FCC Test Report

Test report no.: EMC_799FCC15.247_2004_C2P_2

FCC Part 15.247 for DSSS systems / CANADA RSS-210

EUT: WLAN Model: BCM94318MPG
Modular Approval
FCC ID: QDS-BRCM1016
IC ID: 4324A-BRCM1016

Deutscher Akkreditierungs Rat DAR

TTI-P-G 081/94-A0

Accredited according to **ISO/IEC 17025**

Bluetooth

Bluetooth Qualification Test Facility (BQTF)

CTIA Authorized Test Lab
LAB CODE 20020328-00

FCC listed # 101450

IC recognized # 3925

***CETECOM* Inc.**

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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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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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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	**:**	**Daniel Lawless**
Telephone	**:**	**408-922-5870**
Tele-fax	**:**	**408-543-3399**
e-mail	**:**	**dlawless@broadcom.com**

1.4 Application details

Date of receipt test item	:	2005-03-17
Date of test	:	2005-03-17/28/29

1.5 Test item

Manufacturer	:	Applicant
Model No.	:	BCM94318MPG
Host	:	Test fixture
Description	:	Broadcom 802.11g mini PCI card
FCC ID	**:**	**QDS-BRCM1016**
IC ID	**:**	**4324A-BRCM1016**

Additional information

Frequency	:	2412MHz – 2462MHz
Type of modulation	:	DSSS / OFDM (orthogonal frequency division multiplexing)
Number of channels	:	11
Antenna	:	5dBi max. gain antenna (Netgear MR814 Omni-directional Dipole antenna)
Power supply	:	3.3 VDC from Host
Output power	:	28.95dBm (785.24mW) conducted peak power
Extreme temp. Tolerance	:	0^{o}C to +70^{o}C

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

PROJECT OVERVIEW:

This test report carries all radiated measurements required as per FCC 15.247 for doing a class-2 permissive change on WLAN mini PCI card model# BCM94318MPG tested in test fixture as per DA001407 requirements for modular transmitter approval. Conducted power was measured and found within limits of C2P change rules.

Following are the changes filed under this application;

Change #1 Adding alternate Skyworks power amp. The associated layout and filter circuitry is the same. The average power in packet is maintained the same, 16.5dBm OFDM and 18dBm CCK.

Change #2 Add additional antenna:
Netgear MR814 Omni-directional Dipole antenna Peak gain 5dBi.

All measurements are done with 5dBi max. gain antenna. 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.

802.11g mode: 16.5dBm
802.11b mode: 18dBm

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
2005-04-06	EMC & Radio	Lothar Schmidt (Manager)	

Responsible for test report and project leader:

Date	Section	Name	
2005-04-06	EMC & Radio	Harpreet Sidhu (EMC Engineer)	

2.2 Test report

TEST REPORT

Test report no.: EMC_799FCC15.247_2004_C2P_2

TEST REPORT REFERENCE

LIST OF MEASUREMENTS **PAGE**

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

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)			
Frequency (MHz)			2412	2437	2462
T_{nom}(23)°C	V_{nom}(3.3) VDC	Pk	28.59	28.95	28.57
Measurement uncertainty		±0.5dBm			

RBW / VBW: 10MHz

***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 2.18, 2.16 & 2.16 is 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:

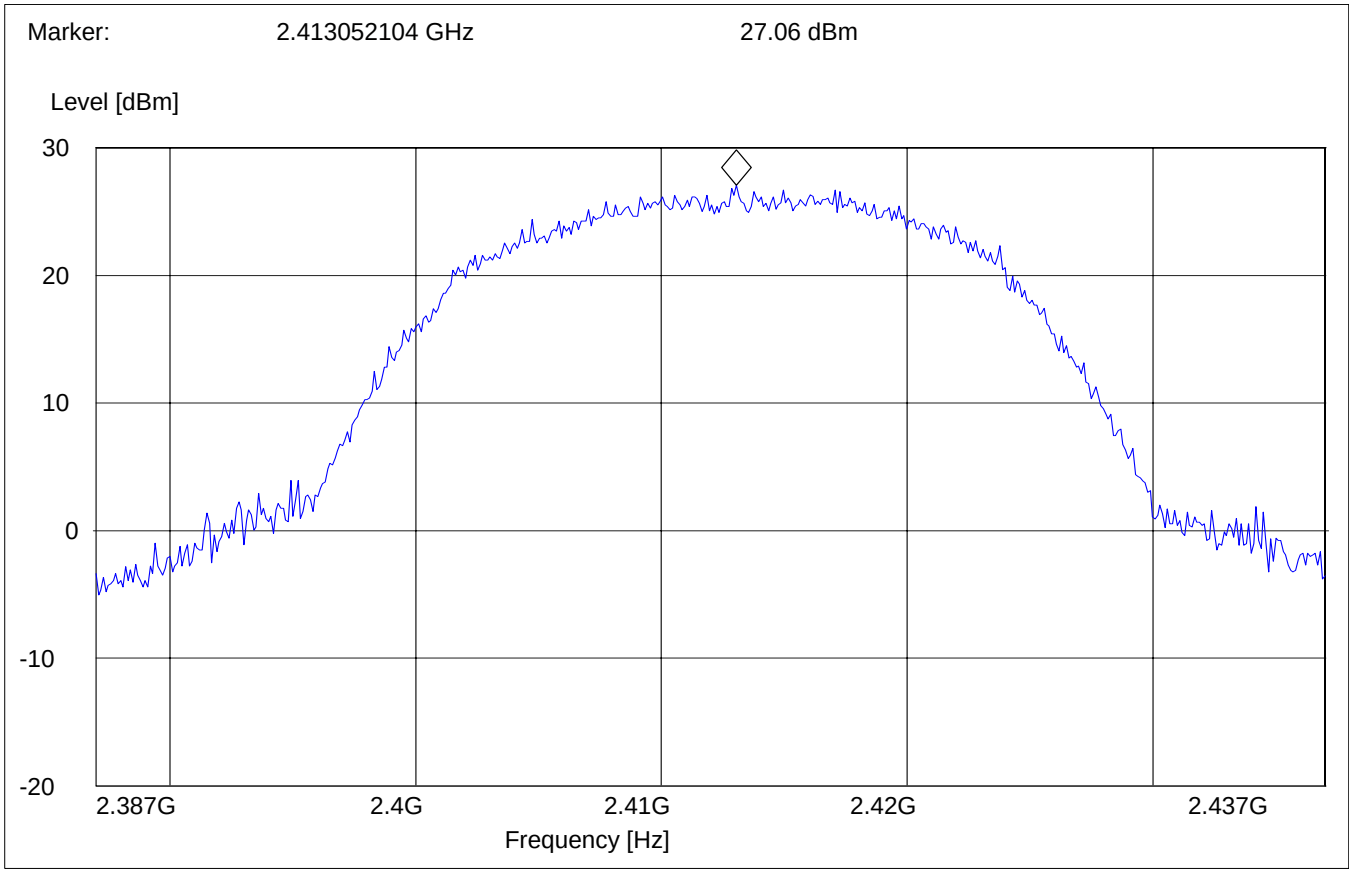
TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
Frequency (MHz)		2412	2437	2462
T_{nom}(23)°C	V_{nom}(3.3) VDC	27.06	27.46	27.85
Measurement uncertainty		±0.5dBm		

RBW / VBW: 10MHz

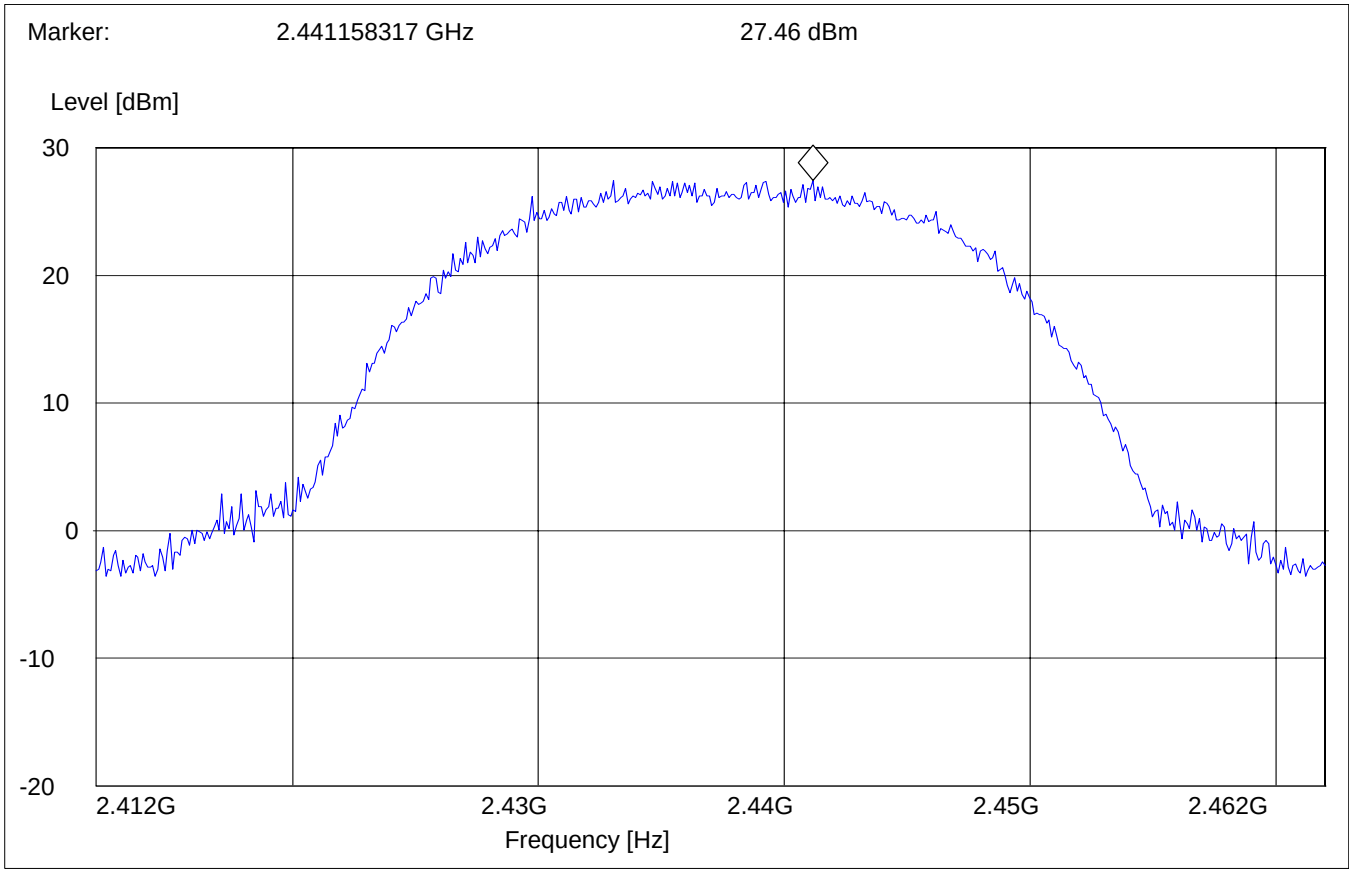
LIMIT **SUBCLAUSE § 15.247 (b) (1)**

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

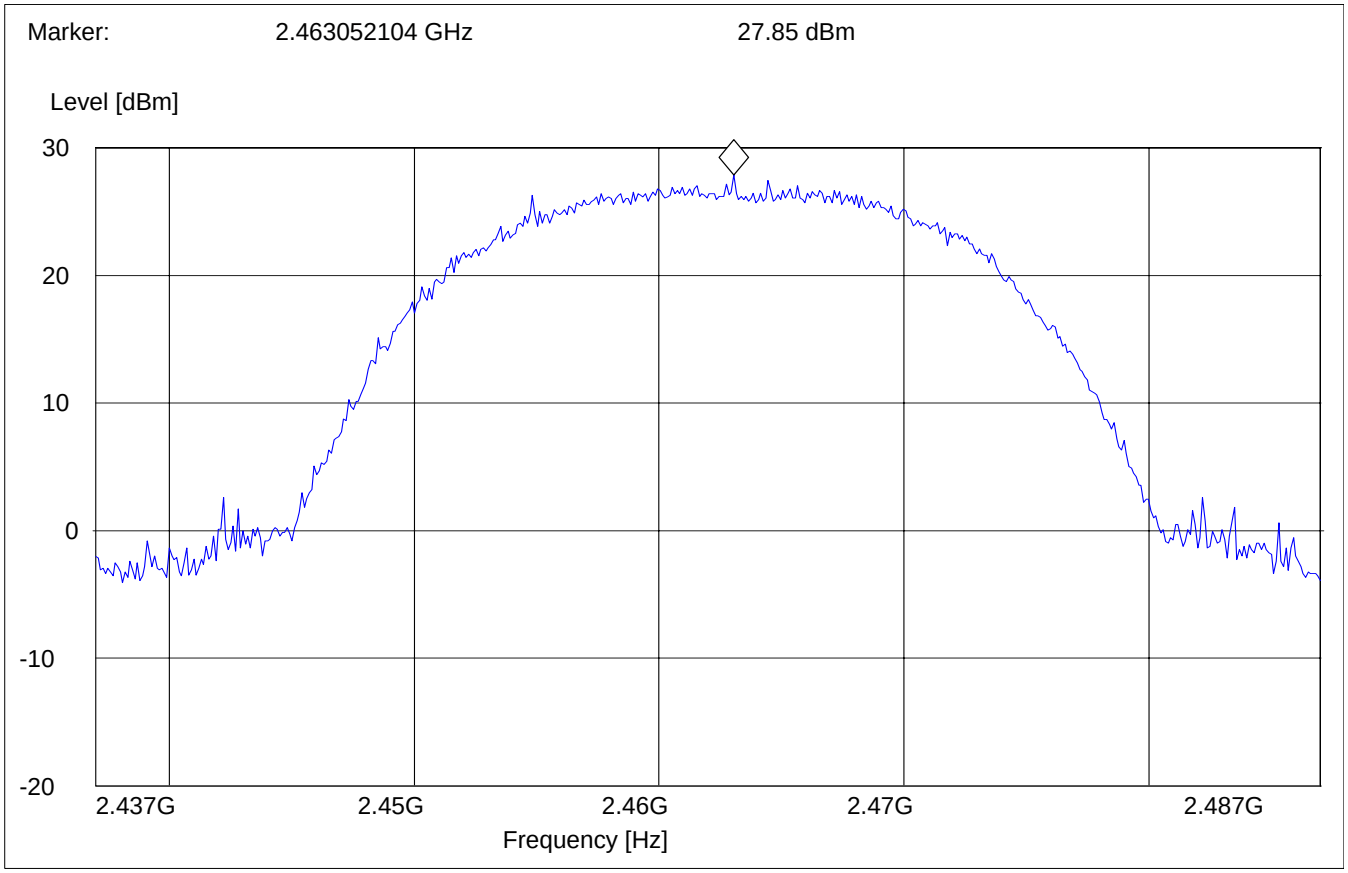
PEAK OUTPUT POWER (RADIATED)
EIRP
Lowest Channel: 2412MHz



PEAK OUTPUT POWER (RADIATED)
EIRP
Mid Channel: 2437MHz



PEAK OUTPUT POWER (RADIATED)
EIRP
Highest Channel: 2462MHz



BAND EDGE COMPLIANCE (802.11g) §15.247 (c)

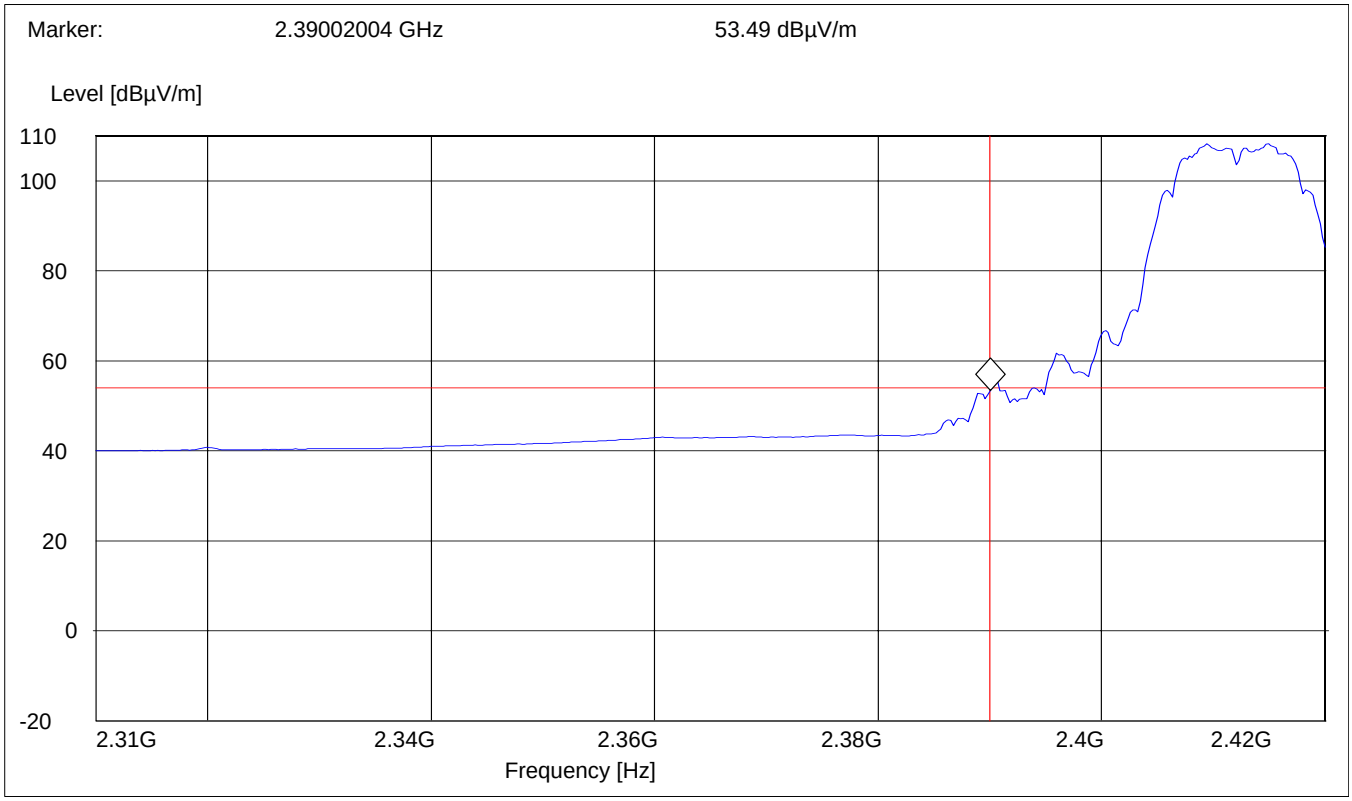
Data rate: 1Mbps

Power Level: 18dBm avg. power in packet

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 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)

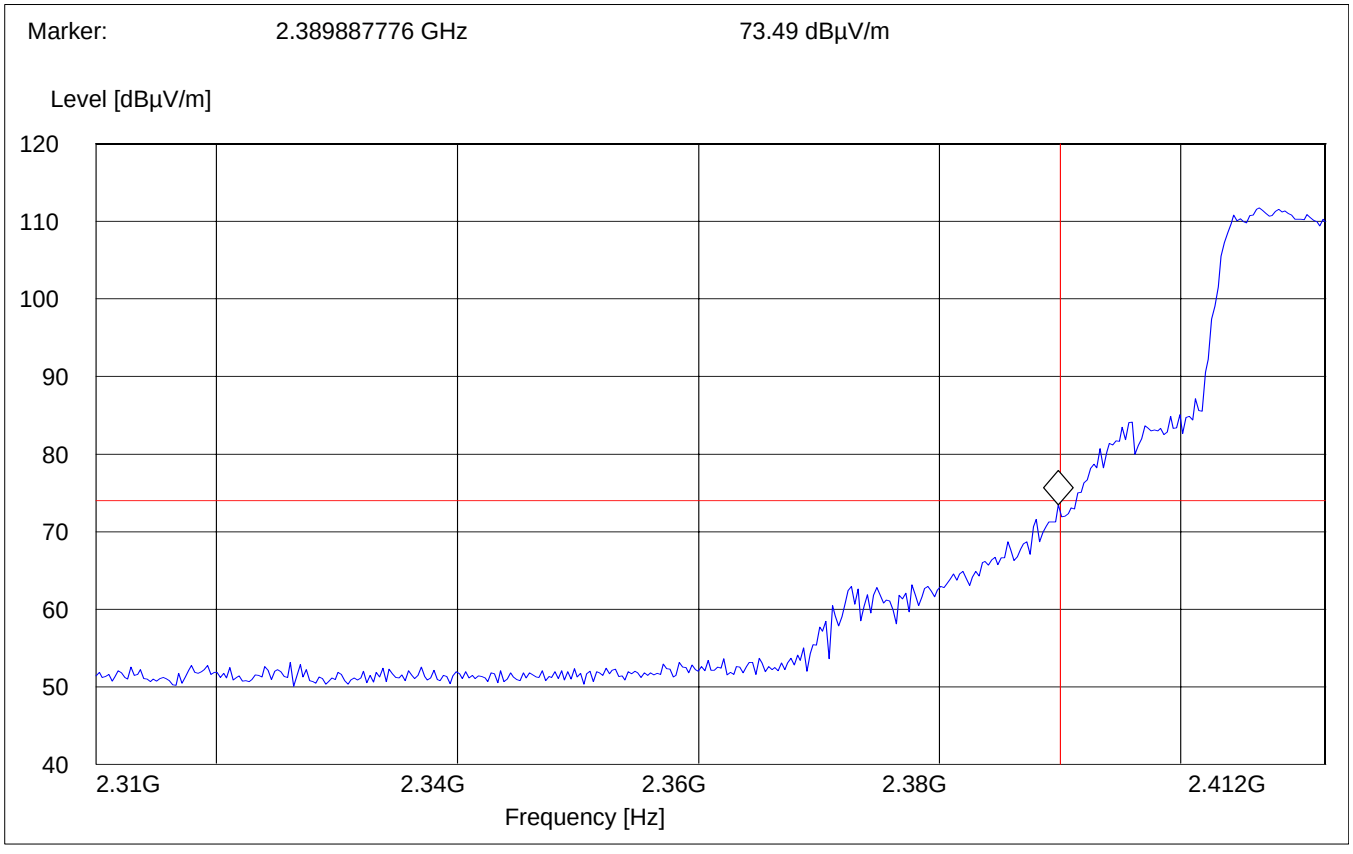
Data rate: 54Mbps

Power Level: 16.5dBm avg. power in packet

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)

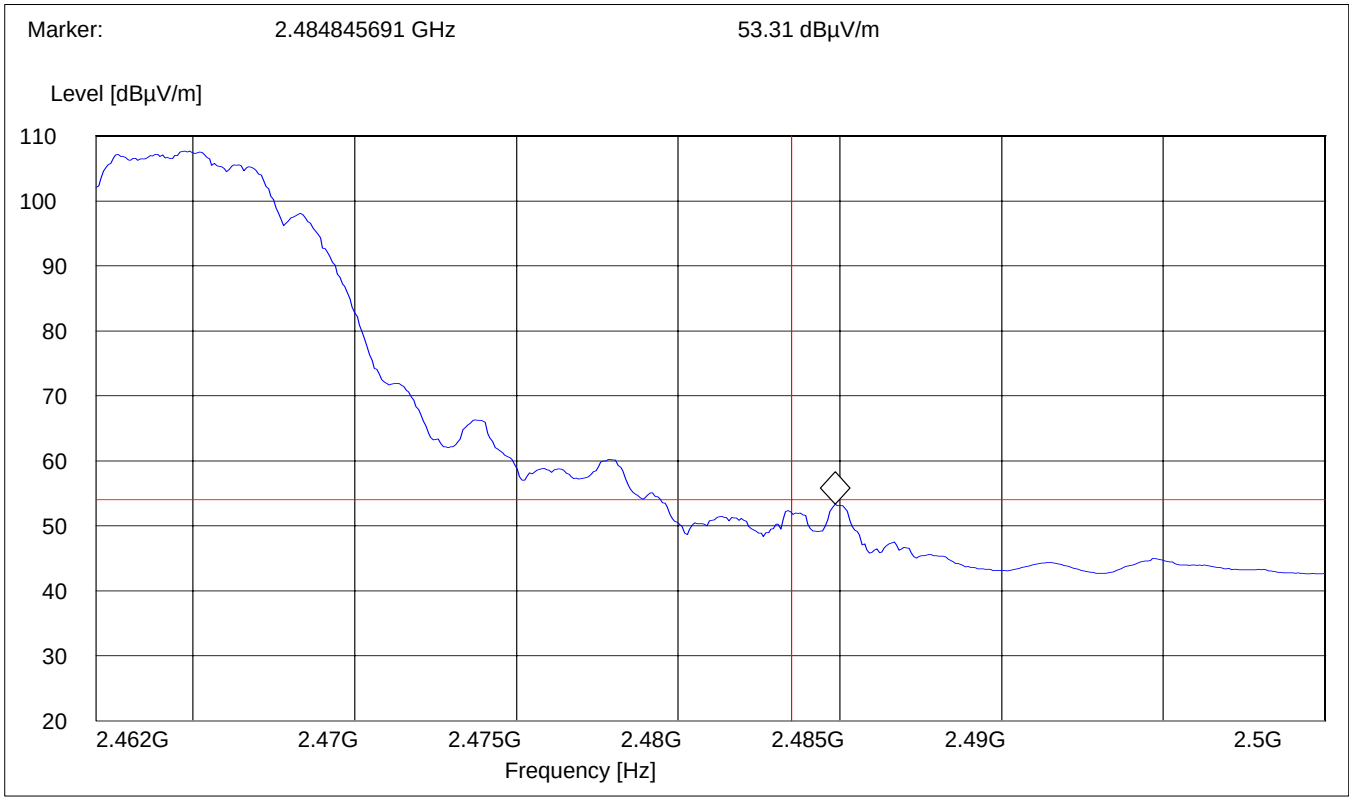
Data rate: 1Mbps

Power Level: 18dBm avg. power in packet

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)

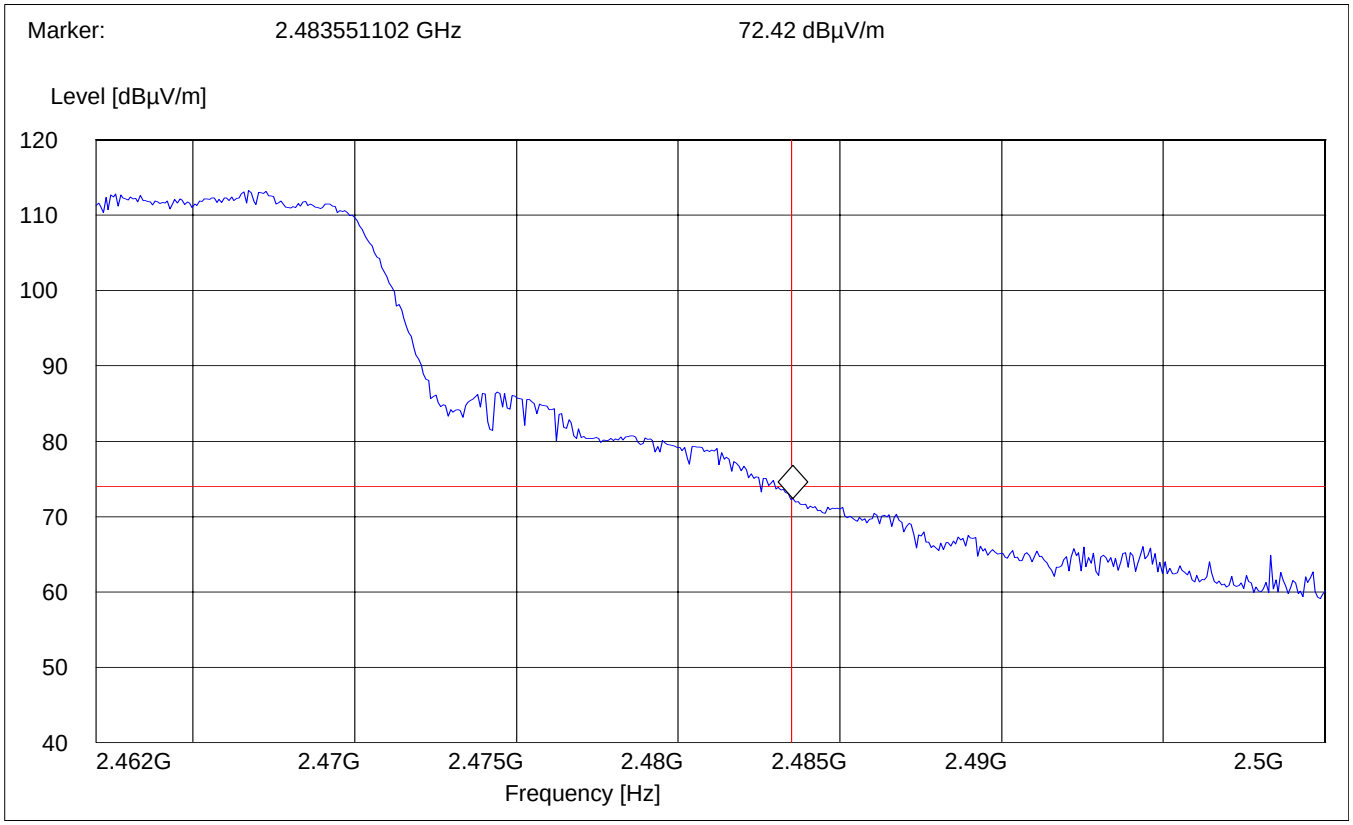
Data rate: 54Mbps

Power Level: 16.5dBm avg. power in packet

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 (802.11g) **§ 15.247 (c) (1)**
Transmitter (Radiated)
Data rate: 54Mbps
Power Level: 16.5dBm avg. power in packet

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 26.5 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)

Power level: 16.5dBm for 802.11g mode

Transmit at Lowest channel Frequency 2412MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Average 54Mbps	Average 6Mbps
SEE PLOTS			

Transmit at Middle channel Frequency 2437MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Average 54Mbps	Average 6Mbps
SEE PLOTS			

Transmit at Highest channel Frequency 2462MHz			
Frequency (MHz)	Level (dBµV/m)		
	Peak	Average 54Mbps	Average 6Mbps
SEE PLOTS			

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

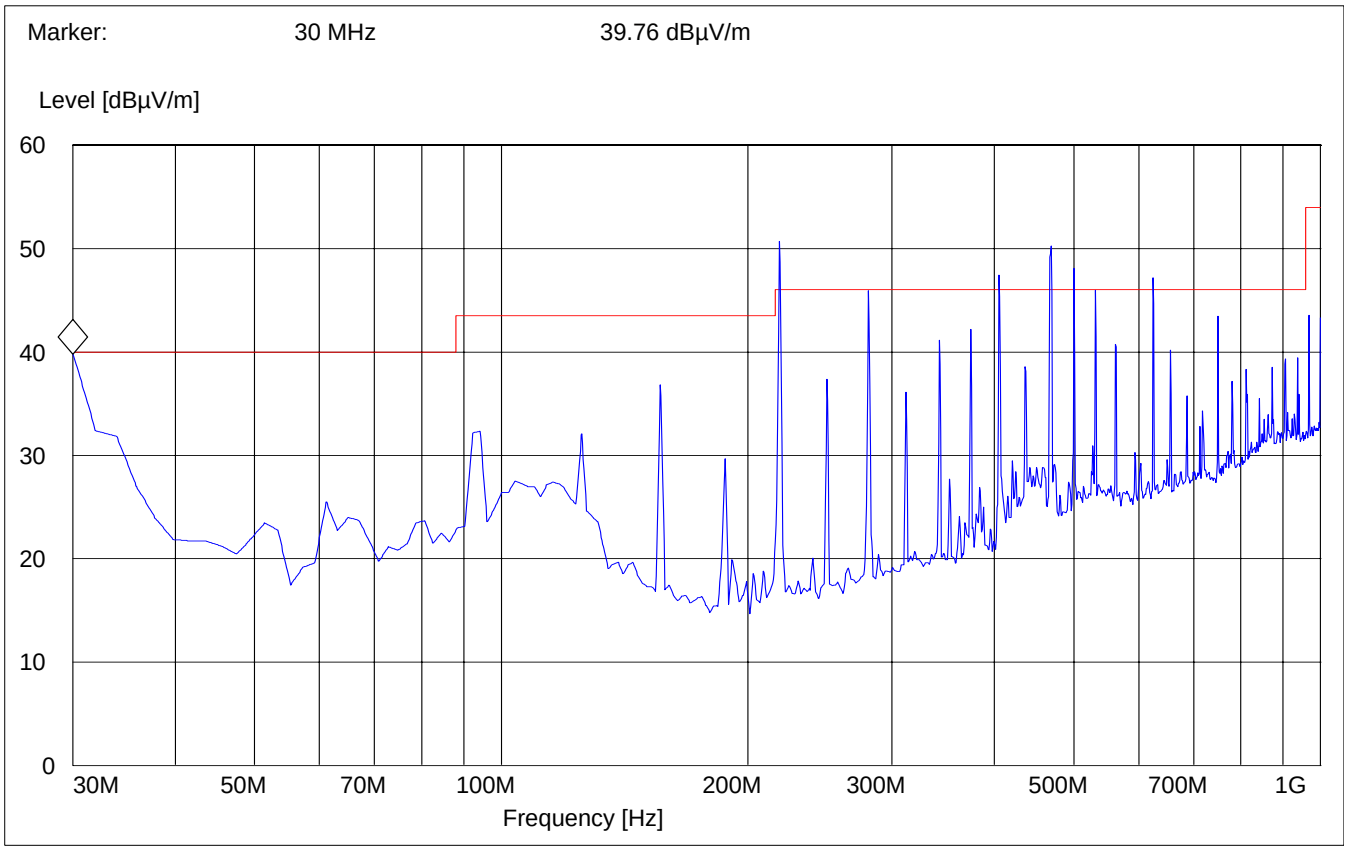
30MHz – 1GHz

Antenna: Vertical

Note: This plot is valid for low, mid, high channels for all data rates and power levels (worst-case plot) All peaks above the limit line are confirmed coming from test fixture. Refer to plots on next pages.

SWEEP TABLE: "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



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

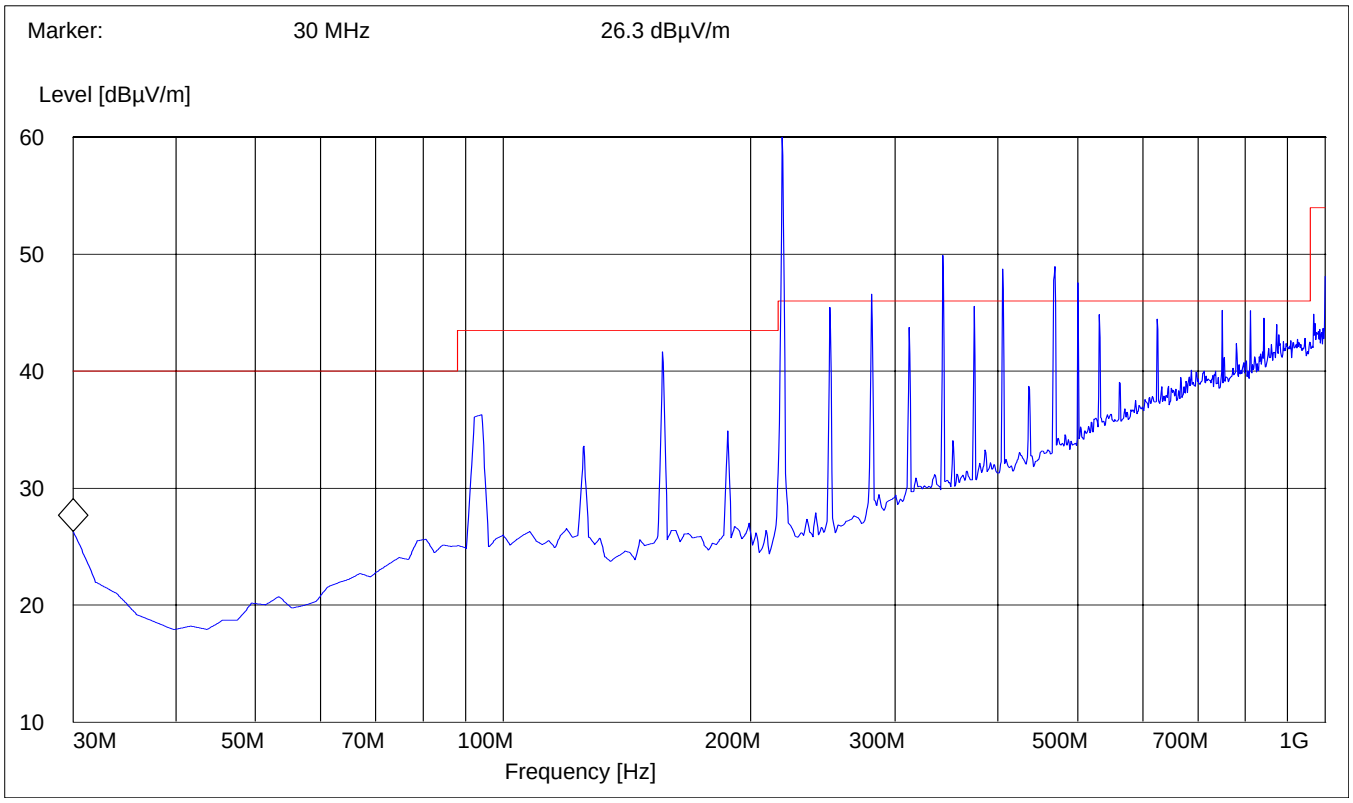
30MHz – 1GHz

Antenna: Horizontal

Note: This plot is valid for low, mid, high channels for all data rates and power levels (worst-case plot) All peaks above the limit line are confirmed coming from test fixture. Refer to plots on next pages.

SWEEP TABLE: "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



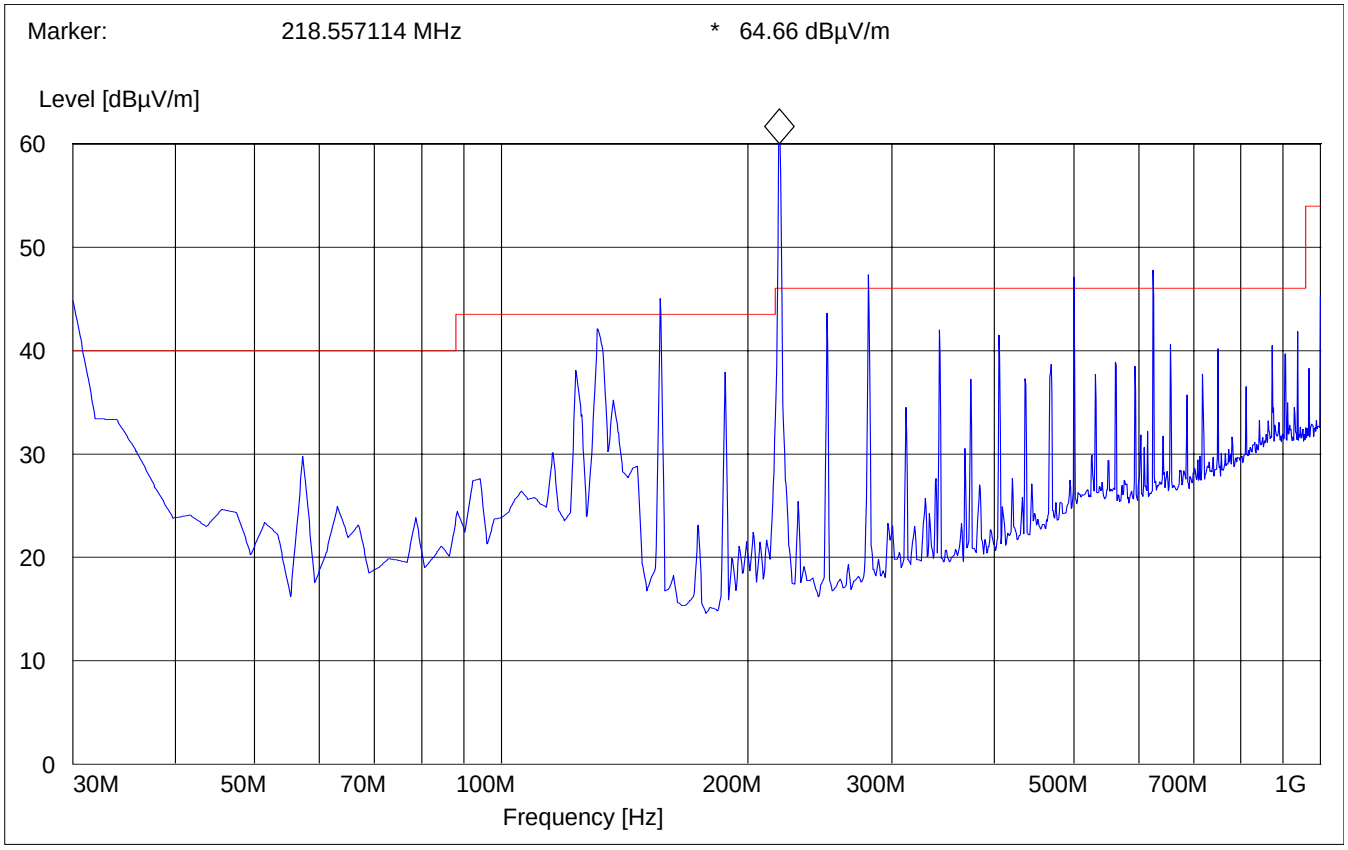
EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
30MHz – 1GHz

NOTE: Test fixture only

Antenna: Vertical

SWEEP TABLE: "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



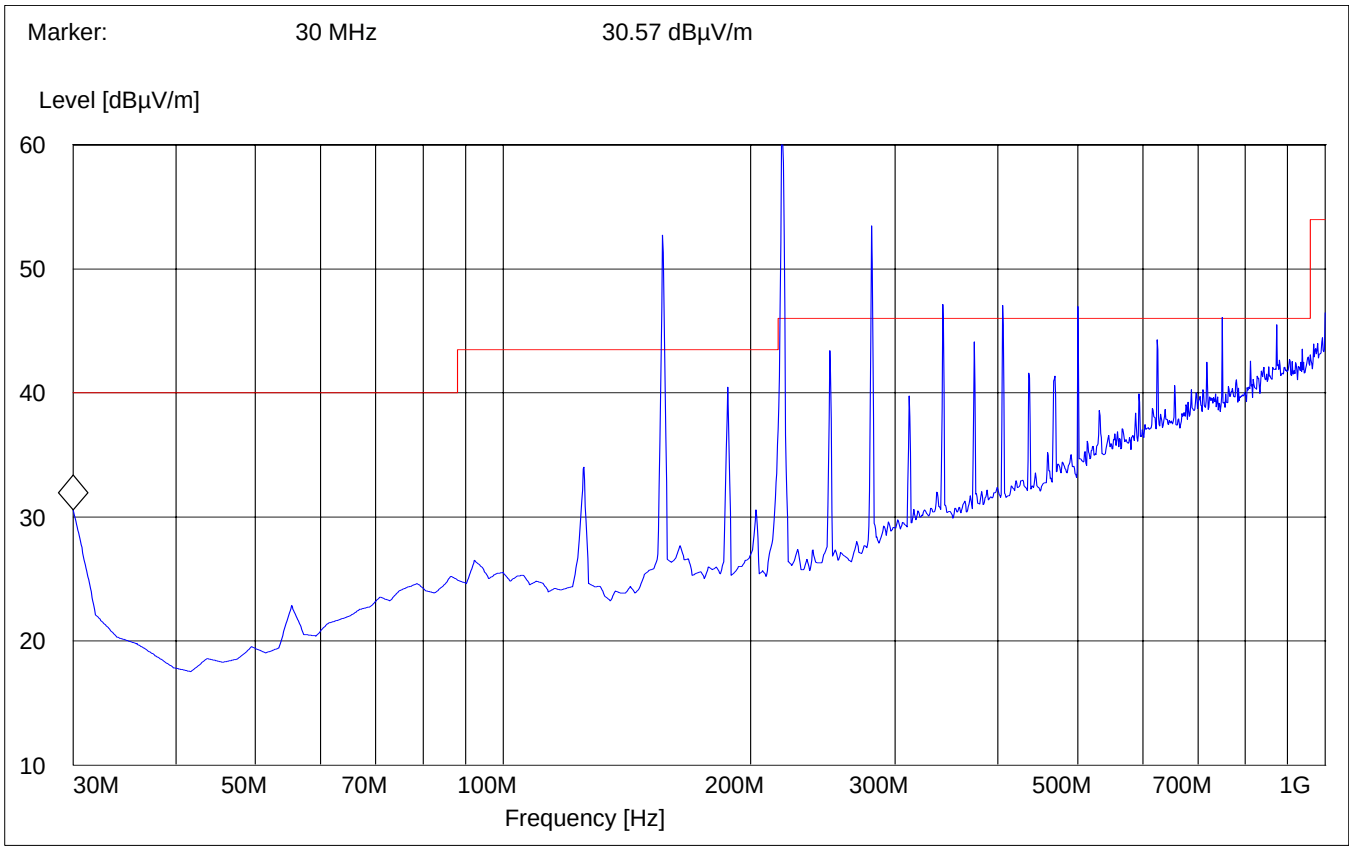
EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
30MHz – 1GHz

NOTE: Test fixture only

Antenna: Horizontal

SWEEP TABLE: "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



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

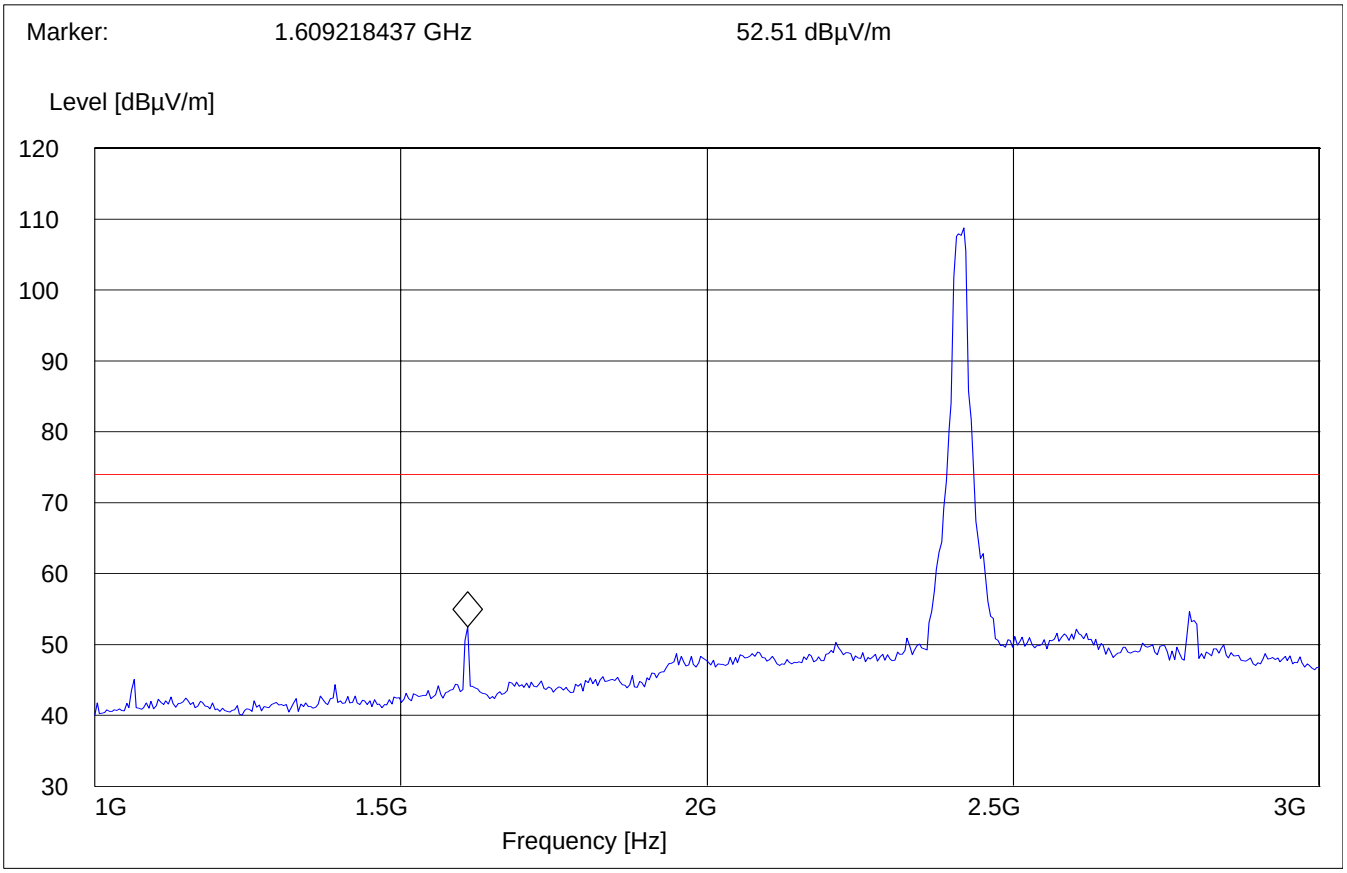
Lowest Channel (2412MHz): 1GHz – 3GHz

Data rate: 54Mbps

Power Level: 16.5dBm avg. power in packet

Note: Peak above the limit line is the carrier freq.

SWEEP TABLE:		"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	#326 horn (dBi)



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

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

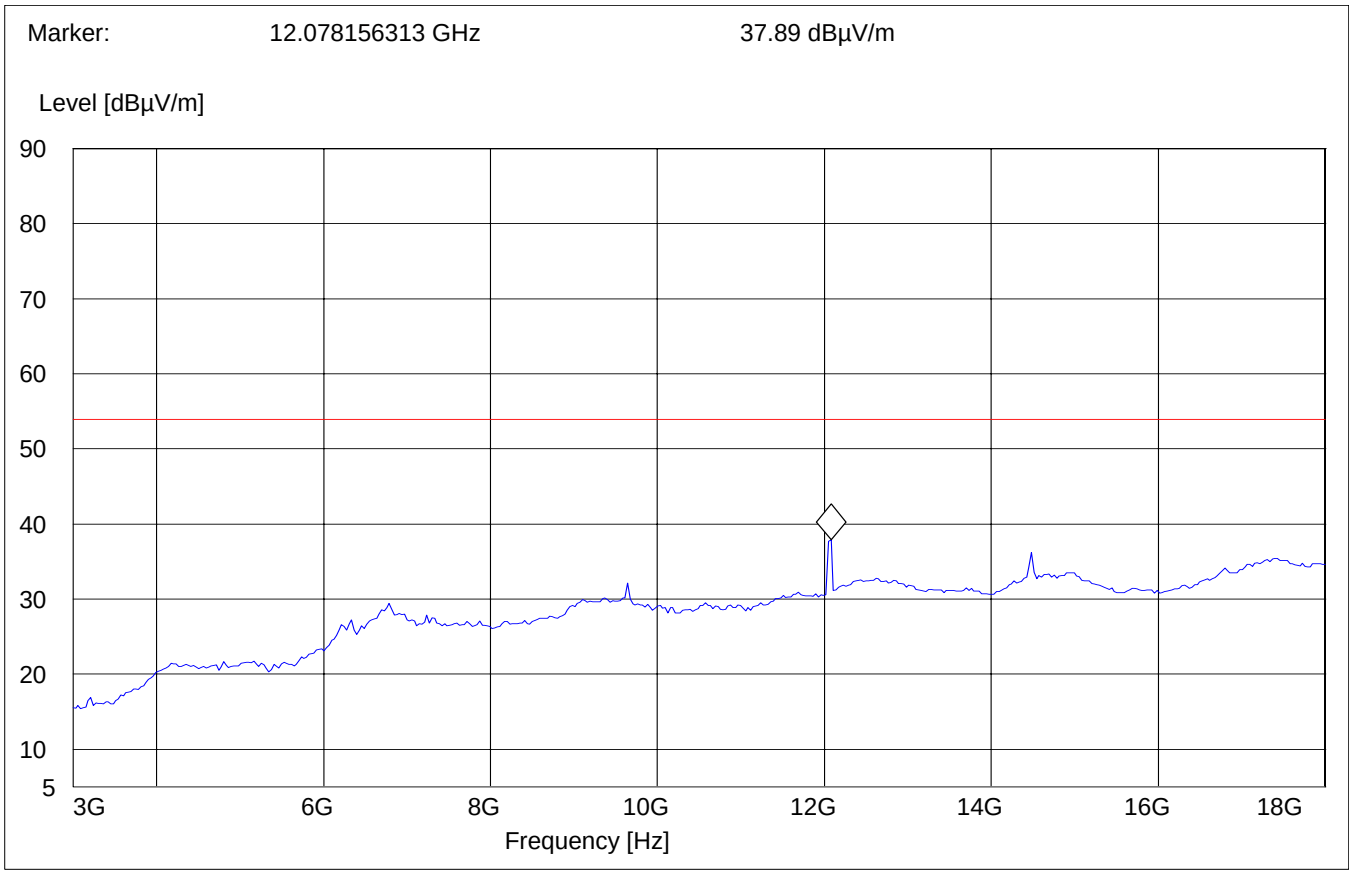
Data rate: 54Mbps

Power Level: 16.5dBm avg. power in packet

Average Measurement

SWEEP TABLE: "Spuri hi 3-18G"

Start Frequency	Stop Frequency	Detector Time	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 (c) (1)**

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

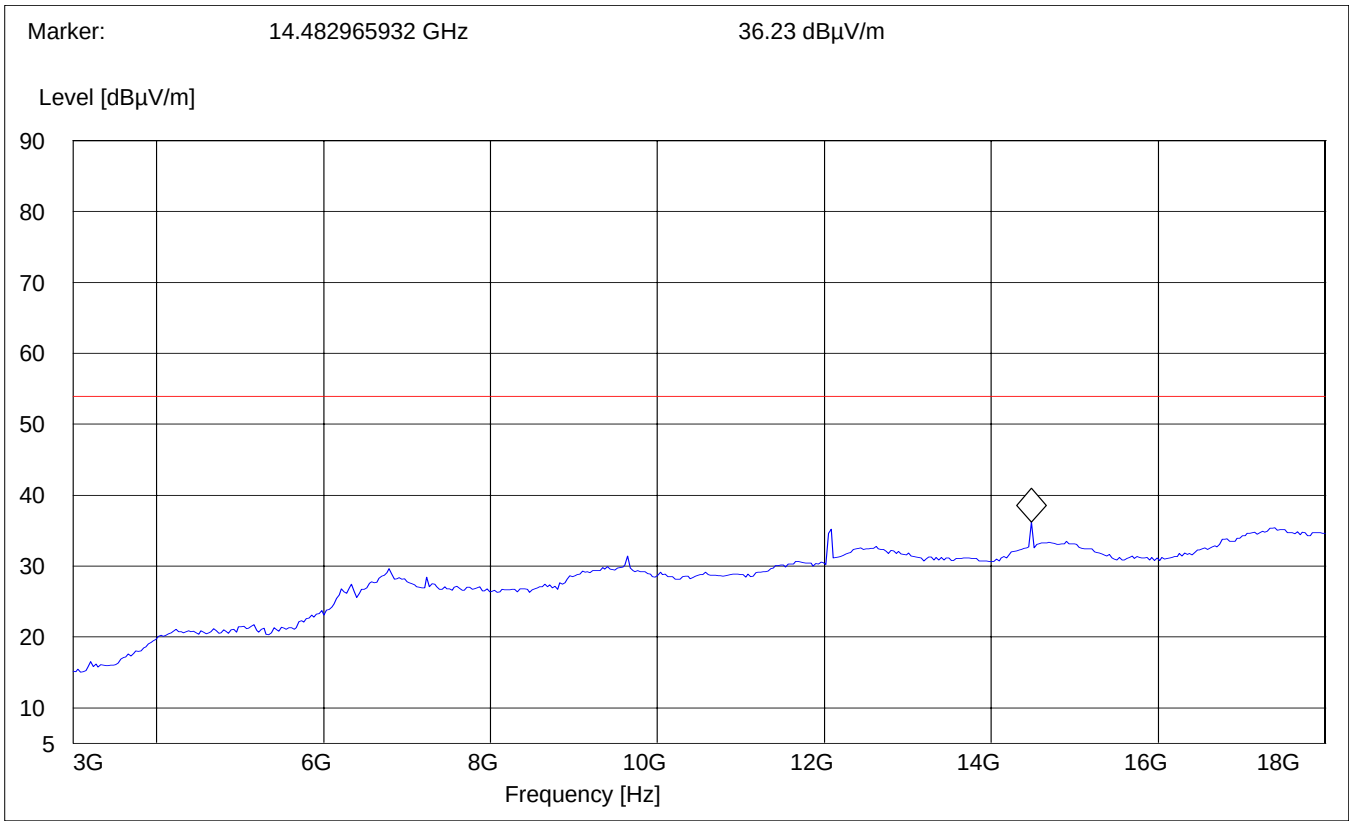
Data rate: 1Mbps

Power Level: 18dBm avg. power in packet

Average Measurement

SWEEP TABLE: "Spuri hi 3-18G"

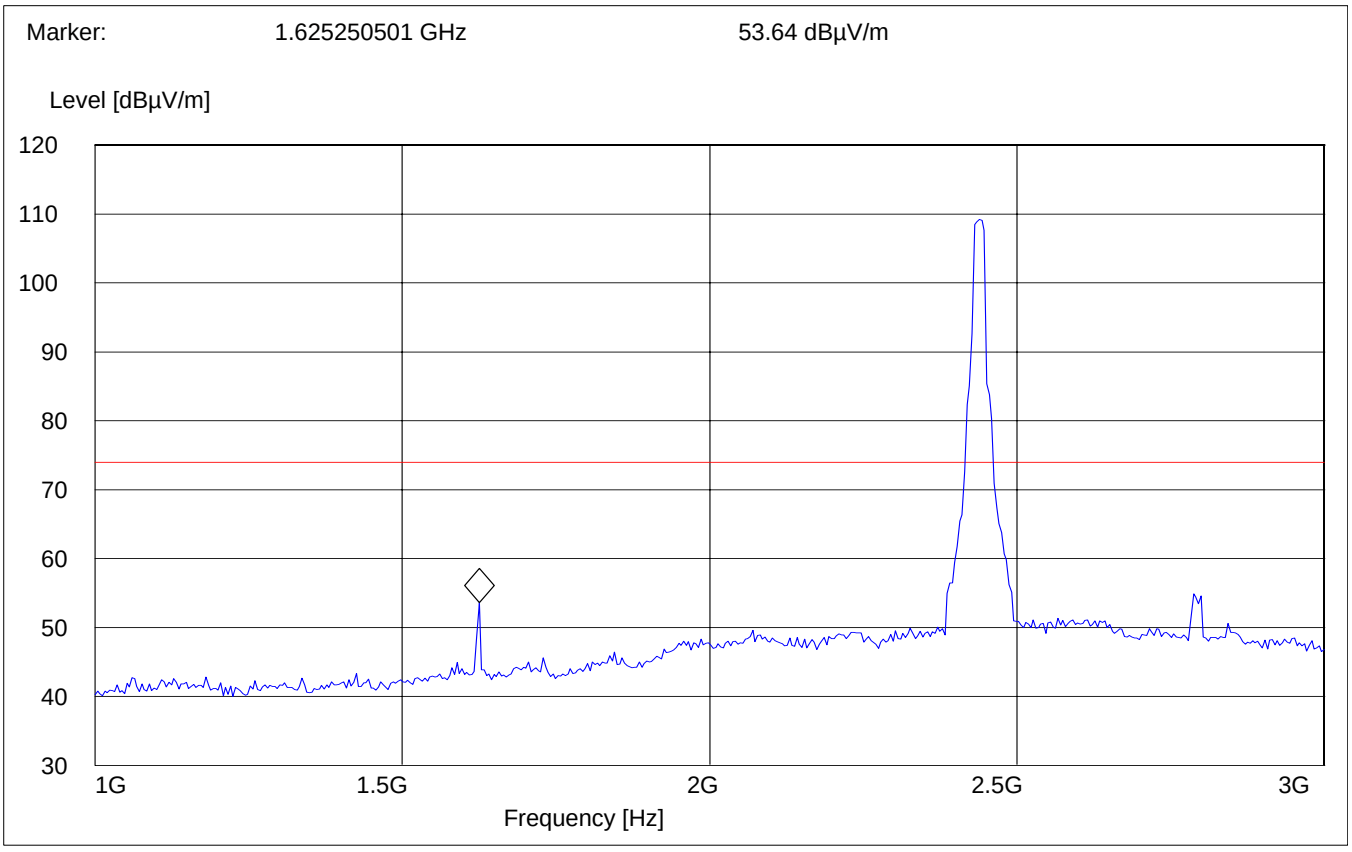
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
3.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Mid Channel (2437MHz): 1GHz – 3GHz
Data rate: 54Mbps
Power Level: 16.5dBm avg. power in packet

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

SWEEP TABLE:		"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	#326 horn (dBi)



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

Mid Channel (2437MHz): 3GHz – 18GHz

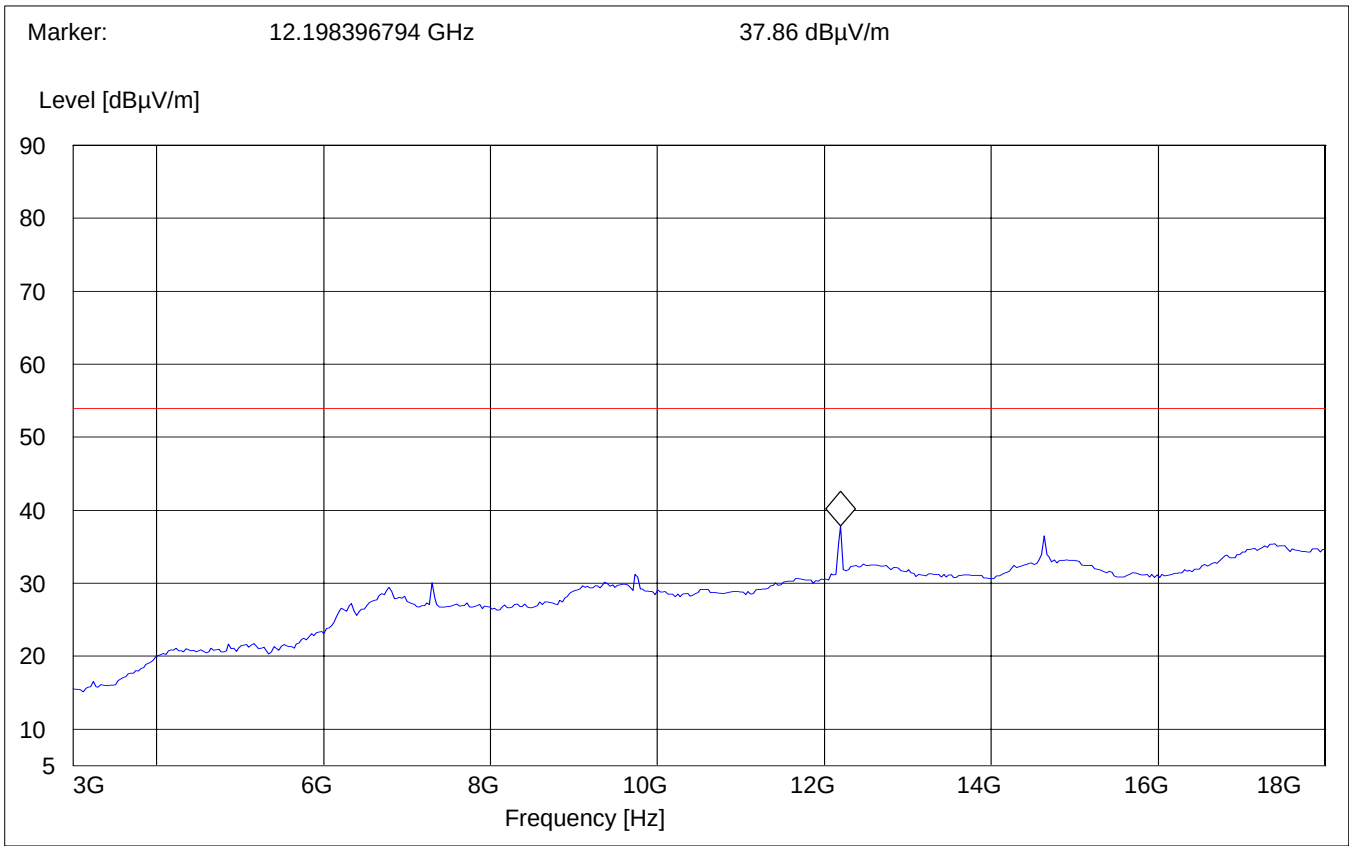
Data rate: 54Mbps

Power Level: 16.5dBm avg. power in packet

Average Measurement

SWEEP TABLE: "Spuri hi 3-18G"

Start Frequency	Stop Frequency	Detector Time	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 (c) (1)**

Mid Channel (2437MHz): 3GHz – 18GHz

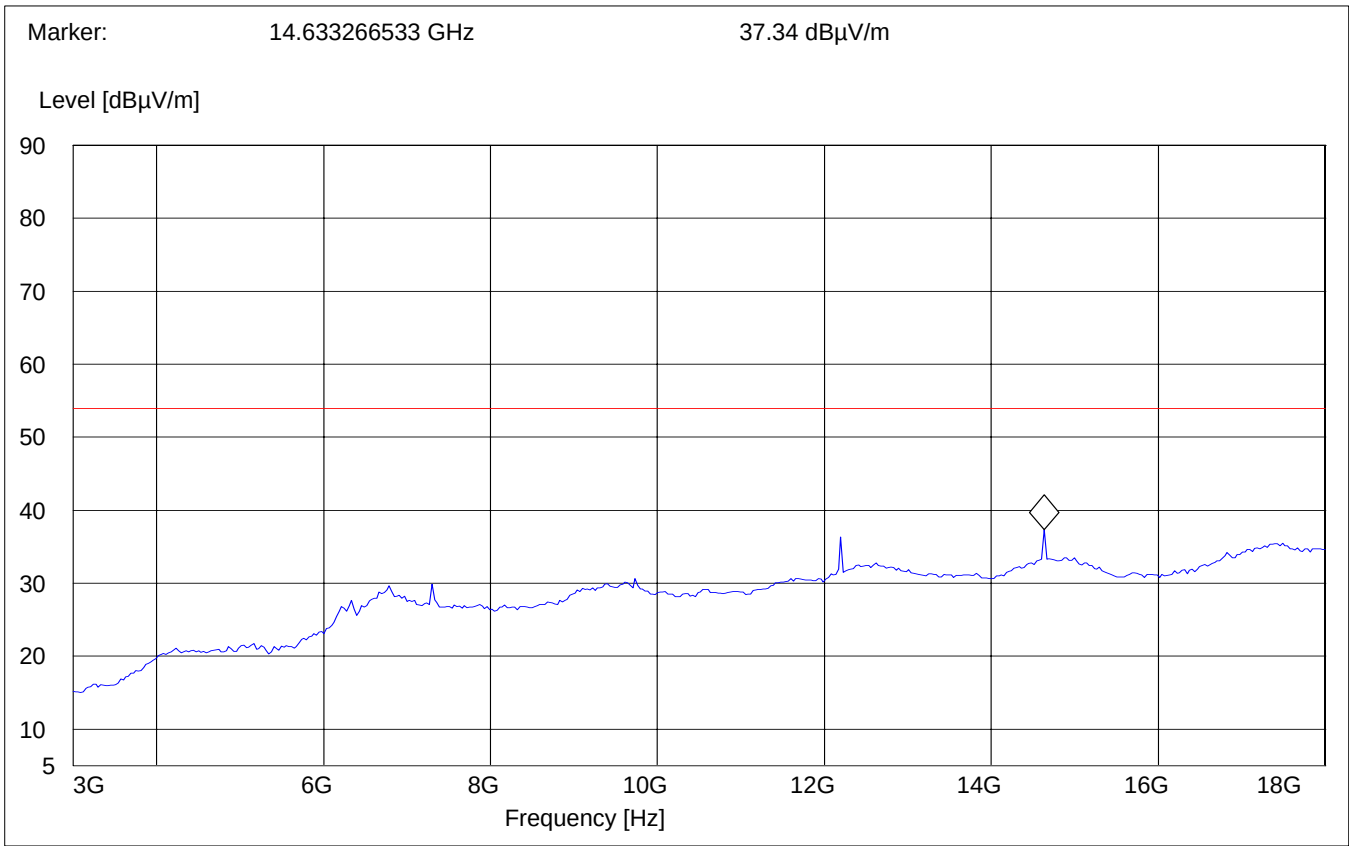
Data rate: 1Mbps

Power Level: 18dBm avg. power in packet

Average Measurement

SWEEP TABLE: "Spuri hi 3-18G"

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

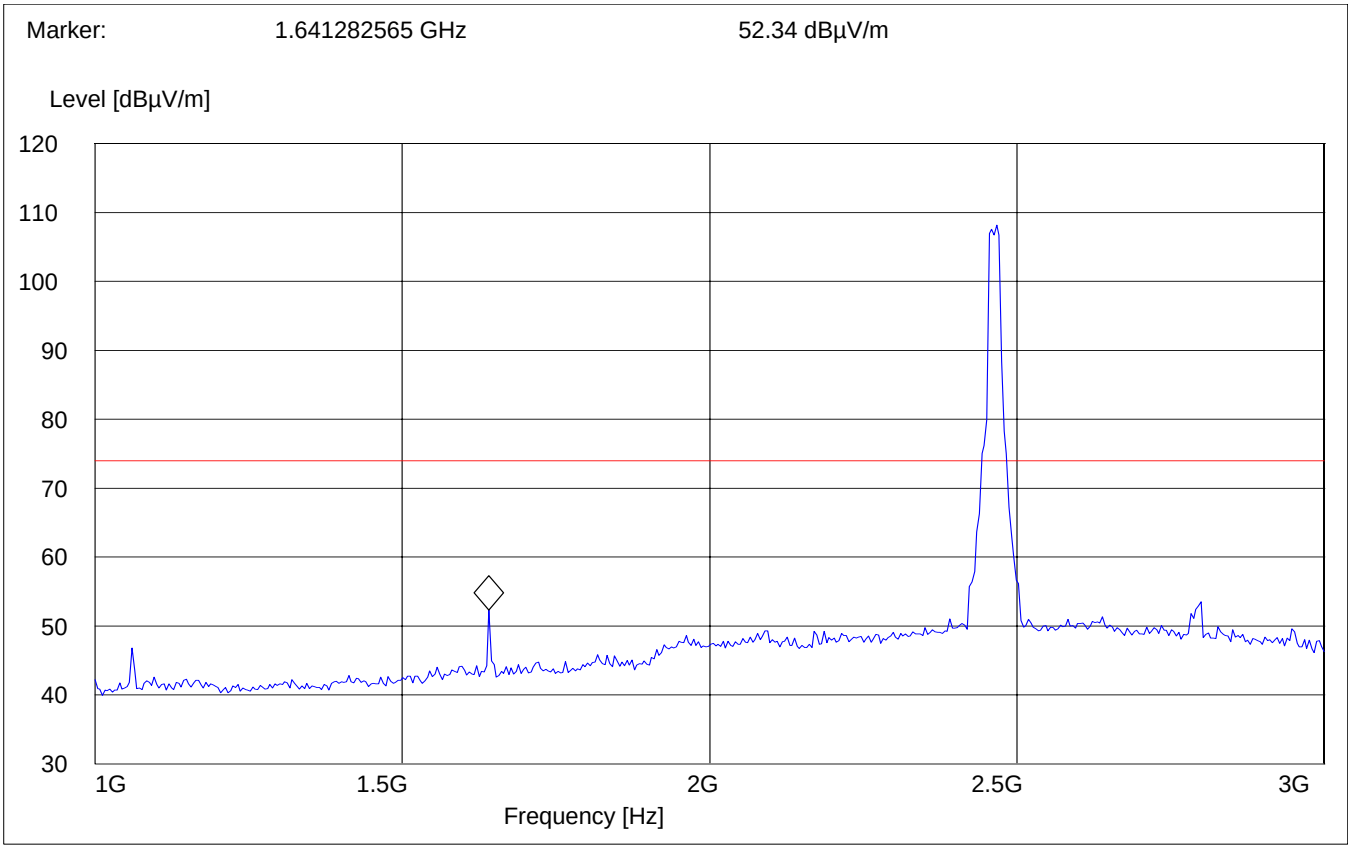


EMISSION LIMITATIONS - Radiated (Transmitter) § 15.247 (c) (1)
Highest Channel (2462MHz): 1GHz – 3GHz
Data rate: 54Mbps
Power Level: 16.5dBm avg. power in packet

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

SWEEP TABLE: "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	#326 horn (dBi)



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

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

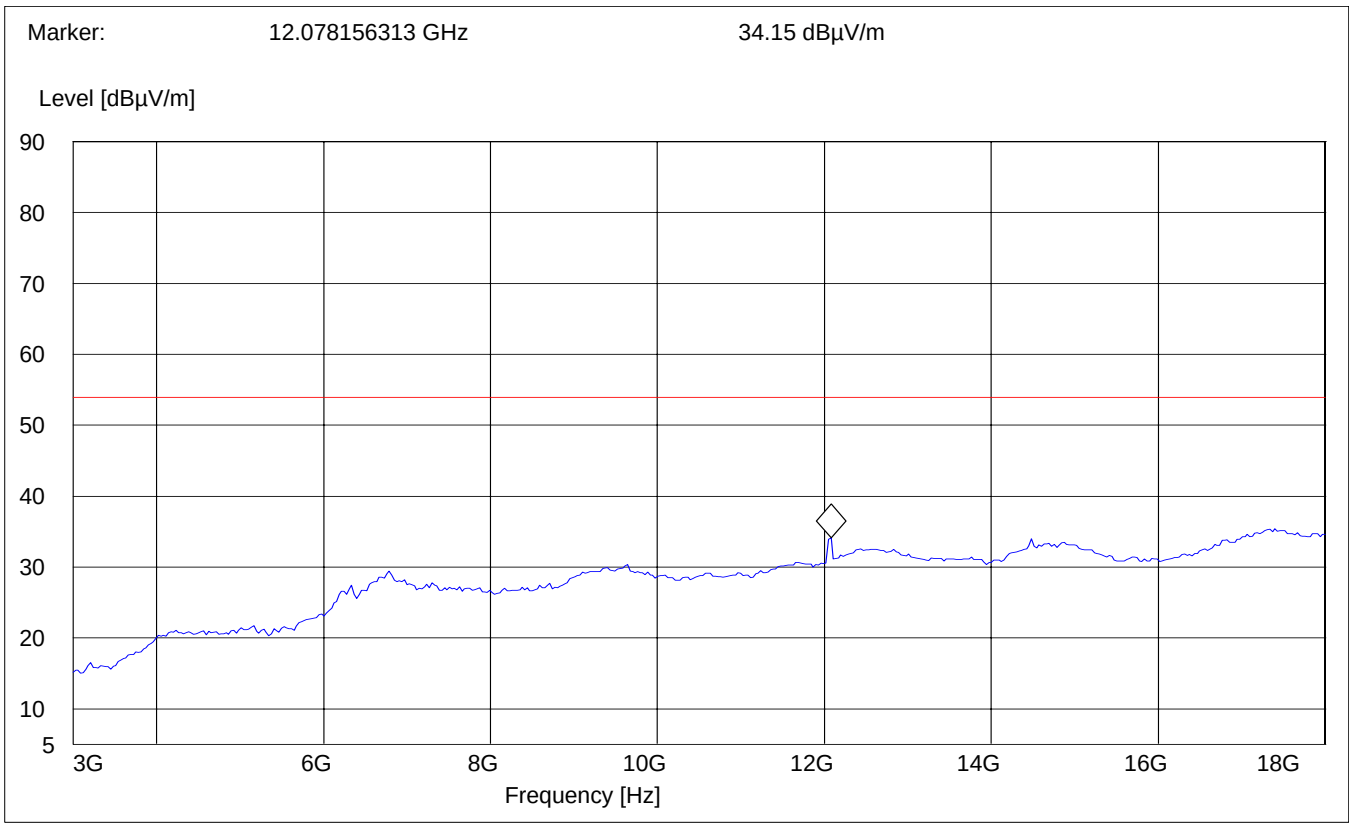
Data rate: 54Mbps

Power Level: 16.5dBm avg. power in packet

Average Measurement

SWEEP TABLE: "Spuri hi 3-18G"

Start Frequency	Stop Frequency	Detector Time	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 (c) (1)**

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

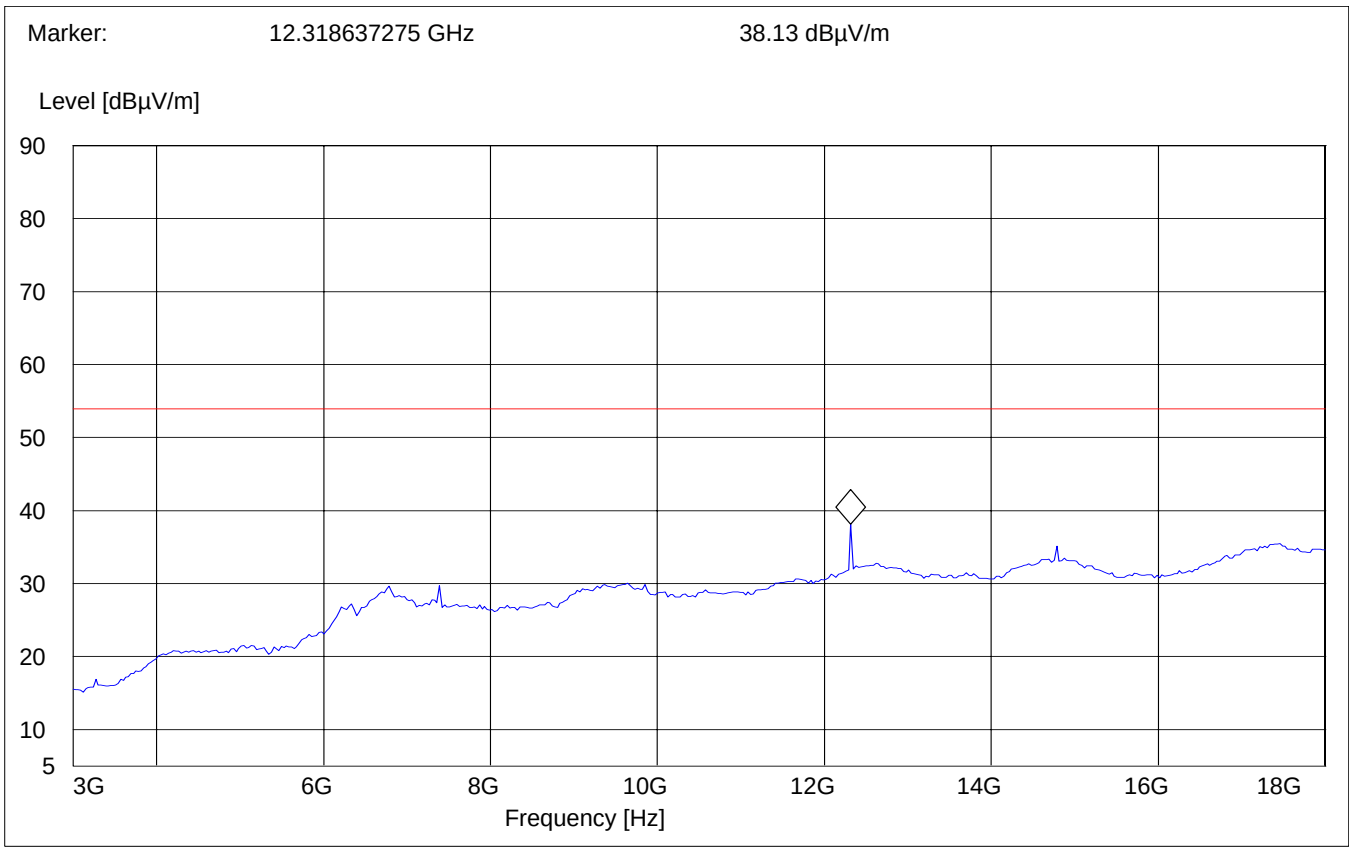
Data rate: 1Mbps

Power Level: 18dBm avg. power in packet

Average Measurement

SWEEP TABLE: "Spuri hi 3-18G"

Start Frequency	Stop Frequency	Detector Time	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 (c) (1)

18GHz – 26.5GHz

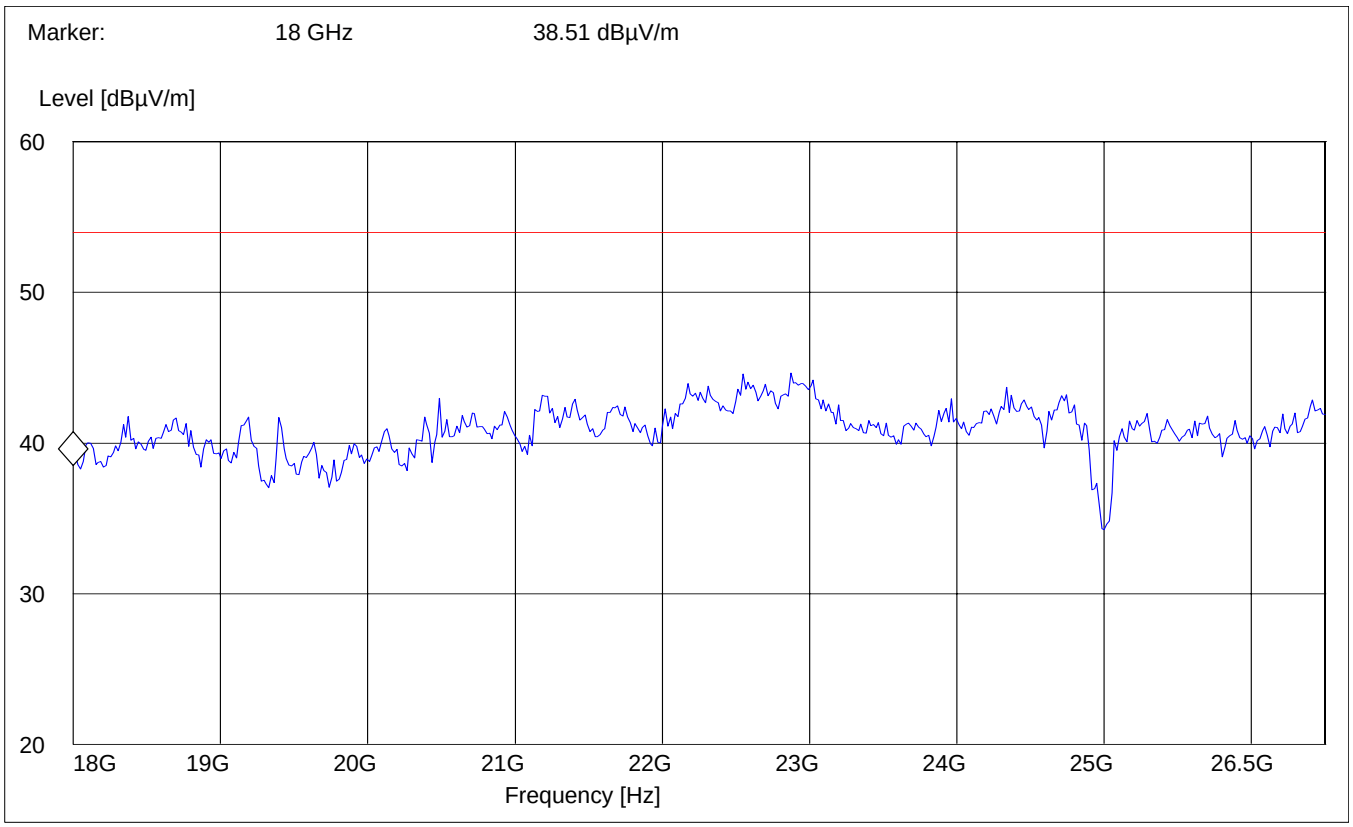
Note: This plot is valid for low, mid, high channels (worst-case plot)

Data rate: 54Mbps

Power Level: 16.5dBm avg. power in packet

SWEEP TABLE: "Spuri hi 18-26.5G"

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18 GHz	26.5 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

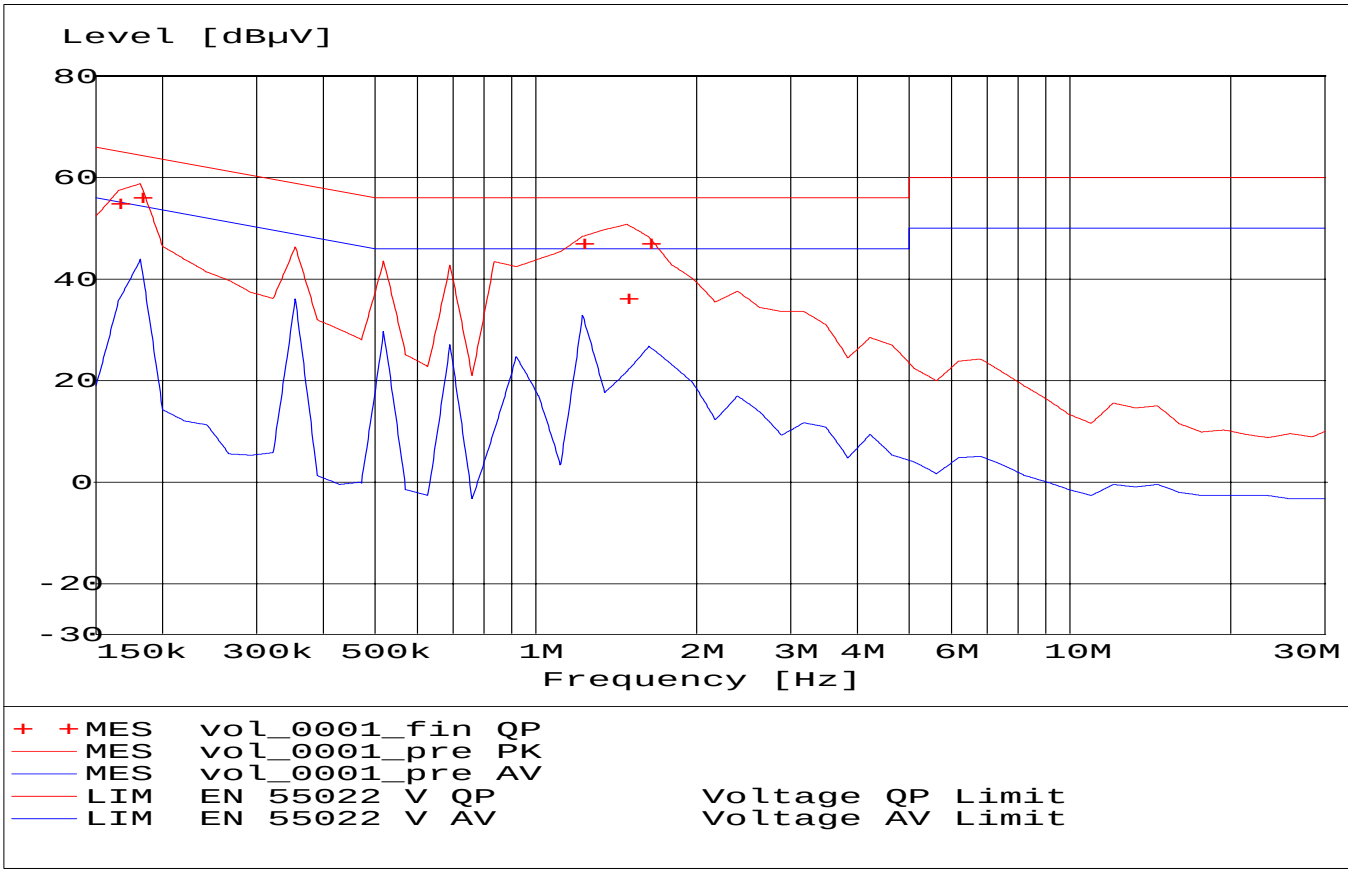
Start Frequency	Stop Frequency	Detector	Meas Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	MaxPeak	Coupled	10 kHz	None

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: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.165000	54.70	0.0	65	10.5	2	---
0.181500	55.90	0.0	64	8.5	1	---
1.221041	46.80	0.0	56	9.2	2	---
1.477460	35.90	0.0	56	20.1	1	---
1.625206	46.90	0.0	56	9.1	1	---

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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 26.5 GHz very short cable connections to the antenna was used to minimize the noise level.

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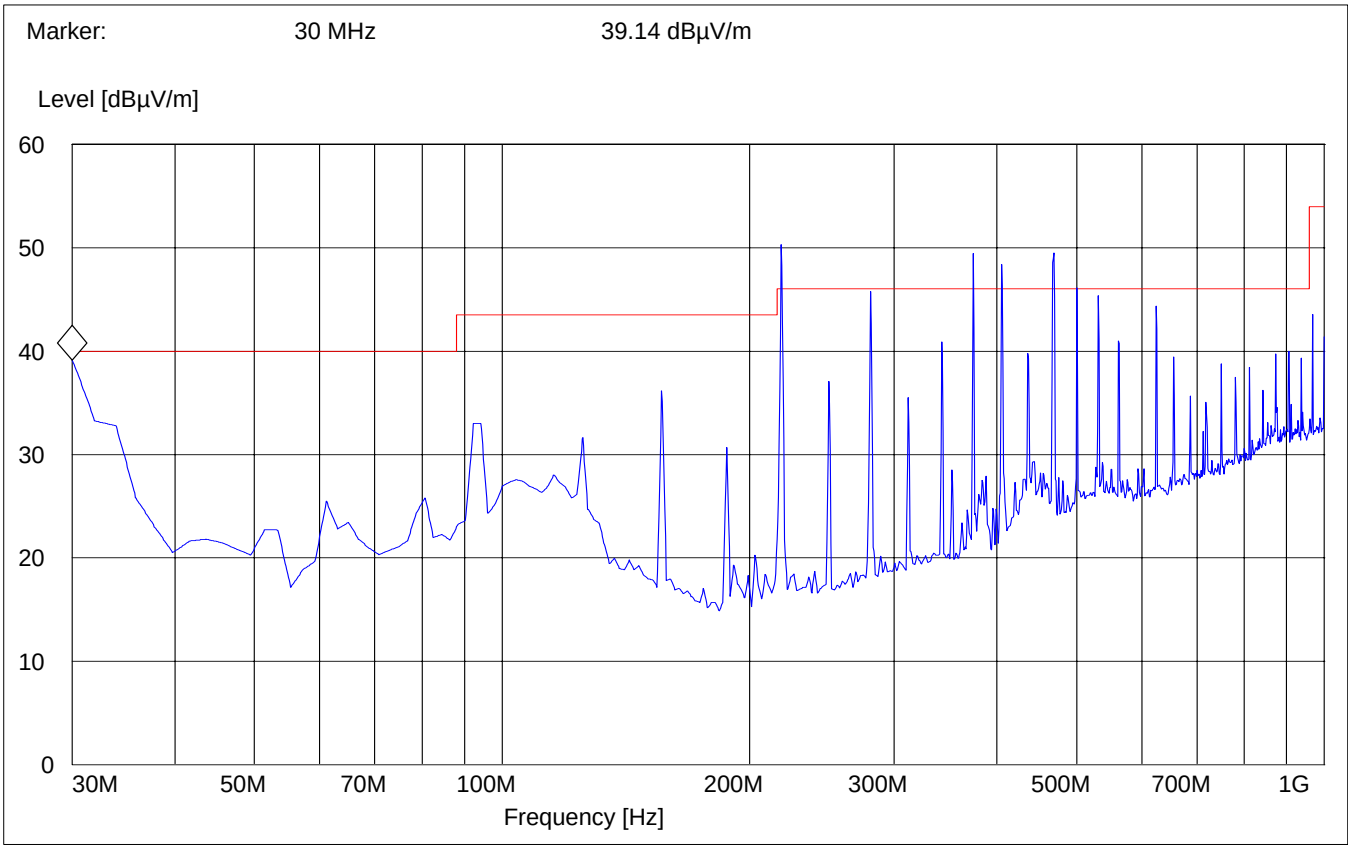
30MHz – 1GHz

Note: This plot is valid for both polarities (worst-case plot). All peaks above the limit line are confirmed coming from test fixture. Refer to plot on next page.

SWEEP TABLE: "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



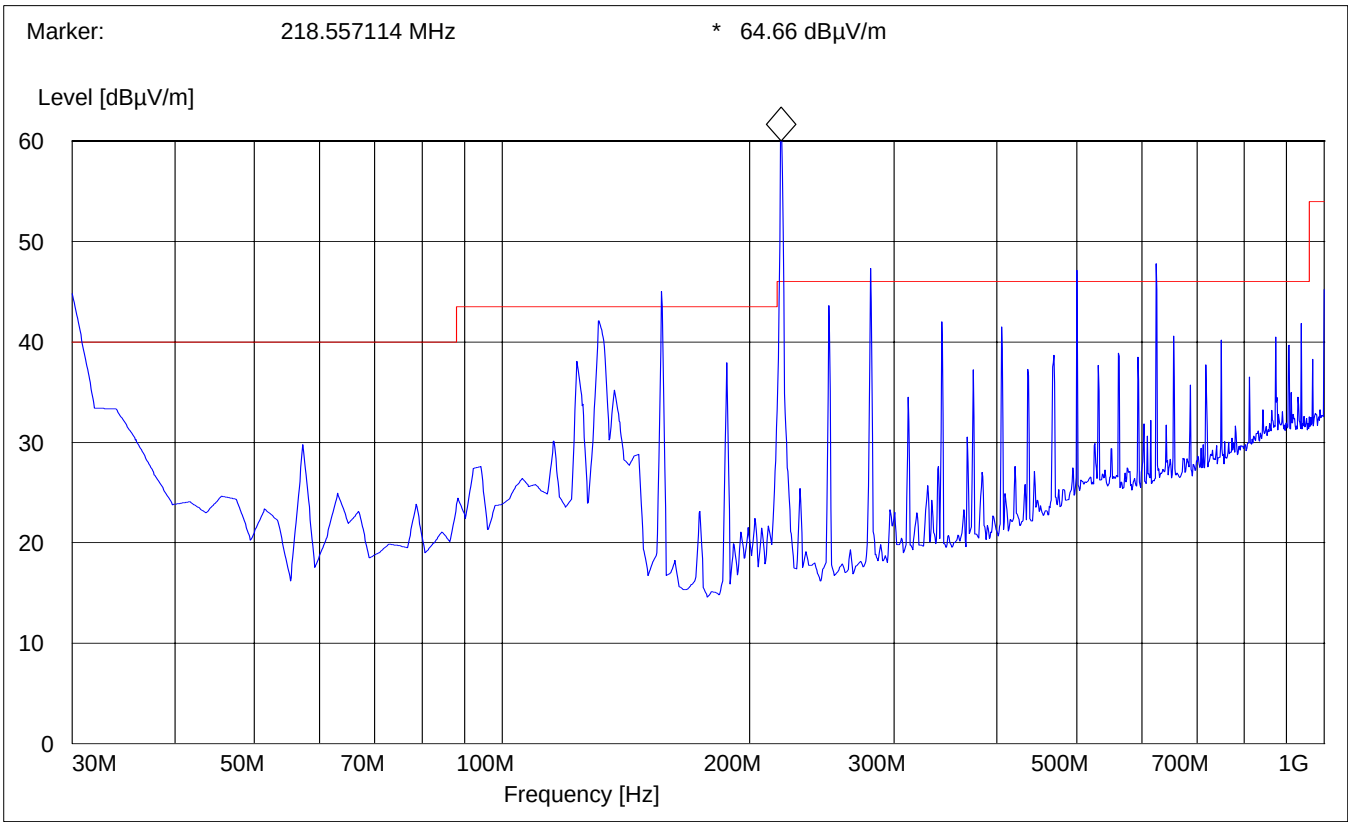
RECEIVER SPURIOUS RADIATION § 15.109

30MHz – 1GHz

Test fixture only

SWEEP TABLE: "Spuri hi 30-1G"

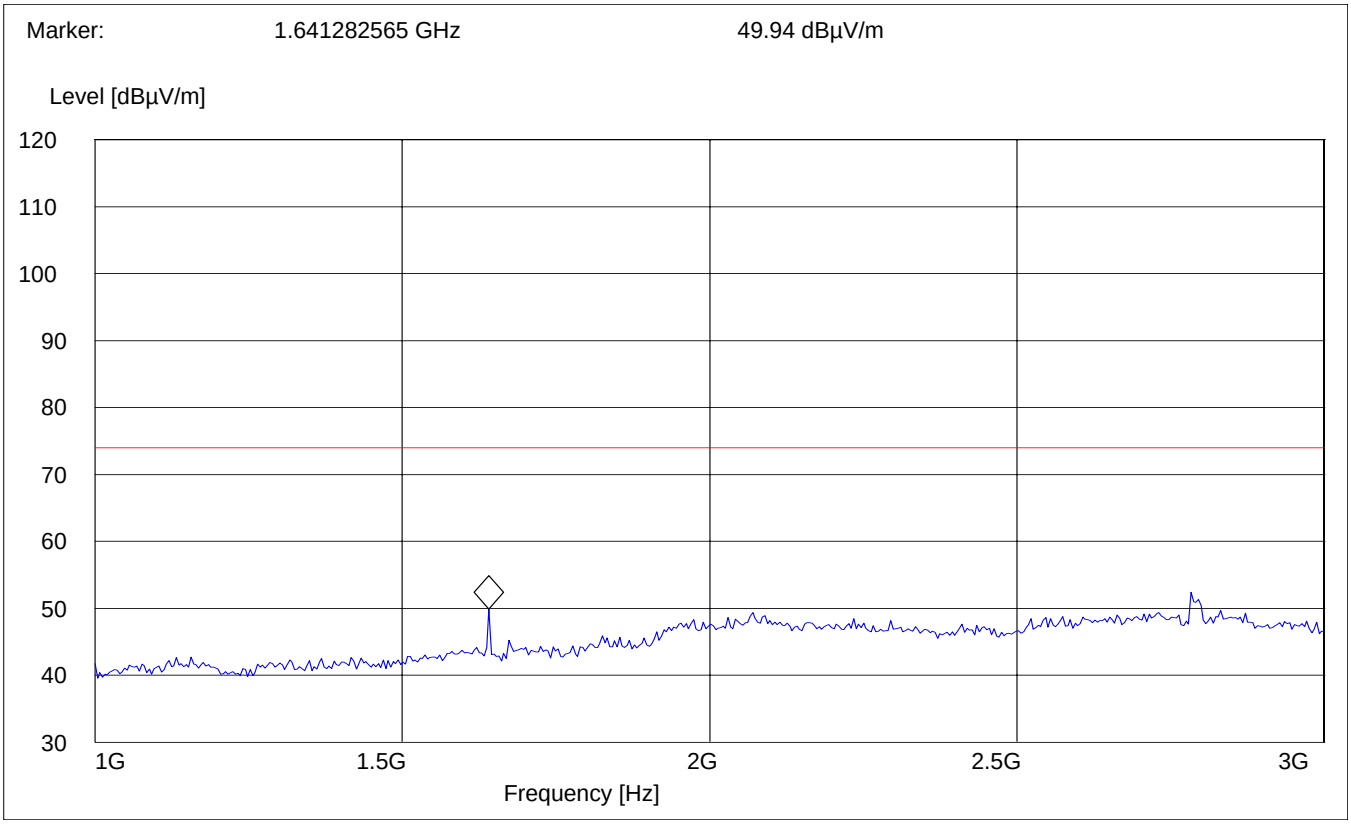
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW VBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186



RECEIVER SPURIOUS RADIATION § 15.109
1GHz – 3GHz

SWEEP TABLE: "Spuri hi 1-3G"

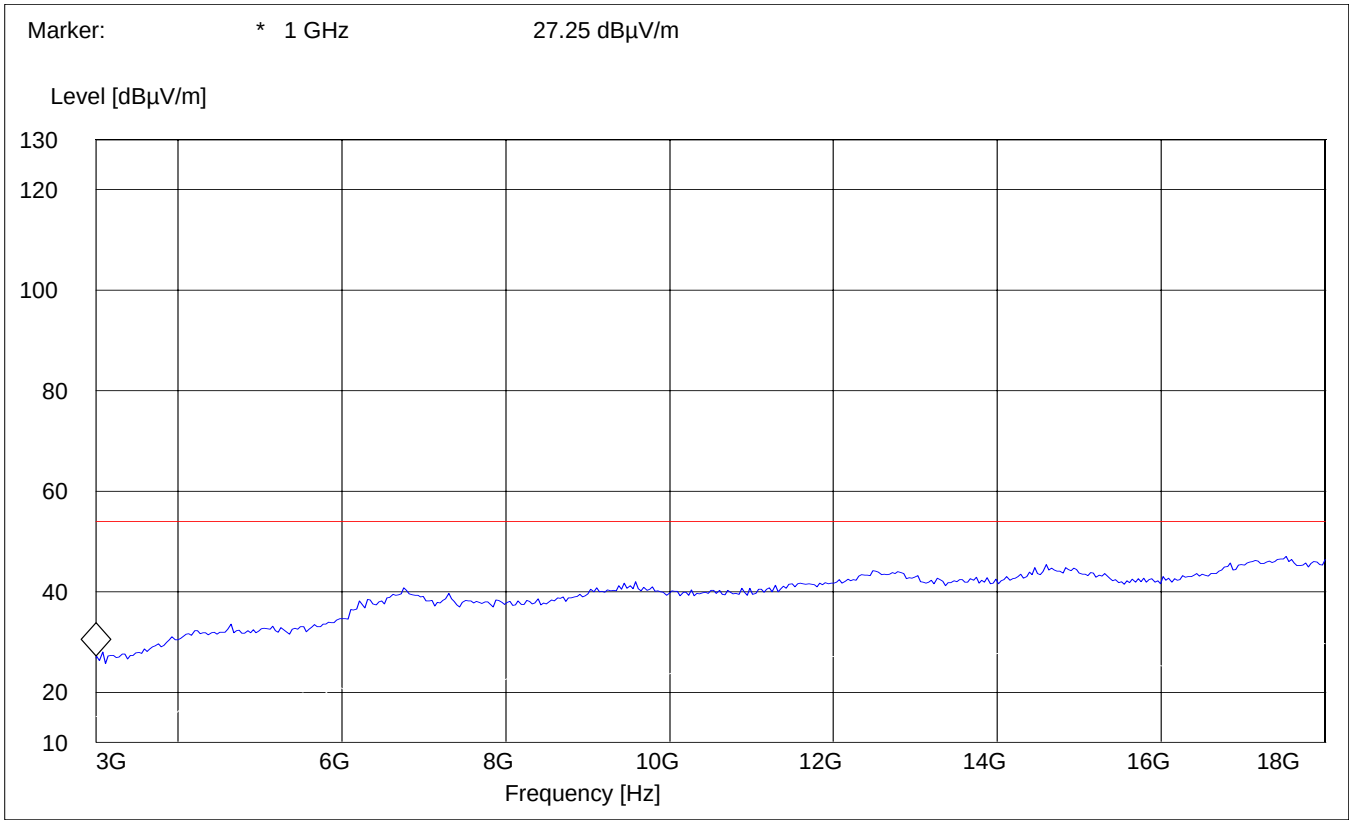
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)



RECEIVER SPURIOUS RADIATION § 15.109
3GHz – 18GHz

SWEEP TABLE: "Spuri hi 3-18G"

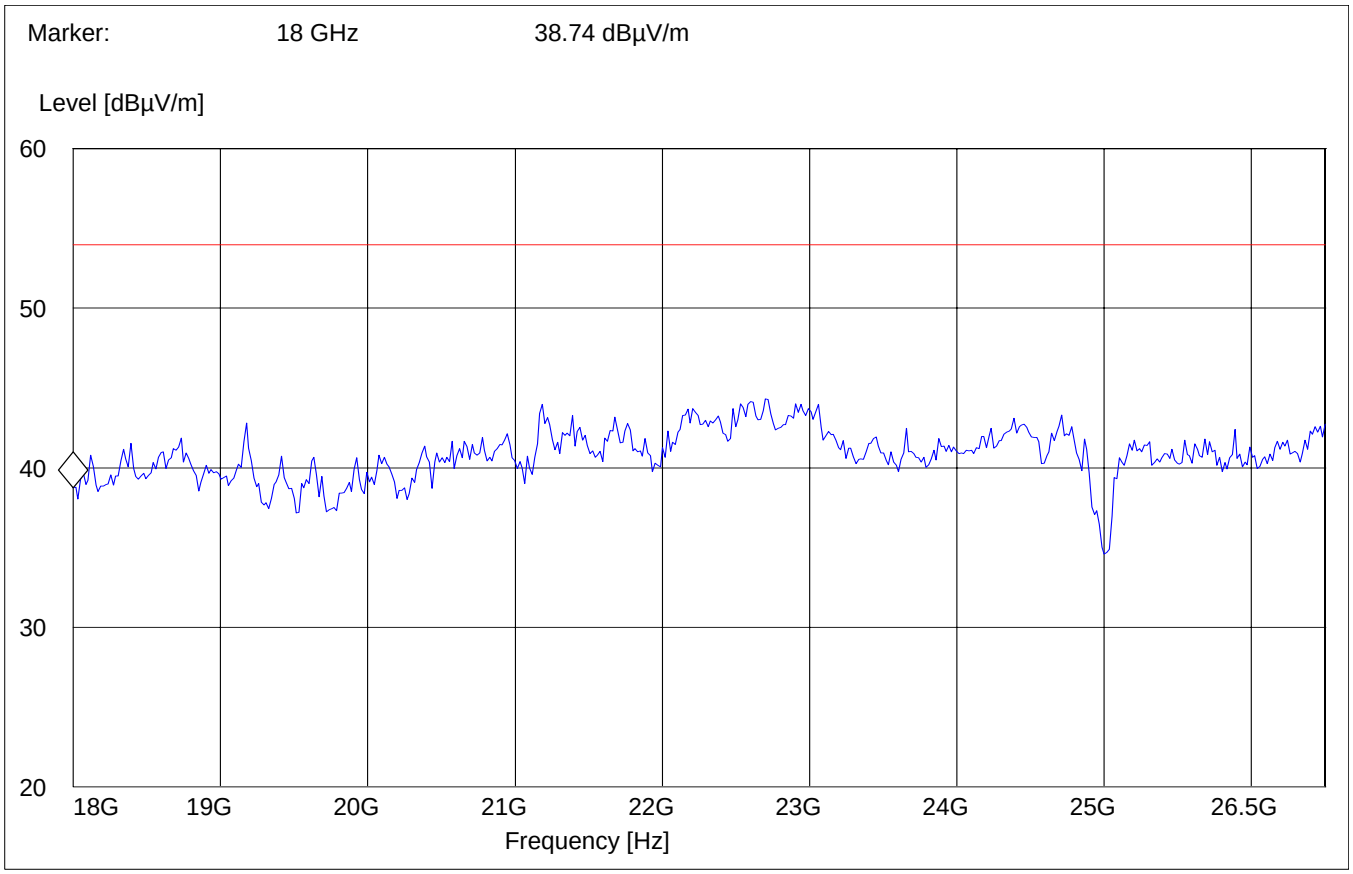
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
3.0 GHz	18 GHz	MaxPeak	Coupled	1 MHz	#326 horn (dBi)



RECEIVER SPURIOUS RADIATION § 15.109
18GHz – 26.5GHz

SWEEP TABLE: "Spuri hi 18-26.5G"

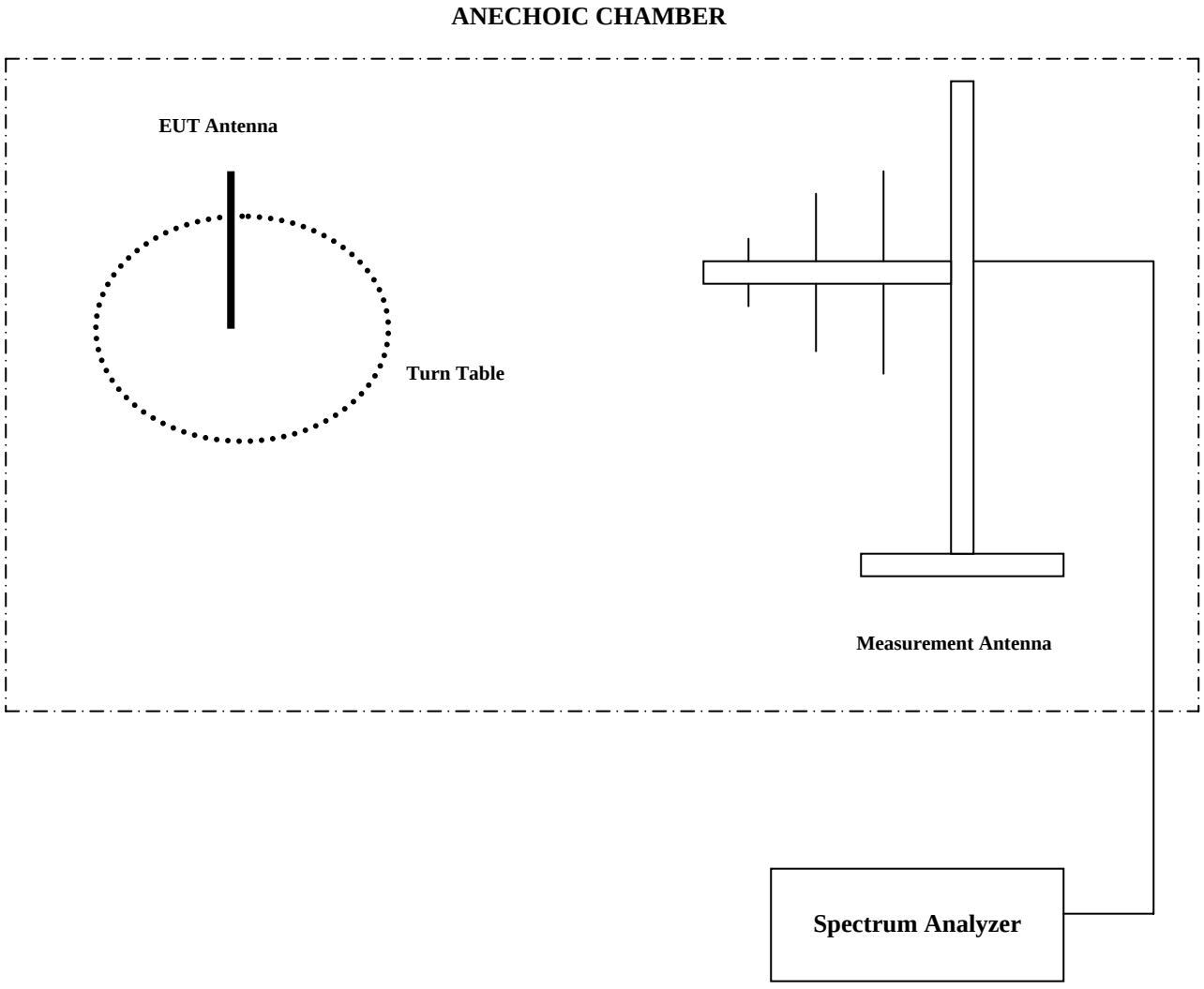
Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW VBW	Transducer
18 GHz	26.5 GHz	MaxPeak	Coupled	1 MHz	#141 horn (dBi)



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
Radiated Testing



Conducted Testing