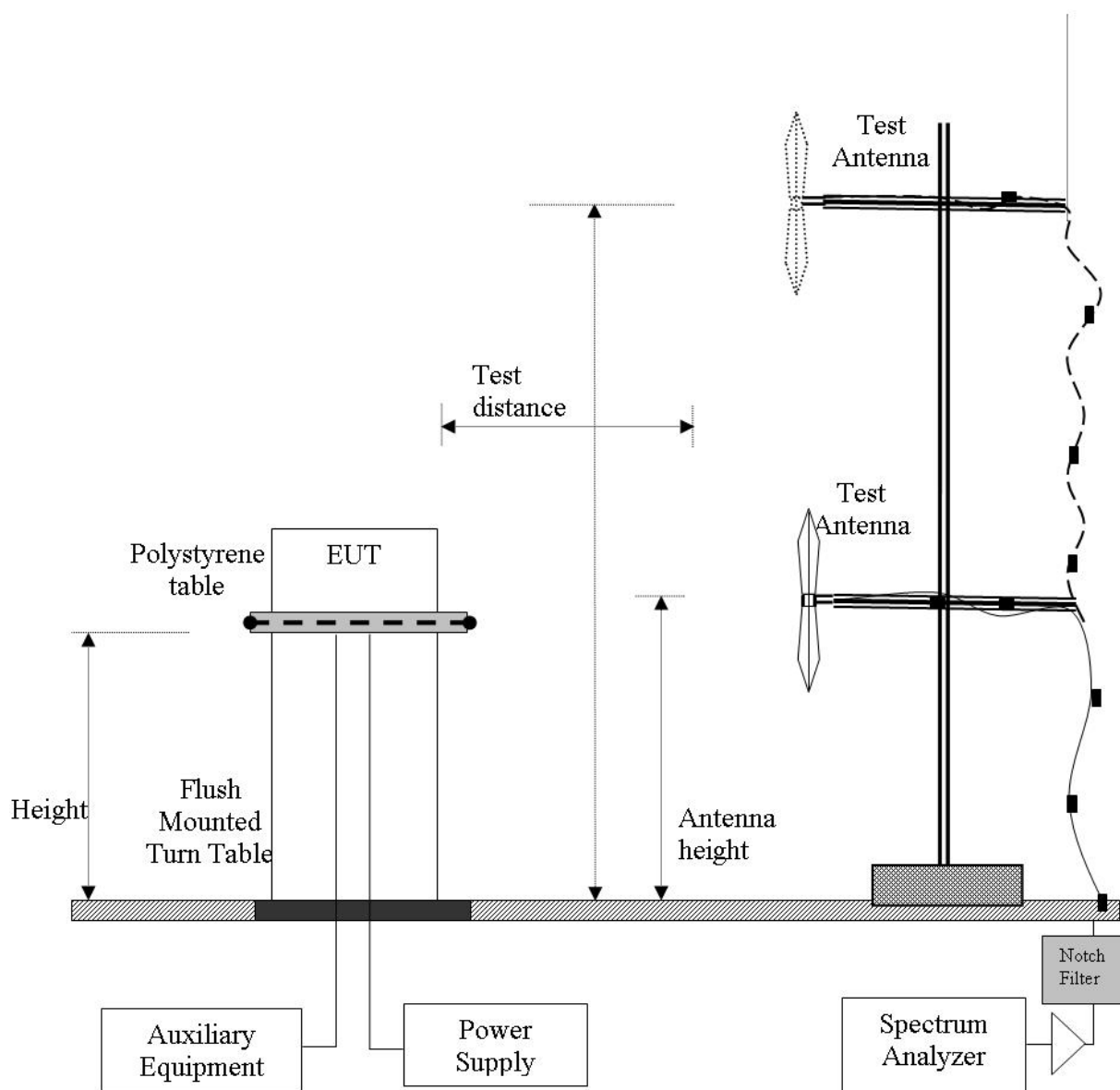
Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass /Fail	Comments
2567.13427	-24.4	3.1	1.9	-19.5	Peak [Scan]	H						FUND
2125.235	-49.0	2.8	1.7	-44.5	Peak [Scan]	H	152	360	-13	-31.5	Pass	
4960.152	-51.2	4.6	3.9	-42.7	Peak [Scan]	V	152	360	-13	-29.7	Pass	HAR
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; HAR = Harmonics												
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

The emission closest to the limit is the fundamental

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7.7.2 Radiated Spurious Emission Results below 1 GHz

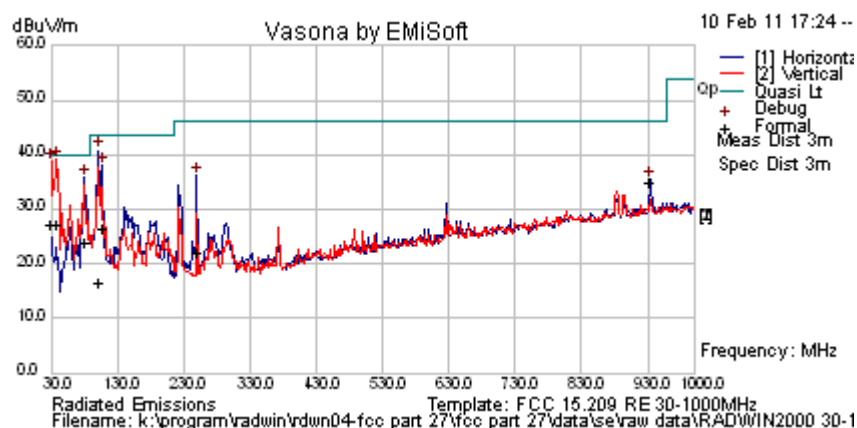
Radiated Emission Measurement Setup – Below 1 GHz





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Test Freq.	Tx 2.499GHz	Engineer	EVF
Variant	Digital Emissions	Temp (°C)	18.5
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	33
Power Setting	maximum (ART power setting 22.5)	Press. (mBars)	1008
Antenna	3 feet long N-type cable with 50Ohm termination x2		
Test Notes 1	Model: RADWIN2000 2.5GHz BAND transmitting at 2.499GHz (Channel Spacing 6MHz)		
Test Notes 2	POE power supply (model: ET0061040) was placed on the table and connected to UUT through shielded ethernet cable; second ethernet cable was connected to PC in order to make the unit operational; PC was placed underneath ground ref. plane in the chamber.		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
38.180	39.3	3.5	-15.6	27.2	Quasi Max	V	98	157	40	-12.8	Pass	
30.321	33.2	3.4	-9.5	27.1	Quasi Max	V	191	255	40	-12.9	Pass	
101.896	32.7	4.2	-20.5	16.4	Quasi Max	H	319	334	43.5	-27.1	Pass	
81.213	43.4	4.0	-23.5	23.8	Quasi Max	H	325	335	40	-16.2	Pass	
107.311	41.2	4.2	-18.9	26.5	Quasi Max	H	165	102	43.5	-17.0	Pass	
249.996	36.0	5.0	-18.8	22.2	Quasi Max	H	110	39	46	-23.8	Pass	
933.312	34.3	7.5	-7.0	34.8	Quasi Max	H	151	212	46	-11.2	Pass	

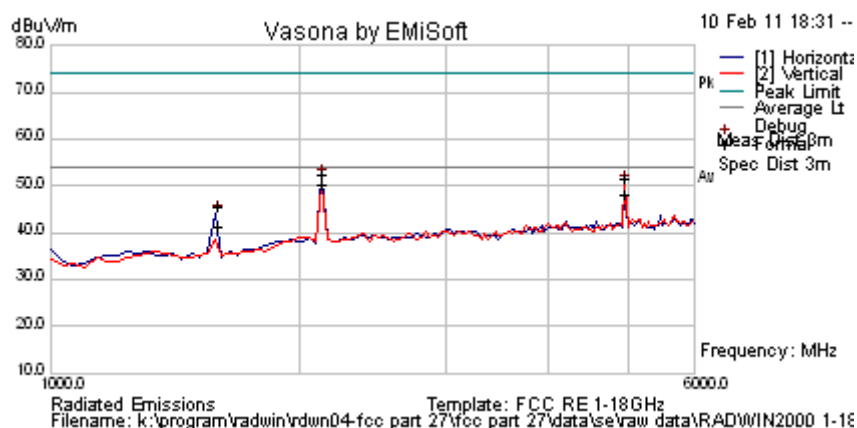
Legend: DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
 NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

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Test Freq.	Rx 2593 MHz	Engineer	EVF
Variant	Digital Emissions	Temp (°C)	18.5
Freq. Range	1000 MHz - 6000 MHz	Rel. Hum.(%)	33
Power Setting	N/A	Press. (mBars)	1000
Antenna	3 feet long N-type cable with 50Ohm termination x2		
Test Notes 1	Model: RADWIN2000 2.5GHz BAND		
Test Notes 2	POE power supply (model: ET0061040) was placed on the table and connected to UUT through shielded ethernet cable; second ethernet cable was connected to PC in order to make the unit operational; PC was placed underneath ground ref. plane in the chamber.		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2133.046	61.2	2.8	-11.5	52.6	Peak Max	H	100	284	74.0	-21.4	Pass	
4960.060	56.2	4.6	-9.1	51.8	Peak Max	V	100	115	74.0	-22.2	Pass	
1600.080	57.4	2.5	-14.3	45.6	Peak Max	H	193	267	74.0	-28.4	Pass	
2133.046	59.2	2.8	-11.5	50.5	Average Max	H	100	284	54.0	-3.5	Pass	
4960.060	52.8	4.6	-9.1	48.4	Average Max	V	100	115	54.0	-5.6	Pass	
1600.080	53.0	2.5	-14.3	41.2	Average Max	H	193	267	54.0	-12.8	Pass	
Legend: DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency												
NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band												

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Specification for FCC Part 15 Radiated Spurious Emissions

FCC §15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

Table 1: FCC 15.209 Spurious Emissions Limits

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Field Strength (dB $\mu\text{V/m}$)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

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7.8 Conducted Disturbance at Mains Terminal (150 kHz – 30 MHz)

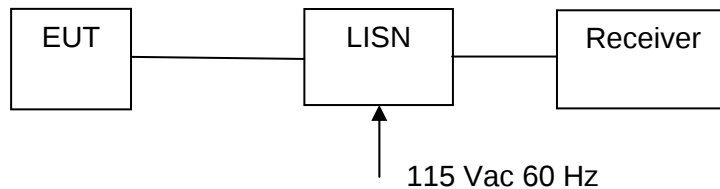
Test Procedure

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

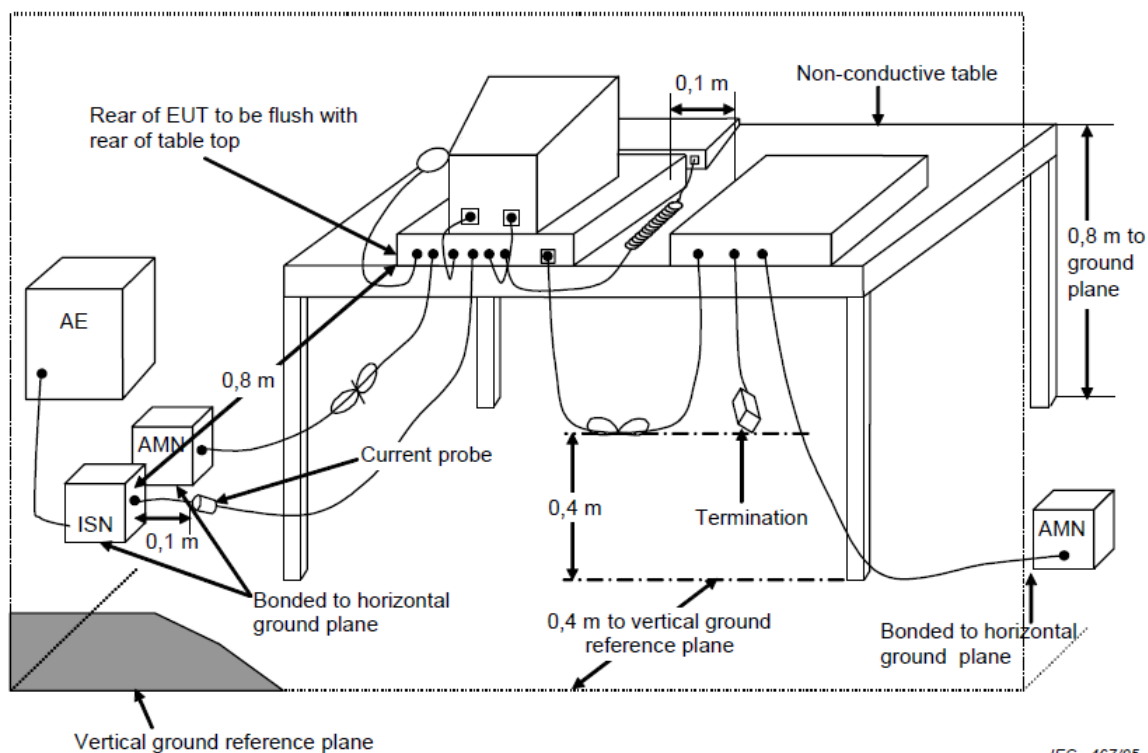
If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Test Measurement Setup



Measurement setup for Conducted Disturbance at Mains Terminals



Specification for Conducted Disturbance at Mains Terminal – Digital Apparatus

FCC §15.207 (a)

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 $\mu\Omega$ line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

Limits

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	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

Traceability

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	± 2.64 dB
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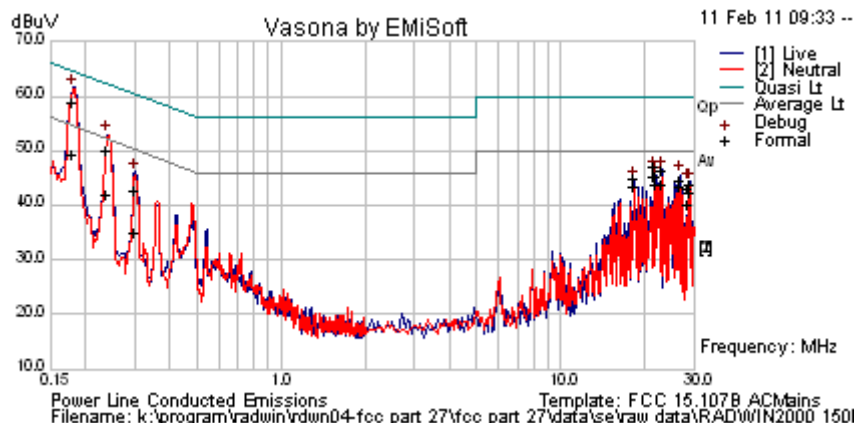
Traceability

Method	Test Equipment Used
Work instruction WI-EMC-01	0158, 0184, 0193, 0190, 0293, 0307



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Test Freq.	N/A	Engineer	EVF
Variant	AC Line Emissions	Temp (°C)	18
Freq. Range	0.150 MHz - 30 MHz	Rel. Hum.(%)	31
Power Setting	120VAC/ 60Hz	Press. (mBars)	1010
Antenna	3 feet long N-type cable with 50Ohm termination x2		
Test Notes 1	Model: RADWIN2000 2.5GHz BAND transmitting at 2.499GHz (Channel Spacing 6MHz)		
Test Notes 2	POE power supply (model: ET0061040) was placed on the table and connected to UUT through shielded ethernet cable; second ethernet cable was connected to PC in order to make the unit operational; PC was placed underneath ground ref. plane in the chamber.		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.179	49.0	9.9	0.1	59.0	Quasi Peak	Live	64.53	-5.6	Pass	
0.239	40.1	9.9	0.1	50.1	Quasi Peak	Live	62.13	-12.0	Pass	
23.129	35.0	10.6	0.9	46.5	Quasi Peak	Live	60	-13.5	Pass	
21.663	35.7	10.6	0.8	47.0	Quasi Peak	Live	60	-13.0	Pass	
0.299	32.9	9.9	0.1	42.9	Quasi Peak	Live	60.27	-17.4	Pass	
26.609	32.8	10.7	0.9	44.4	Quasi Peak	Live	60	-15.6	Pass	
0.179	39.3	9.9	0.1	49.3	Average	Live	54.53	-5.2	Pass	
0.239	31.9	9.9	0.1	41.8	Average	Live	52.13	-10.3	Pass	
23.129	32.3	10.6	0.9	43.8	Average	Live	50	-6.2	Pass	
21.663	34.1	10.6	0.8	45.4	Average	Live	50	-4.6	Pass	
0.299	24.9	9.9	0.1	34.9	Average	Live	50.27	-15.4	Pass	
26.609	31.9	10.7	0.9	43.5	Average	Live	50	-6.5	Pass	
Legend: DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency										
NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band										

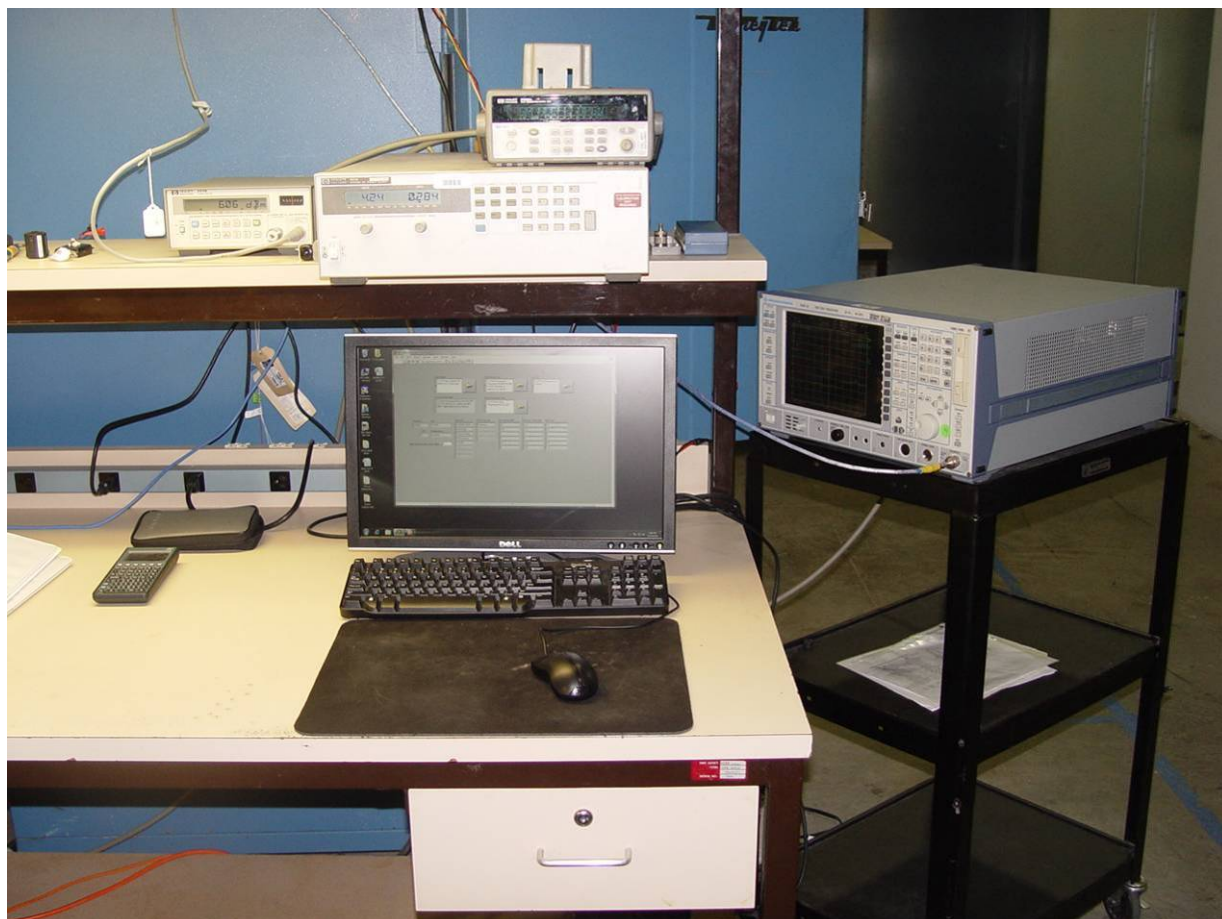
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8 Photographs

8.1 Conducted RF Emissions - EUT

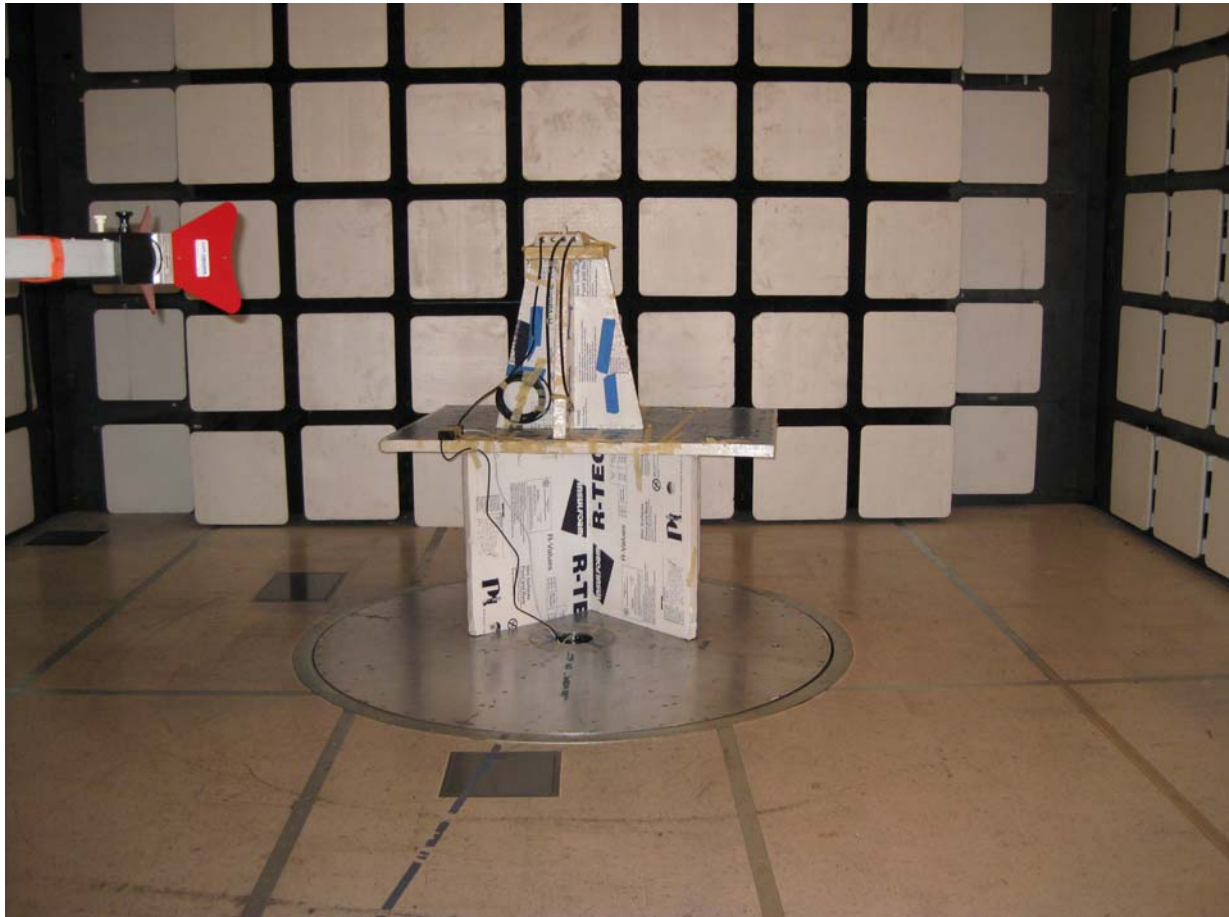


8.2 Conducted RF Emissions - Test Equipment

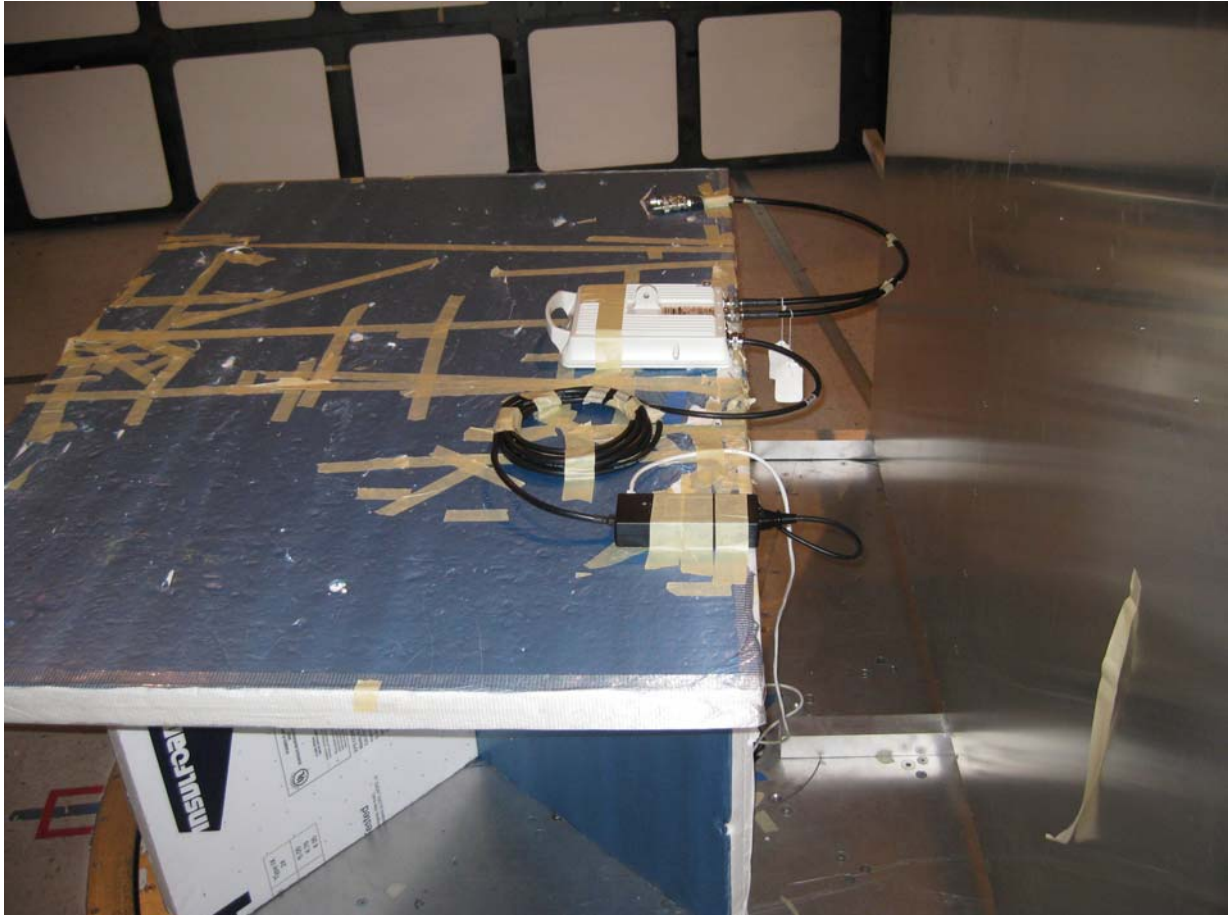


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8.3 Transmitter Radiated Spurious Emission above 1 GHz



8.4 AC Mains Conducted Emissions





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9 TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
0193	EMI Receiver	Rhode & Schwartz	ESIB 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0- 0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1- 1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907
0342	2.4 GHz Notch Filter	EWT	EWT-14-0203	H1

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440 Boulder Court, Suite 200
Pleasanton, CA 94566, USA
Tel: 1.925.462.0304
Fax: 1.925.462.0306
www.micomlabs.com