

Test of 651-XX 802.11a/b/g/n Wireless Controller

To: FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ARUB28-A2 Rev A





Test of 651-XX 802.11a/b/g/n Wireless Controller

to

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ARUB28-A2 Rev A

Note: this report contains data with regard to the 2400 to 2483.5 MHz and 5725 to 5850 MHz operational modes of the Aruba Networks 651-XX Wireless Controller. 5,150 to 5,250 MHz test data is reported in MiCOM Labs test report ARUB28-A4.

This report supersedes: NONE

Applicant: Aruba Networks, Inc
1344 Crossman Avenue
Sunnyvale
California 94089, USA

Product Function: Wireless Controller

Copy No: pdf **Issue Date:** 15th May 2009

This Test Report is Issued Under the Authority of:

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CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



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ACCREDITATION, LISTINGS & RECOGNITION

ACCREDITATION

MiCOM Labs, Inc. an accredited laboratory complies with 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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LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America

Federal Communications Commission (FCC) Listing #: 102167

Canada

Industry Canada (IC) Listing #: 4143A

Japan Registration

VCCI Membership Number: 2959

- Radiation 3 meter site; Registration No. R-2881
- Line Conducted, Registration Nos. C-3181 & T-1470
- Emissions; Registration Nos. C-3180 & T-1469

RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	I	

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DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	15 th May 2009	Initial Release

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1. TEST RESULT CERTIFICATE

Manufacturer:	Aruba Networks, Inc 1344 Crossman Avenue Sunnyvale California 94089, USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wireless Controller	Telephone:	+1 925 462 0304
Model:	651-XX	Fax:	+1 925 462 0306
S/N's:	AF0000495 (Conducted Testing) AF0000185 (Radiated Testing)		
Test Date(s):	17th to 20th Feb 2009	Website:	www.micomlabs.com


STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247 & IC RSS-210	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 is capable of demonstrating compliance with the requirements as documented within this report.

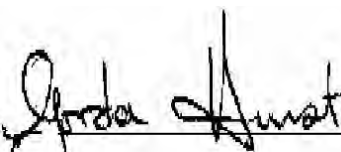
Notes:

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:



Graeme Grieve
Quality Manager MiCOM Labs,



Gordon Hurst
President & CEO MiCOM Labs, Inc.



CERTIFICATE #2381.01

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2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.247	2007	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 7 June 2007	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	Industry Canada RSS-Gen	Issue 2 June 2007	General Requirements and Information for the Certification of Radiocommunication Equipment.
(iv)	ANSI C63.4	2003	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
(v)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(viii)	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
(ix)	A2LA	14 th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

2.2. 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.



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3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the 651-XX 802.11a/b/g/n Wireless Controller to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	As Manufacturer
Manufacturer:	Aruba Networks, Inc 1344 Crossman Avenue Sunnyvale California 94089, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ARUB28-A2 Rev A
Date EUT received:	17 TH February 2009
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	17th to 20th Feb 2009
No of Units Tested:	Two (separate units for conducted and radiated)
Type of Equipment:	802.11a/b/g/n Wireless Controller, 3x3 Spatial Multiplexing MIMO configuration
Manufacturers Trade Name:	Wireless Controller
Model(s):	651-XX
Location for use:	Indoor
Declared Frequency Range(s):	2400 - 2483.5 MHz; 5725 - 5850 MHz
Software Release	3.4.0.0
Type of Modulation:	Per 802.11 –CCK, BPSK, QPSK, DSSS, OFDM
Declared Nominal Average Output Power:	802.11b: +19 dBm 802.11g:Leg. +19dBm,HT-20 +19 dBm,HT-40 +18 dBm 802.11a:Leg. +19dBm,HT-20 +19 dBm,HT-40 +18 dBm
EUT Modes of Operation:	Legacy 802.11a/b/g, 802.11n HT-20, HT-40
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	100-240VAC, 50-60Hz, 2.5A max.
Operating Temperature Range:	Declared range 0 to +40°C
ITU Emission Designator:	2412 – 2462 MHz 802.11b 15M4G1D 2412 – 2462 MHz 802.11g Leg 16M6D1D 2412 – 2462 MHz 802.11n – HT-20 18M0D1D 2422 – 2452 MHz 802.11n – HT-40 36M3D1D 5745 – 5825 MHz 802.11a Leg 16M9D1D 5745 – 5825 MHz 802.11n – HT-20 18M0D1D 5745 – 5825 MHz 802.11n – HT-40 36M7D1D
Frequency Stability:	±20 ppm max
Equipment Dimensions:	13" x 8.5" x 1.5"
Weight:	4.6 lbs
Primary function of equipment:	Wireless Controller

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3.2. Scope of Test Program

The scope of the test program was to test the Aruba Networks 651-XX 802.11a/b/g/n Wireless Controller, 3x3 Spatial Multiplexing MIMO configurations in the frequency ranges 2400 - 2483.5 MHz and 5725 – 5850 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

The Aruba Networks 651-XX has external antennas with reverse SMA.

Original Equipment Manufacturers (OEM) Labeling of product

The 651-XX (where x=a to z, or “blank”) is the original equipment manufacturer’s model number. The equipment is also sold for distribution as model number OAW-4306GW-XX (where x=a to z, or “blank”).

Aruba Networks 651-XX Wireless Controller (Front)



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**Aruba Networks
651-XX Wireless Controller (Rear)**





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3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	802.11a/b/g/n Wireless Controller	Aruba Networks	651-XX	AF0000495 Conducted AF0000185 Radiated
Support	Laptop PC	IBM	Thinkpad	None

3.4. Antenna Details

1. AP-ANT-1B Omni-Directional
 - 2.4 – 2.5 GHz; Gain: 3.8 dBi
 - 4.9 – 5.875 GHz; Gain: 5.8 dBi

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 4 GIGE Ethernet with POE
2. 2 GIGE Ethernet without POE
3. 2 SFP uplink ports
4. 4 USB ports
5. 1 Console serial port (RJ-45)
6. 1 PCI Express card slot
7. 3 Antenna ports (reverse SMA)
8. IEC 320 AC input connector

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3.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. The variant with the highest power was used to exercise the product.

Operational Mode(s) (802.11a/b/g/n)	Variant	Data Rate with Highest Power	Frequencies (MHz)
b	Legacy	1 MBit/s	2,412
g	Legacy	6 MBit/s	2,437
n	HT-20	6.5 MCS	2,462
	HT-40	13.5 MCS	2,422
			2,437
			2,452
a	Legacy	6 MBit/s	5,745
n	HT-20	6.5 MCS	5,785
	HT-40	13.5 MCS	5,825
			5,755
			5,785
			5,815

Legacy – data rates for 802.11abg products

Results for the above configurations are provided in this report.



Conducted Testing

Conducted test parameters were performed on a single antenna connector. The performance testing was carried out on the transmitter port exhibiting the highest output power. A table of output power V's antenna port for each operational mode is provided below. The power from each transmitter is provided together with the aggregate power for all three transmitters. Complete characterization for each chain has been provided only for the power settings utilized in the generation of this report. Aggregate power measurements are provided for all power settings.

Channel 2,412 MHz

b Mode, 1 Mbit/s

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Tx 3 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
b	19	18.15	18.26	17.74	25.14
	18	17.31	17.25	16.32	23.78
	17	16.11	16.15	15.58	22.56
	16	15.04	15.44	14.65	21.45
	15	14.21	14.17	13.45	20.73
	14	13.2	12.87	12.33	19.04
	13	12.01	12.13	11.56	18.08
	12	10.61	11.19	10.54	17.02
	11	10.12	10.01	9.46	15.97
	10	8.91	9.16	8.07	15.11
	9	8.02	8.44	7.56	14.15
	8	7.23	7.39	6.45	13.27
	7	6.21	6.35	5.33	12.06
	6	5.14	5.33	4.1	11.12
	5	4.21	4.51	3.41	10.11
	4	3.13	3.61	2.41	8.91
	3	2.01	2.39	1.6	7.72
	2	1.05	1.47	0.51	6.76
	1	-0.67	0.41	-1.01	5.24



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Channel 2,412 MHz

g Mode Legacy, 6 Mbit/s

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Tx 3 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
g (Legacy)	19	17.91	18.25	17.61	23.85
	18	16.82	17.13	16.47	22.93
	17	15.82	16.18	15.57	21.97
	16	14.91	15.25	14.61	20.73
	15	13.82	14.26	13.61	19.93
	14	12.71	12.97	12.49	18.68
	13	11.64	12.17	11.54	17.72
	12	10.53	11.26	10.54	16.65
	11	9.47	10.11	9.55	15.61
	10	8.74	9.05	8.3	14.64
	9	8.11	8.44	7.74	14.04
	8	6.91	7.46	6.72	12.89
	7	6.01	6.41	5.42	11.89
	6	5.01	5.37	4.36	10.75
	5	4.04	4.61	3.39	9.94
	4	3.02	3.66	2.62	8.96
	3	2.01	2.43	1.66	7.82
	2	0.6	1.54	0.44	6.76
	1	-0.53	0.41	-1.02	5.44

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Channel 2,412 MHz

HT-20 'n' Mode, 6.5 MCS

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Tx 3 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
HT-20 ('n' mode)	19	17.87	18.21	17.72	24.16
	18	16.91	17.11	16.46	22.92
	17	15.81	16.13	15.57	22.11
	16	15.02	15.27	14.72	21.05
	15	13.96	14.26	13.63	19.92
	14	12.82	13.01	12.44	18.75
	13	11.72	12.13	11.51	17.73
	12	10.61	11.21	10.37	16.71
	11	9.55	10.21	9.51	15.59
	10	8.74	9.18	8.43	14.57
	9	8.11	8.44	7.74	13.97
	8	6.97	7.36	6.71	12.85
	7	6.05	6.36	5.44	11.85
	6	5.02	5.46	4.28	10.83
	5	4.01	4.62	3.42	9.91
	4	3.07	3.71	2.61	8.87
	3	1.71	2.46	1.61	7.78
	2	0.61	1.57	0.6	6.75
	1	-0.47	0.41	-0.76	5.51

Channel 2,422 MHz

HT-40 'n' Mode, 13.5 MCS

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Tx 3 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
HT-40 ('n' mode)	19	17.77	18.11	17.62	23.73
	18	16.95	16.92	16.24	22.65
	17	15.74	15.95	15.16	21.55
	16	14.71	14.93	14.37	20.64
	15	13.62	14.14	13.45	19.62
	14	12.62	13.15	12.36	18.58
	13	11.56	11.85	11.36	17.45
	12	10.67	11.02	10.41	16.53
	11	9.56	10.16	9.43	15.54
	10	8.51	9.21	8.51	14.52
	9	7.95	8.18	7.52	13.56
	8	7.21	7.54	6.9	13.05
	7	6.19	6.59	5.93	12.02
	6	5.32	5.7	4.72	11.03
	5	4.44	4.69	3.74	10.06
	4	3.52	4.03	2.9	9.27
	3	2.51	3.13	2.14	8.36
	2	1.44	1.9	1.19	7.19
	1	0.31	0.93	0.27	6.33

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Channel 5,785 MHz

a Mode Legacy, 6 Mbit/s

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Tx 3 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
a (Legacy)	19	17.89	19.01	17.21	23.54
	18	17.02	17.97	16.11	22.61
	17	16.07	16.91	15.11	21.55
	16	15.21	15.84	13.83	20.52
	15	14.07	14.91	12.81	19.41
	14	13.13	13.85	12.00	18.46
	13	12.23	12.94	10.81	17.54
	12	11.05	12.00	9.95	16.44
	11	10.05	10.92	9.06	15.51
	10	9.22	9.91	8.11	14.65
	9	8.72	9.47	7.85	14.23
	8	7.74	8.71	6.75	13.22
	7	6.84	7.62	5.84	12.22
	6	5.76	6.75	4.94	11.21
	5	4.97	5.74	3.87	10.31
	4	4.07	4.52	3.02	9.34
	3	2.88	3.23	1.71	8.01
	2	1.84	2.24	0.53	6.96
	1	0.75	1.17	-0.57	5.73

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Channel 5,785 MHz
HT-20 'n' Mode, 6.5 MCS

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Tx 3 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
HT-20 ('n' mode)	19	17.92	18.97	17.07	23.54
	18	17.02	17.8	16.11	22.51
	17	15.97	16.96	15.00	21.41
	16	15.11	15.92	13.93	20.46
	15	14.14	14.96	12.89	19.38
	14	13.01	13.87	11.91	18.47
	13	12.22	12.96	10.75	17.53
	12	10.99	11.92	10.02	16.57
	11	10.02	10.91	9.01	15.41
	10	9.22	10.04	8.01	14.47
	9	8.72	9.61	7.92	14.21
	8	7.73	8.55	6.81	13.21
	7	6.72	7.55	5.75	12.16
	6	5.72	6.76	4.72	11.15
	5	5.02	5.74	3.81	10.21
	4	4.05	4.75	2.96	9.28
	3	2.79	3.42	1.74	8.06
	2	1.81	2.12	0.54	6.95
	1	0.74	1.32	-0.46	5.90

Channel 5,785 MHz
HT-40 'n' Mode, 13.5 MCS

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Tx 3 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
HT-40 ('n' mode)	19	17.82	19.06	17.21	23.43
	18	16.96	18.11	16.15	22.57
	17	15.92	16.75	14.96	21.46
	16	14.84	15.8	14.05	20.27
	15	13.91	14.93	12.75	19.27
	14	12.83	13.92	11.75	18.29
	13	12.05	12.89	10.91	17.37
	12	11.15	12.00	9.86	16.45
	11	10.02	11.03	9.07	15.40
	10	9.13	10.21	8.16	14.49
	9	8.45	9.22	7.26	13.61
	8	8.05	8.74	7.11	13.32
	7	7.01	7.92	6.12	12.36
	6	6.11	7.00	5.17	11.43
	5	5.15	6.14	4.26	10.52
	4	4.42	5.26	3.34	9.61
	3	3.45	4.22	2.51	8.61
	2	2.35	3.10	1.42	7.47
	1	1.47	2.02	0.35	6.30

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Antenna Test Configurations for Radiated Emissions

Spurious Emission and Band-Edge Test Strategy

When testing radiated spurious emissions and band-edge three identical antennae were connected to the EUT at all times. Transmission during this test process simulated a typical installation. Results for the following configurations are provided in this report.

2,400 – 2483.5 MHz

15.247	
	AP-ANT-1B
802.11b	b SE 2412
	b SE 2437
	b SE 2462
	BE b 2390
	b Pk 2412
	b Pk 2437
	b Pk 2462
	BE b 2483.5
802.11g	g SE 2412
	g SE 2437
	g SE 2462
	BE g 2390
	g Pk 2412
	g Pk 2437
	g Pk 2462
	BE g 2483.5
HT-20 n	g SE 2412
	g SE 2437
	g SE 2462
	BE g 2390
	PK g 2412
	PK g 2437
	PK g 2462
	BE g 2483.5
HT-40 n	g SE 2422
	g SE 2437
	g SE 2452
	BE g 2390
	PK g 2422
	PK g 2437
	PK g 2452
	BE g 2483.5

KEY:-

SE – Spurious Emission
BE – Band-Edge
PK - Peak Emission



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5,725 – 5850 MHz

15.247	
	AP-ANT-1B
Legacy	
802.11a	a SE 5745
	a SE 5785
	a SE 5825
	Pk a 5745
	Pk a 5785
	Pk a 5825
	BE a 5460
HT-20	a SE 5745
	a SE 5785
	a SE 5825
	Pk a 5745
	Pk a 5785
	Pk a 5825
	BE a 5460
HT-40	a SE 5755
	a SE 5785
	a SE 5815
	Pk a 5755
	Pk a 5785
	Pk a 5815
	BE a 5460

KEY:-

SE – Spurious Emission
BE – Band-Edge
PK - Peak Emission

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3.7. Equipment Modifications

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

EUT Software Power Settings - Radiated Testing

1. Reduction in output power to meet band-edge requirements was required in certain circumstances. When testing radiated spurious emissions the following matrix was generated identifying the amended power settings. The matrix identifies whether the reduction in power required bringing the EUT into compliance.

The last column amends the peak power measurements identified in Section 5.1.2 'Peak Output Power' as a result of the band-edge power reduction.

2310-2390MHz				
Channel	ART Power	Passing ART Power	Data Rate	Amended Peak Power(s) (dBm)
3 (2422 MHz) HT40	18	12	13.5 MCS	+18.18
1 (2412 MHz) HT20	18	14.5	6.5 MCS	+22.59
1 (2412 MHz) g	18	16	6 MBPS	+23.14
1 (2412 MHz) b	19	19	1 MBPS	No Change
2483.5-2500MHz				
Channel	ART Power	Passing ART Power	Data Rate	
9 (2452 MHz) HT40	18	11.5	13.5 MCS	+17.83
1 (2412 MHz) HT20	18	14.5	6.5 MCS	+22.91
1 (2412 MHz) g	18	15	6 MBPS	+22.23
1 (2412 MHz) b	19	19	1 MBPS	No Change
5350-5460MHz				
Channel	ART Power	Passing ART Power	Data Rate	
149 (5745 MHz) HT40	19	17	13.5 MCS	+23.93



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3.8. Deviations from the Test Standard

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

1. NONE

3.9. Subcontracted Testing or Third Party Data

1. NONE

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4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) A8.2(1) 4.4	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	5.1.1
15.247(b)(3) 15.31(e) A8.4(4)	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(e) A8.2	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(i) 5.5	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(d) 15.205 / 15.209 A8.5 2.2 4.7	Spurious Emissions (30MHz - 26 GHz b/g and 30 MHz – 40 GHz a)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.5

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List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247**, **Industry Canada RSS-210**, and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) 15.205 / 15.209 A8.5 2.2 2.6 4.7	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.6.1
	Radiated Band Edge	Band-edge results Peak Emissions		Complies	5.1.6.2.
	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.6.3
Industry Canada only RSS-Gen §4.8, §6					
15.205 / 15.209 2.2	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	5.1.6.4
15.207 7.2.2	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	5.1.7

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 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

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5. TEST RESULTS

5.1. Device Characteristics

5.1.1. 6 dB and 99 % Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)

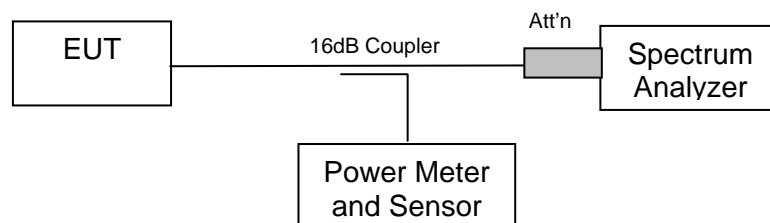
Industry Canada RSS-210 §A8.2

Industry Canada RSS-Gen §4.4

Test Procedure

The bandwidth at 6 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 6 dB and 99 % bandwidth test

Measurement Results for 6 dB & 99% Bandwidth

Ambient conditions.

Temperature: 17 to 23 °C

Relative humidity: 31 to 57 %

Pressure: 999 to 1012 mbar

Radio Parameters

Duty Cycle: 100%

Output: Modulated Carrier

Power: Default, Maximum Power

Test s/w: ART



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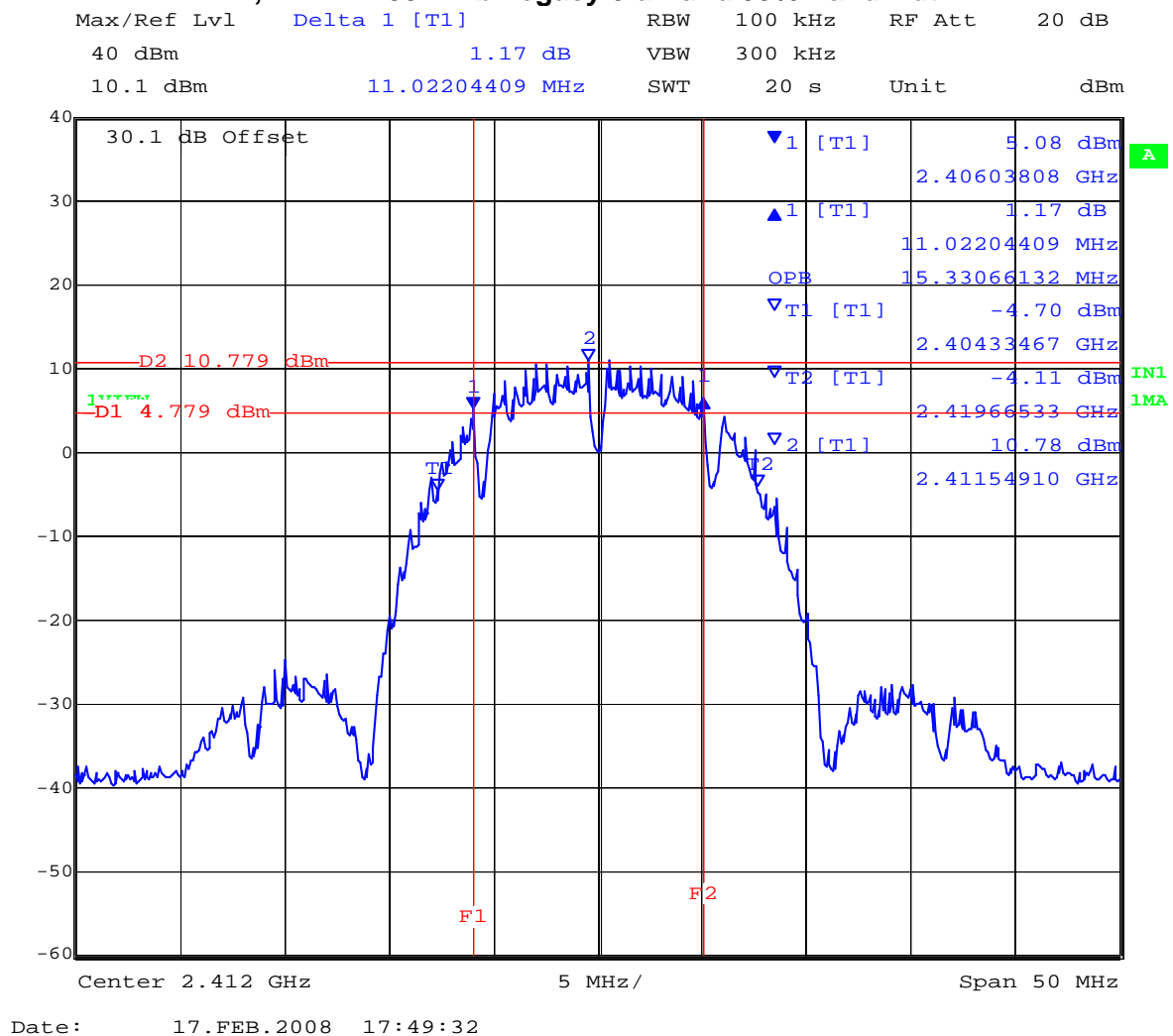
Measurement Results for 6 dB Operational Bandwidth(s) Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

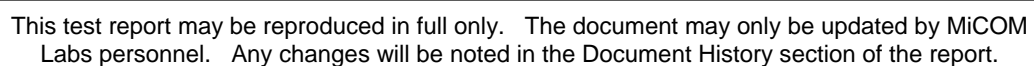
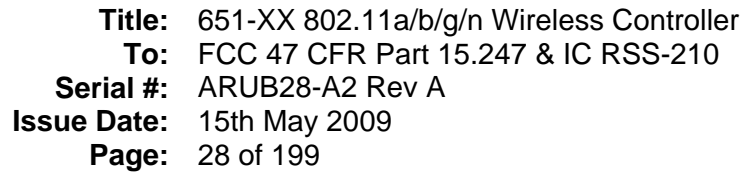
TABLE OF RESULTS – 802.11b Legacy

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,412	11.022	15.331
2,437	12.525	15.431
2,462	11.523	15.431

2,412 MHz 802.11b Legacy 6 dB and 99% Bandwidth



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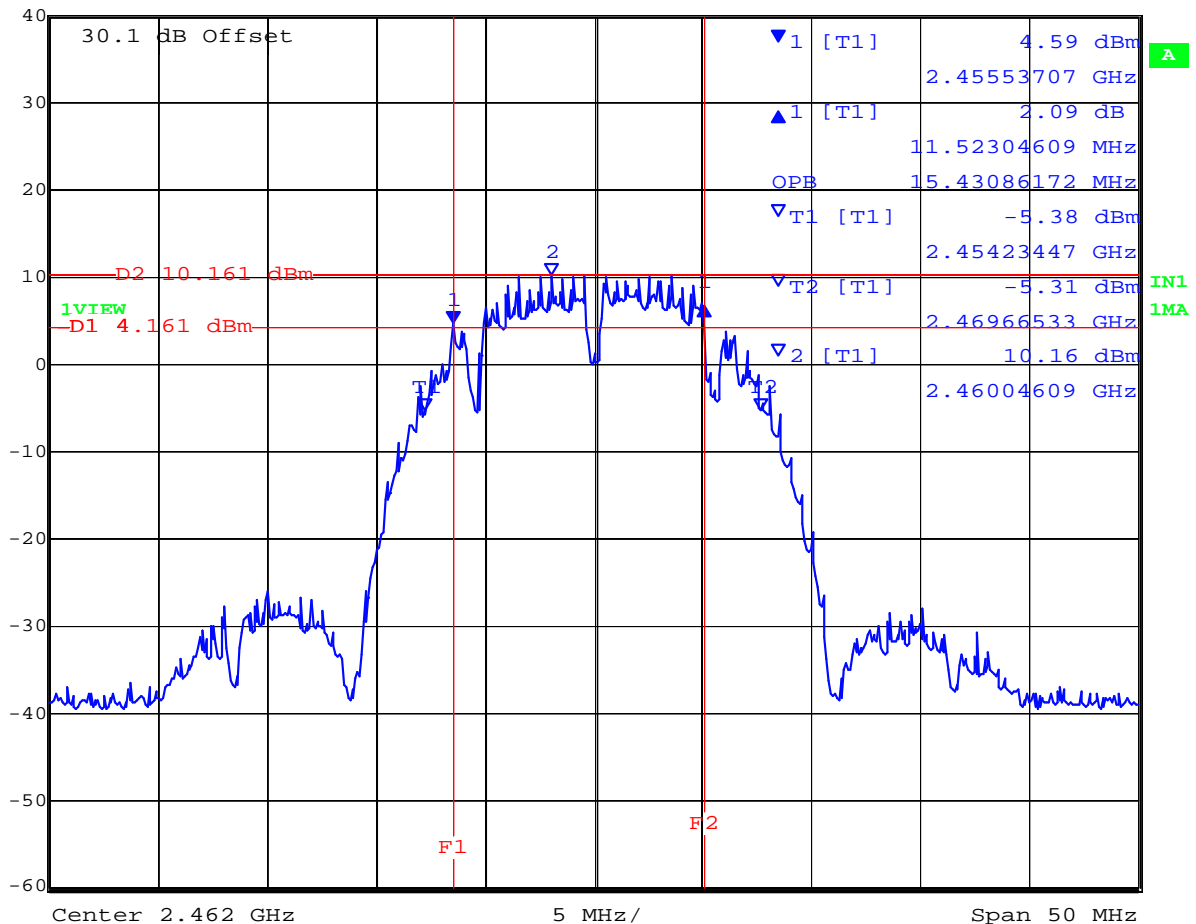




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2,462 MHz 802.11b Legacy 6 dB and 99% Bandwidth

Max/Ref Lvl Delta 1 [T1] RBW 100 kHz RF Att 20 dB
40 dBm 2.09 dB VBW 300 kHz
10.1 dBm 11.52304609 MHz SWT 20 s Unit dBm



Date: 17.FEB.2008 17:58:25

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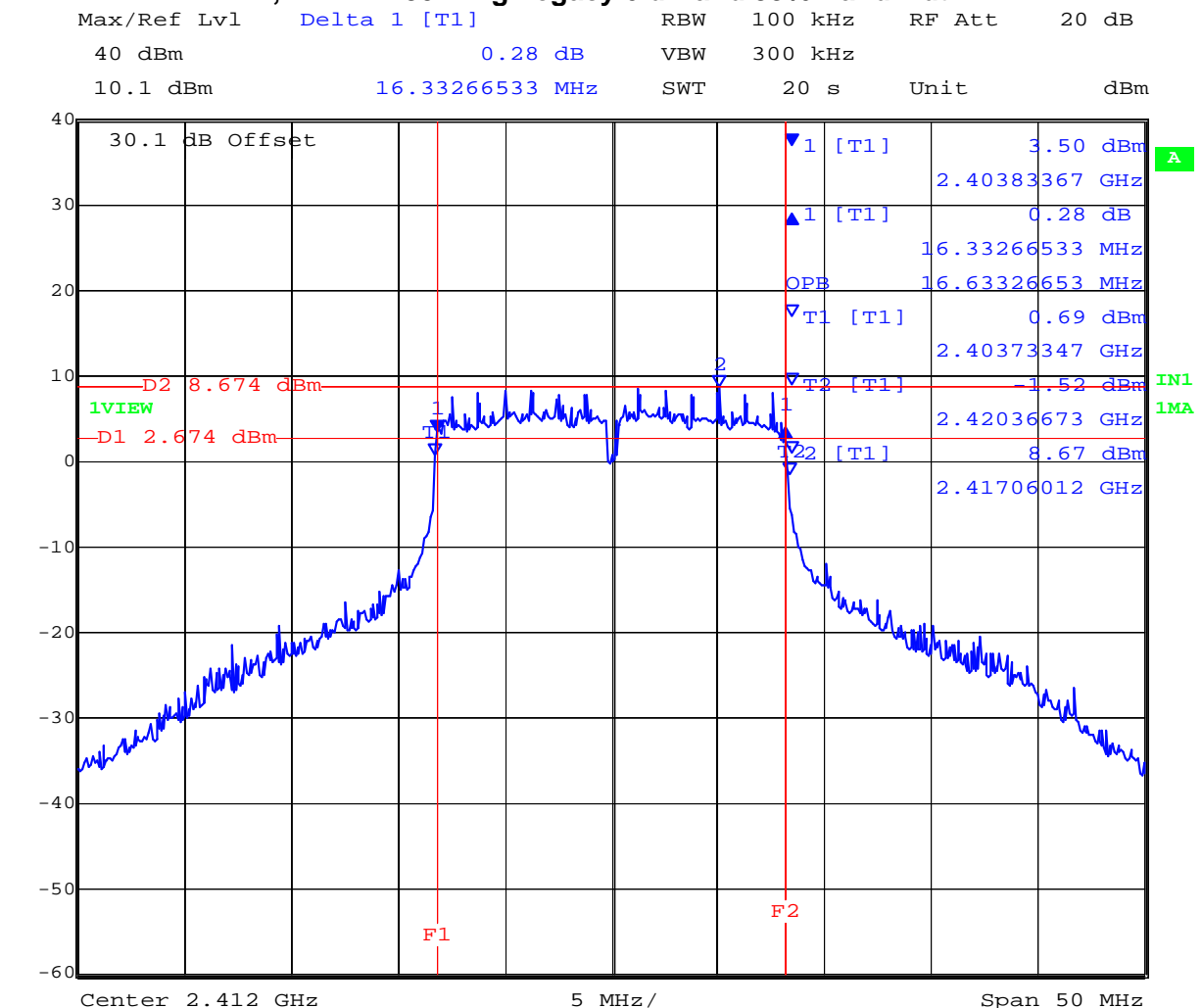


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TABLE OF RESULTS – 802.11g Legacy

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,412	16.333	16.633
2,437	16.333	16.633
2,462	16.333	16.633

2,412 MHz 802.11g Legacy 6 dB and 99% Bandwidth



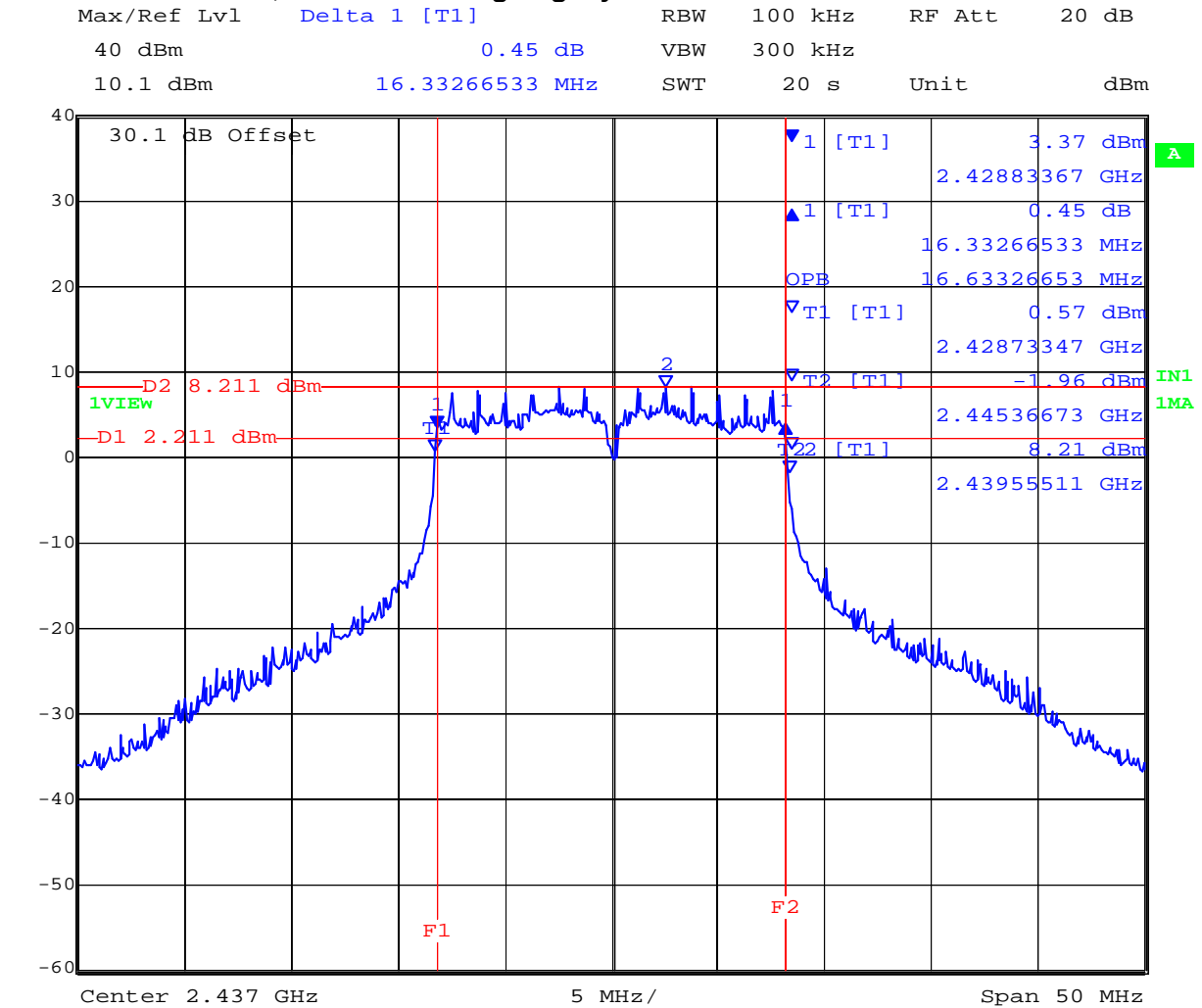
Date: 17.FEB.2008 17:47:52

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2,437 MHz 802.11g Legacy 6 dB and 99% Bandwidth



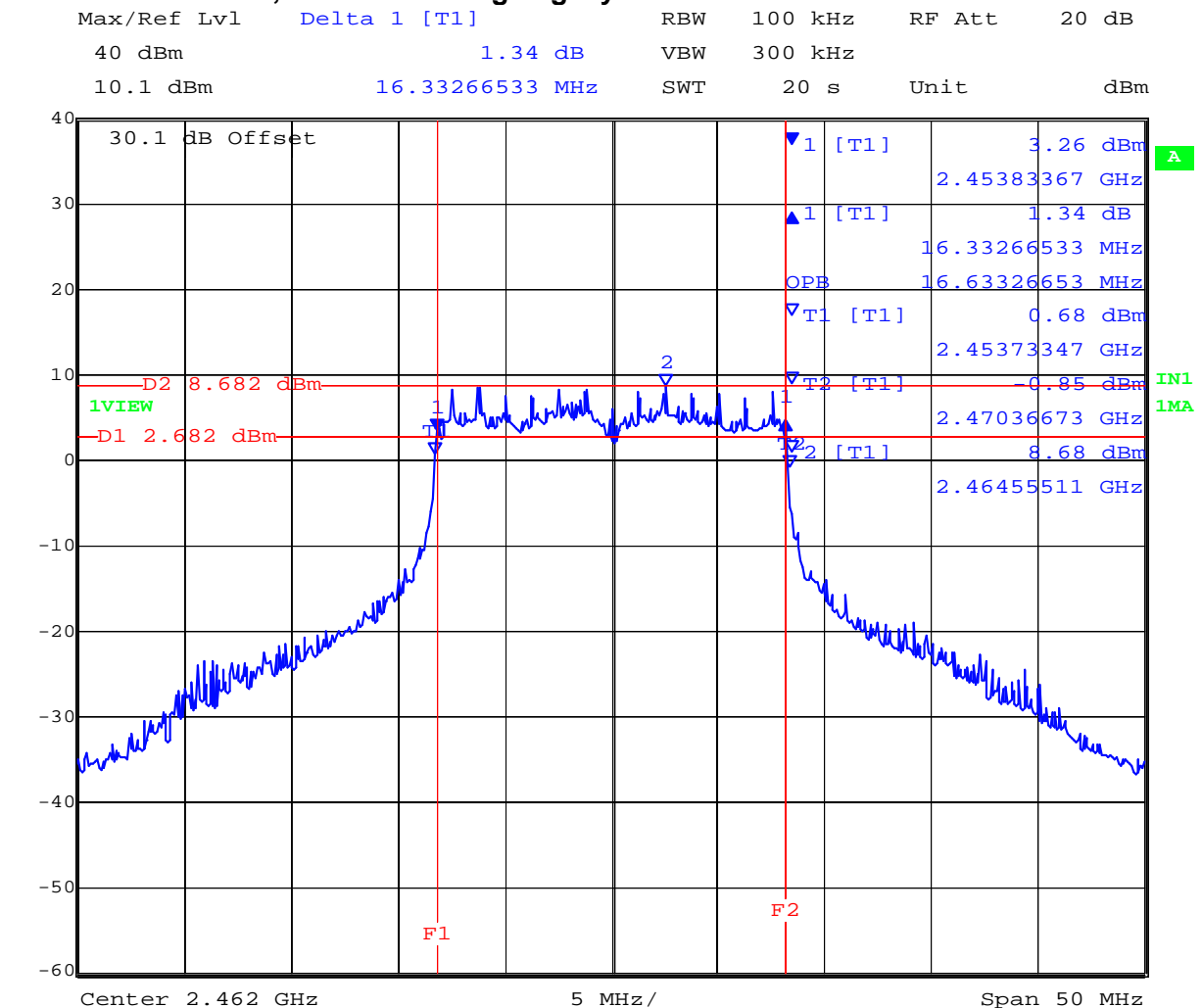
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2,462 MHz 802.11g Legacy 6 dB and 99% Bandwidth



Date: 17.FEB.2008 18:01:28

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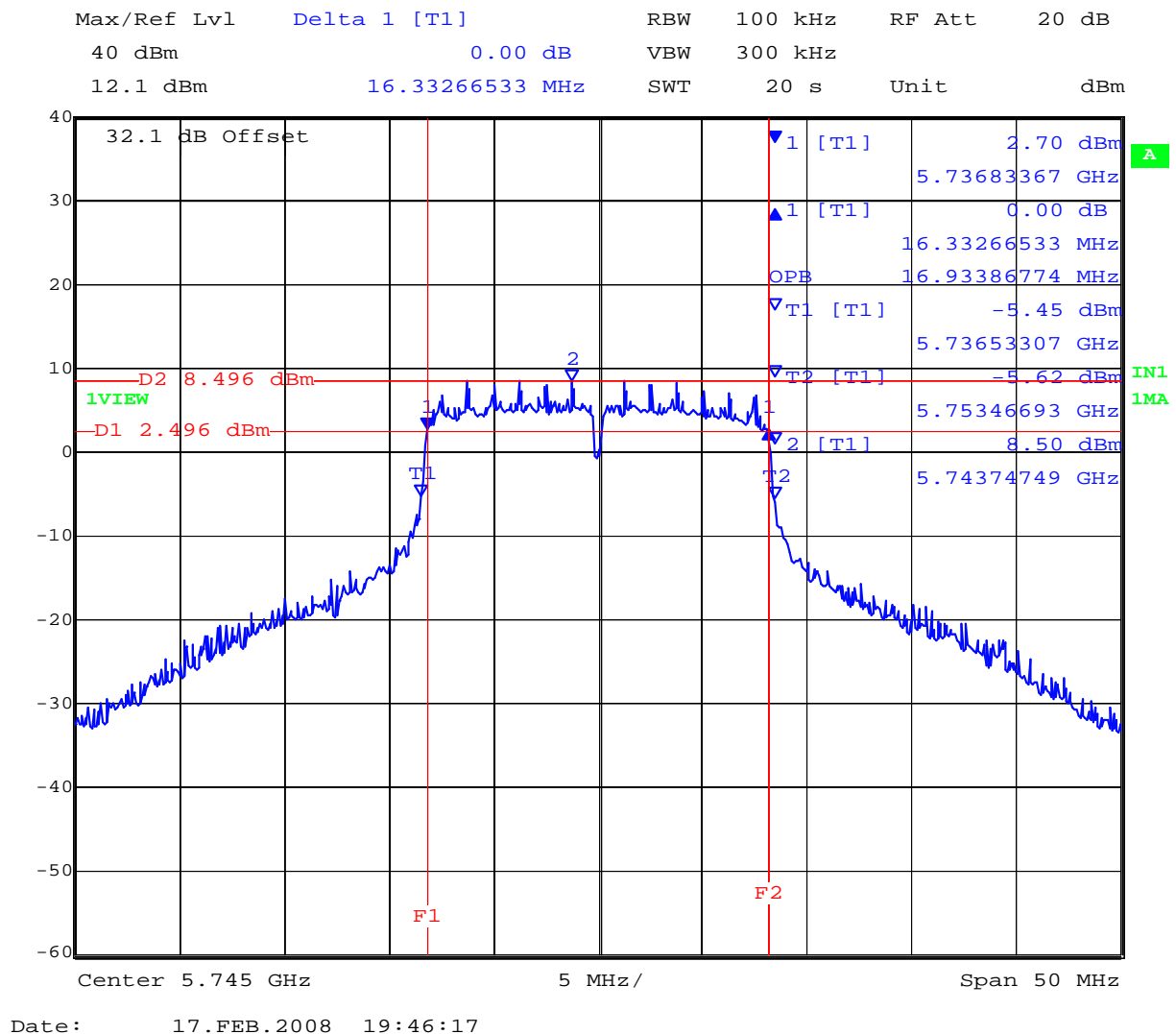


Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11a - Legacy

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
5,745	16.333	16.934
5,785	16.333	16.633
5,825	16.333	16.633

5,745 MHz 802.11a Legacy 6 dB and 99% Bandwidth

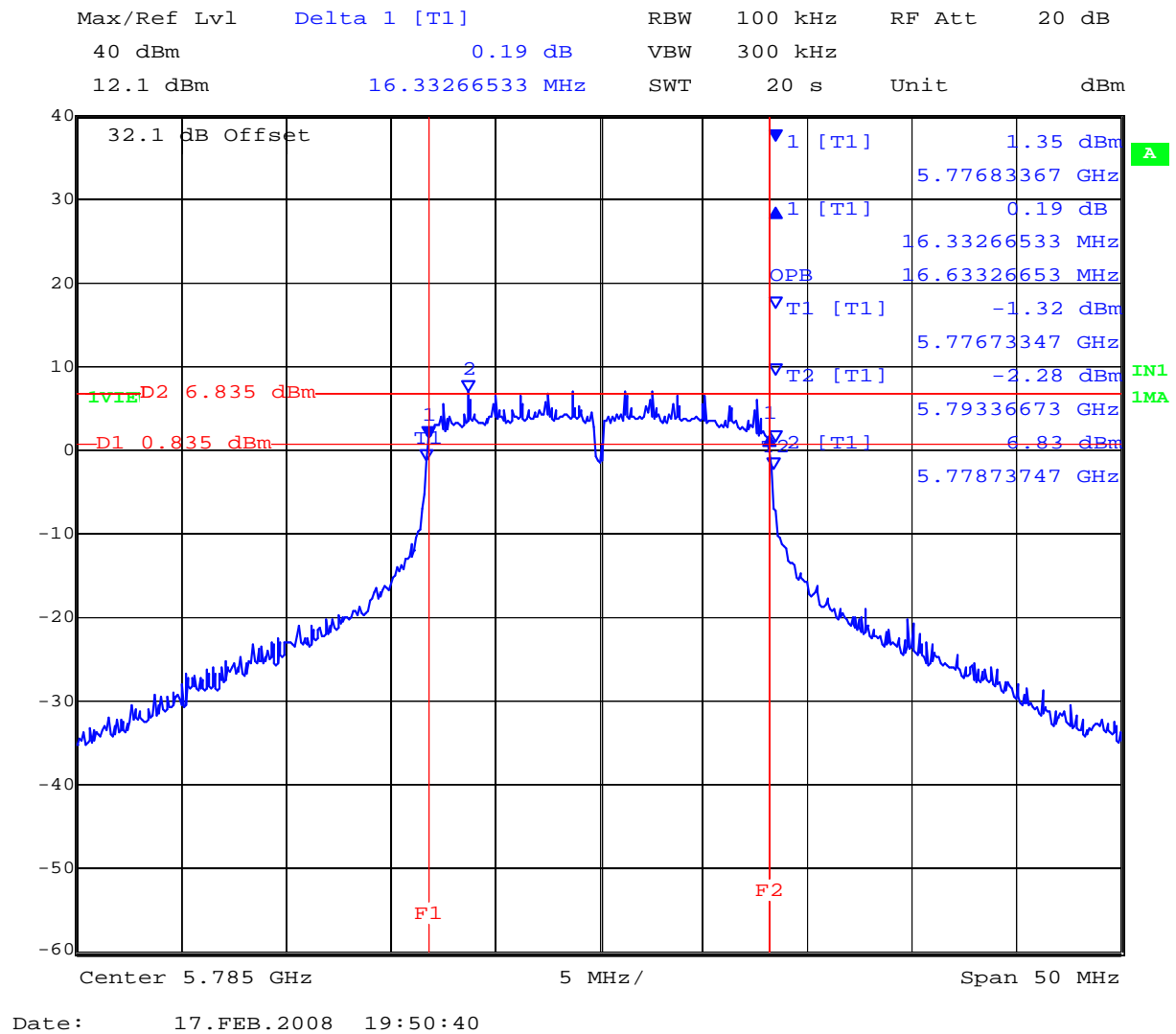


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5,785 MHz 802.11a Legacy 6 dB and 99% Bandwidth

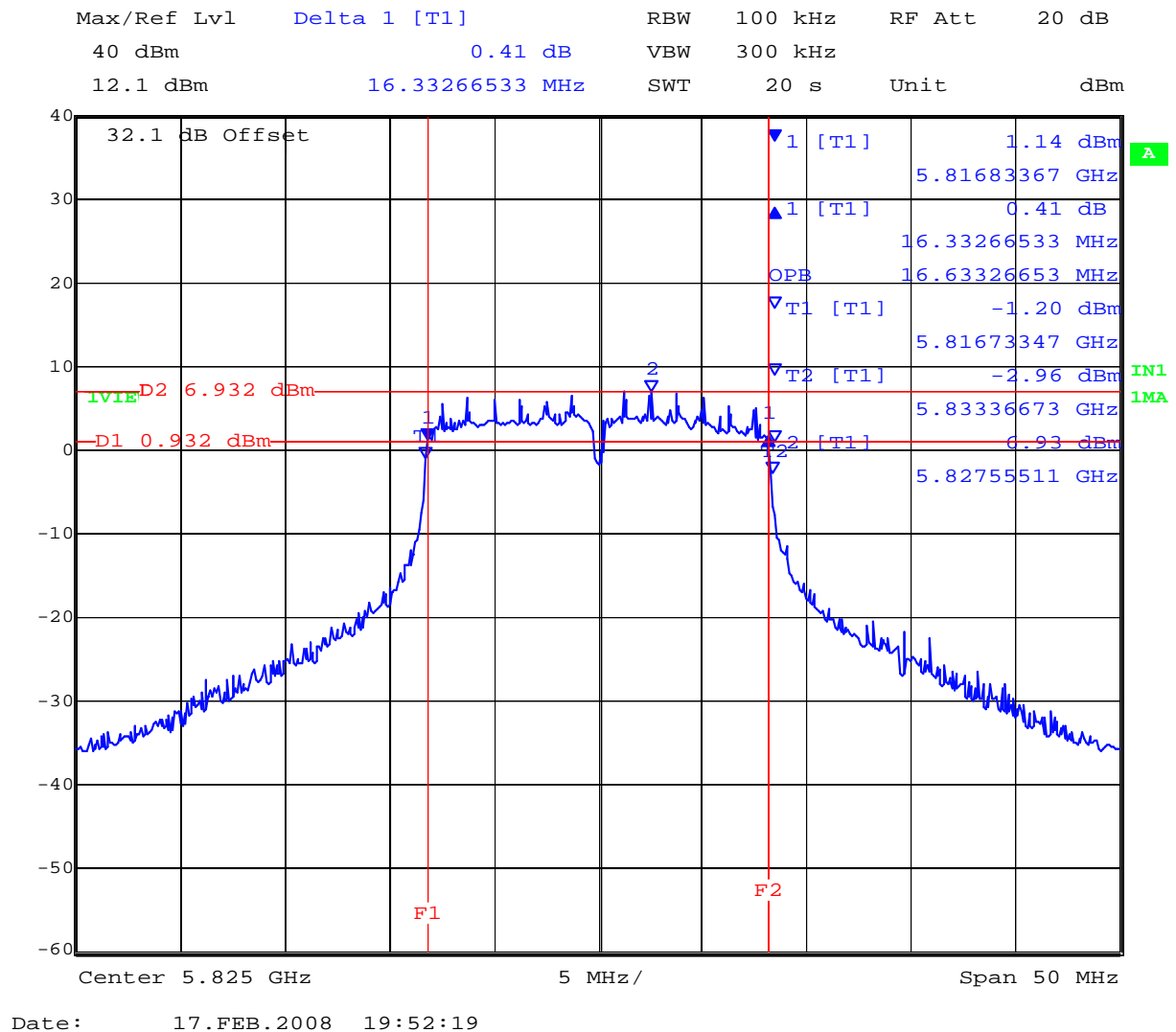


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5,825 MHz 802.11a Legacy 6 dB and 99% Bandwidth



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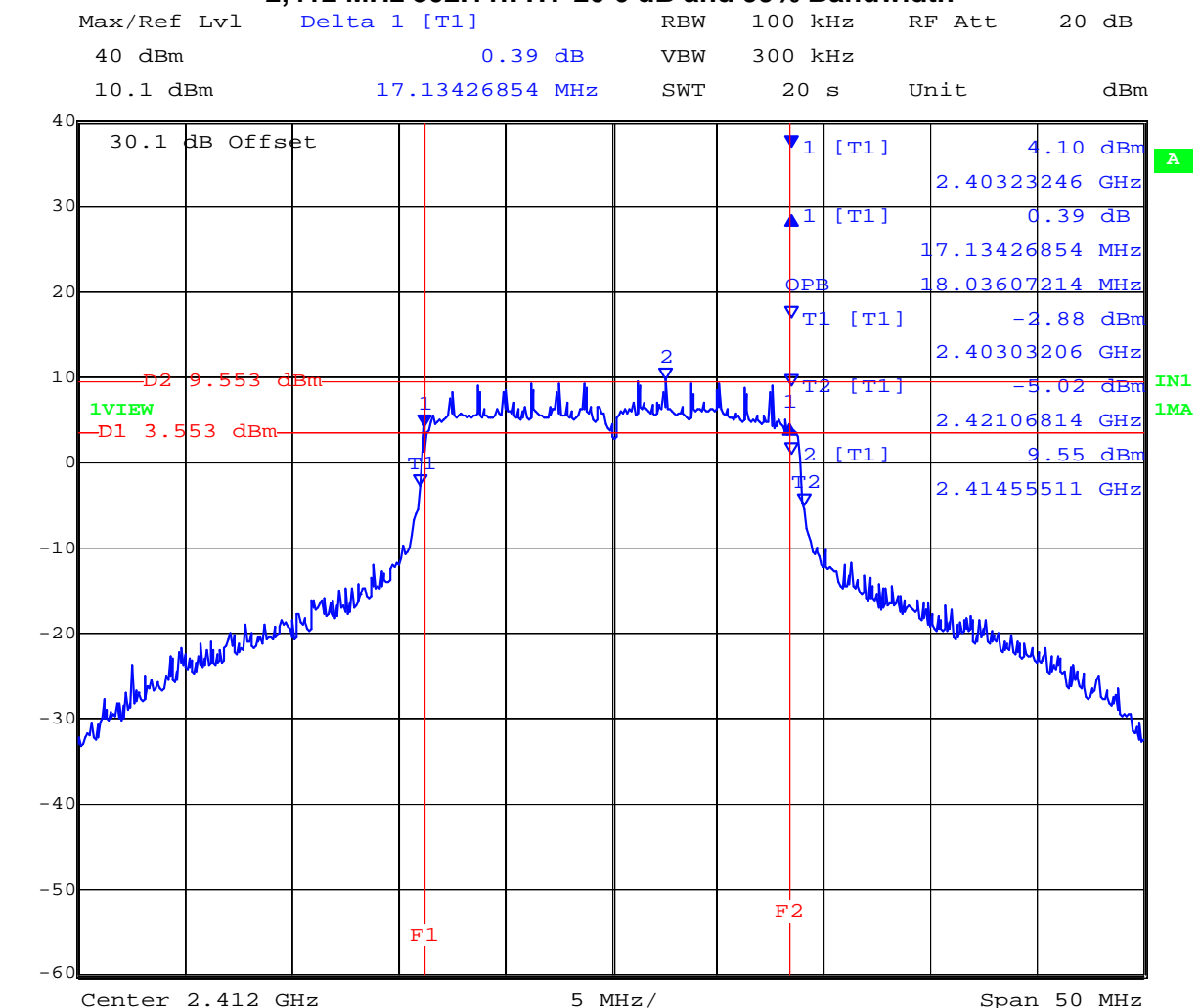


Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11n HT-20

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,412	17.134	18.036
2,437	17.034	17.836
2,462	17.034	17.836

2,412 MHz 802.11n HT-20 6 dB and 99% Bandwidth



Date: 17.FEB.2008 17:50:52

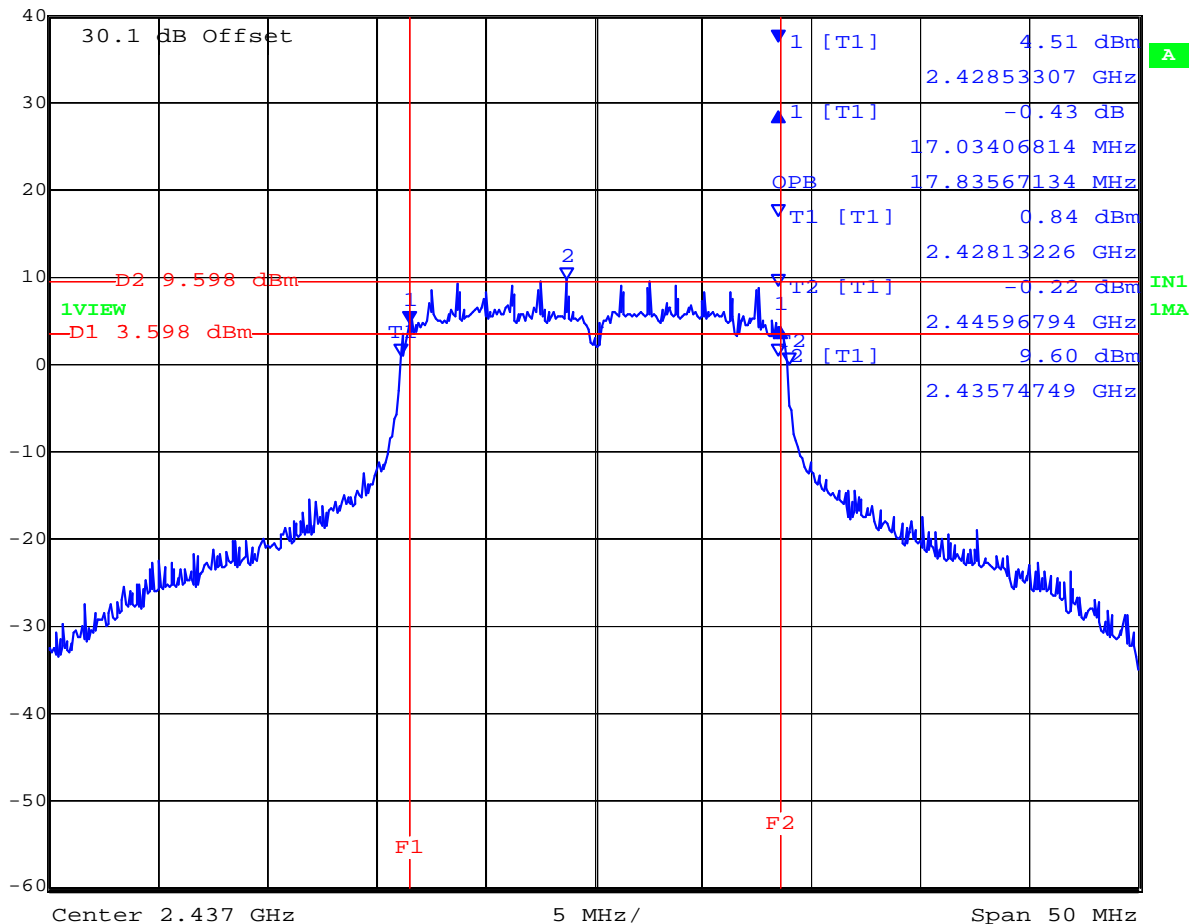
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2,437 MHz 802.11n HT-20 6 dB and 99% Bandwidth

Max/Ref Lvl Delta 1 [T1] RBW 100 kHz RF Att 20 dB
40 dBm -0.43 dB VBW 300 kHz
10.1 dBm 17.03406814 MHz SWT 20 s Unit dBm



Date: 17.FEB.2008 17:52:34

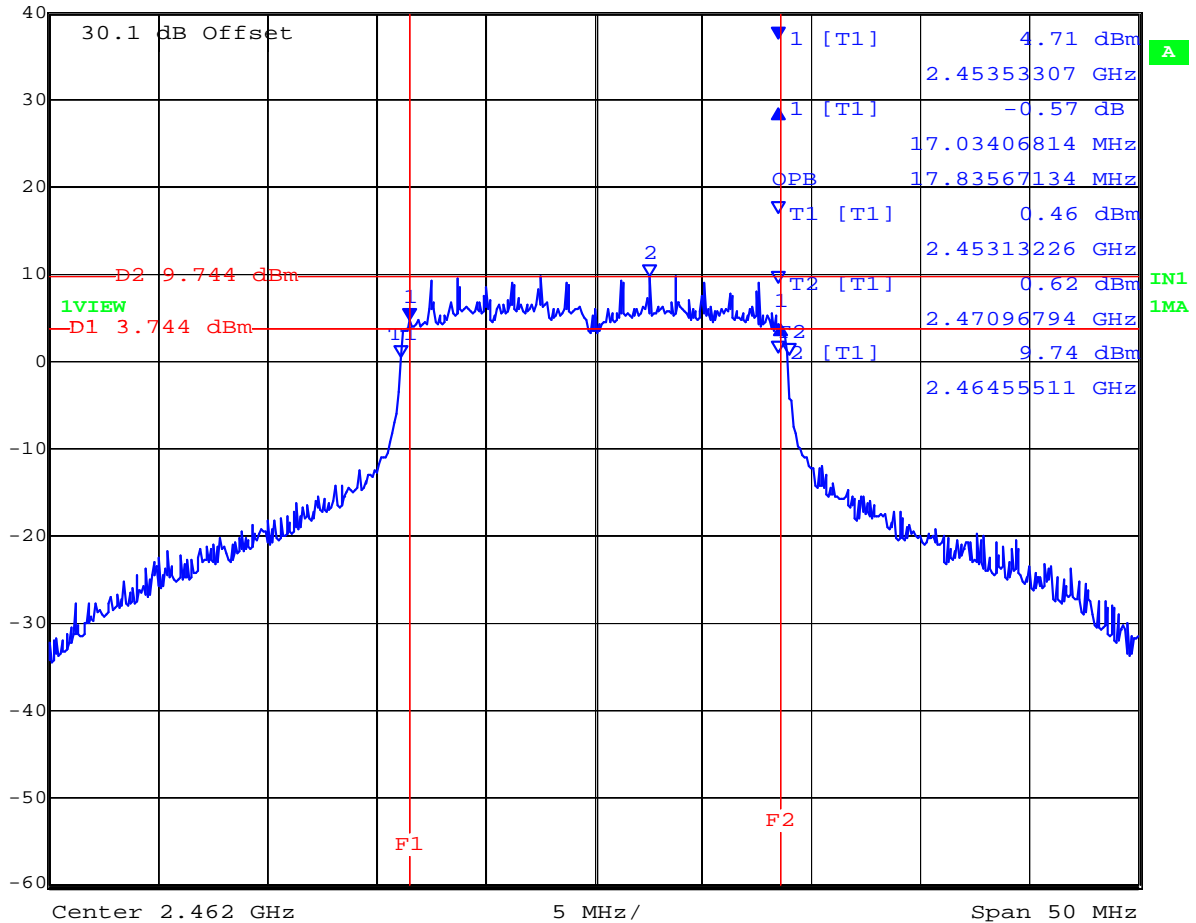
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2,462 MHz 802.11n HT-20 6 dB and 99% Bandwidth

Max/Ref Lvl Delta 1 [T1] RBW 100 kHz RF Att 20 dB
40 dBm -0.57 dB VBW 300 kHz
10.1 dBm 17.03406814 MHz SWT 20 s Unit dBm



Date: 17.FEB.2008 17:59:43

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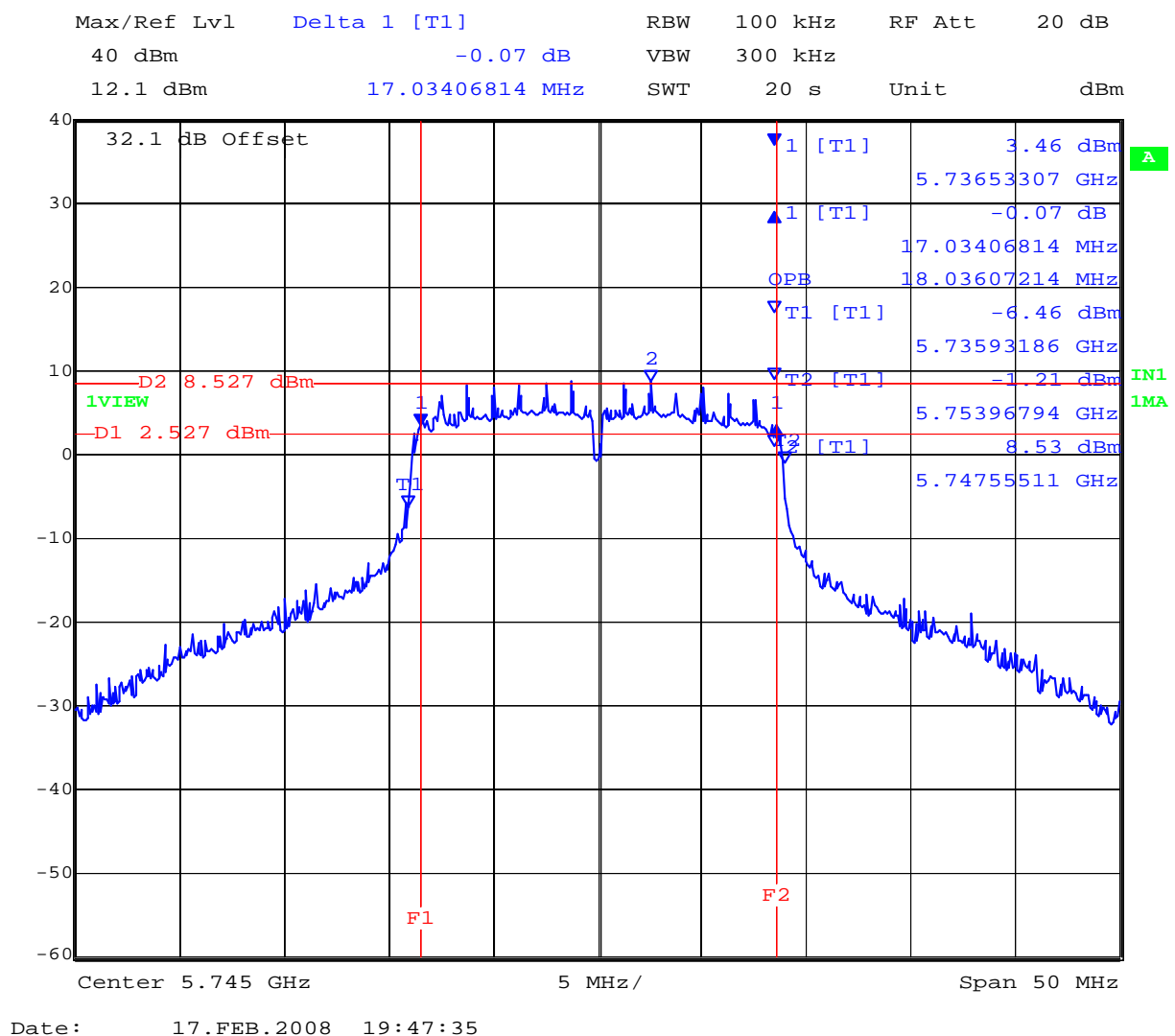


Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11n - HT-20

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
5,745	17.034	18.036
5,785	17.535	17.836
5,825	17.134	17.836

5,745 MHz 802.11n HT-20 6 dB and 99% Bandwidth



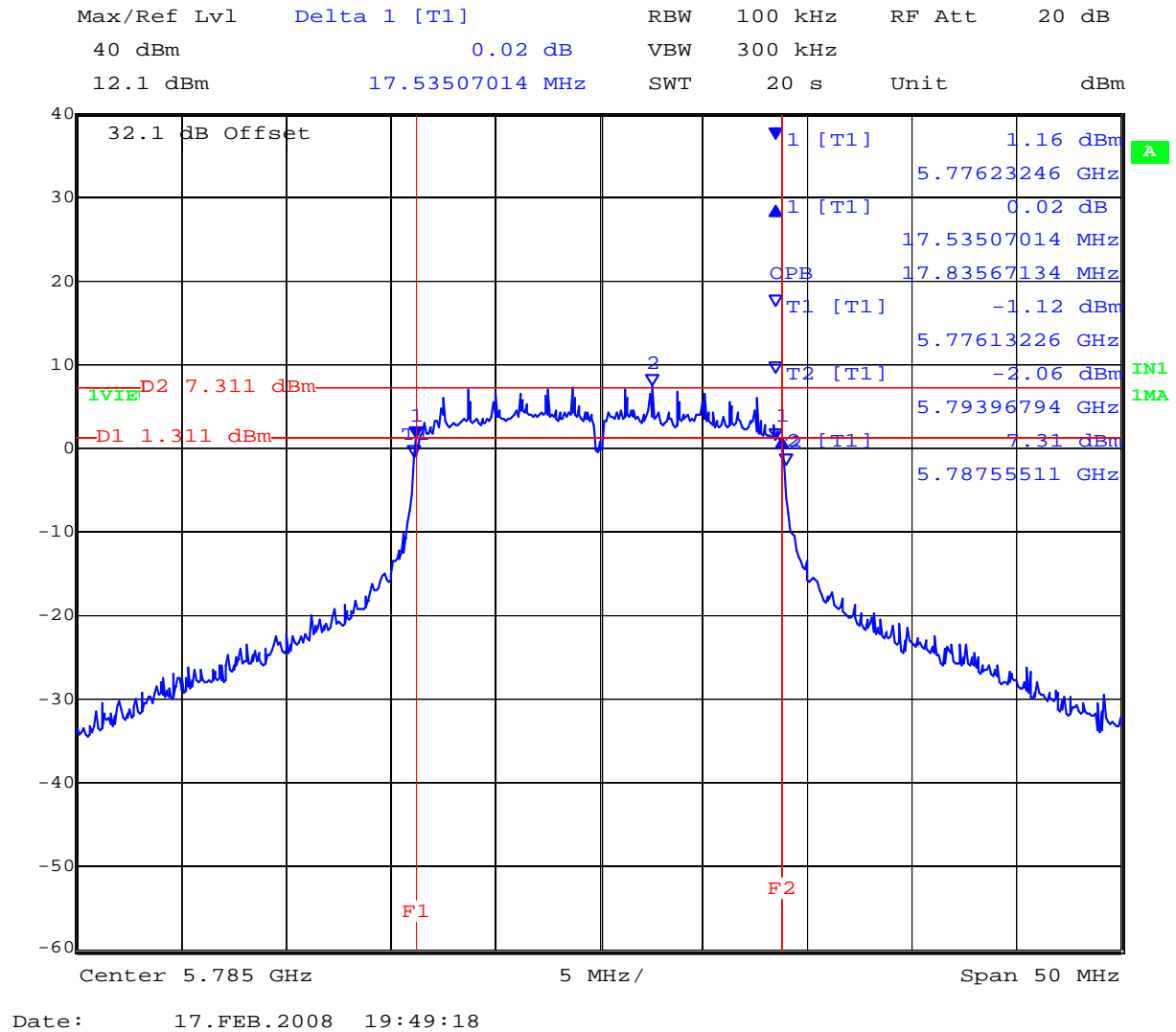
Date: 17.FEB.2008 19:47:35

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5,785 MHz 802.11n HT-20 6 dB and 99% Bandwidth

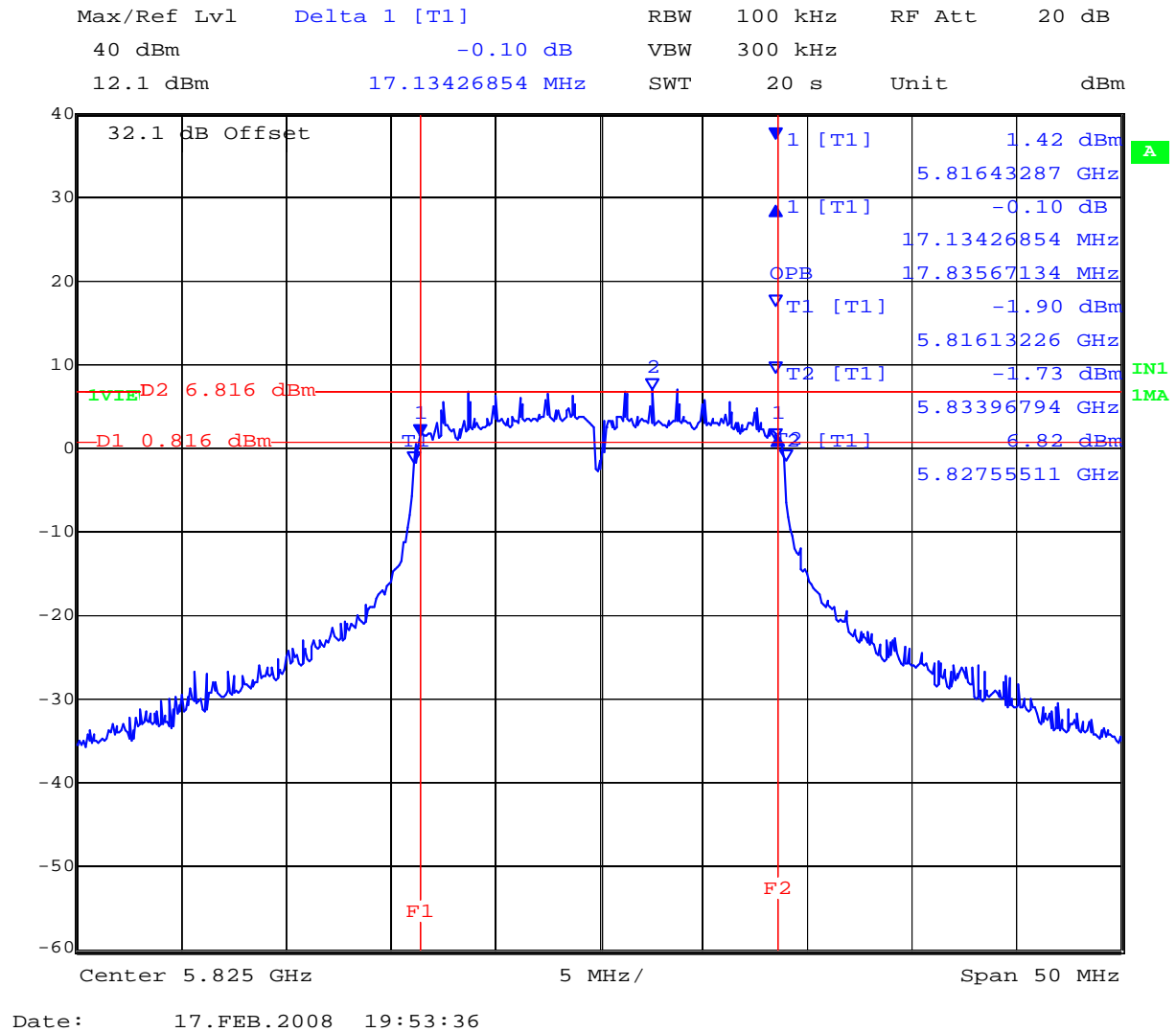


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5,825 MHz 802.11n HT-20 6 dB and 99% Bandwidth



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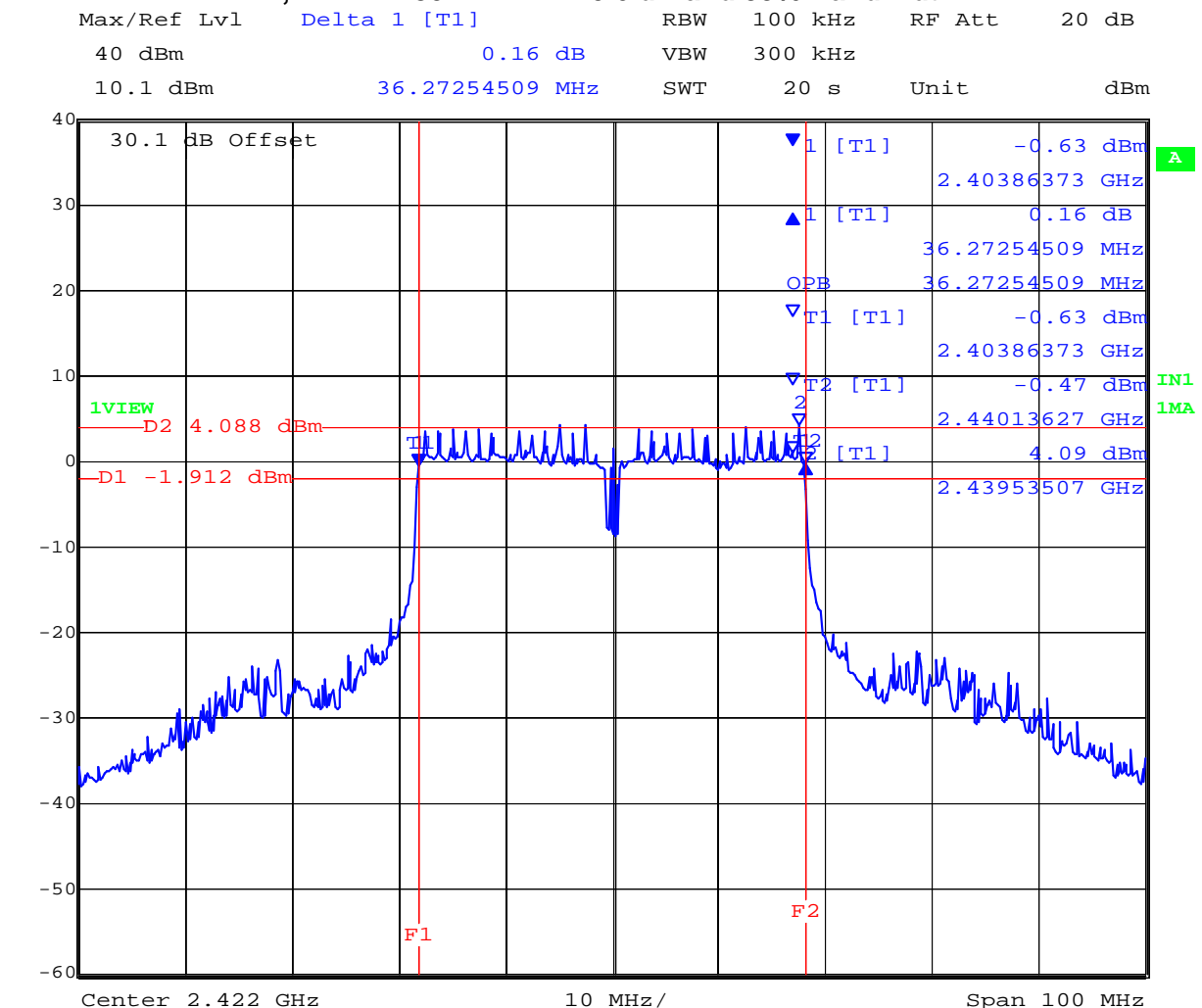


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TABLE OF RESULTS – 802.11N HT-40

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,422	36.273	36.273
2,437	36.273	36.273
2,452	36.273	36.273

2,422 MHz 802.11n HT-40 6 dB and 99% Bandwidth



Date: 17.FEB.2008 18:07:08

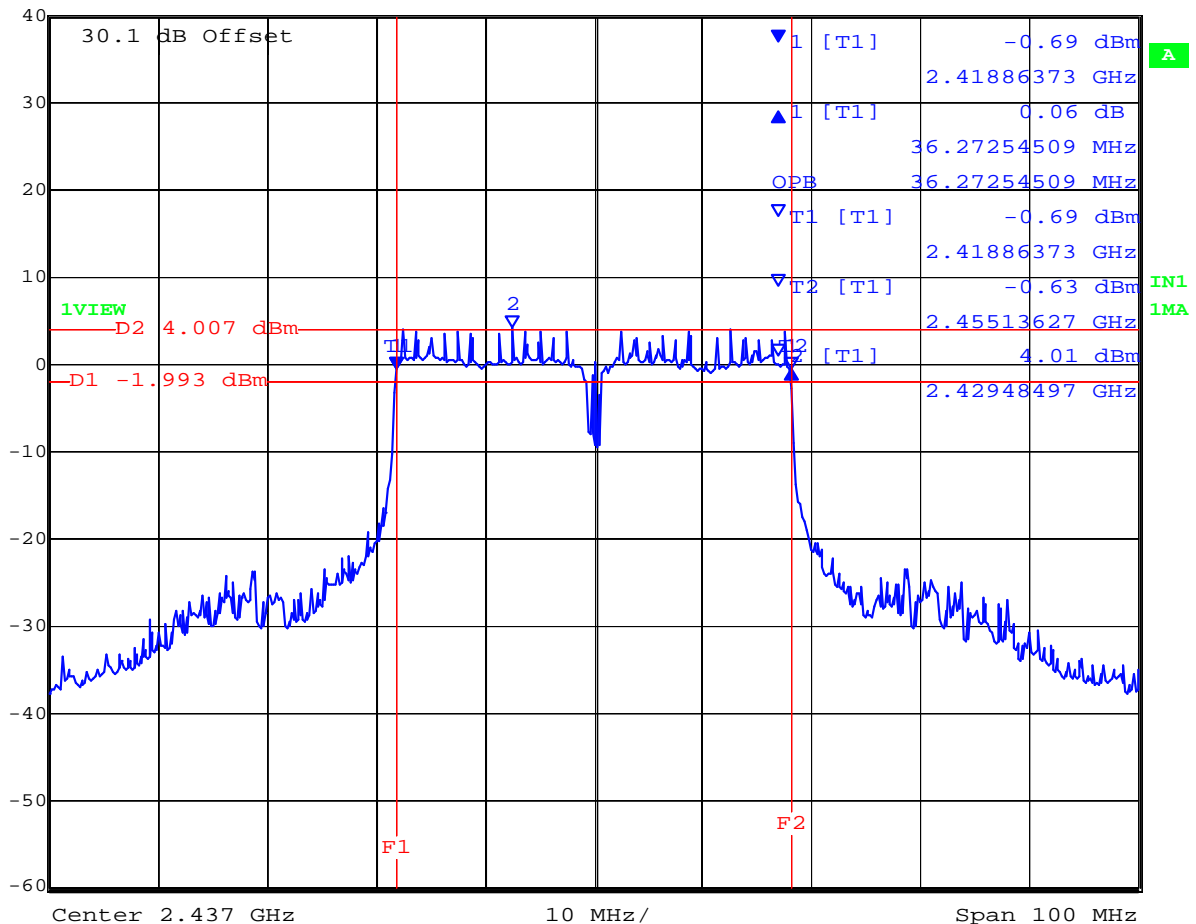
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2,437 MHz 802.11n HT-40 6 dB and 99% Bandwidth

Max/Ref Lvl Delta 1 [T1] RBW 100 kHz RF Att 20 dB
40 dBm 0.06 dB VBW 300 kHz
10.1 dBm 36.27254509 MHz SWT 20 s Unit dBm



Date: 17.FEB.2008 18:05:42

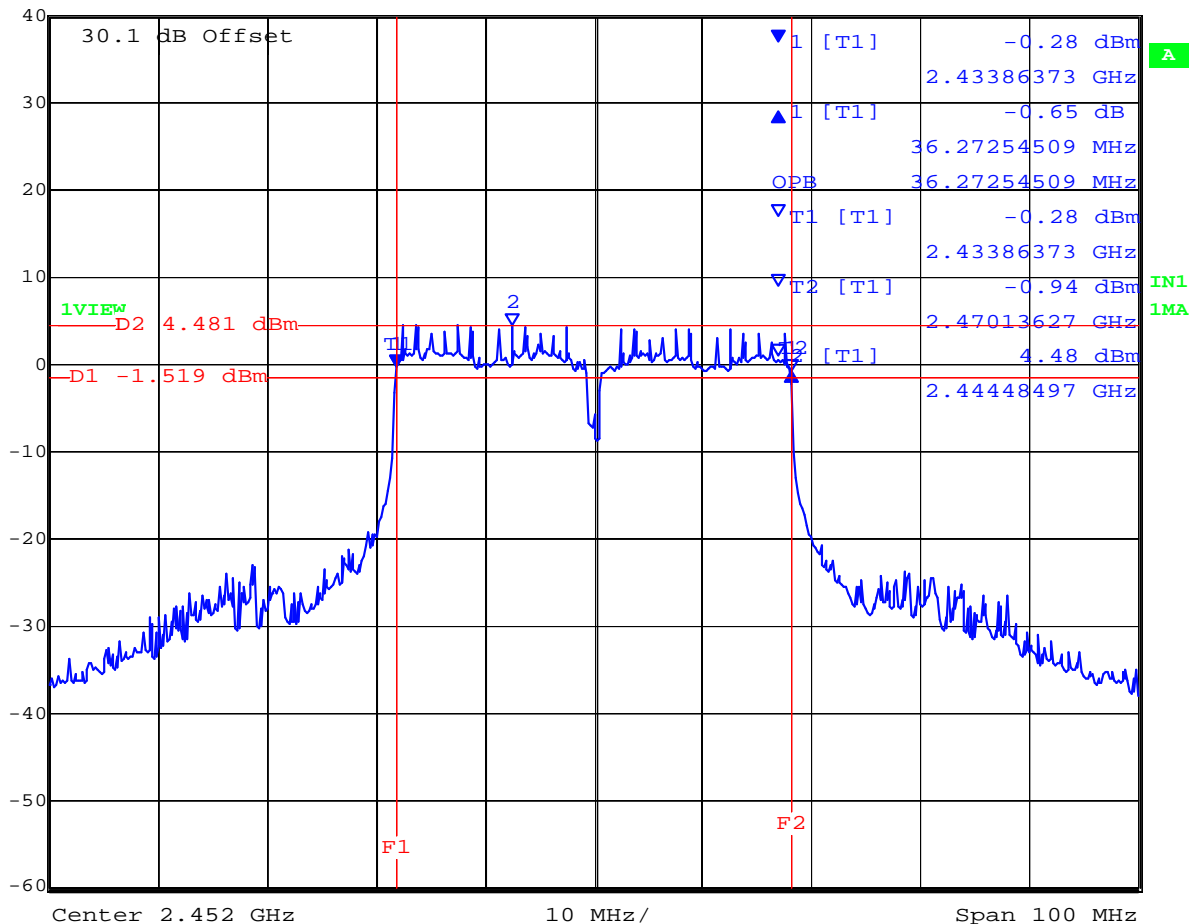
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2,452 MHz 802.11n HT-40 6 dB and 99% Bandwidth

Max/Ref Lvl Delta 1 [T1] RBW 100 kHz RF Att 20 dB
40 dBm -0.65 dB VBW 300 kHz
10.1 dBm 36.27254509 MHz SWT 20 s Unit dBm



Date: 17.FEB.2008 18:04:16

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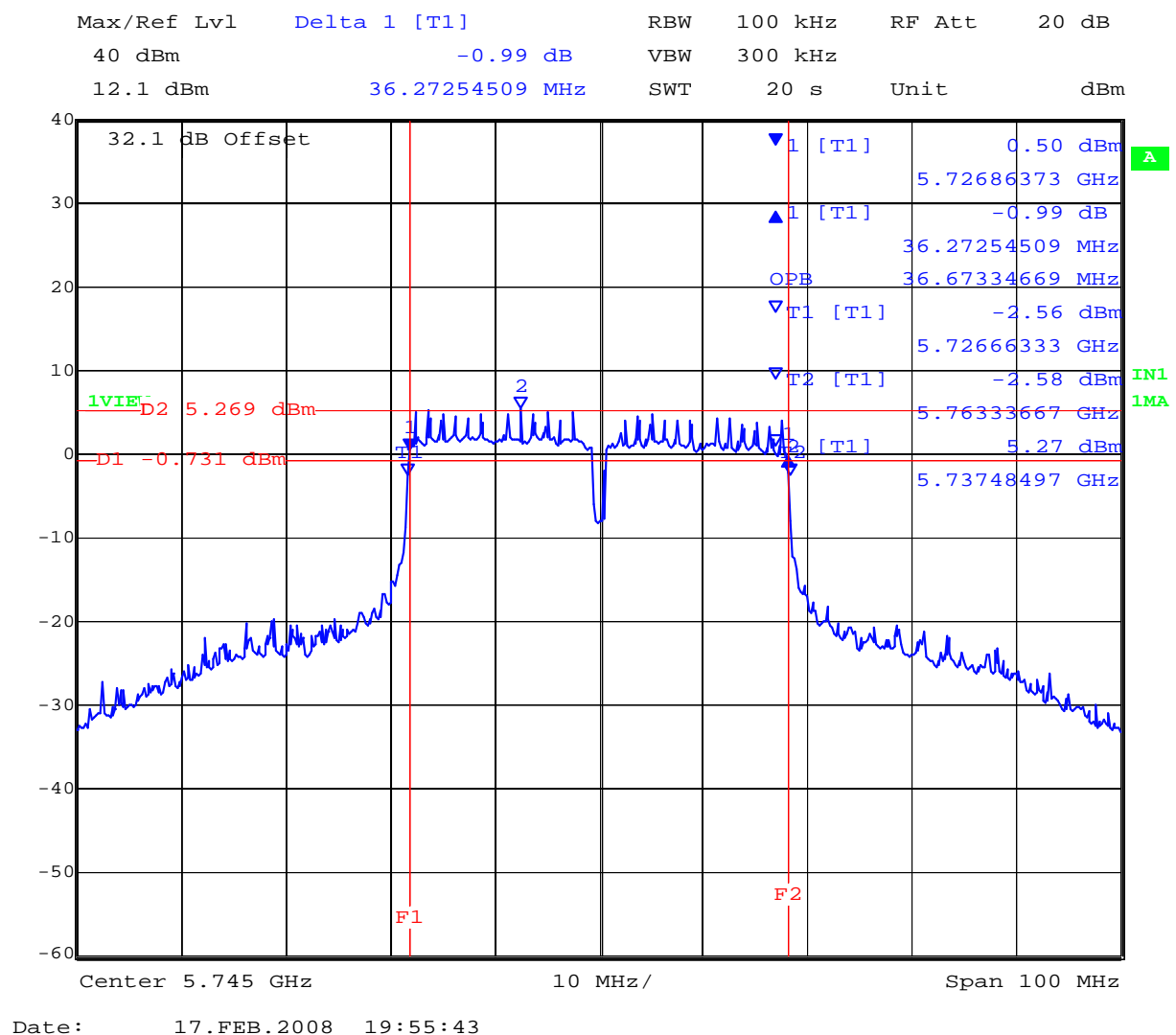


Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11n - HT-40

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
5,745	36.273	36.673
5,785	36.273	36.473
5,825	36.273	36.473

5,745 MHz 802.11n HT-40 6 dB and 99% Bandwidth

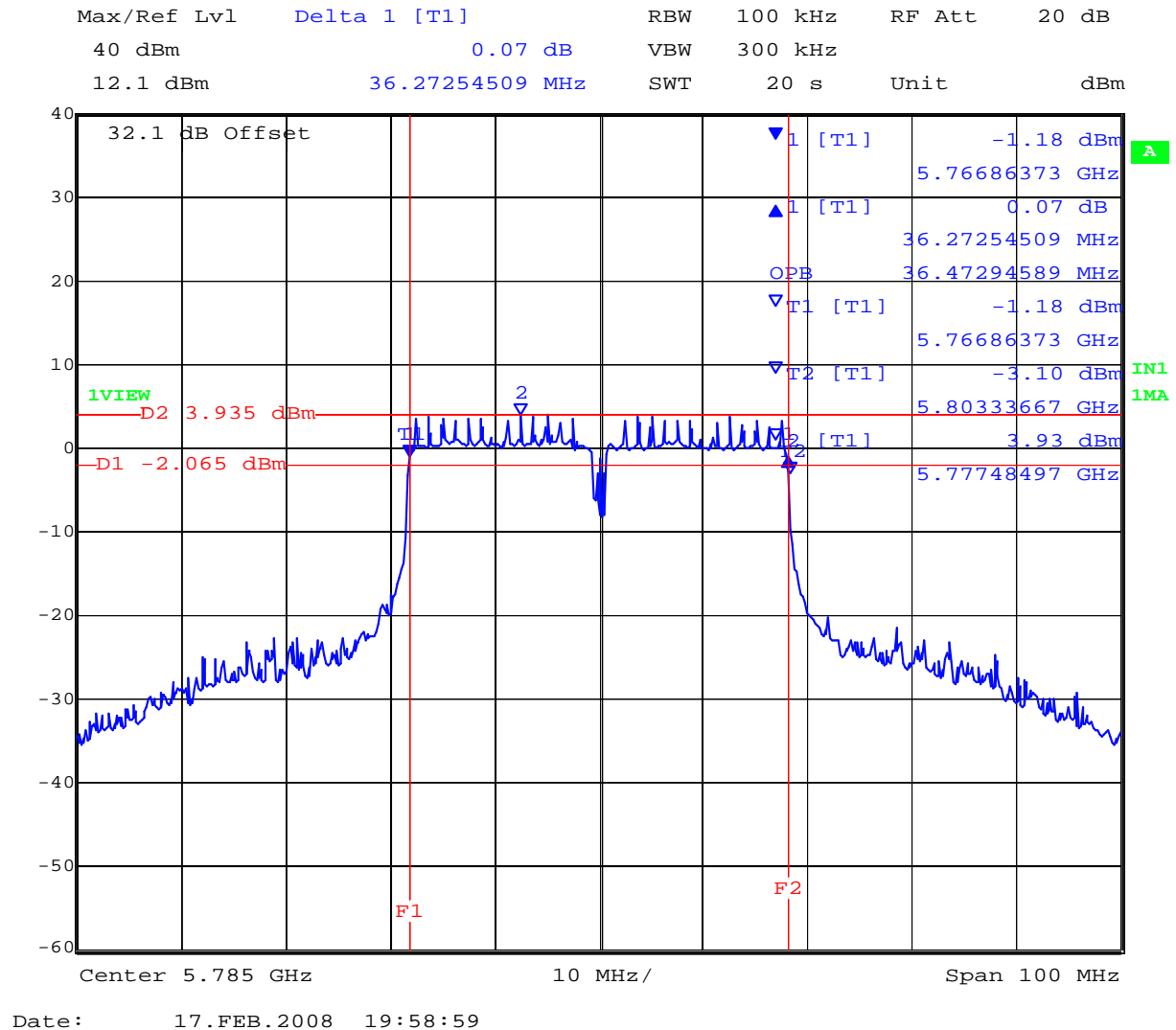


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5,785 MHz 802.11n HT-40 6 dB and 99% Bandwidth

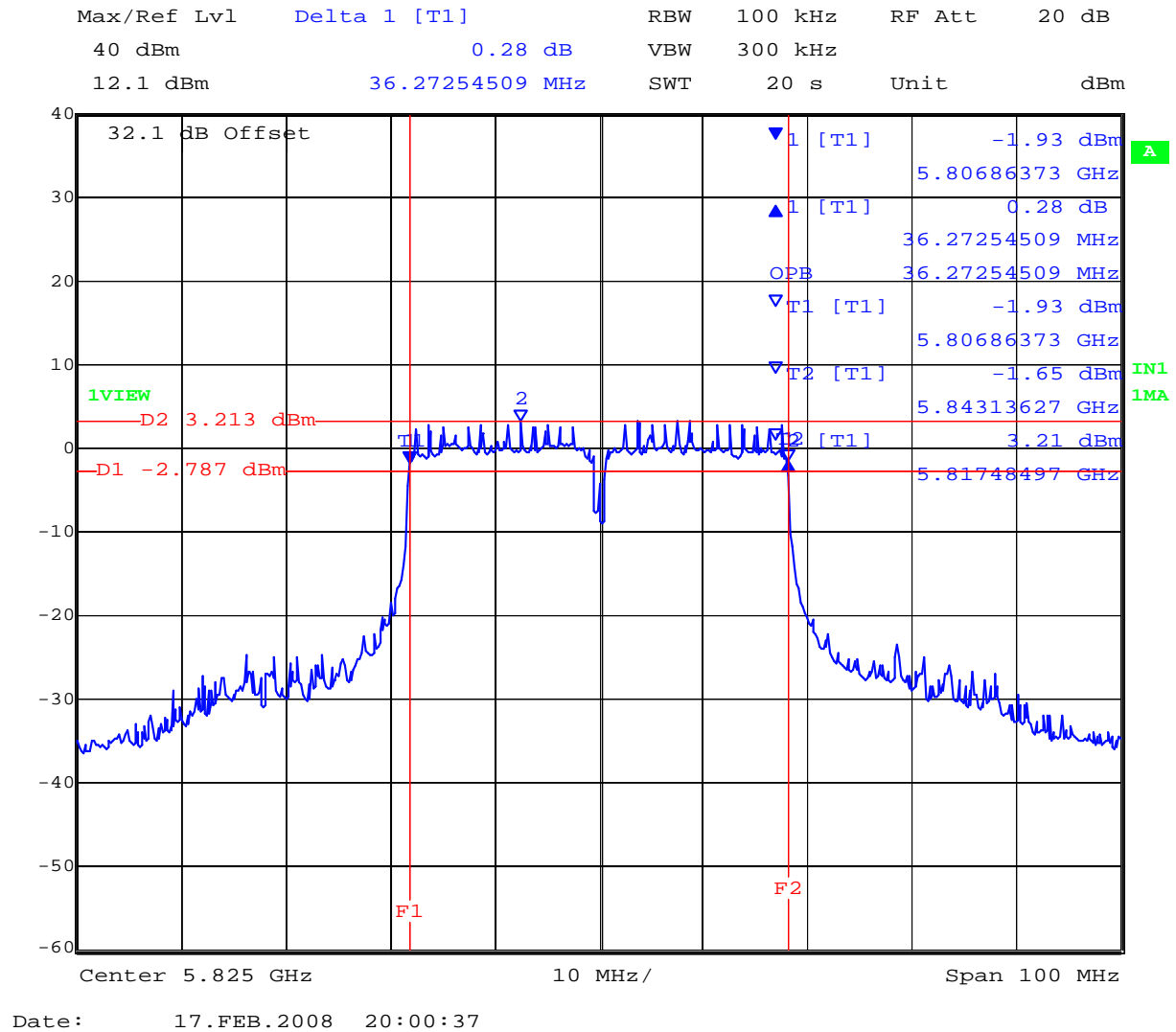


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5,825 MHz 802.11n HT-40 6 dB and 99% Bandwidth



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Specification

Limits

§15.247 (a)(2) & RSS-210 §A8.2(1)

The minimum 6 dB bandwidth shall be at least 500 kHz.

§ IC RSS-Gen 4.4.1 Occupied Bandwidth When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

§ IC RSS-Gen 4.4.2 6 dB Bandwidth Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in-band spectral density of the modulated signal, with the transmitter modulated by a representative signal.

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB
-------------------------	----------

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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5.1.2. Peak Output Power

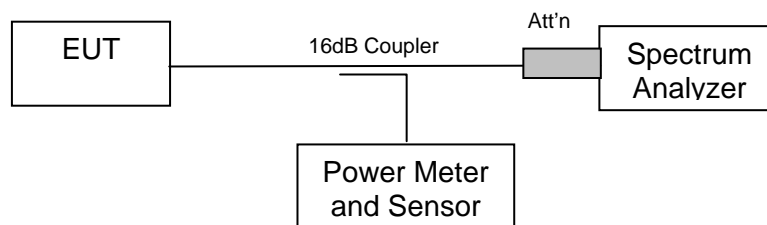
FCC, Part 15 Subpart C §15.247(b)(3), §15.31(e)

Industry Canada RSS-210 §A8.4(4)

Test Procedure

The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure peak power. The resolution filter bandwidth was set to 6 dB, peak detector selected and the analyzer built-in power function was used to measure peak power over the 99 % bandwidth.

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

b/g (2.4 GHz) Maximum Antenna Gain = AP-ANT-1B, +3.8 dBi

a (5.8 GHz) Maximum Antenna Gain = AP-ANT-1B, +5.8 dBi

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Type	Gain (dBi)	Antenna Gain >6dBi (dB)	Power Reduction (dB)	Max. Allowable Conducted Peak Power (dBm)	Maximum EIRP (dBm)
(2.4 GHz) AP-ANT-1B	+3.8	No	0	+30	+36
(5.8 GHz) AP-ANT-1B	+5.8	No	0	+30	+36

Radio Parameters

Duty Cycle: 100%

Output: Modulated Carrier

Power: Maximum Default Power



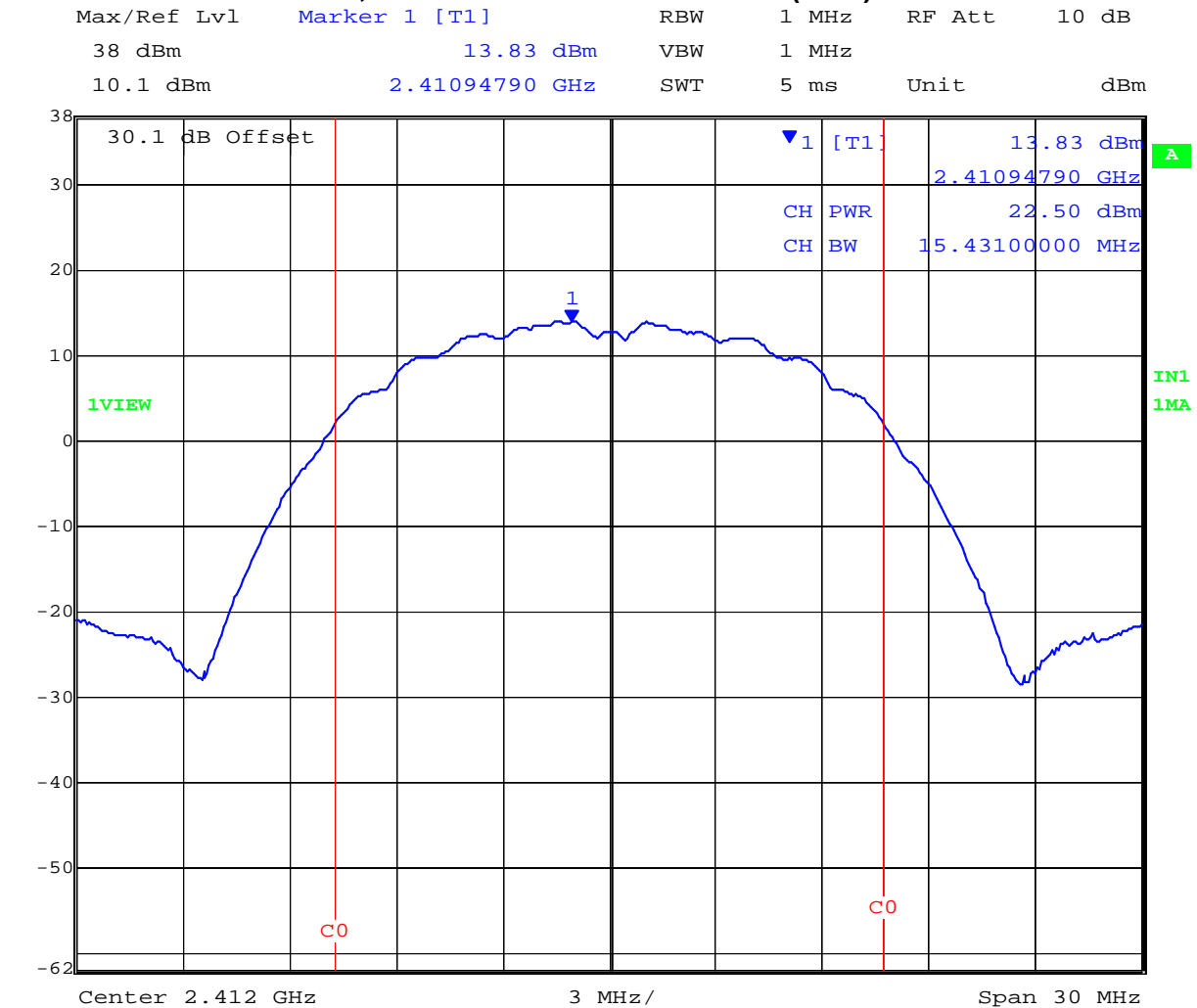
Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11b – Legacy

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) (3.8 dBi Antenna Gain)
2,412	19	15.331	+19.05	+22.50	+26.3
2,437	19	15.431	+18.79	+22.04	+25.8
2,462	19	15.431	+19.01	+22.47	+26.3

2,412 MHz 802.11b - Peak Power (dBm)



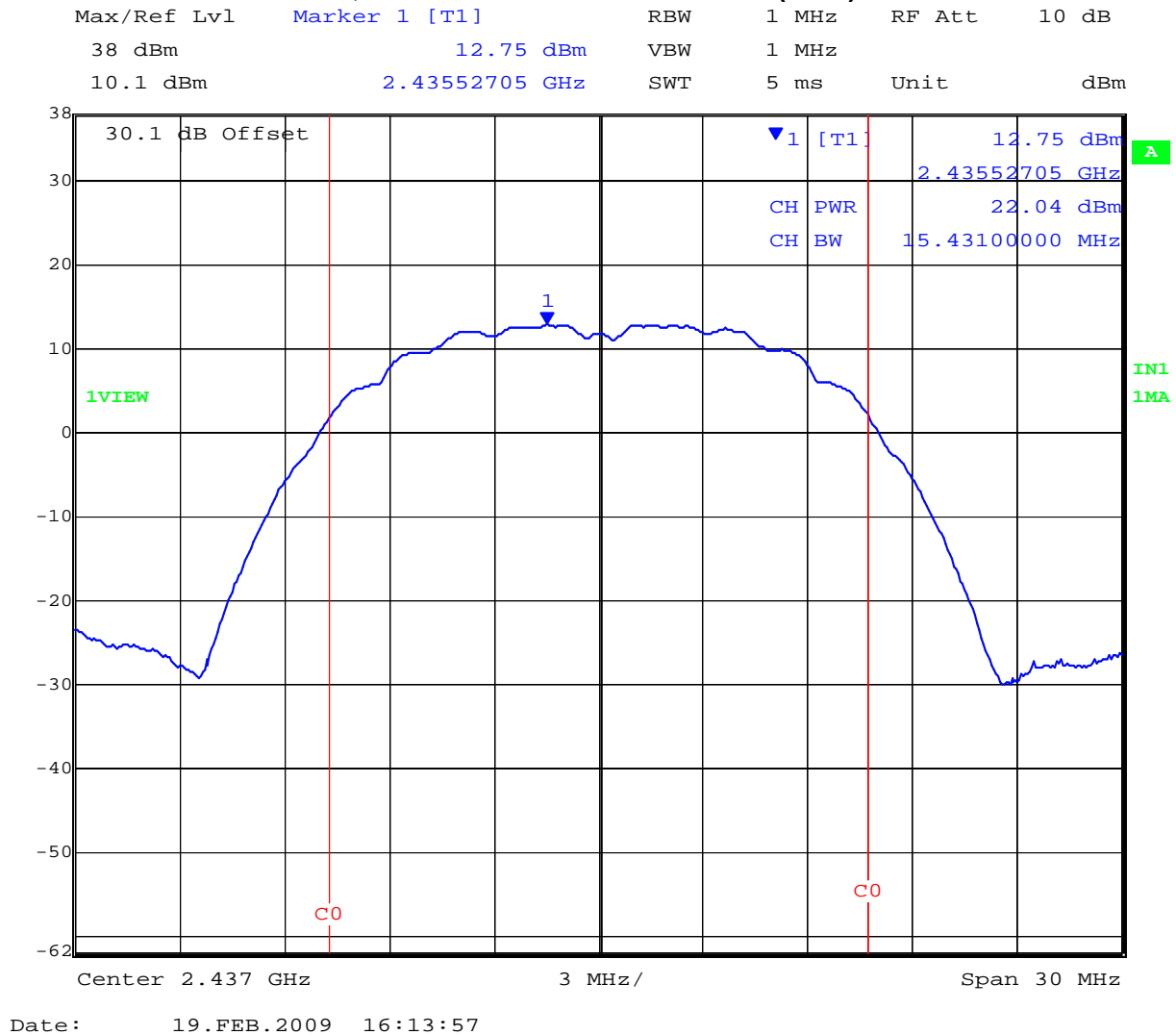
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2,437 MHz 802.11b - Peak Power (dBm)



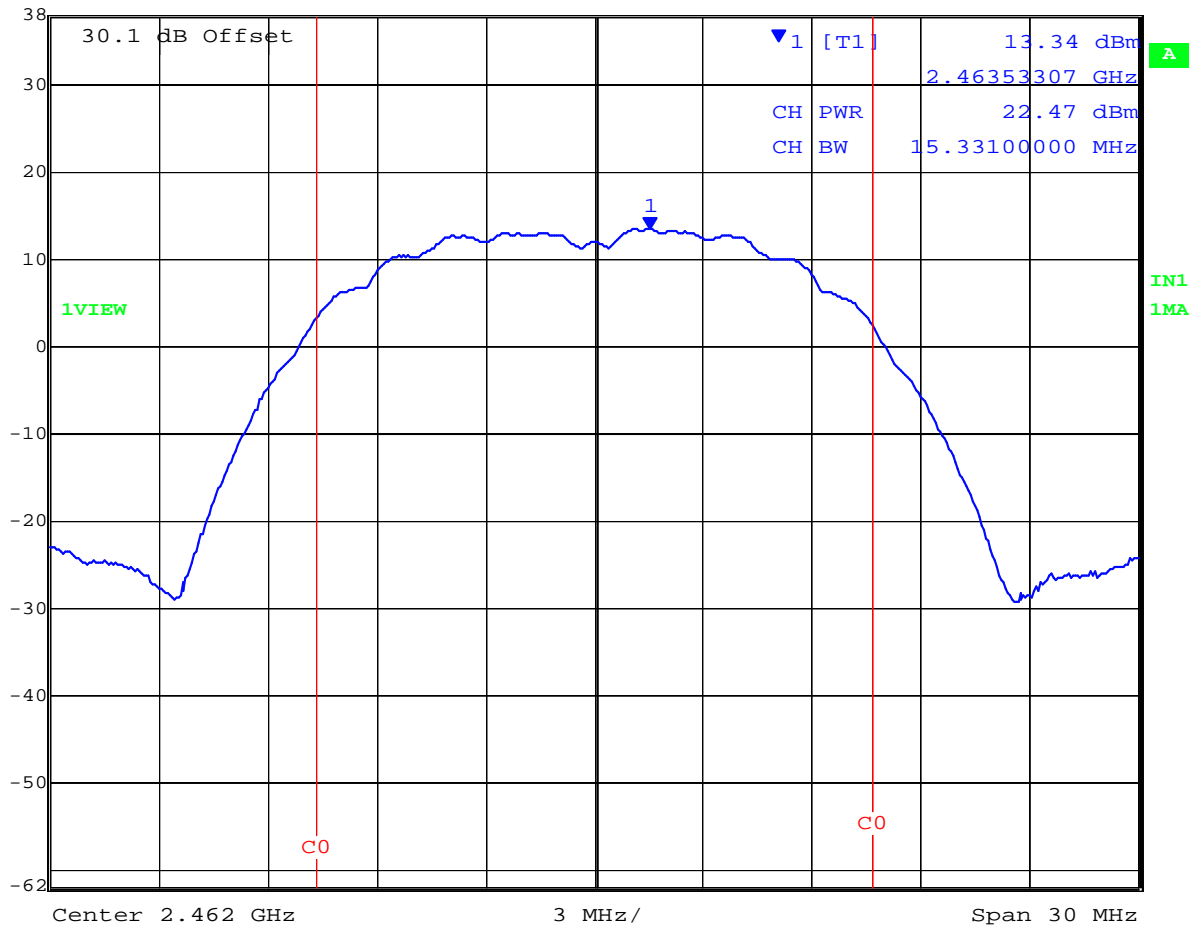
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Title: 651-XX 802.11a/b/g/n Wireless Controller
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2,462 MHz 802.11b - Peak Power (dBm)

Max/Ref Lvl	Marker 1 [T1]	RBW	1 MHz	RF Att	10 dB
38 dBm	13.34 dBm	VBW	1 MHz		
10.1 dBm	2.46353307 GHz	SWT	5 ms	Unit	dBm



Date: 19.FEB.2009 16:12:47

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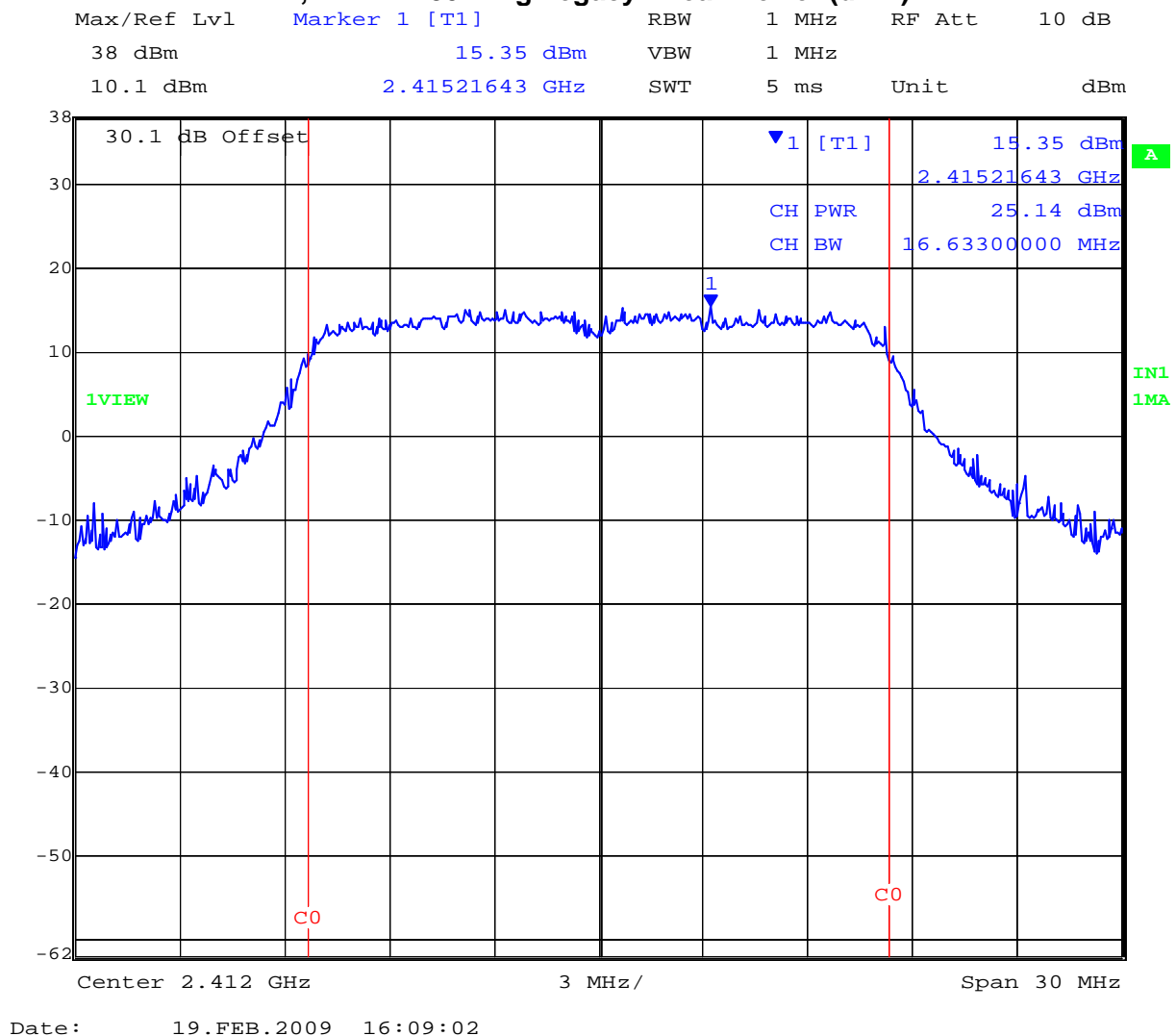
Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11g – Legacy

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) (3.8 dBi Antenna Gain)
2,412	18	16.333	+18.11	+25.14	+28.9
2,437	18	16.333	+17.80	+25.13	+28.9
2,462	18	16.333	+17.99	+25.23	+29.0

2,412 MHz 802.11g Legacy - Peak Power (dBm)

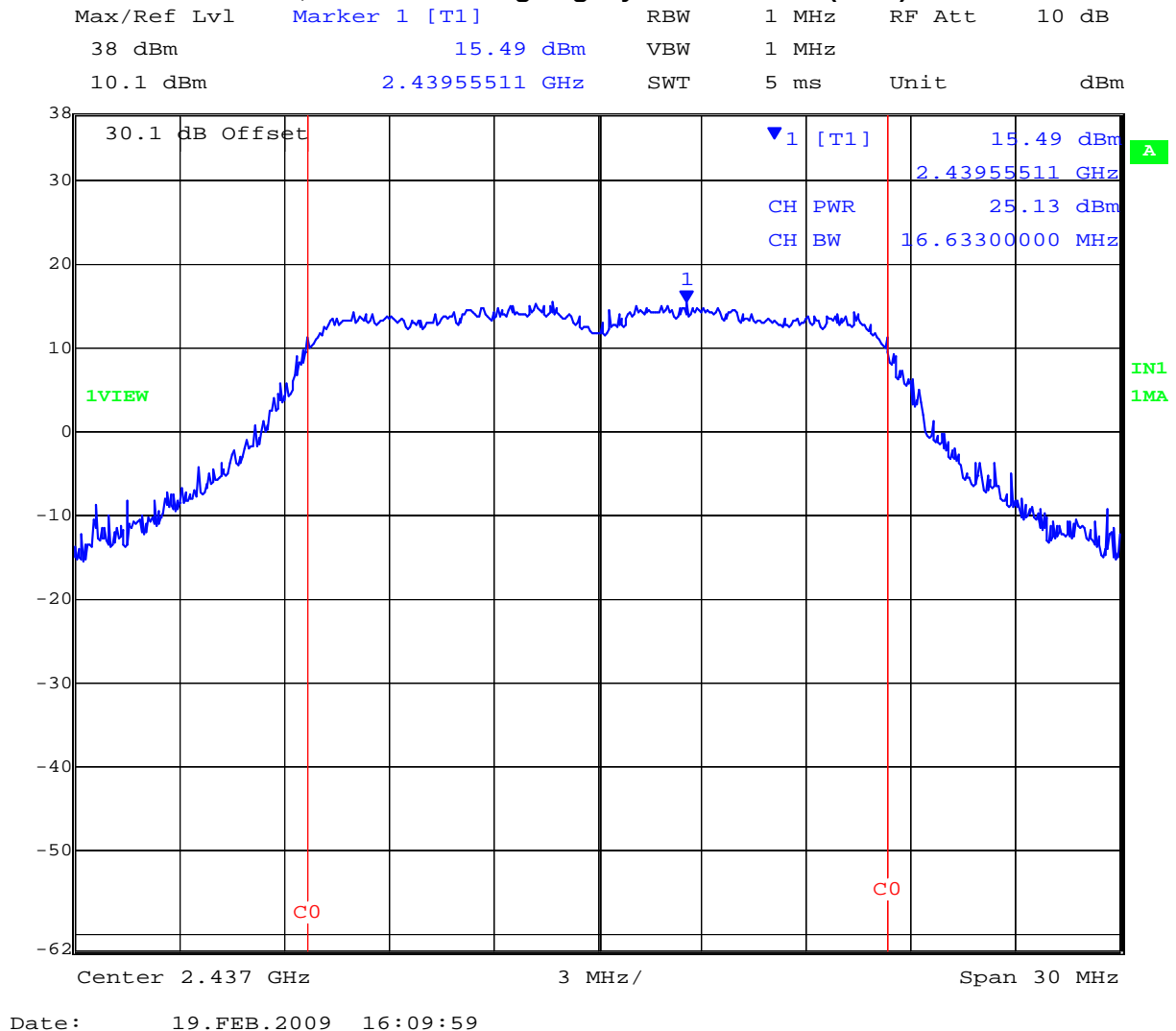


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2,437 MHz 802.11g Legacy - Peak Power (dBm)

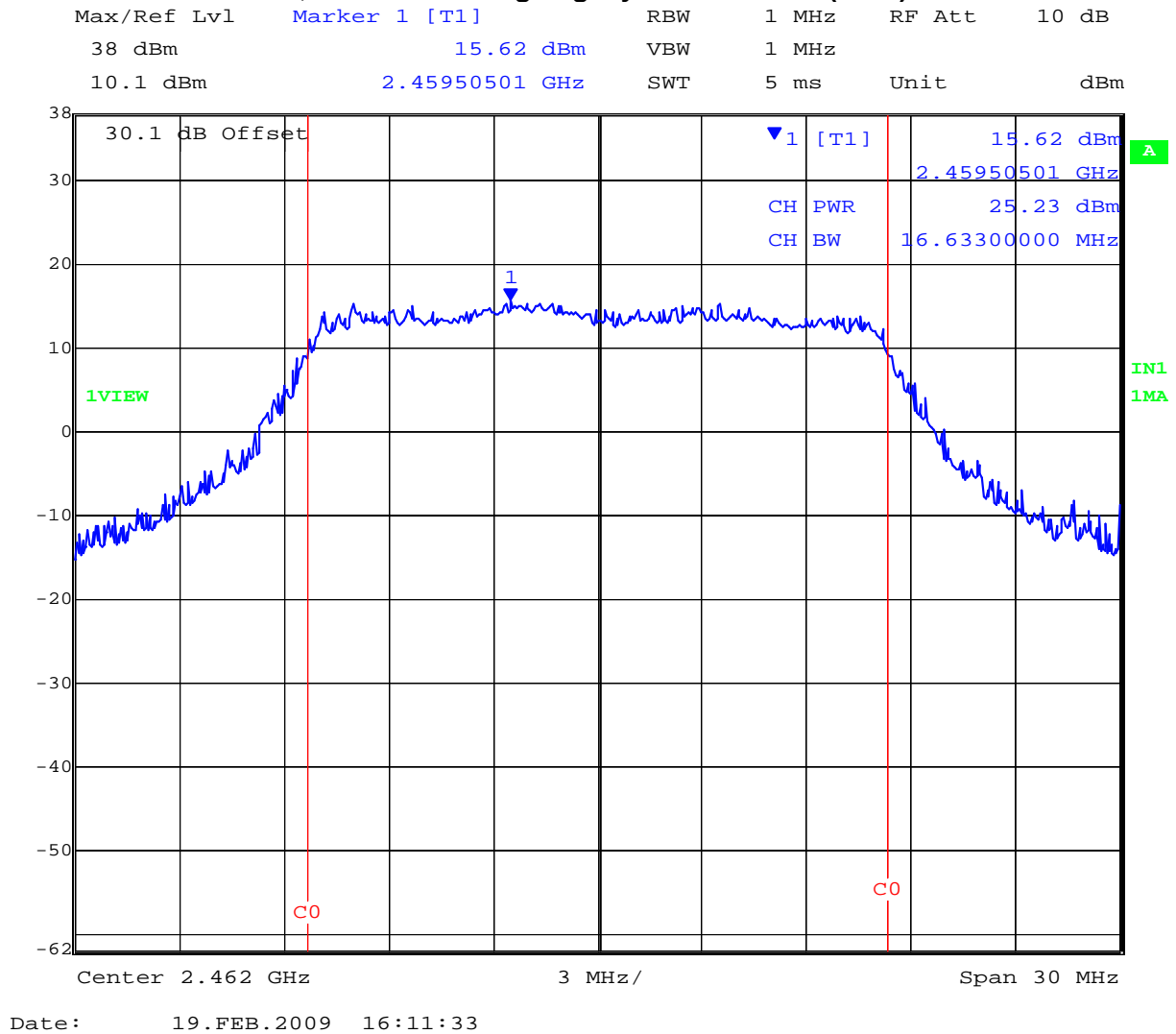


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2,462 MHz 802.11g Legacy - Peak Power (dBm)



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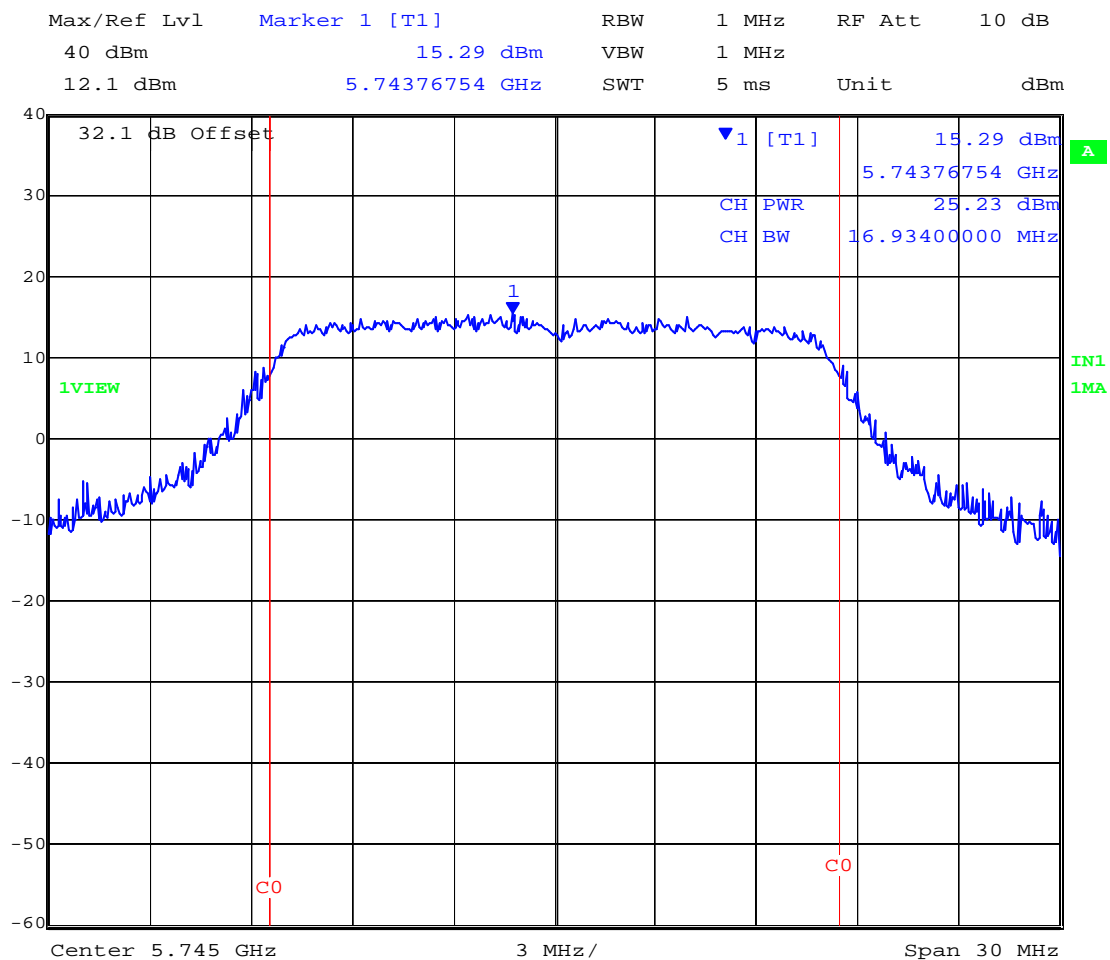
Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11a – Legacy

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) (5.8 dBi Antenna Gain)
5,745	19	16.934	+18.76	+25.23	+31.0
5,785	19	16.633	+17.61	+24.36	+30.2
5,825	19	16.633	+16.97	+24.07	+29.9

5,745 MHz 802.11a Legacy Peak Power (dBm)



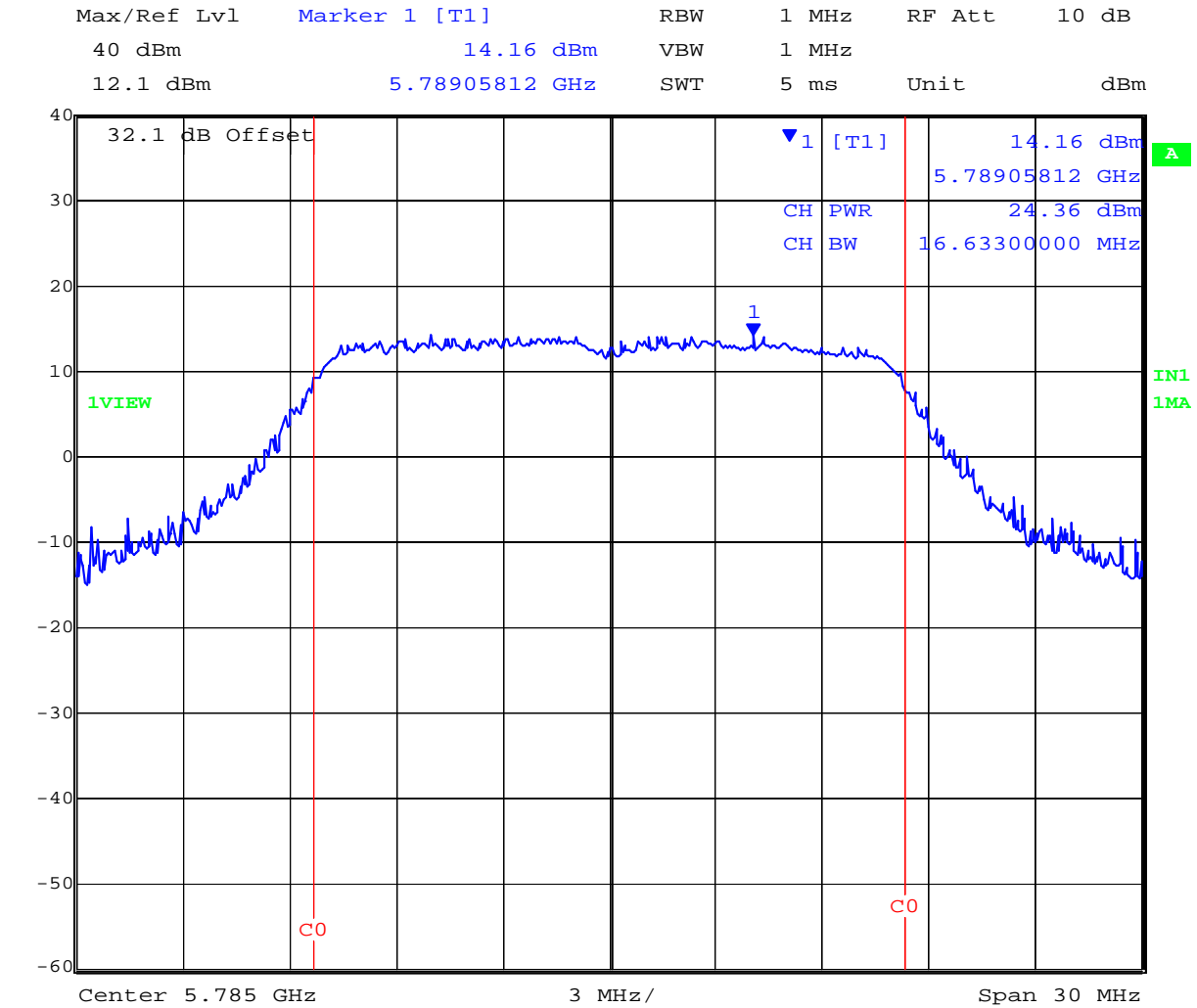
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5,785 MHz 802.11a Legacy Peak Power (dBm)



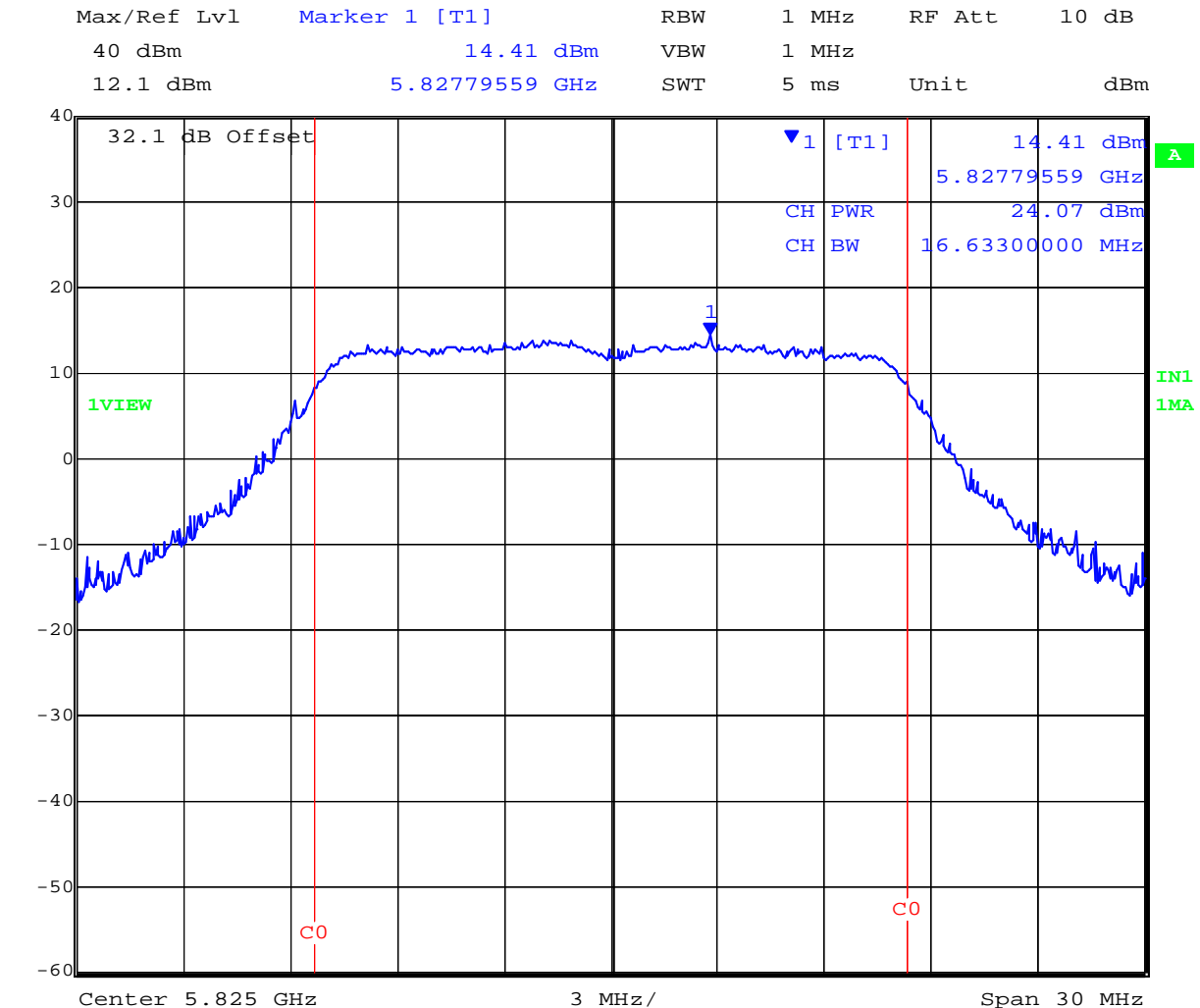
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5,825 MHz 802.11a Legacy Peak Power (dBm)



Date: 19.FEB.2009 15:47:27

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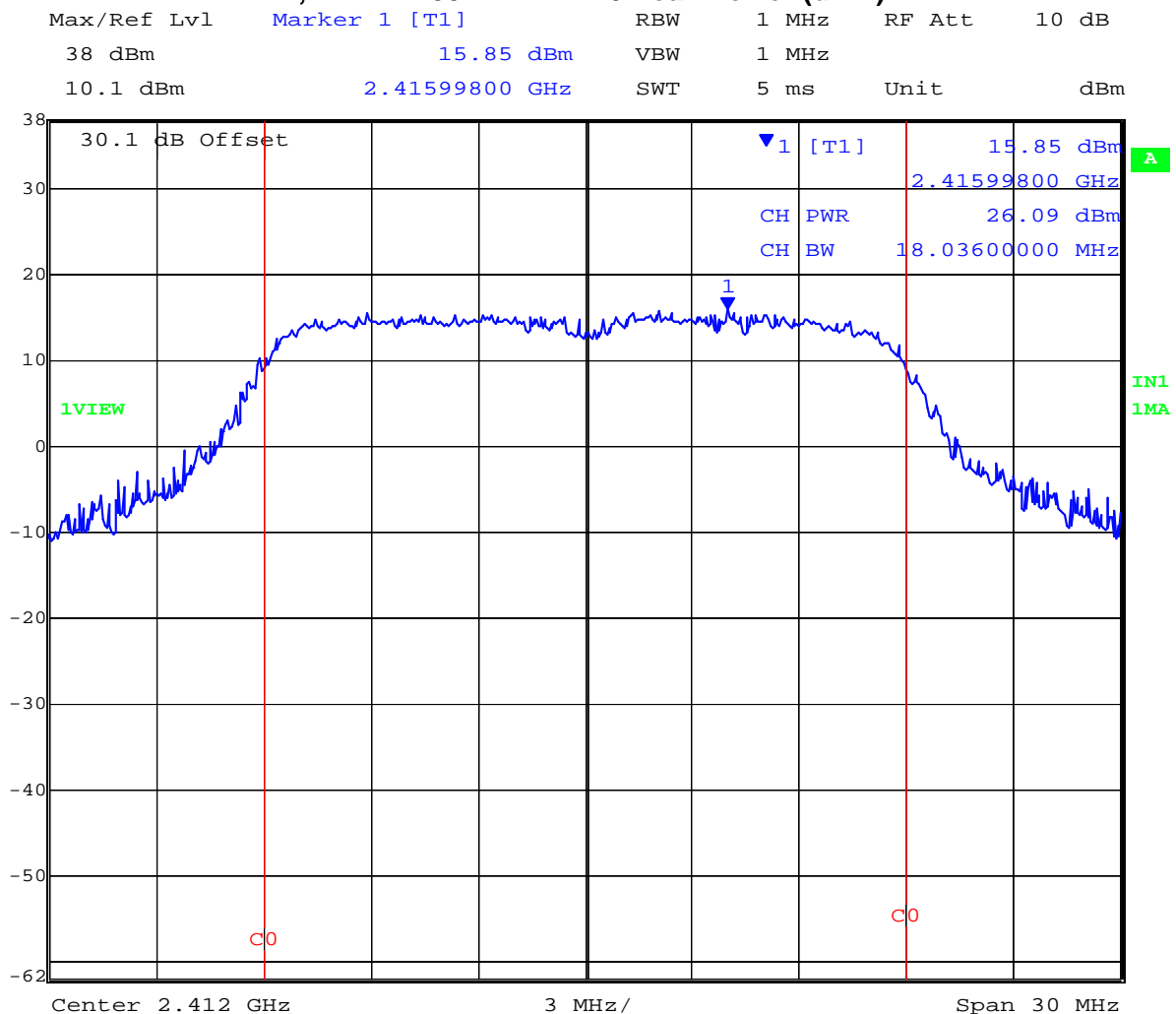
Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11n – HT-20

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) (3.8 dBi Antenna Gain)
2,412	19	18.036	+19.05	+26.09	+29.9
2,437	19	17.836	+18.74	+26.21	+30.0
2,462	19	17.836	+18.92	+26.41	+30.2

2,412 MHz 802.11n HT-20 Peak Power (dBm)



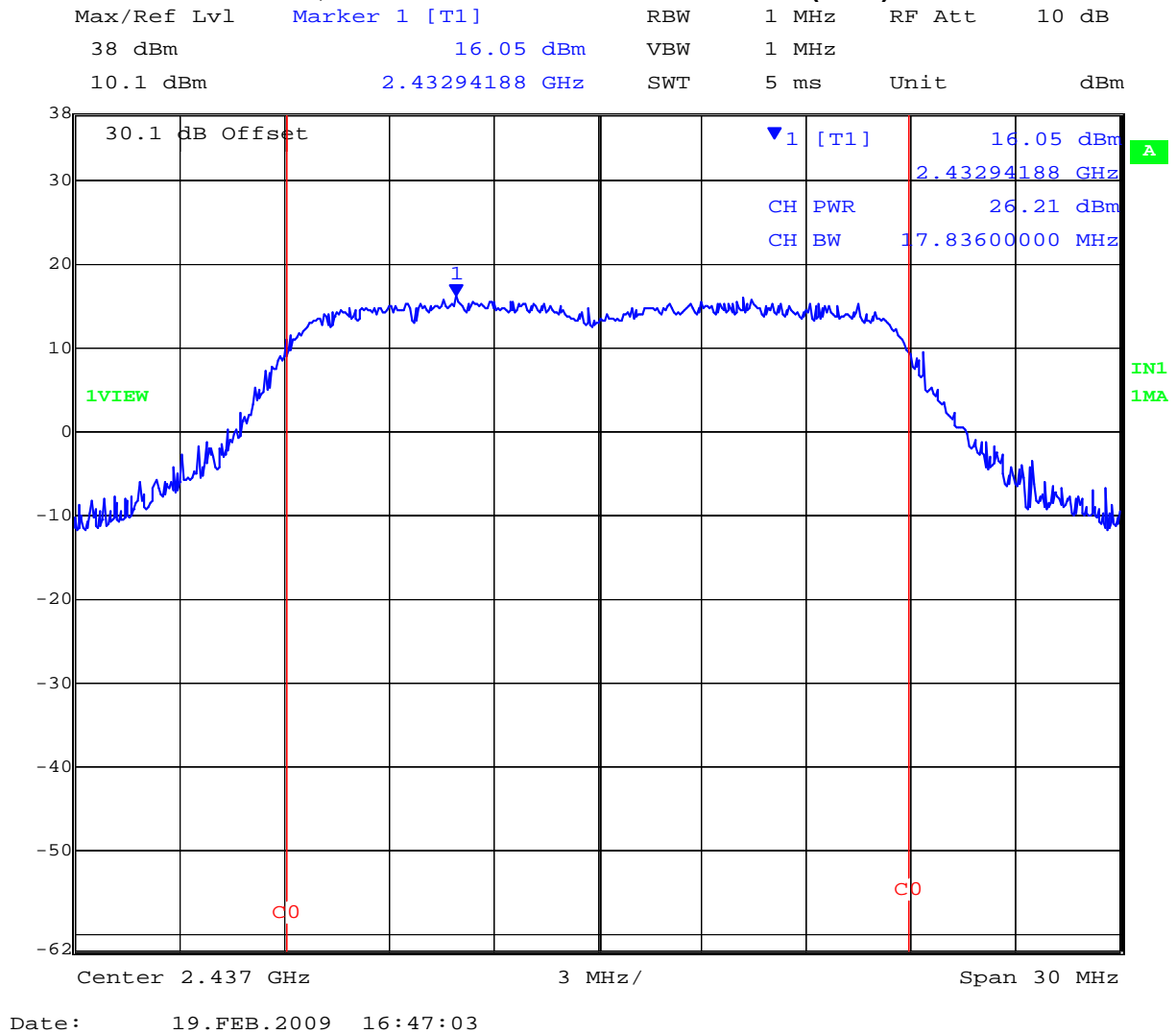
Date: 19.FEB.2009 16:37:54

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2,437 MHz 802.11n HT-20 Peak Power (dBm)

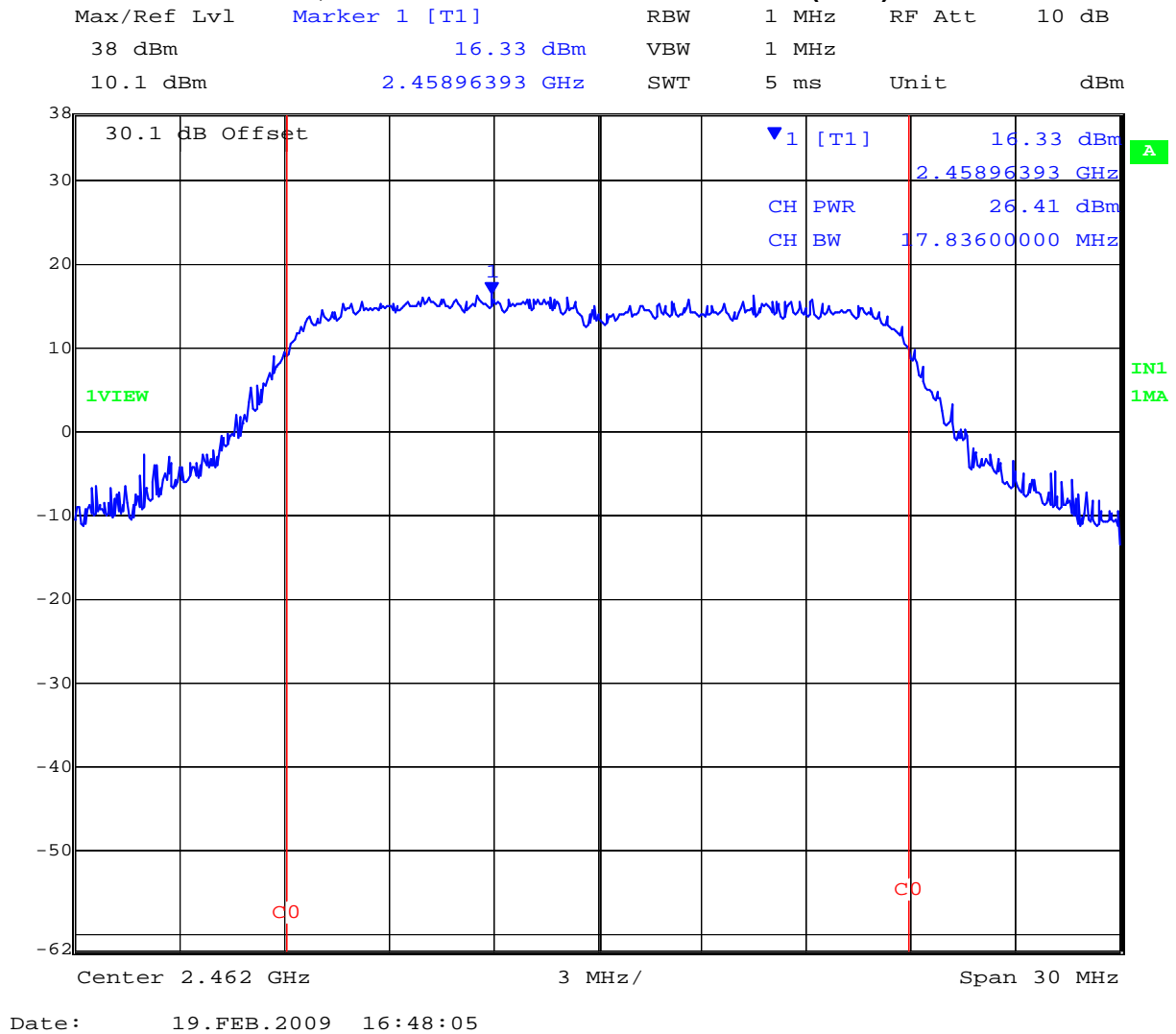


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To: FCC 47 CFR Part 15.247 & IC RSS-210
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2,462 MHz 802.11n HT-20 Peak Power (dBm)



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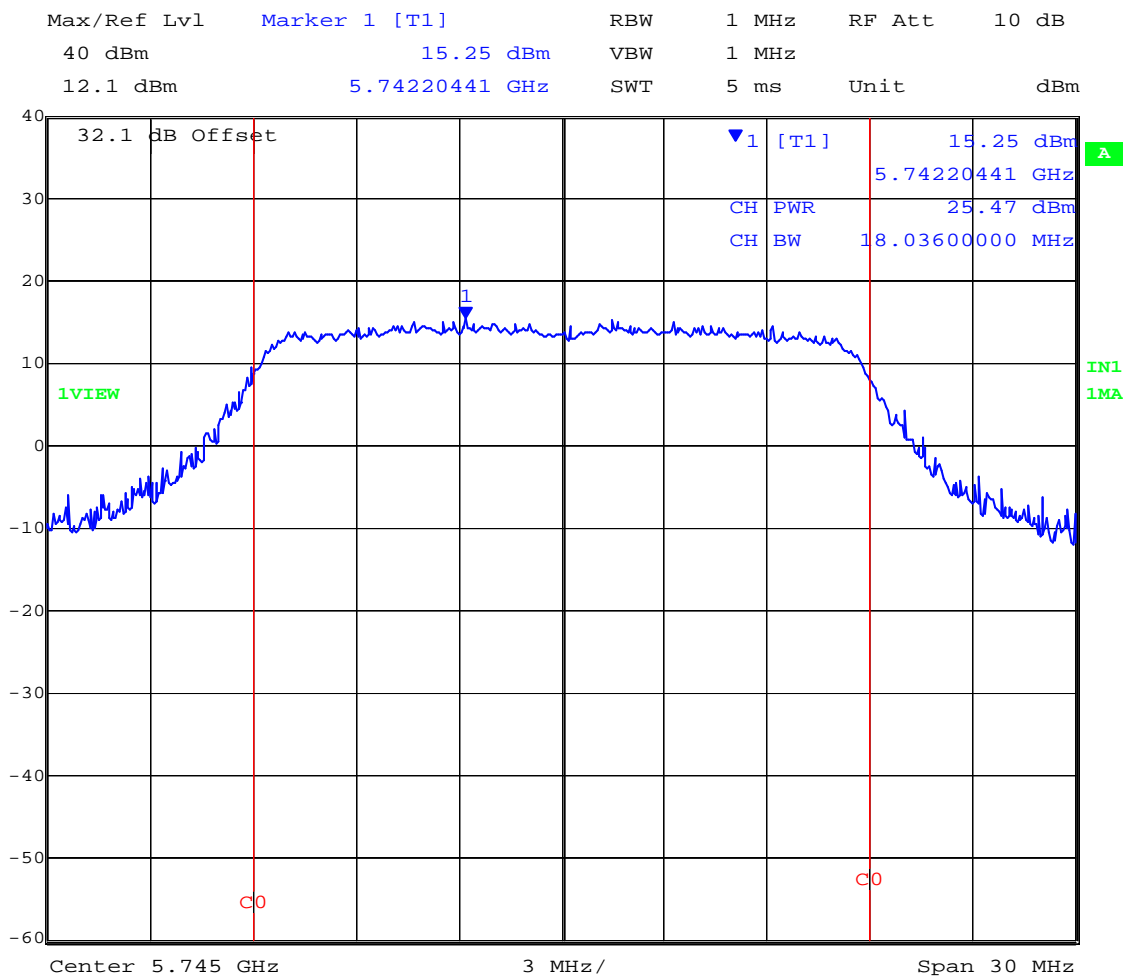
Title: 651-XX 802.11a/b/g/n Wireless Controller
To: FCC 47 CFR Part 15.247 & IC RSS-210
Serial #: ARUB28-A2 Rev A
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TABLE OF RESULTS – 802.11n – HT-20

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) (5.8 dBi Antenna Gain)
5,745	19	18.036	+18.72	+25.47	+31.3
5,785	19	17.836	+17.52	+24.59	+30.4
5,825	19	17.836	+16.89	+24.02	+29.8

5,745 MHz 802.11n HT-20 Peak Power (dBm)



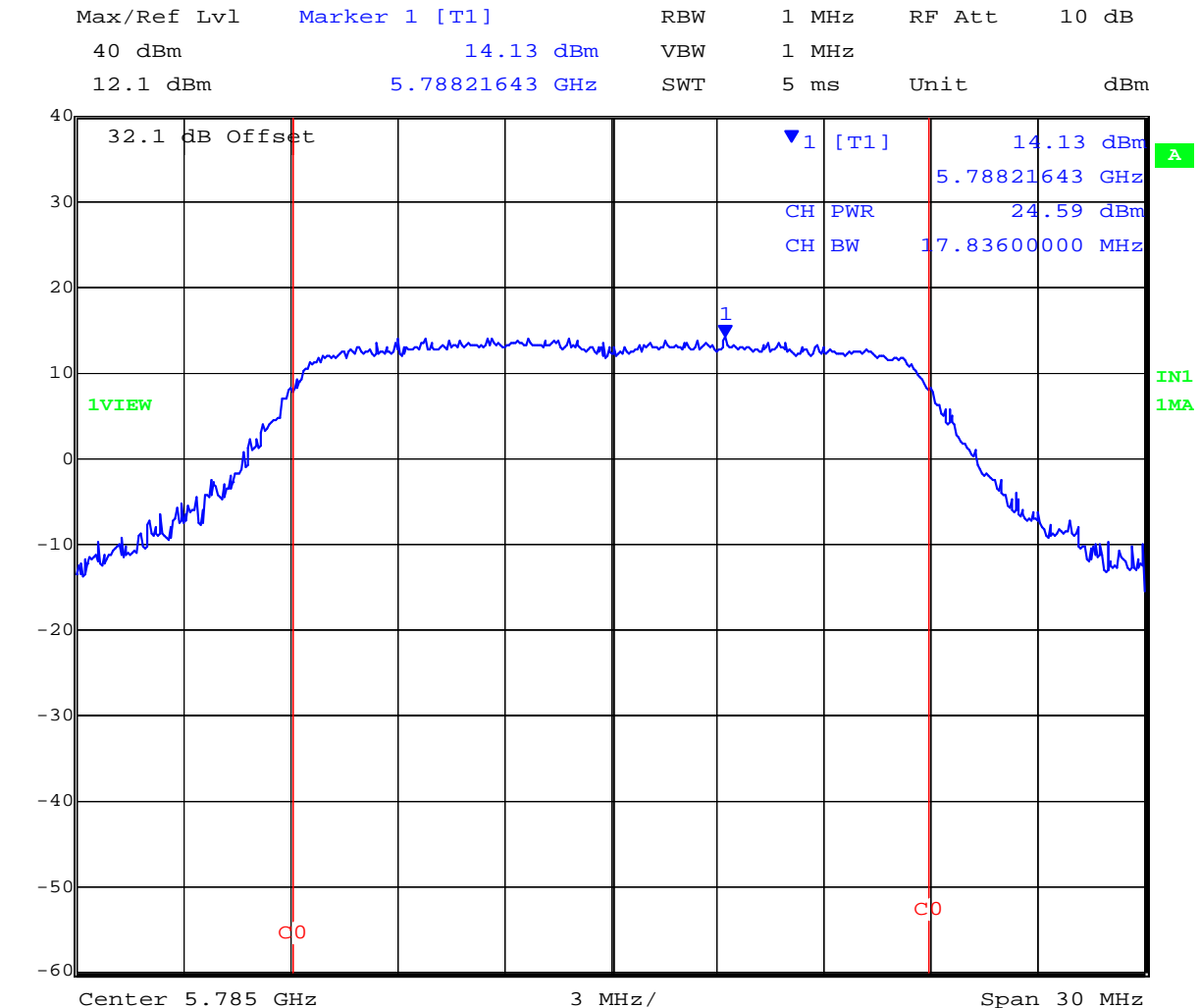
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5,785 MHz 802.11n HT-20 Peak Power (dBm)



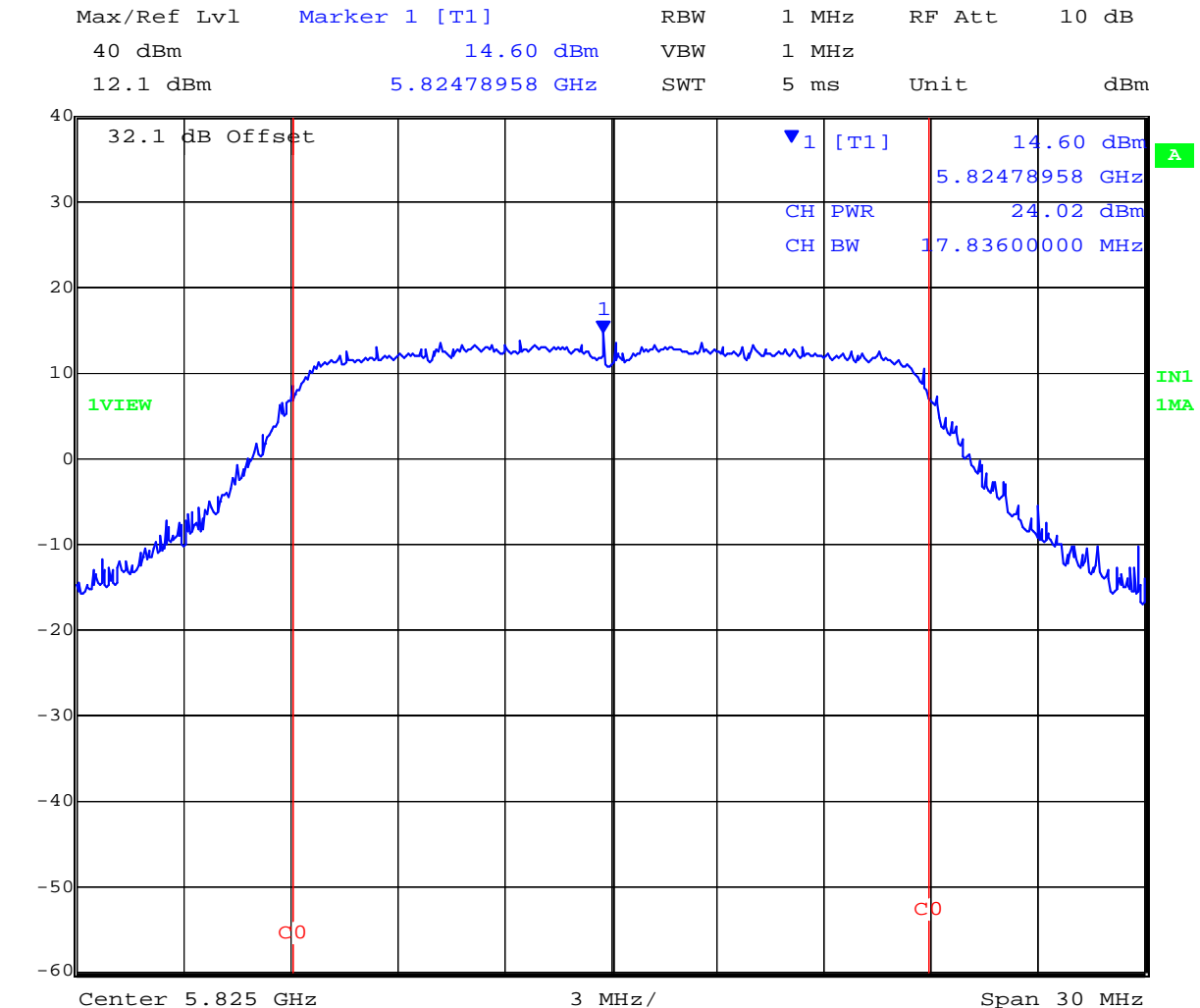
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5,825 MHz 802.11n HT-20 Peak Power (dBm)



Date: 19.FEB.2009 15:55:59

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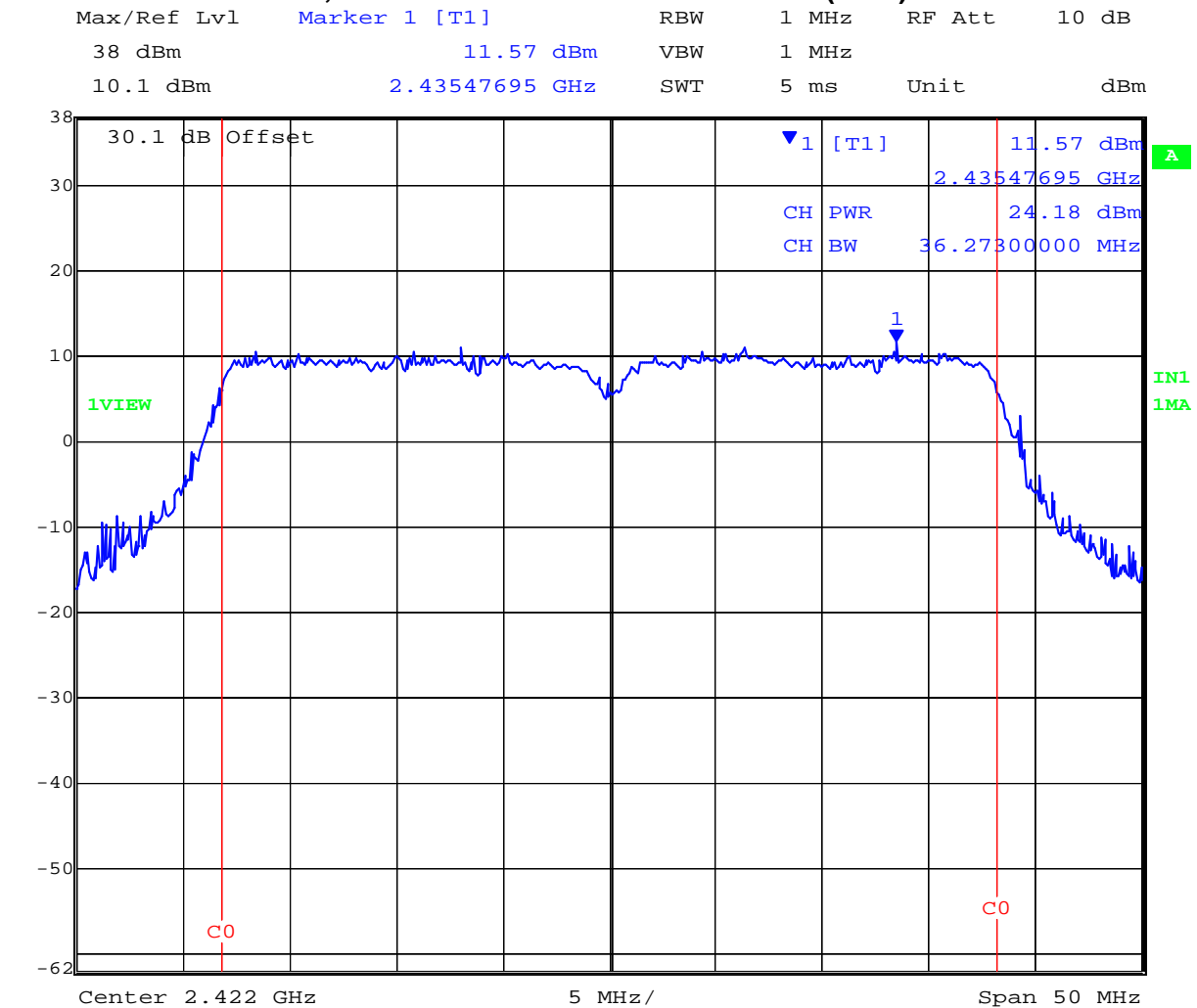
Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11n – HT-40

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) (3.8 dBi Antenna Gain)
2,422	18	36.273	+16.84	+24.18	+28.0
2,437	18	36.273	+16.47	+24.03	+27.8
2,452	18	36.273	+16.66	+24.33	+28.1

2,422 MHz 802.11n HT-40 Peak Power (dBm)



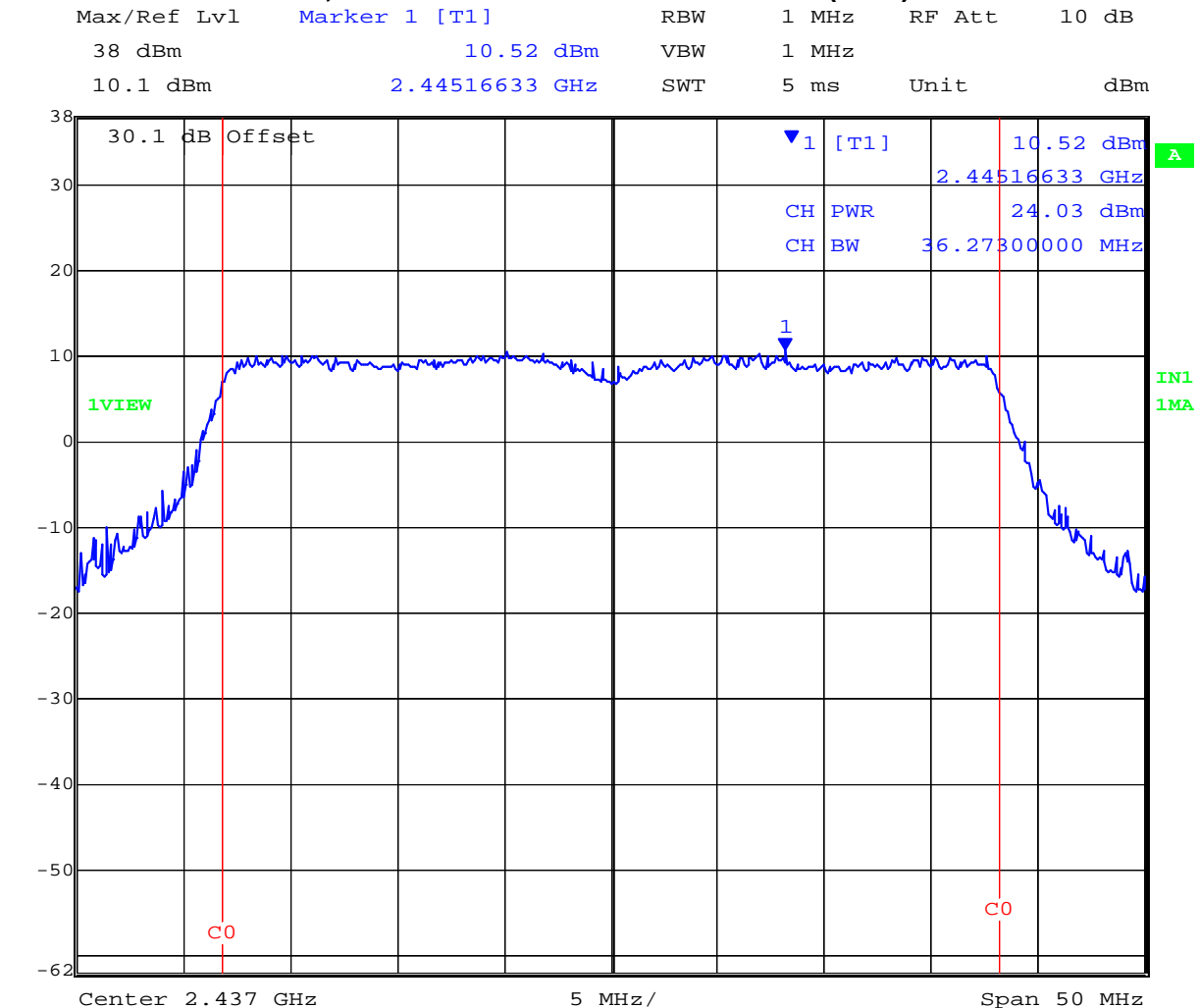
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2,437 MHz 802.11n HT-40 Peak Power (dBm)



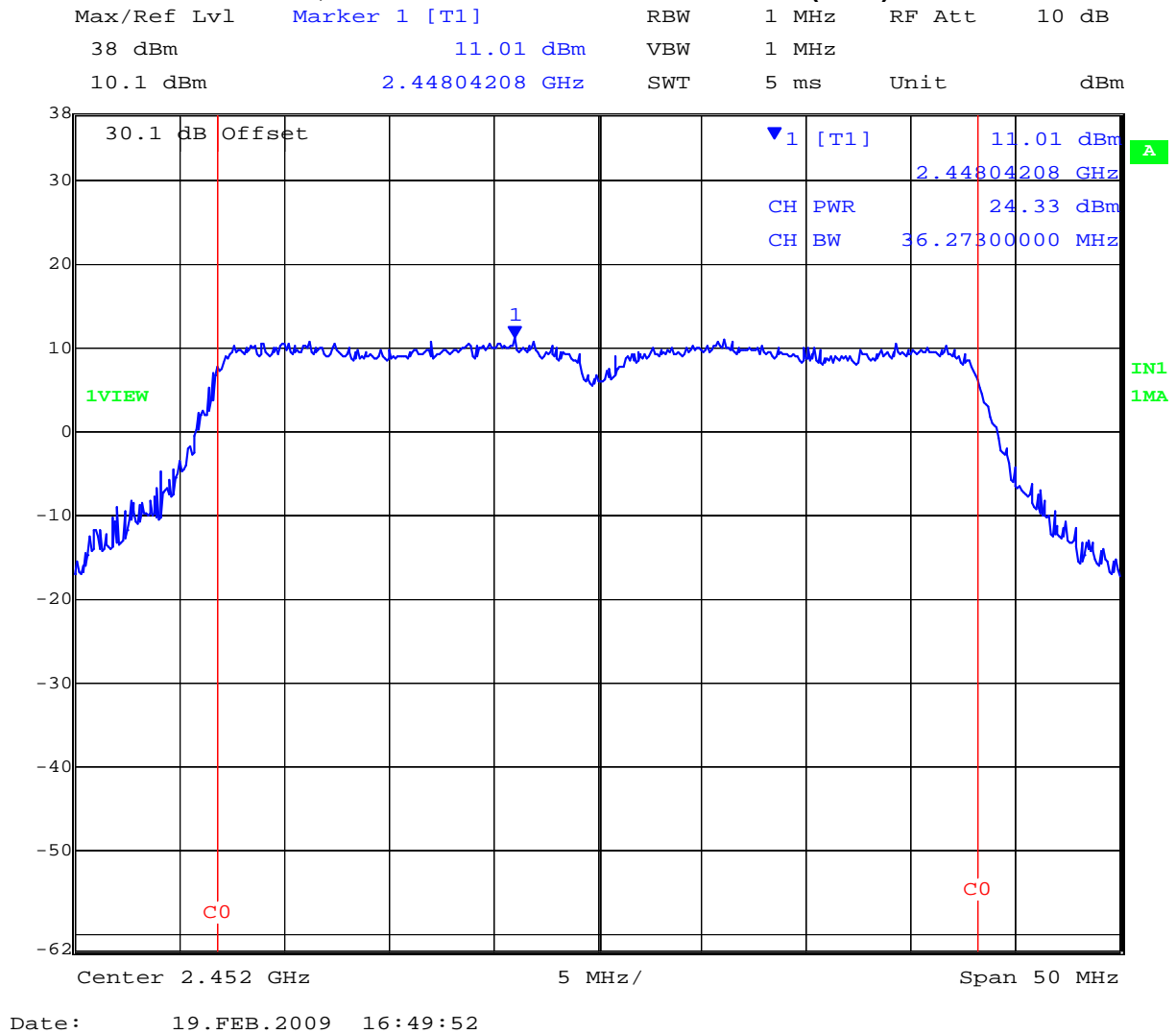
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2,452 MHz 802.11n HT-40 Peak Power (dBm)



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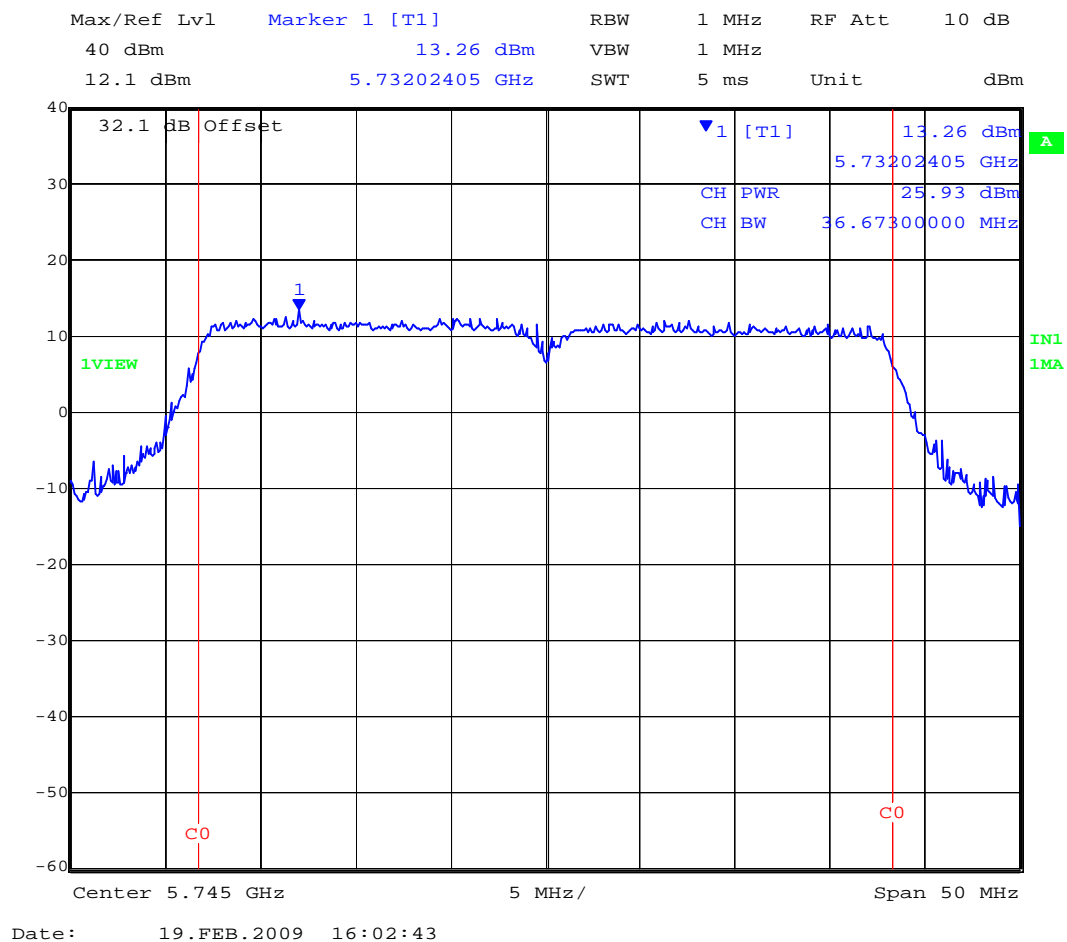
Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11n – HT-40

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) (5.8 dBi Antenna Gain)
5,745	18	36.673	+18.65	+25.93	+31.7
5,785	18	36.473	+17.60	+24.58	+30.4
5,825	18	36.473	+16.64	+24.02	+27.8

5,745 MHz 802.11n HT-40 Peak Power (dBm)

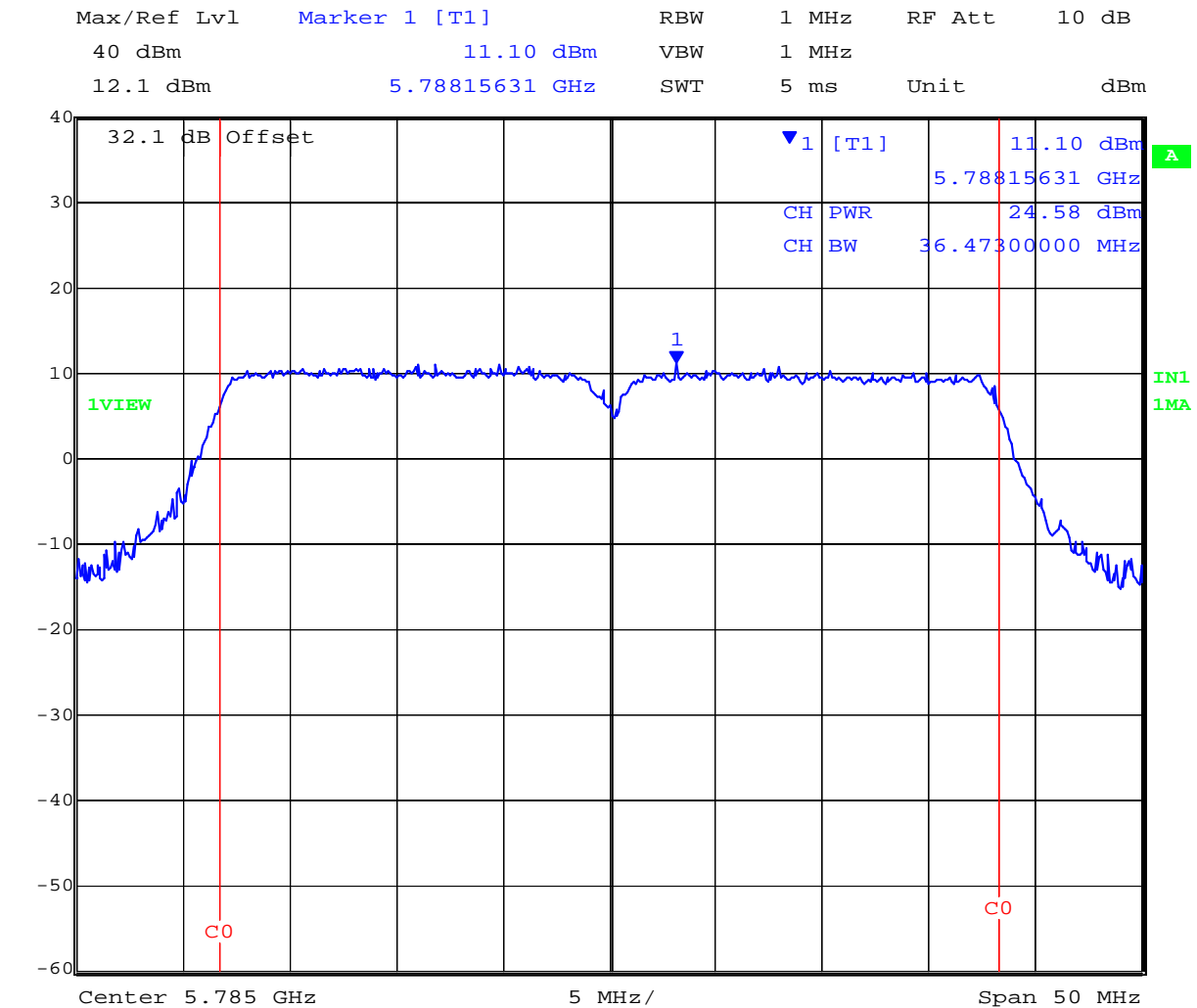


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5,785 MHz 802.11a HT-40 Peak Power (dBm)



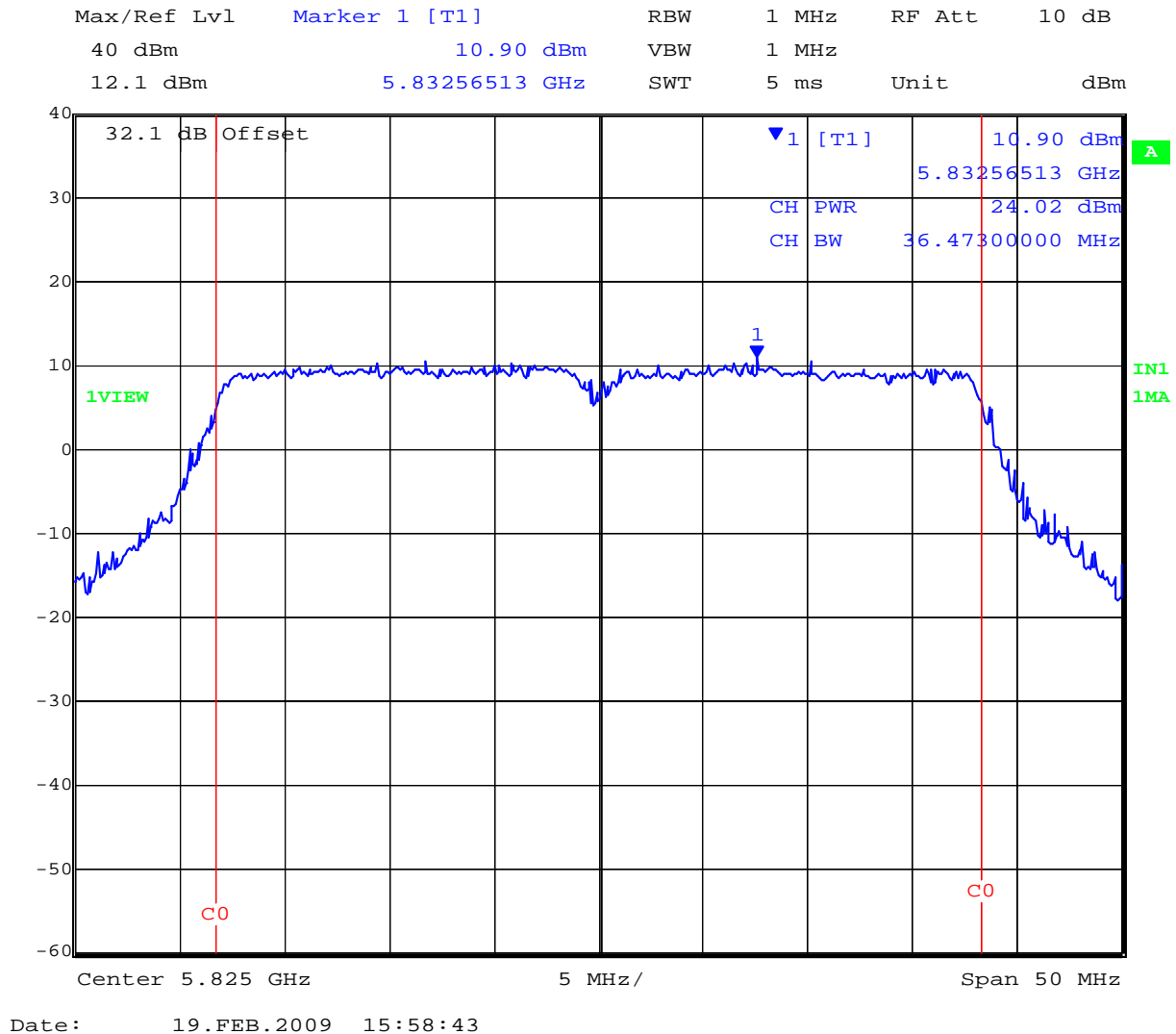
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5,825 MHz 802.11a HT-40 Peak Power (dBm)



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Specification

Limits

§15.247 (b) The maximum peak output power of the intentional radiator shall not exceed the following:

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1.0 watt.

15.247 (b) (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

§15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

§ RSS-210 A8.4(4) For systems employing digital modulation techniques operating in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands the maximum peak conducted power shall not exceed 1 watt.



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Laboratory Measurement Uncertainty for Power Measurements

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

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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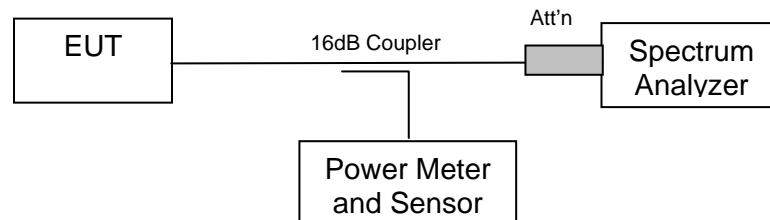
5.1.3. Peak Power Spectral Density

FCC, Part 15 Subpart C §15.247(e)
Industry Canada RSS-210 §A8.2

Test Procedure

The transmitter output was connected to a spectrum analyzer and the maximum level in a 3 kHz bandwidth was measured. A peak value was found over the full emission bandwidth and the frequency span reduced to obtain enhanced resolution. Sweep time \geq span / 3 kHz with video averaging turned off. The Peak Power Spectral Density is the highest level found across the emission in a 3 kHz resolution bandwidth.

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters

Duty Cycle: 100%

Output: Modulated Carrier

Power: Maximum Default Power



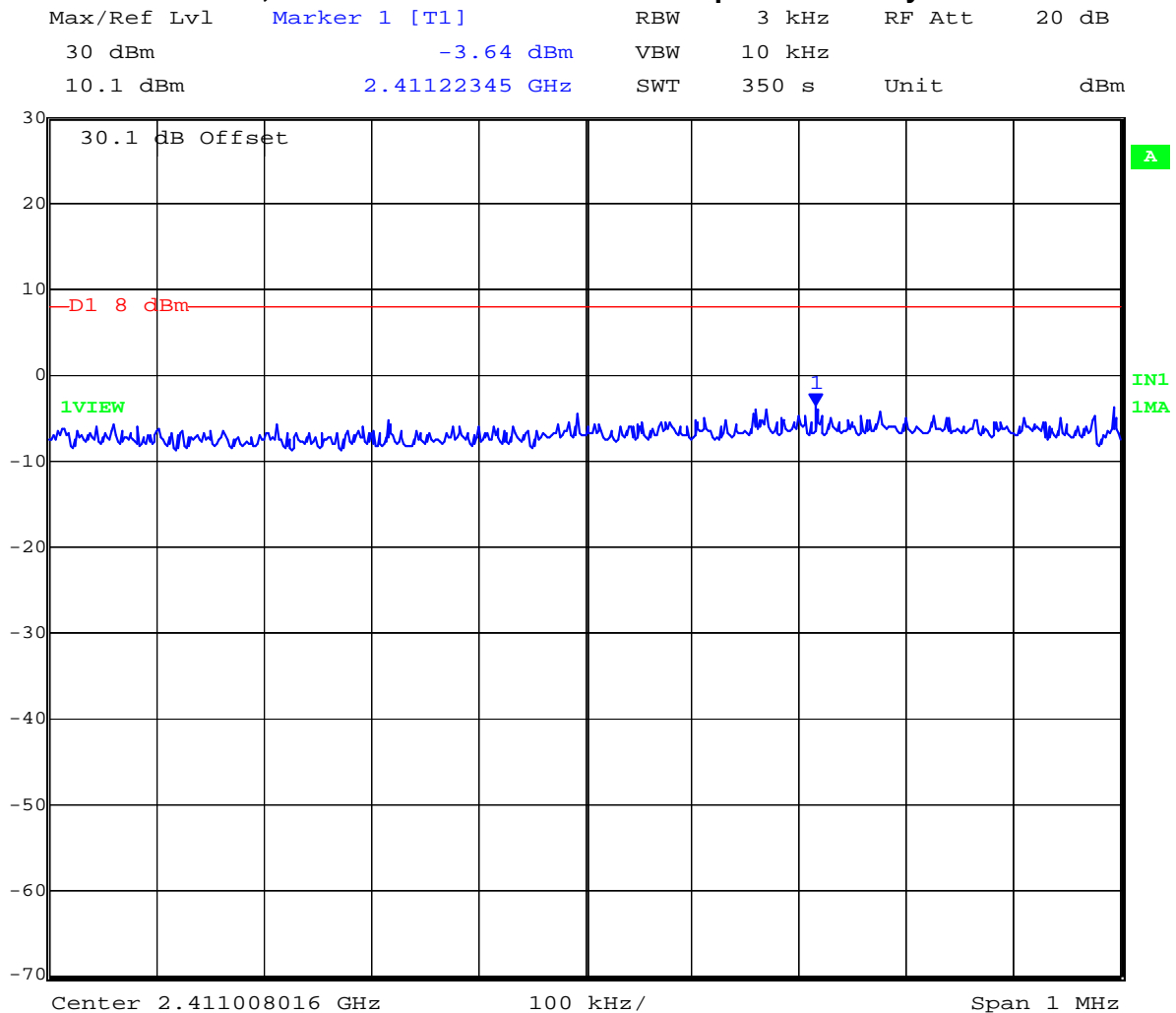
Title: 651-XX 802.11a/b/g/n Wireless Controller
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Peak Power Spectral Density

TABLE OF RESULTS – 802.11b

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2411.22345	-3.64	+8	-11.64
2,437	2436.50200	-4.03	+8	-12.03
2,462	2464.00301	-4.04	+8	-12.04

2,412 MHz 802.11b - Peak Power Spectral Density



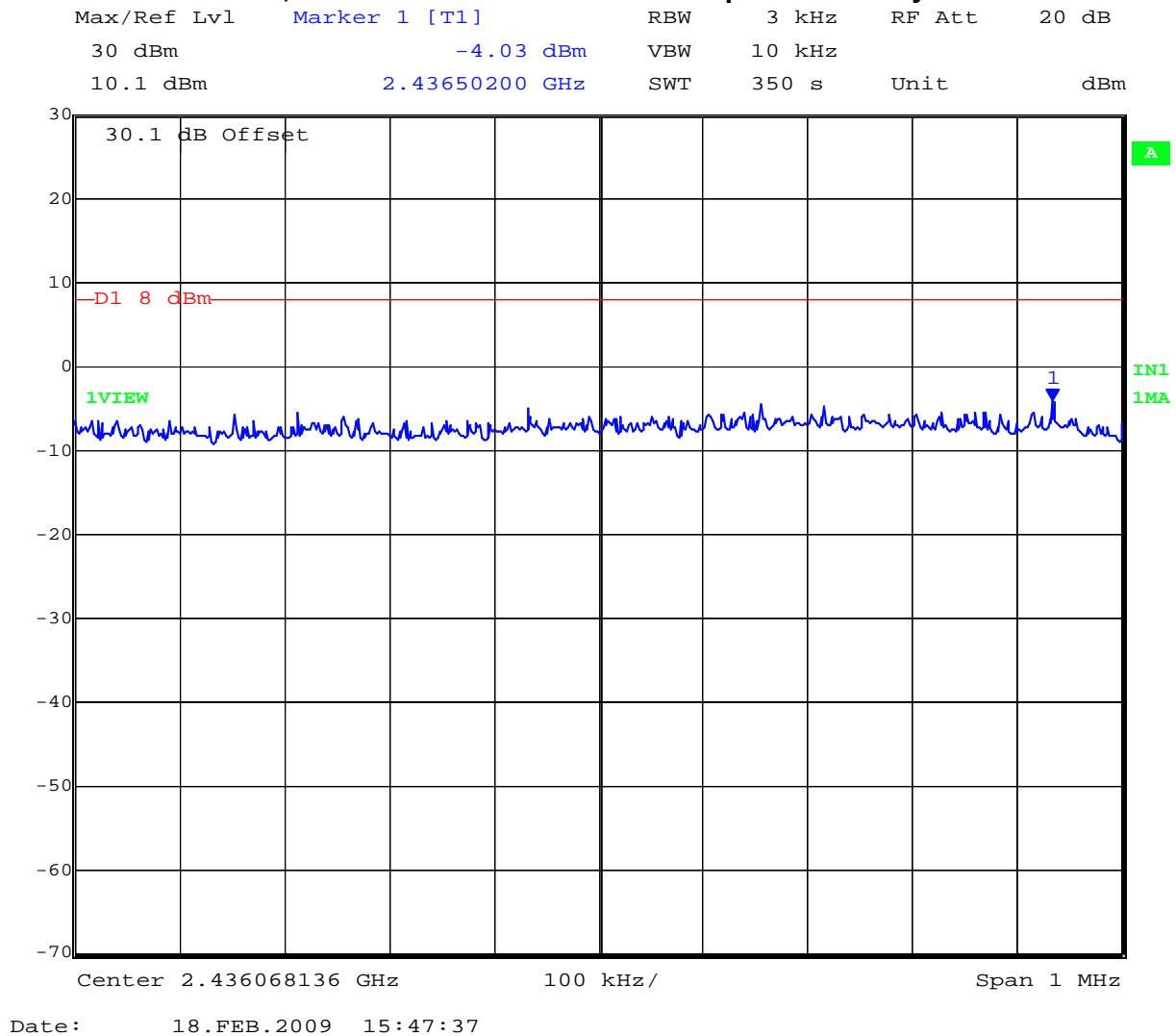
Date: 18.FEB.2009 15:40:21

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2,437 MHz 802.11b - Peak Power Spectral Density

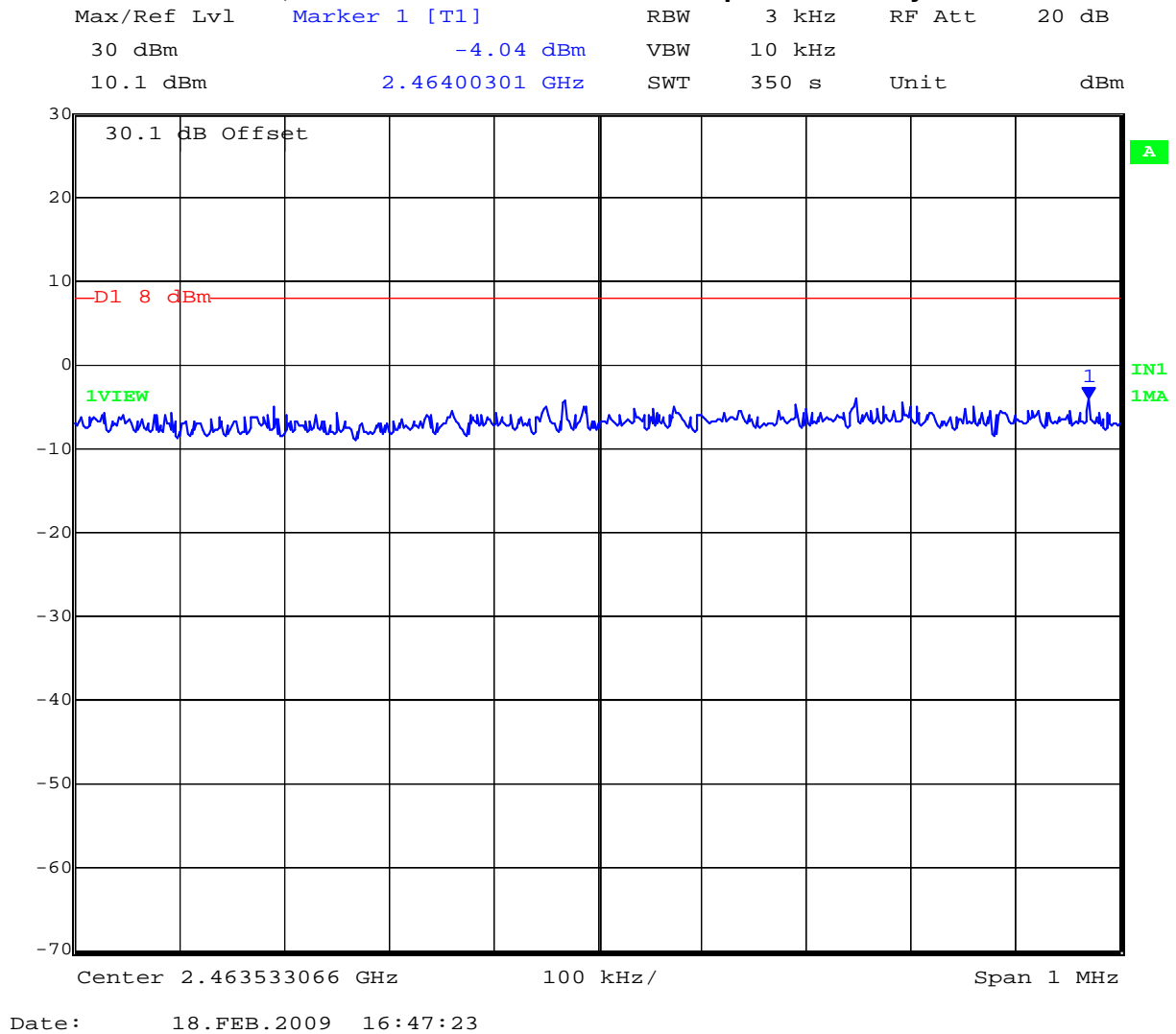


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2,462 MHz 802.11b - Peak Power Spectral Density



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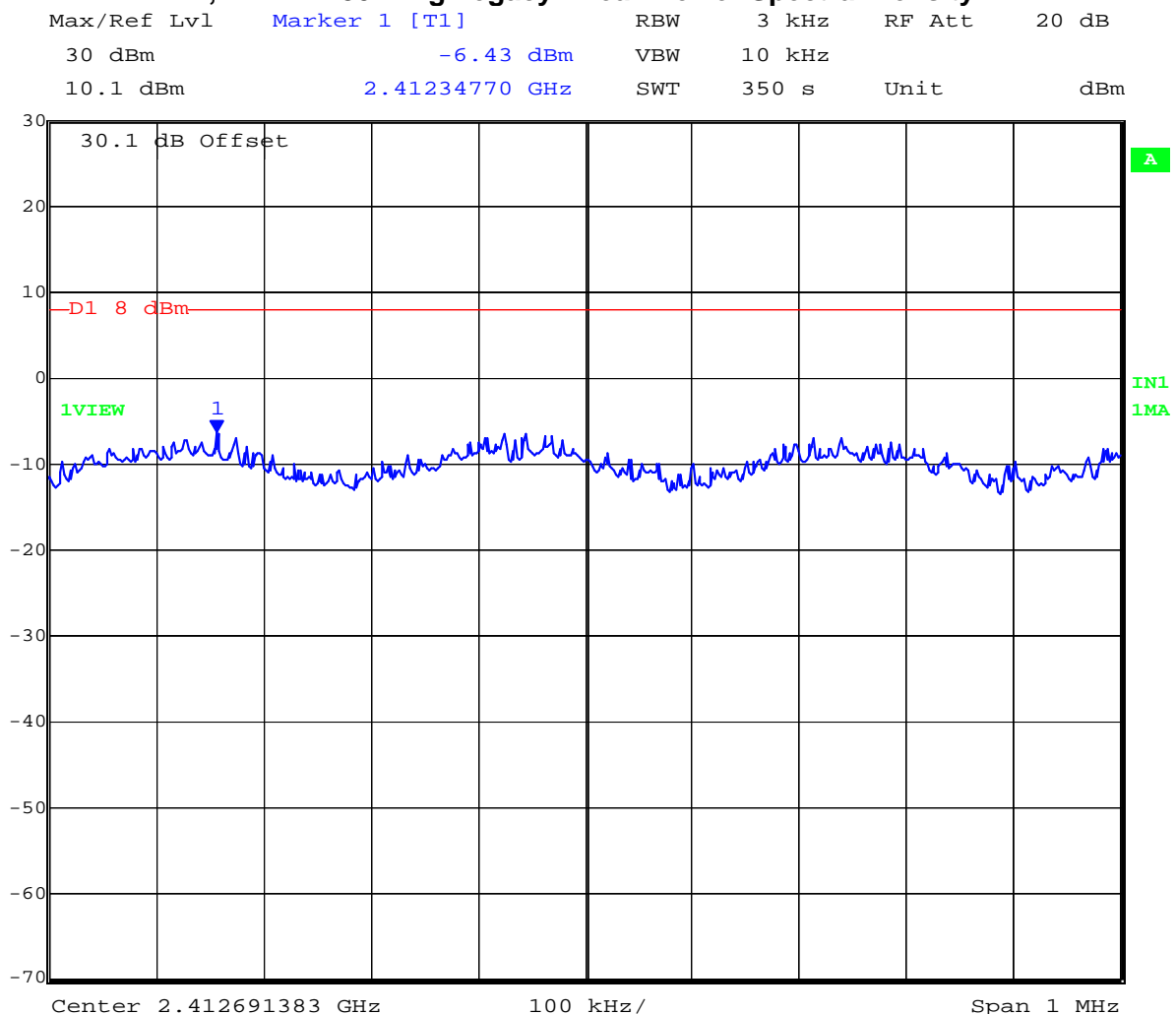
Title: 651-XX 802.11a/b/g/n Wireless Controller
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Peak Power Spectral Density

TABLE OF RESULTS – 802.11g Legacy

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2412.34770	-6.43	+8	-14.43
2,437	2435.40782	-6.11	+8	-14.11
2,462	2460.40782	-5.46	+8	-13.46

2,412 MHz 802.11g Legacy - Peak Power Spectral Density



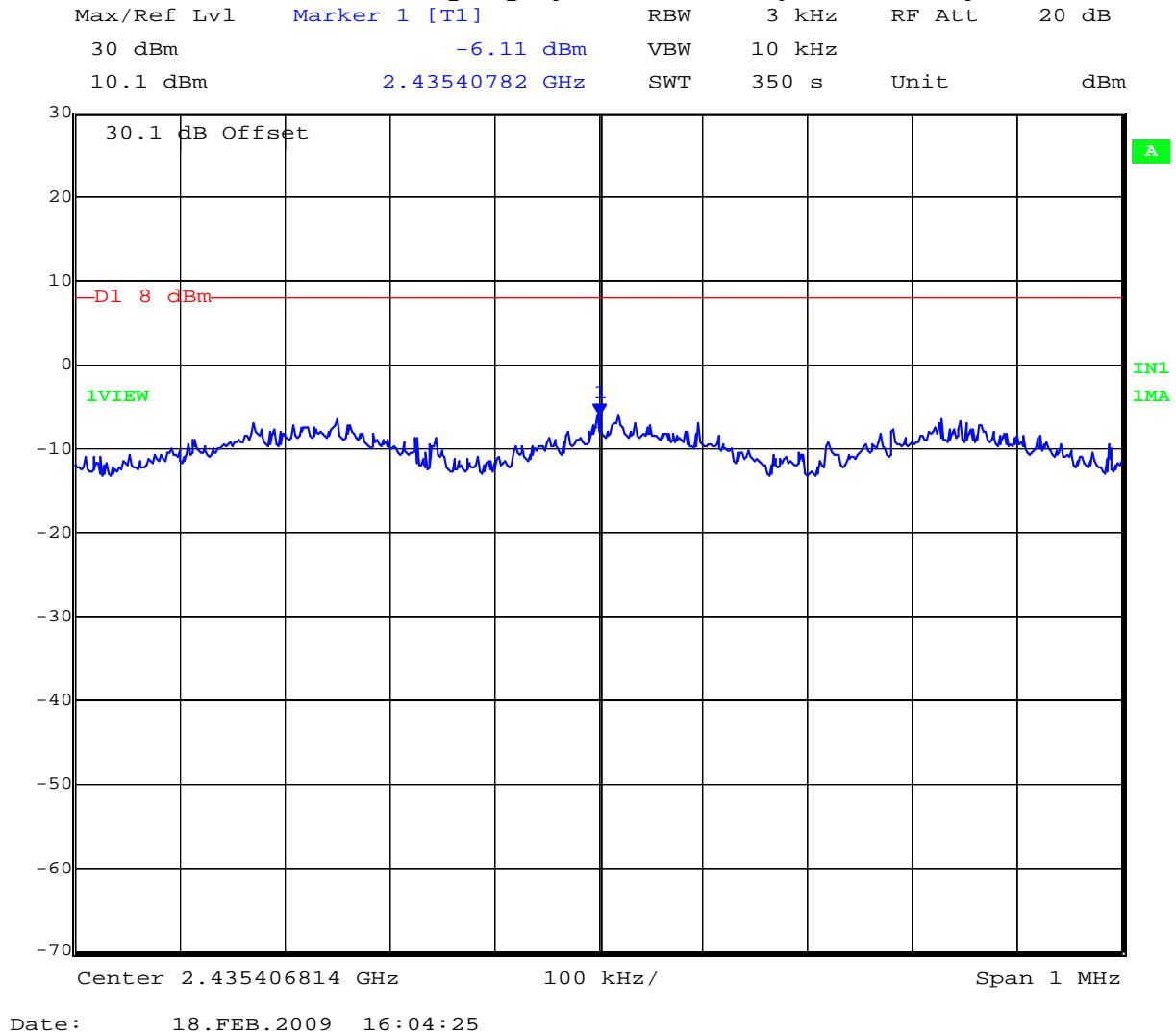
Date: 18.FEB.2009 15:16:17

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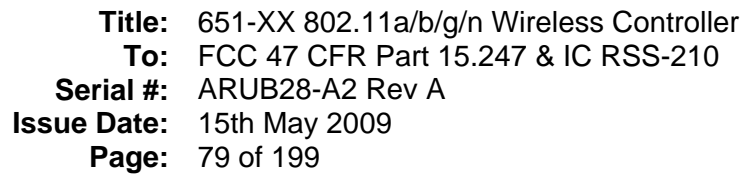


Title: 651-XX 802.11a/b/g/n Wireless Controller
To: FCC 47 CFR Part 15.247 & IC RSS-210
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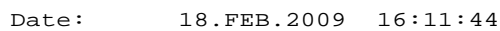
2,437 MHz 802.11g Legacy - Peak Power Spectral Density



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Max/Ref Lvl	Marker 1 [T1]	RBW	3 kHz	RF Att	20 dB
30 dBm	-5.46 dBm	VBW	10 kHz		
10.1 dBm	2.46040782 GHz	SWT	350 s	Unit	dBm



MiCOM Labs, 440 Boulder Court, Suite 200, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, www.micomlabs.com

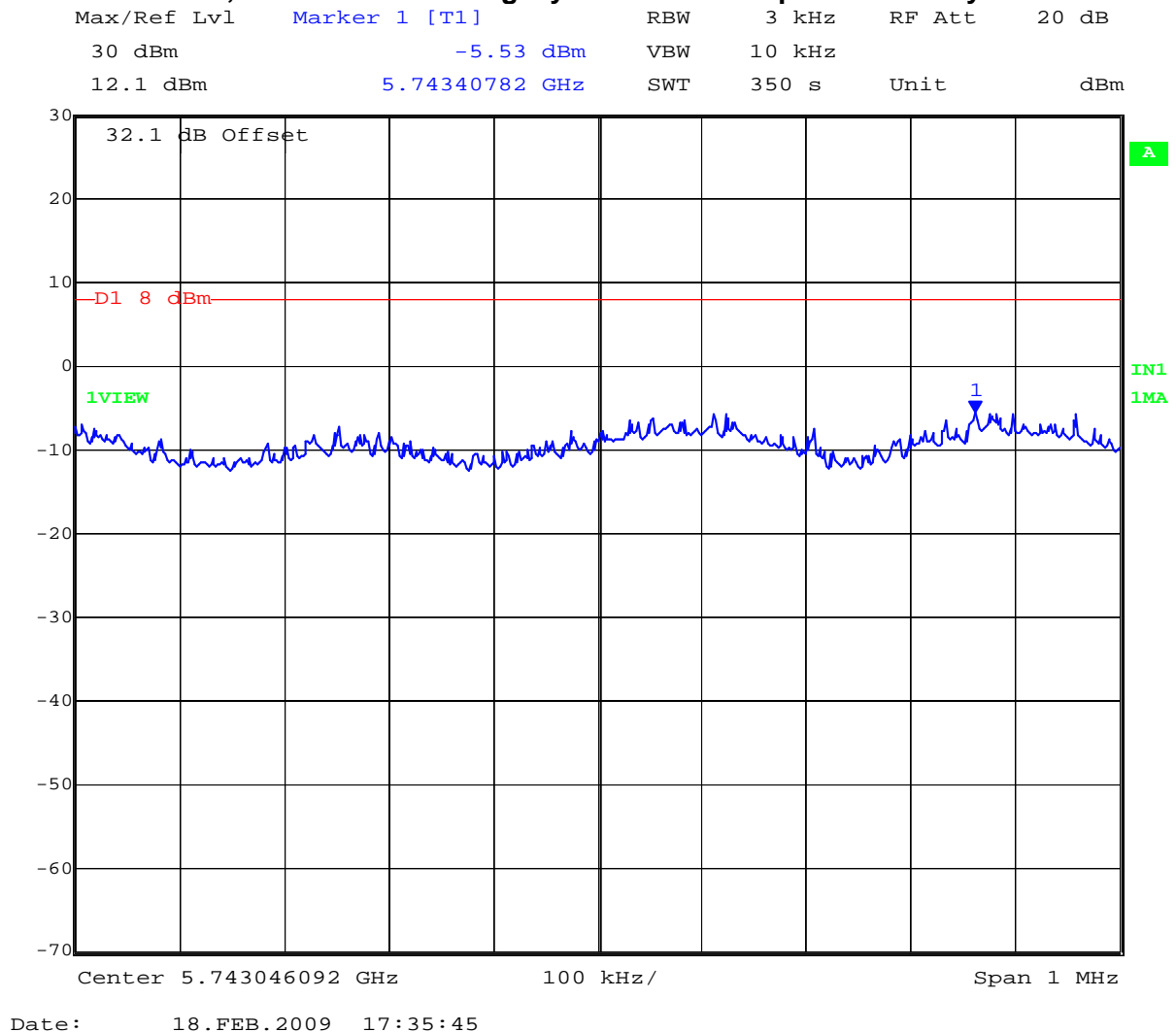


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TABLE OF RESULTS – 802.11a Legacy

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5743.40782	-5.53	+8	-13.53
5,785	5785.61824	-6.86	+8	-14.86
5,825	5828.40581	-6.35	+8	-14.35

5,745 MHz 802.11a Legacy - Peak Power Spectral Density

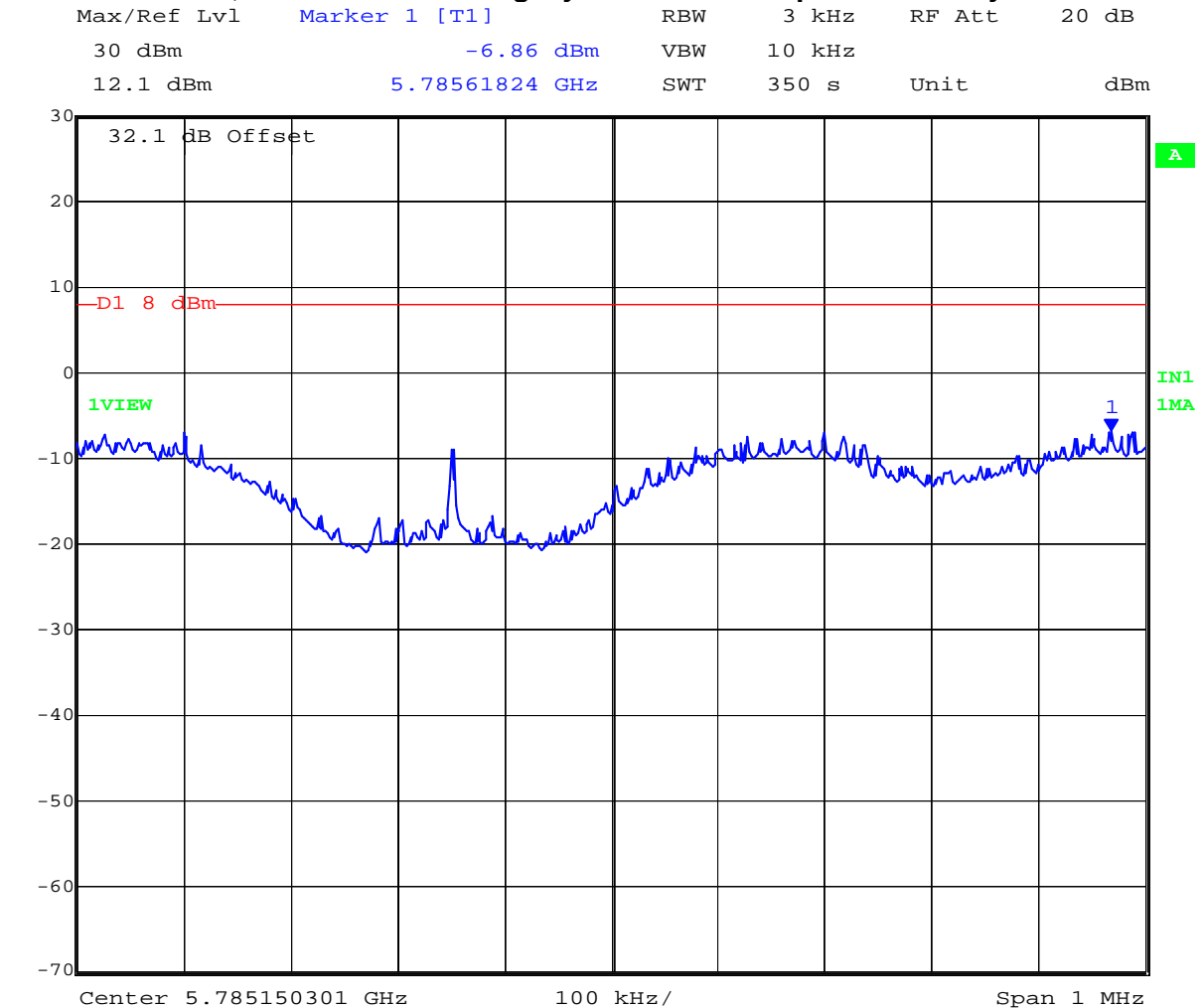


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5,785 MHz 802.11a Legacy - Peak Power Spectral Density



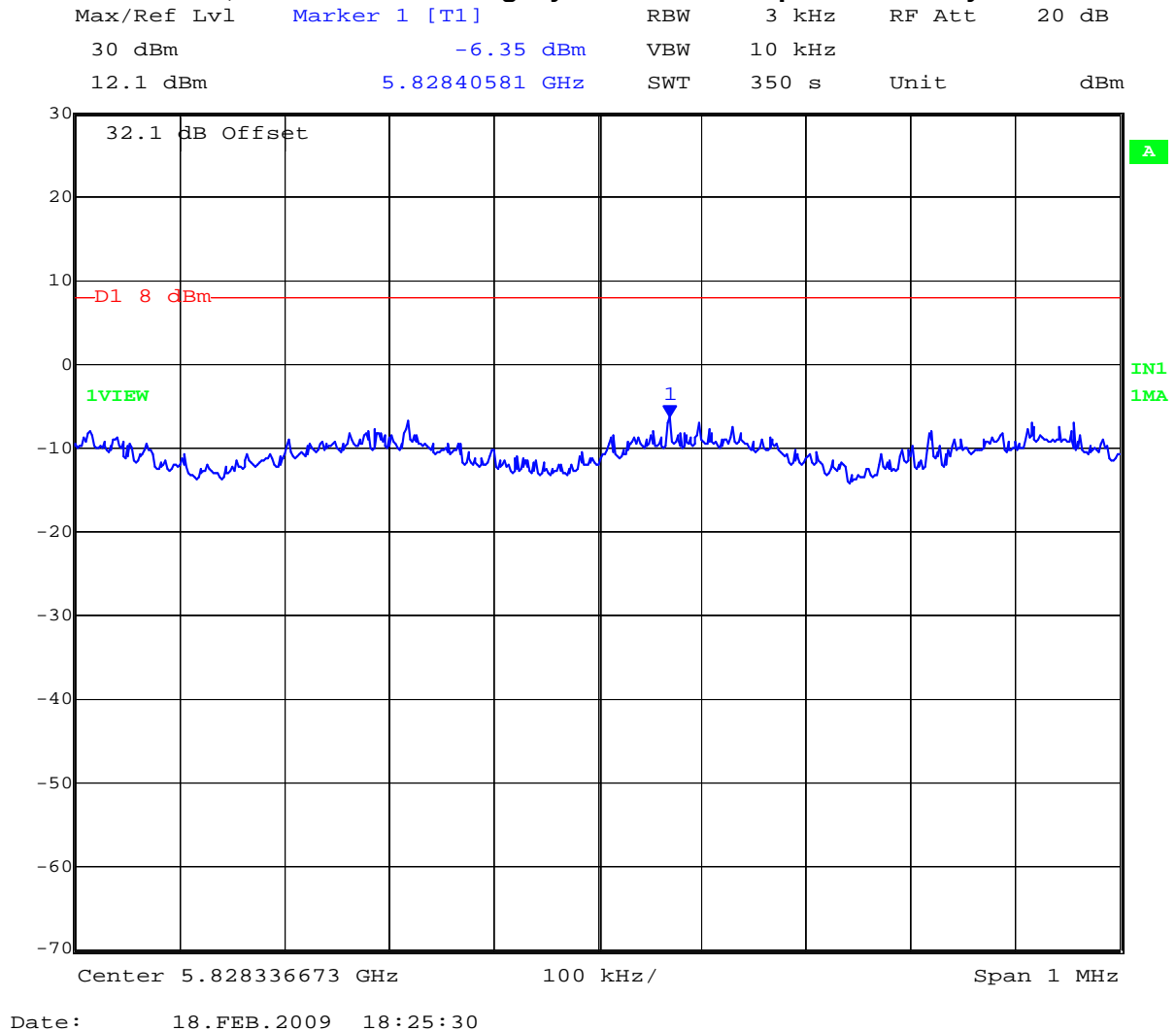
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5,825 MHz 802.11a Legacy - Peak Power Spectral Density



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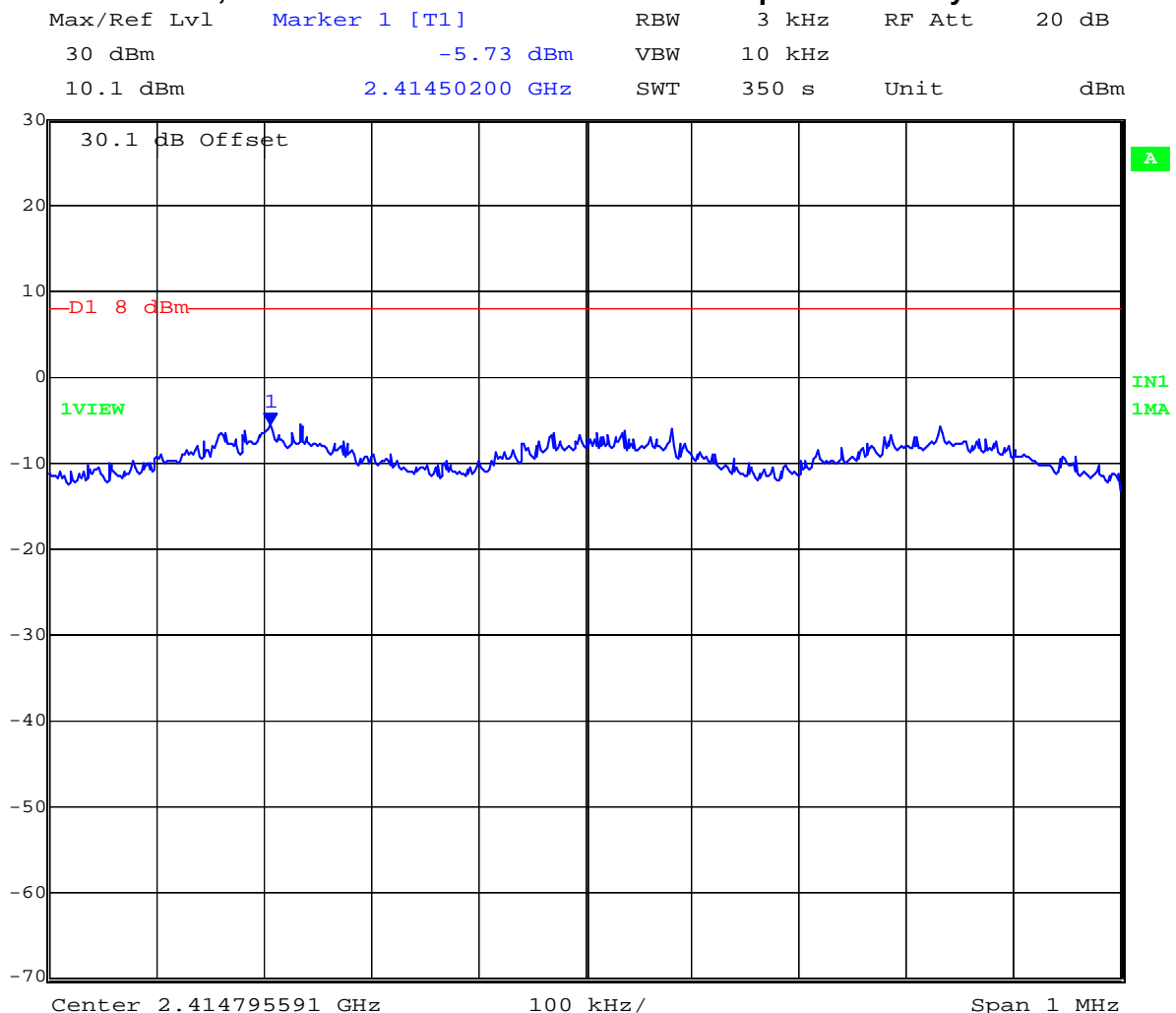
Title: 651-XX 802.11a/b/g/n Wireless Controller
To: FCC 47 CFR Part 15.247 & IC RSS-210
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Peak Power Spectral Density

TABLE OF RESULTS – 802.11n – HT-20

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2414.50200	-5.73	+8	-13.73
2,437	2438.25351	-5.78	+8	-13.78
2,462	2459.50200	-5.51	+8	-13.51

2,412 MHz 802.11n HT-20 - Peak Power Spectral Density



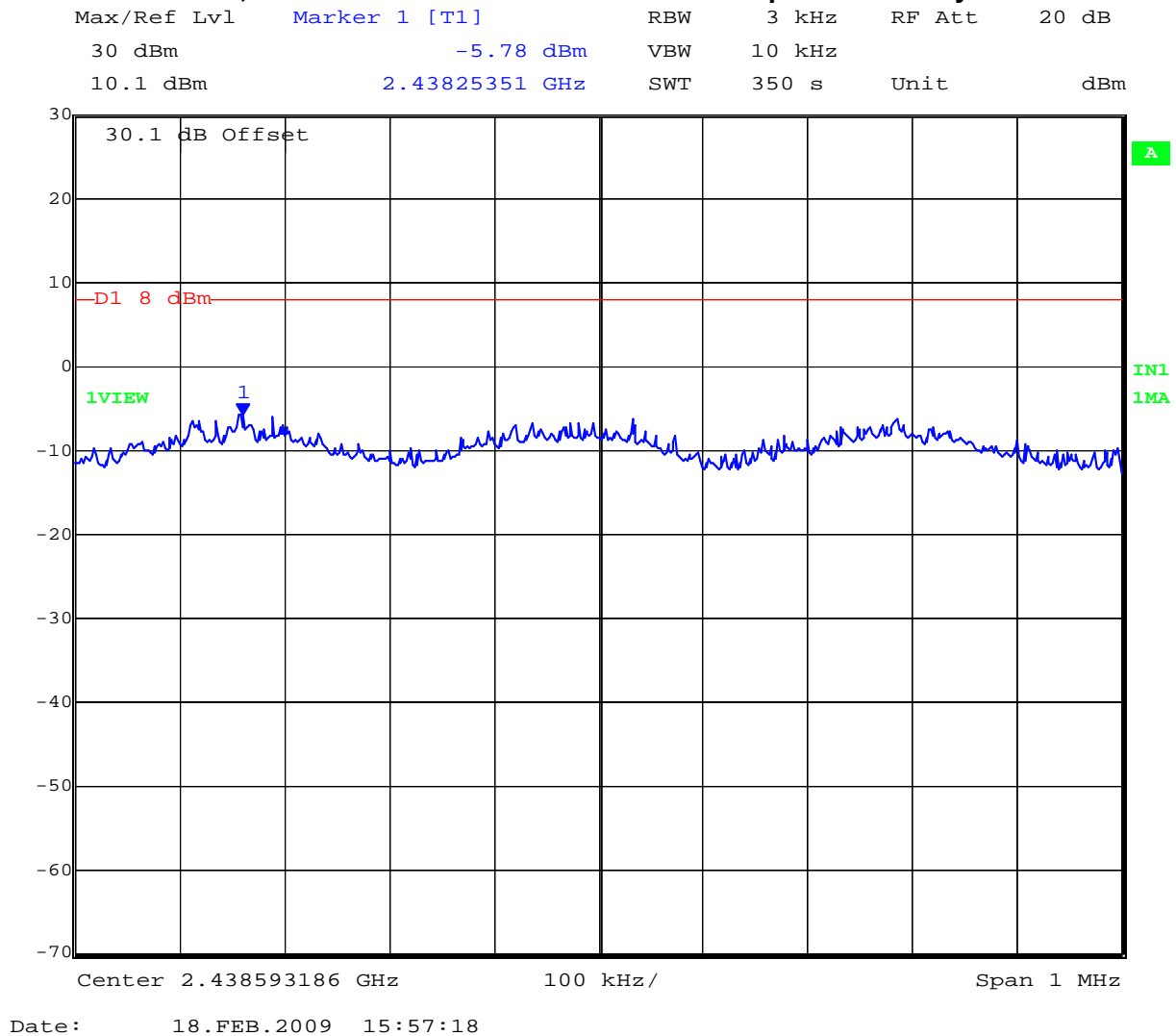
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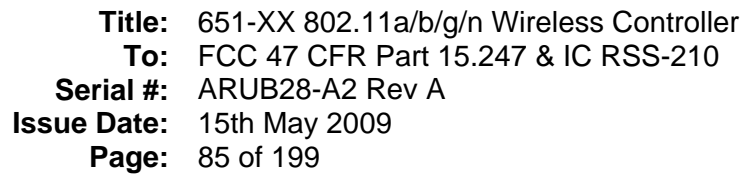


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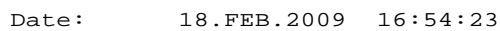
2,437 MHz 802.11n HT-20 - Peak Power Spectral Density



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Max/Ref Lvl	Marker 1 [T1]	RBW	3 kHz	RF Att	20 dB
30 dBm	-5.51 dBm	VBW	10 kHz		
10.1 dBm	2.45950200 GHz	SWT	350 s	Unit	dBm



MiCOM Labs, 440 Boulder Court, Suite 200, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, www.micomlabs.com

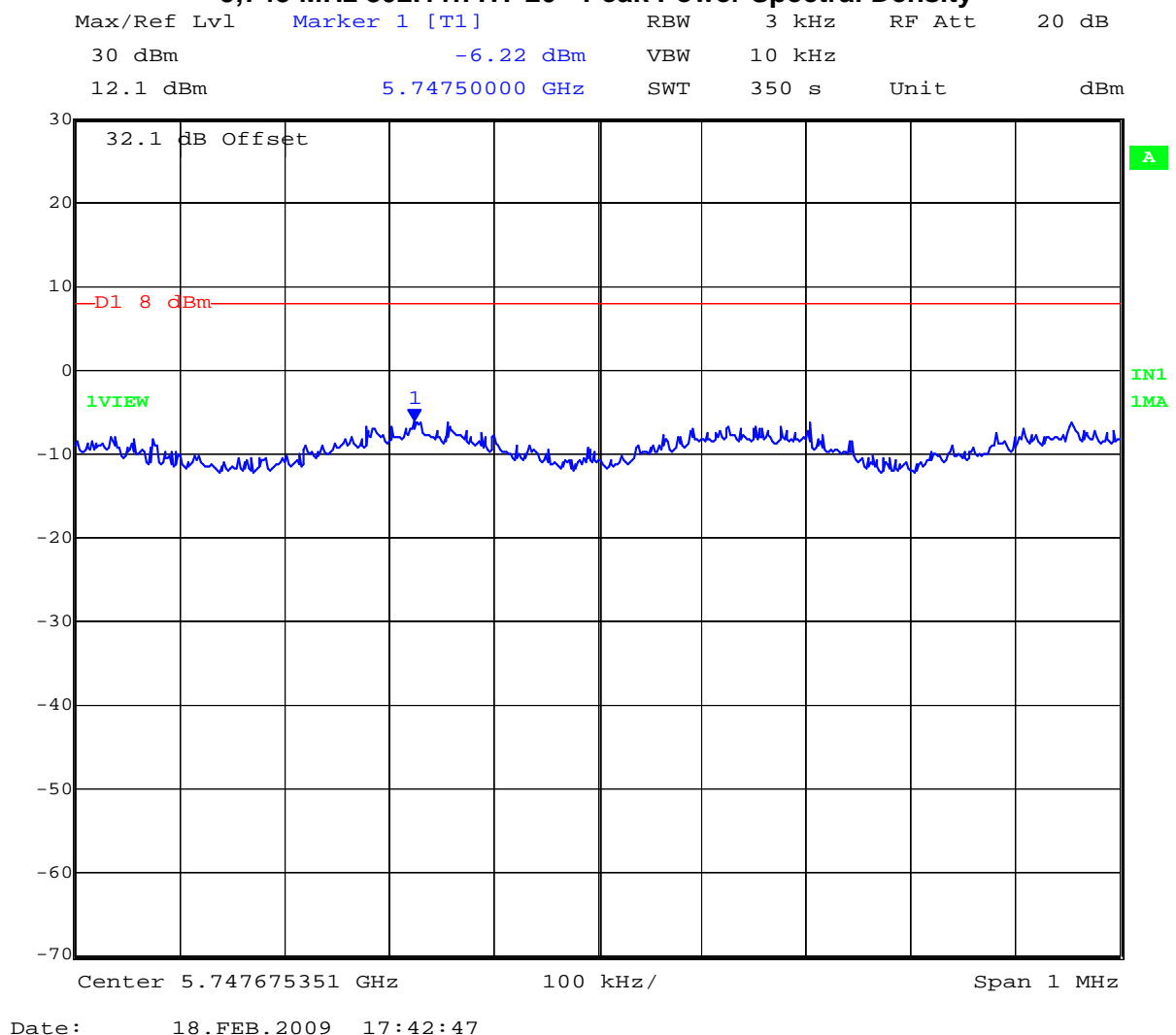


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TABLE OF RESULTS – 802.11n HT-20

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5747.50000	-6.22	+8	-14.22
5,785	5785.00301	-5.84	+8	-13.84
5,825	5823.12926	-7.29	+8	-15.29

5,745 MHz 802.11n HT-20 - Peak Power Spectral Density

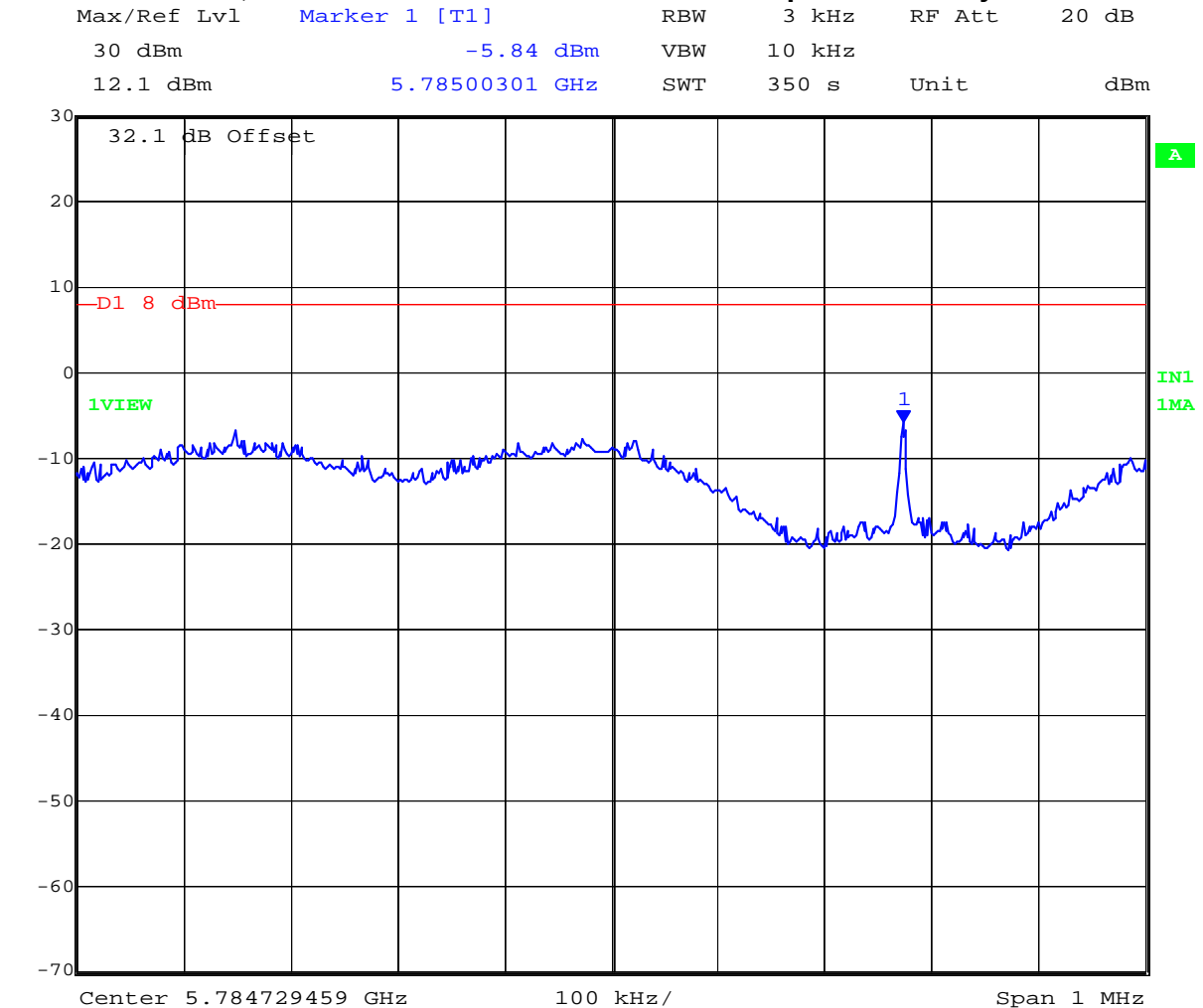


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5,785 MHz 802.11n HT-20 - Peak Power Spectral Density



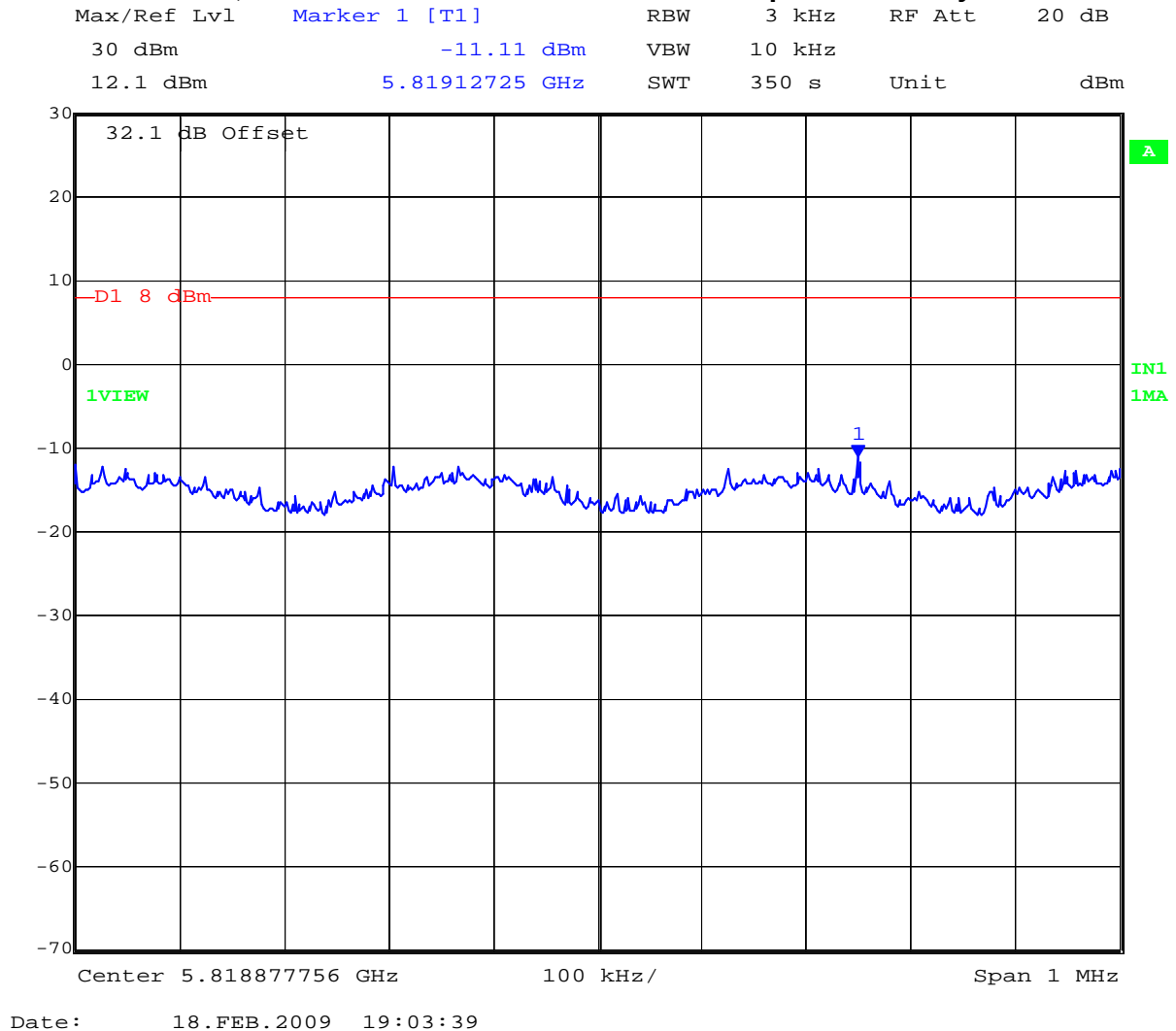
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5,825 MHz 802.11n HT-20 - Peak Power Spectral Density



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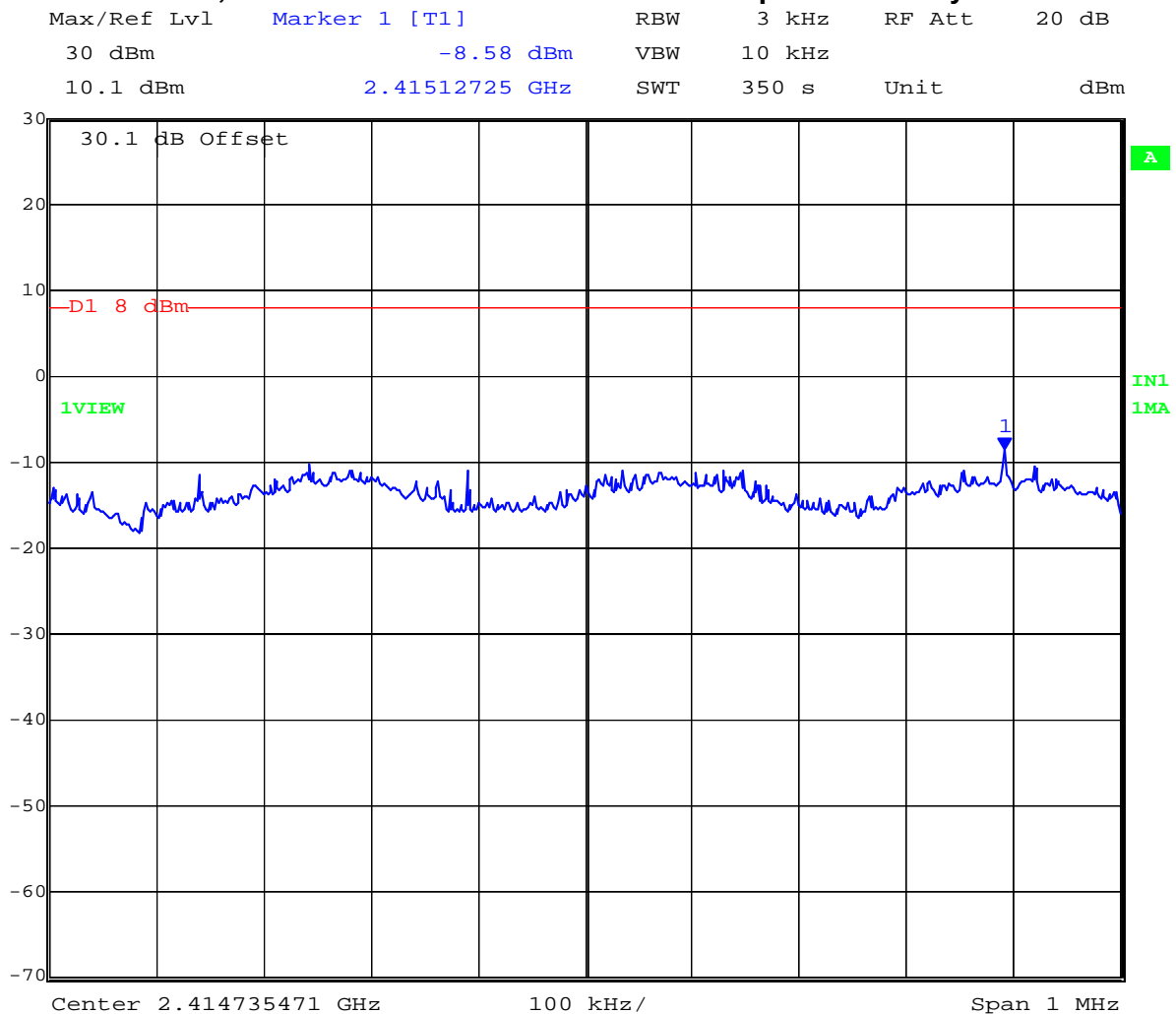
Title: 651-XX 802.11a/b/g/n Wireless Controller
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Peak Power Spectral Density

TABLE OF RESULTS – 802.11n HT-40

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,422	2415.12725	-8.58	+8	-16.58
2,437	2432.31162	-10.2	+8	-18.2
2,452	2446.75251	-8.21	+8	-16.21

2,422 MHz 802.11n HT-40 - Peak Power Spectral Density



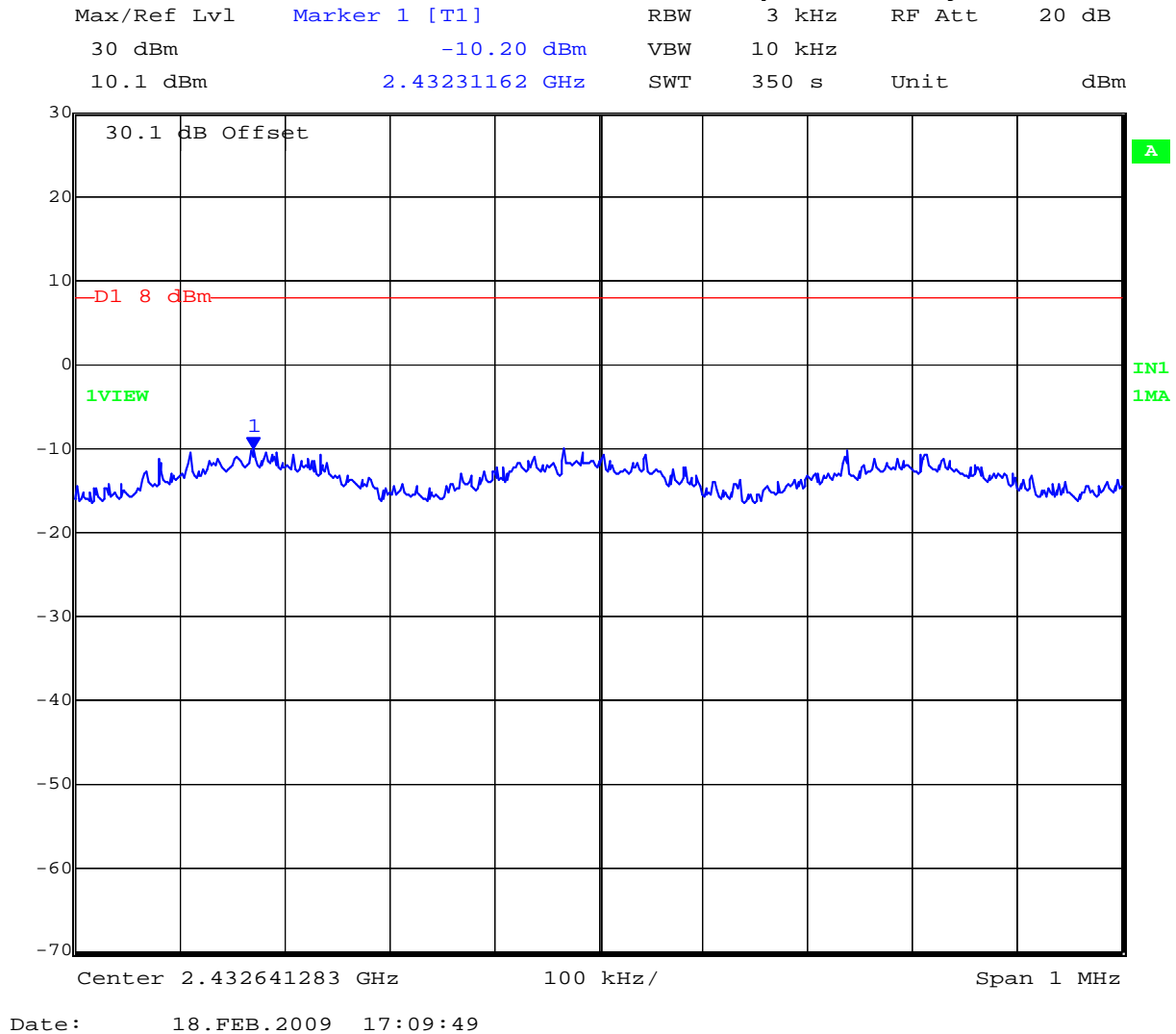
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2,437 MHz 802.11n HT-40 Peak Power Spectral Density

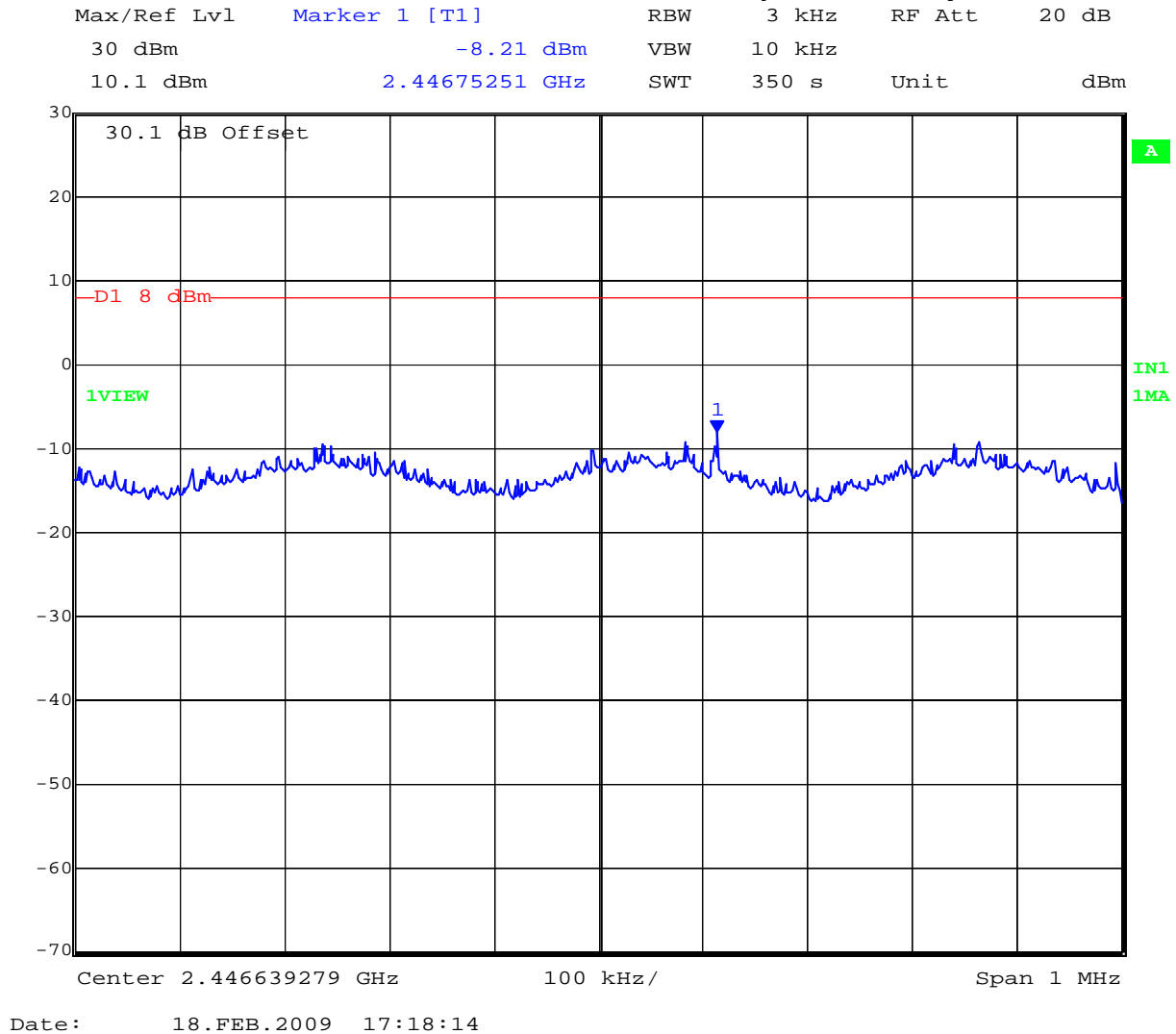


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2,452 MHz 802.11n HT-40 Peak Power Spectral Density



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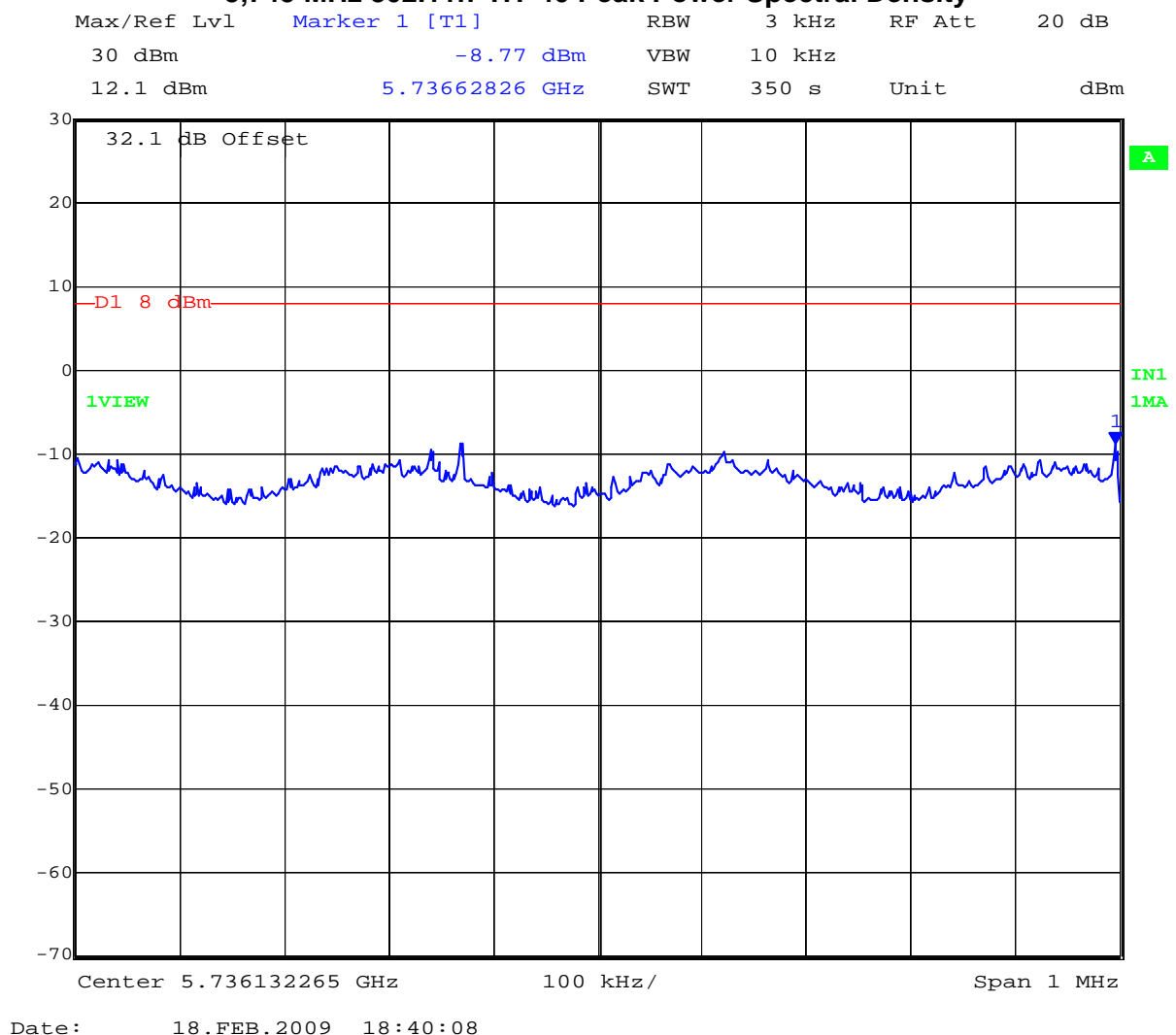


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TABLE OF RESULTS – 802.11n HT-40

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5736.62826	-8.77	+8	-16.77
5,785	5779.75251	-9.61	+8	-17.61
5,825	5820.87675	-10.74	+8	-18.74

5,745 MHz 802.11n HT-40 Peak Power Spectral Density

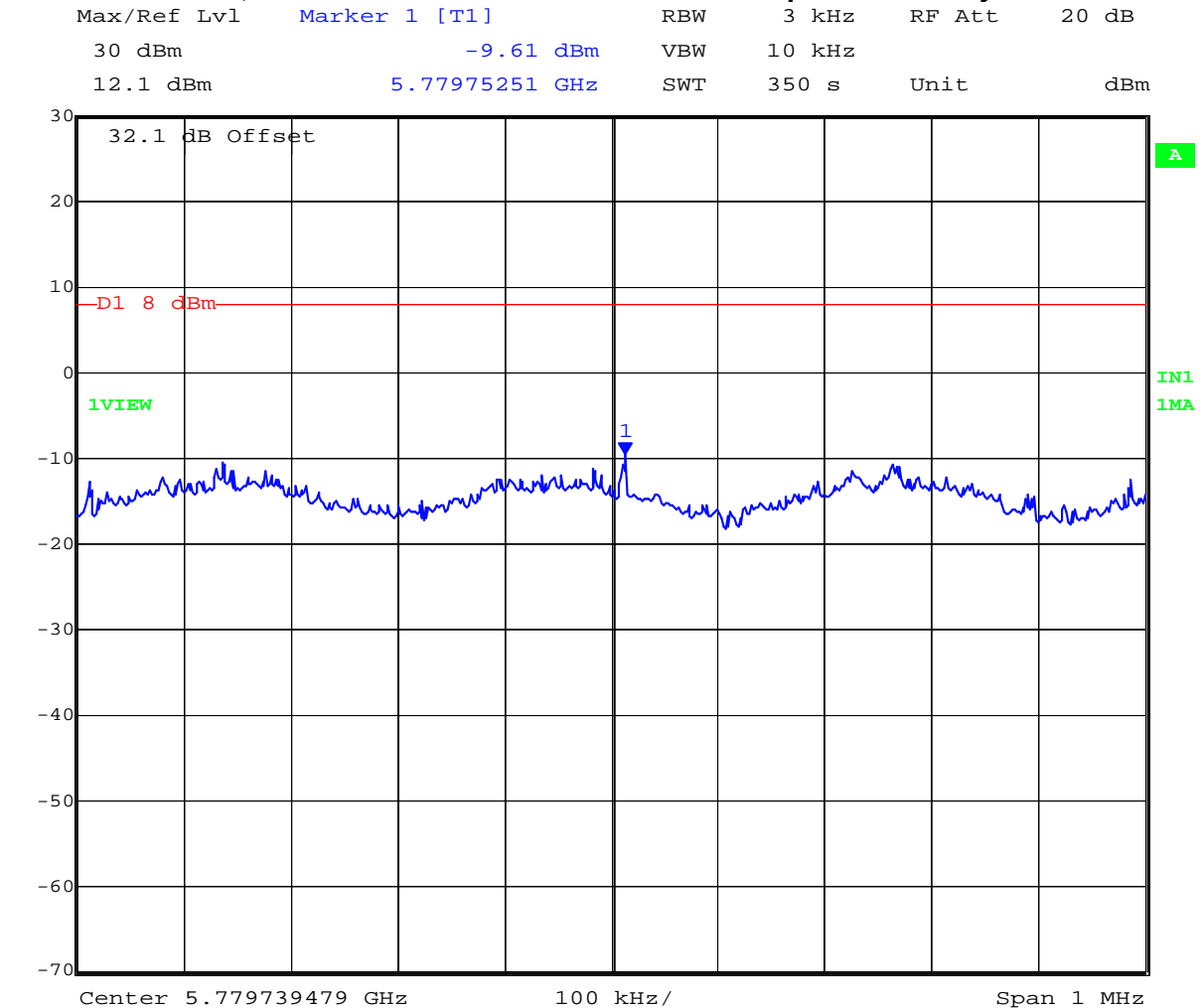


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5,785 MHz 802.11n HT-40 - Peak Power Spectral Density



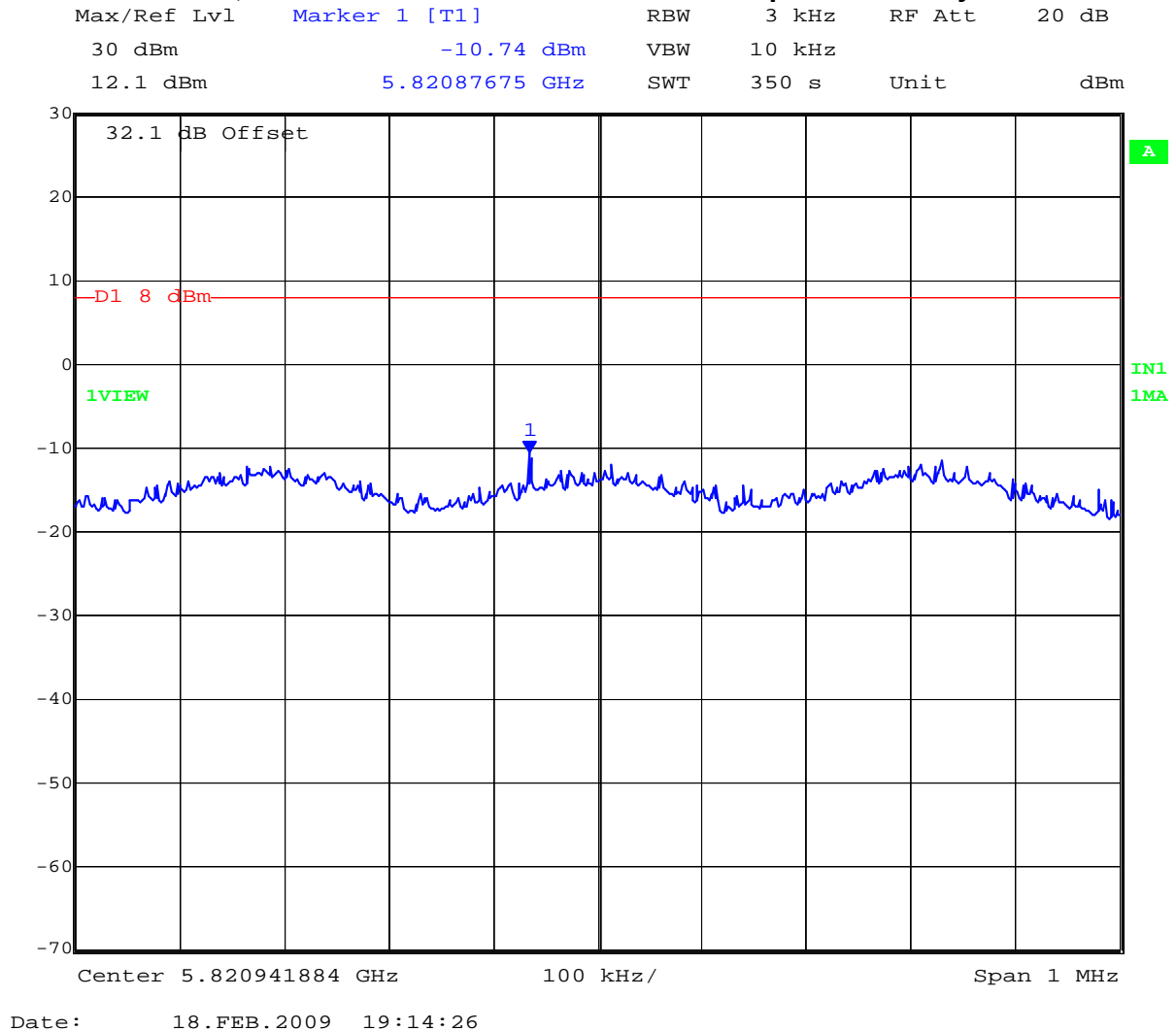
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5,825 MHz 802.11n HT-40 - Peak Power Spectral Density



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Specification

Peak Power Spectral Density Limits

§15.247(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission

RSS-210 §A8.2(2) The transmitter power spectral density (into the antenna) shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

Laboratory Measurement Uncertainty for Spectral Density

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

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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5.1.4. Maximum Permissible Exposure

FCC, Part 15 Subpart C §15.247(i)
Industry Canada RSS-Gen §5.5

Calculations for Maximum Permissible Exposure Levels

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

$EIRP = P * G$

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

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

The Aruba 651-XX has three transmitters. The peak power in the table below is calculated by assuming a worst case scenario where the three transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum allowable conducted power measured in each band and multiplying by 3.

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

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm ² Limit(cm)	Minimum Separation Distance (cm)
2.4	3.8	2.4	+26.41	1313	15.9	20.0*
5.8	5.8	3.8	+25.93	1175	18.9	20.0*

***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

§15.247(i) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines.

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

RSS-Gen §5.5 Before equipment certification is granted, the applicable requirements of RSS-102 shall be met

Laboratory Measurement Uncertainty for Power Measurements

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

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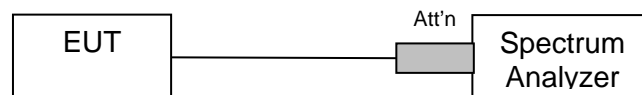
5.1.5. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(d); 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2
Industry Canada RSS-Gen 4.7

Test Procedure

Conducted emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Test Measurement Set up



Band-edge measurement test configuration

Measurement Results of Conducted Spurious Emissions

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters

Duty Cycle: 100%

Output: Modulated Carrier

Power: Maximum Default Power



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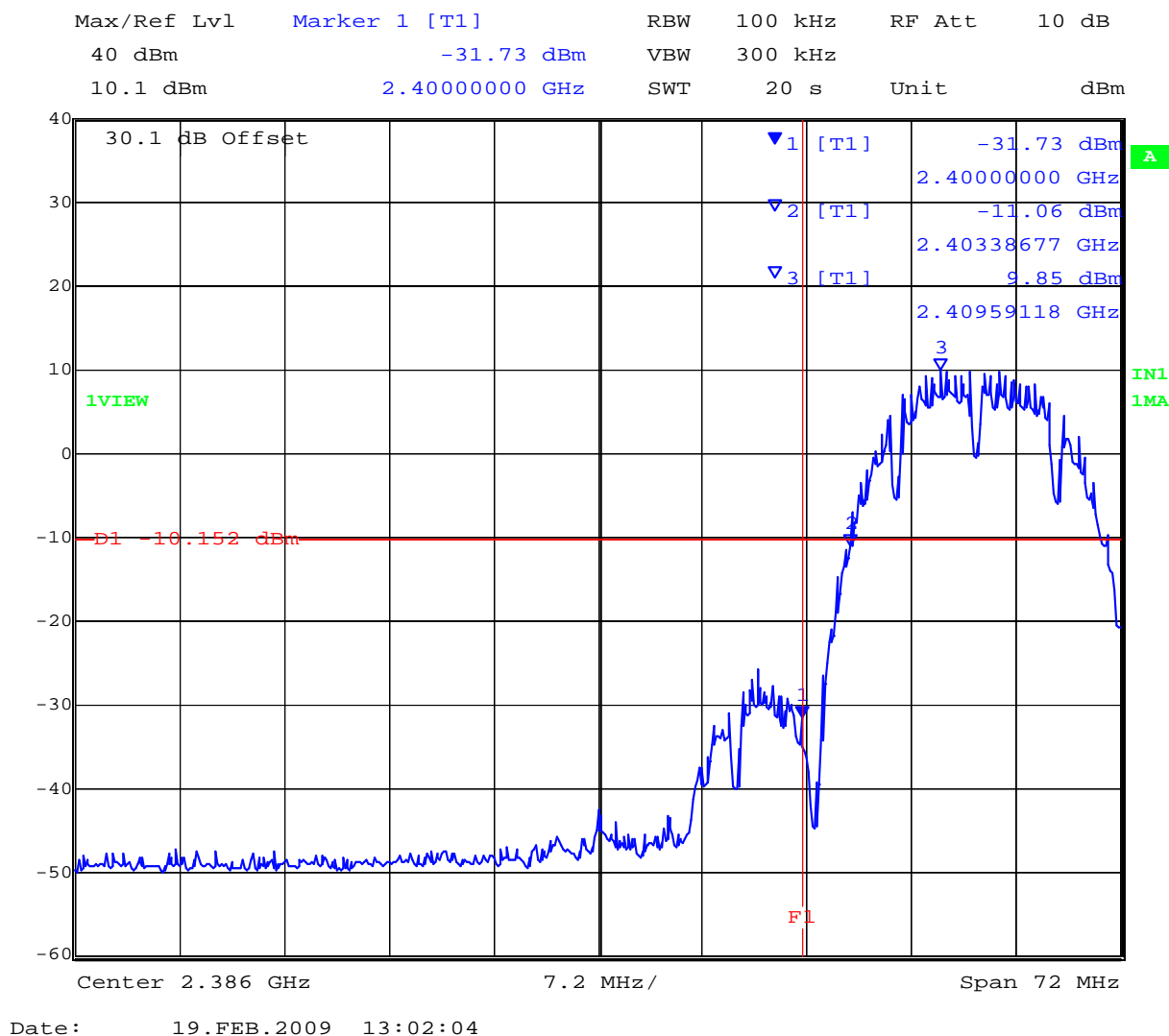
Conducted Band-Edge Results

Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

TABLE OF RESULTS – 802.11b – Legacy

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-10.20	-31.73	-21.53
2,462	2,483.5	-10.21	-47.18	-36.97

b - Conducted Spurious Emissions at the 2,400 MHz Band Edge

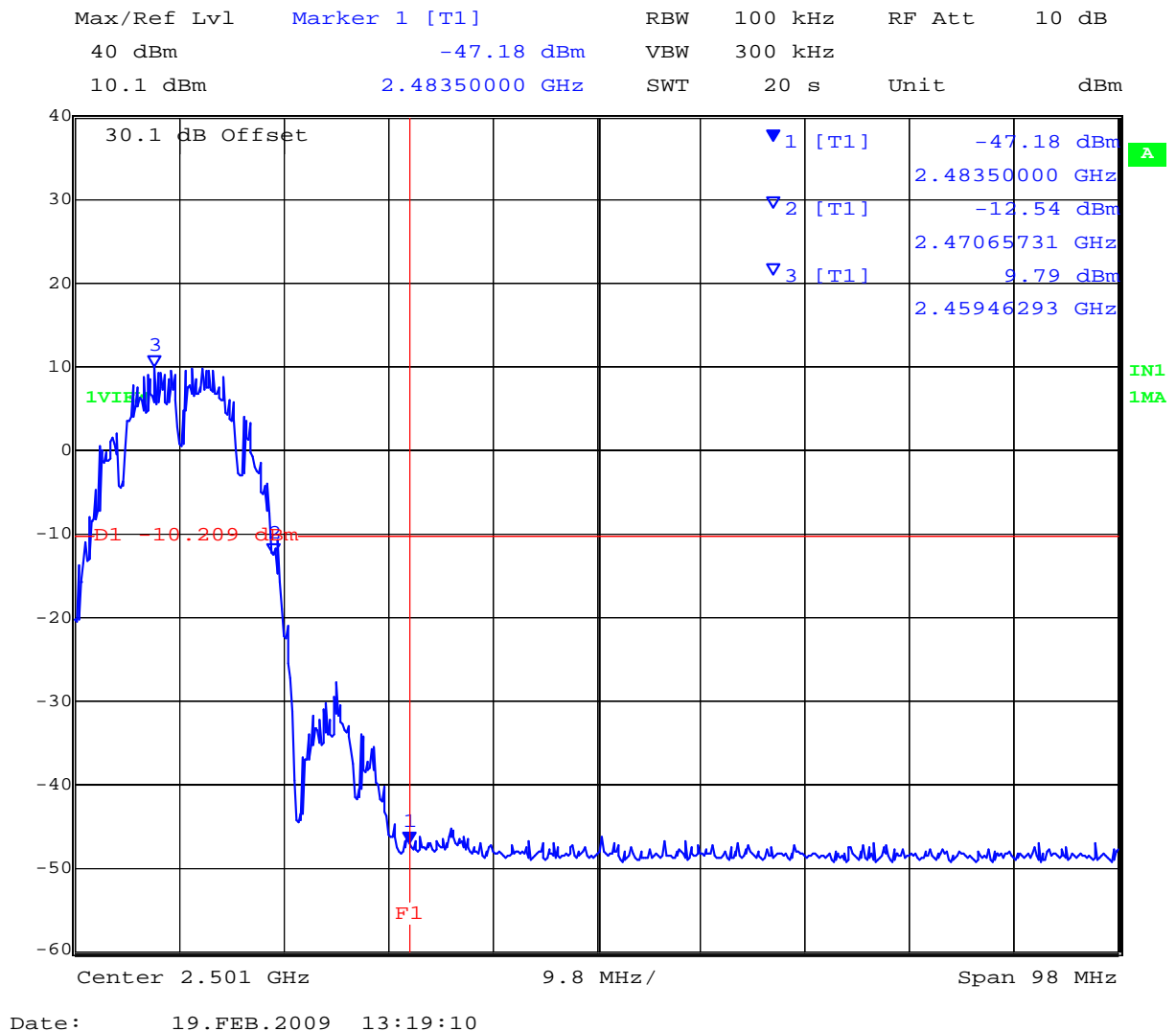


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b - Conducted Spurious Emissions at the 2,483.5 MHz Band Edge



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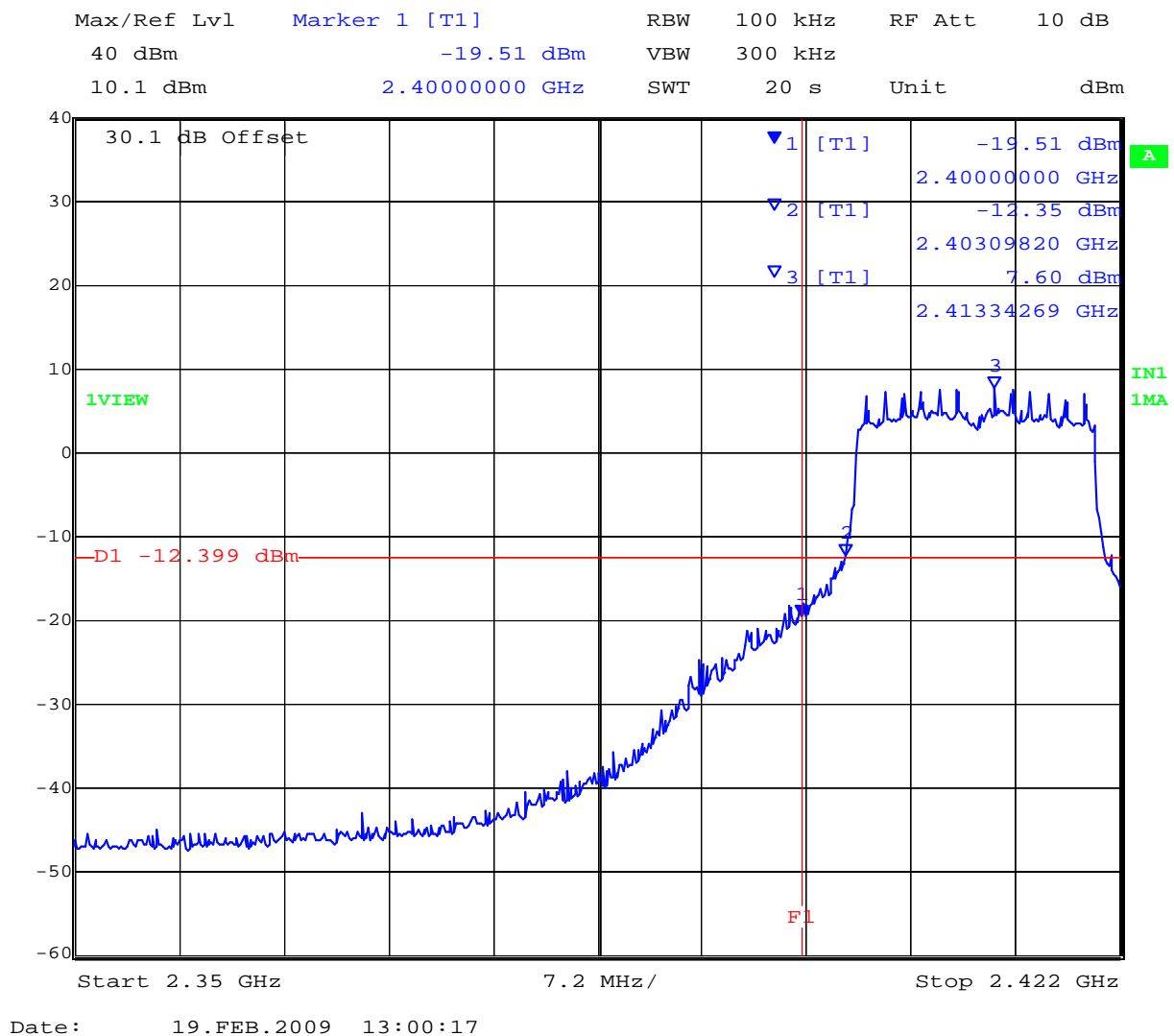
Title: 651-XX 802.11a/b/g/n Wireless Controller
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Conducted Band-Edge Results

TABLE OF RESULTS – 802.11g Legacy

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-12.399	-19.51	-7.1
2,462	2,483.5	-11.612	-30.89	-19.3

g Legacy - Conducted Spurious Emissions at the 2,400 MHz Band Edge

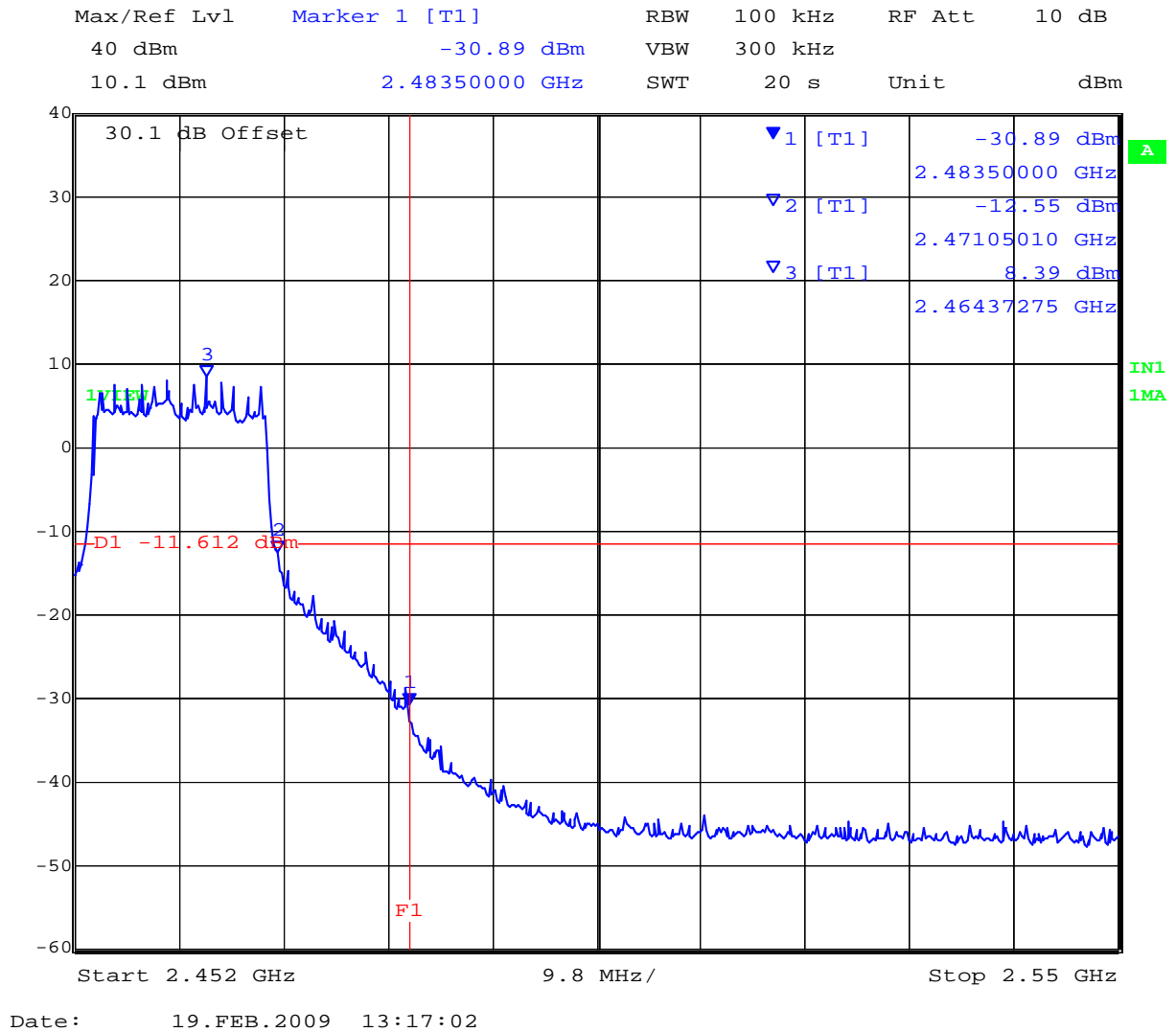


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g Legacy Conducted Spurious Emissions at the 2,483.5 MHz Band Edge



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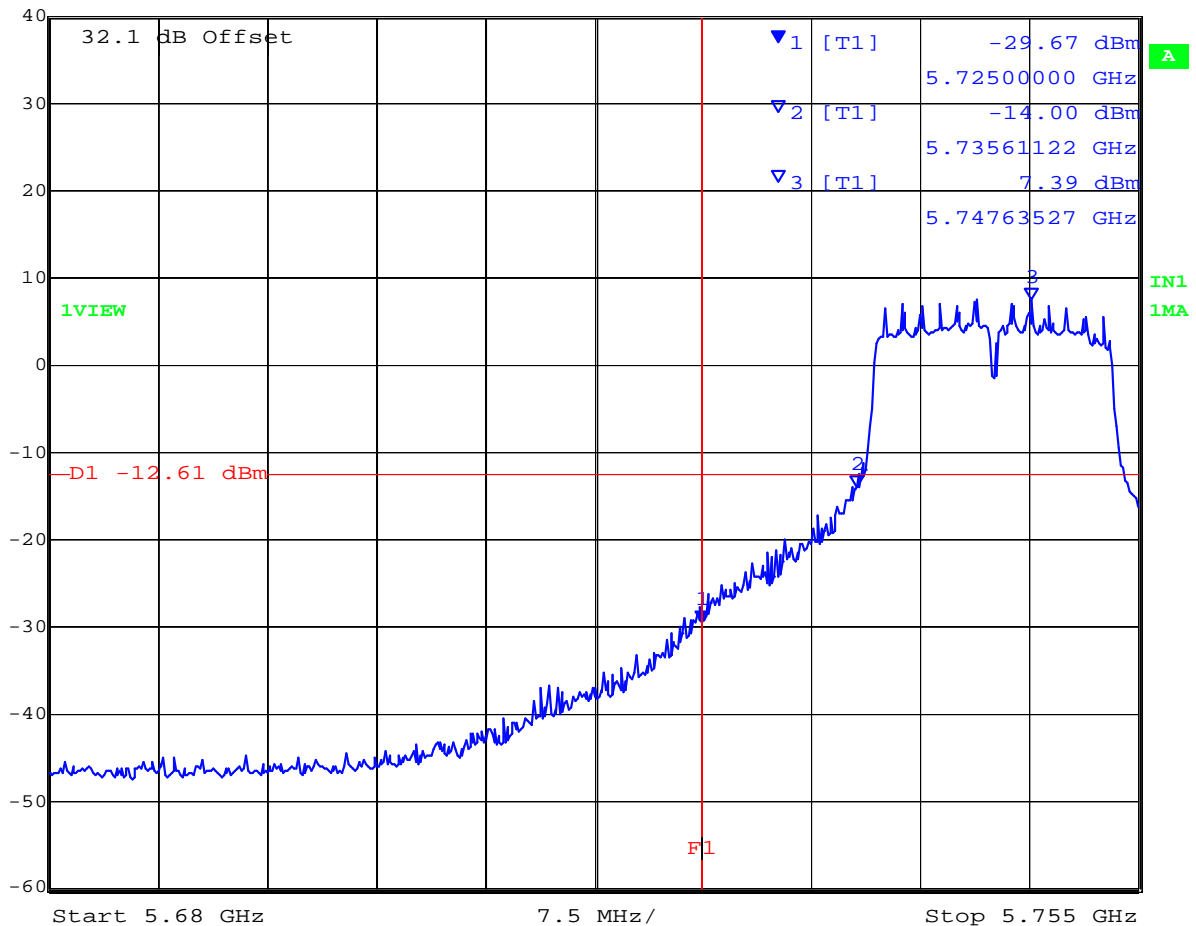
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TABLE OF RESULTS – 802.11a Legacy

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
5,745	5,725	-12.61	-29.67	-17.1
5,825	5,850	-13.20	-40.18	-27.0

a Legacy Conducted Spurious Emissions at the 5,725 MHz Band Edge

Max/Ref Lvl Marker 1 [T1] RBW 100 kHz RF Att 10 dB
 40 dBm -29.67 dBm VBW 300 kHz
 12.1 dBm 5.72500000 GHz SWT 20 s Unit dBm



Date: 19.FEB.2009 13:38:19

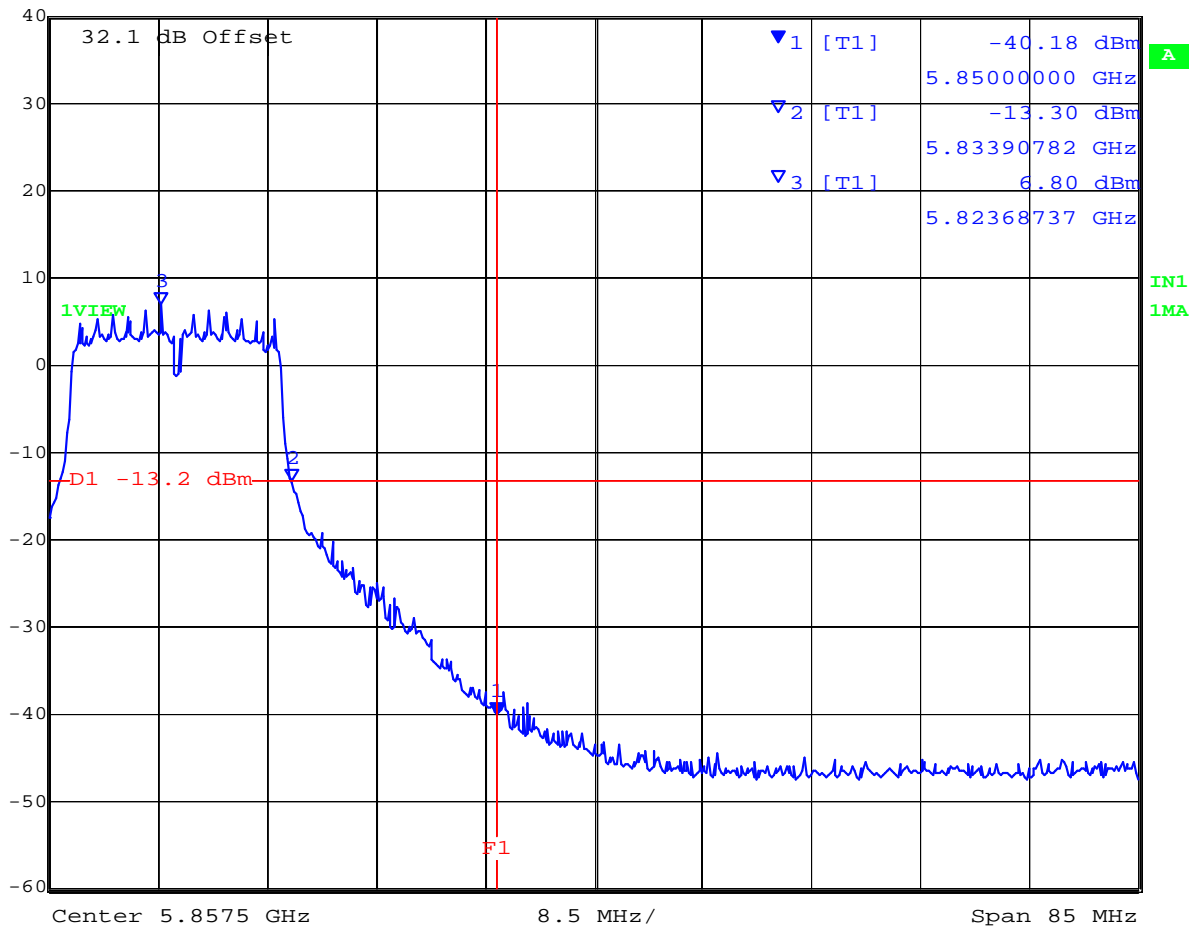
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a Legacy - Conducted Spurious Emissions at the 5,850 MHz Band Edge

Max/Ref Lvl Marker 1 [T1] RBW 100 kHz RF Att 10 dB
40 dBm -40.18 dBm VBW 300 kHz
12.1 dBm 5.85000000 GHz SWT 20 s Unit dBm



Date: 19.FEB.2009 13:59:16

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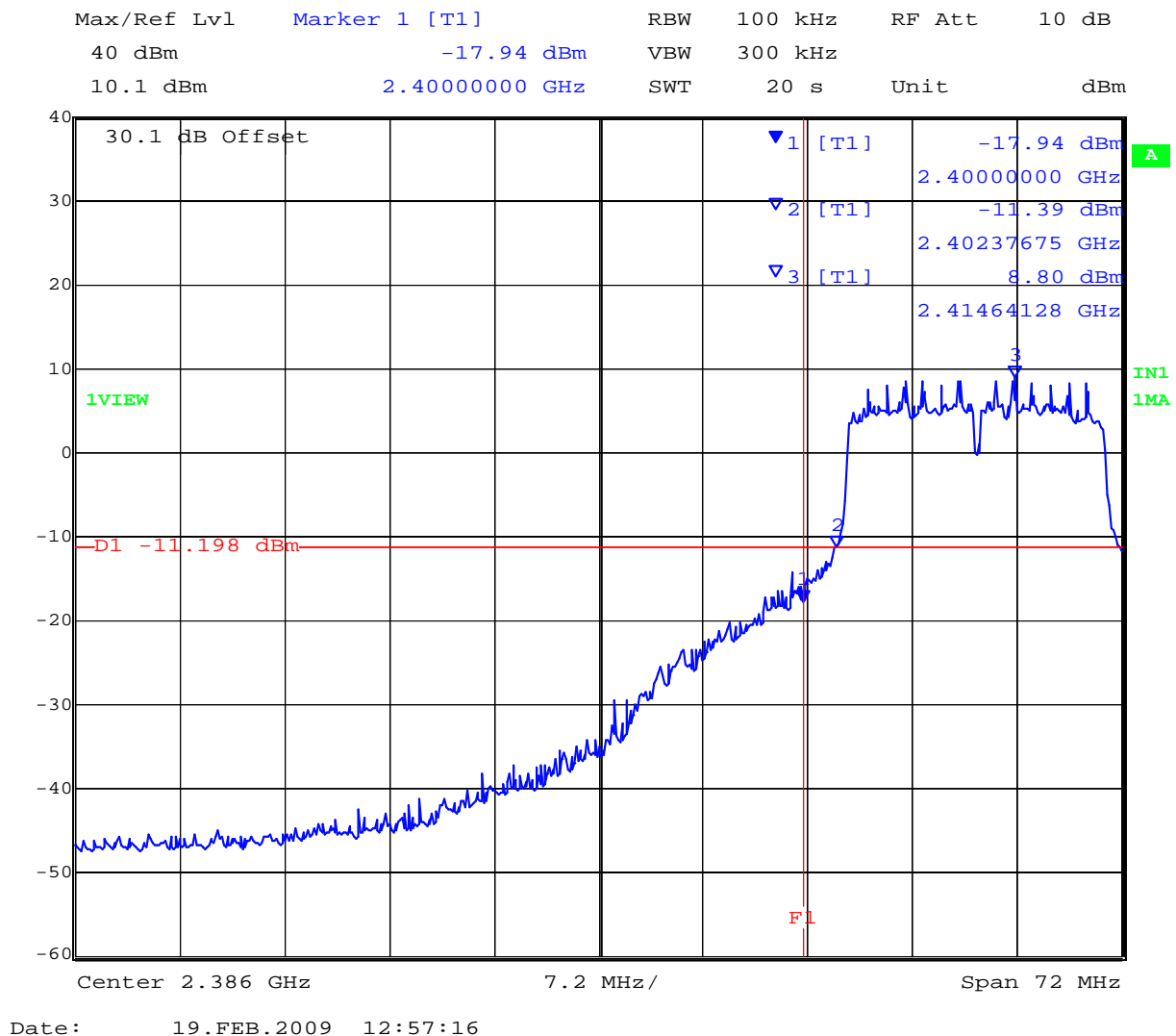
Title: 651-XX 802.11a/b/g/n Wireless Controller
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Conducted Band-Edge Results

TABLE OF RESULTS – 802.11n HT-20

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-11.198	-17.94	-6.7
2,462	2,483.5	-10.880	-27.42	-16.5

n HT-20 Conducted Spurious Emissions at the 2,400 MHz Band Edge

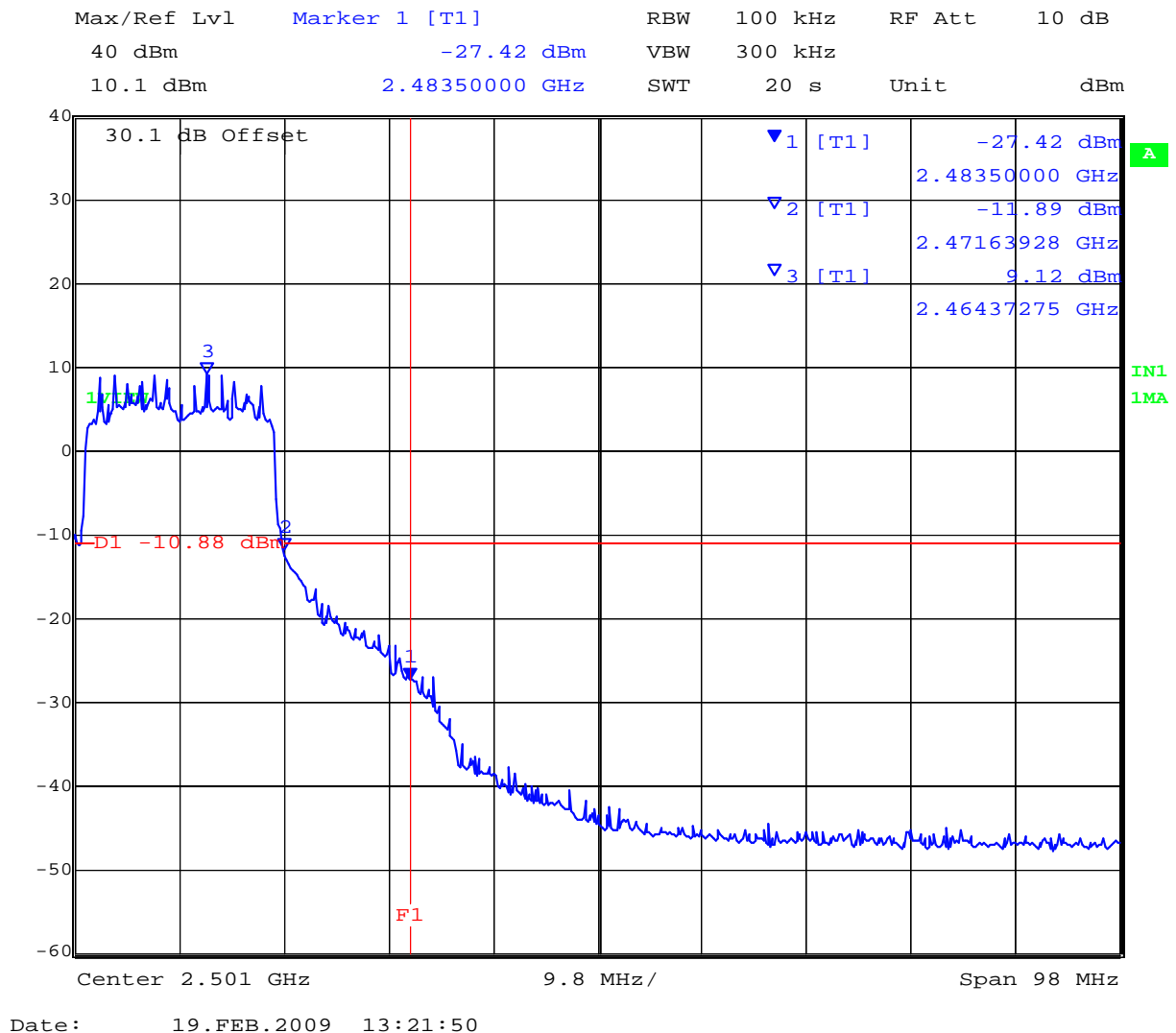


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n HT-20 Conducted Spurious Emissions at the 2,483.5 MHz Band Edge



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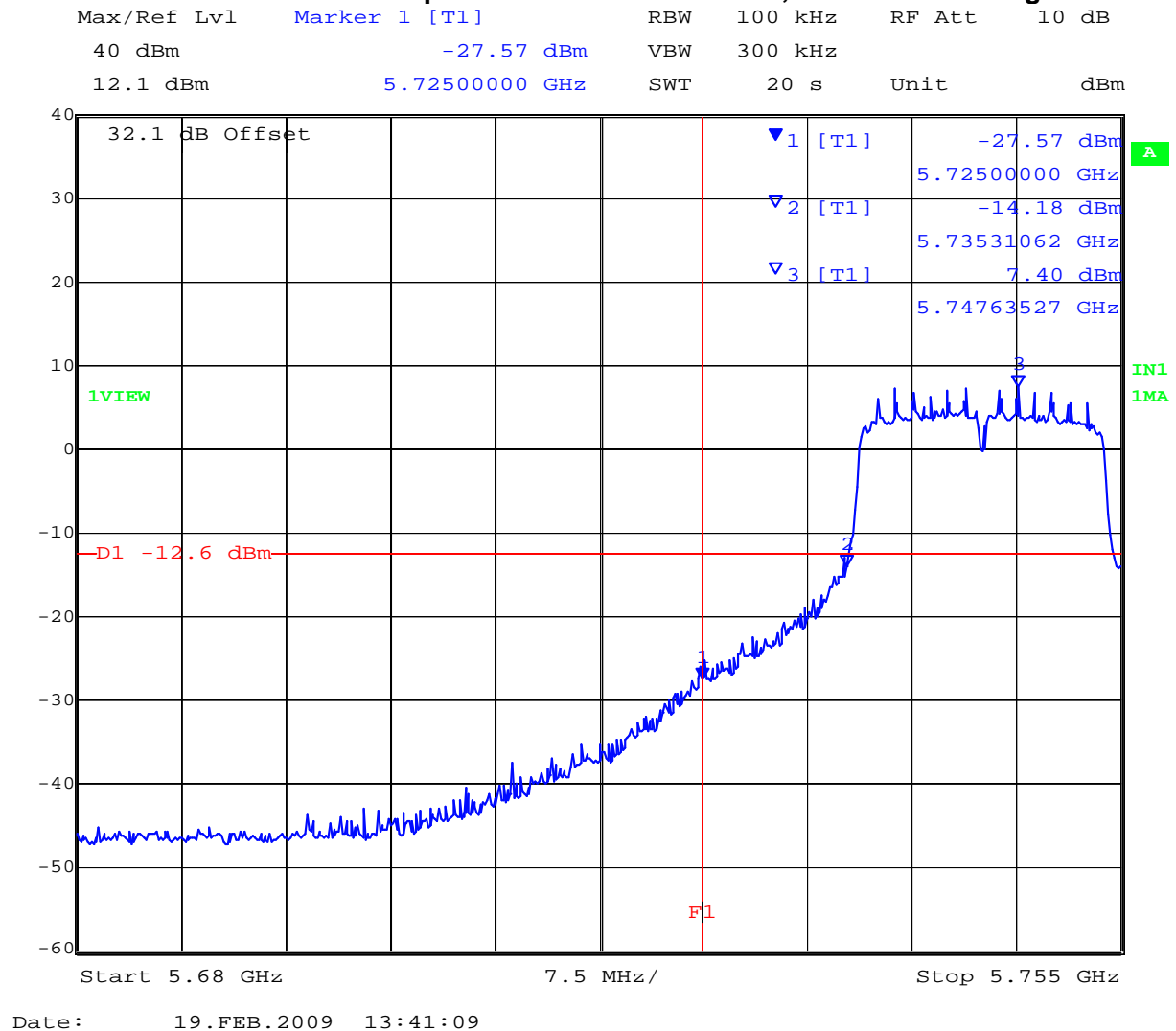


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TABLE OF RESULTS – 802.11n HT-20

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
5,745	5,725	-12.600	-27.57	-15.0
5,825	5,850	-13.202	-37.16	-24.0

n HT-20 Conducted Spurious Emissions at the 5,725 MHz Band Edge



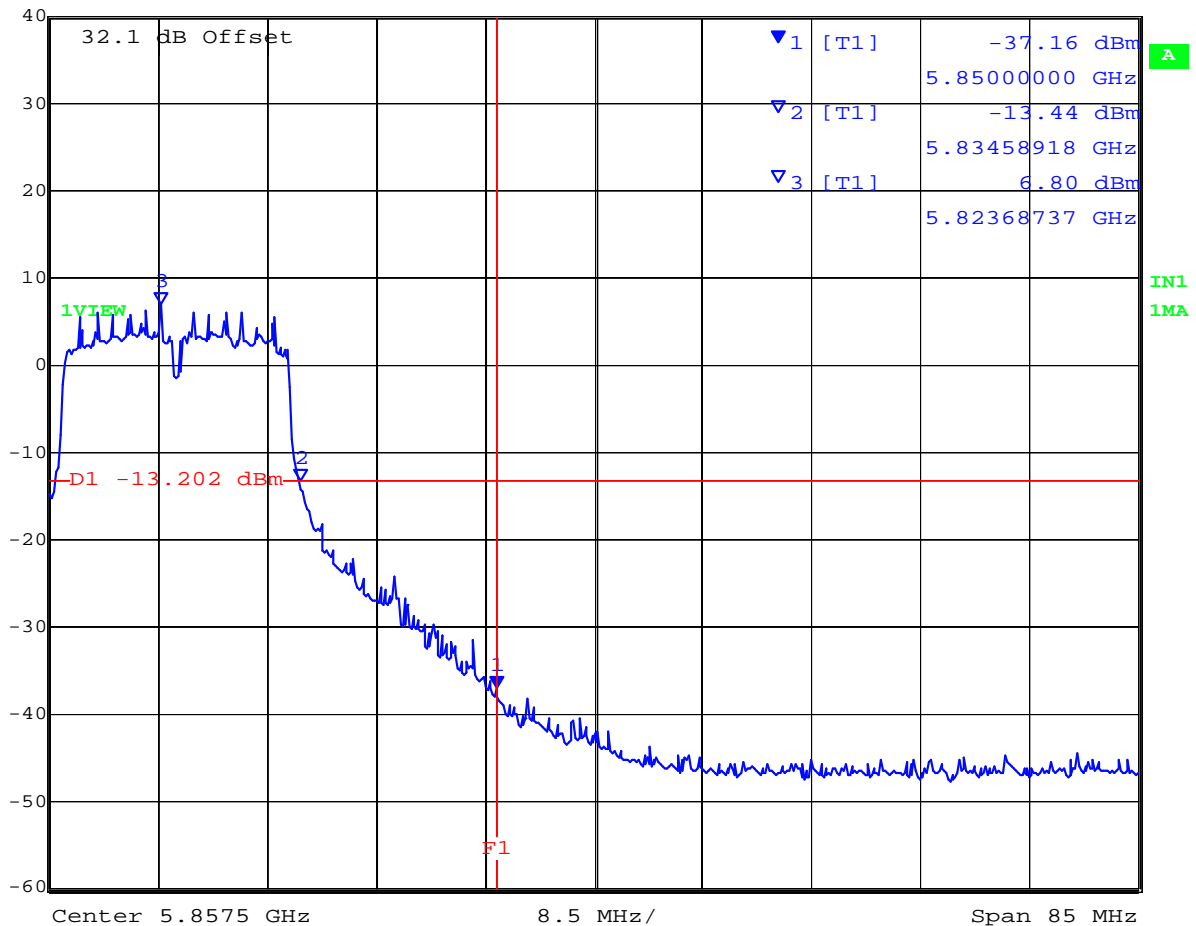
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n HT-20 Conducted Spurious Emissions at the 5,850 MHz Band Edge

Max/Ref Lvl 40 dBm
12.1 dBm
Marker 1 [T1] -37.16 dBm
5.85000000 GHz
RBW 100 kHz
VBW 300 kHz
RF Att 10 dB
SWT 20 s
Unit dBm



Date: 19.FEB.2009 14:01:18

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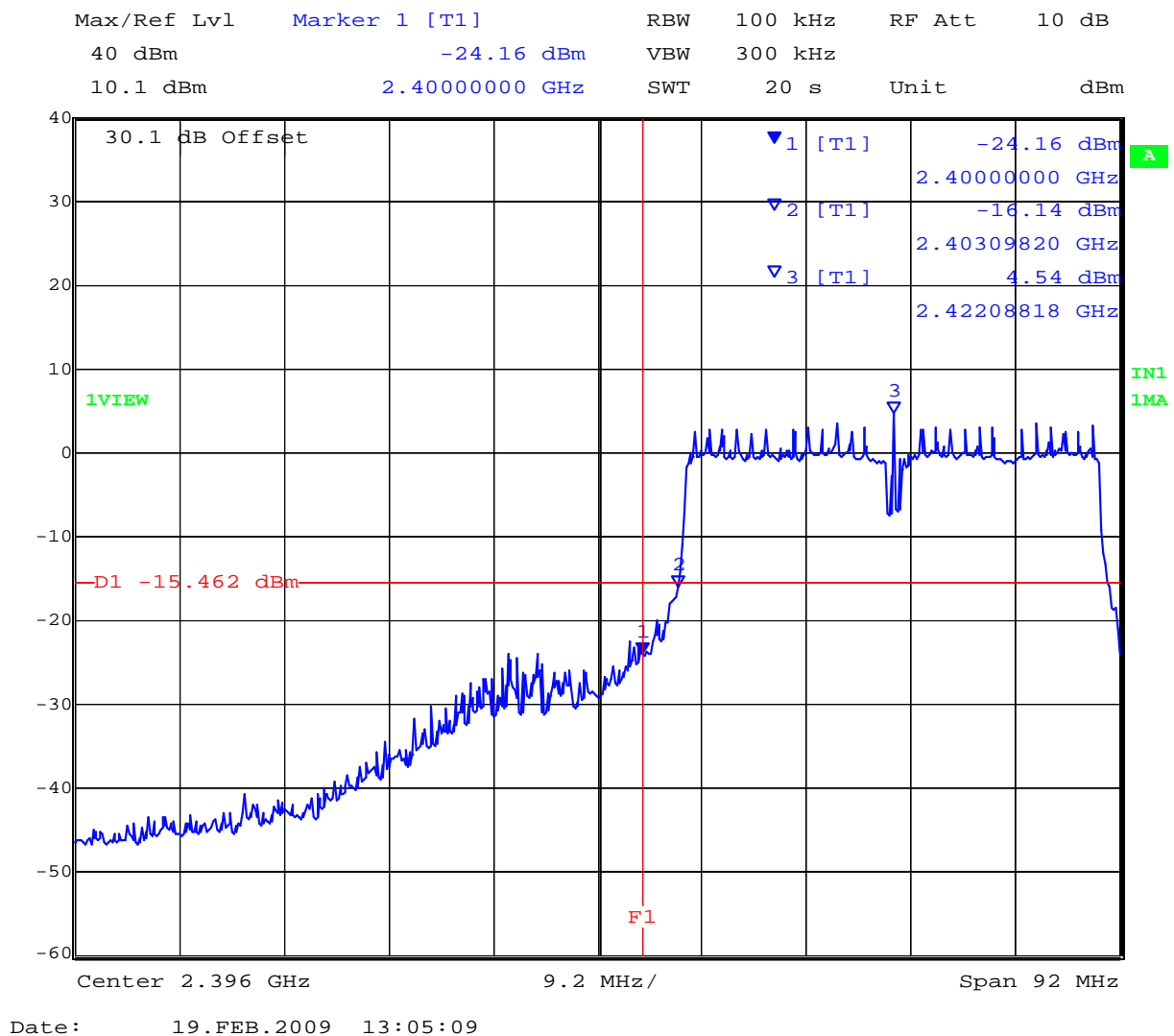
Title: 651-XX 802.11a/b/g/n Wireless Controller
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Conducted Band-Edge Results

TABLE OF RESULTS – 802.11n HT-40

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,422	2,400	-15.462	-24.16	-8.7
2,452	2,483.5	-16.298	-28.02	-11.7

n HT-40 Conducted Spurious Emissions at the 2,400 MHz Band Edge

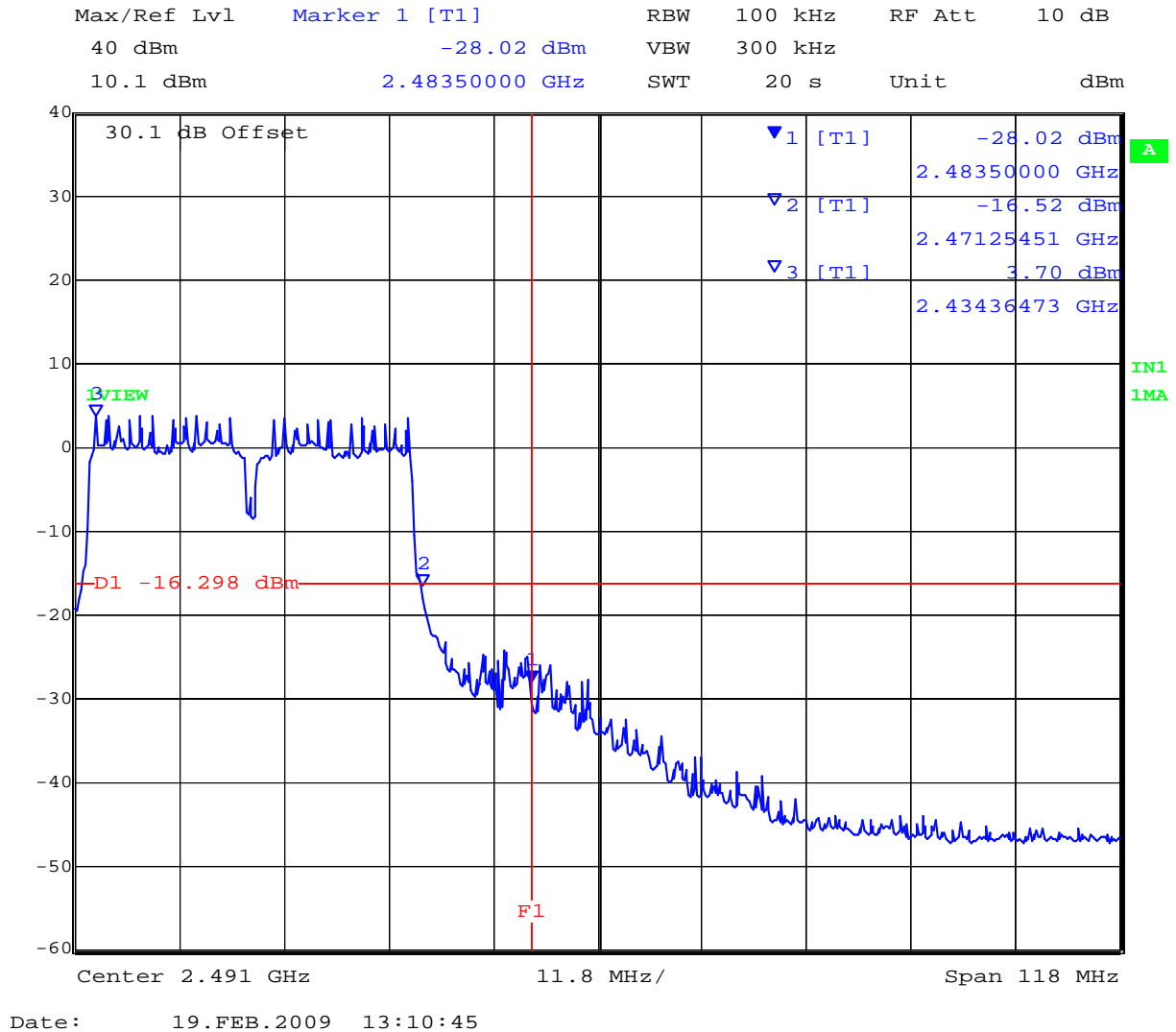


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n HT-40 Conducted Spurious Emissions at the 2,483.5 MHz Band Edge



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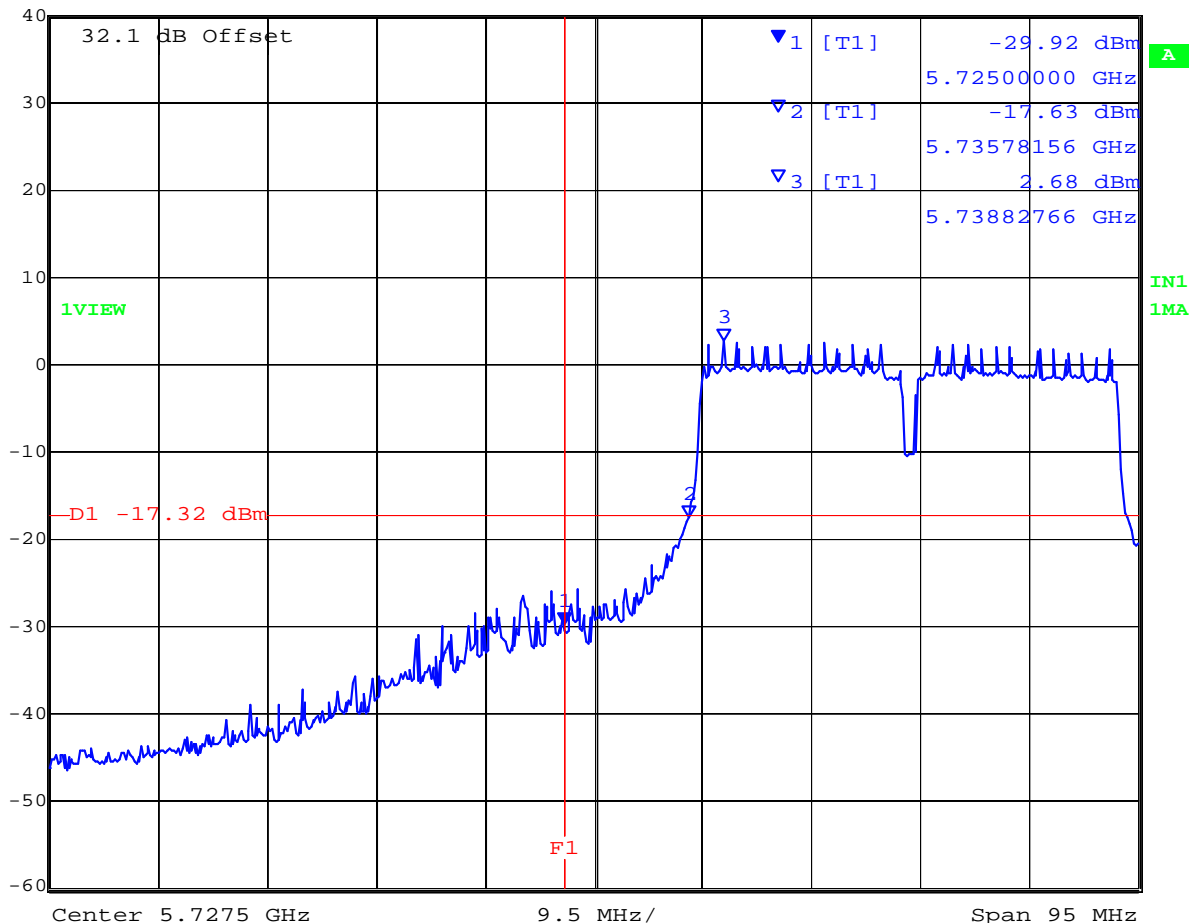
Title: 651-XX 802.11a/b/g/n Wireless Controller
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TABLE OF RESULTS – 802.11n HT-40

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
5,745	5,725	-16.639	-20.12	-3.5
5,825	5,850	-18.264	-32.83	-14.6

n HT-40 Conducted Spurious Emissions at the 5,725 MHz Band Edge

Max/Ref Lvl Marker 1 [T1] RBW 100 kHz RF Att 10 dB
40 dBm -29.92 dBm VBW 300 kHz
12.1 dBm 5.72500000 GHz SWT 20 s Unit dBm



Date: 19.FEB.2009 13:46:32

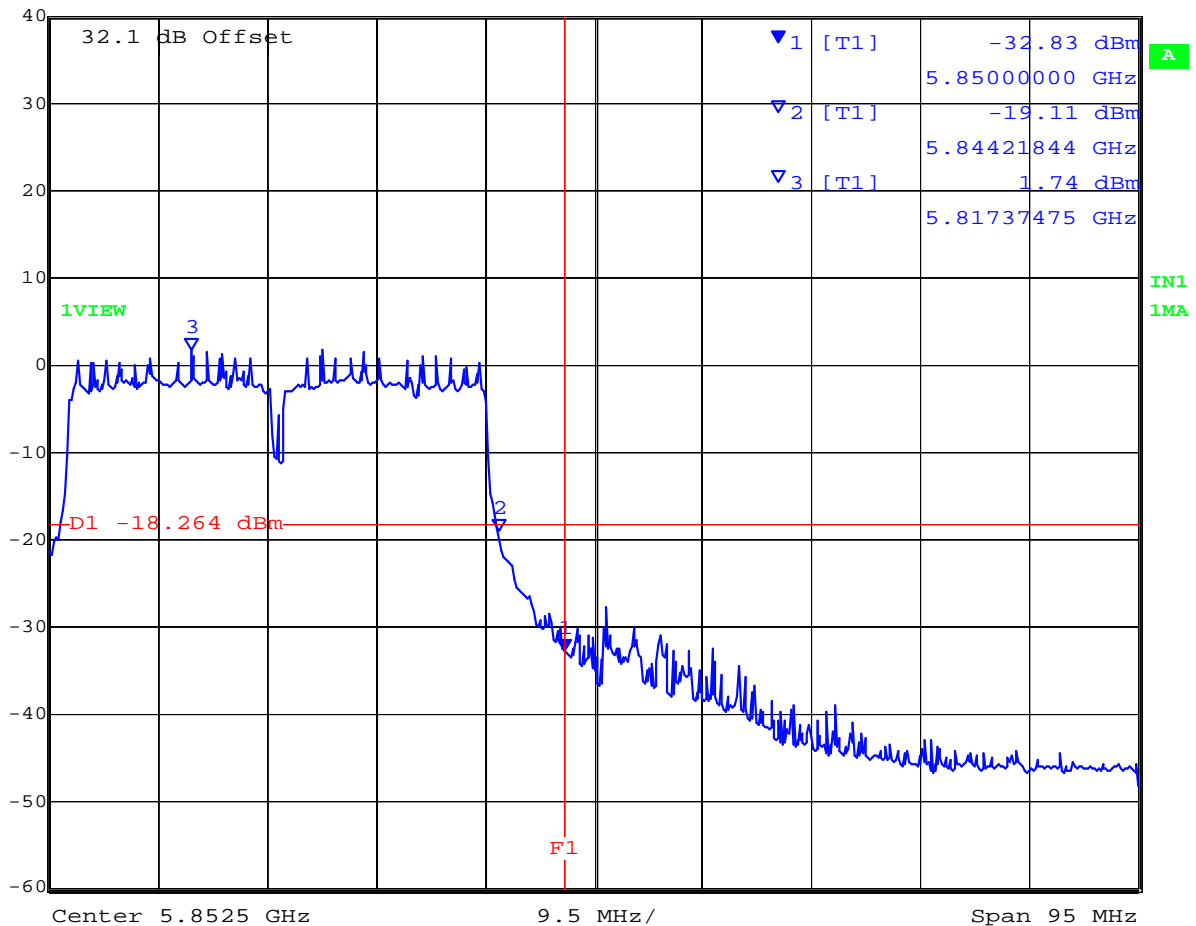
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n HT-40 Conducted Spurious Emissions at the 5,850 MHz Band Edge

Max/Ref Lvl 40 dBm
12.1 dBm
Marker 1 [T1] -32.83 dBm
5.85000000 GHz
RBW 100 kHz
VBW 300 kHz
RF Att 10 dB
SWT 20 s
Unit dBm



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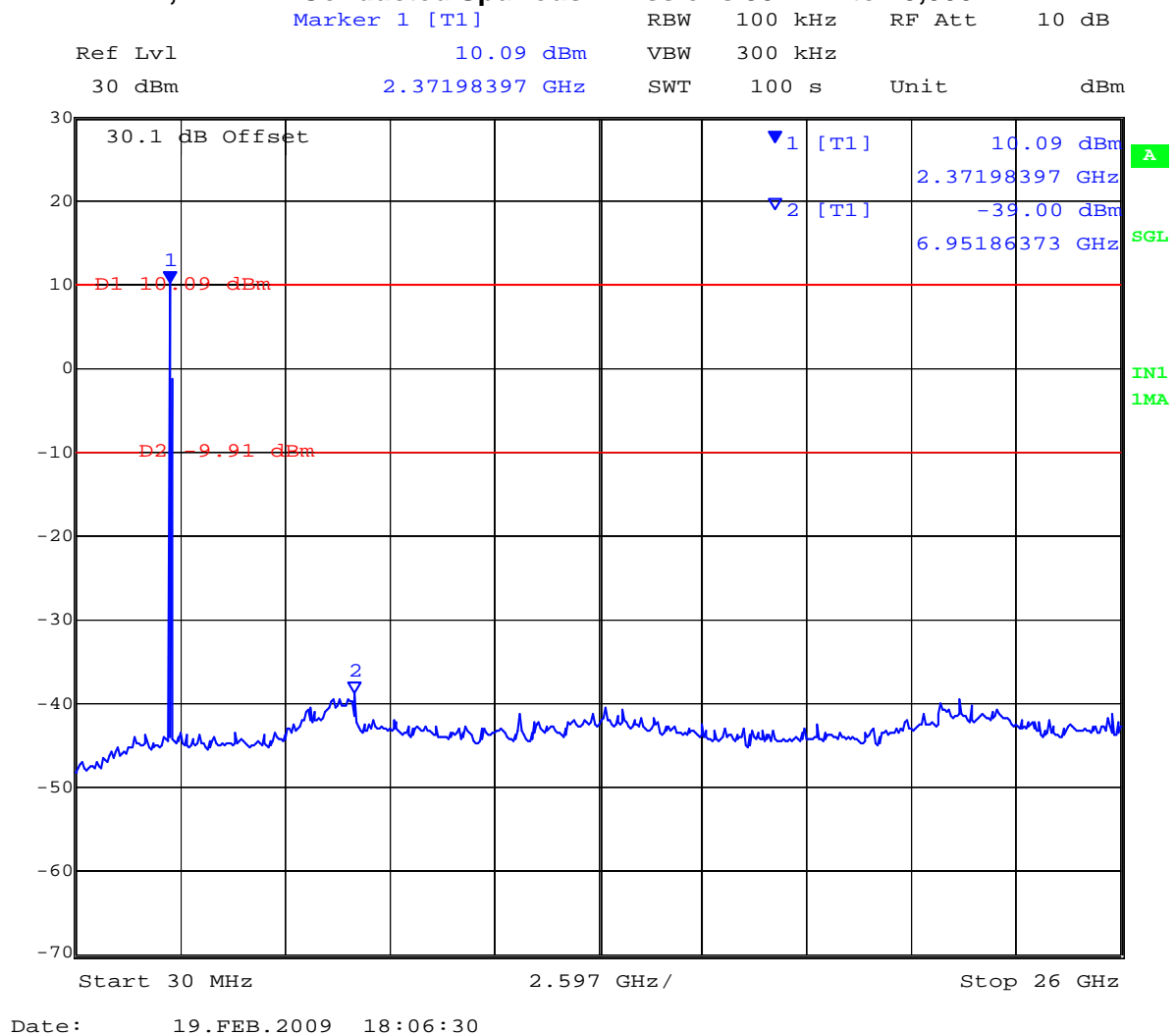
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11b – Legacy

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	30	25,000	-39.00	-9.91	-29.1

802.11b – Legacy

2,412 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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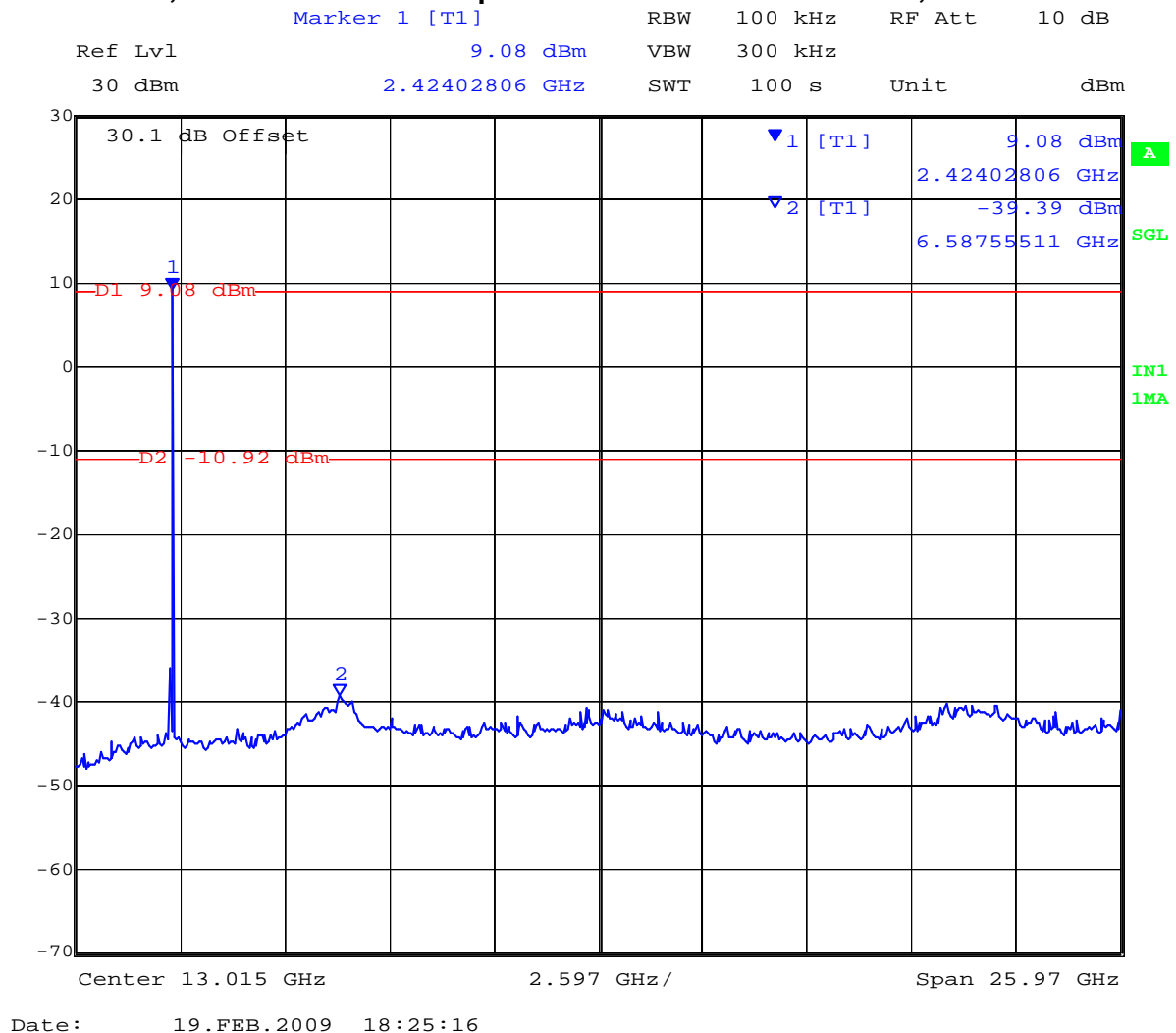
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11b – Legacy

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,437	30	25,000	-39.39	-10.92	-28.5

802.11b – Legacy

2,437 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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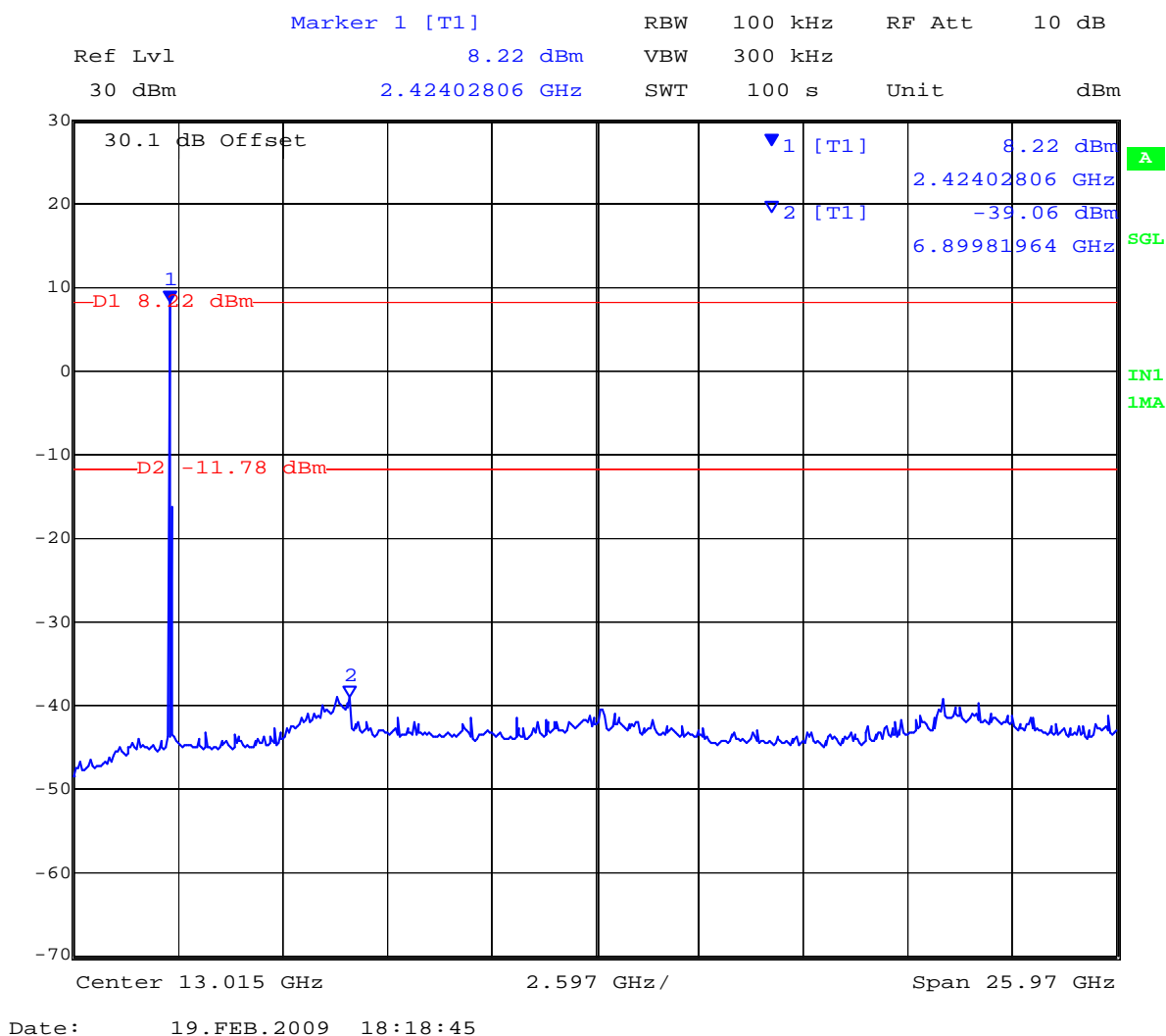
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11b – Legacy

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,462	30	25,000	-39.06	-11.78	-27.3

802.11b – Legacy

2,462 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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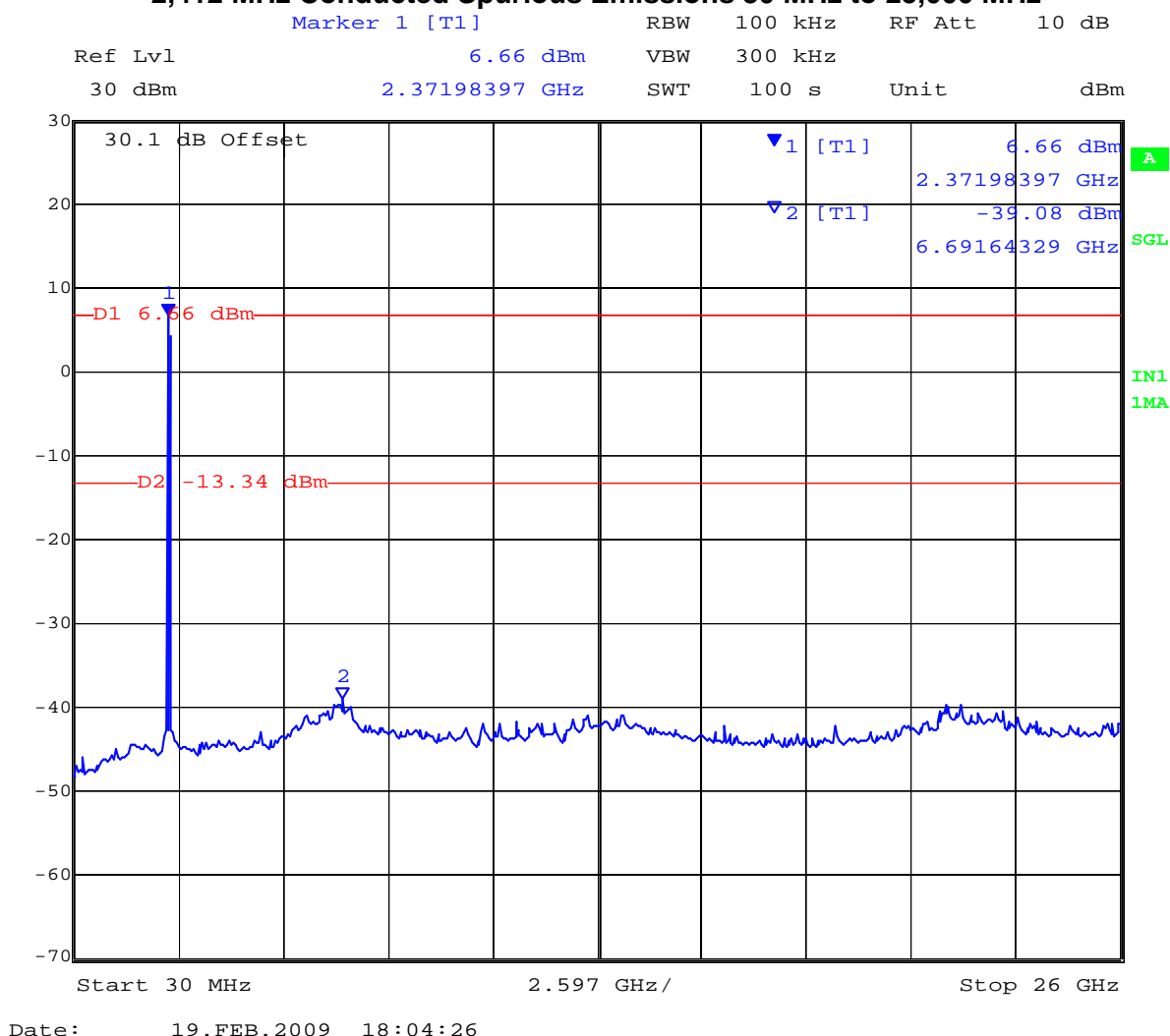
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11g – Legacy

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	30	25,000	-39.08	-13.34	-25.7

802.11g – Legacy

2,412 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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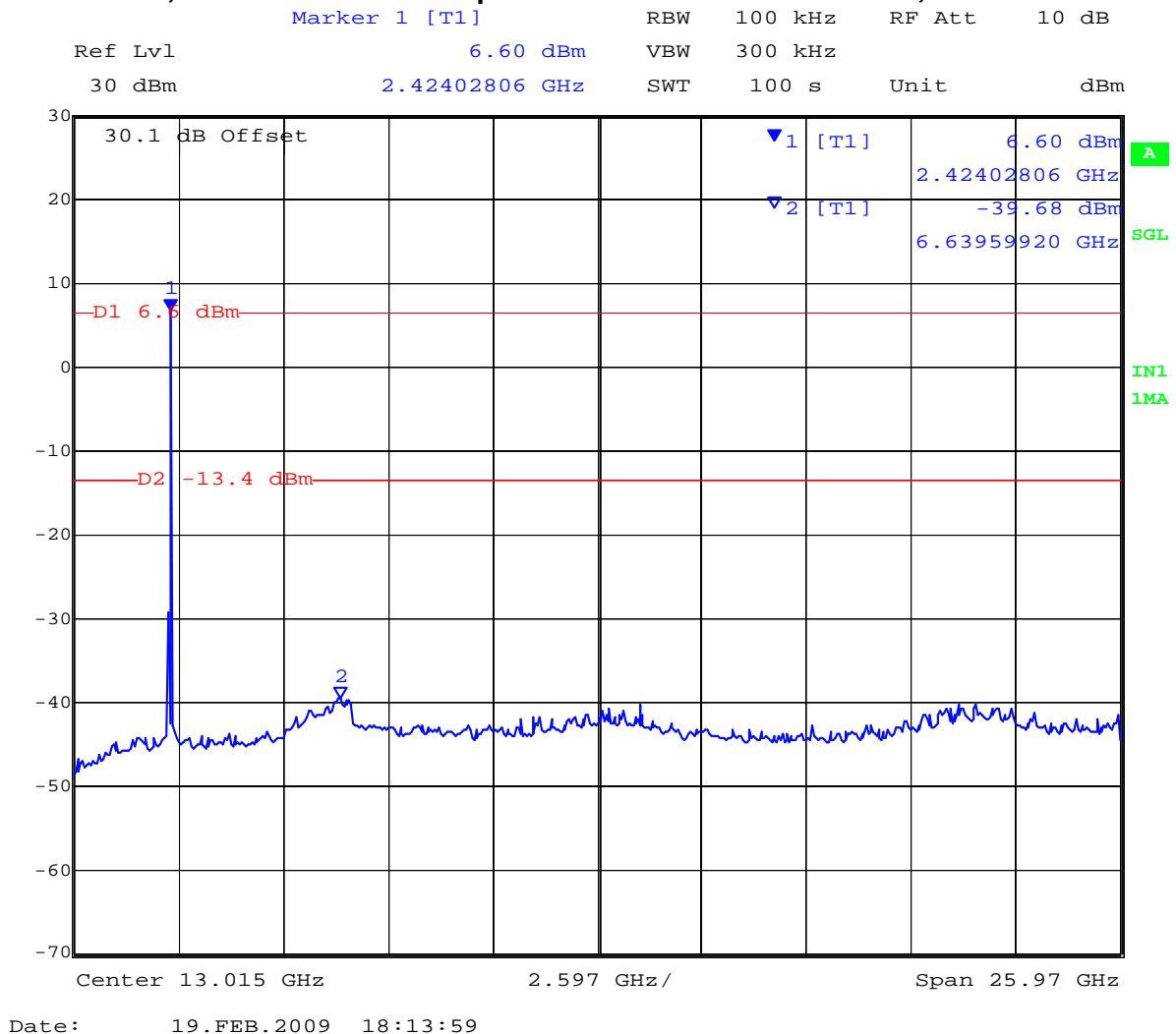
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11g – Legacy

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,437	30	25,000	-39.68	-13.40	-26.3

802.11g – Legacy

2,437 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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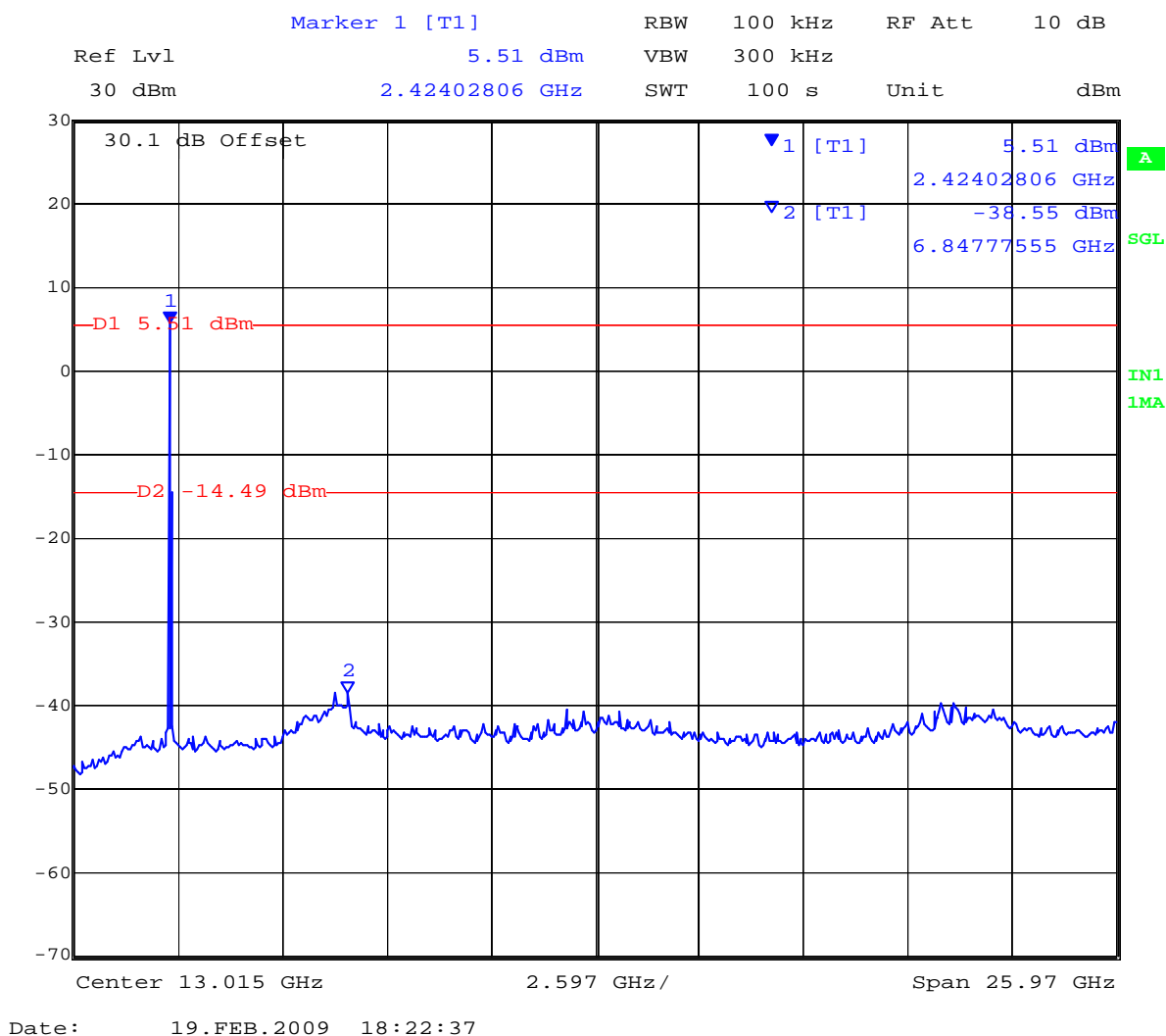
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11g – Legacy

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,462	30	25,000	-38.55	-14.49	-24.06

802.11g – Legacy

2,462 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11a – Legacy

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,745	30	40,000	-27.71	-13.66	-14.05

802.11a – Legacy

5,745 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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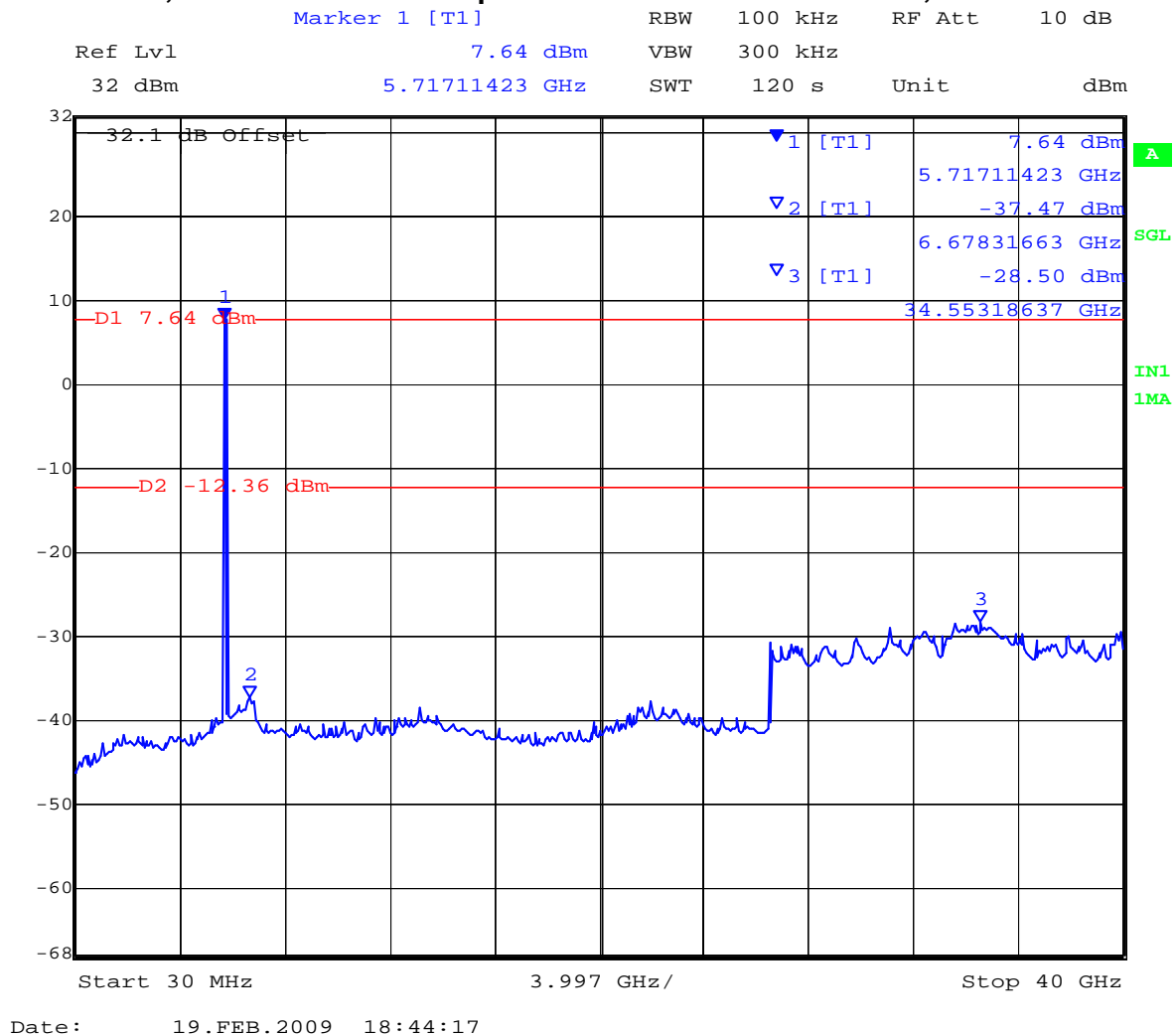
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11a – Legacy

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,785	30	40,000	-28.50	-12.36	-16.1

802.11a – Legacy

5,785 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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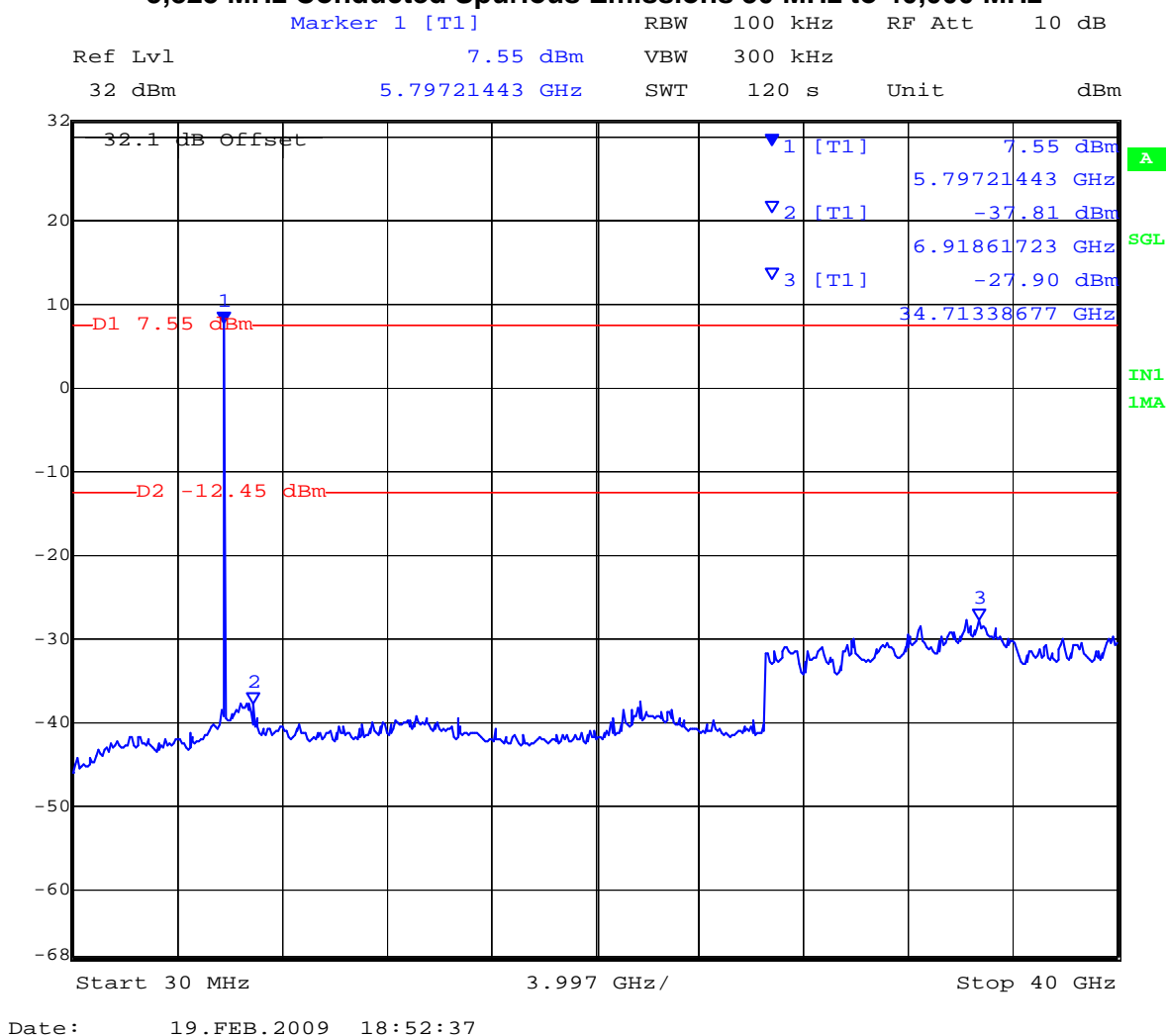
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11a – Legacy

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,825	30	40,000	-27.90	-12.45	-15.5

802.11a – Legacy

5,825 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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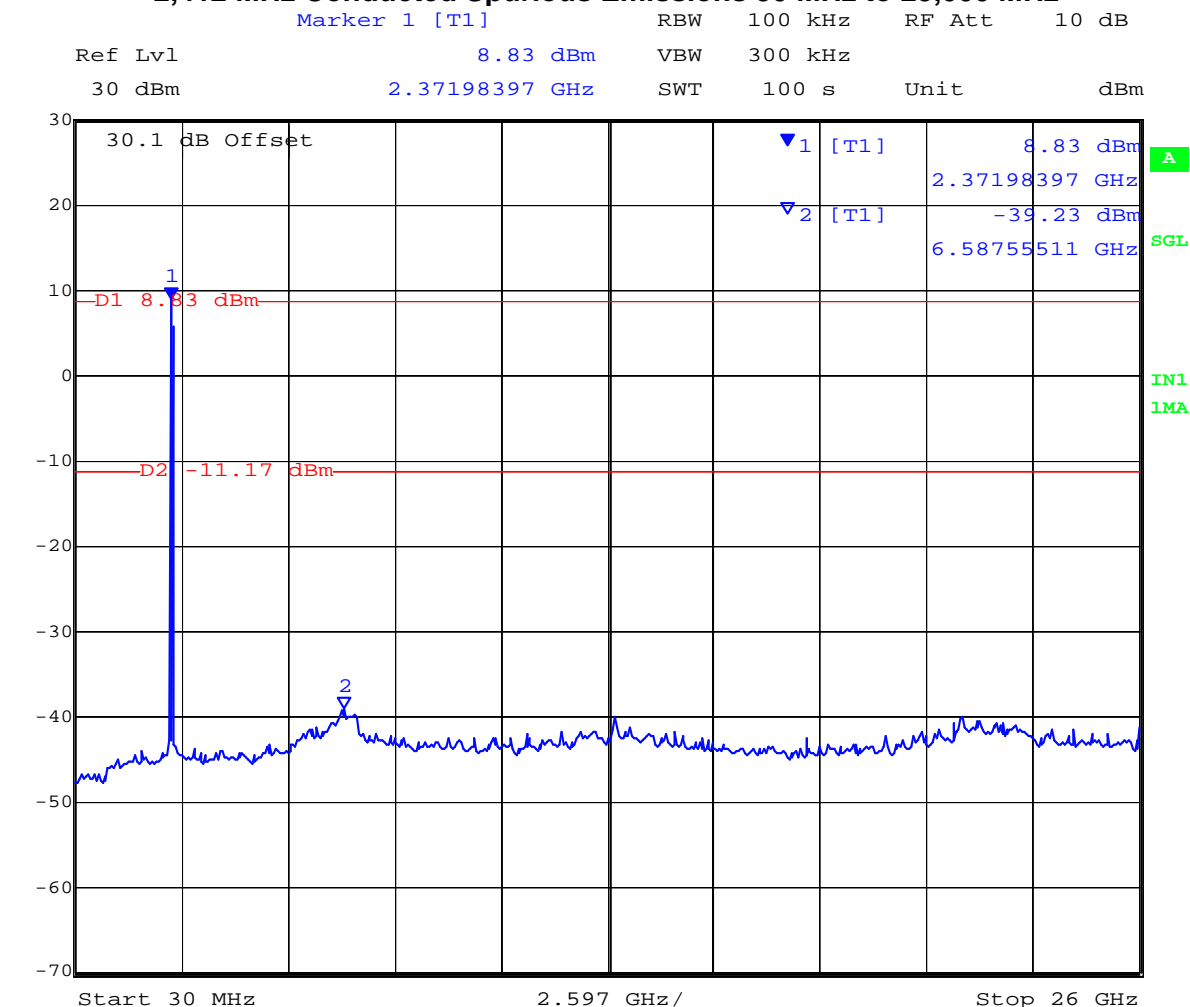
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11g HT-20

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	30	25,000	-39.23	-11.17	-28.1

802.11n HT-20

2,412 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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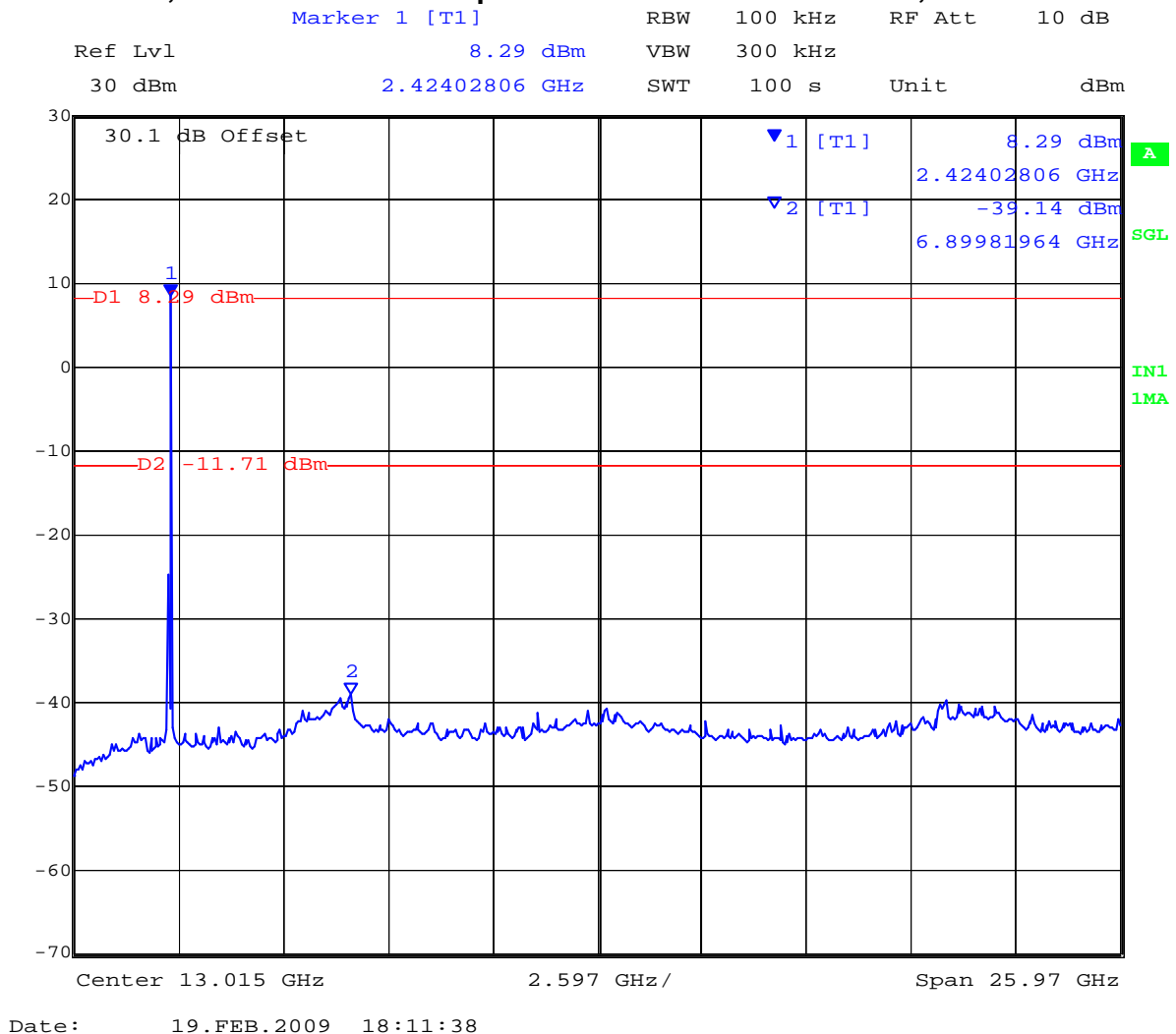
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11g HT-20

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,437	30	25,000	-39.14	-11.71	-27.4

802.11n HT-20

2,437 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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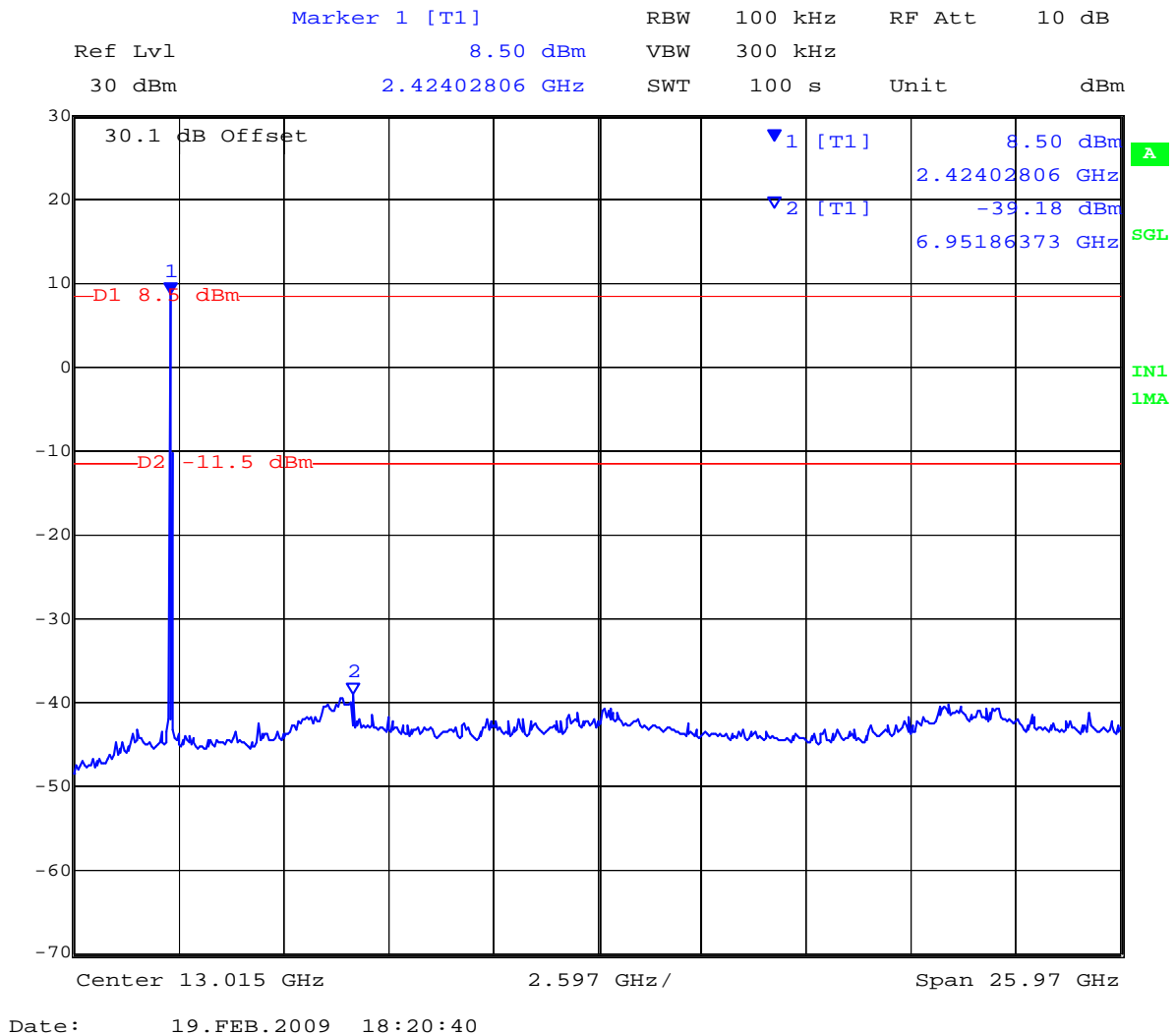
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11n HT-20

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,462	30	25,000	-39.18	-11.50	-27.7

802.11n HT-20

2,462 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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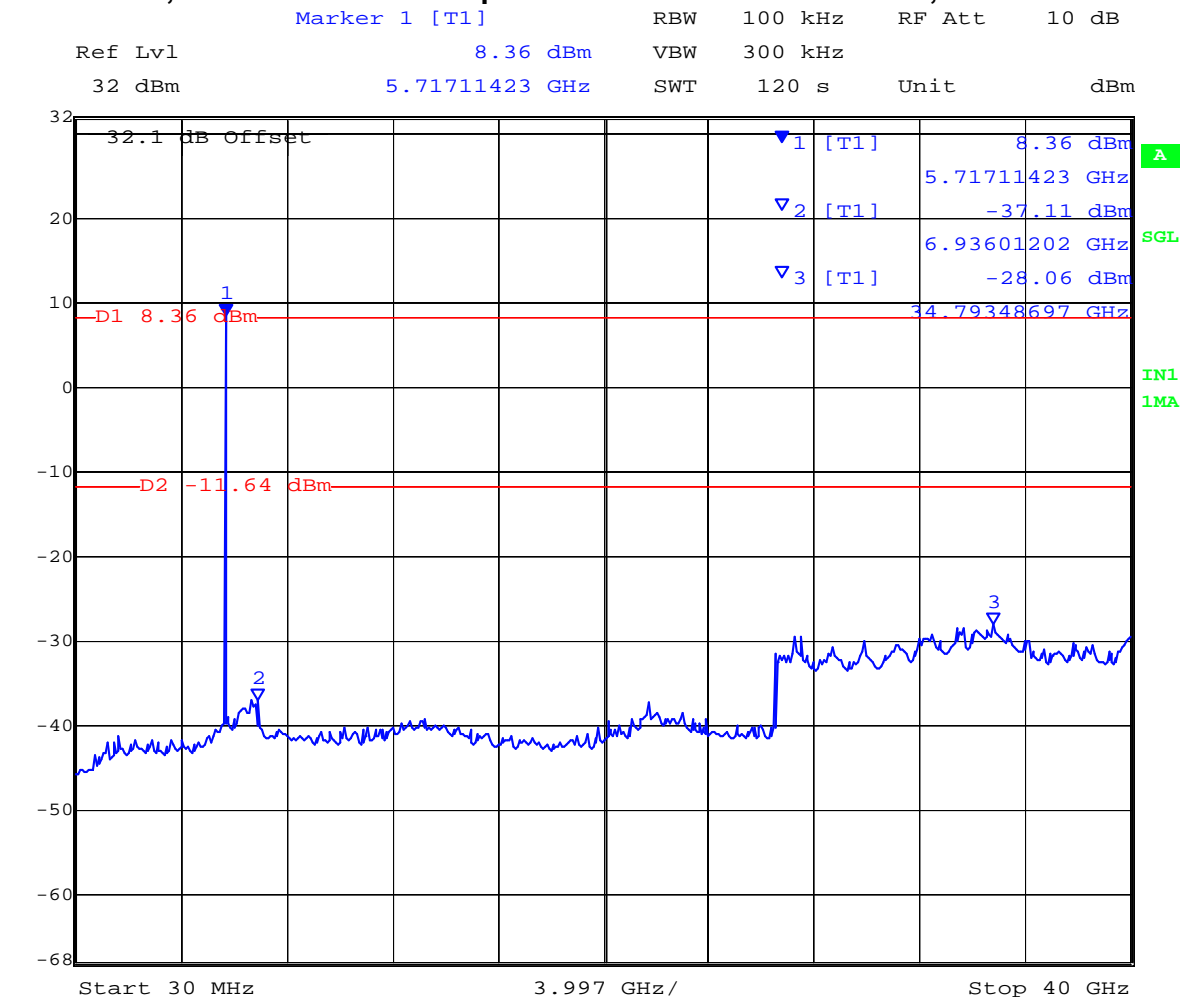
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11n – HT-20

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,745	30	40,000	-28.06	-11.64	-16.4

802.11n HT-20

5,745 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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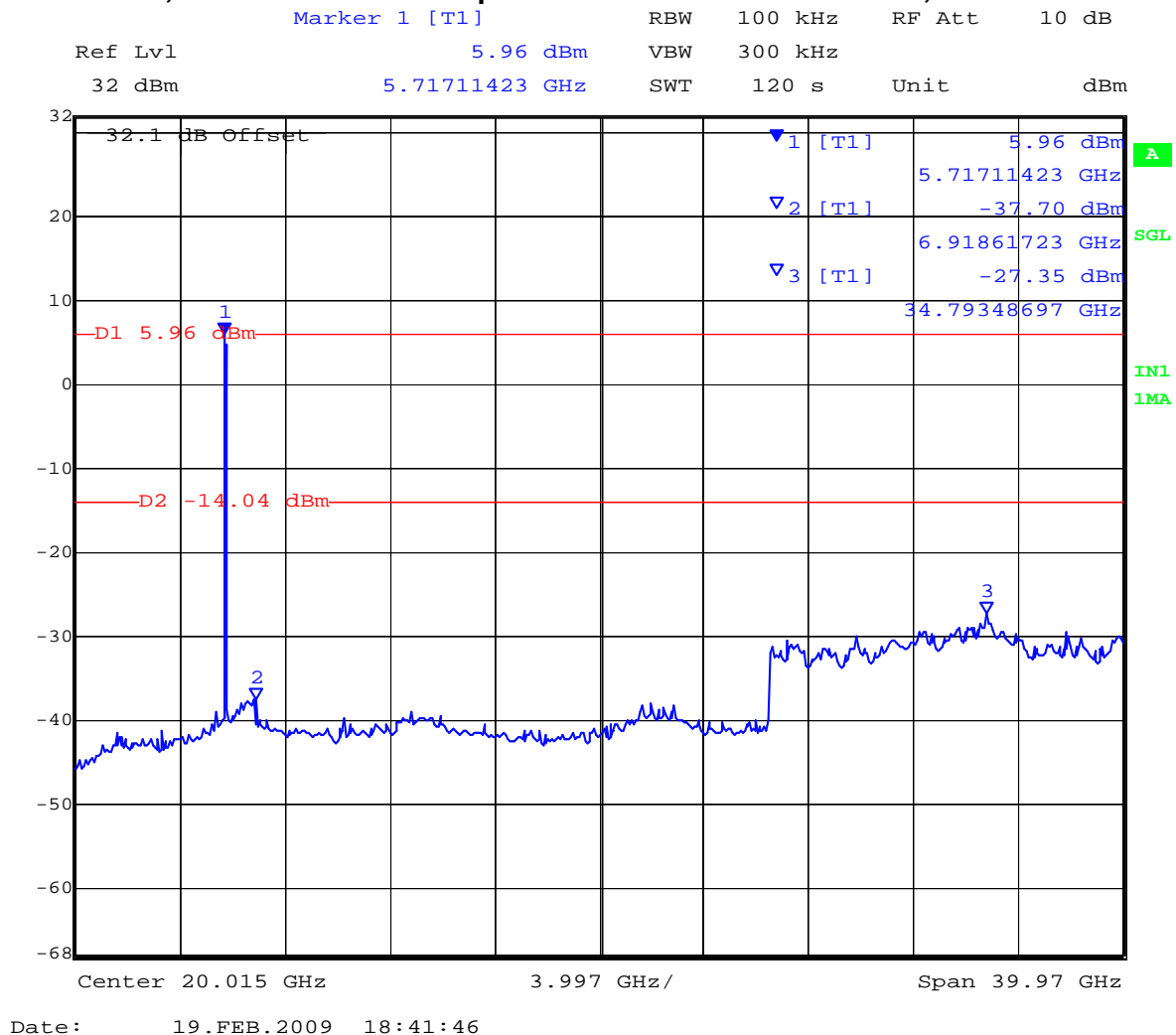
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11n HT-20

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,785	30	40,000	-27.35	-14.04	-13.3

802.11n HT-20

5,785 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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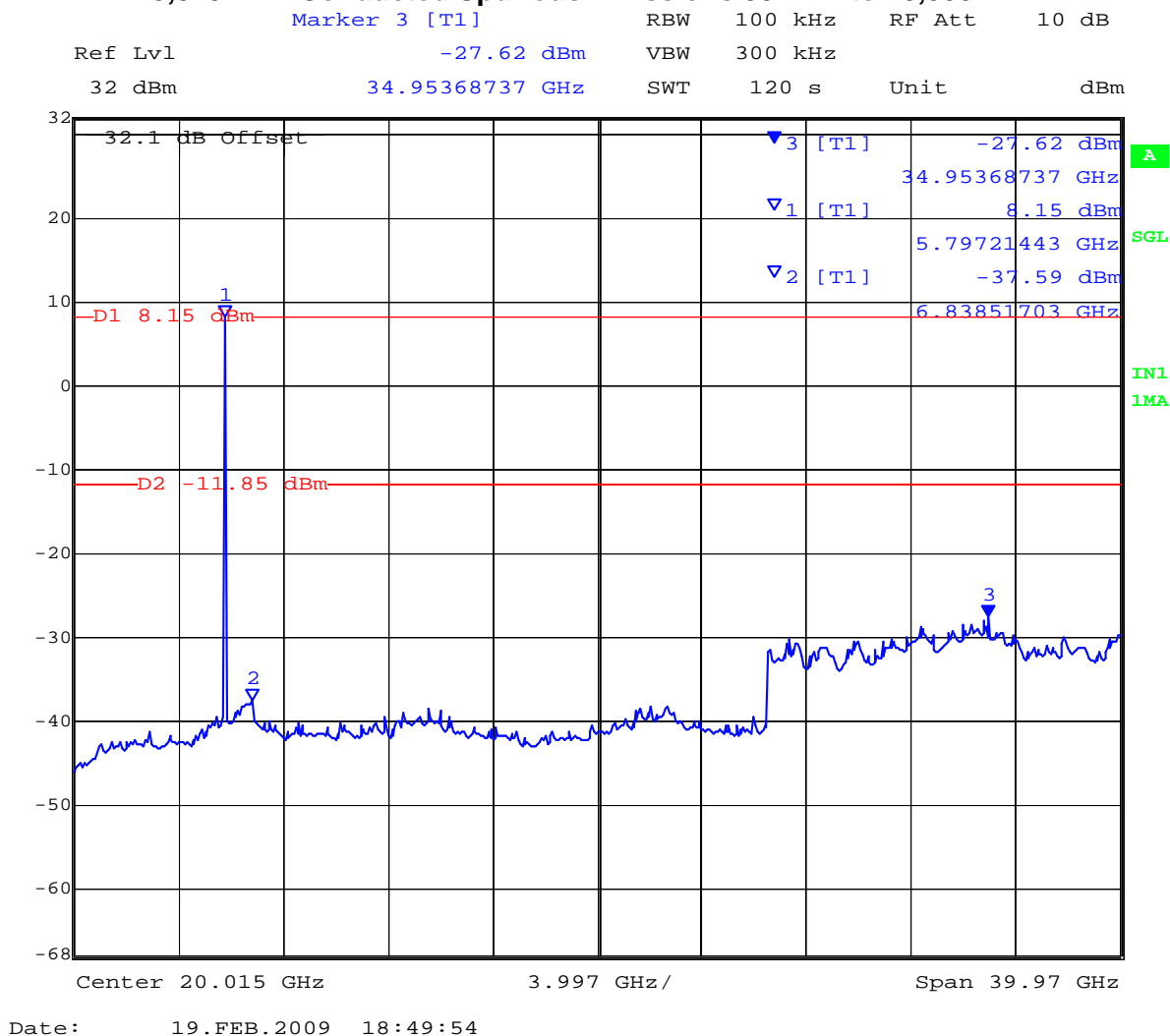
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11n HT-20

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,825	30	40,000	-27.62	-11.85	-15.77

802.11n HT-20

5,825 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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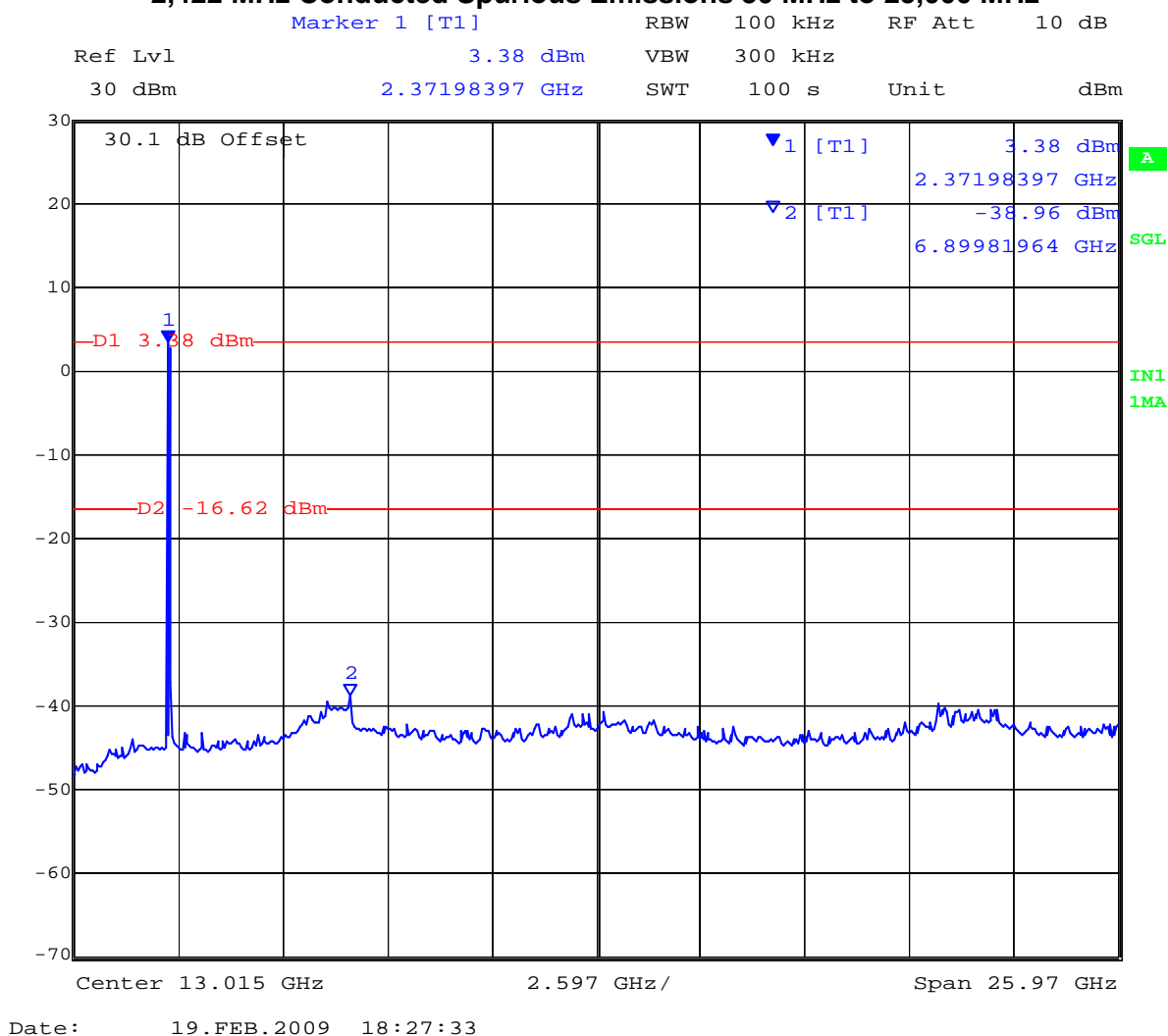
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11n HT-40

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,422	30	25,000	-38.96	-16.62	-22.34

802.11n – HT-40

2,422 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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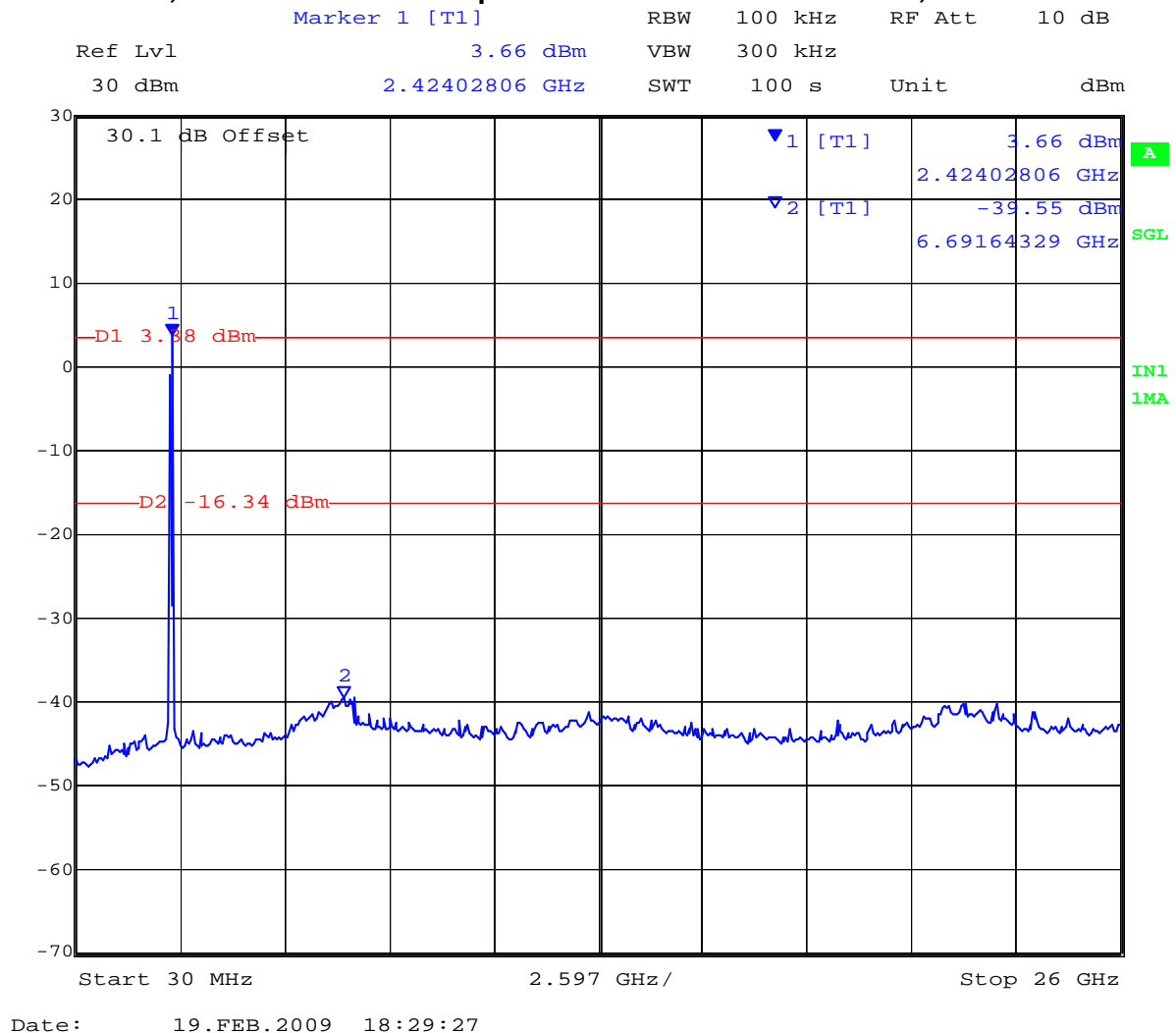
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11n HT-40

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,437	30	25,000	-39.55	-16.34	-23.2

802.11n HT-40

2,437 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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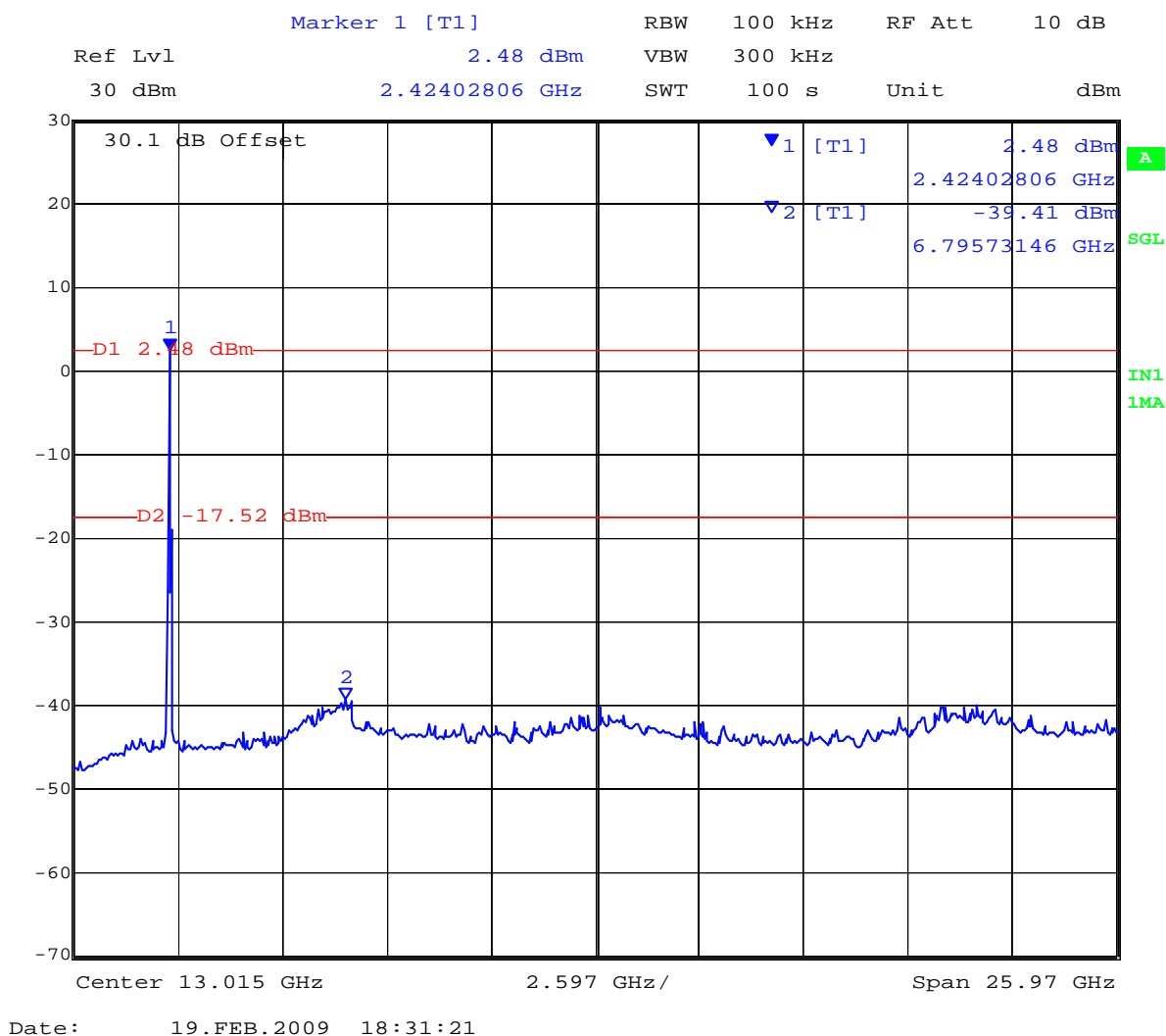
Spurious Emissions (30 - 25,000 MHz)

TABLE OF RESULTS – 802.11n HT-40

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,452	30	25,000	-39.41	-17.52	-21.9

802.11n HT-40

2,452 MHz Conducted Spurious Emissions 30 MHz to 25,000 MHz



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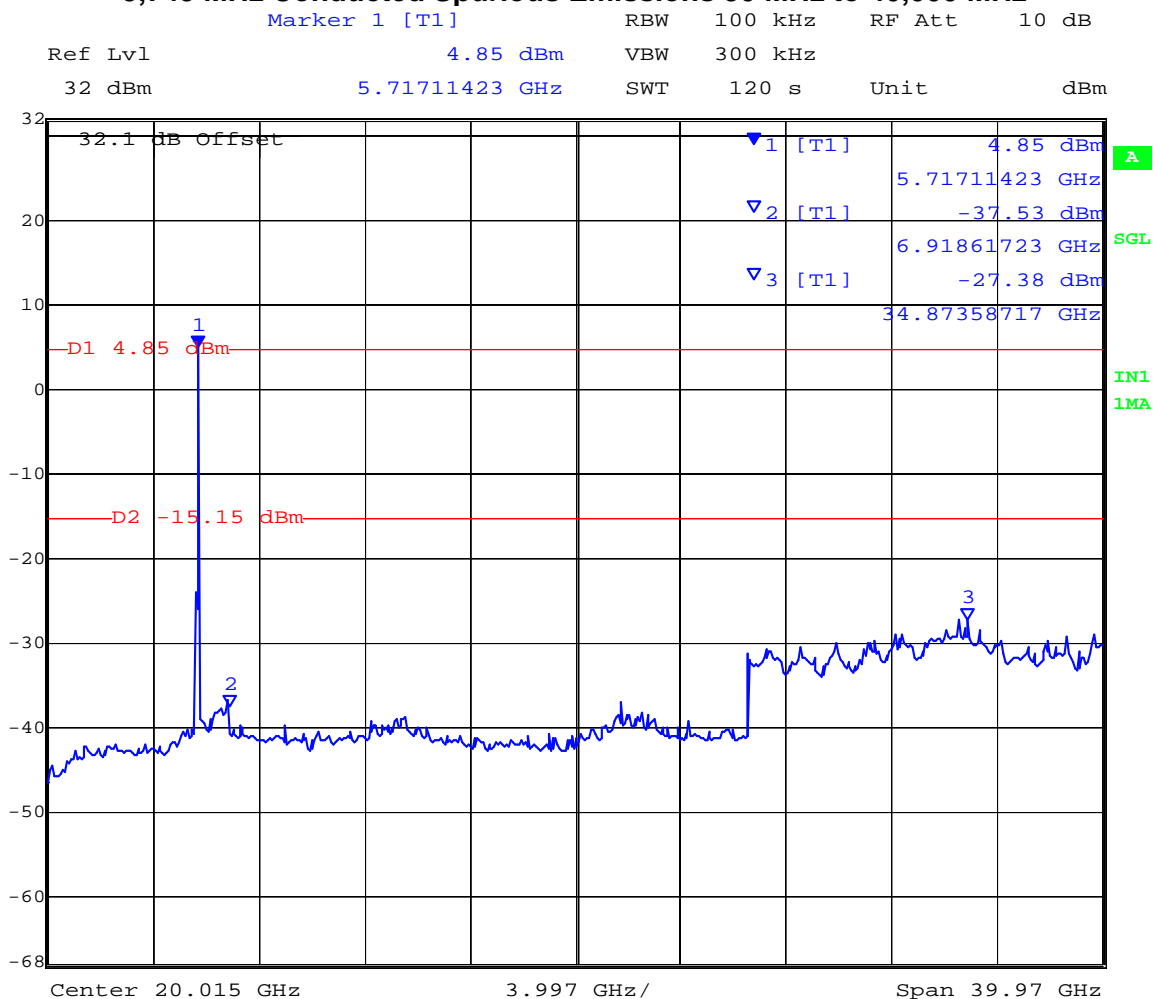
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11n HT-40

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,745	30	40,000	-27.38	-15.15	-12.2

802.11n HT-40

5,745 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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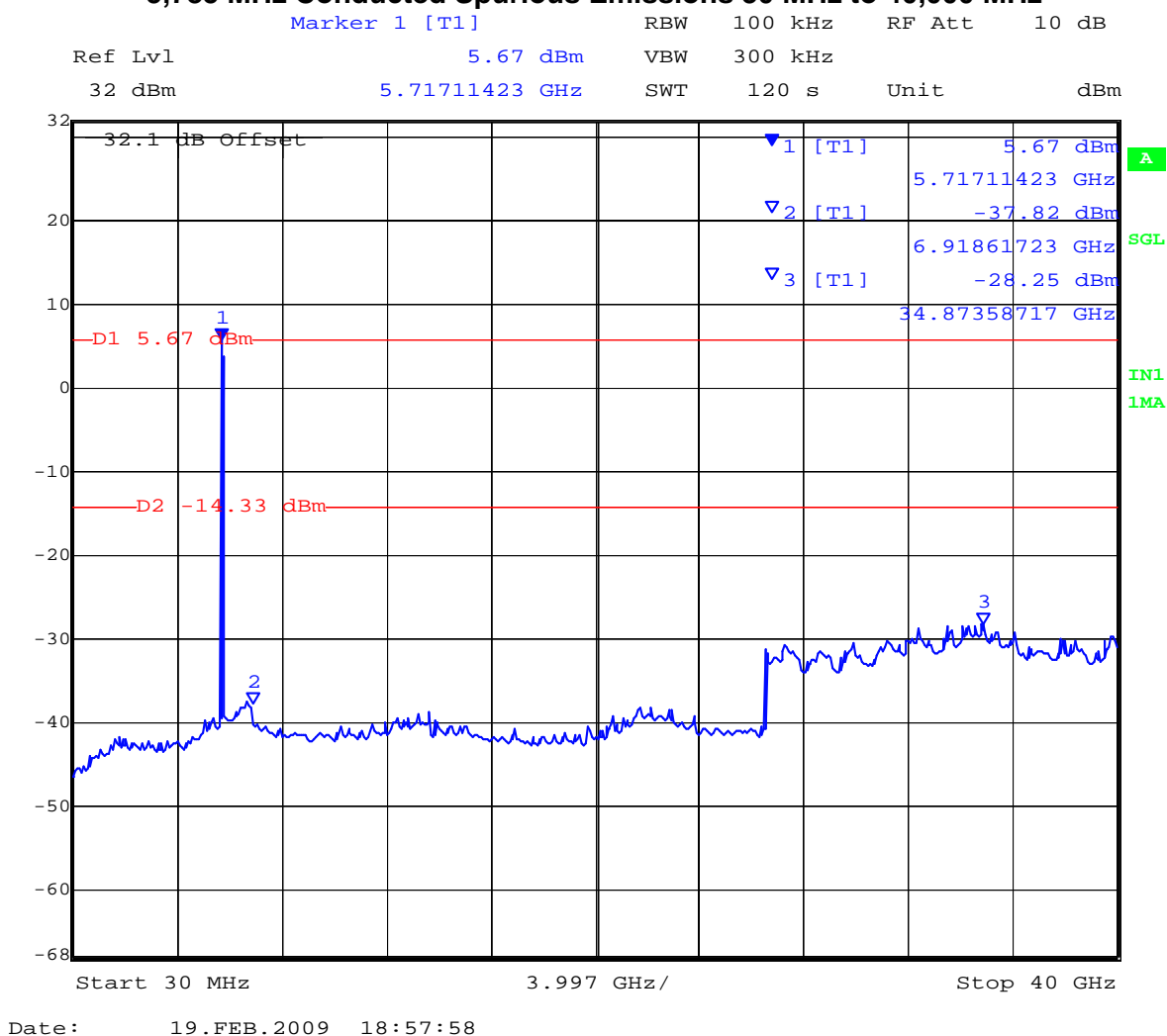
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11n HT-40

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,785	30	40,000	-28.25	-14.33	-13.9

802.11n HT-40

5,785 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – 802.11n HT-40

Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,825	30	40,000	-27.76	-15.77	-12.0

802.11n HT-40

5,825 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB
5725 MHz	5850 MHz	

§15.247(d) and RSS-210 §A8.5 In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

§15.247(d)

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

RSS-Gen §4.7

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB
-------------------------	----------

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0088, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117.

5.1.6. Radiated Emissions

5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz); Peak Field Strength Measurements; and Radiated Band Edge Measurements – Restricted Bands

FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209

Industry Canada RSS-210 §A8.5, §2.2, §2.6

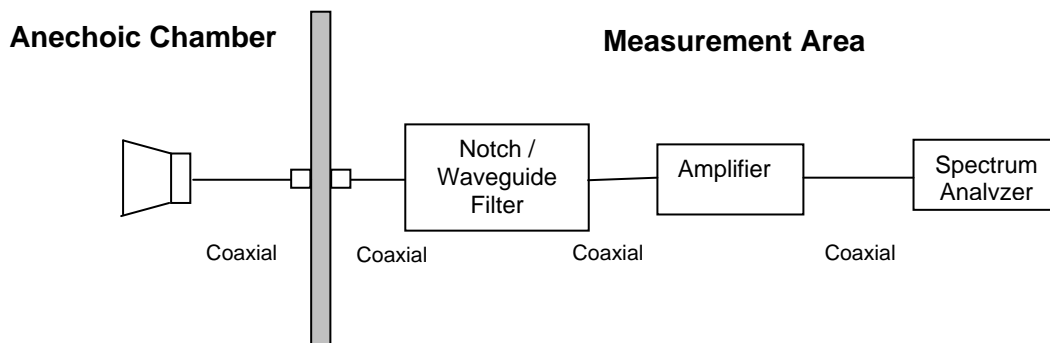
Industry Canada RSS-Gen §4.7

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

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.

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

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss

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For 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:

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

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

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

Ambient conditions.

Temperature: 17 to 23°C

Relative humidity: 31 to 57 %

Pressure: 999 to 1012 mbar

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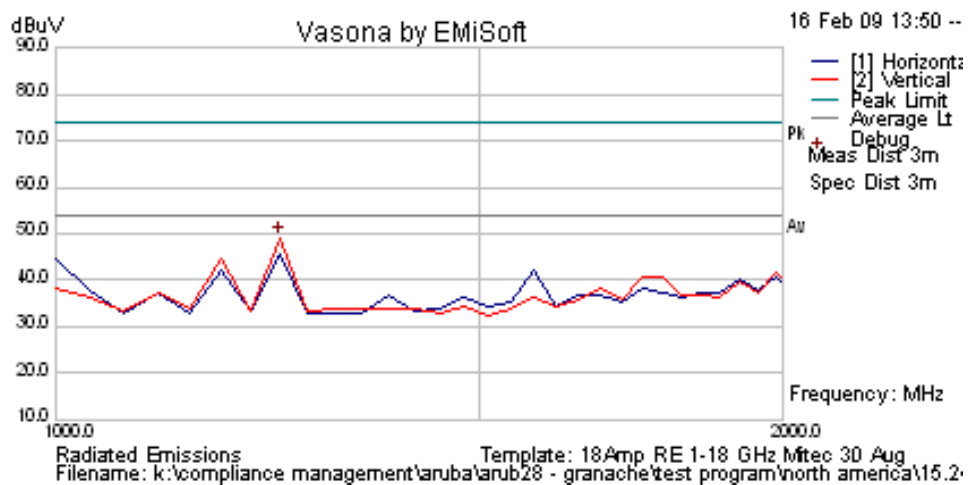


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Emission Characterization 1-2 GHz

It was found several emissions were coming from the EUT (1-2 GHz) irrespective of output frequency and bandwidth setting. As a result a scan was completed in the 1-2 GHz range to characterize these emissions. All emissions in the 1-2 GHz range in the remaining emission plots above 1 GHz were characterized in the plot below and not measured in the remaining plots above 1 GHz.

Spurious Emission Scan



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1250.070	65.38	2.18	-15.24	52.31	Peak Max	V	98	349	74	-21.69	Pass	NRB
1200.014	60.51	2.14	-15.31	47.35	Peak Max	H	135	101	74	-26.65	Pass	RB
1600.061	56.11	2.46	-13.89	44.68	Peak Max	H	98	220	74	-29.32	Pass	RB
1250.070	59.18	2.18	-15.24	46.11	Average Max	V	98	349	54	-7.89	Pass	NRB
1200.014	56.48	2.14	-15.31	43.31	Average Max	H	135	101	54	-10.69	Pass	RB
1600.061	49.93	2.46	-13.89	38.5	Average Max	H	98	220	54	-15.5	Pass	RB

NRB = None Restrictive Band
RB = Restrictive Band

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802.11b: Channel 2412 MHz

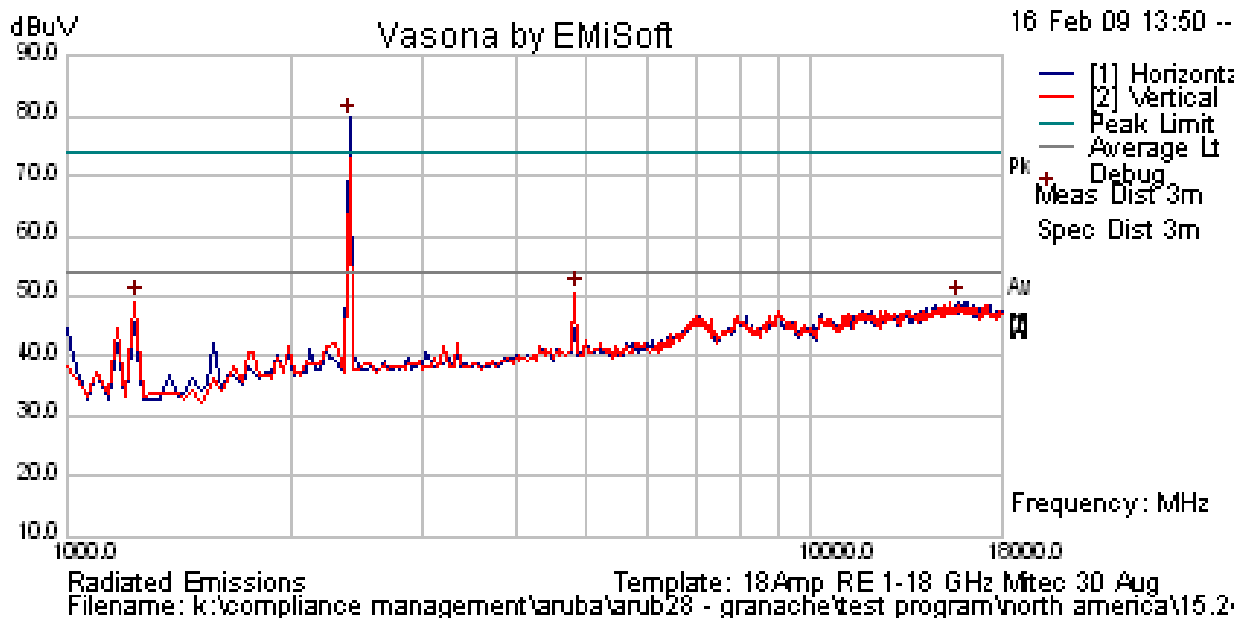
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
1	2412	ART = 19	99%	b 1 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2414.546	70.96	12.96	32.35	116.28	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2386.152	ART Power Setting = 19			62.39	Peak Max	V			74	-11.61	Pass	BE
2386.152				52.59	Average Max	V			54	-1.41	Pass	BE
4884.036	59.1	4.52	-8.74	54.88	Peak Max	V	118	361	74	-19.12	Pass	RB
15665.451	42.58	8.48	-0.6	50.46	Peak Max	H	127	232	74	-23.54	Pass	RB
4884.036	56.46	4.52	-8.74	52.24	Average Max	V	118	361	54	-1.76	Pass	RB
15665.451	29.73	8.48	-0.6	37.61	Average Max	H	127	232	54	-16.39	Pass	RB

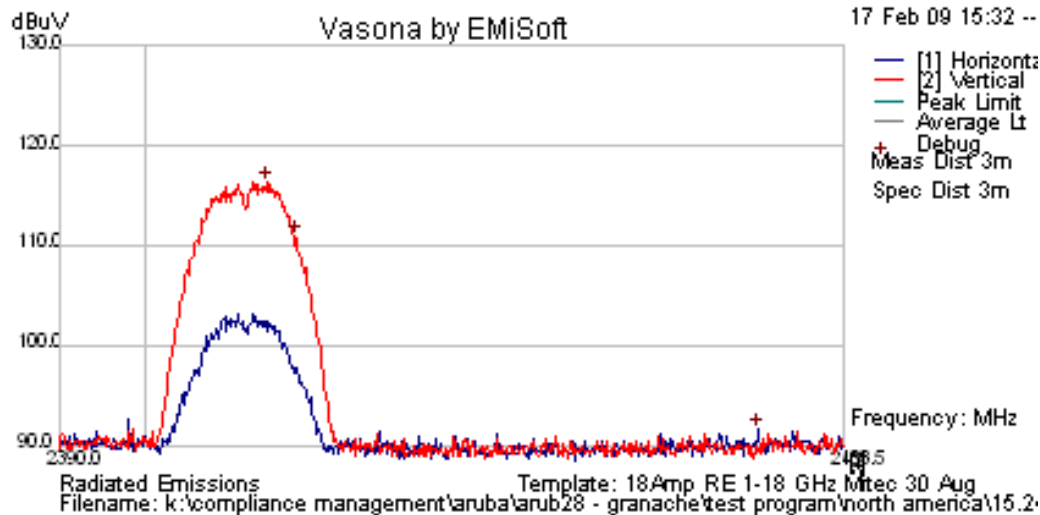
PE = Peak Fundamental Emission
BE = Restricted Band-Edge
RB = Restrictive Band
NRB = Non-Restrictive Band

Spurious Emission Scan

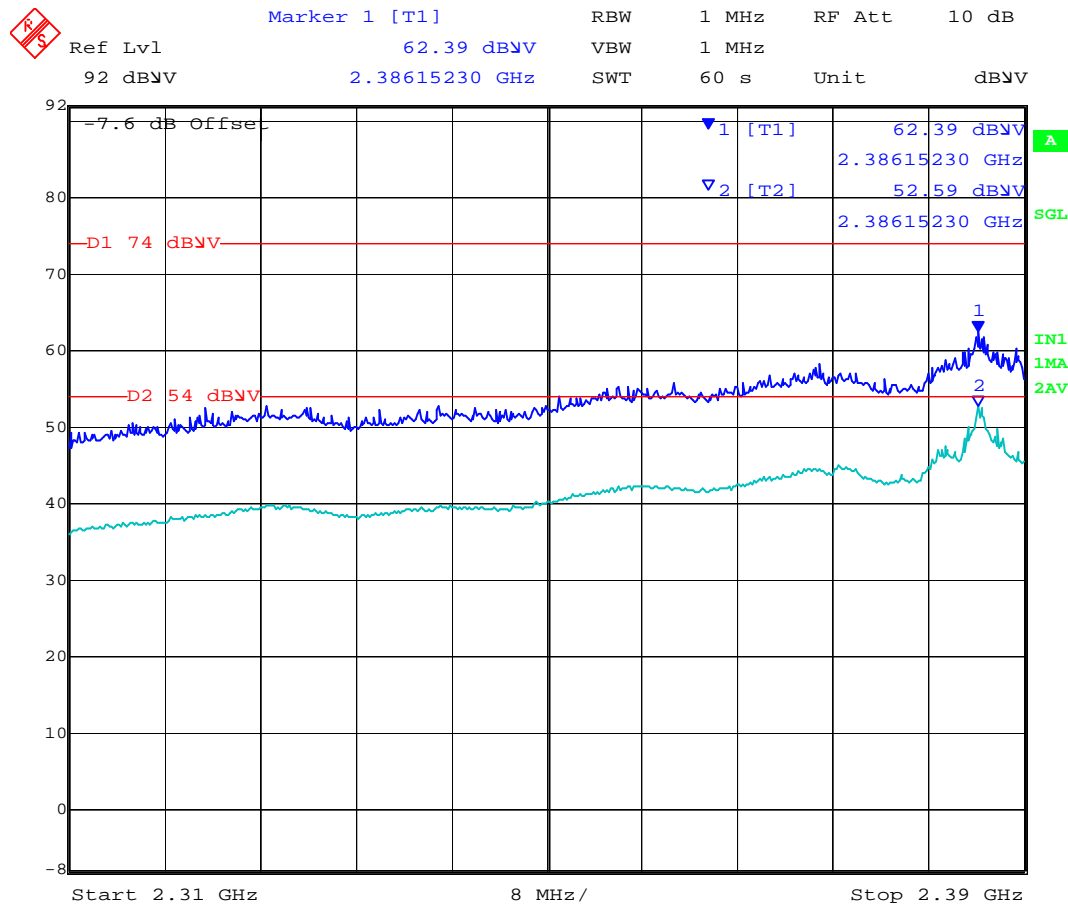


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Peak Emission Scan



Band-Edge Emission Scan - 802.11b 2310 to 2390 MHz



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802.11b: Channel 2437 MHz

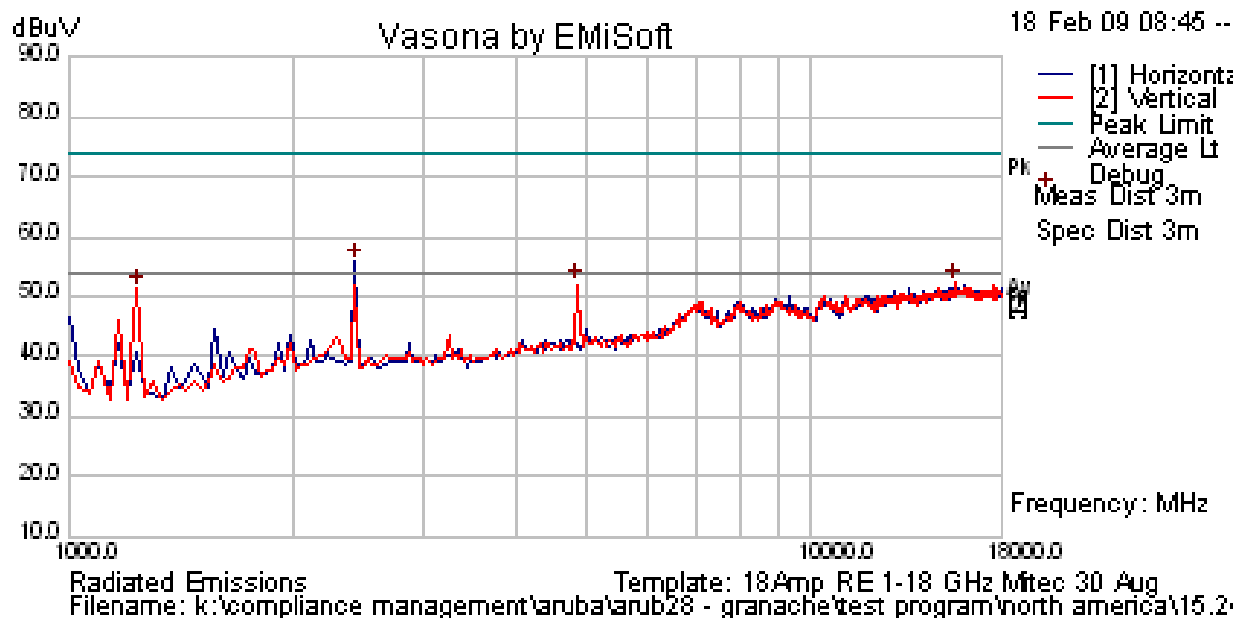
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
6	2437	ART = 19	99%	b 1 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2437.968	72.18	12.97	32.37	117.51	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
4873.998	60.38	4.51	-8.75	56.14	Peak Max	V	127	2	74	-17.86	Pass	RB
1250.04	65.51	2.18	-15.24	52.44	Peak Max	V	98	360	74	-21.56	Pass	RB
4873.998	57.77	4.51	-8.75	53.53	Average Max	V	127	2	54	-0.47	Pass	RB
1250.04	59.13	2.18	-15.24	46.06	Average Max	V	98	360	54	-7.94	Pass	RB

PE = Peak Fundamental Emission
BE = Restricted Band-Edge
RB = Restrictive Band
NRB = Non-Restrictive Band

Spurious Emission Scan

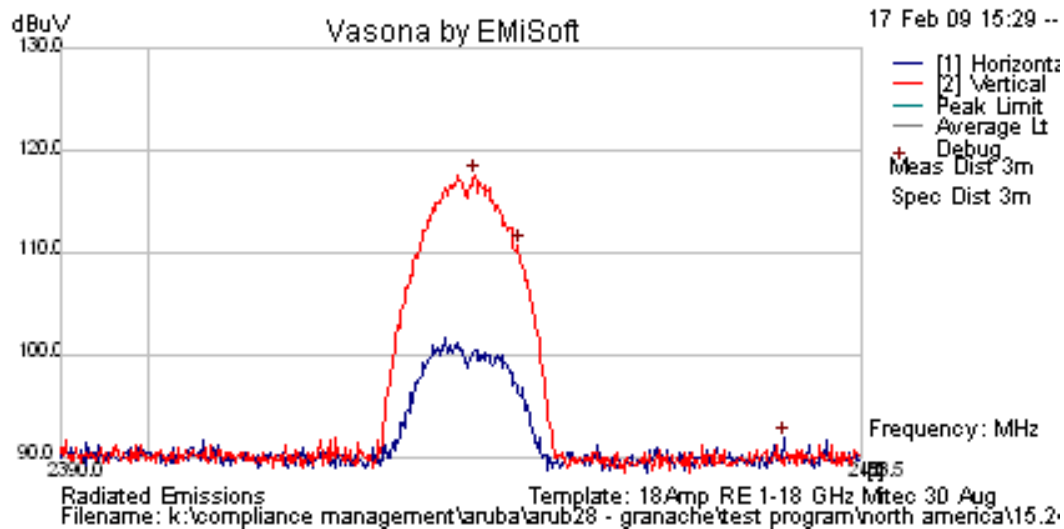


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Peak Emission Scan



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802.11b: Channel 2462 MHz

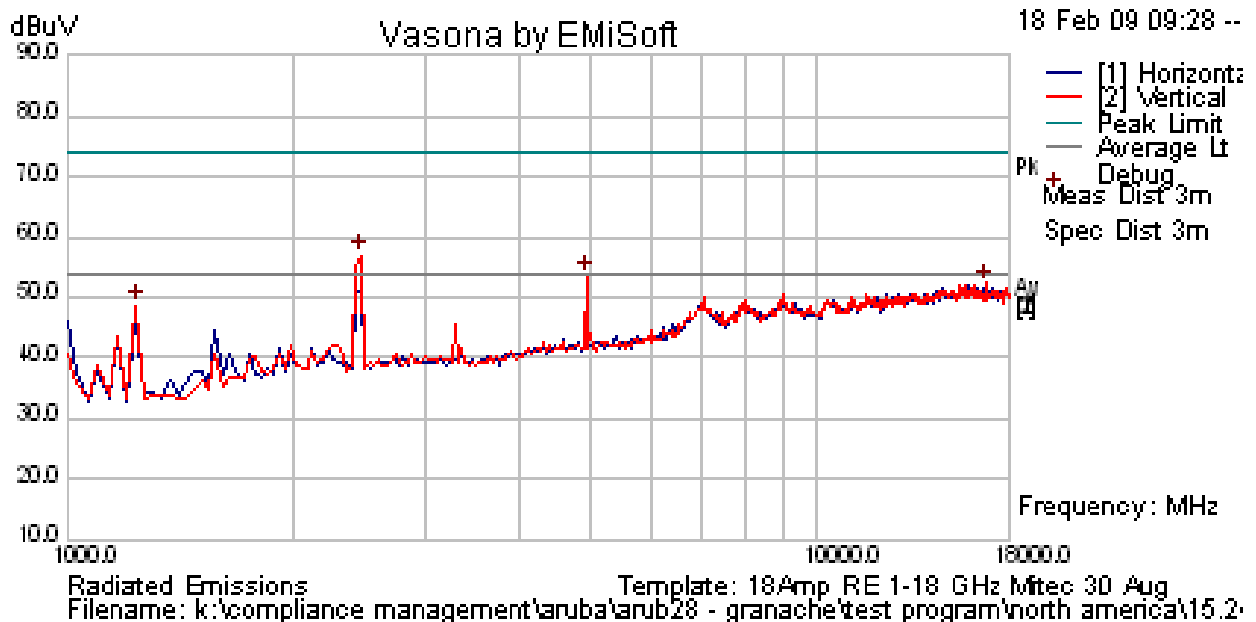
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
11	2462	ART = 19	99%	b 1 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2461.202	72.19	12.98	32.38	117.55	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2484.095	ART Power Setting = 19			63.14	Peak Max	V			74	-10.86	Pass	BE
2487.898				50.29	Average Max	V			54	-3.71	Pass	BE
15665.451	42.58	8.48	-0.6	50.46	Peak Max	H	127	232	74	-23.54	Pass	RB
4917.835	57.94	4.55	-8.75	56.55	Peak Max	V	127	2	74	-17.45	Pass	RB
15665.451	29.73	8.48	-0.6	37.61	Average Max	H	127	232	54	-16.39	Pass	RB
4917.835	57.97	4.55	-8.75	53.77	Average Max	V	127	2	54	-0.23	Pass	RB

PE = Peak Fundamental Emission
BE = Restricted Band-Edge
RB = Restrictive Band
NRB = Non-Restrictive Band

Spurious Emission Scan

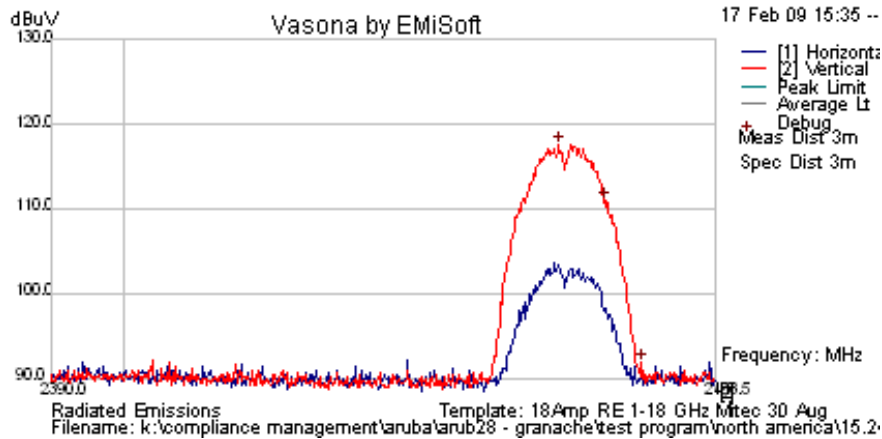


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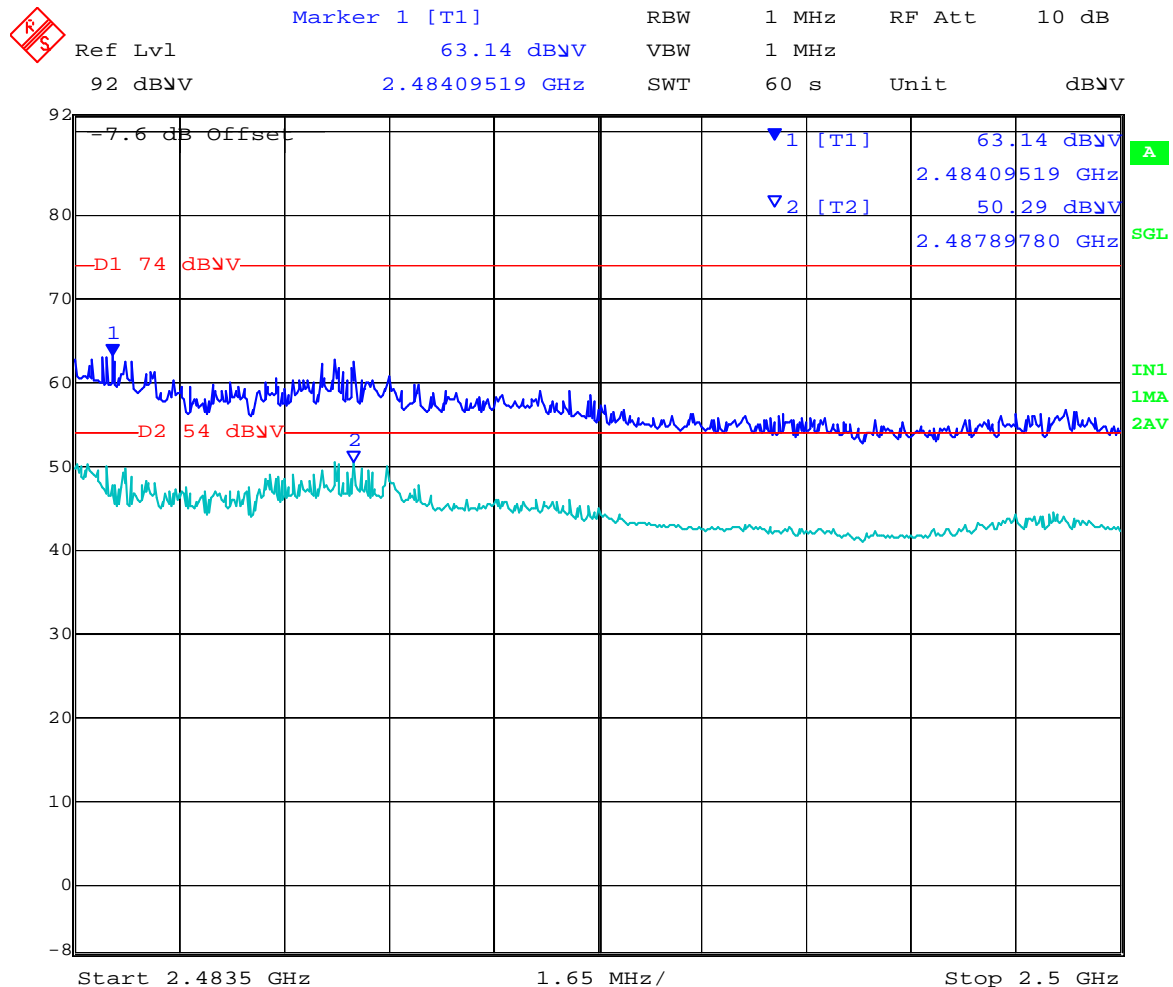


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Peak Emission Scan



Band-Edge Emission Scan - 802.11b 2483.5 – 2500 MHz



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802.11g Legacy: Channel 2412 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
1	2412	ART = 19	99%	g 6 MBit/s	Yes

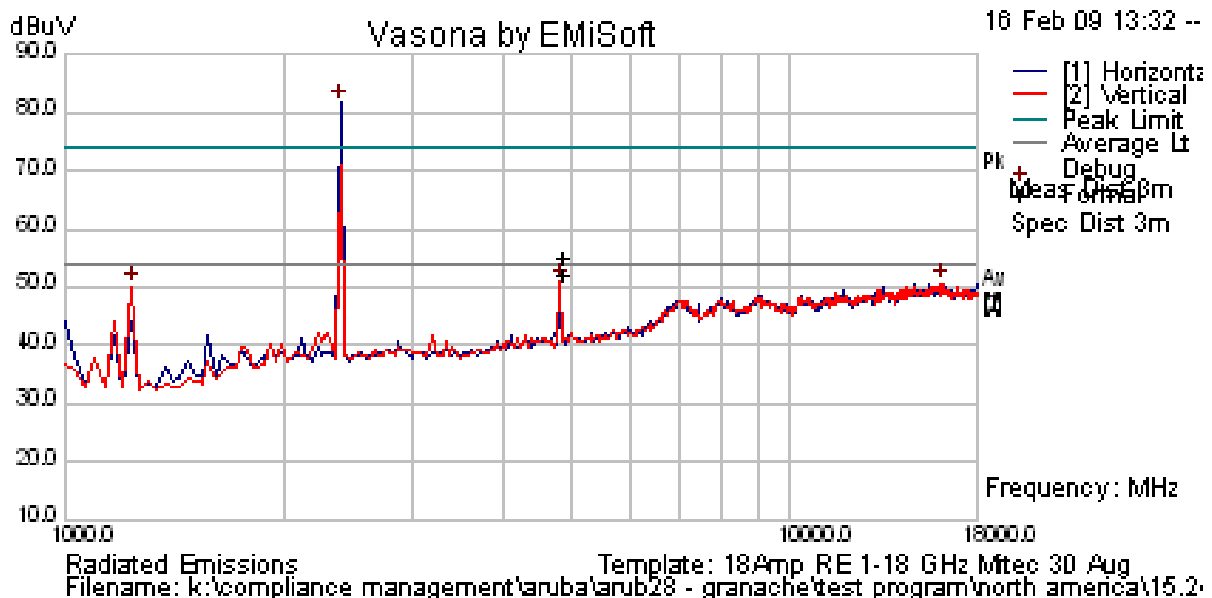
Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2406.489	72.46	12.96	32.35	117.76	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2390.000	ART Power Setting = 16			72.13	Peak Max	V			74	-1.87	Pass	BE
2390.000				51.97	Average Max	V			54	-2.03	Pass	BE
4884.029	59.24	4.52	-8.74	55.02	Peak Max	V	106	2	74	-18.98	Pass	RB
4884.029	56.52	4.52	-8.74	52.3	Average Max	V	106	2	54	-1.7	Pass	RB

Note: Band-edge power reduced 3 dB to bring product into compliance

PE = Peak Fundamental Emission
BE = Restricted Band-Edge
RB = Restrictive Band
NRB = Non-Restrictive Band

Spurious Emission Scan

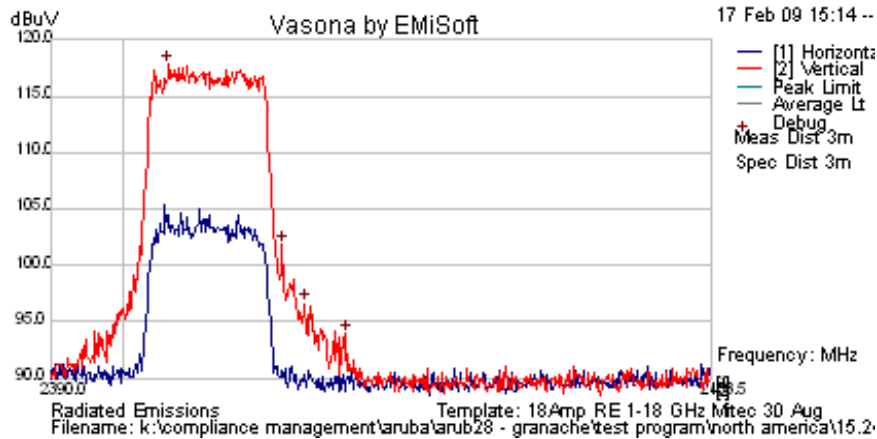


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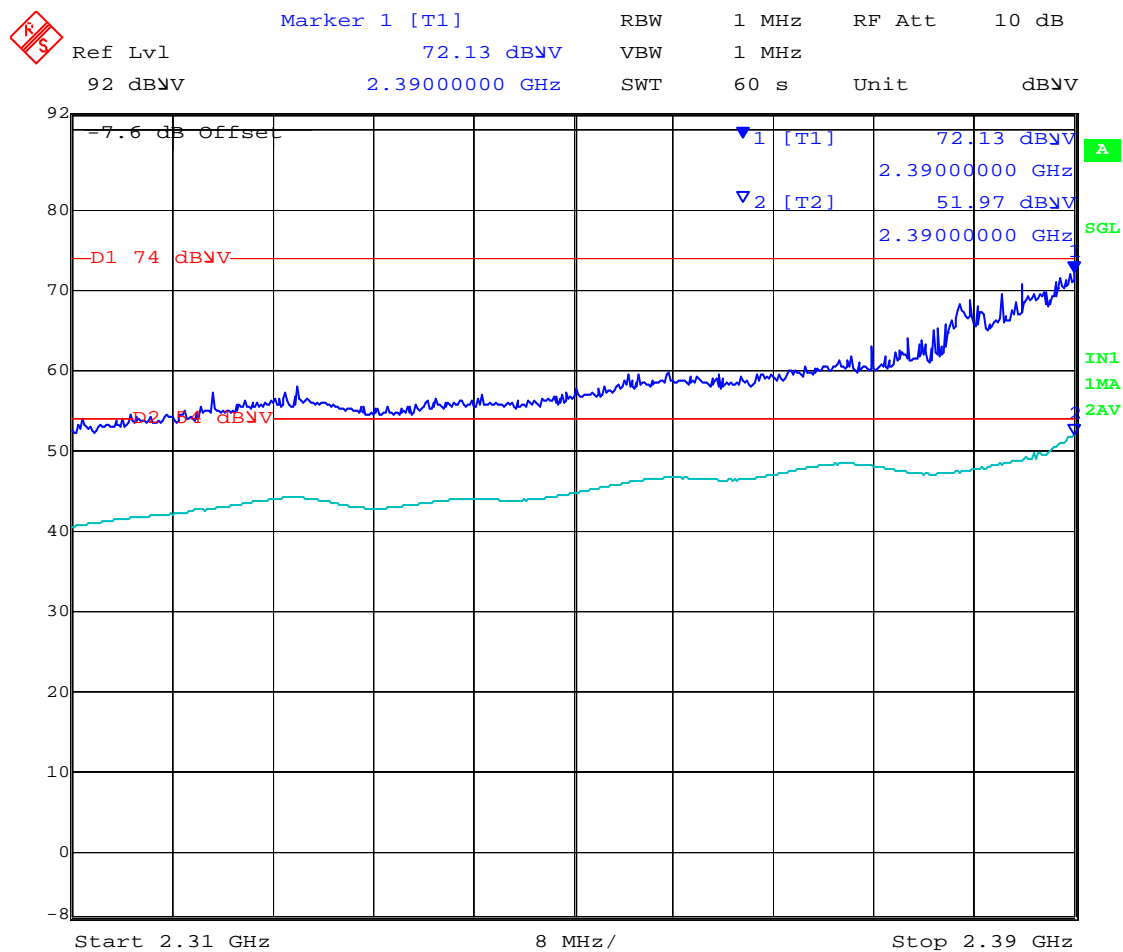


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Peak Emission Scan



Band-Edge Emission Scan - 802.11g Legacy 2310 to 2390 MHz



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802.11g Legacy: Channel 2437 MHz

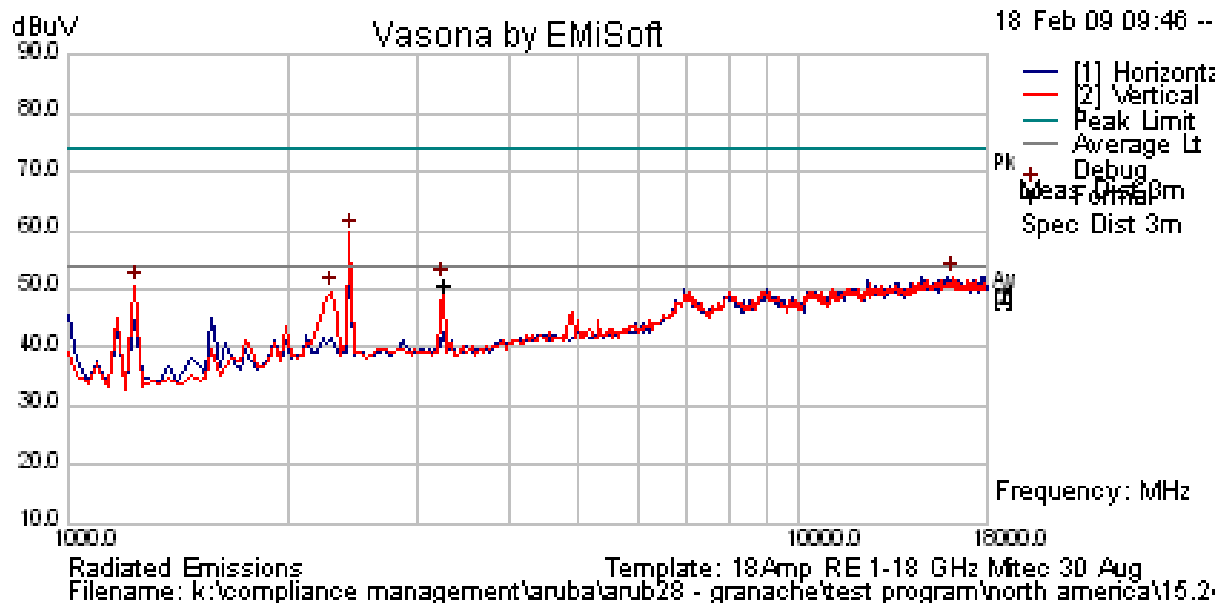
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
6	2437	ART = 19	99%	g Legacy 6 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2438.905	72.31	12.97	32.37	117.65	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
3248.497	58.85	3.49	-11.14	51.2	Peak [Scan]	V	100	0	97.65	-46.45	Pass	NRB

PE = Peak Fundamental Emission
NRB = Non-Restrictive Band

Spurious Emission Scan

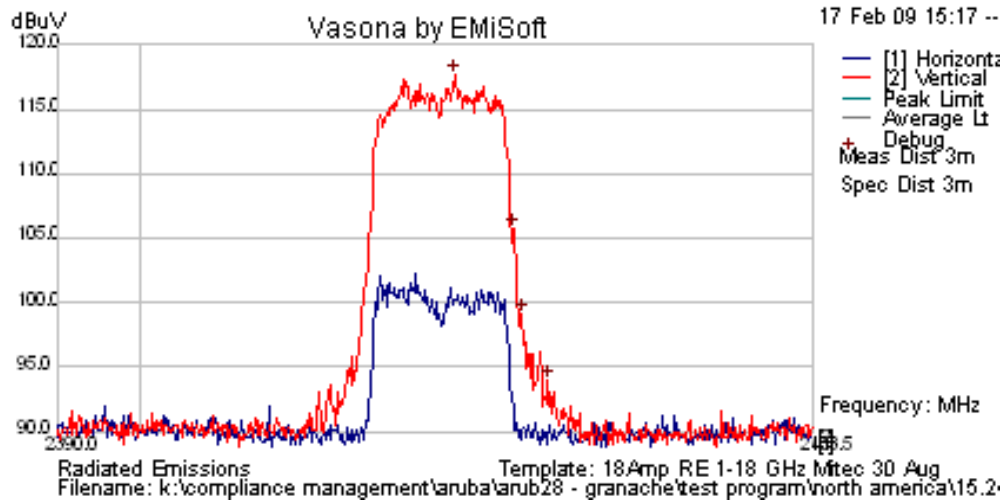


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Peak Emission Scan



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802.11g Legacy: Channel 2462 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
11	2462	ART = 19	99%	g Legacy 6 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2463.451	72.96	12.98	32.38	118.32	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2483.533	ART Power Setting = 15			72.13	Peak Max	V			74	-1.87	Pass	BE
2483.500				51.97	Average Max	V			54	-2.03	Pass	BE
3282.565	58.31	3.51	-11.08	50.73	Peak Max	V	100	0	54	-3.27	Pass	NRB

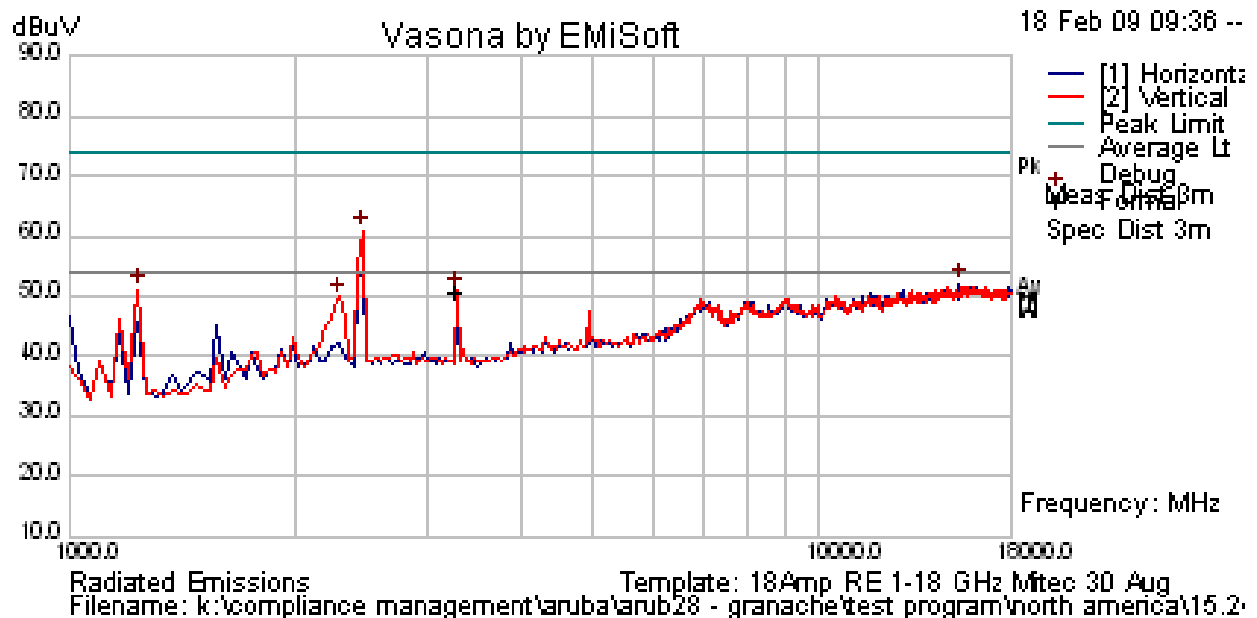
Note: Band-edge power reduced 4 dB to bring product into compliance

PE = Peak Fundamental Emission

BE = Restricted Band-Edge

NRB = Non-Restrictive Band

Spurious Emission Scan

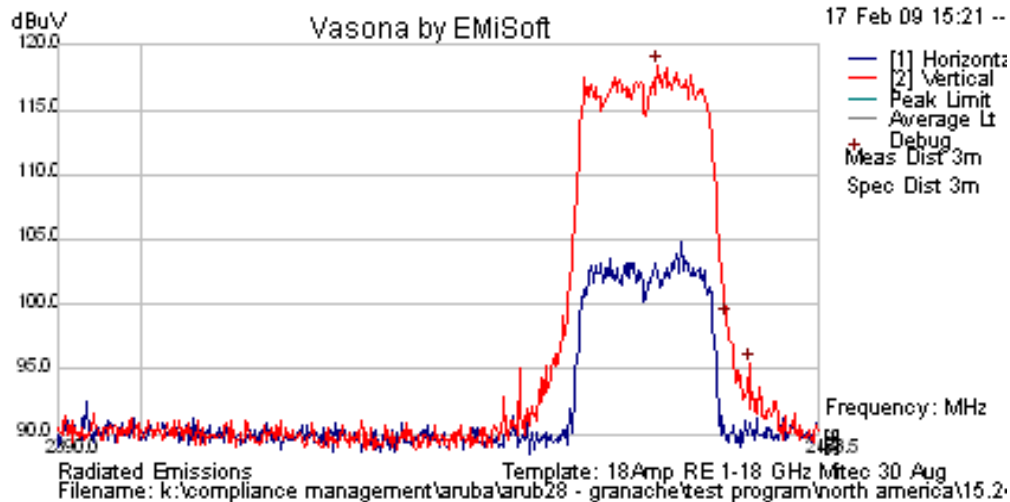


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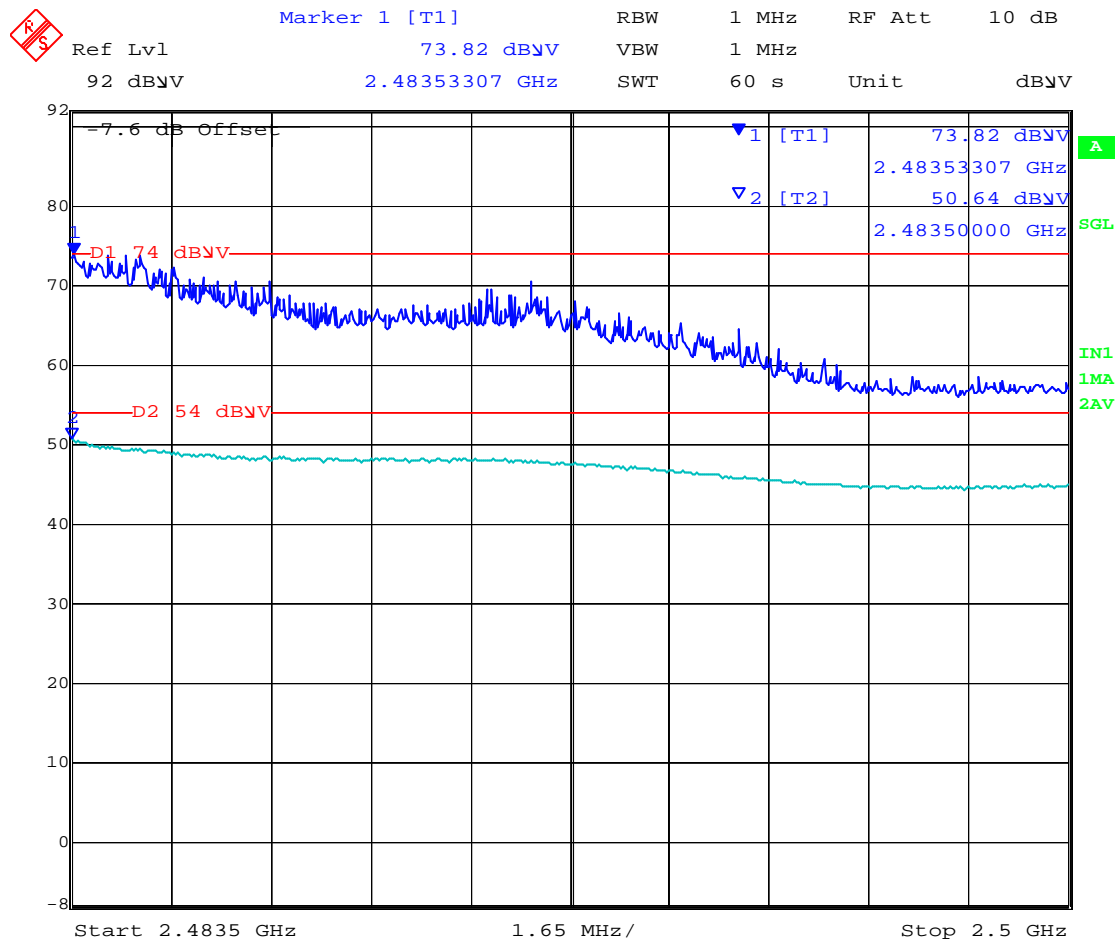


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Peak Emission Scan



Band-Edge Emission Scan - 802.11g 2483.5 – 2500 MHz



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802.11n HT-20: Channel 2412 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
1	2412	ART = 19	99%	6.5 MCS	Yes

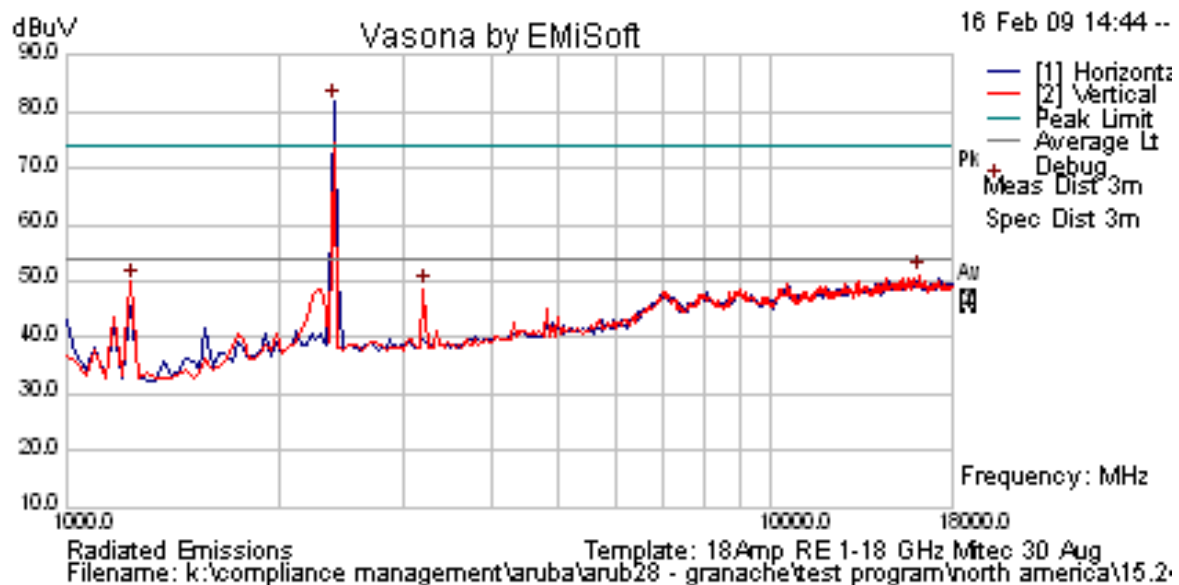
Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2405.739	71.17	12.96	32.35	116.47	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2389.840	ART Power Setting=14.5			73.26	Peak Max	V			74	-0.74	Pass	BE
2390.000				47.94	Average Max	V			54	-6.06	Pass	BE
3255.992	58.56	3.48	-11.08	50.96	Peak Max	V	98	316	96.47	-45.51	Pass	NRB

Note: Band-edge power reduced 3.5 dB to bring product into compliance

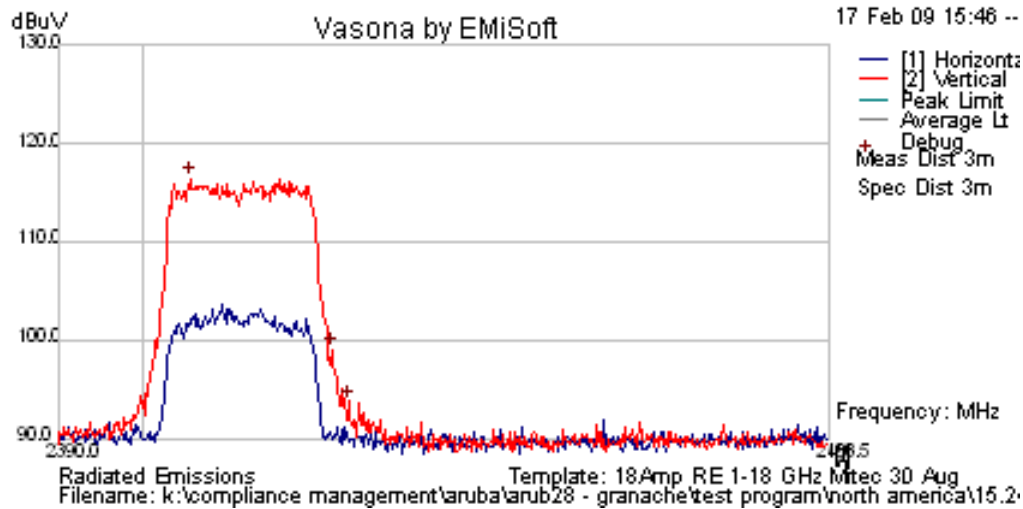
PE = Peak Fundamental Emission
BE = Restricted Band-Edge
NRB = Non-Restrictive Band

Spurious Emission Scan

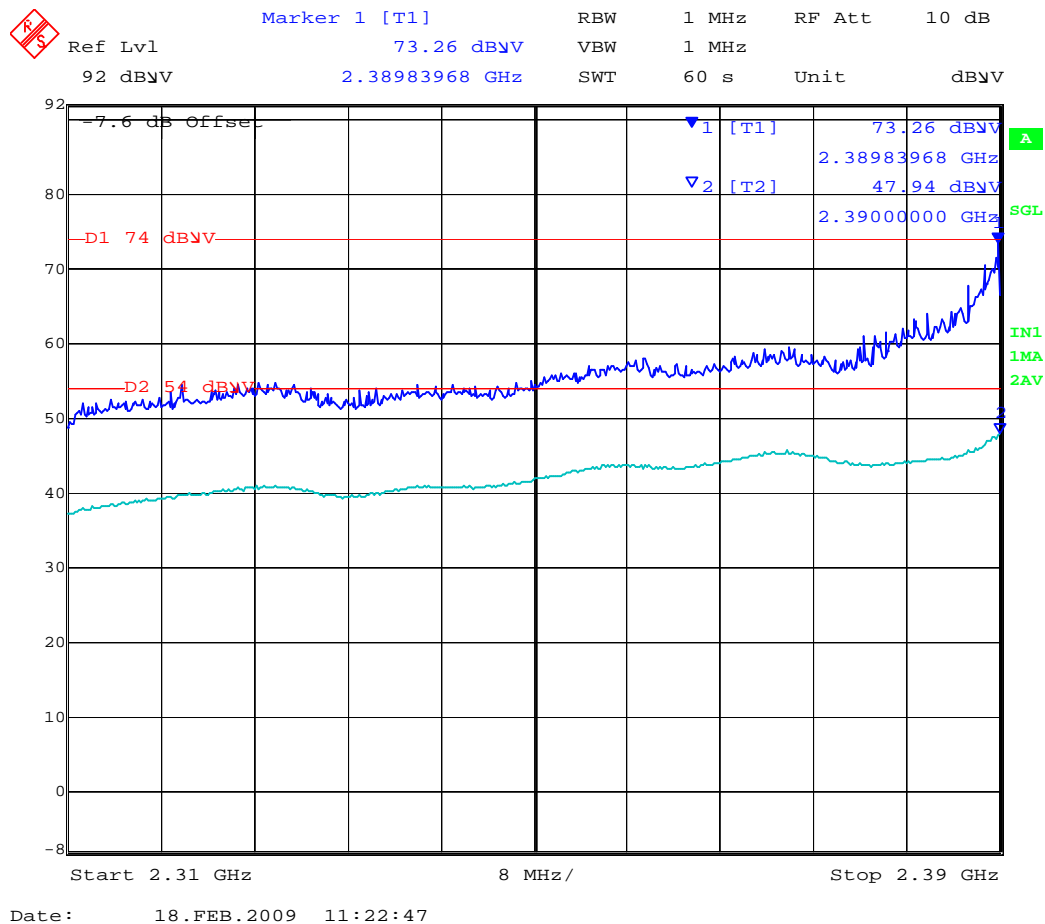


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Peak Emission Scan



Band-Edge Emission Scan - 802.11n HT-20 2310 to 2390 MHz



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802.11n HT-20: Channel 2437 MHz

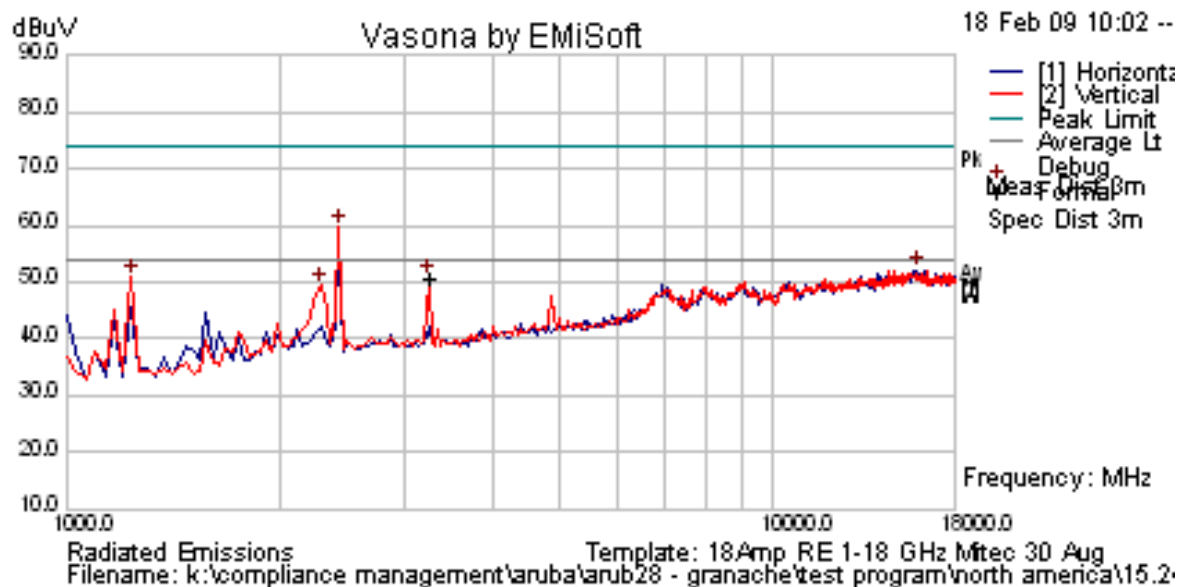
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
6	2437	ART = 19	99%	6.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2437.593	71.68	12.97	32.37	117.02	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
3248.497	58.27	3.49	-11.14	50.62	Peak [Scan]	V	100	0	97.02	-46.40	Pass	NRB

PE = Peak Fundamental Emission
NRB = Non-Restrictive Band

Spurious Emission Scan

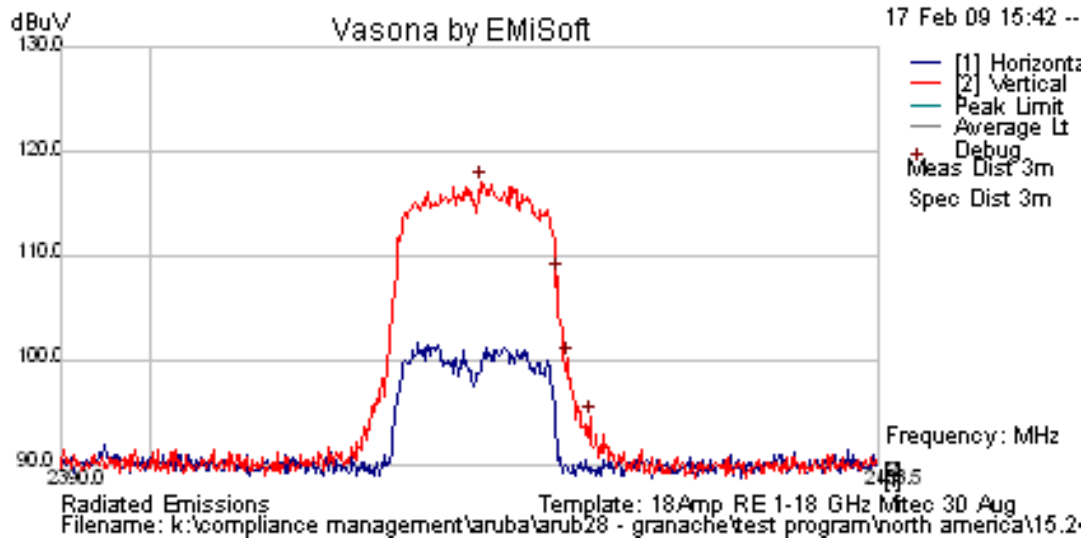


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Peak Emission Scan



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802.11n HT-20: Channel 2462 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
11	2462	ART = 19	99%	6.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2463.451	72.96	12.98	32.38	118.32	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2483.798	ART Power Setting = 14.5			72.66	Peak Max	V			74	-1.87	Pass	BE
2483.566				50.10	Average Max	V			54	-3.90	Pass	BE
3282.565	58.56	3.51	-11.08	52.16	Peak Max	V	100	0	54	-21.84	Pass	RB
3282.565	58.56	3.51	-11.08	48.55	Average Max	V	100	0	54	-5.45	Pass	RB

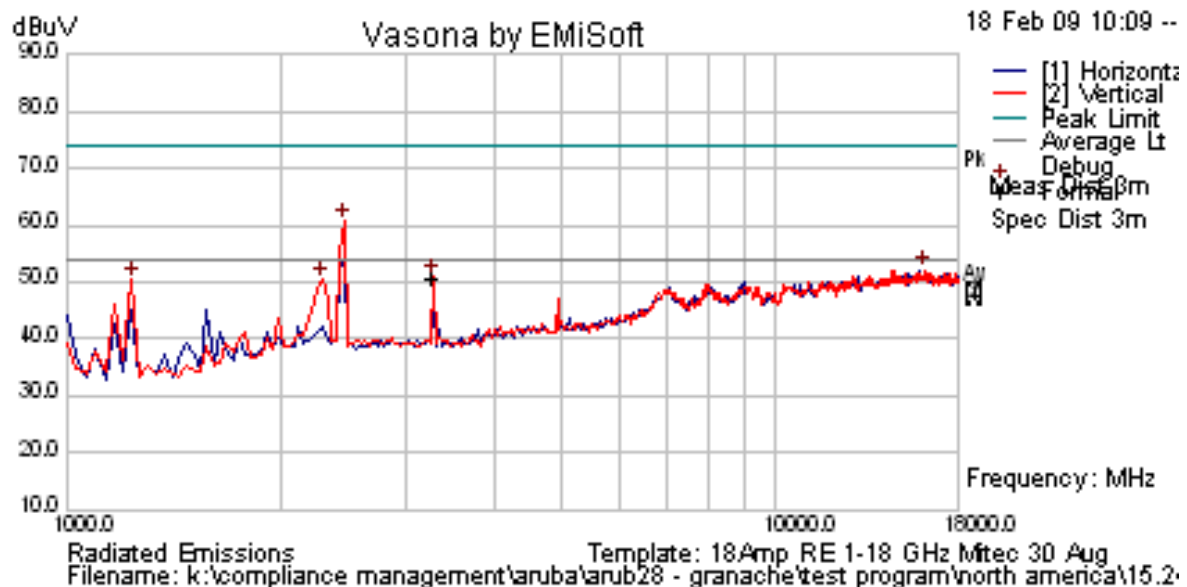
Note: Band-edge power reduced 3.5 dB to bring product into compliance

PE = Peak Fundamental Emission

BE = Restricted Band-Edge

RB = Restrictive Band

Spurious Emission Scan



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Vasona by EMIsoft

17 Feb 09 15:39 --

dBuV

Frequency: MHz

Legend:

- [1] Horizontal
- [2] Vertical
- Peak Limit
- Average Lt
- Debug
- Meas Dist 3m
- Spec Dist 3m

Radiated Emissions

Template: 18Amp RE 1-18 GHz Mitec 30 Aug

Filename: k:\compliance management\aruba\arub28 - granache\test program\north america\15.2

Date: 18.FEB.2009 11:49:09

MiCOM Labs, 440 Boulder Court, Suite 200, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, www.micomlabs.com



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802.11g HT-40: Channel 2422 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
3	2422	ART = 18	99%	13.5 MCS	Yes

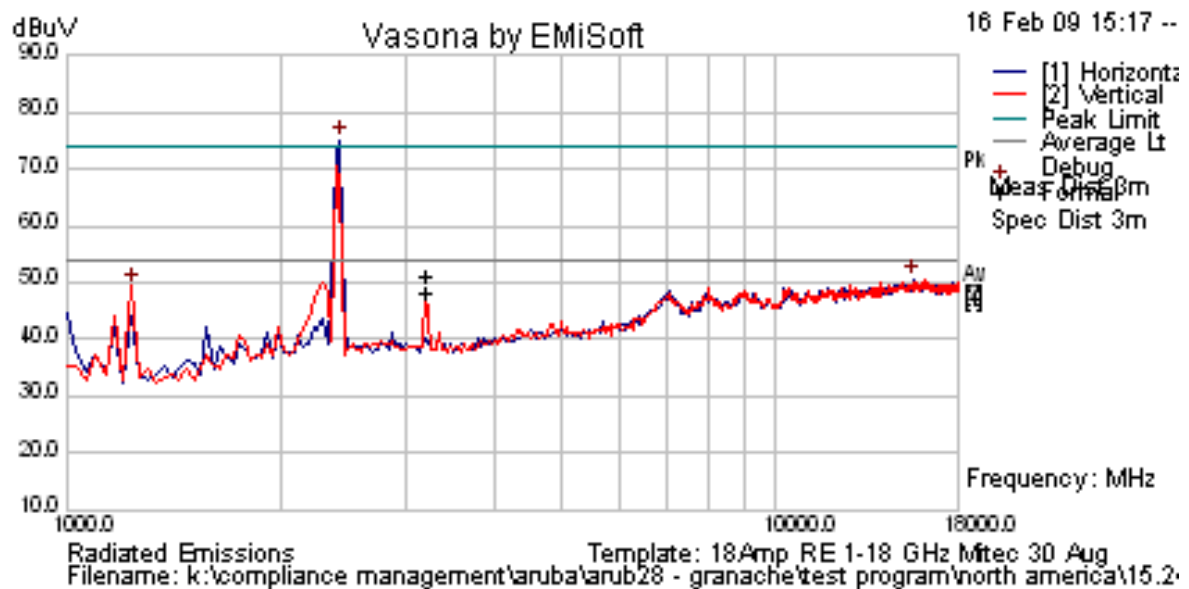
Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2422.041	69.14	12.96	32.36	114.47	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2386.633	ART Power Setting = 12			73.90	Peak Max	V			74	-0.10	Pass	BE
2390.000				48.30	Average Max	V			54	-5.70	Pass	BE
3214.429	56.58	3.48	-11.07	48.99	Peak Max	V	98	316	94.47	-45.48	Pass	NRB

Note: Band-edge power reduced 6 dB to bring product into compliance

PE = Peak Fundamental Emission
BE = Restricted Band-Edge
NRB = Non-Restrictive Band

Spurious Emission Scan

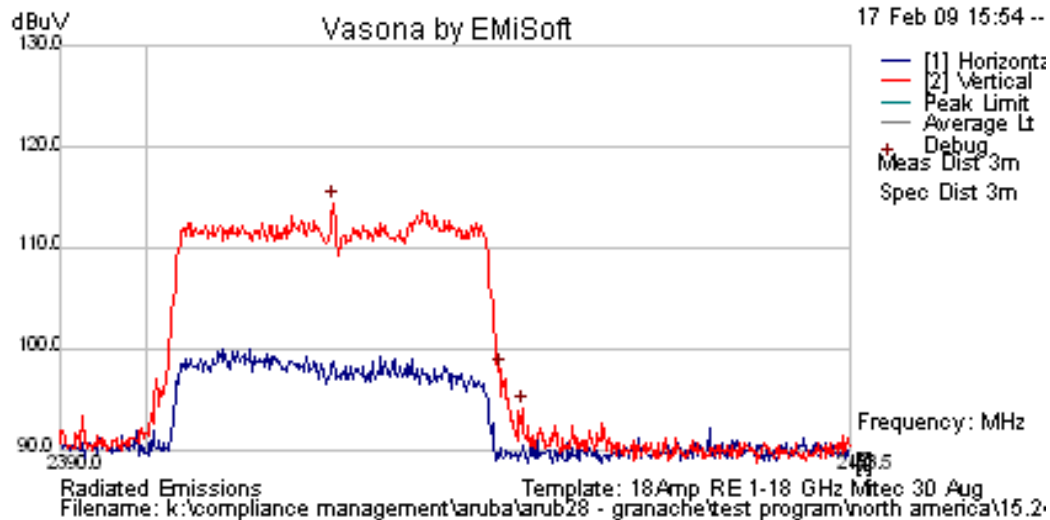


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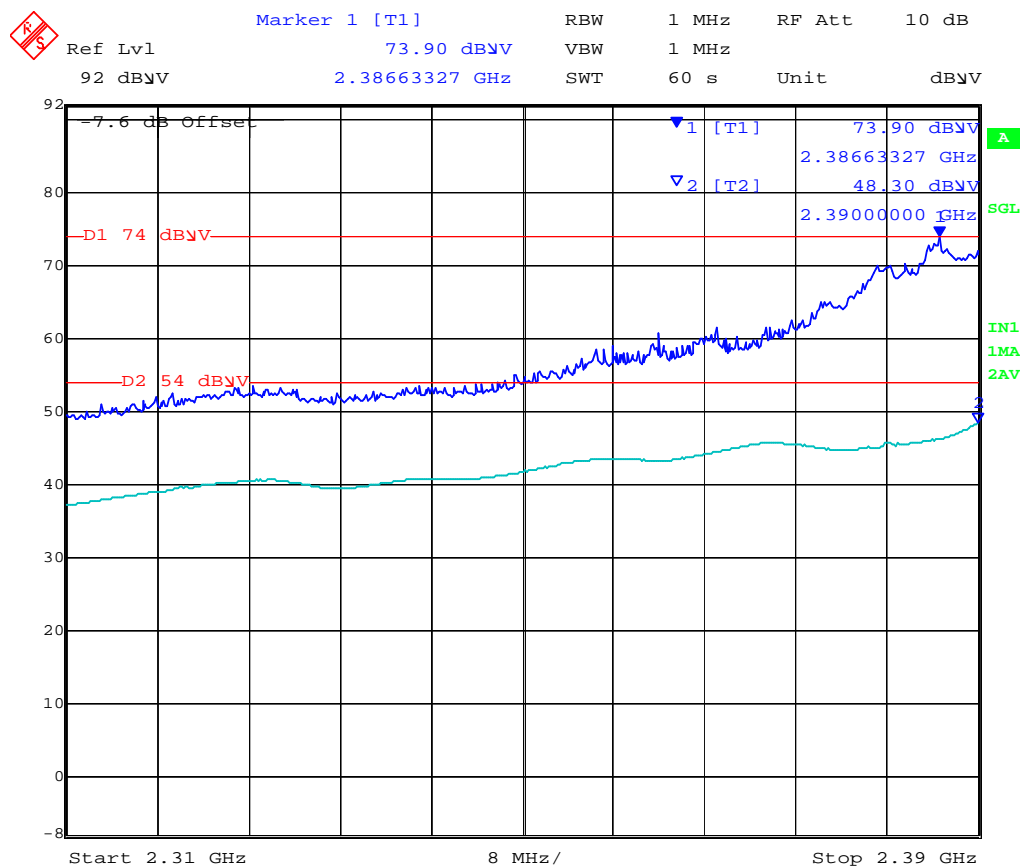


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Peak Emission Scan



Band-Edge Emission Scan - 802.11n HT-40 2310 to 2390 MHz



Date: 18.FEB.2009 10:58:37

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802.11n HT-40: Channel 2437 MHz

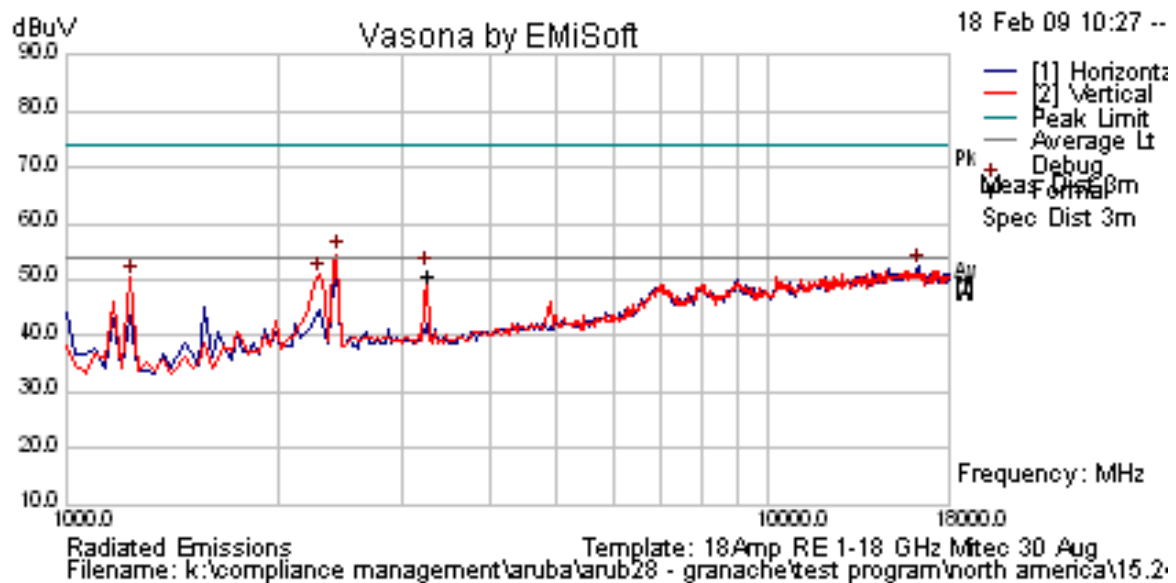
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
6	2437	ART = 19	99%	13.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2450.522	68.91	12.98	32.37	114.26	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
3248.497	59.25	3.49	-11.14	51.61	Peak [Scan]	V	100	0	94.26	-42.65	Pass	NRB

PE = Peak Fundamental Emission
NRB = Non-Restrictive Band

Spurious Emission Scan

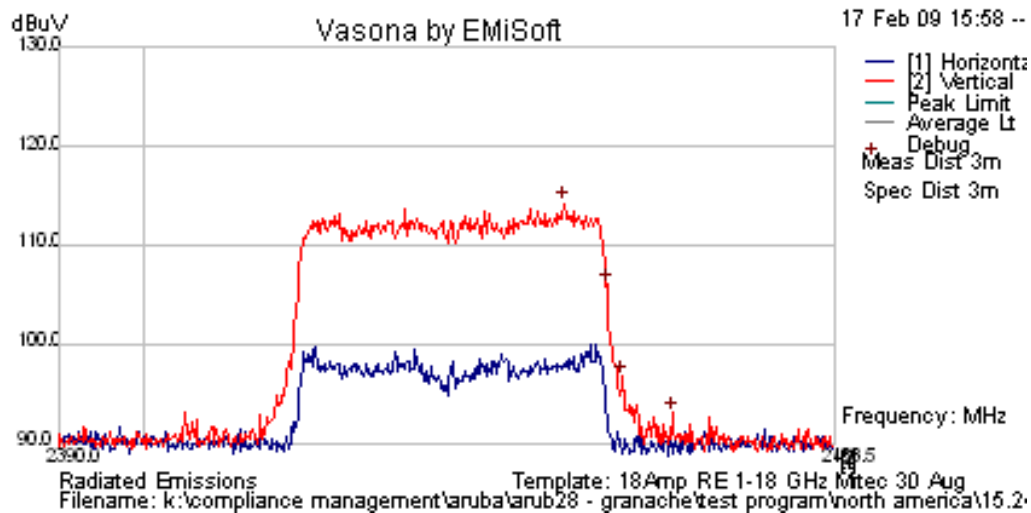


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Peak Emission Scan



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802.11n HT-40: Channel 2452 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
9	2452	ART = 18	99%	13.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2455.206	69.02	12.98	32.38	114.38	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
2483.599	ART Power Setting = 11.5			73.18	Peak Max	V			74	-0.82	Pass	BE
2483.533				50.17	Average Max	V			54	-3.83	Pass	BE
3248.497	58.04	3.49	-11.14	50.39	Peak Max	V	100	0	94.38	-43.99	Pass	NRB

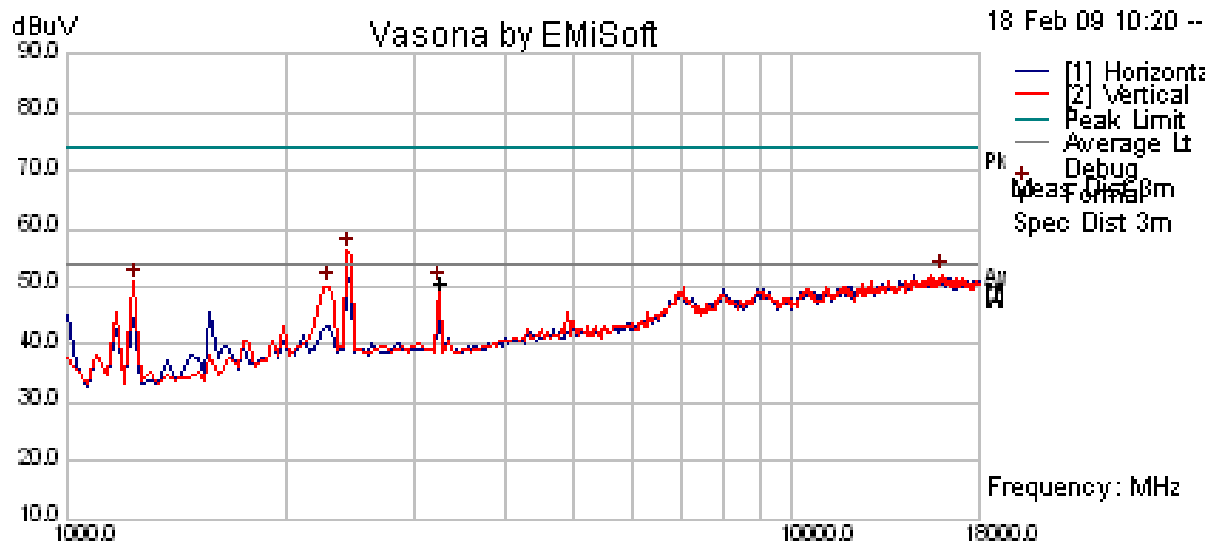
Note: Band-edge power reduced 6.5 dB to bring product into compliance

PE = Peak Fundamental Emission

BE = Restricted Band-Edge

NRB = Non-Restrictive Band

Spurious Emission Scan



Radiated Emissions
Filename: k:\compliance management\aruba\arub28 - granache\test program\north america\15.2

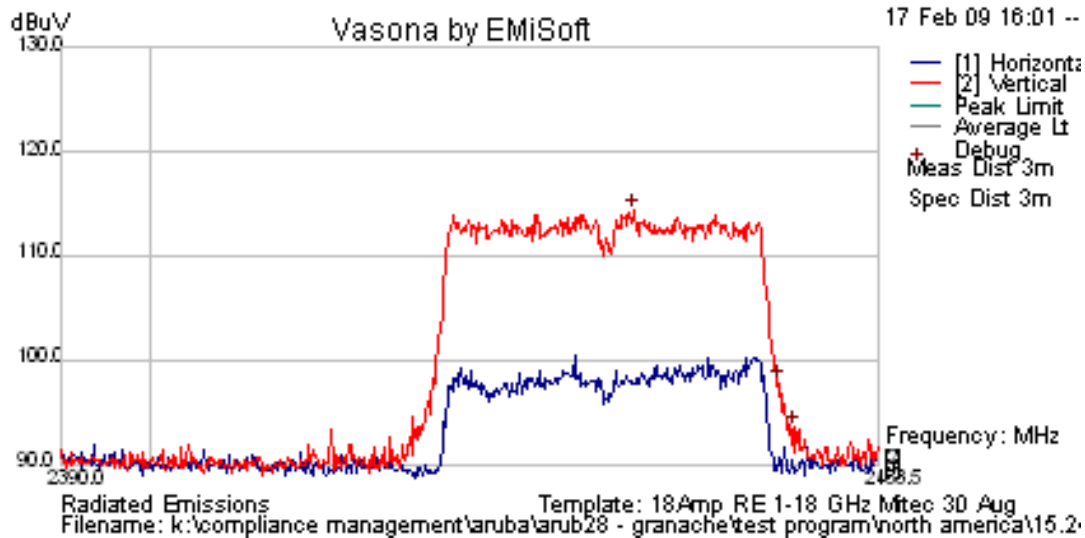
Template: 18Amp RE 1-18 GHz mtec 30 Aug

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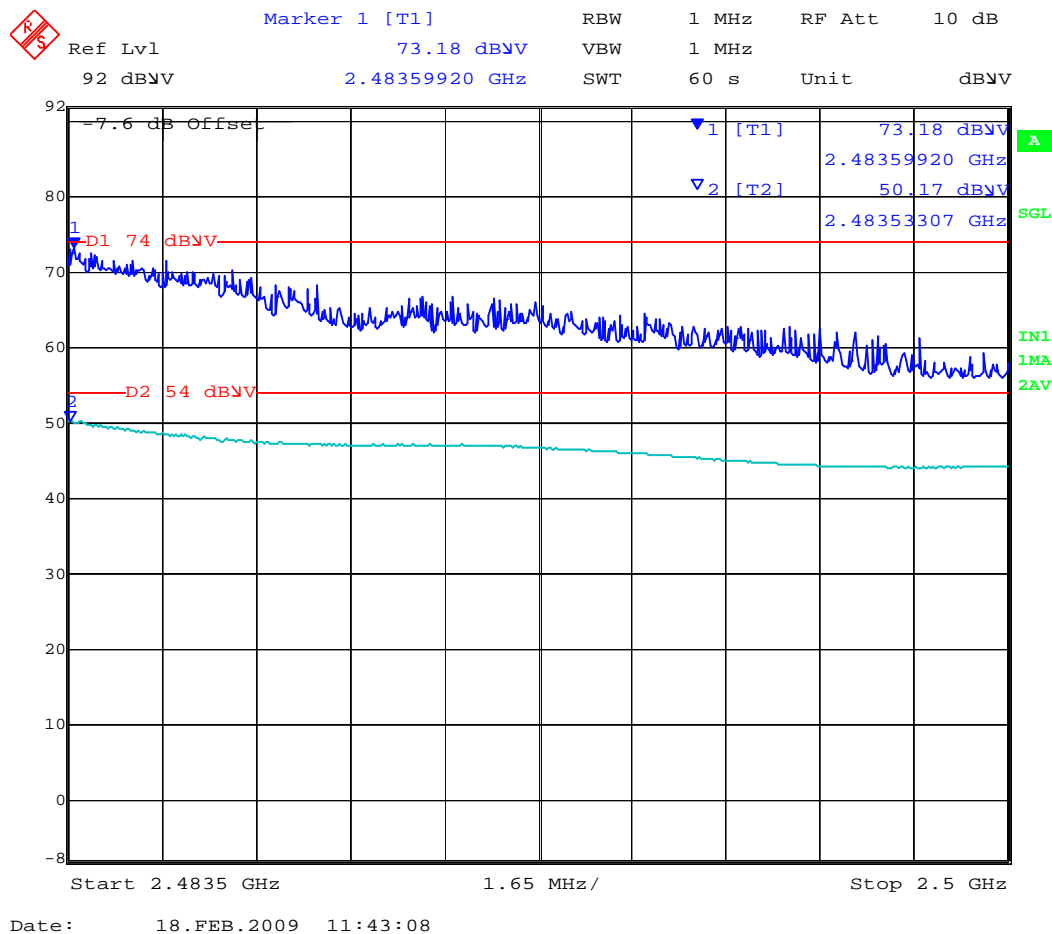


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Peak Emission Scan



Band-Edge Emission Scan - 802.11n HT-40 2483.5 – 2500 MHz



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802.11a Legacy: Channel 5745 MHz

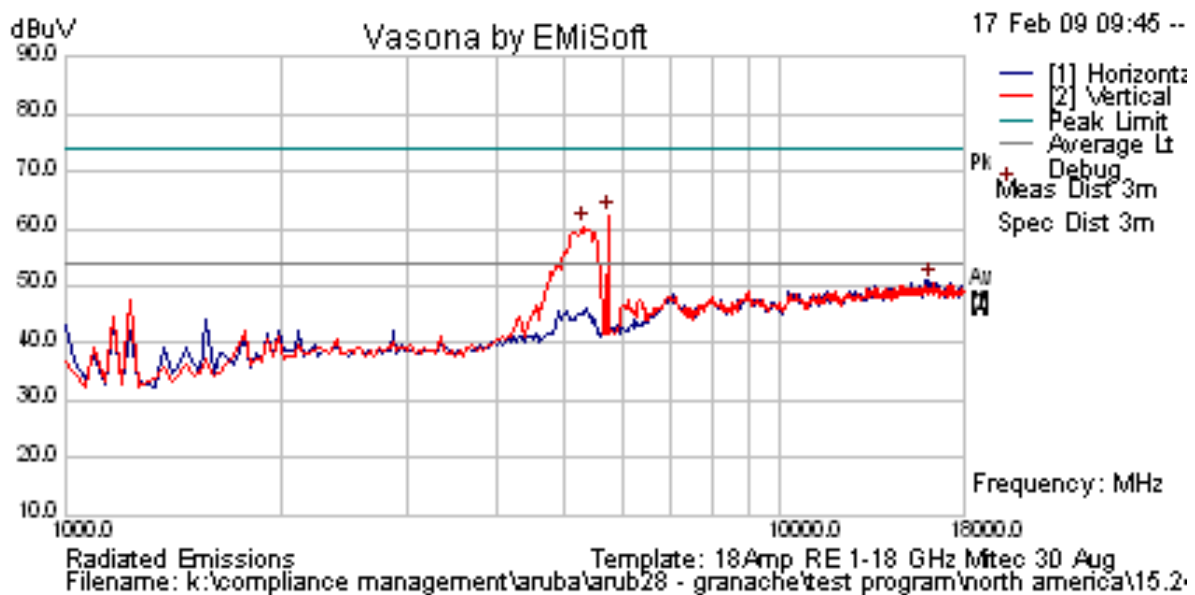
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
149	5745	ART 19	99%	6 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5743.838	70.58	14.75	35.1	120.43	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
5408.858	ART Power Setting = 19			67.05	Peak Max	V			74	-6.95	Pass	BE
5371.824				53.47	Average Max	V			54	-0.53	Pass	BE

PE = Peak Fundamental Emission
BE = Restricted Band-Edge

Spurious Emission Scan

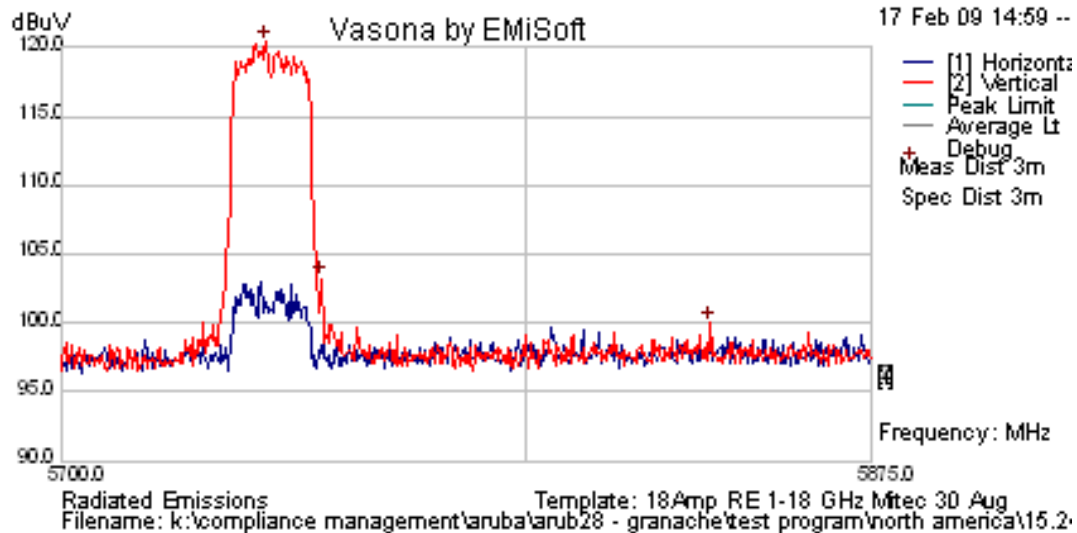


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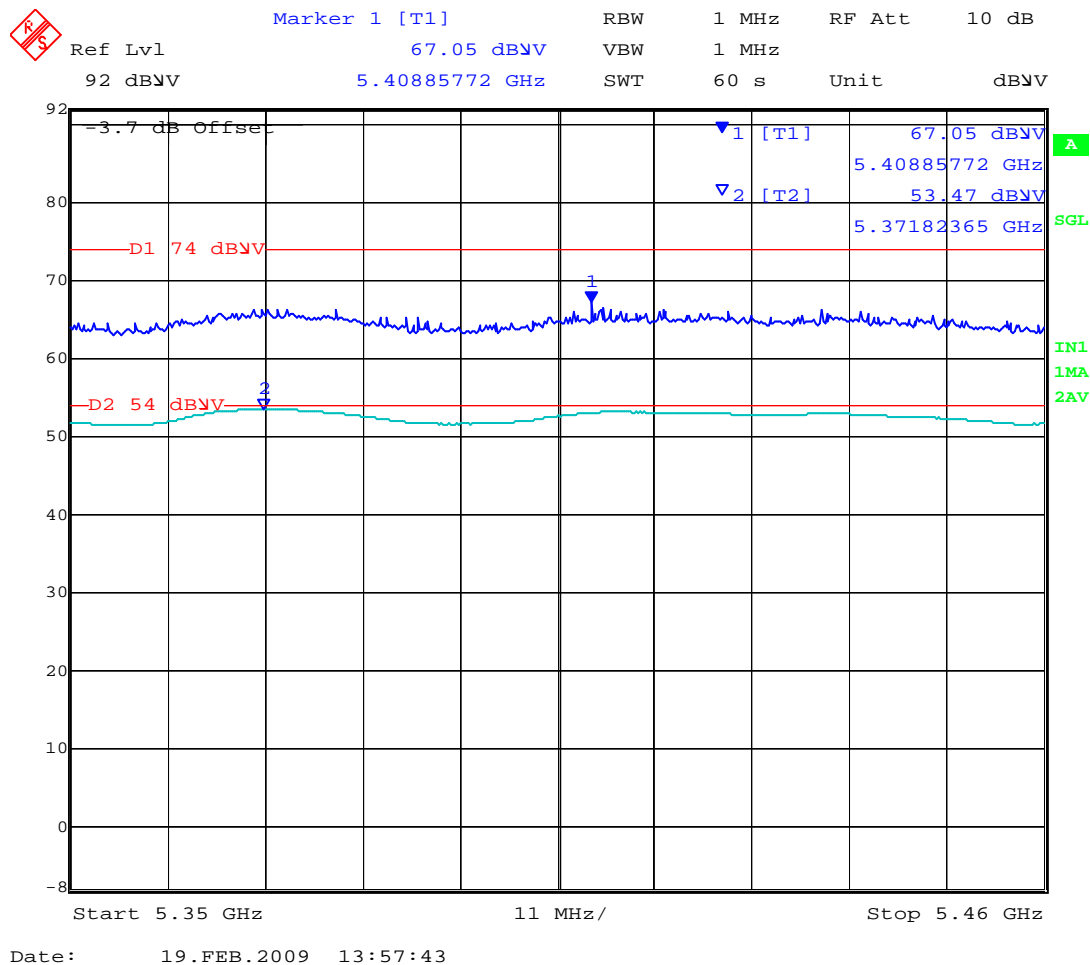


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Peak Emission Scan



802.11a Legacy Band-edge 5460 MHz



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802.11a Legacy: Channel 5785 MHz

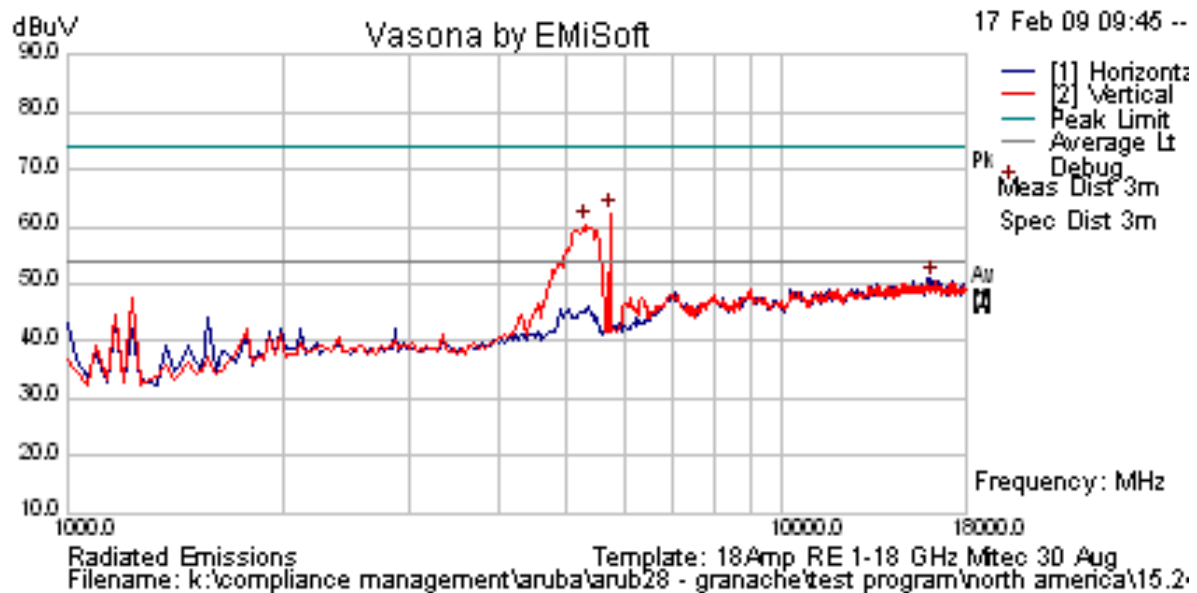
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
157	5785	ART 19	99%	6 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5782.064	70.05	14.78	35.13	119.96	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE

PE = Peak Fundamental Emission

Spurious Emission Scan

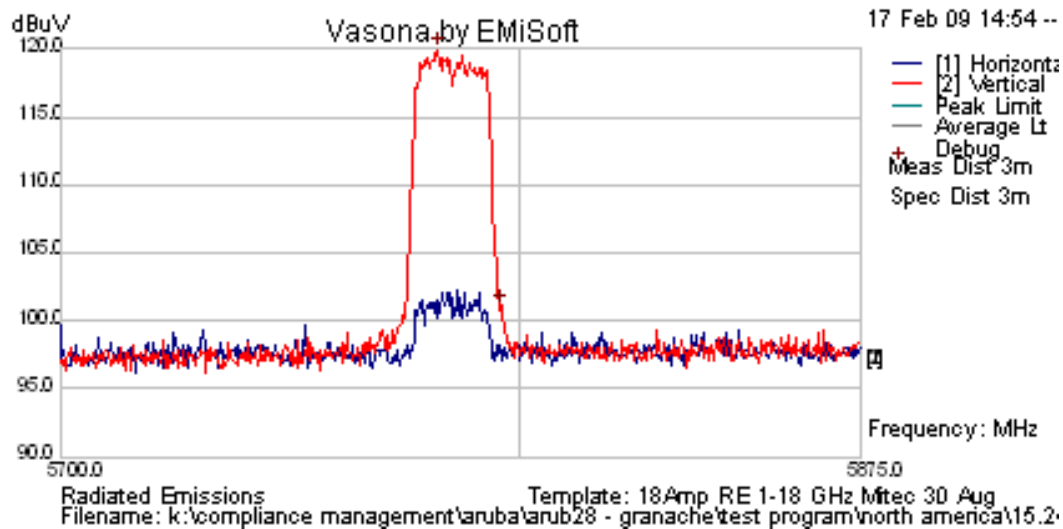


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Peak Emission Scan



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802.11a Legacy: Channel 5825 MHz

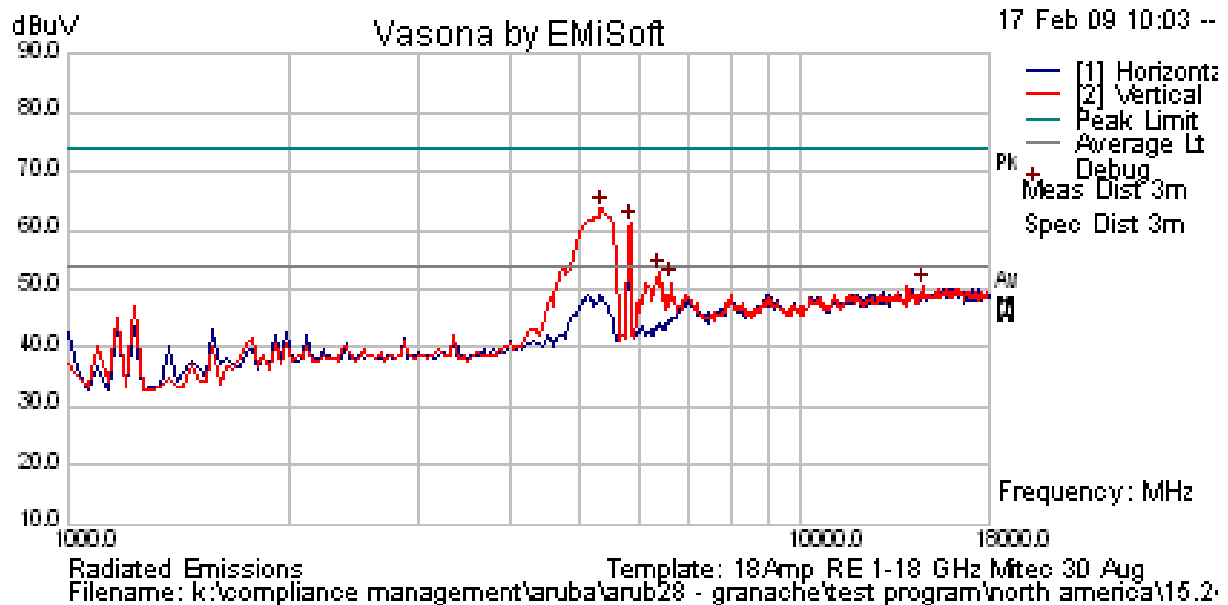
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
165	5825	ART 19	99%	6 MBit/s	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5822.745	70.21	14.8	35.16	120.17	Peak [Scan]	V			N/A	N/A	N/A	PE

PE = Peak Fundamental Emission

Spurious Emission Scan

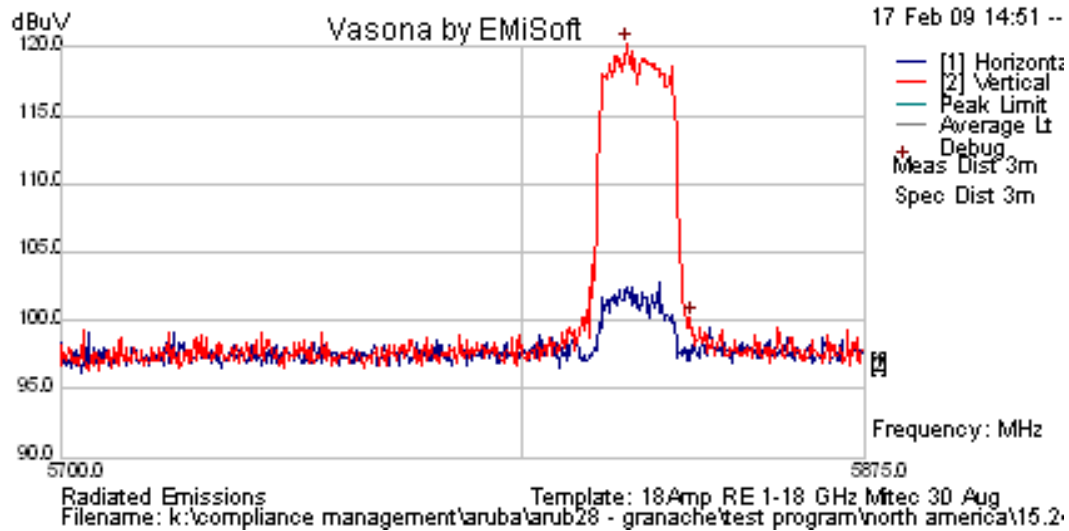


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Peak Emission Scan



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802.11n HT-20: Channel 5745 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
149	5745	ART 19	99%	6.5 MCS	Yes

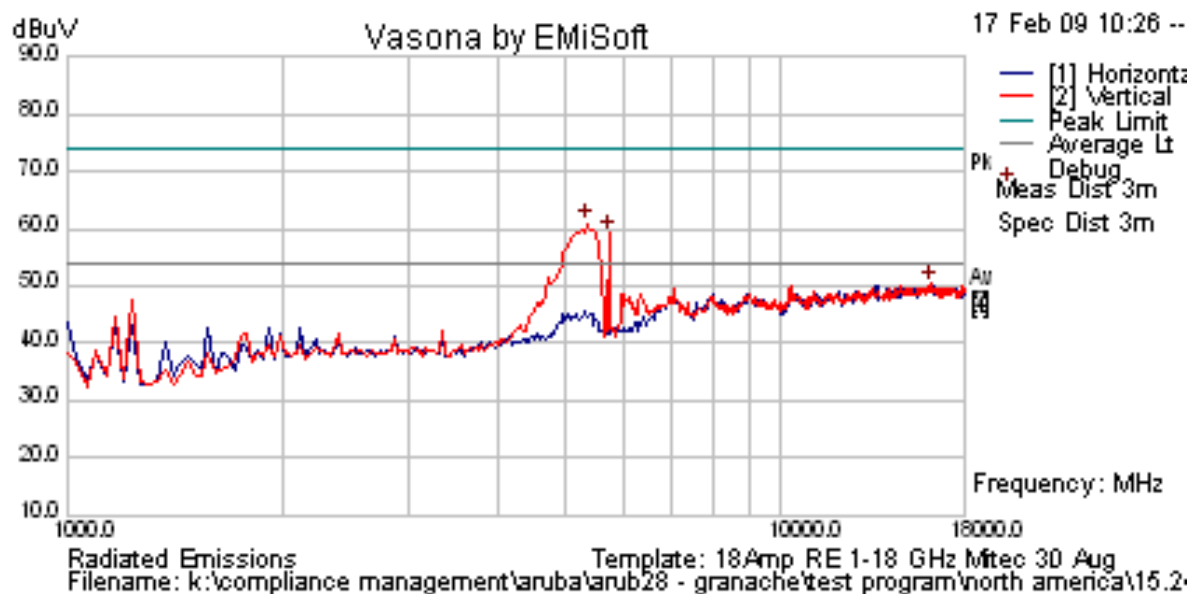
Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5743.287	69.81	14.75	35.1	119.66	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
5375.130	ART Power Setting = 19			67.32	Peak Max	V			74	-6.68	Pass	BE
5372.004				53.56	Average Max	V			54	-0.44	Pass	BE

PE = Peak Fundamental Emission

BE = Restricted Band-Edge

Spurious Emission Scan

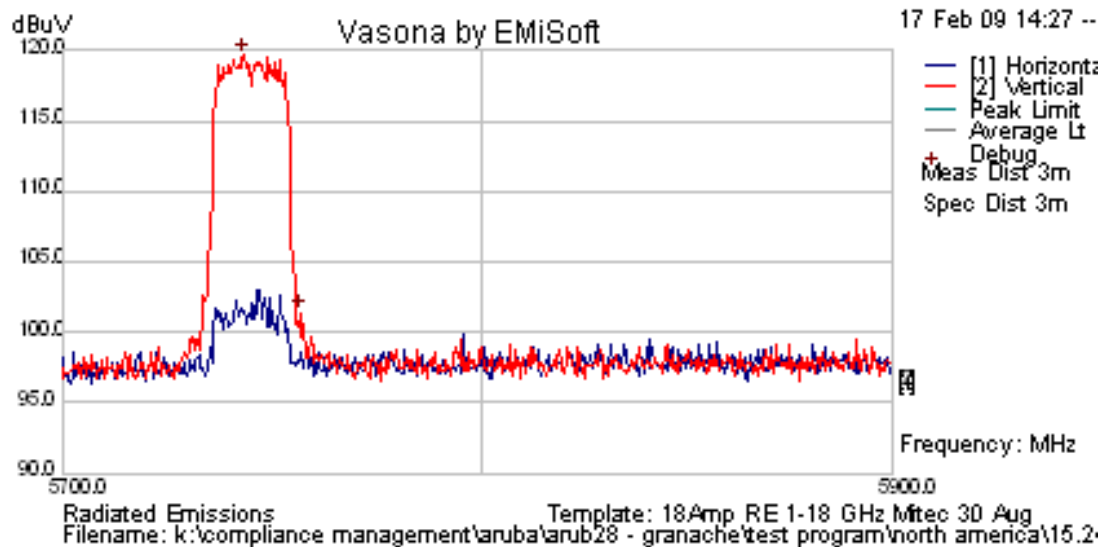


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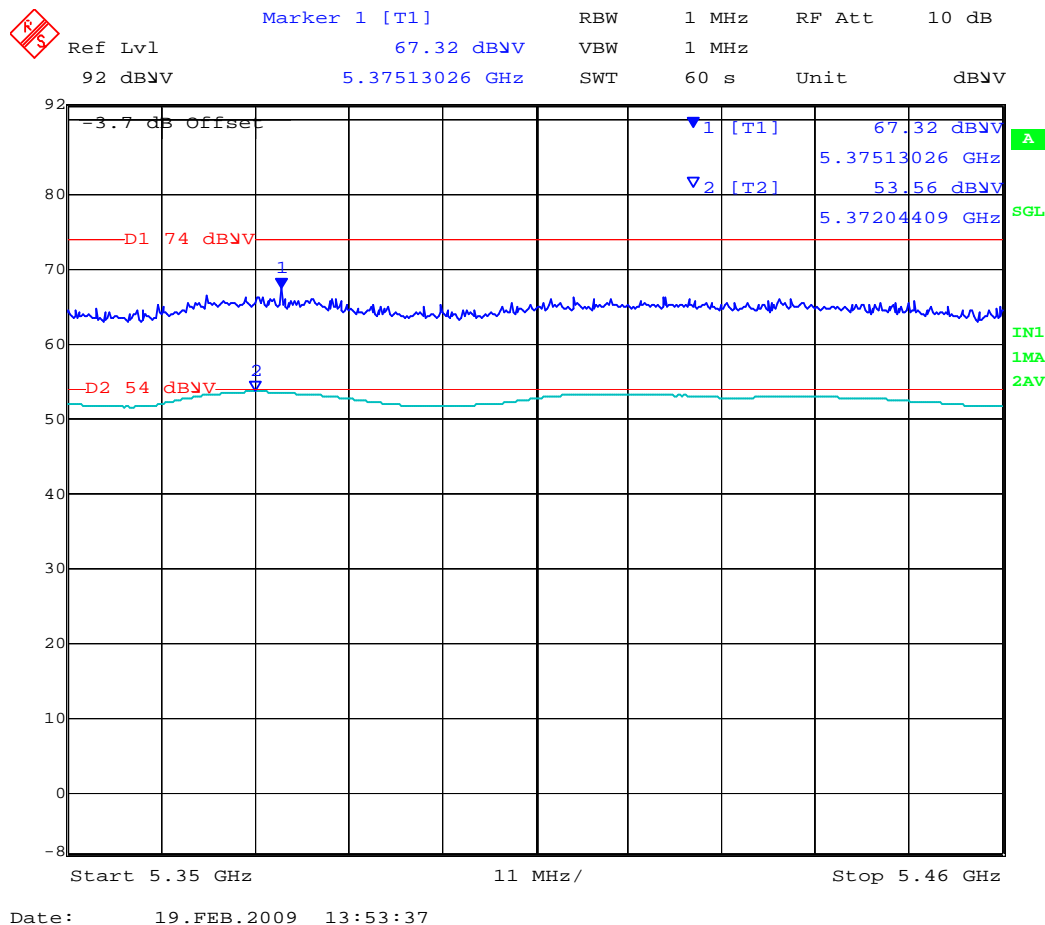


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Peak Emission Scan



802.11n HT-20 Band-edge 5460 MHz



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802.n HT-20: Channel 5785 MHz

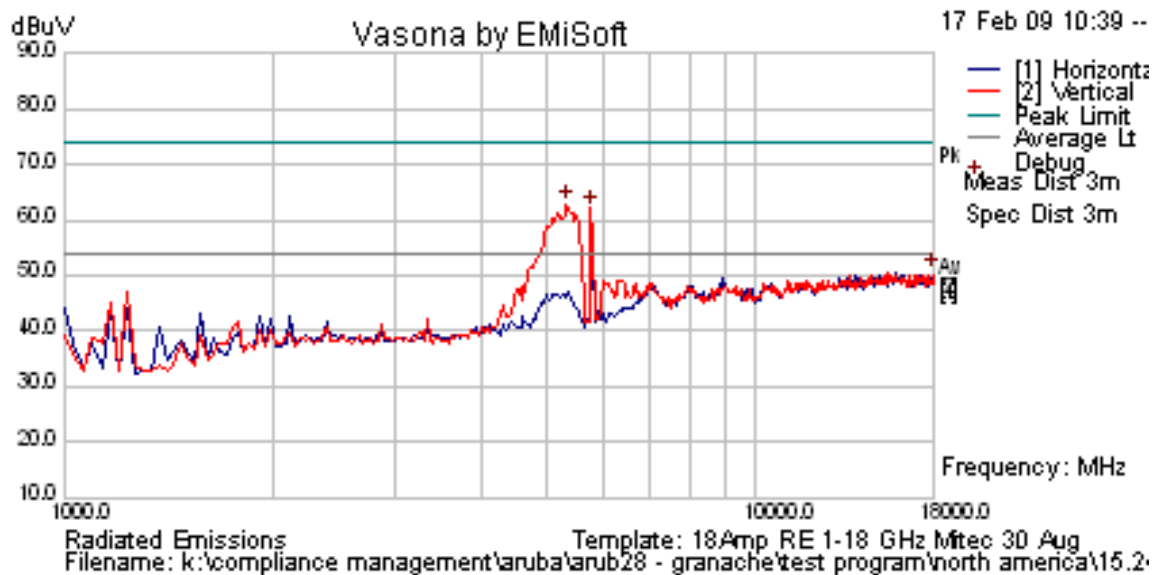
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
157	5785	ART 19	99%	6.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5790.18	69.27	14.78	35.14	119.18	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE

PE = Peak Fundamental Emission

Spurious Emission Scan

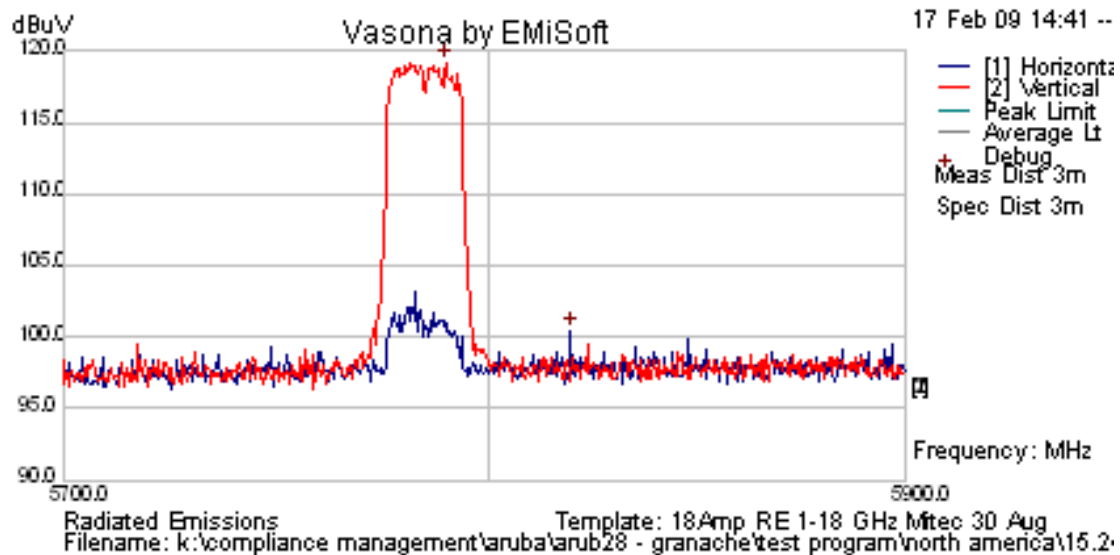


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802.n HT-20: Channel 5825 MHz

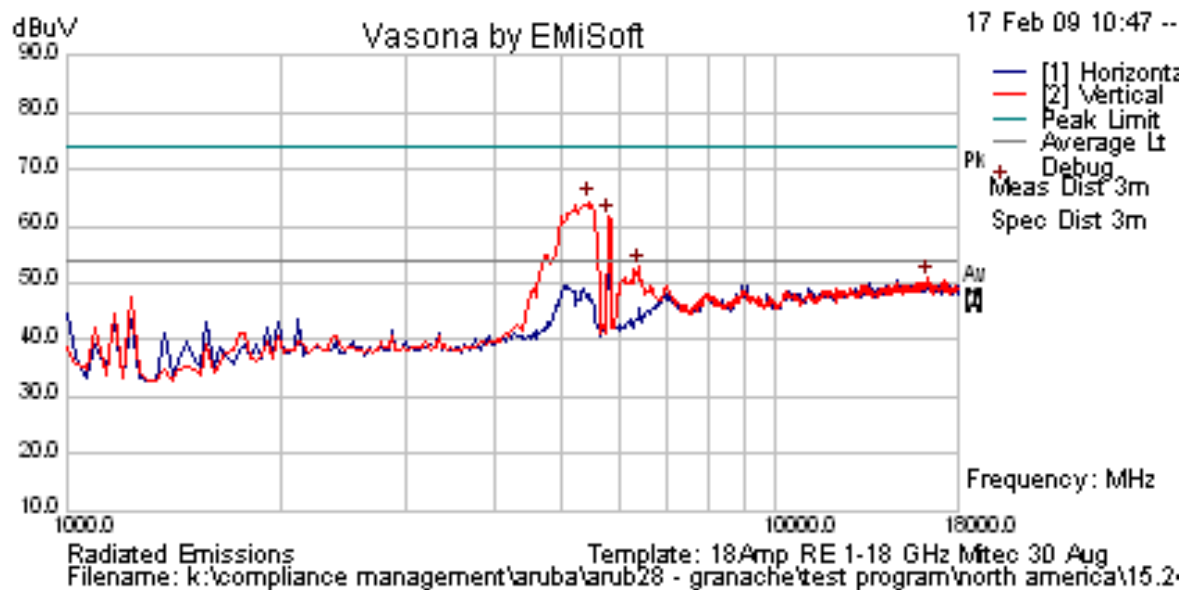
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
165	5825	ART 19	99%	6.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5821.844	69.6	14.8	35.16	119.56	Peak [Scan]	V			N/A	N/A	N/A	PE

PE = Peak Fundamental Emission

Spurious Emission Scan

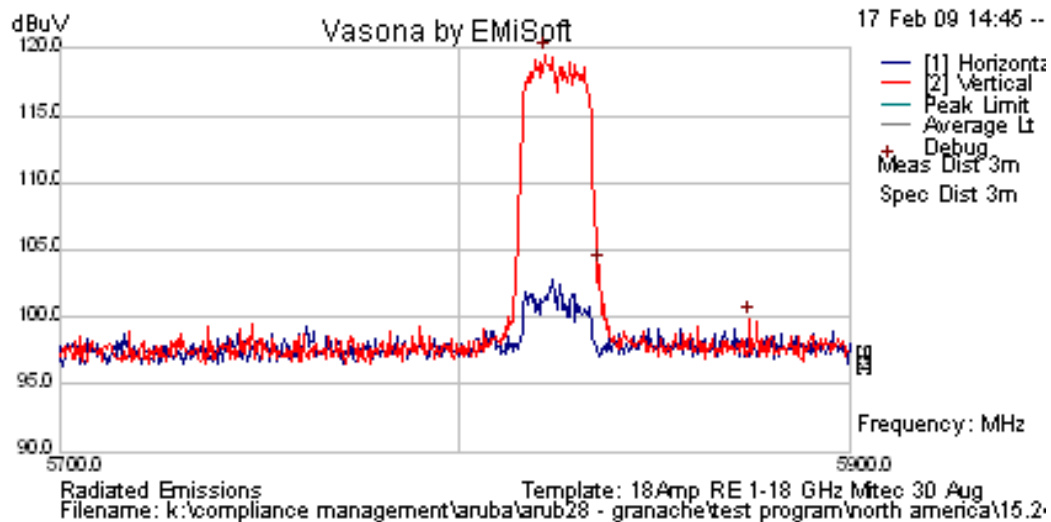


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802.11n HT-40: Channel 5745 MHz

Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
149	5745	ART 18	99%	13.5 MCS	Yes

Three antennas operating simultaneously

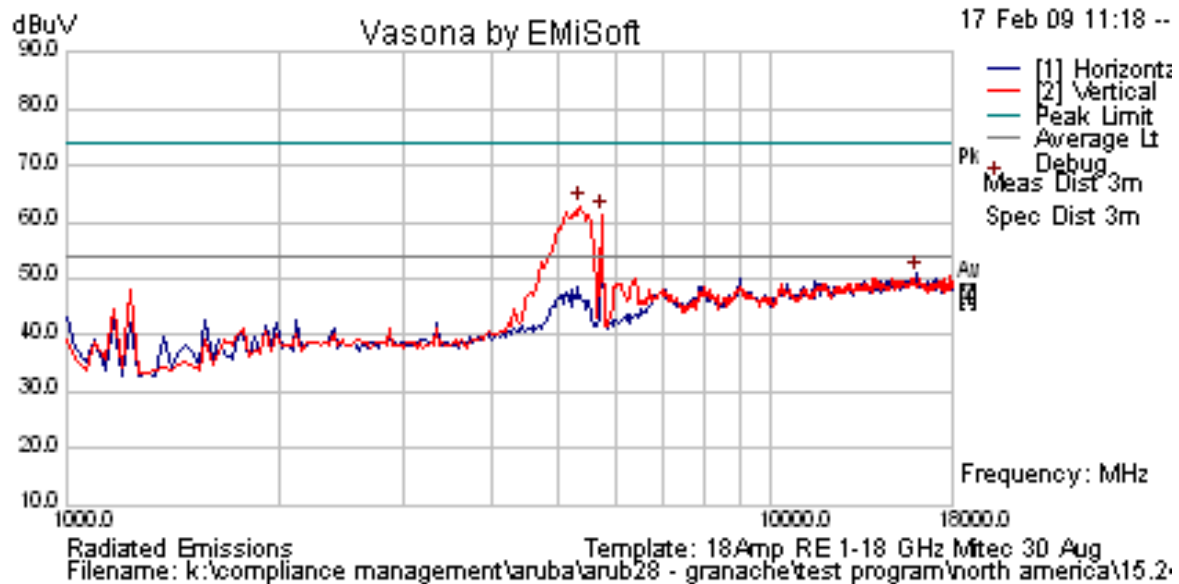
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5753.707	67.23	14.76	35.11	117.1	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE
5421.202	ART Power Setting = 17			67.41	Peak Max	V			74	-6.59	Pass	BE
5371.162				53.85	Average Max	V			54	-0.15	Pass	BE

Note: Band-edge power reduced 1 dB to bring product into compliance

PE = Peak Fundamental Emission

BE = Restricted Band-Edge

Spurious Emission Scan

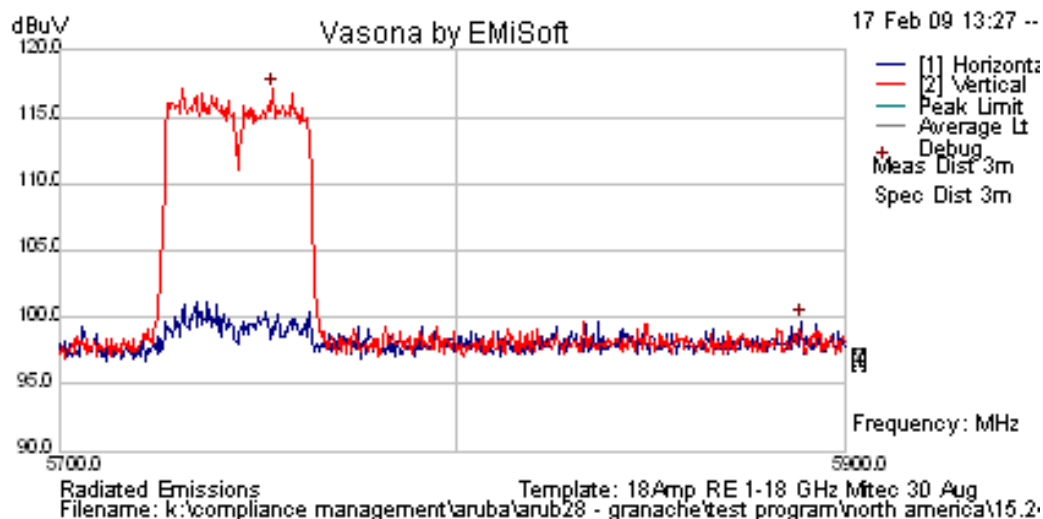


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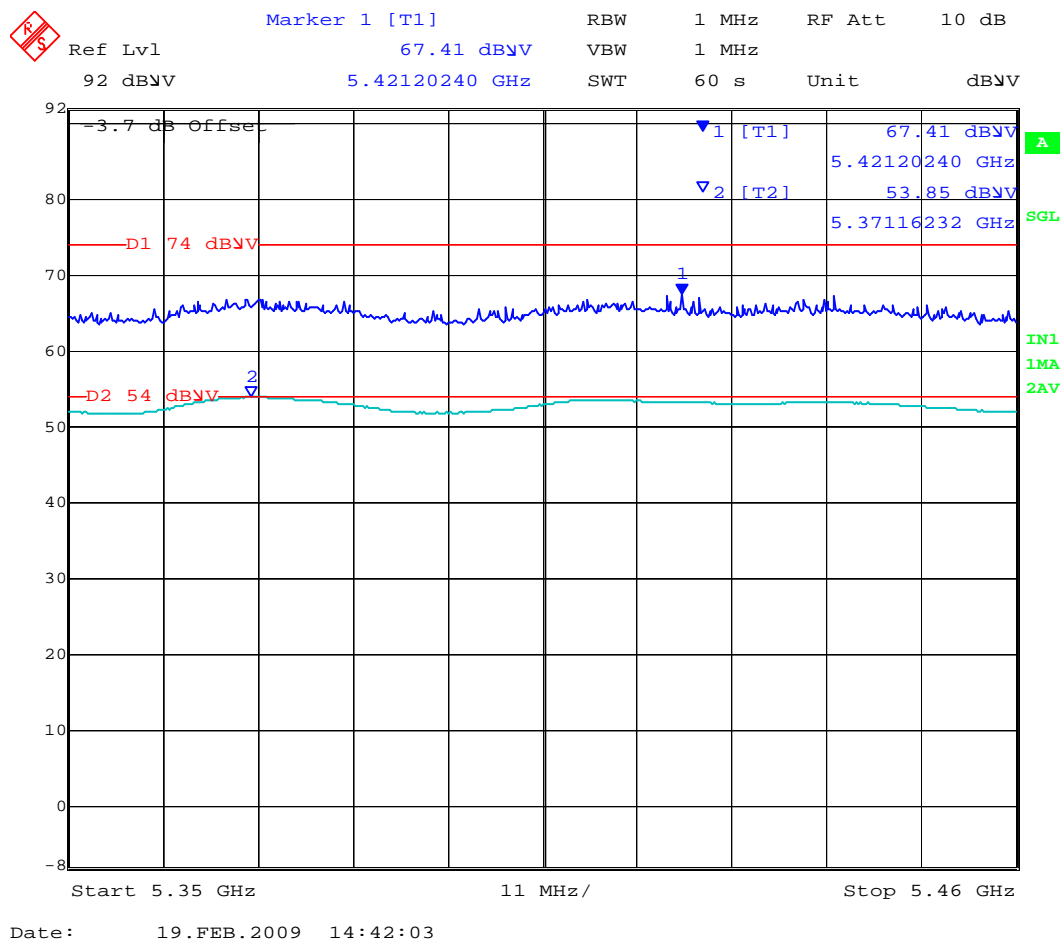


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Peak Emission Scan



802.11n HT-40 Band-edge 5460 MHz



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802.n HT-40: Channel 5785 MHz

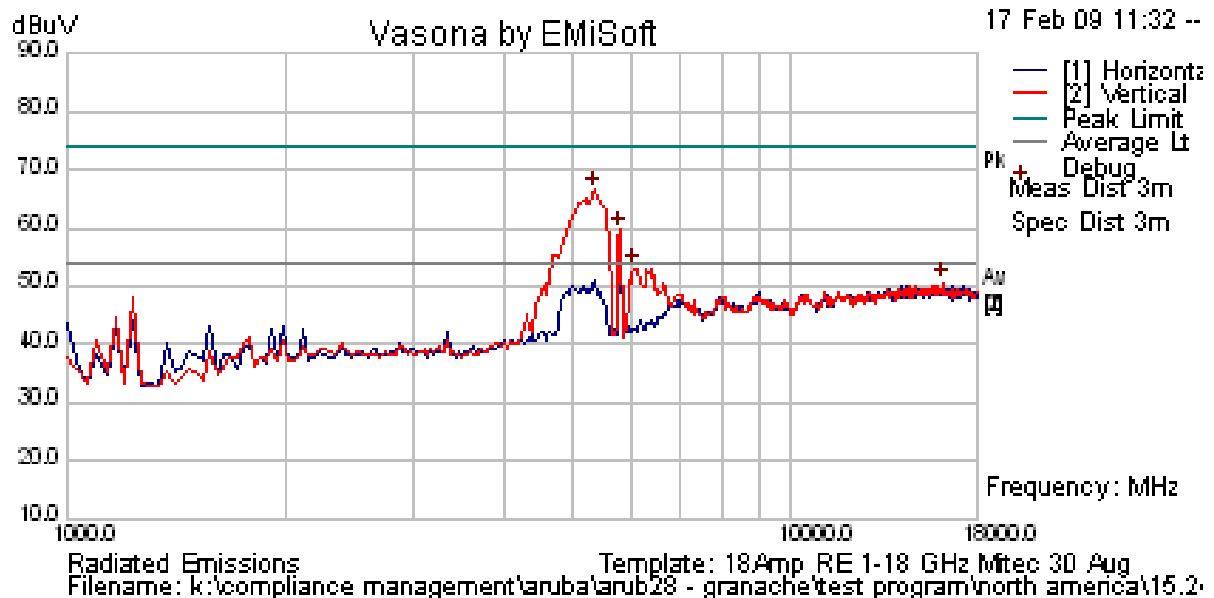
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
157	5785	ART 18	99%	13.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5773.747	67.05	14.77	35.12	116.94	Peak [Scan]	V	100	0	N/A	N/A	N/A	PE

PE = Peak Fundamental Emission

Spurious Emission Scan

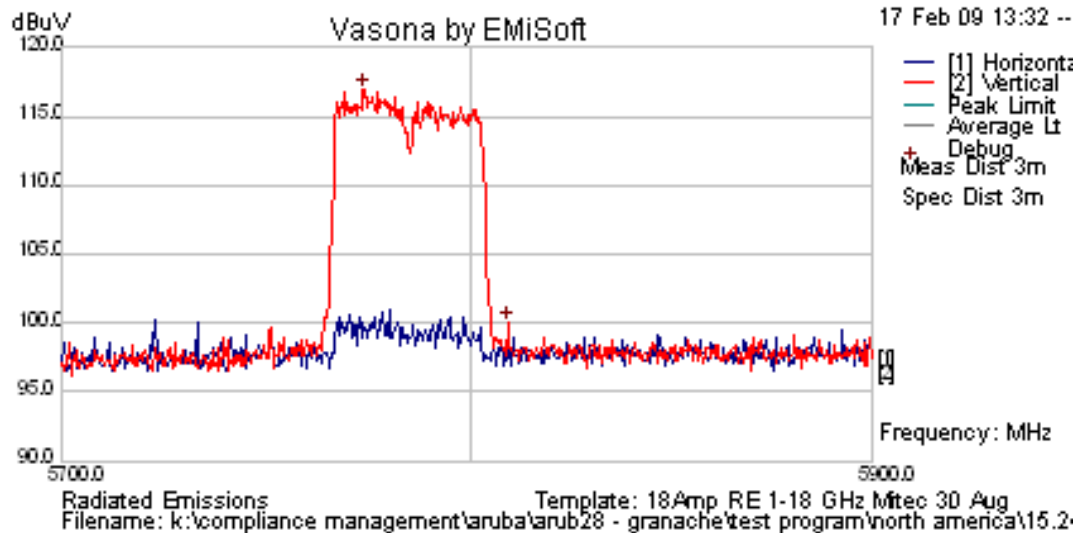


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Peak Emission Scan



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802.n HT-40: Channel 5825 MHz

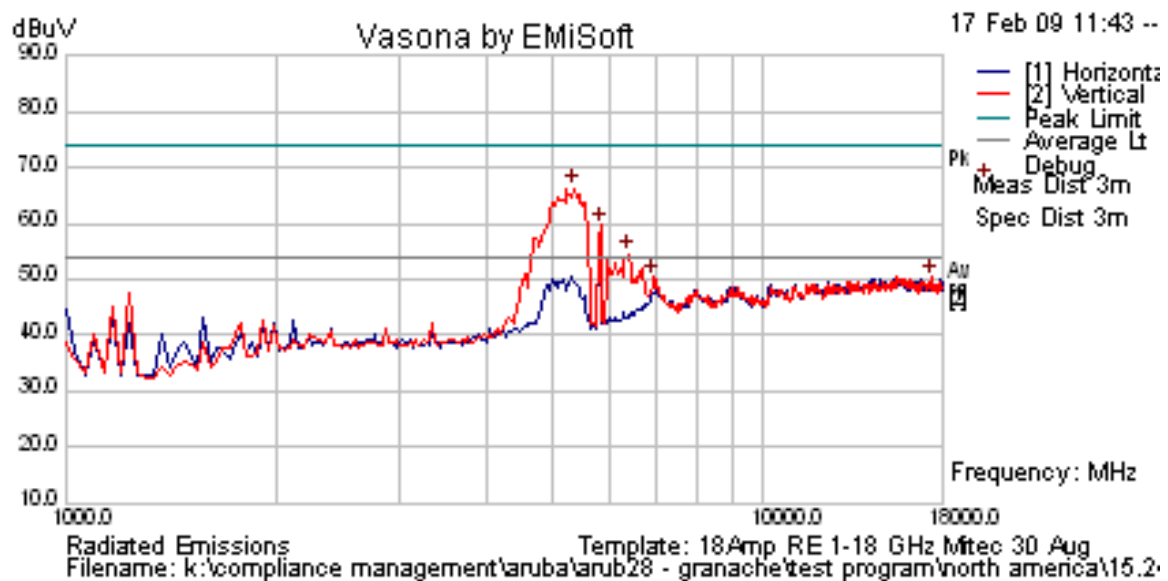
Test Configuration					
Channel	Freq (MHz)	Software Pwr Setting	Duty Cycle	Data Rate (MBit/s)	Compliant
165	5825	ART 18	99%	13.5 MCS	Yes

Three antennas operating simultaneously

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5813.828	66.76	14.79	35.16	116.71	Peak [Scan]	V			N/A	N/A	N/A	PE

PE = Peak Fundamental Emission

Spurious Emission Scan

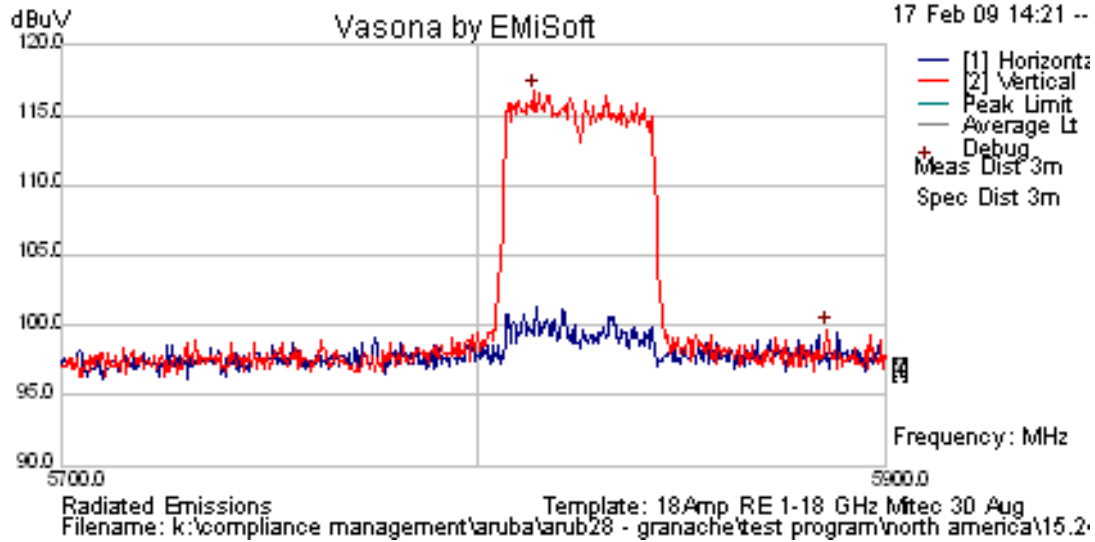


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Peak Emission Scan



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Specification Limits

FCC §15.247(d) and RSS-210 §A8.5 In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

FCC §15.247(d)

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

IC RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

IC RSS-Gen §4.7

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

FCC §15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

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.



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§15.209 (a) Limit Matrix

Frequency(MHz)	Field Strength (μ V/m)	Field Strength (dB μ 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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
-------------------------	---------------

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

Industry Canada RSS-Gen §4.8, §6

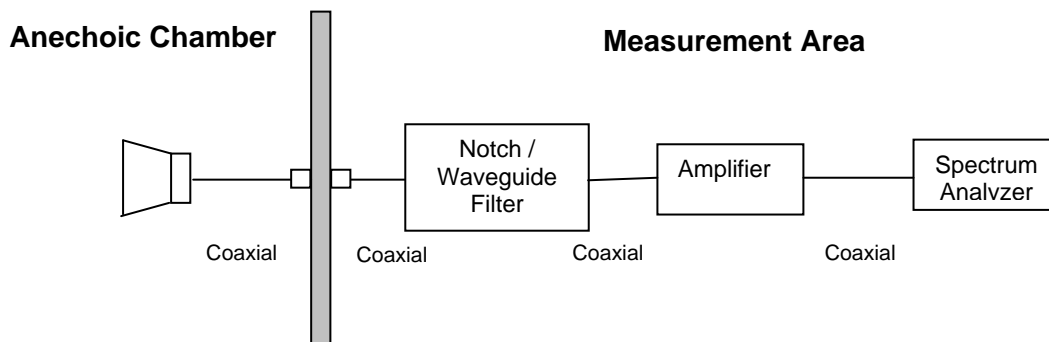
Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

All Sectors of the EUT were tested simultaneously

Test Measurement Set up



Measurement set up for Radiated Emission Test

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.

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

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss



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For 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:

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

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

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

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Receiver Radiated Spurious Emissions above 1 GHz

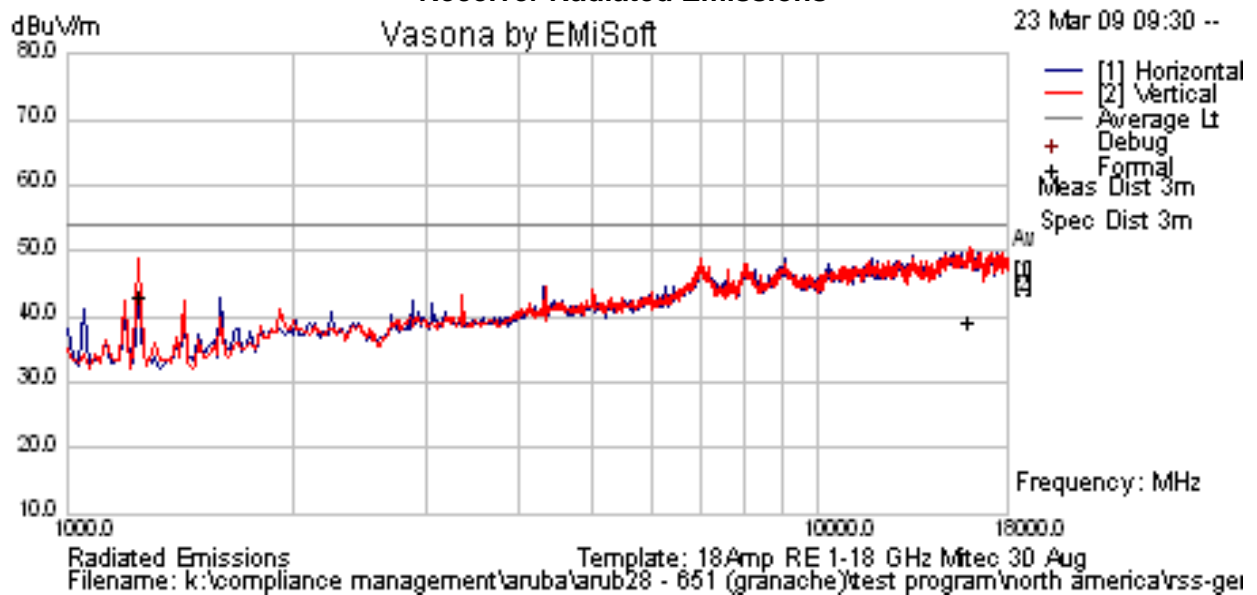
Test Setup Antenna AP-ANT-1B Channel 2437 MHz

All operational modes tested in a single sweep i.e. b, g Legacy, n HT-20/HT-40

TABLE OF RESULTS

Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)

Channel 2437 MHz Antenna AP-ANT-1B (b, g Legacy, n HT-20/HT-40) Receiver Radiated Emissions



No receiver emissions were observed.

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Receiver Radiated Spurious Emissions above 1 GHz

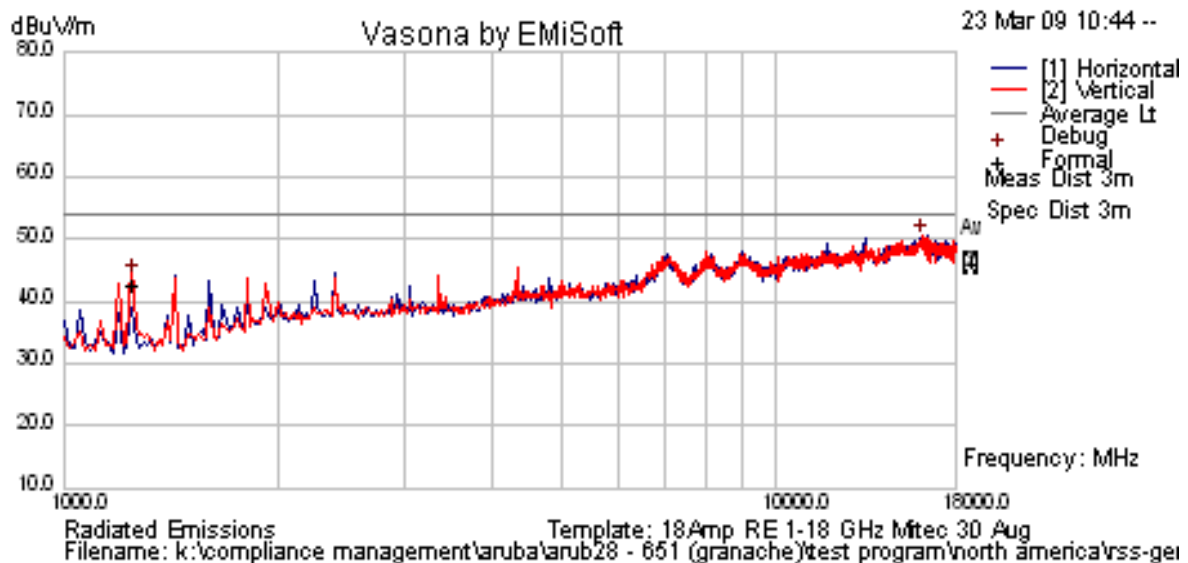
Test Setup – Antenna AP-ANT-1B Channel 5785 MHz

All operational modes tested in a single sweep i.e. b, g Legacy, n HT-20/HT-40

TABLE OF RESULTS

Freq. (MHz)	Pol. (H/V)	Raw Reading (dB μ V/m)	Correction Factor (dB)	Corrected Field Strength (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)

Channel 5785 MHz (b, g Legacy, n HT-20/HT-40) Receiver Radiated Emissions



No receiver emissions were observed.

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Specification

Receiver Radiated Spurious Emissions

Industry Canada RSS-Gen §4.8,

The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

RSS-Gen §6

The following receiver spurious emission limits shall be complied with;

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1.

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
-------------------------	---------------

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.6.3. Radiated Spurious Emissions (30M-1 GHz)

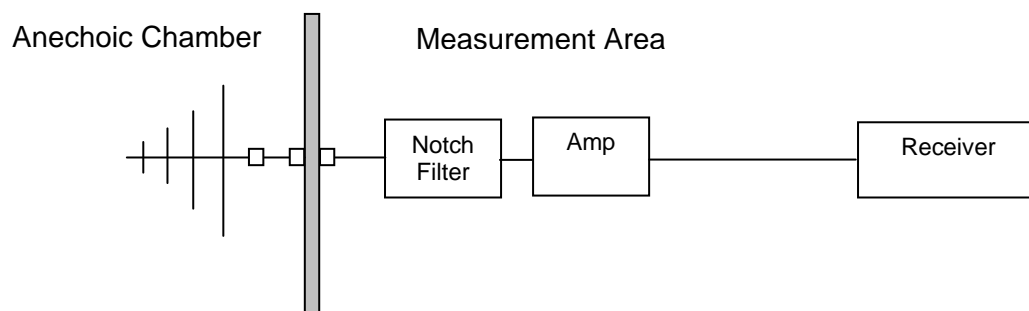
FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

Test Procedure

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

Test Measurement Set up



Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$\text{FS} = \text{R} + \text{AF} + \text{CORR}$$

where:

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain



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For example:

Given a Receiver input reading of 51.5dB μ V; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. 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:

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

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

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

Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

For emissions below 1 GHz the 651-XX Wireless Controller ports were fully loaded and exercised;

1. 4 GIGE Ethernet ports with POE – loaded with active POE driving Access Points 124/125 which were installed in the support chamber
2. 2 GIGE Ethernet without POE – 2 ethernet cables connected to Access Points 124/125
3. 2 SFP uplink ports - fiberoptic cables in loop back configuration for each port; Internally exercised.
4. 4 USB ports – portable USB flash drives in each port
5. 1 Console serial port (RJ-45) – connected to Laptop PC
6. 1 PCI Express card slot – Kyocera PCI Express Card
7. 3 Antenna ports (reverse SMA) – AP-ANT-1B antennas connected
8. IEC 320 AC input connector – powered

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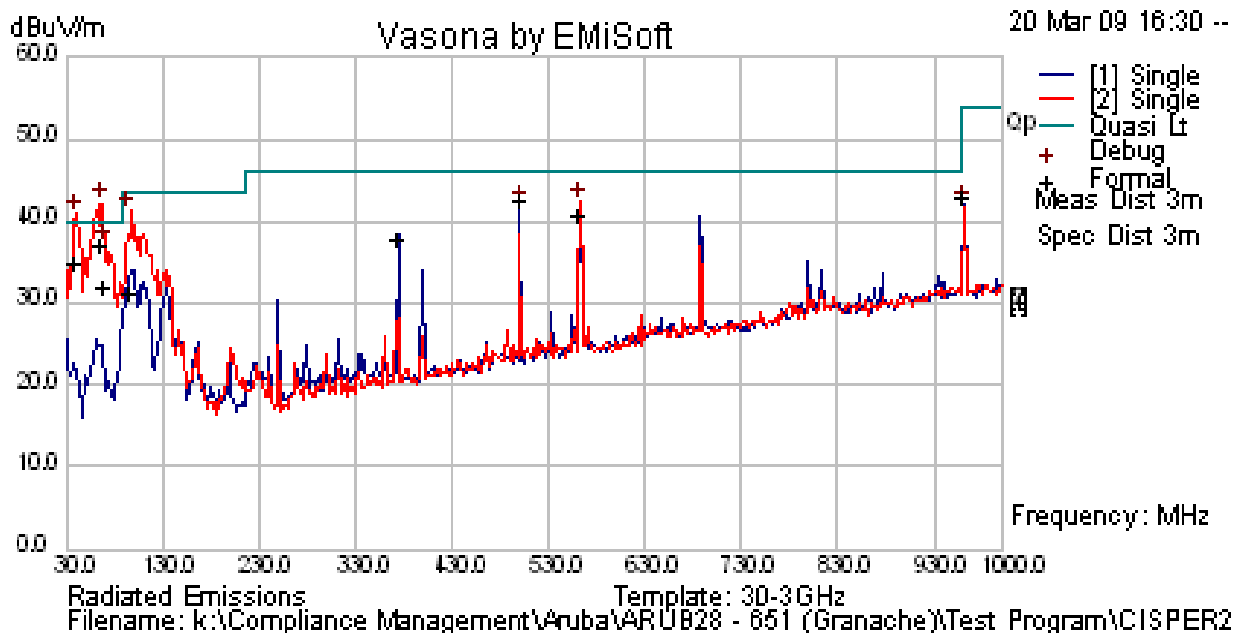
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TABLE OF RESULTS

115 VAC 60 Hz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB
66.823	56.62	3.87	-23.27	37.22	Quasi Peak	V	149	124	40	-2.78
960.022	41.89	7.56	-6.6	42.85	Quasi Max	H	98	120	54	-11.15
499.987	49.12	6	-12.62	42.51	Quasi Max	H	187	142	46	-3.49
40.345	49.07	3.57	-17.6	35.04	Quasi Max	V	110	206	40	-4.96
562.517	46.04	6.29	-11.65	40.68	Quasi Peak	H	168	133	46	-5.32
70.837	51.28	3.89	-23.14	32.03	Quasi Max	V	133	278	40	-7.97

Radiated Spurious Emissions 0.03 to 1 GHz (115 Vac 60 Hz)



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Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§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.

§15.209 (a) and RSS-Gen §2.2 Limit Matrix

Frequency(MHz)	Field Strength (μ V/m)	Field Strength (dB μ 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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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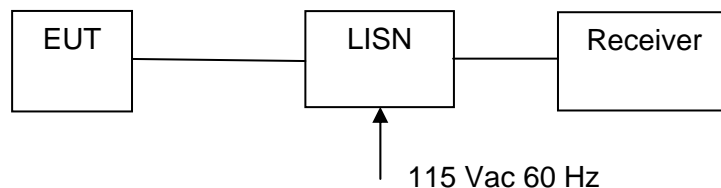
5.1.7. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

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.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

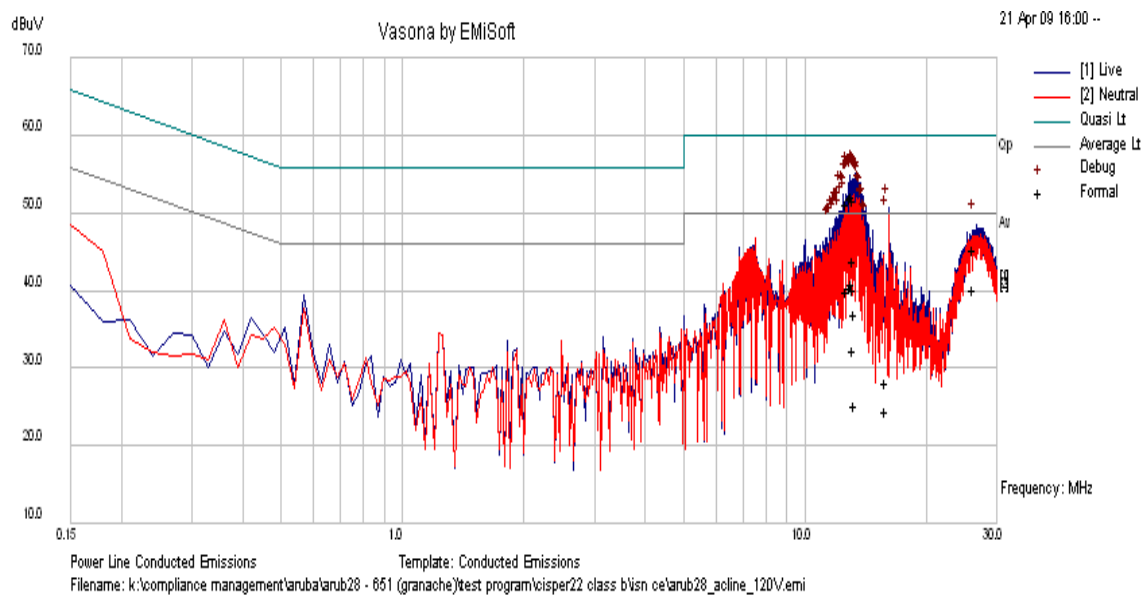
Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS

Freq (MHz)	Line	Peak (dBμV)	QP (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Ave. (dBμV)	Ave. Limit (dBμV)	Ave. Margin (dB)
12.939	Line	51.79	51.17	60	-8.83	39.98	50	-10.00
13.16	Line	52.17	51.94	60	-8.06	40.37	50	-9.63
13.306	Line	50.05	52.21	60	-7.79	40.9	50	-9.10
13.387	Line	49.76	43.92	60	-16.1	32.31	50	-17.70
13.454	Line	46.11	51.75	60	-8.25	40.19	50	-9.81
26.634	Line	44.86	45.39	60	-14.6	40.07	50	-9.93

AC Wireline Conducted Emissions 0.15 – 30 MHz, 115 Vac 60 Hz



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Specification

Limit

§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.

RSS-Gen §7.2.2

The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

§15.207 (a) and **RSS-Gen §7.2.2** Limit Matrix

The lower limit applies at the boundary between frequency ranges

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

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	± 2.64 dB
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Traceability

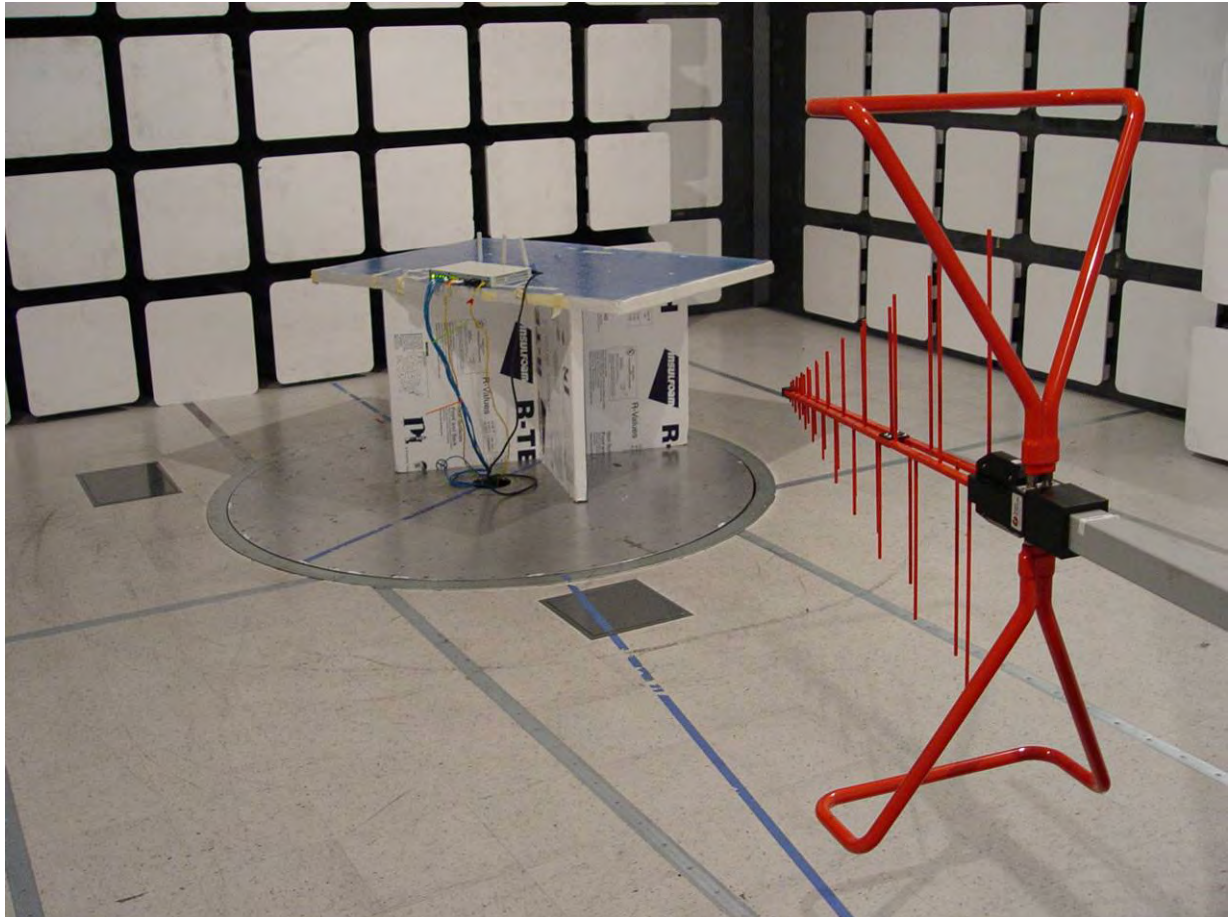
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

6. PHOTOGRAPHS

6.1. Radiated Emissions > 1GHz

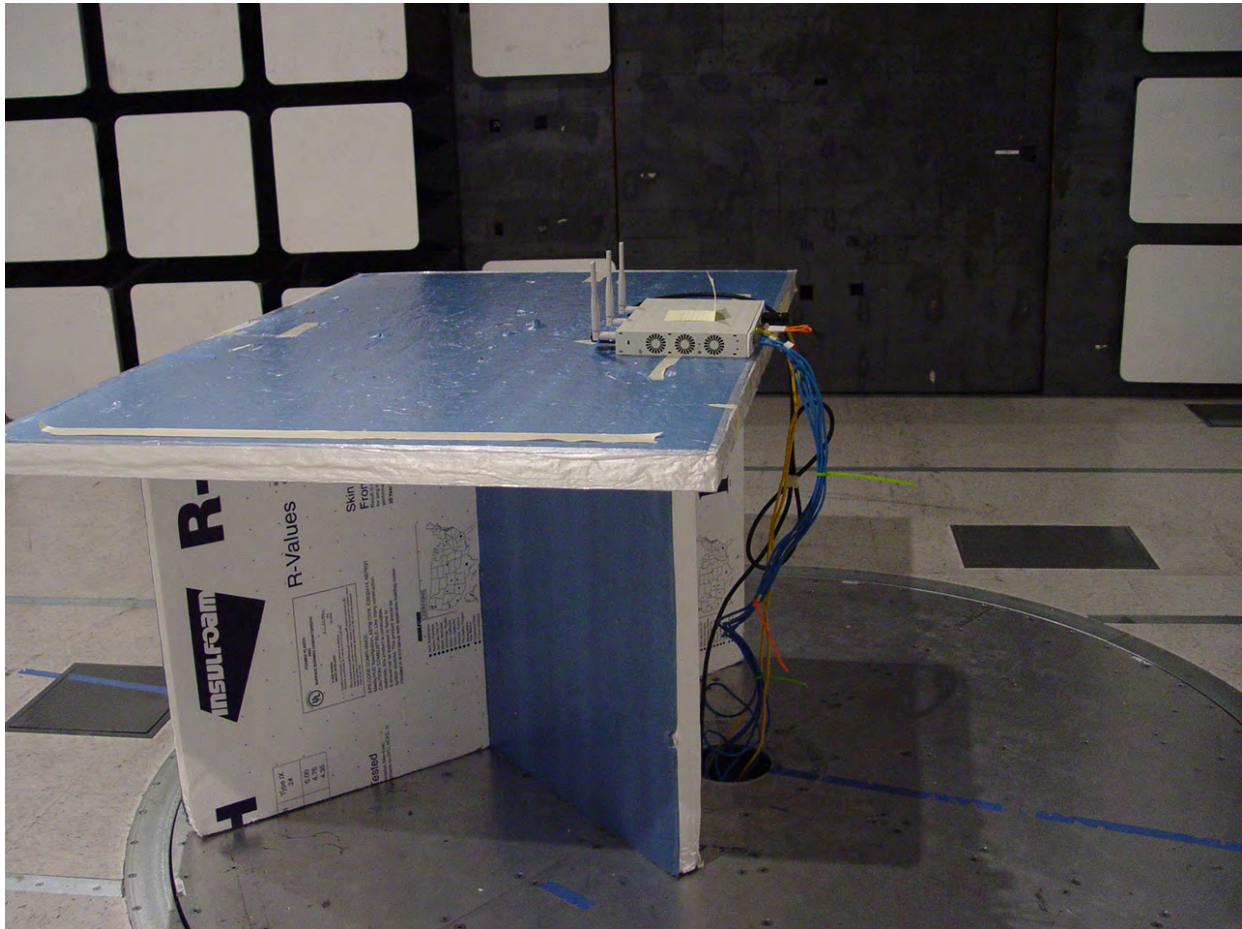


6.2. Radiated Emissions < 1GHz



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6.3. Radiated Emissions Cable & Accessory Configuration

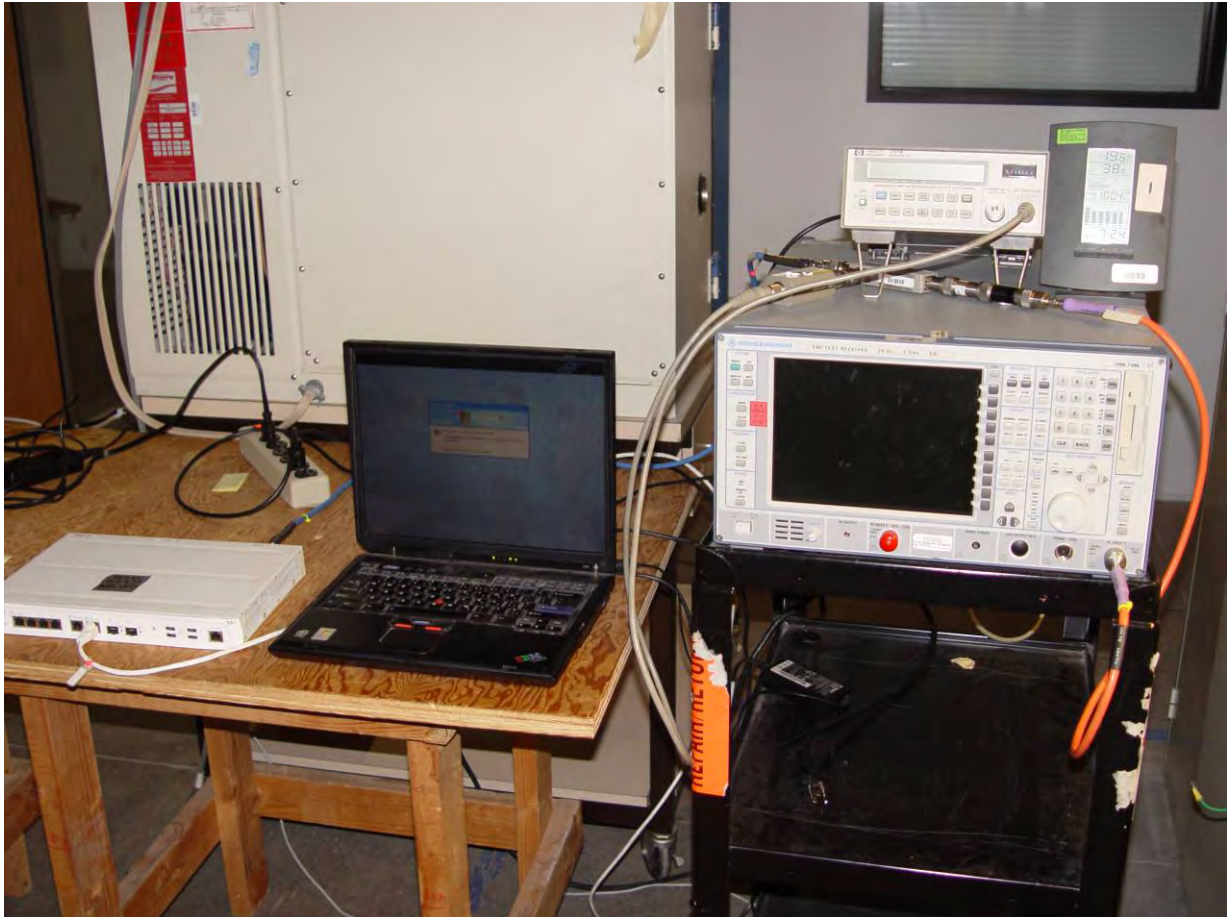


6.4. AC Wireline Conducted Emissions



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6.5. Conducted RF Measurement Test Set-Up



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7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 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

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