FCC CFR47 PART 15 SUBPART C CERTIFICATION

TEST REPORT

FOR

802.11a/b COMBO WIRELESS LAN MODULE

MODEL NUMBER: PA3233U-1MPC

BRAND NAME: TOSHIBA

FCC ID: CJ6UPA3233WL

REPORT NUMBER: 02U1585-1

ISSUE DATE: NOVEMBER 8, 2002

Prepared for
TOSHIBA CORPORATION DIGITAL MEDIA NETWORK COMPANY
2-9, SUEHIRO-CHO, OME,
TOKYO, 198-8710
JAPAN

Prepared by
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1. TEST RESULT CERTIFICATION

COMPANY NAME: TOSHIBA CORPORATION DIGITAL MEDIA NETWORK COMPANY
2-9, SUEHIRO-CHO, OME
TOKYO, 198-8710 JAPAN

EUT DESCRIPTION: 802.11A/B COMBO WLAN MODULE

MODEL NAME: PA3233U-1MPC

DATE TESTED: OCTOBER 17 – NOVEMBER 8, 2002

TYPE OF EQUIPMENT	INTENTIONAL RADIATOR
EQUIPMENT TYPE	2.4 - 2.4835 GHz and 5.725 – 5.850 TRANSCEIVER*
MEASUREMENT PROCEDURE	ANSI 63.4 / 1992, TIA/EIA 603
PROCEDURE	CERTIFICATION
FCC RULE	CFR 47 PART 15.C

* The 2.4 and 5.8 GHz bands are applicable to this report; another band of operation (5.2 GHz) is documented in a separate report

Compliance Certification Services, Inc. tested the above equipment for compliance with the requirements set forth in CFR 47, PART 15, Subpart C. The equipment in the configuration described in this report, shows the measured emission levels emanating from the equipment do not exceed the specified limit. This report only documents the RF performance of the radio module. AC mains conducted emissions and digital device radiated emissions performance is documented by Toshiba Document Number OFD-H3395 dated October 18, 2002, FCC ID: CJ6PP35ASY, Certification Pending.

Note: This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document.

Approved & Released For CCS By:

MIKE HECKROTTE
CHIEF ENGINEER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

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2. EUT DESCRIPTION

The Toshiba WLAN module is an 802.11 a/b wireless Spread Spectrum transceiver. It is constructed on a printed circuit card with a Mini PCI interface and is designed to be installed in a host system. This unit provides a power output of +18.2 dBm (66 mW) in the 2400 – 2483.5 MHz band and +23.1 dBm (204 mW) in the 5725 –5850 MHz band . It is designed to use two dual band inverted F film antennas. A single antenna is used for transmit. Both antennas are used for receive diversity. The highest intended antenna gain is 4.8 dBi.

This transceiver is based on an Atheros AR5001X three-chip solution. The three chips include:

AR5211: Multiprotocol MAC/baseband processor, and CardBus/PCI bus interface.

AR5111 Radio-on-a-Chip (RoC): An all-CMOS single-chip radio transceiver that includes a power amplifier, and integrated dual conversion filters to convert signals from 5 GHz to the baseband range for use by the AR5211. The AR5111 offers fully integrated transmitter, receiver, and frequency synthesizer functions; eliminating the need for external voltage controlled oscillators (VCOs) and surface acoustic wave (SAW) filters.

AR2111 Radio-on-a-Chip (RoC): An all-CMOS single-chip radio transceiver that, when combined with the AR5111,implements a 2.4 GHz 802.11 b/g radio solution. The AR2111 offers fully integrated transmitter, receiver, and frequency synthesizer functions. Like the AR5111, the AR2111 does not require external VCOs or SAW filters.

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3. TEST METHODOLOGY

Conducted and radiated testing were performed according to the procedures documented on chapter 13 of ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, and 15.407.

4. FACILITIES AND ACCREDITATION

4.1. FACILITIES AND EQUIPMENT

The open area test sites and conducted measurement facilities used to collect the radiated data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

Receiving equipment (i.e., receiver, analyzer, quasi-peak adapter, pre-selector) and LISNs conform to CISPR specifications for "Radio Interference Measuring Apparatus and Measurement Methods," Publication 16.

4.2. LABORATORY ACCREDITATIONS AND LISTINGS

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code: 200065-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT (1300F2)).

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4.3. TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	NVLAP*	FCC Part 15, CISPR 22, AS/NZS 3548,IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11, CNS 13438	NVLAP® 200065-0
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	FC 1300
Japan	VCCI	CISPR 22 Two OATS and one conducted Site	VCCI R-1014, R-619, C-640
Norway	NEMKO	EN50081-1, EN50081-2, EN50082-1, EN50082-2, IEC61000-6-1, IEC61000-6-2, EN50083-2, EN50091-2, EN50130-4, EN55011, EN55013, EN55014-1, EN55104, EN55015, EN61547, EN55022, EN55024, EN61000-3-2, EN61000-3-3, EN60945, EN61326-1	N ELA 117
Norway	NEMKO	EN60601-1-2 and IEC 60601-1-2, the Collateral Standards for Electro-Medical Products. MDD, 93/42/EEC, AIMD 90/385/EEC	N ELA-171
Taiwan	BSMI	CNS 13438	商 檢 SL2-IN-E-1012
Canada	Industry Canada	RSS210 Low Power Transmitter and Receiver	Canada IC2324 A,B,C, and F

* No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

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5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

5.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Radiated Emission	
30MHz – 200 MHz	+/- 3.3dB
200MHz – 1000MHz	+4.5/-2.9dB
1000MHz – 2000MHz	+4.6/-2.2dB
Power Line Conducted Emission	
150kHz – 30MHz	+/-2.9

Any results falling within the above values are deemed to be marginal.

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5.3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST AND MEASUREMENT EQUIPMENT LIST				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due Date
Spectrum Analyzer	HP	8566B	3014A06685	6/1/03
Spectrum Display	HP	85662A	2152A03066	6/1/03
Quasi-Peak Detector	HP	85650A	3145A01654	6/1/03
Preamplifier	HP	8447D	2944A06833	8/22/03
Log Periodic Antenna	EMCO	3146	9107-3163	3/30/03
Biconical Antenna	Eaton	94455-1	1197	3/30/03
Spectrum Analyzer	HP	8564E	3943A01643	7/22/03
Spectrum Analyzer	HP	8593EM	3710A00205	6/11/03
Preamplifier (1 - 26.5GHz)	HP	8449B	3008A00369	6/30/03
Horn Antenna (1 - 18GHz)	EMCO	3115	6717	1/31/03
Horn Antenna (18 – 26.5GHz)	ARA	MWH 1826/B	6717	1/31/03
High Pass Filter (4.57GHz)	FSY Microwave	FM-4570-9SS	003	N.C.R.
Harmonic Mixer	HP	11970A	3008A04190	10/14/05
Peak Power Meter	Agilent	E9327A	US40440755	9/5/03
Peak Power Sensor	Agilent	E4416A	GB41291160	8/9/03

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6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Device Type	Manufacturer	Model	Serial Number	FCC ID
Laptop	Toshiba	PP350U	92036659JU	Prototype / EUT
AC Adapter	Toshiba	PA3083U-1ACA	1336963G	DoC

I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US115	Unshielded	2 m	Integrated with AC Adapter
2	RF	2	UFL	Shielded	0.3 m	Integrated with Antennas

TEST SETUP

The EUT is installed in the laptop computer via a PCMCIA-to-MiniPCI adapter / extender card.

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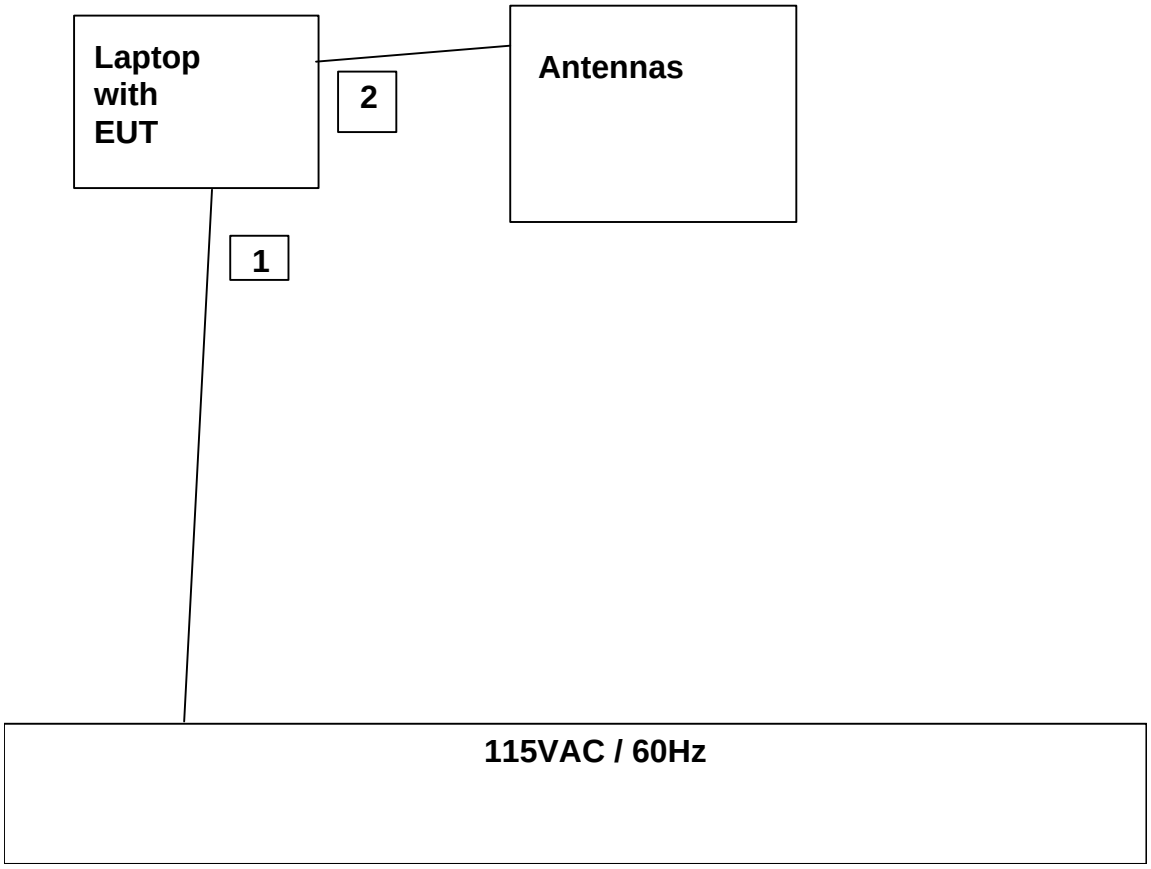
SETUP DIAGRAM FOR TRANSMITTER TESTS



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7. APPLICABLE RULES

§15.247 (a)- BANDWIDTH

(2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

§15.247 (b)- POWER OUTPUT

The maximum peak output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt.

(4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Specification Limit: Maximum Antenna Gain = 4.3 dBi, therefore the limit is 30 dBm

§15.247 (b)- RADIO FREQUENCY EXPOSURE

(5) 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 energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

§15.247 (c)- SPURIOUS EMISSIONS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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 a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

§15.247 (d)- PEAK POWER SPECTRAL DENSITY

(d) For direct sequence systems, the peak 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.

(f) The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

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§15.205- RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), 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.

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§15.209- RADIATED EMISSION LIMITS

(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:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

Frequency Range (MHz)	Field Strength (uV/m at 3 m)	Field Strength (dBuV/m at 3 m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

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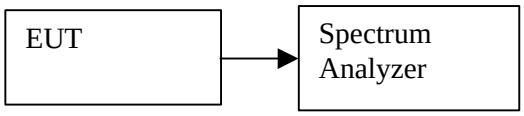
8. TEST SETUP, PROCEDURE AND RESULT

8.1. 6 dB BANDWIDTH

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz and peak detection is used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.

RESULTS

No non-compliance noted:

2.4 GHz Band

Channel	Frequency (MHz)	B (kHz)	Limit (kHz)	Margin (kHz)
Low	2412	10850	500	10350
Middle	2437	10800	500	10300
High	2462	11000	500	10500

5.8 GHz Band Normal Mode

Channel	Frequency (MHz)	B (kHz)	Limit (kHz)	Margin (kHz)
Low	5745	16600	500	16100
Middle	5785	16570	500	16070
High	5825	16470	500	15970

5.8 GHz Band Turbo Mode

Channel	Frequency (MHz)	B (kHz)	Limit (kHz)	Margin (kHz)
Low	5760	32750	500	32250
Middle	N/A	N/A	N/A	N/A
High	5800	32830	500	32330

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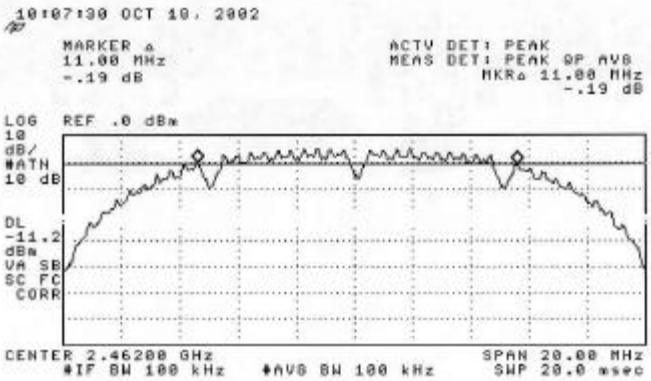
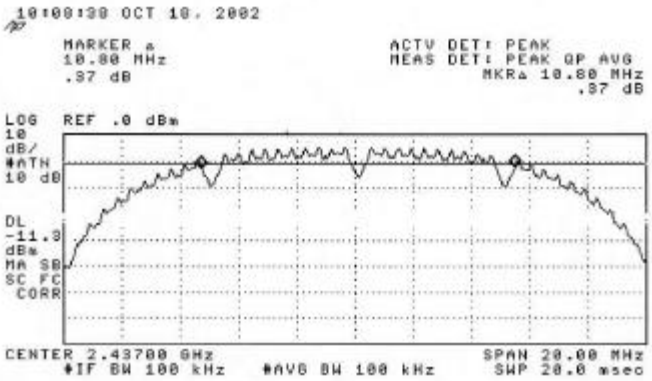
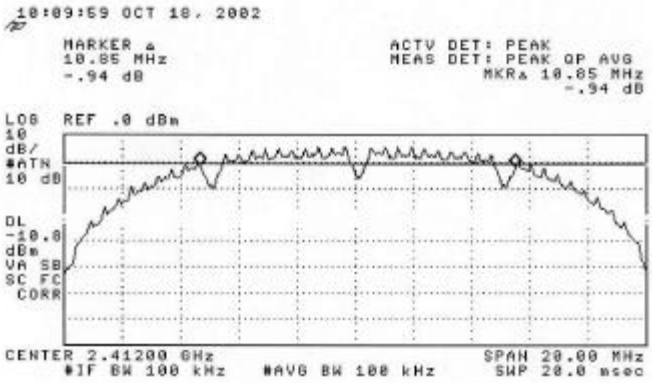
6 DB BANDWIDTH (2.4 GHZ BAND)







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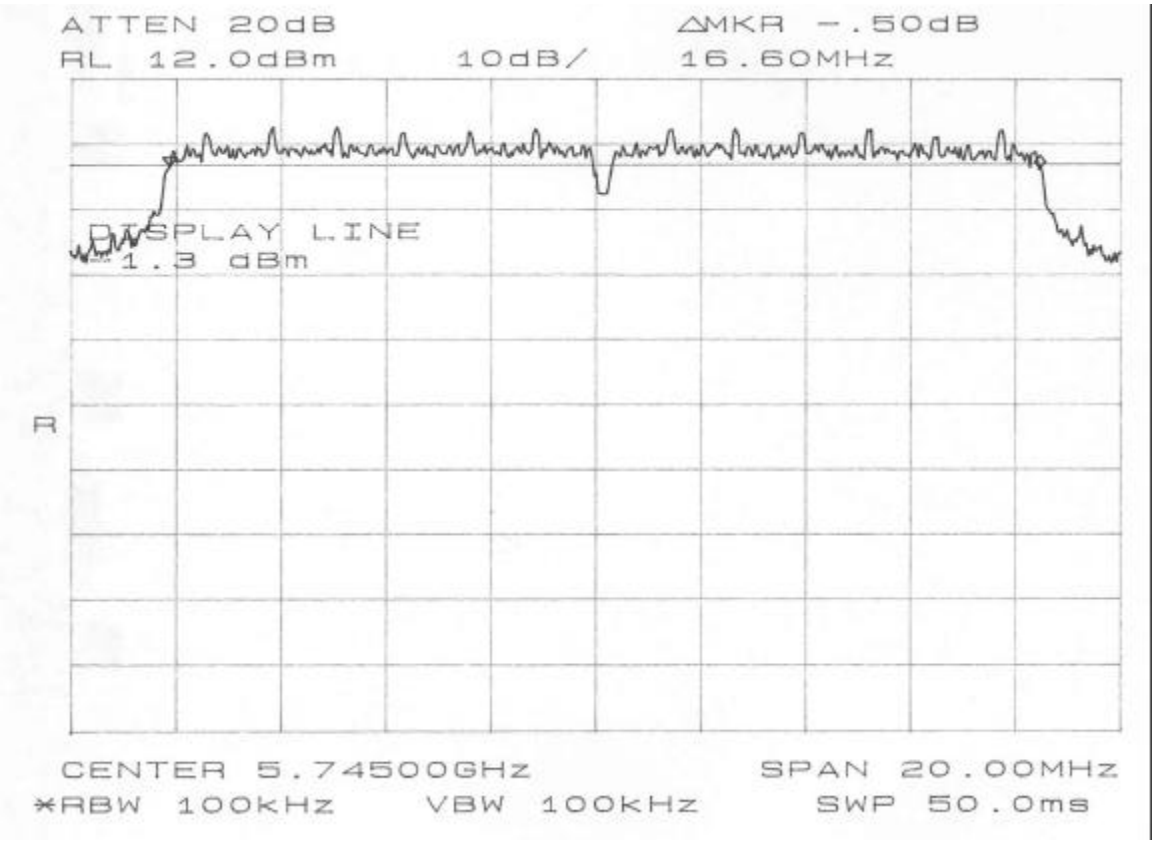
6 DB BANDWIDTH (5.8 GHZ BAND, NORMAL MODE)



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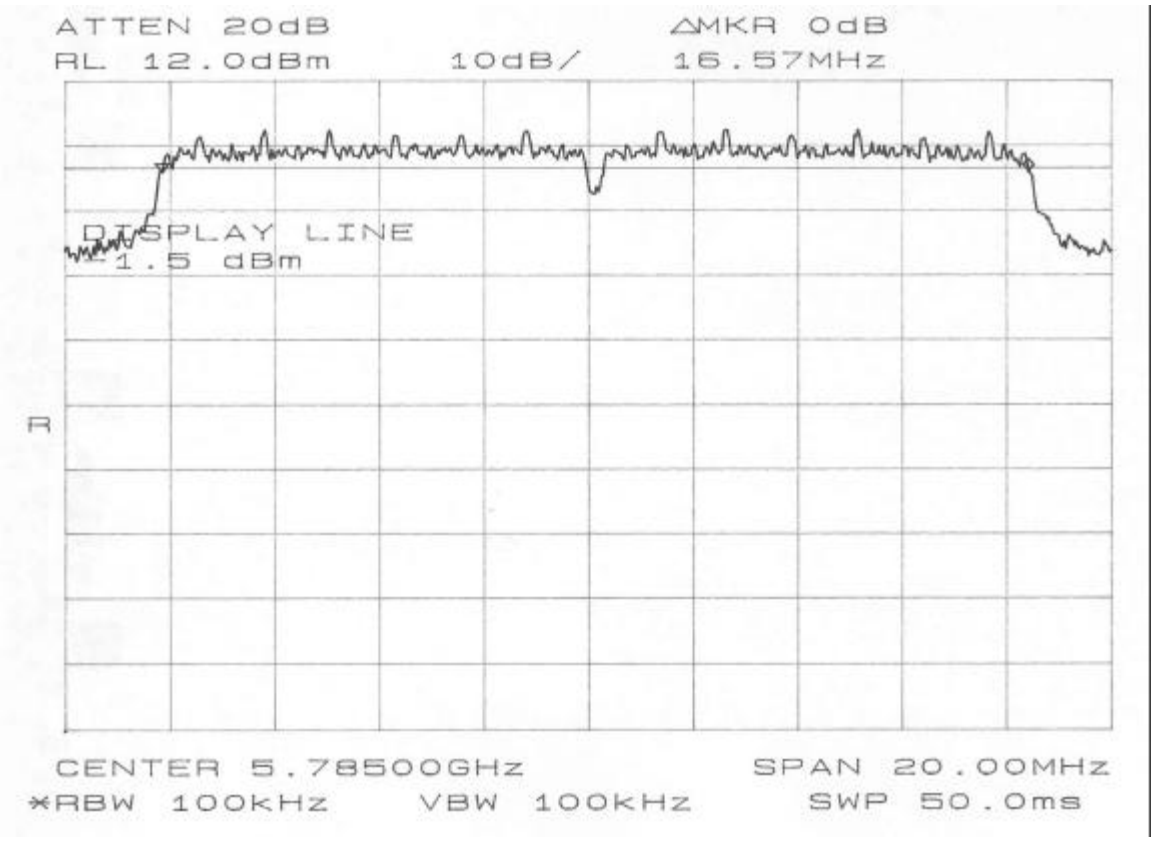

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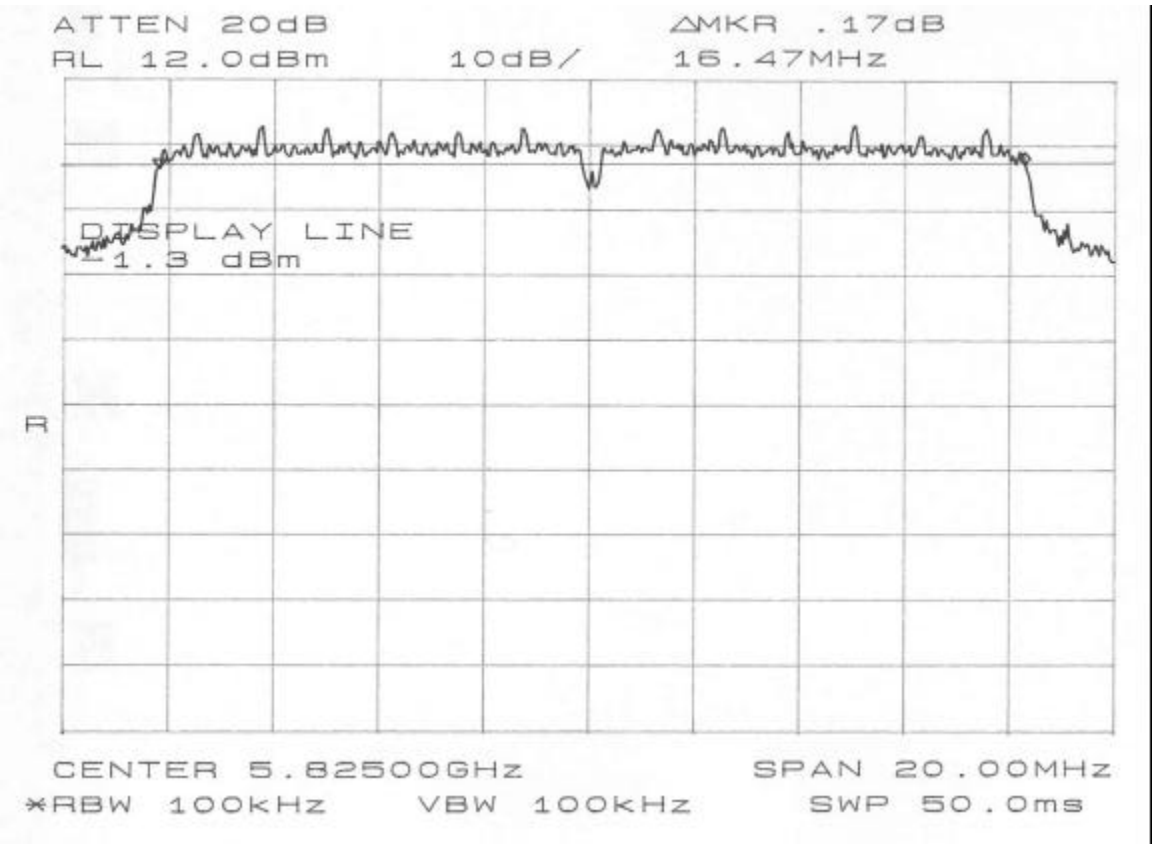

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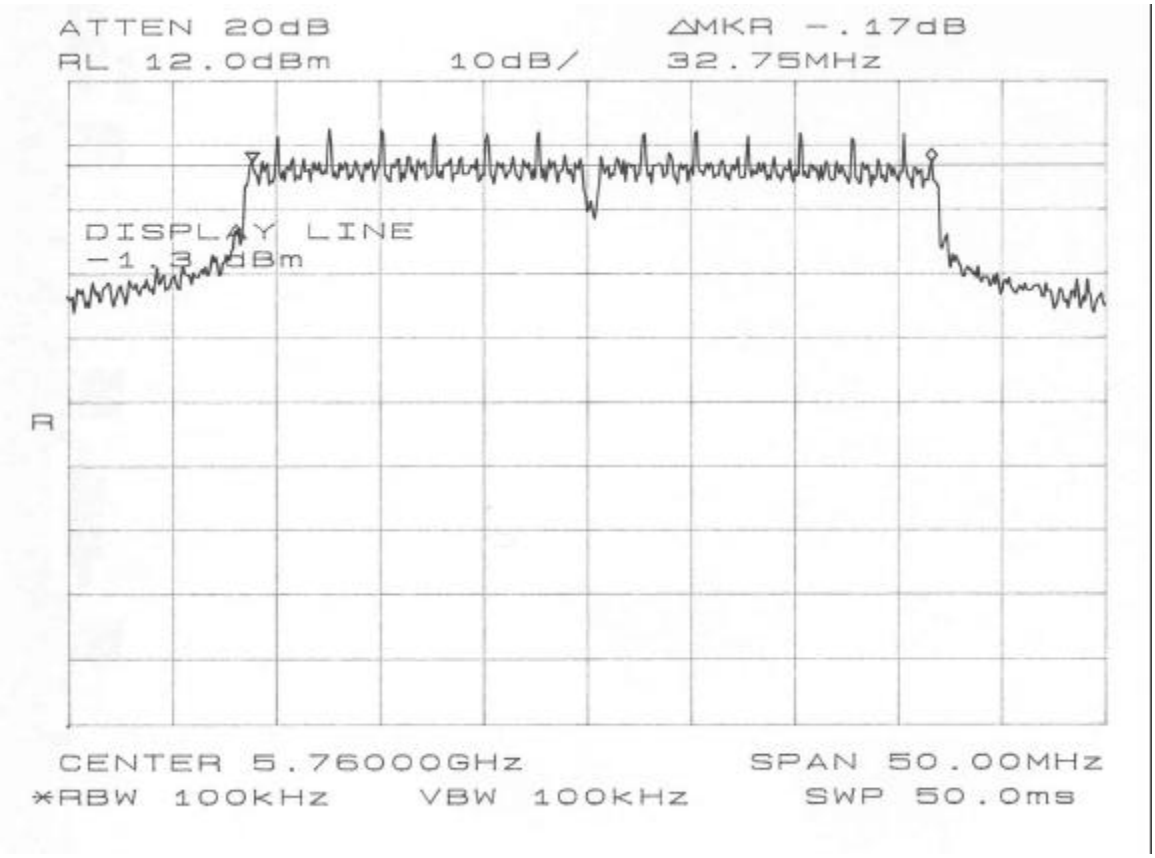
6 DB BANDWIDTH (5.8 GHZ BAND, TURBO MODE)



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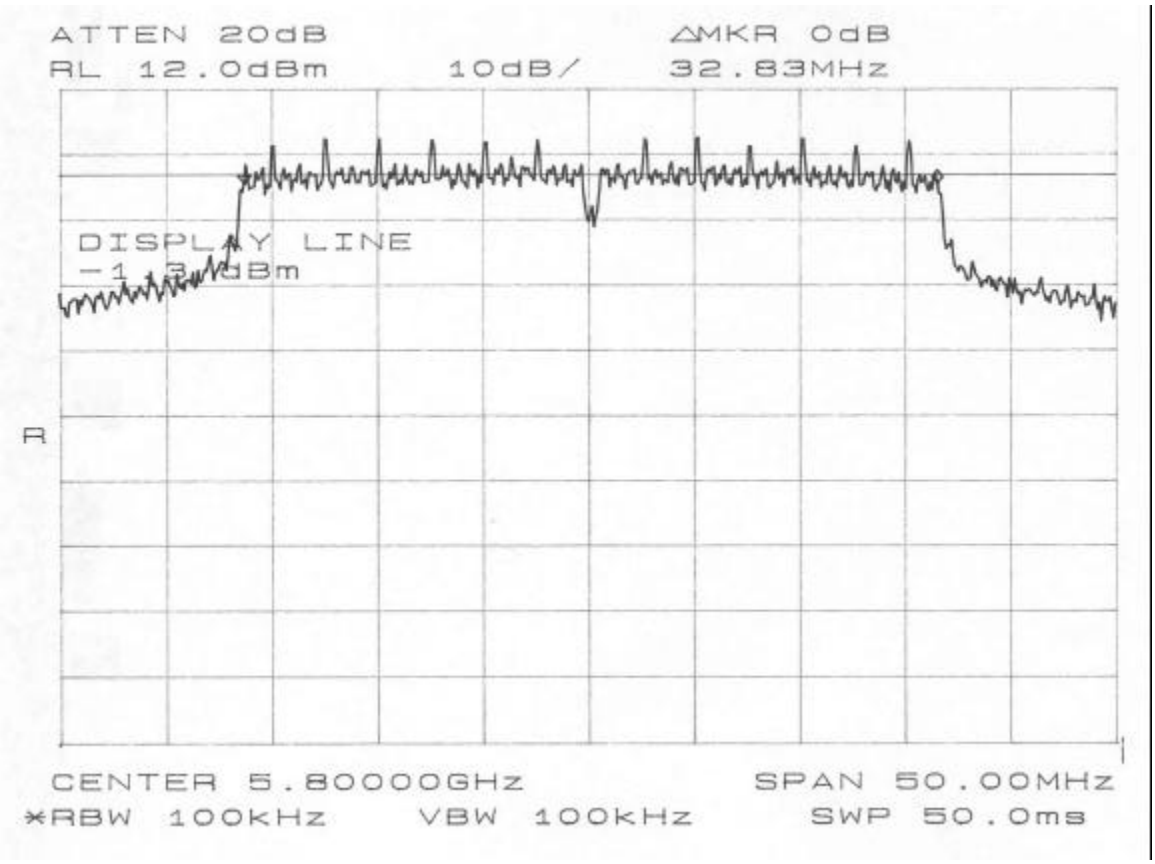

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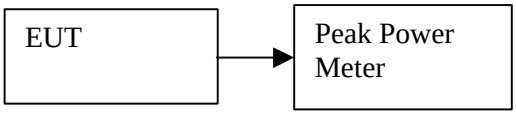
8.2. PEAK POWER

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the power meter. The power meter is set to read peak power.

RESULTS

No non-compliance noted:

2.4 GHz Band

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin dB
Low	2412	13.2	30	-16.8
Middle	2437	18.2	30	-11.8
High	2462	15.9	30	-14.1

5.8 GHz Band Normal Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin dB
Low	5745	23.1	30	-6.9
Middle	5785	22.8	30	-7.2
High	5825	22.5	30	-7.5

5.8 GHz Band Turbo Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin dB
Low	5760	22.2	30	-7.8
Middle	N/A	N/A	N/A	N/A
High	5800	22.1	30	-7.9

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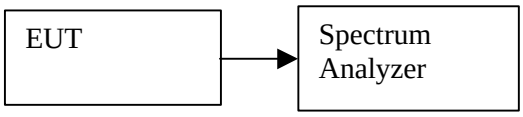
8.3. PEAK POWER SPECTRAL DENSITY

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer, the maximum level in a 3 kHz bandwidth is measured with the spectrum analyzer using RBW = 3 kHz and VBW >= 3KHz, sweep time = span / 3 kHz, and video averaging is turned off. The PPSD is the highest level found across the emission in any 3 kHz band.

RESULTS

No non-compliance noted:

2.4 GHz Band

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin dB
Low	2412	-11.33	8	-19.33
Middle	2437	-6.67	8	-14.67
High	2462	-9.83	8	-17.83

5.8 GHz Band Normal Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin dB
Low	5745	-9.0	8	-17.0
Middle	5785	-8.0	8	-16.0
High	5825	-9.33	8	-17.33

5.8 GHz Band Turbo Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin dB
Low	5760	-12.17	8	-20.17
Middle	N/A	N/A	N/A	N/A
High	5800	-11.83	8	-19.83

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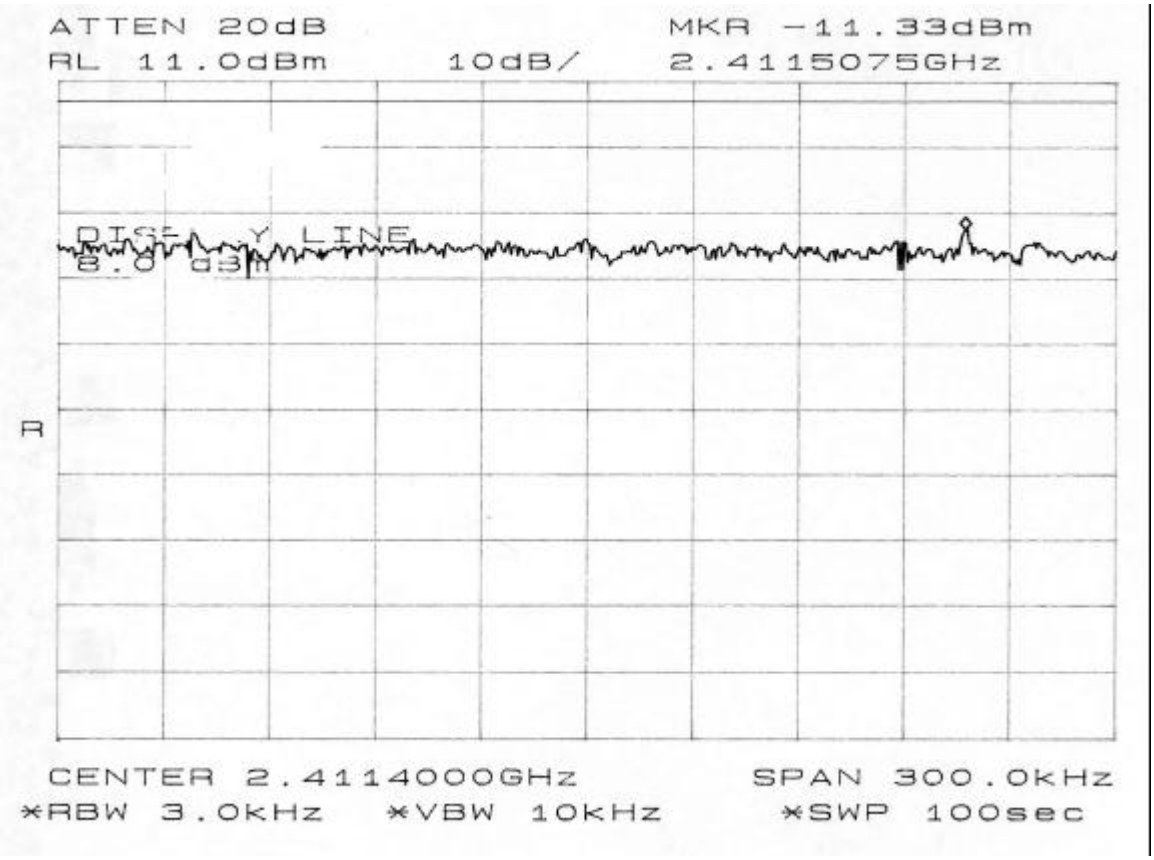
PPSD (2.4 GHZ BAND)



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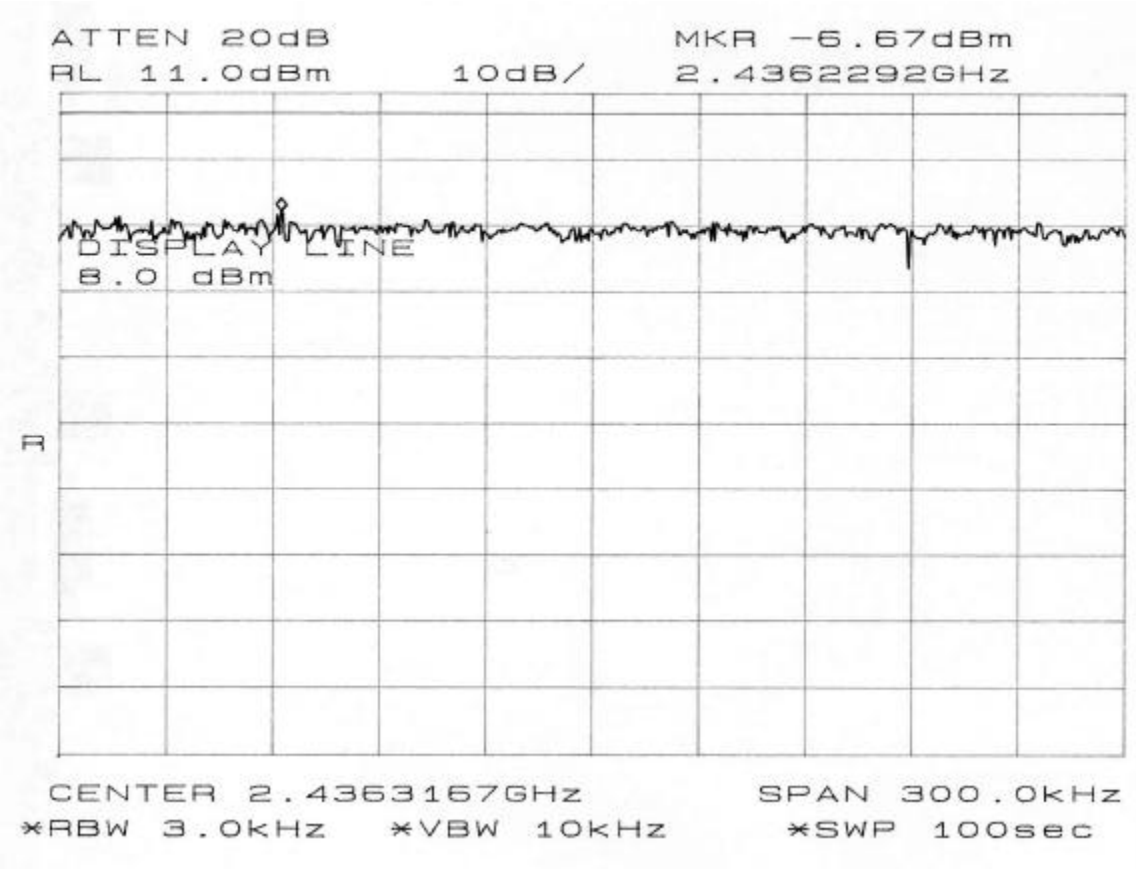

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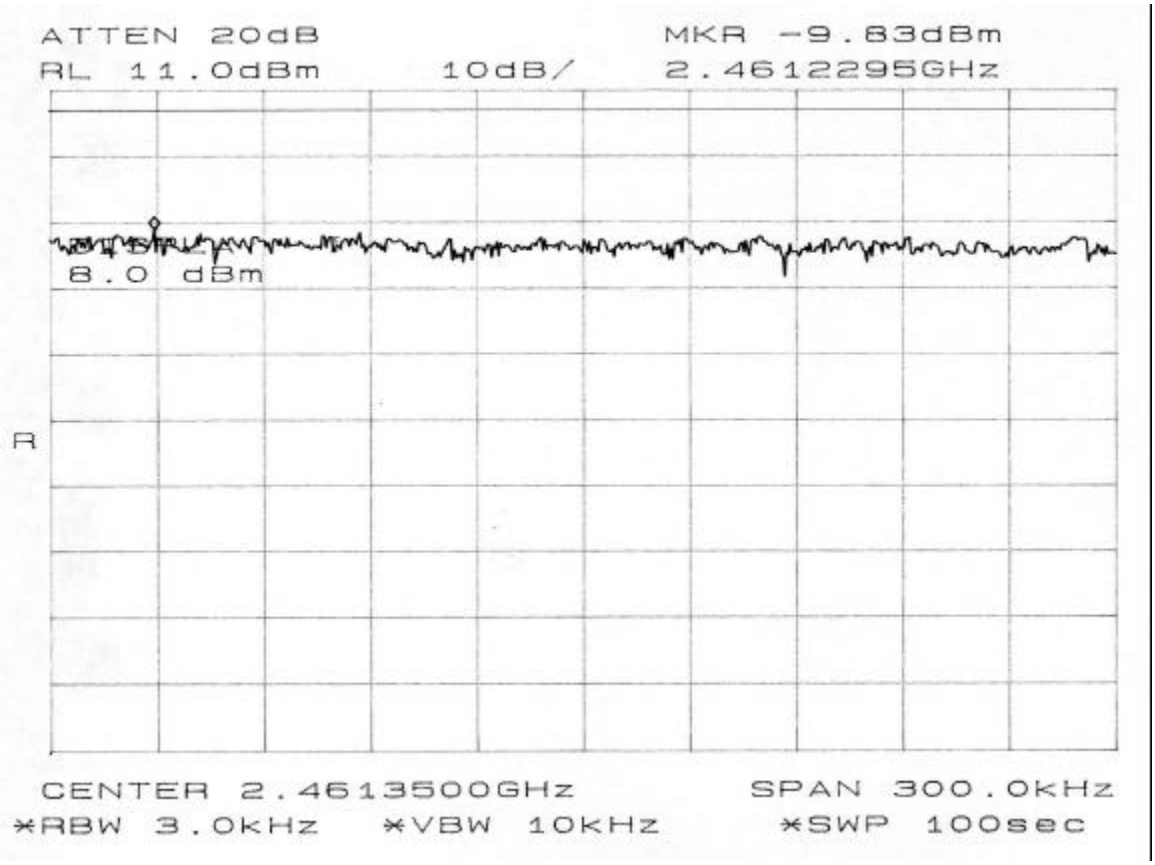

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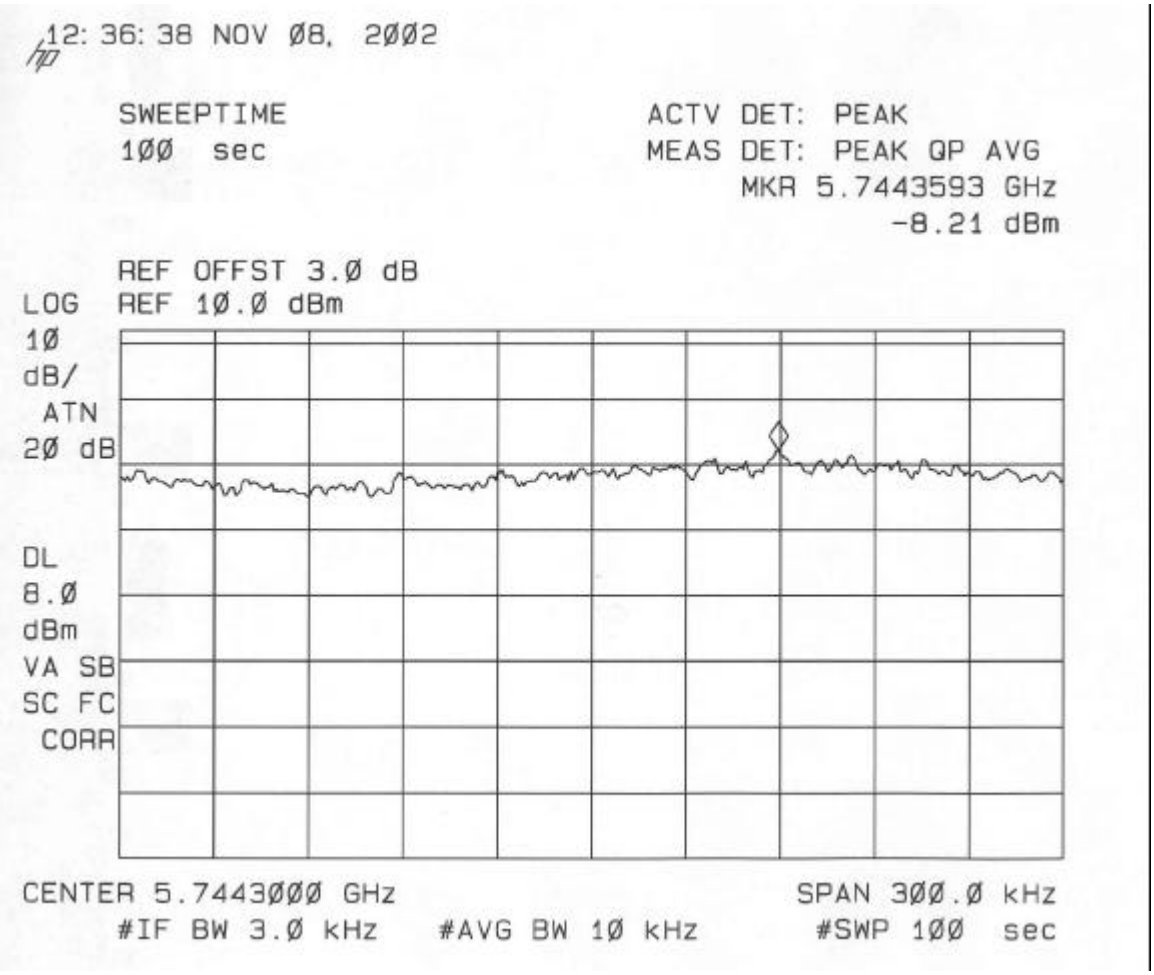
PPSD (5.8 GHZ BAND, NORMAL MODE)



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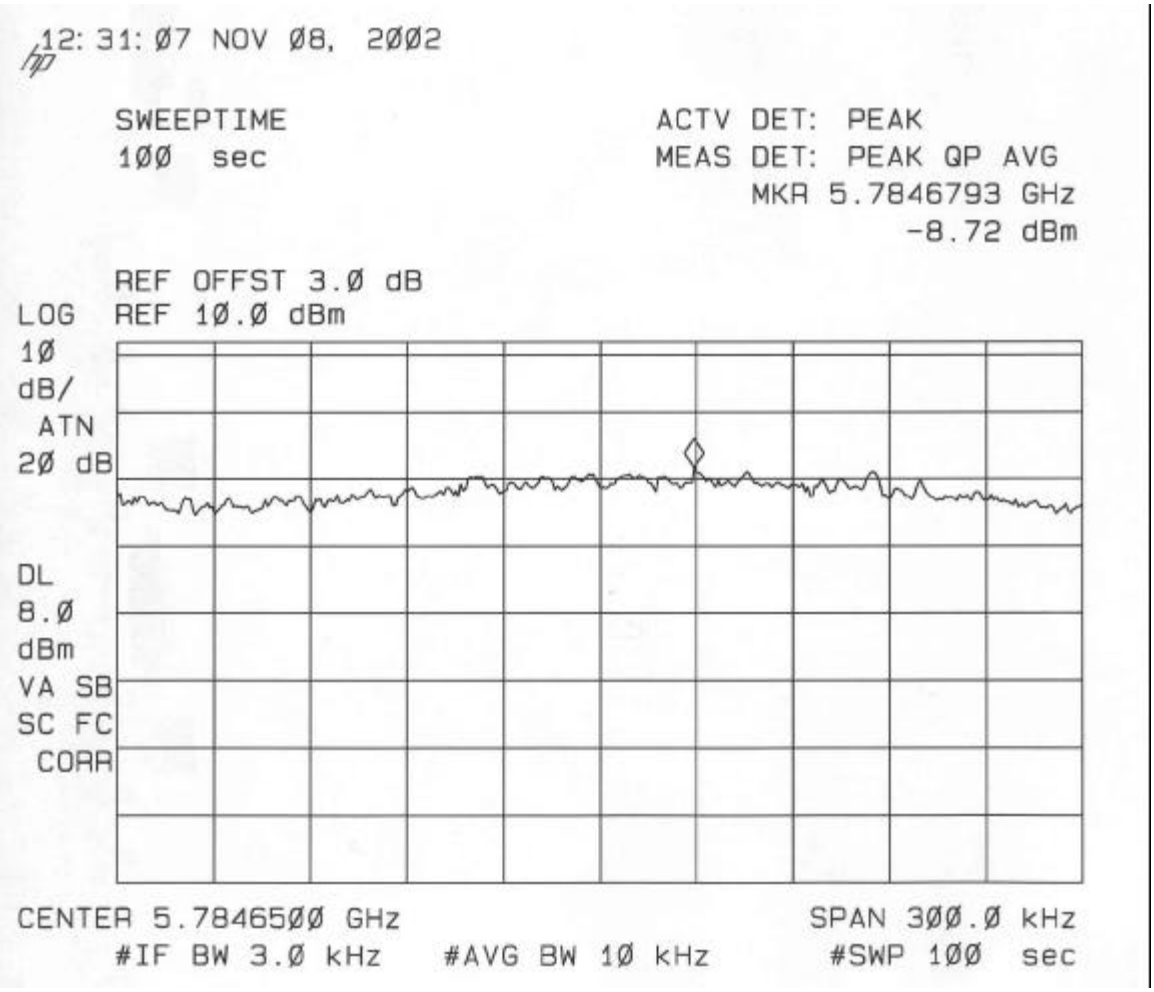

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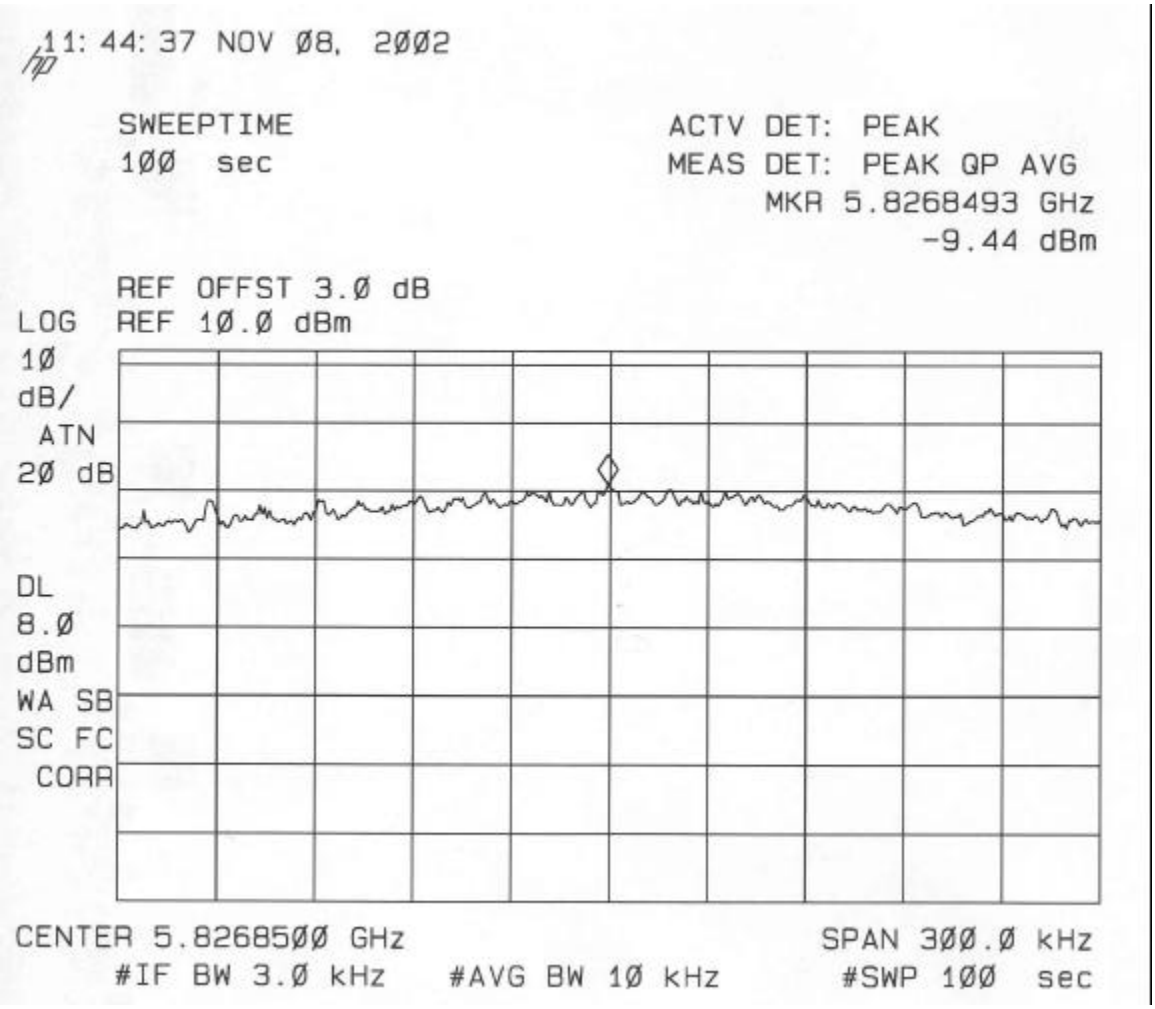

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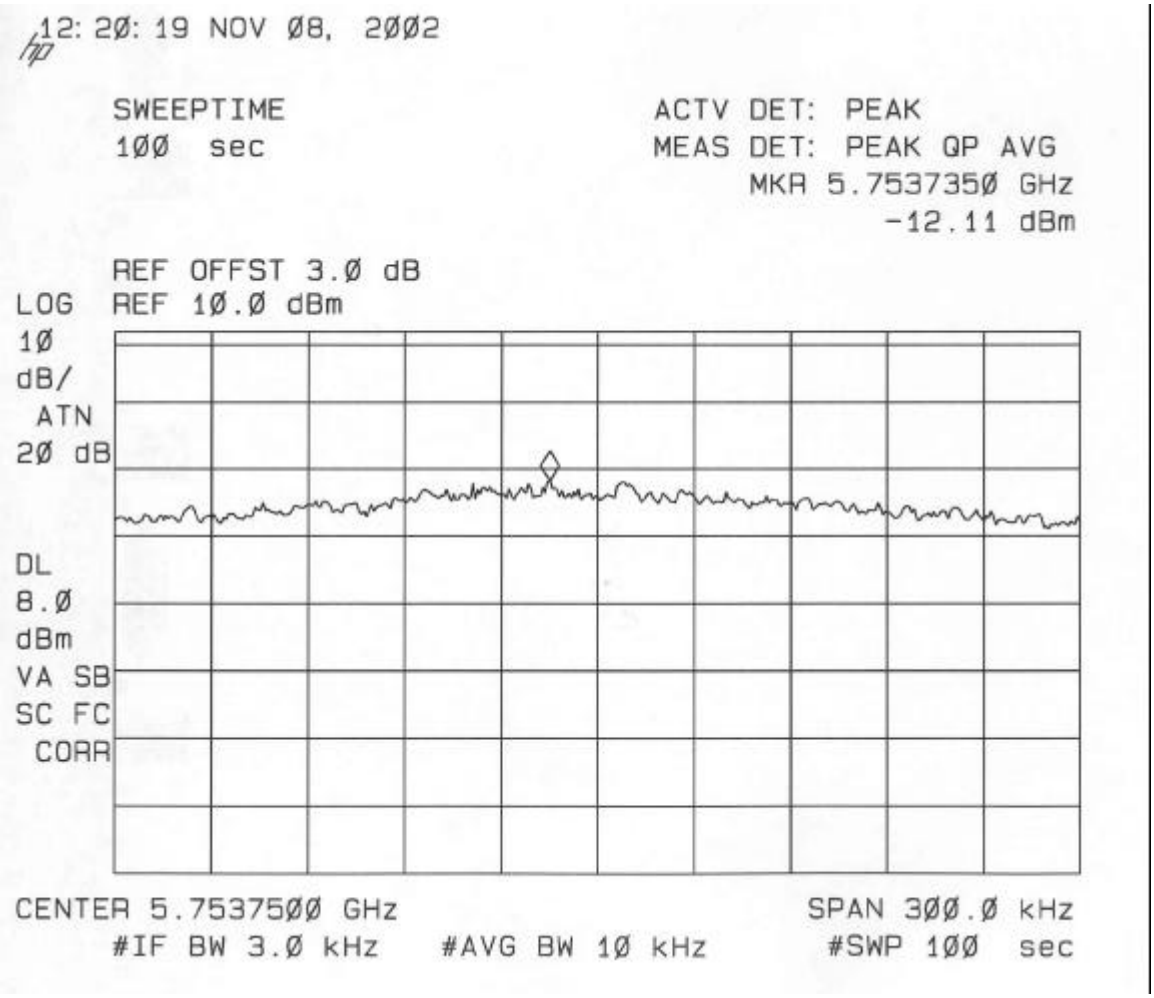
PPSD (5.8 GHZ BAND, TURBO MODE)



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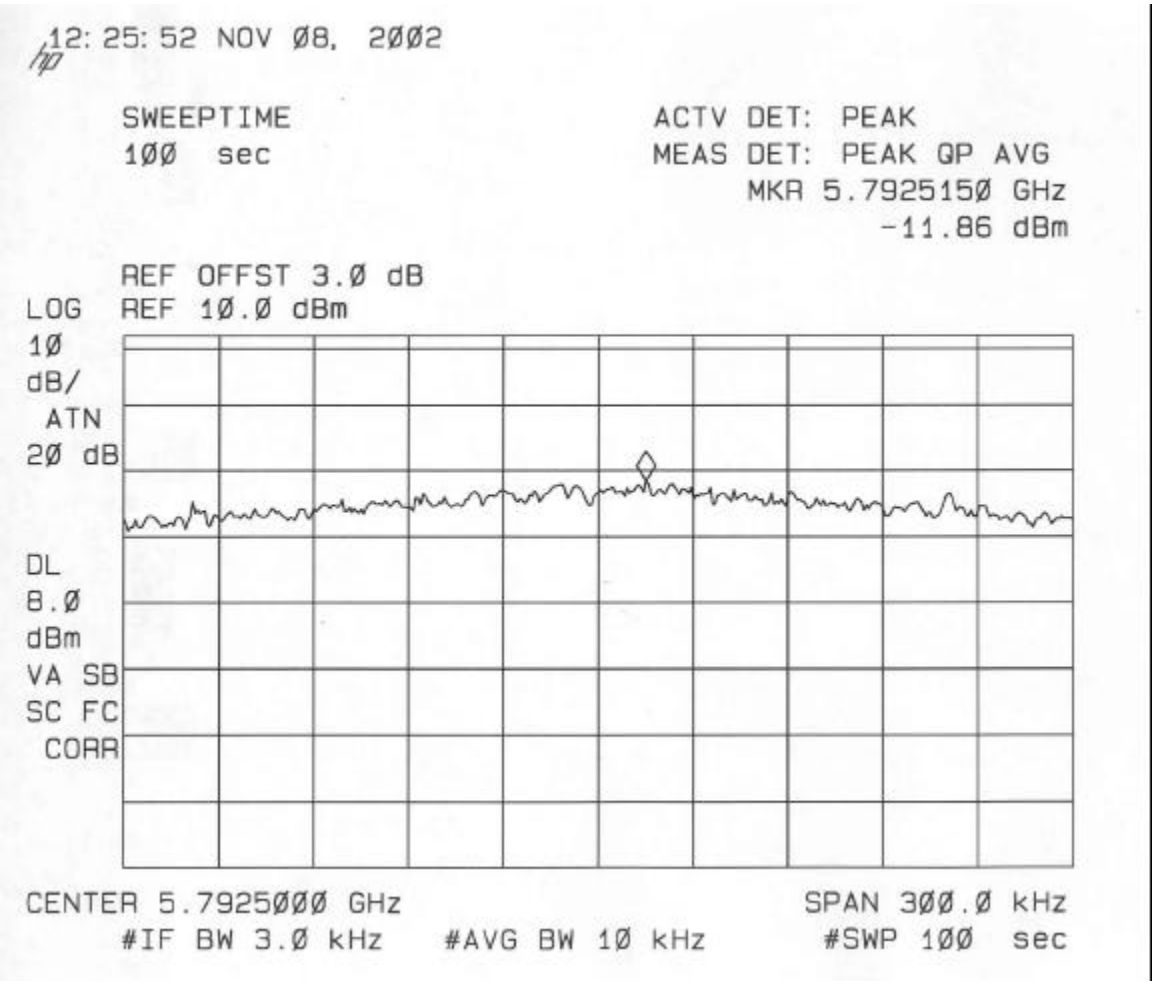

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8.4. MAXIMUM PERMISSIBLE EXPOSURE

CALCULATIONS

Given

$E = \sqrt{(30 * P * G)} / d$

and

$S = E \wedge 2 / 3770$

where

E = Field Strength in Volts / meter
P = Power in Watts
G = Numeric antenna gain
d = distance in meters
S = Power Density in milliwatts / square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and

d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$

$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW / cm^2

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Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and

G (numeric) = 10 ^ (G (dBi) / 10)

yields

d = 0.282 * 10 ^ ((P + G) / 20) / √ S Equation (1)

where
d = MPE safe distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW / cm^2

RESULTS

No non-compliance noted:

MAXIMUM PERMISSIBLE EXPOSURE (2.4 GHZ BAND)

EUT output power = 18.2 dBm
Antenna Gain = 4.8 dBi
S = 1.0 mW / cm^2 from 1.1310 Table 1

Substituting these parameters into Equation (1) above:

MPE Safe Distance = 03.98 cm

MAXIMUM PERMISSIBLE EXPOSURE (5.8 GHZ BAND)

EUT output power = 23.1 dBm
Antenna Gain = 4.8 dBi
S = 1.0 mW / cm^2 from 1.1310 Table 1

Substituting these parameters into Equation (1) above:

MPE Safe Distance = 7.0 cm

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

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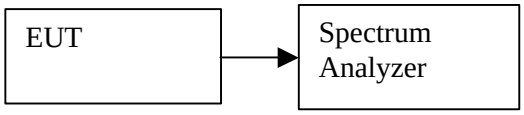
8.5. SPURIOUS EMISSIONS – CONDUCTED MEASUREMENTS

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

Measurements are made over the 30 MHz to 26.5 GHz range with the transmitter set to the lowest, middle, and highest channels within the 2.4 GHz band.

Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels within the 5.8 GHz band.

RESULTS

No non-compliance noted:

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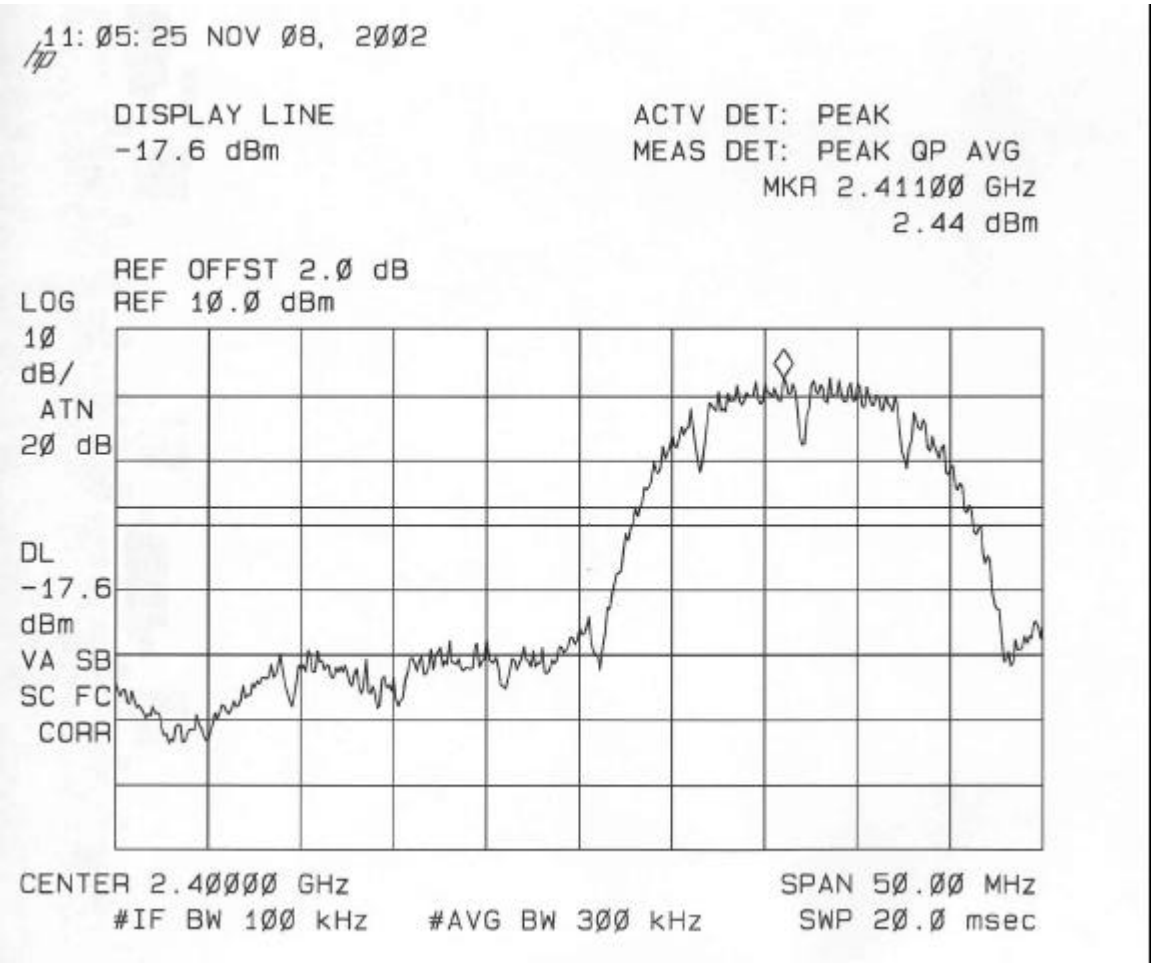
CONDUCTED SPURIOUS EMISSIONS (2.4 GHZ BAND)



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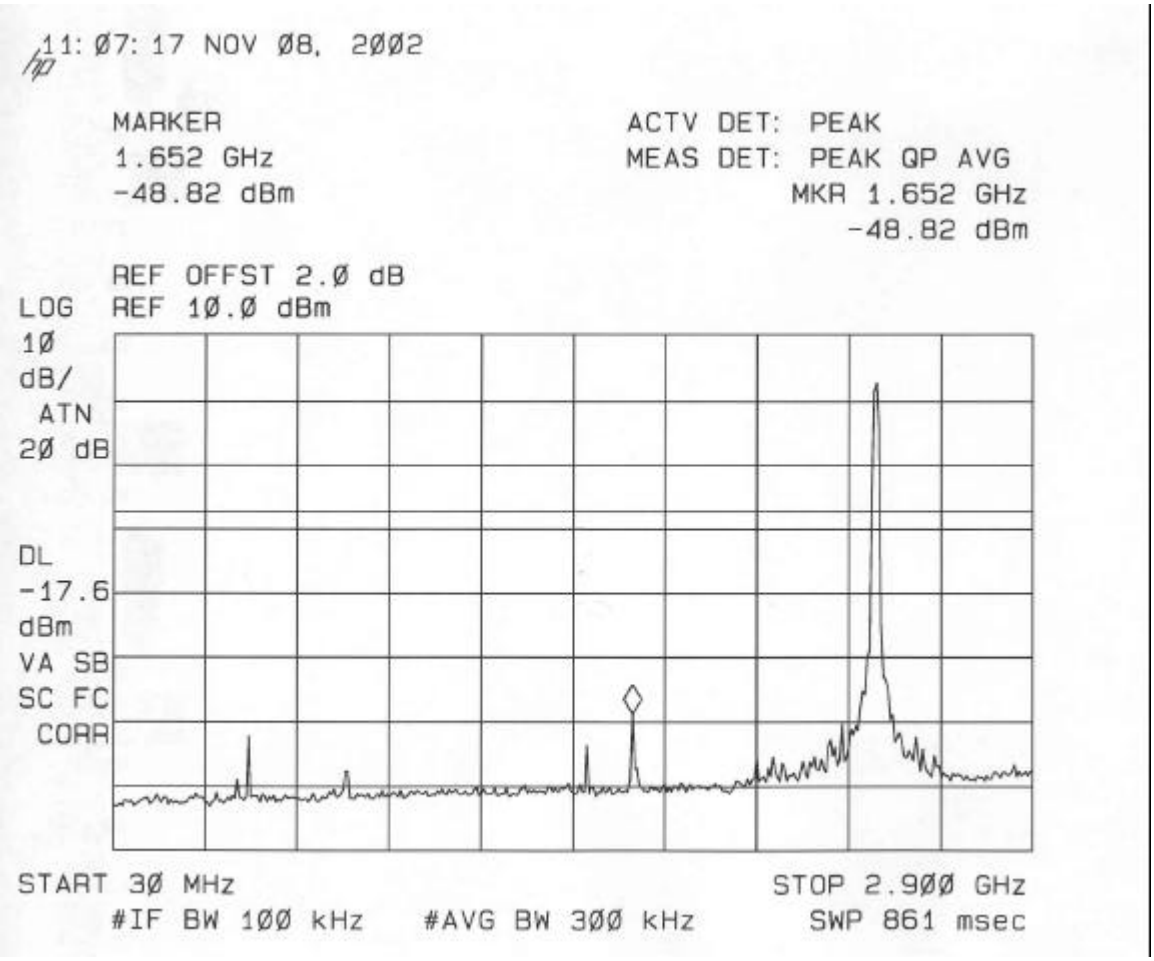

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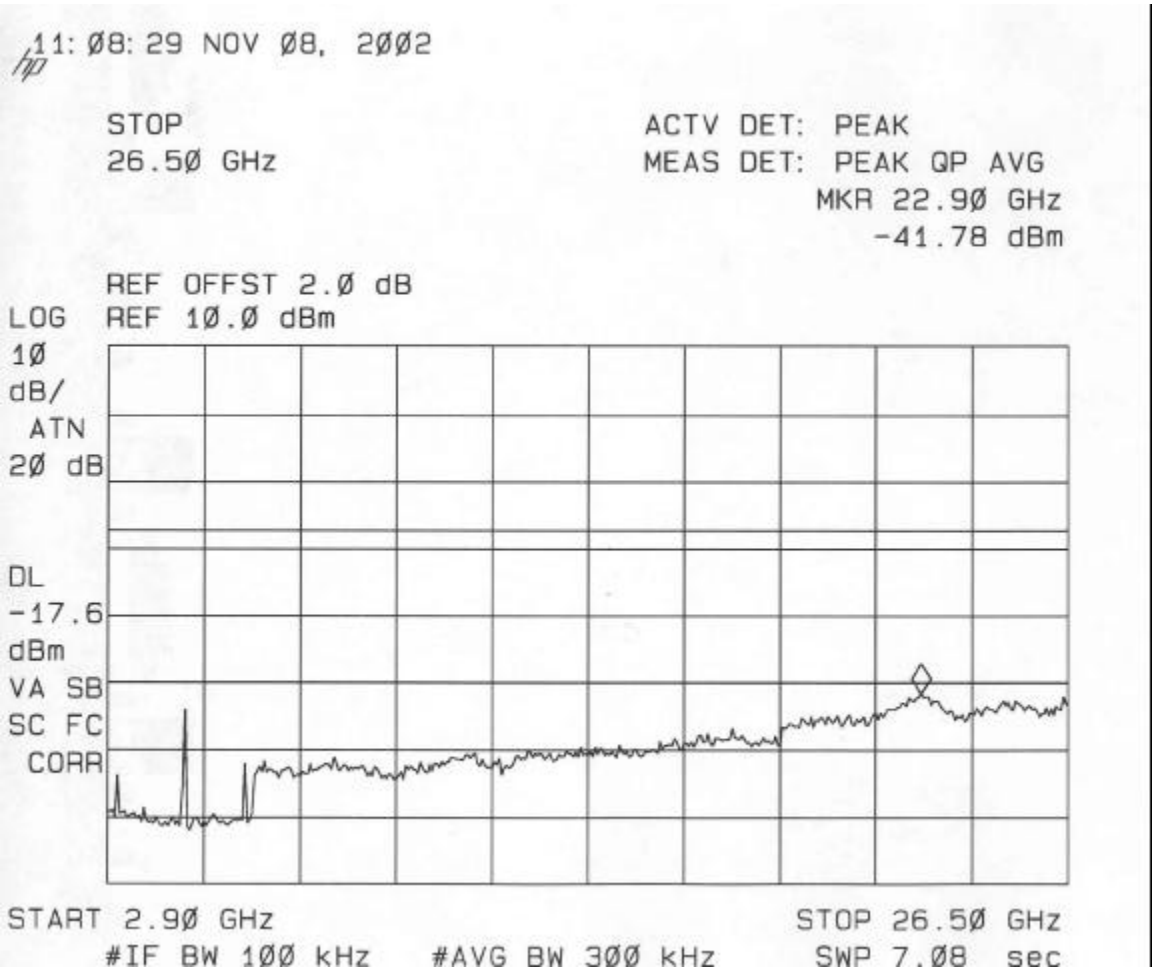

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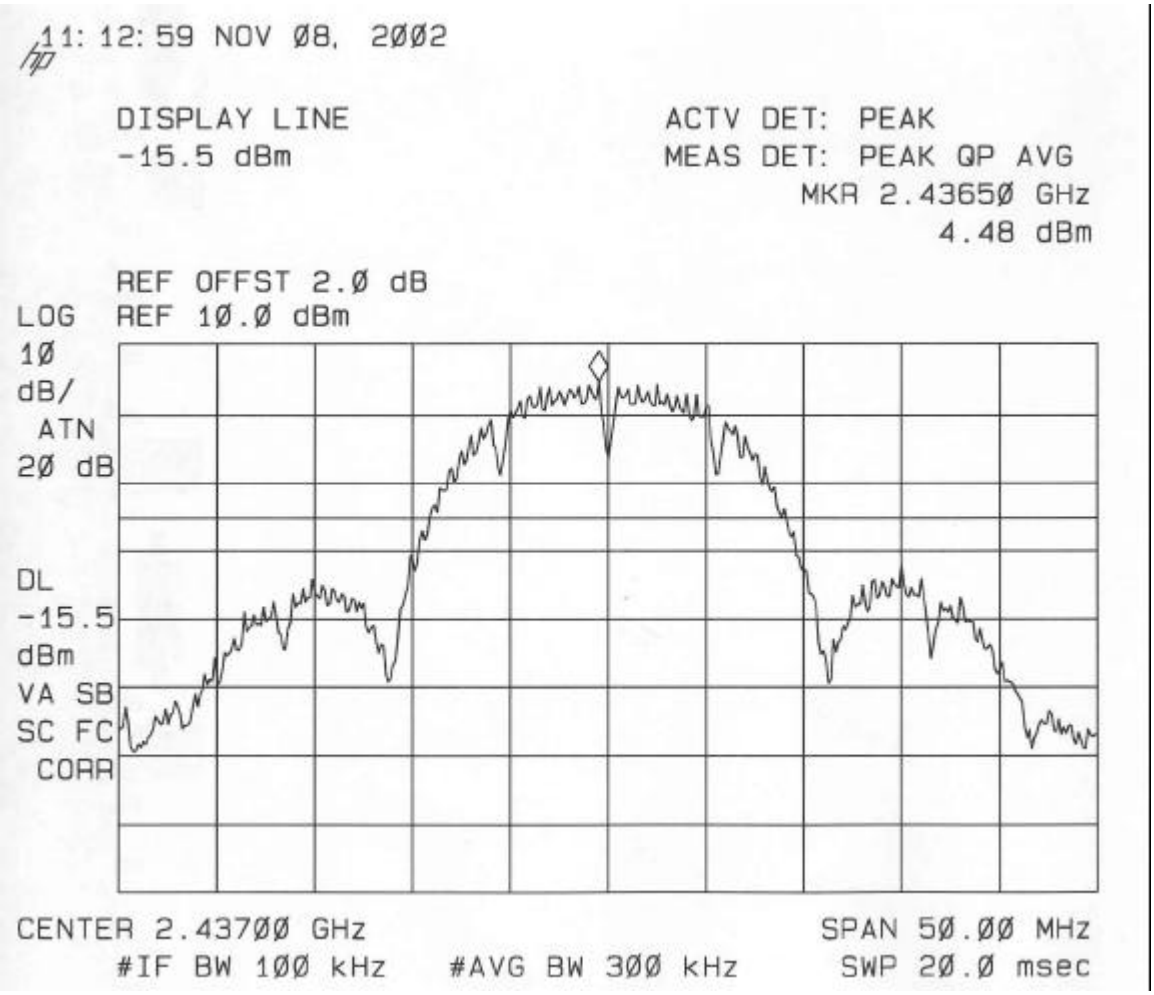

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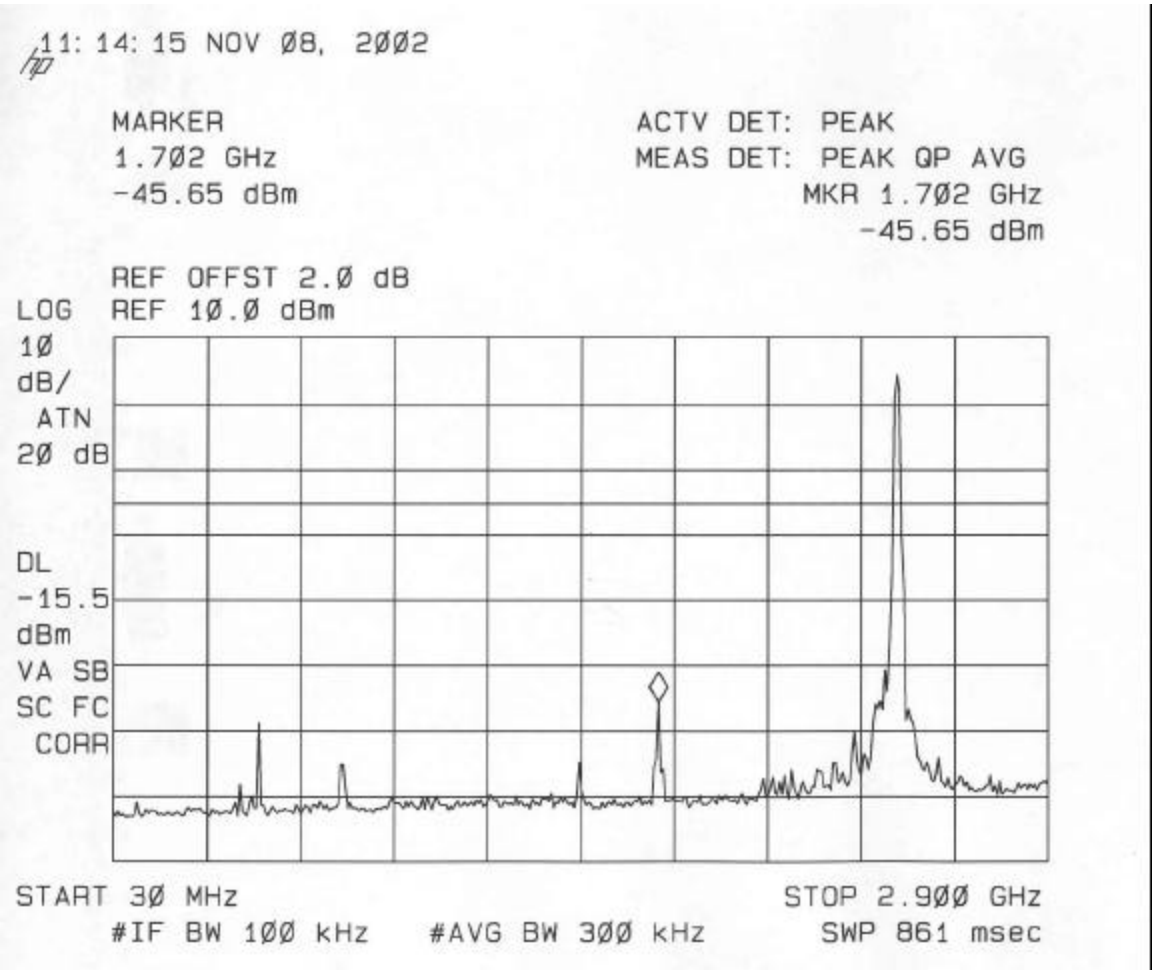

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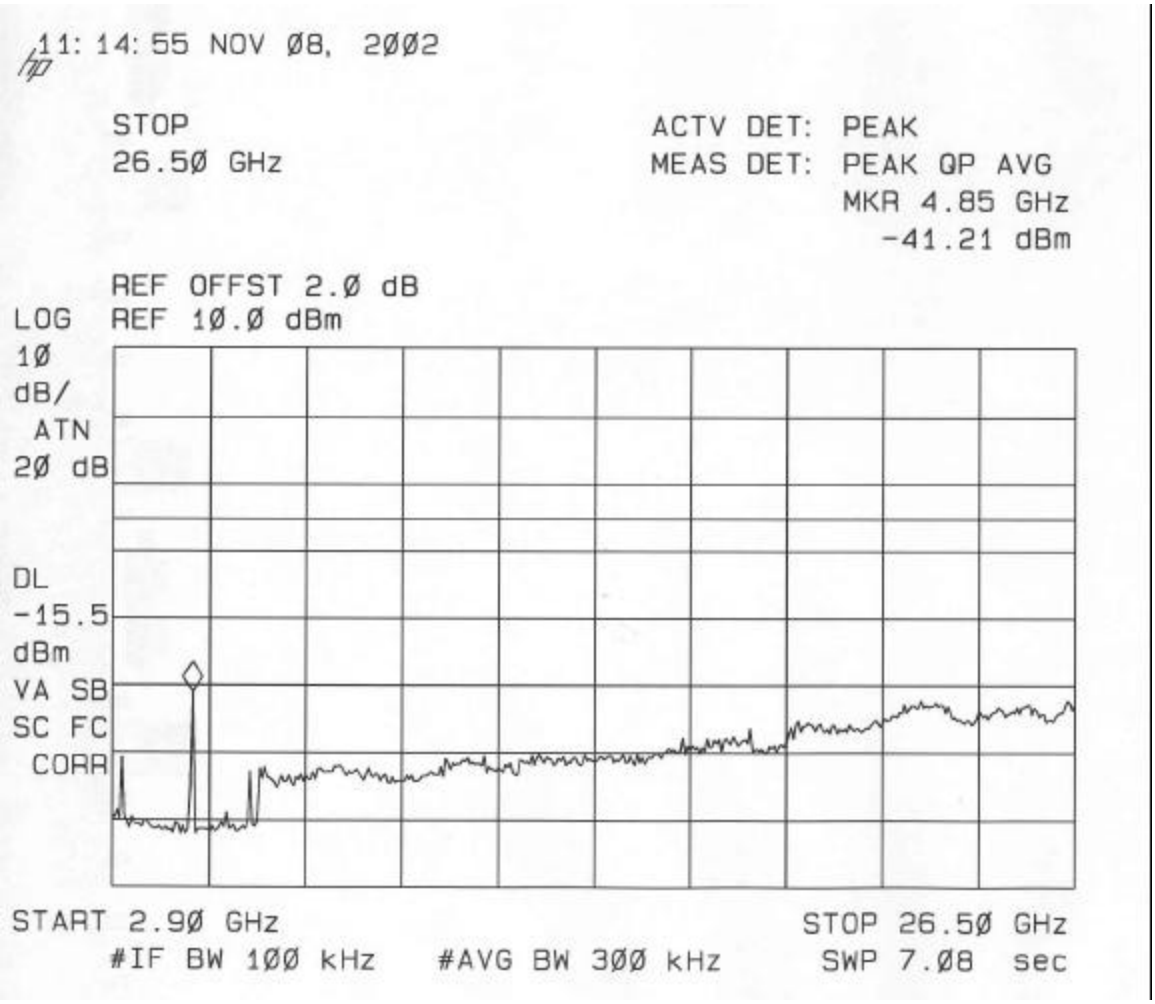

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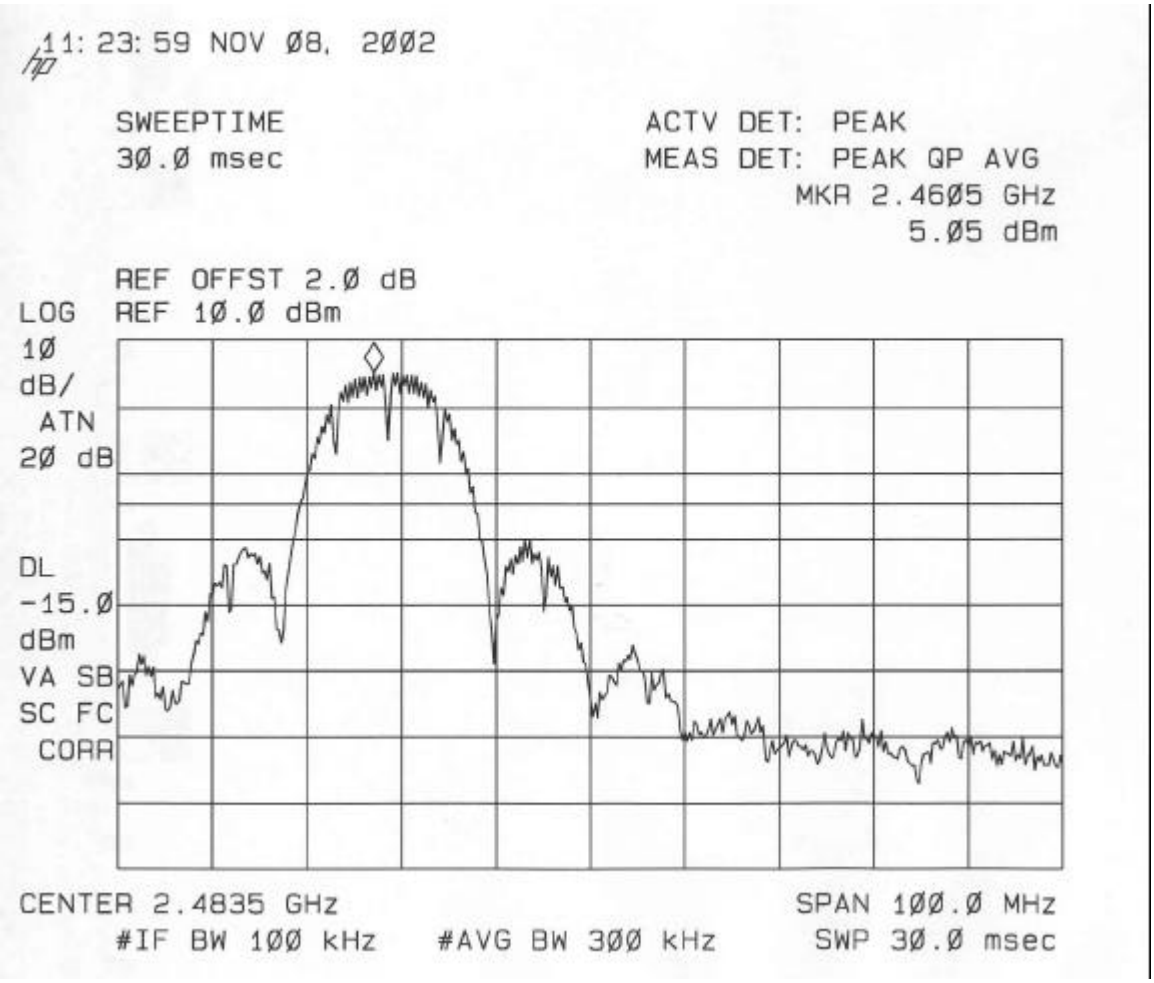

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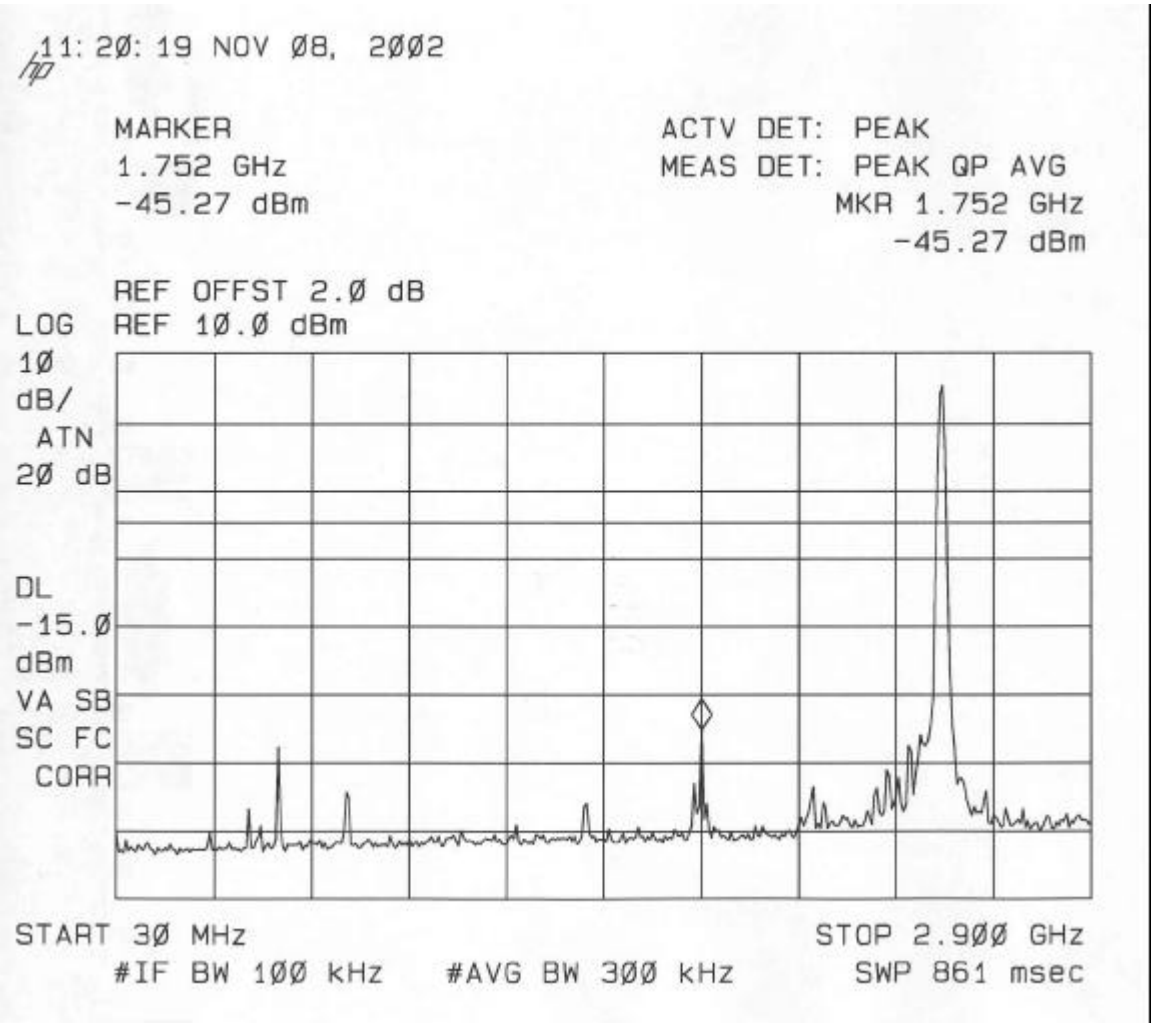

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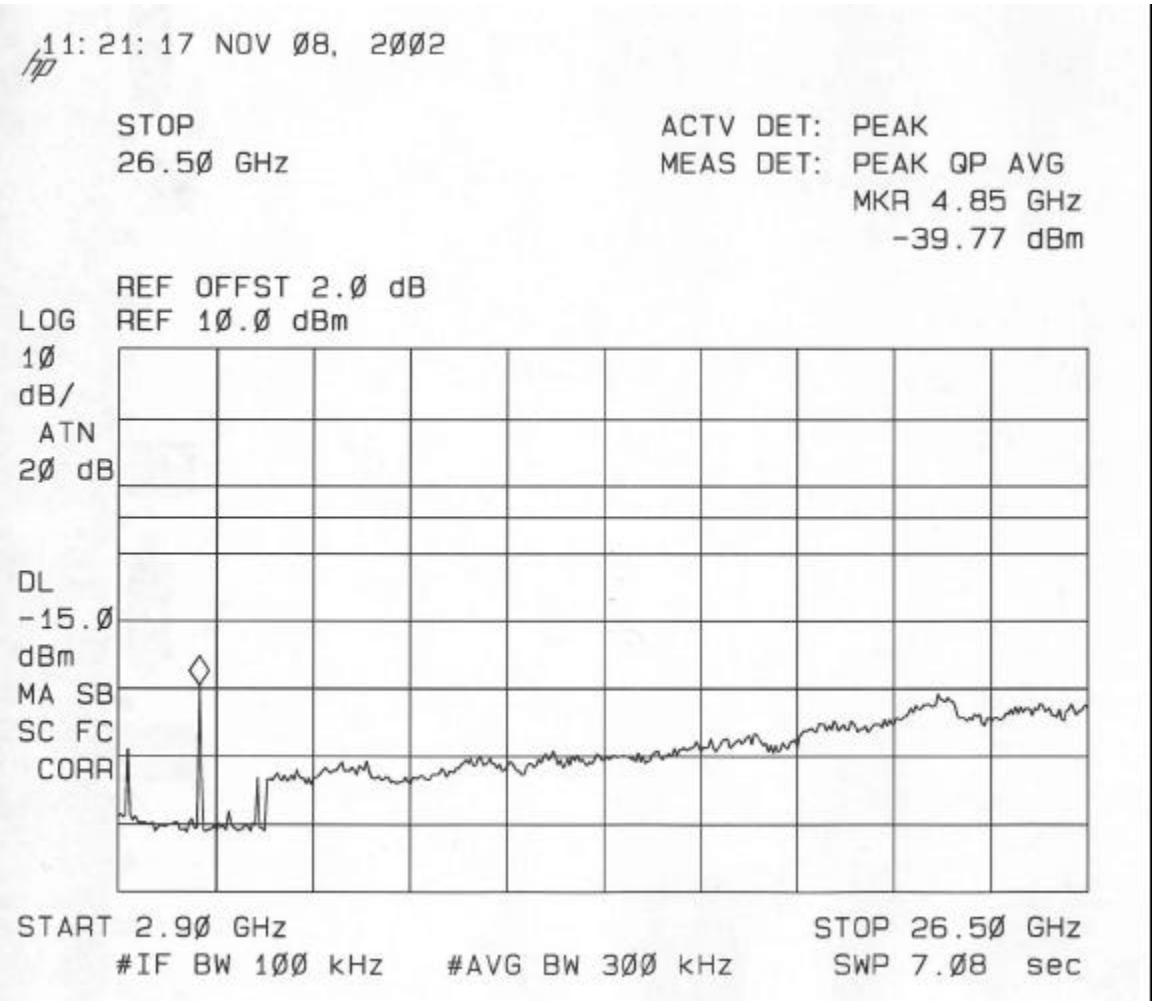

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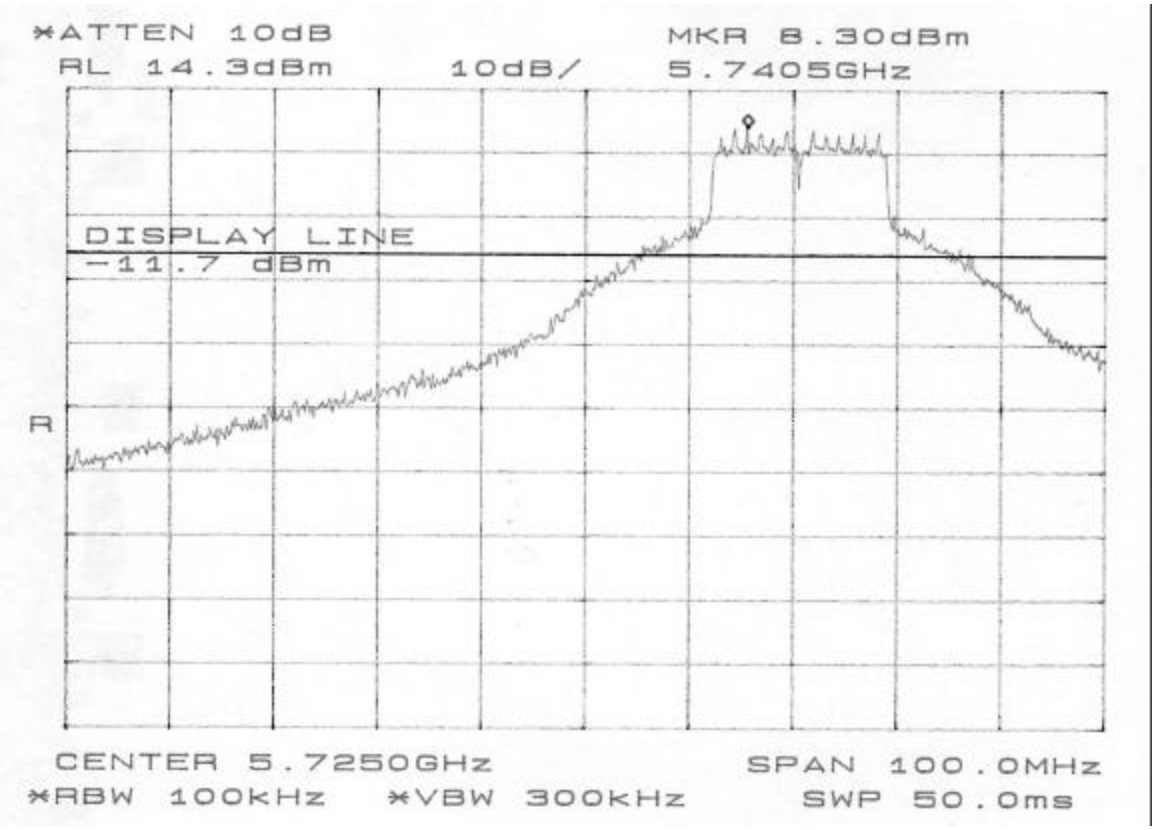
CONDUCTED SPURIOUS EMISSIONS (5.8 GHZ BAND, NORMAL MODE)



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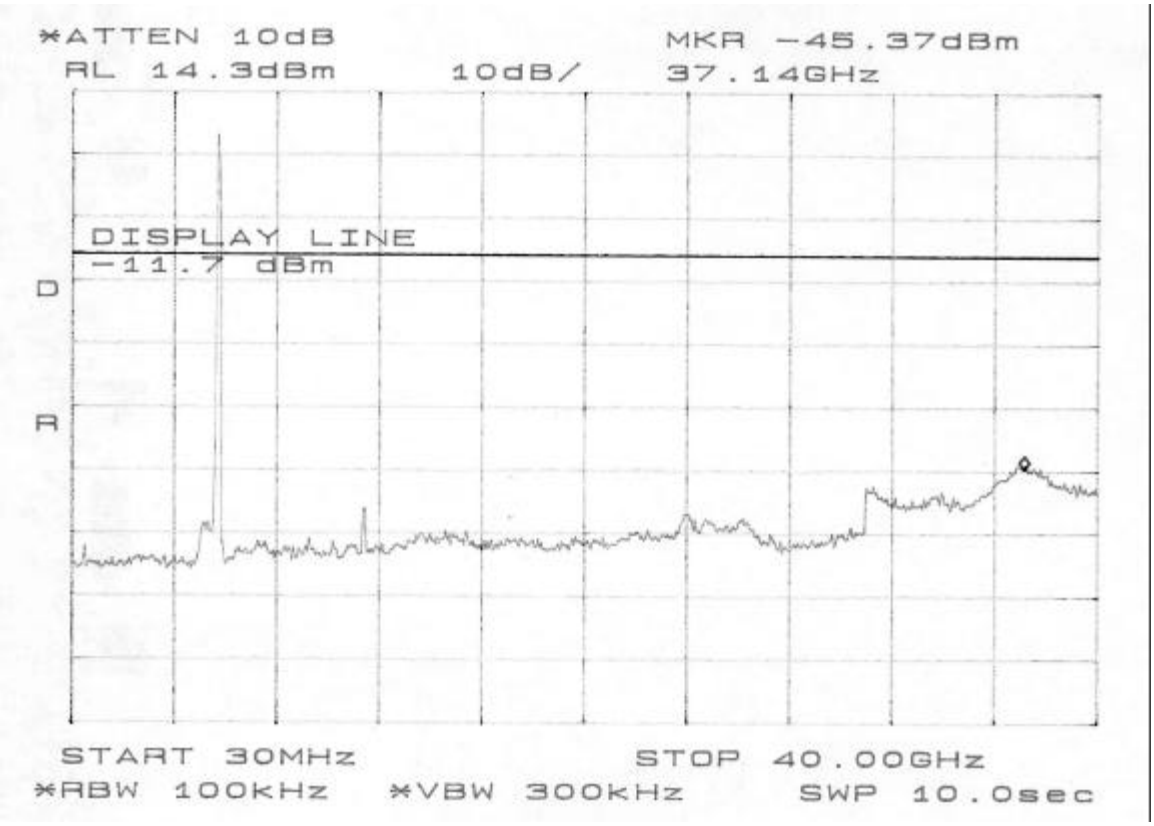

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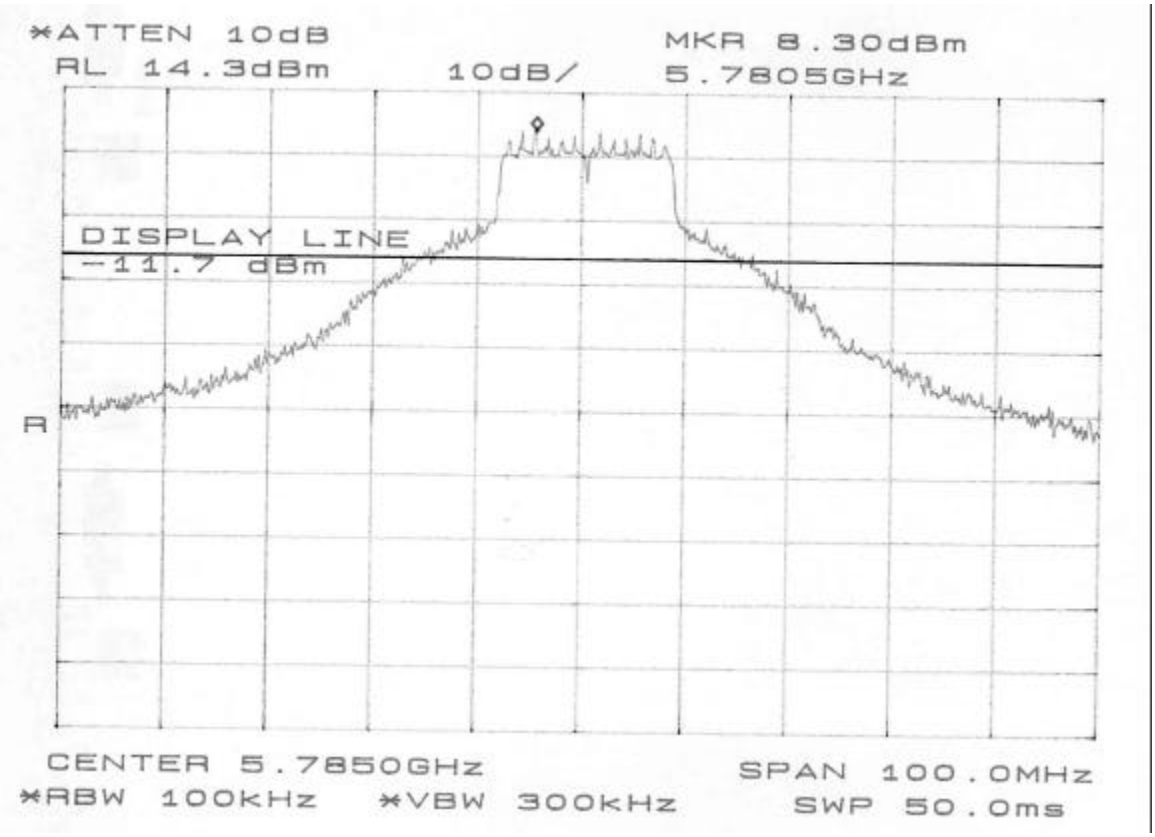

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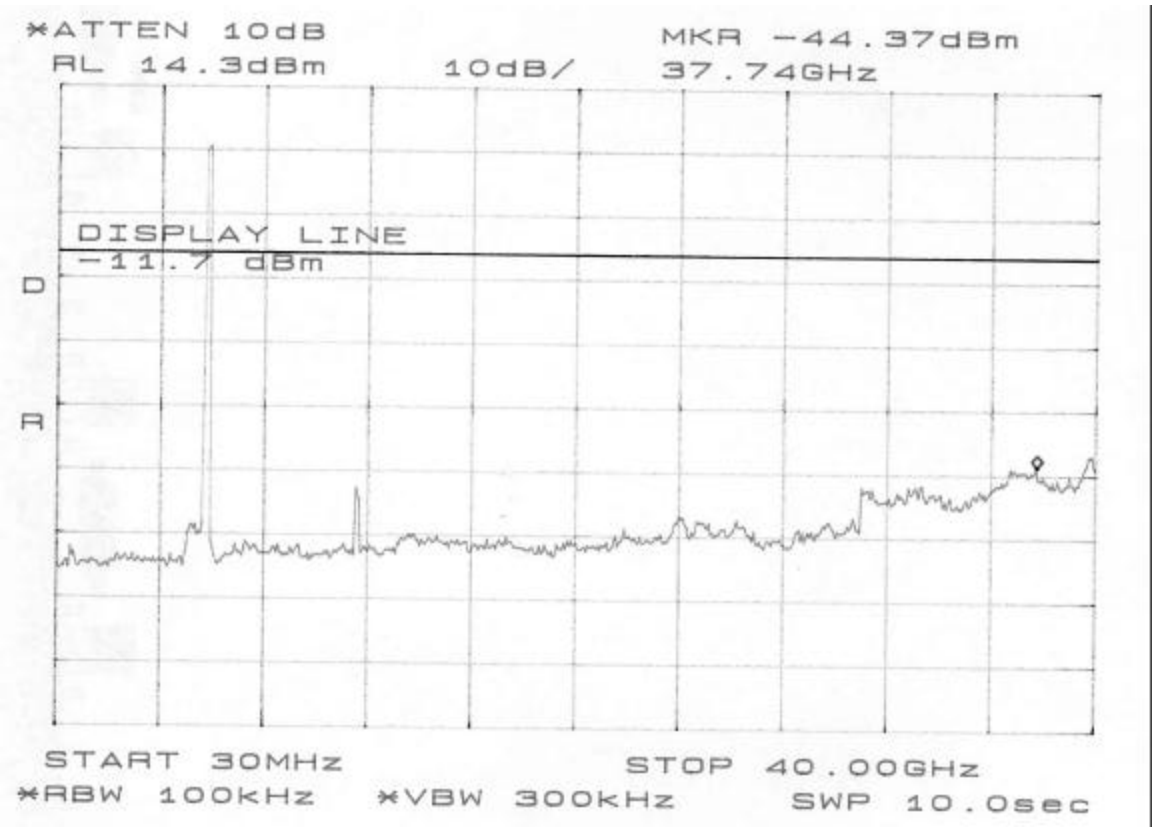

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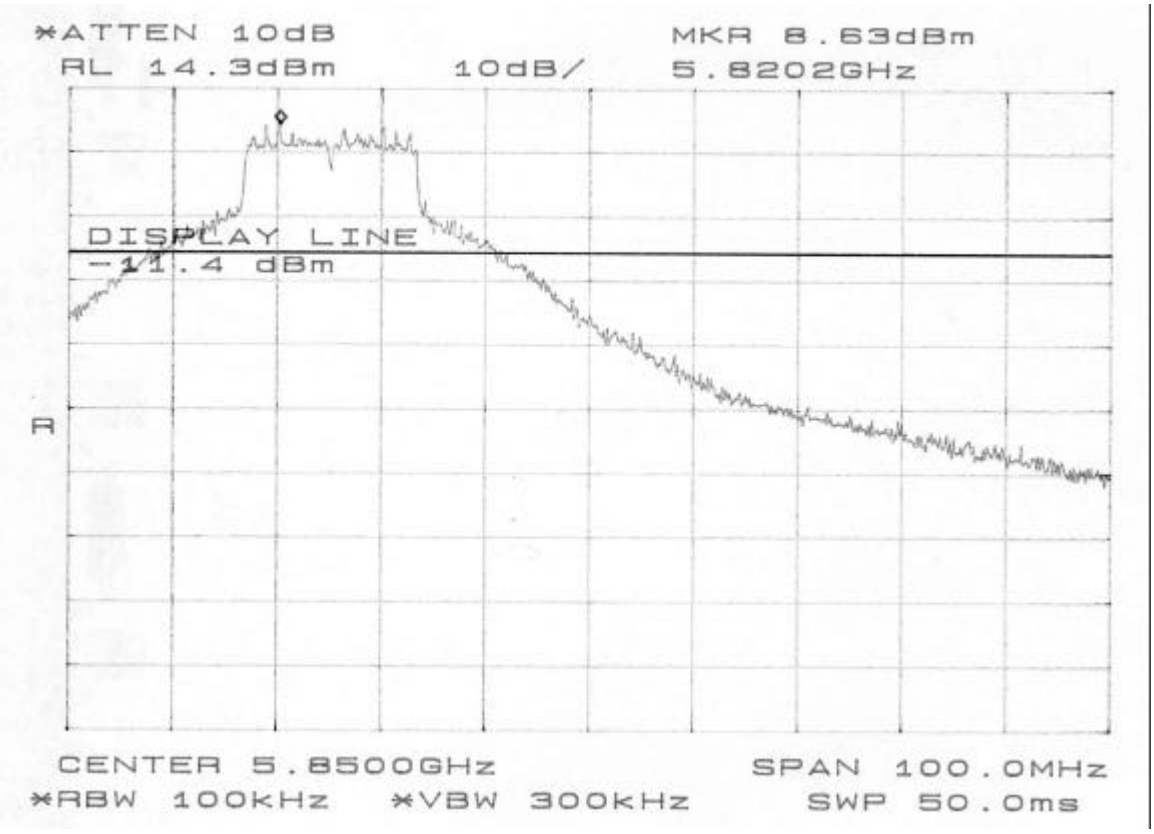

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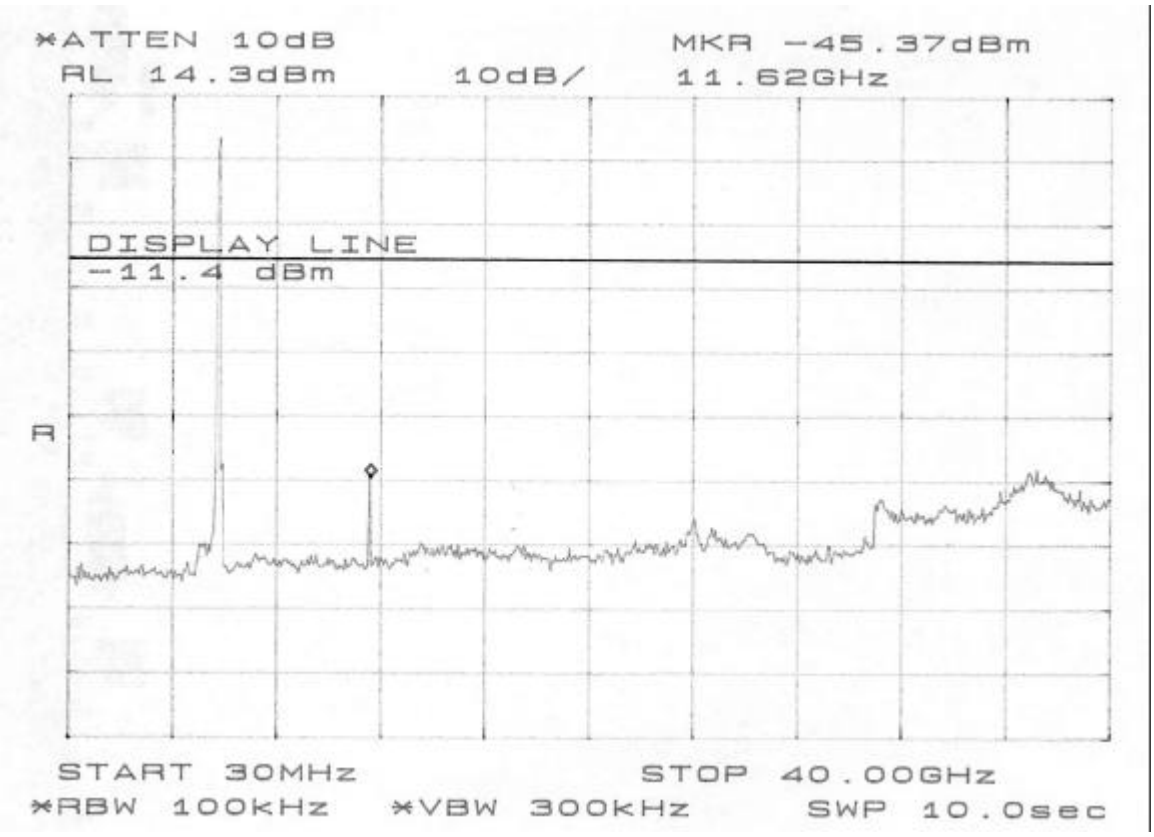

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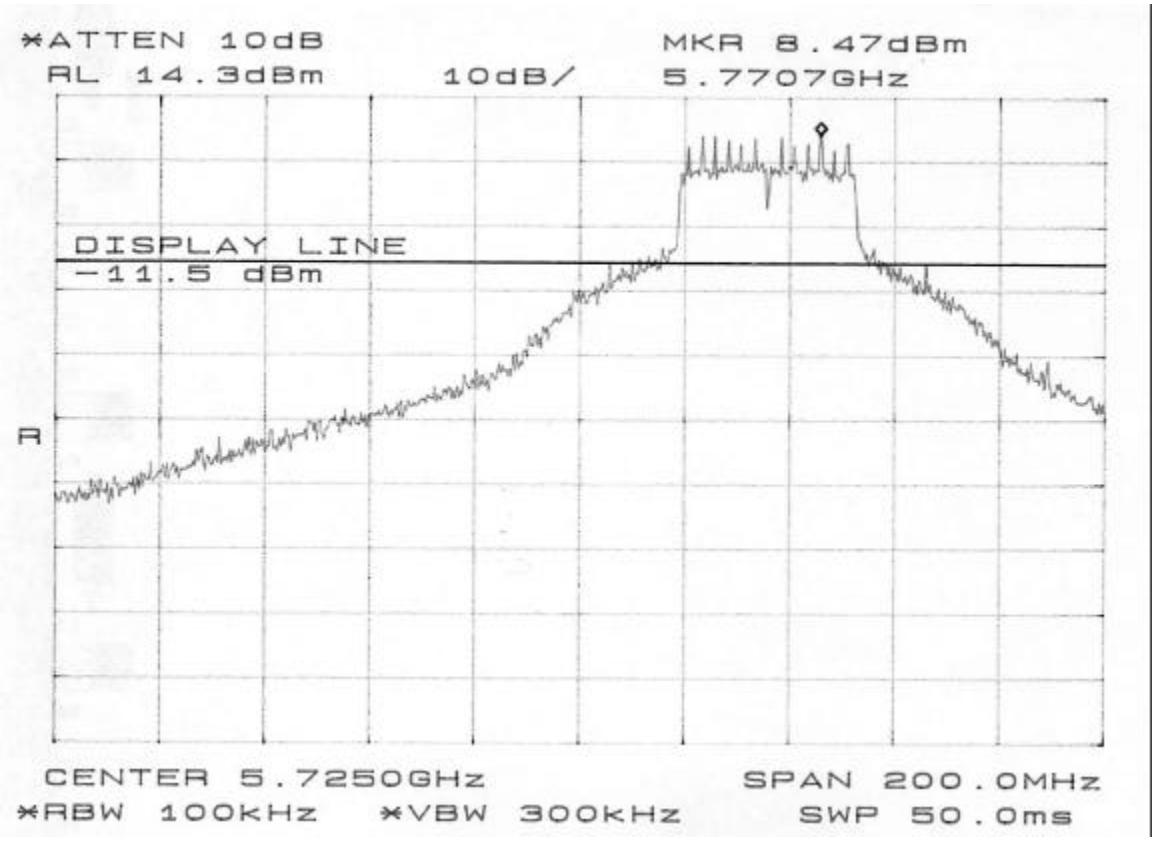
CONDUCTED SPURIOUS EMISSIONS (5.8 GHZ BAND, TURBO MODE)



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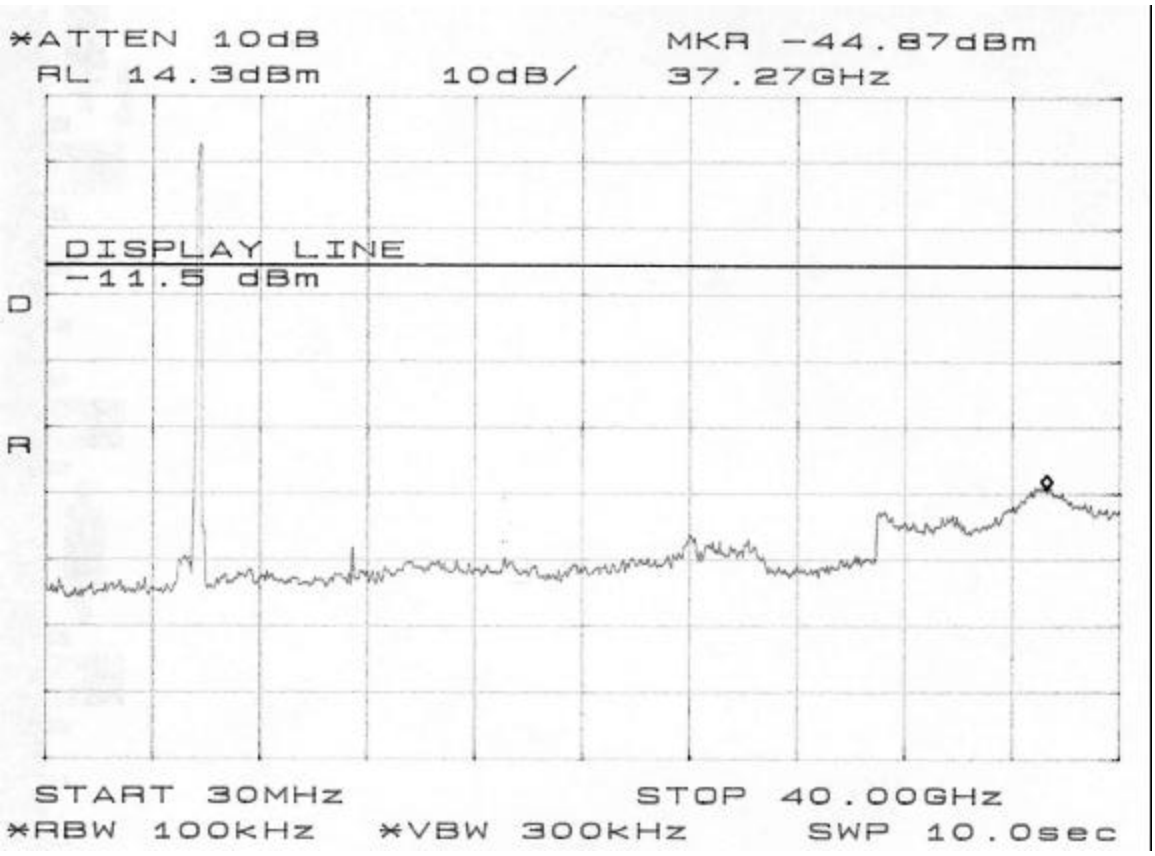

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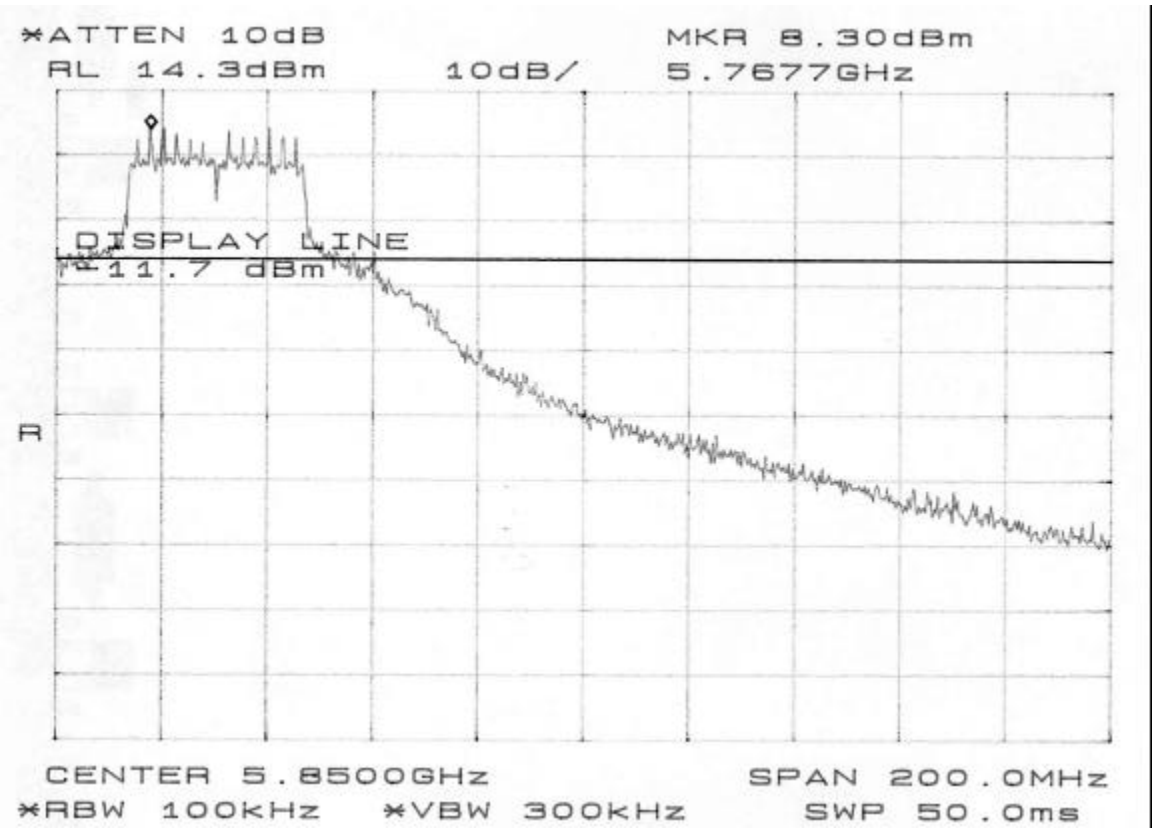

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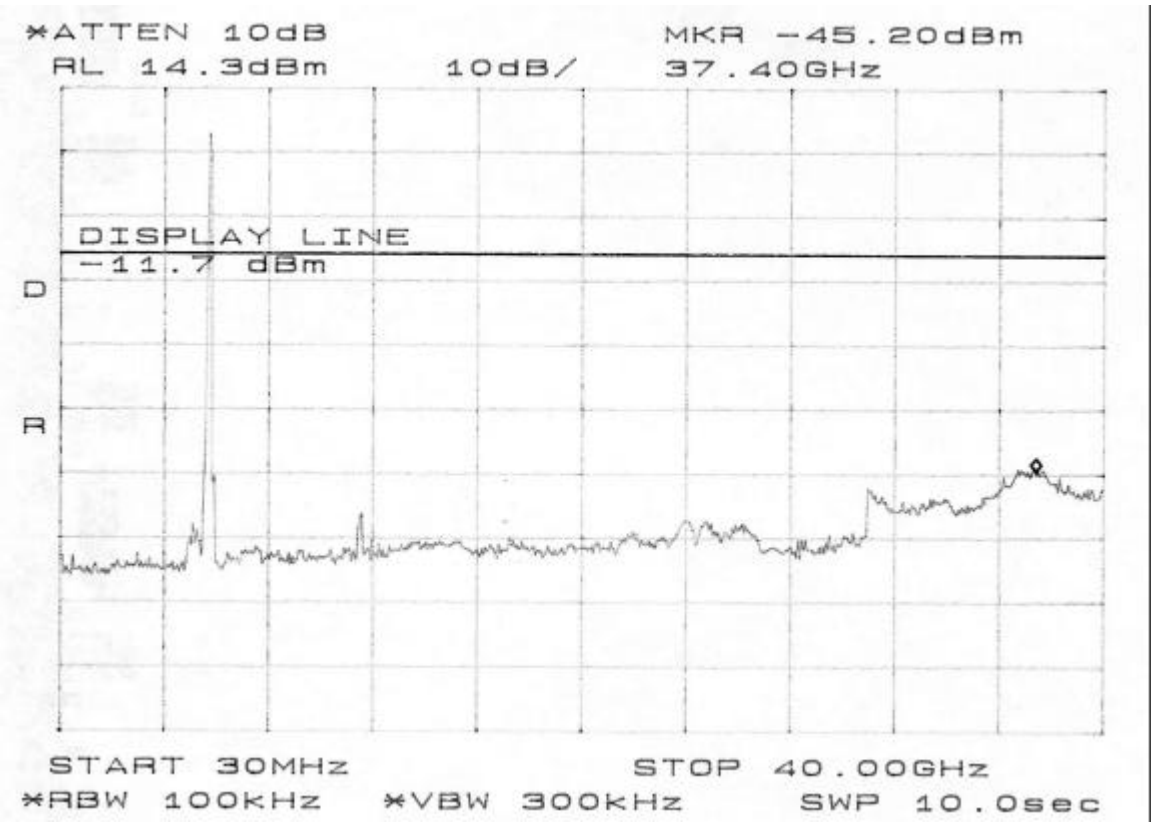

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8.6. UNDESIRABLE EMISSIONS – RADIATED MEASUREMENTS

TEST SETUP

The EUT is placed on the wooden table. The antenna to EUT distance is 3 meters for measurements below 1 GHz and 1 meter for measurements above 1 GHz. The EUT is configured in accordance with Section 8 of ANSI C63.4/1992.

The EUT is set to transmit in a continuous mode.

TEST PROCEDURE

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz within restricted bands, the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels within the 2.4 GHz band.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels within the 5.8 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The frequency span is set small enough to easily differentiate between broadcast stations, intermittent ambient signals and EUT emissions. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the suspected signal. Measurements were made with the antenna polarized in both the vertical and the horizontal positions.

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SYSTEM NOISE FLOOR FOR HARMONIC AND SPURIOUS MEASUREMENTS

Compliance Certification Services

Worst Case Radiated Emissions System Noise Floor

Each band below corresponds to each horn antenna band
Uses the lowest gain preamplifier; actual preamp used may have higher gain
Uses the longest typical cable configuration; actual cables used may have less loss
Noise floor field strength results are compared to the FCC 15.205 Restricted Band limit

Specification Distance: 3 meters

Freq GHz	SA dBuV	AF dB/m	Distance m	Distance dB	Preamp dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
1 to 18 GHz band									
RBW = 1 MHz, peak detection									
18	41.9	47.8	1	-9.5	32.6	13.5	61.06	74	-12.94
RBW = 1 MHz, average detection									
18	28.7	47.8	1	-9.5	32.6	13.5	47.86	54	-6.14
18 to 26.5 GHz band									
RBW = 1 MHz, peak detection									
26.5	44.6	33.4	1	-9.5	35.0	19.5	52.96	74	-21.04
RBW = 1 MHz, average detection									
26.5	32.4	33.4	1	-9.5	35.0	19.5	40.76	54	-13.24

TEST RESULTS

No non-compliance noted:

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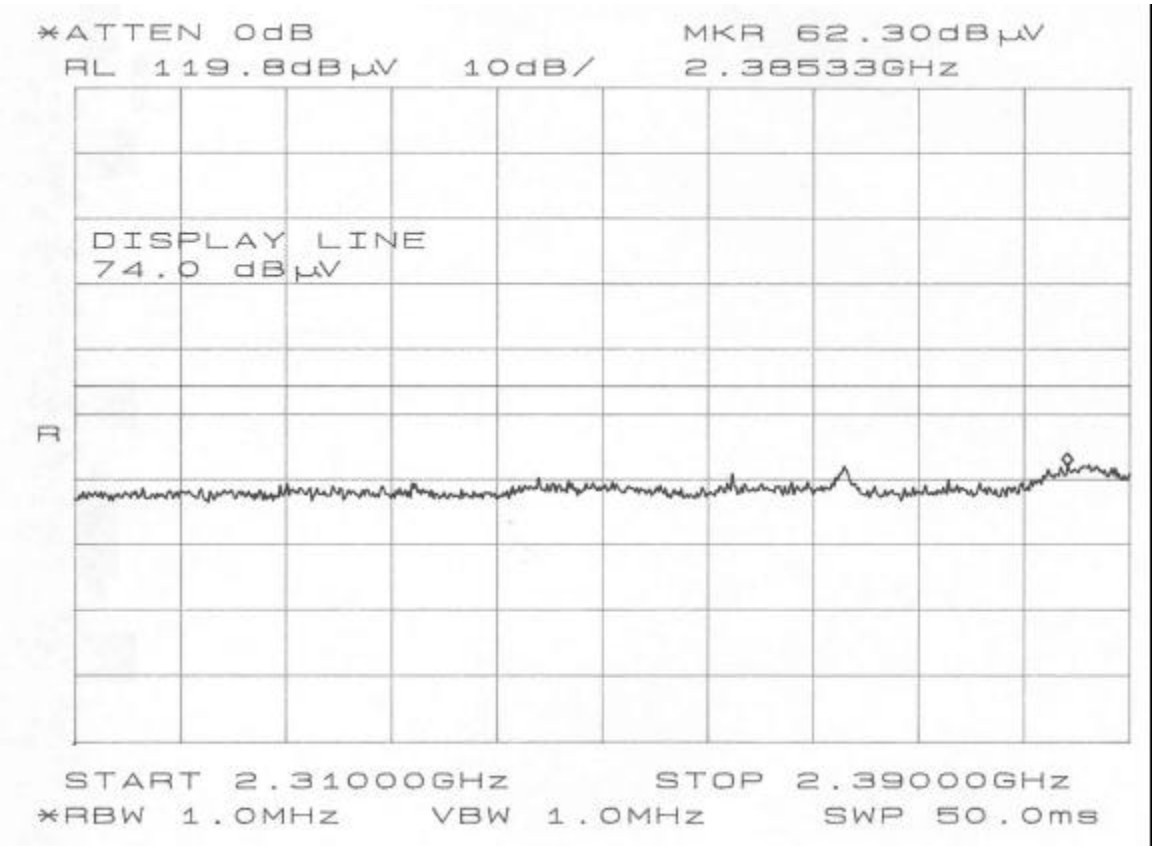
BAND EDGE RADIATED EMISSIONS (LOW CHANNEL, HORIZONTAL POLARIZATION)



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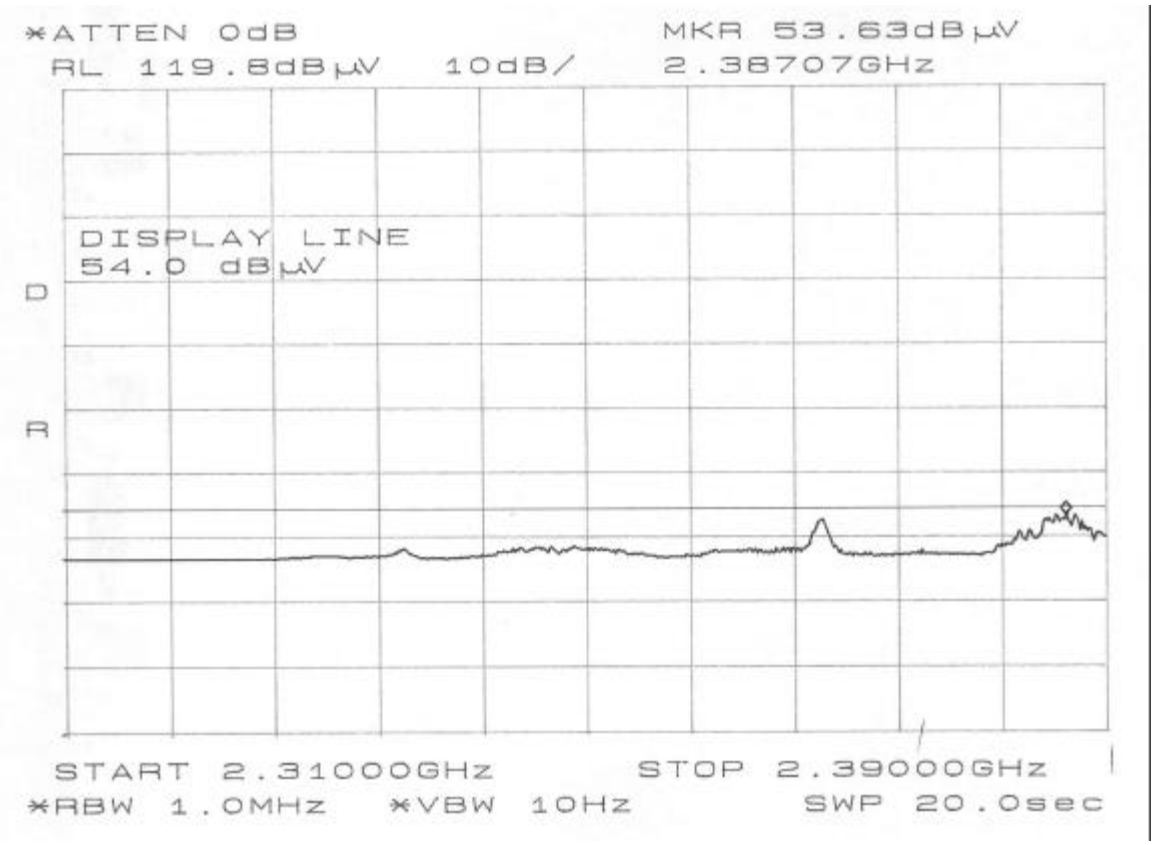

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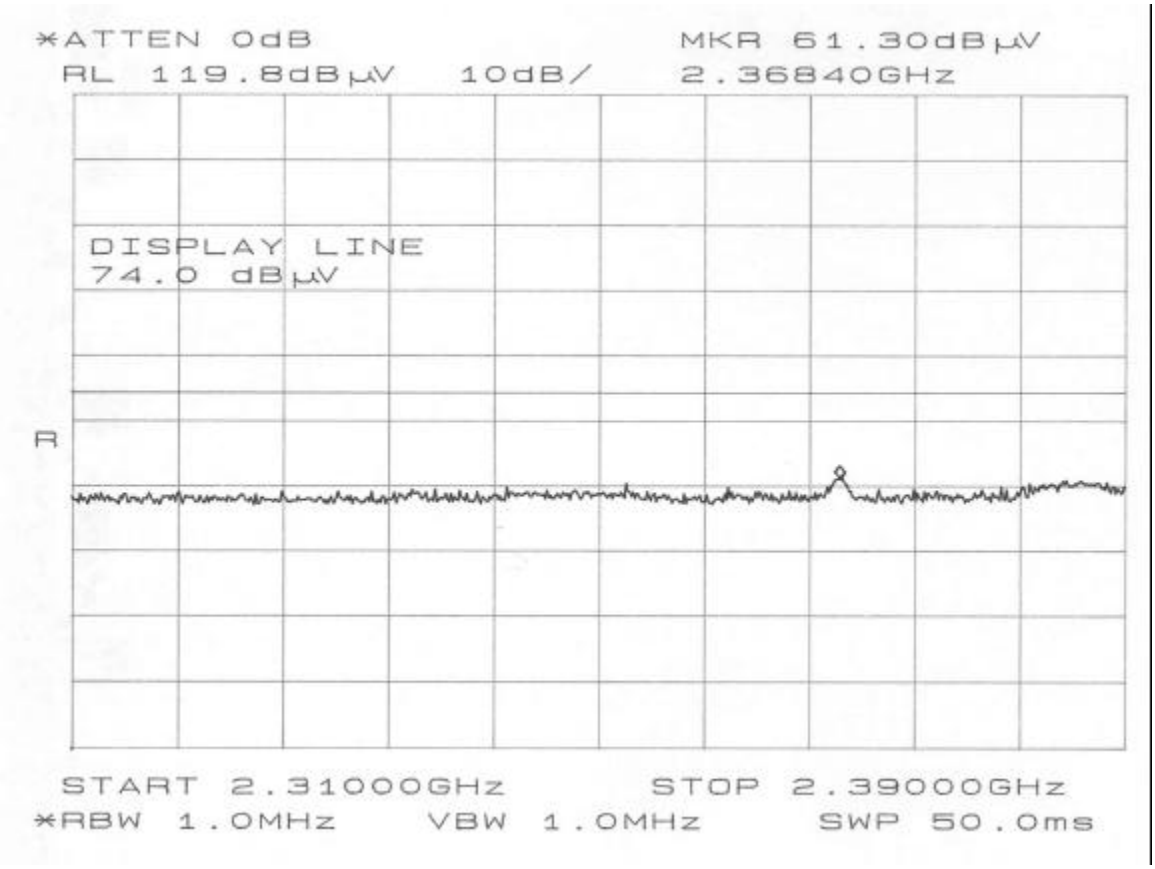
BAND EDGE RADIATED EMISSIONS (LOW CHANNEL, VERTICAL POLARIZATION)



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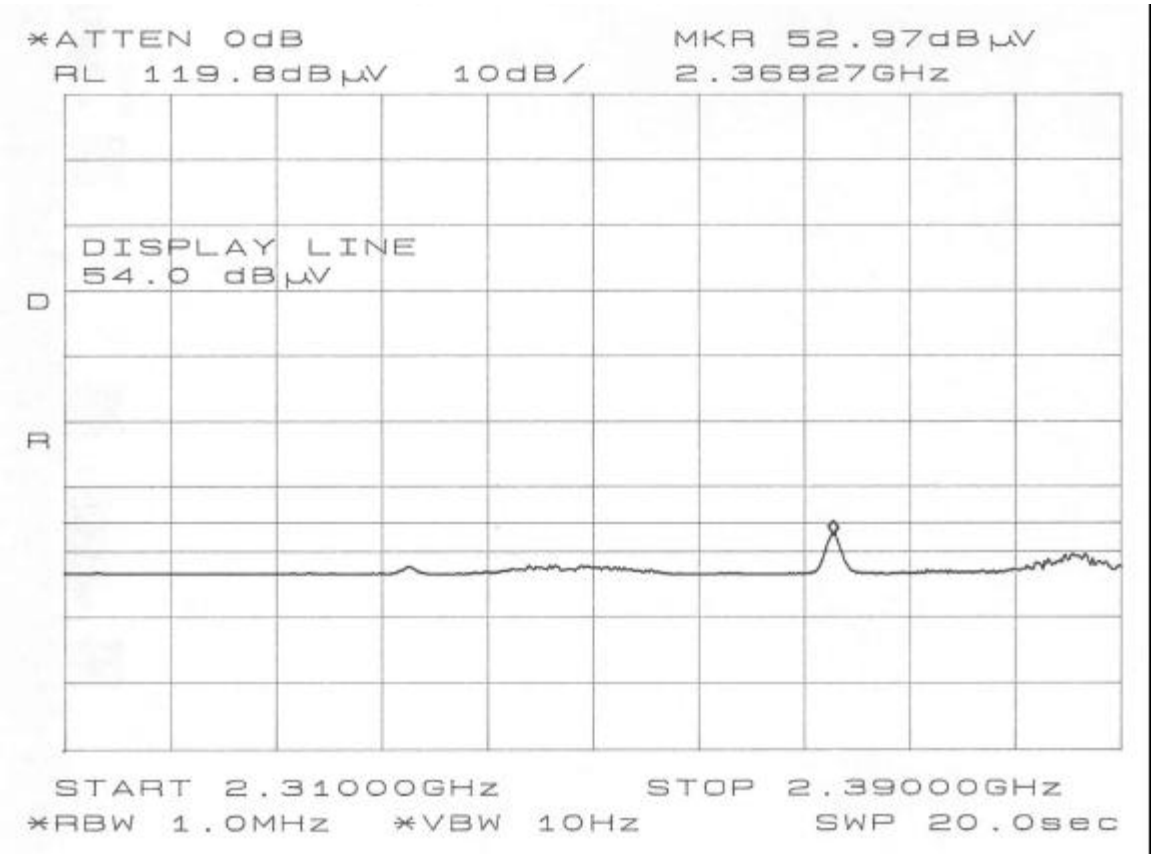

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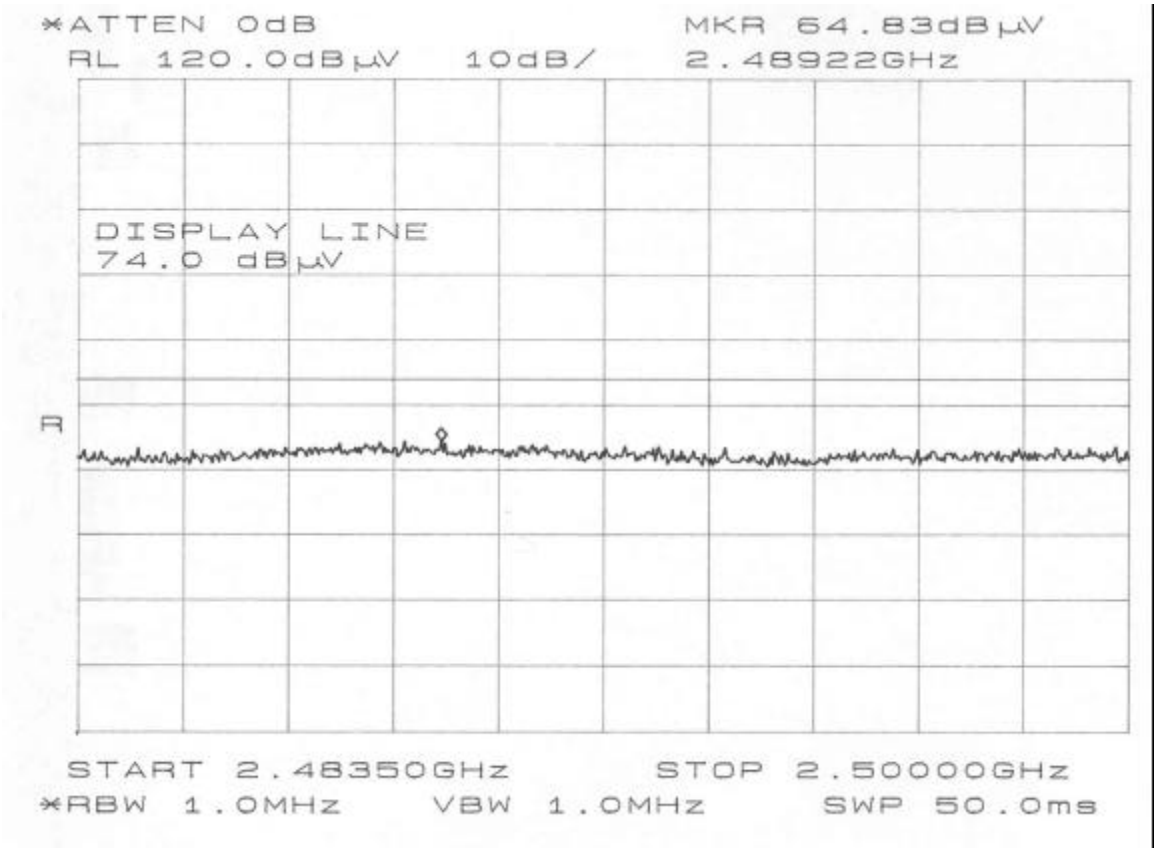
BAND EDGE RADIATED EMISSIONS (HIGH CHANNEL, HORIZONTAL POLARIZATION)



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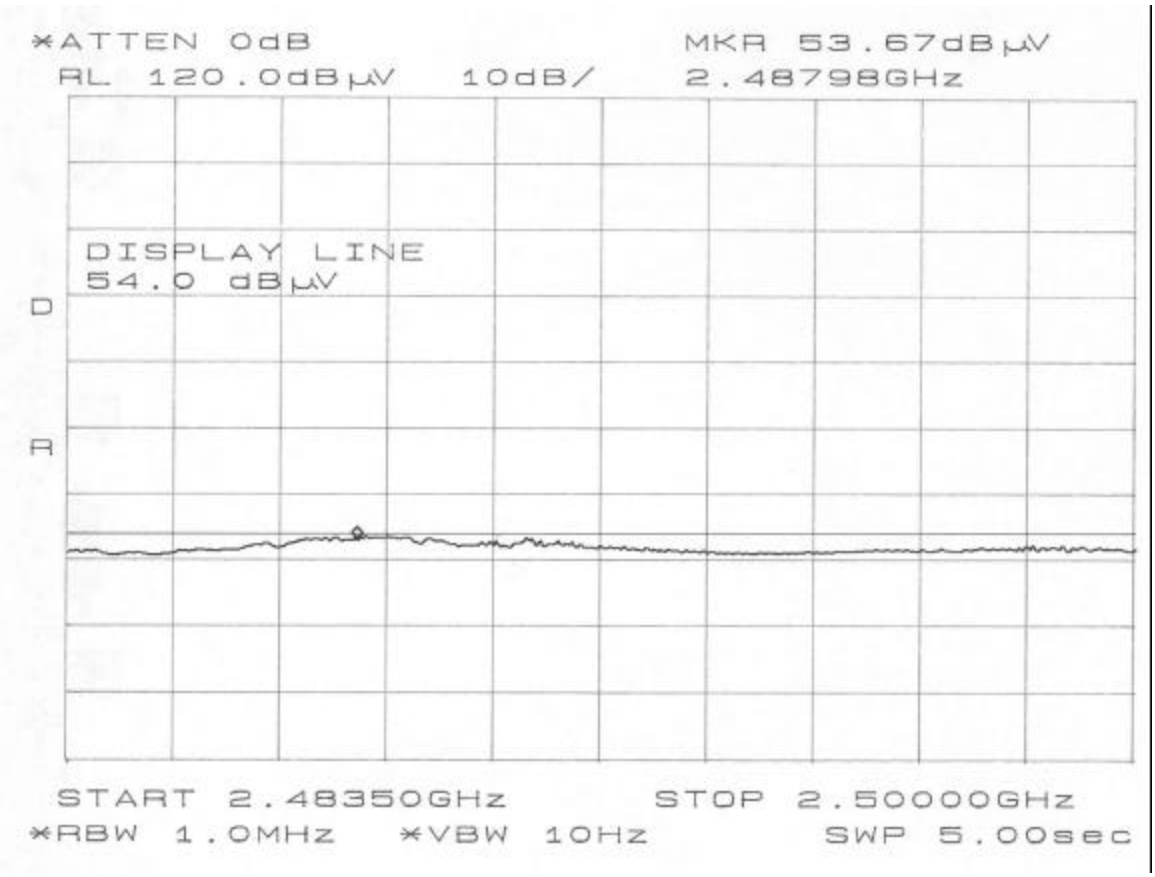

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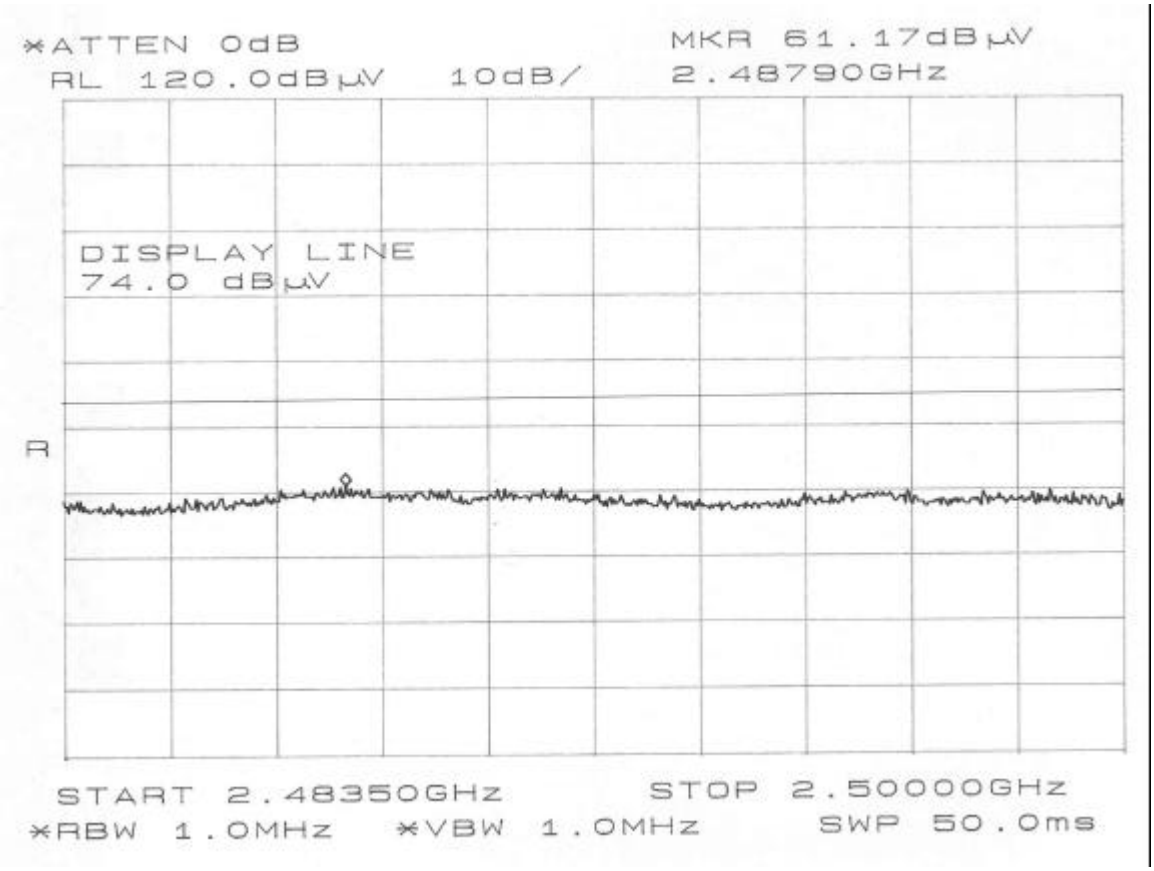
BAND EDGE RADIATED EMISSIONS (HIGH CHANNEL, VERTICAL POLARIZATION)



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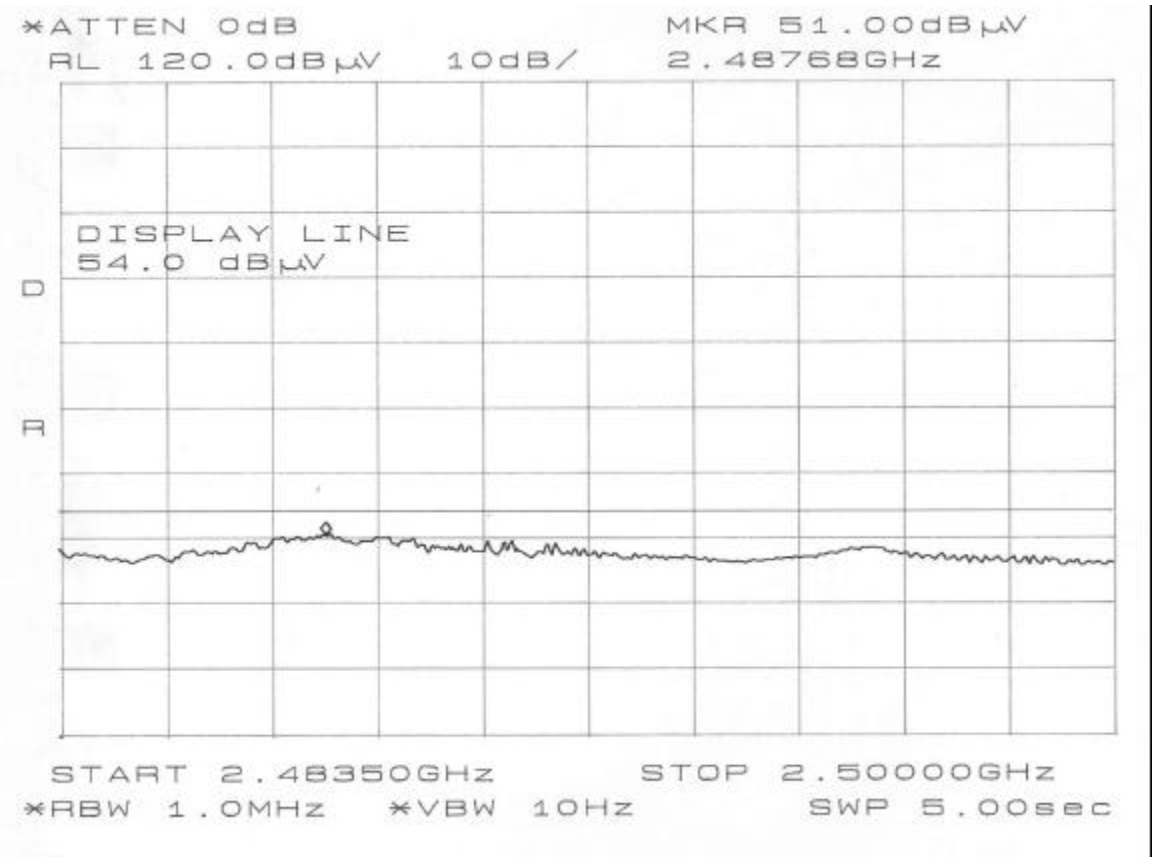

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HARMONIC AND SPURIOUS RADIATED EMISSIONS (2.4 GHZ BAND)

Description of Test:				Radiated Emissions							
Project Number:				02U1585-1							
Date:				11/01/02							
Test Engineer:				VanLee							
Company:				Toshiba							
EUT Description:				802.11 a/b Combo Wireless LAN Module, Card # 3							
Test Configuration:				EUT, Laptop, Mouse, 2 Antennas							
Mode of Operation:				11b Mode, Low Channel (2.412 GHz)							
Specification Distance:				3.0	meters						
Actual Distance:				1.0	meters	Cable Length:		15.0	feet		
Freq	**Pol**	**Det**	**SA**	**Dist**	**AF**	**Preamp**	**Filter**	**Cable**	**Field**	**Limit**	**Margin**
GHz	**V/H**		**dBuV**	**dB**	**dB/m**	**dB**	**dB**	**dB**	**dBuV/m**	**dBuV/m**	**dB**
2.412	H	100 k	78.2	-9.5	28.9	0.0	0.0	3.8	101.4		
2.412	V	100 k	74.3	-9.5	28.9	0.0	0.0	3.8	97.5		
4.824	V	Peak	51.9	-9.5	33.9	36.0	1.0	5.7	46.9	74.0	-27.1
4.824	V	Avg	49.1	-9.5	33.9	36.0	1.0	5.7	44.1	54.0	-9.9
4.824	H	Peak	51.4	-9.5	33.9	36.0	1.0	5.7	46.4	74.0	-27.6
4.824	H	Avg	44.9	-9.5	33.9	36.0	1.0	5.7	39.9	54.0	-14.1

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Description of Test: Radiated Emissions
Project Number: 02U1585-1
Date: 11/01/02
Test Engineer: VanLee

Company: Toshiba
EUT Description: 802.11 a/b Combo Wireless LAN Module, Card # 3
Test Configuration: EUT, Laptop, Mouse, 2 Antennas
Mode of Operation: 11b Mode, Mid Channel (2.437 GHz)

Specification Distance: 3.0 meters
Actual Distance: 1.0 meters Cable Length: 15.0 feet

Freq GHz	Pol V/H	Det	SA dBuV	Dist dB	AF dB/m	Preamp dB	Filter dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
2.437	H	100 k	76.1	-9.5	28.9	0.0	0.0	3.9	99.4		
2.437	V	100 k	71.4	-9.5	28.9	0.0	0.0	3.9	94.7		
4.874	V	Peak	54.8	-9.5	34.0	36.0	1.0	5.8	50.0	74.0	-24.0
4.874	V	Avg	51.4	-9.5	34.0	36.0	1.0	5.8	46.6	54.0	-7.4
4.874	H	Peak	54.7	-9.5	34.0	36.0	1.0	5.8	49.9	74.0	-24.1
4.874	H	Avg	51.7	-9.5	34.0	36.0	1.0	5.8	46.9	54.0	-7.1

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Description of Test: Radiated Emissions
Project Number: 02U1585-1
Date: 11/01/02
Test Engineer: VanLee

Company: Toshiba
EUT Description: 802.11 a/b Combo Wireless LAN Module, Card # 3
Test Configuration: EUT, Laptop, Mouse, 2 Antennas
Mode of Operation: 11b Mode, High Channel (2.462 GHz)

Specification Distance: 3.0 meters
Actual Distance: 1.0 meters Cable Length: 15.0 feet

Freq GHz	Pol V/H	Det	SA dBuV	Dist dB	AF dB/m	Preamp dB	Filter dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
2.462	H	100 k	77.8	-9.5	29.0	0.0	0.0	3.9	101.1		
2.462	V	100 k	75.5	-9.5	29.0	0.0	0.0	3.9	98.8		
4.924	V	Peak	52.6	-9.5	34.2	36.0	1.0	5.8	48.0	74.0	-26.0
4.924	V	Avg	50.0	-9.5	34.2	36.0	1.0	5.8	45.4	54.0	-8.6
4.924	H	Peak	53.5	-9.5	34.2	36.0	1.0	5.8	48.9	74.0	-25.1
4.924	H	Avg	51.3	-9.5	34.2	36.0	1.0	5.8	46.7	54.0	-7.3
7.386	V	Peak	45.4	-9.5	37.3	36.3	1.0	7.3	45.2	74.0	-28.8
7.386	V	Avg	34.5	-9.5	37.3	36.3	1.0	7.3	34.2	54.0	-19.8
7.386	H	Peak	46.2	-9.5	37.3	36.3	1.0	7.3	46.0	74.0	-28.0
7.336	H	Avg	35.5	-9.5	37.2	36.3	1.0	7.3	35.1	54.0	-18.9

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HARMONIC AND SPURIOUS RADIATED EMISSIONS (5.8 GHZ BAND, NORMAL MODE)

Description of Test:				Radiated Emissions							
Project Number:				02U1585-1							
Date:				11/05/02							
Test Engineer:				Frank Ibrahim							
Company:				Toshiba							
EUT Description:				802.11 a/b Combo Wireless LAN Module, Card # 3							
Test Configuration:				EUT, Laptop, Mouse, 2 Antennas							
Mode of Operation:				11a Normal Mode, Low Channel (5.745 GHz)							
Specification Distance:				3.0	meters						
Actual Distance:				1.0	meters	Cable Length:		15.0	feet		
Freq	**Pol**	**Det**	**SA**	**Dist**	**AF**	**Preamp**	**Filter**	**Cable**	**Field**	**Limit**	**Margin**
GHz	**V/H**		**dBuV**	**dB**	**dB/m**	**dB**	**dB**	**dB**	**dBuV/m**	**dBuV/m**	**dB**
5.745	V	Peak	76.4	-9.5	35.2	0.0	0.0	6.4	108.5		
5.745	H	Peak	72.3	-9.5	35.2	0.0	0.0	6.4	104.4		
11.490	V	Peak	63.3	-9.5	39.7	36.0	1.0	9.3	67.7	74.0	-6.3
11.490	V	Avg	48.8	-9.5	39.7	36.0	1.0	9.3	53.2	54.0	-0.8
11.490	H	Peak	57.2	-9.5	39.7	36.0	1.0	9.3	61.6	74.0	-12.4
11.490	H	Avg	44.2	-9.5	39.7	36.0	1.0	9.3	48.6	54.0	-5.4
9.192	V	Peak	49.0	-9.5	39.1	35.4	1.0	8.3	52.4	74.0	-21.6
9.192	V	Avg	42.8	-9.5	39.1	35.4	1.0	8.3	46.3	54.0	-7.7
9.192	H	Peak	47.3	-9.5	39.1	35.4	1.0	8.3	50.8	74.0	-23.2
9.192	H	Avg	36.8	-9.5	39.1	35.4	1.0	8.3	40.3	54.0	-13.7

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Description of Test: Radiated Emissions
Project Number: 02U1585-1
Date: 11/05/02
Test Engineer: Frank Ibrahim

Company: Toshiba
EUT Description: 802.11 a/b Combo Wireless LAN Module, Card # 3
Test Configuration: EUT, Laptop, Mouse, 2 Antennas
Mode of Operation: 11a Normal Mode, Mid Channel (5.785 GHz)

Specification Distance: 3.0 meters
Actual Distance: 1.0 meters Cable Length: 15.0 feet

Freq GHz	Pol V/H	Det	SA dBuV	Dist dB	AF dB/m	Preamp dB	Filter dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
5.785	V	Peak	78.8	-9.5	35.3	0.0	0.0	6.4	111.0		
5.785	H	Peak	76.5	-9.5	35.3	0.0	0.0	6.4	108.7		
11.570	V	Peak	60.0	-9.5	39.7	36.0	1.0	9.3	64.4	74.0	-9.6
11.570	V	Avg	46.7	-9.5	39.7	36.0	1.0	9.3	51.0	54.0	-3.0
11.570	H	Peak	53.2	-9.5	39.7	36.0	1.0	9.3	57.5	74.0	-16.5
11.570	H	Avg	39.7	-9.5	39.7	36.0	1.0	9.3	44.0	54.0	-10.0

Description of Test: Radiated Emissions
Project Number: 02U1585-1
Date: 11/05/02
Test Engineer: Frank Ibrahim

Company: Toshiba
EUT Description: 802.11 a/b Combo Wireless LAN Module, Card # 3
Test Configuration: EUT, Laptop, Mouse, 2 Antennas
Mode of Operation: 11a Normal Mode, High Channel (5.825 GHz)

Specification Distance: 3.0 meters
Actual Distance: 1.0 meters Cable Length: 15.0 feet

Freq GHz	Pol V/H	Det	SA dBuV	Dist dB	AF dB/m	Preamp dB	Filter dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
5.825	V	Peak	75.9	-9.5	35.3	0.0	0.0	6.5	108.1		
5.825	H	Peak	72.3	-9.5	35.3	0.0	0.0	6.5	104.5		
11.650	V	Peak	60.0	-9.5	39.6	36.1	1.0	9.3	64.3	74.0	-9.7
11.650	V	Avg	45.3	-9.5	39.6	36.1	1.0	9.3	49.7	54.0	-4.3
11.650	H	Peak	50.0	-9.5	39.6	36.1	1.0	9.3	54.3	74.0	-19.7
11.650	H	Avg	38.0	-9.5	39.6	36.1	1.0	9.3	42.3	54.0	-11.7
9.320	V	Peak	48.8	-9.5	39.2	35.4	1.0	8.3	52.5	74.0	-21.5
9.320	V	Avg	41.0	-9.5	39.2	35.4	1.0	8.3	44.6	54.0	-9.4

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HARMONIC AND SPURIOUS RADIATED EMISSIONS (5.8 GHZ BAND, TURBO MODE)

Description of Test: Radiated Emissions
Project Number: 02U1585-1
Date: 11/05/02
Test Engineer: Frank Ibrahim

Company: Toshiba
EUT Description: 802.11 a/b Combo Wireless LAN Module, Card # 3
Test Configuration: EUT, Laptop, Mouse, 2 Antennas
Mode of Operation: 11a Turbo Mode, Low Channel (5.76 GHz)

Specification Distance: 3.0 meters
Actual Distance: 1.0 meters Cable Length: 15.0 feet

Freq GHz	Pol V/H	Det	SA dBuV	Dist dB	AF dB/m	Preamp dB	Filter dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
5.760	V	Peak	74.6	-9.5	35.3	0.0	0.0	6.4	106.7		
5.760	H	Peak	70.2	-9.5	35.3	0.0	0.0	6.4	102.3		
11.522	V	Peak	60.8	-9.5	39.7	36.0	1.0	9.3	65.2	74.0	-8.8
11.522	V	Avg	45.7	-9.5	39.7	36.0	1.0	9.3	50.1	54.0	-3.9
11.522	H	Peak	49.8	-9.5	39.7	36.0	1.0	9.3	54.2	74.0	-19.8
11.522	H	Avg	38.8	-9.5	39.7	36.0	1.0	9.3	43.2	54.0	-10.8

Description of Test: Radiated Emissions
Project Number: 02U1585-1
Date: 11/05/02
Test Engineer: Frank Ibrahim

Company: Toshiba
EUT Description: 802.11 a/b Combo Wireless LAN Module, Card # 3
Test Configuration: EUT, Laptop, Mouse, 2 Antennas
Mode of Operation: 11a Turbo Mode, High Channel (5.8 GHz)

Specification Distance: 3.0 meters
Actual Distance: 1.0 meters Cable Length: 15.0 feet

Freq GHz	Pol V/H	Det	SA dBuV	Dist dB	AF dB/m	Preamp dB	Filter dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
5.800	V	Peak	74.2	-9.5	35.3	0.0	0.0	6.5	106.4		
5.800	H	Peak	70.0	-9.5	35.3	0.0	0.0	6.5	102.2		
11.600	V	Peak	53.5	-9.5	39.7	36.1	1.0	9.3	57.9	74.0	-16.1
11.600	V	Avg	40.5	-9.5	39.7	36.1	1.0	9.3	44.9	54.0	-9.1
11.600	H	Peak	46.7	-9.5	39.7	36.1	1.0	9.3	51.0	74.0	-23.0
11.600	H	Avg	36.2	-9.5	39.7	36.1	1.0	9.3	40.5	54.0	-13.5

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8.7. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

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RADIATED RF MEASUREMENT SETUP: ANTENNA IN X-AXIS ORIENTATION

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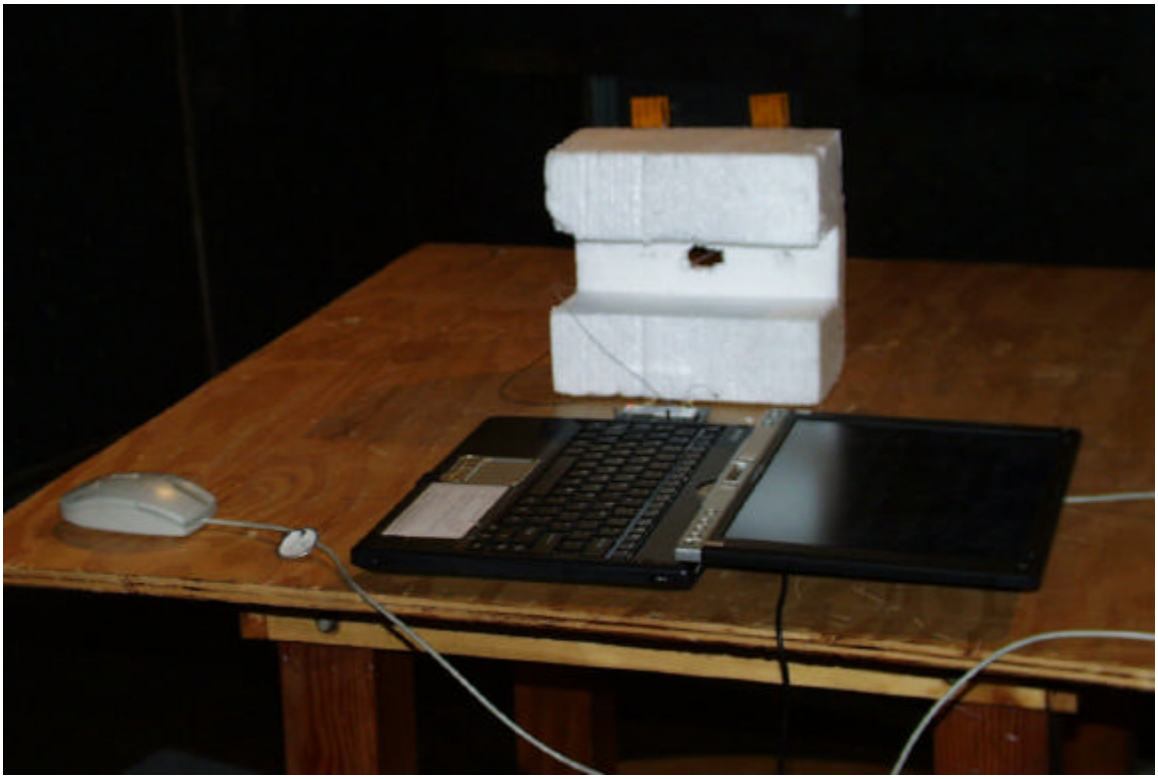
RADIATED RF MEASUREMENT SETUP: ANTENNA IN Y-AXIS ORIENTATION



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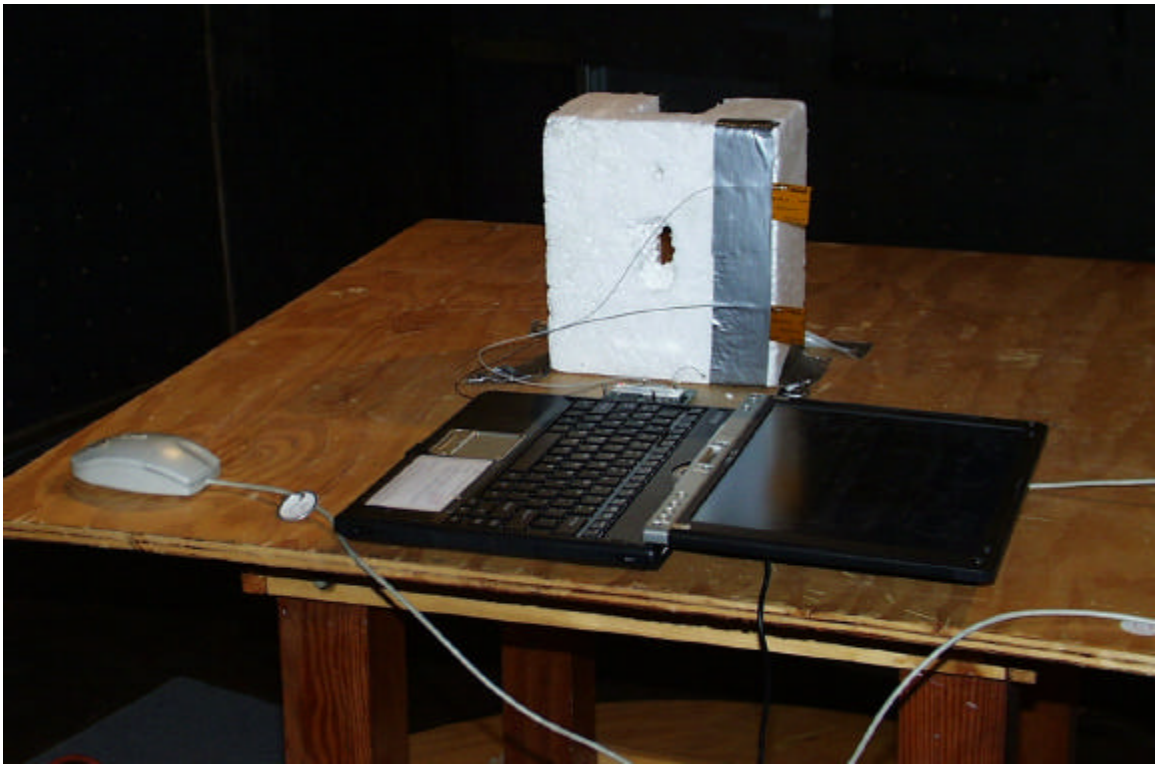
RADIATED RF MEASUREMENT SETUP: ANTENNA IN Z-AXIS ORIENTATION



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