



FCC Test Report

Test report no.: EMC_797FCC15.247_2004_PP14L

FCC Part 15.247 for DSSS systems / CANADA RSS-210

EUT: WLAN Model: BCM94309MP

HOST: Dell Laptop Model: PP14L

FCC ID: QDS-BRCM1015

IC ID: 4324B-94309MP

(This test report covers freq. band 2412 – 2462MHz)



TTI-P-G 081/94-A0

Accredited according to **ISO/IEC 17025**



**Bluetooth Qualification
Test Facility
(BQTF)**



FCC listed # 101450

IC recognized # 3925

CETECOM Inc.

411 Dixon Landing Road • Milpitas, CA 95035 • U.S.A.

Phone: + 1 (408) 586 6200 • Fax: + 1 (408) 586 6299 • E-mail: info@cetecomusa.com • <http://www.cetecom.com>

CETECOM Inc. is a Delaware Corporation with Corporation number: 2113686
Board of Directors: Dr. Harald Ansorge, Dr. Klaus Matkey, Hans Peter May

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TEST REPORT PREPARED BY:

EMC Engineer: Harpreet Sidhu

1.2 Testing laboratory
CETECOM Inc.
411 Dixon Landing Road, Milpitas, CA-95035, USA
Phone: +1 408 586 6200 Fax: +1 408 586 6299
E-mail: lothar.schmidt@cetecomusa.com
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 : 2004-11-15
Date of test : 2003-11-19, 2004-11-15, 2005-02-01

1.5 Test item

Manufacturer : Applicant
Model No. (EUT) : BCM94309MP
Model No. (Host) : PP14L (Dell Laptop)
Description : WLAN MiniPCI Multiband card incorporating 2.4GHz and 5GHz radios
FCC ID : QDS-BRCM1015
IC ID : 4324B-94309MP

Additional information

Frequency : 2412MHz – 2462MHz for 2.4GHz band
Type of modulation : DSSS / OFDM (orthogonal frequency division multiplexing)
Number of channels : 11 for 2.4GHz band
13 for 5GHz band
Antenna : Hitachi Stamped metal sheet antenna 1.5dBi for 2.4GHz
Power supply : 3.3 VDC from Host
Output power : 19.8dBm (0.095W) conducted peak power for 2.4GHz band
Extreme temp. Tolerance : 0°C to +70°C

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

PROJECT OVERVIEW:

BCM94309MP is WLAN MiniPCI Multiband card incorporating 2.4GHz and 5GHz radios. This test report carries all measurements required as per FCC 15.247 on WLAN mini PCI card tested in laptop model PP14L in freq. range 2412-2462MHz **with Hitachi stamped metal sheet ant. max gain 1.5dBi**

WLAN was tested for spurious emissions in different data rates (1, 2, 5.5, 6, 11, and 54) to ensure compliance of the whole device. Test report shows only worst-case test results of all data rates.


BCM94309MP antenna list						
No	Dell Model (Internal Name)	Supplier	Antenna Type	Model number	Max Peak gain 2.4GHz/dBi	Max Peak Gain 5GHz/dBi
1	Dell PP09L	Hitachi	PIFA stamped Metal	HFT08-DL-AS (Antenna side) HFT08-DL-MS (Module side)	2.9 (Aux)	2.8 (Main)
2	Dell PP14L	Hitachi	PIFA stamped Metal	HFT17-DL03	Main 1.5 (H)	Main 5.1 (V)

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:

2005-02-17	EMC & Radio	Lothar Schmidt (Technical Manager)	
Date	Section	Name	Signature

Responsible for test report and project leader:

2005-02-17	EMC & Radio	Harpreet Sidhu (EMC Engineer)	
Date	Section	Name	Signature

2.2 Test report

TEST REPORT

Test report no.: EMC_797FCC15.247_2004

FCC Part 15.247 for DSSS systems / CANADA RSS-210

TEST REPORT REFERENCE

LIST OF MEASUREMENTS

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SPECTRUM BANDWIDTH OF DSSS SYSTEM

§15.247(a) (2)

6 dB bandwidth

(Data rate – 54Mbps)

TEST CONDITIONS		6 dB BANDWIDTH (MHz)		
Frequency (MHz)		2412	2437	2462
T _{nom} (23)°C	V _{nom} (3.3) VDC	16.53	16.48	16.48

LIMIT

SUBCLAUSE §15.247(a) (2)

The minimum 6dB bandwidth shall be at least 500 KHz

SPECTRUM BANDWIDTH OF DSSS SYSTEM

§15.247(a) (2)

6 dB bandwidth
(Data rate – 54Mbps)

Lowest Channel: 2412MHz



Delta 1 [T1]

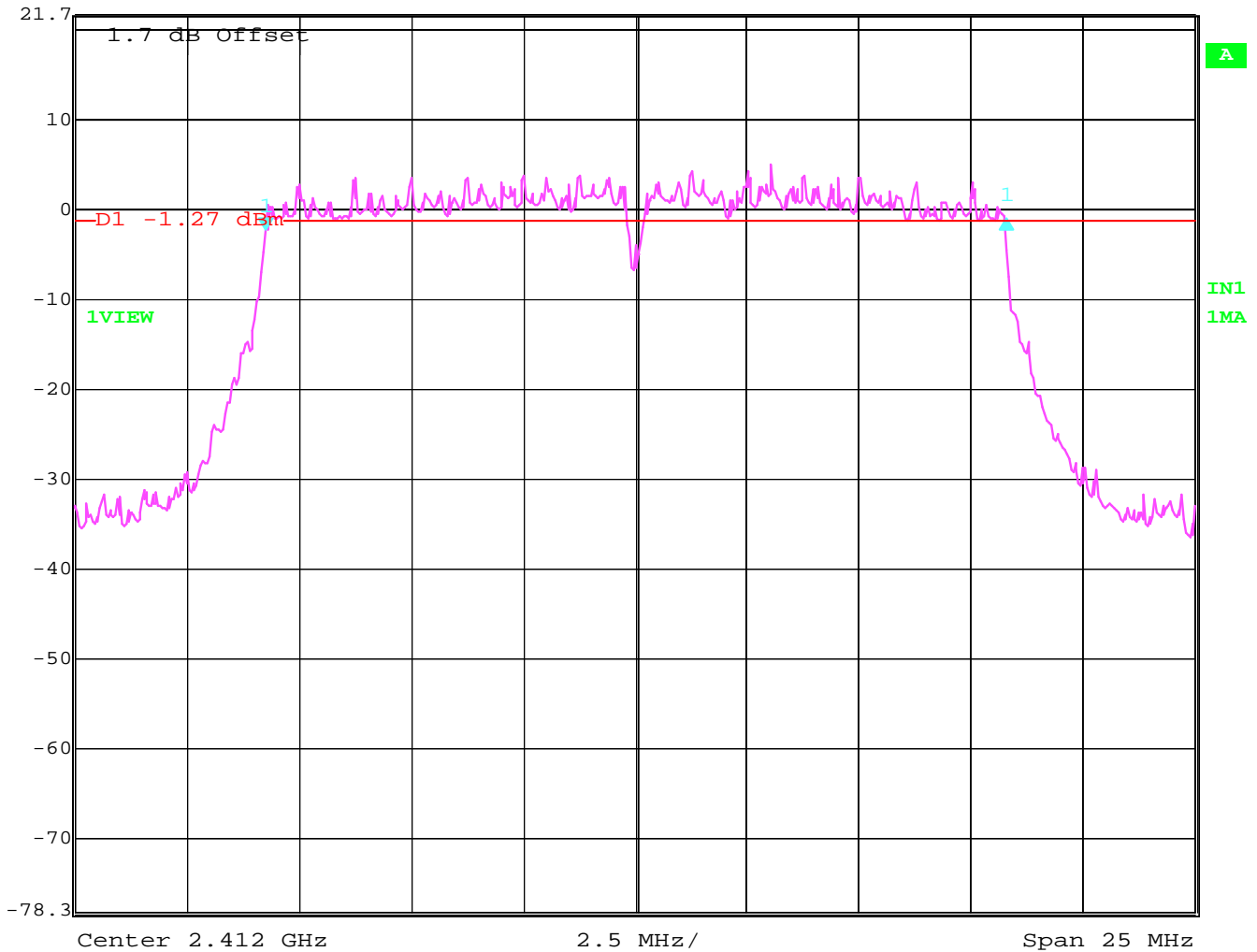
RBW 100 kHz RF Att 30 dB

Ref Lvl 1.49 dB

VBW 1 MHz

21.7 dBm 16.53306613 MHz

SWT 6.5 ms Unit dBm



Date: 19.NOV.2003 10:40:36

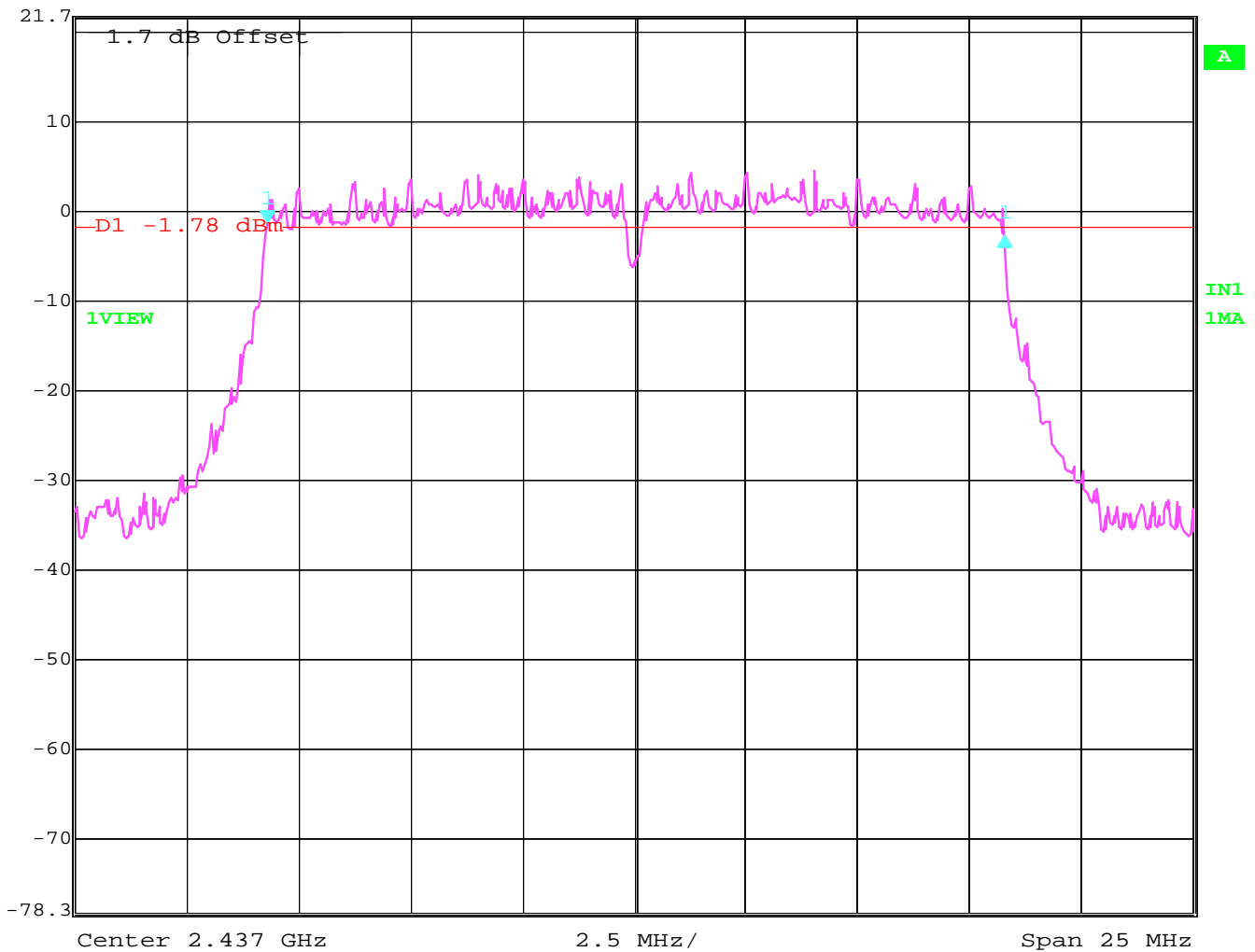
SPECTRUM BANDWIDTH OF DSSSS SYSTEM §15.247(a) (2)

**6 dB bandwidth
(Data rate – 54Mbps)**

Mid Channel: 2437MHz



Delta 1 [T1]	RBW	100 kHz	RF Att	30 dB
Ref Lvl	-1.36 dB	VBW	1 MHz	
21.7 dBm	16.48296593 MHz	SWT	6.5 ms	Unit dBm



Date: 19.NOV.2003 10:42:03

SPECTRUM BANDWIDTH OF DSSS SYSTEM

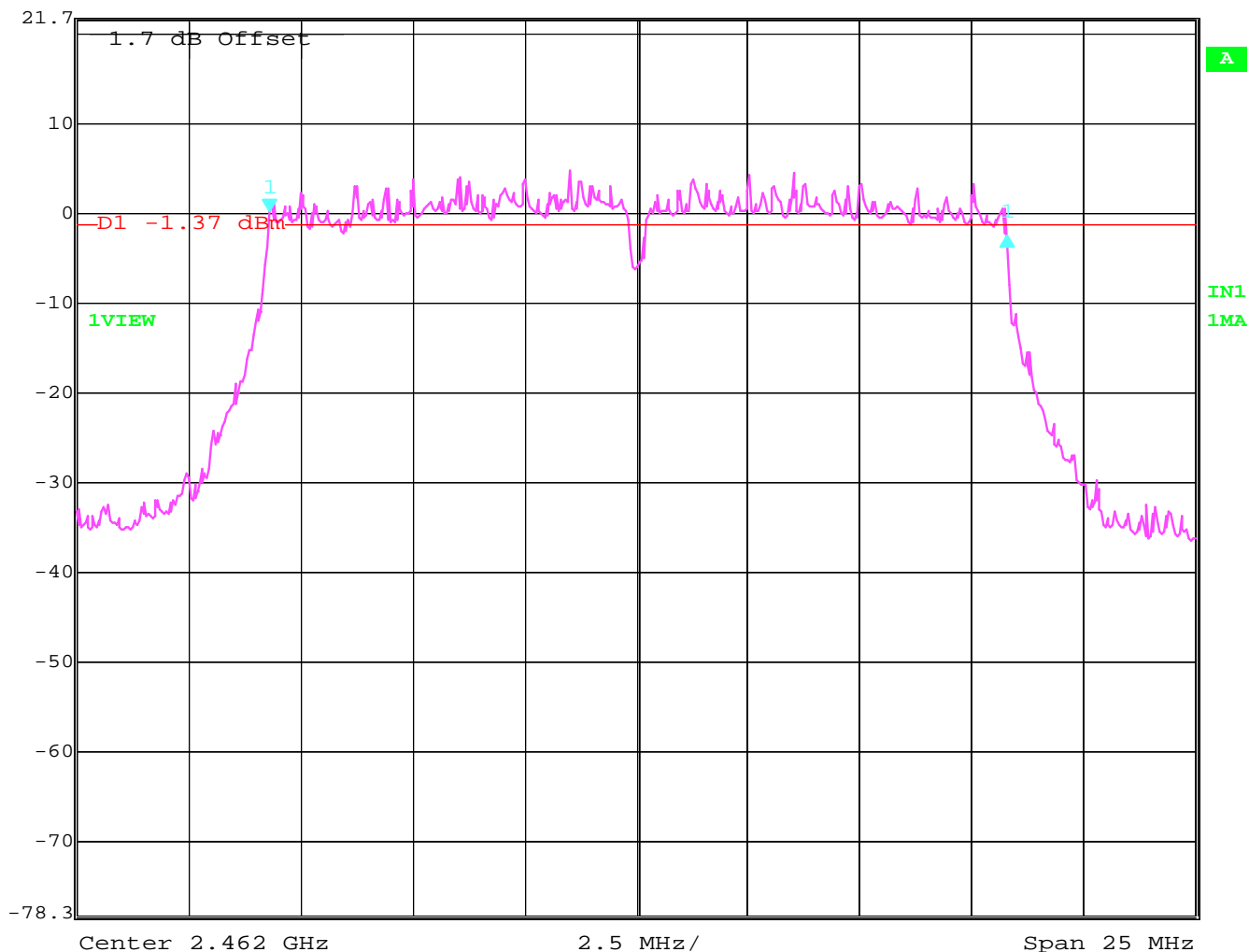
§15.247(a) (2)

6 dB bandwidth
(Data rate – 54Mbps)

Highest Channel: 2462MHz



	Delta 1 [T1]	RBW	100 kHz	RF Att	30 dB
Ref Lvl	-2.97 dB	VBW	1 MHz		
21.7 dBm	16.48296593 MHz	SWT	6.5 ms	Unit	dBm



Date: 19.NOV.2003 10:43:33

MAXIMUM PEAK OUTPUT POWER
 (Conducted)
 (Data rate – 54Mbps)

§ 15.247 (b) (3)

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)			
Frequency (MHz)		2412	2437	2462	
T _{nom} (23)°C	V _{nom} (3.3) VDC	Pk	*19.4	*19.8	*19.5
Measurement uncertainty		±0.5dBm			

*Measurements done using peak power meter.

LIMIT

SUBCLAUSE § 15.247 (b) (3)

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

**MAXIMUM PEAK OUTPUT POWER
(RADIATED)
(Data rate – 54Mbps)**

§ 15.247 (b) (3)

EIRP:

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
		2412	2437	2462
Frequency (MHz)				
T _{nom} (23)°C	V _{nom} (3.3) VDC	*20.9	*21.3	*21
Measurement uncertainty		±0.5dBm		

*Note: EIRP is calculated based on 1.5dBi antenna gain and conducted peak power measurements.

LIMIT

SUBCLAUSE § 15.247 (b) (3)

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

POWER SPECTRAL DENSITY
(Data rate – 1Mbps, DSSS)

§15.247 (e)

TEST CONDITIONS		POWER SPECTRAL DENSITY (dBm)		
		2412	2437	2462
T _{nom} (23)°C	V _{nom} (3.3) VDC	-8.20	-9.40	-9.01

LIMIT

SUBCLAUSE §15.247(d)

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

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

POWER SPECTRAL DENSITY
(Data rate – 6Mbps, OFDM)

§15.247 (e)

TEST CONDITIONS		POWER SPECTRAL DENSITY (dBm)		
		2412	2437	2462
T _{nom} (23)°C	V _{nom} (3.3) VDC	-10.19	-10.84	-10.51

LIMIT

SUBCLAUSE §15.247(e)

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

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

BAND EDGE COMPLIANCE
(Data rate – 54Mbps)

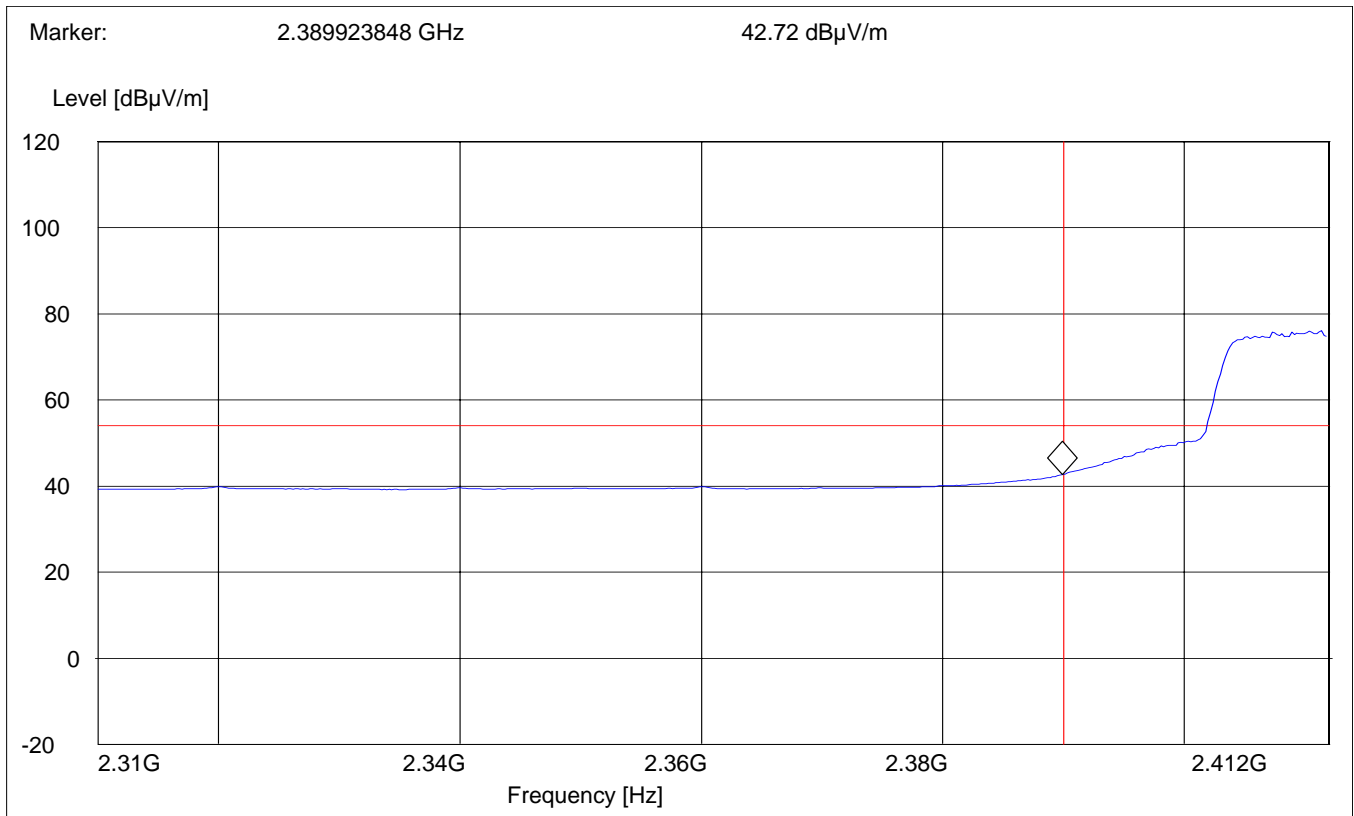
§15.247 (e)

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

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

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 (e)

(Data rate – 54Mbps)

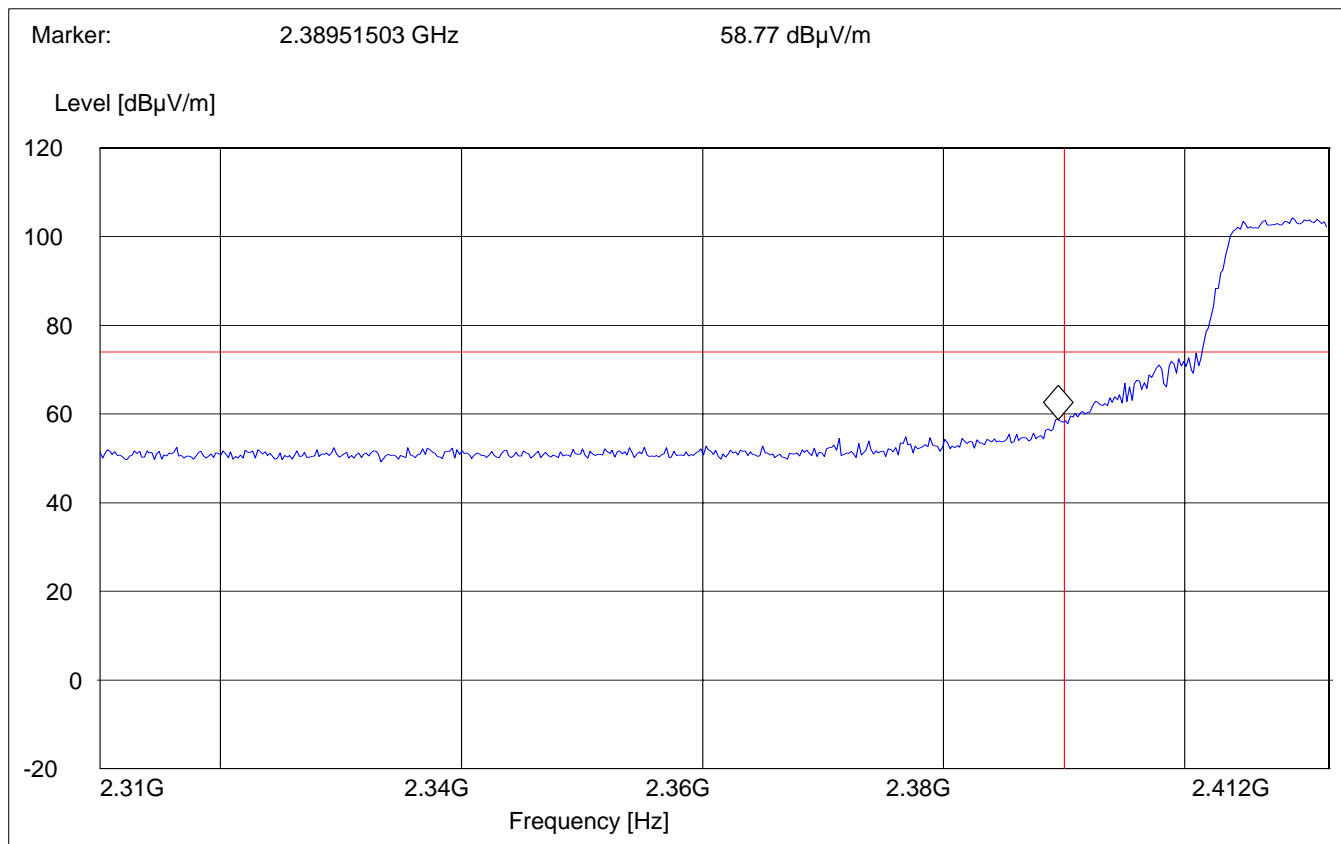
Low frequency section (spurious in the restricted band 2310 – 2390 MHz)

(Peak measurement)

Antenna: **Horizontal**
 EUT plane: **Horizontal with screen vertical @ 90°**

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

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



BAND EDGE COMPLIANCE

§15.247 (e)

(Data rate – 54Mbps)

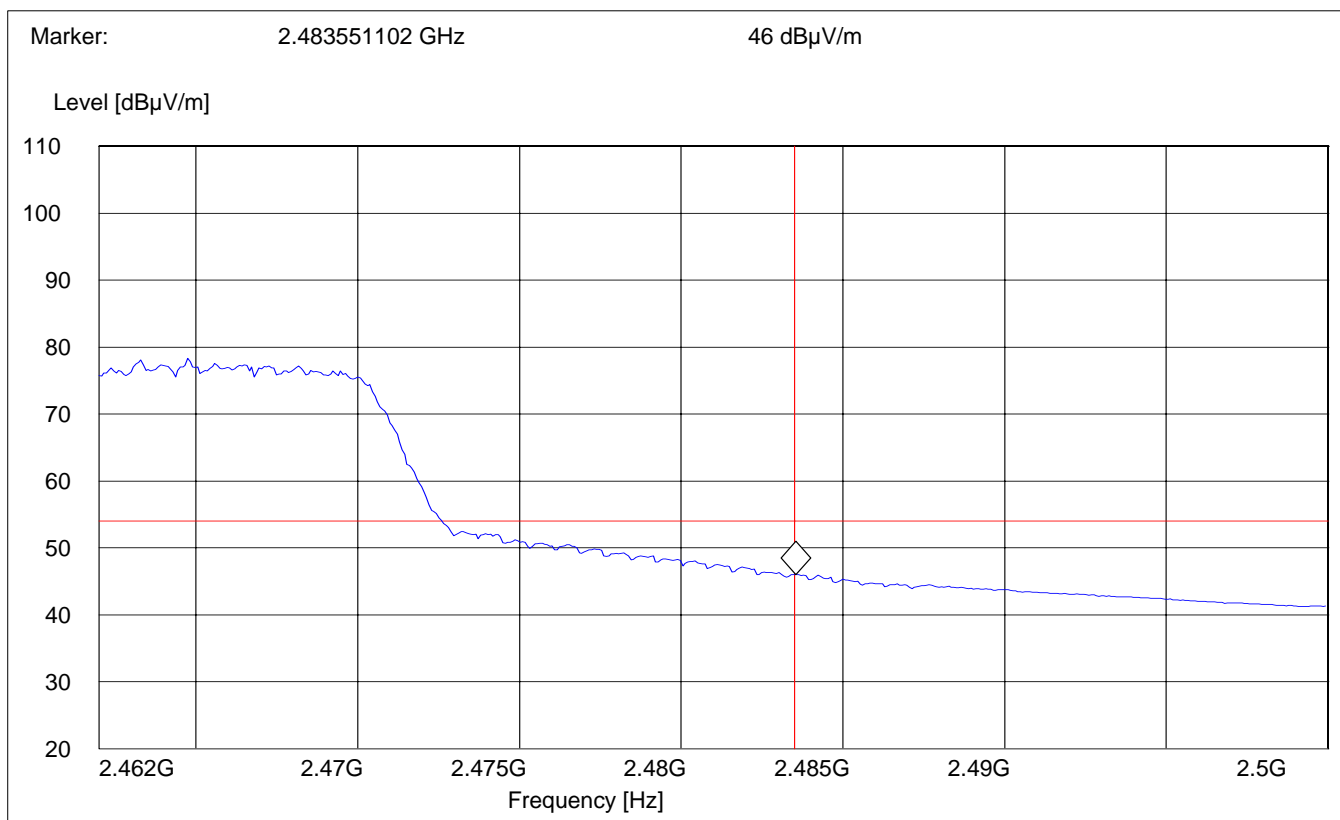
High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)

(Average measurement)

Antenna: **Horizontal**
 EUT plane: **Horizontal with screen vertical @ 90°**

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 (e)

(Data rate – 54Mbps)

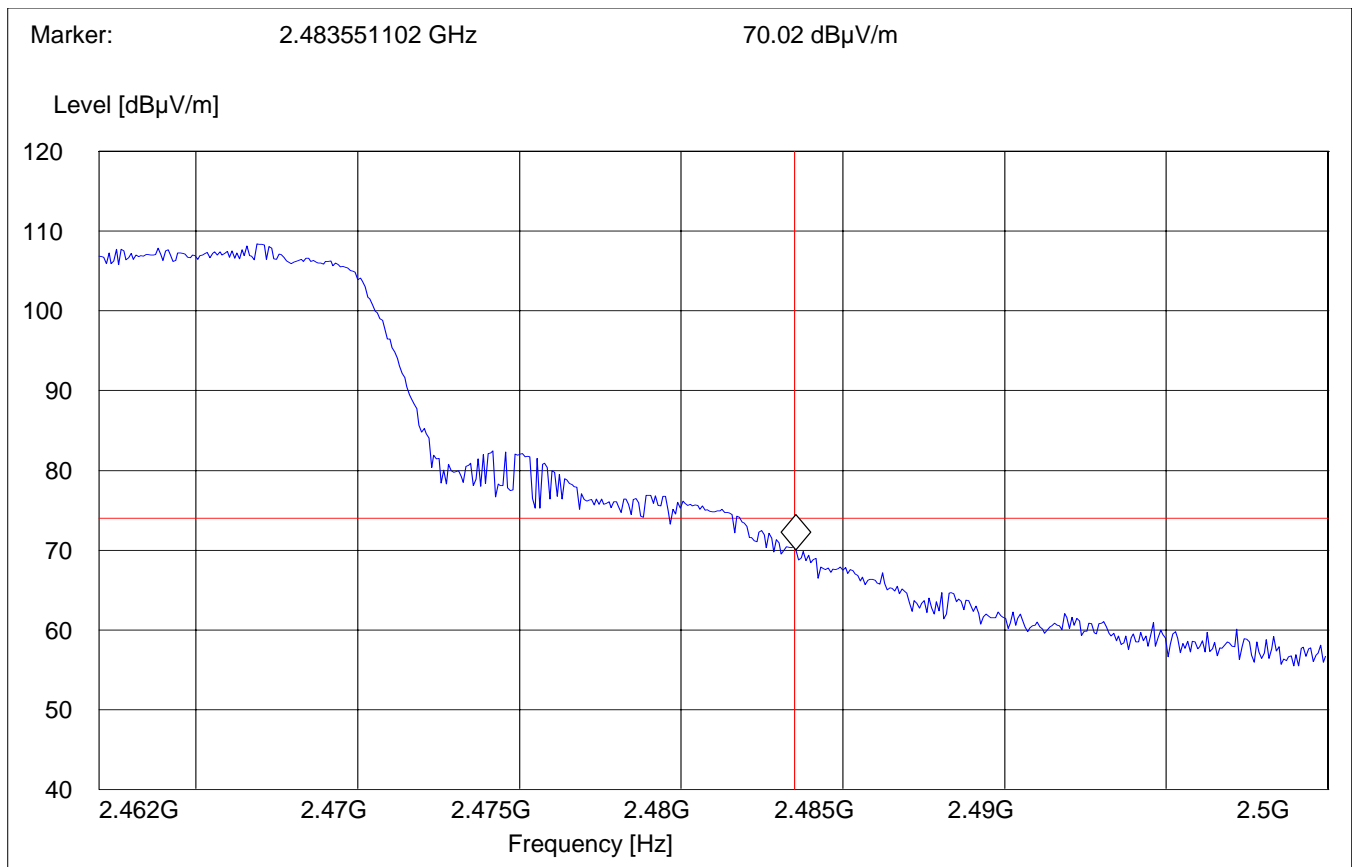
High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)

(Peak measurement)

Antenna: Horizontal
 EUT plane: Horizontal with screen vertical @ 90°

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
Transmitter (Radiated)**

§ 15.247 (e)

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 (e)

Transmit at Lowest channel Frequency 2412MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
SEE PLOTS			
Transmit at Middle channel Frequency 2437MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
SEE PLOTS			
Transmit at Highest channel Frequency 2462MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Quasi-Peak	Average
SEE PLOTS			

EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

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

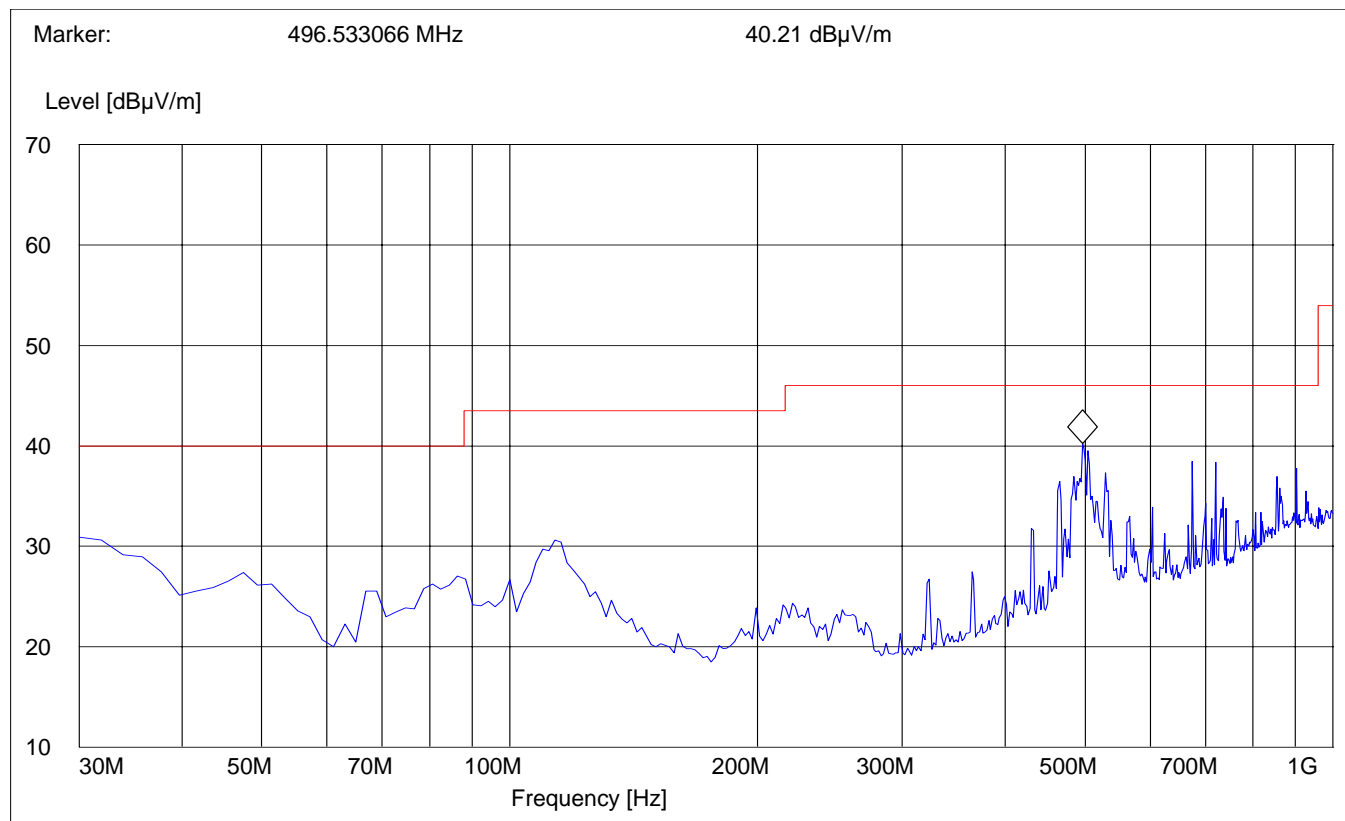
(Data rate – 54Mbps)

Antenna: vertical
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE: "WLAN Spuri hi 30-1G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

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

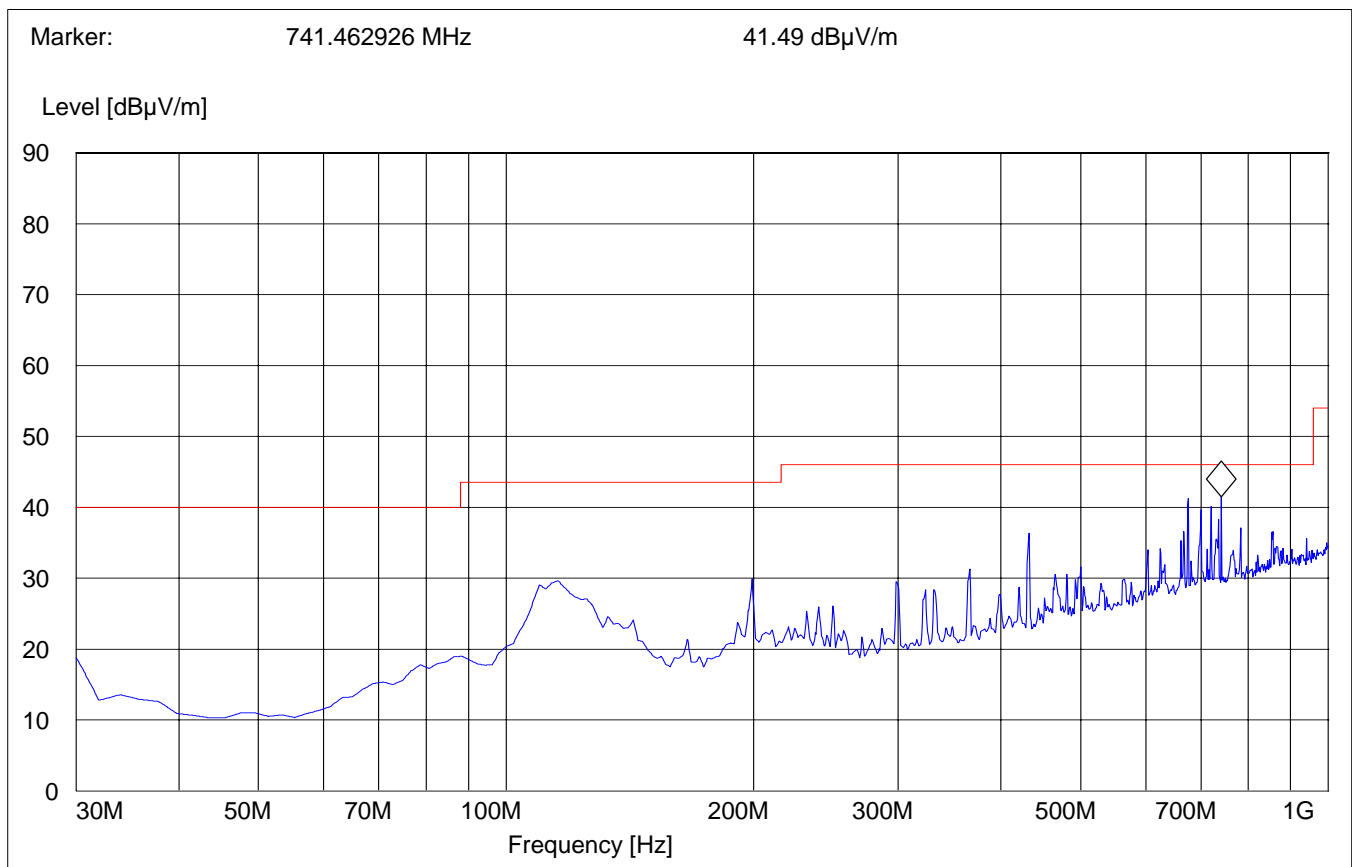
(Data rate – 54Mbps)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

Lowest Channel (2412MHz): 1GHz – 3GHz

(Data rate – 54Mbps)

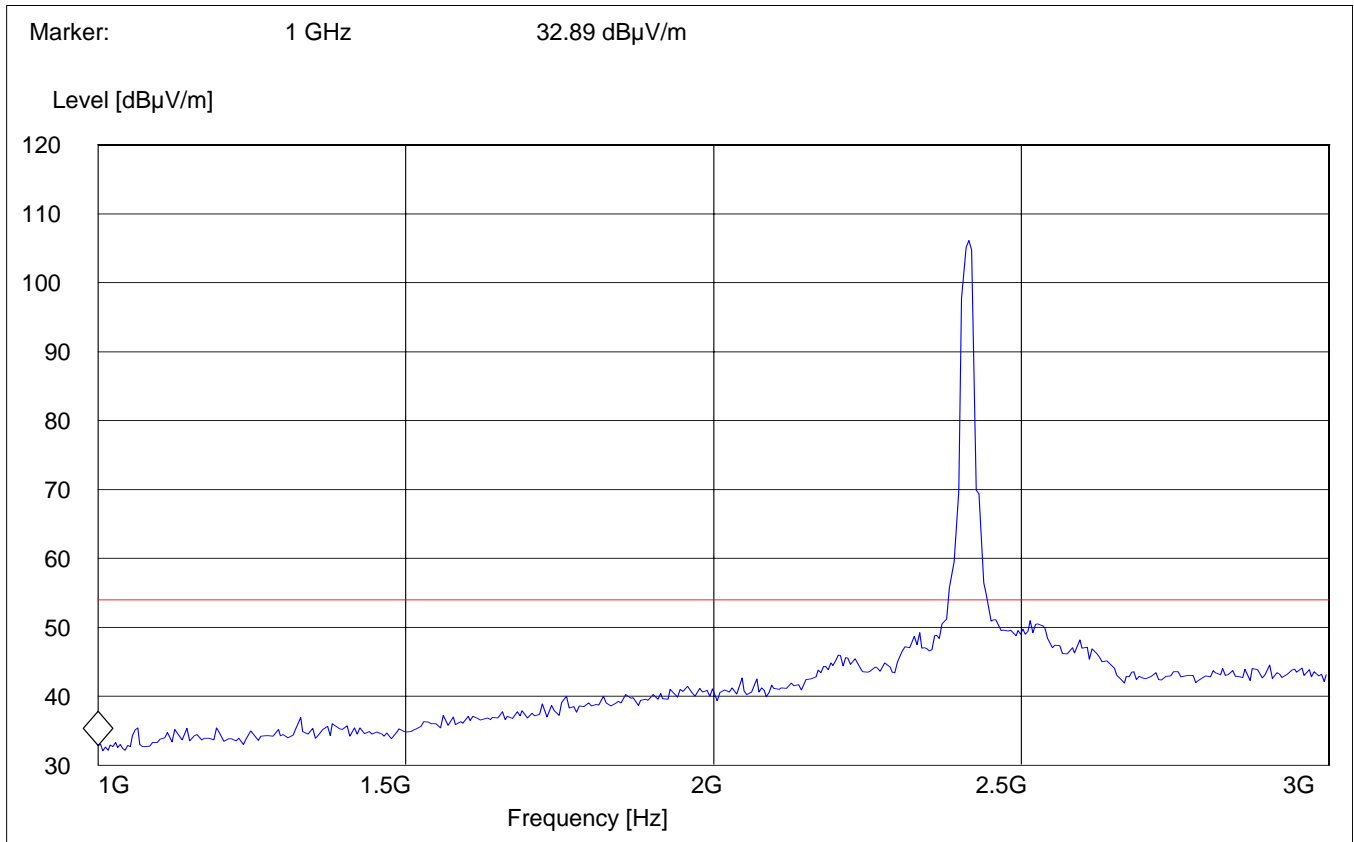
Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE: "WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

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

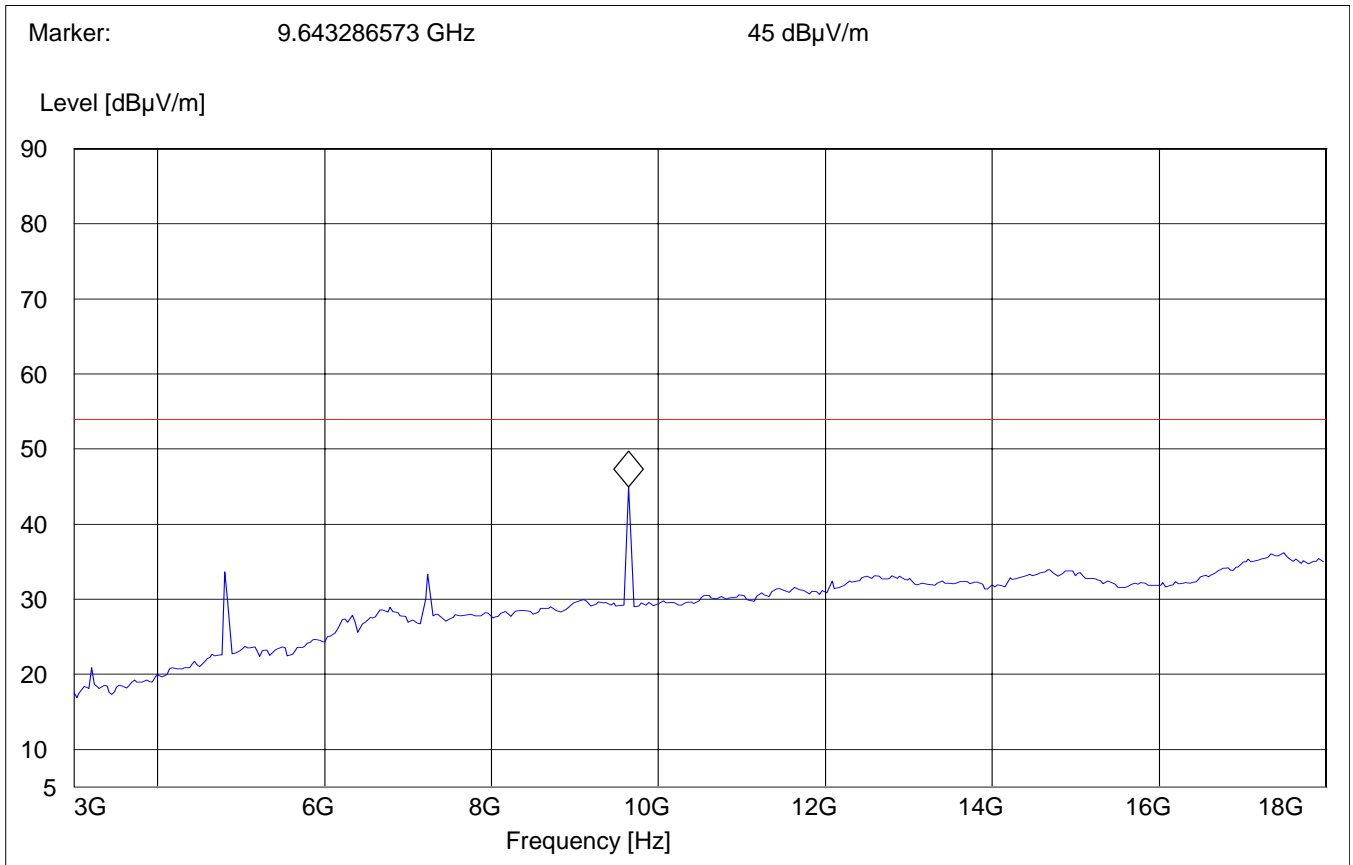
(Data rate – 54Mbps)

(Average measurement)

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE: " WLAN Spuri hi 3-18G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

Mid Channel (2437MHz): 1GHz – 3GHz

(Data rate – 54Mbps)

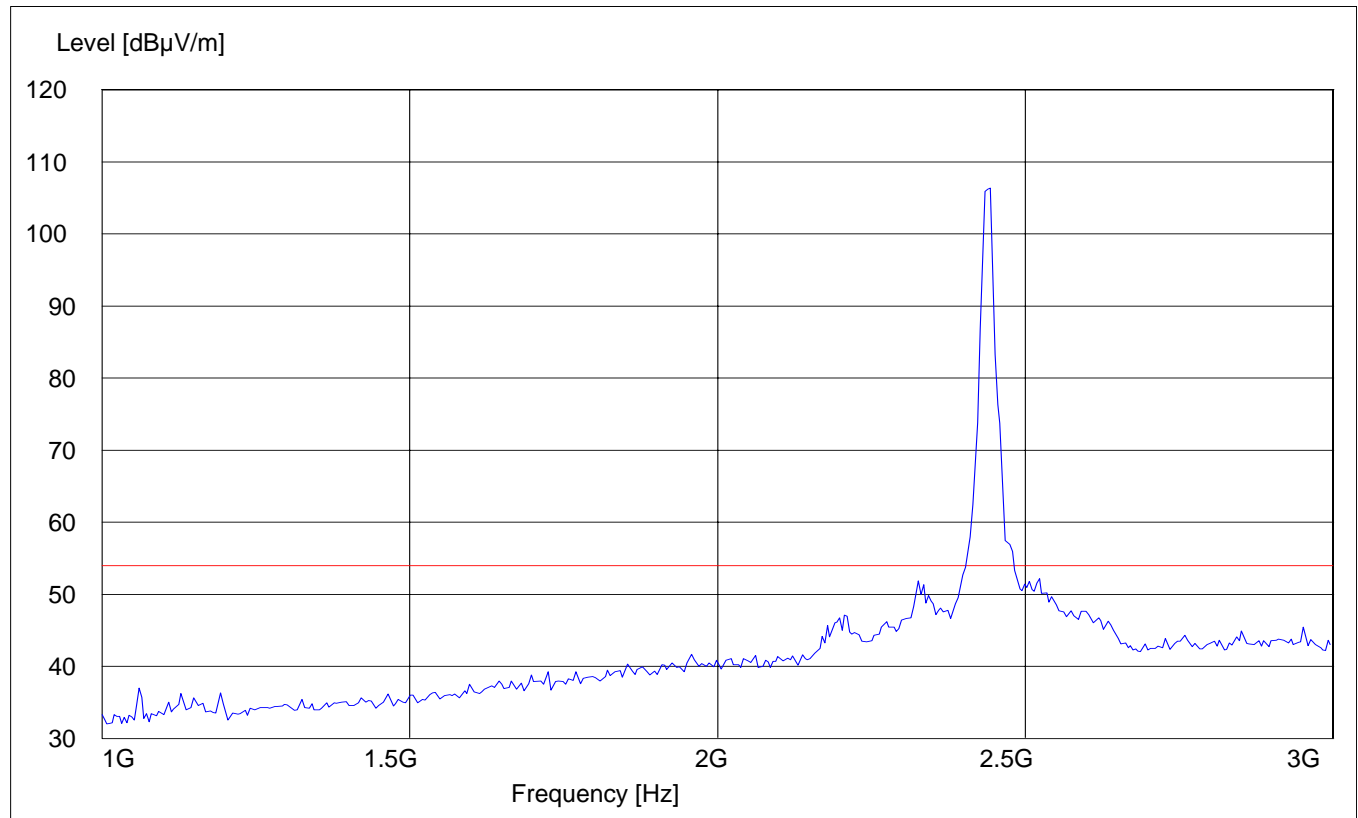
Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE: " WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

Mid Channel (2437MHz): 3GHz – 18GHz

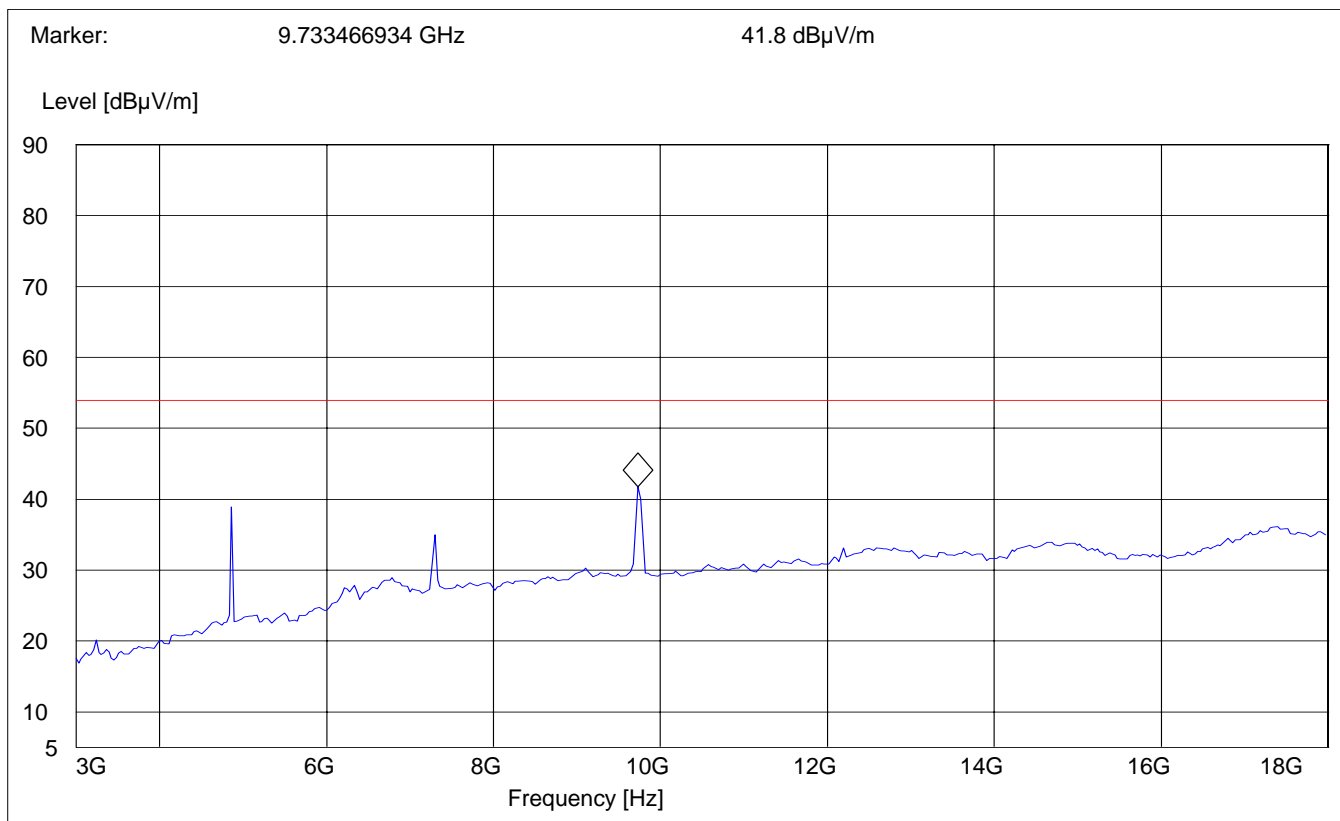
(Data rate – 54Mbps)

(Average Measurement)

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE: " WLAN Spuri hi 3-18G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

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

(Data rate – 54Mbps)

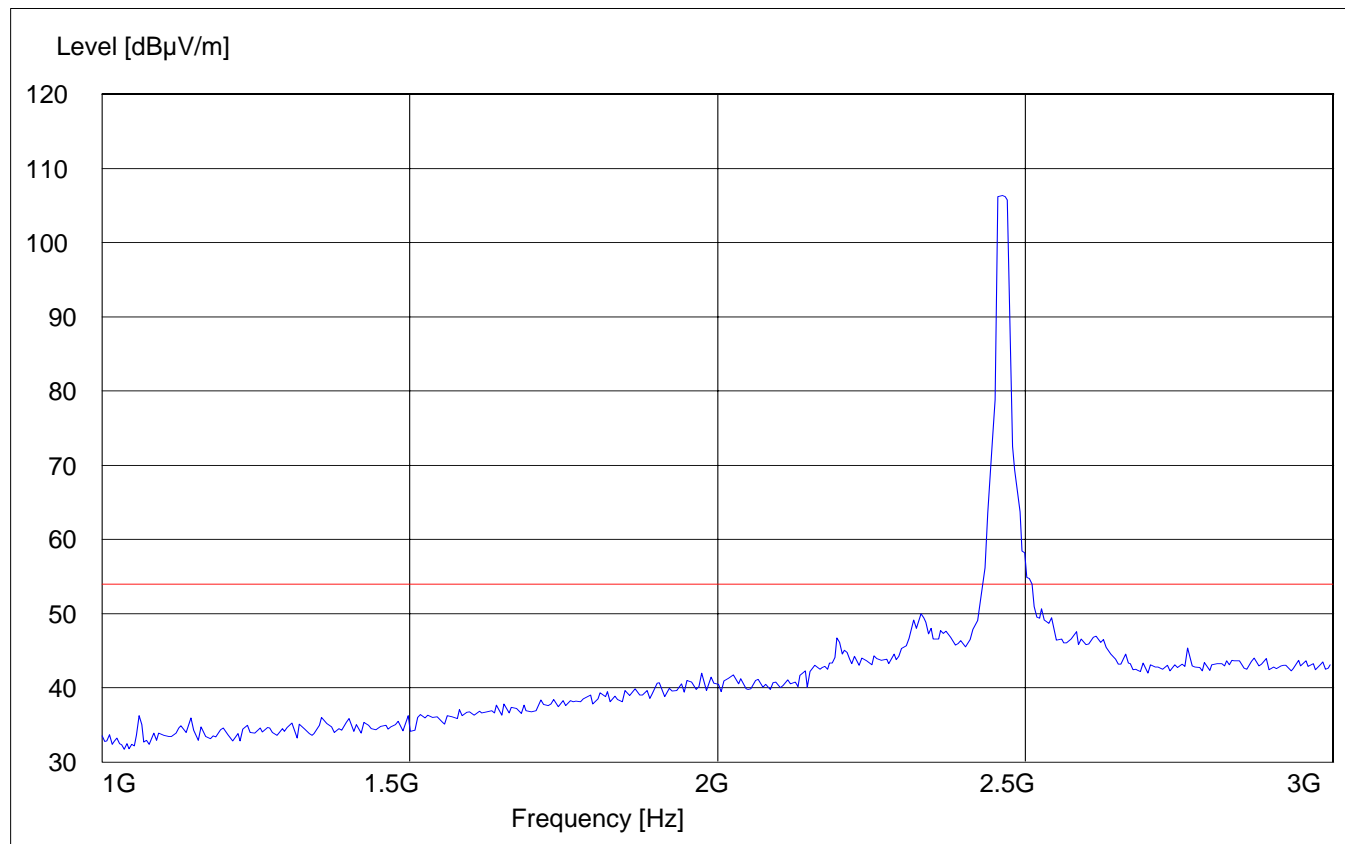
Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE: " WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (e)

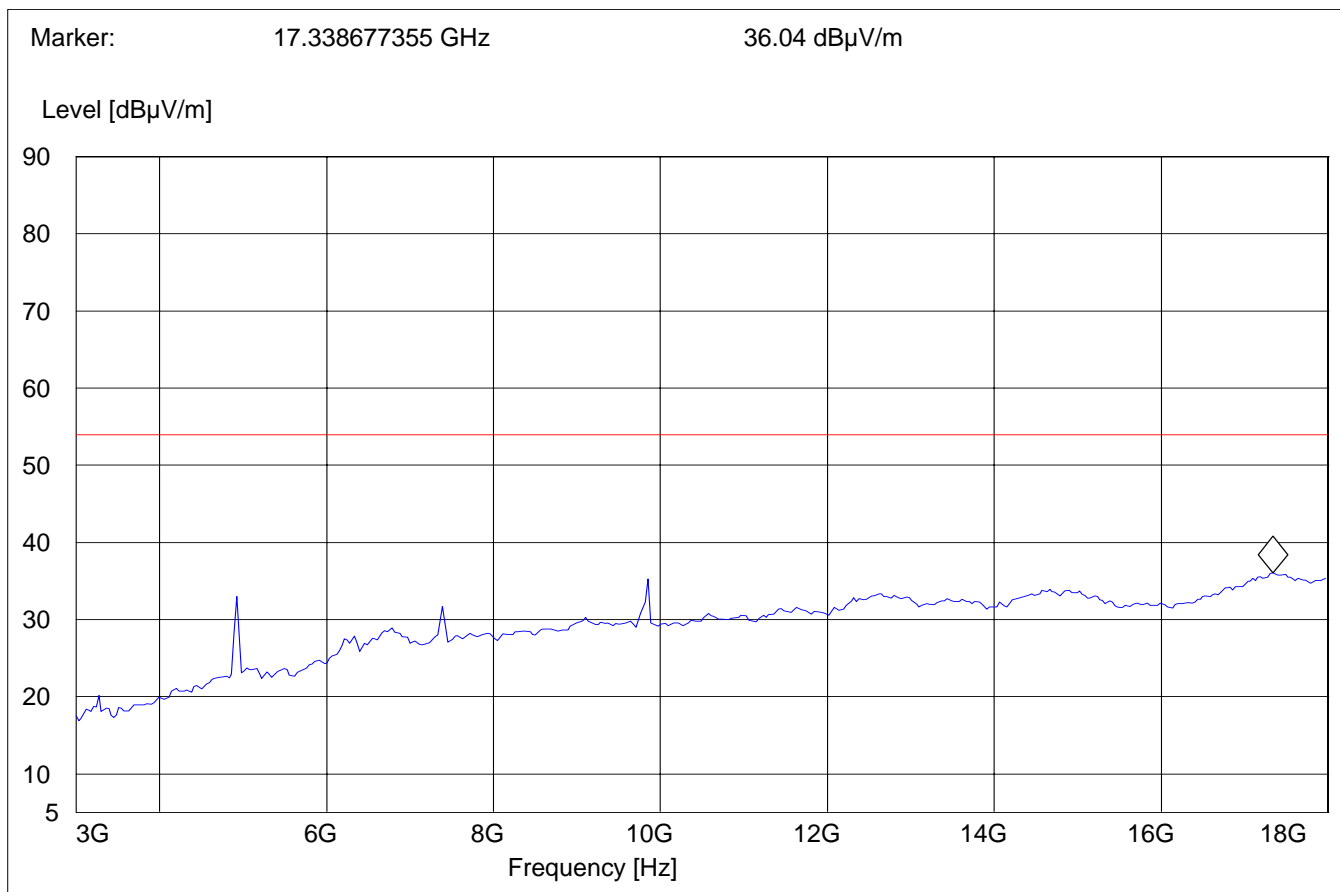
Highest Channel (2462MHz): 3GHz – 18GHz

(Data rate – 54Mbps)

(Average Measurement)

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE:		" WLAN 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 (e)

18GHz – 25GHz

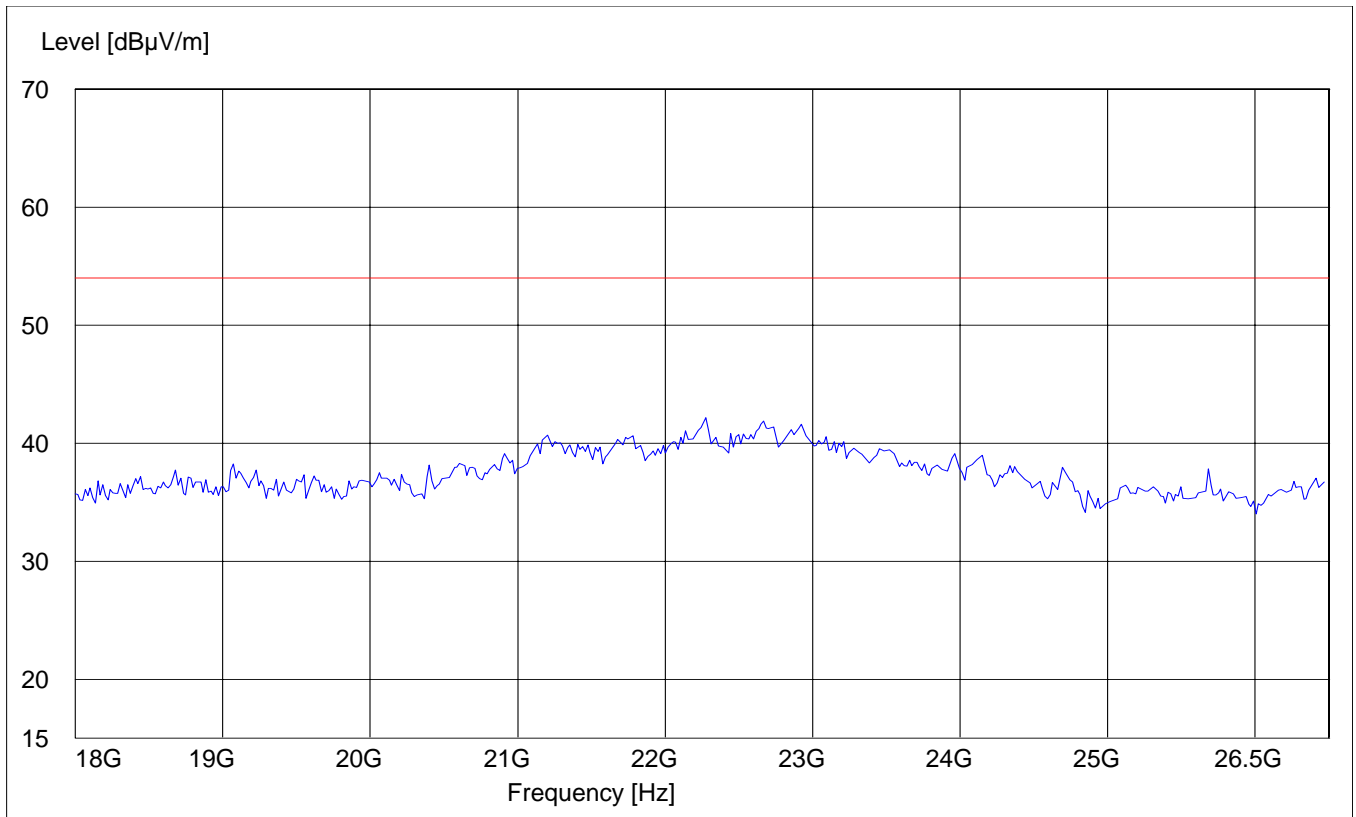
(Data rate – 54Mbps)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:		"WLAN 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)

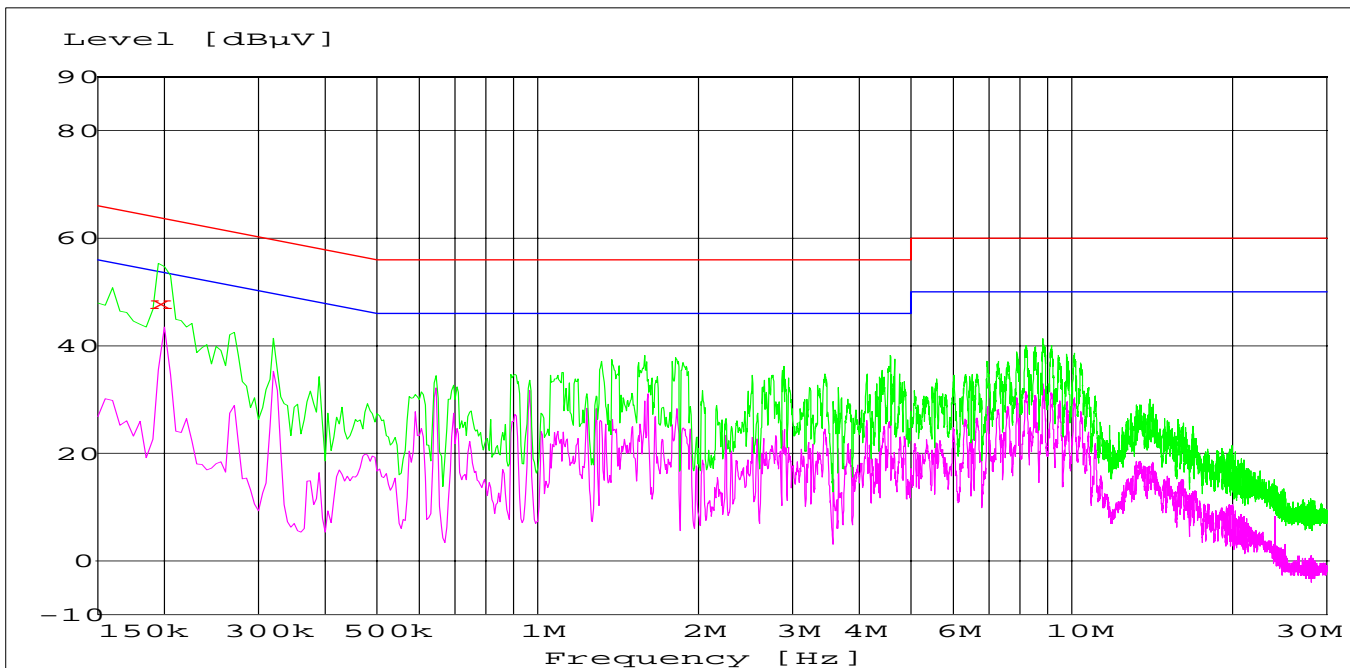
Limit

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



x	x	MES	test_fin	QP	
—	—	MES	test_pre	PK	
—	—	MES	test_pre	AV	
—	—	LIM	EN 55022	V QP	Voltage QP Limit
—	—	LIM	EN 55022	V AV	Voltage AV Limit

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 ($\mu\text{V/m}$)	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.

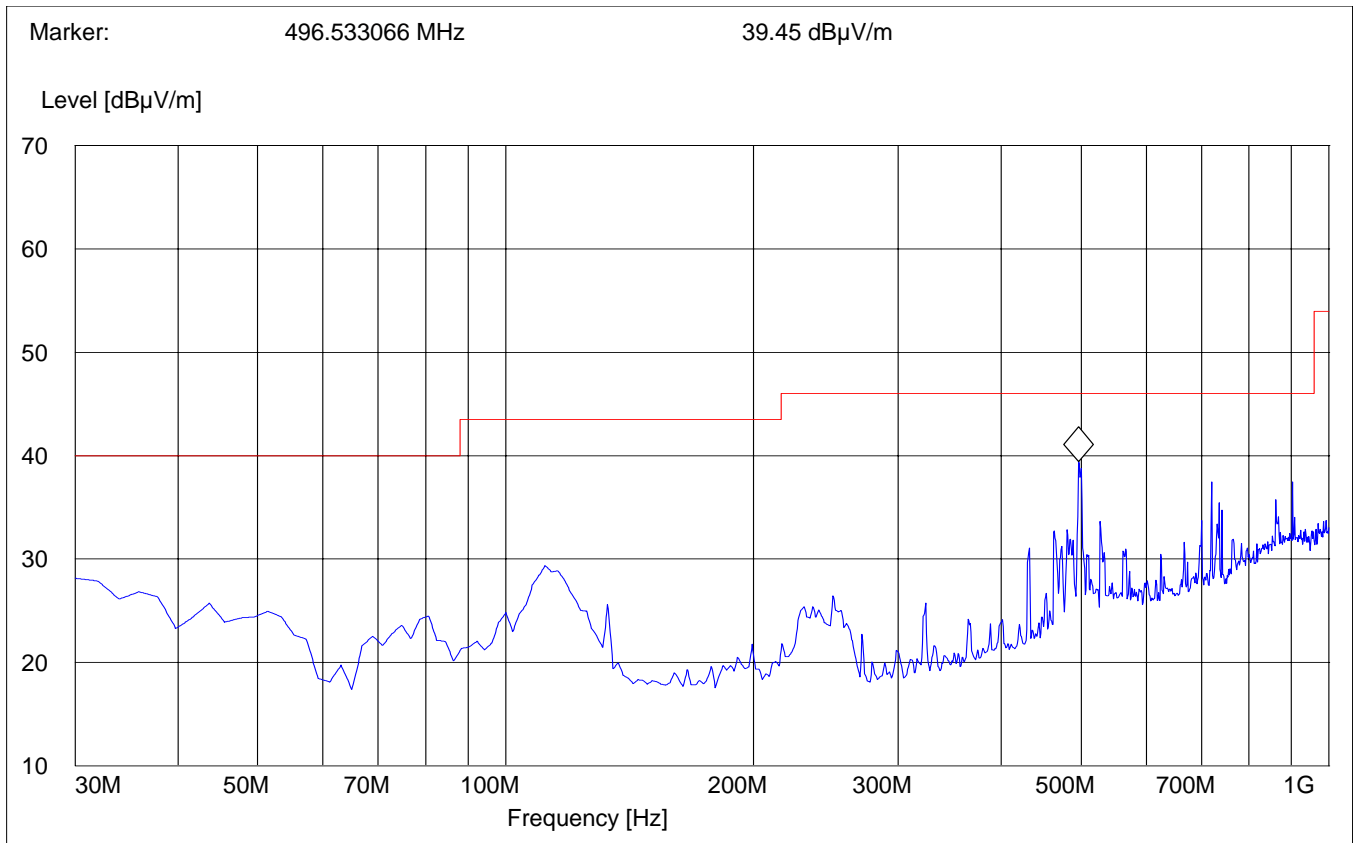
**RECEIVER SPURIOUS RADIATION
30MHz – 1GHz**

§ 15.209

Antenna: Vertical
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE: "WLAN Spuri hi 30-1G"

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



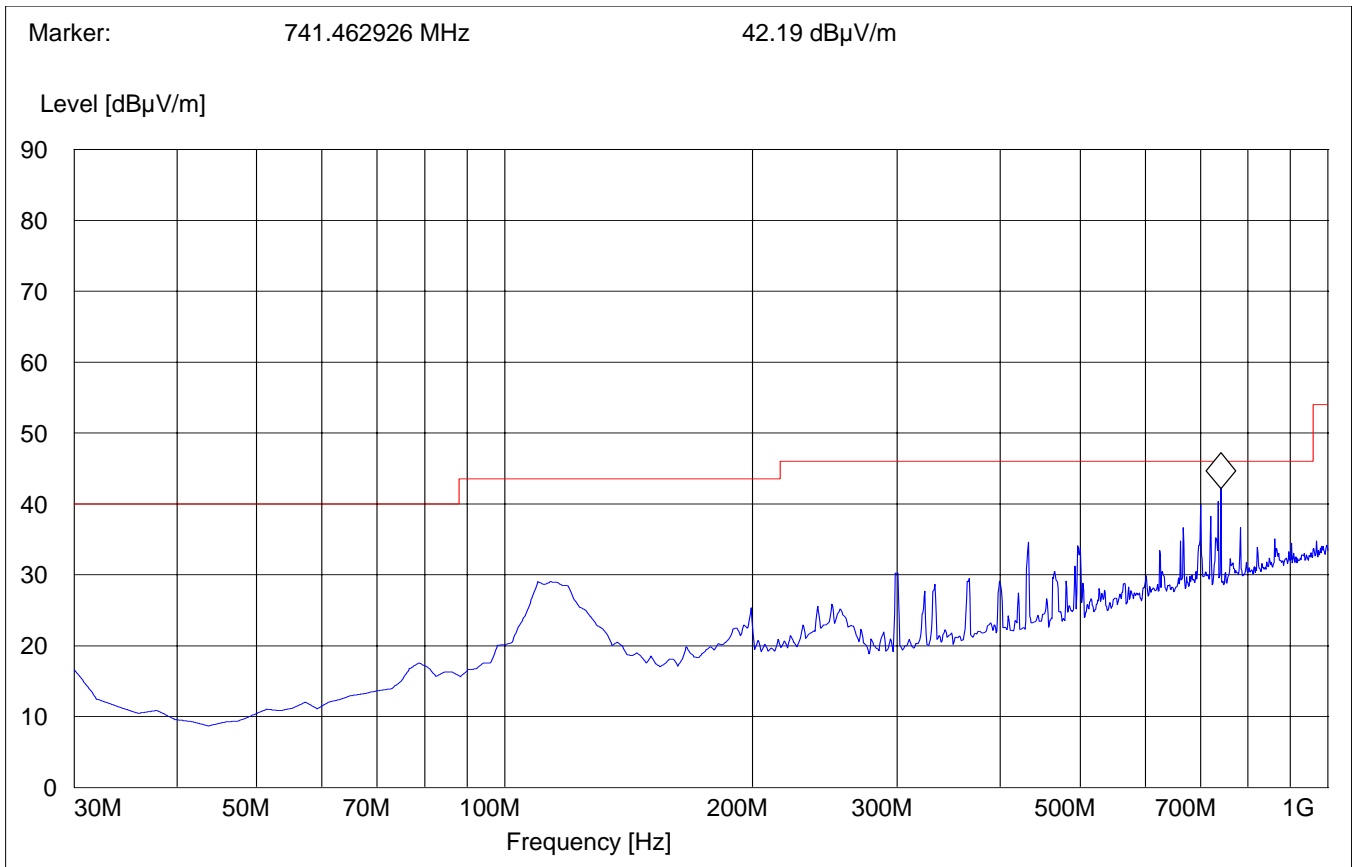
RECEIVER SPURIOUS RADIATION
30MHz – 1GHz

§ 15.209

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE: "WLAN Spuri hi 30-1G"

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



RECEIVER SPURIOUS RADIATION

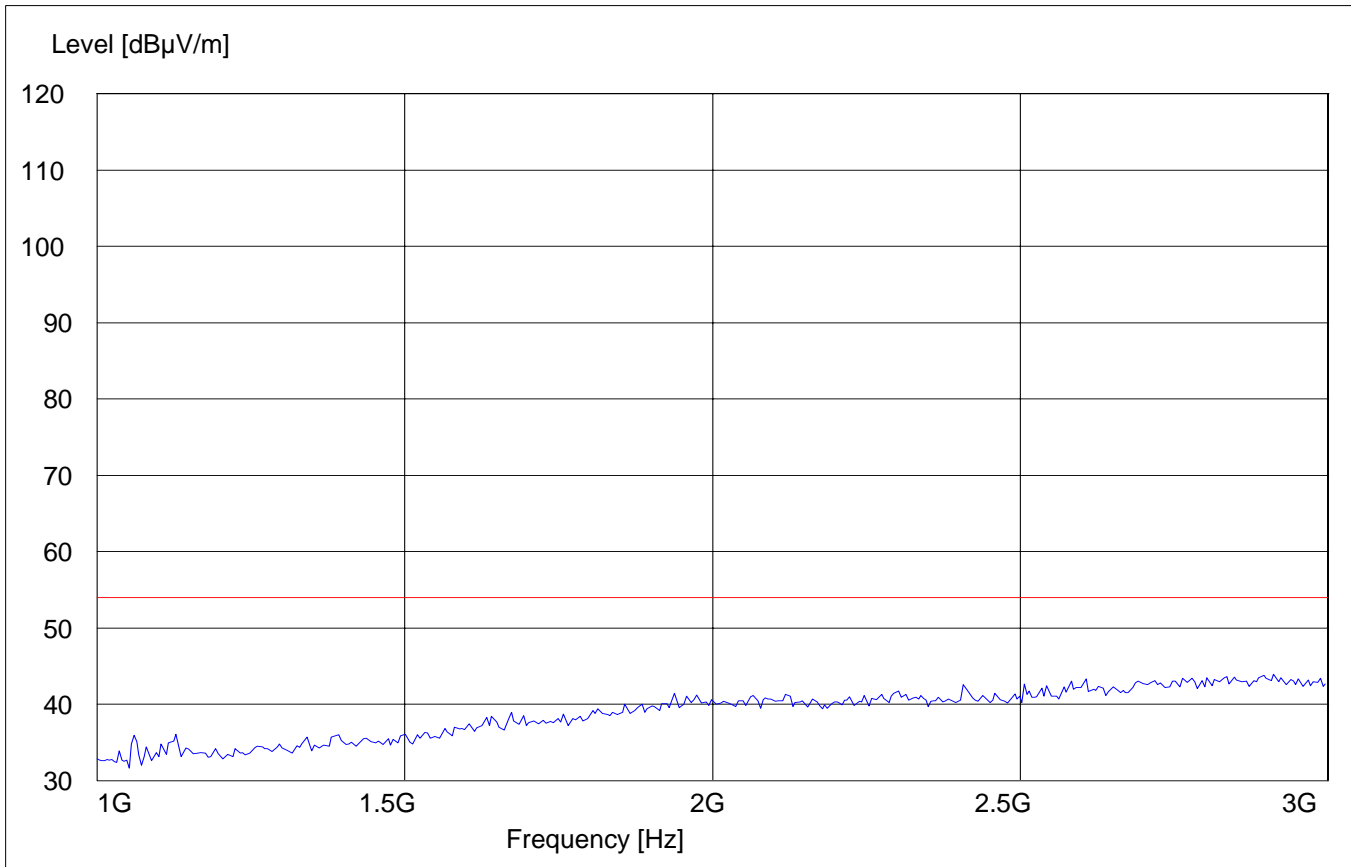
§ 15.209

1GHz – 3GHz

Peak Measurement

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE:		"WLAN 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)



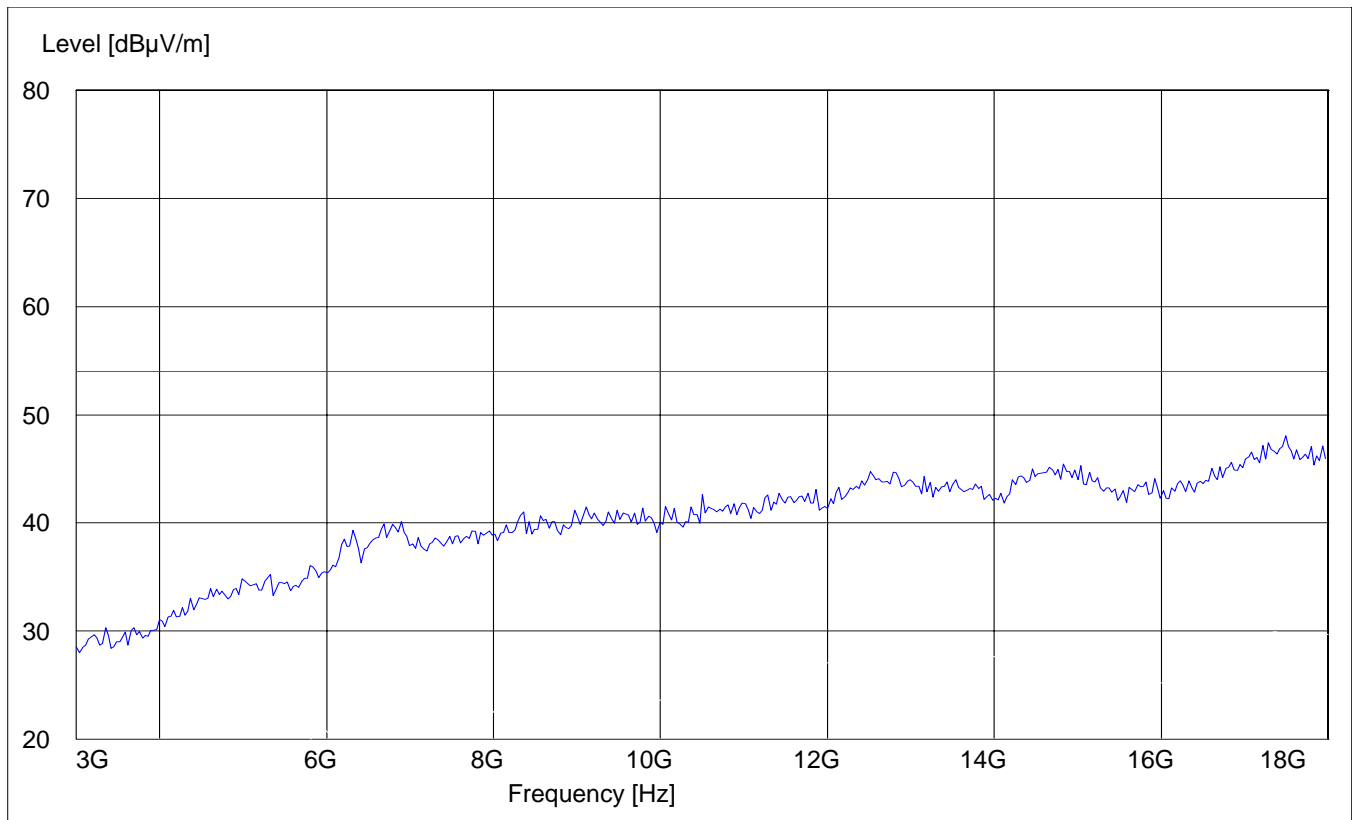
RECEIVER SPURIOUS RADIATION
3GHz – 18GHz

§ 15.209

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE: "WLAN 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)



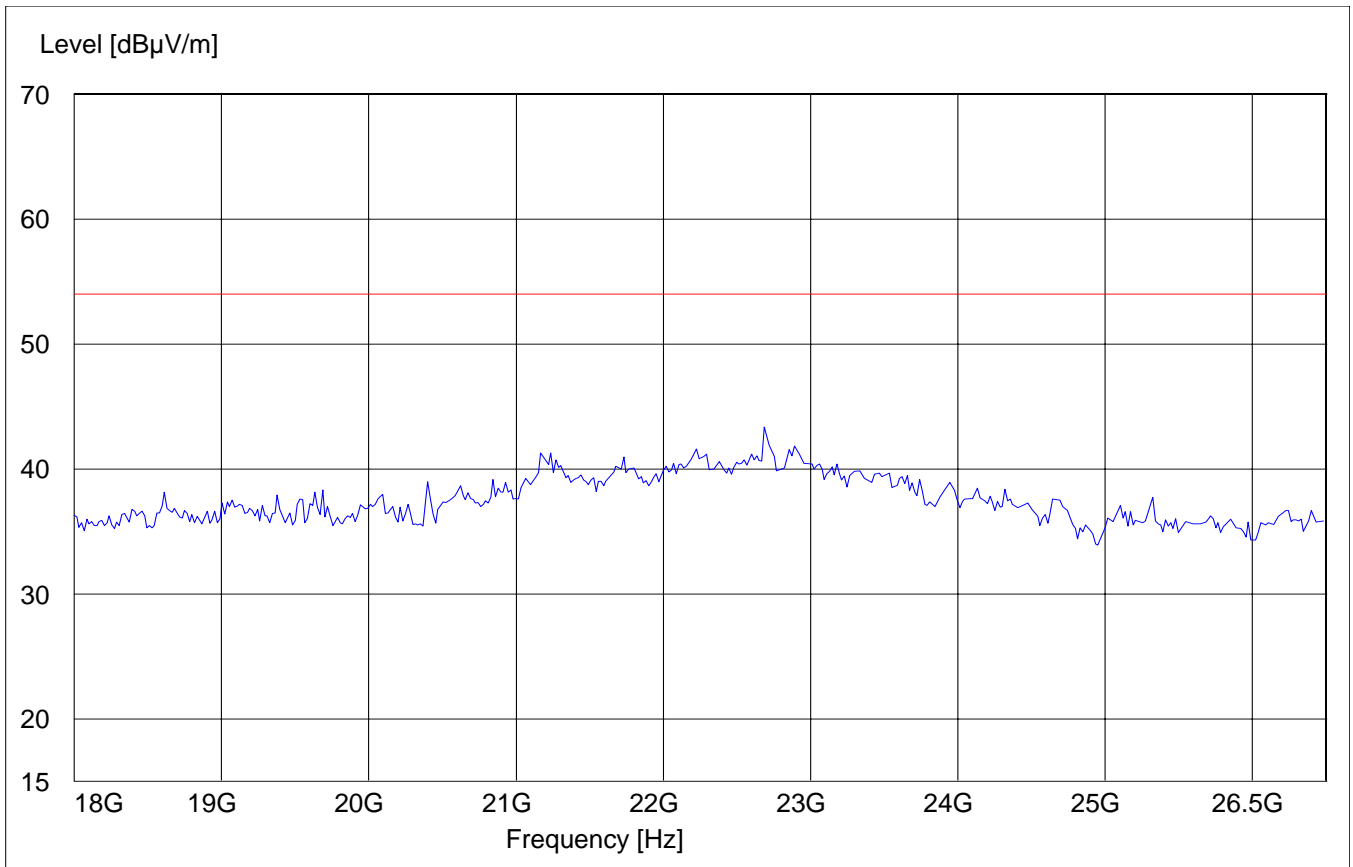
RECEIVER SPURIOUS RADIATION
18GHz – 26.5GHz

§ 15.209

Antenna: Horizontal
EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE: "WLAN Spuri hi 18-26.5G"

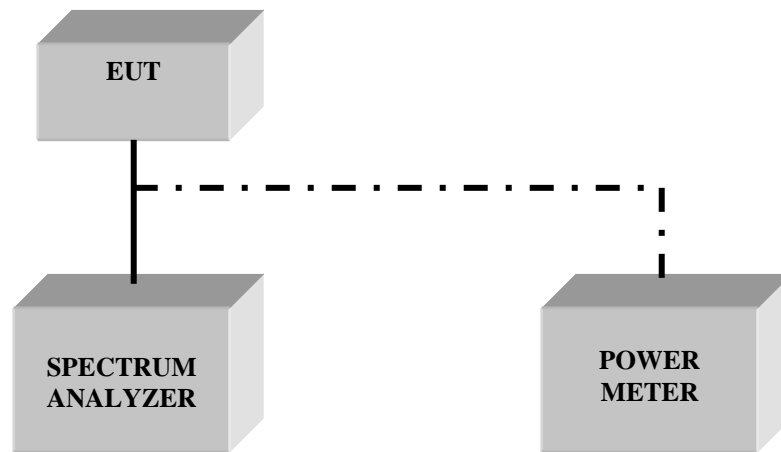
Start	Stop	Detector	Meas.	RBW	Transducer
Frequency	Frequency	Time	Bandw.	VBW	
18 GHz	26.5 GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



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

