

**FCC CFR47 PART 15 SUBPART C
CERTIFICATION**



TEST REPORT

FOR

802.11a/b CARDBUS

MODEL NUMBER: WLC221-D4 / BCP3483U

BRAND NAME: ASKEY

FCC ID: H8NWLC221-D4

REPORT NUMBER: 02T1639-1

ISSUE DATE: NOVEMBER 18, 2002

Prepared for
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1. TEST RESULT CERTIFICATION

COMPANY NAME: ASKEY COMPUTER CORP.
10F, NO. 119, CHIENKANG RD.
CHUNG-HO, TAIPEI, TAIWAN, R.O.C.

EUT DESCRIPTION: 802.11A/B CARDBUS

MODEL NAME: WLC221-D4 / BCP3483U

DATE TESTED: NOVEMBER 9 – NOVEMBER 15, 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.

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:

Tested By:

MIKE HECKROTTE
CHIEF ENGINEER
COMPLIANCE CERTIFICATION SERVICES

NEELESH RAJ
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. EUT DESCRIPTION

The Askey WLAN module is an 802.11 a/b wireless Spread Spectrum transceiver. It is constructed on a printed circuit card with a PCMCIA interface and is designed to be installed in a host system.

This unit provides a peak power output of +17.29 dBm (60 mW) in the 2400 – 2483.5 MHz band and +20.81 dBm (121 mW) in the 5725 – 5850 MHz band. It is designed to use two identical dielectric antennas. A single antenna is used for transmit. Both antennas are used for receive diversity. The antenna gain is 4.5 dBi in the 2.4 GHz band and 5.2 dBi in the 5.8 GHz band. Both antennas are integral to the WLAN module.

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.

3. MODIFICATIONS TO THE EUT

The following modifications were made to the EUT during testing:

1. A jumper was added to the 32 MHz clock distribution trace. This trace, which is primarily on the bottom layer, originally included a short section of printed trace on the top layer. The vias to the top layer section were drilled out, the top layer section was removed, and a jumper wire was soldered to the bottom side of the printed circuit board.
2. The hole in the internal shield plate was covered.
3. The internal shield plate was soldered to the internal shield side wall piece, instead of the original snap fastening. There is no change to the fastening method between the side wall piece and the printed circuit board; this was originally a solder joint and remains as such.

4. 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.

5. FACILITIES AND ACCREDITATION

5.1. 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.

5.2. 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)).

5.3. 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	 200065-0
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	 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	 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	 ELA-171
Taiwan	BSMI	CNS 13438	 SL2-IN-E-1012
Canada	Industry Canada	RSS210 Low Power Transmitter and Receiver	 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.

6. CALIBRATION AND UNCERTAINTY

6.1. 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.

6.2. 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.

6.3. 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
Preamplifier (1 - 26.5GHz)	Miteq	NSP10023988	646456	4/26/03
Horn Antenna (1 - 18GHz)	EMCO	3115	6717	1/31/03
Horn Antenna (1 - 18GHz)	EMCO	3115	6739	1/31/03
Horn Antenna (18 – 26.5GHz)	ARA	MWH 1826/B	1013	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
Spectrum Analyzer	HP	E4404B	ID 963805	3/25/03

7. SETUP OF EQUIPMENT UNDER TEST

SETUP INFORMATION FOR TRANSMITTER TESTS

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Device Type	Manufacturer	Model	Serial Number	FCC ID
Laptop	Personal Computer	N340S8	PB344S811902382	DoC
AC Adapter	Lishin International	LSE9802A2060	010810241A1	N/A

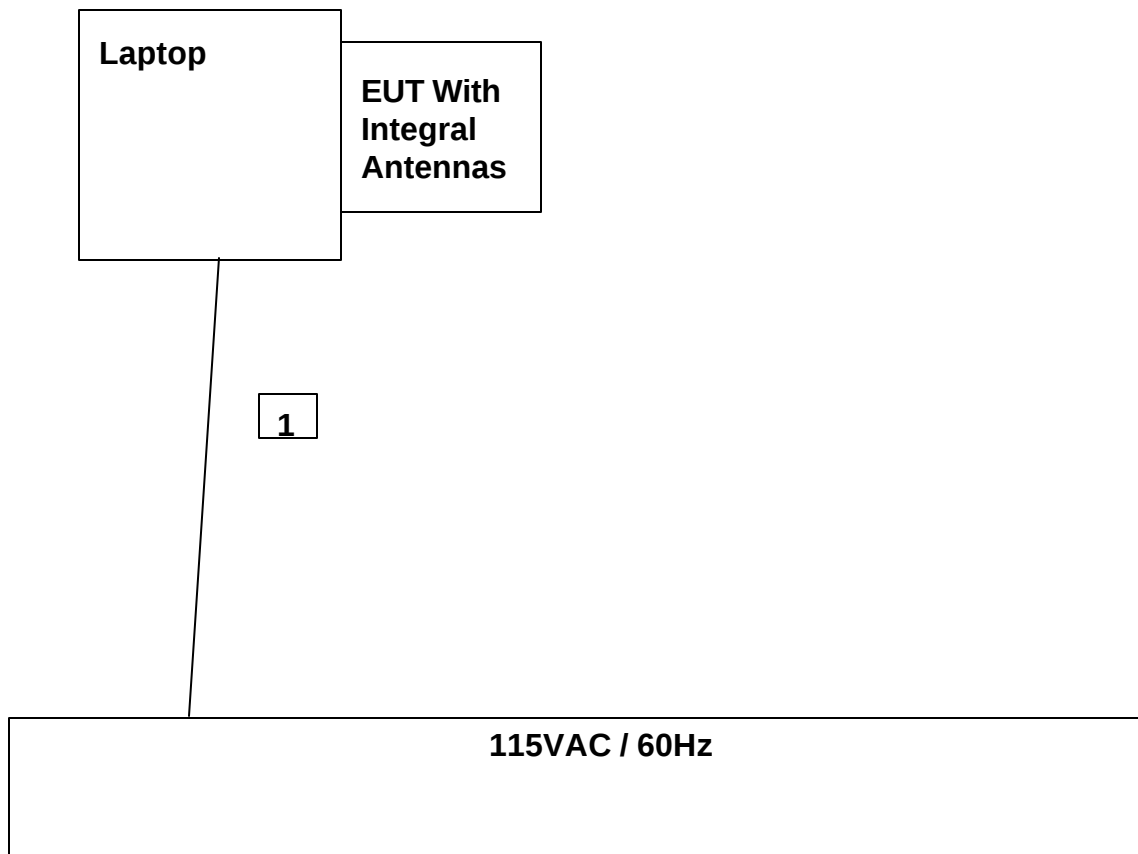
I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US115	Unshielded	2 m	Laptop cable is integrated with AC Adapter

TEST SETUP

The EUT is installed in the laptop computer via a PCMCIA extender card.

SETUP DIAGRAM FOR TRANSMITTER TESTS



SETUP INFORMATION FOR DIGITAL DEVICE TESTS

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Device Type	Manufacturer	Model	Serial Number	FCC ID
MODEM	ACEEX	1414	9013538	IFAXDM1414
PRINTER	HP	2225C	2541S41679	BS46XU2225C
PS/2 MOUSE	PACKARD BELL	FDM-611	FWMC55039667	F4Z4K3FDM-612
LAPTOP	PERSONAL COMPUTER	N340S8	PB344S811902382	DoC
AC/DC ADAPTER	ELISHIN INTERNATIONAL	LSE9802A2060	010810241A1	N/A
DC POWER SUPPLY	HP	E3610A	KR24104150	N/A

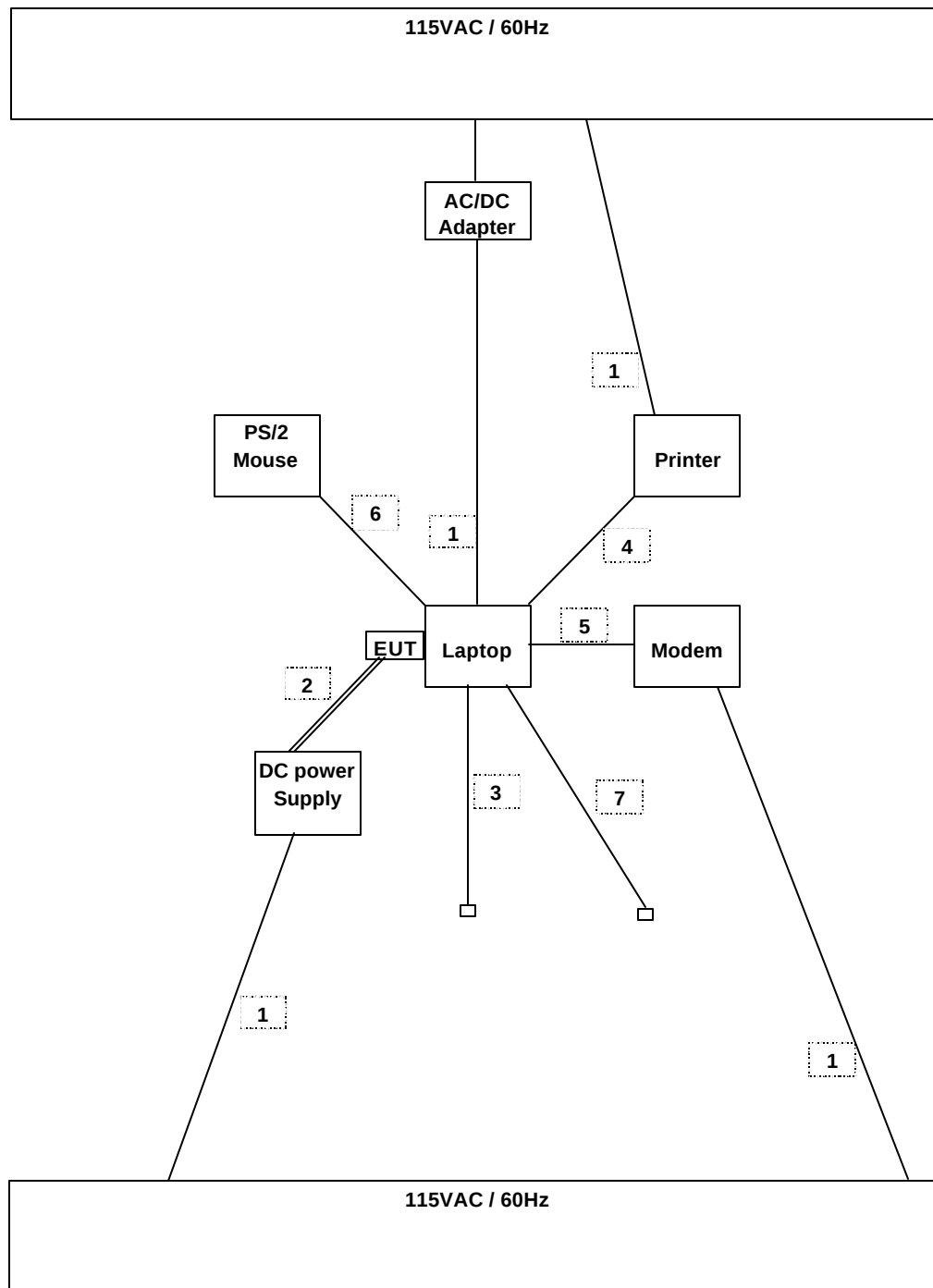
I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	4	US 115V	Un-shielded	2m	Laptop cable is integrated with AC Adapter
2	DC	1	CLIPS	Un-shielded	2m	
3	USB	1	USB	Un-shielded	2m	
4	Parallel	1	DB25	Shielded	2m	
5	Serial	1	DB9	Shielded	2m	
6	Mouse	1	PS/2	Un-shielded	2m	
7	LAN	1	RJ45	Shielded	2m	

TEST SETUP

The EUT is installed in the laptop computer via a PCMCIA extender card.

SETUP DIAGRAM FOR DIGITAL DEVICE TESTS



8. 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 = 5.2 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.

§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.

§15.207- CONDUCTED LIMITS

(a) For an intentional radiator which 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 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

§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.

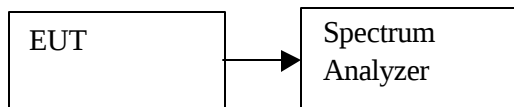
(b) In the emission table above, the tighter limit applies at the band edges.

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

9. TEST SETUP, PROCEDURE AND RESULT

9.1. 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	12550	500	12050
Middle	2437	12100	500	11600
High	2462	12550	500	12050

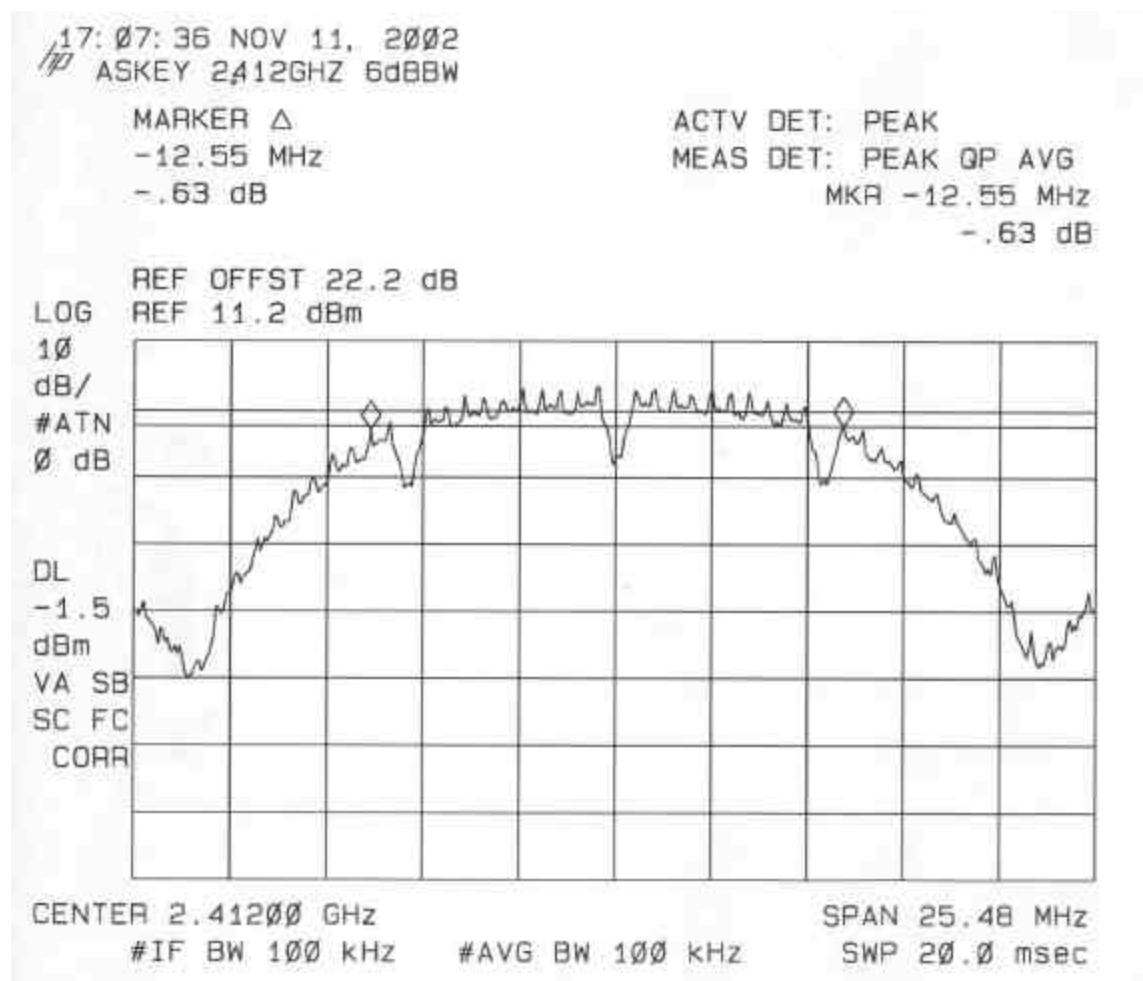
5.8 GHz Band Normal Mode

Channel	Frequency (MHz)	B (kHz)	Limit (kHz)	Margin (kHz)
Low	5745	16560	500	16160
Middle	5785	16560	500	16160
High	5825	16560	500	16160

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	32880	500	32380

6 DB BANDWIDTH (2.4 GHZ BAND)



17:05:44 NOV 11, 2002
ASKEY 2437GHZ 6dBBW

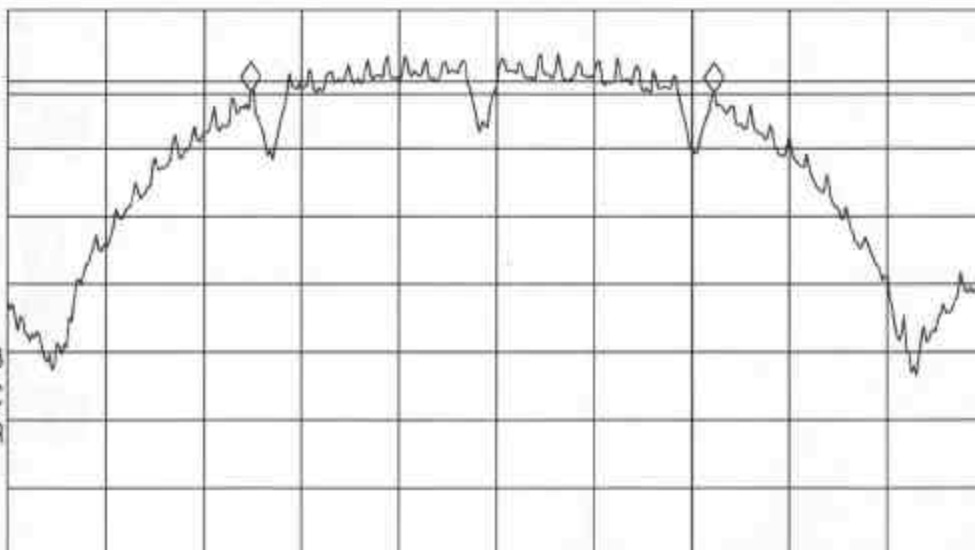
MARKER Δ
-12.10 MHz
.10 dB

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR -12.10 MHz
.10 dB

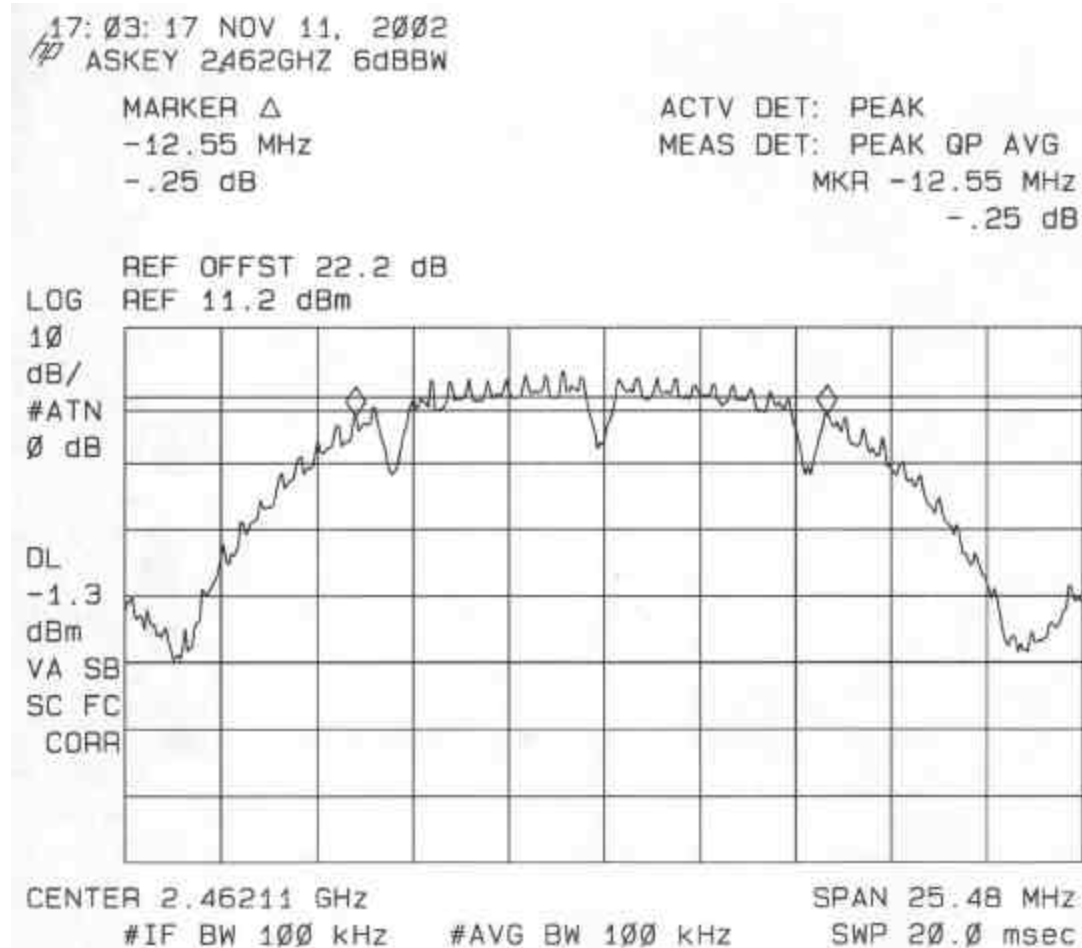
REF OFFST 22.2 dB
LOG REF 11.2 dBm

10
dB/
#ATN
0 dB

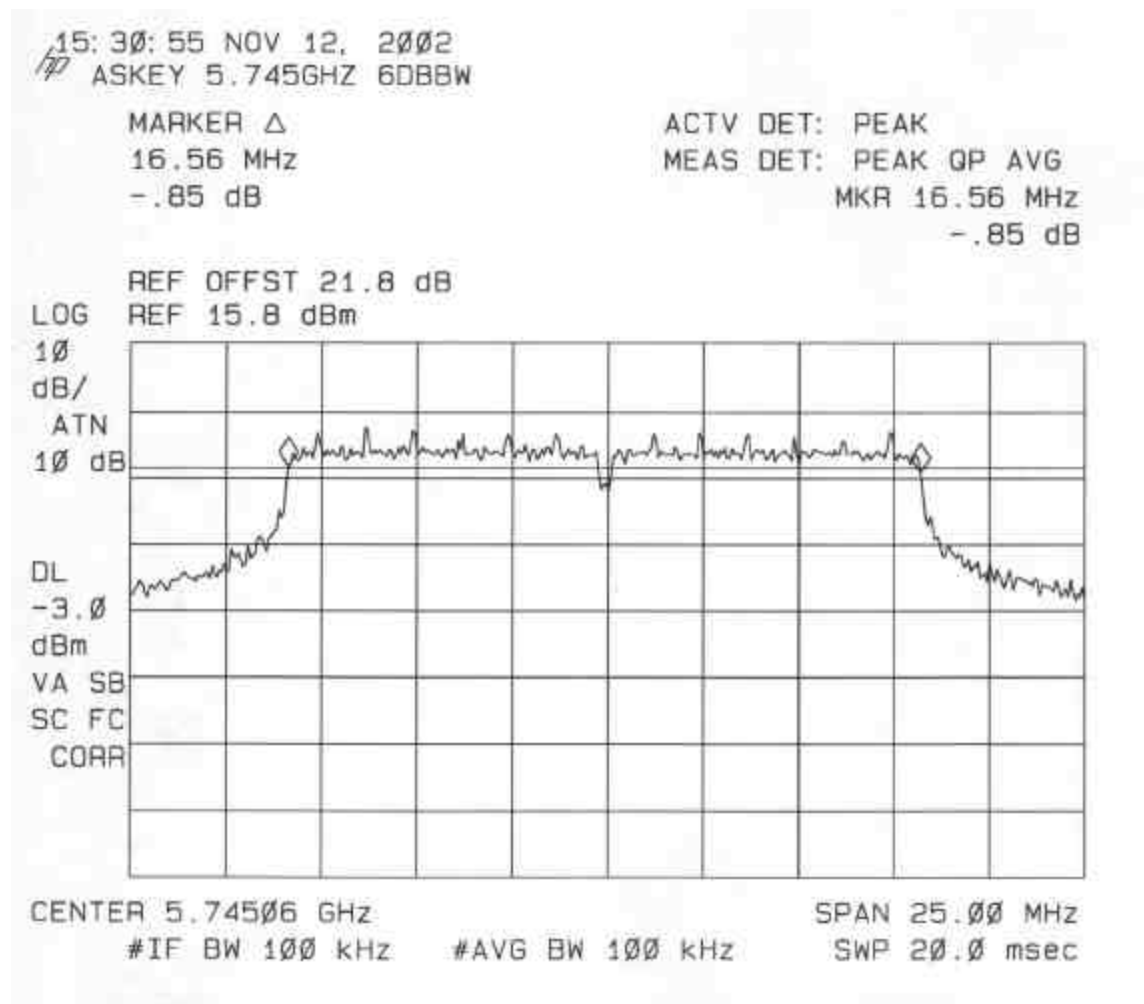
DL
-1.2
dBm
VA SB
SC FC
CORR



CENTER 2.43739 GHz SPAN 25.48 MHz
#IF BW 100 kHz #AVG BW 100 kHz SWP 20.0 msec



6 DB BANDWIDTH (5.8 GHZ BAND, NORMAL MODE)

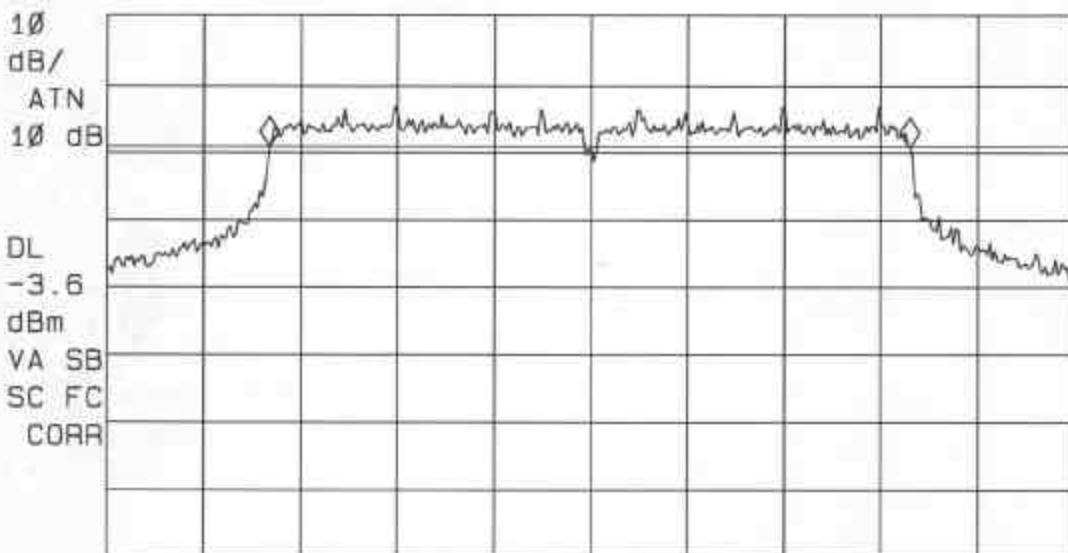


15:12:52 NOV 12, 2002
ASKEY 5.785GHZ 60BBW

MARKER Δ
-16.56 MHz
.09 dB

ACTV DET: PEAK
MEAS DET: PEAK GP AVG
MKR -16.56 MHz
.09 dB

REF OFFST 21.8 dB
LOG REF 15.8 dBm



CENTER 5.78500 GHz SPAN 25.00 MHz
#IF BW 100 kHz #AVG BW 100 kHz SWP 20.0 msec

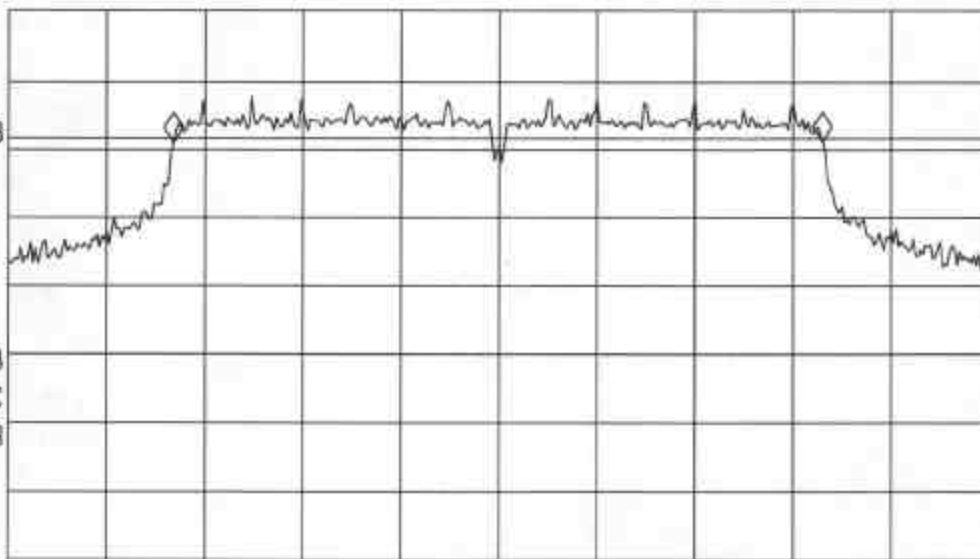
15:00:56 NOV 12, 2002
ASKEY 5.825GHZ 60BBW

MARKER Δ
16.56 MHz
.14 dB

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 16.56 MHz
.14 dB

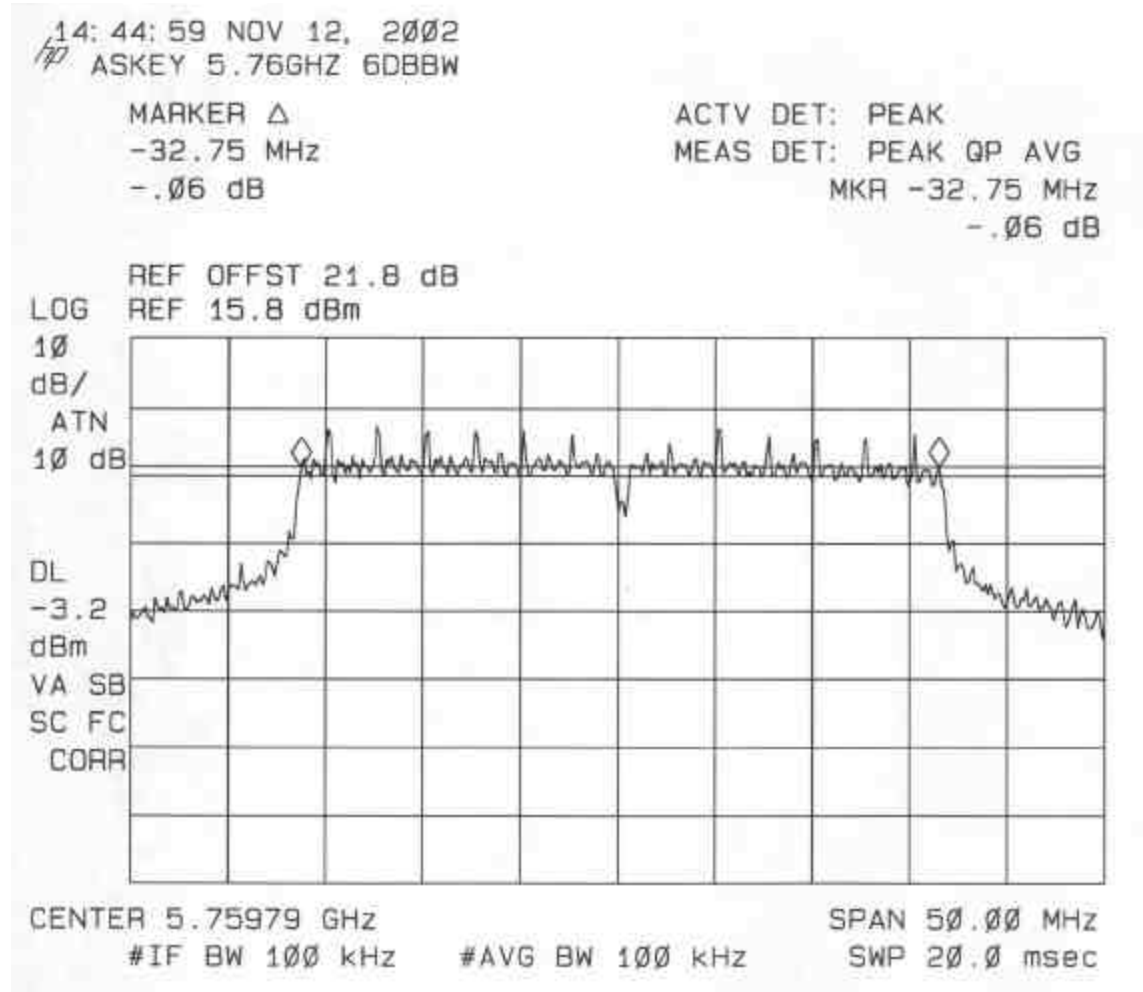
LOG REF OFFST 21.8 dB
REF 15.8 dBm

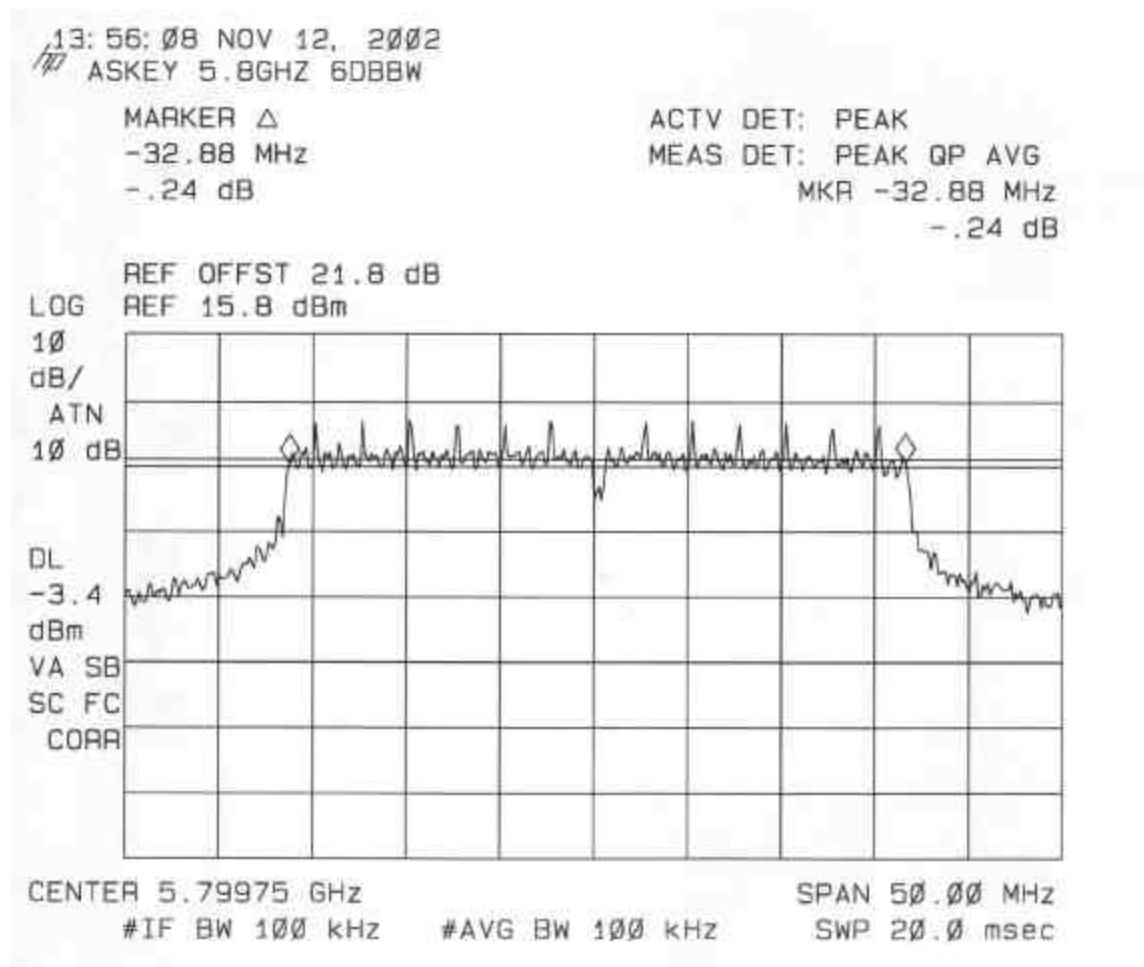
10
dB/
ATN
10 dB
DL
-2.9
dBm
VA SB
SC FC
CORR



CENTER 5.82500 GHz SPAN 25.00 MHz
#IF BW 100 kHz #AVG BW 100 kHz SWP 20.0 msec

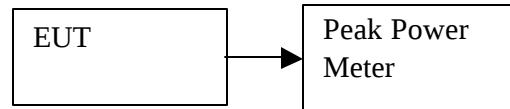
6 DB BANDWIDTH (5.8 GHZ BAND, TURBO MODE)





9.2. 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	16.84	30	-13.16
Middle	2437	17.29	30	-12.71
High	2462	16.87	30	-13.13

5.8 GHz Band Normal Mode

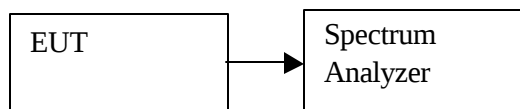
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5745	20.81	30	-9.19
Middle	5785	20.68	30	-9.32
High	5825	20.38	30	-9.62

5.8 GHz Band Turbo Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5760	20.1	30	-9.9
Middle	N/A	N/A	N/A	N/A
High	5800	19.99	30	-10.01

9.3. 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 $\geq$ 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	-7.93	8	-15.93
Middle	2437	-7.48	8	-15.48
High	2462	-8.12	8	-16.12

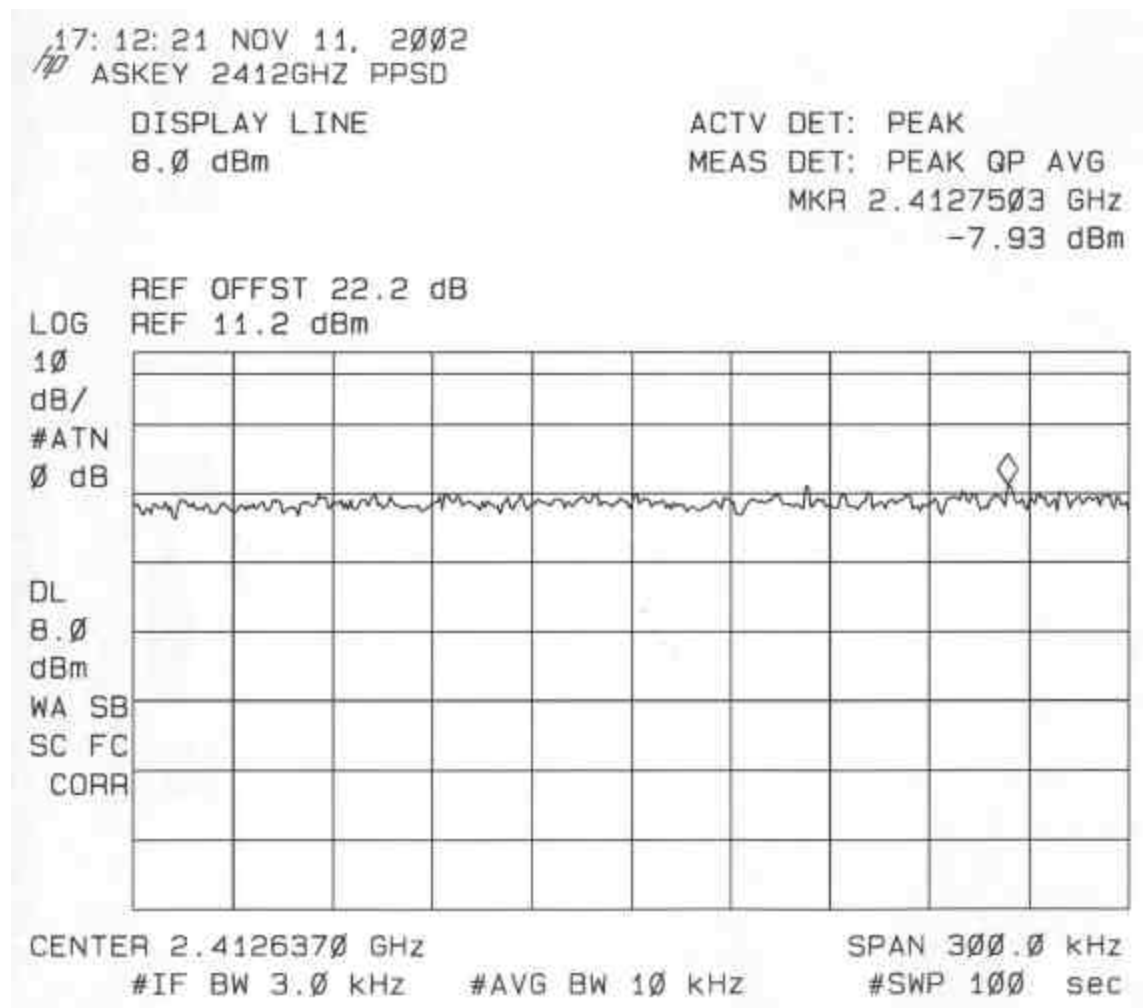
5.8 GHz Band Normal Mode

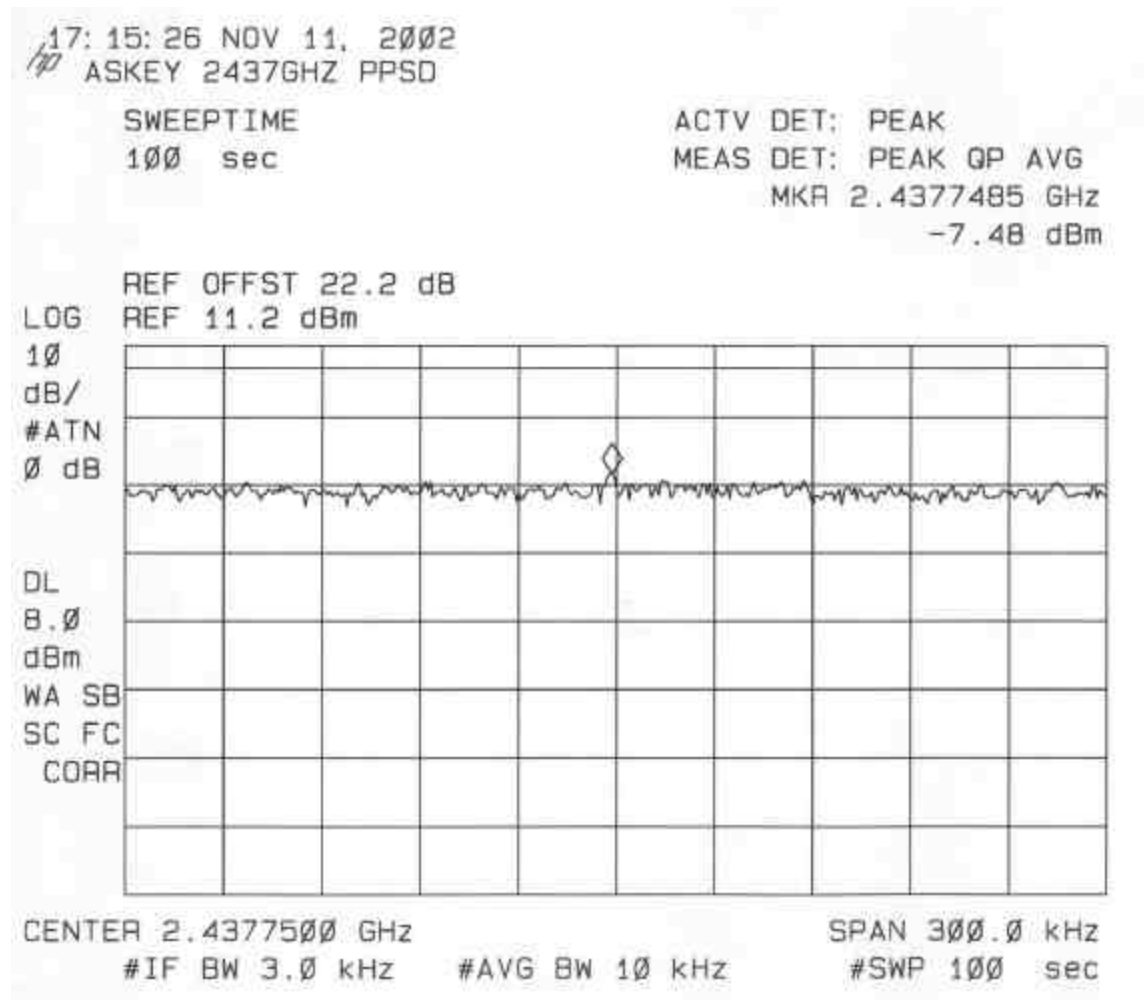
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-7.86	8	-15.86
Middle	5785	-9.66	8	-17.66
High	5825	-9.08	8	-17.08

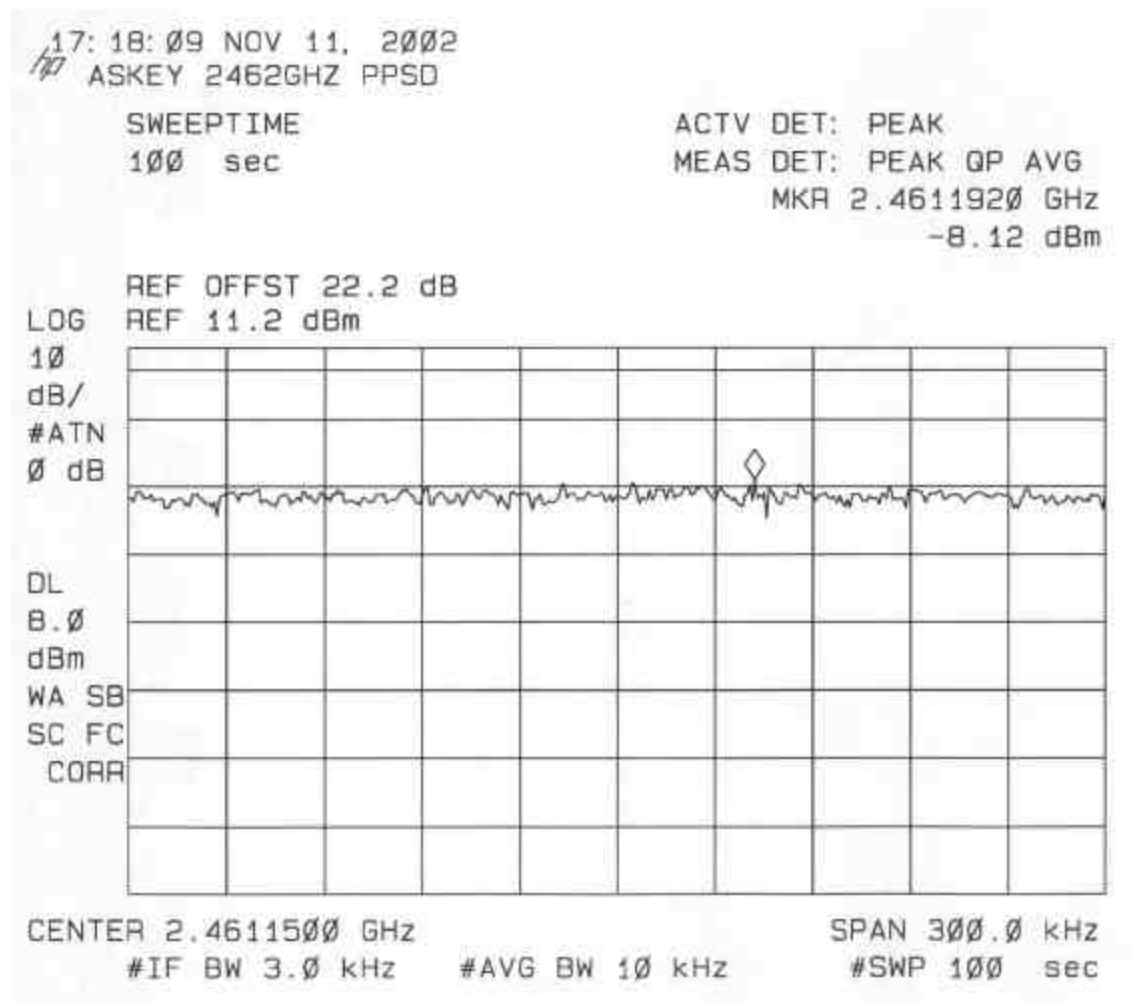
5.8 GHz Band Turbo Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5760	-12.81	8	-20.81
Middle	N/A	N/A	N/A	N/A
High	5800	-15.15	8	-23.15

PPSD (2.4 GHZ BAND)







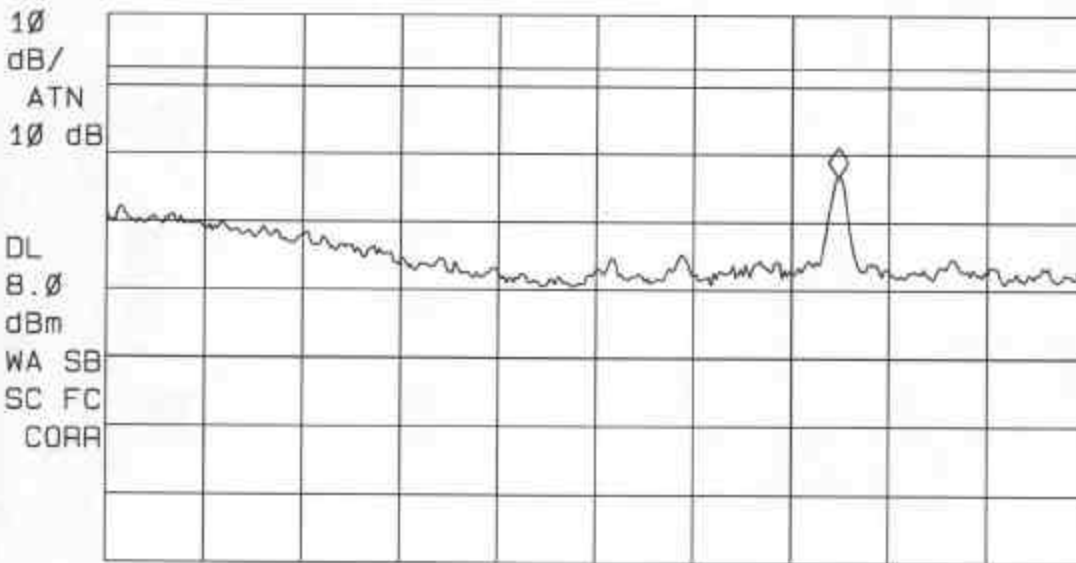
PPSD (5.8 GHZ BAND, NORMAL MODE)

15:17:36 NOV 12, 2002
ASKEY 5.785GHZ PPSD

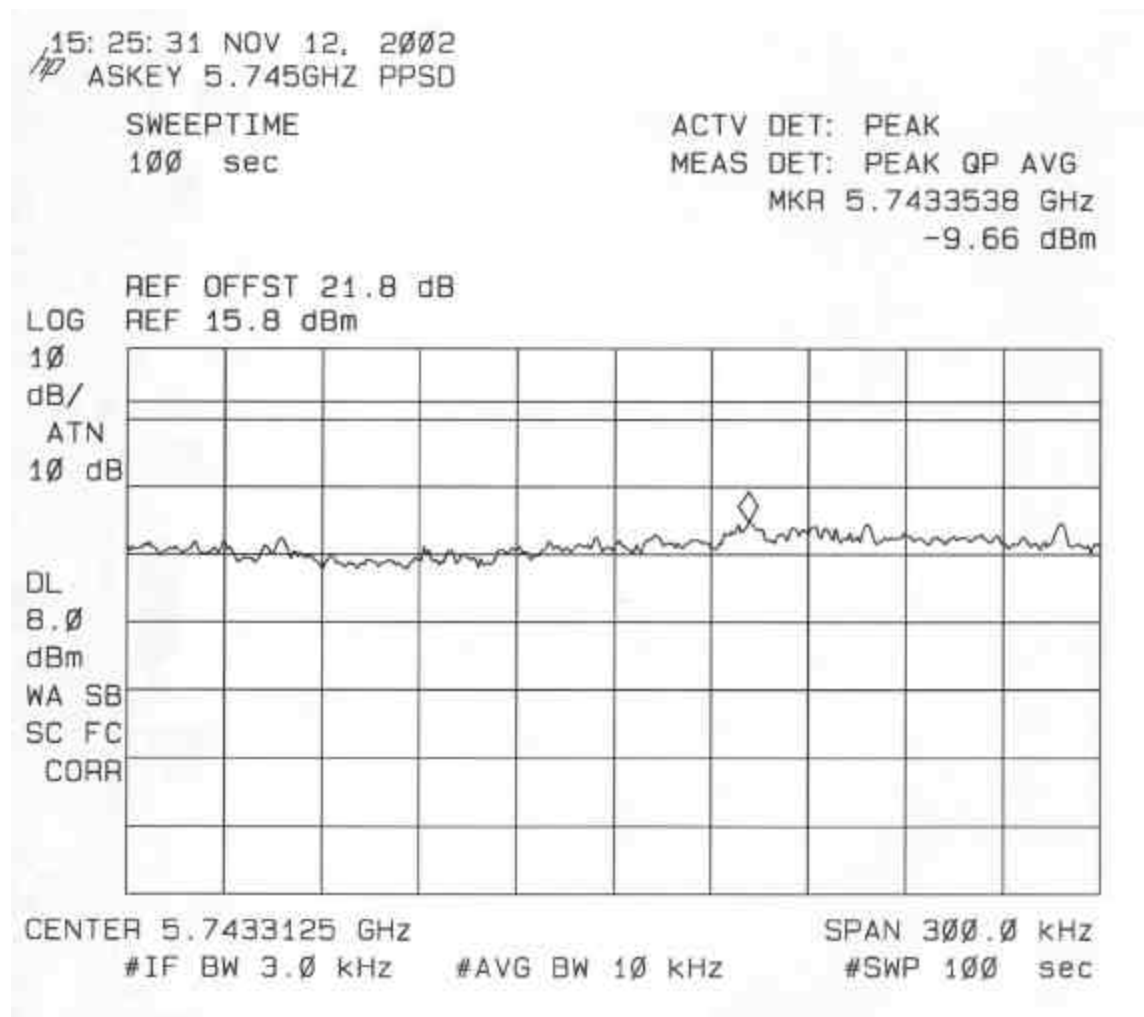
SWEEPTIME
100 sec

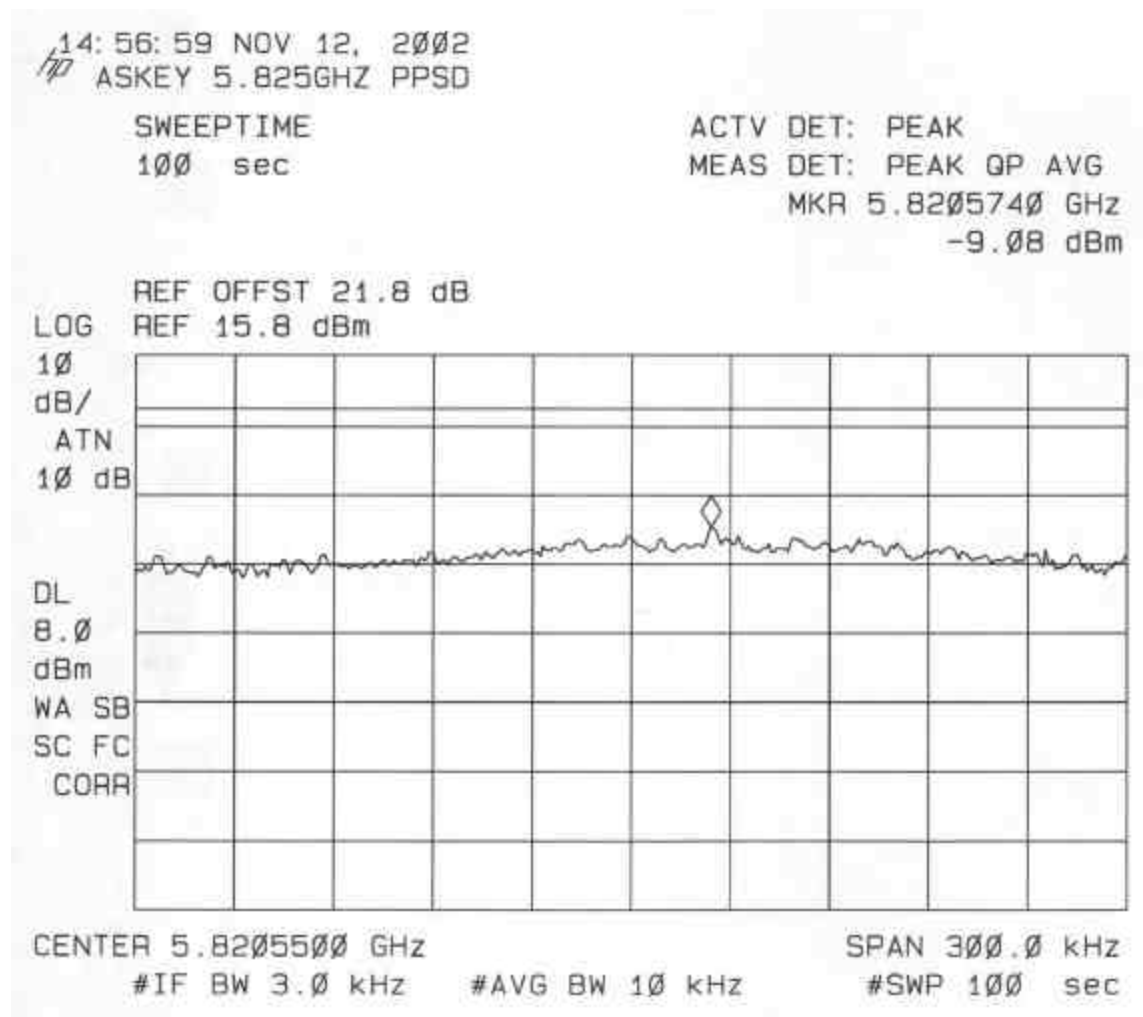
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 5.7849493 GHz
-7.86 dBm

REF OFFST 21.8 dB
LOG REF 15.8 dBm

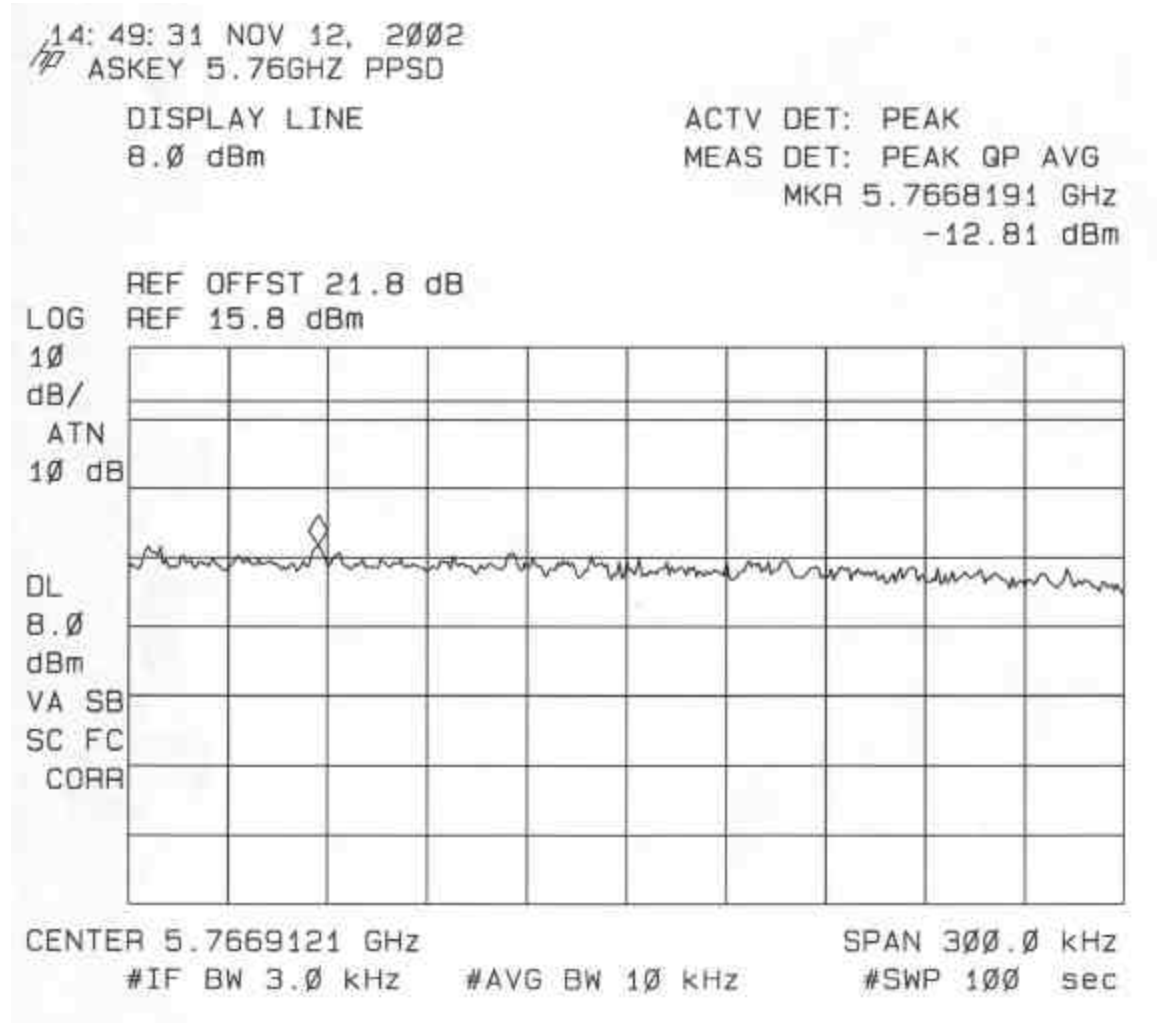


CENTER 5.7848750 GHz SPAN 300.0 kHz
#IF BW 3.0 kHz #AVG BW 10 kHz #SWP 100 sec





PPSD (5.8 GHZ BAND, TURBO MODE)



14:03:26 NOV 12, 2002
ASKEY 5.8GHZ PPSD

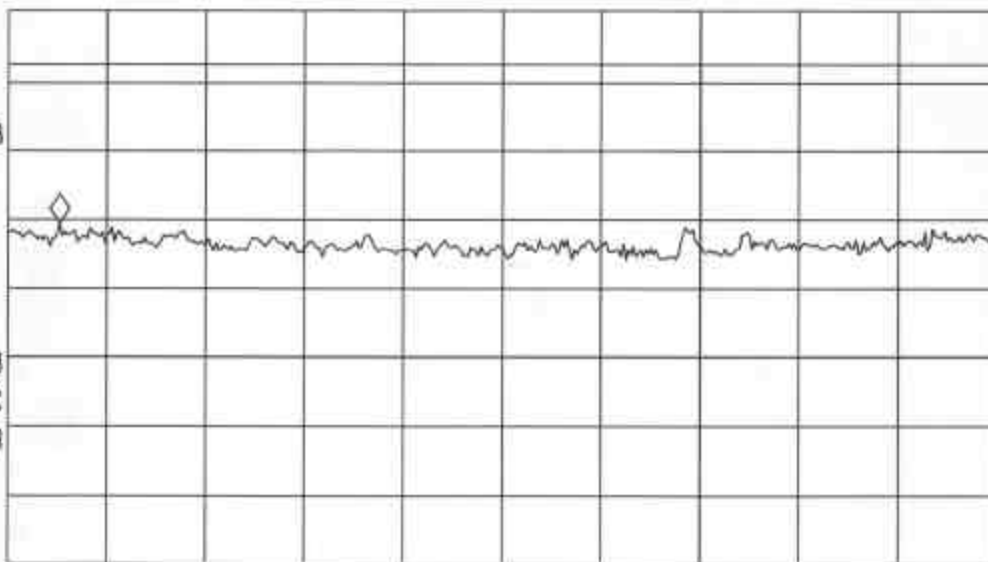
SWEPTIME
100 sec

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 5.7919908 GHz
-15.15 dBm

REF OFFST 21.8 dB
LOG REF 15.8 dBm

10
dB/
ATN
10 dB

DL
8.0
dBm
WA SB
SC FC
CORR



CENTER 5.7921250 GHz
#IF BW 3.0 kHz

#AVG BW 10 kHz

SPAN 300.0 kHz
#SWP 100 sec

9.4. MAXIMUM PERMISSIBLE EXPOSURE

CALCULATIONS

Given

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

and

$$S = E^2 / 3770$$

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:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = 100 * d \text{ (m)}$$

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 / cm²

Substituting the logarithmic form of power and gain using:

$$P \text{ (mW)} = 10^{(P \text{ (dBm)} / 10)} \text{ and}$$

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

yields

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S} \quad \text{Equation (1)}$$

where

d = MPE safe distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW / cm²

RESULTS

No non-compliance noted:

MAXIMUM PERMISSIBLE EXPOSURE (2.4 GHZ BAND)

EUT output power = 17.29 dBm

Antenna Gain = 4.5 dBi

S = 1.0 mW / cm² from 1.1310 Table 1

Substituting these parameters into Equation (1) above:

MPE Safe Distance = 03.47 cm

MAXIMUM PERMISSIBLE EXPOSURE (5.8 GHZ BAND)

EUT output power = 20.81 dBm

Antenna Gain = 5.2 dBi

S = 1.0 mW / cm² from 1.1310 Table 1

Substituting these parameters into Equation (1) above:

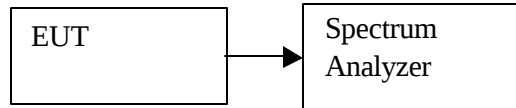
MPE Safe Distance = 5.63 cm

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.

9.5. 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.

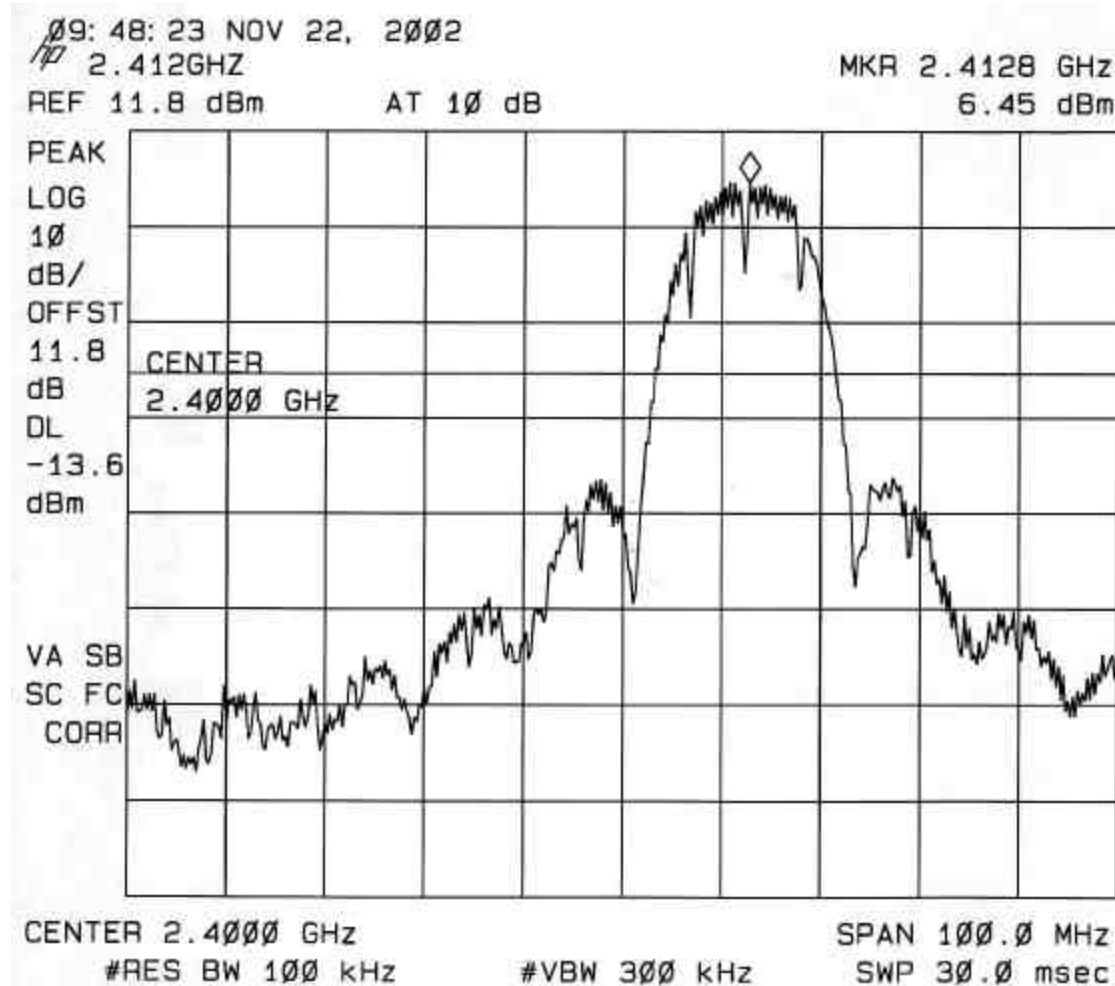
Measurements are made over the 30 MHz to 26.5 GHz range with the transmitter set to the lowest, middle, and highest channels within the 2.4 GHz band.

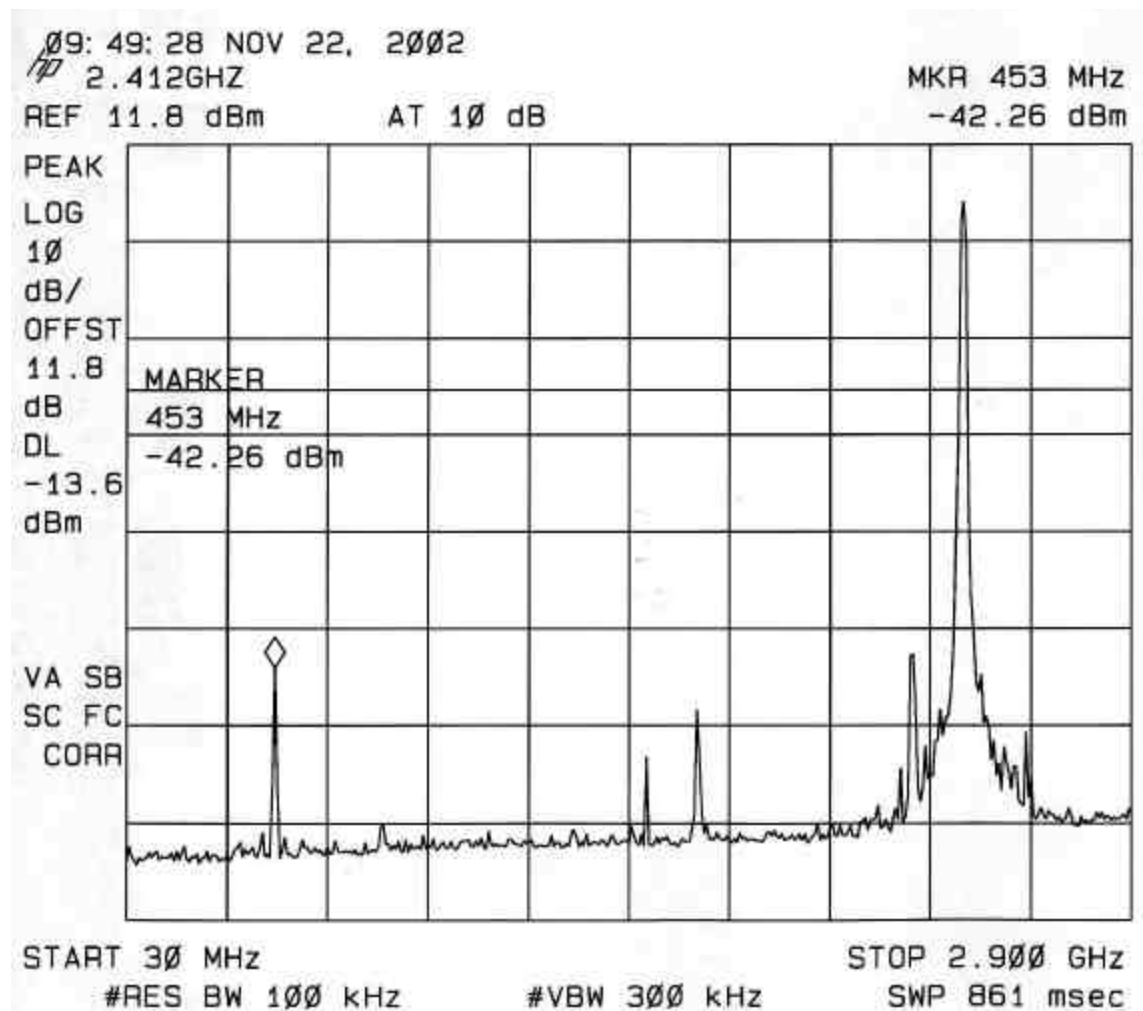
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels within the 5.8 GHz band.

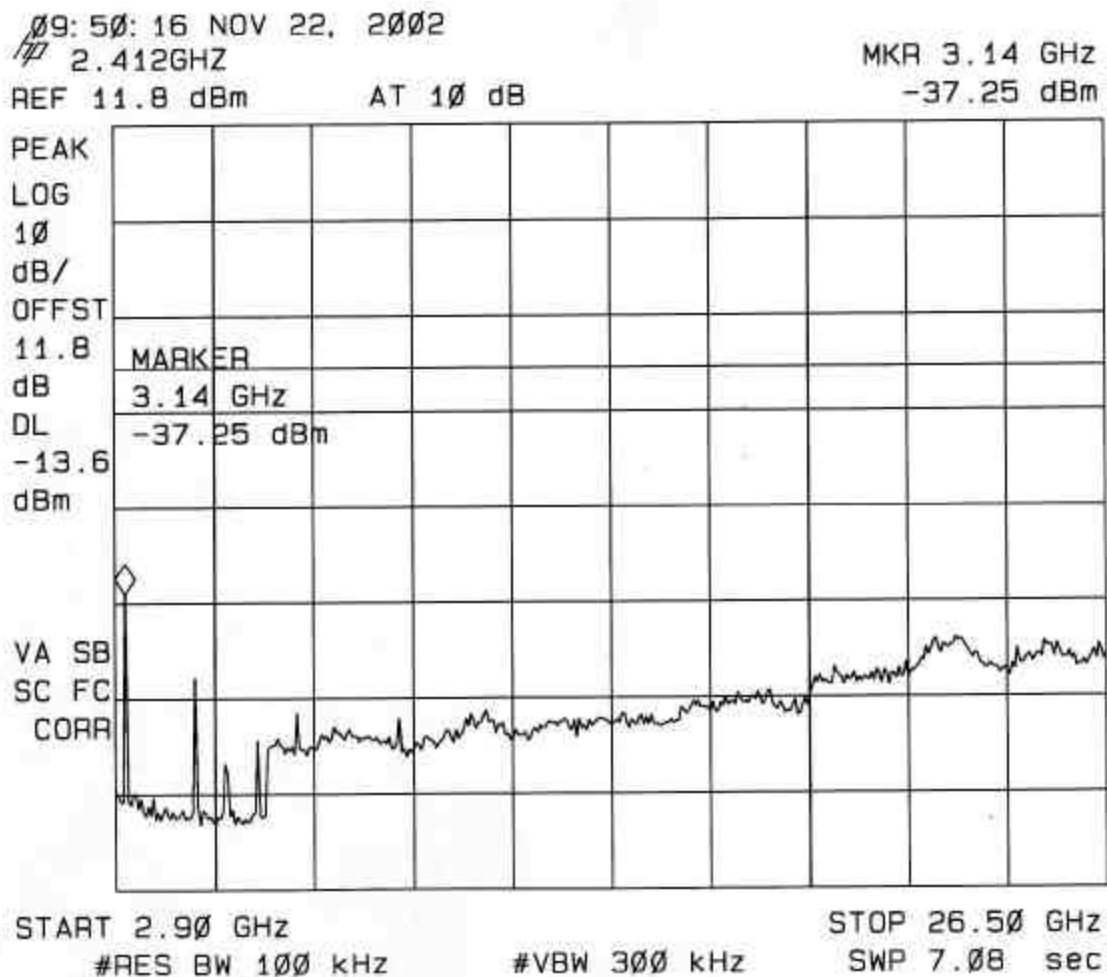
RESULTS

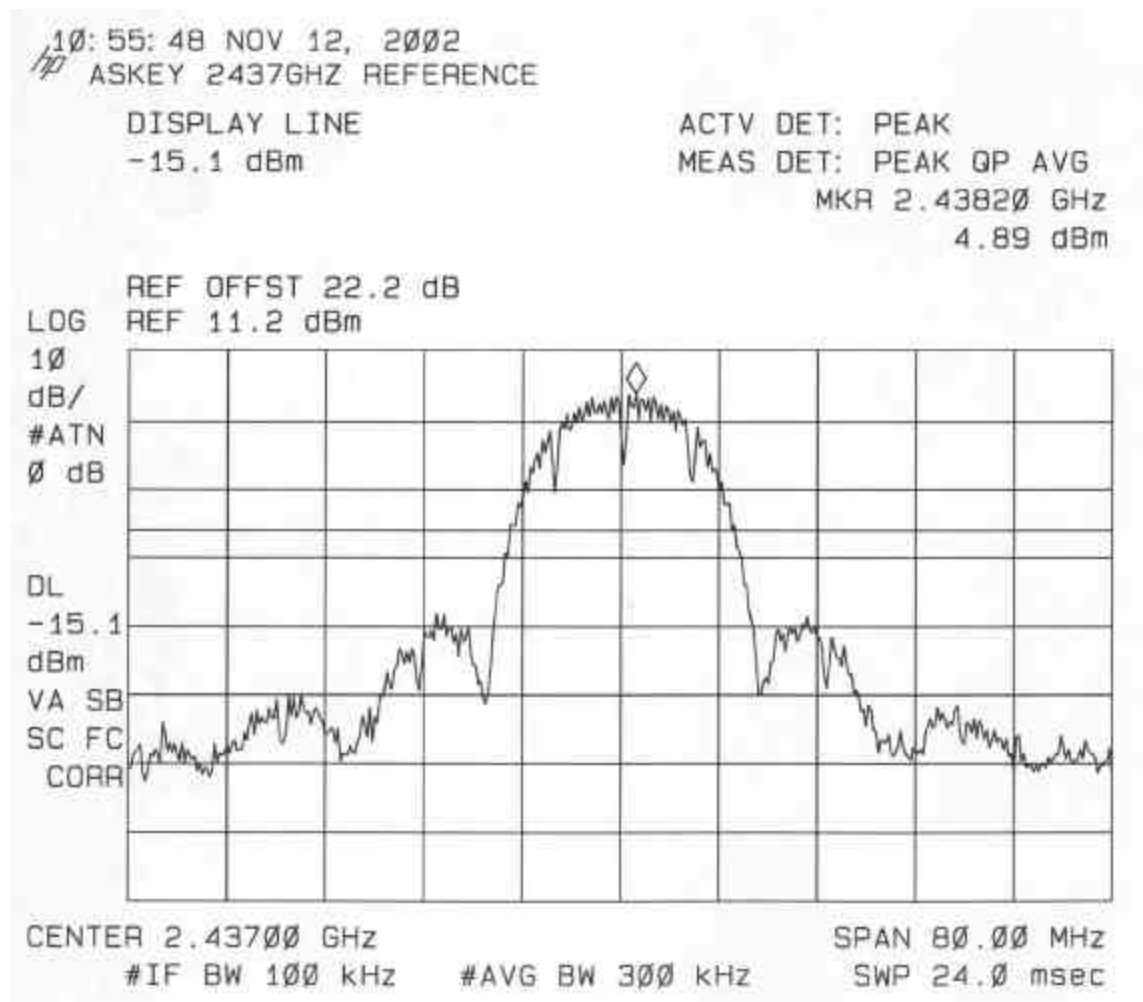
No non-compliance noted:

CONDUCTED SPURIOUS EMISSIONS (2.4 GHZ BAND)





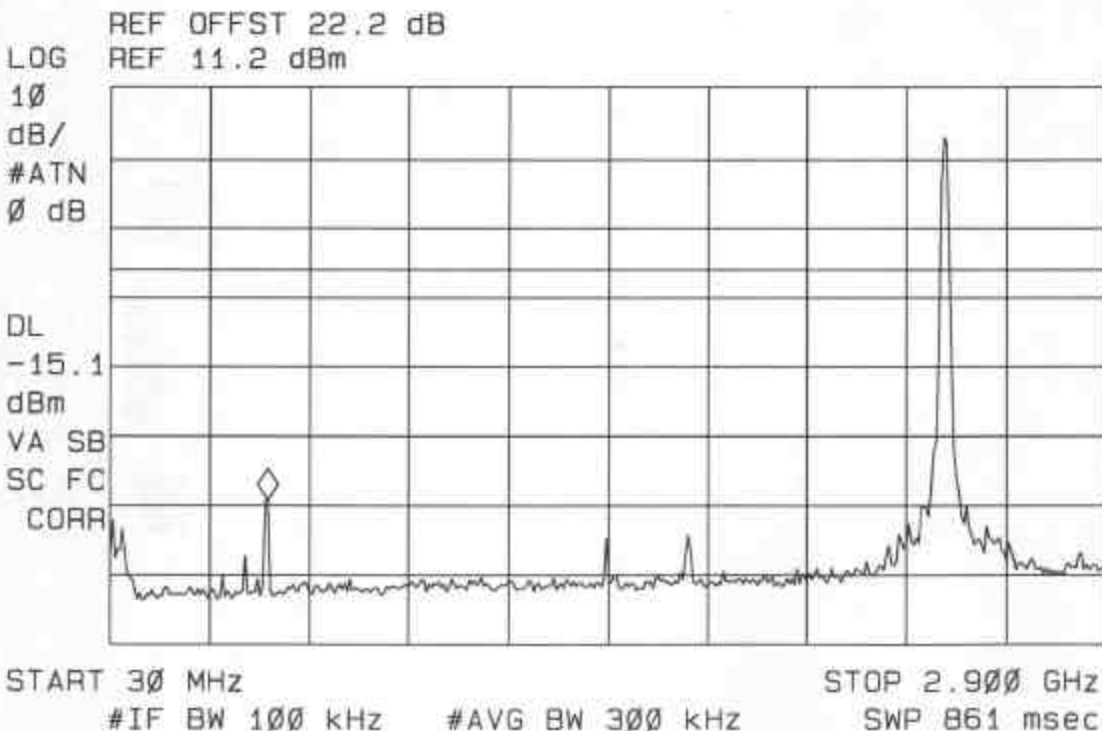




10:56:34 NOV 12, 2002
ASKEY 2437GHZ SPURIOUS

STOP
2.900 GHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 482 MHz
-48.13 dBm

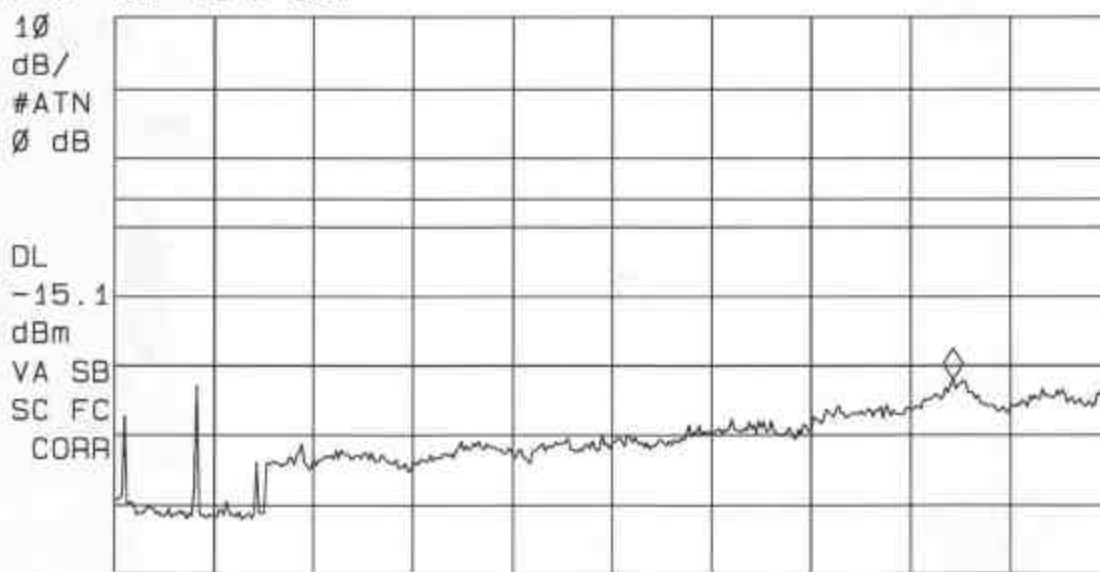


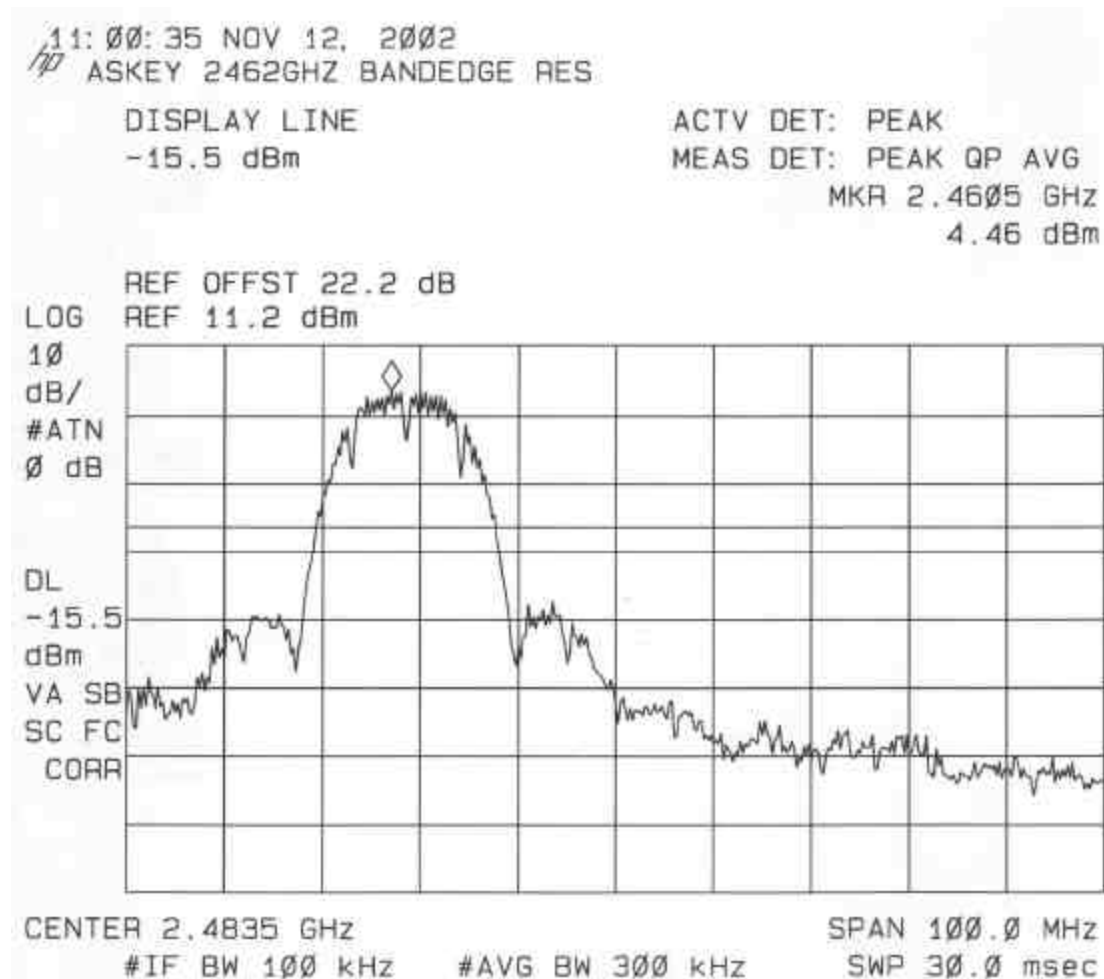
10: 57: 16 NOV 12, 2002
/P ASKEY 2437GHZ SPURIOUS

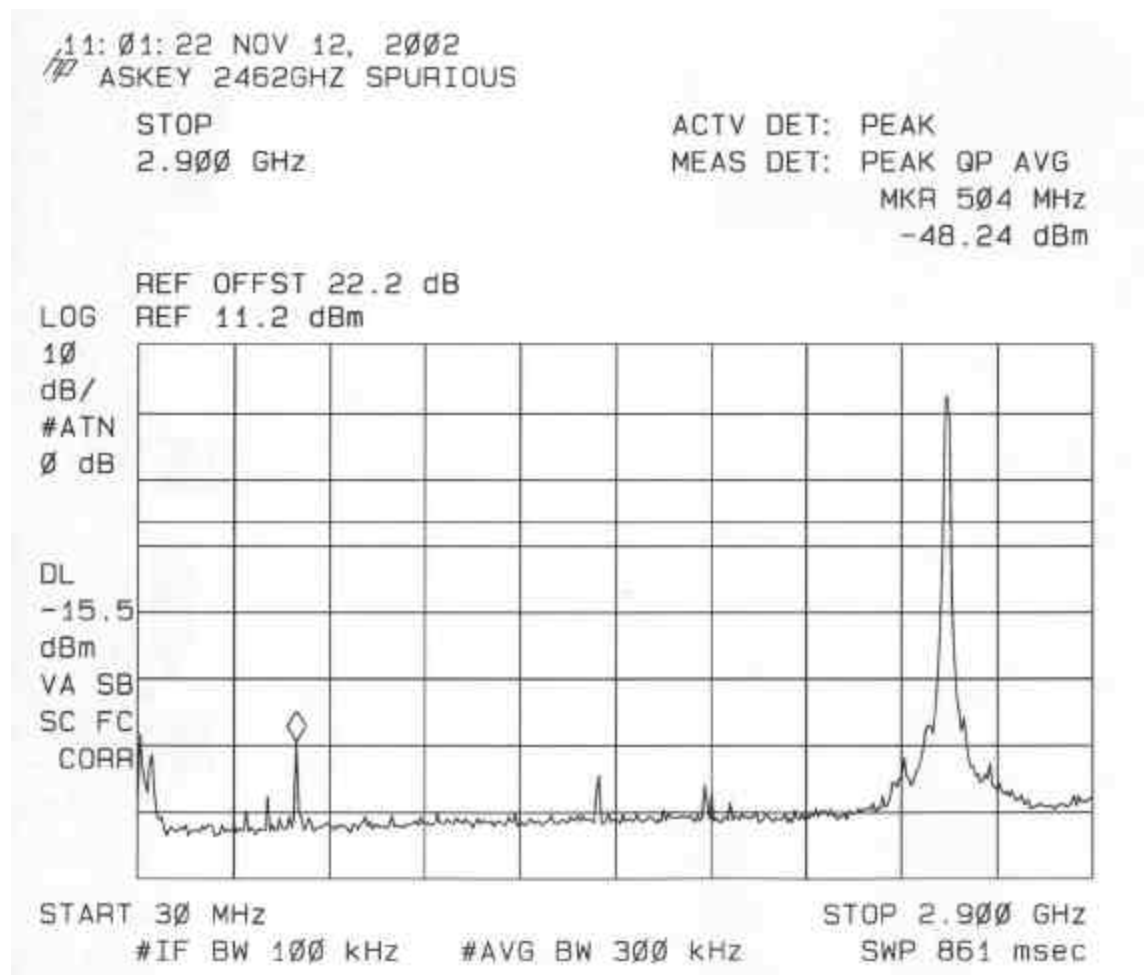
STOP
26.50 GHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 22.78 GHz
-40.98 dBm

REF OFFST 22.2 dB
LOG REF 11.2 dBm







11:03:18 NOV 12, 2002
ASKEY 2462GHZ SPURIOUS

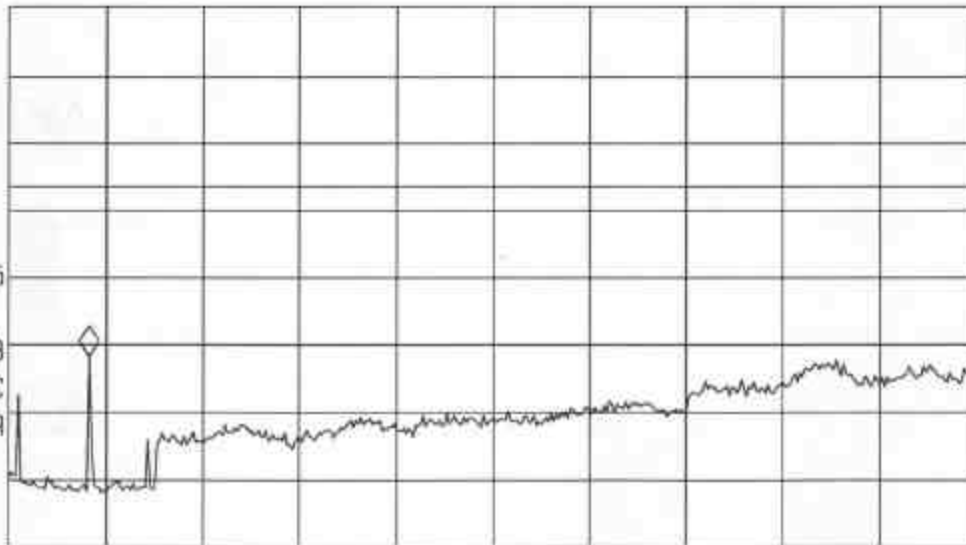
STOP
26.50 GHz

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 4.85 GHz
-40.68 dBm

REF OFFST 22.2 dB
LOG REF 11.2 dBm

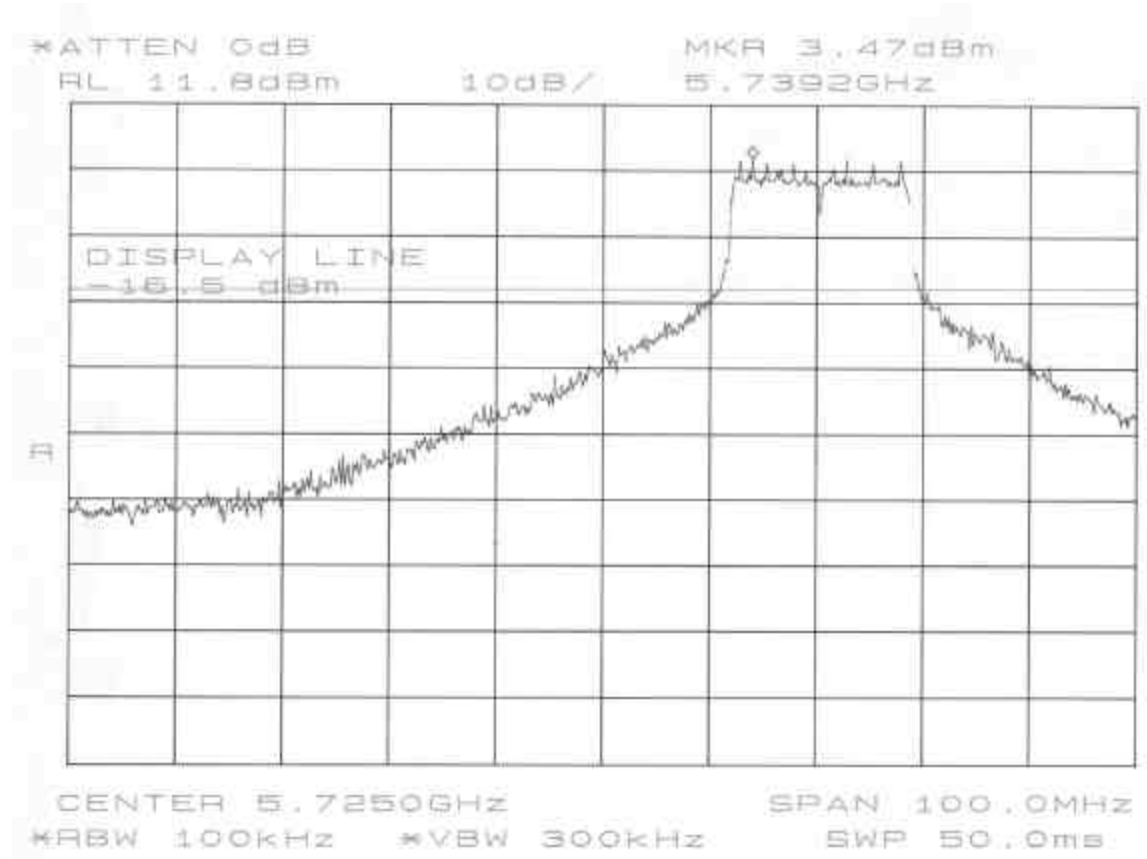
10
dB/
#ATN
0 dB

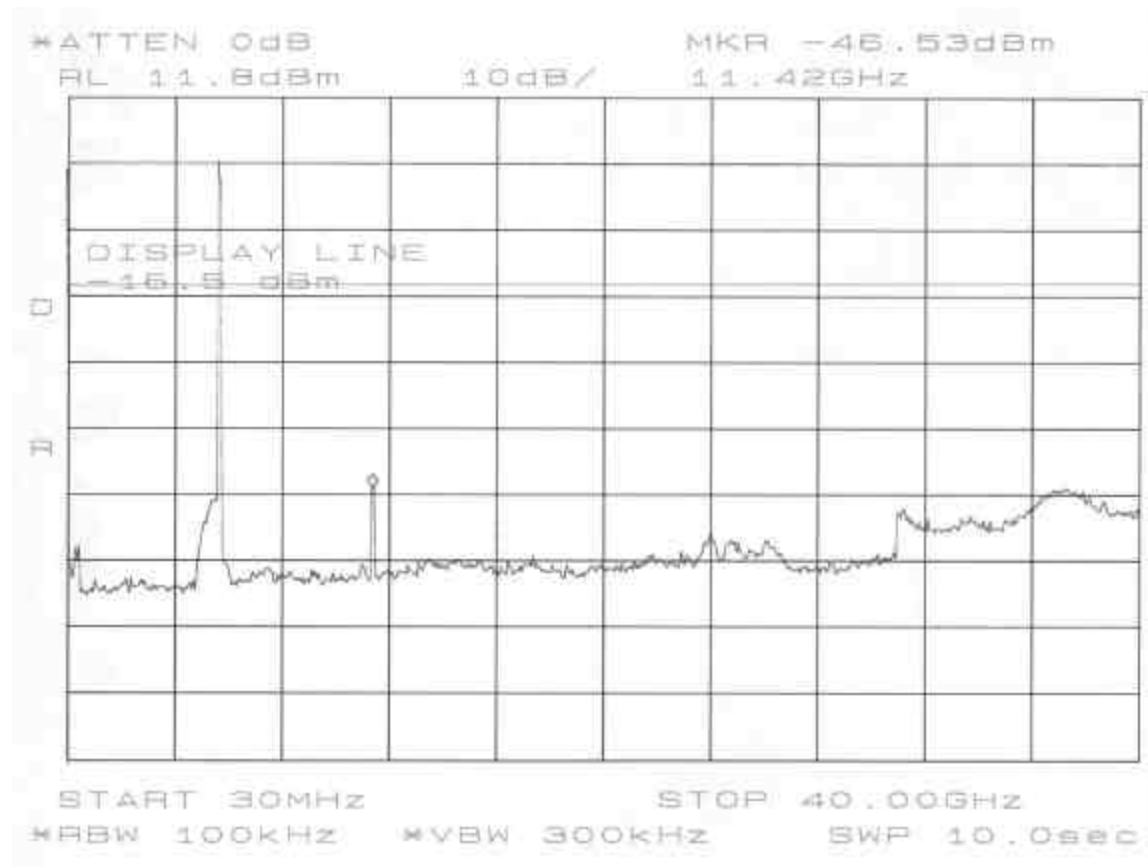
DL
-15.5
dBm
MA SB
SC FC
CORR

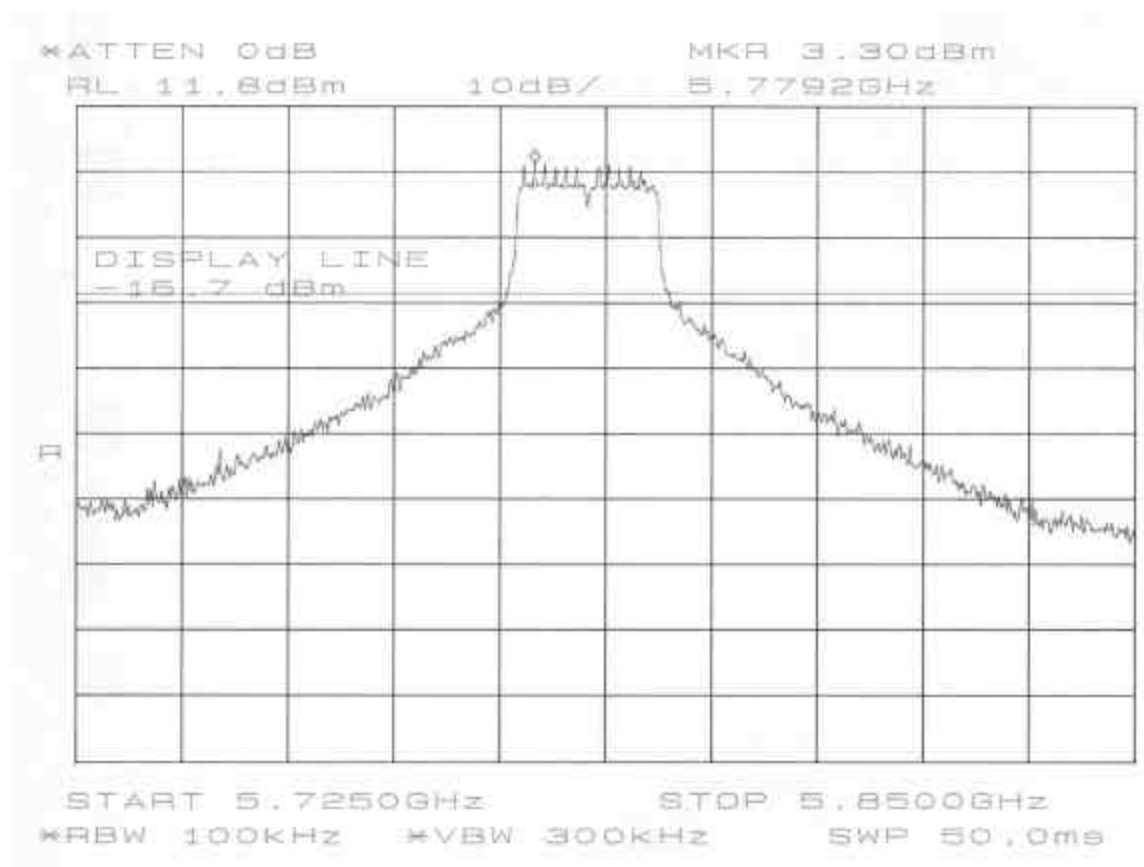


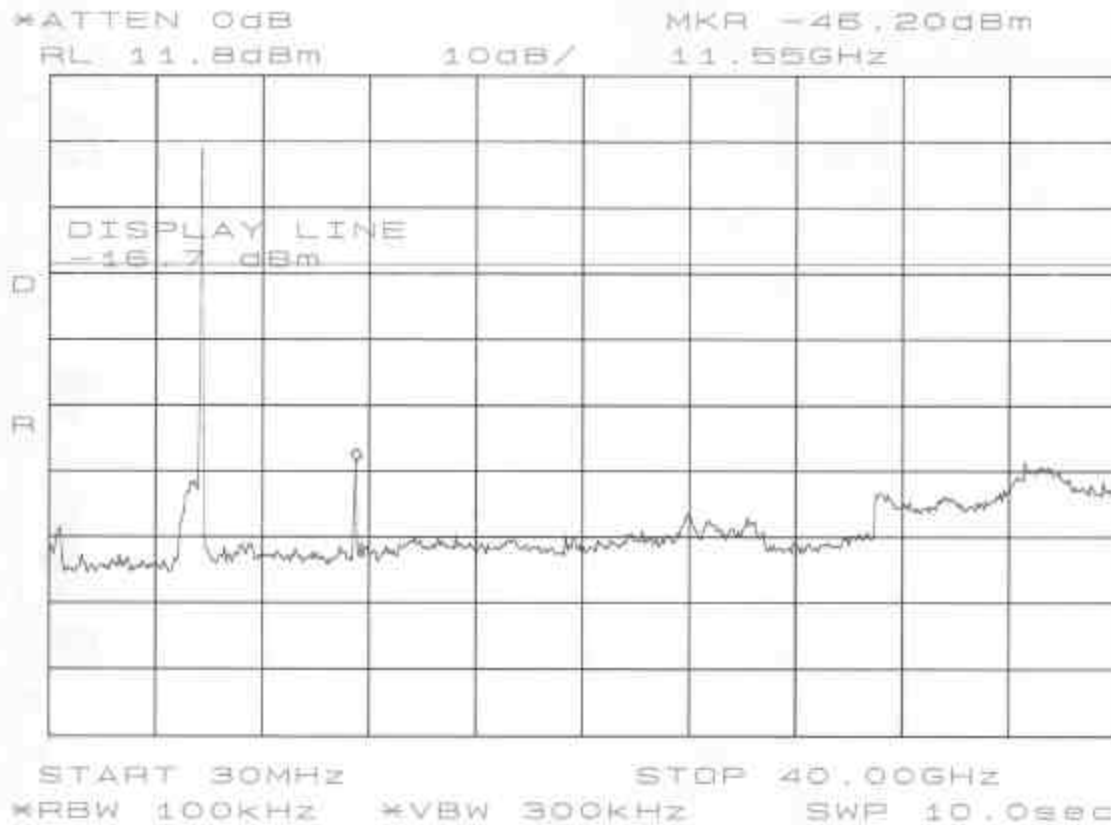
START 2.90 GHz
#IF BW 100 kHz #AVG BW 300 kHz STOP 26.50 GHz
SWP 7.08 sec

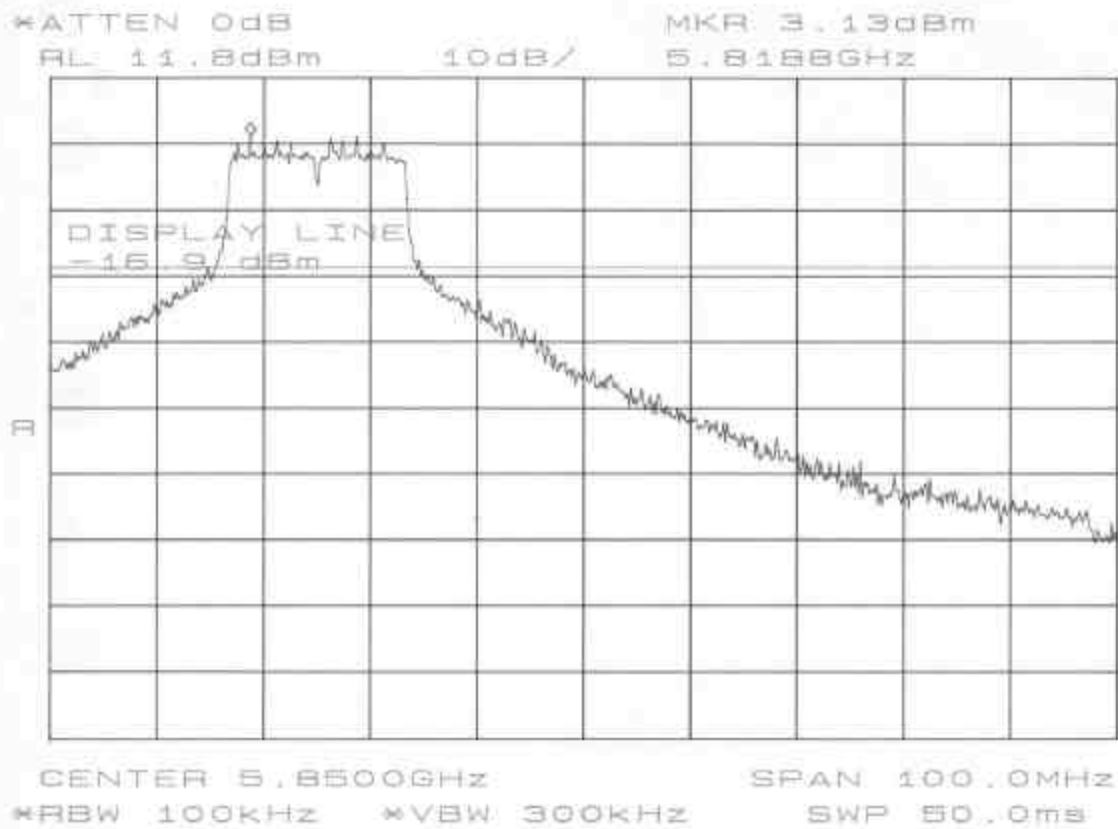
CONDUCTED SPURIOUS EMISSIONS (5.8 GHZ BAND, NORMAL MODE)

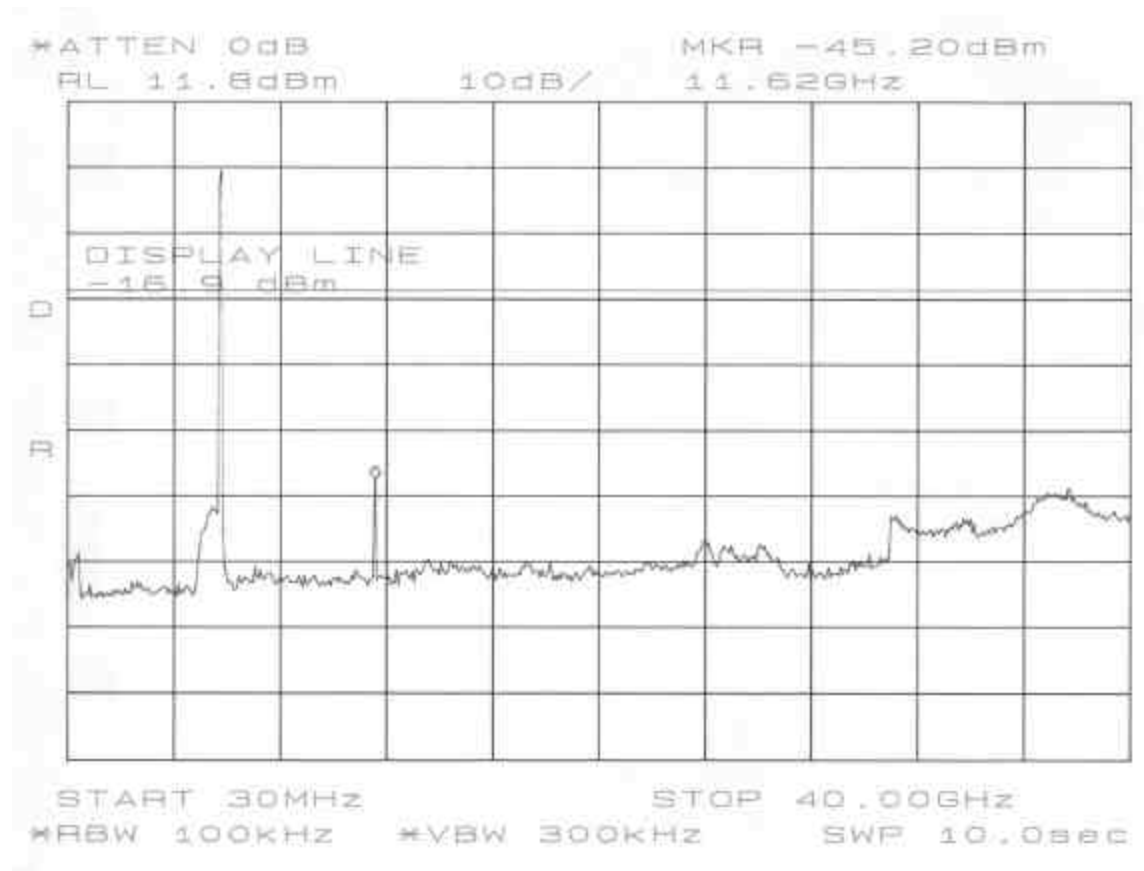




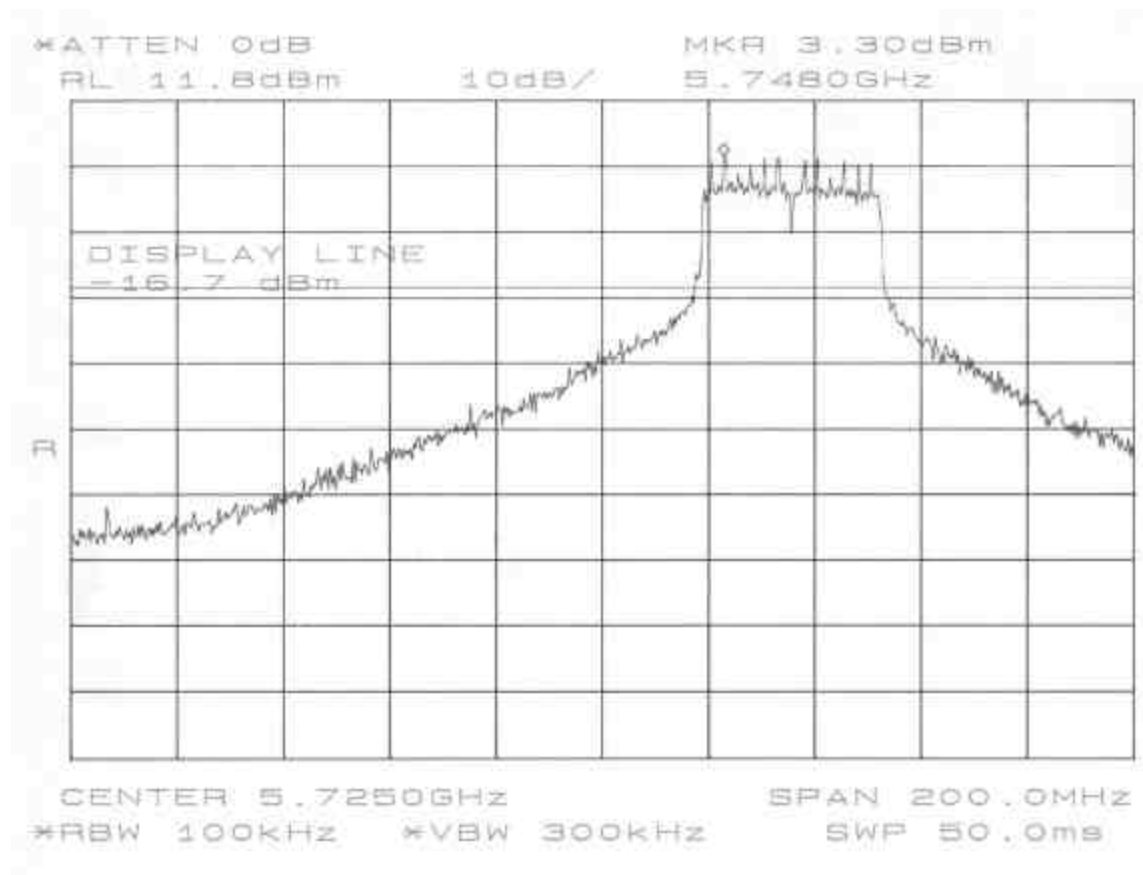


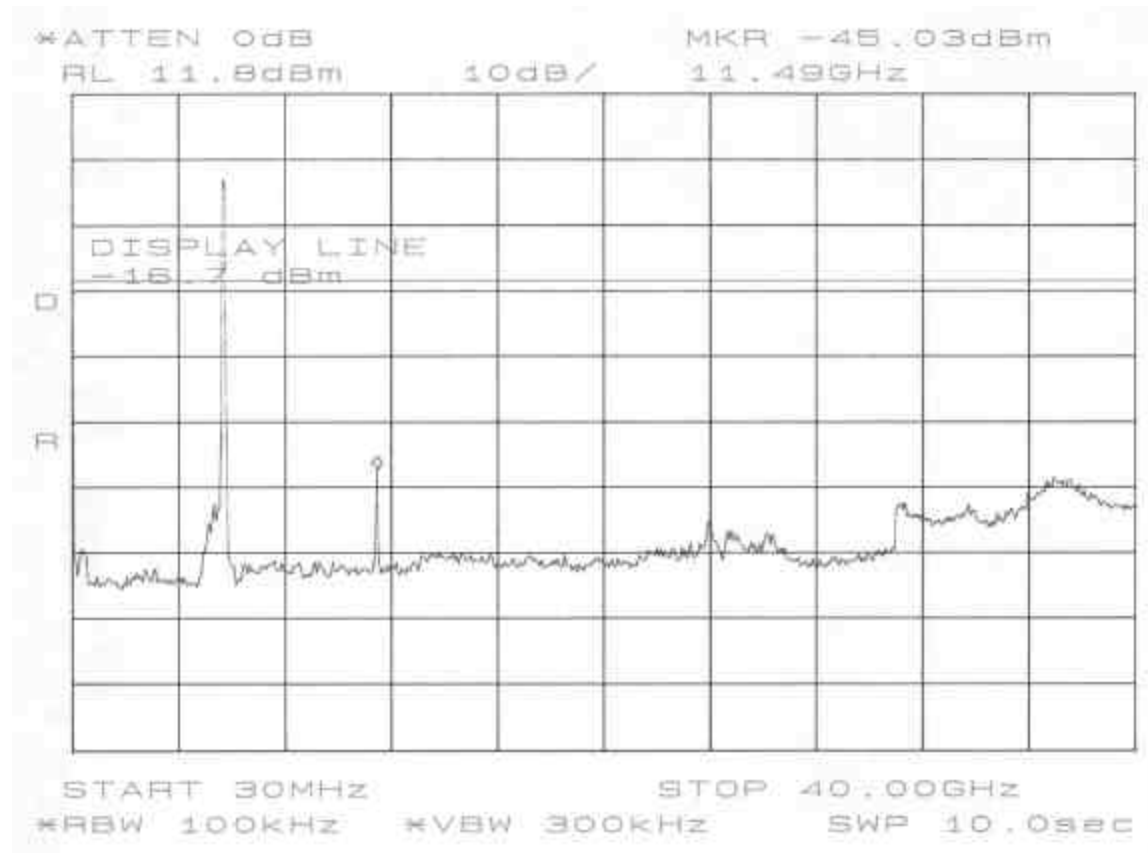


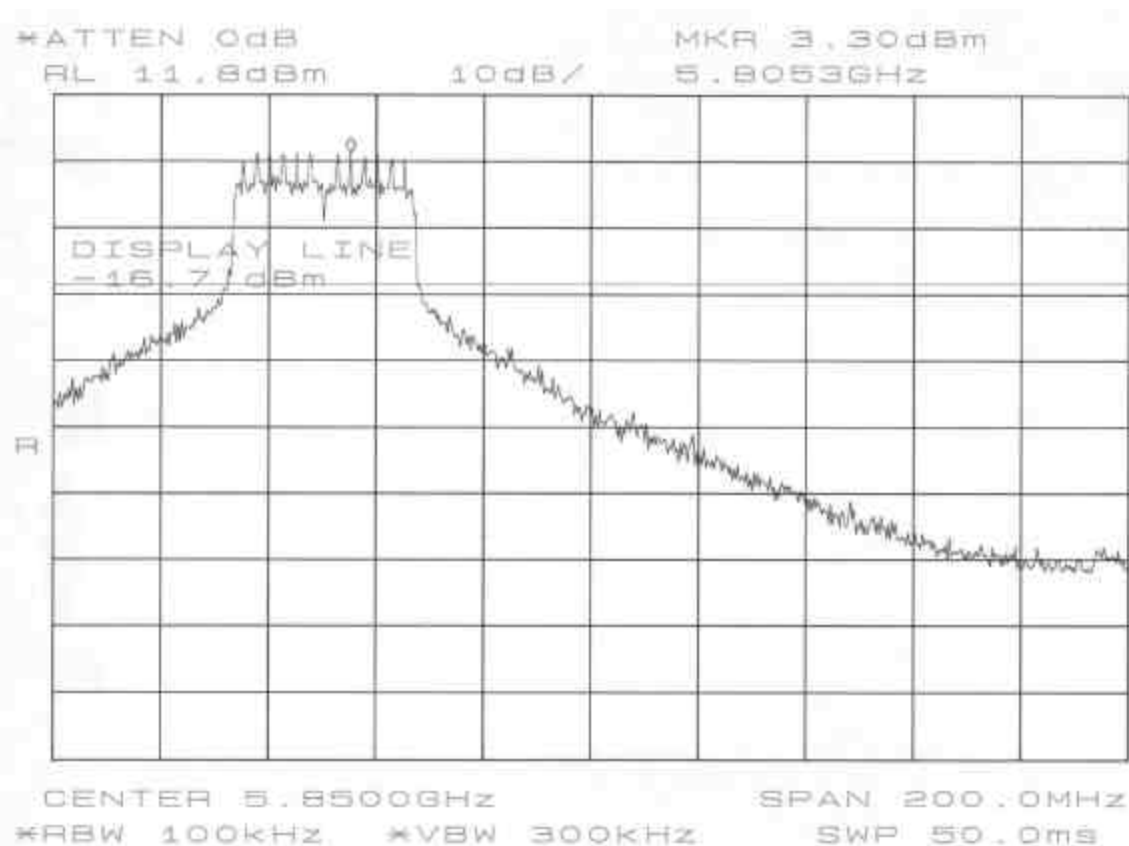


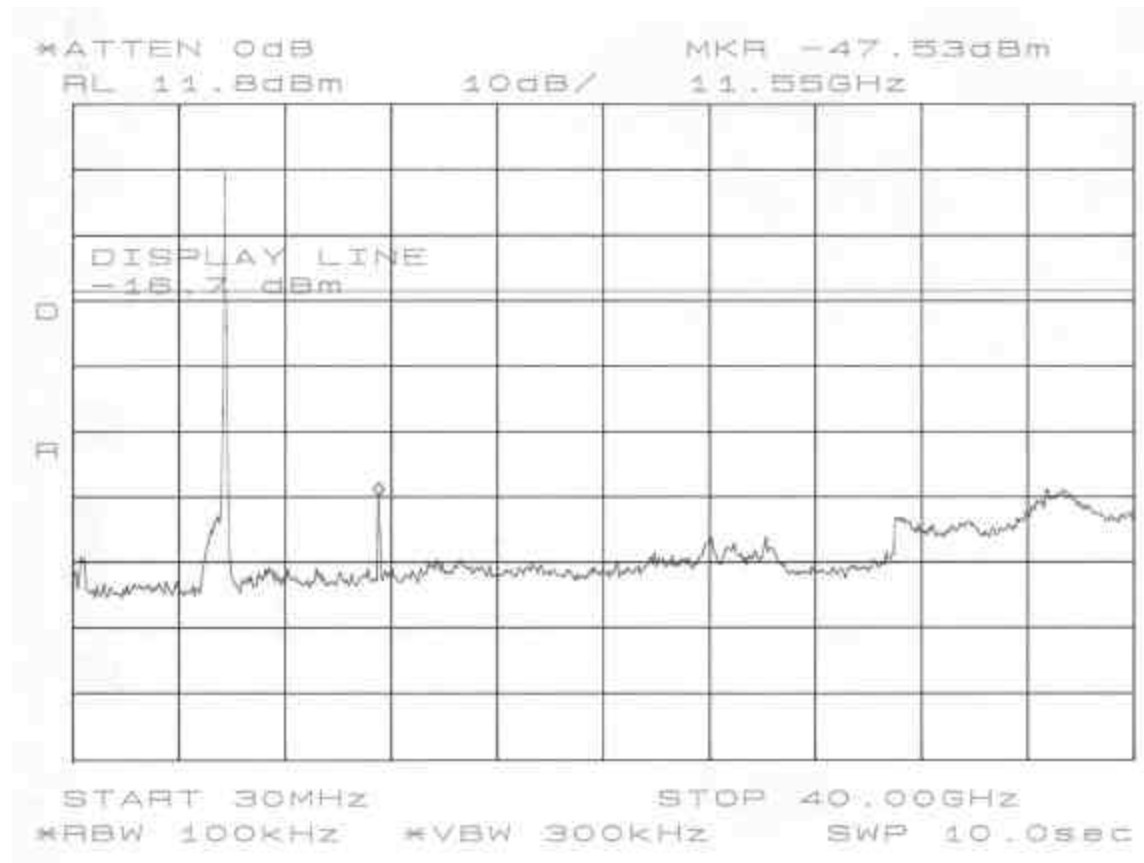


CONDUCTED SPURIOUS EMISSIONS (5.8 GHZ BAND, TURBO MODE)









9.6. 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, 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.

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

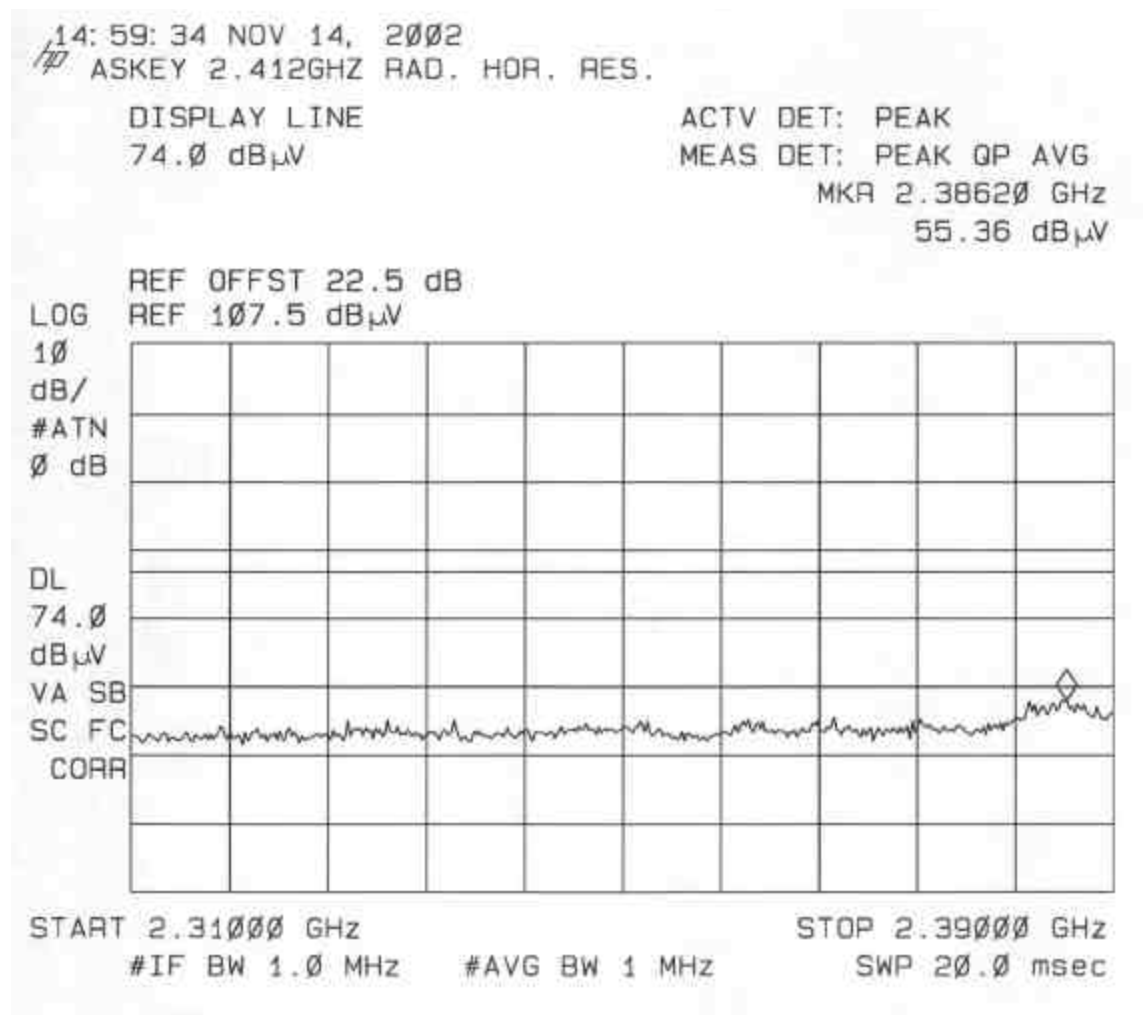
Specification Distance: 3 meters

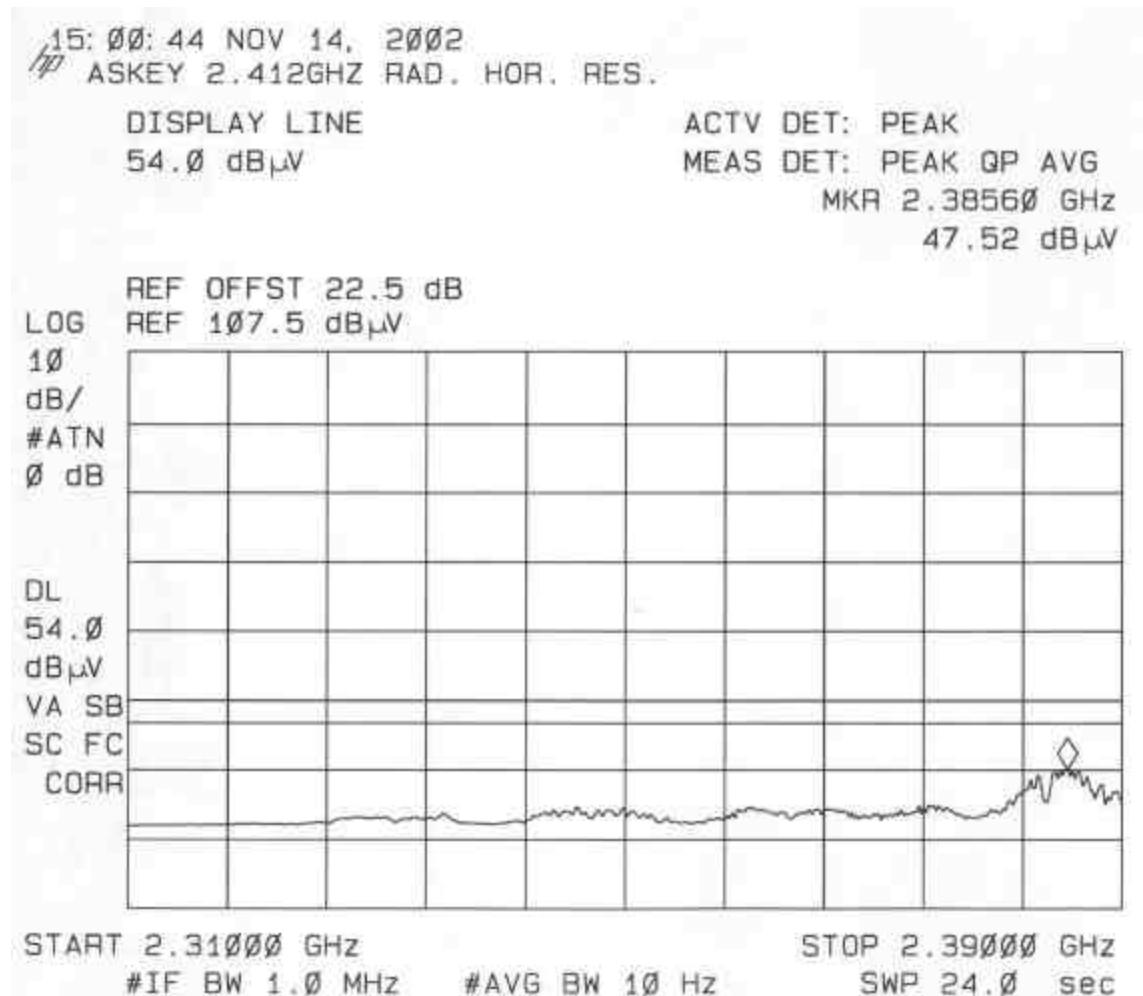
Freq GHz	SA dBuV	AF dB/m	Distance m	Distance dB	Preamp dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin dB
1 to 18 GHz band									
RBW = 1 MHz, peak detection									
18	41.9	47.8	1	-9.5	32.6	13.5	61.06	74	-12.94
RBW = 1 MHz, average detection									
18	28.7	47.8	1	-9.5	32.6	13.5	47.86	54	-6.14
18 to 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

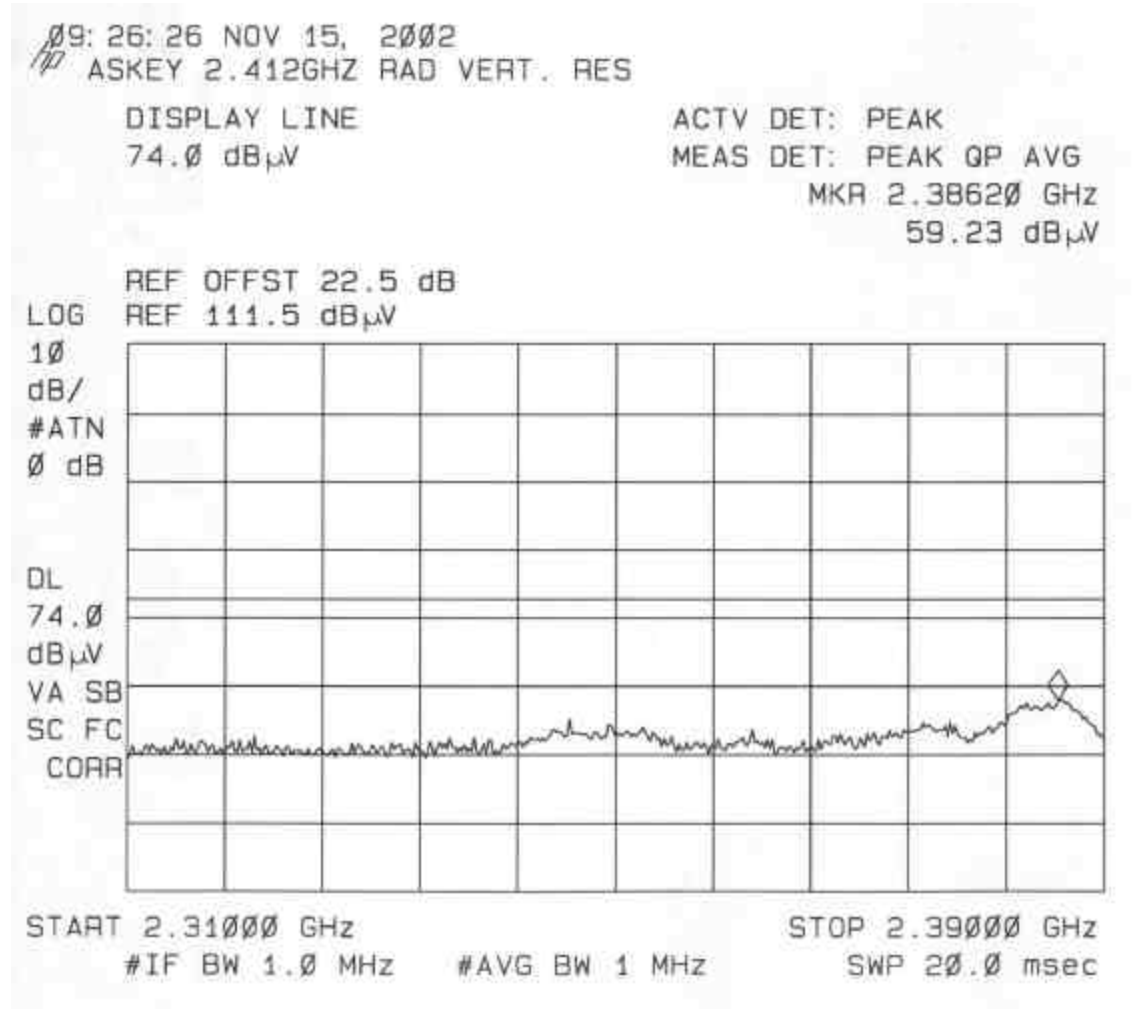
No non-compliance noted:

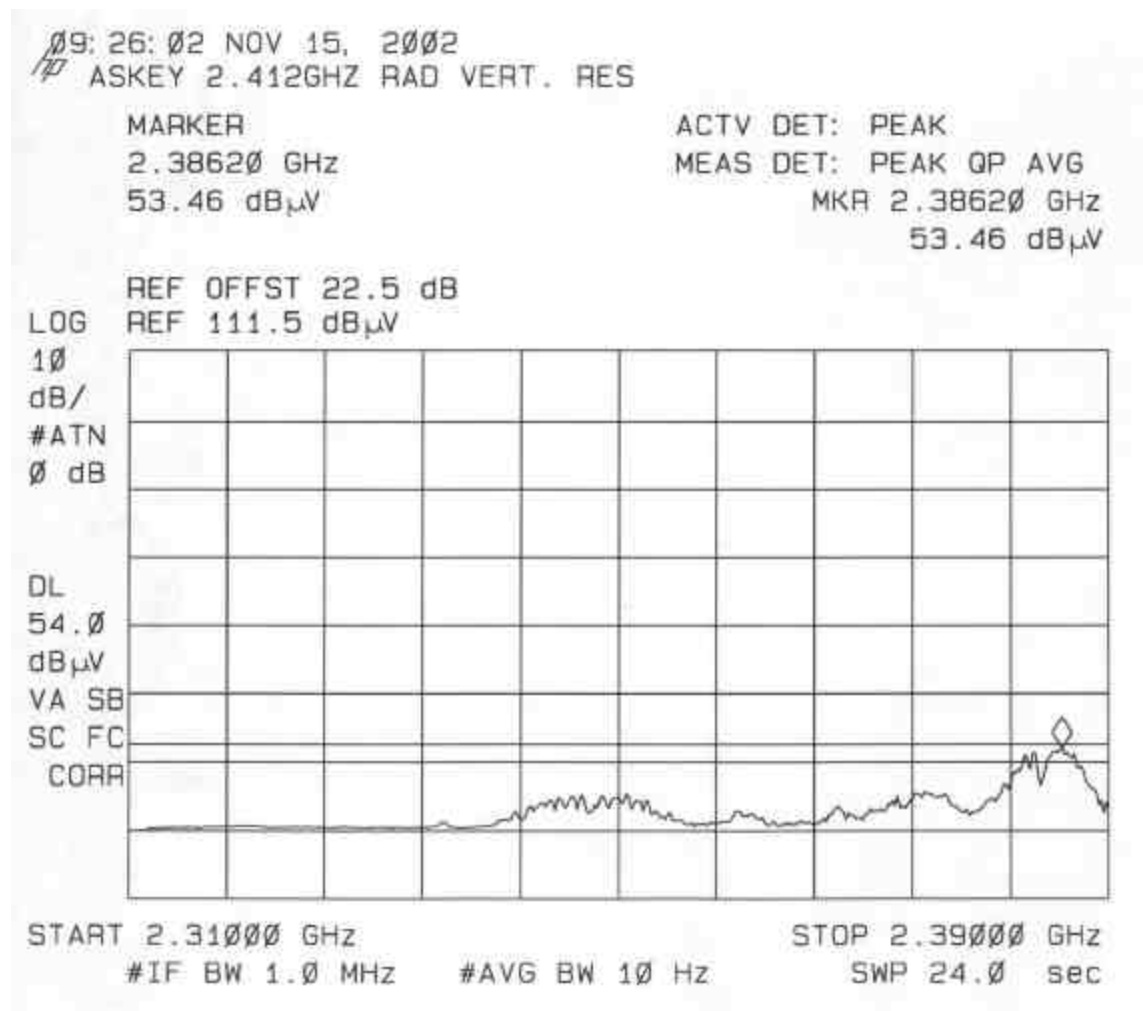
BAND EDGE RADIATED EMISSIONS (LOW CHANNEL, HORIZONTAL POLARIZATION)



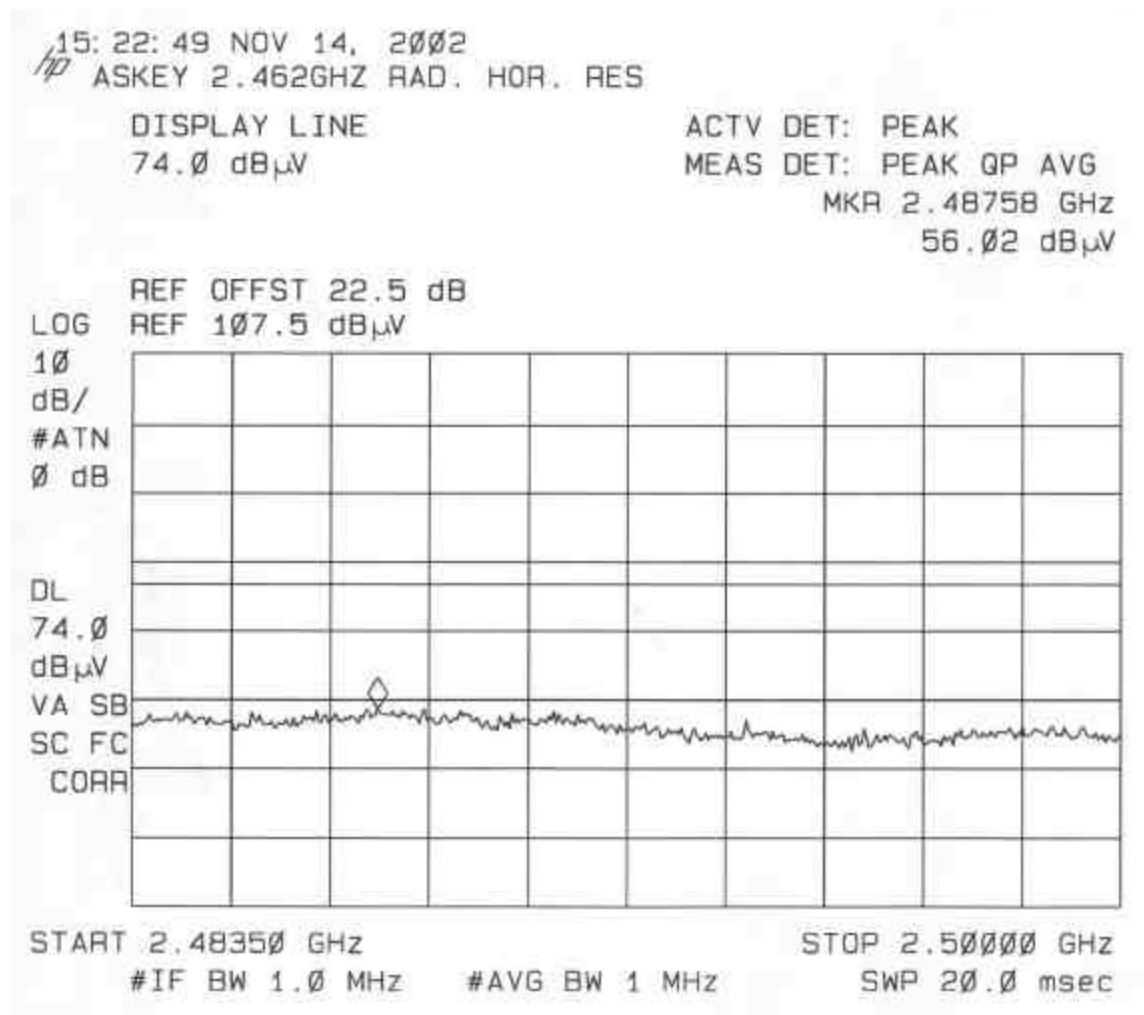


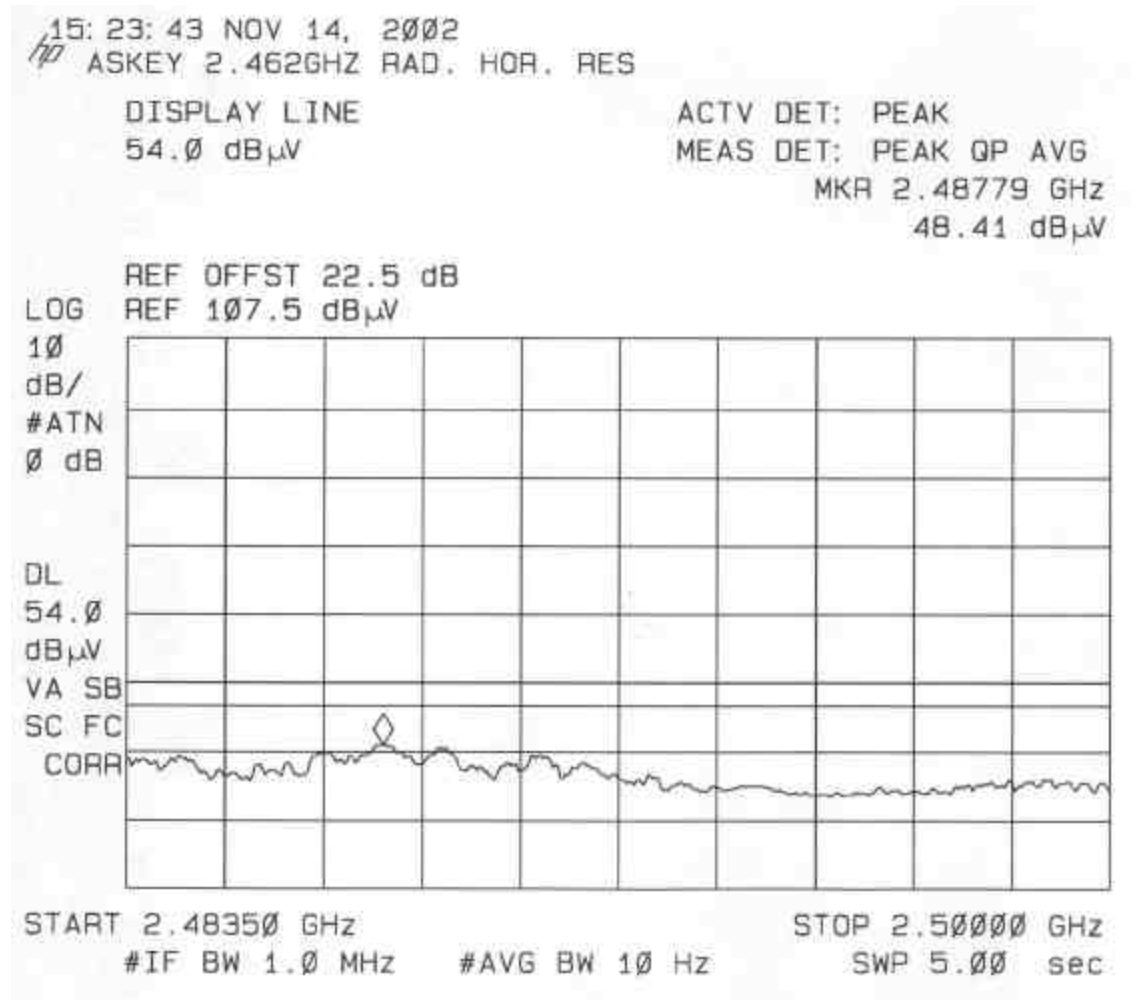
BAND EDGE RADIATED EMISSIONS (LOW CHANNEL, VERTICAL POLARIZATION)



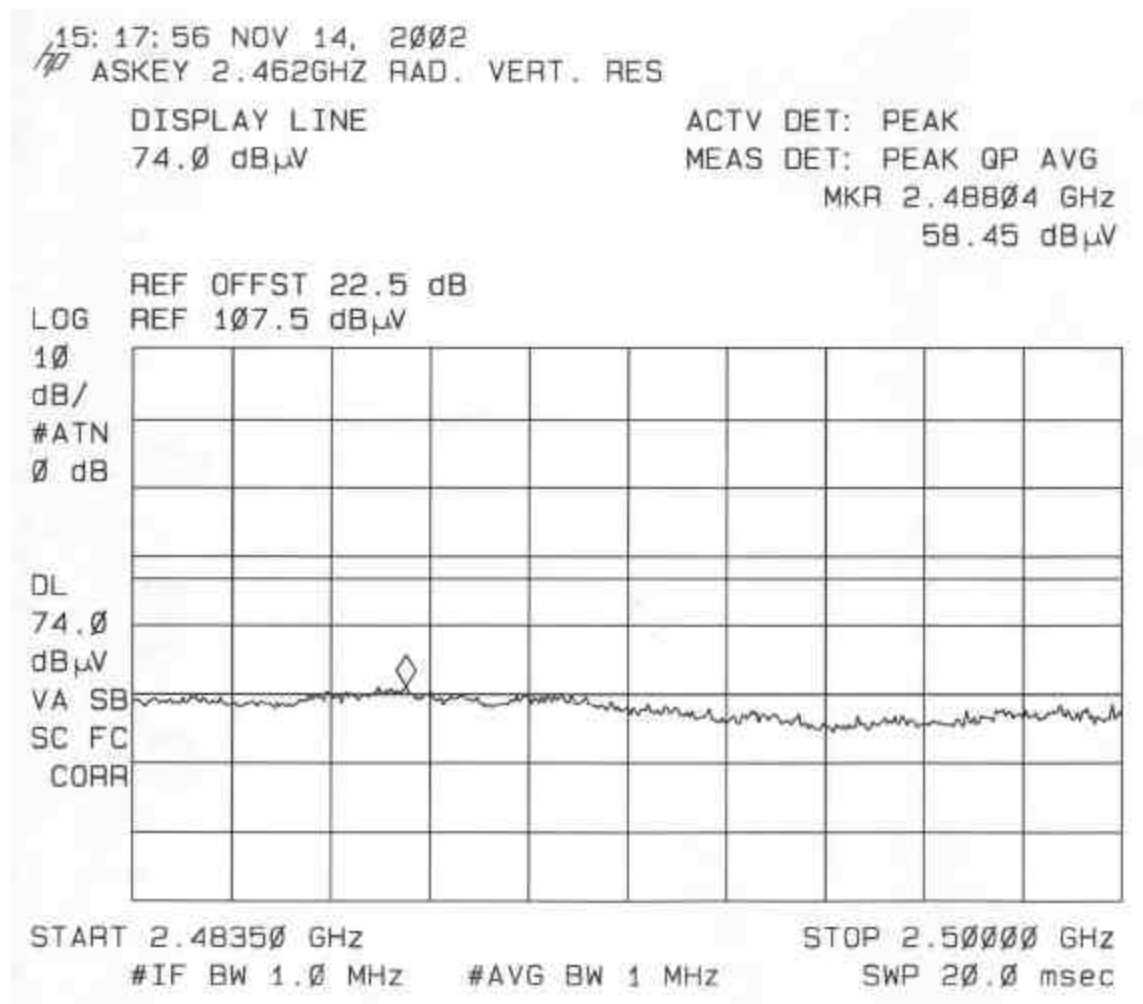


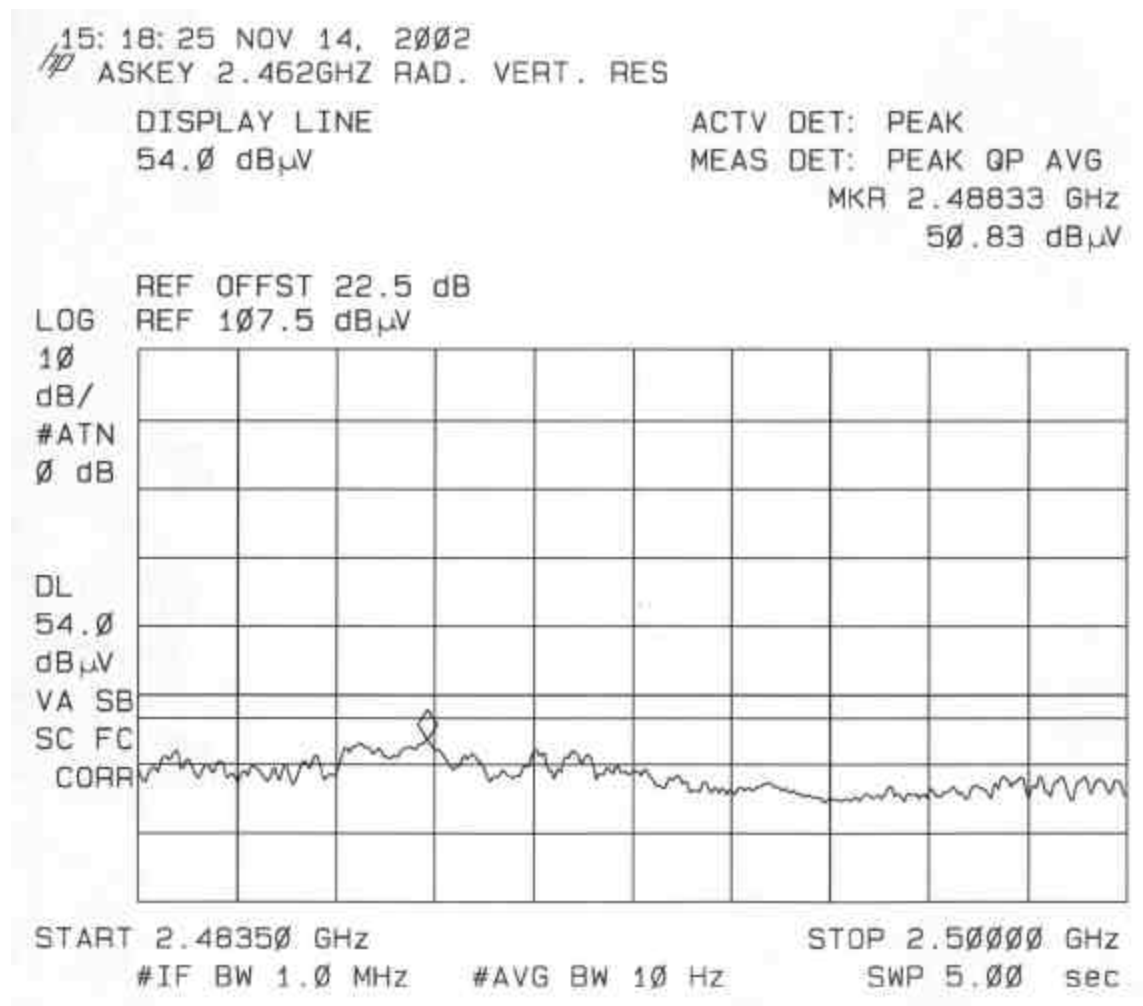
BAND EDGE RADIATED EMISSIONS (HIGH CHANNEL, HORIZONTAL POLARIZATION)





BAND EDGE RADIATED EMISSIONS (HIGH CHANNEL, VERTICAL POLARIZATION)





HARMONIC AND SPURIOUS RADIATED EMISSIONS (2.4 GHZ BAND)

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 2.412 GHz, ART setting = 15											
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
4.824	V	Peak	56.1	-9.5	33.9	34.5	1.0	5.7	52.7	74.0	-21.3
4.824	V	Avg	54.8	-9.5	33.9	34.5	1.0	5.7	51.4	54.0	-2.6
4.824	H	Peak	57.2	-9.5	33.9	34.5	1.0	5.7	53.8	74.0	-20.2
4.824	H	Avg	56.1	-9.5	33.9	34.5	1.0	5.7	52.7	54.0	-1.3
12.050	V	Peak	47.8	-9.5	39.3	33.8	1.0	9.5	54.2	74.0	-19.8
12.050	V	Avg	37.2	-9.5	39.3	33.8	1.0	9.5	43.6	54.0	-10.4
12.050	H	Peak	47.8	-9.5	39.3	33.8	1.0	9.5	54.2	74.0	-19.8
12.050	H	Avg	39.1	-9.5	39.3	33.8	1.0	9.5	45.5	54.0	-8.5

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 2.437 GHz, ART setting = 15											
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
4.873	V	Peak	55.7	-9.5	34.0	34.5	1.0	5.8	52.5	74.0	-21.5
4.873	V	Avg	54.4	-9.5	34.0	34.5	1.0	5.8	51.2	54.0	-2.8
4.873	H	Peak	55.0	-9.5	34.0	34.5	1.0	5.8	51.8	74.0	-22.2
4.873	H	Avg	53.6	-9.5	34.0	34.5	1.0	5.8	50.4	54.0	-3.6
7.311	V	Peak	57.1	-9.5	37.1	34.6	1.0	7.3	58.4	74.0	-15.6
7.311	V	Avg	52.2	-9.5	37.1	34.6	1.0	7.3	53.5	54.0	-0.5
7.311	H	Peak	55.7	-9.5	37.1	34.6	1.0	7.3	57.0	74.0	-17.0
7.311	H	Avg	50.5	-9.5	37.1	34.6	1.0	7.3	51.8	54.0	-2.2
12.185	V	Peak	46.8	-9.5	39.2	33.7	1.0	9.5	53.3	74.0	-20.7
12.185	V	Avg	36.7	-9.5	39.2	33.7	1.0	9.5	43.2	54.0	-10.8
12.185	H	Peak	47.1	-9.5	39.2	33.7	1.0	9.5	53.6	74.0	-20.4
12.185	H	Avg	36.9	-9.5	39.2	33.7	1.0	9.5	43.4	54.0	-10.6

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 2.462 GHz, ART setting = 15											
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
4.923	V	Peak	57.4	-9.5	34.2	34.5	1.0	5.8	54.4	74.0	-19.6
4.923	V	Avg	55.7	-9.5	34.2	34.5	1.0	5.8	52.7	54.0	-1.3
4.923	H	Peak	53.8	-9.5	34.2	34.5	1.0	5.8	50.8	74.0	-23.2
4.923	H	Avg	51.8	-9.5	34.2	34.5	1.0	5.8	48.8	54.0	-5.2
7.380	V	Peak	57.1	-9.5	37.3	34.6	1.0	7.3	58.6	74.0	-15.4
7.380	V	Avg	52.1	-9.5	37.3	34.6	1.0	7.3	53.6	54.0	-0.4
7.380	H	Peak	52.9	-9.5	37.3	34.6	1.0	7.3	54.4	74.0	-19.6
7.380	H	Avg	50.1	-9.5	37.3	34.6	1.0	7.3	51.6	54.0	-2.4
12.300	V	Peak	49.2	-9.5	39.2	33.6	1.0	9.6	55.9	74.0	-18.1
12.300	V	Avg	36.9	-9.5	39.2	33.6	1.0	9.6	43.6	54.0	-10.4
12.300	H	Peak	48.0	-9.5	39.2	33.6	1.0	9.6	54.7	74.0	-19.3
12.300	H	Avg	36.9	-9.5	39.2	33.6	1.0	9.6	43.6	54.0	-10.4

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

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 5.745 GHz, Normal Mode, ART setting = 15											
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
11.490	V	Peak	56.7	-9.5	39.5	34.0	1.0	9.3	62.9	74.0	-11.1
11.490	V	Avg	43.0	-9.5	39.5	34.0	1.0	9.3	49.2	54.0	-4.8
11.490	H	Peak	60.1	-9.5	39.5	34.0	1.0	9.3	66.3	74.0	-7.7
11.490	H	Avg	45.9	-9.5	39.5	34.0	1.0	9.3	52.1	54.0	-1.9

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 5.785 GHz, Normal Mode, ART setting = 15											
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
11.570	V	Peak	56.8	-9.5	39.5	34.0	1.0	9.3	63.0	74.0	-11.0
11.570	V	Avg	44.1	-9.5	39.5	34.0	1.0	9.3	50.4	54.0	-3.6
11.570	H	Peak	61.5	-9.5	39.5	34.0	1.0	9.3	67.8	74.0	-6.2
11.570	H	Avg	46.8	-9.5	39.5	34.0	1.0	9.3	53.0	54.0	-1.0

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 5.825 GHz, Normal Mode, ART setting = 15											
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
11.650	V	Peak	56.7	-9.5	39.4	34.0	1.0	9.3	62.9	74.0	-11.1
11.650	V	Avg	42.5	-9.5	39.4	34.0	1.0	9.3	48.7	54.0	-5.3
11.650	H	Peak	58.5	-9.5	39.4	34.0	1.0	9.3	64.7	74.0	-9.3
11.650	H	Avg	45.3	-9.5	39.4	34.0	1.0	9.3	51.6	54.0	-2.4

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

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 5.76 GHz, Turbo Mode, ART setting = 15											
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
11.520	V	Peak	53.6	-9.5	39.5	34.0	1.0	9.3	59.9	74.0	-14.1
11.520	V	Avg	41.1	-9.5	39.5	34.0	1.0	9.3	47.4	54.0	-6.6
11.520	H	Peak	58.7	-9.5	39.5	34.0	1.0	9.3	64.9	74.0	-9.1
11.520	H	Avg	45.9	-9.5	39.5	34.0	1.0	9.3	52.1	54.0	-1.9

Description of Test: Radiated Emissions - Restricted Bands Project Number: 02T1639-1 Date: 11/15/02 Test Engineer: NEELESH RAJ Company: Askey Computer Corp EUT Description: 802.11 a/b WLAN Card, Model: WLC221-D4, BCP3483U Test Configuration: EUT, Laptop, Mode of Operation: TX ON , Freq = 5.80 GHz, Turbo Mode, ART setting = 15											
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
11.600	V	Peak	53.0	-9.5	39.5	34.0	1.0	9.3	59.3	74.0	-14.7
11.600	V	Avg	41.5	-9.5	39.5	34.0	1.0	9.3	47.7	54.0	-6.3
11.600	H	Peak	57.7	-9.5	39.5	34.0	1.0	9.3	63.9	74.0	-10.1
11.600	H	Avg	44.6	-9.5	39.5	34.0	1.0	9.3	50.8	54.0	-3.2

DIGITAL DEVICE RADIATED EMISSIONS

						Project #: 02T1639-2 Report #: 021114C01 Date& Time: 11/14/02 9:36 AM Test Engr: Frank Ibrahim					
FCC, VCCI, CISPR, CE, AUSTEL, NZ UL, CSA, TUV, BSMI, DHHS, NVLAP 561F MONTEREY ROAD, SAN JOSE, CA 95037-9001 PHONE: (408) 463-0885 FAX: (408) 463-0888											
Company: Askey Computer Corporation EUT Description: 802.11 a/b Dual Band Card Bus, Model: WL C221-D4, BCP3483U Test Configuration : EUT, Laptop, Mouse, Printer, Modem, DC Power Supply Type of Test: FCC 15.407 Mode of Operation: TX ON, Freq = 5.26 MHz, ART setting = 15						<< Main Sheet					

Freq.	Reading	AF	Closs	Pre-amp	Level	Limit	Margin	Pol	Az	Height	Mark
(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	FCC_B	(dB)	(H/V)	(Deg)	(Meter)	(P/Q/A)
480.00	50.90	17.53	3.94	27.47	44.90	46.00	-1.10	3mH	0.00	1.00	QP
416.00	50.70	15.89	3.64	27.19	43.04	46.00	-2.96	3mH	0.00	1.00	QP
533.00	47.50	18.29	4.21	27.64	42.37	46.00	-3.63	3mH	0.00	1.00	P
633.00	45.60	19.69	4.69	27.84	42.14	46.00	-3.86	3mH	0.00	1.00	P
133.00	49.90	13.28	1.93	26.95	38.17	43.50	-5.33	3mV	0.00	1.00	P
544.00	45.10	18.38	4.27	27.66	40.09	46.00	-5.91	3mV	0.00	1.00	P
6 Worst Data											

9.7. POWERLINE CONDUCTED EMISSIONS

TEST SETUP

The EUT is placed on a wooden table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane on the floor.

The EUT is set to transmit in a continuous mode.

TEST PROCEDURE

The resolution bandwidth is set to 10 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

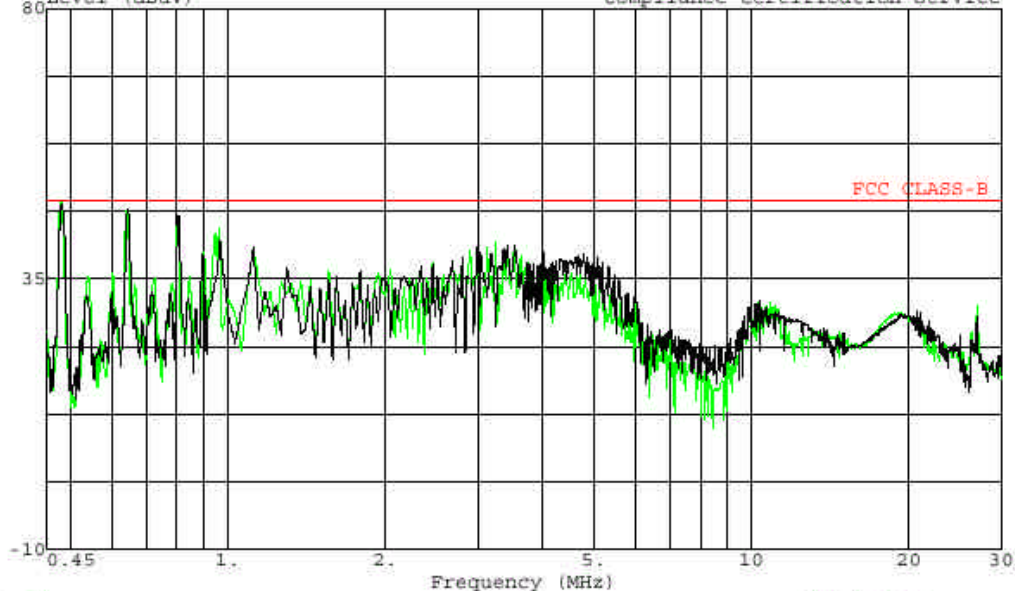
No non-compliance noted:

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	ECC. B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.48	47.90	46.10	--	0.00	48.00	--	-1.90	--	L1
0.64	46.48	45.50	--	0.00	48.00	--	-2.50	--	L1
0.80	44.02	43.40	--	0.00	48.00	--	-4.60	--	L1
0.48	47.44	46.60	--	0.00	48.00	--	-1.40	--	L2
0.64	46.72	45.70	--	0.00	48.00	--	-2.30	--	L2
0.81	45.54	44.20	--	0.00	48.00	--	-3.80	--	L2
6 Worst Data									



561F Monterey Road,
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888

Data#: 7 File#: LC1114:EMI Date: 11-14-2002 Time: 14:26:36
Level (dBuV) Compliance Certification Service

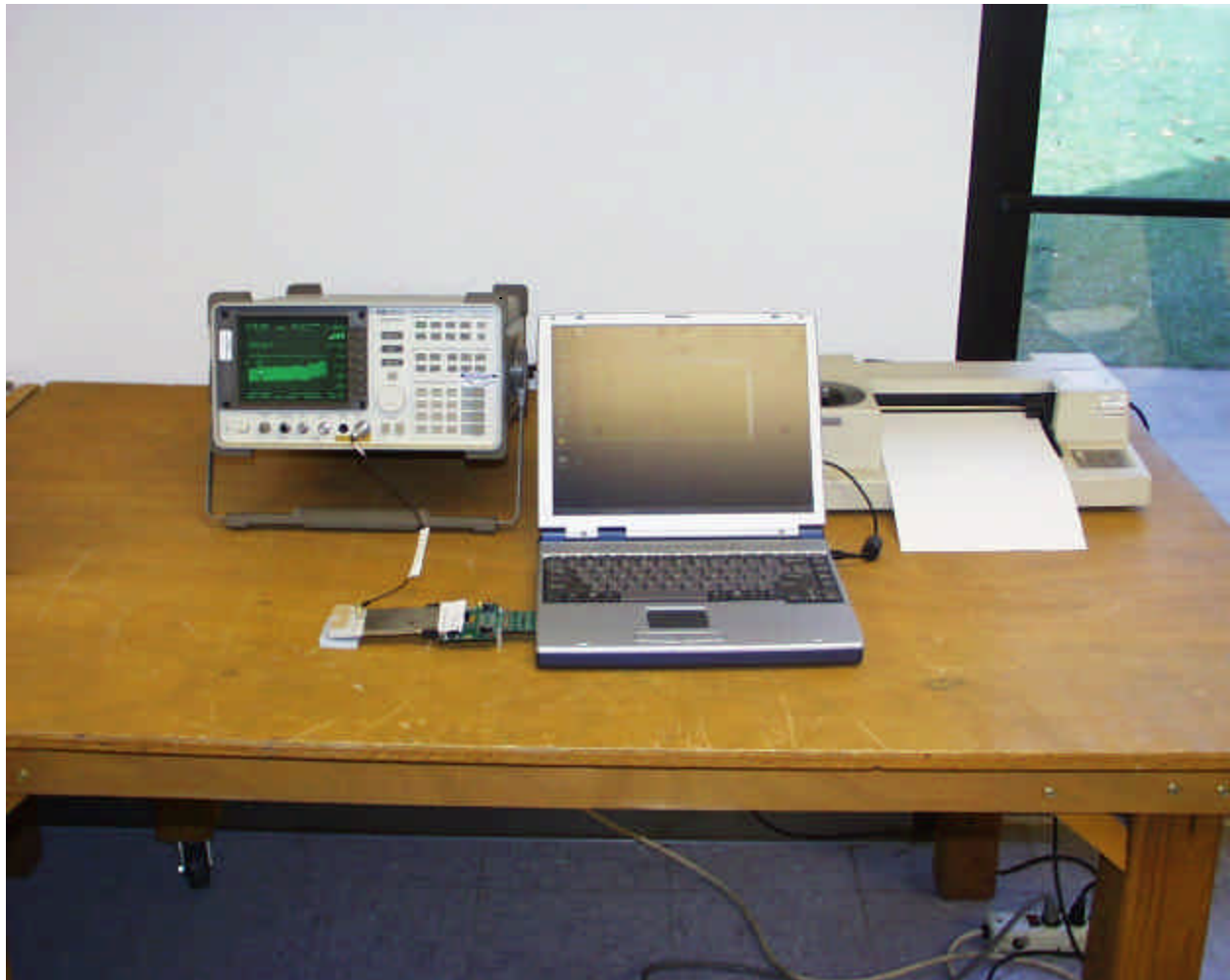


Trace: 3
Project # : 02T1639-2
Test Engineer : Frank Ibrahim
Company : Askey Computer Corp.
EUT : 802.11 a/b Dual Band Card Bus
: with extension card
Model Name : WLC221-D4, BCP3483U
Test Config. : EUT, Laptop, Printer, Mouse, Modem, P.S.
Test of Target: FCC 15.407
Mode of Op. : TX ON, Mid Channel 5.26 GHz, ART(15)
: 115VAC@60Hz
: Peak: L1(Black), L2(Green)

Ref Trace:

9.8. SETUP PHOTOS

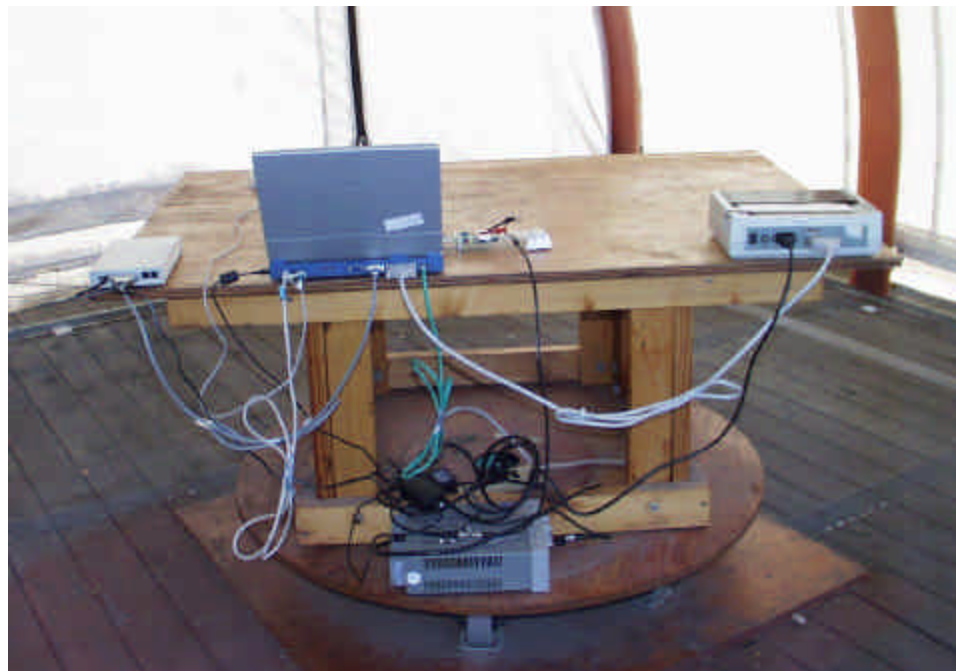
ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



RADIATED RF MEASUREMENT SETUP



DIGITAL DEVICE RADIATED EMISSIONS MEASUREMENT SETUP



POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP



END OF REPORT