CETECOM Inc.

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FCC LISTED, REG. NO.: 101450
&
RECOGNIZED BY INDUSTRY CANADA
IC – 3925

Test report no.: EMC_317_FCC15.247_2002_WLAN
FCC Part 15.247 for DSSS systems / CANADA RSS-210
(PE2030 A)
FCC ID: BEJPDA-PE2030A

Table of Contents

1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM Inc. USA does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM Inc USA.

TEST REPORT PREPARED BY:
EMC Engineer: Harpreet Sidhu

1.2 Testing laboratory

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1.3 Details of applicant

Name	**:**	**LG Electronics Inc.**
Street	**:**	**19-1, Cheongho-Ri, Jinwuy-Myun**
City / Zip Code	**:**	**Pyungtaik-shi, Kunggi-Do 451-713**
Country	**:**	**Korea**
Contact	**:**	**Harvey Sung**
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Tele-fax	**:**	**+82 31 610 5355**
e-mail	**:**	**emission@lge.com**

1.4 Application details

Date of receipt of application	:	2002-07-10
Date of receipt test item	:	2002-07-22
Date of test	:	2002-07-22/23/26

1.5 Test item

Manufacturer	:	Applicant
Brand Name	:	LG Electronics Inc., Hewlett-Packard Company
Marketing Name	:	IPAQ
Model Name	:	PE2030 A
Description	:	Pocket PC with Bluetooth and WLAN
FCC-ID	:	BEJPDA-PE2030A

Additional information

Frequency	:	2412MHz – 2462MHz for WLAN
Type of modulation	:	DBPSK,DQPSK,CCK for WLAN
Number of channels	:	11
Antenna	:	Fixed Integral
Power supply	:	Battery, AC adaptor
Output power	:	20.78dBm(0.12W) EIRP

1.6 Test standards: FCC Part 15 §15.247 / CANADA RSS-210

Note: All radiated measurements were made in all three orthogonal planes. The values reported are the maximum values.

2 Technical test

2.1 Summary of test results

No deviations from the technical specification(s) were ascertained in the course of the tests Performed	
Final Verdict: (only "passed" if all single measurements are "passed")	**Passed**

Technical responsibility for area of testing:

Date	Section	Name	Signature
2002-07-20	EMC & Radio	Lothar Schmidt (Manager)	

Responsible for test report and project leader:

Date	Section	Name	Signature
2002-07-20	EMC & Radio	Harpreet Sidhu (EMC Engineer)	

2.2 Test report

TEST REPORT

Test report no. : EMC_317_FCC15.247_2002_WLAN
(PE2030 A)

TEST REPORT REFERENCE

ANTENNA GAIN **§ 15.204**

The antenna gain of the complete system is calculated by the difference of conducted power of the module and the radiated power in EIRP.

	Low channel	Mid channel	High channel
Conducted Power	15.20dBm	15.49dBm	15.76dBm
Raidated Power (EIRP)	20.78dBm	20.06dBm	19.70dBm
Antenna Gain	5.58dBi	4.57dBi	3.94dBi

The calculated antenna gain is between 5.58dBi and 3.94dBi.

SPECTRUM BANDWIDTH OF DSSS SYSTEM §15.247(a) (2)
6 dB bandwidth

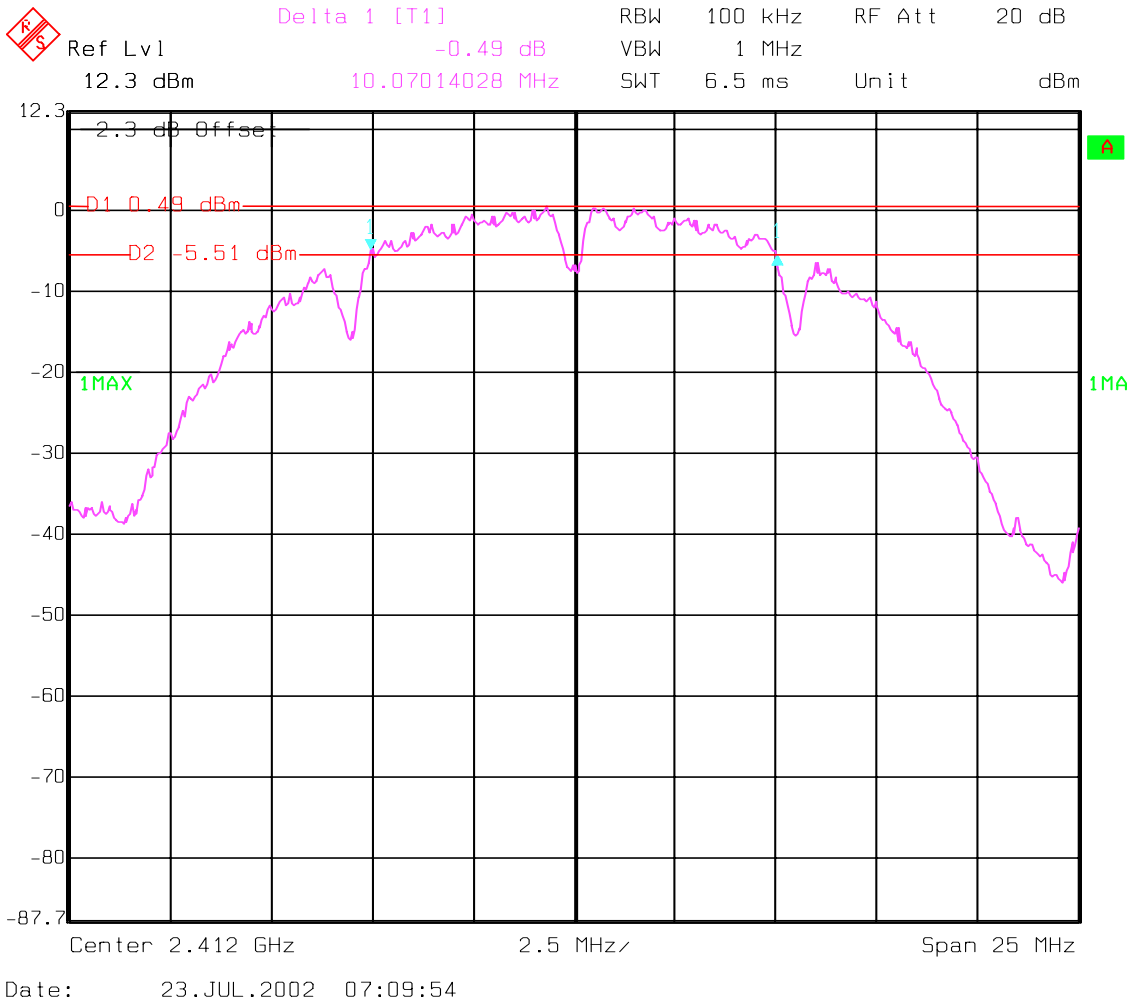
TEST CONDITIONS		6 dB BANDWIDTH (MHz)		
Frequency (MHz)		2412	2437	2462
T_{nom}(23)°C	V_{nom}	10.07	10.07	10.07

LIMIT **SUBCLAUSE §15.247(a) (2)**

The minimum 6dB bandwith shall be at least 500 KHz

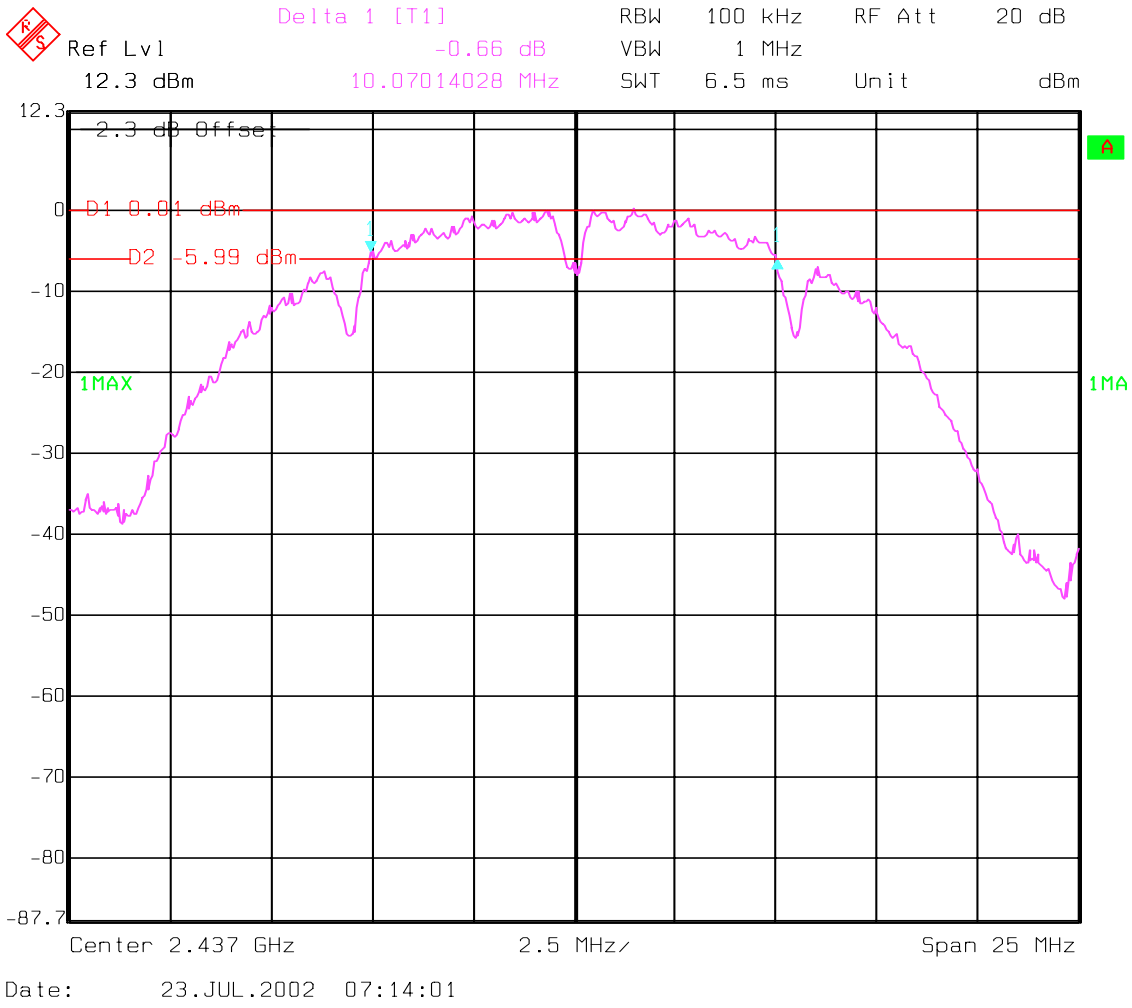
SPECTRUM BANDWIDTH OF DSSS SYSTEM **§15.247(a) (2)**
6 dB bandwidth

Lowest Channel: 2412MHz



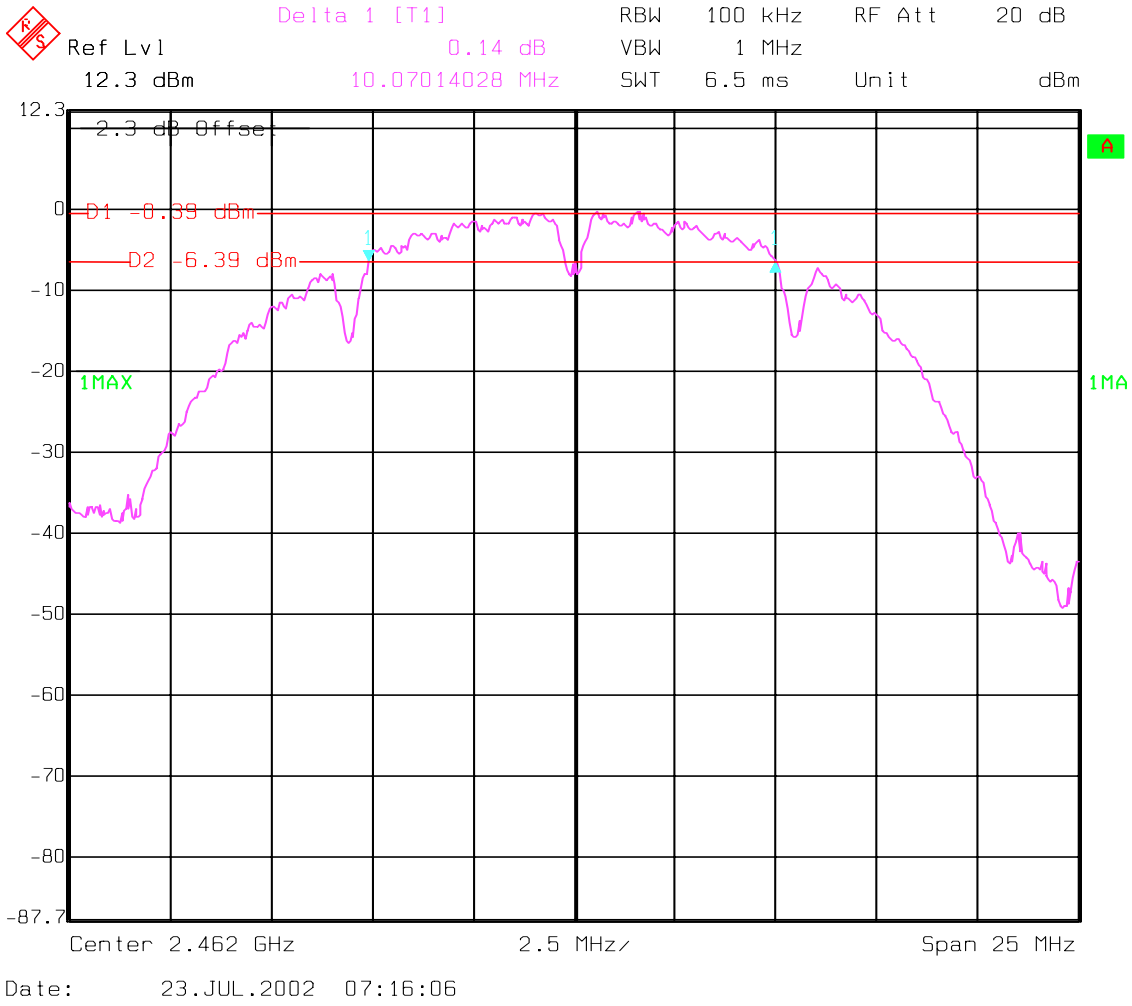
SPECTRUM BANDWIDTH OF DSSSS SYSTEM **§15.247(a) (2)**
6 dB bandwidth

Mid Channel: 2437MHz



SPECTRUM BANDWIDTH OF DSSS SYSTEM **§15.247(a) (2)**
6 dB bandwidth

Highest Channel: 2462MHz



MAXIMUM PEAK OUTPUT POWER **§ 15.247 (b) (1)**
(conducted)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)			
Frequency (MHz)			2412	2437	2462
$T_{nom}(23)°C$	V_{nom}	Pk	15.20	15.49	15.76
		Av	11.20	11.32	11.06
Measurement uncertainity		±0.5dBm			

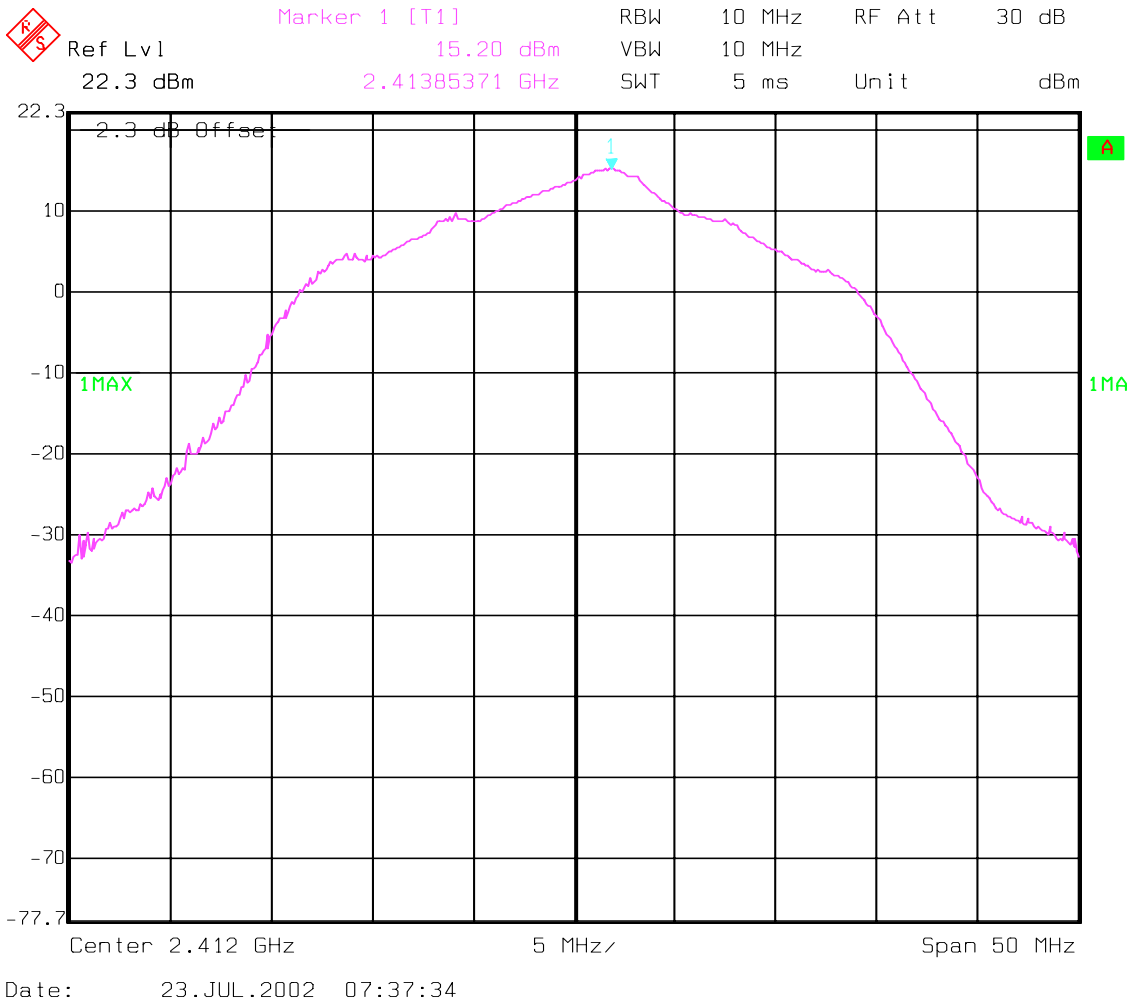
RBW / VBW : 10MHz

LIMIT **SUBCLAUSE § 15.247 (b) (1)**

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt / 30dBm

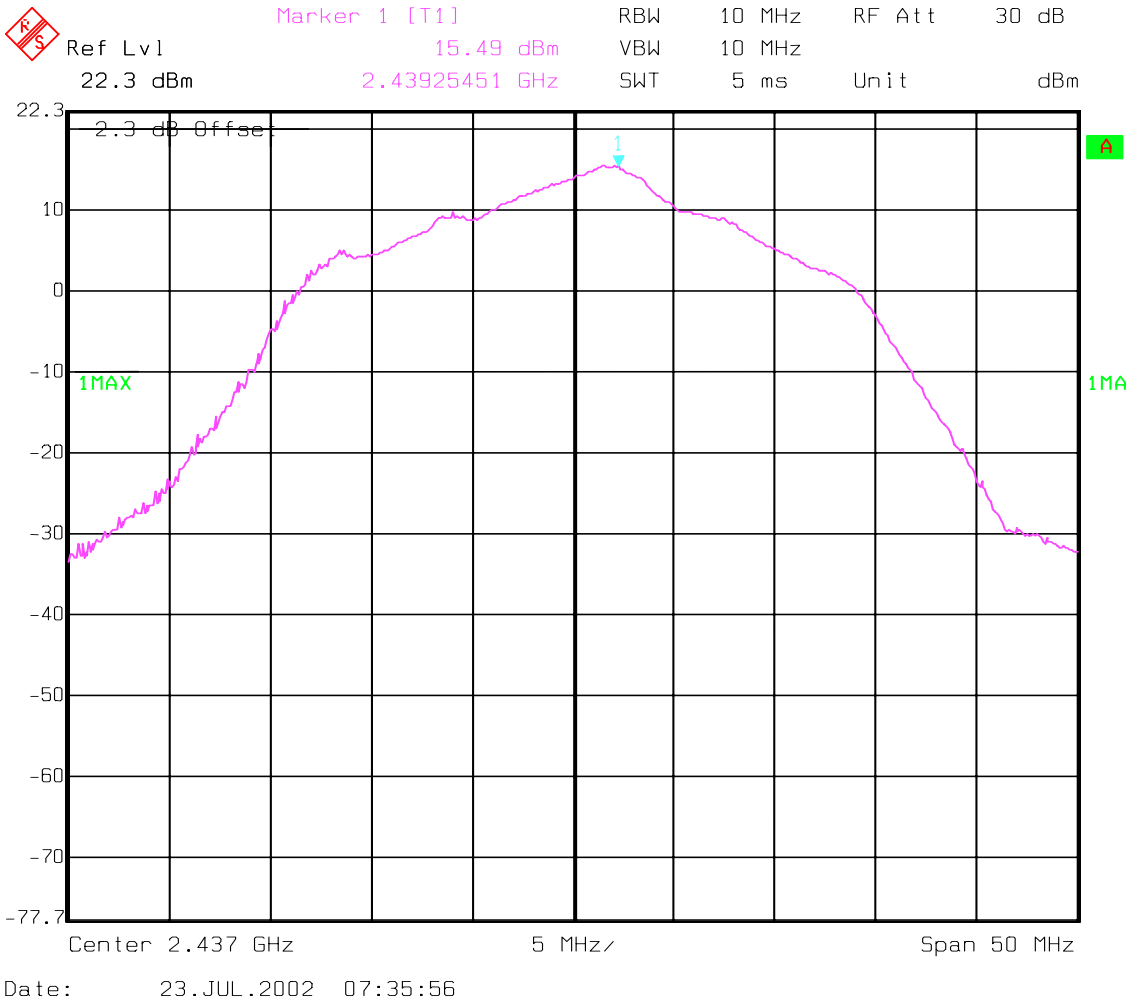
PEAK OUTPUT POWER (CONDUCTED) §15.247 (b) (1)

Lowest Channel: 2412MHz



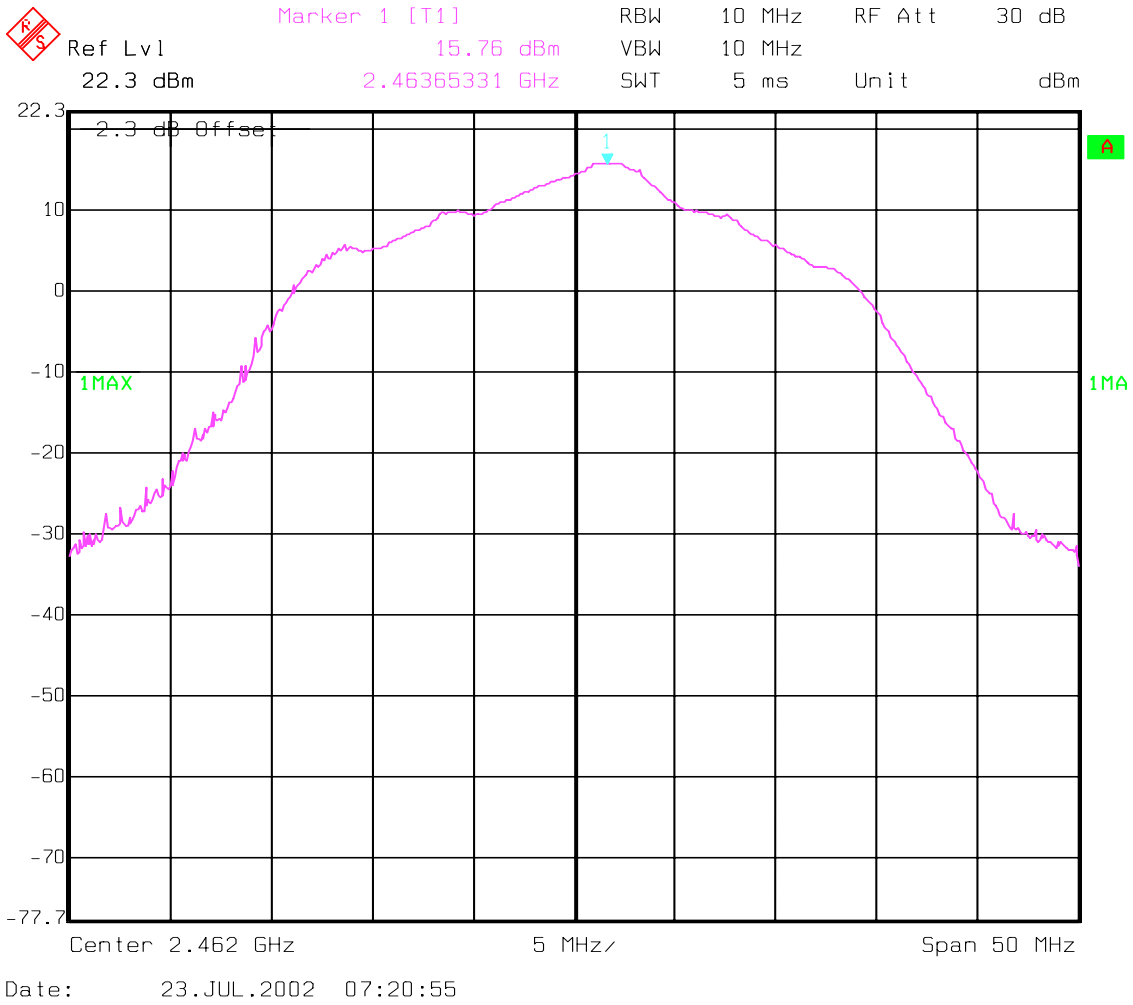
PEAK OUTPUT POWER (CONDUCTED) §15.247 (b)

Mid Channel: 2437MHz



PEAK OUTPUT POWER (CONDUCTED) §15.247 (b)

Highest Channel: 2462MHz



MAXIMUM PEAK OUTPUT POWER (RADIATED) **§ 15.247 (b) (1)**

EIRP:

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2412	2437	2462
T_{nom}(23)°C	V_{nom}	20.78	20.06	19.70
Measurement uncertainty		±0.5dBm		

RBW/VBW : 10MHz

LIMIT **SUBCLAUSE § 15.247 (b) (1)**

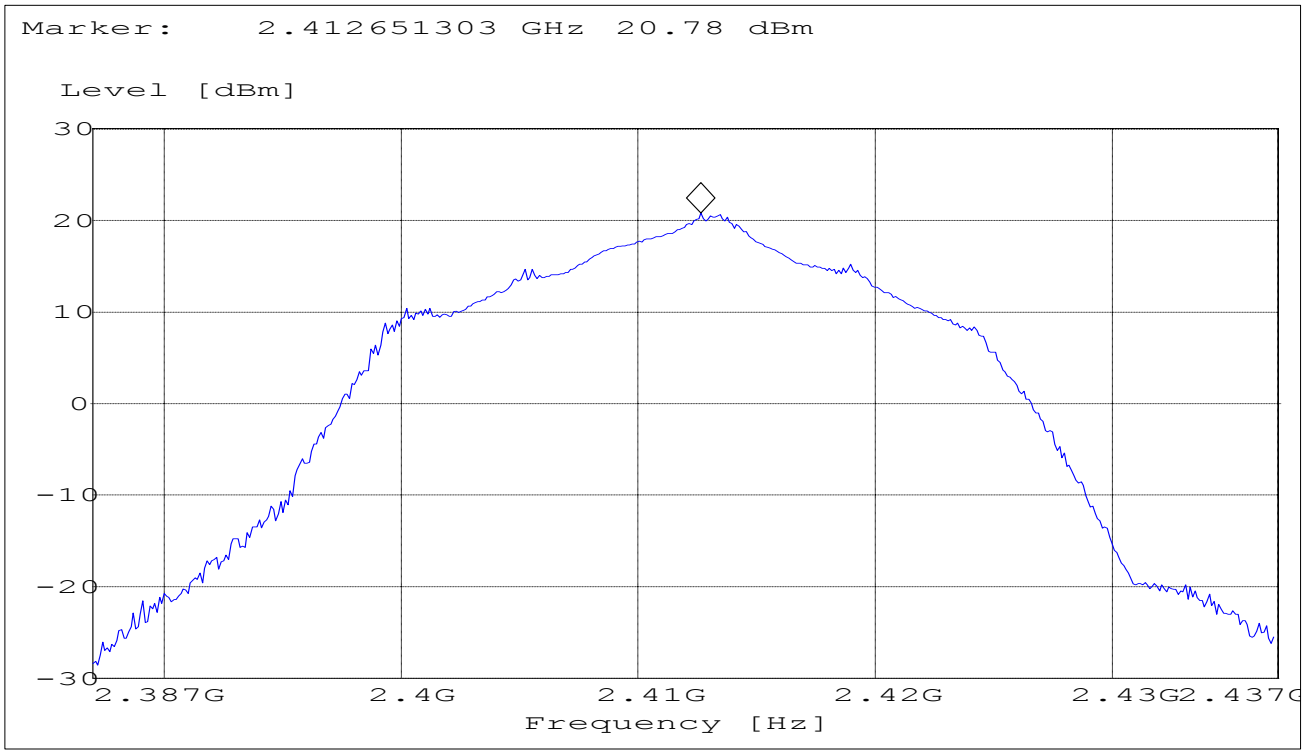
Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt / 30dBm

PEAK OUTPUT POWER (RADIATED) §15.247 (b) (1)

Lowest Channel: 2412MHz

SWEEP TABLE: "EIRP RLAN ch-1"

Short Description:		EIRP RLAN channel-2412MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.387GHz	2.437GHz	MaxPeak	Coupled	10 MHz

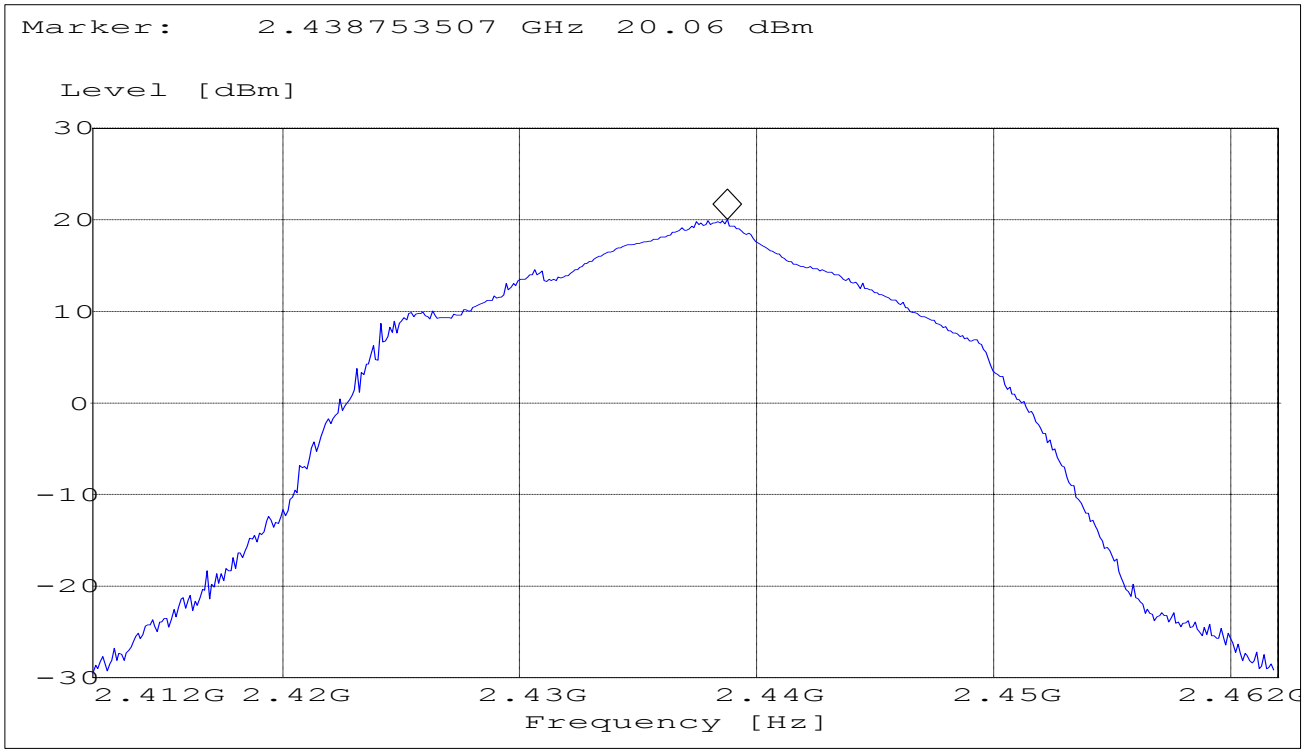


PEAK OUTPUT POWER (RADIATED) §15.247 (b) (1)

Mid Channel: 2437MHz

SWEEP TABLE: "EIRP RLAN CH7"

Short Description:		EIRP RLAN channel-2442MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.417GHz	2.467GHz	MaxPeak	Coupled	10 MHz

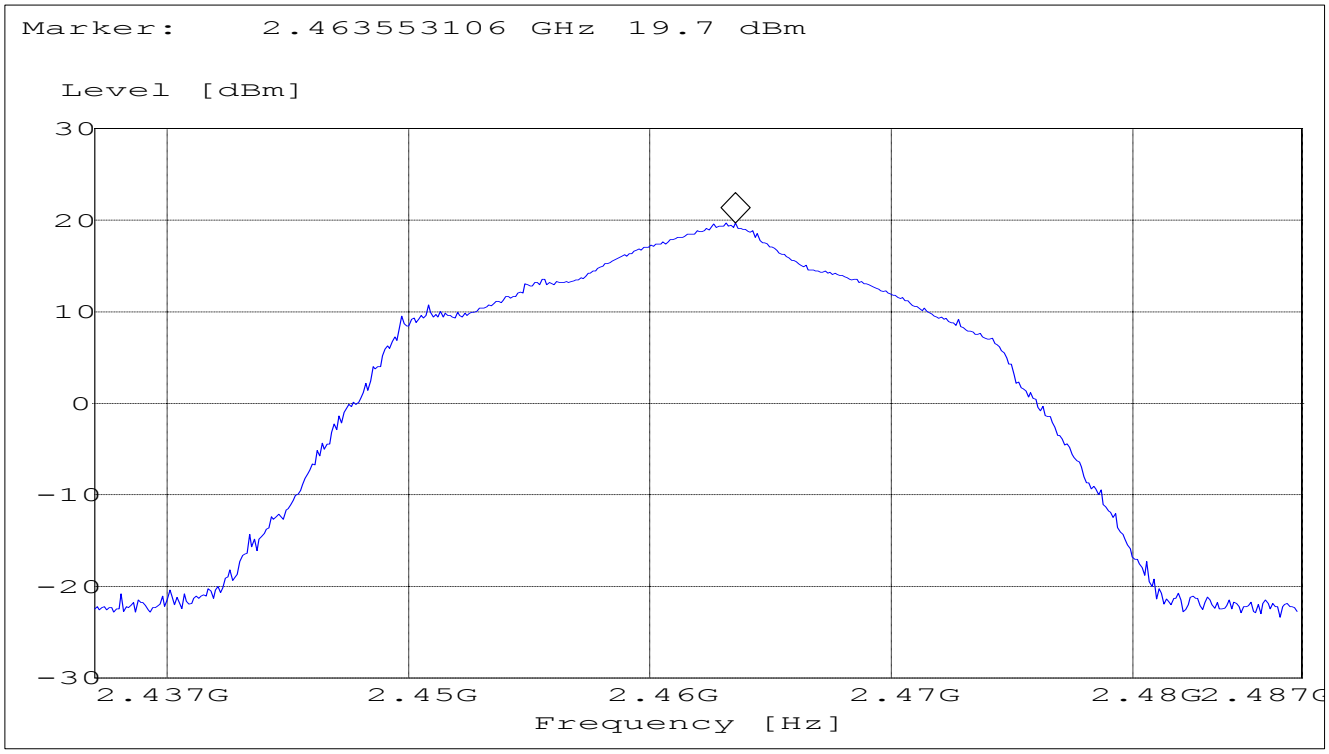


PEAK OUTPUT POWER (RADIATED) §15.247 (b) (1)

Highest Channel: 2462MHz

SWEEP TABLE: "EIRP RLAN CH13"

Short Description:		EIRP RLAN channel-2472MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.447GHz	2.497GHz	MaxPeak	Coupled	10 MHz



POWER SPECTRAL DENSITY §15.247 (d)

TEST CONDITIONS		POWER SPECTRAL DENSITY (dBm)		
Frequency (MHz)		2412	2437	2462
T_{nom}(23)°C	V_{nom}	-14.27	-14.10	-14.30

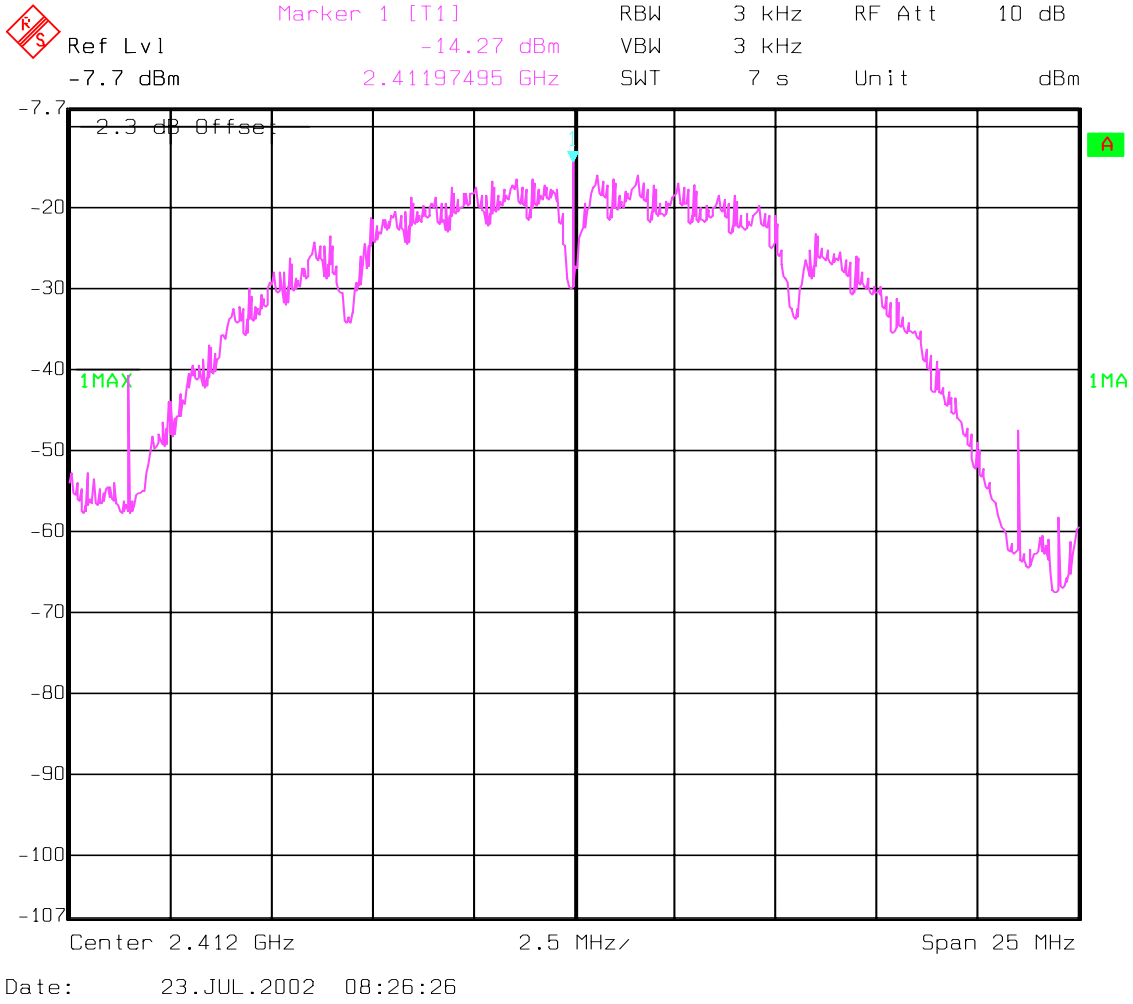
LIMIT **SUBCLAUSE §15.247(d)**

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band

ANALYZER SETTINGS: RBW=3KHz , VBW=3KHz

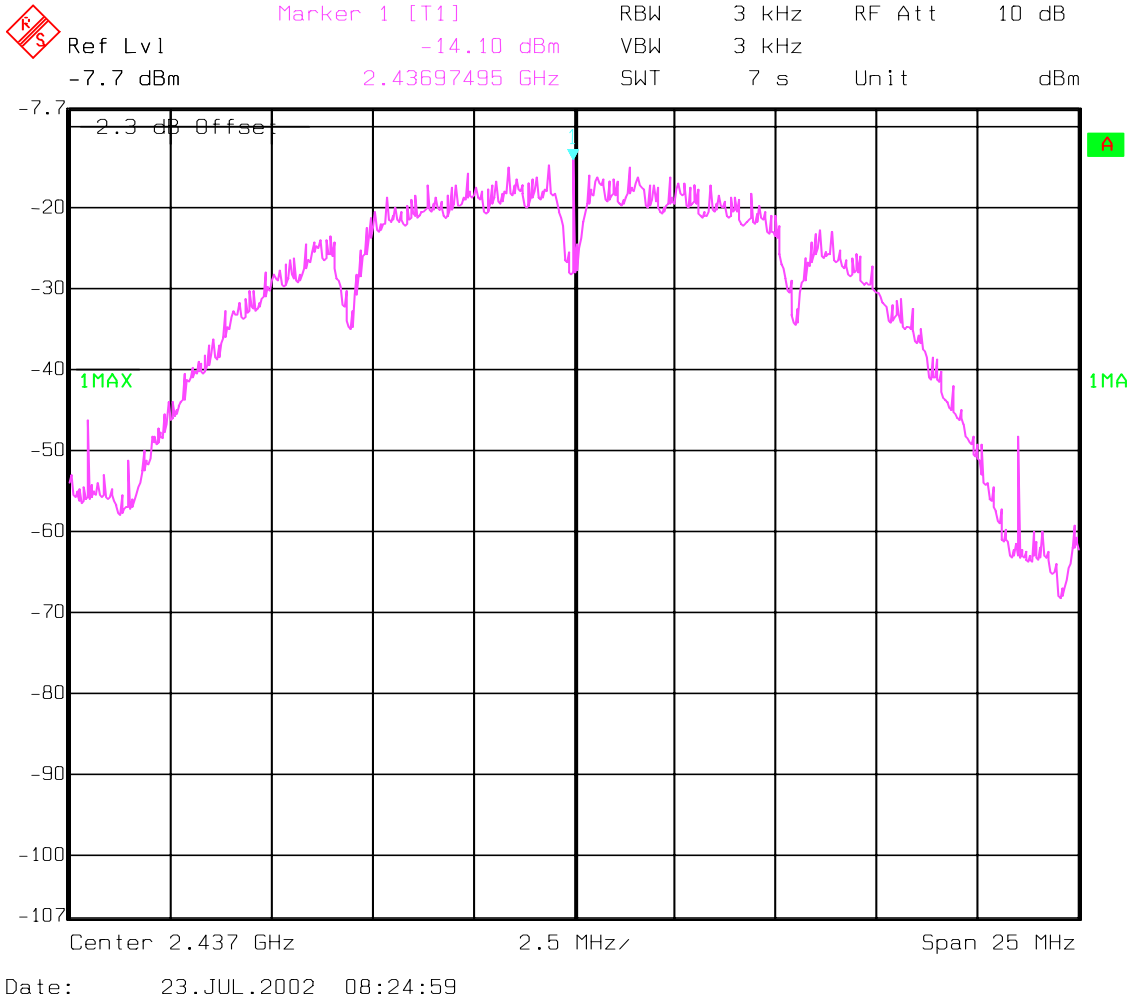
POWER SPECTRAL DENSITY §15.247(d)

Lowest Channel: 2412MHz



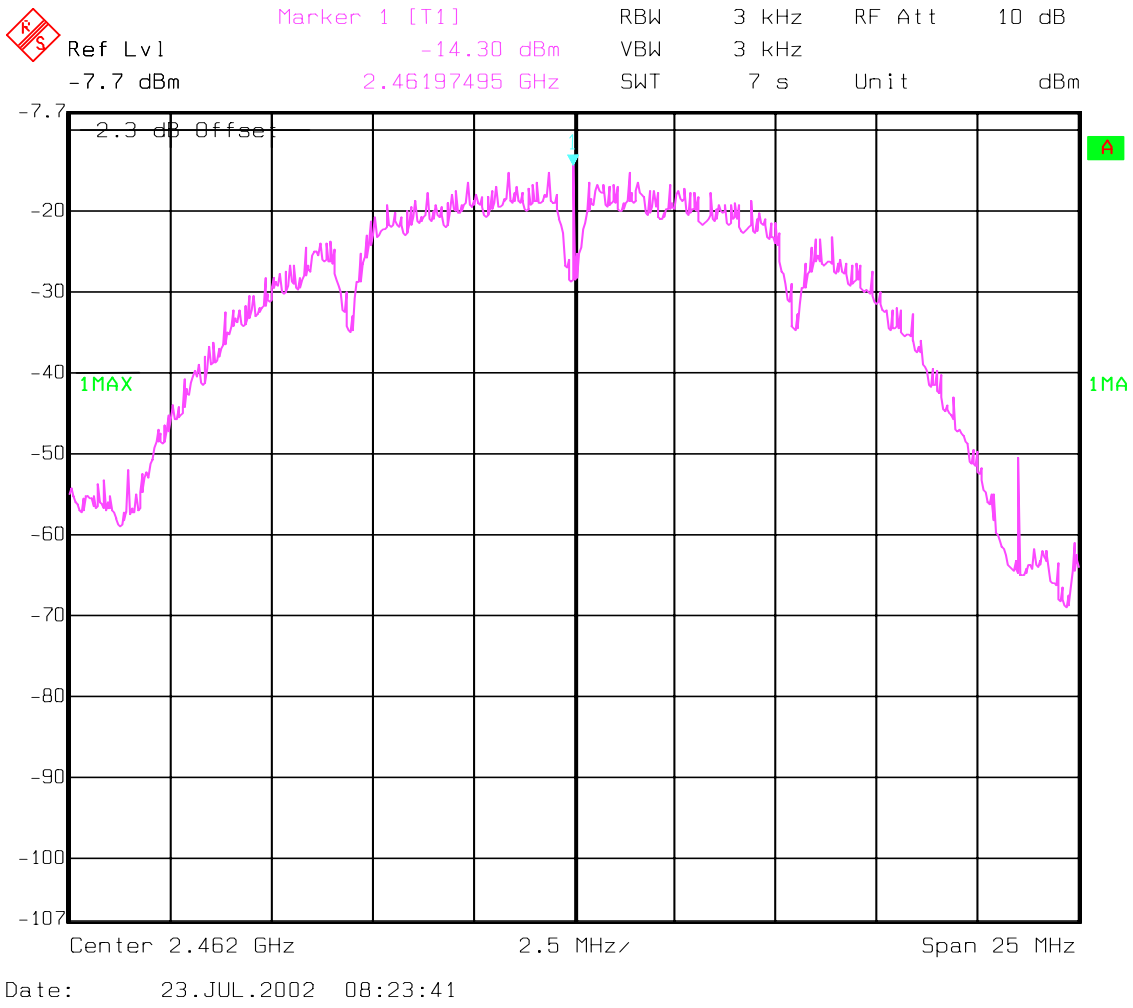
POWER SPECTRAL DENSITY §15.247(d)

Mid Channel: 2437MHz



POWER SPECTRAL DENSITY §15.247(d)

Highest Channel: 2462MHz



POWER SPECTRAL DENSITY **RSS-210**

TEST CONDITIONS		POWER SPECTRAL DENSITY (dBm/MHz)		
Frequency (MHz)		2412	2437	2462
T_{nom}(23)°C	V_{nom}	5.7	6.0	5.6

Correction factor of 60dBm is added to convert measured values from dBm/Hz to dBm/Mhz

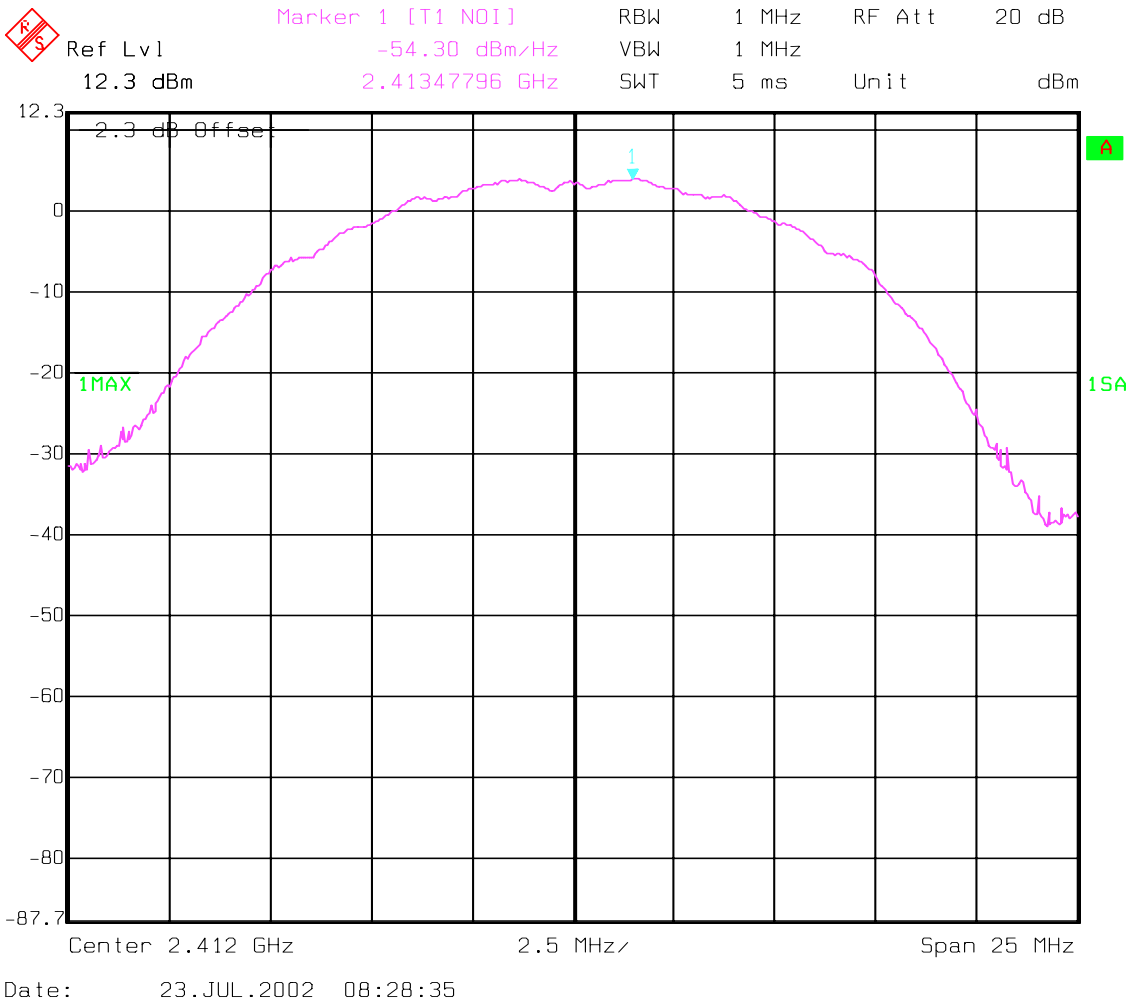
LIMIT **RSS-210**

The peak power spectral density shall be ≤ 50mW/MHz (17dBm/MHz)

ANALYZER SETTINGS: RBW=1MHz , VBW=1MHz

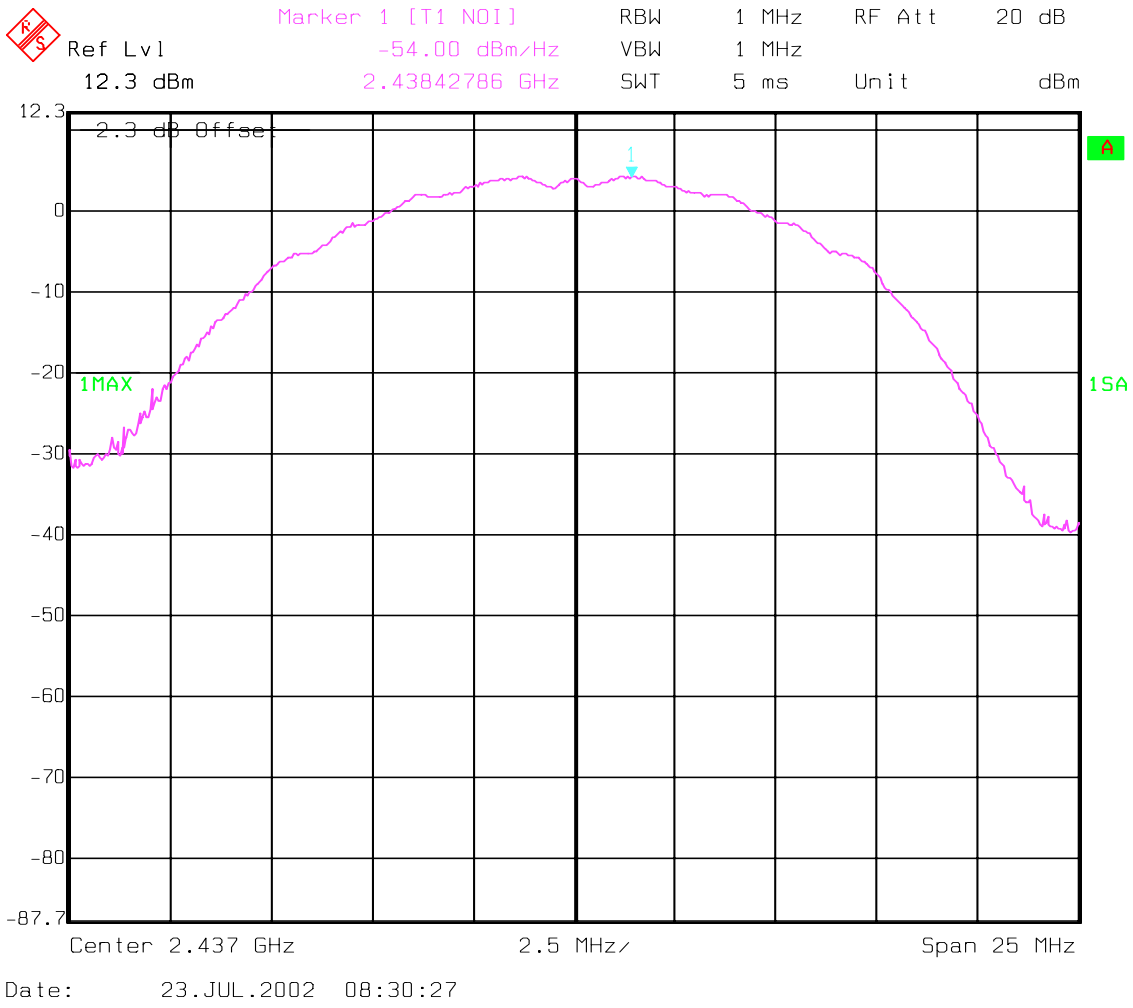
POWER SPECTRAL DENSITY RSS-210

Lowest Channel: 2412MHz



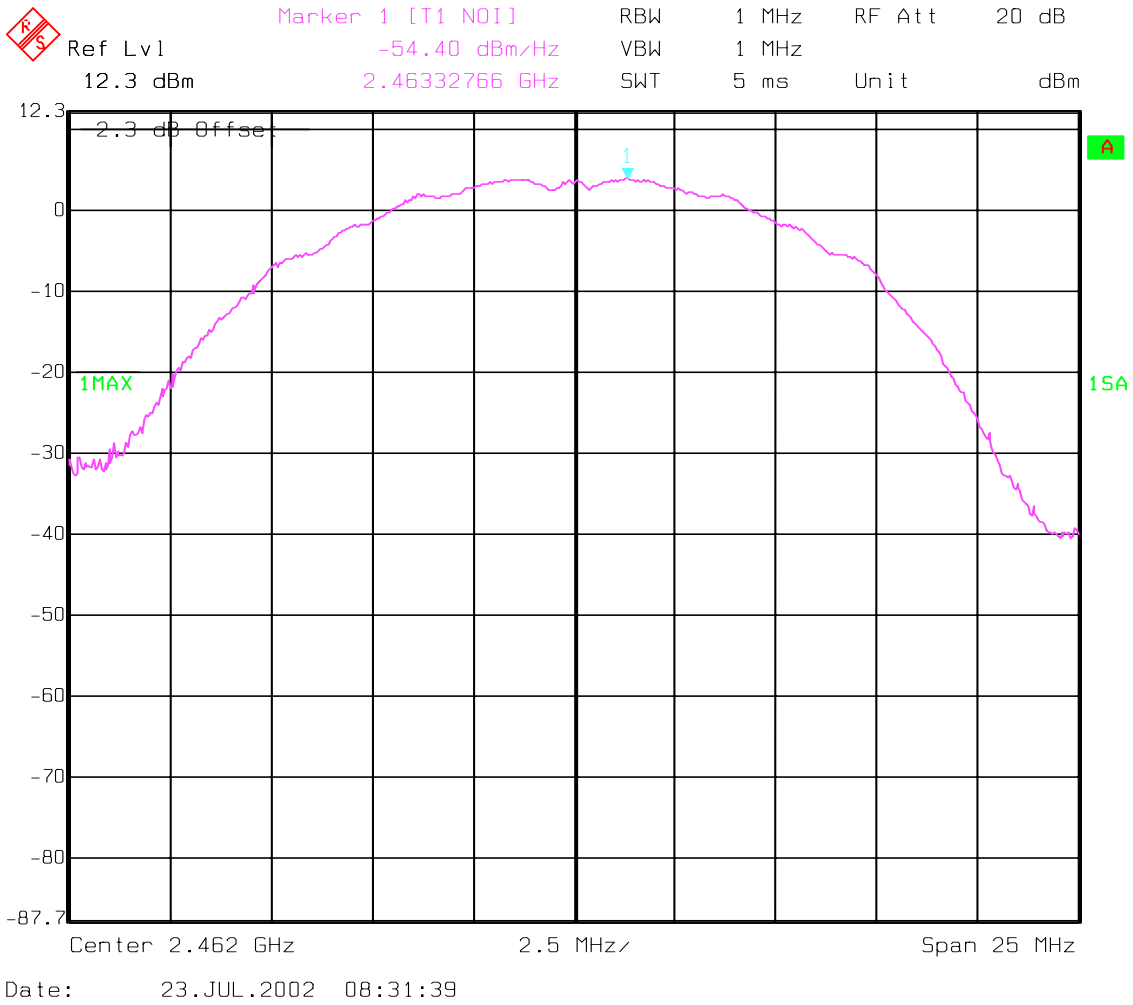
POWER SPECTRAL DENSITY RSS-210

Mid Channel: 2437MHz



POWER SPECTRAL DENSITY RSS-210

Highest Channel: 2462MHz

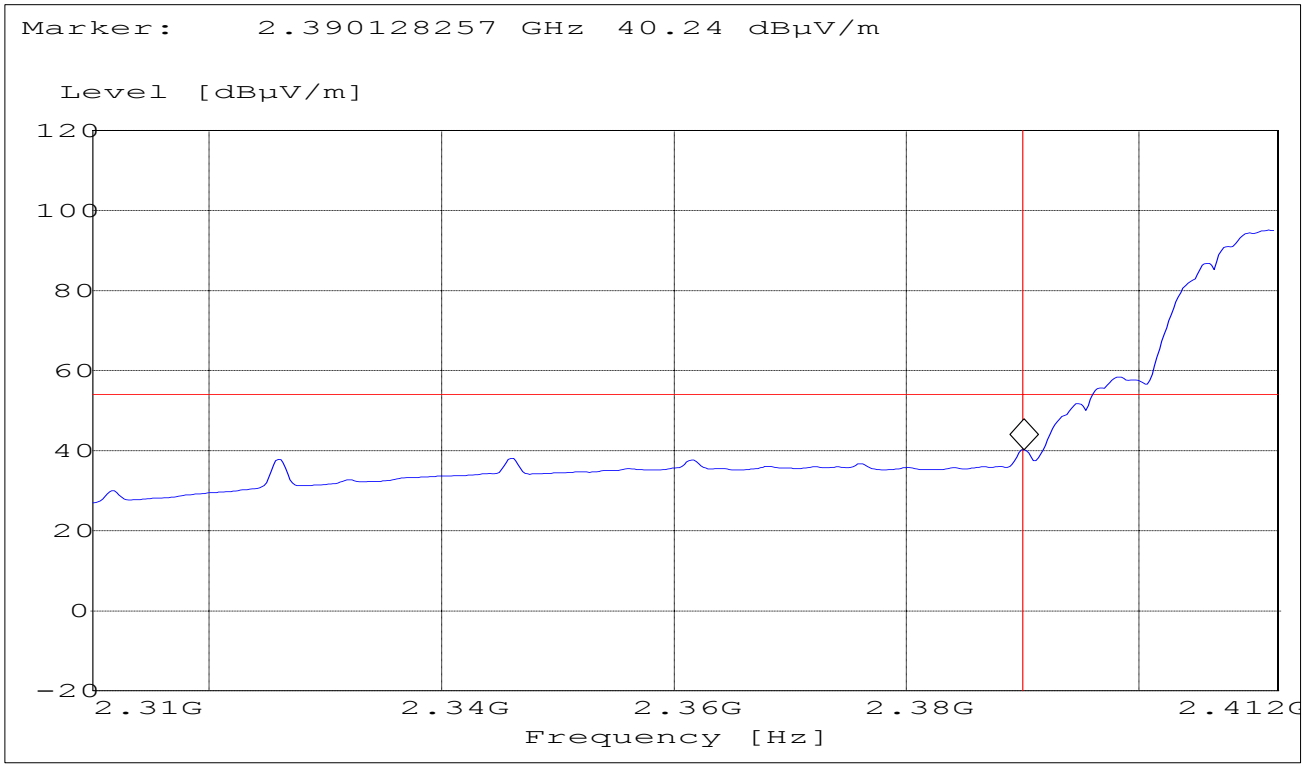


BAND EDGE COMPLIANCE §15.247 (c)

Low frequency section (spurious in the restricted band 2310 – 2390 MHz) (Average meaurement)

Operating condition : Tx at 2412MHz
SWEEP TABLE : "FCC15.247 LBE_AVG"
Limit Line : 54dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.31 GHz	2.412 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)

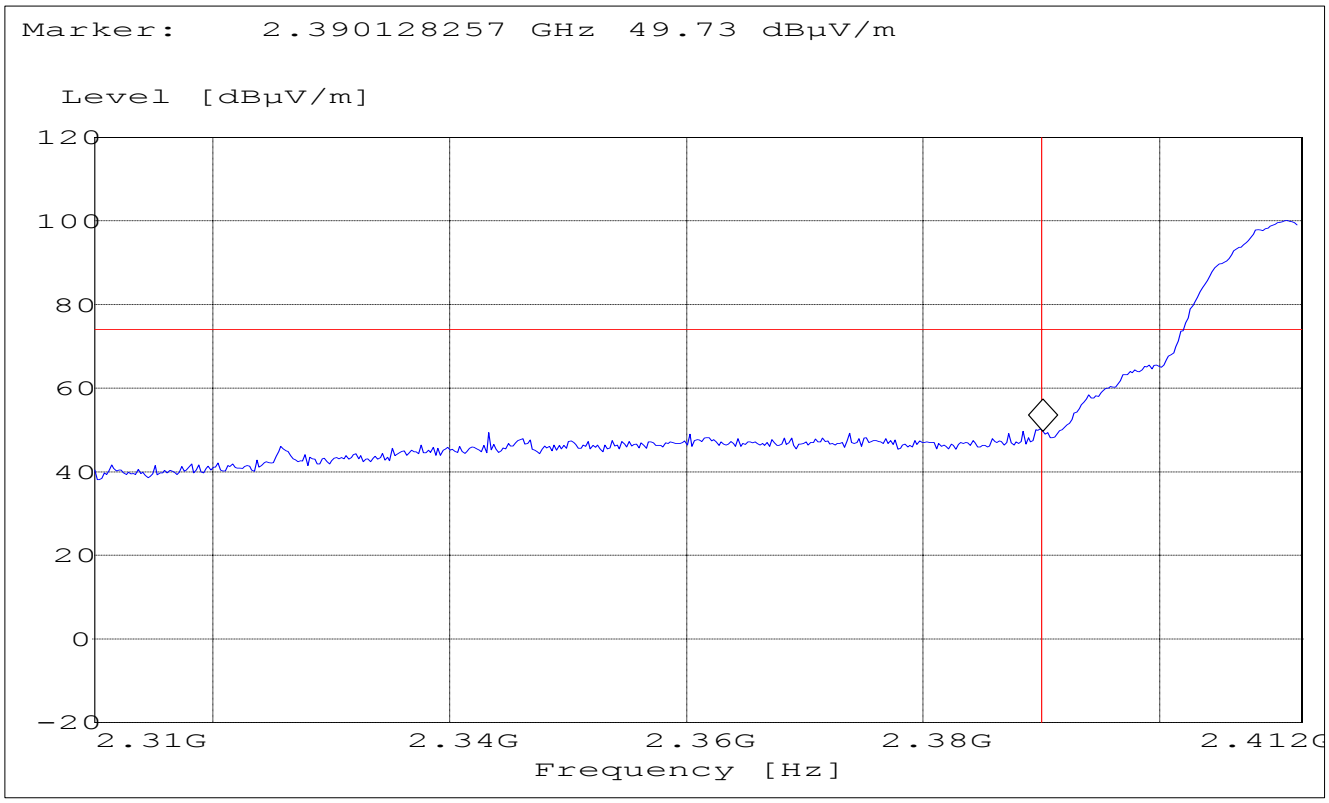


BAND EDGE COMPLIANCE §15.247 (c)

Low frequency section (spurious in the restricted band 2310 – 2390 MHz) (Peak meaurement)

Operating condition : Tx at 2412MHz
SWEEP TABLE : "FCC15.247 LBE_Pk"
Limit Line : 74dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.31 GHz	2.412 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)

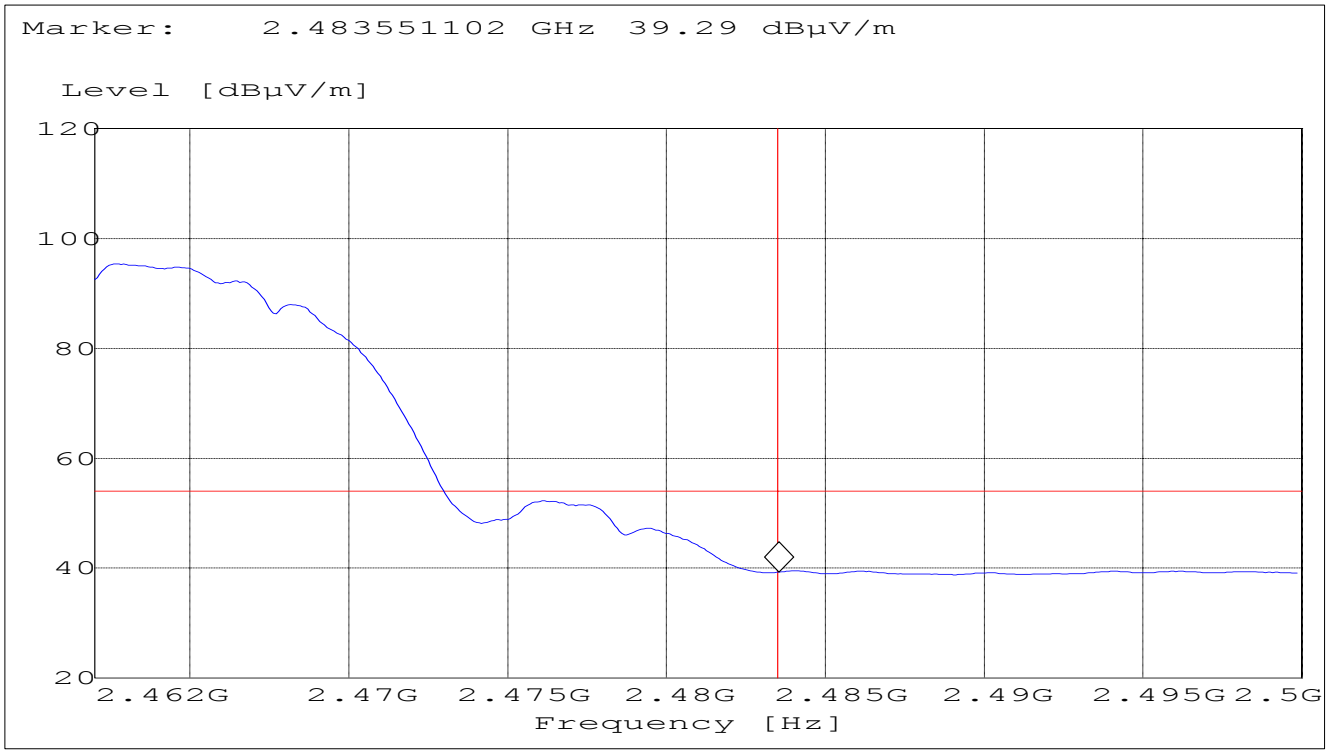


BAND EDGE COMPLIANCE §15.247 (c)

High frequency section (spurious in the restricted band 2483.5 – 2500 MHz) (Average meaurement)

Operating condition : Tx at 2472MHz
SWEEP TABLE : "FCC15.247 HBE_AVG"
Limit Line : 54dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.462 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)

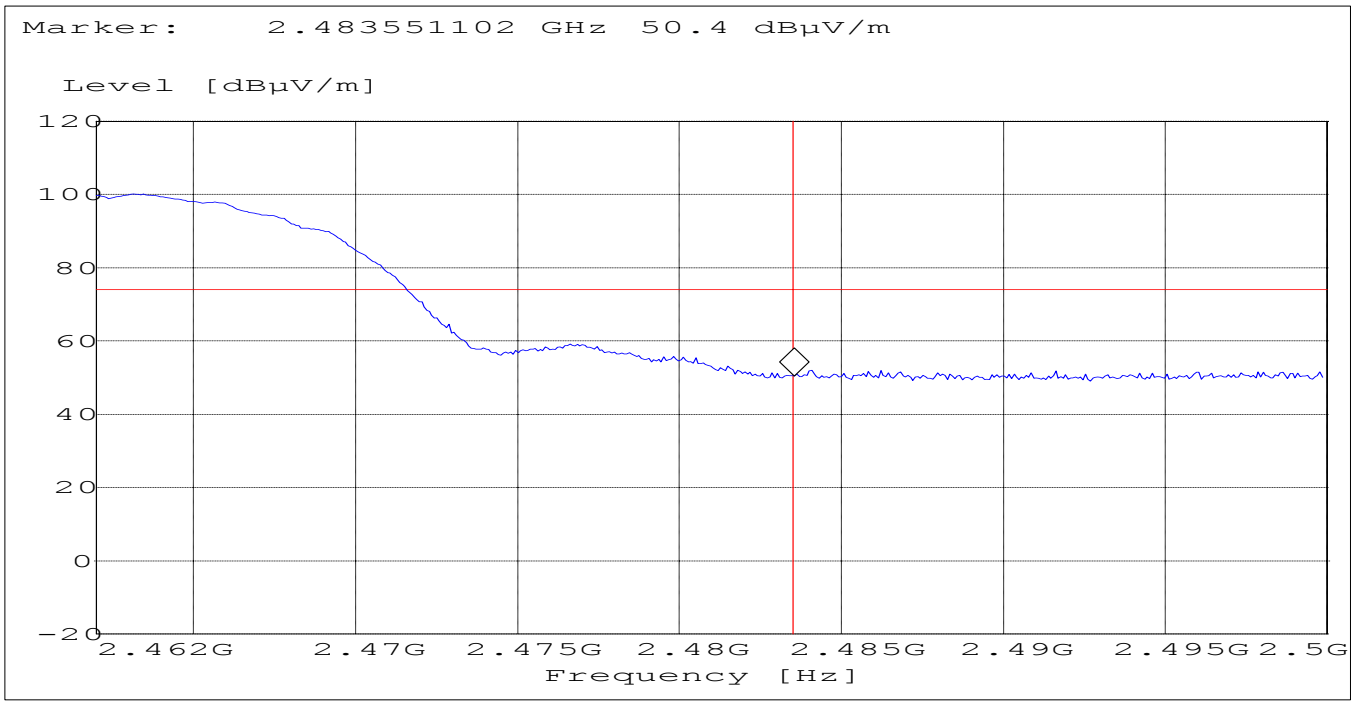


BAND EDGE COMPLIANCE §15.247 (c)

High frequency section (spurious in the restricted band 2483.5 – 2500 MHz) (Peak meaurement)

Operating condition : Tx at 2472MHz
SWEEP TABLE : "FCC15.247 HBE_PK"
Limit Line : 74dBµV

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
2.462 GHz	2.5 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)



EMISSION LIMITATIONS **§ 15.247 (c) (1)**
Transmitter (Conducted)
LIMITS

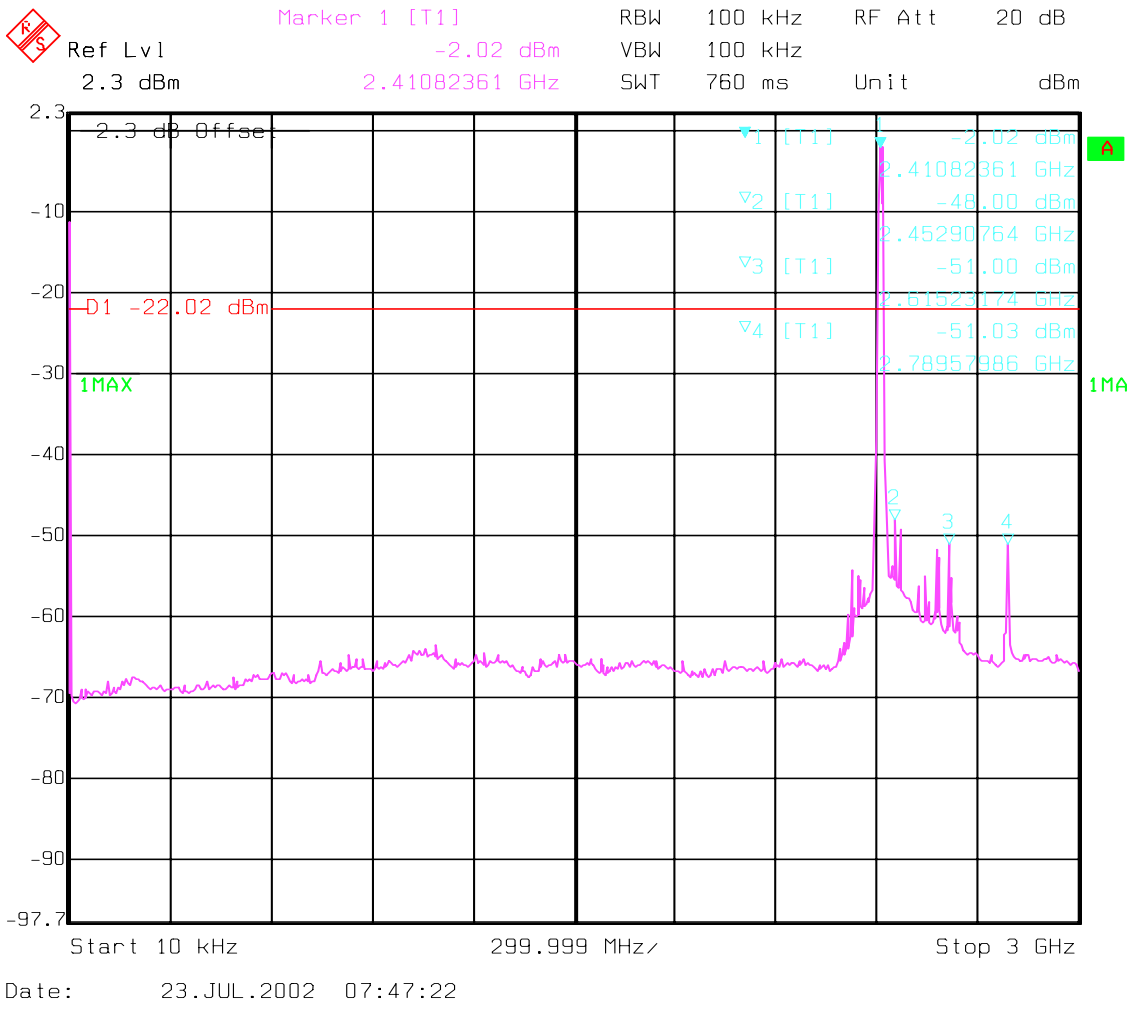
In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

NOTE: Frequency resolution is not fine enough to show the exact frequency of the carrier, refer to plots under EIRP.

EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Lowest Channel(2412MHz): 10KHz - 3GHz

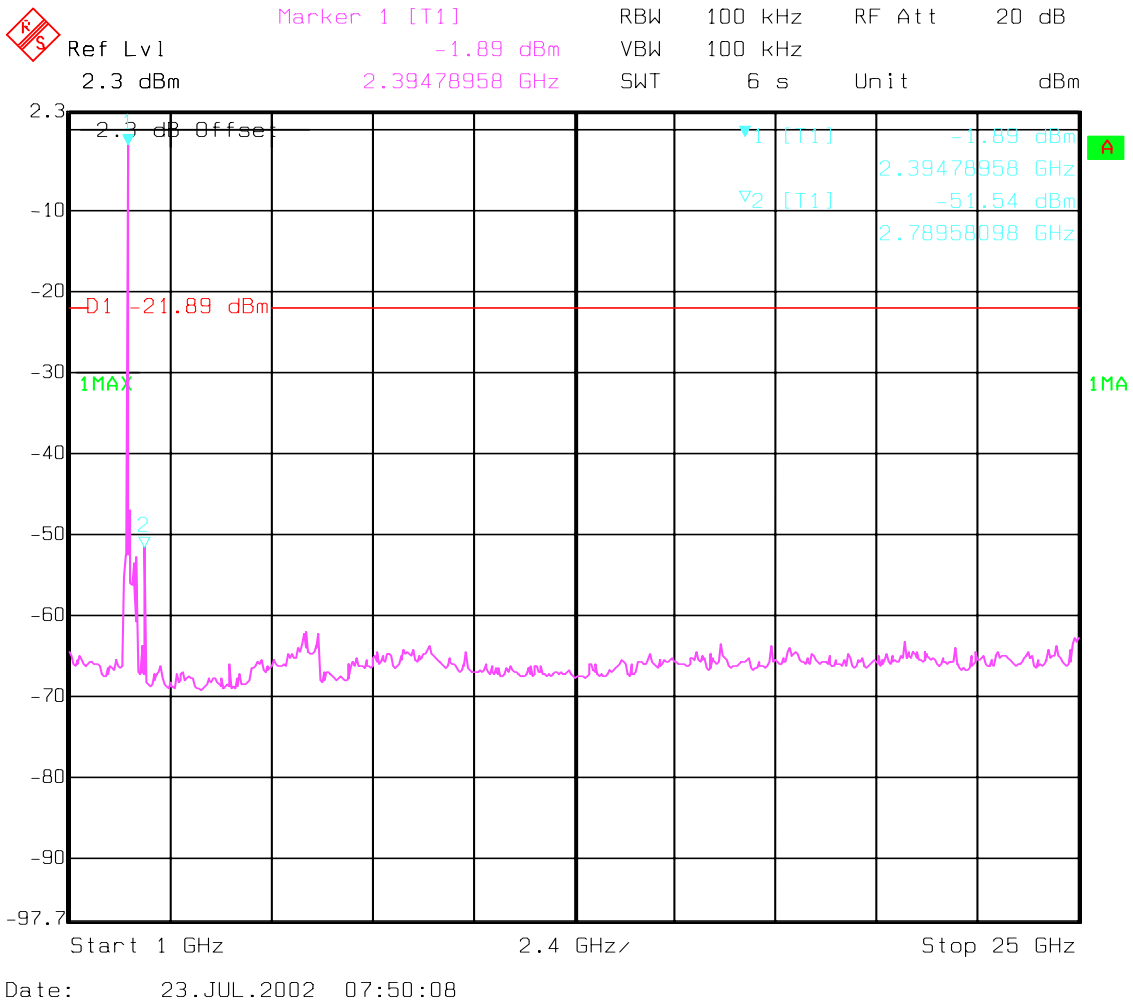
NOTE: The peak above the limit line is the carrier frequency.



EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Lowest Channel(2412MHz): 1GHz - 25GHz

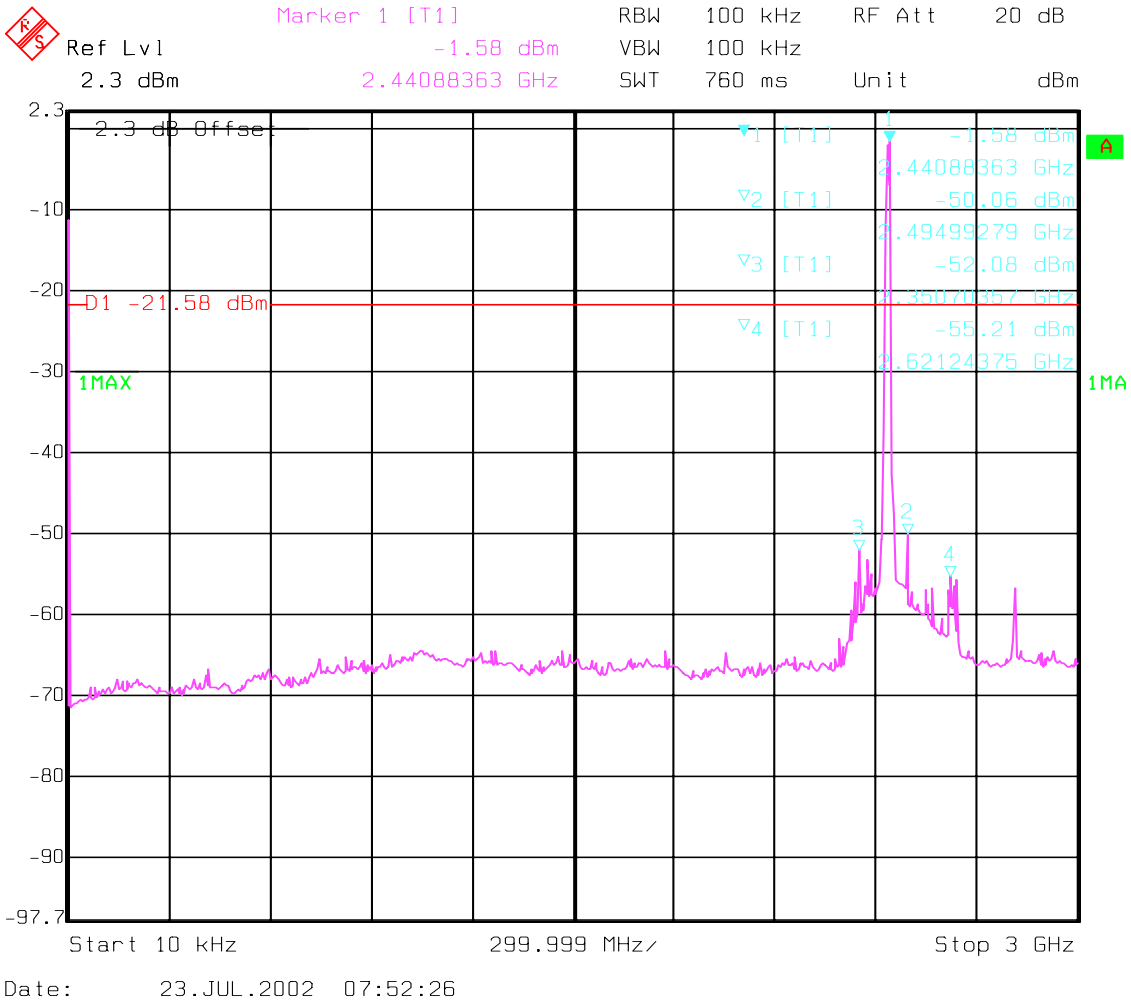
NOTE: The peak above the limit line is the carrier frequency.



EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Mid Channel(2437MHz): 10KHz - 3GHz

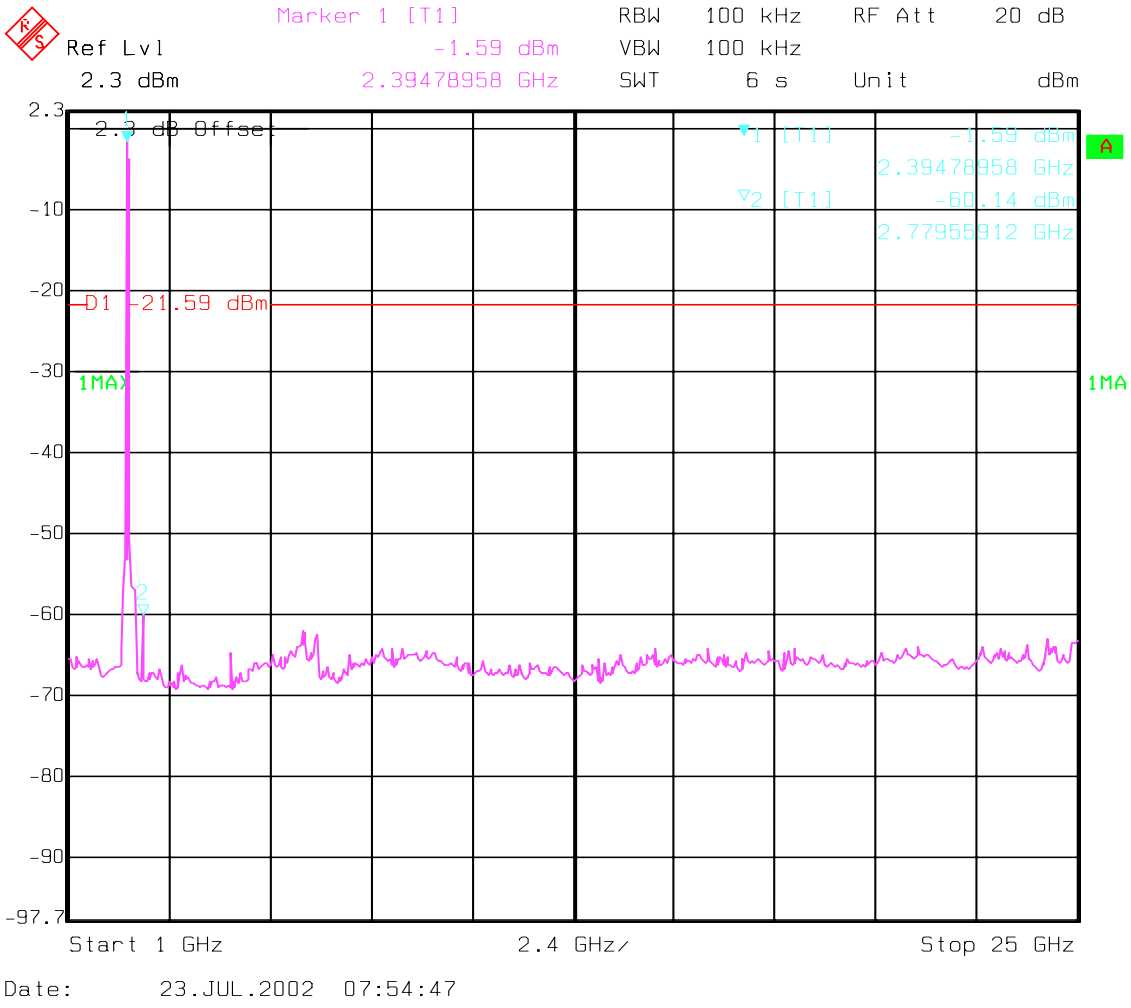
NOTE: The peak above the limit line is the carrier frequency.



EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Mid Channel(2437MHz): 1GHz - 25GHz

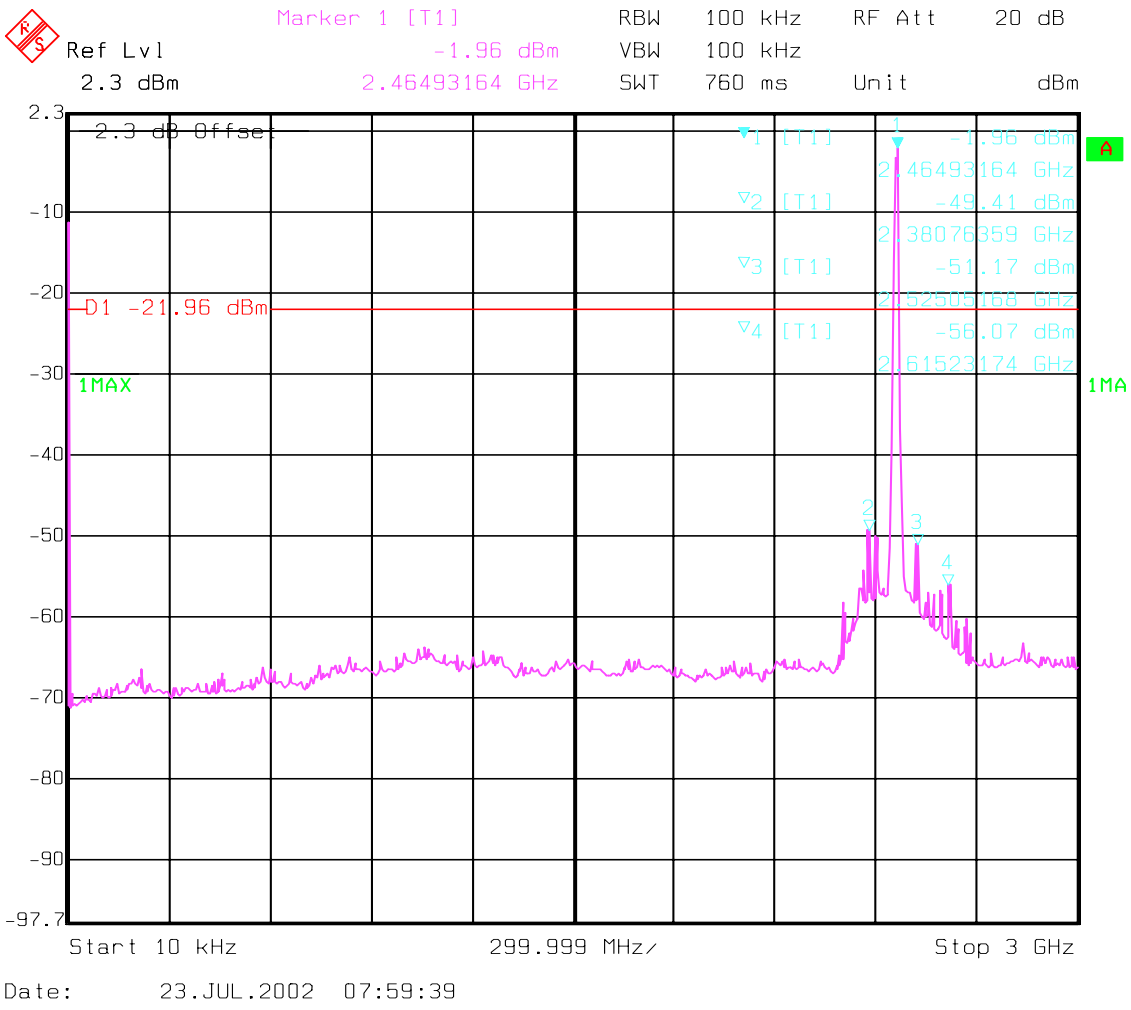
NOTE: The peak above the limit line is the carrier frequency.



EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Highest Channel(2462MHz): 10KHz - 3GHz

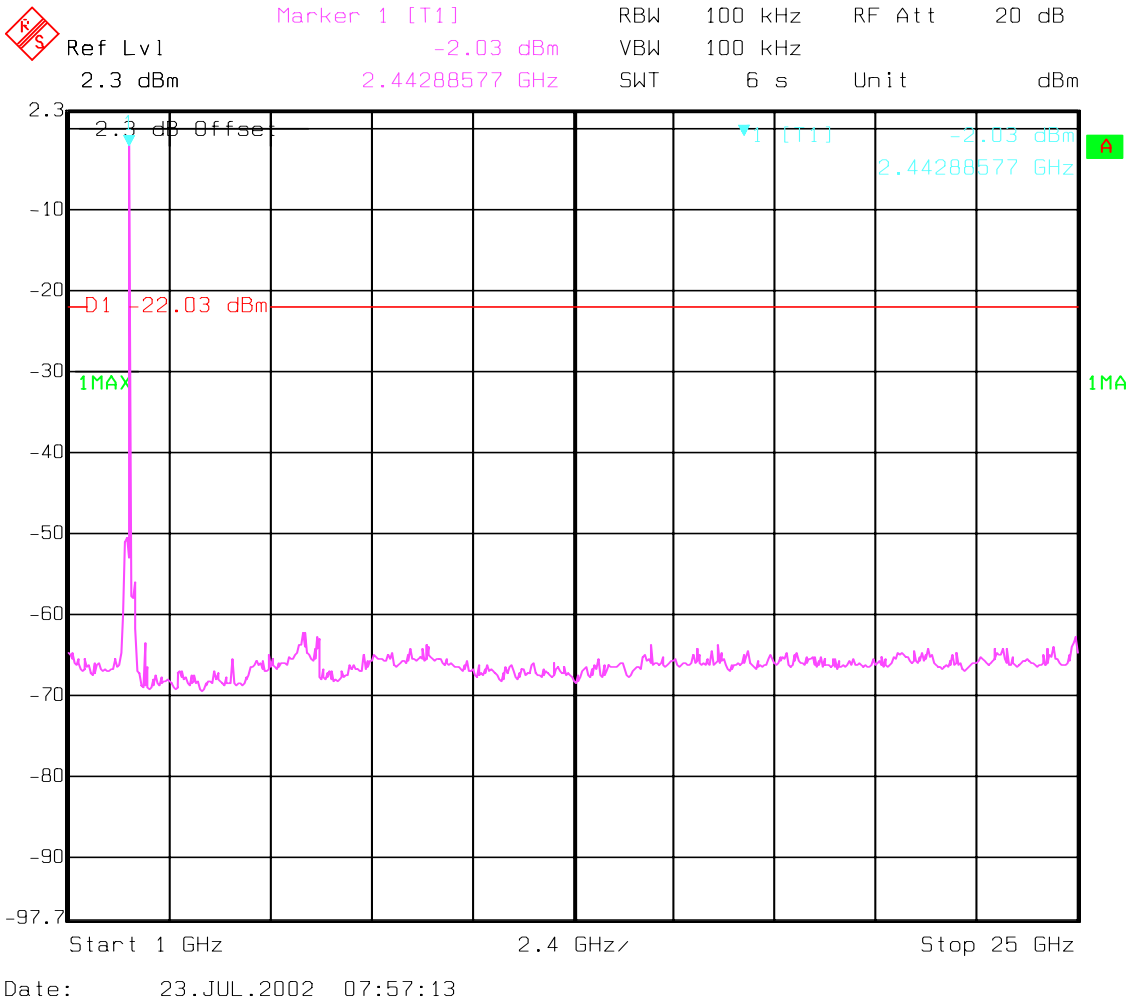
NOTE: The peak above the limit line is the carrier frequency.



EMISSION LIMITATIONS - Conducted (Transmitter) § 15.247 (c) (1)

Highest Channel(2462MHz): 1GHz - 25GHz

NOTE: The peak above the limit line is the carrier frequency.



EMISSION LIMITATIONS **§ 15.247 (c) (1)**
Transmitter (Radiated)

LIMITS

In any 100 kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. 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)).

NOTE:
1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 18 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

2. Frequency resolution is not fine enough to show the exact frequency of the carrier, refer to plots under EIRP.

3. All different possible combinations of EUT and auxilliary equipment were used to produce worst case radiated emissiosn as shown by the plots on next pages.

Setup-1: EUT+Cradle+power cable+USB+Serial cable+Jacket
Setup-2: EUT+power cable+USB +Serial cable+headset+jacket

Results for the radiated measurements below 30MHz according § 15.33

Frequency	Measured values	Remarks
9KHz – 30MHz	No emissions found, caused by the EUT	This is valid for all the tested channels

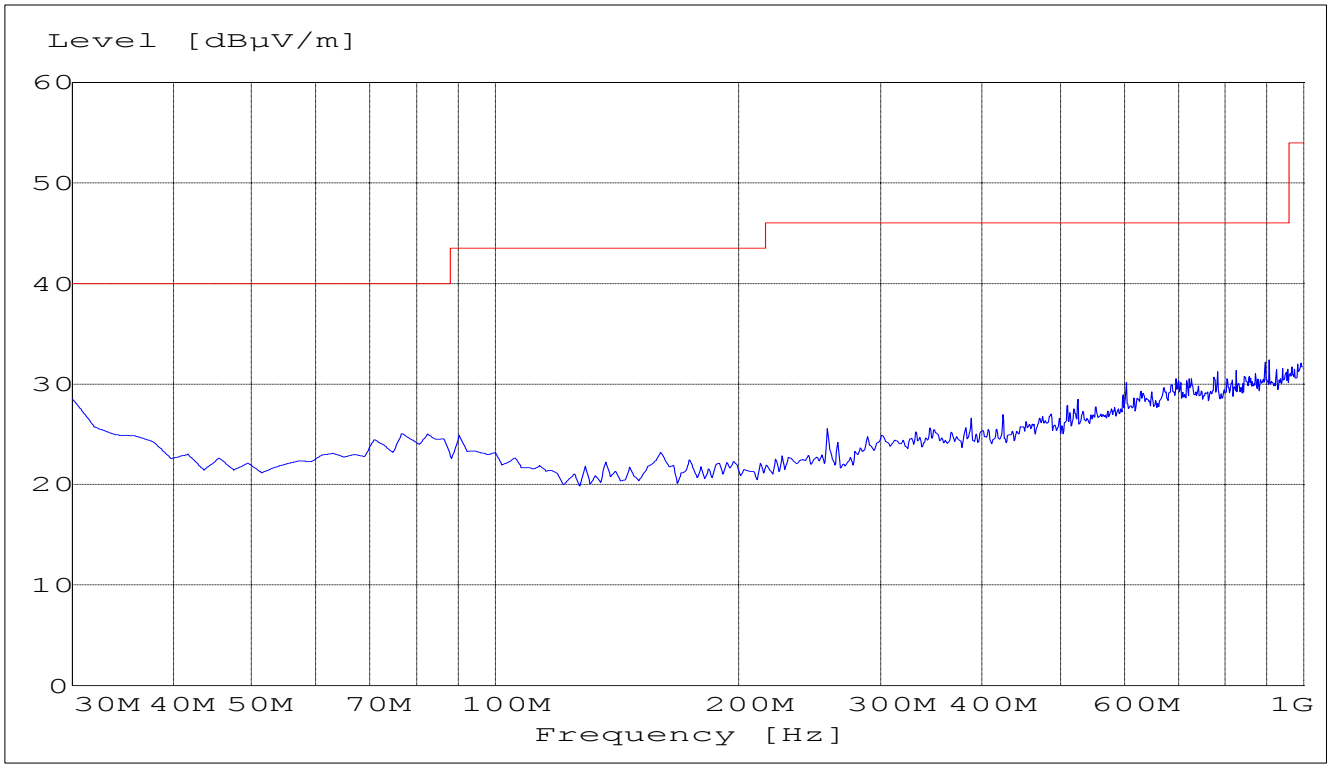
EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)

Note: All radiated measurements were made in all three orthogonal planes. The values reported are the maximum values.

Tx ch-Low 2412 MHz		Tx ch-Mid 2437 MHz		Tx ch-High 2462 MHz	
Freq.(MHz)	Level (dBµV/m)	Freq.(MHz)	Level (dBµV/m)	Freq.(MHz)	Level (dBµV/m)
No significant peaks found					

EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Lowest Channel(2412MHz): 30MHz – 1GHz

SWEEP TABLE:		"BT Spuri hi 30-1G"			
Short Description:		Bluetooth 30MHz-1GHz			
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186

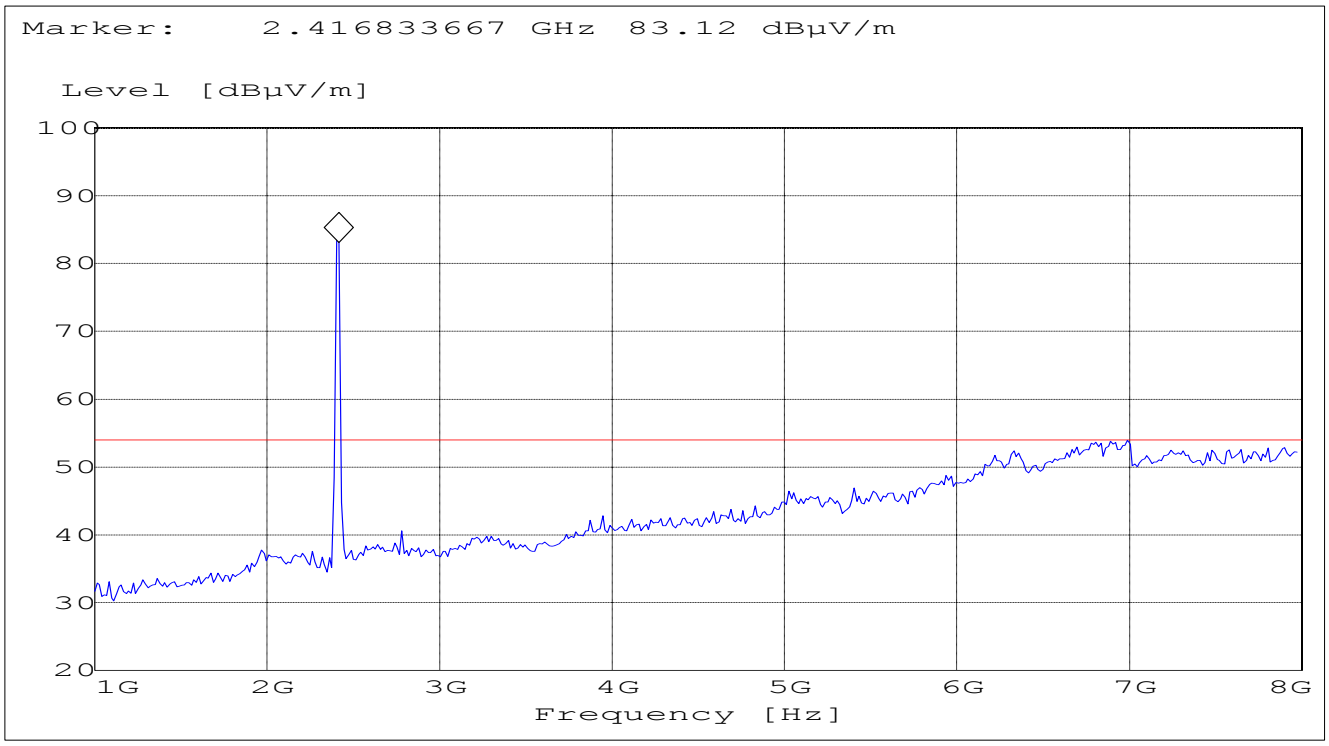


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Lowest Channel(2412MHz): 1GHz – 8GHz

NOTE: The peak above the limit is the carrier frequency.

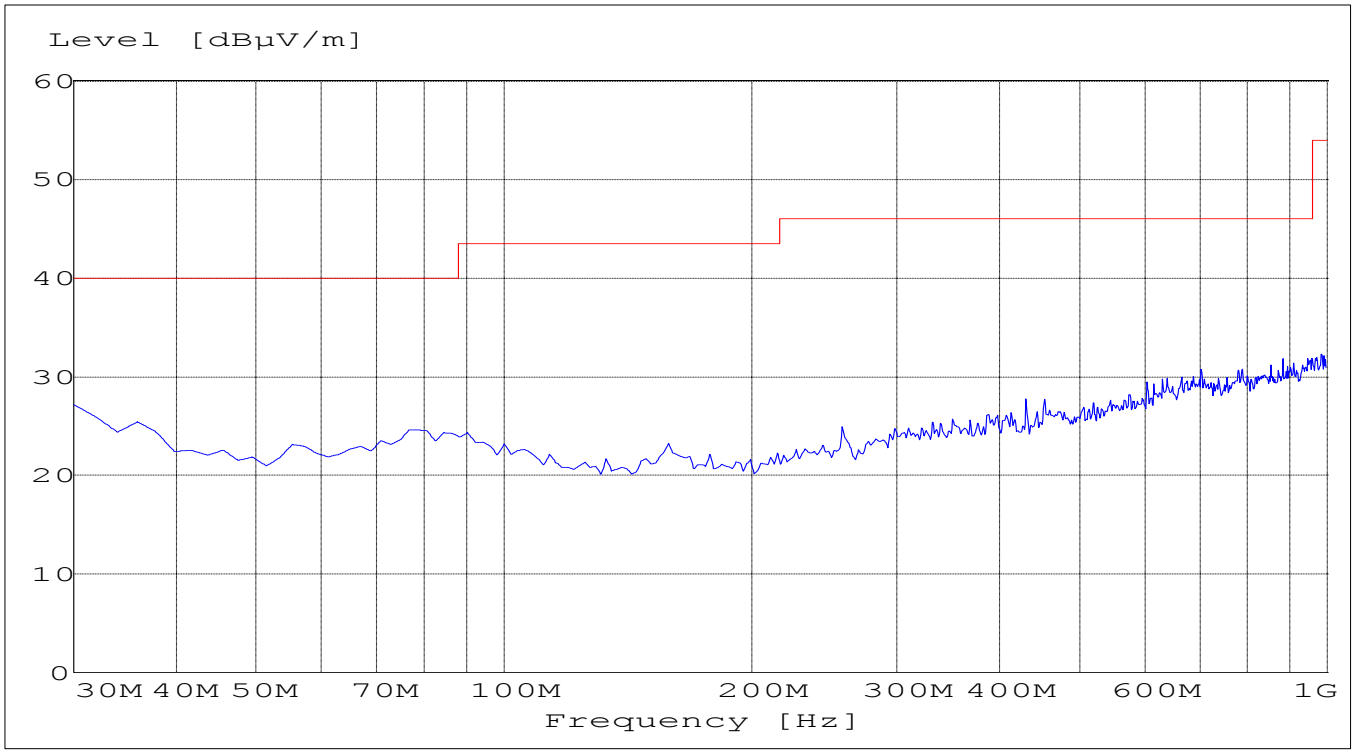
SWEEP TABLE:		"BT Spuri hi 1-8G"			
Short Description:		Bluetooth Spurious 1-8 GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	8.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

Note: due to the high noise floor measurement between 6GHz – 8GHz was repeated with different pre-amp and the emissions were found more than 6dB below the limit line.



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Middle Channel(2437MHz): 30MHz – 1GHz

SWEEP TABLE:		"BT Spuri hi 30-1G"			
Short Description:		Bluetooth 30MHz-1GHz			
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186

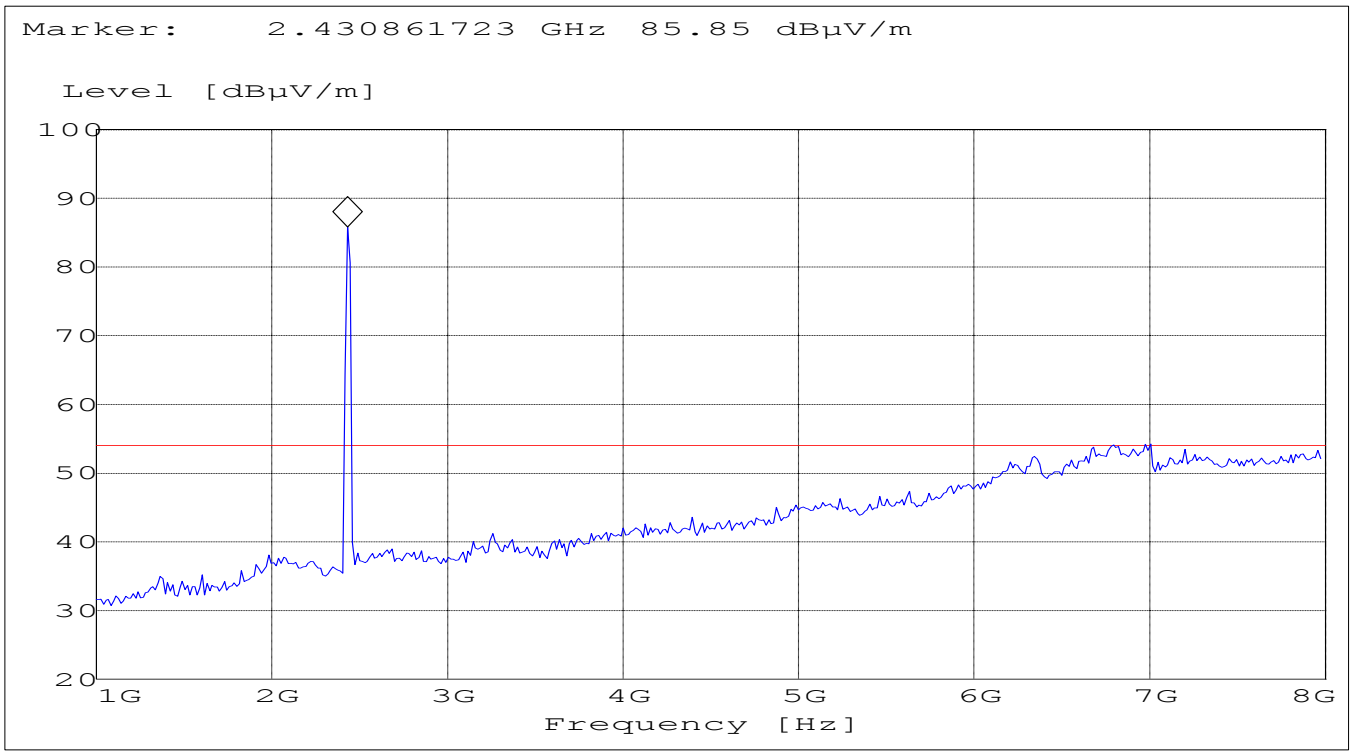


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Middle Channel(2437MHz): 1GHz – 8GHz

NOTE: The peak above the limit is the carrier frequency.

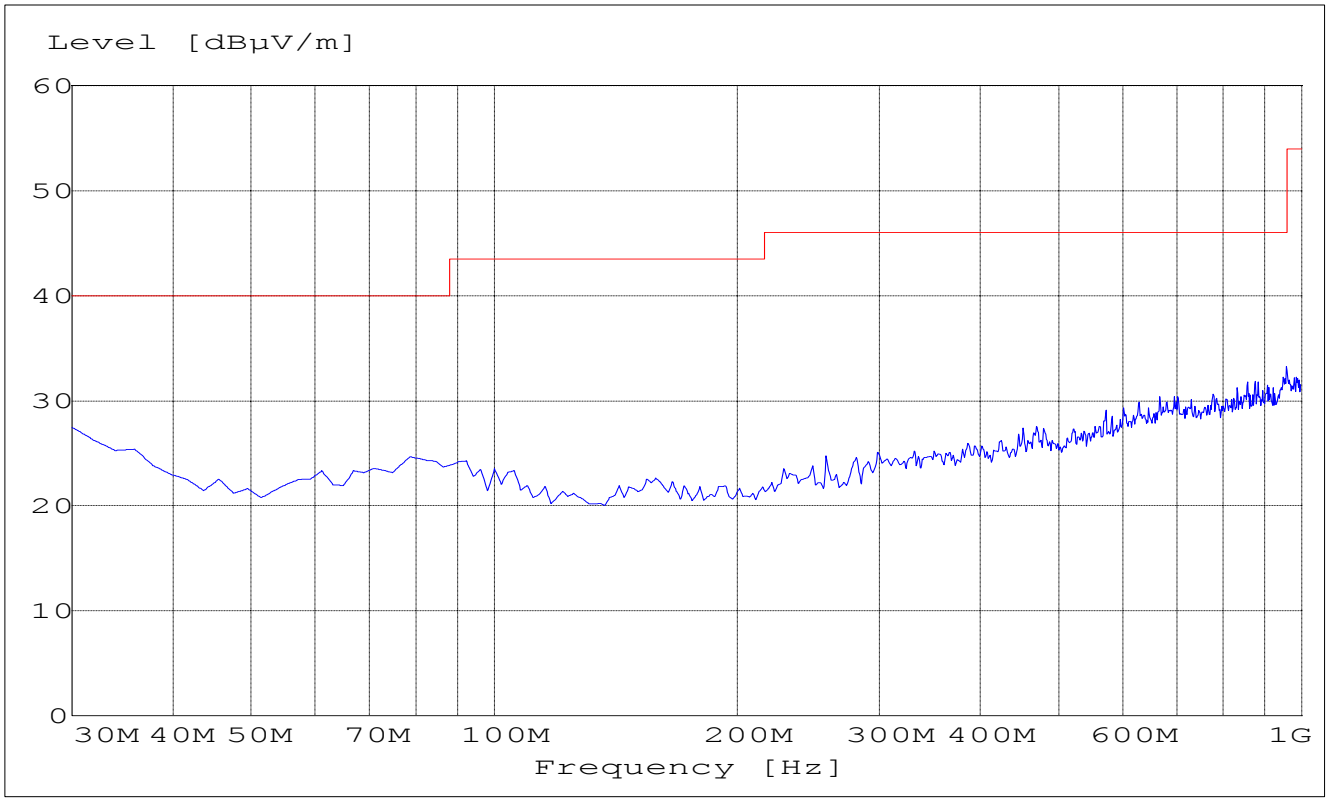
SWEEP TABLE:		"BT Spuri hi 1-8G"			
Short Description:		Bluetooth Spurious 1-8GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	8.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

Note: due to the high noise floor measurement between 6GHz – 8GHz was repeated with different pre-amp and the emissions were found more than 6dB below the limit line.



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Highest Channel(2462MHz): 30MHz – 1GHz

SWEEP TABLE:		"BT Spuri hi 30-1G"			
Short Description:		Bluetooth 30MHz-1GHz			
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186

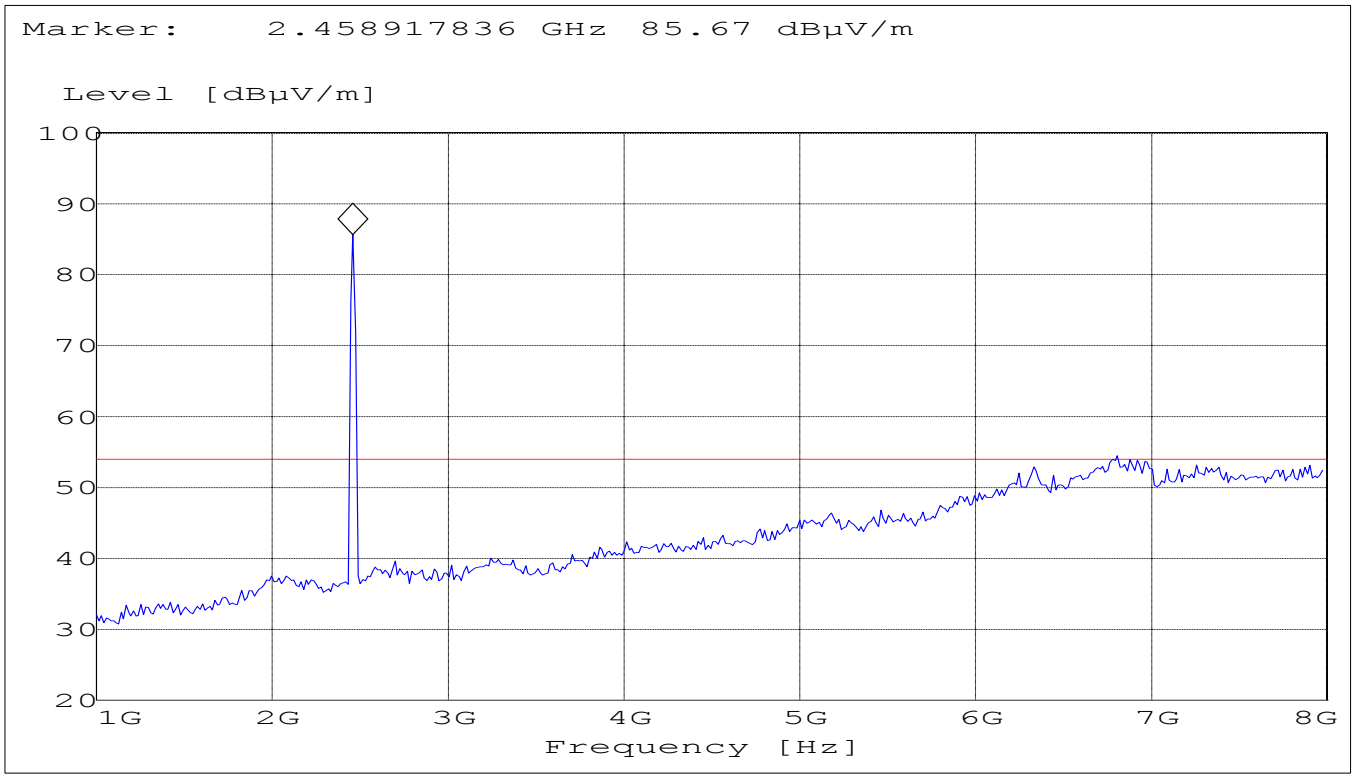


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Highest Channel(2462MHz): 1GHz – 8GHz

NOTE: The peak above the limit is the carrier frequency.

SWEEP TABLE:		"BT Spuri hi 1-8G"			
Short Description:		Bluetooth Spurious 1-8GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	8.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

Note: due to the high noise floor measurement between 6GHz – 8GHz was repeated with different pre-amp and the emissions were found more than 6dB below the limit line.

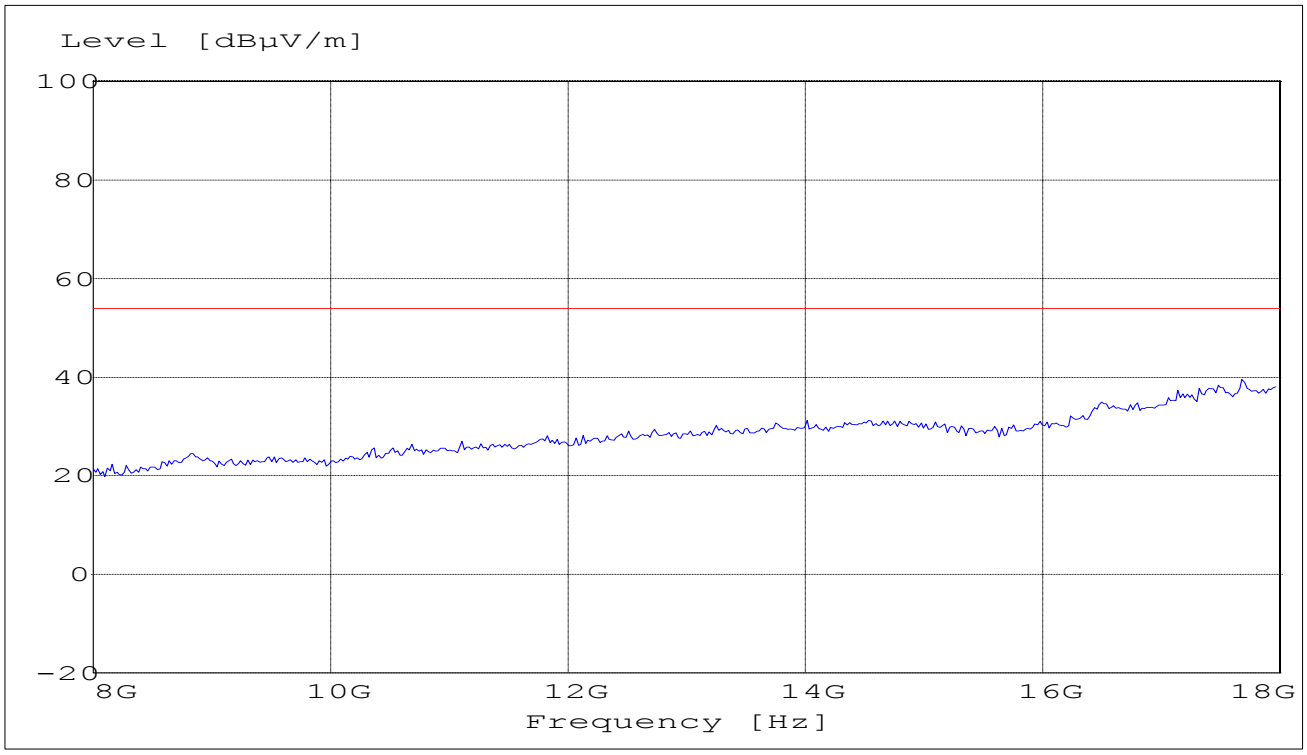


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)

8GHz – 18GHz

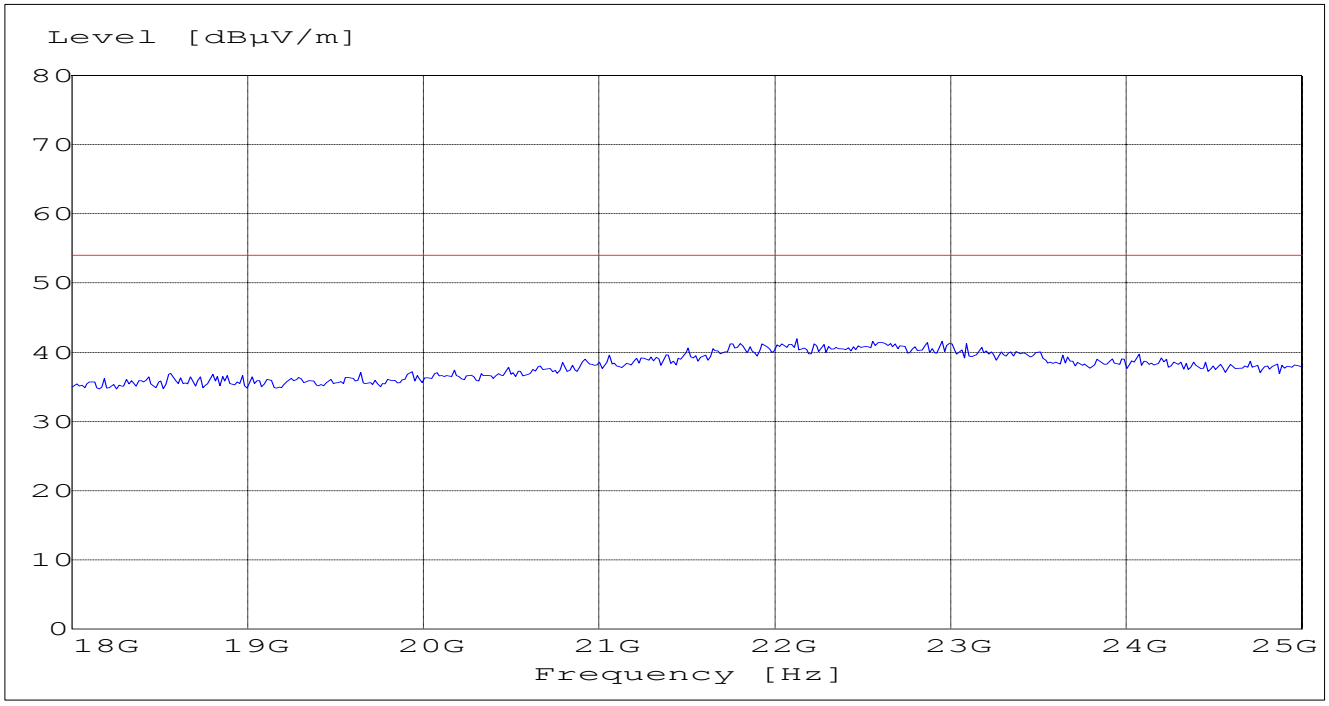
(This plot is valid for all three channels)

SWEEP TABLE:		"BT Spuri hi 8-18G"			
Short Description:		Bluetooth Spurious 8-18GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
8.0 GHz	18 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
18GHz – 25GHz
(This plot is valid for all three channels)

SWEEP TABLE:		"BT Spuri hi 18-25G"			
Short Description:		Bluetooth Spurious 18-25GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18 GHz	25 GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



CONDUCTED EMISSIONS **§ 15.107/207**

Measured with AC/DC power adapter

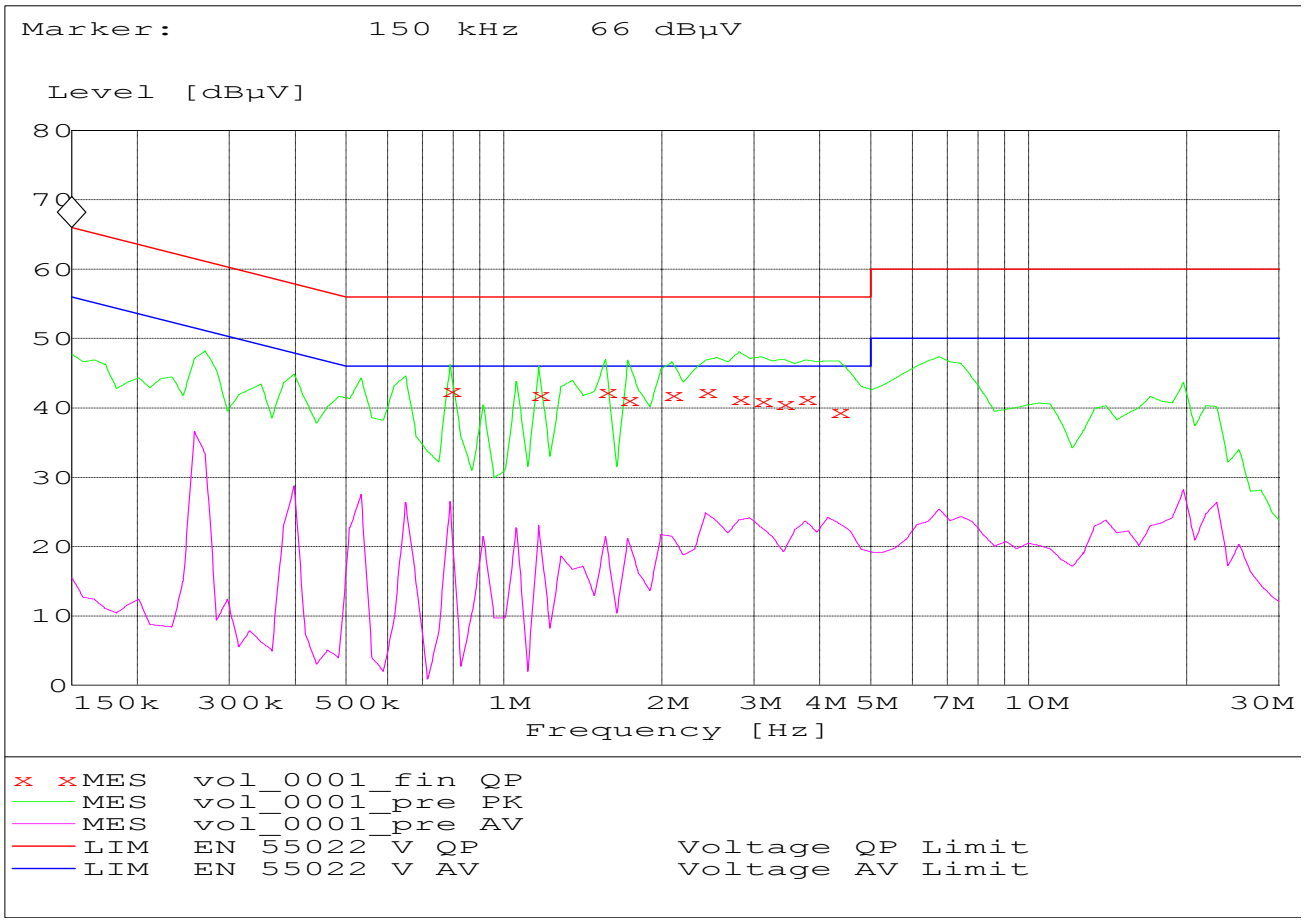
Technical specification : 15.107 / 15.207 (Revised as of October 1, 1991)

Limit

0.45 to 30 MHz	250 µV / 47.96 dBµV

ANALYZER SETTINGS: RBW = 10KHz VBW = 10KHz

Note: This measurement is carried out according to guidelines of FCC 02-157
(Limit: CISPR 22 class-B)



MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	
0.788002	42.60	0.0	56	13.4	2
1.164238	41.90	0.0	56	14.1	1
1.560190	42.30	0.0	56	13.7	1
1.720110	41.20	0.0	56	14.8	1
2.090804	41.90	0.0	56	14.1	2
2.420368	42.40	0.0	56	13.6	2
2.801878	41.40	0.0	56	14.6	2
3.089071	41.00	0.0	56	15.0	2
3.405701	40.60	0.0	56	15.4	1
3.754785	41.40	0.0	56	14.6	2
4.346633	39.50	0.0	56	16.5	1

RECEIVER SPURIOUS RADIATION § 15.209

Limits

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

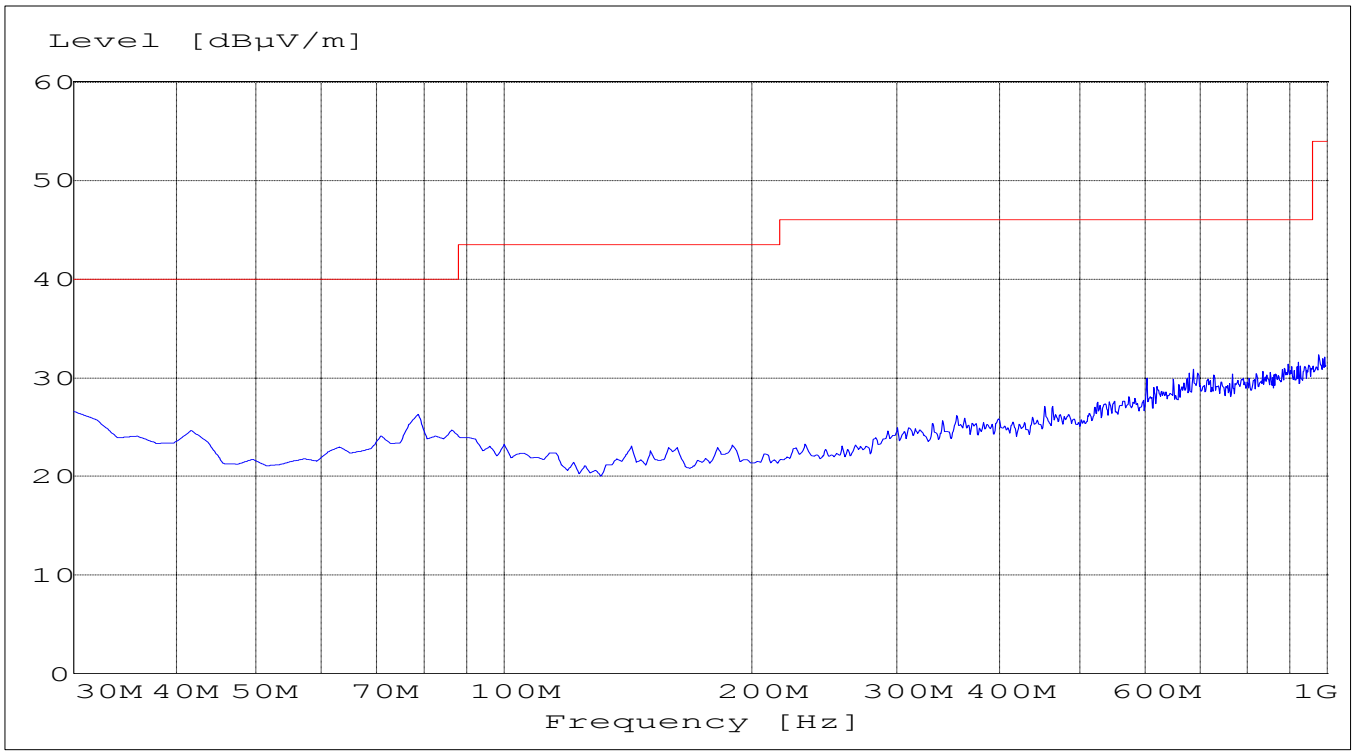
NOTE:
The radiated emissions were done with different settings, using the relevant pre-amplifiers forthe relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 18 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

RECEIVER SPURIOUS RADIATION § 15.209

30MHz – 1GHz

SWEEP TABLE: "BT Spuri hi 30-1G"
Short Description: Bluetooth 30MHz-1GHz

Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186



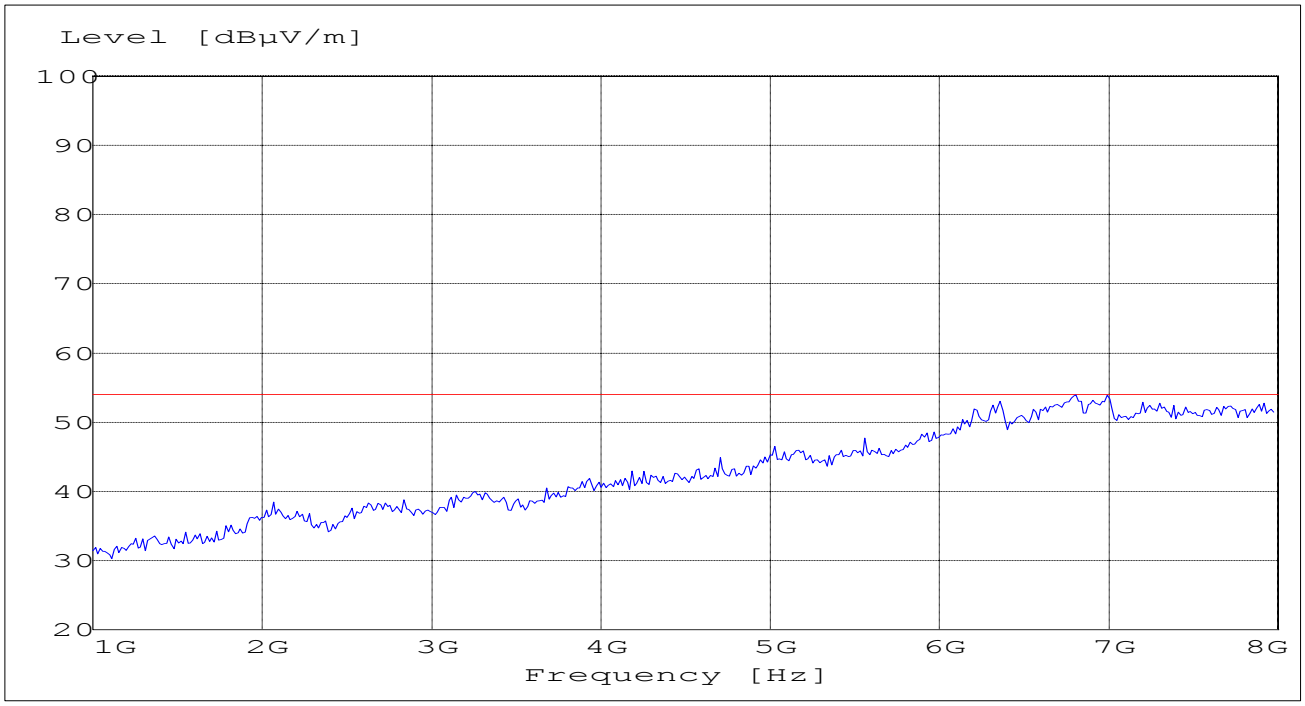
RECEIVER SPURIOUS RADIATION § 15.209

1GHz – 8GHz

SWEEP TABLE: "BT Spuri hi 1-8G"
Short Description: Bluetooth Spurious 1-8 GHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	8.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

Note: due to the high noise floor measurement between 6GHz – 8GHz was repeated with different pre-amp and the emissions were found more than 6dB below the limit line.

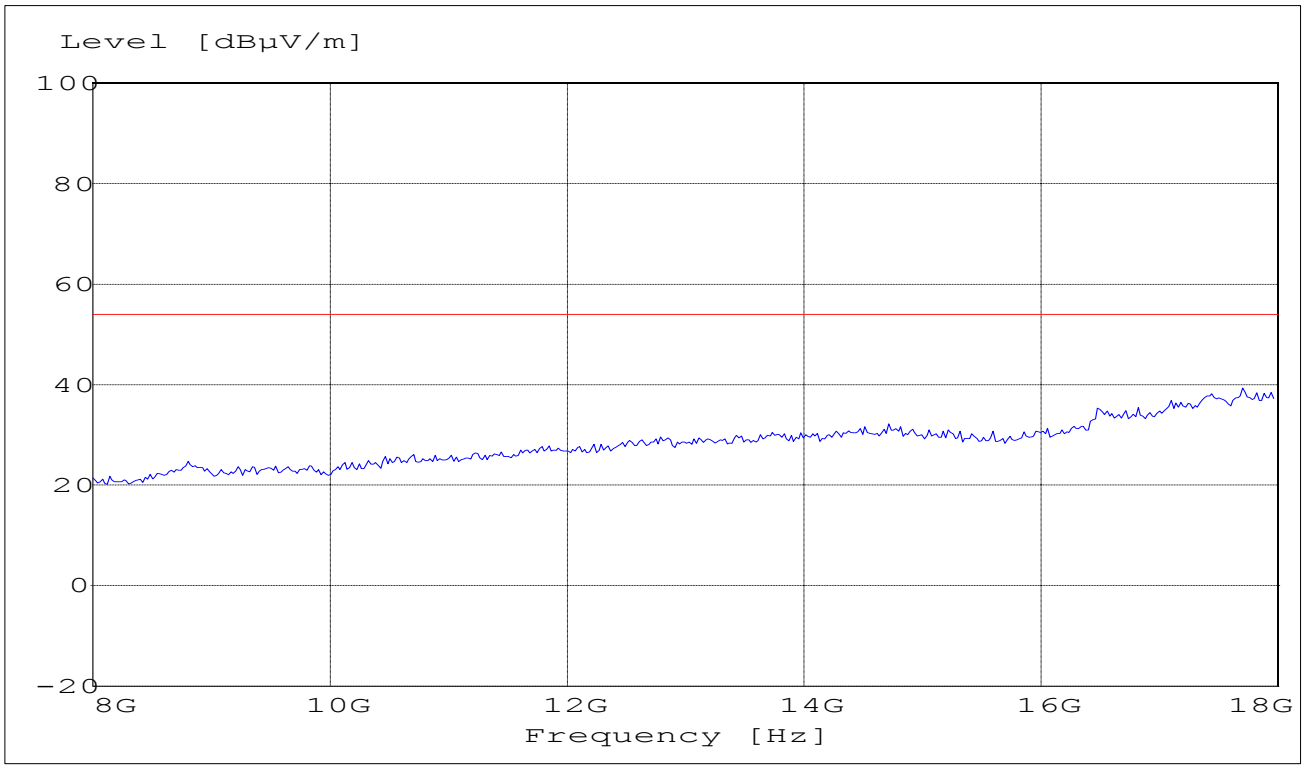


RECEIVER SPURIOUS RADIATION § 15.209

8GHz – 18GHz

SWEEP TABLE: "BT Spuri hi 8-18G"
Short Description: Bluetooth Spurious 8-18GHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
8.0 GHz	18 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

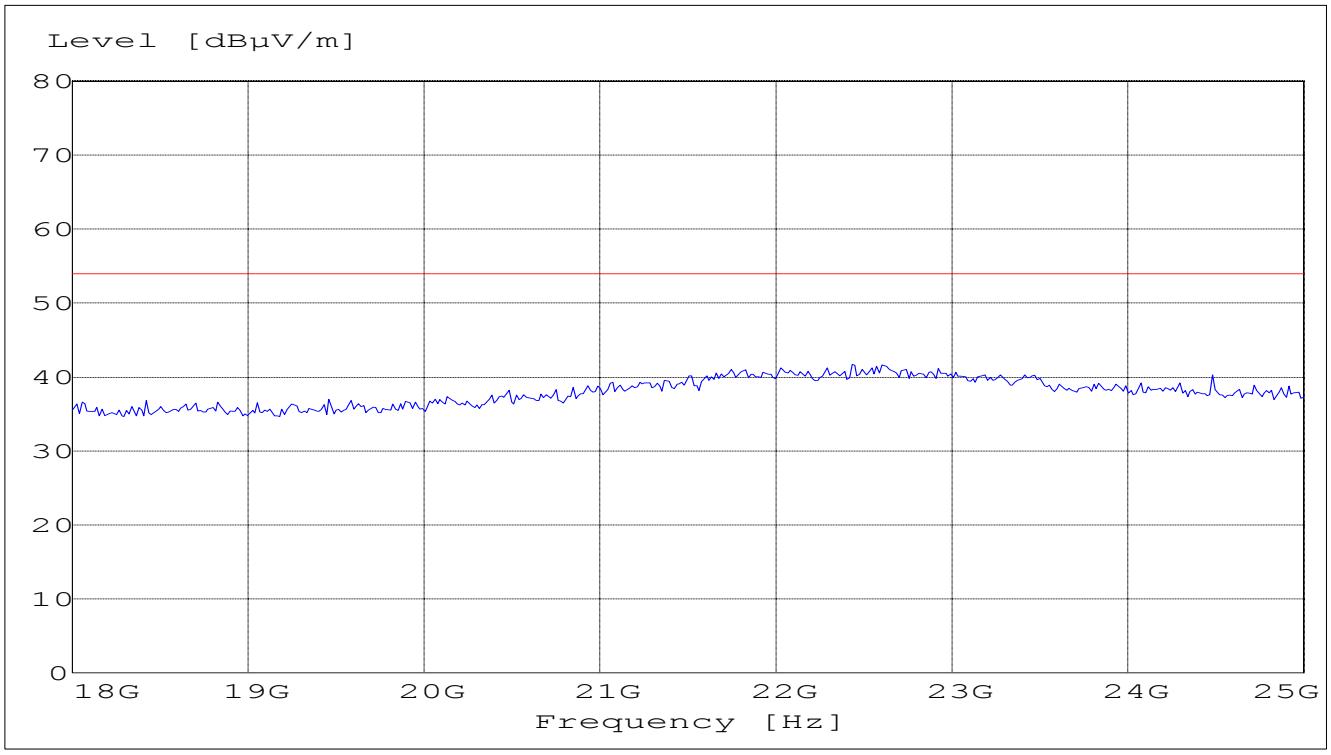


RECEIVER SPURIOUS RADIATION § 15.209

18GHz – 25GHz

SWEEP TABLE: "BT Spuri hi 18-25G"
Short Description: Bluetooth Spurious 18-25GHz

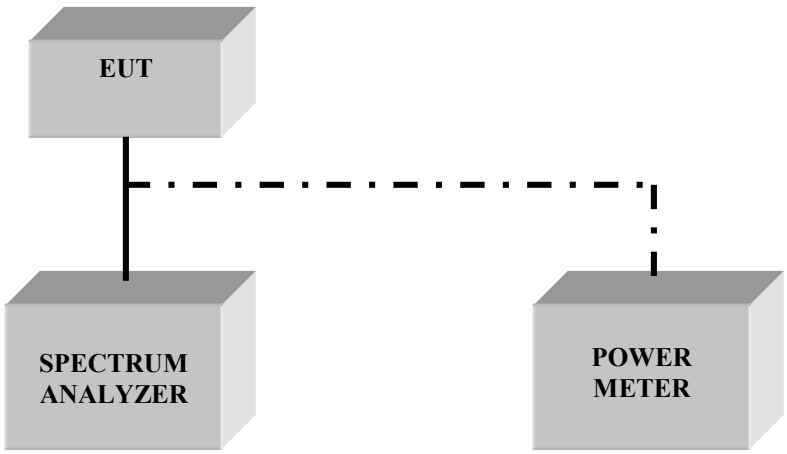
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18 GHz	25 GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	ESIB 40	Rohde & Schwarz	100107
02	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	826880/010
03	Signal Generator	SMY02	Rohde & Schwarz	836878/011
04	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02
05	Power Amlifier	250W1000	Amplifier Research	300031
06	Biconilog Antenna	3141	EMCO	0005-1186
07	Horn Antenna	SAS-200/571	AH Systems	325
08	Power Splitter	11667B	Hewlett Packard	645348
09	Climatic Chamber	VT4004	Votch	G1115
10	Pre-Amplifier	JS4-00102600	Miteq	00616
11	Power Sensor	URV5-Z2	Rohde & Schwarz	DE30807
12	Digital Radio Comm. Tester	CMD-55	Rohde & Schwarz	847958/008

BLOCK DIAGRAMS
Conducted Testing



Radiated Testing