



FCC Test Report

Test report no.: EMC_831FCC15.407_2005_rev1

FCC Part 15.407 for UNII Devices / CANADA RSS-210 Issue 5 for LELEAN Devices

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

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



Accredited according to ISO/IEC 17025



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

Table of Contents

- 1 General information
 - 1.1 Notes
 - 1.2 Testing laboratory
 - 1.3 Details of applicant
 - 1.4 Application details
 - 1.5 Test item
 - 1.6 Test standards
- 2 Technical test
 - 2.1 Summary of test results
 - 2.2 Test report
- 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
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 : 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 (not covered in this test report)
5180MHz – 5320MHz for 5GHz band (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 : 5.1dBi max. gain FPC antenna for 5180-5320GHz band (Hitachi model HFT17-DL03)
3.74dBi max gain stamped metal sheet ant. for 5180-5320GHz band (Phycomp model CAN4313 384 012501B)
Power supply : 3.3 VDC from Host
Output power : 12.77dBm (18.93mW) conducted power for 5150-5250GHz
14.22dBm (26.43mW) conducted power for 5250-5350GHz
Extreme temp. Tolerance : 0°C to +70°C

1.6 Test standards: **FCC Part 15 §15.407 / CANADA RSS-210**
Measurements done as per DA 02-2138

PROJECT OVERVIEW:

This test report carries all measurements required as per FCC 15.407 on WLAN mini PCI card model# BCM94318MPAGH tested in test fixture as per DA001407 requirements for modular transmitter approval.

Test methods were followed as per DA02-2138 & FCC04-165

All measurements are done with under-mentioned max gain antennas for each antenna type.

WLAN was tested for spurious emissions at different data rates. Test report shows only worst-case test results of all data rates with following power levels.

802.11a Mode:

Channels 36-48:12.0dBm

Channels 52-64:15.0dBm

Channel 149-165:15.0dBm


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 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:

2005-02-01	EMC & Radio	Lothar Schmidt (Technical Manager)	
Date	Section	Name	Signature

Responsible for test report and project leader:

2005-02-01	EMC & Radio	Harpreet Sidhu (EMC Engineer)	
Date	Section	Name	Signature

2.2 Test report

TEST REPORT

Test report no.: EMC_831FCC15.407_2005_rev1

FCC Part 15.407 for UNII Devices / CANADA RSS-210

TEST REPORT REFERENCE

	PAGE
LIST OF MEASUREMENTS	
EMISSION BANDWIDTH §15.407(a)(1)(2)	8
99% POWER BANDWIDTH RSS-210 §6.2.2(q1)(i)(ii)	12
PEAK OUTPUT POWER § 15.407 (a)(1)(2)	13
PEAK POWER SPECTRAL DENSITY §15.407 (a)(1)(2)(5)	15
PEAK EXCURSION §15.407 (a)(6)	19
Hitachi FPC antenna	23
BAND EDGE COMPLIANCE §15.407 (b)(1)(2)(4)(6)	24
EMISSION LIMITATIONS § 15.407 (b)(1)(2)(4)(6)	28
Phycomp Stamped Metal Sheet antenna	41
BAND EDGE COMPLIANCE §15.407 (b)(1)(2)(4)(6)	42
EMISSION LIMITATIONS § 15.407 (b)(1)(2)(4)(6)	46
CONDUCTED EMISSIONS § 15.107/207	54
RECEIVER SPURIOUS RADIATION § 15.209	55
TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS	61
BLOCK DIAGRAMS	62

EMISSION BANDWIDTH

§15.407(a)(1)(2)

26dB bandwidth

(Data rate – 6Mbps)

6Mbps is found to be worst-case for this measurement. Following method as defined in DA 02-2138 was used for this measurement.

Test Results

TEST CONDITIONS		26 dB BANDWIDTH (MHz)		
Frequency (MHz)		5180	5260	5320
T_{nom}(23)°C	V_{nom}(3.3) VDC	18.19	18.39	18.47

LIMIT

SUBCLAUSE §15.407(c)

Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

ANALYZER SETTINGS: RBW=200KHz, VBW=200KHz

EMISSION BANDWIDTH

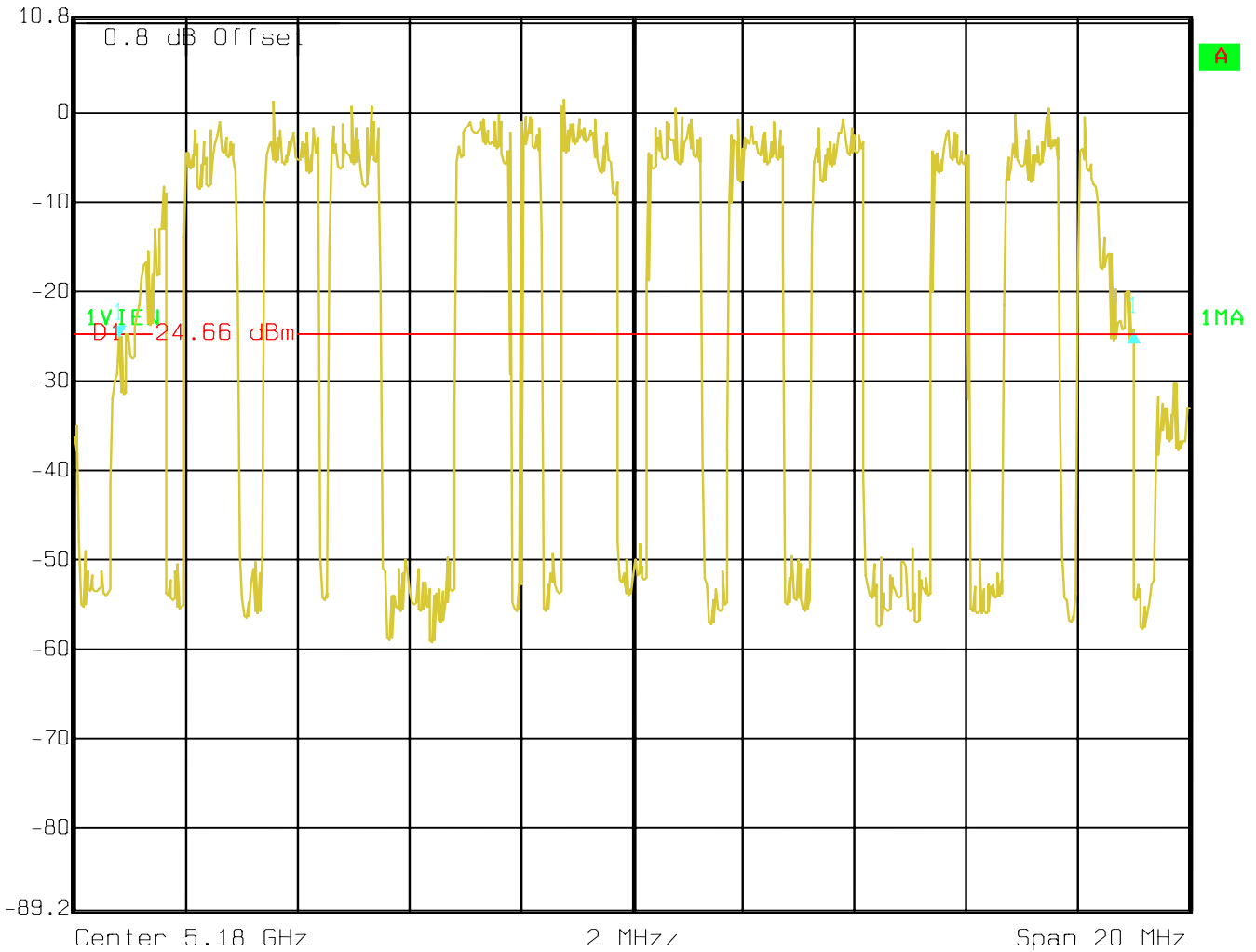
§15.407(a)(1)(2)

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

Lowest Channel: 5180MHz



	Delta 1 [T1]	RBW	200 kHz	RF Att	40 dB
Ref Lvl	0.92 dB	VBW	200 kHz		
10.8 dBm	18.19639279 MHz	SWT	5 ms	Unit	dBm



Date: 19.JAN.2005 16:57:25

EMISSION BANDWIDTH

§15.407(a)(1)(2)

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

Mid Channel: 5260MHz



Delta 1 [T1]

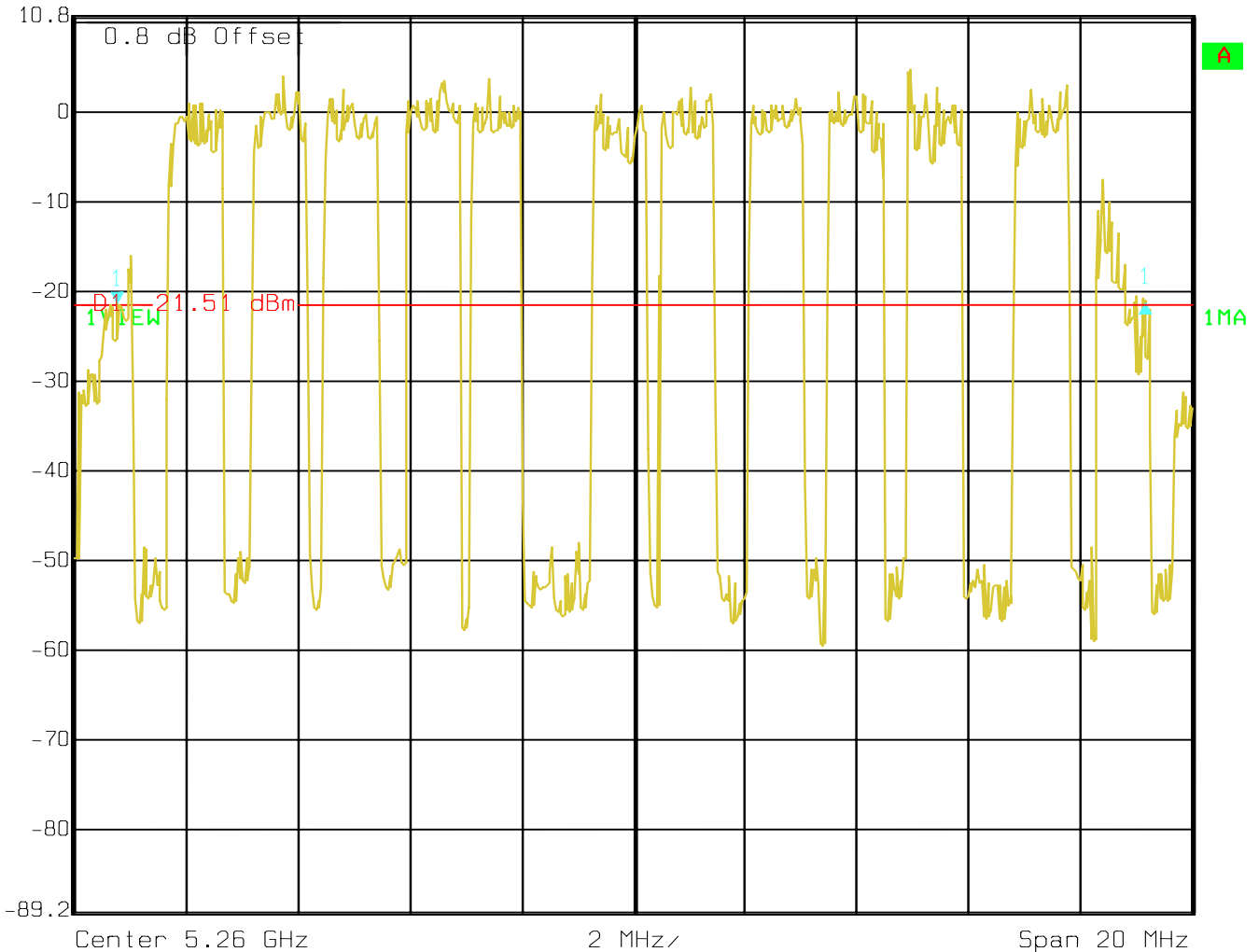
RBW 200 kHz RF Att 40 dB

Ref Lvl 0.27 dB

VBW 200 kHz

10.8 dBm 18.39679359 MHz

SWT 5 ms Unit dBm



Date: 19.JAN.2005 16:59:52

EMISSION BANDWIDTH

§15.407(a)(1)(2)

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

Highest Channel: 5320MHz



Delta 1 [T1]

RBW 200 kHz RF Att 40 dB

Ref Lvl

0.88 dB

VBW 200 kHz

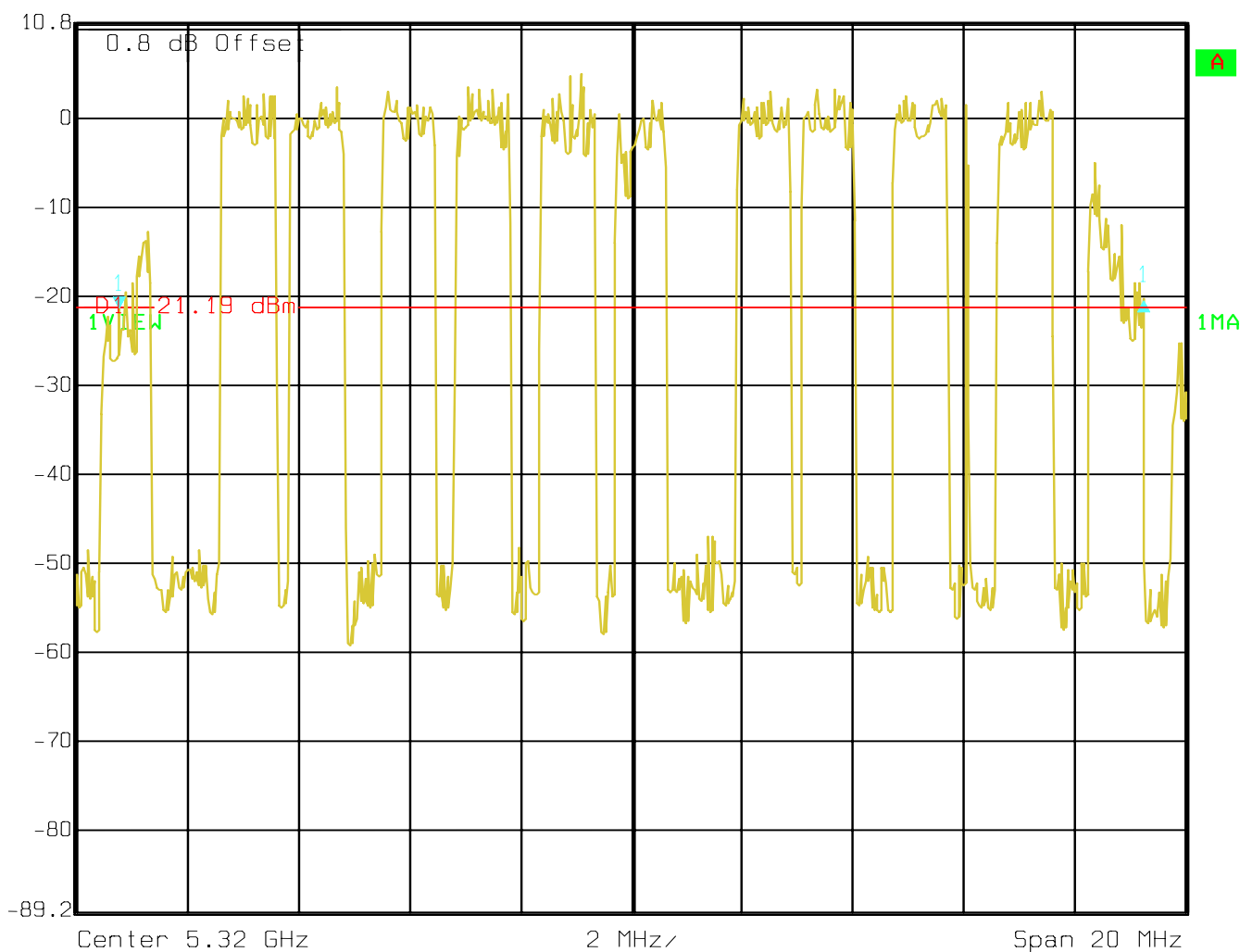
10.8 dBm

18.47695391 MHz

SWT 5 ms

Unit

dBm



99% POWER BANDWIDTH
20 dB bandwidth
(Data rate – 6Mbps)

RSS-210 §6.2.2(q1)(i)(ii)

Test Results

TEST CONDITIONS		20 dB BANDWIDTH (MHz)		
Frequency (MHz)		5180	5260	5320
T_{nom}(23)°C	V_{nom}(3.3) VDC	16.5	16.5	16.7

ANALYZER SETTINGS: RBW=200KHz, VBW=200KHz

PEAK OUTPUT POWER

§ 15.407 (a)(1)(2)

(Conducted)

(Data rate – 54Mbps)

54Mbps is found to be worst-case for peak output power.

Test Procedure:

DA02-2138 Method-3.

Test Results

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)			
Frequency (MHz)		5180	5260	5320	
T _{nom} (23)°C	V _{nom} (3.3) VDC	Pk	12.77	14.22	14.20
Measurement uncertainty		±0.5dBm			

LIMIT

SUBCLAUSE § 15.407 (a)(1)(2)

Frequency range (GHz)	Conducted Peak Power
5.15 – 5.25	17dBm
5.25 – 5.35	24dBm

**MAXIMUM PEAK OUTPUT POWER
(RADIATED)**

§ 15.407 (a)(1)(2)

(Data rate – 54Mbps)

54Mbps is found to be worst-case for peak output power.

EIRP:

Test Results

TEST CONDITIONS		MAXIMUM PEAK OUTPUT POWER (dBm)		
		5180	5260	5320
Frequency (MHz)				
T _{nom} (23)°C	V _{nom} (3.3) VDC	*17.87	*19.32	*19.3
Measurement uncertainty		±0.5dBm		

*Note: EIRP is calculated based on 5.1Bi antenna gain and conducted peak power measurements.

LIMIT

SUBCLAUSE § 15.407 (a)(1)(2)

Frequency range (GHz)	Conducted Peak Power
5.15 – 5.25	17dBm
5.25 – 5.35	24dBm
If transmitting antennas of directional gain greater than 6dBi are used, both the peak transmit power and the peak spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi	

PEAK POWER SPECTRAL DENSITY

§15.407 (a)(1)(2)(5)

(Data rate – 6Mbps)

6Mbps is found to be worst-case data rate for Power spectral density. Method-2 from DA 02-2138 was used for this measurement.

Test Procedure:

DA02-2138 Method-2.

Test Results

TEST CONDITIONS		POWER SPECTRAL DENSITY (dBm)		
		5180	5260	5320
Frequency (MHz)				
T _{nom} (23)°C	V _{nom} (3.3) VDC	2.48	5.67	6.33

LIMIT

SUBCLAUSE § 15.407 (a)(1)(2)

Frequency range (GHz)	Conducted Peak Power
5.15 – 5.25	4dBm in any 1MHz band
5.25 – 5.35	11dBm in any 1MHz band
If transmitting antennas of directional gain greater than 6dBi are used, both the peak transmit power and the peak spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi	

ANALYZER SETTINGS: RBW=1MHz, VBW=3MHz

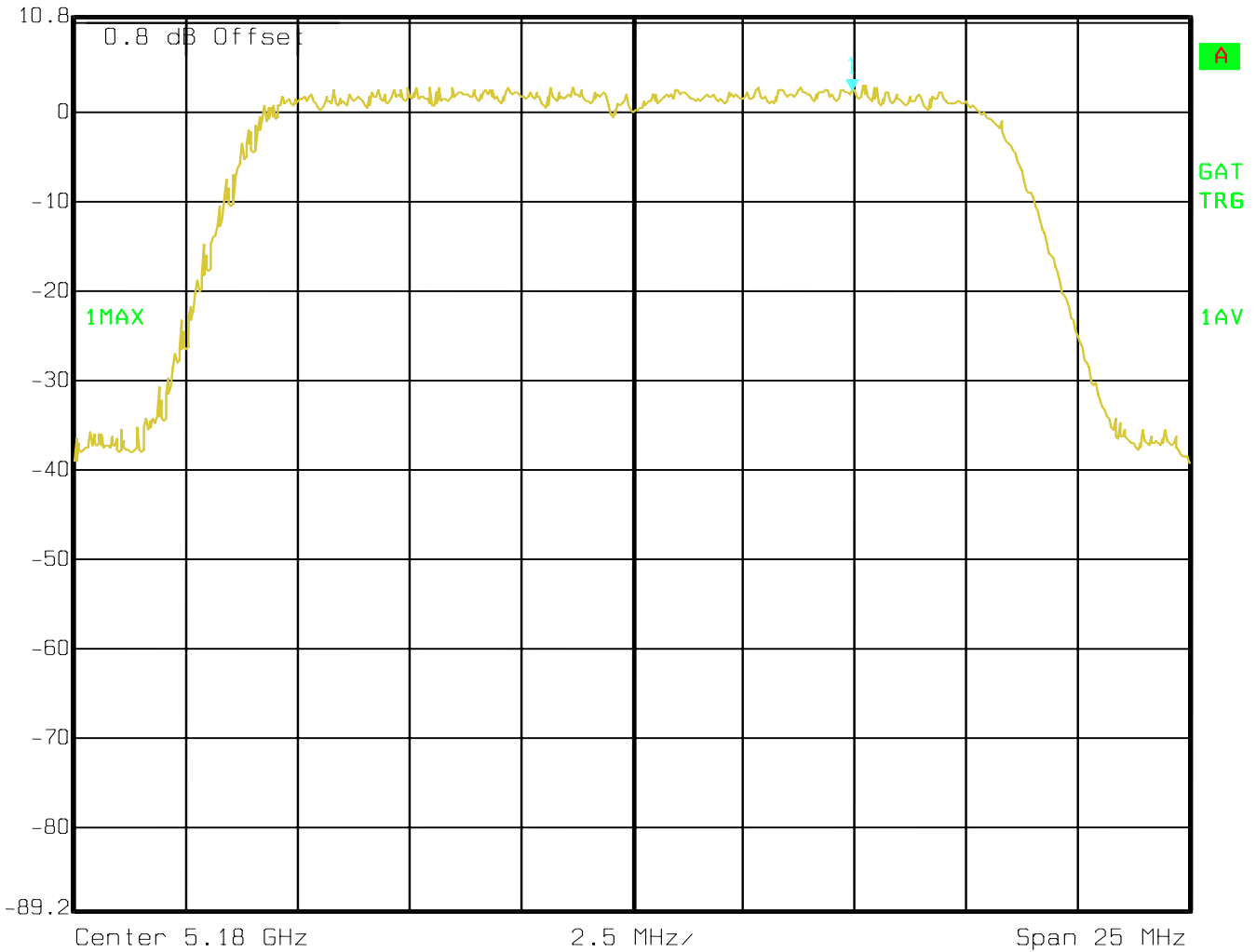
POWER SPECTRAL DENSITY
(Data rate – 6Mbps)

§15.407(a)(1)(2)(5)

Lowest Channel: 5180MHz



Ref Lvl 10.8 dBm
Marker 1 [T1] 2.42 dBm
5.18493487 GHz
RBW 1 MHz RF Att 20 dB
VBW 3 MHz
SWT 5 ms Unit dBm



Date: 19.JAN.2005 18:51:37

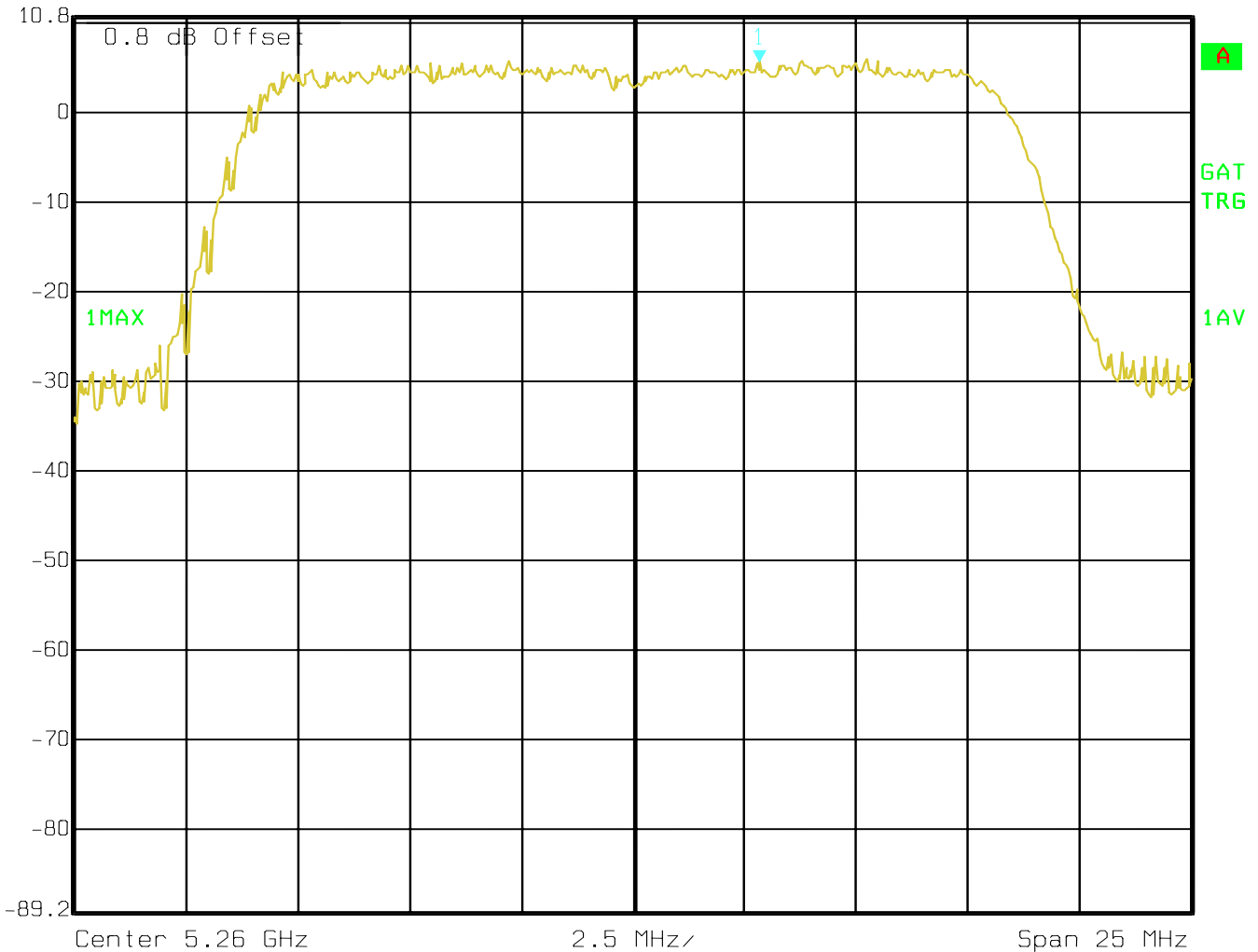
POWER SPECTRAL DENSITY
(Data rate – 6Mbps)

§15.407(a)(1)(2)(5)

Mid Channel: 5260MHz



Ref Lvl 10.8 dBm
Marker 1 [T1] 5.67 dBm
5.26283066 GHz
RBW 1 MHz RF Att 20 dB
VBW 3 MHz
SWT 5 ms Unit dBm



Date: 19.JAN.2005 18:52:41

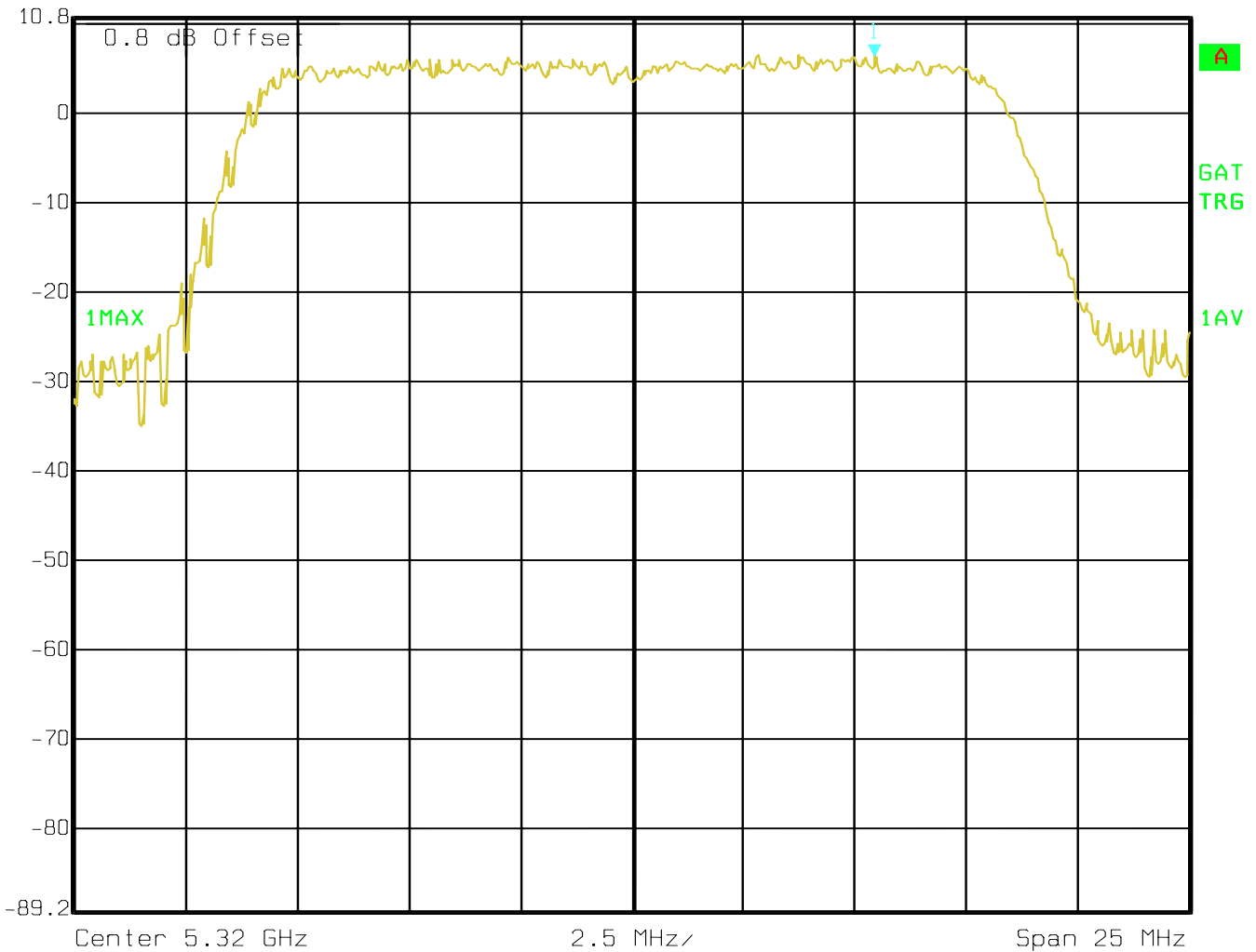
POWER SPECTRAL DENSITY
(Data rate – 6Mbps)

§15.407(a)(1)(2)(5)

Highest Channel: 5320MHz



Ref Lvl 10.8 dBm
Marker 1 [T1] 5.32543587 GHz 6.33 dBm
RBW 1 MHz RF Att 20 dB
VBW 3 MHz
SWT 5 ms Unit dBm



Date: 19.JAN.2005 18:53:22

PEAK EXCURSION

§15.407 (a)(6)

(Data rate – 54Mbps)

54Mbps is found to be worst-case for this measurement. Following method as defined in DA 02-2138 was used for this measurement.

Test Procedure:

Method-3 was used for conducted Peak Power

Test Results

TEST CONDITIONS		PEAK EXCURSION RATIO (dB)		
Frequency (MHz)		5180	5260	5320
T _{nom} (23)°C	V _{nom} (3.3) VDC	2.23	3.67	3.97

LIMIT

SUBCLAUSE §15.407(a)(6)

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power shall not exceed 13dB across any 1MHz bandwidth or the emission bandwidth which ever is less.

PEAK EXCURSION

§15.407 (a)(6)

(Data rate – 54Mbps)

Lowest Channel: 5180MHz



Marker 1 [T1]

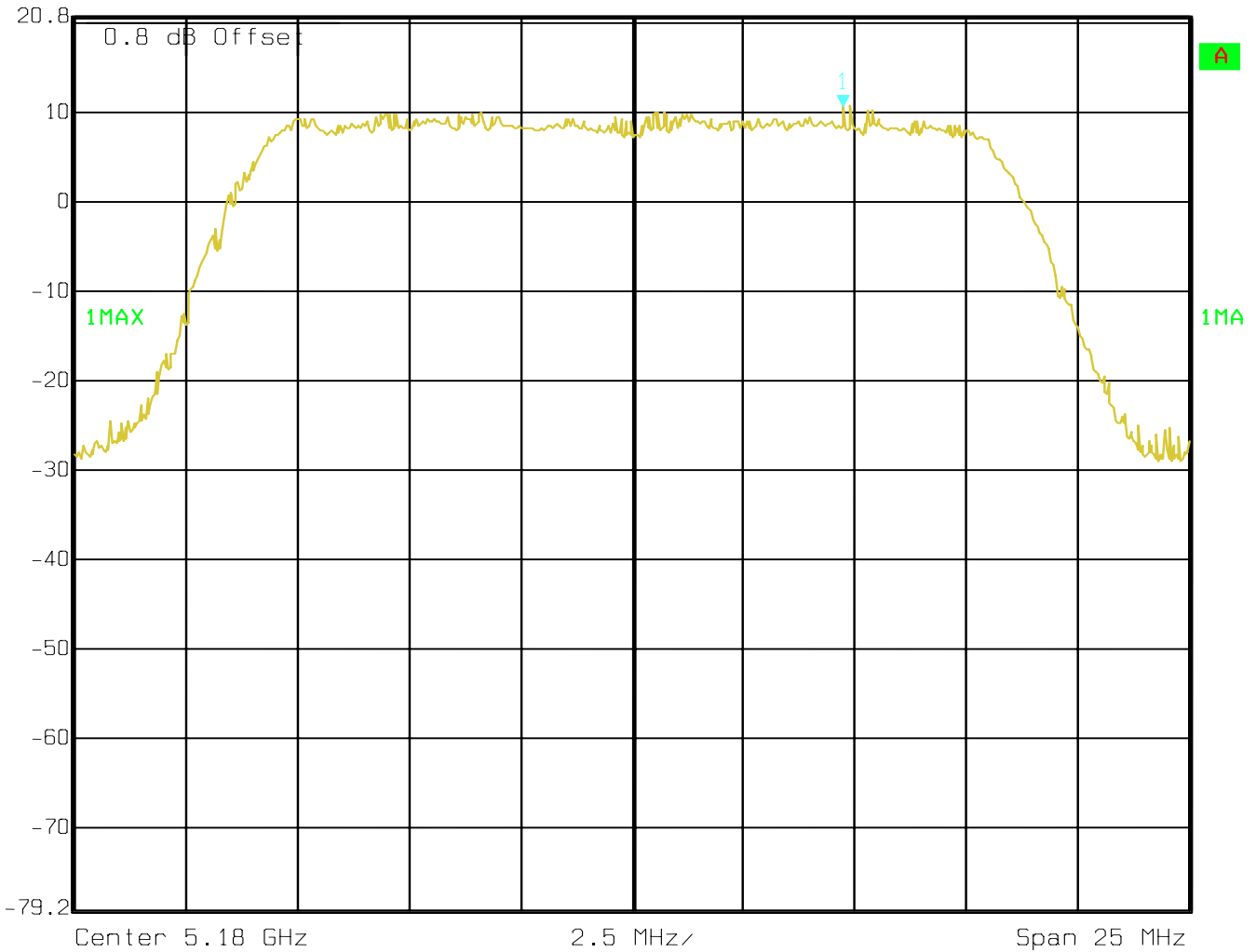
RBW 1 MHz RF Att 50 dB

Ref Lvl 10.58 dBm

VBW 1 MHz

20.8 dBm 5.18473447 GHz

SWT 5 ms Unit dBm



Date: 19.JAN.2005 19:03:14

PEAK EXCURSION

§15.407 (a)(6)

(Data rate – 54Mbps)

Mid Channel: 5260MHz



Marker 1 [T1]

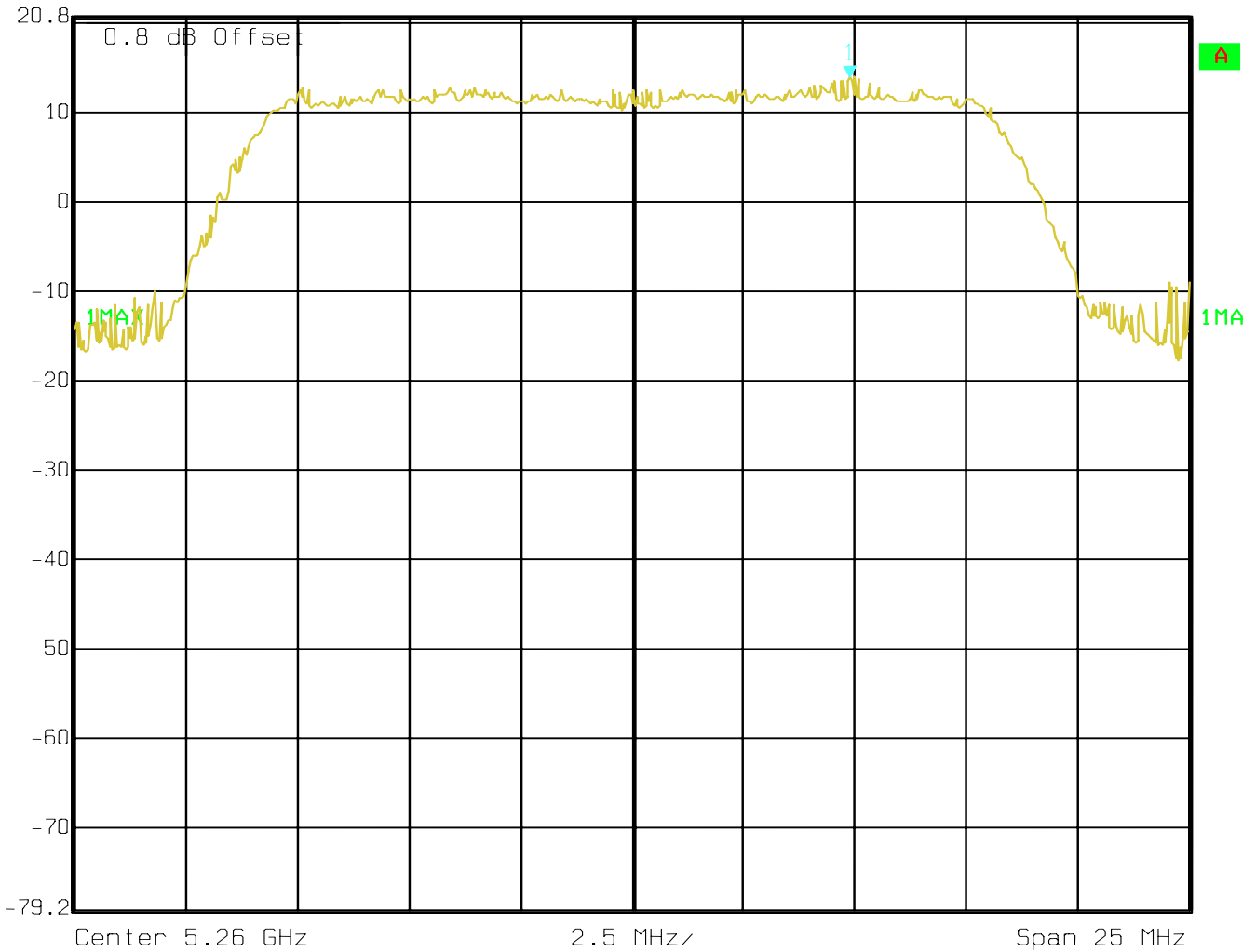
RBW 1 MHz RF Att 50 dB

Ref Lvl 13.92 dBm

VBW 1 MHz

20.8 dBm 5.26488477 GHz

SWT 5 ms Unit dBm



Date: 19.JAN.2005 19:02:24

PEAK EXCURSION

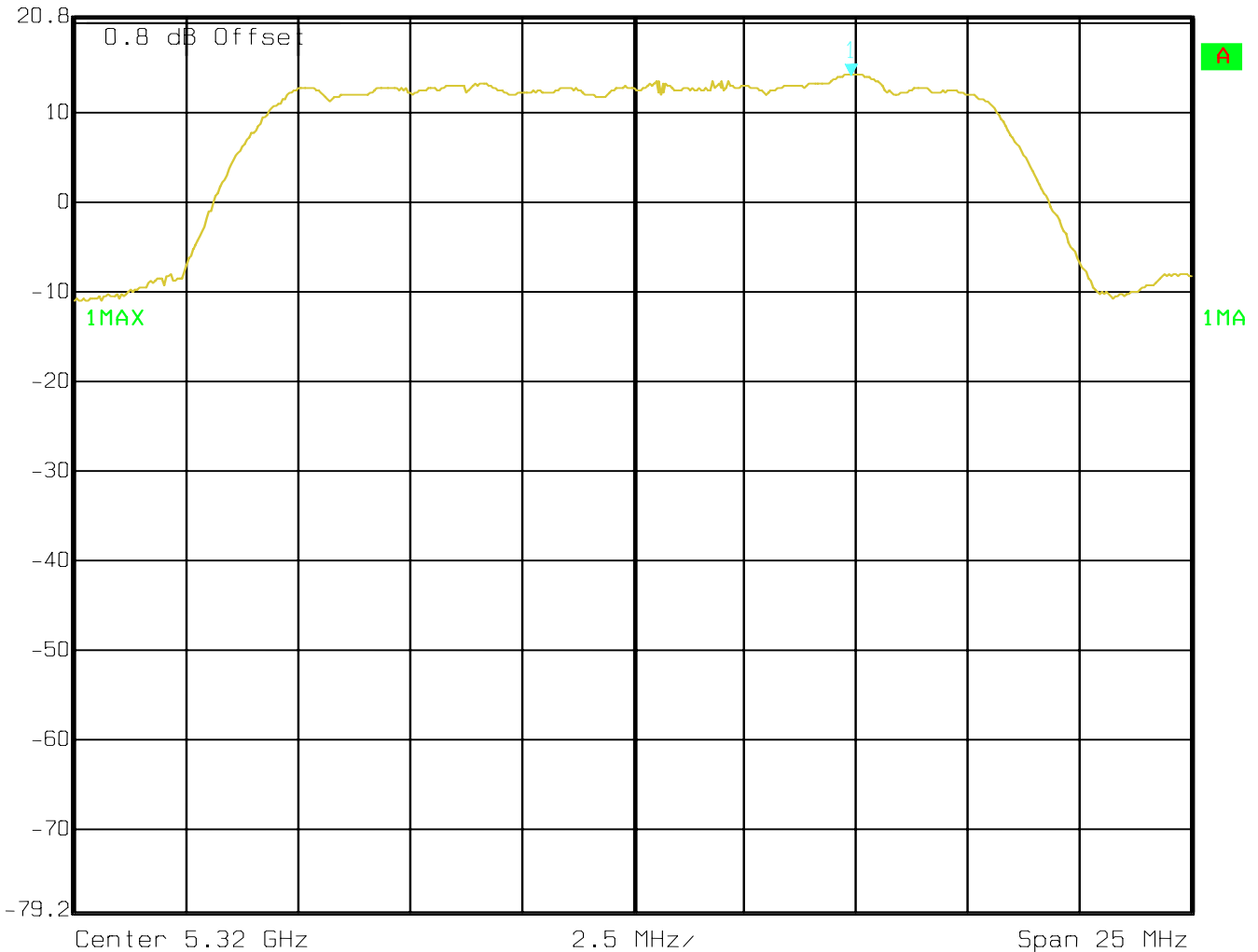
§15.407 (a)(6)

(Data rate – 54Mbps)

Highest Channel: 5320MHz



Marker 1 [T1] RBW 1 MHz RF Att 50 dB
Ref Lvl 14.27 dBm VBW 1 MHz
20.8 dBm 5.32488477 GHz SWT 5 ms Unit dBm



Date: 19.JAN.2005 19:01:54

**Hitachi FPC antenna
(Freq. band: 5180-5320MHz, Gain: 5.1dBi, Model HFT17-DL03)**

BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 6Mbps)

Hitachi FPC Antenna

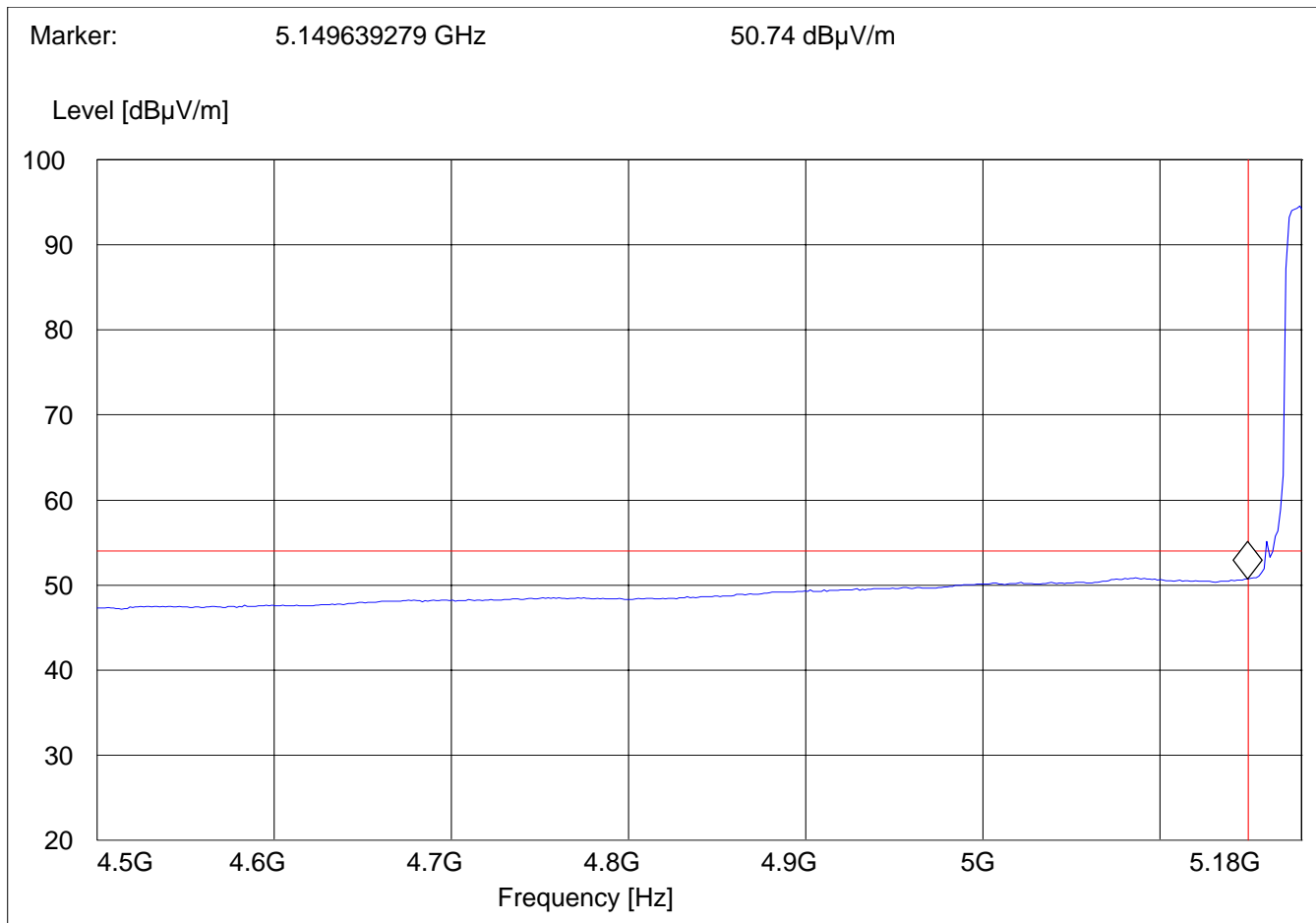
Low frequency section (spurious in the restricted band 4500 – 5150 MHz)

(Average measurement)

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

Operating condition : Tx at 5180MHz
 SWEEP TABLE : "FCC15.407 LBE_AVG"
 Limit Line horizontal : 54dBμV
 Limit Line vertical : 5150MHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
4.5 GHz	5.19 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 54Mbps)

Hitachi FPC Antenna

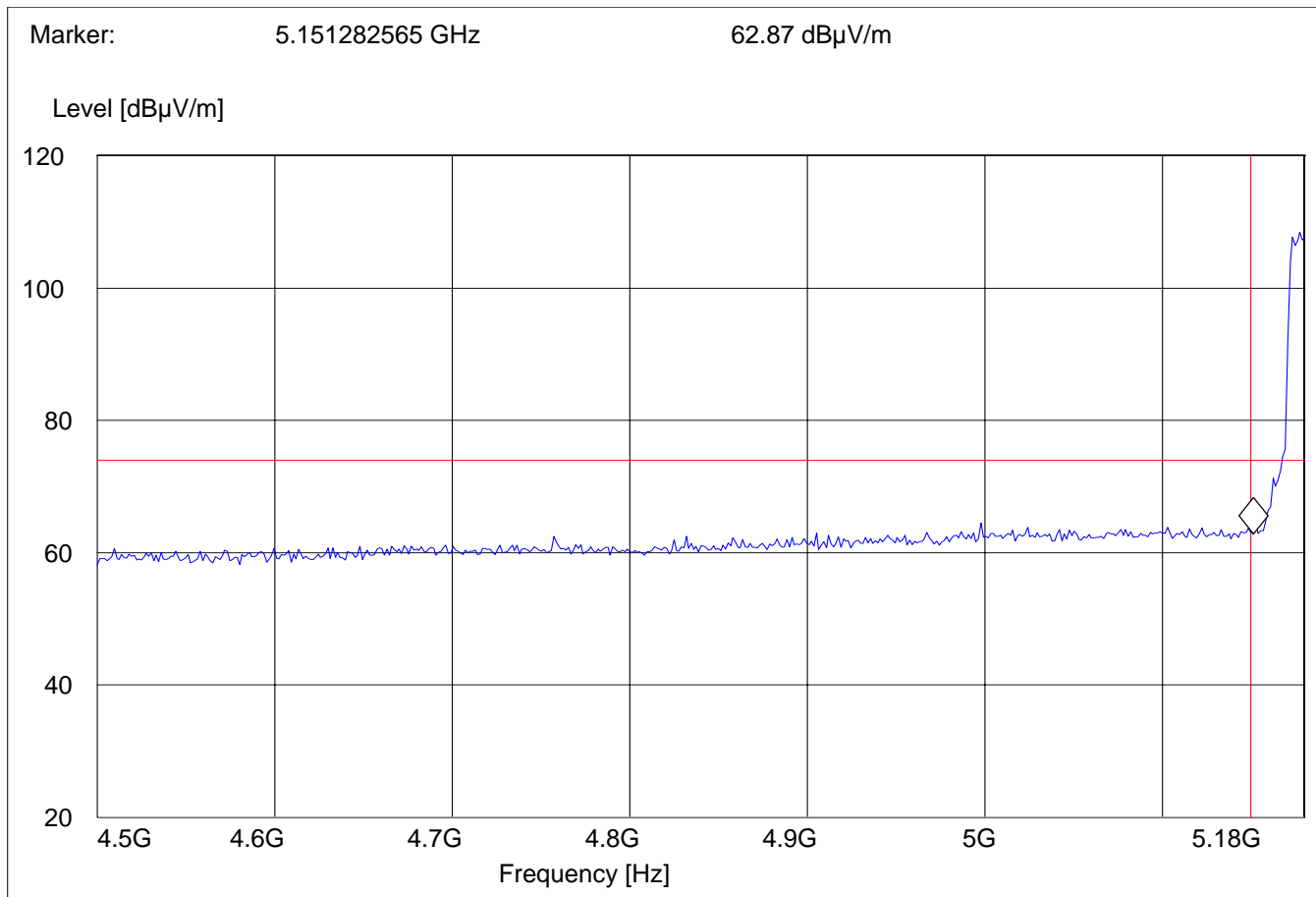
Low frequency section (spurious in the restricted band 4500 – 5150 MHz)

(Peak measurement)

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

Operating condition : Tx at 5180MHz
 SWEEP TABLE : "FCC15.407 LBE_Pk"
 Limit Line horizontal : 74dBμV
 Limit Line vertical : 5150MHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
4.5 GHz	5.19 GHz	MaxPeak	Coupled	1MHz	1MHz	#326 horn (dBi)



BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 6Mbps)

Hitachi FPC Antenna

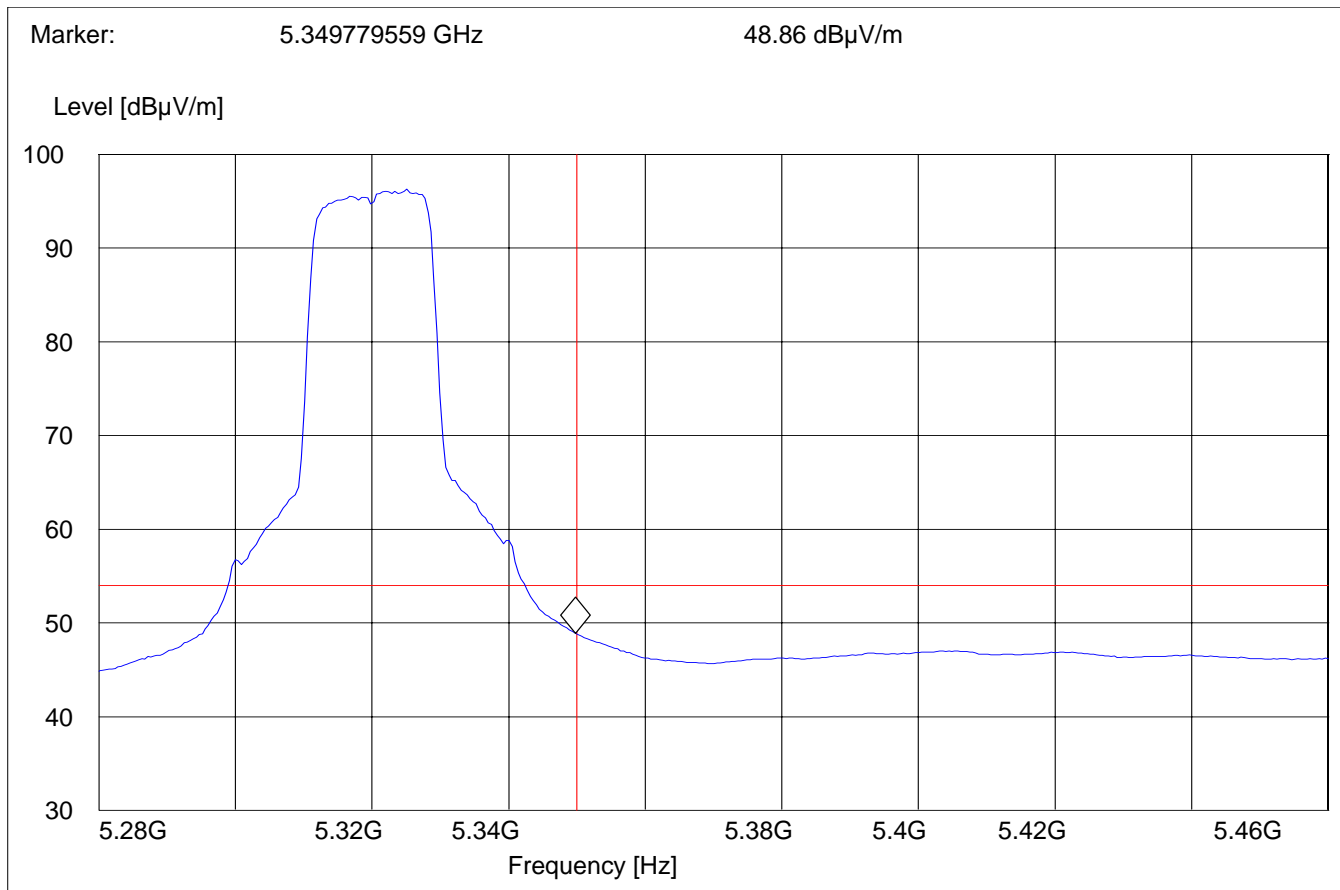
High frequency section (spurious in the restricted band 5350 – 5460 MHz)

(Average measurement)

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

Operating condition : Tx at 5320MHz
 SWEEP TABLE : "FCC15.407 HBE_AVG"
 Limit Line horizontal : 54dBμV
 Limit Line vertical : 5350MHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
5.28 GHz	5.46 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 54Mbps)

Hitachi FPC Antenna

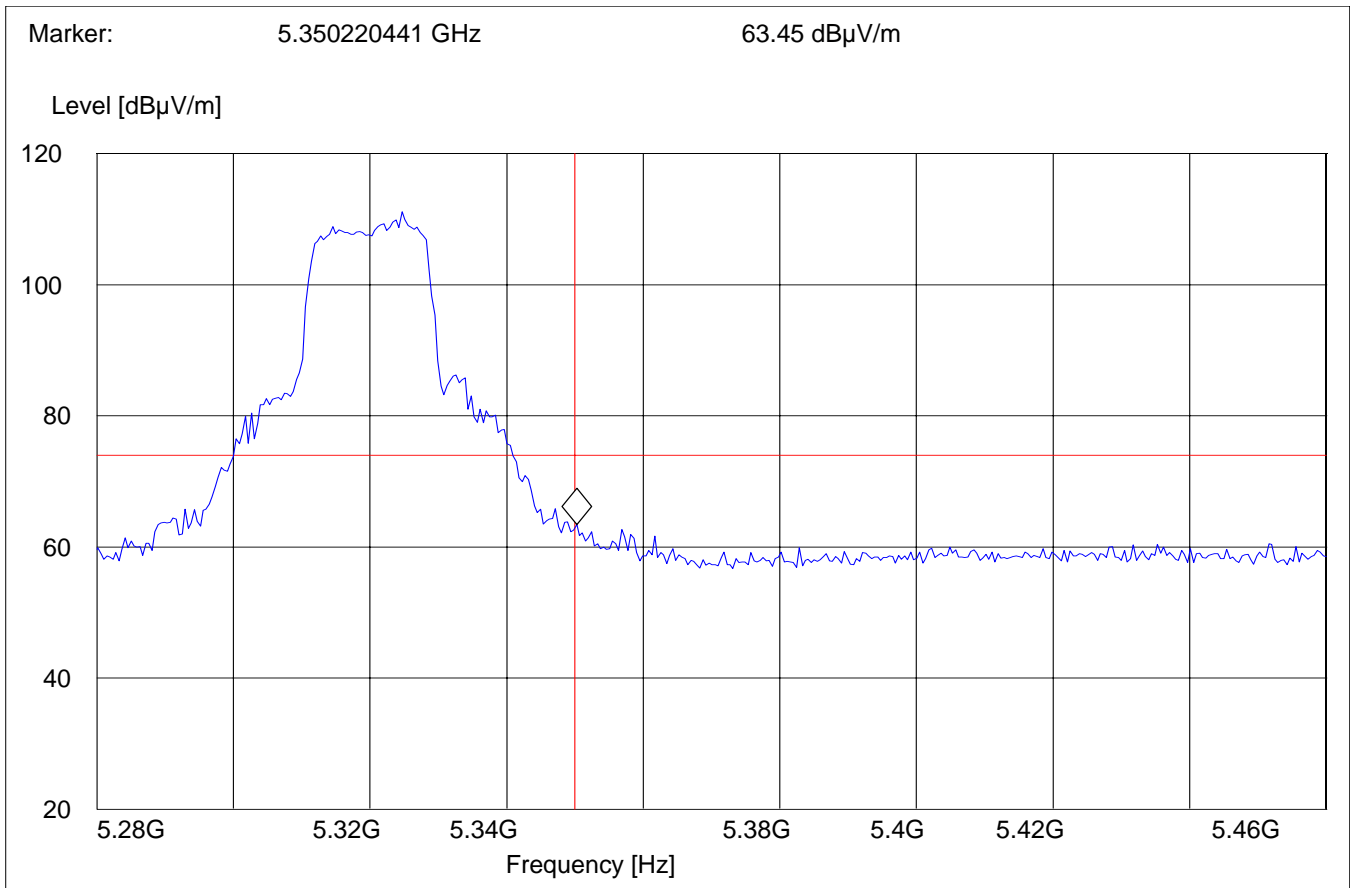
High frequency section (spurious in the restricted band 5350 – 5460 MHz)

(Peak measurement)

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

Operating condition : Tx at 5320MHz
 SWEEP TABLE : "FCC15.407 HBE_Pk"
 Limit Line horizontal : 74dBμV
 Limit Line vertical : 5350MHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
5.28 GHz	5.46 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)



EMISSION LIMITATIONS

§ 15.407 (b)(1)(2)(4)(6)

Transmitter (Radiated)**Hitachi FPC Antenna****(Data rate – 54Mbps)****Limits**

§ 15.209 / § 15.407

Freq. (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)
0.009-0.490	2400/F (kHz)	
0.490-1.750	24000/F (kHz)	
1.705-30.0	30	29.54
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960*	500	53.97
1000-40000**	2013.8	66.08

*) Limit in restricted bands

**) Limit outside restricted bands

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 40 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.

Transmit at Lowest channel Frequency 5180MHz			
Frequency (MHz)	Level (dBμV/m)		
	Peak	Quasi-Peak	Average
1060	41.73		29.82
1130	41.55		27.62
3453	62.97		46.99
5425	58.56		49.43
10368	61.11		48.65
15550	49.07		31.57
Transmit at Middle channel Frequency 5260MHz			
Frequency (MHz)	Level (dBμV/m)		
	Peak	Quasi-Peak	Average
1130	44.32		29.24
3501	63.74		44.73
6996	55.63		36.39
10539	69.27		52.17
15786	57.44		40.34
Transmit at Highest channel Frequency 5320MHz			
Frequency (MHz)	Level (dBμV/m)		
	Peak	Quasi-Peak	Average
1060	40.76		29.82
1130	43.00		29.78
3549	65.11		49.63
5557	61.84		50.28
7098	57.58		34.78
10641	67.26		50.81
15990	51.94		38.68

EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5180MHz): 30MHz – 1GHz

(Data rate – 54Mbps)

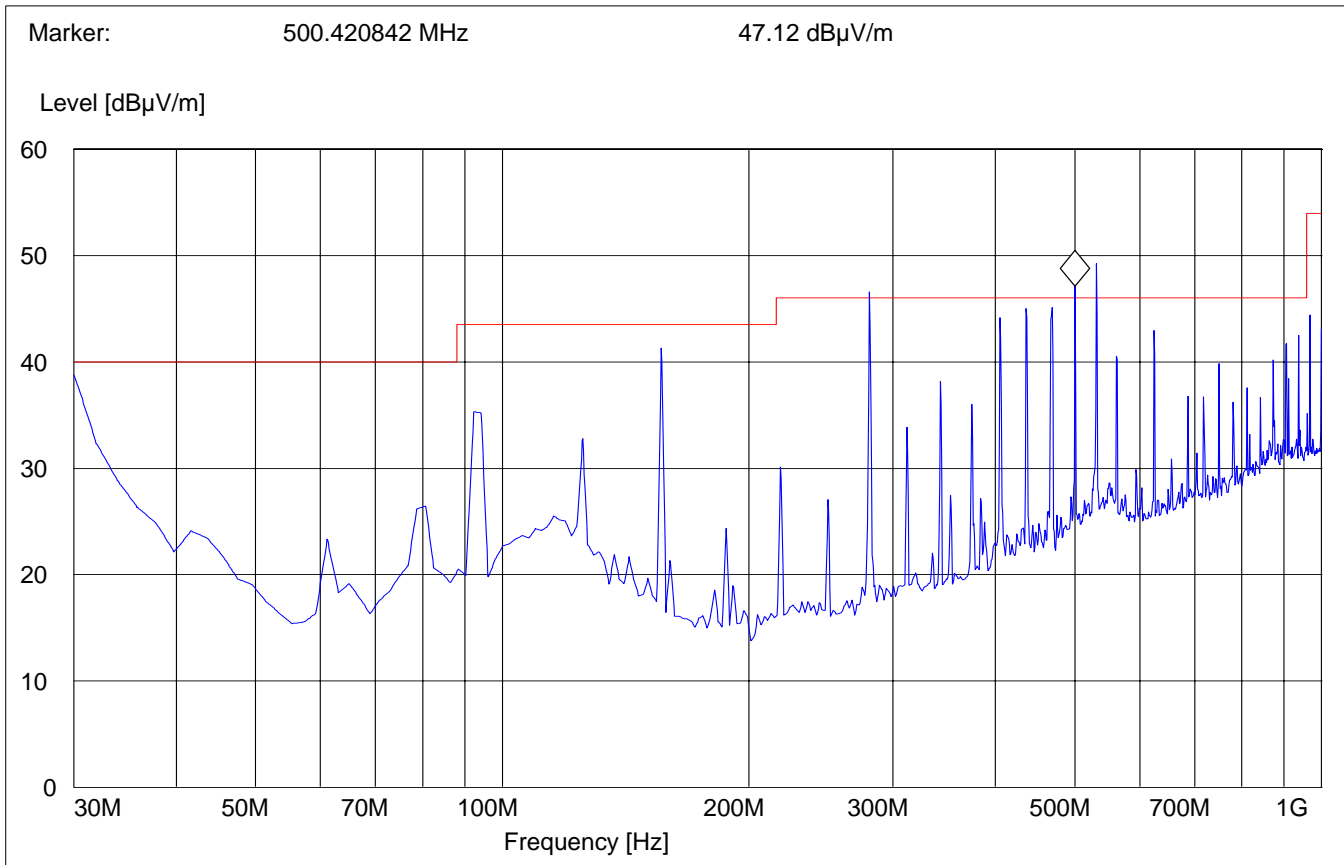
Hitachi FPC Antenna

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

Antenna:	Vertical				
EUT plane:	Horizontal with screen vertical @ 90°				
SWEEP TABLE:					
Start	Stop	Detector	Meas.	RBW	Transducer
Frequency	Frequency		Time	VBW	
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186

Freq. (MHz)	Pk Level (dBµV/m)	QPk Level (dBµV/m)
280.76	46.55	43.55
500.42	47.12	42.12
531.523	49.24	43.24



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5180MHz): 30MHz – 1GHz

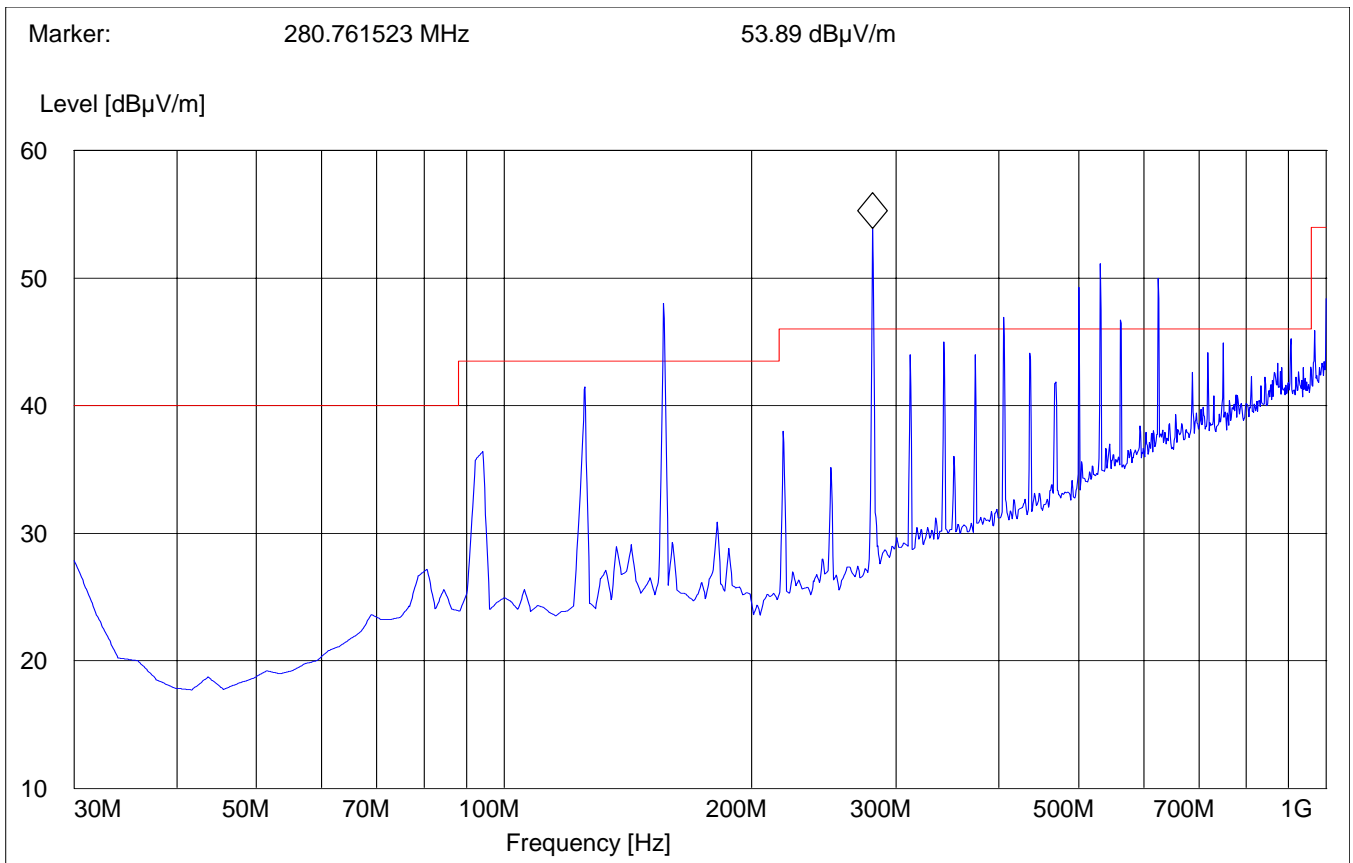
(Data rate – 54Mbps)

Hitachi FPC Antenna

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

Antenna:	Horizontal				
EUT plane:	Horizontal with screen vertical @ 90°				
SWEEP TABLE:	"FCC 15.407 30-1G_H"				
Start	Stop	Detector	Meas. Time	RBW	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186
Freq. (MHz)		Pk Level (dBµV/m)		QPk Level (dBµV/m)	
156.352		48.03		43.03	
280.76		53.89		51.89	
405.17		46.93		40.93	
500.42		49.26		43.76	
531.52		51.13		45.13	
562.62		46.69		40.69	
624.83		49.99		44.29	



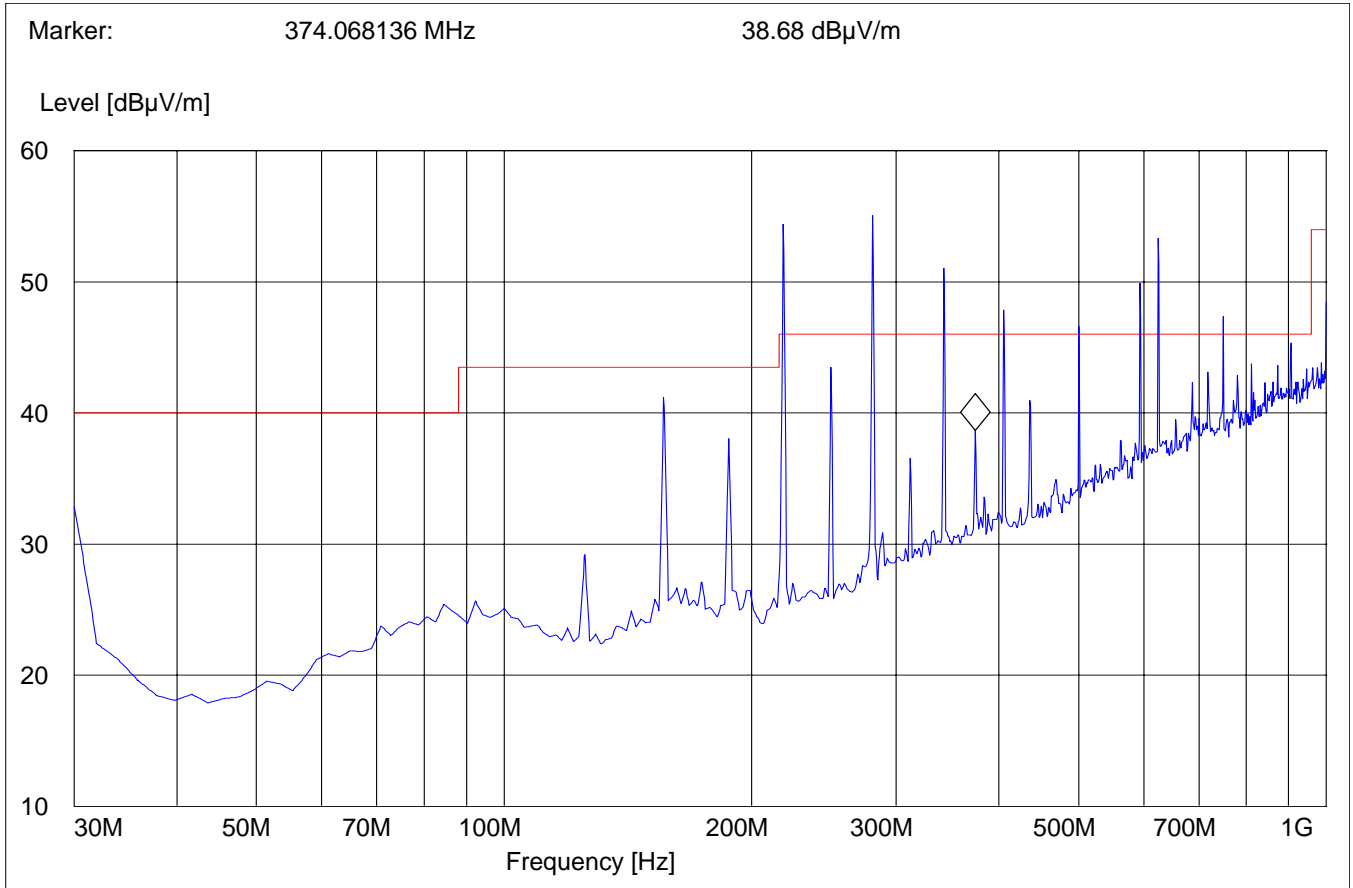
EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.247 (c) (1)

30MHz – 1GHz

Hitachi FPC Antenna

Test Fixture only (no WLAN card)



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5180MHz): 1GHz – 7GHz

(Average)

(Data rate – 6Mbps)

Hitachi FPC Antenna

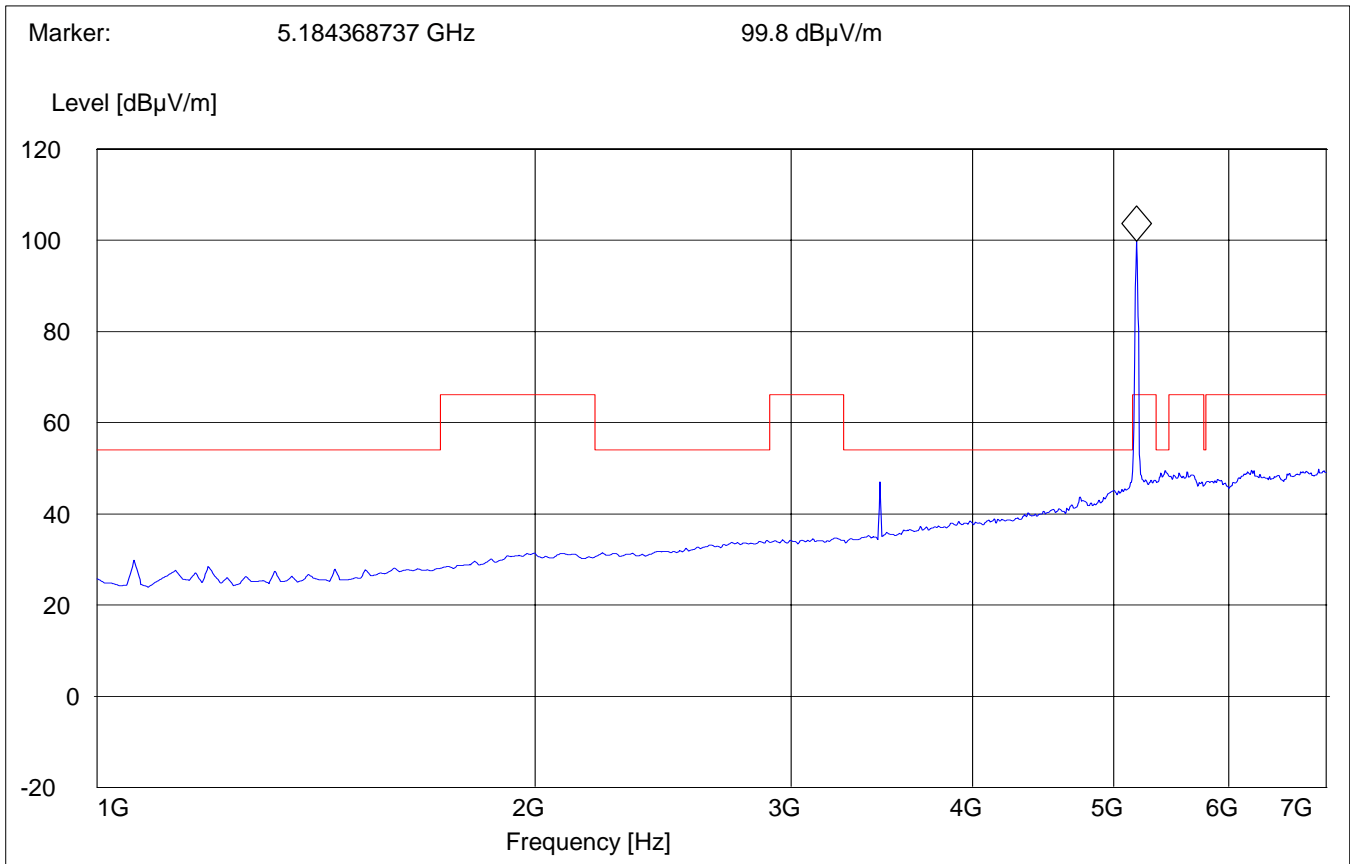
Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE: "FCC 15.407 1-7G"

Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW	Transducer
1GHz	7.0 GHz	MaxPeak	Coupled	1MHz	10Hz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

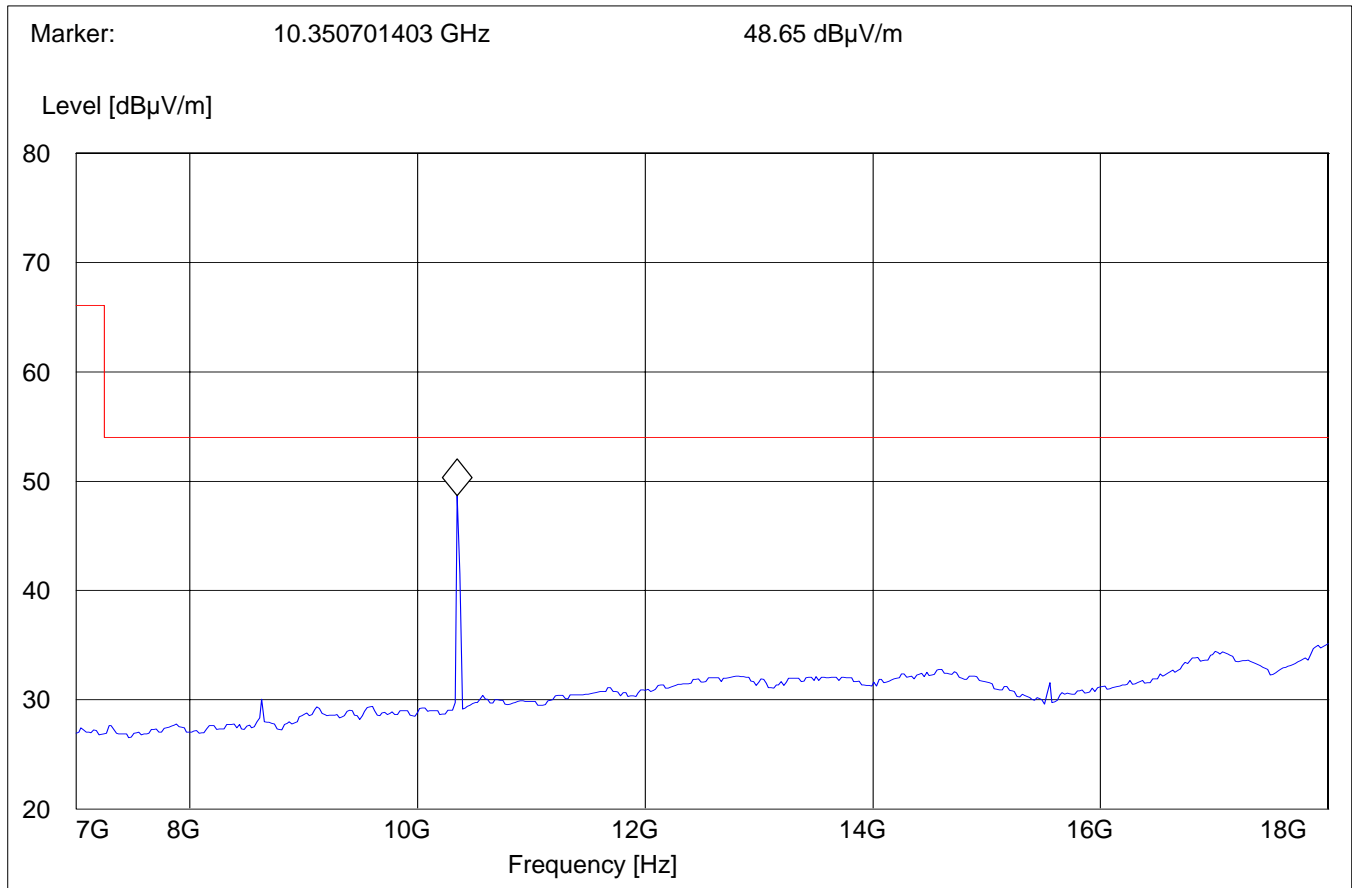
Lowest Channel (5180MHz): 7GHz – 18GHz

(Data rate – 6Mbps)

Hitachi FPC Antenna

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

SWEEP TABLE:		"FCC 15.407 7-18G"			
Start	Stop	Detector	Meas. Time	RBW	Transducer
Frequency	Frequency			VBW	
7GHz	18.0 GHz	MaxPeak	Coupled	1MHz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5260MHz): 1GHz – 7GHz

(Average)

(Data rate – 6Mbps)

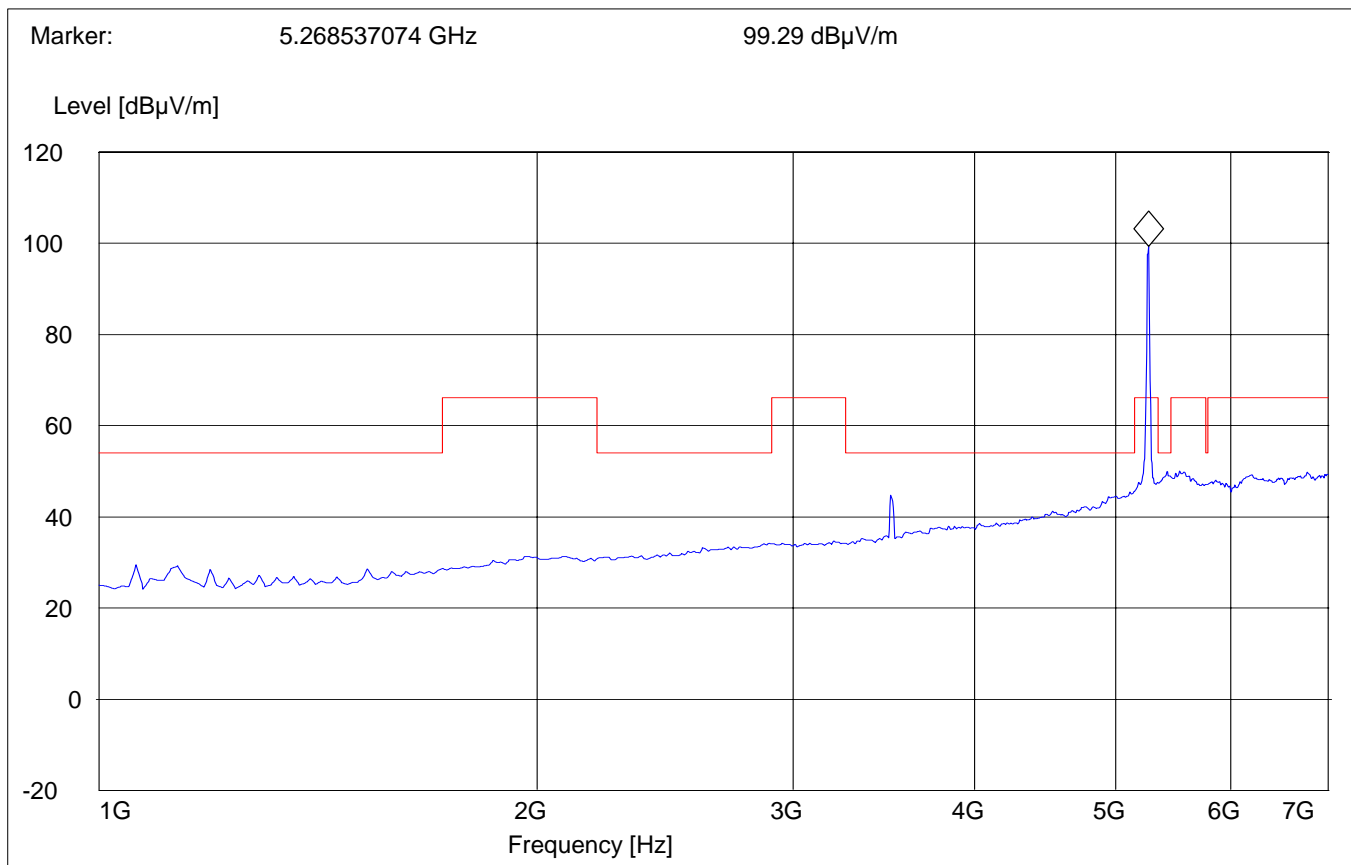
Hitachi FPC Antenna

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:		"FCC 15.407 1-7G"				
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW	Transducer
1GHz	7.0 GHz	MaxPeak	Coupled	1MHz	10Hz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

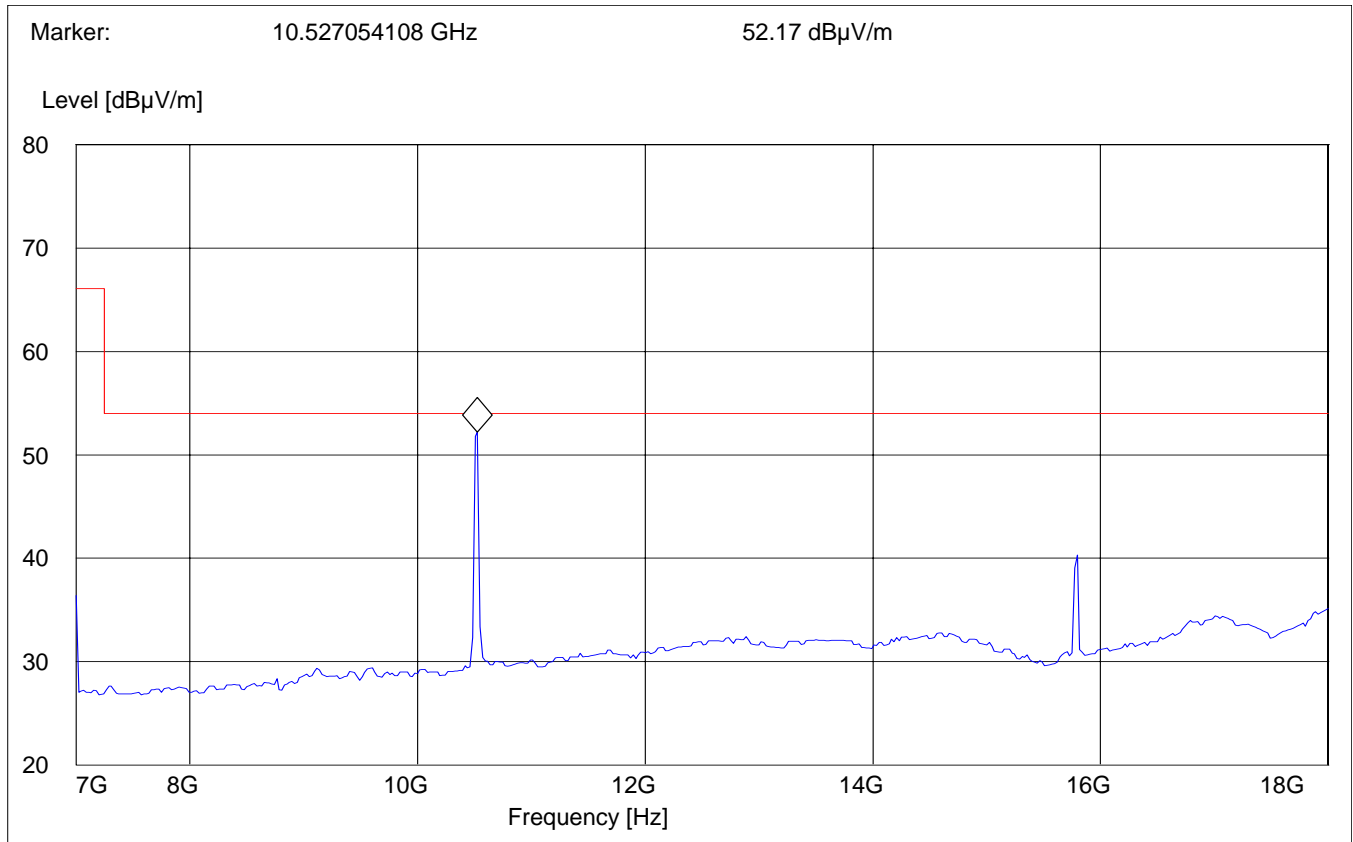
Lowest Channel (5260MHz): 7GHz – 18GHz

(Data rate – 6Mbps)

Hitachi FPC Antenna

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

SWEEP TABLE:		"FCC 15.407 7-18G"			
Start	Stop	Detector	Meas.	RBW	Transducer
Frequency	Frequency		Time	VBW	
7GHz	18.0 GHz	MaxPeak	Coupled	1MHz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5320MHz): 1GHz – 7GHz

(Data rate – 6Mbps)

Hitachi FPC Antenna

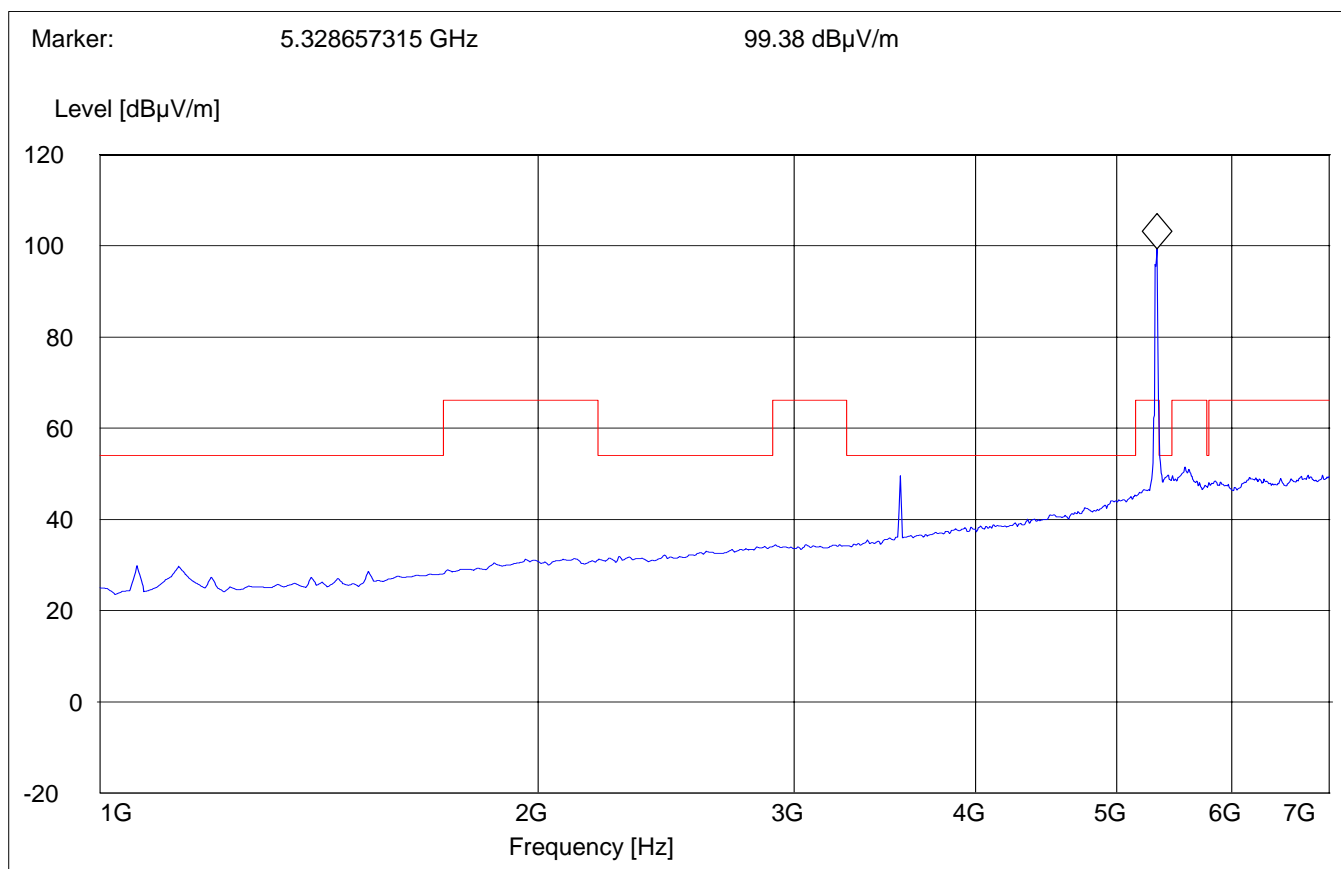
(Average)

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:		"FCC 15.407 1-7G"				
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW	Transducer
1GHz	7.0 GHz	MaxPeak	Coupled	1MHz	10Hz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5320MHz): 7GHz – 18GHz

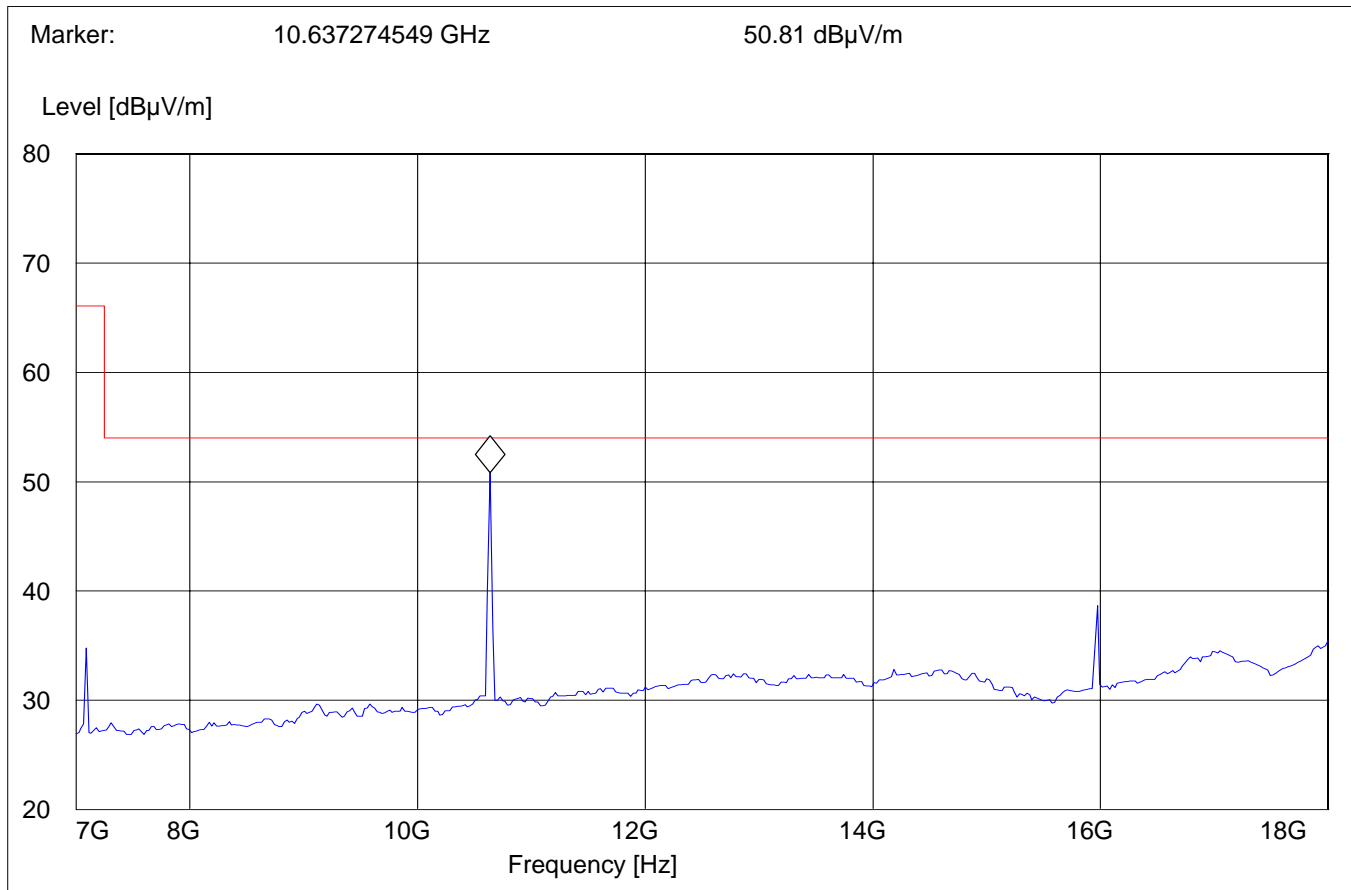
(Data rate – 54Mbps)

Hitachi FPC Antenna

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

SWEEP TABLE: "FCC 15.407 7-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW	Transducer
7GHz	18.0 GHz	MaxPeak	Coupled	1MHz		326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

18GHz – 26.5GHz

(Data rate – 54Mbps)

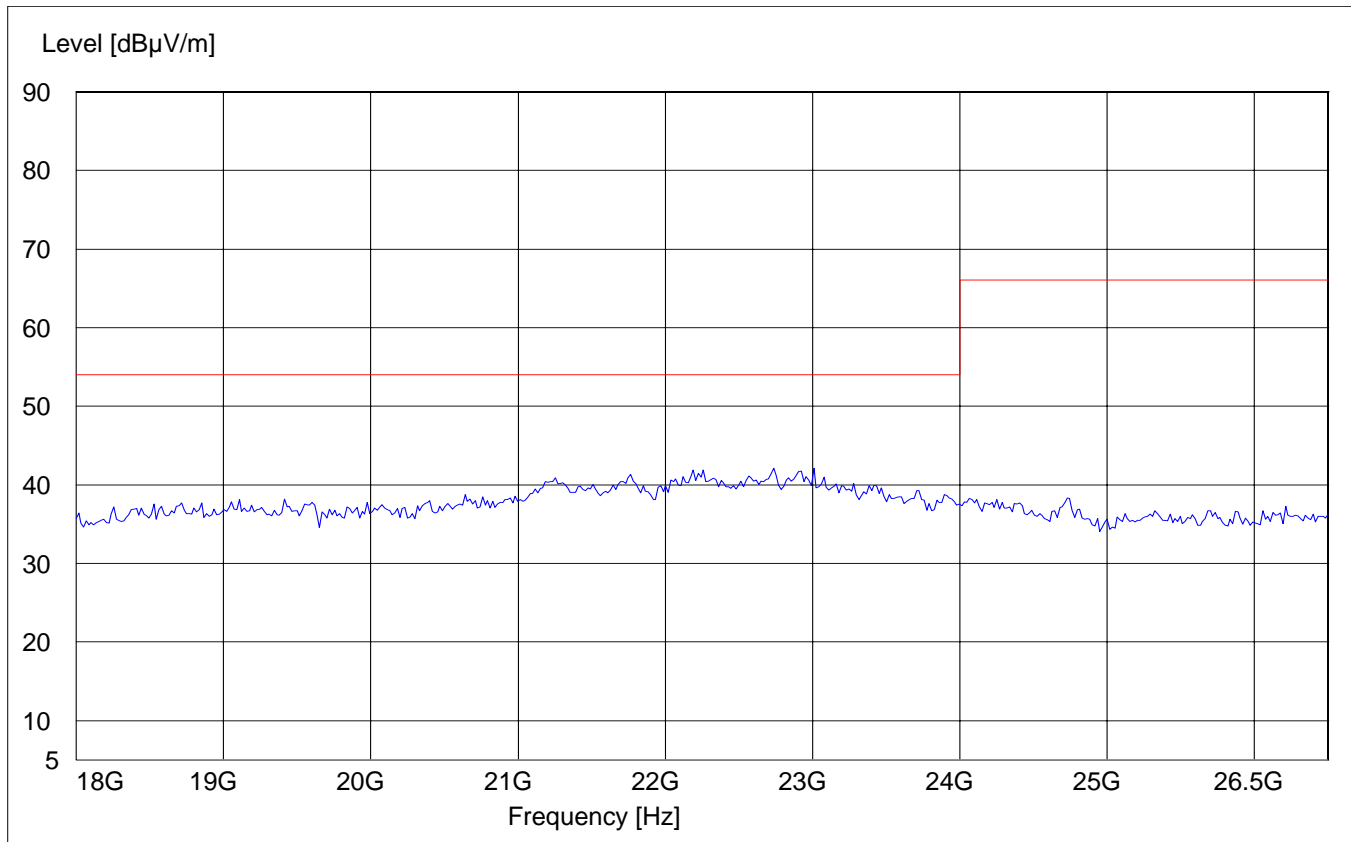
Hitachi FPC Antenna

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

Start	Stop	Detector	Meas. Time	RBW	Transducer
18GHz	26.5 GHz	MaxPeak	Coupled	1MHz	3160-09 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

26.5GHz – 40GHz

(Data rate – 54Mbps)

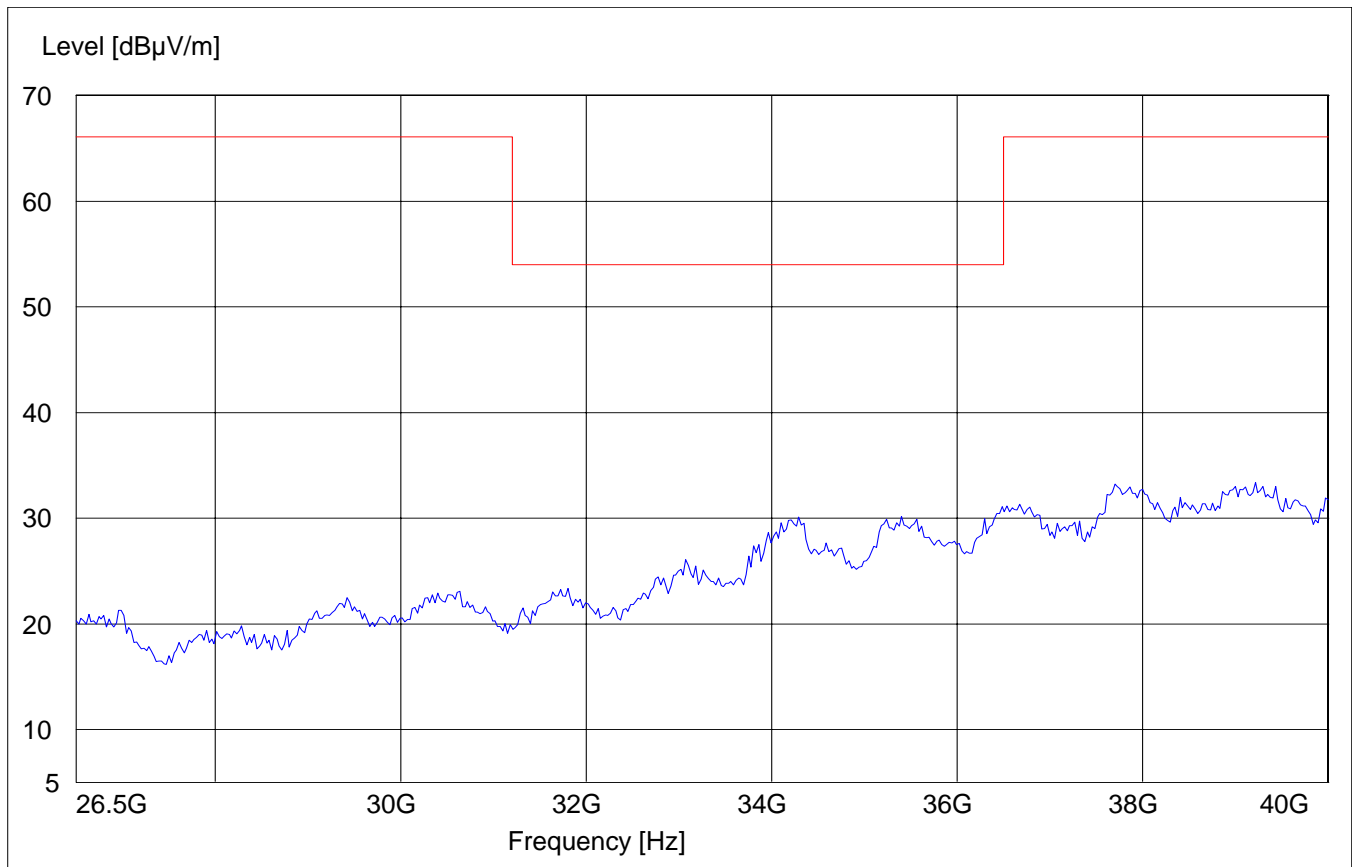
Hitachi FPC Antenna

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:		"FCC 15.407 26.5-40G"			
Start	Stop	Detector	Meas. Time	RBW	Transducer
26.5GHz	40 GHz	MaxPeak	Coupled	1MHz	3160-10 horn



Phycomp Stamped Metal Sheet antenna
(Freq. band: 5180-5320MHz, Gain: 3.74dBi, Model CAN4313 384 012501B)

BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 6Mbps)

Phycomp Stamped Metal Sheet Antenna

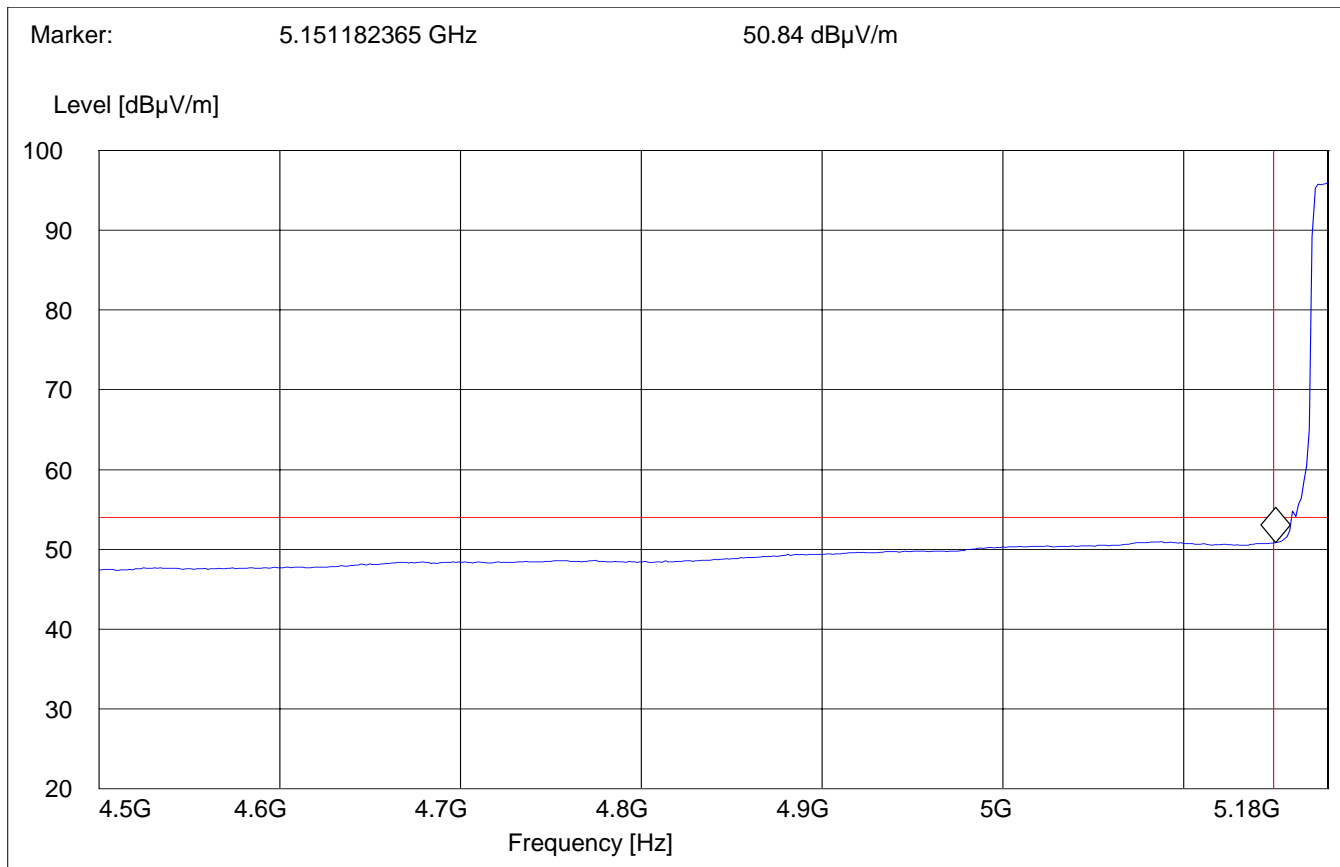
Low frequency section (spurious in the restricted band 4500 – 5150 MHz)

(Average measurement)

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

Operating condition : Tx at 5180MHz
 SWEEP TABLE : "FCC15.407 LBE_AVG"
 Limit Line horizontal : 54dBμV
 Limit Line vertical : 5150MHz

Start Frequency	Stop Frequency	Detector	Meas. Bandw.	RBW	VBW	Transducer
4.5 GHz	5.19 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 54Mbps)

Phycomp Stamped Metal Sheet Antenna

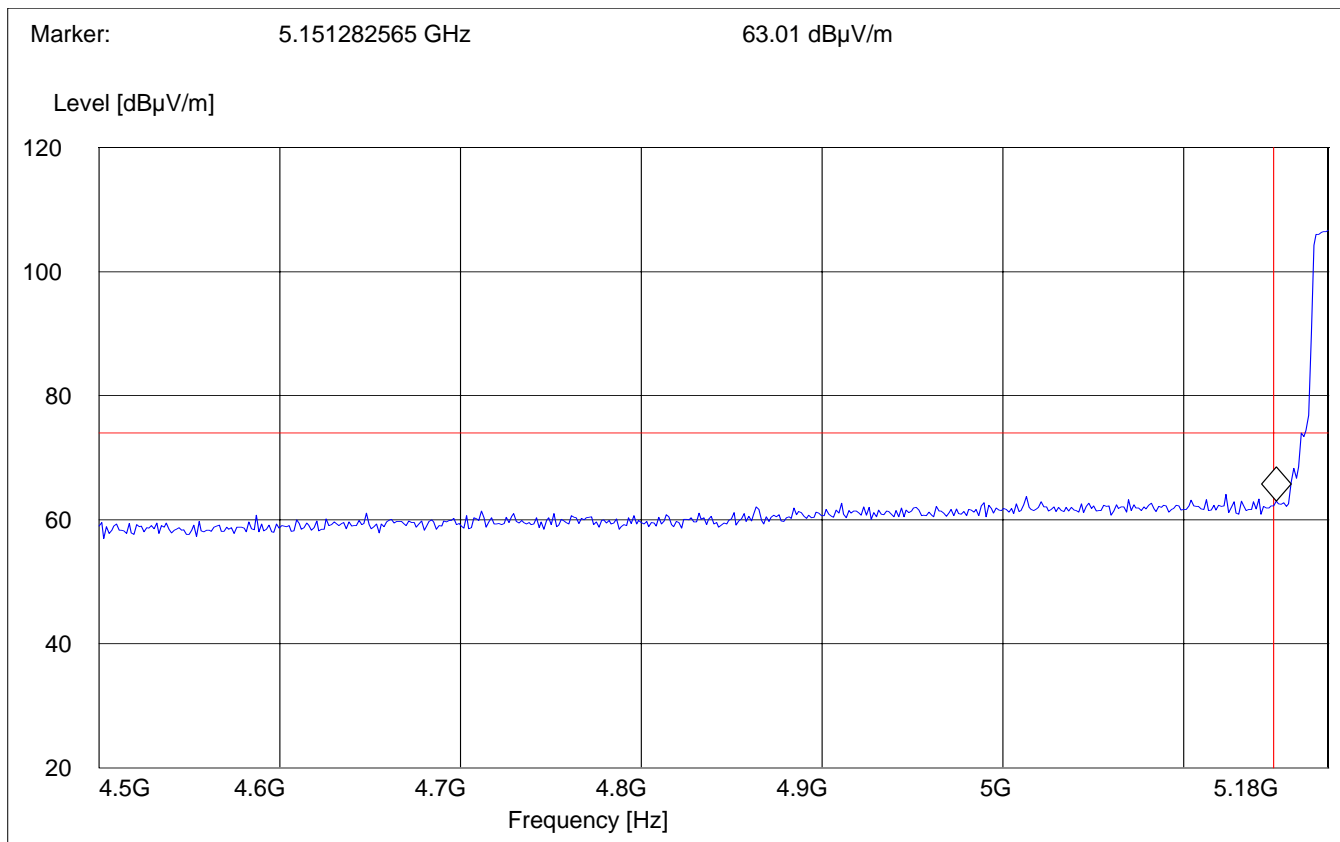
Low frequency section (spurious in the restricted band 4500 – 5150 MHz)

(Peak measurement)

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

Operating condition : Tx at 5180MHz
 SWEEP TABLE : "FCC15.407 LBE_Pk"
 Limit Line horizontal : 74dBμV
 Limit Line vertical : 5150MHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
4.5 GHz	5.19 GHz	MaxPeak	Coupled	1MHz	1MHz	#326 horn (dBi)



BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 6Mbps)

Phycomp Stamped Metal Sheet Antenna

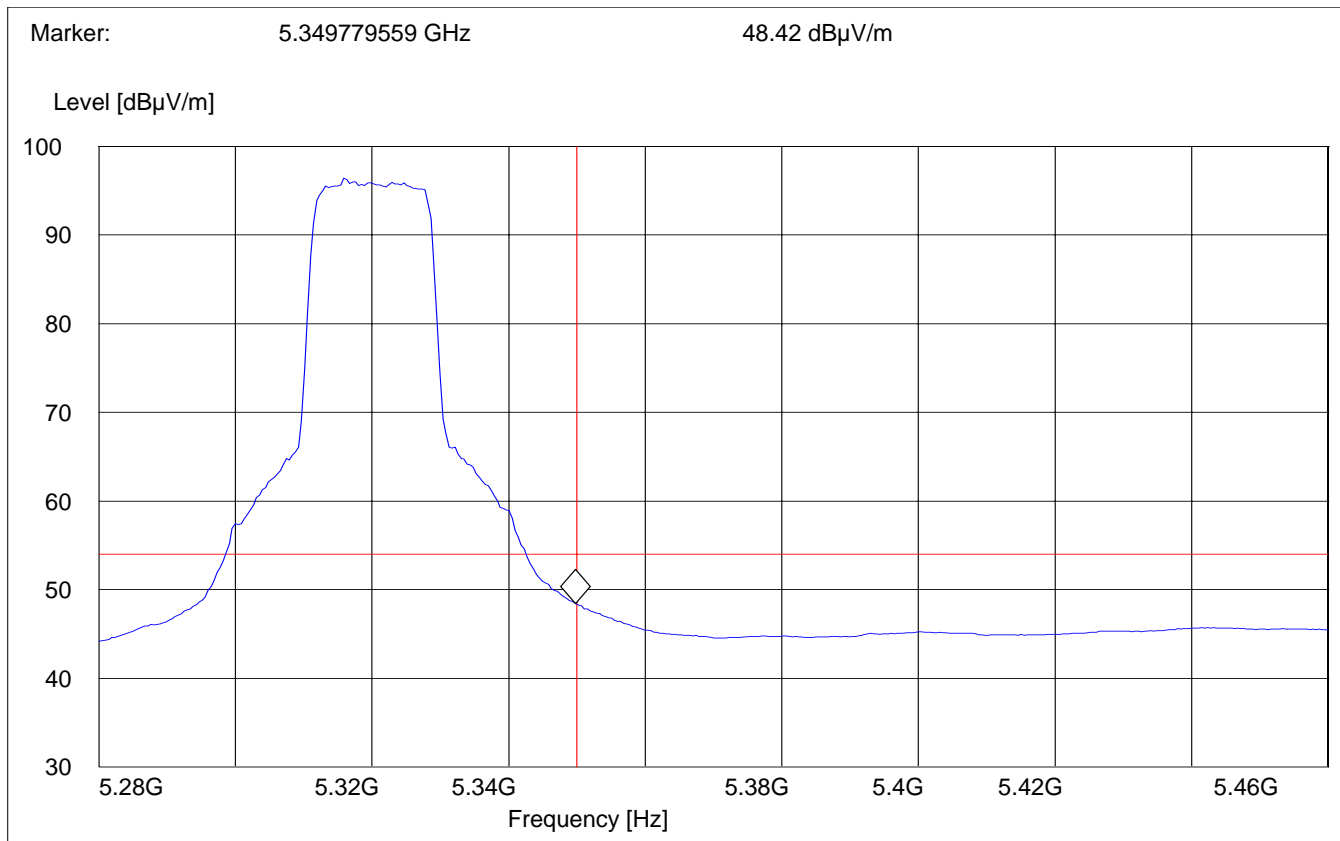
High frequency section (spurious in the restricted band 5350 – 5460 MHz)

(Average measurement)

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

Operating condition : Tx at 5320MHz
 SWEEP TABLE : "FCC15.407 HBE_AVG"
 Limit Line horizontal : 54dBμV
 Limit Line vertical : 5350MHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
5.28 GHz	5.46 GHz	MaxPeak	Coupled	1 MHz	10Hz	#326 horn (dBi)



BAND EDGE COMPLIANCE

§15.407 (b)(1)(2)(4)(6)

(Data rate – 54Mbps)

Phycomp Stamped Metal Sheet Antenna

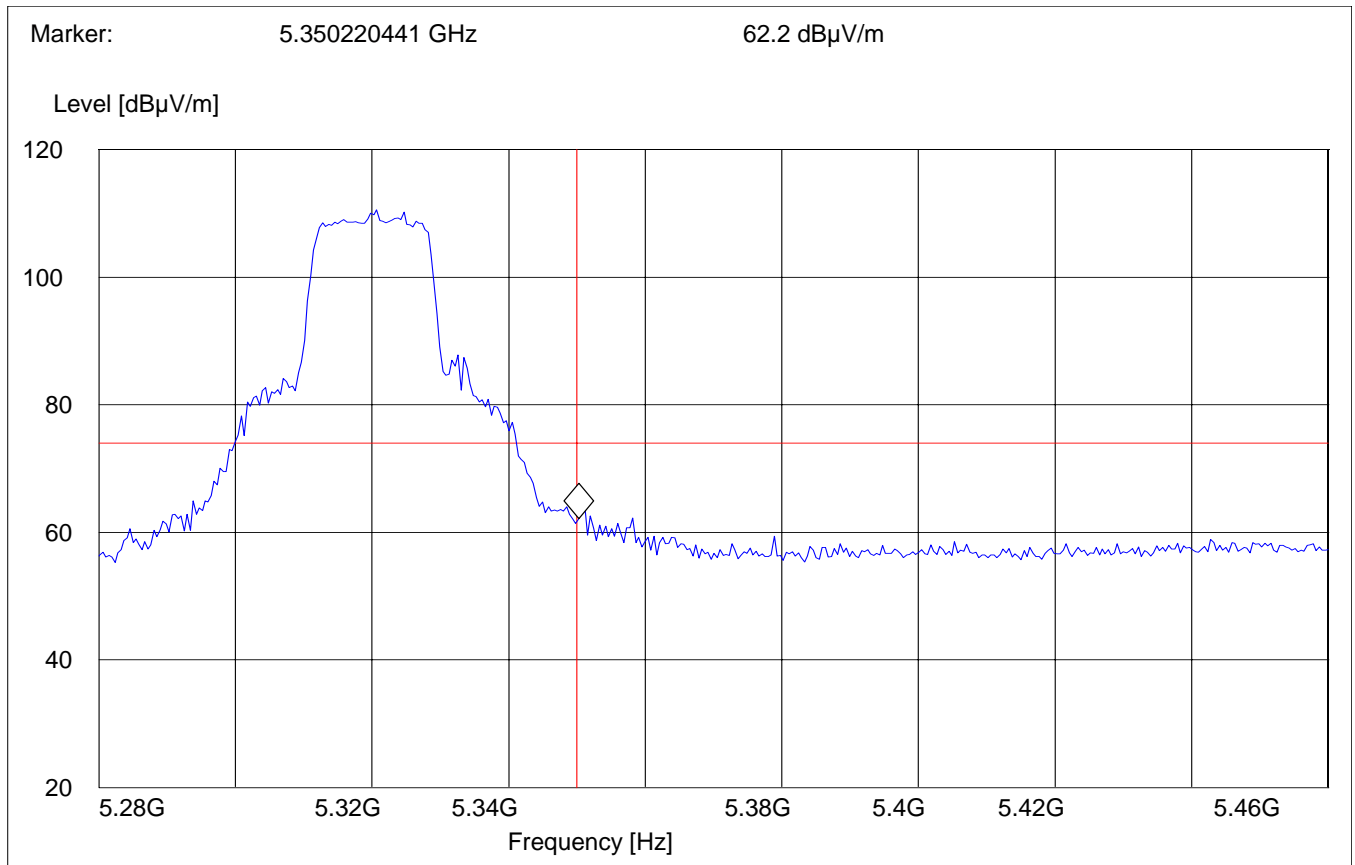
High frequency section (spurious in the restricted band 5350 – 5460 MHz)

(Peak measurement)

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

Operating condition : Tx at 5320MHz
 SWEEP TABLE : "FCC15.407 HBE_Pk"
 Limit Line horizontal : 74dBμV
 Limit Line vertical : 5350MHz

Start Frequency	Stop Frequency	Detector Time	Meas. Bandw.	RBW	VBW	Transducer
5.28 GHz	5.46 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)



EMISSION LIMITATIONS

§ 15.407 (b)(1)(2)(4)(6)

Transmitter (Radiated)**Phycomp Stamped Metal Sheet Antenna****Limits**

§ 15.209 / § 15.407

Freq. (MHz)	Field Strength ($\mu\text{V/m}$)	Field Strength ($\text{dB}\mu\text{V/m}$)
0.009-0.490	2400/F (kHz)	
0.490-1.750	24000/F (kHz)	
1.705-30.0	30	29.54
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960*	500	53.97
1000-40000**	2013.8	66.08

*) Limit in restricted bands

**) Limit outside restricted bands

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 40 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.

Transmit at Lowest channel Frequency 5180MHz			
Frequency (MHz)	Level (dBμV/m)		
	Peak	Quasi-Peak	Average
1130	47.13		33.18
3453	56.70		42.60
10368	62.16		48.65
15547	46.80		32.63
Transmit at Middle channel Frequency 5260MHz			
Frequency (MHz)	Level (dBμV/m)		
	Peak	Quasi-Peak	Average
1192	44.84		35.42
3501	55.09		38.16
5557	59.84		48.55
7000	62.74		42.46
10505	69.45		53.33
15786	56.35		39.28
Transmit at Highest channel Frequency 5320MHz			
Frequency (MHz)	Level (dBμV/m)		
	Peak	Quasi-Peak	Average
1144	43.99		28.56
3550	53.43		39.91
5557	62.10		49.63
7098	64.46		43.87
10641	67.34		54.23
15960	53.48		36.63

EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5180MHz): 1GHz – 7GHz

(Average)

(Data rate – 6Mbps)

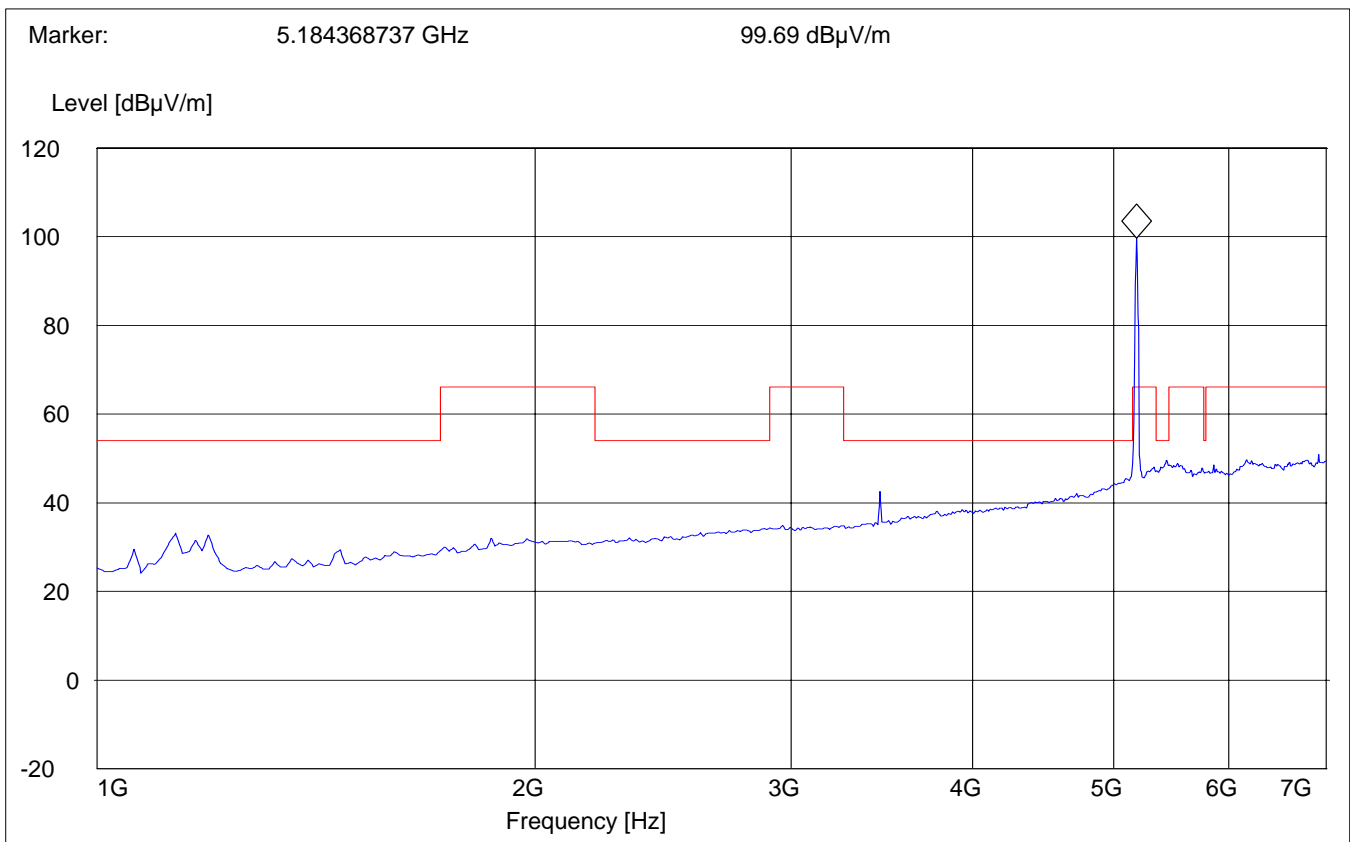
Phycomp Stamped Metal Sheet Antenna

Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE:		"FCC 15.407 1-7G"				
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW	Transducer
1GHz	7.0 GHz	MaxPeak	Coupled	1MHz	10Hz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

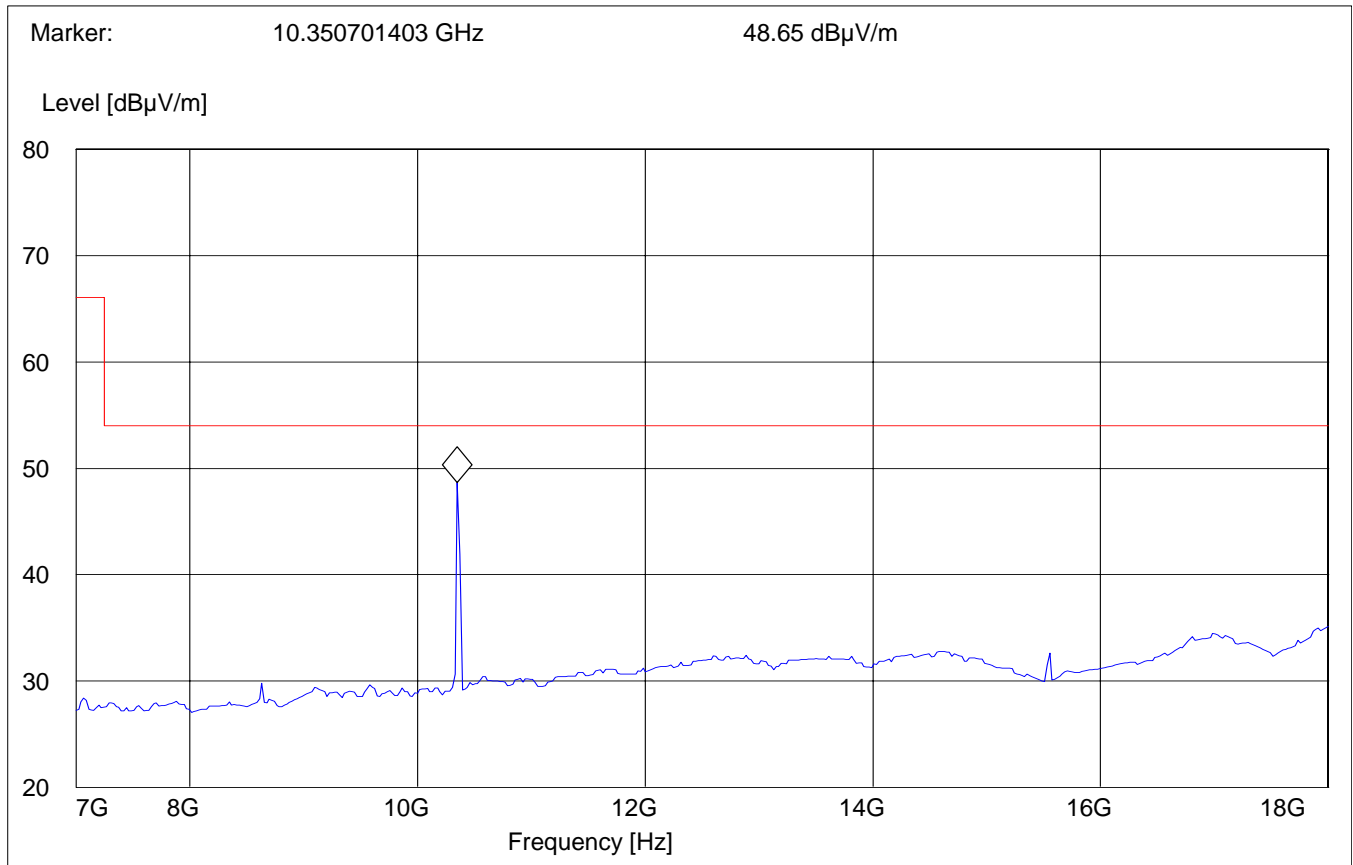
Lowest Channel (5180MHz): 7GHz – 18GHz

(Data rate – 6Mbps)

Phycomp Stamped Metal Sheet Antenna

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

SWEEP TABLE:		"FCC 15.407 7-18G"			
Start	Stop	Detector	Meas. Time	RBW	Transducer
Frequency	Frequency			VBW	
7GHz	18.0 GHz	MaxPeak	Coupled	1MHz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5260MHz): 1GHz – 7GHz

(Average)

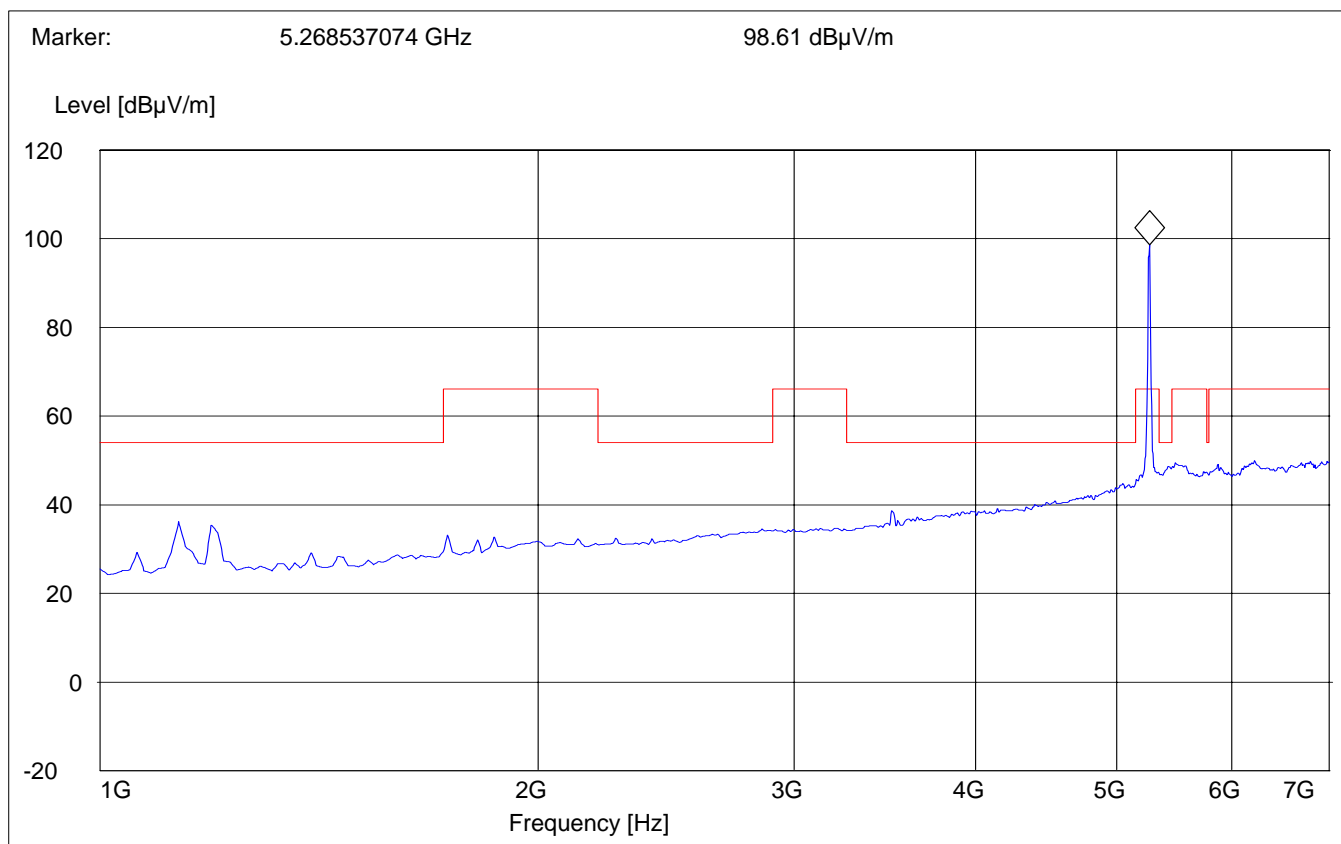
(Data rate – 6Mbps)

Phycomp Stamped Metal Sheet Antenna

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

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

SWEEP TABLE:		"FCC 15.407 1-7G"					Transducer
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW		
1GHz	7.0 GHz	MaxPeak	Coupled	1MHz	10Hz	326 horn	



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

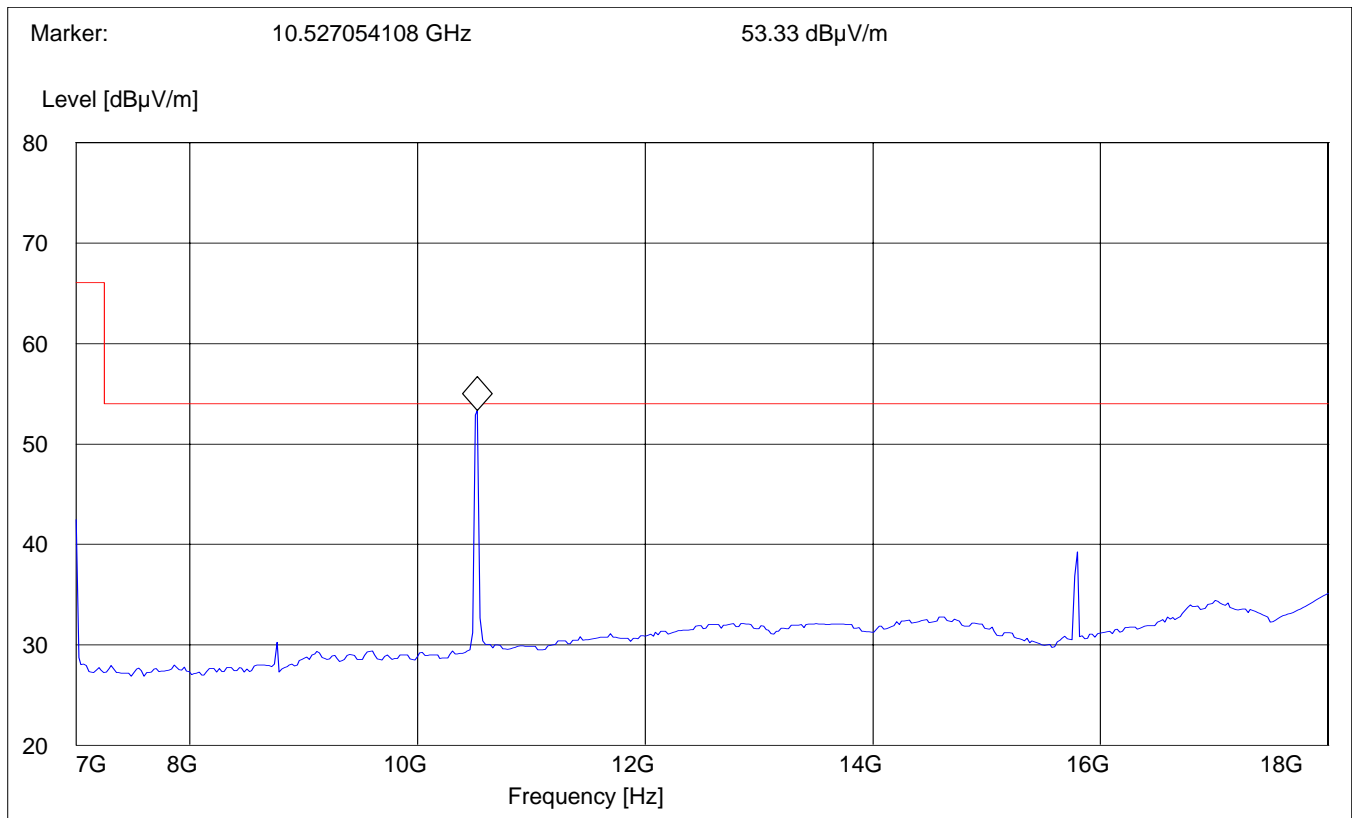
Lowest Channel (5260MHz): 7GHz – 18GHz

(Data rate – 6Mbps)

Phycomp Stamped Metal Sheet Antenna

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

SWEEP TABLE:		"FCC 15.407 7-18G"			
Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	Transducer
7GHz	18.0 GHz	MaxPeak	Coupled	1MHz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5320MHz): 1GHz – 7GHz

(Data rate – 6Mbps)

Phycomp Stamped Metal Sheet Antenna

(Average)

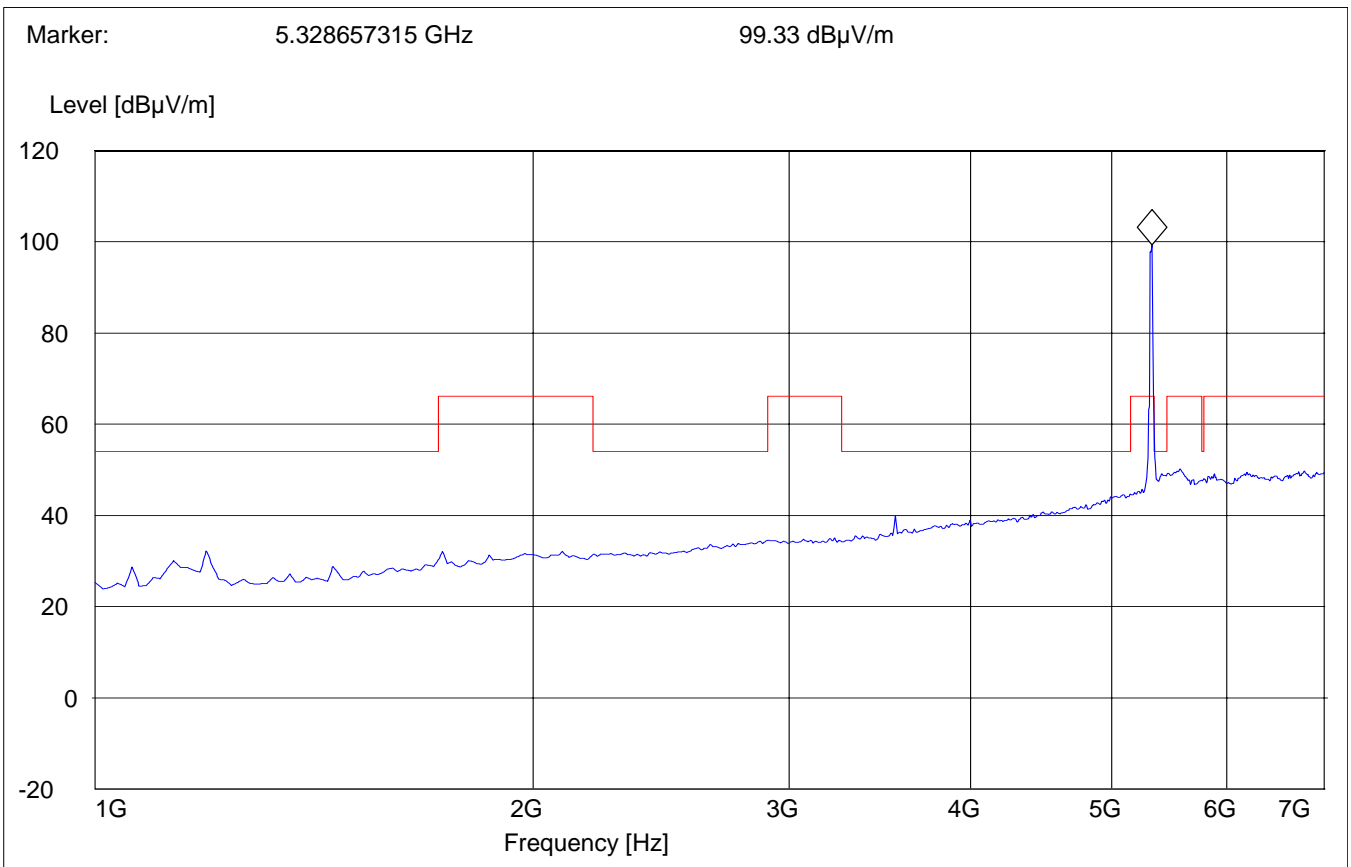
Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

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

SWEEP TABLE: "FCC 15.407 1-7G"

Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW	Transducer
1GHz	7.0 GHz	MaxPeak	Coupled	1MHz	10Hz	326 horn



EMISSION LIMITATIONS - Radiated (Transmitter)

§ 15.407 (b)(1)(2)(4)(6)

Lowest Channel (5320MHz): 7GHz – 18GHz

(Data rate – 54Mbps)

Phycomp Stamped Metal Sheet Antenna

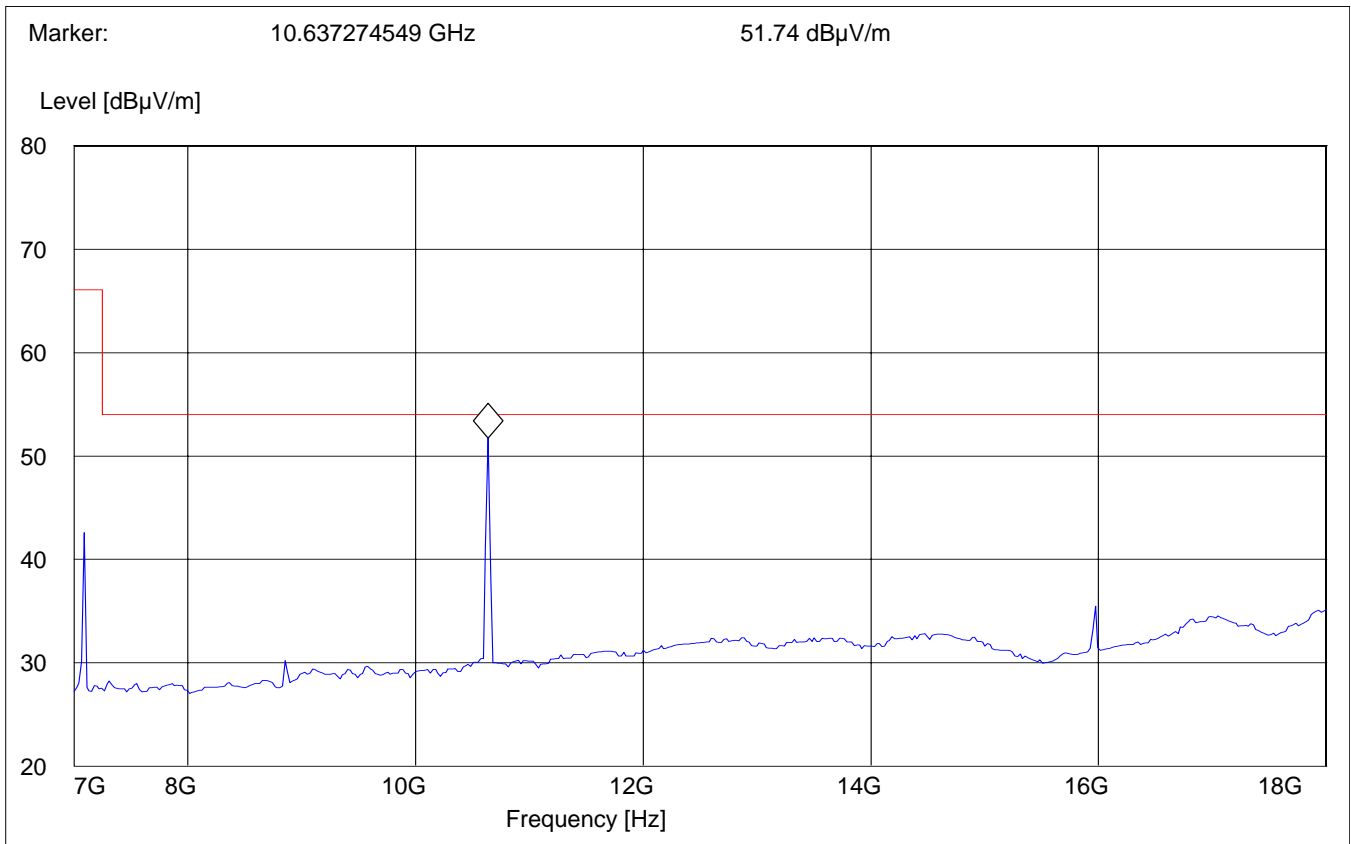
Antenna: Horizontal

EUT plane: Horizontal with screen vertical @ 90°

SWEEP TABLE:

"FCC 15.407 7-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	RBW	VBW	Transducer
7GHz	18.0 GHz	MaxPeak	Coupled	1MHz		326 horn



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)

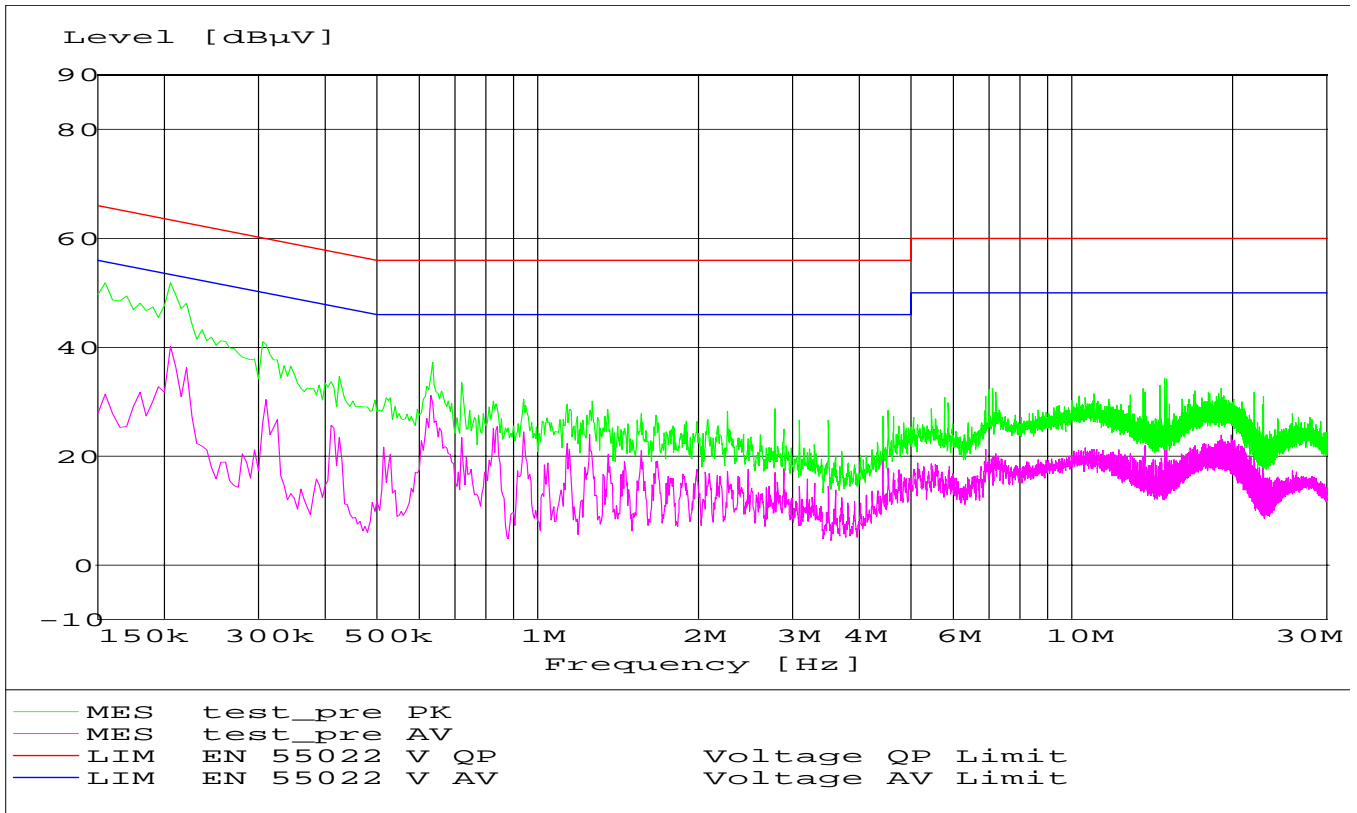
Limit

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 ($\mu\text{V/m}$)	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 40GHz very short cable connections to the antenna was used to minimize the noise level.

RECEIVER SPURIOUS RADIATION

§ 15.209

(Data rate – 54Mbps)

Antenna: vertical

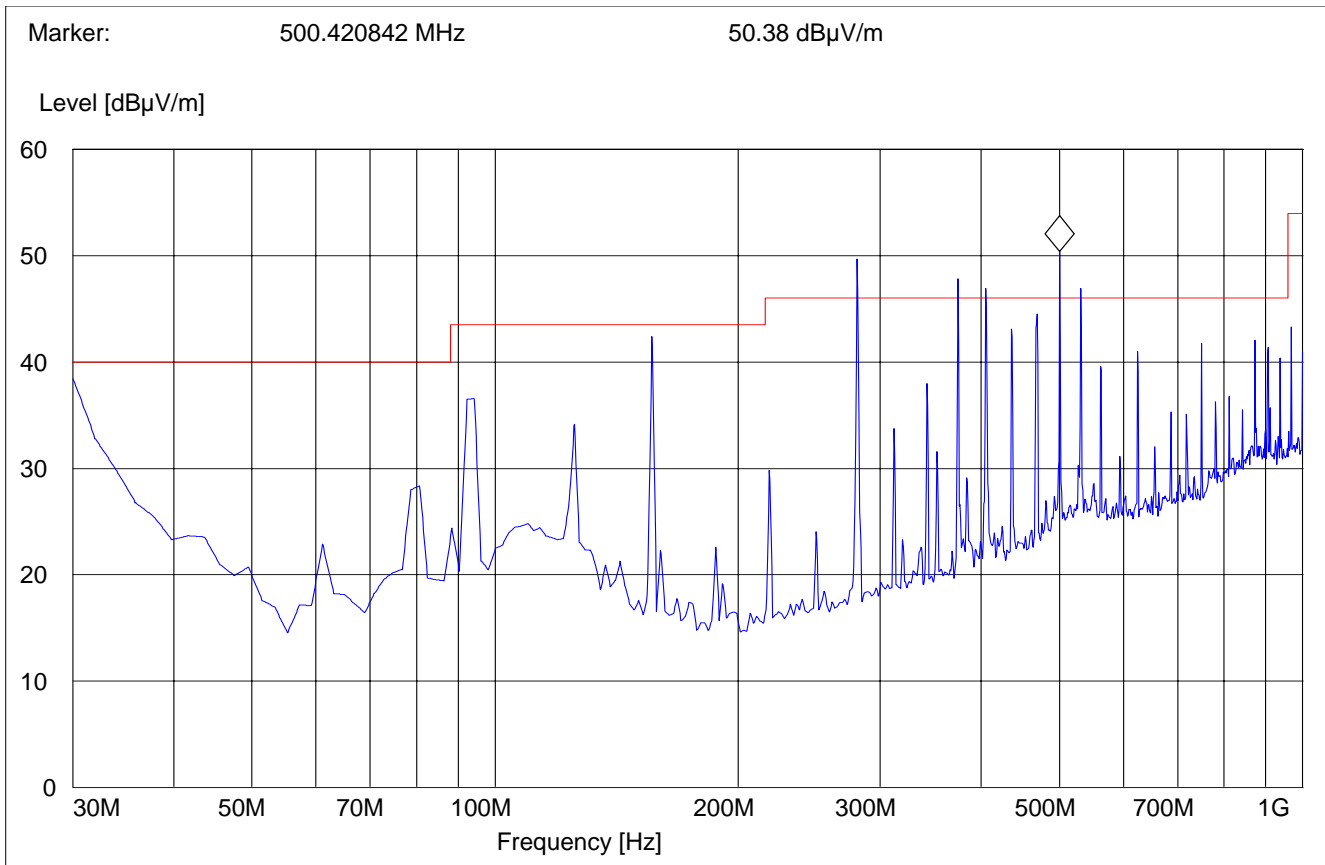
EUT plane: Horizontal with screen vertical @ 90°

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 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(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		



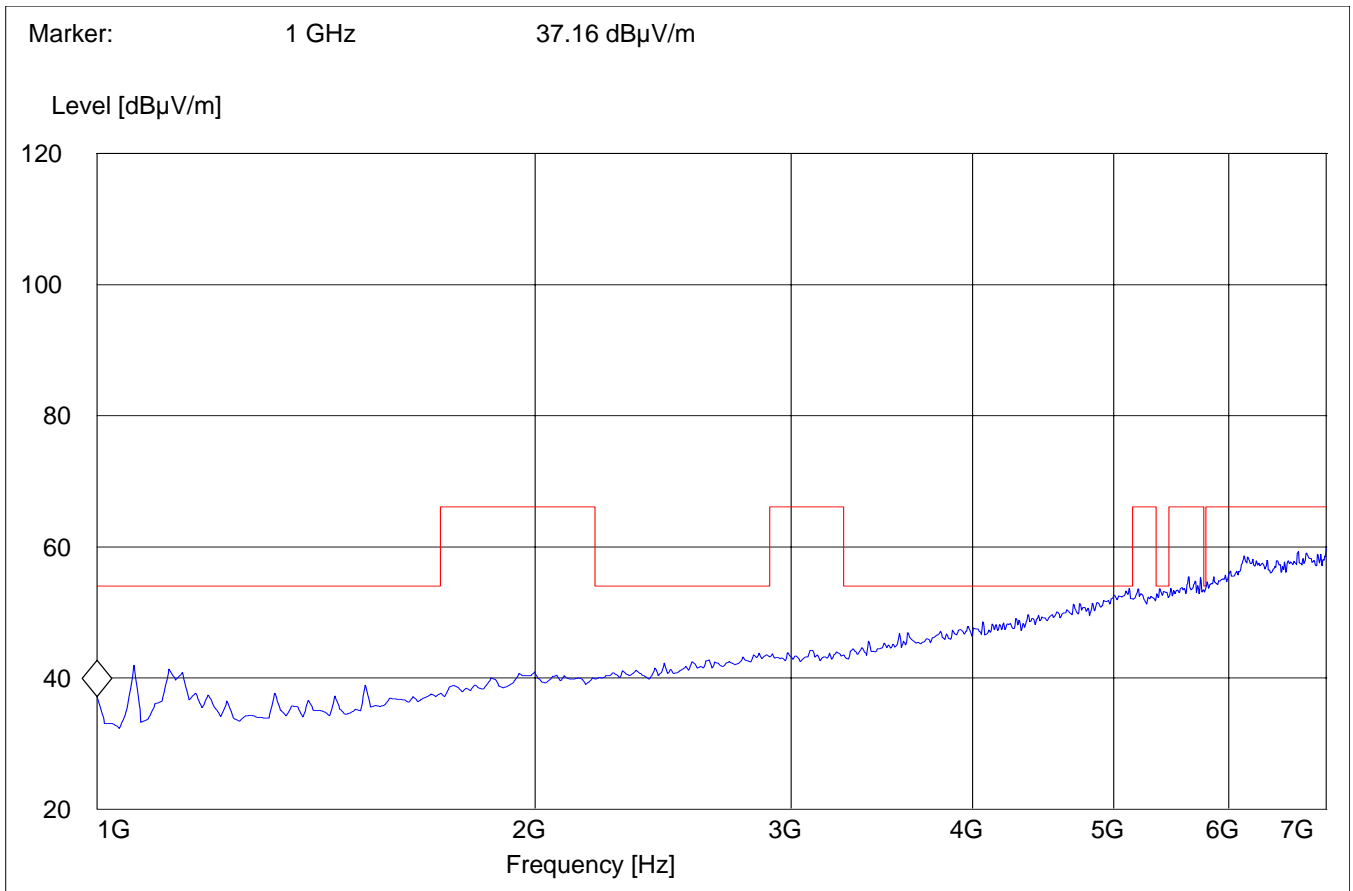
**RECEIVER SPURIOUS RADIATION
1GHz – 7GHz**

§ 15.209

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

SWEEP TABLE: "WLAN Spuri hi 1-7G"

Start	Stop	Detector	Meas.	RBW	VBW	Transducer
Frequency	Frequency	Time	Bandw.			
1.0 GHz	7.0 GHz	MaxPeak	Coupled	1 MHz	1MHz	#326 horn (dBi)



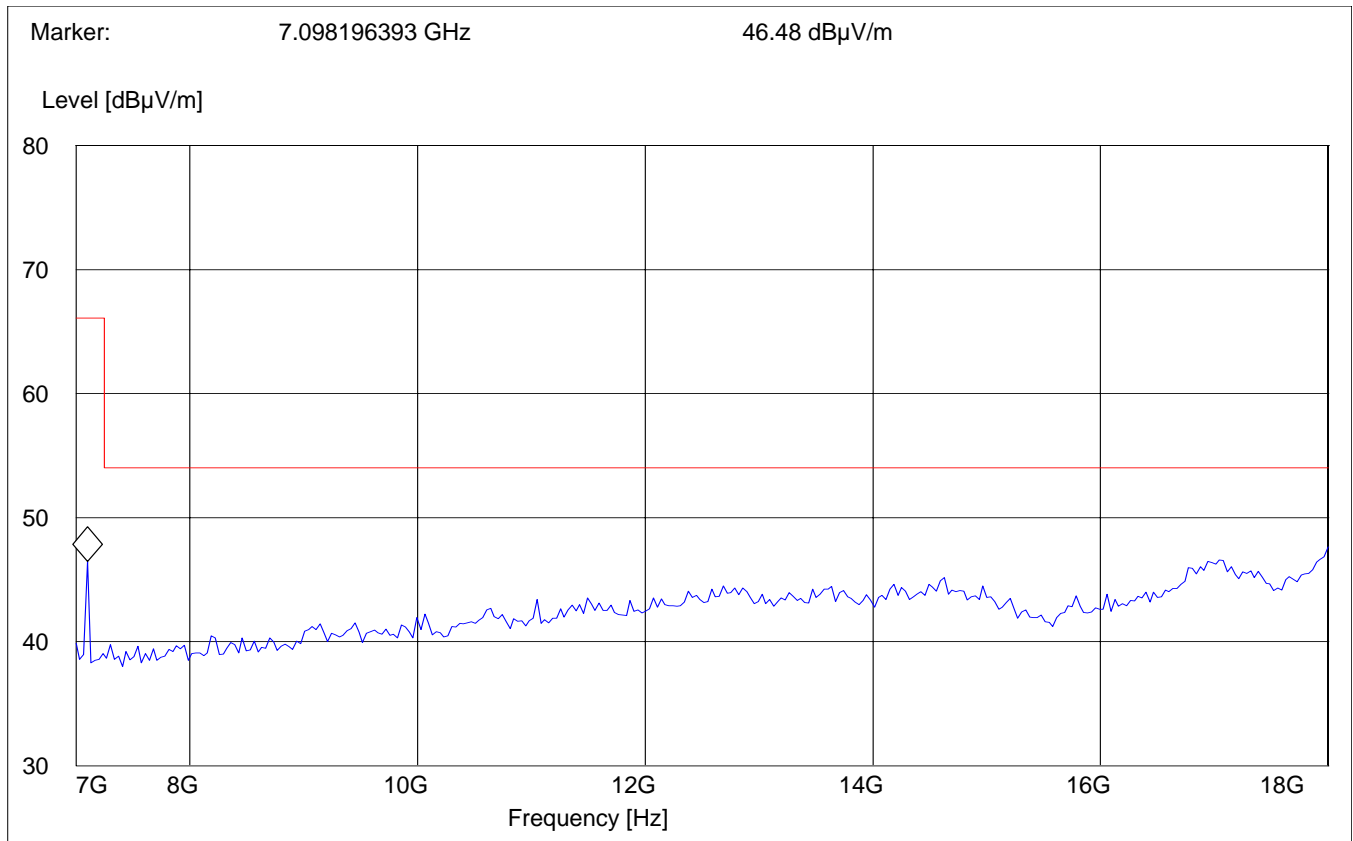
RECEIVER SPURIOUS RADIATION
7GHz – 18GHz

§ 15.209

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

SWEEP TABLE: "WLAN Spuri hi 7-18G"

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



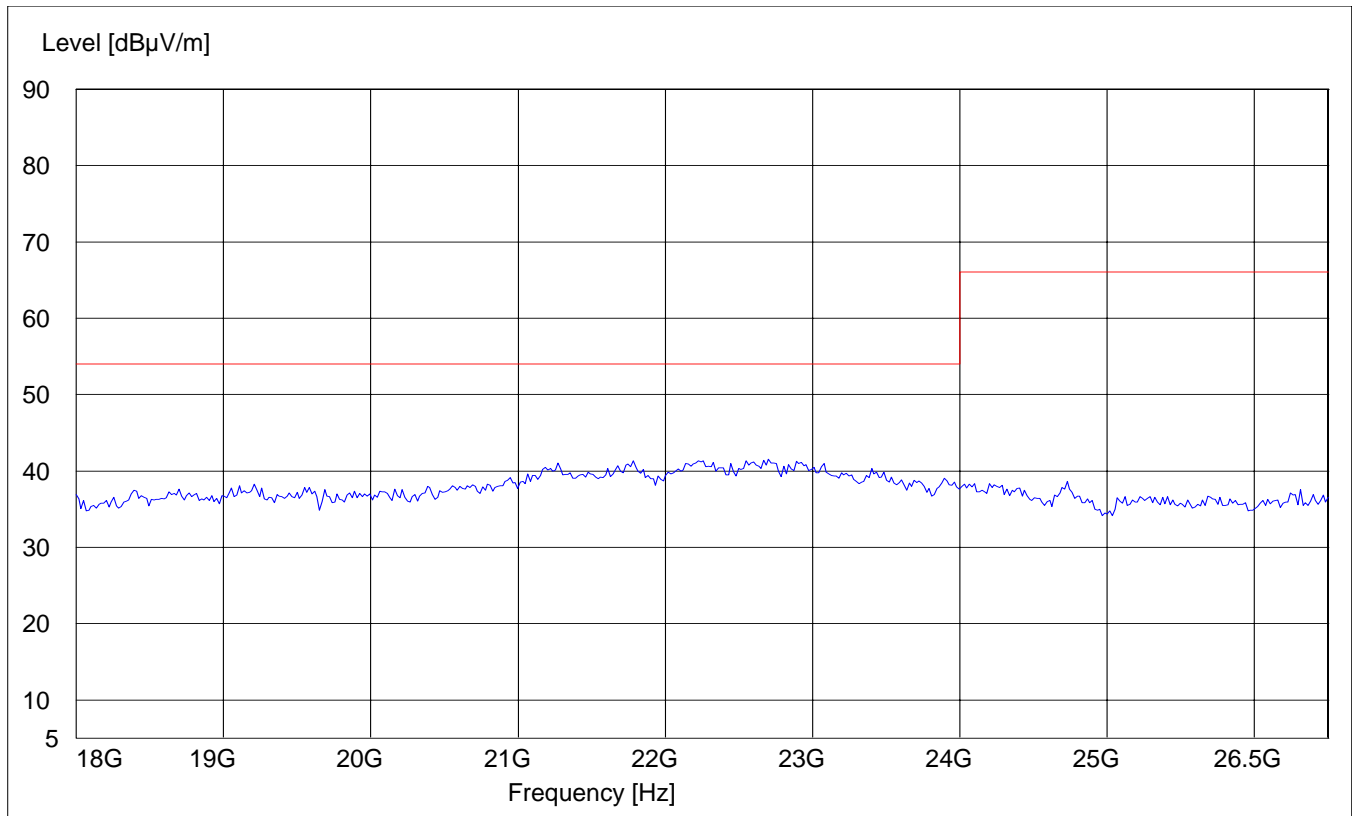
**RECEIVER SPURIOUS RADIATION
18GHz – 26.5GHz**

§ 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)



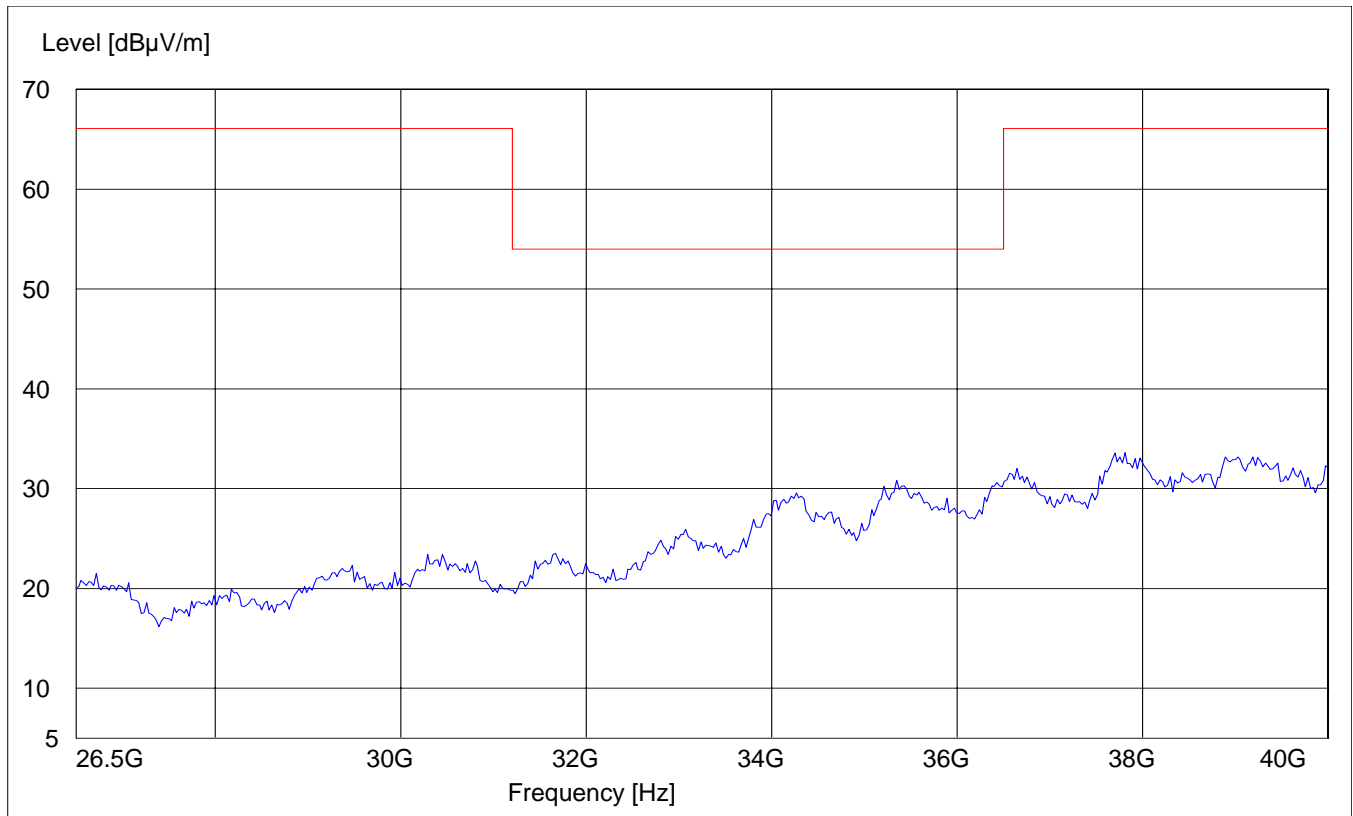
RECEIVER SPURIOUS RADIATION
26.5GHz – 40GHz

§ 15.209

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

SWEEP TABLE: "WLAN Spuri hi 26.5-40G"

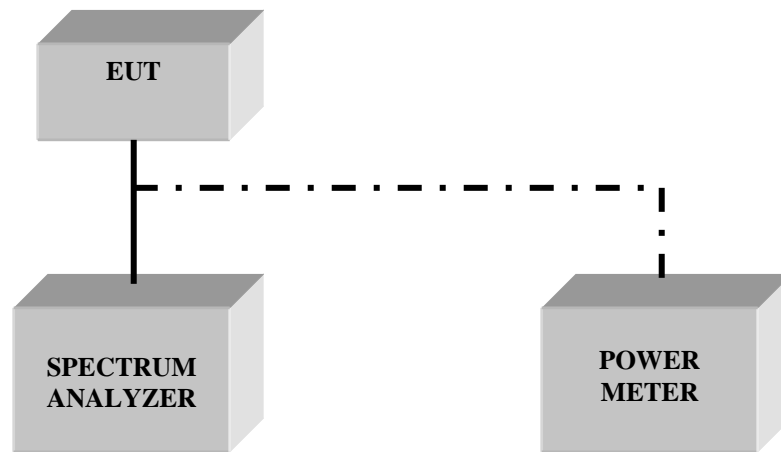
Start	Stop	Detector	Meas.	RBW	Transducer
Frequency	Frequency	Time	Bandw.	VBW	
26.5 GHz	40 GHz	MaxPeak	Coupled	1 MHz	3160-10 horn



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	Horn Antenna (26.5-40GHz)	3160-10	EMCO	1156
07	2-3GHz Band reject filter	BRM50701	Microtronics	6
08	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02
09	Pre-Amplifier	TS-ANA	Rohde & Schwarz	--
10	Pre-Amplifier	JS4-00102600	Miteq	00616

BLOCK DIAGRAMS
Conducted Testing



Radiated Testing

ANECHOIC CHAMBER

