Registration No. DAT-P-207/05

EMI -- T E S T R E P O R T

Test Report No. : T32985-02-01AA	07. April 2009 Date of issue

Type / Model Name : Connection Unit IM 154-6 PN HF IWLAN

Product Description : Network WLAN Client

Applicant : Siemens AG

Address : Werner-von-Siemens-Str. 50

92224 Amberg

Manufacturer : Siemens AG, Industry Sector, I IA AS EWA

Address : Werner-von-Siemens-Str. 50

92224 Amberg

Licence holder : Siemens AG, Industry Sector, I IA AS RD ST TT

Address : Werner-von-Siemens-Str. 50

92224 Amberg

Test Result according to the standards listed in clause 1 test standards:	**Positive**

DAT-P-207/05-00

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart C - Intentional Radiators (October, 2008)

Part 15, Subpart C, Section 15.35(c)	Measurement detector functions and bandwidths
Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.207(a)	AC Line conducted emissions
Part 15, Subpart C, Section 15.209(a)	Radiated emissions, general requirements
Part 15, Subpart C, Section 15.215	Additional provisions to the general radiated emission limitations
Part 15, Subpart C, Section 15.407	Operation within the bands 5.15-5.25 GHz, 5.25-5.35 GHz, 5.47-5.725 GHz and 5.725-5.825 GHz

FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (October, 2008)

Part 15, Subpart B, Section 15.107(a)	AC Line conducted emissions
Part 15, Subpart B, Section 15.109(a)	Radiated emissions, general requirements

FCC Rules and Regulations Part 1 Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits.

OET Bulletin 65, 65A, 65B, 65C Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

2 SUMMARY

GENERAL REMARKS:

The EuT consists of 1 WLAN client module.
It has no radar Interference Detection function
Actual firmware of CM module: T 0.0.13 ART 16.11.2007
Actual firmware of IM module: R 10.10.0

Available Features:

The WLAN client module is compatible with 802.11a, 802.11b, 802.11g technology. It is able to operate in the 2.4 GHz and 5 GHz frequency band.

- 802.11a Mode 5.15 GHz – 5.25 GHz and 5.725 GHz – 5.850 GHz
- 802.11b/g Mode 2400 – 2483.5 MHz

The module uses DSSS or OFDM modulation and is cabable to provide following data rates:

- 802.11b Mode 11, 5.5, 2, 1 Mbps, auto-fallback
- 802.11g Mode 54, 48, 36, 24, 18, 12, 9, 6 Mbps, auto-fallback
- 802.11a 54, 48, 36, 24, 18, 12, 9, 6 Mbps, auto-fallback

There are three different external antennas provided. The following table shows the WEB-power settings depending on the transmitting channel, antenna type and WLAN technology.

Channel/ Frequency	Antenna Type	Antenna Gain	WEB-Power settings (∆dB)
36/ 5180 MHz	ANT IM154-6 IWLAN	2 dBi	0
	ANT793-4MN	5 dBi	-3
	ANT793-6MN	5 dBi	-6
48/ 5240 MHz	ANT IM154-6 IWLAN	2 dBi	0
	ANT793-4MN	5 dBi	0
	ANT793-6MN	5 dBi	-3

Note: The WEB-power settings are related to the measured ART-power settings (worst case conditions).

Note: The US version will be firmware limited to operate only in the 5150-5250 MHz band.

The tests have been carried out in the following frequency band: 5.15-5.25 GHz.
Pre-scan has been performed to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports. The maximum output power depends on used data rate.

As worst case the following data rates are used:

- **802.11a: 6 Mbits**

The EuT has been adjusted to transmit data during the tests with a duty cycle (X) of about X=1.

4 channels are provided to this EuT in 802.11a mode:

802.11a mode:

Channel	Frequency
36	5180
40	5200
44	5220
48	5240

Following channels were selected for the final test as listed below:

Technology	Available Channel	Tested Channel	Modulation	Modulation Type	Data Rate (MBps)
802.11a	36 to 48	36, 40 and 48	OFDM	BPSK	6

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 25. February 2009

Testing concluded on : 17. March 2009

Checked by:

Klaus Gegenfurtner
Ich bestätige die Richtigkeit und Integrität dieses Dokuments
2009.06.05 13:21:07 +02'00'

Klaus Gegenfurtner
Dipl.-Ing.(FH)
Manager: Radio Group

Tested by:

Anton Altmann
Ich bin der Verfasser dieses Dokuments
2009.06.05 13:13:31 +02'00'

Anton Altmann
Dipl.-Ing.(FH)

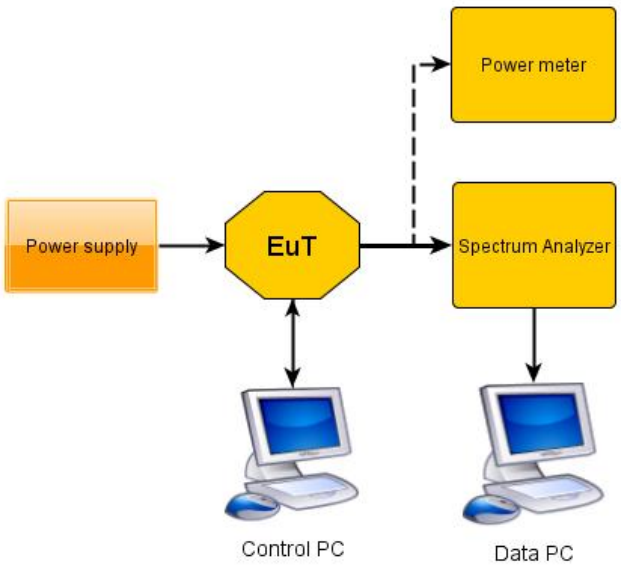
3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EuT – Detailed photos see Attachment A

3.2 Power supply system utilised

Power supply voltage : 10 V DC

3.3 Test setup



3.4 Short description of the Equipment under Test (EuT)

The new interface module is integrated in the communication network as an IWLAN client via an IWLAN access point, such as the Scalance W access point from Siemens. The module works according to the WLAN standards IEEE 802.11 a/b/g/h and therefore operates in the 2.4 and 5 GHz frequency bands. The interface module wirelessly integrates the distributed I/O system into the automation network. It is designed for harsh industrial environments with a high degree of protection (IP65/66/67) and conceived for use directly on the machine. For this purpose, the new 154-6 PN HF IWLAN interface module was developed for the Simatic ET 200pro system.

Number of tested samples: 1
Serial number: Prototype

EuT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- Continuous transmit mode

EuT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

-	Test board (ART Interface)	Model :	RF-PCB, V1.0
-	Network cable RJ45	Model :	Standard
-	Power cable	Model :	AC/DC Power supply
-		Model :	
-		Model :	
-		Model :	

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
94342 Strasskirchen
Germany

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 /11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement Protocol for FCC, VCCI and AUSTEL

4.4.1 GENERAL INFORMATION

4.4.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

In compliance with 47 CFR Part 15 Subpart A Section 15.38 testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using the CISPR 22 Limits.

4.4.1.2 Measurement Error

The data and results referenced in this document are true and accurate. The reader is cautioned that there is some measurement variability due to the tolerances of the test equipment that can contribute to a nominal product measurement uncertainty. The measurement uncertainty was calculated for all measurements listed in this test report according to NIS 81/5.1994 “The treatment of uncertainty in EMC measurements” and is documented in the mikes-testingpartners gmbh quality system according to DIN EN ISO/IEC 17025. Furthermore, component differences and manufacturing process variability of production units similar to that tested may result in additional product uncertainty. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the device.

4.4.1.3 Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

4.4.2.1 General Standard Information

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4-2003 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

5 TEST CONDITIONS AND RESULTS

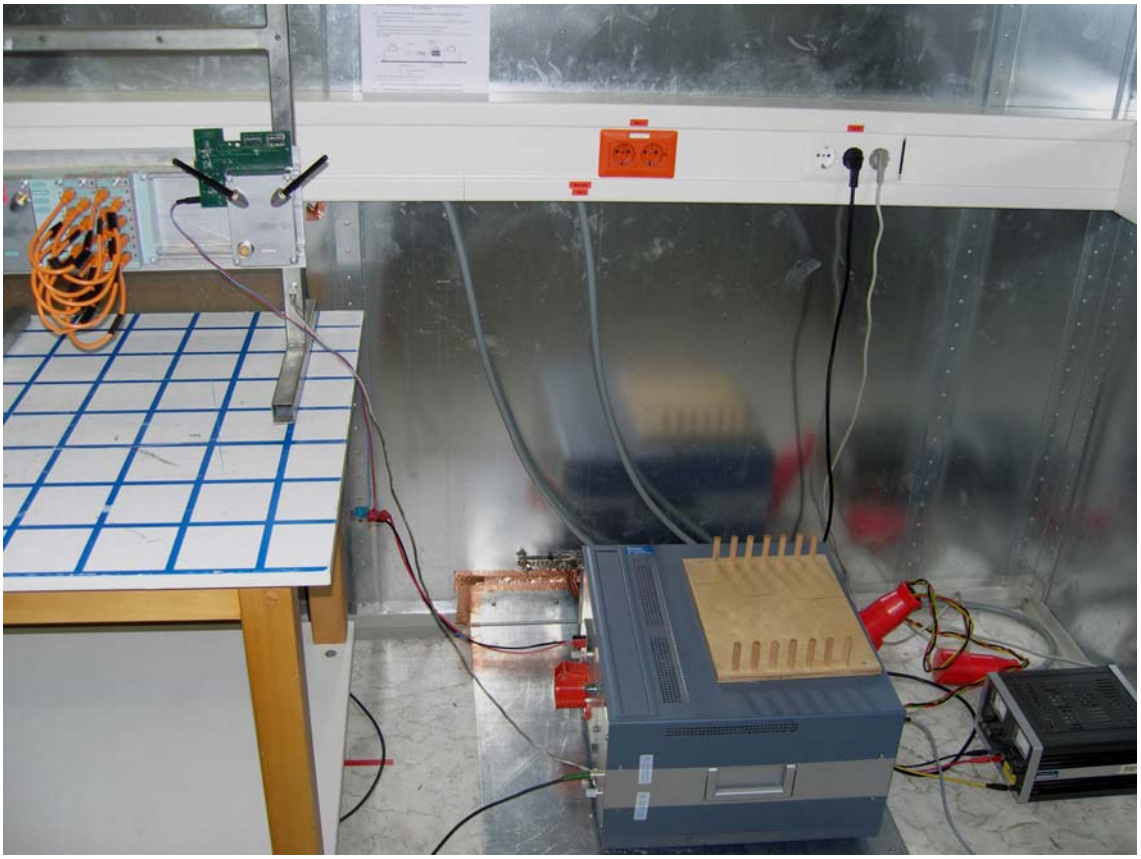
5.1 Conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

According to FCC Part 15 Subpart 15.207 (a): Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.
The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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 the logarithm of the frequency

5.1.4 Description of Measurement

The final level, expressed in dBμV, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit.

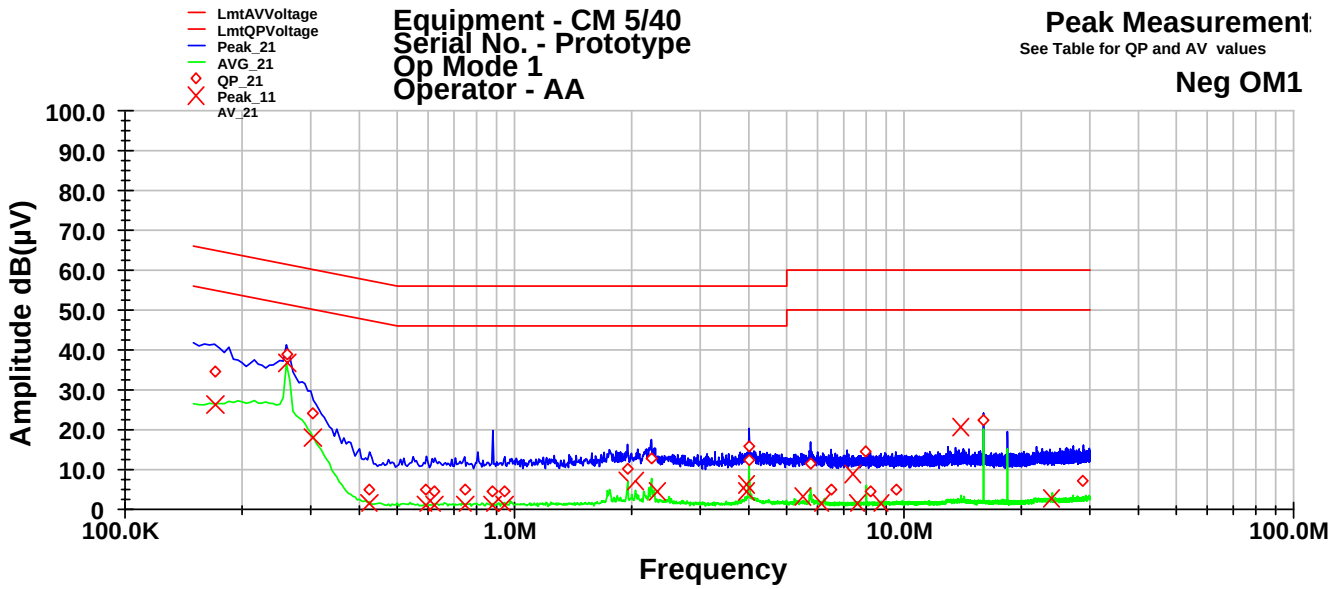
To convert between dBμV and μV, the following conversions apply:

dBμV = 20(log μV)
μV = Inverse log(dBμV/20)

The requirements are **FULFILLED.**

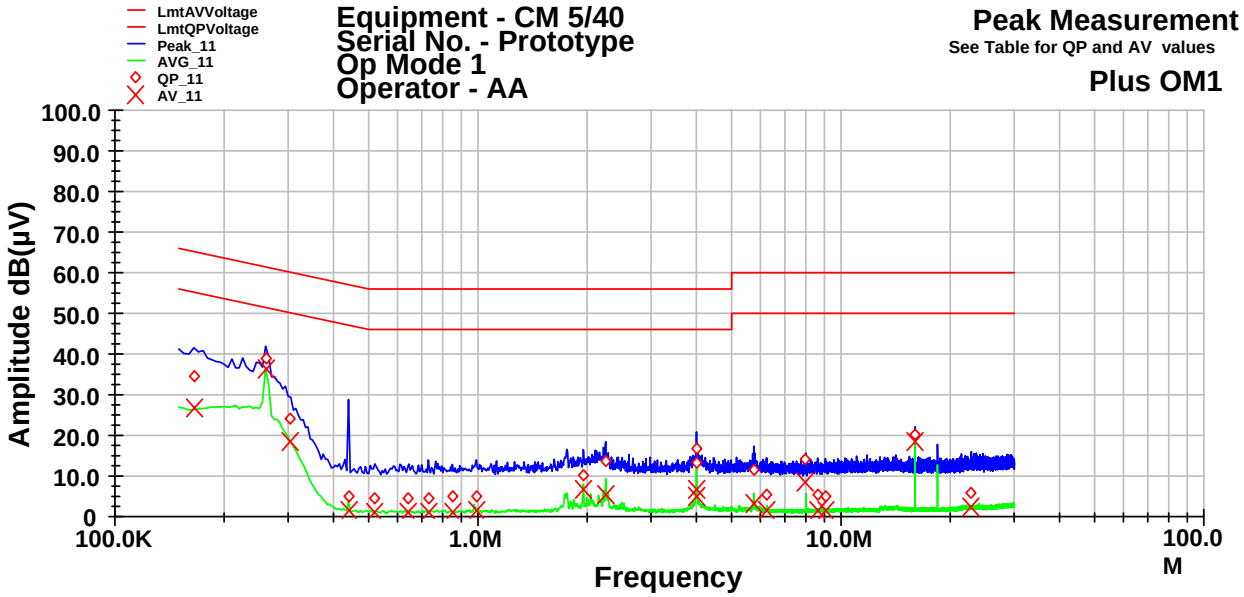
Remarks: For detailed results please refer to the following plots.

Conducted emissions at negative power line



Frequency	QP Level	QP Margin	QP Limit	AV Level	AV Margin	AV Limit
MHz	dB(µV)	dB	dB	dB(µV)	dB	dB
0.17	34.5	-30.5	65.0	26.4	-28.6	55.0
0.26	39.0	-22.4	61.4	36.7	-14.8	51.4
0.305	23.9	-36.2	60.1	17.9	-32.2	50.1
0.425	5.1	-52.3	57.3	1.6	-45.7	47.3
0.595	4.8	-51.2	56.0	1.2	-44.8	46.0
0.625	4.5	-51.5	56.0	1.2	-44.8	46.0
0.745	4.8	-51.3	56.0	1.2	-44.8	46.0
0.88	4.3	-51.7	56.0	1.2	-44.8	46.0
0.945	4.5	-51.5	56.0	1.2	-44.8	46.0
1.955	10.3	-45.7	56.0	7.0	-39.0	46.0
2.25	12.7	-43.3	56.0	4.6	-41.4	46.0
4	15.8	-40.2	56.0	6.4	-39.5	46.0
4.005	12.5	-43.5	56.0	4.4	-41.6	46.0
5.755	11.4	-48.6	60.0	3.3	-46.7	50.0
6.495	4.9	-55.1	60.0	1.4	-48.7	50.0
8	14.6	-45.4	60.0	8.9	-41.1	50.0
8.195	4.7	-55.3	60.0	1.5	-48.5	50.0
9.53	5.1	-54.9	60.0	1.6	-48.4	50.0
16	22.6	-37.4	60.0	20.7	-29.3	50.0
28.85	6.9	-53.1	60.0	2.7	-47.3	50.0

Conducted emissions at positive power line



Frequency	QP Level	QP Margin	QP Limit	AV Level	AV Margin	AV Limit
MHz	dB(µV)	dB	dB	dB(µV)	dB	dB
0.165	34.7	-30.5	65.2	26.7	-28.5	55.2
0.26	38.9	-22.6	61.4	36.4	-15.1	51.4
0.305	24.2	-35.9	60.1	18.3	-31.8	50.1
0.44	4.9	-52.1	57.1	1.4	-45.6	47.1
0.52	4.7	-51.3	56.0	1.2	-44.8	46.0
0.645	4.7	-51.3	56.0	1.2	-44.8	46.0
0.73	4.6	-51.4	56.0	1.2	-44.8	46.0
0.85	4.9	-51.1	56.0	1.2	-44.8	46.0
0.99	5.0	-51.0	56.0	1.4	-44.6	46.0
1.95	10.0	-46.0	56.0	6.6	-39.4	46.0
2.25	13.8	-42.2	56.0	5.2	-40.8	46.0
4	16.7	-39.3	56.0	6.9	-39.1	46.0
4.005	13.2	-42.8	56.0	4.7	-41.3	46.0
5.755	11.5	-48.5	60.0	3.3	-46.7	50.0
6.23	5.2	-54.8	60.0	1.5	-48.5	50.0
8	14.1	-45.9	60.0	8.3	-41.7	50.0
8.615	5.3	-54.8	60.0	1.6	-48.4	50.0
9.045	5.1	-54.9	60.0	1.5	-48.5	50.0
16	20.4	-39.6	60.0	18.4	-31.6	50.0
22.85	5.9	-54.1	60.0	2.4	-47.6	50.0

5.2 26 dB Emission Bandwidth

For test instruments and accessories used see section 6 Part **MB**.

5.2.1 Description of the test location

Test location: AREA4

5.2.2 Photo documentation of the test set-up

5.2.3 Applicable standard

According to FCC Part 15 Subpart 15.401 (i): The emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum of the modulated carrier.

5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level by a specified ratio of -26 dB. The reference level is the level of the highest amplitude signal observed from the transmitter fundamental frequency The measurement has been carried out using a spectrum analyzer with the following settings:
RBW=300 kHz
VBW=1 MHz
PEAK Detector
The table below shows the settings according to ANSI C63.4-2003.

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1kHz
30 to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

5.2.5 Test result

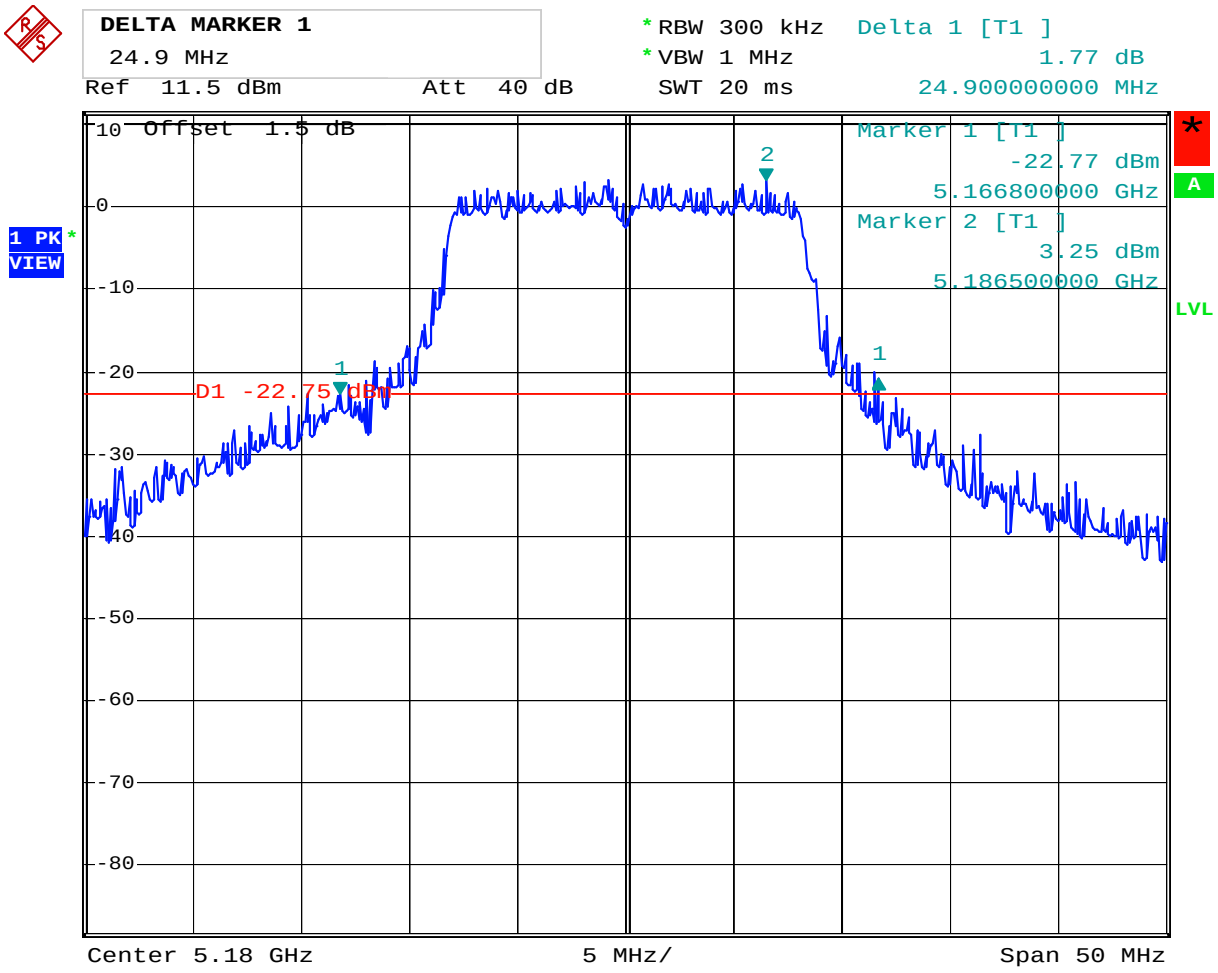
Channel number	Fundamental Frequency (MHz)	26 dB BANDWIDTH (MHz)
36	5180	24.9
40	5200	24.0
48	5240	25.1

Remarks: For detailed test result please refer to following test protocols.

5.2.6 Test protocol

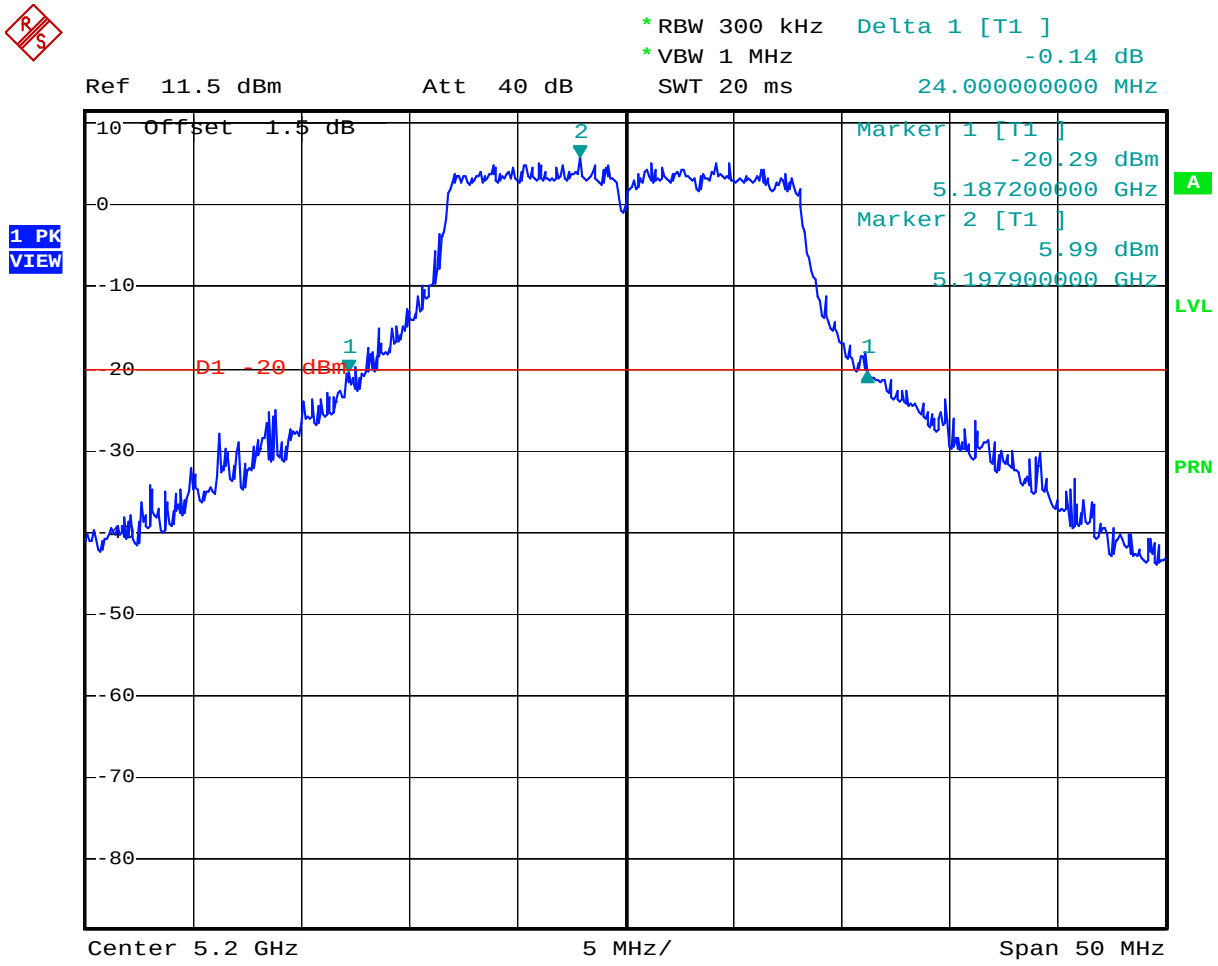
26dB Bandwidth Measurement plots

Channel 36 (5180 MHz)

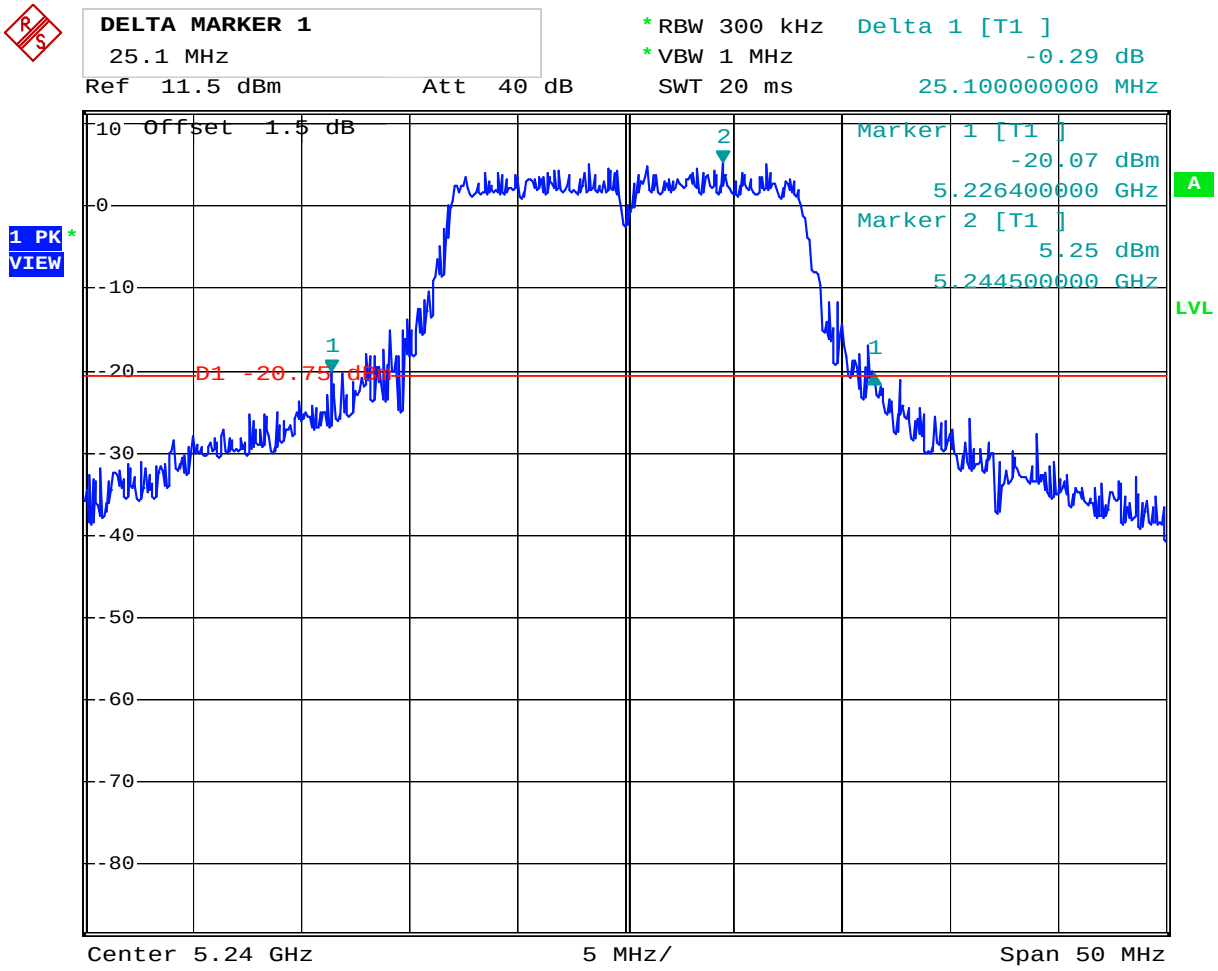


26dB Bandwidth Measurement plots

Channel 40 (5200 MHz)



Channel 48 (5240 MHz)



5.3 Maximum Conducted Output Power

For test instruments and accessories used see section 6 Part **CPC 3**.

5.3.1 Description of the test location

Test location: AREA4

5.3.2 Photo documentation of the test set-up

5.3.3 Applicable standard

According to FCC Part 15 Subpart 15.401 (n): The total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The everage must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level.
The applicable power limits are defined in Part 15.407 (a).
If transmitting antennas of directional gain are greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.4 Description of Measurement

The transmitter output was connected to the spectrum analyzer through an attenuator. The center frequency of the spectrum analyzer is set to the fundamental frequency using 1 MHz RBW and 300 kHz VBW. The span of the spectrum ananlyzer should be larger than the Emission Band Width (EBW). To get the total power of the occupied band width the function “Channel Power Measurement” of the analyzer has been used. The channel band width has been set to EBW. With Peak detector and Power Mode Max Hold the result is the summed maximum output power of the EBW.

5.3.5 Test result

Technology 802.11a

Ch	Frequ. (MHz)	ART Settings (dBm)	Measured Power (dBm)	Correct. (dB)	Power Conducted (dBm)	Antenna Gain (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Delta (dB)
36	5180	13.0	9.2	2.0	11.2	6	17.2	23.0	-5.8
40	5200	14.0	10.3	2.0	12.3	6	18.3	23.0	-4.7
48	5240	15.5	11.6	2.0	13.6	6	19.6	23.0	-3.4

Remarks: Where Correction means cable loss of 2.0 dB.
The calculated EIRP power includes the maximum gain of the applicable antennas.

Peak Power Limit according to FCC Subpart 15.407(a)

Frequency (GHz)	Conducted Power Limit		EIRP Limit
	(dBm)	(mW)	(dBm)
5.15-5.25	**17**	**50**	**23**
5.25-5.35	24	250	30
5.47-5.725	24	250	30

The requirements are **FULFILLED.**

Remarks: This test has been performed conducted at antenna jack on WLAN module.

5.4 Undiserable emissions

For test instruments and accessories used see section 6 Part **SEC 1-3, SER 1, SER 2 and SER 3**.

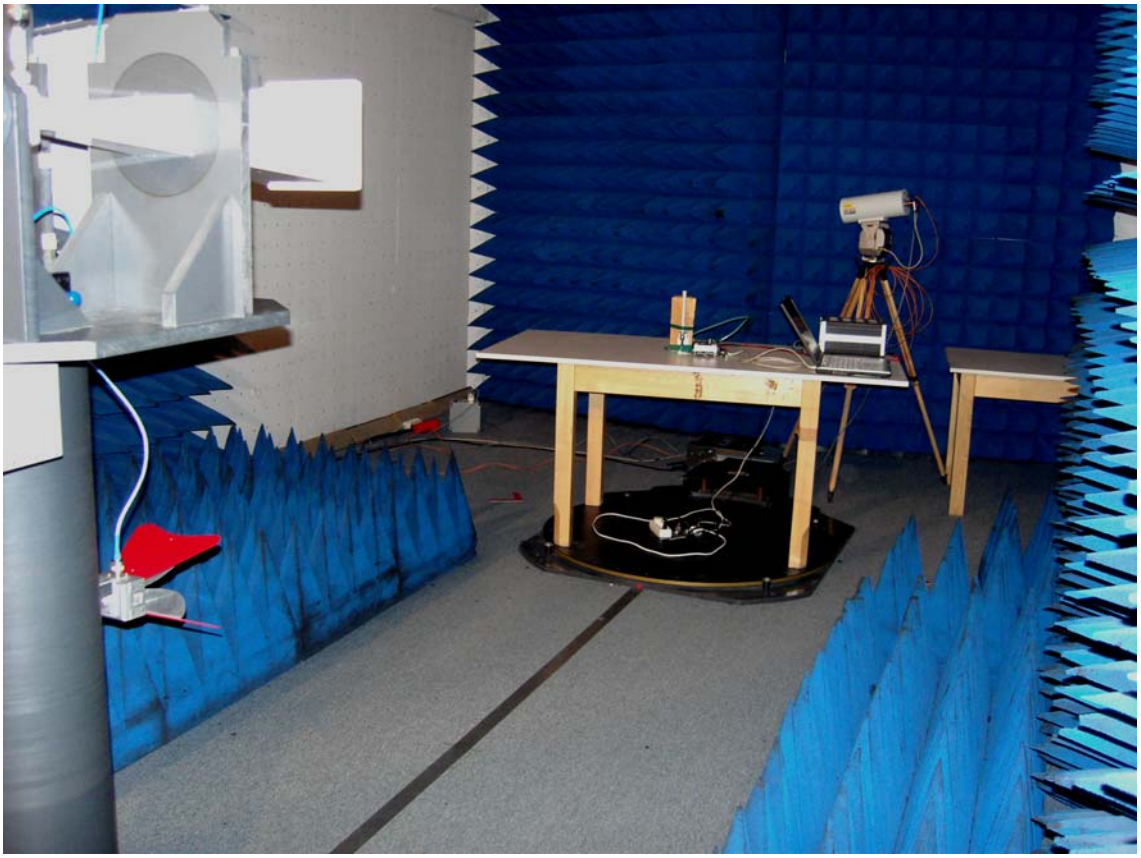
5.4.1 Description of the test location

Test location: OATS1
Anechoic Chamber A2

Test distance: 3 metres

5.4.2 Photo documentation of the test set-up

Anechoic chamber



Open area test site

5.4.3 Applicable standard

According to FCC Part 15 Subpart 15.407 (b):

(1) For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.

(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

5.4.4 Description of Measurement

Radiated spurious emissions from the EuT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The measurements are made with 120 kHz/6 dB bandwidth and quasi-peak detection. The EuT is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.
The antenna was positioned 3 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization`s and the EuT are rotated 360 degrees.

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored.

The radiated emissions from the EuT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a Spectrum Analyzer and appropriate linearly polarized antennas. The EuT is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. The set up of the EuT will be in accordance to ANSI C63.4-2003. The antenna was positioned 3 m horizontally from the EuT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak, RBW 1 MHz and VBW set to 3 MHz for any spurious emission or modulation product that falls in **Restricted bands** as defined in Section 15.205.
All tests are performed at a test-distance of 3 meters. During the tests the EUT measurement scans are made with both horizontal and vertical antenna polarization`s and the EuT are rotated 360 degrees.

According to Part 15.407 (b) (5): The emission measurements have been performed using a minimum RBW of 1 MHz. At some measurements it was necessary to use a RBW of 100 kHz near the band edge. The results than have been calculated to show the total power over 1 MHz.

Average values were measured with spectrum analyzer by taking the following Settings
RBW: 1 MHz
VBW: 10 Hz
Sweep: Auto

5.4.5 Test result

Worst case condition:
All radiated measurements are performed with Antenna ANT793-6MN and ANT793-4MN (max gain of 5 dBi).
The maximum values of the results have been used for declaration of compliance.

5.4.5.1 Radiated emissions and Harmonics in restricted bands

Technology 802.11a

Frequency band: 5.15 GHz to 5.25 GHz

Channel 36 (5180 MHz)

Frequency (MHz)	Detector	Analyzer reading hor (dBµV/m)	Analyzer reading vert (dBµV/m)	Correction (dB)	Result hor (dBµV/m)	Result vert (dBµV/m)	Limit (dBµV/m)	Delta (dB)
5150	Pk	<50	68.3	0.5	---	68.8	74	-5.2
	AV	---	51.7	0.5	---	52.2	54	-1.8

Channel 48 (5240 MHz)

Frequency (MHz)	Detector	Analyzer reading hor (dBµV/m)	Analyzer reading vert (dBµV/m)	Correction (dB)	Result hor (dBµV/m)	Result vert (dBµV/m)	Limit (dBµV/m)	Delta (dB)
5460	Pk	<50	47.8	8.2	---	56.0	74	-18.0
	AV	---	---	8.2	---	---	54	---

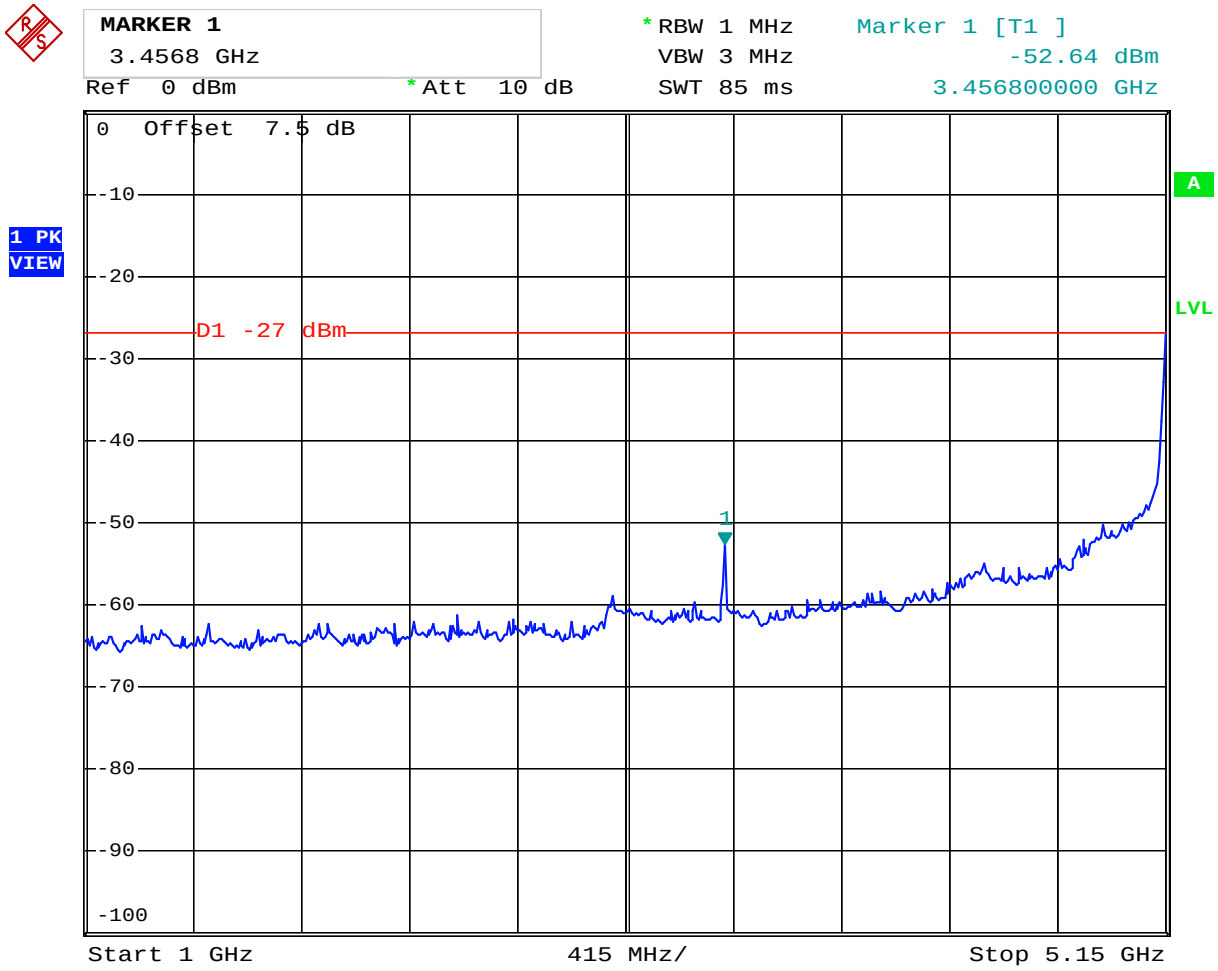
5.4.5.2 Radiated emissions outside of frequency bands (Plots)

Frequency band from 5.15 GHz to 5.25 GHz

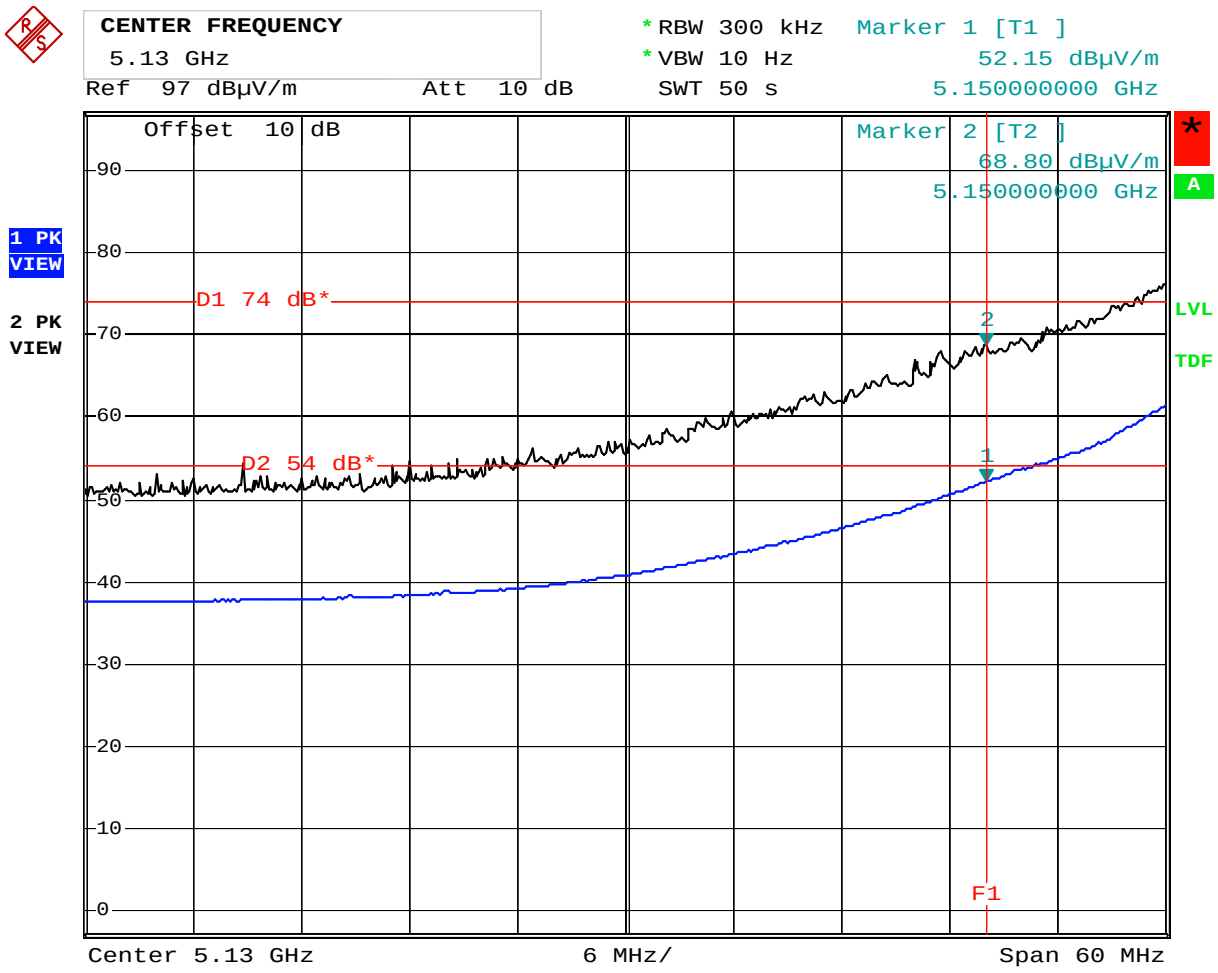
Carrier frequency at channel 36 (5180 MHz)

Three plots have been taken to show the restricted band emission levels and the out-of-band radiated spurious emission levels at and near the lower authorized bandedge.

Emissions out-of-lower-bandedge



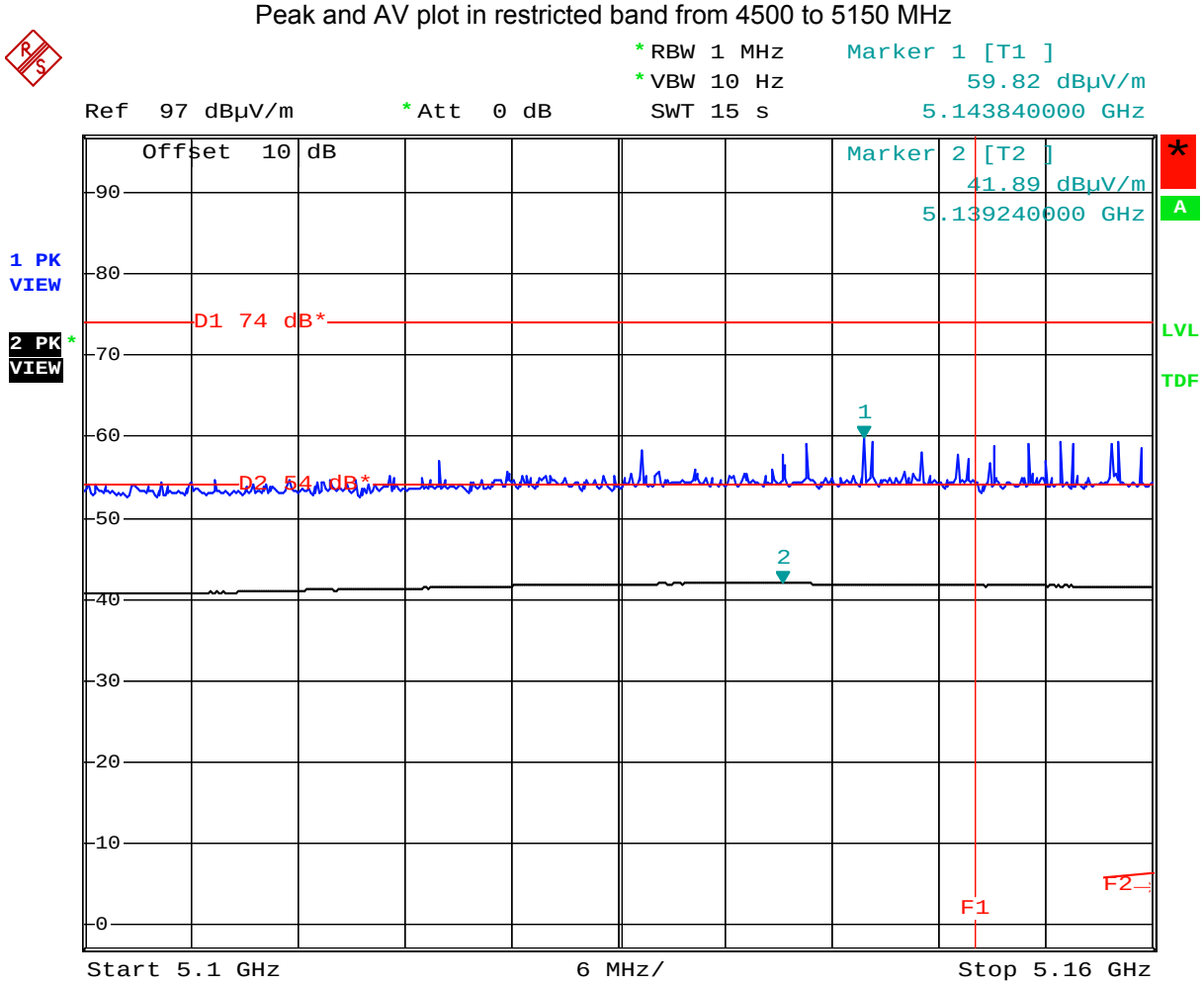
Peak and AV plot in restricted band from 4500 to 5150 MHz



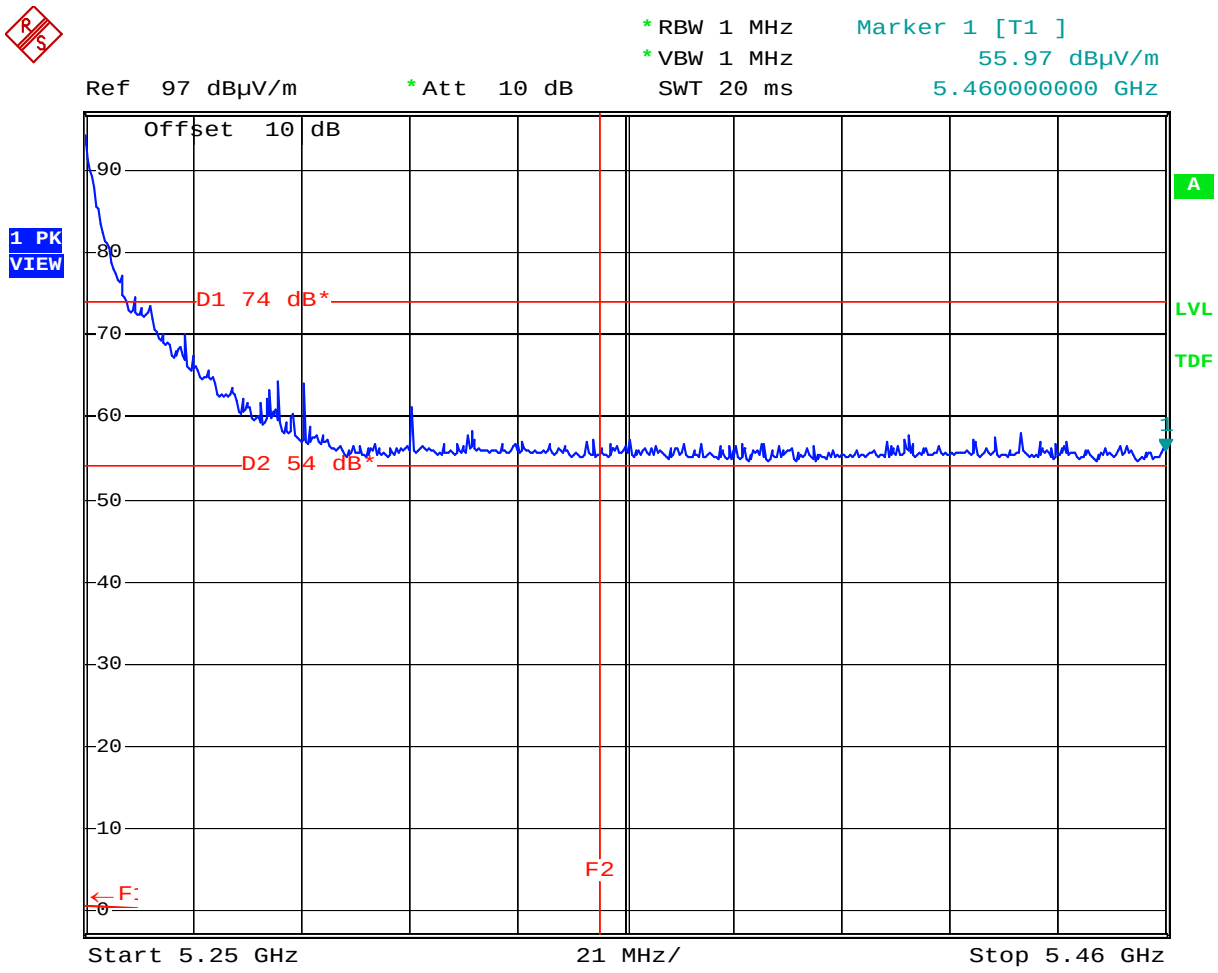
Carrier frequency at channel 48 (5240 MHz)

Two plots have been taken to show the restricted band emission levels and the out-of-band radiated spurious emission levels at and near the lower authorized bandedge.

Peak and AV plot in restricted band from 4500 to 5150 MHz

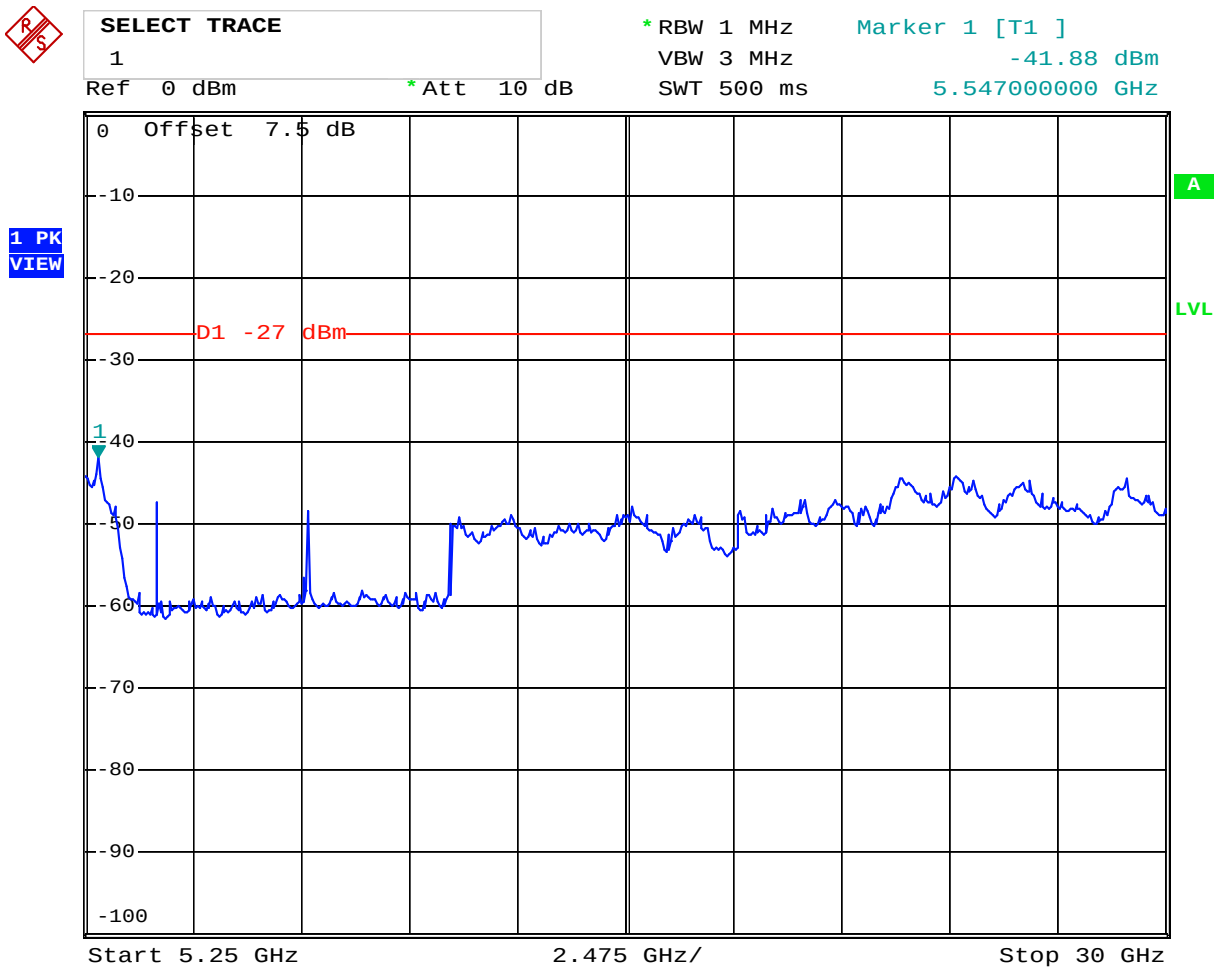


Emissions out-of-upper-bandedge (restricted band from 5350 to 5460 MHz)

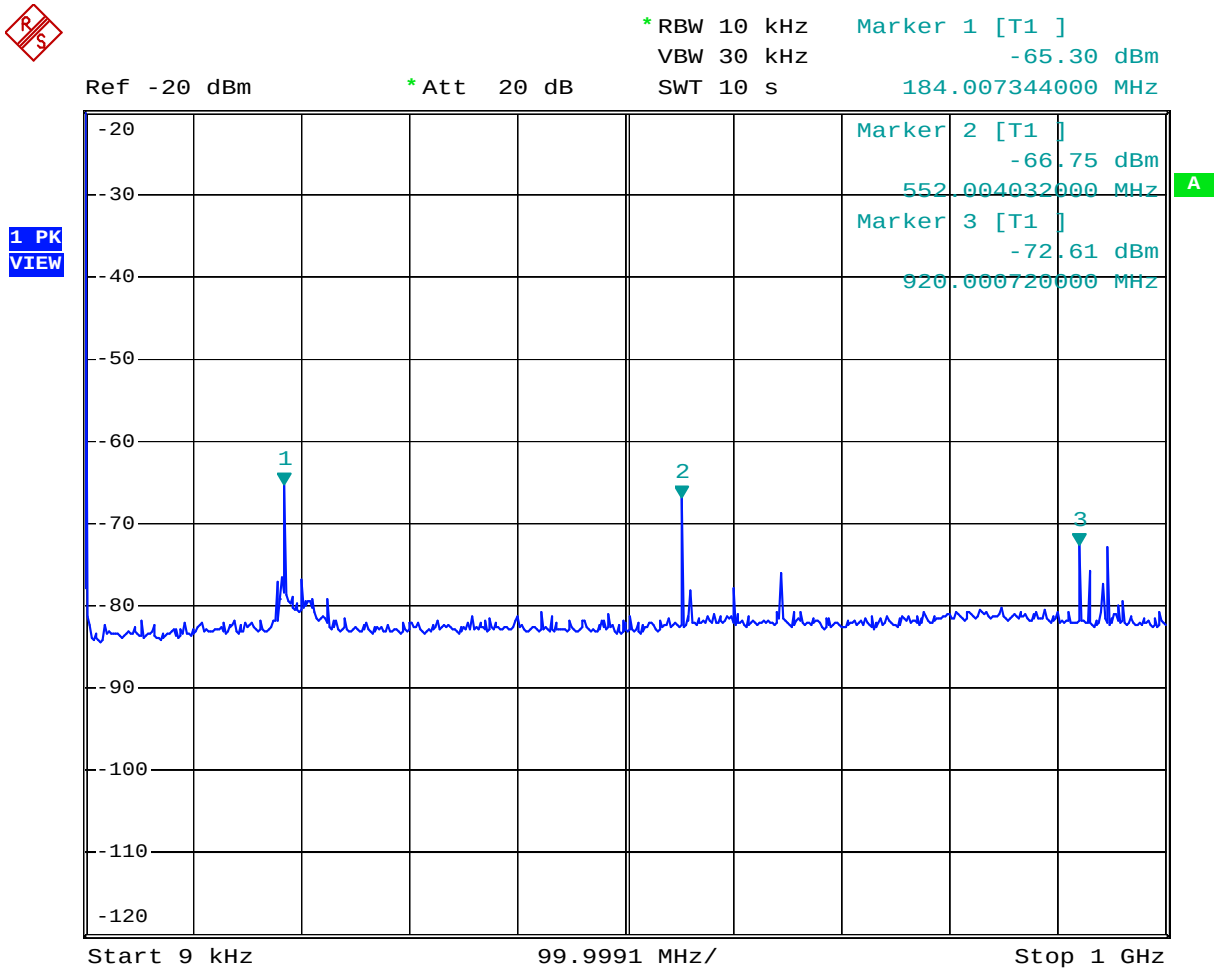


Note: No spurious emissions in restricted band.

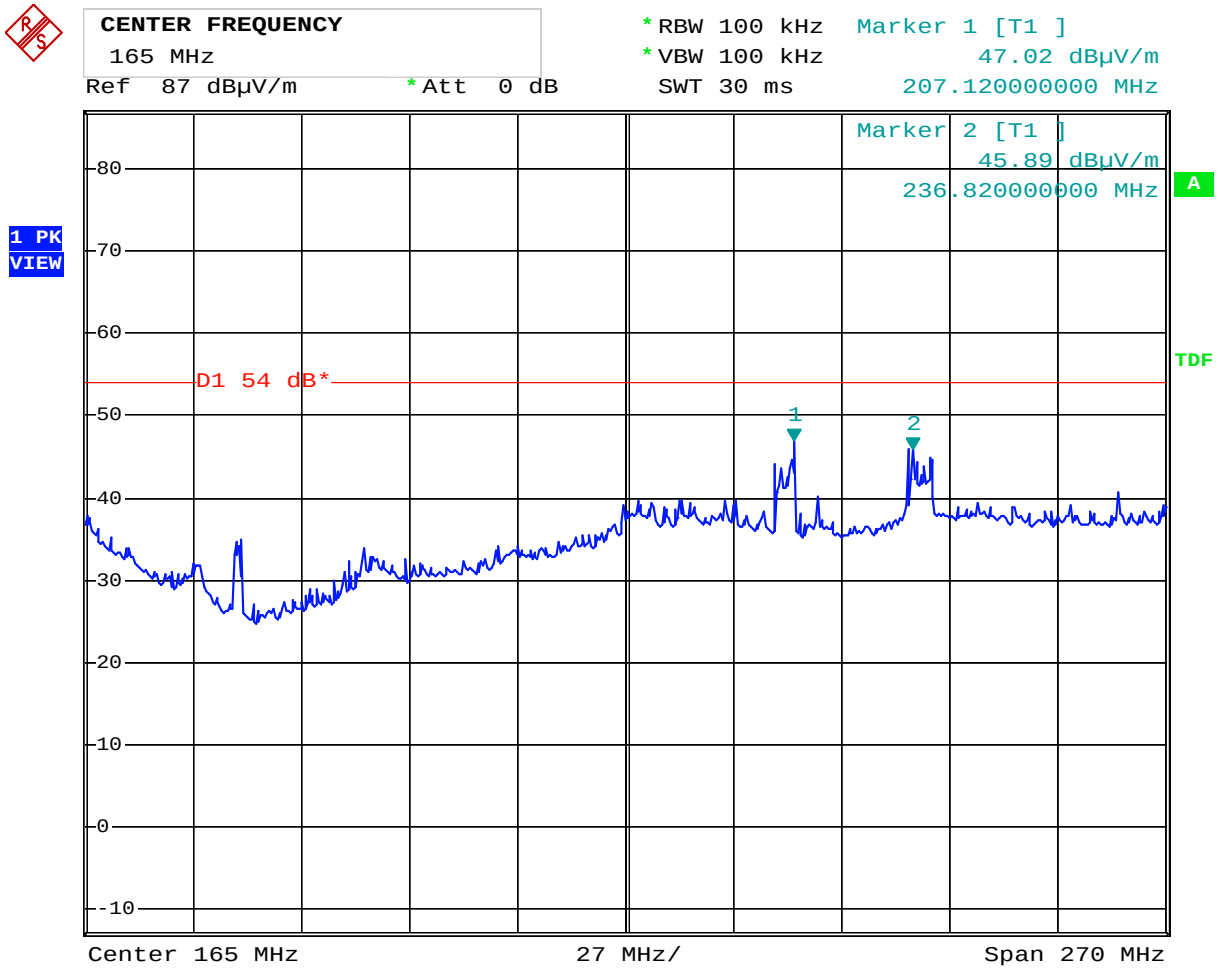
Emissions out-of-upper-bandedge up to 30 GHz



Conducted spurious emissions from 9 kHz to 1000 MHz
(worstcase)

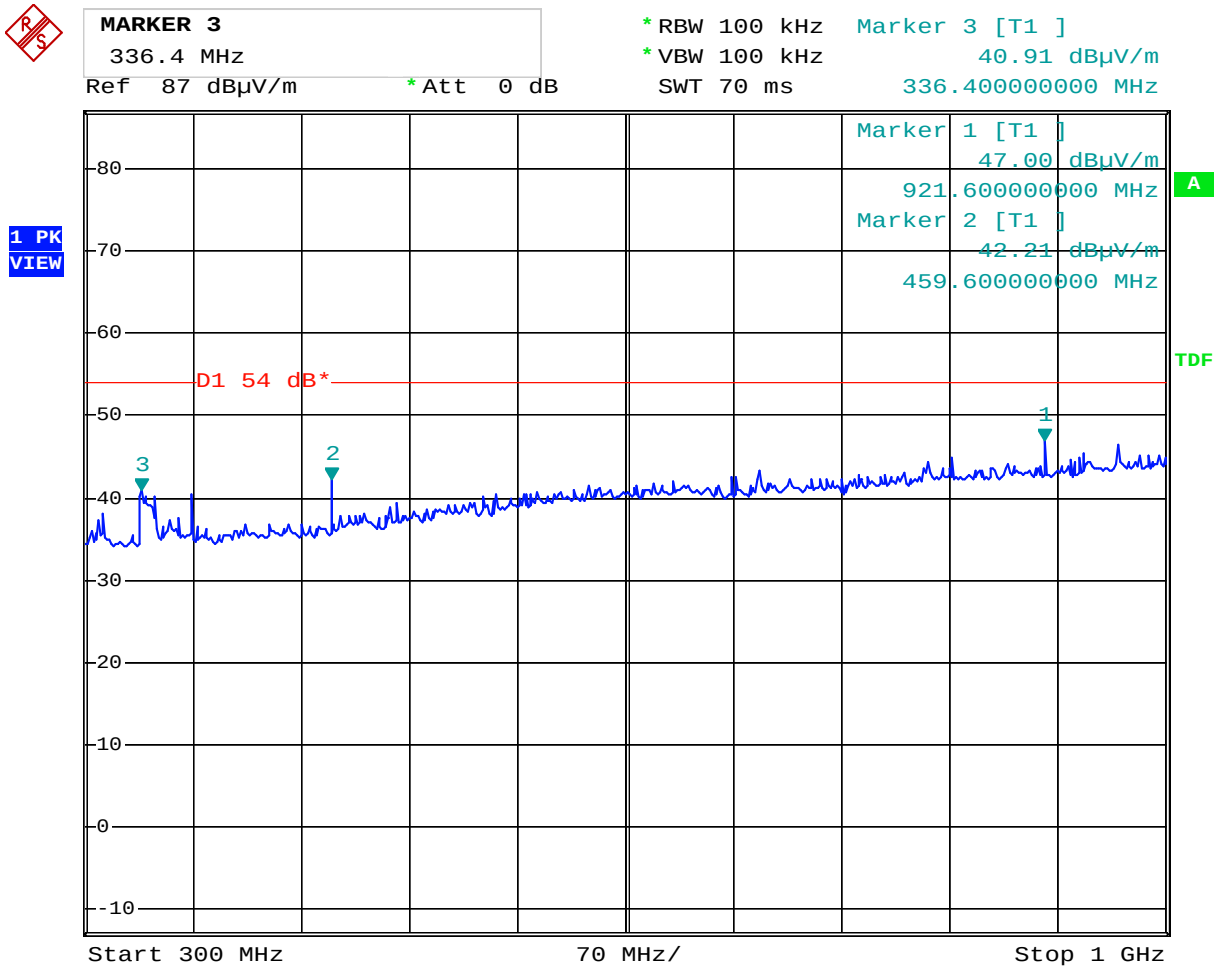


Radiated spurious emissions from 30 MHz to 300 MHz
(worstcase)



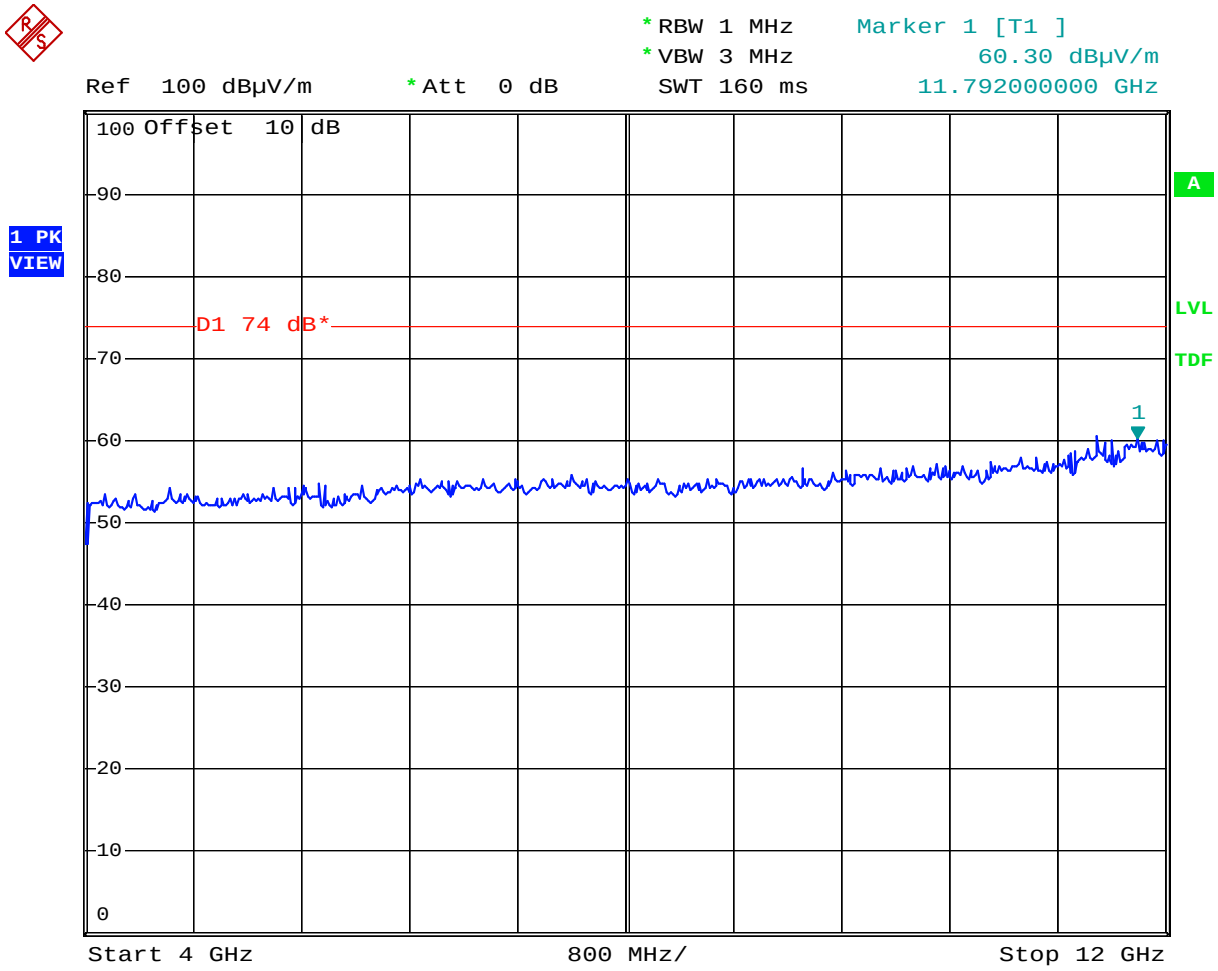
Notes: All peak emissions were below the limits of part 15.209.

Radiated spurious emissions from 300 MHz to 1000 MHz
(worstcase)

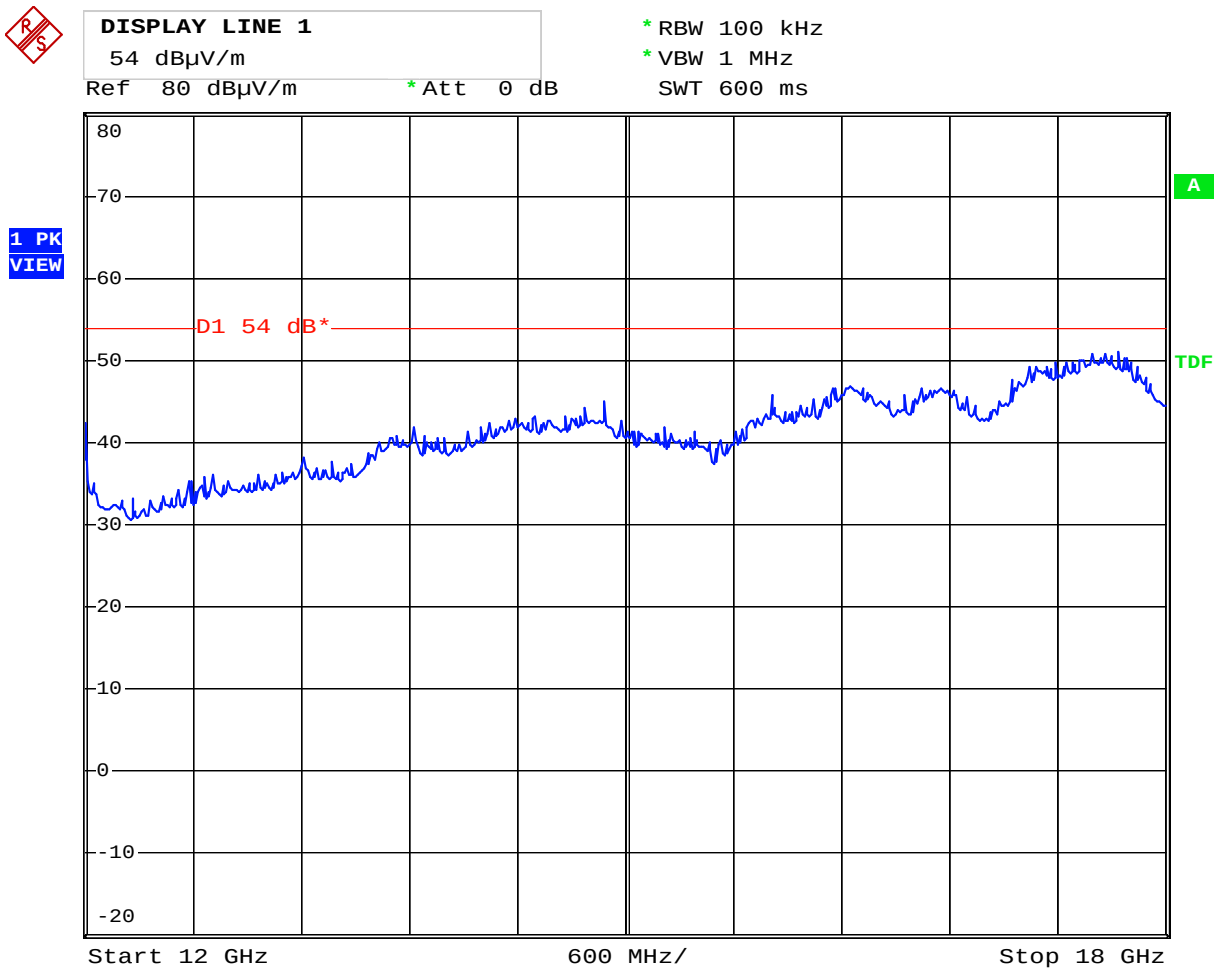


Notes: All peak emissions were below the limits of part 15.209.

Radiated spurious emissions from 4 GHz to 12 GHz
(worstcase)

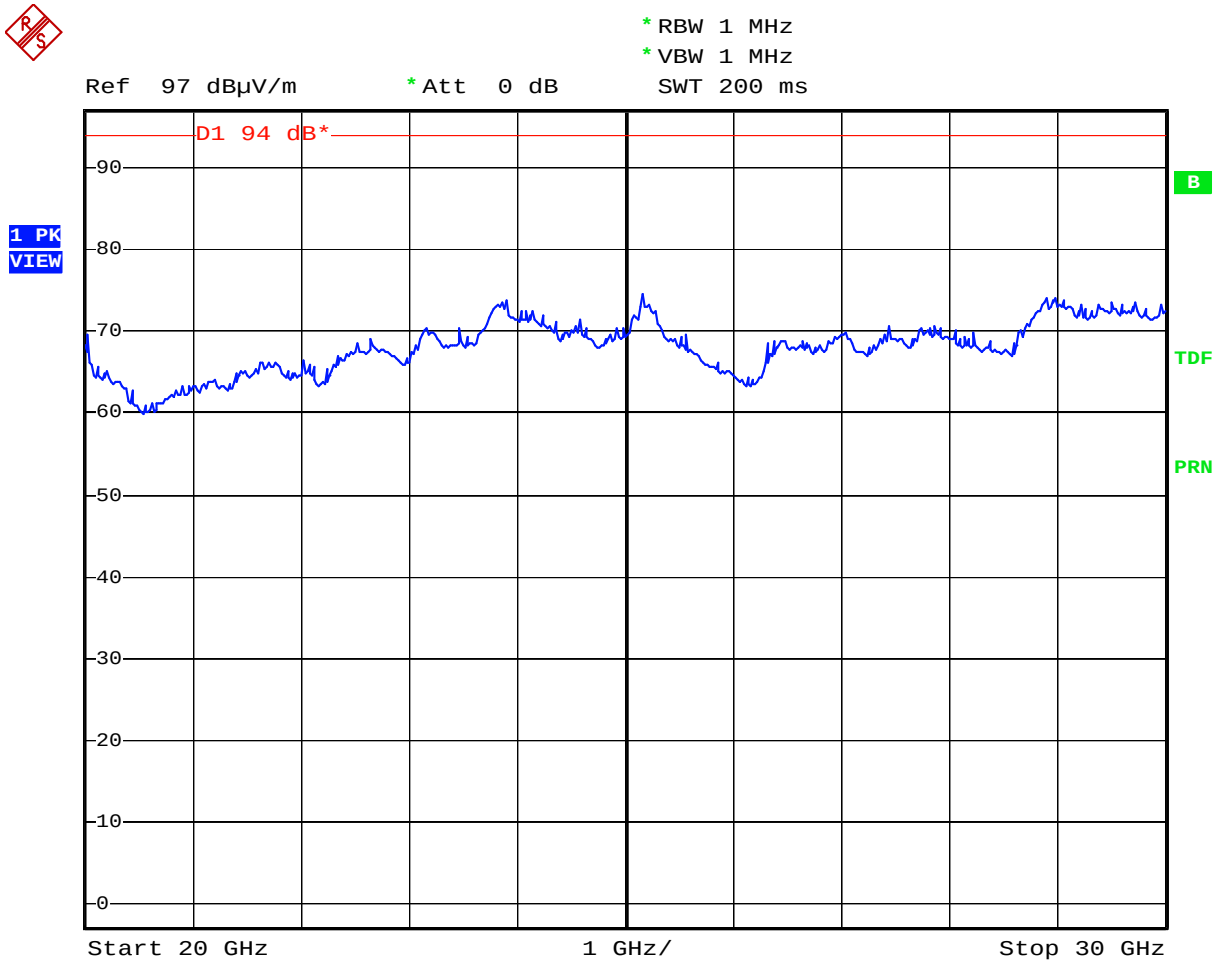


Radiated spurious emissions from 12 GHz to 18 GHz (worstcase)



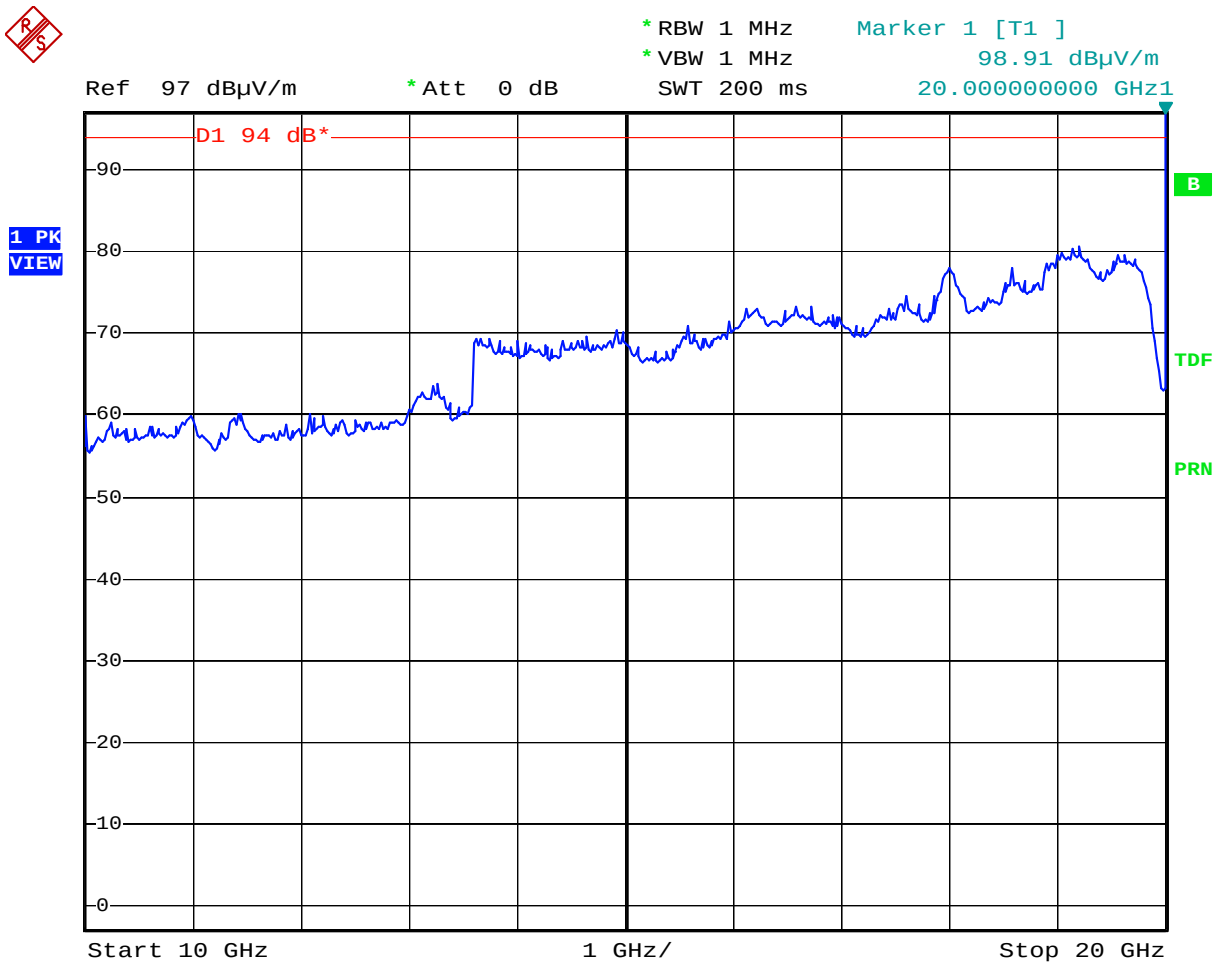
Notes: All peak emissions were below the limits of part 15.209.

Radiated spurious emissions from 20 GHz to 30 GHz
(worstcase)



Notes: All peak emissions were below the limits of part 15.209.
Measurementdistance: 0.3 m
Limit is extrapolated by 20 dB/decade

Radiated spurious emissions from 30 GHz to 40 GHz (worstcase)



Notes: All peak emissions were below the limits of part 15.209.
Measurementdistance: 0.3 m
Limit is extrapolated by 20 dB/decade
The measurement range from 30 – 40 GHz has been transposed by a mixer of 20 GHz to the analyzer range from 10 – 20 GHz.

Radiated limits according to FCC Part 15 Subpart 15.209(a) for spurious emissions which fall in restricted bands:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (meters)
	(µV/m)	dB (µV/m)	
0,009-0,490	2400/F(kHz)		300
0,490-1,705	24000/F(kHz)		30
1,705-30	30	29,5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209

MHz	MHz	GHz
25.5 – 25.67	960 – 1240	4.5 – 5.15
37.5 – 38.25	1300 – 1427	5.35 – 5.46
73 – 74.6	1435 – 1626.5	7.25 – 7.75
74.8 – 75.2	1645.5 – 1646.5	8.025 – 8.5
108 – 121.94	1660 – 1710	9.0 – 9.2
123 – 138	1718.8 – 1722.2	9.3 – 9.5
149.9 – 150.05	2200 – 2300	10.6 – 12.7
156.52475 – 156.52525	2310 – 2390	13.25 – 13.4
156.7 – 156.9	2483.5 – 2500	14.47 – 14.5
162.0125 – 167.17	2655 – 2900	15.35 – 16.2
167.72 – 173.2	3260 – 3267	17.7 – 21.4
240 – 285	3332 – 3339	22.01 – 23.12
322 – 335.4	3345.8 – 3358	23.6 – 24.0
399.9 – 410	3600 – 4400	31.2 – 31.8
608 – 614		36.43 – 36.5

The requirements are **FULFILLED.**

Remarks: The measurement was performed up to the 10th harmonic.

At the frequency range from 9 kHz to 1 GHz no spurious emissions could be measured.

5.5 Peak Power Spectral Density

For test instruments and accessories used see section 6 Part **CPC 3**.

5.5.1 Description of the test location

Test location: Area 4

5.5.2 Photo documentation of the test set-up

5.5.3 Applicable standard

According to FCC Part 15 Subpart 15.407 (a):For the band 5.15-5.25 GHz the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 4 dBm in any 1-MHz band during any time interval of continuous transmission.

5.5.4 Description of Measurement

The EuT was connected to the spectrum analyzer with a suitable attenuator. The peak power spectral density was measured using the analyzer function of measuring the band power/Hz and the same settings like the power measuring. The result is calculated by addition of 60 dB (10 log 1 MHz/Hz) to the readings.

Settings on the spectrum analyzer:

RBW:	1 MHz
VBW:	300 kHz
Sweep:	auto
Detecter function:	AV

5.5.5 Test result

Technology 802.11a

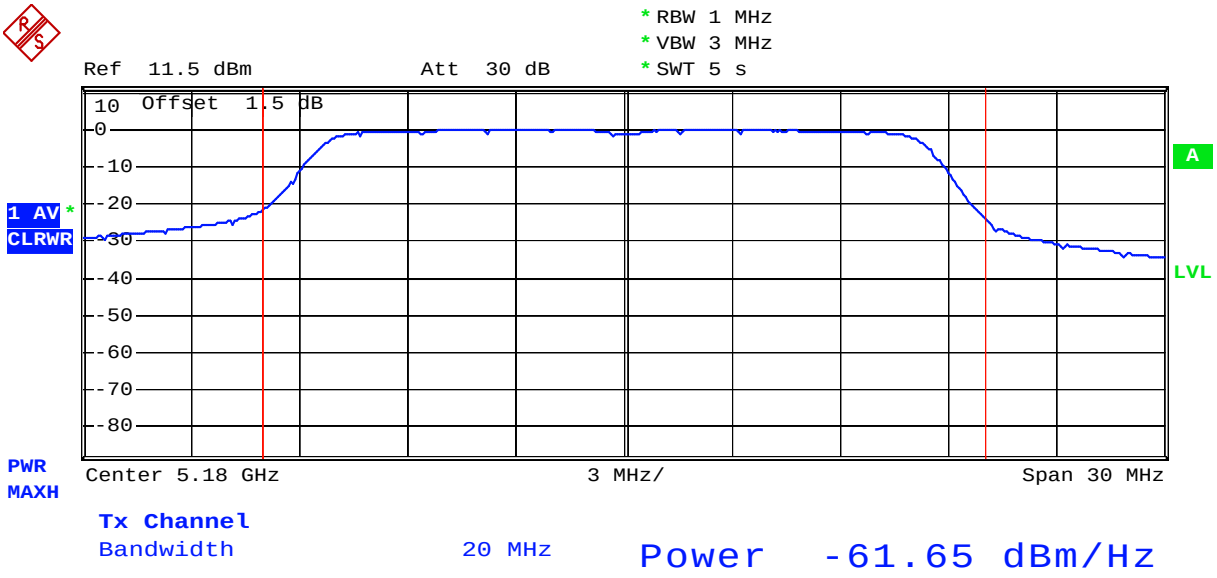
Channel	Fundamental Frequency (MHz)	Reading (dBm/Hz)	Correction to 1 MHz (dB)	PPSD Result (dBm)	Limit (dBm)
36	5180	-61.7	60	-1.7	4
40	5200	-60.7	60	-0.7	4
48	5240	-59.4	60	0.6	4

The requirements are **FULFILLED.**

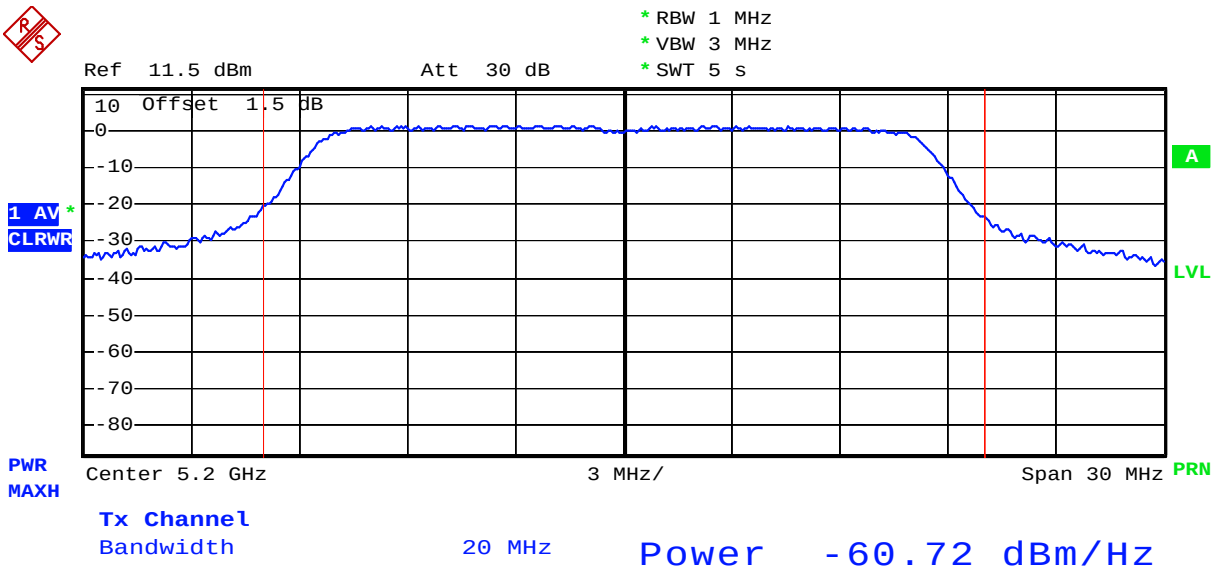
Remarks: For detailed test results please refer to following test protocols.

Peak Power spectral density plots

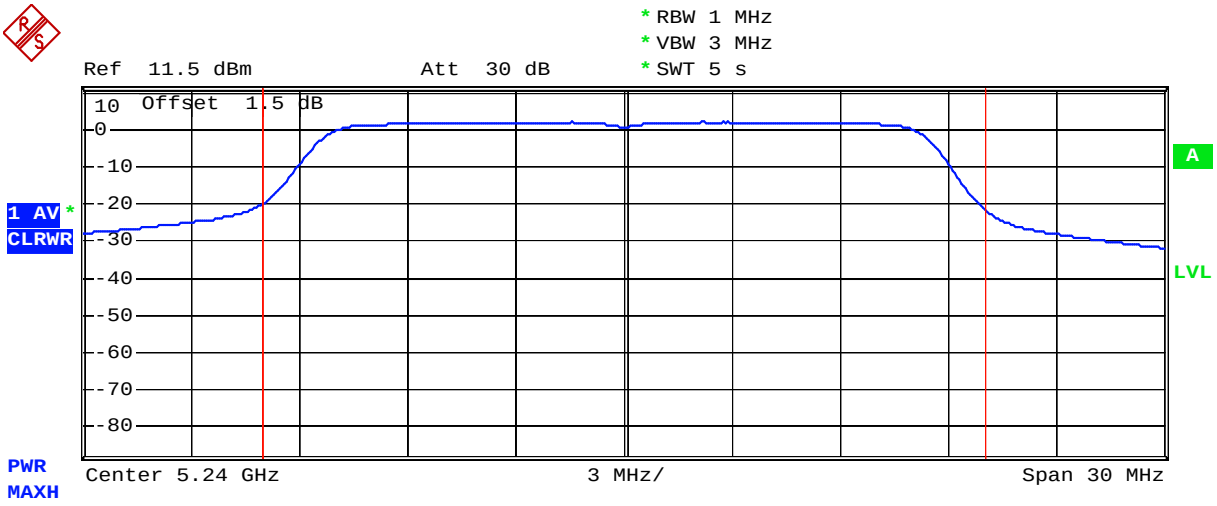
Channel 36 (5180 MHz)



Channel 40 (5200 MHz)



Channel 48 (5240 MHz)



5.6 Peak Excursion

For test instruments and accessories used see section 6 Part **MB**.

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up

5.6.3 Applicable standard

According to FCC Part 15 Subpart 15.407 (a) (6): The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

5.6.4 Description of Measurement

The transmitter output was connected to the spectrum analyzer. Using Peak detector and MAX HOLD-function for Trace 1 with 1 MHz RBW and 3 MHz VBW and Trace 2 with 1 MHz RBW and 300 kHz VBW both traces were recorded. The largest difference between Trace 1 and Trace 2 in any 1 MHz band was noted as maximum Peak Excursion value.

5.6.5 Test result

Technology 802.11a

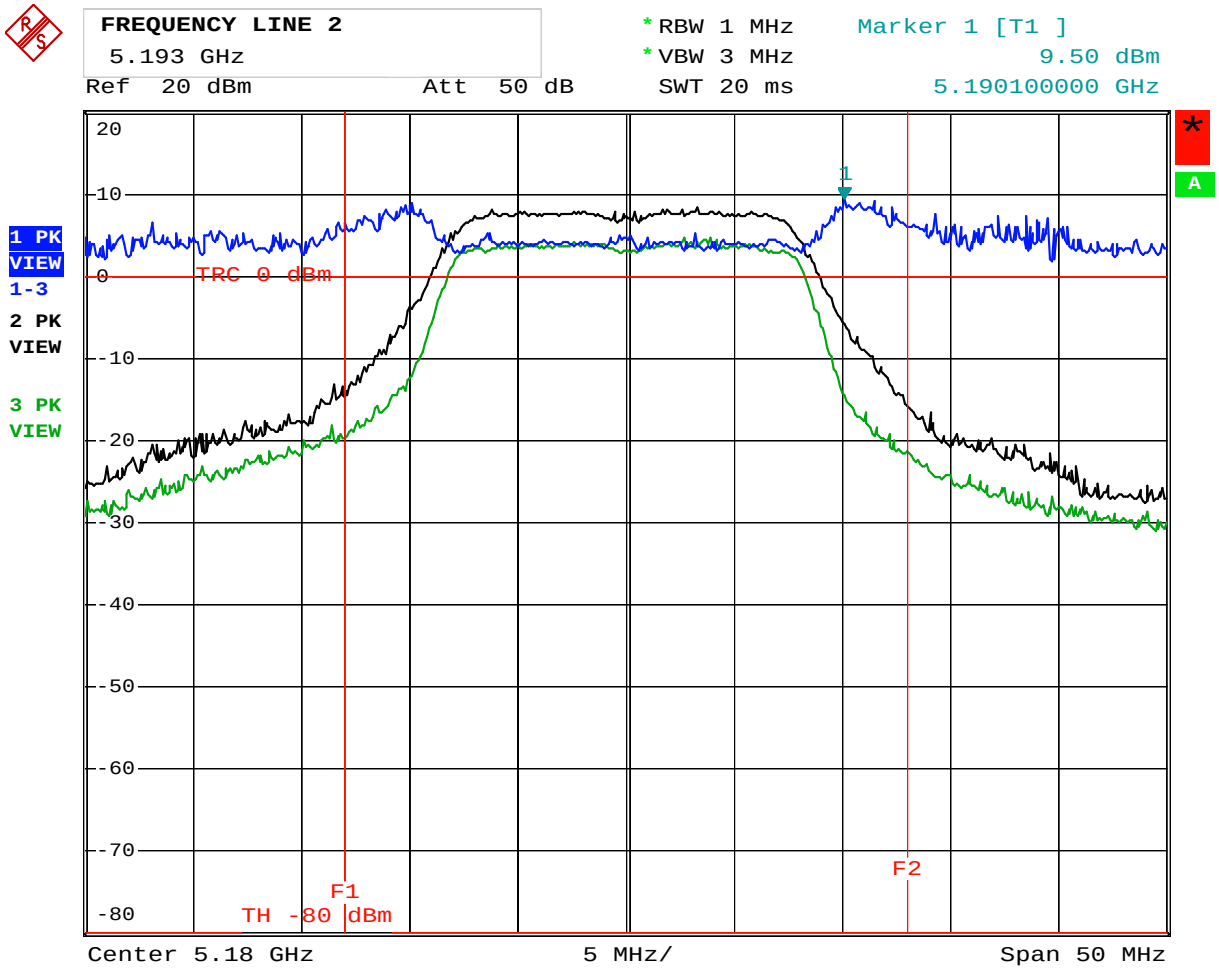
Channel	Frequency (MHz)	Peak Power Excursion (dBm)	Peak to Average Excursion Limit (dBm)	Delta (dB)
36	5180	9.5	13	-3.5
40	5200	9.8	13	-3.2
48	5240	10.4	13	-2.6

The requirements are **FULFILLED.**

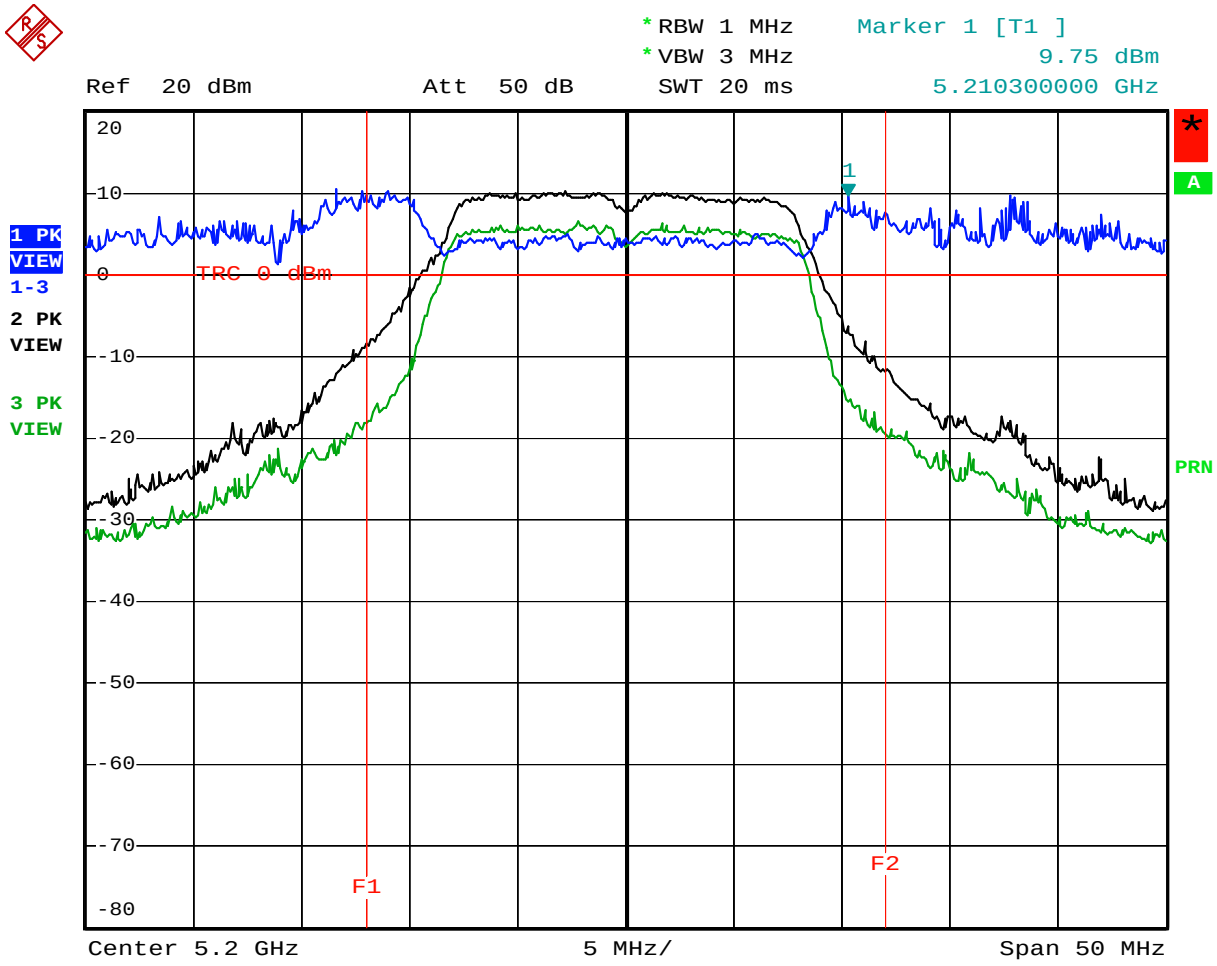
Remarks: For detailed test results please refer to following test protocols.

Peak Excursion Plots

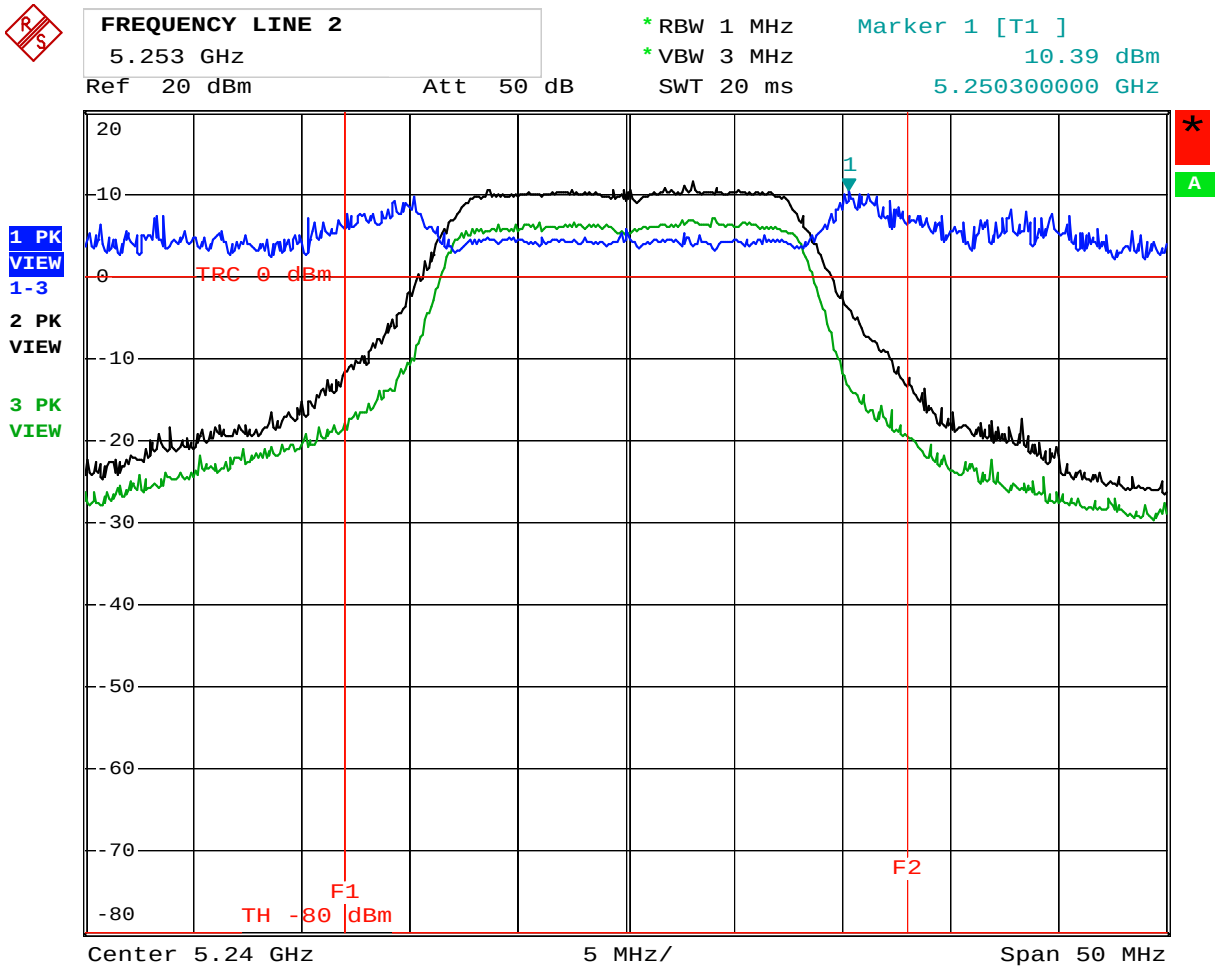
Channel 36 (5180 MHz)



Channel 40 (5200 MHz)



Channel 48 (5240 MHz)



5.7 Frequency stability Measurement

For test instruments and accessories used see section 6 Part **CPC 3**.

5.7.1 Description of the test location

Test location: AREA4

5.7.2 Photo documentation of the test set-up

5.7.3 Applicable standard

According to FCC Part 15 Subpart 15.407 (g): Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

5.7.4 Description of Measurement

This test hve been performed over variations in temperature and voltage. The lowest and the highest channel in the frequency band from 5150 to 5250 MHz have been measured at the 20 dB bandwidth under following conditions:

1. Supply voltage from 85 to 115 % of nominal voltage at normal temperature
2. Extreme temperature from -20 ˚C to 60 ˚C at nominal voltage.

5.7.5 Test result

The carrier frequencies (5180 MHz, 5240 MHz) maintain inside the operating frequency band from 5150 to 5250 MHz.

The requirements are **FULFILLED.**

Remarks: This test has been performed conducted at antenna jack on WLAN module.

5.8 Maximum Permissible Exposure (MPE)

For test instruments and accessories used see section 6 Part **CPC 3**.

5.8.1 Description of the test location

Test location: AREA4

5.8.2 Photo documentation of the test set-up

5.8.3 Applicable standard

According to FCC Part 15 Subpart 15.407 (f): U-NII devices are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307 (b), 2.1091 and 2.1093 of this chapter, as appropriate.

The test methods used comply with ANSI/IEEE C95.1-1992, “IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”.
This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in FCC 1.1307(b).

5.8.4 Description of Measurement

The maximum total power input to the antenna has been measured conducted as described in clause 5.3 of this document. Through the Friis transmission formula, which is a far field assumption and the known maximum gain of the antenna, the maximum MPE at a defined distance away from the product, can be calculated.

Friis transmission formula: $P_d = \frac{P_{out} * G}{4 * \Pi * r^2}$

where

P_d =power density in mW/cm^2
P_{out} = output power to antenna in mW
G = gain of antenna (linear scale)
r = distance between antenna and observation point (cm)

5.8.5 Compliance regarding co-location and co-transmission

Regarding Co-location and Co-transmission there is no assessment necessary, because only 1 module is incorporated in the EuT.

5.8.6 Test result

Worst case: Antenna ANT793-6MN respectively ANT793-4MN with an antenna gain of 5 dBi

Channel No.	Frequency (MHz)	Max Power Output to Antenna (dBm)	(mW)	Antenna gain (dBi)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
36	5180	11.2	13.2	5	0.010	1.0
40	5200	12.3	17.0	5	0.011	1.0
48	5240	13.6	22.9	5	0.018	1.0

Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
(A) Limits for Occupational / Controlled Exposure				
0.3 – 3.0	614	1.63	100	6
3.0 – 30	1842/f	4.89/f	$900/f^2$	6
30 - 300	61.4	0.163	1.0	6
300-1500	---	---	f/300	6
1500-100000	---	---	5.0	6
(**B) Limits for General Population / Uncontrolled Exposure**				
0.3 – 3.0	614	1.63	100	30
3.0 – 30	824/f	2.19/f	$180/f^2$	30
30 - 300	27.5	0.073	0.2	30
300-1500	---	---	f/1500	30
1500-100000	**---**	**---**	**1.0**	**30**

f = Frequency in MHz

The requirements are **FULFILLED.**

Remarks: The Power density has been calculated at a distance of 20 cm.

5.9 Antenna application

5.9.1 Applicable standard

According to FCC Part 15 Subpart 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.
All supplied antennas meet the requirements of part 15.203 and 15.204.
The antennas can be connected only by a cable equiped with a reverse SMA plug supplied by the manufacturer.

5.9.2 Antenna requirements

FCC part 15C section 15.407 (a) requirements:
The conducted output power limit specified in paragraph (a) of 15.407 is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (a)(1), (a)(2) and (a)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6dBi.

The necessary reduction of the output power depends on the used type of antenna. The amount of the reduced output power is implemented in the firmware of the EuT and will be automaticly adjusted on the selected antenna.

5.10 Receiver Spurious Emissions

For test instruments and accessories used see section 6 Part **SER 2 and SER 3.**

5.10.1 Description of the test location

Test location: OATS1
Anechoic Chamber A2

Test distance: 3 metres

5.10.2 Photo documentation of the test set-up

Anechoic chamber

Open area test site

5.10.3 Applicable standard

According to FCC Part 15 Subpart 15.109: Field strength of radiated emissions from unintentional radiators at 3 m.

5.10.4 Description of Measurement

Radiated spurious emissions from the EuT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The measurements are made with 120 kHz/6 dB bandwidth and quasi-peak detection. The EuT is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.
The antenna was positioned 3 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization`s and the EuT are rotated 360 degrees.

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored.

The radiated emissions from the EuT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a Spectrum Analyzer and appropriate linearly polarized antennas. The EuT is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. The set up of the EuT will be in accordance to ANSI C63.4-2003. The antenna was positioned 3 m horizontally from the EuT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak, RBW 1 MHz and VBW set to 3 MHz for any spurious emission or modulation product that falls in Restricted bands as defined in Section 15.205.
All tests are performed at a test-distance of 3 meters. During the tests the EUT measurement scans are made with both horizontal and vertical antenna polarization`s and the EuT are rotated 360 degrees.

Average values were measured with spectrum analyzer by taking the following Settings
RBW: 1 MHz
VBW: 10 Hz
Sweep: Auto

5.10.5 Test result

Frequency (MHz)	Detector	Analyzer reading hor (dBµV/m)	Analyzer reading vert (dBµV/m)	Correction (dB)	Result hor (dBµV/m)	Result vert (dBµV/m)	Limit (dBµV/m)	Delta (dB)
30-1000	Pk	<30	<30		---	---	---	---
	AV	---	---		---	---	---	---
1000-18000	Pk	<54	<54		---	---	74	---
	AV	---	---		---	---	54	---

Limit according to FCC Subpart 15.109(a)

Frequency of emission (MHz)	Field strength Limits (µV/m)	Field strength Limits (dBµV/m)
0,009-0,490	2400/F(kHz)	
0,490-1,705	24000/F(kHz)	
1,705-30	30	
30-88	100	40
88-216	150	44
216-960	200	46
Above 960	500	54

The requirements are **FULFILLED.**

Remarks: The measurement was performed up to the 5th harmonic.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

Test ID	Model / Type	Kind of Equipment	Manufacturer	Equipment No.
A 4	ESHS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-002
	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	ESH 2 - Z 5	LISN	Rohde & Schwarz München	02-02/20-05-004
	N-4000-BNC	RF Cable	mikes-testingpartners gmbh	02-02/50-05-138
	N-1500-N	RF Cable	mikes-testingpartners gmbh	02-02/50-05-140
	ESH 3 - Z 2	Pulse Limiter	Rohde & Schwarz München	02-02/50-05-155
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-031
CPC 3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	THS730A	Handheld Scope	Tektronix GmbH	02-02/13-05-001
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-031
MB	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	THS730A	Handheld Scope	Tektronix GmbH	02-02/13-05-001
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-031
SEC 1-3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	THS730A	Handheld Scope	Tektronix GmbH	02-02/13-05-001
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-031
SER 1	FMZB 1516	Magnetic Field Antenna	Schwarzbeck Mess-Elektronik	01-02/24-01-018
	ESCS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-001
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-031
SER 2	ESVS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-006
	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	VULB 9168	Trilog Broad Band Antenna	Schwarzbeck Mess-Elektronik	02-02/24-05-005
	S10162-B	RF Cable 33 m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20 m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-031
SER 3	FSP 30	Spectrum Analyzer	Rohde & Schwarz München	02-02/11-05-001
	AFS4-01000400-10-10P-4	RF Amplifier 1-4 GHz	PARZICH GMBH	02-02/17-05-003
	AMF-4F-04001200-15-10P	RF Amplifier 4-12 GHz	PARZICH GMBH	02-02/17-05-004
	AFS5-12001800-18-10P-6	RF Amplifier 12-18 GHz	PARZICH GMBH	02-02/17-06-002
	3117	Horn Antenna 1-18 GHz	EMCO Elektronik GmbH	02-02/24-05-009
	Sucoflex N-1600-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-073
	Sucoflex N-2000-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-075
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-031

	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	02-02/03-05-002	04/30/2009	04/30/2008		
	02-02/11-05-001	04/08/2009	04/08/2008		
	02-02/20-05-004	03/13/2011	03/13/2008	04/08/2009	10/08/2008
	02-02/50-05-138				
	02-02/50-05-140				
	02-02/50-05-155	04/06/2009	10/06/2008		
	02-02/50-07-031				
CPC 3	02-02/11-05-001	04/08/2009	04/08/2008		
	02-02/13-05-001	09/10/2009	09/10/2008		
	02-02/50-07-031				
MB	02-02/11-05-001	04/08/2009	04/08/2008		
	02-02/13-05-001	09/10/2009	09/10/2008		
	02-02/50-07-031				
SEC 1-3	02-02/11-05-001	04/08/2009	04/08/2008		
	02-02/13-05-001	09/10/2009	09/10/2008		
	02-02/50-07-031				
SER 1	01-02/24-01-018	02/23/2010	02/23/2009		
	02-02/03-05-001	12/10/2009	12/10/2008		
	02-02/50-07-031				
SER 2	02-02/03-05-006	07/30/2009	07/30/2008		
	02-02/11-05-001	04/08/2009	04/08/2008		
	02-02/24-05-005	05/06/2011	05/06/2008	09/02/2009	03/02/2009
	02-02/50-05-031				
	02-02/50-05-033				
	02-02/50-05-113				
	02-02/50-07-031				
SER 3	02-02/11-05-001	04/08/2009	04/08/2008		
	02-02/17-05-003				
	02-02/17-05-004				
	02-02/17-06-002				
	02-02/24-05-009	02/04/2010	02/04/2009		
	02-02/50-05-073				
	02-02/50-05-075				
	02-02/50-07-031				