



FCC Test Report

Test report no.: EMC_542FCC15.247_2003_306MP_rev2

FCC Part 15.247 for DSSS systems / CANADA RSS-210

EUT: WLAN Model: BCM94306MP
HOST: Dell Laptop Model: PP10L
FCC ID: QDS-BRCM1005-D



Accredited according to ISO/IEC 17025



FCC listed # 101450

IC recognized # 3925

CETECOM Inc.

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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 generalizations 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**

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Internet: www.cetecom.com

1.3 Details of applicant

Name : **Broadcom corporation**
Street : **190 Mathilda Place**
City / Zip Code : **Sunnyvale, CA 94086**
Country : **USA**
Contact : **Dan Lawless**
Telephone : **408-922-5870**
Tele-fax : **408-543-3399**
e-mail : dlawless@broadcom.com

1.4 Application details

Date of receipt test item : 2003-08-29
Date of test : 2002-08-29

1.5 Test item

Manufacturer : Applicant
Model No. (EUT) : BCM94306MP
Model No. (Host) : PP10L (Dell Laptop)
Description : 54g wireless LAN mini PCI card
FCC ID : QDS-BRCM1005-D

Additional information

Frequency : 2412MHz – 2462MHz
Type of modulation : DSSS / OFDM (orthogonal frequency division multiplexing)
Number of channels : 11
Antenna : 2.9dBi max. gain antenna (Phycomp)
1.51dBi lower gain antenna (Wistron NeWeb)
Power supply : 3.3 VDC from Host
Output power : 25.55dBm (359mW) conducted peak power
(For EIRP and Source-based time-averaged output please see page no.8)
Extreme temp. Tolerance : 0°C to +70°C

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

PROJECT OVERVIEW:

This test report carries all measurements required for Class-2 permissive change to FCC ID: QDS-BRCM1005-D with addition of new Dell Laptop Model# PP10L.

This test report covers full radiated testing as per FCC 15.247 on WLAN model# BCM94306MP in laptop model# PP10L. All measurements are done with 2.9dBi max. gain antenna by Phycomp, although these measurements are also valid for 1.51dBi lower gain antenna by Wistron NeWeb. The Conducted peak power was measured and found same as under original equipment authorization grant, therefore all conducted RF measurements from modular approval of WLAN are valid for this model too.

WLAN was tested in both DSSS & OFDM modes at different data rates (1,2,5.5,6,11,54). Test report shows only worst-case test results of all data rates.

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:

2003-09-23 EMC & Radio Lothar Schmidt (Manager)



Date

Section

Name

Signature

Responsible for test report and project leader:

2003-09-23 EMC & Radio Harpreet Sidhu (EMC Engineer)



Date

Section

Name

Signature

2.2 Test report

TEST REPORT

Test report no.: EMC_542FCC15.247_2003_306MP_rev2

FCC Part 15.247 for DSSS systems / CANADA RSS-210

EUT: WLAN Model: BCM94306MP

HOST: Dell Laptop Model: PP10L

FCC ID: QDS-BRCM1005-D

TEST REPORT REFERENCE

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OUTPUT POWER**§ 15.247 (b) (1)**

	Low channel	Mid channel	High channel
*Conducted Peak Power	25.55dBm	24.48dBm	24.11dBm
*Radiated Power (EIRP)	28.45dBm	27.38dBm	27.01dBm
**Source-based time averaged output	21.68dBm	20.61dBm	20.24dBm

***For details please refer to pages 9(Conducted output power results), 13(EIRP calculation) & 14(duty cycle measurements) respectively.**

****The source-based time-averaged output power is calculated using the duty cycle (measurement result see page 14-17, These values are used to determine if the TCB route can be used)**

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

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)			
Frequency (MHz)		2412	2437	2462	
T _{nom} (23)°C	V _{nom} (3.3) VDC	Pk	*25.55	*24.48	*24.11
Measurement uncertainty		±0.5dBm			

To comply with following;*RBW / VBW should be equal to or greater than the 6dB BW****All measured values are corrected by 10log (6dB BW / used BW)****(Therefore correction factor of 2.14, 2.18 & 2.15 was added to low, mid& high channel measurements respectively)****LIMIT****SUBCLAUSE § 15.247 (b) (1)**

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

**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} (3.3) VDC	*28.45	*27.38	*27.01
Measurement uncertainty		±0.5dBm		

Note: EIRP is calculated based on 2.9dBi antenna and conducted peak power measurements.*LIMIT****SUBCLAUSE § 15.247 (b) (1)**

Frequency range	RF power output
2400-2483.5 MHz	30dBm on Conducted

SOURCE-BASED TIME-AVERAGED OUTPUT

$$T_{x\ on} = 140.2\ \mu s$$

$$T_{x\ on} + T_{x\ off} = 661.32\ \mu s$$

$$\text{Duty factor} = T_{x\ on} / T_{x\ on} + T_{x\ off} = 140.2 / 661.32 = 0.21$$

Therefore;

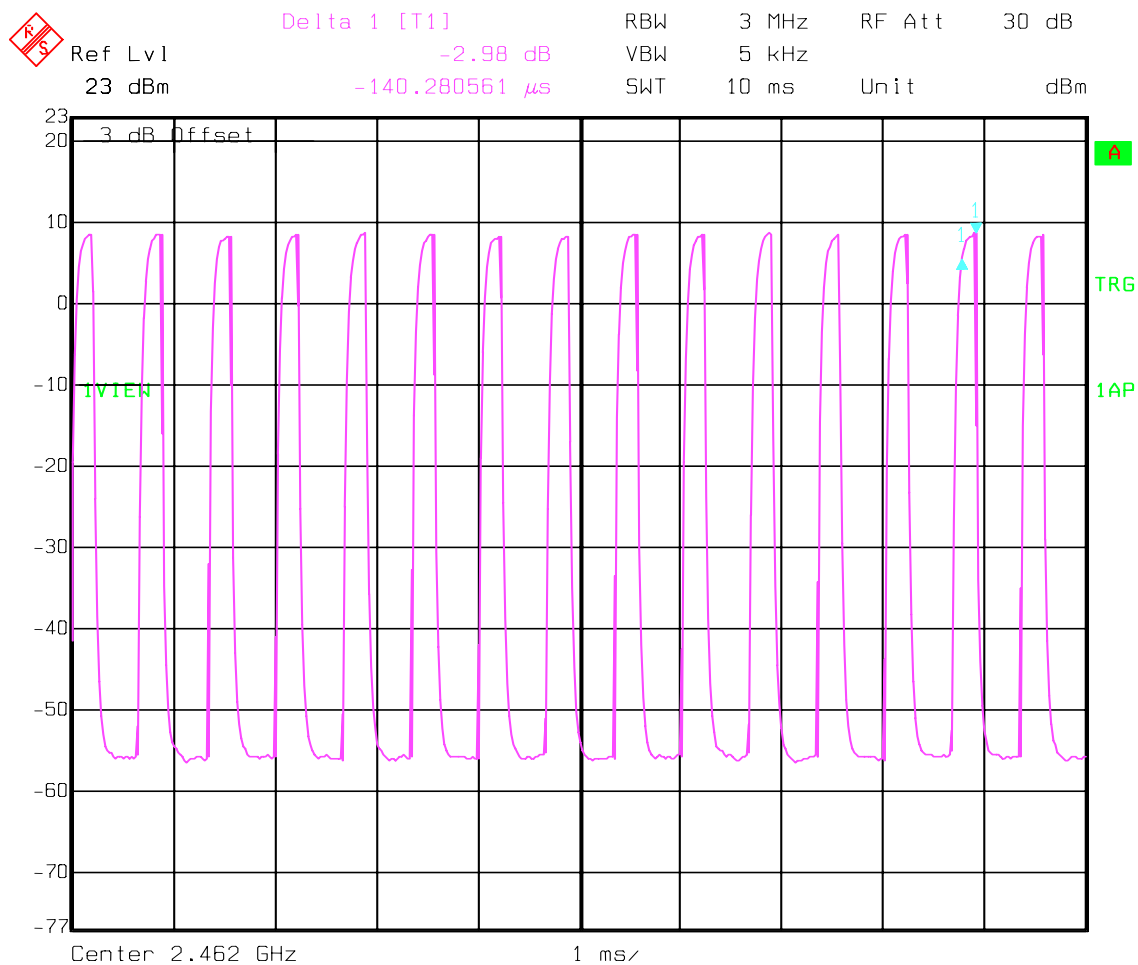
(Example for Low channel)

$$\begin{aligned} \text{Source-based time averaged output} &= \text{Max. EIRP} + 10\log(\text{duty factor}) \\ &= 28.45 - 6.77 = \mathbf{21.68\text{dBm}} \end{aligned}$$

TEST CONDITIONS		SOURCE-BASED TIME AVERAGED OUTPUT (dBm)		
Frequency (MHz)		2412	2437	2462
T _{nom} (23)°C	V _{nom} (3.3) VDC	21.68	20.61	20.24

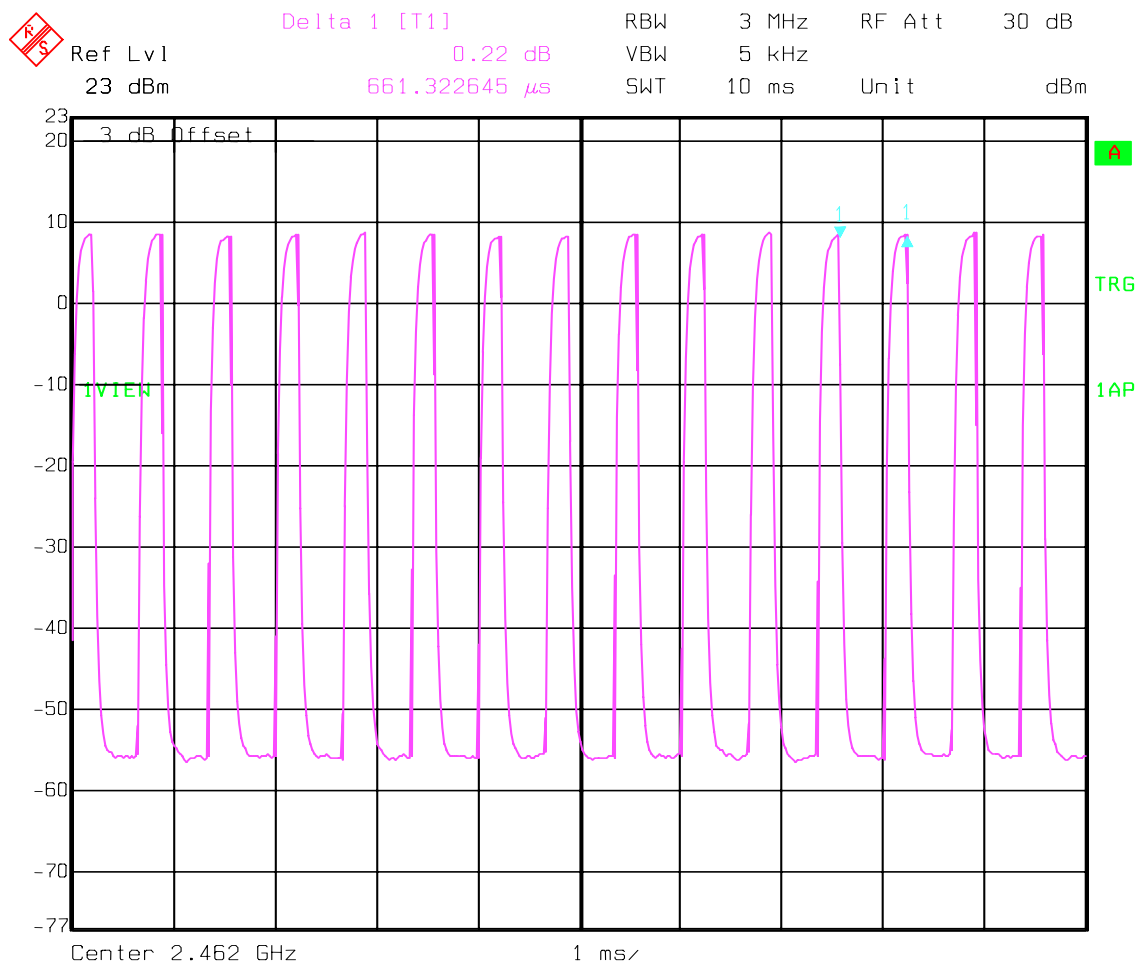
Please refer to the plots on next pages

Transmitter ON time – $T_{x_{on}}$



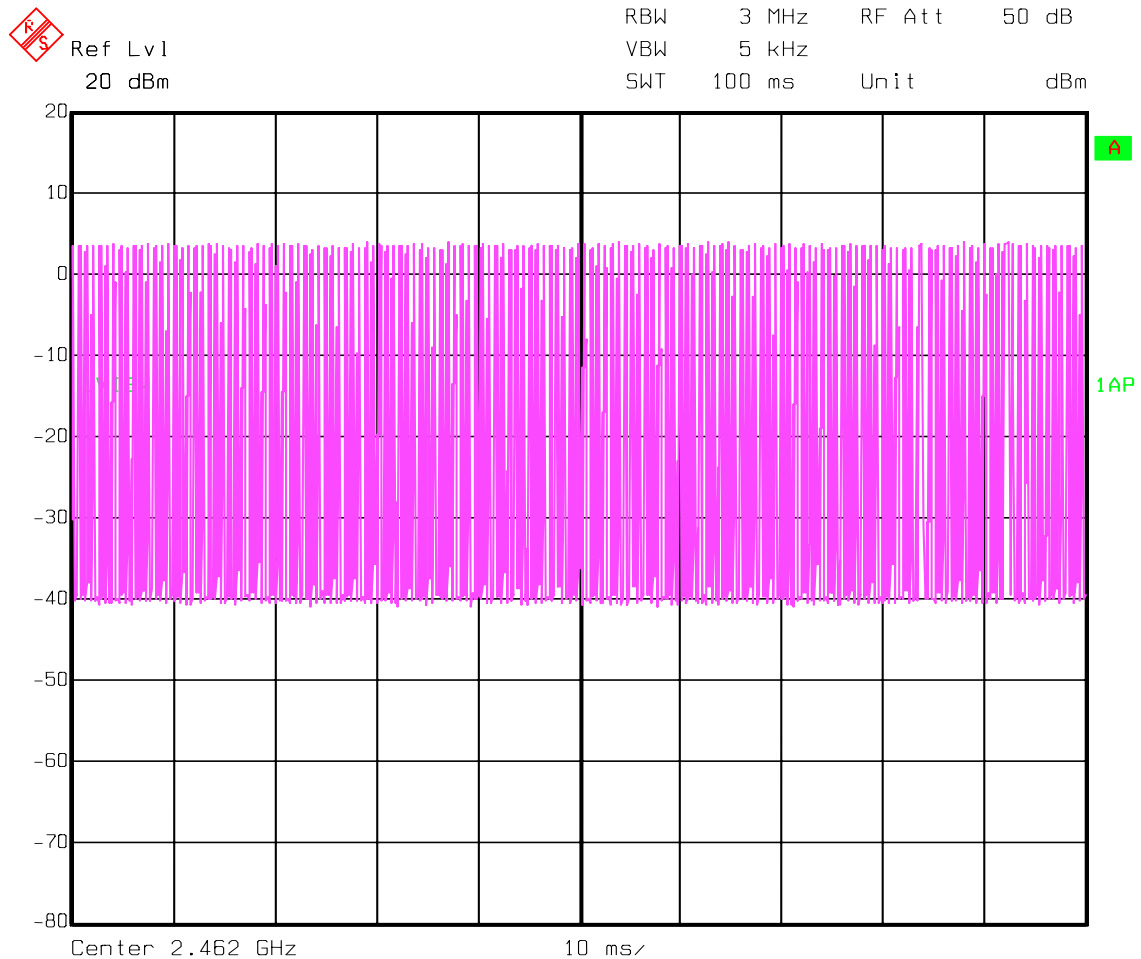
Date: 11.DEC.2002 03:43:11

Transmitter ON+OFF time – $T_{x_{on}}$ + $T_{x_{off}}$



Date: 11.DEC.2002 03:45:09

100ms plot – to show repetition of pattern



Date: 11.DEC.2002 04:22:23

BAND EDGE COMPLIANCE

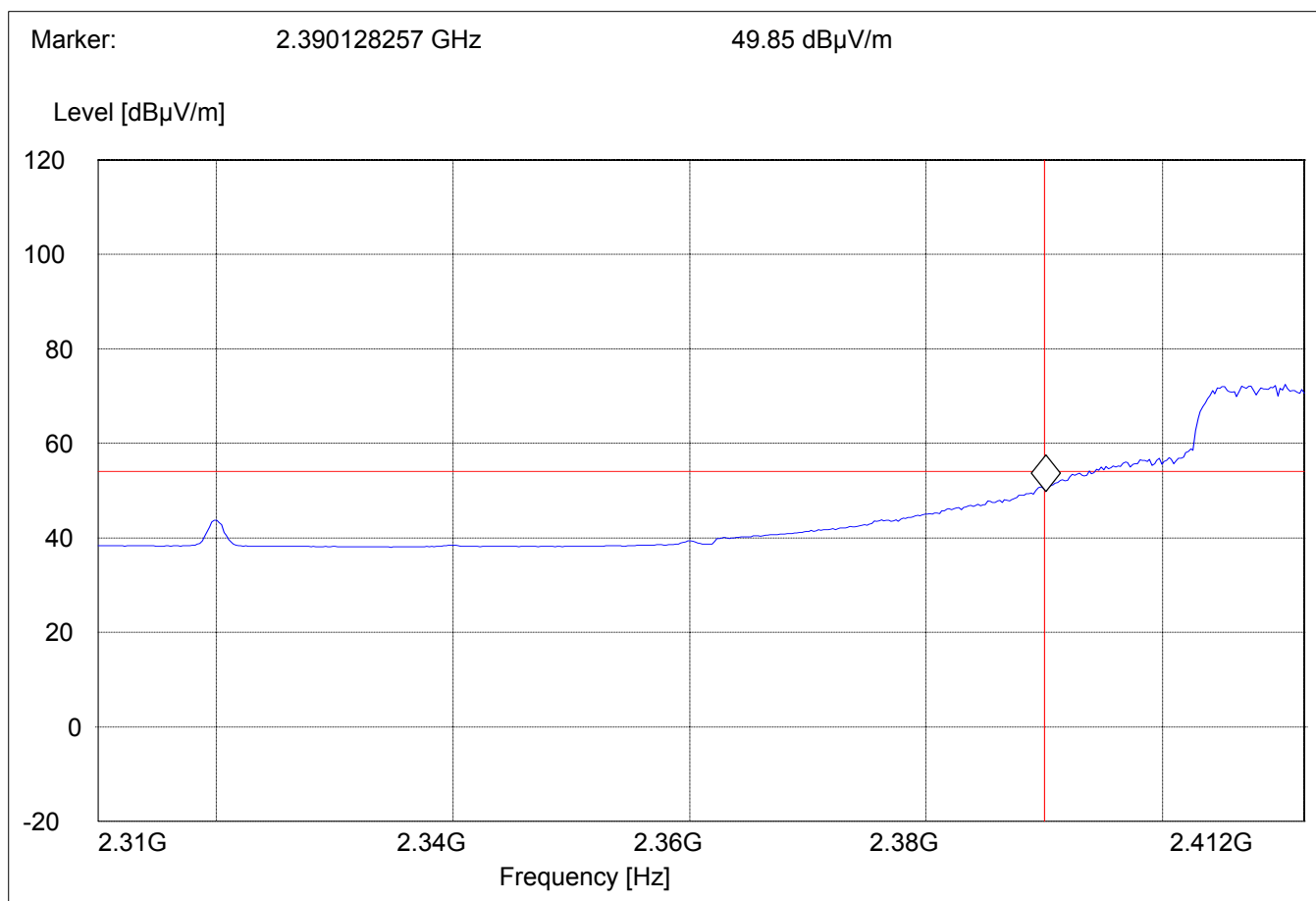
§15.247 (c)

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

(Average measurement)

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

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



BAND EDGE COMPLIANCE

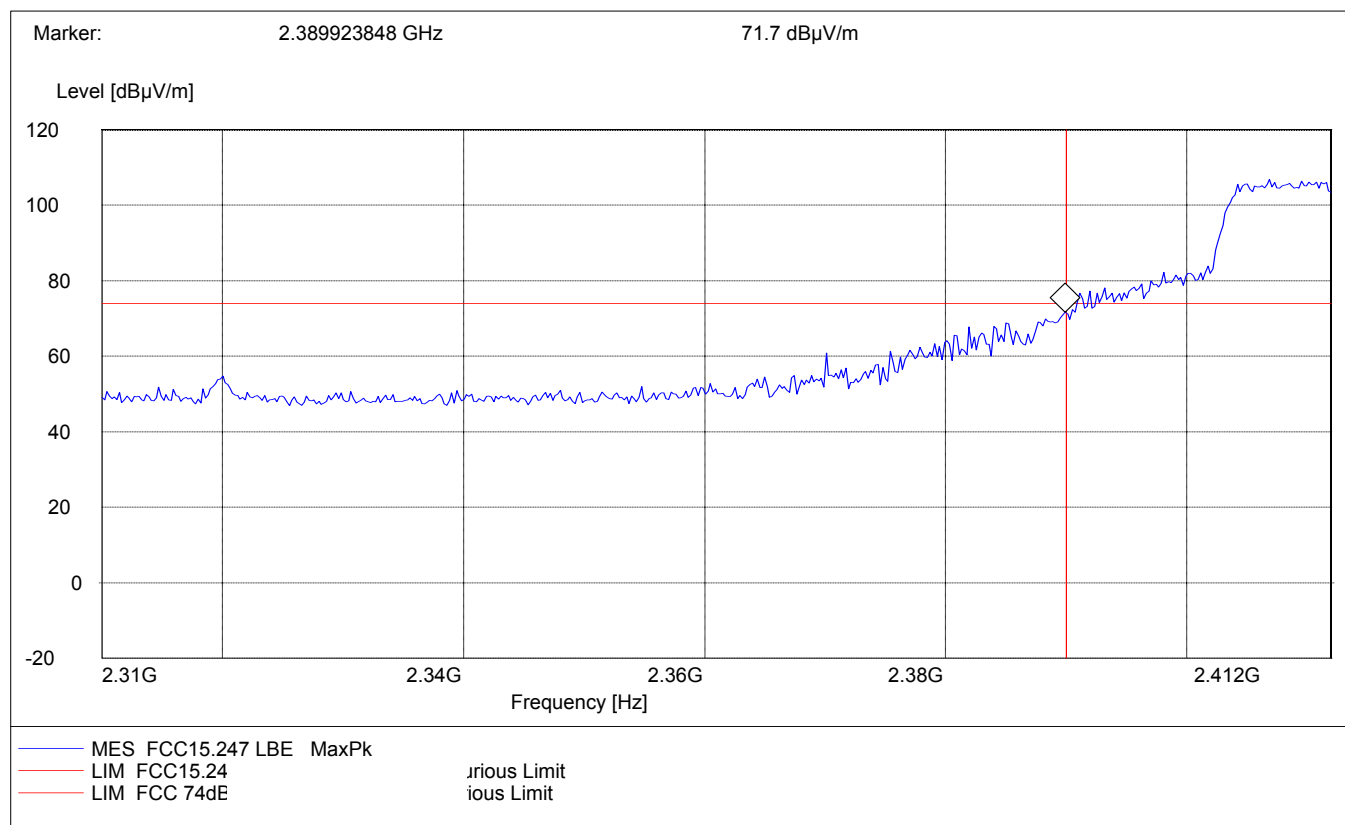
§15.247 (c)

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

(Peak measurement)

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

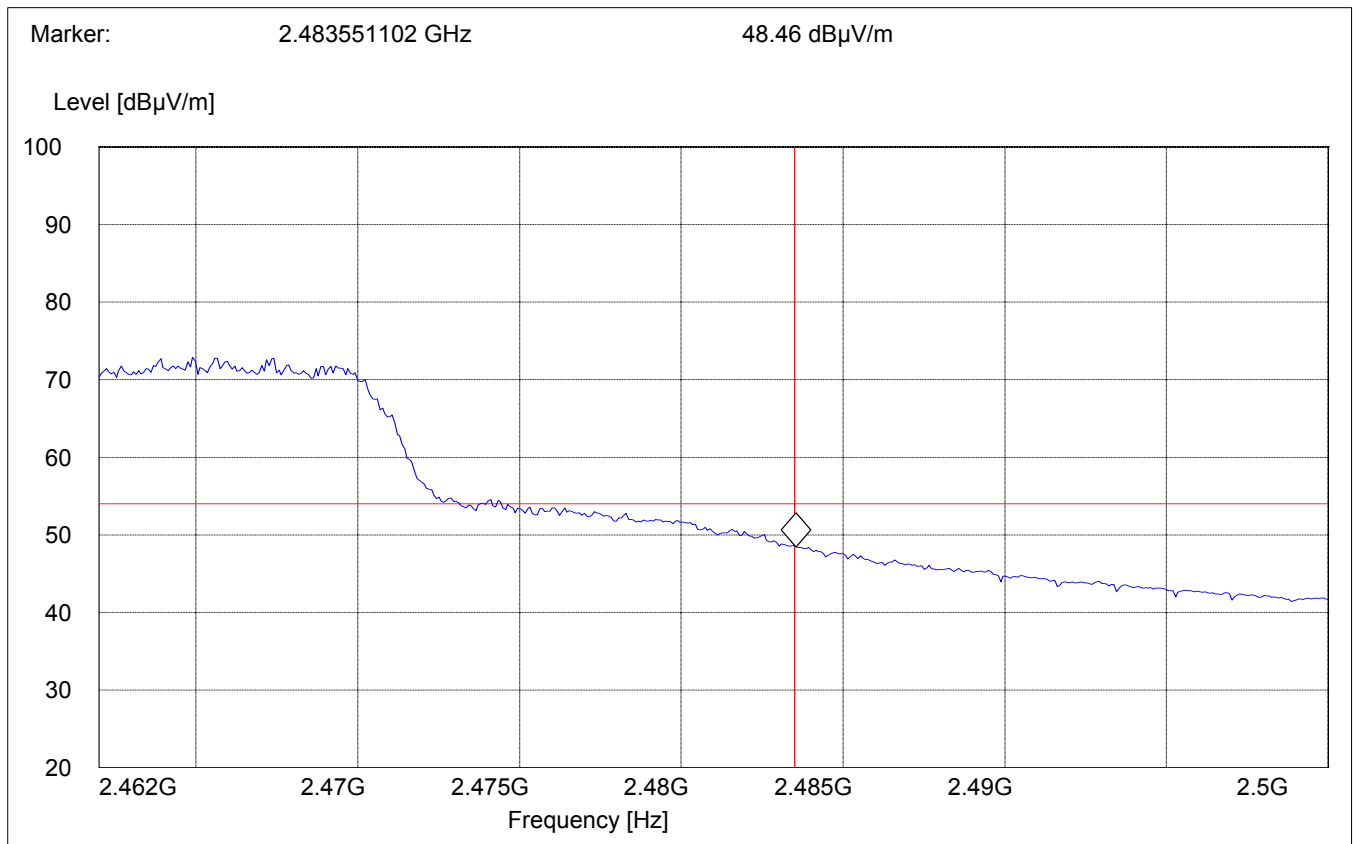
§15.247 (c)

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

(Average measurement)

Operating condition : Tx at 2462MHz
 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

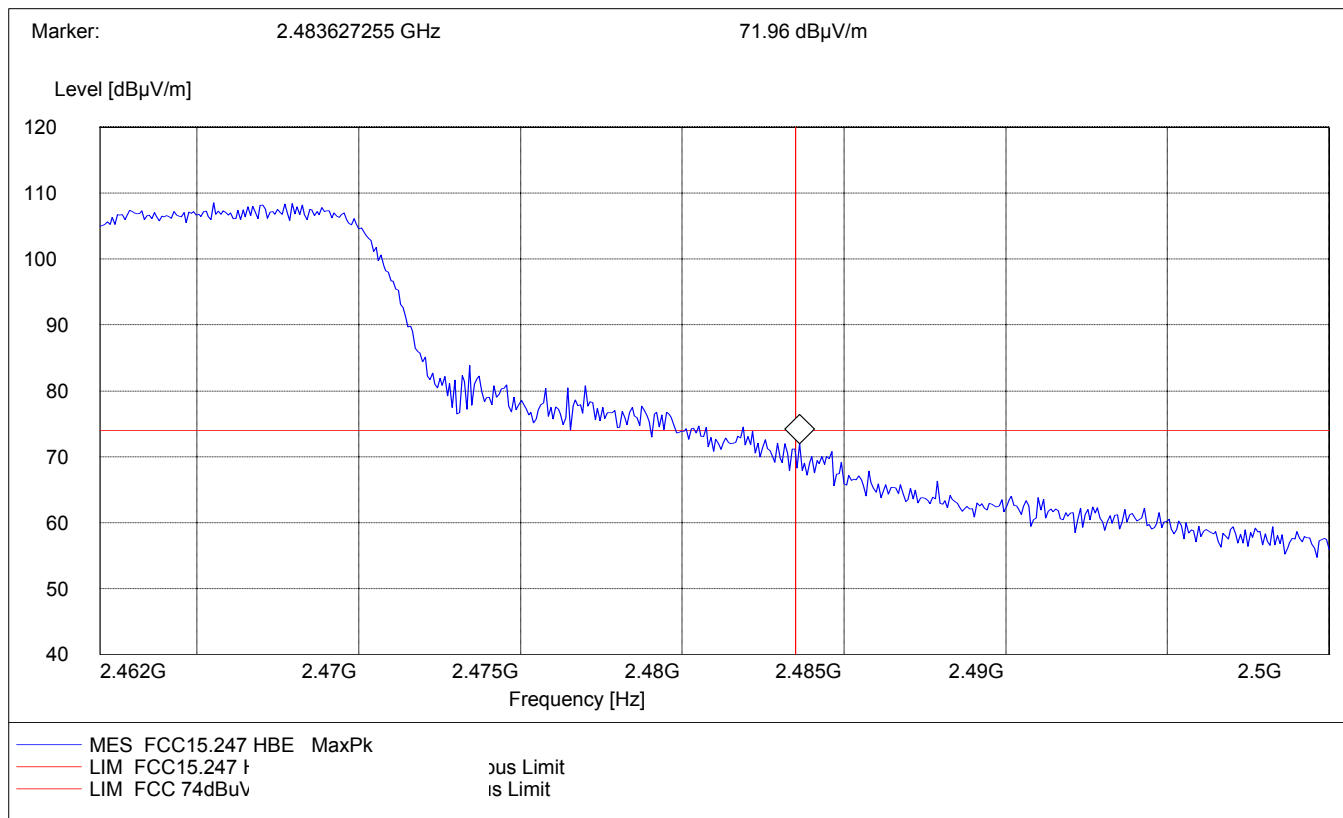
§15.247 (c)

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

(Peak measurement)

Operating condition : Tx at 2462MHz
 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
Transmitter (Radiated)**§ 15.247 (c) (1)****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 3 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.
2. All measurements are done in peak mode unless specified with the plots.

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)**

Transmit at Lowest channel Frequency 2412MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
3210.42	43.60		23.72
4803.6	48.72		27.99
5314.63	48.87		35.50
7238.47	51.94		35.05
Transmit at Middle channel Frequency 2437MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
3240.48	44.07		24.11
4863.72	47.88		36.77
5314.63	50.00		32.80
7298.59	57.40		36.15
Transmit at Highest channel Frequency 2462MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
3270.54	40.40		21.93
4923.84	48.04		31.80
5314.63	48.73		34.13
7388.77	57.03		39.98

EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

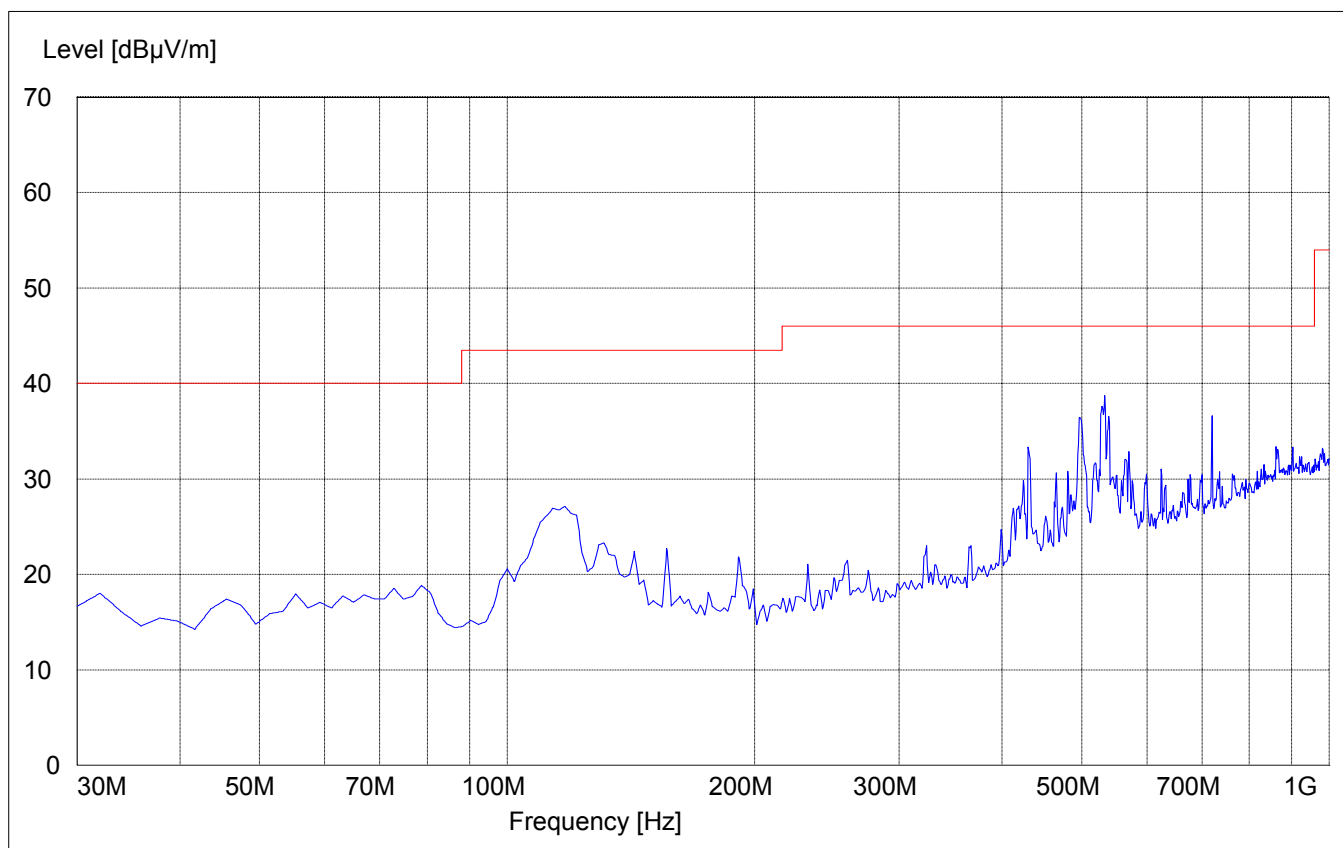
Lowest Channel (2412MHz): 30MHz – 1GHz

Note: This plot is valid for low, mid, high channels (worst-case plot)

SWEEP TABLE:

"BT Spuri hi 30-1G"

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



EMISSION LIMITATIONS - Radiated (Transmitter) Lowest Channel (2412MHz): 1GHz – 3GHz

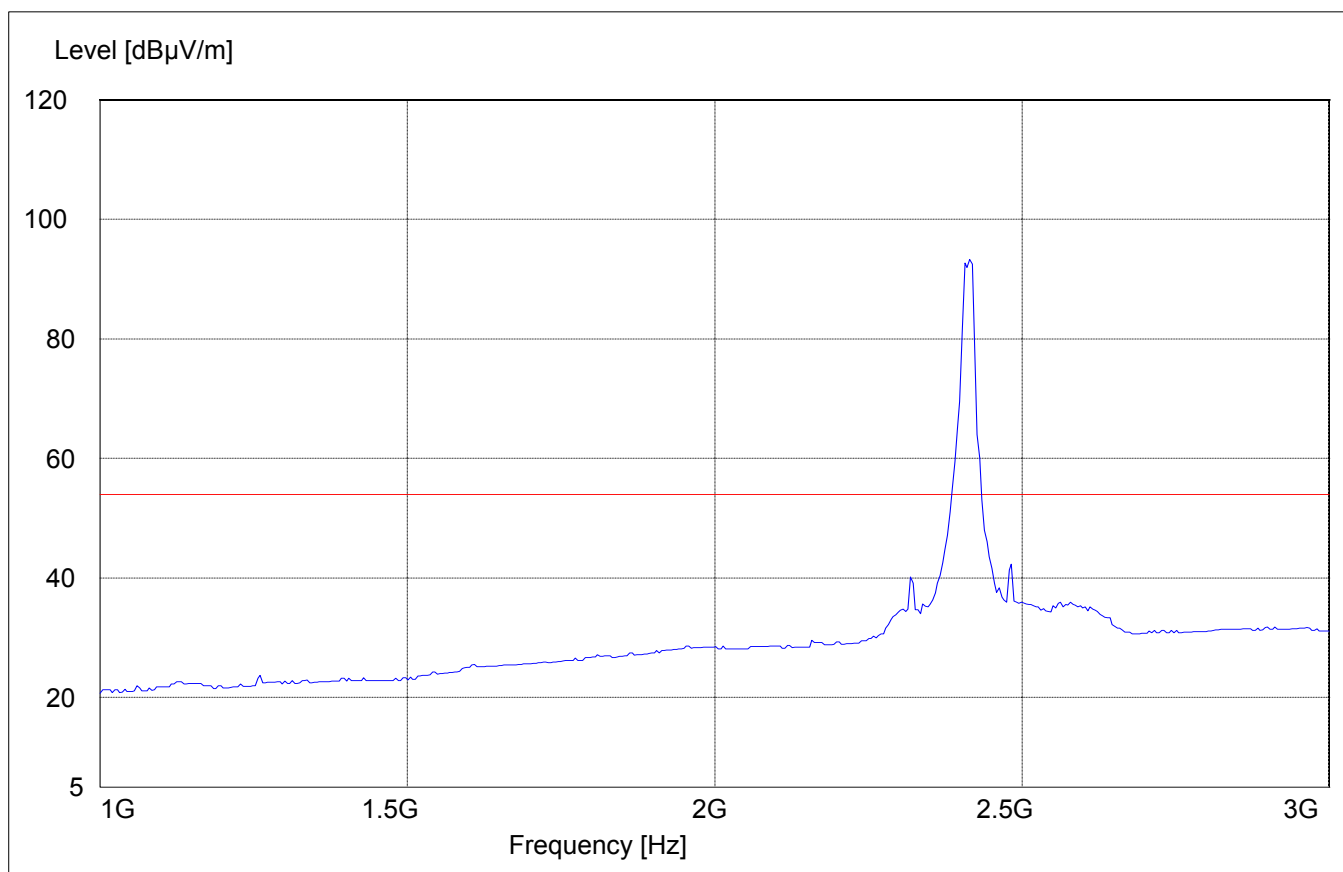
§ 15.247 (c) (1)

Average Measurement

SWEEP TABLE:

Start	Stop	Detector	Meas.	RBW	VBW	Transducer
Frequency	Frequency	Time	Bandw.			
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)

"BT Spuri hi 1-3G"



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

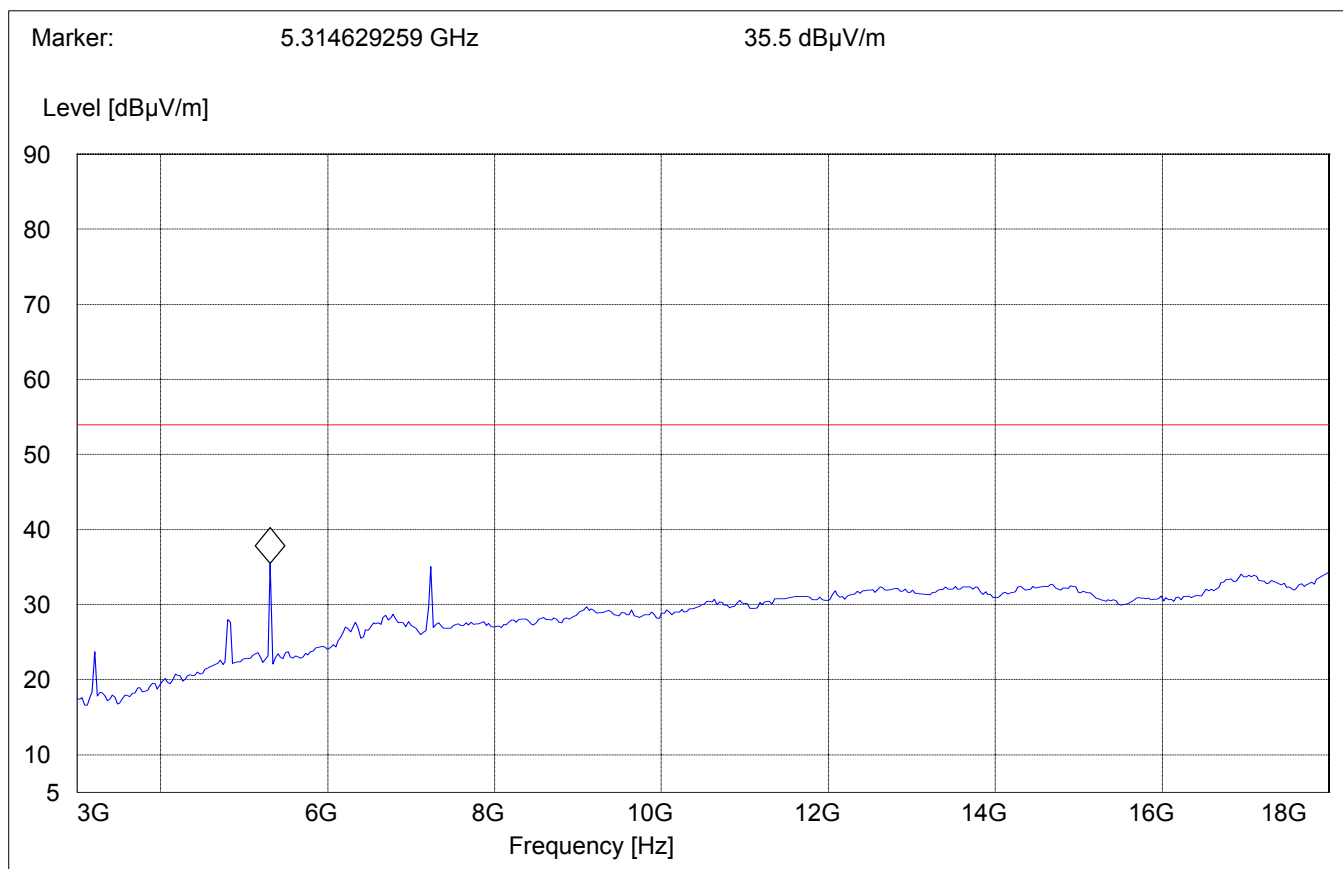
Lowest Channel (2412MHz): 3GHz – 18GHz

Average Measurement

SWEEP TABLE:

"BT Spuri hi 3-18G"

Start	Stop	Detector	Meas.	RBW	VBW	Transducer
Frequency	Frequency	Time	Bandw.			
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

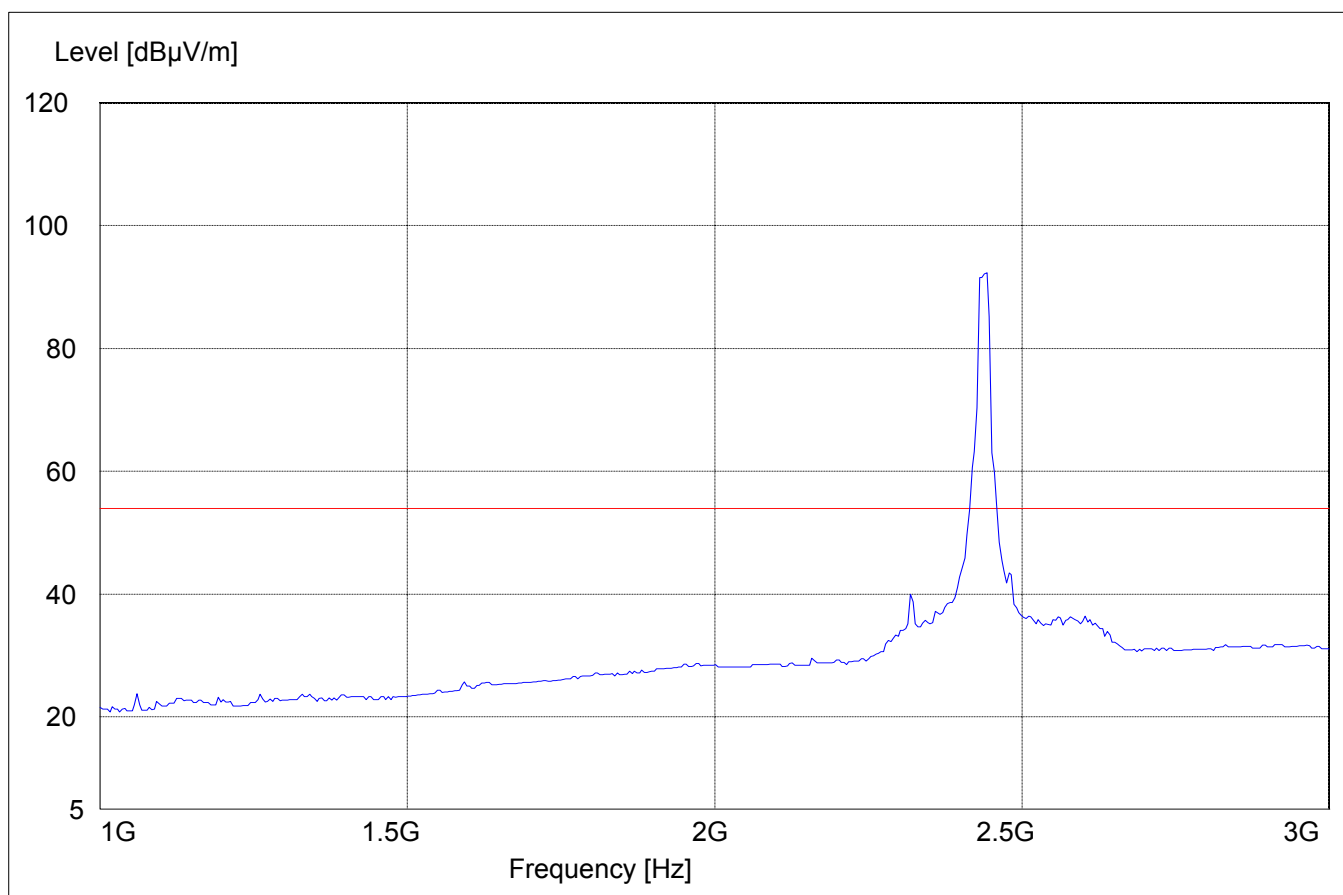
Mid Channel (2437MHz): 1GHz – 3GHz

Average Measurement

Note: The peak above the limit line is the carrier freq.

SWEEP TABLE:

		"BT Spuri hi 1-3G"				
Start	Stop	Detector	Meas.	RBW	VBW	Transducer
Frequency	Frequency	Time	Bandw.			
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

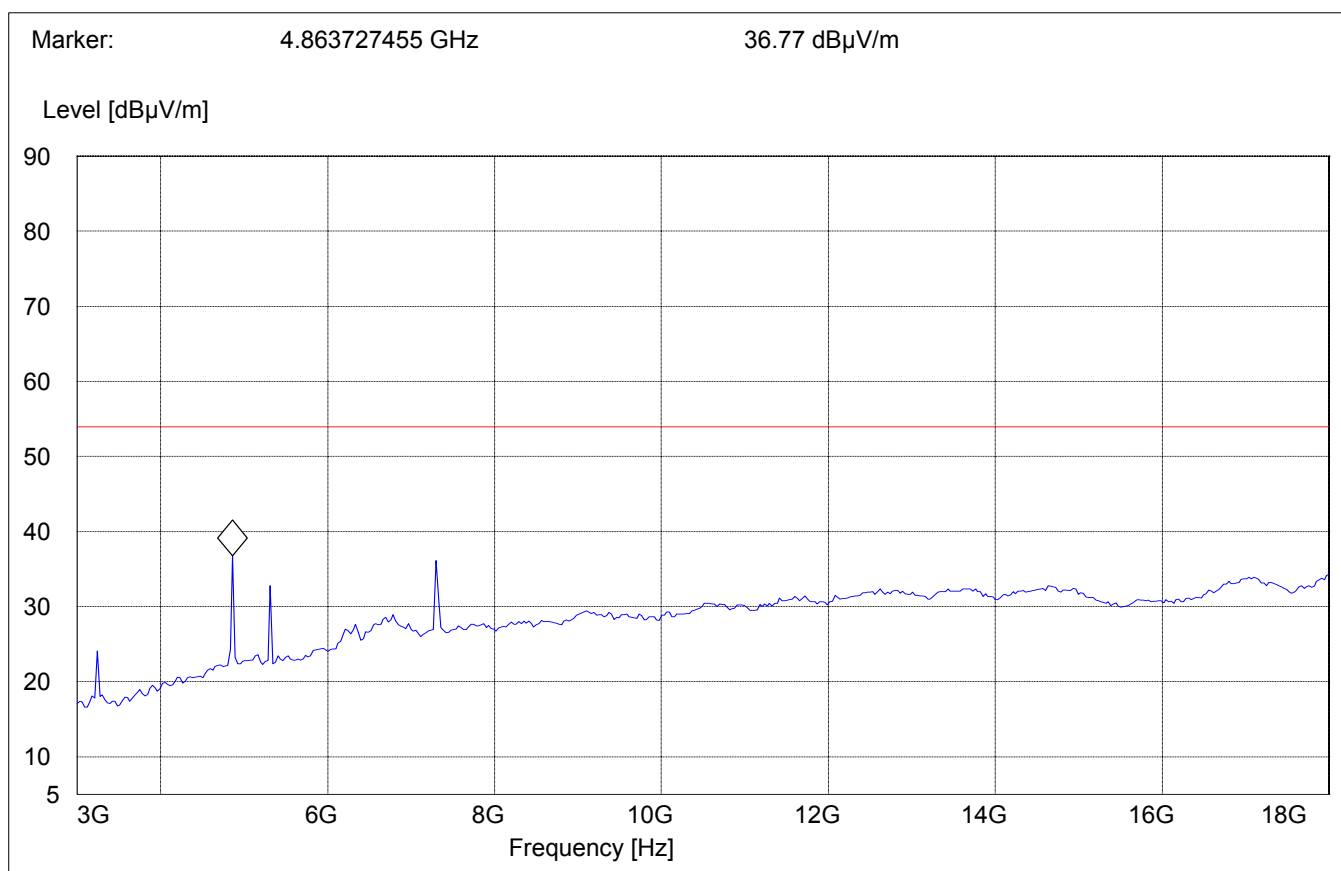
Mid Channel (2437MHz): 3GHz – 18GHz

Average Measurement

SWEEP TABLE:

"BT Spuri hi 3-18G"

Start	Stop	Detector	Meas.	RBW	VBW	Transducer
Frequency	Frequency	Time	Bandw.			
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

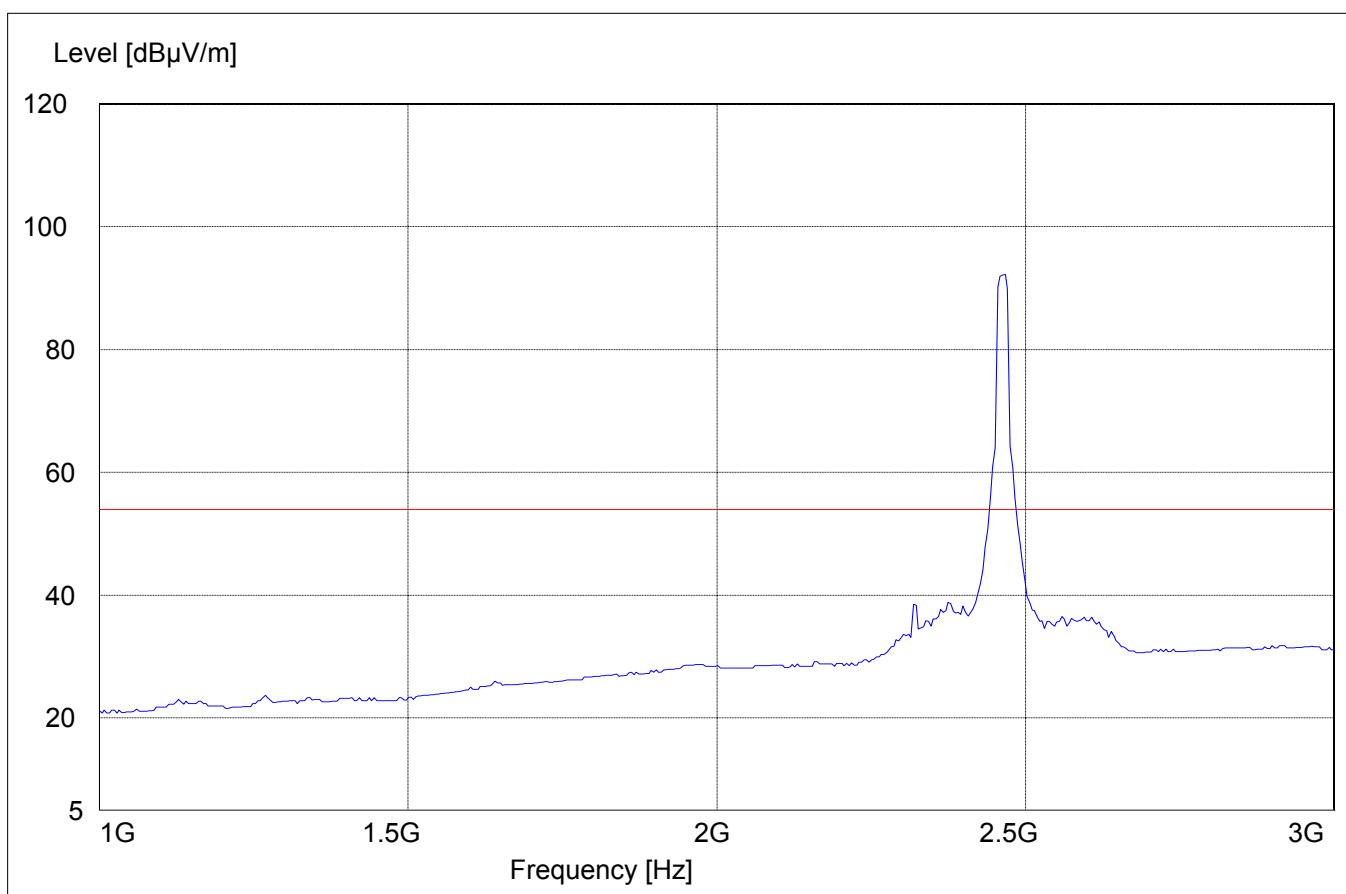
Highest Channel (2462MHz): 1GHz – 3GHz

Average Measurement

Note: The peak above the limit line is the carrier freq.

SWEEP TABLE:

		"BT Spuri hi 1-3G"				
Start	Stop	Detector	Meas.	RBW	Transducer	
Frequency	Frequency	Time	Bandw.		VBW	
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

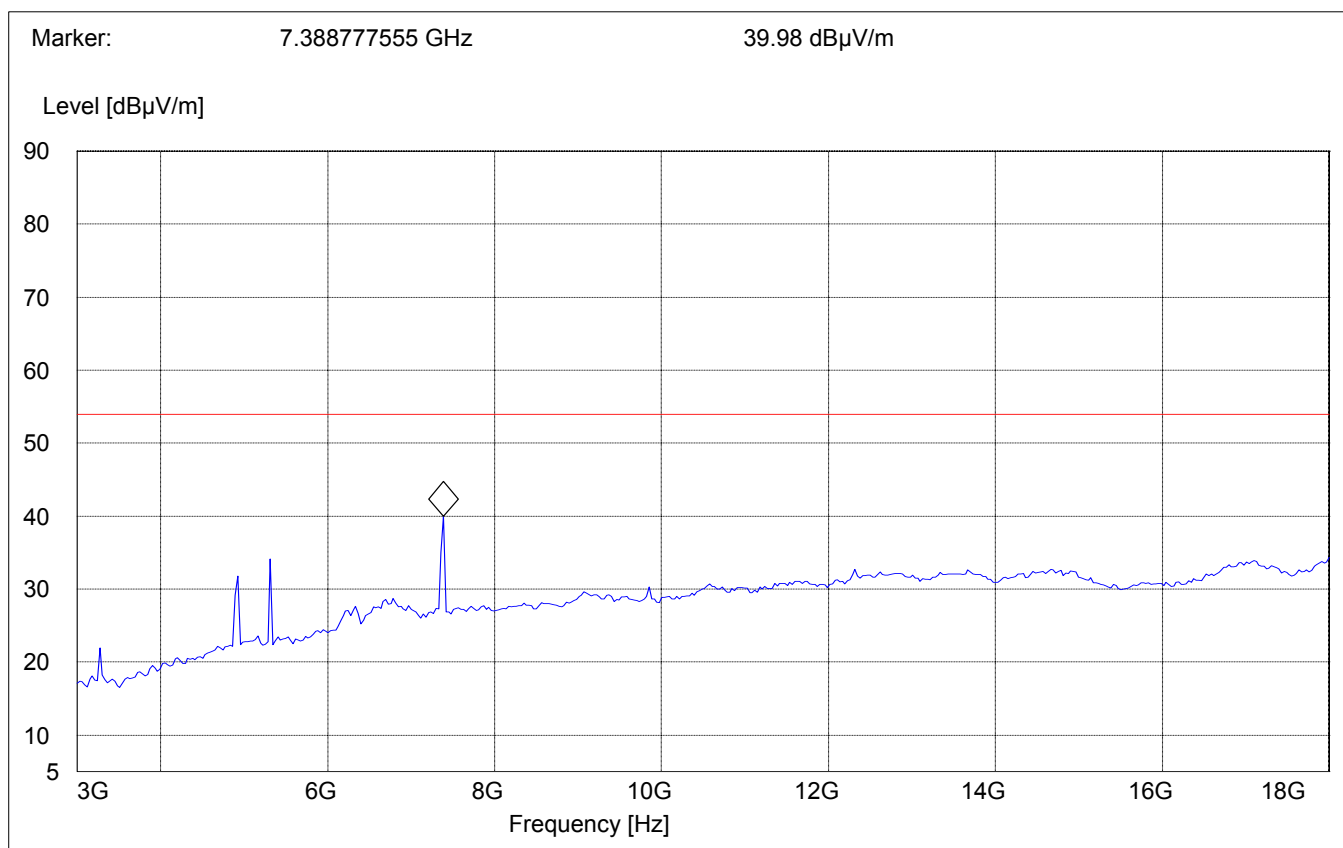
Highest Channel (2462MHz): 3GHz – 18GHz

Average Measurement

SWEEP TABLE:

"BT Spuri hi 3-18G"

Start	Stop	Detector	Meas.	RBW	VBW	Transducer
Frequency	Frequency	Time	Bandw.			
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

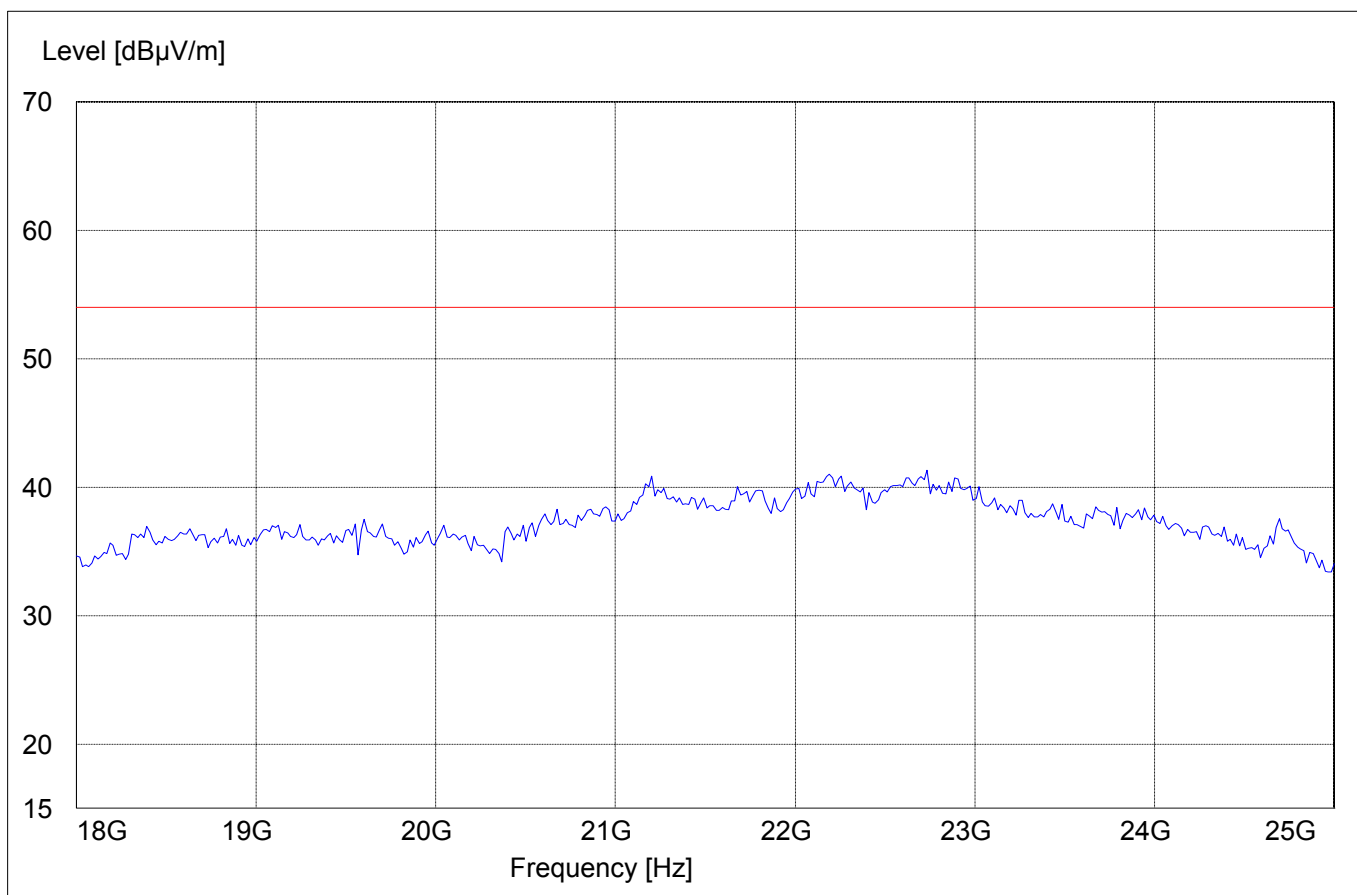
18GHz – 25GHz

Note: This plot is valid for low, mid, high channels (worst-case plot)

SWEEP TABLE:

"BT Spuri hi 18-25G"

Start	Stop	Detector	Meas.	RBW	Transducer
Frequency	Frequency	Time	Bandw.	VBW	
18 GHz	25 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



CONDUCTED EMISSIONS

§ 15.107/207

Measured with AC/DC power adapter

SWEEP TABLE: "55022 cond"

Short Description:		EN 55022 for 150KHz-30MHz			
Start	Stop	Detector	Meas	IF	Transducer
Frequency	Frequency		Time	Bandw.	
150.0 kHz	30.0 MHz	MaxPeak	Coupled	10 kHz	None

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

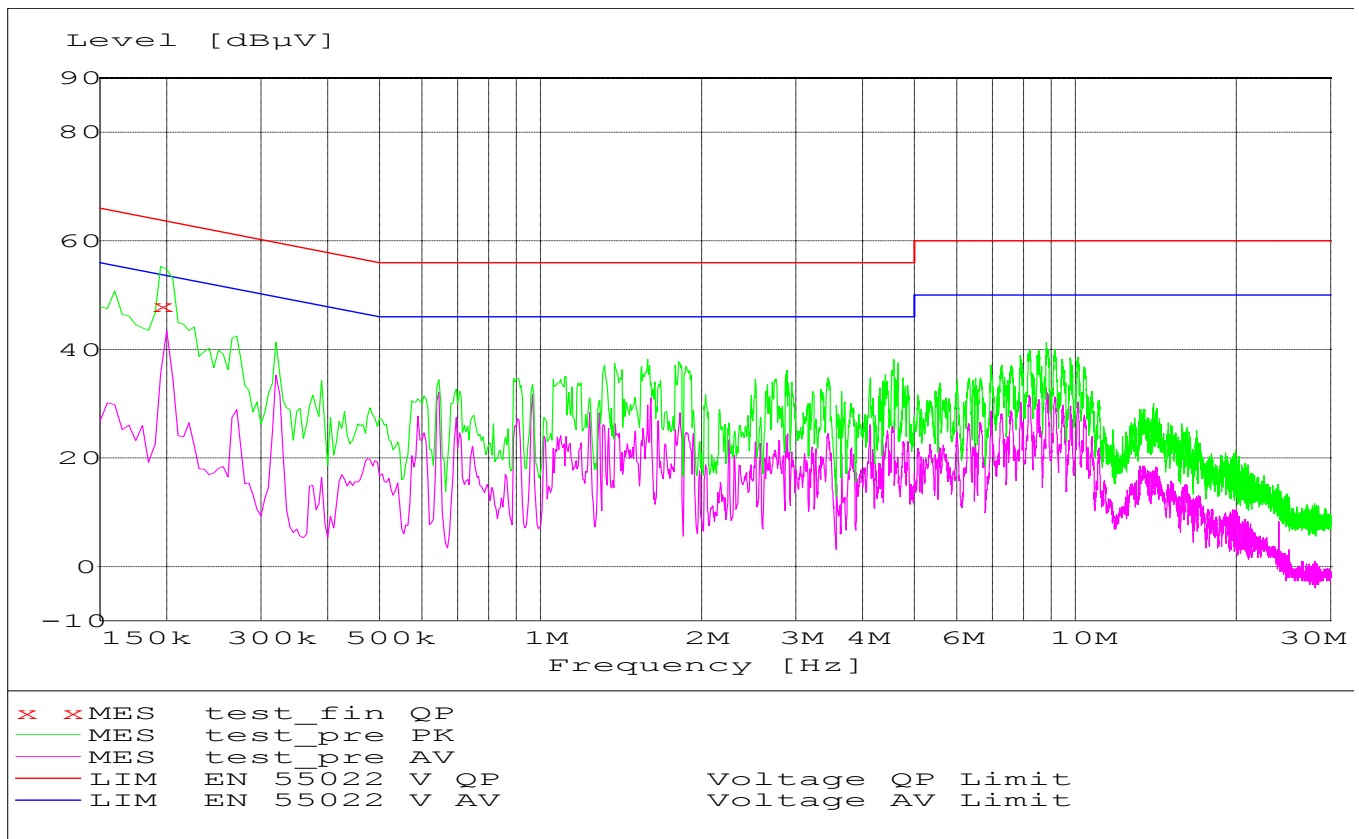
Limit

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: "test_fin QP"

Frequency	Level	Transd	Limit	Margin	Line	PE
MHz	dBµV	dB	dBµV	dB		
0.195000	48.00	0.0	64	15.9	N	GND

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:

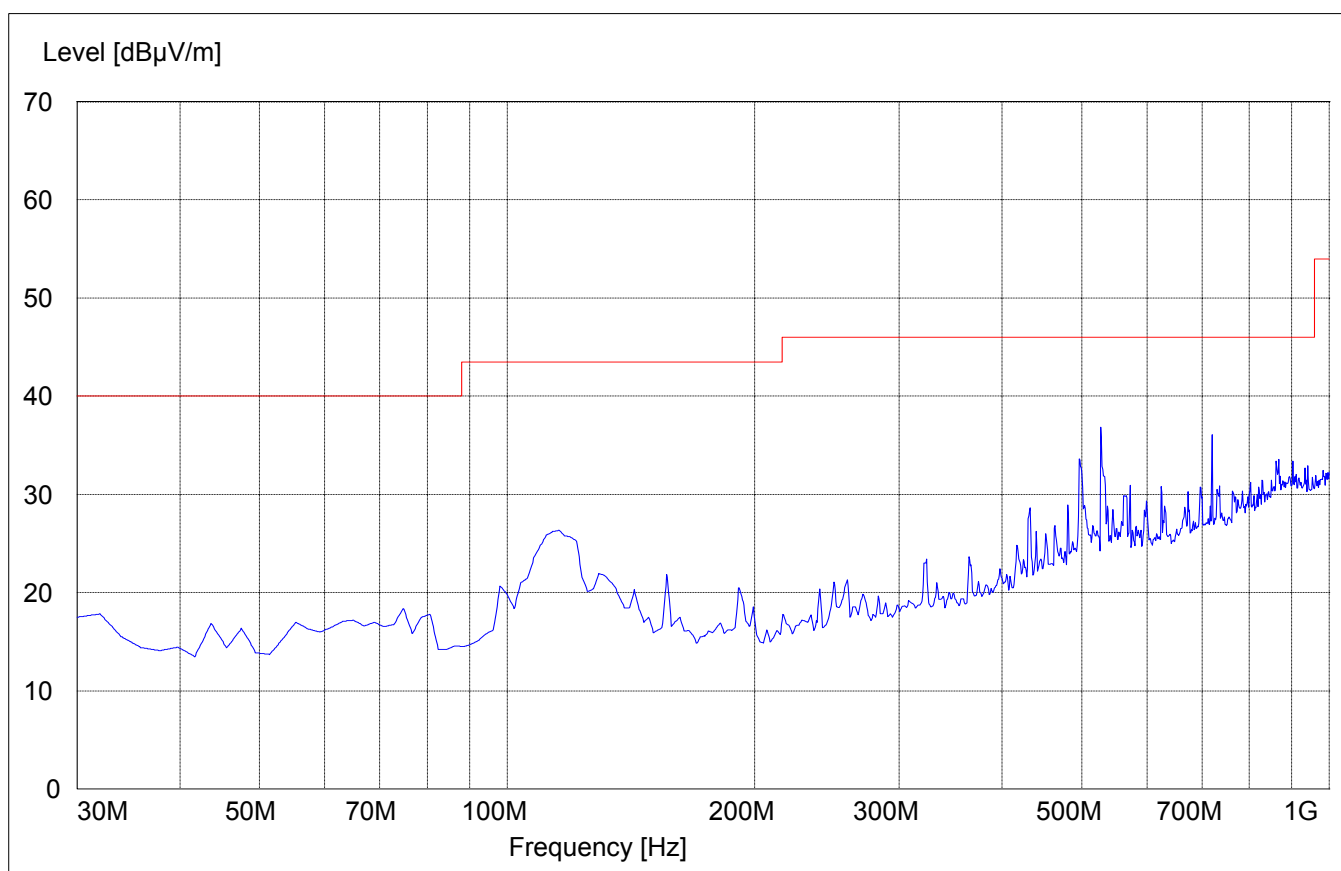
The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 3 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

RECEIVER SPURIOUS RADIATION 30MHz – 1GHz

§ 15.209

SWEEP TABLE:

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



RECEIVER SPURIOUS RADIATION

§ 15.209

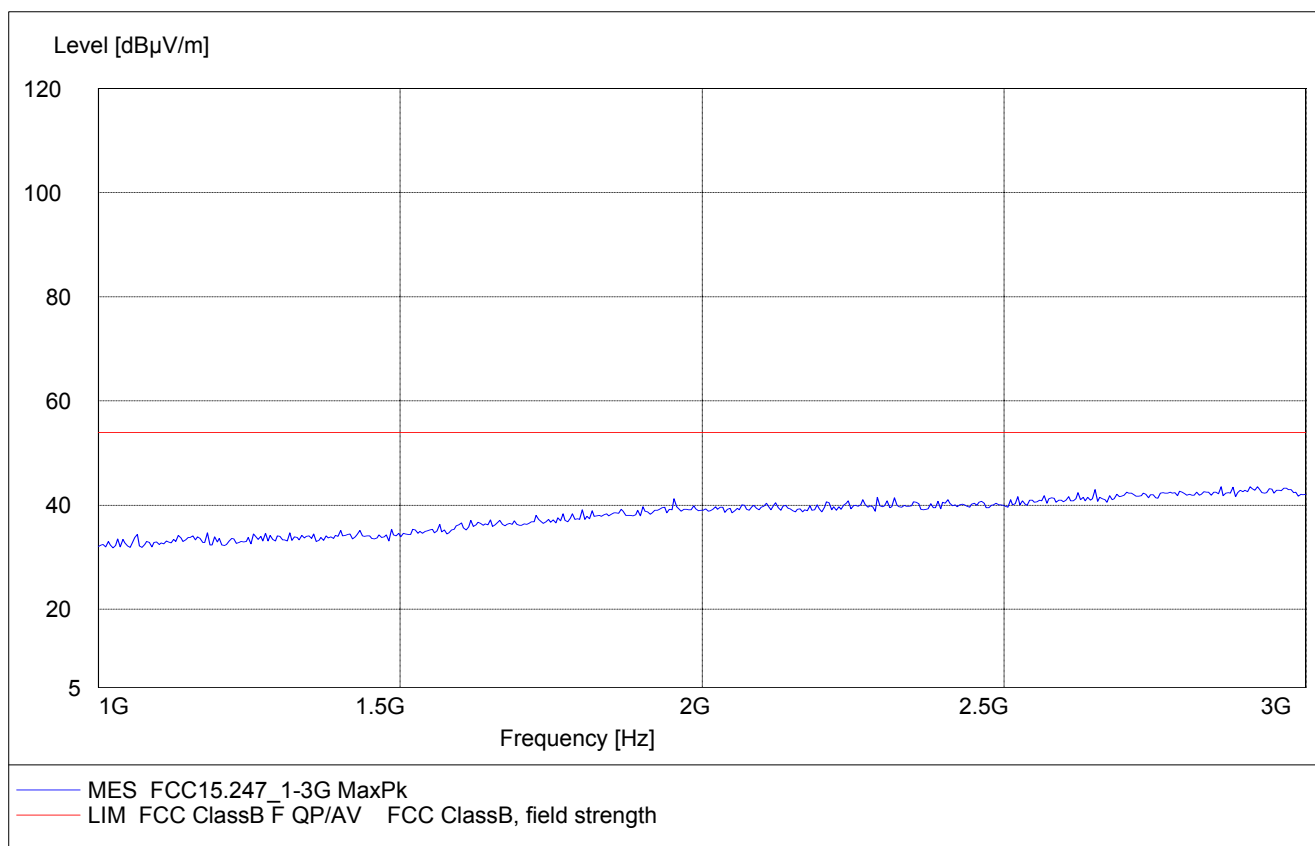
1GHz – 3GHz

Peak Measurement

SWEEP TABLE:

"BT Spuri hi 1-3G"

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



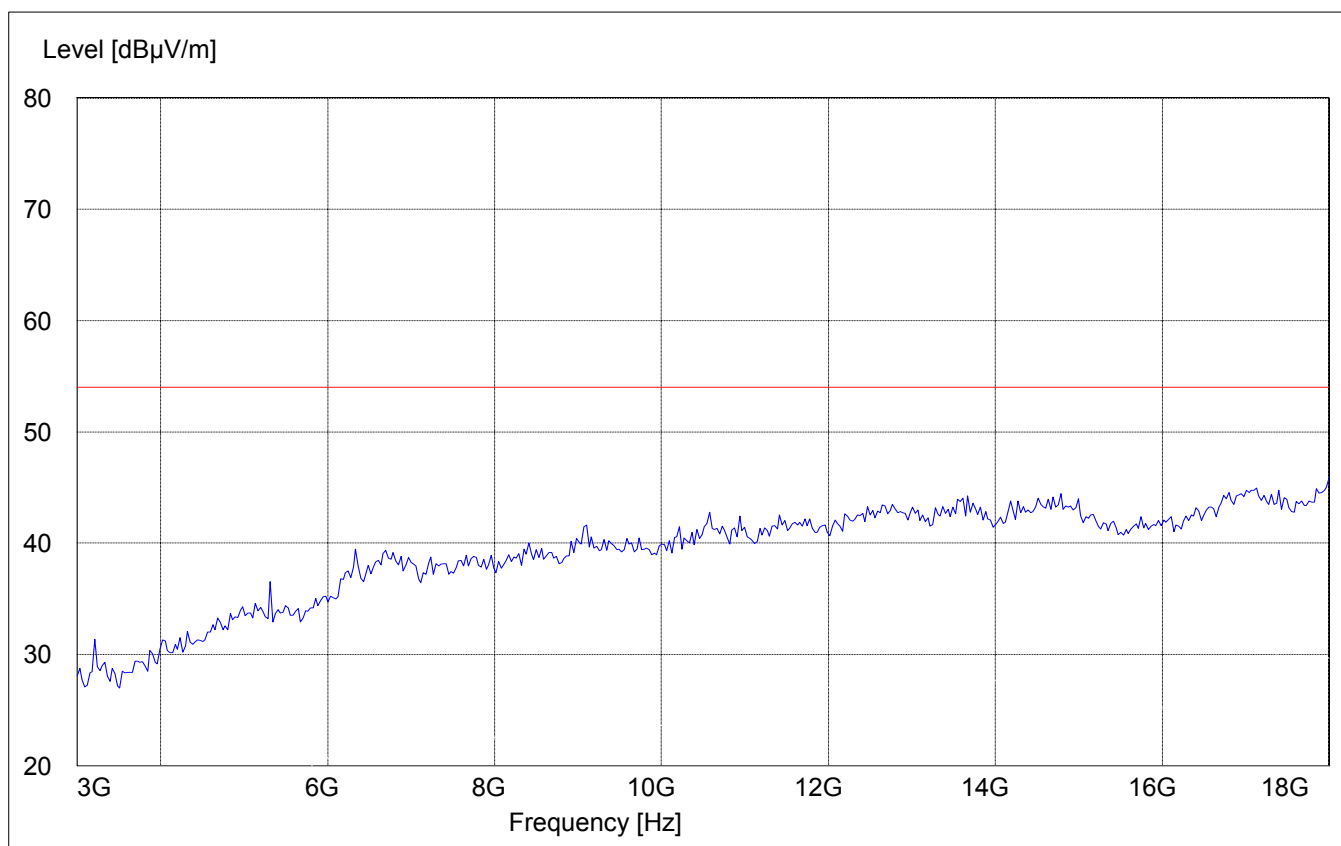
RECEIVER SPURIOUS RADIATION 3GHz – 18GHz

§ 15.209

SWEEP TABLE:

"BT Spuri hi 3-18G"

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

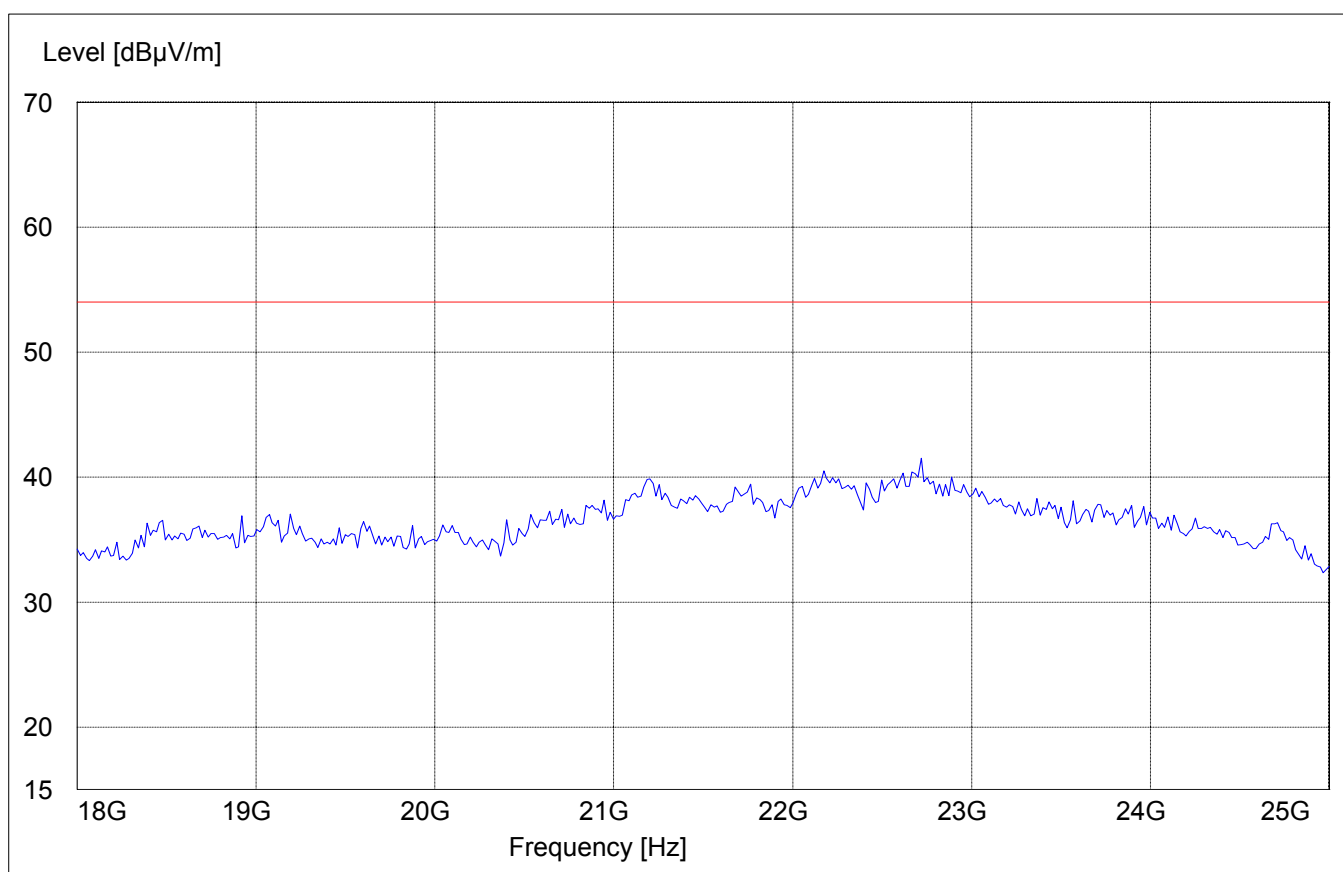


RECEIVER SPURIOUS RADIATION 18GHz – 25GHz

§ 15.209

SWEEP TABLE:

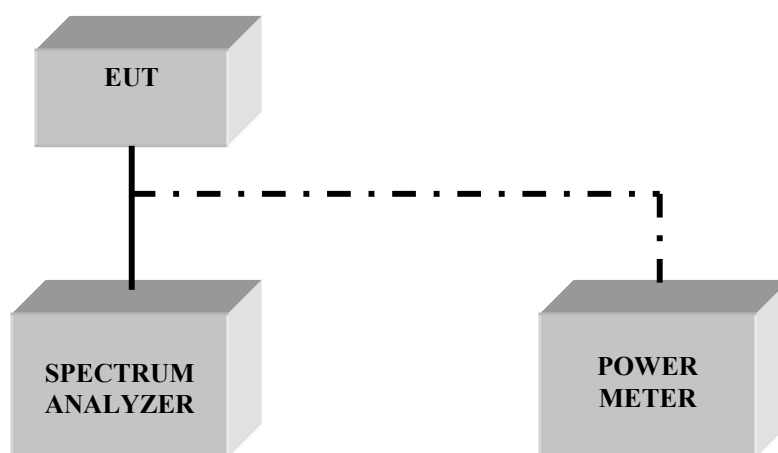
		"BT Spuri hi 18-25G"			
Start	Stop	Detector	Meas.	RBW	Transducer
Frequency	Frequency	Time	Bandw.	VBW	
18 GHz	25 GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



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	Biconilog Antenna	3141	EMCO	0005-1186
04	Horn Antenna (700M-18GHz)	SAS-200/571	AH Systems	325
05	Horn Antenna (18-26.5GHz)	3160-09	EMCO	1240
06	2-3GHz Band reject filter	BRM50701	Microtronics	6
07	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02
08	Pre-Amplifier	TS-ANA	Rohde & Schwarz	--
09	Pre-Amplifier	JS4-00102600	Miteq	00616

BLOCK DIAGRAMS
Conducted Testing



Radiated Testing

ANECHOIC CHAMBER

