FCC ID:BV5SMALLENGINE

EMI – TEST REPORT

- FCC Part 15.247 and RSS 210 Issue 8, Annex 8-

DAkkS Deutsche Akkreditierungsstelle D-PL-12030-01-01

Test Report No. :	**T34325-02-02HS**	08 June 2011 Date of issue

Type / Model Name : Small engine

Product Description : WLAN Module

Applicant : Bang & Olufsen A/S

Address : Peter-Bangs-Vej 15

7600 STRUER, DENMARK

Manufacturer : Bang & Olufsen A/S

Address : Peter-Bangs-Vej 15

7600 STRUER, DENMARK

Licence holder : Bang & Olufsen A/S

Address : Peter-Bangs-Vej 15

7600 STRUER, DENMARK

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

ilac-MRA

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2010)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2010)

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 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.212	Modular transmitters
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

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
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable device

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

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.
ANSI C95.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment
KDB 558074	Measurement of digital transmission systems operating under Section 15.247. March 23, 2005.

2 SUMMARY

2.1 Test result summery

WLAN device using digital modulation:

Operating in the 5725 MHz – 5850 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 7.2.4.	AC power line conducted emissions	passed
15.247(a)(2)	RSS210, A8.2(a)	-6 dB EBW	passed
15.247(b)(3)	RSS-210, A8.4(4)	Peak power	passed
15.247(d)	RSS-210, A8.5	Out-of-band emission, radiated	passed
15.247(d)	RSS-Gen, 7.2.2	Emissions in restricted bands	passed
15.247(e)	RSS-210, A8.2(b)	PSD	passed
15.35(c)	RSS-Gen, 4.5	Pulsed operation	not applicable
15.247(i)	RSS 102, 2.5.2	MPE	passed
15.247(b)(4)	RSS-Gen, 7.1.2	Antenna requirement	passed
15.107	RSS Gen, 7.2.4.	AC power line conducted emissions	passed
15.109(a)	RSS-Gen, 6.1	Receiver spurious emissions, radiated	passed
	RSS-Gen, 7.2.6	Transmitter frequency stability	not applicable
OET Bulletin 65	RSS102, 3.2	Co-location, Co-transmission	passed

The mentioned RSS Rule Parts in the above table are related to:
RSS Gen, Issue 3, December 2010
RSS 210, Issue 8, December 2010
RSS 102, Issue 4, March 2010

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GENERAL REMARKS:

The EUT “small engine” is a host PCB with WLAN module. For the compliance testing the “small engine” is implemented in a reference integration BeoSound5-Encore to provide with the necessary operating voltages and control interfaces.

Available Features:
The WLAN module is compatible with 802.11n technology. It is operating in the 5 GHz frequency band. The operation in the 2.4 GHz band is disabled by firmware. The EUT can operate as client only. The EUT has no ad hoc modes. The output power is not accessible by the user. The EUT use the MIMO function with multiple antennas without beam forming. In legacy mode only one antenna is active, this means a transmission of completely uncorrelated signals.

- 802.11a mode 5725 MHz – 5850 MHz
- 802.11n mode 5725 MHz – 5850 MHz

The module use OFDM modulation and is capable to provide following data rates:

- 802.11a 54, 48, 36, 24, 18, 12, 9, 6 Mbps;
- 802.11n HT20, MCS 0 – 7;
- 802.11n HT40, MCS 0 – 15;

HT20

MCS Index	Modulation	R	$N_{BPSCS(i_{SS})}$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI (see NOTE)
0	BPSK	1/2	1	52	4	52	26	6.5	7.2
1	QPSK	1/2	2	52	4	104	52	13.0	14.4
2	QPSK	3/4	2	52	4	104	78	19.5	21.7
3	16-QAM	1/2	4	52	4	208	104	26.0	28.9
4	16-QAM	3/4	4	52	4	208	156	39.0	43.3
5	64-QAM	2/3	6	52	4	312	208	52.0	57.8
6	64-QAM	3/4	6	52	4	312	234	58.5	65.0
7	64-QAM	5/6	6	52	4	312	260	65.0	72.2
NOTE—Support of 400 ns GI is optional on transmit and receive.									

HT40

MCS Index	Modulation	R	$N_{BPSCS(i_{SS})}$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
0	BPSK	1/2	1	108	6	108	54	13.5	15.0
1	QPSK	1/2	2	108	6	216	108	27.0	30.0
2	QPSK	3/4	2	108	6	216	162	40.5	45.0
3	16-QAM	1/2	4	108	6	432	216	54.0	60.0
4	16-QAM	3/4	4	108	6	432	324	81.0	90.0
5	64-QAM	2/3	6	108	6	648	432	108.0	120.0
6	64-QAM	3/4	6	108	6	648	486	121.5	135.0
7	64-QAM	5/6	6	108	6	648	540	135.0	150.0

MCS Index	Modulation	R	$N_{BPSCS}(i_{SS})$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
8	BPSK	1/2	1	108	6	216	108	27.0	30.0
9	QPSK	1/2	2	108	6	432	216	54.0	60.0
10	QPSK	3/4	2	108	6	432	324	81.0	90.0
11	16-QAM	1/2	4	108	6	864	432	108.0	120.0
12	16-QAM	3/4	4	108	6	864	648	162.0	180.0
13	64-QAM	2/3	6	108	6	1296	864	216.0	240.0
14	64-QAM	3/4	6	108	6	1296	972	243.0	270.0
15	64-QAM	5/6	6	108	6	1296	1080	270.0	300.0

Symbol	Explanation
N_{SS}	Number of spatial streams
R	Coding rate
N_{BPSC}	Number of coded bits per single carrier (total across spatial streams)
$N_{BPSCS}(i_{SS})$	Number of coded bits per single carrier for each spatial stream, $i_{SS} = 1,...,N_{SS}$
N_{SD}	Number of complex data numbers per spatial stream per OFDM symbol
N_{SP}	Number of pilot values per OFDM symbol
N_{CBPS}	Number of coded bits per OFDM symbol
N_{DBPS}	Number of data bits per OFDM symbol
N_{ES}	Number of BCC encoders for the DATA field
N_{TBPS}	Total bits per subcarrier

Channel plan:

HT20 mode:

Channel	Frequency
149	5745
153	5765
157	5785
161	5805
165	5825

HT40 mode:

Channel	Frequency
151	5755
159	5795

802.11a mode:

Channel	Frequency
149	5745
153	5765
157	5785
161	5805
165	5825

There is only the following integrated antenna used with the module:

Number	Characteristic	Name	Connector	Frequency band	Gain
1	MIMO	ASSY PN: 1551359	U.FL	4.9 – 5.875 GHz	5 dBi

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FINAL ASSESSMENT:

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

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

Testing commenced on : 17 December 2010

Testing concluded on : 08 June 2011

Checked by:

Thomas Weise
I confirm the correctness and integrity of this document
2011.08.09 15:07:39 +02'00'

Thomas Weise
Dipl. Ing.(FH)
Laboratory Manager

Tested by:

Hermann Smetana
I am the author of this document
2011.08.09 13:57:36 +02'00'

Hermann Smetana
Dipl.-Ing.(FH)
Radio Expert

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 : 100 - 120 VAC
V_{nom}= 110 VAC
V_{min}= 100 VAC
V_{max}= 120 VAC

3.3 Short description of the equipment under test (EUT)

The EUT is a module WLAN+Host called “small engine” using the 802.11n Standard in the 5 GHz bands only. The EUT has a compatibility mode to 802.11a and 802.11h. Three antenna ports supply 2 TX/RX antennas and 1 RX antenna for MIMO operation. The EUT operates as WLAN client without radar interference detection and without TPC.

Number of tested samples: 1 for radiated measurements and 1 for conducted measurements.
Serial number: Reference integration 22008588 and 22008589

EUT operation mode:

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

- WLAN transmission

- TX continuous mode

- RX continuous 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:

- Power supply 100 – 120 VAC Model : ENCORE EST-3700, #22017610
- _____ 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 may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners gmbh, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component diversity and modifications in production process of devices may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for the specific test. The manufacturer has the sole responsibility of continued compliance of the EUT.

4.4 Measurement protocol for FCC and IC

4.4.1 GENERAL INFORMATION

4.4.1.1 Test methodology

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

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

In compliance with RSS 210 Issue 7 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.2 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.

4.4.1.3 Details of test procedures

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 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.4 Conducted emission

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 conversion formula apply:

dBµV = 20*log(µV);
µV = 10^(dBµV/20);

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. 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 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin of a peak mode measurement appears to be less than 20 dB, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.4.1.5 Radiated emission (electrical field 30 MHz - 1 GHz)

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 polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4.The interface cables that are closer than 40 cm to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 cm from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 m horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 m and the EUT is rotated 360 degrees.
The final level in dBµV/m is calculated by add on the reading value from the EMI receiver (level dBµV) the correction factor. The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency	Level	+	Factor	=	Level	-	CISPR Limit	=	Delta
(MHz)	(dBµV)		(dB)		(dBµV/m)		(dBµV/m)		(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.4.1.6 Radiated emission (electrical field 1 GHz - 40 GHz)

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

4.5 Determination of worst case measurement conditions

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.
The tests are carried out in the following frequency band:
5725 - 5.850 MHz

Preliminary tests were performed to find the worse case mode from all possible combinations between available modulations, data rates and small antenna system is determined through pre-scans. The maximum output power depends on used data rate. As worse case the HT20 mode (data rate of 6.5 Mbps with 1 spatial stream (BW = 20 MHz), 1 TX chain) and HT40 mode (data rate of 27 Mbps with 2 spatial streams (BW = 40 MHz)) is used.
The EUT is controlled for several tests with special test software used for testing only (RALINK using ATE commands) where continuous signals are needed. For the tests a duty cycle (x) of x = 1 is set.
Following channels and test modes were selected for the final test as listed below:

HT20 mode:

Technology	Available channels	Tested channels	Modulation	Modulation type	Data rate (Mbps)
802.11n	149 - 165	149, 157, 165	OFDM	BPSK	6.5, MCS=0 (BW=20 MHz)

HT40 mode:

Technology	Available channels	Tested channels	Modulation	Modulation type	Data rate (Mbps)
802.11n	151 - 159	151, 159	OFDM	BPSK	27, MCS=8 (BW=40 MHz)

802.11a mode:

Technology	Available channels	Tested channels	Modulation	Modulation type	Data rate (Mbps)
802.11a	149 - 165	149, 157, 165	OFDM	BPSK	6, MCS=0 (BW=20 MHz)

5 TEST CONDITIONS AND RESULTS

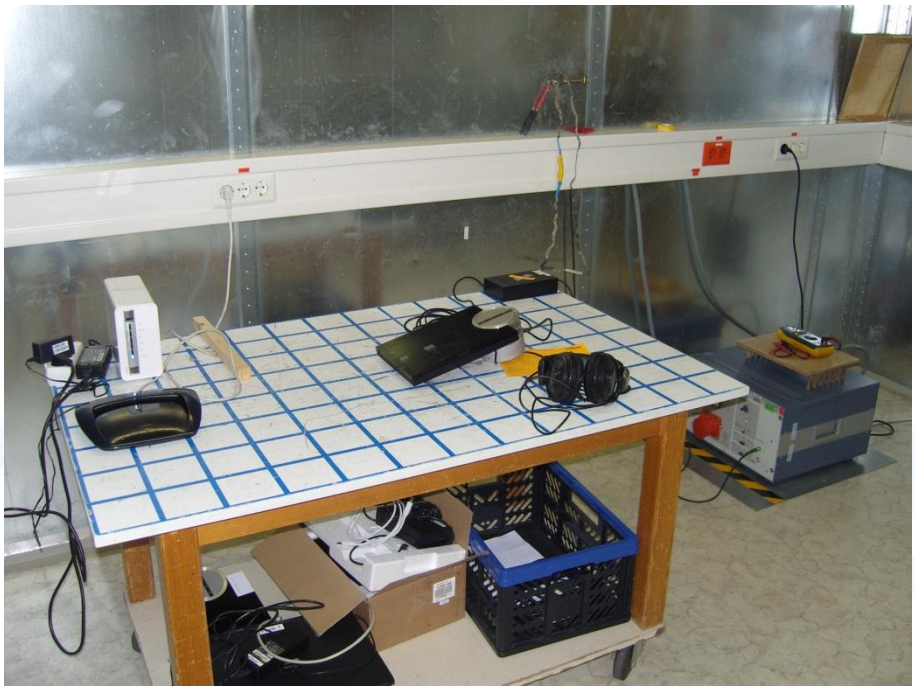
5.1 Conducted emissions

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, Section 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 given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 described under item 4.4.3. 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.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -1.0 dB at 0.64 MHz

Limit according to FCC Part 15, Section 15.207(a):

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

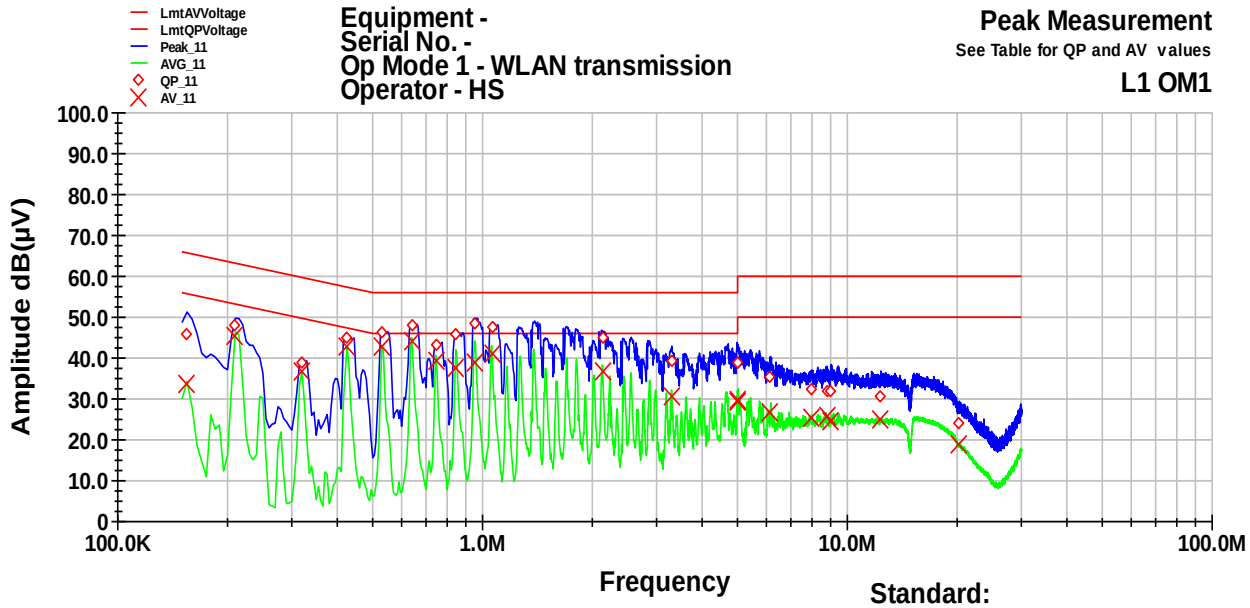
* Decreases with the logarithm of the frequency

The requirements are **FULFILLED.**

Remarks: For detailed test result please see the following test protocols.

5.1.6 Test protocol

Test point L1 Result: passed
Operation mode: WLAN transmission
Remarks:



Frequency MHz	QP Level dB(µV)	QP Margin dB	QP Limit dB	AV Level dB(µV)	AV Margin dB	AV Limit dB
0.155	46.1	-19.6	65.7	33.8	-21.9	55.7
0.21	48.0	-15.2	63.2	45.6	-7.6	53.2
0.32	38.9	-20.8	59.7	36.9	-12.8	49.7
0.425	45.1	-12.2	57.3	42.6	-4.7	47.3
0.53	46.3	-9.7	56.0	42.6	-3.4	46.0
0.64	48.2	-7.8	56.0	44.2	-1.8	46.0
0.745	43.4	-12.6	56.0	39.1	-6.9	46.0
0.845	45.6	-10.4	56.0	37.5	-8.5	46.0
0.95	48.3	-7.7	56.0	39.1	-6.9	46.0
1.06	47.7	-8.3	56.0	40.9	-5.1	46.0
2.13	44.9	-11.1	56.0	36.7	-9.3	46.0
3.3	39.3	-16.7	56.0	30.7	-15.3	46.0
4.98	39.1	-16.9	56.0	29.3	-16.7	46.0
5.005	38.9	-21.1	60.0	29.9	-20.1	50.0
6.145	35.4	-24.6	60.0	26.6	-23.4	50.0
7.975	32.3	-27.7	60.0	25.5	-24.5	50.0
8.785	32.0	-28.0	60.0	25.6	-24.4	50.0
9.02	31.8	-28.2	60.0	24.4	-25.6	50.0
12.35	30.7	-29.3	60.0	24.8	-25.2	50.0
20.265	24.2	-35.8	60.0	18.7	-31.3	50.0

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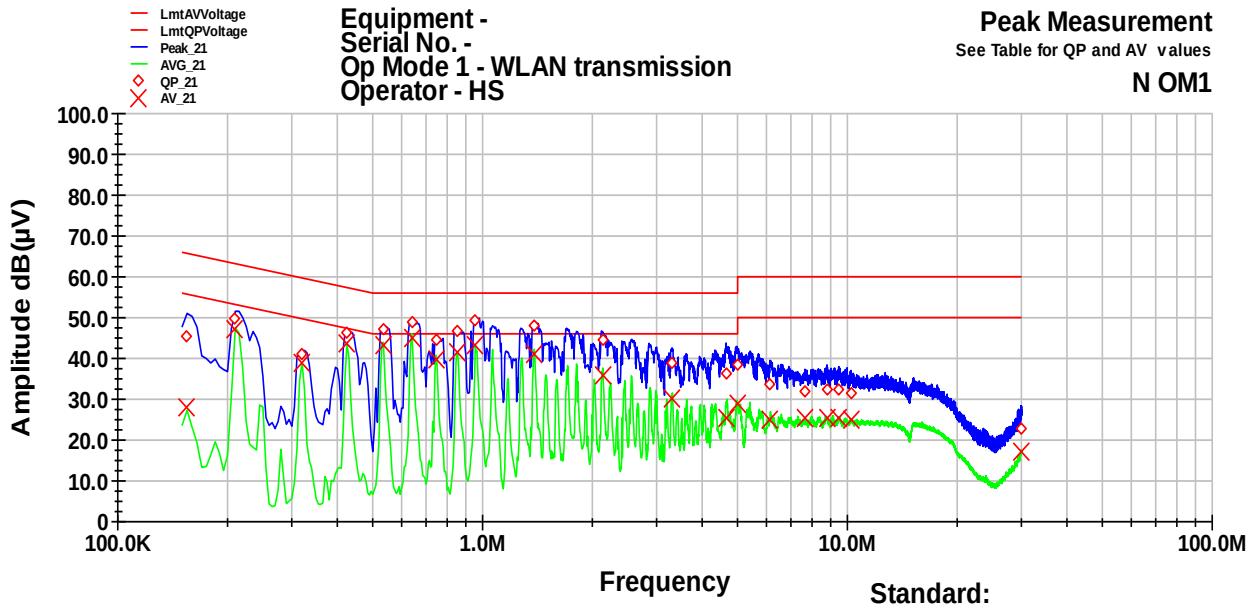
Test point N Result: Passed
Operation mode: WLAN transmission
Remarks:

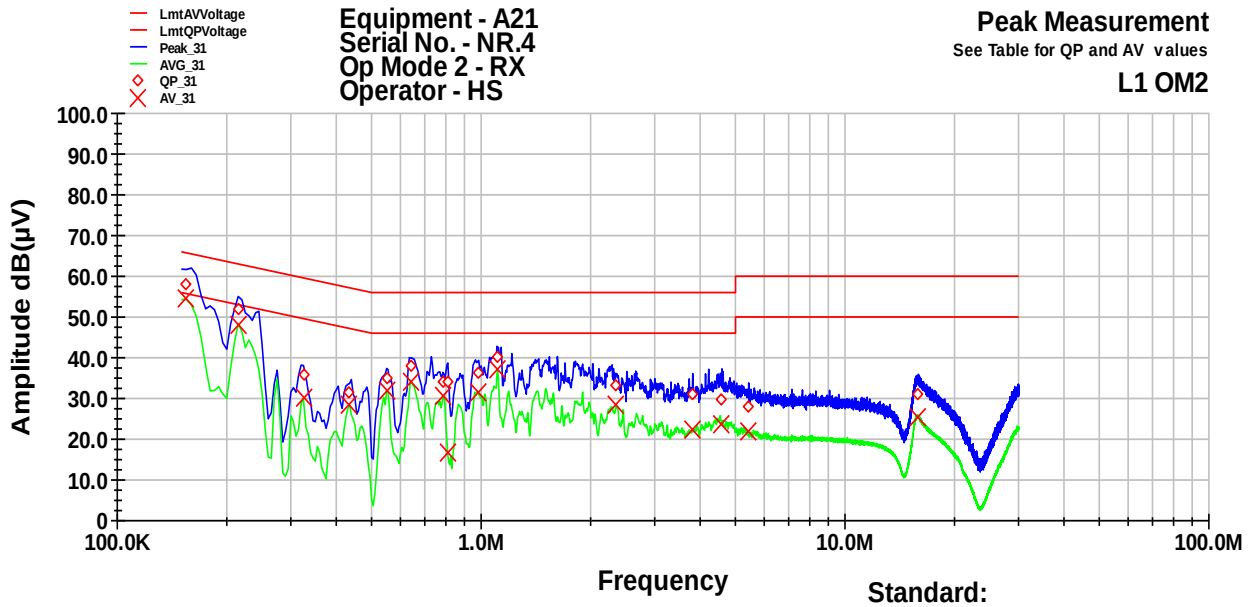


Standard:
File Number: T34325

Frequency MHz	QP Level dB(µV)	QP Margin dB	QP Limit dB	AV Level dB(µV)	AV Margin dB	AV Limit dB
0.155	45.3	-20.4	65.7	28.1	-27.7	55.7
0.21	49.9	-13.3	63.2	47.1	-6.1	53.2
0.32	40.9	-18.8	59.7	39.0	-10.7	49.7
0.425	46.3	-11.0	57.3	43.6	-3.8	47.3
0.535	47.3	-8.7	56.0	43.3	-2.7	46.0
0.64	48.8	-7.2	56.0	45.0	-1.0	46.0
0.745	44.4	-11.6	56.0	39.8	-6.2	46.0
0.85	46.8	-9.2	56.0	41.4	-4.6	46.0
0.955	49.3	-6.7	56.0	43.2	-2.8	46.0
1.385	47.8	-8.2	56.0	40.9	-5.1	46.0
2.135	44.3	-11.7	56.0	35.8	-10.3	46.0
3.305	39.1	-16.9	56.0	30.4	-15.6	46.0
4.65	36.5	-19.5	56.0	25.2	-20.8	46.0
5.025	38.4	-21.6	60.0	28.9	-21.1	50.0
6.135	33.8	-26.2	60.0	25.0	-25.0	50.0
7.645	31.8	-28.2	60.0	25.2	-24.8	50.0
8.785	32.2	-27.8	60.0	25.3	-24.7	50.0
9.46	32.3	-27.7	60.0	25.6	-24.4	50.0
10.22	31.5	-28.5	60.0	24.9	-25.1	50.0
29.865	22.6	-37.4	60.0	17.0	-33.0	50.0

FCC ID:BV5SMALLENGINE

Test point L1 Result: passed
Operation mode: RX continuous mode
Remarks:



Standard:
File Number: T34325

Frequency MHz	QP Level dB(µV)	QP Margin dB	QP Limit dB	AV Level dB(µV)	AV Margin dB	AV Limit dB
0.155	57.8	-7.9	65.7	54.4	-1.3	55.7
0.215	52.1	-10.9	63.0	48.1	-4.9	53.0
0.325	36.0	-23.6	59.6	30.1	-19.5	49.6
0.435	31.4	-25.7	57.2	28.5	-18.7	47.2
0.55	35.1	-20.9	56.0	31.8	-14.2	46.0
0.64	38.0	-18.0	56.0	34.2	-11.8	46.0
0.785	33.9	-22.1	56.0	30.5	-15.5	46.0
0.81	34.3	-21.7	56.0	16.6	-29.4	46.0
0.98	36.2	-19.8	56.0	31.6	-14.4	46.0
1.11	40.0	-16.0	56.0	36.9	-9.1	46.0
2.35	33.1	-22.9	56.0	28.5	-17.5	46.0
3.815	31.1	-24.9	56.0	22.5	-23.5	46.0
4.59	29.5	-26.5	56.0	23.7	-22.3	46.0
5.435	27.9	-32.2	60.0	21.8	-28.2	50.0
15.895	31.0	-29.0	60.0	25.5	-24.5	50.0

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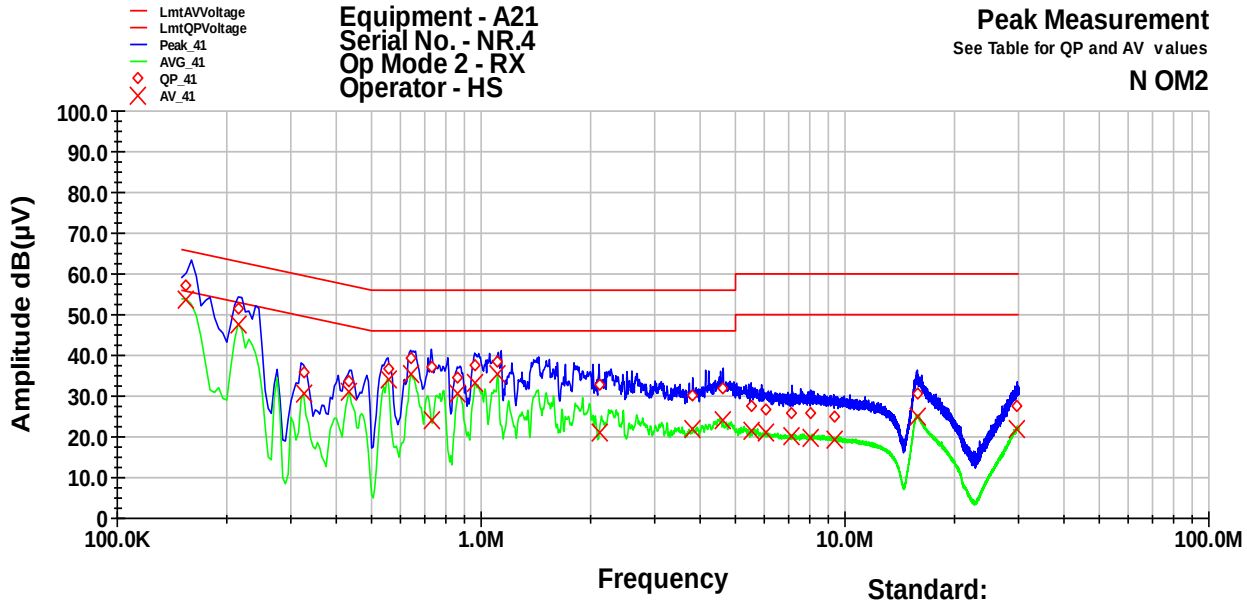
Test point N
Operation mode: RX continuous mode
Remarks:

Result: passed



Standard:
File Number: T34325

Frequency MHz	QP Level dB(µV)	QP Margin dB	QP Limit dB	AV Level dB(µV)	AV Margin dB	AV Limit dB
0.155	57.2	-8.5	65.7	53.9	-1.9	55.7
0.215	51.7	-11.3	63.0	47.7	-5.3	53.0
0.325	36.0	-23.6	59.6	30.8	-18.8	49.6
0.435	33.7	-23.5	57.2	31.0	-16.2	47.2
0.555	36.7	-19.3	56.0	34.0	-12.0	46.0
0.64	39.3	-16.8	56.0	35.6	-10.4	46.0
0.73	37.2	-18.8	56.0	24.0	-22.0	46.0
0.865	34.5	-21.5	56.0	30.5	-15.5	46.0
0.965	37.8	-18.3	56.0	33.1	-12.9	46.0
1.11	38.5	-17.5	56.0	35.5	-10.5	46.0
2.11	32.6	-23.4	56.0	20.9	-25.1	46.0
3.815	30.3	-25.7	56.0	22.0	-24.0	46.0
4.625	31.9	-24.1	56.0	24.1	-21.9	46.0
5.52	27.7	-32.3	60.0	21.3	-28.7	50.0
6.06	26.9	-33.2	60.0	21.2	-28.8	50.0
7.15	25.8	-34.2	60.0	20.0	-30.0	50.0
8.045	25.6	-34.3	60.0	19.9	-30.1	50.0
9.315	25.0	-35.0	60.0	19.3	-30.8	50.0
15.795	30.5	-29.5	60.0	25.0	-25.0	50.0
29.735	27.7	-32.3	60.0	22.1	-27.9	50.0

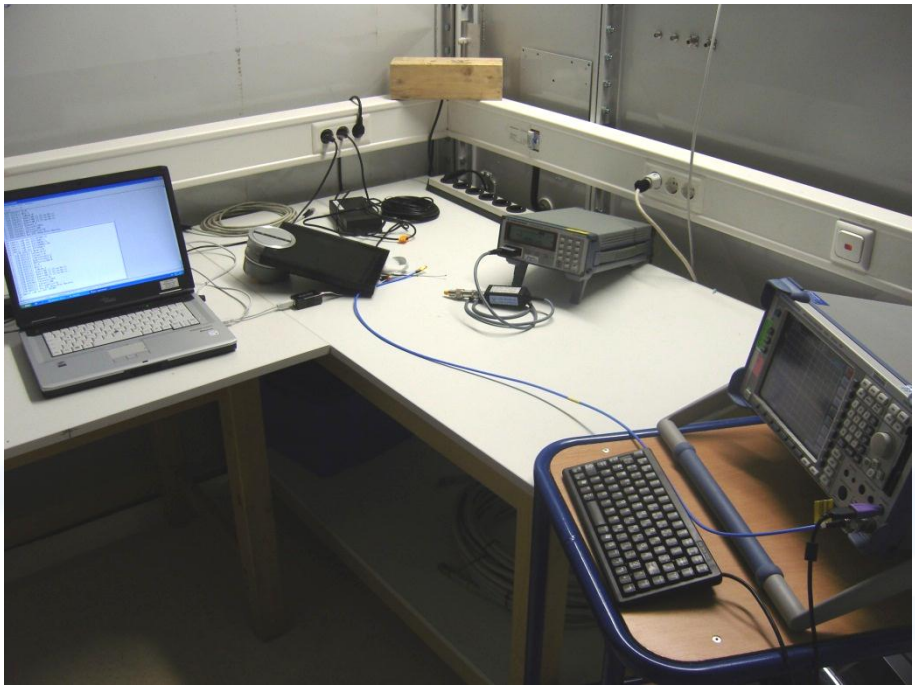
5.2 Emission bandwidth

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

5.2.1 Description of the test location

Test location: AREA 4

5.2.2 Photo documentation of the test set-up



5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):
Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings:

HT20 mode: RBW: 100 kHz	VBW: 300 kHz,	Detector: Peak;
HT40 mode: RBW: 1 MHz	VBW: 3 MHz,	Detector: Peak;

5.2.5 Test result

HT20:

Channel number	Fundamental frequency (MHz)	6 dB Bandwidth (MHz)	Minimum limit (MHz)
149	5745	17.68	0.5
157	5785	17.68	0.5
165	5825	17.76	0.5

HT40:

Channel number	Fundamental frequency (MHz)	6 dB Bandwidth (MHz)	Minimum limit (MHz)
151	5755	35.7	0.5
159	5795	35.7	0.5

802.11a:

Channel number	Fundamental frequency (MHz)	6 dB Bandwidth (MHz)	Minimum limit (MHz)
149	5745	16.56	0.5
157	5785	16.56	0.5
165	5825	16.56	0.5

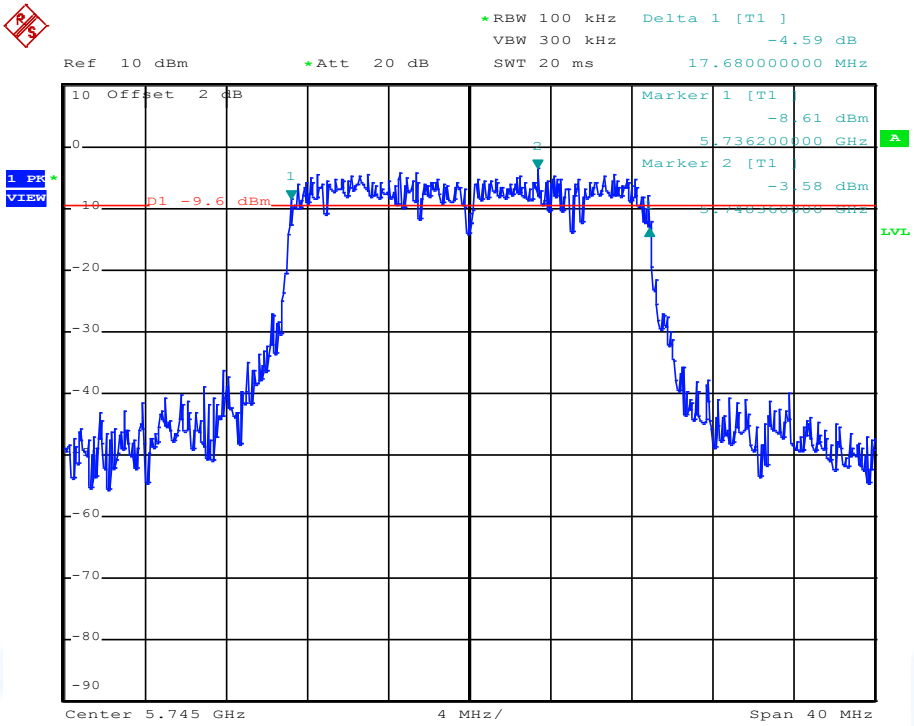
The requirements are **FULFILLED.**

Remarks: For detailed test results please refer to following test protocols. Only the worst case of the plots are listed.

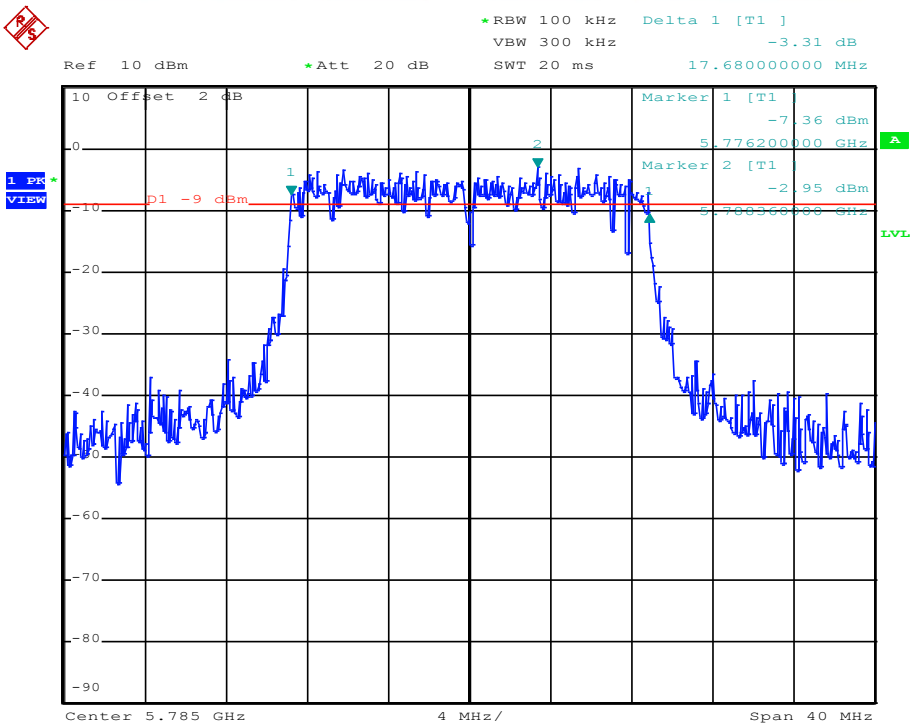
5.2.6 Test protocols

HT20:

Channel 149 (5745 MHz)



Channel 157 (5785 MHz)



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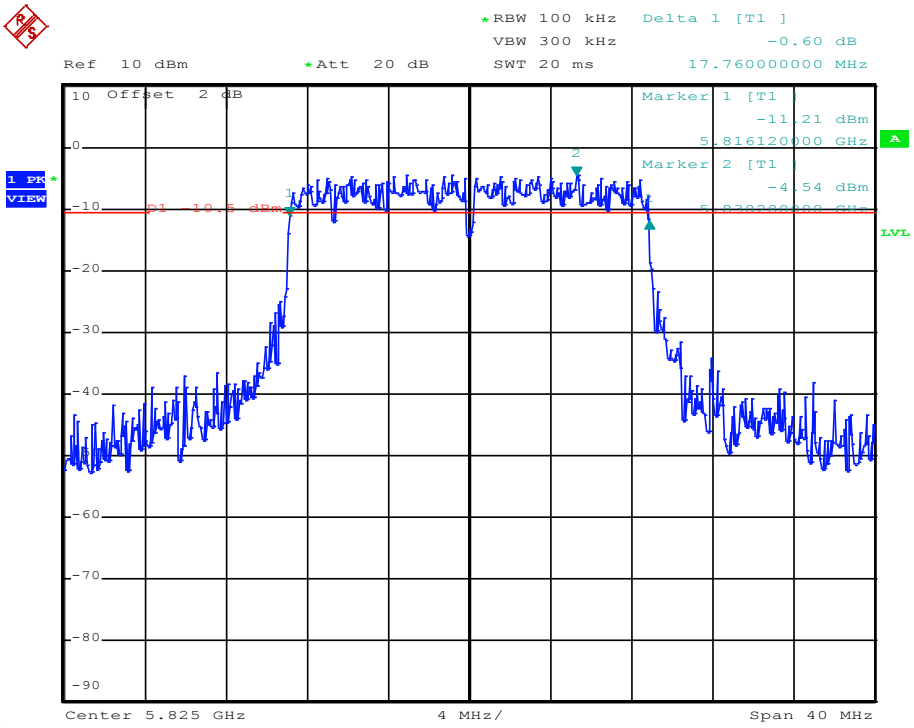
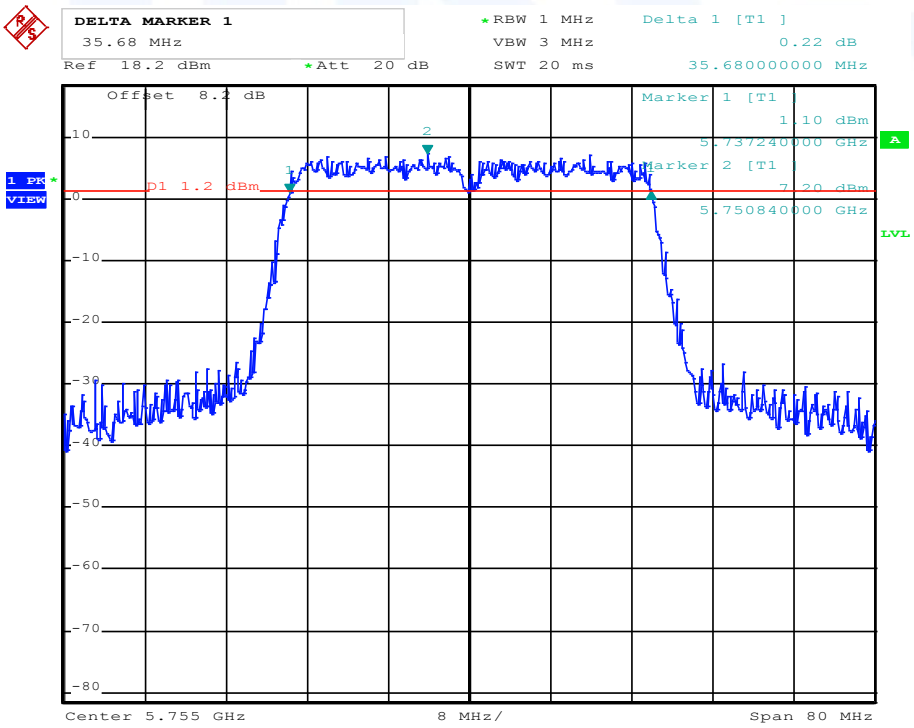
Channel 165 (5825 MHz)



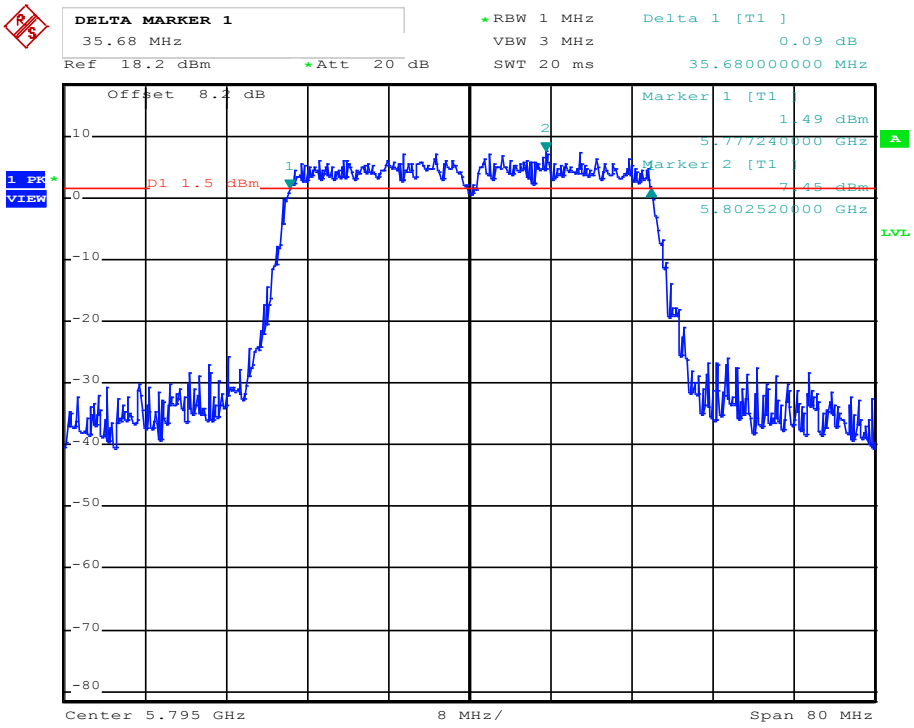
HT40:

Channel 151 (5755 MHz)



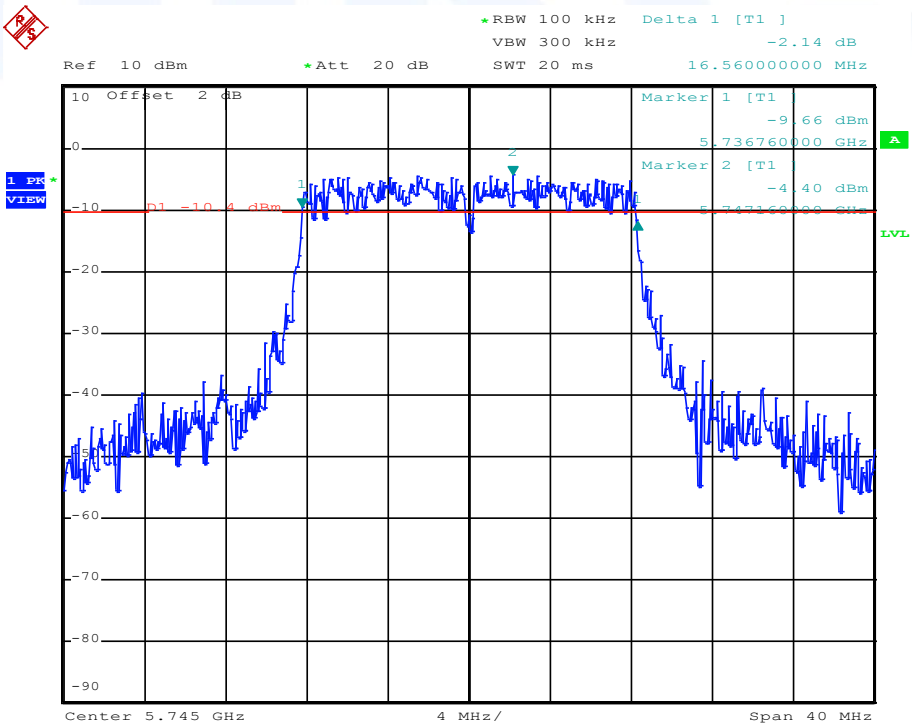
FCC ID:BV5SMALLENGINE

Channel 159 (5795 MHz)



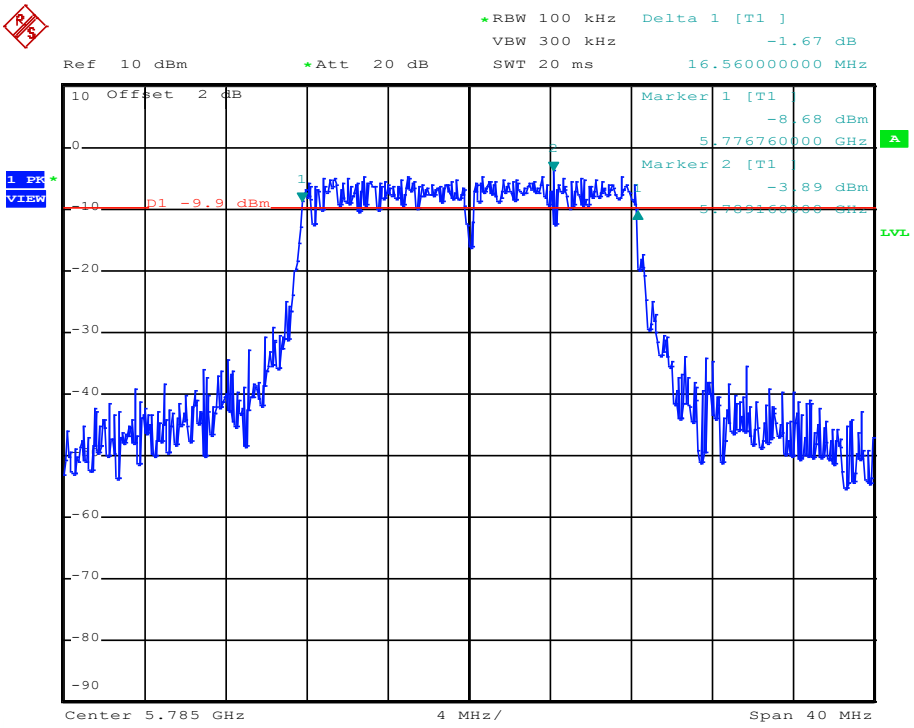
802.11a

Channel 149 (5745 MHz)

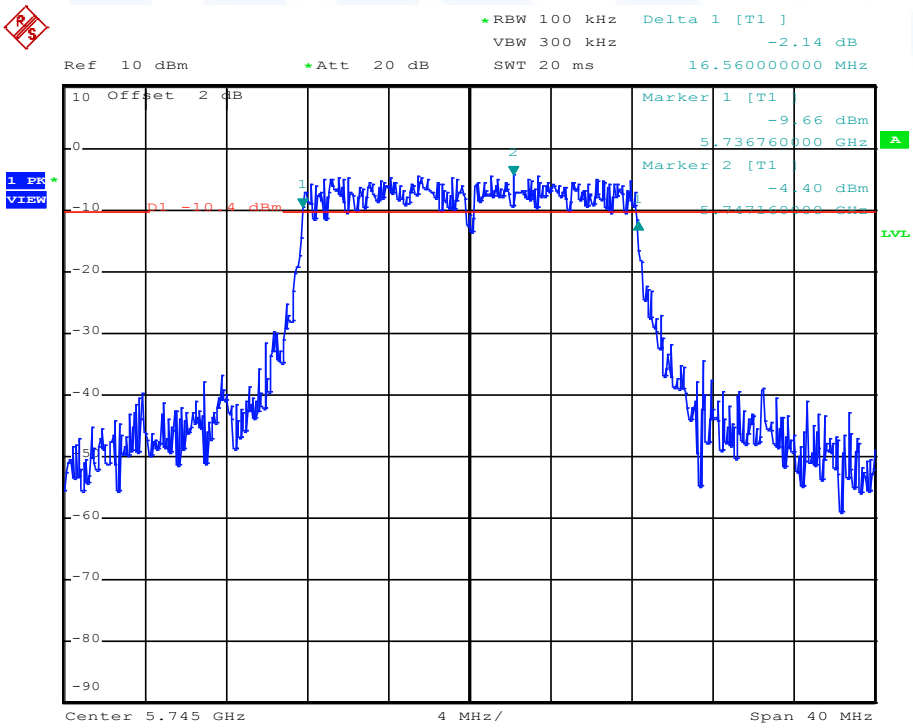


FCC ID:BV5SMALLENGINE

Channel 157 (5785 MHz)



Channel 165 (5825 MHz)



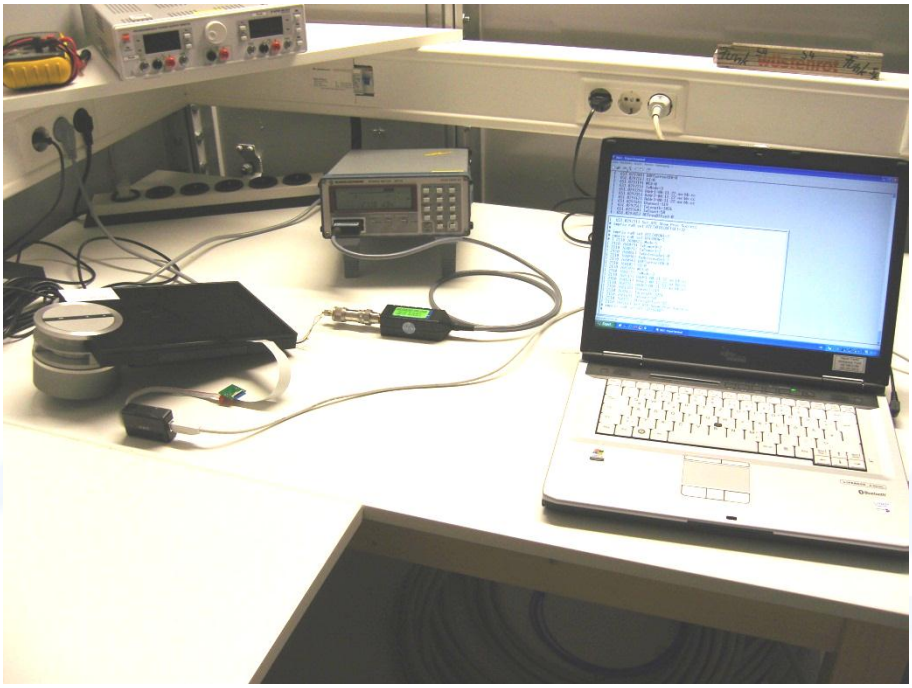
5.3 Maximum peak conducted output power

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

5.3.1 Description of the test location

Test location: AREA 4

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):
For systems using digital modulation in the 2400-2483.5 MHz and 5725 – 5850 MHz bands, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.3.4 Description of Measurement

The output power is measured using the power meter method according ANSI C63.10, clause 6.10.2.1(a). The EUT is set while measuring in TX continuous mode with a duty cycle, x = 1. The total output power is summed over all antenna terminals of the multiple antenna system.

5.3.5 Test result

HT20, Ant1:

Channel	Frequency (MHz)	Power settings	Measured power (dBm)	Peak power limit (dBm)	Delta (dB)
149	5745	2	11.4	30	-18.6
157	5785	2	11.5	30	-18.5
165	5825	2	11.5	30	-18.5

HT20, Ant2:

Channel	Frequency (MHz)	Power settings	Measured power (dBm)	Peak power limit (dBm)	Delta (dB)
149	5745	2	10.2	30	-19.8
157	5785	2	9.7	30	-20.3
165	5825	2	10.0	30	-20.0

HT20, Ant1 + Ant2:

Channel	Frequency (MHz)	Power settings	Measured power (dBm)	Peak power limit (dBm)	Delta (dB)
149	5745		13.9	30	-16.1
157	5785		13.7	30	-16.3
165	5825		13.8	30	-16.2

HT40, Ant1:

Channel	Frequency (MHz)	Power settings	Measured power (dBm)	Peak power limit (dBm)	Delta (dB)
151	5755	2	11.4	30	-18.6
159	5795	2	11.5	30	-18.5

HT40, Ant2:

Channel	Frequency (MHz)	Power settings	Measured power (dBm)	Peak power limit (dBm)	Delta (dB)
151	5755	2	10.4	30	-19.6
159	5795	2	9.9	30	-20.1

HT40, Ant1 + Ant2:

Channel	Frequency (MHz)	Power settings	Measured power (dBm)	Peak power limit (dBm)	Delta (dB)
151	5755		13.9	30	-16.1
159	5795		13.8	30	-16.2

802.11a, Ant1:

Channel	Frequency (MHz)	Power settings	Measured power (dBm)	Peak power limit (dBm)	Delta (dB)
149	5745	2	12.5	30	-17.5
157	5785	2	12.0	30	-18.0
165	5825	2	12.1	30	-17.9

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak power limit	
	(dBm)	(Watt)
902 - 928	30	1.0
2400 - 2483.5	30	1.0
5725 - 5850	30	1.0

The requirements are **FULFILLED.**

Remarks: _____

_____

5.4 Spurious emissions radiated

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

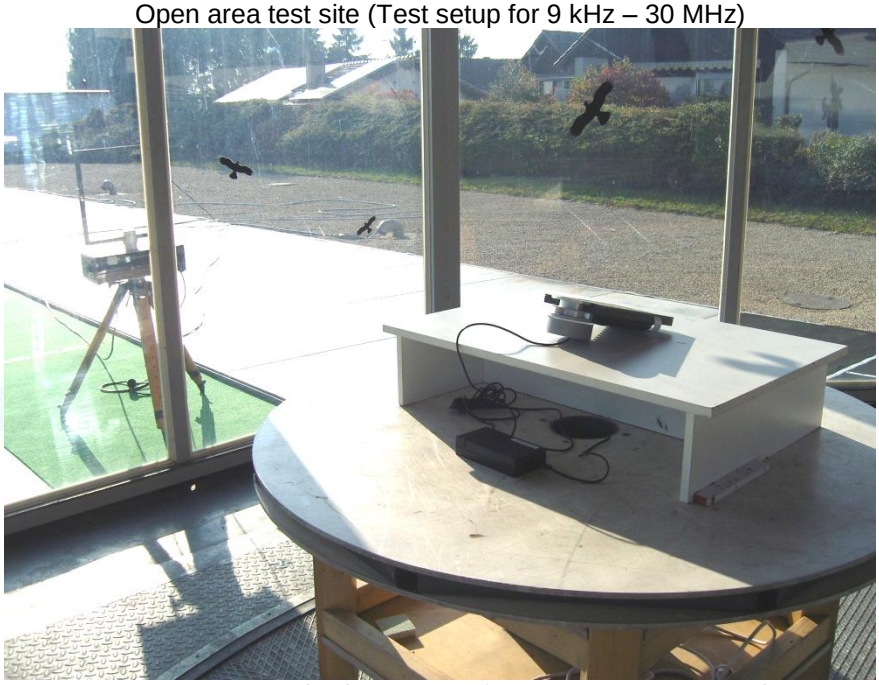
5.4.1 Description of the test location

Test location: OATS 1
Test location: Anechoic Chamber A2

Test distance: 3 metres

5.4.2 Photo documentation of the test set-up

Open area test site (Test setup for 9 kHz – 30 MHz)



Open area test site (Test setup for 30 MHz – 1000 MHz)

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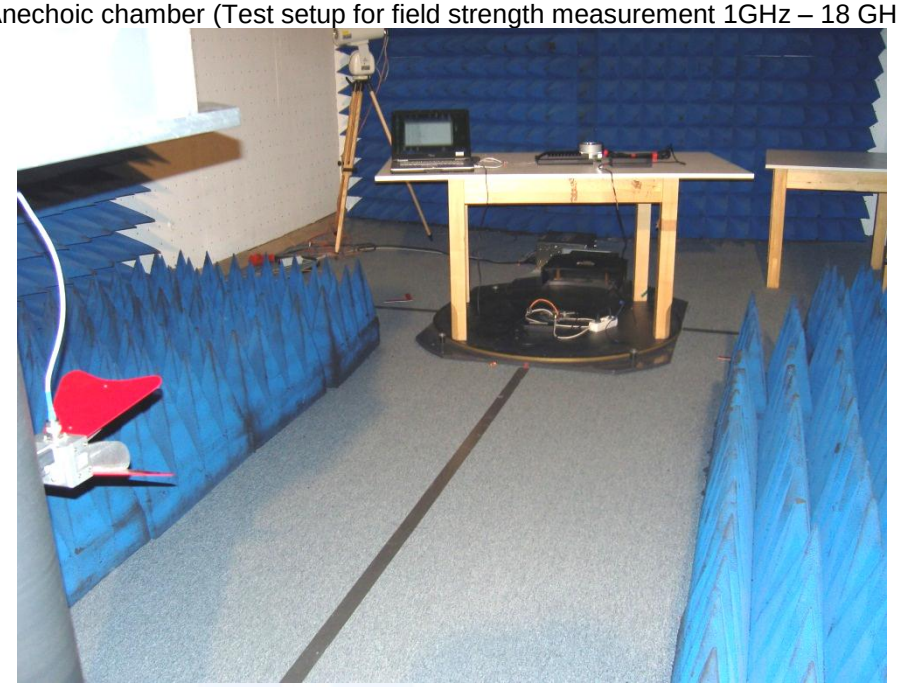
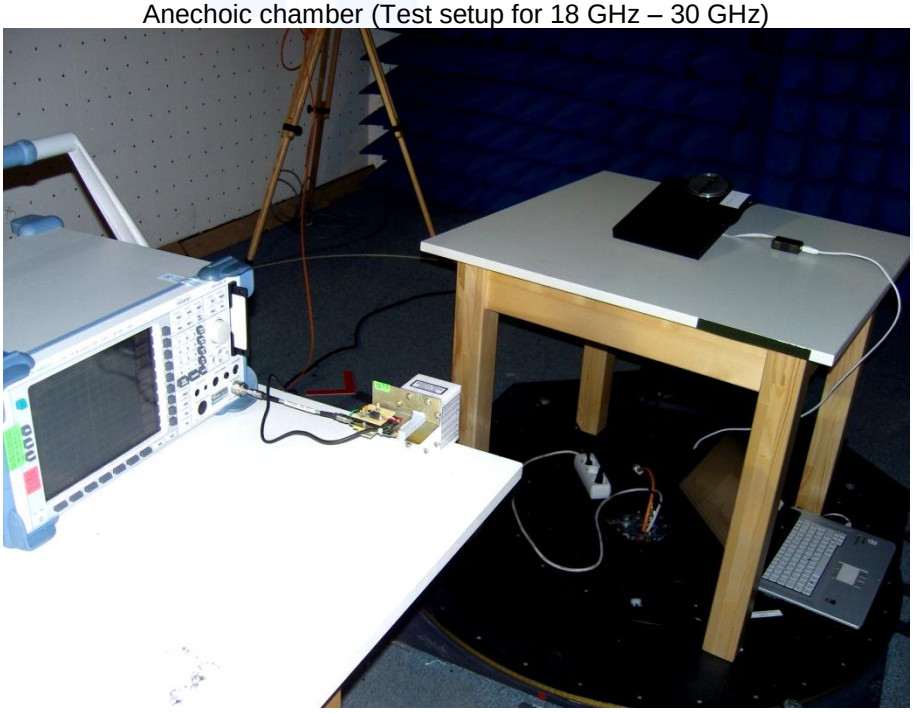
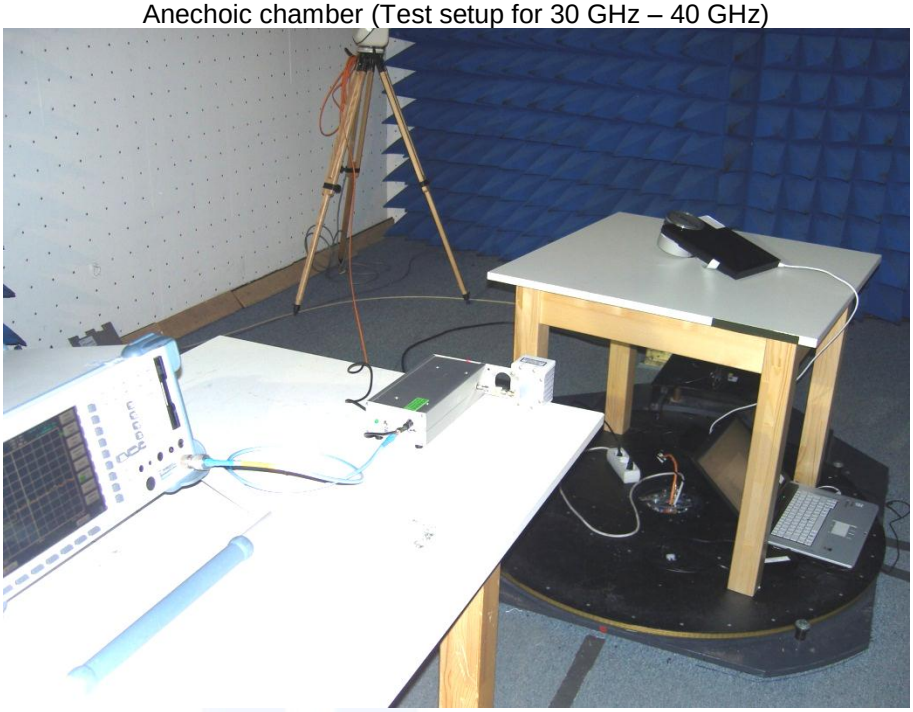
Anechoic chamber (Test setup for field strength measurement 1GHz – 18 GHz)



Anechoic chamber (Test setup for 18 GHz – 30 GHz)



Anechoic chamber (Test setup for 30 GHz – 40 GHz)



5.4.3 Applicable standard

According to FCC Part 15, Section 15.247(d):
In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a) (see Section 15.205(c)).

5.4.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.4. If the emission level of the EUT in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported. Up from 8 GHz a HP filter is used. The measurement system for the frequency range 30 – 40 GHz converts the range down to 10 - 20 GHz.

Spectrum analyser settings:
RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Trace: Max hold, Sweep: Auto;

5.4.5 Test result radiated emissions

HT20, Ant1 + Ant2
Channel 149
Highest level of the desired power: -0.6 dBm

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5		-	-		-	-20.6

Channel 157
Highest level of the desired power: -0.6 dBm

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	-20.6

Channel 165
Highest level of the desired power: -0.6 dBm

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	-20.6

HT40, Ant1 + Ant2:
Channel 151
Highest level of the desired power: -0.6 dBm

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	-20.6

Channel 159
Highest level of the desired power: -0.6 dBm

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	-20.6

802.11a, Ant1:

Channel 149

Highest level of the desired power: -0.6 dBm

Antenna		Power setting	Frequency	Peak		Average	
Type	Gain (dBi)		(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2	-	-		-	-20.6

Channel 157

Highest level of the desired power: -0.6 dBm

Antenna		Power setting	Frequency	Peak		Average	
Type	Gain (dBi)		(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2	-	-		-	-20.6

Channel 165

Highest level of the desired power: -0.6 dBm

Antenna		Power setting	Frequency	Peak		Average	
Type	Gain (dBi)		(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2	-	-		-	-20.6

Limit according to FCC Part 15, Section 15.247(d) for emissions falling not in restricted bands:
In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Frequency (MHz)	Spurious emission limit
Below 1000	20 dB below the highest level of the desired power
Above 1000	20 dB below the highest level of the desired power

The requirements are **FULFILLED.**

Remarks: All emissions not reported are more than 20 dB below the limit. The frequency range from 9 kHz to 40 GHz was scanned. For detailed test results please see the following test protocols. Only the worst cases of the plots are listed.

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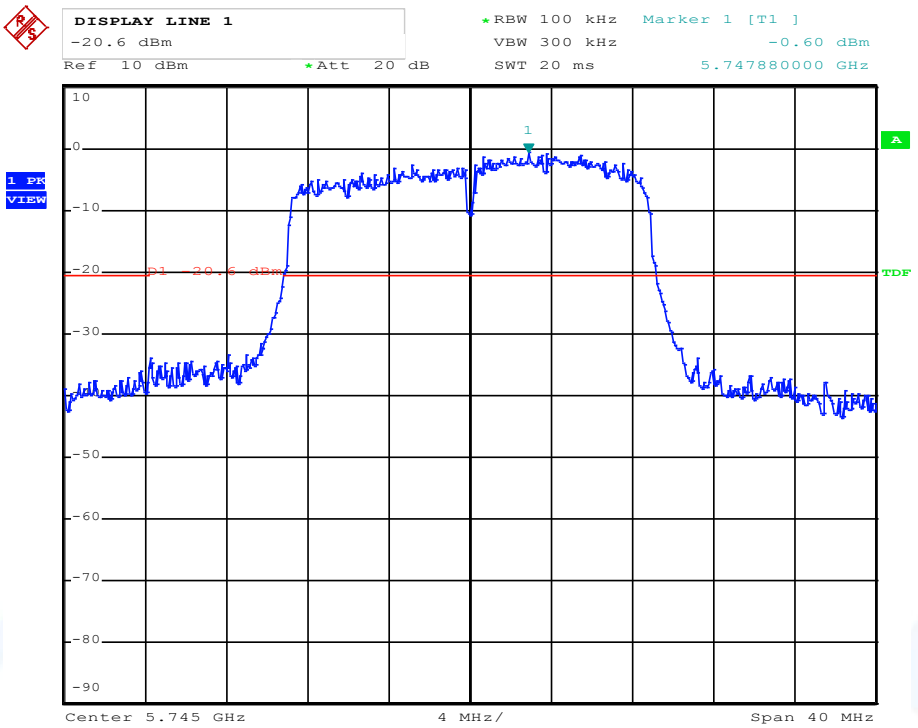
5.4.6 Test protocols of spurious emissions radiated out of operating frequency bands (-20 dBc):

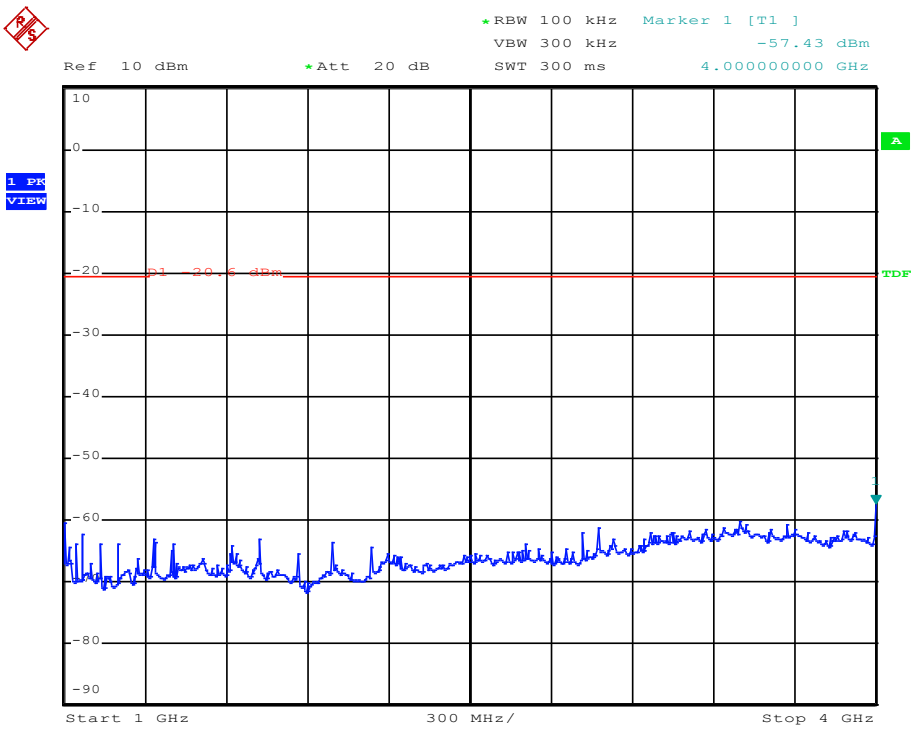
HT20:

Channel 149

Determination of the reference level and limit

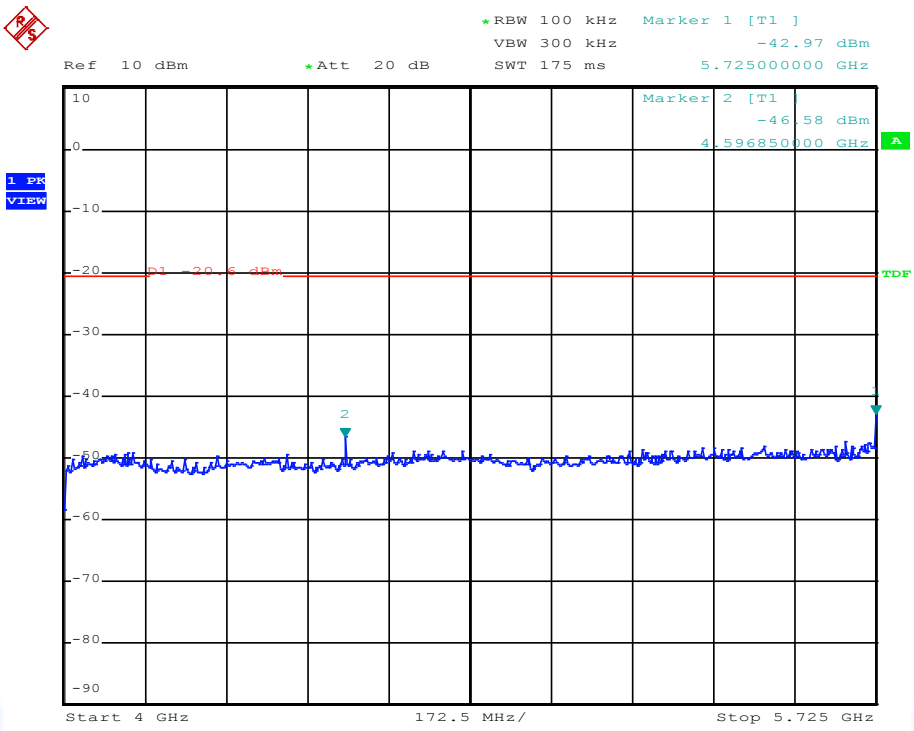


Spurious emissions from 1 GHz to 4 GHz (worst case)

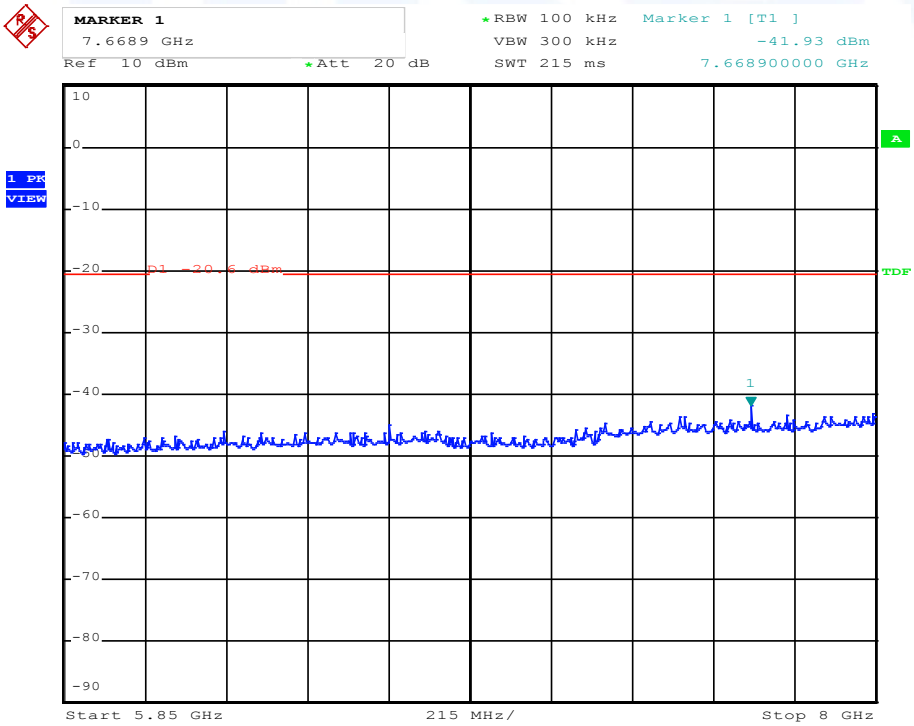


FCC ID:BV5SMALLENGINE

Spurious emissions from 4 GHz to 5725 GHz (worst case)

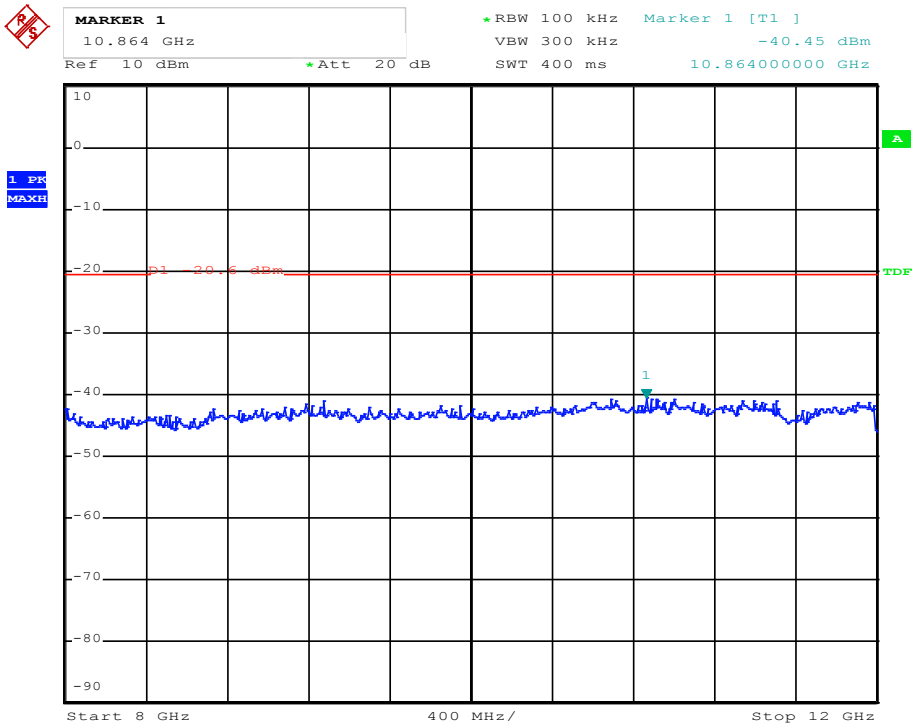


Spurious emissions from 5.850 GHz to 8 GHz (worst case)

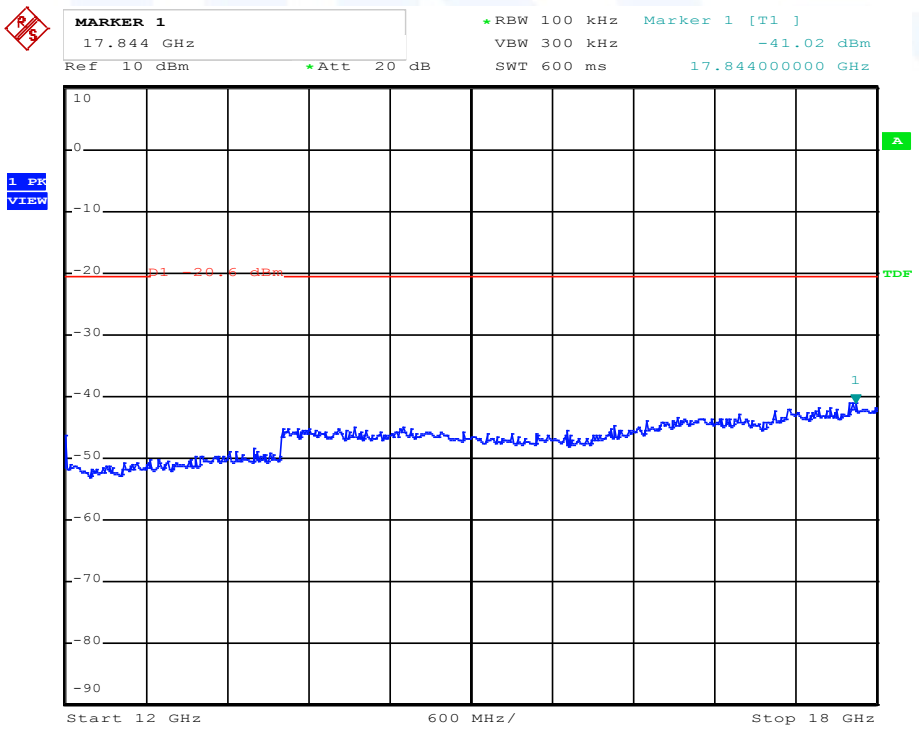


FCC ID:BV5SMALLENGINE

Spurious emissions from 8 GHz to 12 GHz (worst case)

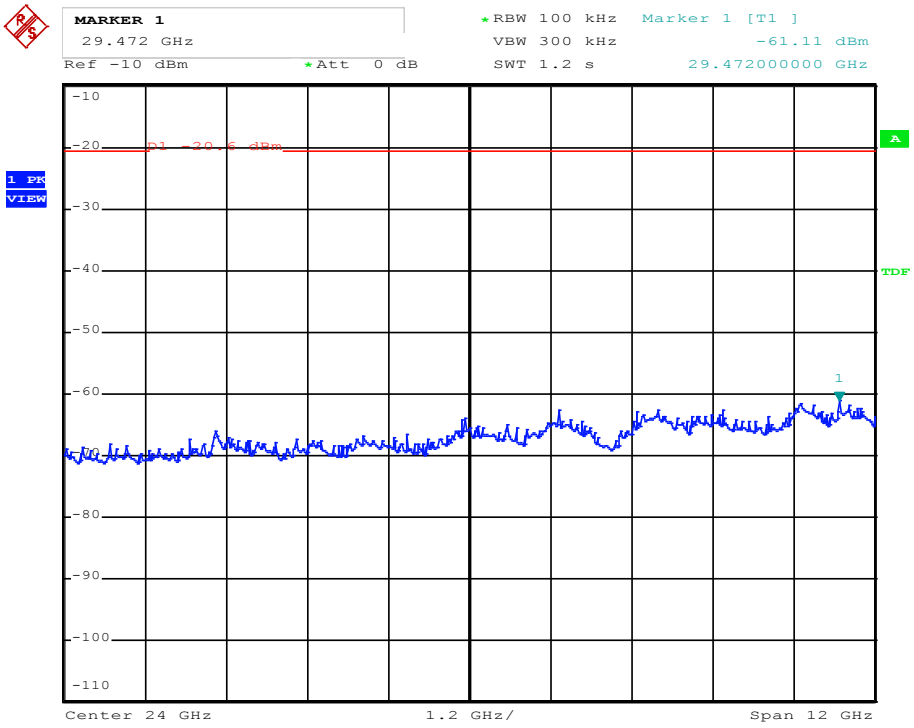


Spurious emissions from 12 GHz to 18 GHz (worst case)

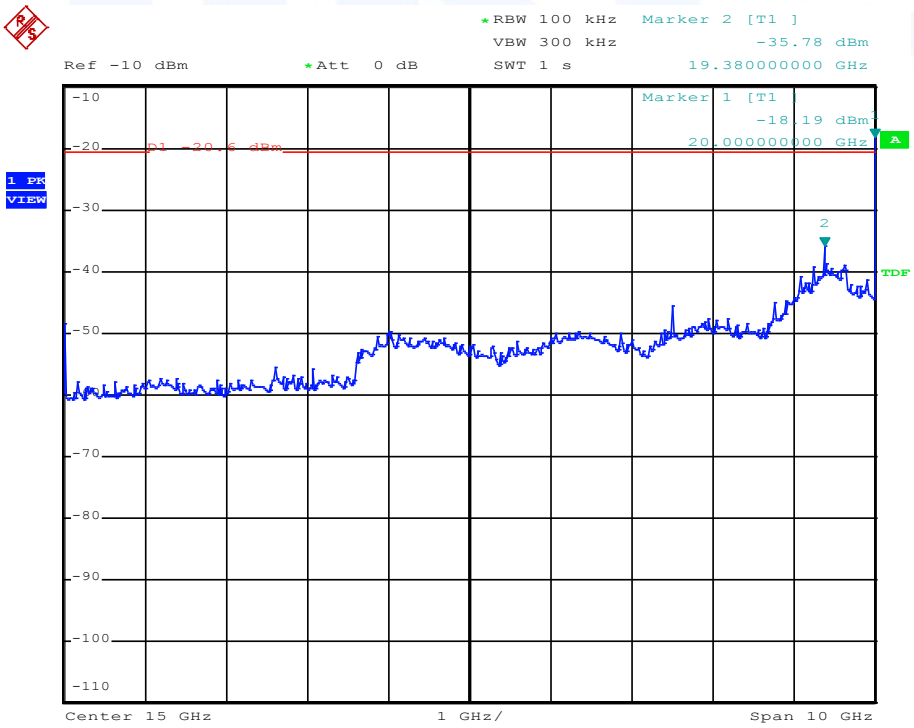


FCC ID:BV5SMALLENGINE

Spurious emissions from 18 GHz to 30 GHz (worst case)



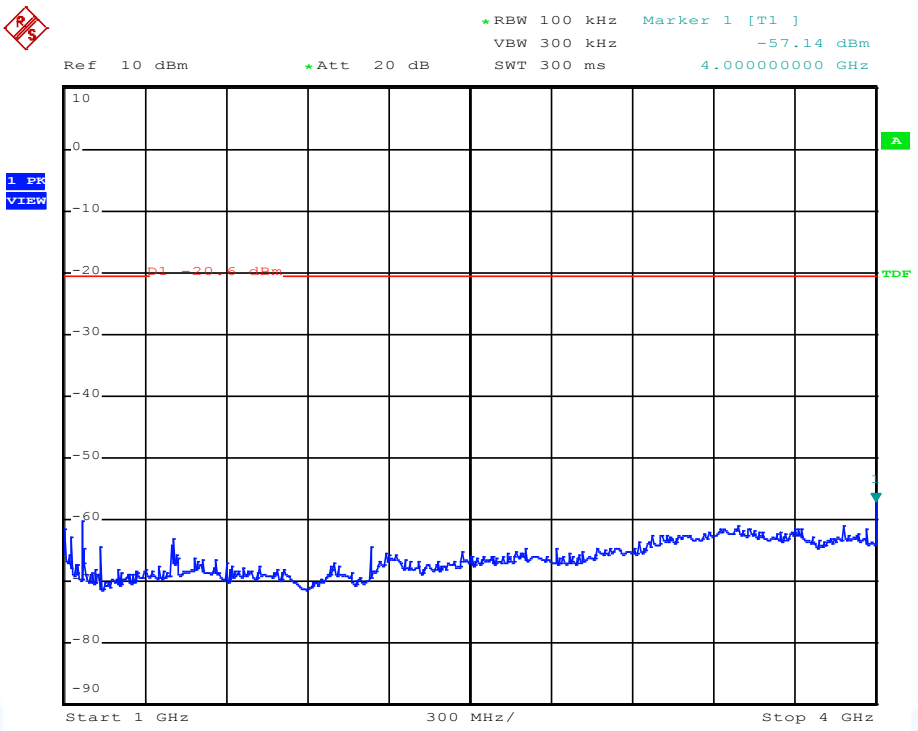
Spurious emissions from 30 GHz to 40 GHz (worst case)



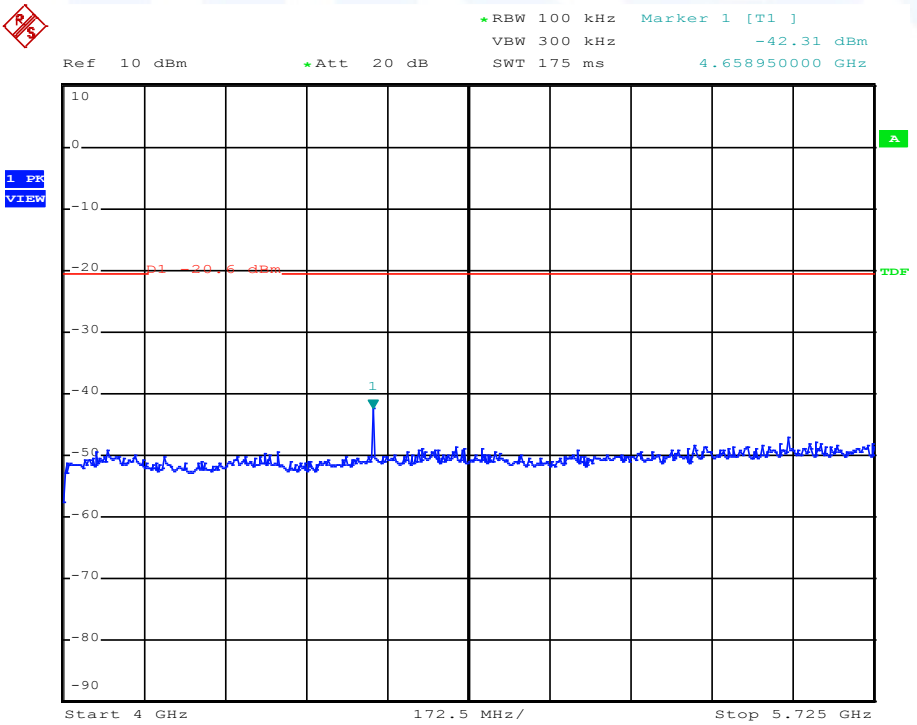
FCC ID:BV5SMALLENGINE

Channel 165

Spurious emissions from 1 GHz to 4 GHz (worst case)

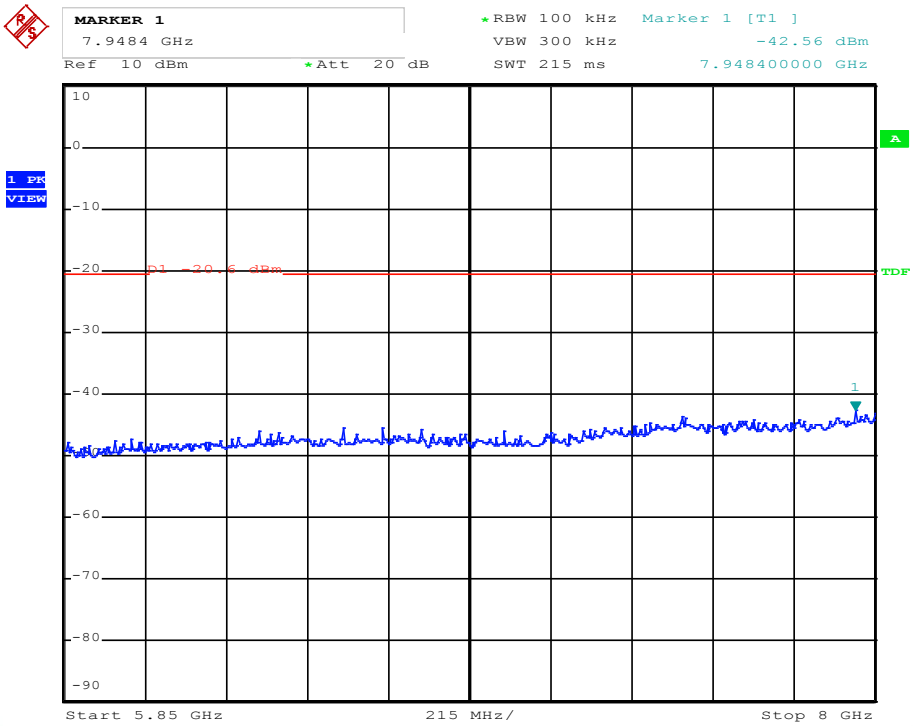


Spurious emissions from 4 GHz to 5725 GHz (worst case)

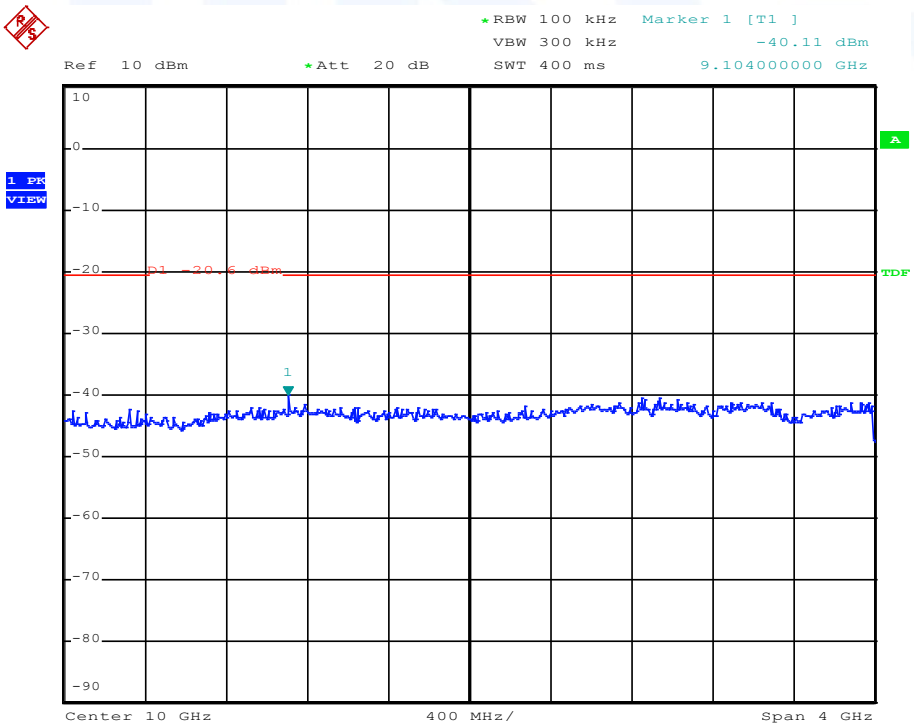


FCC ID:BV5SMALLENGINE

Spurious emissions from 5.850 GHz to 8 GHz (worst case)

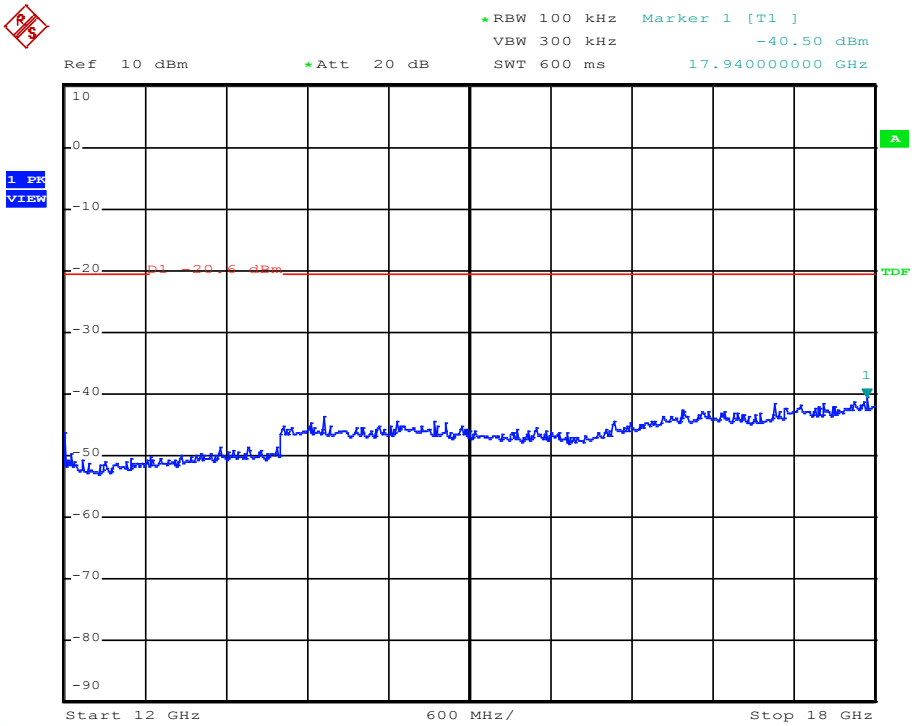


Spurious emissions from 8 GHz to 12 GHz (worst case)

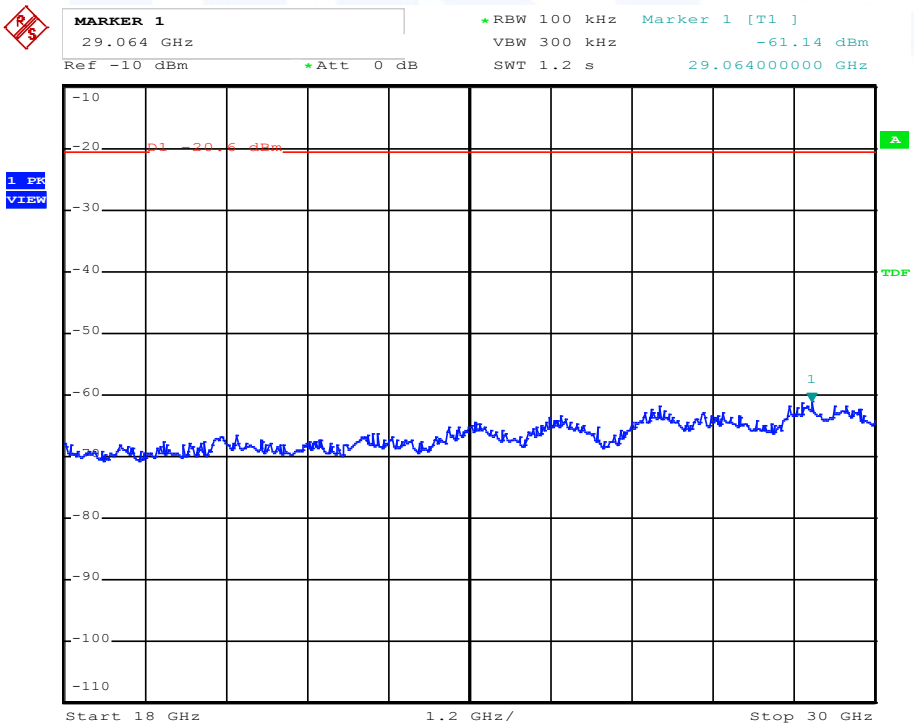


FCC ID:BV5SMALLENGINE

Spurious emissions from 12 GHz to 18 GHz (worst case)

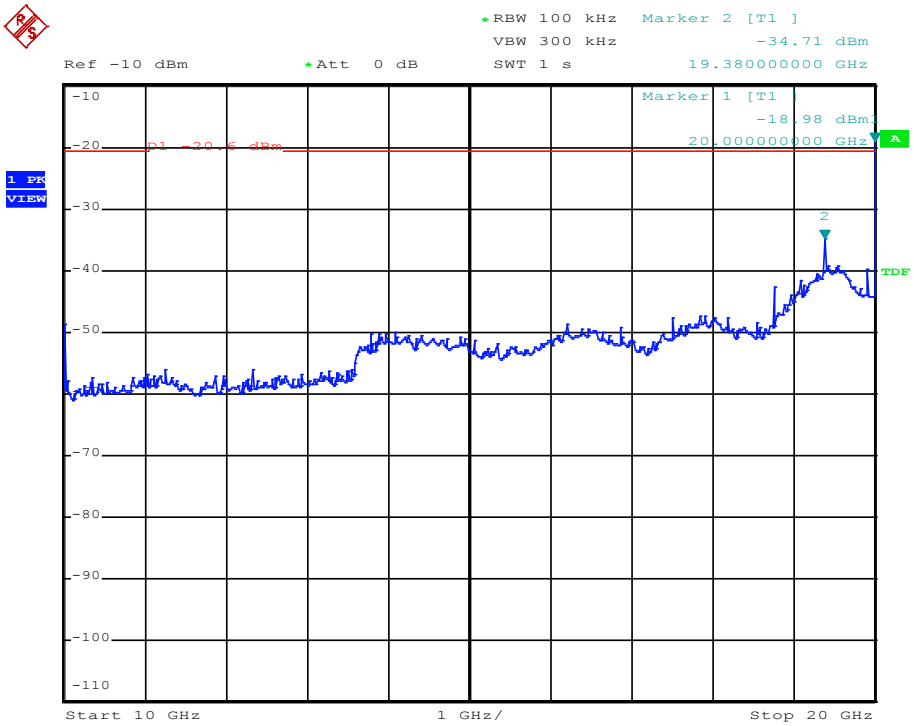


Spurious emissions from 18 GHz to 30 GHz (worst case)



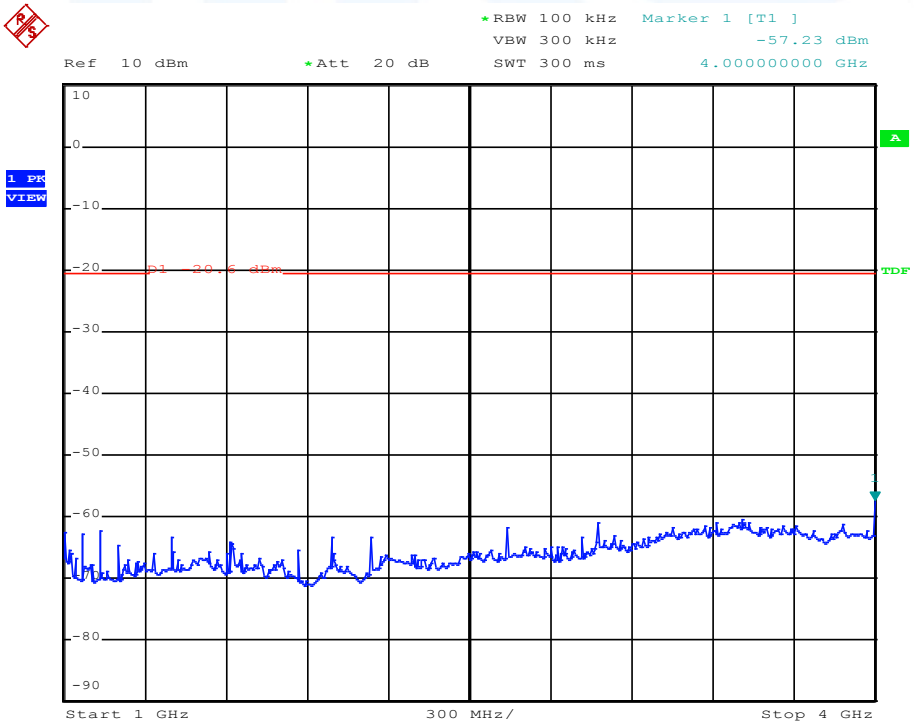
FCC ID:BV5SMALLENGINE

Spurious emissions from 30 GHz to 40 GHz (worst case)



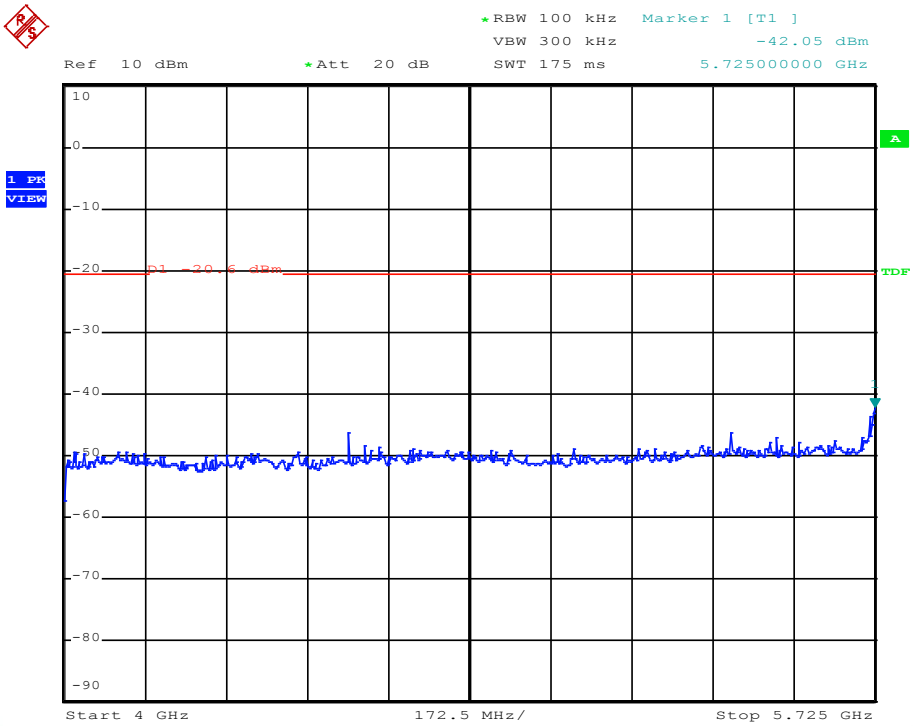
HT40:
Channel 151

Spurious emissions from 1 GHz to 4 GHz (worst case)

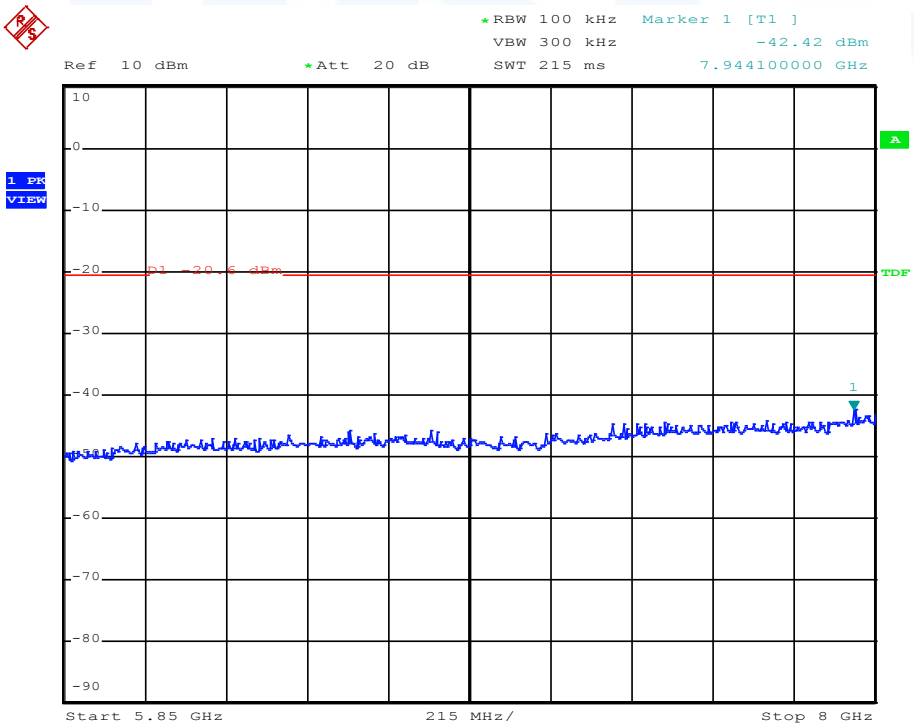


FCC ID:BV5SMALLENGINE

Spurious emissions from 4 GHz to 5725 GHz (worst case)

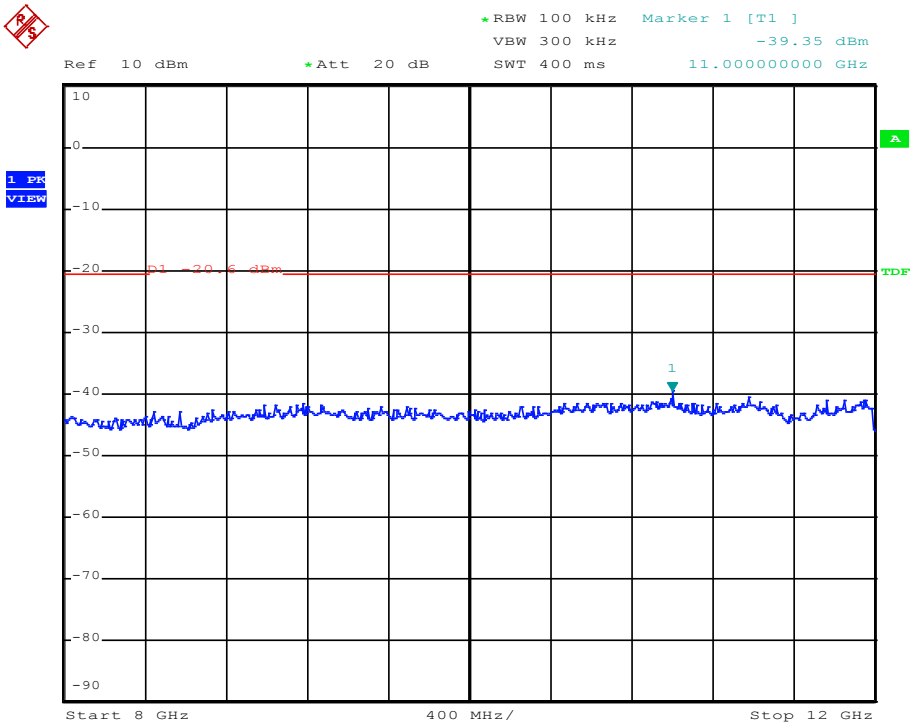


Spurious emissions from 5.850 GHz to 8 GHz (worst case)

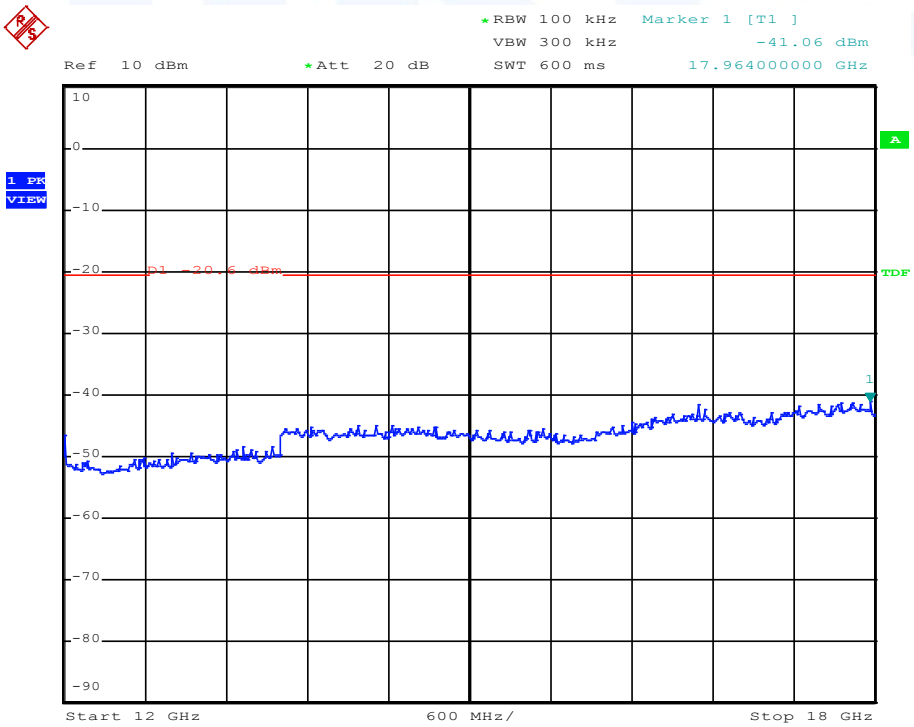


FCC ID:BV5SMALLENGINE

Spurious emissions from 8 GHz to 12 GHz (worst case)

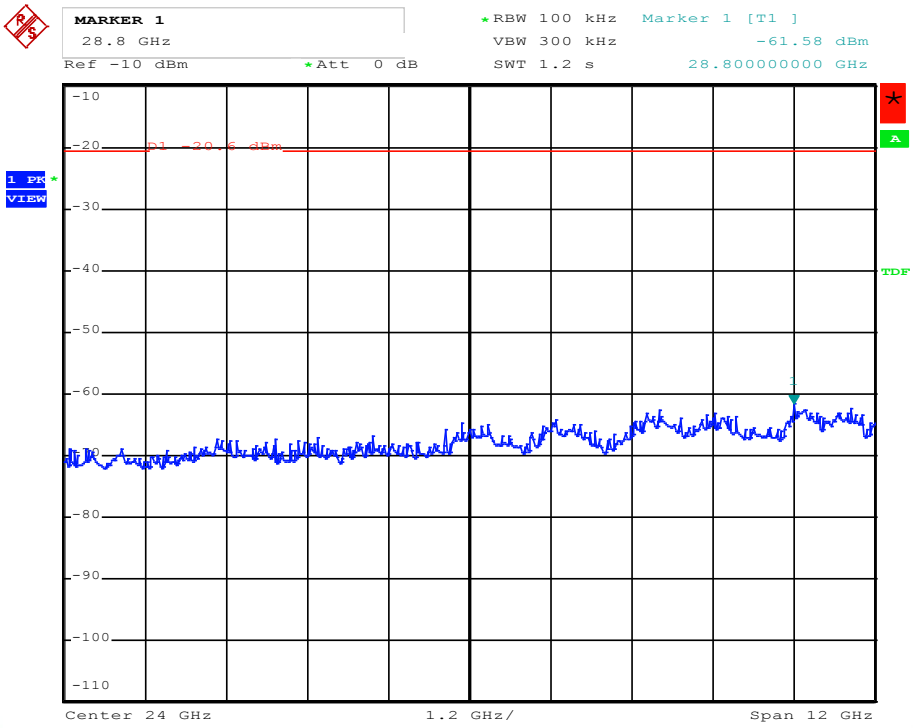


Spurious emissions from 12 GHz to 18 GHz (worst case)

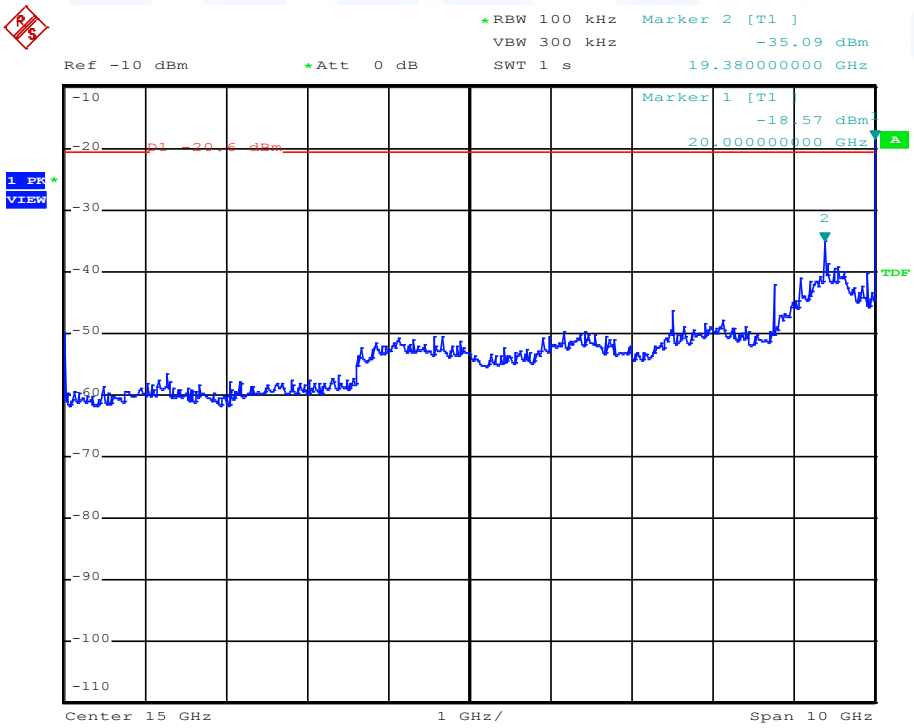


FCC ID:BV5SMALLENGINE

Spurious emissions from 18 GHz to 30 GHz (worst case)



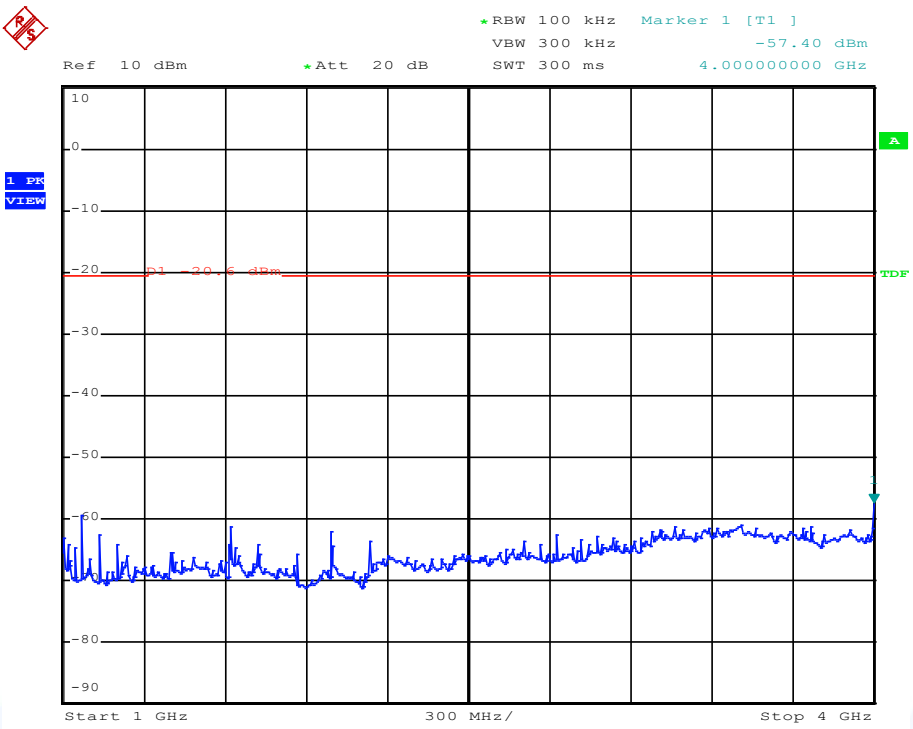
Spurious emissions from 30 GHz to 40 GHz (worst case)



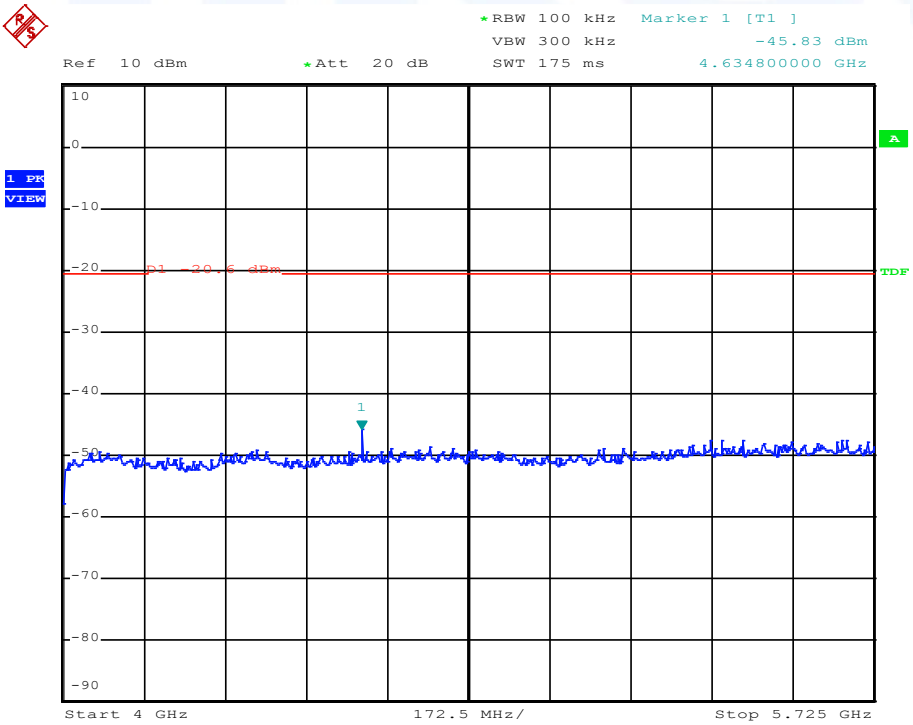
FCC ID:BV5SMALLENGINE

Channel 159

Spurious emissions from 1 GHz to 4 GHz (worst case)

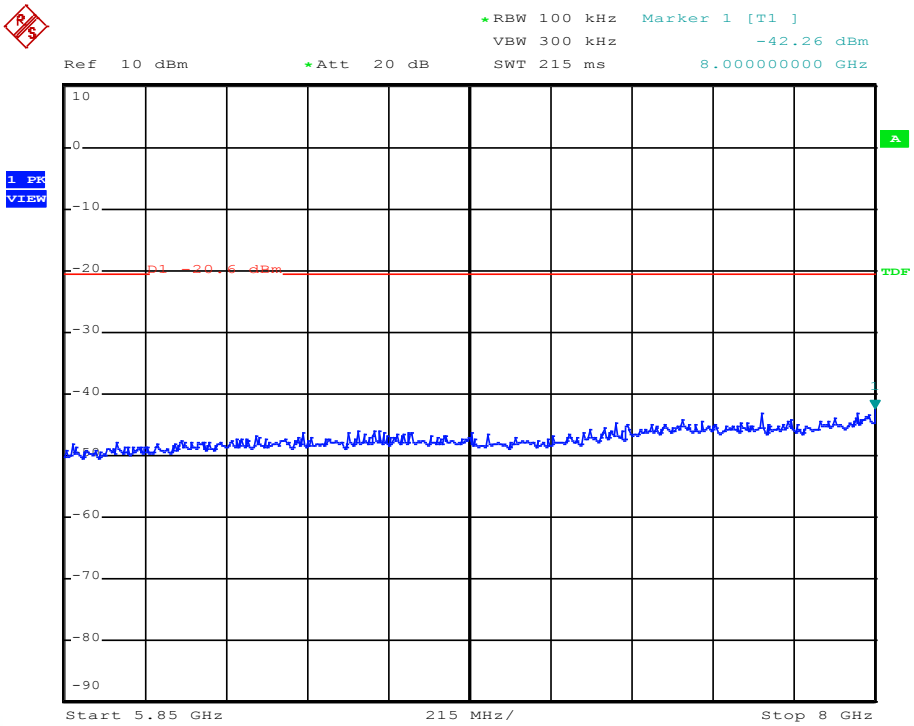


Spurious emissions from 4 GHz to 5725 GHz (worst case)

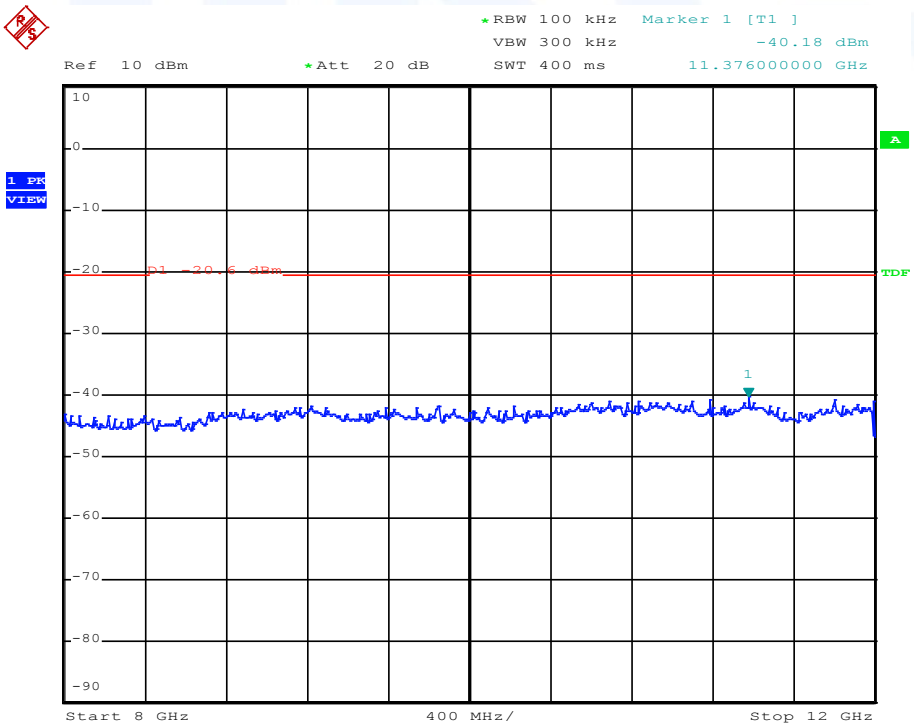


FCC ID:BV5SMALLENGINE

Spurious emissions from 5.850 GHz to 8 GHz (worst case)

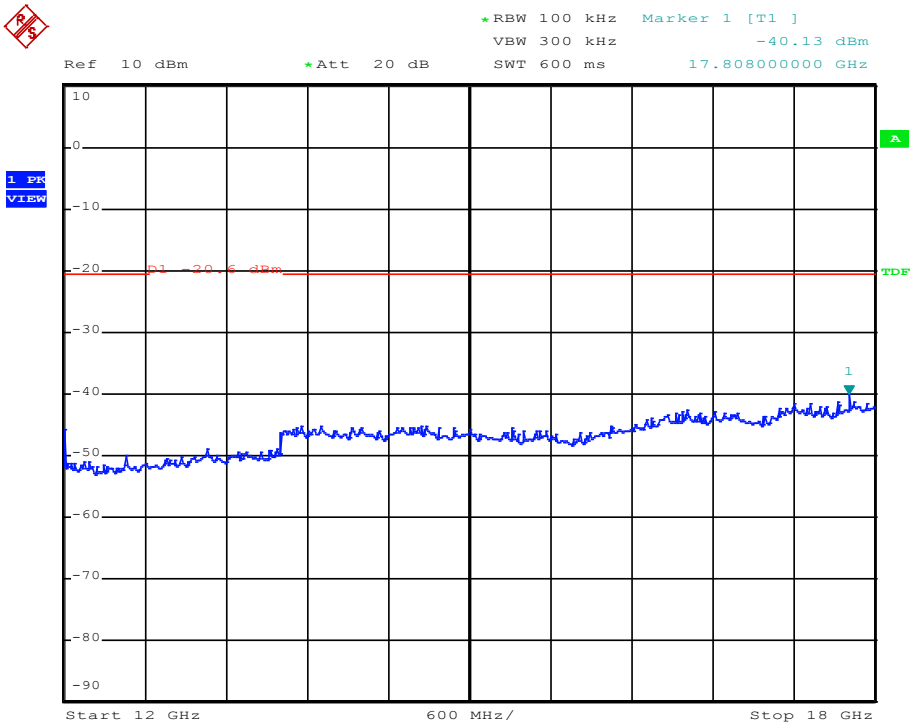


Spurious emissions from 8 GHz to 12 GHz (worst case)

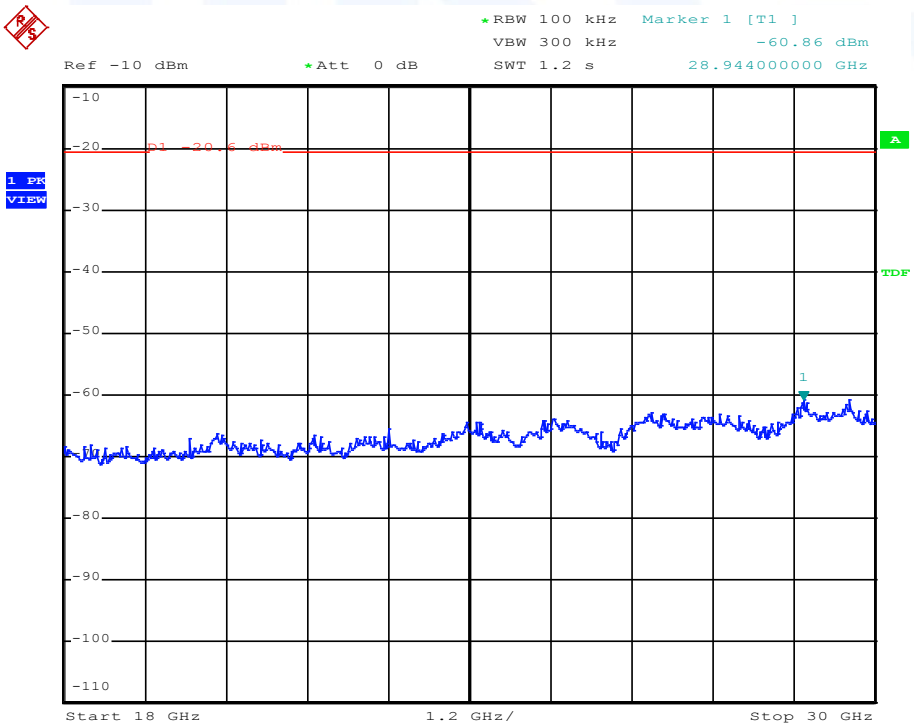


FCC ID:BV5SMALLENGINE

Spurious emissions from 12 GHz to 18 GHz (worst case)

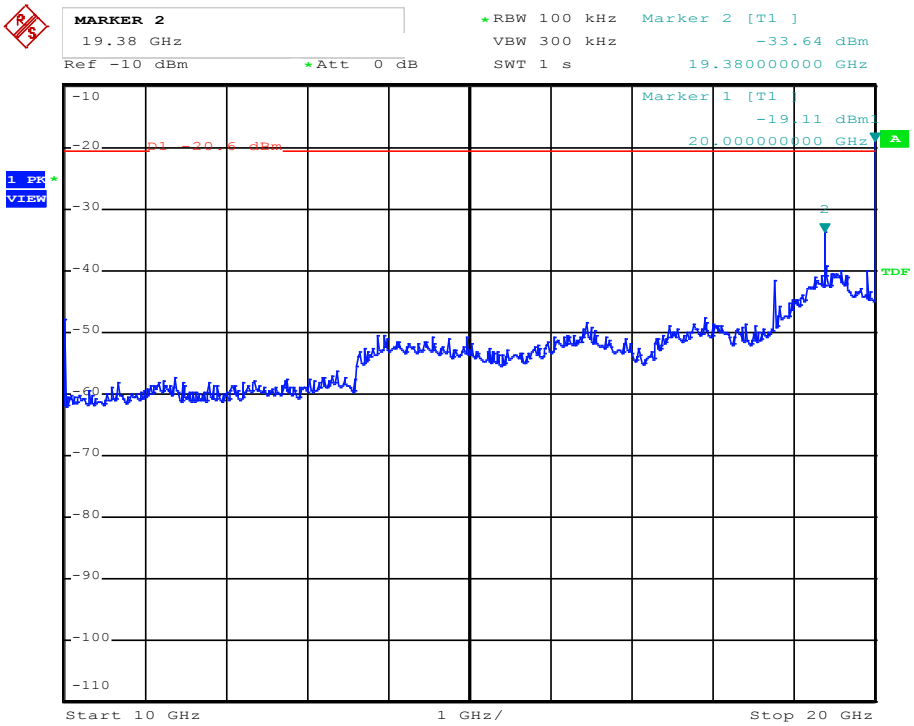


Spurious emissions from 18 GHz to 30 GHz (worst case)



FCC ID:BV5SMALLENGINE

Spurious emissions from 30 GHz to 40 GHz (worst case)



5.5 Radiated emissions in restricted bands

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

5.5.1 Description of the test location

Test location: OATS 1
Test location: Anechoic Chamber A2

Test distance: 3 metres

5.5.2 Photo documentation of the test set-up

Open area test site

Anechoic chamber

5.5.3 Applicable standard

According to FCC Part 15, Section 15.247(d):
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a) (see Section 15.205(c)).

5.5.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.4. If the emission level of the EUT in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured again in average mode and reported.

Spectrum analyser settings:
RBW: 1 MHz, VBW: 3 MHz, Detector: Max peak, Trace: Max hold, Sweep: Auto

5.5.5 Test result

HT20, Ant1 + Ant2:
Channel 149 (5745 MHz)
Nearest restricted band: 5350 - 5460 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	5360	54.6	74.0	38.2	54.0

Nearest restricted band: 7250 - 7750 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	54.0

Channel 165 (5825 MHz)
Nearest restricted band: 5350 - 5460 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	5371	54.5	74.0	40.0	54.0

Nearest restricted band: 7250 - 7750 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (∆dB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	54.0

HT40, Ant1 + Ant2:
Channel 151 (5755 MHz)
Nearest restricted band: 5350 - 5460 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (ΔdB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	54.0

Nearest restricted band: 7250 - 7750 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (ΔdB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	54.0

Channel 159 (5795 MHz)
Nearest restricted band: 5350 - 5460 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (ΔdB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-		-	54.0

Nearest restricted band: 7250 - 7750 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting (ΔdB)	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2, 2	-	-	74.0	-	54.0

802.11a, Ant1:
Channel 149 (5745 MHz)
Nearest restricted band: 5350 - 5460 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2	-	-	74.0	-	54.0

Nearest restricted band: 7250 - 7750 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2	-	-	74.0	-	54.0

Channel 165 (5825 MHz)
Nearest restricted band: 5350 - 5460 MHz

Antenna		Power	Frequency	Peak		Average	
Type	Gain (dBi)	Setting	(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2	-	-	74.0	-	54.0

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Nearest restricted band: 7250 - 7750 MHz

Antenna		Power Setting	Frequency	Peak		Average	
Type	Gain (dBi)		(MHz)	Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
ASSY PN: 1551359	5	2	-	-	74.0	-	54.0

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

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
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 Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

The requirements are **FULFILLED.**

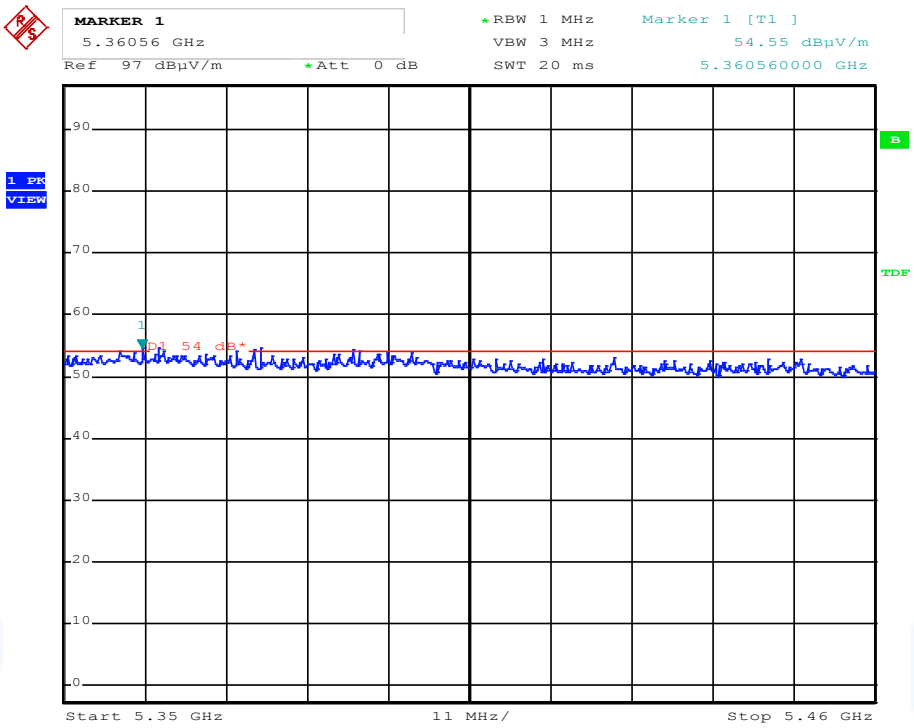
Remarks: All emissions not reported are more than 20 dB below the specified limit. For detailed test results please see the following test protocols. Only the worst cases of the plots are listed.

5.5.6 Test protocols of spurious emissions radiated in nearest restricted bands

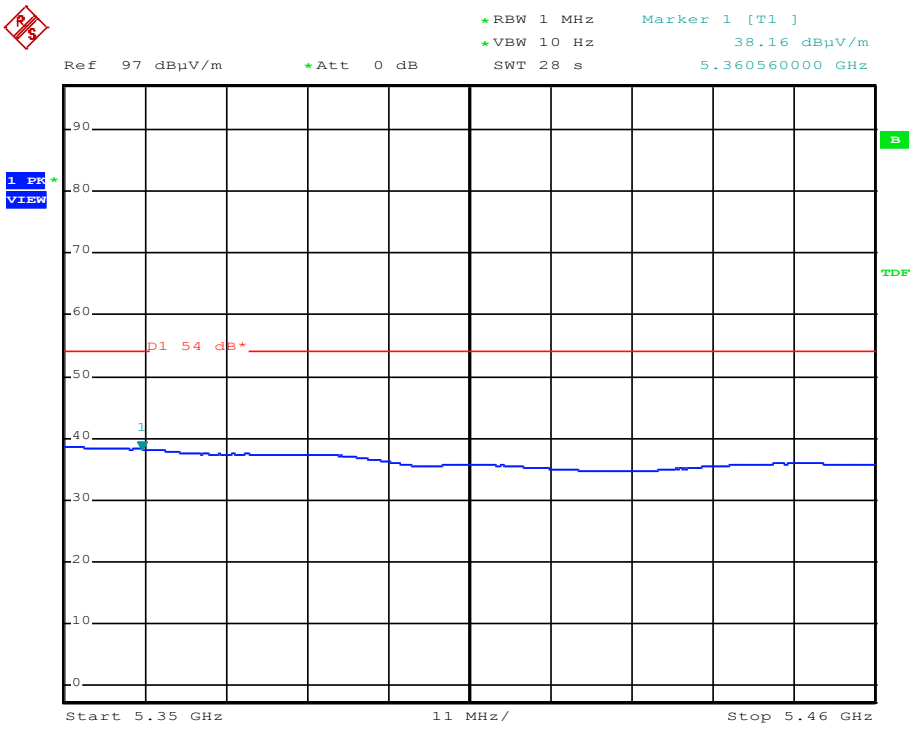
HT20:

Channel 149:

Restricted band 5.35 GHz to 5.46 GHz

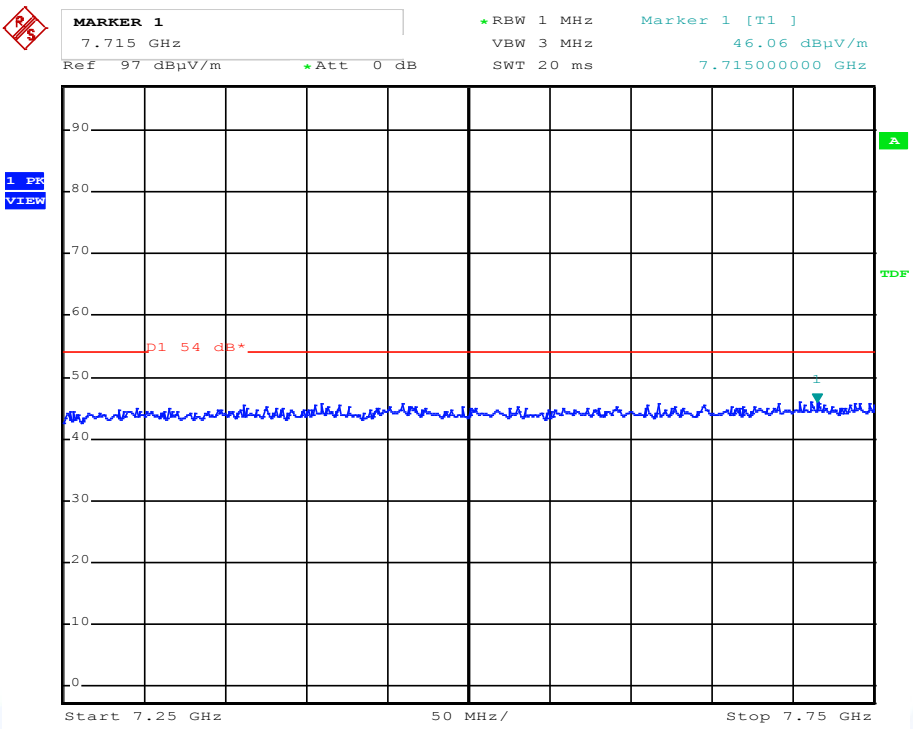


Restricted band 5.35 GHz to 5.46 GHz, AV measurement



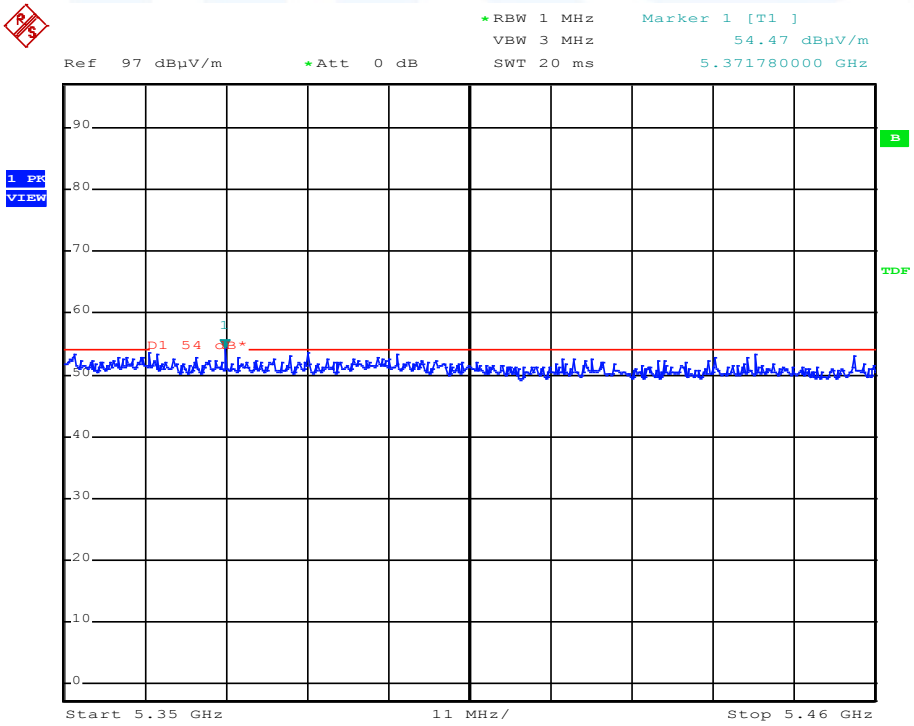
FCC ID:BV5SMALLENGINE

Restricted band 7.25 GHz to 7.75 GHz



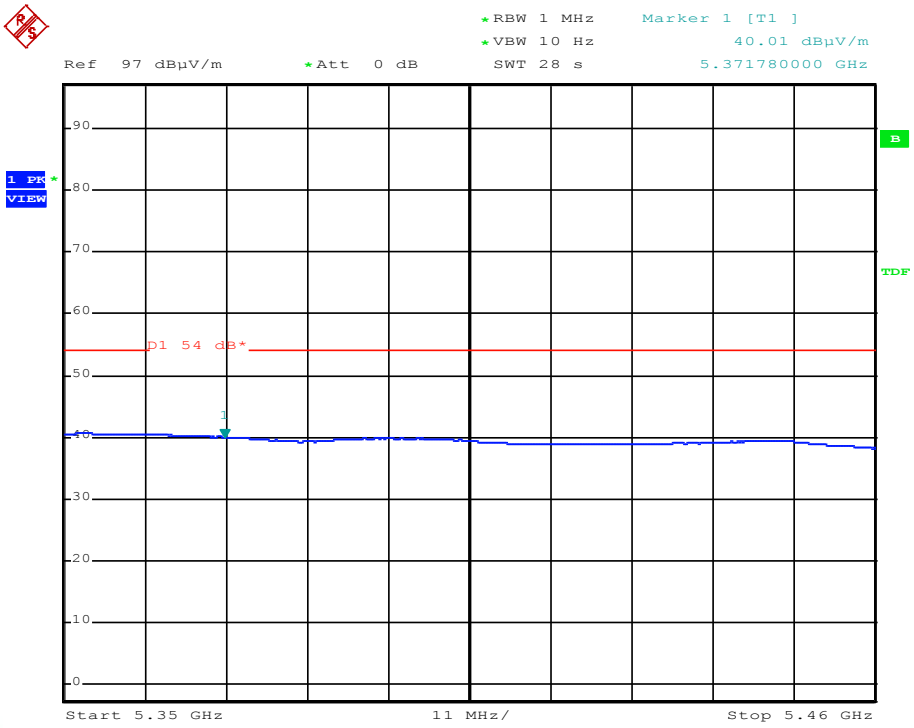
Channel 165:

Restricted band 5.35 GHz to 5.46 GHz

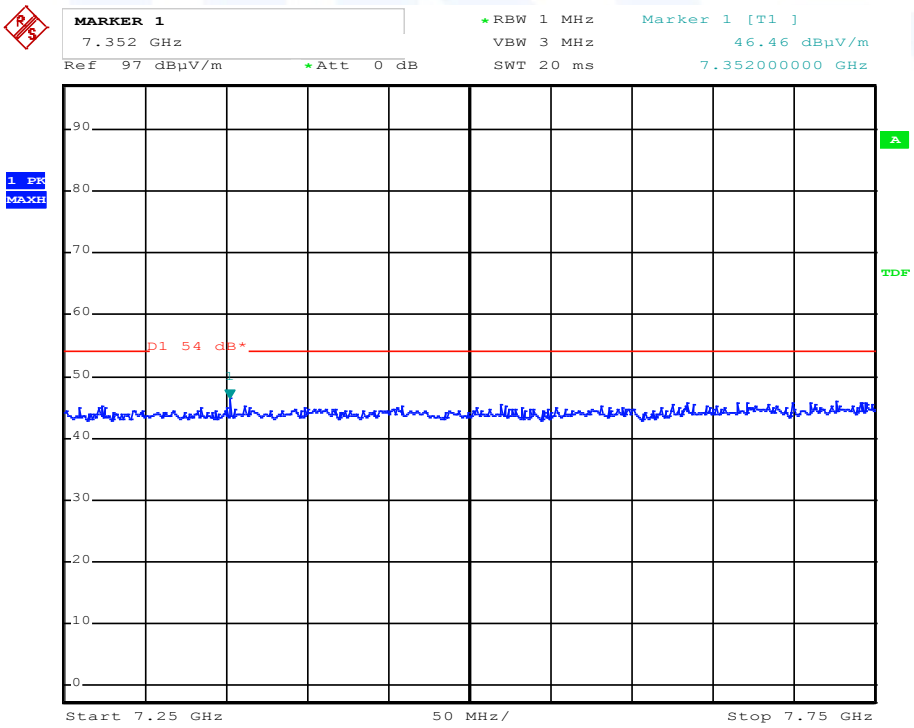


FCC ID:BV5SMALLENGINE

Restricted band 5.35 GHz to 5.46 GHz, AV measurement



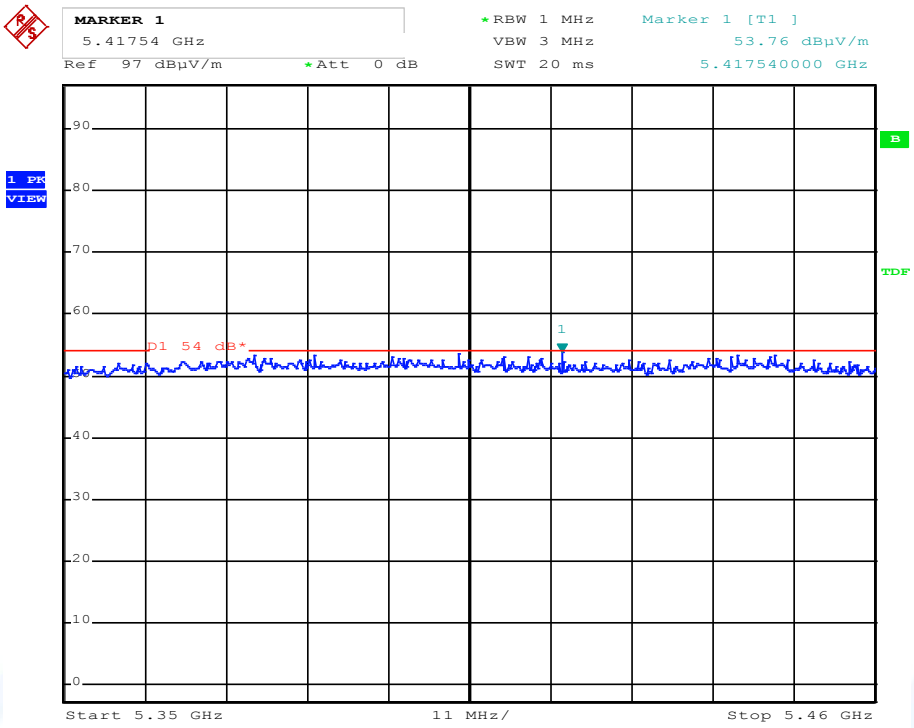
Restricted band 7.25 GHz to 7.75 GHz



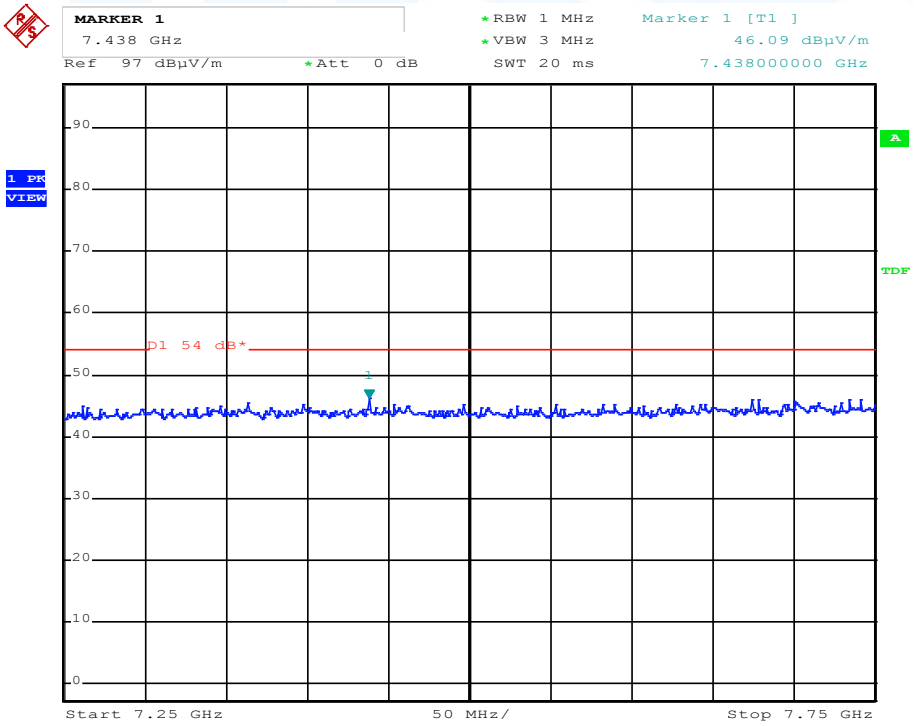
FCC ID:BV5SMALLENGINE

HT40:
Channel 151:

Restricted band 5.35 GHz to 5.46 GHz



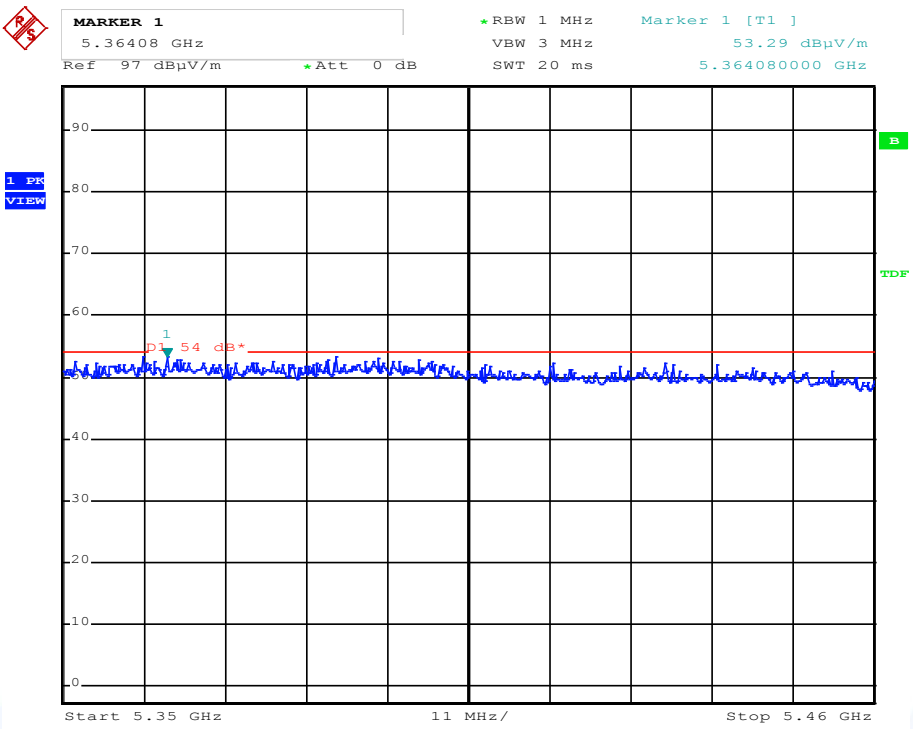
Restricted band 7.25 GHz to 7.75 GHz



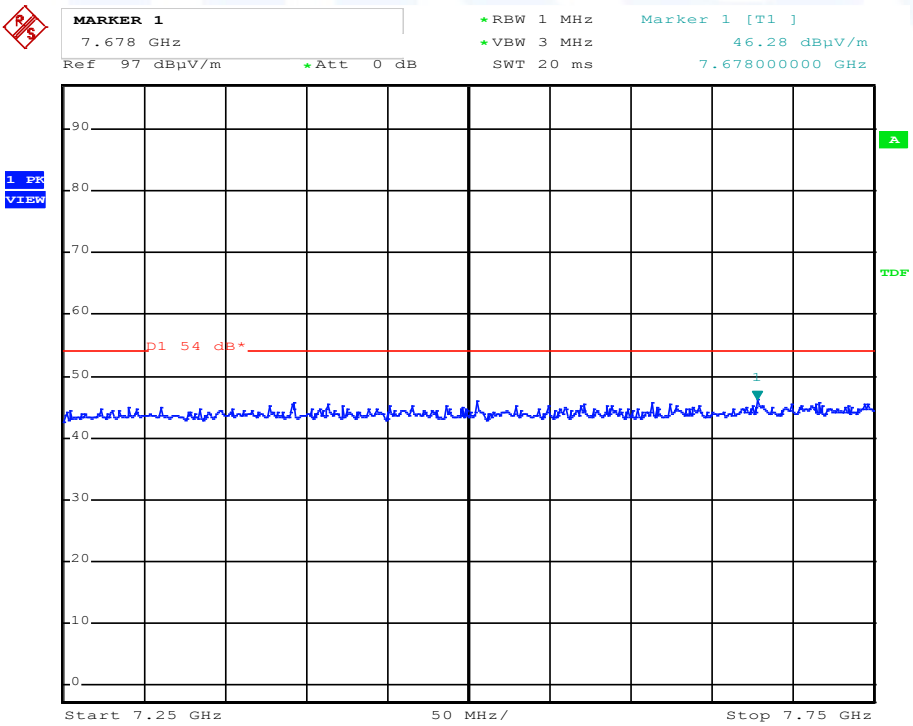
FCC ID:BV5SMALLENGINE

Channel 159:

Restricted band 5.35 GHz to 5.46 GHz



Restricted band 7.25 GHz to 7.75 GHz



Remark: All emissions were below the limits of part 15.209.

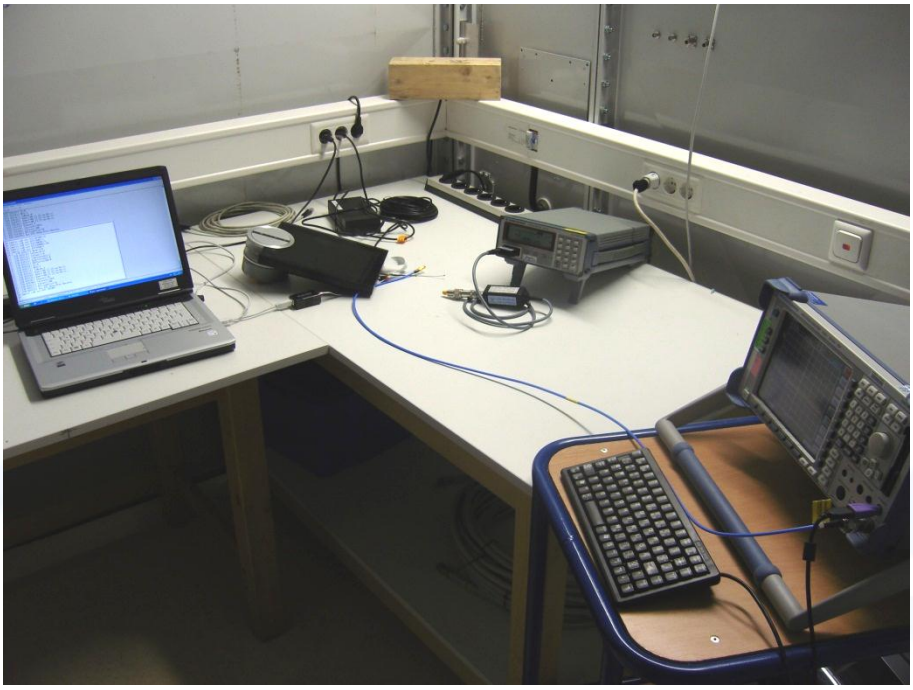
5.6 Power spectral density

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

5.6.1 Description of the test location

Test location: AREA 4

5.6.2 Photo documentation of the test set-up



5.6.3 Applicable standard

According to FCC Part 15, Section 15.247(e):
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.6.4 Description of Measurement

The measurement is performed using the procedure set out in KDB-558074. The power measurement was done using a power meter, option 1. Therefore the PSD is measured with PSD option 1. The max peak was located and zoomed in with the spectrum analyser. The zoom is done with the following settings. The cable loss of 1.6 dB @ 5.8 GHz is taken into account with an amplitude offset. For this MIMO transmitter the antenna output 1 is measured and the output 2 is taken into account with the formula according OET 662911, 10 log (N), where N is the number of outputs. The total sum is calculated to add a correction factor of 3 dB (10 log 2) to the analyser reading of each antenna output.

Spectrum analyser settings:
RBW: 3 kHz, VBW: 10 kHz, Detector: Peak, Sweep time: 10 s,

5.6.5 Test result

HT20, Ant1:

Channel	Fundamental frequency (MHz)	Reading ANT1 (dBm/3 kHz)	Correction output2 (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
149	5745	-26.5	3.0	-23.5	8
157	5785	-27.0	3.0	-24.0	8
165	5825	-26.4	3.0	-23.4	8

HT20, Ant2:

Channel	Fundamental frequency (MHz)	Reading ANT2 (dBm/3 kHz)	Correction output2 (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
149	5745	-23.2	3.0	-20.2	8
157	5785	-25.5	3.0	-22.5	8
165	5825	-26.5	3.0	-23.5	8

HT40, Ant1:

Channel	Fundamental frequency (MHz)	Reading ANT1 (dBm/3 kHz)	Correction for output2 (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
151	5755	-28.1	3.0	-25.1	8
159	5795	-28.9	3.0	-25.9	8

HT40, Ant2:

Channel	Fundamental frequency (MHz)	Reading ANT2 (dBm/3 kHz)	Correction for output2 (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
151	5755	-25.6	3.0	-22.6	8
159	5795	-29.7	3.0	-26.7	8

802.11a, Ant1:

Channel	Fundamental frequency (MHz)	Reading ANT1 (dBm/3 kHz)	Correction for ANT2 (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
149	5745	-27.0	3.0	-24.0	8
157	5785	-25.0	3.0	-22.0	8
165	5825	-24.2	3.0	-21.2	8

802.11a, Ant2:

Channel	Fundamental frequency (MHz)	Reading ANT2 (dBm/3 kHz)	Correction for output2 (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
149	5745	-24.5	3.0	-21.5	8
157	5785	-27.1	3.0	-24.1	8
165	5825	-29.7	3.0	-26.7	8

FCC ID:BV5SMALLENGINE

Power spectral density limit according to FCC Part 15, Section 15.247(e):

Frequency (MHz)	Power spectral density limit (dBm/3kHz)
5725 - 5850	8

The requirements are **FULFILLED.**

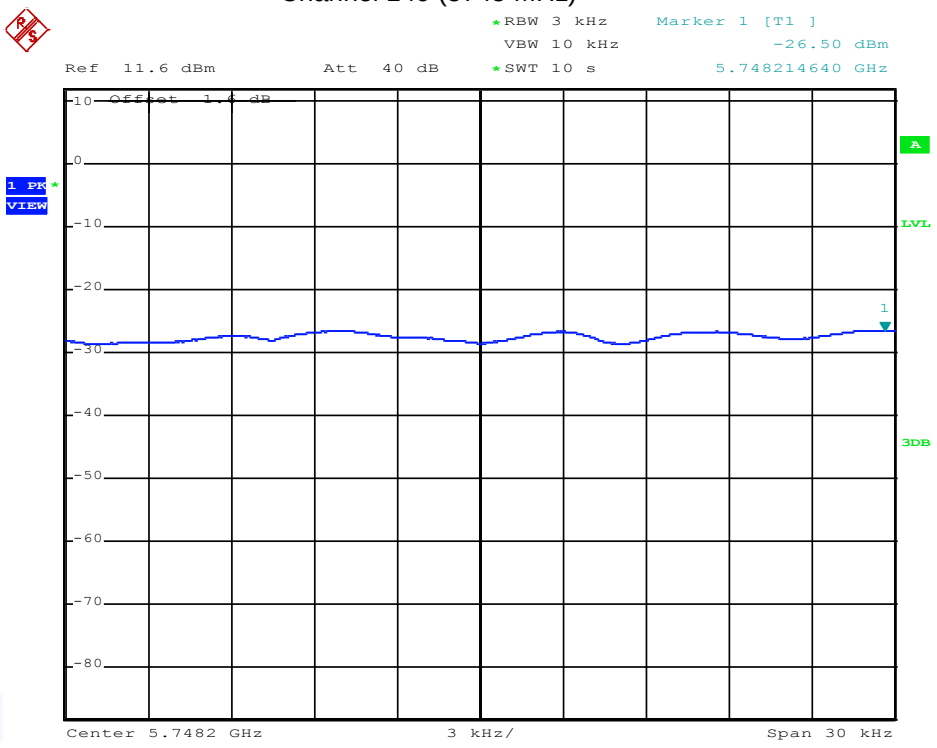
Remarks: For detailed test results please see the following test protocols.

FCC ID:BV5SMALLENGINE

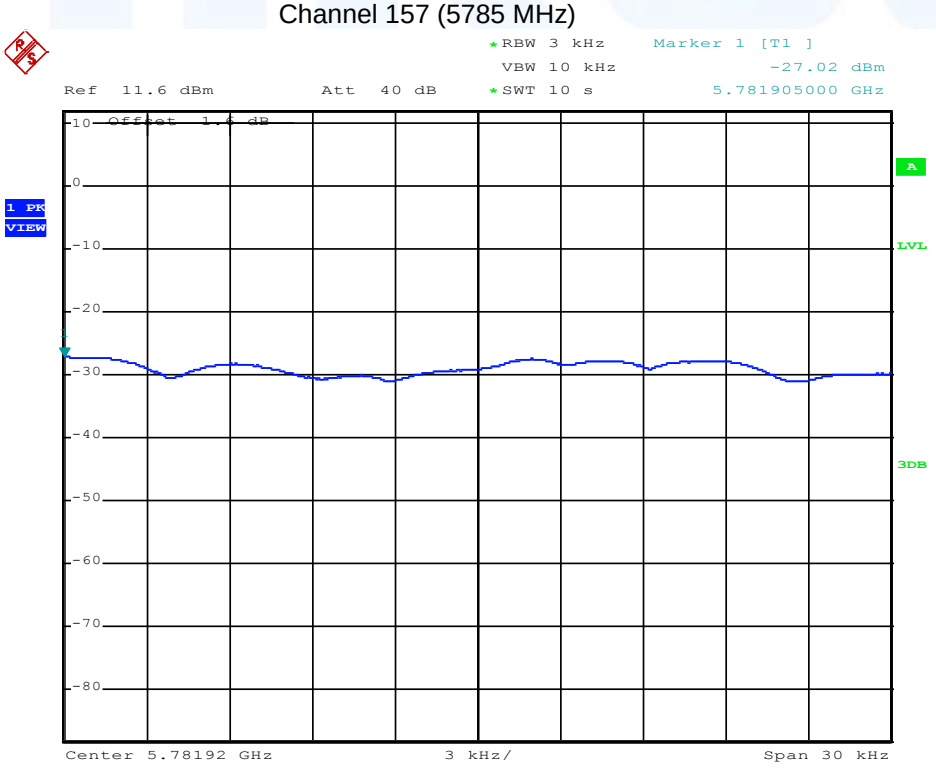
Power spectral density plots

HT20, Ant1

Channel 149 (5745 MHz)

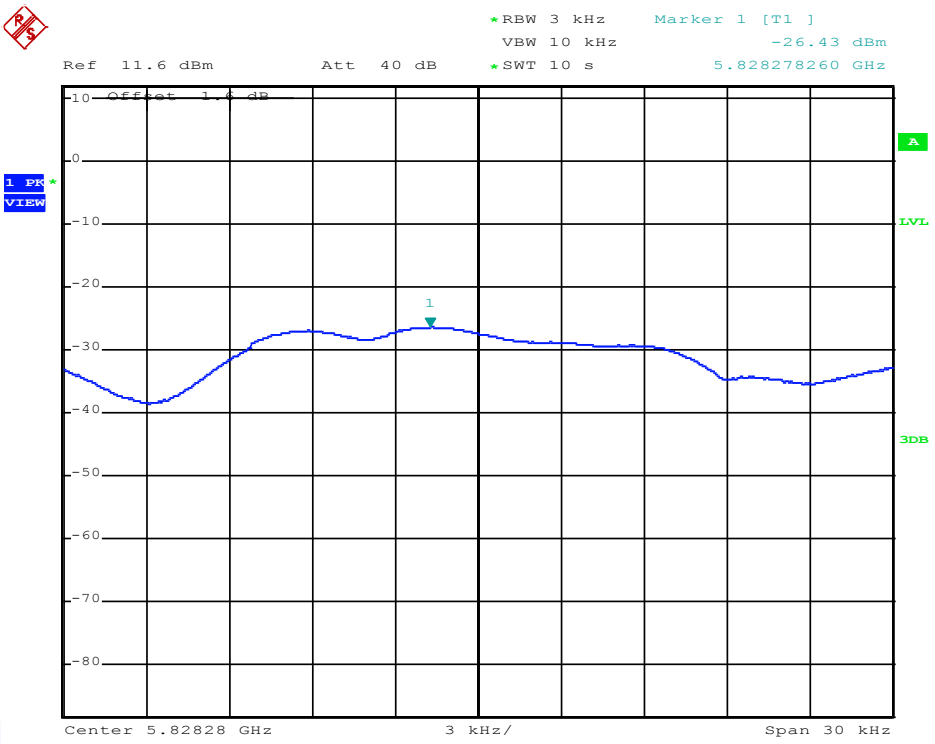


Channel 157 (5785 MHz)



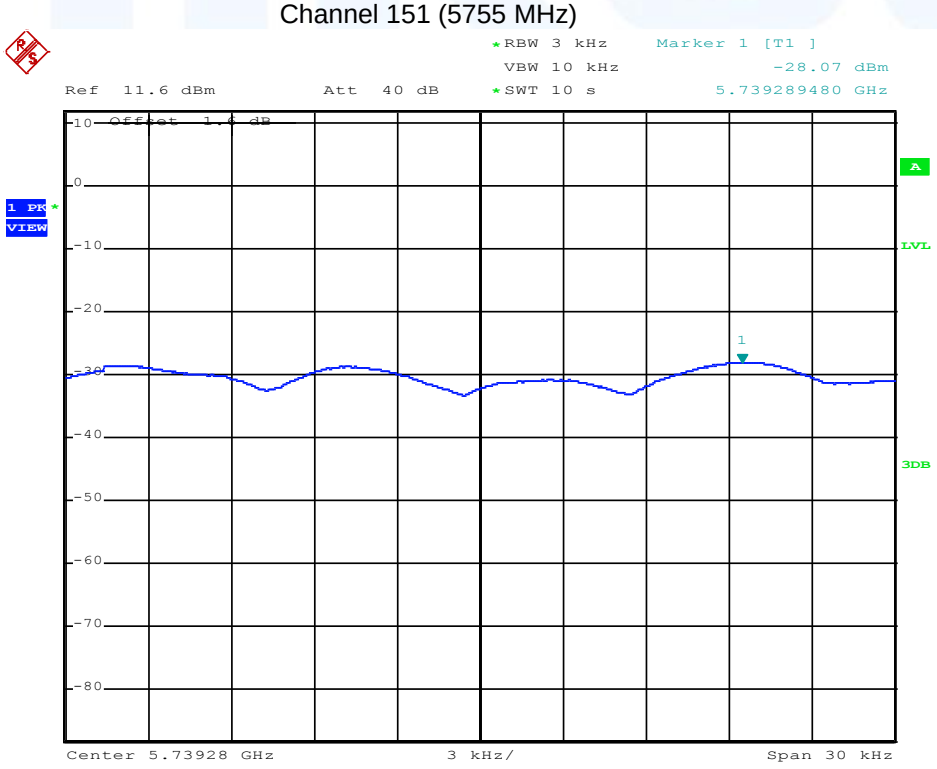
FCC ID:BV5SMALLENGINE

Channel 165 (5825 MHz)



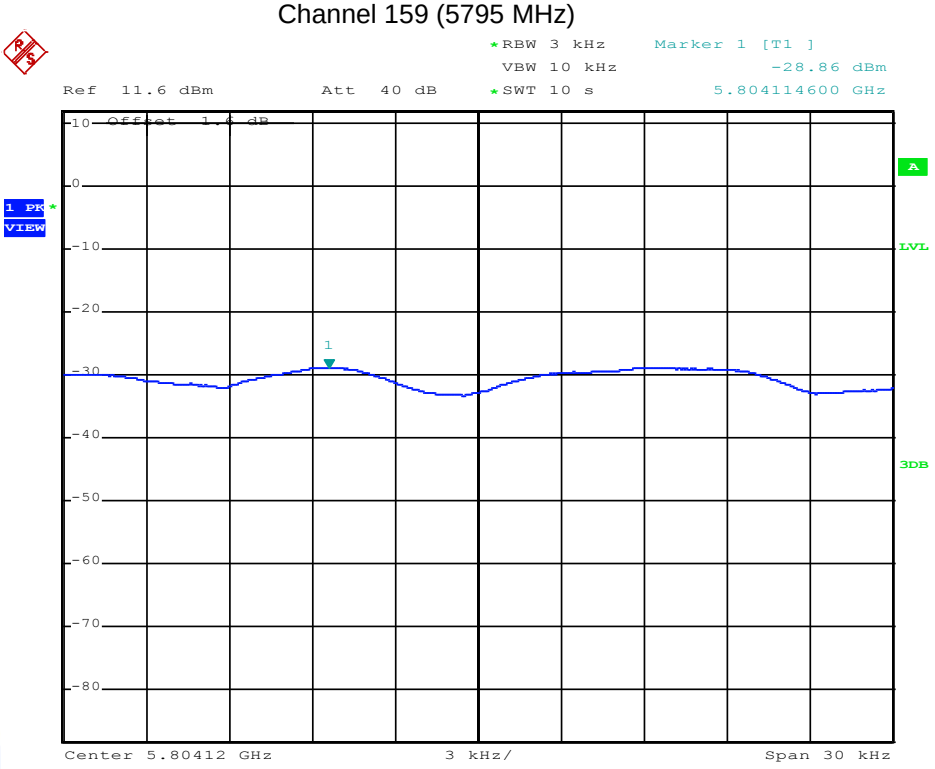
HT40, Ant1:

Channel 151 (5755 MHz)



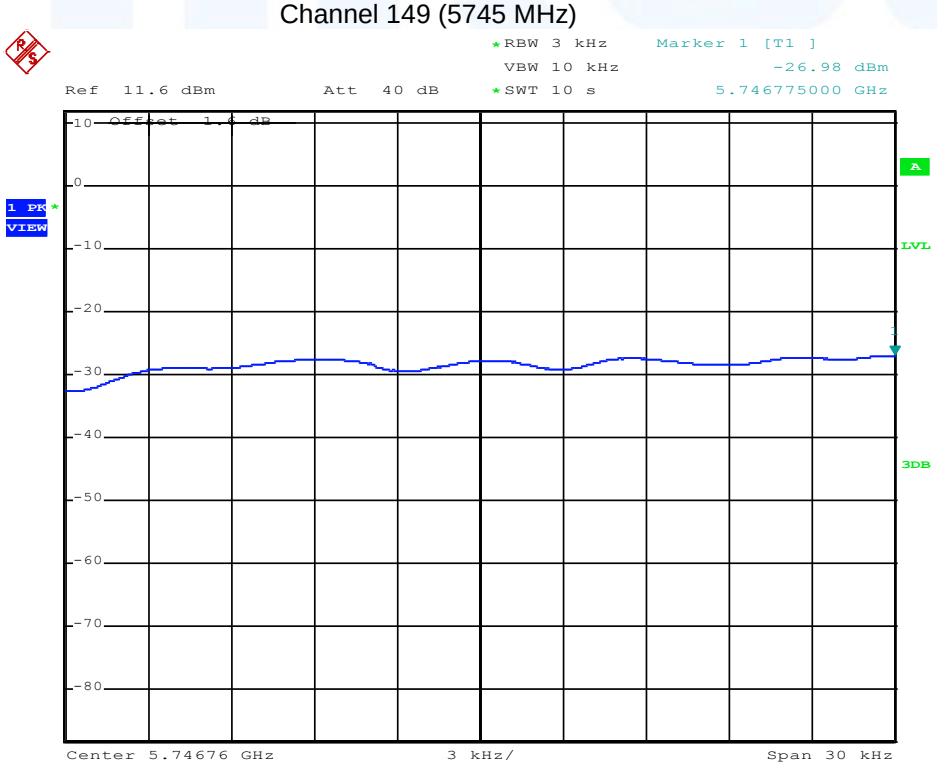
FCC ID:BV5SMALLENGINE

Channel 159 (5795 MHz)



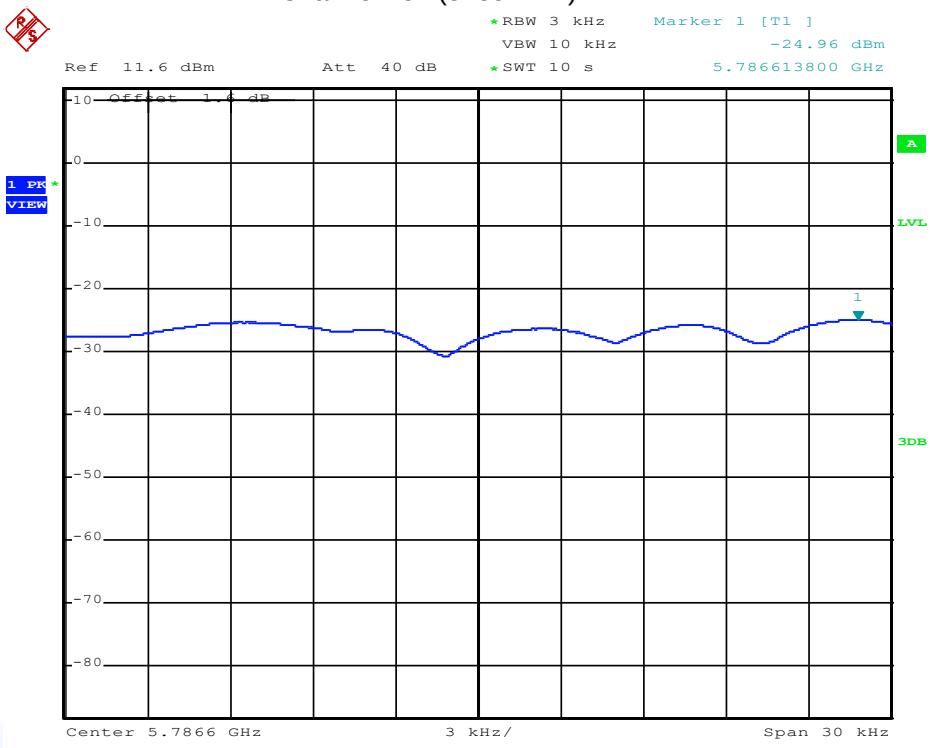
802.11a, Ant1:

Channel 149 (5745 MHz)

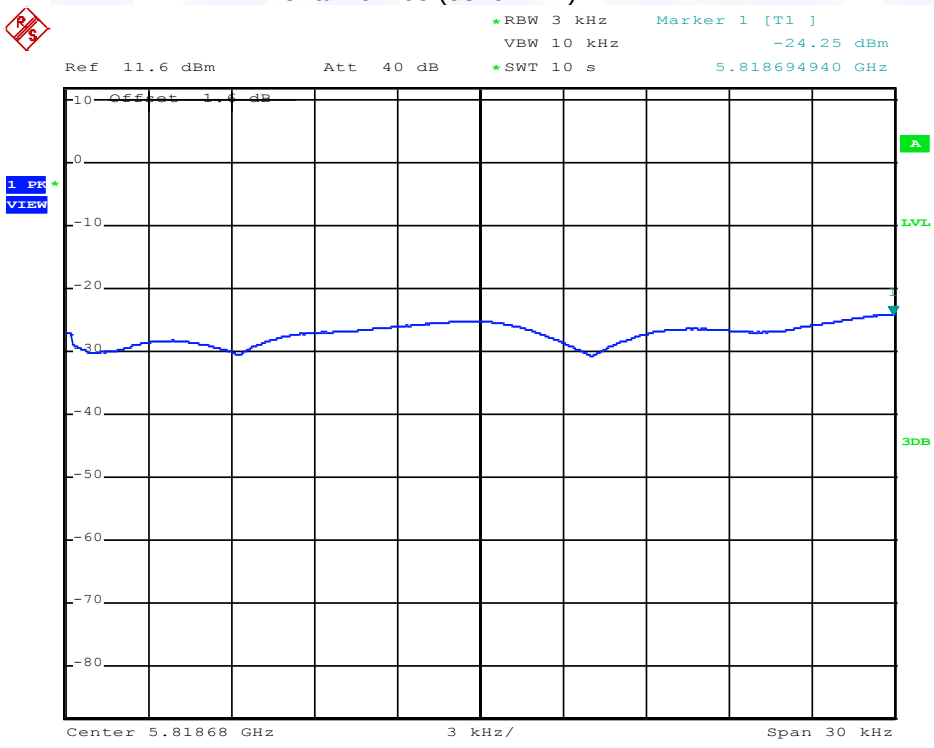


FCC ID:BV5SMALLENGINE

Channel 157 (5785 MHz)



Channel 165 (5825 MHz)



5.7 Maximum permissible exposure (MPE)

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

5.7.1 Description of the test location

Test location: AREA 4

5.7.2 Applicable standard

According to FCC Part 15, Section 15.247(i):
Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.
The test methods used comply with ANSI/IEEE C95.1, "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 Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

5.7.3 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, the known maximum gain of the antenna and the maximum power, can be calculated the MPE in a defined distance away from the product.

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

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

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. (r = 20 cm)

5.7.4 Test result

HT20, Ant1:

Antenna type ASSY PN: 1551359 with an antenna gain of 5 dBi, Power setting: 2, 2;

Channel No.	Frequency	Max power output to antenna		Antenna gain	Power density	Limit of power density
	(MHz)	(dBm)	(mW)	(dBi)	(mW/cm^2)	(mW/cm^2)
149	5745	11.4	13.80	5	0.0087	1.0
157	5785	11.5	14.13	5	0.0089	1.0
165	5825	11.5	14.13	5	0.0089	1.0

HT20, Ant2:

Antenna type ASSY PN: 1551359 with an antenna gain of 5 dBi, Power setting: 2, 2;

Channel No.	Frequency	Max power output to antenna		Antenna gain	Power density	Limit of power density
	(MHz)	(dBm)	(mW)	(dBi)	(mW/cm^2)	(mW/cm^2)
149	5745	10.2	10.47	5	0.0066	1.0
157	5785	9.7	9.33	5	0.0059	1.0
165	5825	10	10.00	5	0.0063	1.0

HT20, Ant1 + Ant2:

Channel No.	Frequency	Max power output to antenna		Antenna gain	Power density	Limit of power density
	(MHz)	(dBm)	(mW)	lin	(mW/cm^2)	(mW/cm^2)
149	5745	13.9	24.27	3.16	0.0153	1.0
157	5785	13.7	23.46	3.16	0.0148	1.0
165	5825	13.8	24.13	3.16	0.0152	1.0

Note: All values in this table are calculated.

HT40, Ant1:

Antenna type ASSY PN: 1551359 with an antenna gain of 5 dBi, Power setting: 2, 2;

Channel No.	Frequency	Max power output to antenna		Antenna gain	Power density	Limit of power density
	(MHz)	(dBm)	(mW)	(dBi)	(mW/cm^2)	(mW/cm^2)
151	5755	11.4	13.80	5	0.0087	1.0
159	5795	11.5	14.13	5	0.0089	1.0

HT40, Ant2:

Antenna type ASSY PN: 1551359 with an antenna gain of 5 dBi, Power setting: 2, 2;

Channel No.	Frequency	Max power output to antenna		Antenna gain	Power density	Limit of power density
	(MHz)	(dBm)	(mW)	(dBi)	(mW/cm^2)	(mW/cm^2)
151	5755	10.4	10.96	5	0.0069	1.0
159	5795	9.9	9.77	5	0.0061	1.0

HT40, Ant1 + Ant2:

Channel No.	Frequency	Max power output to antenna		Antenna gain	Power density	Limit of power density
	(MHz)	(dBm)	(mW)	lin	(mW/cm^2)	(mW/cm^2)
151	5755	13.9	24.76	3.16	0.0156	1.0
159	5795	13.8	23.90	3.16	0.0150	1.0

Note: All values in this table are calculated.

802.11a, Ant1:

Antenna type ASSY PN: 1551359 with an antenna gain of 5 dBi, Power setting: 2;

Channel No.	Frequency	Max power output to antenna		Antenna gain	Power density	Limit of power density
	(MHz)	(dBm)	(mW)	(dBi)	(mW/cm^2)	(mW/cm^2)
149	5745	12.5	17.78	5	0.0112	1.0
157	5785	12.0	15.85	5	0.0100	1.0
165	5825	12.1	16.22	5	0.0102	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)
(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: _____

_____

5.8 Co-location and co-transmission

Applicable standard:
OET Bulletin 65, Edition 97-01, Section 2: Multiple-transmitter sites and Complex Environments

There is no co-location issue. The MIMO antenna technology has been tested and used for the determination of the worst case.

Remarks: _____

_____

5.9 Antenna application - Detailed photos see attachment A

5.9.1 Applicable standard

According to FCC Part 15C, Section 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. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated antenna. No other antenna can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

5.9.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):
The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, 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 (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The output power has not to be reduced using the antenna type ASSY PN: 1551359.

Remarks: _____

_____

5.10 Receiver radiated emissions

For test instruments and accessories used see section 6 Part **SER2** and **SER3**.

5.10.1 Description of the test location

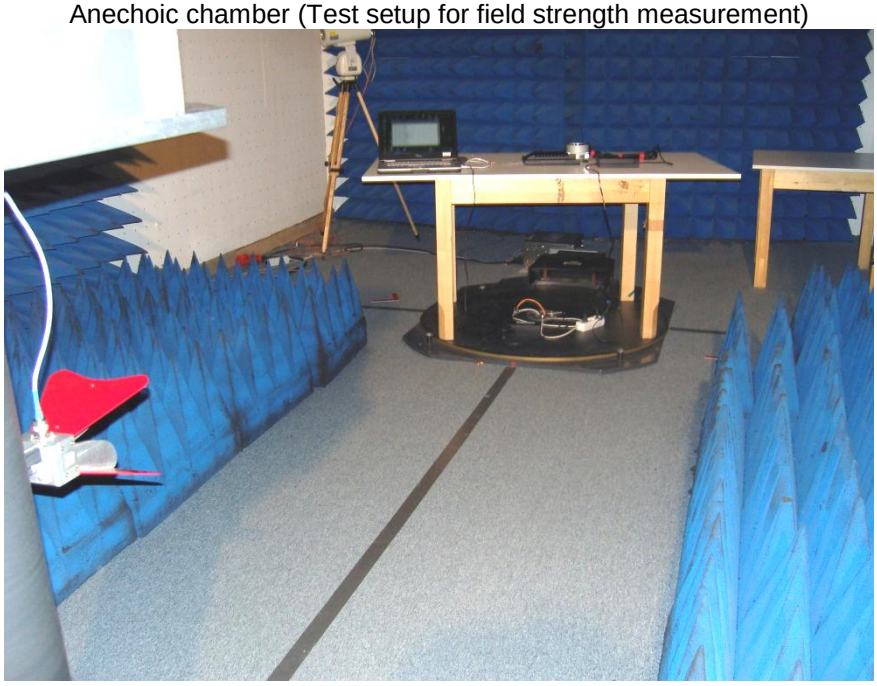
Test location: OATS 1
Test location: Anechoic Chamber A2

Test distance: 3 metres

5.10.2 Photo documentation of the test set-up

Open area test site (Test setup for 30 MHz – 1000 MHz)

Anechoic chamber (Test setup for field strength measurement)



5.10.3 Applicable standard

According to RSS-Gen, Section 6:
Receivers shall comply with the limits of spurious emissions set out in this section, measured over the frequency range determined in accordance with Section 4.10.

5.10.4 Description of Measurement

Radiated emissions from the EUT in the range f < 1 GHz are measured under the circumstances described in point 4.4. In the frequency range of 1 GHz to maximum frequency as specified in section RSS Gen 4.10. For testing above 1 GHz, the emission level of the EUT in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured again in average mode and reported.

5.10.5 Test result

5.10.5.1 Test result f < 1 GHz

Channel 157:

Frequency (MHz)	L: QP (dBµV)	L: AV (dBµV)	Bandwidth (kHz)	Correct. (dB/m)	L: QP (dBµV/m)	L: AV (dBµV/m)	Limit (dBµV/m)	Delta (dB)
200	25.5		120	12.9	38.4		43.5	-5.1
400	21.9		120	19.1	41.0		46.0	-5.0
600	10.7		120	23.8	34.5		46.0	-11.5

5.10.5.2 Test result f > 1 GHz

Frequency band: 5.725 GHz to 5.85 GHz

HT20: CH157			HT40: CH159		
f (MHz)	Level (dBµV/m)	Limit (dBµV/m)	*f* (MHz)	Level (dBµV/m)	Limit (dBµV/m)
-	-	54.0	-	-	54.0
Measurement uncertainty			± 6 dB		

Note: No emission could be detected in the frequency range from 1 GHz to 18 GHz within 20 dB to the limit.

Limit according to RSS-Gen, Table 2:

Frequency (MHz)	Limit (µV/m)	Limit (dBµV/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

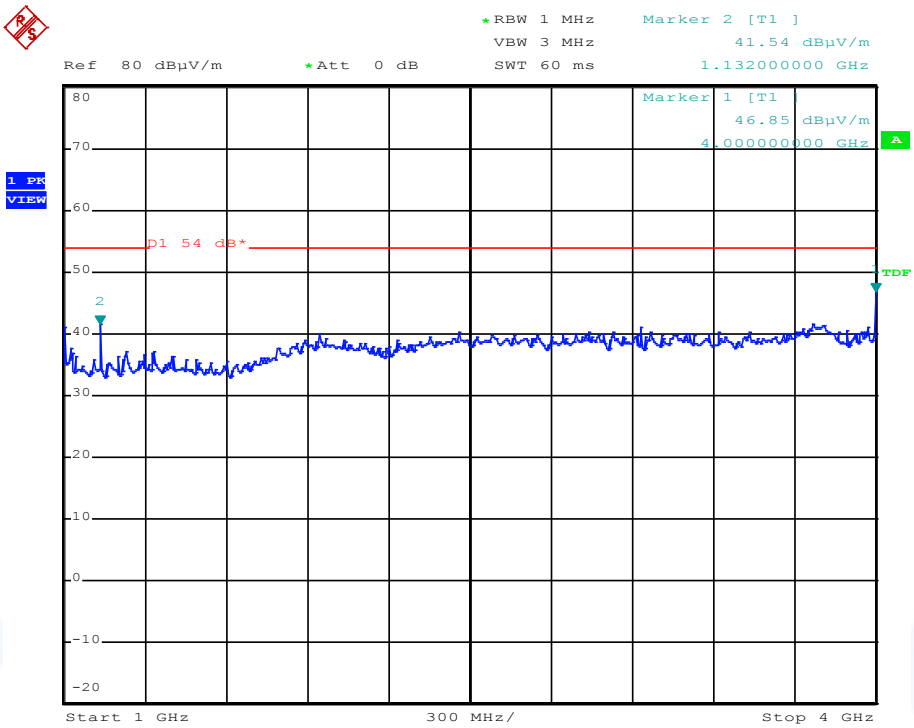
The requirements are **FULFILLED.**

Remarks: During the test, the EUT was set into continuous receiving mode. The measurement was performed up to the 3rd harmonic (18000 MHz). For detailed test results please see the following test protocols.

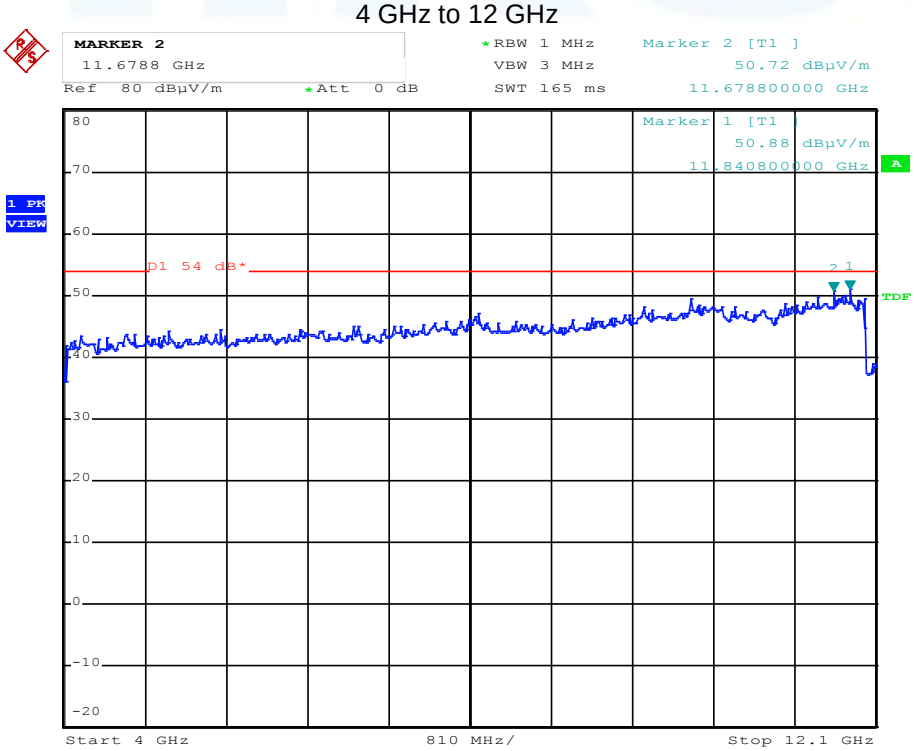
5.10.1 Test protocols receiver spurious emissions

HT20:
Channel 157:

1 GHz to 4 GHz



4 GHz to 12 GHz



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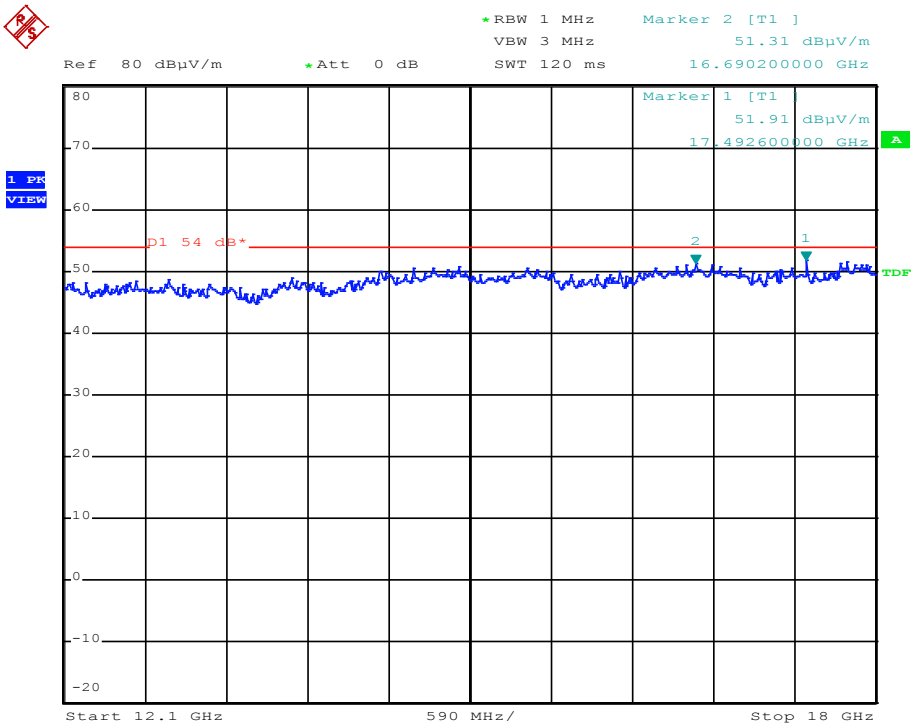
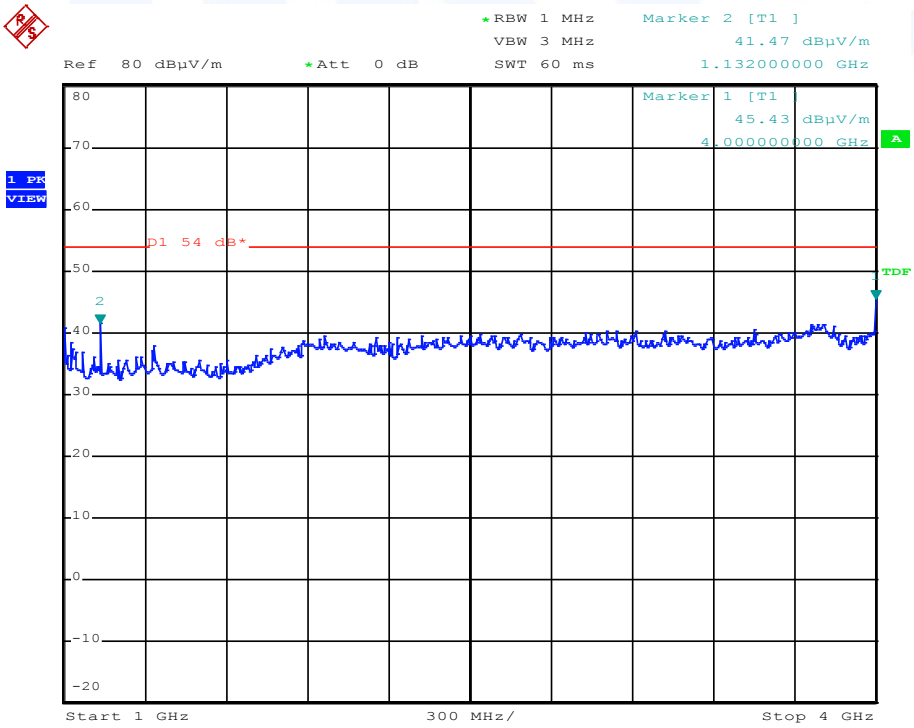
12 GHz to 18 GHz



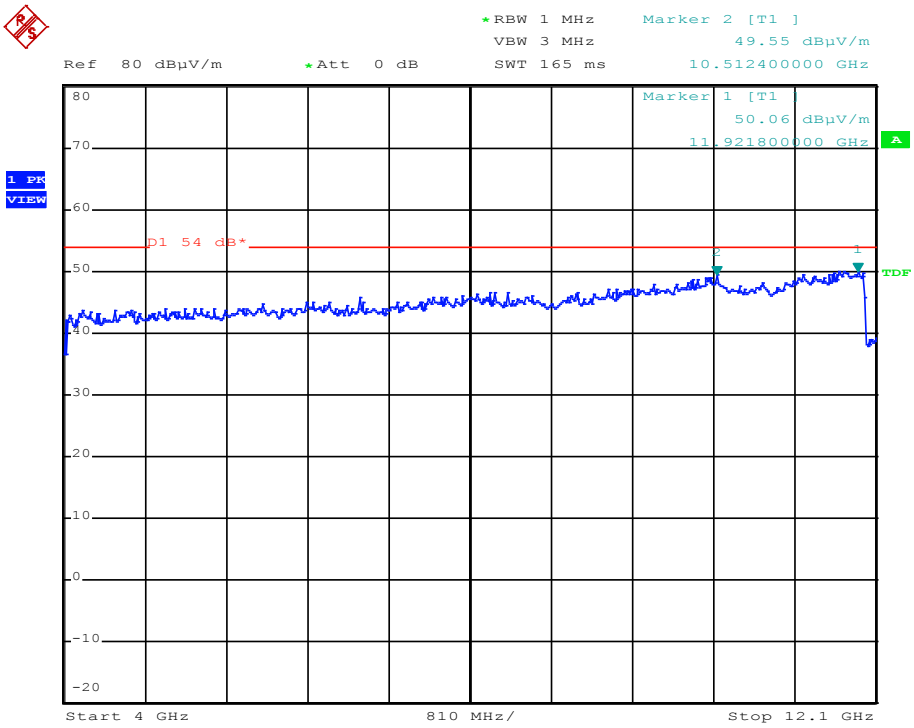
HT40:
Channel 159:

1 GHz to 4 GHz

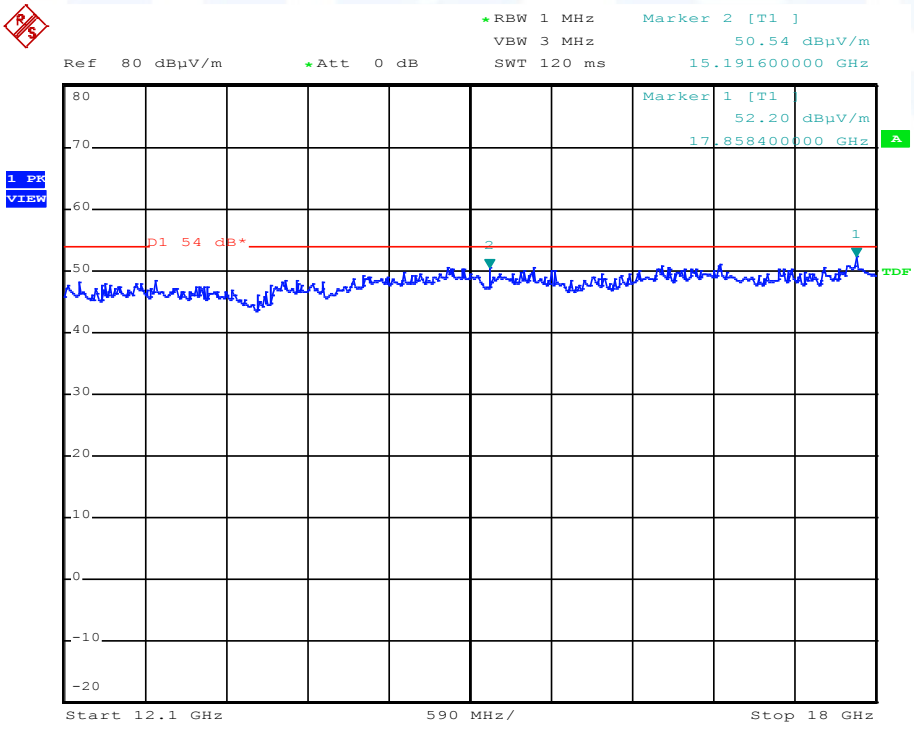


FCC ID:BV5SMALLENGINE

4 GHz to 12 GHz



12 GHz to 18 GHz



6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Next Verif.
A 4	ESHS 30	02-02/03-05-002	18/06/2011	18/06/2010		
	ESH 2 - Z 5	02-02/20-05-004	12/05/2013	12/05/2011	12/11/2011	12/05/2011
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	06/10/2011	06/04/2011		
CPC 3	NRVS	02-02/07-05-005				
	NRV-Z15	02-02/07-07-001	27/07/2011	27/07/2010	02/02/2012	02/02/2011
	FSP 30	02-02/11-05-001	17/05/2012	17/05/2011		
MB	FSP 30	02-02/11-05-001	17/05/2012	17/05/2011		
	Multiflex 141-SMA-N-1500	02-02/50-09-013				
SER 1	FMZB 1516	01-02/24-01-018	16/02/2012	16/02/2011		
	ESCI	02-02/03-05-005	19/11/2011	19/11/2010		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	11/06/2011	11/06/2010		
	VULB 9168	02-02/24-05-005	07/03/2012	07/03/2011	17/09/2011	17/03/2011
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 3	FSP 30	02-02/11-05-001	17/05/2012	17/05/2011		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	BBHA 9120 E 251	02-02/24-05-006	09/09/2011	09/03/2011		
	WBH2-18HN	02-02/24-05-007				
	3117	02-02/24-05-009	11/02/2012	11/02/2011		
	R2 _ 30 - 40 GHz	02-02/30-09-001	02/02/2012	02/02/2011		
	R1 _ 18 - 30 GHz	02-02/30-09-002	02/02/2012	02/02/2011		
	Sucoflex N-1000-SMA	02-02/50-05-072				
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	Multiflex 141-SMA-N-1500	02-02/50-09-015				
	Multiflex 141-SMA-N-1500	02-02/50-09-016				
	H26G40G1	02-02/50-10-011				