Test of Aruba AP-105 802.11a/b/g/n Wireless AP

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

Test Report Serial No.: ARUB50-A2 Rev A

MiCOM Labs

opening wireless markets

TEST REPORT

FROM

Test of Aruba AP-105 802.11a/b/g/n Wireless AP

to

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ARUB50-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 AP-105 Wireless Access Point. 5,150 to 5,250 MHz test data is reported in MiCOM Labs test report ARUB50-A4.

This report supersedes: MiCOM Labs Inc Report ARUB40-A2 Rev A

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

Product Function: Wireless Access Point

Copy No: pdf Issue Date: 30th March 2010

This Test Report is Issued Under the Authority of;

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CERTIFICATE #2381.01

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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

ilac-MRA

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MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA VIRGINIA A2LA

Presented this 26th day of February 2008.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to April 30, 2010
Revised March 22, 2010

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

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 I	
Vietnam	Ministry of Information and Communications	I	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	30th March 2010	Initial release.

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:	802.11a/b/g/n Wireless Access Point	Telephone:	+1 925 462 0304
Model:	AP-105	Fax:	+1 925 462 0306
S/N's:	AL0048955 (Class II Permissive Change)/AL0000439 (Conducted Testing), AL0000437 (Radiated Testing)		
Test Date(s):	22nd - 24th March 2010; 22nd June to 19th August 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.

ACCREDITED

CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

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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	7th August 2009	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.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the Aruba AP-105 802.11a/b/g/n Wireless AP to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	Aruba Networks, Inc 1344 Crossman Avenue Sunnyvale California 94089, USA
Manufacturer:	As applicant.
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ARUB50-A2 Rev A
Date EUT received:	22nd March 2010
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	22nd - 24th March 2010; 22nd June to 19th August 2009
No of Units Tested:	Two (separate units for conducted and radiated)
Type of Equipment:	802.11a/b/g/n Wireless Access Point, 2x2 Spatial Multiplexing MIMO configuration
Manufacturers Trade Name:	Wireless Access Point
Model(s):	AP-105
Location for use:	Indoor
Declared Frequency Range(s):	2400 - 2483.5 MHz; 5725 - 5850 MHz
Software Release	3.3.3.0, ART version is v0_9_b7_ar928xALL
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:	12Vdc 1.25A; POE 48 Vdc 350 mA
Operating Temperature Range:	Declared range 0 to +40ºC
ITU Emission Designator:	2400 – 2483.5 MHz 802.11b 15M8G1D 2400 – 2483.5 MHz 802.11g 17M7D1D 2400 – 2483.5 MHz 802.11n – HT-20 18M5D1D 2400 – 2483.5 MHz 802.11n – HT-40 36M9D1D 5725 – 5850 MHz 802.11a 16M8D1D 5725 – 5850 MHz 802.11n – HT-20 17M9D1D 5725 – 5850 MHz 802.11n – HT-40 36M3D1D
Frequency Stability:	±20 ppm max
Equipment Dimensions:	5½" x 5½" x 1¾"
Weight:	1 lb (454 grams)
Primary function of equipment:	Wireless Access Point for transmitting data and voice.

3.2. Scope of Test Program

The scope of the test program was to test Radiated Emissions below 1GHz and Wireline Emissions on the Aruba Networks AP-105 802.11a/b/g/n Wireless Access Point to verify continuing compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications in the frequency ranges 2400 - 2483.5 MHz and 5725 – 5850 MHz as a result of the following changes:

- Second source flyback transformer.
- Add 33MHz oscillator for TPM circuit instead of using output clock from the AR7161 CPU.
- Second source of DDR memory.

This report uses results previously report in MiCOM Labs test report ARUB40-A2.

Aruba AP-105 Access Point
The AP-105 is a multi-band 802.11a/b/g/n dual-radio indoor wireless access point designed for dense enterprise deployments of 802.11n. The AP-105 delivers unprecedented value with the performance and reliability of 802.11n in a compact, streamlined 2x2 MIMO package. Capable of delivering wireless data rates of up to 300Mbps, the multifunction AP-105 provides wireless LAN access, air monitoring, and wireless intrusion detection and prevention over the 2.4GHz and 5GHz RF spectrum. The access point works in conjunction with Aruba's line of high-performance controllers to deliver high-speed, secure network services.

802.11n enables the use of wireless as a primary network connection with speed and reliability comparable to a wired LAN. 802.11n increases performance through techniques such as channel bonding, block acknowledgement, and Multiple In Multiple Out (MIMO). Advanced RF techniques such Cyclic Delay Diversity also increase range and reliability.

The AP-105 features a 100/1000Base-T Ethernet interface and operates from standard 802.3af Power over Ethernet (PoE) sources. Equipped with four internal omni-directional antennas, the AP-105 provides full RF diversity and 2x2 MIMO operation on both the 2.4GHz and 5GHz bands.

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial Nos.
EUT	802.11a/b/g/n Wireless Access Point	Aruba Networks	AP-105	AL0048955 (Class II Permissive Change)/AL0000439 (Conducted Testing), AL0000437 (Radiated Testing)
Support	Laptop PC	IBM	Thinkpad	None

3.4. Antenna Details

1. Integral Antennas;-
   - 2.4 – 2.5 GHz; Gain: 2.5 dBi
   - 4.9 – 5.875 GHz; Gain: 4.0 dBi

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 10/100/1000 Ethernet
2. Console – serial maintenance terminal
3. 12 Vdc, 4mm supply connector

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 2,437 2,462
g	Legacy	6 MBit/s	
n	HT-20	6.5 MCS	
	HT-40	13.5 MCS	2,422 2,437 2,452
a	Legacy	6 MBit/s	5,745 5,785 5,825
n	HT-20	6.5 MCS	
	HT-40	13.5 MCS	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 both 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)	Aggregate Measured Pwr (dBm)
b	0	-15.57	-4.59	-1.78
	1	-11.66	-1.42	+0.11
	2	-3.58	-0.06	+2.23
	3	-1.30	+1.4	+3.91
	4	+0.79	+1.98	+5.21
	5	+2.30	+3.31	+6.29
	6	+3.84	+3.64	+7.58
	7	+4.81	+4.91	+8.40
	8	+5.93	+6.49	+10.97
	9	+7.47	+7.61	+11.44
	10	+8.06	+8.53	+11.38
	11	+8.95	+9.60	+12.84
	12	+10.10	+10.56	+14.25
	12.5	+10.47	+11.35	+14.40
	13	+10.99	+12.04	+14.55
	14	+12.45	+12.72	+16.74
	15	+13.46	+13.62	+17.08
	16	+14.48	+14.96	+19.04
	17	+15.60	+15.68	+18.96
	18	+16.19	+17.24	+18.42
	19	+17.25	+17.86	+20.88
	20	+19.14	+18.74	+22.04

Channel 2,412 MHz
g Mode Legacy, 6 Mbit/s

Configuration	ART Power Setting	Tx 1 Measured Pwr (dBm)	Tx 2 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
g	0	-17.69	-1.13	+0.23
	1	-4.19	-0.33	+2.86
	2	-1.04	+1.47	+4.33
	3	+1.18	+2.54	+5.54
	4	+2.35	+3.11	+6.6
	5	+3.74	+4.22	+7.71
	6	+4.80	+4.96	+8.62
	7	+5.59	+6.16	+9.72
	8	+6.55	+7.35	+10.68
	9	+7.98	+8.49	+11.66
	10	+8.90	+9.35	+12.69
	11	+10.17	+10.29	+13.57
	12	+11.23	+11.25	+14.53
	12.5	+11.72	+11.83	+15.14
	13	+12.16	+12.37	+15.72
	14	+13.49	+13.37	+16.66
	15	+14.67	+14.25	+17.74
	16	+15.76	+15.00	+18.84
	17	+16.41	+16.22	+19.5
	18	+16.94	+17.22	+20.31
	19	+18.08	+18.01	+21.47
	20	+18.67	+18.91	+22.15

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)	Aggregate Measured Pwr (dBm)
HT-20	0	-32.42	-1.08	+0.29
	1	-4.14	+0.90	+2.82
	2	-0.99	+1.52	+4.27
	3	+1.07	+2.49	+5.51
	4	+2.20	+3.30	+6.48
	5	+3.65	+4.16	+7.68
	6	+4.70	+4.90	+8.58
	7	+5.82	+6.39	+9.68
	8	+6.55	+7.13	+10.75
	9	+7.71	+8.38	+11.76
	10	+9.04	+9.29	+12.66
	11	+9.84	+10.18	+13.59
	11.5	+10.24	+10.67	+14.10
	12	+10.64	+11.16	+14.61
	13	+11.55	+12.30	+15.68
	14	+12.91	+13.31	+16.69
	15	+14.04	+14.23	+17.69
	16	+14.94	+15.00	+18.75
	17	+15.77	+16.05	+19.54
	18	+16.33	+17.16	+20.07
	19	+17.40	+18.13	+21.35
	20	+18.27	+18.87	+22.20

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)	Aggregate Measured Pwr (dBm)
HT-40	0	-19.84	-0.5	+0.52
	1	-3.79	+1.03	+3.06
	2	-0.87	+2.27	+4.38
	3	+1.04	+3.01	+5.60
	4	+2.50	+3.83	+6.70
	5	+3.72	+4.55	+7.73
	6	+4.94	+5.49	+8.72
	7	+5.70	+6.62	+9.80
	7.5	+6.35	+7.30	+10.39
	8	+6.97	+7.95	+10.97
	9	+8.45	+8.72	+12.13
	10	+9.28	+9.94	+13.08
	11	+10.28	+10.62	+14.10
	12	+11.13	+11.74	+15.10
	13	+11.98	+12.75	+16.03
	14	+13.15	+13.57	+17.14
	15	+14.33	+14.55	+18.09
	16	+15.37	+15.59	+19.07
	17	+16.02	+16.43	+19.43
	18	+16.69	+17.36	+20.55
	19	+17.56	+18.27	+21.27
	19.5	+18.02	+18.77	+21.81
	20	+18.45	+19.24	+22.31

Channel 5,745 MHz
a Mode Legacy, 6 Mbit/s

Configuration	ART Power Setting	Tx 3 Measured Pwr (dBm)	Tx 4 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
a	0	-4.64	-0.42	+1.21
	1	-2.91	+1.13	+2.54
	2	-1.47	+2.08	+3.42
	3	-0.59	+2.85	+4.30
	4	+0.40	+3.35	+5.11
	5	+1.62	+4.28	+6.05
	6	+2.66	+5.85	+7.32
	7	+3.69	+7.22	+8.48
	8	+4.64	+8.40	+9.80
	9	+5.57	+9.53	+11.02
	10	+6.37	+10.49	+11.78
	11	+7.38	+12.18	+13.31
	12	+8.80	+13.97	+14.85
	13	+10.36	+15.05	+15.99
	14	+10.99	+15.96	+17.12
	15	+11.95	+16.87	+17.94
	16	+13.10	+17.63	+18.55
	17	+13.81	+17.77	+18.99
	18	+14.94	+18.58	+19.36
	19	+15.66	+18.44	+19.59
	20	+15.57	+18.58	+19.21

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

Configuration	ART Power Setting	Tx 3 Measured Pwr (dBm)	Tx 4 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
HT-20 ('n' mode)	0	-4.51	-0.06	+1.13
	1	-4.63	+1.12	+2.73
	2	-1.52	+1.94	+3.45
	3	-0.53	+2.57	+4.30
	4	+0.46	+3.33	+5.09
	5	+1.61	+4.14	+6.10
	6	+2.51	+5.87	+7.26
	7	+3.65	+6.87	+8.71
	8	+4.71	+8.18	+9.60
	9	+5.48	+9.75	+10.79
	10	+6.23	+10.80	+12.04
	11	+7.30	+12.52	+13.39
	12	+8.81	+13.94	+14.86
	13	+10.18	+14.98	+15.94
	14	+11.09	+15.97	+16.89
	15	+12.10	+16.80	+18.08
	16	+13.00	+17.61	+18.89
	17	+13.94	+17.58	+19.08
	18	+14.80	+18.23	+20.26
	19	+15.78	+18.19	+20.71
	20	+16.73	+18.19	+20.86

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Channel 5,745 MHz
HT-40 'n' Mode, 13.5 MCS

Configuration	ART Power Setting	Tx 3 Measured Pwr (dBm)	Tx 4 Measured Pwr (dBm)	Aggregate Measured Pwr (dBm)
HT-40 ('n' mode)	0	-4.07	+0.17	+1.70
	1	-2.85	+1.70	+2.89
	2	-1.23	+2.44	+3.94
	3	-0.10	+3.36	+4.62
	4	+0.67	+3.94	+5.33
	5	+1.96	+4.58	+6.30
	6	+3.08	+6.24	+7.87
	7	+4.11	+7.52	+8.80
	8	+4.98	+8.75	+9.88
	9	+5.59	+9.77	+11.17
	10	+6.68	+10.85	+12.12
	11	+7.70	+12.71	+13.52
	12	+9.07	+14.02	+14.93
	13	+10.45	+14.97	+16.15
	14	+11.12	+15.88	+17.04
	15	+12.15	+16.84	+17.73
	16	+13.00	+17.67	+18.51
	17	+13.95	+17.82	+19.20
	18	+15.09	+18.73	+19.37
	19	+15.35	+18.69	+19.66
	20	+15.20	+18.69	+19.51

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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 two 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	
	Integral
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

5,725 – 5850 MHz

15.247	
	Integral
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

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 and emission requirements was required in certain circumstances. The following matrix was generated identifying the reduction in power required bringing the EUT into compliance.

2400 - 2483.5 MHz

	Channel Freq (MHz)	Nominal ART Power	Passing ART Power	Aggregate Measured Pwr (dBm)
11b	2412	20	12	+14.25
	2437	20	11	+12.84
	2462	20	12.5	+14.40
11g	2412	20	12.5	+15.14
	2437	20	12.5	+15.14
	2462	20	12.5	+15.14
HT-20	2412	20	11.5	+14.10
	2437	20	17	+19.54
	2462	20	11.5	+14.10
HT-40	2422	20	7.5	+10.39
	2437	20	19.5	+21.81
	2452	20	9	+12.13

5725 – 5850 MHz

	Channel Freq (MHz)	Nominal ART Power	Passing ART Power	Aggregate Measured Pwr (dBm)
11a	5745	20	17	+18.99
	5785	20	17	+18.99
	5825	20	17	+18.99
HT-20	5745	20	11	+13.39
	5785	20	11	+13.39
	5825	20	11	+13.39
HT-40	5755	20	12	+14.93
	5785	20	12	+14.93
	5815	20	12	+14.93

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

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

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.*
Industry Canada only **RSS-Gen §4.10, §6**	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.3*
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*

5. TEST RESULTS

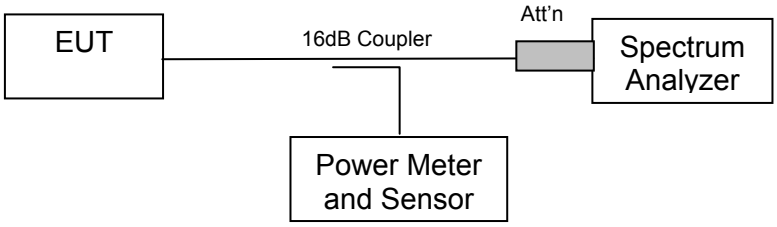
5.1. Device Characteristics

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

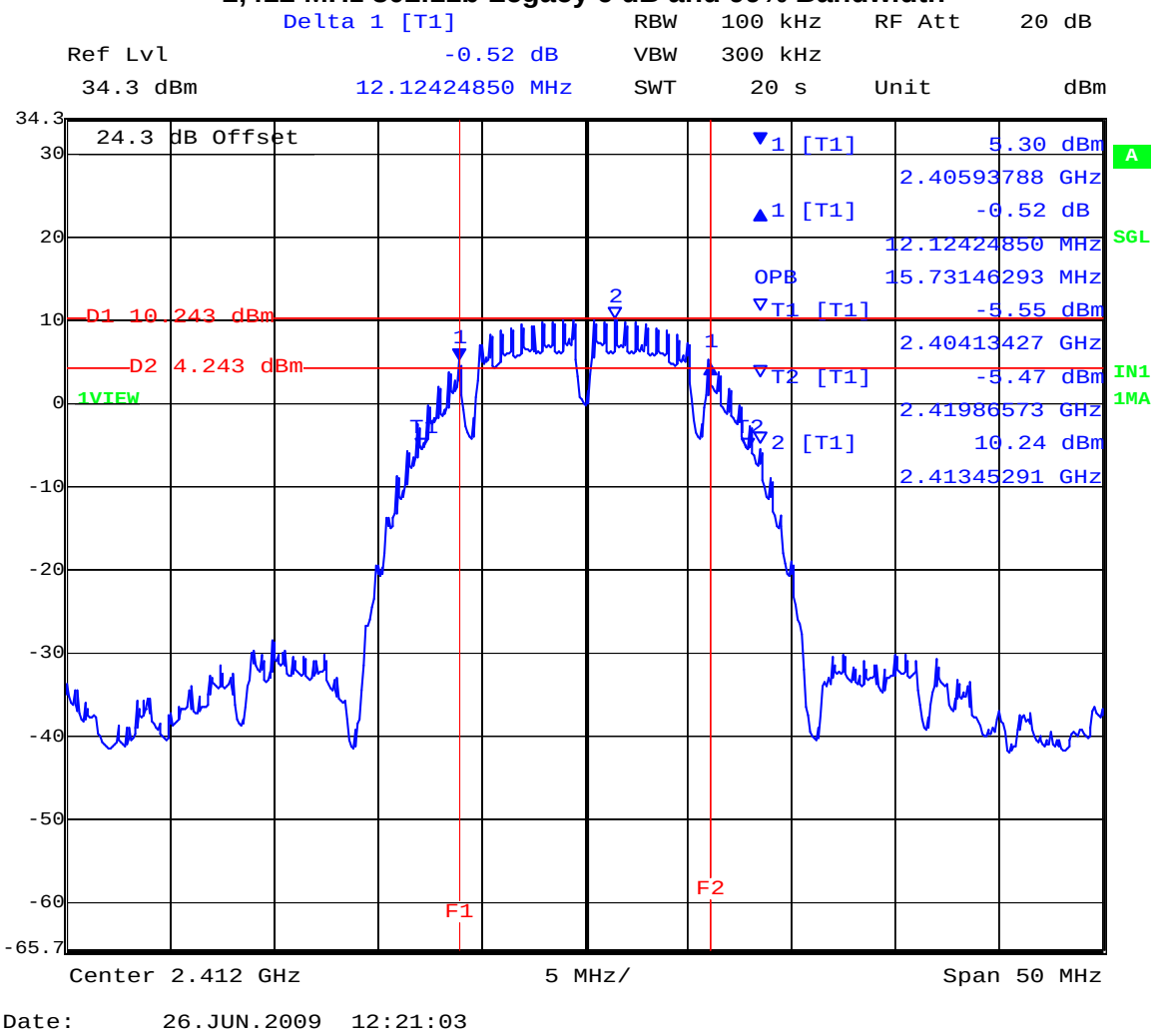
Measurement Results for 6 dB Operational Bandwidth(s) Ambient conditions.

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

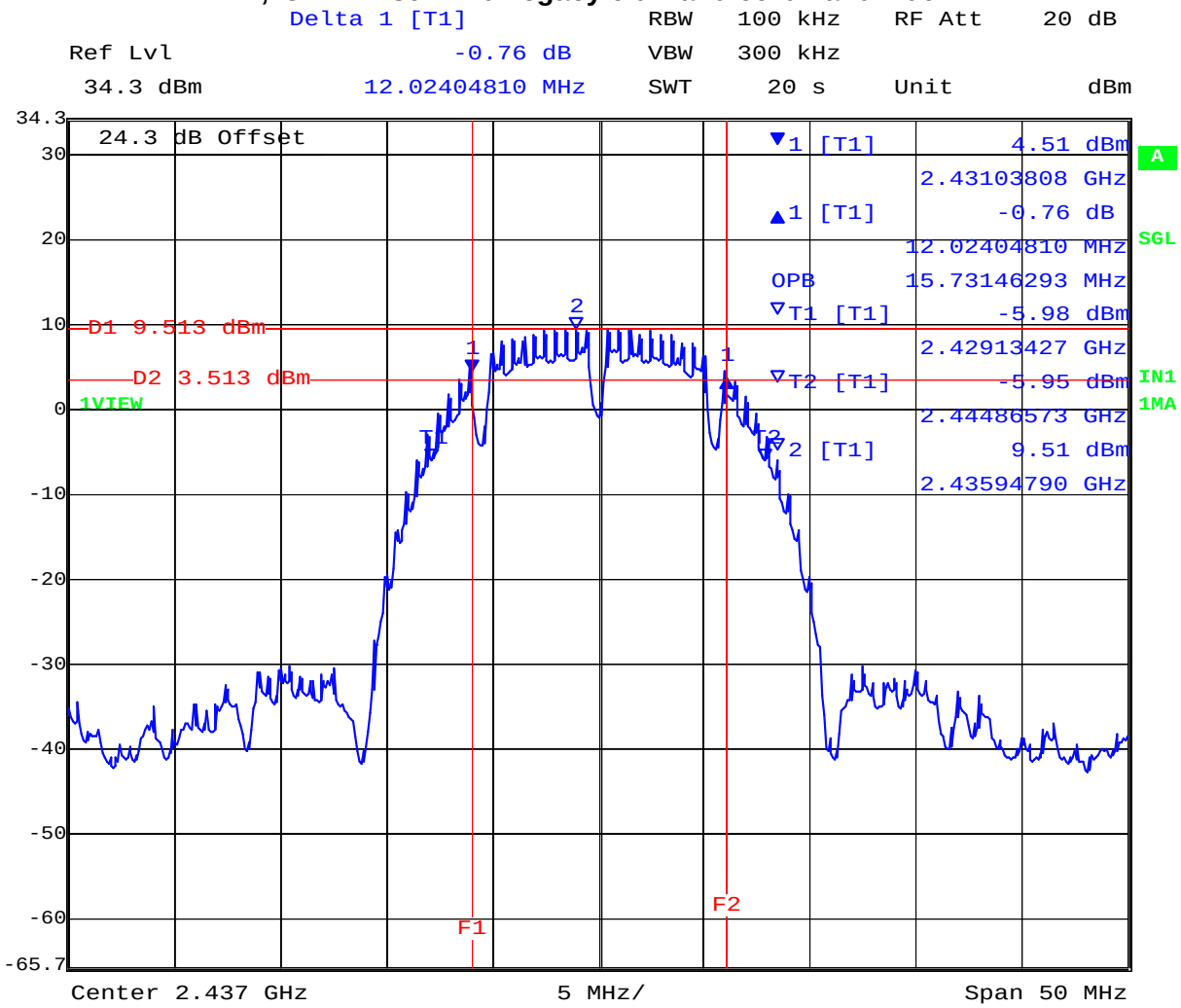
TABLE OF RESULTS – **802.11b Legacy**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,412	12.124	15.731
2,437	12.024	15.731
2,462	12.124	15.731

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

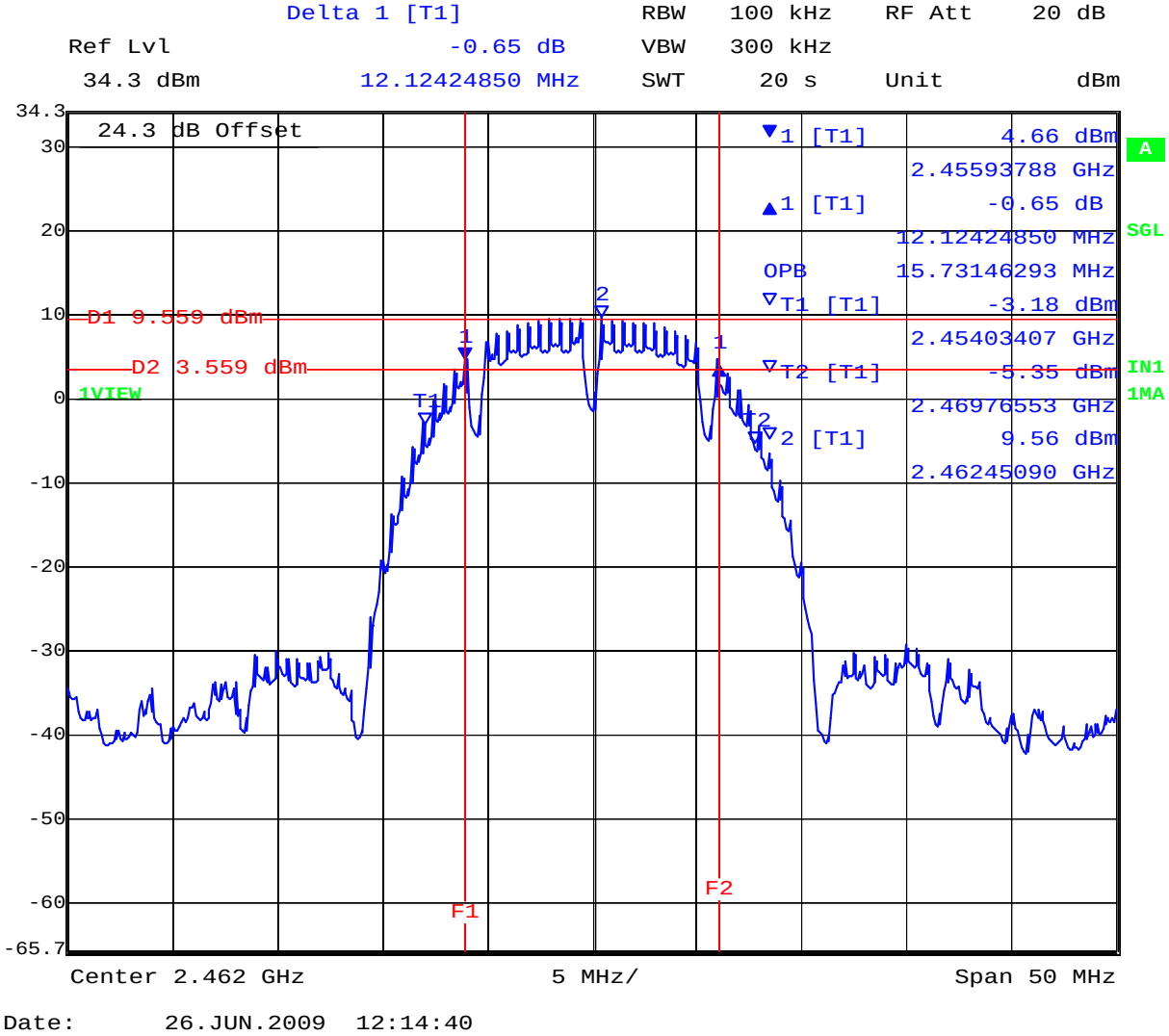


2,437 MHz 802.11b Legacy 6 dB and 99% Bandwidth



Date: 26.JUN.2009 12:17:34

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

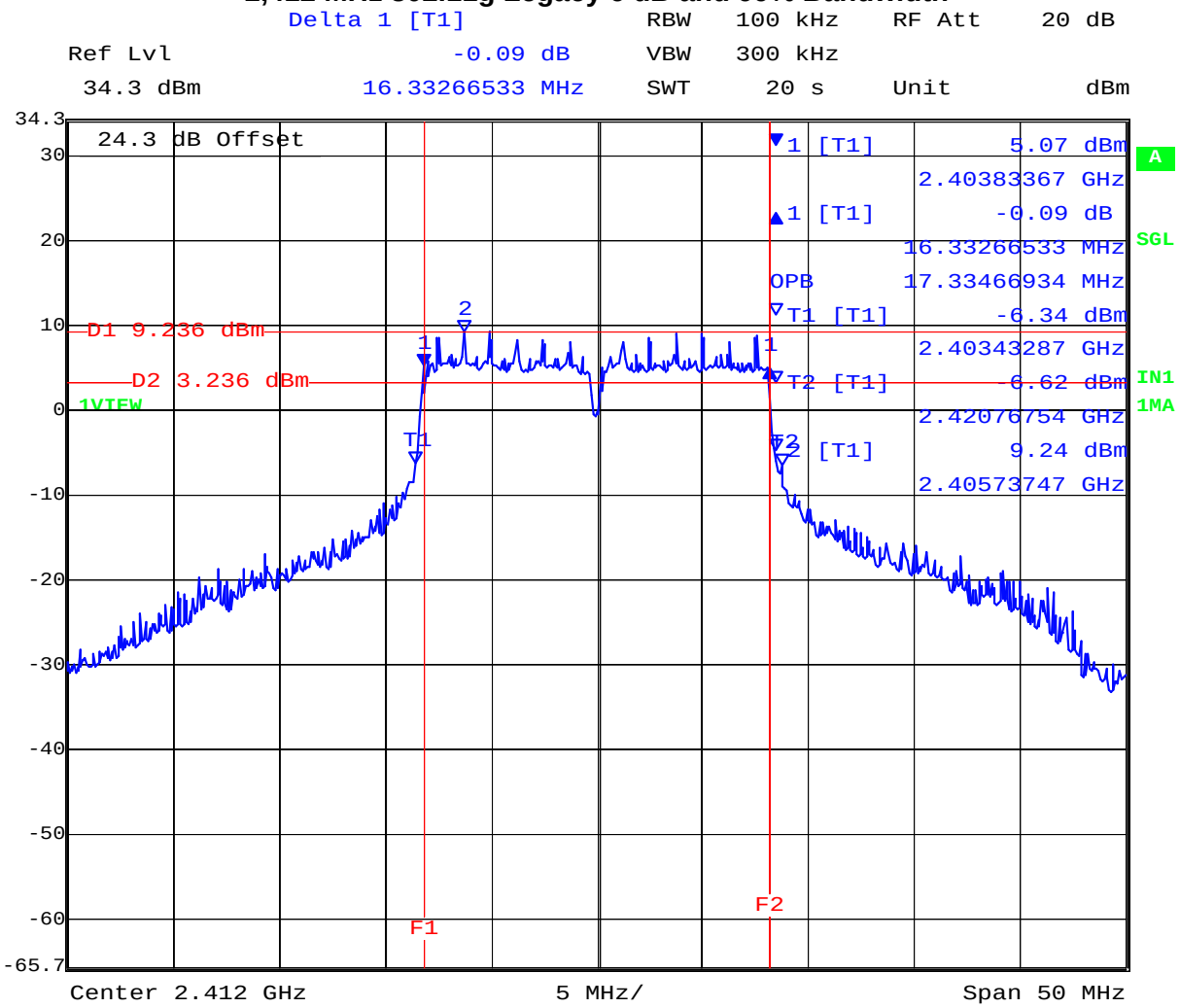


Date: 26.JUN.2009 12:14:40

TABLE OF RESULTS – **802.11g Legacy**

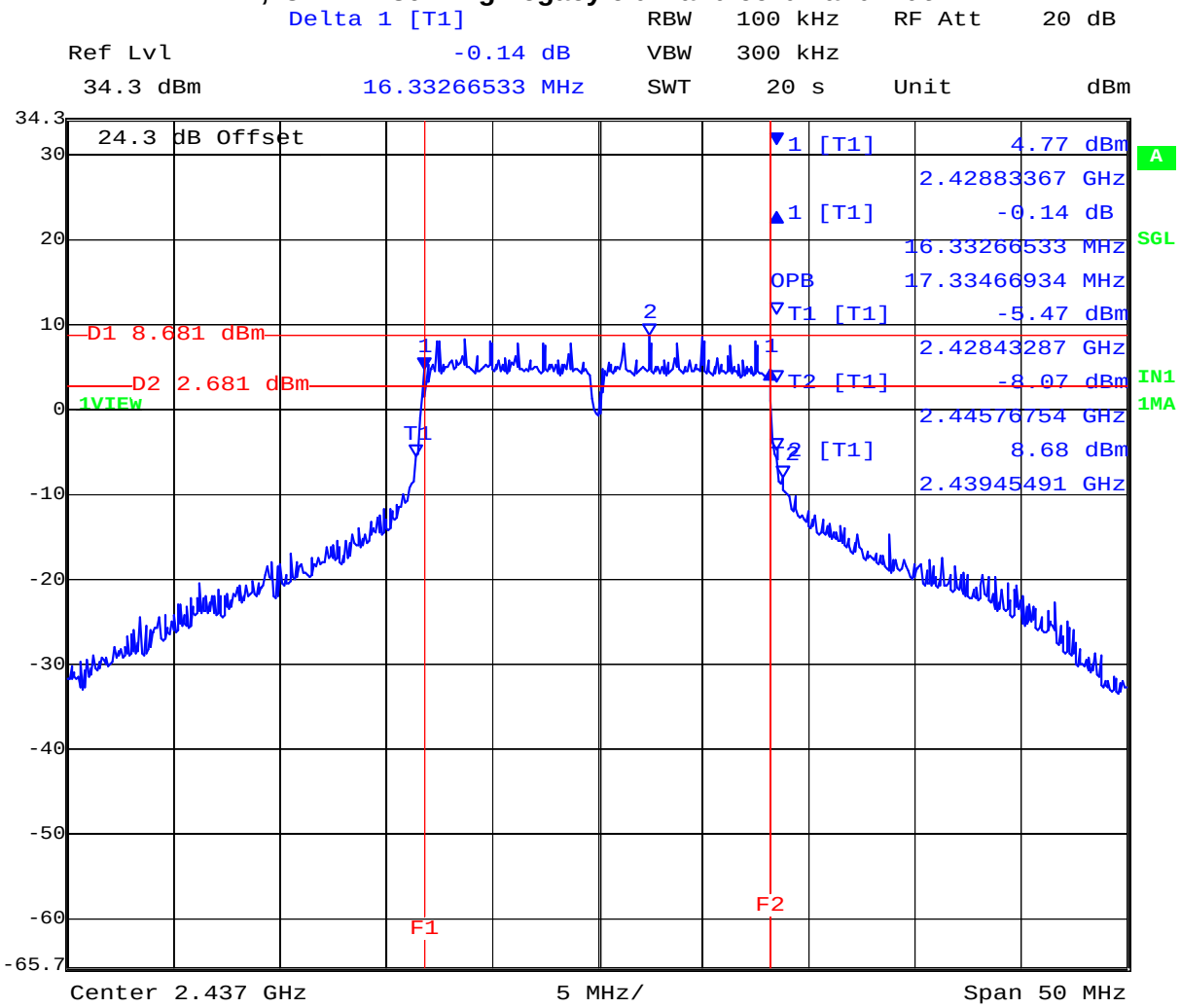
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,412	16.332	17.334
2,437	16.332	17.334
2,462	16.332	17.635

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



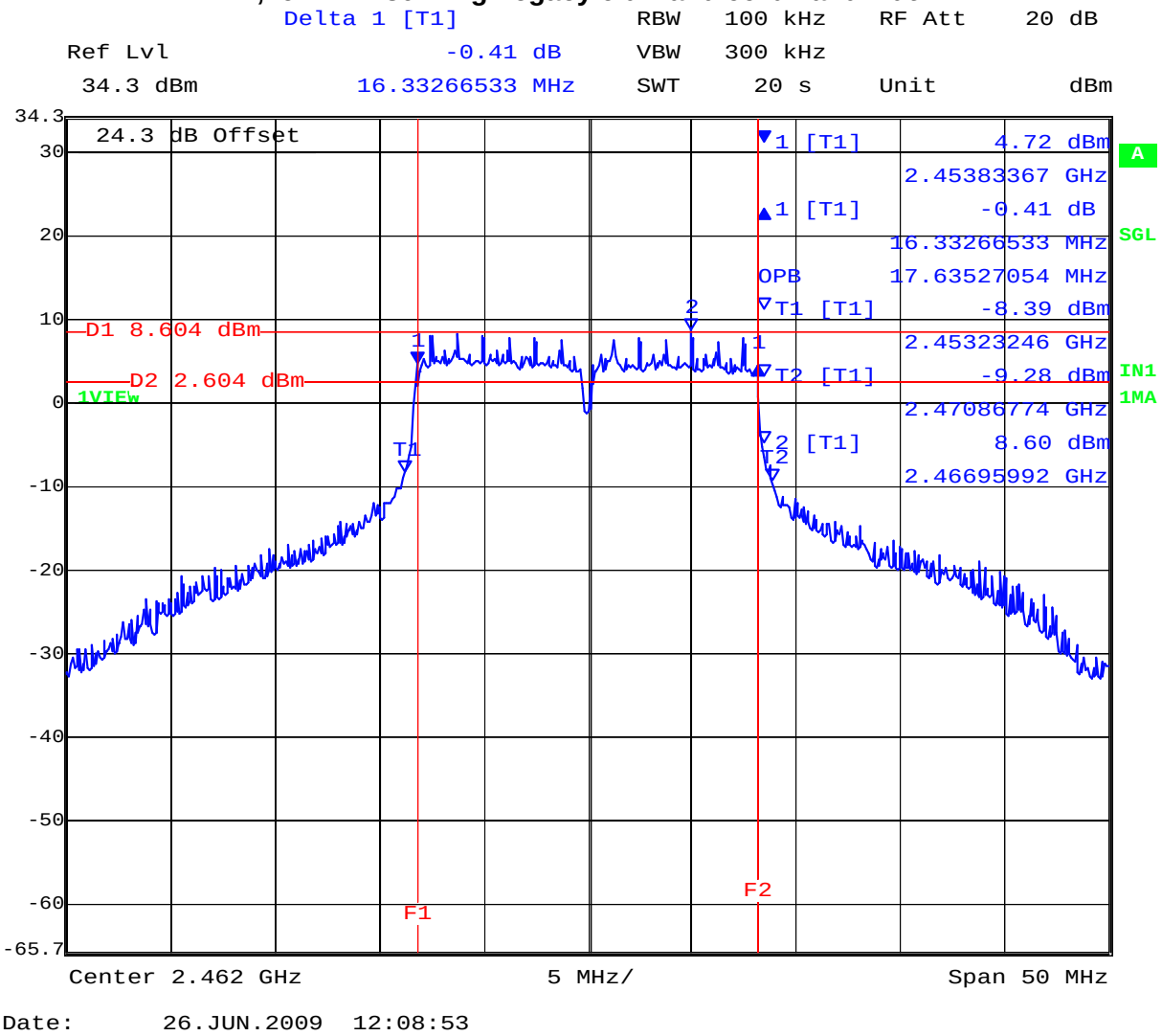
Date: 26.JUN.2009 12:03:09

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



Date: 26.JUN.2009 12:05:30

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

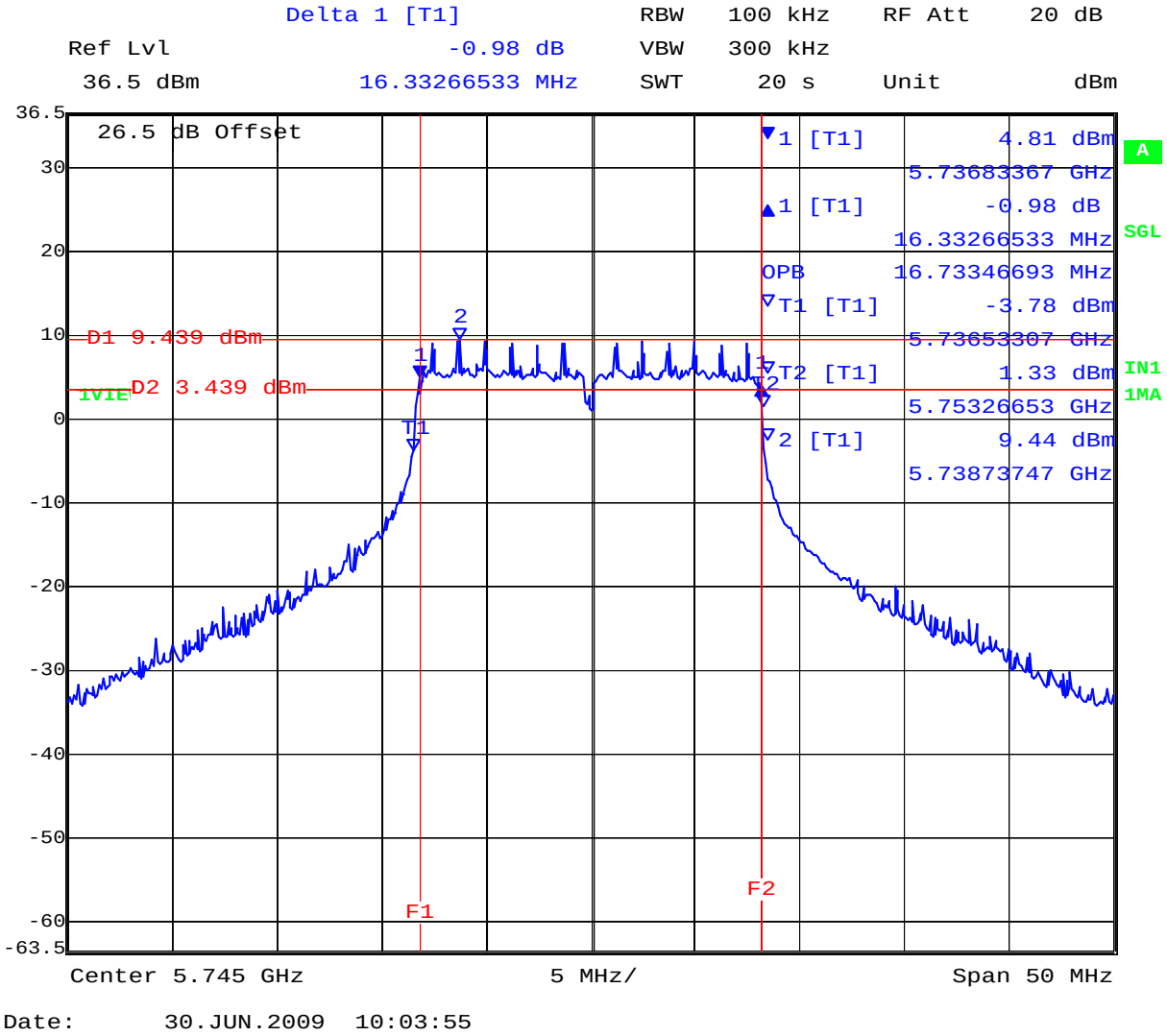


Date: 26.JUN.2009 12:08:53

TABLE OF RESULTS – **802.11a - Legacy**

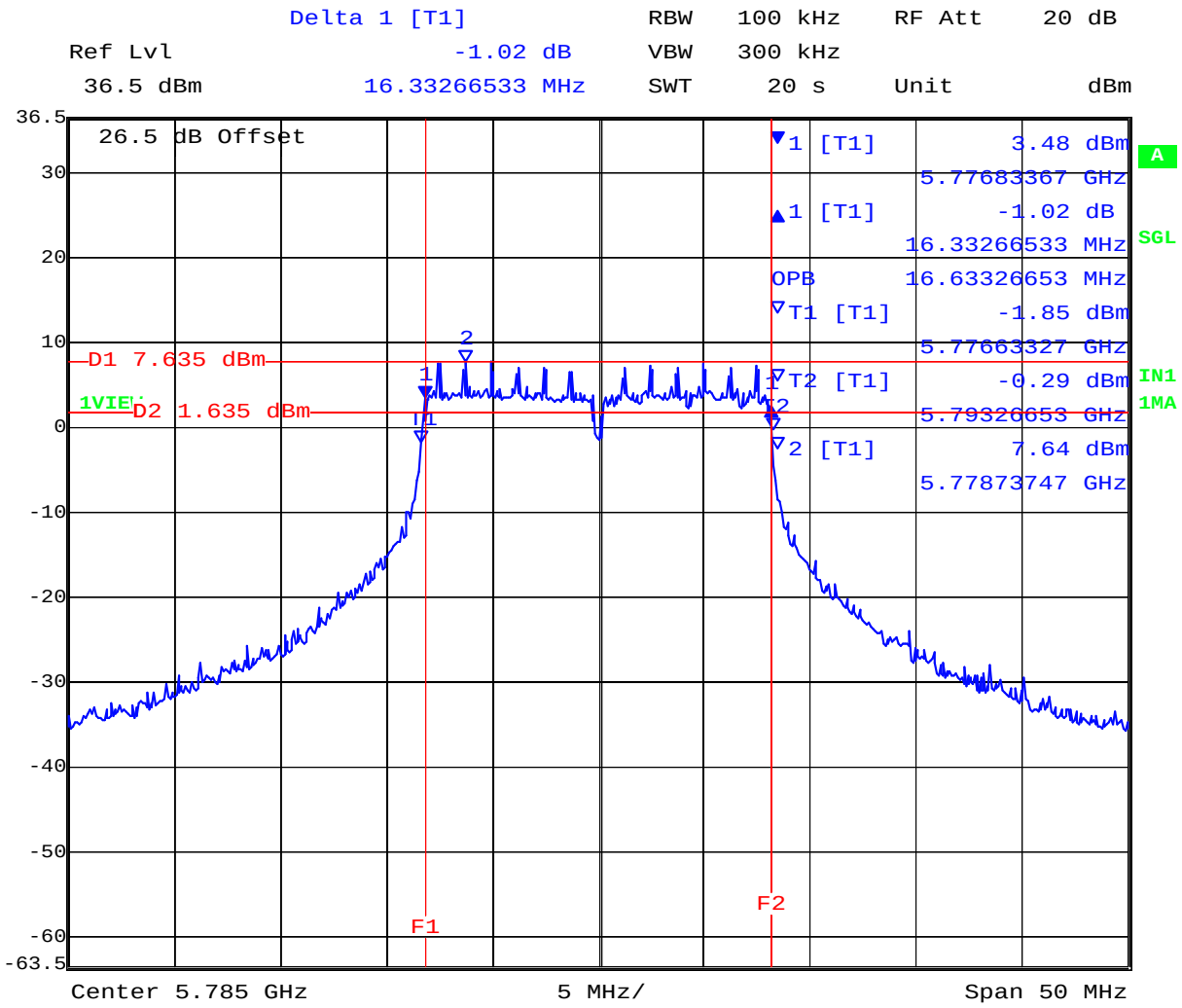
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
5,745	16.332	16.733
5,785	16.332	16.633
5,825	16.332	16.633

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



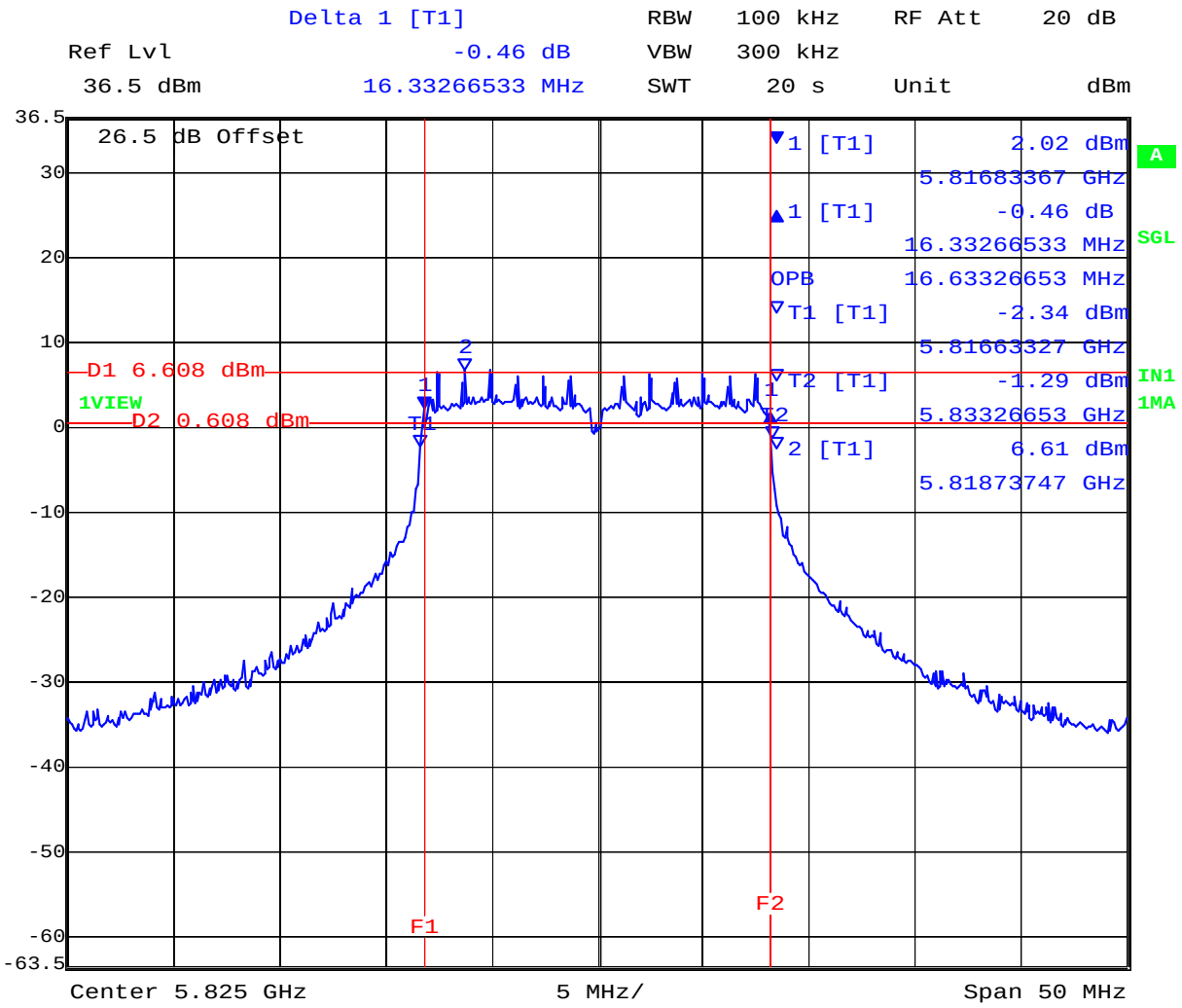
Date: 30.JUN.2009 10:03:55

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



Date: 30.JUN.2009 10:29:46

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

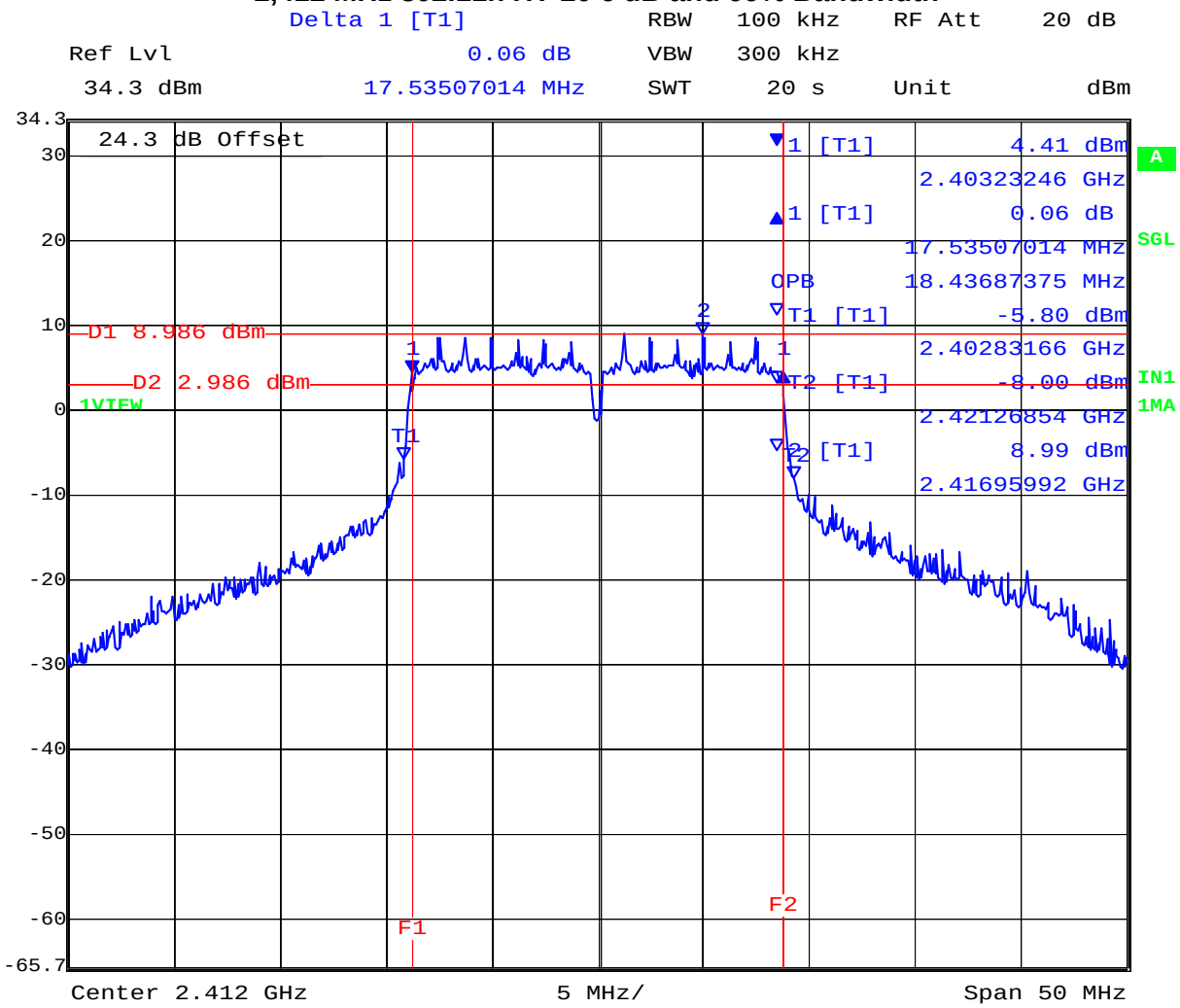


Date: 30.JUN.2009 10:57:43

TABLE OF RESULTS – **802.11n HT-20**

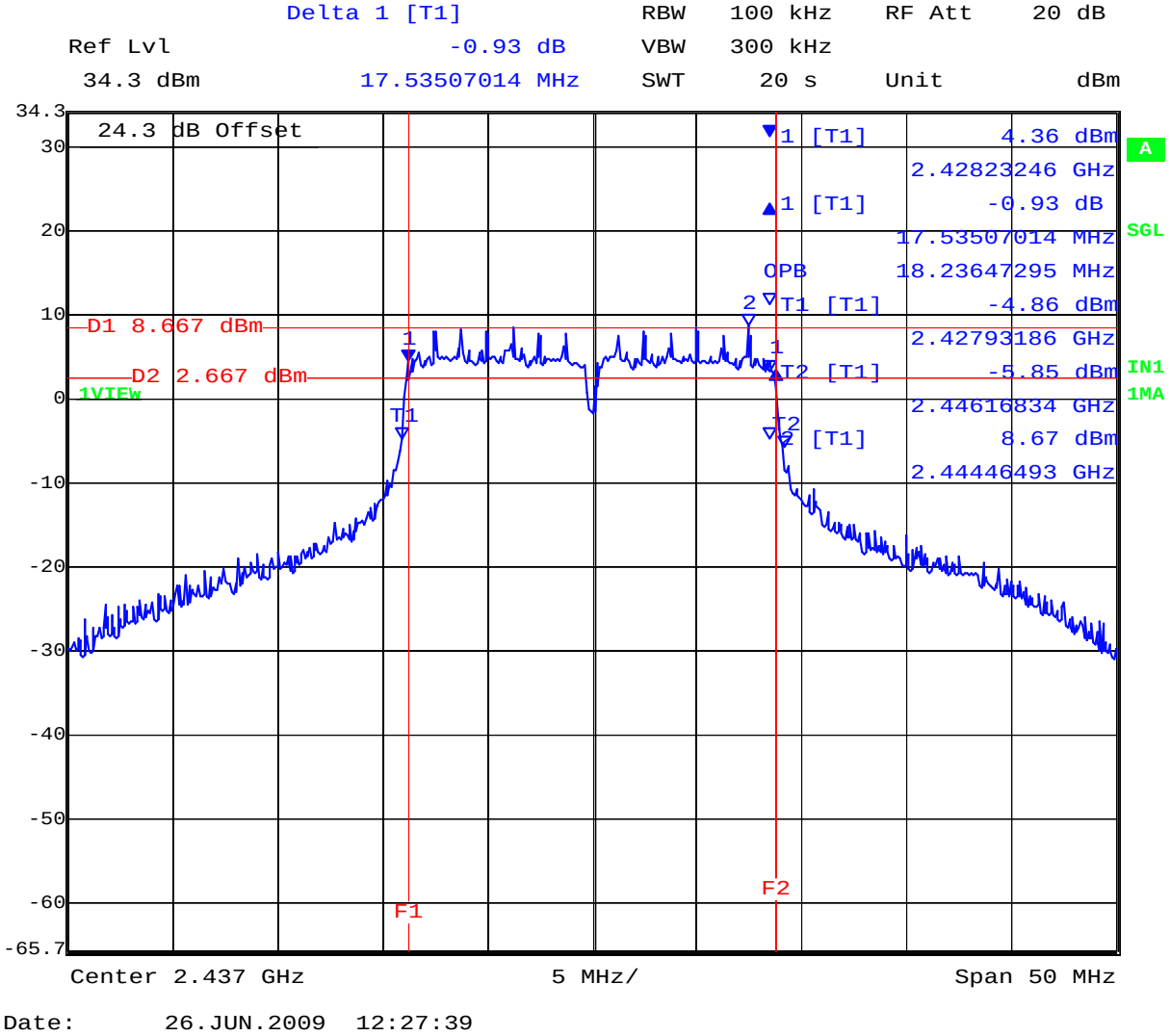
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,412	17.535	18.436
2,437	17.535	18.236
2,462	17.635	18.436

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



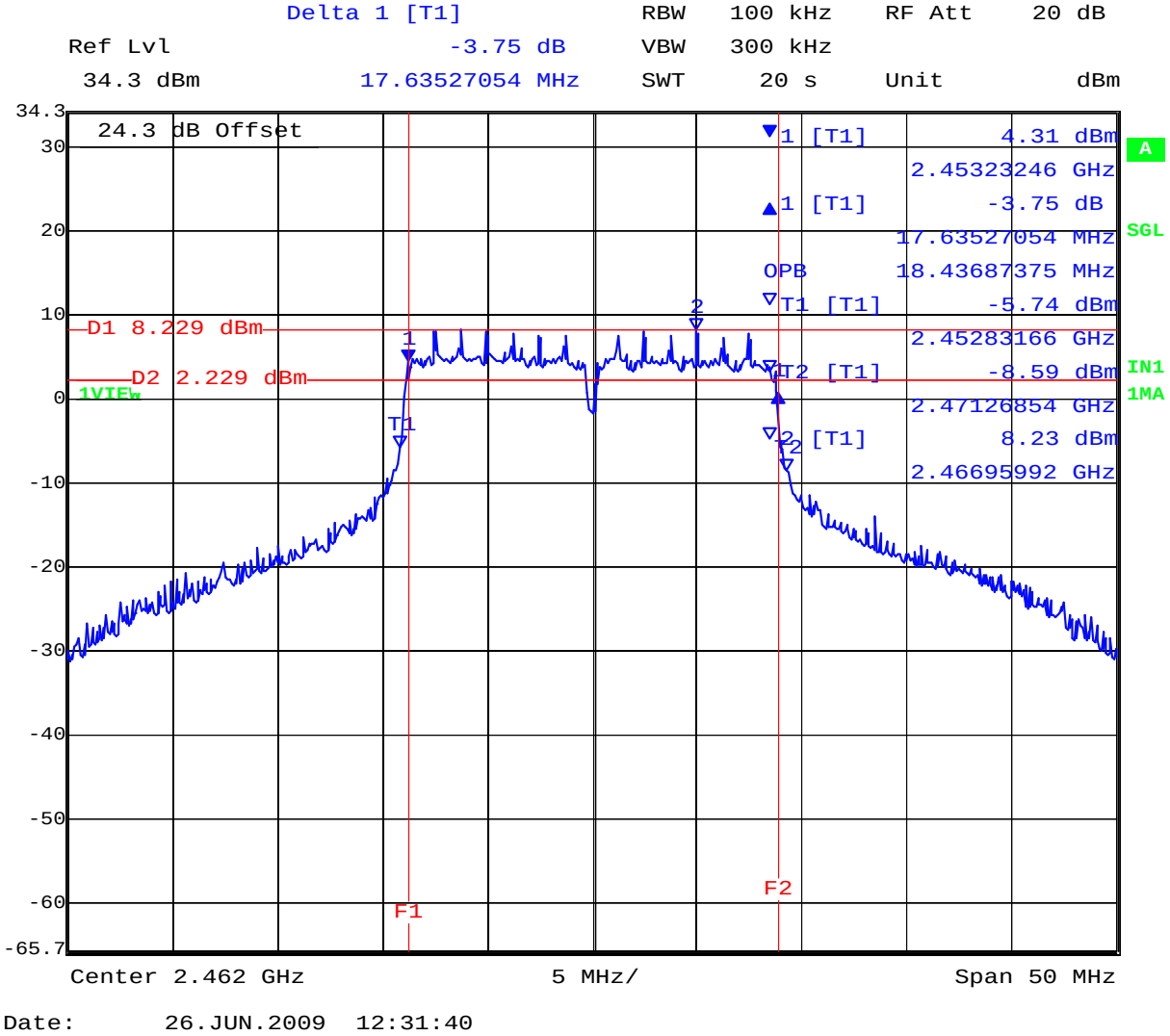
Date: 26.JUN.2009 12:24:26

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



Date: 26.JUN.2009 12:27:39

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

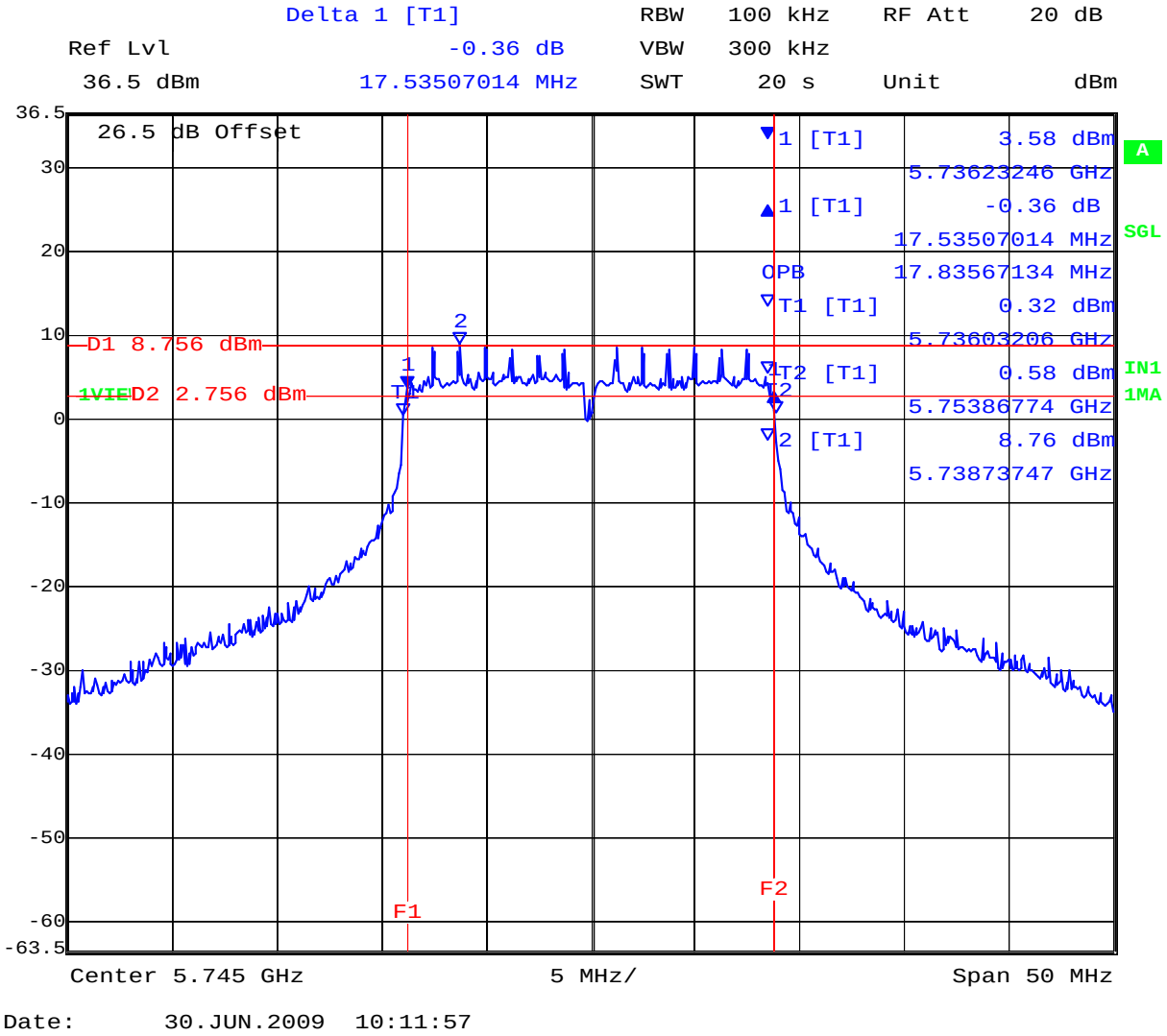


Date: 26.JUN.2009 12:31:40

TABLE OF RESULTS – **802.11n - HT-20**

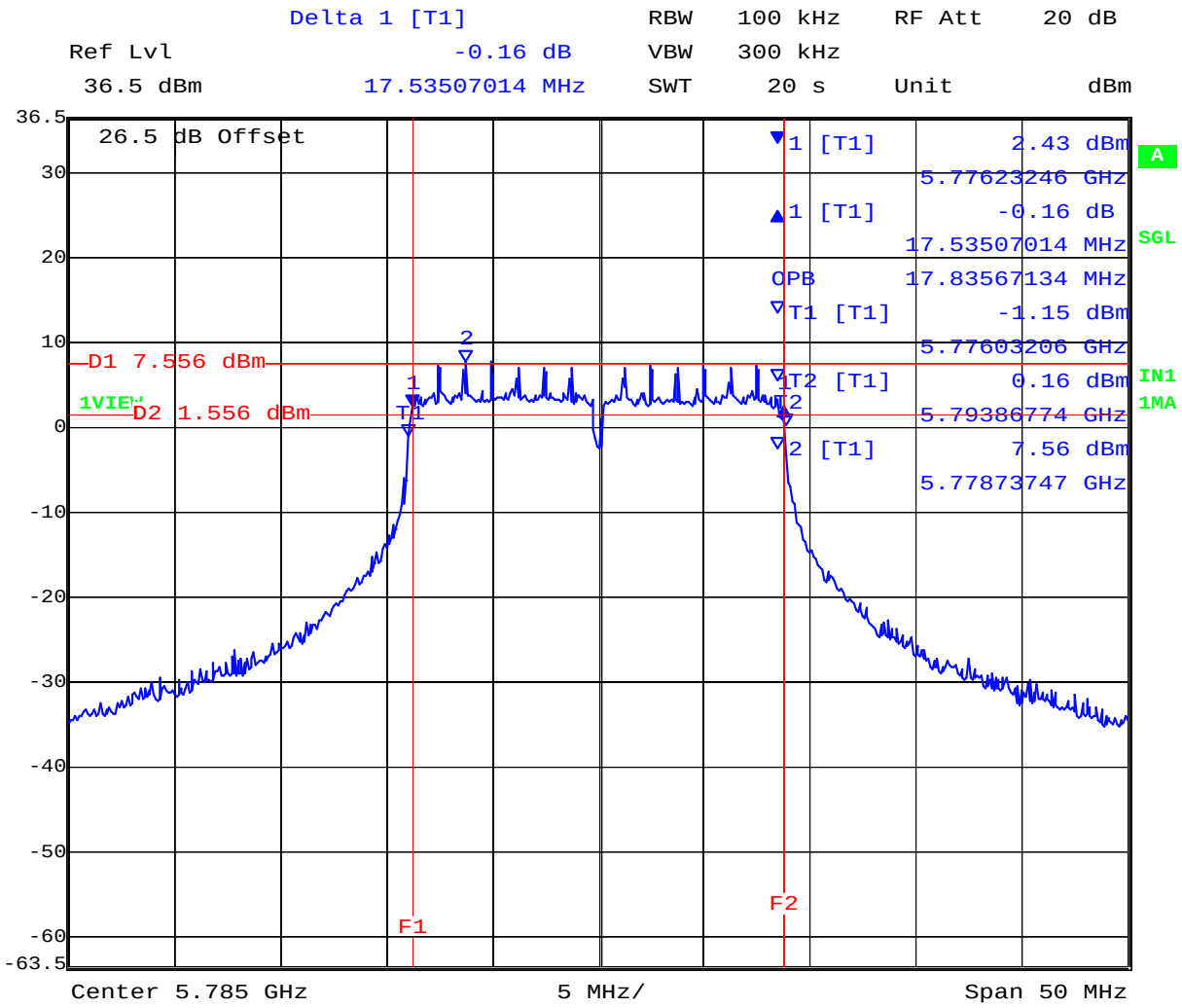
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
5,745	17.535	17.835
5,785	17.535	17.835
5,825	17.535	17.835

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



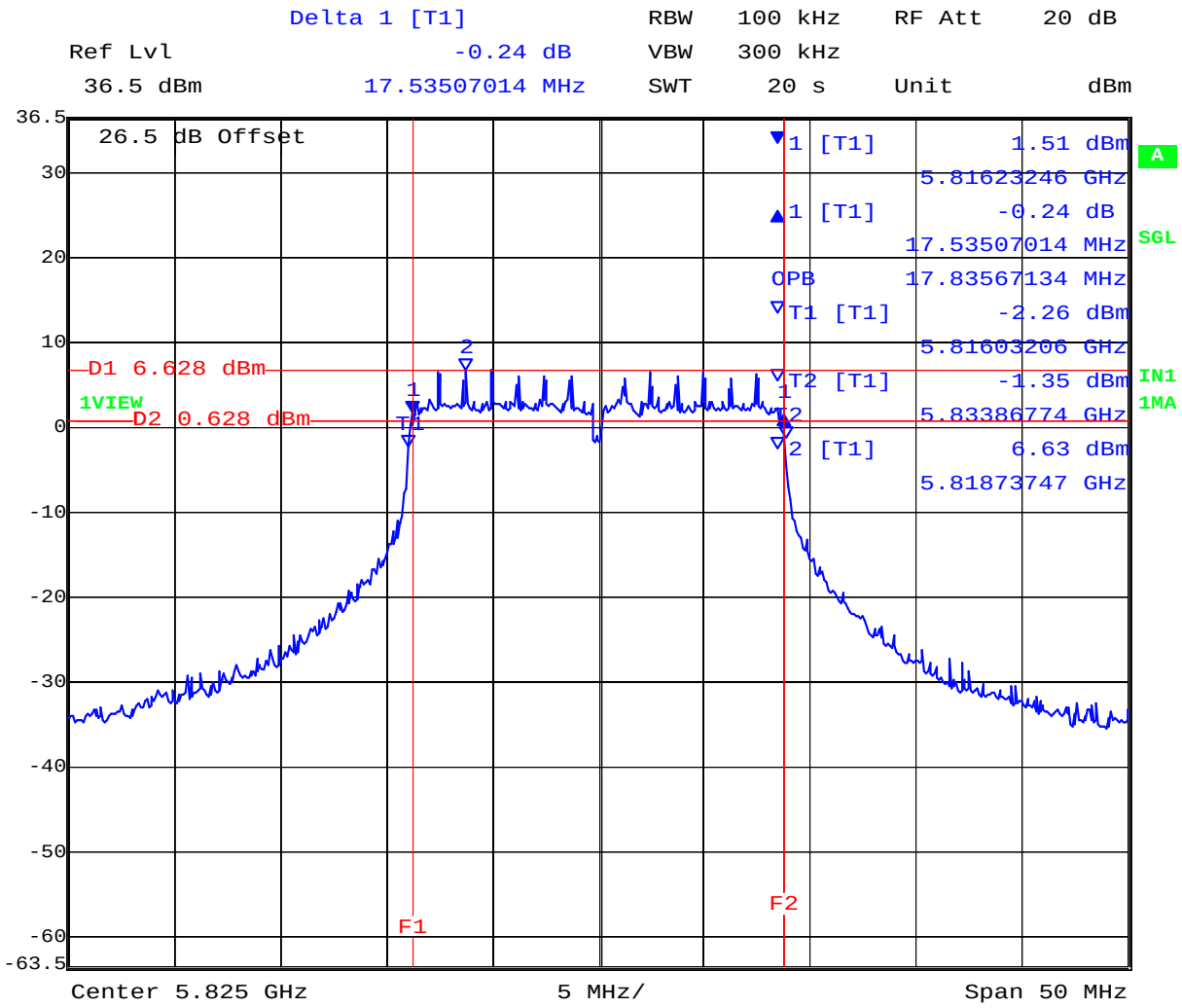
Date: 30.JUN.2009 10:11:57

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



Date: 30.JUN.2009 10:32:28

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

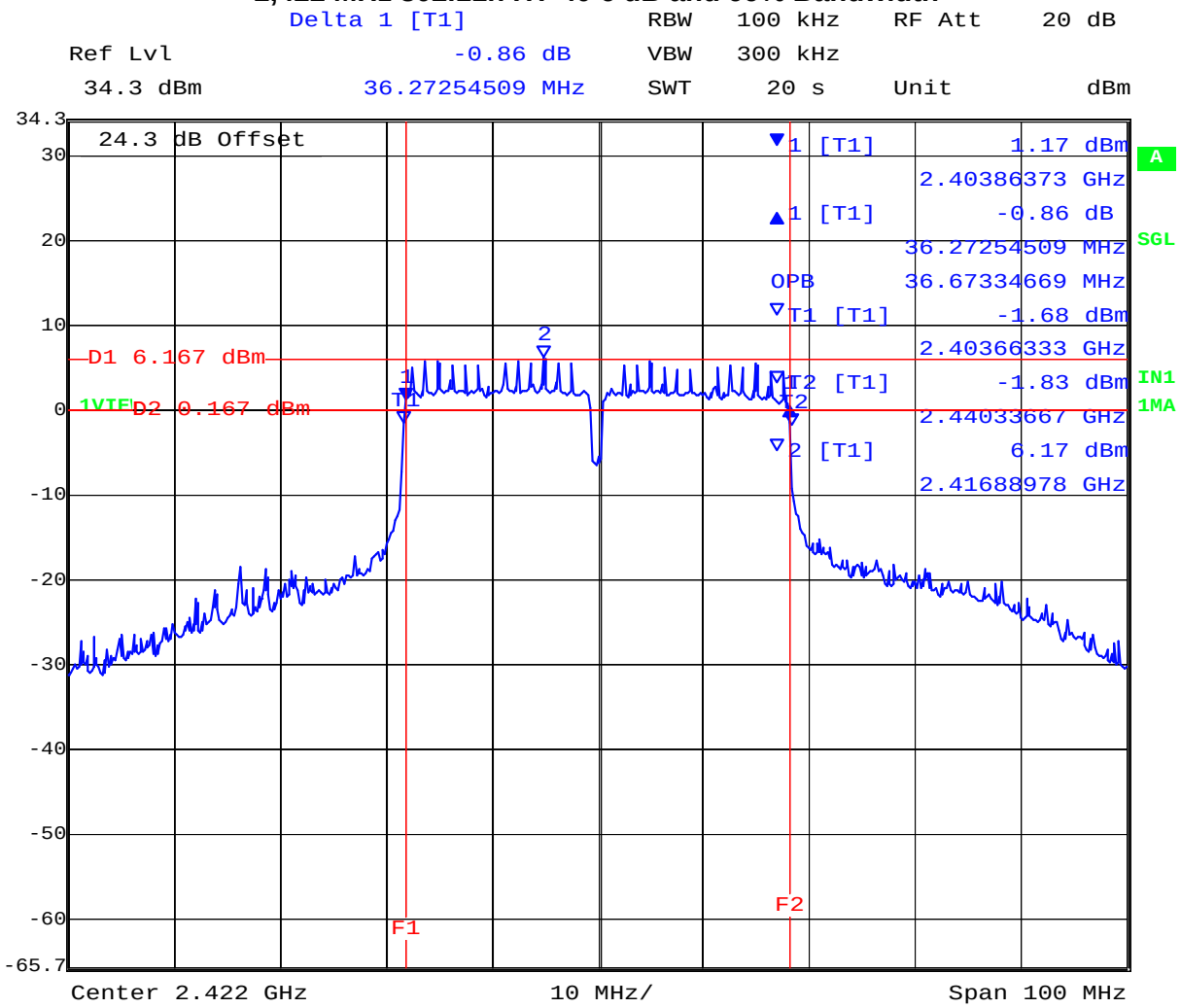


Date: 30.JUN.2009 10:59:15

TABLE OF RESULTS – **802.11N HT-40**

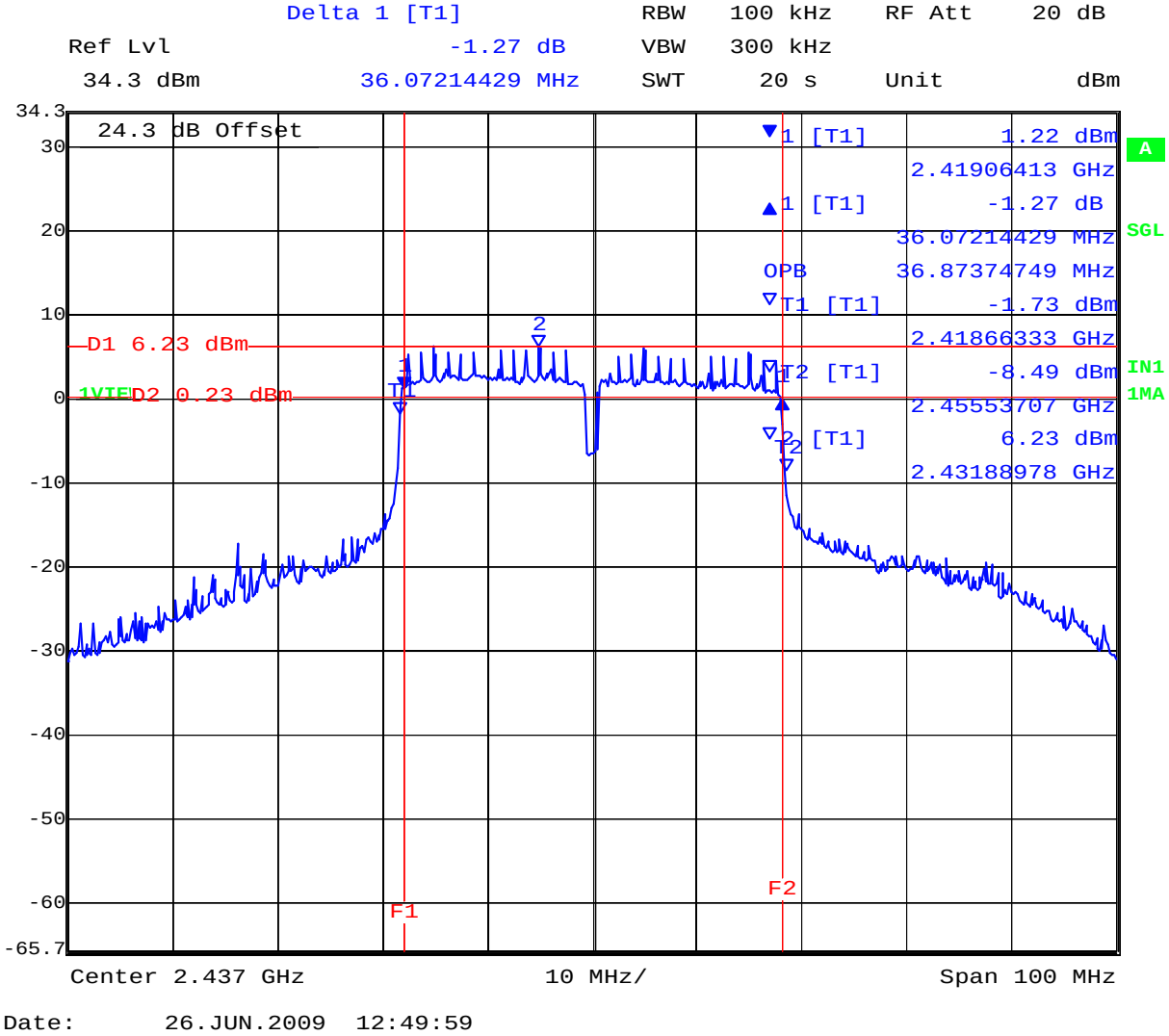
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
2,422	36.272	36.673
2,437	36.072	36.873
2,452	36.871	36.673

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

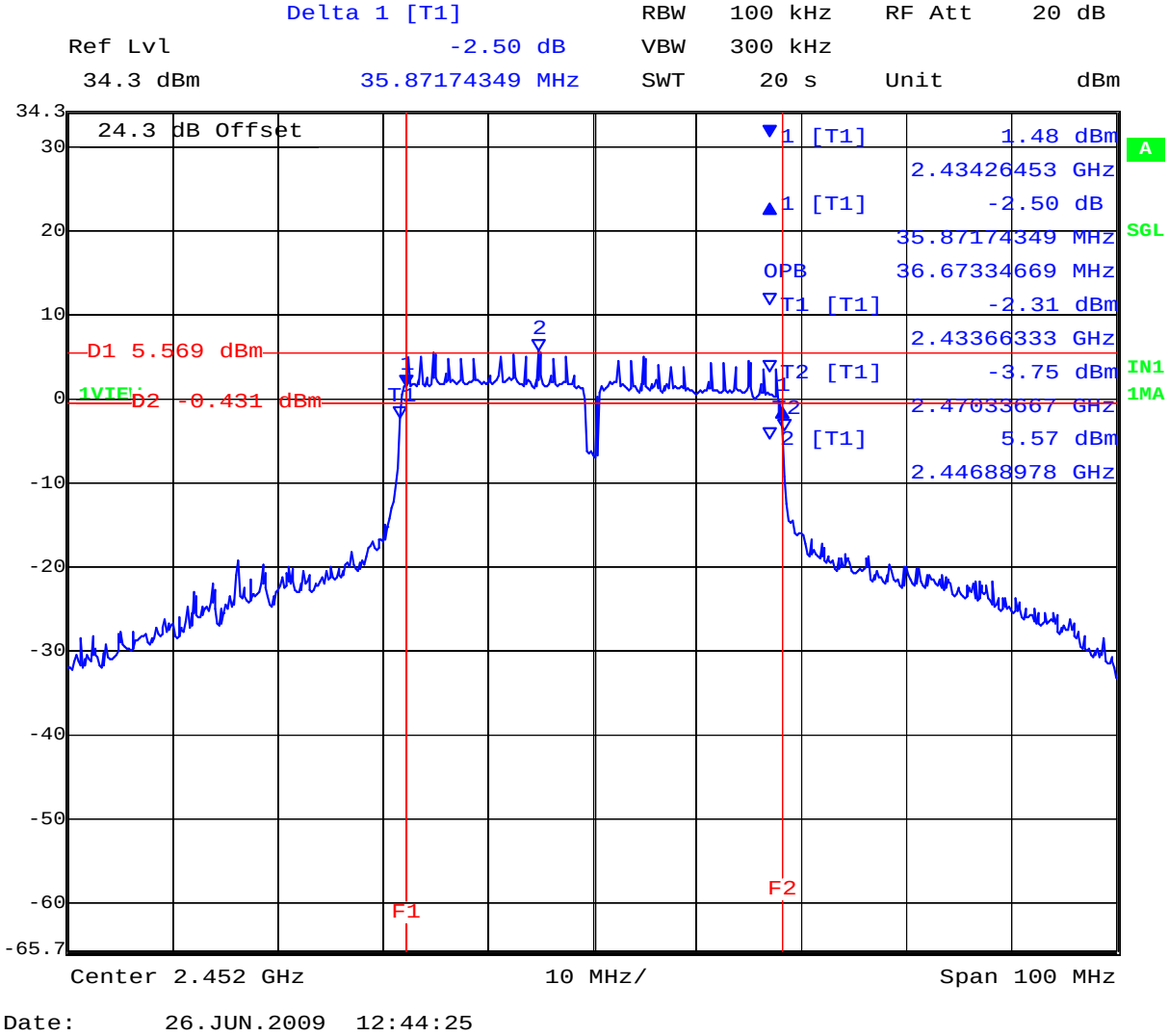


Date: 26.JUN.2009 12:53:15

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



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

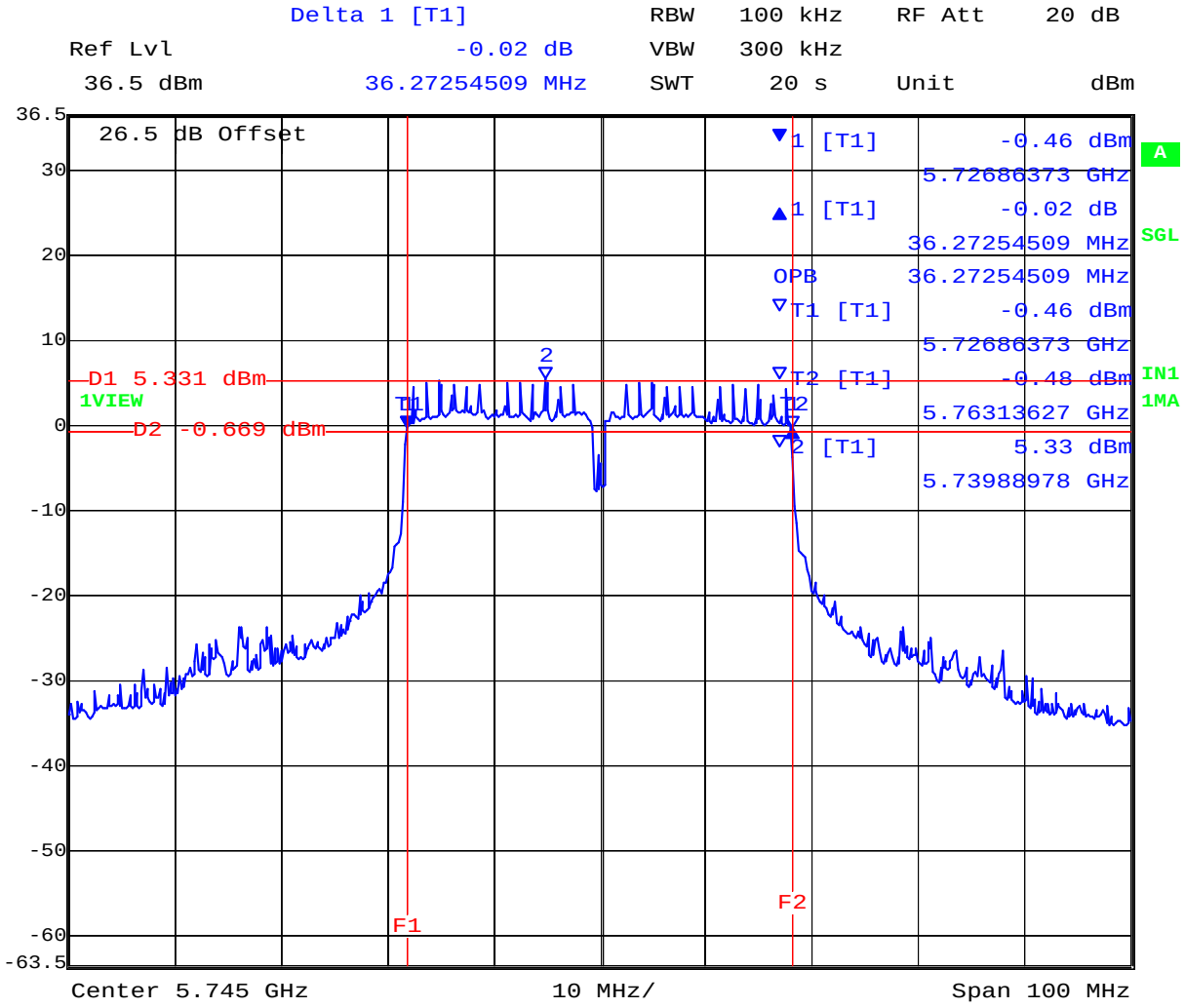


Date: 26.JUN.2009 12:44:25

TABLE OF RESULTS – **802.11n - HT-40**

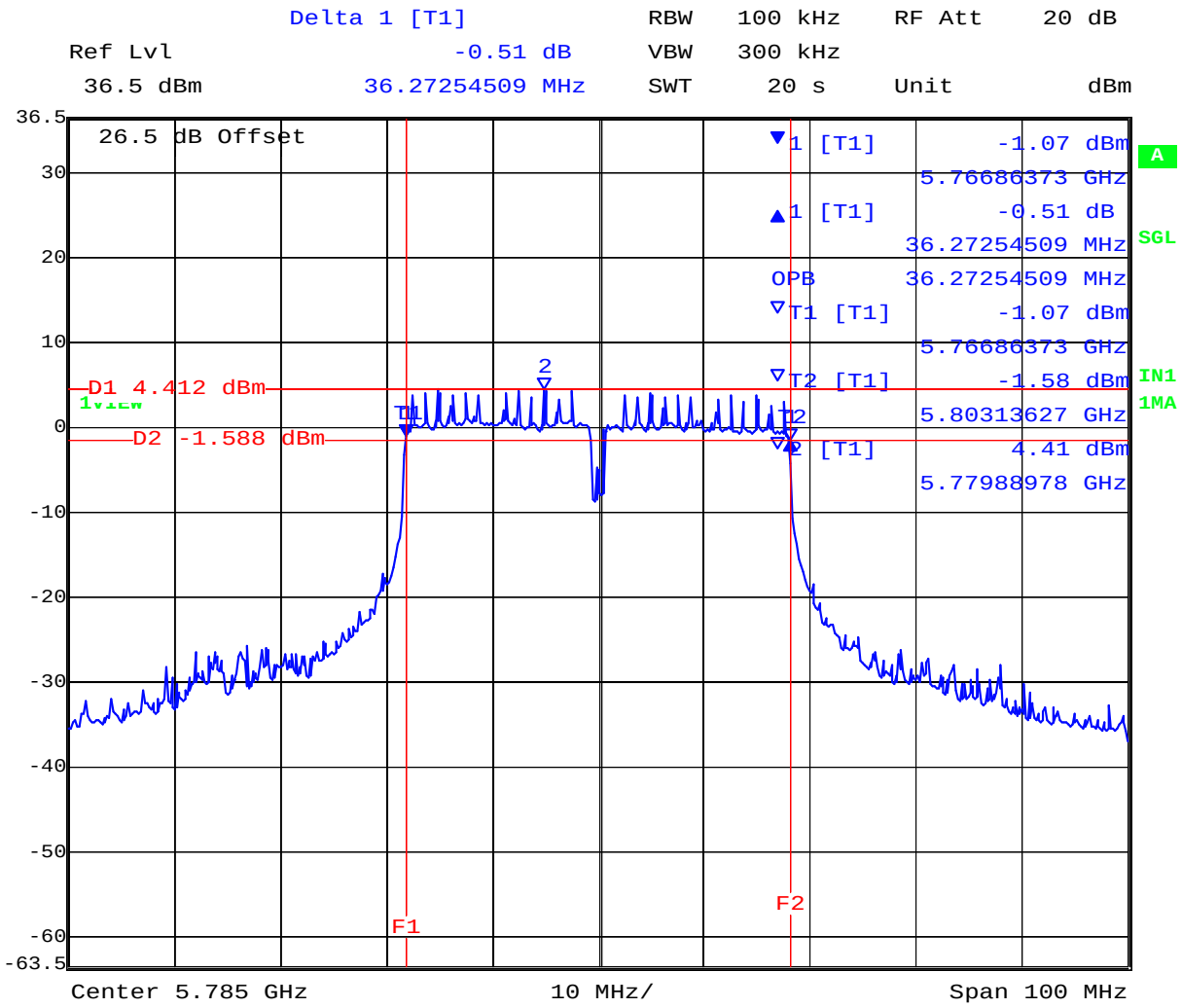
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% BW (MHz)
5,745	36.272	36.272
5,785	36.272	36.272
5,825	36.272	36.272

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



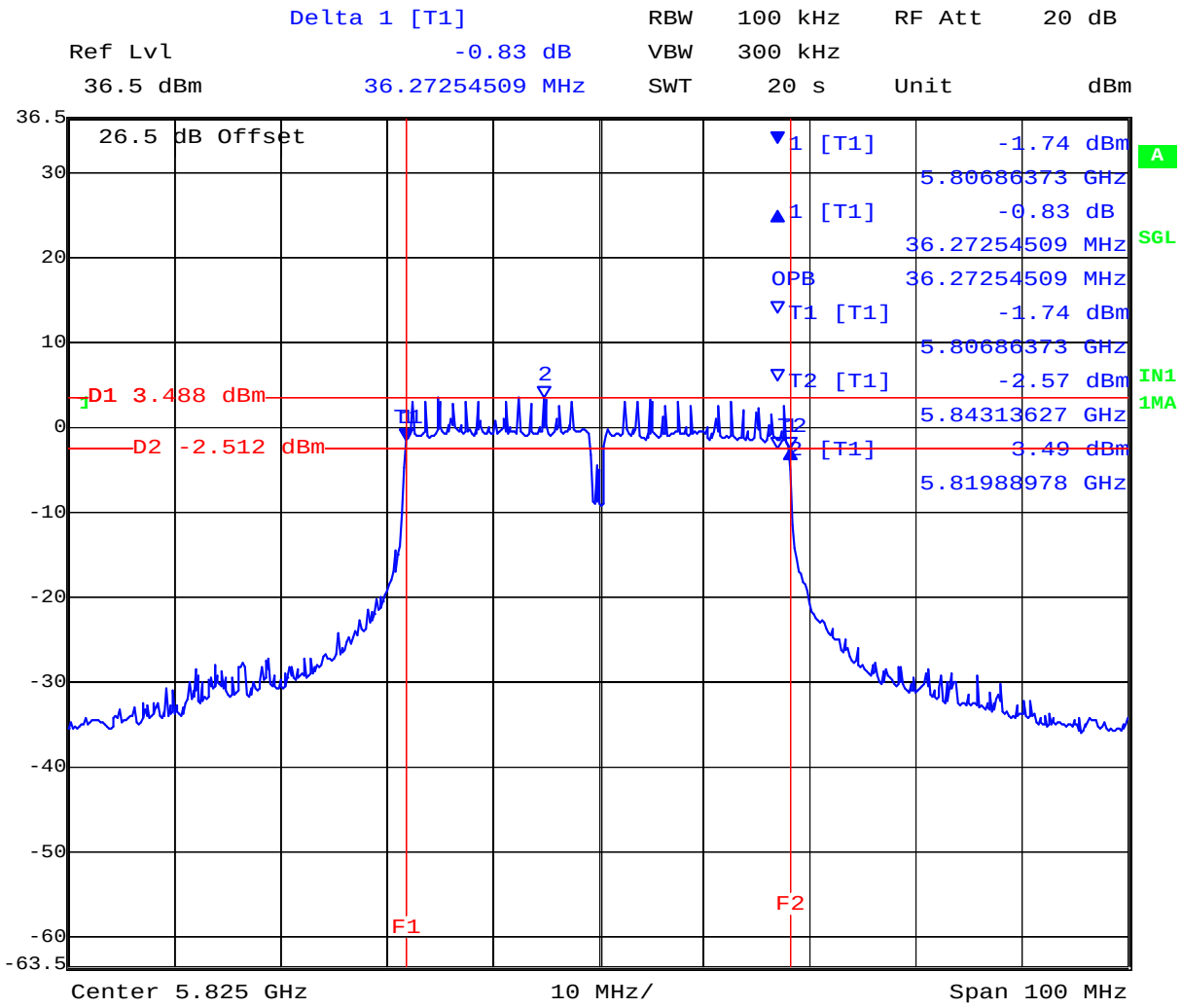
Date: 30.JUN.2009 10:42:46

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



Date: 30.JUN.2009 10:38:30

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



Date: 30.JUN.2009 10:49:03

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

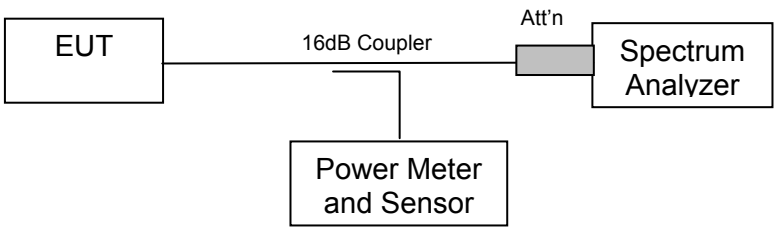
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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

2.4 GHz Maximum Antenna Gain = Integral +2.5 dBi
5.8 GHz Maximum Antenna Gain = Integral +4.0 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)
Integral	+2.5	No	0	+30	+36
Integral	+4.0	No	0	+30	+36

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

TABLE OF RESULTS – **802.11b – Legacy**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	Average Power (dBm)	EIRP (dBm) (2.5 dBi Antenna Gain)
2,412	20	+19.81	+22.31
2,437	20	+19.30	+21.80
2,462	20	+19.32	+21.82

TABLE OF RESULTS – **802.11g – Legacy**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	Average Power (dBm)	EIRP (dBm) (2.5 dBi Antenna Gain)
2,412	20	+19.81	+22.31
2,437	20	+19.25	+21.75
2,462	20	+19.22	+21.72

TABLE OF RESULTS – **802.11a – Legacy**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	Average Power (dBm)	EIRP (dBm) (4.0 dBi Antenna Gain)
5,745	20	+18.51	+22.51
5,785	20	+17.81	+21.81
5,825	20	+17.03	+21.03

TABLE OF RESULTS – **802.11n – HT-20**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	Average Power (dBm)	EIRP (dBm) (2.5 dBi Antenna Gain)
2,412	20	+19.76	+22.26
2,437	20	+19.13	+21.63
2,462	20	+19.33	+21.83

TABLE OF RESULTS – **802.11n – HT-20**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	Average Power (dBm)	EIRP (dBm) (4.0 dBi Antenna Gain)
5,745	20	+18.49	+22.49
5,785	20	+17.81	+21.81
5,825	20	+17.01	+21.01

TABLE OF RESULTS – **802.11n – HT-40**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	Average Power (dBm)	EIRP (dBm) (2.5 dBi Antenna Gain)
2,422	20	+19.55	+22.05
2,437	20	+19.25	+21.75
2,452	20	+19.22	+21.72

TABLE OF RESULTS – **802.11n – HT-40**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	Average Power (dBm)	EIRP (dBm) (4.0 dBi Antenna Gain)
5,745	20	+18.22	+22.22
5,785	20	+17.58	+21.58
5,825	20	+16.74	+20.74

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.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

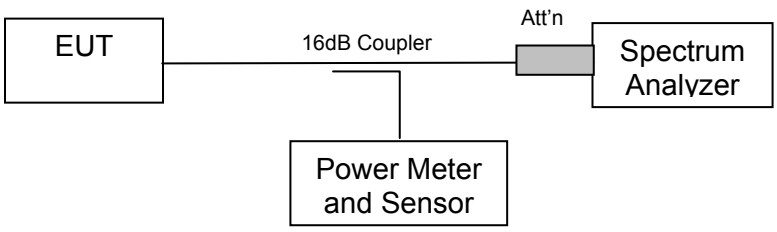
Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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 ≥ 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

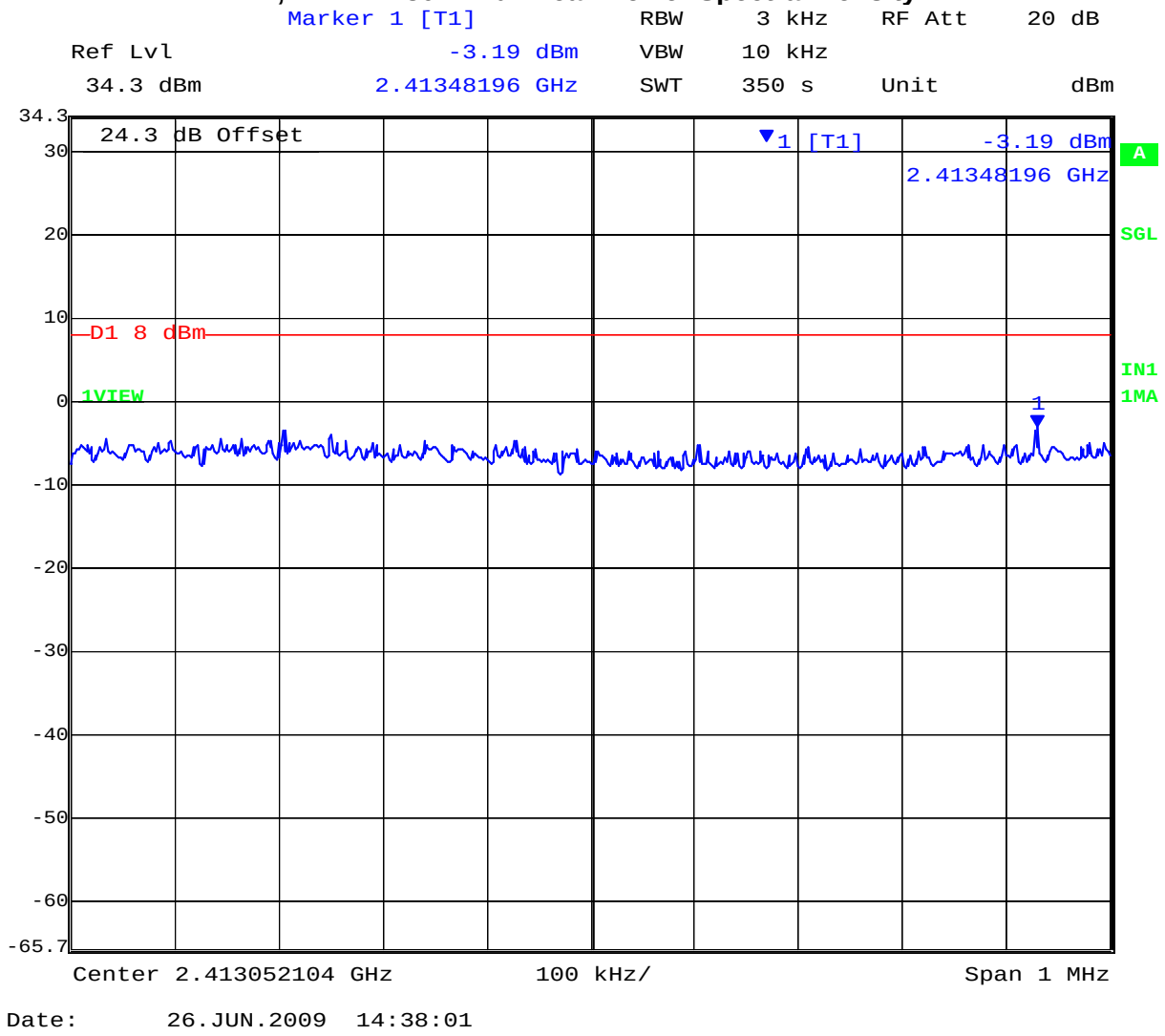
Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

Peak Power Spectral Density

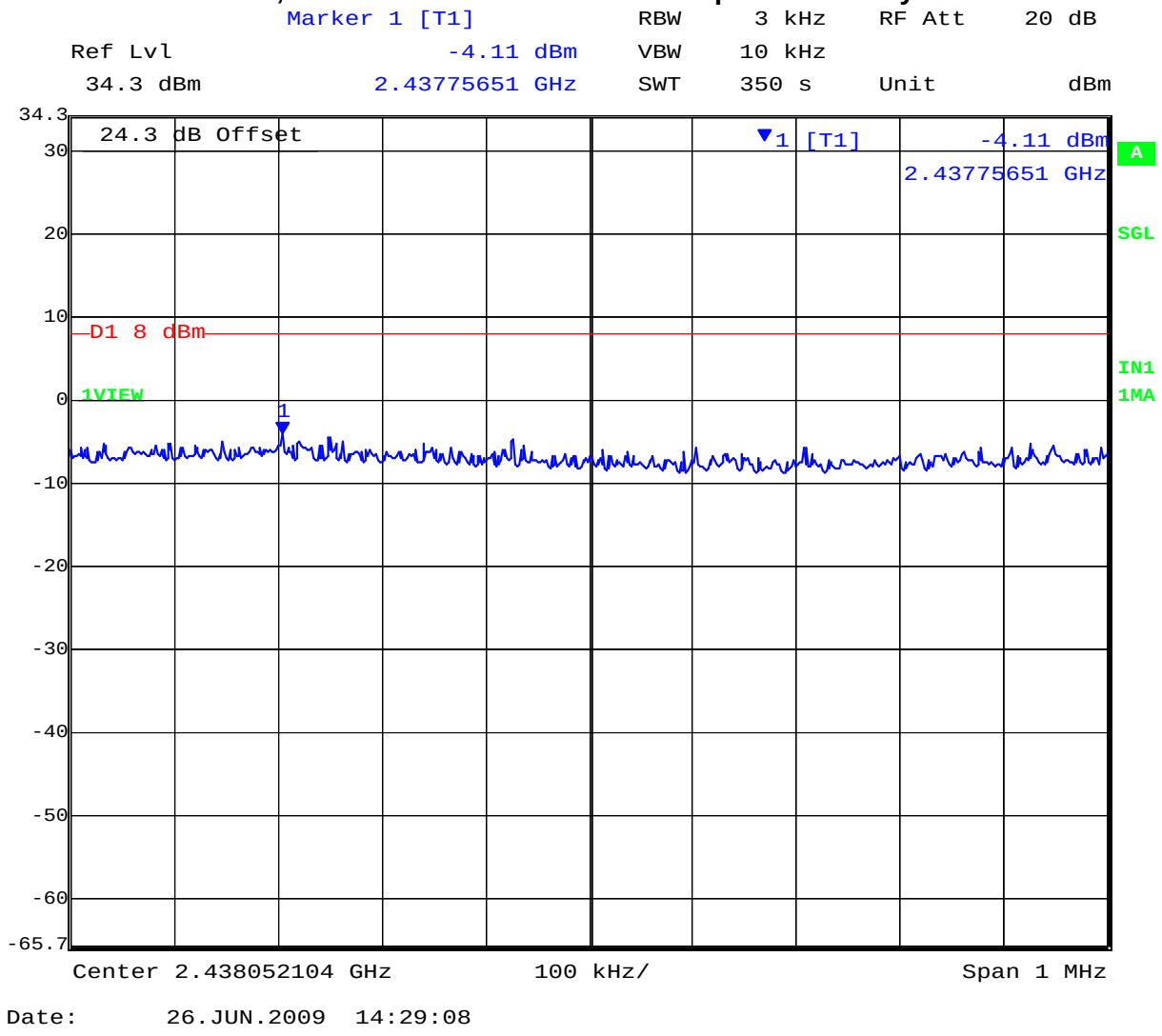
TABLE OF RESULTS – **802.11b**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2413.48196	-3.19	+8	-11.19
2,437	2437.75651	-4.11	+8	-12.11
2,462	2463.47996	-3.94	+8	-11.94

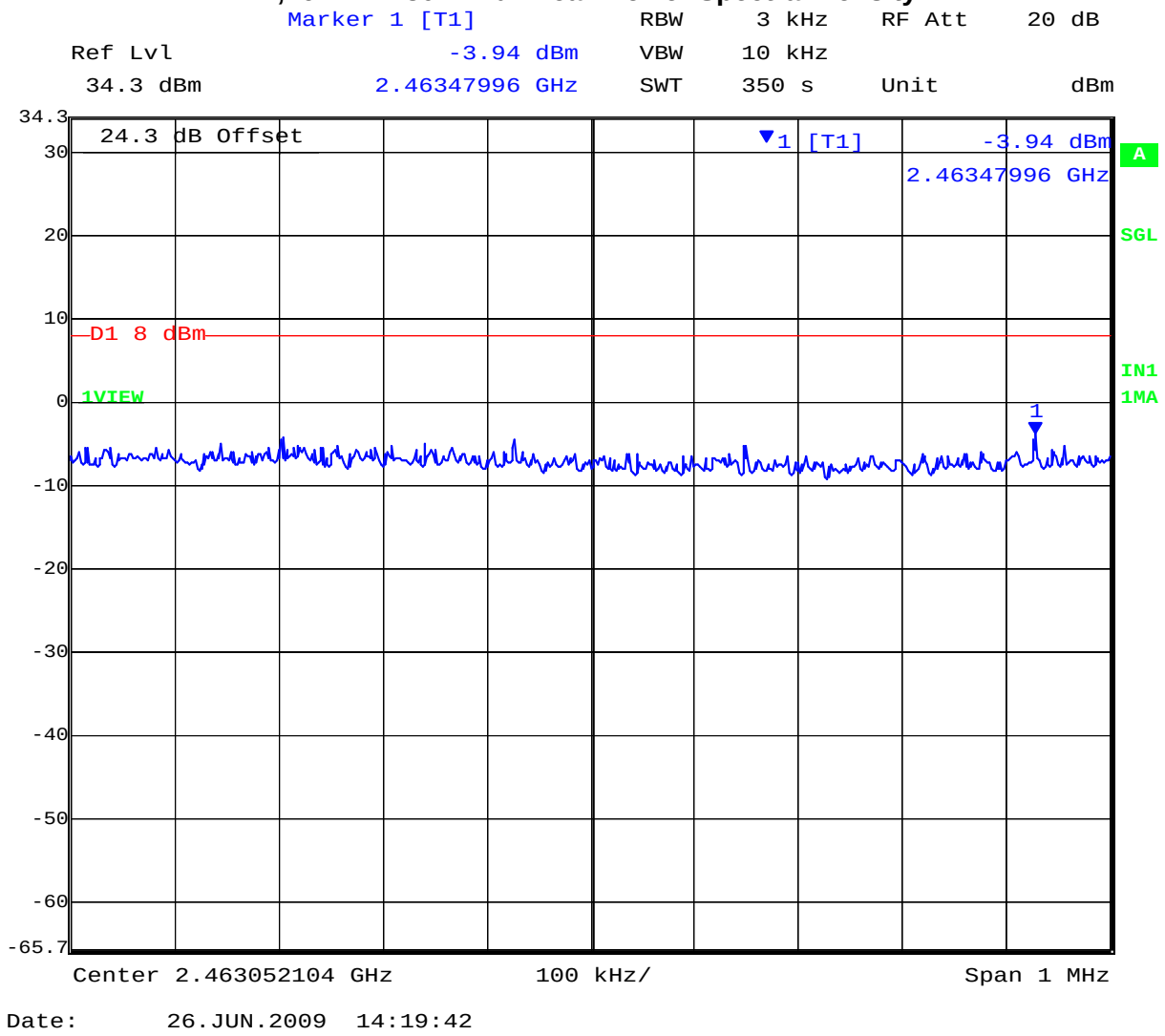
2,412 MHz 802.11b - Peak Power Spectral Density



2,437 MHz 802.11b - Peak Power Spectral Density



2,462 MHz 802.11b - Peak Power Spectral Density

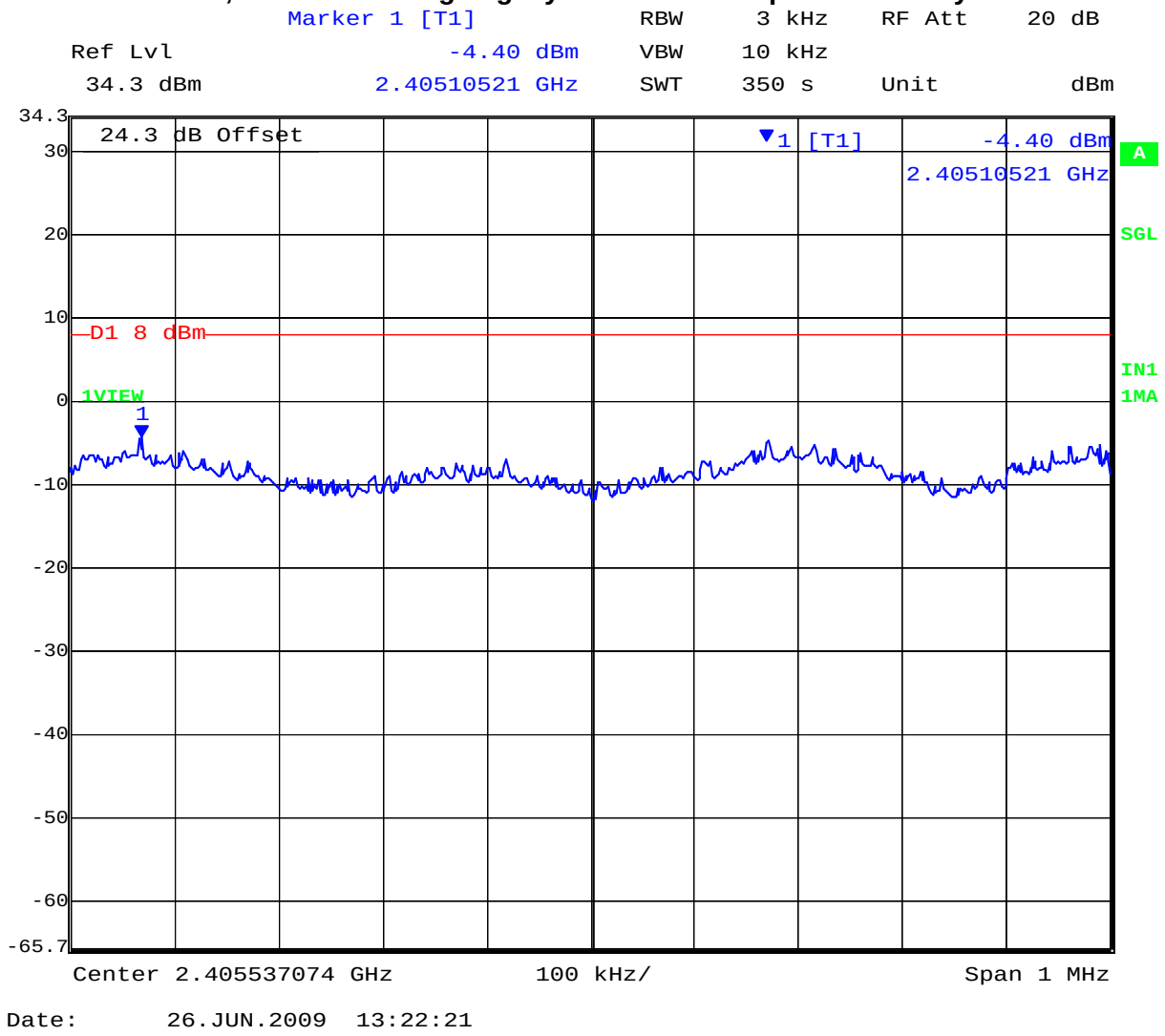


Peak Power Spectral Density

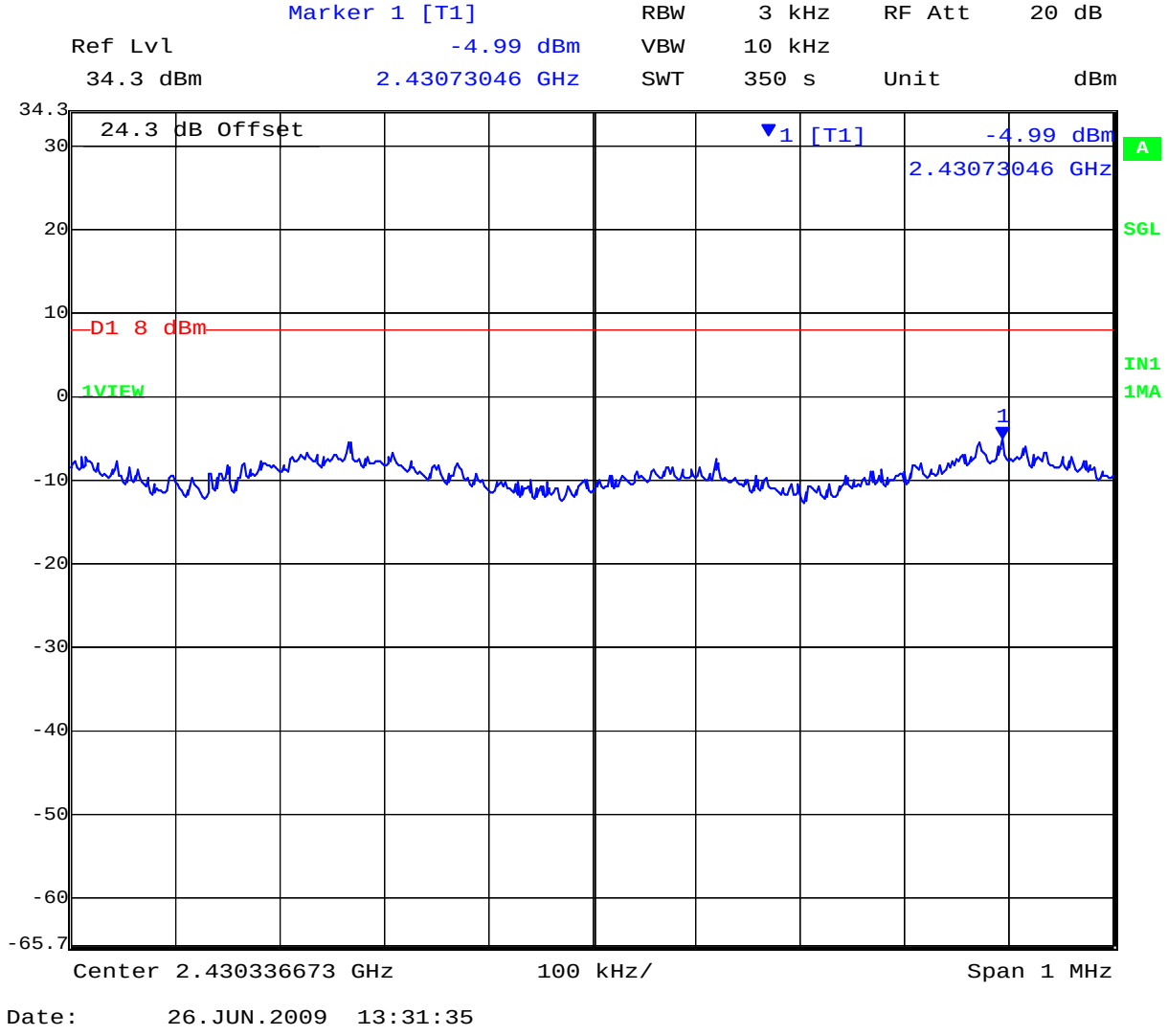
TABLE OF RESULTS – **802.11g Legacy**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2405.10521	-4.40	+8	-12.40
2,437	2430.73046	-4.99	+8	-12.99
2,462	2455.10521	-5.20	+8	-13.20

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



2,437 MHz 802.11g Legacy - Peak Power Spectral Density



2,462 MHz 802.11g Legacy - Peak Power Spectral Density

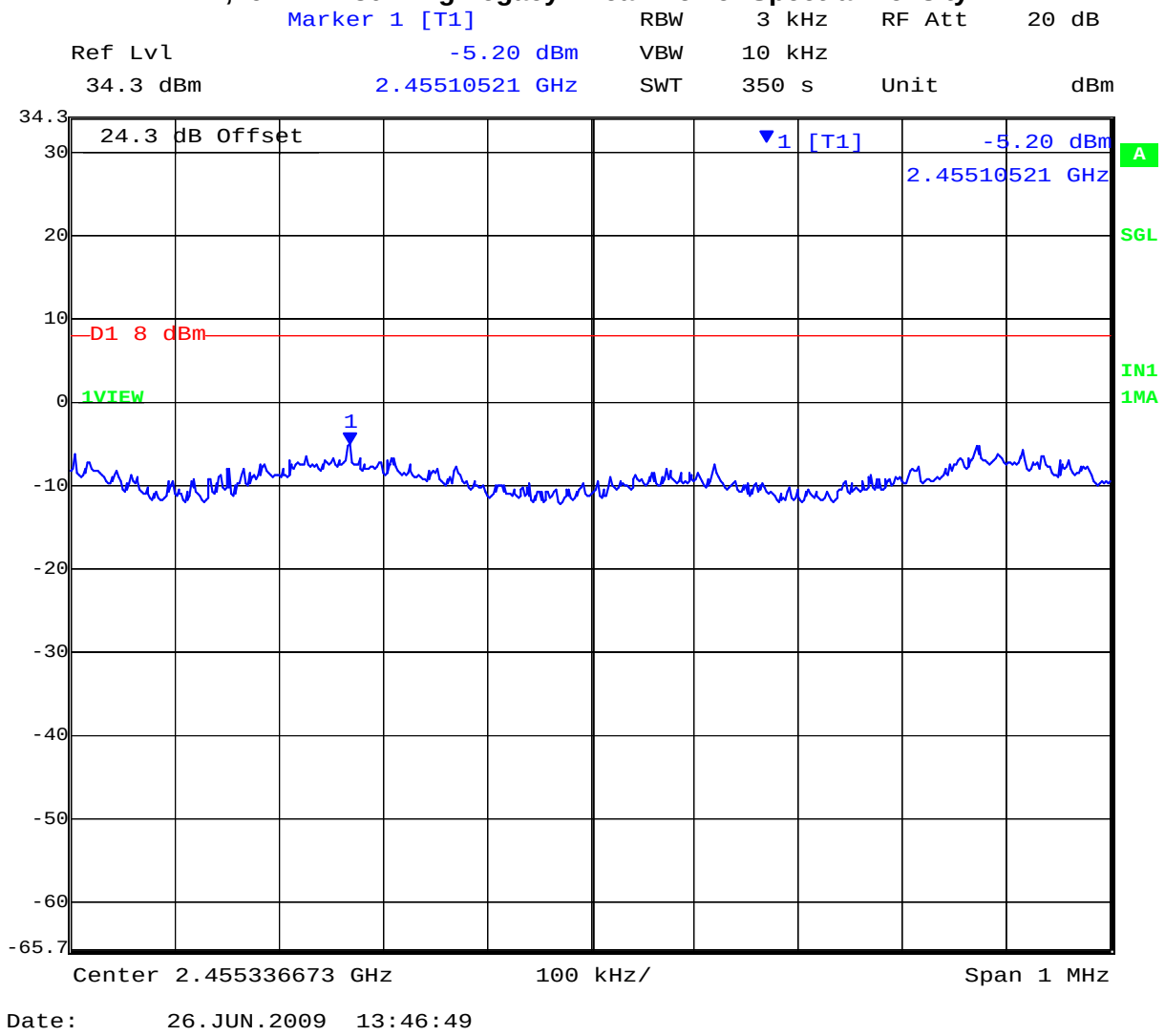
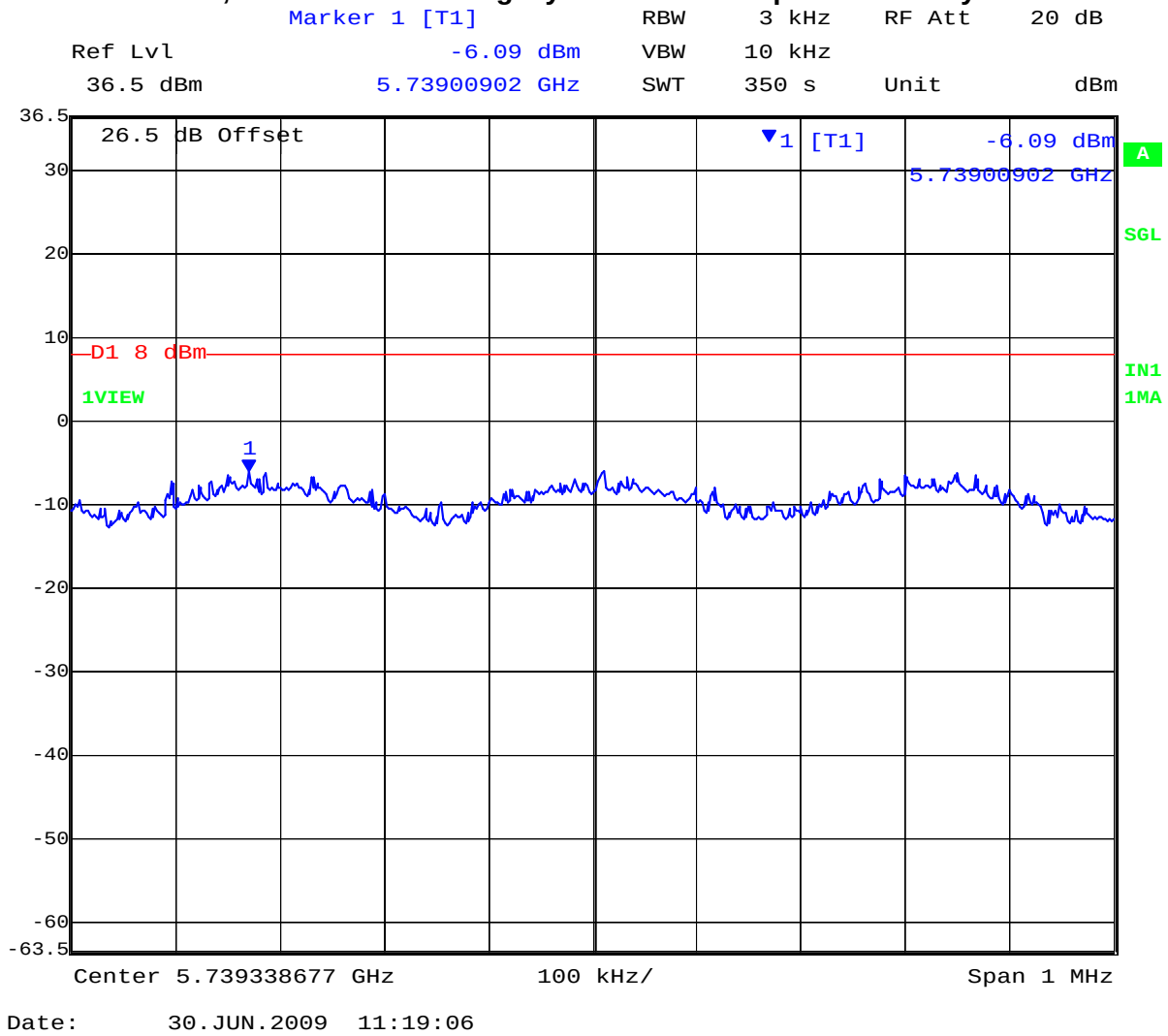


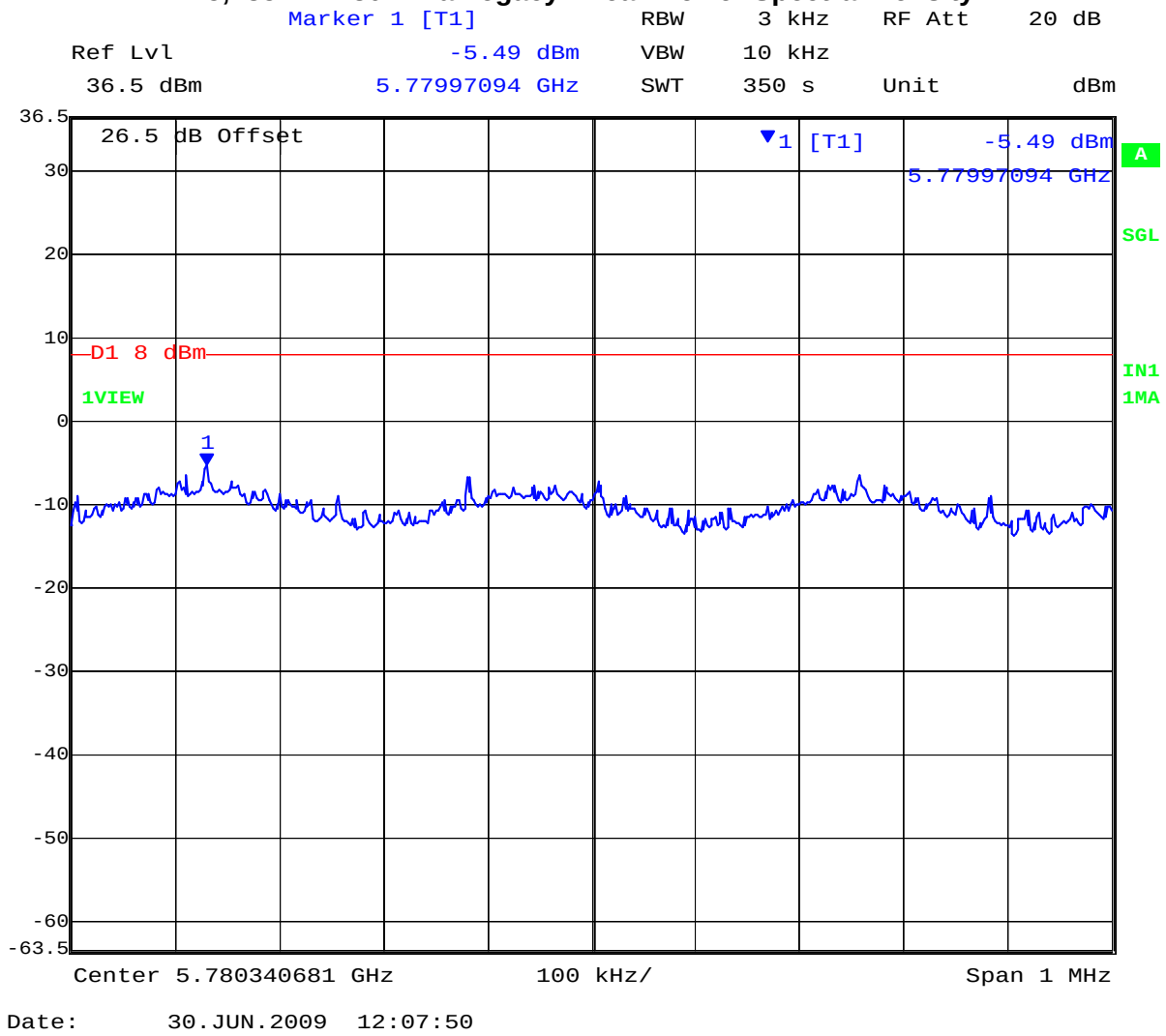
TABLE OF RESULTS – **802.11a Legacy**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5739.00902	-6.09	+8	-14.09
5,785	5779.97094	-5.49	+8	-13.49
5,825	5819.97094	-6.37	+8	-14.37

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



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



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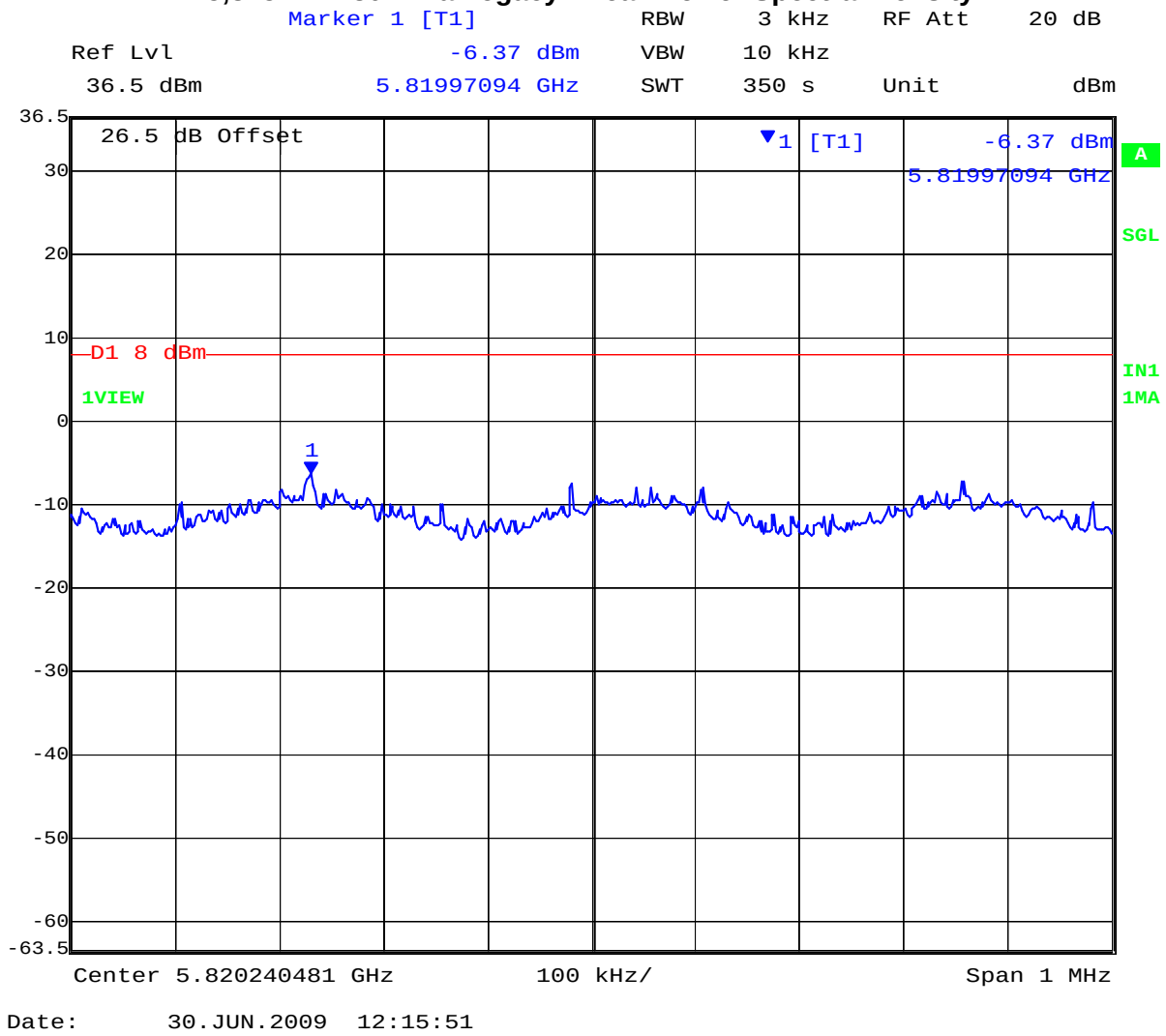
5,825 MHz 802.11a Legacy - Peak Power Spectral Density

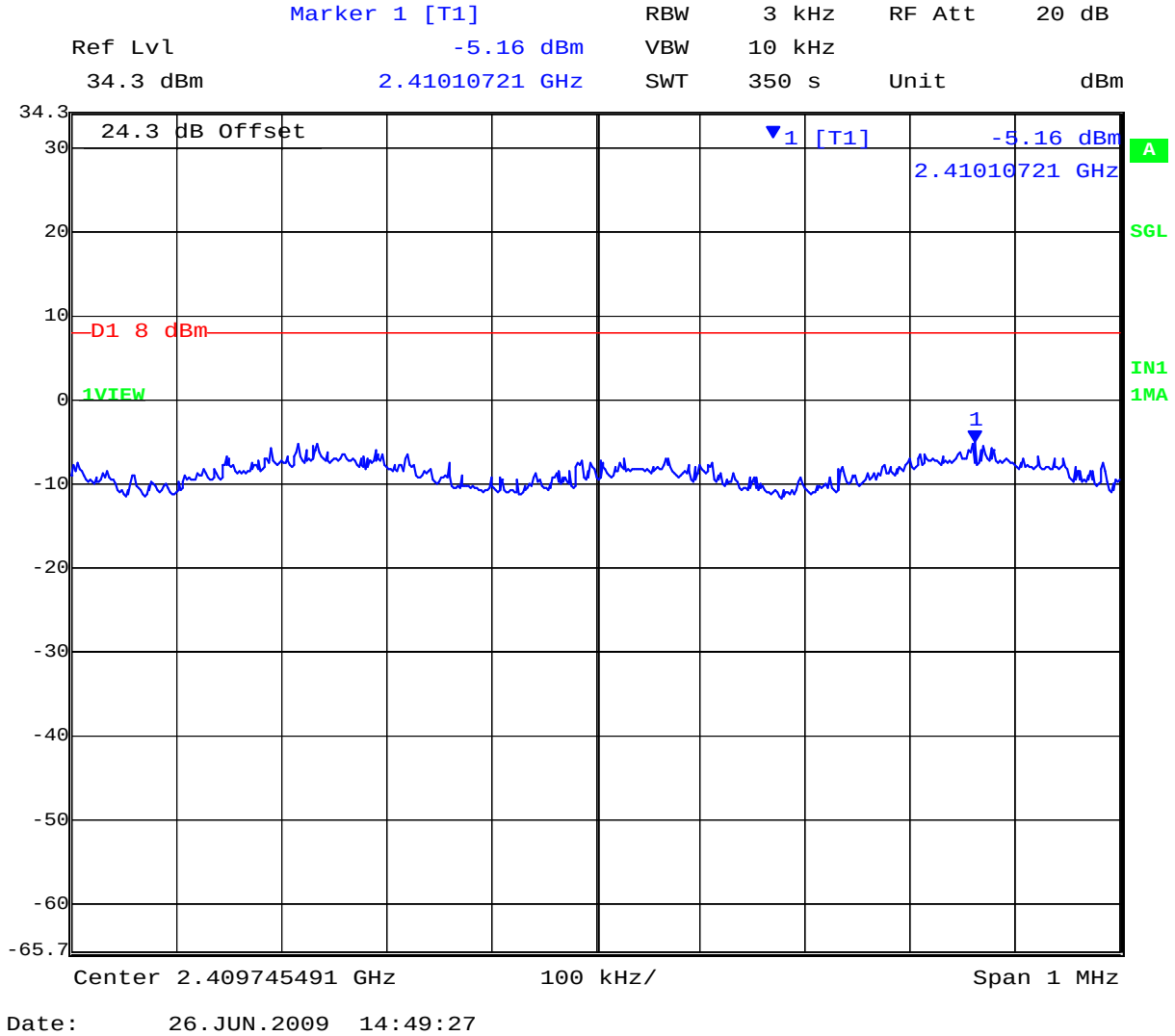


Peak Power Spectral Density

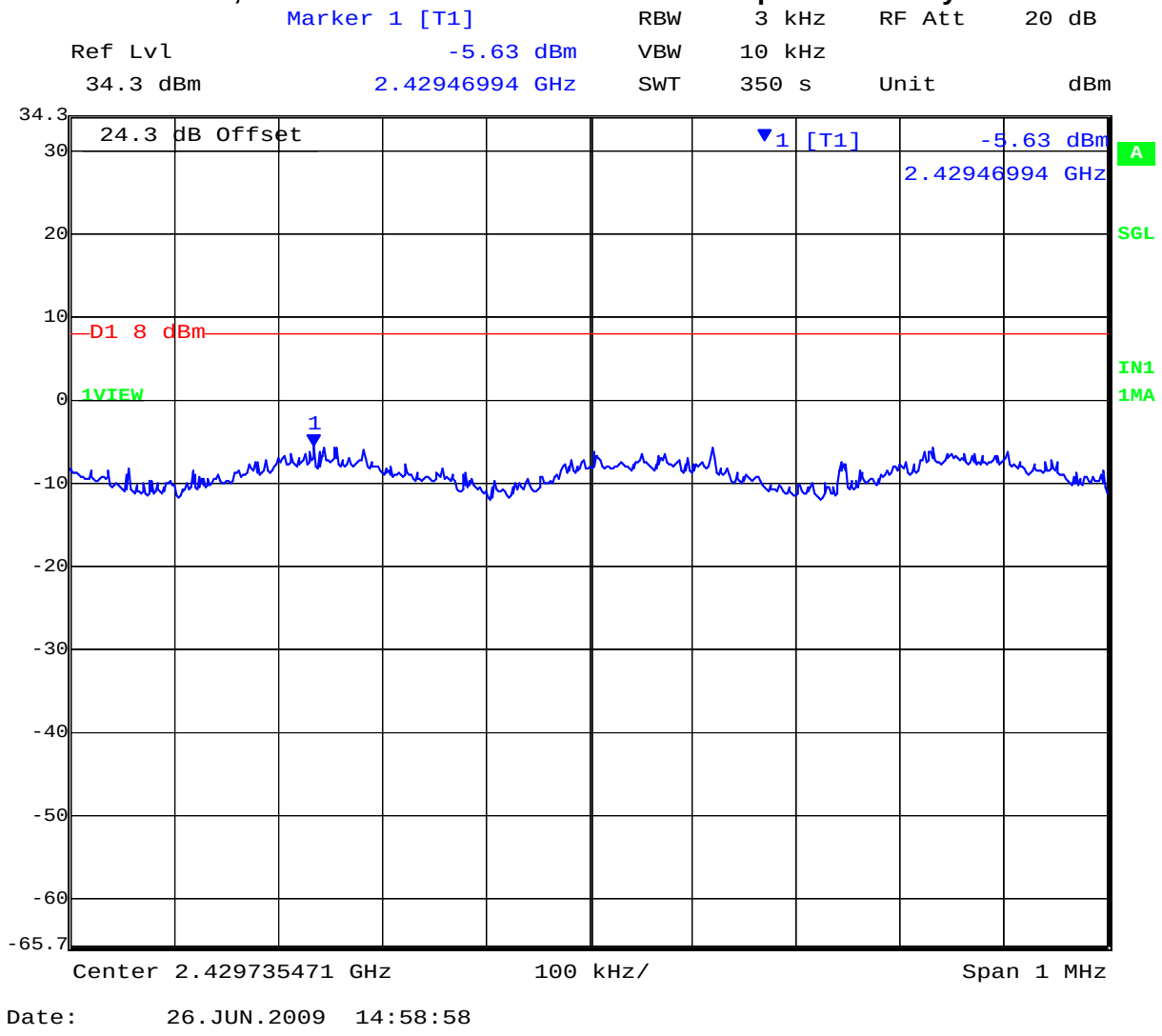
TABLE OF RESULTS – **802.11n – HT-20**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2410.10721	-5.16	+8	-13.16
2,437	2429.46994	-5.63	+8	-13.63
2,462	2457.60421	-5.55	+8	-13.55

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



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



2,462 MHz 802.11n HT-20 - Peak Power Spectral Density

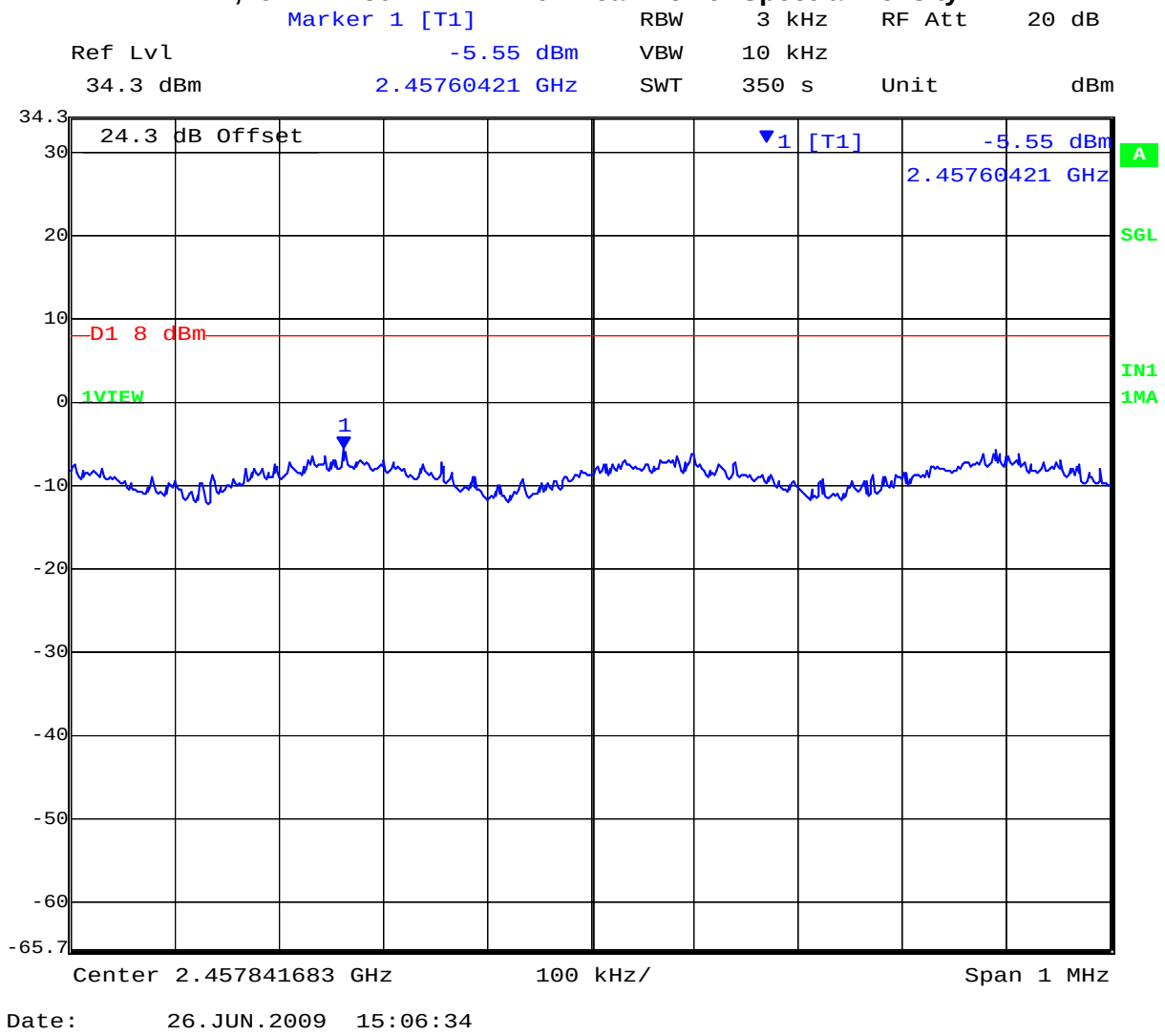
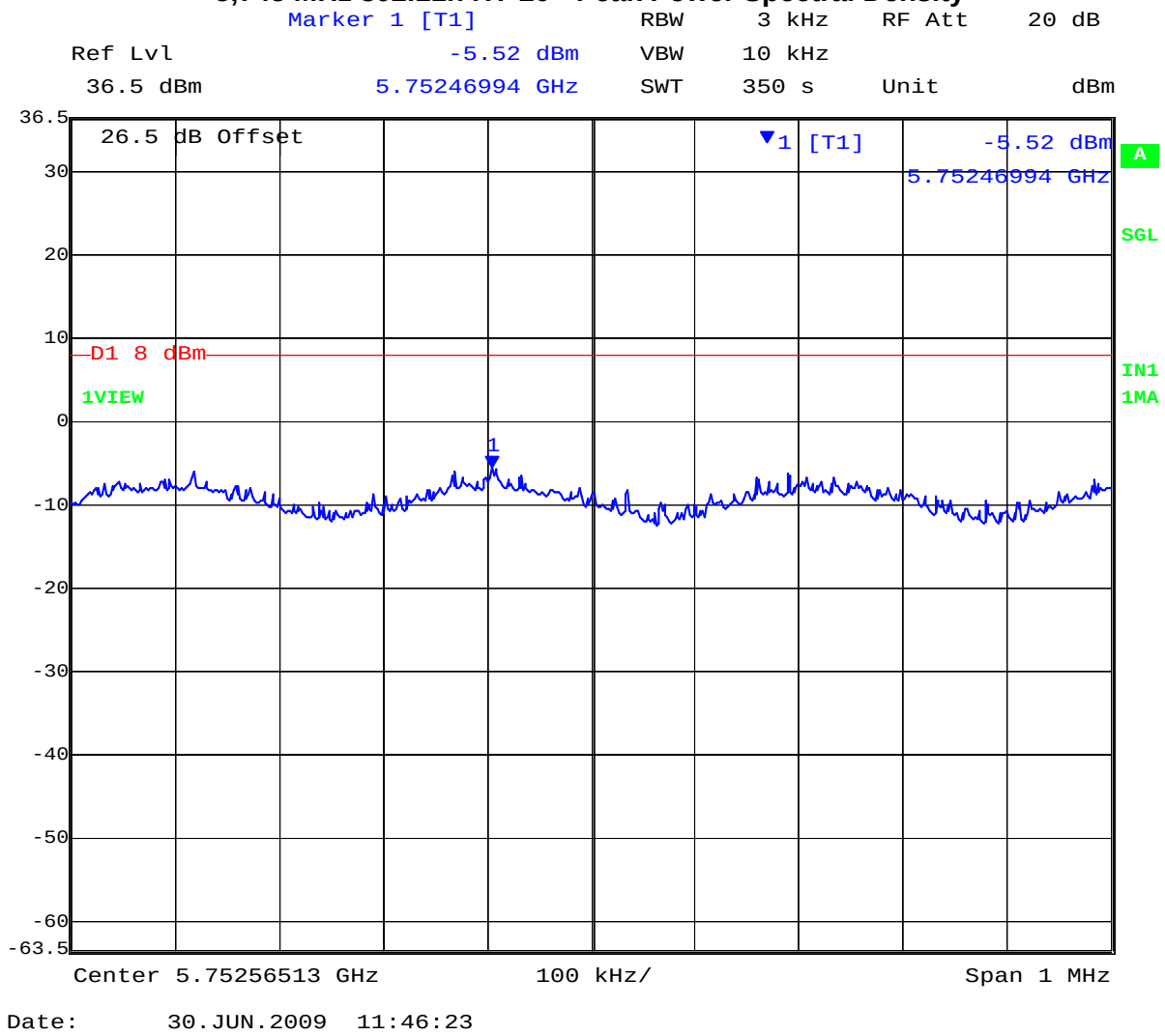


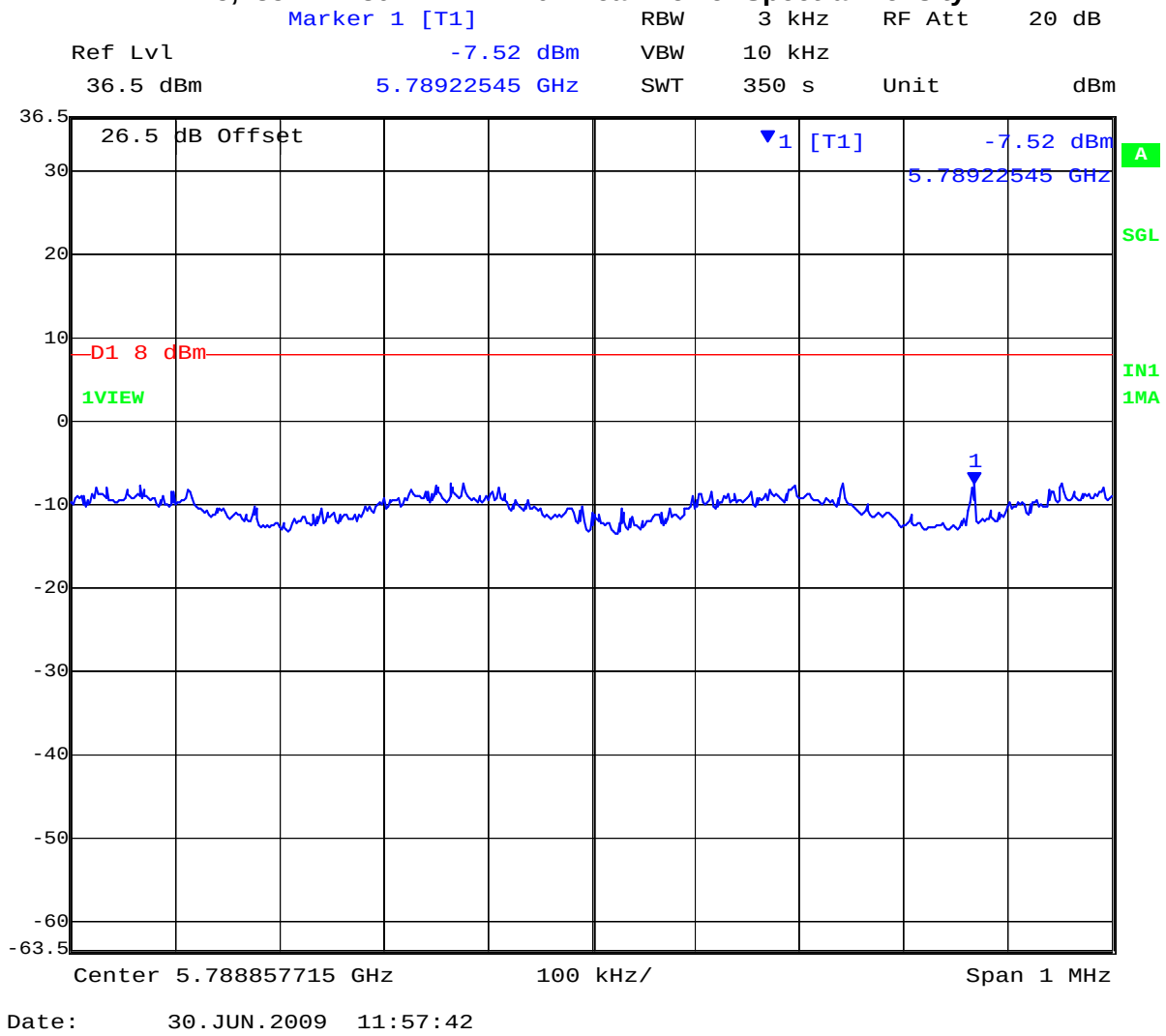
TABLE OF RESULTS – **802.11n HT-20**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5752.46994	-5.52	+8	-13.52
5,785	5789.22545	-7.52	+8	-15.52
5,825	5828.09719	-8.31	+8	-16.31

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



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



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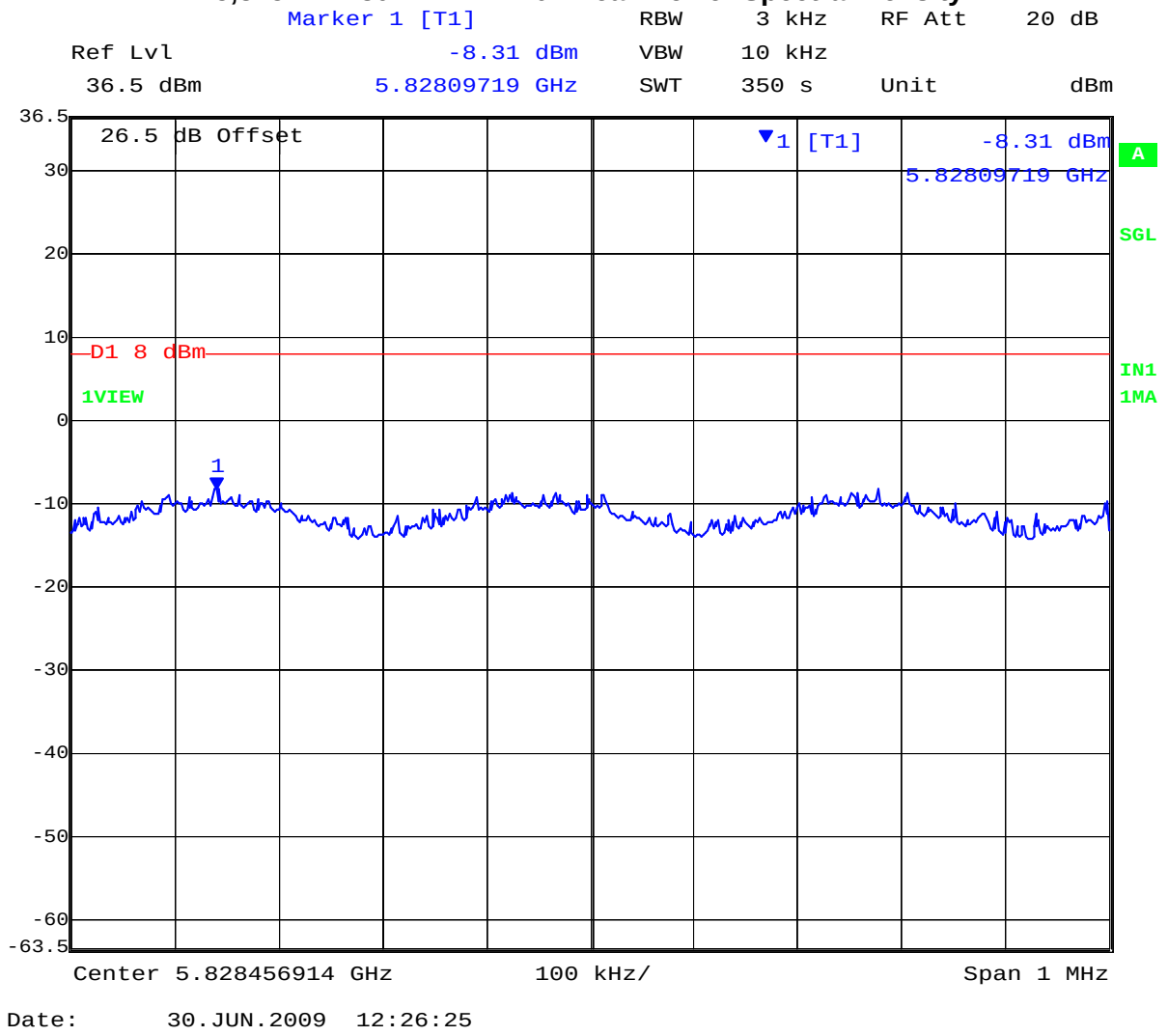
5,825 MHz 802.11n HT-20 - Peak Power Spectral Density



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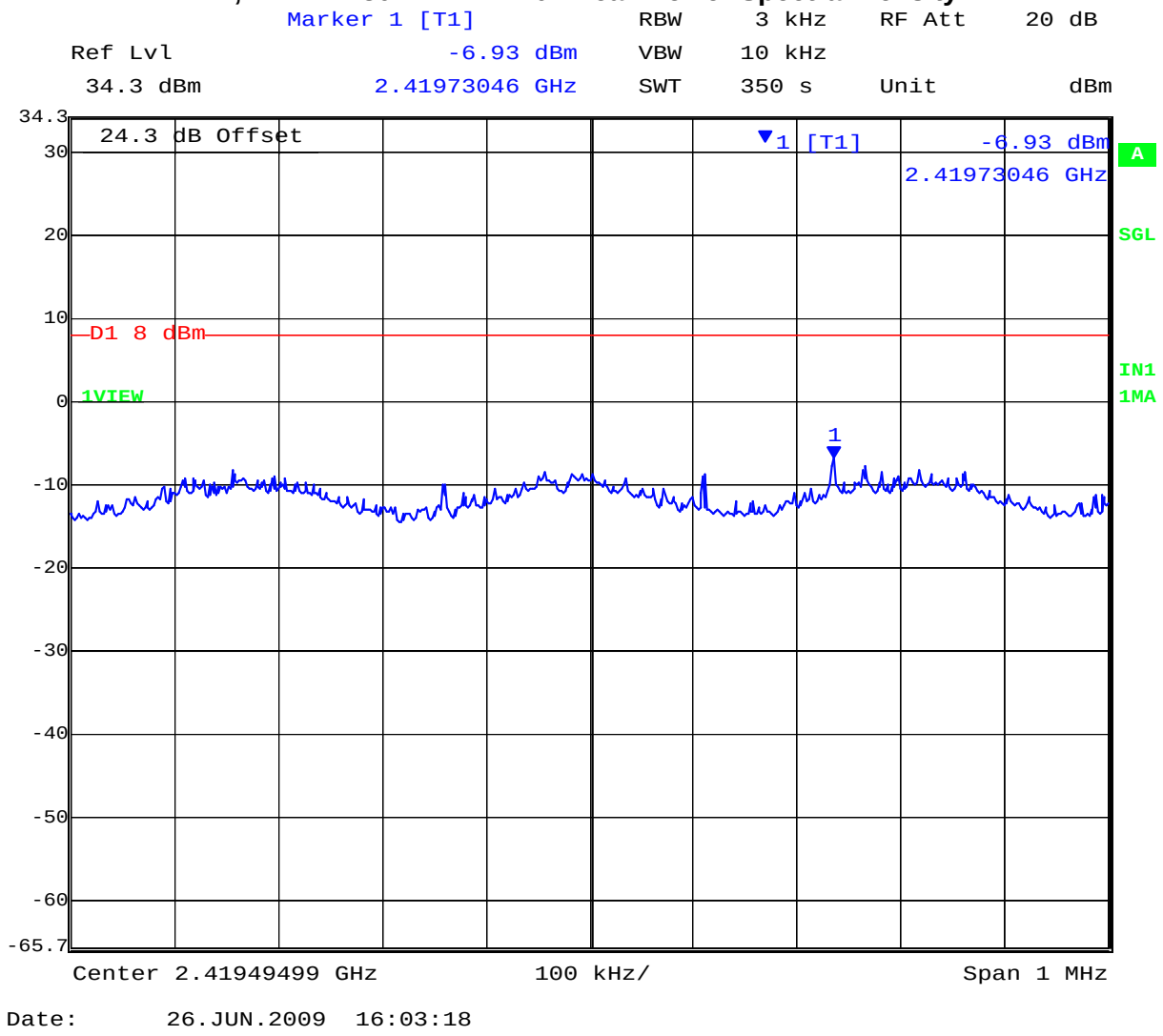
Peak Power Spectral Density

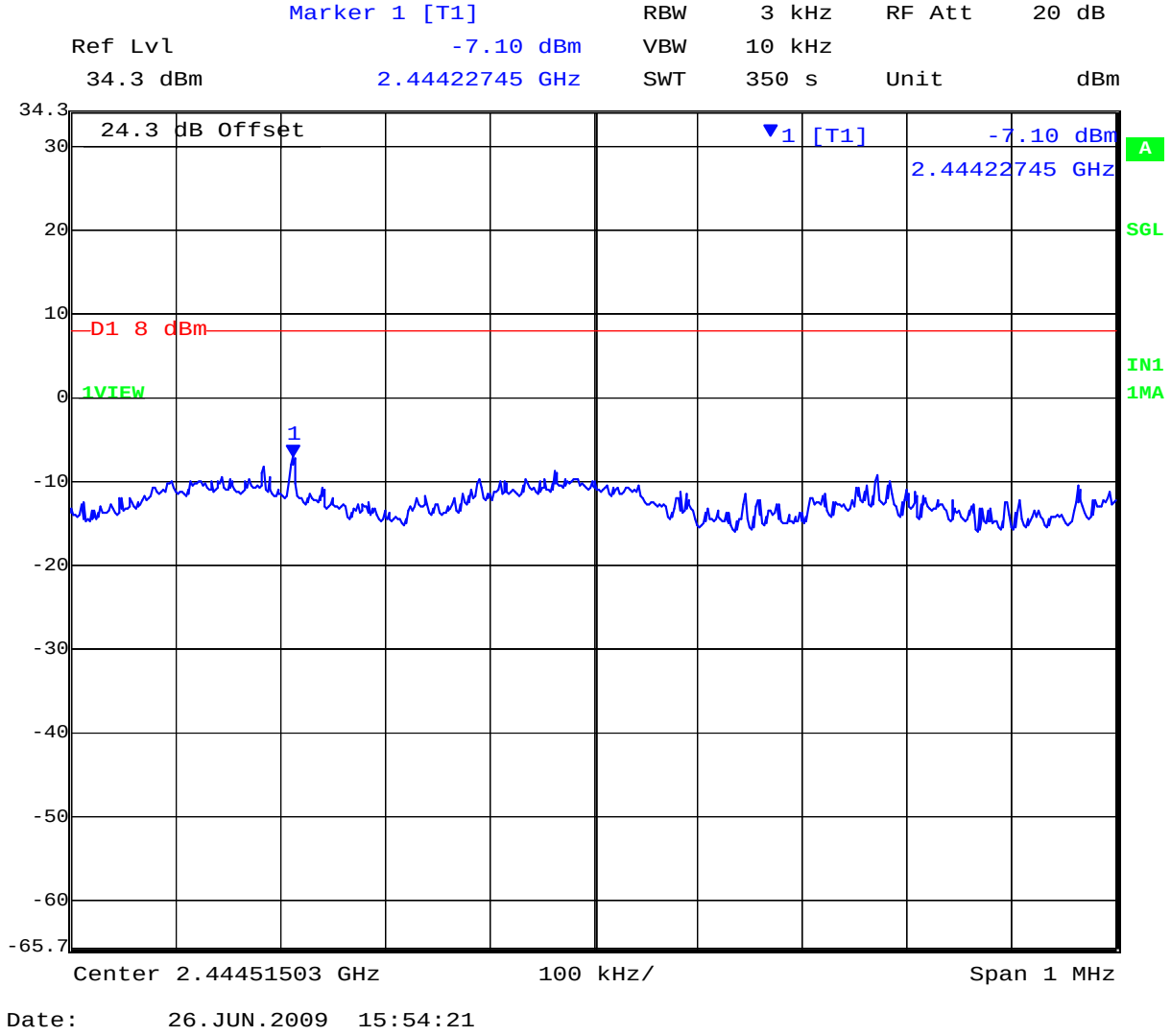
TABLE OF RESULTS – **802.11n HT-40**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,422	2419.73046	-6.93	+8	-14.93
2,437	2444.22745	-7.10	+8	-15.10
2,452	2458.48196	-7.86	+8	-15.86

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



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



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

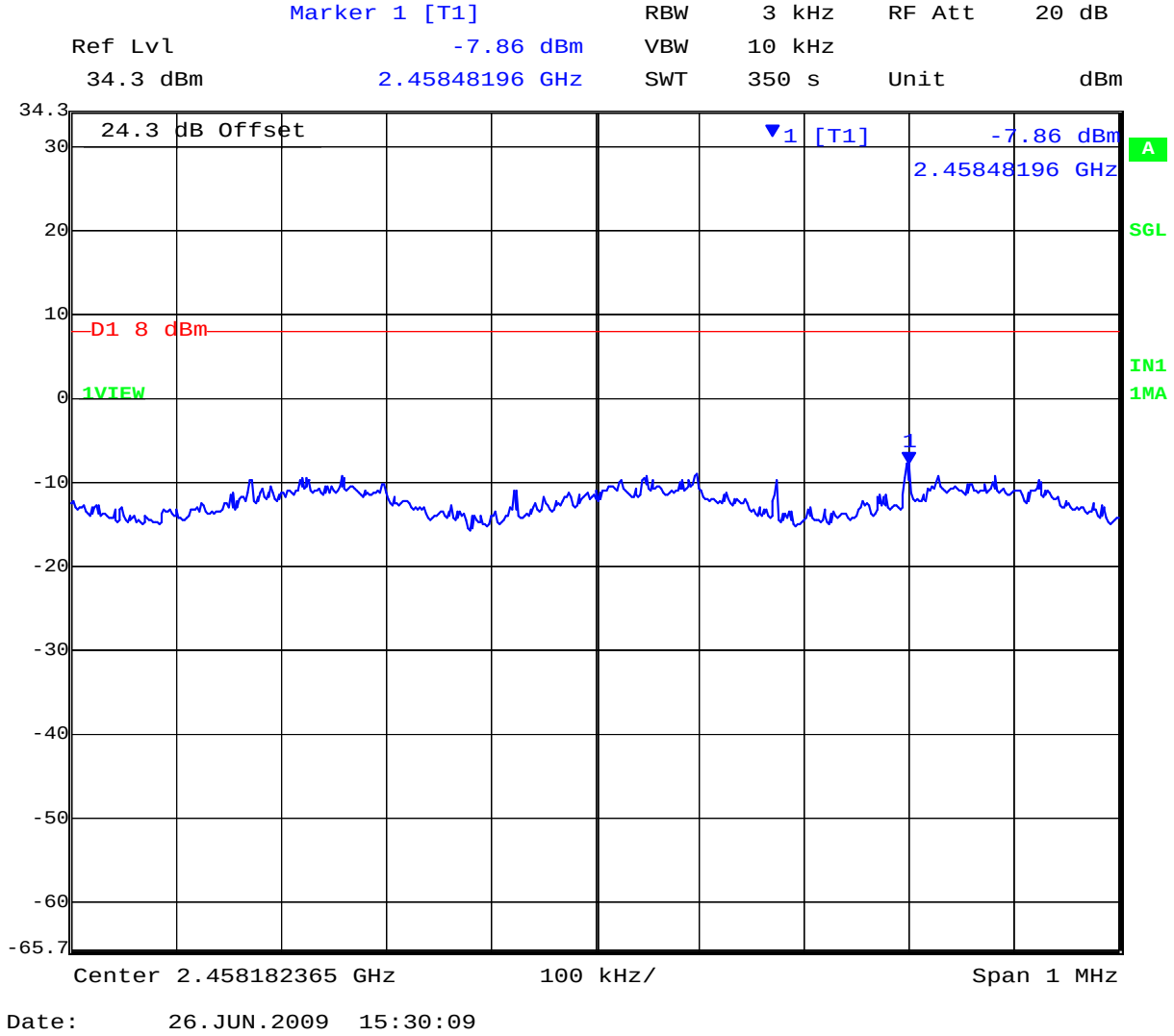


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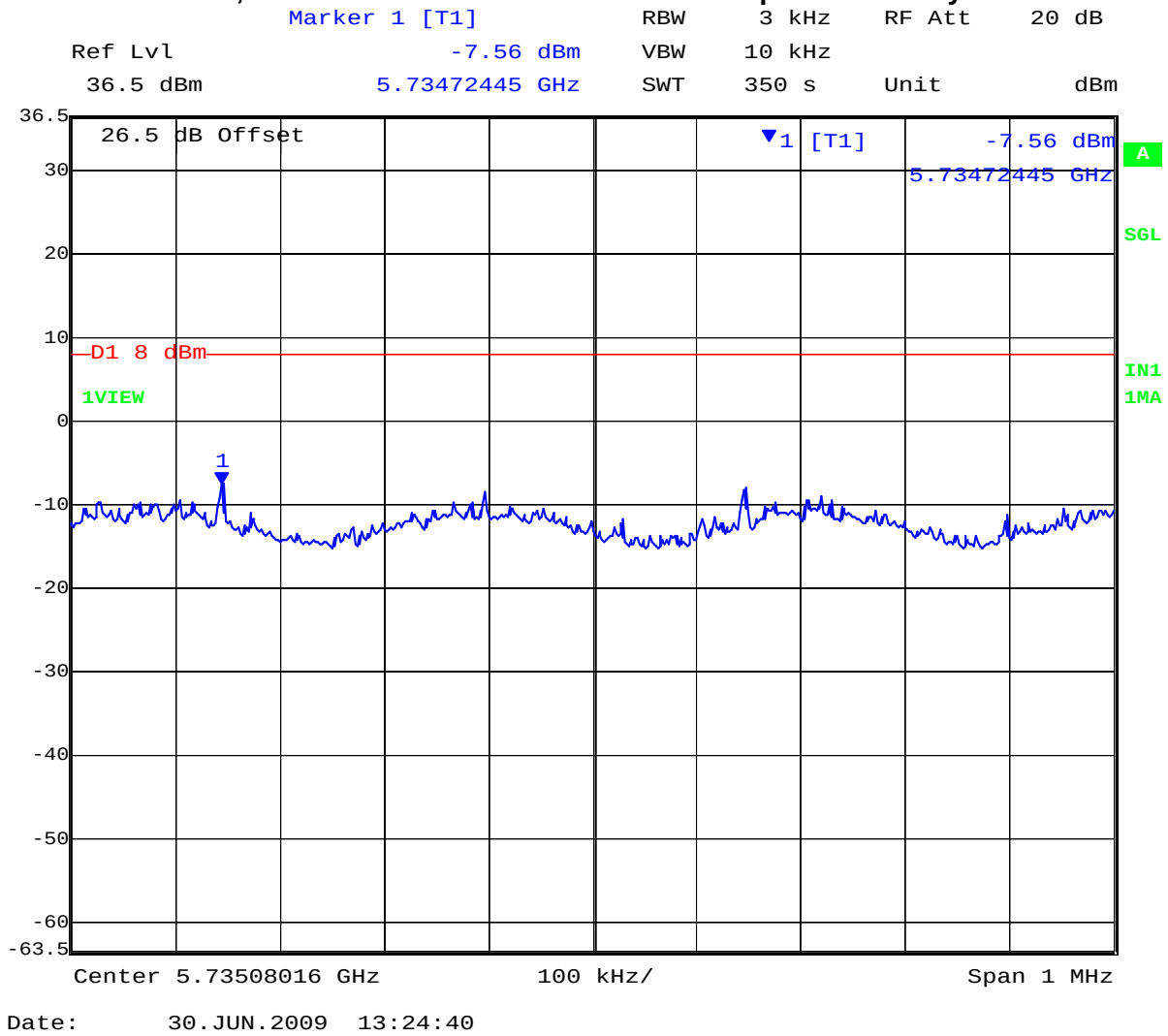
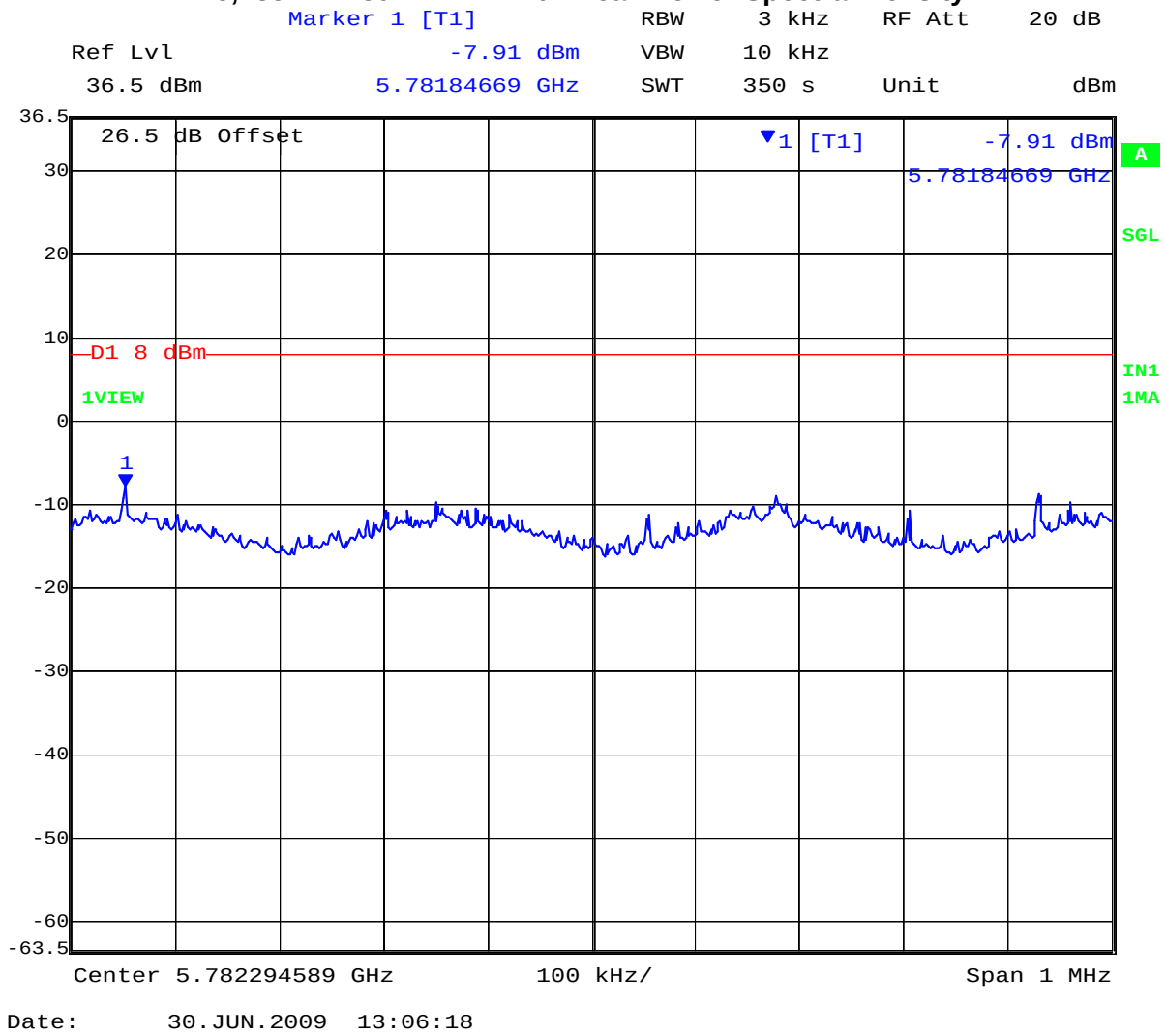
TABLE OF RESULTS – **802.11n HT-40**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5734.72445	-7.56	+8	-15.56
5,785	5781.84669	-7.91	+8	-15.91
5,825	5812.47395	-9.19	+8	-17.19

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



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



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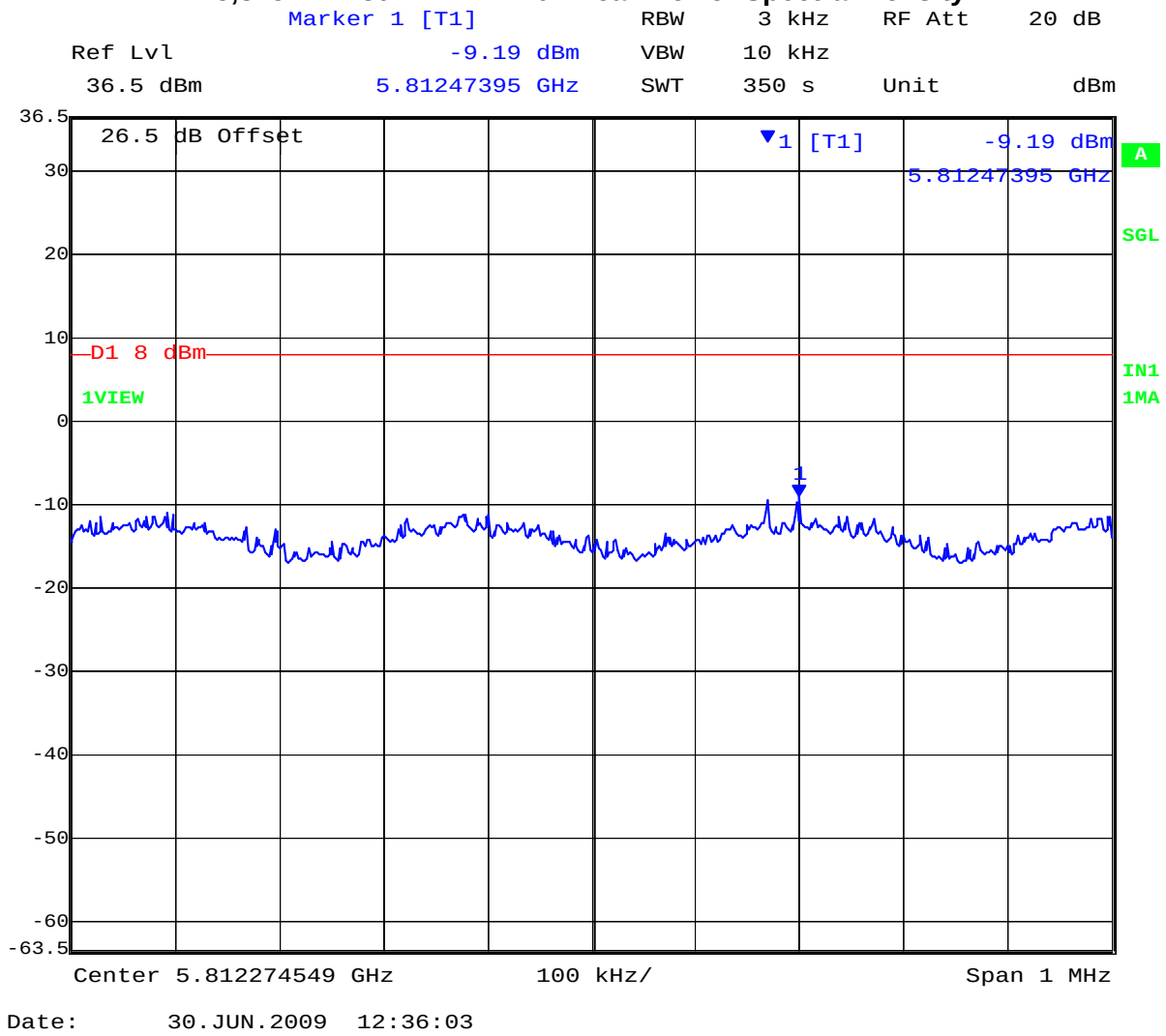
5,825 MHz 802.11n HT-40 - Peak Power Spectral Density



Date: 30.JUN.2009 12:36:03

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, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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 = Pd (mW/cm^2) = EIRP/(4πd^2)

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

The Aruba AP-105 has two transmitters operating in each band. The peak power in the table below is calculated by assuming a worst case scenario where the two transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum allowable conducted power measured in each band and multiplying by 2.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm^2

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	2.5	1.78	+19.81	191.5	5.2	20.0*
5.8	4.0	2.51	+18.51	141.9	5.3	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 / cm^2 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

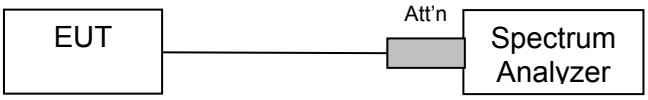
Measurement uncertainty	±1.33 dB

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

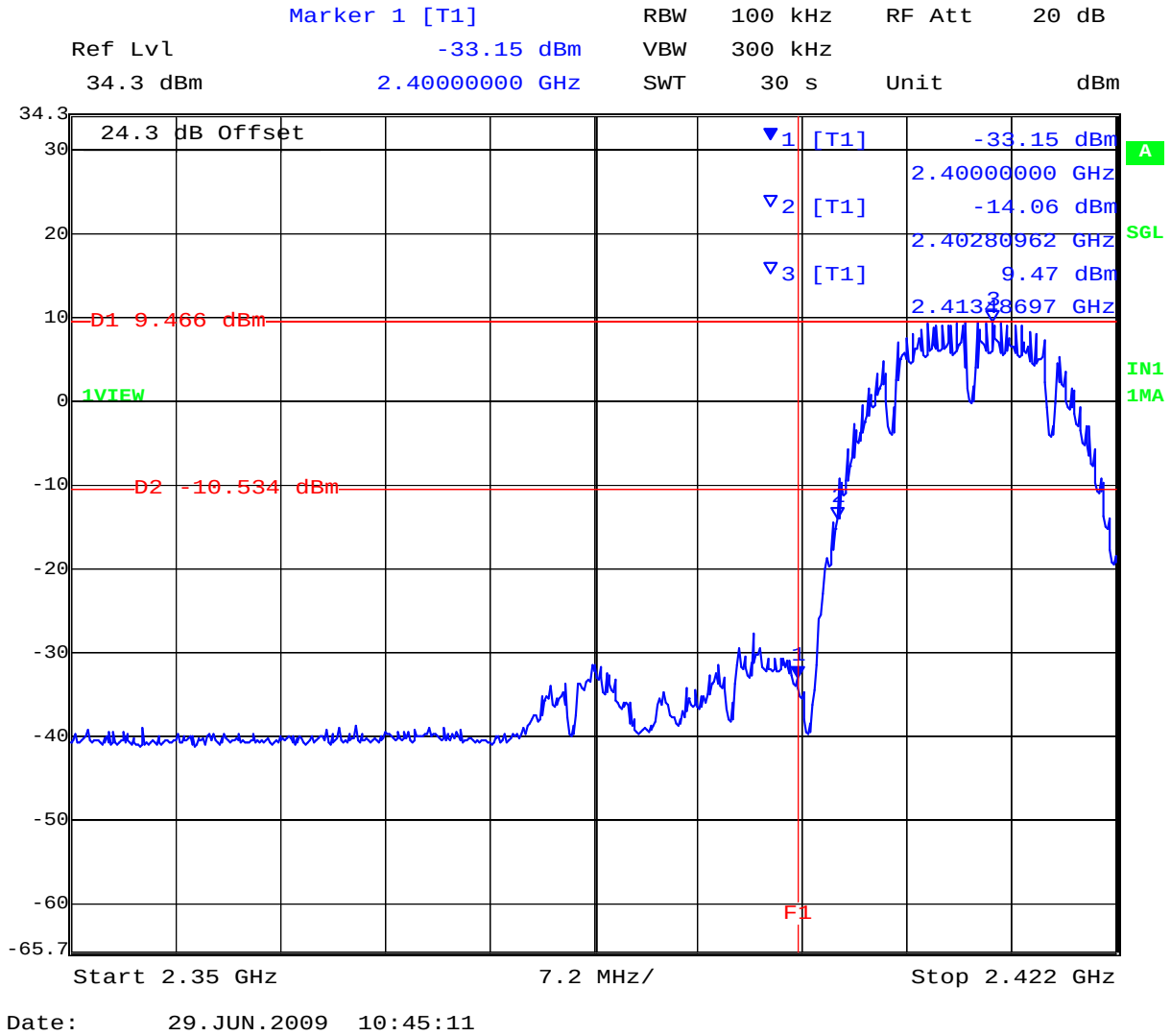
Conducted Band-Edge Results

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.

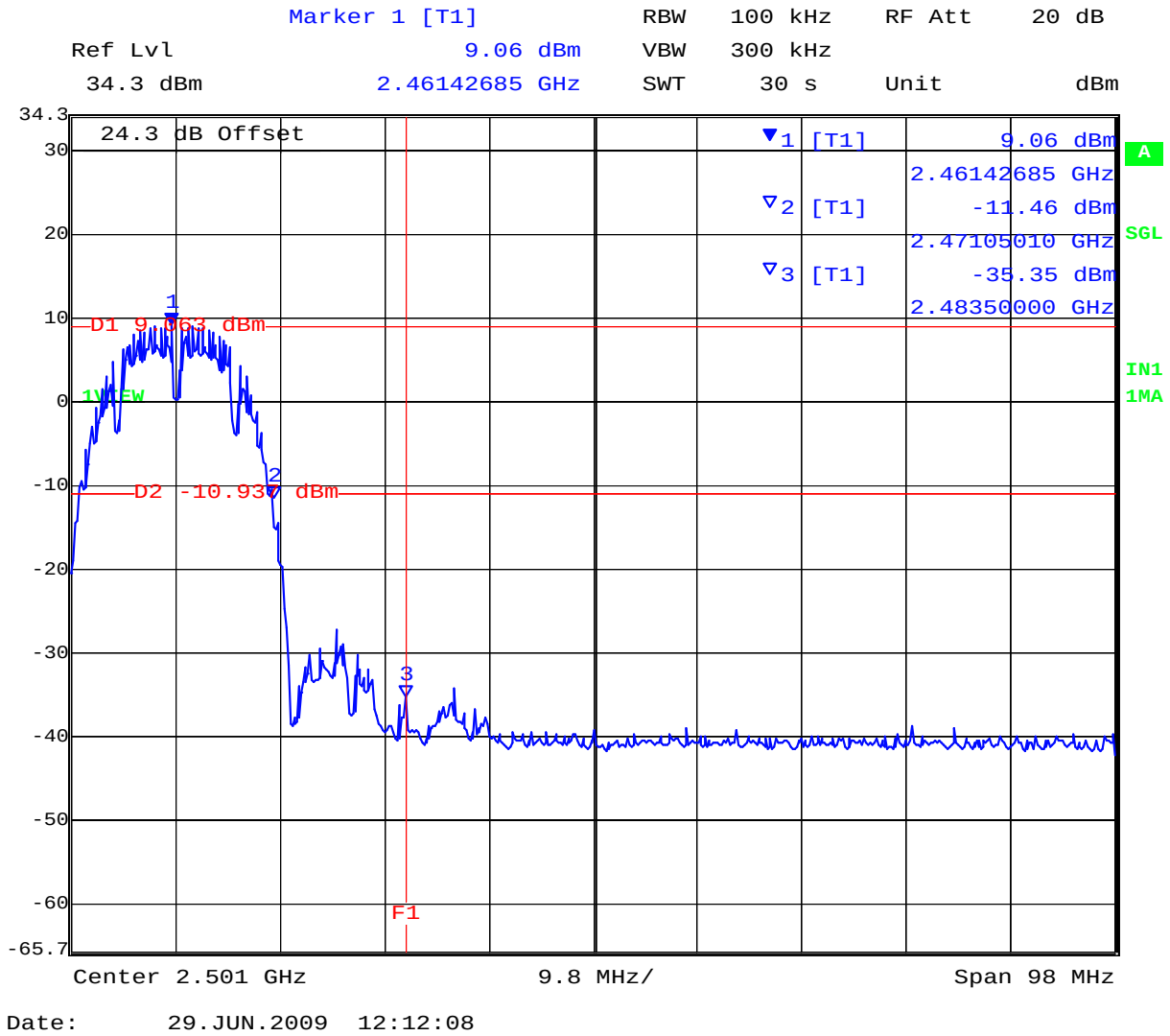
TABLE OF RESULTS – **802.11b – Legacy**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-10.534	-33.15	-22.616
2,462	2,483.5	-10.937	-35.35	-24.413

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



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

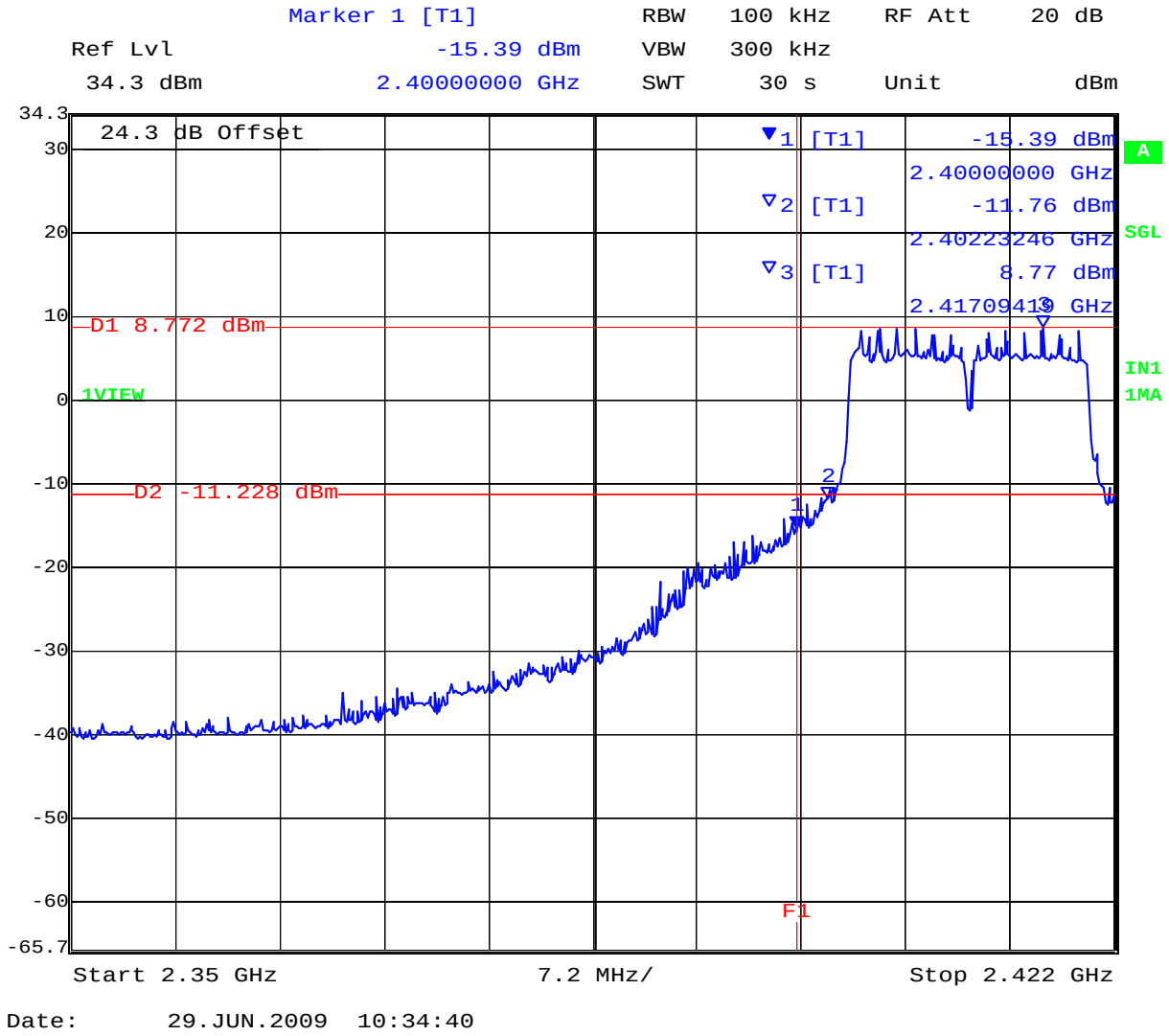


Conducted Band-Edge Results

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	-11.228	-15.39	-4.162
2,462	2,483.5	-11.726	-26.35	-14.624

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



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

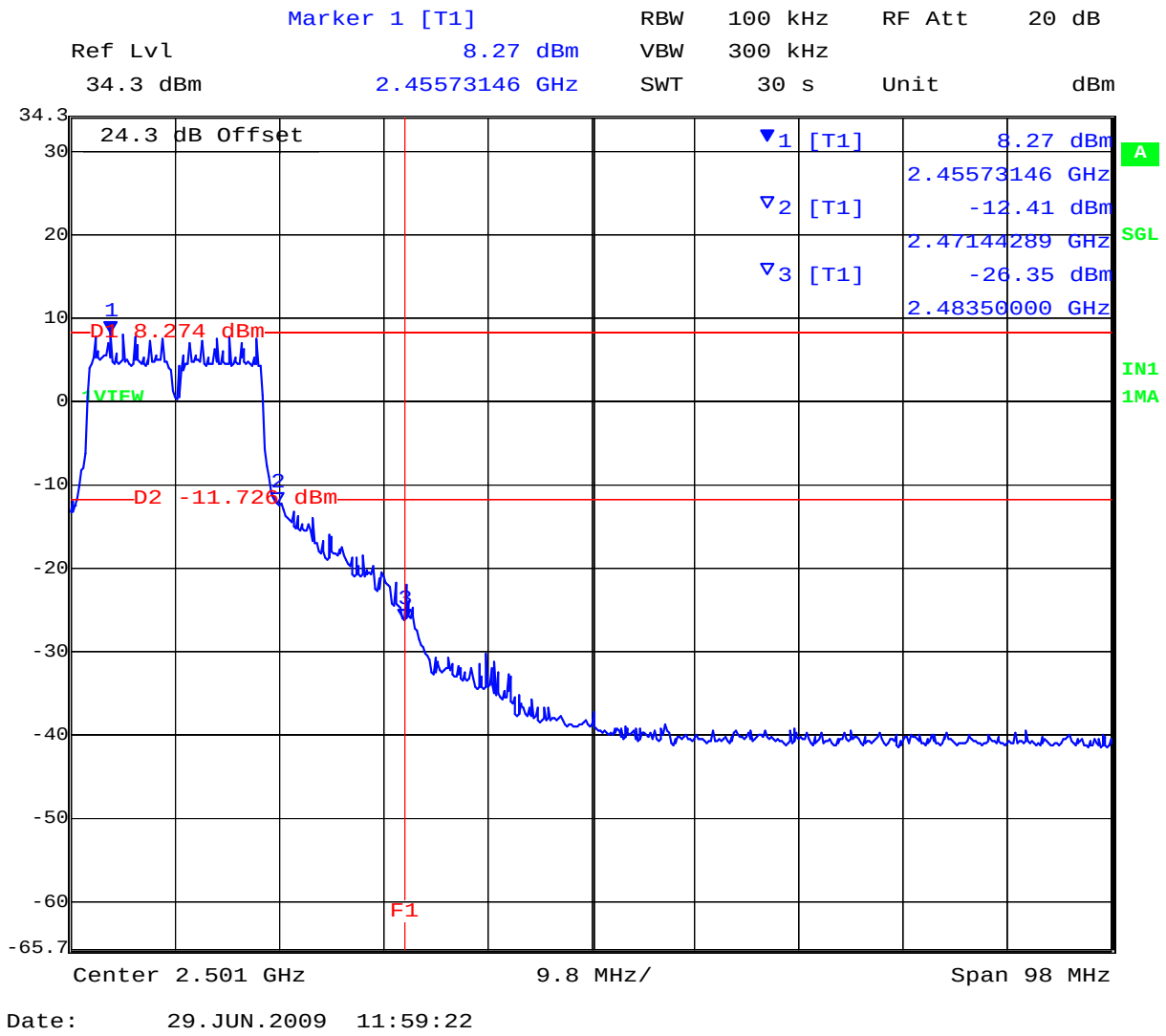
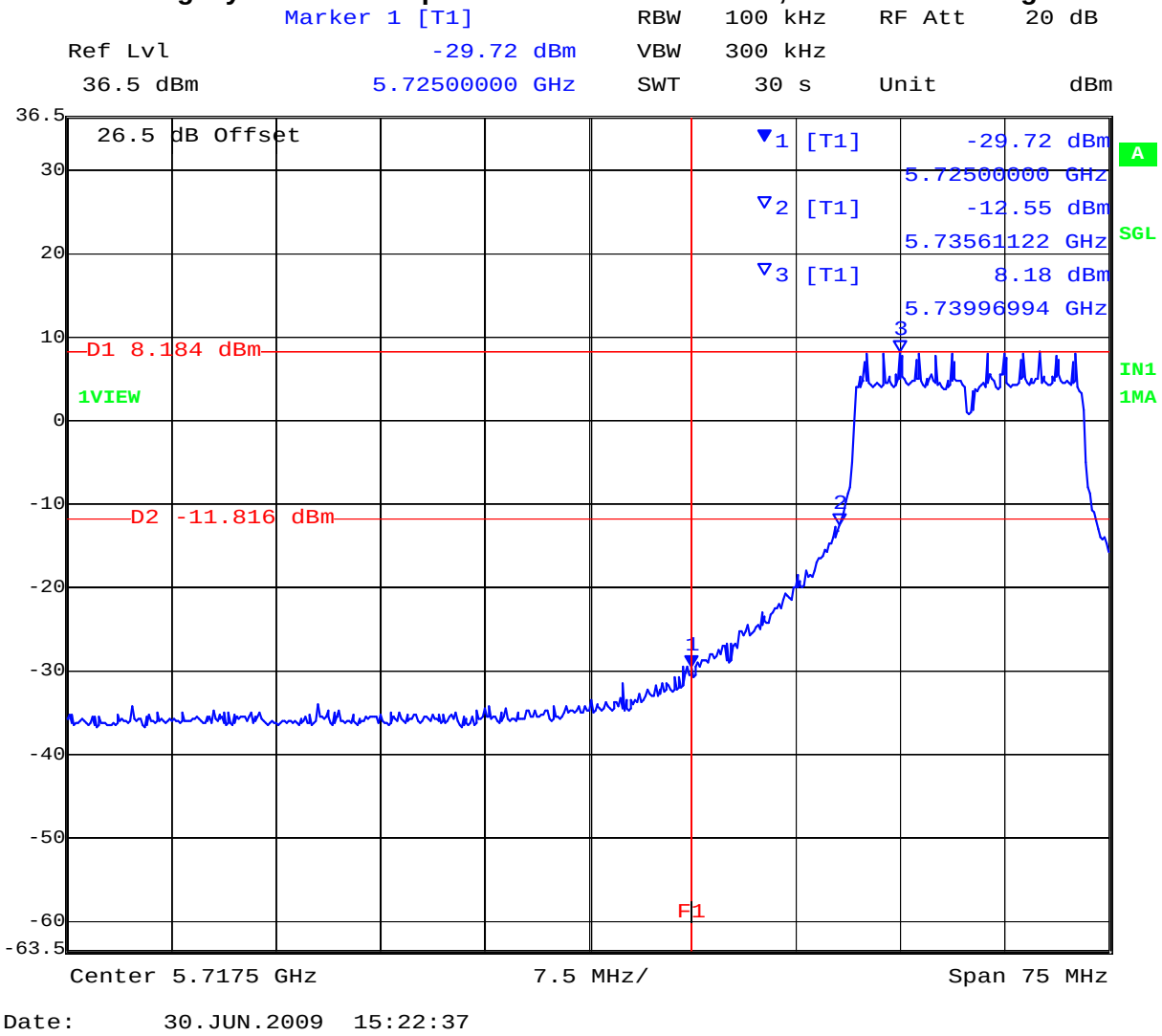


TABLE OF RESULTS – **802.11a Legacy**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
5,745	5,725	-11.816	-29.72	-17.904
5,825	5,850	-13.514	-34.99	-21.476

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



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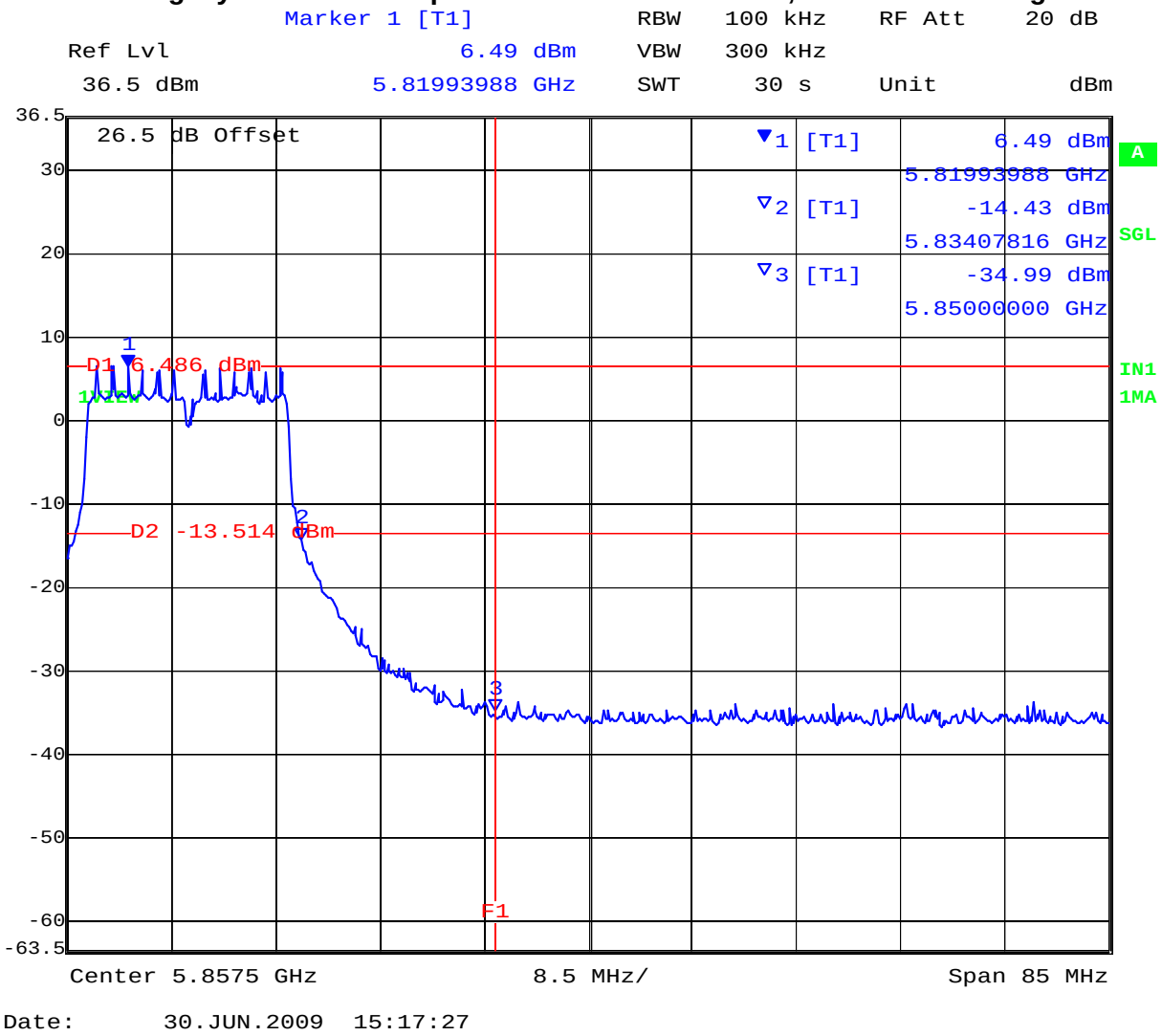
a Legacy - Conducted Spurious Emissions at the 5,850 MHz Band Edge



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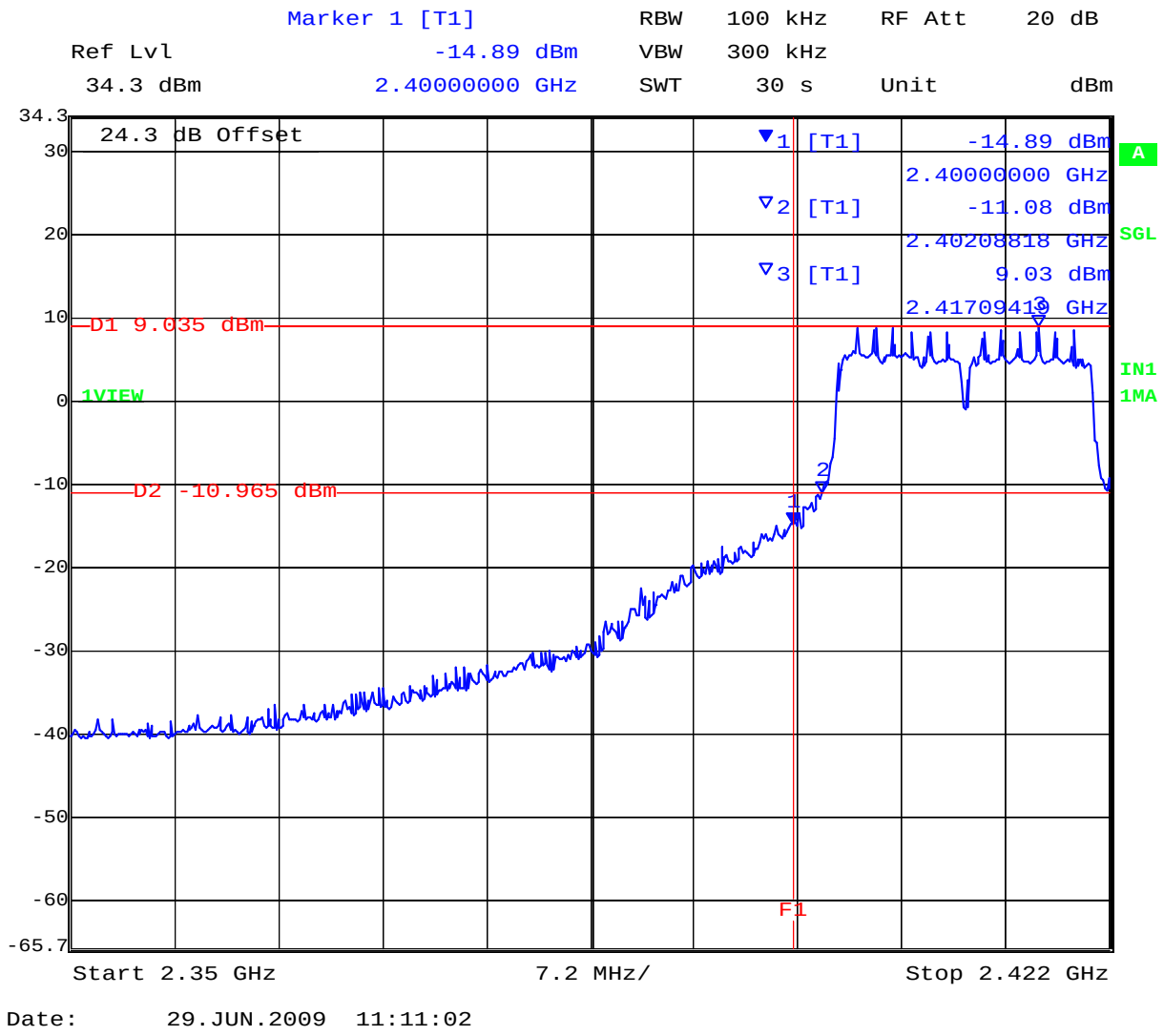
Conducted Band-Edge Results

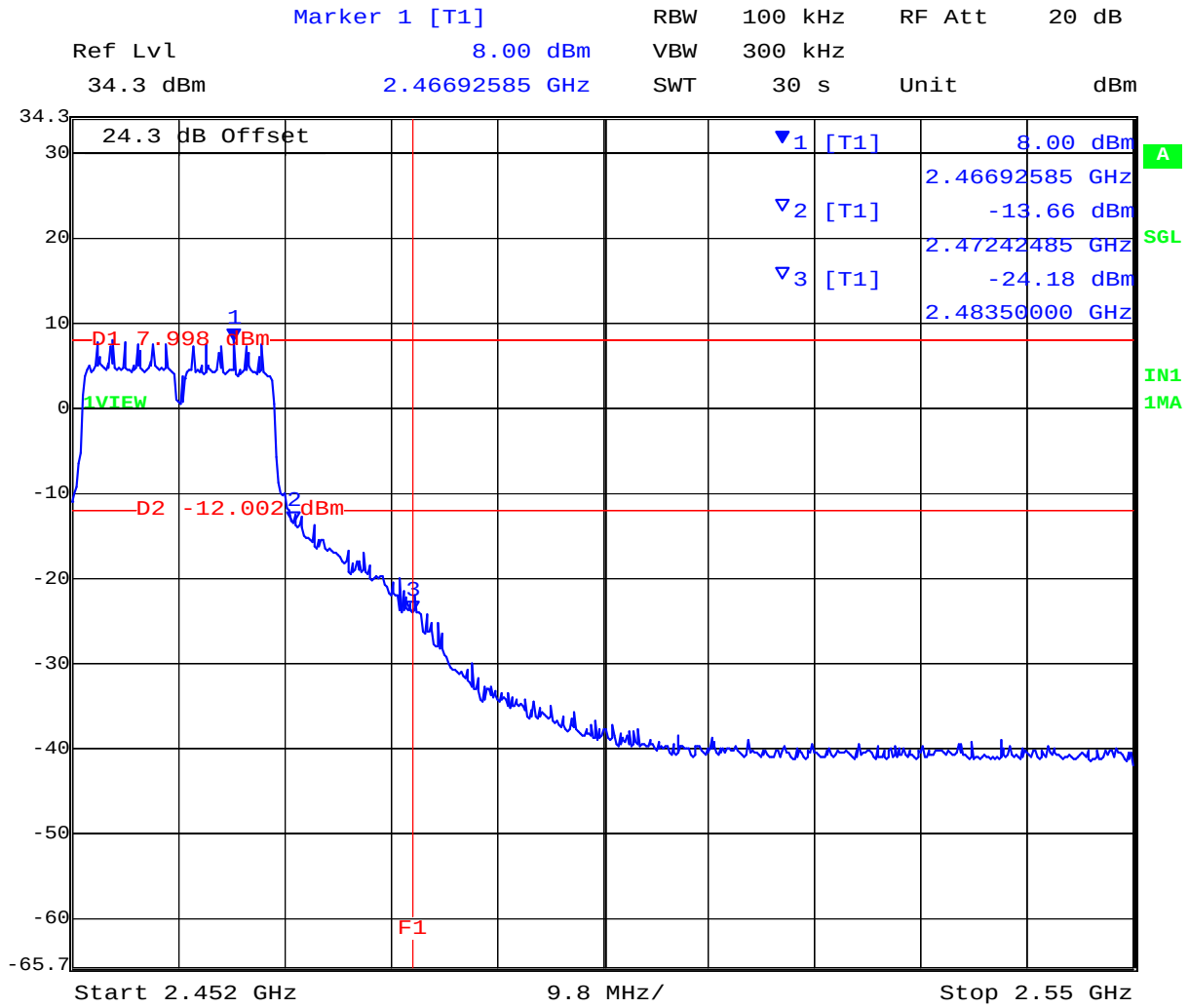
TABLE OF RESULTS – **802.11n HT-20**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-10.965	-14.89	-3.925
2,462	2,483.5	-12.002	-24.18	-12.178

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



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

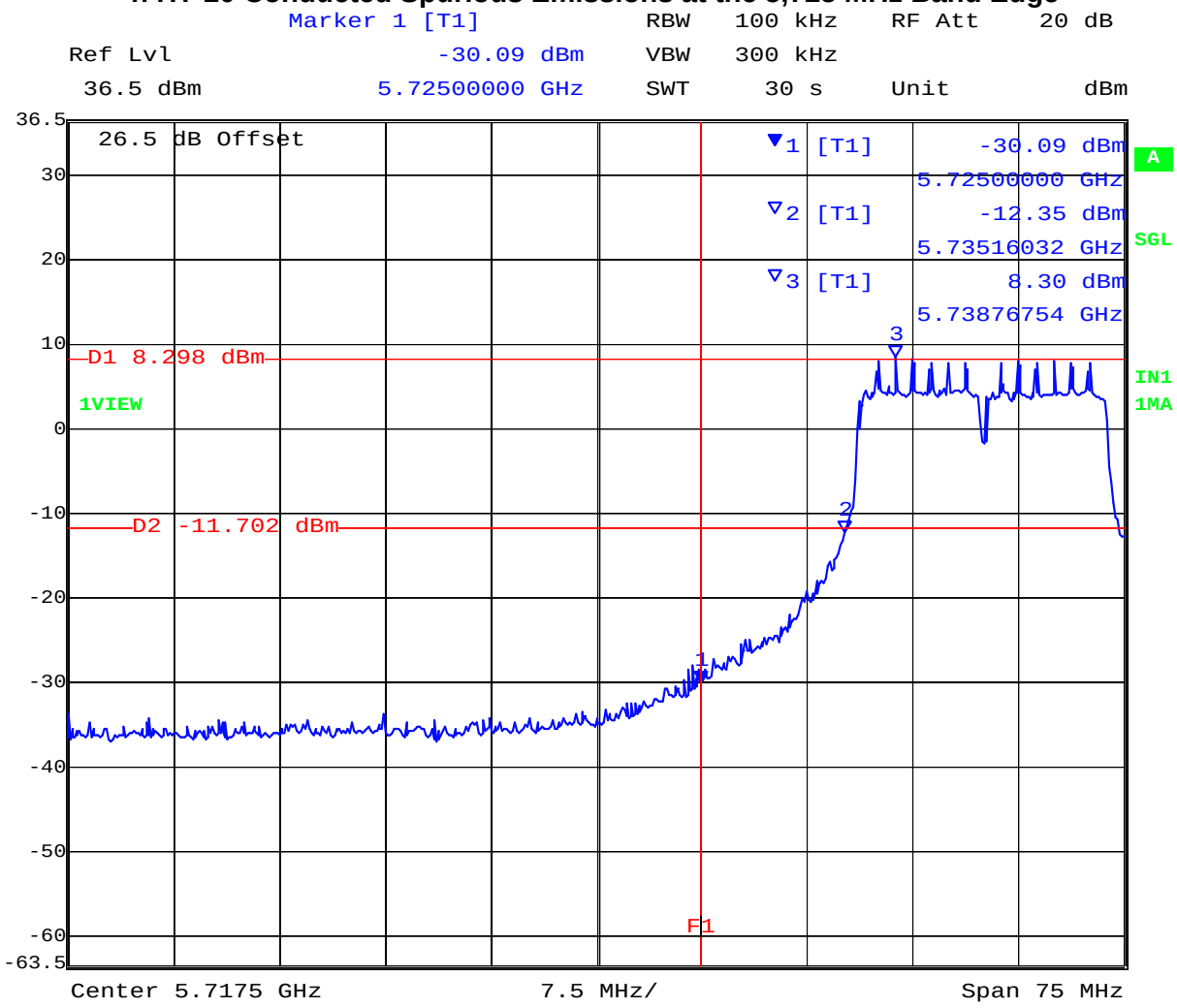


Date: 29.JUN.2009 12:14:08

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	-11.702	-30.09	-18.388
5,825	5,850	-13.532	-35.45	-21.918

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



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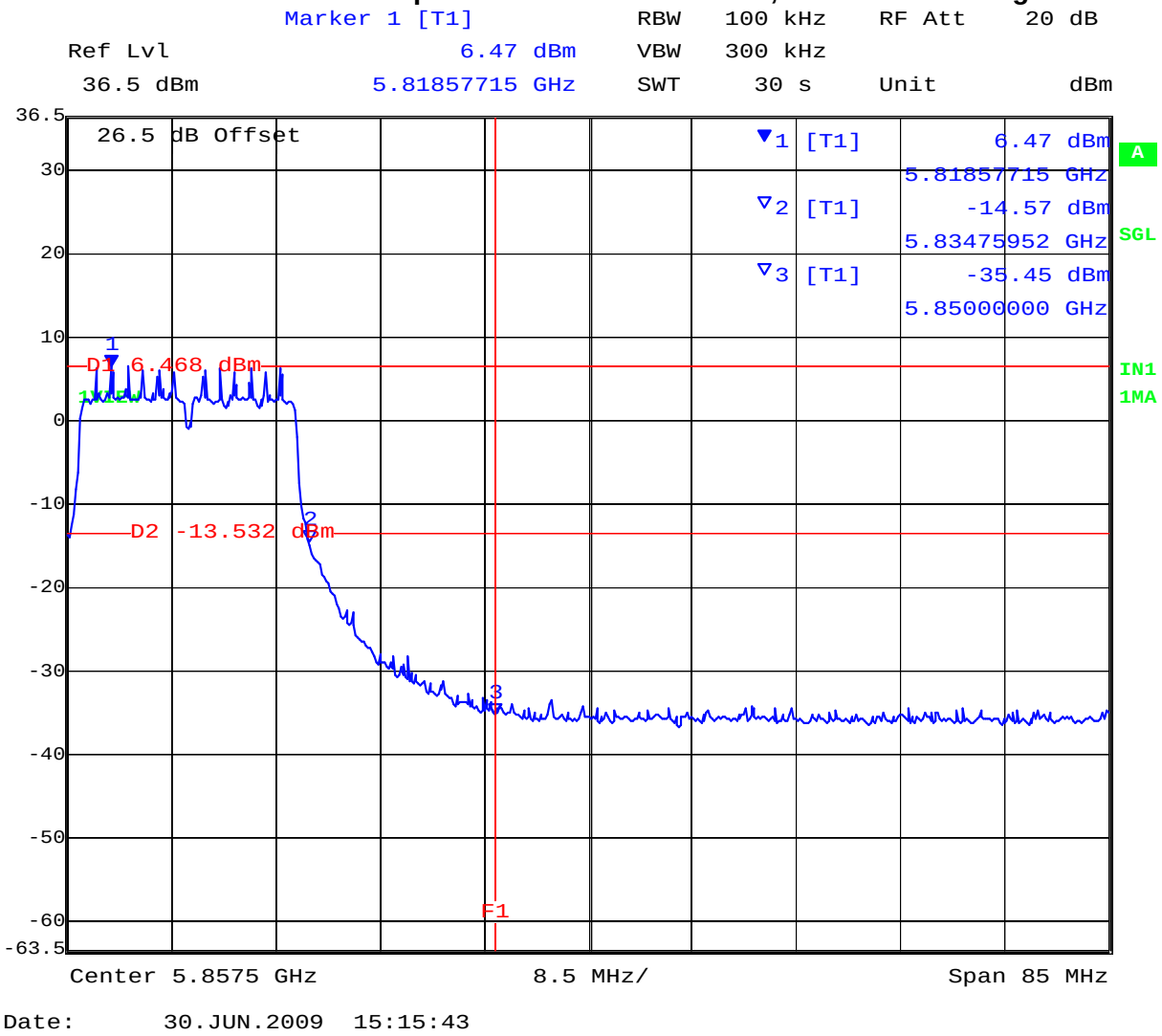
n HT-20 Conducted Spurious Emissions at the 5,850 MHz Band Edge



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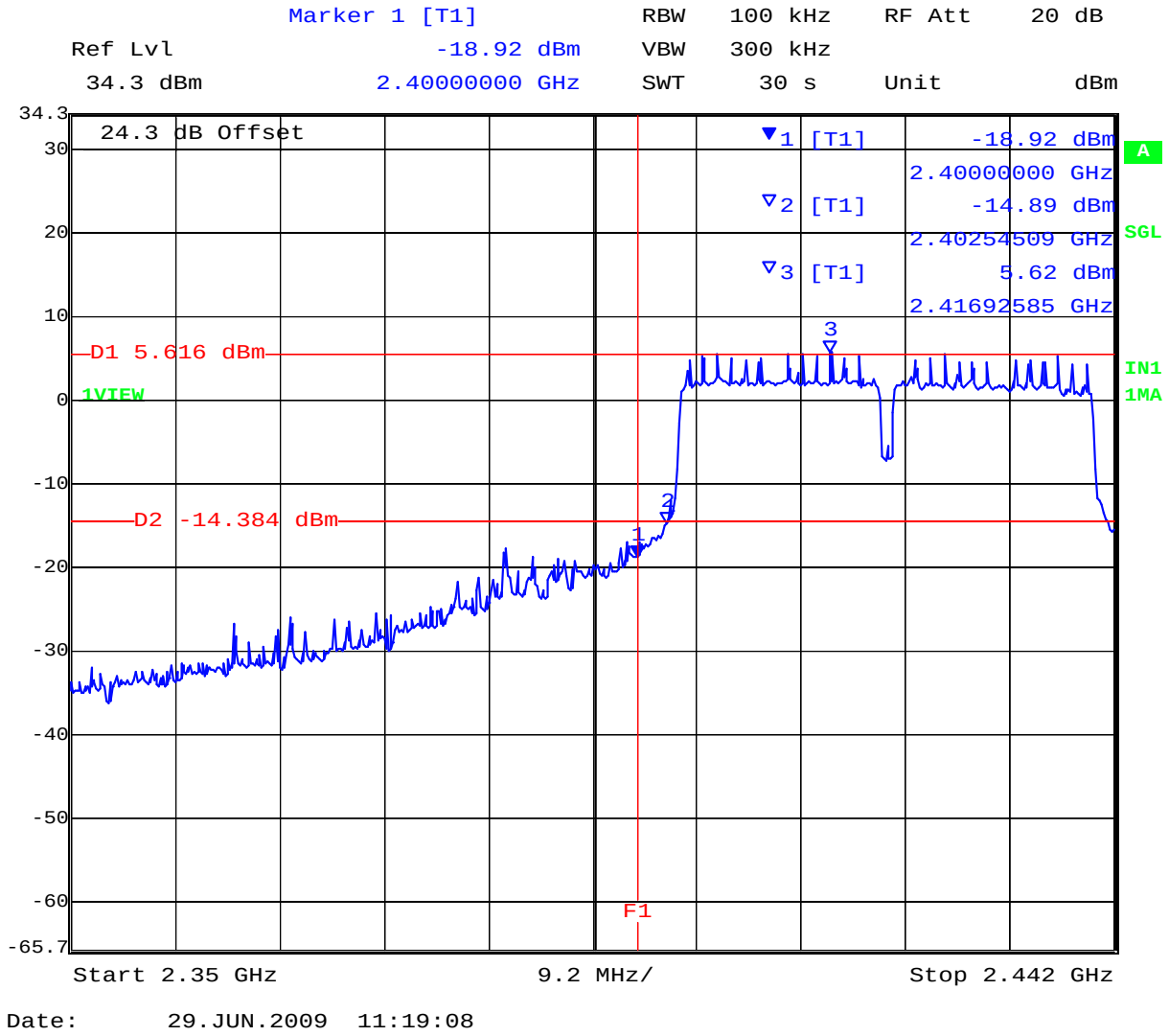
Conducted Band-Edge Results

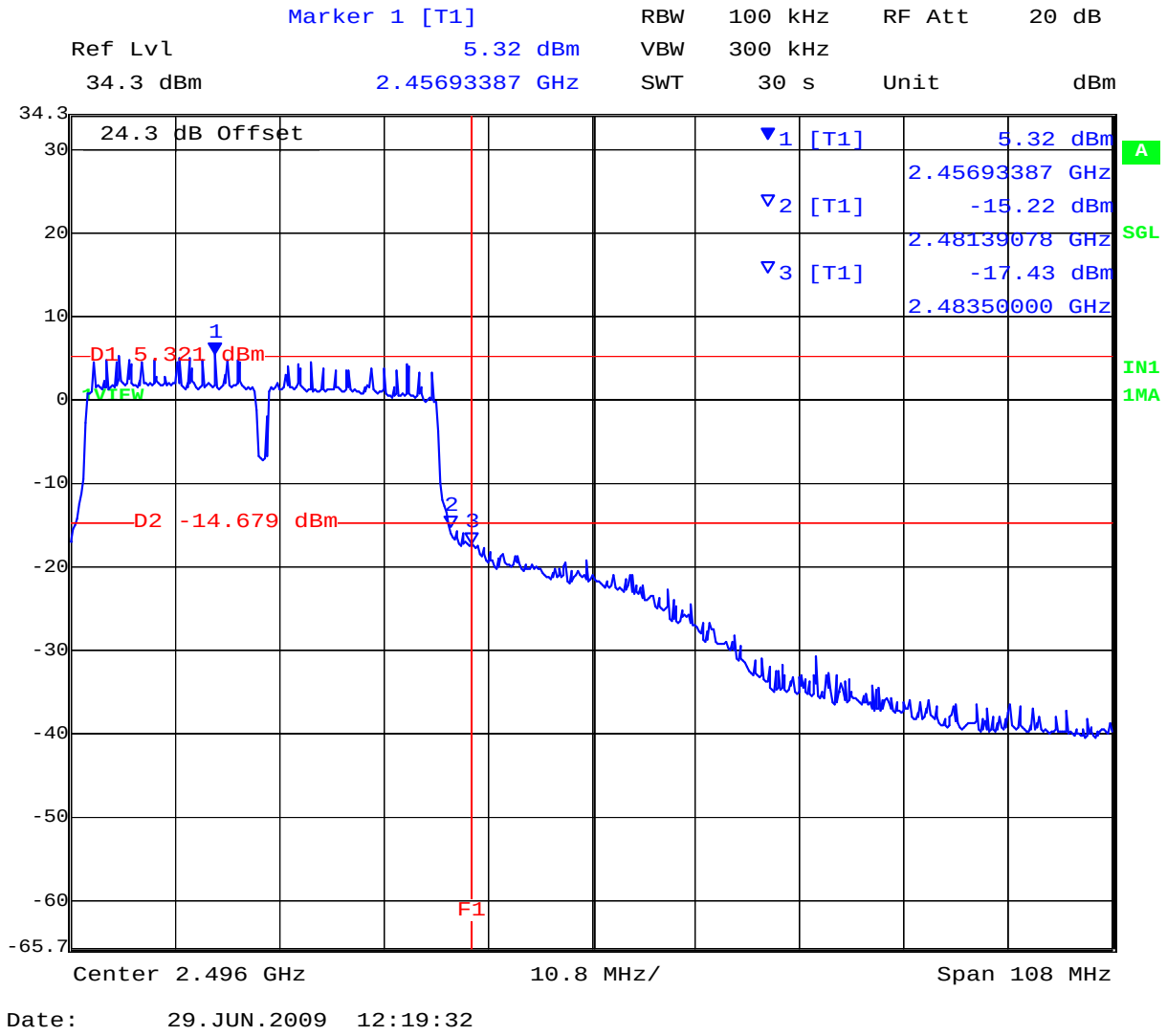
TABLE OF RESULTS – **802.11n HT-40**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,422	2,400	-14.384	-18.92	-4.536
2,452	2,483.5	-14.679	-17.43	-2.751

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



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

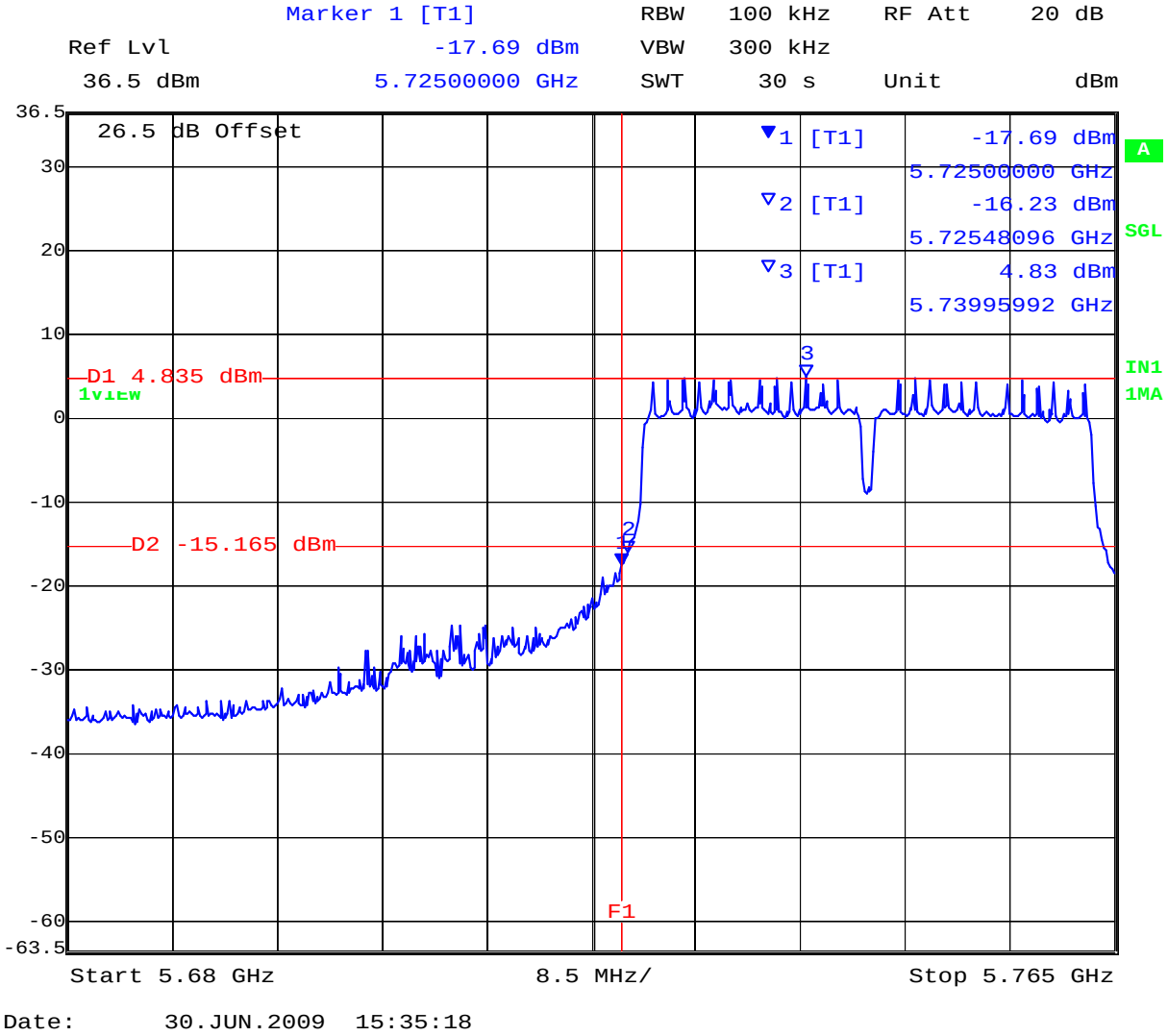


Date: 29.JUN.2009 12:19:32

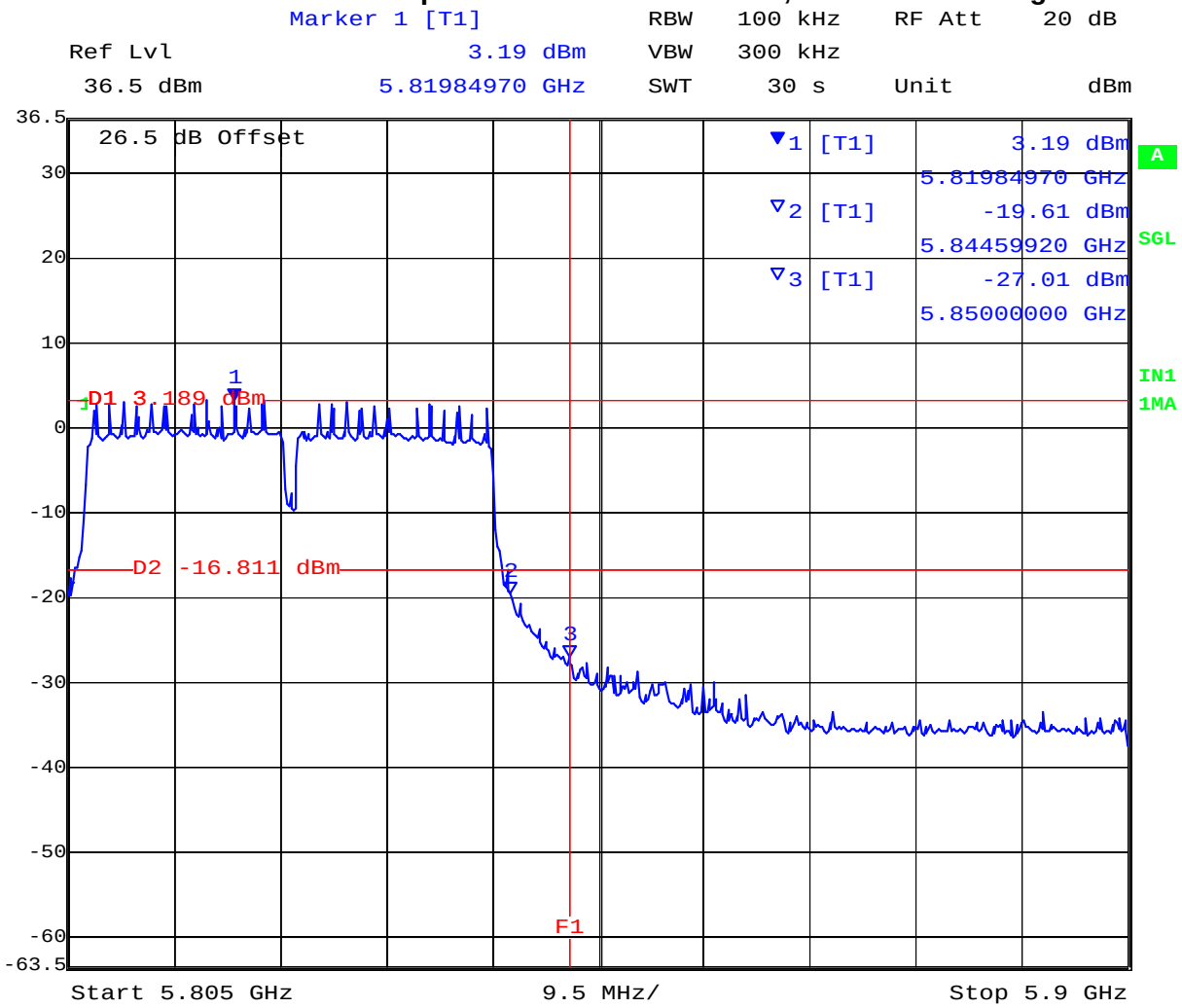
TABLE OF RESULTS – **802.11n HT-40**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
5,745	5,725	-15.165	-17.69	-2.525
5,825	5,850	-16.811	-27.01	-10.199

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



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



Date: 30.JUN.2009 15:42:59

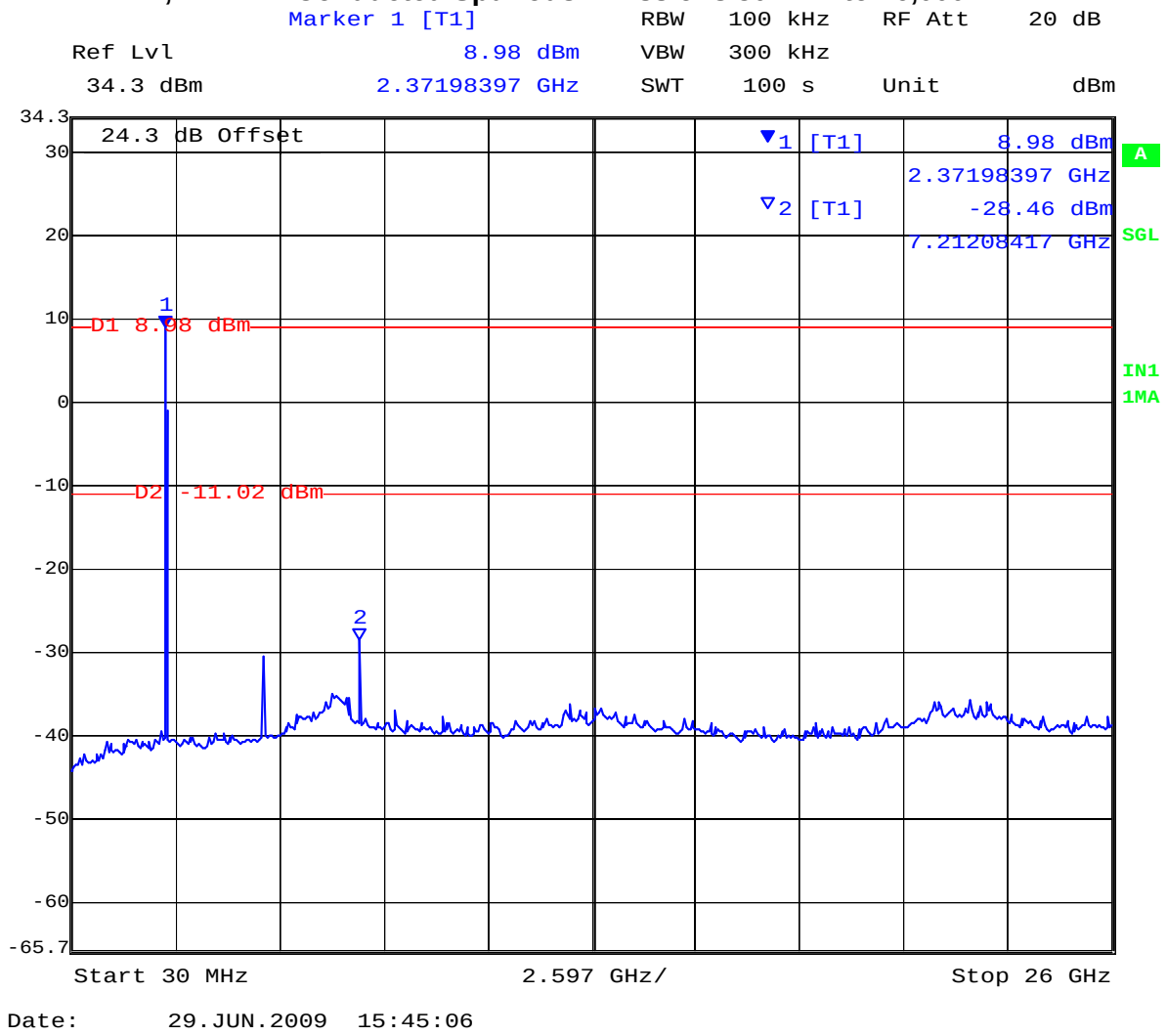
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-28.46	-11.02	-17.44

802.11b – Legacy

2,412 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



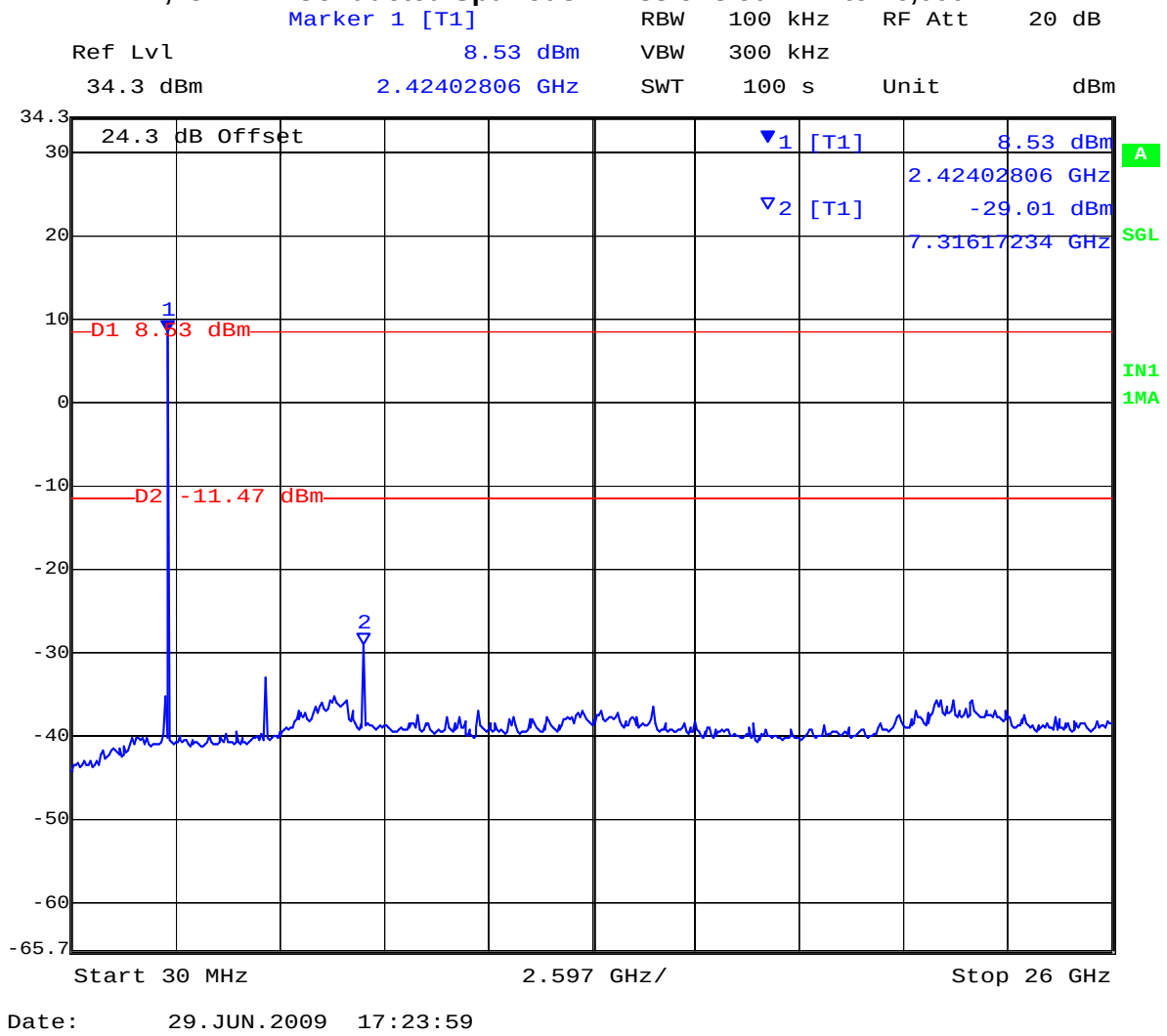
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-29.01	-11.47	-17.54

802.11b – Legacy

2,437 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



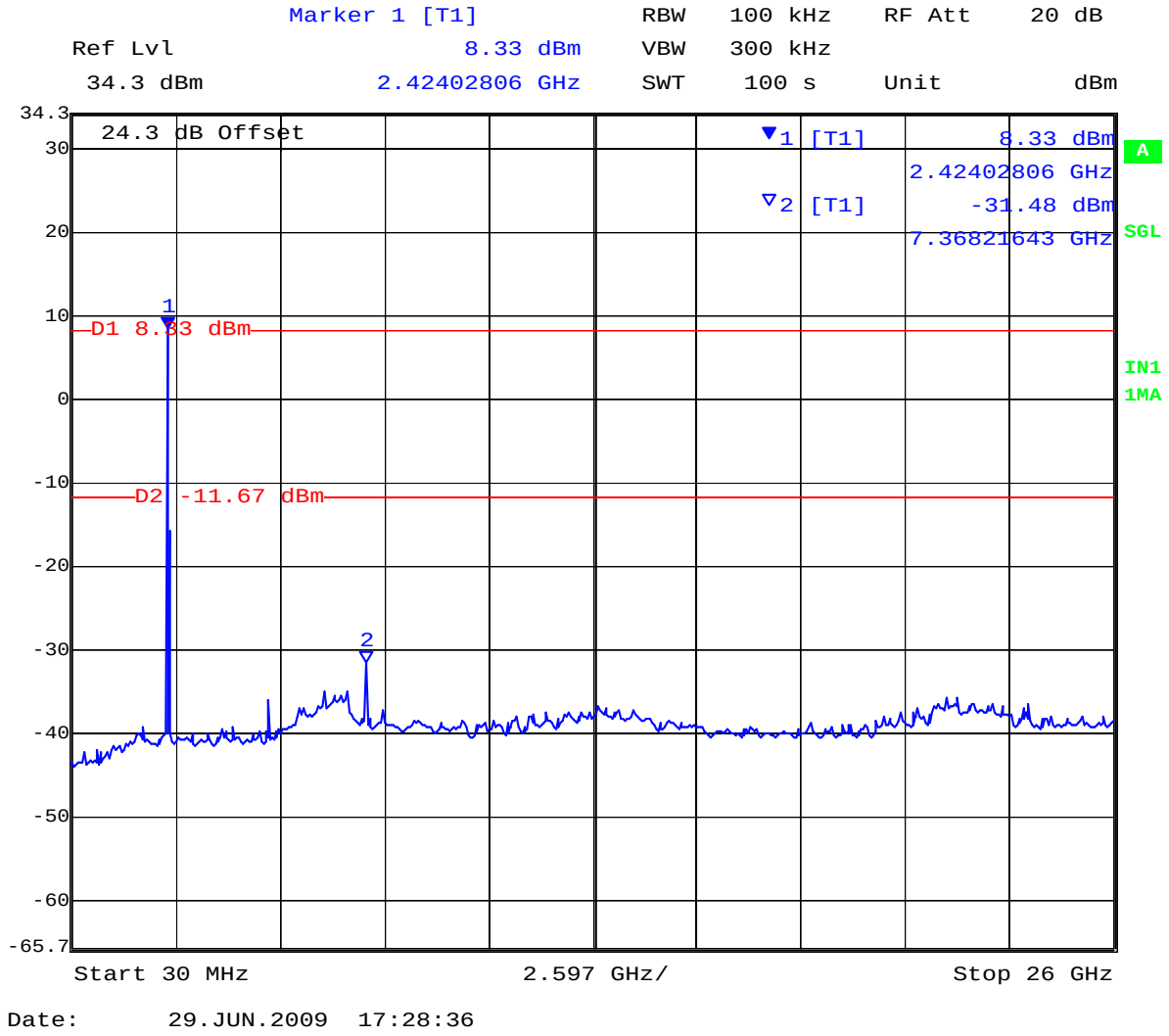
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-31.48	-11.67	-19.81

802.11b – Legacy

2,462 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



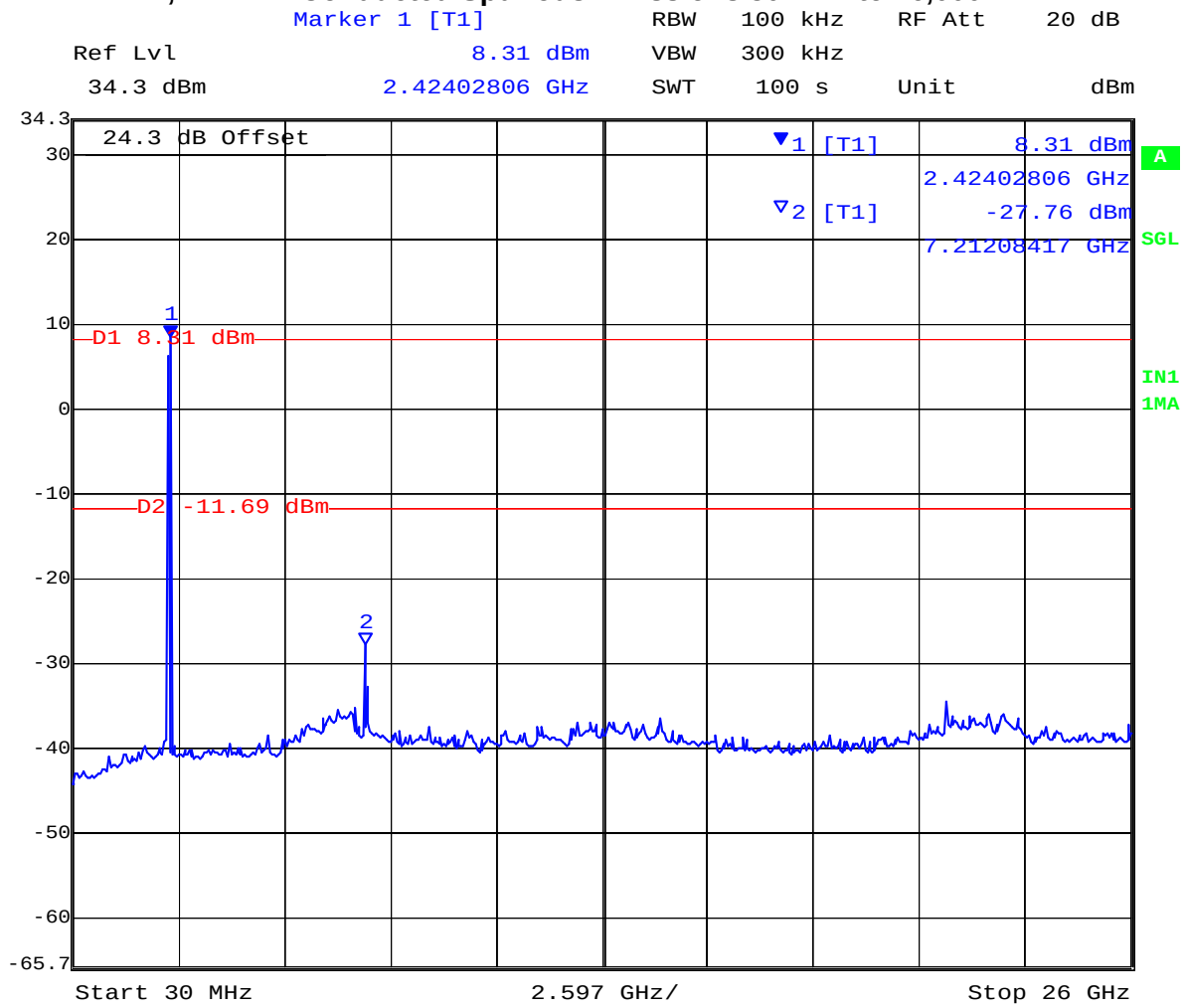
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-27.76	-11.69	-16.07

802.11g – Legacy

2,412 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



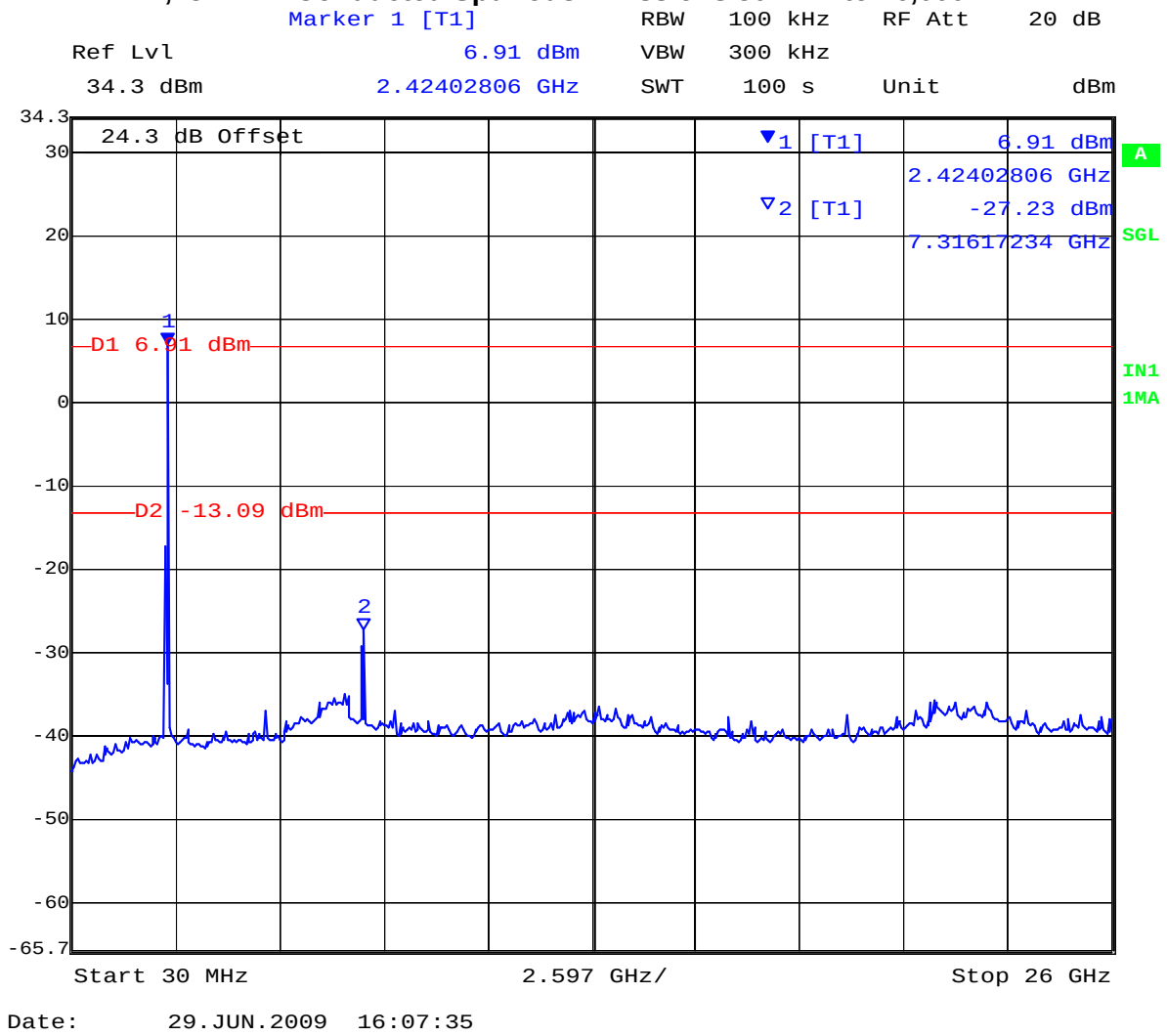
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-27.23	-13.09	-14.14

802.11g – Legacy

2,437 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



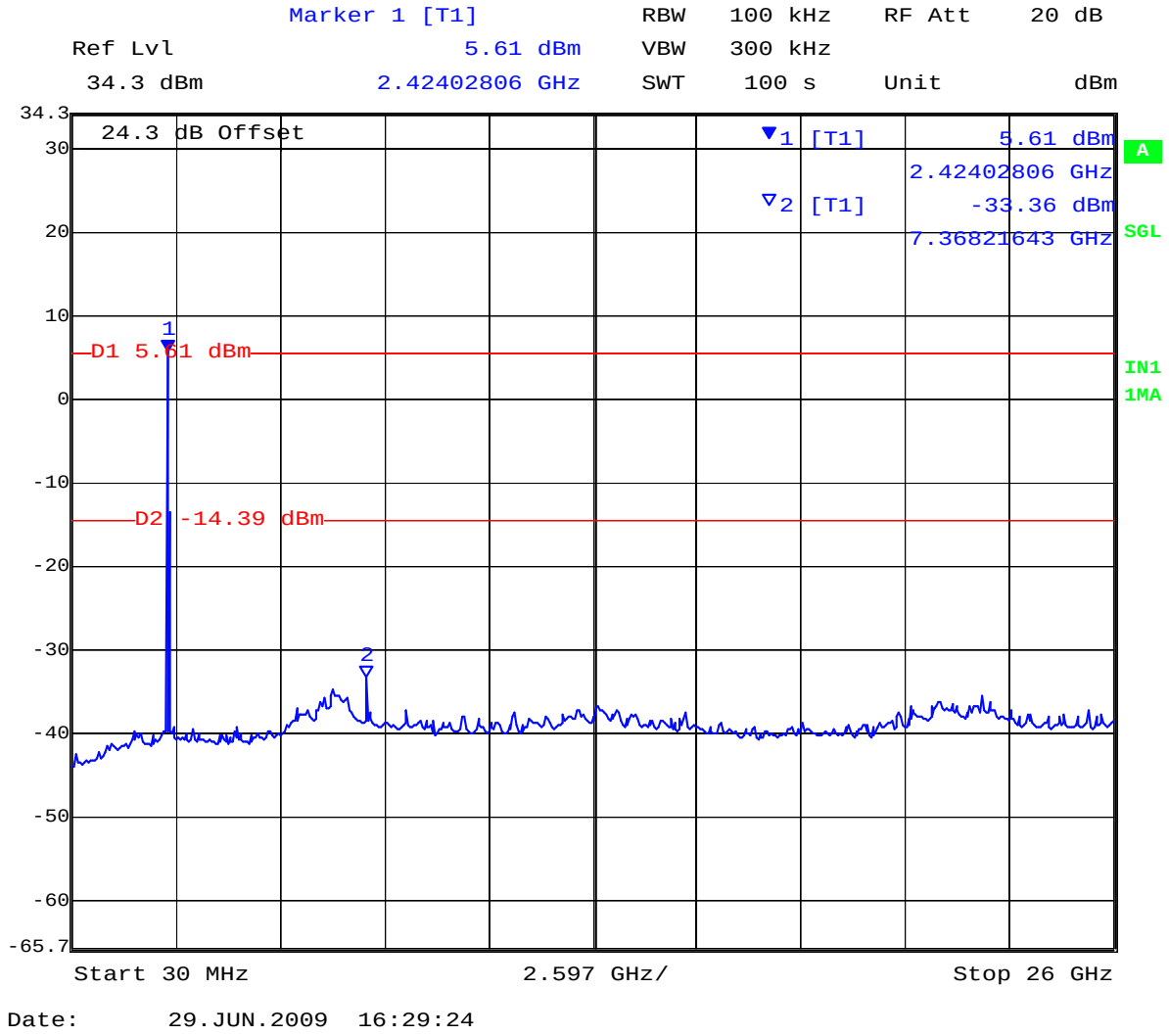
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-33.36	-14.39	-18.97

802.11g – Legacy

2,462 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



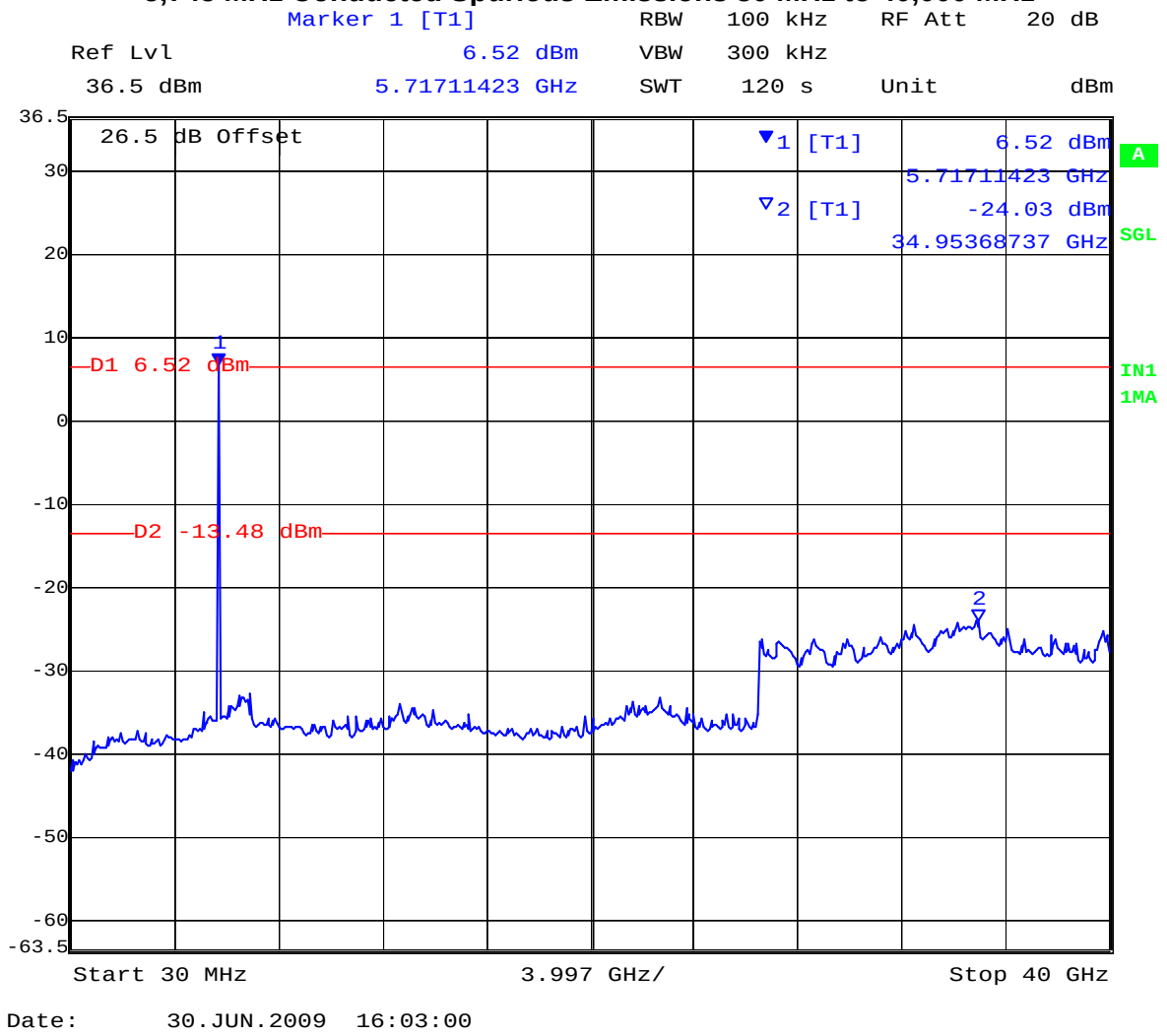
Spurious Emissions (30 - 40,000 MHz)

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	-24.03	-13.48	-10.55

802.11a – Legacy

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



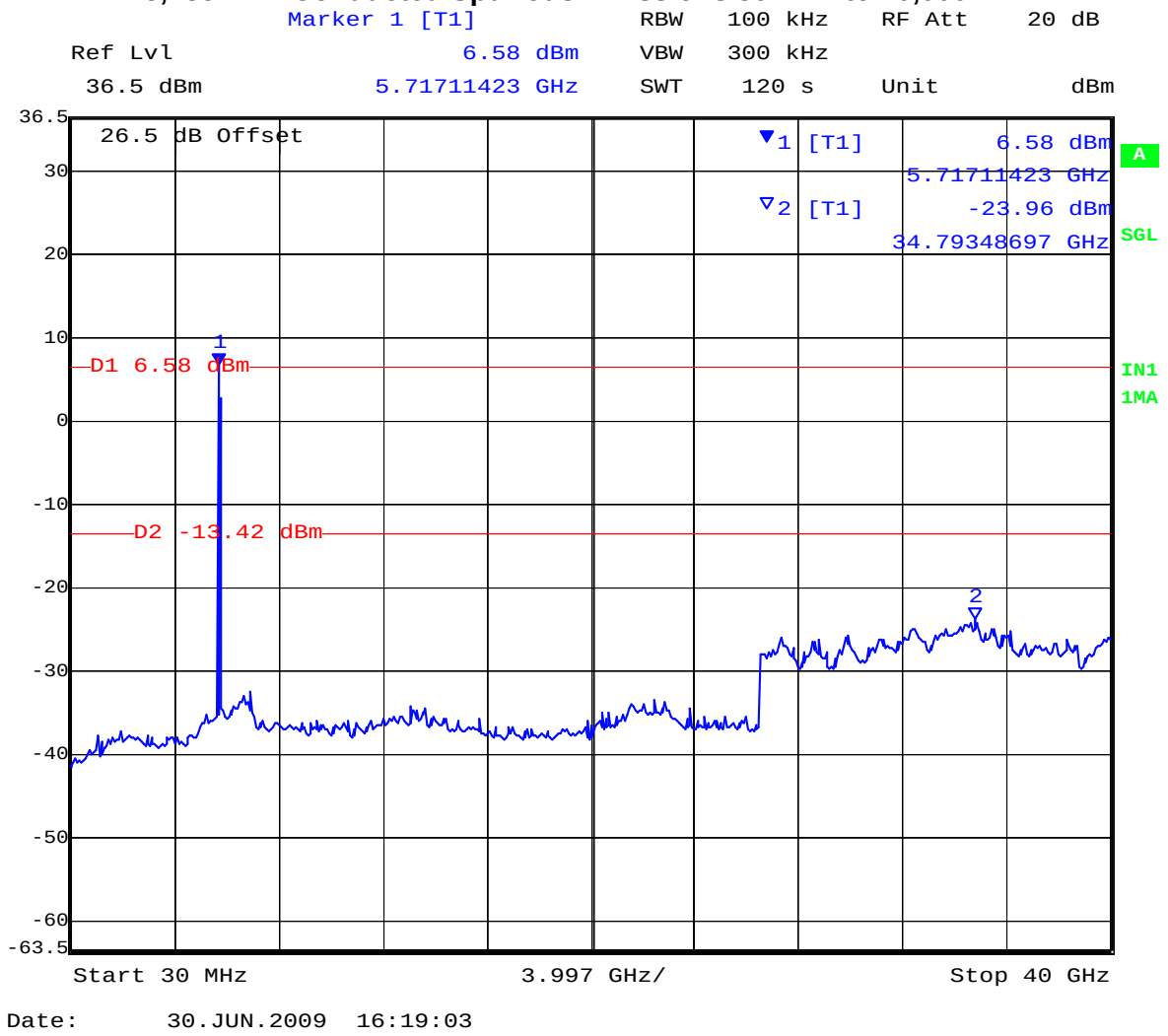
Spurious Emissions (30 - 40,000 MHz)

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	-23.96	-13.42	-10.54

802.11a – Legacy

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



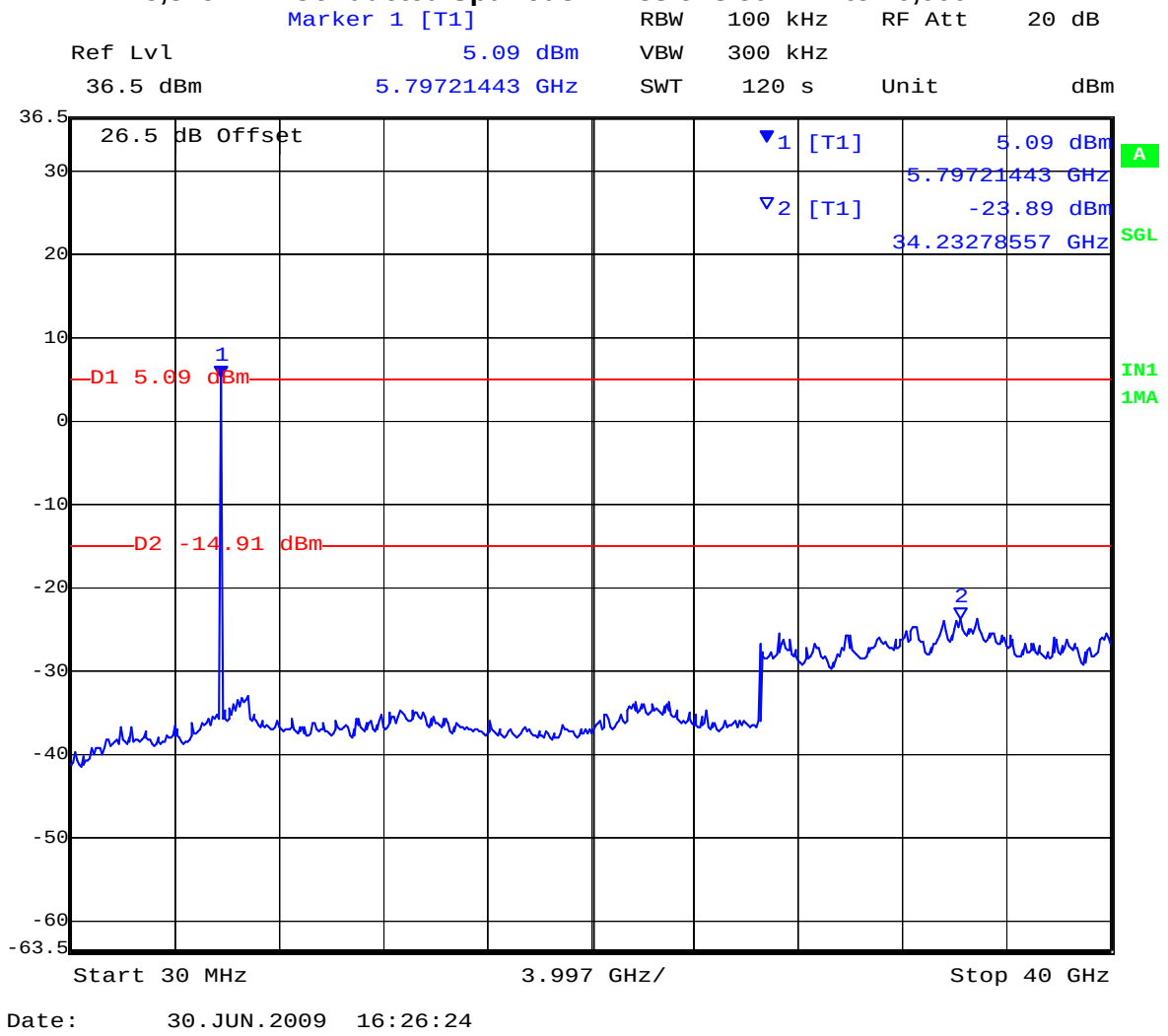
Spurious Emissions (30 - 40,000 MHz)

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	-23.89	-14.91	-8.98

802.11a – Legacy

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



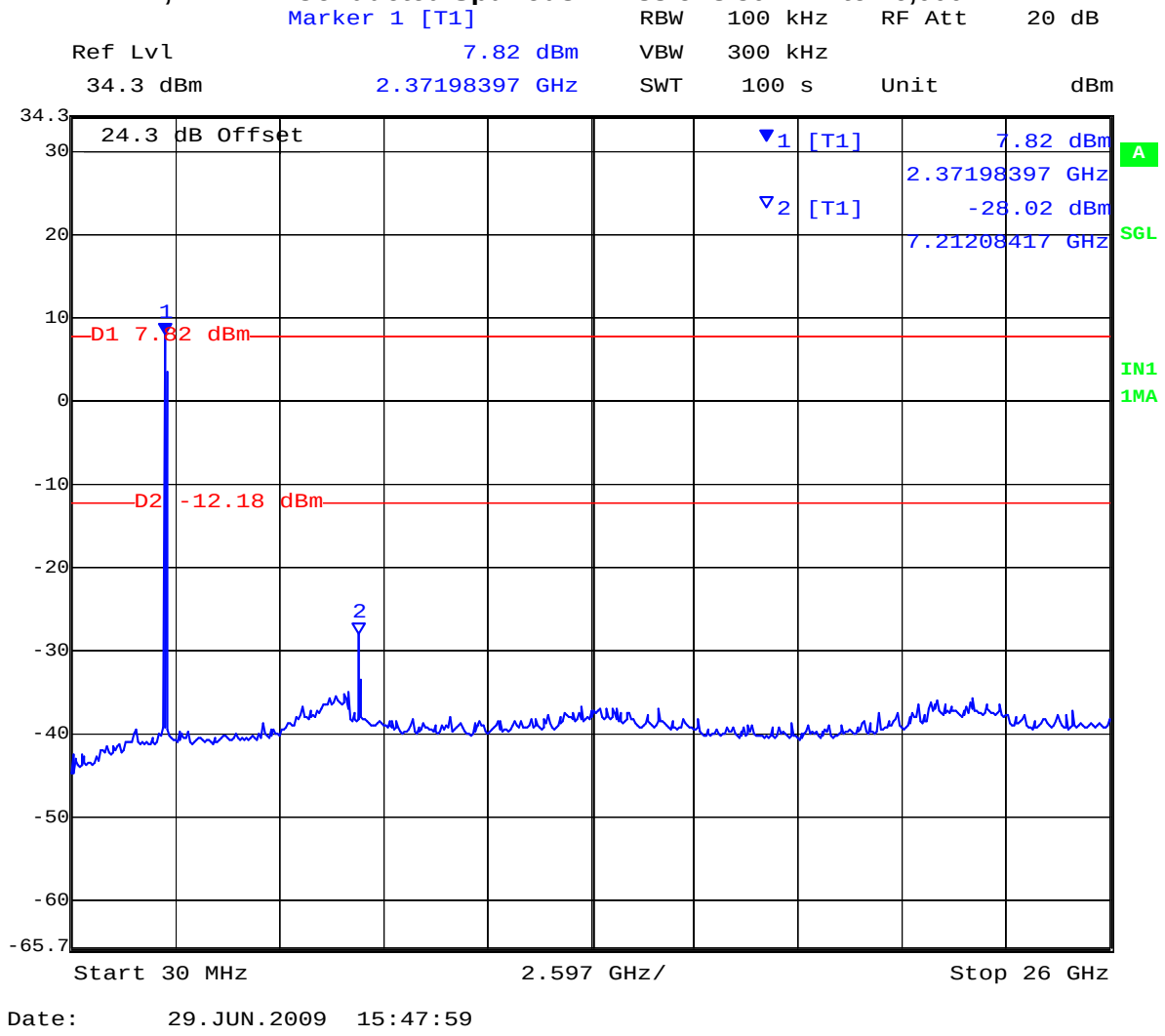
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-28.02	-12.18	-15.84

802.11n HT-20

2,412 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



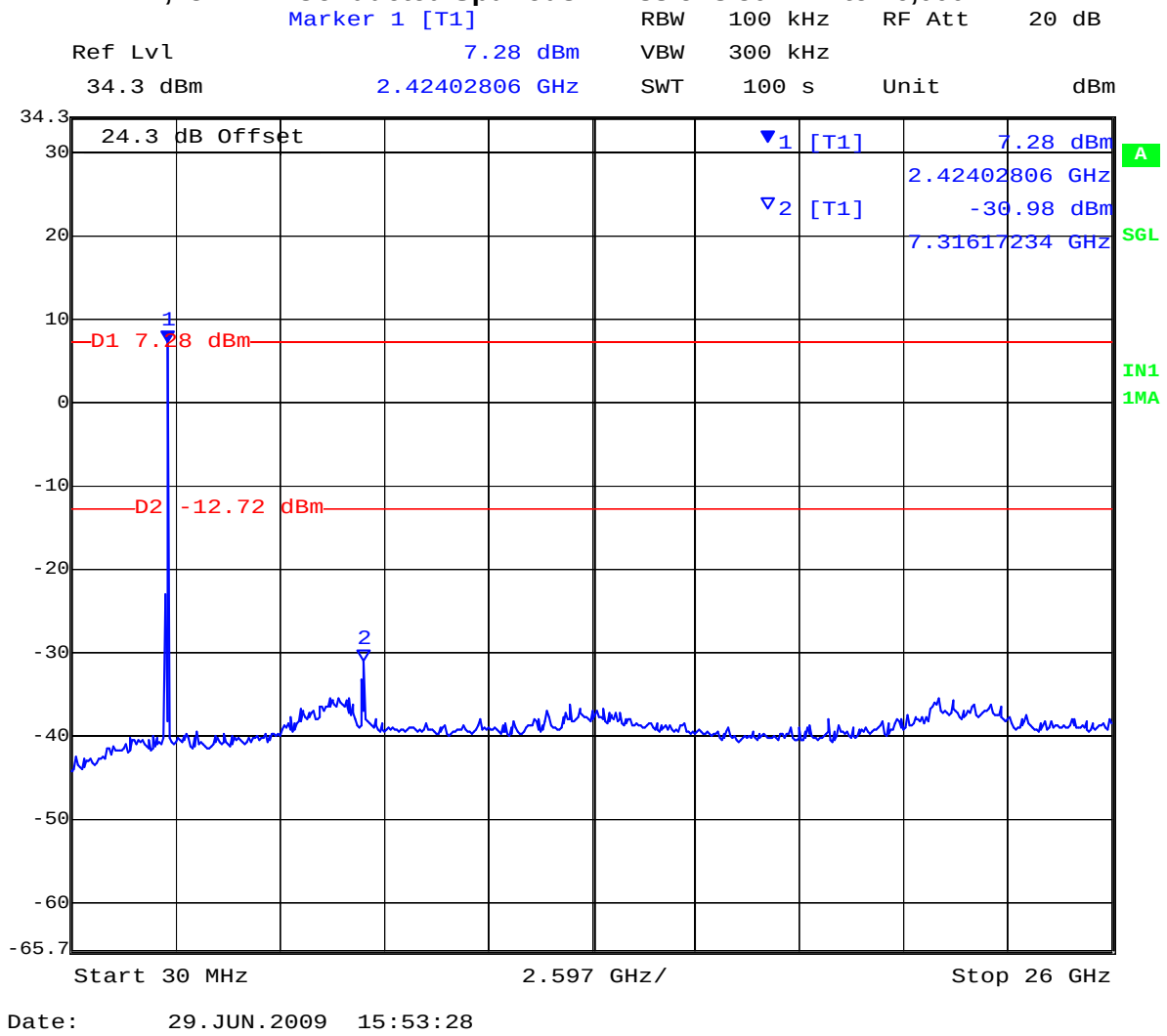
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-30.98	-12.72	-18.26

802.11n HT-20

2,437 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



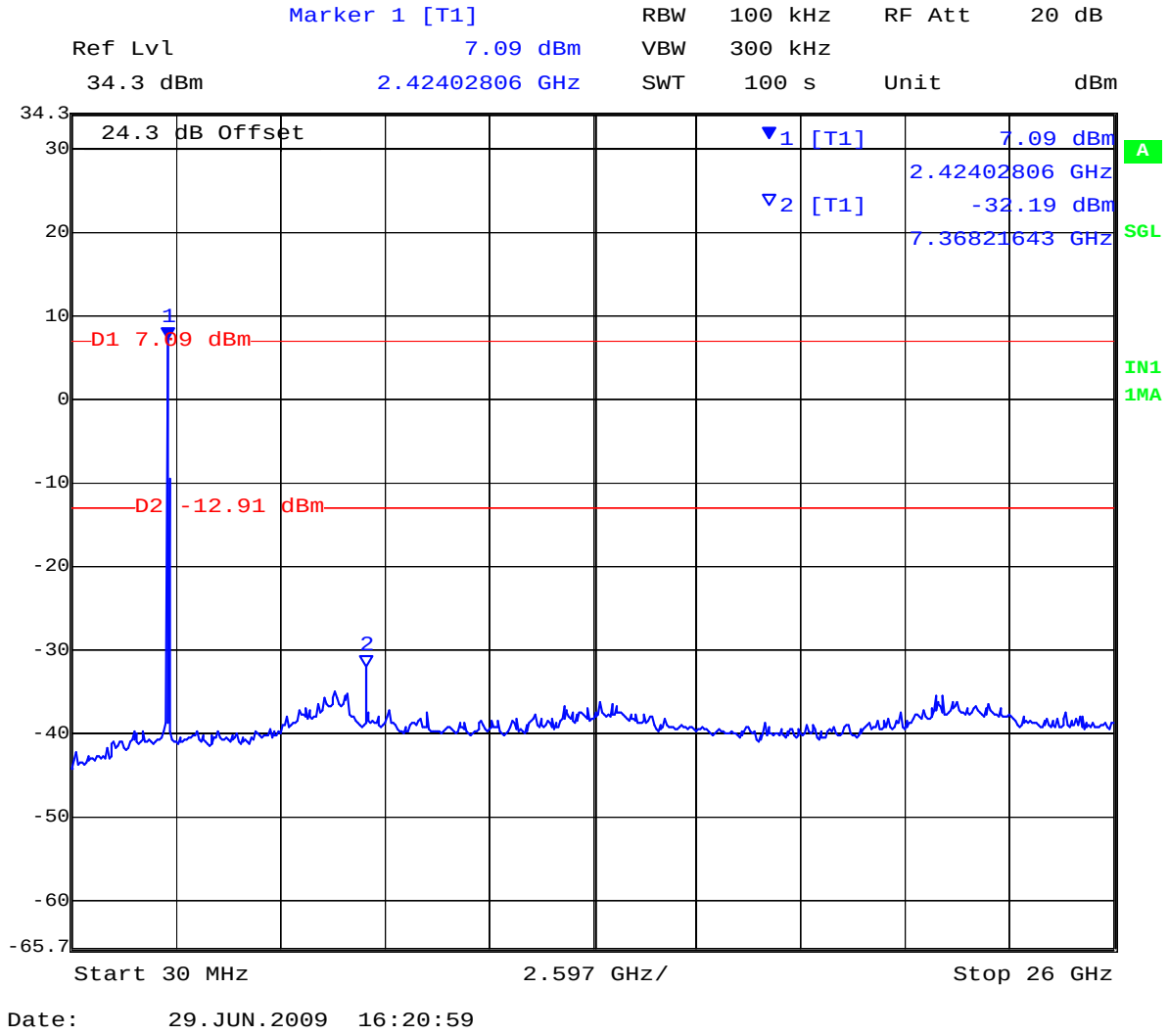
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-32.19	-12.91	-19.28

802.11n HT-20

2,462 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



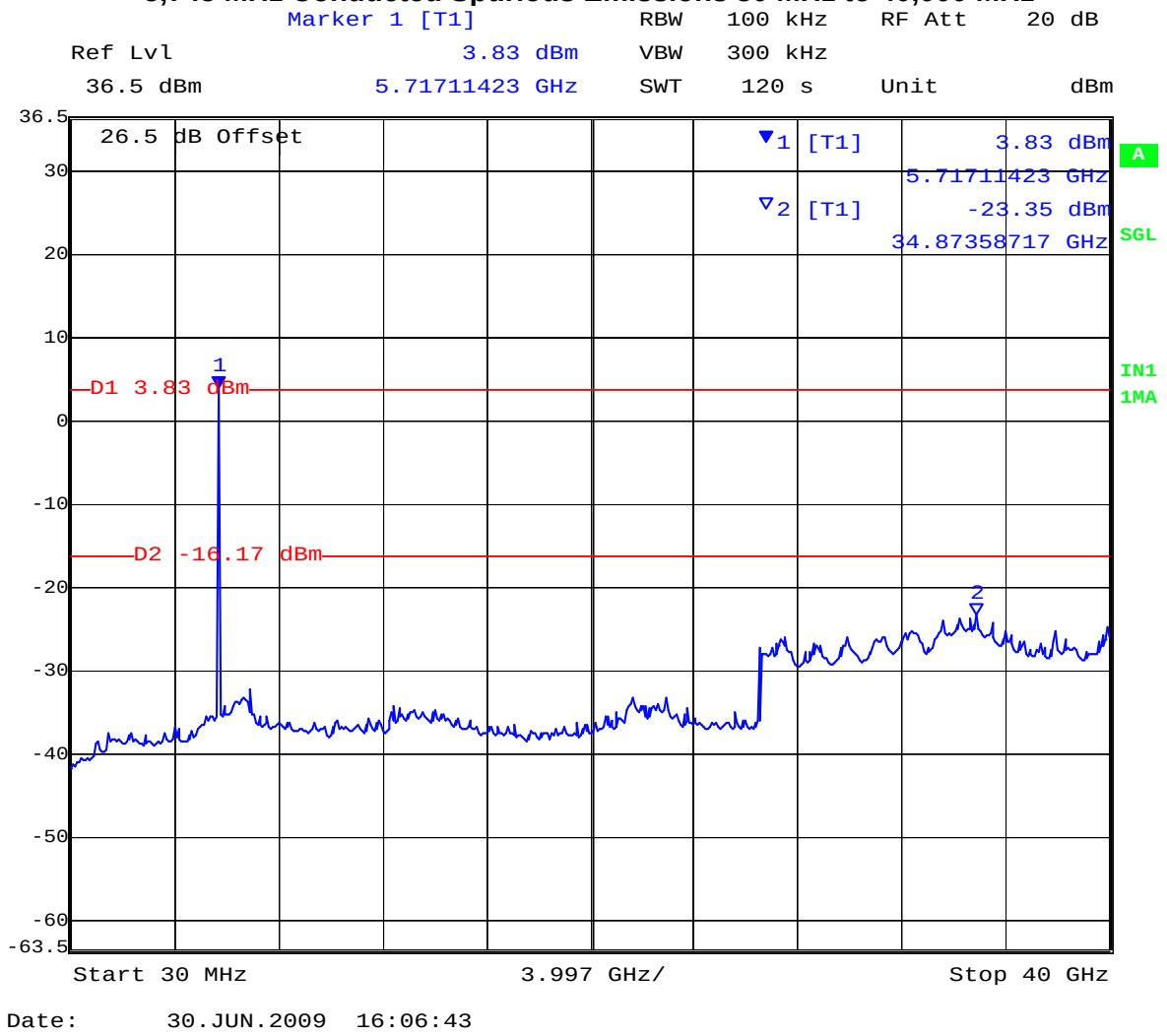
Spurious Emissions (30 - 40,000 MHz)

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	-23.35	-16.17	-7.18

802.11n HT-20

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



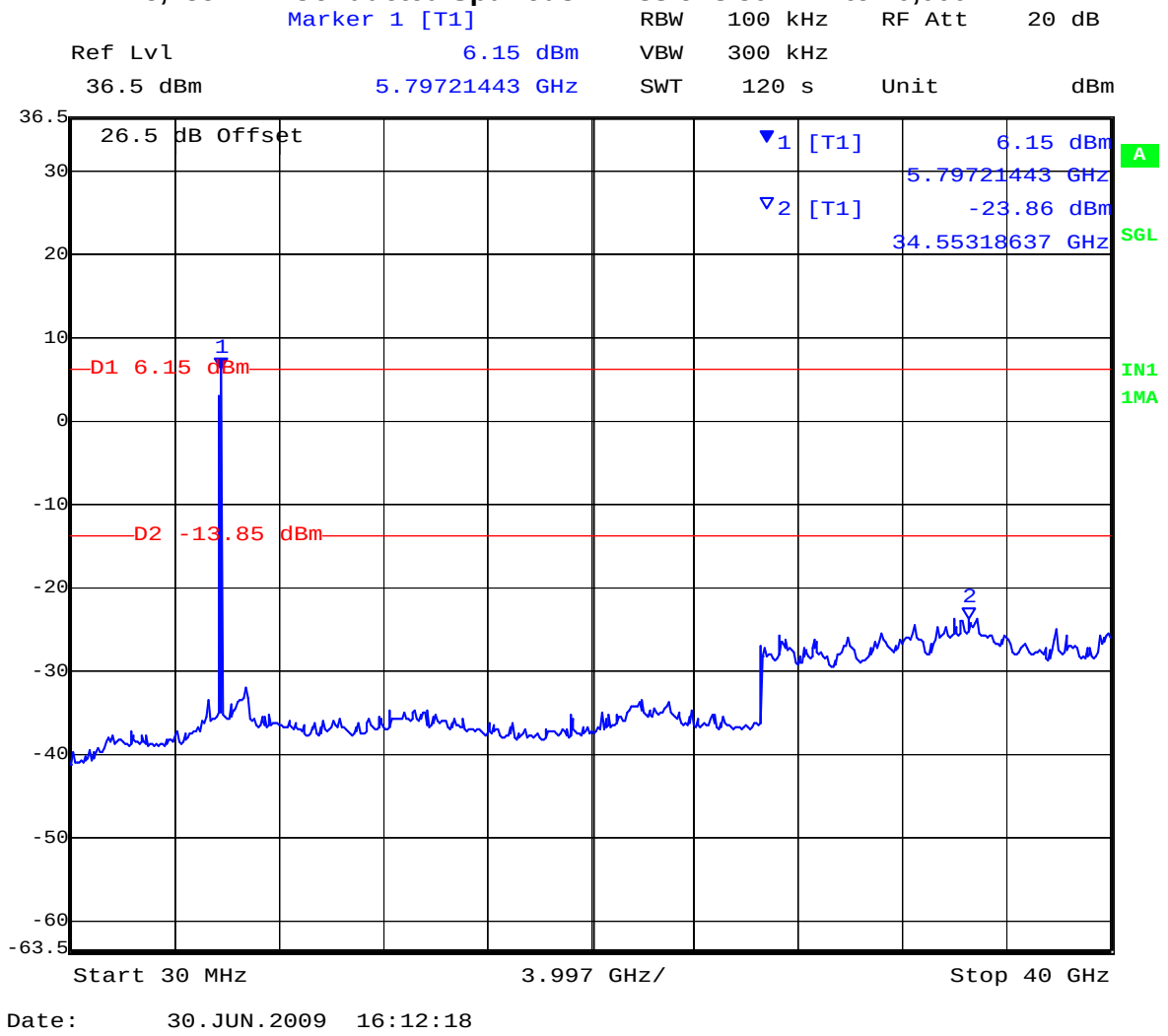
Spurious Emissions (30 - 40,000 MHz)

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	-23.86	-13.85	-10.01

802.11n HT-20

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



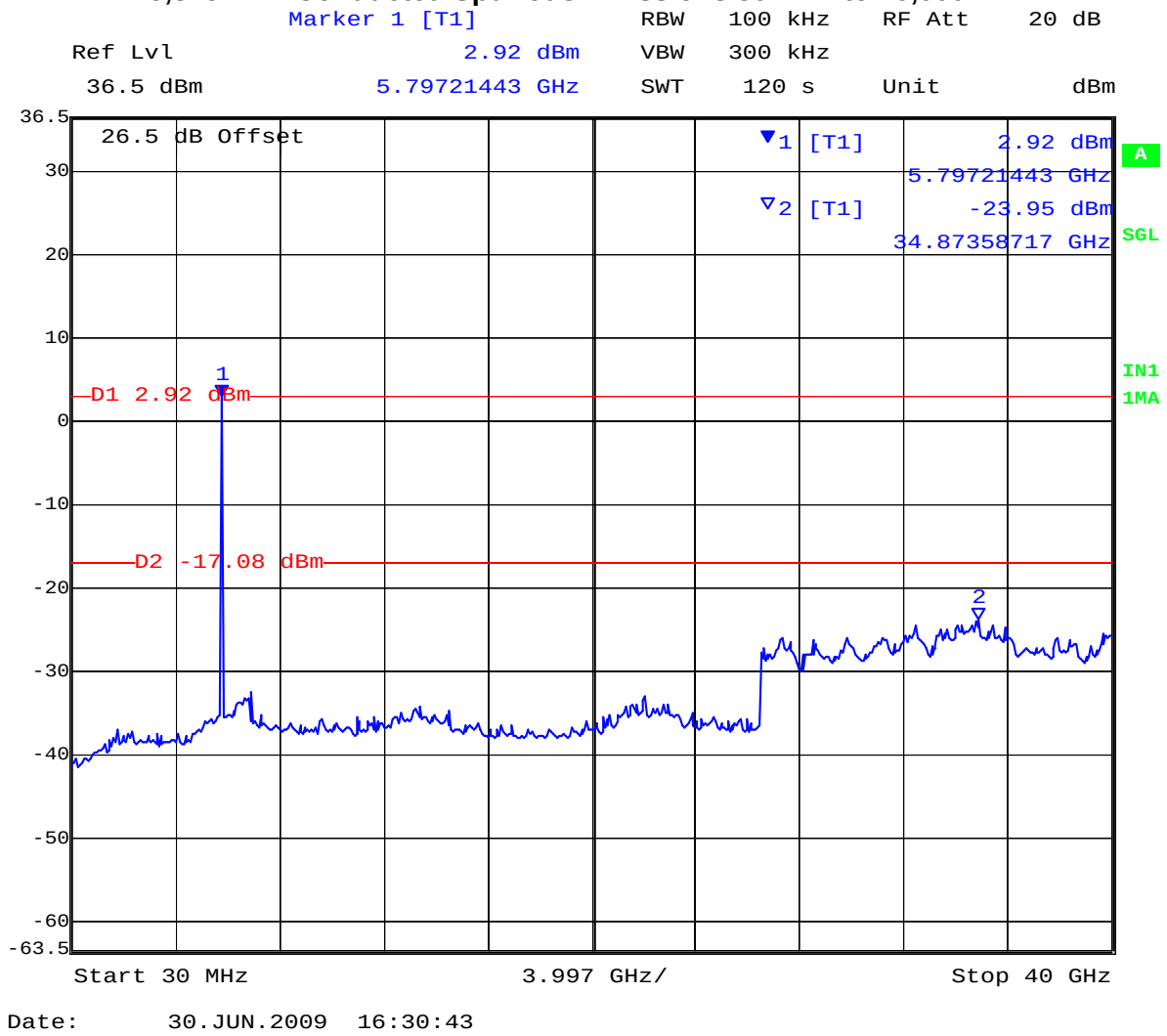
Spurious Emissions (30 - 40,000 MHz)

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	-23.95	-17.08	-6.87

802.11n HT-20

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



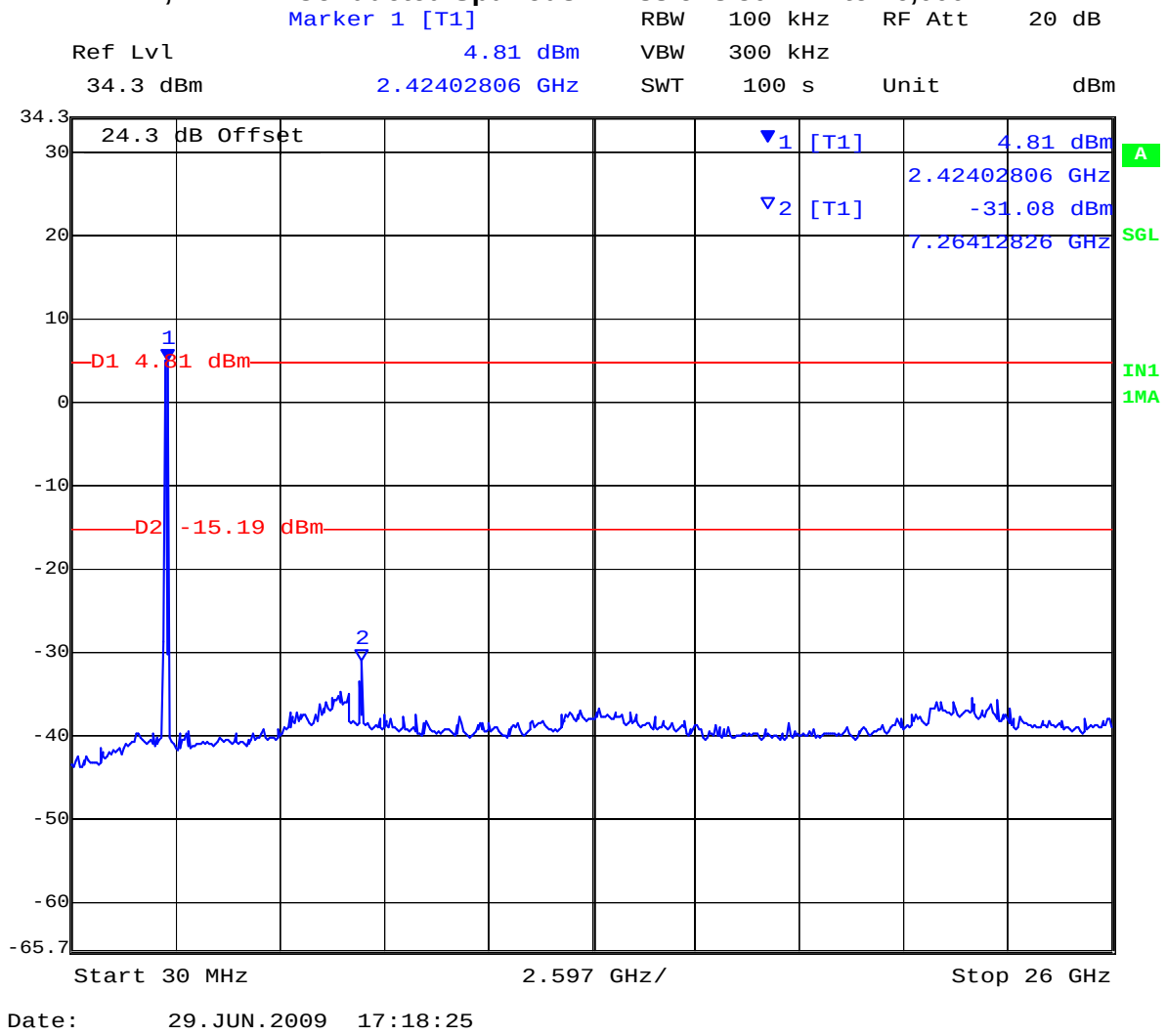
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-31.08	-15.19	-15.89

802.11n – HT-40

2,422 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



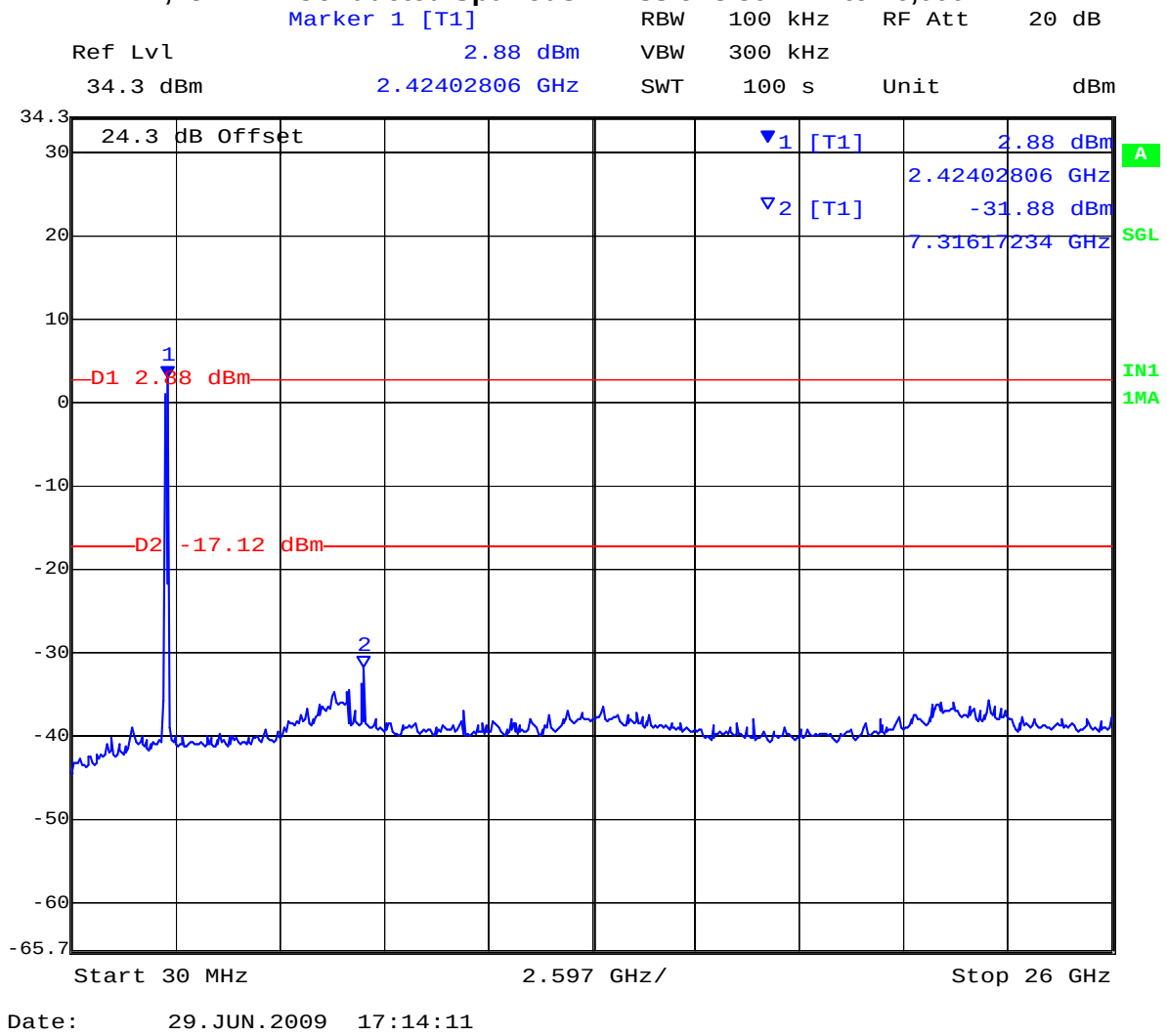
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-31.88	-17.22	-14.66

802.11n HT-40

2,437 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



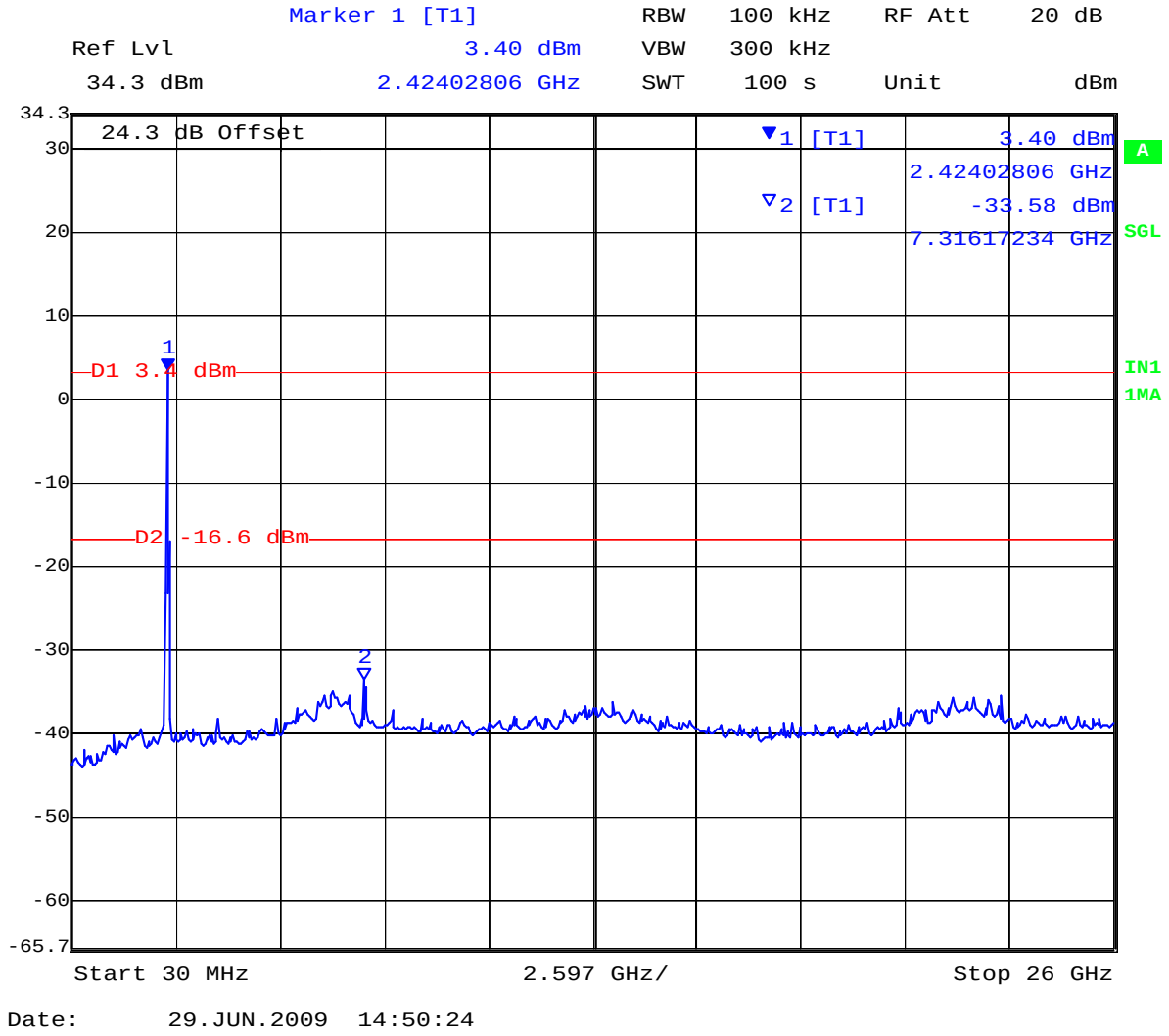
Spurious Emissions (30 - 26,000 MHz)

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	26,000	-33.58	-16.6	-16.98

802.11n HT-40

2,452 MHz Conducted Spurious Emissions 30 MHz to 26,000 MHz



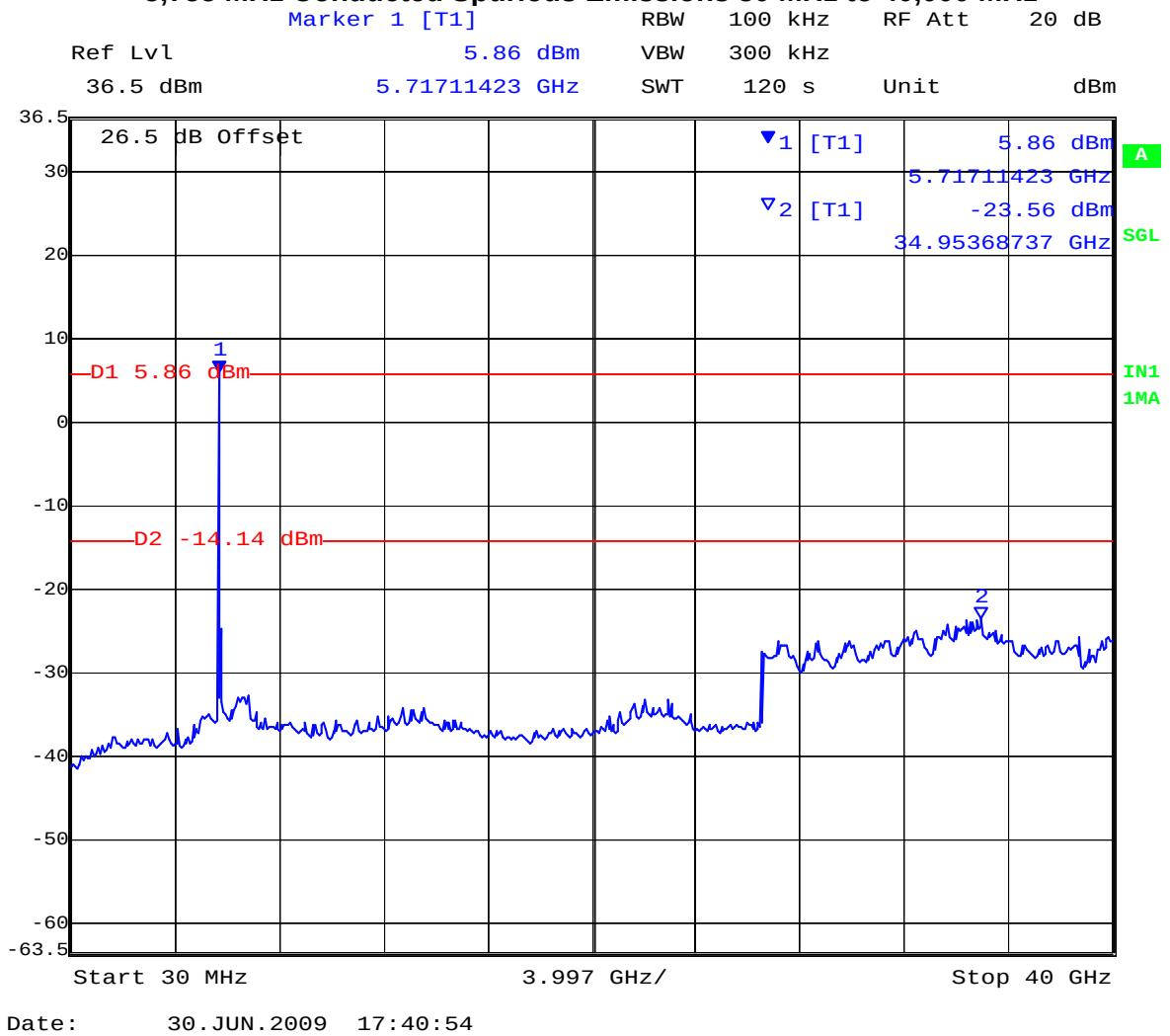
Spurious Emissions (30 - 40,000 MHz)

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)
5,755	30	40,000	-23.56	-14.14	-9.42

802.11n HT-40

5,755 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



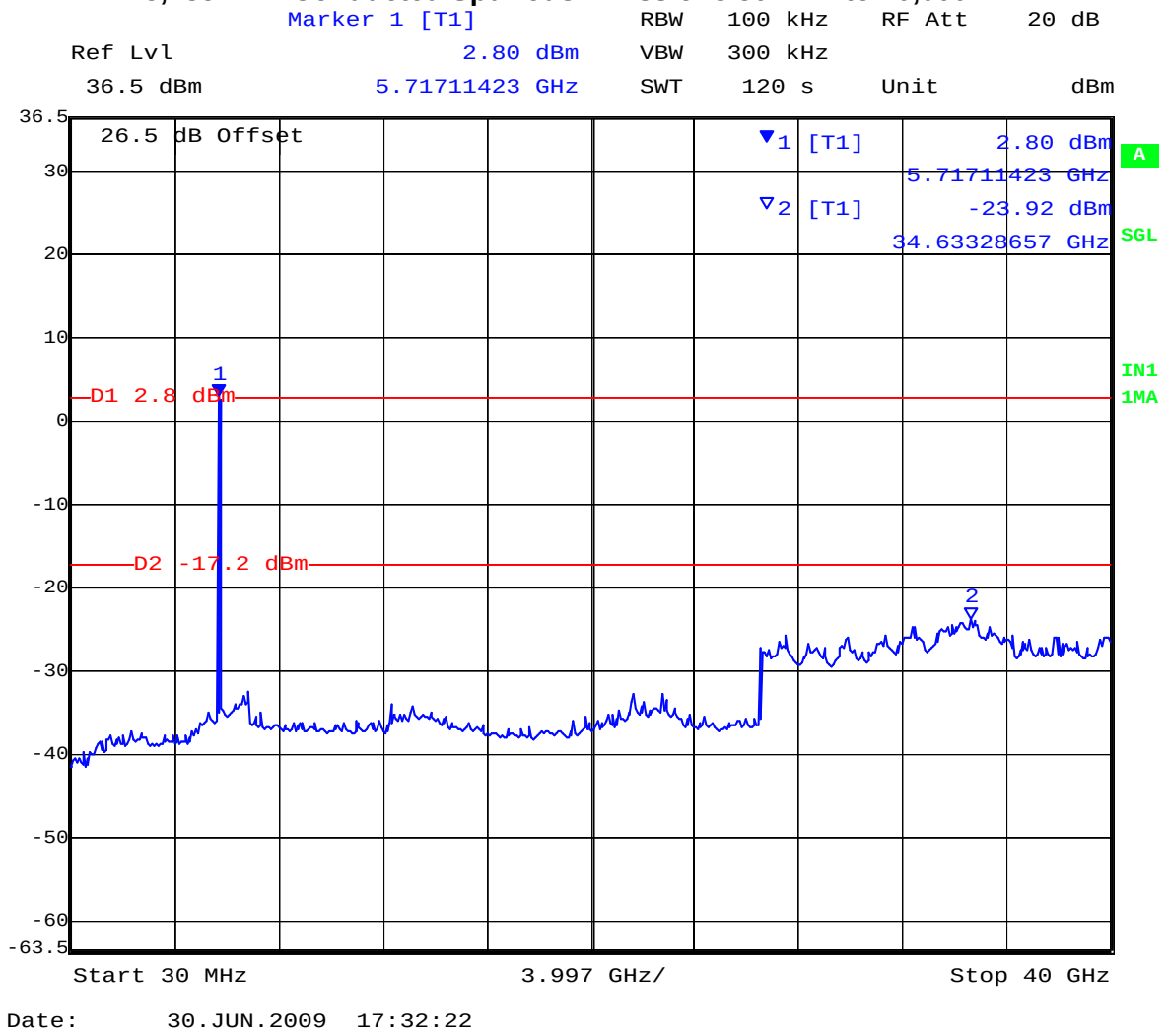
Spurious Emissions (30 - 40,000 MHz)

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	-23.92	-17.2	-6.72

802.11n HT-40

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



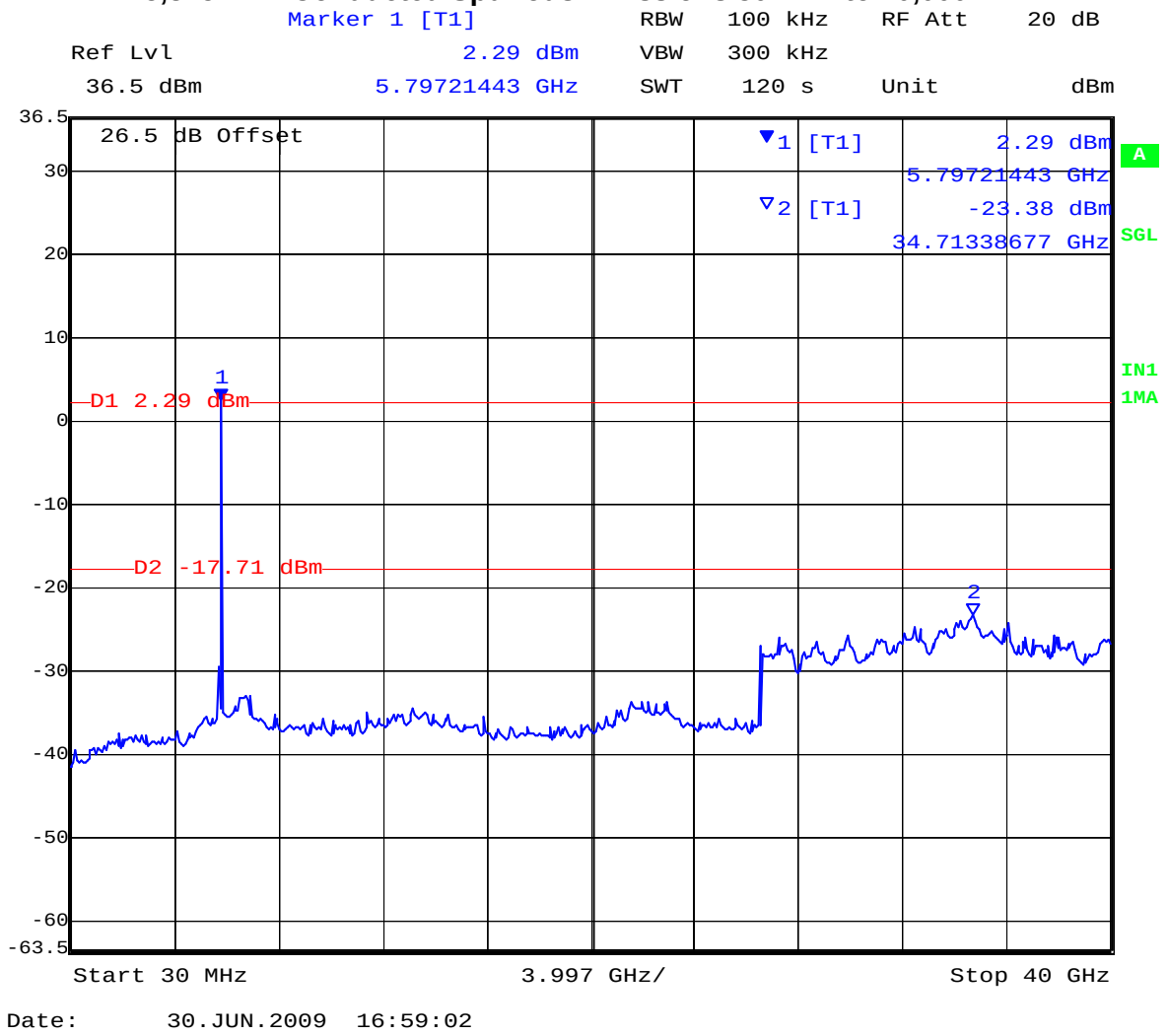
Spurious Emissions (30 - 40,000 MHz)

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)
5,815	30	40,000	-23.38	-17.71	-5.67

802.11n HT-40

5,815 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



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, 0287, 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

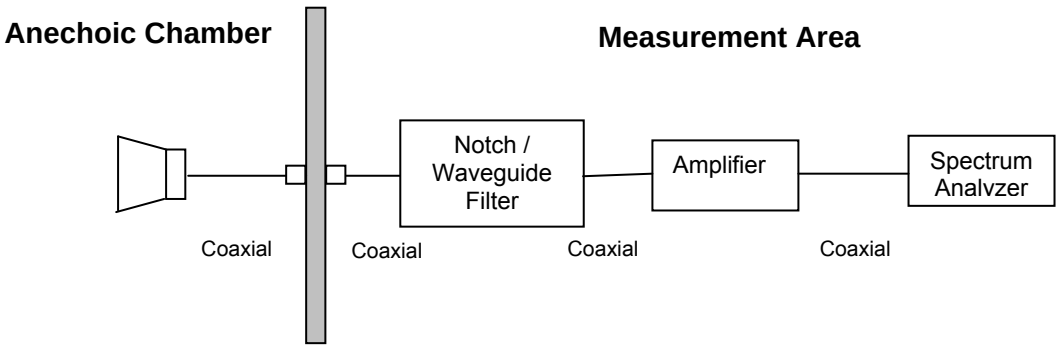
FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2, §2.6
Industry Canada RSS-Gen §4.7

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

For example:
Given receiver input reading of 51.5 dBμV; 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 dBμV/m

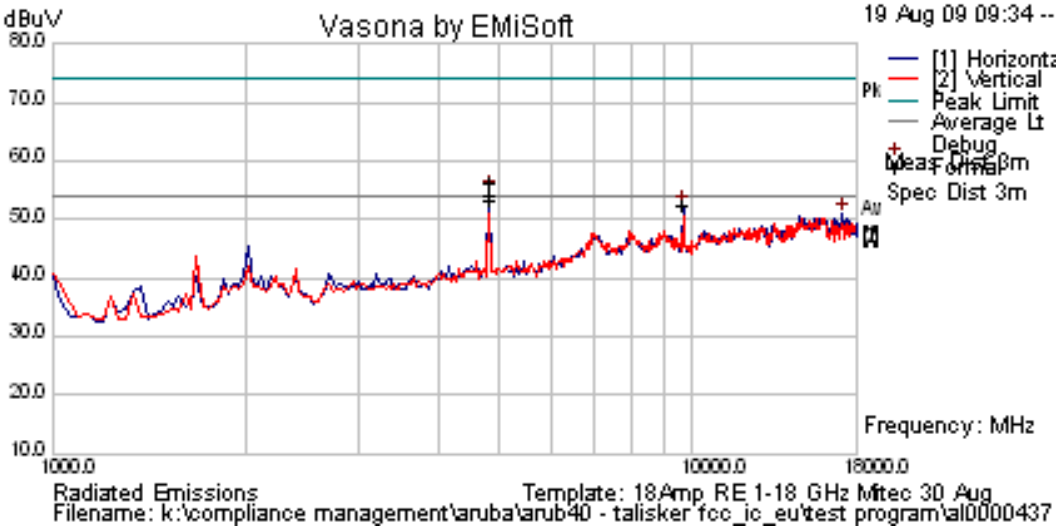
Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

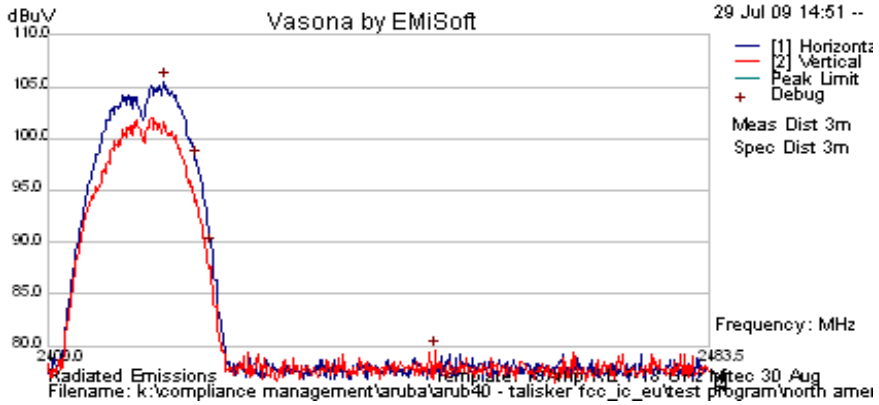
Ambient conditions.
Temperature: 17 to 23°C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Date	August 19th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2412; 802.11b;
Antenna Model	Integral Antenna Connected
Power setting	12 in ART Test Utility
Test Conditions	EUT with N.A. Power Supply, Ethernet Cable 2 for ART control EUT EMI New Shield; SN AL0000437 - ART Cal 08/18/2009

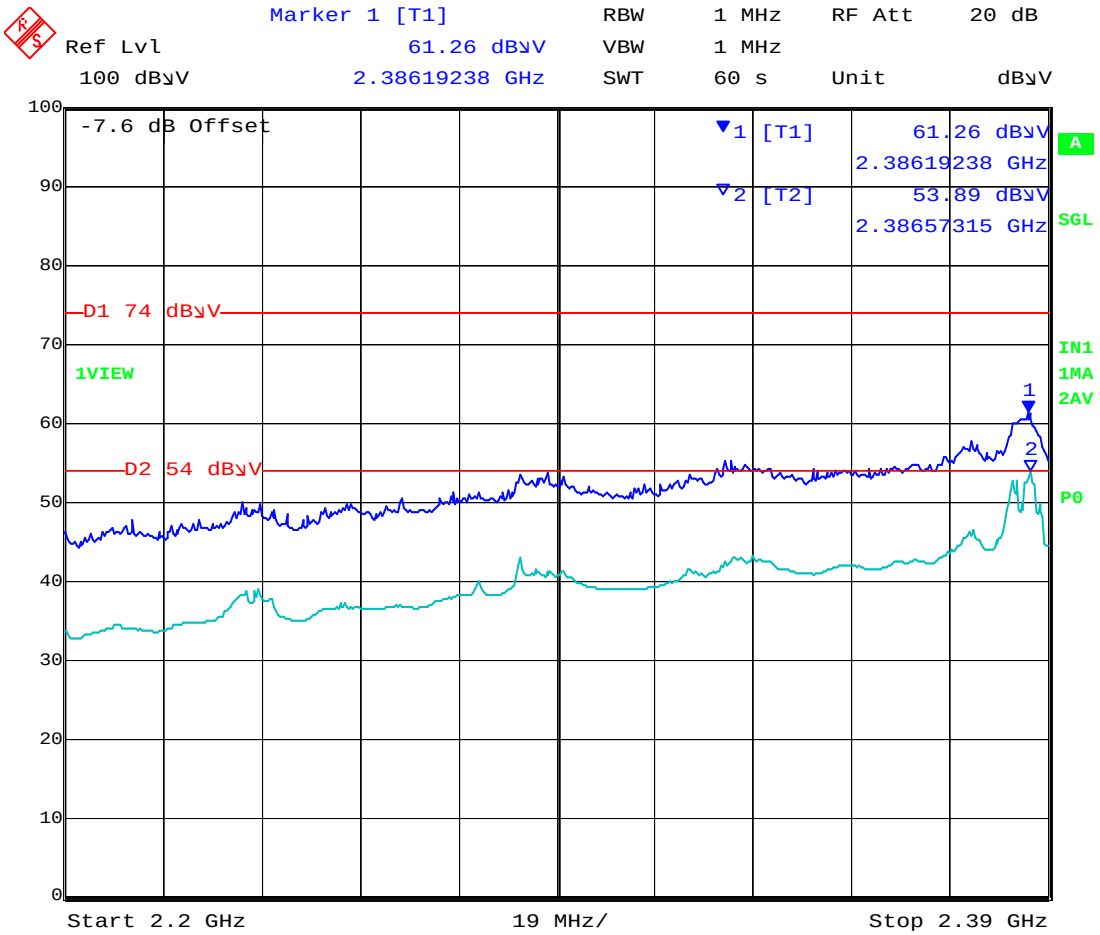


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2386.192	ART Power = 12			61.26	Peak	H	112	359	74	-12.74	Pass	BE
2386.573				53.89	Average	H	112	359	54	-0.11	Pass	BE
2414.558	60.21	13	32.35	105.5	Peak	H	--	--	--	--	--	FUND
4823.966	60.42	4.47	-8.75	56.14	Peak	H	102	310	74	-17.86	Pass	RB
4823.966	57.72	4.47	-8.75	53.45	Average	H	102	310	54	-0.55	Pass	RB
9647.956	47.61	6.31	-1.64	52.28	Peak	H	100	0	85.52	-33.24	Pass	NRB

Peak Emission Scan

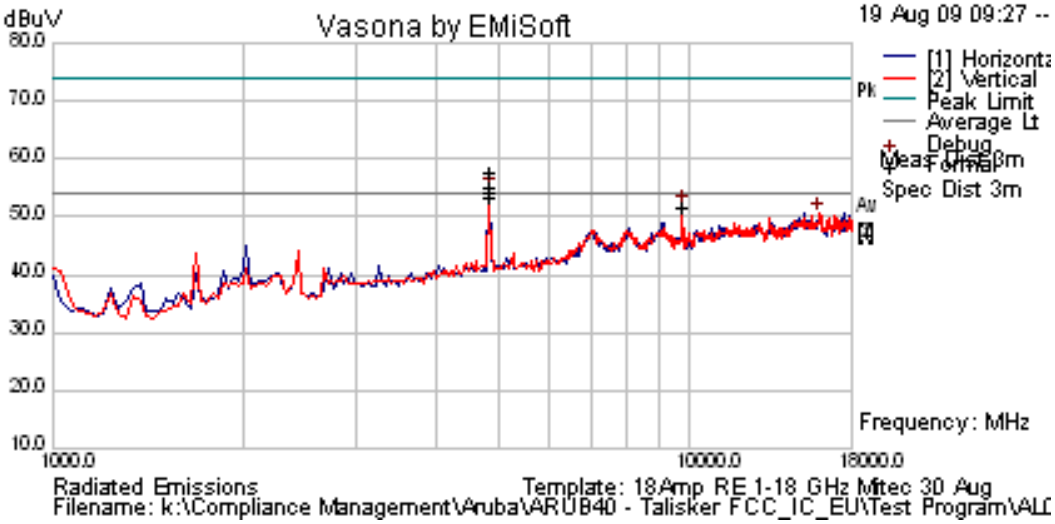


Band-Edge Emission Scan - 802.11b 2310 to 2390 MHz



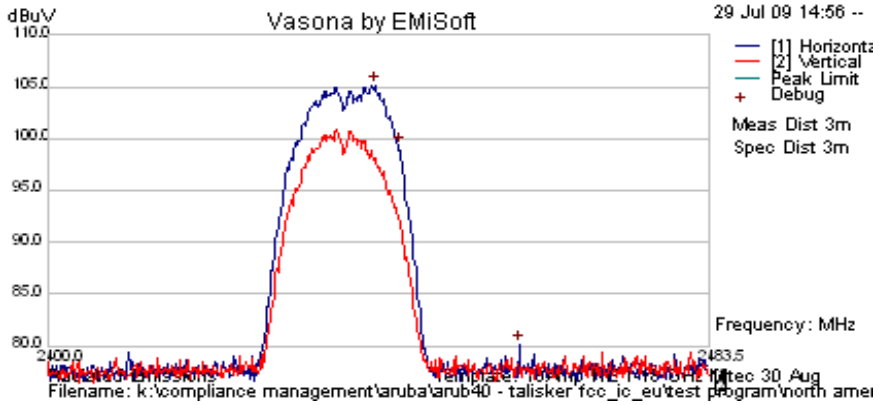
Date: 14.AUG.2009 14:35:11

Date	August 19th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2437; 802.11b;
Antenna Model	Integral Antenna Connected
Power setting	11 in ART Test Utility
Test Conditions	EUT with N.A. Power Supply, Ethernet Cable 2 for ART control EUT EMI New Shield; SN AL0000437 - ART Cal 08/18/2009

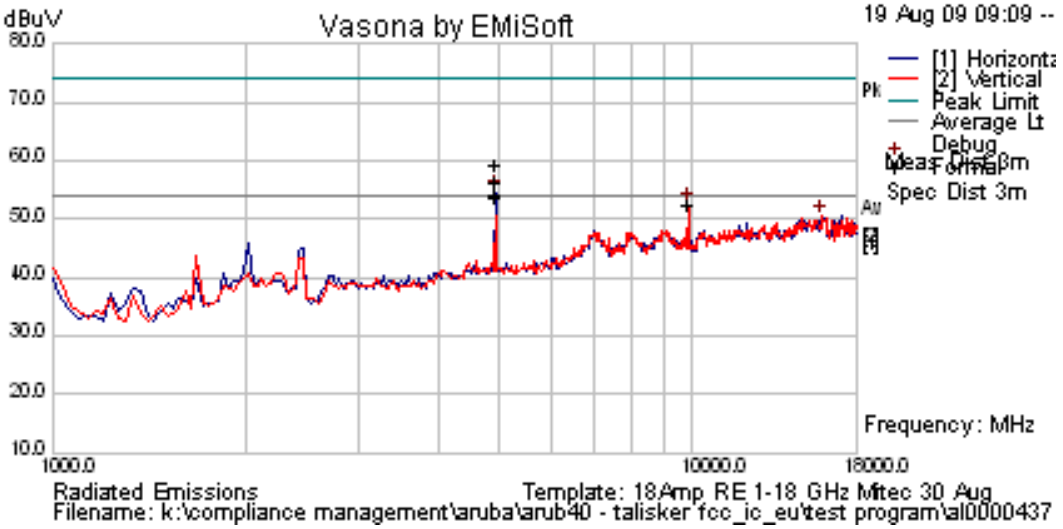


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2440.997	59.84	13	32.37	105.2	Peak	H	--	--	--	--	--	FUND
4873.984	61.95	4.51	-8.75	57.71	Peak	H	101	321	74	-16.29	Pass	RB
4873.984	57.65	4.51	-8.75	53.41	Average	H	101	321	54	-0.59	Pass	RB
9748.144	47.09	6.36	-1.81	51.64	Peak	V	100	0	85.18	-33.54	Pass	NRB

Peak Emission Scan

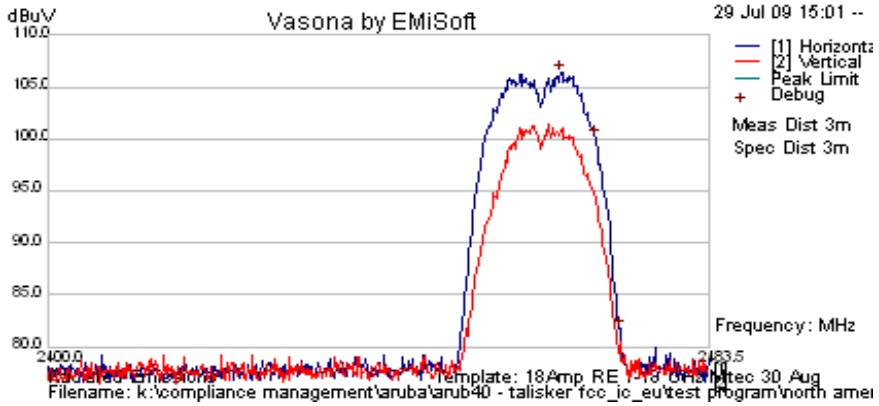


Date	August 19th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2462 MHz; 802.11b; 1Mbps
Antenna Model	Integral Antenna Connected
Power setting	12.5 in ART Test Utility
Test Conditions	EUT with N.A. Power Supply, Ethernet Cable 2 for ART control EUT EMI New Shield; SN AL0000437 - ART Cal 08/18/2009

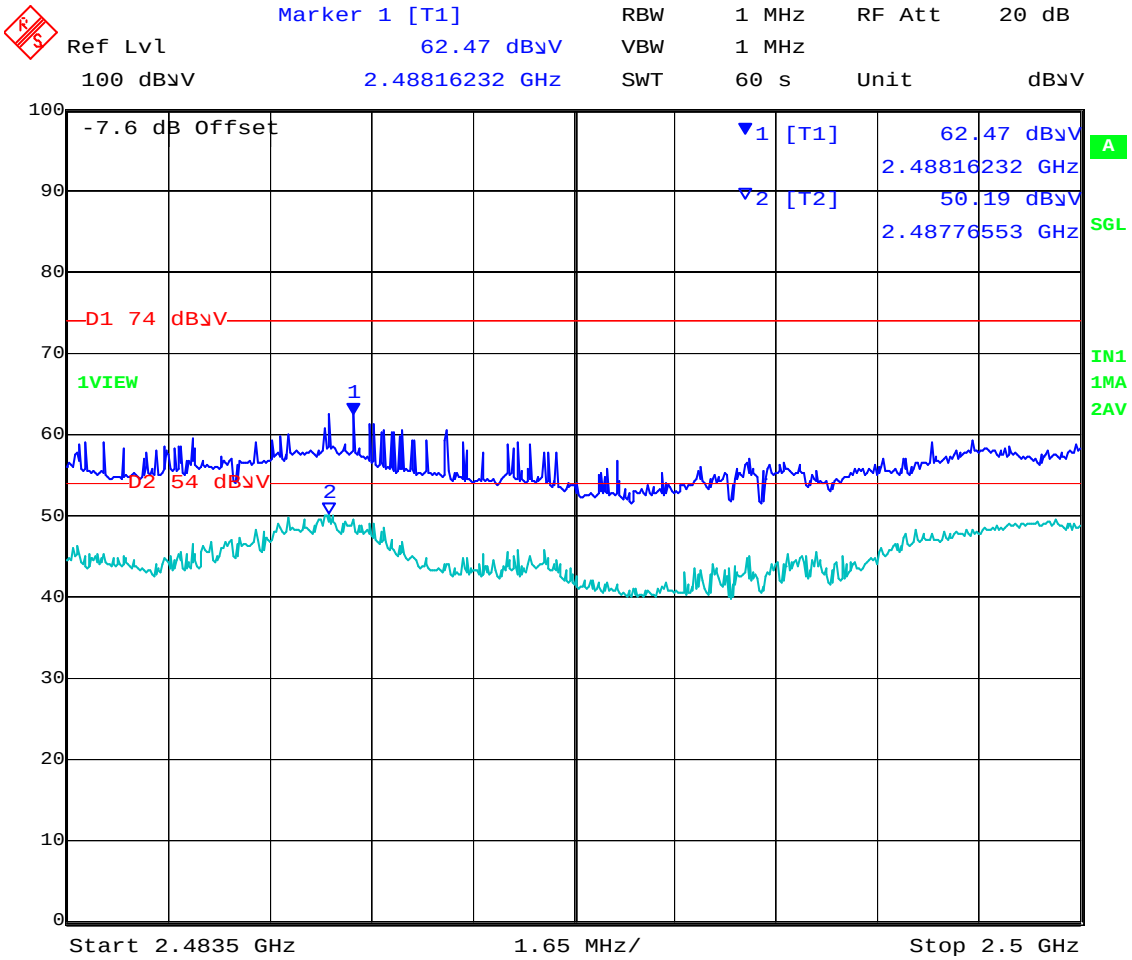


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2464.591	60.99	13	32.38	106.4	Peak	H	--	--	--	--	--	FUND
2487.766	ART Power = 12.5			50.19	Average	H	105	46	54	-3.81	Pass	BE
2488.162				62.47	Peak	H	105	46	74	-11.53	Pass	BE
4923.972	60.7	4.55	-8.76	56.5	Peak	H	100	329	74	-17.5	Pass	RB
4923.972	57.99	4.55	-8.76	53.79	Average	H	100	329	54	-0.21	Pass	RB
9847.91	47.92	6.4	-1.93	52.39	Peak	V	100	0	86.36	-33.97	Pass	NRB
7308.337	46.62	5.44	-2.82	49.24	Average	H	115	36	54	-4.76	Pass	RB
16398.8	41.25	8.86	-0.41	49.7	Peak	H	100	0	86.36	-36.66	Pass	NRB

Peak Emission Scan

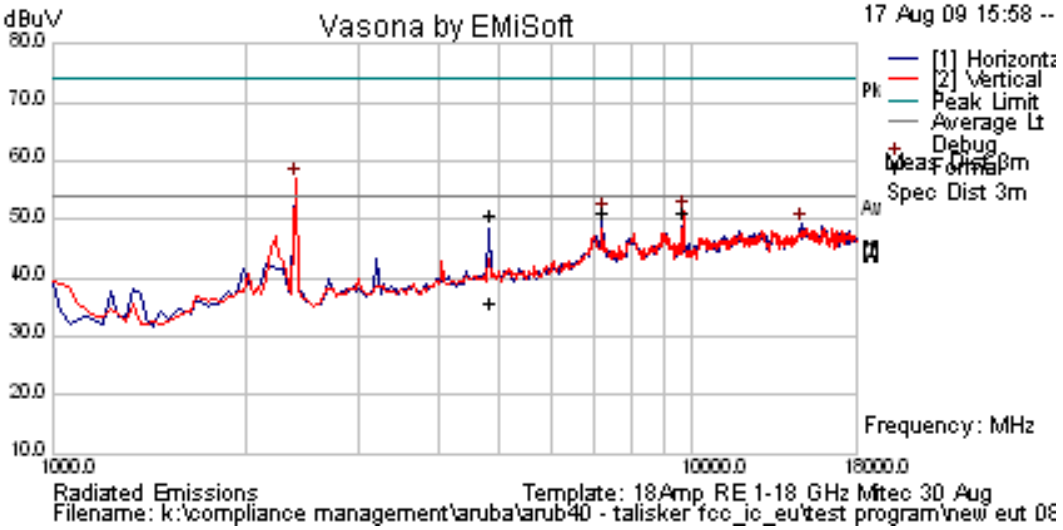


Band-Edge Emission Scan - 802.11b 2483.5 – 2500 MHz



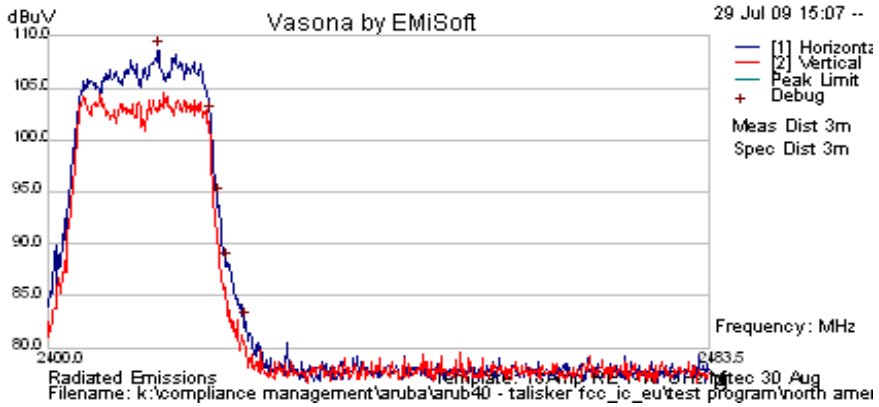
Date: 14.AUG.2009 16:18:15

Date	August 17th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2412; 802.11g; 6Mbps
Antenna Model	Integral Antenna Connected
Power setting	12.5 in ART Test Utility
Test Conditions	EUT with N.A. Power Supply, Ethernet Cable 2 for ART control EUT EMI New Shield; SN AL0000437

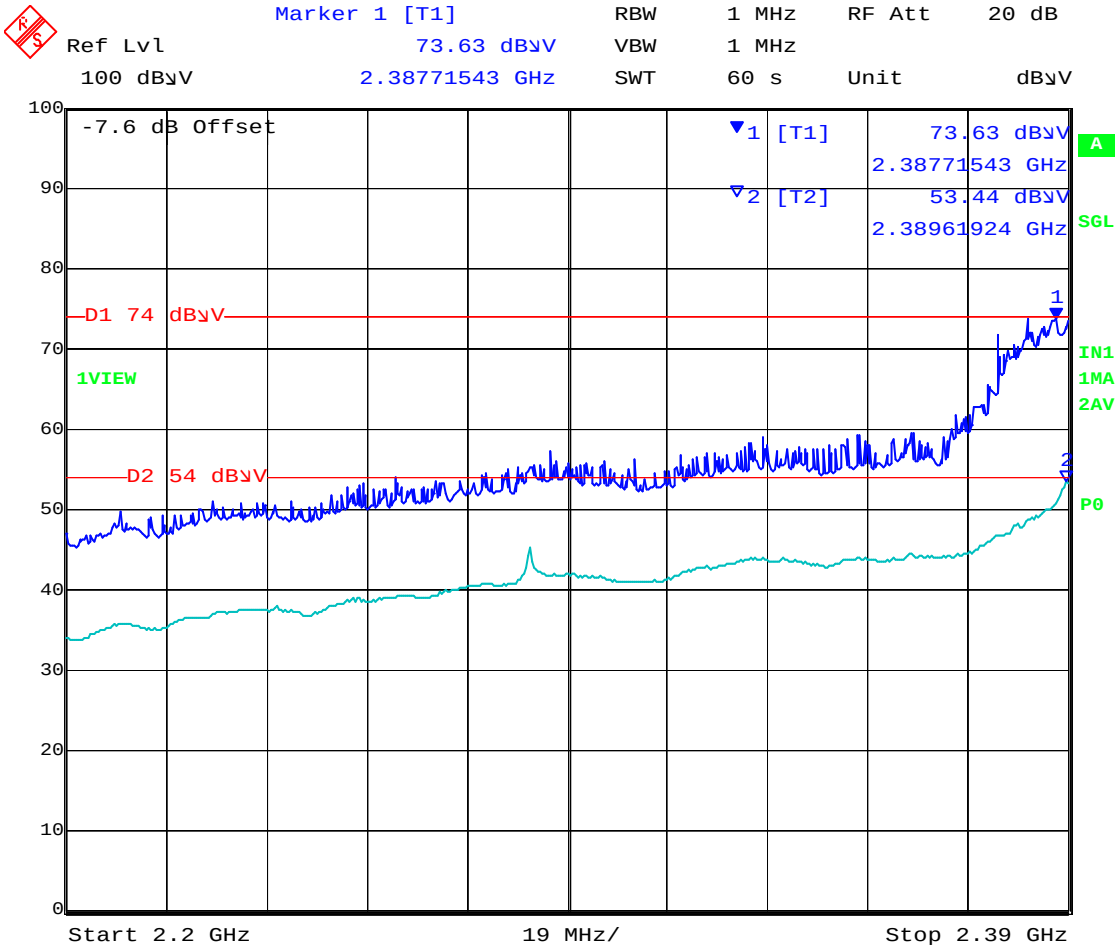


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2387.715	ART Power = 12.5			73.63	Peak	H	112	359	74	-0.37	Pass	BE
2389.619				53.44	Average	H	112	359	54	-0.56	Pass	BE
2413.889	63.33	13	32.35	108.7	Peak	H	--	--	--	--	--	FUND
4822.521	54.93	4.47	-8.74	50.65	Peak	H	108	343	74	-23.35	Pass	RB
4822.521	40.2	4.47	-8.74	35.92	Average	H	108	343	54	-18.08	Pass	RB
7234.469	48.03	5.43	-2.46	51.0	Peak	H	--	--	88.65	-37.65	Pass	NRB
9647.655	46.56	6.31	-1.64	51.23	Peak	V	--	--	88.65	-37.42	Pass	NRB

Peak Emission Scan

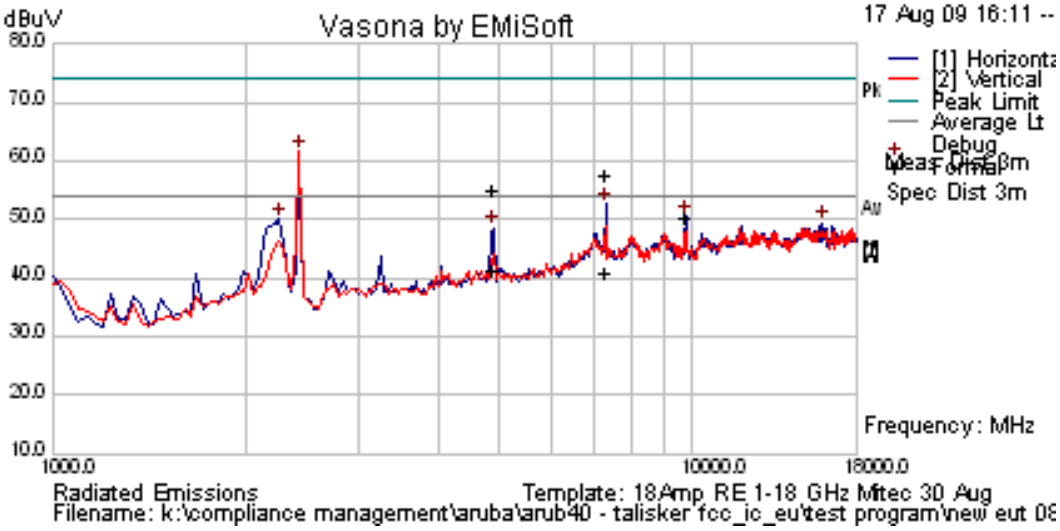


Band-Edge Emission Scan - 802.11g Legacy 2310 to 2390 MHz



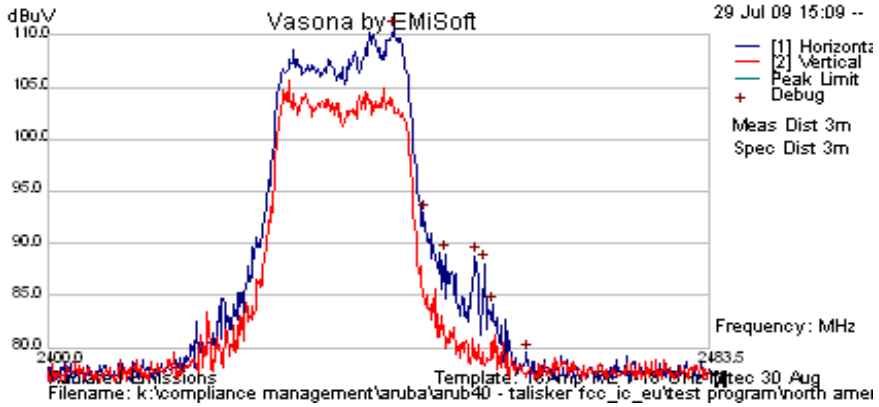
Date: 14.AUG.2009 14:47:24

Date	August 17th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2437; 802.11g; 6Mbps
Antenna Model	Integral Antenna Connected
Power setting	12.5 in ART Test Utility
Test Conditions	EUT with N.A. Power Supply, Ethernet Cable 2 for ART control EUT EMI New Shield; SN AL0000437

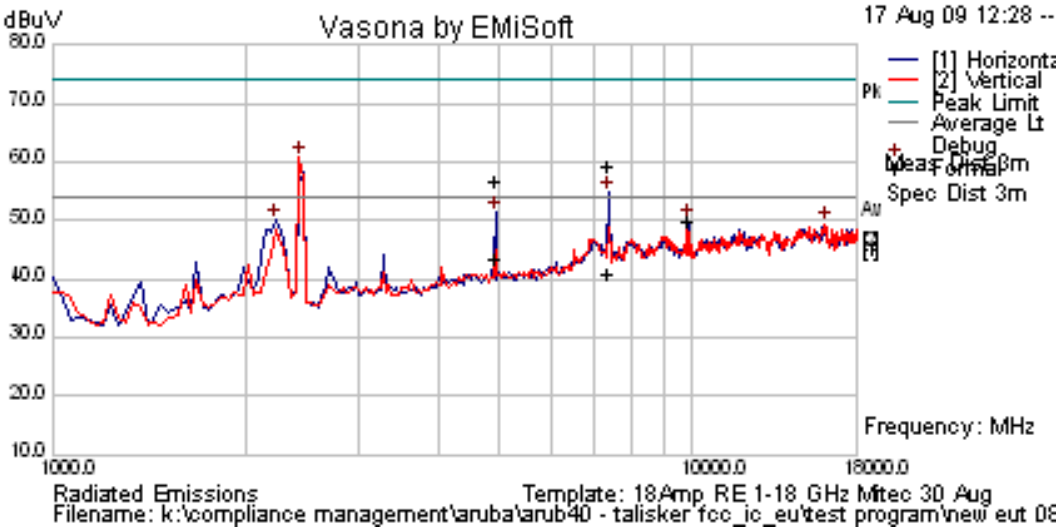


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2443.34	65.19	13	32.37	110.5	Peak	H	--	--	--	--	--	FUND
4873.146	45.72	4.51	-8.75	41.48	Average	H	102	355	54	-12.52	Pass	RB
4873.166	59.45	4.51	-8.75	55.21	Peak	H	102	355	74	-18.79	Pass	RB
7308.817	38.45	5.44	-2.82	41.07	Average	H	100	12	54	-12.93	Pass	RB
7309.759	55.18	5.44	-2.83	57.8	Peak	H	100	12	74	-16.2	Pass	RB
9755.511	45.81	6.36	-1.81	50.36	Peak	H	--	--	90.53	-40.17	Pass	NRB

Peak Emission Scan

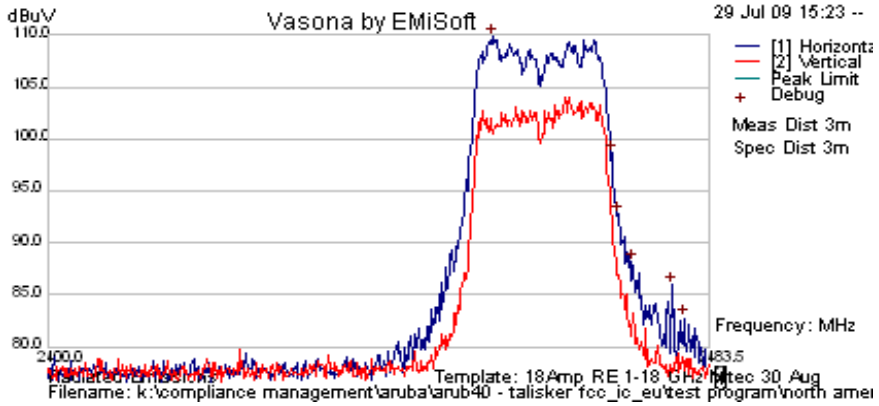


Date	August 17th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2462; 802.11g; 6Mbps
Antenna Model	Integral Antenna Connected
Power setting	12.5 in ART Test Utility
Test Conditions	EUT with N.A. Power Supply, Ethernet Cable 2 for ART control EUT EMI New Shield; SN AL0000437

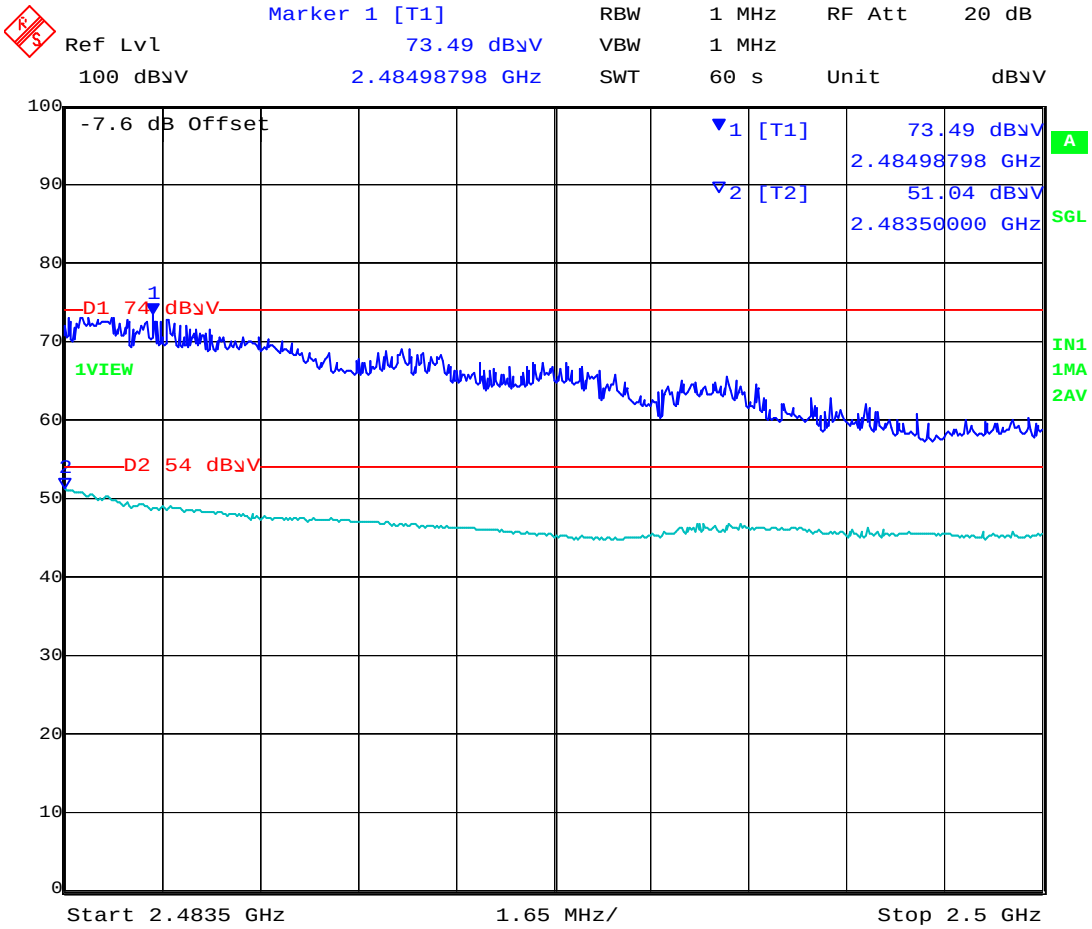


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2456.057	61.59	13	32.38	107.0	Peak	H	--	--	--	--	--	FUND
2483.5	ART Power =12.5			51.04	Average	H	105	46	54	-2.96	Pass	BE
2484.988				73.49	Peak	H	105	46	74	-0.51	Pass	BE
4923.012	47.62	4.55	-8.75	43.42	Average	H	101	359	54	-10.58	Pass	RB
4923.353	63.69	4.55	-8.76	59.49	Peak	H	102	-1	74	-14.51	Pass	RB
7384.228	56.93	5.46	-3.21	59.17	Peak	H	146	53	74	-14.83	Pass	RB
7384.228	38.53	5.46	-3.21	40.77	Average	H	146	53	54	-13.23	Pass	RB
9842.164	45.54	6.4	-1.94	50.0	Peak [Scan]	H	--	--	86.95	-36.95	Pass	NRB

Peak Emission Scan

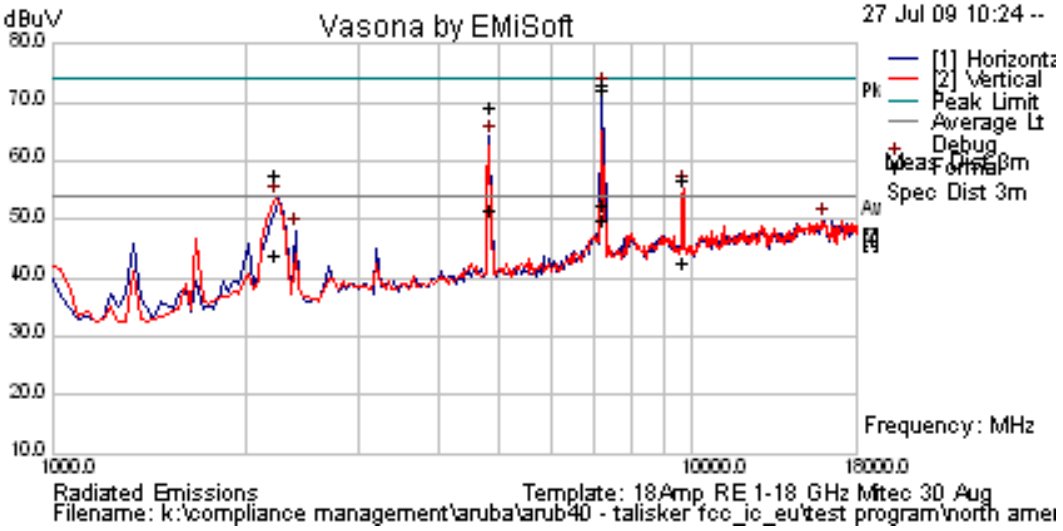


Band-Edge Emission Scan - 802.11g 2483.5 – 2500 MHz



Date: 14.AUG.2009 16:24:16

Date	July 27th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2412 MHz
Antenna Model	Integral Antenna Connected
Power setting	11.5 in ART test Utility
Test Conditions	802.11n HT-20 6.5 MCS 120V AC - Ethernet cable connected to PC for ART control



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2231.904	65.13	2.87	-10.57	57.43	Peak	H	117	361	74	-16.57	Pass	RB
2231.904	51.4	2.87	-10.57	43.7	Average	H	117	361	54	-10.3	Pass	RB
2390	ART Power = 11.5			72.02	Peak	H	112	359	74	-1.98	Pass	BE
2390				53.44	Peak	H	112	359	54	-0.56	Pass	BE
2418.574	63.39	12.96	32.36	108.7	Peak	H	--	--	--	--	--	FUND
4824.648	56.05	4.47	-8.75	51.77	Average	H	116	14	54	-2.23	Pass	RB
4825.625	73.54	4.47	-8.75	69.26	Peak	H	115	15	74	-4.74	Pass	RB
7237.961	70.11	5.43	-2.47	73.07	Peak	V	130	70	88.71	-15.64	Pass	NRB
9648.176	51.92	6.31	-1.64	56.59	Peak	H	98	34	88.71	-32.12	Pass	NRB

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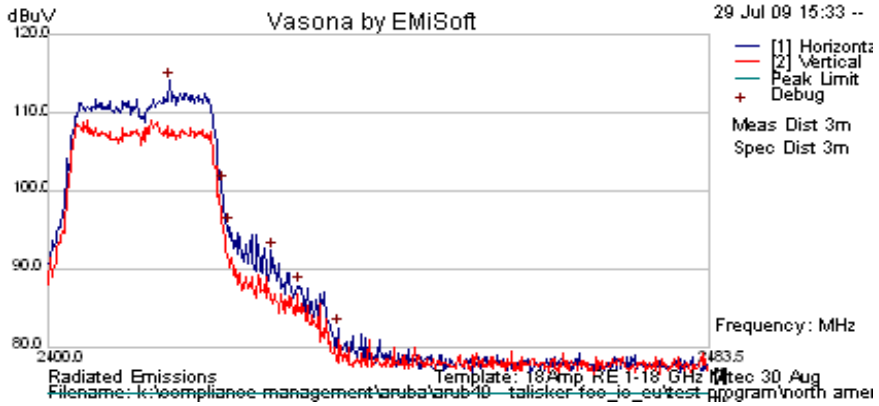
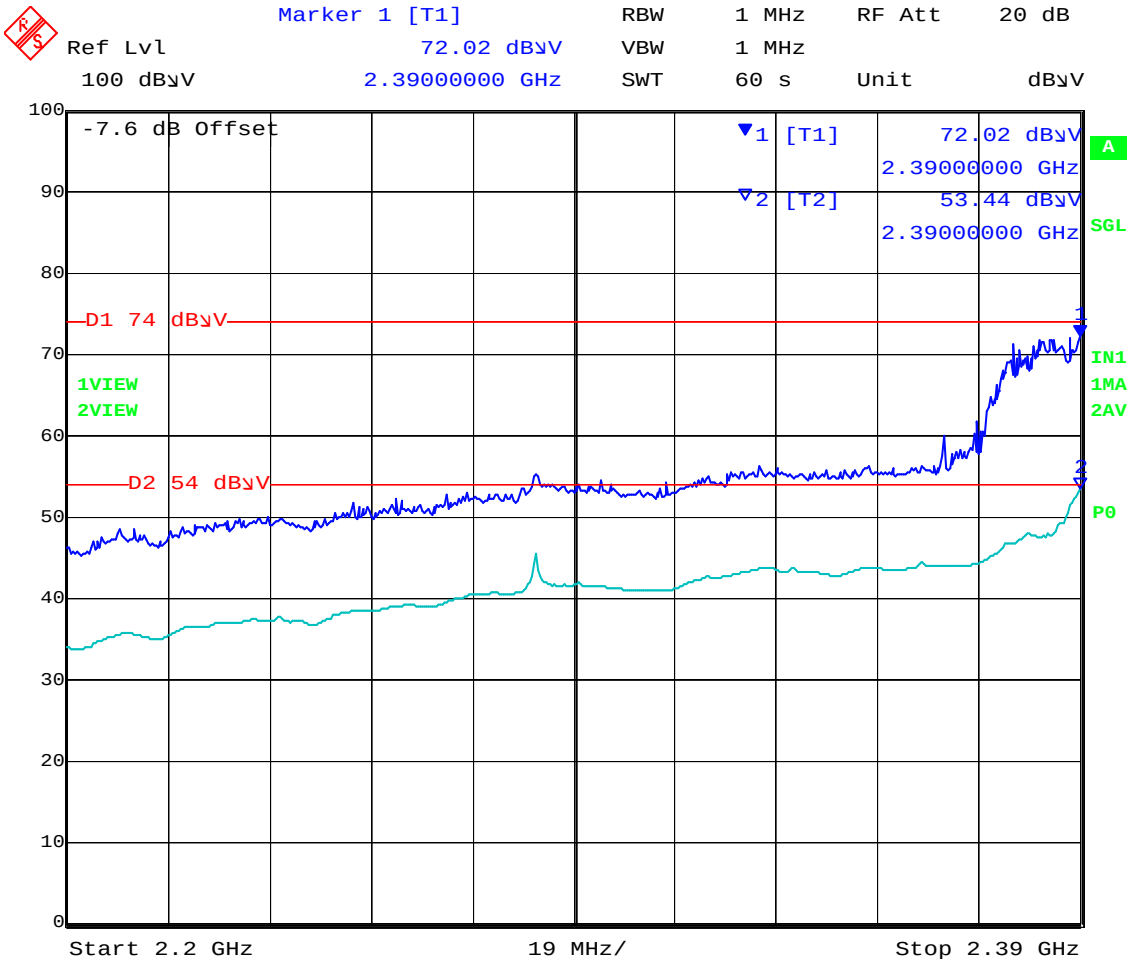
Peak Emission Scan

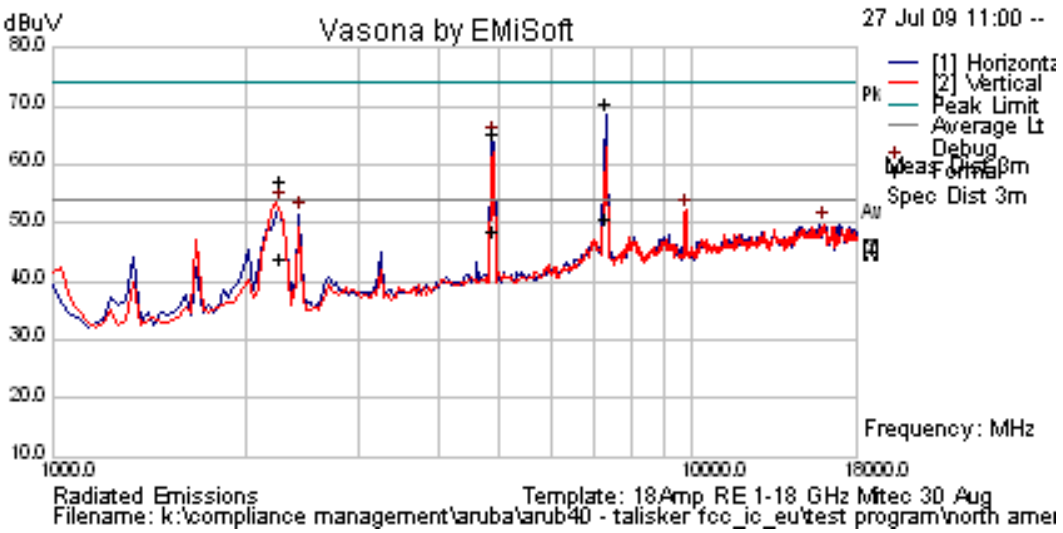


Band-Edge Emission Scan - 802.11n HT-20 2310 to 2390 MHz



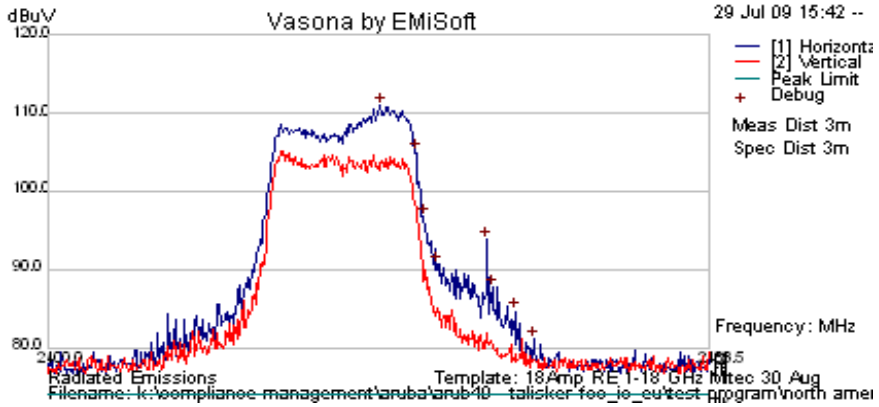
Date: 14.AUG.2009 14:41:31

Date	July 27th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2437 MHz
Antenna Model	Integral Antenna Connected
Power setting	17.0 in ART test Utility
Test Conditions	802.11n HT-20 6.5 MCS 120V AC - Ethernet cable connected to PC for ART control

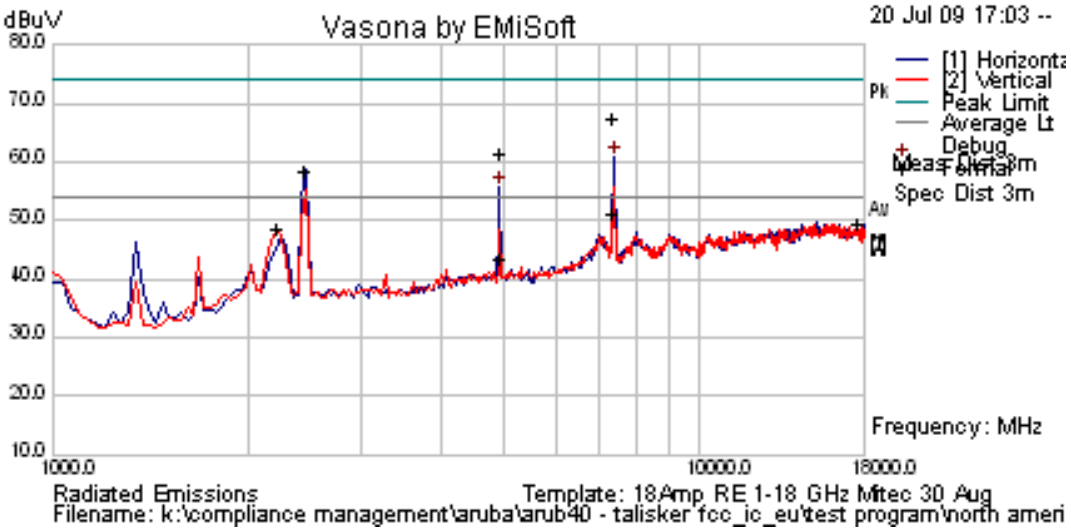


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2265.691	64.74	2.89	-10.57	57.06	Peak	H	114	69	74	-16.94	Pass	RB
2265.691	51.5	2.89	-10.57	43.82	Average	H	114	69	54	-10.18	Pass	RB
2441.666	65.69	12.97	32.37	111.0	Peak	H	--	--	--	--	--	FUND
4881.443	69.57	4.52	-8.74	65.35	Peak	H	102	45	74	-8.65	Pass	RB
4881.443	53.05	4.52	-8.74	48.82	Average	H	102	45	54	-5.18	Pass	RB
7308.644	48.07	5.44	-2.82	50.69	Average	H	101	64	54	-3.31	Pass	RB
7309.955	67.9	5.44	-2.83	70.51	Peak	H	101	64	74	-3.49	Pass	RB
9756.613	47.75	6.36	-1.81	52.3	Peak	H	98	36	91.03	-38.73	Pass	NRB

Peak Emission Scan

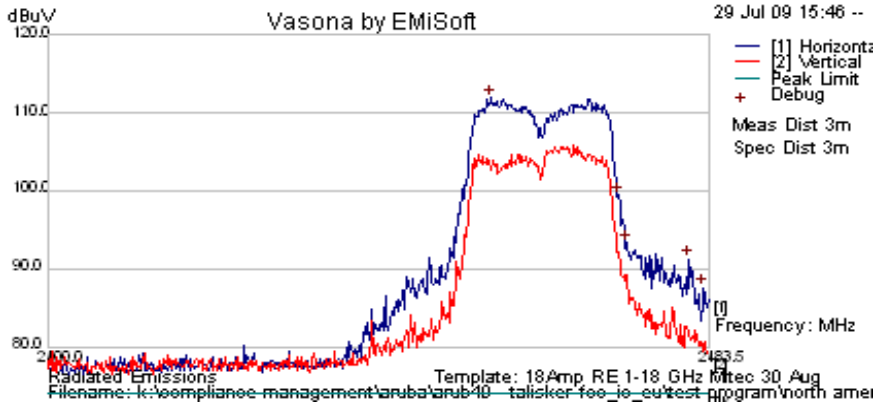


Date	July 27th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2462 MHz
Antenna Model	Integral Antenna Connected
Power setting	11.5 in ART test utility
Test Conditions	802.11n HT-20 6.5 MCS 120V AC - Ethernet cable connected to PC for ART control

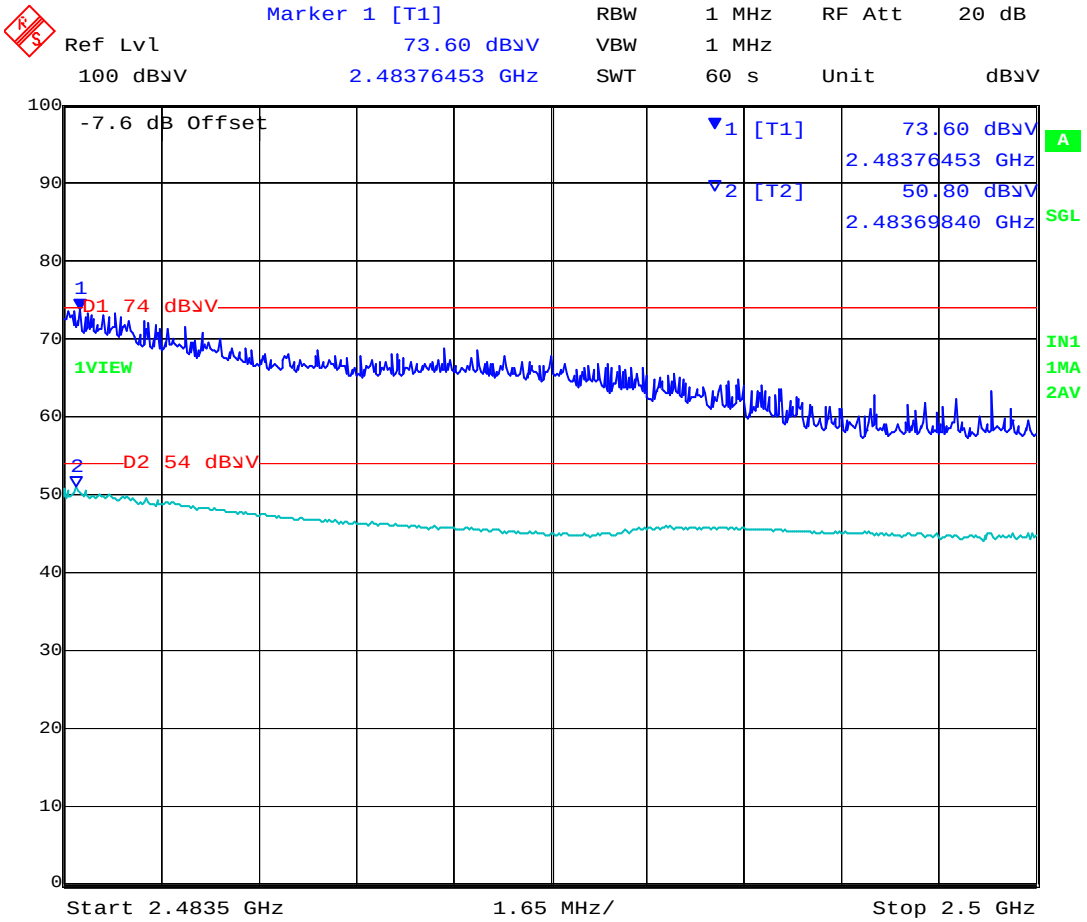


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2456.559	61.74	12.98	32.38	107.1	Peak	H	--	--	--	--	--	FUND
2483.698	ART Power = 11.5			50.8	Average	H	105	46	54	-3.2	Pass	BE
2483.765				73.6	Peak	H	105	46	74	-0.4	Pass	BE
4930.581	65.51	4.56	-8.76	61.31	Peak	H	124	75	74	-12.69	Pass	RB
4930.581	47.56	4.56	-8.76	43.35	Average	H	125	75	54	-10.65	Pass	RB
7382.445	65.25	5.46	-3.2	67.51	Peak	H	103	67	74	-6.49	Pass	RB
7382.445	49.1	5.46	-3.2	51.36	Average	H	101	67	54	-2.64	Pass	RB

Peak Emission Scan

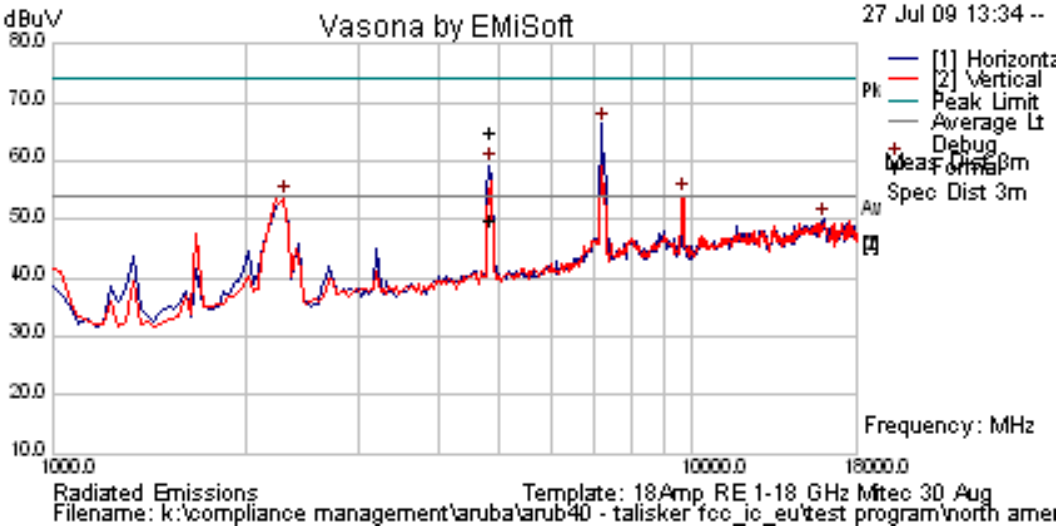


Band-Edge Emission Scan - 802.11n HT-20 2483.5 – 2500 MHz



Date: 14.AUG.2009 16:29:30

Date	July 27th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2422 MHz
Antenna Model	Integral Antenna Connected
Power setting	7.5 in ART test Utility
Test Conditions	802.11n HT-40 13.5 MCS 120V AC - Ethernet cable connected to PC for ART control



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2251.924	65.13	2.88	-10.58	57.43	Peak	H	129	329	74	-16.57	Pass	RB
2251.924	51.83	2.88	-10.58	44.13	Average	H	129	329	54	-9.87	Pass	RB
2389.238	ART Power = 7.5			72.42	Peak	H	112	359	74	-1.58	Pass	BE
2388.858				52.9	Average	H	112	359	54	-1.1	Pass	BE
2427.945	54.39	12.97	32.36	99.72	Peak	H	--	--	--	--	--	FUND
4851.539	70.39	4.49	-8.78	66.1	Peak	H	151	14	74	-7.9	Pass	RB
4851.539	55.61	4.49	-8.78	51.32	Average	H	151	14	54	-2.68	Pass	RB
7271.704	48.8	5.44	-2.64	51.6	Average	H	131	71	54	-2.4	Pass	RB
7272.165	68.9	5.44	-2.65	71.69	Peak	H	129	72	74	-2.31	Pass	RB
9687.375	48.85	6.33	-1.64	53.54	Peak	H	100	31	79.72	-26.18	Pass	NRB

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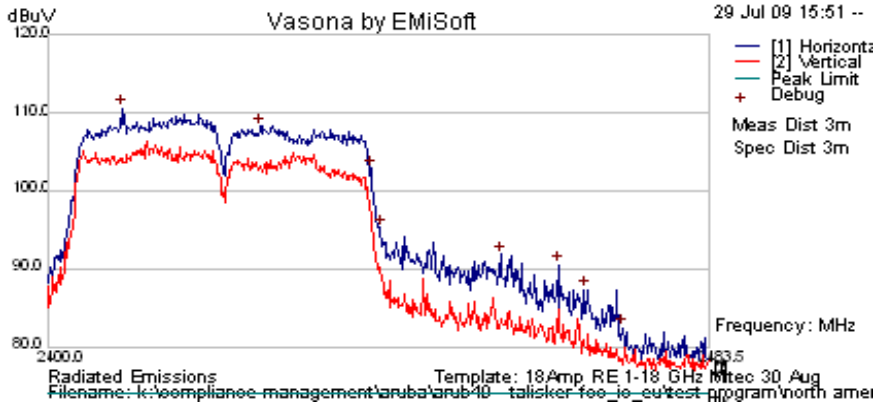
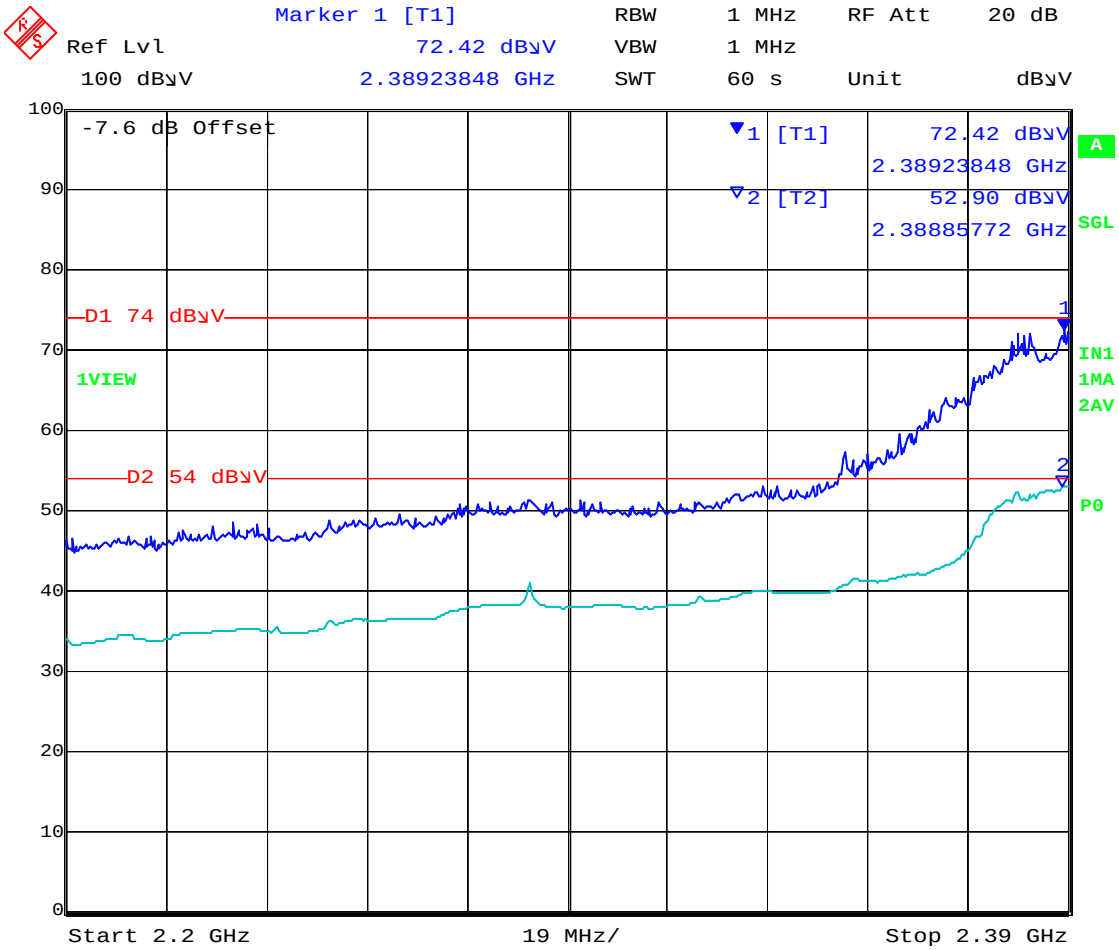
Peak Emission Scan

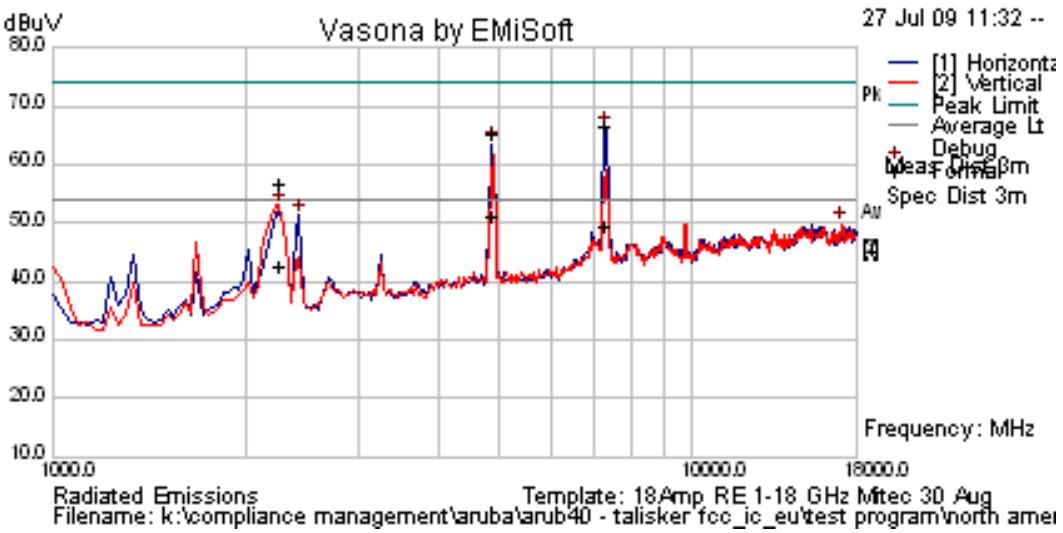


Band-Edge Emission Scan - 802.11n HT-40 2310 to 2390 MHz



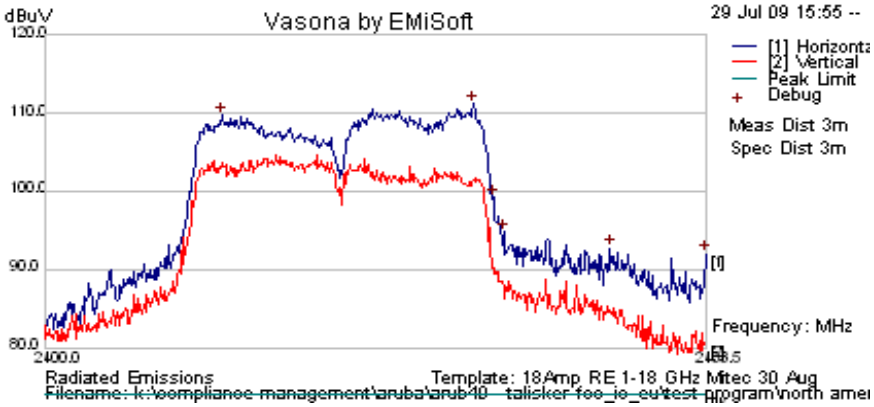
Date: 14.AUG.2009 15:20:13

Date	July 27th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2437 MHz
Antenna Model	Integral Antenna Connected
Power setting	19.5 in ART test Utility
Test Conditions	802.11n HT-40 13.5 MCS 120V AC - Ethernet cable connected to PC for ART control

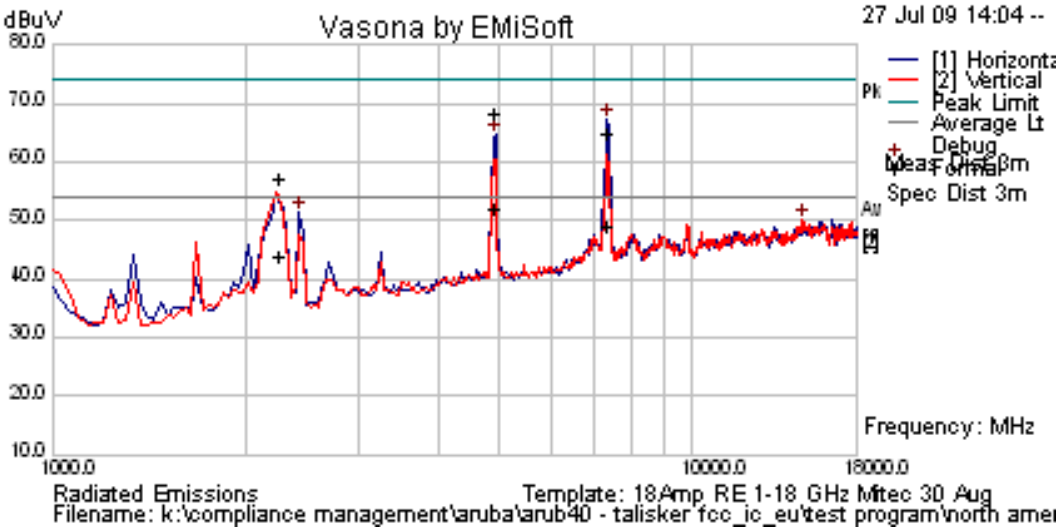


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2265.932	64.49	2.89	-10.57	56.8	Peak	H	98	337	74	-17.2	Pass	RB
2265.932	50.48	2.89	-10.57	42.8	Average	H	98	337	54	-11.2	Pass	RB
2453.882	65.85	12.98	32.37	111.2	Peak	H	--	--	--	--	--	FUND
4874.549	69.57	4.51	-8.75	65.33	Peak	H	116	16	74	-8.67	Pass	RB
4875.374	55.54	4.51	-8.75	51.3	Average	H	113	15	54	-2.7	Pass	RB
7299.88	64.11	5.44	-2.78	66.77	Peak	H	151	7	74	-7.23	Pass	RB
7299.88	46.72	5.44	-2.78	49.38	Average	H	151	7	54	-4.62	Pass	RB

Peak Emission Scan

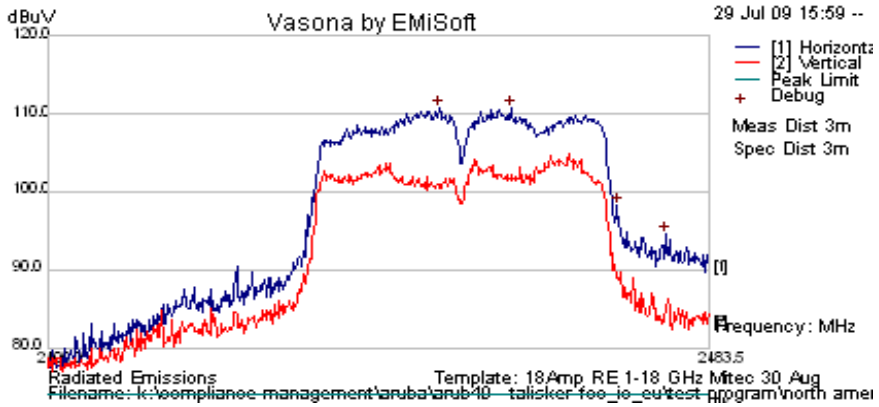


Date	July 27th, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2452 MHz
Antenna Model	Integral Antenna Connected
Power setting	9 in ART test Utility
Test Conditions	802.11n HT-40 13.5 MCS 120V AC - Ethernet cable connected to PC for ART control

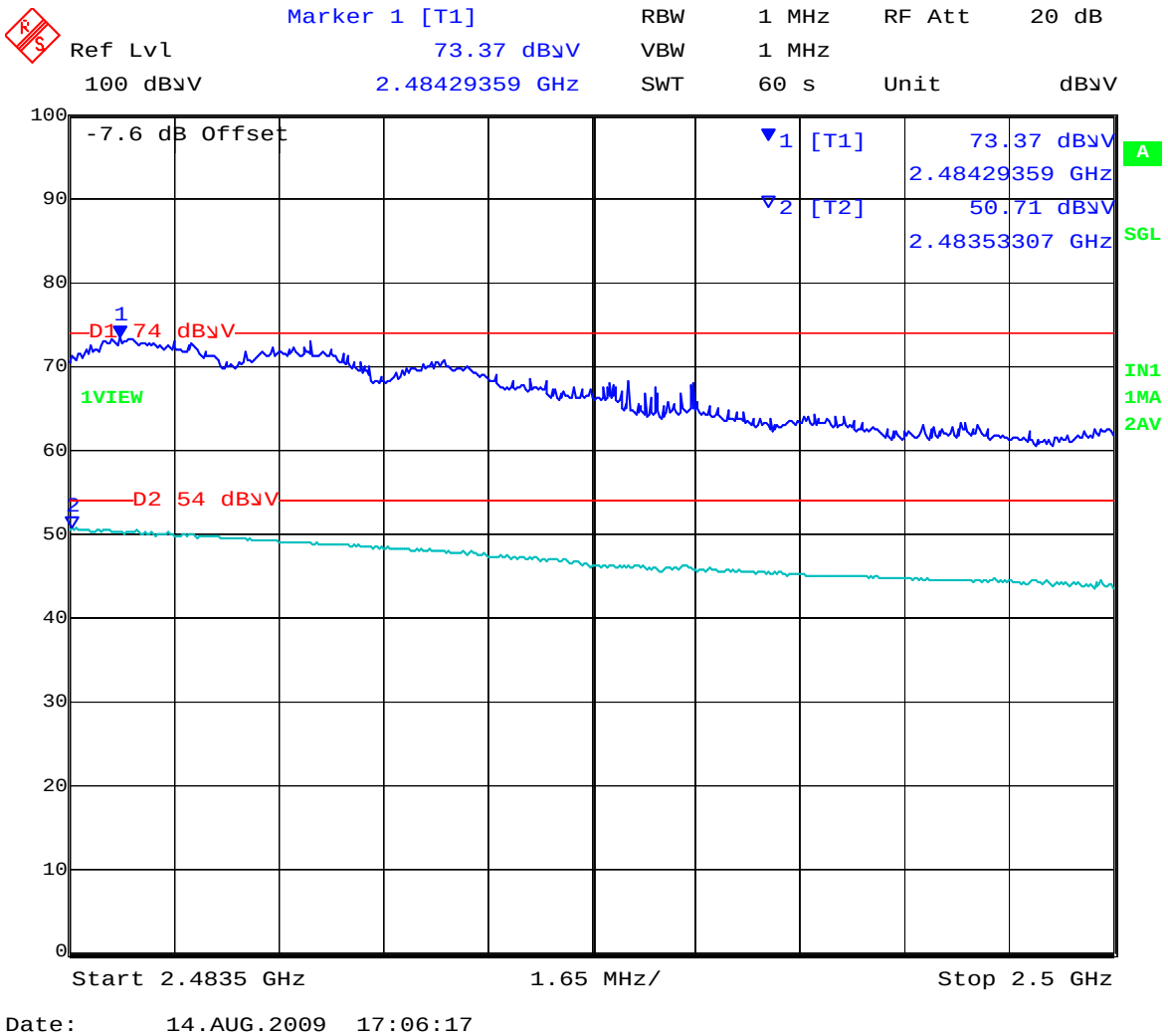


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2267.174	65	2.89	-10.57	57.31	Peak	H	130	337	74	-16.69	Pass	RB
2267.174	51.7	2.89	-10.57	44.02	Average	H	130	337	54	-9.98	Pass	RB
2459.906	57.42	12.98	32.38	102.8	Peak	H	--	--	--	--	--	FUND
2484.294	ART Power = 9			73.37	Peak	H	105	49	74	-0.63	Pass	BE
2483.533				50.71	Average	H	105	49	54	-3.29	Pass	BE
4905.772	72.5	4.54	-8.73	68.3	Peak	H	98	18	74	-5.7	Pass	RB
4914.301	56.26	4.55	-8.74	52.06	Average	H	146	18	54	-1.94	Pass	RB
7357.034	62.36	5.45	-3.07	64.74	Peak	V	108	29	74	-9.26	Pass	RB
7357.034	46.87	5.45	-3.07	49.25	Average	V	108	29	54	-4.75	Pass	RB

Peak Emission Scan

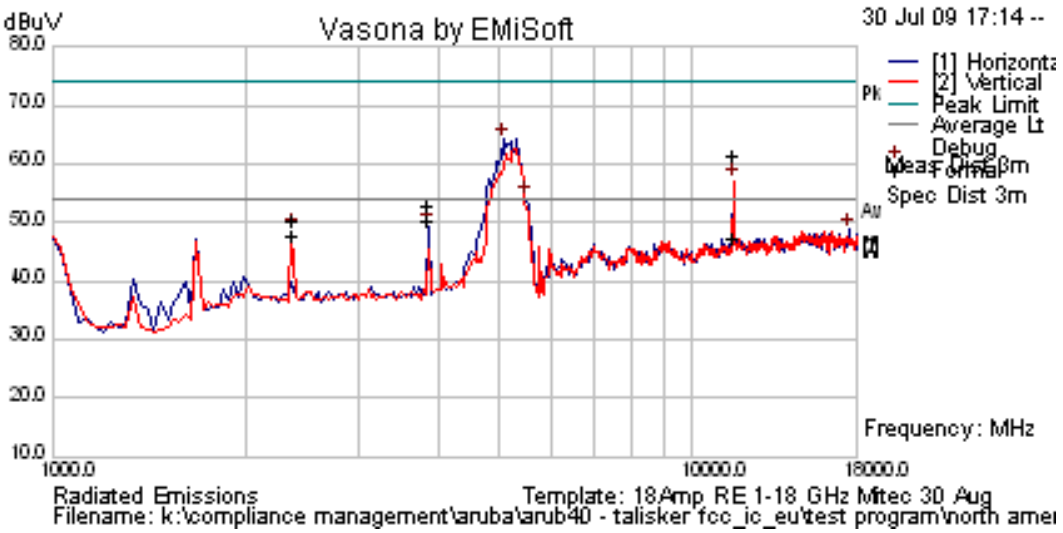


Band-Edge Emission Scan - 802.11n HT-40 2483.5 – 2500 MHz



Date: 14.AUG.2009 17:06:17

Date	30th July, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5745 MHz
Antenna Model	Integral
Power setting	17 in ART test utility
Test Conditions	802.11a; 6 Mbps 120V AC - Ethernet cable connected to PC for ART control



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2379.986	58.1	2.94	-10.56	50.49	Peak	V	98	357	74	-23.51	Pass	RB
2379.986	55.33	2.94	-10.56	47.71	Average	V	98	357	54	-6.29	Pass	RB
3856.626	59.27	3.82	-10.18	52.91	Peak	H	104	76	74	-21.09	Pass	RB
3856.626	56.78	3.82	-10.18	50.42	Average	H	104	76	54	-3.58	Pass	RB
5088.697	ART Power = 17			64.45	Peak				74	-9.55	Pass	BE
5092.545				51.4	Average				54	-2.6	Pass	BE
5746.543	57.97	14.76	35.1	107.8	Peak	V						FUND
11567.46	55.91	6.81	-1.11	61.61	Peak	H	98	17	74	-12.39	Pass	RB
11567.46	41.82	6.81	-1.11	47.52	Average	H	98	17	54	-6.48	Pass	RB

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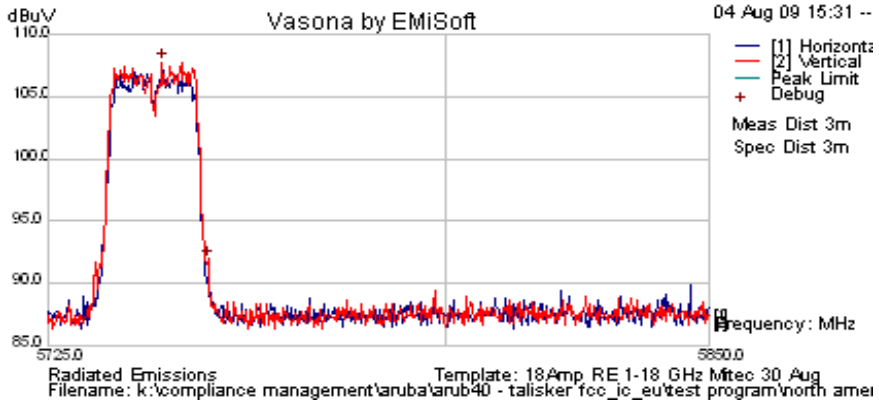
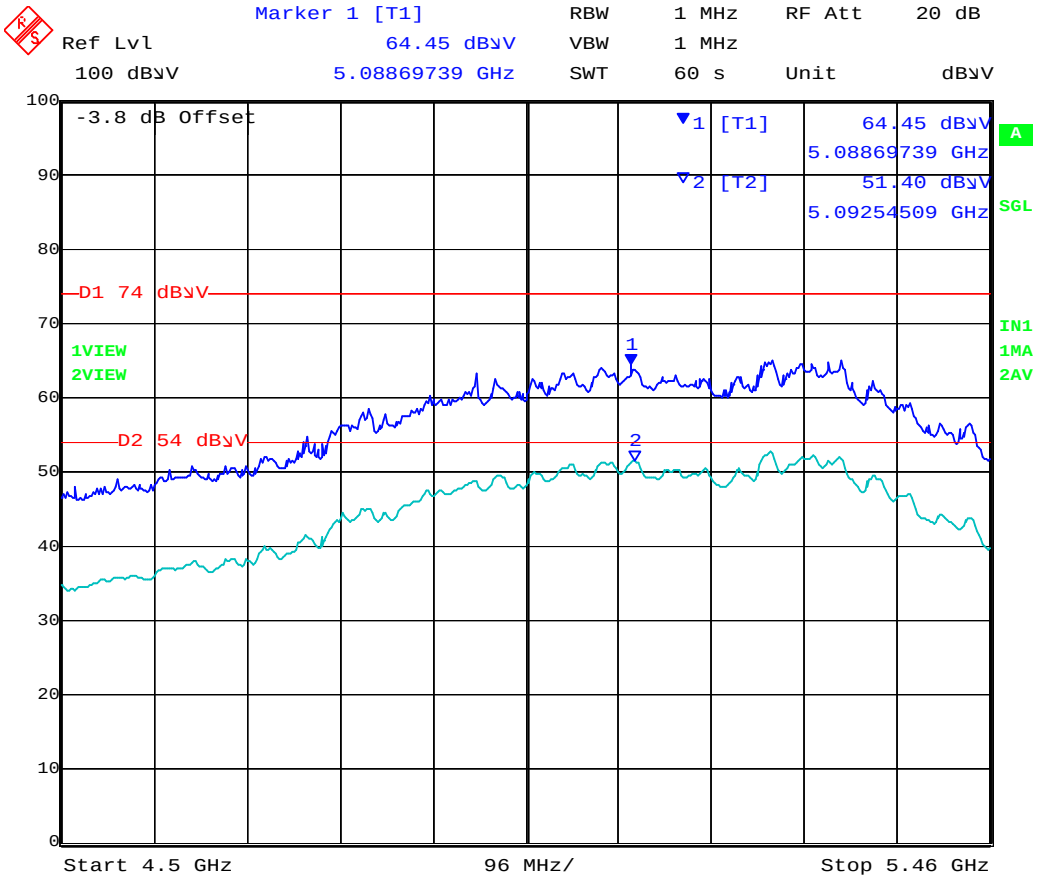
Peak Emission Scan

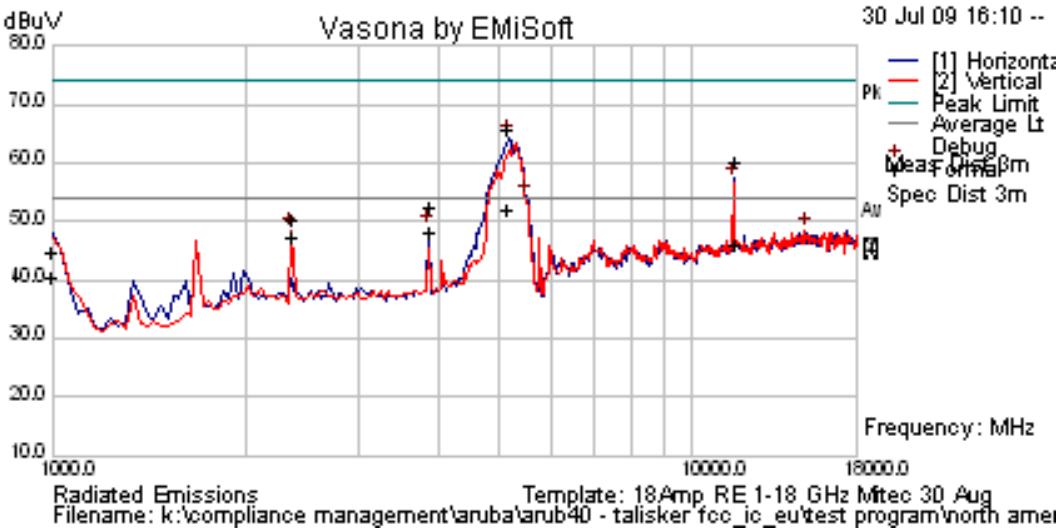


802.11a Legacy Band-edge 5460 MHz



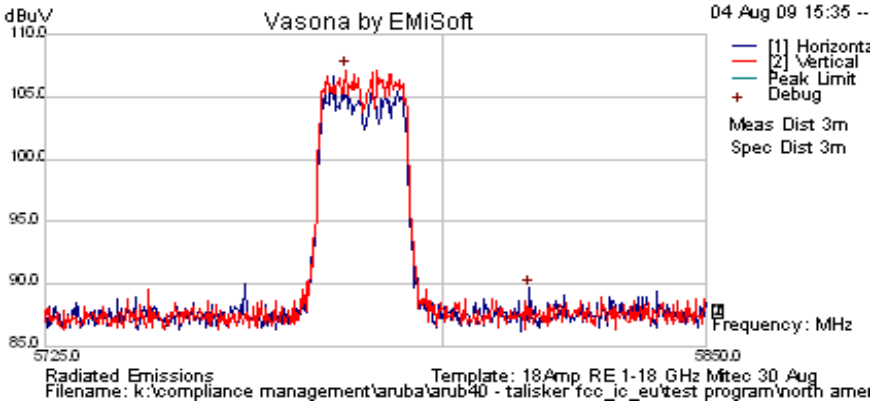
Date: 4.AUG.2009 15:17:27

Date	30th July, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5785 MHz
Antenna Model	Integral
Power setting	17 in ART test utility
Test Conditions	802.11a; 6 Mbps 120V AC - Ethernet cable connected to PC for ART control

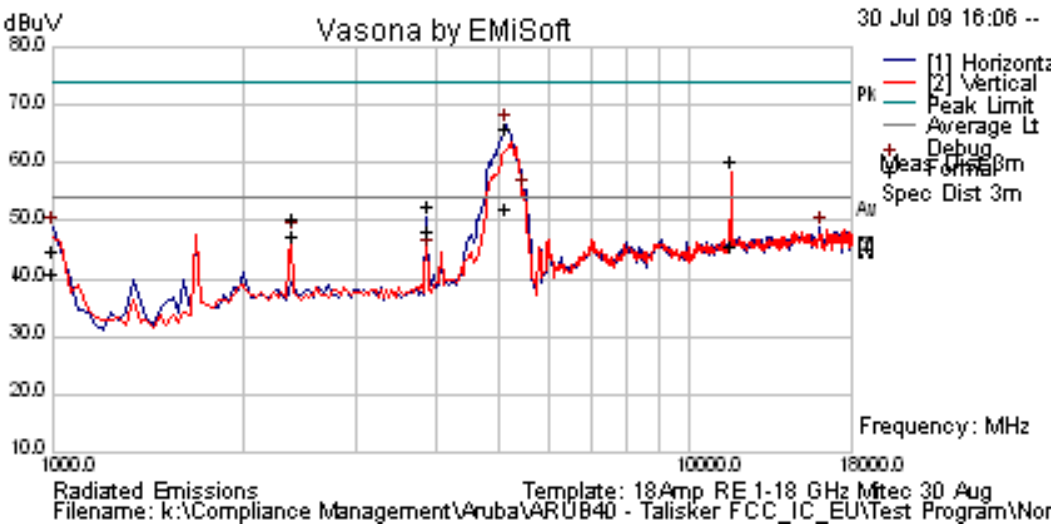


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2379.985	57.97	2.94	-10.56	50.36	Peak	V	98	351	74	-23.64	Pass	RB
2379.985	55.26	2.94	-10.56	47.65	Average	V	98	351	54	-6.35	Pass	RB
3856.635	59.88	3.82	-10.18	53.51	Peak	H	107	69	74	-20.49	Pass	RB
3856.635	57.26	3.82	-10.18	50.9	Average	H	107	69	54	-3.1	Pass	RB
5781.6132	57.27	14.77	35.13	107.2	Peak	V						FUND
11567.695	54.28	6.81	-1.11	59.98	Peak	H	109	16	74	-14.02	Pass	RB
11567.695	40.68	6.81	-1.11	46.38	Average	H	109	16	54	-7.62	Pass	RB

Peak Emission Scan

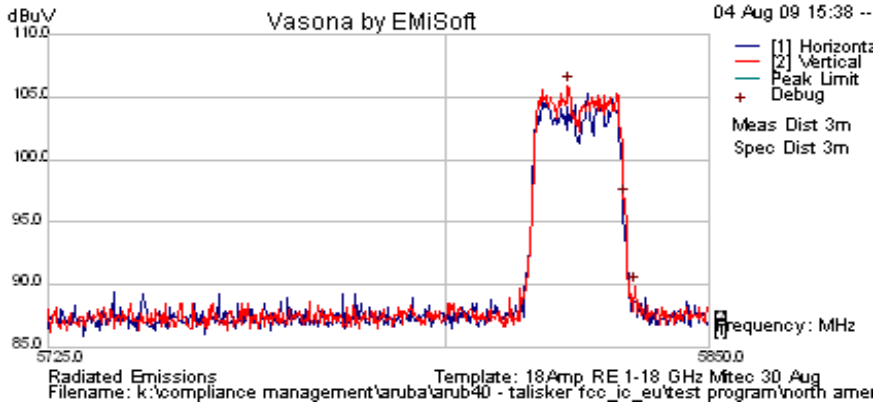


Date	30th July, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5825 MHz
Antenna Model	Integral
Power setting	17 in ART test utility
Test Conditions	802.11a; 6 Mbps 120V AC - Ethernet cable connected to PC for ART control

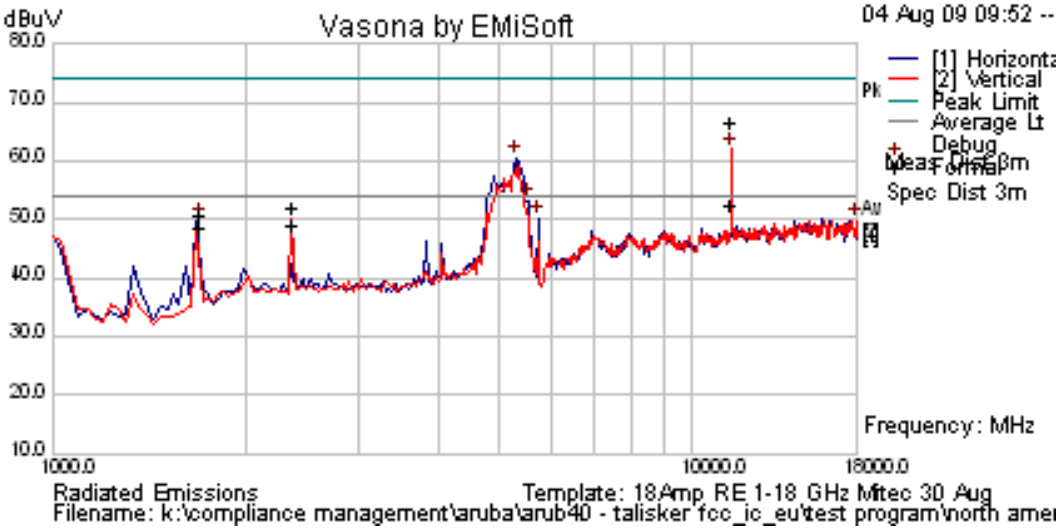


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1000.001	58.76	1.95	-15.82	44.89	Peak	H	152	214	74	-29.11	Pass	RB
1000.001	54.55	1.95	-15.82	40.68	Average	H	148	215	54	-13.32	Pass	RB
2379.975	57.84	2.94	-10.56	50.23	Peak	V	126	360	74	-23.77	Pass	RB
2379.975	55	2.94	-10.56	47.39	Average	V	126	360	54	-6.61	Pass	RB
3883.28	58.76	3.83	-10.1	52.5	Peak	H	139	302	74	-21.5	Pass	RB
3883.28	54.55	3.83	-10.1	48.28	Average	H	139	302	54	-5.72	Pass	RB
5128.479	69.71	4.62	-8.5	65.83	Peak	H	123	75	74	-8.17	Pass	BE
5128.479	55.91	4.62	-8.5	52.03	Average	H	123	75	54	-1.97	Pass	BE
5823.1964	56.01	14.8	35.16	106	Peak	V						FUND
11651.789	54.4	6.83	-1.01	60.22	Peak	H	98	21	74	-13.78	Pass	RB
11651.789	40.01	6.83	-1.01	45.83	Average	H	98	21	54	-8.17	Pass	RB

Peak Emission Scan

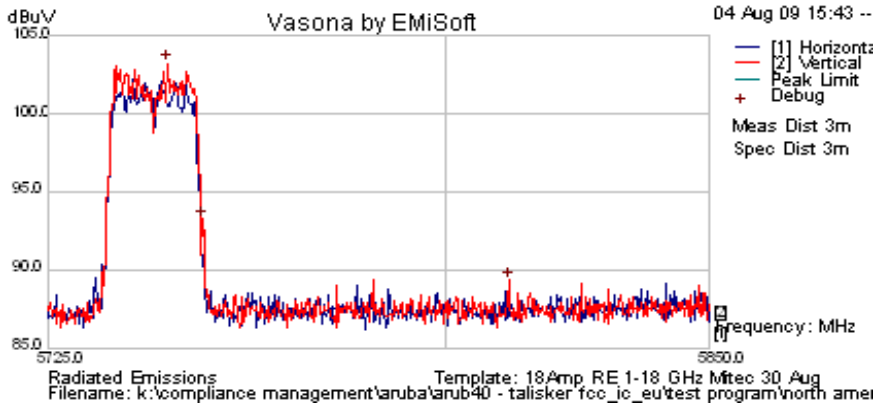


Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5745 MHz
Antenna Model	Integral
Power setting	11 in ART test utility
Test Conditions	802.11n; HT-20 6.5 MCS 120V AC - Ethernet cable connected to PC for ART control

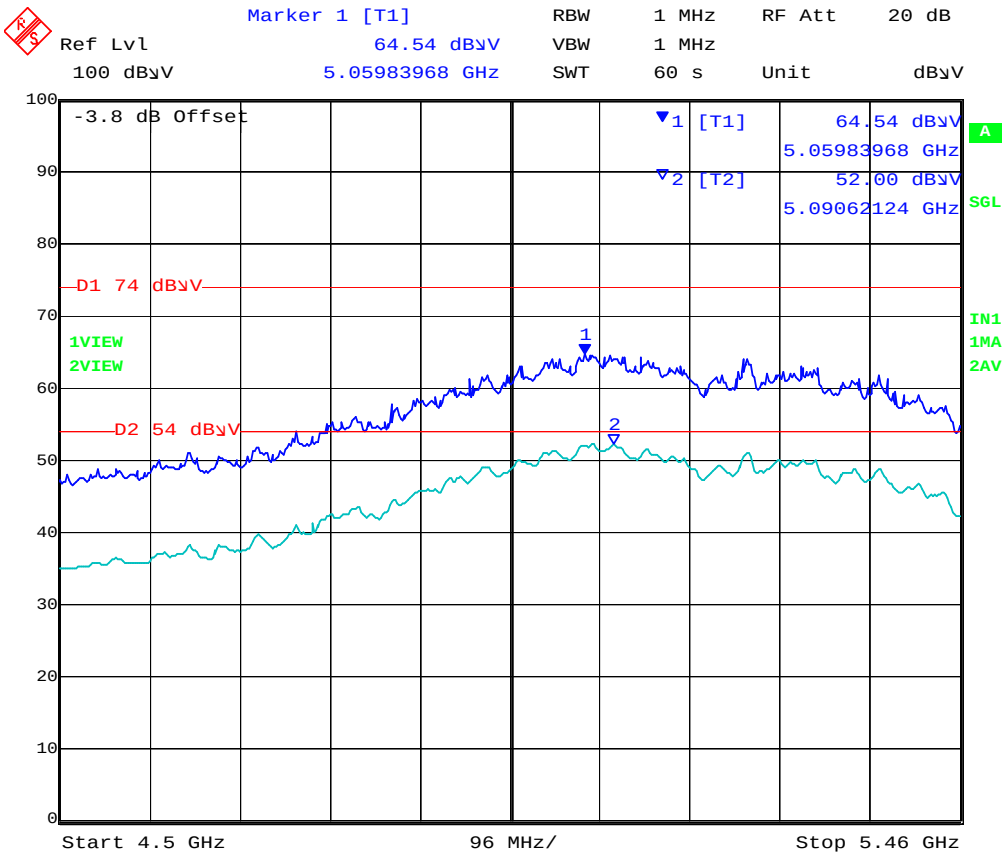


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1699.79	61.12	2.54	-13.03	50.63	Peak	H	130	319	74	-23.37	Pass	Digital
1700.002	59.1	2.54	-13.03	48.61	Average	H	130	319	54	-5.39	Pass	Digital
2379.991	59.51	2.94	-10.56	51.9	Peak	V	98	312	74	-22.1	Pass	RB
2379.991	56.57	2.94	-10.56	48.96	Average	V	98	312	54	-5.04	Pass	RB
5059.84	ART Power = 11			64.54	Peak				74	-9.46	Pass	BE
5090.621				52.00	Average				54	-2.00	Pass	BE
5747.545	53.36	14.76	35.1	103.2	Peak	V						FUND
11485.53	61.26	6.8	-1.37	66.68	Peak	V	98	350	74	-7.32	Pass	RB
11485.53	47.08	6.8	-1.37	52.5	Average	V	98	350	54	-1.5	Pass	RB

Peak Emission Scan

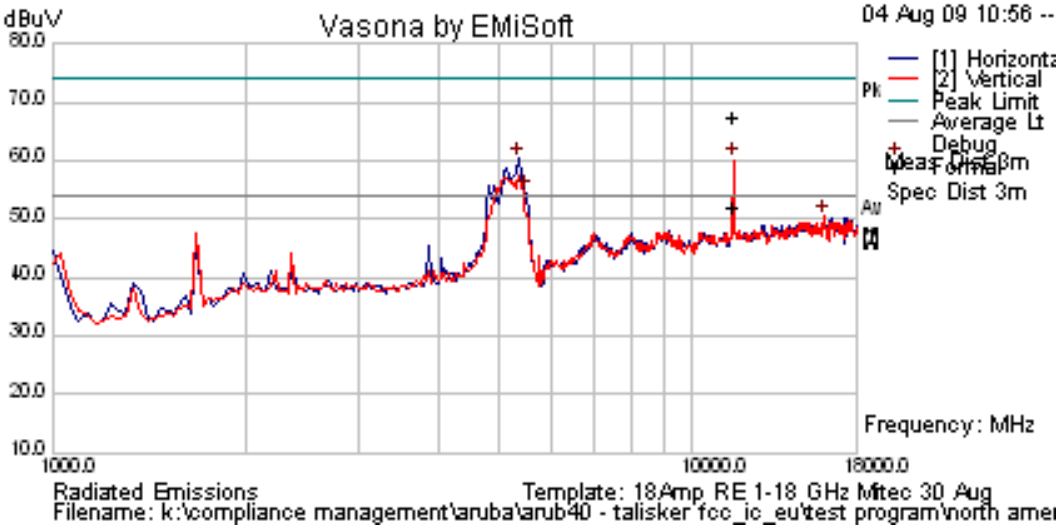


802.11n HT-20 Band-edge 5460 MHz



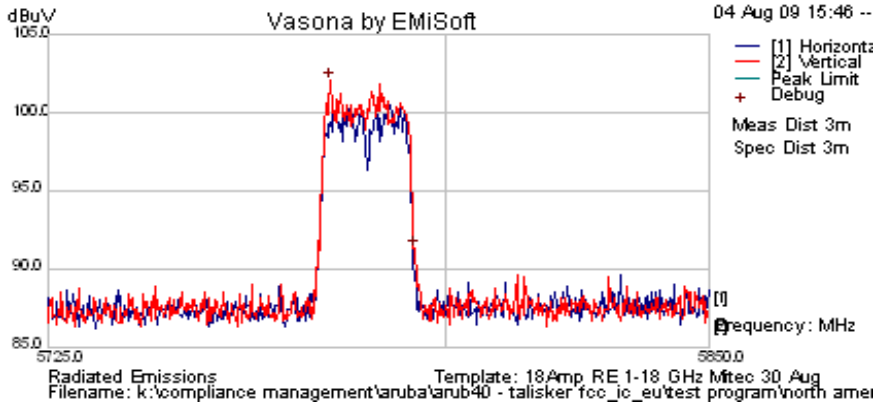
Date: 4.AUG.2009 15:29:17

Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5785 MHz
Antenna Model	Integral
Power setting	11 in ART test utility
Test Conditions	802.11n; HT-20 6.5 MCS 120V AC - Ethernet cable connected to PC for ART control

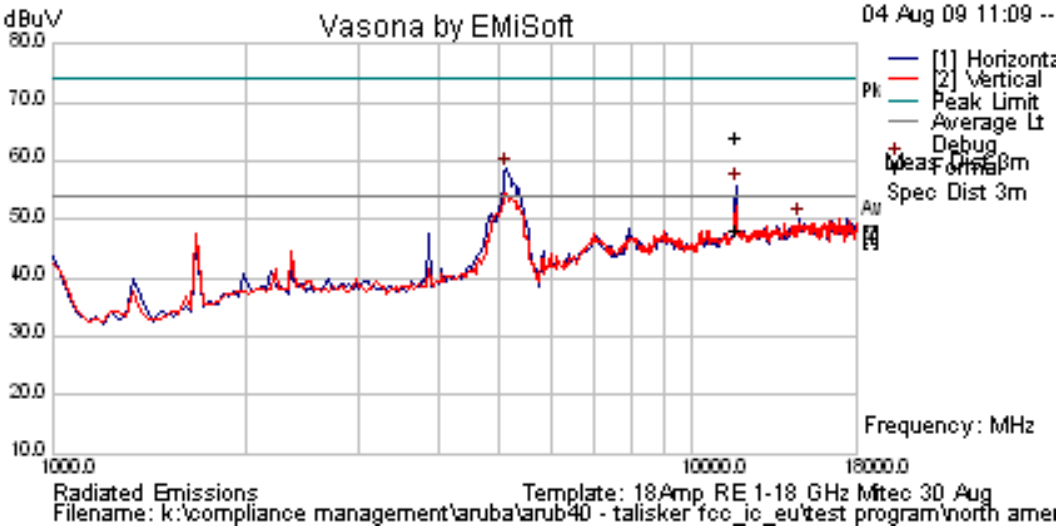


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5778.106	52.17	14.77	35.13	102.1	Peak	V						FUND
11568.72	61.67	6.81	-1.11	67.37	Peak	V	107	344	74	-6.63	Pass	RB
11568.72	46.16	6.81	-1.11	51.86	Average	V	107	344	54	-2.14	Pass	RB

Peak Emission Scan

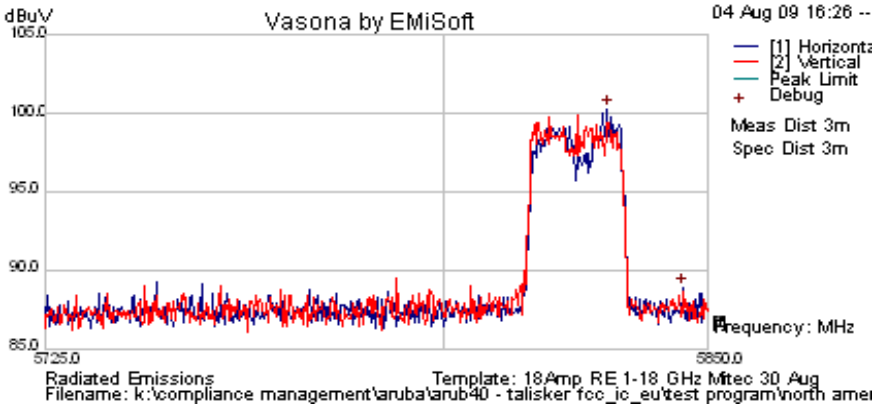


Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5825 MHz
Antenna Model	Integral
Power setting	11 in ART test utility
Test Conditions	802.11n; HT-20 6.5 MCS 120V AC - Ethernet cable connected to PC for ART control

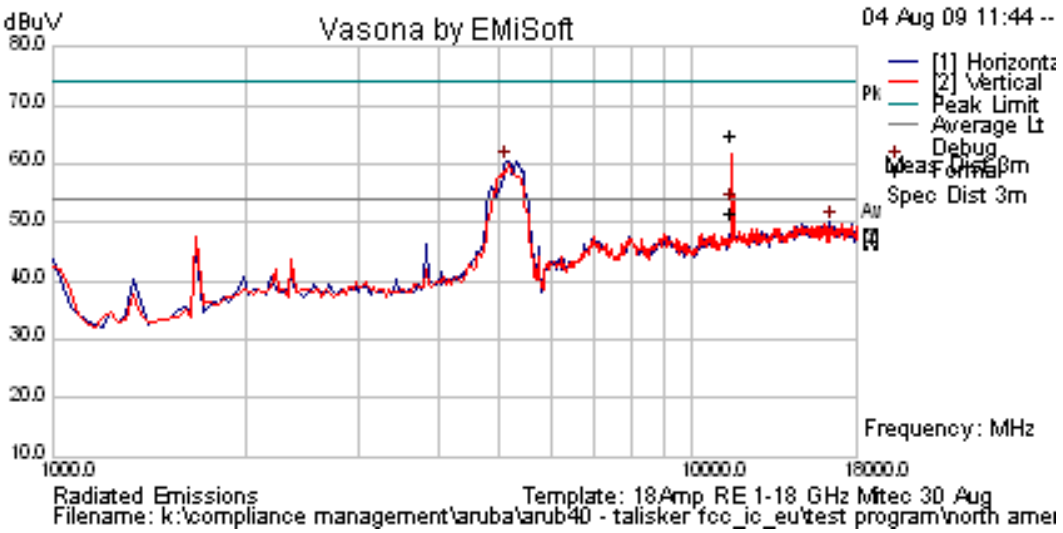


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5831.463	50.88	14.8	35.17	100.3	Peak	V						FUND
11648.5	58.1	6.83	-1.01	63.92	Peak	V	101	343	74	-10.08	Pass	RB
11648.6	42.31	6.83	-1.01	48.13	Average	V	113	339	54	-5.87	Pass	RB

Peak Emission Scan

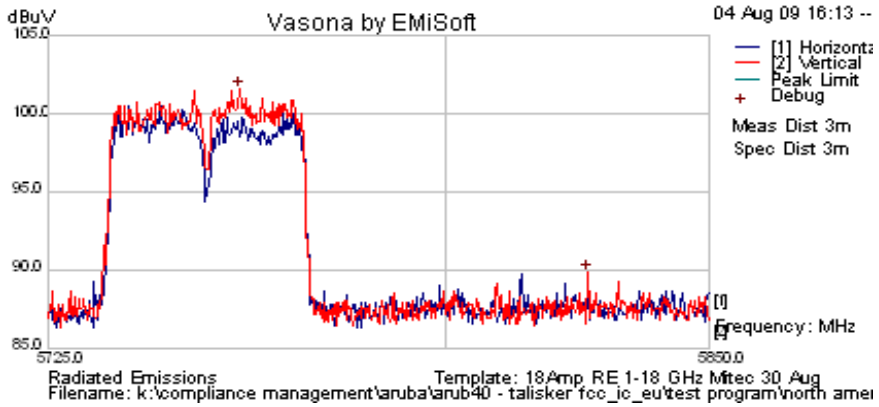


Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5755 MHz
Antenna Model	Integral
Power setting	12 in ART test utility
Test Conditions	802.11n; HT-40 13.5 MCS 120V AC - Ethernet cable connected to PC for ART control

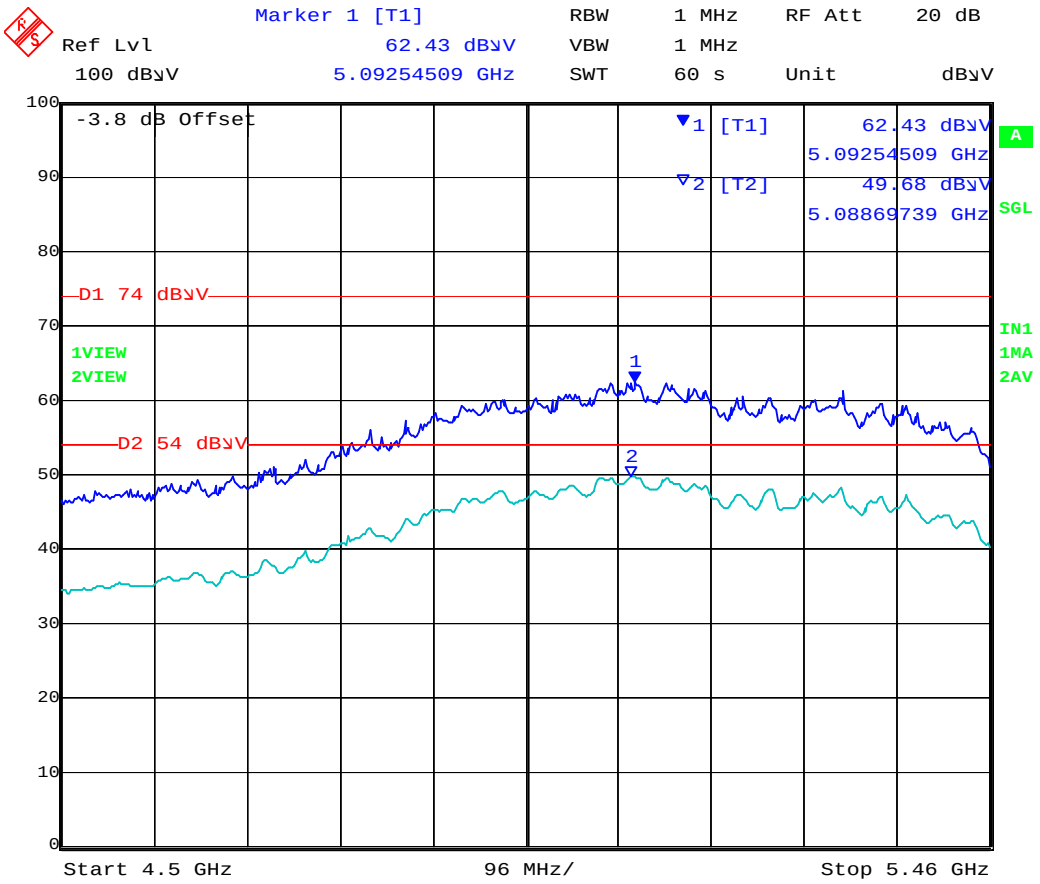


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5088.697	ART Power = 12			49.68	Average				54	-4.32	Pass	BE
5092.545				62.43	Peak				74	-11.57	Pass	BE
5761.072	51.71	14.76	35.11	101.6	Peak	V						FUND
11504.37	59.51	6.79	-1.32	64.98	Peak	V	102	354	74	-9.02	Pass	RB
11504.37	46.05	6.79	-1.32	51.52	Average	V	104	343	54	-2.48	Pass	RB

Peak Emission Scan

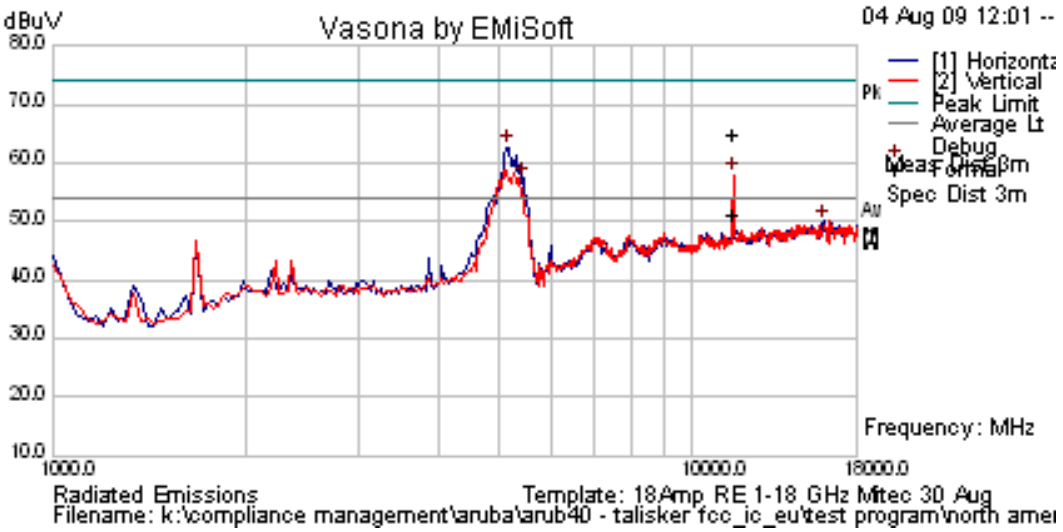


802.11n HT-40 Band-edge 5460 MHz



Date: 4.AUG.2009 15:39:54

Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5785 MHz
Antenna Model	Integral
Power setting	12 in ART test utility
Test Conditions	802.11n; HT-40 13.5 MCS 120V AC - Ethernet cable connected to PC for ART control



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5797.395	50.26	14.78	35.14	100.2	Peak	V						FUND
11563.97	59.39	6.81	-1.11	65.09	Peak	V	108	343	74	-8.91	Pass	RB
11563.97	45.57	6.81	-1.11	51.26	Average	V	108	343	54	-2.74	Pass	RB

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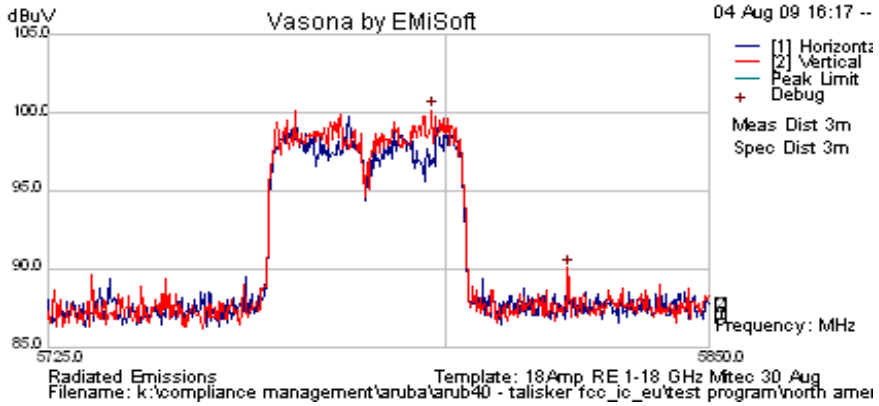
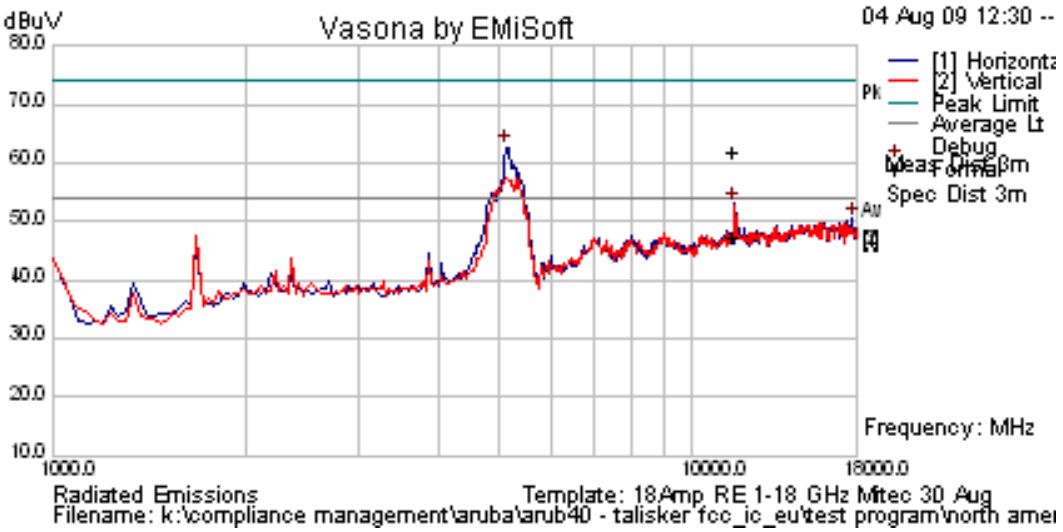
Peak Emission Scan

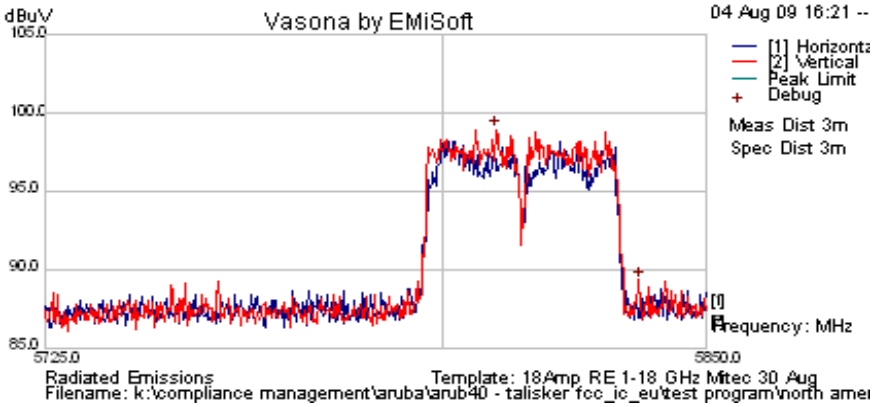


Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5815 MHz
Antenna Model	Integral
Power setting	12 in ART test utility
Test Conditions	802.11n; HT-40 13.5 MCS 120V AC - Ethernet cable connected to PC for ART control



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5809.92	48.99	14.79	35.15	98.93	Peak	V						FUND
11627.8	56.04	6.82	-1.02	61.84	Peak	V	101	343	74	-12.16	Pass	RB
11627.8	41.55	6.82	-1.02	47.35	Average	V	101	343	54	-6.65	Pass	RB

Peak Emission Scan



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 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.

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.

§15.209 (a) Limit Matrix

Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/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

5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

Industry Canada RSS-Gen §4.10, §6

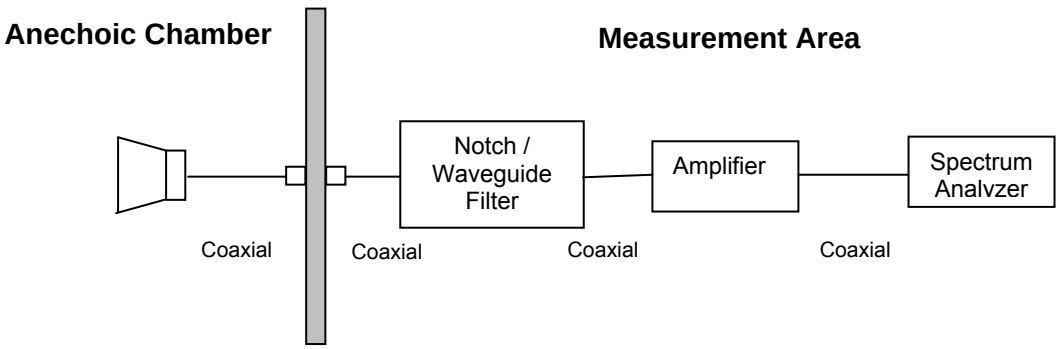
Test Procedure

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 simulatneously

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

For example:
Given receiver input reading of 51.5 dBμV; 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 dBμV/m

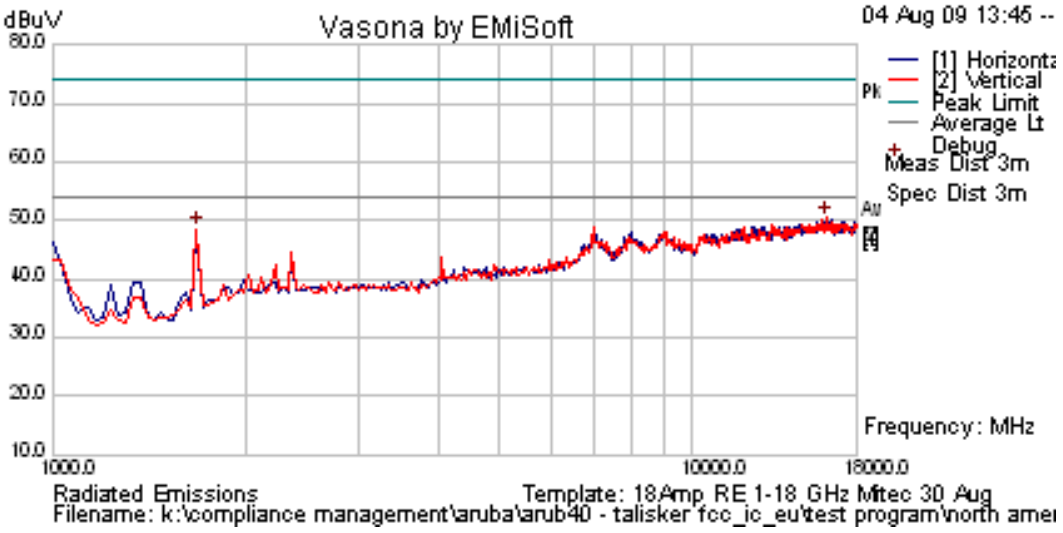
Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

Receiver Radiated Spurious Emissions above 1 GHz

Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	2437 MHz
Antenna Model	Integral
Power setting	Receive in ART test utility
Test Conditions	802.11b/g/n Receive 120V AC - Ethernet cable connected to PC for ART control

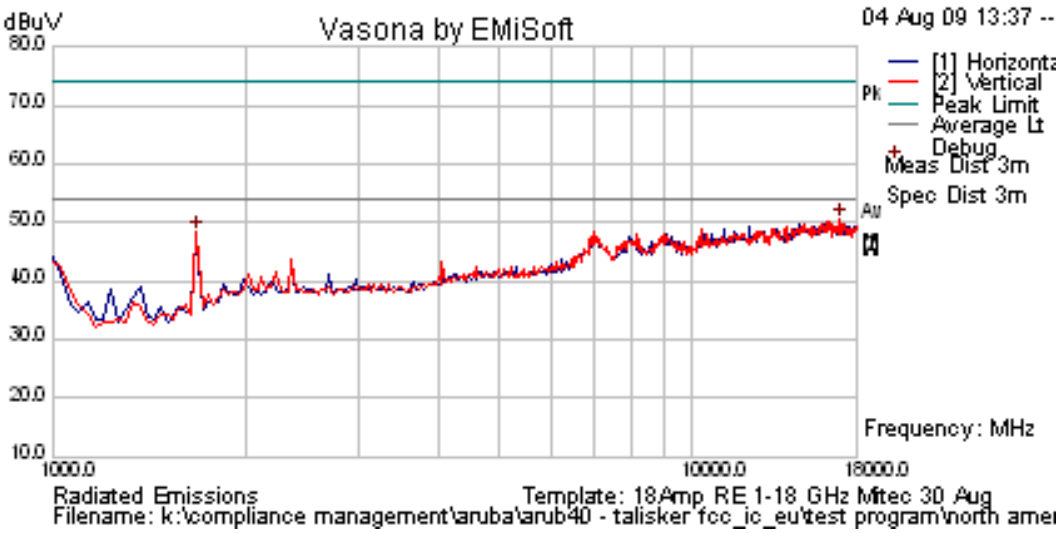


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1699.79	61.12	2.54	-13.03	50.63	Peak	H	130	319	74	-23.37	Pass	Digital
1700.002	59.1	2.54	-13.03	48.61	Average	H	130	319	54	-5.39	Pass	Digital

No receiver emissions were observed.

Receiver Radiated Spurious Emissions above 1 GHz

Date	4th August, 2009
Engineer	CSB
Test Case	ARUB40
Frequency	5785 MHz
Antenna Model	Integral
Power setting	Receive in ART test utility
Test Conditions	802.11a/n Receive 120V AC - Ethernet cable connected to PC for ART control



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
1699.79	61.12	2.54	-13.03	50.63	Peak	H	130	319	74	-23.37	Pass	Digital
1700.002	59.1	2.54	-13.03	48.61	Average	H	130	319	54	-5.39	Pass	Digital

No receiver emissions were observed.

Specification

Receiver Radiated Spurious Emissions

Industry Canada RSS-Gen §4.10,
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 hall comply with the limits of Table 1.

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/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

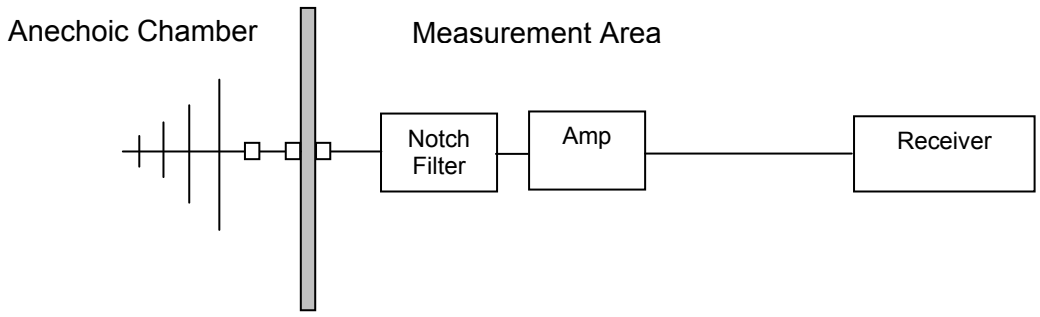
5.1.6.3. Radiated Spurious Emissions (30M-1 GHz)

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.

$$FS = R + AF + CORR$$

where:

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

For example:
Given a Receiver input reading of 51.5dBμV; 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 = 36.3dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

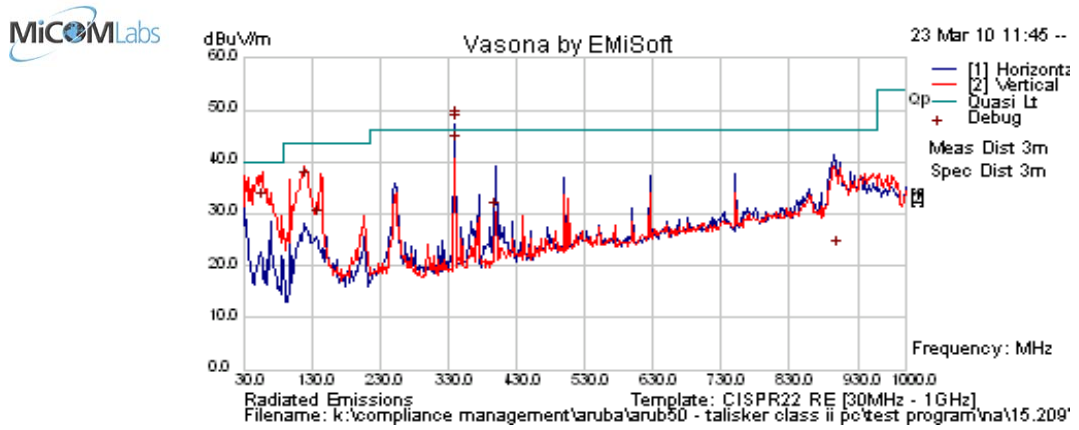
40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

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

TABLE OF RESULTS – AC Power Supply

Test Freq.	2437 MHz	**Engineer**	CSB
Variant	Radiated Digital Emissions	**Temp (ºC)**	20.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	38
Power Setting	Default (ART = 20)	**Press. (mBars)**	1008
Antenna	Integral Antenna's connected		
Test Notes 1			
Test Notes 2			



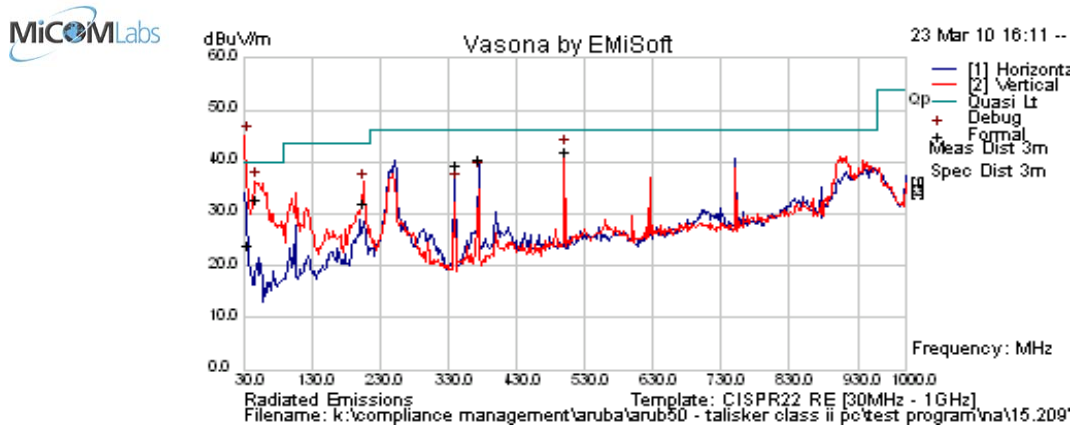
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
57.199	52.6	3.8	-23.9	32.5	Quasi Peak	V	98	360	40	-7.5	Pass	DIG
119.508	49.3	4.3	-17.2	36.4	Quasi Peak	V	100	44	43.5	-7.1	Pass	DIG
139.299	42.6	4.4	-18.0	29.0	Quasi Peak	V	98	262	43.5	-14.5	Pass	DIG
339.995	54.1	5.4	-16.1	43.4	Quasi Peak	H	101	250	46	-2.6	Pass	DIG
399.991	39.2	5.7	-14.4	30.4	Quasi Peak	H	107	252	46	-15.6	Pass	DIG
901.082	23.4	7.3	-7.4	23.3	Quasi Peak	H	102	91	46	-22.8	Pass	DIG

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

TABLE OF RESULTS – POE Power Supply

Test Freq.	2437 MHz	**Engineer**	CSB
Variant	Radiated Digital Emissions	**Temp (ºC)**	20.5
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	38
Power Setting	Default (ART = 20)	**Press. (mBars)**	1008
Antenna	Integral Antenna's connected		
Test Notes 1	EUT Powered by PoE Adaptor		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
34.790	33.7	3.5	-13.3	23.9	Quasi Max	V	123	295	40	-16.1	Pass	DIG
48.481	51.0	3.7	-22.0	32.7	Quasi Max	V	111	228	40	-7.3	Pass	DIG
206.718	46.8	4.8	-19.5	32.1	Quasi Max	V	98	179	43.5	-11.4	Pass	DIG
499.979	48.6	6.0	-12.6	42.0	Quasi Max	V	98	95	46	-4.0	Pass	DIG
374.989	50.1	5.6	-15.1	40.6	Quasi Max	H	102	49	46	-5.5	Pass	DIG
339.988	50.1	5.4	-16.1	39.4	Quasi Max	H	106	325	46	-6.6	Pass	DIG

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

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 (μV/m)	Field Strength (dBμV/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

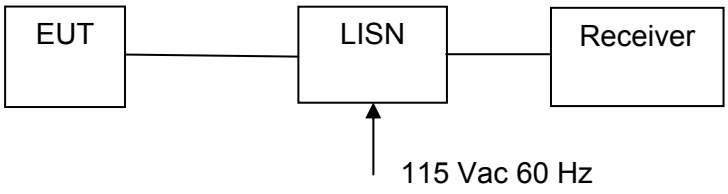
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.7. 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.

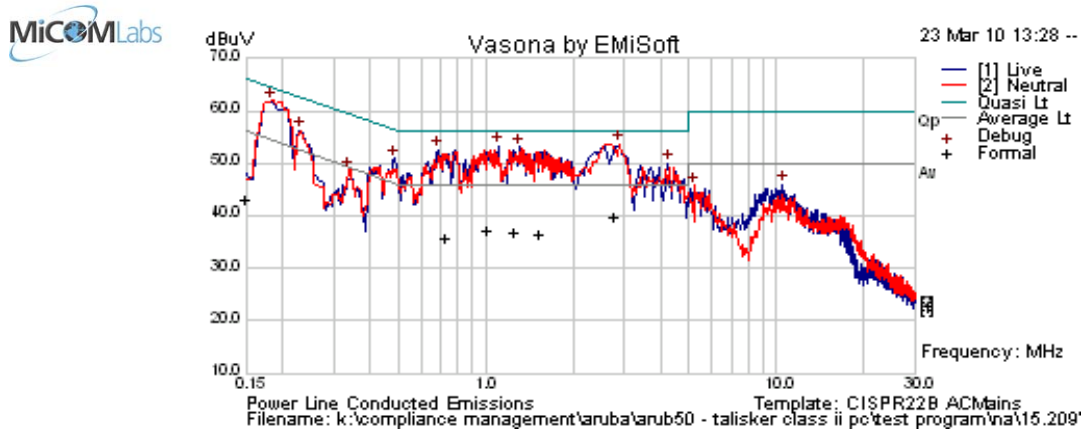
Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

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

Test Freq.	2437	**Engineer**	CSB
Variant	Conducted Emissions - AC Line	**Temp (ºC)**	21.5
Freq. Range	0.150 MHz - 30 MHz	**Rel. Hum.(%)**	37
Power Setting	Defualt (ART = 20)	**Press. (mBars)**	1007
Antenna	Integral Antenna's attached		
Test Notes 1	Plot below includes peak emissions; 2nd plot includes average detector emissions (next page)		
Test Notes 2	EUT Powered by AC/DC Adaptor		



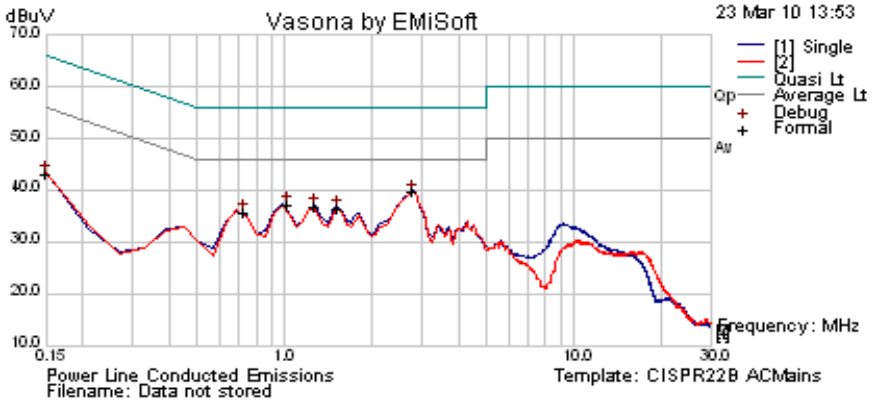
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.150	33.2	9.9	0.1	43.2	Quasi Peak	Live	66	-22.8	Pass	DIG
0.150	16.9	9.9	0.1	26.9	Average	Live	56	-29.1	Pass	DIG
0.729	29.5	10.0	0.1	39.5	Average	Neutral	46	-6.5	Pass	DIG
0.729	39.3	10.0	0.1	49.4	Quasi Peak	Neutral	56	-6.6	Pass	DIG
1.023	29.6	9.9	0.1	39.6	Average	Neutral	46	-6.4	Pass	DIG
1.023	39.0	9.9	0.1	49.0	Quasi Peak	Neutral	56	-7.0	Pass	DIG
1.271	38.7	10.0	0.1	48.7	Quasi Peak	Neutral	56	-7.3	Pass	DIG
1.271	29.2	10.0	0.1	39.3	Average	Neutral	46	-6.7	Pass	DIG
1.544	38.1	10.0	0.1	48.2	Quasi Peak	Neutral	56	-7.8	Pass	DIG
1.544	28.6	10.0	0.1	38.7	Average	Neutral	46	-7.3	Pass	DIG
2.791	39.0	10.1	0.1	49.3	Quasi Peak	Neutral	56	-6.7	Pass	DIG
2.791	29.9	10.1	0.1	40.1	Average	Neutral	46	-5.9	Pass	DIG

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

Average Detector plot – AC Wireline Emissions

Test Freq.	2437		CSB
Variant	Conducted Emissions - AC Line		21.5
Freq. Range	0.150 MHz - 30 MHz		37
Power Setting	Defualt (ART = 20)		1007
Antenna	Integral Antenna's attached		
Test Notes 1	Plot below indicated average detector emissions		
Test Notes 2	EUT Powered by AC/DC Adaptor		



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 μΩ 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 (dBμV)	
	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

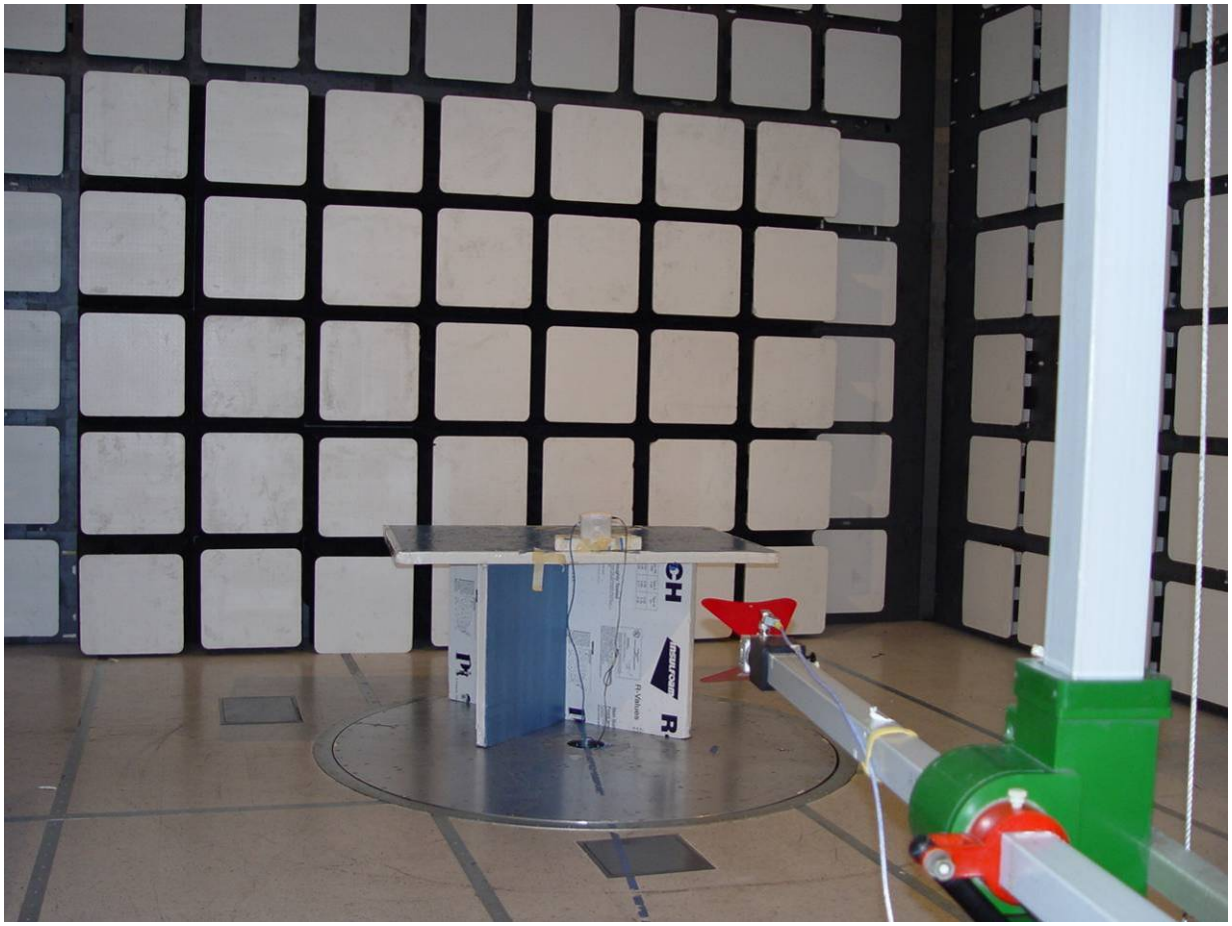
Measurement uncertainty	±2.64 dB

Traceability

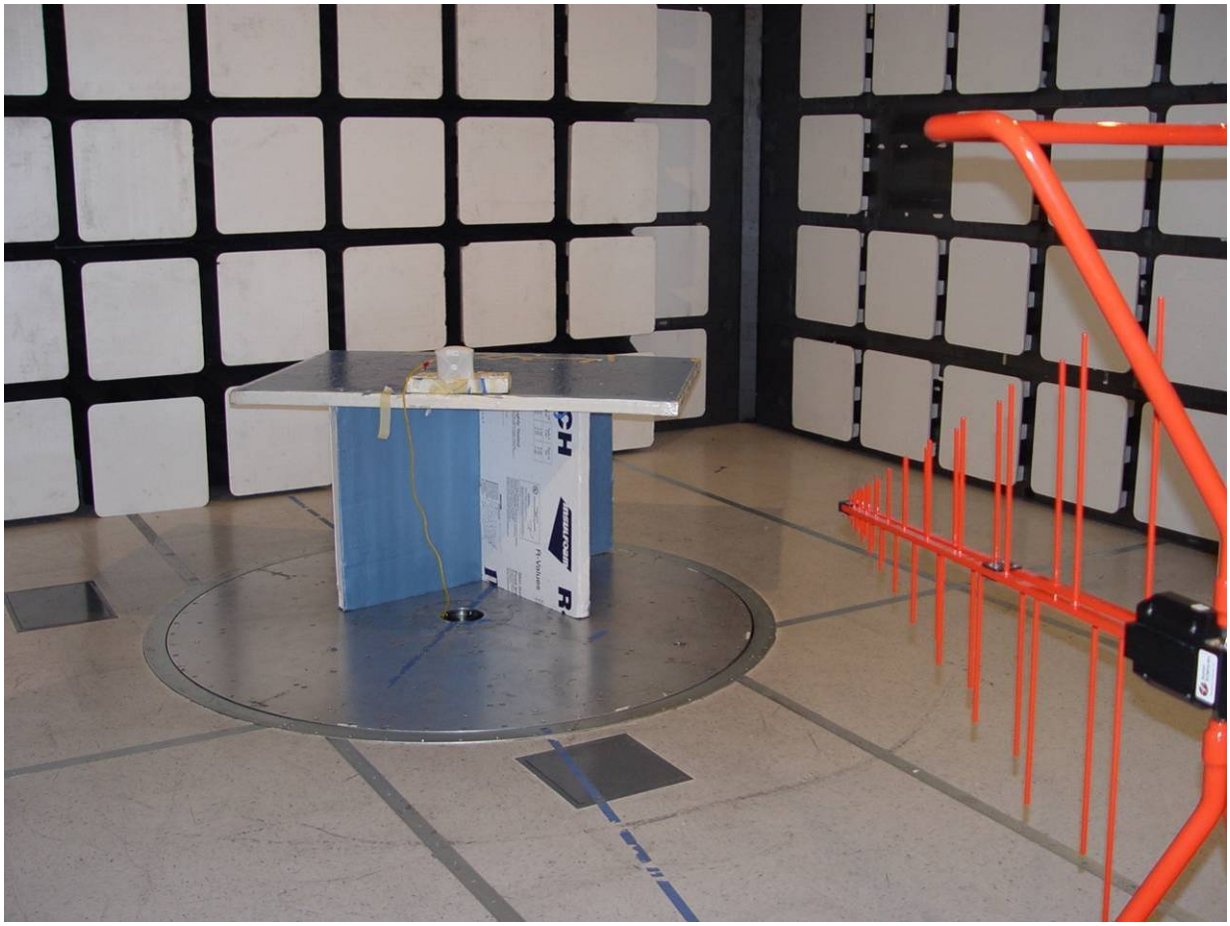
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0287, 0190, 0293, 0307

6. PHOTOGRAPHS

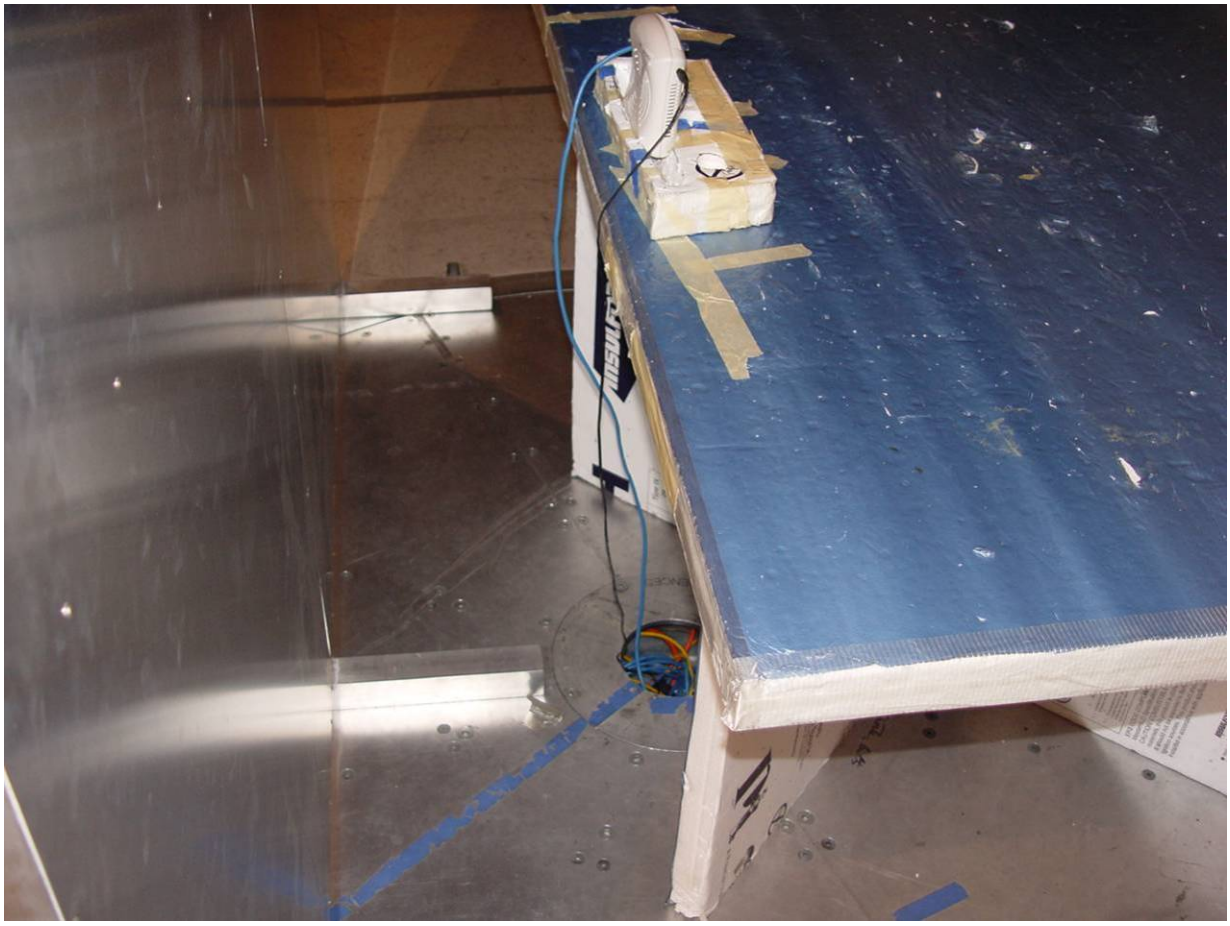
6.1. Radiated Emissions > 1GHz



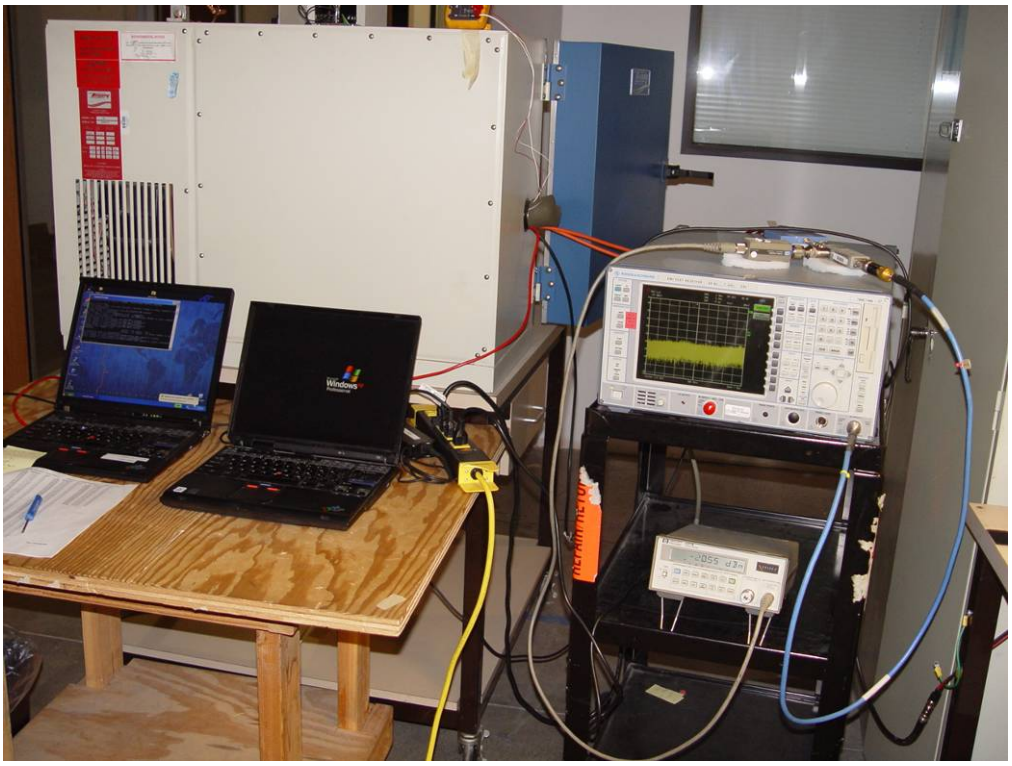
6.2. Radiated Emissions < 1GHz



6.3. AC Wireline Conducted Emissions



6.4. Conducted RF Measurement Test Set-Up



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
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
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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