



FCC Test Report

Test report no.: EMC_831FCC15.247_2005

FCC Part 15.247 for DSSS systems / CANADA RSS-210

EUT: WLAN Model: BCM94318MPAGH
HOST: Test Fixture (Modular Approval)

FCC ID: QDS-BRCM1017
IC ID: 4324A-BRCM1017



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.

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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 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**

1.2 Testing laboratory
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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 : 2005-01-11
Date of test : 2005-01-11 to 2005-01-25

1.5 Test item

Manufacturer : Applicant
Model No. (EUT) : [BCM94318MPAGH \(sample# 2000\)](#)
Host : [Test Fixture](#)
Description : [WLAN MiniPCI Multiband card incorporating 2.4GHz and 5GHz radios](#)
FCC ID : QDS-BRCM1017
IC ID : 4324A-BRCM1017

Additional information

Frequency : 2412MHz – 2472MHz for 2.4GHz band (covered in this test report)
5180MHz – 5320MHz for 5GHz band (not covered in this test report)
5745MHz – 5825MHz for 5GHz band (not covered in this test report)
Type of modulation : DSSS / OFDM (orthogonal frequency division multiplexing)
Number of channels : 13 for 2.4GHz band
13 for 5GHz band
Antenna : 3.24dBi max. gain stamped metal sheet ant. for 2.4GHz band
(WNC model 81.ED415.002)
2.1dBi max gain FPC ant. for 2.4GHz band
(Hitachi model HFT17-DL04)
Power supply : 3.3 VDC from Host
Output power : 19.1dBm (81.28mW) conducted avg. 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:

This test report carries all measurements required as per FCC 15.247 on WLAN mini PCI card model# BCM94318MPAGH tested in test fixture as per DA001407 requirements for modular transmitter approval.

All measurements are done with under-mentioned max gain antennas for each antenna type. WLAN was tested for spurious emissions in both DSSS & OFDM modes at 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 with following power levels. As mentioned below all measurements for 802.11g mode were done on *ch-1,6,10,11,13* and for 802.11b mode all measurements were done on *ch-1,6,11,13*.

802.11g Mode:

Channels 1-10:19.0dBm

Channel 11:16.0dBm

Channels 12-13:10.5dBm

802.11b Mode:

Channels 1-11:19.0dBm

Channels 12-13:14.0dBm

Antenna Manufacturer	Antenna Type	Model	Peak gain @ 2400-2483.5MHz	Peak gain 5150-5350MHz	Peak gain @ 5725-5850
Wistron NeWeb	Metal sheet inverted F antenna	EBB-Q	1.51	2.51(Main)	4.49 (Aux)
Phycomp	Stamped Metal	CAN4313 384 012501B	Main 0.57 (H) white	3.74 (Main)	Main 3.56 (V) white
WNC	PIFA	81.ED415.002	3.24dBi (Main)	1.51dBi (Main)	Main -0.35dBi

Hitachi	FPC	HFT17-DL04	Main 2.1 (H) White	4.3 (aux)	Aux 3.6 (V) Black
Hitachi	FPC	HFT17-DL03	Main 1.5 (H)	Main 5.1 (V)	Main 5.7 (V+H)

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

2005-02-01	EMC & Radio	Lothar Schmidt (Technical Manager)
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Schmidt

Signature

2005-02-01 EMC & Radio Harpreet Sidhu (EMC Engineer)

H. V.

Signature

2.2 Test report

TEST REPORT

Test report no.: EMC_831FCC15.247_2005

FCC Part 15.247 for DSSS systems / CANADA RSS-210

TEST REPORT REFERENCE**LIST OF MEASUREMENTS****PAGE****SPECTRUM BANDWIDTH OF DSSS SYSTEM §15.247(a) (2)****8****MAXIMUM PEAK OUTPUT POWER § 15.247 (b) (3)****14****POWER SPECTRAL DENSITY §15.247 (e)****16****WNC stamped metal sheet antenna****21****BAND EDGE COMPLIANCE §15.247 (c)****22****EMISSION LIMITATIONS § 15.247 (c) (1)****30****Hitachi FPC antenna****46****BAND EDGE COMPLIANCE §15.247 (c)****47****CONDUCTED EMISSIONS § 15.107/207****66****RECEIVER SPURIOUS RADIATION § 15.209****67****TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS****72****BLOCK DIAGRAMS****73**

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	2457	2462	2472
T _{nom} (23)°C	V _{nom} (3.3) VDC	16.53	16.48	16.53	16.53	16.48

LIMIT**SUBCLAUSE §15.247(a) (2)**

The minimum 6dB bandwidth shall be at least 500 KHz

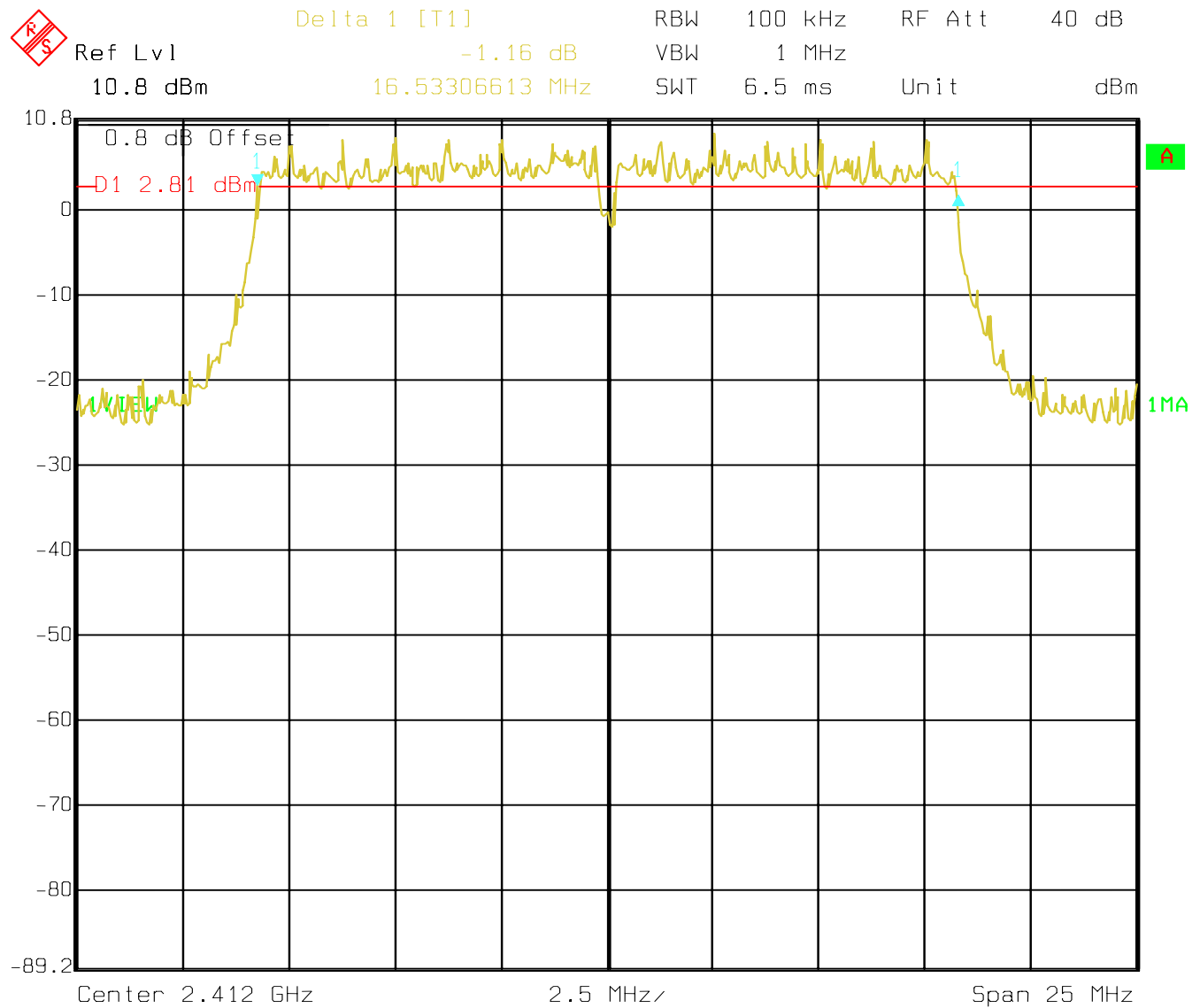
SPECTRUM BANDWIDTH OF DSSS SYSTEM

§15.247(a) (2)

6 dB bandwidth

(Data rate – 54Mbps)

Ch-1: 2412MHz



Date: 19.JAN.2005 13:26:22

SPECTRUM BANDWIDTH OF DSSS SYSTEM

§15.247(a) (2)

6 dB bandwidth

(Data rate – 54Mbps)

Ch-6: 2437MHz



Delta 1 [T1]

RBW 100 kHz RF Att 40 dB

Ref Lvl -1.05 dB

VBW 1 MHz

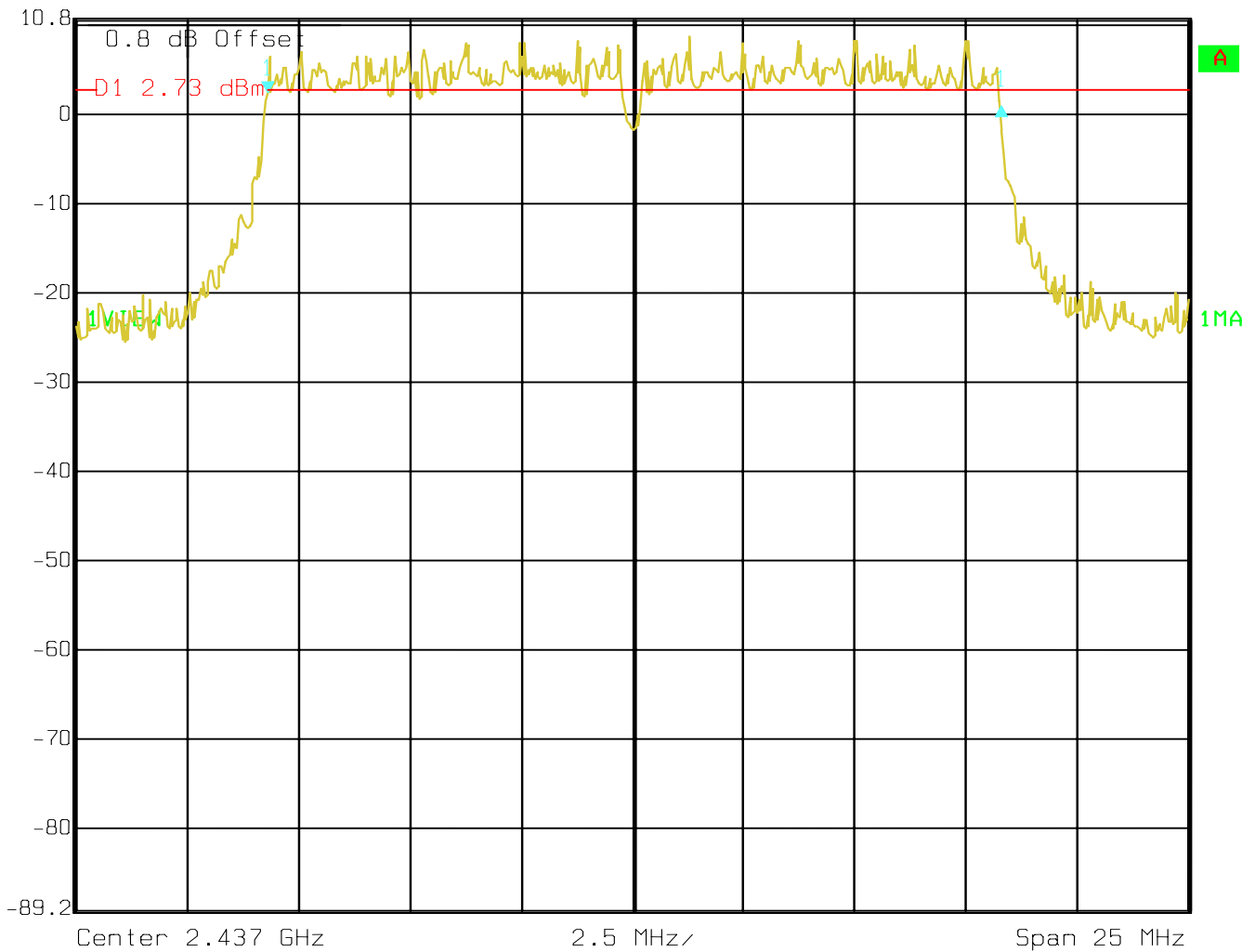
10.8 dBm

16.48296593 MHz

SWT 6.5 ms

Unit

dBm



Date: 19.JAN.2005 13:25:26

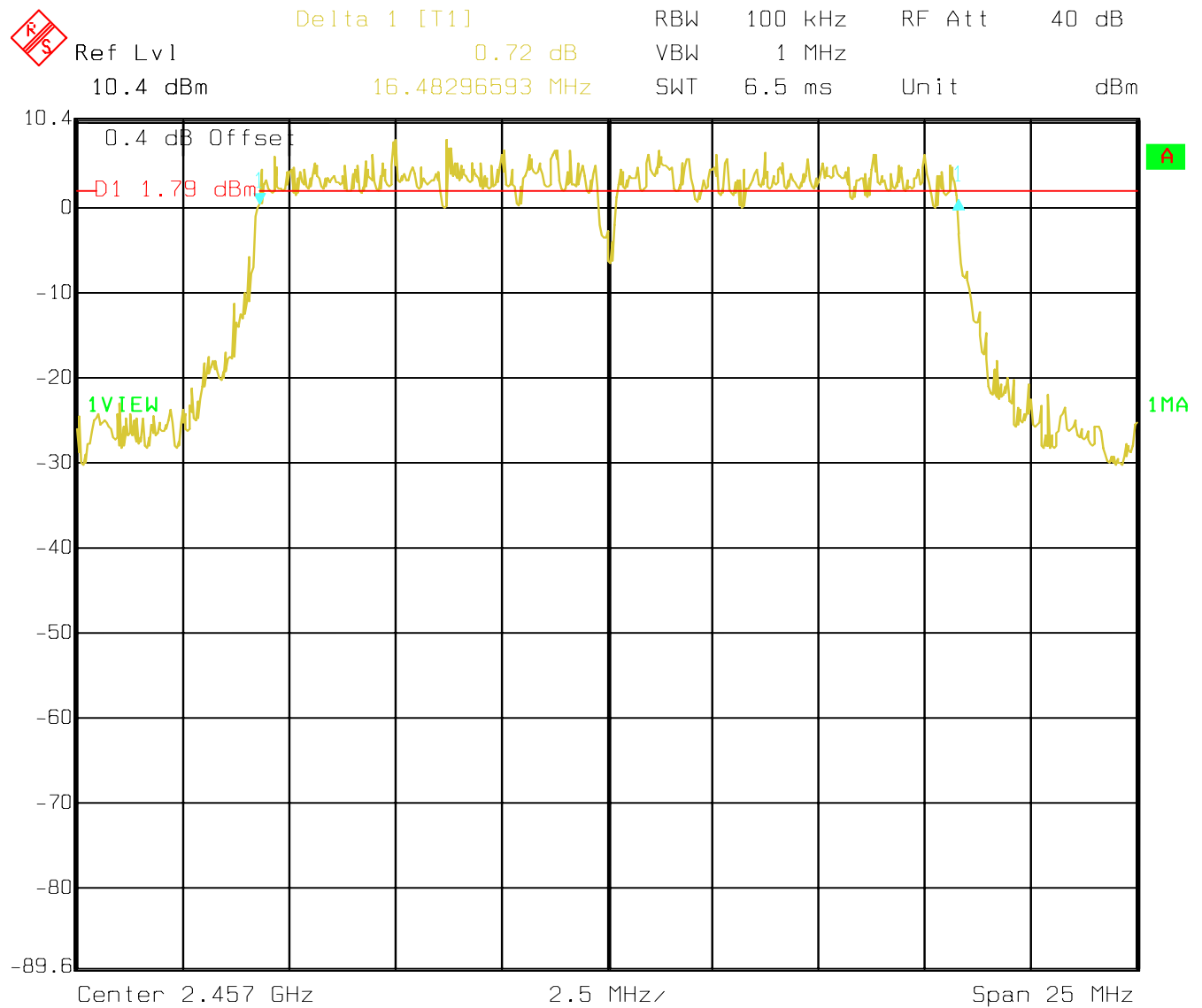
SPECTRUM BANDWIDTH OF DSSS SYSTEM

§15.247(a) (2)

6 dB bandwidth

(Data rate – 54Mbps)

Ch-10: 2457MHz



Date: 26.JAN.2005 13:45:28

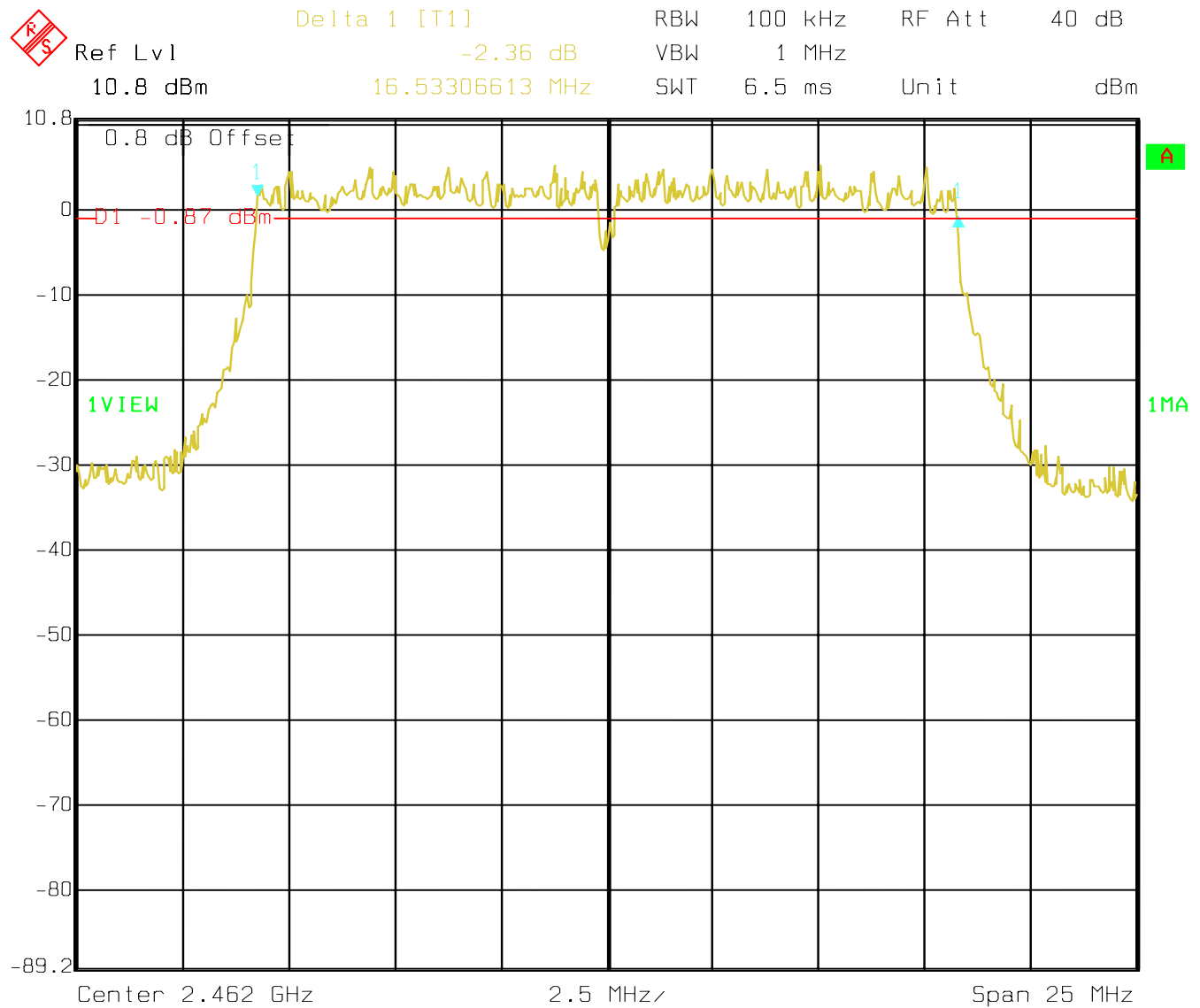
SPECTRUM BANDWIDTH OF DSSS SYSTEM

§15.247(a) (2)

6 dB bandwidth

(Data rate – 54Mbps)

Ch-11: 2462MHz



Date: 19.JAN.2005 13:24:01

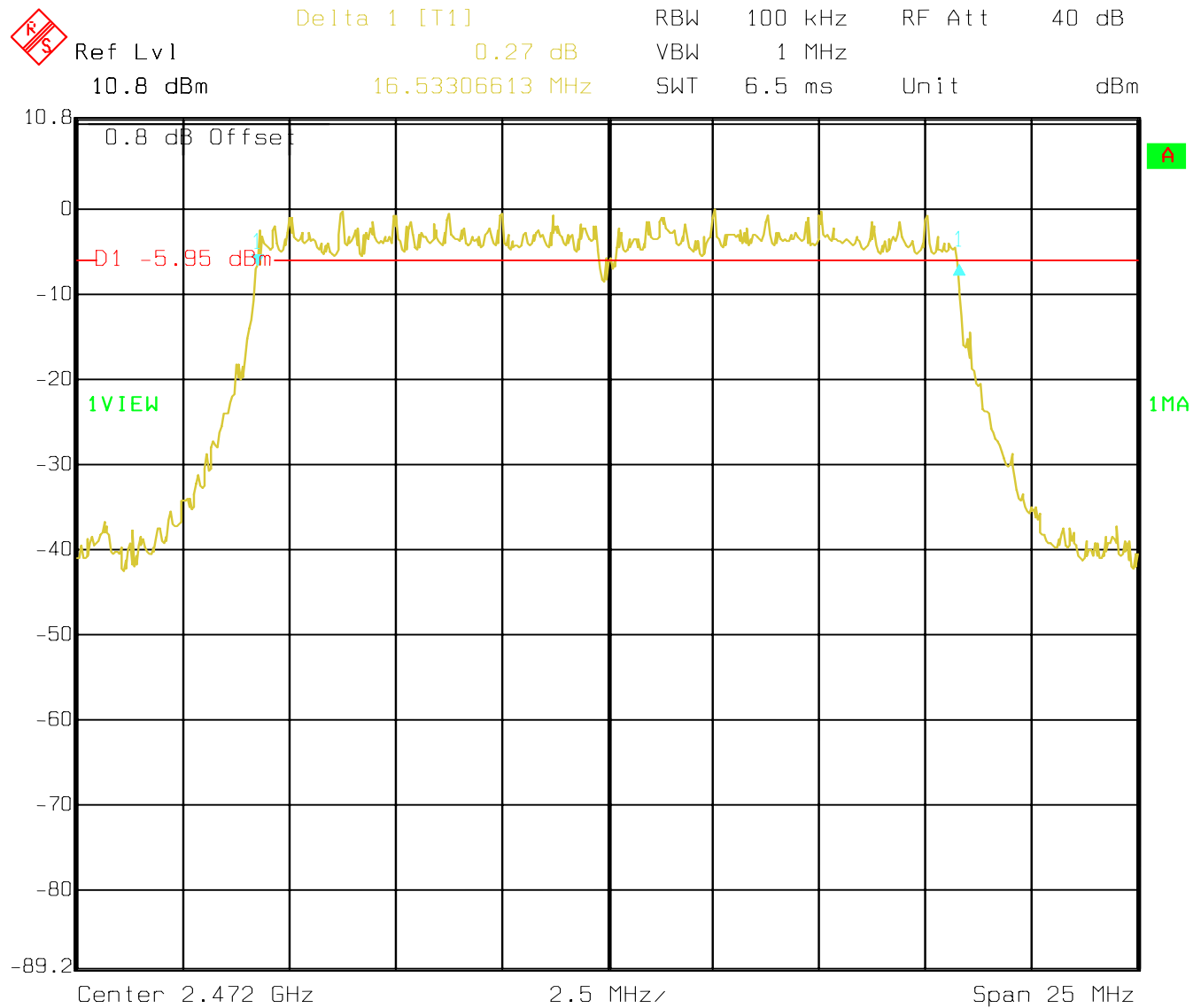
SPECTRUM BANDWIDTH OF DSSS SYSTEM

§15.247(a) (2)

6 dB bandwidth

(Data rate – 54Mbps)

Ch-13: 2472MHz



Date: 19.JAN.2005 14:57:29

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

§ 15.247 (b) (3)

TEST CONDITIONS		*AVERAGE OUTPUT POWER (dBm)				
Frequency (MHz)		2412	2437	2457	2462	2472
T _{nom} (23)°C	V _{nom} (3.3) VDC	19.1	19.0	19.1	16.2	10.5
Measurement uncertainty		±0.5dBm				

*Measured with power meter.

LIMIT

SUBCLAUSE § 15.247 (b) (3)

Frequency range	RF power output
2400-2483.5 MHz & 5725-5850 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)				
Frequency (MHz)		2412	2437	2457	2462	2472
T _{nom} (23)°C	V _{nom} (3.3) VDC	*22.34	*22.24	*22.34	*19.44	*13.74
Measurement uncertainty		±0.5dBm				

NOTE:

*EIRP is calculated based on 3.24dBi antenna gain and conducted peak power measurements.

**EIRP is calculated based on 5.7dBi antenna.

LIMIT**SUBCLAUSE § 15.247 (b) (3)**

Frequency range	RF power output
2400-2483.5 MHz & 5725-5850 MHz	30dBm on Conducted

POWER SPECTRAL DENSITY
(Data rate – 6Mbps b-mode)

§15.247 (e)

TEST CONDITIONS		POWER SPECTRAL DENSITY (dBm)			
Frequency (MHz)		2412	2437	2462	2472
T _{nom} (23)°C	V _{nom} (3.3) VDC	-4.0	-4.62	-5.12	-7.93

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

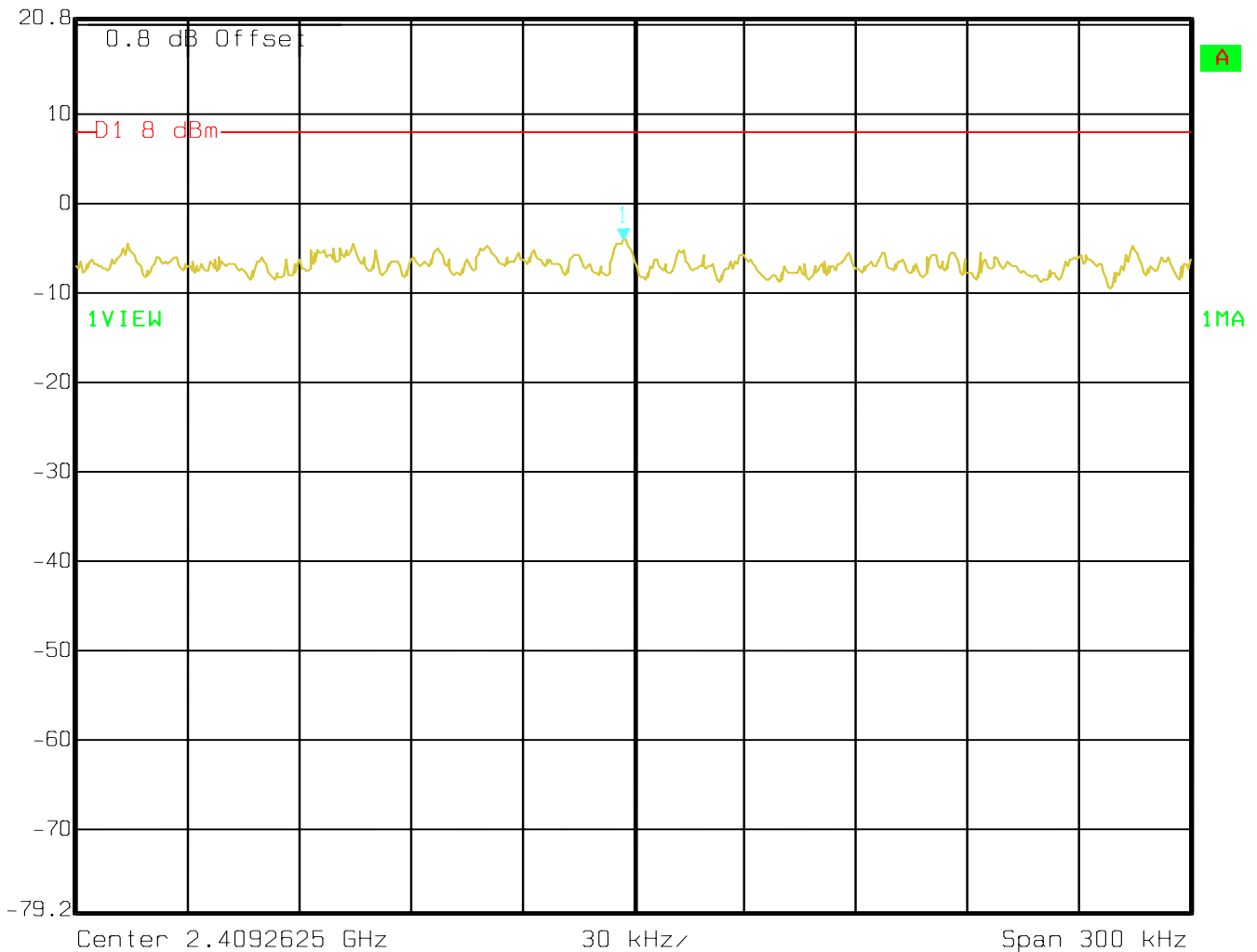
POWER SPECTRAL DENSITY (Data rate – 6Mbps, DSSS)

§15.247(e)

Ch-1: 2412MHz



Ref Lvl 20.8 dBm
Marker 1 [T1] -4.00 dBm
RBW 3 kHz RF Att 50 dB
VBW 3 kHz
SWT 100 s Unit dBm

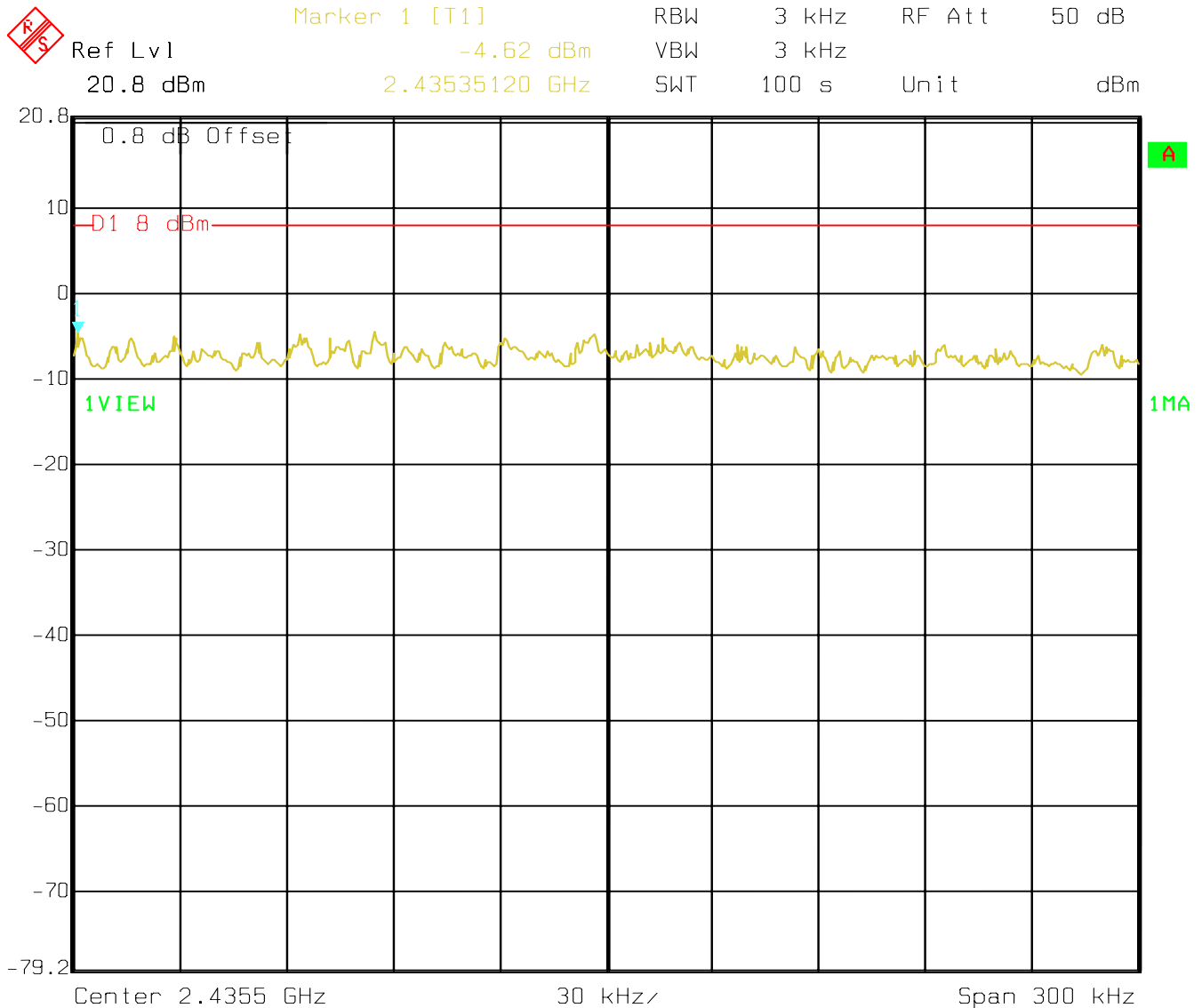


Date: 18.JAN.2005 18:14:00

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

§15.247(e)

Ch-6: 2437MHz



Date: 18.JAN.2005 18:10:24

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

§15.247(e)

Ch-11: 2462MHz



Marker 1 [T1]

RBW 3 kHz RF Att 50 dB

Ref Lvl -5.12 dBm

VBW 3 kHz

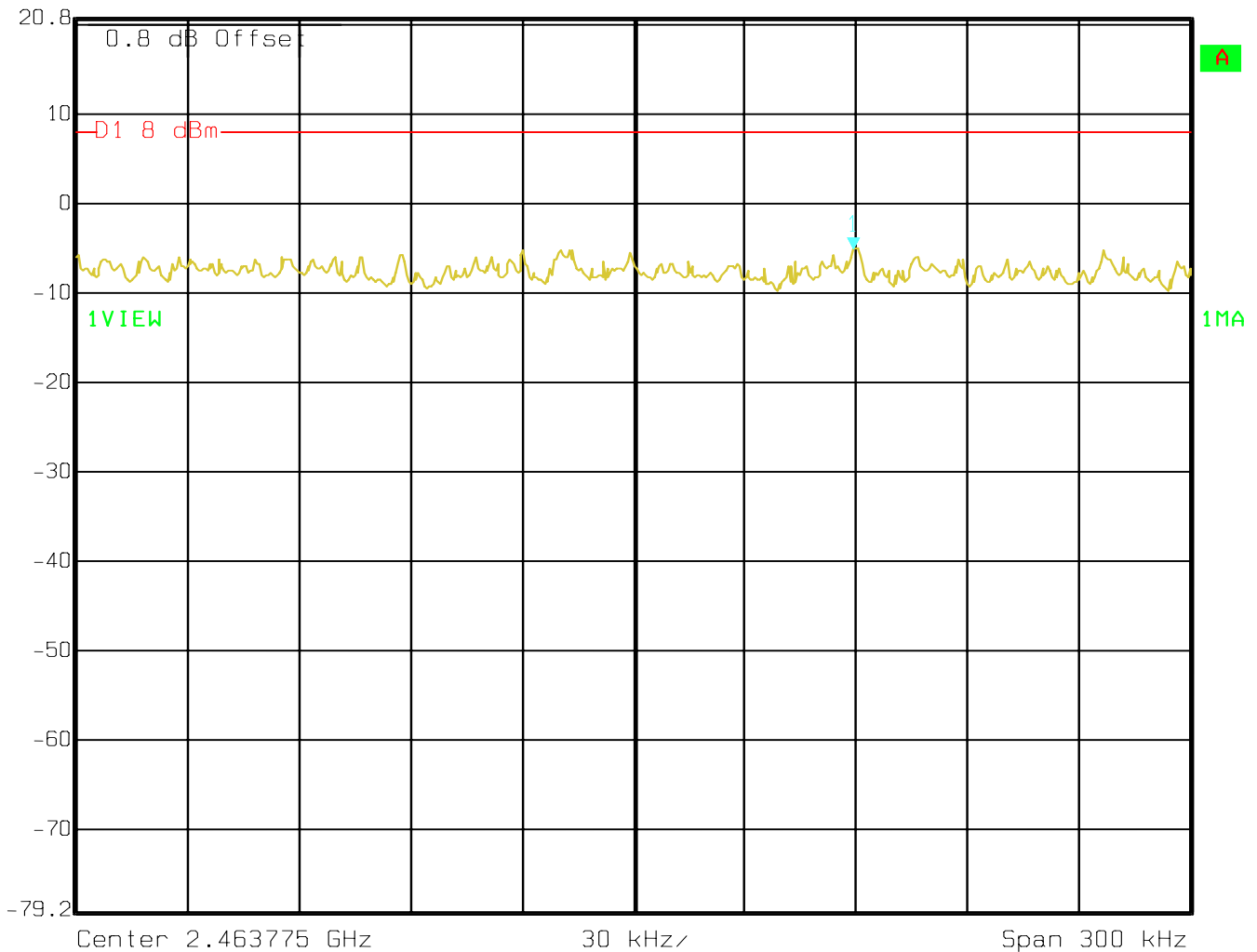
20.8 dBm

2.46383422 GHz

SWT 100 s

Unit

dBm



Date: 18.JAN.2005 18:06:21

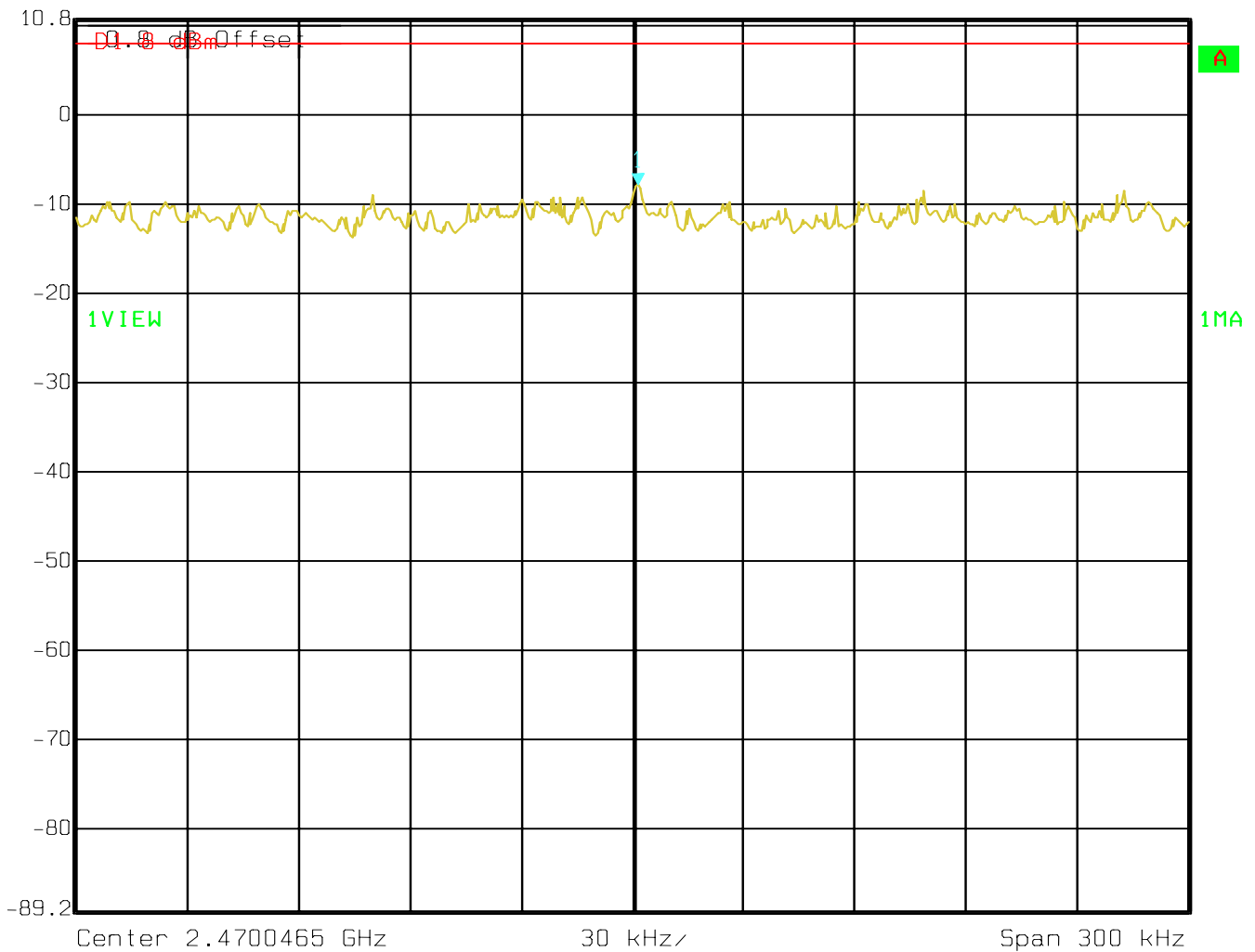
POWER SPECTRAL DENSITY (Data rate – 6Mbps, DSSS)

§15.247(e)

Ch-13: 2472MHz



Ref Lvl 10.8 dBm
Marker 1 [T1] -7.93 dBm
2.47004800 GHz
RBW 3 kHz
VBW 3 kHz
SWT 100 s
RF Att 40 dB
Unit dBm



Date: 19.JAN.2005 15:07:53

**WNC stamped metal sheet antenna
(Freq. band: 2.4GHz, Gain: 3.24dBi, Model 81.ED415.002)**

BAND EDGE COMPLIANCE

§15.247 (c)

(Data rate – 6Mbps g-mode)

WNC stamped metal sheet antenna

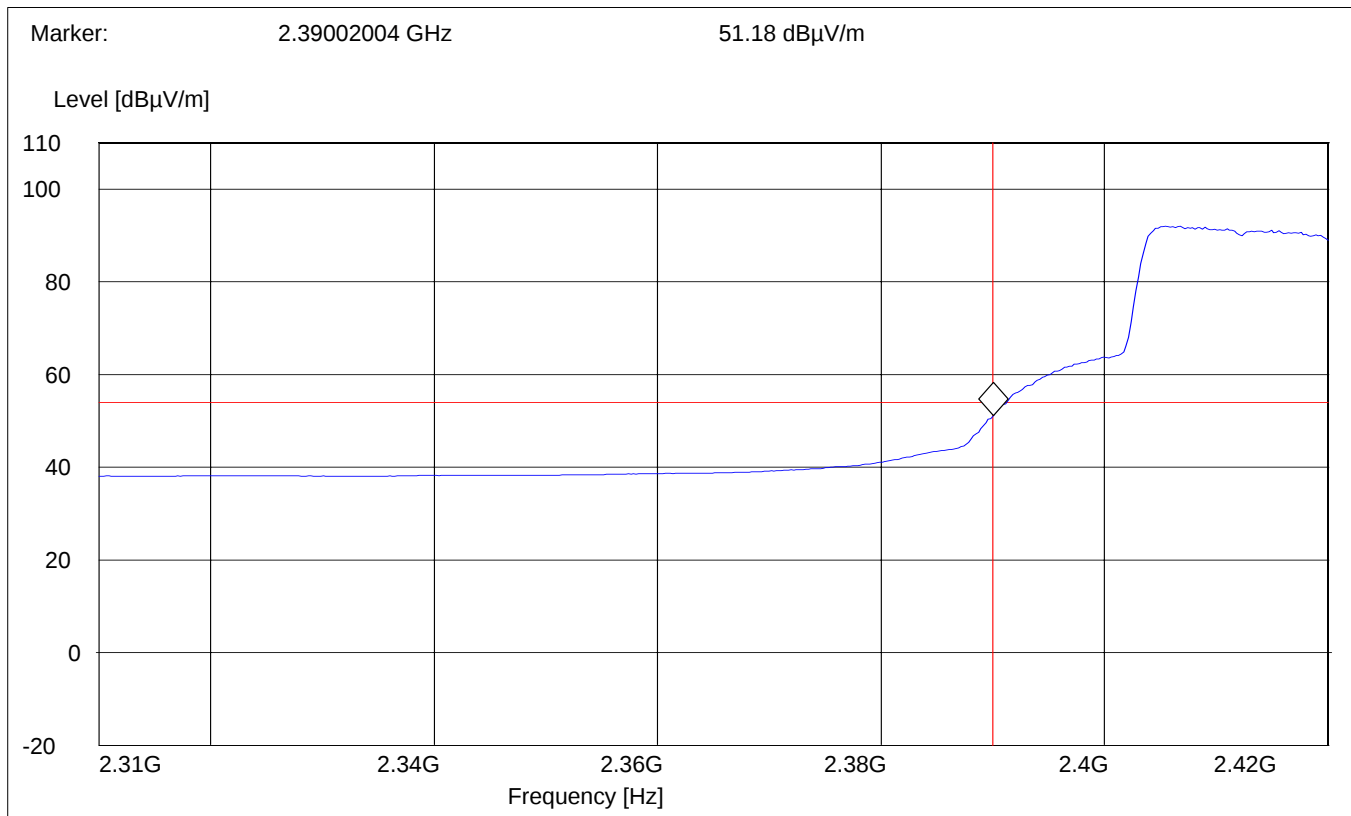
Low frequency section (spurious in the restricted band 2310 – 2390 MHz)

(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 (c)

(Data rate – 54Mbps g-mode)

WNC stamped metal sheet antenna

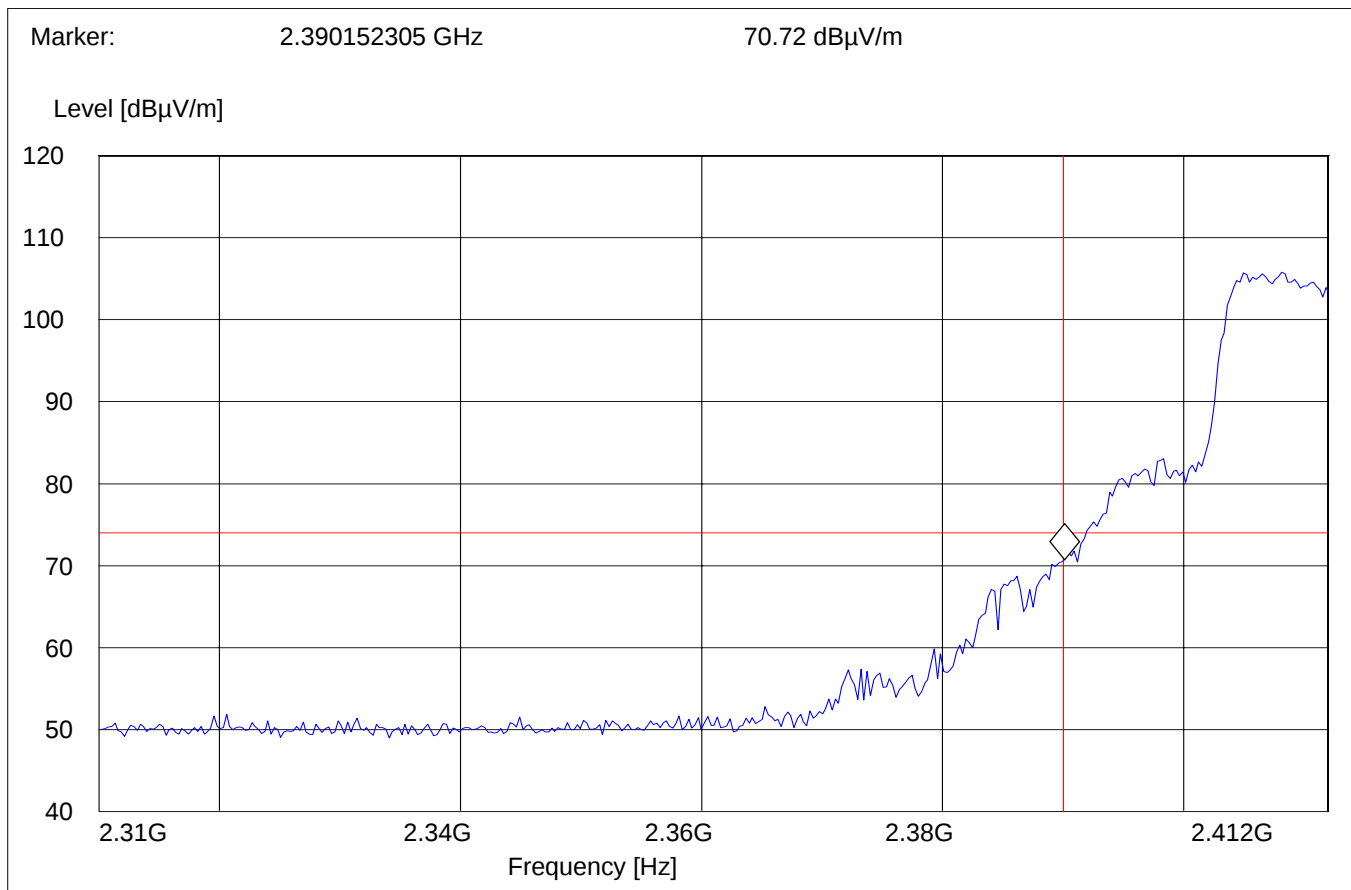
Low frequency section (spurious in the restricted band 2310 – 2390 MHz)

(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 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)

(Data rate – 6Mbps g-mode)

WNC stamped metal sheet antenna

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

(Average measurement)

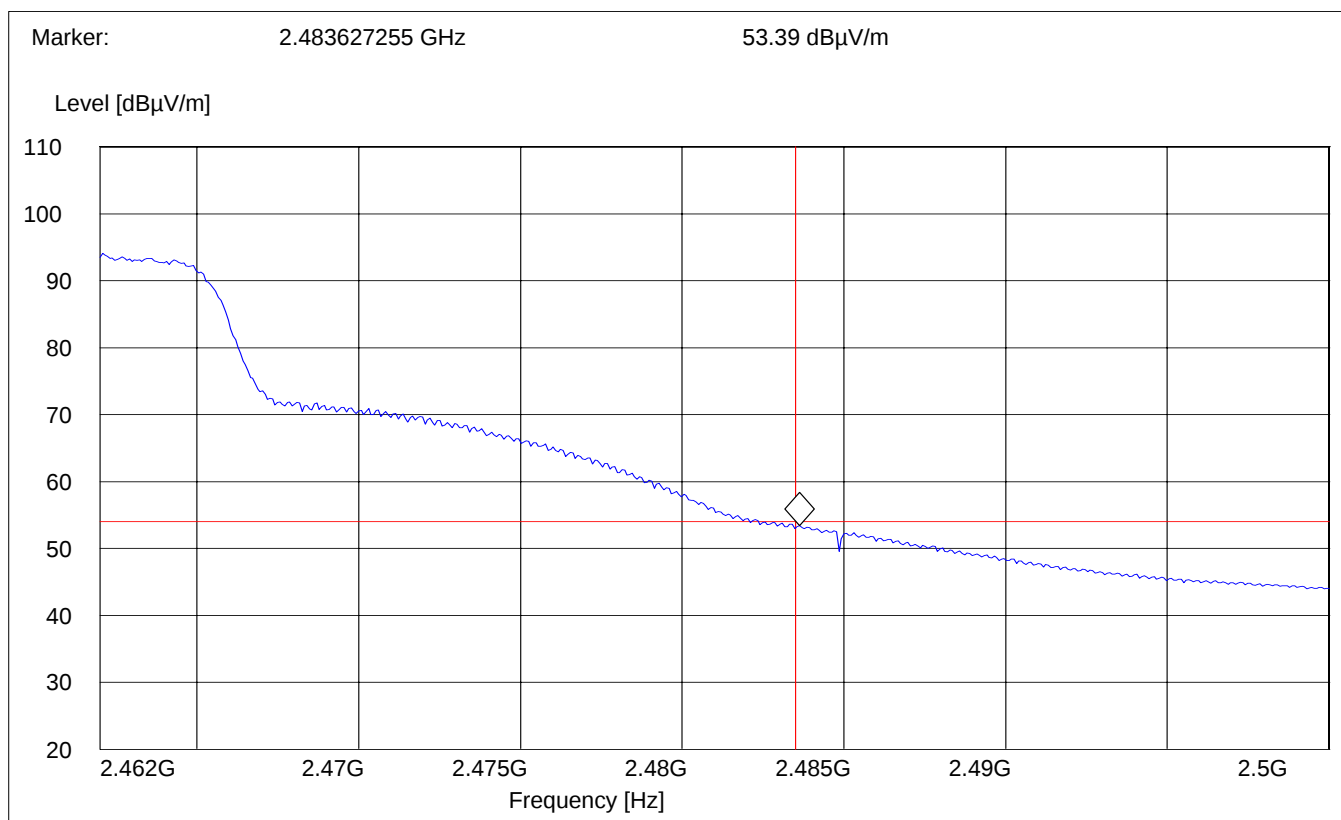
(Pwr tuned 0.5dB higher)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

Operating condition : Tx at 2457MHz
 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)

(Data rate – 54Mbps g-mode)

WNC stamped metal sheet antenna

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

(Peak measurement)

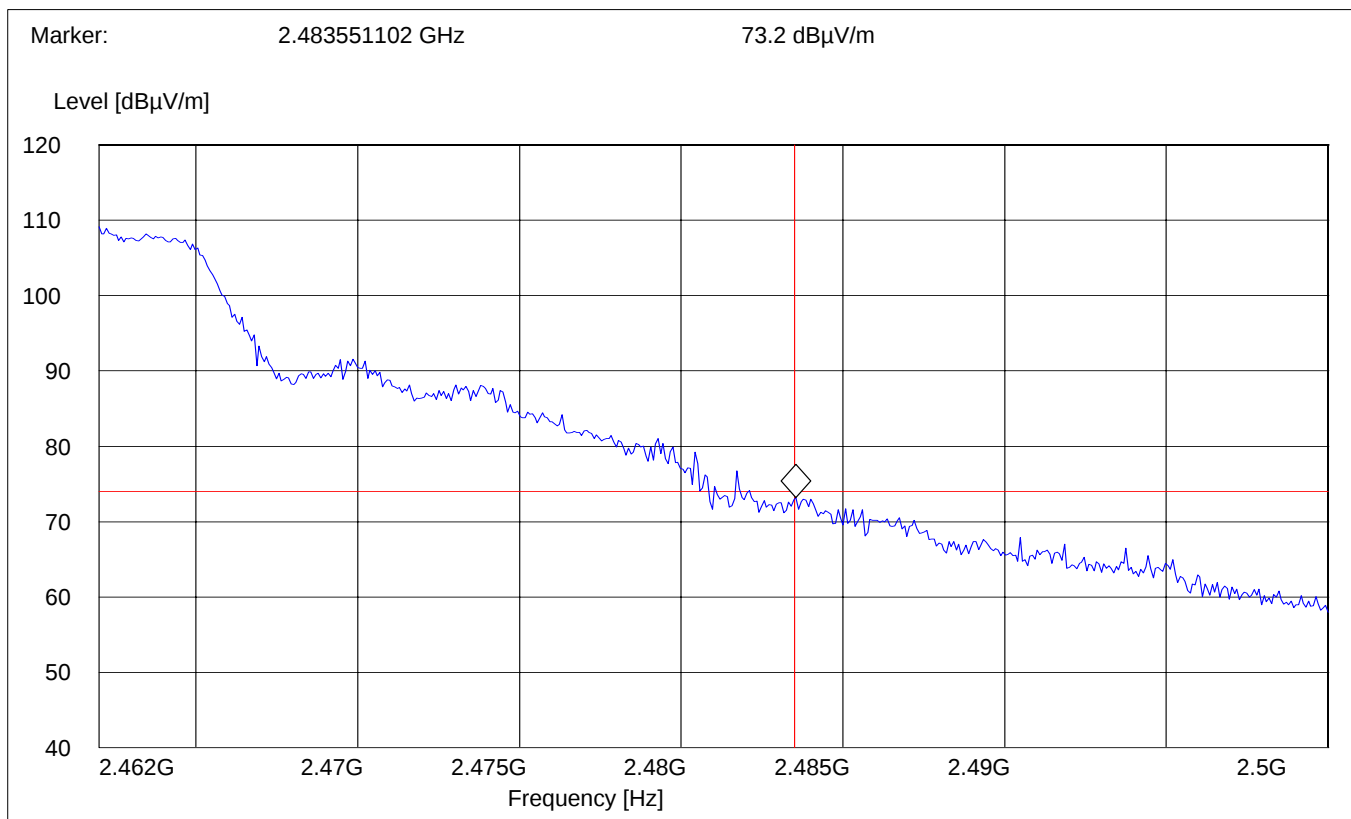
(pwr in packet tuned to higher than (very high) for this particular plot)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

Operating condition : Tx at 2457MHz
 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)



BAND EDGE COMPLIANCE

§15.247 (c)

(Data rate – 6Mbps g-mode)

WNC stamped metal sheet antenna

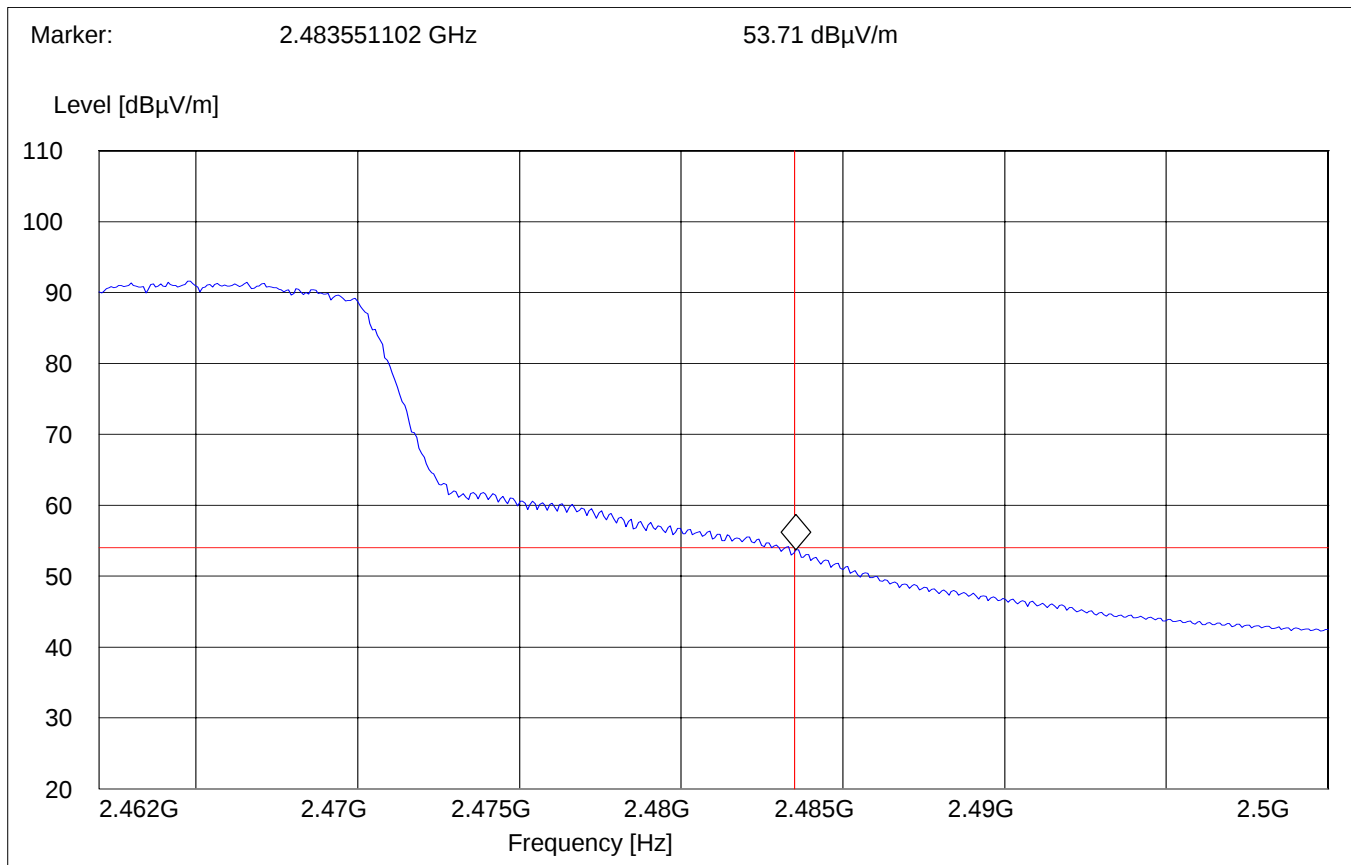
High frequency section (spurious in the restricted band 2483.5 – 2500MHz)

(Average measurement)

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

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)

(Data rate – 54Mbps g-mode)

WNC stamped metal sheet antenna

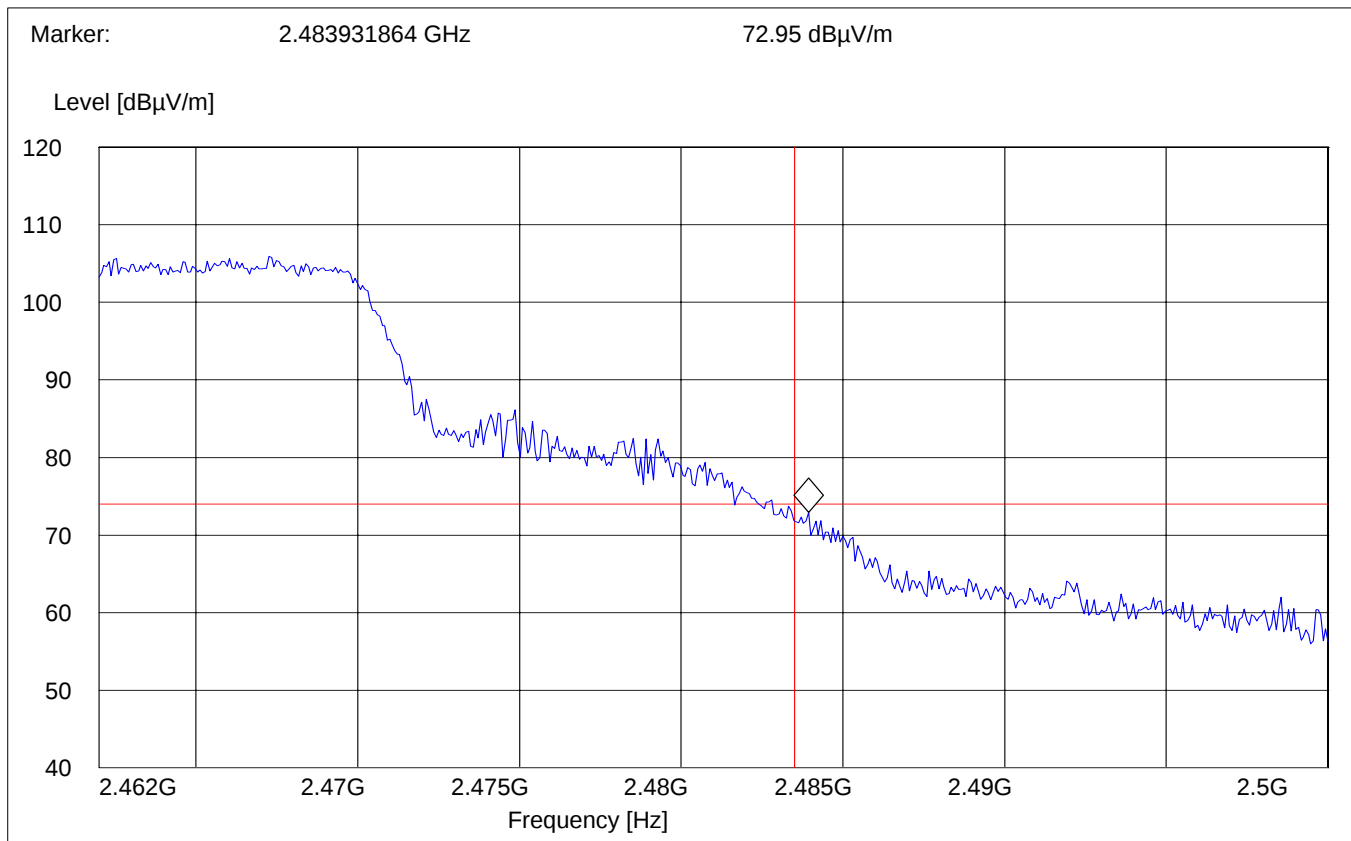
High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)

(Peak measurement)

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

Operating condition : Tx at 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)



BAND EDGE COMPLIANCE

§15.247 (c)

(Data rate – 6Mbps g-mode)

WNC stamped metal sheet antenna

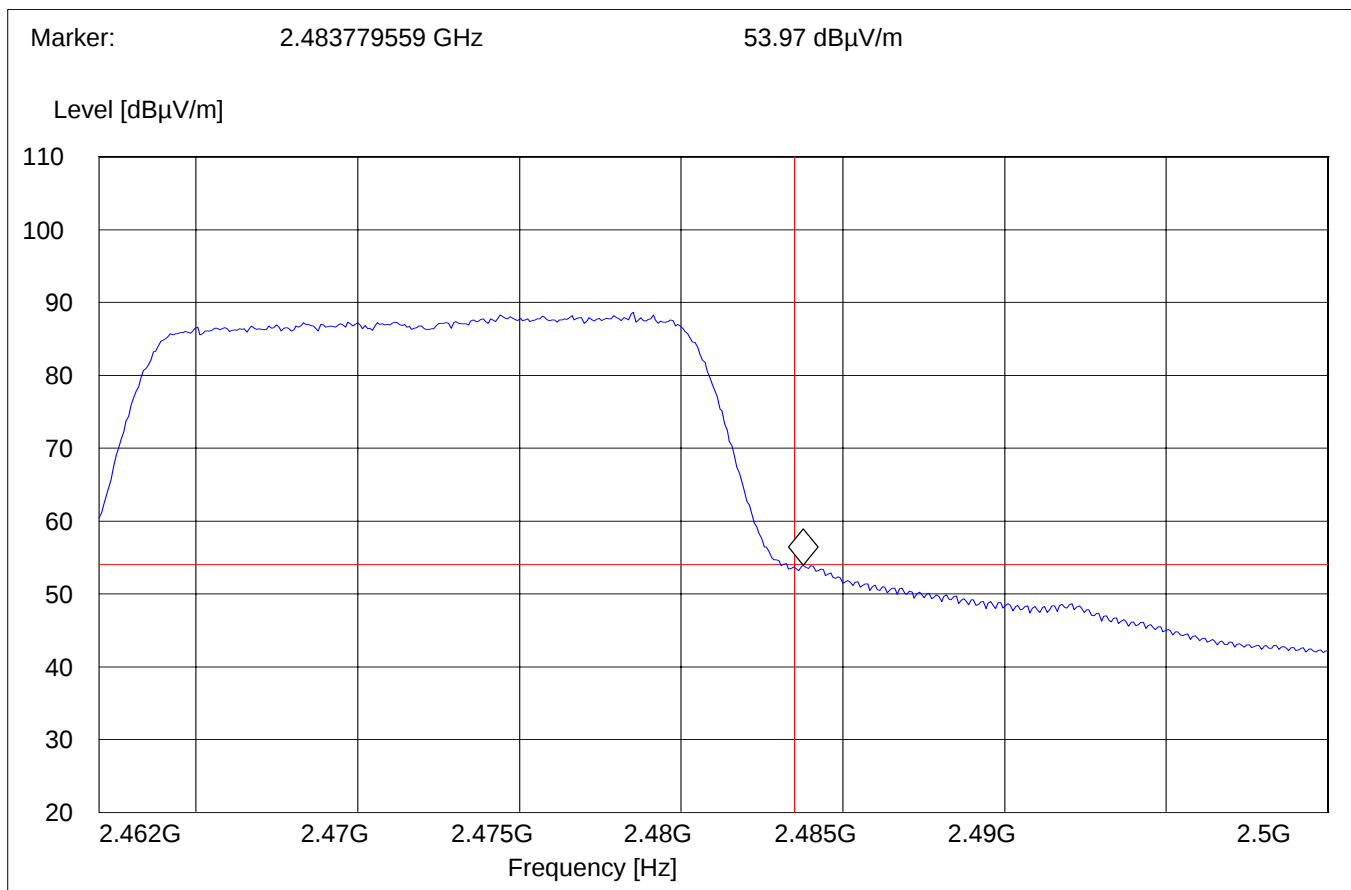
High frequency section (spurious in the restricted band 2483.5 – 2500MHz)

(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 (c)

(Data rate – 54Mbps)

WNC stamped metal sheet antenna

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

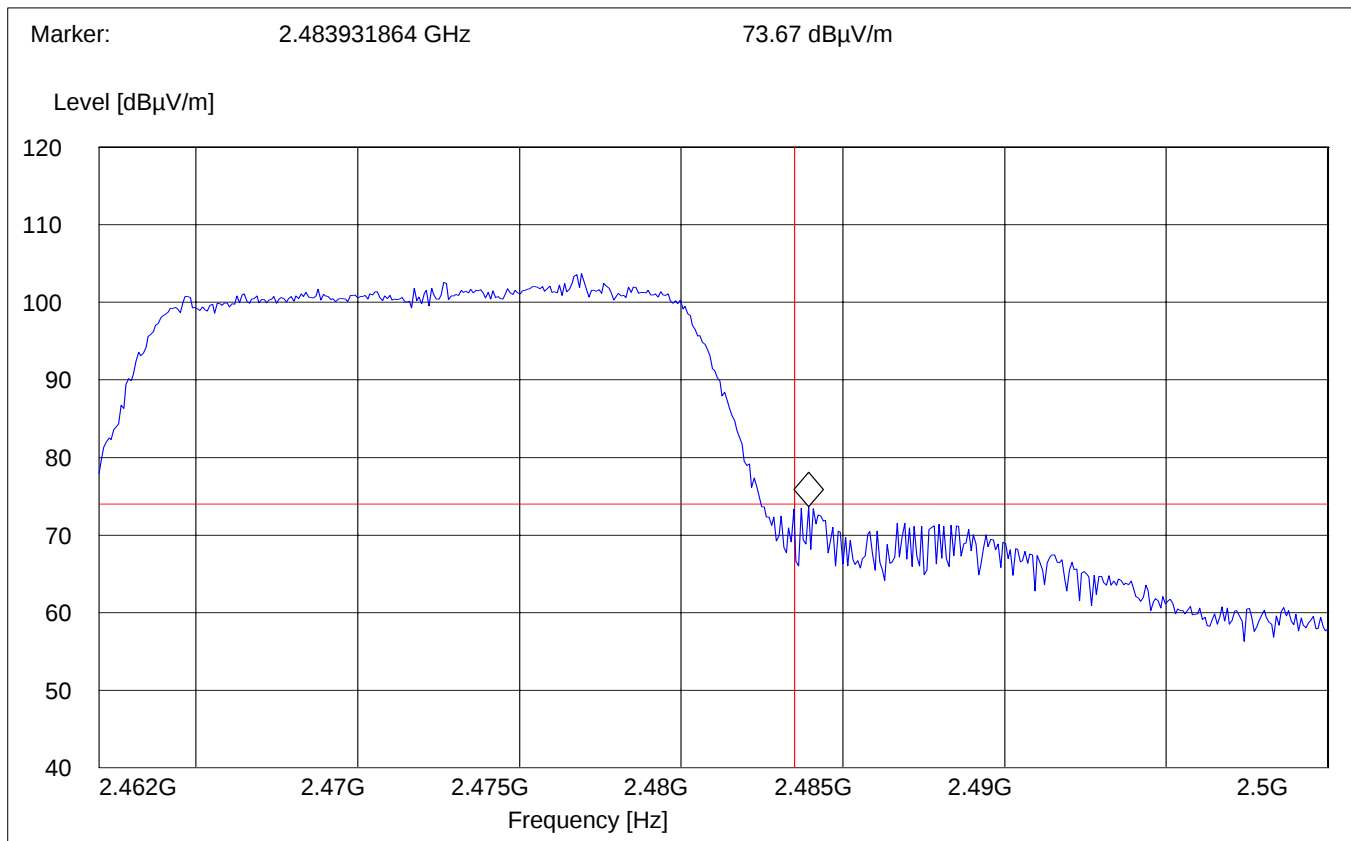
SWEEP TABLE

: "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

§ 15.247 (c) (1)

Transmitter (Radiated)**WNC stamped metal sheet antenna****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)

WNC stamped metal sheet antenna

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 (c) (1)

30MHz – 1GHz

WNC stamped metal sheet antenna

Data rate – 54Mbps)

Antenna: vertical

EUT plane: Horizontal with screen vertical @ 90°

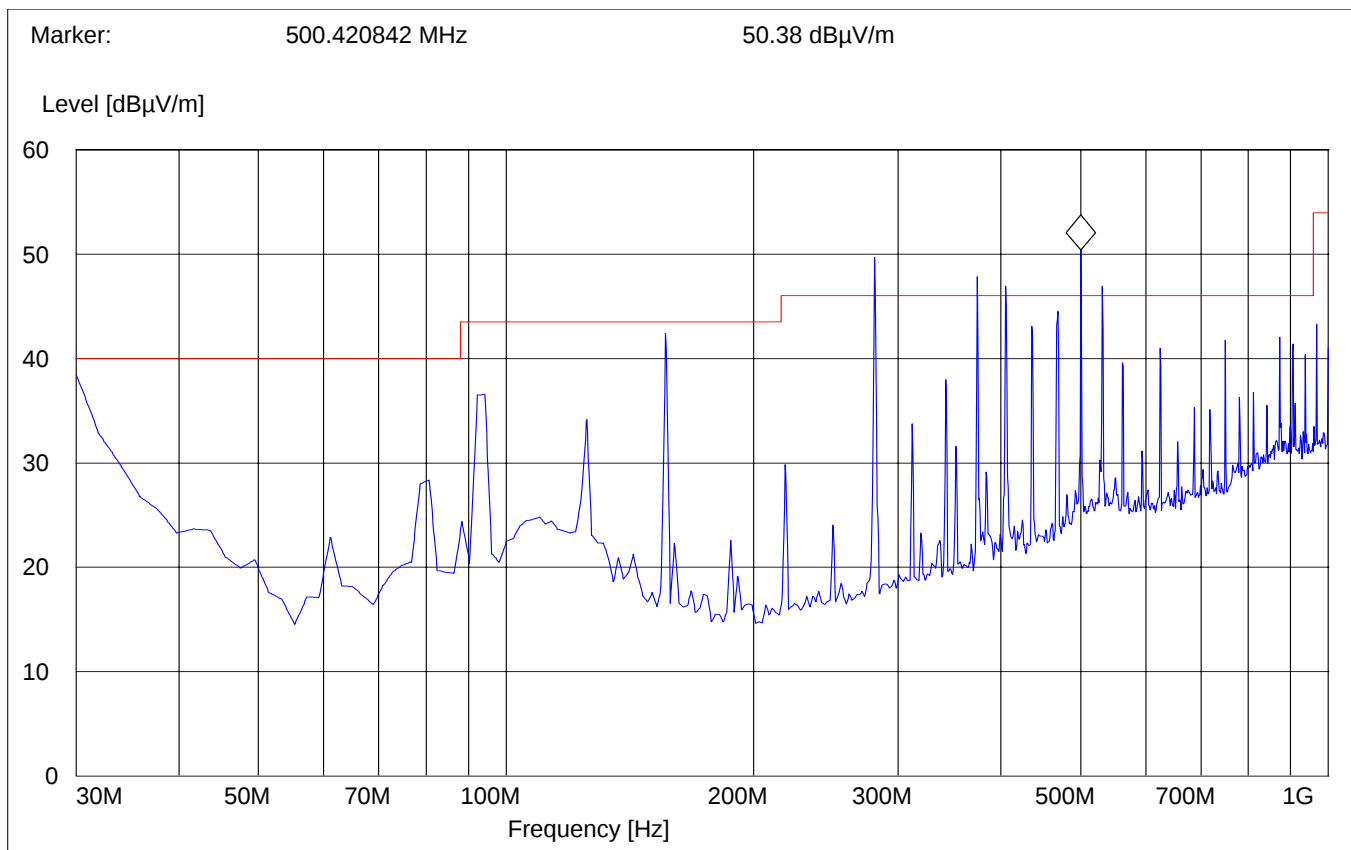
Note:

1. This plot is valid for low, mid, high channels (worst-case plot valid for all antennas)
2. All significant peaks were confirmed originating from test fixture, see plot on page 34 with test fixture tested alone with no WLAN card

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

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

Freq.	Pk(dBm)	QPk(dBm)
280.761MHz	49.69	46.69
374.068MHz	47.83	41.83
405.17MHz	46.90	41.90
500.4208MHz	50.38	40.90
531.523MHz	46.90	40.90



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

30MHz – 1GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

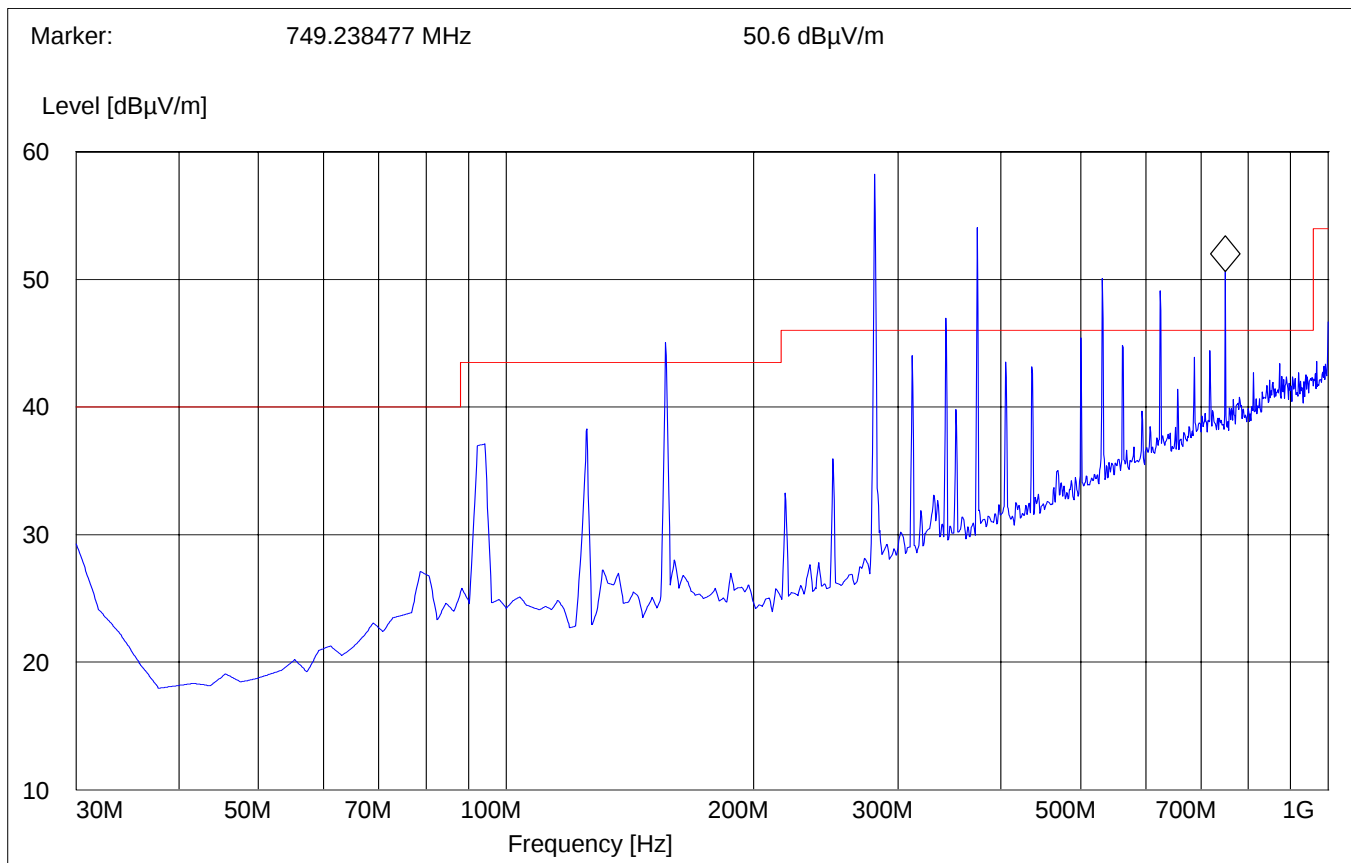
Note:

1. This plot is valid for low, mid, high channels (worst-case plot valid for all antennas)
2. All significant peaks were confirmed originating from test fixture, see plot on page 35 with test fixture tested alone with no WLAN card

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

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

Freq.	Pk(MHz)	QPk(MHz)
156.3527MHz	45.06	40.06
280.761MHz	58.24	57.24
342.966MHz	46.98	40.98
374.068MHz	54.05	45.05
531.523MHz	50.05	44.05
624.8296MHz	49.09	44.09
749.2385MHz	50.60	44.60



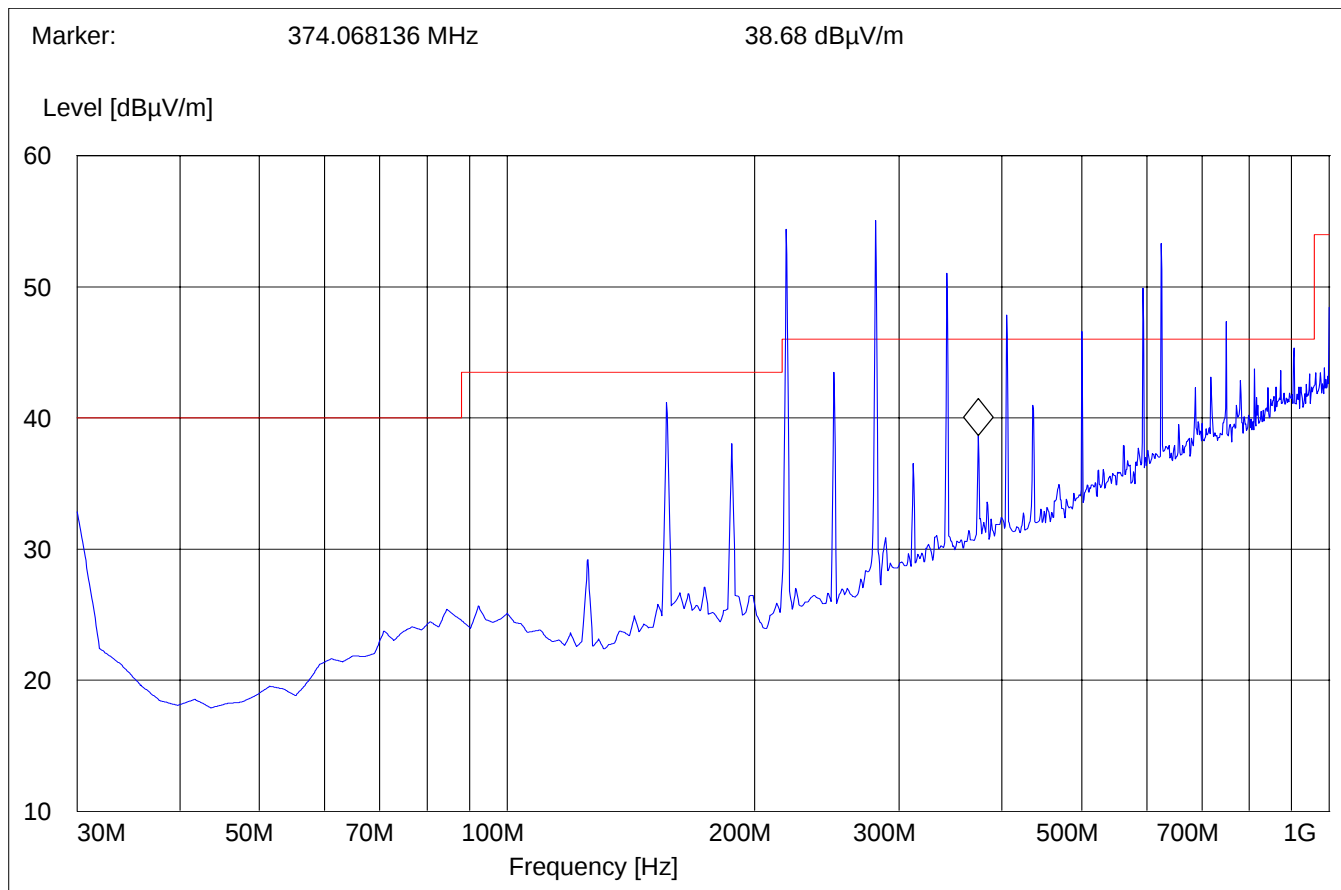
EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

30MHz – 1GHz

WNC stamped metal sheet antenna

Test Fixture only (no WLAN card)



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-1 (2412MHz): 1GHz – 3GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

Antenna: Horizontal

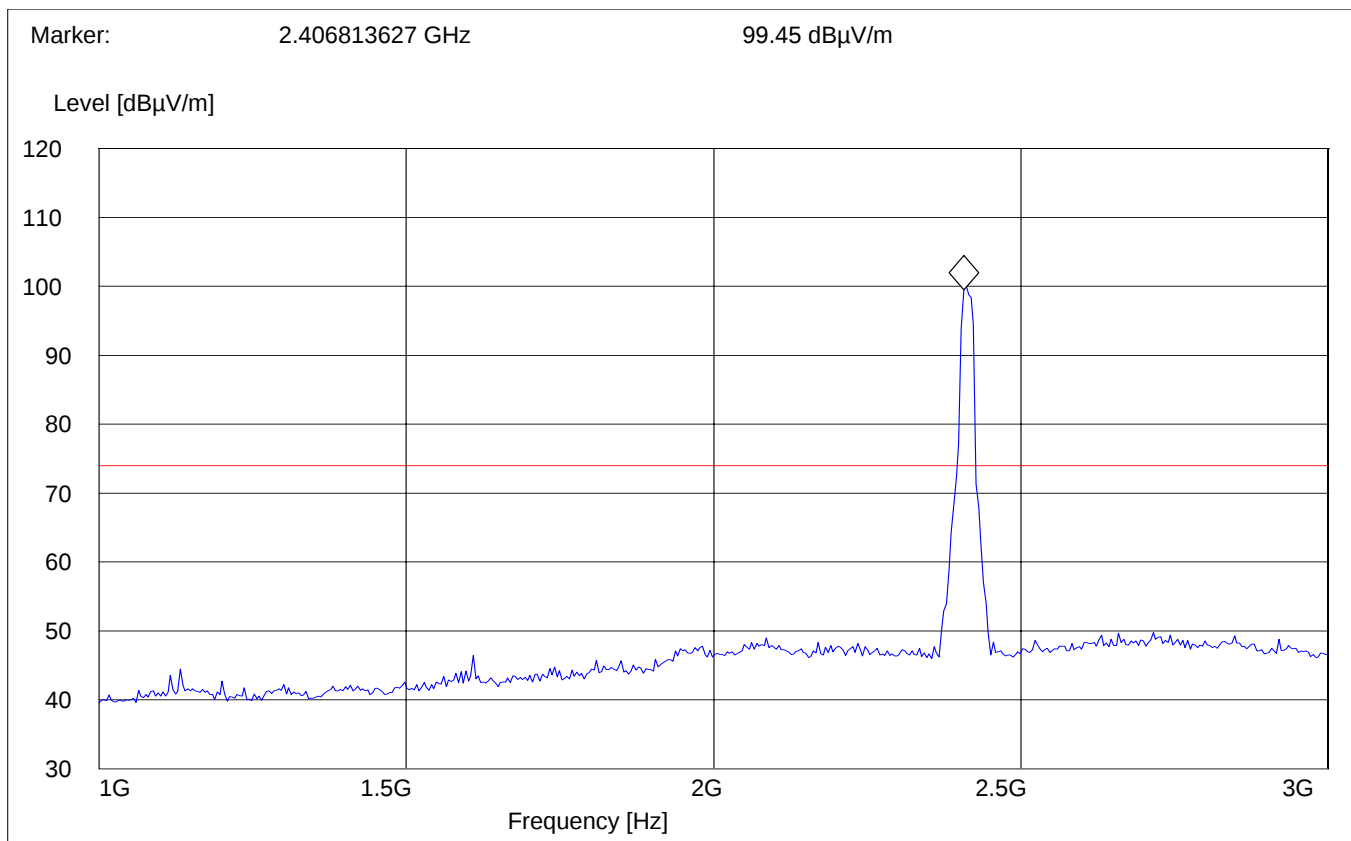
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

"WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-1 (2412MHz): 3GHz – 18GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

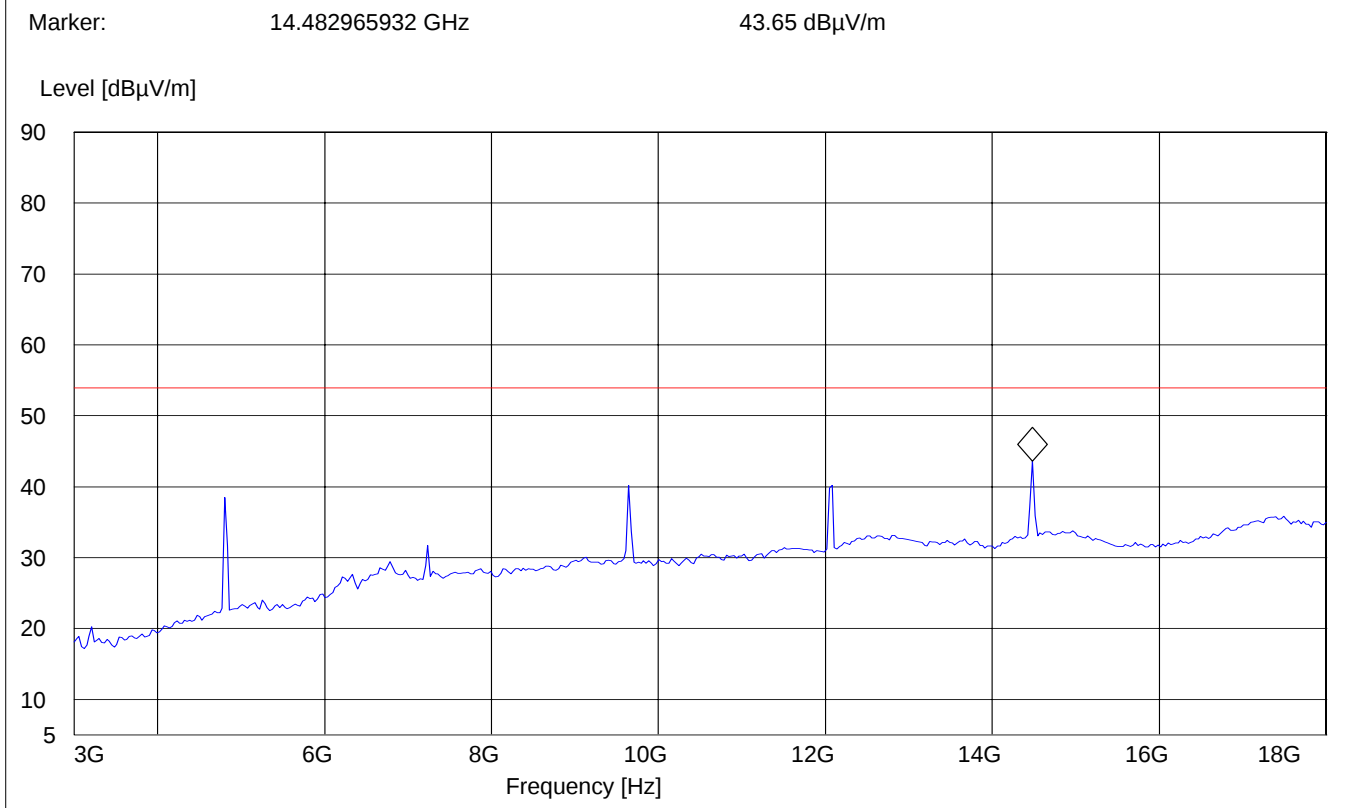
(Average measurement)

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 (c) (1)

Channel-6 (2437MHz): 1GHz – 3GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

Antenna: Horizontal

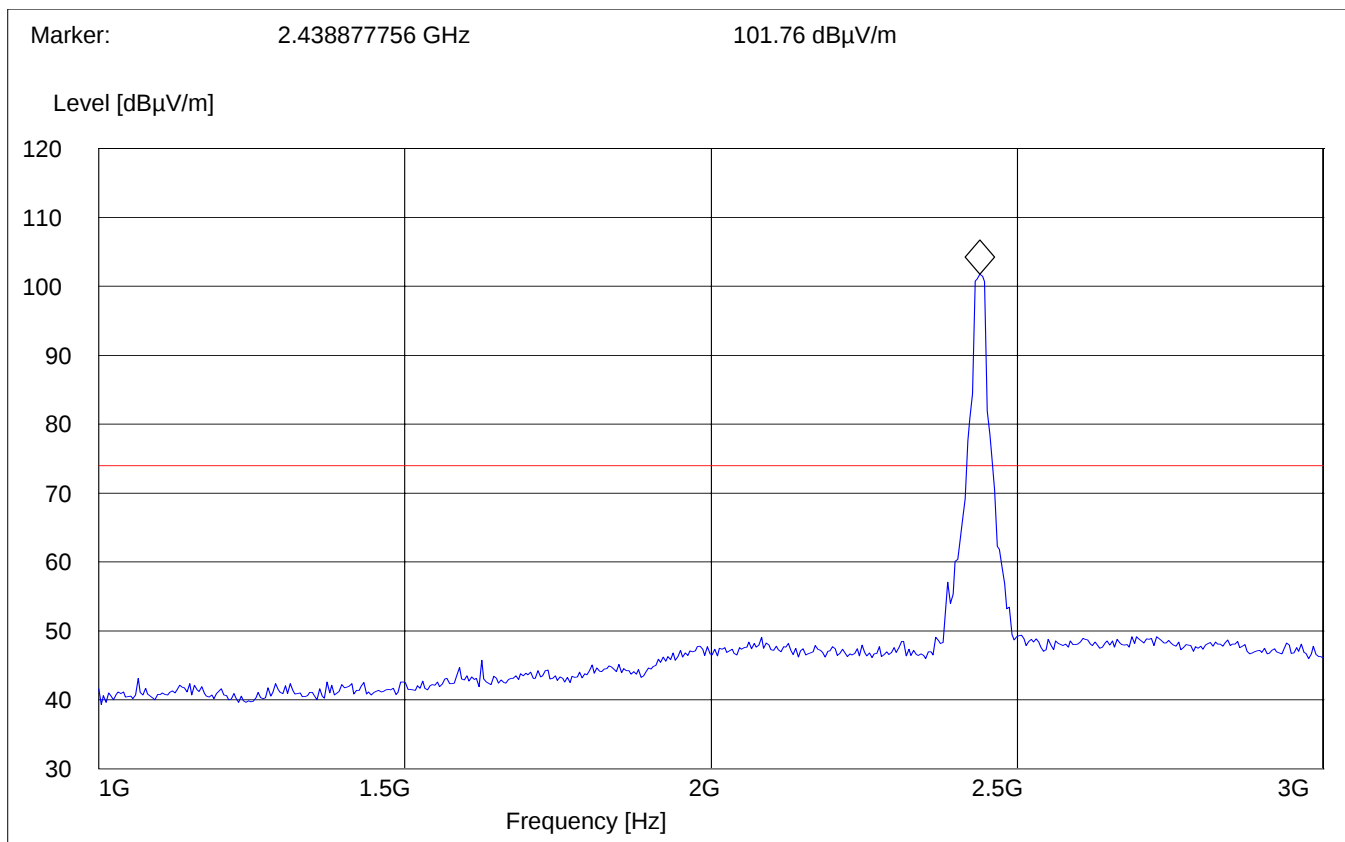
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-6 (2437MHz): 3GHz – 18GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

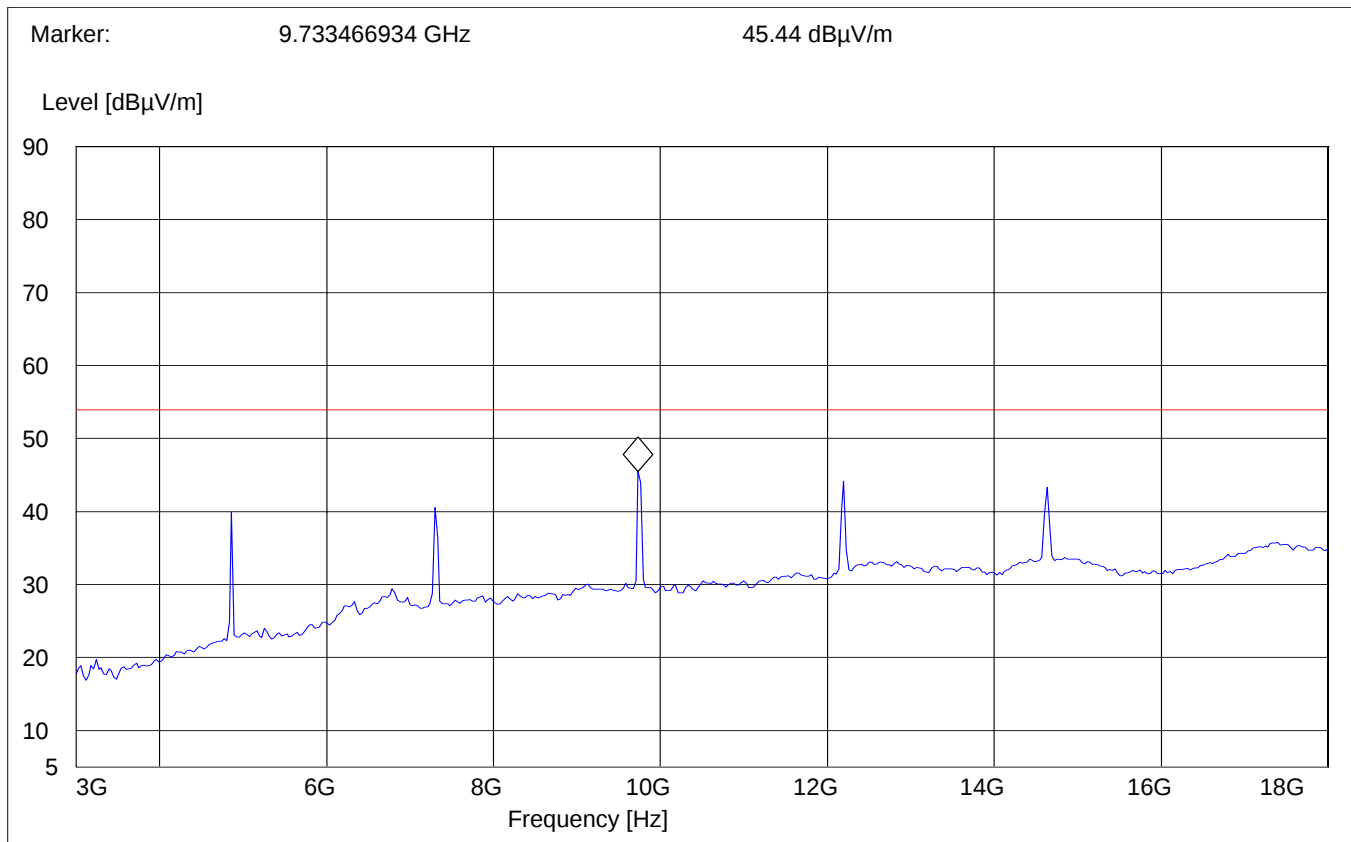
EUT plane:

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 (c) (1)

Channel-10 (2457MHz): 1GHz – 3GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

Antenna: Horizontal

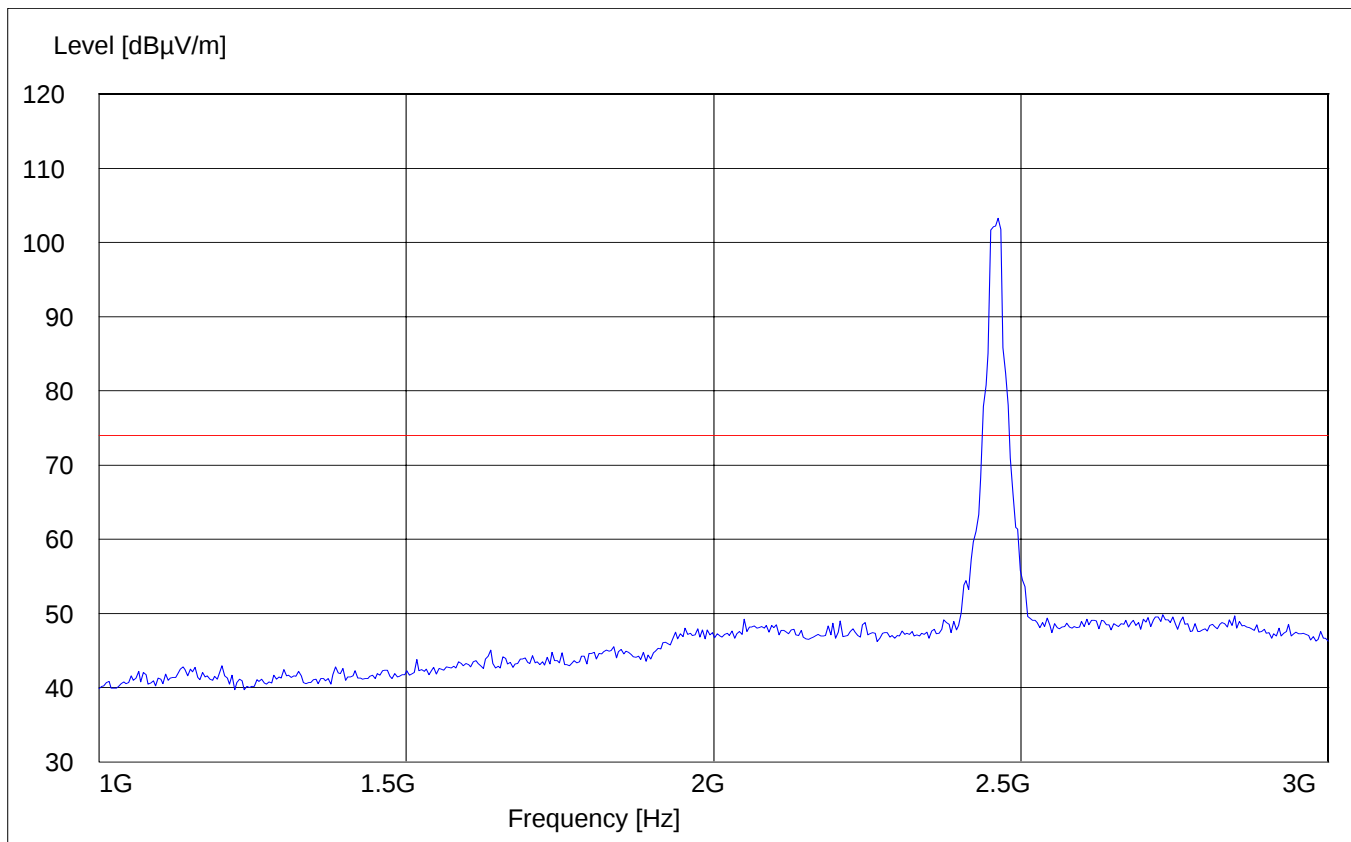
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-10 (2457MHz): 3GHz – 18GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

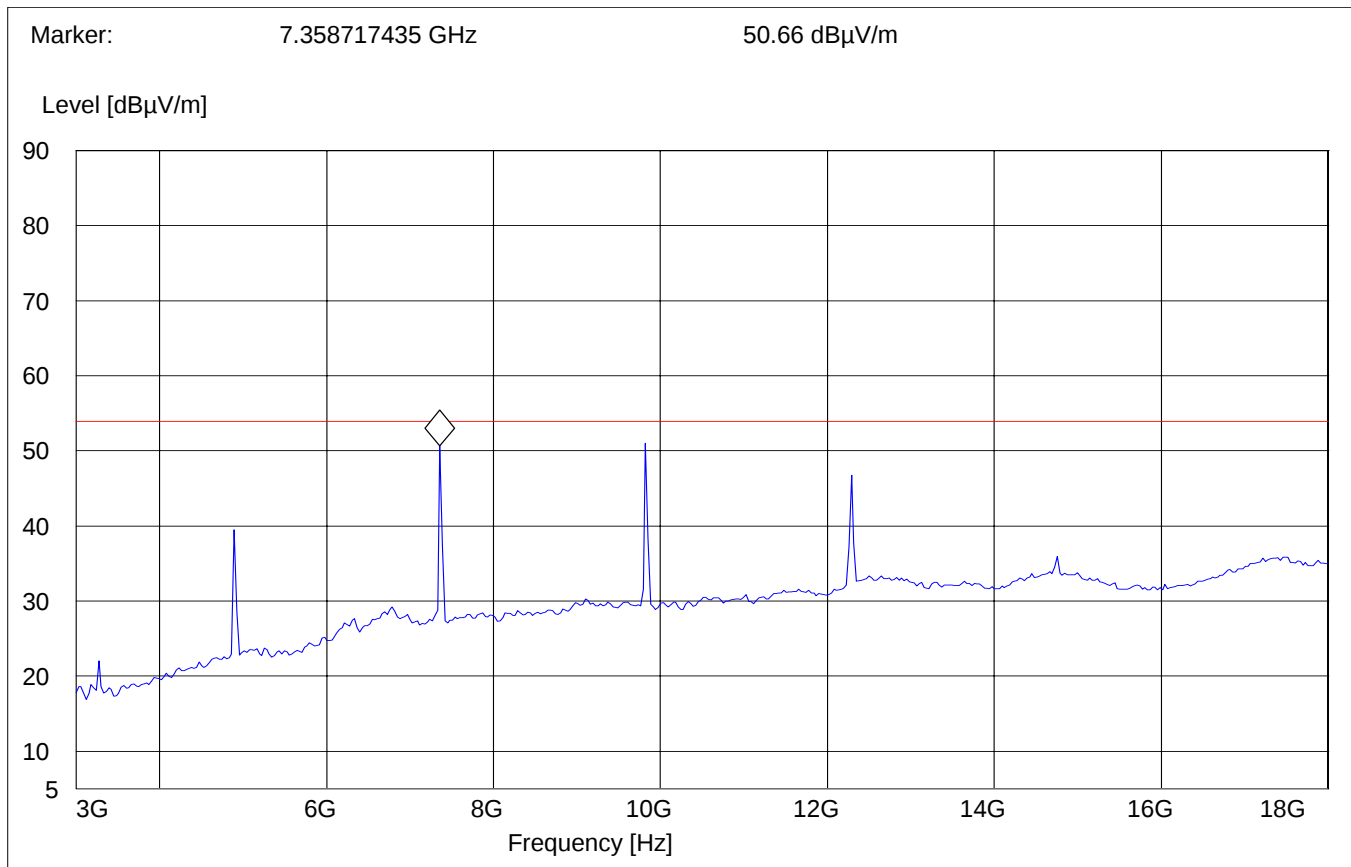
EUT plane:

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 (c) (1)

Channel-11 (2462MHz): 1GHz – 3GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

Antenna: Horizontal

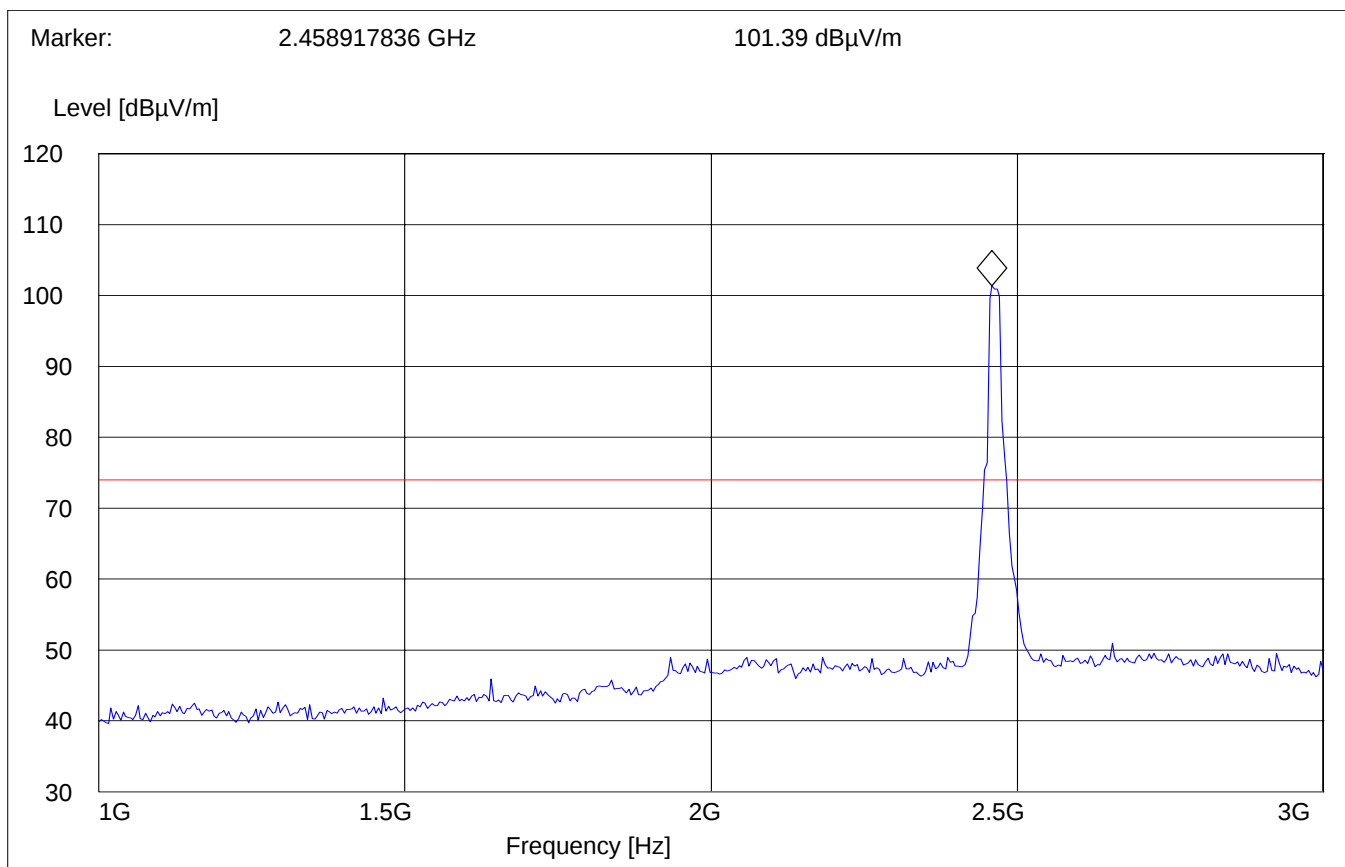
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-11 (2462MHz): 3GHz – 18GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

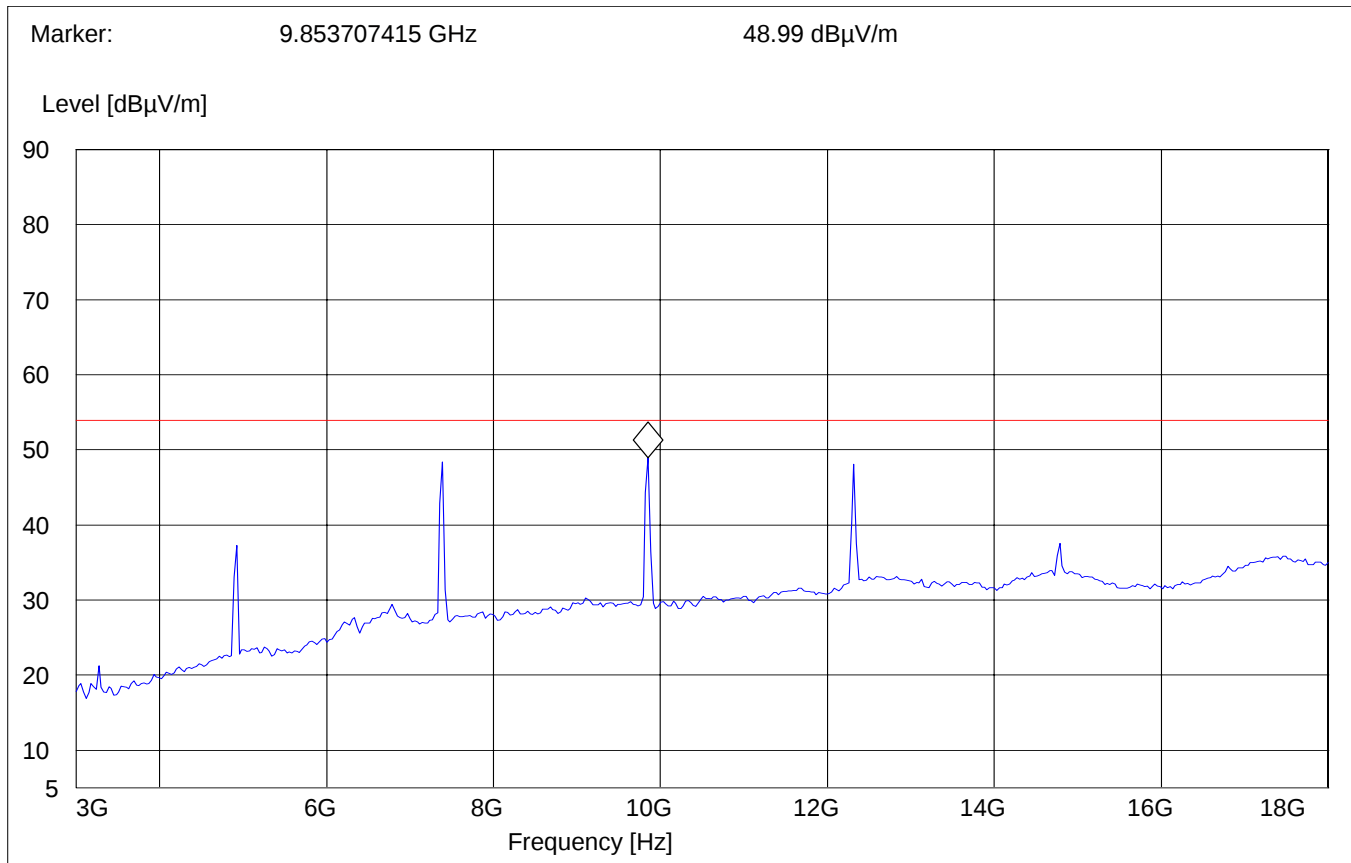
EUT plane:

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 (c) (1)

Channel-13 (2472MHz): 1GHz – 3GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

Antenna: Horizontal

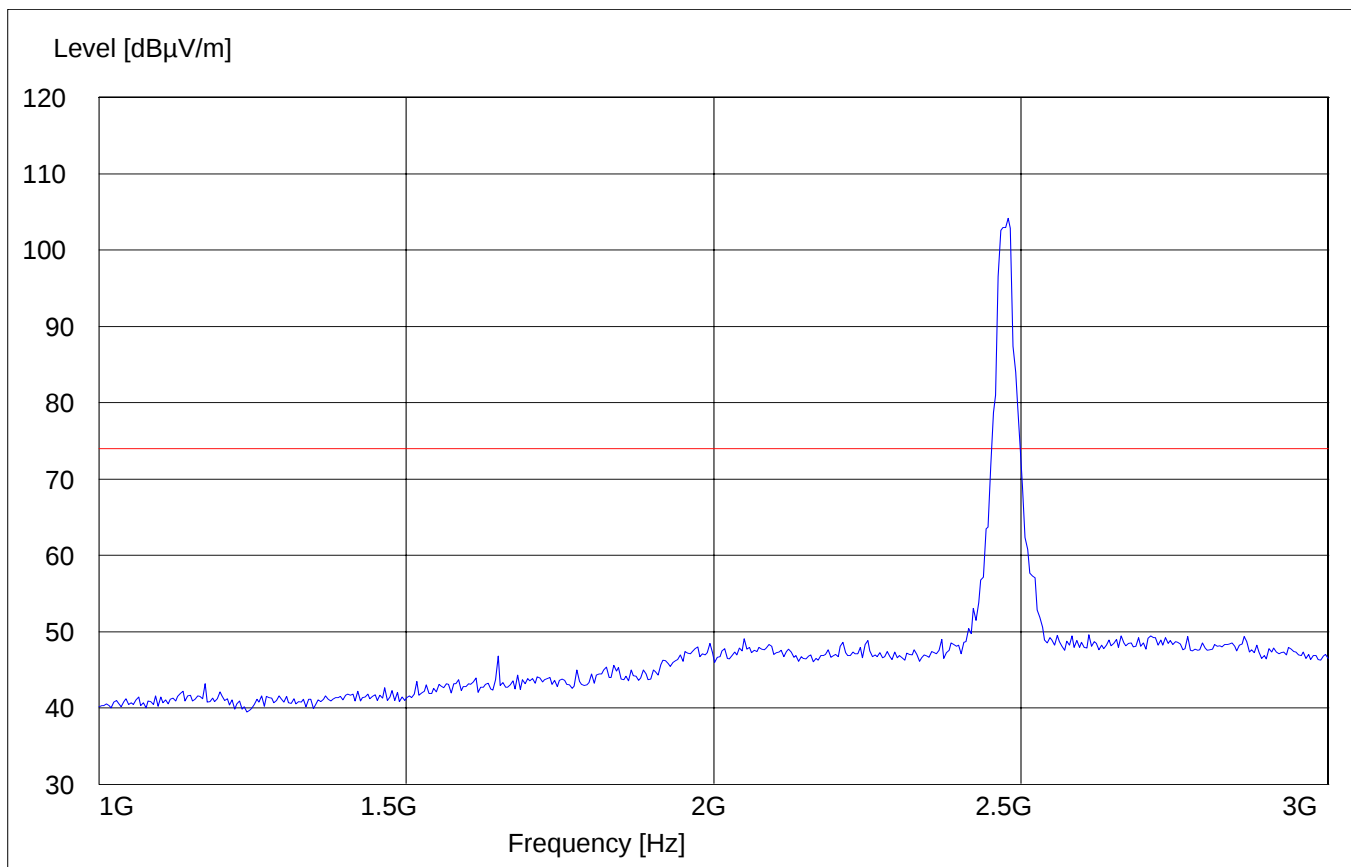
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-13 (2472MHz): 3GHz – 18GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

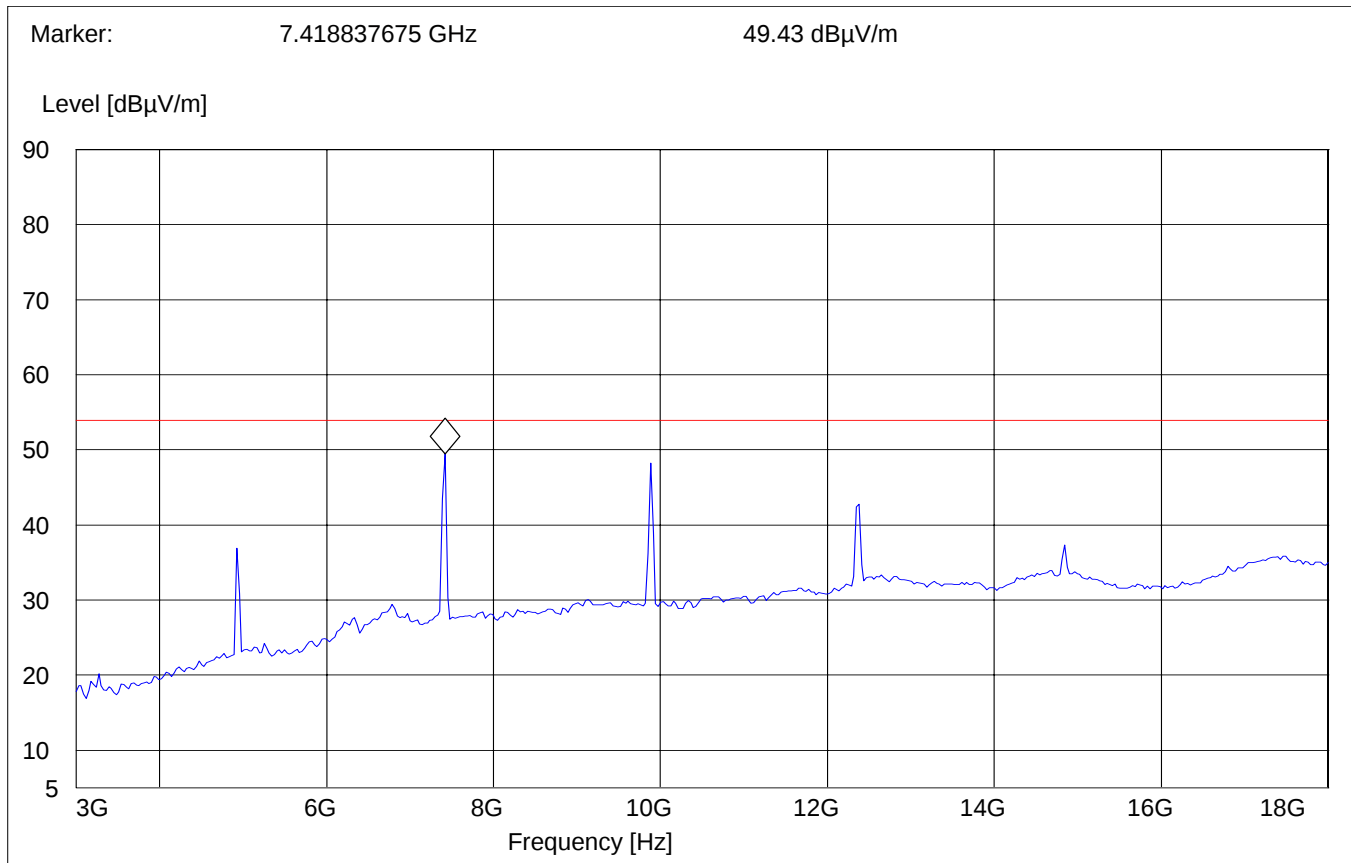
EUT plane:

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 (c) (1)

18GHz – 25GHz

WNC stamped metal sheet antenna

(Data rate – 54Mbps)

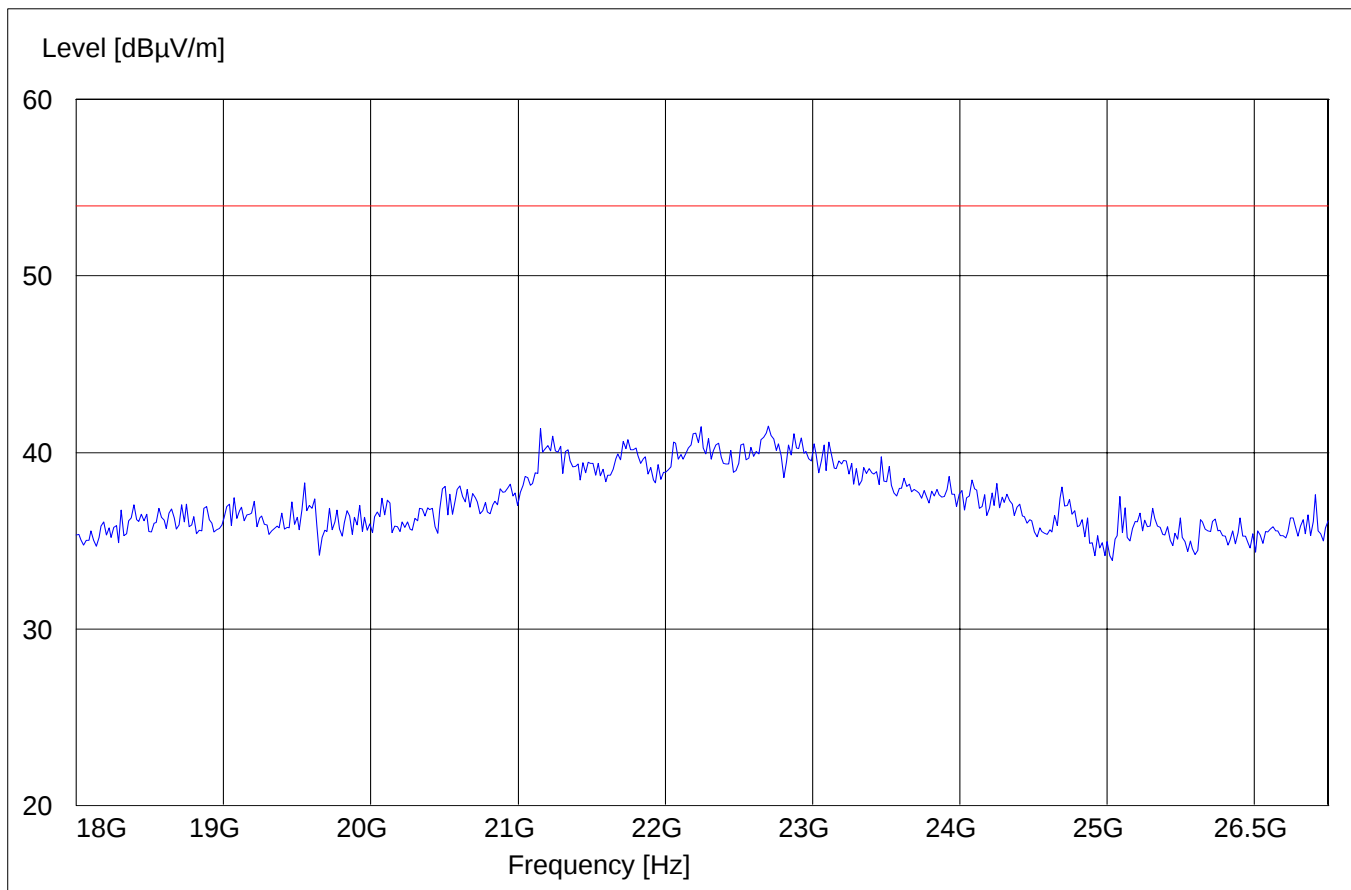
Antenna: Horizontal

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)



**Hitachi FPC antenna
(Freq. band: 2.4GHz, Gain: 2.1dBi, Model HFT17-DL04)**

BAND EDGE COMPLIANCE

§15.247 (c)

(Data rate – 6Mbps g-mode)

Hitachi FPC antenna

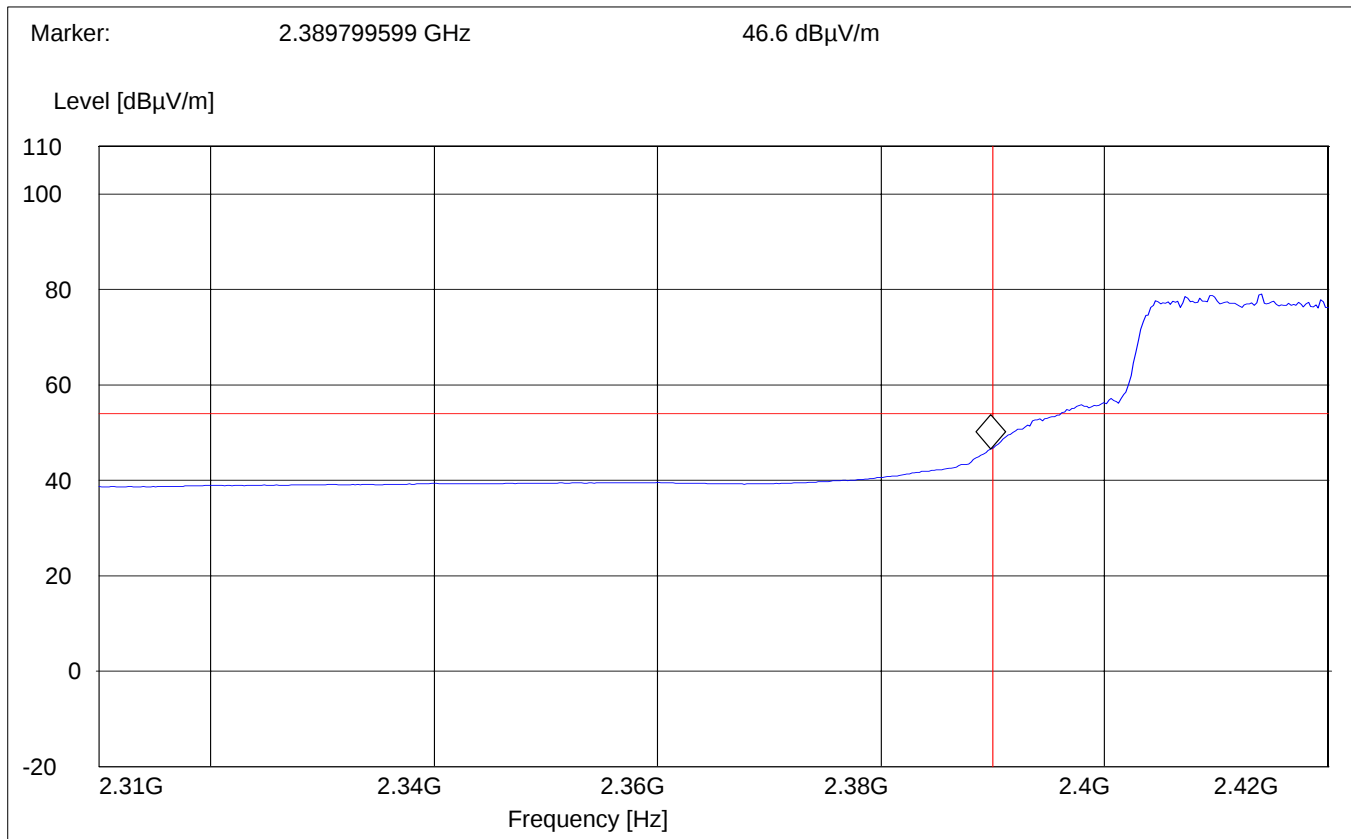
Low frequency section (spurious in the restricted band 2310 – 2390 MHz)

(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 (c)

(Data rate – 54Mbps g-mode)

Hitachi FPC antenna

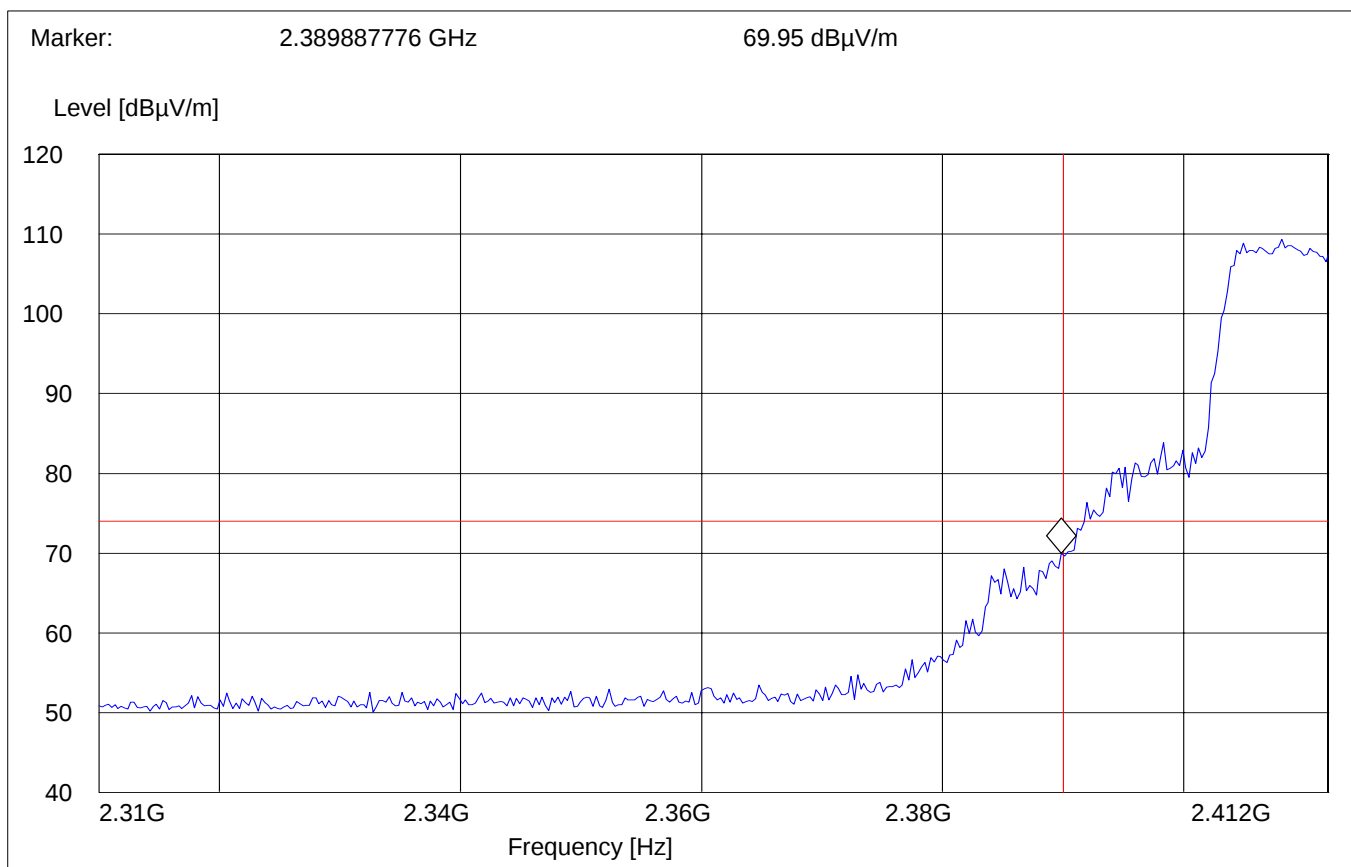
Low frequency section (spurious in the restricted band 2310 – 2390 MHz)

(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 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)

(Data rate – 6Mbps g-mode)

Hitachi FPC antenna

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

(Average measurement)

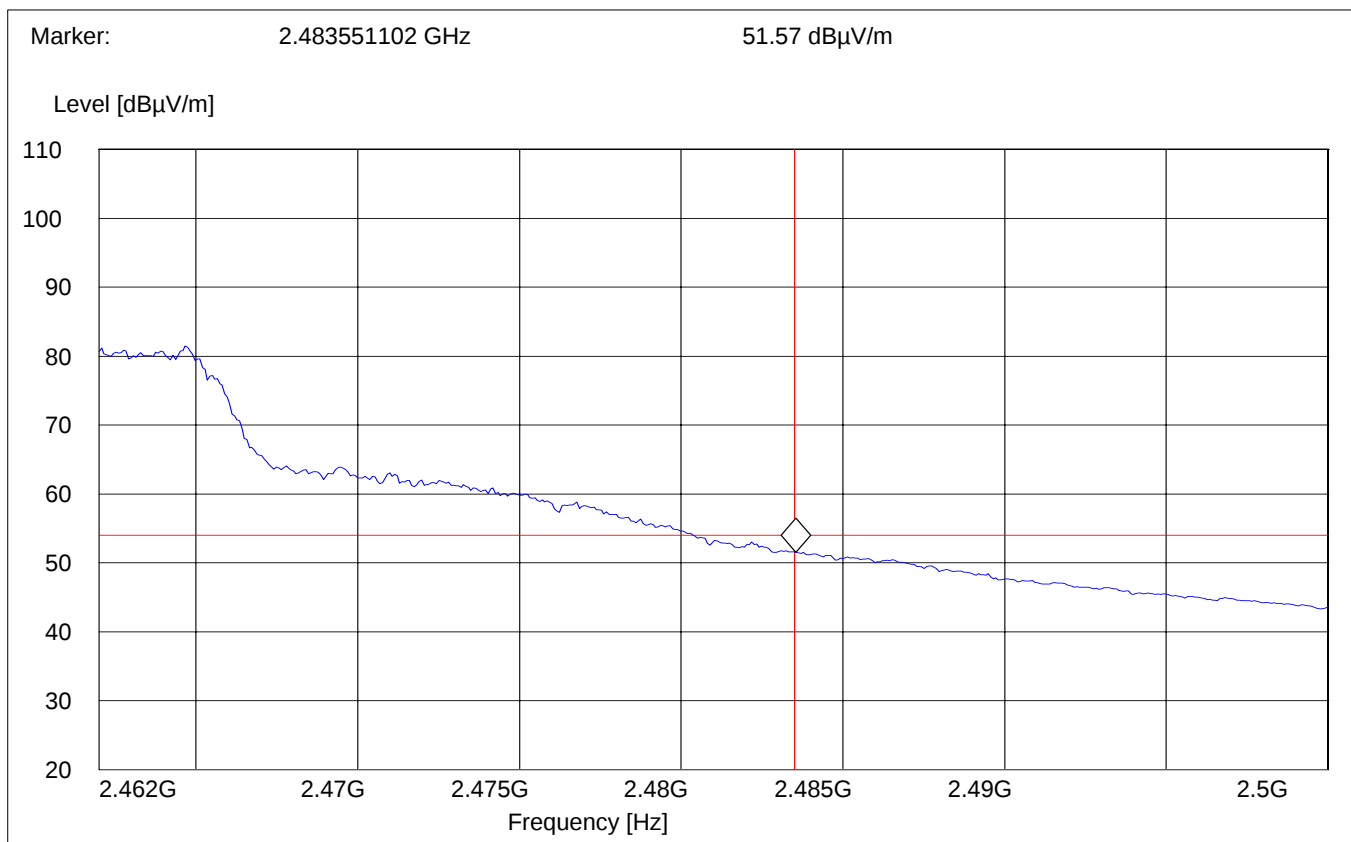
(Pwr tuned 0.5dB higher)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

Operating condition : Tx at 2457MHz
 SWEEP TABLE : "FCC15.247 HBE_AVG"
 Limit Line : 54dB μ V

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)

(Data rate – 54Mbps g-mode)

Hitachi FPC antenna

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

(Peak measurement)

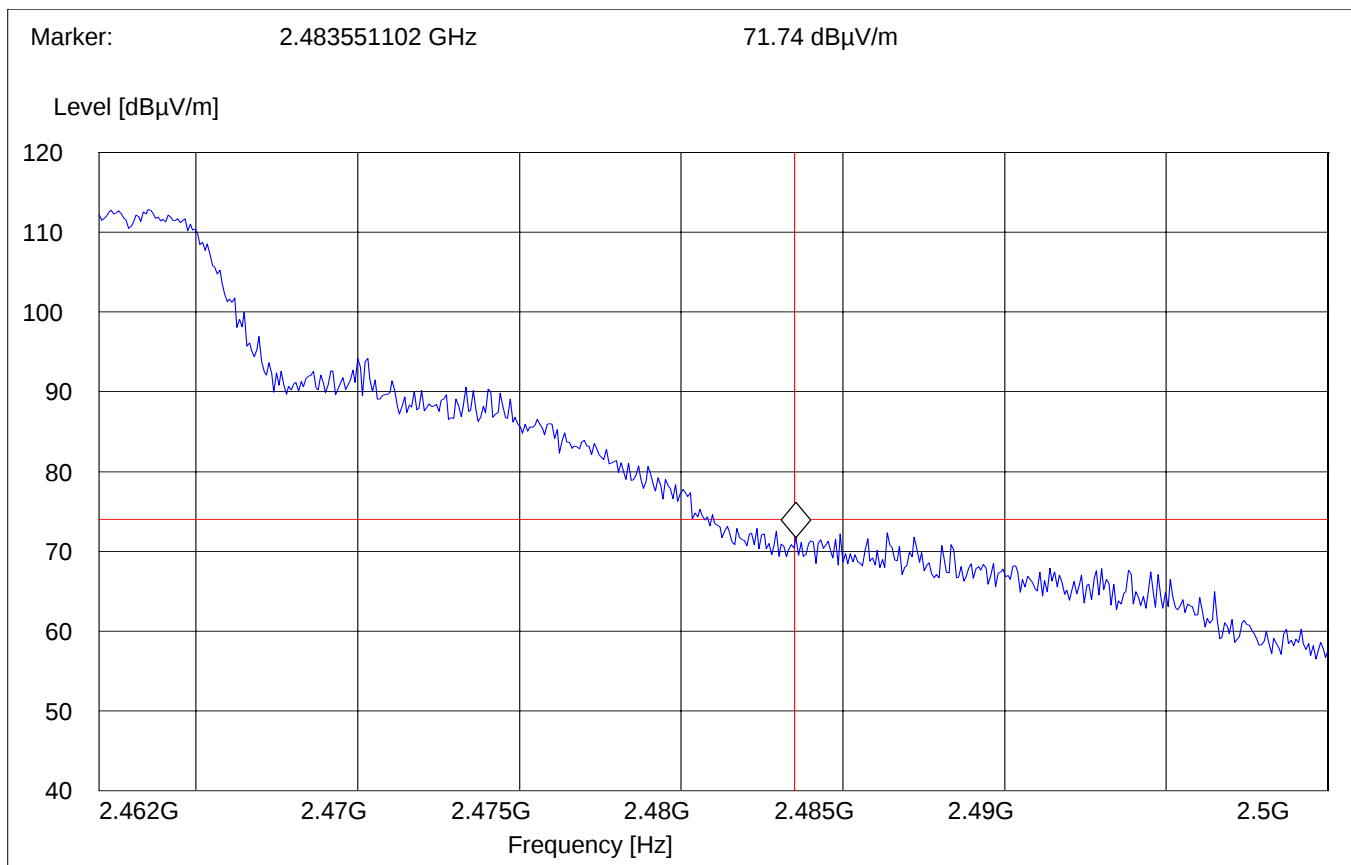
(pwr in packet tuned to higher than (very high) for this particular plot)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

Operating condition : Tx at 2457MHz
 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)



BAND EDGE COMPLIANCE

§15.247 (c)

(Data rate – 6Mbps g-mode)

Hitachi FPC antenna

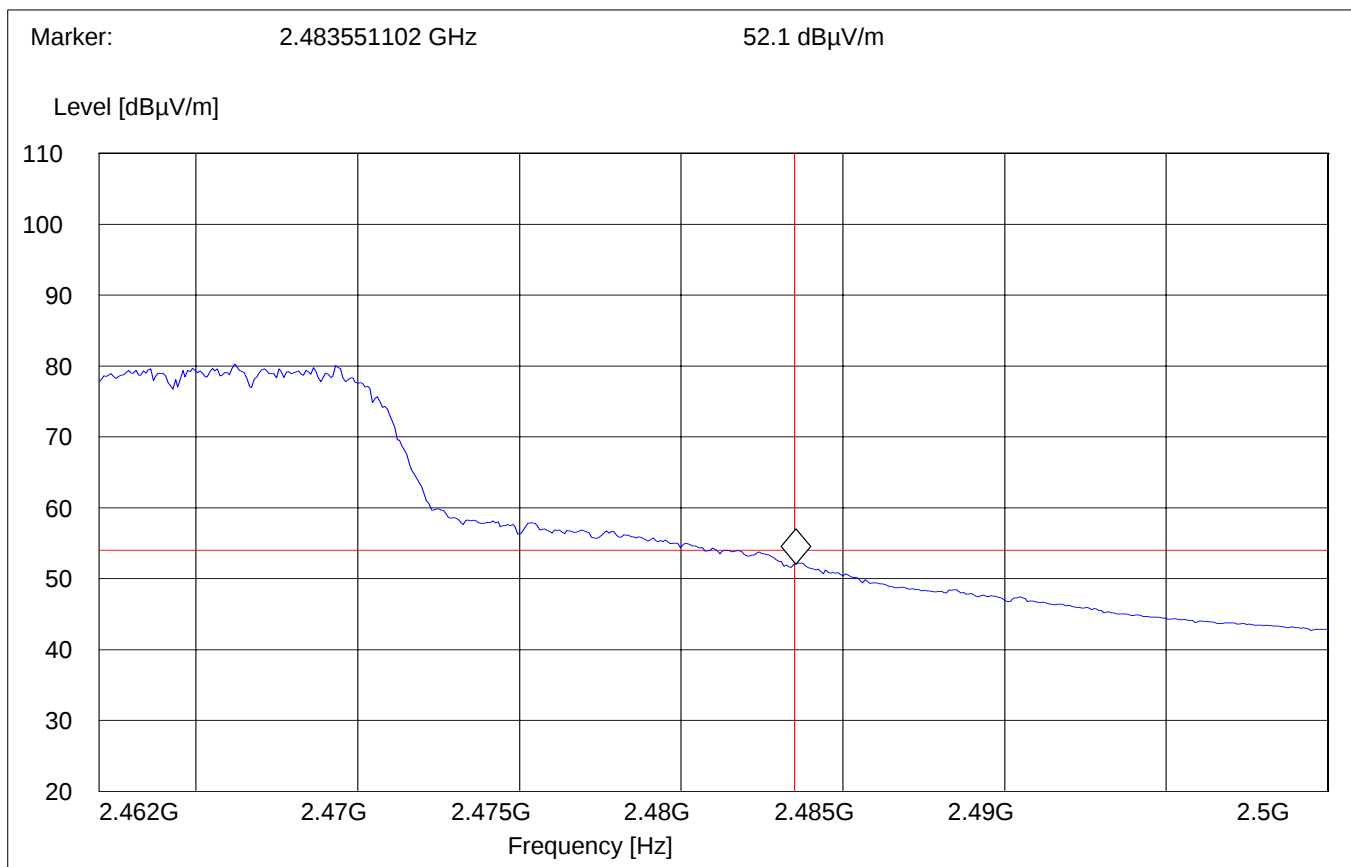
High frequency section (spurious in the restricted band 2483.5 – 2500MHz)

(Average measurement)

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

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)

(Data rate – 54Mbps g-mode)

Hitachi FPC antenna

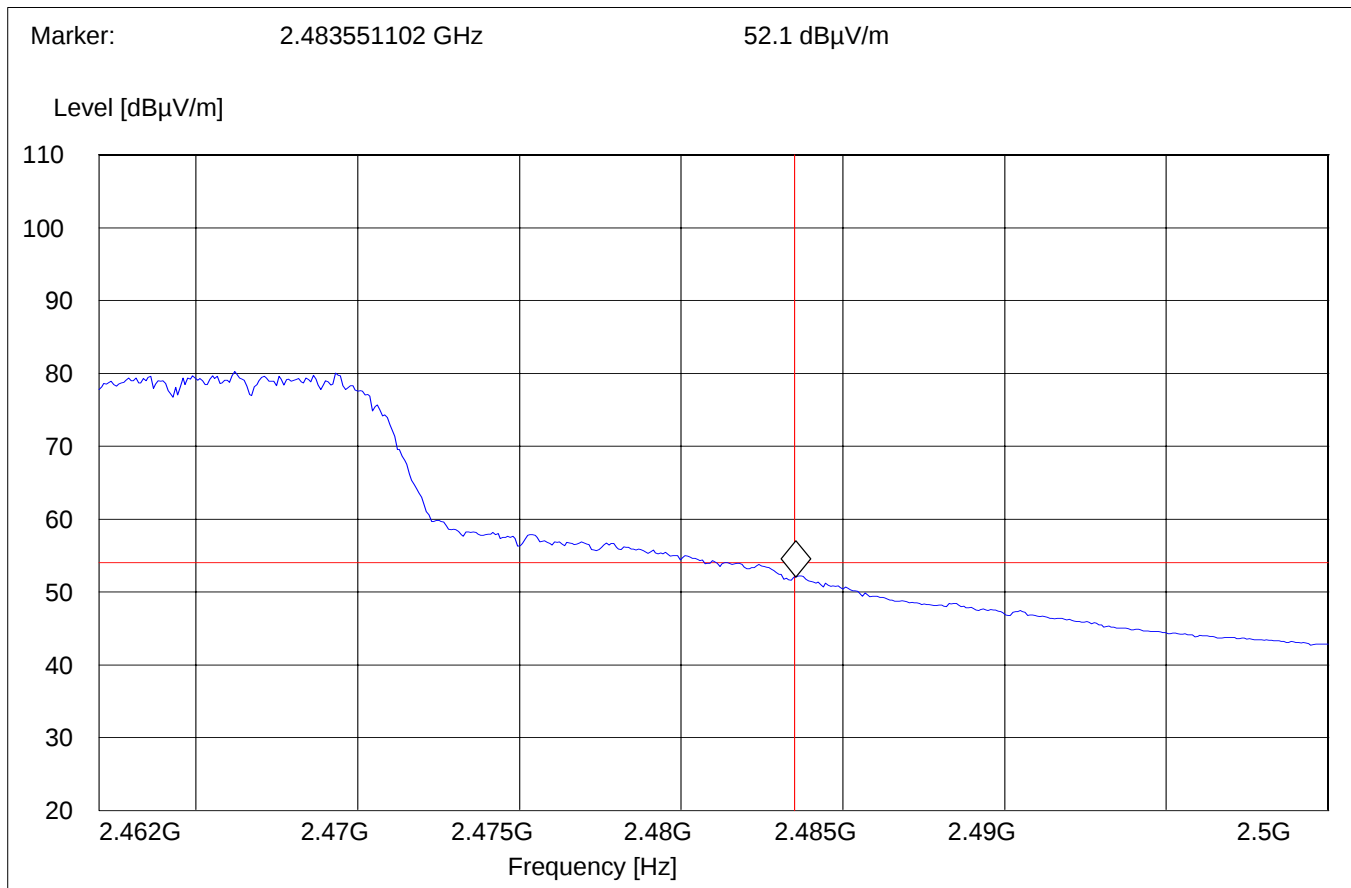
High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)

(Peak measurement)

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

Operating condition : Tx at 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)



BAND EDGE COMPLIANCE

§15.247 (c)

(Data rate – 6Mbps g-mode)

Hitachi FPC antenna

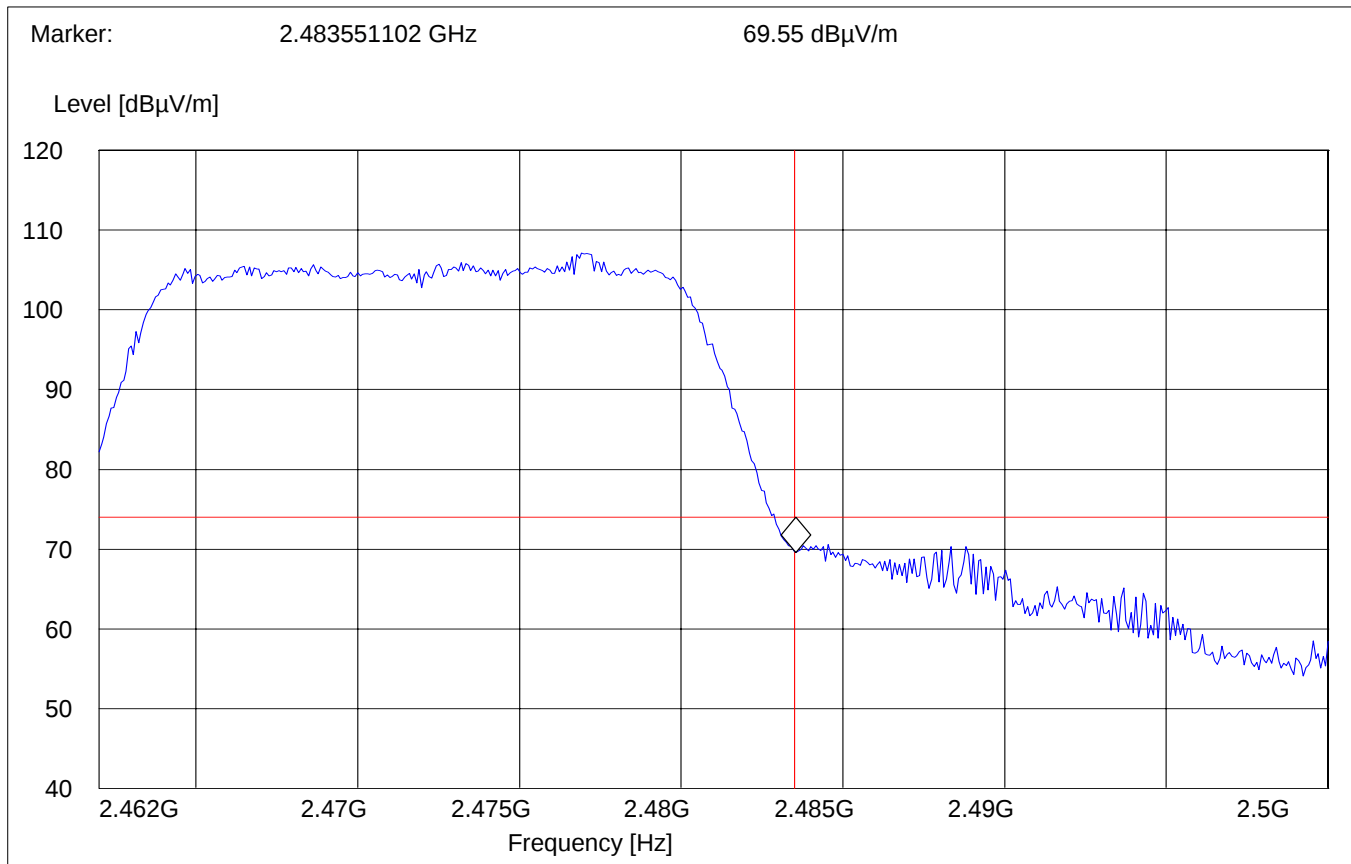
High frequency section (spurious in the restricted band 2483.5 – 2500MHz)

(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 (c)

(Data rate – 54Mbps)

Hitachi FPC antenna

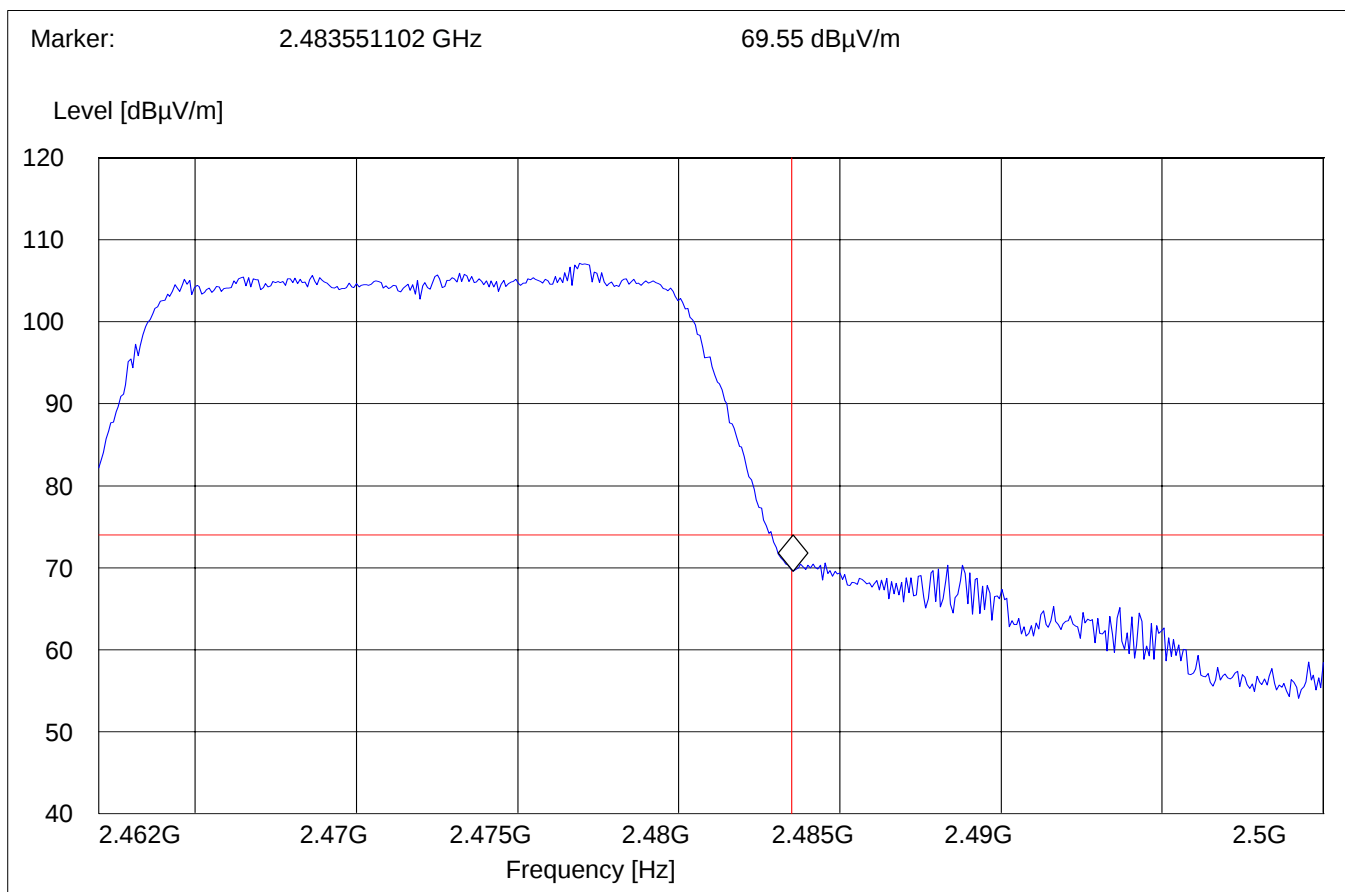
High frequency section (spurious in the restricted band 2483.5 – 2500 MHz)

(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 - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-1 (2412MHz): 1GHz – 3GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

Antenna: Horizontal

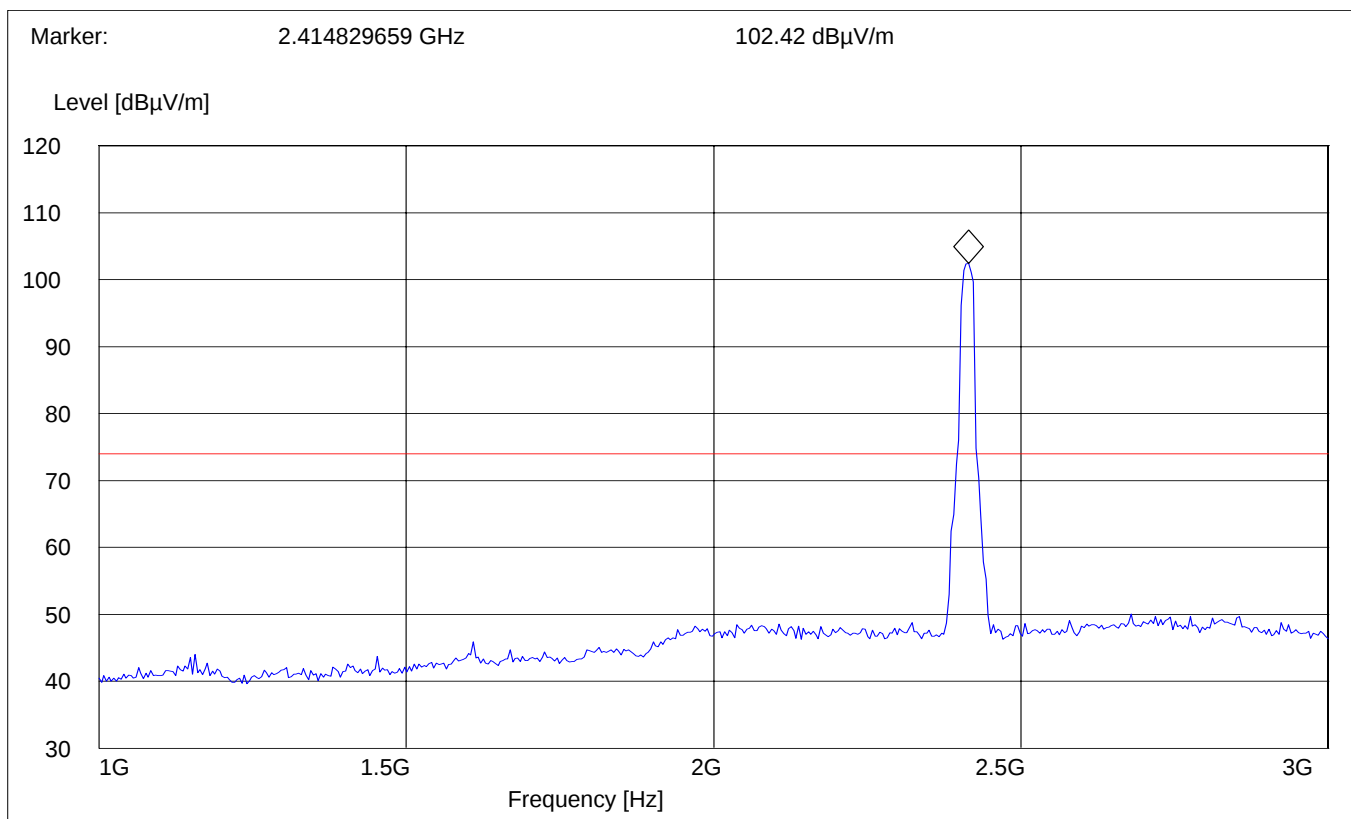
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

"WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-1 (2412MHz): 3GHz – 18GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

(Average measurement)

Antenna:

Horizontal

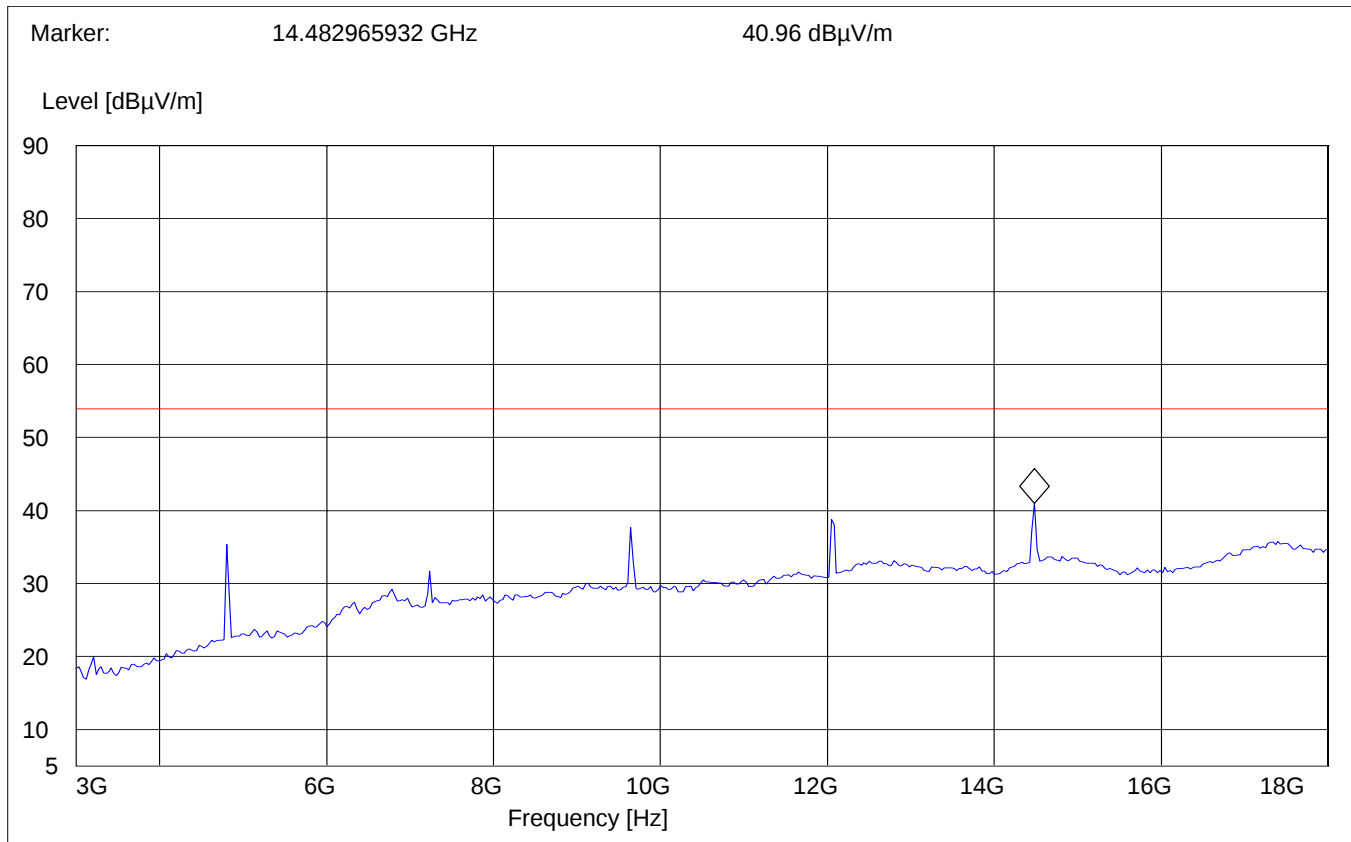
EUT plane:

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 (c) (1)

Channel-6 (2437MHz): 1GHz – 3GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

Antenna: Horizontal

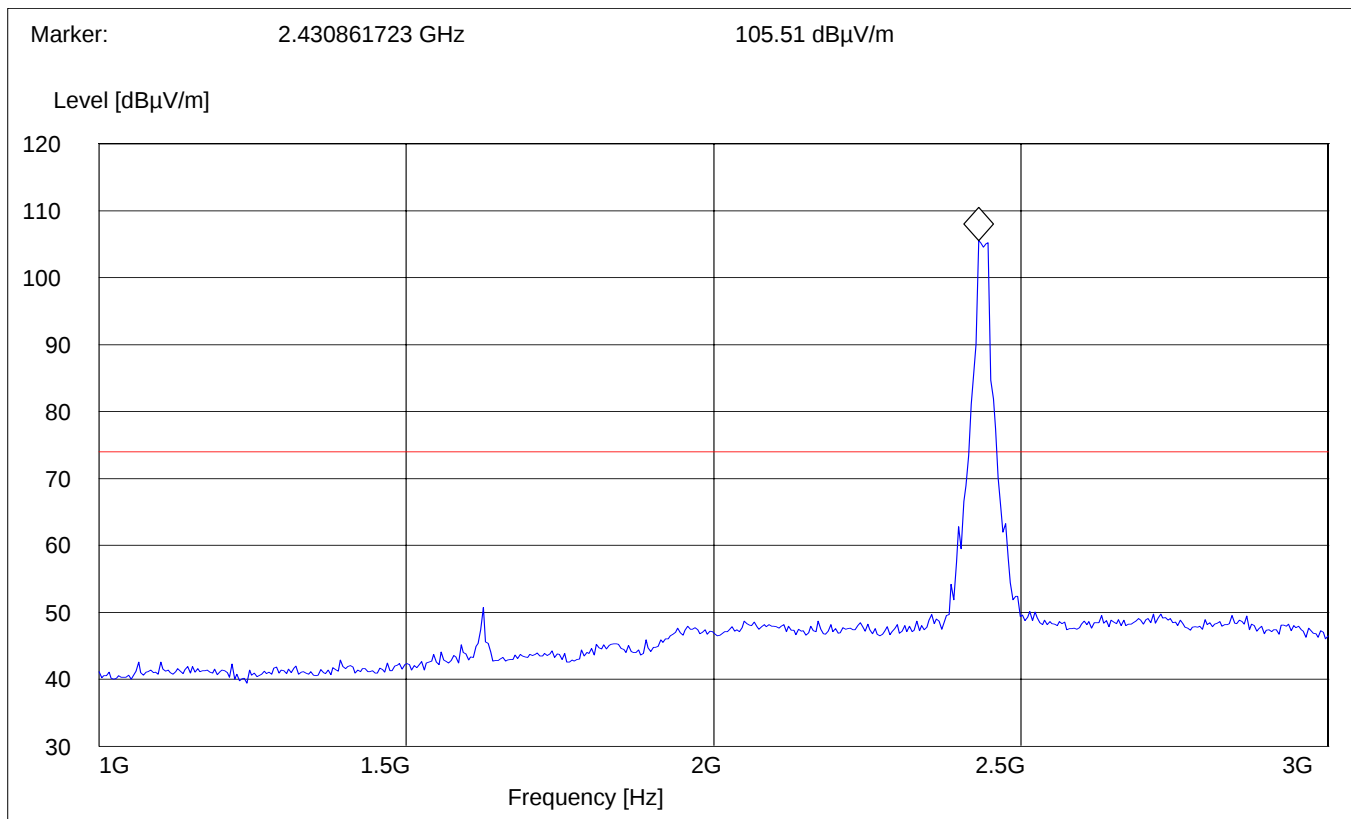
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-6 (2437MHz): 3GHz – 18GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

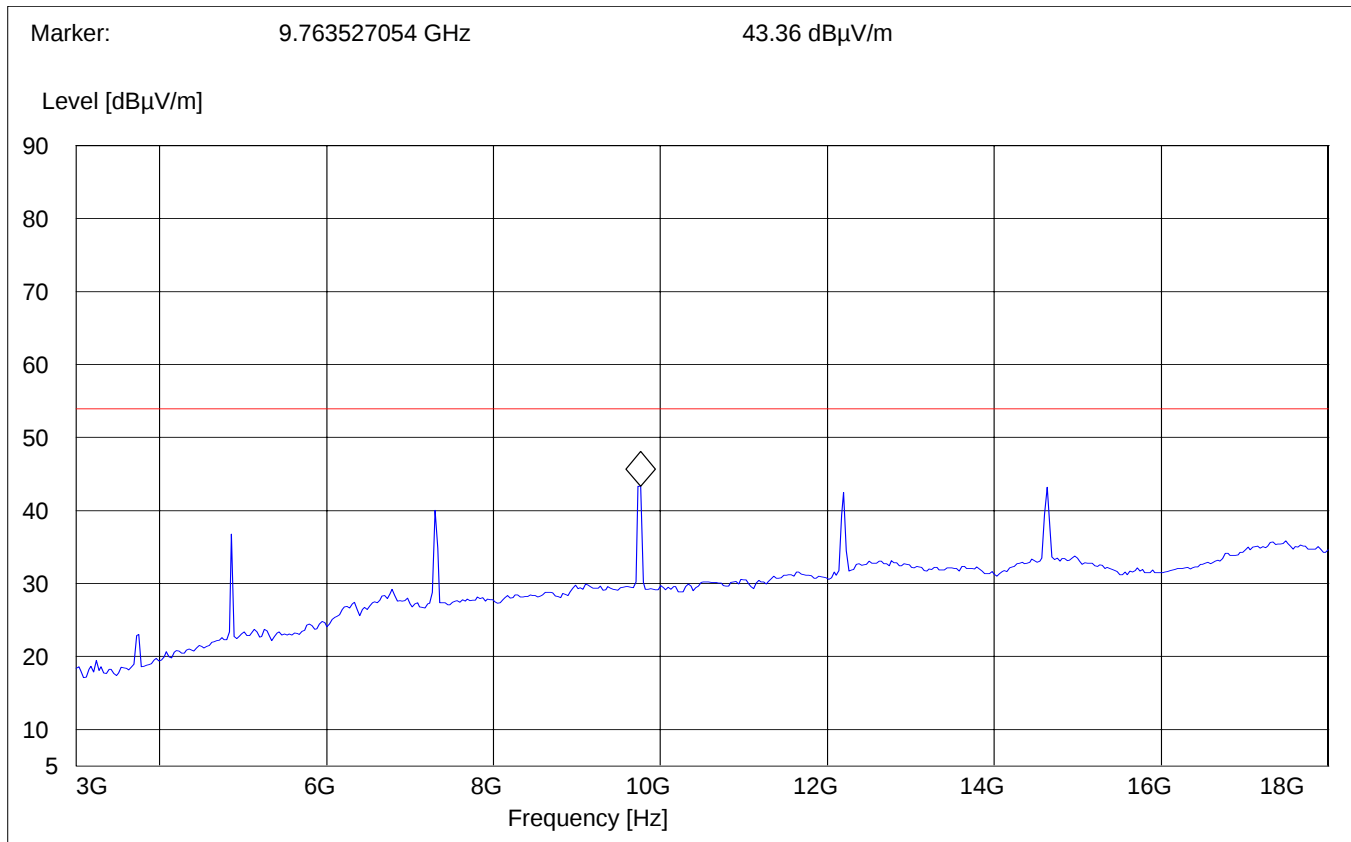
EUT plane:

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 (c) (1)

Channel-10 (2457MHz): 1GHz – 3GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

Antenna: Horizontal

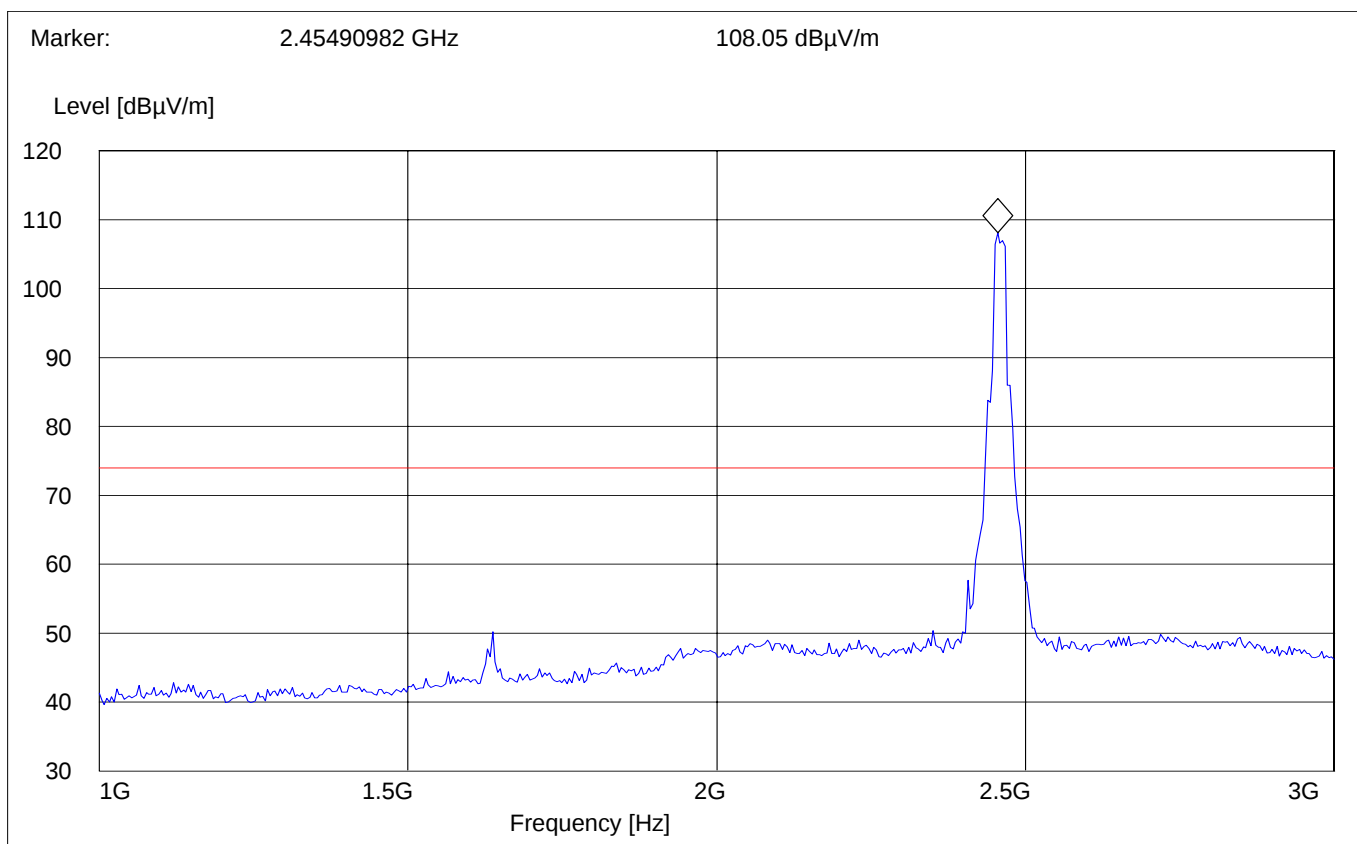
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-10 (2457MHz): 3GHz – 18GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

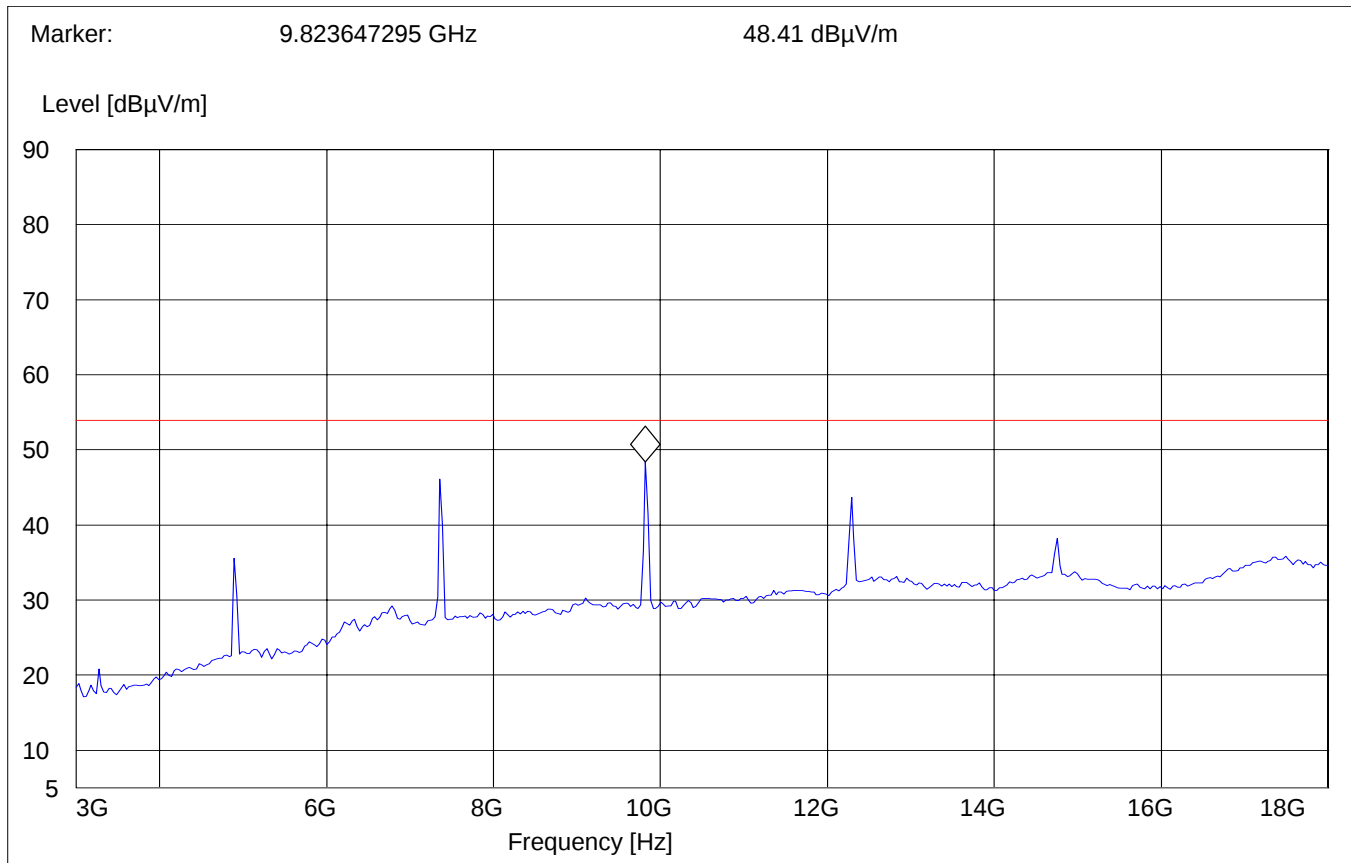
EUT plane:

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 (c) (1)

Channel-11 (2462MHz): 1GHz – 3GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

Antenna: Horizontal

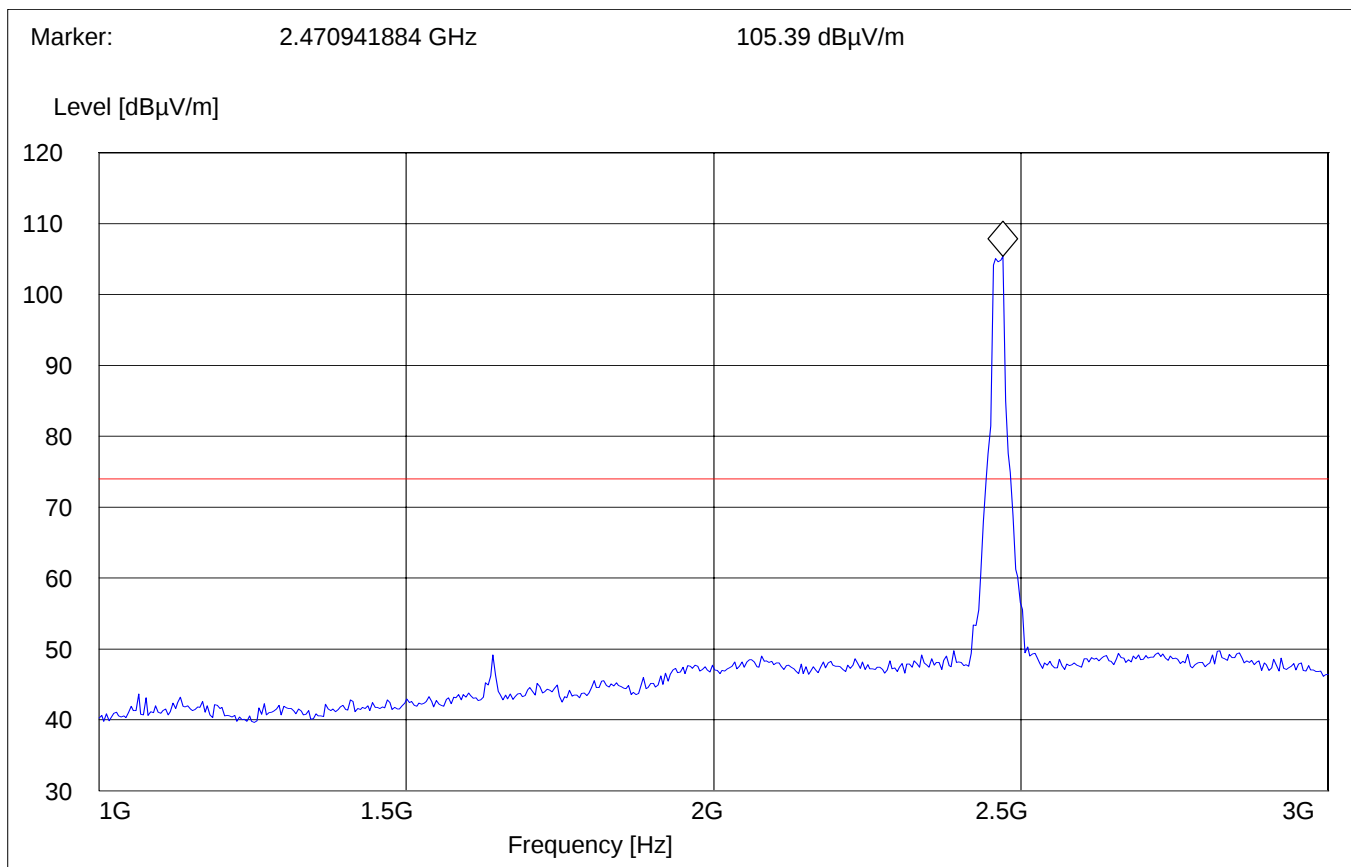
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-11 (2462MHz): 3GHz – 18GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

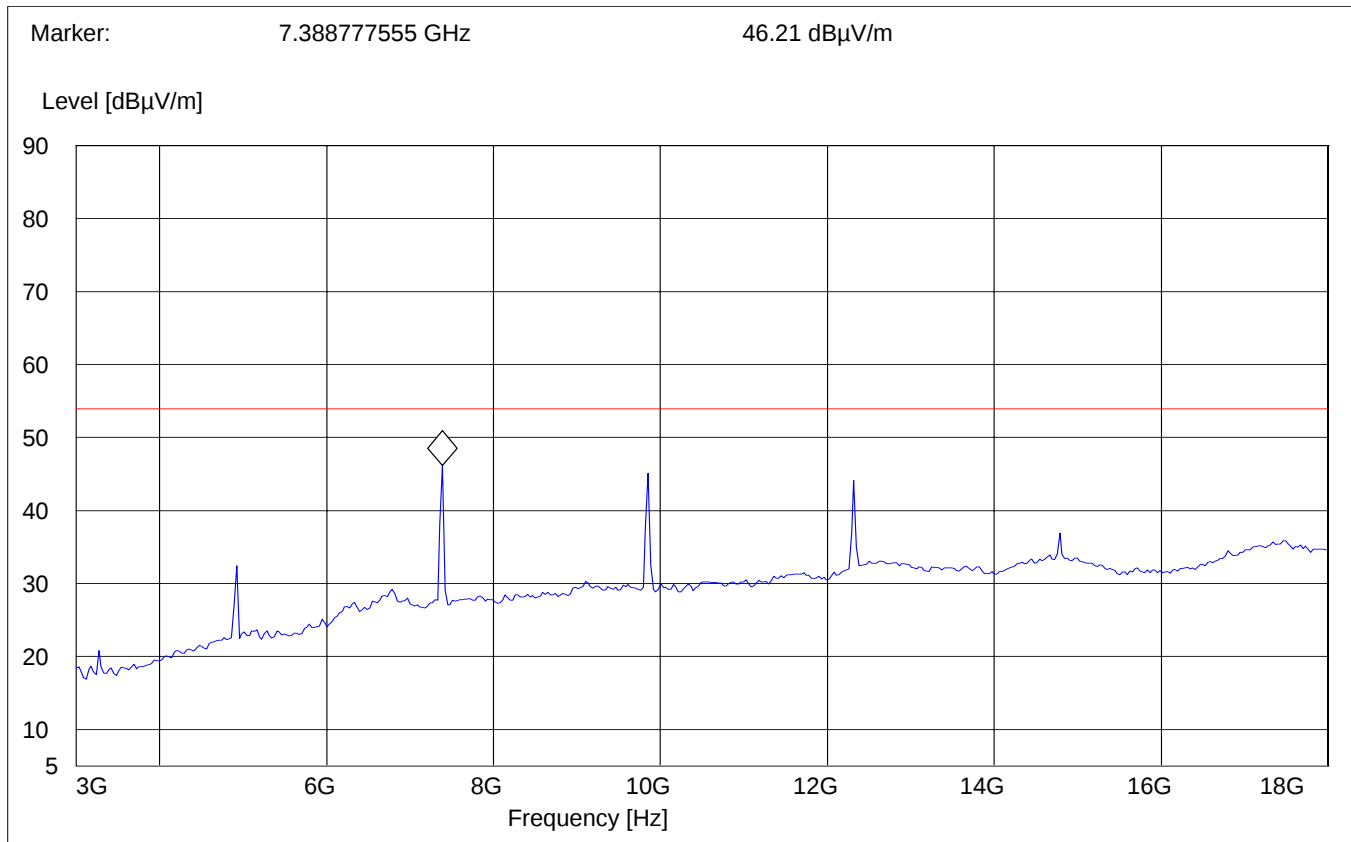
EUT plane:

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 (c) (1)

Channel-13 (2472MHz): 1GHz – 3GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

Antenna: Horizontal

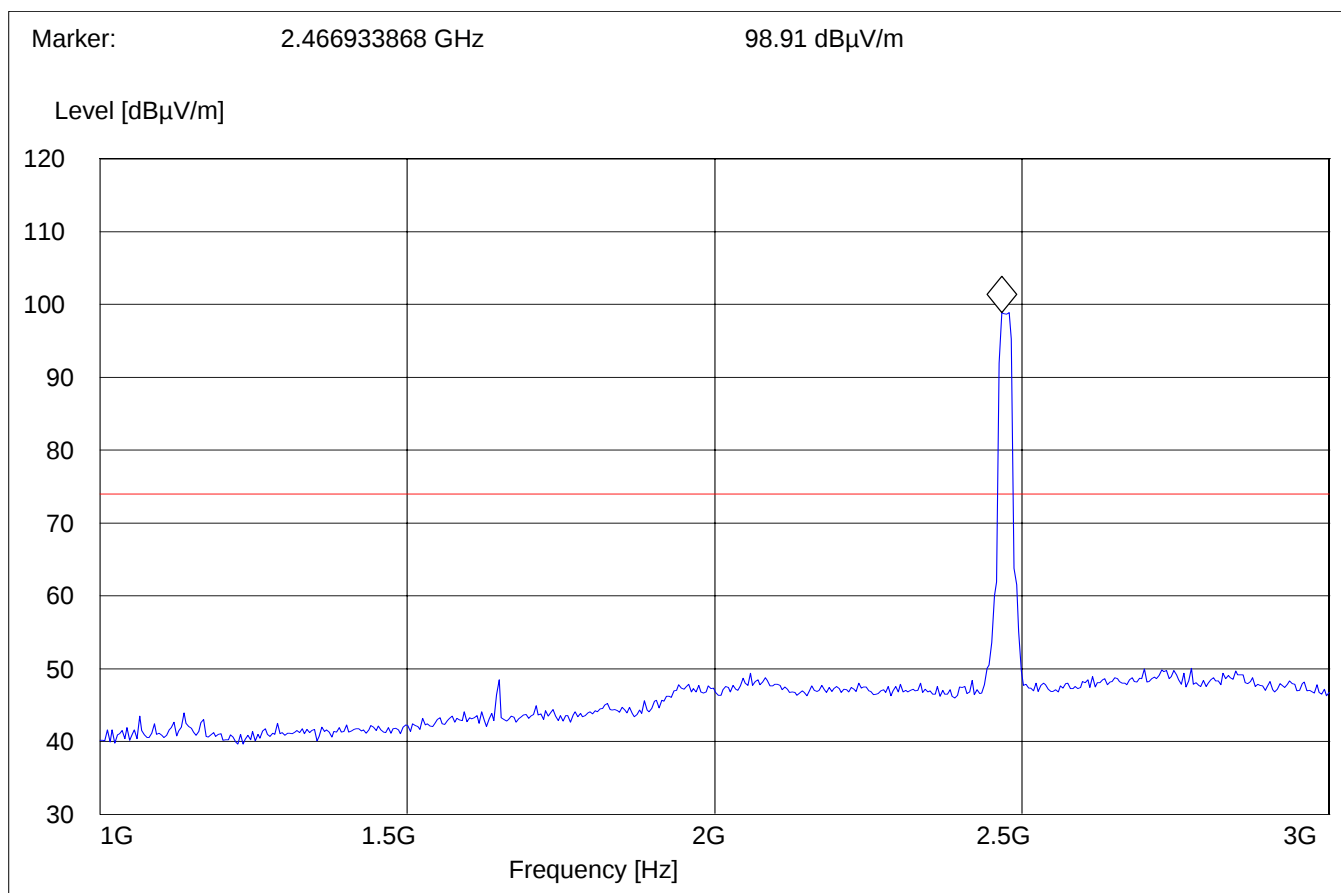
EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:

" WLAN Spuri hi 1-3G"

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



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

Channel-13 (2472MHz): 3GHz – 18GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

(Average Measurement)

Antenna:

Horizontal

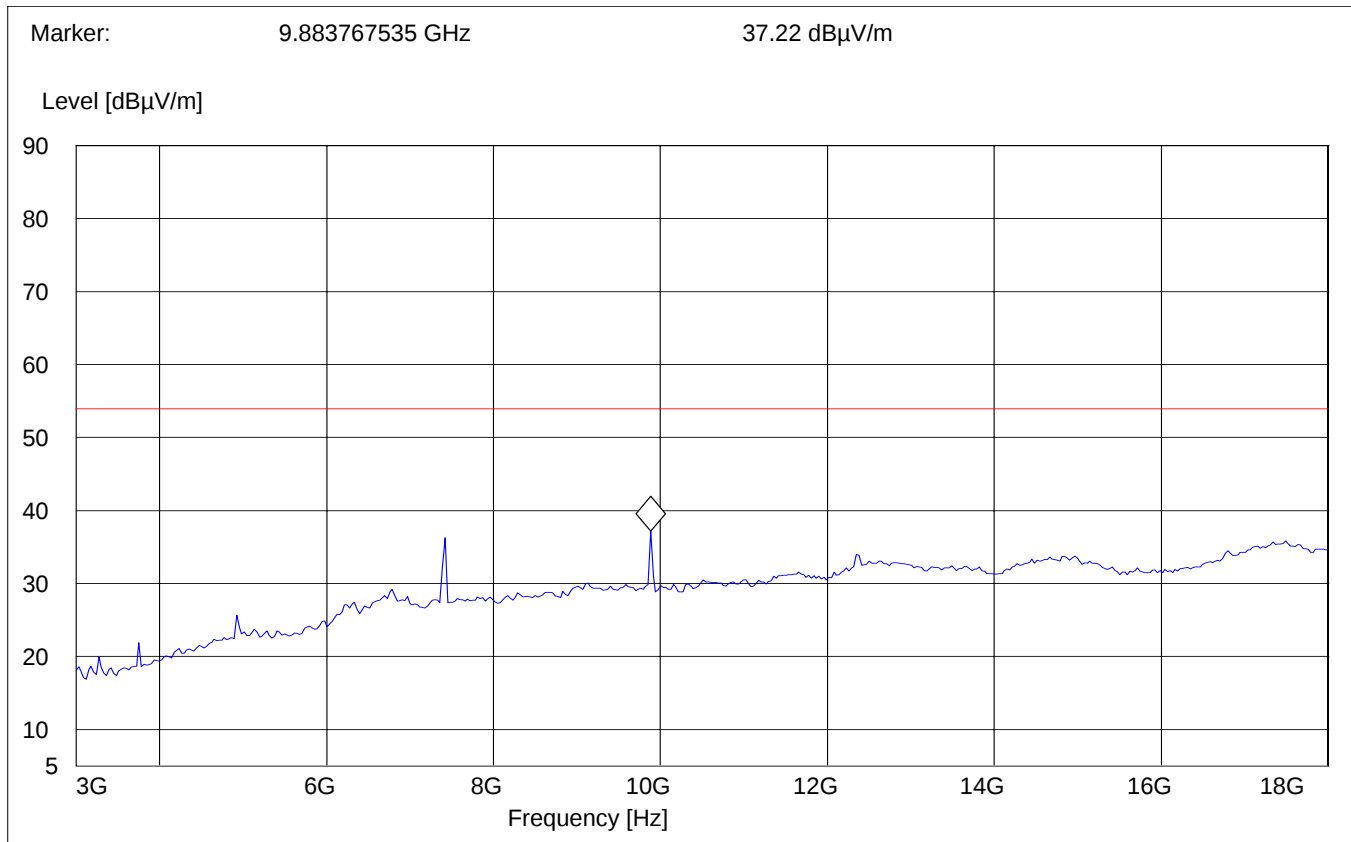
EUT plane:

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 (c) (1)

18GHz – 25GHz

Hitachi FPC antenna

(Data rate – 54Mbps)

Antenna: Horizontal

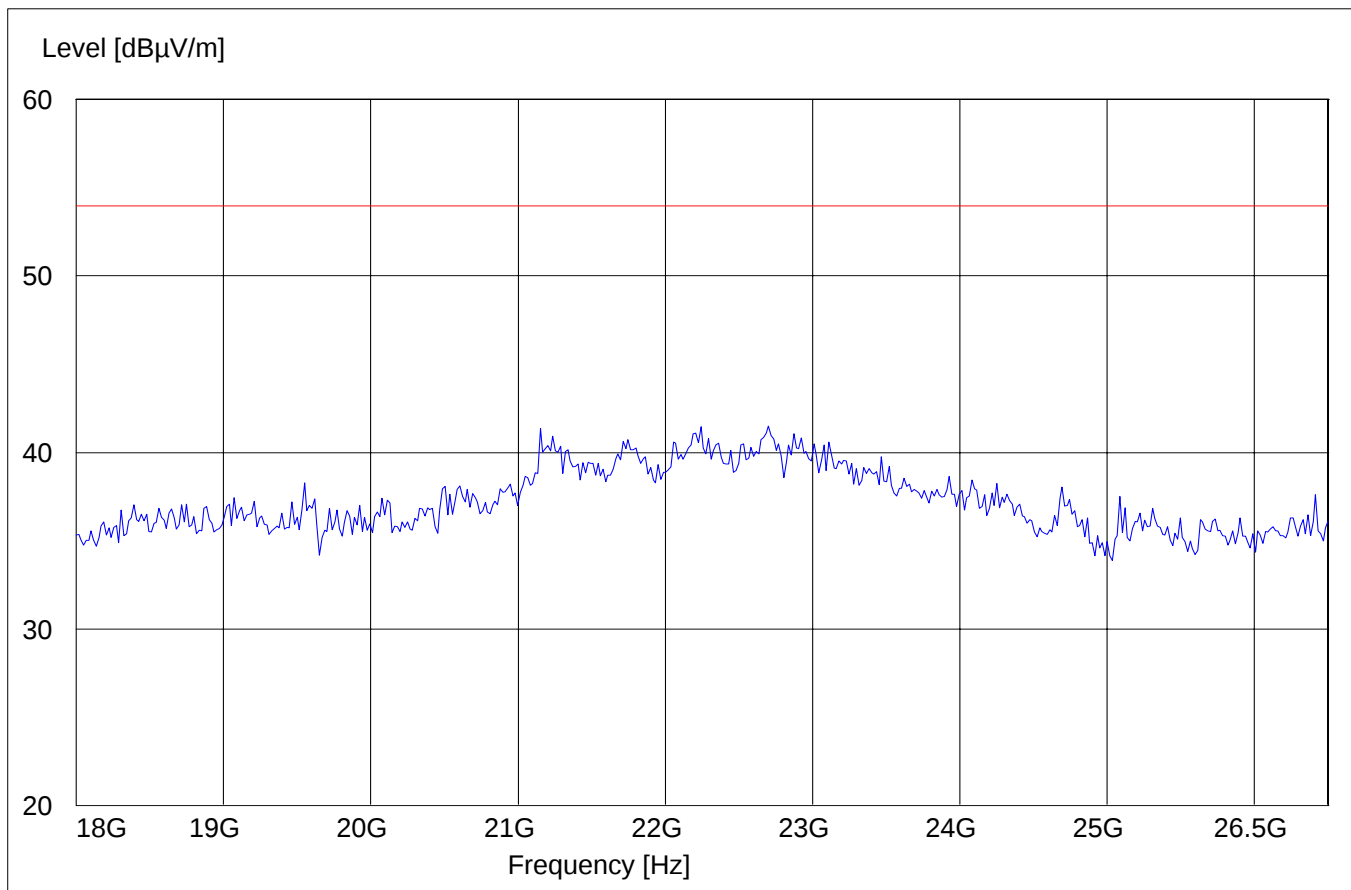
EUT plane: Horizontal with screen vertical @ 90°

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)

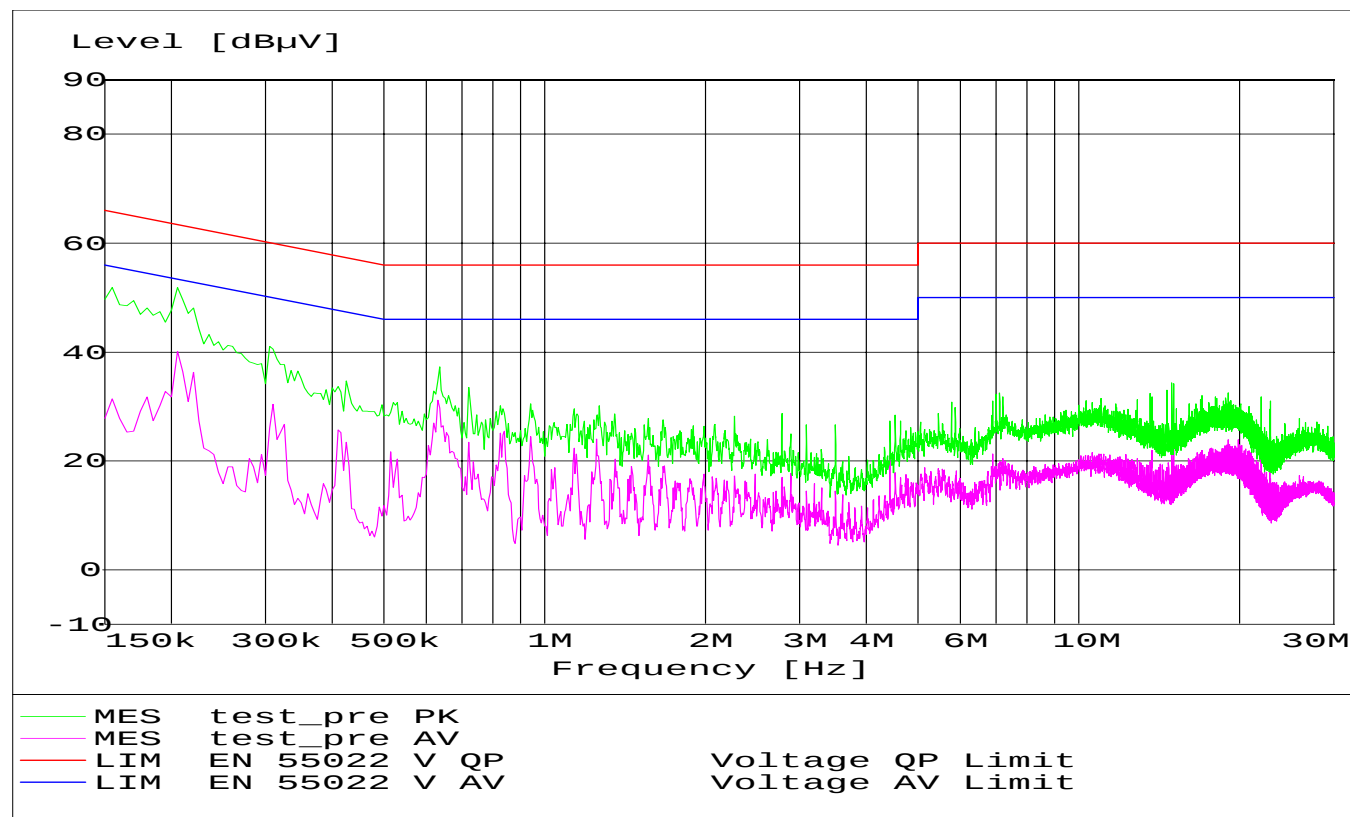
Limit

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



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

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Data rate – 54Mbps)

Antenna: vertical

EUT plane: Horizontal with screen vertical @ 90°

Note:

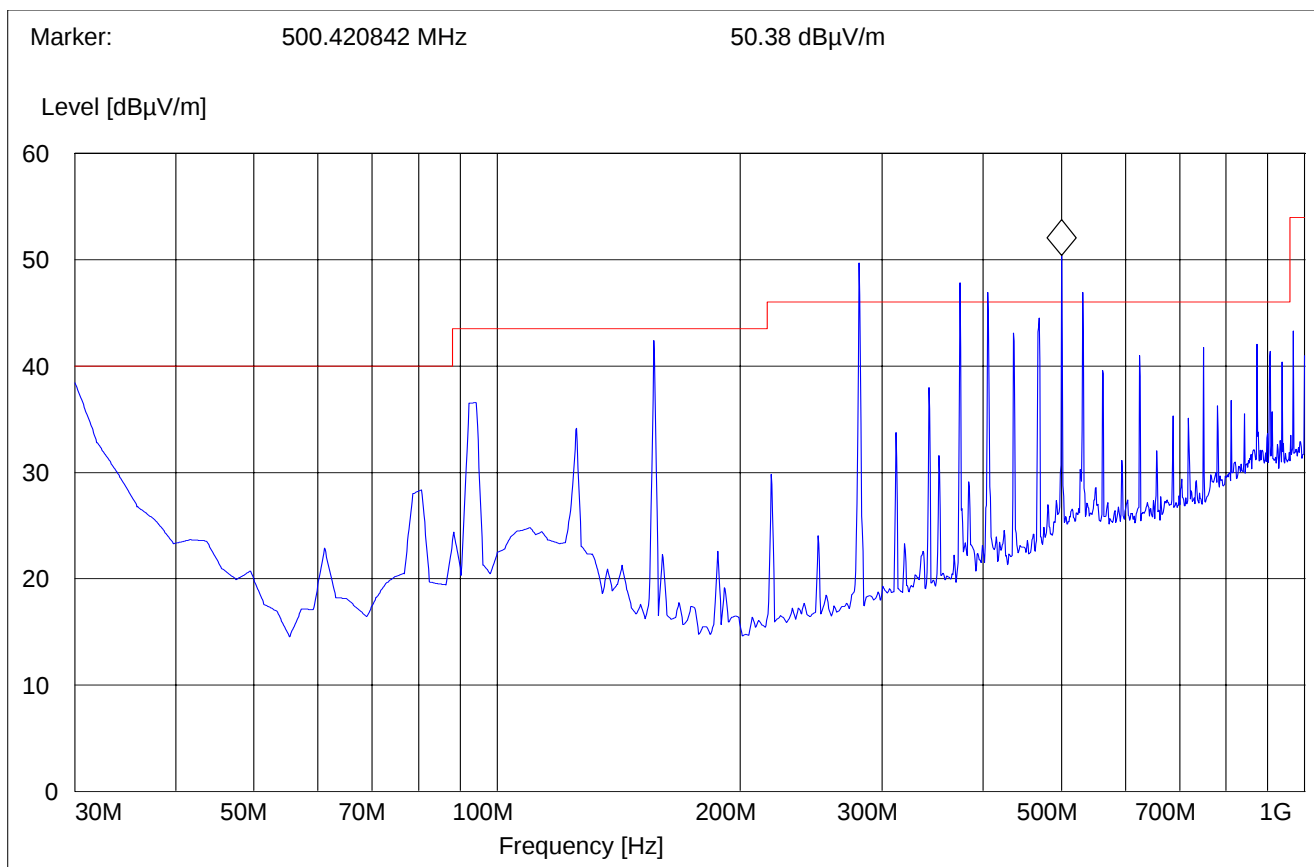
3. This plot is valid for low, mid, high channels (worst-case plot valid for all antennas)
4. All significant peaks were confirmed originating from test fixture, see plot on page 35 with test fixture tested alone with no WLAN card

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

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

Freq. **Pk(dBm)** **QPk(dBm)**

280.761MHz	49.69	46.69
374.068MHz	47.83	41.83
405.17MHz	46.90	41.90
500.4208MHz	50.38	40.90
531.523MHz	46.90	40.90



RECEIVER SPURIOUS RADIATION

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1GHz – 3GHz

Peak Measurement

worst-case plot valid for all antennas

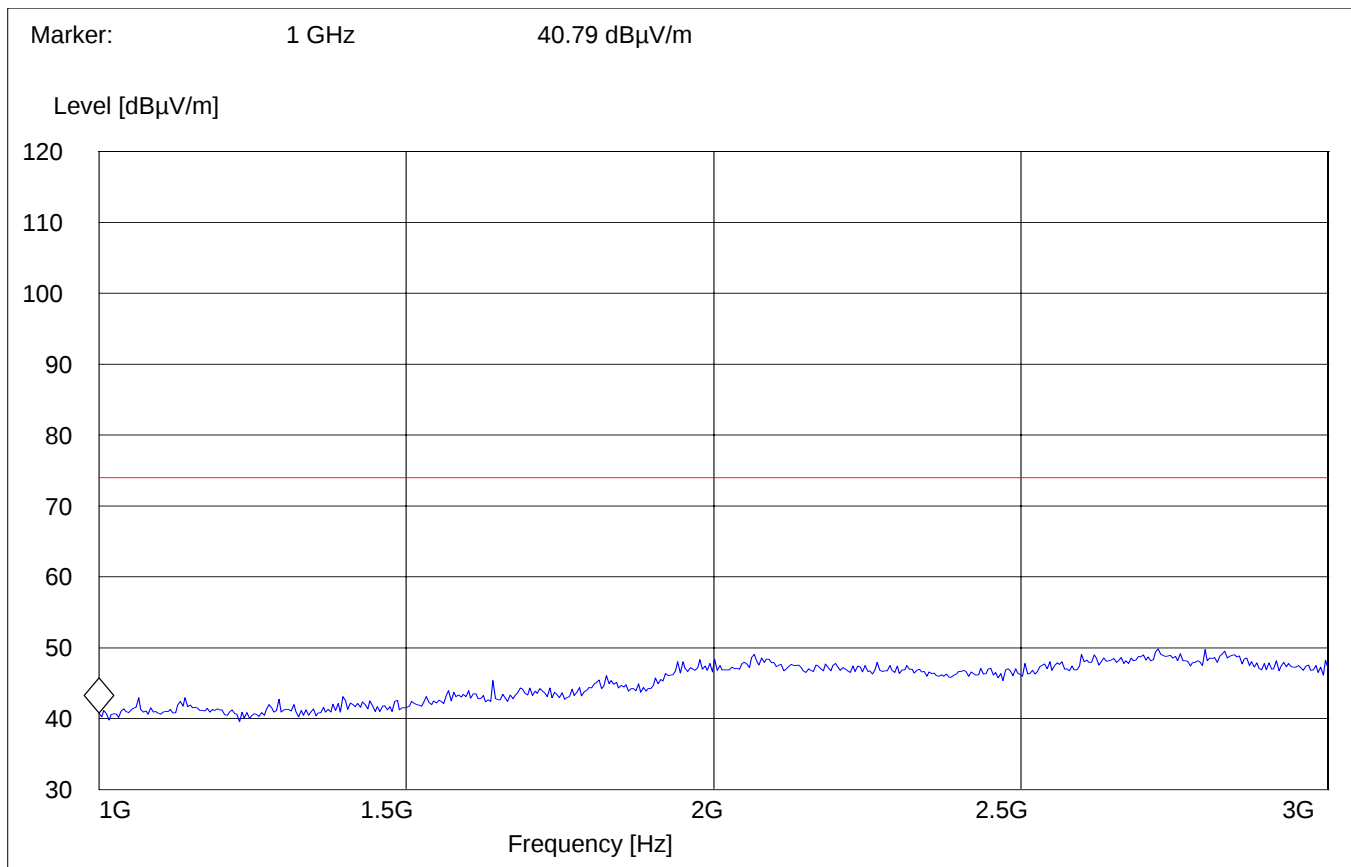
Antenna: Horizontal

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)



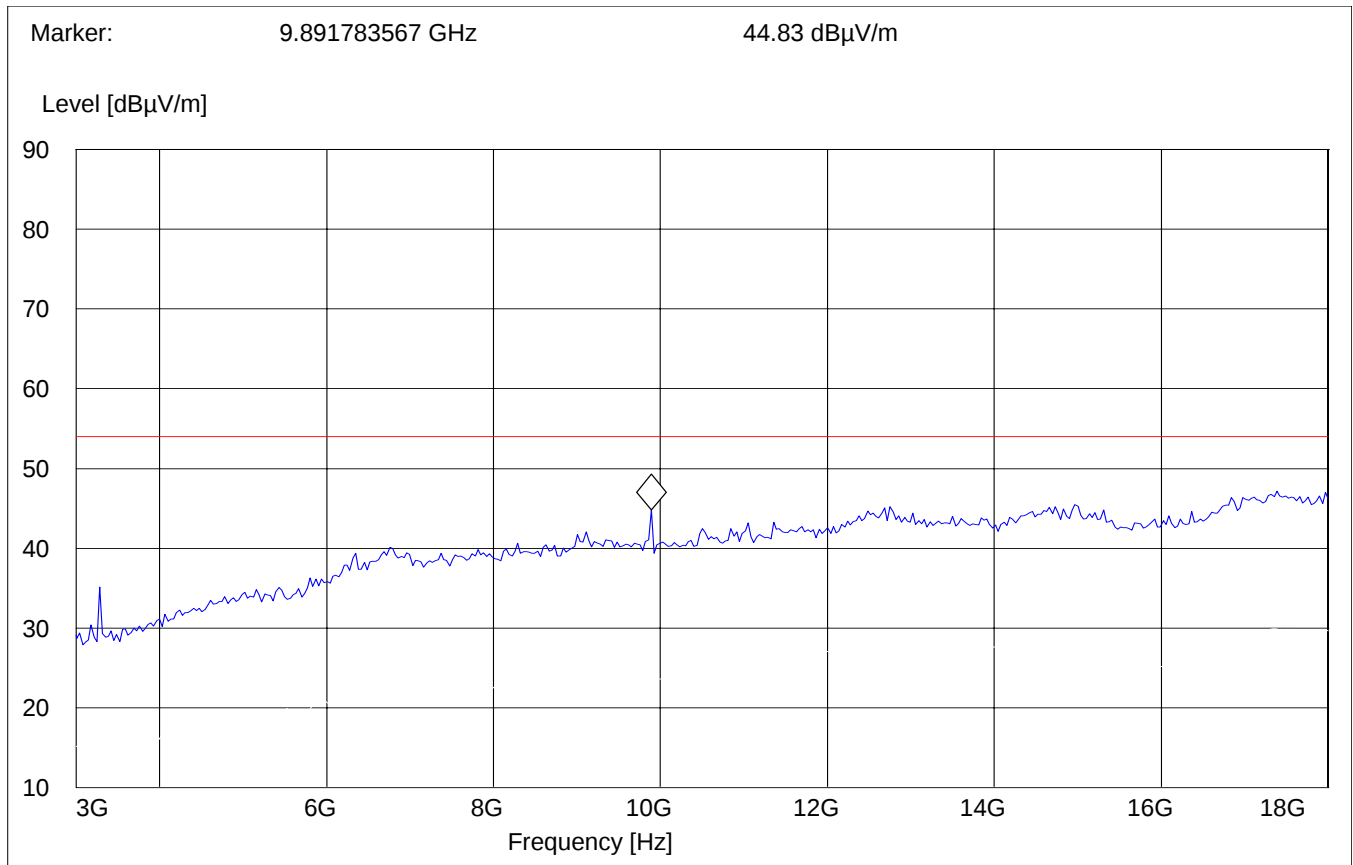
RECEIVER SPURIOUS RADIATION 3GHz – 18GHz

§ 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)



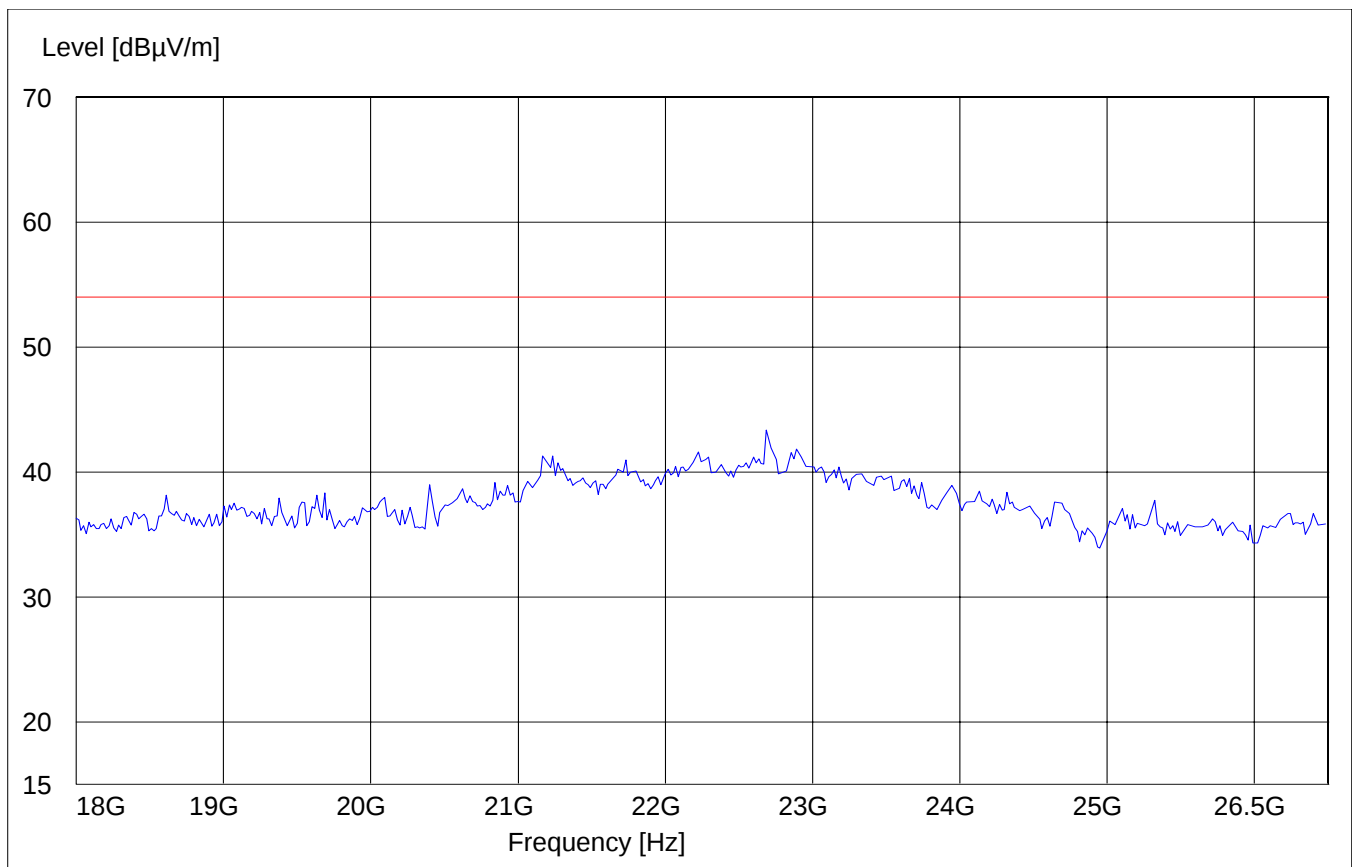
RECEIVER SPURIOUS RADIATION 18GHz – 26.5GHz

§ 15.209

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

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

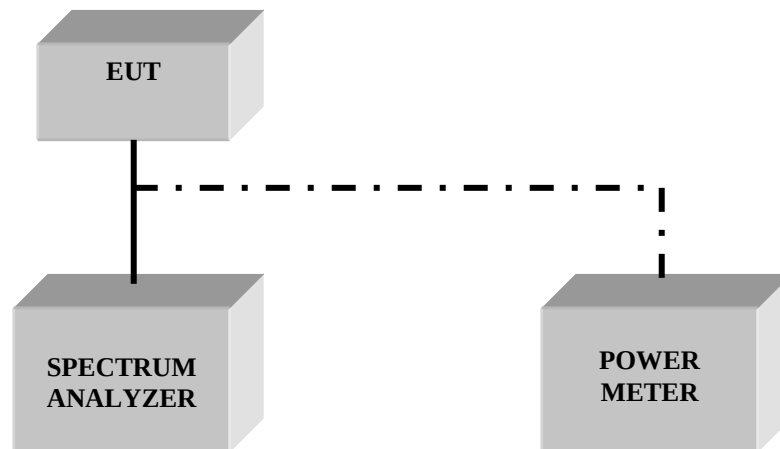
Start	Stop	Detector	Meas.	RBW	Transducer
Frequency	Frequency	Time	Bandw.	VBW	
18 GHz	26.5 GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



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

