CETECOM Inc.

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

Test report no.: EMC_382_FCC15.247_2002_S56
FCC Part 15.247 for FHSS systems / CANADA RSS-210
(S56)
FCC ID: PWX-S56

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: Philip Kim

1.2 Testing laboratory

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Phone: +1 408 586 6200 Fax: +1 408 586 6299
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1.3 Details of applicant

Name	**:**	**SIEMENS Mobile LLC**
Street	**:**	**16745 West Bernardo Dr.**
City / Zip Code	**:**	**San Diego, CA 92129**
Country	**:**	**U.S.A**
Contact	**:**	**Dr. Peter Nevermann**
Telephone	**:**	**(858) 521 3282**
Tele-fax	**:**	**(858) 521 3105**
e-mail	**:**	**peter.nevermann@icm.siemens.com**

1.4 Application details

Date of receipt of application	:	2002-11-23
Date of receipt test item	:	2002-11-23
Date of test	:	2002-11-23, 11-25 through 11-26

1.5 Test item

Manufacturer	:	SIEMENS
Street Address	:	Suedstr. 9
City / Zip Code	:	47475 Kamp-Lintfort
Country	:	Germany
Marketing Name	:	S56
Model No.	:	L56 Marlin
Serial No.	:	IMEI: 001002000214036
Description	:	GSM 850/1900 mobile phone + Bluetooth
FCC-ID	:	PWX-S56

Additional information

Frequency	:	2402 MHz – 2480 MHz for Bluetooth
Type of modulation	:	GFSK / FHSS for Bluetooth
Number of channels	:	79 for Bluetooth
Antenna	:	embedded
Power supply	:	Battery or charger (AC adaptor)
Output power	:	1.38dBm (1.374mW) max. EIRP
Extreme vol. Limits	:	3.6 VDC – 5.2 VDC
Extreme temp. Tolerance	:	-30 C to +50 C

1.6 Test standards: FCC Part 15 §15.247 (DA00-705)

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
2002-12-18	EMC & Radio	Siegfried Lehmann (Technical Manager)	

Responsible for test report and project leader:

Date	Section	Name	Signature
2002-12-18	EMC & Radio	Philip Kim (EMC Engineer)	

2.2 Test report

TEST REPORT

Test report no. : EMC_382_FCC15.247_2002_S56 (S56)

TEST REPORT REFERENCE

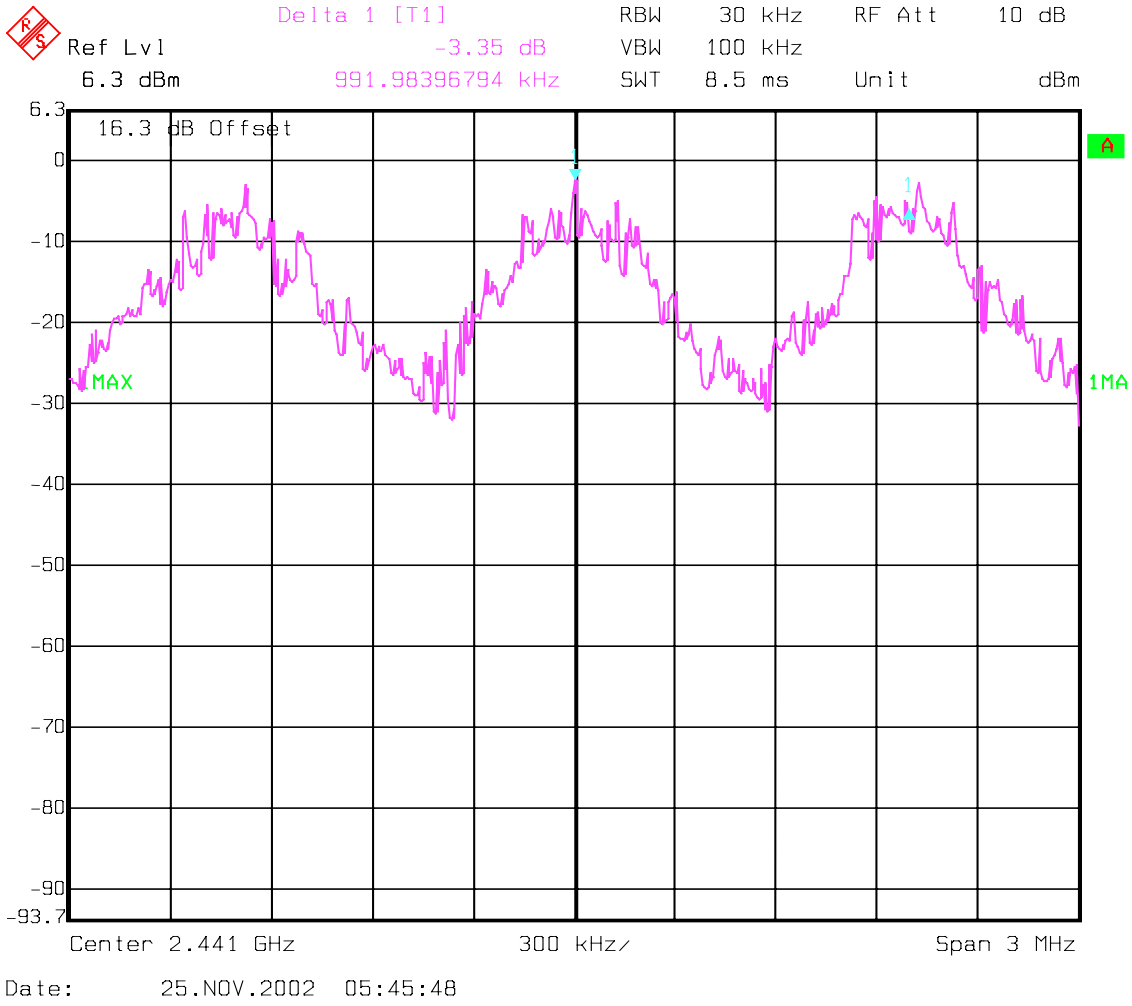
ANTENNA GAIN **§ 15.204**

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	0.17 dBm	-2.01 dBm	-2.23 dBm
Raidated Power (EIRP)	1.38 dBm	0.37 dBm	1.01 dBm
Antenna Gain	1.21 dBi	2.38 dBi	3.24dBi

The calculated antenna gain is between 1.21 and 3.24 dBi.

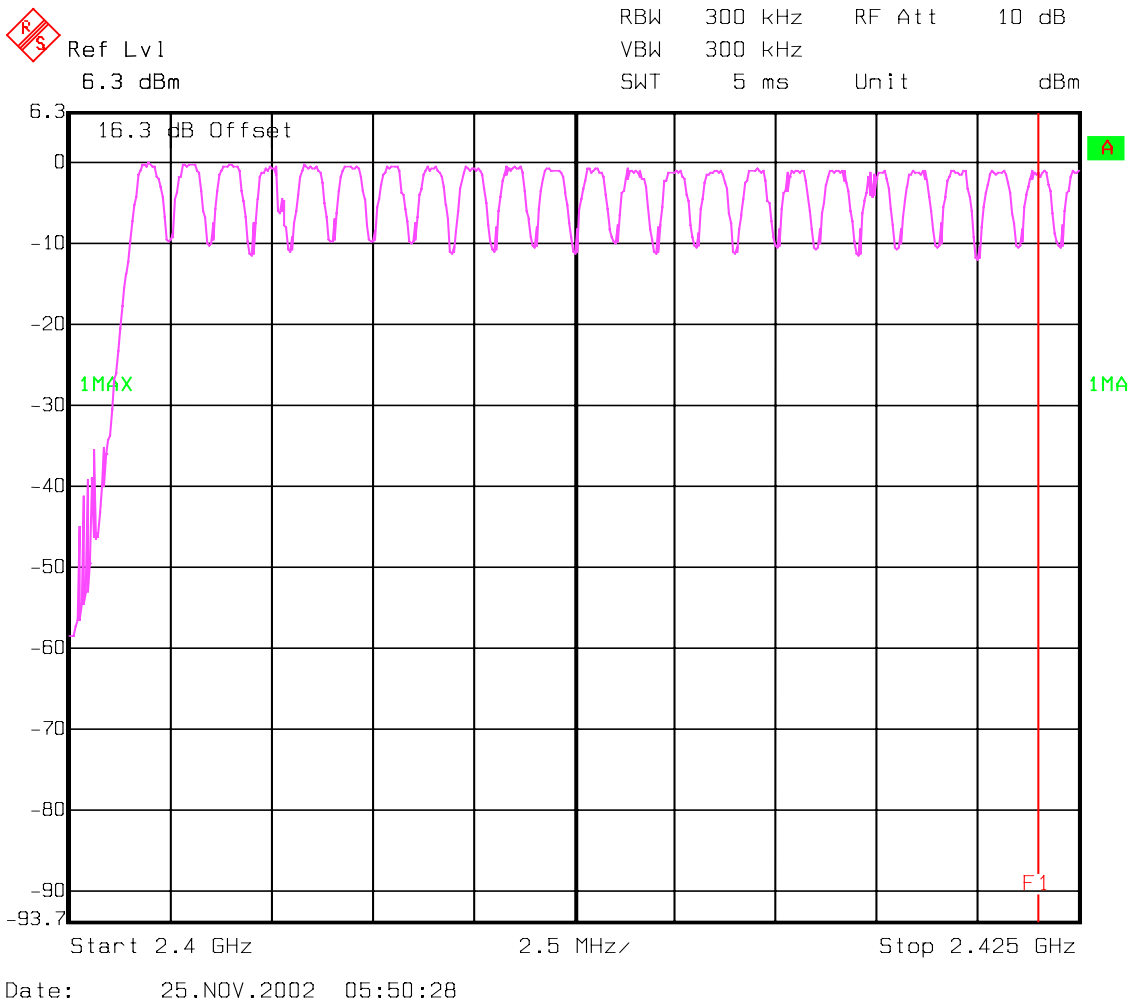
CARRIER FREQUENCY SEPERATION §15.247(a)



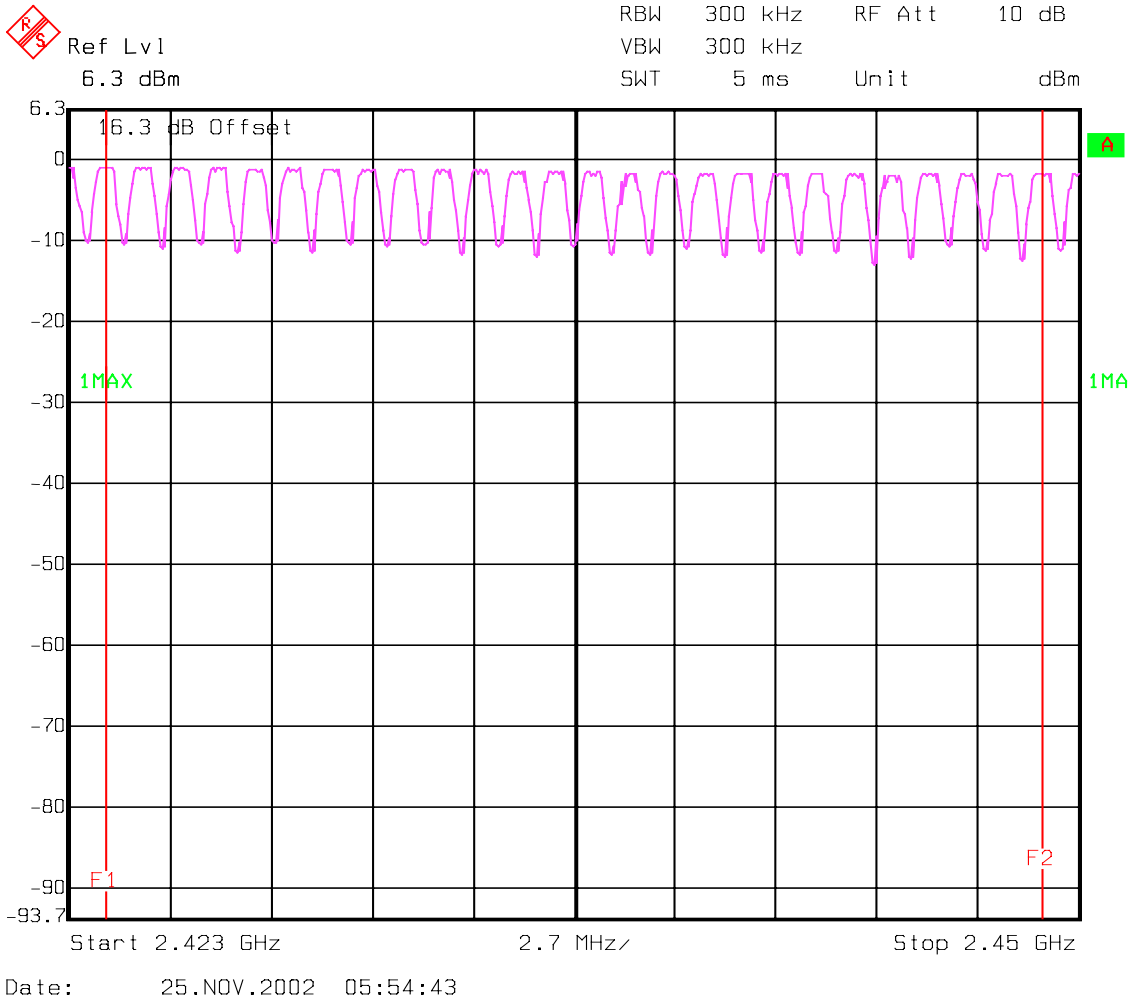
NUMBER OF HOPPING CHANNELS §15.247(a)

The number of hopping channels is 79 (see next 4 plots)
The right red line corresponds to the left red line from the next plot.

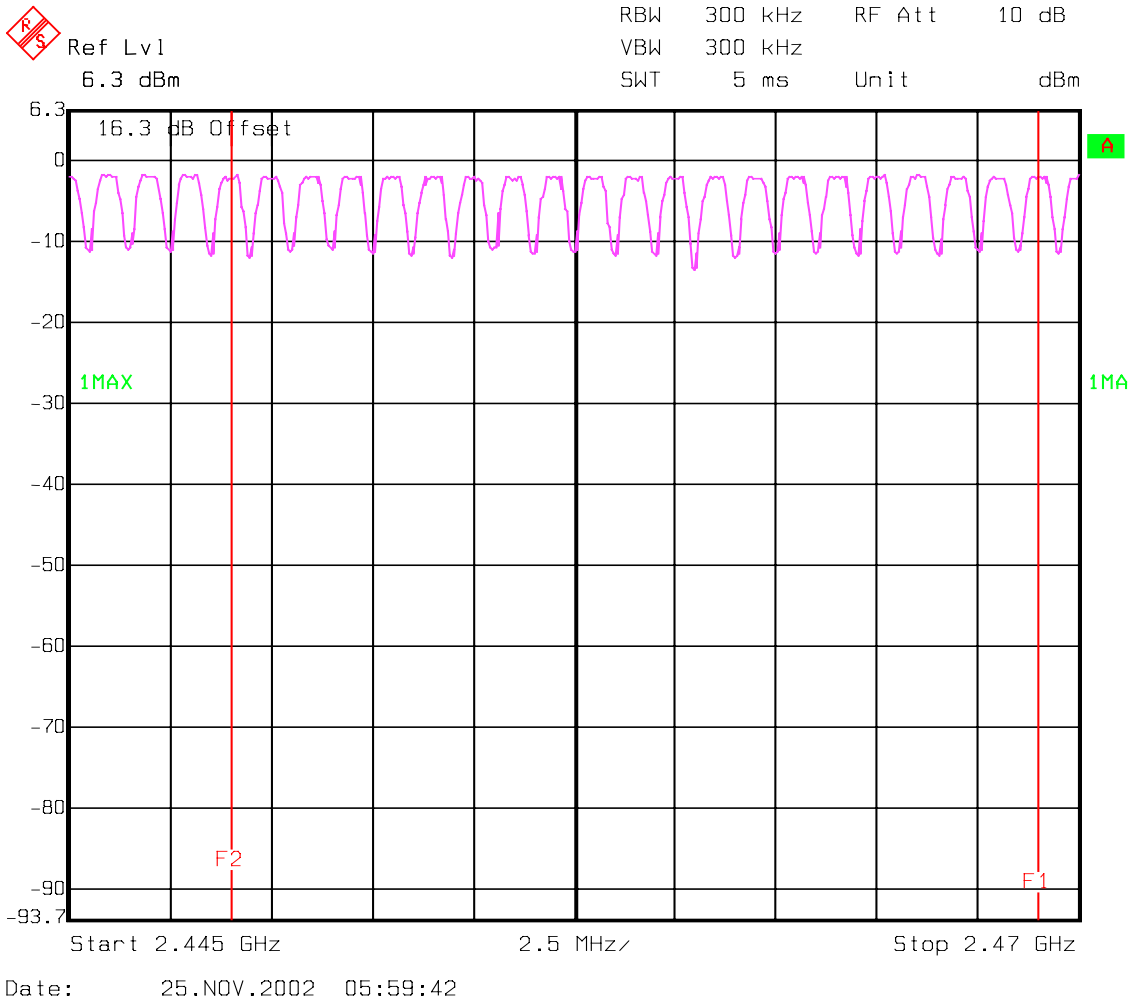
Plot 1: Total 23



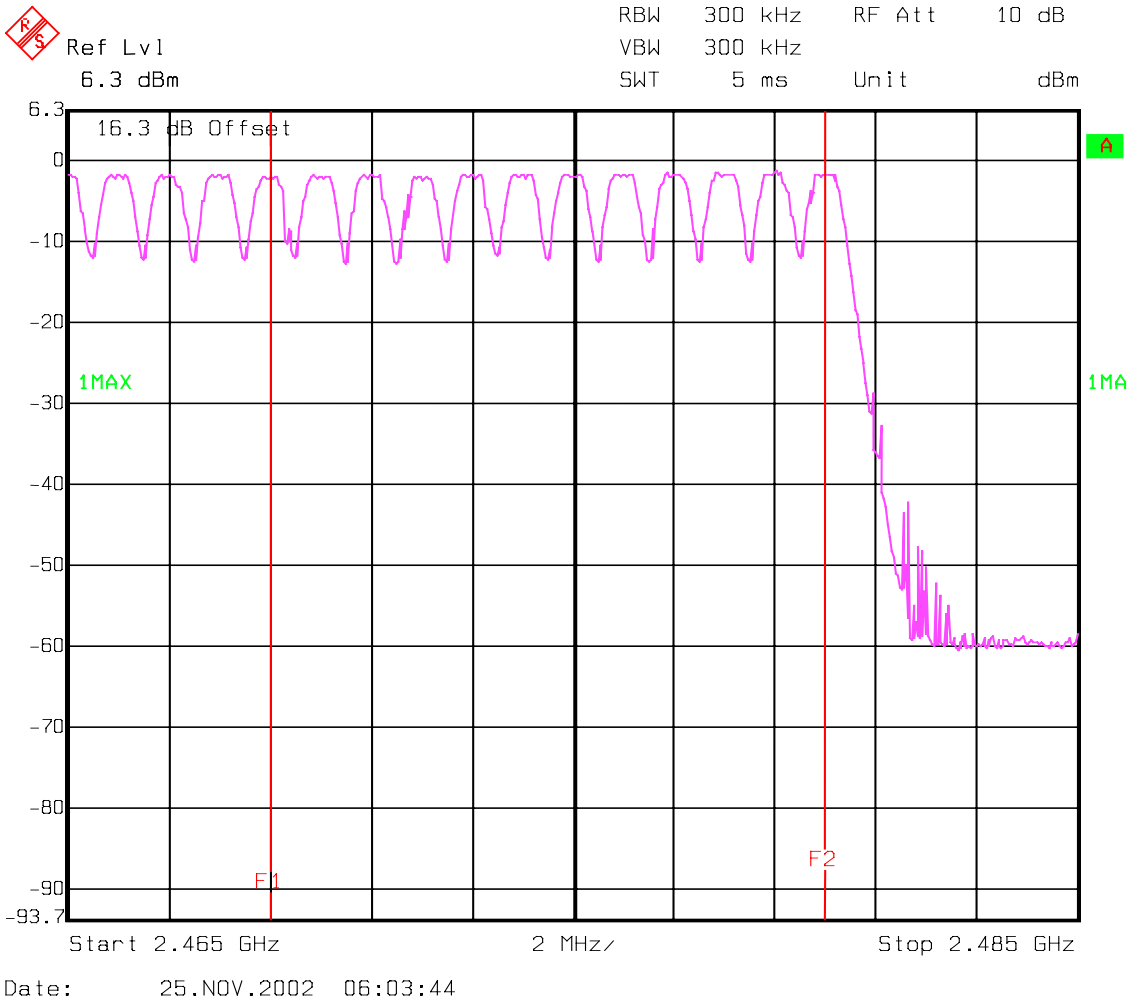
Plot 2: Total 25



Plot 3: Total 20



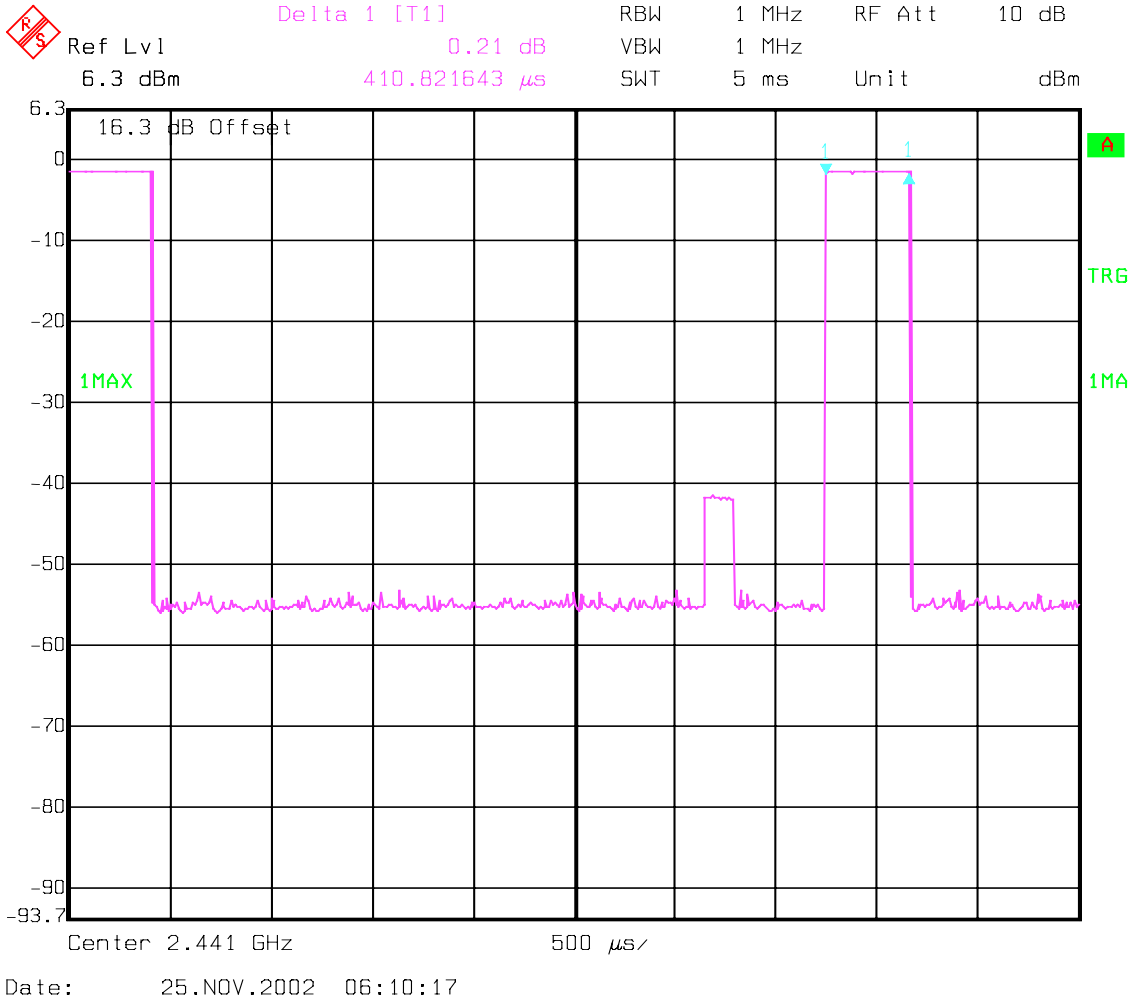
Plot 4: Total 11



TIME OF OCCUPANCY (DWELL TIME) §15.247(a)

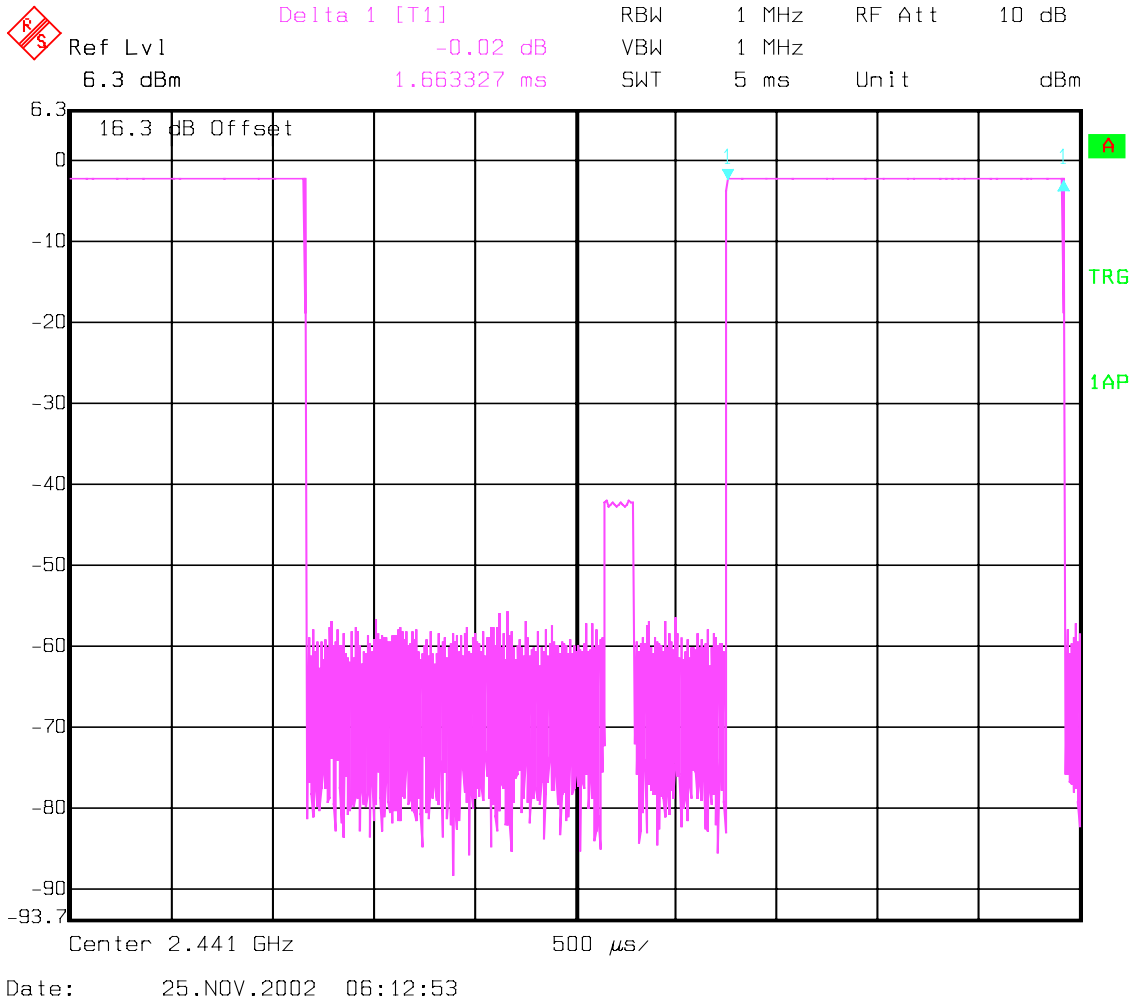
DH1 – Packet

The system makes worst case 1600 hops per second or 1 time slot has a length of 625µs with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 800 hops per second with 79 channels. So you have each channel 10.13 times per second and so for 30 seconds you have 303.9 times of appearence .
Each Tx-time per appearence is 410.8 µs.
So we have 303.9 * 410.8 µs = 124.84 ms per 30 seconds.



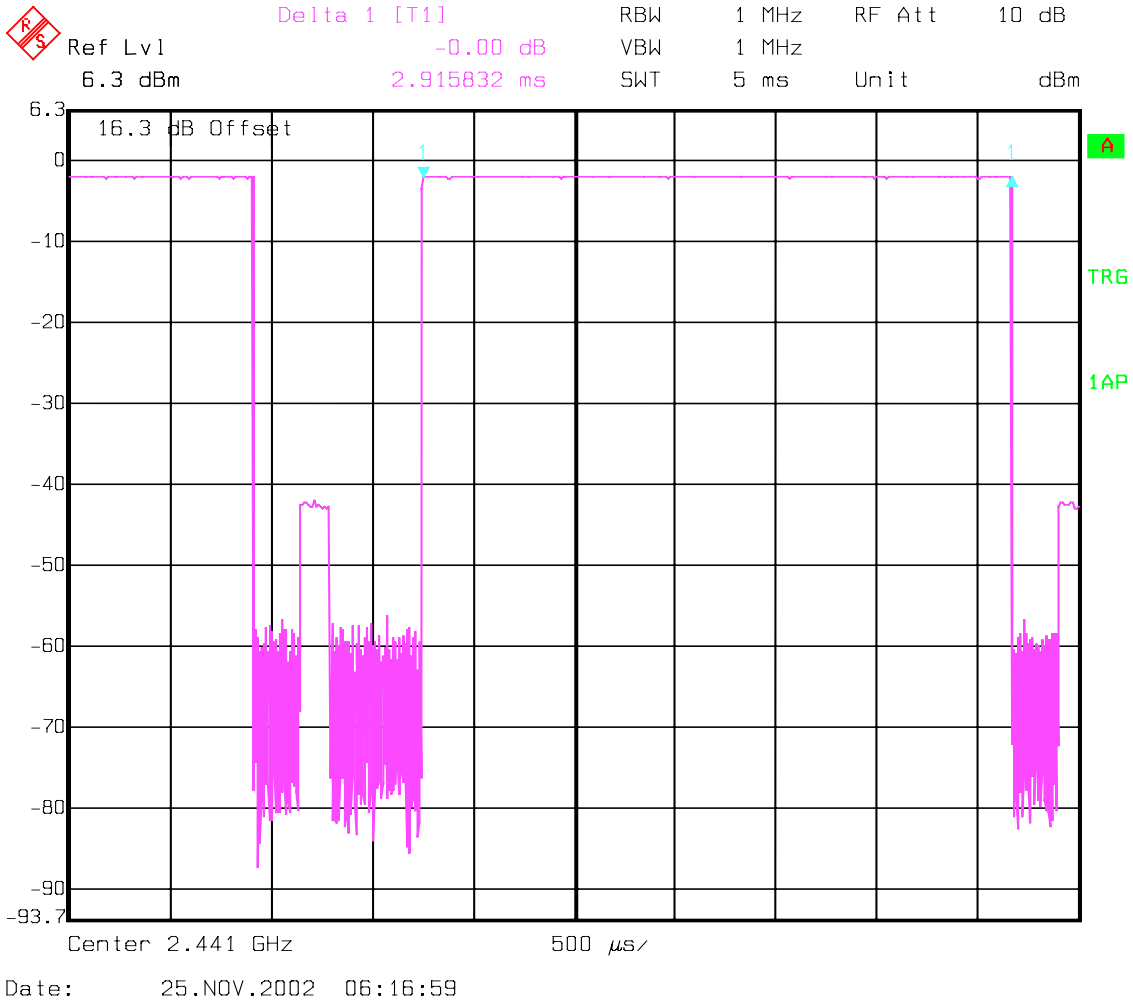
TIME OF OCCUPANCY (DWELL TIME) §15.247(a)
DH3 – Packet

A DH3 Packets need 3 time slots for transmit and 1 for receicing, then the system makes worst case 400 hops per second with 79 channels. So you have each channel 5.1 times per second and so for 30 seconds you have 153 times of appearence .
Each Tx-time per appearence is 1.66 ms.
So we have 153 * 1.66 ms = 253.98 ms per 30 seconds.



TIME OF OCCUPANCY (DWELL TIME) §15.247(a)
DH5 – Packet

At DH5 Packets you need 5 time slots for transmit and 1 for receicing,then the system makes worst case 266,7 hops per second with 79 channels. So you have each channel 3.36 times per second and so for 30 seconds you have 100.8 times of appearence .
Each tx-time per appearence is 2.91ms.
<u>So we have 100.8 * 2.91ms = 293.32 ms per 30 seconds.</u>



SPECTRUM BANDWIDTH OF FHSS SYSTEM §15.247(a)
20 dB bandwidth

TEST CONDITIONS		20 dB BANDWIDTH (kHz)		
Frequency (MHz)		2402	2441	2480
T_{nom}(23)°C	V_{nom}(3.8)VDC	921.84	929.86	925.85

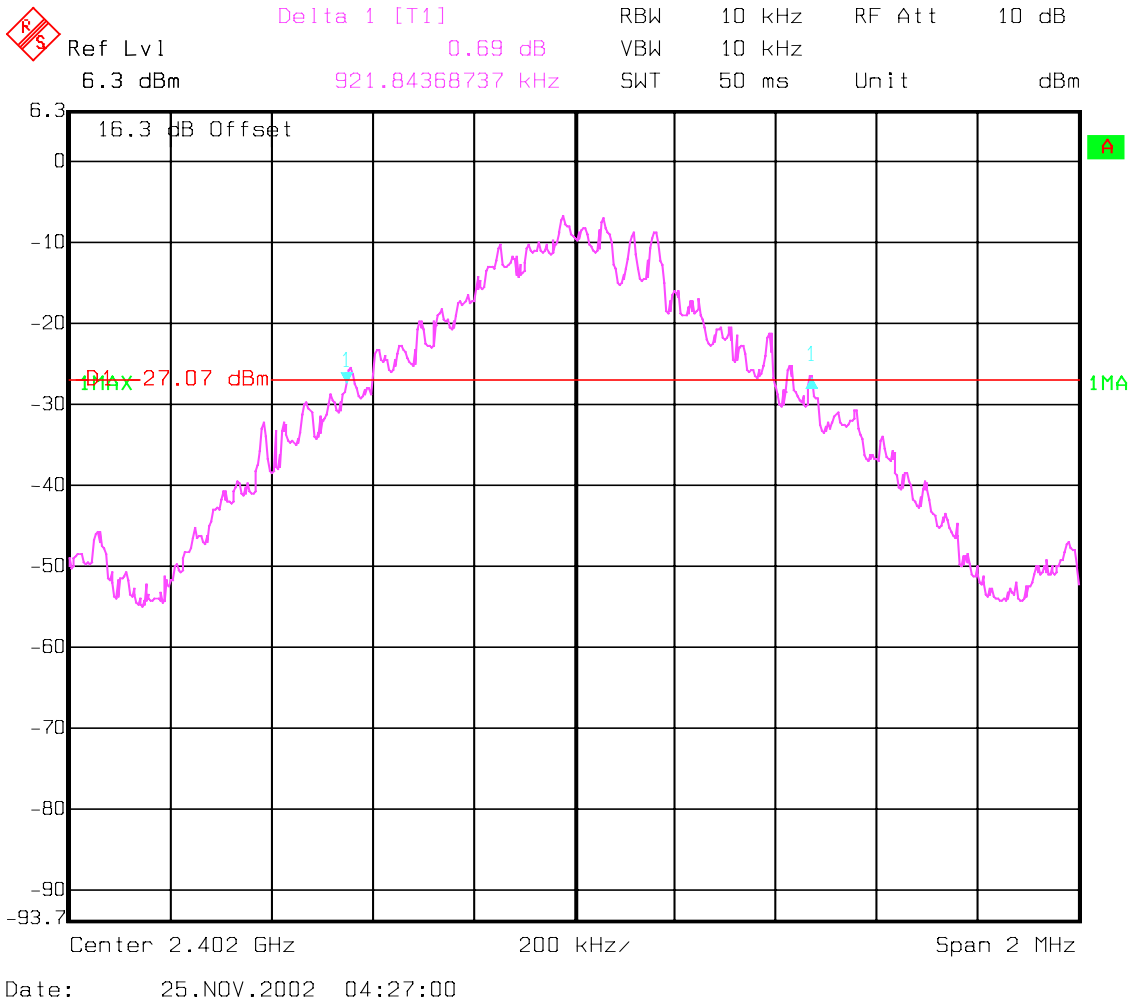
RBW / VBW as provided in the "Measurement Guidelines'' (DA 00-705, March 30, 2000)

LIMIT SUBCLAUSE §15.247(a) (1)

The maximum 20dB bandwith shall be at maximum 1000 KHz

SPECTRUM BANDWIDTH OF FHSS SYSTEM **§15.247(a)**
20 dB bandwidth

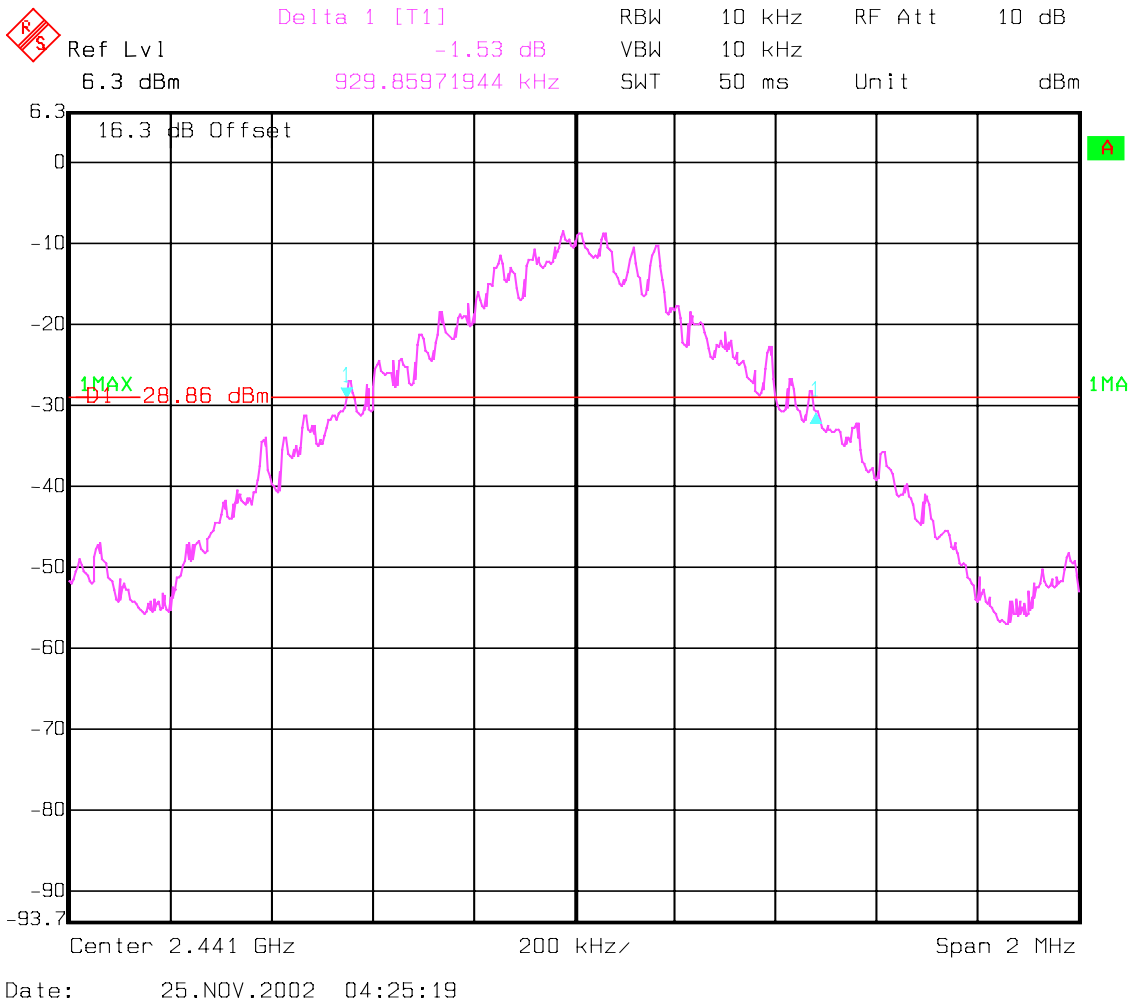
Lowest Channel: 2402MHz



SPECTRUM BANDWIDTH OF FHSS SYSTEM §15.247(a)

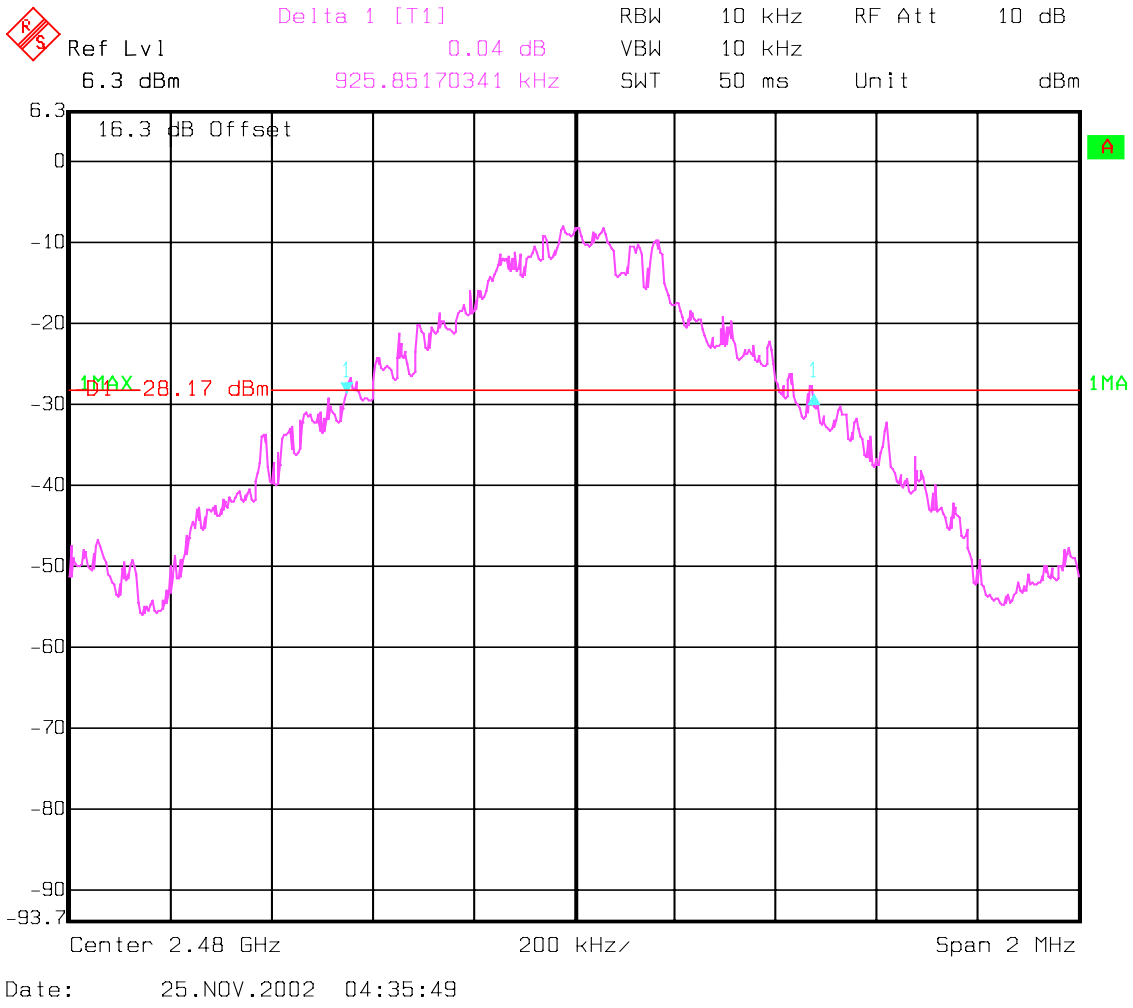
20 dB bandwidth

Mid Channel: 2441MHz



SPECTRUM BANDWIDTH OF FHSS SYSTEM §15.247(a)
20 dB bandwidth

Highest Channel: 2480MHz



POWER SPECTRAL DENSITY §15.247 (d)

TEST CONDITIONS		POWER SPECTRAL DENSITY (dBm)		
Frequency (MHz)		2402	2441	2480
T_{nom}(23)°C	V_{nom}(3.8)VDC	-12.00	-13.79	-13.48

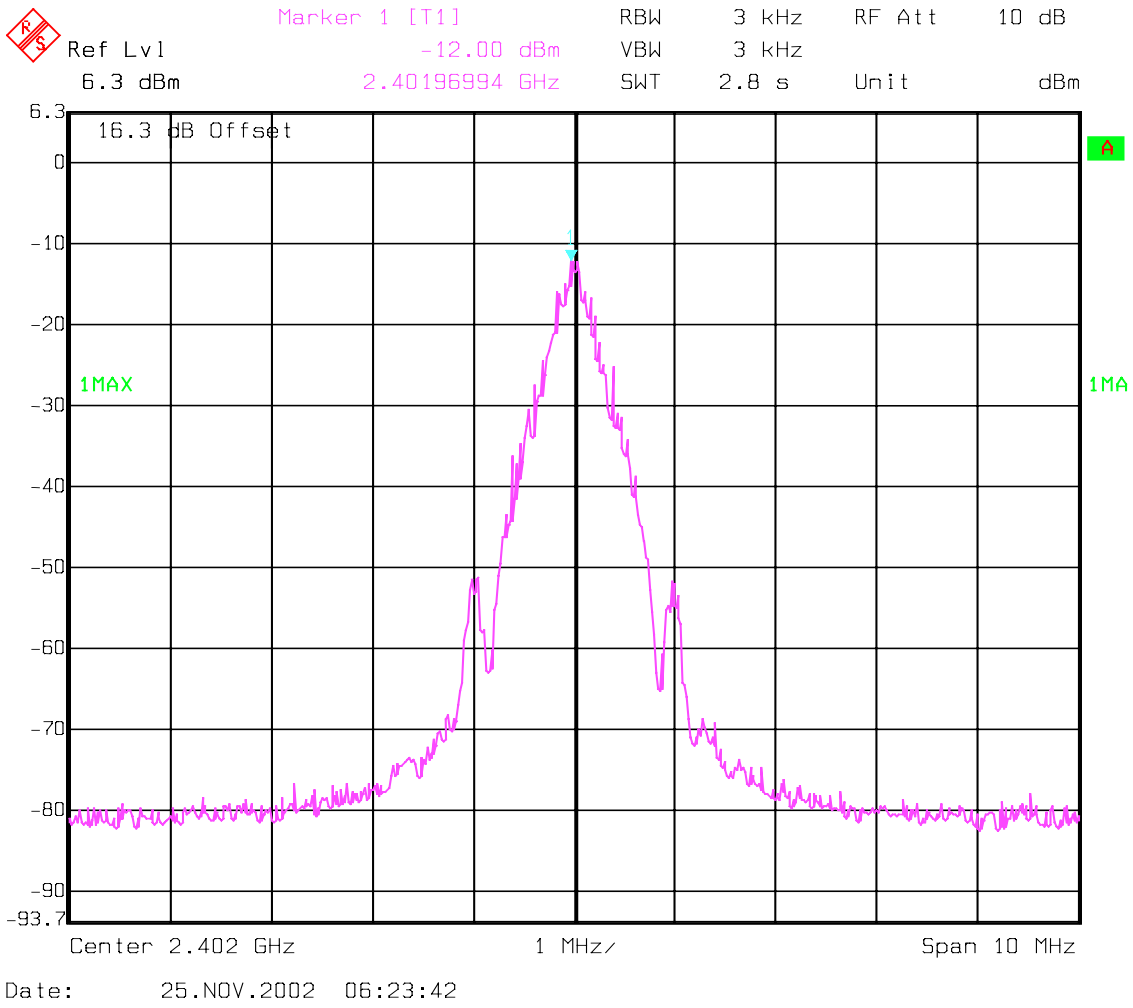
LIMIT **SUBCLAUSE §15.247(d)**

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

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

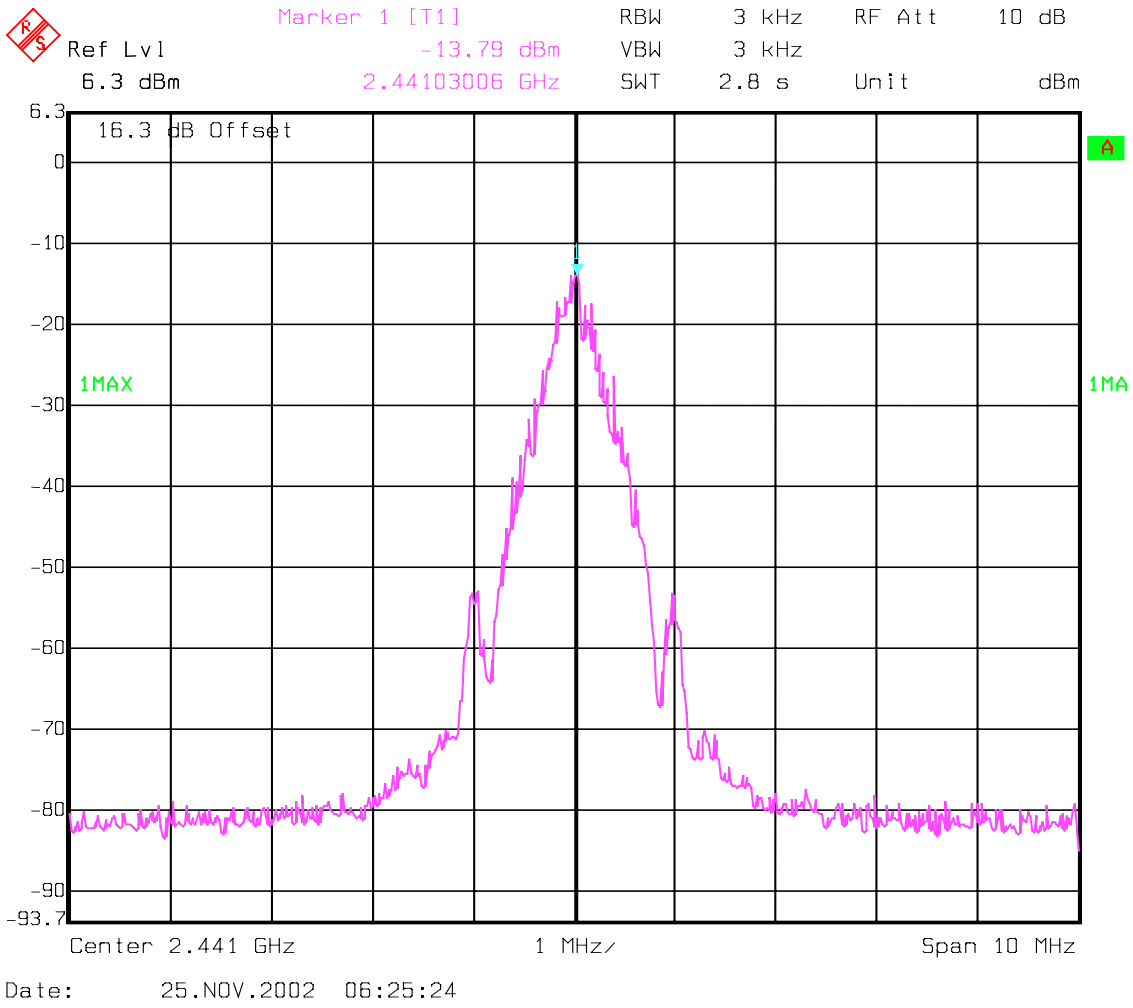
POWER SPECTRAL DENSITY §15.247(d)

Lowest Channel: 2402MHz



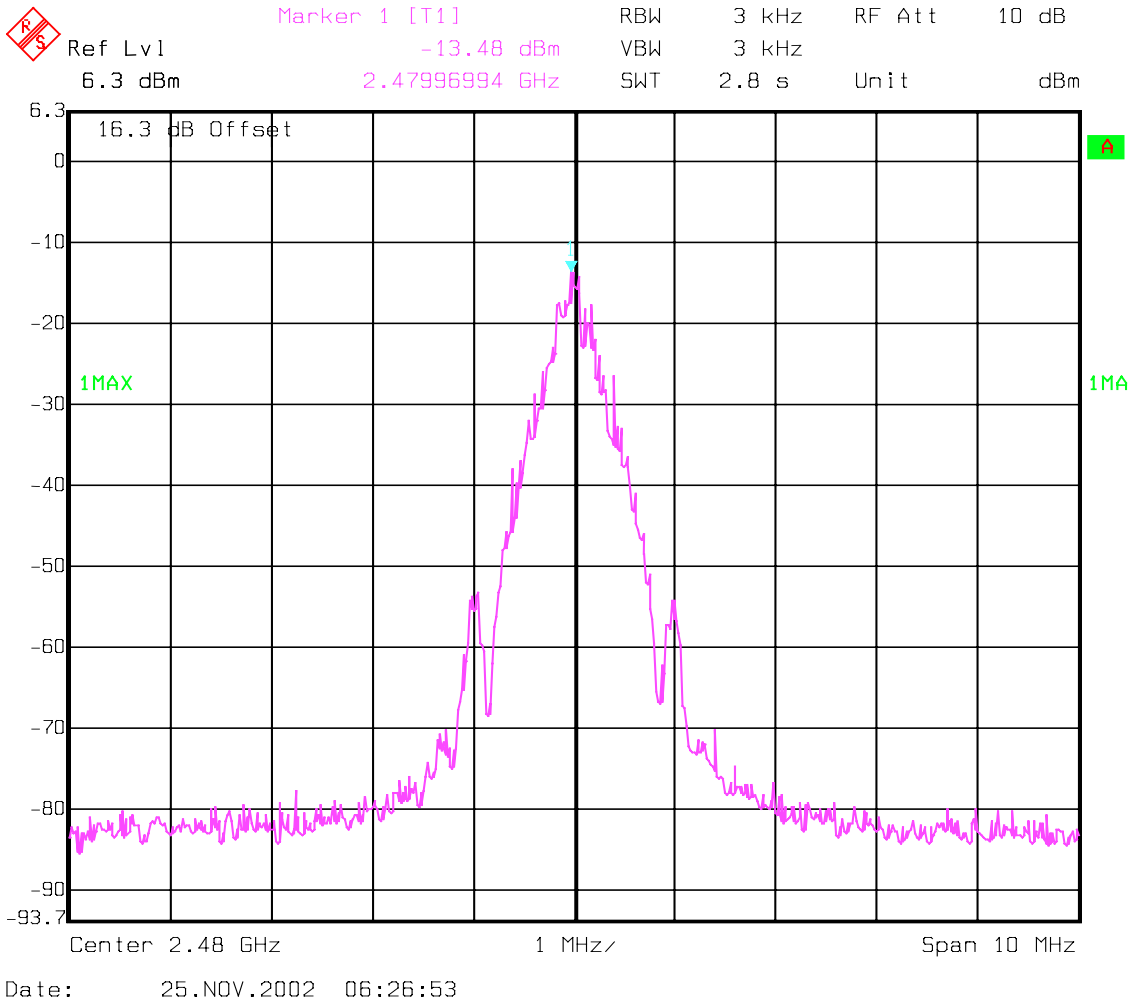
POWER SPECTRAL DENSITY §15.247(d)

Middle Channel: 2441MHz



POWER SPECTRAL DENSITY §15.247(d)

Highest Channel: 2480MHz



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

Note: No plots has been provide for conducted measurements, see plots under EIRP.

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402	2441	2480
T_{nom}(23)°C	V_{nom}(3.8)VDC	0.17	-2.01	-2.23
Measurement uncertainity		±0.5dBm		

RBW / VBW : 3 MHz

LIMIT **SUBCLAUSE § 15.247 (b) (1)**

Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

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

EIRP:

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2402	2441	2480
T_{nom}(23)°C	V_{nom}(3.8)VDC	1.38	0.37	1.01
Measurement uncertainty		±0.5dBm		

RBW/VBW : 3 MHz

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

LIMIT **SUBCLAUSE § 15.247 (b) (1)**

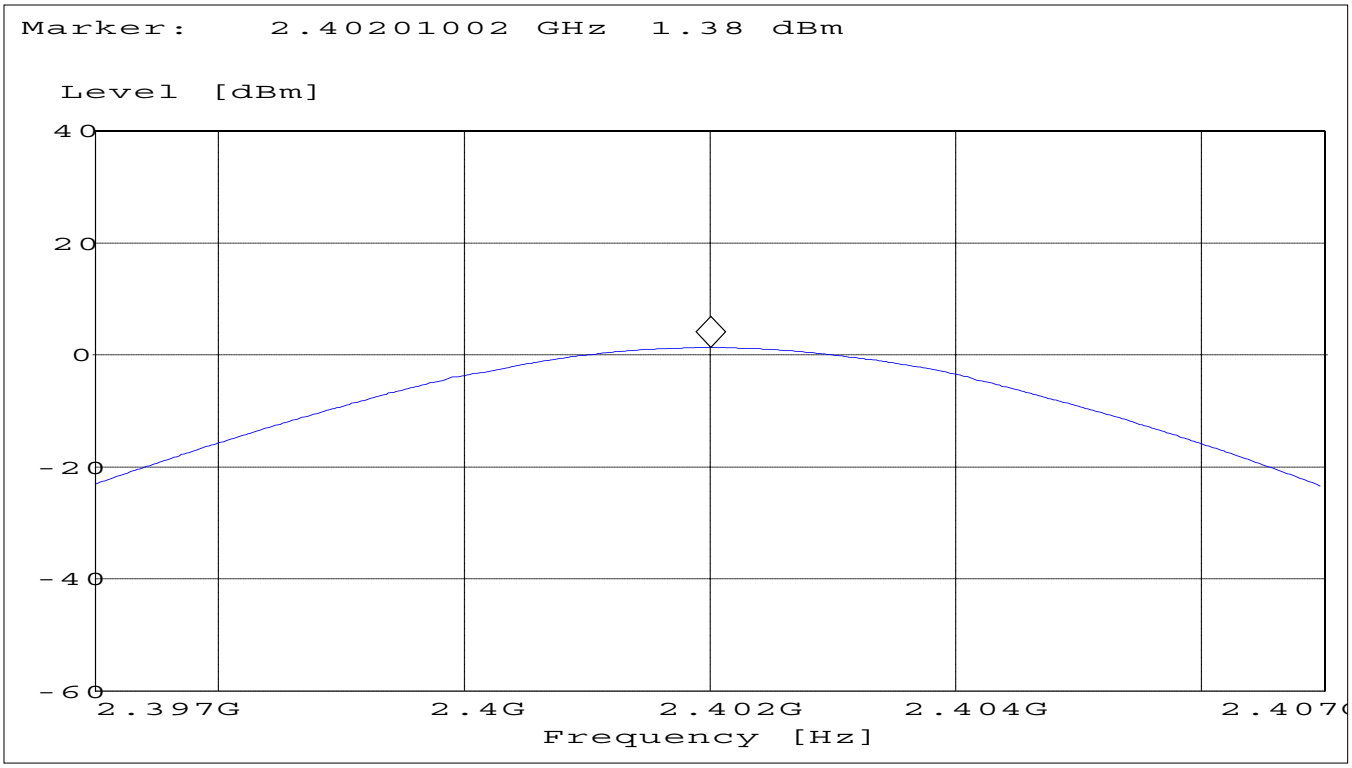
Frequency range	RF power output
2400-2483.5 MHz	1.0 Watt

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

Lowest Channel: 2402MHz

SWEEP TABLE: "EIRP BT low channel"

Short Description:		EIRP Bluetooth channel-2402MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.397GHz	2.407GHz	MaxPeak	Coupled	3 MHz



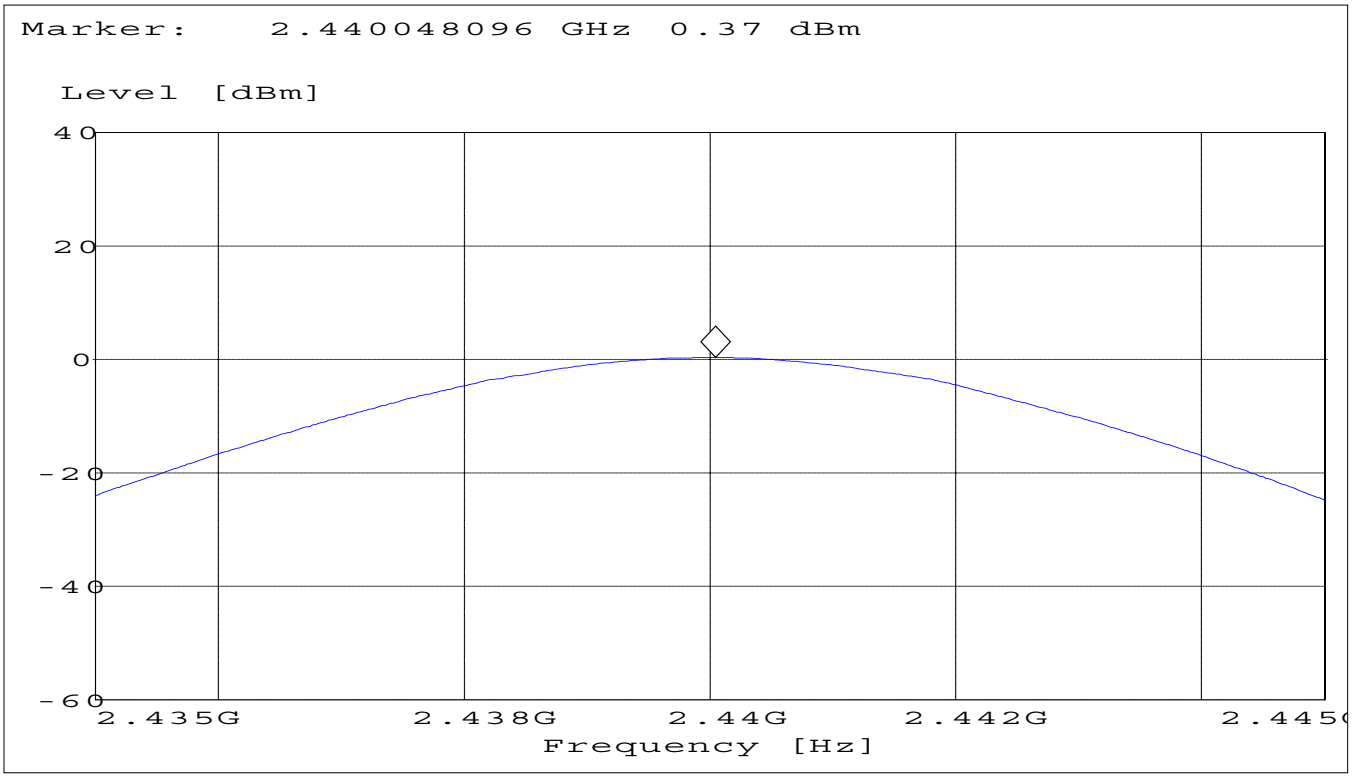
PEAK OUTPUT POWER (RADIATED) §15.247 (b) (1)

Mid Channel: 2441MHz

SWEEP TABLE: "EIRP BT Mid channel"

Short Description: EIRP Bluetooth channel-2441MHz

Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.435GHz	2.445GHz	MaxPeak	Coupled	3 MHz

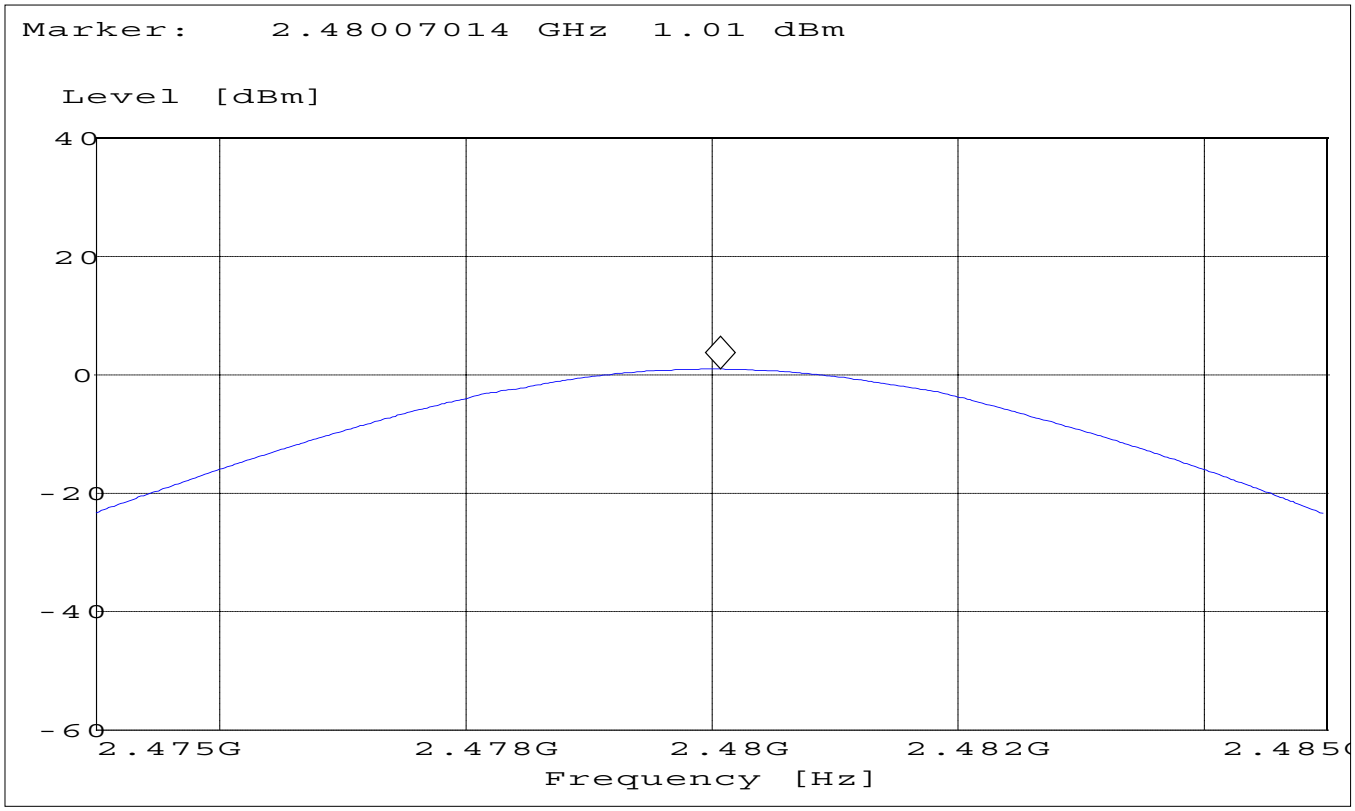


PEAK OUTPUT POWER (RADIATED) §15.247 (b) (1)

Highest Channel: 2480MHz

SWEEP TABLE: "EIRP BT High channel"

Short Description:		EIRP Bluetooth channel-2480MHz		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF BW
2.475GHz	2.485GHz	MaxPeak	Coupled	3 MHz

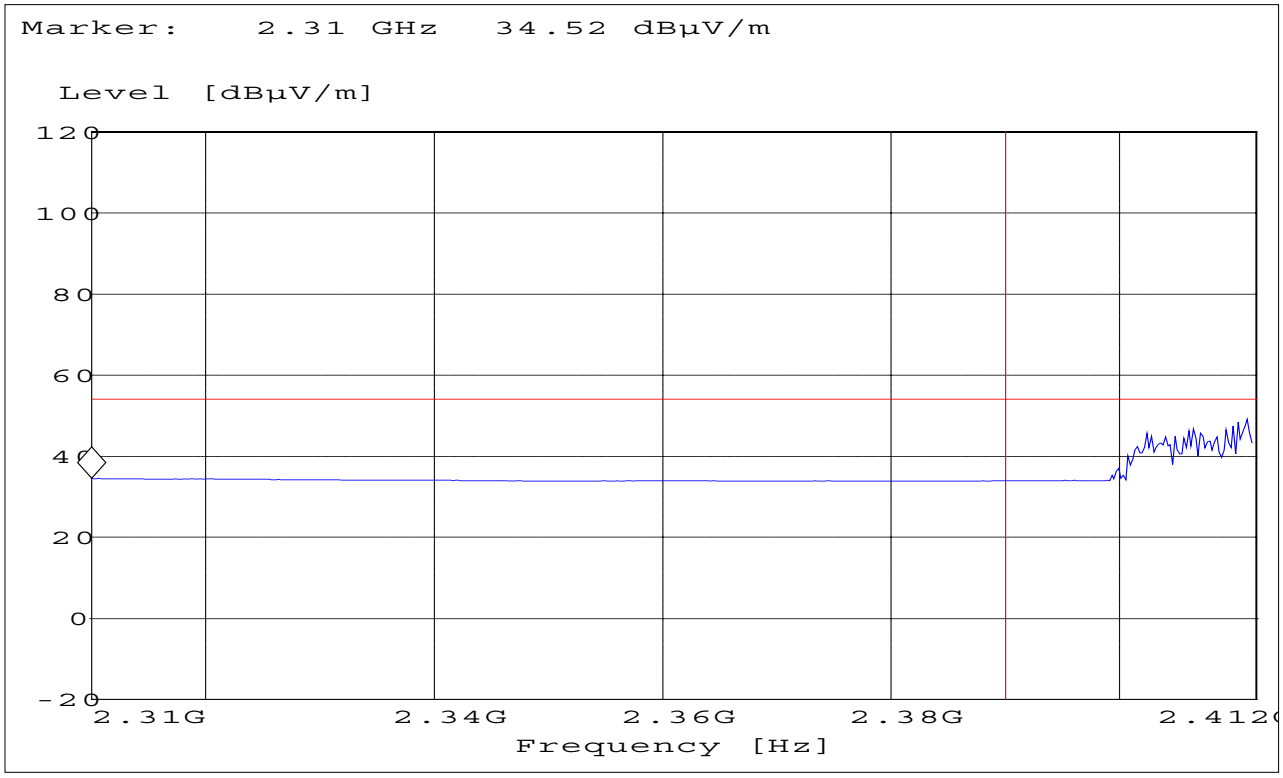


BAND EDGE COMPLIANCE §15.247 (c)

Low frequency section (spurious in the restricted band 2310 – 2390 MHz)
(Hopping – ON, Average meaurement)
Note: This plot is valid for both hopping ON & OFF

Operating condition	:	Tx at 2402MHz
SWEEP TABLE	:	"FCC15.247 LBE_AVG"
Short Description	:	FCC15.247 BT Low-band-edge
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)

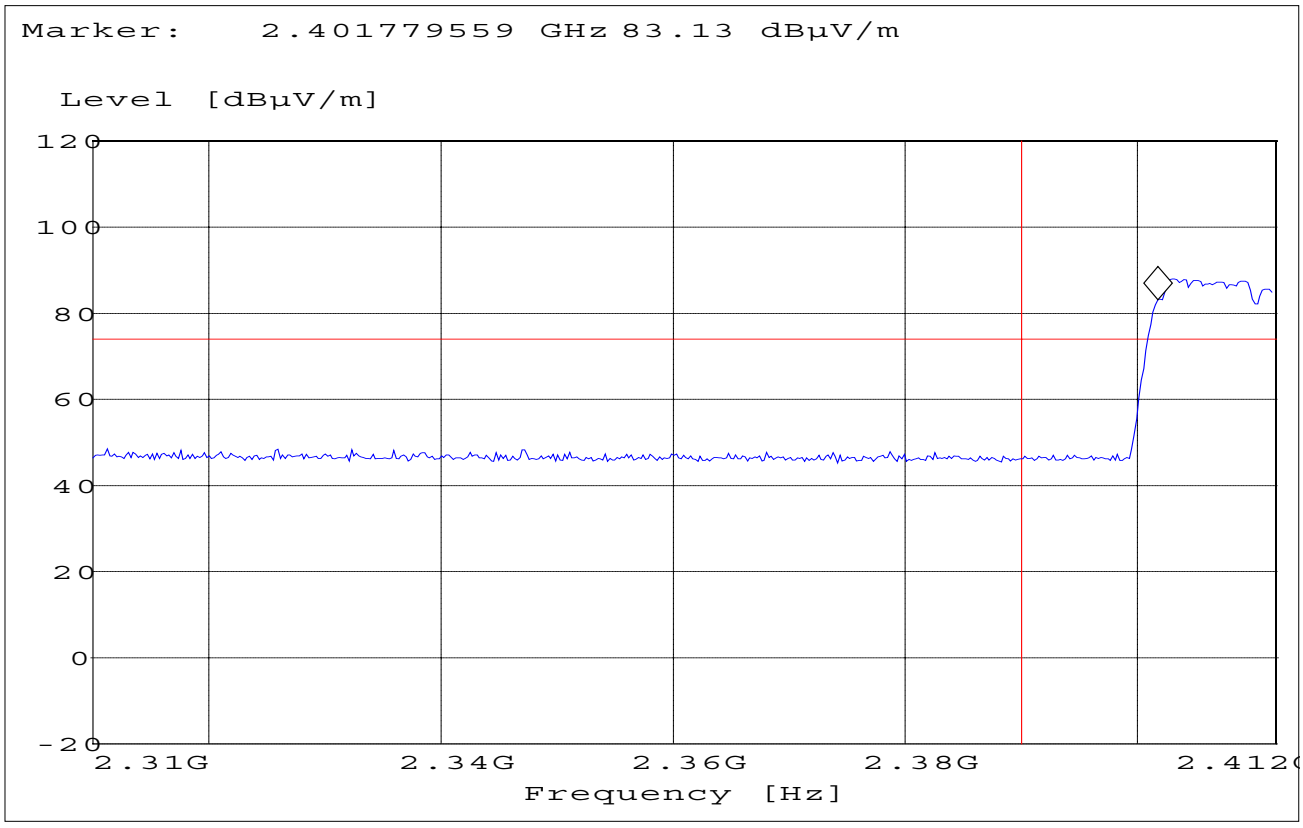


BAND EDGE COMPLIANCE §15.247 (c)

Low frequency section (spurious in the restricted band 2310 – 2390 MHz)
(Hopping – ON, Peak meaurement)
Note: This plot is valid for both hopping ON & OFF

Operating condition	:	Tx at 2402MHz
SWEEP TABLE	:	"FCC15.247 LBE_Pk"
Short Description	:	FCC15.247 BT Low-band-edge
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)

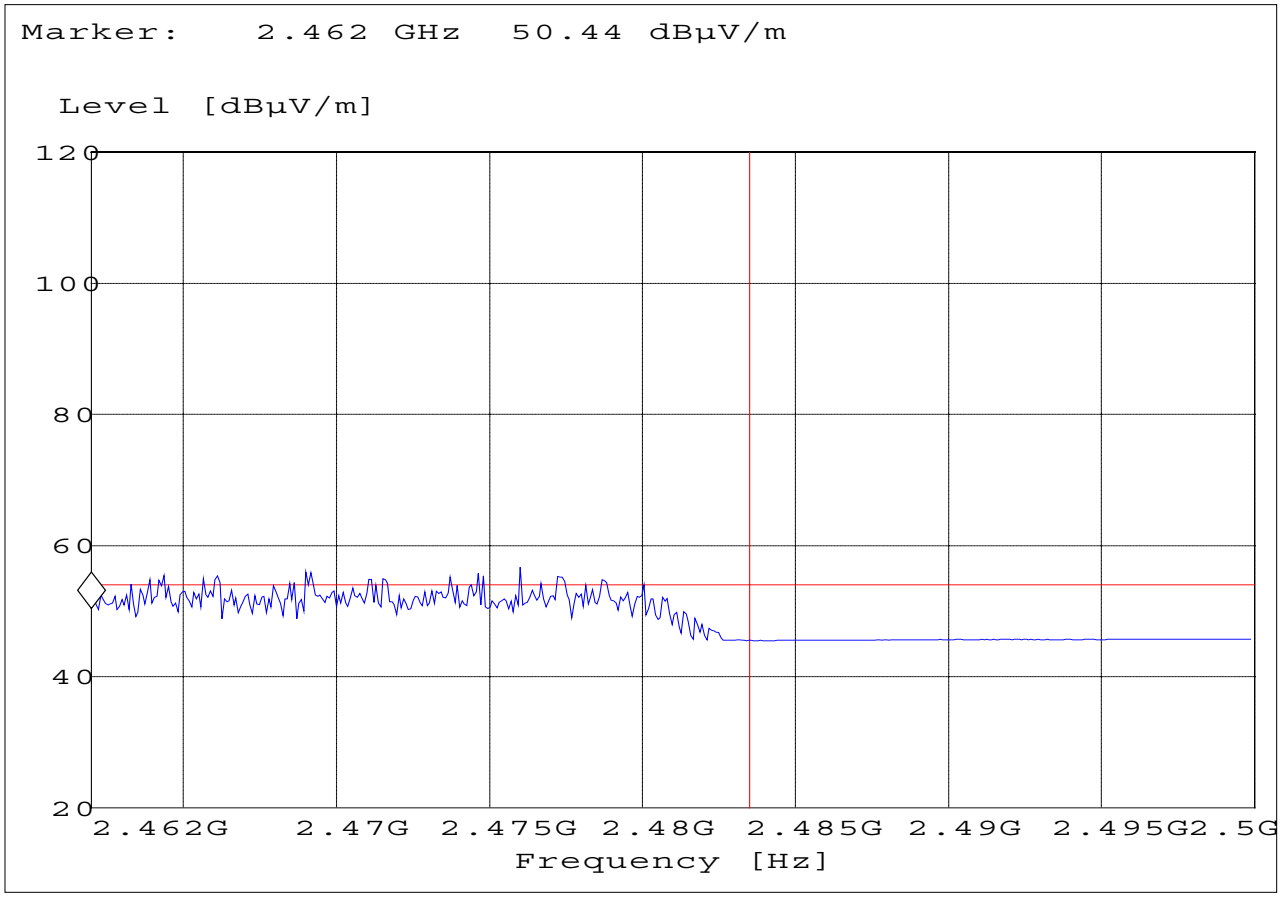


BAND EDGE COMPLIANCE §15.247 (c)

High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)
(Hopping – ON, Average meaurement)
Note: This plot is valid for both hopping ON & OFF

Operating condition	:	Tx at 2480MHz
SWEEP TABLE	:	"FCC15.247 HBE_AVG"
Short Description	:	FCC15.247 BT High-band-edge
Limit Line	:	54dBµV

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

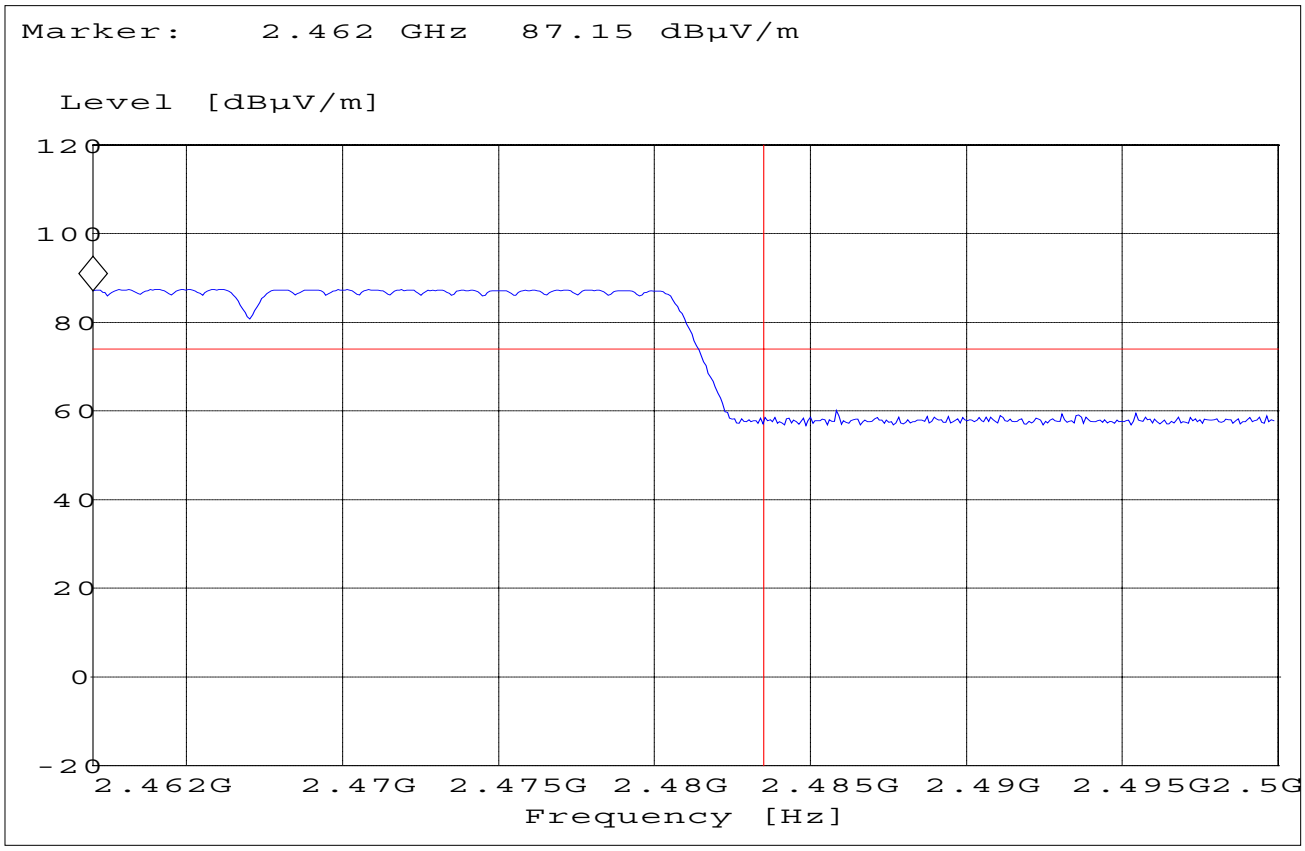


BAND EDGE COMPLIANCE §15.247 (c)

High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)
(Hopping – ON, Peak meaurement)
Note: This plot is valid for both hopping ON & OFF

Operating condition	:	Tx at 2480MHz
SWEEP TABLE	:	"FCC15.247 HBE_PK"
Short Description	:	FCC15.247 BT High-band-edge
Limit Line	:	74dBµV

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



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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

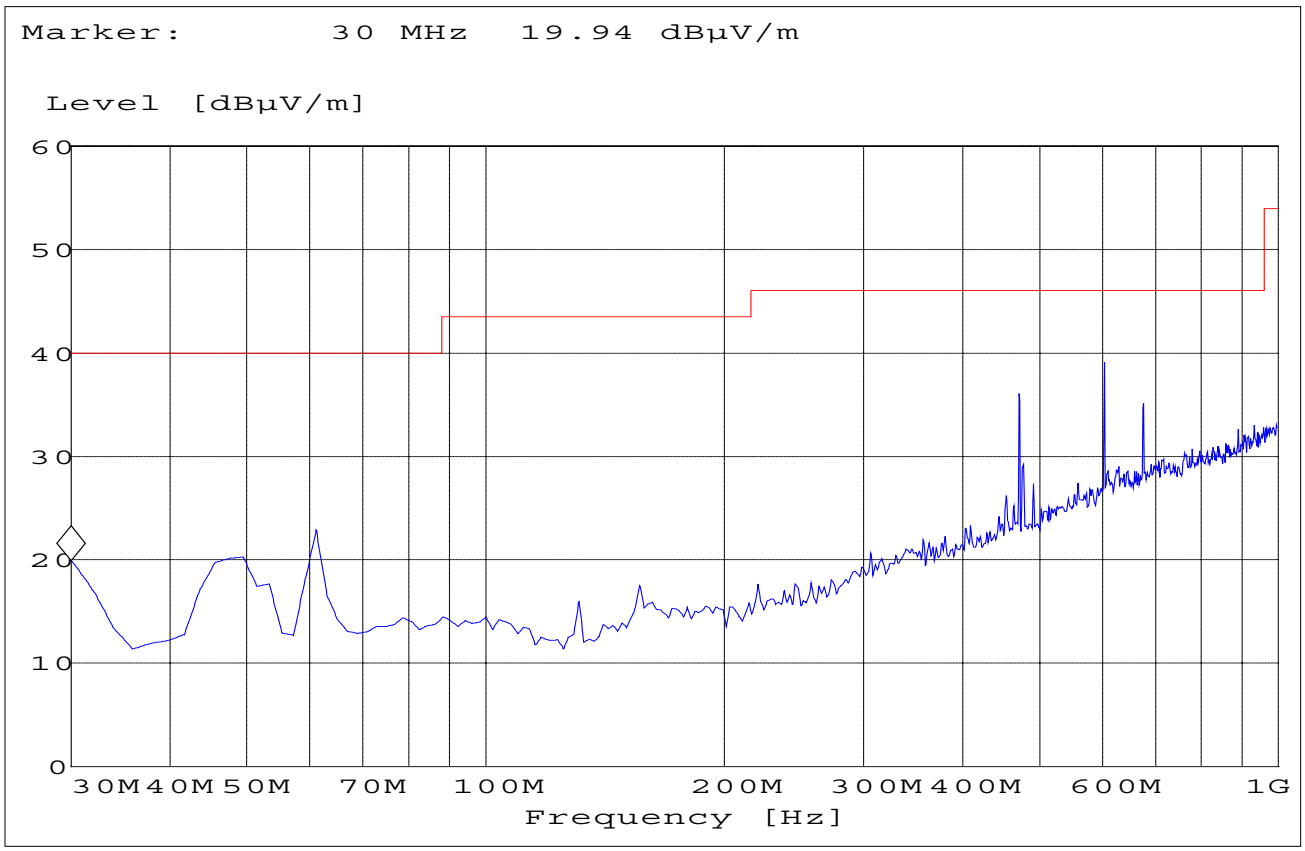
NOTE: Frequency resolution is not fine enough to show the exact frequency of the carrier, refer to plots under EIRP.

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

30MHz – 1GHz (This plot is valid for all three channels)

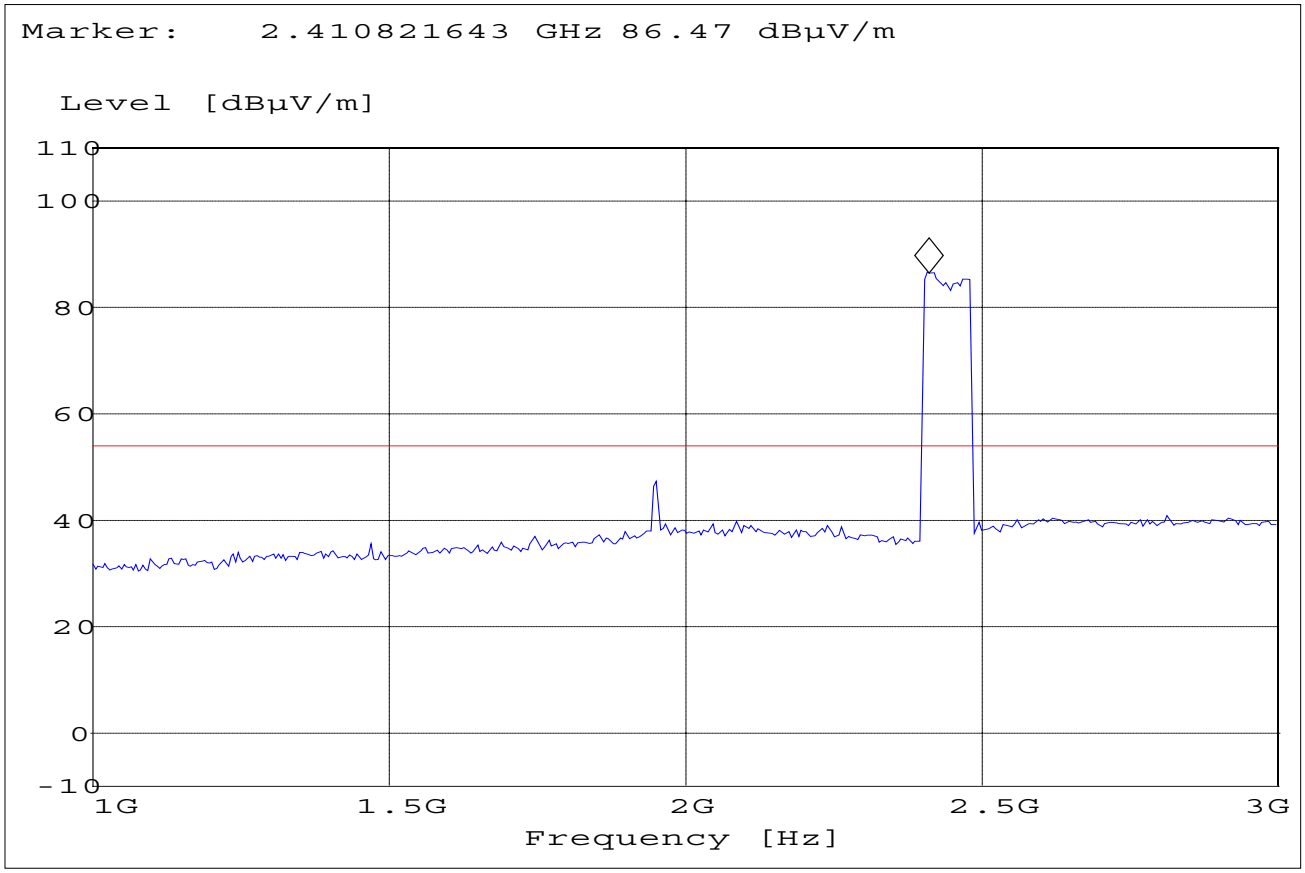
SWEEP TABLE: "BT Spuri hi 30-1G"
Short Description: Bluetooth 30MHz-1GHz

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)**
1GHz – 3GHz (This plot is valid for all three channels)
Note: Frequency out of spec. is BT transmitter in hopping mode.

SWEEP TABLE:		"BT Spuri hi 1-3G"			
Short Description:		Bluetooth Spurious 1-3 GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

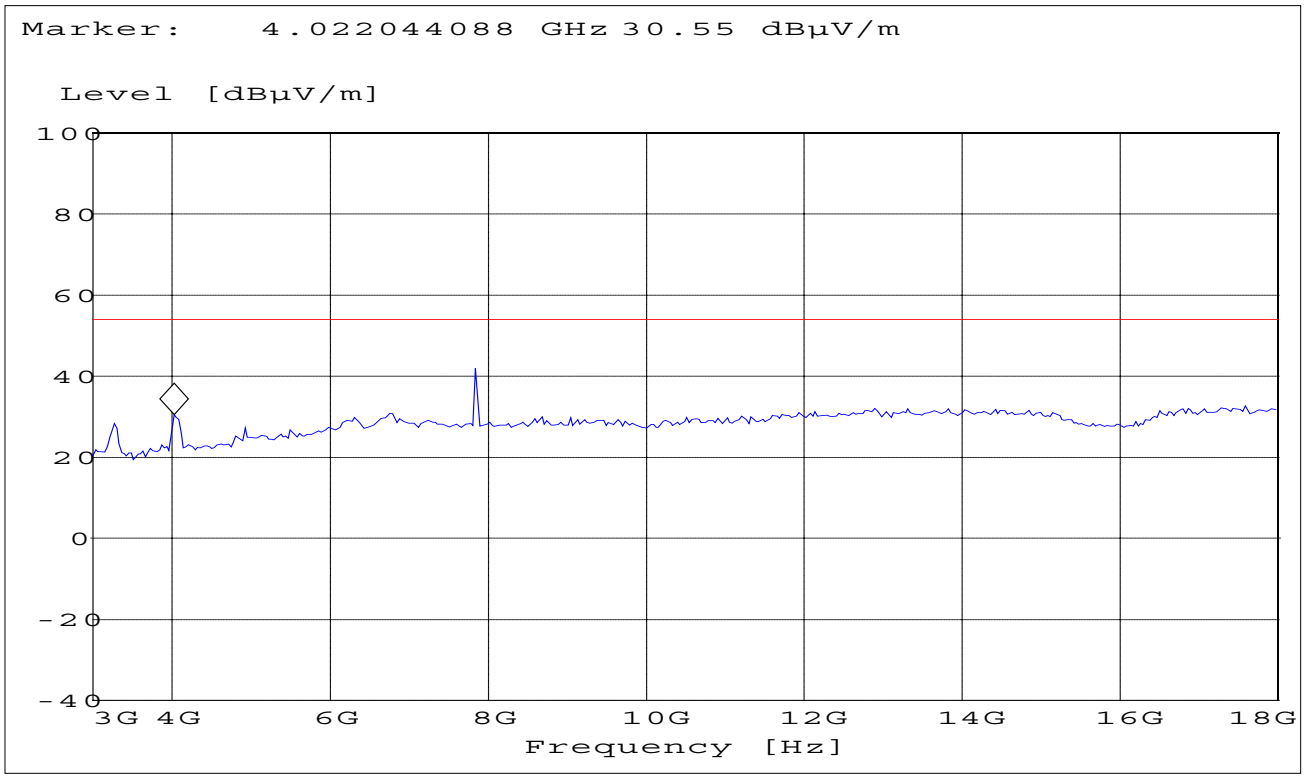


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)

3GHz – 18GHz (This plot is valid for all three channels)

SWEEP TABLE: "BT Spuri hi 3-18G"
Short Description: Bluetooth Spurious 3-18GHz

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

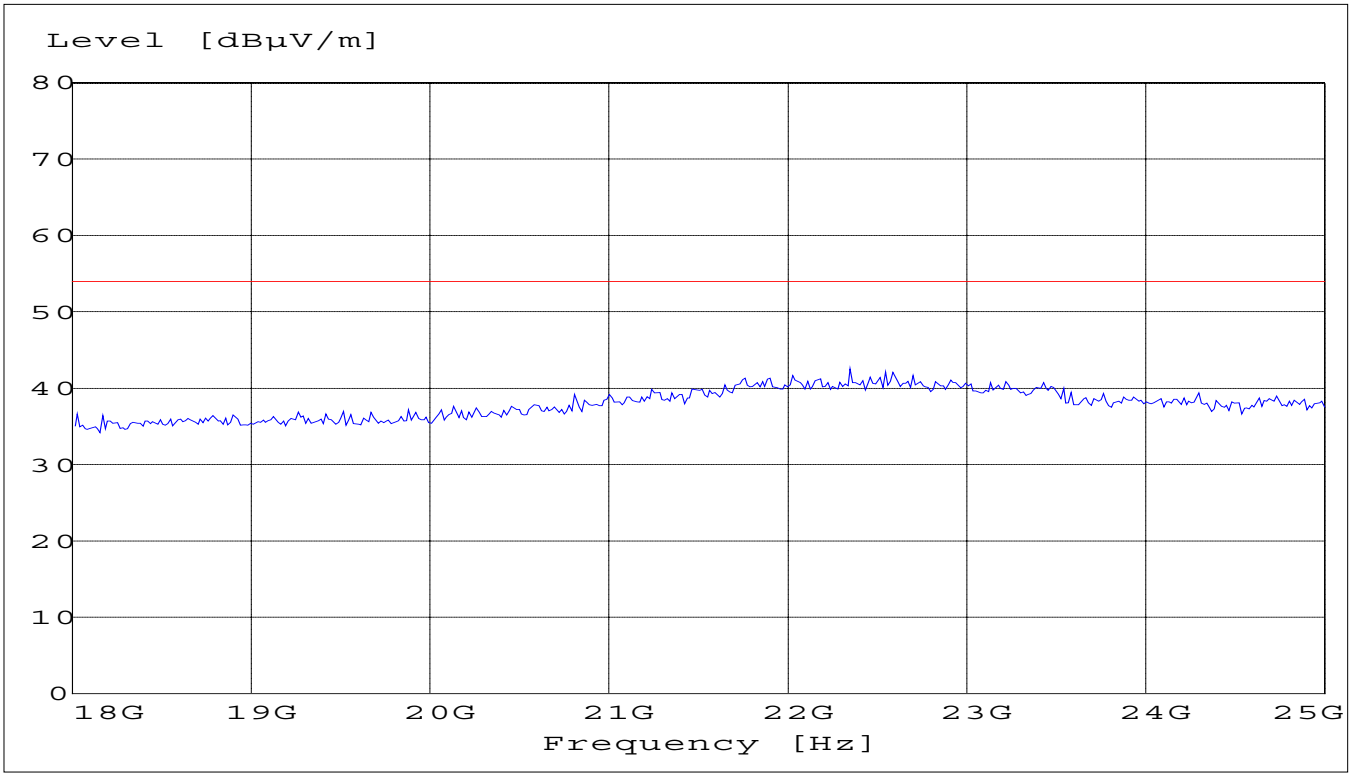


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)

18GHz – 25GHz (This plot is valid for all three channels)

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

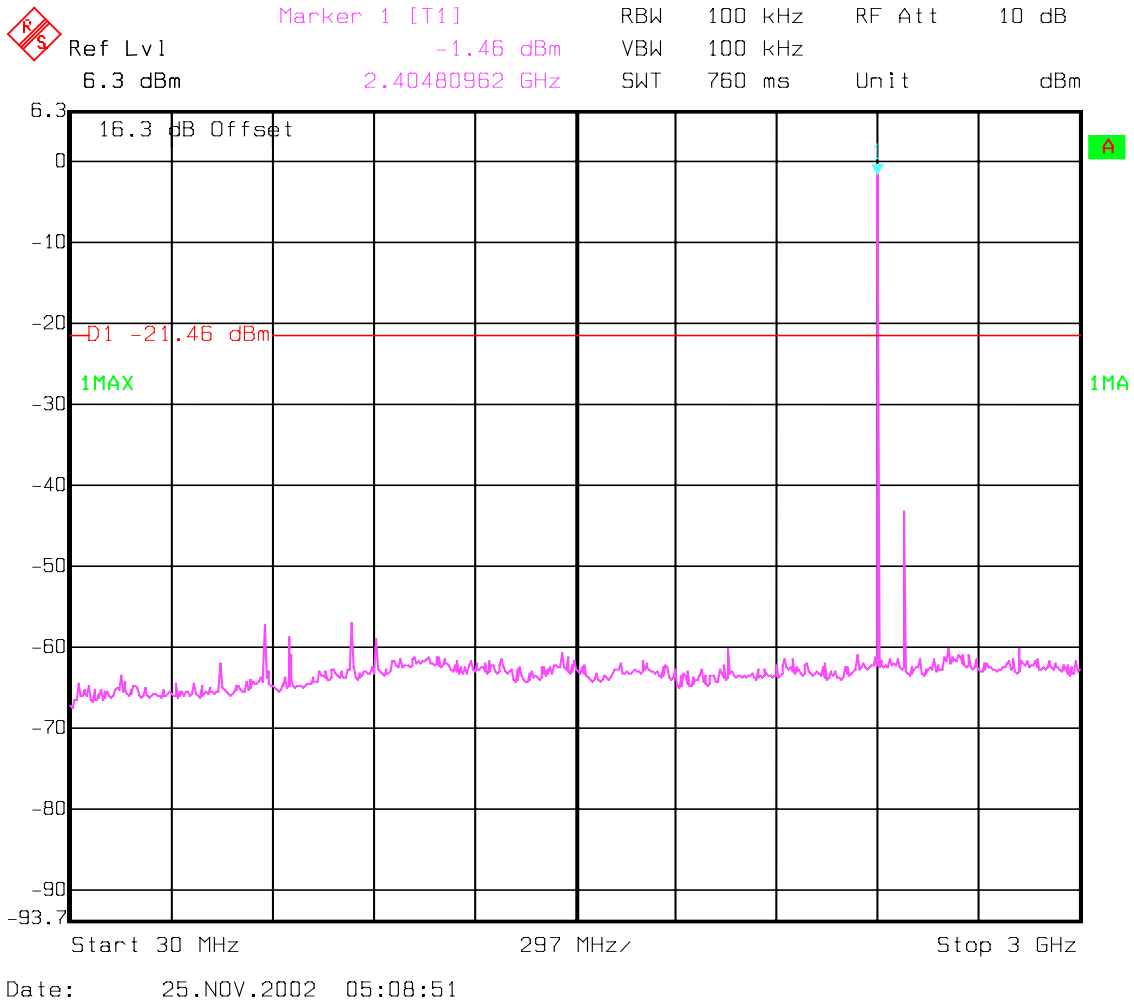
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18 GHz	25GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



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

Lowest Channel(2402MHz): 30MHz - 3GHz

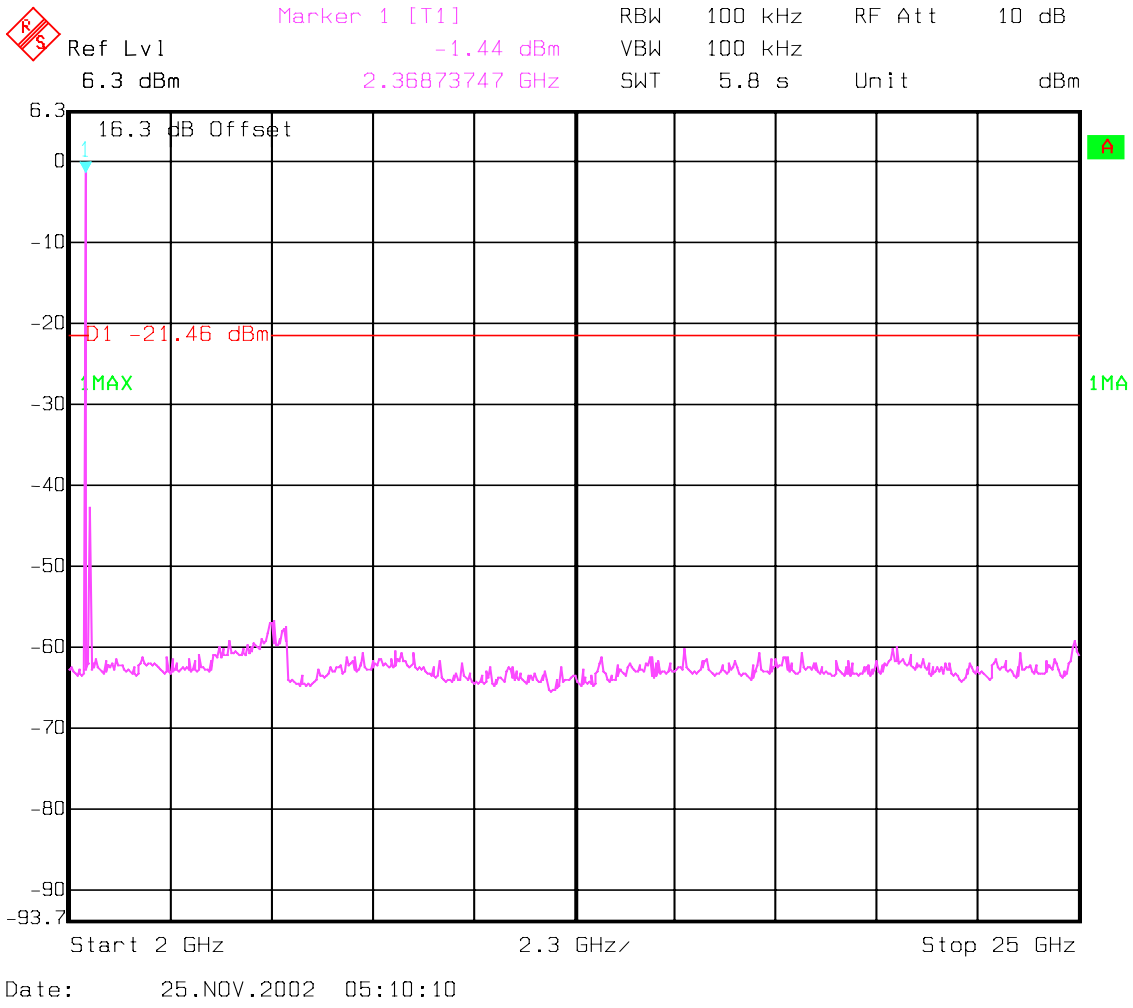
NOTE: The peak above the limit line is the carrier frequency.



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

Lowest Channel(2402MHz): 2GHz - 25GHz

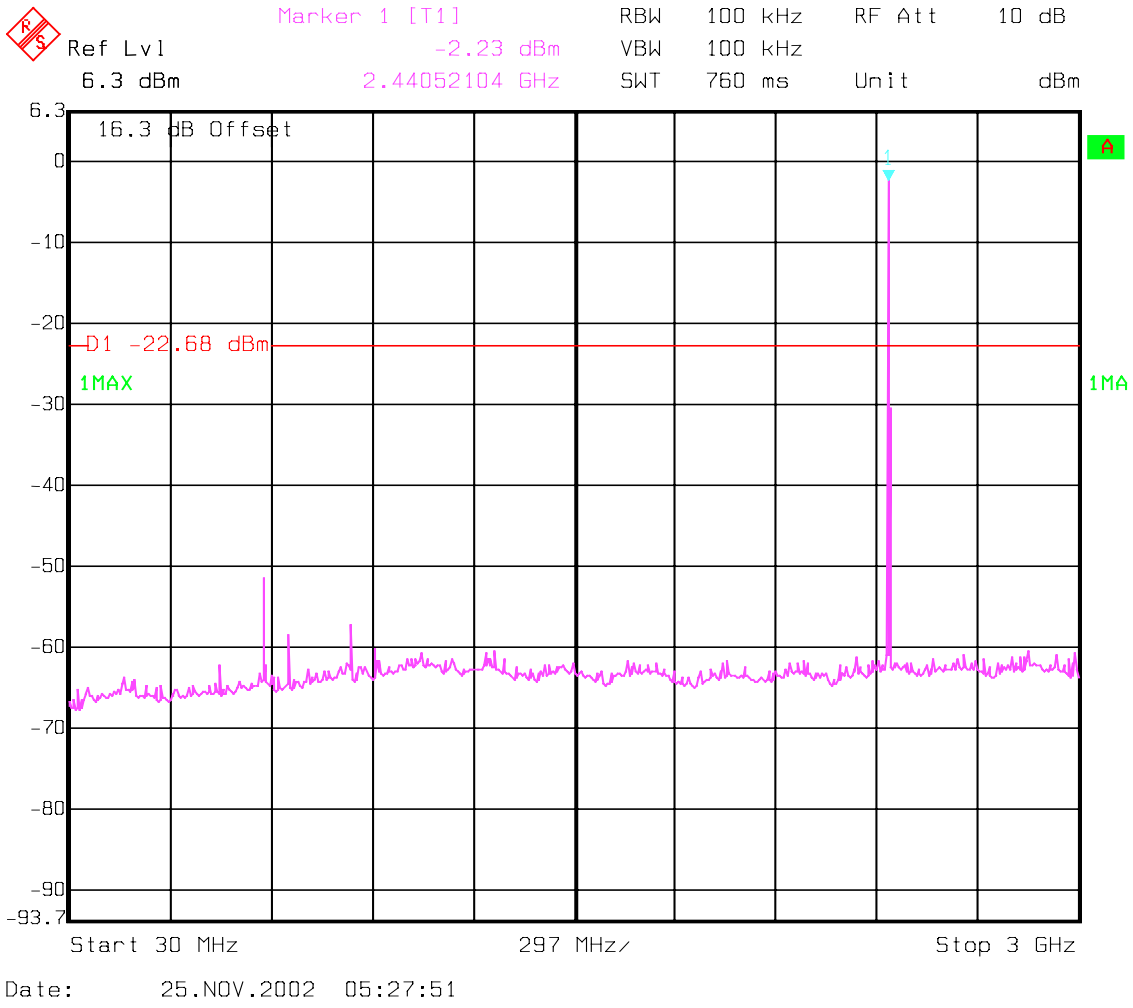
NOTE: The peak above the limit line is the carrier frequency.



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

Mid Channel(2441MHz): 30MHz - 3GHz

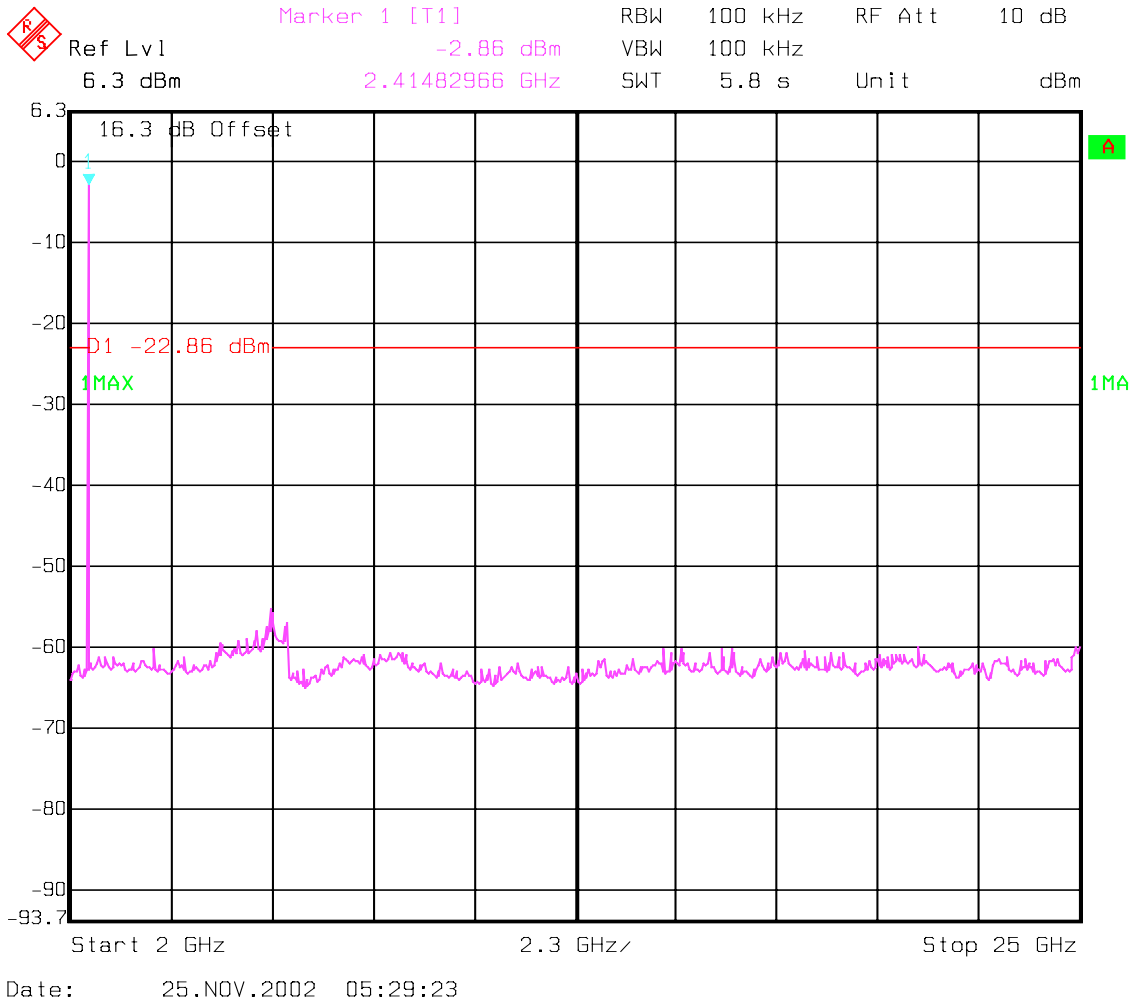
NOTE: The peak above the limit line is the carrier frequency.



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

Mid Channel(2441MHz): 2GHz - 25GHz

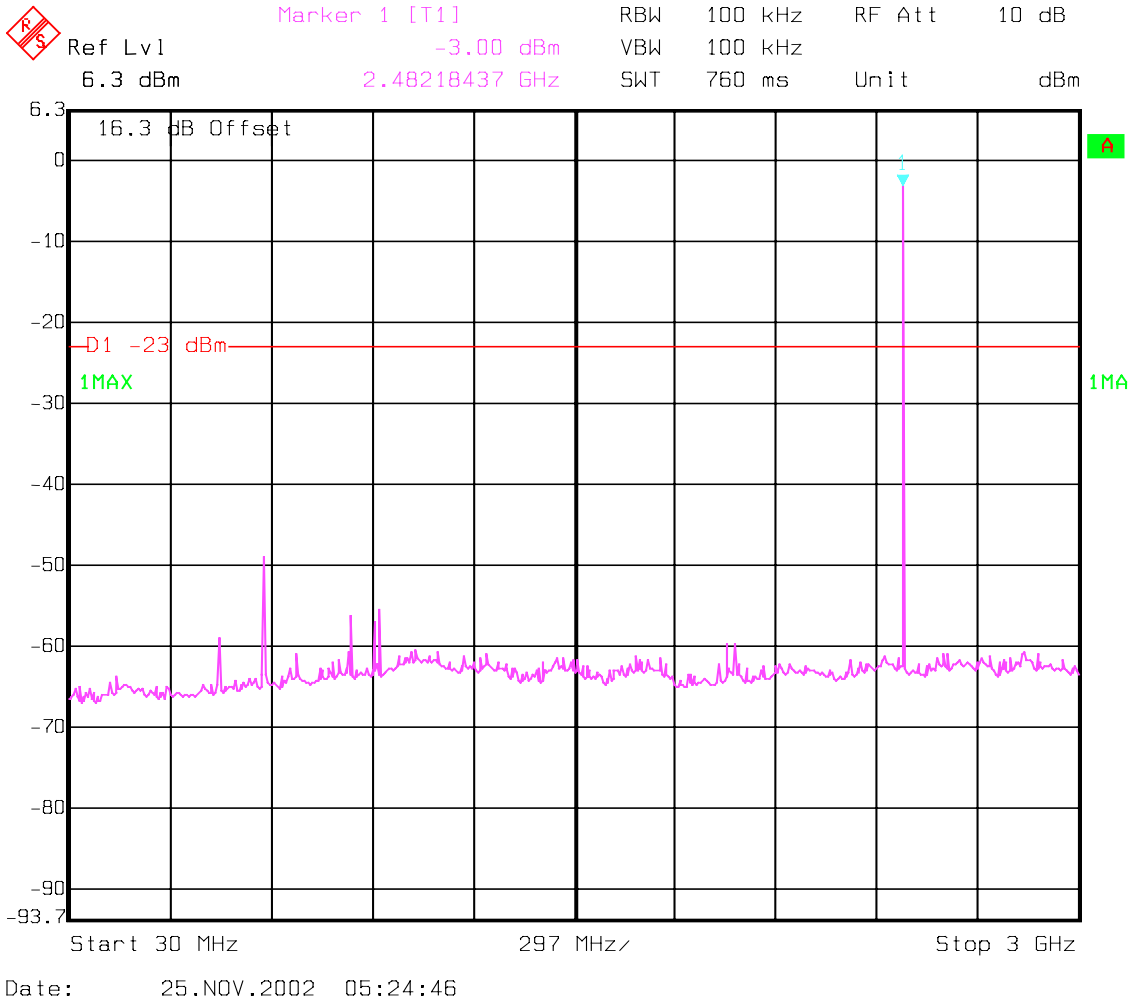
NOTE: The peak above the limit line is the carrier frequency.



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

Highest Channel(2480MHz): 30MHz - 3GHz

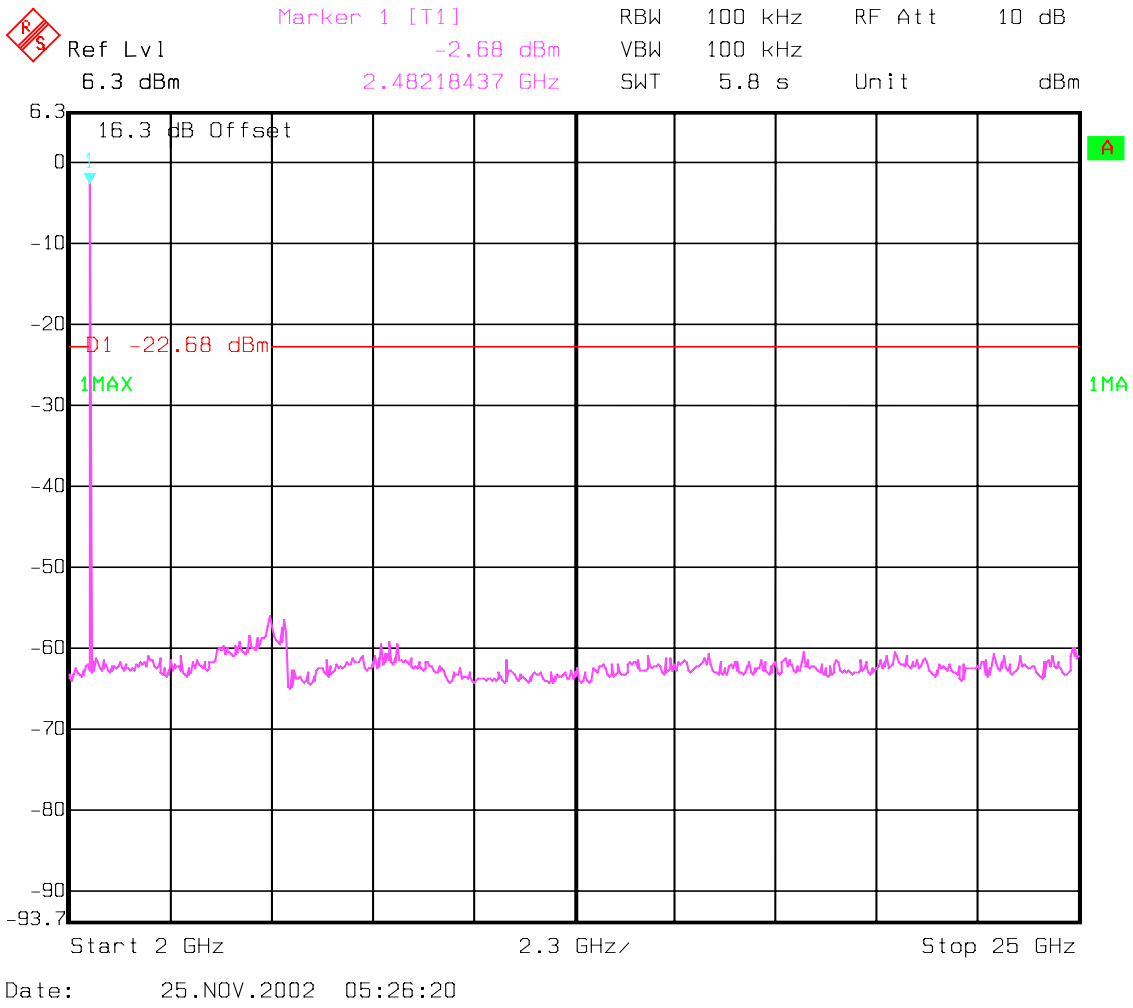
NOTE: The peak above the limit line is the carrier frequency.



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

Highest Channel(2480MHz): 2GHz - 25GHz

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



CONDUCTED EMISSIONS **§ 15.107/207**

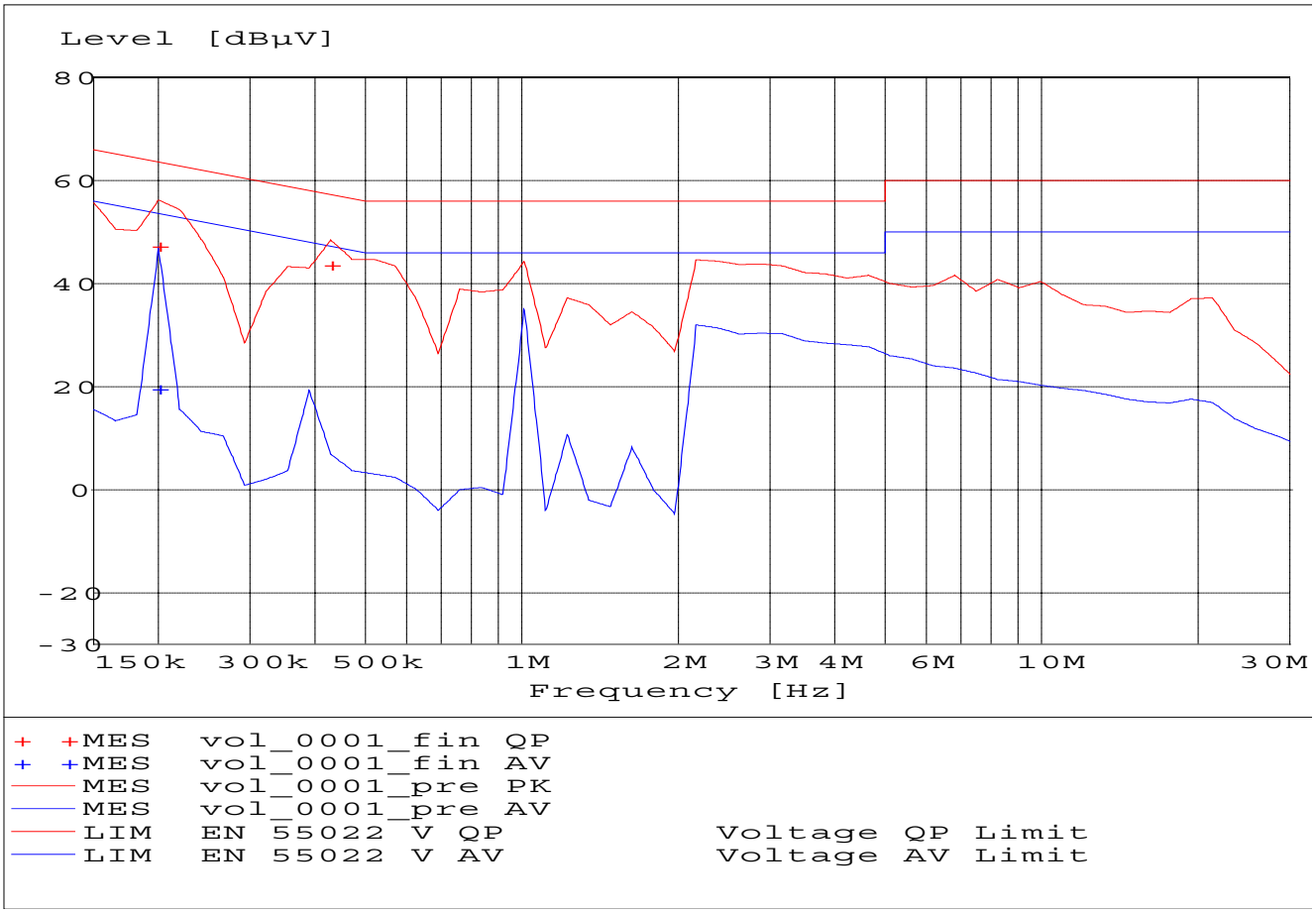
Measured with AC/DC power adapter

Technical specification : 15.107 / 15.207 (Revised as of August 20, 2002)

Limit

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50
* Decreases with logarithm of the frequency		

ANALYZER SETTINGS: RBW = 10KHz **VBW = 10KHz**



MEASUREMENT RESULT: "vol_0001_fin QP"

11/26/02 7:31PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.199650	47.50	0.0	64	16.1	1	---
0.427968	43.80	0.0	57	13.5	2	---

MEASUREMENT RESULT: "vol_0001_fin AV"

11/26/02 7:31PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.199650	19.90	0.0	54	33.8	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

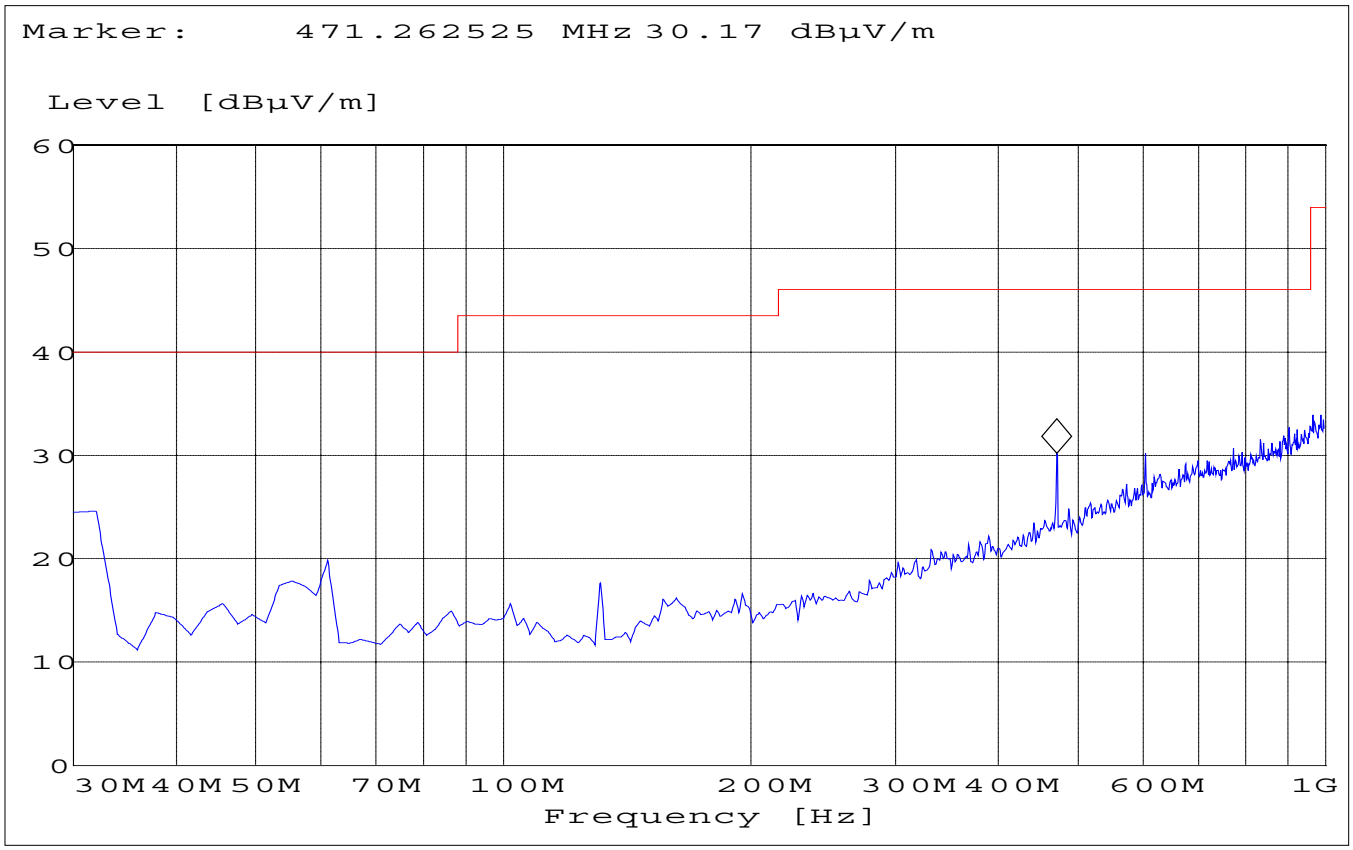
NOTE:
The radiated emissions were done with different settings, using the relevant pre-amplifiers forthe relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 18 and 25 GHz very short cable connections to the antenna was used to minimize the noise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

RECEIVER SPURIOUS RADIATION § 15.209

30MHz – 1GHz

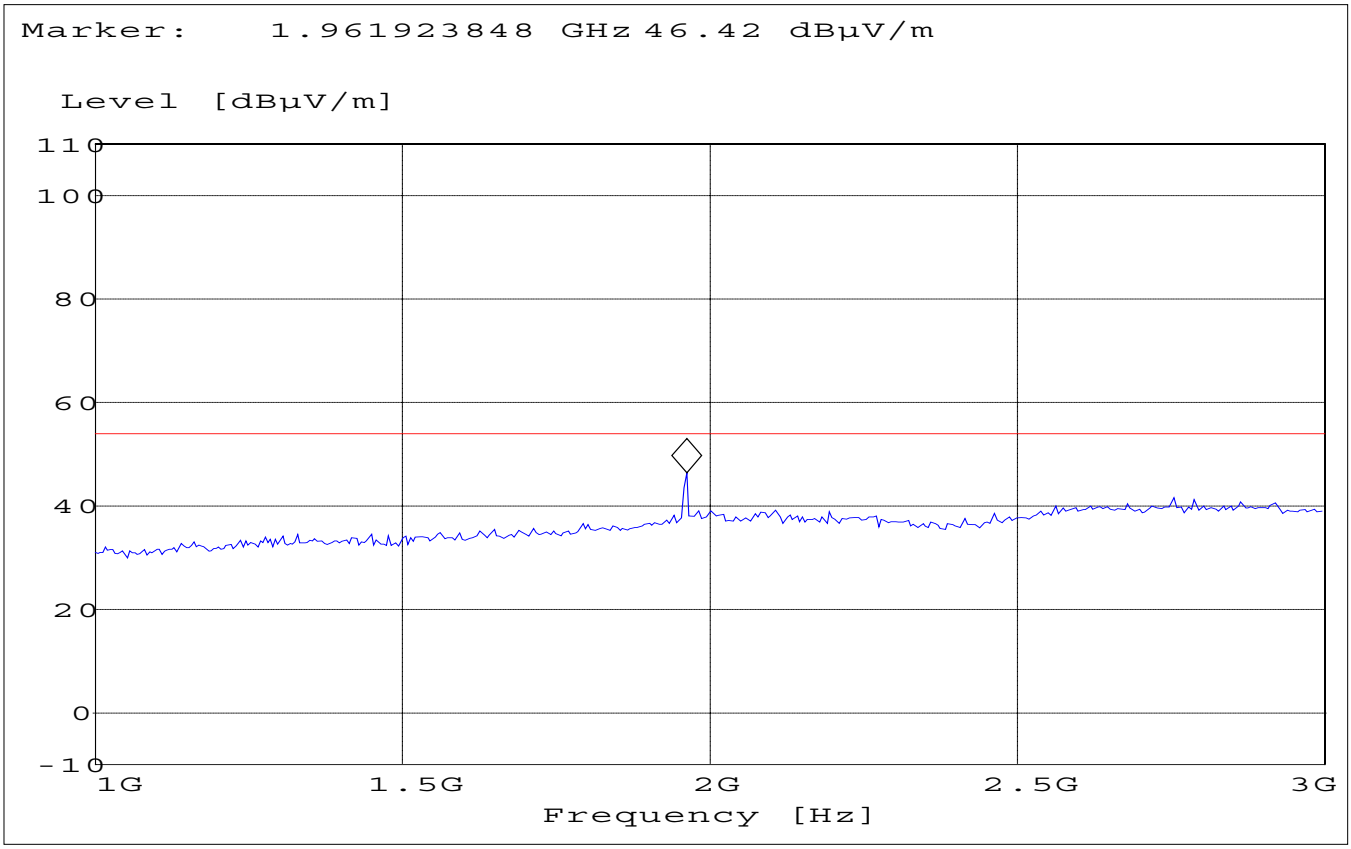
SWEEP TABLE: "BT Spuri hi 30-1G"
Short Description: Bluetooth 30MHz-1GHz

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 – 3GHz

SWEEP TABLE:		"BT Spuri hi 1-3G"			
Short Description:		Bluetooth Spurious 1-3 GHz			
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)

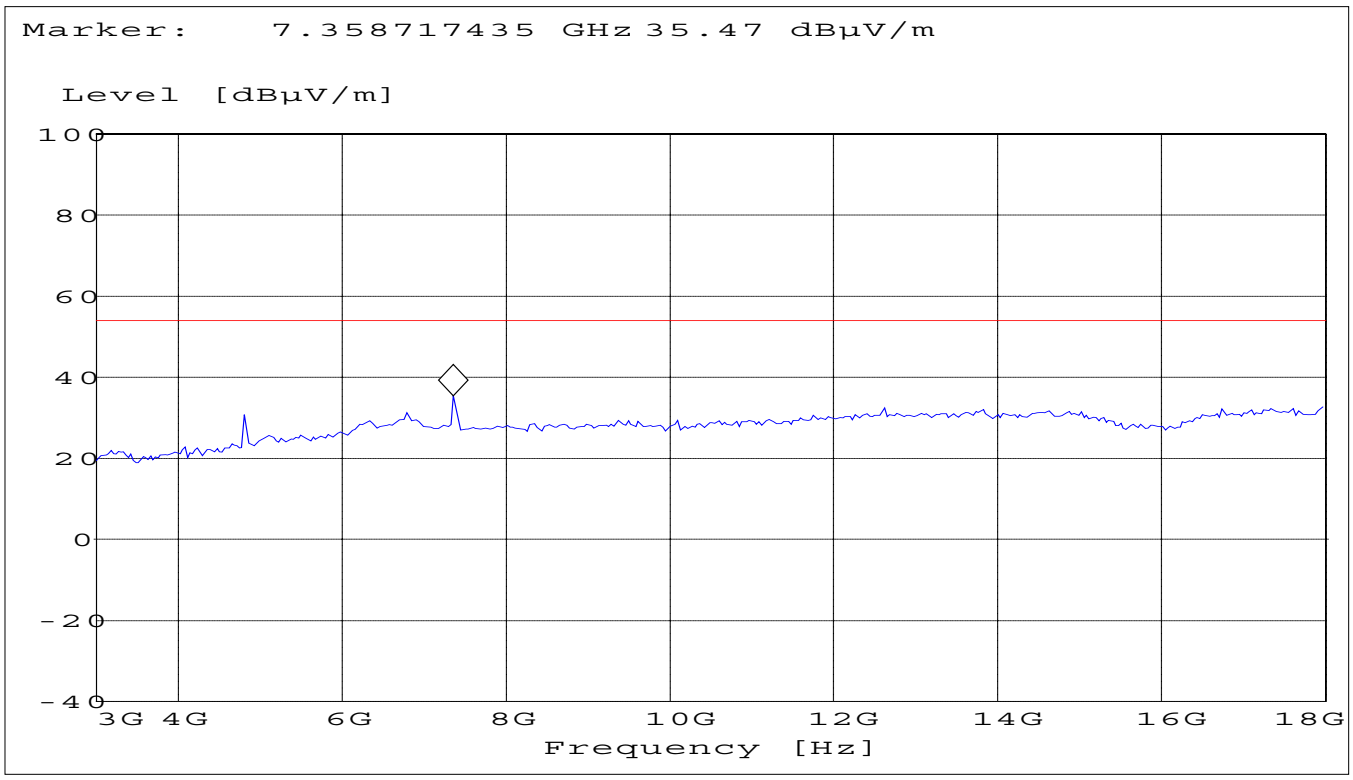


RECEIVER SPURIOUS RADIATION § 15.209

3GHz – 18GHz

SWEEP TABLE: "BT Spuri hi 3-18G"
Short Description: Bluetooth Spurious 3-18GHz

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

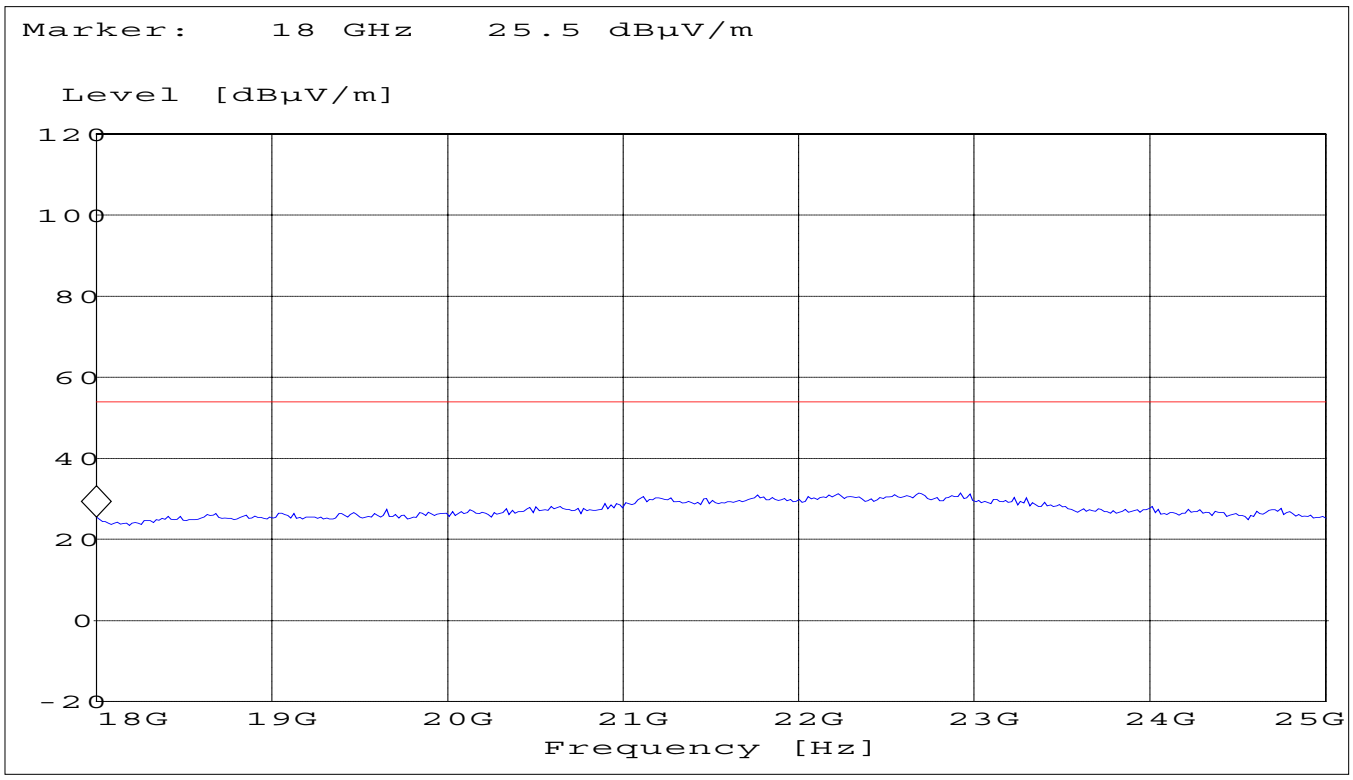


RECEIVER SPURIOUS RADIATION § 15.209

18GHz – 25GHz

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

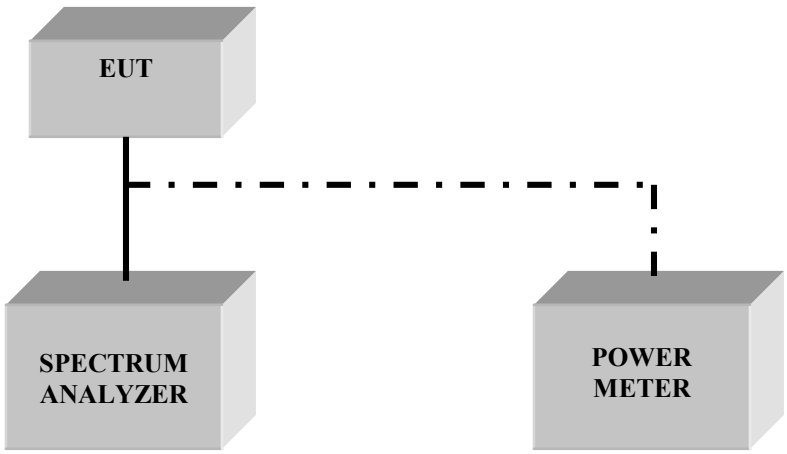
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18 GHz	25GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



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	2-3GHz band reject filter	BRM50701	Microtronics	NA
13	Digital Radio Comm. Tester	CMD-55	Rohde & Schwarz	847958/008

BLOCK DIAGRAMS
Conducted Testing



Radiated Testing