FCC ID: LYHMPCIE1V1

EMI – TEST REPORT

- FCC Part 15.247 and RSS 210 -

Deutsche Akkreditierungsstelle D-PL-12030-01-01

Test Report No. :	**T35222-06-07HS**	04. September 2012 Date of issue

Type / Model Name : WLAN n-module MPCIE-R1-ABGN-U3

Product Description : Module for industrial WLAN applications 2.4 / 5 GHz

Applicant : Siemens AG, Industrial Automation Division

Address : Gleiwitzer Strasse 555

90475 NUERNBERG, GERMANY

Manufacturer : Siemens AG, Sensors & Communication

Address : Oestliche Rheinbrueckenstrasse 50

76187 KARLSRUHE, GERMANY

Licence holder : Siemens AG, Industrial Automation Division

Address : Gleiwitzer Strasse 555

90475 NUERNBERG, GERMANY

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

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Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2011)

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, 2011)

Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz
ANSI C63.4: 2009	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10: 2009	Testing Unlicensed Wireless Devices
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 D01	Guidance for performing compliance measurements on DTS operating under Section 15.247, 2012-1-18.
KDB 662911 D01	Emission testing of transmitter with multiple outputs in the same band, 2011-4-4.

2 SUMMARY

2.1 Test result summary

WLAN device using digital modulation:

Operating in the 5725 MHz – 5850 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.247(d)	RSS-Gen, 7.2.2	Emissions in restricted bands	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

2.2 GENERAL REMARKS:

This testing is limited to the specific 4500 MHz -5150 MHz restricted band for the operating modes in the DTS 5 GHz band. For all other restricted bands compliance with the radiated limits is based on the conducted emissions tests as allowed in KDB 558074 and reported in Test Report T35222-06-01HS. Operating modes in the 2.4 GHz bands complied with the conducted emissions test requirements.

The EUT is a WLAN module. The EUT may be access point or client. The WLAN module is compatible with 802.11a, g and 802.11n standard. It supports the 2.4 GHz and 5 GHz frequency band. It supports MIMO at 3 Antenna ports which is 3T3R. The firmware does not support the ad-hoc modes. The EUT use the MIMO function without beam forming.

Test jig

The used test jig provides the necessary power supply and control signals to operate the WLAN module for testing. The test jig is DC power supplied with a view to the planned industrial application. The test ports are connected via UFL-RSMA-Pigtail which is used also in the end application.

Operation frequency and channel plan

The operating frequency is 5725 MHz to 5850 MHz.

Channel plan WLAN Standard 802.11a/n, HT20:

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

HT40 mode:

Channel, HT40 up	Frequency	Channel, HT40 down	Frequency
149 up	5755 MHz	153 down	5755 MHz
157 up	5795 MHz	161 down	5795 MHz

Antennas

Antennas intended for use are classified into 3 gain groups:
2.4 GHz:

- Ant. group 1: Antennas 0 to 6 dBi
- Ant. group 2: Antennas 7 to 9 dBi
- Ant. group 3: Antennas 10 to 14 dBi

5 GHz:

- Ant. group 1: Antennas 0 to 6 dBi
- Ant. group 2: Antennas 7 to 9 dBi
- Ant. group 3: Antennas 10 to 14 dBi

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The following listed antennas shall be used with the EUT:

Number	Characteristic	Certification name	Plug	Frequency	Gain (dBi)
1	Directed	ANT793-8DK	N	5	23
2	Directed	ANT793-8DJ	N	5	18
3	Wide angle	ANT793-6DG	N	5	9
4	Wide angle	ANT793-6DT	3*QMA	5	9
5	Omni	ANT793-4MN	N	5	6
6	Omni	ANT793-6MN	N	5	5
7	Directed	ANT792-8DN	N	2.4	14
8	Omni	ANT792-6MN	N	2.4	6
9	Helix	ANT792-4DN	N	2.4	4
10	Wide angle	ANT795-6DC	N	2.4, 5	9, 9
11	Omni	ANT795-6MN	N	2.4, 5	6, 8
12	Omni	ANT795-6MT	3*QMA	2.4, 5	5, 7
13	Omni	ANT795-4MC	N	2.4, 5	3, 5
14	Omni	ANT795-4MD	N	2.4, 5	3, 5
15	Omni	ANT795-4MA	R-SMA	2.4, 5	3, 5
16	Omni	A5E002280427-06	integrated	2.4, 5	3, 5
17	Rcoax	Rcoax 2G	N	2.4	0
18	Rcoax	Rcoax 5G	N	5	0

Ant. group 3 antenna assemly with max 10 to 14 dBi gain:

Number	Characteristic	Certification name	Plug	Frequency range (GHz)	Gain (dBi)	Cable loss	Effective Gain
1	Directed	ANT793-8DJ	N	5	18	4.4	14.2
2	Directed	ANT793-8DK	N	5	23	8.8	13.6

Note: The directed antenna number 1 may be used only with minimum 5 m antenna cable, Type 6XV 1875-5CH50 with cable loss 4.4 dB at 5.7 GHz.
The directed antenna number 2 may be used only with minimum 10 m antenna cable, Type 6XV 1875-5CN10 with cable loss 8.8 dB at 5.7 GHz.

For testing the following antennas are used:

5 GHz:

- Ant. group 1: Antennas 0 to 6 dBi, ANT792-6MN, 1 m antenna connection cable.
- Ant. group 2: Antennas 7 to 9 dBi, ANT793-6DT, 2 m antenna connection cable.
- Ant. group 3: Antennas 10 to 14 dBi, ANT793-8DJ, 5 m antenna connection cable.

Transmit operating modes

Both modules use DSSS or OFDM modulation and may provide following data rates:

- 802.11a mode 54, 48, 36, 24, 18, 12, 9, 6 Mbps
- 802.11n HT20, MCS 0 - 23
- 802.11n HT40, MCS 0 - 23

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HT20

MCS parameters for mandatory 20 MHz, NSS = 1, NES = 1

MCS Index	Modulation	R	$N_{BPSCS(iSS)}$	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.

MCS parameters for optional 20 MHz, *NSS* = 2, *NES* = 1, EQM

MCS Index	Modulation	R	$N_{BPSCS(iSS)}$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI (see NOTE)
8	BPSK	1/2	1	52	4	104	52	13.0	14.4
9	QPSK	1/2	2	52	4	208	104	26.0	28.9
10	QPSK	3/4	2	52	4	208	156	39.0	43.3
11	16-QAM	1/2	4	52	4	416	208	52.0	57.8
12	16-QAM	3/4	4	52	4	416	312	78.0	86.7
13	64-QAM	2/3	6	52	4	624	416	104.0	115.6
14	64-QAM	3/4	6	52	4	624	468	117.0	130.0
15	64-QAM	5/6	6	52	4	624	520	130.0	144.4

NOTE—The 400 ns GI rate values are rounded to 1 decimal place.

MCS parameters for optional 20 MHz, NSS = 3, NES = 1, EQM

MCS Index	Modulation	R	$N_{BPSCS(iSS)}$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mb/s)	
								800 ns GI	400 ns GI
16	BPSK	1/2	1	52	4	156	78	19.5	21.7
17	QPSK	1/2	2	52	4	312	156	39.0	43.3
18	QPSK	3/4	2	52	4	312	234	58.5	65.0
19	16-QAM	1/2	4	52	4	624	312	78.0	86.7
20	16-QAM	3/4	4	52	4	624	468	117.0	130.0
21	64-QAM	2/3	6	52	4	936	624	156.0	173.3
22	64-QAM	3/4	6	52	4	936	702	175.5	195.0
23	64-QAM	5/6	6	52	4	936	780	195.0	216.7

HT40

MCS parameters for optional 40 MHz, NSS = 1, NES = 1

MCS Index	Modulation	R	$N_{BPSCS(iSS)}$	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 parameters for optional 40 MHz, NSS = 2, NES = 1, EQM

MCS Index	Modulation	R	$N_{BPSCS(iSS)}$	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

MCS parameters for optional 40 MHz, NSS = 3, EQM

MCS Index	Modulation	R	$N_{BPSCS(iSS)}$	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)	
									800 ns GI	400 ns GI
16	BPSK	1/2	1	108	6	324	162	1	40.5	45.0
17	QPSK	1/2	2	108	6	648	324	1	81.0	90.0
18	QPSK	3/4	2	108	6	648	486	1	121.5	135.0
19	16-QAM	1/2	4	108	6	1296	648	1	162.0	180.0
20	16-QAM	3/4	4	108	6	1296	972	1	243.0	270.0
21	64-QAM	2/3	6	108	6	1944	1296	2	324.0	360.0
22	64-QAM	3/4	6	108	6	1944	1458	2	364.5	405.0
23	64-QAM	5/6	6	108	6	1944	1620	2	405.0	450.0

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

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 : 20 August 2012

Testing concluded on 30 August 2012

Checked by:

Thomas Weise
I confirm the correctness and integrity of this document
2012.09.04 10:38:37 +02'00'

Thomas Weise
Dipl. Ing.(FH)
Laboratory Manager

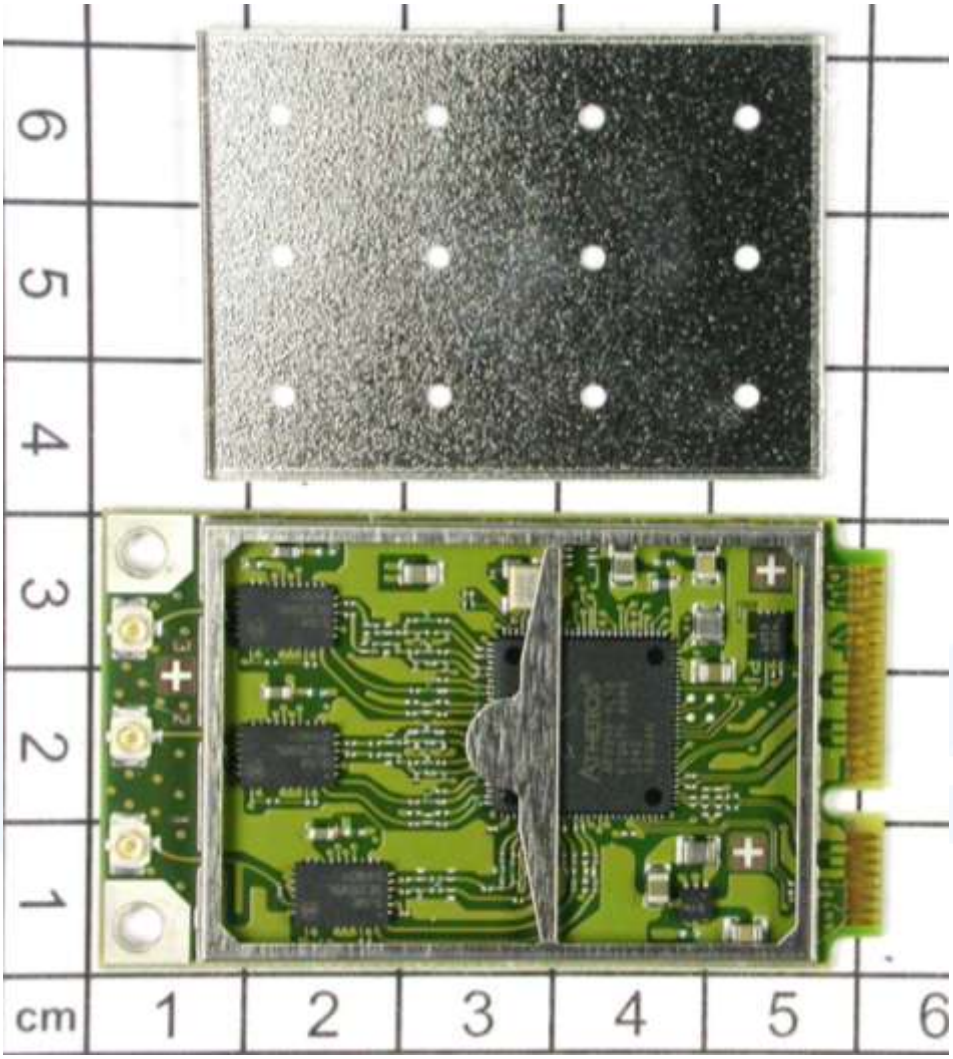
Tested by:

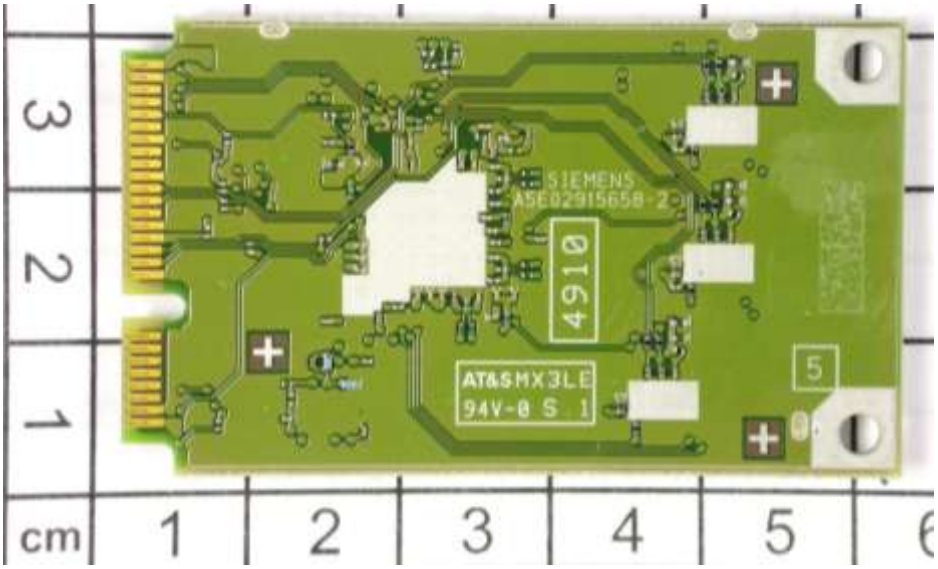
Hermann Smetana
I am the author of this document
2012.09.04 09:41:20 +02'00'

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

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT





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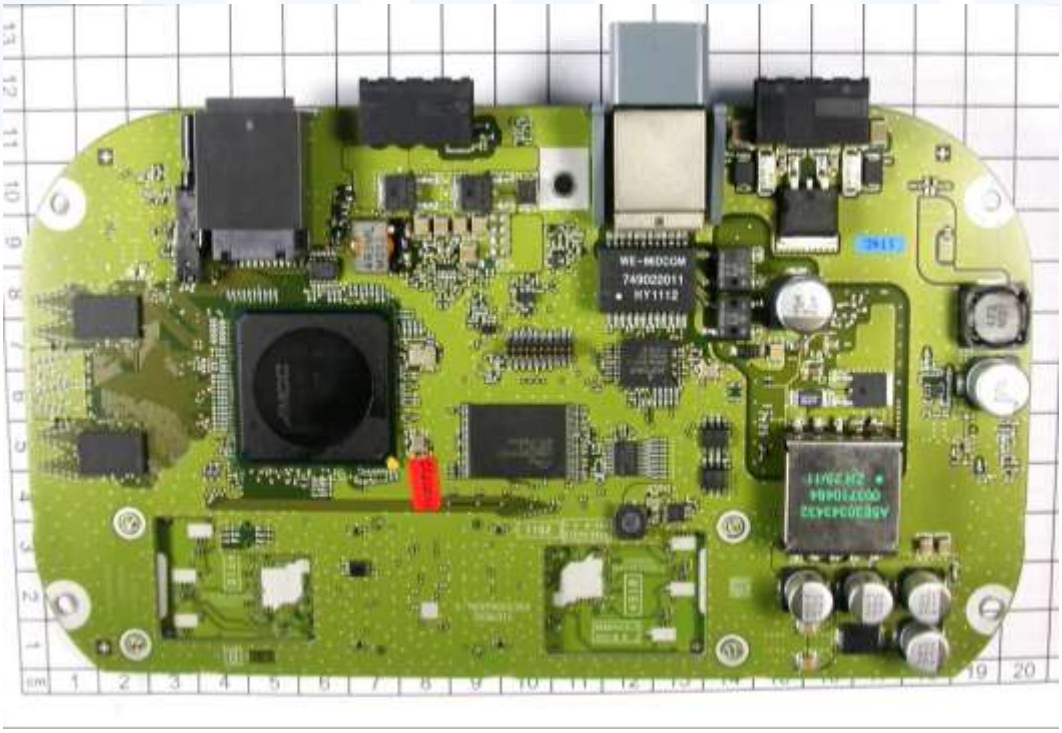
Test jig, reference integration:



3.2 Power supply system utilised

Power supply voltage, V_{nom} : 24 VDC (industrial DC power supply)

The extreme voltages for the EUT are: V_{min} = 19.2 VDC
V_{max} = 28.8 VDC

3.3 Short description of the equipment under test (EUT)

The EUT is a WLAN module for industrial applications in the 2.4 GHz and 5 GHz frequency range.

Number of tested samples: 1
Serial number: #45

EUT operation mode:

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

- TX continuous mode in 802.11a

- TX continuous mode in 802.11n, HT20

- TX continuous mode in 802.11n, HT40

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:

- LAN cable, 3m Model : CAT5
- Power supply cable, 1m Model : Self-made
- C-Plug-Adaptor for test mode control Model : Self-made

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 under the Canadian Test-Sites File-No:

IC 3009A-1

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4, ANSI C63.10 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 without termination. 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, ANSI C63.10 and applying the CISPR 22 limits.

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 worst case mode from all possible combinations between available modulations and data rates. The maximum output power depends on used data rate. The output power can be set by application software from 1 dBm to 20 dBm (P1 to P20) in 1 dB steps.

The test software for the EUT provides free power setting, the special test mode RX and the TX continuous mode, modulated. The EUT was set with test modulation to transmit data during the tests with a duty cycle (x) of nearly x = 1 from an internal packet generator.

Following channels and test modes has been selected for the final test as listed below:

WLAN	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
802.11a	149 to 165	149, 157, 165	P20	OFDM	BPSK	6 Mbps
802.11n; HT20	149 to 165	149, 157, 165	P20	OFDM	BPSK	MCS8 (BW=20 MHz)
802.11n; HT40	149up, 157up	149up, 157up	P20	OFDM	BPSK	MCS16 (BW=40 MHz)

Conducted measurements are performed on every port of the module. A test jig is used to provide the EUT with the appropriate control and data signals for testing. Between the module port and the end product port a UFL to R-SMA pigtail (20 cm) is used. All measurements are related to the R-SMA-Port.

Measurements in the HT40 mode are only done for the HT40 up mode because of the same frequency arrangement for both modes and for only two non-overlapping channels in the 2.4 GHz and 5 GHz range.

5 TEST CONDITIONS AND RESULTS

5.1 Spurious emissions radiated, in restricted bands

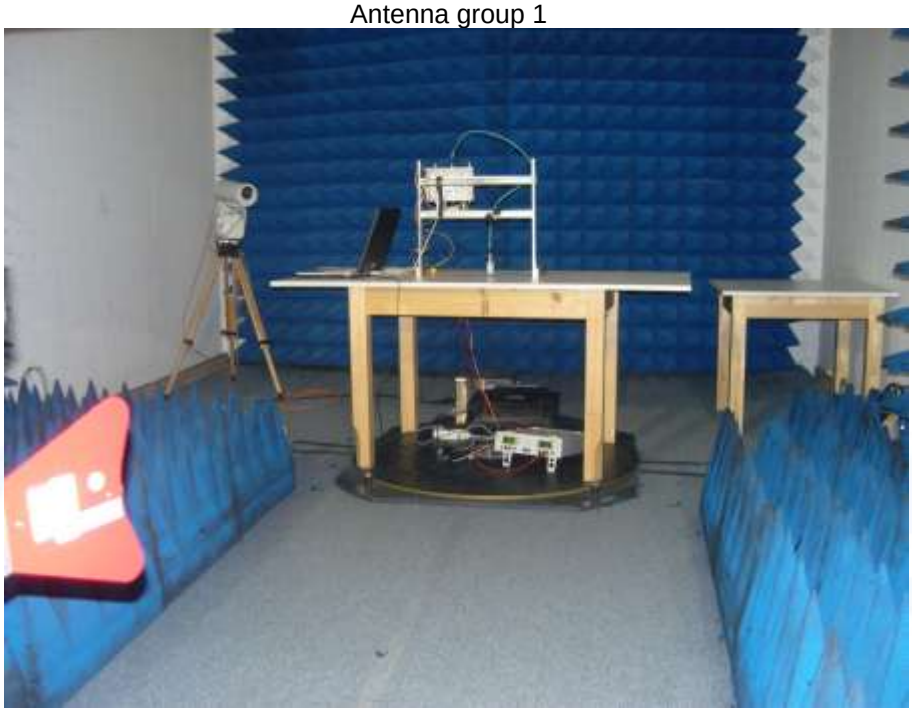
For test instruments and accessories used see section 6 Part **SER 3**.

5.1.1 Description of the test location

Test location: AREA4

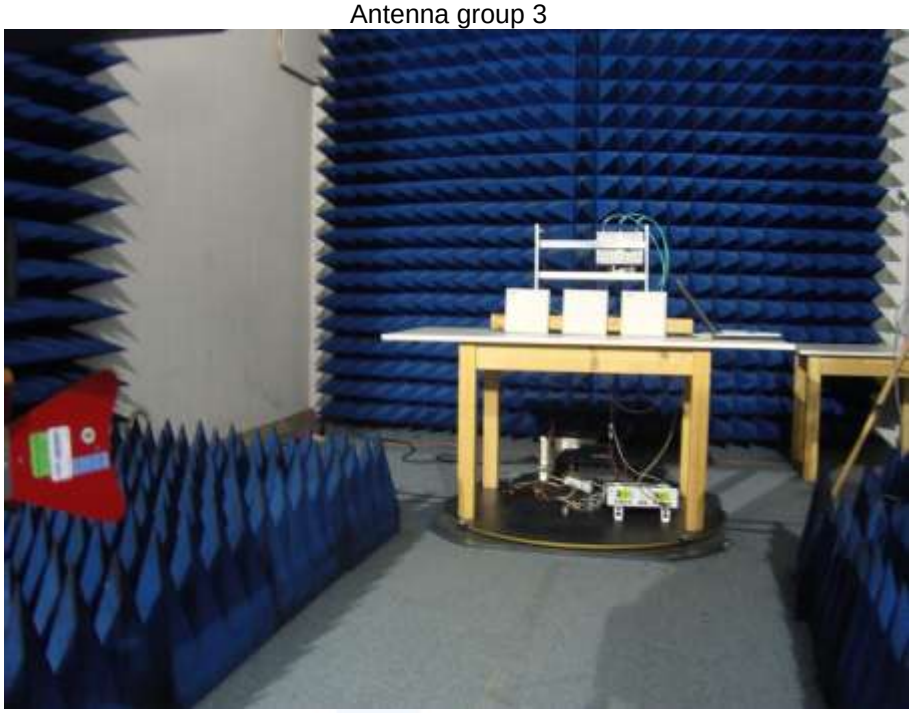
5.1.2 Photo documentation of the test set-up

Antenna group 1



Antenna group 2

Antenna group 3



5.1.3 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)).

5.1.4 Description of Measurement

The spurious emissions falling in the restricted bands are measured radiated using a spectrum analyser in a test setup following the procedures set out in KDB 558074 D01 for DTS. The frequency spectrum outside from the operating frequency range (2400 - 2483.5 MHz and 5725 – 5850 MHz) is scanned for emissions that exceed the limit. The cable loss is taken into account with an amplitude offset. The measurement is performed at normal test conditions in modulated TX continuous mode.

Spectrum analyser settings:

Peak-Measurement:				
f > 1000 MHz:	RBW: 1 MHz,	VBW: 3 MHz,	Detector: Max peak,	Trace Mode: Max hold
AV-Measurement:				
f > 1000 MHz:	RBW: 1 MHz,	VBW: 10 Hz,	Detector: Max peak	

5.1.5 Test result

5.1.5.1 **5 GHz range:**

The measurement is performed at the worst case with 3 TX and 3 antennas. The max duty cycle of the test software is 99%.

5.1.5.1.1 HT20

Ant. group 1

PK-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX , P20, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	44.6	74.0	-29.4
4500	5150	1000	4960	45.2	74.0	-28.8
4500	5150	1000	4998	52.9	74.0	-21.1
4500	5150	1000	5040	47.3	74.0	-26.7
Measurement uncertainty			±6 dB			

Peak readings below average limit, no average measurements required.

PK-measurement						
Middle frequency: CH157						
Test conditions: 3 TX , P20, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	44.2	74.0	-29.8
4500	5150	1000	4960	46.1	74.0	-27.9
4500	5150	1000	4998	52.7	74.0	-21.3
4500	5150	1000	5040	47.5	74.0	-26.5
Measurement uncertainty			±6 dB			

Peak readings below average limit, no average measurements required.

PK-measurement						
Highest frequency: CH165						
Test conditions: 3 TX , P20, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	44.0	74.0	-30.0
4500	5150	1000	4960	45.0	74.0	-29.0
4500	5150	1000	4998	53.3	74.0	-20.7
4500	5150	1000	5040	47.3	74.0	-26.7
Measurement uncertainty			±6 dB			

Peak readings below average limit, no average measurements required.

Ant. group 2

PK-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX , P17, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	47.5	74.0	-26.5
4500	5150	1000	4960	48.2	74.0	-25.8
4500	5150	1000	4998	53.7	74.0	-20.3
4500	5150	1000	5040	40.5	74.0	-33.5
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Middle frequency: CH157						
Test conditions: 3 TX , P17, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	44.0	54.0	-10.0
4500	5150	1000	4960	44.8	54.0	-9.2
4500	5150	1000	4999	51.7	54.0	-2.3
4500	5150	1000	5040	46.0	54.0	-8.0
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Highest frequency: CH165						
Test conditions: 3 TX , P17, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	46.0	74.0	-28.0
4500	5150	1000	4960	46.1	74.0	-27.9
4500	5150	1000	4999	51.9	74.0	-22.1
4500	5150	1000	5040	47.5	74.0	-26.5
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

FCC ID: LYHMPCIE1V1

Ant. group 3

PK-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX, P10, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	57.6	74.0	-16.4
4500	5150	1000	4960	58.2	74.0	-15.8
4500	5150	1000	4991	63.4	74.0	-10.6
4500	5150	1000	5040	50.7	74.0	-23.3
Measurement uncertainty				±6 dB		

AV-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX, P10				Test results		
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	49.7	54.0	-4.3
4500	5150	1000	4960	51.5	54.0	-2.5
4500	5150	1000	5000	46.5	54.0	-7.5
4500	5150	1000	5040	50.8	54.0	-3.2
Measurement uncertainty				±6 dB		

PK-measurement						
Middle frequency: CH157						
Test conditions: 3 TX, P10, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	58.2	74.0	-15.8
4500	5150	1000	4960	57.6	74.0	-16.4
4500	5150	1000	4991	62.8	74.0	-11.2
4500	5150	1000	5040	59.2	74.0	-14.8
Measurement uncertainty				±6 dB		

AV-measurement						
Middle frequency: CH157						
Test conditions: 3 TX, P10				Test results		
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	50.9	54.0	-3.1
4500	5150	1000	4960	49.0	54.0	-5.0
4500	5150	1000	5000	49.1	54.0	-4.9
4500	5150	1000	5040	49.9	54.0	-4.1
Measurement uncertainty				±6 dB		

PK-measurement						
Highest frequency: CH165						
Test conditions: 3 TX, P10, MCS8						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	57.7	74.0	-16.3
4500	5150	1000	4960	58.1	74.0	-15.9
4500	5150	1000	4988	64.0	74.0	-10.0
4500	5150	1000	5040	59.6	74.0	-14.4
Measurement uncertainty				±6 dB		

AV-measurement						
Highest frequency: CH165						
Test conditions: 3 TX, P10				Test results		
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	50.5	54.0	-3.5
4500	5150	1000	4960	50.4	54.0	-3.6
4500	5150	1000	4991	47.8	54.0	-6.2
4500	5150	1000	5040	50.0	54.0	-4.0
Measurement uncertainty				±6 dB		

5.1.5.1.2 HT40
Ant. group 1

PK-measurement						
Lowest frequency: CH149up						
Test conditions: 3 TX, P20, MCS16						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	43.7	74.0	-30.3
4500	5150	1000	4960	45.3	74.0	-28.7
4500	5150	1000	4999	52.5	74.0	-21.5
4500	5150	1000	5040	40.6	74.0	-33.4
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Highest frequency: CH157up						
Test conditions: 3 TX , P20, MCS16						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	48.9	74.0	-25.1
4500	5150	1000	4960	45.2	74.0	-28.8
4500	5150	1000	4999	52.9	74.0	-21.1
4500	5150	1000	5040	47.3	74.0	-26.7
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

Ant. group 2

PK-measurement						
Lowest frequency: CH149up						
Test conditions: 3 TX , P17, MCS16						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	43.6	74.0	-30.4
4500	5150	1000	4960	44.4	74.0	-29.6
4500	5150	1000	4999	51.4	74.0	-22.6
4500	5150	1000	5040	45.7	74.0	-28.3
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Highest frequency: CH157up						
Test conditions: 3 TX , P17, MCS16						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	44.0	74.0	-30.0
4500	5150	1000	4960	44.8	74.0	-29.2
4500	5150	1000	4999	51.7	74.0	-22.3
4500	5150	1000	5040	46.0	74.0	-28.0
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

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Ant. group 3

PK-measurement						
Lowest frequency: CH149up						
Test conditions: 3 TX , P12, MCS16						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	58.6	74.0	-15.4
4500	5150	1000	4960	60.6	74.0	-13.4
4500	5150	1000	4988	66.6	74.0	-7.4
4500	5150	1000	5040	59.7	74.0	-14.3
Measurement uncertainty				±6 dB		

AV-measurement						
Lowest frequency: CH149up						
Test conditions: 3 TX , P12, MCS16			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	47.6	54.0	-6.4
4500	5150	1000	4960	49.3	54.0	-4.7
4500	5150	1000	4991	46.5	54.0	-7.5
4500	5150	1000	5040	46.0	54.0	-8.0
Measurement uncertainty				±6 dB		

PK-measurement						
Highest frequency: CH157up						
Test conditions: 3 TX , P12, MCS16						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	58.2	74.0	-15.8
4500	5150	1000	4960	59.8	74.0	-14.2
4500	5150	1000	4987	66.7	74.0	-7.3
4500	5150	1000	5040	59.0	74.0	-15.0
Measurement uncertainty				±6 dB		

AV-measurement						
Highest frequency: CH157up						
Test conditions: 3 TX , P12, MCS16			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	47	54.0	-7.0
4500	5150	1000	4960	48.7	54.0	-5.3
4500	5150	1000	4991	46.3	54.0	-7.7
4500	5150	1000	5040	45.8	54.0	-8.2
Measurement uncertainty				±6 dB		

5.1.5.1.3 802.11a:
Ant. group 1

PK-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX , P20, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	45.6	74.0	-28.4
4500	5150	1000	4960	45.5	74.0	-28.5
4500	5150	1000	4998	53.7	74.0	-20.3
4500	5150	1000	5040	46.8	74.0	-27.2
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Middle frequency: CH157						
Test conditions: 3 TX , P20, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	45.2	74.0	-28.8
4500	5150	1000	4960	45.2	74.0	-28.8
4500	5150	1000	4998	52.4	74.0	-21.6
4500	5150	1000	5040	47.3	74.0	-26.7
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Highest frequency: CH165						
Test conditions: 3 TX , P20, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	44.7	74.0	-29.3
4500	5150	1000	4960	44.6	74.0	-29.4
4500	5150	1000	4998	53.0	74.0	-21.0
4500	5150	1000	5040	47.6	74.0	-26.4
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

Ant. group 2

PK-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX , P17, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	47.7	74.0	-26.3
4500	5150	1000	4960	48.9	74.0	-25.1
4500	5150	1000	4991	53.1	74.0	-20.9
4500	5150	1000	5040	40.2	74.0	-33.8
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Middle frequency: CH157						
Test conditions: 3 TX , P17, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	47.9	74.0	-26.1
4500	5150	1000	4960	49.3	74.0	-24.7
4500	5150	1000	4985	54.0	74.0	-20.0
4500	5150	1000	5040	40.6	74.0	-33.4
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

PK-measurement						
Highest frequency: CH165						
Test conditions: 3 TX , P17, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	44.7	74.0	-29.3
4500	5150	1000	4960	44.9	74.0	-29.1
4500	5150	1000	4997	53.2	74.0	-20.8
4500	5150	1000	5040	40.3	74.0	-33.7
Measurement uncertainty				±6 dB		

Peak readings below average limit, no average measurements required.

Ant. group 3

PK-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX , P10, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	58.1	74.0	-15.9
4500	5150	1000	4960	54.0	74.0	-20.0
4500	5150	1000	4991	62.5	74.0	-11.5
4500	5150	1000	5040	56.6	74.0	-17.4
Measurement uncertainty				±6 dB		

AV-measurement						
Lowest frequency: CH149						
Test conditions: 3 TX , P10				Test results		
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	52.9	54.0	-1.1
4500	5150	1000	4960	46.5	54.0	-7.5
4500	5150	1000	4991	52.4	54.0	-1.6
4500	5150	1000	5040	48.0	54.0	-6.0
Measurement uncertainty				±6 dB		

PK-measurement						
Middle frequency: CH157						
Test conditions: 3 TX , P10, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	58.0	74.0	-16.0
4500	5150	1000	4960	57.4	74.0	-16.6
4500	5150	1000	4991	62.7	74.0	-11.3
4500	5150	1000	5040	58.2	74.0	-15.8
Measurement uncertainty				±6 dB		

AV-measurement						
Middle frequency: CH157						
Test conditions: 3 TX , P10				Test results		
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	52.0	54.0	-2.0
4500	5150	1000	4960	51.1	54.0	-2.9
4500	5150	1000	4991	50.1	54.0	-3.9
4500	5150	1000	5040	51.1	54.0	-2.9
Measurement uncertainty				±6 dB		

PK-measurement						
Highest frequency: CH165						
Test conditions: 3 TX , P10, 6 Mbps						
Chain1+2+3			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	57.8	74.0	-16.2
4500	5150	1000	4960	58.5	74.0	-15.5
4500	5150	1000	4992	64.0	74.0	-10.0
4500	5150	1000	5040	59.8	74.0	-14.2
Measurement uncertainty				±6 dB		

AV-measurement						
Highest frequency: CH165						
Test conditions: 3 TX , P10				Test results		
Start *f*	Stop *f*	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4920	52.8	54.0	-1.2
4500	5150	1000	4960	49.6	54.0	-4.4
4500	5150	1000	4991	50.9	54.0	-3.1
4500	5150	1000	5040	50.4	54.0	-3.6
Measurement uncertainty				±6 dB		

Limit according to FCC Part 15, Section 15.247(d):
Attenuation below the general limits specified in Section 15.209(a) is not required.

Frequency	General limit radiated	PK limit	AV limit
(MHz)	(mV/m)	(dBµV/m)	(dBµV/m)
Above 960	500	74.0	54.0

The requirements are **FULFILLED.**

Remarks: No power reduction was required to comply with the radiated spurious limits. For detailed test results please see the following test protocols. Only the worst cases of the plots are listed.

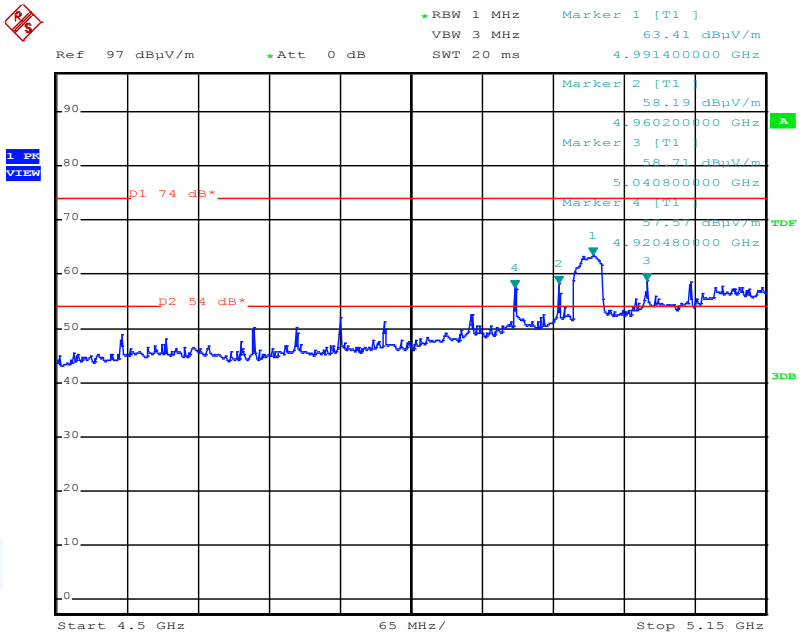
5.1.6 Test protocols of SER in restricted band 4500 MHz – 5150 MHz:

Antenna group 3:

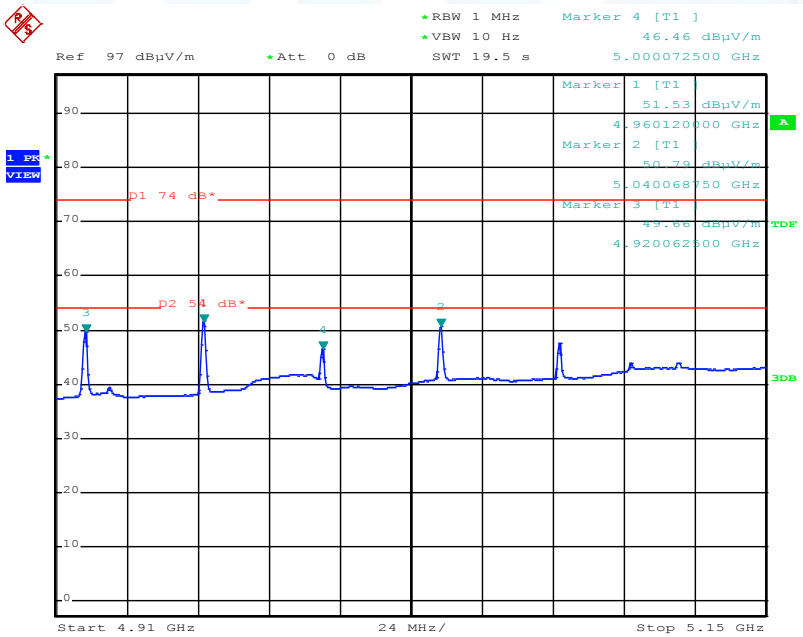
5.1.6.1 **HT20:**

CH149

Peak measurement



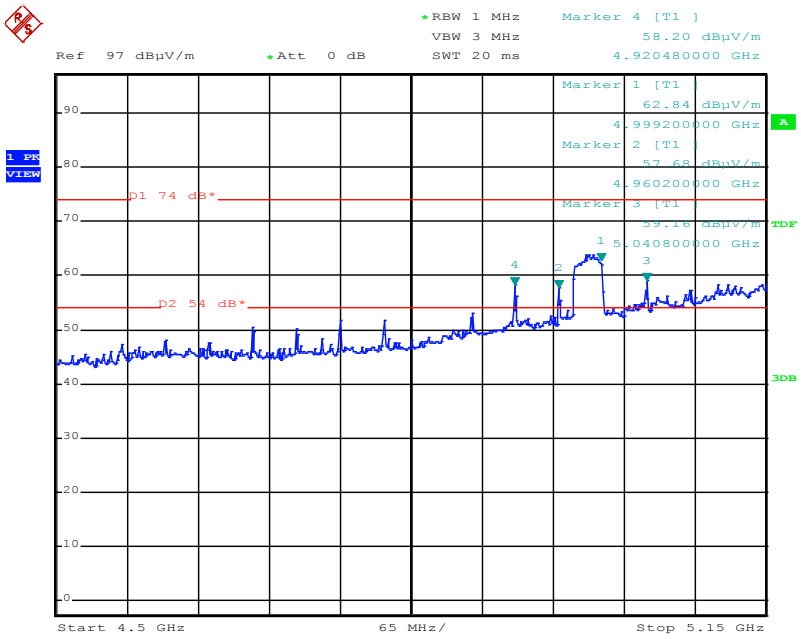
AV measurement



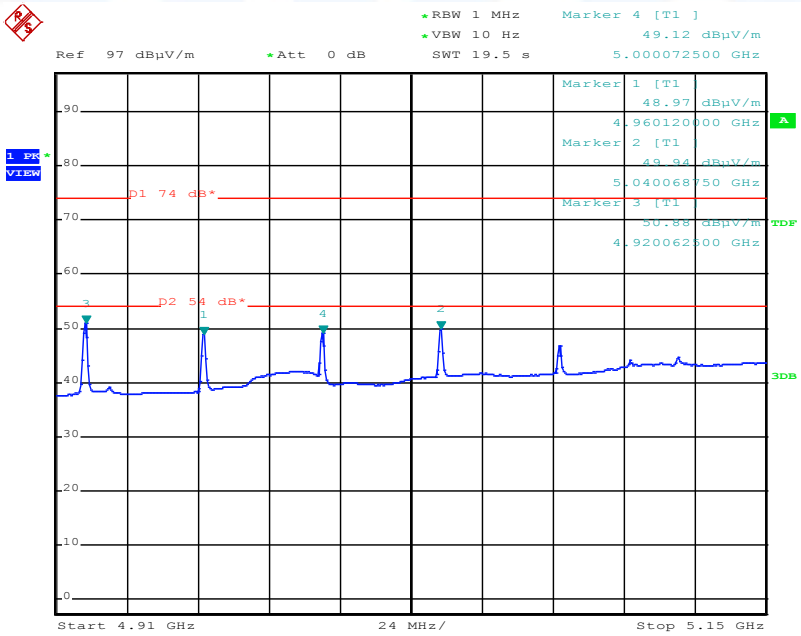
FCC ID: LYHMPCIE1V1

CH157

Peak measurement



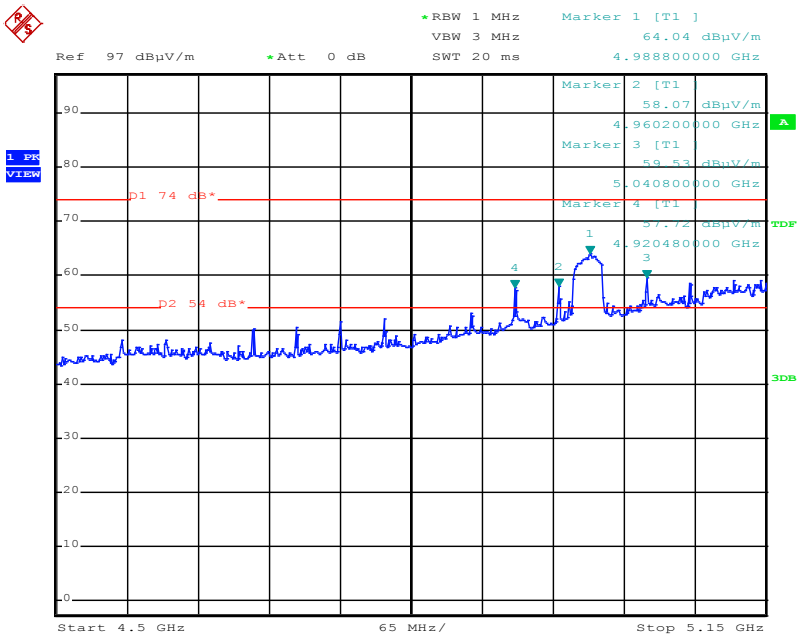
AV measurement



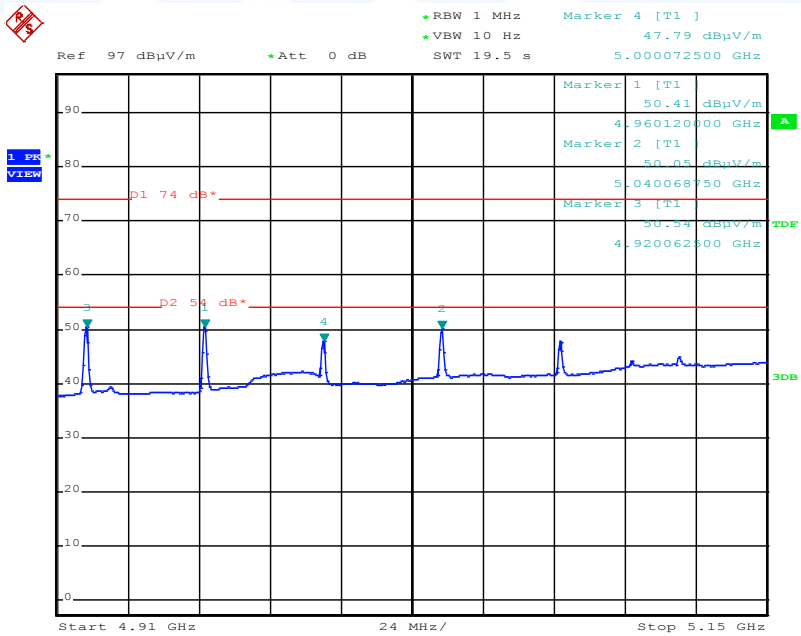
FCC ID: LYHMPCIE1V1

CH165

Peak measurement



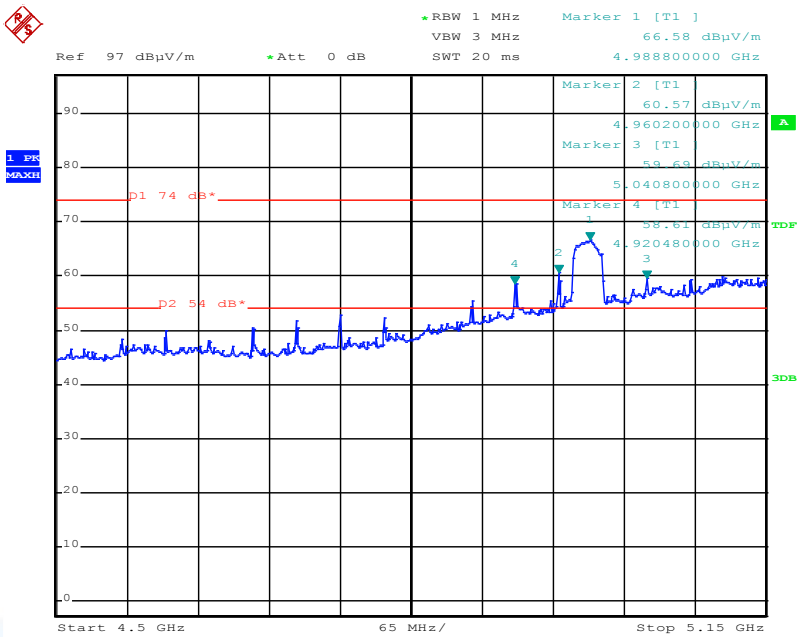
AV measurement



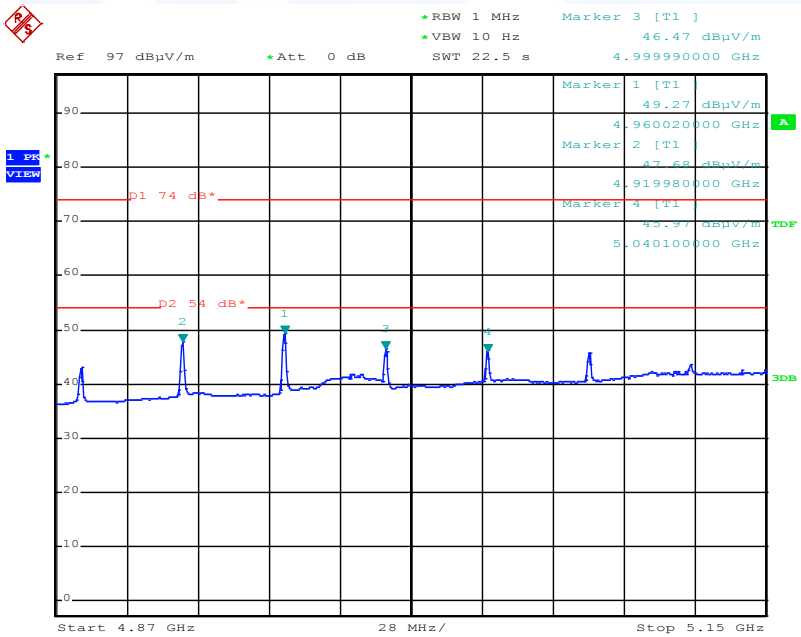
5.1.6.2 **HT40:**

Channel 149up

Peak measurement



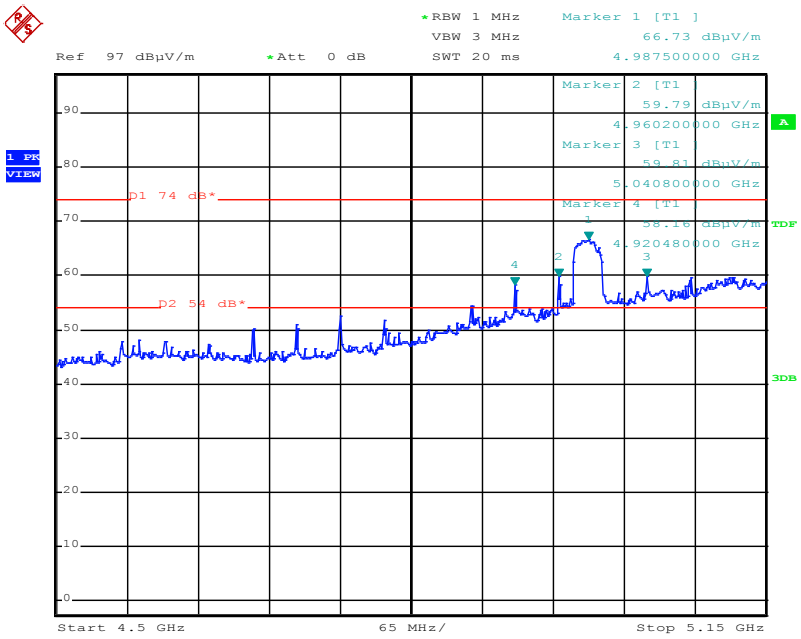
AV measurement



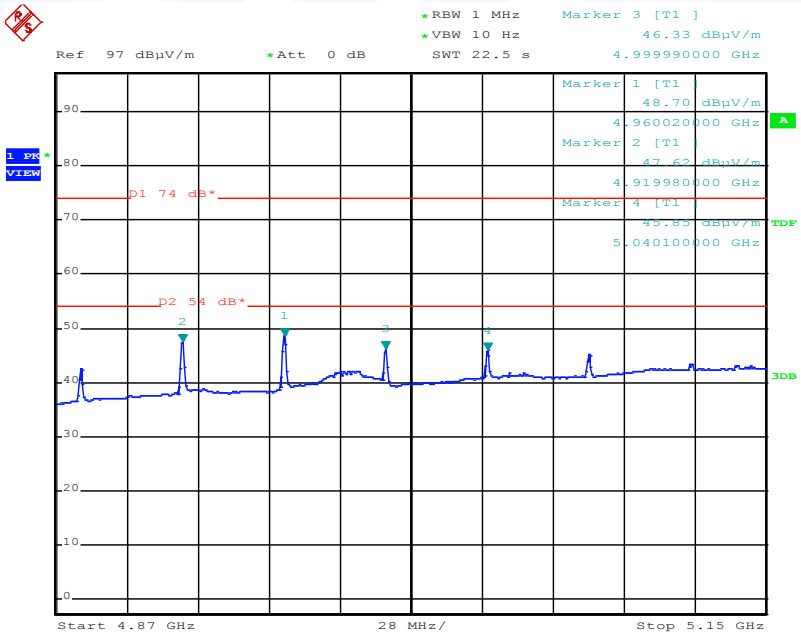
FCC ID: LYHMPCIE1V1

Channel 157up

Peak measurement



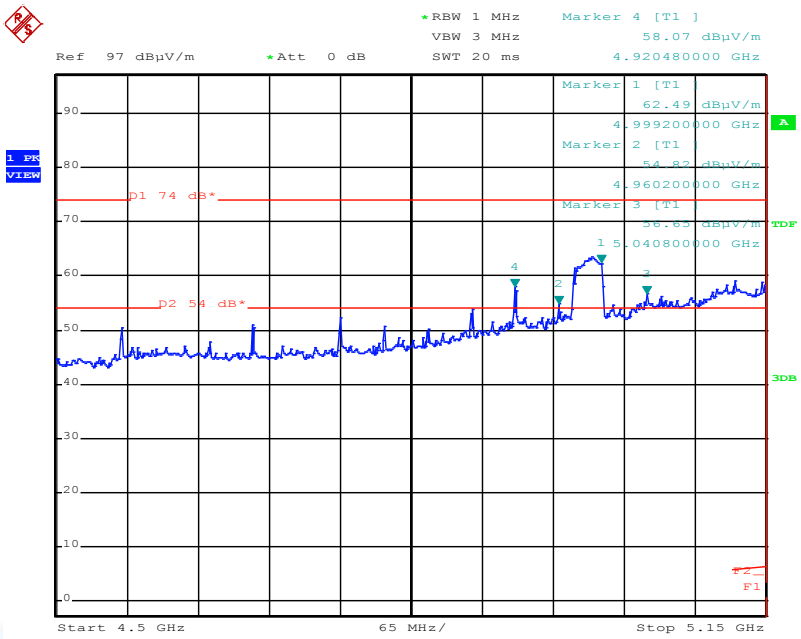
AV measurement



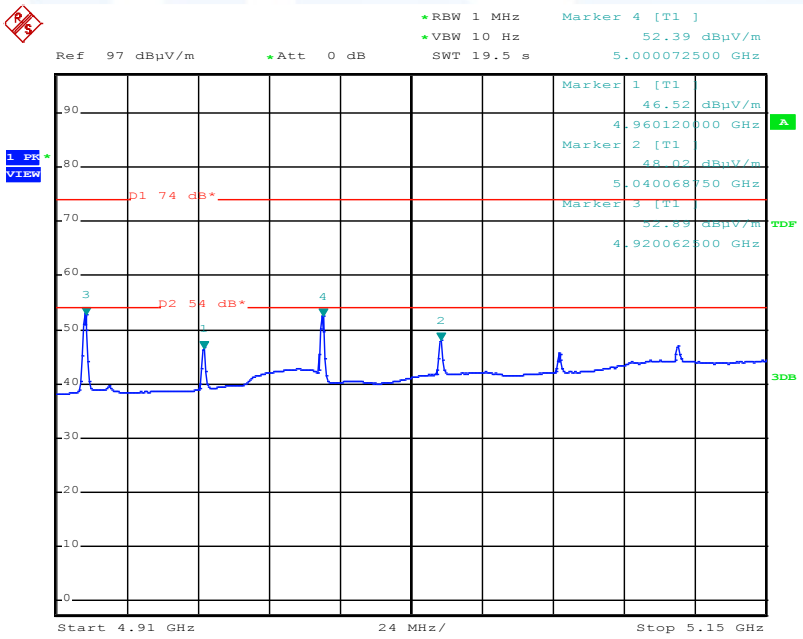
5.1.6.1 **Legacy:**

CH149

Peak measurement



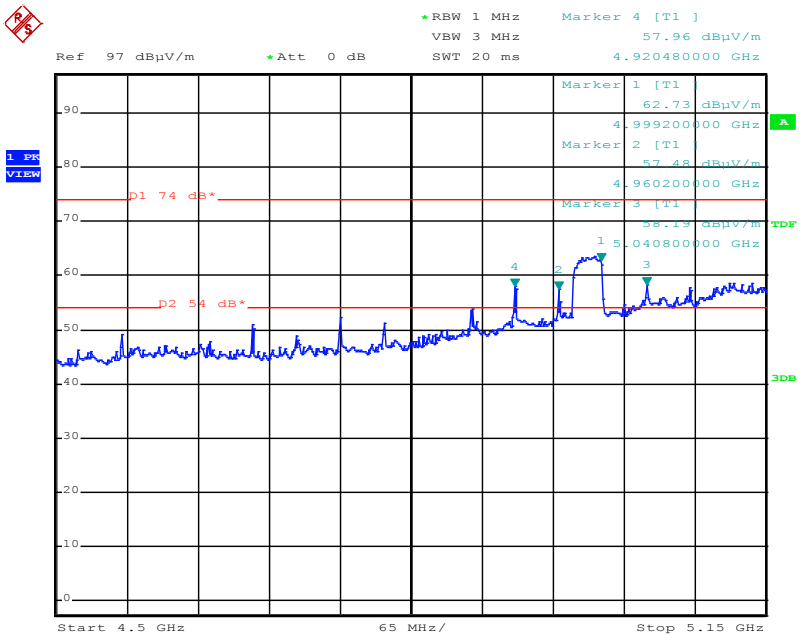
AV measurement



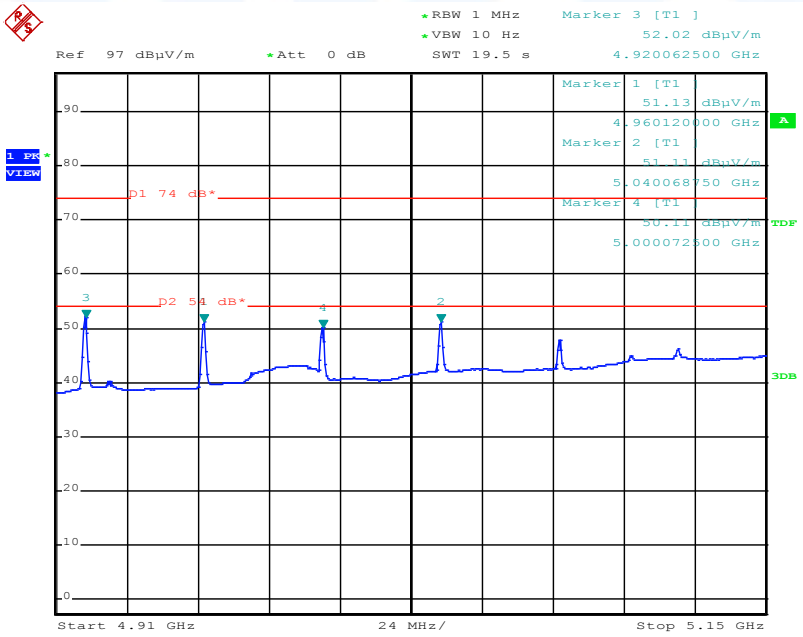
FCC ID: LYHMPCIE1V1

CH157

Peak measurement

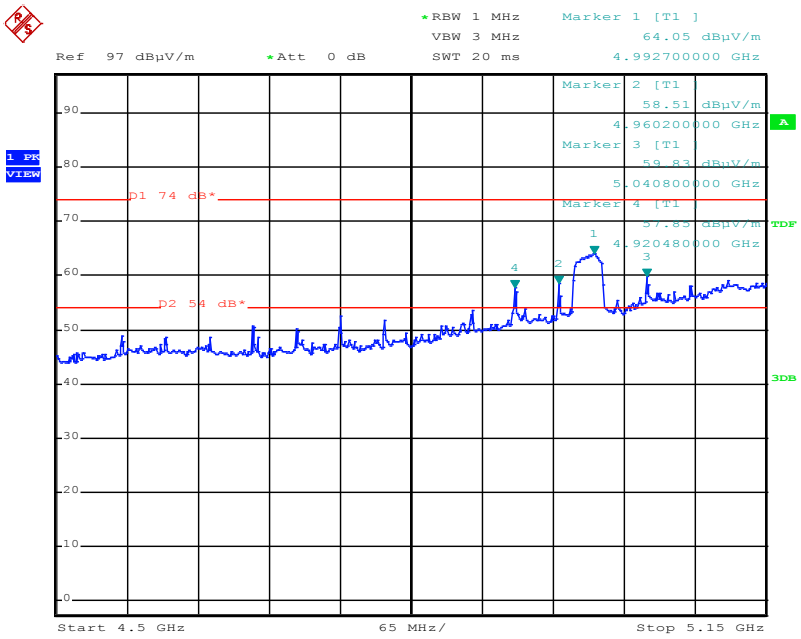


AV measurement

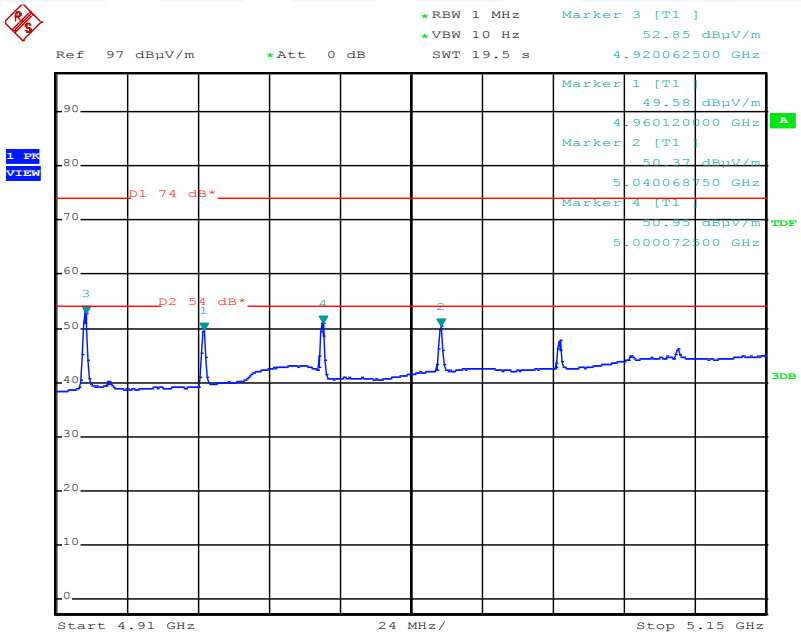


CH165

Peak measurement



AV measurement



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.
SER 3	FSP 40	02-02/11-11-001	02/09/2012	02/09/2011		
	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				
	3117	02-02/24-05-009	16/02/2013	16/02/2012		